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REUNIÓN ANUAL DE COMUNICACIONES DE LA ASOCIACIÓN PALEONTOLÓGICA ARGENTINA
Y
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REUNIÓN ANUAL DE COMUNICACIONES DE LA ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

AVANCES EN EL ESTUDIO DE LOS MARSUPIALES PAUCITUBERCULATA (PALAEOTHENTOIDEA) Y POLYDOLOPIMORPHIA (ARGYROLAGIDAE) DE LOS ESTRATOS DE SALLA (OLIGOCENO TARDÍO), BOLIVIA

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Se presentan los resultados preliminares del estudio de ejemplares inéditos de marsupiales Argyrolagidae y Palaeothentoidea, alojados en las colecciones del Museo Nacional de Historia Natural de Bolivia. Se destaca el reconocimiento de dos nuevos taxa, referidos a los Argyrolagidae y Palaeothentidae, y la identificación de numerosos ejemplares asignables a dos especies ya registradas en los estratos de Salla: *Proargyrolagus bolivianus* Wolff (Argyrolagidae) y *Palaeothentes boliviensis* Patterson y Marshall (Palaeothentoidea). El nuevo paleotentoideo presenta una combinación de caracteres (*e.g.* orientación oblicua de la postparacrístida de los m2-3, presencia de paracónido en el m2) que permite referirlo a los Palaeothentidae y sugiere una posición basal en esta familia. El nuevo Argyrolagidae posee ciertos caracteres derivados, como la presencia de dientes euhipsodontes, que indican un parentesco cercano con los argirolágidos neógenos registrados en Argentina (*e.g. Anargyrolagus* Carlini, Pascual y Goin). Los nuevos materiales referidos a *P. boliviensis* permiten ampliar su diagnosis. Entre los nuevos rasgos diagnósticos se cuentan la ubicación labial a la muesca de la protocrístida del extremo distal de la crístida oblicua del m2 y la ausencia de cúspide anterobasal en el P3. La información que surge del estudio de esta evidencia fósil incrementa en gran medida el conocimiento de la anatomía y diversidad de los Metatheria no-carnívoros de los estratos de Salla, representados hasta el momento sólo por las especies *P. bolivianus*, *P. boliviensis* y *Evolestes hadrommatos* Goin, Sanchez-Villagra, Abello y Kay.

BIOESTRATIGRAFÍA DE LAS SUCESIONES ORDOVÍCICAS EXPUESTAS EN SANTA VICTORIA, CORDILLERA ORIENTAL DE SALTA

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En la sierra de Santa Victoria se definieron originalmente las unidades estratigráficas del Ordovícico Inferior de la Cordillera Oriental del noroeste argentino. Los estratos superiores de la Formación Santa Rosita y los suprayacentes de la Formación Acoite, aflorantes sobre la margen sur del río Santa Victoria, en inmediaciones de la localidad homónima, son datados mediante bioestratigrafía de conodontes, graptolitos y trilobites. El intervalo superior de la Formación Santa Rosita, aproximadamente 750 m de espesor, consiste en areniscas intercaladas con pelitas moradas a grisáceas y coquinas ocasionales, las cuales fueron muestreadas para microfósiles. Se procesaron 15 muestras de *ca.* 3 kg cada una, mediante métodos convencionales para la recuperación de conodontes; entre éstas, 5 produjeron 15 especies de los géneros *Acanthodus* Furnish, *Acodus* Pander, *Drepanodus, Drepanoistodus* Lindström, *Kallidontus* Pyle y Barnes, *Paltodus* Pander y *Utahconus* Miller, y el protoconodonte *Phakelodus* Miller. Se registraron una nueva subespecie de *Paltodus deltifer* (Lindström) y una nueva especie de *Acodus* documentadas previamente para el Miembro Humacha de la Formación Santa Rosita y la Formación Coquena del sector oriental de Cordillera Oriental, verificándose la correlación entre estas unidades, que se restringen a la Subzona de *Paltodus d. deltifer* de la Zona de *P. deltifer* (Tremadociano medio). Los conodontes recuperados exhiben un índice de alteración del color (CAI) 3, que indica paleotemperaturas de soterramiento de *ca.* 200°C. A 350 m del contacto normal con la Formación Santa Rosita, las pelitas de la Formación Acoite presentan *Araneograptus murrayi* (Hall) y *Thysanopyge* sp., cuyos rangos transitan el límite Tremadociano-Floiano.

ASPECTOS TAXONÓMICOS, BIOCRONOLÓGICOS Y BIOGEOGRÁFICOS DEL GÉNERO EXTINTO *MORENELAPHUS* CARETTE (ARTIODACTYLA, CERVIDAE) EN LA ARGENTINA

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El género *Morenelaphus* está representado en Argentina por *Morenelaphus lujanensis* (Ameghino) y *Morenelaphus brachyceros* (H. Gervais y Ameghino), caracterizadas por la morfología de las astas, y diferenciadas por su curvatura general, la disposición de la 2º y 3º rama respecto a la 1º (garceta) y el mayor tamaño y gracilidad de *M. lujanensis*. En la región Pampeana, *M. brachyceros* aparece exclusivamente en el Pleistoceno medio (Piso/Edad Bonaerense) y *M. lujanensis* en el Pleistoceno medio-tardío (Pisos/Edades Bonaerense-Lujanense). Para la Mesopotamia los hallazgos son puntuales y ambas especies son exclusivas del Pleistoceno tardío. El objetivo de esta contribución es brindar un panorama más ajustado sobre la taxonomía, bioestratigrafía, biocronología y biogeografía de *Morenelaphus*. En este sentido, se reasignó el ejemplar CTES-PZ 7369 a *M. lujanensis* y se ajustó la determinación del material MACN-PV 2335.1, correspondiente a la misma especie. Se identificó la presencia de *Morenelaphus* en las provincias de Chaco y Formosa (CTEZ-PZ 1585, CTES-PZ 3548a, CTES-PZ 1587, PVE-F 26), extendiéndose su distribución geográfica hacia la región Chaqueña. Se reconoció el probable registro de *M. lujanensis* (PVE-F 78) en el Holoceno de la Formación Río Bermejo (Formosa), datada en 9570±90 años AP (LP-2389). Se estableció la primera cita de *M. brachyceros* (MLP 00-XI-1-19) para el Pleistoceno tardío de la provincia de Buenos Aires, restringida previamente al Piso/Edad Bonaerense (Pleistoceno medio) de la región Pampeana. Considerando que *Morenelaphus* se registra en diferentes áreas geográficas, desde una perspectiva paleoecológica, es probable que el taxón se haya adaptado a condiciones climático-ambientales diversas durante el Pleistoceno/Holoceno.

A TRAUMATIC FRACTURE IN A GIANT EOCENE PENGUIN FROM ANTARCTICA

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A penguin femur from the La Meseta Formation (Submeseta Allmomember, Late Eocene, Antarctica) was recovered. The material, housed at the Museo de Ciencias Naturales (MLP 11-II-20-05), exhibits a set of fractures as a result of the action of palaeocological and taphonomic processes. The presence of collagen at the moment of the trauma that generated an antermortem fracture was recognized by its splintery and irregular morphology. A third fragment attached to a mineral deposit is interpreted as an organized fracture hematoma. The X-Ray diffractogram show peaks of maximum reflection of hematite, in contrast with the sedimentary quartz composition. It would correspond to the supply of accumulated blood in the area, before death. The penguin would have survived, the impact, thus reaching the inflammation phase. Hematoma platelets release local factors triggering the proliferation, migration and differentiation of mesenchymal cells, and the appearance of vascular buds invading the focus. There is no periosteal reaction. In this bending fracture the force acted distally, keeping fixed the proximal end. Since the bone is less resistant to traction than compression, this would have caused a loss of cohesion at the point of maximum convexity. The postmortem damage includes eyelet-shaped fractures, parallel to the diaphysis, resulting from bioestratinomic processes, caused by pre-burial weathering, and fossil diagenetic fractures characterized by a perpendicular or oblique split and "clean" surfaces. After that, the secondary fractures would correspond to weathering before burial, and to subsequent stages, where the femur was in situ.

RECONSTRUCCIÓN ECOLÓGICA DEL BOSQUE IN SITU DE MARAYES, FORMACIÓN EL CARRIZAL (TRIÁSICO), SAN JUAN, ARGENTINA

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Se da a conocer un bosque *in situ* hallado en el miembro inferior de la Formación Carrizal, cercano a la localidad de Marayes (provincia de San Juan), Argentina. El nivel correspondiente al bosque comprende areniscas medianas a gruesas a las que se asocia una capa de areniscas finas, lateralmente aparecen también ortoconglomerados con clastos de 20 mm y areniscas conglomerádicas. Se interpreta como un sistema fluvial caracterizado por depósitos de carga tractiva. Aunque los estudios sistemáticos no están terminados, se considera que el bosque era monotípico, integrado por un nuevo género de Corystospermaceae. El bosque fue mapeado usando brújula, cinta métrica y GPS, y se confeccionó un mapa detallado con la ubicación relativa de más de 38 tallos en posición de vida. Cada tocón fue muestreado y medido (diámetro) con el objeto de inferir los datos estructurales del bosque. La densidad fue calculada usando la distancia promedio al vecino más cercano. El diámetro basal del tronco fue usado para calcular el área basal total, la altura estimada de los árboles y la biomasa del bosque. Se utilizaron histogramas de clases diamétricas y los de alturas inferidas para establecer la posición del dosel. Para el bosque *in situ* de Marayes se infiere una densidad total de 1008 árboles/ha y un área basal total de 50 m^2/ha. Los árboles tienen una altura estimada promedio de 15 m. De acuerdo con los histogramas de distribución de alturas se deduce que el bosque estaba constituido por un solo estrato arbóreo con algunos árboles emergentes.

CHAPMANOXYLON PANT Y SINGH, *MUSSAEOXYLON* MERLOTTI, Y *PODOCARPOXYLON* GOTHAN EN LOS SEDIMENTOS DE LA FORMACIÓN YAGUARÍ, PÉRMICO SUPERIOR DE URUGUAY*

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Las sedimentitas de la Formación Yaguarí albergan una xilotafoflora diversa ya conocida compuesta por diferentes géneros de Coniferales y por uno de los registros más antiguos de maderas afines a las Ginkgoales. En esta contribución se presentan nuevos hallazgos de *Zalesskioxylon* Lepekhina y Yatsenko y *Agathoxylon* Hartig y por primera vez se registra la presencia de *Chapmanoxylon* Pant y Singh, *Mussaeoxylon* Merlotti y *Podocarpoxylon* Gothan en esta Formación. Estos ejemplares se encuentran depositados en la Colección Paleobotánica de la Facultad de Ciencias Exactas y Naturales y Agrimensura, UNNE, Corrientes, Argentina. *Chapmanoxylon* es un género con médula homogénea originario de la Formación Raniganj (India) presente también en las formaciones Olta (Argentina) y Tres Islas (Uruguay), estas dos últimas del Pérmico Inferior. *Mussaeoxylon* se registró en la Formación Río Bonito (Brasil) y comparte con *Kaokoxylon* Kräusel el contenido medular esclerenquimático, sin embargo se distingue del mismo porque el xilema secundario presenta un plan mixto mientras que *Kaokoxylon* posee un plan araucarioide. Se amplía con este hallazgo el biocrón de *Mussaeoxylon* al Pérmico Superior. *Podocarpoxylon indicum* (Bhardwaj) Bose y Maheshwari, fue registrado en sedimentitas del Pérmico al Jurásico del Gondwana, entre ellas también en las formaciones Olta y Tres Islas. Estos hallazgos enriquecen el conocimiento de esta asociación xilológica, pudiendo constatarse la presencia de estas maderas de tipo I, III y V de la clasificación de Pant y Singh que resume las características de los leños paleozoicos de Gondwana.

REGISTRO DE *CAIMAN* CF. *C. LATIROSTRIS* (ALLIGATORIDAE, CAIMANINAE) EN EL MIOCENO TARDÍO EN EL NOROESTE ARGENTINO

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En la actualidad *Caiman* Spix está representado por tres especies, *C. latirostris* (Daudin), *C. yacare* (Daudin) y *C. crocodilus* (Linnaeus) distribuidas principalmente en el centro-Este de América del Sur. A excepción de ciertos restos fragmentarios del Oligoceno de Brasil (i.e. *C. tremembensis* Chiappe), este género se registra con seguridad por primera vez en el Mioceno siendo un componente de la cocodrilofauna durante el Neógeno en este continente. En el Mioceno tardío se registra una diversificación taxonómica de *Caiman*. Ésta se evidencia en el área de Paraná (NE Argentino), por la presencia de un gavial y caimaninos con al menos cinco especies de *Caiman* (entre ellas *C. latirostris*). En el presente trabajo se da a conocer la presencia de *Caiman* cf. *C. latirostris* en NO Argentino. El material, con repositorio en la División de Paleontología de Vertebrados del Museo de La Plata, consiste en gran parte de un dentario izquierdo con la misma ornamentación, contorno, tipo de dentición y morfología dentaria presente en *Caiman* y una morfología de la región sinfiseal similar a la presente en *C. latirostris*. Este resto proviene de la zona sur del Valle Calchaquí, de niveles superiores de la Formación Palo Pintado. Esta última se depositó entre los 10.29 ± 0.11 Ma (K/Ar) y los 5.27 ± 0.28 Ma ($^{206}Pb/^{238}U$), en ambientes interpretados como de un sistema fluvial sinuoso areno-gravoso con desarrollo de lagunas. Los restos de mamíferos recuperados de niveles cercanos en dicha formación permiten acotar la edad de los sedimentos portadores al Mioceno tardío (Huayqueriense).

NUEVAS PTERIDOSPERMOPSIDA DE LA FORMACIÓN SPRINGHILL (CRETÁCICO INFERIOR), PATAGONIA, ARGENTINA*

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Se dan a conocer dos nuevas Pteridopermopsida de la megaflora hallada en la Formación Springhill (Berriasiano–Valanginiano) aflorante en la localidad Estancia El Correntoso, Santa Cruz. Los fósiles (repositorio MPMPB) consisten en compresiones de frondes al menos bipinnadas, con cutículas muy bien preservadas. Las pinnas se disponen alternas a sub-opuestas, en ángulos de 90º las más basales, hasta 45º las más apicales. Las pinnulas son alternas y están inervadas por un haz principal con dos o más divisiones. Si bien ambos taxones son morfológicamente semejantes las diferencias se observan a nivel cuticular. La epidermis del primer taxón posee tricomas uni y pluricelulares en ambas caras y la cutícula se presenta fuertemente estriada y reticulada en todas las células epidérmicas, así como en las células subsidiarias papilosas que rodean a los estomas en la cutícula inferior; caracteres que permiten asignar a este fósil a una nueva especie del género *Ruflorinia* Archangelsky. Por otro lado, el segundo taxón se distingue porque las superficies epidérmicas tanto adaxial como abaxial son totalmente lisas; también la cutícula presenta tres capas: una externa granular y menos electrón-densa, la del medio fibrilar y la más interna granular, muy electrón-densa y atravesada por numerosos canales

irregularmente ramificados. Estas características distinguen a este fósil de otras Pteridospermopsida ya descriptas por lo que constituiría un nuevo género dentro del grupo. A su vez los estomas en grupo de este último taxón lo distinguen de los géneros *Ticoa* Archangelsky, *Mesodescolea* Archangelsky, Mesosingeria Archangelsky y *Pachypteris* Brongniart cuyas frondes presentan una morfología similar.

FLORA Y FAUNA DE LA FORMACIÓN PIEDRA CLAVADA, ALBIANO, DEL PUESTO EL RABÓN, LAGO CARDIEL, SANTA CRUZ, ARGENTINA*

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En el puesto El Rabón, Lago Cardiel, Santa Cruz, aflora la parte más alta de la Formación Piedra Clavada (Albiano inferior) con un espesor de 140 m. Comprende dos miembros, el inferior, Miembro Cerro Karken (areniscas gris verdosas a pardo amarillentas), con 71 m de espesor, es completamente marino y contiene una diversa fauna de moluscos (repositorio MACN Pi-exCIRGEO PI). Los bivalvos están dominados por ejemplares excavadores, suspensívoros, con conchilla gruesa, característicos de un ambiente somero de alta energía (*Pacitrigonia palaeopatagonica* Piatnitzky, *Megatrigonia piatnitzkyi* Medina, *Iotrigonia rolli* Piatnitzky, *Iotrigonia feruglioi* Medina, *Pisotrigonia feruglioi* Piatnitzky, *Epicyprina* sp. nov.). Ocasionalmente hay otros organismos bentónicos (i.e. *Panopea* cf. *awaterensis* Woods, *Gervillella* sp. nov., *Meleagrinella* sp. y *Tatella aptiana* Whitehouse). A 30 metros de la base se reconocieron ejemplares de *Aioloceras* sp. Por otro lado, el miembro superior, Puesto El Rabón (areniscas finas y pelitas blancas a gris claras), es continental, de 67 m de espesor, caracterizado por abundante flora y horizontes con troncos permineralizados (repositorio MPMPB). Dos niveles fueron estudiados en este trabajo. En el inferior se reconocen improntas y compresiones de frondes de *Nathorstia alata* Halle, *Gleichenites sanmartinii* Halle, *Cladophlebis* Brongniart y *Sphenopteris* Brongniart; semillas de *Carpolithus* Seward; ramas con hojas tipo *Brachyphyllum* Brongniart y *Elatocladus* Halle y estructuras reproductivas de *Araucarites* Presl y *Athrotaxis ungeri* Florin. Estos géneros ya fueron registrados en otras localidades de la misma formación. En el nivel superior se hallaron troncos *in situ* de Araucariaceae; improntas de *Sphenopteris* y de tres morfotipos nuevos de hojas de angiospermas.

ANÁLISIS ECOMORFOLÓGICO DEL APARATO MASTICATORIO DE LOS UNGULADOS DE LA FORMACIÓN SANTA CRUZ

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Los ungulados nativos sudamericanos comprenden varios linajes actualmente extintos. En los afloramientos de Edad Santacrucense (Mioceno Temprano tardío) de la Formación Santa Cruz a lo largo de la costa atlántica, entre las rías Coyle y Gallegos (Provincia de Santa Cruz, Argentina), están representados los órdenes Notoungulata (*Adinotherium* Ameghino, *Nesodon* Owen, *Interatherium* Ameghino, *Protypotherium* Ameghino, *Hegetotherium* Ameghino y *Pachyrukhos* Ameghino), Litopterna (*Theosodon* Ameghino, *Anisolophus* Burmeister, *Tetramerorhinus* Ameghino, *Diadiaphorus* Ameghino y *Thoatherium* Ameghino) y Astrapotheria (*Astrapotherium* Burmeister). En este trabajo se realizó un estudio ecomorfológico del aparato masticatorio de estos taxones. Se incluyeron 624 especímenes actuales de los órdenes Artiodactyla, Perissodactyla, Hyracoidea y Diprotodontia. Se utilizaron 36 *landmarks* tridimensionales craneanos y 27 mandibulares. Se realizaron análisis de componentes principales (ACP) de cráneo y mandíbula por separado. El ACP de cráneo muestra una distribución más condicionada por la filogenia, mientras que el ACP de mandíbula muestra una distribución más relacionada a aspectos funcionales. Los ungulados actuales de ambientes cerrados y más braquiodontes poseen una mandíbula con la sínfisis alargada y estrecha y el cuerpo mandibular más bajo que las especies de ambientes abiertos y más hipsodontes, las que poseen mandíbulas con la sínfisis corta y el cuerpo mandibular alto y curvado. Este patrón general se repite entre los ungulados santacrucenses, de manera que se puede asociar a los Notoungulata a ambientes abiertos, alimentándose preferentemente de gramíneas, y a los Litoperna y Astrapotheria a hábitats más cerrados, y alimentándose mayormente de dicotiledóneas.

AVANCES EN EL ESTUDIO DE LA FAUNA DE GASTRÓPODOS DEL CRETÁCICO TEMPRANO DE LA CUENCA NEUQUINA, ARGENTINA

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Los gastrópodos del Cretácico Temprano de Argentina han sido relativamente poco estudiados a pesar de ser abundantes. En particular, sus aspectos paleoecológicos y sus afinidades paleobiogeográficas han sido escasamente abordados. En el presente trabajo se presenta un resumen

de los avances en el estudio de la sistemática paleontológica de los gastrópodos marinos del Cretácico Temprano de la Cuenca Neuquina. El material de estudio fue colectado en afloramientos de las formaciones Mulichinco (Valanginiano) y Agrio (Valanginiano tardío-Hauteriviano tardío) en más de 30 localidades en las provincias de Neuquén y Mendoza, en nueve de las cuales se midieron perfiles sedimentológicos de detalle. Los ejemplares se encuentran alojados en la Colección de Paleontología de la FCEyN-UBA (Buenos Aires) y en el Museo de Ciencias Naturales y Antropológicas "Juan Cornelio Moyano" (Mendoza). El estudio taxonómico reveló la presencia de 25 especies de gastrópodos en la Formación Agrio, de las cuales al menos 11 no han sido descriptas previamente para esa unidad. La Formación Mulichinco ha arrojado cinco especies, las cuales se reconocen por primera vez para esa unidad. Entre los grupos representados pueden mencionarse las familias Pleurotomariidae, Proconulidae, Eucyclidae, Turbinidae?, Neritidae, Cassiopidae, Procerithiidae, Turritellidae, Metacerithiidae, Epitoniidae?, Rissoidae, Aporrhaidae, Tylostomidae, Vanikoridae, Nerineidae y Ringiculidae, y la superfamilia Naticoidea. Esta fauna de gastrópodos muestra una alta proporción de taxones endémicos a nivel especie, aunque a niveles género y familia muestra afinidad con faunas coetáneas de Europa, Chile y el norte de Sudamérica.

MICROESTRUCTURA ÓSEA DE LOS OSTEODERMOS DE *CHANARESUCHUS* (ARCHOSAURIFORMES: PROTEROCHAMPSIDAE) DE LA FORMACION ISCHIGUALASTO (TRIÁSICO SUPERIOR) DE ARGENTINA

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En esta contribución se describe e interpreta la osteohistología de los osteodermos del Proterochamsidae *Chanaresuchus* sp. nov. El material corresponde al espécimen depositado en División Paleontología de Vertebrados del Museo de Ciencias Naturales de la Universidad Nacional de San Juan (PVSJ-567). El espécimen procede del Miembro Cancha de Bochas, Formación Ischigualasto (Carniano). Los osteodermos tienen un tamaño muy reducido (no superando los 8 mm en su eje mayor) y se dispondrían sobre las espinas neurales formando una hilera única. Cada elemento posee un surco longitudinal en su superficie externa. Los osteodermos son estructuras compactas, constituidas por hueso primario y avascular. La matriz ósea está conformada por tejido pseudolamelar. En las regiones ventral y latero-dorsal de los osteodermos se identifican abundantes fibras de *Sharpey*. El surco externo medio que caracteriza a los osteodermos no exhibe muestras se reabsorción y nueva depositación de tejido óseo. El tejido primario esta interrumpido por numerosas (20) marcas de crecimiento. La ausencia de remodelación secundaria y el carácter anual de las marcas de crecimiento en reptiles actuales indica que las mismas corresponden al total de marcas formadas durante la ontogenia del animal, brindando así una estimación confiable de su edad mínima. La ausencia de fibras estructurales sugiere que los osteodermos no se originaron a partir de la mineralización de la dermis (metaplasia). La microanatomía e histología de los osteodermos de *Chananresuchus* sp nov. difiere notoriamente de la descripta para otros arcosauriformes (Aetosauria, Rauisuchidae, Crocodylia), sugiriendo variaciones tanto en el origen, desarrollo y función de estas estructuras.

LOS DEPÓSITOS GLACIALES CARBONÍFEROS DEL ÁREA DE LOMA DE LOS PIOJOS, PRECORDILLERA DE LA PROVINCIA DE SAN JUAN*

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La secuencia neopaleozoica aflorante en el área conocida como Loma de Los Piojos (oeste de Jáchal, provincia de San juan) ha planteado significativos interrogantes desde los estudios pioneros realizados a principios del siglo pasado. Básicamente, la región muestra dos escamas de afloramientos glaciales paleozoicos de interés en esta contribución. La occidental, tradicionalmente atribuida al intervalo Carbonífero-Pérmico, y la oriental que ha sido considerada en la mayoría de las contribuciones previas como de "edad incierta". En la faja occidental se han recuperado asociaciones palinológicas referibles a la Subzona A de la Biozona *Raistrickia densa-Convolutispora muriornata*. Este hallazgo confirma una edad serpukhoviana tardía-bashkiriana temprana para las pelitas que cubren a niveles diamictiticos que conforman la base de la secuencia, por lo que es posible incluir a este conjunto en la Formación Guandacol. Esta unidad sobreyace en la zona a depósitos que contienen restos paleoflorísticos de la biozona *Frenguellia eximia–Nothorhacopteris kellaybelenensis–Cordaicarpus cesarii*. Por otra parte, las evidencias estratigráficas llevan a suponer una edad post devónica para los estratos de la faja oriental, teniendo en cuenta la existencia de clastos de la Formación Talacasto en las diamictitas basales. Asimismo, numerosas palinofloras recuperadas de esta sección se caracterizan por la ausencia de polen y de especies diagnósticas del Devónico. En lo que respecta a la correlación entre las dos fajas de afloramientos, y más allá de la existencia de diamictitas glaciales en ambas, se observan diferencias litológicas y estructurales que justifican separar los dos conjuntos.

FRONDES DE *BOTRYCHIOPSIS* ASOCIADAS A ÓVULOS EN LA FORMACIÓN TUPE, CERRO GUANDACOL, PROVINCIA DE LA RIOJA*

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La Formación Tupe (Carbonífero), aflorante en el flanco sudoeste del Cerro Guandacol, provincia de La Rioja, ha sido analizada por primera vez desde el punto de vista paleobotánico. Varios especímenes que representan la clásica Biozona *Nothorhacopteris-Botrychiopsis-Ginkgophyllum* de nuestro país, han sido recuperados de la sección inferior de la unidad. Se trata de depósitos de ambiente fluvial multicanalizado, que pueden ser caracterizados como un sistema anastomosado dominado por carga de lecho. Entre ellos se destacan fragmentos de frondes de *Botrychiopsis weissiana* Kurtz *emend*. Archangelsky y Arrondo. Un ejemplar correspondiente probablemente a la porción basal de una pinna, muestra en el sector inferior óvulos de 15 mm de largo y 10 mm de ancho, insertos a ambos lados de un eje de 8 mm de ancho. El sector apical del segmento exhibe pínulas cortamente trilobadas con venación abierta, dicótoma. El hallazgo de óvulos en conexión con pínulas de *Botrychiopsis* refuerza la afinidad de este taxón con las pteridospermas, ya sugerida por la presencia de ejes dicótomos con esporangios fusiformes hallados en asociación. El registro mundial de óvulos o semillas en conexión con frondes de pteridospermas del Paleozoico Superior es escaso y más aún en la región gondwánica. Por lo tanto, el ejemplar tupense contribuye al mejor conocimiento de este grupo de plantas en el Hemisferio Sur.

UN NUEVO MESUNGULÁTIDO (MAMMALIA, DRYOLESTOIDEA) DEL CRETÁCICO TARDÍO DE ARGENTINA

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Mesungulatidae constituye una familia de mamíferos driolestoideos exclusivos de América del Sur. Representantes de este grupo fueron hallados en las provincias de Río Negro (*Mesungulatum* Bonaparte y Soria; Formaciones Allen y Los Alamitos) y Chubut (*Coloniatherium* Rougier, Forasiepi, Hill y Novacek; Formación La Colonia) en rocas de edad Campaniano-Maastrichtiano y también en Chubut en estratos paleocenos (*Peligrotherium* Bonaparte, Van Valen y Kramarz; Formación Salamanca). Los hallazgos constan principalmente de restos mandibulares y dentarios. Se describe de modo preliminar un nuevo Mesungulatidae representado por la porción posterior de un resto mandibular derecho, edéntulo, con los alvéolos de los tres últimos molariformes y de tamaño intermedio entre *Mesungulatum* y *Peligrotherium*. El resto (MLP 89-XI-1-1) fue mencionado originalmente por Casamiquela como un mamífero indeterminado proveniente de las inmediaciones de Ingeniero Jacobacci (Provincia de Río Negro) en estratos mastrichtianos de la Formación Coli Toro. La mandíbula, de un individuo adulto, muestra los alvéolos comprimidos mesiodistalmente y de contorno cuadrangular, mientras que el último alvéolo del molariforme más posterior es más pequeño y de contorno redondeado. Esta morfología coincide con la de los mesungulátidos conocidos, en quienes se observan dos raíces grandes, cortas y anchas, insertadas en alvéolos cuadrangulares, los cuales reducen progresivamente su tamaño desde le primer al último locus. Un análisis de componentes principales, utilizando como variables distintas medidas lineales, permite discriminar el resto aquí descripto de los restantes mesungulátidos. Se infiere que el mismo podría corresponder a un nuevo taxón, ampliando la distribución geográfica y la diversidad de la familia.

REVISIÓN DE LA DIVERSIDAD DE LOS DINOSAURIOS HADROSÁURIDOS DE PATAGONIA

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El registro de hadrosáuridos de América del Sur, hasta la fecha exclusivamente patagónico, es revisado desde un punto de vista taxonómico a fin de identificar la diversidad de formas representadas. *Secernosaurus koerneri* Brett-Surman es un Hadrosauridae más derivado que *Telmatosaurus transilvanicus* Nopcsa y diagnosticado por una cresta supracetabular poco desarrollada y proceso postacetabular con bordes lateral y medial paralelos. *"Kritosaurus" australis* Bonaparte, Franchi, Powell y Sepúlveda es reconocida como taxonómicamente válido en base a una combinación única de caracteres craneanos y postcraneanos, aunque no vinculado al género *Kritosaurus* y diferente a *Secernosaurus*. *Willinakaqe salitralensis* Juárez Valieri, Haro, Fiorelli y Calvo, que involucraría a todos los hadrosáuridos de la Formación Allen, está basado en un premaxilar incompleto (holotipo) y elementos craneanos y postcraneanos (paratipo). Su estatus taxonómico es controvertido ya que la procedencia estratigráfica de los materiales tipo es diversa, los materiales incluyen dos morfologías humerales diferentes y en la elección del holotipo no se incluye un ejemplar casi completo y articulado (MPCA-Pv SM 2). Materiales asignados a *Willinakaqe salitralensis* procedentes de la Provincia de La Pampa (MPHN-Pv 01) son identificados como un diferente a "*Kritosaurus*" *australis*, *Secernosaurus koerneri* y *Willinakaqe salitralensis*, caracterizada por la presencia

de forámenes laterales en la base de las espinas neurales cervicales y una cresta deltoidea de borde afilado. Finalmente, ciertos materiales de las formaciones Allen y Colitoro/Angostura Colorada (MLP-62-XII-13-1) son distinguidos de otros hadrosáuridos patagónicos por la combinación de varios caracteres que incluyen esqueletos apendiculares muy robustos y espinas caudales altas y gruesas.

NUEVOS MATERIALES DEL EJEMPLAR HOLOTIPO DE *ANTARCTOPELTA OLIVEROI* SALGADO Y GASPARINI (DINOSAURIA, ORNITHISCHIA, ANKYLOSAURIA) DEL CRETÁCICO SUPERIOR DE ANTÁRTIDA

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La especie *Antarctopelta oliveroi* (Holotipo, MLP 86-X-28-1) fue establecida en base a un esqueleto incompleto de ankilosaurio hallado en niveles inferiores del Miembro Gamma de la Formación Santa Marta (Grupo Marambio, Campaniano superior) aflorantes en la Caleta Santa Marta de la isla James Ross. El material original incluye un dentario izquierdo fragmentario, tres dientes aislados, osificaciones craneanas, dos vertebras cervicales y el molde en látex de tres cervicales articuladas, fragmentos de costillas dorsales, dos cuerpos vertebrales dorsales, un sacro parcial, el extremo proximal de la escápula izquierda, ocho caudales incompletas, un fragmento del ilion derecho, extremo distal del fémur izquierdo, cinco metápodos, dos falanges, y varios osteodermos. Durante la Campaña Antártica de Verano 2009, fue posible la reubicación del sitio de procedencia de dichos restos, lo que permitió, por primera vez, la determinación de sus coordenadas geográficas mediante la utilización de un GPS. Asimismo, en dicho sitio fueron recolectados varios elementos óseos que por su ubicación estratigráfica, características tafonómicas y taxonómicas fueron atribuidos al mismo ejemplar holotipo de *Antarctopelta oliveroi*. Entre los nuevos materiales pudieron identificarse varios dientes maxilares y dentarios, un posible fragmento maxilar, cuerpos vertebrales, un extremo proximal de metatarsiano, tres falanges intermedias, una falange ungueal incompleta, placas óseas y varios osículos dérmicos. La información procedente de estos nuevos restos no permiten establecer con más precisión las relaciones filogenéticas de *Antarctopelta oliveroi* dentro de los Ankilosauria.

EL REGISTRO ALÓCTONO DEL BIVALVO *WEYLA ALATA* (VON BUCH) EN EL SITIO ARQUEOLÓGICO PUKARA DE LA CUEVA, JUJUY

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El registro arqueológico de elementos fósiles es particularmente escaso en el Noroeste Argentino, y los bivalvos eran desconocidos en ese contexto. En niveles de ocupación inferiores de una estructura en el sitio arqueológico Pukara de La Cueva, Departamento de Humahuaca, Jujuy, se halló un ejemplar de *Weyla alata* (von Buch). Se trata de un registro claramente alóctono, ya que, de acuerdo al conocimiento geológico de la región, su procedencia original se halla con seguridad a más de 400 km de distancia. *Weyla alata* era un bivalvo pectínido de amplia distribución geográfica en los mares someros del Jurásico temprano (Sinemuriano–Toarciano). Se lo conoce en regiones andinas desde Colombia hasta Neuquén central, de modo que para acotar el posible lugar de origen de este ejemplar fue necesario recurrir a otros datos, como el tipo de preservación (silicificación incompleta) y la roca matriz (caliza micrítica). De esta manera se puede limitar su procedencia a los Andes chilenos al norte de 26° lat. sur, o a Perú central al norte de Cuzco. En una reciente contribución se ha considerado la relevancia de este hallazgo desde el punto de vista arqueológico, demostrando que esas áreas se hallaban seguramente dentro de la región que interactuaba con la comarca de quebrada de La Cueva. Se ha especulado también sobre una posible función simbólica del ejemplar, y teniendo en cuenta la similitud de este taxón con moluscos vivientes, este hallazgo permite reflexionar sobre la posibilidad de que sociedades pre-hispánicas hubieran reconocido la naturaleza orgánica de estos restos fósiles.

ANÁLISIS ^{87}SR/^{86}SR EN *"CHLAMYS" ACTINODES* (SOWERBY): HALLAZGO DE PLIOCENO MARINO EN PATAGONIA*

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La edad de los horizontes fosilíferos pre-cuaternarios que coronan las terrazas de Cabo Buentiempo y Cerro Laciar (Provincia de Santa Cruz) han sido objeto de discusión desde su descubrimiento hacia fines del siglo XIX. Desde entonces, y sobre la base del contenido porcentual

de las especies de moluscos sobrevivientes en el Atlántico Sudoccidental, se los ha ubicado indistintamente en el Mioceno o en el Plioceno. De esta forma, la ausencia en la región de sedimentitas pliocenas de origen marino constituyó siempre un interrogante. Mediante el análisis $^{87}Sr/^{86}Sr$ en conchillas calcíticas del pectínido "*Chlamys" actinodes* (Sowerby) contenidas en las terrazas del Cerro Laciar se comprobó la existencia de una transgresión marina ocurrida en el Plioceno temprano datada en $5{,}06^{+0{,}28}/_{-0{,}32}$ Ma. Los especímenes analizados procedentes de Cabo Buentiempo presentan una edad ligeramente más antigua que la obtenida para Cerro Laciar, correspondiente a $5{,}46^{+0{,}26}/_{-0{,}33}$ Ma., cercana al límite Mioceno-Plioceno. Estos resultados permiten cerrar el hiato entre el Mioceno tardío, representado en la región por la fauna de moluscos "entrerrienses", y el Pleistoceno, posibilitándose el estudio de los cambios evolutivos de las asociaciones de moluscos desde el Mioceno hasta el Reciente en el Atlántico Sudoccidental.

VARIACIÓN MORFOLÓGICA EN "*CHLAMYS" ACTINODES* (SOWERBY) (MIOCENO, ARGENTINA): UN ESTUDIO PRELIMINAR*

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El presente análisis cuantifica una notable variación en la morfología del pectínido "*Chlamys" actinodes* (Sowerby) observable desde los términos basales a los cuspidales de la Formación Puerto Madryn (Mioceno). Se aplicó un análisis de morfometría geométrica en 3D utilizando 23 *landmarks* sobre la base de imágenes de tomografía computada, realizándose un análisis de Procruster Generalizado sobre las coordenadas de los *landmarks* digitalizados. Se utilizaron análisis de la varianza (ANOVA) y análisis discriminante que permitieron encontrar diferencias estadísticamente significativas en la forma. Estos resultados, combinados con estudios tafonómicos que indican que se trata de asociaciones autóctonas, permitieron llegar a las siguientes conclusiones:1) las facies basales del *shoreface*, asociadas a sustratos firmes de ambientes de alta energía afectados por corrientes tidales, son portadoras de ejemplares con conchillas convexas, seno bisales profundos y pliegues radiales altos; 2) las facies de *offshore*, de ambientes de baja energía asociadas a sustratos blandos, se caracterizan por ejemplares con conchillas más planas y con pliegues más bajos que los especímenes procedentes del *shoreface*. Los cambios registrados conducen a inferir que los pectínidos de aguas someras, sometidos a ambientes de alta energía, tienden a reforzar sus conchillas con el desarrollo de valvas más convexas provistas de elevados pliegues radiales lo que confieren más resistencia, y de un gran seno bisal, probablemente proporcional al tamaño del biso responsable de mantener la conchilla fija a un sustrato sometido a una alta energía.

APORTES AL CONOCIMIENTO OSTEOLÓGICO DEL AVE MIOCENICA *MACRANHINGA PARANENSIS* NORIEGA (PELECANIFORMES: ANHINGIDAE)

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Macranhinga paranensis Noriega, conocida por restos aislados, es registrada en la base de la Formación Ituzaingó ("Conglomerado Osífero", Mioceno tardío) y en la Formación Paraná (Mioceno medio-tardío) de Entre Ríos. En esta contribución se brindan caracteres de la anatomía del sinsacro, porción proximal del húmero y del tibiotarso de dicho taxón. La porción proximal del húmero presenta el *tuberculum ventrale* asociado con una notoria concavidad (inserción del *m. coracobrachialis caudalis*), que en *Phalacrocorax brasilianus* (Gmelin) es reducida y más aún en *Anhinga anhinga* Linnaeus; la inserción del *m. scapulohumeralis caudalis* es similar a *A. anhinga*. La porción proximal del tibiotarso presenta la *impressio ligamenti collateralis medialis* reducida y ubicada más caudalmente que en *A. anhinga*; *crista cnemialis lateralis* delgada y dirigida más lateralmente que en *A. anhinga*, como en *P. brasilianus*. El sinsacro en la región postacetabular, presenta un conspicuo *processus costalis* que delimita cranealmente a la *fossa renalis pars ischiadica*, similar a *P. brasilianus*. Estos caracteres resultarían de utilidad, en el marco de futuros análisis filogenéticos, para esclarecer las relaciones de parentesco entre las especies fósiles de Anhingidae de América del Sur. Asimismo, podrían servir de base para dilucidar aspectos poco conocidos de la paleobiología de esta especie, vinculados con el vuelo y la natación.

ESTIMACIÓN DE LA MASA CORPORAL EN GÉNEROS DEL ORDEN NOTOUNGULATA

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Los Notoungulata son un grupo de mamíferos fósiles ampliamente diversos y sin representantes vivientes. Prácticamente no se dispone de estimaciones de masa corporal para la mayoría de los géneros, ni de un método objetivo para seleccionar los estimadores de masa. El objetivo del trabajo es estimar la masa corporal de los representantes del Orden Notoungulata y reconocer las mejores ecuaciones predictivas para tal fin, respecto a cada taxón, a cada familia y al Orden en general. Se incluyen 535 ejemplares fósiles correspondientes a 50 géneros. La masa corporal de cada género se estima sobre la base de 24 ecuaciones alométricas construidas en mamíferos vivientes, basadas en 19 medidas del

esqueleto apendicular y tres medidas dentarias tomadas con calibre digital. El intervalo de masa corporal dado por los valores estimados para el orden se encuentra entre 0,57 kg en *Archaeophylus* Ameghino (Interatheriidae) y 3797 Kg en *Mixotoxodon* Van Frank (Toxodontidae), lo que refleja la gran diversidad de tamaños corporales que caracteriza al grupo. Los menores tamaños se dan en las familias Interatheriidae, Archaeohyracidae y Hegetotheriidae; tamaños intermedios en los Notohippidae y Mesotheriidae y tamaños grandes en representantes de los Homalodotheriidae. En los Leontiniidae y Toxodontidae los tamaños van de intermedios a grandes, siendo esta última la de mayor variación de masa y con los taxones de mayor tamaño. En comparación con los ungulados holárticos, los notoungulados presentan un intervalo más amplio y variable de masa corporal hacia las formas de menor tamaño.

NUEVOS REGISTROS DE LA SECCIÓN *ARAUCARIA* WILDE Y EAMES DEL OLIGOCENO–MIOCENO DE PATAGONIA, REPÚBLICA ARGENTINA

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Las araucariáceas son coníferas de distribución actual sudamericana y australasiática. De las cuatro secciones del género *Araucaria*, la sección *Araucaria* Wilde y Eames está representada actualmente por dos únicas especies sudamericanas: *A. araucana* (Mol.) K. Koch. y *A. angustifolia* (Bert.) O. Kuntze. En este trabajo se dan a conocer dos nuevos registros cenozoicos, los cuales amplían el rango temporal y geográfico conocido para dicha sección en Patagonia extra-andina y pre-andina. De la Formación Ñirihuau (Oligoceno superior–Mioceno inferior, provincia de Río Negro), se reporta un complejo bráctea-escama ovulífera asociado a hojas con cutícula de *Araucaria nathorstii* Dusén. Éste constituye el primer registro de estructuras reproductivas de la sección *Araucaria* para Sudamérica. De la Formación Cullen (Mioceno inferior–Mioceneo medio, provincia de Tierra del Fuego) provienen improntas foliares, sin cutícula, de *Araucaria* sp., afines a *A. nathorstii* Dusén y *A. pararaucana* Panti, Césari, Marenssi y Olivero (sección *Araucaria*). La información disponible permite sugerir que la sección alcanzó su mayor distribución geográfica en el Hemisferio Sur durante el Cretácico Temprano, se mantuvo durante el Eoceno y se restringió a partir del Oligoceno a territorios sudamericanos. La mayor retracción se registra con posterioridad al Mioceno Tardío, ligada probablemente a la apertura del pasaje de Drake y el levantamiento andino, sucesos que provocaron un paulatino y sostenido enfriamiento del sur de Sudamérica y una mayor duración de las estaciones secas.

BIOFACIES DE CONODONTES EN EL INTERVALO DEL CONTACTO ENTRE LA FORMACIÓN SAN JUAN Y UNIDADES SUPRAYACENTES (ORDOVÍCICO MEDIO), EN LA PRECORDILLERA CENTRAL DE SAN JUAN

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El anegamiento de la plataforma carbonática de la Formación San Juan, Precordillera Central de San Juan, durante el Ordovícico medio, está representado por el inicio de sedimentación pelítica en la Formación Las Aguaditas, sierra de Los Blanquitos, y por la facies de calizas lajosas en la Formación Las Chacritas, sierra de La Trampa. Este cambio en las condiciones de sedimentación, que acontece en la cuenca, está reflejado por una segregación lateral de comunidades de conodontes de plataforma abierta, margen de plataforma y talud superior. Los estratos cuspidales de la Formación San Juan (*wackestones, packstones*) produjeron una asociación donde prevalecen los géneros *Paroistodus* Lindström, *Periodon* Hadding y *Protopanderodus* Lindström, con una alta abundancia (1000 especímenes/kg de roca, promedio entre distintos niveles) y diversidad (22 especies), en la Zona de *Yangtzeplacognathus crassus* (Chen y Zhang) (Darriwiliano medio). En la parte media de la Formación Las Chacritas, así como en el tramo medio del miembro inferior de la Formación Las Aguaditas, la batimetría aumenta bajo condiciones euxínicas con sedimentación de fangolitas calcáreas y pelitas negras, respectivamente, donde la abundancia (< 10 elementos/kg de roca) y diversidad decrecen súbitamente, permaneciendo formas pelágicas de mar abierto, como las previamente dominantes y paraconodontes, verificándose enanismo. La riqueza de conodontes se recupera a través de 25 m de espesor, hacia el techo de la Formación Las Chacritas y nivel equivalente de la Formación Las Aguaditas (120 especímenes/kg de roca y 12 especies), donde las secuencias somerizan a facies de *packstones-graintones*, en la Zona de *Eoplacognathus suecicus* Bergström.

SOBRE LA PRESENCIA DE MALPIGHIACEAE EN LA FORMACIÓN RÍO TURBIO, EOCENO DE SANTA CRUZ, ARGENTINA

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Se da a conocer el hallazgo de granos de polen (BAPal ex CIRGEO 98-100) y de una impronta foliar (MPMPB 2911) de Malphigiaceae en

la Formación Río Turbio, SO de Santa Cruz, destacando la presencia de esta familia neotropical en el extremo austral de Sudamérica durante el Eoceno. *Perisyncolporites pokornyi* Germeraad *et al.*, definido para agrupar polen fósil afín a Malpighiaceae, incluye formas con gran variabilidad morfológica. Los clados actuales más afines a las formas fósiles de la Formación Río Turbio (Tetrapteroide y Stigmaphylloide) están actualmente distribuidos en zonas tropicales y subtropicales de Sudamérica, llegando sólo a latitudes de 35°S. La única especie actual más cercana geográficamente al área de estudio (*Gallardoa fischeri* Hicken) y que representa la penetración más austral de la familia en el mundo (alcanza una latitud de 42°S), se aparta morfológicamente del material estudiado. El megafósil se asemeja a otros previamente reconocidos en la localidad de Río Pichileufú, provincia de Río Negro (*Mascagnia sepiumoides* Berry*, Tetrapteris precrebrifolia* Berry) y también en la Fm. Río Turbio (*Tetrapteris precrebrifolia* Berry). El análisis paleoclimático de la Fm. Río Turbio indica condiciones de paleotemperaturas cercanas a las que actualmente se desarrollan en la Provincia de Misiones (MAT 18 ± 1,5ºC). Estos resultados estarían sustentando hipótesis previas sobre una importante penetración de linajes neotropicales en altas latitudes durante el Eoceno, así como una posible ruta migratoria de la familia desde Sudamérica hacia Australia a través de Antártida, al menos para las formas perisincolporadas, que son típicamente Americanas.

APLICACIÓN DE LA OBRA (FLORA POLÍNICA DEL NORDESTE ARGENTINO - POACEAE)

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La Flora Polínica de Nordeste Argentino constituye una herramienta para hallar afines actuales del polen fósil disperso y ayudar a su determinación. En esta presentación se dan a conocer las características palinológicas de la familia Poaceae. En el NE argentino, esta familia está representada por 383 especies. Desde el punto de vista palinológico, esta familia es estenopolínica, compuesta de granos monoporados, pequeños a grandes, heteropolares, de simetría bilateral, oblato-esferoidales, esferoidales, prolato-esferoidales, ámbito circular. La exina es delgada de 1–3 µm, tectada microrugulada y microgranulada. Con el Microscopio Electrónico de Barrido se observa que en algunas especies las endoaperturas poseen anillos sobresalientes, reconociéndose 2 tipos polínicos: Tipo: *Andropogon bicornis* Linnaeus, granos de polen cuya endoapertura se encuentra rodeada por un anillo y Tipo: *Chloris gayana* Kunth, granos de polen cuya endoapertura no se encuentra rodeada por un anillo. De acuerdo a estas características, fue posible determinar que en las Formaciones San José y Chiquimil (Mioceno medio a superior, respectivamente) que afloran en el noroeste argentino se hallaron granos de polen afines al tipo *Andropogon bicornis*, los que están incluidos en el morfogénero *Graminidites media* (Cookson) Potonié, estos ejemplares se hallan en la colección de preparados microscópicos de la Universidad Nacional del Nordeste. Por otra parte en sedimentos holocénicos de los Esteros del Iberá (noreste argentino) se hallaron especies de *Andropogon* Linnaeus*, Chloris* Swartz y *Cynodon* Richard (incluidos en el tipo *Andropogon bicornis.,* además de especies pertenecientes al los géneros *Eragrostis* Wolf y *Luziola* Jussieu (incluidos en el tipo *Chloris gayana* Kunth).

PRESENCIA DE *ASTEROTHECA* EN EL PÉRMICO SUPERIOR (FORMACIÓN TACUARY) DE PARAGUAY

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La Formación Tacuary, del Pérmico superior, aflora en extensas áreas del Paraguay Oriental. Hasta ahora solamente había brindado unas pocas impresiones de Articuladas y Lycopsidas y abundantes restos de maderas silicificadas de Coníferas, Ginkgoales y Filices, ya descritas en diversos trabajos. Recientemente se han encontrado por primera vez, abundantes restos bien preservados de impresiones adjudicadas al género *Asterotheca* Presl*, in* Corda 1845, en una cantera ubicada sobre la ruta 2, entre Coronel Oviedo y Caaguazú. El material consiste en fragmentos de frondes con pinnas de hasta 12 cm de largo x 1,8 cm de ancho, portando pínnulas pecopterídeas del orden de 7–8 mm de largo x 2,5–3 mm de ancho. La venación lateral es furcada una vez, a mitad de recorrido hacia el borde. Sinangios de aproximadamente 0,8–1 mm de diámetro con 5–6 esporangios. El nivel portador, una pelita verdosa fina de origen lacustre, solamente preserva restos de esta especie y ningún otro fósil vegetal acompañante lo que implica un interesante problema tafonómico. La presencia de frondes relativamente grandes condice con la presencia en la misma formación y en localidades cercanas, de troncos del género *Tuvichapteris* Herbst, un helecho Marattial de gran tamaño, con el cual podrían estar relacionadas.

A NEW TETRAPOD-BEARING ASSEMBLAGE FROM THE LATE MIDDLE TRIASSIC CHAÑARES FORMATION, LA RIOJA PROVINCE, ARGENTINA*

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The Ladinian Chañares Formation is one of the most fossiliferous Middle Triassic tetrapod-bearing assemblages around the world. Its best sampled locality is the classic Los Chañares locality which yielded hundreds of tetrapod specimens. Cynodonts are the most common elements (82%), in which *Massetognathus* Romer is the most abundant taxon, and archosauriforms (13%) and dicynodonts (5%) are less numerous. During the Fall of 2011, field work was conducted in a locality, coined here as Brazo del Puma, which is situated within the dawning of the Gualo River in the upper-most levels of the Lower Member of the Chañares Formation. Brazo del Puma formed part of a fluvial system with some meandering paleocanals in a fluvial plain, showing paleofloristic and paleofaunistic differences and diverse taphonomic attributes in each microenvironment. In this locality were recovered several fragmentary tetrapod remains of parautochthonous origin housed at the Centro Regional de Investigaciones La Rioja. In contrast with the classic assemblage, Brazo del Puma depicts a greater proportion of dicynodonts (59%), being followed by archosauriforms (27%) and cynodonts (14%), respectively. Among the archosauriforms, we identified small specimens assigned to proterochampsids and doswelliids and a medium-sized indeterminate form. Brazo del Puma strongly differs from the classic locality in the high abundance of dicynodonts, but resembles the condition documented in the co-eval *Dinodontosaurus* Assemblage Zone of southern Brazil. Accordingly, the new explorations conducted in the Chañares Formation indicate that its tetrapod assemblages were more disparate than previously thought showing paleoecological differences between them.

PRIMER REGISTRO DE LEÑO FÓSIL DE CONÍFERA (PODOCARPACEAE) PARA EL CENOZOICO DE LA MESOPOTAMIA ARGENTINA (FORMACIÓN ITUZAINGÓ)*

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Se conocen numerosas contribuciones de estudios de leños fósiles de gimnospermas provenientes de la región oeste del país y de Patagonia. Sin embargo, su registro en la Mesopotomia Argentina es muy escaso y está confirmado únicamente por estudios palinológicos. En el presente trabajo se da a conocer un nuevo morfotaxón preservado como madera fósil de Podocarpaceae, cuyo género actual más afín es *Prumnopitys* Philippi. El ejemplar se encuentra depositado en la Colección Paleobotánica del Museo Antonio Serrano (Paraná, Argentina). El material fosilizado por silicificación, conserva únicamente el xilema secundario y proviene de los afloramientos de la Formación Ituzaingó (Plioceno–Pleistoceno) expuestos en la barrancas del río Paraná, Entre Ríos. Sus caracteres diagnóstico son: anillos de crecimiento distinguibles a indistinguibles; parénquima axial ausente; radios homogéneos, uniseriados; traqueidas de contorno elíptico a circular; punteaduras areoladas en una o dos series; campos de cruzamiento con punteaduras tipo taxodioide o cupresoide. A partir del estudio de este ejemplar, se confirma por primera vez la presencia de leños fósiles de coníferas, en particular de Podocarpaceae, para el Cenozoico de la Mesopotamia Argentina. Este leño fósil es un indicio de que en el pasado las Podocarpaceae tuvieron una extensión mayor y probablemente más continua que en la actualidad. Además, aporta nueva evidencia a la hipótesis sobre su amplia distribución en la Mesopotamia Argentina durante el Cenozoico y se brinda un nuevo elemento de análisis para interpretar su historia biogeográfica.

SIMBIOSIS ENTRE CORALES COLONIALES Y SERPÚLIDOS EN DEPÓSITOS MARINOS DEL CRETÁCICO TEMPRANO DE CUENCA NEUQUINA, CENTRO-OESTE DE ARGENTINA

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La presencia de serpúlidos y ostras incrustantes es común en las plataformas marinas subtropicales del Cretácico. En este trabajo se describen dos especies de serpúlidos (Sabellida, Serpulidae) y una de sabélido (Sabellida, Sabellidae) encontradas como incrustantes de corales coloniales escleractínidos de las especies *Stereocaenia triboleti* Koby y *Columastrea antiqua* Gerth. Los especímenes analizados, depositados en la Colección de Paleontología de la Universidad de Buenos Aires, proceden de concentraciones fósiles marinas de distintas secciones del Miembro Pilmatué de la Formación Agrio en Neuquén. La edad de las concentraciones es Hauteriviana sobre la base de los amonoideos asociados. El estudio de los incrustantes permitió distinguir dos asociaciones: una caracterizada por incrustaciones post-mortem y otra representada por simbiosis serpúlido-coral. En el primer caso se observa a los serpúlidos cementados sobre zonas muertas del coral y por lo tanto sin una respuesta del hospedador frente a la presencia del incrustante. En el segundo caso se pudo interpretar que los tubos de los serpúlidos se asentaron sobre coralios vivos siendo englobados a medida que crecían lo cual permite inferir una simbiosis. La relación simbiótica puede ser caracterizada como mutualismo desde el punto de vista ecológico y como bioinmuración desde el estructural. Esta simbiosis, que parece ser facultativa y de la que hasta ahora no se habían registrado casos similares, demuestra que estos dos grupos ya mantenían relaciones complejas a principios del Cretácico, y constituye un antecedente de la simbiosis obligada que mantienen en la actualidad varias especies del género *Spirobranchus* de Blainville con corales.

EVIDENCIAS DE LA PRESENCIA DE TERMITAS EN MADERAS DEL MIOCENO DE LA RIOJA, ARGENTINA

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Se reporta la presencia de coprolitos atribuibles a termitas (Isoptera) en tramos de galerías en madera silicificada (muestras depositadas en la colección paleobotánica del CRILAR) proveniente de la Formación Salicas (Mioceno Superior) en el noreste de La Rioja. Estos son cilíndricos, a veces ovalados, de extremos redondeados y con una sección transversal generalmente hexagonal, y en algunos casos circular. Los coprolitos llenan totalmente galerías alargadas de sección circular construidas en el xilema secundario de pequeños fragmentos de madera afines al género *Prosopis* Linnaeus. Estas características permiten relacionar a los coprolitos en las galerías a la actividad en madera muerta de las "termitas de madera seca" (Kalotermitidae) en climas subtropicales a tropicales actuales. En sección transversal a longitudinal algunos coprolitos muestran filamentos tubulares dispuestos radialmente que en ocasiones parecen conectar individuos entre si. Su afinidad es incierta aunque podrían representar hifas de hongos o restos de la microbiota intestinal de las termitas. Este es el primer registro sobre la presencia de termitas fósiles en La Rioja lo que expande el rango paleobiogeográfico de este grupo en Argentina. La presencia de "termitas de madera seca" en la Formación Salicas sugiere un ambiente arbolado en un clima subtropical o tropical que habría proveído suficiente substrato en forma de madera para su desarrollo. En este ambiente las comunidades de termitas habrían tenido un rol significativo en el reciclado de materia orgánica. Por último, la asociación con maderas afines a *Prosopis* L. sugiere que la relación actual conocida entre este género y las "termitas de madera seca" existe desde el Mioceno.

ANÁLISIS PALEODENDROLÓGICO DE MADERAS DE LA FORMACIÓN ROCA BLANCA, JURÁSICO INFERIOR, SANTA CRUZ, ARGENTINA

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En el presente trabajo se dan a conocer los primeros resultados del análisis paleodendrológico de maderas de la Formación Roca Blanca (Jurásico Inferior), Santa Cruz, Argentina. Los ejemplares analizados se encuentran depositados en la colección paleobotánica del Museo Padre Molina, Río Gallegos, Santa Cruz. De acuerdo a sus caracteres anatómicos, fueron asignados a *Circoporoxylon* Kräusel y a *Protojuniperoxylon*? Eckhold. El análisis anatómico-cuantitativo de los anillos de crecimiento propuesto por Falcon-Lang permite concluir que los árboles eran gimnospermas de hábito siempreverde, ya que ambas especies exhiben curvas CSDM (*cumulative algebraic sum of each cell's deviation from the mean)* sesgadas hacia la derecha (+74,92 y +82,45% respectivamente), tal como ocurre en las coníferas perennifolias con moderada a alta retención foliar. El promedio del porcentaje de leño tardío es de 8,63 y 11,46, el porcentaje promedio de disminución celular es de 52,29 y 56,33 y el promedio del índice marcado de anillo es de 4,43 y 5,98 respectivamente. El espesor medio de los anillos anuales de *Circoporoxylon* Kräusel es de, 0,91mm siendo el anillo más delgado de 0,51 mm y el anillo más ancho de 1,26 mm. Mientras que *Protojuniperoxylon*? posee valores de 2,25 mm (1,46 mm y 3,11 mm). La sensibilidad media es menor a 0,3, determinando que eran árboles complacientes, es decir, que crecieron bajo condiciones climáticas constantes y regulares a lo largo de los años medidos. Las maderas analizadas muestran un crecimiento estacional por temperatura y con abastecimiento hídrico relativamente uniforme a lo largo del año.

PALINOLOGÍA Y LITOFACIES DE LA FORMACIÓN PALO PINTADO (MIOCENO SUPERIOR) EN LAS LOCALIDADES RÍO CALCHAQUÍ Y QUEBRADA EL ESTANQUE, SALTA, ARGENTINA

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La Formación Palo Pintado aflora al sur de la provincia de Salta, datada entre 10.29±0.11 Ma (K/Ar) y 5.27 ± 0.28 Ma (206Pb/238U). Litológicamente, se la define como un "sistema fluvial areno-gravoso". La arquitectura fluvial y sus litofacies asociadas señalan diferencias entre los perfiles de las localidades Río Calchaquí y Quebrada del Estanque. En la primera predominan los depósitos intracanal y de *overbank,* con poco desarrollo de llanura de inundación; mientras en la segunda los depósitos de *overbank* están más desarrollados y representados por una amplia llanura de inundación, con presencia de lagunas formadas a partir de crecidas no encauzadas ocasionadas por lluvias excepcionales. Estas lagunas se encuentran asociadas a un

subambiente palustre localizado en las orillas de las mismas. Los preparados estudiados pertenecen a la Colección de preparados Micropaleontológicos de la Universidad Nacional del Nordeste, Corrientes. Del análisis palinológico se reconocen las paleocomunidades dulceacuícolas, palustres, bosques higrófilos y sabanas. En la Quebrada El Estanque se halló un alto porcentaje de colonias de *Pediastrum simplex* (Meyen) Lemmermann, *P. boryanum* var. *longicorne* Reinsch y *Brotryococcus braunii* Kützing, que indican un predomino de la paleocomunidad acuática planctónica sobre las demás. En cambio, en río Calchaquí predominan esporomorfos reconocidos como integrantes de sabanas o praderas, por ejemplo *Chenopodipollis chenopodiaceioides* (Martin) Truswell en Truswell, Sluiter y Harris y *Tubulifloridites* spp.. Como resultado del análisis en conjunto de los datos anteriores, se ve reflejada la correlación entre las paleocomunidades identificadas y los paleoambientes inferidos a partir de la litofacies de ambas localidades.

NUEVA LEGUMINOSA DEL MIOCENO DE LA FORMACIÓN SOLIMÕES, ESTADO DE ACRE, AMAZONIA, BRASIL

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En esta contribución se da a conocer la anatomía de un nuevo taxón de madera de angiospermas del Mioceno de la Formación Solimões, hallada en la localidad Mississipi II del Río Juruá, Estado de Acre, Sudoeste de Amazonia, Brasil. El ejemplar fósil analizado está silicificado con los elementos celulares bien preservados y se encuentra depositado en la Colección Paleobotánica del Laboratorio de Paleobotánica de la Universidad Federal de Acre, Brasil. Se observaron los siguientes caracteres anatómicos: anillos de crecimiento indistintos, porosidad difusa, vasos solitarios y múltiples hasta cuatro, elementos de vasos cortos con placas de perforación simples y puntuaciones pequeñas y ornadas, fibras no septadas, el parénquima axial abundante y radios muy bajos y uni-biseriados. Por los caracteres presentes, el espécimen es afín a los miembros actuales de la familia Leguminosae, más precisamente a la subfamilia Papilionoideae. Este hallazgo es la primera cita para esta formación y constituye un nuevo aporte al conocimiento de la composición de la paleoflora miocénica de Sudamérica.

LA DISPERSIÓN HUMANA EN LAS AMÉRICAS COMO UNA INVASIÓN BIOLÓGICA

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Nuestra propuesta es analizar el primer poblamiento americano como una invasión biológica bajo el marco de la ecología de las invasiones. Este enfoque involucra varios conceptos aplicables al *Homo sapiens* Linnaeus tales como fuerza del invasor, resistencia biótica, *enemy release* y evolución del aumento de la habilidad competitiva. A partir de ello pueden desarrollarse diferentes hipótesis de trabajo (*e.g.* pre-adaptación, superioridad inherente, nicho vacío, eventos de fundación, arquitectura genética, etc.), algunas de las cuales señalan estrechas relaciones entre la dispersión humana y su impacto en el ambiente. Por consiguiente, ésta puedo haber tenido un grado de incidencia diferencial en la extinción de la megafauna. En este sentido habría habido respuestas adaptativas variadas en las distintas especies de mamíferos y en los diversos paleoambientes americanos, en consonancia con la relación establecida con los humanos y las modificaciones que éstos realizaron en los recursos disponibles durante la transición Pleistoceno–Holoceno. Analizaremos esta propuesta a través de las distintas teorías que brinda el marco paleoecológico, su relación y su aplicación para el caso del *Homo sapiens* como especie invasora dentro de un ambiente novedoso como fueron las Américas durante la mencionada transición.

PRIMER REGISTRO DE MOLUSCOS PROCEDENTES DE LA FORMACIÓN CASTILLO, ALBIANO DE LA CUENCA DEL GOLFO SAN JORGE, PATAGONIA, ARGENTINA

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Durante la realización de estudios estratigráficos en la Formación Castillo (Albiano de la Cuenca del Golfo San Jorge) se hallaron moluscos en su Sección Inferior. Los ejemplares, depositados en el Museo Feruglio, proceden de la Sierra del Castillo en la Sierra de San Bernardo, Chubut. Se recuperaron 55 moldes internos articulados de bivalvos heterodontos. Los mismos poseen contorno subelíptico, con el largo

superando la altura, comisura lisa, umbones desplazados hacia el margen anterior, carena umbonal y línea paleal entera. Al no observarse caracteres charnelares su identificación es dificultosa, y por el momento se asignan con dudas a Corbiculoidea. Se han identificado además dos taxones de gastrópodos entre los que se encontraron 25 ejemplares asignables a Viviparidae (Caenogastropoda), que corresponde a formas operculadas de agua dulce, y 6 ejemplares asignables a Physidae (Pulmonata) que corresponden a formas acuáticas de agua dulce, con un característico enroscamiento sinestral, y carentes de opérculo. La asociación de moluscos fue registrada en facies de areniscas tobáceas medianas, en parte sabulíticas, con clastos de tobas verdes en la base. El estrato fosilífero se encuentra limitado en su techo y base por tobas verdes tabulares, tiene una potencia de 50 cm y geometría lenticular. Los restos se registran dispersos y sin orientación preferencial. Los gastrópodos, de menor tamaño, se encuentran en las facies más finas. Por su heterometría y la presencia de fósiles retrabajados se interpreta su depositación en un medio lagunar costero. La asociación registrada es consistente con la depositación en un medio continental de oxigenación normal.

RELEVAMIENTO DIGITAL DE LAS MEGAFLORAS (IMPRESIONES Y MADERAS) DEL PÉRMICO–TRIÁSICO INFERIOR DE ARGENTINA, PARAGUAY Y URUGUAY

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La finalidad de este trabajo es ofrecer un compendio actualizado de los principales registros de floras de impresiones y leños en diferentes formaciones del Pérmico y Triásico Inferior de Argentina, Paraguay y Uruguay. El trabajo de recopilación desarrollado, se presenta en el formato de fichas en el programa Microsoft Word y de página web con enlaces a varios links de entradas, referidos a descripciones, enmiendas, cambios de estatus taxonómicos y procedencias actualizadas. Se ofrece también comentarios sobre la importancia, las novedades y otros datos que facilitarán las determinaciones y permitirán una búsqueda eficiente de las paleofloras, incluyendo en las mismas, además, reseñas bibliográficas. Las fichas compendian información de varios trabajos para cada taxón tratado, con un comentario sobre el aporte que brinda cada obra al conocimiento de dicha especie. Las mismas tendrán un sistema abierto que permitirá a los usuarios el continuo aporte de nuevos registros, para que pueda seguir enriqueciendo este relevamiento de manera abierta y se puedan conocer nuevos hallazgos fosilíferos para el intervalo Permo–Triásico.

MORFOTIPOS ASTRAGALARES DE LOS MAMÍFEROS DEL EOCENO TEMPRANO DE PASO DEL SAPO (PATAGONIA, ARGENTINA)

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Los mamíferos de las localidades de Laguna Fría (49,51 ± 0,23 Ma) y La Barda (entre 47,89 ± 1,21 y 43 Ma), conocidos en conjunto como la fauna de Paso del Sapo, comprenden una importante colección de marsupiales ("Didelphimorphia", Paucituberculata, Sparassodonta, Microbiotheria y Polydolopimorphia) y placentarios, representados por Xenarthra (Cingulata), Chiroptera y diversos ungulados nativos sudamericanos ("Condylarthra", Litopterna, Notoungulata y Astrapotheria), todos ellos reconocidos sobre la base de elementos dentales. En este trabajo se analiza la diversidad de astrágalos de La Barda, depositados en LIEB-PV. Se observaron cuatro morfotipos principales. El morfotipo-1 se caracteriza por la ausencia de cuello articular y cabezas anchas que llegan hasta la tróclea, lo que permite asignarlos a marsupiales. La presencia de cuerpos aplanados, trócleas anchas y comprimidas en la línea sagital caracteriza al morfotipo-2 y es referible a dasipodios. El morfotipo-3 que recuerda al de litopternos, se caracteriza por astrágalos largos de trócleas largas y marcadamente cóncavas que se extienden anteriormente, con crestas paralelas, cabeza desarrollada en sentido dorsoplantar, pero no lateromedial. El último morfotipo, asignado a los Notoungulata, comprende el mayor número de restos y la mayor variación de tamaños. Presentan perforación astragaliana en distintos grados de desarrollo, cresta extendida desde el borde anterior de la faceta lateral hasta la cabeza, cabeza redondeada y un proceso que se proyectado medialmente. Excepto por los escasos tarsos referidos a marsupiales, existe una buena correlación entra la cantidad de restos dentarios recuperados de cada grupo taxonómico y los astrágalos aquí asignados.

PECTÍNIDOS DEL GÉNERO *PROHINNITES* GILLET Y SU FAUNA DE INCRUSTANTES: ISLAS DE SUSTRATOS DUROS SOBRE FONDOS BLANDOS EN LA FORMACIÓN AGRIO, CRETÁCICO TEMPRANO, CUENCA NEUQUINA, ARGENTINA

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El género *Prohinnites* Gillet está representado por una especie de pectínido de gran tamaño y valvas gruesas, abundante en carbonatos del Valanginiano tardío del Miembro Pilmatué de la Formación Agrio, en Cerro Marucho y Cerro Birrete, sur de Neuquén. Este pectínido experimenta cambios en su

hábito de vida, pasando de un estadío juvenil epibisado a una etapa epifaunal cementante, tras la cual, habiendo alcanzado un tamaño considerable, es probable que pasaran a ser reclinantes. De esta manera fueron aprovechados como sustrato por una abundante y diversa fauna de incrustantes. Tras examinar 72 valvas alojadas en la colección de Paleontología, FCEN, UBA se observa que si bien ambas valvas fueron colonizadas, es llamativo que las derechas (cementadas al sustrato, o reclinantes) presenten mayor cantidad de incrustantes. Varios factores pueden explicar este fenómeno: la preferencia de los incrustantes por un hábito críptico, el desplazamiento de éstos por parte de competidores superiores (por ejemplo algas, que son epibiontes comunes y requieren luz para poder fotosintetizar), o la preservación preferencial de las valvas derechas. Los incrustantes más abundantes son ostras pertenecientes a *Amphidonte (Ceratostreon)* Bayle, seguidos por serpúlidos solitarios, con formas enroscadas (*Placostegus conchophilus* Radwanska, y Spirorbinae indeterminados) y desenroscadas (géneros *Parsimonia* Regenhardt, *Filogranula* Langerhans y *Propomatoceros* Ware). Ostras y serpúlidos suelen hallarse agregados. Asimismo son comunes los sabéllidos del género *Glomerula* Nielsen, que suelen disponerse paralelos a las líneas de crecimiento más marcadas del pectínido. Finalmente se hallaron briozoarios los cuales están representados por un cyclostomado y varios cheilostomados; en raras ocasiones pueden cubrir gran parte de la valva.

XILOFLORA DE LA FORMACIÓN PORTEZUELO, CRETÁCICO SUPERIOR, CUENCA NEUQUINA, ARGENTINA*

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La Formación Portezuelo (Turoniano–Conaiciano) aflora en las provincias del Neuquén y Río Negro y posee gran cantidad de maderas fósiles las cuales han sido exiguamente estudiadas. El objetivo de este trabajo fue realizar un estudio anatómico, sistemático y paleo-dendrológico de 26 leños permineralizados colectados en sedimentos de la Formación Portezuelo en el Yacimiento "Lago Barreales" (Dpto. Añelo, Neuquén). A partir de esos datos se han podido inferir las probables condiciones ecológicas y climáticas en las que se desarrollaron esas xilofloras durante el Cretácico Superior en dicha localidad. Hasta el momento, 18 maderas fueron clasificadas, 14 se corresponden al género *Cupressinoxylon* Göppert; mientras que 3 serían afines a *Agathoxylon* Hartig y sólo un ejemplar a Magnoliophyta (gen. indet.). Los leños aquí descriptos se caracterizan por tener anillos de crecimiento no definidos; sin embargo se observan algunas fluctuaciones de densidad en su xilema o falsos anillos. Estos datos permiten suponer que dicha xiloflora conformaba bosques en los que el estrato arbóreo estaría integrado por las coníferas con *Cupressinoxylon* como taxón dominante, mientras que la Magnoliophyta formaría parte del sotobosque, habiéndose desarrollado bajo un clima tropical húmedo, con leves y ocasionales períodos de sequía.

GRANOS DE POLEN AFINES A PALMERAS EN EL CRETÁCICO INFERIOR DE LA CUENCA AUSTRAL DE PATAGONIA, ARGENTINA*

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Las palinofloras del Cretácico Inferior de Patagonia estuvieron fundamentalmente conformadas y dominadas por granos de polen de gimnospermas y esporas de pteridofitas; incorporándose hacia finales de este periodo las Magnoliophytas. En esta comunicación se presentan descripciones de granos de polen afines a la familia Palmae, procedentes de la Formación Piedra Clavada (Albiano) en Cerro Bayo, Cuenca Austral (provincia de Santa Cruz), Argentina. Los granos están agrupados en tétrades o también libres, son de forma oval, con una apertura ecuatorial (zonasulcada) con paredes gruesas y largas espinas. Tales características permiten ubicarlos dentro del género *Spinizonocolpites* Muller, el cual tiene una gran filiación morfológica con géneros afines a la subfamilia Calamoideae. El hallazgo de este tipo de granos en el Albiano se condice con lo establecido por datos moleculares, que presumen el origen de las Palmae en el Cretácico Inferior hace unos 120 Ma. Otras menciones de *Spinizonocolpites* proceden del Cretácico Superior de la Cuenca Neuquina, (Formación Loncoche) en el sur de la provincia de Mendoza; y del Paleoceno de Chubut (Formación Salamanca). Cabe destacar que la presencia de *Spinizonocolpites* en el Albiano ampliaría tanto la distribución temporal (al Cretácico Inferior) como espacial (Patagonia Austral) de la familia y del género, además de indicar condiciones ambientales cálidas y húmedas como en las que se desarrollan los actuales miembros de las Calamoideae.

ESPORAS TRILETES VERRUCOSAS DE LA FORMACIÓN LAGARCITO, ALBIANO, SIERRA DE GUAYAGUAS, PROVINCIA DE SAN JUAN, ARGENTINA

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Se presentan los resultados de un estudio sistemático detallado de las esporas triletes verrucosas halladas en la Formación Lagarcito. El ma-

terial procede de una sección expuesta en el borde oriental de la Sierra de Guayaguas, sureste de la provincia de San Juan. Los preparados palinológicos se encuentran depositados en la paleopalinoteca del IANIGLA, CCT-Mendoza. Este grupo de esporas está presente en la formación con una gran diversidad morfológica, lo cual en algunos casos dificulta la distinción entre las diferentes especies. Han sido identificadas hasta ahora: *Trilobosporites hannonicus* (Delcourt y Sprumont) Potonié, *Trilobosporites purverulentus* (Verbitskaya) Dettmann, *Trilobosporites apiverrucatus* Couper, *Concavissimisporites penolaensis* Dettmann, *Concavissimisporites punctatus* (Delcourt y Sprumont) Brenner, *Concavissimisporites variverrucatus* (Couper) Brenner, *Concavissimisporites* sp., *Converrucosisporites* cf. *C. exquisitus* Singh, *Converrucosisporites* sp., *Verrucosisporites rotundus* Singh, *Verrucosisporites varians* Volkheimer, *Verrucosisporites* sp., *Leptolepidites major* Couper y *Leptolepidites verrucatus* Couper. La Formación Lagarcito, de edad albiana, de acuerdo al registro paleontológico y relaciones estratigráficas, forma parte del Grupo El Gigante y está constituída por sedimentos continentales de origen fluvio-lacustres depositados en una cuenca de tipo extensional. En esta asociación palinológica las esporas triletes verrucosas son abundantes y corresponden a las familias de pteridofitas: Lycopodiaceae, Selaginellaceae, Cyatheaceae, Dicksoniaceae y Schizaeaceae, indicadoras de un ambiente local húmedo cercano a los cuerpos lacustres. Este estudio sistemático constituye un aporte fundamental para conocer la diversidad vegetal durante el Cretácico Temprano en la región centro oeste de Argentina y complementa los estudios realizados en la Formación La Cantera dentro de la misma cuenca.

CONODONTES ORDOVÍCICOS DE LA FORMACIÓN SANTA ROSITA EN EL ÁREA DE NAZARENO, CORDILLERA ORIENTAL DE SALTA, ARGENTINA

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Se recuperaron conodontes de la Formación Santa Rosita en el área de Nazareno, sierra de Santa Victoria, Cordillera Oriental argentina. Esta unidad, en el área mencionada, suprayace con base erosiva al Grupo Mesón y subyace en discordancia angular a sedimentitas terciarias continentales. La parte superior de la formación en la sección analizada, comprende una sucesión de rocas psamopelíticas con potentes bancos de areniscas, entre las que intercalan pelitas y esporádicos niveles de coquinas (Miembro Alfarcito) y una secuencia superior de pelitas negras y areniscas finas laminadas con concreciones y nódulos calcáreos ocasionales (Miembro Rupasca). La colección de conodontes procede de niveles calcáreos localizados a 200 m y 130 m por debajo del contacto entre los miembros mencionados y a 30 m y 105 m por encima del mismo, incluyendo: *Drepanodus arcuatus* Pander, *Drepanoistodus chucaleznensis* Albanesi y Aceñolaza, *Teridontus gallicus* Serpagli, Ferreti, Nicoll y Serventi, *"Utahconus" humahuacensis* Albanesi y Aceñolaza, *Acanthodus* sp. y *Utahconus* sp. Esta asociación de conodontes incluye a las subespecies epónimas de las Subzonas de *Paltodus deltifer pristinus* y de *P. d. deltifer* de la Zona de *Paltodus deltifer*, para los niveles del Miembro Alfarcito y del Miembro Rupasca, respectivamente, sugiriendo una edad tremadociana media (Tr2). Estos conodontes de la Provincia Gondwánica Sudoccidental presentan un índice de alteración del color (CAI) 3,5, que indica paleotemperaturas de soterramiento de *ca.* 200°C. En estratos pelíticos basales del Miembro Rupasca se registraron, asimismo, graptolitos (*Bryograptus* sp.) en ambientes característicos de plataforma abierta para el Ordovícico Inferior de la Cuenca Andina Central.

EL ALCANCE DE LA MORFOLOGÍA ILÍACA EN LA IDENTIFICACIÓN DE ESPECIES DE ANUROS: UNA APROXIMACIÓN MORFOGEOMÉTRICA EN BUFÓNIDOS FÓSILES

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Con frecuencia la identificación de restos desarticulados de anuros fósiles se basa en el ilión. Restos holocenos de Laguna Tres Reyes, provincia de Buenos Aires, pertenecientes al Museo de La Plata (86-VIII-1-2), incluyen un ilión cuya morfología (*i.e.* prominencia dorsal bien desarrollada, ausencia de cresta ilíaca) remite a algunos bufónidos, particularmente a *Rhinella arenarum* (Hensel 1867) y *R. schneideri* (Werner 1894) por sus proporciones relativas (*i.e.* altura de prominencia dorsal vs. expansión acetabular dorsal). Dado que el ilión de estas especies es muy similar, para la asignación del ejemplar fósil se buscó diferenciarlas cuantitativamente utilizando morfometría geométrica y análisis multivariados. Para ello se realizó un análisis de Procrustes generalizado en 25 ejemplares de *R. arenarum* y seis *R. schneideri*. El análisis discriminante de los cuatro primeros *relative warps* permitió distinguir estas especies, pero ambas se solapaban debido a 6 individuos de *R. arenarum* cuyas configuraciones se encontraban alejadas de los restantes miembros considerados de la especie. La asignación en uno u otro taxón fue variable en los distintos análisis realizados dado que el fósil se encontraba cercano en el morfoespacio tanto a *R. schneideri* como a este pequeño grupo de *R. arenarum*; de no haber contado con este último, la asignación a *R. schneideri* hubiera sido inequívoca. Estos resultados resaltan la importancia de contar con numerosos individuos de comparación que permitan analizar la variación intraespecífica; esta condición, frecuentemente difícil de satisfacer en la práctica, debe ser considerada para evaluar el grado de resolución taxonómica que puede ofrecer un elemento aislado.

LA BIOZONA *PAKHAPITES FUSUS-VITTATINA SUBSACCATA* EN LA FORMACIÓN PATQUIA, CERRO VELADERO, PROVINCIA DE LA RIOJA

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La formaciones Quebrada Larga y Patquía, aflorantes en la zona de Cerro Veladero (provincia de La Rioja) han sido analizadas por primera vez desde el punto de vista palinológico. Se han recuperado numerosas asociaciones palinológicas de esta secuencia que abarca desde el Serpukhoviano al Cisuraliano. La sección basal de la Formación Patquía registra un evento transgresivo del cual se han obtenido 9 asociaciones palinológicas. Las mismas pueden ser referidas a la Biozona *Vittatina subsaccata-Pakhapites fusus* de Argentina. Las especies que permiten dicha asignación bioestratigráfica son: *Equisetosporites* sp., *Illinites unicus Kosanke* emend. Jansonius y Hills, *Pakhapites fusus* (Bose y Kar) Menéndez, *Pakhapites ovatus* (Bose y Kar) García, *Protohaploxypinus amplus* (Balme y Hennelly) Hart, *Protohaploxypinus limpidus* (Balme y Hennelly) Balme y Playford, *Vittatina costabilis* (Wilson) emend. Tschudy y Kosanke, *Vittatina corrugata* Marques-Toigo, *Vittatina fasciolata* (Balme y Hennelly) Bharadwaj, *Vittatina subsaccata* Samoilovich y *Weylandites magmus* (Bose y Kar) Backhouse. Los registros previos de esta biozona en nuestro país incluyen asociaciones de las formaciones Tasa Cuna, Bajo de Véliz, Los Sauces, Rio del Peñón y de la parte superior de las formaciones Santa Máxima y El Imperial. Todas ellas pueden ser correlacionadas con las típicas palinofloras de la Formación Río Bonito en Brasil, referidas a la Subzona *Protohaploxypinus goraiensis*, y datada entre 299.0±0.8 Ma a 284.4±0.7 Ma. Una edad similar puede ser adjudicada a las asociaciones argentinas, considerando que de acuerdo a dataciones recientes no pueden ser más antiguas que 310.63±0.1 Ma y probablemente no más jóvenes de 296.09±0.085 Ma.

Contribución a los proyectos de investigación PICT-1499, PICT-1650 y PIP-0512

PRELIMINARY HISTORICAL PALEOBIOGEOGRAPHIC ANALYSIS OF THE *AUSTROVENUS* FINLAY AND *AMEGHINOMYA* IHERING LINEAGES (BIVALVIA: CHIONINAE) FROM THE NEOGENE OF SOUTH AMERICA AND NEW ZEALAND

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Ameghinomya is an important member of the South American Cenozoic molluscan assemblages. Its phylogenetic and biogeographic relationships have been poorly studied. A recent phylogenetic revision of a subset of 21 chionines recovered *Ameghinomya* (Miocene–Recent, South America) species within a monophyletic clade sister-group of a *Protothaca* clade [*Austrovenus* (Pliocene–Recent, New Zealand)-*Protothaca* Dall (three extant species, American Pacific)-*Nioche* (*Antinioche*) *burmeisteri* (Borchert) (Miocene, Entre Ríos)-*Chionista* Keen (Recent, American Pacific)]. Within this numerical phylogenetic framework at species level, we tested the previous proposal of a dispersal event of *Austrovenus* from South America to Australasia from an *Ameghinomya* ancestry during the Neogene. A tree reconciliation analysis rendered evidence ($p<0.0001$) supporting a monophyletic area-clade including the south Pacific as the sister-area of Australasia and the north Pacific. The north and south Atlantic areas were recovered basal to the latter ones. A Dispersal-Vicariance Analysis found within the *Protothaca* clade a dispersal event from the south Pacific to the south Atlantic during the early Miocene and subsequently a dispersion from the south Pacific to the north Pacific and then from the north Pacific to Australasia during the Pliocene. Our results are inconsistent with the *Austrovenus*-dispersal hypothesis, but led to the preliminary suggestion of a new route of dispersion within these species: the south Pacific was the ancestral area for the *Ameghiniomya-Protothaca* clade; and then two distinct events occurred: an eastern dispersion to the south Atlantic of *Ameghinomya* and *Nioche* (*Antinioche*) and a counter-clockwise intra-Pacific route of dispersions of *Protothaca*, *Chionista*, and *Austrovenus*. More comprehensive numerical analyses will test these preliminary results.

PRIMER REGISTRO CORPÓREO ARTICULADO DE OFIUROIDEOS (ECHINODERMATA: ASTEROZOA: OPHIUROIDEA) PARA EL MESOZOICO DE AMÉRICA DEL SUR

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Debido a la fragilidad de sus endoesqueletos, el registro fósil de ofiuroideos es sumamente escaso. Los ejemplares articulados y/o completos en América del Sur se restringen al Devónico de Argentina y Brasil y al Cenozoico de Venezuela, Chile y Argentina. El Miembro Agua de la Mula (Hauteriviano tardío–Barremiano temprano) de la Formación Agrio (cuenca Neuquina, Argentina) es una sucesión marina mixta (carbonática-siliciclástica). El nivel portador de los ofiuroideos se encuentra unos 12 metros por encima del contacto con el Miembro Avilé, en la localidad de Loma de la Torre. En el área de estudio, los depósitos basales del Miembro Agua de la Mula han sido interpretados anteriormente como de *offshore* proximal con condiciones exaeróbicas en el ámbito de una rampa marina abierta. El análisis (por medio de DRX, microscopia óptica y SEM) del nivel donde han sido encontrados los ofiuroideos demuestra que se trata de *mudstones* masivos y coincide con los estudios precedentes. Los ejemplares (Área de Paleontología-UBA) presentan un alto grado de articulación, se hallan recristalizados, y se observan tanto en cara oral como aboral. Tienen un diámetro máximo de 12 mm. En la mayoría, los brazos se hallan casi completos; en varios se preservan también fragmentos del disco central. Debido a la relativamente pobre preservación de los materiales, una asignación taxonómica más precisa es dificultosa. Estos especímenes representan el primer registro corpóreo articulado de ofiuroideos para el Mesozoico de América del Sur.

HALLAZGO DE BIVALVOS DREISSENIDOS EN EL MIOCENO DE ARGENTINA Y SU SIGNIFICACIÓN PALEOBIOGEOGRÁFICA

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La Formación Paraná (Mioceno) aflora discontinuamente a lo largo del río Paraná en Entre Ríos, portando una fauna de invertebrados descripta por primera vez por Alcide d'Orbigny. Algunos taxones de esta fauna son francamente marinos, mientras que otros estuvieron adaptados a condiciones de salinidad variable y/o reducida (salobres a casi dulceacuícolas). En tal contexto, se da a conocer para dicha unidad el primer registro (MAS-Pi 012; Museo A. Serrano, Paraná) de una nueva especie de *Mytilopsis* Conrad. Este es un grupo de bivalvos habitantes de ambientes hiposalinos, en muchos casos intolerantes a salinidades normales. La novedosa presencia de este dreissenido en latitudes tan australes de América reviste gran interés, pues arroja nueva luz sobre una hipótesis planteada (a partir de otras evidencias) por Hermann von Ihering, un estrecho colaborador de Florentino Ameghino. En el año 1927, Ihering explicó la distribución de ciertos grupos de estirpe caribeña en áreas sudorientales de América del Sur, invocando la hipotética existencia de un brazo austral del Tethys, el que habría tenido una expresión marginal costeando el pie oriental de los Andes (entonces de menor altura). Así, podría haber comunicado, al menos intermitentemente, cuencas septentrionales de América del Sur con aquellas situadas en el área ocupada hoy por la llanura chaco-pampeana. Considerando la distribución actual de *Mytilopsi*s, y los rangos de tolerancia a la salinidad conocidos, surgen argumentos en favor de dicha explicación (en vez de una migración a lo largo del litoral marino atlántico sudamericano), y esa idea visionaria de Ihering resultaría así reivindicada.

ABERTELLA DURHAM, 1955 (ECHINOIDEA: SCUTELLINA) EN LA FM PARANÁ (MIOCENO TARDÍO)

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Se comunica el hallazgo del género *Abertella* Durham en la provincia de Entre Ríos, en estratos pertenecientes a la Formación Paraná (Mioceno tardío). Éstos, conocidos como "Entrerriense", afloran en el centro-este de Argentina, Uruguay y sur de Brasil y son considerados por algunos autores como parte de la conexión del mar epicontinental entre el Océano Atlántico Sur y el Mar Caribe. El género *Abertella* había sido reconocido en el noreste de la provincia de Río Negro en niveles asignados a la Formación Gran Bajo del Gualicho (Mioceno temprano tardío – Mioceno medio temprano). *Abertella* se caracteriza por tener un endosesqueleto delgado, escotadura muy marcada en el margen correspondiente al interambulacro posterior, e interambulacros discontinuos en la cara oral. El material analizado MAS-Pi 511 (Museo A. Serrano, Paraná), un único ejemplar y fragmentos, proviene del nivel bioclástico de la localidad "Punta Gorda Sur" [32°04,035 S - 60°39,141 W]. *Abertella* sp. presenta gran similitud con *Abertella gualichensis* Martínez, Reichler y Mooi diferenciándose de esta última de acuerdo a los caracteres observables por ser más gruesa, más redondeada y con la escotadura anal menos marcada. El estudio de más material permitirá definir en el futuro la asignación específica de esta forma. La presencia del género *Abertella* en Entre Ríos amplía la distribución paleobiogeográfica del género y lleva su registro en Argentina hasta el Mioceno Tardío. La Formación Paraná posee una rica fauna de invertebrados marinos, integrando *Abertella* sp. y *Monophoraster duboisi* (Cotteau, 1884) la única asociación de equinodermos conocida hasta el presente.

TAFONOMÍA DE DINOSAURIOS DEL CRETÁCICO SUPERIOR DE MENDOZA, ARGENTINA

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La cuenca Neuquina es una de las regiones más importantes de América del Sur en vertebrados cretácicos. No obstante, son escasos los estudios tafonómicos de dinosaurios. En la región septentrional de la cuenca, extremo sur de Mendoza, afloran sedimentitas continentales del Grupo Neuquén (Cretácico Superior) con abundantes fósiles de dinosaurios saurópodos y terópodos. Tal como acontece en otros vertebrados, la preservación de dinosaurios está condicionada por factores intrínsecos y extrínsecos a los organismos. En este estudio se analizan procesos fosildiagenéticos como factores extrínsecos que afectan la preservación ósea. Los fósiles analizados provienen de dos localidades del sur mendocino: Paso de las Bardas y Cerro Guillermo. En Paso de las Bardas se hallaron huesos desarticulados pero asociados del saurópodo *Malarguesaurus florenciae* (González Riga, Previtera y Pirrone) en facies pelíticas de planicies de inundación. En contraste, en Cerro Guillermo se descubrieron huesos aislados y fragmentarios de terópodos *indet*. en facies arenosas de canales fluviales meandriformes. Mediante estudios microscópicos y difractometría de rayos X se reconstruyeron las etapas fosildiagenéticas de los restos estudiados. En estas etapas, los huesos sufrieron procesos de deformación plástica y diferentes eventos de permineralización: cementación y relleno mineral de canales vasculares y fracturas. Tales procesos se relacionan con la profundidad de soterramiento, temperatura y presión geostática experimentadas por los fósiles en cada ambiente depositacional. Las características observadas en los dinosaurios preservados en distintos subambientes fluviales, se asocian al sistema roca-fluido de cada facies sedimentaria, que influyó en forma diferencial, en los procesos de precipitación, crecimiento y disolución mineral.

FIRST TAXON DATE AND STABLE ISOTOPES (C, N) FOR THE LARGE HYPERCARNIVOROUS SOUTH AMERICAN CANID *PROTOCYON TROGLODYTES* (CANIDAE, CARNIVORA)

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Protocyon troglodytes (Lund) was a hypercarnivorous South American canid that died out during the late Pleistocene extinction, an event that eliminated most large mammals on the continent. The precise timing of these extinctions is poorly understood, primarily due to a lack of radiometric dates on taxa. Of the extinct South American canids, *P. troglodytes* have the best fossil record and widest distribution. However, the age of these specimens is based on relatively coarse association with other dated taxa or sediments. Here we describe an unpublished specimen of *P. troglodytes,* deposited at the Museo de La Plata, and present the first 14C date and C/N analysis for the species. This constitutes the first taxon date and the oldest record for the genus and species, with an age of 17,338 ± 85 yr BP. The isotopes indicate that *P. troglodytes* was a hypercarnivore species, in agreement with morphological studies, and that *Equus neogeus* Lund, *Hippidion principale* (Lund), *Lama guanicoe* Müller, *Stegomastodon platensis* Ameghino, and *Toxodon* Owen may have been part of its diet.

MACROFÓSILES DE MARSILEÁCEAS DE EDAD MAASTRICHTIANA DE LA FORMACIÓN LONCOCHE, MENDOZA, ARGENTINA

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Se describen folíolos de Marsileaceae procedentes de la localidad de Calmu-Co, al sur de Malargüe, provincia de Mendoza, Argentina. Los restos estudiados fueron encontrados en el miembro inferior (a 75 m de la base) de la Formación Loncoche (Grupo Malargüe) de edad campaniana?–maastrichtiana, que en este sector de la cuenca corresponde a facies de planicie de inundación, en un sistema fluvial. La mayoría de los restos fósiles se encuentran muy fragmentados, representados por folíolos dispersos y rizomas. Los mismos están depositados en el IANIGLA-CCT-Mendoza. Los folíolos son de tamaño pequeño, estériles y con forma de abanico, la venación es dicotómica abierta y presentan una vena intramarginal. Además, se distingue en ellos la venación anastomosada característica de las Marsileaceas actuales. Estos restos son asignados al morfogénero *Marsileaceaephyllum* Nagalingum, creado para el Cretácico Temprano del sur de Gondwana (Australia y Antártida) y que incluye restos fósiles estériles correspondientes a la familia Marsileaceae. Estos helechos heterosporados semi-acuáticos han sido citados principalmente en el registro fósil a través de sus micro- y megaesporas, en asociaciones de edad tan antigua como Jurásico Tardío. Sin embargo, los macro- y mesofósiles son escasos y no se conocen citas previas de marsileáceas fósiles para Argentina. Los macrofósiles de la Formación Loncoche constituyen una evidencia concreta de la existencia de esta familia a partir del Cretácico en la Argentina, hasta ahora solo indicada por la presencia de la microespora *Crybelosporites* Dettmann *y* la megaespora *Arcellites* Miner, emend. Ellis y Tschudy en varias asociaciones palinoflorísticas de esa edad.

PALEOXILOLOGÍA DE LA FORMACIÓN LA MESETA (EOCENO DE ANTÁRTIDA OCCIDENTAL): NUEVAS EVIDENCIAS DE UN BOSQUE DOMINADO POR GIMNOSPERMAS

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La Formación La Meseta aflora en la Isla Marambio (Seymour) en la Antártida Occidental y es portadora de diversos restos paleobotánicos. A esta unidad se le asigna una edad eocena en base a dataciones y en base a su contenido paleontológico. Se estudió una extensa colección de maderas fósiles consistente en 120 ejemplares depositada en la colección de Paleobotánica del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" bajo las siglas BA Pb. Previos estudios de maderas fósiles de la misma formación fueron basados en escasos ejemplares o sus estudios taxonómicos no fueron realizados en detalle. Las gimnospermas representan aproximadamente el 70 % de las maderas, y entre ellas dominan las Podocarpaceae del morfogénero *Phyllocladoxylon* Gothan. Se hallaron también maderas afines a Araucariaceae y Cupressaceae. Entre las angiospermas, se encontró *Nothofagoxylon* Gothan afín a las Nothofagaceae. Los estudios paleodendrocronológicos de las maderas indican una estacionalidad marcada, condiciones anualmente constantes que sugieren un clima templado. Los resultados obtenidos son, en su mayor parte, acordes a las conclusiones de otros investigadores para estudios de la misma formación.

NUEVO MATERIAL DE ZORRO DEL PLEISTOCENO DE LA LOCALIDAD DE MERCEDES, PROVINCIA DE BUENOS AIRES

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Los zorros se encuentran bien representados en el registro fósil en la República Argentina, tanto por el número de especímenes recolectados como de especies reconocidas. Actualmente se reconocen tres especies extintas que son *"Dusicyon" cultridens* (Gervais y Ameghino), *"Dusicyon" ensenadensis* (Ameghino) y *Dusicyon avus* (Burmeister). También existen numerosos registros de especies actuales como *Lycalopex gymnocercus* (Fischer). En la presente contribución se describe un nuevo material (depositado en el Museo de Ciencias Naturales "Carlos Ameghino" de Mercedes), una hemimandíbula derecha con los c1-m2 preservados, proveniente del Pleistoceno tardío de la localidad de Mercedes, provincia de Buenos Aires. Se realizaron comparaciones morfológicas cualitativas y análisis morfométricos (morfometría geométrica y "tradicional") para evaluar la posición taxonómica del material. La morfología del fósil (*e.g.* rama horizontal robusta; serie premolar con diastemas reducidas) sugiere que esta mandíbula podría pertenecer a la especie *"D." ensenadensis*. Los análisis morfométricos indican que el ejemplar fósil se encuentra dentro del rango de variación de la especie viviente *L. gymnocercus* y ponen en evidencia la existencia de una conspicua variación intraespecífica en esta especie. De acuerdo a estos resultados, el fósil estudiado pertenecería a *L. gymnocercus* y la validez de *"D." ensenadensis* debe ser corroborada.

UNA NUEVA LOCALIDAD PARA *ANTIFER ULTRA* AMEGHINO (ARTIODACTYLA, CERVIDAE) EN SEDIMENTOS DE EDAD LUJANENSE (SALTO, PROVINCIA DE BUENOS AIRES)

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Se comunica una nueva localidad, con control radiocarbónico, para *Antifer ultra* extraído de la sección finipleistocena de la Formación Luján, en Salto, Provincia de Buenos Aires. En 1889, Ameghino consideró esta especie como exclusiva de la Edad Bonaerense y recientemente otros autores la reportaron también en sedimentos de Edad Lujanense en la Provincia de Entre Ríos y en las Republicas de Uruguay y Chile. Se recuperó la parte inferior del asta izquierda fragmentada luego de la primera bifurcación, con ceratóforo, fragmento de frontal, roseta y pedúnculo. Las dimensión de la sección a nivel de la base, el pedúnculo subtriangular, la morfología de los canales longitudinales y el aplanamiento transversal del asta son diagnosticas de *A. ultra*. El fragmento no presenta evidencias de transporte y se halló en la base de la Secuencia Luján Verde Superior (*ca*. 13–16 AP) equivalente al Miembro Guerrero "verde" de la Formación Luján. En el sitio del hallazgo (34°12'30.45"S–60°12'14.36"O), presenta depósitos de origen fluvio-palustre con conglomerados basales de calcrete que gradan hacia el techo a arenas limosas y limos verdosos. Los conglomerados y los mantos negros que sellan esta secuencia, se dataron por moluscos en 16 ka cal C14 AMS AP y 11–12 ka cal C14 AMS AP respectivamente. Se concluye que este hallazgo confirma la presencia de *Antifer ultra* en la Pampa Ondulada, luego del último máximo glacial y en condiciones interestadiales, entre 13 y 16 ka AP. Es así comparable al hallazgo de *Antifer ultra* en el sitio arqueológico chileno de Quereo I. El material se encuentra depositado en el Museo de Paleontología de Salto.

TRAZAS DE HERBIVORÍA EN IMPRESIONES DE HOJAS FÓSILES DE LA FORMACIÓN PALO PINTADO (MIOCENO SUPERIOR), PROVINCIA DE SALTA, ARGENTINA

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El presente trabajo tiene como objetivo dar a conocer trazas de insectos herbívoros en impresiones de hojas fósiles de monocotiledóneas, dicotiledóneas y pteridofitas de la formación Palo Pintado (Mioceno superior). El material depositado en la colección CTES-PB de la Facultad de Ciencias Exactas y Naturales y Agrimensura (UNNE), proviene de las localidades Quebradas del Horno, del Estanque y de Alfredo, al sur de la provincia de Salta (Argentina). Las impresiones de hojas se hallan en niveles pelíticos verde-marrones situados en la sección medio-basal de la formación. Se identificaron diferentes tipos de trazas, las cuales fueron asignadas a los icnogéneros e icnoespecies: *Phagophytichnus ekowskii* Van Amerom y *Phagophytichnus* sp. B. para excisiones marginales, Icnogénero sp. A e Icnogénero I *circumsecans* Straus para excisiones no marginales, Icnogénero II *nervillos-reliquens* Straus para esqueletonizaciones, *Folifenestra dubia* Vasilenko para excisiones en ventana y por último el Icnogénero V para picaduras. Es importante resaltar que, a pesar de los numerosos estudios paleobotánicos, geológicos y paleoambientales realizados previamente en la formación Palo Pintado, las trazas fósiles de insectos encontradas representan las primeras menciones de icnotaxones en la formación e incluso en los Valles Calchaquíes (Neógeno) del noroeste argentino. La presente contribución es un aporte al conocimiento de la evolución del comportamiento de alimentación de los insectos productores y a la incipiente icnotaxonomía de trazas fósiles en hojas del Cenozoico de Sudamérica.

LEÑOS DE CUPRESSACEAE EN LA FORMACIÓN CORTADERITA (TRIÁSICO MEDIO), CUENCA DE BARREAL-CALINGASTA, PROVINCIA DE SAN JUAN, ARGENTINA

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En la Formación Cortaderita se registran bosques permineralizados *in situ*, en cuya xiloflora sólo había sido descripta una Corystospermaceae: *Rhexoxylon cortaderitaense* (Menéndez) Bodnar. En este trabajo se presenta el hallazgo de leños asignables al Orden Coniferales, provenientes de los mismos estratos fosilíferos. Para ubicar los fósiles en la columna estratigráfica, se levantaron dos perfiles de la Formación Cortaderita, en la Quebrada de la Tinta. Las asociaciones de litofacies corresponden a ambientes fluviales meandrosos, gravoso-arenosos de mediana a alta sinuosidad. Los leños se preservaron en limolitas bentoníticas grises masivas, con evidencias de edafización. Se realizaron superficies pulidas y cortes petrográficos de los tres planos utilizados en histología vegetal (transversal, radial, tangencial). El material está depositado en la Colección Paleobotánica del Museo de Ciencias Naturales de San Juan. Los ejemplares se caracterizan por presentar médula y xilema secundario. En todos los casos, el leño es picnoxílico y homoxílico. Presenta anillos de crecimiento definidos, de ancho variable, con transición abrupta entre el leño temprano y el leño tardío. Las punteaduras de las traqueidas siguen un plan abietinoide, son areoladas, uniseriadas, espaciadas, circulares, y poseen un torus conspicuo. El parénquima axial es escaso o ausente. Los campos de cruzamiento presentan 1 a 2 punteaduras cupresoides en una hilera. Los radios son homocelulares, uniseriados, altos (1–33 células de altura). Estas características permiten asignar estos materiales al género *Cupressinoxylon* Göppert y vincularlos con la familia Cupressaceae *sensu lato*. Cabe destacar que ya habían sido citados en la Formación Cortaderita impresiones-compresiones de hojas pertenecientes a Coniferales.

NUEVO REGISTRO DE MESOTHERIIDAE (NOTOUNGULATA) EN LA FORMACIÓN SALICAS (MIOCENO TARDÍO), LA RIOJA, ARGENTINA

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Las recientes campañas en la Formación Salicas, provincia de La Rioja, propiciaron el hallazgo de nuevos fósiles que se suman a los previamente conocidos de dicha formación. En esta contribución, se analiza un ejemplar de mesotérido Mesotheriinae hallado en el área de El Degolladito. Dicho resto, depositado en el Centro Regional de Investigación Científica y Transferencia Tecnológica de La Rioja (CRILAR 433), es un paladar con ambos I1, P2-M3 y arco cigomático incompleto derechos, y fragmentos de M2-M3 izquierdos. Los I1 son arriñonados con surco lingual marcado. El P2 es de contorno triangular y más pequeño que P3-P4. El P3 es subtriangular, sin surco lingual. El P4 es cuadrangular, con surco lingual en forma de Y y parastilo proyectado sobre el P3. En M1-M2, el lóbulo medio alcanza el nivel lingual del lóbulo anterior y el posterior está ligeramente más proyectado. En M3, el lóbulo anterior es delgado y dirigido hacia atrás; el lóbulo medio es apenas más corto que los otros dos y más triangular que en M1-M2; el parastilo es ancho y apuntado anteriormente. Los mesoterinos reconocidos en el Mioceno tardío de Argentina son *Typotheriopsis* Cabrera y Kraglievich y *Pseudotypotherium* Ameghino, cuya principal diferencia reside en la morfología del P4. El surco lingual desarrollado en el P4 de CRILAR 433 lo asemeja a *Pseudotypotherium*. La morfología de P2-P4 no coincide con la de dientes deciduos, por lo que la presencia de tres premolares difiere de la condición conocida de los mesoterinos y podría tratarse de un taxón nuevo.

YANGTZEPLACOGNATHUS CRASSUS (CONODONTA) EN EL INTERVALO DE TRANSICIÓN ENTRE LA FORMACIÓN SAN JUAN Y UNIDADES SUPRAYACENTES DEL ORDOVÍCICO MEDIO EN LA PRECORDILLERA CENTRAL DE SAN JUAN, ARGENTINA

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El intervalo de transición estratigráfica entre la Formación San Juan y las unidades suprayacentes representa un importante evento de cambios paleoambientales en la Precordillera del oeste argentino. De acuerdo con registros previos, el cambio de facies sedimentarias entre estas unidades aconteció diacrónicamente a lo largo de la cuenca precordillerana en sentido meridional, iniciándose inmediatamente por encima de la Zona de *Oepikodus evae* Lindström, durante el Dapingiano, en el extremo norte de la cuenca. Este cambio significativo en las condiciones de sedimentación, producido por múltiples causas; *e.g.*, eustáticas, tectónicas, volcánicas, habría ocurrido sincrónicamente desde el sector central de la cuenca hacia el sur, como se verifica en distintos corrimientos tectónicos al este y oeste de las localidades de Jáchal y Niquivil (corrimientos de Huaco, Los Blanquitos y La Trampa), donde los estratos del techo de la Formación San Juan y de la base de las unidades equivalentes que contactan en forma paraconcordante, proporcionaron elementos de la especie guía *Yangtzeplacognathus crassus* (Chen y Zhang). Esta especie se encuentra asociada a otras especies guía, tales como *Histiodella holodentata* Ethington y Clark, permitiendo una correlación intercontinental de alta resolución. Las biozonas homónimas refieren a un breve intervalo en el Darriwiliano medio (Ordovícico Medio). Las asociaciones de especies en las distintas localidades caracterizan variaciones biofaciales que revelan un gradiente paleoambiental vinculado a la paleotopografía de la cuenca a través de las localidades de Los Azules, Las Aguaditas y Las Chacritas, en la transecta noreste-suroeste de la comarca estudiada.

MANTOS NEGROS (*BLACK MATS*) Y LA EXTINCIÓN DE MEGAMAMÍFEROS EN PAMPA (12–13 KA AP)

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Se describe y analiza la estratigrafía del límite Pleistoceno-Holoceno en los valles pampeanos, la evidencia sedimentológica de una crisis climática significativa y su relación con la desaparición de la megafauna. Dicha evidencia la constituyen los Mantos negros, horizontes ricos en materia orgánica, oscuros, arcillo-limosos y que sellan los depósitos clásicamente conocidos como "Lujanense". Facialmente representan el cambio abrupto entre los sistemas fluvio-palustres del "lujanense verde", últimos portadores de restos articulados de megafauna, y los sistemas palustres-lacustres del "Platense". Estos niveles oscuros fueron denominados "capa negra", "capa turbosa", "suelo Puesto Callejón Viejo", "suelo sin nombre", etc. Para su estudio se relevaron afloramientos de diversos valles de la pampa ondulada y del área Interserrana, y se dataron con AMS en moluscos y materia orgánica (~10.5–12.5 ka cal. AP), incorporando los numerosos estudios palinológicos y cronológicos previos. Se correlacionan temporalmente con los *Black Mats* que sellan los sitios Clovis en USA y se interpretan como indicadores de la instalación repentina de condiciones estacionales marcadamente mas húmedas (evento X) cuyo origen (evento Y) es por el momento, desconocido. Se define igualmente el período crítico como el lapso comprendido entre el inicio del cambio climático y la disminución de las poblaciones por debajo de la Población MínimaViable, con registro geológico relíctico a nulo y al límite de la resolución radiocarbónica. Dichos eventos habrían tenido lugar en pocos siglos, entre 12 y 13 ka AP.

LA GEOLOGÍA DE VALLES E INTERFLUVIOS PAMPEANOS Y LA ATRIBUCIÓN ESTRATIGRÁFICA DE FAUNAS LOCALES

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Se analizan los problemas de atribución estratigráfica del contenido fósil que se generan al aplicar los modelos litoestratigráficos para los depósitos clásicamente conocidos como "lujanense" y "bonaerense". Sin un conocimiento detallado de la cronología, tipo y geometría de facies pueden adjudicarse asociaciones locales a unidades estratigráficas no correlativas. Para analizar e ilustrar esta problemática se construyó un modelo estratigráfico de valles y planicies loésicas de interfluvios a partir del análisis de facies, de la definición de unidades estratigráficas separadas por discontinuidades y de numerosas dataciones absolutas. Ello permitió la correlación entre ambos sectores y la asignación de las secuencias a eventos climático-isotópicos precisos. Así, se observó que las respuestas sedimentológicas de distintos eventos interestadiales y pleniglaciares son similares entre sí. Esto, sumado a los afloramientos escasos o de mala calidad más la utilización de modelos geológicos simples, muy generalizados e incompletos, puede llevar a atribuciones taxón-estratigrafía-paleoclima e interpretaciones tafonómicas equívocas. En particular se destaca la confusión entre facies macroscópicamente similares de loess y loessoides pardo-rojizos de la Formación Luján y de la Formación Buenos Aires en los valles de Reconquista, Luján y Salto/Arrecifes. Se concluye que un número significativo de restos fósiles asignados a la unidad estratigráfica "bonaerense" y "belgranense" en pampa ondulada, pertenecen en realidad a diversas facies de la unidad estratigráfica "lujanense" datada entres 50 y 13 ka AP. Se evidencia entonces la necesidad de revisar y reordenar estratigráficamente algunos de los hallazgos, principalmente de vertebrados, en los valles citados.

EL MIEMBRO POSTERIOR DE LOS FOLIVORA (XENARTHRA, MAMMALIA) DEL MIOCENO TEMPRANO, PATAGONIA, ARGENTINA: MORFOLOGÍA Y CONSIDERACIONES FUNCIONALES

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Los perezosos del Mioceno temprano de Patagonia incluyen una diversidad de formas que varía entre 40 y 100 kg. de masa corporal. El esqueleto apendicular presenta marcadas diferencias morfológicas con respecto al de los representantes vivientes del clado, *Bradypus* Linnaeus y *Choloepus* Illiger. El análisis cualitativo del miembro posterior y cintura pélvica permite evidenciar una serie de rasgos morfológicos de interés funcional. La pelvis muestra un acetábulo algo orientado lateralmente, permitiendo una gran abducción femoral. El trocánter mayor del fémur, más bajo que la cabeza, incrementaría el rango de movilidad de la articulación acetábulo-femoral. El trocánter menor, conspicuo y orientado medialmente, maximizaría la ventaja mecánica para la rotación externa del fémur. El aplanamiento antero-posterior de la diáfisis femoral permitiría una aducción poderosa: el surco patelar ancho y somero indicaría movimientos lentos en una postura flexionada. La morfología de los cóndilos femorales y de la meseta tibial sugiere una postura flexionada y la transmisión de cargas mecánicas mayoritariamente a través del cóndilo medial. La tibia y la fíbula son cortas y robustas. La morfología del astrágalo indica escasas capacidades de inversión-eversión. El túber calcáneo expandido sugiere una configuración plantígrada del pie, con arco metatarsiano prominente y excelente ventaja mecánica para la extensión poderosa del pie. Muchas de estas características, especialmente aquellas que involucran elevadas capacidades de abducción y aducción del fémur, articulación femoro-tibial preparada para una postura flexionada, así como extensión y plantar-flexión poderosas del pie, son mecánicamente coherentes con la habilidad de escalar soportes no mucho mayores que el ancho del individuo.

IMPLICACIONES BIOESTRATIGRÁFICAS DEL ESTUDIO DE LAS SUBESPECIES DE GRAPTOLITOS *RHABDINOPORA FLABELLIFORMIS* (TREMADOCIANO) DE LA CUENCA ANDINA CENTRAL DE ARGENTINA Y BOLIVIA*

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Se presenta el análisis comparativo de subespecies de *Rhabdinopora flabelliformis* (Eichwald) del noroeste de Argentina y sur de Bolivia, depositadas en el Centro de Investigaciones Paleobiológicas. Los estadios de desarrollo, vistas discoidales y mallas distales, de *Rhabdinopora flabelliformis parabolla* (Bulman) confirman, por primera vez, la presencia de esta subespecie en niveles de la Formación Las Vicuñas, quebrada de Lari en la Faja Eruptiva de la Puna Occidental, (Salta). Este registro sugiere la existencia del límite Cámbrico/Ordovícico y se ubica pocos metros por encima de la aparición de *Jujuyaspis* Kobayashi. La presencia de *R. f. canadensis* (Lapworth), asociada con el trilobite *Saltaspis steimani* (Hoek), indica una edad más joven para los niveles de la Formación Iscayachi en Tambo Guanacuno. Ejemplares provenientes de la quebrada de Yacoraite, (Jujuy), se asignan tentativamente a *R. f. flabelliformis* (Eichwald). Los ejemplares poseen estructuras siculares de flotación, tecas denticuladas, mallas irregularmente espaciadas, más abiertas distalmente, y estan asociadas con especies del trilobite *Kainella* Walcott. Estos registros resultan compatibles con la sucesión reconocida para el Tremadociano inferior de la Cordillera Oriental, caracterizada por *Jujuyaspis*, seguida por *Saltaspis* Harrington y *Kainella* Walcott. Sin embargo, el material coleccionado por encima del primer registro de *Jujuyaspis keideli* Kobayashi y por debajo de la primera aparición de *Saltaspis steimani* en la quebrada Amarilla, (Jujuy), resulta similar a *Rhabdinopora f. anglica* (Bulman). De confirmarse esta asignación, se replantearía el significado bioestratigráfico de este taxón en la Cuenca Andina Central, el cual caracteriza mundialmente la cronozona de graptolitos más jóvenes del Tremadociano temprano.

FOSSIL DUGONGIDAE (MAMMALIA, SIRENIA) FROM THE PARANÁ FORMATION (LATE MIOCENE) OF ENTRE RÍOS PROVINCE, ARGENTINA

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Fossil sirenians are well known from the Western Atlantic and Caribbean (WAC) region. Neogene records from the Atlantic coast of South America, although scarcer, seem to reflect a taxonomic composition similar to that of its northern contemporaries. Fossil sirenians from Argentina are known from the late Miocene Paraná and Ituzaingó formations in Entre Ríos Province. An upper third molar deposited at the Museo de Paleontología de la Universidad Nacional de Córdoba (CORD-PZ 4301), from the Paraná Formation, was originally described and assigned to the dugongid genus *Metaxytherium* de Christol. Subsequent workers suggested it could instead belong to the dugongid genus *Dioplotherium* Cope; a designation which we confirmed upon examination of the material. Additionally we describe new sirenian

remains from the Paraná Formation, consisting of two incomplete maxillae with teeth belonging to one individual deposited at the Museo de Ciencias Naturales de Paraná (MASP). This specimen shows similarities with species of *Metaxytherium* from the northern WAC. The Paraná Formation sirenians represent the southernmost occurrences of these two genera, and the geologically youngest occurrence of dugongids in the southern WAC. *Dioplotherium* and *Metaxytherium* also occur in the early Miocene of northern Brazil. The presence of these taxa as far south as Entre Ríos suggests two possible dispersal routes: 1) across a marginal connection between a southern arm of the Amazonian Sea and the "Paranaense Sea", or; 2) along the Brazilian coast. Lastly, the occurrence of dugongids, which feed mainly on seagrasses, indicates that these marine angiosperms were present in the region as well.

LAS SUBZONAS DE *CYMATOGRAPTUS PROTOBALTICUS* Y *BALTOGRAPTUS VACILLANS* (ZONA DE *TETRAGRAPTUS AKZHARENSIS*, FLOIANO) EN EL BORDE OCCIDENTAL DE LA CORDILLERA ORIENTAL, ARGENTINA*

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El estudio y las revisiones de graptolitos de Argentina y del resto del mundo se incrementaron notablemente en los últimos años. Esto permite obtener nuevas precisiones para el ajuste de esquemas bioestratigráficos del Ordovícico Inferior de la Cordillera Oriental y su correlación regional e intercontinental. A partir del análisis de los taxones registrados en el tramo inferior de la Formación Acoite de la sierra de Aguilar (provincia de Jujuy), depositados en el repositorio del IANIGLA, se propone la subdivisión de la Zona de *Tetragraptus akzharensis*, reconocida por primera vez en la misma unidad del área de Los Colorados. Se plantea, una subzona inferior de *Cymatograptus protobalticus*, donde se encontraron también *Tetragraptus approximatus* (Nicholson), *Tetragraptus amii* (Lapworth) y *Cymatograptus balticus* (Tullberg), y una superior, de *Baltograptus vacillans* (Tullberg), en la que se hallan además de la especie homónima, *Corymbograptus v-fractus tullbergi* (Monsen), *Expansograptus latus* (Hall), *Expansograptus holmi* (Törquinst), *Trichograptus dilaceratus* (Herrmann) y *Acrograptus gracilis* (Törquinst). El esquema se verifica en las secciones de Quinilicán, Agua Chica y Lumara, extendiéndose al área de Los Colorados mediante la correlación regional de la Subzona de *Cymatograptus protobalticus* y el tramo inferior de la Zona de *T. akzharensis*, mientras que el tramo superior correspondería a la Subzona de *Baltograptus vacillans*. Este esquema permite una correlación intercontinental más precisa de los niveles estudiados con aquellos correspondientes a las zonas homónimas del suroeste de Suecia, donde fueron definidas las zonas de *Cymatograptus protobalticus* y *Baltograptus vacillans*, y confirma las relaciones paleobiogeográficas con Baltoescandinavia durante el Ordovícico Inferior.

NEW DINOSAUR TRACKSITE FROM PERÚ (LOWER CRETACEOUS)*

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Dinosaur tracksites are very abundant in South America. In this contribution we describe a dinosaur tracksite located on the Conococha-Yanacancha route, Huaraz Province, Peru. The dinosaur tracks were produced on a coastal area under tidal influence during a regressive-transgressive event (Carhuaz Formation, Barremian). The dinosaur-tracks slabs are placed vertically because of Andean orogeny during the Tertiary. More than 300 dinosaur tracks were recognizef, belonging to small and giant sized theropods and ornithopods. The largest track is 86 cm long and 61 cm wide, showing that huge dinosaurs were present in the area in the Early Cretaceous. Some tracks are preserved in tridimensional sandstone casts, while others are original prints. Small theropod tracks include well printed tracks (walking) and many with just the impressions of sharp claws, wide interdigital angle and long steps (running). However, some of them reveal well-developed metatarsal impressions suggesting stalking behavior. Tracks belonging to huge a theropod are wel-marked with very sharp claw impressions. Ornithischian tracks do not show web impressions. At least sixteen different types of dinosaur-tracks are present, among which we could recognize the presence of at least 9 theropod and 7 ornithopod ichnoforms. There is no evidence of sauropod tracks in this interval, but they are present in higher stratigraphic levels.

MADERAS GIMNOSPERMAS DE LA FORMACIÓN UTIARITI (CRETÁCICO SUPERIOR), GRUPO PARECIS, RONDÔNIA, BRASIL

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El Grupo Parecis se extiende entre los estados de Mato Grosso y Rondônia de Brasil y está representado por las formaciones Rio Ávila y Rio Utiariti, cuyos sedimentos fueron depositados durante el Mesozoico. En el presente trabajo se da a conocer la anatomía de maderas de gimnospermas procedentes de la Formación Utiariti (Cretácico Superior), entre los municipios de Vilhena y Colorado, Estado de Rondônia, Brasil. Los antecedentes paleontológicos de esta formación son de antigua data y escasos. Los ejemplares estudiados muestran una preservación regular, bastante mineralizada de la estructura secundaria y pertenecen a la colección paleobotánica del Museo Geológico de Estado de Rondônia y del Servicio Geológico de Brasil. De acuerdo a los caracteres anatómicos observados se identificaron dos morfogéneros: *Podocarpoxylon* Gothan y *Cupressinoxylon* (Goeppert) Gothan. Al primer morfogénero se lo relaciona a la familia Podocarpaceae por la presencia de punteaduras uniseriadas, espaciadas y contiguas en las paredes radiales de las traqueidas y punteaduras tipo podocarpoide en los campos de cruzamiento. El segundo morfogénero es referido a las Cupressaceae porque exhibe punteaduras radiales uni-biseriadas, espaciadas, contiguas, y opuestas y punteaduras tipo cupressoide en los campos de cruzamiento. Ambos morfogéneros se registran por primera vez en la Formación Utiariti, Brasil. La coexistencia de estos dos taxones caracteriza las xilofloras del Cretácico Superior de otras regiones de Gondwana (Argentina, India, Chile, Antártida, entre otros).

CONODONTES METAMORFIZADOS DEL ORDOVÍCICO INFERIOR EN LA FORMACIÓN SAN JUAN EXPUESTA EN ULLUM, PRECORDILLERA CENTRAL DE SAN JUAN, ARGENTINA

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En la ventana tectónica de Ullum, sobre el borde oriental de la Precordillera Central a la latitud del río San Juan, afloran grandes bloques carbonáticos de la Formación San Juan. Las relaciones estratigráficas en este sector son afectadas por una compleja estructura tectónica y enmascaradas por volcanismo mioceno. Generalmente, los bloques carbonáticos se presentan aislados e incluidos en dacitas. En esta área, se tomaron seis muestras de caliza (21,3 kg) para conodontes en distintos afloramientos, con el objeto de establecer variaciones paleotermométricas espaciales y temporales. Las muestras se procesaron siguiendo las técnicas convencionales de laboratorio, obteniendo 1150 especímenes. Los conodontes recuperados pertenecen a la Zona de *Oepikodus evae* (Lindström) (Floiano tardío), reconociéndose la subzona inferior en los niveles próximos al contacto entre un bloque calcáreo y un cuerpo intrusivo, y la superior a 50 m del mismo. Entre los 20 y 60 m de distancia del cuerpo intrusivo se observa un decrecimiento gradual del índice de alteración del color (CAI) 7 a 6, sugiriendo paleotemperaturas de 500–600ºC. Los conodontes presentan un estado de conservación directamente relacionado con la distancia a los intrusivos, con un mayor número de microfracturas y una textura sacaroide más gruesa hacia el contacto referido. Los recubrimientos minerales suelen ser escasos y de naturaleza silícea. El estado de preservación de los conodontes de Ullum es consistente con los fenómenos de metamorfismo de contacto-hidrotermalismo que caracterizan al área y que en otros sectores de la Precordillera (*e.g.*, Distrito Minero de Gualilán, San Juan) produjeron mineralizaciones de importancia económica.

LA PROVINCIA GONDWÁNICA SUDOCCIDENTAL DE CONODONTES EN LA CUENCA ANDINA CENTRAL DE SUDAMÉRICA Y EL TERRANE OAXAQUIA DE NORTEAMÉRICA DURANTE EL ORDOVÍCICO TEMPRANO

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La Formación Tiñú aflorante en el estado de Oaxaca, México meridional, es una sucesión heterolítica conformada por calizas, lutitas y areniscas, distribuidas en los miembros Yudachica (inferior) y Río Salinas (superior). Distintos autores propusieron un origen alóctono para el terrane Oaxaquia que comprende a esta unidad estratigráfica. El Miembro Río Salinas contiene abundantes restos bioclásticos de trilobites polímeros y agnóstidos, junto con una alta frecuencia del protoconodonte *Phakelodus elongatus* (Zhang) y los conodontes *Coelocerodontus* sp., *Paltodus deltifer deltifer* (Lindström), *Paroistodus numarcuatus* (Lindström), *Protoprioniodus*? sp., *Semiacontiodus minutus* Zeballo, Albanesi y Ortega, *Furnishina* sp., "*Utahconus*" *humahuacensis* Albanesi y Aceñolaza, *Variabiloconus variabilis* (Lindström), así como nuevas especies de *Kallidontus* y *Utahconus* registradas hasta el presente únicamente en estratos de la Cordillera Oriental argentina. La fauna de conodontes corresponde a la Zona de *Paltodus deltifer* (Subzona de *P. d. deltifer*) del Tremadociano medio (Tr2), Ordovícico Temprano. La asociación de especies mencionada, que mantiene una marcada afinidad con las faunas registradas en el noroeste argentino, *e.g.*, sierras de Tilcara, Zenta y Santa Victoria, y área de Purmamarca, apoyaría la hipótesis de que el terrane Oaxaquia habría tenido una posición perigondwánica, po-

siblemente dentro del mismo ámbito que la Cuenca Andina Central. Las faunas de ambas regiones, Oaxaca y noroeste argentino, forman parte de la Provincia Gondwánica Sudoccidental, que compone el Dominio Frío del Reino de Aguas Someras de conodontes ordovícicos.

MIDDLE-LATE JURASSIC BENNETTITALES FROM DESEADO MASSIF, PATAGONIA AUSTRAL, ARGENTINA

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In this contribution we present a preliminary analysis of the fossil record of Bennettitales in the Deseado Massif during Middle–Late Jurassic, based on the study and comparisons of taphofloras recovered from several localities: Flecha Negra (FN), Bajo Pellegrini (BP), San Agustín (SA) and Gran Bajo de San Julián (SJ). Biodiversity of the group is represented by leaves, including *Dictyozamites* Oldham *et* Morris, *Otozamites* F. Braun, *Pterophyllum* Brongniart and *Zamites* Brongniart. The clade does not show a uniform distribution across the Deseado Massif, being dominant in two of the floras (SA and BP); at FN and SJ it appears only as a secondary element. *Dictyozamites* is the dominant genus in SA and BP floras with 8 species, and is apparently absent in FN and SJ. On the other hand, *Pterophyllum* seems to be the least represented genus, with only one species. Analysis of the taphofloras shows a high endemism at species level.

CICLO DE CONFERENCIAS
"VIDA Y OBRA DE FLORENTINO AMEGHINO"

CIENCIA Y POLÍTICA. FLORENTINO AMEGHINO Y LA CONTRIBUCIÓN AL CONOCIMIENTO DE LOS MAMÍFEROS FÓSILES DE LA REPÚBLICA ARGENTINA

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En la segunda mitad del siglo XIX, en la Argentina, el interés por la paleontología y el destino de las colecciones de fósiles escapó en varias oportunidades el ámbito de los museos. Así vamos a encontrar a personalidades como D.F. Sarmiento y J. Hernández ocupándose de la paleontología en conferencias o debates en el Senado. Además del Museo Público con Burmeister, el Museo de La Plata con Moreno, sumará a F. Ameghino en un emprendimiento que busca encumbrar al Museo de La Plata, desplazando al Museo Público, que aunque nuevo Museo Nacional seguía bajo Burmeister. No tolerado en el Museo Nacional y excluído del Museo de La Plata, luego del conflicto con Moreno, Ameghino queda fuera de las dos instituciones más importantes en cuanto a la paleontología. Sin embargo, será en ese momento en que F. Ameghino publicará la "Contribución al conocimiento de los mamíferos fósiles de la República Argentina", una obra monumental en su texto y con un atlas profusamente ilustrado, editada en las Actas de la Academia de Ciencias en Córdoba con el apoyo inclaudicable de los hermanos Doering. La academia sólo podrá sufragar una parte de la impresión de esta obra, por lo que Oscar Doering y Ameghino buscarán el resto del financiamiento a través de contactos políticos que poseen. La obra editada será un orgullo para su autor, la Academia, los Doering y la Nación Argentina, pero también mostrará de qué manera la ciencia necesitó el apoyo político para llevar esta obra a su finalización.

AMEGHINO, BURMEISTER Y MORENO: TRES NATURALISTAS, DOS MUSEOS

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En 1886, Francisco P. Moreno, Director del Museo de La Plata, y Florentino Ameghino iniciaron un conjunto de negociaciones en aras de incorporar a este último como Secretario Subdirector de dicha institución, a su hermano Carlos como Ayudante preparador de Paleontología, y adquirir, para la misma, sus colecciones paleontológicas, arqueológicas y geológicas. Esta sociedad, en la que se aunaron distintos intereses personales, transformó a Hermann Burmeister, Director del Museo Nacional, en el rival a vencer para posicionar al museo platense como el primero de América. Sin embargo, en los primeros días de 1888 Ameghino renunció a su puesto en el Museo. Esta ruptura ha sido interpretada básicamente de dos formas. Durante el siglo XX primó la idea de que las desavenencias tuvieron su origen y desenlace en el inevitable choque de fuertes personalidades atravesadas por celos profesionales que pudieron más que los acuerdos alcanzados. Recientemente, se sostuvo que el conflicto se habría desencadenado por la reducción del apoyo económico que, hasta mediados 1887, el gobierno provincial le había dado a la institución. Esto generó un cambio en los objetivos institucionales del Director, lo cual tensionó la relación de tal forma que Ameghino finalmente renunció. Sin embargo, un análisis de la relación que ambos directores tuvieron durante el corto periodo que trabajaron juntos, indica que la competencia que ambos mantenían con Burmeister y las discrepancias que surgieron por la publicación in extenso de la magnífica colección de mamíferos fósiles 1887, obtenida por Carlos Ameghino en el río Santa Cruz, provocó la renuncia de Ameghino.

EL *DILUVIUM*, LA GEOLOGÍA DEL TERCIARIO Y LA PALEONTOLOGÍA EN EL PLATA EN LA DÉCADA DE 1880

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La expansión del término Néogeno permanece como un tema pendiente de la historia de la geología extra-europea del siglo XIX. Esta conferencia se refiere a las vías sudamericanas de la clasificación del Cenozoico Neotropical en la década de 1880, argumentando que la "sudamericanización" de los sistemas geológicos combina el sistema de clasificación acuñado para la cuenca de Viena, la escuela geológica austríaca de Eduard Suess y las disputas locales por imponerse en las lábiles instituciones científicas argentinas.En ese marco, se discuten las polémicas geológicas con los "diluvianistas" y las alianzas urdidas para derrotarlos, en particular la colaboración entre Florentino Ameghino y Adolf Doering para cuestionar las interpretaciones geológicas de Hermann Burmeister. Mostraremos, además, cómo la historiografía reinterpretará esa polémica en términos de dogma religioso, transformando el término "*Diluvium*" en un equivalente del diluvio bíblico, y a Burmeister en un defensor de esa visión. En este sentido, esta ponencia profundiza la línea de investigación iniciada en 1994 para analizar los distintos elementos que contribuyeron a armar la biografía de Florentino Ameghino como un santo laico de la cultura argentina.

LAS IDEAS ARQUEOLÓGICAS Y BIO-ANTROPOLÓGICAS DE AMEGHINO A 100 AÑOS DE SU MUERTE

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En esta conferencia se presenta una puesta al día sobre los principales hallazgos arqueológicos y bio-antropológicos en los que se basó Florentino Ameghino para proponer que el origen pampeano de la humanidad. Se sintetizan los descubrimientos más importantes del "Hombre Fósil" y de las "industrias" costeras propuestas por Ameghino ("la piedra quebrada" y "la piedra hendida") y se analizan a la luz del conocimiento contemporáneo. Además, se presenta información original (dataciones radiocarbónicas con AMS y resultados de investigaciones recientes de sitios arqueológicos de la costa atlántica pampeana) relativa a la antigüedad de los esqueletos humanos y de los artefactos líticos que estudió Ameghino. Finalmente, se concluye que los restos humanos, a los que les atribuyó una remota antigüedad y con los cuales formuló su esquema evolutivo de la humanidad son de edad holocena (con la excepción del esqueleto de Arroyo de Frías) y los materiales líticos costeros no son entidades arqueológicas discretas, sino parte de complejos tecnológicos más amplios, también de edad holocena.

FLORENTINO AMEGHINO, ERNST HAECKEL, Y LA DIMENSIÓN COSMOLÓGICA DE LA EVOLUCIÓN

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Los escritos y la correspondencia de Florentino Ameghino incluyen algunos textos sobre temas a primera vista ajenos al quehacer científico, como el origen y perduración de la vida. Sólo una pequeña parte de ellos fue conocida en vida de su autor, en la que se destaca "Mi Credo". El estudio del resto de los escritos de Ameghino sobre esos temas revela que son parte de una tradición especulativa propia de la actividad científica de la segunda mitad del siglo XIX. El objetivo de esta tradición era dar una explicación de todo lo que ha sucedido, sucede y sucederá en el universo en base a causas homogéneas y únicas. Estas causas son los resultados de la actividad científica en física y química que tiene su punto culminante en la década del cincuenta de ese siglo. Los principales autores de esta tradición científico-especulativa son Herbert Spencer y Ernst Haeckel. Si bien la fuente de las ideas que presenta Ameghino en estos textos es la investigación científica europea, la originalidad de Ameghino consiste en la justificación axiomática de su interpretación de la evolución orgánica en el contexto de las controversias sobre el darwinismo, particularmente en Francia. Puntos relevantes de su proyecto son su postura frente a debates contemporáneos acerca de la evolución orgánica como una forma de la evolución general de la materia, la posibilidad de la reducción de ésta a energía, la posibilidad de la abiogénesis, la evolución como perfeccionamiento, y la lingüística y la economía política como fuentes del Darwinismo.

LA EVOLUCIÓN BIOLÓGICA EN EL PENSAMIENTO Y LA OBRA DE FLORENTINO AMEGHINO

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Como evolucionista, Florentino Ameghino fue en parte lamarckista y sobre todo ortogenetista, más que darwinista. En efecto, la explicación que dio acerca del origen de ciertos caracteres de adaptación es ciertamente lamarckista, en tanto que, según él, otros caracteres evolucionaban progresiva y constantemente en una sola dirección, es decir ortogenéticamente. A partir de su teoría de la "bestialización", la cual fue basada en ciertos postulados de la ortogénesis, Ameghino pudo recrear una historia de la evolución humana que preservaba la "Ley biogenética" de Haeckel, explicaba la evolución temprana de los grandes simios africanos y asiáticos, e incorporaba en nuestra línea ascendente directa a ciertos primates fósiles hallados en América del Sur. La "bestialización" fue aplicada por primera vez al gorila en su obra "Filogenia" de 1884, y luego a un número de formas fósiles, en las que Ameghino advertía un diferente grado de "bestialización". La "bestialización" explicaba no sólo el origen sino la extinción de todas esas formas.

AMEGHINO Y LA ESTRATIGRAFÍA PAMPEANA UN SIGLO DESPUÉS

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Se realiza una síntesis histórica de la estratigrafía del Cenozoico superior continental de la región pampeana, tomando como base al esquema generado por Florentino Ameghino (1889). Se analiza el significado de los distintos términos estratigráficos a lo largo del tiempo y en la actualidad, concluyéndose que desde la segunda mitad del siglo XIX y especialmente a partir de los aportes de Ameghino, se buscó desarrollar un esquema estratigráfico con base bioestratigráfica. Este desarrollo se detuvo o disminuyó en intensidad a partir de la década de 1960, como

consecuencia de la introducción en nuestro medio del nuevo paradigma de las "Edades mamífero". A comienzos de la década de 1990, la realización de nuevas e intensas prospecciones paleontológicas en distintos sectores de la región pampeana, permitió generar el actual esquema cronoestratigráfico/geocronológico con base bioestratigráfica.

CARTAS A FLORENTINO DESDE PATAGONIA

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La correspondencia entre Florentino y Carlos Ameghino durante las permanencias de Carlos de 1887 a 1902 en Patagonia ha sido recopilada en las "Obras completas y correspondencia científica de Florentino Ameghino" por Torcelli. Durante esos 15 años, Carlos, habría estado efectivamente al menos 13 en Patagonia. Existen 50 cartas de Carlos y 42 de Florentino y un número indeterminado, pero aparentemente escaso, de cartas se ha perdido. Sus contenidos pueden ser considerados desde diversos puntos de vista: resaltan el valor de las cartas como documentos de la perspicacia paleontológica y geológica de Carlos, certifi can la fuerte competencia con otros científicos locales y la buena disposición hacia los extranjeros, permiten considerar la falta de fondos con que se hicieron los trabajos de campo de Carlos y el de gabinete de Florentino en el contexto de la situación política y económica del país, revelan relaciones muy directas con altos funcionarios de la época e ilustran sobre aspectos de la relación entre los hermanos evidenciando sentimientos recíprocos de profundo aprecio, lealtad, respeto y admiración.

IV CONGRESO LATINOAMERICANO DE PALEONTOLOGÍA DE VERTEBRADOS
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RESÚMENES

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LA TAFONOMÍA DE VERTEBRADOS: MÉTODOS Y APLICACIÓN
Coordinadores: Dra. Carina Colombi, Dr. Raymond Rogers, Dr. Roger Smith

BIOMECÁNICA DE VERTEBRADOS: INTEGRACIÓN DE MORFOLOGÍA, FISIOLOGÍA Y COMPORTAMIENTO
Coordinadores: Dra. Regina Fechner y Dra. Daniela Schwarz-Wings

PECES FÓSILES DE LOS CONTINENTES DE GONDWANA
Coordinador: Dra. Gloria Arratia

ANATOMÍA, FILOGENIA, Y PALEOBIOLOGÍA DE ARCOSAURIOS BASALES
Coordinadores: Dra. Julia Desojo y Dr. Sterling Nesbitt

SEGUNDO SIMPOSIO SOBRE EVOLUCIÓN DE CROCODYLIFORMES
Coordinadores: Dr. Diego Pol, Dr. Douglas Riff y Dr. Chris Broch

170 AÑOS DESDE OWEN: ANATOMÍA, FILOGENIA Y PALEOBIOLOGÍA DE SAURÓPODOS
Coordinadores: Dr. Leonardo Salgado y Dr. Jeffrey A. Wilson

MAMÍFEROS Y CINODONTES NO MAMÍFEROS MESOZOICOS: EVOLUCIÓN, FILOGENIA Y PALEOBIOGEOGRAFÍA
Coordinadores: Dr. Guillermo Rougier, Dr. John Wible y Dr. Chris Sidor

LA GRAN RADIACIÓN DE TERÓPODOS: FAUNAS Y EVOLUCIÓN DURANTE EL TRIÁSICO Y JURÁSICO
Coordinadores: Dr. Max Cardozo Langer y Dr. Oliver Rauhut

VERTEBRADOS CAMPANIANOS Y MAASTRICHTIANOS EN PATAGONIA: DIVERSIDAD, FILOGENIAS, PALEOBIOLOGÍA Y ESCENARIOS PALEOAMBIENTALES
Coordinadores: Dra. Zulma Gasparini y Dr. Leonardo Salgado

NUEVAS PERSPECTIVAS ACERCA DEL ORIGEN Y EVOLUCIÓN DEL NEOTRÓPICO SUDAMERICANO
Coordinadores: Dr. Alfredo Carlini, Dr. Darin Croft y Dr. Michael Woodburne

Sesiones Regulares

LA TAFONOMÍA DE VERTEBRADOS: MÉTODOS Y APLICACIÓN

Coordinadores: DRA. CARINA COLOMBI, DR. RAYMOND ROGERS, DR. ROGER SMITH

TAPHONOMY OF THE VERTEBRATE ACCUMULATIONS OF NATURAL TANKS: SINGULAR FOSSILIFEROUS DEPOSITS FROM THE NORTHEASTERN BRAZIL

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Tanks are small natural depressions formed by physical and chemical weathering in outcrops of basement rocks. These depressions occur only in northeastern Brazil and house Late Pleistocene South American fossil vertebrates. Taxonomy of the fossil accumulations in the tanks is very well-known, but taphonomic analyses of these assemblages are rare. The main taphonomic features observed so far in the bone accumulations of natural tanks are herein reviewed and interpreted. Fossils found in tanks are always disarticulated and fragmented, rarely occurring as articulated skeletal portions. The macroscopic taphonomic features identified in these accumulations are longitudinal fractures, heavy wear marks, and the absence of long bone ends. The more abundant elements are isolated teeth, podial, metapodial, vertebrae, phalanges and osteoderms of carapace. The megamammals of the families Megatheriidae (Pilosa, Xenarthra), Gomphotheriidae (Proboscidea), Glyptodontidae (Cingulata, Xenarthra) and Toxodontidae (Notoungulata) are the most common taxa in the fossil assemblages, while small mammals, crocodiles and turtles are rarely represented. The main diagenetic process observed is permineralization, but substitution and encrustation also occur. In some deposits the bone concentrations are loosely packed, while bone breccias are observed in others. Low representation of small vertebrates associated with high bone fragmentation of megamammal bones can be the result of the tanathocoenoses being exposed to biostratinomic processes (transport, weathering, abrasion), which can rapidly destroy the smallest bones and modify the preservational quality of the larger elements. Moreover, the association between fragmented and complete bones in the same assemblage supports the hypothesis of time-averaging in natural tanks. We infer that tank assemblages do not reflect prolonged transport, because all three groups of the "Fluvial Transport Index" are present. The bone accumulations in natural tanks exhibit consistent taphonomic features; however new taphonomic approaches should be carried out in order to improve the knowledge on patterns and process that act on the vertebrate assemblages preserved in these deposits.

TAPHONOMIC ASPECTS OF THE JIRAU FOSSIL ACCUMULATION OF PLEISTOCENE VERTEBRATES IN A TANK, ITAPIPOCA, CEARÁ STATE, NORTHEASTERN BRAZIL

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A taphonomic analysis of the Jirau vertebrate assemblage (tank n° 1), Itapipoca city, Ceará State, Brazil (Late Pleistocene), provides insights on the origin, preservational biases, and paleobiological significance of one of the richest and most diverse late Pleistocene vertebrate sites known to date from northeastern Brazil. Although the bone assemblage has not been thoroughly studied yet, 1.405 skeletal elements were recovered and are housed at the Museu de Pré-história de Itapipoca (MUPHI). A basic taphonomic analysis was undertaken, including the identification and interpretation of macroscopical taphonomic features, such as skeletal representation, breakage patterns, sorting patterns and desiccation and scratch marks. Megamammals (>1000 Kg) are the most common animals in the assemblage, but small mammals, including crocodilians and chelonians, are present too. All bones are disarticulated and 82% of the elements are fragmented. The most common skeletal elements are ribs (38%), vertebrae (18%) and humeri (15%). Smooth and irregular edges are more common in transverse bone breaks, which may indicate that they have been produced after fossilization. Breaks produced before fossilization can be observed too. About 96% of the elements show some wear signals, which can result from transportation of the material to the deposit or reworking of skeletal elements after deposition in the tank. The fossils (95%) show desiccation marks which were classified in the five stages of "Behrensmeyer's Weathering Scale", indicating a wide time of exposure to weathering and time-averaging in the bonebed. Teeth marks are visible in relatively few skeletal elements (2%), and humeri and ribs are the most affected bones. Some fossils (6%) have scratches probably related to trampling of bones before burial. It was also noted that there is poor size sorting of clasts and bioclasts in the bonebed, which can be attributed to short transport of skeletal parts, thus leading us to consider the abrasion observed in the elements a result of reworking in the assemblage. The abundance of megamammals was previously identified as a taphonomic bias of the natural tanks. Additional studies are in progress to improve the understanding of the taphonomic history of the Jirau vertebrate assemblage.

A LARGE "RAUISUCHID" ARCHOSAUR FROM THE OMINGONDE FORMATION (EARLY MIDDLE TRIASSIC), NAMIBIA

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In 1995, during the course of a palaeontological survey in the vicinity of Mount Etjo, Namibia, an articulated skull of a large archosauromorph was reported, figured and assigned to *Erythrosuchus* sp. (Pickford, 1995). A few years later —in 2000— the rest of the skeleton was collected, fully prepared and placed on display in the Geological Survey Museum in Windhoek (Smith and Swart, 2002). The specimen is very well preserved and includes both lateral sides of the skull, the complete presacral column, most caudal vertebrae in articulation with dorsal scutes, and part of the coracoid and of the humerus. This specimen was recently reviewed by the authors as part of an ongoing investigation of the Omingonde fauna and the preliminary result is the identification of it as a "rauisuchid" archosaur, the top terrestrial predators at the time and a very distinct group of crurotarsal archosaurs that were phylogenetically departed from basal *Erythrosuchus*-like archosauromorphs. This new identification is based, among other characters, on the presence of distinctive interdental plates in the maxilla, cervical and dorsal vertebrae anteroposteriorly compressed, with concave ventral edges, the presence of a strongly developed calcaneal tuberosity, and the arrangement of numerous heart-shaped dorsal paired osteoderms along the vertebral column. This new taxonomic assignment supports the interpreted early Middle Triassic age of the upper Omingonde Formation based on the associated fauna, that includes cynodonts and dicynodonts, some of them showing South American affinities (Abdala and Smith, 2009). This age assignment makes this specimen possibly the oldest and certainly the most complete African representative of the group. "Rauisuchids" have been subjected to a worldwide review during the last few years. Consequently, it is expected that further studies of the Namibian specimen will yield important information about the origin and early evolution of this group of archosaurs.

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Pickford, M. 1995. Karoo Supergroup palaeontology of Namibia and brief description of a thecodont from Omingonde. *Palaeontologia Africana* 45: 82–100.

Smith, R.M.H. and Swart, R. 2002. Changing Fluvial Environments and Vertebrate Taphonomy in Response to Climatic Drying in a Mid-Triassic Rift Valley Fill: The Omingonde Formation (Karoo Supergroup) of Central Namibia. *Palaios* 17: 249–267.

BIOSTRATINOMIC ASPECTS OF VERTEBRATE FOSSILS FROM BAURU BASIN, UPPER CRETACEOUS, BRAZIL

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The Bauru Basin covers an area of about 370,000 km^2, occurring in parts of São Paulo, Paraná, Mato Grosso, Mato Grosso do Sul, Minas Gerais and Goiás states (Brazil), and northeastern Paraguay. The Upper Cretaceous sediments of the Bauru Basin represent a semi-arid to arid climate. Considering the fossil record of the basin, crocodiles and dinosaurs are most abundant, but there are also abundant records of turtles and fishes. Anura, Squamata, birds and Mammalia are relatively rare. Ichnofossils, eggs, gastroliths and coprolites are also known from the basin. This work presents a biostratinomic approach to vertebrate fossils found in the basin. In addition to bibliographical research, field trips to Marília and Monte Alto (SP) and Uberaba (MG) were made to analyze the depositional context and collect fossiliferous material. Visits to the vertebrate collections of the Paleontology Museums of Marília and Monte Alto (SP), as well as Uberaba Museum of Dinosaurs (MG), were also made. Four biostratinomic types related to articulated/disartriculated fossils were identified in the Vale do Rio Peixe, Uberaba, Marília, São José do Rio Preto and Presidente Prudente formations. Type 1 represents articulated and almost complete specimens, corresponding to turtles and crocodiles. Type 2 comprises partially articulated specimens of skull and jaw fossils, or sequences of vertebrae. Types 1 and 2 were recorded in the Vale do Rio do Peixe, Marília (Serra da Galga Member) and Presidente Prudente formations. Type 3 is represented by isolated bones, and Type 4 by fragmented bones. These two types appear in all units of the basin. A fifth type (Type 5) represents eggs and coprolites and occurs in the Vale do Rio do Peixe, Uberaba and Marília (Serra da Galga Member) formations. The majority of fragmented bones are related to the environmental context, characterized by braided fluvial flows with high sediment loads. Complete and articulated turtles and crocodiles, like those reported by other authors, may reflect mass mortality or may be related to aestivation behavior of these reptiles. The biostratinomic characteristics observed on the Bauru Basin fossils are consistent with the semi-arid paleoclimate.

THE TAPHONOMY OF A MASS MORTALITY EVENT IN AMBOSELI PARK, KENYA

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The partial collapse of a large herbivore community in Amboseli National Park, Kenya in 2009 provided a unique opportunity to examine the impact of catastrophic mortality on a modern bone assemblage and increase understanding of how such events may have contributed to the vertebrate

fossil record. The 2009 mass mortality followed a series of ecological changes culminating in a severe drought that caused the demise of over 12,000 herbivores. Between May and mid-November, the dominant grazing species —wildebeest, zebra, and buffalo— lost 7–-95% of their standing populations. Taphonomic surveys in August/September 2010 documented skeletal remains on 20 previously sampled transects and 22 ecological plots to investigate the impact of the mass mortality on the surface bone assemblage. In normal times, this assemblage consists of skeletal remains representing 1–3 decades of input from predation, disease, and other causes of attritional deaths. The number of dead in 2009 far exceeded the recycling capacity of the local scavengers (mainly *Crocuta crocuta* —the spotted hyena), initially leaving most carcasses untouched and concentrated around the permanent swamps. After mummification during the drought, heavy rains stimulated microbial decomposition that led to nearly complete defleshing of the drought death skeletons. Many of the carcasses were also covered by vegetation, enhanced by dense growth from the fertilizing effect of soft-tissue decomposition. Comparisons with the previous four decades of data on the attritional bone assemblage show that the mass mortality event is indicated by (1) skeletal completeness and low incidence of scavenger damage, (2) little scattering of the skeletons because of rapid overgrowth by plants, (3) a spike in the abundance of bones of grazing herbivores in Weathering Stages 0–1. Although in some areas carcasses occur within meters of one another, there are no bonebeds with juxtaposed skeletal remains of many individuals. Food rather than water was the limiting resource in Amboseli during this drought, and animals died over large areas of swamp edge habitat searching for any remaining forage. There were no specific sites for mass mortality such as waterholes or other causes of spatial focusing of animal deaths.

BEYOND BONEBEDS – TAPHONOMY'S CONTRIBUTIONS TO UNDERSTANDING THE VERTEBRATE FOSSIL RECORD

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Vertebrate paleontologists are familiar with the patchiness of the vertebrate fossil record in time and space. Certain regions, geological formations and strata are consistently rich in fossils, while others are not. Are there predictable patterns in this uneven distribution of vertebrate remains throughout the Phanerozoic? This broad taphonomic question can be addressed through consideration of (1) life habits and causes of death, (2) environmental context, (3) biotic and abiotic (physical and chemical) processes that affect vertebrate remains before, during, and after burial. These variables determine the rates and efficiency of natural recycling, thus they also control the biogenic remains that escape recycling to become fossils. Taphonomic research over the past five decades has expanded understanding of these variables, and some general hypotheses are emerging. Input to the fossil record can be summarized as a "race" between the rate of recycling and the rate of burial. Bonebeds, for example, have diverse causes but represent accumulations that exceeded the capacity of local scavengers and decomposers to recycle the nutrients contained in the skeletal remains. Many bonebeds were preserved by rapid burial that stopped or limited the effects of these recycling processes. The same general principle (different ratios of recycling to burial rates) could explain observed variability in other types of fossil bone occurrences, such as the presence or absence of dispersed bones in paleosols or channel fill deposits. Given that established ecosystems and their food webs typically are limited by essential nutrients, (*e.g.*, nitrogen, phosphorus), the long-term survival of any skeletal remains, from dense bone concentrations to dispersed fragments, could indicate a departure from normal ecological recycling processes. This also suggests that many types of ecosystems and many geographic areas left little vertebrate record throughout the Phanerozoic because remains were efficiently recycled (*e.g.*, most tropical and temperate rain forests). It is possible that much of the vertebrate fossil record accumulated in unusual ecological circumstances rather than "normal" ones, and that the patchiness reflects the frequency of both large and small-scale deviations from equilibrium recycling conditions in ancient ecosystems.

TAPHONOMIC AND PALEOECOLOGICAL ASPECTS OF A FOSSIL *PANTHERA ONCA* (MAMMALIA: FELIDAE) FROM QUATERNARY CAVE DEPOSITS OF GRUTA DOS MOURA, TOCANTINS, BRAZIL

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Taphonomic and paleoecological studies can provide information concerning the biology of fossil mammals, in this case an almost complete fossil skeleton of *Panthera onca* (Linnaeus, 1758) from the Gruta dos Moura Quaternary cave site, in the municipality of Aurora do Tocantins, southeastern Brazil. The skeleton is preserved in a right lateral-up attitude, almost completely articulated, missing only a few teeth and some appendicular bones. Fragmented cranial remains were found *in situ*, close to its anatomical position and associated with the scattered teeth. The skull suffered compression most likely by *post-mortem* trampling or possibly by pressure from rapid burial. This taphonomic pattern suggests that there was very little or no *post-mortem* transportation of the carcass. Most of the right appendicular bones are well preserved and complete, while the left limb bones are fragmented or absent which suggests that the left side of the carcass was, at some point, affected by sub-aerial exposure and weathering. This interpretation is supported by the darker coloration of these bones, probably caused by oxidation. Tooth wear patterns show that the specimen was a mature adult 10–12 years old. The death position of the skeleton and the elderly age determination suggest that the animal may have chosen the cave as place to lie down and die —an usual behavior among big felids. Paleopathological analysis revealed a round hole surrounded by small bone projections on the mandi-

bular symphysis. It is apparent that the projections are pathogenic bone deformities caused by the central puncture mark. This deformity pattern is in accordance with the diagnosis of osteomyelitis, a pathology associated with osseous infection most commonly caused by bacteria. Osteomyelitis is especially associated with open fractures, where infection causes inflammation of the periosteum (periostitis). However, in some severe cases, the inflammation advances to the medullar cavity and destroys the bone tissue. On the rostral portion of the jaw, the disease commonly affects the symphyseal region. Jaw fractures from zebra kicking are the main cause of death among adult African lions. They are commonly sustained when chasing their prey. Other animals, like peccaries, are also known to use kicking as a defense strategy, although in the literature this behavior is more characteristic for equids. Therefore, it is concluded that the elderly *P. onca* from Gruta dos Moura cave was presumably hit by a kick in the jaw while hunting a prey. Subsequently, the injury became infected, leading to pathological osteomyelitis and ultimately to death by starvation. Thus, it is possible that the Gruta dos Moura cave was its final resting place.

Linnaeus, C. 1758. *Systema Naturae per regna tria naturae, secundum classis, ordines, genera, species cum characteribus, differentiis, synonymis, locis*. Laurentii Salvii, Stockholm, 824 p.

VERTEBRATE TAPHONOMY – IMPORTANCE AND FUTURE TRENDS

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Although taphonomy is not new in paleontological science, many researchers have difficulty in regarding their fossils as the result of numerous physical and chemical processes which led to their preservation for hundreds, thousands, or millions of years. Understanding how and why preservation occurs is crucial for paleontologists. In Brazil, there are very few graduate courses focused on taphonomy, and only few paleontologists actually endeavor to venture into the most geological of the paleontological branches, even though everyone acknowledges the importance of taphonomic studies as guidelines for paleoecological interpretations, which are important for understanding the ecologic successions of life on Earth along geological time. This is especially valid for terrestrial fossil assemblages, where the differences between the preserved taphocoenosis and the original biocenosis are normally very strong. One can say that Brazilian taphonomy mostly focuses on biostratinomy, elucidating one of the fundamental questions in every paleontological study: is the site of preservation the same as the site of death? Besides the classical approaches to disarticulation, transport and fossildiagenesis, nowadays new trends have emerged in taphonomic researches. Some taphocoenosis are being restudied with a different approach and researchers are coming up with very different results in comparison to traditional interpretations. This new trend includes the study of fossil assemblages with a peculiar preservation mode —the vertebrate ichnocoenosis. On the other hand, there is a re-discovery of the principles of actuopaleontology, which focuses on the transport mechanisms of modern large skeletal remains which are analogs for dinosaur and the Plio–Pleistocene fossil megafauna. Today there are new protocols for fossil preparation based on Scanning Electron Microscopy, isotope geochemistry (as the U-series, for example), REE analysis and laser ablation inductively coupled plasma mass spectrometry. In Brazil, some researchers are working with these new perspectives, using geochemical analyses to investigate time averaging, for instance; and applying sequence stratigraphic concepts to the fossil record. The bottom-line is that studies in taphonomy clearly should be stimulated among the new generation of vertebrate paleontologists. It is not acceptable that today, seventy years after the birth of taphonomy, there are still researchers who collect fossils without recording any kind of geological or taphonomic information.

TAFONOMIA EXPERIMENTAL EM AMBIENTE FLUVIAL TROPICAL: FEIÇÕES BIOESTRATINÔMICAS EM OSSOS DE BOI SUBMERSOS NAS ÁGUAS DO RIO MADEIRA (ESTADO DE RONDÔNIA, BRASIL)

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Experimentos controlados em tafonomia, visando melhor compreender os processos de formação e modificação de depósitos fossilíferos, vêm sendo cada vez mais realizados. Destacam-se nesse campo estudos com invertebrados marinhos, sendo comparativamente escassos os trabalhos realizados com vertebrados em ambientes fluviais. Este trabalho teve por objetivo, por meio de um experimento realizado com ossos de boi doméstico (*Bos taurus*) no Rio Madeira (Rondônia, Brasil), melhor compreender as alterações bioestratinômicas possíveis de serem encontradas em ossos depositados em ambientes fluviais tropicais. Ao todo 27 ossos, previamente descarnados, obtidos em frigoríficos e carcaças em decomposição encontradas na mata amazônica, foram colocados em uma caixa de volume 0,6 m3, confeccionadas com peneira de ferro, de malha 1cm^2, contendo tampa de abertura e suportes laterais. A caixa foi presa em uma balsa por meio de um cabo de aço de cinco metros de comprimento e mergulhada no Rio Madeira sem atingir o leito. A fim de gerar uma série controle, a caixa foi içada mensalmente, durante um período de sete meses para retirada de um dos elementos ósseos. Os resultados obtidos, observáveis macroscopicamente, foram: (1) Pronunciado desgaste, com exposição das trabéculas ósseas em áreas menos densas dos ossos (porções esponjosas), (2) Presença de bioerosões vermiformes nas porções compactas dos ossos atribuíveis a invertebrados aquáticos, preliminarmente, a Oligochaeta ou larvas

de Chironomidae, (3) Alteração superficial da camada de osso compacto obliterando feições de intemperismo adquiridas previamente em etapas bioestratinômicas típicas de ambiente terrestre, (4) Colonização por larvas de Trichoptera e Megaloptera sem importância aparente no desgaste ósseo. A exposição das trabéculas em porções esponjosas dos ossos submetidos ao experimento, mesmo na ausência de transporte, trazem importantes implicações tafonômicas, uma vez que essa característica é apontada, em muitos casos, como evidência de transporte e abrasão pré-soterramento. No caso aqui descrito atribuímos essa alteração superficial como resultado de uma abrasão química de causa ainda não identificada possivelmente acentuada pelas galerias vermiformes produzidas, provavelmente por invertebrados aquáticos. Dentre os ossos submetidos à experimentação, uma mandíbula coletada de uma carcaça em decomposição apresentava, pré-experimento, intemperismo tipo 2 (Behrensmeyer, 1978) e, após sete meses imersa nas águas do Rio Madeira, essa feição superficial foi totalmente obliterada por bioerosões e abrasão química. Esse resultado traz diretas implicações para as análises de intemperismo em ossos depositados em ambientes fluviais. Os resultados aqui obtidos demonstram, portanto, que a interpretação tafonômica de conjuntos fossilíferos gerados em ambientes de sedimentação fluvial deve levar em consideração uma gama de processos bioestratinômicos até então desconhecidos.

Behrensmeyer, A.K. 1978. Taphonomic and ecologic information from bone weathering. *Paleobiology* 4: 150–162.

ESTIMATING STRATIGRAPHIC FIRST OCCURRENCES IN RARE TAXA

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Estimates of taxonomic first occurrences in the fossil record play a key role in determining patterns of turnover and diversity, and in correlations between biotic and abiotic events. The primary data for determining first appearances is primarily dependent on field collection methodologies and assessment of taphonomic factors. Estimates of origination or speciation through a stratigraphic sequence are best assessed with abundance data in the samples, or sometimes with presence absence data across many samples. Equally important as samples containing the species of interest are samples without the species of interest. These data can be used to place confidence intervals on first appearance data, and the same methodology applies to estimating the timing of last occurrences or extinction events. Here I present new taphonomic sampling methods used in paleontological context in eastern Africa. The samples derive from field work in the Hadar region of Ethiopia and the Turkana region of Kenya. The Hadar sample consists of nearly 600 fossil vertebrates and that from Turkana about 200 specimens. Results show that for rare taxa the 95% confidence intervals associated with speciation events tend to be wide, and that very large samples are needed to constrain the timing of key events in the fossil record. Here I also suggest applications to assessing the time of origin of platyrrhine primates in South America.

PRESERVAÇÃO DE TECIDOS MOLES EM PTEROSAURIA DA FORMAÇÃO SANTANA, CRETÁCEO DA BACIA DO ARARIPE, NORDESTE DO BRASIL: NOVAS EVIDÊNCIAS

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Novas descobertas de tecidos moles em pterodátilos foram reportadas nos últimos anos. Neste trabalho discute-se a presença de membrana alar com prováveis estruturas de revestimento. O exemplar é constituído por uma concreção calcária coletada no Município de Santana do Cariri, Ceará e depositado na coleção da Universidade Federal de Pernambuco (UFPE). O material estudado provém do Membro Romualdo, da Formação Santana, apresentando o quarto digito do membro anterior, em posição semi-articulada, mostrando o estrato córneo da asa com dobra de pós-morte, além de outros componentes, tais como, medula óssea, tendões, fibras musculares e "capilares" preservados. Esses últimos estão dispostos em forma de leque e não entrelaçados como descritos na literatura. Portanto, pelas afinidades filogenéticas com os Diapsida e a aparência de filoplumas, sugerimos uma redefinição destas estruturas mais compatível com os Archosauria, do que com "pêlos" dos Synapsida. Salienta-se também que se encontram associados numerosos ostracodes não marinhos. Considerando-se os hábitos alimentares de microcrustáceos atuais, postula-se a hipótese de que os ostracodes eventualmente consumiam a queratina do corpo do individuo, dificultando assim uma melhor visualização e diagnose dessas estruturas.

ASPECTS OF A PATAGONIAN REGIONAL TAPHONOMY. MODELS, DATA, AND PERSPECTIVES

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The results of a long-term taphonomic project in southern Patagonia and northern Tierra del Fuego are presented. The archaeological implications of a series of taphonomic models related with the contamination of archaeological assemblages, vertical migration of bones and carnivore transport of animal parts are explored. These models clearly indicate the widespread conditions under which contamination of archaeological faunal assemblages with recently deposited bones occur. Case studies involving late Pleistocene faunas in Santa Cruz, Argentina and Última Esperanza, Chile are presented and discussed. It is suggested that a taphonomic approach is necessary in order to obtain archaeologically relevant information.

EVIDENCE OF GREGARIOUS AND BURROWING HABITS IN *DINODONTOSAURUS TURPIOR* (THERAPSIDA, DICYNODONTIA) FROM THE TRIASSIC SANTA MARIA FORMATION OF RIO GRANDE DO SUL, BRAZIL

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Dicynodonts are an extinct clade of Permo-Triassic therapsid with global distribution and were the dominant terrestrial herbivores. *Dinodontosaurus turpior* Cox, 1965, is the main taxon of the *Dinodontosaurus* AZ from the Santa Maria Formation. Ten almost complete and associated skeletons of juveniles of this taxon are stored in the Universidade Federal do Rio Grande do Sul (specimens UFRGS-PV-0111-T => PV-0120-T). These were collected in 1970, in the Candelária Municipality of Rio Grande do Sul State. The discovery of juveniles of this taxon, fully articulated and associated, is here interpreted as indirect evidence for gregariousness. Assuming that these animals used the K-reproductive strategy of reduced offspring and parental care (Begon *et al.*, 2007), this aggregation probably contained the offspring of several parents. The quality of preservation, full degree of articulation, limb positions, and skeletal deformations (by compression) of these juveniles, altogether indicate a catastrophic death and burial in the same event such as collapse of an underground shelter. Unfortunately, the presence of an underground cavity, cannot be confirmed because no sedimentological information was recorded during collection of the specimens. Only one record similar to the Brazilian one is known in the world, *i..e.*, an association of nine juveniles of *Parakannemeyeria brevirostris* Sun, 1978, from the Upper Triassic of China. However, there are other known mono-specific associations with low degree of disarticulation elsewhere (Gale 1988). Many studies indicate gregariousness as lifestyle adopted by dicynodonts of medium and large size, due to occurrences of monospecific associations (Bandhyopadyay, 1988) or multiple trackways (Marsicano *et al.*, 2010). Osteohistological research on dicynodonts suggests that both Permian and Triassic species could have had fossorial or digging behaviours. Ichnological evidence shows that some Permian species were fossorial. Regarding the Triassic taxa there are some indications that these were diggers or that they kept these adaptations as their ancestral heritage (Botha-Brink and Angielczyk 2010). This kind of behaviour is likely an adaptation to strong seasonal climate changes, as those proposed for this time (Zerfass *et al.*, 2003). Modern ungulate herds are normally formed by females along with their offspring, and such group organization seems to be represented in *Dinodontosaurus*. Several modern tetrapod species are both gregarious and fossorial, such as crocodiles, lizards, suricates and warthogs. These taxa could constitute modern analogues to *Dinodontosaurus*. The association of ten juveniles of *Dinodontosaurus* and their preservation mode provide support for gregariousness in this taxon, and constituting indirect evidence of burrow construction and communal shelter sharing, although direct ichnological evidence is yet to be found in Brazilian sediments.

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THE LATE PLEISTOCENE PILAUCO SITE, SOUTH CENTRAL CHILE: GENERAL TAPHONOMY AND CULTURAL ASSOCIATION

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Open locations in the Intermediate Depression in south–central Chile are the most frequent type of paleontological and archaeological site. The present work involves the results of two field and laboratory seasons at the Pilauco Site (40°34′11.7″S–73°06′13.4″W). The simple and clear stratigraphy and a robust radiocarbon age model of the Pilauco site allows to propose that before 12,540 ± 90 14C yr BP the old Damas river eroded an older a volcaniclastic hill; after that a swamp was formed in a ox-bow lake. The site was developed until 11,004 ± 186 14C yr BP, the date of the youngest fossil. Like in Tagua-Tagua and Monte Verde, gomphotheres are the best represented elements of the megafauna. At Pilauco there are also records of Equidae, Camelidae, Cervidae, Mephitidae, Muridae, Myocastoridae and Mylodontidae. A total of 718 bones, 30 teeth and 11 coprolites represent the extinct and extant animals. Preliminary studies have been developed on the taphonomy of the site, particularly related to the concentration of bone remains,. At the site there is clear evidence of concentration of bone elements in the 40 cm thick PB-7 bed, which is within the 13.6 and 14.0 ky isolines. This indicates a short accumulation period, with a high deposition rate of about 1cm yr^{-1}. The local accumulation of gomphothere skeletal elements and the low rate of duplications, suggests the presence of only two individuals. On the other hand, the absence of articulated remains in anatomical position could indicate long exposure of the carcass before burial or butchering activities. It is not clear how weathering can affect bones in a swamp milieu, dominated by the deposition of fine sedi-

ments and high contents of carbon organic matter. An orientation analysis of 22 long bones excavated during the 2010/2011 season shows that 78% of the elements are arranged in southeast–northwest direction. However this observation could agree with the expected direction of the water floods; in some units gomphothere ribs are recorded at 90º. Until now, it is not possible to discard both short and low energy fluvial reorientation processes and butchering activities. With a northern Patagonian park landscape, the Pilauco area held a variety of animal, plant and stone resources. We recorded 101 lithics; basalt and quartzite were collected from nearby fluvial deposits, dacitic obsidian from the local volcaniclastic layers, the latter preventing an interpretation of them as pseudo-artifacts. The debitage is the most represented lithic item (75%), while cores (12%) and marginal edge-trimmed artifacts (13%) were subordinate.. This industry, characterized by a recurrent lithic expeditive technology, seems to be connected to strategic conditions of high diversity, especially of groups with high- to moderate mobility. We discuss the presence of some conspicuous marks on gomphothere ribs, the presence of small tusk fragments near a gomphothere skull and the spatial relation between stone artifacts and flakes with high bone concentrations.

SEQUENCE STRATIGRAPHY AS A CONTROL IN THE TAPHONOMY OF THE UPPER TRIASSIC ISCHIGUALASTO FORMATION, NW ARGENTINA

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The Upper Triassic Ischigualasto Formation in NW Argentina was deposited in a fluvial system during synrift filling of the extensional Ischigualasto Basin. This formation —characterized by a high abundance and diversity of paleovertebrates— consists of 300–700m of channel sandstones, overbank mudstones, and paleosols. The fluvial architecture of the Ischigualasto Formation presents temporal and spatial changes that illustrate allogenic tectonic and/or climatic controls produced by recurrent changes in the stream equilibrium profile (SEP) in relation to the stream profile (SP). This sequence stratigraphy has been correlated with the preserved features of the fossil assemblage, recognizing 6 sedimentary packages and its corresponding taphofacies, interpreted as (1) Bypass stage, represented by an incised valley, after a tectonic event that produced a fall of SEP; (2) Confined low-accommodation stage, represented by amalgamated conglomeratic-sandy channels formed by aggradation without accommodation space when the SP reached the SEP (the low rate of subsidence, relatively short time to accumulate carcasses, the cannibalism of the floodplain—main reservoirs of fossils—, and re-working of the channel deposits, did not allow for the preservation of vertebrates in the depocenter and just few highly altered fossil in the margins, where some relatively badly-drained floodplain were preserved); (3) Unstable-accommodation stage, represented by vertically-stacked channels with incisive bases in the depocenter, with well-drained floodplains containing mature calcisols interpreted as terraces in the margin of the basin. This situation was generated by consecutive erosive-aggradation periods triggered by tectonic events that generated minor lowering of the SEP that were quickly reached by the SP. In the depocenter no fossils were preserved, however the margins preserve ~80% of the vertebrate fossils found in this formation. The fossil assemblage is characterized by minimal deformation, various stages of weathering and articulation (*i.e.*, long time average), and a thick calcic-mineralization. This taphocenosis interpreted to reflect the combination of long periods of carcass accumulation, sporadic buried by overbank flows, and rapid mineralization by alkaline soil solutions; (4) Unconfined high-accommodation stage, represented in the entire basin by channels interlayered with thick floodplain argillisols. This stage represents a climatic change to more humid conditions that produced an elevation of the SEP. During this period the number of vertebrate fossils preserved drops significantly and their mineralization becomes mainly hematite (originally Fe-hydroxides) accompanied by partial dissolution of the bones. This taphocenosis is interpreted to reflect reduced carcass accumulation time and seasonal acidic geochemical conditions in the subsurface; (5) Unconfined low-accommodation stage, represented by amalgamated channel sheets produced by aggradation without accommodation space produced when the SP reached the SEP. Vertebrates are scarce, with the same preservation style as in stage 4. Finally, (6) an unconfined high-accommodation stage is characterized by similar proportions of channels and floodplains with protosols. This stage is considered close to the equilibrium profile, during which, carcass accumulation is brief, and overbank flows infrequent. Climatic conditions were similar to stage 5, and vertebrate fossils were not preserved.

TAFONOMÍA DEL YACIMIENTO DEL ARROYO DEL VIZCAÍNO, SAUCE, URUGUAY

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El objetivo de esta comunicación es describir los aspectos tafonómicos más relevantes asociados al yacimiento finipleistocénico de Arroyo del Vizcaíno, ubicado en la localidad de Sauce, departamento de Canelones, Uruguay. La información que se presenta da cuenta principalmente de los resultados correspondientes al trabajo de campo de tipo exploratorio realizado en marzo del presente año, destinado a ampliar el número y la calidad de los elementos diagnósticos de este yacimiento descripto como sitio de interacción de humanos con megafauna (Arribas *et al.*, 2001); se incluyen también los datos relevados sobre el material extraído en 1997, momento en que fue descubierto el yacimiento. Desde el punto de vista geológico, los sedimentos se asignan a la Formación Sopas-Dolores (Panario y Gutiérrez, 1999) y la edad obtenida a partir de las dataciones radiocarbónicas de los restos es compatible con su inclusión en el piso-edad Lujanense (29.000 años AP, Fariña y Castilla, 2007; Fariña *et al.*, comunicaciones de este congreso). El yacimiento muestra una asociación de gran cantidad de restos fósiles de megafauna, de los cuales se ha extraído hasta el momento solo una pequeña proporción

(1109 especímenes, NISP= 447), donde predomina el perezoso terrestre gigante *Lestodon* Gervais 1855 (84% de los restos identificables, MNI= 5). Se cuenta también con huesos correspondientes a los gliptodontes *Glyptodon* Owen, 1839, *Panochthus* Burmeister, 1866 y *Doedicurus* Burmeister, 1874, así como varios restos de corazas. La mayor parte de los restos corresponde a individuos adultos, aunque algunos se han identificado como pertenecientes a juveniles. La representación de los diferentes grupos óseos según su transportabilidad en corrientes fluviales, la orientación de los huesos largos, el hallazgo de algunos miembros articulados, así como el estado de preservación general de los restos, indica que éstos no sufrieron transporte; además, los huesos no muestran evidencias de meteorización, lo cual sugiere un sepultamiento rápido. Por otra parte, tampoco se encontraron evidencias de fracturas producidas por compactación durante la fase diagenética. Los huesos presentan evidencias de marcas, de las cuales una importante proporción son atribuibles a herramientas de manufactura humana, según se describe en otro resumen presentado en este congreso. Además de los elementos óseos, se encontraron en asociación elementos líticos cuya morfología es compatible con la descrita para las herramientas primitivas, así como un resto de madera fósil.

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FACIES-RELATED PRESERVATIONAL PROCESSES IN THE MIDDLE–UPPER TRIASSIC OF SOUTHERN BRAZIL

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The Middl–Upper Triassic sedimentary deposits of Southern Brazil belong to the Rosario do Sul Group (Santa Maria and Caturrita formations), or the Santa Maria supersequence, a 200 m thick second-order sequence, subdivided into the third-order sequences Santa Maria 1, 2 and 3 (Andreis *et al.*, 1982; Zerfass *et al.*, 2003). The faunal content of sequences SM 1 and 2 allowed establishing a biostratigraphic scheme, *i.e.*, the Ladinian *Dinodontosaurus* Assemblage-Zone,the late Ladinian? Traversodontidae biozone, the Carnian – early Norian *Hyperodapedon* Assemblage-Zone, and the Norian Mammaliamorpha Assemblage-Zone (Langer *et al.*, 2007). The main lithofacies and architectural elements (*sensu* Miall, 1996) are: coarse to conglomeratic, cross-stratified sandstones (St) of low-sinuosity channels (CH) with argillaceous or sandy intraclasts (Gt/i), intercalated with massive or laminated mudstones (Fm/l). Levees (LV) comprise intercalations of reddish massive mudstones (Fm) with laterally-persistent, bioturbated fine sandstones (Sr). Massive mudstones, with carbonate concretions and paleosol features (P), finely laminated mudstones (Fl), massive siltstones (Sm), probably of loessic origin (AE) are characteristic of floodplain deposition (FF); and finely laminated mudstones (Fl) and tabular fine sandstones (Sh and Sr) are indicative of lacustrine conditions (L). Crevasse splays (CR) are represented by tabular, fine sandstones that are commonly bioturbated (Sh and Sr). Fossils are most common in St (CH) and Fm (FF) lithofacies, suggesting a near- or far-from-channel preservation, respectively. No vertebrates were recorded in levee environments. Thin sections of fossil bones from two biozones (*Dinodontosaurus* and *Hyperodapedon* Assemblage-Zones) indicated the following preservation processes: infilling of the vascular canals with microcrystalline carbonate mud, substitution of phosphate with calcite in the non-vascular areas, iron oxide encrustation, precipitation of fibrous, displacive calcite and varying degrees of calcite recrystallization. Reichel and Schultz (2004) also indicated chalcedony substitution in the Traversodontidae biozone. A continuum of preservation types between the two extremes ("best" and "worst" conditions) is sometimes observed in the same outcrop, independently from the biozone. Consequently, the preservation of the fossils from outcrops of both *Dinodontosaurus* and *Hyperodapedon* Assemblage-Zones were analyzed according to their host lithofacies. At Santa Maria city, a distal floodplain is overlapped by proximal floodplain facies and finally eroded by braided channels of the Caturrita Formation. Preservation type changed from articulated, but not well preserved rhynchosaur fossils at the bottom of the outcrop, to disarticulated, well preserved fossils at the top. At the city of São João do Polêsine, the same preservation types are recorded, above and below distal crevasse splays. Near the cities of Paraíso do Sul and Dona Francisca, dicynodont preservation changes in a similar fashion.

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LA EXTINCIÓN DE LA MEGAFAUNA Y LA DISPERSIÓN HUMANA: UNA PROPUESTA TAFONÓMICA INTERDISCIPLINAR

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Nuestro objetivo es presentar los resultados preliminares del análisis tafonómico de muestras faunísticas procedentes de la Colección Rodrigo Botet del Museo de Ciencias Naturales de Valencia (Chichkoyan, 2010). Estos son los primeros dentro de un proyecto que reanaliza colecciones paleontológicas de La Pampa y Patagonia depositadas en diversos museos de Argentina y Europa. El objetivo de este proyecto se aproxima de una manera diferente al estudio de la extinción de la megafauna sudamericana ocurrida a finales del Pleistoceno y principios del Holoceno. Este evento ha recibido especial atención científica ya que ocurre en coexistencia con la dispersión humana en el continente, hecho que pudo haber quebrado la adaptación a la fluctuación climática característica del Pleistoceno (Cione *et al.*, 2009). En nuestro caso, consideramos al *Homo sapiens* como una especie invasiva (*sensu* Lanata *et al.*, 2008) que habría desarrollado un nicho ecológico particular, repercutiendo diferencialmente en la supervivencia de la fauna nativa. En los estudios de la Colección Rodrigo Botet se diferenciaron las huellas antrópicas de las marcas naturales que podrían haber sufrido los restos óseos de los animales después de su muerte. De esta manera, la continuidad y futuro desarrollo de este proyecto de investigación se concibe como un aporte al conocimiento acerca de la dinámica de extinción de la megafauna y de dispersión humana, a partir del estudio tafonómico y combinando de aspectos paleontológicos y arqueológicos.

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PALEOECOLOGICAL, TAPHONOMIC AND CHRONOLOGICAL ASPECTS OF THE GOMPHOTHERE POPULATION FROM ARAXÁ, MINAS GERAIS, BRAZIL

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The paleoecological history of the South American gomphotheres is generally poorly known. The fossil remains from the Quaternary of Águas de Araxá are assigned to a single herd of the gomphothere Notiomastodon platensis (Ameghino, 1888). The aim of this contribution is to retrace the taphonomic pathway through evidence found in these fossil remains, and to place this herd in the chronological context and paleoecological setting of the Pleistocene. The fossils are housed at the Departamento Nacional de Produção Mineral and the Taua Grande Hotel. The taphonomic sample includes 88 postcranial elements of N. platensis: approximately 70% are long bones and cervical vertebrae. Also, Electron Spin Resonance dating of an upper right molar plus sediment was performed using Neutron Activation Analysis *to detect the levels of Uranium, Thorium and Potassium*. These samples used for radiometric dating indicated an age between 60 and 55 ky (Bonaerian, Late Pleistocene). Several post-mortem modifications of the bones were found during the analysis. The pittings, punctures and scratches observed on long bones are interpreted as canid gnaw marks. Therefore, the most plausible producer of these tooth marks is the hypercarnivorous Protocyon troglodytes (Lund, 1839), which is believed to be the first necrophagous organism that fed on the carcasses in early decomposition stage. Borings on cervical vertebrae were assigned to Cubiculum ornatus (Roberts, Rogers and Foreman, 2007), are interpreted as pupal chambers of dermestid beetles, suggesting a prolonged sub-aerial exposure of the carcasses. These insects are the last consumers of carcasses, acting only when body fat is completely lost (around 230 days). The QAA fossil bones can be assigned to a mas--death event related to n low environmental humidity period. Under such conditions, the scarcity of resources probably caused a mass mortality of proboscideans. According to the evidence available, after death the carcasses firstly suffered necrophagy by canids and subsequent boring by dermestid beetles, before final burial of the assemblage.

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TAFONOMÍA DE VERTEBRADOS CONTINENTALES DEL SITIO LA PASTOSA (FORMACIÓN PUERTO MADRYN, MIOCENO TARDÍO) EN PENÍNSULA VALDÉS (CHUBUT, ARGENTINA)

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Los fósiles que componen una variada y rica fauna de vertebrados continentales en los niveles superiores de la Formación Puerto Madryn ("Rionegrense", Mioceno tardío) en el Sitio La Pastosa (Península Valdés) fueron hallados en un conglomerado lenticular intercalado en la base de una sucesión típica de un canal estuárico con influencia de mareas. La fauna está integrada por peces Osteichthyes, aves Gruiformes, Falconiformes y Anseriformes y mamíferos Xenarthra (Pampatheriidae), Rodentia (Hydrochoeridae) y Litopterna (Macraucheniidae). Los restos más abundantes corresponden a los roedores hidroquéridos de la especie *Cardiatherium patagonicum* Vucetich, Deschamps, Olivares y Dozo, 2005 (Dozo *et al.*, 2010). Los elementos óseos recuperados, alrededor de 120, están desarticulados, algo incompletos y fragmentarios. Los mamíferos (89%) están representados por varios cráneos completos, fragmentos de cráneo, osteodermos, dientes aislados, y elementos postcraneales; los peces (6%) por vértebras y espinas; las aves (5%) por un cráneo, dos vértebras, dos húmeros, una falange y un sinsacro. Del porcentaje de mamíferos, el 71% corresponde a la especie *Cardiatherium patagonicum*, 17% a Macraucheniidae, 2% a Pampatheriidae y 10% a Mammalia indet. Según el modelo de Voorhies (1969) de acuerdo a su potencial para transporte hidráulico, se encontraron elementos óseos de los Grupos I, II y III, pero en distinta proporción. Los restos fósiles habrían sido rápidamente enterrados ya que no muestran mucho desgaste, ni meteorización. La presencia de elementos del Grupo III, como es el caso de varios cráneos enteros, indicaría además la ocurrencia de un corto transporte en la formación de la concentración de los fósiles. Las características de las facies sedimentarias sugieren la presencia de canales meandriformes con fuerte migración lateral en la zona de transición fluvial-mareal (*sensu* Dalrymple y Choi, 2007) en un ambiente estuarial. En este sector los canales están rodeados por planicies fluviales pantanosas, lagunas de agua dulce y albardones. Las condiciones de algunos de los fósiles indicarían que proceden de ambientes próximos y por lo tanto podría considerarse al conjunto como representativo de una fauna local. En ese sentido el roedor hidroquérido*, Cardiatherium patagonicum*, el más abundante con varios cráneos enteros (Grupo III), permite inferir que podría tratarse de una asociación autóctona. Los hidroquéridos actuales también son formas ligadas a ambientes acuáticos de agua dulce. Los restos de estos organismos se habrían acumulado inicialmente en los ambientes marginales al canal en los cuales vivían. Posteriormente la erosión asociada con la migración lateral del canal incorporó los huesos a los depósitos gruesos de la base del canal PIP a MTD.

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ANÁLISE DOS ESTÁGIOS DE INTEMPERISMO EM FÓSSEIS DA MEGAFAUNA DO QUATERNÁRIO TARDIO DE LAGOA DO RUMO, BAIXA GRANDE, BAHIA, BRASIL

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A decomposição de carcaças de vertebrados em superfícies subáreas e a sua desintegração fazem parte do processo natural de ciclagem de nutrientes do solo, no qual o processo de fossilização depende não somente das condições físico-químicas do ambiente deposicional, mas também de um forte controle tafonômico, relacionado à taxa de variação dos processos destrutivos que afetam os ossos, antes de sua destruição total frente aos agentes externos (bióticos e abióticos). Este trabalho trata da análise dos estágios de intemperismo em 110 amostras de fósseis, provenientes do depósito fossilífero de Lagoa do Rumo, Baixa Grande, Bahia. Neste depósito, um tanque encaixado num ortognaisse migmatítico, foram identificados os respectivos táxons: *Eremotherium laurillardi* (Lund, 1842) Cartelle e Bohórquez, 1982*, Panochthus greslebini* Castellanos, 1941*, Stegomastodon waringi* (Holland, 1920) e Toxodontinae indet. No depósito ocorrem duas camadas: a primeira é uma brecha fossilífera suportada por bioclastos e clastos mal selecionados, com um metro de espessura. A segunda é um lamito rico em matéria orgânica, com dois metros de espessura, sem a presença de macrofósseis. O transporte desses restos ósseos ocorreu por meio de um fluxo de detritos, que carreou juntamente com estes, clastos de modo não seletivo. O diagnóstico realizado nos fósseis de mamíferos da Lagoa do Rumo baseia-se nos seis estágios de intemperismo propostos por Behrensmeyer (1978), para restos ósseos expostos na interface ar/água/sedimento, com o objetivo de apontar o tempo de exposição aos agentes do intemperismo durante a necrólise das carcaças, antes do soterramento final dos restos esqueletais. Estas feições tafonômicas podem apontar para uma mistura temporal da tanatocenose, onde esta é composta por diversos animais que morreram em tempos distintos, tendo seus restos sido acumulados na superfície do solo, para posteriormente serem soterrados em um mesmo evento deposicional. Este processo tafonômico, que pode ser observado nos fósseis de megafauna provenientes do depósito fossilífero estudado, já que ocorrem bioclastos em diversos estágios de intemperismo, apontando para uma mistura temporal para

o cenário de morte. A análise das feições intempéricas em fósseis ressalta a importância do estudo dos processos de necrólise na aquisição de informações ecológicas para uma assembleia fossilifera.

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TAPHONOMIC CHARACTERIZATION OF THE NEOSAUROPOD PALEOHYDROTHERMAL NESTING SITE OF SANAGASTA, LA RIOJA, NW ARGENTINA

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The recent discovery of the Sanagasta dinosaur nesting site in the Lower Cretaceous, Los Llanos Formation, La Rioja Province (NW Argentina), has shed unexpected insights on the reproductive behavior of neosauropods. This nesting site documents colonial behavior, site fidelity with possible phylopatry, and an opportunistic environment-dependent-reproduction relationship with a geothermally active paleoenvironment (Grellet-Tinner and Fiorelli, 2010). The taphonomy of this monotypic nesting site is described in order to assess its biostratinomy and fossil diagenesis. The 3D spatial arrangement of the egg-clutches is well preserved and suggests the presence of autochthonous associations (see Martin, 1999) with *in-situ* ovipositions, yet without any trace of nest structures. The egg-bearing level represents an "intrinsic" biogenic accumulation (Kidwell et al., 1986) that implies a gregarious behavior for these dinosaurs through their preferential colonization of a specific nesting site (Martin, 1999) that is characterized by a paleohydrothermal environment (Grellet-Tinner and Fiorelli, 2010). The biocenosis is of biogenically deposited eggs, with eggshell mineralization altered by hydrothermal activity, and extremophile microorganisms (stromatolites, cyanobacteria, and diatoms). The thanatocenosis and time-averaging were virtually zero because the eggs buried in the substrate immediately after being laid. In contrast, the taphocenosis (buried associations) represents the most important taphonomic feature. The eggshells display several synchronous taphonomic alterations (*e.g.*, high fragmentation, chemical erosion, and eggshell thinning) produced by acidic hot spring solutions, while re-calcification and silicification (mainly micro-sparry, chalcedony, microchert, opal-A, and epidotes) are the most common eggshell recrystallizations. The presence of ~10 µm Ø opal-A microspheres, epidote aggregates (*e.g.*, clinozoisite through the "saussuritization" process), and fibrous clay minerals (smectites derivates from plagioclase through the "argillization" process) replacing parts of the eggshell and egg membranes indicates extreme hydrothermal alteration (see Pirajno, 2009) under exceptional conditions. Subsequently, the eggs were exposed to compression forces leading to fracturing of the shells during eodiagenesis. Considering the association of fossil stromatolites, cyanobacterians, and diatoms, silicified rhizoliths, coupled with sedimentary structures, such as microfacies and hydrothermal microfabrics, and with complete egg clutches, we can infer that the Sanagasta nesting site represents a particular instance of taphocenosis and an exceptional *lagerstätte*. The Sanagasta dinosaur nesting site is thus the first documented case of environment-dependent reproduction amongst neosauropods.

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STORM EVENTS AND THE CONCENTRATION OF EARLY PERMIAN MESOSAURID REPTILES AND PYGOCEPHALMORPH CRUSTACEANS FROM THE IRATI FORMATION, EARLY PERMIAN OF BRAZIL

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The Irati Formation consists of a series of shales and limestones, deposited in a calm offshore marine shelf environment, at shallow depth and with anoxic bottom waters, disturbed by episodic storm events (Lavina *et al.*, 1991). The most abundant fossils in these strata are mesosaurid reptiles and pygocephalomorph crustaceans, both preserved in varying degrees of disarticulation. Previous studies interpreted some concentrations of these fossils as mass mortality events associated with severe storms (Lavina *et al.*, 1991; Soares, 2003). Additionally, Soares (2003) classified the mesosaurid concentrations into distinct taphofacies, that characterized their occurrence in terms of shore proximity, water depth and storm action. Recently, new studies were conducted in the Passo do São Borja outcrop, Rio Grande do Sul state, Brazil. This locality is described (Lavina *et al.*, 1991) as a package of black shales, interbedded with a carbonate rich lens that is interpreted as a tempestite deposit. The main goal of the present work is to refine the description of the storm-generated deposits, and observe how bioclasts are distributed along the tempest facies, to infer the nature of the mass mortality events. Field observations showed that the storm-generated

facies have two subfacies: on the lower portion of the carbonate rich strata there is a classic high density turbidite succession, the Bouma sequence (Bouma, 1962), showing fining-upward texture grading into unidirectional low density current flow deposits (as shown by bioclast imbrication). Fossils preserved in the turbiditic subfacies consist mainly of disarticulated, isolated and fragmented elements, to which an intense reworking and transport is inferred. At the top of the turbiditic subfacies is the tempestite subfacies, comprising a basal erosive contact, with residual lag conglomerate, succeeded by sandstones with hummocky cross-stratification, and finally, the deposition of suspended sediment load. On top of this tempestite sequence, concentrations of articulated mesosaurid skeletons and crustacean remains are common, which suggests these organisms died over a short period of time and where buried in the same event. This observation is consistent with the interpretations of Lavina *et al.* (1991) and Soares (2003), who postulate a mass mortality associated with mixing up of fresh superficial water with the deep anoxic water, toxic to the pelagic fauna. This mixing could have been caused by the same wave action that generated the hummocky cross-bedded bedforms. It is concluded that the mass mortality events observed in the Irati outcrops are not all associated with all types of storm-generated deposits. The storm generated turbiditic facies operated below the storm wave base and did not cause breakdown of the thermal stratification of the water column. Only the storms that generated the hummocky deposits were powerful enough to cause the mixing that led to mass-mortality of the crustaceans and mesosaurs.

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TAPHONOMY OF LACUSTRINE ECOSYSTEMS

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Lacustrine ecosystems are particularly sensitive to environmental changes and their fine-grained deposits commonly display rapid variations in sedimentary facies, which influence fossil preservation. Thus, lacustrine deposits have particular features that allow us to distinguish them from other continental deposits. These features include, *e.g.*, predominance of fine grain sizes and dominant tabular geometry with a high degree of lateral continuity of individual beds, among others. Taphonomic processes vary with the environment, and they can result in general patterns of preservation that are characteristic of each depositional setting. Two rift basin lacustrine successions (Cacheuta and Los Rastros Formations) in the Middle Triassic of Argentina were analyzed and compared with regard to taphonomic attributes of the aquatic vertebrate record in an effort to identify patterns and distinctions. The most common biostratinomic processes observed include float, or rapid fall, transport, decay, predation, scavenging, and turbulence. The different taphonomic features recorded for remains that were found in different lacustrine sub-environments allow us to define a taphonomic model that characterizes the preservation of aquatic vertebrates in rift-related lacustrine basins. The aquatic vertebrate assemblages studied allows us to suggest that aquatic vertebrates preserved in delta front, underflow, and turbidity current deposits were allochthonous to the lake and probably inhabited the delta plains and affluent fluvial system. In contrast, the articulated and isolated remains of aquatic vertebrates preserved in open lake deposits might represent both autochthonous or allochthonous specimens. This study highlights the main differences in preservation and development of two different aquatic faunas and their relation with the sub-environments they inhabited.

ASSEMBLAGES OF NEOGENE MICROMAMMALS FROM CENTRAL ARGENTINA. CASE STUDY AND ACTUALISTIC MODELS

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Taphonomic analysis of Neogene fossil bone assemblages from Argentina is becoming more frequent. In this context, different stratigraphic intervals of Cerro Azul Formation (late Miocene, La Pampa, Argentina) have been analyzed with taphonomic criteria. At Caleufú, Estancia Ré, and Bajo Giuliani localities the fossil-bearing sediments are loess deposits with development of paleosols. These assemblages are characterized by high density of remains of small mammals (less than 5 kg of estimated body mass), found mostly disarticulated; high minimal number of individuals (MNI) with predominance of few taxa of Notoungulata and Rodentia, and very common remains of juvenile and subadult specimens. The relationship between cranial and postcranial elements shows a predominance of cranial remains (maxillae, mandibles and isolated teeth). A marked loss of postcranial elements is evident with better preservation of proximal elements (femora and humeri). Also, the complete metapodials and phalanges are very abundant. The remains show a particular breakage pattern, with jaws generally lacking the posterior portion, skulls represented by broken maxillae, and long bones by epiphyses. Spiral or step-like fractures are frequently observed in all broken elements. Gnawed bones and specimens with tooth marks were found in all the assemblages, but remains with evidence of corrosion by digestion are scarce. Associated with these assemblages, cylindrical coprolites with tapering ends were found. These coprolites contain a high density of bone remains with strong corrosion by digestion, and thus were assigned to carnivorous mammals. Remains from Telén and Cerro La Bota localities exhibit taphonomic features similar to the assemblages mentioned above, but with evidence of abrasion (wear and polishing features). This attribute indicates reworking caused by wind or water. As the working hypothesis, we propose that the origin of fossil assemblages could be biological. Taphonomic evaluations of extant accumulations were also conducted, being a useful tool to

interpret the taphonomic history of fossil remains. The analysis included accumulations produced by bird of prey and carnivorous mammals of central Argentina and Patagonia. Bone modifications (relative abundance of skeletal elements, and degree of breakage and digestion) produced by predation both on digested and uneaten remains of their prey were evaluated. Although late Miocene faunas are different from today, several of the characteristics shown by the Cerro Azul Formation assemblages can be attributed to modifications produced by predator activity. While evidence of corrosion by digestion is absent or minimal, the sum of attributes mentioned above allows us to rule out the possibility of a predator causing the modifications in the prey bones. Instead, these fossil assemblages could correspond to the uneaten remains of prey accumulated by predation. These mammal bone assemblages produced by predatory activity represent a short time interval and their significance for biochronologic and biostratigraphic studies are discussed.

SCAVENGING MARKS ON AN ARCHOSAUR FROM THE LATE TRIASSIC (NORIAN) OF RIO GRANDE DO SUL STATE, BRAZIL

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Bioerosion and bone alteration provide important paleoecological and taphonomic information. Here we report on biologically generated perforations in fragments of a fossil archosaurian bone (MMACR-PV-012-T). The material was collected from a sandstone layer in the Sesmaria do Pinhal 2 outcrop, near the municipality of Candelária, assigned to the Late Triassic *Riograndia* Assemblage Zone (Soares *et al.*, 2011). It consists of isolated bone fragments that were found associated with mudrock intraclasts and carbonate concretions. We have identified gastralia, ribs, an ungual phalanx and some girdle fragments, the latter, showing signs of scavenging in the form of burrows. Detailed measurements of diameter and depth of the burrows were made with an electronic caliper rule. Silicone casts of some marks were made to aid the visualization of structures. Seven elliptical perforations were identified, with diameters ranging from 2.2 to 5.5 mm. They can be distinguished by their depth and shape in three groups: two ovoid burrows that reach the medullary bone; three shallow perforations in the bone cortex; and two ovoid, tubular perforations with more than 4mm of depth. The uniformity of the shape and length of these perforations is compatible with the activity of dermestid beetles. These insects are known to infest dry carcasses in the late stage of decay and they require a very specific range of humidity and temperature (Britt *et al.* 2008). Another type of perforation (with a diameter of more than 5 mm) was also observed. One is a shallow hole with irregular border, and the other is a puncture that penetrates the medullary portion of the bone, with star-shaped cracks around the edge. The morphology of these marks and the fragmentation of the borders (with sharp and irregular fractures) are characteristic of tooth marks, indicating the activity of a tetrapod predator or scavenger (Holz and Simões, 2002). Forensic entomology concepts applied to taphonomy were adopted to rebuild the post-mortem process with more accuracy. It is proposed a scenario where the carcass was exposed for at least four months before burial, a time period estimated for the infestation by dermestids (Schoenly *et al.*, 2006). The arid, seasonal paleoenvironment attributed to the Late Triassic (Rubert and Schultz, 2004) could provide these optimum conditions. The fragmentation and weathering suffered by the bones also evidence of prolonged sub-aerial exposure. This record, along with that of Schwanke and Kellner (1999) supports the emergence of dermestid beetles before the Jurassic as proposed by Beal and Zhantiev (2001).

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THE OLDEST RECORD OF THE INCHNOTAXON *OSTEOCALIS MANDIBULUS* ON LATE TRIASSIC OF THE SOUTHERN BRAZIL

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This study reports a new ichnofossil for the Late Triassic of Brazil interpreted as the action of necrophagous insects on a lower jaw (UFRGS-PV-1177-T) of the traversodontid cynodont *Exaeretodon riograndensis* Abdala *et al.* (2002). The traces consist of two shallow trails (31 mm and 13 mm long and no more than 1mm deep) bored into the inner mandibular surface, at the coronoid process region. The depth of the excavations varies through the extent of the longest trail, and its width ranges from 3.6 to 5.9mm. The shorter trail varies between 2.3 to

2.6 mm in width. Another mark on the outer side of the lower jaw presents an ovoid/clavate perforation, still undetermined. The two trails are compatible to the ichnospecies *Osteocalis mandibulus* Roberts *et al.* (2007), an ichnotaxon typical of continental settings. Although the mean width in *O. mandibulus* is smaller than the one observed in the material presented here, wide trails could be the result of the action of individuals of larger sizes, feeding at late stages of larval development, as referred at the original description (Roberts *et al.*, 2007). It is possible that these marks represent dermestid beetle larval action, indicating that the carcass was buried either at a late stage of decomposition or after drying and mummification. More refined imaging techniques (as SEM photomicrography) will be conducted on the specimen, to reveal more information on the morphology of the bite marks. Not withstanding, the Late Triassic occurrence of this ichnospecies expands the temporal distribution of *Osteocalis* to older strata, indeed representing its oldest global record.

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AVALIAÇÃO DO USO DE JOGO DIDÁTICO NO ENSINO DE TAFONOMIA

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O jogo lúdico é um recurso interessante para o ensino, por permitir a socialização entre os estudantes, reforçar conceitos já aprendidos, desenvolver a argumentação e abrir espaço para a interdisciplinaridade. A natureza dinâmica dos jogos aumenta o interesse e a motivação dos estudantes no processo ensino-aprendizagem (Grando, 2001). Contudo, apesar da importância do jogo como ferramenta de ensino, nota-se uma carência deste recurso didático no ensino de Ciências (Neves et al., 2008), em especial em Paleontologia. Além do grande potencial que os temas paleontológicos têm para cativar os alunos, a Paleontologia exerce papel essencial na compreensão da evolução do planeta e dos seres vivos, sendo, portanto, peça-chave no ensino de Ciências. Somado a isso, é fundamental ressaltar a importância de cada fóssil como registro da vida. Uma das maneiras de atingir essa meta é demonstrar o longo processo de formação de um fóssil, e os vários fatores destrutivos enfrentados pelos restos orgânicos durante a fossilização (tema de estudo da Tafonomia), evidenciando a raridade implícita em cada espécime fóssil. Com o objetivo de ilustrar os processos tafonômicos de uma maneira paralela à explanação teórica, foi criado o "Tafonogame: o jogo da fossilização" (adaptado de Pretto and Bertoni-Machado, 2009). A proposta consiste em um jogo de tabuleiro, no qual cada jogador assume o papel de um vertebrado extinto e percorre os processos bioestratinômicos e diagenéticos envolvidos na fossilização, de modo a fazer seu animal preservar-se ao final do trajeto. Cada jogador recebe um número de cartões, representando ossos, que podem ser "destruídos" a cada vez que o seu esqueleto enfrenta uma etapa destrutiva do processo tafonômico (como o transporte, o retrabalhamento, a necrofagia, ou o efeito de coleta, por exemplo). Desse modo, o jogador compreende o quão difícil é a preservação de um organismo. Ao final do jogo, "vence" o jogador que conseguir completar o caminho com mais ossos "preservados". Os jogadores que perderem todos seus ossos ao longo do trajeto "perdem" o jogo, pois os esqueletos de seus vertebrados não se "fossilizam". O Tafonogame já passou pela fase de validação entre os autores, em seminários de Paleontologia e em um curso de atualização de docentes de ensino fundamental e médio ministrado durante o XXI Congresso Brasileiro de Paleontologia, realizado em Belém, no ano de 2009. Atualmente encontra-se em fase de testagem em disciplinas da graduação em Geologia e em Ciências Biológicas da Universidade Federal do Rio Grande do Sul (UFRGS) e da Universidade Federal do Paraná (UFPR). A proposta foi recebida com grande interesse por parte de estudantes e professores. Essa etapa consiste, além da aplicação do jogo em si, na aplicação de dois questionários (um relacionado aos conceitos de Tafonomia abordados e outro sobre o jogo propriamente dito). Espera-se, desse modo, avaliar o impacto que o Tafonogame tem no processo ensino-aprendizagem dos estudantes.

Grando, R.C. 2001. O jogo na educação: aspectos didático-metodológicos do jogo na educação matemática. www.cempem.fae.unicamp.br/lapemmec/cursos/el654/2001/jessica_e_paula/JOGO.doc (último acesso em 13/06/2011).

Neves, J.P; Campos, L.M.L. e Simoes, M.G. 2008. Jogos como recurso didático para o ensino de conceitos paleontológicos básicos aos estudantes do ensino fundamental. Terr@Plural 2: 103–114.

Pretto, F.A. e Bertoni-Machado. 2009. Tafonogame: o jogo da fossilização. En: Soares, M.B. (Organiz.) Livro digital de Paleontologia – A Paleontologia na Sala de Aula. http://www.ufrgs.br/paleodigital/Atividade7_Tafonomia.html (último acesso em 13/06/2011).

TAPHONOMY OF SAUROPOD AND THEROPOD DINOSAURS FROM THE UPPER CRETACEOUS OF MENDOZA, ARGENTINA

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The Neuquén Basin, located in northwestern Patagonia of Argentina, has the most important record of Cretaceous dinosaurs from South America. The Neuquén Group (Cenomanian–early Campanian) is the richest dinosaur-bearing unit of the basin. Taphonomic studies of

these vertebrates are scarce since most papers are focused on systematic aspects. Disarticulated, isolated or partially articulated sauropods and theropods are abundant in this group. In this context, the present contribution focuses on three main aspects: biostratinomic and fossil diagenetic processes of dinosaurs and diagenetic features of the sedimentary facies. In Mendoza province, four dinosaur sites were found from Paso de las Bardas (Quebrada Norte site) and Cerro Guillermo (CG1, CG2, CG3 sites). These discoveries led to the recognition of four taphonomic preservational modes (MT): MT1. Articulated bones of Titanosauria indet. specimen in well-drained floodplain facies. In this case the bones are preserved articulated in facies with abundant paleosols and intense bioturbation and they do not show evidence of weathering or orientation due to sporadic currents. MT 2. Disarticulated but associated bones of sauropod in poorly drained floodplain facies. This is the case of Malarguesaurus florenciae (González Riga et al., 2009) and two specimens of an indeterminate titanosaur. The bones are preserved in poorly drained floodplain facies with poorly developed paleosols. They show a complete disarticulation processes, subaerial biodegradation, weathering and limited hydraulic winnowing. MT 3. Disarticulated bones of an indeterminate theropod in crevasse splays. The bone remains exhibit abrasion and sorting due to intense hydraulic transport related to crevasse splays facies, and MT 4. Isolated bones of a sauropod and indeterminate theropod in channel facies. In this case, the bones are fragmentary remains that show total disarticulation, abrasion and hydraulic sorting processes due to transport within fluvial channel-lag deposits. The fossil diagenetic stages observed in theropods (MT4) and sauropods (MT2) are reconstructed using microscopic studies and compositional analysis using X-ray diffractometry. In these stages, the bones suffered intense plastic deformation, permineralization with iron oxides and other diverse minerals in vascular canals and fractures. These processes are the result of the different burial depths, temperature regimes, and geostatic pressures experienced by sauropod and theropod bones preserved in floodplains and channel facies, respectively. Bone preservation differences observed in both depositional environmental are associated with the rock-fluid system of each sedimentary facies. In summary, according to the biostratinomic and fossil diagenetic studies, the dinosaurs preservation in fluvial systems is strongly controlled by intrinsic factors of the organisms such as the morphology, skeletal relative proportions and taxonomic group, and extrinsic factors such as the depositional environmental and its mineralogical and petrographical conditions.

González Riga, B.J., Previtera, E. and Pirrone, C.A. 2009. *Malarguesaurus florenciae* gen. et sp. nov., a new titanosauriform (Dinosauria, Sauropoda) from the Upper Cretaceous of Mendoza, Argentina. *Cretaceous Research* 30: 135–148.

NEW LATE MIOCENE MARINE TETRAPODS AND THE ORIGIN OF THE BAHIA INGLESA FORMATION BONEBED FROM THE ATACAMA DESERT OF CHILE

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Recent fieldwork has documented a new site with dense accumulation of late Miocene marine vertebrates from the Bahía Inglesa (BI) Formation of northern Chile. Nearly 70 vertebrate taxa have been identified from the bonebed, but only a few of these taxa have been formally described. The BI bonebed is located in the middle of the BI Fm., a ~40 m sequence of sandstones, siltstones, coquinas and conglomerates. Below the bonebed, a basal hardground has been historically exploited by local mining operations, which targeted cobble to boulder-sized phosphatic nodules. Fossil marine vertebrates from the bonebed level include some of the earliest records of marine vertebrates that live in the Humboldt Current today, including rorqual whales (Balaenopteridae) and modern penguins (Spheniscidae). Intriguingly, the bonebed also includes lineages that are extinct and absent from today's Chilean coast, such as marine crocodylians, pelagornithid birds, dugongids, and extinct crown phocids. Recent fieldwork has documented the occurrences of several unique taxa in this assemblage, which have been previously reported only from the Pisco Basin of Peru: an extinct, aquatic nothrotheriine sloth; *Odobenocetops* Muizon 1993, a bizarre walrus-convergent delphinoid; and *Livyatan* Lambert, Bianucci, Post, de Muizon, Salas-Gismondi, Urbina, and Reumer 2010, a physeteroid with large upper and lower dentition. The recovery of the world's most complete pelagornithid, *Pelagornis chilensis* Mayr and Rubilar-Rogers 2010, with large, fragile and thin-walled bones, highlights the unusual potential for excellent preservation. The rich and non-analogous composition of the BI marine vertebrate assemblage suggests that major changes in oceanographic conditions (*e.g.*, changes in upwelling and productivity of the Humboldt Current) have shaped the evolution of marine vertebrate communities since the late Miocene. We aim to better understand the bonebed's genesis, geochronology, biostratigraphy, and fossil vertebrate assemblage. New geologic data will test hypotheses of the bonebed's formation (*e.g.*, mass death, sediment starvation, or episodic changes in sea-level) and provide a basis for comparing it to other marine bonebeds, such as the middle Miocene Sharktooth Hill in California.

MOLECULAR TAPHONOMY OF THE SANTONIAN HADROSAURID DINOSAUR: TESTING BONES CONTAINING CO-

LLAGEN

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A non destructive analysis based on Particle Induced X-Ray Emission (PIXE), Ionoluminiscence, FT-RAMAN spectrometry, micro-scale XRD, and Confocal microscopy documents molecular preservation of bones and soft tissue remains from an 84 Myr-old hadrosaur from the Late Cretaceous bonebeds of Southern México (see Benammi et al., 2005). Well-preserved bones were fully scanned by PIXE using an external proton-beam of an ionic accelerator, and results show elemental composition measurements of Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, As, Sr, Y, and U. An average P/Ca ratio of 0.30 is reported. This analysis was compared with recent bones from a flightless running bird (*Struthio camelus*, Struthionidae). Results show that the phosphorus content of the hadrosaur bones is increased by a factor of 3. Ionoluminiscence testing detected a variable concentration level of divalent Mn2+ and Fe2+ content, which represents a gradual change during burial from well oxidized to reducing conditions. Furthermore, the very fine sediment of volcanoclastic sandstone that surrounds the bones exhibits the highest luminescence intensity which suggests uptake of Mn2+ linked to reducing conditions in the depositional environment. Oriented small-scale XRD measurements display hydroxylapatite phases from inner sections of bones, while the external zones show a fluorapatite content and crystal size interpreted as indicative of coalescive neomorphism because they show a progressive enlargement of all crystals. Ultraestructural microanalysis of the bone matrix reveals mineral coatings, infillings, and biomineralization features that preserve micro-anatomical details such as large, longitudinal collagen fibrils. This potentially biomineralized soft tissue was tested by μ-FT-RAMAN, and shows a characteristic pattern strongly related to relict collagen type 1. The results suggest that post-burial modification may stabilize bones. It is likely that the hadrosaur specimen was buried rapidly by a debris flow generated by the mobilization of epiclastic volcanic deposits. This biogeochemical environment in the taphonomically active zone was characterized by reducing conditions that favored biomineralization in and around bones and the long-term preservation of organic remains.

Benammi, M., Centeno-García, E., Martínez-Hernández, E., Morales-Gámez, M., Tolson, G. and Urrutia-Fucugauchi, J. 2005. Presencia de dinosaurios en la Barranca Los Bonetes en el sur de México (Región de Tiquicheo, Estado de Michoacán) y sus implicaciones cronoestratigráficas. *Revista Mexicana de Ciencias Geológicas* 22: 429–435.

EXPLORING BURIAL DYNAMICS IN CRETACEOUS BONEBEDS IN THE MAEVARANO FORMATION (MAASTRICHTIAN, MADAGASCAR) USING FIELD-BASED DATA AND HIGH-RESOLUTION X-RAY COMPUTED TOMOGRAPHY

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Vertebrate fossils are remarkably abundant and exceptionally well preserved within the Maastrichtian Maevarano Formation of northwestern Madagascar. The vast majority of these fossils, including all of the known bonebeds, are entombed within deposits of fine-grained cohesive debris flows (Rogers, 2005). These burial events shielded vertebrate remains from destructive surface processes and also afforded protection for soft tissues. The recurrent association of bonebeds and debris-flow deposits reflects seasonality in the Late Cretaceous Maevarano ecosystem, with prolonged dry spells and associated hardships instigating mortality and subsequent rains setting debris flows in motion. Initial reconstructions of burial dynamics based on taphonomic observations in the field indicated that debris flow burial events had limited transport potential. Disarticulated skeletal elements from large and small individuals are recovered in close association, and the representation of skeletal elements in bonebeds is inconsistent with significant hydraulic sorting related to element size, shape, or density. For example, bonebed MAD96-01 yielded a nearly complete skull of *Majungasaurus crenatissimus* (Depéret, 1896) that consisted of pristinely preserved elements that were disarticulated but remained closely associated in the burial horizon. It is likely that the skull was partially articulated prior to the onset of rains and final burial. More recent observations in bonebed MAD05-42, which has been carefully excavated and mapped with the goal of revealing patterns in fossil distribution, further demonstrate the limited transport potential of the debris flows. This locality has yielded several semi-articulated small avialan skeletons in association with remains of large dinosaurs. High-resolution x-ray computed tomography (microCT) was used to generate detailed sub-millimeter spatial characterizations and preliminary anatomical assessments of unprepared avialan specimens encased within matrix. All samples were scanned at 85kVP, 400 mA, and slice thicknesses of either 0.092 mm or 0.045 mm, depending on the absolute size of the sample. Resultant 3-D visualizations of bone-bearing matrix reveal remarkable preservation of articulated vertebral, costal, and gastralial series and multiple limb segments, with many retaining original three-dimensional organization. Some specimens exhibit slight (≤2 cm) dislocation of intact elements across joints. Other specimens consist of fragmentary partial elements that display the effects of sheer stresses and minor displacement of fragmentary bone debris during burial. MicroCT analysis provides freeze-frame views of the finest bioclast fraction at the time of entombment, and

yields novel perspectives on depositional kinematics in the remarkable bonebeds of ancient Madagascar.

Depéret. 1896. Note sur les dinosauriens sauropodes & théropodes du Crétacé supérieur de Madagascar [Note on the sauropod and theropod dinosaurs from the Upper Cretaceous of Madagascar]. *Bulletin de la Société Géologique de France*, *3ème série* 24: 176–194

Rogers, R.R. 2005. Fine-grained debris flows and extraordinary vertebrate burials in the Late Cretaceous of Madagascar. *Geology* 33: 297–300.

SEDIMENTOLOGY, ICHNOLOGY AND VERTEBRATE TAPHONOMY OF A 'WET DESERT': THE LATE PERMIAN MORADI FORMATION OF NIGER

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Paleogeographic models position the vertebrate fauna of the upper Permian Moradi Formation, northern Niger, approximately 20°S of the paleoequator in central Pangea. This basin lies east of the Tethys Sea within a 5000 km wide "corridor" between Gondwana and Laurasia. Recent field investigations have confirmed that climate was warm, arid with seasonal monsoonal rainfall and, possibly as a result of these unique physio-climatic conditions, the tetrapod fauna shows a high degree of endemism (Sidor *et al.*, 2005). The Moradi sediments accumulated on a flat semi-arid to arid alluvial plain with large, low angle gravelly alluvial fans prograding from the tectonically active Aïr Massif to the east, which at times impinged on a large stable meandering channel system flowing generally northwards along the axis of the basin. Fossil rich intervals are characterized by wide shallow anastomosing channels conformably filled with a conglomerate of reworked pedogenic carbonate nodules, rhizocretions, and claystone clods overlain by massive sandy siltstone. At Ibadanane, 20 km west of Arlit, an area measuring 280 x 50 m was found to contain at least 15 surface concentrations of scattered bones comprising ribs, vertebrae and long bones of pareiasaurians. Preliminary quarrying and mapping of these disarticulated bones revealed scattered, but still associated, skeletons of *Bunostegos* (Sidor *et al.*, 2003) as well as amphibians such as *Nigerpeton* (Sidor *et al.* 2005) and the captorhinid *Moradisaurus* (Taquet, 1969). The bone scatters generally dip gently towards the channel axis. The preliminary interpretation of the depositional setting of the pareiasaur "cemetery" site is of a distal alluvial fan where ephemeral flash-flood streams swept across a silt-dominated loessic plain, scouring through the sparsely vegetated soils to the more resistant calcrete horizons, reworking previously buried bones and burying desiccated drought-stricken cadavers. In the same area are some isolated low mesas are interpreted as examples of inverted topography in that they were originally localized water filled depressions. Approximately 60 m in diameter and 5 m high, they comprise a brecciated micritic limestone overlain by finely-laminated calcic siltstone and are interpreted as end-point playa deposits. They demonstrate that this area of "wet desert" hosted standing water bodies for extended periods and interestingly they preserve a range of insect, arthropod, amphibian and reptile tracks not previously recorded from the Moradi Formation.

Sidor, C.A., Blackburn, D.C., and Gado, B. 2003. The vertebrate fauna of the Upper Permian of Niger – II, Preliminary description of a new pareiasaur. *Palaeontologia Africana* 39: 45–52

Sidor, C.A., O'Keefe, R., Damiani, R., Steyer, S., Smith, R.M.H., Larsson, H.C.E, Sereno, P.C., Oumaru, I. and Abdoulaye, M. 2005. Permian tetrapods from the Sahara show climate controlled endemism in Pangaea. *Nature* 434: 886–889

Taquet, P. 1969. Première découverte en Afrique d'un Reptile Captorhinomorphe (Cotylosaurien). *Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences Paris*, *Série D* 268: 779–781

MODOS TAFONÓMICOS EN LOS DEPÓSITOS FLUVIALES DE LA FORMACIÓN MONTE HERMOSO (BUENOS AIRES, ARGENTINA)

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La Formación Monte Hermoso está constituida por depósitos que representan un sistema fluvial meandriforme (Zavala y Navarro, 1993). La abundancia y calidad de los restos de vertebrados procedentes de las facies de llanura de inundación Fl y fondo de canal St, permitió el desarrollo de estudios tafonómicos de detalle. La facies Fl (NR=195) está constituida por limolitas arcillosas de desborde, de las que provienen abundantes restos de micro y macrovertebrados, en muchos casos articulados y/o asociados. Los materiales no presentaban orientaciones preferenciales y su inclinación varió entre 0º y 10º. Se encontraban muy distantes unos de otros, por lo que no fue posible evaluar la densidad (restos por unidad de superficie). El 29,74% estaban enteros y en los demás predominaron las roturas longitudinales (bioestratinómicas). El 27,69% presentó evidencias de meteorización subaérea y sólo en el 6,15% se reconocieron leves indicios de abrasión. En el 43,59% se identificaron señales de corrosión, principalmente producidas por acción de raíces. Se interpreta que la mayoría de los elementos fueron poco afectados por las corrientes hidráulicas. La facies St (NR=473) está constituida por brechas clasto-sostén, con intraclastos y restos de vertebrados, que representan la carga tractiva del curso. Predominan los materiales de pequeño tamaño (micromamíferos y peces), con tendencia a las formas cúbicas. La inclinación de los restos varió entre 0º y 80º y muchos estaban dispuestos según la misma orientación de la paleocorriente de esta facies. No se recuperaron ejemplares asociados ni articulados. La densidad varió entre 38,93 y 52,86 restos/m^2. Sólo el 8,03% estaban

enteros y entre los restantes predominaron las roturas transversales (fosildiagenéticas). El 10,36% presentó leves indicios de meteorización subaérea y en el 57,51% se reconocieron signos de abrasión. El 25,16% manifestó señales de corrosión, pero en pocas ocasiones producidas por acción de raíces. Se interpreta que la mayoría de los ejemplares fueron intensamente movilizados y seleccionados por acción de las corrientes hidráulicas. Las evidencias obtenidas en estos depósitos permitieron reconocer dos modos tafonómicos (*sensu* Behrensmeyer, 1988) claramente diferenciables entre sí, los cuales se vinculan con los procesos ocurridos en cada uno de estos subambientes. El de la facies Fl se definió como modo tafonómico de llanura de inundación y está constituido principalmente por materiales resedimentados. El de la facies St se denominó modo tafonómico de fondo de canal o *lag-channel* y comprende tanto elementos resedimentados como reelaborados. Ambos modos son similares a los definidos por Behrensmeyer (1988) y Behrensmeyer y Hook (1992) para este tipo de subambientes y las diferencias que existen en relación a éstos se pueden atribuir a caracteres propios de este yacimiento.

Behrensmeyer, A.K. 1988. Vertebrate preservation in fluvial channels. *Palaeogeography, Palaeoclimatology, Palaeoecology* 63: 183–189.

Behrensmeyer, A.K. y Hook, R.W. 1992. Paleoenvironmental contexts and taphonomic modes. En: A.K. Behrensmeyer, J.D. Damuth, W.A. DiMichele, R. Potts, H. Sues y S.L. Wings (Eds.), *Terrestrial ecosystems through time: evolutionary paleoecology of terrestrial plants and animals*. University of Chicago Press, Chicago, p. 15–136.

Zavala, C. y Navarro, E. 1993 Depósitos fluviales en la Formación Monte Hermoso (Plioceno inferior–medio). Provincia de Buenos Aires. *12° Congreso Geológico Argentino y 2° Congreso de Exploración de Hidrocarburos* (Mendoza), *Actas* 2: 236–244.

PRESERVATION PATTERNS OF VERTEBRATE ASSEMBLAGES IN CONTINENTAL LATE PLEISTOCENE BEDS FROM NORTHERN URUGUAY

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The fossiliferous Pleistocene beds that crop out along river and creek margins in sections up to 15 m high in northern Uruguay (Sopas Formation; 30° to 32°S and 56° to 58°W), yield numerous vertebrate taxa, with mammals as the dominant group (45 genera). The mammalian assemblage is correlated with the Lujanian Stage (late Pleistocene–early Holocene) and includes extinct taxa and extant species of the Neotropical region. In addition to mammals, freshwater molluscs, plants, and trace fossils were used to analyze the taphonomic framework. Variations in lithology, facies and preservation patterns were observed. The Sopas Formation, which is predominantly brown in color, includes conglomerates, conglomeratic sandstones, siltstones, sandy siltstones, and carbonates (dust, concretions, duricrusts). Fluvial facies are most abundant, but, in some places paleosol formation has masked the depositional evidence. Two different examples of preservation patterns are presented here: (1) Outcrops at Malo Creek (32°03′S, 56°07′W): to assess the significance of transport processes, the taphonomy of vertebrate bones was analyzed as part of an ongoing study. Different absolute ages are available: ^{14}C of >45 kyrs BP (mollusc samples) and TL ages of 58.3 +/- 7.4 kyrs BP, 200 +/- 25 kyrs BP and 314 +/- 39 kyrs BP. Two of these ages are affected by stratigraphic inversion. Three lithofacies (conglomerates, sandstones and siltstones) with evidence of hydraulic deposition (wavy and ripple lamination, freshwater molluscs, freshwater mammals, and a bonebed of teleostean fishes) were taken into account. The mammal taxa are represented by 26 genera and can be assumed to be representative of the Sopas Formation. In this analysis mammals were subdivided into <5 and >5 kg categories. Five taphonomic attributes were studied, namely articulation, fragmentation, abrasion, weathering and surface marks, on 180 specimens (out of a total of 380). Skulls, mandibles and many postcranial remains were found. Even though fragmentary bones outnumber complete bones (as would be expected in fluvial deposits) in >5 kg mammals, bones without abrasion dominate the sample. Most fragmentary bones show fresh fractures and minimal evidence of weathering. In addition, some articulated bones were documented. These articulated specimens suggest short-distance transport from the source area and, at least for this locality, rapid burial. Thus it is unlikely that reworking has occurred and contrary to the absolute ages obtained, the site may represent a short span of time. Two unexpected results were obtained for Malo Creek: deer are the most important source of skeletal elements (followed by caviids rodents) and there is a low representation of dermal plates of glyptodonts and dasipodids, which are represented in the sample by 4 species. This pattern may reflect ancient ecological conditions. (2) Outcrops at Sopas Creek (31°15´S, 57°0´W): here there is a combination of depositional processes (floodplain contexts) and soil development, which is suggested by highly bioturbated massive mudstones and terrestrial mammals. It is difficult to disentangle the preservation steps at this locality and some aspects are open to questions. A TL age of 43.5 +/- 3.6 kyrs BP is known for the base of the section. Many mammal taxa were recovered (20 genera) and bones have are generally scattered throughout the section. Skulls, mandibles, postcranial remains, and occasionally articulated bones were recovered (representing camelids, caniids and caviine rodents). Earthworm aestivation chambers and rodent burrows are frequently encountered in the section and both provide clues to preservation processes. However, they provide some contradictory results. Living earthworms need humid soils to construct their aestivation chambers and these were observed in some of their burrows. In contrast, the mammals that presumably generated the rodent burrows are related to arid/semiarid environments and their bones are closely related to the chambers. Perhaps the ecological associations of these mammals should be reconsidered? Alternatively, perhaps the fossil bones and fossil burrows are not contemporaneous, and perhaps some time-averaging is involved in the formation of this locality.

VERTEBRATE NESTING SITES AS A DISTINCT TAPHONOMIC MODE

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Behrensmeyer and Hook (1995) define a taphonomic mode as a set of fossil occurrences resulting from similar physical, chemical and biological processes associated with specific depositional environments or biological circumstances. Recognition of taphonomic modes facilitates accurate comparisons of assemblages across space and time, detection of preservation bias, and location of specific types of fossil assemblages. Here we consider nesting localities of extant amniote vertebrates from a taphonomic perspective with data gathered from scientific literature and from direct observations in order to develop a conceptual taphonomic mode for these sites. Modern nesting sites range from solitary to colonial and span a wide variety of substrates and depositional settings, including rock outcrops; beach, bar, and riverbank sands; lacustrine, lagoonal, and marsh muds; and a wide variety of floodplain soils. Nevertheless, biotic processes predominate these localities as the major agents of transportation, deposition, and modification of organic remains. Transported material may include nesting materials and both vertebrate and invertebrate prey items brought into the nesting site, as well as the removal of eggs, eggshell, and dead offspring. Vertebrates may deposit eggs at the surface or bury them within sediments. Feces and pellets in and around nests represent additional deposits. Whereas individual eggs represent body fossils, their emplacement either at the surface or underground and their resulting configurations represent nesting traces. Biotic modification may include nest construction and hatching events that alter existing substrates, trampling that leads to the breakage and scattering of eggs and skeletons (Cruz, 2007), and alteration of eggs and bones thru predation and feeding. The extent of these activities at a given locality likely reflects residence time both within a given reproductive season and cumulative across multiple years, as well as a suite of reproductive and ecologic factors. Relevant biologic factors would include the extent of parental care (none, eggs only, eggs and young), condition of neonates (precocial thru altricial), the mode of incubation (buried within substrates, vegetation mounds, brooding), and diet. Potentially, nesting localities could generate fossil assemblages containing varying amounts of eggs, eggshell, young and adult skeletons, scat, pellets, invertebrate and vertebrate prey, and nesting traces and materials. However with few exceptions (*e.g.*, Hayward *et al.*, 1989), processes of geologic burial of modern nesting sites remain largely unknown. Modern localities suggest that nesting sites in the fossil record would represent a distinct taphonomic mode distinguished by a predominance of biotic taphonomic processes, potentially resulting in a characteristic assemblage. Most taphonomic modes have been categorized by depositional environment, thus emphasizing abiotic physical and chemical processes. Because nesting sites may occur in a variety of depositional settings, their associated biotic processes could potentially overprint background sediments and assemblages. Recognition of nesting locales in the fossil record is thus critical to both proper taphonomic reconstructions and understanding reproductive behavior of extinct vertebrates.

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VERTEBRATE TAPHONOMY AND SEDIMENTOLOGY OF EARLY TRIASSIC *LYSTROSAURUS* BONEBED OCCURRENCES: A PALAEOENVIRONMENT RECONSTRUCTION OF THE KATBERG FORMATION, SOUTH AFRICA

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It is widely accepted that the most devastating mass-extinction the earth has seen occurred at the end of the Permian approximately 251 Ma ago. The southern Karoo Basin in South Africa is one of the few places in the world where one can see an almost continuous stratigraphic record of terrestrial sedimentation through the Permian/Triassic Boundary (PTB). Emphasis on the rapid annihilation of marine and tetrapod faunas in this extinction has generally overshadowed the nearly as rapid regeneration of terrestrial ecosystems in southern Gondwana during the Early Triassic (Botha *et al.*, 2006). The apparent sudden appearance and expansion of *Lystrosaurus* Assemblage Zone fauna into the Karoo Basin, fossilization mode changes from Latest Permian (isolated skulls and bone material) to Early Triassic (articulated "curled up" skeletons) and the preferential preservation of multi-individual accumulations (bonebeds) are believed to reflect a gradual aridification of climate, which made the Karoo Basin prone to periods of deficient rainfall and drought (Smith *et al.*, 2005). Sedimentologically, this is seen as a change in fluvial style from stable perennial meandering rivers (mudstone dominated strata) in the latest Permian to ephemeral braided streams (sandstone dominated) of the earliest Triassic. The presence of red palaeosols, sand-filled mudcracks, and pedogenic carbonate nodules near or on same horizons of bonebeds also supports the hypothesis.

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BIOMECÁNICA DE VERTEBRADOS: INTEGRACIÓN DE MORFOLOGÍA, FISIOLOGÍA Y COMPORTAMIENTO

Coordinadores: DRA. REGINA FECHNER Y DRA. DANIELA SCHWARZ-WINGS

BIOMECÁNICA CRANEODENTARIA EN *SMILODON FATALIS* LEIDY 1868 COMPARADA CON *PANTHERA ONCA* LINNAEUS 1758 Y *PUMA CONCOLOR* LINNAEUS 1771: UN ANÁLISIS PREDICTIVO DEL COMPORTAMIENTO PREDATORIO EN UN CARNÍVORO FÓSIL

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Luego de más de 150 años de estudio de la anatomía craneodentaria del tigre dientes de sable, *Smilodon fatalis* Leidy, 1868, aún persisten muchas interrogantes sobre su comportamiento predatorio (McHenry *et al.*, 2007). Estudiar la ecomorfología de carnívoros existentes como el jaguar, *Panthera onca* (Linnaeus, 1758), y el puma, *Puma concolor* (Linnaeus, 1771), es fundamental para entender la mecánica de la mordedura de otras especies de tamaño similar. En el presente estudio analizamos, mediante el "método del cráneo seco" (Thomason, 1991), cráneos completos de *S. fatalis* (n=1), *P. onca* (n=21) y *P. concolor* (n=30), a fin de obtener las fuerzas de mordedura canina y carnasial, esfuerzos de corte y momentos flexores máximos a lo largo del vano mandibular de cada especie. La obtención de estas variables en una estructura hiperestática se efectúo según el Método de Aproximaciones Sucesivas de Cross (Del Moral *et al.*, 2007). Estimamos la fuerza canina máxima de *S. fatalis* en ~ 365,202 Newton [N] siendo ~ 7,18 veces más compresiva en los carnasiales (~ 2.624,46 N). *P. onca* tuvo 1,86 veces más fuerza canina (~ 681,56 N) respecto a *S. fatalis*, y *P. concolor* denotó una relación de 1,34 (~ 488 N) comparado con el tigre dientes de sable. En tanto la fuerza de mordedura carnasial fue 1,27 veces superior en *S. fatalis* respecto de *P. onca*, y 2,47 veces más compresiva que *P. concolor*. Los resultados obtenidos con *S. fatalis* corroboran las conclusiones de McHenry *et al.* (2007). Probablemente el tigre dientes de sable acechaba grandes mamíferos herbívoros para luego iniciar una corta persecución durante la cual lograría desestabilizarlos y someterlos con sus cuartos delanteros e infligir laceraciones mortales con sus caninos hipertrofiados. En *S. fatalis*, una boca más amplia le confirió mejor agarre y una distribución más uniforme de las fuerzas de mordedura, lo cual resultaría útil tanto para provocar heridas profundas que sangrarían profusamente hasta causarle la muerte a la presa, como para asfixiarla mediante la obstrucción de la tráquea con una mordedura en el cuello (McHenry *et al.*, 2007). La fuerza altamente compresiva de los carnasiales en *S. fatalis* sugiere una eficiente masticación ortal para la remoción y destrucción de grandes secciones de músculos y huesos durante el consumo de carcasas.

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MOMENT ARM IN HINDLIMB MUSCLES OF *SATURNALIA TUPINIQUIM*

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The number of studies on the locomotion of dinosaurs has increased in the last years with new approaches that allow assessing their muscle dynamics. The main determinant of muscle function is the moment arm (*d*), *i.e.*, the smallest distance between the line of action of a muscle-tendon complex and the center of rotation of a joint. The moment arm of pelvic and hindlimb muscles of extant and extinct theropod dinosaurs have already been measured, showing interesting results. In basal dinosaurs, the study of moment arms of *Staurikosaurus pricei* Colbert, 1970 contributed to elucidate the evolution of bipedal locomotion in Saurischia. In order to assess the evolution of locomotion at the base

of Sauropodomorpha, we constructed a virtual 3D model of the skeleton of the stem-sauropodomorph *Saturnalia tupiniquim* Langer *et al.*, 1999 and measured the moment arms of pelvic and hindlimb muscles in two models of locomotion: (1) simple anterior-posterior rotation of the femur, and (2) anterior-posterior rotation plus 45° lateral rotation (*i.e.*, lateral surface turn craniolateral during protraction) of the femur during the stance phase. Based on living crocodiles and birds, we assumed the maximum values of protraction-retraction were -50º/50º. In the simple anterior-posterior rotation model, we also analyzed the protraction-retraction moment arms of the hip joint when the femur was adducted to 5° and abducted to 15°. All muscles showed some variation in the protraction-retraction component of their moment arms when adducted and abducted, and *iliotibialis 1* lost the retraction capability altogether when the femur was abducted. The lateral rotation resulted in a reduced *d* in the following muscles: *flexor tibialis externus*, *flexor tibialis internus 2*, *ischiotrochantericus*, *puboischiofemorales externi 1–3*, *puboischiofemoralis internus 1*, anterior portion of *caudofemoralis longus*, and *caudofemoralis brevis*. Usually, smaller moment arms are not favorable for muscle contraction, but in fast locomotion, the opposite occurs: when muscles reach maximum contraction velocity, longer moment arms result in smaller joint moment, power, and work outputs (Nagano and Komura, 2003). Consequently, it is probable that the lateral rotation increased the locomotor performance of *Saturnalia* during fast locomotion. These preliminary results can help elucidating questions regarding the evolution of locomotion in basal Sauropodomorpha.

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MOMENT ARM IN FORELIMB MUSCLES OF *SATURNALIA TUPINIQUIM*

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Biomechanical studies assessing the locomotor capabilities of dinosaur forelimbs are very scarce, but they are important to evaluate the possibility of quadruped locomotion in some taxa. The most basal dinosaurs were probably bipeds, but the sauropodomorphs returned to a quadruped posture. Accordingly, studying scapular and forelimb muscle function and dynamics in basal sauropodomorph dinosaurs is crucial to understand the nature of their evolutionary changes and its association with locomotion and may provide some clues about posture. The forelimb of the stem-sauropodomorph *Saturnalia tupiniquim* Langer *et al.*, 1999 corresponds to nearly 50% of the hindlimb length and this suggests it was a bipedal animal, but the analysis of muscle function may contribute to evaluate the ideal posture for *Saturnalia*. The main determinant of muscle function is the moment arm (*d*), the smallest distance between the line of action of a muscle-tendon complex, and the center of rotation of a joint. In order to evaluate forelimb function in basal sauropodomorphs, we used Rolan Picza 3D Laser Scanner LPX-250 and the software Autodesk 3ds Max 2010 to construct a virtual 3D model of the skeleton of *Saturnalia*. The model was used to measure, in 3ds Max, the moment arms in three positions in a simple anterior-posterior rotation of the humerus: (1) initial position, (2) adducted 30º, and (3) abducted 30º. For the forearm, *d* was measurement in the initial position of the humerus. Based on virtual manipulation of the joints, we assumed the maximum values of protraction-retraction were 30º/140º for the limb and 150º/60º for the forearm. The results show that the function of all muscles remained the same for all positions of the humerus: (1) dorsal group of the pectoral girdle musculature (i.e. *deltoideus clavicularis et scapularis, scapulohumeralis caudalis et cranialis* and *teres major*) and *triceps brachii* remained flexors, and (2) ventral group of the pectoral girdle musculature (*i.e.*, *coracobrachialis*, *supracoracoideus pars coracoideus et pars scapularis*) and *biceps brachii 1–2* remained extensors. The forearm muscles remained (1) extensor: *triceps brachii*, *triceps brachii caput humerale laterale et mediale*; and (2) flexor: *abdcuctor radialis*, *brachialis 1–2*, *biceps brachii 1–2*, *ectepicondylo-ulnaris*, *entepicondyle-ulnaris*, *pronator teres* and *supinator*. However, these results are preliminary and it is also necessary to evaluate ad-/abduction of the forelimb for a comprehensive analysis of locomotor capabilities. The comparison of these values will indicate the ideal forelimb posture to maximize muscle extension, *i.e.*, maximizing body support if a quadruped posture was adopted. Yet, it is also necessary to congregate hindlimb data in order to obtain a complete picture of the ideal posture of the *Saturnalia*.

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BIOMECHANICS ON LAND, AIR AND SEA: HOW TO UNDERSTAND EXTINCT VERTEBRATES

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Among other contributions, the classical work by Neill Alexander (1983) set a landmark of biomechanical studies in vertebrates, establishing approaches that proved to be extremely fruitful for palaeobiological analyses. Following that lead, here I'll summarise several aspects of the efforts undertaken by myself and fellow palaeontologists to understand the life history of extinct vertebrates that lived on land, air and sea. Particularly, in the last decades our look at the south american Pleistocene megafauna, an assemblage with little or no modern analogue, has been enriched

by our works on feeding habits (Fariña, 1985; Fariña and Blanco, 1996; Fariña and Vizcaíno, 2001; Vizcaíno, 2009), locomotion (Fariña, 1995; Bargo *et al.*, 2000; Alexander *et al.*, 1999) and other aspects related to large body size, energetics and palaeoecology (Fariña, 1996, 2002; Fariña *et al.*, 1998; Prevosti and Vizcaíno, 2006; Vizcaíno *et al.*, 2006). Among other applications, this kind of tools has also been used to investigate the habits of very large flying birds (Vizcaíno and Fariña, 1999), with the consequential influence on our understanding of the size limit for a flying organism, as in the case of argentavis magnificens. Moreover, palaeozoic agnathan fishes (Botella and Fariña, 2008) have been the subject of yet another line of related research, which shed light on our view of locomotion and manoeuvrability in fluids without paired appendages. This approach has shown the importance of the usage of differential water jet expelling through the branchial openings for propulsion and control by inferred changes in the flow vorticity regime over the body of the animal.

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THE PELVIS ARCHITECTURE OF EXTANT ARCHOSAURS AND DINOSAURS: A FUNCTIONAL EXPLANATION

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As early as 1887, Seeley recognized that dinosaurs can be subdivided into two major clades differentiated by the architecture of their pelvis: the clade Saurischia, characterized by a propubic pelvis and the clade Ornithischia, characterized by an opisthopubic pelvis. Although increasing knowledge on dinosaur anatomy and diversity has drastically changed our understanding of their phylogenetic systematics over the last 120 years, Seeley's basic classification is still valid. However, despite of the systematic importance of the pelvis of dinosaurs, the mechanisms of the development of propubic and opisthopubic pelvises remains unexplained. This is all the more remarkable considering that both pelvic types occur in extant archosaurs. In order to find a functional explanation for the development of the archosaurian propubic and opisthopubic pelvises, we studied the mechanical loading of their pelvises. Our study is based on the assumption that bone represents a comprise structure formed as a response to its mechanical loading. Soft-tissue attaching to the pubis and ischium of extant crocodiles and birds was dissected and measurements were taken. Finite element models were created on the basis of CT scans of the pelvis of extant crocodiles and birds. External forces were applied and the statical balance of the muscles was adjusted. In crocodiles, *Mm. obliquus externus*, *transversus abdominis* and *rectus abdominis* pull the pubis craniodorsally, whereas *M. ilioischiocaudalis* pulls the ischium caudodorsally. *Mm. ischiopubis*, *ischiotruncus* and truncocaudalis counteract this mechanical loading by pulling pubis and ischium towards each other. In birds, *Mm. obliquus externus abdominis*, *transversus abdominis* and *rectus abdominis* pull the pubis craniodorsally, whereas *Mm. pubocaudalis externus* and *internus* pull the distal end of the pubis caudodorsally. The *Membrana puboischiadica* permits the uniform loading of the pubis. According to these findings, the arrangement of ventrolateral and ventral abdominal muscles is responsible for the orientation of the pubis and ischium in extant archosaurs. In extant crocodiles and birds, these muscles stabilize the trunk and relate to the respiratory system. Applying these findings to dinosaurs reveal also that the architecture of the dinosaurian pelvis is strongly influenced by requirement of trunk stabilization and by mechanisms of their respiratory system.

Seeley, H.G. 1887. On the classification of the fossil animals commonly named Dinosauria. *Proceedings of the Royal Society of London* 43: 258–265.

STAURIKOSAURUS PRICEI: MODERN STUDIES

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Virtual 3D modeling and prototyping technologies represent new methods that are useful to evaluate anatomical and biomechanical properties of biological material. In the Museu Nacional (Universidade Federal do Rio de Janeiro), such technologies are implemented in the Digital Image Processing Lab (Laboratório de Processamento de Imagem Digital, LAPID) for studying paleontological and archaeological material. One of the research fields of the LAPID is the study of biomechanical and locomotor properties of dinosaurs. The saurischian dinosaur *Staurikosaurus pricei* Colbert, 1970 has served as our model for the implementation of most of the techniques in this area. First, the holotype MCZ 1669 was digitized using the scanner Roland Picza 3D Laser Scanner LPX-250. Distortions and missing parts were digitally corrected with the software Autodesk 3ds Max using data from the holotype itself or from closely related species (Grillo, 2004; Grillo and Azevedo, 2011a), and a virtual 3D model of the entire skeleton of *Staurikosaurus* was produced. Secondly, data about the myology of the pelvis and hind limb (Grillo and Azevedo, 2011b) were incorporated into the 3D model and the data was combined with results about mass and center of mass position, obtained from a virtual model of the body constructed over the skeletal model, to evaluate posture and locomotion. Results from these models suggest *Staurikosaurus* moved with the trunk inclined about 25° and weighted 16.9 to 20.4 kg. Our most recent step in this research was the production of a full scale physical 3D prototype of the complete *Staurikosaurus* skeleton using the prototyping machine Zprinter 310 Plus. All bones were prototyped in high resolution (300x450 dpi) and may be articulated to produce a fully mounted skeleton for exhibitions. This is a new application, so that new research possibilities will be explored.

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Grillo, O.N. 2004. [*Reconstrução do esqueleto de Staurikosaurus pricei (Dinosauria, Theropoda): uso de scanner laser 3D e modelagem virtual tridimensional para reconstruir vertebrados fosseis*. Monografia de Bacharelado em Ciências Biológicas, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 64 p. Unpublished]

Grillo, O.N. and Azevedo, S.A.K. 2011a. Recovering missing data: estimating position and size of caudal vertebrae in *Staurikosaurus pricei* Colbert, 1970. *Anais da Academia Brasileira de Ciências* 83: 61–71.

Grillo, O.N. and Azevedo, S.A.K. 2011b. Pelvic and hind limb musculature of *Staurikosaurus pricei* (Dinosauria: Saurischia). *Anais da Academia Brasileira de Ciências* 83: 73–98.

THE GAITS OF CERTAIN IN-FINGERED TETRAPODS

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The oldest trackways of mammaloid galloping, known as *Ameghinichnus* Casamiquela, 1964, were first found in Argentina. This Jurassic ichnogenus was initially ascribed to pantotherians and then to multituberculates or even tritylodonts or trithelodonts. However, the gait of this trackway was not analyzed properly until now. Our analysis is based on the cast of the holotype MLP-60-X-31-14 exposed in Ameghino's home museum in Lujan. The gait is the paired gallop (bound) with 100 mm stride length. As calculated from a similar-sized laboratory mouse with known stride/speed equation, the galloping speed of *Ameghinichnus* was about 0.75 m/s. Extant mammals don't gallop so slowly: in the laboratory mouse the trot-gallop transition occurs at 1.1 m/s and in similar-sized wild rodents it takes place at even higher speeds. The sluggishness of *Ameghinichnus* may have been due to a steeper trajectory of jumps than in any modern bounding mammal. In spite of steep jumps, *Ameghinichnus* obviously surpassed anurans in the ability to sustain horizontal speed from jump to jump, as seen from the fact that its hindlimbs landed in front of the forelimbs. It may have even produced a brief jump (known as the cross-limbed aerial phase) by the forelimb thrust. Similar to mice, its hindlimb was digitigrade and the forelimb was plantigrade. In addition, its manus was specifically in-fingered, which helps anurans to prevent hitting the chin after jump. This precaution would be superfluous with parasagittal forelimbs, so we conclude that in *Ameghinichnus* the forepaw in-fingerness was associated with sprawling stance. The in-fingered forelimbs were acquired by various tetrapods well before the origin of jumping gaits. Their use can be shown on the late Permian pareiasaurian trackways from the Severnaya Dvina river basin in Russia. The longest trackway is 16.5 m long, 80 cm wide and includes 15 full strides. The footprints are deep, which means that the ground was soft and that the body weight was not supported by water. Pareiasaurians were short-bodied quadrupeds: available data suggest that their glenoacetabular length could be hardly more than 6 times greater than the pes length. Given this ratio, the gait of the trackway must have been the slow pace, where four-legged phases alternate with ipsilateral two-legged ones. With the barrel-shaped body and sprawling limbs, the animal could only pace tilting from side to side in the manner of the "walking rocking bullcalf" (Russian traditional wooden toy). Tilting of the body must have been produced by means of a medially-directed push of the ipsilateral limb pair which was going to lose contact with the ground in the next phase. The footprints show the signs of such push: first, there are definite imprints of the inward-pointing claws of the forepaws; second, the floor in the hindprints is gently but persistently lowering mediad. Generally, pace is considered impossible for sprawling quadrupeds. This cons-

traint for the stepping sequence is aimed to sustain a sprawler's static equilibrium. However, the constraint is entirely disabled on a sticky substrate. On swamps, which must have been the commonplace for pareiasaurians as well as stegocephalians, unsticking of any limb inevitably causes loss of balance and requires tilting of the body to the opposite side. In this case, rocking from side to side in slow pace may be of advantage. Noteworthy, the extant spiny anteater *Zaglossus*, in spite of the sprawling limb posture, uses a special kind of walk with the phases of ipsilateral pace-like support. According to our video records, rocking movements are driven in *Zaglossus* by its peculiar in-fingered forelimbs bearing strong claws. We hypothesize that the therian gallop evolved from the pace-like gait of Paleozoic in-fingered barrel-bodied swamp-walkers, bypassing the trot-like gaits typical to modern lizards, which were hitherto regarded as inevitable. Roughly speaking, the process can be modeled by an imaginary pareiasaurian-*Zaglossus*-*Ameghinichnus* sequence. The forepaw in-fingerness was apparently lost together with acquisition of parasagittal stance for gallop perfection.

ANATOMY AND FUNCTION OF THE FORELIMB OF *MUSSAURUS PATAGONICUS* (DINOSAURIA, SAUROPODOMORPHA)

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A key point in the transition from basal sauropodomorphs to sauropods is the acquisition of a quadrupedal locomotion. Such a dramatic postural change involved, among others, a pronated manus and a semicircular metacarpus, the former of which is achieved by the development of the craniolateral process of the ulna that accommodates the radius in a cranial position with respect to the ulna (Bonnan and Yates, 2007). *Mussaurus patagonicus* Bonaparte and Vince, 1979, from the Late Triassic of Santa Cruz Province, Argentina, has been interpreted as a taxon closer related to derived sauropodomorphs (*e.g.*, melanorosaurids) than to more plesiomorphic forms (*e.g.*, *Plateosaurus*) (Pol and Powell, 2005). We present the forelimb anatomy of adult specimens of *M. patagonicus* and attempt to shed light on the functional and evolutionary scenario that involved this dramatic locomotory transition. The forelimb of *M. patagonicus* displays many plesiomorphic features, such as the well expanded humeral ends, aligned metacarpus, and robust metacarpal I with a medial divergent pollex. On the contrary, the development of an incipient craniolateral process of the ulna is a derived feature, shared with other anchisaurian sauropodomorphs (*e.g.*, *Aardonyx*, *Melanorosauurus*) and sauropods. Such pattern is congruent with the mosaic evolution of the forelimb, implying that the morphology of the antebrachium and the manus are not temporally linked, and were separate phylogenetic events (Bonnan and Yates, 2007). Taking into account this functional incongruence between the antebrachium and the manus in *M. patagonicus* and following the terminology of Gould and Vrba (1982), we propose that the morphology of the antebrachium of *M. patagonicus* and other advanced sauropodomorphs represents a nonaptation (a feature whose origin cannot be ascribed to the direct action of natural selection) but that was subsequently co-opted in eusauropods to the function of body support, together with other traits (*e.g.*, 'U'-shaped metacarpus), and therefore should be interpreted

as an exaptation of Eusauropoda.

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LAS AVES DE FLORENTINO AMEGHINO: ESTATUS REVISADO

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Hacia el final del siglo XIX, Florentino Ameghino (1854–1911) era un distinguido paleontólogo argentino. Sus publicaciones aplicaban conceptos y conclusiones sobre la evidencia fósil que lo ubicaron entre las pocas figuras mundiales con un enfoque paleontológico aplicado a la biología evolutiva. Si bien se dedicaba fundamentalmente a la paleomastozoología, en el campo de las aves su actividad no fue menor. En solamente diez trabajos publicados entre 1882 y 1905 nominó 81 especies, todas provenientes de unas pocas localidades oligocenas y miocenas de la Patagonia y pleistocenas de la región Pampeana. La mayor parte de ellas fueron coleccionadas por su hermano Carlos Ameghino (1865–1936), quien realizó 14 viajes a Patagonia entre 1887 y 1902. En todos los casos, los especímenes son macroscópicos, resultado del estilo de búsqueda en el campo, de manera que está reflejada solo parcialmente la diversidad avifaunística. Ameghino estructuró sus argumentaciones con descripciones meticulosas aunque en general se detuvo en caracteres poco diagnósticos, quizás como consecuencia de su menor experiencia en la identificación de aves y un limitado número de esqueletos disponibles para comparación. Sus descripciones no están acompañadas de ilustraciones apropiadas y muchas de las especies que nominó están basadas en materiales extremadamente fragmentarios y muy poco informativos. Como resultado del reordenamiento de las colecciones del Natural Hustory Museum (Londres), Museo Argentino de Ciencias Naturales y Museo de La Plata, la mayoría de los holotipos que se estimaban perdidos han sido localizados. El acceso a los mismos permite revisar y actualizar el estatus de cada uno de los taxones de aves nominados por Florentino Ameghino a cien años de su muerte (6 de agosto de 1911). Este trabajo es una puesta al día necesaria y postergada de la información referida a estas aves, sustentada en la consulta bibliográfica y la revisión directa o comparación fotográfica de los holotipos que durante décadas estuvieron inaccesibles. De las 81 especies descriptas por Ameghino, solamente 23 permanecen como válidas. De las restantes nominaciones, 45 son consideradas sinónimos, 10 son *nomina dubia* y una es *nomen inquirendum*. Adicionalmente, dos nominaciones son consideradas *nomina nulla*. Solo dos holotipos no han podido ser localizados en las colecciones. De forma llamativa, prácticamente no se conocen en la Argentina otras aves de edad oligocena más que las que nominara Ameghino. En general los taxones descriptos para el Oligoceno son de afinidades inciertas y no incluyen miembros del *crown group* de familias de aves modernas; los del Mioceno incluyen los primeros registros de clados endémicos [Rheiformes (Forbes, 1884)] y varios linajes de aves grandes a gigantes (Cariamiformes Verheyen, 1957 y Anseriformes Wagler, 1831); los del Pleistoceno incluyen solamente tres taxones extinguidos pertenecientes a crown group de aves modernas. Se destaca además que no hay registros de Passeriformes Linnaeus, 1758, ni de aves de pequeño tamaño posiblemente como resultado del método de muestreo.

COMPARATIVE ANALYSIS OF THE HINDLIMB MORPHOLOGY OF DIOGENORNIS FRAGILIS (AVES, RATITES – PALEOCENE) AND FLIGHTLESS EXTANT AND EXTINCT BIRDS

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Despite its relatively small size, the São José de Itaboraí Basin (Paleocene) comprises a diversified fossil assemblage. Among the groups found there, fossil birds are very rare, mainly due to their pneumatized bones. Only three bird species have been described up to this moment from the Itaboraí Basin. *Diogenornis fragilis* Alvarenga, 1993, a probable ratite ancestor, stands out for its good preservation and the number of specimens preserved. The present study focuses on hindlimbs of this species (tibiotarsus and tarsometatarsus, since the femur was not preserved in any sample) with the purpose of comparing the hindlimb morphology of *D. fragilis* with other extant and extinct flightless birds. According to Alexander (2002), animals with similar body proportions are inclined to move in similar ways. Based on Alexander (2002) and Dickison (2007), we analyzed femur, tibiotarsus and tarsometatarsus of a total of 108 specimens of extant and extinct flightless birds from the collections of the Museu de Zoologia da Universidade de São Paulo (São Paulo), Museu Nacional (Rio de Janeiro), Museu de Ciências Naturais de Taubaté (São Paulo) and from similar published studies. In order to estimate *D. fragilis* femur length, a multiple linear regression was done with tibiotarsus length and tarsometatarsus length as independent variables. Using the found equation, LogFemur = 0.063 + 0.84*LogTibiotarsus – 0.02*LogTarsometatarsus, we estimated the femur length as 15.75 cm. Based on this result, we computed a series of bivariate analyses with the purpose of identifying to which ratite group *D. fragilis* is closer, morphologically speaking. Among the analyzed ratite bones, the best relation was found between femur length and tibiotarsus length. *Diogenornis fragilis* presented a hindlimb morpholo-

gically comparable to *Rhea americana*, but with the size of a juvenile specimen. In view of this morphological similarity regarding hindlimb proportion, we suggest a possible biomechanical locomotion congruence between *Rhea* and *Diogenornis*.

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Dickison, M.R. 2007. [*The allometry of giant flightless birds.* PhD thesis. Duke University, 114 p. Unpublished]

ANATOMÍA, FILOGENIA, Y PALEOBIOLOGÍA DE ARCOSAURIOS BASALES

Coordinadores: DRA. JULIA DESOJO Y DR. STERLING NESBITT

A LARGE "RAUISUCHID" ARCHOSAUR FROM THE OMINGONDE FORMATION (EARLY–MIDDLE TRIASSIC) IN NAMIBIA

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In 1995, during the course of a palaeontological survey in the vicinity of Mount Etjo, Namibia, an articulated skull of a large archosauromorph was reported, figured and assigned to *Erythrosuchus* sp. (Pickford, 1995). A few years later, in 2000, the rest of the skeleton was collected, fully prepared and placed on display in the Geological Survey Museum in Windhoek (Smith and Swart, 2002). The specimen is very well preserved and includes both lateral sides of the skull, the complete presacral column, part of the coracoid and the humerus and most caudal vertebrae in articulation with dorsal scutes. This specimen was recently reviewed by the authors as part of an ongoing investigation on the Omingonde fauna and the preliminary result is the identification of it as a "rauisuchid" archosaur, the top terrestrial predators at the time and a very distinct group of crurotarsal Archosaurs that were phylogenetically departed from basal *Erythrosuchus*–like archosauromorphs. This new identification is based, among other characters, on the presence of distinctive interdental plates in the maxilla, cervical and dorsal vertebrae anteroposteriorly compresed, with concave ventral edges, the presence of a strongly developed calcaneal tuberosity, and the arrangement of numerous heart-shape dorsal paired osteoderms along the vertebral column. This new taxonomic assignment supports the interpreted early Middle Triassic age of the upper Omingonde Formation based on the associated fauna, that includes cynodonts and dicynodonts, some of them showing South American affinities (Abdala and Smith, 2009). This age assignment makes this specimen possibly the oldest and certainly the most complete African representative of the group. During the last few years "rauisuchids" have been subjected to a worldwide review and consequently it is expected that further studies of the Namibian specimen will yield important information about the origin and early evolution of this group of basal archosaurs.

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Pickford, M. 1995. Karoo Supergroup palaeontology of Namibia and brief description of a thecodont from Omingonde. *Palaeontologia Africana* 45: 82–100.

Smith, R.M.H. and Swart, R. 2002. Changing fluvial environments and vertebrate taphonomy in response to climatic drying in a Mid-Triassic rift valley fill: the Omingonde Formation (Karoo Supergroup) of Central Namibia. Palaios 17: 249–267.

THE ANATOMY OF THE EARLY DINOSAURIFORM *LEWISUCHUS ADMIXTUS*, LADINIAN OF ARGENTINA, AND ITS PHYLOGENETIC IMPLICATIONS

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The archosaur fauna from the Ladinian Chañares Formation, Argentina, includes several taxa that have been regarded as close outgroups to Dinosauria. This is the case of *Lewisuchus admixtus* Romer, 1972, a putative member of the Silesauridae Langer *et al.*, 2010, an early dinosauriform clade known from Anisian to Norian strata of Africa, South and North America, and Europe (Nesbitt *et al.* 2010; Nesbitt, 2011). Yet, *L. admixtus* differs markedly from Late Triassic silesaurids in the anatomy of the braincase, dentition, and vertebral column. After a detailed re-examination of its holotype, we identified several features of the axial skeleton previously unrecognized among silesaurids. These include pterygoid teeth, which are known in a number of early archosauriforms and basal dinosaurs; a stout ascending buttress on the basioccipital that splits the columellar and prootic recesses; the posttemporal foramen dorsally opened on the otoccipital; four foramina on the caudal region of the prootic-otoccipital probably associated with cranial nerves X–XII; connected neural spines in some postaxial neck/trunk vertebrae, also observed in *Marasuchus lilloensis* (Sereno and Arcucci, 1994); and small spine tables in mid-trunk vertebrae. We also confirm the

presence of previously reported traits, as a single row of presacral scutes, which occurs in several non-ornithodiran archosauriforms, including coeval proterochampsids, and a typical carnivorous dentition, with high, labiolingually compressed, and caudally curved tooth crowns with finely serrated carinae (nine spatulate serrations per millimeter). The anatomical information available for the holotype was preliminarily rescored into phylogenetic data-matrices of the literature (Brusatte *et al.*, 2010; Nesbitt *et al.*, 2010; Nesbitt, 2011). Parsimony analyses of these datasets support the dinosauriform affinity of *L. admixtus*, but its position, either as a silesaurid or basal to the Silesauridae-Dinosauria dichotomy, is ambiguous. Possible synapomorphies of Silesauridae present in *L. admixtus* such as the dorsoventral alignment of the hypoglossal foramina behind the metotic strut (also seen in *Marasuchus*), the rugose ridge between the supraoccipital and the paraoccipital process (also seen in herrerasaurids, plateosaurids and some basal ornithischians), and the elongation of the cervical vertebrae are variously detected in other dinosauriforms. In addition, *L. admixtus* lacks several features present in the typical Late Triassic silesaurids (*e.g.*, an edentulous and pointed rostral end of the dentary), including tooth crowns enlarged at the base, a trait also detected in some basal dinosaurs. As discussed by Nesbitt *et al.* (2010) the position of *L. admixtus* as a silesaurid, even with the reassessment discussed above, is better supported if considered conspecific with *Pseudolagosuchus major* Arcucci, 1987, from the same stratigraphic unit, and scored accordingly into the data-matrices. Yet, the synonymization between these taxa still requires further investigation.

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THE IMPORTANCE OF ICHNOLOGY IN STUDYING THE ORIGIN AND EARLY EVOLUTION OF ARCHOSAURS

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The rise of archosaurs during the Triassic was central to the establishment of modern ecosystems and laid the groundwork for another 200+ million years of archosaur evolution, which included the Age of Dinosaurs and the origin of birds. Understanding the tempo of the archosaur evolutionary radiation, however, is hampered by a patchy fossil record. Archosaurs are generally inferred to have originated sometime in the Early Triassic (252.3–247.2 million years ago), but the oldest archosaur body fossils (*Ctenosauriscus* Kuhn, 1964, *Xilousuchus* Wu, 1981) are approximately coincident with the Early/Middle Triassic boundary (ca. 247.2 million years ago) and the first relatively well-known archosaur-dominated faunas are from the early Middle Triassic. Therefore, body fossils currently give only limited insight into the archosaur radiation. Footprints have often been ignored in the debate over archosaur and dinosaur origins, but recently discoveries reveal that the oldest unequivocal archosaur fossils are footprints from the Early Triassic of Poland (ca. 251–249 million years ago) (Brusatte *et al.,* 2011). These specimens, which belong to the ichnogenus *Prorodotactylus* Ptaszyński, 2000, are identified as members of the dinosauromorph clade using a conservative synapomorphy-based approach, in which diagnostic characters of the archosaur and dinosauromorph skeleton were explicitly recorded in the footprints. Such diagnostic characters include a narrow-gauge posture (Archosauria) and bunched metatarsus and proximal digits, digitigrade posture, reduction of digits I and V, and posterior deflection of digit V (Avemetatarsalia or Dinosauromorpha). Aside from being the oldest known dinosauromorphs in the fossil record, these *Prorotodactylus* tracks show that early dinosauromorphs were small (footprints ~2–4 cm in length), quadrupedal, and remarkably rare (3–5% of total ichnofauna). Additional footprints from slightly younger Early–Middle Triassic deposits indicate that dinosauromorphs remained rare, but became larger in size and developed a bipedal posture (in some lineages) by the earliest Middle Triassic. Continuing integration of the body fossil and ichnofossil record may provide a new frontier in understanding the early evolution of archosaurs. Footprints must not remain a neglected source of information, but at the same time, they must be identified using a rigorous synapomorphy-based approach and interpreted with understanding of potential preservational biases due to locomotor behavior and substrate cohesiveness.

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OSTEODERM MICROSTRUCTURE OF THE RAUISUCHIAN ARCHOSAURS FROM THE SANTA MARIA FORMATION

(MIDDLE–LATE TRIASSIC) OF BRAZIL

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In this contribution we analyse and discuss the microanatomy and histology of postcranial osteoderms of "rauisuchians" from the Santa Maria Formation (Middle–Late Triassic) of Brazil. The studied sample includes osteoderms of *Prestosuchus chiniquensis* Huene 1938 (UFRGS-PV0156T and UFRGS-PV0629T) and two undetermined "rauisuchians" (UFRGSPV0152T and CPEZ-239). Whereas the osteoderms of UFRGS-PV0156T and CPEZ-239 have a rather compact structure, specimens UFRGS-PV0629T and UFRGSPV0152T show a diploe architecture, with a central cancellous core bordered by two compact cortices. Both external and basal cortices are composed of poorly vascularised, coarse parallel-fibred bone and networks of overcrossing mineralized fibre bundles. The internal region of the non-remodelled specimens consists of a well vascularized core in which the intrinsic fibres exhibit important variation (even in the same specimen), ranging from coarse, parallel fibred to woven fibred bone tissues. Growth marks are well recorded in both basal and external cortices. Differences in the bone microstructure (compact vs. diploe) appear to be related to the ontogenetic stage of specimens (osteoderms of the older specimens are more remodelled). Hence, age estimation based on the count of growth marks in "rauisuchians" osteoderms is only reliable in the first stages of the ontogeny. The bone microstructure suggests that "rauisuchian" osteoderms were originated through a mechanism that involves both intramemenbraneuos and metaplastic ossifications (Scheyer and Desojo, in press).

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A JUVENILE AETOSAUR SPECIMEN FROM THE UPPER TRIASSIC OF SOUTHERN BRAZIL (CARNIAN OF THE SANTA MARIA FORMATION, PARANA BASIN)

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We report the new discovery of material recognized as a juvenile aetosaur from the Upper Triassic Santa Maria Formation of Paraná Basin (*Hyperdapedon* acme zone, Carnian) of southern Brazil. This unit with Triassic tetrapods crops out at the central region of the state of Rio Grande do Sul. At present, the record of aetosaurs in the Santa Maria Formation comprises poorly preserved specimens, thus our knowledge about these specimens is scarce. The new specimen is housed in the collection of the Lutheran University of Brazil under the number ULBRAPVT003 and consists of the following elements: occiput, coracoids, scapulae, humerus, ulna, ilium, femur, tibia, fibula, astragalus, calcaneum, several vertebrae, metatarsal, phalanges and other still unidentified remains, probably cranial bones. Several osteoderms from its dorsal and ventral armour are also present. All elements are in an excellent state of preservation, but disarticulated. This new specimen is important because it provides new information regarding anatomical features, as a large number of these elements are not known for other Brazilian forms. The juvenile ontogenetic stage is supported by the fact that vertebral centrum and neural spines are not fused and the small size of the femur (9 cm) compared with that of holotype of *Aetosauroides scagliai* Casamiquela 1960 (17 cm). The new material possesses only one articulated dorsal vertebrae, comparing the total size with the dorsals of the specimen MCP13a-bPV (17 mm to 28.94 mm), ULBRAPVT003 represents a much smaller specimen. Unfortunately, the skull consists of only very few disarticulated elements, not allowing the determination of the sutures which would help establish additional evidence for the ontogenetic stage of the specimen. This new material should provide new information that will allow both ontogenetic and phylogenetic studies for the Aetosauria.

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A REVIEW OF THE PHYLOGENETIC RELATIONSHIPS WITHIN AETOSAURIA (ARCHOSAURIA: PSEUDOSUCHIA) AND THE PARAPHYLY OF AETOSAURINAE

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The aetosaurs are a group of pseudosuchian archosaurs from the Late Triassic of South America, North America, Europe, India, and Africa. The most recent phylogenetic analyses recovered two main lineages of aetosaurs: aetosaurines and desmatosuchines (Parker, 2007). Within the former clade, the North American and European typothoracisines were found as a monophyletic entity sister-group of an unnamed clade composed of globally distributed species. In the present contribution we review the aetosaur phylogenetic intrarelationships based on a modified version of Parker *et al.* (2008) data matrix. The analysis resulted in three most parsimonious trees, in which the late Carnian–early Norian South American *Aetosauroides scagliai* Casamiquela, 1960, was found as the most basal aetosaur and sister-taxon of the stagonolepidids. The base of Stagonolepididae Lydekker, 1887 is represented by a polytomy composed of *Neoaetosauroides* Bonaparte, 1969, *Coahomasuchus* Heckert and Lucas, 1999, *Aetosaurus* Fraas, 1877, and more derived aetosaurs, supported by the presence of a synapomorphic 'slipper-shaped' mandible. In this context, aetosaurines are a paraphyletic group. In the next lesser inclusive node a trichotomy is found, which is represented by *Stagonolepis robertsoni* Agassiz, 1844, *Calyptosuchus wellesi* Long and Ballew, 1985, and more derived forms, which is characterized by the presence of paramedian dorsal osteoderms strongly flexed ventrally. A new Brazilian genus (CPE2 168) was recovered as the sister-taxon of a monophyletic clade composed of desmatosuchines and typothorasicines. This node is supported by the absence of cervical vertebrae with a ventral keel. This phylogenetic arrangement contrast with that published by Parker (2007) and Parker *et al.* (2008) in that the typothoracisines were found as more closely related to desmatosuchines than to the remaining aetosaurs. The Typothoracisinae plus Desmatosuchinae clade is supported by a synapomorphic presacral neural spine generally lower than the height of the centrum. The new phylogenetic hypothesis recovered here depicts a different scheme for the evolution of osteoderm ornamentation. In this regard, the presence of a radial pattern of ornamentation is optimized as a symplesiomorphic character of Aetosauria, which is retained by basal members of the clade (*e.g.*, *Neoaetosauroides*, *Coahomasuchus*, *Aetosaurus*). The radial ornamentation seems to be plesiomorphic to the random and reticular patterns which are present in some desmatosuchines and typothorasicines, respectively.

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A NEW MEDIUM-SIZED BASAL CROCODYLOMORPH WITH A LIGHTLY BUILT AXIAL SKELETON FROM THE LATE TRIASSIC ISCHIGUALASTO FORMATION, SAN JUAN, ARGENTINA

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Crocodylomorpha is the only pseudosuchian clade with extant representatives and their oldest known members are the small-sized *Trialestes romeri* Reig, 1963, and *Barberenasuchus brasiliensis* Mattar, 1987, from the early Late Triassic (late Carnian–earliest Norian) of the South American Ischigualasto and Santa María formations, respectively. Both species are based on poorly preserved materials and several aspects about the early evolution of the group remain enigmatic. We describe a new early crocodylomorph species represented by two specimens coming from the Cancha de Bochas Member of the Ischigualasto Formation, Argentina. The more complete and smaller specimen (PVSJ 846) is represented by several cranial and postcranial bones, whereas the larger specimen (PVSJ 890) corresponds to an isolated posterior cervical vertebra with a maximum height of 13.2 cm. Both specimens are assigned to the same species due to a unique combination of features associated with a lightly built axial skeleton, including the presence of a very deep fossa occupying most of the lateral surface of medium-posterior cervical centra. A preliminar phylogenetic analysis based on the matrix of Nesbitt (2011) nested the new species within Crocodylomorpha and as the sister-taxon of *Trialestes*, but outside a paraphyletic "Sphenosuchia". The synapomorphies that support its assignment to Crocodylomorpha are maxillary palatal processes forming a secondary bony plate and ilium with well-developed preacetabular process and a concave acetabular ventral margin, among others. The new species is found more closely related to *Trialestes* than to other suchians due to the presence of a hypertrophied subacromial process and elongated anterior cervical vertebrae. However, the new taxon differs from *Trialestes* in several aspects, including a longer anterior maxillary ramus and scapula with a large process above the glenoid fossa. The most conspicuous features of the new crocodylomorph

are related with a lightly built cervical series, absent in *Trialestes* and other crocodylomorphs. The anterior cervical vertebrae present a deep and blind longitudinal fossa dorsolateral to the posterior exit of the neural canal and a deep longitudinal depression along the lateroventral border of the neural arch, which opens into a dorsally oriented blind fossa. The posterior cervical vertebrae present a series of thin laminae in the neural arch and a large and very deep lateral fossa that strongly compresses the centrum. These features resemble the condition of basal theropods and poposauroids (Nesbitt, 2007). However, we could not found unambiguous evidence for the presence of postcranial pneumaticity (O'Connor, 2006), but it constitutes a plausible explanation for the origin of these structures. The new species documents a novel axial morphology present in Crocodylomorpha, represents one of the largest known non-crocodyliform crocodylomorphs, and enlarges our knowledge about the early evolution of the group.

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INCORPORATING *DECURIASUCHUS QUARTACOLONIA* (PSEUDOSUCHIA) INTO THE ARCHOSAUR PHYLOGENY

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The "rauisuchian" *Decuriasuchus quartacolonia* França, Langer and Ferigolo 2011 was recently described based on an assemblage composed of ten individuals from the Middle Triassic *Dinodontosaurus* assemblage-zone (Santa Maria Formation), Rio Grande do Sul, Brazil. Besides the paleobiological questions raised by this taxon (regarding possible gregarious behaviour), it is important for the relatively rare preservation of three almost complete skulls, plus post-cranial remains. The aim of this work is to discuss the relationships of *Decuriasuchus quartacolonia* in the light of the most recent phylogenetic analysis of basal archosaurs (Nesbitt, 2011). Using an Heuristic search (10.000 replicates, hold = 10) in TNT, with the characters ordered as in the original analysis, the incorporation of *D. quartacolonia* resulted in 270 most parsimonius trees of 1296 steps (11 steps more than original analysis). The strict consensus is very similar to that originally presented, except for *Ticinosuchus* (Krebs, 1965), which was placed as a basal Suchia by Nesbitt (2011), but as a basal Loricata with the inclusion of *D. quartacolonia*, which is recovered as the basalmost representative of this group. In this context, Loricata is supported by five unambigous synapomorphies: four teeth in the pre-maxila; antorbital fenestra with anterior margin nearly pointed; squamosal with ridge on lateral side of the ventral process (reversed in Rauisuchidae [Huene, 1942] and Crocodylomorpha); lower temporal fenestra perforate by anteroventral process of squamosal (modified in Rauichidae and reversed in Crocodylomorpha); orbit with keyhole shaped (reversed in Crocodylomorpha). In addition, there is one unambiguous character that supports the clade composed of *Ticinosuchus* and other Loricata (excluding *D. quartacolonia*): distal portion of ischium is rounded or elliptical in out line. Its plesiomorphy, distal portion of ischium thin and plate-like is retained in *D. quartacolonia*.

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Huene, F.v. 1942. Ergebnisse der Sauriergrabungen in Südbrasilien 1928/29. *Die fossilen Reptilien des südamerikanischen Gondwanalandes*. C. H. Beck, Munich, 332 p.

Krebs, B. 1965. *Ticinosuchus ferox nov. gen. nov. sp*. Ein neuer Pseudosuchier aus der Trias des Monte San Giorgio. *Neues Jahrbuch fur Geologie und Paläontologie, Abhandlungen* 81: 1–140.

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WHAT DO WE KNOW ABOUT PROTEROSUCHIANS?

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Proterosuchia Broom, 1906, corresponds to Erythrosuchidae Watson, 1917 + Proterosuchidae Broom, 1906. Together these two late Permian to Early (possibly Middle) Triassic archosauromorph families are generally considered to comprise a paraphyletic assemblage of successive sister taxa to crown-group-archosaurs + Euparkeriidae von Huene, 1920 + Proterochampsidae Romer, 1966. Relatively little attention has been paid to studies of proterosuchians, but results from a recent surge in studies documenting the anatomical and phylogenetic diversity of Triassic archosaurs have paved the way for, and are now prompting, a detailed reassessment. I studied proterosuchians in the early 1990s and published knowledge has not advanced greatly since then, though much has changed in Triassic archosauromorph biology in this period, both in knowledge and how it is generated. I will summarise aspects of the history of proterosuchian research, what we know about the group, and comment on some unpublished findings. Outstanding gaps in knowledge and future research directions will be highlighted. Proterosuchian monophyly is unlikely, but support for it depends on preferred character formulations for some features, such as a downturned snout and reduced tarsal ossification. Proterosuchid and erythrosuchid monophyly are not well established, and most potential species members of each family remain inadequately documented. New information includes likely new species and increased spatial distribution for at least two genera. Existing material will benefit from reassessments and, in some notable instances, additional preparation and/or modern imaging techniques. Reassessment might have broader implications for understanding early archosauromorph evolution.

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MANDIBULAR SYMPHYSIS ANATOMY AND PATTERNS OF DIVERSITY IN EARLY ARCHOSAUR EVOLUTION

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Archosauromorphs, particularly the subclade Archosauria, radiated into numerous trophic niches during the Mesozoic, many of which correlate with particular suites of cranial adaptations and feeding behaviors. The mandibular symphysis, the joint linking the two hemimandibles (Scapino 1981), is a poorly understood cranial joint which may offer significant insight into skull function and feeding ecology in extinct taxa. In particular, several Triassic archosauromorph clades iteratively evolved beaks, a feature frequently associated with herbivory and other specialized diets (Zanno and Makovicky, 2011), however adequate details are currently lacking to study this phenomenon. Using CT scanning, histology, and dissection data from extant reptiles (Holliday *et al.*, 2010), we investigated the skeletal anatomy and osteological correlates of relevant soft tissues in a preliminary survey of archosauromorph mandibular symphyses. Character complexes of specific clades were identified and their evolution was mapped using a current phylogeny of archosauriforms (Nesbitt, 2011) with the addition of non-archosauriform archosauromorphs. Extinct taxa with the fibrous, Class I condition (*e.g.*, proterochampsids, "rauisuchians"), intermediate Class II (aetosaurs, protosuchians, silesaurids), and interdigitating Class III symphyses (*e.g.*, phytosaurs, trilophosaurids, crocodyliforms) build the joints in expected ways, though they differ in contributions of bony elements and Meckel's cartilage. The morphology of Meckelian grooves reveal that in some taxa (*e.g.*, silesaurids) the rods were likely separate and rostrally continuous within a single-element beak; whereas those of aetosaurs are limited caudally and excavate a shallow fossa within a Class II beak, with contributions from the splenial similar to the pattern found in many crocodyliforms. It remains unclear if shuvosaurids possess Class III, or fused, Class IV symphyses. Optimization of the different classes of symphyses across an archosauromorph clade indicate that archosauromorphs evolved classes II and III from a plesiomorphic class I throughout the clade. However, assigning class types to juveniles should be approached with caution as species may undergo significant transformations in symphyseal morphology and thus feeding function during their ontogeny. These data not only offer insights into chewing behavior in fossil taxa, but show archosauriforms evolved several different solutions to building beaks, further supporting the iterative evolution of specialized diets in the clade. These data are critical to testing additional evolutionary, developmental, and functional hypotheses of feeding in this diverse radiation of vertebrates.

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Scapino, R. 1981. Morphological investigation into functions of the jaw symphysis in carnivorans. *Journal of Morphology* 167: 339–375.

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THE GEOCHRONOLOGIC CONTEXT OF EARLY ARCHOSAUR EVOLUTION

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A robust chronostratigraphic framework based on precise and accurate geochronology is necessary for understanding the tempo of early archosaur origins and diversification, and testing hypotheses of biotic provincialism/cosmopolitanism. Such a framework requires both an accurately calibrated timescale (ultimately based off marine stages), and precise radioisotopic ages from the principal fossil-bearing strata, so that paleoenvironmental events and processes that operate on a global scale can be identified and confidently correlated. Although there is a rapidly expanding record of Triassic early archosaur diversity and abundance across Pangaea, the geochronologic context lags far behind. Most fossiliferous deposits have only been dated using long-distance biostratigraphic correlations, which are unacceptably fragile in the absence of independent geochronologic constraints. New zircon U-Pb and $^{40}Ar/^{39}Ar$ radioisotopic data from marine Tethyan sections in China and Europe greatly improve the Early and Middle Triassic timescale, but the ~35 million year Late Triassic interval remains poorly dated, with only a handful of precise ages from biostratigraphically-calibrated marine strata. Nevertheless, even the best calibrated timescales are of limited use if the terrestrial stratum of interest cannot be correlated to them. Direct correlation of non-marine and marine strata is usually difficult, and precise radioisotopic ages arguably afford the only means for their chronostratigraphic ordering

and comparison. Recent Late Triassic $^{40}Ar/^{39}Ar$ ages (normalized for comparison with the U-Pb system) from the Ischigualasto Formation of Argentina indicate that its famous pseudosuchian and early dinosaur assemblages are latest Carnian to earliest Norian in age. In contrast, new TIMS U-Pb ages on chemically abraded (CA) zircons from the Chinle Formation of southwestern North America demonstrate that its archosaur assemblages are wholly Norian in age (mostly mid- to late Norian). This is significantly younger than the Ischigualasto fossils, even though they share closely related aetosaurs, shuvosaurids, crocodylomorphs, and saurischian dinosaurs that had previously led to the assumption that these strata are partially contemporaneous. Nonetheless, many important Late Triassic archosaur assemblages from Europe, India, South Africa, and South America remain unconstrained by reliable radioisotopic ages. The same is true for nearly all Early and Middle Triassic archosaur fossils; recently published U-Pb ages using microbeam techniques (SIMS and LA-ICPMS) from some strata in South America, North America, and southern Africa are inferior regarding precision and accuracy (compared to U-Pb CA-TIMS), and inadequate to test biogeographic and evolutionary tempo hypotheses. Nonetheless, they provide important preliminary data that help target sampling of strata for more precise $^{40}Ar/^{39}Ar$ and CA-TIMS U-Pb ages. We expect that additional high-resolution geochronologic data from marine and terrestrial Late Triassic sections around the world will significantly improve (and adjust) the chronostratigraphic framework, and will lead to better constrained hypotheses regarding the origin and diversification of early archosaurs.

A FOSSIL ASSEMBLAGE COMPOSED OF AT LEAST TWO JUVENILE SPECIMENS OF *PRESTOSUCHUS CHINIQUENSIS* FROM THE *DINODONTOSAURUS* ASSEMBLAGE ZONE (AZ), MIDDLE TRIASSIC, SANTA MARIA FORMATION, RIO GRANDE DO SUL STATE, BRAZIL

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A fossil assemblage, numbered CPEZ-239, was discovered in the outcrop "Sanga da Árvore" in the Xiniquá region of Rio Grande do Sul State, near the city of São Pedro do Sul, southern Brazil. Part of this assemblage (CPEZ-239a) was identified as a new taxon: *Archeopelta arborensis* Desojo *et al.,* 2011, a Doswellidae, whereas the rest of it (CPEZ-239b) was identified as cranial and post-cranial elements of at least two specimens belonging to the Rauisuchia, a problematic group of mostly medium to large sized terrestrial pseudosuchian archosaurs that lived during the Middle to the Late Triassic. In Brazil, rauisuchians are restricted to the Santa Maria Formation, where *Rauisuchus tiradentes* Huene, 1938, is from the *Hyperodapedon* AZ and *Prestosuchus loricatus* Huene, 1938, *Prestosuchus chiniquensis* Huene, 1938, and *Decuriasuchus quartacolonia* França *et al.,* 2011, are from the *Dinodontosaurus* AZ and are the best known taxa. The main characteristics of the specimens in the assemblage CPEZ-239b are: the presence of a small subnarinal fenestra between the premaxilla and the maxilla, a wide dorsoventraly expanded ascending process of the maxilla with a slender anterior margin of the antorbital fenestra, the overall form of the lacrimal and prefrontal, and an anteroposteriorly shortened cervical vertebra. A comparative study indicated a close similarity to the rauisuchian *Prestosuchus chiniquensis,* with the slight morphological differences attributed to ontogenetic variation, because these specimens are comparatively smaller than those of UFRGS-PV-0156-T and UFRGS-PV-0629-T which are assigned to, respectively, an adult and a sub-adult of this species. This diagnosis was further tested using a modified matrix of Brusatte *et. al.* (2010) and the resulting consensus trees show CPEZ-239b forming a polytomy with *Prestosuchus chiniquensis* and UFRGS-PV-0629-T, which is a more complete specimen attributed to this species. The phylogenetic analysis indicated that CPEZ-239b is an assemblage composed of specimens of *P. chiniquensis*. Furthermore, the new specimens are juveniles contributing information on the ontogenetic variation within this taxon (variation of problematic structures, such as the case of the subnarinal fenestra) that is important in phylogenetic studies.

Desojo, J.B., Ezcurra, M.D. and Schultz, C.L. 2011. An unusual new archosauriform from the Middle–Late Triassic of southern Brazil and the monophyly of Doswelliidae. *Zoological Journal of the Linnean Society* 161: 839–871.

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França, M.A.G., Ferigolo, J. and Langer, M.C. 2011. Associated skeletons of a new middle Triassic "Rauisuchia" from Brazil. *Naturwissenschaften* 98: 389–395.

Mastrantonio, B. 2010. [*Descrição Osteológica de Materiais Cranianos e Pós-Cranianos de* Prestosuchus chiniquensis *(Archosauria, Rauisuchia) do Mesotriássico do RS (Biozona de* Dinodontosaurus*, Formação Santa Maria) e Considerações Filogenéticas Sobre os Raussúquios*. Tese de Doutorado, Universidad Federal do Rio Grande do Sul, Porto Alegre, 244 p. Unpublished].

Brusatte, S. L., Benton, M.J., Desojo, J.B. and Langer, M.C. 2010. The higher-level phylogeny of Archosauria (Tetrapoda: Diapsida). *Journal of Systematic Paleontology* 8: 3–47.

RECONSTRUCTION OF THE DEEP DORSAL THIGH MUSCULATURE OF THE EXTINCT 'RAUISUCHIAN' *PRESTOSUCHUS CHINIQUENSIS* HUENE, 1938 (PSEUDOSUCHIA: LORICATA) FROM THE SANTA MARIA FORMATION (TRIASSIC, *DINODONTOSAURUS* ASSEMBLAGE ZONE)

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Witmer (1995) provided a detailed methodology for reconstructing soft tissues of extinct animals based on osteological features and on an explicit phylogenetic context, using extant animals as parameters [Extant Phylogenetic Bracket (EPB); Witmer, 1995]. The material analyzed

in this study consists of a partially complete specimen of *Prestosuchus chiniquensis* Huene, 1938 (UFRGS-PV-0629-T). Among other bones, all the presacral, sacral, and the first three caudal vertebrae, both ilia, pubis, ischia and femora, and the right tibia and fibula are preserved. Reconstruction of its deep dorsal thigh musculature was chosen since the homology of this musculature was extensively debated for Archosauria and related outgroups, and appears to be well resolved. Muscle homologies and nomenclature follows Rowe (1986) and Kischlat (2003). Historical evolution of the deep dorsal group indicates the presence of three muscles in the crurotarsan (crocodiles) lineage –*i.e.*, *M. iliofemoralis* (ILFM), *M. cuppedicus* (CUPD) and *M. iliotrochantericus* (ILTR)– and five in the ornithodiran (birds) lineage –*i.e.*, ILFM-*cranialis*, ILFM-*caudalis*, CUPD, ILTR-*lateralis*, and ILTR-*medialis* (*sensu* Kischlat, 2003). Although not all muscle attachments leave scars, the surfaces for attachment of the deep dorsal thigh musculature were recognized. Deep lateral fossae, as well as long and wide transverse processes in the more caudal presacral vertebrae may be associated with the origin of ILTR. A concave surface at the medial side of the ilium is related to the origin of CUPD, and a concave surface at the lateral side of the illium –just caudal to the subvertical ridge dorsal to the acetabulum at the ala postacetabularis ilii– is regarded to the origin of a single ILFM. In the femur, a deep fossa along the medial and caudal sides of the fourth trochanter indicates the site of insertion of CUPD, and opposed to it, at the craniolateral surface, a slight lifting was tentatively associated to the insertion of the ILFM. Two muscles scars at the proximal end of the femur, in its cranial facing surface, were considered as the divided insertion of the ILTR. The division of both ILTR and ILFM in two distinct muscles occurred only in the ornithodiran line and was considered to be absent in the specimen under study. On the other hand, the division of the insertion of ILTR observed in crocodiles (=*M. pubo-ischio-femoralis internus pars II*) may also be present in *Prestosuchus chiniquensis* Huene, 1938. These insertions seem to have migrated proximally in the material under study, in a similar condition to that found in birds, regardless of its site of origin, which remained as in the crocodilian condition. This proximal migration may be related to a more parasagittal displacement of the limbs, when compared with their living relatives (crocodiles), where the ILTR would act more as a femur rotator than a femur abductor. Because no evident osteological structure in the femur could be directly associated with the insertion of the ILFM, which is different in each of the extant relatives compared, its extent and function could not be determined. The results observed herein corroborate with an independent and convergent evolution of a parasagittal limb posture in both main archosaurian lineages and differs from the reconstructions made for other non-crocodyliform crurotarsans.

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O NEUROCRÂNIO DE *PRESTOSUCHUS CHINIQUENSIS* (ARCHOSAURIA, RAUISUCHIA) DO MESOTRIÁSSICO DO RIO GRANDE DO SUL (BIOZONA DE *DINODONTOSAURUS*, FORMAÇÃO SANTA MARIA)

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A filogenia dos rauissúquios sempre esteve longe de ser consensual. Embora, nos últimos anos, vários trabalhos tenham acrescentado dados sobre este grupo, e se conheça a importância do neurocrânio para estudos anatômicos e filogenéticos, entre os rauissúquios, o neurocrânio foi descrito somente para *Postosuchus kirkpatricki* Chatterjee, 1985 (Weinbaum, 2002), *Saurosuchus galilei* Reig, 1959 (Alcober, 2000) *Batrachotomus kupferzellensis* Gower, 1999 (Gower, 2002) e *Arizonasaurus babbitti* Welles, 1947 (Gower e Nesbitt, 2006). Em *Tikisuchus romeri* Chatterjee e Majumdar, 1987, alguns elementos do neurocrânio estão preservados, mas não foram descritos em detalhe, enquanto em *Postosuchus alisonae* Peyer *et al.*, 2008 somente o opistótico, o proótico e o supra-occipital estão preservados e descritos. O presente estudo do neurocrânio de *Prestosuchus chiniquensis* Huene, 1938 se baseia no material UFRGS-PV-0629-T, coletado no município de Dona Francisca, RS, e depositado na Coleção de Paleovertebrados da Universidade Federal do Rio Grande do Sul (UFRGS). Utilizou-se ainda, para comparações, o espécime UFRGS-PV-0156-T (Barberena, 1978) e as bibliografias existentes. Os elementos endocondrais que compõem o neurocrânio de UFRGS-PV-0629-T encontram-se completamente preservados e firmemente ligados entre si e a alguns elementos do dermocrânio. Entretanto, assim como ocorre em UFRGS-PV-0156-T, a visualização das suturas e de algumas estruturas é bastante difícil. Foram reconhecidos os elementos visíveis na face externa (basioccipital, exoccipital, supraoccipital, opistótico, proótico, basisfenóide e lateroesfenóide). O basisfenóide foi abordado em conjunto com o paraesfenóide (parabasisfenóide) uma vez que não foi possível identificar separação entre ambos. A descrição do neurocrânio deste espécime acrescenta dados inéditos à espécie, tendo em vista que o material descrito por Huene (1938) não apresentava o neurocrânio preservado, enquanto o crânio de UFRGS-PV-0156-T, descrito por Barberena (1978), embora apresente esta região preservada, não teve a mesma descrita em detalhe. Além disso, estas informações incrementam o conhecimento da osteologia dos rauissúquios e disponibilizam novas informações para futuras análises filogenéticas.

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Barberena, M.C. 1978. A huge thecodont skull from the Triassic of Brazil. *Pesquisas* 7: 111–129

Gower, D.J. 2002. Braincase evolution in suchian archosaurs: evidence from the rauisuchian *Batrachotomus*. *Zoological Journal of the Linnean Society* 136: 49–76.

Gower, D.J. and Nesbitt, S.J. 2006. The braincase of *Arizonasaurus babbitti* - further evidence for the non-monophyly of rauisuchians. *Journal of Vertebrate Paleontology* 26: 79–87.

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ARCHOSAURIFORMS FROM THE MIDDLE TRIASSIC MANDA BEDS: A DIVERSE ASSEMBLAGE OF EARLY ARCHOSAURS SAMPLING THE RISE OF ARCHOSAURIA

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The early record of the archosaur divergence is recorded in track sites from around the world and isolated elements and a few partial skeletons from Early–early Middle Triassic deposits distributed throughout Pangea. However, with few exceptions, the phylogenetic placement of many Middle Triassic archosaur remains poorly understood, whereas by the Late Triassic, nearly all taxa can be easily placed into clearly diagnosed clades (*e.g.*, Aetosauria, Ornithosuchidae, Dinosauromorpha). To date, most Middle Triassic archosaurs are assigned to the poorly understood and likely paraphyletic "Rauisuchia" with only a few assigned to basal positions within the clearly diagnosed Late Triassic clades. To date, only two formations from the Middle Triassic have produced an early archosaur fauna, the Chañares Formation of Argentina (Ladinian) and the Manda Beds of Tanzania (late Anisian). The fossiliferous Manda Beds archosauriform assemblage consists of a minimum of twelve unique archosauriforms including *Parringtonia* Huene, 1939*, Asilisaurus* Nesbitt *et al.*, 2010*, Hypselorhachis* Butler *et al.*, 2009*, Stagonosuchus* Huene, 1938*, 'Mandasuchus,'* Charig, 1967 *'Teleocrater,'* Charig, 1967 *'Nyasasaurus,'* Charig, 1967 *'Pallisteria,'* Charig, 1967 NHM (Natural History Museum London) R36615, NHM unnumbered, NMT (National Museum of Tanzania) RB48, NMT RB28. Of these, NHM R36615, NHM unnumbered, and *'Teleocrater',* likely represent non-archosaur archosauriforms whereas all of the other taxa listed above represent archosaurs. Among the archosaurs, some taxa are readably assigned to Early–Late Triassic clades (*e.g.*, *Parringtonia, Asilisaurus, Hypselorhachis*) whereas others may represent primitive members of clades currently restricted to the Late Triassic (*e.g.*, NMT RB48, NMT RB28). The assignment of *Stagonosuchus, 'Mandasuchus,'* and *'Pallisteria,'* to a major clade remains difficult given that the ancestral body plan of the crocodylian-line archosaur or Archosauria as a whole may look similar to Middle Triassic taxa classically assigned to "Rauisuchia." The Manda Beds archosaur assemblage is both diverse and has high disparity early in the Middle Triassic. Combined with other Middle Triassic localities across Pangea (*e.g.*, Moenkopi Formation, Russian localities), the Manda Beds archosaur assemblage demonstrates that the archosaur radiation was well underway by the early part of the Middle Triassic, although fossil evidence of this radiation remains elusive in Early–early Middle Triassic localities.

Butler, R.J., Barrett, P.M., Abel, R.L. and Gower, D.J. 2009. A possible ctenosauriscid archosaur from the Middle Triassic Manda Beds of Tanzania. *Journal of Vertebrate Paleontology* 29: 1022–1031.

Charig, A. 1967. Subclass Archosauria. In: W.B. Hartland (Ed.), *The Fossil Record*. Geological Society of London, London. p. 708–718.

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Huene, F. v. 1939. Ein kleiner Pseudosuchier und ein Saurischier aus den ostafrikanischen Mandaschichten. *Neues Jahrbuch für Geologie und Paläeontologie, Beilage-Bände Abteilung B* 81: 61–69.

NEW ARCHOSAUROMORPH FINDS FROM THE EARLY TRIASSIC OF POLAND

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The Early Triassic is a very interesting time of the Mesozoic era, witnessing a changeover from the archaic faunas of the Permian to those more typically associated with the Triassic and the later Jurassic. The end-Permian mass extinction resulted in the loss of typical Permian forms and the Early Triassic time saw the early radiation of Archosauromorpha (Reptilia: Diapsida). Early Triassic vertebrate assemblages are known from several regions. There is a range of southern faunal assemblages from continental sedimentary basins in South Africa (Karroo), India, Australia, Antarctica, and from more coastal regions in Madagascar and northwest Australia. Typically, these assemblages are dominated by synapsids (dicynodonts and other therapsids), or by temnospondyl amphibians (in terms of number of species present). The northern continental assemblages include those of the East European platform, northern China, Mongolia and, in the boreal regions, those of Greenland and Siberia. The Early Triassic and early Anisian Buntsandstein of Western and Central Europe and the late Olenekian to early Anisian Moenkopi Formation of southern North America are typical of this belt. In all of these deposits, tetrapods are relatively poorly known. The Lower Triassic formations from the southern Poland has been a source of vertebrate trace fossils since the seventies, with the first published account in 1990 and 2000 (Fuglewicz *et al.*, 1990; Ptaszyński, 2000). The recovery of a bone breccia including a diverse vertebrate assemblage of the Early Triassic age at Czatkowice, enriched our knowledge about the Early Triassic faunas from Europe (see Borsuk-Bialynicka and Evans, 2009). Later, numerous short papers about new Lower–Middle Triassic vertebrate tracksites were published (see Niedźwiedzki

and Ptaszyński, 2007). In 2010 and 2011 two new Olenekian sites with trace fossils (vertebrate tracks) and body fossils were discovered in the Middle Buntsandstein deposits of the Holy Cross Mountains. Archosauromorph fossils are rare in both sites and usually fragmentary but the few finds suggest the presence of large erythrosuchids and small archosauromorphs of uncertain taxonomic position, possibly representing new species of proterosuchids or euparkerids. In both sites isolated remains of large temnospondyl amphibians were also found. The age of both sites is based on biostratigraphic data (palynomorphs and conchostracans). Discoveries of new vertebrate remains from the Early Triassic of southern Poland are a new, unique source of information about diversity and distribution of early Archosaromorpha.

Borsuk-Białynicka M. and Evans, S.E. (Eds.) 2009. Early Triassic vertebrate assemblage from karst deposits at Czatkowice, Poland. *Palaeontologia Polonica* 65: 1–332.

Fuglewicz, R., Ptaszyński, T. and Rdzanek, K. 1990. Lower Triassic footprints from the Świętokrzyskie (Holy Cross) Mountains, Poland. *Acta Palaeontologica Polonica* 35: 109–164.

Niedźwiedzki, G. and Ptaszyński, T. 2007. Large Chirotheriidae tracks in the Early Triassic of Wióry, Holy Cross Mountains, Poland. *Acta Geologica Polonica* 57: 325–342.

Ptaszyński, T. 2000. Lower Triassic vertebrate footprints from Wióry, Holy Cross Mountains, Poland. *Acta Palaeontologica Polonica* 45: 151–194.

THE SKULL OF *POPOSAURUS GRACILIS* (PARACROCODYLOMORPHA: POPOSAUROIDEA) BASED ON A NEW SPECIMEN FROM THE UPPER TRIASSIC CHINLE FORMATION OF ARIZONA

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Although *Poposaurus gracilis* Mehl, 1915 was originally thought to be a dinosaur in its original description, subsequent discoveries including a nearly complete articulated specimen from Utah, have demonstrated that *P. gracilis* is a crocodile-line archosaur. Furthermore, *P. gracilis* is hypothesized as an obligate biped, demonstrating many morphological and possible behavioral convergences with theropod dinosaurs. Nonetheless, little is known about the skull of this taxon, with only a fragmentary premaxilla having been previously recognized. This is significant as poposauroid skulls show unusual morphological disparity, including edentulous, *Effigia okeeffeae* Nesbitt and Norell, 2006 and *Lotosaurus adentus* Zhang, 1975, and toothed, *Arizonasaurus babbitti* Welles, 1947 and *Xilousuchus sapingensis* Wu, 1981; forms, and the most recent phylogenetic analysis of basal Archosauria places *P. gracilis* closer to the former group. A new partial skeleton (PEFO 34865) from the Chinle Formation of Petrified Forest National Park (Arizona, USA) preserves pelvic elements referable to *P. gracilis*. More importantly, this new specimen includes skull bones, such as a left maxilla, a left dentary, and a right prearticular. The jaw elements possess large mediolaterally compressed, recurved teeth demonstrating that the jaws of *P. gracilis* were not edentulous. The maxilla and dentary are much longer than tall and the palatal process is in the same plane as the maxillary body, suggesting that the maxillae were parallel to one another and that the snout was narrow. The ascending process of the maxilla is very similar to that of poposaurids, and unlike those of rauisuchids such as *Postosuchus*; however, unlike other poposauroids, the process is directed posteriorly about 20º above horizontal, and not directed strongly dorsally as in *Arizonasaurus* and *Effigia*. The maxilla of PEFO 34865 is morphologically very different from the Otis Chalk maxilla tentatively referred to *P. gracilis* by Weinbaum and Hungerbühler (2007) and demonstrates that they represent different taxa. Finally, this new specimen is from the base of the Sonsela Member of the Chinle Formation and represents the youngest known occurrence for *Poposaurus*, suggesting that this taxon was present until close to the Adamanian–Revueltian faunal turnover.

Mehl, M.G. 1915. *Poposaurus gracilis*, a new reptile from the Triassic of Wyoming. *Journal of Geology* 23: 516–522.

Nesbitt, S.J. and Norell, M.A. 2006. Extreme convergence in the body plans of an early suchian (Archosauria) and ornithomimid dinosaurs (Theropoda). *Proceedings of the Royal Society of London B* 273: 1045–1048.

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Welles, S.P. 1947. Vertebrates from the Upper Moenkopi Formation of the Northern Arizona. University of California *Publications in Geological Science* 27: 241–294.

Wu, X.-C. 1981. The discovery of a new thecodont from north east Shanxi. *Vertebrata PalAsiatica* 19: 122–132.

Zhang, F.K. 1975. A new thecodont Lotosaurus, from the Middle Triassic of Hunan. *Vertebrata PalAsiatica* 13: 144–147.

THE FIRST OCURRENCE OF *CHANARESUCHUS BONAPARTEI* ROMER 1971 (ARCHOSAURIFORMES, PROTEROCHAMPSIA) IN THE *SANTACRUZODON* ASSEMBLAGE ZONE, SANTA MARIA FORMATION (PARANÁ BASIN), MIDDLE TRIASSIC OF BRAZIL

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The Proterochampsia (*sensu* Nesbitt, 2011) are represented by quadrupedal forms that display a series of diagnostic characters, most of

them related with a semi-aquatic habit, such as an elongated rostrum and a dorso-ventrally compressed skull. Despite the problematic phylogeneticposition of the group, the application of cladistic methodologies in archosauriform studies revealed a tendency to establish the proterochampsians as the sister-group of Archosauria (*sensu strictu*). In Brazil, these forms are found in the Paraná Basin (Santa Maria Formation), including the species *Rhadinosuchus gracilis* Huene,1938, *Cerritosaurus binsfeldi* Price, 1946, and *Proterochampsa nodosa* Barberena, 1982, coming from the Rhynchosauria Assemblage Zone (early Upper Triassic) and *Chanaresuchus* sp. (Romer 1971) occurring in the *Dinodontosaurus* Assemblage Zone (late Middle Triassic). In Argentina (Ischigualasto-Villa Unión Basin), the species *Proterochampsa barrionuevoi* Reig, 1959, and *Chanaresuchus* sp. occur in the Ischigualasto Formation (early Upper Triassic) and the genera *Chanaresuchus, Gualosuchus*, and *Tropidosuchus* were recorded in the Chañares Formation (late Middle Triassic, Specimen UFRGS-PV-0877-T was discovered in 2003 at the Schöenstatt outcrop (Santacruzodon AZ), Municipality of Santa Cruz do Sul, Rio Grande do Sul State (Brazil), near the highway RST 471 (UTM SAD 69-fuso 22J-359794 E, 6709033 N). This specimen was originally identified as "*Rhadinosuchidae indeterminado*" by Machado and Kischlat (2003), but a more detailed analysis resulted in the identification of this specimen (composed by incomplete cranial and post-cranial elements) as a new specimen of *Chanaresuchus bonapartei* Romer, 1971. This conclusion is based on the following characters, which are shared with the Argentinean specimen (holotype): (1) Radial ornamentations spread from the frontal (at the level of the middle portion of the orbit) and becoming longitudinally elongated near the anterior portion of the frontal, from which they follow sinuously along the nasal. On the parietal, the radial ornamentations extend from the posterior portion of the frontal and meet with small ridges that are formed by a larger ridge that delimitates the anterior and medial margin of the supra-temporal fenestra, and posteriorly, is part of the occipital crest; (2) the supra-temporal fenestra is triangular-shaped, with its anterior margin being the widest and the latero-posterior one the shortest. It also displays a ridge along its anterior and medial rims; (3) the post-cranial bones are of very similar in form and proportions. Among the Middle and Upper Triassic paleofauna, *Chanaresuchus bonapartei* is the only proterochampsian taxon that has been found at both sides of the Middle/Upper Triassic boundary.

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Price, L.I. 1946. Sôbre um novo pseudosuquio do Triássico Superior do Rio Grande Sul. *Boletim, Divisão de Geologia e Mineralogia (DNPM)* 120: 1–38.

Romer, A.S. 1971. The Chañares (Argentina) Triassic reptile fauna. XI. Two new longsnouted thecodonts, *Chanaresuchus* and *Gualosuchus*. *Breviora* 379: 1–22.

THE REVIEW OF EARLY ARCHOSAURS FROM RUSSIA

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Several diverse and stratigraphically successive tetrapod faunas are known from the Permian and Triassic of Eastern Europe. Newly discovered and recently described Late Permian and Early to Middle Triassic Russian diapsids have provided new insight into the morphology, phylogenetic relationships and paleoecology of Permo-Triassic vertebrates as well as Permian and Triassic biostratigraphy and paleogeography. The most complete Permo-Triassic stratigraphic succession at the Russian platform presents a unique possibility for such kind of investigations, as at least ten stages in the Permian and eight stages in the Triassic distinguished in the biotic history. Early archosaurs were important components of late Permian and especially Early and Middle Triassic faunas of European Russia. They include proterosuchids, erythrosuchids, rauisuchids, ctenosauriscids and euperkeriids. More advanced thecodonts, crocodiles and dinosaurs have not been recorded from the Russian Permo-Triassic. The first thecodont remains (the rauisuchid *Tsylmosuchus*) from the Lower Triassic were discovered at the beginning of XX century and originally described as belonging to the prosauropod *Thecodontosaurus* sp. The systematic list and stratigraphic distribution of early archosaurs from European Russia are as follow: (1) Proterosuchidae –*Vonhuenia friedrichi*, *Blomosuchus georgii*, *Chasmatosuchus rossicus*, *Chasmatosuchus* sp., *Gamosaurus lozovskii*, *Exilisuchus tubercularis*, *Sarmatosuchus otschevi*; (2) Erythrosuchidae –*Garjainia prima*, *G. triplicostata*, *Uralosaurus magnus*, *Chalishevia cothurnata*; (3) Rauisuchidae –*Tsylmosuchus jakovlevi*, *Ts. samariensis, Ts. donensis, Vytshegdosuchus zheshartensis*, *Dongusia colorata*, *Dongusuchus efremovi*, *Energosuchus garjainovi*, *Jaikosuchus magnus*, *Scythosuchus basileus*, *Vjushkovisaurus berdjanensis*, *Jushatyria vjushkovi*; (4) Ctenosauriscidae –gen. *et* sp. nov.; (5) Euparkeriidae –*Dorosuchus neoetus*. Archosauromorph remains from the Upper Permian of European Russia are very rare: (1) Severodvinian stage, upper substage – earliest archosauromorph-protorosaurid *Eorasaurus olsoni*; (2) Tatarian stage, upper substage (uppermost part) –proterosuchid *Archosaurus rossicus*. Triassic archosaurs were numerous and widespread: (1) Lower Triassic, Induan stage –proterosuchids *Vonhuenia friedrichi*, *Blomosuchus georgii*, *Chasmatosuchus* sp.; (2) Lower Triassic, Olenekian stage, lower substage –proterosuchids *Chasmatosuchus rossicus*, *Exilisuchus tubercularis*, rauisuchids *Tsylmosuchus jakovlevi*, *Ts. samariensis*; (3) Lower Triassic, Olenekian stage, upper substage –proterosuchid *Gamosaurus lozovskii*, erythrosuchids *Garjainia prima*, *G.* triplicostata, rauisuchids *Tsylmosuchus donensis*, *Vytshegdosuchus zheshartensis*, *Jaikosuchus magnus*, *Scythosuchus basileus*; (4) Middle Triassic, Anisian stage –proterosuchid *Sarmatosuchus otschevi*, erythrosuchid *Uralosaurus magnus*, rauisuchids *Dongusia colorata*, *Dongusuchus efremovi*, *Vjushkovisaurus berdjanensis*, euparkeriid *Dorosuchus neoetus*; (5) Middle Triassic, Ladinian stage –erythrosuchid *Chalishevia cothurnata*, rauisuchids *Energosuchus garjainovi*, *Jushatyria vjushkovi*, new undescribed ctenosauriscid. Study of the early archosaurs from Russia provides us with the following important information: data on early archosaurs from Russia show that their appearance and the initial differentiation occurred in the Late Permian and Early Triassic. Archosaurus is the oldest archosaur, only one known from Permian. It is the most important component of unique Vyazniki tetrapod community of Terminal Permian. Here we can observe the faunistic takeover

at Permo-Triassic boundary and the replacement of therapsids by archosaurs. Garjainia from Early Triassic is perhaps the earliest known erythrosuchid. Sarmatosuchus is a latest, only one proterosuchid from Middle Triassic. *Chalishevia* from Ladinian is one of youngest known erythrosuchids. Diverse rauisuchians from Tsylmosuchus to *Vytshegdosuchus* are the oldest in the world, prolonging the history of this group far into the Early Triassic.

REASSESMENT OF AETOSAURUS FROM THE CHINLE FORMATION, EAGLE BASIN, COLORADO: HISTOLOGICAL AND OSTEOLOGICAL EVIDENCE

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The aetosaurian genus *Aetosaurus* O. Fraas, 1887 reportedly ranged across Europe and North America and has been used as a Late Triassic index fossil. *Aetosaurus* is also important in its basal position in some phylogenetic analyses of the Aetosauria. *Aetosaurus* sp. has been reported from the Chinle Formation of the Eagle Basin in Colorado, USA and is the most common archosaur. The Eagle Basin "*Aetosaurus"*identification is based on the similarity of osteoderms to those of *Aetosaurus ferratus* O. Fraas, 1887 from Germany. Recent redescription of *A. ferratus* from Germany has demonstrated that most *A. ferratus* are juveniles and the stratigraphically higher *A. crassicauda* E. Fraas, 1907 is an adult individual of *A. ferratus*. The recent preparation of an " *A. crassicauda"*–like aetosaur (DMNH 60708) from the Eagle Basin warrants analysis of the Eagle Basin "*Aetosaurus"* specimens to determine if they are juveniles or adults, and whatever their ontogenetic stage, are they really attributable to *Aetosaurus.* A histologic study of osteoderms and femora was undertaken on the Eagle Basin "*Aetosaurus"*. The larger DMNH 60708 shows extensive remodeling with secondary osteons in the upper layer of the osteoderms indicating a relatively mature individual. Secondary osteons have previously been related to individuals of more than two or three years of age. The presence of LAGs is unclear in this specimen. The smallest size range (and most numerous osteoderms from the Eagle Basin) is primarily composed of avascular tissue with no secondary osteoderms and no LAGs, indicating juveniles. Histology of two smaller femora (DMNH 39253, 51357) demonstrates that they are subadults. In DMNH 39253, the structure of the zonal bone in the cortex, combined with multiple resting lines indicates that this is not a juvenile. Conversely, the absence of clearly secondary osteons reworking the tissue suggests this is not a fully mature adult. In DMNH 51357 there are at least three zones present. All three zones consist of fibro-laminar primary bone. The outer, less vascular bone is divided into two layers by a faint LAG that suggests at least two periods of growth. A more pronounced LAG separates the inner, more vascularised layer from the outer tissue layer and is composed of laminar bone. The absence of secondary bone tissue suggests this is not an adult. However, the zonation of this bone suggests it is not a juvenile. This mixed signal from the smallest specimens may indicate that armor might mature at a slower rate than other postcranial bones and might not be a good indicator of age. These results seemingly corroborate recent findings regarding ontogeny in *A. ferratus*. In conclusion, the smaller Eagle Basin "*Aetosaurus"* specimens, though showing signs of maturity are younger than DMNH 60708. However, morphology of ventral osteoderms differs between the two size ranges. It is unclear whether this is ontogenetic or phylogenetic. The osteoderms of the Eagle Basin aetosaurs and the German *A. ferratus* are similar, which was the basis for the identification of the Eagle Basin aetosaurs. However, cranially, the Eagle Basin aetosaurs differ from the German *A. ferratus*, especially in the configuration of bones in the region of the temporal openings. It seems that the characters that define *A. ferratus* osteoderms are actually plesiomorphic for some Aetosaurinae aetosaurs in general, casting doubt on the phylogenetic utility of *Aetosaurus*-like osteoderms, requiring other skeletal elements for precise identification.

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Fraas, O. 1887. *Aetosaurus ferratus*, die gepanzerte Vogelechse aus dem Stubensandstein bei Stuttgart. *Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg* 33: 1–21.

ANATOMY AND AFFINITIES OF LARGE ARCHOSAUROMORPHS FROM THE LOWER FREMOUW FORMATION (EARLY TRIASSIC) OF ANTARCTICA

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The vertebrate assemblages of the Fremouw Formation have been studied for nearly 50 years, but many components remain poorly known. Chief among these include the reptile assemblage of the Early Triassic lower member of the Fremouw Formation. We describe a partial presacral vertebra and the distal end of a left humerus collected just above the Permian–Triassic boundary in the Shackleton Glacier region of the central Transantarctic Mountains. Our identification of these specimens as archosauromorphs (Reptilia: Diapsida) that represent at least one taxon of large-bodied archosauriform increases the known reptile diversity of the Fremouw Formation considerably, and provides the first definitive evidence for the presence of Archosauriformes in the Early Triassic of Antarctica. These records increase faunal similarities between the lower Fremouw Formation and other Early Triassic assemblages worldwide. Although the lower Fremouw assemblage is typically considered a subset of the coeval *Lystrosaurus* Cope, 1870 Assemblage Zone (LAZ) of South Africa, the discrepancy in inferred body size between the Antarctic specimens and the South African archosauriform *Proterosuchus fergusi* Broom, 1903, coupled with the fact that the LAZ of the Karoo Basin has

been sampled much more thoroughly, suggests a real disparity in the maximum body size of apex carnivores between the lower Fremouw assemblage and the LAZ. The lower Fremouw specimens also demonstrate that one or more lineages of archosauriform had attained the large body size characteristic of later members of the clade very soon after the end-Permian mass extinction. This offers a point of contrast with the global pattern of post-extinction terrestrial communities, which are typified by a marked reduction in body-size (*i.e.*, the 'Lilliput effect').

Broom, R. 1903. On a new reptile (*Proterosuchus fergusi*) from the Karoo beds of Tarkastad, South Africa. *Annals of the South African Museum* 4: 159–164.

Cope, E.D. 1870. On the skull of dicynodont Reptilia; *Lystrosaurus frontons* from Cape Colony. *Proceedings of the American Philosophical Society* 11: 419.

THE EARLY EVOLUTION OF PHYTOSAURIA: NEW INSIGHTS ON SYSTEMATIC RELATIONSHIPS AND GEOGRAPHIC DISTRIBUTION

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Although Phytosauria is recognized consistently as a monophyletic group of archosauriforms, and recent analyses supported increasingly resolved ingroup relationships, basal phytosaur phylogeny and taxonomy remain contentious. Clarification of relationships among those basal taxa is crucial for establishing biostratigraphic and biochronologic correlations in the Late Triassic, reconstructing morphological evolution within Phytosauria, and documenting the biogeographic distribution and center of origin of the clade. *Paleorhinus* Williston, 1904, and other plesiomoprhic specimens referred to that taxon are well represented by specimens from the Late Triassic of India, Morocco, Poland, Germany, and the United States. There is no consensus regarding the number of species of *'Paleorhinus.'* As many as nine species and four genera were synonymized at various times. Cursory descriptions lacking detailed comparisons, an emphasis on plesiomorphic cranial morphology, and the lack of phylogenetic analyses confounded the taxonomy of those specimens. Using an explicitly cladistic framework, I redescribed a key phytosaur specimen from the Dockum Group of Texas and examined this specimen and others previously referred to *'Paleorhinus'*. This specimen, TTU P-00539, comprises much of the skull and braincase, except for the rostrum anterior to the nares, most of the frontals, the orbital margins, most of the quadrates, the quadratojugals, and most of the squamosals. Referral to *Paleorhinus* was based on an extreme anterior position of the external nares with respect to the antorbital fenestrae as well as a laterally oriented quadrate foramen. TTU P-00539 designated the holotype of *Paleorhinus scurriensis* Langston, 1949, because of dorsoventral flattening of the skull, large palatine (=suborbital) fenestrae, and moderately elongate posttemporal fenestrae. However, an expanded phylogenetic analysis of Phytosauria following Stocker (2010) showed that characters thought to be diagnostic of *Paleorhinus* (*e.g.*, nares anterior to the antorbital fenestrae, supratemporal fenestrae in the same horizontal plane as the skull roof) actually are more complicated character complexes or are plesiomorphic for Phytosauria, and characters regarding skull flattening or orbit orientation often are related to crushing typical of phytosaur cranial material. Therefore, TTU P-00539 is a non-phytosaurid phytosaur and not a member of a monophyletic *Paleorhinus*. Resolution of the taxonomic and phylogenetic issues that have plagued *'Paleorhinus'* for nearly a century has important consequences for archosauriform relationships and Triassic biostratigraphy. Recognizing *'Paleorhinus'* as paraphyletic documents extensive, previously hidden, morphological diversity at the base of Phytosauria. Moreover, fragmentary specimens cannot be diagnosed as *Paleorhinus* as traditionally conceptualized because it is now demonstrated to be a paraphyletic grade of basal phytosaurs diagnosed by character states that are plesiomorphic for Phytosauria. *Paleorhinus* currently is used as an index taxon for the Late Triassic (Carnian) Otischalkian land vertebrate faunachron. Therefore, a reassessment of all specimens previously identified as *Paleorhinus* is required before the biostratigraphic and biochronologic utility of a restricted, monophyletic *Paleorhinus* is elucidated.

Langston, W. Jr. 1949. A new species of *Paleorhinus* from the Triassic of Texas. *American Journal of Science* 247: 324–341.

Stocker, M.R. 2010. A new taxon of phytosaur (Archosauria: Pseudosuchia) from the Late Triassic (Norian) Sonsela Member (Chinle Formation) in Arizona, and a critical reevaluation of *Leptosuchus* Case, 1922. *Palaeontology* 53: 997–1022.

Williston, S.W. 1904. Notice of some new reptiles from the Upper Trias of Wyoming. *Journal of Geology* 12: 688–697.

A NEW LOOK AT THE SAIL-BACKED, EDENTULOUS 'RAUISUCHIAN' *LOTOSAURUS* FROM THE MIDDLE TRIASSIC OF CHINA

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The unusual Chinese archosaur *Lotosaurus adentus* (Zhang, 1975) was named on the basis of specimens discovered in the early 1970s in the Middle Triassic Badong Formation of Furongqiao Township, Hunan Province. *Lotosaurus* is an edentulous reptile of moderate size whose neural spines are elongated to form a dorsal 'sail'. Following its initial brief description and classification as a 'thecodont' by Zhang (1975), the *Lotosaurus* material at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) was incorporated into display mounts and became difficult for researchers to examine. Nevertheless, *Lotosaurus* was tentatively regarded by Gower (2000) as a 'rauisuchian', based on a phylogenetic analysis by Parrish (1993). We arranged for the *Lotosaurus* specimens at the IVPP to be fully cleaned, in order to facilitate the first complete description of the anatomy of this strange archosaur. This operation revealed a number of phylogenetically significant features, some of which have already been incorporated into a comprehensive analysis of archo-

saur phylogeny by Nesbitt (2011). In particular, *Lotosaurus* displays some characteristic poposauroid apomorphies, including elongate cervical ribs and the apparent presence of a third sacral vertebra interpolated between the two primitive sacrals. Within Poposauroidea, *Lotosaurus* displays an interesting combination of basal and derived characteristics. Like the advanced taxa *Effigia* and *Shuvosaurus*, *Lotosaurus* is edentulous, and such features as its dorsoventrally compressed unguals and a ventrally oriented supraacetabular crest also point to a relatively derived position within Poposauroidea. However, the elongated neural spines of *Lotosaurus* are reminiscent of the more basal taxa *Arizonasaurus* and *Xilousuchus*, and *Lotosaurus* is also primitive in its heavily-built, clearly quadrupedal morphology and in some details of the skeleton. Nesbitt (2011) found *Lotosaurus* to be deeply nested within Poposauroidea, and suggested that the massive forequarters and possibly the dorsal sail represented reversals rather than plesiomorphies. The short, edentulous, box-like skull of *Lotosaurus* implies that this taxon may have had a herbivorous diet, potentially requiring a massive gut cavity and leading to reversion to quadrupedality.

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DINÁMICA DE CRECIMIENTO EN AETOSAURIOS AETOSAURINAE, RESULTADOS PRELIMINARES

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Recientes estudios paleohistológicos en osteodermos paramediales de aetosaurios Aetosaurinae (*sensu* Parker, 2007) demostraron la ausencia de remodelación en el tejido óseo de estas estructuras. Esta ausencia de remodelación permite estimar la edad de los individuos mediante el conteo de las líneas de crecimiento. En la presente contribución se confeccionaron curvas de crecimiento para analizar las relaciones entre tamaño corporal y edad, utilizando ejemplares de *Aetosauroides scagliai* Casamiquela, 1960, *Neoaetosauroides engaeus* Bonaparte, 1969, *Aetosaurus ferratus* Fraas, 1877, un Aetosaurinae nov. gen. nov. sp., un Aetosaurinae indet., y un ejemplar del Typothoracisinae (Parker, 2007) *Typothorax coccinarum* (Cope, 1875). Para construir las curvas de crecimiento se elaboraron ecuaciones de estimación de edad en base al largo total de los ejemplares MCP 13 y UFRGS 11070 (*Aetosauroides scagliai*), y MLP 61-VIII 2-34 (Aetoasaurine indet.). A partir de estas ecuaciones se estimaron las edades de los ejemplares en los cuales no se cuenta con cortes histológicos. Asimismo, se realizaron estimaciones de largo corporal total a partir de las relaciones lineales existentes entre el largo corporal y las dimensiones lineales de las piezas esqueletarias (principalmente cráneo, húmero y fémur). Finalmente, las masas corporales se estimaron en base a la ecuación propuesta por Anderson (1985). Con los datos obtenidos en las estimaciones de edades, masa corporal y largo corporal total, se construyeron curvas de crecimiento para el grupo de los aetosaurios Aetosaurinae. En el análisis de las curvas obtenidas se observo que los aetosaurios estudiados presentan un patrón de crecimiento similar en cuanto al largo corporal total. Sin embargo, diferencias en la morfología corporal hacen que *Typothorax* sea más pesado que los Aetosaurinae no Typothoracisinae para un mismo largo total y edad. Estas diferencias morfológicas son principalmente el contorno de la coraza dorsal (la cual es suboval en *Typothorax* y subrectangular en los Aetosaurinae no Typothoracisinae), y el contorno de la sección transversal del tórax (suboval en *Typothorax* y subcircular en Aetosaurine no Typothoracisinae). También se observa, tanto en las curvas como en los cortes histológicos, que para los aetosaurios Aetosaurinae no Typothoracisinae se produce una gran disminución de la tasa de crecimiento aproximadamente a partir de los cinco años de edad.

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TAMAÑO CORPORAL DE LOS PROTEROCHÁMPSIDOS DE LA FORMACIÓN ISCHIGUALASTO (TRIÁSICO TARDÍO–CARNIANO) DE ARGENTINA

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Los proterochámpsidos son arcosauriformes endémicos de América del Sur, registrados desde el Triásico Medio hasta el Triásico Tardío de Brasil y Argentina. Actualmente se reconocen dos especies para la Formación Ischigualasto (Carniano 230 Ma.; Martínez *et al.*, 2011): *Proterochampsa barrionuevoi* Reig, 1959 y *Chanaresuchus* sp. nov. Ambas están representadas por ejemplares completos, con cráneo y poscráneo articulados y bien preservados, depositados en el Instituto y Museo de Ciencias Naturales de San Juan (PVSJ 567 y PVSJ 606, respectivamente). Adicionalmente, se incluyeron en este trabajo ejemplares de *Chanaresuchus bonapartei* Romer, 1971, y *Tropidosuchus romeri* Arcucci, 1990, procedentes de la Formación Chañares (Anisiano temprano–Carniano; Roger *et al.*, 2001). Se estimó la masa corporal a partir las circunferencias de las diáfisis del húmero y del fémur (Anderson *et al.*, 1985). Los ejemplares analizados de *Chanaresuchus* tendrían masas intermedia entre los otros especímenes (mayor que *T. romeri* y menor que *Proterochampsa barrionuevoi*). Además, los ejemplares de las especies procedentes de la Formación Los Chañares son de menor tamaño que los de la Formación Ischigualasto. Esta diferencia también se observa en el género *Chanaresuchus* ya que la especie procedente de la Formación Ischigualasto tenía mayor masa que la procedente de la Formación Chañares. El estudio de mayor número de ejemplares, junto a análisis paleohistológicos y morfométricos, permitirá identificar el estadio ontogenético y establecer el sesgo ocasionado por éste en la estimación de masa de los distintos ejemplares.

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THE PHYLOGENETIC RELATIONSHIPS AND MONOPHYLY OF PROTEROCHAMPSIDAE

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The proterochampsids are a Triassic group belonging in the Archosauriformes. The fossil record of the clade is restricted to the late Middle to the early Late Triassic of South America. The phylogenetic relationships of this group have not been analyzed yet at a species level including all the taxa from South America. The purpose of the present contribution is to establish a species-level phylogenetic hypothesis of proterochampsid interrelationships and test the monophyly of the clade as a whole. The data matrix used was a modified version of the one published by Dilkes and Sues (2009). It includes four new characters and five species-level taxa of proterochampsids (*Proterochampsa barrionuevoi*, *Proterochampsa nodosa*, *Chanaresuchus bonapartei*, *Gualosuchus reigi* and *Chanaresuchus* sp. nov.). The matrix consists of 24 taxa, including basal archosaurs (*e.g.*, *Saurosuchus*, *Arizonasaurus*), archosauriforms (*e.g.*, *Doswellia*, *Vancleavea*), and the arcosauromorph *Prolacerta* and *Mesosuchus*, which was the root taxa. The data set is composed of 89 characters: 34 from the skull, 14 from the braincase, and 41 from postcranium. The most parsimonious trees recovered revealed a new clade, i.e., Proterochampsoidea. This clade is formed by a trichotomy including *Vancleavea campi*, *Tropidosuchus romeri,* and the unnamed "group A". Group A is composed of *Doswellia kaltenbachi* and Proterochampsidae. In the present contribution, the conformation of Proterochampsidae follows the one proposed by Barberena (1982), including the genera *Chanaresuchus* Romer, 1971, *Proterochampsa* Reig, 1959, and *Gualosuchus* Romer, 1971. This group is supported by two synapomorphies: basiesphenoid with a semilunar groove and pterygoid with only one row of teeth on its transverse flange. Besides, the monophyly of the genus *Proterochampsa* is supported by the presence of a skull ornamented with nodular crests. The clade including the two species of *Chanaresuchus* is supported by the presence of a skull ornamented with longitudinal crests and depressions on the nasals and parietal, and with a radial pattern on the frontals. Finally, *Chanaresuchus* is nested as the sister-group of *Gualosuchus*, based on the presence of a depressed region on the maxilla-lacrimal contact. Finally, this analysis supports the monophyly of Proterochampsidae including *Proterochampsa*, *Chanaresuchus* and *Gualosuchus reigi*, but excluding *Tropidosuchus romeri*.

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BODY SIZE EVOLUTION AND THE EARLY ARCHOSAUR RADIATION

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Recently a burst of research into the early evolution of archosaurs and their precursors among basal archosauriforms has led to refined phylogenetic hypotheses, increased data on species diversity and disparity, and a better handle of the patterns of the archosaur radiation, particularly at the regional scale. Here we add to this growing body of research by examining archosauriform body size evolution during the early parts of their radiation. In general we are interested in examining the role body size played in the archosaur radiation. In particular, we looked to address the following questions: Is there a common pattern of body size change in the archosaur clades (Dinosauria, Pterosauria, Crocodylomorpha) surviving across the Triassic–Jurassic (T–J) boundary? Is the origin of Crocodylomorpha marked by a drop in body size or a trend in body size decrease? Do the rates of body size change in basal archosaurs vary among clades and through time? Using femoral length [FL] as a proxy for body size and a temporally calibrated phylogeny of Archosauriformes, we estimated ancestral body sizes among basal members of the clade using a maximum likelihood (ML) approach implemented in COMPARE. The fit of the data to a Brownian motion model was determined in BayesTraits and the estimates of the scaling parameters (k and d) were used in COMPARE. From these results we found the archosaurs crossing the T–J boundary show a wide range in ancestral body size values. Pterosaurs and basal crocodyliforms have the lowest values (~60 mm FL and ~80–90 mm FL, respectively). The dinosaur clades crossing the boundary were considerably bigger with sauropodomorphs over 190mm FL and theropods over 210 mm FL. Crocodylomorph origins are indeed characterized by a drop in body size (from ~290 mm FL to ~175 mm FL), however, both the relative amount of size change and the rate of size change is matched among other archosaur clades. A strict reading of the ancestral body sizes among loricatans would seem to suggest a progressive trend of body size decrease leading to the origins of crocodyliforms. To explicitly test if such a trend is present we used a generalized least squares (PGLS) approach implemented in BayesTraits to compared a neutral model to a model with an explicit directional bias. The directional model was not a better fit to the data (based on a likelihood ratio test) and therefore we could not reject the simpler non-directional model. Our results indicate that no directional trend in body size decrease was present on the evolutionary line leading to crocodylomorph or crocodyliform origins. Additionally, the PGLS analysis provides insight into the nature of archosaur body size evolution. The scaling parameter k adjusts individual branch lengths and can test for punctuational modes of evolution. The parameter d scales total path length and low values are evidence for adaptive radiations. The ML estimates of these values are both low (k=0.19, d=0.48) suggesting that the early evolution of archosaurs was marked by punctuated change with more change occurring earlier in the phylogeny. Examination of rates of body size change among archosaurs is supportive of this notion. The average rate of archosaur body size change was exceptionally high during the Induan and Olenekian stages (between 40 and 50mm/myr) but was followed by an abrupt drop to rates below 10 mm/myr for the remainder of the Triassic and into the Jurassic.

NEW DATA ON THE LATE TRIASSIC *VENATICOSUCHUS RUSCONII* (ARCHOSAURIA: PSEUDOSUCHIA) FROM THE ISCHIGUALASTO FORMATION, LA RIOJA, ARGENTINA

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The Family Ornithosuchidae von Huene, 1914 is a group of pseudosuchian archosaurs represented by three species, *Ornithosuchus longidens* Huxley, 1877, from the Elgin Sandstones (early Late Triassic), Scotland; *Riojasuchus tenuisceps* Bonaparte, 1967, from the Los Colorados Formation (late Late Triassic), Argentina; and *Venaticosuchus rusconii* Bonaparte, 1970. The latter species was collected near to Cerro Las Lajas in outcrops of the Ischigualasto Formation (western La Rioja Province), from Late Triassic beds that also yielded the archosaurs *Trialestes* and *Pisanosaurus*. *Venaticosuchus rusconii* was briefly described by Bonaparte in 1970 and is only known by the holotype that consists of an incomplete skull (*i.e.*, part of the palate, antorbital region, without most of the basicranium) and mandible in articulation. In 1971, this author assigned it to Ornithosuchidae based on the following characters: downturned premaxilla, two-tooth diastema between premaxilla and maxilla, and lower jaws shorter than the skull. The jugal of *V. rusconii* presents a single dorsal process that bifurcates in a Y-shaped fashion,

although the posterior ramus is broken. The lower jaws are shorter than the snout but extend further anteriorly than the posterior end of the external naris. The dentary bears two big caniniform teeth followed by very short teeth. The teeth disposition and the jugal morphology of *V. rusconii* resemble that of *R. tenuisceps* but differ from the latter in having an antorbital fossa that does not reach the alveolar margin of the maxilla. The anterior extension of the lower jaw of *V. rusconii* is similar to that of *O. longidens*. However, in contrast with *O. longidens*, but as occuring in *R. tenuisceps*, *V. rusconii* lacks a very short procumbent first tooth. Nevertheless, the absence of a surangular ridge and the depth of the parabasisphenoid recess sets *V. rusconiii* apart from the other two genera. The holotype of *V. rusconii* suffered some kind of pathology on the left side of the skull exhibiting an unusual outgrowth of facial bone. This pathology probably caused the thickened maxilla-jugal region and provoked the loss of the last two alveoli. In the present contribution, the cladistic analysis using a data matrix modified from Nesbitt (2011) supports the inclusion of *V. rusconii* in the Family Ornithosuchidae based on the following synapomorphies: absence of subnarial foramen between premaxilla and maxilla; palatal process of the maxilla not meeting at the midline; and absence of a foramen on the medial side of the articular. These preliminary results do not resolve the relationships within the ornithosuchids, but agree with Nesbitt (2011) in considering this family as the most basal pseudosuchians. These problems are probably caused by the incompleteness of the specimen, but a more detailed analysis of characters would help to resolve this issue in the future.

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POSTCRANIAL SKELETON OF *POSTOSUCHUS KIRKPATRICKI*

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Postosuchus kirkpatricki is a Late Triassic (Norian) rauisuchid paracrocodylomorph archosaur from the United States. Chatterjee (1985) initially included elements from two poposaurids into his description of the *Postosuchus* type material from the Post Quarry in the Cooper Canyon Formation of West Texas. Long and Murry (1995) later removed the poposaurid material, referring much of the postcranial material to *Shuvosaurus* and the ilium to a new taxon they erected, *Lythrosuchus*. Weinbaum and Hungerbühler (2007) synonymized *Lythrosuchus* with *Poposaurus* and erected a new species, *P. langstoni*. This confusion has prevented adequate description of the material. Re-preparation of the type material and examination of other fossil specimens of *Postosuchus* (especially from Arizona and North Carolina), and of related taxa has clarified the osteology of *Postosuchus*. The holotype and paratype specimens represent approximately 75% of the skeleton. With other referred material, *Postosuchus* remains one of the most completely known 'rauisuchids'. The paratype skeleton, which is relatively complete, would have reached approximately four meters in length, while the holotype specimen would have been closer to six or seven meters. Analysis of the postcranial skeleton of *Postosuchus* suggests that it was likely an obligate biped. This is based in part on limb proportions, which are similar to some theropod dinosaurs, the size of the manus (30% of the size of the pes) and the highly reduced nature of the manual digits, measurements of the vertebrae, which suggest that the center of gravity was directly over the pelvis, and the elongate, narrow pubis and ischium. Possible postcranial autapomorphies of *Postosuchus* include a large, rugose triangular supraacetabular buttress confluent with the dorsal margin of the iliac blade above the acetabular rim, and manus with recurved ungual present only on digit one, semi-opposable digit one, symmetrical pes with digits two and three being roughly equal in length.

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ARCHOSAUROMORPH BONE HISTOLOGY REVEALS EARLY EVOLUTION OF ELEVATED GROWTH AND METABOLIC RATES

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Bone histology has established that birds, dinosaurs, and pterosaurs grew at much higher rates and had much higher metabolic rates compared to extant crocodylians and other reptiles, but it remains uncertain when these features evolved, temporally and phylogenetically. The

study of key fossil taxa allows us to track changes in growth rate and its underlying metabolism through deep time and in taxa whose character states are not represented among living animals. We expanded the histological database of archosaurs and their ancestors to include early archosauromorph, pseudosuchian, and dinosauromorph taxa. Our study differs from previous works in its approach, phylogenetic breadth, and level of taxonomic sampling, but also in that we used apomorphy-based identifications for all specimens and sampled the same location on homologous elements from individuals of comparable ontogenetic stage. This allowed more rigorous control over factors affecting interpretations of histology and growth dynamics (*e.g.*, differences in ontogeny or biomechanics). We then mapped characters relevant to growth and metabolism (*e.g.*, osteocyte density, collagen organization, osteonal development, and vascularity) on a recent phylogeny of archosauromorph reptiles to assess where particular adaptations of growth dynamics first evolved, focusing on the lineages leading to Archosauria, Crocodylomorpha, Dinosauria, and Theropoda. Many histological features associated with high growth and metabolic rates in living birds evolved much earlier than the common ancestor of birds and pterosaurs, and several aspects of the accelerated growth syndrome did not evolve simultaneously. Most of these character changes accumulated in a short segment of the archosauriform tree before the end of the Early Triassic. Therefore, many physiological features related to high growth and metabolic rates of living birds evolved not in dinosaurs or the common ancestor of Ornithodira, but before the most recent common ancestor of crocodiles and dinosaurs.

SEGUNDO SIMPOSIO SOBRE EVOLUCIÓN DE CROCODYLIFORMES

Coordinadores: DR. DIEGO POL, DR. DOUGLAS RIFF Y DR. CHRIS BROCHU

A NEW NEOSUCHIAN CROCODYLIFORM FROM THE LOWER CRETACEOUS (LATE APTIAN) TWIN MOUNTAINS FORMATION OF NORTH-CENTRAL TEXAS

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A new genus and species of crocodyliform from the Lower Cretaceous (Late Aptian) Twin Mountains Formation of north-central Texas is described on the basis of a nearly complete skull. Its discovery at the Jones Ranch locality, in close association to the sauropod *Paluxysaurus jonesi* Rose, 2007, is significant for our understanding of both the local vertebrate fauna and the diversity of Crocodyliformes in Texas. The Jones Ranch taxon is comprised of partially articulated and disarticulated cranial material, missing only the premaxillae, left palatine, and left pterygoid. Skull morphology (teeth not constricted at base, frontal separated medially from orbital margin, shape and size of the supratemporal fenestra) suggests that the new taxon appears to be phylogenetically closer to Goniopholididae than to Eusuchia. It does not share the diagnostic goniopholidid depression on the posterolateral surface of the maxilla. The anterolateral process of the postorbital (present in goniopholidids, pholidosaurids, and dyrosaurids) is extremely elongate and closely resembles the condition observed in *Sarcosuchus* Brion and Taquet, 1966. Within the Twin Mountains Formation, the Jones Ranch locality is characterized by low diversity including multiple individuals of a single dinosaur and crocodyliform species but few other taxa. Deposition occurred in a seasonally dry fluvial environment, consisting of loosely consolidated channel sands and muds with pockets of hard, calcite cemented sandstone concretions. The Twin Mountains Formation lies at the base of the Lower Cretaceous Trinity Group of north-central Texas, and is considered to be no older than Aptian in age.

AFFINITY OF NORTH AMERICAN AND EUROPEAN *GONIOPHOLIS*

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Goniopholididae Cope, 1875, includes some of the most common, widespread, and distinctive crocodyliforms of the Late Jurassic and Early Cretaceous of Laurasia, and includes some of the first crocodyliforms to superficially resemble living forms. Goniopholidids from Europe and North America have historically been referred to the genus *Goniopholis* Owen, 1841. Recently, the affinity of North American forms with the nominally European *Goniopholis* has come under question. North American forms are morphologically distinct from their European counterparts. Phylogenetic analysis increasing taxon sampling to including the most comprehensive treatment of goniopholidids to date, including all currently-recognized Jurassic taxa, supports a monophyletic North American group distinguished from European forms in part by the palatal expression of the nasal passages, lacrimal which does not contact the orbit, and a different periorbital morphology of the frontal and prefrontal. As such, *Goniopholis* as currently understood is polyphyletic and North American forms, which are more closely related to Goniopholidids of Asia than Europe, should be re-ascribed to *Amphicotylus* (Cope 1878). In addition to taxonomic revision, these results have profound implications for the stratigraphic and biogeographic history of Goniopholididae with at least two morphologically and geographically isolated clades, as well as the evolution of Neosuchia as a whole with the required invocation of ghost-lineages for several Cretaceous groups extending to the early Jurassic.

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SKULL ANATOMY OF THE BIZARRE CROCODYLIAN *MOURASUCHUS NATIVUS* (ALLIGATORIDAE, CAIMANINAE)

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Mourasuchus Price, 1964, is a Miocene Alligatoridae endemic to South America and including four species. Together with the giant *Purussaurus* Barbosa-Rodrigues, 1892, *Mourasuchus* representa the most peculiar crocodylian taxon of South American Neogene Caimaninae and even one of the most bizarre forms between eusuchians crocodiles. The phylogenetic relationships between *Mourasuchus* species have never been explored and its sister-group relationship with North American Eocene *Orthogenysuchus olseni* Mook, 1924 (Aguilera *et al.*, 2006; Brochu, 1999) deserves consideration. Detailed skull descriptions of *Mourasuchus* are scarce (Langston, 1965) and only early and general descriptions of *M. nativus* (*e.g.*, Gasparini, 1985) are known. The main goal of this study is to provide new skull morphological data and cranial recesses of *M. nativus*, including a new CAT scan analysis (3D modeling). We observed that several diagnostic characters of *Purussaurus* given by Aguilera *et al.* (2006), such as nasal and lacrymal bones not in contact, nasal and frontal separated by prefrontal bones and posterior dorsal margin of the skull table strongly concave, are shared with *Mourasuchus. M. nativus* is characterized by the presence of solid transversal squamosal bumps, a large postemporal fenestrae and a latero-cudal bridge caudal to the lateral bridge of laterosphenoid and separating the V2–V3 trigeminal branches. Although the exoccipital in Caimaninae extends ventrally to the occipital tubera, in *M. nativus* these processes are short, as in *Alligator* Cuvier, 1807. The general morphology of the endocast of *M. nativus* is similar to that of the rest of crocodilians but more sigmoidal in lateral view. The supraorbital ramus of V2 is more vertically orientated than in other crocodiles and the tympanic trigeminal branch is thick, opening in a large foramen aligned with the trigeminal foramen. The tympanic ramus of the X nerve is also very thick compared with that of other crocodiles. Contrary to extant alligatorids, the medial pharyngeal recess remains pair along all its extension and only connects its symmetrical tube near the external ventral opening. This recess presents a peculiar dorso rostral projection that pneumatizes the basisphenoid and has no communication with the tympanic system. The knowledge of the internal anatomy of *Mourasuchus´* skull contributes to the understanding of the general morphology and its variations. This study provides a source of external and internal bone-characters, of which the implications in systematics, evolution and paleobiology should be tested.

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A HUGE LATE MIOCENE SPECIES OF *CAIMAN* (ALLIGATORIDAE, CAIMANINAE) FROM PRARANÁ, ARGENTINA

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The richest and most diverse record of Crocodyliformes in the South American Cenozoic corresponds to Neogene localities in basins surrounding the areas of Urumaco (Venezuela), La Venta (Colombia), Acre (northwestern Brazil), Fitzcarrald (Peru) and Paraná (Northeast Argentina). Late Miocene fossils from the Paraná area were recovered from the "Conglomerado Osífero" (Ituzaingó Formation) and assigned to several caimanine alligatorid taxa and one gavialoid. Rovereto (1912) was the first to carry out a more detailed study of the vertebrate fauna recorded there, providing clear illustrations and descriptions of several crocodylian taxa. *Alligator? ameghinoi* (Rovereto, 1912) was based on large isolated cranial and postcranial material. Among these we recognize a fragment of premaxilla with morphological features that match the rostral mor-

phology of a more complete new specimen housed in the Museo de La Plata, Argentina. We conclude that both specimens belong in the same taxon, *i.e.*, a large sized caimaninae alligatorid with a *Caiman*-like general morphology that differs from other large taxa such as *Purussaurus* Barbosa-Rodrigues, 1892, by the outline and proportions of the narial openings, a lower premaxilla in lateral view, and general morphology of the skull table. Snout features related to narial position, bone proportions and sculpturing differentiate this taxon from extant caimans. Although this species belonged to a broad snouted caimanine it differs from *C. latirostris* (Daudin, 1802) by not having conspicuous maxillary crests and by the presence of straight and relatively narrow nasals. Posteriorly, the internal carotid foramina are distinctively placed laterally and not on the occipital table. The basicranium is missing, allowing the construction of a latex endocast. As is generally the case for reptiles (Hopson, 1979), the brain itself did not fill the endocranial cavity, so the endocast is mainly that of the dural envelope. As in other caimanines, the brain endocast is slightly larger than in crocodylids and presents a relatively wider olfactory tract. There is no evidence of a marked large dorsal longitudinal sinus, as described in *Crocodylus* (Witmer *et al.*, 2008). The semicircular canals of the labyrinth of both inner ears are exposed by fractures, sowing three semicircular canals with a diameter of about 2mm. This Late Miocene taxon from Argentina represents one of the largest known species of *Caiman*, and to which numerous huge mandibular and postcranial remains found in the area of Paraná could possibly be assigned.

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SAMPLING STRATEGIES AND THE APPROACHING PARADIGM SHIFT IN CROCODYLIFORM PHYLOGENETICS AND CROCODYLIAN ORIGINS

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Although consensus exists over most aspects of crocodylian phylogeny, the gharials remain problematic –molecular data support a close relationship and Cenozoic divergence between the Indian (*Gavialis gangeticus*) and false (*Tomistoma schlegelii*) gharials, but morphological data draw *Gavialis* and extinct relatives to the base of Crocodylia. Morphological character matrices used to test crocodylian phylogeny have focused on species thought to belong to the crown group and the character information they preserve, but few other neosuchians have been included, primarily as designated outgroups. This might constrain analyses to place non-crocodylian taxa within the crown and, in turn, preserve a misleading signal with respect to character state polarity and rooting. We have expanded existing crocodylian matrices to include a larger range of neosuchians and relevant character variation. Maximum parsimony and Bayesian analyses of the larger data matrix reinforce the hypothesis that several alligator-like fossils from the Late Cretaceous of Europe, such as *Acynodon* and *Allodaposuchus*, are not crocodylians and may instead be hylaeochampsids. They also reveal outgroup-dependent instability on the position of *Borealosuchus* from the Cretaceous through Eocene of North America – when atoposaurids are included, they move from a position basal to Brevirostres to the base of Gavialoidea. The closest outgroups to Crocodylia (*e.g.*, Hylaeochampsidae, Paralligatoridae, Susisuchidae) are strikingly alligator-like in appearance and preserve character states previously viewed as synapomorphies for Alligatoroidea and subordinate clades. If these character states are instead plesiomorphic for Crocodylia, current morphological trees might be incorrectly rooted on gavialoids. Conversely, features previously optimized as shared plesiomorphies in basal gavialoids ("thoracosaurs") and *Borealosuchus* might actually be synapomorphies, calling the gavialoid affinity of "thoracosaurs" into question. Previous efforts at resolving the gharial problem focused on slender-snouted fossils, but resolution might instead come from fossils with very different specializations. The problem might not be the alleged inherent unreliability of morphological data, but inadequate taxon and character sampling – problems faced by all systematists.

USING *ITERPCR* SCRIPT IN THE SUPERTREE CONTEXT: AN EXAMPLE USING FOSSIL CROCODYLIFORMES

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With fossils found worldwide, Crocodyliformes stands as one of the best documented Mesozoic-Cenozoic vertebrate groups. The multiple phylogenetic studies of the group include many contentious hypotheses, partially because of a small overlapping of taxa between analyses and disagreeing homology statements. We built a species-level supertree of Crocodyliformes with emphasis on "non-Crocodylia", employing the potential of this kind of meta-analysis to summarize phylogenetic data into a synthetic consensus of the current knowledge on the evolutionary patterns of a given group. Numerical analysis of the MRP data-matrix derived from 97 source trees resulted in 722 MPTs, which were analyzed using the *IterPCR* script in the software TNT. This script was developed in the milieu of primary phylogenetic analyses to objectively identify unstable taxa that cause polytomies in the strict consensus trees, due to their missing entries or to conflicting information among characters. In the supertree context missing entries correspond to taxa that are poorly sampled in the source trees, whereas conflicting scoring represent alternative placement of a taxa in different source trees. In the Crocodyliformes supertree, the *IterPCR* script shows that 21 taxa are unstable due to its missing entries, whereas the instability of further three taxa apparently results from missing entries plus conflic-

ting characters which represent alternative placements for these taxa. Half of those poorly sampled taxa were described after 2001, and their instability may simply result from the fairly recent inclusion into phylogentic studies. Conversely, recently described taxa that do not form polytomies in the supertree but have alternative positions in the source trees will not be identified using the *IterPCR* script. This does not mean that they are well sampled, and the protocol is only effective to identify poorly-sampled taxa that are also unstable. Despite this bias the *IterPCR* script may represent an effective tool to spot taxa that should be included in future primary phylogenetic analyses, and recent works have advocated extensive taxon sampling to improve phylogenetic studies. This represents a entirely new level of applicability for this kind of meta-analysis. The potential of supertrees for macro-evolutionary studies was already recognized. In this scenario, the supertree of Crocodyliformes presented here represents the largest compilation of phylogenetic information for the group and can be used as a framework for future studies as already done for other important extinct vertebrate groups such as non-avian dinosaurs and Temnospondyli

PECTORAL AND FORELIM EVOLUTION IN CROCODYLIA

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Any statement about evolutionary morphological transformation of pectoral and forelimb bones in Crocodylia has been essentially based on qualitative observations. We explored the morphological variation and the covariation between scapula, coracoid, humerus, radius and ulna using 3D geometric morphometrics. The sample includes species of crocodylids, alligatorids and the gharial. The analyses showed that the variation of each element is concentrated in two dimensions: (1) its relative robustness, expressed as the relative increase in volume of distal and proximal articulations of the forelimb elements, and in the cranio-caudal width for pectoral elements, and (2) the torsion of the bones related with proximal and/or distal epiphyses in forelimb elements, and the bending for scapula and coracoid blades. Phenotypic integration was explored by testing the statistical covariation between bone elements. The statistical significance (p-values) and the degree of association (RV coefficient) between pairs indicated that most of the pair-wise comparisons tested were statistically significant. However, our analyses unexpectedly indicated that the coracoid-humerus pair bears a latent taxonomic signal (*i.e.*, separating Alligatoridae *vs.* Crocodylidae). The integration of such pair of bones addresses a gradient of bone robustness, thus stressing the presence of two trends in Crocodylia. We interpret that the morphological integration of this pair took place at a node in which critical skeletal reorganizations occurred in Crocodylia. Namely, we suggest that the Humerus-Coracoid pair is a module that remains evolutionarily preserved since the late Cretaceous. The robust configuration in alligatorids, in which the relative expansion of dorsal and ventral coracoid edges is correlated with the higher development of the distal and proximal humeral epiphyses, differs from that in crocodylids. This suggests differences in growth pattern between alligatorids and crocodylids as well as in their skeletal ossification that should be added to the deep divergence found in the phylogenetic and the ecological dynamics of these clades at a macroevolutionary scale.

CROCODYLIFORM EGG CLUTCHES FROM THE ADAMANTINA FORMATION (BAURU BASIN), UPPER CRETACEOUS OF BRAZIL

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Here we report on egg clutches consisting of almost complete eggs and eggshells from the Upper Cretaceous Adamantina Formation collected near Marília City, São Paulo State (Brazil). All clutches were found close to each other, distributed in a semicircle and associated with skeleton remains of the notosuchian crocodyliform *Mariliasuchus amarali* Carvalho and Bertini, 1999. The material consist of six egg clutches (MN 7242-V, MN 7243-V, MN 7244-V, MN 7245-V, MN 7246-V and MN 7247-V) deposited in the Paleovertebrate Collection of the Departamento de Geologia e Paleontologia, Museu Nacional/Universidade Federal do Rio de Janeiro. Each egg clutch has at least two eggs. Specimens MN 7242-V and MN 7247-V consist exclusively of eggshells, while MN 7243-V includes also some fragmentary bones. The remaining egg clutches are composed as follows: MN 7244-V, one well preserved and two partially preserved eggs; MN 7245-V, one well preserved and another incomplete egg; and MN 7246-V, two eggs in good condition. The eggs are elongated and elliptical with blunt ends, but all were subjected to lithostatic pressure that may have resulted in an increase in length and modified their original diameter. The size of the eggs was measured for the four most complete specimens and ranges from 33 mm to 47 mm in length, with the equatorial diameter varying from 23 mm to 33 mm. The length/diameter ratio for MN 7244-V is 1:0.69, for MN 7245-V it is 1:0.74, for MN 7246-V (specimen a) it is 1:0.73 and for MN 7246-V (specimen b) it is 1:0.66. The shape, size and association with remains of *M. amarali* indicate that the eggs are crocodiloid, tentatively assigned to oofamily Krokolithidae. This is one of the rare cases of egg clutches associated with a crocodyliform taxon reported in Brazil.

Carvalho, I.S. and Bertini, R.J. 1999. *Mariliasuchus*: um novo Crocodylomorpha (Notosuchia) do Cretáceo da Bacia Bauru. *Geologia Colombiana* 24: 83–105.

A CROCODYLIAN BRAINCASE NEOMORPH: THE EXTRA LATEROSPHENOID BRIDGE IN *MOURASUCHUS NATIVUS* (ALLIGATORIDAE, CAIMANINAE)

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The laterosphenoid bone in crocodylians is generally composed by a main body, a postorbital process, a capitate process, and several other processes of variable size and shape, including lateral and caudal bridges. The development of these structures is variable among mesoeucrocodylians, although they are both present in all extant species. The caudal bridge of the laterosphenoid encloses the supraorbital nerve and articulates with the quadrate. The lateral bridge encloses the soft tissues of the *cavum epiptericum*, including the ophthalmic ramus (V_1) of the trigeminal ganglion, the rostral trigeminal artery and a branch of the *vena capitis lateralis*, and it articulates with the pterygoid. Both bridges form a bony separation of underlying innervation and vasculature from the adductor chamber and the main trunks of the maxillary (V_2) and mandibular (V_3) rami of the trigeminal ganglion (Holliday and Witmer, 2009). V_2 and V_3 exit together from the midbrain through the large maxillomandibular foramen. However, juvenile and adult specimens of the late Miocene South American caimanine *Mourasuchus nativus* (Gasparini, 1985) exhibit what appears to be a third bridge transversally dividing the maxillomandibular foramen. This structure is formed by an ascending process from the lateral bridge of the laterosphenoid that sutures dorsally to a larger descending process of the quadrate. The quadrate portion of this third bridge emerges anteroventrally from the caudal border of the trigeminal fossa and in fact comprises the main part of this extra bridge. According to the position of this structure, we infer that it separated the root of the nerves V_2 and V_3 as they diverged from the trigeminal fossa. Such bony separation of the nerves V_2 and V_3 has not been described in any other taxon, although an analogous occurrence is described by Holliday and Witmer (2009) in the extant *Crocodylus palustris* Lesson, 1831. In this case, however, there is no additional bony bridge apart from the the caudal and lateral bridges, but a ventral enlargement of the caudal bridge of the laterosphenoid, which contacts the ventral portion of the lateral bridge, encircling V_2 and consequently separating it from V_3. In *Mourasuchus nativus* the caudal bridge, though robust, is not ventrally expanded and does not contribute to the extra bridge described here. The presence of this feature can be considered as a new autapomorphy of this very peculiar caimanine.

Gasparini, Z. 1985. Un nuevo cocodrilo (Eusuchia) Cenozoico de América del Sur. In: Departamento Nacional da Produção Mineral/Ministerio de Minas e Energia do Brasil, *Coletânea de Trabalhos Paleontológicos do IX Congresso Brasileiro de Paleontologia, Serie Geologia, numero 27, Seção Paleontologia e Estratigrafia 2*. DNPM, Brasilia, p. 51–53.

Holliday, C.M. and Witmer, L.M. The epipterygoid of Crocodyliforms and its significance for the evolution of the orbitotemporal region of Eusuchians. *Journal of Vertebrate Paleontology* 29: 715–733.

PRELIMINAR MORPHOMETRIC ANALYSIS OF THE SQUAMOSAL HYPERTROPHIES OF *MOURASUCHUS NATIVUS* (ALLIGATORIDAE, CAIMANINAE)

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Mourasuchus nativus (Gasparini, 1985) is distinguished from other species of the genus mainly by a peculiar horn-like hypertrophy on its squamosal bone that projects itself as a "platform", the longest axis of which is transversally oriented to the posterior edge of the skull table. First described from the late Miocene Ituizangó Formation of Argentina, this taxon was subsequently found in the late Miocene Solimões Formation in the northern Acre State, Brazil. Nine specimens were collected between 1987 and 2001 on the right bank of the Acre Riveral the locality known as Niterói site (10°08'30,0"S, 67°48'46,3"W), where the Solimões Formation is exposed. All nine specimens show extremely hypertrophied squamosals. They only differ in size, robustness, degree of fusion of the cranial sutures and by the proportions of their squamosal hypertrophies, so we interpreted such differences as ontogenetic variations, recognizing three adults, five juveniles and one intermediate, or sub-adult, specimen. We performed a preliminary morphometric analysis in order to investigate the presence of possible developmental patterns in the growth of the squamosal hypertrophies so typical of this species. These structures are thin and flat in the juveniles, while in the adults they are more voluminous and rounded. The hypertrophy of both squamosal bones of each specimen was measured in three dimensions: latero-medial width (W), antero-posterior thickness (T) and height (H). Results showed that the difference in measurements of W and T is greateer from the juveniles (~40 mm and 30 mm, respectively) to the intermediate (66 mm and 45 mm) than from the intermediate to the adults (~75 mm and 50 mm, respectively). The the difference of "H" is greater between the intermediate specimen (25 mm) and the adults (~50 mm) than between the juveniles (~20 mm) to the intermediate specimen. These results indicate that the hypertrophy of the squamosal bones in *M. nativus* had two distinct growing stages: the first one in width and thickness, and the second in height. Further advances in the description of these specimens and the application of a geometrical morphometric analysis should provide

a deeper knowledge on the anatomy and ontogeny of *Mourasuchus nativus*.

Gasparini, Z. 1985. Un nuevo cocodrilo (Eusuchia) Cenozoico de América del Sur. In: Departamento Nacional da Produção Mineral/Ministerio de Minas e Energia do Brasil, *Coletânea de Trabalhos Paleontológicos do IX Congresso Brasileiro de Paleontologia, Serie Geologia, numero 27, Seção Paleontologia e Estratigrafia 2*. DNPM, Brasilia, p. 51–53.

THE SKULL OF *JUNGGARSUCHUS SLOANI* AND THE ORIGIN OF THE CROCODYLIFORM SKULL

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Junggarsuchus sloani Clark *et al.*, 2004 was briefly described from an articulated skull and the anterior part of the postcranial skeleton discovered in the late Middle Jurassic portion of the Shishugou Formation, NW China. The skull shares several features with crocodyliforms not found in other "sphenosuchians," and the authors inferred it to be the sister-taxon to Crocodyliformes. Further preparation of the skull, completely removing all remaining matrix, modifies several interpretations of the cranial morphology but does not alter its phylogenetic position. A prominent anterolateral process on the basisphenoid is interpreted to be the basipterygoid process, so that the basisphenoid was not tightly sutured with the pterygoid as in crocodyliforms. An extensive lateral expansion of the braincase that is presumably pneumatic is formed largely by the quadrate and pterygoid rather than the basisphenoid. A ventrolateral extension of the basisphenoid is damaged but appears to be similar to one found in basal crocodyliforms. The dorsal head of the quadrate is relatively narrow mediolaterally, the postorbital is unusually small and does not border the supratemporal fenestra, and CT scans demonstrate that the supraoccipital was solid and not traversed by a pneumatic canal. The phylogenetic position of Junggarsuchus is modified only by consideration of the recently discovered "sphenosuchian" from Upper Jurassic sediments in Chubut, Argentina, which appears to be closer to crocodyliforms than is Junggarsuchus, to be discussed elsewhere in this symposium.

Clark, J.M., Xu, X., Forster, C.A., and Wang, Y. 2004. A Middle Jurassic 'sphenosuchian' from China and the origin of the crocodylian skull. *Nature* 430: 1021–1023.

NEW OCCURENCES OF PEIROSAURIDS TEETH AT BARREALES LAKE, NEUQUÉN PROVINCE, ARGENTINA.

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Upper Cretaceous continental outcrops belonging to the top of Portezuelo Formation, Río Neuquén Subgroup, Neuquén Group, lie exposed at Futalognko, on the northern shore of Barreales Lake, Neuquén Province, Argentina. Hundred of fossils have been collected at this locality, including bivalves, angiosperms, fish, turtles, pterosaurs, crocodiles, eggshell fragments, ornithopod, sauropod and theropod dinosaurs. Over the last years new taxa were described, such as *Futalognkosaurus dukei,* and *Unenlagia paynemili*, and also new material of *Megaraptor namunhuaiquii*. Calvo and Porfiri (2010) described a tooth under (MUCPv-411) and assigned it to the Peirosauridae based on morphological similarities to the teeth of *Lomasuchus palpebrosus* (Gasparini, Chiappe and Fernandéz, 1991), a peirosaurid found 5 km away from Futalognko. Here we present new occurrences of Peirosaurids teeth from Futalognko quarry. The analyzed material includes six teeth belonging to the Paleontological Collection in the Museum of the Universidad Nacional del Comahue, Centro Paleontológico Lago Barreales (MUCPv-525, MUCPv-1046, MUCPv-1111, MUCPv-1228, MUCPv-1316 and MUCPv-1317). All teeth show a very well marked basal constriction between the crown and the root. The crown is straight, its lingual face is slightly convex, and the labial face strongly convex. The crown is lancet-shaped on both faces, and carries finely serrated carinae. On the lingual face, a furrow runs close to the carinae, but is more visible on the anterior border. Denticles are straight and perpendicular to the margin. The denticle density per millimeter is 5 on the base of the tooth and 4 on the medial and apical portions. Based on comparison with the tooth described by Calvo and Porfiri, and on the localization of the finding, we conclude that these teeth belong to a peirosaurid, but no species-level identification is possible at this moment.

Calvo, J.O. and Porfiri, J.D. 2010. New material of peirosaurids from Neuquén, Patagonia: its age. *Brazilian Geographical Journal: Geosciences and Humanities research medium* 1: 50–64.

Gasparini, Z. Chiappe, L.M. and Fernández, M.A. 1991. New peirosaurid (Crocodylomorpha) from Argentina and a synopsis of the South American Cretaceous crocodilians. *Journal of Vertebrate Palaeontology* 11: 316–333.

THE CERVICO-THORACIC REGION IN CROCODYLIA

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The morphology of the crocodylian vertebral column has been scarcely studied and, so far, available studies are essentially descriptive.

Here we present a quantitative approach using 3D geometric morphometrics to analyze morphological variation of the vertebral column in Crocodylia, focusing on the cervical-thoracic region (from the third cervical, C3, to the second dorsal, D2). The sample (32 specimens) covers a high diversity of Crocodylia, encompassing 16 species of Crocodylidae (several species of *Crocodylus* Laurenti, 1768, *Tomistoma shclegelii* Müller, 1838, and *Osteolaemus tetraspis* Cope, 1861), Alligatoridae (*Alligator mississippiensis* Daudin, 1802, and *A. sinensis* Fauvel, 1879, *Caiman crocodilus* Linnaeus, 1758, and *C. yacare* Daudin, 1802, *Melanosuchus niger* Spix, 1825, and *Paleosuchus palpebrosus* Cuvier, 1807) and Gavialidae (*Gavialis gangeticus* Gmelin, 1789). The segment of vertebral spine studied reflects an intimate pattern of rib and vertebral shape variation. On the other hand, the analyses revealed a distinction between two subregions –a cranial (C3 to C6) and a caudal (C7 to D2) subregion– which do not coincide with the cervical-thoracic boundary. On the contrary, such split between two subregions of vertebral variability coincides topographically with a domain of *Hox*-4 expression in early crocodylian axial patterning. The correspondence between the latter variation pattern and the regional arrangement of other muscule-skeletal elements (dermal shield, and neck musculature), strongly suggest that the crocodylian axial column is highly integrated and conservative throughout the lineage. However, given that intracolumnar variation may be the by-product of other latent mechanisms, we also explored the individual variation of each vertebra at their corresponding position. Unexpectedly, we identified a phylogenetic signal on the basis of subtle morphological differences between vertebral positions. Namely, Alligatoridae and Crocodylidae can be differentiated by the association between the relative size and orientation of their neural spines and hypapophyses. In Crocodylidae these structures are relatively longer at the cranial cervical region (C3–C6), possibly reflecting the influence of an overdeveloped musculature to support their sturdier skull. In Alligatoridae hypapophyses are relatively larger and more cranially oriented at the cervico-thoracic region (C7–D2). The vertebral morphology of *G. gangeticus* is more similar to the pattern of variation detected in Crocodylidae. Nevertheless, more specimens of *G. gangeticus* are required to support this observation.

THE MORPHOLOGICAL DIVERSITY OF CROCODYLIFORMES

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Compared to the conservative bauplan of extant crocodylians, fossil Crocodyliformes, especially the Mesozoic radiation, show a diverse set of highly divergent morphologies. Unlike modern crocodiles, whose morphological uniformity is linked to their shared semi-aquatic habits, fossil Crocodyliformes were morphologically and ecologically diverse, suggesting that extant forms only occupy a tiny fragment of the range of morphologies this clade once inhabited. Although the extremes of such divergent taxa are well studied, such as the pelagic Thalattosuchia or the terrestrial Baurusuchia, the range of morphological diversity within this group has yet to be analysed. Few attempts have been made to study the evolution of disparity (morphological diversity) within Crocodyliformes and most discussions remain mostly speculative. Here we examine both disparity and morphospace occupation among Crocodyliformes using a large, well resolved character dataset. We show that there is clear morphospace separation between various clades and examine rates of evolutionary dissimilarity between and within specific clades. We also examined the significance of non-phylogenetic factors such as body size, ecology, and clade age on the underlying trends presented. Combining evolutionary rate analysis with morphospace occupation provides new insights into the evolutionary history of Crocodyliformes.

PHYLOGENETIC SYSTEMATICS AND BIOGEOGRAPHIC HISTORY OF NEOTROPICAL *CROCODYLUS*

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The taxonomy of Neotropical *Crocodylus* is widely accepted and divides the genus into four species: *C. acutus*, *C. moreletii*, *C. rhombifer* and *C. intermedius*, although the systematics for this group remains unclear. Long-term conservation for the Neotropical crocodiles requires a holistic approach in order to establish clear species boundaries and accurate levels of intraspecific diversification. With the development of strategies that combine different methodologies such as DNA sequence analysis, geometric morphometrics and geographic computation, new avenues have been opened to generate integrative phylogeographic analyses that have greater resolution. This type of approach also facilitates design and implementation of more effective management and conservation plans. Our research focuses on establishing the phylogenetic systematics and phylobiogeographic history of evolutionary units comprising the genus *Crocodylus* in the Americas, using molecular, morphological, climatic and geographic data. Preliminary molecular and morphometric results have shown that this genus is considerably more diverse than initially thought within the Neotropics. Preliminary 2-D geometric morphometric analyses conducted on a total of 68 Neotropical *Crocodylus* skulls indicate that *C. acutus* occupies a very large area of morphospace while the other three species have somewhat more specialized morphospace occupation. Using 256 samples across the natural distribution of Neotropical crocodiles, we amplified 2,220 base pairs from two mitochondrial genes (CO1 and *Cyt-b*) and one nuclear gene (RAG-1), as well as 7 microsatellite markers. The results of these phylogenetic analyses are not concordant with the current recognized taxonomy of Neotropical *Crocodylus*, due to the paraphyletic positioning of a number of *C. acutus* with respect to *C. rhombifer* and *C. intermedius*. We identified a 1% divergence between *Crocodylus* species in the Greater Antilles and a 1.4% divergence between two South American morphospecies. The genetic divergence between *C. acutus* in Cuba compared to any mainland *C. acutus* clade is approximately 8%. Molecular data have shown that the Neotropical *Crocodylus* group is comprised of five major clades that currently defy their taxonomic status. Since *C. acutus* was originally described by Cuvier (1807) using a specimen from the island of Hispaniola,

our results indicate that a number of crocodiles collected from Central and South America represent taxonomic units that have not currently been described; as a result we propose a complete taxonomic review for members of Neotropical *Crocodylus*.

POSTCRANIAL ANATOMY AND PHYLOGENETIC POSITION OF *PEPESUCHUS DEISEAE* (CROCODYLIFORMES: MESOEUCROCODYLIA) FROM THE UPPER CRETACEOUS BAURU GROUP, BRAZIL

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The Cretaceous deposits of the Bauru Group have yielded several well-preserved crocodyliform specimens over the past few years. This fauna is typically represented by terrestrial animals such as notosuchians and sebecians (including Peirosauridae). *Pepesuchus deiseae* Campos, Oliveira, Figueiredo, Riff, Azevedo, Carvalho and Kellner, 2011, was recently described from the Upper Cretaceous (Campanian–Maastrichtian) Presidente Prudente Formation of Brazil. The holotype (MN7005-V) comprises the skull, lower jaw, bones of the fore and hind limbs and the pelvic girdle, dorsal, sacral and caudal vertebrae, and osteoderms. The general morphology of the appendicular skeleton is rather derived, similar to that of extant eusuchians. The forelimb is shorter than the hind limb. The sigmoid femur presents a well-developed fourth trochanter and is longer than both the tibia and the humerus. The fibula presents a strongly bent diaphysis and its proximal articular surface has a sharp projection. The phalangeal formula of the manus is 1:2:3:4:3 and long and curved unguals are present on the first three digits. However, the axial skeleton presents basal features. All vertebrae are amphicoelous. The dorsals are more cylindrical in shape and the caudals are spool-shaped and laterally compressed. There are two sacral vertebrae. The rectangular osteoderms are highly ornamented, with a smooth anterior articular surface and no anterolateral processes. The dorsal transverse rows are formed by only two osteoderms. *Pepesuchus deiseae* presents some cranial features traditionally linked to Peirosauridae (*e.g.*, five premaxillary teeth, the two anterior premaxillary alveoli nearly confluent). The current phylogenetic status regarding these crocodyliforms is disputed and the monophyly of Peirosauridae is one of the major issues about the systematic affinities of Sebecia. A cladistic analysis of 252 characters for 43 ingroup taxa was performed in order to establish the phylogenetic positiong of *Pepesuchus deiseae*. Two most parsimonious trees of 1018 steps were found after 1000 replications. The sebecians form a monophyletic group, but a monophyletic Peirosauridae was not recovered in this analysis. *Pepesuchus deisae* was found to be the sister taxon of *Stolokrosuchus lapparenti* Larsson and Gado, 2000.

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IN THE LAND OF THE CAIMAN, THE CROCODILE IS KING: ON THE PRESENCE OF *CROCODYLUS* IN THE QUATERNARY OF BRAZIL

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The fossil record of crocodylians in Brazil is sparse during the Paleogene and Quaternary. Conversely, the Brazilian Neogene has a diverse and abundant record of at least a dozen species, including alligatorids, crocodylids and gavialids. Fossils of true crocodiles (genus *Crocodylus* Laurenti, 1768) have not been yet described from South America, even though two species are known from the area today. Here we present a new species of *Crocodylus*, the first from Brazil, from deposits only forty thousand years in age (latest Pleistocene) from the Rio Madeira Formation, collected in the Rio Madeira channel, close to the border between Rondônia State (southwestern Amazonia) and Bolivia. This is the first true fossil crocodile from South America, and may be the first fossil species from the Quaternary of the Americas, depending on the validity of *Crocodylus antillensis* Varona, 1966. The fossil is a nearly complete 60 cm long skull, with a narrow and low shape. It shows the common features of true crocodiles, *i.e.*, fifth maxillary tooth developed, notch for the fourth dentary tooth and expanded quadrate medial hemicondyles. The specimen is morphologically similar to the Orinoco crocodile (*C. intermedius* Graves, 1819), but shows some distinctive features that led us to erect a new species. A phylogenetic analysis was conducted using a total of 33 characters and 18 taxa in the final dataset, based mainly on the previous work of Brochu *et al.* (2010). Four osteolaemines were chosen as outgroups, and 14 species of *Crocodylus*, extant and extinct. The analysis resulted in 12 most parsimonious trees. All of them depict the new material and *C. intermedius* as sister groups, supporting their close relationship. We propose a biogeographic hypothesis to explain the presence of *Crocodylus* in Brazil. A dispersal event might have occurred from the Orinoco Basin to the Amazon Basin across the Cassiquiare Channel, a distributary of the upper Orinoco, which flows southward into the Rio Negro, connecting both hydrographic basins. A posterior migration to the Madeira River might have occurred. This scenario suggests the presence of crocodiles in other parts of the Amazon Basin. The population of crocodiles in Rondônia probably underwent extinction du-

ring the Last Glacial Maximum (LGM), when the Amazon rainforest retracted and open areas expanded. This hypothesis is commonly used to explain the extinction of the megafauna. Ecological Niche Modeling was conducted to test the geographical occurrence of *C. intermedius* along with the present environmental data, data from the LGM (21 kya) and from the Last Interglacial (120–140 kya). Results indicate that the southwestern Amazon was a potential distribution area during the Last Interglacial, but not during the LGM, supporting the extinction hypothesis related to climatic changes. Including this new species, Brazil becomes the country with the highest biodiversity of crocodylians during the Quaternary, being not only important for the evolutionary history of caimans, but also for that of crocodiles.

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A POSSIBLY JUVENILE BAURUSUCHID LOWER JAW FROM THE LATE CRETACEOUS OF MINAS GERAIS (BRAZIL)

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The assignment of different ontogenetic stages to the same vertebrate taxon is relatively uncommon in the fossil record. Deposits of the Vale do Rio do Peixe Formation (Bauru Group, Late Cretaceous) in Campina Verde (Minas Gerais, Brazil), have yielded several crocodyliform specimens, all likely referable to a new baurusuchid. Some of the fossils correspond to small individuals, which may represent the first juveniles recognized for this group of crocodyliforms. The best preserved of the specimens corresponds to the rostral portion of the mandibular rami, including 13 cm long dentaries with teeth. The splenial and parts of the angular are also preserved on the inner surface of both rami. The mandibular symphysis is composed of both splenial and dentary, and the suture between these bones extends, transversally, from the level of the sixth to that of the eighth tooth. Each dentary bears ten alveoli, eight of which are within the symphyseal region. The fourth tooth is hypertrophied. The assignment of the specimen to Baurusuchidae is supported by the presence of ziphodont teeth, an extensive mandibular symphysis, the sigmoidal arrangement of the tooth rows in dorsal view, the orientation of the anterodorsal margin of the symphysis at an angle of 45°, and a longitudinal depression in the lateral surface of the dentary. The comparison of the partial jaw to those of larger individuals (possibly adults) allows the recognition of anatomical differences that may be related to ontogeny. Among these, the presence of procumbent alveoli in the symphyseal region of the new specimen is remarkable. This condition is better seen in the first tooth, the alveolus of which forms an angle of approximately 146° to the long axis of the mandibular ramus. This pattern differs from that found in adult baurusuchids, such as *Baurusuchus salgadoensis* (Carvalho et al., 2005), in which the angle is about 135°. Yet, in basal mesoeucrocodylians such as *Araripesuchus* (Sereno and Larsson, 2009), *Mariliasuchus* (Carvalho and Bertini, 1999), and other "notosuchians" (Nobre and Carvalho, 2006; Marinho and Carvalho, 2009; Novas et al., 2009), procumbent mesial teeth are seen both in juveniles and adults. If this represents the plesiomorphic condition to Baurusuchidae, the modification seen in adults of the group (non-procumbemt mesial teeth) may be interpreted as peramorphic. At the same time, however, this represents the general condition among Crocodyliformes. Accordingly, further data may reveal that the procumbent mesial teeth in adults of some "notosuchians" are paedomorphic, corresponding to the retention of an otherwise more typically juvenile condition.

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TESTING FOR GENETIC INTROGRESSION WITHIN MORELET'S AND AMERICAN CROCODILES IN MEXICO: USING 40 MICROSATELLITES

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Although introgressive hybridization is an important evolutionary process, it is considered extremely rare and difficult to prove in animal spe-

ciation. However, hybridization is considered a very important aspect in the conservation of biodiversity, especially in the case of conserving natural populations of charismatic fauna, such as crocodilians. Molecular genetic analyses have shown to be useful tools in testing for ancient and current hybridizations in several taxa, as well as in crocodilians. Our study is focusing on testing 40 microsatellite loci out of the 253 isolated and characterized from the saltwater crocodile (*Crocodylus porosus*), for cross-species amplification and polymorphism in American (*C. acutus*) and Morelet's (*C. moreletii*) crocodiles collected from various localities within Mexico. The utilization of a large set of multi-locus markers, will not only help to understand the evolutionary history of Neotropical Crocodilians, but to also increase our knowledge of current population dynamics that ultimately lead to the development of better management and conservation plans. Our preliminary results have found consistent cross-species amplification for 20 out of the 40 markers in both pure and hybrid species and indicate differing degrees of genetic variation. From the 20 microsatellites, 7 of them showed varying degrees of intra-specific polymorphisms. The other 13 markers showed different grades of inter-specific genetic variation. We are currently testing these 20 markers on 17 individuals chosen randomly (5 *C. acutus*, 7 *C. moreletii*, and 5 Hybrids) from 9 different localities within the Yucatan Peninsula. The purpose of the poster is to present the methodology and preliminary results of our research.

EFFECTS OF SHORT-SNOUTED DYROSAURIDS FROM COLOMBIA ON THE PROBLEM OF LONGIROSTRINE RELATIONSHIPS WITHIN CROCODYLIFORMES

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Since the earliest studies of crocodyliform phylogeny, there has been a problem of association of long-snouted taxa grouping together, united solely by characters associated with longirostry. The most problematic of these associations is pairing of the dominantly Jurassic thalattosuchians with the Cretaceous Pholidosauridae (Zittel and Eastman, 1902) and Cretaceous/Paleogene Dyrosauridae (de Stefano, 1903). Dyrosauridae and Pholidosauridae are shown to share a close relationship, irrespective of longirostry, and are also both known from Cretaceous African deposits. However, in many studies when Dyrosauridae is removed, thalattosuchians instead place very basally within Crocodyliformes, closer to other Jurassic taxa. Dyrosauridae is an extinct family known for having long, narrow snouts, thus explaining their convergence with thalattosuchians. Longirostrine dyrosaurids have been found in Africa, South America, North America, Europe, and Asia. Two dyrosaurid taxa (one recently described and one undescribed) from the Paleocene of Colombia represent the shortest-snouted forms which can still be definitively diagnosed to Dyrosauridae. Initial study using a character matrix developed for all dyrosaurids has placed these and *Chenanisuchus* (Jouve *et al.*, 2005), the only other known short-snouted dyrosaurid, as some of the basal-most members of Dyrosauridae. This suggests a possible shorter-snouted condition being primitive for Dyrosauridae, which may indicate the family was instead derived from a shorter-snouted lineage. An analysis developed for testing relationships across Crocodyliformes was run using 234 cranial, mandibular, and postcranial characters for 49 taxa. All characters were unordered and unweighted. Thalattosuchians, pholidosaurids, and dyrosaurids still share a close relationship in the current analysis. When dyrosaurids are removed, thalattosuchians and pholidosaurids remain paired. When characters for longirostry are removed, Dyrosauridae and Pholidosauridae remain paired, and thalattosuchians occur in a basal position within Crocodyliformes between protosuchians and notosuchians. The retention of these relationships, despite the shorter-snouted forms outnumbering the longirostrine dyrosaurids in the analysis, suggest the validity of the pholidosaurid relationship with dyrosaurids and the pervasiveness of the longirostrine problem, such that even only moderately elongate skulls still allow convergence to drive topology. The addition of more long- and short-snouted taxa to the analysis would likely improve results and help to mollify this problem.

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SISTEMA NEUMÁTICO PARANASAL Y ESTRUCTURAS ASOCIADAS EN *CRICOSAURUS ARAUCANENSIS* (THALATTOSUCHIA: CROCODYLOMORPHA): CORRESPONDENCIA ENTRE MOLDES NATURALES Y DIGITALES

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El estudio del sistema neumático paranasal en Archosauria está casi exclusivamente sustentado sobre la base de modelos digitales generados a partir de tomografías axiales computadas (TAC) (*e.g.*, Sampson y Witmer, 2007; Witmer y Ridgely, 2008; Tahara y Larsson, 2011). La preservación de moldes naturales de dicho sistema es sumamente escasa, por lo que el descubrimiento de moldes naturales, de excelente calidad, de la región preorbital de *Cricosaurus araucanensis* (Gasparini y Dellapé, 1976) adquiere particular relevancia. El contar con moldes naturales, así como con cráneos de una misma especie y preservados en tres dimensiones, permitió reconstruir el sistema de senos paranasales sobre la base de los moldes naturales y, a través de TAC, reconstruir las mismas estructuras digitalmente. La morfología general que se recupera con el modelo digital, tanto de la cavidad nasal como de las estructuras asociadas, es similar a la obtenida a partir de los moldes naturales, aunque en cada caso se recuperan detalles diferentes. En ambas reconstrucciones se pudo identificar parte de la cavidad nasal (*i.e.* la cavidad nasal propia

y los ductos nasofaríngeos) y el seno antorbital. En los moldes naturales el seno antorbital de *C. araucanensis* está preservado hasta el nivel de la coana primaria. No obstante, mediante TAC se pudo comprobar que este seno se continúa anteriormente en el maxilar. La extensión total, el curso y las evaginaciones de dicho seno dentro del maxilar sólo fueron identificables a partir del modelo digital. La morfología en detalle de las estructuras identificadas por Fernández y Gasparini (2000, 2008) como glándulas exocrinas hipertrofiadas para la excreción de sales (*i.e.*, "glándula de la sal"), sólo pudo ser recuperada a través de los moldes naturales. Así, la reconstrucción digital no recupera el detalle de la presencia de lóbulos bien definidos sobre el cuerpo glandular. En el caso de la región preorbital de *C. araucanensis,* los moldes naturales brindan detalles que no son factibles de reconstruir digitalmente. Además del ejemplo antes mencionado, sólo los moldes naturales permitieron identificar la presencia de un divertículo suborbital, la separación de la cavidad nasal propia en dos regiones (aquí identificadas como la región respiratoria y la olfatoria), así como el relleno de varios vasos sanguíneos sobre las superficies de la cápsula nasal cartilaginosa, sobre las "glándulas de la sal" y sobre los ductos nasofaríngeos.

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A NEW EUSUCHIAN CROCODYLIFORM WITH A NOVEL DISPLAY STRUCTURE AND ITS SIGNIFICANCE FOR THE ORIGIN AND EVOLUTION OF CROCODYLIA

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The adaptive significance of bizarre cranial structures adorning fossil species remains a contentious topic in archosaur paleobiology and animal behavioral evolution. Cranial display structures akin to crests, frills, and bosses are common among avemetarsalian archosaurs but have been absent from the crocodylomorph fossil record. We describe a new, giant crocodyliform from the early Late Cretaceous (Cenomanian) Kem Kem Beds of Morocco sharing several features with the enigmatic stomatosuchids. Represented only by cranial remains, the specimen has an extremely long, flat skull and a novel integumentary display structure previously unknown for crocodyliforms. The frontals are ornamented by a series of thick obliquely-oriented parallel ridges which expand caudally to form a broad, circular, rough bony integumentary boss on the parietal. The boss is surrounded by a broad, smooth, shallow fossa that communicates with deep vascular grooves which emerge from small, constricted, dorsotemporal fossae. These features support the presence of an integumentary display structure likely used in mate selection and thermoregulation. The skull bears a massive, rostrally-situated adductor tubercle, large, sub-horizontally oriented fossae for jaw closing muscles and immense post-occipital protuberances indicating the animal had a very flat profile. The laterosphenoid bodies have small isolated, vestigial epipterygoids allying the taxon with derived neosuchians (Holliday and Witmer, 2009). Applying previous regression analyses from *Alligator* (1802) skull table width and crocodyliform brain size suggests that the skull was well over 2 meters long. Separate phylogenetic analyses using crocodyliform (Sereno and Larsson, 2009) and crocodylian (Delfino *et al.*, 2010) matrices found the taxon, and its sister taxon *Aegyptosuchus peyerii* (Stromer, 1933), to be a derived eusuchian and the sister clade of crown-clade Crocodylia making this group the earliest eusuchian crocodyliforms known from Africa and suggesting modern crocodylians may have circum-Tethyan rather than North American origins.

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A NEW METRIORHYNCHID (CROCODYLIFORMES, THALATTOSUCHIA) FROM THE EARLY CRETACEOUS OF COLOMBIA (ROSABLANCO FORMATION, LATE VALANGINIAN)

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Metriorhynchidae are the only known fully pelagic archosaurs and have highly morphologies compared to other Crocodyliformes. The monophyly of this clade is well established and strongly supported by numerous cranial and postcranial characters, not all of them solely related to their unique lifestyle. Metriorhynchidae was a numerous and diverse group, whose diversity peaked in the Jurassic when they were a ubiquitous component in both Laurasian and Gondwanic marine deposits. The diversity of the clade declined in the Early Cretaceous as taxa became geographically restricted to localities in the northern Border of the Tethys in Europe and less common within those deposits. Here we report a new Early Cretaceous metriorhynchid crocodyliform based on a nearly complete skull and postcranial remains from the Rosablanco Formation of Colombia. This locality is within the *Sayonoceras verrucosum* Amonite Zone, which indicates an early late Valanginian age in the Tethian realm. A preliminary parsimony analysis recovered the Colombian taxon as a member of the Metriorhynchinae subgroup, forming a clade with *Cricosaurus*. This represents the first definitive Cretaceous metriorhychid from the southern border of the Tethys, and has significant implications for understanding the evolutionary history of the group. In addition to expanding the range of Early Cretaceous Metriorhynchidae, this discovery has implications for understanding the evolution of the Juro-Cretacic Tethian ecosystem, because metriorhynchids were apex pelagic predators. The discovery of this new taxon from the upper limit of the temporal range of Metriorhynchidae reveals new insights into the diversity of this group, as well as helping to map the decline and eventual extinction of the clade.

THE HOMOLOGY OF THE ANTORBITAL FENESTRA OF METRIORHYNCHIDAE (CROCODYLIFORMES, THALATTOSUCHIA)

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The antorbital fenestra is a structure associated with a pneumatic feature of the skull, the paranasal cavity, diagnostic of Archosauriformes (Witmer, 1997). In metriorhynchid crocodyliforms the structure of this fenestra contrasts strongly with the condition of other crocodyliforms (as well as other archosaurs), as it involves the participation of the nasals on the edges of the fenestra, is not exposed in lateral view, and is enclosed within a deep oblique fossa. Fernandez and Herrera (2009) have recently questioned the homology of the fenestra of metriorhynchids with that of other archosaurs, based on the interpretation of exceptionally preserved natural inner casts of metriorhynchid rostra. In this contribution we test alternative homology hypotheses for these cranial openings using the dynamic homology approach (Ramirez, 2007). As the phylogenetic position of thalattosuchians is still debated, we evaluate the different homology scenarios using three alternative topologies that represent the three possible phylogenetic placements of thalattosuchians: as neosuchians, as basal mesoeucrocodylians and as basal crocodyliforms. Our results indicate the fenestra located anterior to the orbit of metriorhynchids is most parsimoniously interpreted as non-homologous to the antorbital fenestra of all other Crocodyliformes, regardless of the phylogenetic position of Thalattosuchia. This implies that metriorhynchids have internalized their antorbital cavity early in their evolutionary history and developed a neomorphic preorbital opening. These results are consistent with previous contributions and with the most parsimonious topology recovered in recent analyses for the group, as they are found as members of Neosuchia, a clade of crocodyliforms in which the antorbital fenestra is usually closed. The fenestra of basal thalattosuchians ("teleosaurids") is instead most parsimoniously interpreted as homologous with the antorbital fenestra of other archosaurs, although further studies of the internal anatomy of their rostrum are critical to fully evaluate the homology of the small opening present in these taxa.

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Fernández, M. and Herrera, Y. 2009. Paranasal sinus system of *Geosaurus araucanensis* and the homology of the antorbital fenestra of metriorhynchids (Thalattosuchia; Crocodylomorpha). *Journal of Vertebrate Paleontology* 29: 702–714.

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CROCODYLIFORM AFFINITIES OF *KEMKEMIA AUDITOREI* CAU AND MAGANUCO, 2009, FROM THE LATE CRETACEOUS OF MOROCCO

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Kemkemia auditorei Cau and Maganuco, 2009, was recently described as a new genus and species of theropod dinosaur on the basis on an

isolated distal caudal vertebra. The holotype and only known specimen comes from the Kem Kem beds (Upper Cretaceous) of Morocco. In this contribution we review the phylogenetic position of *Kemkemia* and we conclude that this taxon belongs to Crocodyliformes. It shares with crocodyliforms the presence of a concavity at the posterolateral margin of the neural spines, an inflated neural canal, and reduced prezygapophyses, among other traits. This combination of characters clearly distinguishes *Kemkemia* from theropod dinosaurs. Thus, *Kemkemia* is herein considered as a Crocodyliformes *incertae sedis*; based on the absence of unique characters, the genus and species *Kemkemia auditorei* is deemed to be a *nomen dubium*.

Cau, A. and Maganuco, S. 2009. A new theropod dinosaur, represented by a single unusual caudal vertebra, from the Kem Kem Beds (Cretaceous) of Morocco. *Attidella Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 150: 239–257.

FIRST RECORD OF A NON-MARINE CROCODYLOMORPH (ARCHOSAURIA) FROM THE UPPER JURASSIC OF CHILE

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The Jurassic record of South American crocodylomorphs is strongly biased towards marine forms (Pol and Gasparini, 2007). Here we present the first record of a non-marine Crocodylomorpha from the Late Jurassic of Patagonia. The specimen comes from the continental Tithonian Toqui Formation, cropping out close to Lake General Carrera, Southern Chile. This sedimentary unit has yielded abundant remains of theropod dinosaurs (Salgado *et al.*, 2008) as well as yet undescribed remains of sauropods and ornithopods. The specimen (field collection number CH8059) includes a right femur, isolated posterior dorsal vertebrae, and several incomplete osteoderms. It belongs to a small animal with a femur length of 75mm. Available osteoderms show a straight posterior margin, a character that is present in Mesoeucrocodylia. However, the absence of both a median dorsal keel and anterolateral processes, supports the exclusion of the Chilean specimen from basal mesoeucrocodylians and goniopholids. The osteoderms also exhibit neosuchian characters, including the presence of anterior surface for articulation with the preceding osteoderm, and a pitted dorsal surface. The femoral shaft is strongly sigmoid, and its distal condyles are asymmetrical, contrasting with the symmetrical condition of notosuchians and sebecosuchians, but resembling eusuchians. Available vertebrae are amphicoelous, in contrast with the procoelous condition of derived Neosuchia. The new form helps to expand the poor fossil record of Jurassic terrestrial crocodylomorphs, and documents that small-sized neosuchians formed part of continental assemblages dominated by dinosaurs.

Pol, D. and Gasparini, Z.B. 2007. Crocodyliformes. In: Gasparini, Z., Salgado, L. and Coria, R. (Eds.), *Patagonian Mesozoic Reptiles*. Indiana University Press, Bloomington, p. 116–142.

Salgado, L., De La Cruz, R., Suárez, M., Fernández, M., Gasparini, Z.B, Palma-Heldt, S. and Fanning. M. 2008. First Late Jurassic dinosaur bones from Chile. *Journal of Vertebrate Paleontology* 28: 529–534.

BAURUSUCHID EGGS FROM THE VALE DO RIO DO PEIXE FORMATION (BAURU GROUP), UPPER CRETACEOUS OF MINAS GERAIS, BRAZIL

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The Vale do Rio do Peixe Formation (VRPF) is the most extensive superficial stratigraphic unit in the Bauru Group and has been alternatively dated as Turonian–Santonian or Campanian–Maastrichtian. The body-fossil record of crocodyliforms in this unit is one of the most extensive of Gondwana, but oological reports are more restricted. Previous crocodyliform egg/eggshell occurrences in the VRPF are limited to São Paulo State, but further material was recently recovered from a single outcrop in Minas Gerais (19°20′41.8″S–49°55′12,9″W), in the northernmost exposures of the stratigraphic unit. Twelve eggs were found in three associations of four eggs. Seven of them are weatheres, and the other five are complete with no signs of hatching, crushing, or predation. The four largest eggs are clustered and have a main axis length ranging from 7.2 to 4.2 cm. Likewise, the four smallest eggs are also clustered (main axis ranging from 6.6 to 3.4 cm). The assignment of the eggs to Crocodyliformes rests on their elliptical shape with blunt ends and the smooth to slightly rough outer surface. The same outcrop also yielded a rich monospecific association of skeletal remains attributed to a new baurusuchid, including five skulls, some with articulated post-crania, ranging from juveniles to fully grown animals. This strongly suggests the association of the eggs to those baurusuchid body-fossils (Mikhailov *et al.*, 1996). This taphocoenosis composed of articulated skeletons and the particularly fragile crocodyliform eggs (Grellet-Tinner *et al.*, 2006) precludes long-range transport that would probably have damaged the eggs (Hayward *et al.*, 2000). Previous works (Avilla *et al.*, 2004; Vansconcelos and Carvalho, 2010) suggest a certain level of social interactions for baurusuchids, as also seen in extant crocodiles. Indeed, the recurrent record of notosuchian taxa (*Mariliasuchus amarali*, *Yacarerani boliviensis*, *Baurusuchus pachecoi*) associated with eggs, along with the evidence presented herein, corroborates a scenario involving complex nesting behavior and overlapping of generations in the same spot. In the framework of the current phylogenetic hypotheses, a deeper origin for the behavior patterns found in modern crocodiles can be

suggested, extending its origin at least to the base of Mesoeucrocodylia/Metasuchia.

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Vasconcellos, F.M. and Carvalho, I.S. 2010. Paleoichnological assemblage associated with *Baurusuchus salgadoensis* remains, a Baurusuchidae Mesoeucrocodylia from the Bauru Basin, Brazil (Late Cretaceous). *New Mexico Museum of Natural History and Science Bulletin* 51: 227–237.

NEW REPORT OF THE LARGE CROCODILIAN '*SUNOSUCHUS*' *THAILANDICUS* FROM THE PHU KRADUNG FORMATION OF NORTHEASTERN THAILAND

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In the early 1980s, remains of a large crocodilian, consisting of a complete lower jaw, were referred to a distinct species of *Sunosuchus*, *i.e.*, *S. thailandicus*. The specimen was recovered from a road-cut near Nong Bua Lum Phu, Udon-Thani Province in the upper part of the continental Phu Kradung Formation, then considered Early to Middle Jurassic in age (Buffetaut and Ingavat, 1984). Since then, the age of this formation has been reviewed and most of the formation is considered Early Cretaceous, although a Late Jurassic age is possible for its lowermost part (Racey and Goodall, 2009). Here, we report mandibular remains assignable to '*S*'. *thailandicus* and, for the first time, associated cranial elements. The new specimen comes from the same formation but from a location distant from the type locality of '*S*'. *thailandicus*. An attribution to Pholidosauridae is proposed on the basis of premaxillary morphology and the original attribution of this taxon to the genus *Sunosuchus* is discarded. Nevertheless, we revive a possible close relationship between Goniopholididae (which includes the genus *Sunosuchus*) and Pholidosauridae (Buffetaut, 1982) due to the presence of a depression localized on the posterolateral maxillary wall of several pholidosaurid taxa. A review of the variability of this character in Pholidosauridae is presented. Although the new Thai skull is much fragmented, its original shape is reconstructed and is compared to other pholidosaurid genera, namely *Elosuchus*, *Oceanosuchus*, *Pholidosaurus*, *Sarcosuchus* and *Terminonaris*. The presence of the genus *Sunosuchus* being highly questionable, it cannot be used as evidence to link the Chinese and Indochinese blocks. Instead, the recognition of a freshwater pholidosaurid in a continental formation of the Indochinese block suggests that these crocodilians, already known from Europe, Africa and South America, were more widely distributed along the northern margin of the Tethys than previously recognized.

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TAXONOMIC REVIEW OF ARGENTINIAN SPECIMENS REFERRED TO *PEIROSAURUS TORMINNI* PRICE (CROCODYLIFORMES, PEIROSAURIDAE) FROM THE LATE CRETACEOUS OF BRAZIL

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Peirosaurid mesoeucrocodylians are a relatively common component of many South American Cretaceous terrestrial faunas. At present, six species have been recognized: *Barcinosuchus gradilis* Leardi and Pol, 2009; *Lomasuchus palpebrosus* Gasparini, Chiappe and Fernández, 1991; *Peirosaurus torminni* Price 1955; *Uberabasuchus terrificus* Carvalho Ribeiro and Avilla, 2004; *Montealtosuchus arrudacamposi* Carvalho, Vasconcellos and Tavares, 2007; and *Pepesuchus deiseae* Campos, Oliveira, Figueiredo, Riff, Azevedo, Carvalho and Kellner, 2011, all restricted to the Cretaceous of Argentina and Brazil. Currently, only *P. torminni* has been identified from both countries though the two specimens originally referred to *P. torminni*, MOZ 1750 PV (Bajo de la Carpa Formation, Loma de la Lata locality, Neuquén Province, Argentina; Gasparini, 1982; Gasparini *et al.*, 1991) and PV-CRIDC-12 (Anacleto Formation, Cañadón Amarillo locality, Mendoza Province, Argentina; Praderio *et al.*, 2009), are here excluded from the Brazilian taxon and likely constitute a distinct genus. No unique features are shared between the Brazilian and Argentinian specimens and most traits used to justify the original referrals including the presence of 5 premaxillary teeth, a

notably smooth perinarial fossa, a laterally open notch at the premaxilla-maxilla facial contact for reception of an enlarged anterior dentary tooth, and the shape of the external nares are features widely distributed among many basal mesoeucrocodylians, including peirosaurids. The presence of a more rounded and broad snout, a shorter premaxilla concomitant with a reduced smooth perinareal fossa, and shorter interalveolar space among premaxillary teeth distinguish MOZ 1750 PV and PV-CRIDC-12 from *P. torminni* (holotype DGM 433-R, Marília Formation, Peirópolis locality, Minas Gerais State, Brazil). On the basis of these observations, the presence of the Brazilian taxon *P. torminni* in the Late Cretaceous of Argentina, one of the few faunal links between these two regions, is not supported.

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THE PHYLOGENY OF BAURUSUCHIDAE

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Baurusuchidae Price, 1945, is a recurrent example of unusual morphology within fossil crocodyliforms and ubiquitous in discussions regarding the evolution and biogeography of Mesoeucrocodylia. Still, Baurusuchidae is frequently represented solely by its type-species, *Baurusuchus pachecoi* (Price, 1945), based on which most assumptions and further discussions were extrapolated to the group. Yet, the great number of baurusuchids described in the past decade revealed a much larger morphological variation, which failed to be promptly incorporated into phylogenetic studies. Here we present an update of a previous analysis (Montefeltro *et al.*, 2011) focused on the internal relationships of the clade. The ingroup includes all South American baurusuchids (8 taxa) and 3 basal notosuchians as outgroups. Other poorly known putative baurusuchids were excluded because their baurusuchid affinity was repeatedly challenged. The transformational series reflect the morphological variation of the ingroup (66 characters: 58 informative and 8 autapomorphies) scored based on published accounts and on first hand analyses of most taxa. The Implicit Enumeration algorithm resulted in a single MPT (86 steps) depicting a monophyletic Baurusuchidae, which is diagnosed by 21 synapomorphies. This implies a large morphological gap between Baurusuchidae and the notosuchian outgroup, addressed by the employment of different phylogenetic definitions of Baurusuchidae and Baurusuchia in order to create a putative taxonomic space between ingroup and outgroup. This is expected to be filled by future findings, and even new rearrangements, placing taxa in the lineage leading to, but not within, Baurusuchidae. In addition, the internal branching arrangement of Baurusuchidae places most taxa in a dichotomy composed of Pissarrachampsinae and Baurusuchinae, as recently proposed. This internal split represents an unforeseen evolutionary pattern of the clade, requiring biogeographic, stratigraphic, and morphological reinterpretations. Pissarrachampsinae possesses a relatively broad geographical range, spanning between Argentina (Bajo de La Carpa Formation) and Brazil (Vale do Rio do Peixe Formation). On the other side, Baurusuchinae is endemic to the deposits of Vale do Rio do Peixe Formation. The new proposed characters and the new interpretation of the internal evolution of Baurusuchidae are now available to be tested in larger Mesoeucrocodylia phylogenies. Future tests will be important to better evaluate the role of Baurusuchidae in the phylogeny of Mesoeucrocodylia, including the validity/rejection of Sebecosuchia and Sebecia.

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A NEW NOTOSUCHIAN SKULL (CROCODYLIFORMES, MESOEUCROCODYLIA) FROM THE LATE CRETACEOUS OF THE BAURU BASIN, STATE OF SÃO PAULO, BRAZIL

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We report here a new notosuchian crocodyliform from the Late Cretaceous Bauru Group in the State of São Paulo (southeastern of Brazil). The new taxon is represented by an almost complete skull and lower jaw that has several features indicating a close relationship with the genus *Sphagesaurus* Price, 1950, but also with other advanced notosuchians, such as *Notosuchus* Woodward, 1896*, Mariliasuchus* Carvalho and Bertini, 1999*, Adamantinasuchus* Nobre and Carvalho, 2006*,* and *Yacarerani* Novas *et al.* 2009. These features include the presence of obliquely oriented maxillary and posterior dentary teeth with extensive wear facets produced by tooth-tooth occlusion. The morphology of the posterior tooth crowns closely resembles those present in *Armadillosuchus* Marinho and Carvalho, 2009*, Sphages-*

aurus huenei Price, 1950 and *S. montealtensis* Andrade and Bertini, 2008, including the presence of pebbled outer surface of the enamel, well-developed apicobasal carinae, and large tuberous denticles on the distal keel of upper teeth and mesial keel of lower teeth. Among these taxa, the present specimen shares remarkable derived similarities with *S. montealtensis*, another form recently described from the Late Cretaceous deposits of the State of São Paulo. The new taxon, however, differs from *S. montealtensis* in many features: the maxilla is excluded from the orbital margin (*i.e.*, absence of jugal-lacrimal contact); there is a v-shaped orientation of the palatal branches of the maxilla in cross section; there is an anteriorly tapering choanal septum with a concave ventral surface; and the deep depression (parachoanal fossa) in the ventromedial face of the pterygoid wing, present in *S. montealtensis,* is absent. Other autapomorphies of the new taxon include: nasal with dorsal smooth depressions on their posterior region close to the contact with the maxilla and lacrimal, postorbital with posterior palpebral facet that extends posteriorly underneath the ear-flap groove, and distinct anterior process of the medial flange of the retroarticular process.

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A NEW SEBECIA (METASUCHIA, CROCODYLIFORMES) FROM THE ITABORAÍ BASIN (PALEOGENE) RIO DE JANEIRO, SOUTHEAST BRAZIL

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The São José de Itaboraí Basin is the most important paleontological deposit in Rio de Janeiro State, southeastern Brazil. This tectonic structure was originated by hydrotermalism in the "Southeast Brazilian Continental Rift" tectonic context (travertine deposition), followed by lacustrine sedimentation (marls, calcilutites and calcirrudites). Although very fossiliferous only the mammalian fauna –which reflects the basal mammalian radiation occurred during the early Paleogene– has been well studied. However, other groups are abundant such as gastropods, anurans, lizards, snakes, chelonians, crocodyliforms, birds and plants, much of them not documented in detail. Here we report a new genus and species of crocodyliform. The material consists of an almost complete skull and mandible housed in the Museu de Ciências da Terra (MCT 1730-R, know in the literature as the "Itaborai-bretesuchid Form"). The specimen came from one of the carbonatic fossiliferous infilling fissures regarded as Paleocene in age corresponding to the SALMA Itaboraiense (58.2 – 56.5MA). A cladIstic analysis (based on Larsson and Sues, 2007) reveals that the new taxon belongs to the Sebecia group and is more closely related to *Sebecus icaeorhinus* Simpson (Eocene of Argentina) than *Bretesuchus bonapartei* Gasparini, Fernandes and Powell (Late Paleocene of Argentina), contrary to previous interpretation by Gasparini *et al.* (1993). The suprafamiliar clade "Sebecosuchia" is also shown to be paraphyletic, with Baurusushidae in sister-group relationships with the Notosuchia (*sensu lato*). The characters used to support "Sebecosuchia" revealed to be homoplastic. Among the main features of the new taxon are the following: high degree oreinirostry (high compressed rostrum) and high and laterally expanded posterior jugal process; external border of the supratemporal fossa rugous; basisphenoid small and verticalized; circular choana between palatines and pterigoid; no external mandibular fenestra; presence of an externo-ventral ridge trat crosses the angular and part of dentary. Furthermore, the maxillary teeth show heterodonty presenting three distinct morphotypes: first five ziphodont, three medium lanceolat, and posterior globidont (blunt apex). This dentition pattern and the characters of supratemporal fenestra, pterygoid, and the posterior region of the mandible, suggests an addutory jaw musculature arrangement different than observed in extant semi-aquatic ambushers crocodylians, and indicates a carnivorous generalist forager rather than a strict high trophic predator.

Gasparini, Z., Fernandez, M. and Powell, J. 1993. New Tertiary Sebecosuchians (Crocodylomorpha) from South America: Phylogenetic Implications. *Historical Biology* 7: 1–19.

Larsson, H.C.E. and Sues, H-D. 2007. Cranial osteology and phylogenetic relationships of *Hamadasuchus rebouli* (Crocodyliformes: Mesoeucrocodylia) from the Cretaceous of Morocco. *Zoological Journal of the Linnean Society* 149: 533–567.

THE PRESENCE OF *SEBECUS* CF. *HUILENSIS* LANGSTON (SEBECIA, METASUCHIA) IN THE MIDDLE PALEOCENE OF THE ITABORAÍ BASIN, RIO DE JANEIRO STATE, SOUTHEASTERN BRAZIL

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During the Paleogene and early Neogene of South America, numerous terrestrial carnivorous crocodyliform taxa thrived in the new complex ecosystems that originated after the Cretaceous/Paleogene biotic crisis. Most authors agree on the monophyly of Sebecidae, a group that clusters all these forms. Larsson and Sues (2007) regarded sebecids as close relatives to Cretaceous peirosaurids, forming the unranked Sebecia. Among sebecids, *Sebecus huilensis* Langston was found in fluvial continental sediments of Central Colombia (late Miocene [Friasian]) of Monkey Locality of La Venta Formation. Buffetaut and Hoffsteter (1977) mentioned the presence of this taxon in the Miocene of Peru, nevertheless doubts remain about this assignment. Here, we report the presence of *Sebecus* cf. *huilensis* in the middle Paleocene of the Itaboraí Basin (Itaboraian SALMA), a small continental carbonatic basin with hydrothermal lacustrine deposits that crops out in Rio de Janeiro State (Southeastern Brazil). These deposits are highly fossiliferous (containing gastropods, anurans, lizards, chelonians, crocodyliforms, birds, mammals, and plants). The sebecid material reported here represents a third sebecid crocodyliform from Itaboraí, distinct from the taxon referred as a bretesuchid by Gasparini *et al.* (1993), and the *Sebecus* sp. reported by Price and Paula Couto (1946). The material (MCT 1795-R / 1796-R) includes a complete left premaxilla (with four alveoli and the third tooth preserved) and a small piece of the left maxilla bearing two alveoli. As in *S. huilensis*, the Itaborai form has widely spaced alveoli, diastematic fossa between premaxilla- maxilla with a medial wall, highly laterally compressed teeth with finely serrated carina (ziphodont dentition), maxilla highly compressed, ornamentation poorly developed and mainly located on the alveolar margin of maxilla, very reduced perinarial fossa. The ocurrence of a taxon with close similarities with *S. huilensis* in the Itaboraí Basin suggests the presence of a group of sebecids with an extensive temporal and geographic range, from middle Paleocene to late Miocene, a time span of about 50 Ma. The generic status of *Sebecus huilensis* was recently questioned by Paollilo and Linares (2007) who created a new genus (*Langstonia*) for this species due to the differences from *Sebecus icaeorhinus* Simpson (Eocene of Argentina). However, we consider that given the lack of robust phylogenetic analyses of this group it is premature to propose nomenclatural changes and therefore use the generic assignment proposed by Langston (1965).

Buffetaut, E. and Hoffstetter, R. 1977. Découverte du crocodilien *Sebecus* dans Miocène du Pérou oriental. *Comptes Rendus l'Académie des Sciences de Paris* (D) 284: 1663–1666.

Gasparini, Z., Fernandez, M. and Powell, J. 1993. New Tertiary sebecosuchians (Crocodylomorpha) from South America: phylogenetic implications. *Historical Biology* 7: 1–19.

Langston, W.Jr. 1965. Fossil crocodilians from Colombia and the Cenozoic history of the Crocodilia in South America. *University of California Publications in Geological Sciences* 52: 1–157.

Paolillo A. and Linares, O. 2007. Nuevos cocodrilos Sebecosuchia del Cenozoico Suramericano (Mesosuchia: Crocodylia). Paleobiologia Neotropical 3: 1–25.

Price, L.I. y Paula Couto, C. 1946. Vertebrados terrestres do Eoceno na Bacia Calcárea de Itaboraí, Brasil. *2º Congresso Pan-Americano de Engenharia de Minas e Geologia* (Rio de Janeiro) *Boletim* 3: 149–173.

MAJOR ISSUES IN NOTOSUCHIAN PHYLOGENY: TAXON AND CHARACTER SAMPLING

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The taxonomic diversity of Cretaceous crocodyliforms from Gondwana has notably increased during the last decade. Most of these taxa have been related to Notosuchia Gasparini 1971, a large clade of basal mesoeucrocodylians that includes small-bodied taxa as well as baurusuchids, and according to some authors *Araripesuchus* Price, 1959, and sebecids (*e.g.*, Pol and Apesteguía, 2005). Other authors, however, consider either of the latter two taxa as more closely related to peirosaurids and/or neosuchians (*e.g.*, Ortega *et al.*, 2000; Larsson and Sues, 2007). In this contribution we present a phylogenetic analysis that expands the taxon and character sampling from previous studies, gathering characters stemming from previously published studies but most importantly adding 92 new characters relevant to the relationships of Cretaceous crocodyliforms from Gondwana. The new characters include 52 postcranial characters and 40 cranial characters. The incorporation of postcranial characters to the phylogenetic analysis is critical to produce a novel arrangement of the basal mesoeucrocodylians recorded in the Cretaceous–Cenozoic of Gondwana, clustering *Araripesuchus* and peirosaurids as sister taxa and this clade as the sister group of all other notosuchians. A large clade of basal mesoeucrocodylians with similar taxonomic content (*i.e.*, peirosaurids, *Araripesuchus*, and notosuchians, including sebecosuchians) has been previously referred as Gondwanasuchia (Carvalho *et al.*, 2004) as it clusters most of the Cretaceous crocodyliform diversity from Gondwana.The new skull and mandibular data provides high character support for the monophyly of advanced notosuchians, a clade formed by taxa found in the Late Cretaceous of South America, excluding all other notosuchians recorded in other regions of Gondwana (Africa, Madagascar). The new postcranial characters (*e.g.*, dorsally projected and strongly curved prezygapophysis of anterior cervicals, deep circular depression on the proximal humerus for the *M. scapulohumeralis caudalis*, subrectangular posterior end of postacetabular process of the ilium with ventral margin horizontally directed ventrally to acetabular roof, trapezoidal fibular facet on the astragalus) incorporated in the cladistic analysis provide decisive support for monophyly of Gondwanasuchia and strengthen the affinities of Sebecidae with Baurusuchidae (sebecosuchian monophyly), as deeply nested within Notosuchia.

Carvalho, I.S., Ribeiro, L.C.B. and Avilla, L.S. 2004. *Uberabasuchus terrificus* sp. Nov., a new Crocodylomorpha from the Bauru Basin (Upper Cretaceous), Brazil. *Cretaceous Research* 7: 975–1002.

Larsson, H.D.C. and Sues, H.-D. 2007. Cranial osteology and phylogenetic relationships of *Hamadasuchus rebouli* (Crocodyliformes: Mesoeucrocodylia)

from the Cretaceous of Morocco. *Zoological Journal of the Linnean Society* 149: 533–567.

Ortega, F., Buscalioni, A.D., Gasparini, Z. and Calvo, J.O., 2000. A new species of *Araripesuchus* (Crocodylomorpha, Mesoeucrocodylia). *Journal of Vertebrate Paleontology* 20: 57–76.

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AMAZONIAN CROCODYLIANS THROUGH TIME: DIVERSIFICATION, EXTINCTION AND ASSOCIATED LANDSCAPE REVOLUTIONS

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Development of the Amazonian biota has been a long and complex process deeply influenced by extensive environmental and climatic changes driven by the relatively fast uplift of the Central, Northern and Venezuelan Andes, mainly during the middle to late Miocene (Hoorn *et al.*, 2010). Eocene cratonic river systems flowing northward to the Caribbean (sub-Andean River System) changed to the modern transcontinental Atlantic-directed Amazon River system. Large and continuous freshwater habitats in northern South America were interrupted by short-lived but widespread marine incursions until sedimentary systems of Andean origin were fragmented and dissected into the dynamic edaphic systems that sustain the highest biodiversity in the world. Successive changes in composition of the Amazonian crocodyliform fossil record since the Tertiary are consistent with such view, with environmental changes that led to the rise and fall of the two main Neogene continental systems in Western Amazonia being notably influential to this group. From *c.* 23 to 10 My the Pebas System mega-wetland housed the first, but still modest, pulse of crocodyliform diversification in the region, particularly within Caimaninae. On land, Sebecidae was an important component of coeval faunas. Sebecids are absent from the late Miocene deposits of Urumaco (Venezuela) and Acre (Brazil), even after almost a century of exploration and hundreds of collected non-sebecid crocodyliform specimens, suggesting that the group become extinct after the Middle Miocene. Amazon sebecids were the last non-eusuchian crocodylomorphs in the world, and their extinction is coincident with the outflow of the Pebas System, driven by a pulse of elevation of the Northern Andes, which inaugurated the fluvial or fluviotidal Upper Miocene Acre System. At this time the Caimaninae became even more diversified, but the increase among the Gavialoidea was particularly notable. A lower diversity of gavialoids characterizes the early–middle Miocene of northern South America, with only one species in the late Oligocene–early Miocene Castillo Formation (Venezuela) and one in the middle Miocene Honda Group (Colombia). However, we do have three genera and at least five species in the late Miocene Urumaco and Solimões Formations, where the greater number of specimens also suggests larger gavialoid populations. Although rich, the Neogene fossil record, as suggested by caimanines, is nonetheless incomplete when compared to minimum expected number of species derived from phylogenetic reconstructions. The demise of the Acre System after the last intensified period of Andean uplift in the Pliocene led to the onset of the modern Amazon River system and is coincident with the extinction of a notable suite of almost 20 species and a disparity of morphotypes greater than that seen in any other crocodylian fauna, extant or otherwise.

Hoorn, C., Wesselingh, F.P., ter Steege, H., Bermudez, M.A., Mora, A., Sevink, J., Sanmartin, I., Sanchez-Meseguer, A., Anderson, C.L., Figueiredo, J.P., Jaramillo, C., Riff, D., Negri, F.R., Hooghiemstra, H., Lundberg, J., Stadler, T., Sarkinen, T. and Antonelli, A. 2010. Amazonia through time: Andean uplift, climate change, landscape evolution, and biodiversity. *Science* 330: 927–931.

CRETACEOUS CROCODYLOMORPHS ON AFRICA AND THEIR BEARING ON GONDWANAN PALEOBIOGEOGRAPHY

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African crocodylomorphs achieved a diversity matching that of South America during the Cretaceous. Recent work provided evidence of an indigenous radiation of elongate flat-skulled crocodylomorphs (*Laganosuchus*, *Stomatosuchus*), unequivocally demonstrated the presence of the genus *Araripesuchus*, and established a close relationship between African and Malagasy taxa (*Anatosuchus* and *Simosuchus*; *Kaprosuchus* and *Majungasuchus*). We describe four new crocodylomorph genera from Niger. Two are goniopholodids from rocks of Early Cretaceous age. A third genus, which appears to be related to sebecids, has a meter-long skull that is very deep. The vertical body of the maxilla houses sabre-shaped teeth, and the external naris faces laterally. The fourth genus, an araripesuchid, has a broad triangular skull with upright limb posture. It bears many similarities to *Araripesuchus tsangatsangana* from Madagascar. The new crocodylomorphs add to an increasingly complex paleobiogeographic scene during the Cretaceous, with exchange well documented between Africa and both South America and Madagascar. There is no support for early separation of Africa from other landmasses.

DESCRIÇÃO PRÉVIA DE UM NOVO ESPÉCIME DE *GRYPOSUCHUS* (CROCODYLIA: GAVIALOIDEA) DO MIOCENO

SUPERIOR DO ESTADO DO ACRE

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Um crânio parcial de um gavialóideo foi coletado, pela equipe UFAC/UNIR em 2003, na localidade "Morro do Careca" (Km 29 da rodovia BR-364, sentido Feijó-Tarauacá), um afloramento da Formação Solimões exposto em 14 m seção vertical. O material provém da camada inferior que compõe os primeiros 2 m desta seção e é caracterizada pela presença de sedimentos finos (principalmente siltitos e argilitos) com freqüentes veios de calcita secundária e concreções calcárias, depositada sobre planícies de inundação. Nesta mesma camada foram encontrados restos de peixes pulmonados, bem como de decápodes dulcícolas. O crânio, depositado na Universidade Federal do Acre (UFAC-5298), encontra-se em bom estado de conservação apesar da ausência do terço distal do rostro. Este espécime apresenta as seguintes características que o posiciona no gênero *Gryposuchus* (Gürich, 1912): esquamosal com processo posterior alongado; sutura frontoparietal parcialmente inserida nas fenestras supratemporais, de modo que o frontal impede um contato amplo entre o pós-orbital e o parietal; a distância entre fenestras supratemporais bastante reduzida (18 mm em UFAC-5298, cujas fenestras têm diâmetro transversal de 128 mm); diâmetro transversal da fenestra supratemporal com quase o dobro do diâmetro orbital; o parietal avança sobre o supraoccipital (sinapomorfias ambíguas); e as bordas laterais dos palatinos alargam-se posteriormente (sinapomorfia não ambígua). É provável que este fóssil represente uma nova espécie de *Gryposuchus* por apresentar as seguintes autapomorfias: ausência/extrema redução de foramens aéreos; e presença de extensa fenestração pós-orbital, formada por um grande forâmen anterior seguido de três ou mais foramens menores (com cerca de 50% do diâmetro do primeiro) e dispostos linearmente. Tais características são compartilhadas com outros dois crânios que se encontram depositadas no Rio de Janeiro (DNPM/sem número e MN 4097-V), também procedentes de depósitos acreanos da Formação Solimões, sugerindo sua co-especificidade. Estes materiais, atualmente sob descrição, ampliam a já alta diversidade dos Gavialoidea no Neógeno amazônico.

Gürich, G. 1912. *Gryposuchus jessei*, ein neues schmalschnauziges Krokodil aus den jüngeren Ablageruden des oberen Amazonas-Gebietes. *Mitteilugen des Mineralogischen* 4: 59–71.

NEOSUCHIAN PHYLOGENY AND A REEVALUATION OF THE CROCODYLIFORM *SHAMOSUCHUS* FROM THE CRETA-

CEOUS OF ASIA

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Relationships among basal neosuchian crocodyliforms remain in flux. A series of clades whose monophyly is generally accepted (*e.g.*, Goniopholididae, Atoposauridae, Dyrosauridae, Pholidosauridae, Hylaeochampsidae) form successive sister taxa to the crown group Crocodylia. However, relationships among these clades are far from clear, but resolution remains important because of the impact it has on establishing the ancestral condition for Crocodylia. Recent work has shown that a growing number of basal neosuchian clades appear broadly similar in overall morphology to the alligator gestalt. One such clade is Paralligatoridae, which is likely comprised of the taxa *Shamosuchus* and *Rugosuchus*. *Shamosuchus* is known from a number of Late Cretaceous localities in southern and eastern Mongolia and fragmentary remains from Uzbekistan. In total seven species of *Shamosuchus* have been named from six localities in Mongolia and three in Uzbekistan. Three species originally described as *Paralligator* (*P. ancestralis*, *P. gradilifrons*, *P. sungaricus*) were later referred to *Shamosuchus* extending its range to the Albian. Much remains unknown about this potentially species-rich *Shamosuchus* clade. Only the type species, *S. djadochtaensis* has be examined in detail and phylogenetic analysis suggests it is an advanced neosuchian outside of Eusuchia and closely related to *Rugosuchus* from the Early Cretaceous of China. The derived placement of this paralligatorid clade highlights its importance in understanding the suite of character changes taking place at the origin of Eusuchia. However, the morphology of the remaining 9 species has largely been unexamined and their phylogenetic placement and impact on more derived eusuchian relationships remain unknown. Many of the named species of *Shamosuchus* show striking differences in size and cranial morphology. Furthermore, most are based on partial remains of skulls suggesting that the true species diversity is overestimated and the assumed monophyly of *Shamosuchus* is perhaps unwarranted. Detailed firsthand reexamination of the known *Shamosuchus* specimens reveal that only three valid species are present within Shamosuchus (*S. djadochtaensis*, *S. gradilifrons* and *S. ancestralis* represent). We included these additional *Shamosuchus* species in a maximum parsimony analysis utilizing an expanded phylogenetic dataset focused on elucidating neosuchian and early eusuchian relationships. The *Shamosuchus* species share a number of derived characters including a distinct depression on the dorsal surface of the squamosal together with a corresponding flared posterior process of the squamosal, a prominent crest on the lateral surface of the jugal, and an open cranioquadrate canal. These results suggest the presence of a diverse *Shamosuchus* clade (Paralligatoridae) present in eastern Asia during the Cretaceous which exhibited a remarkable range in cranial morphology and body size.

TEARING OR CRUSHING? MORPHOFUNCTIONAL ANALYSES OF THE BITE OF *BAURUSUCHUS SALGADOENSIS* FROM THE ADAMANTINA FORMATION, BAURU BASIN

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Baurusuchus salgadoensis Carvalho, Campos and Nobre, 2005, is a baurusuchid crocodyliform from the Adamantina Formation (Bauru Basin, Late Cretaceous, Turonian–Santonian). Its main features are a skeleton well adapted to cursoriality, large and massive skull, reduced dentition with some hypertrophied teeth. It is characterized as a hypercarnivore, probably competing with theropod dinosaurs in Brazilian Cretaceous continental habitats. Traditionally, the foraging habits of *Baurusuchus* were compared to those of the large monitor lizards coupled with a tearing bite similar to abelisaurid theropods. However, its tooth morphology and disposition seems to suggest other predatorial strategies. The teeth of *Baurusuchus salgadoensis* are robust; premaxillary and anterior maxillary teeth are high and subcircular in cross section while posterior teeth are more ziphodont and laterally compressed. The third premaxillary, second and third maxillary and third dentary teeth are hypertrophied, and the third dentary tooth occludes in a notch between the premaxilla and maxilla when the jaw is closed. The posterior teeth bear prominent serrations comprised of chisel-like denticles, while the anterior hypertrophied teeth bear discrete serrations that are usually worn. When the mandibular adductor muscle forces are distributed, its main vectors are located close to the smaller cutting teeth, and main movement vectors are at the rostral region next to the hypertrophied teeth. Combining the tooth distribution with the bite mechanics, the posterior teeth, those that might act as tearing elements, are unlikely to contact prey. The hypertrophied teeth could have acted more easily in combat, without the cutting function but with piercing and crushing action given by the movement energy. Teeth distribution suggests that prey could be captured but not torn by *Baurusuchus* in a pull-back movement. The function of the serrations would be restricted to unravel carcasses. It is proposed here that *Baurusuchus* would have been an agile terrestrial hypercarnivore that used its piercing and crushing bites to slaughter its prey and using its serrated teeth for manipulating carcasses, differing thus from traditional interpretations.

Carvalho, I.S., Campos, A.C.A. and Nobre, P.H. 2005. *Baurusuchus salgadoensis*, a new Crocodylomorpha from the Bauru Basin (Cretaceous), Brazil. *Gondwana Research* 8:11–30.

CURRENT ISSUES IN CROCODYLOMORPH PHYLOGENETICS: OUTGROUP CHOICE AND CLARITY IN CHARACTER

STATE DESCRIPTIONS

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Study of the evolution of crocodile-line archosaurs (Pseudosuchia) has intensified in recent years. Along with this increased attention have come dramatic changes in our understanding of the evolutionary relationships of the group. This new understanding of pseudosuchian relationships has important implications for phylogenetic studies of crocodylomorphs in particular. Previous studies of crocodylomorph and crocodyliform relationships have rooted trees on outgroups that in many cases are either quite distantly related to the group under study (*e.g.*, *Gracilisuchus stipanicicorum* (Romer, 1972), a basal suchian), or could actually belong within the ingroup. Thalattosuchia is one of the earliest occurring groups of crocodyliforms (Early Jurassic, Sinemurian). However, the earliest known thalattosuchian, *Peipehsuchus teleorhinus* (Young, 1948), already possesses the cranial specializations diagnostic of the group. This lack of plesiomorphic, or "intermediate", forms may have contributed to the debate over their phylogenetic position within Crocodyliformes –they are recovered in either a basal position, nested high up in the tree, or more recently, sister to (and not within) Crocodyliformes. Thalattosuchians lack several crocodyliform apomorphies, but share several characters with highly derived forms sharing a similar ecological habit, suggesting their derived position may be a result of convergent evolution. Several of these "shared" characters may result from ambiguously worded character state definitions –structures that are superficially similar (though anatomically different in detail) are scored the same. For example, thalattosuchians and other long-snouted taxa "share" a transversally flattened postorbital bar. However, in the postorbital bar of thalattosuchians the postorbital is lateral to the jugal, as opposed to its medial position in other crocodyliforms. Additional characters referring to the general size of the supratemporal fenestrae or shape of the snout ignore osteological details that differ conspicuously between the groups. A new analysis of crocodylomorphs recovers the thalattosuchians as sister group to Crocodyliformes outside of the "protosuchians" and all other crocodyliforms. These results highlight some current issues in crocodylomorph phylogenetics, particularly outgroup selection and character state definitions.

170 AÑOS DESDE OWEN: ANATOMÍA, FILOGENIA Y PALEOBIOLOGÍA DE SAURÓPODOS

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THE PRESPINAL COMPLEX IN SAUROPODS: A ZIPPER MODEL

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During vertebrate ontogeny, the neural spines of dorsal vertebrae originate from two equal halves that fuse differentially from bottom to top (Romer, 1956, p. 226).This occurs along a 'wave' that follows a cranial progression along the vertebral series, from sacrum to neck (Salgado, 1999, p. 212). Embryonic hemispines complete its ontogenetic closure in most sauropods and the suture that evidences the fusion remains evident in the middle axis of the spine (Romer 1956, p. 226). In basal sauropods the plane of fusion is included in a wide rugose zone ('prespinal bump') whereas in Macronaria it is reduced to a vertical rugose rod: the 'prespinal rugosity'. Built over its solid base develops a 'prespinal lamina', a commonly tall and sharp ridge of bone over the median axis of the anterior side of the neural spine in different sectors of the axial skeleton of Neosauropoda. Although present in cervical and anterior dorsal vertebrae, it is strong and well-developed in posterior dorsal, sacral and caudal vertebrae (where there are no evidences of bifurcation, even in diplodocoids). The study of the laminar development along the axial series is a useful tool in order to understand their constituent components and homologies. In the anterior dorsal vertebrae of basal eusauropods, spinoprezygapophyseal laminae (SPRL) add to the 'prespinal rugosity' to form a profusely striated and vertical 'prespinal bump'. This widens toward the summits of the neural spine. In the bifid-spined taxa (*e.g.*, some diplodocoids), the 'prespinal rugosity' is present between the paired SPRL at mid dorsal vertebrae, when the median cleft (=bifurcation) in the neural spine is reduced (Wilson, 1999). In both bifid and single-spined diplodocoids as well as in the single-spined basal titanosauriforms, the incorporation of the SPRL to the 'prespinal rugosity' occurs slowly along the entire dorsal series, being only complete toward the posterior-most dorsal vertebrae. On the other hand, in advanced titanosaurs the process is summarized to only the first two dorsal vertebrae. This way, all the additional changes along the dorsal series of a derived titanosaur include aspects that never occurred in a basal titanosauriform; they are new and not comparable to other sauropod lineages. As portrayed, the prespinal lamina bears a complex evolutionary history that affects the homologies and phylogenetic resolution of the involved taxa. Along phylogeny, the primary 'prespinal rugosity' is successively strengthened by the addition of at least the two recognized generations of SPRL (Bonaparte *et al.*, 2006): the MSPRL at first (*Prespinal Complex 1*) and the (LSPRL) later (*Prespinal Complex 2*). This way, the 'prespinal lamina' of a derived titanosaur has a three-component 'prespinal lamina' on its neural spine, thus being non-homologous, for example, to the wide and rough 'prespinal bump' of a basal eusauropod. The pattern briefly summarized here, although more complex than that of previous proposals, is an oversimplification of an evolutionary process that we are just beginning to interpret, and most probably implied several additional steps.

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NEW INFORMATION ON A LARGE TITANOSAUR (SAUROPODA-– TITANOSAURIA) FROM THE PRESIDENTE PRUDENTE FORMATION, SÃO PAULO STATE, BRAZIL

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Titanosaur sauropods are quite common in Cretaceous strata of Brazil, particularly in the Bauru Group. Most described taxa belong to small and medium sized species, such as *Gondwanatitan faustoi* Kellner and de Azevedo, 1999 and *Maxakalisaurus topai* Kellner *et al.,* 2006. Remains of large to giant species are exceedingly rare. During the last century, some vertebrae of a large titanosaur have been collected from the Bauru Basin, specifically from the outcrops of the Presidente Prudente Formation (Upper Cretaceous) in the Presidente Prudente municipality (São Paulo State, Brazil). Housed at the Museu de Ciências da Terra of the Departamento Nacional de Produção Mineral, Rio de Janeiro, the specimen (MCT 1628-R) consists of posterior cervical and anterior dorsal vertebrae that are now fully prepared. Although no field data is available, we regard all elements as representing a single individual, based on the preservation and the matrix where preserved. Where preserved, all centra tend to be elongated but rather flattened dorsoventrally. The neural spine of cervical elements is incomplete, but based on their preserved parts appear to have a triangular shape. There is no evidence of the lateral expansion that is typical of the Lognkosauria. There is also no indication of pleurocoels. Where preserved, the articular surfaces of the pre- and postzygapophyses are well developed and bordered by a low rim of bone. No hyposphene-hypantrum articulation has been observed. The last cervical vertebra shows a bifid posterior centrodiapophyseal lamina. At the contact area of the intrapostzygapophyseal laminae and the neural canal, there is a well-marked constriction that is quite unusual within titanosaurs. Regarding the dorsal elements, the neural spines are incomplete. Judging from the preserved part, they are vertically oriented, differing from *Mendozasaurus neguyelap* González Riga, 2003, *Futalognkosaurus dukei* Calvo *et al.,* 2007, and *Trigonosaurus pricei* Campos *et al.* 2005. A well-developed and rather thick prespinal lamina is present along the neural spine. The centroprezygapophyseal and the anterior centrodiapophyseal laminae are preserved on both dorsal vertebrae, delimiting two big and triangular-shaped fossae. The diapophyses are flattened dorsoventrally and directed laterally. MCT 1628-R represents the largest dinosaur recovered from Brazil so far, whose length is estimated around 20 m.

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NUEVO HALLAZGO DE RESTOS DE UN TITANOSAURIO EN LA COSTA SUR DEL LAGO BARREALES (NEUQUÉN, ARGENTINA)

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En el curso de un relevamiento en la costa sur del Lago Barreales (Provincia del Neuquén, Argentina), en sedimentitas referidas a la Formación Portezuelo, se hallaron restos que corresponden a una vértebra dorsal y una vértebra caudal atribuidas a un dinosaurio saurópodo. La vértebra dorsal se presenta en un buen estado de conservación, resultando incompleto el extremo distal de las parapófisis, diapófisis y espina neural. El centro es robusto y fuertemente opistocélico, la articulación anterior presenta una bocha bien desarrollada, la articulación posterior, cóncava, es de forma subelíptica. La parapófisis se ubica adelante del pleurocelo. El pleurocelo está poco desarrollado anteroposteriormente, es profundo y con una lámina oblicua que lo divide. La diapófisis es amplia. En vista lateral se preservan las láminas centrodiapofisial anterior y posterior dejando una depresión en la base no presente en *Rinconsaurus caudamirus* Calvo y González Riga, 2003. No se observa una lámina centroprezigapofisial como en *Muyelensaurus pecheni* Calvo, González Riga y Porfiri, 2007. La espina neural, incompleta, está ligeramente inclinada anteriormente. En vista dorsal se preservan las láminas espinopostzigapofisial, espinoprezigapofisial, preespinal, y la espinodiapofisial. Basándose en la posición y la forma de la parapófisis, de la espina neural y las características

del centro, la vértebra puede ser considerada cervicodorsal, probablemente la número 2. La vértebra caudal, probablemente una de las primeras dos, conserva el cuerpo vertebral y parte del arco neural dirigido caudodorsalmente como en otros Titanosauria. El cuerpo vertebral es procélico, con la cara posterior fuertemente convexa. El arco neural se ubica en posición anterior. Las prezigapófisis son elongadas y están parcialmente preservadas y se unen a los procesos transversos a través de una lámina. Hay una desarrollada lámina prespinal que llega hasta la base del arco neural, diferente a *Futalognkosaurus dukei* Calvo, Porfiri, González Riga y Kellner, 2007. Se ha conservado la base de las dos laminas espinoprezigapofisiales. Las postzigapófisis están adosadas a la base del arco neural y están conectadas a la espina neural por una lamina espinopostzigapofisial. La ausencia del hiposfeno-hipantrum y lámina prespinal alcanzando la base del arco neural y el centro fuertemente procélico y arco neural en posición anterior de la caudal anterior, entre otros caracteres, permite atribuir estos restos a un dinosaurio saurópodo Titanosauridae. La presencia de este Titanosauridae en rocas de la Formación Portezuelo muestra que la fauna de saurópodos fue más diversa de lo que se conoce.

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THE CONTINENTAL CENOMANIAN OF PATAGONIA: A COMPARISON BETWEEN THE FOSSIL VERTEBRATE FAUNAS OF THE RÍO LIMAY SUBGROUP (NEUQUÉN GROUP) AND OF THE BAJO BARREAL FORMATION (CHUBUT GROUP)

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Cenomanian continental sediments are well represented in Patagonia, and two major stratigraphic units are particularly important regarding their geographic extent and fossiliferous richness. The Río Limay Subgroup, including the Candeleros and Huincul formations, is exposed in the provinces of Neuquén and Río Negro. Secondly, the lower member of the Bajo Barreal Formation outcrops extensively in Chubut Province. These units have yielded a large number of vertebrate fossils and show showing remarkable faunal similarities. The hypothesis of a faunal relationships between those stratigraphic units was tested using an UPGMA cluster analyses (Sokal and Michener, 1958) based on the Bray-Curtis distance coefficient (using Jaccard and Simpson similarity coefficients). In this analysis were included other stratigraphic units of the Neuquén Group (Río Neuquén and Río Colorado Subgroups) and the Allen Formation (Garrido, 2011). Likewise, the beds preliminarily assigned to the upper member of the Bajo Barreal Formation exposed in the southeastern region of Lago Colhué Huapi were also included (Casal *et al.*, 2006, 2007). Results showed that the latter clearly group with the Allen Formation in particular, and in general with all post-Turonian units analyzed. The analysis revealed –from evidence provided by the fossil record– the marked difference between the faunal associations found in both members of the Bajo Barreal Formation. This agrees with previous proposals about an important diacronism within this Formation (Casal *et al.*, 2007). Cenomanian units analyzed display a strong clustering, characterized by the presence of basal coelurosaurs (*Aniksosaurus* Martínez and Novas, 2006, and related forms), rebbachisaurids and basal titanosauriforms (*Andesaurus* Calvo and Bonaparte, 1991). In addition, they are separated from the rest of the post-Turonian units, which present moderate to strong clustering among them. This pattern suggests that faunal associations of wide geographical distribution in Patagonia suffered a significant turnover, probably related to an extinction event at the Cenomanian/Turonian boundary (Coria and Salgado, 2005).

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BONE MICROSTRUCTURE OF THE UPPER CRETACEOUS TITANOSAUR SAUROPOD *NEUQUENSAURUS AUSTRALIS*

LYDEKKER, 1893

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We present the bone histology of *Neuquensaurus australis* Lydekker, 1893, a saltasaurini titanosaur from the Upper Cretaceous of Patagonia, and explore its paleobiological implications. The sample analyzed includes diverse axial and appendicular elements of several specimens, including different bones belonging to a single one (MCS-Pv 5, Museo de Cinco Saltos, Paleovertebrados). Long bones consist of compact bone cortex enclosing a medullar core filled with secondary cancellous tissue. The cortical bone tissue is mostly composed of dense Haversian bone tissue. Primary bone remains are preserved in the outer cortex, and consist of fibro-lamellar bone tissue. Growth marks are present as *annuli* and/or lines of arrested growth. The externalmost cortex of some specimens reveals the deposition of an outer circumferential layer (OCL). Internally, axial bones are composed of a compact cortex of variable thickness that surrounds a camellate bone tissue. The camellate structure consists entirely of secondary bone tissue. The long bone histology of *N. australis* indicates that the growth of this sauropod dinosaur was cyclic in –at least– the later phase of its ontogeny. The presence of an OCL reveals a determinate growth. Dense Haversian bone tissue in the cortex of the limb bones has been recorded previously in other sauropods such as *Alamosaurus sanjuanensis* Gilmore, 1922 and *Lirainosaurus astibiae* Sanz, Powell, Le Loeuff, Martínez and Pereda Suberbiola,, 1999 (Woodward and Lehman, 2009; Company, 2011) and appears to be a common feature of advanced titanosaurs.

Company, J. 2010. Bone histology of the titanosaur *Lirainosaurus astibiae* (Dinosauria: Sauropoda) from the latest Cretaceous of Spain. *Naturwissenschaften* 98: 67–78.

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THE BRAINCASE OF A 3D PRESERVED PTEROSAUR FROM THE JURASSIC OF PATAGONIA

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The braincase of the specimen MPEF PV 3613, a pterosaur from the Middle Jurassic of the Cañadón Asfalto Formation, Chubut Province (Codorniú *et al.*, 2010) is well-preserved and almost undistorted. No sutures are discernible between the braincase elements. The use of CT scans revealed aspects of the pneumaticity of the braincase that is affecting the paired frontals, supraoccipital, and basisphenoid. The parietal is approximately 60% the length of the frontal (excluding the nasal processes). The nuchal crest is almost at the same level with the skull roof in lateral view and is V-shaped in dorsal view. The supratemporal fossae are deeply excavated on the parietals, separated by a narrow sagittal crest. The frontal is mostly a flat element in the skull roof and the frontal postorbital processes are strongly projected laterally, each one having a large oval foramen posteroventrally that communicates internally with a pneumatic cavity. The occiput is mainly formed by the supraoccipital and the exoccipitals. Dorsolateral to the foramen magnum there is a large dorsal head vein foramen, and more laterally is a smaller postemporal fenestra. The paroccipital processes are dorsoventrally high, but short transversely. The metotic foramen for cranial nerves (CN) IX-XI open ventrolaterally to the occipital condyle and a single foramen for CN XII open just under and slightly lateral to the occipital condyle. The occipital condyle is smaller than the foramen magnum, subspherical, posteroventrally directed and has not a constricted neck. The basal tubera are anteroposteriorly elongate but transversely narrow structures. Ventrally, the basisphenoid is rhomboidal in outline, with a tapering anterior end. It has a moderately deep, elongate basisphenoid recess along its midline. The basipterygoid processes are slender, long and narrow, anteroventrally projected and separated over their entire length. In lateral view, the basipterygoid processes diverge at an angle of approximately 45° from the dorsal skull roof. The CN V foramen is oval and 4 mm diameter. The postorbital process of the laterosphenoid is a narrow triangular projection adjacent to the posteroventral side of the postorbital process of the frontal. A ventral and narrow projection of the laterosphenoid is probably forming the anterior margin of the CN V foramen. Comparisons with the braincases of other pterosaurs, reveal a mosaic of characters in the Argentinean specimen, which shares some traits with "rhamphorhynchoids" but also with pterodactyloids taxa. Preliminary phylogenetic analysis places the taxon in a polytomy with the recently described *Darwinopterus* (Lü *et al.*, 2010) at the base of the Pterodactyloidea (Codorniú *et al.*, 2010).

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TITANOSAUR OSTEODERM ONTOGENY, ANATOMY, AND FUNCTION: NEW DATA FROM *RAPETOSAURUS KRAUSEI* CURRY ROGERS AND FORSTER, 2001 (MAEVARANO FORMATION, MADAGASCAR)

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Osteoderms are mineralized organs embedded within the dermis that occur within every major tetrapod lineage. For most osteoderm-bearing tetrapods, dozens to hundreds of interlocking or imbricated osteoderms function in roles as diverse as protection, thermoregulation, display, mineral storage, buoyancy, and lactate sequestration. Titanosaur sauropod dinosaurs are the largest vertebrates known to possess osteoderms, but the anatomy and function of these elements in titanosaurs remains unresolved. Here we report on two osteoderms, one from a juvenile and another from an adult individual of *Rapetosaurus krausei* Curry Rogers and Forster 2001, a titanosaur from the Late Cretaceous of Madagascar. Combined, these specimens reveal the development of a unique osteoderm topological distribution and morphology and shed light on osteoderm function in titanosaurs. Three distinctive bonebeds at site MAD 93-18 (BB1, BB2, BB3) in the Maevarano Formation of northwestern Madagascar preserve the remains of *R. krausei.* BB3 yielded a subadult skeleton of *R. krausei* that exhibits no duplication of elements and some instances of articulation (*e.g.*, foot, ribs, hindlimb, and forelimb in anatomical position). An ellipsoid osteoderm (UA 9331) recovered in close association with a series of four mid-caudal vertebrae from this specimen measures 14 x 9 x 8 cm, exhibits an external midpoint convexity, and tapers to ~2 cm near the thinnest part of the element. Of particular note is a prominent canal that passes uninterrupted through the element. As evidenced by Computed Tomography (CT) scans, this canal widens to form a sinus cavity midway into the osteoderm, within a cancellous core. BB1 preserves a single skeleton of an adult (femur length = 146 cm) that includes the most massive sauropod osteoderm yet discovered (FMNH PR 2342). FMNH PR 2342 was closely associated with pelvic elements, is ellipsoid, and exhibits a characteristic bulb and root morphology. It measures 57 x 26.7 x 19.2 cm, and tapers to a height of 3.6 cm and width of 12.5 cm near the thinnest part of the element. CT scans and exploratory cores taken for histological purposes reveal that FMNH PR 2342 is hollow. The void is filled with unconsolidated sediment and contains no broken internal trabeculae. This cavity is estimated to be 4.9 L in volume, representing more than 50% of the total volume of the osteoderm. The thickness of bone surrounding the cavity varies from 1.2 cm to 3.5 cm. The inner margin of the cavity is scalloped and grades into heavily remodeled fibrolamellar bone. Taphonomic data confirm that *Rapetosaurus* bore only limited numbers of osteoderms in its integument. Moreover, FMNH PR 2342 is the most massive integumentary skeletal element yet described, with an estimated volume of 9.6 L. Uniquely, this specimen possesses an internal cavity that forms from the structural remodeling of a cancellous core present in subadult UA 9331. Large cavitied osteoderms may have functional implications for mineral storage and reproductive biology in titanosaurs, like *Rapetosaurus,* that inhabiting stressful, drought-prone environments.

Curry Rogers, K. and Forster C.A. 2001. The last of the dinosaur titans: a new sauropod from Madagascar. *Nature* 412: 530–534.

EARLY TITANOSAURIFORM SAUROPOD DINOSAUR EVOLUTION

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Titanosauriformes was a globally-distributed, long-lived clade of dinosaurs that contains both the largest and smallest known sauropods. These megaherbivores evolved a suite of cranial and locomotory specializations that contributed to their success through the Mesozoic. The early evolution of Titanosauriformes is enigmatic; over a dozen genera have been described in the last decade as 'basal titanosauriforms' without further knowledge of their interrelationships. Likewise, phylogenies focusing on basal titanosauriforms show little consensus. I developed a cladistic analysis tailored to basal titanosauriforms that incorporates many novel characters. The analysis results in the recovery of three main titanosauriform clades: Brachiosauridae, Titanosauria, and a clade of Cretaceous East Asian sauropods. Early titanosauriforms and their outgroups were present on most landmasses, but towards the middle of the Cretaceous, brachiosaurids, East Asian sauropods, and titanosaur clades display endemism. Titanosauriform relationships reflect several paleobiogeographic patterns including differential regional extinction, vicariance, and dispersal. A reevaluation of the phylogenetic affinities of fragmentary taxa based on synapomorphies recovered in this analysis finds no body fossil evidence for titanosaurs before the Early Cretaceous, in contrast to previous reports of Late Jurassic taxa. This study provides a foundation for future study of basal titanosauriform phylogeny and the origins of Titanosauria.

HISTOVARIABILIDAD ÓSEA EN *BONITASAURA SALGADOI* APESTEGUÍA, 2004 (SAUROPODA: TITANOSAURIA)

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Las diferencias histológicas reconocidas entre diferentes taxa, entre diferentes especímenes de un mismo taxón, entre diferentes elementos e inclusive dentro de un mismo elemento esqueletal, pueden ser abordadas desde el estudio de la histovariabilidad ósea. Para el caso de los dinosaurios saurópodos, numerosos análisis histológicos se han realizado fundamentalmente comparando las características microestructurales de diferentes taxones o dentro de un mismo género o especie, aunque la variabilidad histológica de un único especímen es prácticamente desconocida. Por lo tanto, el estudio de 15 muestras provenientes de diferentes sectores del esqueleto de *Bonitasaura sagadoi* Apesteguía, 2004, ha permitido por primera vez reconocer las diferencias histológicas presentes en el esqueleto de un único animal. Las muestras de fémur y húmero presentan una corteza amplia conformada fundamentalmente por tejido primario del tipo fibrolamelar, altamente vascularizado, producto de una alta tasa de depositación ósea. En este tejido sólo se advierte la presencia de una discontinuidad en el crecimiento que respondería a una LAG, y lo que posiblemente sea un *annulus* en la región subperiosteal. Por su parte, las muestras de ulna, metacarpiano y de una zigapófisis vertebral comparten cierta semejanza histológica. En estos elementos se reconoce una alta remodelación interna con presencia de tejido secundario del tipo haversiano que por sectores presenta varias generaciones, conformando prácticamente toda la región cortical. Sólo en pequeños intersticios de la corteza y en la región subperiosteal se advierte tejido primario del tipo fibrolamelar con una o dos discontinuidades (LAGs o *annuli*). En estos elementos también se reconocen numerosos sectores con cúmulos de fibras de Sharpey empaquetadas en sectores de la corteza más externa. En la zigapófisis se reconoce una probable patología la cual presenta un desarrollo diferencial de tejido primario con respecto al resto de la muestra. En el caso de los elementos costales de la región cervical, estos presentan fundamentalmente un tejido altamente remodelado conformado por tejido secundario pero sin formar un tejido haversiano denso, aunque en varios sectores de la región cortical más externa se advierten restos de una matriz primaria fibrosa sin presencia de discontinuidades. La histología observada en el arco hemal muestra una marcada asimetría en su construcción interna conformando una región medular que se desarrolla sobre el margen medial del elemento y una corteza amplia hacia el sector lateral. Se observa un gran desarrollo de tejido primario del tipo fibrolamelar que se interrumpe por una discontinuidad (LAG), la cual posteriormente fue reemplazada por una banda de osteones secundarios. Por último, las muestras provenientes de distintas zonas de las costillas dorsales muestran semejanzas y diferencias entre sí, evidenciando una importante variabilidad histológica intraelemental. En las mismas se advierte la presencia de tejido primario fibrolamelar exhibiendo cierto bandeado producto del tamaño diferencial de los canales vasculares longitudinales alineados, acompañado por al menos dos LAGs. Por otro lado, es notable el desarrollo de manchones de tejido haversiano en ciertas zonas de la corteza, mostrando agrupaciones de osteones de Havers alargados y orientados oblicuamente. En sectores proximales de las costillas dorsales se reconoce una línea de reabsorción, producto del proceso de modelación ósea diferencial en estos elementos de morfología compleja. La amplia variabilidad histológica observada en este especímen evidencia claramente un crecimiento óseo diferencial en los diferentes sectores del esqueleto de estos grandes vertebrados terrestres, permitiendo así abordar distintas problemáticas paleobiológicas considerando esta importante información de base.

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NEW EVIDENCE ON THE ANATOMY, FUNCTION AND EVOLUTIONARY CONSTRAINTS IN SAUROPOD PEDES BASED ON NEW MATERIAL FROM MUPALEO SITE (CANDELEROS FORMATION), NEUQUÉN, PATAGONIA, ARGENTINA

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Recent field work at the Barda Atravesada de Las Campanas (Lago Ezequiel Ramos Mexía area, Neuquén Province, Argentina), where the uppermost section of Candeleros Formation (Cenomanian) crops out, provided articulated material of both hind limbs of a small-sized sauropod. The presence of associated platycoelus anterior caudal vertebrae, with high neural spines reinforced by lateral laminae, allows the assignment of this specimen to Rebbachisauridae (Sereno *et al.*, 1999). The distal part of the left leg is preserved and the right hind limb is almost complete, lacking only the distal phalanges. The astragalus is medially tapering, showing the wedge shape that is present in other neosauropods. However, the ascending process is anteriorly oriented as in the primitive condition for sauropods (Upchurch *et al.*, 2004; Bonnan, 2005). The pes is asymmetric like that of other neosauropods (Upchurch *et al.*, 2004). Metatarsal I is robust and, given the extreme reduction of the medial part of the astragalus, it articulates directly with the medial surface of the tibia. Metatarsal II and III are the most developed; the latter is the largest one. Both of them articulate with the astragalus. Metatarsal IV and V articulate with the calcaneum. The new material presented here allows a reinterpretation of metatarsals described for *Limaysaurus tessonei* (Calvo and Salgado, 1995). The fifth metatarsal shows a slightly concave distal surface bounded by medial and lateral articular condyles, suggesting the existence of an ungual phalanx. Four proximal phalanges and a fragmentary ungual were found in close association to the pes. These evidences allow the interpretation of the rebbachisaurid pes as retaining two phalanges in the first digit, an ungual phalanx in fifth digit and probably more phalanges for digits II, III and IV. This condition is comparable to that observed in well-known diplodocoid pedes. On other hand, macronarian pedes suffered consecutive reductions in the pedal phalangeal formula (González Riga *et al.*, 2008). The observation of a "semi-plantigrade" posture in this little sauropod reinforces the proposed hypothesis of the evolutionary constraint observed in the insertion angle of the m. gastrocnemius, given the vertical reorientation of leg (Bonnan, 2005), showing its independence on the weight supported by the hind limb.

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HAEMAL ARCHES WITHIN SAUROPODA: MORPHOLOGICAL AND PHYLOGENETIC CONSIDERATIONS

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Sauropod haemal arches ('chevrons') are caudal bony structures that traditionally have been classified in two different morphological types observed in different anatomical views (*i.e.*, anterior vs. lateral): forked and Y-shaped (Upchurch *et al.*, 2004). Forked chevrons are characterized by the possession of distal cranial and caudal processes and are present in middle and posterior caudal vertebrae of several non-titanosaurifom eusauropods (*e.g.*, basal eusauropods, diplodocids). On the other hand, Y-shaped chevrons display two dorsal rami that close the haemal canal ventrally, as well as a ventral or distal blade, typical of most anterior region of the tail of all sauropods and present along the tail of most titanosauriforms. Instead of this traditional classification, this research proposes one using the combination of information observed in both anterior and lateral views: the 'Y-shaped' and the 'V-shaped' chevrons. Four types of 'Y-shaped' and six types of 'V-shaped' chevrons were recognized. Complete chevron series in some eusauropods allows the comparison of topological equivalent structures along the tail and also among taxa. A basal titanosaur from Patagonia, Argentina, exhibits a peculiar mid-caudal haemal arch morphology in which more than one cranial and caudal process is present. The projections rising from the distal blade are topologically equivalent to those seen in other taxa, because the unequivocal correlate is the distal blade. Nonetheless, the projections rising from the proximal rami do not seem to be topologically correlative to other projections seen before in a sauropod dinosaur since they are linked to a different osteological correlate (*i.e.*, proximal rami). The morphological variability seen in sauropod chevrons along the tail could be in close relationship with the development and distribution of M. caudofemoralis longus, as seen in extant crocodiles and as previously proposed for non-avian theropods (Persons and Currie, 2011) and caudal centra and transverse processes of sauropod dinosaurs (Salgado and García, 2002; Gallina and Otero, 2009). Two new characters devoted to middle chevrons are here proposed, in which the transitional morphology is described.

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PALEONEUROLOGY OF THE DICRAEOSAURID SAUROPOD *AMARGASAURUS CAZAUI* SALGADO AND BONAPARTE, 1991

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The braincase of the type specimen of *Amargasaurus cazaui* Salgado and Bonaparte, 1991 (MACN-N 15), from the Early Cretaceous of Argentina, is complete and undistorted, and represents the only known neurocranial material in South America for the dicraeosaurid family. It was described in detail by Salgado and Calvo (1992). This study reinterprets two cranial foramina: cranial nerve (CN) III is reinterpreted as CN III–IV, and CN IV is reinterpreted as the middle cerebral vein foramen. The specimen has been Computed Tomography (CT) scanned and a three-dimensional digital reconstruction of the endocranium and inner ear has been prepared. The cranial endocast is complete in that it terminates anteriorly at the opening for the olfactory tract and posteriorly at the foramen magnum, and is 10 cm in total anteroposterior length. The cerebral and pontine flexures are similar to those in *Dicraeosaurus hansemanni* Janensch, 1914. Although *Amargasaurus cazaui* shares with *Dicraeosaurus hansemanni* the presence of a large dorsal longitudinal sinus and an enlarged endocranial space related to the postparietal fenestra, the latter seems to be different from that illustrated by Janensch (1936) for *Dicraeosaurus hansemanni*. In *Amargasaurus cazaui*, the enlarged endocranial space is dorsal to the forebrain, being a paired cavity posteriorly but fused into a single cavity strongly related

to the olfactory tract area anteriorly. The pituitary fossa descends from the ventral surface of the endocast and is oriented slightly posteroventrally. CN II has long passages across the laterosphenoid-orbitosphenoid complex. These nerves extend posteromedially to converge at the midline of the anteroventral margin of the main body of the diencephalon. Not only CN VI is anteroventrally projected, but also CN V and III-IV, unlike the laterally projected nerves in titanosaurids (Paulina Carabajal, 2009). Dorsal to the labyrinth of the inner ear, there is a vascular element, probably for the dorsal head vein. The inner ear can be partially reconstructed and is described for the first time for this family of sauropods.

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ANATOMICAL TERMINOLOGY FOR THE SACRUM OF SAUROPOD DINOSAURS

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The sacrum represents a key element in the anatomy of Dinosauria, beginning with the first use of the taxon name. Owen (1842:102–103) diagnosed this group of large, terrestrial reptiles in part by "a large sacrum composed of five anchylosed vertebrae of unusual construction". Since that time, the sacrum has mostly furnished meristic characters that have been widely applied, but little of the "unusual construction" of the sacrum has contributed to phylogenetic analysis. Sacral characters typically contribute less than 2% of character data to cladistic analyses of dinosaurs (*e.g.*, theropods, Rauhut 2003; ornithischians, Butler 2009). The sacrum is especially complex in sauropod dinosaurs, for which sacral characters have played a similarly minor role in establishing interrelationships (≤3% total characters in three analyses; Whitlock, 2011: fig. 8). I identified only 14 different sacral characters used in cladistic analyses focused on sauropods, which in addition to meristic characters include proportional characters (*e.g.*, height of neural spines), pneumatic characters (*e.g.*, presence of pleurocoels), and neural arch lamina characters (*e.g.*, shape of prespinal lamina). Although these characters apply at higher and lower taxonomic levels, they do not cover the scope of morphological variation within sauropod sacra. Here I present a nomenclature for the sauropod sacrum that is designed to aid description of these complex structures and to facilitate development of novel character data. Although based on sauropods, it is applicable to closely related taxa. The sacrum is composed of a series of elements that fuse to one another and to the ilia at maturity. Often referred to as a series of "sacral vertebrae", each element actually consists of a sacral vertebra (*i.e.*, centrum, neural arch) and a pair of sacral ribs. Adjacent lower arms of the sacral ribs contact one another distally to form the "sacricostal yoke" (Riggs, 1903:178), which is an anteroposteriorly oriented bar that contacts the base of the ilium and typically forms part of the acetabular surface in eusauropods. In ventral view, a series of oval aperatures are visible between the sacral ribs on either side of the midline. These were referred to as "intervertebral fenestrae" by Wilson and Sereno (1998:43), but they are more appropriately termed "ventral intercostal foramina" because they open between ribs (rather than vertebrae) and transmitted soft tissue structures into and out of the sacrum. These are distinct in size and shape from the "dorsal intercostal foramina" that open between the dorsal arms of the ribs and diapophyses on the dorsal aspect of the sacrum. Medially, the capitulum and tuberculum of the sacral ribs contact the diapophysis and parapophysis of the sacral vertebra, and there is occasionally a "transverse foramen" that opens between these four structures, as in presacral vertebrae. Laterally, the two processes of the sacral rib contact the acetabular rim and blade of the ilium, and the opening between these is termed the "intracostal fenestra".

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LÁMINAS COMPLEJAS, PLEUROCELOS E HIPÓSFENOS EN AVES Y SAURÓPODOS DE ESPINAS SIMPLES

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Luego de reconocer que las aves eran sobrevivientes del linaje de los dinosaurios, notables esfuerzos se han realizado en la comparación punto a punto de su anatomía. Así, se incluyó en estos estudios a los dinosaurios saurópodos, realizando comparaciones enfocadas fundamentalmente en los grupos con espinas neurales bífidas como los diplodócidos, y utilizando al grupo de la ratites como taxón viviente. Contrariamente, el estudio comparativo entre aves y saurópodos de espina simple no ha sido aún abordado. Un análisis preliminar de la osteología vertebral de *Chauna torquata* Oken, 1816, el chajá, permitió reconocer características morfológicas muy similares a las observadas en muchos saurópodos con este tipo de espina. Mientras que las vértebras cervicales mostraron grandes semejanzas con las de los saurópodos macronarios, las dorsales, permitieron además realizar comparaciones con ambos clados de neosaurópodos. En este sentido, se reconoció la presencia de conspicuas láminas espinales (*i.e.*, prsl y posl) y diapofisales (*i.e.,* spdl) como las presentes en vértebras dorsales de neosaurópodos y láminas zigapofisiales (*e.g.,* cprl, cpol) como en las vértebras cervicales y dorsales de los diplodócidos. Asimismo, se han reconocido amplios espacios en el arco neural y en el centro vertebral, resultado de la invasión del sistema neumático como también fuera reconocido para los saurópodos (Wedel, 2003). Los primeros incluyen cavidades ubicadas por encima de las prezigapófisis conformando los amplios espacios de las fosas espinoprezigapofisiales y espinodiapofisiales (Wilson *et al.*, 2011). Del mismo modo, se reconocen fosas espinopostzigapofisiales en las últimas vértebras dorsales y amplias fosas centrodiapofisiales en el aspecto lateral de las últimas vértebras cervicales. Los segundos, en el cuerpo de las vértebras cervicales y dorsales, forman pleurocelos ovoidales no acuminados, comparables morfológica y espacialmente a los de los diplodócidos. Además, se ha reconocido la presencia de articulaciones accesorias (hipósfeno-hipantro) en las últimas vértebras dorsales, en las cuales el hipósfeno presenta una morfología de tipo romboidal reducida muy similar a la observada en eusaurópodos basales y diplodócidos (Apesteguía, 2005). El reconocimiento de numerosas estructuras correlacionables entre un ave neognata basal herbívora, pesada, de hábitos terrestres, mala voladora y de cuello moderado como el chajá y los dinosaurios saurópodos resulta sumamente alentador para incrementar los estudios paleobiológicos del grupo.

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MAMÍFEROS Y CINODONTES NO MAMÍFEROS MESOZOICOS: EVOLUCIÓN, FILOGENIA Y PALEOBIOGEOGRAFÍA

Coordinadores: DR. GUILLERMO ROUGIER, DR. JOHN WIBLE y DR. CHRIS SIDOR

GRAN HERMANO EN EL PERMICO SUPERIOR: NUEVO CINODONTE DE SUDÁFRICA REPRESENTA LA MAYOR ESPECIE DEL GRUPO AL FINAL DEL PALEOZOICO

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Reciente actividad de colecta en Ripplemead, Graff Reinet del Karoo sudafricano por Roger Smith resultó en el descubrimiento del cráneo y mandíbula articulada de un nuevo cinodonte para el Pérmico de Sudáfrica. El nuevo espécimen fue localizado aproximadamente a 20 metros debajo del límite Permo/Triásico y es el individuo de cinodonte Pérmico más cercano a los niveles de transición Paleozoico/Mesozoico en Sudáfrica. La nueva especie está también representada por otros tres especímenes en colecciones de Sudáfrica: un cráneo incompleto de otro adulto y dos cráneos de juveniles sin mandíbula. El nuevo taxon presenta unos 18 cm de largo craneano, superando los 13 cm de longitud craneana máxima de *Procynosuchus*, el cinodonte del Pérmico Superior de mayor tamaño. Además la morfología del nuevo taxon es mucho más robusta en general que la conocida previamente en cinodontes del Pérmico superior (y también en relación a los del Triásico Inferior basal). Este robusto cinodonte presenta un hocico extremadamente corto y masivo con cuatro incisivos superiores y un canino de moderado tamaño. Sorprendentemente, los postcaninos son notoriamente pequeños como lo demuestran las raíces de los últimos tres dientes preservados en el segundo espécimen adulto. La mandíbula presentan la sínfisis fusionada, un proceso coronoideo bien desarrollado y alto localizado apenas detrás de la barra postorbital, y la fosa masetérica extendida hasta el ángulo del dentario y limitada antero dorsalmente por una marcada elevación ósea. Es interesante remarcar que con la documentación de este nuevo cinodonte de gran tamaño, los tres grupos de terápsidos avanzados (gorgonópsios, terocéfalos y cinodontes) así como también dicinodontes, presentan una tendencia a desarrollar formas de mayor talla al final de Paleozoico.

SYSTEMATICS AND EVOLUTION OF THE MIDDLE AND LATE TRIASSIC BRASILODONTIDAE

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The Middle and Late Triassic Brasilodontidae from southern Brazil have further improved the knowledge on the Epicynodontia as follows. They bear derived characters such as the reduced parietal crest, an inflated braincase, well-defined promontorium, double jaw articulation, and incipient bifurcation of postcanines root, but at the same time, have retained primitive characters such as the narrow and elongate skull, interorbital opening, 3 or 5 incisiforms, axially elongate premaxila, slender cygomatic arch, slender and elongate unfused lower jaws, and a ventrally wide pterygoid bearing an interpterigoid opening. This set of characters shared with Tritheledontidae, are absent in Thrinaxodontidae, Cynognathidae, Probainognathidae and Chiniquodontidae, suggesting they represent two clades, with important anatomical differences, although both derived from common ancestry: the Procynosuchidae. The term "non-mammalian epicynodonts", generally applied to all the epicynodonts, here excludes brasilodontids and tritheledontids which are distinguished as "pre-mammalian epicynodonts". The theory of miniaturisation proposed by Rowe to explain the small size and the improvement of mammalian anatomical characters is not supported by the knowledge on the Brasilodontidae. Brasilodontids contribute to better understanding the origin of mammals. The detailed anatomy of the skull and of the few available appendicular bones suggests very close relationships with the Morganucodontidae. When considering only the lower jaw and dentition of *Brasilitherium*, it is almost identical with *Morganucodon*, but the upper dentition shows differences. Promontorium and dentary condyles are smaller. All of the characters of *Brasilitherium* that differ with those of *Morganucodon* are more primitive in *Brasilitherium*, as the dentary condyle and the glenoid on the squamosal are less developed; the root of the postcanines only incipiently bifurcated; the promontorio less developed; and the contact between lower postcanines is less developed; the interorbital opening larger in *Brasilitherium*; premolars and molars are less defined or absent, etc. Only a few autopomorphies of *Brasilitherium*, of the pterygoid and the stapedial recess, negate its direct ancestry to Morganucodontidae.

ON THE ORIGIN OF MAMMALS

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Even when the varied morphological evidence from skull, lower jaws dentition and appendicular bones recorded in brasilodontids may cover satisfactorily the morphological aspect of the transition between epicynodonts and morganucodontids, there are other not less significant subjects on which available information is actually poor. Morphology appears to be only the final expression of a set of various environmental and genetic sources leading towards the complex components of the phenotype. The particular back grounds of the genetic code defining the morphological changes, the influence of the environment on the behaviour and feeding of pre-mammalian epicynodonts are only two complementary subjects to analyse when looking for a wider understanding of the origin of mammals. A tentative approach to partially explain the development of so many derived characters in brasilodontids is that the insectivorous behaviour, the small size and the unknown habits led to a diversity of improvements supported by a favourable and well defined genetic code. As it is well known, the Triassic was very fertile in producing so many derived tetrapod groups with quite new levels of anatomical organization: anurans, turtles, crocs, dinosaurs, pterosaurs, mammals, etc. that were dependent on a diversified climate, vegetation, paleogeography and cosmic factors of that period. The very marked diversity in the Triassic environment, with both flourishing and decaying stages of tetrapods and flora, probably influenced genetic changes producing more derived and new adaptive types. Thus, the origin of mammals in the late Triassic is not a unique evolutionary chapter independent from the rest of the Triassic tetrapods evolution but only a part of that complex evolutionary process.

THE RODENT-LIKE DIPHYODONT DENTITION OF THE EUCYNODONT *RIOGRANDIA GUAIBENSIS* BONAPARTE, FERIGOLO AND RIBEIRO, 2001, FROM THE LATE TRIASSIC OF SOUTHERN BRAZIL AND ITS IMPLICATIONS FOR MAMMALIAN EVOLUTION

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Mandibular materials (UFRGS-PV-0787-T and UFRGS-PV-1033-T) of the tritheledontid *Riograndia guaibensis* Bonaparte, Ferigolo, and Ribeiro, 2001, under macro- and microscopic analyses, revealed incisors and canines with self-shearing borders. The hypertrophied and hypselodont i1 displays an open-root as well as an unequal enamel coat that are evidence of an ever-growing nature. Prismatic enamel covers only the buccal, medial, and distal faces of this tooth. The lingual face lacks the enamel coat and bears an occlusal wear surface. A bulk boss of lamellar bone in the dentary of both specimens bears airborne cavitations and bone pillars also in resemblance with rodent architecture. This suite of features points to a herbivore durophagous diet for *Riograndia*, and this is the same condition presented by extant and fossil Rodentia (Tummers and Thesleff, 2006). Inside the dentary, sequential buds of postcanines of UFRGS-PV-0791-T show a succession of developmental stages that point to a reversal sequential wave of substitution, in a diphyodont eutherian pattern (Kielan-Jaworowska *et al.*, 2004; Van Nievelt and Smith, 2005). This developmental pattern shows that the immediate postcanines are truly premolariforms and the subsequent dental units are molariforms. The last were added posteriorly, with no signs of replacement. Moreover, their roots display two parted canals that are externally united in a single apex. This could indicate a progenetic state derived from a probable ancestor that had a molar with two full bifurcated roots (Luo *et al.*, 2002). The dental formula of *Riograndia*, I3-C-P5-M4, signals a diphyodont, well anteriormost reductive eutherian-like pattern, in which the hypselodont i1 precludes functional replacement. The ever-growing i1 suggests that the feeding habit of *Riograndia* was

in agreement with high metabolic rates. These conclusions conflict with the previous concept that advanced non-mammaliaform eucynodonts, such as tritheledontids, were carnivorous-insectivorous animals with a primitive dental pattern. The dentition of *Riograndia* strongly suggests that diphyodonty allied with complex occlusion were already established among non-mammaliaform eucynodonts, and these characters would be integrated with endothermy, limited growth pattern, placentation, lactation, parental care, and a fur coat. As *Riograndia* and other tritheledontids bear a transitional double jaw-joint (Bonaparte *et al.*, 2001; Kielan-Jaworowska *et al.*, 2004), in resemblance with Mesozoic mammaliaforms, we can hypothesize here that diphyodonty was the first basic apomorphic character that anticipated the establishment of the dentary-squamosal temporomandibular joint and the three-boned middle ear during mammalian evolution.

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THE EUTHERIAN ENAMEL PATTERN OF THE EUCYNODONT *RIOGRANDIA GUAIBENSIS* BONAPARTE, FERIGOLO, AND RIBEIRO, 2001 (LATE TRIASSIC, SOUTHERN BRAZIL)

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The dentition of *Riograndia guaibensis* Bonaparte, Ferigolo, and Ribeiro, 2001, was studied under petrographic microscopy and Scanning Electron Microscopy (SEM). In the specimen UFRGS-PV-0787-T, the hypselodont lower incisor (i1) shows an unequal enamel coat on the buccal, mesial, and distal faces, while the lingual one is bare and shows dental wear. Thin prismatic enamel covers the cervical zone and the s*chmelzmuster* is formed by three layers. A thin first coat with at least 1.0 µm of prismless enamel occurs where the crystallites stand parallel to each other and vertical to the Enamel-Dentine Junction (EDJ). Radial enamel rises vertically from this flat first layer and, in the vicinity of the outer enamel surface (OES), it changes to a thin external sheet of prismless enamel. However, inside the thick incisal enamel there is a complex four-layered arrangement. Over the first prismless enamel layer, small rod-prisms with sizes around 3.0 µm in diameter are grouped in rows and upsurge perpendicularly. They decussate collectively in apical trajectories throughout an intermediate layer of Hunter-Schreger Band (HSB) enamel. The external layer of prismless enamel shows no clear ultrastructure. Reflected light microscopy shows collective prism decussations that result in a staggered transitional pattern between radial and HSB enamel. Under polarized light, the fourth premolariform of UFRGS-PV-0791-T and the canine of UFRGS-PV-0789-T display a regular HSB pattern. SEM of UFRGS-PV-0856-T reveals incremental lines that represent the periodicity of the ameloblasts secretions. Near the EDJ, prisms are small rod-like packed units with a narrow layer of oblique interprismatic matrix, and their size enlarges through apical trajectories. Radial and HSB layers show circular and arc-shaped superimposed sheaths, in a "honeycomb" appearance, as occurs in *Pachygenelus* Watson, 1913, and *Megazostrodon* Crompton and Jenkins, 1968 (Wood and Stern, 1997). In the HSB layer, few ovate prism sheaths with planar seams occur. In cross section of the i1, we observe columnar-like structures that denote the sequential discontinuities of planar seams, as in *Sinoconodon* Patterson and Olson, 1961 (Wood and Stern, 1997). Also in *Riograndia* the "triconodont" prismless pinnate pattern with no clear interprismatic matrix or sheaths was encountered on the transversal enamel sections of the cervical buccal region. In mammals, the presence of four-layered *Schmelzmuster* enamel with HSB, linked to other enamel arrays, is physiologically related to a precise and powerful occlusion, slow tooth wear, and long-lasting dentition (Koenigswald, 1997; Wood and Stern, 1997; Wood and Rougier, 2005). Thus, its presence in the tritheledontid *Riograndia,* as well as the ever-growing nature of the hypselodont i1, should be associated with an eutherian pattern of remarkably reductive dental replacement. These integrated features suggest that the emergence of mammalian characters, such as lactation, placentation, diphyodonty, homeothermy/endothermy, mastication, limited growth pattern, fur coat, and parental care, were established in a most inclusive level of the therapsid lineage, before the origin of the first mammaliaforms.

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PHYLOGENETIC ANALYSIS INDICATES AFROTHERIAN AFFINITIES FOR THE LITOPTERNA AND OTHER NATIVE

SOUTH AMERICAN UNGULATES

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Since its original descriptions, the phylogenetic affinities of native South American ungulates have been a matter of debate; the same applies to the Order Litopterna Ameghino, 1889. Litopterna is a peculiar clade, containing more than 50 genera distributed in at least four different families and was one of the dominant groups of "native ungulates". The affinities of litopterns are dubious, and most authors ally them with different groups of the polyphyletic "Condylarthra". However, recent claims doubted this referral and consider the position of Litopterna as uncertain. In order to review the phylogenetic position of litopterns we conducted a phylogenetic analysis. In this new analysis, Litopterna is nested within the afrotherian clade, a mammalian group that includes a large array of African mammals and possibly other South American native ungulates. Litopterna shares with these taxa the presence of a very deep and well-defined astragalar cotylar fossa, and the presence of more than 19 thoracolumbar vertebrae (usually 21), both features considered as synapomorphic of Afrotheria. A third synapomorphy, the retention of milk teeth until total adult size cannot be clearly corroborated in available specimens, and thus is uncertain. However, it is worthy to note that some litopterns of adult size still exhibit dp3-4 on lower and upper dentitions, suggesting that the afrotherian-like delayed dental eruption was probably present in this clade. The afrotherian affinities of South American ungulates reinforce the "Long Fuse Model" hypothesis on the Cretaceous origin of these clades. The definitive separation between South America and Africa appears to be by mid-Cretaceous times (approximately 90 Mya), and thus, the two main groups of Afrotheria may differentiate by vicariance: in Africa the Afrotheria *sensu stricto* (Stanhope *et al.*, 1998) (including afroinsectivorans, tubulidentates, and paenungulates), and in South America the Meridiungulata (including notoungulates, astrapotherians, pyrotherians, xenungulates, and litopterns; McKenna, 1975).

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REDESCRIPTION AND TAXONOMIC REINTERPRETATION OF CF. *PROBAINOGNATHUS* (CYNODONTIA, PROBAINOGNATHIA) FROM THE UPPER TRIASSIC ISCHIGUALASTO FORMATION (SAN JUAN, ARGENTINA)

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Five non-mammalian cynodonts are known from the Late Triassic Ischigualasto Formation, two traversodontids and three faunivorous probainognathians. Within this latter clade the recognized taxa are: *Chiniquodon sanjuanensis* Martínez and Forster, *Ecteninion lunensis* Martínez, May and Forster, and cf. *Probainognathus* sp. Romer, all sharing sectorial postcanines and a skull average ranging from 30 to 130 mm. The specimen PVSJ 410 consists of a complete skull with articulated lower jaws with a total length of 31 mm and constitutes the only material from Ischigualasto Formation referred to cf. *Probainognathus* (Bonaparte and Crompton, 1994). It was identified as a juvenile individual of this genus based essentially on the upper postcanine morphology. The upper postcanines of PVSJ 410 are transversely narrow, without cingulum, with a main cusp A, one accessory mesial cusp B, and one to two distal accessory cusps (C and D). The cusps are sharp with well marked carnassial notch. The main cusp is the tallest and located slightly mesial on the crown; the accessory cusps B and C are almost at the same level whereas the cusp D is placed more dorsally. Clearly, this postcanine pattern differs from that of *Probainognathus*, which has upper postcanines with a prominent central cusp and small accessory mesial and distal cusps that decrease gradually in size. The dentition of PVSJ 410 also differs from that of *Ecteninion* and chiniquodontids (two to three cusps with the main central cusp strongly curved backwards) and brasilodontids (one vertical large cusp with and anterior and posterior smaller accesory cups). Juvenile features and the presence of some associated derived traits in PVSJ 410 hampered a precise taxonomic identification. However, the postcanine tooth pattern in association with other derived features (*e.g.*, slender dentary and zygoma; absence of contact between the prefrontal and postorbital on the orbital margin; the alveolar level of the incisors positioned at a higher position than the level of the postcanines) permit us to reassess and revise its filogenetic position. In our results, PVSJ410 is a new probainognathian taxon, positioned as more derived than *Probainognathus* and *Prozostrodon* Bonaparte and Barberena, and as sister taxon of *Therioherpeton cargnini* Bonaparte and Barberena plus its inclusive clade (*e.g.*, tritheledontids, tritylodontids, brasilodontids, and Mammaliaformes).

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FIRST "AMPHILESTID" TRICONODONT FROM PATAGONIA, ARGENTINA

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We report here on the first amphilestid triconodont from South America. The specimen (MPEF-PV 2365), an isolated left lower molariform, representing a new taxon, was found in the Jurassic Cañadón Asfalto Fm. at Queso Rallado locality, Cerro Cóndor area, Chubut Province, Argentina. Among mammals, this locality has also yielded an alticonodontine triconodontid, two australosphenidans, and an unpublished allotherian (Gaetano and Rougier, 2011). MPEF-PV2365 is characterized by the presence of a compressed lower molariform bearing five mesiodistally aligned cusps (a-e) with the enamel cover thicker lingually than labially. The main cusp (a) is dominant, centered on the crown, and slightly recumbent. Cusp b and c are mesially and distally pointing, respectively. *Tendagurodon janenschi* Heinrich, 1998, an amphilestid from the Late Jurassic of Tanzania, is the most morphologically similar form to MPEF-PV2365, a fact that is reflected in the results of our preliminary phylogenetic analysis that show these taxa as sister-groups. They share the presence of labiolingually compressed molariforms lacking any dental interlocking structure mesially, crowns longer than tall bearing five cusps mesiodistally aligned, cusp **c** taller than **b**, and the mesial margin of cusp **a** shallowly notched. MPEF-PV2365 is only distantly related to *Argentoconodon fariasorum* Rougier, Garrido, Gaetano, Puerta, Corbitt and Novacek, 2007, the other triconodont known from Cañadón Asfalto Fm. Although similar in size, they differ greatly in molariform morphology. The teeth of *Argentoconodon* are tall, thin, and trenchant, suggesting a specialized faunivorous/ictivorous habit; the new triconodont (MPEF-PV2365) has the blunter and rounder cusps of a generalist. Amphilestid triconodonts are a wide array of stem-cladotherians that flourished from the Middle Jurassic to the Late Cretaceous (see Kielan-Jaworowska *et al.*, 2004 for a review; Rougier *et al.*, 2007; Gao *et al.*, 2010; Lopatin *et al.*, 2010). They are well represented in northern landmasses while scarce in southern continents. The inclusion of MPEF-PV2365 among amphilestids, and its early age, points to the origin and diversification of these forms under a Pangeic continental configuration at least by Jurassic times.

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DEVELOPMENTAL PATTERNS IN MESOZOIC EVOLUTION OF MAMMAL EARS

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The definitive mammalian middle ear, with its significance for hearing adaptation, is a key evolutionary innovation of all living mammals. The detachment of the ear from the jaw, an important transformation in the descent of mammals from premammalian cynodonts, is now shown to have major homoplasies in Early Cretaceous eutriconodont and spalacotheroid mammals. The genetic mechanism for the morphogenesis of the middle ear structure has been deciphered in recent years by developmental studies of extant mammals. The characteristics of the middle ear in some well-preserved Mesozoic mammals and the phenotype characteristics of genetic experiments of extant mammals can now be correlated with an unprecedented level of detail. It is possible to directly extrapolate the gene patterning and developmental heterochrony of extant mammals to the evolutionary pattern in the middle ears of Mesozoic mammals. The developmental morphogenesis of genetic studies and the fossil record of early mammals can now provide an integrated case study of how development has impacted, mechanistically, the transformation of major structural complexes in evolution, such as the mammalian middle ear.

BRASILITHERIUM (CYNODONTIA) AND THE ORIGIN OF MAMMALIAN FEATURES

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During the second half of the XX Century, the monophyly of Mammalia and its closest sister group have been hotly debated. At least six families of non-mammaliaform cynodonts were central to the arguments: Thrinaxodontidae, Probainognathidae, Dromatheriidae, Therioherpetidae, Tritylodontidae, and Tritheledontidae (or Ictidosauria). Traditionally, the latter two families have been alternatively defended as the closest relative to mammals. The discovery of new materials of advanced non-mammaliaform probainognathians from the Late Triassic Caturrita Formation of southern Brazil (*e.g.*, Bonaparte *et al.*, 2005; Soares *et al.*, 2011) provide new evidence concerning the sister group of mammals and their impact on character transformations. The most relevant taxa are *Brasilodon quadrangularis* Bonaparte, Martinelli, Schultz and Rubert, 2003 and *Brasilitherium riograndensis* Bonaparte, Martinelli, Schultz and Rubert, 2003; they nest closer to mammaliaforms than do tritylodontids and ictidosaurs. *Brasilodon* and especially *Brasilitherium* show an unexpected mosaic of features crucial for understanding

mammaliaform origin. *Brasilitherium* is a very small probainognathian (<100 gr.) phylogenetically closer to mammaliaforms than any other known cynodont. Derived features of *Brasilitherium* include: (1) lack of prefrontal and postorbital bones; (2) slender and low zygomatic arch; (3) muzzle longer than temporal portion of the skull; (4) separated fenestra rotunda and foramen jugular; (5) fused opisthotic and prootic (petrosal); (6) well defined promontorium; (7) trigeminal nerve (V) exits via three foramina on petrosal anterior lamina [the anterior one related to exit for maxillary branch (V_2), and the remaining two ventral and slightly posterior to it related to mandibular branch (V_3)]; (8) wide primary palate, posterior to the choana; (9) foramen for the prootic sinus vein; (10) quadrate with a well developed stapedial process; (11) presence of maxillo-, naso- and ethmoturbinals; (12) extremely low horizontal ramus of the dentary; (13) dentary reaching squamosal; (14) unfused mandibular symphysis; (15) position and relative size of the main crown cusps similar to morganucodontids with the presence of cusps e and g (*kuhnecone*) on middle postcanines; (16) lower postcanines with a tongue (by cusp d) and groove-like (by cusps b and e) system; (17) labially constricted postcanine root with two internally separated canals; (18) presence of a close pattern of wear facet between upper/lower postcanines; and, (19) delayed postcanine tooth replacement (although still alternated with a postero-anterior direction). Even though some of these traits occur in other cynodonts, others are synapomorphies (*e.g.*, 3, 5, 6, 7, 14, 15) for *Brasilitherium* and Mammaliaformes, underscoring the importance of the former in cynodont evolution.

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A NEW ADVANCED EUCYNODONT (SYNAPSIDA, CYNODONTIA) FROM THE CARNIN—NORIAN ISCHIGUALASTO FORMATION, NORTHWESTERN ARGENTINA

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The cynodonts of Ischigualasto Formation (late Carnia- early Norian) are abundant and diverse. They include the mid-size traversodontids *Exaeretodon argentinus* Bonaparte, 1962 and *Ischignathus sudamericanus* Bonaparte, 1963, and the small animalivorous *Ecteninion lunensis* Martínez, Forster and May, 1996, *Probelesodon sanjuanensis* Martínez and Forster, 1996, cf. *Chiniquodon* Huene, 1936 (Bonaparte, 1966), and *Probainognathus* sp. Romer, 1970 (Bonaparte and Crompton, 1994). We report here on the discovery of a new small eucynodont (PVSJ 882) that expands the diversity of the group in Ischigualasto Formation and gives more information about the advanced non-mammalian eucynodont phylogeny. The remains come from the lower levels of *Scaphonyx-Exaeretodon-Herrerasaurus* biozone (*sensu* Martínez *et al.*, 2011) and thus are contemporaneuos of the aforementioned taxa. The new species is based on a well preserved and almost complete skull lacking both premaxillae and lower jaws. Approximately 8 cm in length, at first view the new species resembles *Ecteninion lunensis* in size, long upper canines, anteroposteriorly expanded temporal fenestrae, and posteriorly projected occipital crest. In other aspects, it has a set of characters that clearly differ from all other known cynodonts from Ischigualasto Formation. The upper canines of PVSJ 882 are long (almost 5 times longer than postcanine), anteroposteriorly thin, labiolingually flat, unserrated, and with two longitudinal shallow grooves along the labial surface. PVSJ 882 has nine imbricated postcanines of different sizes, and separated from the canine by a moderate diastema. The crowns have a larger central cusp (A) and two accessory cusps located one anteriorly (B) and the other posteriorly (C) to the main one. The last three postcanines differ from the anterior ones in having three cuspules on the labial side of the cusp C. Other features of the new specimen include lack of postorbital bar, postorbital and prefrontal; secondary palate expands posteriorly well behind the level of the last postcanine; interpterygoid vacuities; short basisphenoid wings; and incipient promontorium. The teeth have wear facets that affect mainly the main cusp (A) and are not similarly developed in all the teeth—less wear is present in the smaller teeth. The worn surfaces are flat and medioventrally oriented. The development of the wear could indicates a juvenile adult age of the specimen and/or fast tooth replacement rate. The irregular develop of wear and the alternate different sizes of the postcanines, indicate the alternated replacement of teeth. The set of characters supports the interpretation of PVSJ 882 as a new taxon. Phylogenetic analysis locates the new species as an unresolved politomy with *Brasilodon* Bonaparte, Martinelli, Schultz and Rubert, 2003; *Adelobasileus* Lucas and Hunt, 1990; tritylodontids; and mammaliaformes.

Bonaparte, J.F. 1966. *Chiniquodon* Huene (Therapsida-Cynodontia) en el Triásico de Ischigualasto, Argentina. *Acta Geológica Lilloana* 8: 157–169.

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Martinez, R.N., Sereno, P.C., Alcober, O.A., Colombi, C.E., Renne, P.R., Montañez, I.P. and Currie, B.S. 2011. A basal dinosaur from the Dawn of the Dinosaur Era in Southwestern Pangaea. *Science* 331: 201–210

NEW INFORMATION ON THE DENTITION OF THE TRAVERSODONTID CYNODONT *MENADON BESAIRIEI* FLYNN, PARRISH, RAKOTOSAMIMANANA, RANIVOHARIMANANA, SIMPSON AND WYSS 2000 FROM THE SANTA MARIA FORMATION (MIDDLE–LATE TRIASSIC), SOUTHERN BRAZIL

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The *Santacruzodon* Assemblage Zone (AZ) (Soares *et al.*, 2011) of the Santa Maria Formation is is composed mostly by traversodontid cynodonts, but also chiniquodontid and probainognatid cynodonts and a proterochampsid archosaurmorph. Recently, there has been faund that the cynodont formerly called "Traversodontid Type I" (Abdala *et al.* 2001) was in fact almost indistinguishable from the Malagasy *Menadon besairiei* Flynn, Parrish, Rakotosamimanana, Ranivoharimanana, Simpson and Wyss, 2000, correlating biostratigraphically the *Santacruzodon* AZ to the "Isalo II" beds from Madagascar and strengthening the proposed Ladinian–Carnian age of both strata (Melo *et al.*, 2009; 2010). In this work, we aim to present new contributions on the dentition of *Menadon besairiei* as revealed by several Brazilian specimens. As though the teeth are mostly compatible with the specimens from Madagascar in regard of morphology and position, there are dissimilarities in the size of the canines and upper postcanine count (PC5/6). These differences are likely to be ontogenetic in nature, given that the largest animals have broader (upper and lower) canines and only 5 upper postcanines, while the holotype had 7 postcanines and was probably a subadult. This was hypothesized by Kammerer *et al.* (2008), although they considered the reduced labio-lingual width of the upper canines as an autapomorphy. Throughout the ontogenetic series recorded in the Brazilian strata, the number and morphology of lower postcanines remained surprisingly regular (6), being pc1 and pc2 small and ovoid in cross section, pc3 roughly quadrangular with round edges, pc4-5 quadrangular (slightly trapezoidal), pc6 greatly reduced, similar to pc1. We propose the extreme reduction of the last lower postcanine as an additional autapomorphy for the species. In spite of the lack of younger specimens bearing a complete set of upper postcanines, there are a number of isolated teeth found in association with crania showing no differentiation between root and crown. The isolated teeth, as well as the ontogenetic regularity, suggest the presence of hypsodont postcanines in this taxon, an unknown feature among traversodontids.

Abdala, F., Ribeiro, A.M. and Schultz, C.L. 2001. A rich cynodont fauna of Santa Cruz do Sul, Santa Maria Formation (Middle–Late Triassic), southern Brazil. *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte* 2001: 669–687.

Flynn, J.J., Parish, J.M., Rakotosamimanana, B.R., Ranivoharimanana, L., Simpson, W.F. and Wyss, A.R. 2000. New traversodontids (Synapsida: Eucynodontia) from the Triassic of Madagascar. *Journal of Vertebrate Paleontology* 20: 422–427.

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Melo, T.P., Soares, M.B. and Oliveira, T.V. 2009. Primeiro registro do traversodontídeo *Menadon* sp. (Flynn *et al.*, 2000) na Biozona de Traversodontídeos da Formação Santa Maria, Triássico Médio do Rio Grande do Sul, Brasil (São João do Polêsine), *Livro de resumos* 1: 16.

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DESCRIÇÃO ANATÔMICA E SISTEMÁTICA PRELIMINAR DE ALGUNS MATERIAIS CRANIANOS DE CINODONTES DA COLEÇÃO PALEONTOLÓGICA DA UFSM, SUL DO BRASIL

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O levantamento, descrição anatômica e avaliação sistemática preliminar de alguns cinodontes existentes na coleção paleontológica da Universidade Federal de Santa Maria (UFSM), foi realizado como trabalho de conclusão de Curso de Graduação em Ciências Biológicas – Nível Bacharelado. Inicialmente, foram identificados 80 espécimes, dos quais foram selecionados para este reporte aqueles com materiais cranianos e mandibulares preservados. Assim podemos destacar os seguintes materiais: UFSM 11060, crânio bem preservado, coletado no município de Dona Francisca, identificado como *Exaeretodon* Cabrera, 1943, não sendo possível atribuí-lo a uma espécie determinada, já que o basicrânio não está bem preservado, impedindo o reconhecimento de características diagnósticas presentes nessa região (Abdala *et al.*, 2002). Os crânios UFSM 11162, procedente do Sítio Cortado (Da-Rosa *et al.*, 2004); UFSM 11231, procedente do Sítio Linha Várzea 1; e a mandíbula UFSM 11232 procedente do Sítio Linha Várzea 1, foram identificados como *Massetognathus* Romer, 1967, pelas suas dentições, comparables as do material descrito por Liu *et al.* (2008). Os dois crânios estão em fase de preparação, e ainda não foi possível reconhecer características diagnósticas para enquadrá-los em uma espécie; em relação à mandíbula, ocorreu o material está fragmentado, dificultando uma diagnose ao nivel de especie. Destaca-se também UFSM 11274, uma pequena mandíbula com os dentes pós-caninos comprimidos buco-lingualmente, procedente do Sitio Cortado, sugerindo tratar-se de um pequeno cinodonte carnívoro (chiniquodontídeo?). Com essa descrição sistemática preliminar é possível observar que os materiais cranianos de cinodontes tombados na coleção paleontológica da UFSM, são oriundos, em sua maioria, da Cenozona de Therapsida, (Schultz and Langer, 2007) da Formação Santa Maria, Membro Alemoa, do Triássico Médio do Rio Grande do Sul. Permitem igualmente a ampliação do conhecimento sobre os cinodontes presentes em diversos sítios fossilíferos da região central do Rio Grande do Sul, com base no reconhecimento do material fóssil da coleção paleontológica da Universidade Federal de Santa Maria.

Abdala, F., Barberena, M.C. and Dornelles, J. 2002. A new species of the traversodontid cynodont *Exaeretodon* from the Santa Maria Formation (Middle/Late Triassic) of Southern Brazil. *Journal of Vertebrate Paleontology* 22: 313–325.

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TRAVERSODONTID CYNODONTS (THERAPSIDA – EUCYNODONTIA) FROM TWO UPPER TRIASSIC LOCALITIES OF THE PARANÁ BASIN, SOUTHERN BRAZIL

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Traversodontidae are cosmopolitan non mammaliaform cynodonts characterized mostly by their bucco-lingually expanded postcanine teeth (Abdala *et al.,* 2002). In Rio Grande do Sul State, Brazil, this group is recorded in several localities of the Middle–Late Triassic Santa Maria Formation, being represented until now in the *Dinodontosaurus*, *Santacruzodon* and *Hyperodapedon* Assemblage Zones (AZ) (Soares *et al.*, 2011a). The main goal of this work is to put on record traversodontid remains deposited in the scientific collection of Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul. Part of these materials are associated to the archosauriform *Sacisaurus* inside the urban area of Agudo municipality, and to the fauna of small amniotes of the Sesmaria do Pinhal in Candelária municipality. In the first site five mandibles, isolated teeth and a Traversodontidae postcranium were collected from beds formed by fine grained sandstones. These layers are considered as part of the *Hyperodapedon* AZ, but in the overlaying beds, composed of fine grained sandstones including mudstone rip-up clasts, was collected a tooth of a traversodont cynodont associated with *Sacisaurus agudoensis* Ferigolo and Langer, 2006; and the probainognathian cynodonts *Riograndia guaibensis* Bonaparte, Ferigolo, and Ribeiro, 2001 and *Brasilitherium riograndensis* Bonaparte, Martinelli, Schultz, and Rubert, 2003. In the Sesmaria do Pinhal site, usually referred as "Poste outcrop", were collected teeth and maxilla fragment of a traversodontid, associated with *Brasilitherium riograndensis,* fragments possibly representing a sphenodontian and teeth of archosaur. The morphology of the material of both localities is similar to *Exaeretodon* Cabrera, 1943. The presence of *Exaeretodon*-like traversodontids with taxa typical of *Riograndia* AZ can be interpreted as follows: this taxon has survived until the *Riograndia* AZ or until the contact between the *Hyperodapedon* and *Riograndia* AZs, and was posteriorly redeposited in the later assemblage zone. These findings are very important in biostratigraphic terms, as they represent the younger records of traversodontid cynodonts in South America, and suggests the extension of a classic Ischigualastian member like *Exaeretodon* to the *Riograndia* AZ, which is typically considered post-Ischigualastian and of Upper Norian to Rhaetian age (Abdala and Ribeiro, 2010; Soares *et al.*, 2011b). In addition, these findings highlight the necessity of more detailed stratigraphic studies in these regions, because the outcrops producing these traversodontid remains could represent a contact area between the *Hyperodapedon* and *Riograndia* Azs. The Sesmaria do Pinhal (Poste) site, for example, is located between the outcrops were *Riograndia* and *Guaibasaurus* were collected and outcrops were *Exaeretodon* and *Hyperodapedon* were recovered. In the Sesmaria do Pinhal outcrop the collected specimens show a much larger degree of fragmentation in comparison to the remains recovered from the two other outcrops mentioned.

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DIGITAL ENDOCAST OF THE BRAIN AND INNER EAR OF THE EUCYNODONT *BRASILITHERIUM RIOGRANDENSIS* BONAPARTE, MARTINELLI, SCHULTZ AND RUBERT, 2003 (LATE TRIASSIC, BRAZIL) AND ITS CONTRIBUTION TO THE KNOWLEDGE OF MAMMALIAN ORIGINS

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Digital 3D reconstructions of the endocasts of the brain and the inner ear (infilling of the braincase and otic region of the skull) of *Brasilitherium riograndensis* Bonaparte, Martinelli, Schultz and Rubert, 2003 (UFRGS-PV-1043-T), were obtained from CT scan images. This taxon is considered the sister-group of the mammaliaforms and is the only non-mammaliaform cynodont with a promontorium (Bonaparte *et al.*, 2003, 2005). The endocast of *Brasilitherium* shows olfactory bulbs casts relatively larger than other non-mammaliaforms cynodonts, cerebral hemispheres elongated, clearly divided by a median sulcus, and probably concealing the midbrain in dorsal view. The paraflocular casts, a big

hypophyseal cast, and a wide opening for the *cavum epiptericum* are prominent. The encephalization quotient (EQ) calculated for *Brasilitherium* is above the range of EQs reported for other non-mammaliaform cynodonts, but falls below that of the Mammalia crown group (*e.g.,* Kielan-jaworowska *et al.*, 2004; Macrini *et al.*, 2007). The inner ear, reconstructed on the left side of the skull, shows an elongated cochlear canal, which extends anteriorly for about 54% of the length of the promontorium. The ratio between the cochlear canal and the skull length is similar to the value reported for *Yunnanodon* (Luo, 2001), being above the values for other non-mammalian cynodonts and below those calculated for mesozoic mammaliaforms (Luo *et al.*, 1995; Hurum, 1998). Comparing the allometric relationship of the cochlear canal and the estimated body mass with the values of this ratio reported for other taxa in other studies (Graybeal *et al.*, 1989; Rosowski and Graybeal, 1991; Luo, 2001), *Brasilitherium* can be grouped with *Yunnanodon* and *Morganucodon* in a regression line that, like that for extant birds, is placed below the line of mammals and above the line of non-avian reptiles. Such intermediate condition can represent an increase in the capacity to hear higher frequencies. The semicircular canals are irregular in shape, with the lateral canal being the smallest and the anterior the largest, involving the paraflocular cast. This study indicate a slighter increase of the brain of *Brasilitherium* in comparison to other non- mammaliaform cynodonts, and a more pronunciated increment in the inner ear and olfactory bulbs, which support the proposition for the early evolution of the mammalian brain associated to selective pressures for better sensorial acuity in the small, and possibly nocturnal, Mesozoic cynodont taxa.

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MAMMALS FROM THE LATE CRETACEOUS OF ARGENTINA AND THE RADIATION OF THE SOUTH AMERICAN DRYOLESTOIDS

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Mesungulatum houssayi Bonaparte and Soria, 1985, was the first Mesozoic mammal described from South America and mesungulatids have been found in all Late Cretaceous localities subsequently discovered where more than a single mammalian specimen has been found (Rougier *et al.*, 2011). Mesungulatids represent a morphologically diverse group of taxa which in most cases have originally been identified as units of familiar level, including Mesungulatidae, Reigitheriidae and Peligrotheriidae. Both, Peligrotheriidae and Reigitheriidae are monotypic, while Mesungulatidae includes two species of *Mesungulatum*, *Coloniatherium*, plus a couple of yet unnamed species. Other taxa have been referred to the group but the status is uncertain. Mesungulatids are characterized by a great development of the pre- and post- cingula, bunodont cusps, robust and almost bifid metaconid, mesiodistally compressed lower roots, thick prismatic enamel with a small AP zone, complex last premolar and complete lack of talonid. Most of these forms have supernumerary roots in the penultimate and last premolars as well among other features. Mesungulatids range in age from the Campanian to the Paleocene and include small forms such as *Reigitherium* and relative giants as *Peligrotherium*. The petrosals and basicranium known indicate the retention of a primitive braincase made mostly by the anterior lamina and derive inner ear structures with a minimum of one cochlear turn in *Peligrotherium* and *Coloniatherium*. Mesungulatids like other SA dryolestoids lack evidence of Meckel's cartilage, coronoid bone, and postdentary elements. *Mesungulatum* and allies are members of a derived clade of SA dryolestoid with forms like *Leonardus*, The low number of molars and premolars (3-3) in *Coloniatherium*, *Peligrotherium* and other features suggest that the mesungulatids may have arisen from a paurodont-like morphotype with small number of postcanines, and sub-equal roots. A broad phylogeny of non-tribosphenic mammals still recovered the more gracile forms as part of a monophyletic SA assemblage sharing as most distinctive trait the lack of metacone (a feature recognized by Bonaparte, 1994). However, because the incomplete nature of most of the SA material, alternative resolutions, are just a few steps longer. The more complete materials of mesungulatids now available allow to evaluate positional variations and propose taxonomic synonyms which significantly reduce the otherwise artificial Late Cretaceous mammalian diversity.

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NEW INFORMATION ON THE MIDDLE TRIASSIC CYNODONTS OF TANZANIA AND ZAMBIA

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The Ruhuhu Basin of Tanzania and the Luangwa Basin of Zambia are two rift basins that preserve lower Middle Triassic strata (in the Manda Beds and Ntawere Formation, respectively) that document terrestrial communities approximately eight million years after the Permo-Triassic mass extinction. The faunal dynamics of this interval are not particularly well known, although contemporaneous deposits exist across southern Pangea (*e.g.*, Omingonde Formation of Namibia, Burgersdorp Formation of South Africa, and the upper Fremouw Formation of Antarctica). Interestingly, preliminary data from Tanzania suggest that its remarkably diverse archosaur assemblage (Nesbitt *et al.*, 2010), represents the broader pattern of the replacement of a regional Permian fauna by provincial Triassic faunas by the Anisian. Our recent fieldwork efforts in the upper Ntawere Formation have yielded three new cynodont records, including at least one new species. We have recorded the first record of a trirachodontid from Zambia, which consists of a disarticulated, subadult specimen including parts of the skull as well as much of the appendicular skeleton. The same locality also yielded at least two skulls of a new, derived traversodontid cynodont with an enlarged, procumbent lower first incisor and three small upper incisors. Both the upper and lower canines are reduced in size. A third, relatively large cynodont is represented by a scattered axial skeleton, ilium, and isolated sectorial postcanine tooth, but its taxonomic identity is currently unclear. We failed to find additional material of *Luangwa*. The most abundant therapsid fossils collected in the Lifua Member of the Manda Beds were the remains of cynodonts, including *Aleodon*, *Cricodon*, and *Scalenodon angustifrons*. A single edentulous mandible compares favorably to the derived traversodont from the Ntawere by virtue of its single enlarged incisor coupled with a reduced canine. The probainognathian *Aleodon brachyrhamphus* numerically dominates the new collection, with partial skulls, isolated jaws, and postcranial elements. The new collection also includes multiple complete skulls of the traversodontid *Scalenodon angustifrons* and cranial and postcranial materials of the trirachodontid *Cricodon metabolus*. In addition to the completeness and fine preservation of the new fossils, our collection is remarkable for including growth series for *S. angustifrons* and *Aleodon*. The Manda cynodont fauna is comparable to the Anisian faunas of the *Cynognathus* C Zone in South Africa, the upper Omingonde Formation in Namibia, and upper Ntawere Formation in Zambia. However, the Tanzanian fauna is more diverse taxonomically, with seven nominal species (those noted above plus *Luangwa*, '*Scalenodon*' *attridgei*, and '*S.*' *charigi*).

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A NEW SMALL NON-MAMMALIAFORM CYNODONT FROM THE LATE TRIASSIC OF SOUTHERN BRAZIL

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Since 2000 new fossiliferous oucrops of the upper portion of the Santa Maria 2 Sequence (Norian) (Zerfass *et al.*, 2003) have revealed new advanced non-mammaliaform cynodonts closely related to mammalian origins. These taxa flourished during what we recognized as the *Riograndia* Assemblage Zone (AZ) (Soares *et al.*, 2011) that can be correlated with the fauna of the Los Colorados Formation, early Norian of Argentina (Arcucci *et al.*, 2004). In this contribution we describe a new sectorial toothed cynodont from the *Riograndia* AZ. The specimen MMACR-PV-003-T is represented by a left lower jaw (50 mm long), without postdentary bones, bearing the canine and four postcanines. The anteriormost portion of the dentary was lost. Two other maxillary fragments, one with a broken canine and another with only one postcanine preserved, were associated with the lower jaw. The mandibular ramus is not deep, showing a horizontal Meckelian canal and a postdentary trough posterodorsally directed from the level of the pc4. The margin of the angular process is broken. The prominent coronoid process rises behind the pc4, not covering it in buccal view. The lower canine apex is broken, but the tooth is a robust element. A wide diastema is present between the canine and the postcanine sequence. The second and the fourth postcanines are better preserved and it is possible to see that both have a larger main cusp, that is buccally aligned with one mesial and two distal accessory cusps, being the first distal cusp the tallest. In general, the cusps are not bulbous and are slightly curved backwards. In lingual view, there is one mesial cusp that is followed by a series of very tiny cuspules, forming a tenuous cingular shelf positioned in the first half of the crown. The upper isolated postcanine is smaller than the lower ones and shows three symmetrically aligned cusps in the buccal side, being the central one the largest. In the lingual side the tooth has a pair of mesial and another pair of distal cuspules symmetrically positioned; no cingular shelf is visible. The postcanine roots are incipiently bifurcated. The upper canine is mesiodistally longer than the lower. The postcanine pattern of the MMACR-PV-003-T is quite different from those of tritheledontids and brasilodontids from the *Riograndia* AZ. The pattern in the new taxon resembles more the sectorial dentition of the Carnian *Prozostrodon* Bonaparte and Barberena, 2001, in which the posterior lower postcanines are also tetracuspidate, but with a shorter crown and a more developed cingular shelf. The upper postcanine of MMACR-PV-003-T also differs from those of *Prozostrodon* in having three buccal cusps (instead of four) and four lingual cuspules. In addition, the reduced number of postcanines contrasts with that of the other Norian taxa and seems to be unique of the MMACR-PV-003-T.

Arcucci, A.B, Marsicano, C.A. and Caselli, T. 2004. Tetrapod association and paleoenvironment of the Los Colorados Formation (Argentina): a significant sample from the Western Godwana at the end of the Triassic. *Geobios* 37: 557–568.

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THE DIVERSITY OF BRAZILIAN NON-MAMMALIAFORM CYNODONTS THROUGH THE TRIASSIC

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The rich fossil tetrapod content from the Middle–Upper Triassic of southern Brazil is recorded in beds related to the Santa Maria 1 Sequence (Ladinian) and Santa Maria 2 Sequence (Carnian–Norian), in which a succession of four faunal tetrapod associations has been recognized, *i.e.*, the *Dinodontosaurus, Santacruzodon, Hyperodapedon* and *Riograndia* Assemblage Zones (AZ) (Abdala and Ribeiro, 2010). In all of these biostratigraphic units –the ages of which are based on correlations with Argentinean and Malagasy faunas– the non-mammaliaform cynodonts account for a significant percentage of the recorded taxa, comprising the taxonomically most diverse group. Eight taxa are recorded from the *Dinodontosaurus* AZ (*e.g.*, *Chiniquodon* von Huene, 1936; *Massetognathus* Romer, 1967; *Luangwa* Brink, 1963), five from the *San-*

tacruzodon AZ (*e.g.*, *Santacruzodon* Abdala and Ribeiro, 2003; *Menadon* Flynn, Parrish, Rakotosamimanana, Ranivoharimanana, Simpson, and Wyss, 2000), seven from the *Hyperodapedon* AZ (*e.g.*, *Exaeretodon* Cabrera, 1943*; Therioherpeton* Bonaparte and Barberena, 1975*; Trucidocynodon* Oliveira, Soares, and Schultz, 2010), and six from the *Riograndia* AZ (*e.g.*, *Riograndia* Bonaparte, Ferigolo, and Ribeiro, 2001*; Brasilodon*, *Brasilitherium* Bonaparte, Martinelli, Schultz, and Rubert, 2003). This taxonomic predominance reflects the morphological and ecological diversity achieved by the group during the Triassic in what is presently Brazil: their skull sizes ranged from 2, 5 cm up to 40 cm; three of them were strictly carnivorous, eleven were carnivorous-insectivorous, and thirteen were herbivorous. Such taxonomic richness and stable representation over time contrast somewhat with the scenario in Argentina, where the diversity of the group decreases through the Carnian–Norian interval, being restrict to four taxa in the Ischigualasto Formation [*Scaphonyx-Exaeretodon-Herrerasaurus* Biozone (Carnian) and *Exaeretodon* Biozone (Carnian–Norian)], none in the impoverished fauna of the *Jachaleria* Biozone (early Norian) (Martinez *et al.*, 2011), and only one in the upper part of the Los Colorados Formation (Arcucci *et al.*, 2004). This scarcity observed in the Norian faunas from Argentina may suggest a taphonomic bias against the preservation of small tetrapods (Martinez *et al.*, 2011). It is a plausible hypothesis, considering that near the Triassic/Jurassic boundary the members of Cynodontia exhibit smaller sizes. But, curiously, this bias did not occur in the Norian fauna from Brazil, in which there are six taxa of very small non-mammaliaform cynodonts. Another hypothesis could be that members of the latter fauna were less vulnerable to the regional extinction events that occurred at the end of the Carnian and that played an important role in the major faunal changes observed in southwestern Pangea. Anyway, as the first dinosaurs, the Brazilian non-mammaliaform cynodonts opportunistically occupied the ecospace after it had been vacated due to the Carnian crisis (Benton, 2004). In fact, nowadays in Brazil the fossil collections show a taxonomic supremacy of the Norian non-mammaliaform cynodonts over the dinosaurs. But for how long? Only the future will tell...

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MESOZOIC THERIANS AND THE ORIGINS OF THE CENOZOIC AND MODERN FAUNAS

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The timing of the origin of the modern therian mammal faunas (marsupials and placentals) is the subject of controversy, with origination dates based on molecular evidence consistently much older than those inferred from the fossil record. The most complete morphological phylogenetic analysis in terms of taxa and characters published to date that addresses this controversy for placental mammals is Wible *et al.* (2007). This analysis found no Cretaceous taxa placed within any placental lineages and recovered some higher-level placental clades supported by molecular evidence (such as Euarchontaglires and Afrotheria minus tenrecs). Here, this analysis is expanded with the addition of more extant and extinct taxa (some of the latter newly described) and morphological characters (including several proposed afrothere features). The results derived from the increased sampling are presented and the implications for the paleobiogeography of the major placental radiations are discussed.

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A NEW MULTITUBERCULATE SKULL FROM THE UPPER CAMPANIAN "EL GALLO" FORMATION, BAJA CALIFORNIA, MEXICO

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Terrestrial vertebrate faunas from the Late Cretaceous (99–66 Ma) of Mexico, because of their position in geologic time and space, have potential to significantly impact our view of key events in vertebrate evolutionary history, namely dispersal between the Americas, the Cretaceous/Paleogene extinction, and the Paleocene radiation of mammals (Rowe *et al.*, 1992). The fossil record of the Late Cretaceous of Mexico, however, is poorly known. In the area of El Rosario, Baja California, Mexico, exposures of the Upper Cretaceous "El Gallo" Formation represent a 1280 m thick non-marine, sedimentary sequence (Fulford and Busby, 1993). The age of the vertebrate fossil-bearing lower El Disecado Member is constrained between 74.25 + 0.07 Ma and 73.59 + 0.09 Ma (Renne *et al.*, 1991), corresponding to a late Judithian or early "Edmontonian" North American Land Mammal 'Age' (Cifelli *et al.*, 2004). Previous paleontological fieldwork in the area (1965–1974) focused on recovery of dinosaur remains, though small collections of other fossil vertebrates, invertebrates, and plants were

also made (Morris, 1973). Reported mammalian fossils include three fragmentary jaws and 12 isolated teeth representing four taxa, *i.e.*, the multituberculates *Mesodma* cf. *M. formosa* and ?*Stygimys* sp., the metatherian *Pediomys* sp., and the eutherian *Gallolestes pachymandibularis* (Lillegraven, 1972, 1976; Clemens. 1980). Recent paleontological fieldwork (2005–2010) in the area has focused on recovery of vertebrate microfossils and has yielded important discoveries (Montellano *et al.*, 2005; Peecook *et al.*, 2010), most notably a partial mammalian skull, the first from the Cretaceous of Mexico. Whereas the basicranium is missing and the skull roof is crushed, the specimen includes complete and well-preserved upper and lower dentitions that are attributable to the multituberculate *Cimolodon*, which is known from other Cenomanian–Maastrichtian local faunas of North America (Cifelli *et al.*, 2004). A proximal ulna and a femoral head, both consistent in size with the skull material, were also found within the specimen block. This is the first occurrence of *Cimolodon* from El Rosario and contrasts with more endemic aspects of the mammalian fauna (*Gallolestes*, *Stygimys*). Ongoing fieldwork in the area will aim to develop a more complete sample of this Late Cretaceous mammalian fauna.

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LA GRAN RADIACIÓN DE TERÓPODOS: FAUNAS Y EVOLUCIÓN DURANTE EL TRIÁSICO Y JURÁSICO

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AVIAN ANCESTORS: A REVIEW OF THE PHYLOGENETIC RELATIONSHIPS OF COELUROSAURIAN THEROPODS CLOSELY RELATED TO BIRDS

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Although consensus exists among authors that birds evolved from coelurosaurian theropods, paleontologists still debate about the identification of the group of coelurosaurians that most closely approaches to the common ancestor of birds. The last 20 years witnessed the discovery of a wide array of avian-like theropods that considerably amplified the anatomical disparity among deinonychosaurians, some of which resemble more closely basal birds rather than dromaeosaurids. Among these newly discovered theropods that show remarkable bird-like characteristics are the four-winged theropods *Microraptor* Xu, Zhou and Wang, 2000, and *Anchiornis* Xu, Zhao, Norell, Sullivan, Hone, Erickson, Wang, Han and Guo, 2008, and the unenlagiids (Agnolin and Novas, 2011). Besides, a bizarre group of minute-sized coelurosaurs, the Scansoriopterygidae (Zhou *et al.*, 2008), also exhibits some avian similarities that led some authors to interpret them as more closely related to birds than other dinosaurs. Direct examination of important fossil specimens, together with the re-analysis of published data, allows recognizing several features previously overlooked in these specimens. With the purpose of exploring the phylogenetic relationships of these coelurosaurians and birds, we merged recently published integrative databases, resulting in significant changes in the topological distribution of taxa within Paraves. We present evidence that Microraptoria (Senter *et al.*, 2004), Unenlagiidae (Makovicky *et al.*, 2005), and *Anchiornis* Xu *et al.*, 2008, form succesive sister taxa of Aves, and that the Scansoriopterygidae Zhang *et al.*, 2008, are basal coelurosaurians not directly related to birds. Moreover, the deinonychosaurian clade is considered as paraphyletic, with troodontids and dromaeosaurids representing successive sister taxa to Aves. In this way, our analysis supports that the acquisition of aerial locomotion is parsimoniously recovered as occu-

rred just only once among paravians. Several features related with the acquisition of flying control (alula, protopatagium, automatic control of forearms, development of muscles that flex the forearms allowing sustained flight) have developed well before the origin of birds, probably at the Microraptoria + Avialae node.

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EVOLUTIONARY TRENDS IN THEROPOD CRANIAL FORM AND FUNCTION: INSIGHT FROM GEOMETRIC MORPHOMETRICS, BIOMECHANICS, AND PHYLOGENY

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The evolutionary radiation of theropod dinosaurs during the Triassic and Jurassic was a profound event that shaped Mesozoic terrestrial ecosystems and set the foundation for the evolution of birds and avian-style flight. Although large-bodied carnivores such as Tyrannosaurus and small, bird-like predators like Velociraptor are the most stereotypical theropods, this clade developed a great diversity of body size, skull form, and feeding habits during its 160+ million year evolutionary history. Perhaps surprisingly, however, there has been little work on large-scale macroevolutionary patterns across theropod phylogeny and evolutionary history. In particular, there has been no quantitative documentation of broad patterns of skull shape variation in theropods, and little examination of how differences in cranial morphology relate to feeding behavior. Here we utilize geometric morphometrics and biomechanical skull modeling, both interpreted in a phylogenetic context, to study major patterns in Mesozoic theropod cranial variation and assess how skull shape may be related to functional biting behavior. Our dataset includes 51 theropods, whose cranial shape is modeled in lateral view with two-dimensional geometric morphometrics (24 landmarks) and feeding biomechanics are modeled using mechanical advantage biting profiles. We find that theropod skulls primarily differ in relative anteroposterior length and snout depth, and to a lesser extent in orbit size and the depth of the cheek region. Oviraptorosaurs, bizarre bird-like theropods, deviate most strongly from the "typical" and ancestral theropod skull shape. Non-carnivorous theropods generally fall out in distinct regions of skull morphospace and exhibit greater overall disparity (diversity of skull shape) than carnivorous taxa. Independent radiations of large-bodied carnivores (allosauroids, tyrannosauroids, ceratosaurs) independently converge on the same region of morphospace, suggesting that there is a limited morphological toolkit for building a colossal predatory dinosaur. The distribution of taxa in morphospace is strongly correlated with phylogeny but only weakly correlated with functional biting behavior, indicating that phylogeny, not function, was the major determinant of theropod skull shape.

THE EVOLUTIONARY HISTORY OF BASAL TETANURAN THEROPOD DINOSAURS

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Basal (non-coelurosaur) tetanuran theropods were a global radiation represented by dozens of taxa spanning more than 120 million years. Unfortunately, much of their record has been fragmentary and poorly sampled, leading to uncertainties regarding even their basic interrelationships. As a result, critical aspects of their evolutionary history have remained poorly understood. Over the past decade, we have pursued an exhaustive study of all basal tetanuran taxa and all existing character data, incorporating several recent discoveries along with new morphological, temporal and geographic data. We analyzed 61 basal tetanuran taxa and 351 characters in a cladistic analysis and achieved significantly improved phylogenetic resolution over previous efforts. Our results position several taxa (*Cryolophosaurus* Hammer and Hickerson, 1994, *Chuandongocoelurus* He, 1984, *Monolophosaurus* Zhao and Currie, 1994) as "stem"-tetanurans to a succession of monophyletic clades (Megalosauroidea, Allosauroidea) that are outside Coelurosauria. Megalosauroidea is a diverse clade of 19 taxa arrayed in three families; another 25 forms are housed in four allosauroid families, including nine metriacanthosaurids. Although ingroup resolution is poor within a few highly nested clades, the basic tree topology is well supported. We also assessed more than 40 additional taxa that were too fragmentary to include in the formal analysis, along with hundreds of additional indeterminate reports of tetanurans. Such fragmentary materials are

especially important in understanding the timing and global spread of this group. The earliest possible tetanuran fossils occur in the Early Jurassic of Europe, and by the Middle Jurassic there is definitive evidence of both derived megalosauroids and allosauroids (as well as coelurosaurs) from several continents. The appearance of Tetanurae well prior to the breakup of Pangaea requires developing a biogeographic model distinct from that used to characterize later Mesozoic clades. We propose that early Mesozoic groups had the potential to disperse globally, and that their absence in specific regions, and at later times, should be due to poor sampling, dispersal failure or regional extinction events

DO *EODROMAEUS*, *DAEMONOSAURUS*, AND *TAWA* BRIDGE THE HERRERASAUR-NEOTHEROPOD GAP?M. CARDOSO

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In the phylogentic hypotheses advocated along with their descriptions, three basal dinosaurs from the Late Triassic of the Americas –*Eodromaeus murphi*, *Tawa hallae*, and *Daemonosaurus chauliodus* (Martinez *et al.*, 2011; Nesbitt *et al.*, 2009; Sues *et al.*, 2011)– were placed in the theropod branch, between Herrerasauria and Neotheropoda. This defines an alternative view, in which herrerasaurs are considered non-theropod saurischians. Re-analyses of the character-taxon matrices of those studies revealed that *E. murphi*/*T. hallae*/*D. chauliodus* lack various potential eusaurischian apomorphies, *e.g.*, premaxilla with reduced subnarial ramus, dorsal process of the maxilla with enlarged antorbital fossa, nasal bordering the antorbital fossa, radius shorter than 80% of humerus, medialmost distal carpal larger than lateral elements, metacarpal of digit I subequal or shorter than ungual, metacarpal II equal or longer than metacarpal III. This advocates against their nesting within Eusaurischia/Theropoda. Otherwise, their inclusion may have improved cladistic analyses by disrupting "artificial" patterns, in which eusaurischian apomorphies accumulate in the absence of "intermediate" taxa. Accordingly, the three original studies were reanalyzed to assess if the scoring of those three species contributes to pull herrerasaurs into Theropoda. Yet, counter-intuitively, and unlike the exclusion of *T. hallae* in Nesbitt (2011), their removal did not change the relationship of the remaining taxa. This pattern is surely enforced by the numerous Herrerasauria+Neotheropoda apomorphies seen in the evaluated data-matrices, some of which are endorsed because also reported for *E. murphi*/*T. hallae*/*D. chauliodus*. These include axis with intercentrum broader than centrum, humerus shorter than 0.6 of the femur, manus longer than 0.4 the humerus+radius, metacarpal IV significantly narrow relative to more medial elements. Other proposed theropod apomorphies are more problematic for their erratic distribution (dorsally displaced cranial part of meckelian groove, surangular ridge, scar/fossa on the cranial surface of distal femur, fibular condyle at the caudal margin of proximal tibia), because they are poorly defined/scored for basal saurischians (promaxillary fenestra/antrum, elongated distal caudal vertebrae prezygapophyses, non-overlapping proximal metacarpals, manual digit V lacking phalanges, narrow distal pubis with "foot" expansion restricted to the lateral margin, crescentic fourth trochanter), because they represent typical carnivorous traits that may respond to convergent habits (mandible glenoid level with dorsal margin of the dentary, recurved and not mesiodistally expanded tooth crowns with fine serrations, manus with elongated penultimate phalanges), or the latter two combined (intramandibular joint, asymmetrical deep extensor pits on metacarpals 1–3, trenchant manual ungual). Otherwise, apomorphies of Eusaurischia (exclusive of herrerasaurs) reported in *E. murphi*/*T. hallae*/*D. chauliodus* are more scarce, including external naris partially dorsal to maxilla, tall lachrymal, caudal cervicovertebral centra (6–8) longer than those of cranial part of the trunk, and extensive brevis fossa in the iliac postacetabular ala. In conclusion, the minor improvement of the analyses after the incorporation of taxa suggests that additional and better defined characters, more than the discovery of new forms, are likely to help unravel basal saurischian relationships.

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PHYLOGENETIC RELATIONSHIPS OF BASAL SAURISCHIANS: TESTING THE EVIDENCE FOR THE HERRERASAURIAN AFFINITIES OF *TAWA*

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Over the last few years, several new basal saurischians and theropods have been described from Triassic beds of South America (Martinez and Alcober, 2009; Alcober and Martinez, 2010; Ezcurra, 2010; Martinez *et al.*, 2011), North America (Nesbitt *et al.*, 2009; Sues *et al.*, 2011), and India (Novas *et al.*, 2011), increasing our knowledge about the early evolutionary radiation of these groups. Such discoveries were accompanied by their respective phylogenetic analyses, with contrasting results. Among these taxa, the North American *Tawa* Nesbitt, Smith, Irmis, Turner, Downs and Norell 2009 exhibits a mosaic of plesiomorphic and derived features that led to its being interpreted as a transitional form between herrerasaurids and neotheropods (Nesbitt *et al.*, 2009). However, our phylogenetic analysis recovers *Tawa* as a basal member of Herrerasauria, based on the following synapomorphies:

jugal with anterodorsally inclined main axis, expanded anterior process with well-developed dorsal prong, and minimum height equal or more than 30% of the orbit height; mandible with blocky and dorsally raised retroarticular process; scapular blade poorly expanded distally and with a straight anterior margin; metacarpal IV:metacarpal III ratio less than 0.6; ilium with a pubic peduncle distinctly more ventrally extended than the ischial one; and pubis with distal pubic boot. In the context of the present study, Herrerasauria is composed of ISI R282, *Tawa*, *Staurikosaurus* Colbert 1970, *Herrerasaurus* Reig, 1963, and *Sanjuansaurus* Alcober and Martinez, 2010, ordered in a pectinate topology. Moreover, Herrerasauria is recovered as the sister-group of Eusaurischia (= Theropoda + Sauropodomorpha), in agreement with Langer (2004), but contrary to Nesbitt *et al.* (2009) and Martinez *et al.* (2011), who depicted Herrerasauria as basal theropods. We agree with Martinez *et al.* (2011) in considering *Eodromaeus* Martinez, Sereno, Alcober, Colombi, Renne, Montañez and Currie 2011 as a basal theropod and *Eoraptor* Sereno, Forster, Rogers and Monetta, 1993 as the most basal sauropodomorph. The results of the present analysis indicate that the early evolution of Saurischia was more complex than thought, and included branches that did not belong to the main lineages into which Dinosauria is usually divided. In our view, Herrerasauria and the basal sauropodomorphs Guaibasauridae Bonaparte *et al.*, 1999, represent evolutionary radiations that started before the flowering of neotheropods and more derived sauropodomorphs, and that become extinct during the latest Triassic.

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CONSTRAINING THE 'DAWN OF THE DINOSAURS' IN THE UPPER TRIASSIC CHINLE FORMATION, ARIZONA, USA

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The geologically oldest dinosaur specimen from the Upper Triassic Chinle Formation is the partial skeleton of the coelophysid (basal neotheropod) *Camposaurus arizonensis* from the *Placerias* Quarry south of St. Johns Arizona. Historically this site, located in an area of discontinuous outcrops, was considered to be situated in what is now called the Blue Mesa Member; however, stratigraphic revisions during the 1990s reassigned the quarry to older strata in the lower part of the Bluewater Creek Member, placing the first occurrence of dinosaurs in the Chinle Formation very near the base of the formation. Thus the *Placerias* Quarry would be much older than the next lowest purported dinosaur bearing bed in the Chinle Formation, the Dinosaur Wash (=Dying Grounds) locality in the upper Blue Mesa Member in Petrified Forest National Park (PEFO), Arizona. Moreover, it was hypothesized that the *Placerias* Quarry was roughly equivalent in age to the earliest dinosaur bearing beds in Argentina. Our lithostratigraphic investigation of the St. Johns area, especially around the Salado area (approximately 4 km southeast of the *Placerias* Quarry) demonstrates that the entire basal Chinle section is present in the area from the Mesa Redondo Member through the lower part of the Sonsela Member. Correlations between the Zuni Mountains of New Mexico, Salado, the Blue Hills, and the type Blue Mesa section at Petrified Forest National Park demonstrate that the lower part of the Blue Mesa Member is laterally equivalent to the Bluewater Creek Member and that the top of these beds are marked by the presence of micaceous, ripple-laminated fine grained sandstones. The *Placerias* Quarry and an associated fossil bearing horizon at Salado occur above these beds in blue, purple, and gray mudstones with interbedded white tuffaceous sandstones and thus are assignable to the upper portion of the Blue Mesa Member and roughly equivalent to the Dying Ground locality in PEFO. Purported "mottled strata" at the *Placerias* Quarry are simply pedogenically modified mudstones common in the upper Blue Mesa Member, and "Bluewater Creek redbeds" are actually interbedded clays and sandstones of much younger, probably Cenozoic age strata. The new correlation and recently published radioisotopic ages bracket the age of the *Placerias* Quarry between 223.04 Ma and 219.32 Ma (early Norian), demonstrating that the earliest dinosaurs in the Chinle Formation are at least 7 million years younger than those in Argentina (Late Carnian) and -–10 million years older than the dinosaur bearing beds at the Hayden Quarry in New Mexico (middle Norian). Furthermore, the presence of the "coelophysoids", the basal dinosauromorph *Dromomeron*, and silesaurid dinosauriforms at the *Placerias* Quarry, Dying Grounds, and Hayden Quarry in conjunction with our correlations and published ages, demonstrates that non-dinosaurian dinosauromorphs and dinosauriforms co-existed with basal neotheropod dinosaurs in the Chinle Formation for at least 4–6 million years.

NEW INFORMATION ON THE BRAINCASE OF *SINRAPTOR DONGI* CURRIE AND ZHAO 1993 (THEROPODA: ALLOSAUROIDEA)

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The braincase of the basal theropod *Sinraptor dongi* (IVPP 10600) was described in detail when the name of the taxon was coined. Further mechanical preparation and new CT scanning of the material provides information about the endocranial morphology, inner ear and braincase pneumaticity of this taxon (Paulina Carabajal and Currie, in press). The ossified ethmoidal elements were found separated from the rest of the braincase. These are poorly known elements within dinosaurs, because they remain cartilaginous in most subadult and adult theropods (Currie, 1997). This is the reason why they were not recognized when the specimen was originally described (Currie and Zhao, 1993). The ethmoidal elements of *Sinraptor* are U-shaped, and the frontal roofs the olfactory tract and bulb cavities. When the ethmoidal ossification is placed in anatomical position, an unossified space remains between the sphenethmoid and the orbitosphenoid, suggesting a cartilaginous septosphenoid when the animal was alive. Comparison with other theropods indicates four ossification patterns for the ethmoidal elements within this group (Paulina Carabajal, 2009). The braincase was CT scanned after removing the sediment filling the endocranium and pneumatic recesses. Particularly interesting is the presence of a developed caudal tympanic recess (considered as a trait characteristic of coelurosaurs), and the internal morphology of the basisphenoidal recess and associated pneumatic cavities. There is a longitudinal passage connecting the lateral tympanic recess with the basisphenoid recess that probably had both pneumatic and vascular functions. In the endocranium there is no medullar eminence, and the floccular recess has an hour-glass shape. The volume of the endocranial cavity, excluding the olfactory tract and bulbs, is 95 ml. The cephalic and pontine flexures are similar to those in carcharodontosaurids (Larsson, 2000; Paulina Carabajal and Canale, 2010), although the disposition of cranial nerves II–IV in the midbrain varies amongst these taxa. The encephalization quotient calculated for *Sinraptor* is within the range calculated for other basal theropods (Hopson, 1980).

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NEW INFORMATION ON LATE JURASSIC THEROPOD DINOSAURS FROM SOUTHERN GERMANY

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The marine Late Jurassic plattenkalk series of southern Germany has yielded a number of remains of terrestrial vertebrates, including theropod dinosaurs. Most famous of these is certainly the early avialian *Archaeopteryx*, which has been found in the Early Tithonian Solnhofen Formation and the overlying Mörnsheim Formation (Wellnhofer, 2008). Non-avian theropods are represented by the basal coelurosaur *Compsognathus* from the Tithonian of the area of Kelheim (Ostrom, 1978) and the recently described *Juravenator* from the Late Kimmeridgian of Schamhaupten. The latter was considered to be a compsognathid, and thus a basal coelurosaur, in the original descriptions (Göhlich and Chiappe, 2006; Chiappe and Göhlich, 2010). It is furthermore noteworthy for preserving a scaly tail and little evidence for filamentous protofeathers. A new specimen from the latest Kimmeridgian of Painten represents a new taxon and provides new evidence on the anatomy, integumentary structures, and ontogeny of basal tetanurans. The new taxon shows a number of primitive characters, and phylogenetic analyses, using several recently published datasets, places it consistently as a basal tetanuran. In a detailed analysis of basal tetanuran relationships the new taxon is found to be a member of the Megalosauroidea, making it the most basal theropod taxon reported from the Late Jurassic of central Europe so far. Furthermore, this new specimen represents the most complete megalosauroid theropod known so far. The new taxon shows elongate mono-filaments that exceed the caudal vertebrae two to three times in height in the dorsal side of the tail base. Shorter filaments are present on the ventral tail flank, above the dorsal vertebrae, and below the gastralia. Thus, filamentous protofeathers were present in basal tetanurans, at least in juvenile individuals. The lack of any fusion of elements in the skeleton, including the vertebrae and skull, as well as the striated bone surface indicate that both specimens represent very young, probably early post-hatchling individuals. Given the very small size of hatchling or early post-hatchling individuals of other dinosaurs in comparison with the adults of the same species, the length of approximately 70–80 cm of this specimen indicates that this taxon was rather large as adult. Many similarities between this juvenile megalo-

sauroid and the also early juvenile type of *Juravenator* (round orbit, dentition, lack of several muscle attachment areas) drag the latter taxon also into the Megalosauroidea when both taxa are analysed together; if the new taxon is excluded from the phylogenetic analyses, *Juravenator* is recovered as a basal coelurosaur.

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NEW THEROPOD DINOSAURS FROM THE MIDDLE AND LATE JURASSIC OF CHUBUT, ARGENTINA

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Recent phylogenetic analyses indicate that the Jurassic was a crucial time in the evolution of theropod dinosaurs, during which many groups originated or experienced their first major radiation. However, the Jurassic theropod fossil record is rather poor, especially in the Southern Hemisphere, from where only few and mainly fragmentary theropod specimens have been reported. Recent fieldwork in the Middle Jurassic (Aalenian–Bajocian) Cañadón Asfalto Formation of Chubut, Argentina, resulted in the discovery of two theropod skeletons, which represent the most complete theropods recovered from the Middle Jurassic of Gondwana. Both skeletons come from fine-grained sediments and were found partially articulated. An almost complete skeleton, missing only the anterior part of the skull, lower jaws, a few vertebrae, and distal phalanges, represents a new taxon of ceratosaur. Phylogenetic analysis places it at the base of the Abelisauridae, based on several characters, including a laterally hidden lacrimal antorbital fossa, a broad prespinal fossa in the cervical vertebrae, the presence of rudimentary centro-diapophyseal laminae in the anterior caudal vertebrae, and the presence of a flexor groove rather than a tubercle, in the pedal phalanges. Thus, the new taxon extends the fossil record of this clade from the Early Cretaceous into the early Middle Jurassic. This find indicates that ceratosaur radiation happened considerably earlier than currently recognized and that abelisauroids failed to reach the Northern Hemisphere during Pangean times, in contrast to other, globally distributed theropod lineages. The new taxon further demonstrates that forelimb reduction in ceratosaurs proceeded from the distal elements proximally. The second specimen represents a basal tetanuran, which is represented by an almost complete skull and lower jaws, complete presacral vertebral series, complete forelimbs, pubis, and partial hindlimbs. The taxon shows an interesting character combination in combining tetanuran plesiomorphies (amphi-platyan cervical vertebrae, lack of ventral keel in anterior dorsals) with megalosauroid synapomorphies (U-shaped cross-section of the postorbital jugal ramus, deep groove ventral to the occipital condyle on the basioccipital) and a derived, three-fingered hand. Due to this character combination, coding the new taxon into a recent large phylogenetic analysis of basal tetanurans fails to resolve the phylogenetic relationships of this new taxon. A fragmentary, but articulated theropod specimen from the Upper Jurassic Cañadón Calcáreo Formation represents the first diagnostic theropod remain from this epoch found in South America. The taxon is represented by caudal vertebrae, fragmentary scapulocoracoid and humerus, and fragments of the hindlimb. Phylogenetic analysis places it as a basal tetanuran, but an exact placement is made difficult by the very unusual character combination, in which a laterally facing scapula glenoid fossa is combined with an astragalus with a low, spike-like ascending process and a distally flared fibula. Thus, the new tetanurans from the Cañadón Asfalto and the Cañadón Calcáreo formations indicate that character evolution in basal tetanurans is more complex than currently recognized.

A NEW THEROPOD RECORD FROM THE LOWER CRETACEOUS OF THE SANFRANCISCANA BASIN (STATE OF MINAS GERAIS, BRAZIL)

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We report remains of a theropod dinosaur discovered in outcrops of Aptian beds of the Quiricó Formation of the Sanfranciscana Basin, in northern Minas Gerais, Brazil. Until now, the fossil record of the Quiricó Formation –a lacustrine deposit– was composed of sarcopterygian fishes, fragmented teeth of theropods and the recently described titanosaurian *Tapuiassaurus macedoi* Zaher, Pol, Carvalho, Nascimento and Riccomini, 2011. The new material reported here consists of an almost complete right hindlimb, including the fibula, tibia, astragalus, calcaneum, metatarsals II, III, IV, and pedal unguals. The specimen shares with abelisauroids the following derived features: the proximal end of metatarsal III is considerably larger anteroposteriorly and mediolaterally (the same 'eyrymetatarsal' condition is present in *Velocisaurus unicus* Bonaparte, 1991, and other ceratosaurs); metatarsus shows a dorsoventrally depressed ginglymus; the presence of proximally bifurcated vascular grooves on the lateral and medial pedal unguals (*e.g.*, *Masiakasaurus knopleri* Sampson, Carrano and Forster, 2001). However, the new specimen differs from known abelisauroid genera by the following features: absence of the sulcus in proximomedial region of fibula, which is present in *Ceratosaursus, M. knopleri and Xenotarsosaurus bonapartei* Martínez, Giménez, Rodrígues and Bochatey, 1986; absence of fusion between fibula and distal tibia; absence of fusion astragalus and calcaneum to each other and partially fused to the tibia as in *X. bonapartei, Aucasaurus garridoi* Coria, Chiappe and Dingus, 2002 and *Ekrixinatosaurus novasi* Calvo, Rubilar-Roger and Moreno, 2004.

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THE STATUS OF MORPHOLOGICAL AND DEVELOPMENTAL EVIDENCE ON DIGIT IDENTITY IN THE THEROPOD HAND

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The identification of the digits for most tetrapod species is often a trivial affair according to two classic data sources, digit morphology and embryological position, which usually deliver mutually consistent assessments. The evolutionary history of morphology shows that the digits of the wing of birds correspond to digits I, II, III of early pentadactyl theropods. However, spatial relationships among embryonic skeletal elements show the digits of the bird wing unquestionably develop from cartilaginous precursors at positions that become digits II, III and IV in pentadactyl amniotes. A homeotic frameshift event in the evolution of the bird wing could explain how digits I, II, III switched to develop from embryological positions 2, 3, 4. Lack of HoxD-10, HoxD-11 and HoxD-12 gene expression in the anteriormost digit of the embryonic wing specifically resembles digit 1 of other amniotes. However, it is argued that this evidence for digit I identity is equivocal: Lack of HoxD10-12 in the anterior digit could relate mainly to its position as most anterior digit, and should not be considered evidence for digit I identity (Woltering and Duboule, 2010). To test this argument, we have cloned and observed the expression of HoxD-10 and HoxD-12 for the first time in an amniote limb that has undisputedly lost digit I: The foot of the rabbit. We found that expression of this gene is present in the anteriormost digit II, supporting the use of HoxD expression to distinguish digit I from digit II. In another well-publicized paper, it was argued that the morphological evidence for the I, II, III identification of tetanuran digits was inconclusive (Xu *et al.*, 2009). Quantitative analysis was presented showing the II, III, IV alternative to be only six steps longer than I, II, III, and equal if traits are considered unordered. Using published morphological descriptions and a different methodological approach, we ran an alternative analysis for 12 theropod taxa straddling the origin of Tetanurae Gauthier 1986. Our results show the II, III, IV hypothesis was 34–39 steps longer than I, II, III under different conditions of analysis, including unordered traits. We conclude that morphological and gene expression data provide strong support for I, II, III: Recent criticism is largely speculative. Using cell-lineage studies, my lab has demonstrated that a frameshift of morphology and HoxD expression can be produced experimentally through down-regulation of the posterior gradient of Shh signaling. These experiments confirm that homeotic frameshifts are developmentally possible (as previously inferred from the evolution of the wing). They also demonstrate that intermediate morphologies are not a mechanistic necessity, contrary to the argument that a "gradual frameshift" occurred towards the origin of Tetanurae (Xu *et al.*, 2009).

Woltering, J.M. and Duboule, D. 2010. The origin of digits: expression patterns versus regulatory mechanisms. *Developmental Cell* 18: 526–32.

Xu, X., Clark, J.M., Mo, J., Choiniere, J., Forster, C.A., Erickson, G.M., Hone, D.W.E., Sullivan, C., Eberth, D.A., Nesbitt, S., Zhao, Q., Hernandez, R., Jia, C.-K., Han, F.-L., and Guo, Y. 2009. A Jurassic ceratosaur from China helps clarify avian digit homologies. *Nature* 459: 940–944.

THE PALEODIET OF *NOTIOMASTODON PLATENSIS* (MAMMALIA, PROBOSCIDEA, GOMPHOTHERIIDAE) FROM THE QUATERNARY OF ÁGUAS DE ARAXÁ, SOUTHEASTERN BRAZIL

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The gomphothere assemblage from the Pleistocene of Águas de Araxá (Minas Gerais, Brazil) is composed of several isolated teeth and cranial and postcranial fragments assigned to a single population of *Notiomastodon platensis* (Ameghino, 1888). The age profile of individuals at the site is similar to that of a declining population (disproportionately high number of senile and mature adult individuals). The mortality event occurred during a period of low environmental humidity, which may have caused mass deaths of proboscideans close to water-source refuges.

The ancient feeding ecology of these gomphotheres was reconstructed through stereomicrowear and analyses of plant microfossils in tooth calculus. We analyzed 35 molars, previously classified into four age classes (subadult, adult, mature adult and senile adult individuals) according to the current literature. The microwear patterns were recognized according to published studies and the pit and scratch frequencies was compared with microwear of extant herbivores. The plant microfossils were chemically recovered and microscopically analyzed. Isotopic analyses of South American gomphotheres suggest a wide dietary range for *N. platensis*. Except for one locality in Argentina (Santiago del Estero) and one in Ecuador (La Carolina), in which isotope analyses suggested an exclusive C4 diet, all other South American localities studied so far indicate an exclusive C3 diet or a mixed C3 and C4 diet for *Notiomastodon*. The *N. platensis* stereomicrowear analyses exhibited average scratch and pit values that place this species within the extant mixed feeder morphospace. The higher frequency of fine scratches indicates the ingestion of C3 grasses. On the other hand, the presence of coarse and hypercoarse scratches along with gouges and large pits suggests the ingestion of foliage and lignified portions of plants. The plant microfossil analysis recovered a pollen grain (Polygonaceae), fragments of conifer tracheid and vessel elements with a ray of parenchyma cells, (confirming the consumption of woody plants), and record spores (Polypodiaceae) and fibers. According to results, the Araxá gomphotheres were feeding generalists with a diet composed of wood elements, leaves, and C3 grasses.

Ameghino, F. 1888. Rápidas diagnosis de algunos mamíferos fósiles nuevos de la República Argentina. En: J. Torcelli (Ed.),1916, *Obras Completas y Correspondencia Científica de Florentino Ameghino, Volumen 5.* Talleres de Impresiones Oficiales, La Plata, p. 469–480.

VERTEBRATE PALEONTOLOGY IN THE AMAZON BASIN: WHERE WE STAND

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The Amazon Basin covers an area equal to almost 40 percent of the South American continent, or an area equivalent to 90 percent of the continental United States, excluding Alaska. Although Amazonia is a tropical paradise in terms of modern biodiversity, it is often perceived to be a vast wasteland as far as vertebrate paleontology is concerned. There are many reasons for this misconception, but, in fact, Amazonia is rich in vertebrate fossils. Paleontology in Amazonia is difficult because of its vast area, the complete coverage of vegetation, and the limited exposures of outcrops in riverbanks and a few road cuts. Exploration is limited to dry seasons when rivers are low, and it is most effective, yet most difficult, in the smaller rivers and streams. Equally important is our limited knowledge of the geologic history of the region, which is exemplified by the lack of agreement among workers as to the basic stratigraphy of lowland Amazonia. Chronostratigraphic data are lacking, except for limited areas of the southwestern portion of the basin where volcanic ashes have been dated and some magnetostratigraphic data obtained. Paleontology in Amazonia can be very rewarding because richly fossiliferous deposits occur in many regions. The Santa Rosa locality in Peru (Campbell, 2004) has produced an amazingly diverse Paleogene microfauna, including the oldest known rodent fauna for the continent and a diverse array of early marsupials, many of unknown affinities. There exist many other areas where exposures of similarly-aged formations are exposed in river banks, and it only requires persistent effort to find comparably rich paleofaunas. Late Miocene vertebrates have been collected for many decades by numerous workers from riverbank exposures of the Acre Conglomerate and lag deposits derived from that conglomerate in western Amazonia. Initially, these fossils were considered to be reworked Miocene fossils occurring in Pleistocene sediments, along with Pleistocene vertebrates. The latter, however, have proven to be early dispersants from North America that represent the first pulse of the Great American Faunal Interchange, which occurred in the late Miocene. The most productive localities are sources for both abundant macro- and microvertebrate assemblages (*e.g.*, Frailey, 1986). The fossils from the Acre Conglomerate date to the Huayquerian/Chasicoan SALMAs based on biostratigraphy and the limited chronostratigraphic data available. This conglomerate directly overlies the pan-Amazonian Ucayali Unconformity (Campbell *et al.*, 2006), which provides a means of correlation for these deposits throughout lowland Amazonia. Most of the biotic history of Amazonia remains a mystery, but efforts to close the large gaps in our knowledge can be successful, if persistent. Success can only come, however, if progress is also made in resolving the stratigraphy of lowland Amazonia.

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EVOLUCIÓN DE DASYPODINAE (XENARTHRA, CINGULATA, DASYPODIDAE) Y SU RELACIÓN CON GRANDES EVENTOS CLIMÁTICOS CENOZOICOS

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Los Dasypodinae Gray, 1821, son los más antiguos Xenarthra conocidos. En la actualidad presentan la mayor diversidad específica (7 especies de *Dasypus* Linnaeus, 1758) y más amplia distribución geográfica (40ºN a 40ºS). Se reconocen tres tribus: Astegotheriini Ameghino, 1906

(Paleoceno tardío–Mioceno medio), Stegotheriini Ameghino, 1889 (Eoceno tardío–Mioceno medio) y Dasypodini Gray, 1821 (Mioceno medio–actual). El objetivo de esta contribución es resaltar cómo la historia evolutiva de los Dasypodinae se correlaciona con grandes eventos climáticos ocurridos en América del Sur durante el Cenozoico. Los más antiguos Astegotheriini se registran desde el Paleoceno tardío de Brasil (EM Itaboraiense), en el tiempo en que los bosques tropicales y subtropicales se extendieron ampliamente por el continente sudamericano. En las subsiguientes EMs Riochiquense y Casamayorense, se registran Astegotheriini y Stegotheriini en depósitos patagónicos; concordantemente, los bosques tropicales llegaron hasta 47ºS como efecto del Optimo Climático del Eoceno temprano. Con el descenso gradual de temperatura, sabanas y pastizales remplazaron a los densos bosques en el Eoceno medio y tardío de Patagonia, la diversidad de Astegotheriini decayó y se comienzan a registrar los eufractinos (actualmente característicos de zonas templadas). En la transición Eoceno/Oligoceno se produce un abrupto descenso global de las temperaturas, se establecen bosques templados fríos en Patagonia y los Dasypodinae disminuyen notablemente en diversidad y en abundancia relativa. A partir del Oligoceno tardío comienza un incremento global en la temperatura, que culmina en el Optimo Climático del Mioceno medio. En ese lapso, asociados a ambientes de selva húmeda, surgen los primeros Dasypodini en bajas latitudes (Colombia y Ecuador) y se registran los últimos Astegotheriini (mientras que en Patagonia desaparecen los Stegotheriini). A partir del Plioceno medio se inician los ciclos de glaciaciones, confiriendo una fuerte estacionalidad a los ambientes sudamericanos. Siguiendo una tendencia general de incremento en tamaño, taxones de gran porte (*e.g.*, *Propraopus grandis* Ameghino, 1881) son registrados del Plioceno tardío al Pleistoceno tardío. Finalmente, los Dasypodini participaron en el Gran Intercambio Biótico Americano, llegando hasta el sur de Estados Unidos. Los datos muestran que históricamente los Dasypodinae estuvieron restringidos a climas tropicales y subtropicales. En la actualidad, *Dasypus* ocupa distintos biomas, sugiriendo que su distribución está más limitada por temperatura y humedad que por el tipo de cobertura vegetal. También es más diverso en bajas latitudes, y las distintas especies incrementan en tamaño hacia el Ecuador. Para armadillos actuales, se considera que la distribución en climas templados se limita tanto por la disponibilidad de alimentos, como por factores fisiológicos (*e.g.*, termorregulación). Así, la densa cobertura pilosa de *D. pilosus* Fitzinger, 1856 habría permitido ser la única especie en ocupar zonas frías, en las montañas de Perú. La alta especialización de los Stegotheriini hacia la mirmecofagia pudo también estar vinculada a su extinción. Por otro lado, *Dasypus* tiene una dieta variada, favoreciendo la ocupación de distintos ambientes.

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DISTRIBUCIÓN DE LOS CINGULATA (XENARTHRA, MAMMALIA) DURANTE EL OLIGOCENO EN AMÉRICA DEL SUR

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Los yacimientos fosilíferos asignados al Oligoceno en America del Sur, tienen sus principales afloramientos en Patagonia (Argentina) y, además, en Mendoza, Neuquén, Corrientes y Entre Ríos, aunque no tan ricos. En otros países sudamericanos los principales yacimientos se encuentran en Tinguiririca, Chile; Salla y Lacayani, Bolivia; Fray Bentos, Uruguay y Taubaté, Brasil. Teniendo en cuenta la diversidad de Cingulata de las localidades asignadas al oligoceno, se realizó un análisis de Similitud Faunística (utilizando los coeficientes de Jaccard y Simpson) entre ellas utilizando el programa PAST. Como resultado se observa una primera separación entre las localidades que representan a las edades mamífero (EM) Tinguiririquense y Deseadense *s.l.* Dentro de las localidades deseadenses *s.l.* se produce una primera dicotomía entre las localidades extrapatagónicas (nodo 5) y las localidades patagónicas (nodo 4), la cual podría tener su explicación en diferencias temporales y/o paleobiogeográficas. Tomando como referencia la edad de Salla (Bolivia), las localidades del nodo 5 podrían ubicarse dentro del lapso comprendido entre los 25,82 y los 27,02 Ma (Kay *et al*,. 1998). Por otra parte, dentro del conjunto de localidades patagónicas, se encuentran faunas datadas entre los ~30 Ma (La Cantera, nodo 7) y los ~24 Ma (La Flecha, nodo 6). Por lo tanto, se podría suponer que las diferencias en la composición faunística de todos ellos con el nodo 5 no serían causadas exclusivamente por una diacronía entre las localidades. De esta manera, las distintas composiciones entre las localidades Oligocenas de Uruguay, Corrientes, Brasil y Bolivia por un lado y las patagónicas por otro, podrían explicarse no sólo por diacronía, sino fundamentalmente debido a diferencias paleobiogeográficas. Al analizar los taxones presentes en cada uno de los grandes grupos, se observa que la principal diferencia entre ellos reside en la ausencia de stegotherinos (Dasypodinae, Gray 1821) y eutatinos (Euphractinae, Winge 1923) en las localidades septentrionales, y la ausencia de *Eocoleophorus* Oliveira *et al.*, 1997, en las localidades australes, un taxón que se habría originado en bajas latitudes, relacionado con un nuevo taxón proveniente del Paleógeno de Perú (Carlini y Scillato-Yané, 1999; Ciancio *et al.*, 2005). Lamentablemente, no existen localidades de edades equivalentes en latitudes intermedias que permitan estudiar mejor estas diferencias, la localidad del nodo 4 ubicada más al norte es Quebrada Fiera y presenta dasypodoideos netamente patagónicos, por lo que se asocia, obviamente, a las faunas patagónicas. A partir de este análisis faunístico y teniendo en cuenta la ubicación geográfica de las áreas estudiadas, se han reconocido dos zonas biogeográficas de Cingulata diferentes para el Oligoceno, una exclusivamente patagónica y otra incluyendo las actuales provincias de Corrientes y Entre Ríos en Argentina, Uruguay, Brasil y Bolivia. Estas dos zonas coinciden con la Región Andina (Reino Austral) y la Región Neotropical (Reino Holotropical) propuestas por Morrone (2006), por lo que se especula que estas áreas biogeográficas podrían haber estado diferenciadas desde al menos el Oligoceno.

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EARLY TO MIDDLE MIOCENE MAMMAL COMMUNITIES IN THE MIDDLE LATITUDES OF THE NEOTROPICS

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Southern South America has long been a model to illustrate broader trends in Cenozoic mammal communities. Nevertheless, much of South America lies north of the Southern Cone. Whether patterns in southern mammal communities are representative of those in the Neotropics is not known. The present study compares characteristics of early to middle Miocene mammal communities from the middle latitudes to those elsewhere in South America. We define middle latitude faunas as those from 15° to 30° S; high latitude faunas are south of 30° S, and low latitude faunas are north of 15° S. These divisions are primarily based on spatial gaps in sampling during this interval and characteristics of faunas within each region. The late early Miocene fauna of Chucal, Chile shares roughly 60% of genera with classic Santacrucian SALMA localities, but many fewer genera and families of mammals have been recorded in total. This may be partly due to fewer identified specimens, but even Santa Cruz museum collections of similar size include more genera and families. More recent and carefully documented collections from Santa Cruz show more limited taxonomic breadth, indicating that older collections may include time and/or habitat-averaging. Nevertheless, the mammal fauna of Chucal and other factors suggest a mostly open but not arid habitat in northern Chile, contrasting with the more mixed vegetation inferred for southern Patagonia. Thus, both ecological and biogeographic factors likely contribute to faunal differences between these middle and high latitude localities. Slight temporal differences may be an additional factor. The early middle Miocene (Colloncuran?) fauna of Cerdas, Bolivia shares about 0-–70% of genera with the roughly coeval faunas of Collón-Curá (Colloncuran SALMA) and Río Frías (Friasian s.s. SALMA). It differs from both localities and instead resembles Chucal in its very abundant mesotheriid notoungulates, an apparently biogeographic characteristic shared by most middle latitude faunas. The late middle Miocene (Laventan SALMA) fauna of Quebrada Honda, Bolivia shares only 13 percent of genera with the coeval fauna of La Venta, Colombia. The diverse fauna of Quebrada Honda suggests a predominantly open habitat, and a recent ecological diversity analysis highlighted similarities with Australian open habitat faunas. This habitat contrasts markedly with the complex vegetational mosaic of La Venta, indicating both ecological and biogeographic differentiation of these two faunas. El Petiso, a potentially coeval Patagonian fauna, has not yet been studied in sufficient detail to permit faunal or ecological comparisons, though a recently named cavioid occurs at Quebrada Honda and El Petiso but not La Venta. A moderately well-sampled fauna derives from Nazareno, Bolivia. Most of the fauna is older than 12.79 Ma (Horton, 1998), though the total time span represented is unknown. Its fauna is very similar to that of Cerdas, including at least six shared genera, and differs markedly from Quebrada Honda. This suggests an early middle Miocene age and corroborates its referral to the Colloncuran SALMA as suggested by Oiso (1991).

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NEW MORPHOTYPES OF SMALL NOTOUNGULATES FROM THE MIDDLE EOCENE AND SOME CONSIDERATIONS ON UNGULATE FOSSIL FAUNAS FROM NORTHWESTERN ARGENTINA

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The Geste Formation (Eocene) crops out in several localities of northwestern Argentina. Of these, the site of Quebrada El Paso (near Pozuelos salt flat, Salta) and the locality of Antofagasta de la Sierra (Catamarca) have yielded an important record of fossil vertebrates including crocodiles, snakes, lizards, and several mammals. Recent fieldwork conducted at Antofagasta de la Sierra led to the discovery of new notoungulate specimens including interatheriids, oldfieldthomasiids, henricosborniids, and archaeohyracids. The interatheriid material has special interest, given the integrity of the material, which includes a left maxilla with P4 (partially preserved) and the complete series of upper molars. In the context of recent phylogenies, the specimen shows an early diverging position (within a basal polytomy that also includes *Punapithecus* López and Bond, 1995, an interatheriid of

the same locality). In spite of this unresolved position, the new material exhibits features that differentiate it from *Punapithecus* (larger size, reduction of cingulae, and less persistent fossettes). The material referred to Archaeohyracidae Ameghino, 1897, Oldfieldthomasiidae Simpson, 1945, and Henricosborniidae Ameghino, 1901 includes mostly mandibular fragments and isolated lower molars. The archaeohyracids include a morphotype very different from *Punahyrax* Reguero *et al.*, 2008 (an early diverging taxon recorded in this formation), showing higher crowns and wider fossettids. Regarding the specimen of Oldfieldthomasiidae (a mandibular fragment with m1-2) the height of the crowns, greater than any other representative of the family known in northwestern Argentina, is similar to that of some Patagonian forms. Finally, henricosborniids are represented by an incomplete lower molar which, although fragmentary, is strikingly small. Among all the specimens recovered, interatheriids and archaeohyracids largely represent the most abundant 'ungulate' forms in the Geste Formation. This fact and the greater crown height exhibited by most of the specimens recovered could indicate biogeographic and even temporal differences of this and other Eocene units of northwestern Argentina, an idea already stated by several authors. Nevertheless, recent contributions based on cingulate species favor a correlation between Lumbrera, Casa Grande, and Quebrada de los Colorados formations. Ungulates could greatly contribute to the resolution of this apparent contradiction. Furthermore, the Eocene ungulates from northwestern Argentina evolving at lower latitudes could reliably clarify the phylogenetic/geographic relationship of this fauna with other non-Patagonian Paleogene units. Ameghino, F. 1897. Mammifères crétacés de l'Argentine. (Duxième contribution à la connaissance de la faune mammalogique des couches à Pyrotherium). *Boletín la Academia Nacional de Ciencias en Córdoba* 16: 349–426.

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EQUATORIAL SQUAMATES FROM THE EARLY PALEOGENE OF SOUTH AMERICA

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Extant reptile diversity is highest at equatorial latitudes; however, their evolutionary histories are poorly constrained because the fossil record at these latitudes is mostly unsampled. This is especially true for the interval spanning the Paleogene greenhouse, which limits our understanding of poikilothermic vertebrates during the globally warmest intervals. Fieldwork in the late Paleocene through early Eocene of Colombia has produced diverse vertebrate faunas including the first record of equatorial squamates. The late Paleocene Cerrejón Formation, which crops out in the Guajira Peninsula, was likely deposited in lowland tidal-flat plains incised by large-scale river systems with vertebrate fossils concentrated in the clay-stone underlying major economic coal seams. To date, the Cerrejón squamate record is composed of snakes including the giant boid *Titanoboa cerrejonensis*, and a single precloacal vertebra referable to Anilioidea. In contrast, the early Eocene Bogotá Formation, which crops out in the southern part of Bogotá city, consists of fluvial sandstones and mudstones with well-developed paleosols indicative of a more terrestrial environment, and vertebrate fossils are concentrated in conglomeratic channel-lags. Squamates from the Bogotá Formation include small-bodied iguanian and teiid lizards, represented by mandibular, dentary, and vertebral elements, and a snake fauna consisting of boines and possible tropidophiines, represented by vertebrae, and a derived snake represented by a single partial parietal element. The parietal possesses numerous characteristics present in caenophidian snakes: the parietal table is broad with well-defined margins extending posteriorly as a prominent saggital crest. The orbital region is narrow and the parietal contribution to the optic fenestra combined with a limited articular facet for the frontal lateral flange indicates an open interorbital space, similar to some colubroids. The presence of a derived snake in early Eocene of Colombia is the oldest New World record by approximately 19 Ma and is approximately coeval with the oldest known record globally from the Vastan Lignite Mine of northern India. This record requires either an earliest Paleogene dispersal or Cretaceous vicariance event based on the simultaneous occurrence in South America and Indopakistan. The composition of Cerrejón and Bogotá Formation squamate records indicates early Paleogene assembly and persistence of extant Neotropical herpetofaunas throughout the Cenozoic, despite dramatic changes in global climate systems.

ENDEMIC SOUTH AMERICAN UNGULATE (MAMMALIA) FOSSILS FROM THE LAGUNA DEL LAJA REGION, ANDEAN MAIN RANGE, CENTRAL CHILE

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A recently discovered, stratigraphically superposed series of early–late Miocene fossil mammal assemblages from the Andean Main Range of

Chile near Laguna del Laja (~37.5º S, 71º W) sheds light on the poorly known extra-Patagonian history of South America's early mammals. The Cura-Mallín and overlying Trapa-Trapa formations at Laguna del Laja, from which several hundred specimens were recovered, are well constrained stratigraphically and radioisotopically with high precision $^{40}Ar/^{39}Ar$ ages (Flynn *et al.,* 2008, Gans *et al.,* in progress), providing a robust temporal framework for the fossiliferous units spanning ~20–9 Ma. Previous analyses of the Laguna del Laja rodents have suggested an increasingly high degree of endemism through this section (Flynn *et al.,* 2008). Herein we provide the first detailed account of ungulates recovered from the Cura-Mallín Formation at Laguna del Laja; these range in age from ~20–15 Ma. Specimens assignable to *Protypotherium* Ameghino 1885, *Astrapothericulus* Ameghino 1902, and *Pachyrukhos* Ameghino 1885, together with their radioisotopic ages, suggest superposed Colhuehuapian, Santacrucian, Friasian?, and Colloncuran South American land Mammal "Ages" (SALMAs). In addition, three new genera are present, adding to the degree of endemism already observed in the rodent faunas from Laguna del Laja. Two of these new taxa belong to the Interatheriinae (sensu Hitz *et al.,* 2000), and the other to the Hegetotheriinae Ameghino 1894. Given the geographic proximity of coeval faunas, the high level of endemism over multiple SALMAs at Laguna del Laja relative to Argentine assemblages is thought to reflect sampling of a regionally distinct and isolated paleoenvironment, potentially related to uplift of the central Chilean Andes in this area.

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EVIDENCE ON THE TROPICAL HISTORY OF PALEOGENE CINGULATA

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The Contamana area yields new remarkable Paleogene fossil localities in the Loreto Department, Peruvian Amazonia. The lower vertebrate-bearing horizons are referred to the late middle Eocene Yahuarango Fm. (localities CTA-27 and CTA 29) by both mammalian biochronology and radioisotopy ($^{40}Ar/^{39}Ar$: 43.44 ± 2.5 Myr). Higher in the series, the CTA-32 locality is likely to document a post-Tinguirirican/pre-Deseadan interval, as recorded in Patagonia (Vucetich *et al.*, 2010) and Peruvian Amazonia (Campbell, 2004). Among mammals, stem rodents and marsupials are abundant in the Contamana area. On the other hand, xenarthrans are scarce but extremely significant given their poorly documented early evolutionary history in tropical areas. Late middle Eocene levels have produced isolated fixed osteoderms of a very small astegotheriine dasypodid (CTA-27) and the enigmatic medium-sized *Eocoleophorus* Oliveira *et al.*, 1997 (CTA-29). Astegotheriini are represented by a quadrangular osteoderm (MUSM 1918; ~ 4 mm) with smooth sutures and surface. No sulci (principal or radial) are discernable. Four large foramina confine the trapezoidal anterior half of the principal figure. This particular feature resembles some osteoderms of *Prostegotherium notostylopianum* Ameghino, 1902. Oddly, the size and general pattern are closer to *Nanoastegotherium prostatum* Carlini *et al.*, 1997 from the middle Miocene of Colombia. As is typical in *E. glyptodontoides* Oliveira *et al.*, 1997, MUSM 1586 (~24 mm) from CTA-29 presents a large circular principal figure displaced posteriorly, seven peripheral figures, and an incomplete second row of anterolateral figures. It differs from the Deseadan species in having a smooth surface without a keel or foramina. The early late Oligocene locality CTA-32 has produced two partial relatively small osteoderms (MUSM 1940; ~17 mm wide), probably of the movable bands, that we assign to the oldest undoubted pampatheriid known as far, due to their rough surface and wide principal figure, sub-quadrangular in outline. Foramina are well developed, not just preceding the principal figure in a single row, but also along the sides in a depressed margin. The locality also yielded a minute fixed osteoderm of a glyptateline-like taxon (MUSM 1719; ~6 mm) with a pattern close to *Pachyarmatherium* Downing and White, 1995. It is hexagonal in outline with a subcircular principal figure that reaches the posterior margin, wide sulci, and three peripheral figures at the front and lateral sides. One foramen is present at the intersection of sulci. All cingulates recovered from the Contamana area represent unknown taxa, most belonging to clades of uncertain affinities and/or with relatives recorded much earlier or later at higher latitudes. Evidence from new tropical Tertiary localities tests our present knowledge about the real scenario of mammalian evolution in South America.

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ESTADO ATUAL DO CONHECIMENTO DOS GOMPHOTHERIIDAE DO ESTADO DO PARANÁ, BRASIL

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São conhecidas ocorrências de Gomphotheriidae em quase todos os estados brasileiros (Marcon, 2008), no entanto, apenas três são registradas para o Estado do Paraná. O primeiro foi feito para o Município de Chopinzinho e consiste de vários fragmentos de ossos pós-cranianos, um incisivo e um primeiro molar inferior, depositados no Museu Municipal de Ponta Grossa, PR (Pilatti and Bortoli, 1978). Estes autores atribuíram o m1 do espécime à *Haplomastodon waringi* (Holland, 1920). Posteriormente Sedor and Born (1999) relatam a ocorrência de fragmentos de um incisivo para o Município de Mangueirinha, PR, determinados como *Haplomastodon* (Hoffstetter, 1952), depositados no Museu de Ciências Naturais (MCN-SCB) e Centro de Pesquisas Arqueológicas (CEPA), ambos da Universidade Federal do Paraná. Uma terceira ocorrência foi relatada por Silva *et al.* (2009) para o Município de Icaraíma, PR, a partir de um terceiro molar (superior?), representado apenas pela porção correspondente ao esmalte (coroa) que foi atribuído pelos autores a *Stegomastodon* (Polhig, 1912) e depositado na coleção de Paleontologia Centro Paleontológico (CENPÁLEO), Mafra, Estado de Santa Catarina. No espécime ilustrado por Pilatti & Bortoli (1978) não é possível observar as raízes, pré-trites, pós-trites e cônulidos acessórios. Segundo a revisão realizada por Prado *et al.* (2005), o gênero *Haplomastodon* é considerado sinônimo júnior de *Stegomastodon.* Nenhum dos espécimes do Estado do Paraná aqui estudados permitem determinação em nível especifico, e os fragmentos de Mangueirinha apenas podem ser determinados como Gomphotheriidae de gênero indeterminado.

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BASAL OR NOT SO BASAL CINGULATES IN THE MIDDLE MIOCENE OF PERUVIAN AMAZONIA

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Cingulate fossils from the Tertiary tropical region have been changing our view of the phyletic and biogeographic history of this group. Some new Paleogene (Salas-Gismondi *et al.*, this volume) and Neogene (Antoine *et al.*, 2007) localities in Peruvian Amazonia have yielded important, yet fragmentary, cingulate material. Here we present the remarkable cingulate assemblage from Fitzcarrald, named from a major geomorphic feature of the Amazon basin (Espurt *et al.*, 2007), located around 10ºS latitude, in Ucayali, Peru. This fauna is middle Miocene in age (Antoine *et al.*, 2007) and particularly interesting because of its cingulate taxonomic diversity. Indeed, Glyptodontidae material includes at least four taxa of different evolutionary "stages" comprising basal forms like *Parapropalaehoplophorus* and Glyptatelinae (*Glyptatelus*), as well as derived ones (Glyptodontinae). The record in the middle Miocene of basal morphotypes, already extinct long ago in coeval faunas from higher latitudes, point to the continued presence of basal clades at tropical areas throughout the Tertiary. Interesting is the Fitzcarrald record of *Pachyarmatherium*, a genus so far reported from the Plio–Pleistocene of USA (Downing & White, 1995), and Pleistocene of South America (*e.g.*, Porpino *et al.*, 2009; Rincón & White, 2007). This new record therefore widely predates the previous FAD of this controversial genus, and establishes temporal concurrence with *Neoglyptatelus*, a genus suggested as junior synonym (*e.g.*, Vizcaíno *et al.*, 2003). Some questions – rather than answers – arise at this point. If we consider that tropical areas represent the center of cingulates radiation, as already

proposed by other authors (*e.g.*, Carlini *et al.*, 1997), then, it is valid to question whether plesiomorphic character states, usually based on high latitude cingulates forms, are really primitive. Given the fact that both "basal" and "derived" morphotypes are shown to be synchronous and sympatric, both states might have appeared at about the same time.

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A LATE MIOCENE ANDEAN ECOSYSTEM FROM PERU

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Localities that record many aspects of any South American ecosystem present just before the GABI are scarce. This number is even more reduced if we restrict our search to areas outside the Southern Cone. Espinar, a new locality in the South Andes of Peru (4000 m high) has yielded important fossils recording fauna and flora from middle and late Miocene of El Descanso Formation (Tejada *et al.*, 2009); these ages have been inferred by biochronology, and tuff datations (Cerpa *et al.*, 2004). Espinar is located 14° S latitude, about 250 km south of Cusco, and presents especially rich late Miocene horizons with vertebrate fossils corresponding to cingulates, pilosans, and notoungulates. Glyptodontid cingulates are the most common vertebrates identified by carapaces and cranial elements of the subfamilies Glyptodontinae (at least 2 species and 1 new genus) and Hoplophoriinae (2 species). Pilosans are represented by mylodontids and an almost complete skeleton of a megathere ascribable to the genus *Megatheriops* Ameghino and Kraglievich, 1921, originally described from the Huayquerías of Mendoza, Argentina. Other megathere remains from an even older new locality (San Miguel, middle Miocene) are also noteworthy to mention. The possibility to assess certain anatomical characteristics, unknown in pre-Pliocene megatheriines (*e.g.*, complete skull including premaxilla, forelimb, etc.) highlights the phyllogenetic relevance of the Espinar specimens to set the trend in the evolution of the clade. Notoungulates are only represented by *Posnanskytherium viscachanense*, a species so far restricted to the Mio–Pliocene of Bolivia (Saint-André, 1999). The fauna of Espinar is not fully comparable with other coeval localities (given its preliminary knowledge), however there are some common elements with other Bolivian faunas (*e.g.*, Inchasi, Viscachani) suggesting similar conditions in the ancient Andean ecosystem. An important source of information on the paleoenvironment comes from new localities with perfectly preserved fossil leaves. This record is particularly interesting because it provides data on the altitude of this region during the late Miocene, well below its current elevation.

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PHYLOGENY AND PALEOBIOGEOGRAPHY OF PLATYRRHINE PRIMATES: THE PATAGONIAN CONNECTION

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Early to middle Miocene Patagonian primates are relatively diverse compared to other primate assemblages in South America and the Caribbean and exhibit several unusual characters that sometimes led to misinterpretations of their affinities with living forms. Living platyrrhines inhabit only the Neotropical Region, and controversies have arisen about the extinct Patagonian primates as an integrated part of the Neotropical radiation. Thus, two opposing phylogenetic models are currently under debate. One of them considers the Patagonian primates as stem platyrrhines (Kay *et al.*, 2008), and the second, maintained here (see also Rosenberger, 2010), supports the evolutionary continuity of primates from Patagonia and the Neotropics, especially with the middle Miocene primate fauna from La Venta, Colombia. Several Patagonian taxa are related to extant subfamilies via dental and cranial characters, also resembling certain groups from La Venta. Extinct Patagonian cebines, such us *Dolichocebus* (Kraglievich, 1951) and *Killikaike* Tejedor *et al.*, 2006, are probably related to each other, while dental characters link *Dolichocebus* with cebines from La Venta. On the other hand, the Patagonian pitheciines *Mazzonicebus* Kay, 2010, *Soriacebus* Fleagle *et al.*, 1987, and, definitively, *Proteropithecia* Kay *et al.*, 1998, represent ancient forms of a clade including the more modern Laventan pitheciines. Finally, the Patagonian *Tremacebus* Hershkovitz, 1974 may be part of the lineage leading to the extant *Aotus*, which is also reinforced by the presence of an extinct *Aotus* species in La Venta. Recent estimates of primate divergences integrating paleontological and molecular data provide a temporal framework supporting the idea that Patagonian primates are part of the crown Platyrrhini (Wilkinson *et al.*, 2011). As an additional scenario supporting these phylogenetic relationships, we suggest here a possible paleobiogeographic connection, persistence of a paleobiogeographic corridor along western South America. This is based on the fact that the Andean cordillera did not represent a geographic barrier for primate dispersal to the west and north by the time of the early platyrrhine radiation, and that several Miocene mammalian assemblages are represented along western South America from Argentina and Chile up to Colombia. The dynamics of Andean tectonics along this western corridor could easily have allowed a later diversification of platyrrhines into the Amazonian basin.

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PERSISTENCE OF A LINEAGE OF GONDWANAN MAMMALS IN MID-PALEOGENE LEVELS OF WESTERN PATAGONIA

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Recently, Tejedor *et al.* (2009) described a new Paleogene mammalian fauna from levels of the Volcanic-Pyroclastic Complex of the Middle Chubut River. All specimens were recovered from two localities in the vicinity of Paso del Sapo (Chubut Province, Argentina). The specimens described here (LIEB-PV 2000 and LIEB-PV 2001) come from the locality known as La Barda ("26 de Mayo" Farm), with an estimated age ranging between 47–45 Ma (middle Eocene; early Lutetian). They consist of two, probably upper molariform teeth referable to the same taxon of Gondwanatheria (Mammalia, ?Allotheria). The Gondwanatheria include two families: first, the Sudamericidae Scillato-Yané and Pascual, 1985, of hypsodont dentitions, that have been recorded from the Late Cretaceous of Patagonia, Madagascar, India, and possibly Africa, as well as from the medial Paleocene of Patagonia and the Eocene of Antarctica. Second, the more generalized, brachydont Ferugliotheriidae Bonaparte, 1986, which are only known from the Late Cretaceous of Patagonia (Los Alamitos, La Colonia, and Cerro Tortuga localities). The new molariform specimens are characterized by: (1) size larger than other Gondwanatheria; (2) molariforms are probably protohypsodont, comparable to the earliest Sudamericidae; (3) there are strong transverse crests that alternate with labial furrows; (4) each

tooth has a single root, very short and rounded; (5) the teeth are strongly worn at their occlusal surfaces, and the labial edge is less worn than the lingual one. The protohypsodont aspect of the teeth, as well as the strong, transverse crests, suggest affinities with the Sudamericidae; on the other hand, the occlusal pattern performed by the crests and furrows shows more similarities with the Ferugliotheriidae. If the allocation of the new taxon to this latter family is confirmed, this would extend its biochron approximately 20 Ma, up to the middle Eocene. The new record agrees with the known distribution of other gondwanatherians in the southernmost portion of South America (but see Goin *et al.*, 2004). Therefore, it needs to be confirmed whether the distribution of this group in South America included other (Neotropical) areas of this continent or, to the contrary, if it represents an endemic radiation of the Andean Region (Patagonian Subregion) of the Austral Kingdom.

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LATE PLEISTOCENE–EARLY HOLOCENE MAMMALS OF THE SANTA LUCIA BASIN (SOUTHERN URUGUAY)

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In the late Pleistocene–early Holocene of South America occurred not only the disappearance of the megafauna and other mammals but also many local extinctions that brought about the rearrangement of mammal communities and their geographic distribution. Rich fossiliferous beds that crop out alongside the Santa Lucia River (Santa Lucía Basin, Southern Uruguay), provide useful information in order to study the vertebrate assemblage, latest records of megafauna, local extinctions and climatic and environmental conditions. This study includes outcrops in sections up to 20 m high, spanning 80 to 100 kms along the river, involving different facies with a fluvial origin that may change laterally. The bases of the sections are mainly dominated by brown mudstones that include sandy levels; overlying this bed are gray to green clayey beds with sandy levels that have a patchy distribution in the studied transect. Above this level can occur brown sandy beds and gray to brownish mudstones. The first OSL ages and a new ^{14}C dating range from 30,000 to 8,000 yrs. BP. Three OSL ages were obtained (UIC-Lum. Dating Res. Lab., Illinois) from sandy levels: 31,160 +/- 2,285 (UIC-2826) (34°16′13.3″S–55°59′34.8″W), 30,855 +/- 2,370 (UIC-2822) (34°17′25″S–55°56’0 5.1″W) and 8,760 +/- 965 yrs BP (UIC-2823) (34°17′9.50″S–55°56′39.24″W). The AMS ^{14}C age was obtained from a gray to greenish claystone level (tooth enamel; indeterminate deer) (NSF-Arizona AMS Laboratory): 21,530 +/- 140 yrs BP (AA91726) (34°17′9.50″S–55°56′39.24″W). In addition to these ages, four ^{14}C dates from other localities of the green claystone level are available based on wood remains ranging from 11,200 to 10,500 yrs BP. While more samples are in progress in order to evaluate this arrangement of ages, it is evident that in the horizontal sequence of outcrops under study there are facies not only with different genesis in terms of energy but also with different ages in the last 30 yrs BP interval. The mammalian assemblage includes *ca.* 28 genera. From the levels of 30,000 yrs BP many taxa were unearthed including typical extinct megafauna (ground sloths, armadillos and glyptodonts, horses, macraucheniids, etc.) and some mammals that are now locally extinct (hairy armadillo, some guinea pig rodents, the living mara, the plains vizcacha and vicuña-like camelids). Some of the recorded taxa live today in the Patagonian region and central Argentina, suggesting arid/semiarid environments and perhaps a cold climate. The 11,200 to 10,500 yrs BP levels include ground sloths, extinct deer, horses, glyptodonts, and large extinct camelids along with wood and palynological remains. The section that yields a green clayey level at its base with ^{14}C age of 21,530 yrs BP, underlying a sandy level with the OSL of 8,760 yrs BP that is overlain by a mudstone upper level deserves particular consideration. The clayey level yields few mammal remains (the rodent mara and a vicuña-like species) which indicate arid/semiarid environments. In addition, the palynological content shows a predominance of grassland species related to open environments along with lotic environments. This is an expected scenario related to the influence of the Last Glacial Maximum in this area of South America. The sandy and mudstone level of early Holocene age yields megafauna (horses, large camelids, and some armadillos). Taphonomic patterns such as similar type of preservation, some articulated bones, no evidence of abrasion, and some bioerosion marks shared by many of the remains, suggest that reworking processes are unlikely. This pattern implies that extinct mammals in South America were still living in the last 8,000 yrs BP at these latitudes. It is highlighted that there are few reliable sites in South America with this kind of information. These beds bear significant information for the reconstruction of vertebrate assemblages, environments, climate and for the study of the latest records of megafauna in South America.

MOLECULAR PHYLOGENY, DIVERGENCE TIMING, AND BIOGEOGRAPHY OF THE NEOTROPICAL CAVIOMORPH LINEAGE OCTODONTOIDEA (RODENTIA: HYSTRICOGNATHI)

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The rodent superfamily Octodontoidea (degus, spiny rats, and their relatives) comprises 6 families, 38 genera and 193 living species, all endemic to the Neotropical Region and representing roughly three-quarters of extant caviomorphs. Although caviomorph monophyly is well established and phylogenetic hypotheses exist for several families, understanding of octodontoid relationships is clouded by sparse taxon sampling and single-gene analyses. Temporal and spatial patterns of diversification are also poorly understood, yet these rodents have robust fossil records (78 fossil genera since the Oligocene) that offer opportunities to illuminate their diverse evolutionary history. We examined DNA sequence variation in one mitochondrial (12S rRNA) and three nuclear genes (vWF, GHR, and RAG1) across all caviomorph families (including 47 octodontoid taxa), all phiomorph families, and the sole remaining hystricognath family, using the gundi (*Ctenodactylus*) and springhaas (*Pedetes*) as

outgroups. Our analyses support the monophyly of Phiomorpha, Caviomorpha, and the caviomorph superfamilies Cavioidea (Dasyproctidae, Cuniculidae, and Caviidae, the latter including Hydrochoerus), Erethizontoidea, Chinchilloidea (including Dinomyidae), and Octodontoidea. Cavioids and erethizontoids are strongly supported as sisters, whereas chinchilloids appear to be sister to octodontoids. Among octodontoids, Abrocomidae is consistently recovered as the basal element, sister to a pair of strongly supported clades: one includes Octodontidae and Ctenomyidae as reciprocally monophyletic lineages, whereas the other includes taxa currently allocated to Echimyidae, Capromyidae and Myocastoridae. Capromys appears near the base of this clade, in keeping with current classification, but Myocastor is nested securely inside a clade of Echimyidae that also contains eumysopines, echimyines and dactylomyines. Another weakly supported clade of Echimyidae contains fossorial and scansorial taxa from the Chaco-Cerrado-Caatinga and the Atlantic Forest. Divergence-time analyses using a conservative placement of five internal fossil calibrations dates the radiation of crown caviomorphs at ~35 Ma. Biogeographic analyses robustly recover the Patagonia-Southern Andes complex as ancestral for the Octodontoidea, with three component lineages emerging by the Oligocene/Miocene boundary (~23 Ma): (1) stem abrocomids in the Central and Southern Andes; (2) a lineage leading to octodontids plus ctenomyids in Patagonia, later dispersing into the Chaco-Cerrado-Caatinga; and (3) a lineage leading to echimyids, capromyids, and myocastorids that subsequently radiated in more mesic biomes, including Amazonia, Atlantic Forest, and the Antilles. This reconstruction refutes earlier ideas that the diverse, generalized, and lowland family Echimyidae, which appears early in the fossil record, gave rise to the Andean lineages of octodontoids—instead, the reverse derivation appears to be true. Octodontoidea's fossil record appears to be an exceptional resource for calibrating rates of evolution in this group. Future work focuses on investigating the ecomorphological context of the Octodontoidea radiation.

LA EXTENSIÓN AUSTRAL DE LA REGIÓN NEOTROPICAL DURANTE EL OLIGOCENO–PLEISTOCENO SEGÚN LOS CAVIOMORFOS (MAMMALIA, RODENTIA)

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Los roedores caviomorfos ingresaron a América del Sur con anterioridad al Oligoceno y su primera diferenciación ocurrió, seguramente, en la actual región Neotropical (Morrone, 2006). Sin embargo, los caviomorfos más antiguos, con una datación precisa, provienen de las localidades de Tinguiririca (Chile central) y La Cantera (Gran Barranca, sur de Chubut) en lo que actualmente es la región Andina. Ambas localidades tienen una antigüedad Oligoceno temprano. Los roedores de La Cantera comparten, probablemente, un género con la localidad de Santa Rosa (Eoceno tardío–Oligoceno tardío; noreste de Perú) por lo que puede inferirse que la región Neotropical se habría extendido hasta el centro de Patagonia extra-andina. Los dos roedores de Tinguiririca, por el contrario, indican ya un fuerte endemismo para la actual zona cordillerana, con taxones de nivel familia y ¿subfamilia? (chinchíllido y un género de afinidades inciertas) no registrados en la región Neotropical. Desde el Oligoceno tardío y hasta el Mioceno medio las faunas de roedores de localidades de Patagonia y Argentina central tienen una composición mixta, con taxones de nivel familia y subfamilia, de abolengos Neotropical (equímidos, eretizóntidos) y Andino (chinchíllidos, acareminos), más otros de relaciones aún dudosas. Los géneros son mayormente de abolengo Andino, aunque algunos equímidos (e.gr. *Maruchito* Vucetich *et al.*, 1993) podrían estar relacionados a equímidos vivientes de la provincia del Bosque Atlántico Brasílico y de la subregión Amazónica. Por otra parte, algunos géneros de cavioideos de este lapso tienen amplia distribución desde Colombia al sur de Patagonia. Luego del Mioceno medio desaparecen de esta región (o disminuyen drásticamente) los taxones de abolengo Neotropical. A partir del Mioceno tardío, en el centro de Argentina ya predominan en diversidad y abundancia los taxones de abolengo Andino (chinchíllidos, octodóntidos, abrocómidos). Sin embargo, algunos géneros de equímidos (*Pampamys* Verzi *et al.*, 1995, *Reigechimys* Verzi *et al.*, 1994 y *Theridomysops* Vucetich, 1995) registrados en Catamarca y La Pampa están filogenéticamente relacionados con géneros actuales y extintos de las provincias del Cerrado, Chaco y Caatinga (subregión Chaqueña) y habrían migrado hacia el sur luego de la retirada del Mar Paranense. En Entre Ríos se registran eretizontinos y neoepiblémidos relacionados con taxones de la región Neotropical. En este lapso en la parte más austral de la provincia Pampa se diferencian taxones típicamente australes como los ctenominos y el equímido *Eumysops* Ameghino 1888. En esta misma región, durante el Plio–Pleistoceno, se registra el ingreso temporario y alternado de taxones típicamente Andinos (octodontinos, *Abrocoma* Waterhouse, 1837) y Neotropicales (aff. *Clyomys* y *Plesiaguti* Vucetich y Verzi, 2002). Para los roedores caviomorfos, el sur de la provincia Pampa fue una zona de transición (Morrone, 2006).

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GEOHISTORICAL EVOLUTION OF THE NEOTROPICAL REGION IN SOUTH AMERICA

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The geohistorical evolution of South America began with the late Jurassic subduction of the Farallon plate on the west, and activity of the Caribbean plate on the north. The Neotropical Region is contained within the South American plate north of 24ºS. The craton (the Guiana and Brazilian shields) has been relatively stable since the Late Cretaceous. The majority of geological events affected areas mostly north, west, and southwest of the craton, as well as between the two shields (Amazon River district). During the Cenozoic the Farallon plate intersected the South American plate at an oblique angle as it passed progressively southward, to be followed after about 24 Ma by the more orthogonally subducting Nazca plate. The northern margin of South America was largely passive from the Late Cretaceous, with marine shelf basins (*e.g.*, Maracaibo) receiving nonmarine input from rising Cordilleran elements into the Eocene. The proto-Maracaibo drainage began at this time, followed at ca 30 Ma by the proto-Orinoco and proto-Magdalena rivers and basins as uplift and shortening continued in the Colombian Cordillera. The Orinoco River system was completed from about 15 Ma. Western Colombia, Ecuador, Peru, Bolivia, northern Chile and Argentina recorded Late Cretaceous post-rifting platform and coastal marine deposits to the west, and inception of foreland basin sedimentation to the east of the Cordilleras. Ranges were of very low elevation, and underwent post-tectonic erosion into the Eocene. A late Eocene pulse in tectonism (also in Argentina) is reflected in renewed foreland basin sedimentation. To the west, Ecuador recorded late Maastrichtian accretion and considerable crustal shortening through the Eocene, the latter also seen in Bolivia, Chile, and Argentina. The Amazonian Pebas Formation and coeval units elsewhere reflect Nazca plate subduction and late Oligocene and early Miocene proto-Andean uplift across the region, with fluvio-lacustrine deposition eastward. Ranges remained relatively low, less than 2 km, so rainfall was unimpeded. As recently as 15–10 Ma, elevations mostly did not exceed 2 km, even in spite of another episode of crustal shortening between 30–10 Ma. Thereafter, shortening ceased in the Cordilleras, but propagated eastward. In Peru, Bolivia, and Chile, basins west of the main Cordillera show the onset of aridity and increased elevation from about 15 Ma, with a strong pulse at about 10 Ma. Near-modern elevations were reached by about 10–6 Ma, and even earlier in the Argentine Puna (ca 27 Ma). In Amazonia, the Pebas mega-lake system developed from about 16 Ma, with Andean uplift well underway there and elsewhere. The Pebas system formed a large, low elevation, fluvio-lacustrine plain, but also recorded a number of marginal marine incursions, mainly from the north. At about 8 Ma the Pebas-Acre basin was overfilled and streams trended eastward to become a through-going Amazon River system that reached the Atlantic coast, separated from the Orinoco system by the 4 Ma uplift of the Fitzcarrald Arch of southern Peru. Paleobotanical data in Colombia and Amazonia show the basic Neotropical rainforest structure already present in the Paleocene, with Eocene pollen diversity exceeding that of modern rainforests. The Eocene/Oligocene boundary saw a decrease in diversity coeval with global temperature change, but diversity was recovered in the Miocene, along with the onset of low seasonality and high precipitation. This is in strong contrast to the greater seasonality and increased aridity of more southern parts of the continent, which had begun even earlier. The land mammal faunas of the two regions show distinct facies differences from at least the late Eocene.

SESIONES REGULARES

DENTAL MICROWEAR AND ISOTOPIC ANALYSES FOR INVESTIGATING THE DIET OF *CARODNIA VIEIRAI* (MAMMALIA: XENUNGULATA)

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Carodnia vieirai Paula-Couto, 1952 is the best known species of the order Xenungulata, a peculiar group of the Cenozoic South American ungulates recovered from São José de Itaboraí Basin, state of Rio de Janeiro, Brazil. The aim of this study is to analyze dental microware and carbon isotopic signatures in molars of this species, in order to infer its possible food habits and provide new information for a future paleoenvironment interpretation of the basin. Two complete mandibles and skull fragments (DGM 333M and DGM 334M) were considered for the analyses. According to the wear level, the first specimens (DGM 333M) belonged to an older individual. SEM images were taken from occlusal region of paracone/paraconid enamel of M1/m1 and M2/m2 and analyzed with Microware 4.02 software with magnifications of X300 and X500. The isotopic analysis was obtained from enamel samples. The microwear analysis revealed a density of 173.12 pits and 1188.05 scratches (N/mm²) in DGM 333M and 234.77 pits and 822.61 scratches (N/mm²) in DGM 334M. Both results, compared with diet data obtained in Rivals and Deniaux (2003), placed *C. vieirai* very close to the grazer group. The $\delta^{13}C$ values varied between of -11.1‰ and -11.6‰. According to the geochemical results C3 plants were dominant in the diet of these mammals. However there is a significant microwear difference between the two specimens. The microwear features indicate a more abrasive diet in DGM 333M than in DGM 334M. This difference can be related to the difference observed in mandibular morphology: the dentary of DGM 333M is deeper than DGM 334M. The presence of verticals Hunter-Schreger bands in the teeth of *C. vieirai* may be associated with the need of a greater resistance to eating C3 grasses or other kind of plants bearing phytollytes. These results disagree with Souto and Avilla (2005) who suggested, based on the analysis of coprolites possibly relateds to *C. vieirai*, that this species was a browser. The plant record of Itaboraí Basin is scarce. Some pteridophytes, angiosperms non-identified and palms, among other plants, were identified by Lima

and Cunha (1986). Volcanic ashes, when eaten mixed with plants during feeding can also provoke the same microware pattern of an animal that feeds on grass. Although there is an ankaramite lava flow at the north border of the basin, it is posterior to the limestone sedimentation, from where both mandibles were recovered. Based on the evidences presented here, *C. vieirai* fed an abrasive vegetation, possibly C3 grasses or other angiosperms and pteridophytes bearing phytollytes.

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VARIACIONES MORFOLÓGICAS DEL TARSOMETATARSO DE *SPHENISCUS* (AVES, SPHENISCIFOMES) EN LA FORMACIÓN PISCO (MIOCENO–PLIOCENO), PERÚ

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El presente estudio tiene como objetivo analizar la variabilidad morfológica de los pingüinos de la Formación Pisco, revisar su asignación sistemática a *Spheniscus* (Brisson, 1760) y discutir sus connotaciones taxonómicas y ambientales. La Formación Pisco constituye una secuencia sedimentaria marina que aflora por unos 325 km en las regiones Ica y Arequipa, en la costa centro-sur del Perú. Se han identificado nueve localidades con vertebrados fósiles, con edades entre 13 Ma. y 1.5 Ma. (Mioceno Medio–Plioceno Tardío). Se practicaron análisis cuantitativos métricos y morfo-geométricos y se realizaron descripciones comparadas de 39 restos preliminarmente atribuidos a *Spheniscus* depositados en el Departamento de Paleontología de Vertebrados del Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos (MUSM), en Lima (Perú), y en la División Paleontología Vertebrados del Museo de La Plata (MLP), Ciudad de La Plata (Argentina). Los resultados obtenidos permiten reafirmar la asignación sistemática de los restos al género *Spheniscus* por la presencia de un *sulcus longitudinalis medialis* y de un *foramen vasculare proximale mediale* bien desarrollados, que en *Palaeospheniscus* (Moreno y Mercerat, 1891), género morfológicamente afín y presente en el Mioceno de Perú están poco desarrollados. La tróclea para el dígito II es lateralmente poco divergente y el *margo lateralis* es de sección redondeada (aguzado en *Palaeospheniscus*). La *crista hypotarsalis medialis* está poco extendida distalmente y adquiere forma triangular en vista plantar y medial. Las sutiles diferencias inter-específicas han sido también descriptas para las cuatro especies actuales y las cuatro fósiles de *Spheniscus*. Los resultados revelaron que *Spheniscus muizoni* Göhlich, 2007, *S. megaramphus* Stucchi *et al.*, 2003*, S. urbinai* Stucchi 2002, y dos especies indeterminadas se distribuyen en más de un nivel. La presencia de cinco especies de *Spheniscus* viviendo en la misma área durante el Mio–Plioceno podría ser explicada por el advenimiento de condiciones propicias para su diversificación. La cuenca de antearco en la Formación Pisco es consistente con un ambiente desértico influenciado en gran parte por una corriente fría que habría estado presente desde el Mioceno medio o considerablemente antes. Hacia finales del Mioceno se verifica un enfriamiento de las aguas, que habría creado condiciones propicias para la radiación del género en la costa pacífica de América del Sur.

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ANÁLISIS DE UN MOLAR PERTENECIENTE A LA FAUNA DEL PLEISTOCENO TARDÍO DEL SITIO PILAUCO, OSORNO, CHILE

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Las piezas dentarias son las estructuras anatómicas más frecuentes y mejor conservadas en el registro fósil de mamíferos, siendo además elementos claves para la determinación taxonómica de los mismos. Dado que la mayor parte de los elementos diagnósticos se ubican en las cúspides, en aquellos dientes que presentan un alto grado de desgaste de la corona o una mala preservación la asignación taxonómica resulta compleja. En estos casos el uso de análisis complementarios (ej. isótopos, ADN ancestral) puede resultar útil para el refinamiento de estas asignaciones. El presente estudio tiene por finalidad determinar las afinidades taxonómicas de un molar aislado (MHMOP/PI74) registrado durante la temporada

2008 en el Sitio Pilauco (40° 34' 11,50"S, 73° 6' 12,78"O), sur de Chile. Se empleó la interpretación crítica de las estructuras morfológicas y análisis de $\delta^{13}C$ y $\delta^{15}N$. El material procede del nivel PB-7 fechado entre 11.004 ± 186 y 12.540 ± 90 años ^{14}C A.P. La morfología general de la corona y las raíces sugieren que el espécimen posiblemente corresponda a un M1, el cual sin embargo presenta una superficie oclusal extremadamente desgastada, por lo que no se observa la morfología de las cúspides. La superficie es suave y pulimentada, permitiendo observar con claridad un mínimo de 27 annulis. En la base de la corona se observan surcos perpendiculares que no alcanzan el contacto con las raíces. Su altura total es de 3 mm, mientras que la corona tiene un ancho de 30 mm y un largo de 33 mm. La observación de muestras del esmalte mediante luz oblicua sugiere un patrón en zig-zag para las bandas de Hunter-Schreger, las cuales son propias de mamíferos consumidores de huesos (Stefen, 2001). El valor obtenido para $\delta^{13}C$ y $\delta^{15}N$ fue de -25,26 y 7,96, respectivamente. Según Richards *et al.* (2007) el $\delta^{15}N$ en carnívoros oscila entre 5,7 y 9,8, lo que sugiere una afinidad con este tipo de consumo en la muestra de Pilauco. Los valores de $\delta^{13}C$ se encuentran en el rango de los de un consumidor de plantas tipo C3 (Koch, 2008). Sin embargo si al fin del Pleistoceno en el Sur de Chile dominaba la vegetación C3 esta señal también puede tener su origen en el contenido isotópico presente en la presa consumida. De este modo, la existencia de marcadores isotópicos afines al consumo de carne y vegetales, y la comparación con muestras de herbívoros locales sugiere una mayor afinidad con una dieta omnívora para el taxón representado por el molar MHMOP/PI/74. Se discute su posible afinidad con carnívoros de la familia Ursidae, teniendo en cuenta los resultados isotópicos, junto con la morfología general y el número de annulis que señalan la pertenencia a un animal de edad avanzada y grandes dimensiones. Esta investigación fue financiada por el proyecto FONDECYT 1100555.

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SPHENISCIFORM REMAINS AND OTHERS FOSSIL VERTEBRATES FROM THE OTUMA FORMATION IN THE PARACAS NATIONAL RESERVE, PERU

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Fieldwork at the Paracas National Reserve, South-Central Peru, has produced a wealth of fossil material at three different Paleogene localities (RNP/YU, RNP/PC and RNP/CSC) of the Late Eocene–Early Oligocene Otuma Formation (*sensu* DeVries *et al.,* 2006). Exceptional preservation is present at the locality RNP/YU where the fossil penguin *Inkayacu paracasensis* Clarke, Ksepka, Salas-Gismondi, Altamirano, Shawkey, D´Alba, Vinther, DeVries and Baby 2010, was collected. Two additional penguin specimens were recovered from this locality, a proximal humerus (MUSM 1431) and a proximal portion of a tarsusmetatarsus (MUSM 1432). MUSM 1431 share diagnostic characters with *Inkayacu*, however it is different in the morphology of the *caput humeri*, the *coracobrachialis posterior* scar, and the dorsal tubercle. MUSM 1432 probably corresponds to a new species. It is distinct from *I. paracasensis* in its smaller size (30% smaller) and the position of the proximal vascular foramina. Another vertebrate collected from this locality include the chondrichthyan *Carcharocles auriculatus* Blainville 1818, *Alopias* sp., *Striatolamia macrota* Agassiz 1843, *S. striata* Winkler 1874, *Carcharhinus* sp. 1, *Carcharhinus* sp. 2, *Physogaleu*s sp., Hemigaleidae indet., *Isurus praecursor* Leriche 1905, *Pristis* sp, the osteichthyan *Cylindracanthus* sp., and Sphyraenidae indet. At the locality RNP/PC, an almost complete right humerus (most of the proximal part and the distal end) of a new penguin species (MUSM 1433) was also recovered, distinctive by its size (55% smaller than *I. paracasensis*, morphology of the *caput humeri* and presence of a ligamental pit in the anterior side of the humerus. At RNP/CSC, an endocast and a partial skull of a Sphenisciдae, a humerus of Pelagornithidae indet., and remains of the chondrichthyan species: *Carcharocles auriculatus* Blainville 1818, *C. angustidens* Agassiz 1843, *Isurus praecursor* Leriche 1905 and *Carcharhinus* sp; Osteichthyes and Chelonidae were also found. Based on previous geological information of the locality (Clarke *et al.*, 2010), the presence of *C. auriculatus* Blainville 1818, *S. striata* Winkler 1874*, S. macrota* Agassiz 1843 and *Isurus praecursor* Leriche, 1905 at RNP/YU, specimens MUSM 1431 and MUSM 1432 are assigned to the Upper Eocene. Data on the geology (Tsuchi *et al.*, 1990) and the finding of *C. Auriculatus* Blainville 1818, and *C. angustidens* Agassiz 1843 allows assigning RNP/CSC to an Upper Eocene–Lower Oligocene age.

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NEW INSIGHTS ON THE PHYLOGENETIC AND BIOGEOGRAPHIC RELATIONSHIPS OF BASAL SAUROPODOMORPHA

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'Prosauropods' are a grade of herbivorous/omnivorous dinosaurs that traditionally include most non-sauropod sauropodomorphs. Earliest representatives of this group date back to the end of Carnian, and after reaching a nearly global distribution, 'prosauropods' disappeared before the end of Jurassic. Despite recent advances, the phylogenetic relationships among basal sauropodomorphs are still controversial. The analysis of Yates (2007), which has been largely accepted in more recent studies, supports the clade Plateosauria, comprising typical 'prosauropod' families as Plateosauridae (*Plateosaurus* Meyer + *Unaysaurus* Leal, Azevedo, Kellner and Da Rosa), Riojasauridae (*Riojasaurus* Bonaparte + *Eucnemesaurus* Hoepen), Massospondylidae (*Lufengosaurus* Young + *Coloradisaurus* Bonaparte + *Massospondylus* Owen) plus Anchisauria and its stem-taxa. An alternative phylogenetic hypothesis (Upchurch *et al.* 2007) assembles *Plateosaurus*, *Riojasaurus* and *Coloradisaurus* into Plateosauridae, and this latter with *Massopondylus* and *Lufengosaurus* into Plateosauria. We perform a new analysis of a previously modified version of the Yates (2007) dataset, adding the reassessment of some taxa and resulting in a different phylogenetic scheme. Plateosauridae is shown as a more restrict clade, including only the species formerly ascribed to the genus *Plateosaurus*, from Europe, whereas *Unaysaurus* is found in a new basal massopod clade that also includes *Sarahsaurus* Rowe, Sues and Reisz and *Ignavusaurus* Knoll. Massospondylidae is mostly represented by taxa from Southern Hemisphere. *Seitaad* Sertich and Loewen, recently described from the Early Jurassic of North America, resulted as closely related to Anchisauria. Previous phylogenetic scenarios in which the plateosaurids comprise species from both Europe and South America are problematic, as an exclusive faunal sharing between these areas is not supported by geological and biostratigraphic evidence. A bayesian biogeographic analysis over the geographical distribution of sauropodomorphs within the original phylogenetic frameworks of Upchurch *et al.* (2007) and Yates (2007) suggests that dispersal across Pangaea would explain the occurrence of plateosaurids in those areas. Yet, the lack of unambiguous plateosaurid representatives in North America and Africa contradicts this scenario, hinting at spurious phylogenetic signal. Alternatively, the close relationship of the South American 'prosauropods' with taxa from connected areas fits better to the available biostratigraphic data. Indeed, our results suggest some provincialism in the Late Triassic evolution of sauropodomorphs. Plateosauridae is restricted to northern Pangaea, whereas basal Massopoda inhabited predominantly the southern hemisphere, achieving a global distribution during the Early Jurassic.

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PRELIMINARY DENTAL MICROWEAR AND DIET ANALYSIS OF THREE UNGULATES SPECIES FROM ITABORAÍ BASIN, ITABORAIAN, RIO DE JANEIRO, BRAZIL

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Itaboraí Basin has a wide record of Paleocene mammals with diverse body size and teeth morphology, and the ungulates are the most common mammal group. *Paulacoutoia protocenica* (Paula-Couto, 1952), *Paranisolambda prodromus* (Paula-Couto, 1952) and *Othinielmarshia pristina* (Paula-Couto, 1978) are small to medium ungulates with low crowned and bunodont teeth (*P. protocenica*, a "condylarth") or bunolophodont teeth (*P. prodromus*, a litoptern and *O. pristina*, a notoungulate). With the information provided by their diets, it will be possible to have a better picture of the ancient vegetation of Itaboraí Basin. To achieve this goal, a microwear and isotopic analysis were undertaken to infer the probable food habits of these mammals. Several SEM pictures were taken from the oclusal region of enamel paracone of the second upper molar and the tooth marks were counted and measured with Microware 4.02 software, using a magnification of 500x. The isotopic analyses were obtained from enamel samples of *P. protocenica* and *P. prodromus*. In microwear analyses *P. protocenica* presented an average of 32.33 pits and 63 scratches; *O. pristina* an average of 36 pits and 76.33 scratches, and *P. prodromus* an average of 17.5 pits and 20 scratches. These results led to a density of 658.52 pits and 1283.1 scratches (N/mm²) in *P. protocenica;* 356.42 pits and 407.33 scratches in *P. prodromus,* and 733.2 pits and 1554.65 scratches in *O. pristina*. The Kolmogorov-Smirnov test showed that the densities of scratches and pits are significantly different among the three species ($p < 0.05$). The density of scratches suggested that *P. prodromus* was a browser (low density) and *P. protocenica* and *O. pristina* were grazers (high density). The $\delta^{13}C$ mean value for *P. protocenica* is -8,2‰, and for *P. prodromus* ranged between -8,3‰ and -8,6‰, indicating that C3 plants were dominant in the diet of these mammals. Moreover, the results suggested that tooth crown morphology has little influence on the food habits, as one bunolophodont species (*O. pristina*) was a grazer and the other (*P. prodromus*) was a browser, and *P. protocenica*, with bunodont teeth, was also a grazer. Another interesting result is the seeming absence of interference of Hunter-Schreger bands in tooth wear and diet, as all species bear horizontal HSB (Line and Bergqvist, 2005). The Itaboraí Basin plant record is incipient, but Lima and Cunha (1986) recognized the presence of pteridophytes angiosperms,

and Palmacea palinomorphs, however, microwear and isotopic analysis results suggest the occurrence of C3 grass and/or other kind of plants bearing phytollytes.

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THE OLDEST CRETACEOUS SAUROPOD EGGS FROM PATAGONIA, CHUBUT, ARGENTINA (CERRO BARCINO FORMATION, APTIAN–ALBIAN)

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The Late Cretaceous of South America has yielded several important nesting sites and isolated dinosaur eggs and eggshells. However, the record of Early Cretaceous eggs is not yet well represented on this continent, besides the Hauterivian–Aptian nesting site from Sanagasta in La Rioja Province, Argentina. We present, here, the oldest Cretaceous sauropod eggs from Patagonia. These two dinosaur eggs, the first ones from Chubut (Patagonia), were discovered in the Cerro Castaño Member of the Aptian–Albian Cerro Barcino Formation that outcrops at Huanimán. The specimens were preserved in a fine, pedogenized, tuffaceous sandstone in proximal floodplain facies and multiepisodic channel facies. Sedimentary analyses suggest the presence of an anastomosing fluvial system, probably related to sub humid to semiarid paleoclimatic conditions. The eggshells morphology is similar to other megaloolithid eggs (a paraphyletic egg parataxonomic group) from Patagonia, namely Auca Mahuevo (Neuquén), positively identified as sauropods titanosaurs by embryos *in ovo*, and Salitral Moreno (Río Negro). However, this new Chubut material exhibits a structural eggshell feature not previously reported. A horizontal pore canal network is clearly visible near and under the outer nodular eggshell surface, differently from the Neuquén eggs where it overlays the membrana testacea. This morphological feature and the 1.5 mm thick eggshell illustrate a novel adaptation to this specific nesting environment. Although only two isolated eggs were found in Huanimán, this discovery may imply the existence of a more substantial nesting site with several eggs clutches like other sauropods nesting sites.

NEW STUDIES ON *PURUSSAURUS BRASILIENSIS*: MORPHOMETRY AND BITE FORCE CALCULATION

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Morphometry and bite force estimates are very important features to understand the palaeobiology and contribute to the knowledge on how particular extinct taxa interacted with each another. We studied polynomial functions generated by statistical morphometric measurements of *Caiman latirostris* Daudin 1801, and *C. crocodilus* Linnaeus 1758, and also statistical data obtained from bite forces of many *Alligator mississippiensis* Daudin 1801, individuals presented by Verdade, 2000, and Erickson, 2003. Morphometric measurements of *Purussaurus brasiliensis* Barbosa Rodrigues 1892, were gathered from the specimen UFAC-1403, a complete 140 cm skull from the Upper Miocene Solimões Formation, Acre State, Brazil. The results show that its total body length was 12.53 m (± 0.42), its body mass was 8281.9411 Kg (± 0.8792) and had a bite force of 97676 N (± 6875). This estimate represents the most powerful bite ever calculated for any continental predator. This is, however, considered a conservative estimate because it was based on bite force data collected from *A. mississipiensis* individuals, and recent studies show that the shape of the rostrum in crocodilians is directly involved to the power of the bite. The shorter and broader the rostrum is, the stronger bites it could support. So, the skull shape differences between *P. brasiliensis* and *A. mississippiensis* show that the first species could have supported stronger bites. The stress caused by approximately 98 tons of force should be accompanied by structural modifications to facilitate new demands on rostral mechanics. In extant species the force components acting vertically along the tooth rows tend to push the nasals together, and such bones also transmit compressive forces back along the dorsal midline to the rostral anchor in the antorbital region. One remarkable feature of both giant Upper Miocene species, *P. brasiliensis* and *P. mirandai* (Urumaco Formation, Venezuela), is the reduction of the nasal bones to the posterior border of a huge external nostril (45 X 32 cm), which occupies 2/3 of the rostral length. We suggest that the large cranial vacuity formed by this unique narial morphology can act as an energy dissipator, allowing the rostral walls to accommodate the stress imposed by the mandibular adduction.

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THE SOUTH AMERICAN EQUIDAE (MAMMALIA, PERISSODACTYLA): TAXONOMY AND PHYLOGENY

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The taxonomy and phylogeny of the South American Equidae (Gray, 1821) are still controversial, especially regarding the diagnoses of the species and their relationships. Dental characters and autopodial proportions are frequently considered informative characters in taxonomic definitions and cladistic analyses of the group. However, the intraspecific morphological variations are usually not properly considered, causing homology and taxonomy incongruencies. In this contribution, we analized all the valid species of South American Equidae – five species of *Equus* (Linnaeus, 1758) and three species of hippidiforms. We also included the North American *Onohippidium galushai* (MacFadden and Skinner, 1979) and two extant equids. Attributes that presented irregularities on its formulation, such as intraspecific variations among others, were excluded or reviewed. The taxonomic revision showed that most of South American Equidae are diagnosed by differences in size proportions. However, when a great number of specimens are analyzed, most of the diagnostic features are not informative. Therefore, after the taxonomic revision, the only valid species of South American Equidae are *Equus neogeus* Lund, 1840, *E. andium* Branco, 1833 *ex* Wagner, 1860, *Hippidion principale* (Lund, 1846) and *H. saldiasi* (Roth, 1899). Moreover, *Hippidion* (Owen, 1869) was the only hippidiform genus in South America. A new cladistic matrix was produced and a taxonomic revision was conducted for the South American Equidae. The outgroup for the cladistic analysis included *Parahippus leonensis* (Hulbert Jr, 1984) and *Merychippus primus* (Osborn, 1918). The trees were calculated using TNT software on the implied weighting and the new technology search options. Hence, a new phylogenetic proposal is presented here for the South American Equidae. *Hippidion* is a monophyletic clade whose sister group is *O. galushai*. This may indicate that *Hippidion* speciated before its arrival in South America. The genera *Dinohippus* (Quinn, 1955) and *Equus* are paraphyletic, and both are in need of revision. The South American species of *Equus* form a monophyletic clade. Probably, the ancestral of this clade arrived in South America just after the establishment of the Panamanian Isthmus and the subsequent Great American Biotic Interchange. The diversification of this clade shows a biogeographic pattern similar to that of other South American Pleistocene mammals, such as gomphotheres and tapirs, with an andean and a lowland lineage. Our results show a great diversification of the Equini in North and Central America during the middle to late Miocene. This may be related to the selection of the monodactyly (among other features) in a spreading out of grasslands. Furthermore, from the Pliocene to present the one-toed equids were the only survivors.

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PROCESSOS DE DIGITALIZAÇÃO 3D E PROTOTIPAGEM FÍSICA UTILIZADOS NO LABORATÓRIO DE PROCESSAMENTO DE IMAGEM DIGITAL DO MUSEU NACIONAL/UFRJ

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Pela possibilidade de materializar fisicamente peças raras de uma coleção, os modelos virtuais e físicos auxiliam estudos em acervos científicos e históricos. O Museu Nacional/UFRJ é detentor de um importante acervo paleontológico e arqueológico e seu Laboratório de Processa-

mento de Imagem Digital vem utilizando essa metodologia ao longo dos últimos anos para replicação de peças que podem complementar os acervos e exposições, além de evitar o manuseio desnecessário de peças raras e frágeis e de permitir o intercâmbio do material replicado entre instituições científicas. Devido à fidelidade dos arquivos, os materiais podem, ainda, ser usados para estudos científicos (principalmente de morfologia) e contribuem didaticamente nas exposições, possibilitando o contato físico do público visitante com determinadas peças, principalmente no caso de deficientes visuais. Para a construção de modelos virtuais é utilizado o scanner Roland Picza 3D Laser Scanner LPX-250, que captura a superfície externa de objetos com até 40 cm de altura e 23 cm de largura total e com resolução máxima de 0,20 mm. A resolução é escolhida de acordo com a complexidade da superfície do objeto. O tempo de captura e de edição da malha varia de acordo com a resolução escolhida, o tamanho da peça e outros parâmetros, como o método de captura, que pode ser por planos ou por rotação. O scanner gera uma série de superfícies que precisam ser unidas para obter um modelo virtual completo do objeto. Antes de unir as superfícies, elas são processadas para eliminar todos os ruídos existentes e para ajustar a triangulação, garantindo a boa qualidade da malha. Após a limpeza, as superfícies são fusionadas e quaisquer buracos remanescentes na malha são fechados virtualmente. Finalmente, o modelo pronto é exportado no formato STL (estereolitografia). Esse é o principal tipo de arquivo para Prototipagem Rápida (impressão tridimensional), que consiste num processo de manufatura aditiva em que o modelo virtual é "fatiado" virtualmente em camadas que são sequencialmente enviadas à impressora, aonde diversos materiais são depositados, camada a camada, para reproduzir o modelo fisicamente. Nesse processo foi utilizada a máquina Zprinter 310 Plus, que possui alto padrão de desempenho e alta definição de impressão em 3D (resolução de 300x450 dpi). Esse processo permite obter peças físicas com qualquer forma, complexidade e em dimensões reais de modo automático e rápido. Ao final do processo de impressão, para conferir resistência às peças, faz-se a infiltração por compostos como sulfato de magnésio e cianocrilato de baixa viscosidade, entre outros. A metodologia aqui apresentada possibilita uma maior velocidade na obtenção de réplicas se comparado aos processos tradicionais de moldagem e replicagem (que usam borracha de silicone e resinas diversas) e elimina problemas típicos desse método tradicional, como a presença de rebarbas de união e o alinhamento incorreto das partes das réplicas, bem como não sofre dos problemas de deformação e deterioração que ocorrem com os moldes de borracha de silicone quando não são corretamente acondicionados ou após período prolongado de armazenamento. Através das tecnologias descritas, novos caminhos podem ser explorados, ajudando diferentes disciplinas científicas como a paleontologia e a arqueologia a visualizar, analisar e reconstruir estruturas de forma rápida, eficiente e com alta qualidade.

THE DIVERSE CRETACEOUS NEOBATRACHIAN FAUNA OF SOUTH AMERICA: A NEW RECORD FROM THE MAASTRICHTIAN MARÍLIA FORMATION AT UBERABA, MINAS GERAIS, BRAZIL

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Neobatrachians, which are distributed worldwide and occupy a wide variety of environments today, constitute the most derived and diverse clade of extant anurans. Their oldest known records date back to the mid-Cretaceous of South America and document an early diversification by that time (Báez *et al.*, 2009). However, neobatrachian remains are still scarce throughout the rest of the Mesozoic, mainly consisting of isolated bones of Senonian age. The articulated materials from the Upper Cretaceous of Brazil, such as those from the Adamatina (Carvalho *et al.*, 2003) and Marília (Báez & Perí, 1989) formations, constitute outstanding exceptions. Herein we report on a new frog (Centro de Pesquisas Paleontologicas L.I. Price [CPP] 1115) from the latter stratigraphic unit at the well-known paleontological site "Ponto 1 do Price" near Peirópolis, Uberaba, Minas Gerais State, which has also yielded a diverse vertebrate assemblage (*e.g.*, Novas *et al.*, 2008). The age of these fossiliferous beds has been considered Maastrichtian based on microfossils (Dias-Brito *et al.*, 2001). The specimen CPP1115 consists of an articulated partial skeleton characterized by a broad, well-ossified skull without dermal ornamentation, eight procoelous presacrals, and posteriorly deflected, cylindrical sacral diapophyses; these features, together with the possible presence of a discrete palatine, are consistent with neobatrachian affinities. It clearly differs from the neobatrachian *Baurubatrachus* Báez and Perí 1989, also from the Marília Formation, in having a skull without exostosis and with a different temporal architecture, among other features. It also differs from the unnamed Campanian–Mastrichtian neobatrachian from the Adamatina Formation (Carvalho *et al.*, 2003) in the presence of paired frontoparietals with small supraorbital flanges in the mid-orbital region and maxilla-squamosal contact. The new material is not referable to any of the neobatrachian taxa of the Aptian–Albian Crato Formation (Báez *et al.*, 2009) owing to different cranial features (*e.g.*, position of the jaw articulation; relative width of the braincase; morphology of the frontoparietal). With respect to the extant neobatrachians in the context of recent phylogenetic hypotheses, the cylindrical sacral diapophyses of CPP1115 contrast with the dilated configuration of australobatrachian hyloids and microhyloid ranoids, whereas the procoelous presacral column is unlike the diplasiocoelous condition of most other ranoids. This evidence together with the combination of features of CPP1115 suggests a placement among nobleobatrachians, although this combination is not shared with any extant or extinct species for which the skeletal information is known. From the foregoing we conclude that CPP1115 might represent a new nobleobatrachian taxon, a record that reinforces the hypothesis of a diversified neobatrachian fauna in South America already in the Cretaceous (Báez *et al.*, 2009). Finantial support: ANCyPT PICT223/06 (Argentina); FAPEMIG, CNPq, UFTM (Brazil)

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DESCRIPTION OF A NEW ANHAGUERID SPECIMEN WITH COMMENTS ON THE VARIATION OF THE PREMAXILLARY CREST IN THIS GROUP

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The Anhangueridae is diagnosed by the presence of a sagittal crest on the front of the skull and jaw, distal expansions of the premaxilla and dentary and a combination of post-cranial features. They are represented by seven species, six of them with cranial remains. To that we add a new anhanguerid specimen (MPSC 1126cp). The cranium (preserved length 470mm and estimated 670mm) represent the second largest skull, after *Anhanguera spielbergi* Veldmeijer, 2003. It has a sub-triangular cross section with a long crest (260mm long; 35mm high). The crest starts on the second alveoli and ending at the beginning of the nasoantorbital fenestra, representing 40% the total length of skull. MPSC 1126cp shows 16 pairs of developed and prominent alveoli, a feature never observed before in the Anhangueridae. Only the 14th and 15th teeth are preserved. The low nasoantorbital fenestra is incomplete (at least 130mm length). It differs from all other anhanguerids on the position of the crest, following *Tropeognathus mesembrinus* Wellnhofer, 1987 on the more rostral location of this structure. When compared with other anhanguerids it has the second lowest crest. Regarding this structure, anhanguerids show low variations, ranging from 29 to 40% of the skull totality. Most of the differences among the species are related to the presence, sizes and shapes of sagittal crests, the number of teeth, and some proportions of the skull. As pointed out by Kellner and Tomida (2000) in the four species which composes the *Anhanguera*, the variations of the cranial crests could be regarded as minor, raising the question whether those features could be related to sexual dimorphism. Specimens show a broad variation on skull sizes, ranging from 465mm in *Anhanguera santanae* Wellnhofer, 1985 (specimen AMNH 22555) to 730mm in *A. spielbergi*. Also the crests present different extensions on the skull, ending at the beginning of the nasoantorbital fenestra in *Anhanguera blittersdorffi* Campos and Kellner, 1985; before the nasoantorbital fenestra in *A. spielbergi* whereas in *Anhanguera piscator* Kellner and Tomida, 2000 at the 13° teeth. The form can vary too, with *T. mesembrinus* having a keel like crest and *A. piscator* a low and elongated one, looking more like a small elevation. Since the number of teeth and the shape of the crest are different we can state that MPSC 1126cp does not belong to *Tropeognathus*, but this resembles the *Anhanguera*, and possibly could represent a new species. More data are needed to confirm or refuse that hypothesis.

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ANTE-MORTEM BONE ALTERATIONS IN PLEISTOCENE FOSSIL MAMMALS FROM THE NORTHEASTERN BRAZIL

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Anatomo-pathological studies on fossils of non-human vertebrates allow avoiding taxonomic and taphonomic mistakes in paleontological analyses (to differenciate anatomical features of pathological/taphonomic features) and can provide informations about: living conditions of animals, paleoenvironment, paleoecology and paleoepidemiology. However, *ante-mortem* bone observations on fossil mammals from the Upper Pleistocene from the Northeastern Brazil are still incipient. Recently, a new fossil vertebrate assemblage was discovered in a natural tank at the Jirau Paleontological Site, Itapipoca City, Ceará State, Brazil. The assemblage has fossils with *ante-mortem* bone alterations, which are identified in this work. About 20 taxa and 4150 bones were identified in the fossil association so far. Fossils are housed in the paleontological collection of the Museu de Pré-história de Itapipoca. The analyzed material consists in disarticulated and fragmented bones, however the fragmentation does not affect the recognition of the analyzed evidences. Within skeletal elements, were observed *ante-mortem* alterations in five phalanges, two tibiae, two vertebrae and one humerus, all belonging to *Eremotherium laurillardi* (Mammalia, Pilosa, Megatheriidae; Cartelle and Bohórquez, 1982). Other taxa registered in the assemblage do not show evidences of *ante-mortem* alterations. One of the vertebrae,

possibly of the lumbar portion, shows irregular bone growth on the pulpous nucleus. This growth presents a well-defined rounded depression on the around it. Dorsal edge of the vertebra (cranial view) shows signs of osteophytosis. Moreover, the vertebral centrum has asymmetrical form. The other vertebra shows a bone callus located in the dorsal portion of the vertebral centrum. In the tibiae, phalanges and humerus only signs of bone remodelation in the proximal ends was observed, which can be associated with trauma and microtrauma. Osteophytosis and bone remodelation can be related to signs of overload on the vertebrae and senility. This analysis is part of a series of taphonomic and paleopathological studies developed by authors on the Brazilian Pleistocene fossil vertebrates.

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NEW ISOLATED TEETH OF MANIDENS CONDORENSIS FROM THE CAÑADÓN ASFALTO FORMATION: EXPLORING NEW METHODS OF MORPHOLOGYCAL ANALYSIS

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The recently published ornithischian *Manidens condorensis* Pol *et al.* 2011 is one of the most complete records of the family Heterodontosauridae in southern landmasses. The holotype—a partial skeleton with most skull elements, lower jaws, precaudal vertebrae, the left scapula and coracoid, and almost complete pelvic girdles (Pol *et al.*, 2011) —as well as other specimens represented by isolated teeth were recovered from outcrops of the Cañadón Asfalto Formation at the Queso Rallado locality (Middle Jurassic, Chubut Province, Argentina). The aforementioned additional material includes ten isolated leaf-shaped tooth crowns, laterally compressed and mesiodistally asymmetrical. The presence of a mesial concavity for dental interlocking, enameloid crenulations, and denticles asymmetrically disposed allow us to assign these isolated dental material to *M. condorensis*. An hypothetical position for these teeth is proposed on the basis of comparison with the teeth in place on the jaw of the type specimen. In this context, the tooth row was divided in three regions (anterior, medial and posterior) and the isolated teeth were assigned to a specific region considering morphologycal features and proportions of the lingual face of the crown. In order to test our hypotheses on tooth position we included the dental data available in a morphometrical analysis. With this analysis we evaluate if the isolated crowns occupy the same region in the morphospace as the teeth in place on the dentary, following the positional characterization based on the morphological and proportional analysis. The results obtained are in accordance with the positional determinations made on a morphological basis. Finally, the validity of the proposed positional groups was verified by means of a discriminant analysis of canonical factors based on the morphometric information. The study of the isolated crowns assigned to *M. condorensis* allowed us to explore new working methodologies that have proved to be of good use when a limited amount of information is available, a case much frequent when studying fossil material. Moreover, in this particular case, this methodology made it possible to improve our knowledge on the morphology of some dental elements of approximately known position on the taxon under study as, unlike the type specimen of *Manidens*, the isolated teeth are completely free of matrix and better preserved.

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BODY MASS ESTIMATES OF FOSSIL UNGULATES OF ITABORAÍ BASIN, BRAZIL

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Paleoenvironment reconstruction is one of the major goals of Paleontology and the body size of an animal is one of the most important ecological factor, as it influences dietary preferences, predatory behavior and niche partitioning. Itaboraí mammals, with the exception of *Carodnia* Simpson, 1935, are known from isolated teeth and, in some cases, few postcranial bones. Available data on these mammals is almost exclusively morphological or taxonomical, and paleobiological information is wanting. In this study we present estimates of the body mass of all ungulate species of Itaboraí Basin (but *Asmithwoodwardia scotti* Paula-Couto, 1952), as part of a broad investigation on paleobiological requirements of Itaboraí mammals. Itaboraí Basin is a very small basin of Itaboraian age, located at Rio de Janeiro State, Brazil. It is filled with interbedded chemical and clastic limestone, vertically cut by fissure filled marl deposits, richly fossiliferous. Due to the lack of extant correspondents of Itaboraí ungulate orders, the estimation was based on previously proposed equations based on ungulates, rodents and carnivores. From many possible equations with coefficient of determination higher than 0.9 available in literature, 23 equations were employed to predict Itaboraí ungulates body mass. In this try we restricted to equations based on postcranium measurements (radius, humerus, femur and tibia), as limb bones are widely accepted as a good indicator of body mass due to their role in skeletal support (Millien and Bovy, 2010), but in the near future estimates based on dental measurements will be also undertaken and compared. The

normality of the mass estimations was tested and outliers removed. The results pointed out (from the largest to the smallest mammal, in kilograms), that the body mass of *Carodnia vierai* Paula-Couto, 1952 (Xenungulata) ranged from 130.77 to 750.07; of *Lamegoia conodonta* Paula-Couto, 1952 (Condylarthra) from 29.1 to 36.6; of *Victorlemoinea prototypica* Paula-Couto, 1952 (Condylarthra) from 13.05 to 33.94; of *Tetragonostylops apthomasi* (Price and Paula-Couto, 1950) (Astrapotheria) from 11.6 to 19.6; of *Paranisolambda prodromus* (Paula-Couto, 1952) (Litopterna), from 9.19 to 16.1; *Paulacoutoia protocenica* (Paula-Couto, 1952) (Condylarthra) ranged 4.7 to 9.37; *Colbertia magellanica* Price & Paula-Couto, 1950) (Notoungulata) from 4.25 to 7.07; *Othinielmarshia pristina* (Paula-Couto, 1978) (Notoungulata) from 1.61 to 1.98; of *Miguelsoria parayirunhor* (Paula-Couto, 1952) (Litopterna), from 1.18 to 2.3; of *Protolipterna ellipsodontoides* Cifelli, 1983 (Litopterna) from 0.34 to 1.43 and of *Itaboraitherium atavum* Paula-Couto, 1954 (Notoungulata) from 0.43 to 1.02. The body mass estimates agreed with the size of m2 of these species –species with bigger masses have larger tooth area – except for *O. pristina* and *M. parayrunhor*, and *P. ellipsodontoides* and *I. atavum*, but this reversal may be related to different sampling. The next step involves estimations of body mass from tooth measurements and comparison of both results to a more confident estimation of Itaboraí ungulates body mass.

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THE FIRST POSTCRANIAL BONES OF *NOTOSTYLOPS* SIMPSON, 1948, FROM CHUBUT, ARGENTINA (BARRANCAN)

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Notostylopidae has been considered a basal family of the order Notoungulata, for long time placed in the paraphyletic order Notioprogonia. Recently, *Notostylops* Ameghino, 1897 was considered the sister taxon of Pyrotheria, a group nested within Notoungulata (Billet, 2010). *Notostylops* is well-known by its cranial and dental morphology but none of its postcranium was known so far, with the exception of the astragali referred by Ameghino (1905) but not clearly associated. The material here described was discovered in 1982, in Valle Hermoso, Chubut, of Casamayoran (Barrancan) age, and is deposited at Museo de La Plata (MLP 82-V-1-8). It comprises a complete humerus and femur, an almost complete radius and calcaneum and a partially broken pelvis with some fused sacral vertebrae still partially recovered with matrix. The humerus resembles those of *Pleurostylodon* Ameghino, 1897 in the shallow radial fossa, absence of a supratrochlear foramen and projection of the deltopectoral crest. It is distinct from all other notoungulates by its well-projected, triangular and proximally displaced medial epicondyle, and by its large and proximodistally elongated capitulum, slightly projected below the level of the trochlear crest. The radius lacks the distal articular surface. The distal half is craniocaudally flat, as in *Pleurostylodon*. The proximal surface is partially broken, but the head seems to be oval and oblique, as in *Pleurostylodon*. The femur presents a suit of features that distinguish it from all other notoungulates. The greater trochanter is at the same level of the head and is well-developed. The fourth trochanter is projected as in all notoungulates, but long and straight. It begins at the distal level of the projected lesser trochanter. The patellar surface is long and triangular, as in *Pleurostylodon*. The calcaneum of *Notostylops* bears the general primitive morphology of Condylarthra, but the diameter of the sustentacular facet is anteroposteriorly longer than transversally, like in most notoungulates, although the sustentaculum is not thick as in Toxodontia. The astragalocalcaneal facets are located closer to the cuboid facet so the neck is short and the tuber is longer, as in isotemnids and toxodontids. The cuboid facet is partially broken, but it seems that the calcaneum bore a faint "beak". The sustentaculum is well-developed and less deep than in most notoungulates; the sustentacular facet extends onto the calcaneal neck. The pelvis is robust and craniocaudally long. It differs from that of Typotheria in the wider ilium and from Toxodontia in the weaker ischiatic tuberosity. This first *Notostylops* postcranium analysis revealed that it is closer to toxodontids than to typotheres, but bear a suit of features, mainly on humerus, distinguishing it from other notoungulates. The body mass of *Notostylops* was tentatively estimated from twelve allometric equations previously established on postcranial measurements. Equations based on humerus dimensions predicted a mass ranging from 18–55 kg; the femur predicted a mass ranging from 7 to 27kg.

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UN NUEVO TOXODÓNTIDO (NOTOUNGULATA, TOXODONTIDAE) DEL NEÓGENO DE LA PROVINCIA DE CATAMAR-

CA, ARGENTINA

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Los toxodóntidos, un grupo de ungulados nativos que incluye formas de mediano y gran tamaño, se hallan relativamente bien representados en sedimentos neógenos de América del Sur. Particularmente en el Mioceno tardío–Plioceno de Catamarca se reconocen al menos cuatro especies agrupadas en tres géneros: *Xotodon cristatus* Moreno y Mercerat, 1891, *Xotodon* cf. *X. foricurvatus* Ameghino, 1885, *Toxodontherium andinum* Kraglievich, 1931 y *Calchaquitherium mixtum* Nasif, Musalem y Cerdeño, 2000. En esta contribución se da a conocer un nuevo toxodóntido Toxodontinae procedente de la Formación Corral Quemado (Plioceno inferior), en sedimentos aflorantes en la localidad Corral Quemado (provincia de Catamarca). El nuevo toxodóntido, ejemplar MLP 77-V-20-1, consta de un cráneo parcialmente completo con gran parte de la dentición, fragmentos mandibulares con molares, y varios restos del postcráneo. El análisis comparativo, contemplando la variabilidad ontogenética, del MLP 77-V-20-1 en el contexto de los toxodóntidos del Mioceno–Plioceno, permite considerarlo como un nuevo taxón de esta familia. Éste se diferencia de *Xotodon* por presentar frontales aplanados, borde posterior del foramen preorbitario ubicado más anteriormente, borde inferior de la cavidad orbitaria más redondeado, menor altura de la cavidad orbitaria, paladar relativamente más ancho y aplanado, canino desplazado labialmente, premolares más cóncavos labialmente, P4 con plegamiento del esmalte lingual apenas insinuado y por el tipo de imbricación de los molares. El nuevo toxodóntido se diferencia de *Xotodon* y *Calchaquitherium* por el menor tamaño relativo de los molares inferiores y el menor desarrollo relativo del talónido. Se realizó un análisis cladístico preliminar, utilizando las caracteres de Nasif *et al.* (2000), en el que se codificaron un total de 59 caracteres cráneo mandibulares y dentarios para 25 taxones Uno de los resultados de este análisis es la obtención de un clado integrado por *Xotodon* y el nuevo ejemplar, sustentado por las siguientes sinapomorfías: 1) I1 de sección arriñonada, con un surco medio lingual, 2) esmalte lingual del M3 completo y 3) pliegue anterior (paracónido-metacónido) de los m1-2 bien desarrollado. Un análisis más exhaustivo, incluyendo mayor número de caracteres que los utilizados en este análisis, así como también mayor número de taxones, permitirá corroborar la hipótesis filogenética propuesta.

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DICYNODONTS FROM BRAZIL: IMPORTANCE OF TAXA TO PALEOBIOLOGY STUDIES AND BIOSTRATIGRAPHY

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Dicynodonts were the dominant herbivores of terrestrial ecosystems of the Permo-Triassic period. Until now, Brazilian dicynodonts are recorded in the Paraná Basin, at the Rio do Rasto Formation (Upper Permian) of Paraná and Rio Grande do Sul states, and also at the Santa Maria 1 and 2 Sequences (Middle/Upper Triassic) of Rio Grande do Sul. Permian forms comprise two specimens, one assigned to the genus *Endothiodon* Owen, 1876, and the other an unclassified small-bodied form. Both specimens are currently under study. The presence of *Endothiodon* reinforces correlation among the Serra do Cadeado and some of the Karoo Assemblage Zones faunas (i.e. *Pristerognathus*, *Tropidostoma* and *Cistecephalus* Assemblage Zones; Rubidge, 1995). Middle Triassic dicynodonts comprise *Dinodontosaurus* Romer, 1943, *Stahleckeria* Huene, 1935, and the Late Triassic *Jachaleria* Bonaparte, 1970. *Dinodontosaurus* are the most abundant and complete dicynodont material found in Brazil, which allowed for detailed morphological studies, ontogenetic analysis and biomechanical studies on the posture of these vertebrates (Morato, 2006). *Stahleckeria* comprises adult and juvenile individuals (Vega-Dias *et al.*, 2005), with some of the latter presenting osseous pathologies (Vega-Dias, 2005). *Jachaleria* is the younger South American dicynodont and coexisted with the first dinosaurs at the end of the Triassic. Scavengers or predator marks were described in a scapula of this genus, indicating that a carnivorous archosaur fed on it (Vega-Dias and Schultz, 2007) whereas an osseous pathology was reported on another scapula (Vega-Dias and Schultz, 2003). *Dinodontosaurus* and *Jachaleria* are found also in Argentina, at Los Chañares Formation (Middle Triassic), and *Jachaleria* at Los Colorados Formation (Upper Triassic). *Stahleckeria* might represent an endemic taxon, since it was only reported on Middle Triassic of South Brazil. The relatively abundant register of dicynodonts in Brazil allows paleobiologic and stratigraphic studies, that justify the importance of the continuous studies on these basins.

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FURTHER DATA ON THE PRESENCE OF ENDOTHIODON OWEN, 1876 (THERAPSIDA, DICYNODONTIA) IN BRAZIL

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Dicynodonts are a group of herbivore therapsids that flourished worldwide during the Permian and Triassic periods. Permian dicynodonts are especially represented in South Africa and Russia. The first record of a Permian dicynodont in South America comes from the Upper Permian rocks of Serra do Cadeado (Rio do Rasto Formation, Paraná Basin, Brazil) and is represented by a highly compressed skull lacking the occiput region, with the associated lower jaw. This material was first reported by Barberena and Araújo (1975), who assigned it to *Endothiodon* Owen, 1876, previously known from the African continent, and more recently described in India as well. However, these authors did not provide a formal description of the Brazilian specimen. Recent detailed reanalysis of this material and comparison of it with *Endothiodon* specimens housed at the American Museum of Natural History confirmed the preliminary identification of Barberena and Araújo. The specimen from Brazil shows the following characters: distinct boss on the ventral margin of the jugal (Modesto *et al.*, 2002); pineal foramen situated on a boss (Ray, 2000); prominent bulbous swelling on the anterolateral side of the dentary (Ray, 2000); teeth on the mid-dorsal surface of the dentary, arranged in replacement waves (Ray, 2000; Latimer *et al.*, 1995); deep longitudinal groove occurring lateral to the tooth row in the lower jaw (Ray, 2000; Cluver and King, 1983). This set of characters corroborates the occurrence of *Endothiodon* in Brazil, but is not enough to establish a specific taxonomic assignment to it.

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THE CINGULATA (MAMMALIA, XENARTHRA) OF THE FRAY BENTOS FORMATION (LATE OLIGOCENE) OF URUGUAY

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Late Oligocene South American fossil faunas from middle latitudes are extremely scarce. In Uruguay, this temporal interval is represented by the Fray Bentos Formation, with two well-known fossiliferous localities: the Nueva Palmira area, and the Santa Lucia river basin. Local facies include sub-aerial and fluvial deposits, with diverse well formed paleosols, and calcretes (Tófalo and Morrás, 2009). The fossil mammal assemblages collected from these deposits suggest correlation with the late Oligocene Deseadan SALMA of Patagonia (Ubilla *et al.,* 2004). Since Kraglievich´s (1928) first report of a fossil cingulate on his "*Piso Palmirense*", only a handful subsequent studies have referred to the specimens collected in the Nueva Palmira and the Santa Lucia River localities. In this communication we present an updated review of the history and taxonomy of all known remains of Paleogene cingulates collected in Uruguay. Glyptodonts are represented at the Santa Lucia river basin by three isolated osteoderms assignable to the Glyptatelinae, cf. *Glyptatelus* (Ameghino, 1897). Of special interest is the mobile osteoderm, previously referred by Perea (1993) to a eutatine armadillo. At the Barrancas de Nueva Palmira, a set of ten "rosette"-patterned osteoderms, in which a sub-circular central figure is surrounded by numerous small peripheral ones, can be assigned to the Glyptodontidae incertae sedis. Three postcranial remains were associated with these osteoderms. The armadillos are represented by two different genera of Euphractinae Euphractinii. The first one is a large-bodied form, probably representing a new genus and species, and closely allied to the Miocene genus *Vetelia*, Ameghino, 1891. The isolated osteoderms belonging to this taxon represents the most abundant cingulate remains of the Uruguayan Paleogene. Different sets of osteoderms have been collected from five localities around the Nueva Palmira basin, and a small specimen (hesitantly referred to this taxon) also comes from the Santa Lucia River. Typically, the osteoderms are rectangular and thick, with a smooth, punctuated, external surface. The sculptures include an "anchor shape" central figure that does not extend to the posterior margin,

surrounded antero-laterally by trapezoidal figures. The peculiar piliferous system consists of two large, circular foramina, located in the posterior border, coupled with numerous small foramina along the lateral and posterior margins of the osteoderms. The second armadillo genus is known from small, associated osteoderms; these remains appear more derived than the typical Deseadan species known from Patagonia. Finally, a set of fragmentary remains of a small cingulate from the Santa Lucia River is tentatively referred to the Peltephilidae incertae sedis. Comparisons with other late Oligocene faunas from Bolivia and Argentina are briefly discussed.

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FIRST RECORD OF *DIABOLOTHERIUM* CF. *NORDESKIOLDI,* KRAGLIEVICH 1926, (MAMMALIA, TARDIGRADA, MEGALONYCHIDAE), FROM THE LATE PLEISTOCENE OF CHILE

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Althoug Chile is a country with an abundant Cenozoic fossil record, there remains a surprisingly imperfect knowledge of its Quaternary fossil faunas. Only in Patagonia (Aysén and Magallanes regions) is the country's late Pleistocene mammal diversity well documented. In the present communication we add to this known diversity, presenting the first Chilean record of the enigmatic genus *Diabolotherium* Pujos *et al.,* 2007; a small to medium size ground sloth, extremely rare in the fossil record. The remains come from Unit 4b, level 6b of the Baño Nuevo-1 site, located 80 km to the northeast of the city of Coyhaique. The 4 m. wide cave is filled by sediments 2 m. deep, with six defined layers (Mena *et al.*, 2003). The two bottom layers (4 and 5) are characterized by a rich assemblage of extinct Pleistocene fauna and ground sloth fecal remains, ranging in age from 9.000 to 13.500 BP. (López, 2009). FACSO-BN-1/Unidad 4B/Capa 4B/Nº2 is a mandibular fragment that includes the left horizontal ramus and complete dental series, as well as the symphysial region. In lateral view, the symphysis appears robust, elongated and has a conspicuous mental foramen at the external border. The dental series consists of four molariforms, with the m1 and m2 bearing trapezoidal sections, and the m3 and m4 bearing sub-rectangular and sub-circular sections respectively. Lateral longitudinal grooves are marked in m1 to m3, while in m4 they are only observed labially. FACSO-BN-1/Unidad 6B/Capa 4B/Nº1 probably corresponds to a second manual phalanx of the digit IV. We also assigned to *Diabolotherium cf. nordenskioldi* a small molariform of a juvenile specimen (SGOPV 313), housed in the Museo Nacional de Historia Natural in Santiago. The tooth was collected in Pleistocene deposits of the Pampa del Tamarugal (Casamiquela, 1999). *Diabolotherium* was erected to reunite remains discovered in Peru since the beginning of the XX century at both, coastal and Andean localities. The paratype of *D. nordenskioldi* (right dentary, NRM-PZM 4287), is essentially identical, in terms of the alveolar shape and symphyseal region, to the Chilean material. In addition, several specimens of *Diabolotherium* recently recovered from a cave in the central Peruvian Andes (Shockey *et al.*, 2009), allowed us to verify dental characteristics and also to determine intraspecific and ontogenetic variation of the dentary. This new record follows a recent report of remains from Chubut, Argentina (Pardiñas *et al.,* 2008), confirming the Patagonian occurrence of this peculiar representative of the late Pleistocene–early Holocene fossil fauna. This research was partly financed by FONDECYT Project 1090027.

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THE DEVELOPMENTAL ORIGIN OF THE AVIAN RETROVERTED HALLUX AND THE ROLE OF EMBRYONIC MUSCULAR ACTIVITY

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A major modification in the evolution of the avian foot is the acquisition of an opposable hallux. The posterior orientation of the hallux made it possible for birds to perch, and understanding its evolution is central for the debate between cursorial or arboreal origins of birds (Padian and Chiappe 1998). Modern birds have different grades of hallux retroversion, ranging from moderately opposable, as observed in Pelicaniformes Sharpe, 1891, to fully retroverted, as observed in Galliformes Temminck 1820. The variation in orientation of the hallux in extant birds is a consequence of two factors: (*1*) the variation in the position of the articulation from the medial to the posterior face of metatarsal II and (*2*) the grade of torsion of metatarsal I upon its longitudinal axis (Middleton, 2001). The evolutionary origin of the retroverted hallux was clarified by the report of 10th fossil specimen of *Archaeopteryx litographica* von Meyer 1861 (Mayr *et al.*, 2005; Mayr *et al.*, 2007). In this specimen both feet were preserved articulated and show that the digit I was not retroverted as in extant birds. The metatarsal I articulates its medial surface to the medial surface of metatarsal II and the shaft of metatarsal I was straight. Therefore an opposable hallux evolved in Aves Linnaeus 1978 more derivate than *Archaeopteryx* von Meyer, as observed in *Confuciusornis* Hou, Zhou, Gu and Zhang, 1995. Using chicken embryos; we investigated how a modern bird develops its opposable hallux. In the chicken the opposable orientation of digit I is acquired after embryonic day 9. Firstly, the articulation changes from the medial face (day 8) to the posterior face (days 9 and 10) of metatarsal II. At day 10 all metatarsals except metatarsal I have their shafts completely ossified. At embryonic day 11 the cartilage of metatarsal I begins to hypertrophy, originating just one epiphysis (distal) at day 12. The torsion occurs upon the cartilaginous distal epiphysis between embryonic days 12 and 15. At embryonic day 16 the epiphysis is eventually ossified. As chicken embryos start to move their toes at embryonic day 9, we investigate if the muscular activity causes the torsion of metatarsal I. The muscles that control the movement of the digits differentiate between embryonic days 8 and 10. Embryos paralyzed at day 8 with decamethonium bromide have the medial face of metatarsal I articulated to the medial surface of metatarsal II and a straight shaft at day 14. We propose that the origin of a "perching toe" in the avian lineage is related to the delayed ossification of metatarsal I and the lost of its proximal epiphysis. That would have allowed forces generated by the muscular activity to produce the torsion observed in the derivate avian hallux.

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ENAMEL MICROSTRUCTURAL DEFECTS AND ENAMEL HYPOPLASIA IN *TOXODON* (MAMMALIA, NOTOUNGULATA) FROM RIO GRANDE DO SUL PLEISTOCENE, BRAZIL

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The Paleopathology describes and interprets the diseases in populations already extinct, among them the indicators of stress such as enamel hypoplasia (EH), characterized by focal reductions of enamel thickness on the surface of the tooth crown, in the form of pits, grooves or complete absence of enamel over a considerable area of dentine (F.D.I. Commission on Oral Health Research and Epidemiology, 1982). These defects result from disruption of ameloblast activity during the process of enamel formation due to systemic physiological stress, being widely used in Human Paleopathology and of non-humans vertebrates as indicative of environmental and/or nutritional stress (*e.g.* Goodman and Rose, 1990; Franz-Odendaal *et al.*, 2004). Furthermore, based on the histology of tooth enamel, it is possible relate microstructural changes in this tissue to the impact of various stress factors on the secretory ameloblasts. *Toxodon* Owen, 1837 has often EH, and it presents on various forms, such as continuous lines or series of pits where the enamel is much thinner. These defects are alternated with areas of normal enamel, where there may be one, two or more forms on the same tooth (Ferigolo, 1987a, 1987b, 2007). In this study we observed 327 upper and lower teeth belonging to the Museu de Ciências Naturais of the Fundação Zoobotânica do Rio Grande do Sul and to the Museu da Universidade Federal de Rio Grande paleontological collections; including incisors, premolars and molars, from Pleistocene deposits along of Coastal Plain of Rio Grande do Sul State. The classification of six types of EH observed was performed by direct macroscopic examination and under a stereomicroscope. In the upper teeth predominated mild grooves on the buccal surface, defects less significant than those observed in the lower teeth. In the lower incisors were observed deep grooves on the buccal surface in mesiodistal rows of pits, showing cyclical

changes probably due to accelerated growth of the euhypsodont teeth. In the lower premolars and molars were observed the most important ones, as series of vertical and mesiodistal rows of pits, as well as randomly distributed pits. For comparative study with the macroscopic results obtained, eight specimens were analyzed by scanning electron microscopy, and under optical microscopy, which showed the occurrence of microstructural changes in the enamel associated to macroscopic enamel defects. The enamel underlying the bottom and the vicinity of hipoplastic defects was aprismatic, lacking a prism/interprism pattern, as well as prominent pathologic striae (Wilson bands) associated. Because there are signs of EH in all types of teeth, with relatively high frequencies in some, this pathological condition indicate that probably toxodonts had been exposed to severe stress conditions, or, much probably were due to a rapid growing of teeth, which were easily abraded.

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A PROBABLE POLYCHROTINAE* (SQUAMATA: IGUANIA) LIZARD REMAIN FROM THE MID–UPPER PLIOCENE OF THE ATLANTIC COAST OF ARGENTINA

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At the moment, the Cenozoic record of Iguania from Argentina is limited to the Neogene. The earliest record is from the early Miocene of Patagonia where both subfamilies currently living in Argentina, the Tropidurinae* Shulte, Valladares and Larson 2003 and Polychrotinae* Shulte, Valladares and Larson 2003, are represented with Liolaemus Wiegmann 1834 and Pristidactylus Fitzinger 1843 respectively (Albino, 2008). From the early–middle Miocene of Patagonia, Ameghino (1899) described the extinct genus Erichosaurus whose relationships with other Iguania are still unclear. Iguanians have been recovered from Pliocene sediments of South America only recently. García López *et al.* (2010) cited an iguanian with Tropidurinae* affinities from the Uquia Formation (upper Pliocene) of Jujuy province (Argentina). Also, an almost complete fossil frontal of an iguanian has been recovered from the Chapadmalal "Formation" (*Paraglyptodon chapadmalensis* Biozone, mid–upper Pliocene, Cione and Tonni, 2005) outcropping at the coastal cliffs of San Eduardo del Mar (10km North of Miramar, Buenos Aires province). This specimen (MMP 5142) shows an important intraorbital constriction, supraorbital flanges, low ventral crests (i.e. no developed descending process), a large pineal foramen at the frontoparietal suture, and dorsal ornamentation. These characteristics indicate Polychrotinae* affinities (Cei, 1993; Smith, 2009). Polychrotinae* are currently absent in Atlantic coastal areas of Buenos Aires province, although Anisolepis undulatus Wiegmann 1834 has been cited in Punta Lara while Pristidactylus casuhatiensis Gallardo 1968 is endemic of the Ventania mountain system (Cei, 1993). If the subfamiliar affinities here suggested are correct, the subfamily previously recognized in the Miocene is now recovered in the Pliocene. This very limited and scattered record is the only known data of an iguanian Pliocene presence in South America.

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A WELL PRESERVED SKULL OF PROTYPOTHERIUM CF. AUSTRALE AMEGHINO 1887, (MAMMALIA, NOTOUNGULATA, INTERATHERIIDAE), FROM THE EARLY MIOCENE OF CHILE

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The genus *Protypotherium* Ameghino, 1885, includes a dozen Mio–Pliocene species whose earliest well-characterized species are from Santacrucian faunas of Patagonia Argentina (Sinclair, 1909; Tauber, 1996). In Chile, the possible occurrence of the genus has been mentioned briefly, for various early Miocene deposits. In this contribution we describe a magnificent new specimen of *Protypotherium* collected 20 years ago, currently deposited in the Museo Nacional de Historia Natural in Santiago. SGOPV 21.000 includes a partially complete skull of an adult animal exhumed in the vicinity of the Bio Bío River, in fluvial sediments of the Cura-Mallín Formation, Lonquimay sub basin. K-Ar ages coupled with a small vertebrate fauna permit a tentative "Pinturan" – Santacrucian age to be proposed for the base of these deposits. The skull is remarkable for its robustness and great size, close to the largest known specimens of *Protypotherium*. The braincase is shifted ventrally due to some fracturing and plastic deformation. The jugals are not preserved, and the basioccipital region along with the condyles has been eroded, exposing the internal cavity. The rostrum appears short, with a high maxilla and wide nasals. The palate is concave and elongated due to the development of the incisors. The dental series is completely preserved but some of the incisors, canines and premolars are partially damaged. The subcircular I1 shows no hypertrophy and is similar in size to the I2 and I3. The canines, premolars and molars exhibit marked imbrication, sharp edges, and well defined external sulci. In the molars, a shallow lingual groove separates the protocone from the hypocone without forming a middle lobe. The M3 does not exhibit a posteriorly projected metastyle. Currently, two (three?) species of *Protypotherium* are recognized for the early to middle Miocene (Tauber, 1996; Krapovickas, 2009): *Protypotherium australe* Ameghino 1887 and *P. attenuatum* Ameghino 1887b (including *P. praerutilum*). Our review of most of the holotypes corroborates the distinction of these two morphs, plus some other species of uncertain characterization. From this we conclude that: 1) the specific taxonomy of the genus *Protypotherium* should be reviewed given the complex situation of the type material on which the genus was founded; 2) *Protypotherium minor* Bordas (1939) of Colhuehuapian age may not be congeneric with other species of *Protypotherium* and; 3) unlike typical Santacrucian forms, SGOPV 21.000 presents a mixed set of characters shared with both *P. australe* (large size, molar and premolar proportions, marked imbrication, and a well-developed canine) and *P. attenuatum* (short rostrum, incisors implanted in an open series with small mesiodistal diameter and more uniform size between them). Various hypotheses may account for the observed morphological diversity including specific differentiation (traditional hypothesis) and/or intraspecific variation (sexual dimorphism or phenotypic plasticity in a single polymorphic taxa).

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UN ARQUEOCETO (CETACEA: ARCHAEOCETI) DEL EOCENO TEMPRANO TARDÍO DE ISLA MARAMBIO (FORMACIÓN LA MESETA), ANTÁRTIDA

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Los Archaeoceti son cetáceos extintos basales, probablemente parafiléticos, del cual derivan los Neoceti o cetáceos modernos. Su registro fósil, que

abarca desde el Eoceno temprano al Eoceno tardío, está bien documentado en varias localidades del Hemisferio Norte (*e.g.* Kellog, 1936; Thewissen, 1998). En cambio en el Hemisferio Sur, los registros son escasos y basados en material postcraneano que no es posible determinarlo a niveles específicos (*e.g.* Borsuk-Bialynicka, 1988; Fordyce, 1989; Fostowicz-Frelik, 2003; Marocco y De Muizon, 1988), con excepción de la presencia del basilosaurido dorudontino *Zyghoriza* True 1908 en el Eoceno medio–tardío de Nueva Zelanda (Köhler y Fordyce, 1997) y en el Eoceno tardío de la Península Antártica (Cozzuol, 1988). Recientes trabajos paleontológicos en isla Marambio (=Seymour), Península Antártica, resultaron en el hallazgo de un fragmento mandibular con un diente asociado correspondiente a un arqueoceto. Los restos fueron colectados en los niveles inferiores del Alomiembro *Cucullaea* I (Ypresiano, 49.5 Ma) de la Formación La Meseta. El fragmento mandibular corresponde a los 2/3 anteriores de la rama mandibular izquierda, faltando gran parte la región coronoidea. La cara labial es convexa, a diferencia de la cara lingual que es plana a nivel de la sínfisis mandibular y convexa posteriormente al PM_2. En la superficie dorsal presenta 4 alveolos completos correspondientes al C, PM_1, PM_2 y PM_3. Únicamente la raíz anterior y la corona y raíz posterior del PM_2 se preservaron in situ. El PM_2 está lateralmente comprimido y presenta tres cúspides accesorias completas con facetas de desgaste bien desarrolladas. La cúspide principal, al igual que la tercera cúspide accesoria, están rotas en la base. El esmalte de la corona carece de estriaciones y ornamentaciones, pero presenta un cíngulo que rodea la base de la tercera y cuarta cúspide en la cara lingual y labial. La presencia de dientes molariformes comprimidos lateralmente con cúspides accesorias en la corona, permite la asignación inequívoca del espécimen a la familia Basilosauridae Cope, 1868. Asimismo, el tamaño del PM_2 y del fragmento mandibular es similar al descripto para el basilosaurido dorudontino *Zyghoriza* True 1908 y notablemente menor al de los basilosauridos basilosaurinos. Estos caracteres permiten asignar preliminarmente a los Dorudontinae (Miller, 1923) el nuevo material, confirmando la presencia de estos arqueocetos en aguas antárticas durante el Eoceno temprano tardío e incrementando el conocimiento de la distribución de los basilosauridos en el Hemisferio Sur.

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NUEVOS REGISTROS DE DINOSAURIA EN LA FORMACIÓN ALLEN, (CRETACICO SUPERIOR) EN EL ÁREA NATURAL PROTEGIDA PASO CÓRDOBA. GENERAL ROCA, RÍO NEGRO

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La localidad de Paso Córdoba, en la provincia de Río Negro, ha sido trabajada desde el punto de vista paleontológico desde principios del 1900. El Grupo Neuquén ha sido reconocido por las Formaciones Bajo de la Carpa y Anacleto (Campaniano Inferior). La primera ha dado restos Cretácicos correspondientes al cocodrilo *Notosuchus terrestris* Woodward 1896, la serpiente *Dinilysia patagonica* Woodward 1901, y otros restos de vertebrados. La Formación Allen, del Grupo Malargüe (Campaniano Superior) al que Wichmann (1927) definió como *Senoniano Lacustre,* ha dado el saurópodo *Antarctosaurus wichmanianus* Huene 1929, restos de placas de tortugas, cocodrilos y dientes de peces pulmonados, además de impresiones de vegetales indeterminados, valvas de moluscos de agua dulce *Córbicula* (Hugo y Leanza, 2001). En el área fosilífera, una de las geoformas mas sobresalientes son las areniscas del Peñón, que sobresalen del paisaje circundante aquí reconocidas como Formación Allen. En la base del Peñón aflora el tope de la Formación Anacleto con material pelítico depositado en un ambiente fluvial de bajo gradiente, y por ende de energía débil a moderada. El contacto con la Formación Allen está representado por una biozona constituida por una arenisca gris blanquecina donde se hallaron *Neocorbicula, Lioplacodes*, placas de tortugas, y placas de *Ceratodus*. A unos 5 metros del contacto, la Formacion Allen presenta niveles con registro de huellas de dinosaurios Hadrosauridae de pequeño tamaño, con talón redondeado, dedos cortos y romos, y patas mas anchas que largas; Sauropoda Titanosauridae de mediano porte por la presencia de impresión de manos semilunares y patas traseras redondeadas; y aves de tamaño reducido. Mientras que en niveles superiores se hallaron restos de dinosaurios terópodos, saurópodos y cocodrilos. En suma, la estratigrafía de la zona de Paso Córdoba muestra un contacto transicional entre los afloramientos pelíticos de la formación Anacleto y las areniscas fluviales de la Formación Allen, ésta última portadora de huellas y restos de dinosaurios, huellas de aves y numerosos invertebrados. Se demuestra además un ambiente continental para ambas secuencias estudiadas, infiriendo para el Miembro Inferior de Allen un ambiente próximo al nivel de base.

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HALLAZGO DE HUELLAS DE ORNITÓPODO EN LA FORMACIÓN PICÚN LEUFÚ, TITHONIANO – BERRIASIANO DE LA CUENCA NEUQUINA

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Los ornitópodos basales en Patagonia están representados por *Notohypsilophodon comodorensis* (Martínez 1998), *Gasparinisaura cincosaltensis* (Coria y Salgado, 1996), *Anabisetia saldiviai* (Coria y Calvo, 2002), *Talenkahuen santacrucensis* (Novas *et al.,* 2004) y *Macrogryphosaurus gondwanicus* (Calvo, et al, 2007). Sin embargo, huellas asignadas a este grupo en Patagonia solo han sido reconocidas en rocas del Albiano–Cenomaniano de la Formación Candeleros (Grupo Neuquén): *Limayichnus major* (Calvo, 1991) y *Sousaichnium moneate* (Calvo, 1991). Aquí, damos a conocer nuevas huellas de ornitópodos del límite Jurásico–Cretácico de la Formación Picún Leufú (Grupo Mendoza), Tithoniano–Berriasiano. Las huellas están a unos 8 km al oeste de la localidad Puente Picún Leufú. Dicha unidad se desarrolla en el sector meridional de la Cuenca Neuquina, lindante a la Dorsal de Huincul. Se compone en su localidad tipo de aproximadamente 350 m de margas, calizas coquinoides, limolitas y arcillitas; mostrando de base a techo un pasaje litológico gradual desde un dominio carbonático a uno netamente clástico. Paleoambientalmente, los depósitos de esta unidad corresponden a sedimentitas tidales y de plataforma carbonática interna de baja energía, con desarrollo de *patch reefs*. El nivel portador de las huellas corresponde a depósitos margosos desarrollados en áreas intermareales. La pista, compuesta por 5 huellas, corresponde a un ornitópodo de pequeño tamaño con un huellas de 20 a 23 cm de largo y 20 cm de ancho, la impresión de los dedos son anchos, cortos y con el borde anterior redondeado, el ángulo interdigital oscila entre 30 y 35. El paso oblicuo varía entre 70 y 88 cm y el paso doble de 170 cm. El ángulo de paso es 144 grados. En base a la morfología de las huellas y características de la pista; las icnitas de la Formación Picún Leufú se asignan a un dinosaurio ornitópodo, sería el registro más antiguo de este tipo de huellas en Argentina.

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TOOTH MORPHOLOGY OF ECHIMYIDAE (RODENTIA, CAVIOMORPHA): HOMOLOGY ASSESSMENTS, FOSSILS AND EVOLUTION

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Echimyidae constitute the most important radiation of caviomorphs in the Neotropical region, represented by 20 extant genera and several extinct taxa, many of them known nearly exclusively by dental remains. Although profuse information on molar morphology and systematics of the Echimyidae is available, dental evolution of the family is yet poorly understood, because of the controversial identification of the homologies of the crown structures among different echimyid groups, and outside these rodents into a caviomorph higher-level phylogenetic framework. In this work we inspect crown structures of extinct and living echimyids and evaluate alternative primary homology hypotheses for echimyid crown structures of deciduous teeth and lower molars, comparing them particularly with those of the erethizontids. We explore the testing of alternative primary hypotheses of lophid correspondences of Echimyidae in a phylogenetic context. Following a "dynamic" approach, we choose the "best" primary homology hypothesis and evaluate the evolutionary transformations of the characters analyzed. Obtained results point out that pentalophodonty is primitive condition for the dp4, and the derived condition for the lower molars in Echimyidae, trilophodonty in lower molars evolved independently at least three times during the evolutionary history of these rodents, and the tetralophodonty represents the plesiomorphic condition. The phylogenetic analysis of extinct and extant echimyids here evaluated produced results which were concordant with traditional proposals and early times of divergence of extant genera proposed by molecular data.

IDENTIFICAÇÃO DOS FÓSSEIS DE PEQUENOS CARNÍVOROS DO MUSEU DE HISTÓRIA NATURAL E JARDIM BOTÂNICO DA UNIVERSIDADE FEDERAL DE MINAS GERAIS (UFMG)

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Os carnívoros chegaram à América do Sul durante um evento conhecido como Grande Intercâmbio Biótico Americano (GIBA), que iniciou-se no final do Plioceno (~3,5Ma) (Woodburne, 2010). Assim sendo, os fósseis deste grupo encontrados neste continente, são relativamente recentes, normalmente datando do Quartenário. Este trabalho visa a identificação dos fósseis de carnívoros de pequeno porte do Museu de História Natural da UFMG. O material estudado conta de cinco hemimandíbulas; um crânio; alguns fragmentos de mandíbulas e dentes. Até o momento foi possível identificar três espécies, duas pertencentes à família Canidae e uma da família Felidae. Os demais espécimes, por estarem muito fragmentados ou mau conservados ainda estão com sua identificação pendente. Família Canidae: *Speothos venaticus* (Lund, 1839) e *Cerdocyon thous* (Smith, 1839). *S. venaticus* é um dos mais raros e pouco conhecidos canídeos sul-americanos e fósseis desta espécie foram encontrados em cavernas em Lagoa Santa/MG (Langguth, 1972). *C. thous*, por sua vez, é o canídeo mais abundante do Brasil e fósseis desta espécie já foram encontrados em Lagoa Santa/MG, estado da Bahia (Lessa *et al.,* 1998) e no Piauí (Guérin, 1993). Família Felidae: *Leopardus pardalis* (Linné, 1758). Felino de médio porte, ocorre atualmente desde o norte dos Estados Unidos até a Argentina. No Brasil, são descritos fósseis para esta espécie proveniente de Lagoa Santa/MG (Berta and Marshall, 1978) e Bahia (Lessa *et al*., 1998). Estes resultados são preliminares, uma vez que o trabalho continua em andamento e com sua finalização, espera-se acrescentar dados dos registros fósseis de carnívoros de pequeno porte para o estado de Minas Gerais.

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ORIGIN OF NORTH AMERICAN GLYPTODONTS: *GLYPTOTHERIUM TEXANUM* FROM MEXICO AND THE UNITED STATES (PLIOCENE EPOCH)

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Recent discoveries in Mexico have refined the timing of the Great American Biotic Interchange and indicate the first wave of immigrants began near the transition of Late Hemphillian (4.8–4.7 my) to Early Blancan (4.7–3.3 my) North American Land Mammal Ages (NALMA). Fossil evidence from Rancho El Ocote, San Miguel Allende Graben in Guanajuato, proves the existence of the first immigrant *Glossotherium* Owen, 1840 in sediments of the latest Late Hemphillian and the first record of *Plaina* Castellanos 1937 from sediments approximately 4.7 my. Discoveries of glyptodonts in Early Blancan sediments (3.9 my) include isolated scutes from the dorsal region and partial carapace of a juvenile. Carapacial scutes are arranged in transverse rows, and have large central figure and a single row of peripheral figures delimited by a shallow sulcus. The sulci that separate peripheral figures are contiguous with sulci of adjoining scutes. Interior scutes have flat, central figures no smaller than fifty percent the diameter of the scute. Marginal scutes are rectangular with weak boss. Another specimen collected from slightly higher stratigraphic position has the same characters in the scutes. In this specimen isolated teeth have several longitudinal lines on the posterior surface of each prism. External cementum surfaces of the prisms have fine, regularly spaced, transverse furrows that appear to be growth lines with approximately 16 per centimeter that are slightly oblique with respect to the occlusal surface. Both specimens are associated with *Nannipus peninsulatus* Cope 1885, an index fossil of Early Blancan NALMA. The new finds from Mexico compare favorably with the glyptodonts of the 111 Ranch fauna in southeastern Arizona (Late Blancan, 2.5 my), previously recognized as the earliest glyptodonts in North America. The carapaces of the glyptodonts from these two areas are similar with respect to hexagonal dorsal scutes with large central figures. The 111 Ranch specimens differ from the Mexican specimens with respect to the surface of the central figures, which are flat in the Mexican specimens, but in the 111 Ranch specimens range from slightly concave, concave with central depression, to strongly convex, and the lateral marginal scutes are enlarged and strongly convex. In the same fauna some individual carapaces have strongly enlarged bosses on the caudal aperture, but in others the same scutes are flat and concave, suggesting sexual dimorphism. The 111 Ranch fauna includes a juvenile with incomplete carapace and fragmentary teeth, which possess growth lines with variable depth. Scutes are similar to those of adult *G. texanum* Osborn 1903. Another specimen from the Early Invingtonian of Guanajuato is a young juvenile. Carapacial scutes of both juvenile specimens resemble those of adults but differ in proportion of the central and peripheral figures. There are no significant differences between *G. texanum* and *G. arizonae* Gidley 1926. *G. texanum* Osborn

1903 has priority. *Glyptotherium texanum* Osborn has a stratigraphic range of Early Blancan (3.9 my) to Early Irvingtonian (1.4 my) NALMA.

PRESENCIA DEL GÉNERO *XIPHACTINUS* LEIDY, 1870 (TELEOSTEI: ICHTHYODECTIFORMES) EN LA FORMACION LA LUNA, CRETACICO SUPERIOR DE LOS ANDES DE TRUJILLO, VENEZUELA OCCIDENTAL

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El género *Xiphactinus* Leidy, 1870, está incluido dentro del orden de los Ichthyodectiformes, el cual es un grupo extinto y basal de primitivos peces teleósteos, que aparecieron en el Jurasico medio, momento en el cual comenzó su diversificación, hasta alcanzar un gran desarrollo en el Cretácico superior (Bardack y Sprinkle, 1969; Patterson y Rosen, 1977). El género *Xiphactinus* se corresponde a un grupo peces muy activos, de hábitos predadores, con tamaños que oscilaban entre los cuatro y seis metros de longitud; los mismos habitaron los mares del Cretácico superior, y su registro fósil era solo conocido en sedimentos marinos de Asia, Australia, Europa y Norteamérica (Bardack, 1965; Schwimmer *et al.*, 1997). En la presente contribución, se da a conocer el registro del género *Xiphactinus*, en rocas del Cretácico superior de Venezuela, proveniente de la Formación la Luna (Cenomaniano–Campaniano), específicamente del Miembro la Aguada (Cenomaniano) en los Andes de Trujillo. El material referenciado proviene de una cantera de rocas calcáreas para la fabricación de cemento, y los restos pertenecen a un solo ejemplar de *Xiphactinus*, correspondiéndose a elementos craneales y postcraniales articulados, referidos a premaxilares, dentarios y vertebras abdominales. El espécimen fue extraído y preparado, a partir de un fragmento de caliza de alta dureza, y en la actualidad el material se encuentra depositado en la colección de paleontología del Museo Tulene Bertoni, de la Ciudad de Valera, Venezuela. Características morfológicas del ejemplar, como la presencia de una sola hilera de dientes en el dentario, premaxilar y maxilar, con una sección dentada recta en este último, al igual que el tamaño, número y la forma hipertrofiada de algunos dientes, permiten incluirlo en el grupo de los *Xiphactinus*, ya que estos caracteres son diagnósticos del género. La presencia *Xiphactinus* para el Cretácico superior de Venezuela, incrementa el conocimiento sobre la paleoictiofauna de esta región (Aguilera, 2010), constituyendo el primer registró para el Mesozoico de América del Sur, lo cual amplía la distribución paleobiogeográfica del género a nivel mundial.

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VERTEBRADOS MARINOS DEL PLIOCENO DE LA FORMACIÓN HORCÓN, REGIÓN DE VALPARAÍSO, CHILE CENTRAL: ANÁLISIS PRELIMINAR

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La Formación Horcón se corresponde a una unidad geológica del Neógeno de Chile central, ubicada en los acantilados costeros que se encuentran entre las localidades de Horcón y Maitencillo, en la Comuna de Puchuncaví, región de Valparaíso. Esta formación fue descrita originalmente por Thomas (1958), y la misma aflora en superficie en forma de estratos subhorizontales, caracterizándose por una litología compuesta de areniscas poco consolidadas, las cuales fueron depositadas netamente en un ambiente marino durante el Plioceno (Tavera, 1960; Araya *et al.*, 1978). En este trabajo se presenta un análisis preliminar de los vertebrados marinos de la Formación Horcón, los cuales fueron colectados en prospecciones superficiales y posteriormente preparados para su identificación taxonómica, basada en la comparación con ejemplares actuales y fósiles depositados en colecciones nacionales y extranjeras. Se identificaron aproximadamente 30 taxones fósiles, basados en elementos dentales, craneales y apendiculares. Los taxones registrados corresponden a Chondrichthyes (Carcharhiniformes, Chimaeriformes, Heterodontiformes, Hexanchiformes, Lamniformes, Pristiophoriformes, Myliobatiformes, Rajiformes, Squaliformes, Squatiniformes), Osteichthyes (Gadiformes, Ophidiiformes, Perciformes, Pleuronectiformes), Aves (Charadriiformes, Sphenisciformes, Suliformes) y Mammalia (Odontoceti, Mysticeti, Pinnipedia). La fauna fósil presente en la Formación Horcón, refleja una importancia en los rangos estratigráficos y paleobiogeográficos de los grupos fósiles representados y permite incrementar el conocimiento sobre la paleofauna marina y condiciones paleoceanográficas que imperaron en la zona costera de Chile central durante el Plioceno.

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CUANDO LOS XENARTHRA TENÍAN ESMALTE: 80 AÑOS DESPUÉS DE SIMPSON

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Los Xenarthra conforman uno de los principales clados de Eutheria, algunas de sus sinapomorfias se encuentran asociadas a su dentición: reducción o pérdida de dientes en el premaxilar, perdida de dentición decidua y reducción o pérdida del esmalte (ver McDonald, 2003). La mayoría de los Xenarthra han perdido el esmalte, sin embargo, se ha mencionado su presencia en un armadillo extinto *Utaetus buccatus* Ameghino, 1902 del Eoceno tardío de Patagonia (sub-edad "Barranquense", EM Casamayorense) (Simpson, 1932) y en especies vivientes de *Dasypus* (Martin, 1916; Ciancio *et al.*, 2010). En esta contribución se describe la primer evidencia de esmalte en un Astegotheriini Ameghino, 1906 (Cingulata; Dasypodidae Gray, 1921; Dasypodinae Gray, 1921), el resto estudiado (MMP 676-M) corresponde a un fragmento mandibular con tres molariformes asignado a *Astegotherium dichotomus* Ameghino, 1902. Los restos provienen de Cañadón Vaca (Chubut, Patagonia Argentina), los sedimentos portadores están asignados al Eoceno medio de Patagonia, sub-edad "Vaquense" (EM Casamayorense) siendo este el registro más antiguo de piezas dentarias para Xenarthra. Cada molariforme presenta una lámina delgada de esmalte cubriendo parcialmente las superficies lingual y labial, a modo de sendas "uñas", desde la superficie apical hasta la porción media del diente sin rodearlo totalmente. Con el objetivo de estudiar la microestructura del esmalte, una de las piezas dentarias fue preparada desgastando su porción apical en los planos transversal y vertical para su análisis con microscopio electrónico de barrido. El esmalte de *A. dichotomus* está formado por una sola capa de esmalte radial, cuyo espesor es de ~57µm en la porción apical disminuyendo hacia la base del diente hasta desaparecer. Los prismas son de vaina cerrada y miden de 3 a 4,5µm y la matriz interprismática es abundante. La porción más externa de la capa de esmalte es aprismática. El resto del diente está formado solo por ortodentina, con los túbulos de dentina ampliamente separados por dentina intertubular. Desde una perspectiva evolutiva, la presencia exclusiva de esmalte radial, con prismas menores a 5µm y abundante matriz interprismática, es plesiomórfica para Eutheria (Koenigswald, 1997); además, el tipo de dentina de *A. dichotomus* es muy similar a la que fue descripta para un molariforme referido a *Utaetus* (Kalthoff, 2011). Estos resultados nos muestran la condición plesiomórfica de la estructura dentaria para Dasypodidae en particular y posiblemente para Xenarthra.

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NUEVAS INFORMACIONES SOBRE *TIARAJUDENS ECCENTRICUS* Y *ANOMOCEPHALUS AFRICANUS*, DOS ANOMODONTES BASALES DEL PÉRMICO DE GONDWANA

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Tiarajudens eccentricus Cisneros, Abdala, Rubidge, Dentzien-Dias y Bueno 2011 de Brasil y *Anomocephalus africanus* Modesto, Rubidge y Welman 1999 de Sudáfrica son dos anomodontes basales caracterizados por una peculiar dentición heterodonte, y los únicos miembros del clado Anomocephaloidea. La continuación del trabajo de preparación en ambos holotipos y la realización de tomografías axiales computarizadas han permitido conocer más detalles sobre la osteología y la dentición de ambas especies. En *T. eccentricus* se reporta la presencia de por lo menos 4 incisivos de substitución y un canino de crecimiento continuo con una extensa raíz abierta (~95 mm) que se extiende prác-

ticamente hasta el borde dorsal del hocico en frente de la órbita. Los rasgos más notables en el postcráneo de *T. eccentricus* son la presencia de falanges discoidales en el pie, y gastralia. En *A. africanus* se reporta la presencia de un canino alargado (aunque notablemente menor que en *Tiarajudens*), ligeramente proyectado hacia adelante, y mostrando una curiosa quilla longitudinal sobre su faz medial (lingual). En *Anomocephalus* pueden verse claramente al menos 7 dientes palatales transversalmente ensanchados y evidencias de desgaste, muy parecidos a los que han sido descriptos en *Tiarajudens*. Al igual que en *T. eccentricus*, estos dientes se encuentran localizados en los huesos ectopterigoides y pterigoides. Sin embargo, los dientes palatales se diferencian de los de *T. eccentricus* por poseer un cuello más fino. Se reportan también 4 dientes palatales de reposición en *A. africanus*, y se verifica la presencia de algunos dientes molariformes en la mandíbula, que se encuentran en oclusión con los dientes superiores del paladar. En el postcráneo de *Anomocephalus* también pueden verse claramente preservadas una serie de gastralia. Los descubrimientos confirman que en los Anomocephaloidea, los dientes palatales hacen oclusión con los mandibulares, un mecanismo que era conocido únicamente en el sinápsido basal *Edaphosaurus*. Los nuevos estudios muestran que las especies brasileña y sudafricana son más semejantes de lo que se pensaba, aunque también presentan algunas importantes diferencias anatómicas tales como la forma y posición de sus respectivos caninos, y el cuello de sus dientes palatales. La presencia de falanges discoidales en *Tiarajudens* extiende el registro de estas estructuras en anomodontes, dado que las mismas han sido previamente descriptas en el anomodonte basal ruso *Suminia*. Se concluye que los Anomocephaloidea forman un clado con adaptaciones dentales y postcraneanas bizarras, representando una importante novedad evolutiva de los Anomodontia.

THE BRAINCASE OF A 3D PRESERVED PTEROSAUR FROM THE JURASSIC OF PATAGONIA

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The braincase of the specimen MPEF PV 3613, a pterosaur from the Middle Jurassic of the Cañadón Asfalto Formation, Chubut Province (Codorniú *et al.*, 2010) is well-preserved and almost undistorted. No sutures are discernible between the braincase elements. The use of CT scans revealed aspects of the pneumaticity of the braincase that is affecting the paired frontals, supraoccipital, and basisphenoid. The parietal is approximately 60% the length of the frontal (excluding the nasal processes). The nuchal crest is almost at the same level with the skull roof in lateral view and is V-shaped in dorsal view. The supratemporal fossae are deeply excavated on the parietals, separated by a narrow sagittal crest. The frontal is mostly a flat element in the skull roof and the frontal postorbital processes are strongly projected laterally, each one having a large oval foramen posteroventrally that communicates internally with a pneumatic cavity. The occiput is mainly formed by the supraoccipital and the exoccipitals. Dorsolateral to the foramen magnum there is a large dorsal head vein foramen, and more laterally is a smaller postemporal fenestra. The paroccipital processes are dorsoventrally high, but short transversely. The metotic foramen for cranial nerves (CN) IX-XI open ventrolaterally to the occipital condyle and a single foramen for CN XII open just under and slightly lateral to the occipital condyle. The occipital condyle is smaller than the foramen magnum, subspherical, posteroventrally directed and has not a constricted neck. The basal tubera are anteroposteriorly elongate but transversely narrow structures. Ventrally, the basisphenoid is rhomboidal in outline, with a tapering anterior end. It has a moderately deep, elongate basisphenoid recess along its midline. The basipterygoid processes are slender, long and narrow, anteroventrally projected and separated over their entire length. In lateral view, the basipterygoid processes diverge at an angle of approximately 45° from the dorsal skull roof. The CN V foramen is oval and 4 mm diameter. The postorbital process of the laterosphenoid is a narrow triangular projection adjacent to the posteroventral side of the postorbital process of the frontal. A ventral and narrow projection of the laterosphenoid is probably forming the anterior margin of the CN V foramen. Comparisons with the braincases of other pterosaurs, reveal a mosaic of characters in the Argentinean specimen, which shares some traits with "rhamphorhynchoids" but also with pterodactyloids taxa. Preliminary phylogenetic analysis places the taxon in a polytomy with the recently described *Darwinopterus* (Lü *et al.*, 2010) at the base of the Pterodactyloidea (Codorniú *et al.*, 2010).

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TAXONOMÍA Y PALEOECOLOGÍA DE LA ICNOFAUNA DE VERTEBRADOS NEÓGENOS DE PUCHUZUM, SAN JUAN, OESTE DE ARGENTINA

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Los depósitos de la Formación Las Flores en la localidad de Puchuzum, región norteña del valle de Calingasta (San Juan), oeste de Argentina,

constituyen un notable yacimiento con huellas de vertebrados, representativo del Mioceno tardío (Peralta *et al.*, 1995; Contreras, 1996, 2006). La mayoría de las huellas se han conservado como epirrelieve positivo y documentan una icnofauna muy diversa a través de numerosos morfotipos correspondientes a aves de hábitos acuáticos y terrestres y algunos pocos morfotipos representativos de mamíferos de mediano y gran porte, preservadas en facies de depósitos fluviales. La presencia de restos óseos en los mismos niveles con huellas ha permitido establecer la edad de la icnofauna de Puchuzum, asignada al Huayqueriense (Mioceno superior tardío) (Peralta *et al.*, 1995; Contreras, 1996, 2006; Cerdeño y Contreras, 2000). Las excepcionales condiciones de preservación de la icnofauna de Puchuzum favorecen la interpretación de esta asociación icnológica de la Formación Las Flores como un buen ejemplo de una fauna de vertebrados que habitó el oeste de Argentina durante el Neógeno tardío. La interpretación de los posibles productores de las huellas de Puchuzum contribuyen al establecimiento de las condiciones paleoambientales del área y permite la comparación con otros yacimientos icnológicos de edades similares como la Formación Toro Negro (La Rioja, Argentina) (Krapovickas *et al.*, 2007, 2009); Formación Río Negro (Río Negro, Argentina) (Angulo y Casamiquela, 1982; Aramayo, 2007), con el fin de establecer posibles diferencias paleobiogeográficas.

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A COMPLETE ABELISAURID (THEROPODA) PELVIS FROM NEUQUÉN PROVINCE, ARGENTINA

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The Abelisauridae are a typical group of Gondwanan theropods, whose higher diversity lies so far on the Patagonian record that spans from the Cenomanian (Candeleros Fm.) up to the Maastrichtian (La Colonia Fm.). In Neuquén Province, the outcrops of Neuquén Group have yielded abelisaurid remains virtually throughout the entire section. The identified taxa include *Ekrixinatosaurus novasi* Calvo, Rubilar-Rogers and Moreno (Candeleros Fm.), *Ilokesia* aguadagrandensis Coria and Salgado, *Skorpiovenator bustingorryi* Canale, Scanferla, Agnolin and Novas (Huincul Fm.), *Abelisaurus comahuensis* Bonaparte and Novas, and *Aucasaurus garridoi* Coria, Chiappe and Dingus (Anacleto Fm.). Here we report the complete sacrum and pelvic elements of a medium-size theropod specimen (MCF-PVPH-820) recovered from Huincul Formation's sandstones (Cenomanian, Upper Cretaceous). The specimen represents an adult individual based on the fully fused pelvic elements, and exhibits a combination of several features observed in most Abelisauridae (i.e. *Carnotaurus sastrei* Bonaparte, *Majungasaurus atopus* Sampson, Witmer, Forster, Krause, O'Connor, Dodson and Ravoavy) such as a low iliac blade, slightly dorsoventrally expanded pre and postacetabular processes, pubis with closed obturator foramen, broad brevis shelf and a sinsacrum composed by six vertebrae. Like in *Carnotaurus* and *Aucasaurus*, the dorsal edge of the ilium is straight, unlike the convex condition described for *Skorpiovenator* (Canale *et al.*, 2008). Unlike *Carnotaurus* and *Skorpiovenator*, the preacetabular process bears an anterior projection dorsally placed and the ventral border is rather convex, and the ilium seems to be dorsoventrally narrower. Based on the size, MCF-PVPH-820 matches with the holotype specimen of *Ilokelesia*, although spite the similar stratigraphic provenance, the lack of overlapping elements (Coria and Salgado, 1998) impedes a certain comparison with that form.

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FIRST OCCURRENCE OF VERTEBRATE REMAINS IN GYPSUM DEPOSITS OF THE IPUBI MEMBER. LOWER CRETACEOUS, SANTANA FORMATION, ARARIPE SEDIMENTARY BASIN, *NORTHEASTERN BRAZIL*

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The Ipubi Member is located on Santana Formation at the superior part of the Crato Member, beneath the Romualdo Member. These deposits are composed primarily of gypsum with intercalated beds of shales. These layers are deposited under the control of eustatic variations in an arid climate. So far, this formation has yielded fishes, ostracods, turtles, plants, coprolites and ichnofossils, all of them being found on discontinuous layers of black shales. The aim of this study is to describe the first occurrence of vertebrate fossil in the gypsum deposits of the Ipubi Layers. The material described herein was collected in the gypsum quarry Pedra Branca, located between the towns of Santana do Cariri and Nova Olinda (7° 8' 24" S / 39° 42' 41" W). The fossil is housed in the Museu de Paleontologia de Santana do Cariri of Universidade Regional do Cariri (URCA) under the number MPSC-P 2310. The specimen is a fish with a slim body, a large opercular bone without striae and the lower jaw is sturdy with a subtriangular shape in outline. It is laterally compressed and almost complete. Lacking part of the caudal skeleton and fin, due to fragmentation of the rock containing it. The length measured from the tip of snout to the tail fin was 165,0 mm and 32 vertebrae could be counted. These features identify the fossil as Chanidae fish of the genus *Dastilbe* Jordan 1910. To determine the preservation process of the fossil was carried an X-ray powder diffraction analysis (XRD). The XRD analysis results show that the specimen was replaced by iron sulfide and the rock matrix on which is deposited is composed of hydrated calcium sulfate (Gypsum). Similar replacement of fossils by iron sulfide (Pyrite) was previously reported in the black shales of Ipubi Formation, suggesting similar diagenetic processes. This result indicates that probably the pyritization is the fossilization process in this case. More analyses are being carried out in order to understand the diagenetic and ecological implications of this interesting occurrence.

BIOSTRATIGRAPHY OF THE LATE CENOZOIC IN CÓRDOBA PROVINCE (CENTRAL ARGENTINA)

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During the last twenty years, several geological and stratigraphical studies have been undertaken in Córdoba Province, which provided useful bases for biostratigraphic researches of the late Cenozoic. However, the paleontological contributions are still preliminary analyses or specific discoveries. The aim of this work is to contribute to the knowledge of the biostratigraphy in central Argentina, through the study of fossil mammals from Córdoba Province. Five localities were analyzed, i.e., San Francisco, Miramar, Río Cuarto, Isla Verde, and Valle de Traslasierra. The exposures at each locality were prospected in order to recognize the different sedimentary strata and to establish the precise provenance of the fossil mammals studied. As a result, a biostratigraphic analysis was performed, and three "assemblage zones" (*biozonas de asociación*) are proposed: 1) *Neosclerocalyptus paskoensis* Zurita, 2002-*Equus* (*Amerhippus*) sp. Assemblage Zone, with type area and section in San Francisco, referred to the Lujanian (late Pleistocene–early Holocene), and comparable to the *Equus (Amerhippus) neogeus* Lund, 1840 Biozone from Buenos Aires Province; 2) *Neosclerocalyptus ornatus* Owen, 1845-*Catonyx tarijensis* Gervais and Ameghino, 1880 Assemblage Zone with type area and section in San Francisco, referred to the Ensenadan (early Pleistocene) and comparable to the *Mesotherium cristatum* Serres, 1867 Biozone from Buenos Aires Province, and 3) *Nonotherium hennigi* Castellanos, 1942-*Propanochthus bullifer* Burmeister, 1870–1874 Assemblage Zone with type area and section at Los Sauces River, Valle de Traslasierra, referred to the Montehermosan–Chapadmalalan interval (late Miocene–late Pliocene), and comparable to the *Trigodon gaudryi* Ameghino, 1887, *Neocavia depressidens* Parodi and Kraglievich, 1848, and/or *Paraglyptodon chapadmalensis* Rovereto, 1914 biozones from Buenos Aires Province.

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THE LATE PLEISTOCENE PILAUCO SITE, SOUTH CENTRAL CHILE: GENERAL TAPHONOMY AND CULTURAL ASSOCIATION.

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Open locations in the Intermediate Depression in south–central Chile are the most frequent type of paleontological and archaeological site. The present work involves the results of two field and laboratory seasons in the Pilauco Site (40º34′11.7″S–73º06′13.4″W). The simple and clear stratigraphy and a robust radiocarbon age model of the Pilauco site allows to propose that before 12,540 ± 90 14C yr B.P. the old Damas river eroded an older a volcaniclastic hill; after that a swamp was formed in a ox-bow lake. The site was developed until 11,004 ± 186 14C yr B.P., the date of the youngest fossil. Like in Tagua-Tagua and Monte Verde, gomphotheres are the most represented elements of the megafauna. In Pilauco there are also records of Equidae, Camelidae, Cervidae, Mephitidae, Muridae, Myocastoridae and Mylodontidae. In total, 718 bones, 30 tooth and 11 coprolites represent the extints and extants animals. Preliminary studies on the taphonomy of the site, in particular related to the concentration of bone remains, have been developed. In the site there is clear evidence of concentration of bone elements in the 40 cm thick PB-7 strata, which is within the 13.6 and 14.0 ky isolines. This indicates a short time accumulation period, with a high deposition rate similar to 1cm yr^{-1}. The local accumulation of gomphothere skeletal elements and the low rate of duplications, suggests the presence of only two individuals. On the other hand, the absence of articulated remains in anatomical position could indicate long exposure of the carcass before burial or butchering activities. It is not clear how weathering can affect bones in a swamp milieu, dominated by the deposition of fine sediments and high contents of carbon organic matter. An orientation analysis of 22 long bones excavated during the 2010–2011 season shows that 78% of the elements are arranged in southeast-northwest direction. However this observation could agree with the expected direction of the water floods, in some units gomphothere ribs are registered at 90º. Until now, it is not possible to discard both short and low energy fluvial reorientation process and butchering activities. With a north-Patagonian park landscape, the Pilauco area possessed a variety of animal, plant and stone resources. We recorded 101 lithics; basalt and cuarcite was recollected from nearby fluvial deposits, dacitic obsidian from the local volcaniclastic layers, the last avoiding the possibility to be pseudo-artifacts. The debitage is the most represented lithic item (75%); cores and marginal edge-trimmed artifacts included only 12 and 13%, respectively. This industry, characterized by a recurrent lithic expeditive technology, seems to be connected to strategic conditions of high diversity, especially of groups with a high or medium mobility. We discuss the presence of some conspicuous marks on gomphothere ribs, the presence of little tusk fragments near a gomphothere skull and the spatial relation between stone artifacts and flakes with high bone concentrations.

NUEVOS REGISTROS DE MAMÍFEROS DEL CERRO PAN DE AZÚCAR (GAIMAN, PROVINCIA DEL CHUBUT, ARGENTINA) Y SU APORTE BIOCRONOLÓGICO

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Simpson (1936), sobre la base de los estudios de Roth (1903), analizó la fauna del Cerro Pan de Azúcar, y reconoció tres especies de mamíferos procedentes de un nivel basal de areniscas rojizas: un Metatheria: *Polydolops rothi* (Polydolopimorphia, Polydolopidae Ameghino 1897) y dos Notoungulata: *Isotemnus haugi* (Oldfieldthomasiidae Simpson 1945) y ?*Henricosbornia minuta* (Henricosborniidae Ameghino 1901). Adicionalmente, registró placas de tortugas y cocodrilos y vértebras de serpientes. Simpson (1935 a, b) la refirió a la Edad Riochiquense *s.l.* (considerada actualmente como Paleoceno tardío–Eoceno temprano), sin descartar la posibilidad de que fuera Casamayorense (Eoceno medio–tardío). Una reciente campaña a Pan de Azúcar permitió identificar los niveles basales y colectar nuevos restos de mamíferos (MPEF 10510-10527). Entre estos se identificaron: Metatheria: 1) Polydolopimorphia (*P. rothi* y *Polydolops* sp.), 2) Microbiotheria (*Eomicrobiotherium* sp.), 3) "Didelphimorphia" Protodidelphidae Marshall 1987 (*Protodidelphis* sp. y *Guggenheimia* sp.), Derorhynchidae Marshall 1987 (*Derorhynchus* sp., *Didelphopsis* sp.), Sternbergiidae Szalay 1994 (*Sternbergia* sp.) y un peradéctido indeterminado. El biocrón de algunos de estos taxones es extenso, pero ninguno es más moderno que la subedad Barranquense (Edad Casamayorense). Los euterios están representados por el Xenarthra astegoterino *Prostegotherium astrifer* Ameghino 1902 (hasta ahora exhumado en rocas de edad Riochiquense *s.l.*) y por restos fragmentarios de Notoungulata: Archaeopitecidae Ameghino 1897 y Olfieldthomasiidae, ambos registrados entre el Itaboraiense y el Barranquense. La asociación faunística mencionada restringe la posible antigüedad de los niveles portadores al lapso Itaboraiense–Barranquense, siendo probable su referencia al Riochiquense *s.s.* (Eoceno temprano).

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REGISTRO DE MODIFICAÇÃO OSSEA EM DENTE DA PREGUIÇA GIGANTE *EREMOTHERIUM LAURILLARDI* LUND 1842

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A confecção de adornos e utensílios através da modificação de ossos foi comum em populações humanas pré-coloniais. No Brasil, a maioria dos adornos encontrados foram fabricados em ossos de mamíferos de pequeno a médio porte (Castilho; Simões Lopes, 2008), mas, há um registro para modificação em ossos da megafauna (Neves e Piló, 2008). Em 2010, foi encontrado no Estado de Sergipe, Brasil, um fragmento de dente [LPUFS 4992] de *Eremotherium laurillardi* Lund 1842) trabalhado pelo homem. Em vista transversal apresenta a disposição de camadas observadas em dentes da Família Megatheridae: cemento, ortodentina modificada e ortodentina (Ferigolo, 1985). No Brasil são encontradas duas espécies desta família: *Megatherium americanum* Cuvier, 1976, com distribuição restrita a região Sul do país, e *E. laurillardi* com ocorrência nas demais regiões do Brasil (Cartelle e De Iuliis, 1995). As marcas atribuídas à ação antrópica são caracterizadas pelo desgaste de toda a face interna do dente, enquanto na face externa do dente observam-se marcas sulcadas apenas na base, no lado esquerdo. Observam-se também estrias paralelas sulcadas na lateral do dente, o que confeccionou uma peça triangular. A olho nu, na região dessas estrias, observa-se um aspecto de alisamento. Em Sergipe a tradição lítica mais antiga está associada a cultura Canindé, que, de acordo com datações ^{14}C teria ocorrido entre 8.950–5.570 AP (Carvalho, 2003). Este achado nos leva a três hipóteses: (1) a de que esta espécie viveu até o Holoceno, e interagiu com o Homem; (2) O homem esteve na América antes do que se supunha, no mínimo há 15.000 anos, que são as idades mínimas encontradas para esta espécie no Nordeste brasileiro, e interagiu com a megafauna (*e.g.* Auler *et al.*, 2006); ou, (3) o homem de Canindé encontrou "fósseis" e o trabalhou. As pesquisas na área continuam, buscando novas informações que possam esclarecer qual dessas hipóteses é a correta.

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USO DE POLIETILENO GLICOL 4000 NA PREPARAÇÃO MECÂNICA DE UM ESPÉCIME DE TARTARUGA DA BACIA DE SÃO JOSÉ DE ITABORAÍ

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A Bacia de São José de Itaboraí (Paleoceno), localizada no Estado do Rio de Janeiro, Sudeste do Brasil, é uma das menores bacias brasileiras, representando o registro mais antigo da fauna continental cenozóica do Brasil. Aqui nós reportamos uma tartaruga proveniente desta bacia, que encontra-se depositado no Museu de Ciências da Terra (DNPM-RJ) e está sendo preparado no Museu Nacional / UFRJ. A preparação do espécime foi realizada a partir de três blocos isolados: um contendo plastrão bem preservado, crânio parcialmente preservado e mandíbula; um casco; e um bloco contendo neurais, costais e periferais posteriores. O material encontrava-se preservado em calcário travertine, onde há grande quantidade de fósseis. Inicialmente foi realizada a preparação através de métodos químicos, utilizando-se ácido orgânico (fórmico 3%), visto que, segundo Kellner 1995, os melhores resultados de preparação química de vertebrados fósseis preservados em rochas calcárias

são obtidos com ácidos orgânicos, com objetivo de preservar o máximo possível a estrutura óssea. Entretanto, devido a não uniformidade natural e as impurezas presentes na matriz de calcário na qual o espécime se encontrava a preparação química foi descartada, pois o ácido reagiu com o sedimento desproporcionalmente, representando risco ao material. Deste modo, optamos pela preparação mecânica do material, utilizando canetas pneumáticas, com auxílio de polietileno glicol 4000 (PEG 4000). O PEG 4000 é um polímero que à temperatura ambiente apresenta-se no estado sólido. Este polímero, quando aquecido, torna-se um líquido viscoso, com peso molecular igual á 4000. O PEG 4000, em estado líquido, é utilizado sobre um tecido não texturizado (tnt). Esse material, confeccionado a base de prolipopileno e viscose que apresenta entre suas principais características o fato de ser atóxico e semipermeável. Desta forma, o tnt evita o contato direto entre o PEG 4000 e o fóssil, formando uma película protetora. Em materiais frágeis, como o crânio e a mandíbula, após a formação da película composta por tnt e PEG 4000, deve-se espessar a camada do polímero, formando uma superfície rígida, o que confere ao preparador maior segurança e estabilidade durante a preparação. A utilização do PEG 4000 na preparação mecânica não é uma técnica recente, entretanto, na maioria das vezes, esse polímero é utilizado de maneira permanente, como fixador, semelhante à parafina, que necessita ser aquecido para ser retirado. Porém, parte do residuo ainda permanece no fóssil. Nessa técnica o PEG 4000 em conjunto com o tnt, consolidam o material, dando apoio a áreas expostas do exemplar, permitindo ao preparador, manusear e preparar áreas frágeis com segurança. E, ao final de todo o processo de preparação a película de tnt e PEG 4000 é totalmente removida.

Kellner, A.W. 1995. Técnica de preparação para Tetrápodes fósseis preservados em rochas calcarias. *Revista técnica e informativa da CPRM.* Ano I, 0: 24 – 31

RECONSTRUÇÃO TRIDIMENSIONAL DE ESTRUTURAS INTRACRANIANAS EM PELOMEDUSOIDES (TESTUDINES, PLEURODIRA)

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A tomografia computadorizada (TC) é um método não-invasivo de visualização de estruturas internas. Por essa razão, representa uma excelente ferramenta para a paleontologia, tendo em vista a raridade ou o caráter único de alguns espécimes fósseis. Através da TC, estruturas internas de fósseis que não poderiam ser submetidos a secções mecânicas tornam-se acessíveis para estudo. Esse método tem se tornado cada vez mais comum e tem promovido uma "revolução" na manipulação de dados de imagem (Rowe e Frank, 2011). O presente trabalho utilizou essa técnica para reconstruir tridimensionalmente estruturas intracranianas de espécies das principais linhagens de tartarugas da Hiperfamília Pelomedusoides Cope, com ênfase em Podocnemididae Cope. As imagens foram obtidas através de Tomografia Computadorizada Helicoidal 3D, e a posterior edição das tomografias foi feita através do software biomédico Mimics (Materialise). Os resultados foram armazenados tanto na forma de arquivos de imagem (TIFF) quanto em arquivos de alta resolução (DICOM). Foram utilizadas 4 espécies viventes e 6 fósseis, sendo elas: *Pelusios sinuatus* Smith, 1838, *Podocnemis unifilis* (Troschel) e *Hamadachelys escuilliei*† Tong e Buffetaut, (imagens obtidas por Tim Rowe na University of Texas High-Resolution X-ray Computed Tomography Facility, EUA, e cedidas por Eugene Gaffney, curador emérito do American Museum of Natural History, EUA), e *Podocnemis expansa* Schweigger, *Peltocephalus dumerillianus* (Schweigger), *Bauruemys elegans*† (Suárez, 1969), *Araripemys barretoi*† Price, *Caninemys tridentata*† Meylan, Gaffney and Campos, *Peiropemys mezzaliraí*† Gaffney *et al*e *Pricemys caiera*† Gaffney *et al* (imagens obtidas em tomógrafo computadorizado helicoidal multislice da Clínica de Diagnóstico por Imagens – CDPI, Unidade Nova América, Rio de Janeiro). As imagens tridimensionais resultantes englobam endocrânio, ouvido interno e cavidade nasal. Como resultados futuros, as estruturas encontradas terão agora sua morfologia descrita detalhadamente, baseando-se em dados da literatura (como Gaffney *et al.*, 2006 e Gaffney *et al.*, 2011). As descrições serão comparadas interespecificamente, visando auxiliar na elucidação da história evolutiva do grupo. Serão feitas comparações entre os espécimes fósseis (muitas vezes fragmentados) e os viventes, como um controle qualitativo e quantitativo das informações obtidas. Devido à escassez, em relação a outros grupos, de estudos envolvendo tartarugas utilizando a metodologia apresentada (*e.g.* Witmer e Ridgely, 2008), o interior do crânio pode constituir uma fonte em potencial de novas características diagnósticas, enriquecendo análises filogenéticas existentes.

Gaffney, E.S., Tong, H. e Meylan, P.A. 2006. Evolution of the side-necked Turtles: the families Bothremydidae, Euraxemydidae, and Araripemydidae. *Bulletin of the American Museum of Natural History* 300: 1–698.

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MORPHOLOGY OF THE FORELIMB OF *PSILOPTERUS BACHMANNI* (AVES, CARIAMIFORMES) (EARLY MIOCENE OF PATAGONIA)

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Psilopterines are the smallest and most gracile predatory birds belonging to the large terrestrial family Phorusrhacidae, which were abundant during the Tertiary of South America. Two taxa are recognized from the Santacrucian (Early Miocene) beds of the Argentinean Patagonia: *Psilopterus lemoinei* Moreno and Mercerat 1891 and *Psilopterus bachmanni* Moreno and Mercerat 1891 both described in a very ambiguous manner by Sinclair y Farr (1932). The first species is very well-known by several individuals including skulls, fore and hind limb bones and has been recently redescribed by Degrange and Tambussi (in press). The smallest one, *P. bachmanni*, had its fore limb skeleton practically unknown until the recent collection made by a joint Museo de La Plata-Duke University expedition. The fossils herein described come from the locality Puesto Estancia La Costa (= Corriguen Aike), situated at the coast of Santa Cruz Province, between Coyle and Gallegos rivers, and were recovered from the middle levels of Estancia La Costa Member (level 5.3 of Tauber *et al.*, 2004), Santa Cruz Formation. The specimen (MPM-PV4243) is housed at the Museo Regional Provincial Padre Manuel Jesús Molina and includes associated bones of both forelimbs (proximal and distal ends of left humerus, both fragmentary zeugopods, and a nearly complete left manus) and a fragmentary furcula. Differences in size and several others related to the hind limbs with *P. lemoinei* (Degrange and Tambussi, in press) allow us to refer this new specimen to *P. bachmanni*. The furcula has a prominent "V" shape when viewed frontally, with very robust *corpus claviculae* and lacks *apophysis furculae*. The humerus shows no significant differences with *P. lemoinei* (see Degrange and Tambussi in press). In the ulna, the *olecranon* is robust but poorly salient. The manus of this species was previously unknown and is here described for the first time. The *os carpi ulnare et radiale* are both very stout bones. The carpometacarpus has *processi extensorius et alularis* very marked and stout. The *os metacarpale majus* is very robust and depressed. The *phalanx digiti minoris* is flattened. The *phalanges digiti majoris* are both very robust. It has been proposed that some species belonging to *Psilopterus* were able to fly (Tonni and Tambussi, 1988; Degrange and Tambussi, unpublished data) in a clumpsy manner. While this work is not intended to certify this condition, the information provided here represents an effort to bring some new data useful in future systematical, morpho-functional and evolutionary studies.

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Tonni, E.P. and Tambussi, C.P. 1988. Un nuevo Psilopterinae (Aves: Ralliformes) del Mioceno tardío de la provincia de Buenos Aires, República Argentina. *Ameghiniana* 25: 155–160.

HALLAZGO DE UN ESQUELETO COMPLETO Y ARTICULADO DE UN NUEVO PHORUSRHACIDAE (AVES) EN EL PLIOCENO TARDIO DE LA ARGENTINA

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Un excepcional esqueleto completo y articulado perteneciente a una nueva especie de Phorusrhacidae Ameghino 1899 de mediano tamaño fue hallado en los sedimentos de la Formación Chapadmalal (La Estafeta, Chapadmalal). Los depósitos se corresponden al Plioceno tardío (~3.3 MA; Schultz *et al.,* 1998). Un fenómeno de rápido enterramiento por sedimentos pelíticos depositados en una planicie de inundación de bajo gradiente, impidió que procesos tafonómicos superficiales tuvieran lugar sobre la carcasa, motivando una preservación excepcional del ejemplar. La acción de corrientes ácueas durante el evento de sepultamiento final generó una disposición contorsionada de la carcasa en donde el cráneo actuó como ancla del resto del cuerpo. El material (MMP 5050) permite conocer por primera vez para los Phorusrhacidae estructuras como la tráquea osificada con anillos *in situ*, anillos escleróticos de ambas órbitas, ectetmoides, vómer, osificación del ligamento lacrimoyugal (*os uncinatum*, una característica que comparten únicamente con su grupo hermano, los cariámidos), fúrcula y tendones postero-mesiales osificados asociados al tarsometatarso. Asimismo el ejemplar consta del único paladar completo conocido permitiendo corroborar la presencia de vómer y de procesos rostrales de los palatinos. La ausencia de las zonas flexoria del arco yugal y del paladar demuestran la restricción en la quinesis craneana (aunque la zona flexoria craneofacial está presente). Características como el arco pélvico preacetabular muy marcado, la placa ilíaca desarrollada, la cresta supratrocantérica roma, más extendida lateralmente que el antitrocánter, el hipotarso asimétrico y el largo del tarsometatarso que corresponde al 88% de la longitud del tibiotarso, permiten asignarlo a Mesembriornithinae (Kraglievich, 1932). De esta última se conocen dos especies, *Mesembriornis milneedwarsi* Moreno, 1889 de mayor tamaño, coetánea y simpátrica y *M. incertus* (Rovereto, 1914) del Plioceno temprano de Catamarca, de las cuales difiere por no tener la clavícula y coracoides anquilosados, entre otros rasgos. El nuevo material permite rediagnosticar varios de los caracteres de la familia y aporta datos esenciales para elucidar no solo aspectos filogenéticos sino también paleobiológicos, entre ellos evaluar la capacidad cursorial y depredadora.

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THE *EQUUS* (EQUIDAE: PERISSODACTYLA: MAMMALIA) FROM THE QUATERNARY ANDEAN VALLEYS OF ECUADOR: A COMPARATIVE MORPHOLOGICAL ANALYSIS

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The only extant representatives of *Equus* Linnaeus, 1758 are horses, zebras and asses, whose geographic distribution includes only Africa and Asia. However, during the Pleistocene this taxon was more diverse and presented a wider range, occurring in all continents except for Antarctica. In South America, *Equus* was represented by the following species: *E. neogeus* Lund, 1840, *E. santaeelenae* Spillmann, 1938, *E. lasallei* Daniel, 1948, *E. insulatus* Ameghino, 1904 and *E. andium* Branco, 1883. These equids have records both in lowland plains and interandean highland valleys. The systematics of the South American *Equus* is based especially in morphological characters of the distal limbs. Here, we performed a biometrical comparative analysis of tibia, metatarsal and phalange bones of equids from several localities in the Ecuadorian Andes. Subsequently, a grouping analysis was made considering the specimens as samples by simple linkage. It was possible to identify a clear distinction among these specimens that differs from the current morphotypes known for *Equus*. Yet, this distinction is notably evident on the metatarsals, which are also larger in this new morphotype. Despite of differences in size between *E. insulatus* and *E. andium*, which the former is larger, the proportions between the tibia and metatarsal bones are conserved (the tibia is almost double in length). This new gracile form do not presents this pattern, since these bones have a very proximate length. According to ecomorphological studies, this is characterized as an adaptation to a greater cursoriality life when compared to *E. insulatus* and *E. andium*. This is plausible since *Equus* is considered as extremely adapted to cursoriality (*e.g.* monodactyly). Therefore, the present contribution evidentiates a forth morphotype for the South American *Equus*, where a more gracile form occurred on the Ecuadorian Andean valleys. However, these results cannot be viewed as the occurrence of a new species. Further analyses and the inclusion of the *Equus* from southern Central America are needed, since recent studies show that most taxa that were exclusive of Central and North America have also been registered in locations from the northern South America (*e.g. Glyptotherium* Osborn, 1903 and *Panthera atrox* Leidy, 1853).

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DESCRIPTION OF AN ONTOGENETIC SERIES IN *COQUENIA BONDI* DERACO, POWELL AND LÓPEZ 2008 (LEONTINIIDAE)

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Ontogenetic analyses focused on paleogene notoungulates are scarce. In this contribution we present a comparison of three almost complete skulls of the Eocene species *Coquenia bondi* Deraco, Powell and López 2008 (Leontiniidae Ameghino, 1895) which represent three different ontogenetic stages, from juvenile to adult. The juvenil specimen PVL S-IV-1 shows all its deciduous teeth plus its first and second upper molar. The first molar is erupted and presents a low wear degree, while the second molar is not erupted. The second specimen PVL S-VI-2a is here considered as an advanced juvenile. Only the anterior deciduous premolars are still present and, within permanent dentition, incisors, posterior premolars, and first and second upper molars are erupted. The upper canine and second permanent premolar are not erupted although these teeth are visible at the sides of the maxilla. The third upper molar is absent. In the adult individual (PVL 5853), all permanent teeth are present showing some wear degree, which is higher in the first upper premolar and the first upper molar. A notable feature derived from the observation of the juvenile individual is that, in unerupted molars, exposed dentine is present on the occlusal surface. Besides these evident changes in the dentition, striking modifications in skull structures were observed along the series. The skull length increases about 50% from the juvenile to the

adult. The postorbital constriction appears thicker in the juvenile but becomes progressively narrower with age. Tympanic bullae and epitympanic sinuses became relatively smaller. Other structures are small or slender in the juvenile, but are considerably well developed in the adult, such as the sagittal crest, the paraoccipital process, the narial process, the postorbital process, the exit of the Eustachian tube, and the meatal crest. Moreover, the basioccipital surface became strongly crested in the adult, the rostrum is higher, and the narial apertures are wider. Other evident differences are observed in the basicranial angle, which is progressively more open, and the zygomatic arch, which becomes stouter and sigmoid, with its posterior root shifted dorsally in response to the mentioned modification of the basicranial angle. Finally, the external auditory meatus, which exhibits a subhorizontal orientation in the juvenile, becomes more vertical in the adult. The availability of several well-preserved specimens of *C. bondi* represents a unique opportunity for the study of morphological trends present in the ontogenetic series of a Paleogene notoungulate recorded previously to the "modernization" of the 'ungulate' faunas in South America (Croft *et al.*, 2008). This is useful to assess the phylogenetic or taxonomic weight of potential characters observed in isolated remains. Moreover, this study provides an important source of information for morphofunctional and paleobiological analyses.

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MORFOMETRÍA DE LAS PALEOCUEVAS DE LA "FORMACIÓN" CHAPADMALAL Y SU ASIGNACIÓN A *ACTENOMYS* (RODENTIA), *PAEDOTHERIUM* (NOTOUNGULATA) Y OTROS MAMÍFEROS FÓSILES HOSPEDANTES

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En la "Formación" Chapadmalal, aflorante en las barrancas que se extienden desde Mar del Plata a Miramar, se diferencian paleocuevas que históricamente se asignan al roedor fósil *Actenomys* sp. (Rodentia, Caviomorpha). La asignación se basa en la elevada frecuencia de restos de *Actenomys* sp. hallados en estas bioestructuras y en su capacidad cavadora. Si bien es evidente que *Actenomys* sp. construía cuevas, no es la única especie coetánea que puedo haberlas construido. Se analizaron morfométricamente las paleocuevas aflorantes en las barrancas costeras de Mar del Plata–Miramar correspondientes a los Pisos/Edad Chapadmalalense y Marplatense y se identificaron sus posibles constructores. Se seleccionaron las paleocuevas aflorantes en sección transversal y se tomaron dos medidas estructurales, correspondientes a los diámetros transverso y dorsoventral, con las que se construyó un índice estructural. Se registró el material fósil asociado a las mismas en los casos donde estaba expuesto. Los análisis estadísticos incluyeron distribución de frecuencias, correlaciones, análisis de residuales y diferencia de medias, en las medidas individuales y en el índice. Con los resultados obtenidos fue posible identificar diferencias métricas en las paleocuevas asociadas a individuos juveniles y adultos de *Actenomys* sp. y a *Paedotherium* sp. (Notoungulata, Hegetotheriidae). Se reconocen diferencias métricas entre las paleocuevas del Chapadmalalense y Marplatense, posiblemente asociadas a una diferencia en la abundancia relativa de *Paedotherium* sp. y *Actenomys* sp., avalada por el número mínimo de individuos. Asimismo, se refuerza la existencia de cuevas de *Lagostomopsis* sp. (Rodentia, Caviomorpha) y se identifica la posible construcción, o uso oportunista, de las mismas para otros caviomorfos como *Eumysops* sp., *Dolicavia* sp. y otros cávidos.

CRANIAL ANATOMY OF *AUSTRALERPETON COSGRIFFI* BARBERENA 1998: A PERMIAN TEMNOSPONDYL FROM SOUTH BRAZIL

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The cranial anatomy of *Australerpeton cosgriffi* was briefly described based on four well preserved partial skulls collected in the Permian deposits of the Rio do Rasto Formation at Serra do Cadeado, northern Paraná, Brazil (Barberena, 1998). The holotype skull (UFRGS-PV-0227-P) lacks most of its right-side and the anterior part of rostrum. The paratypes correspond to: UFRGS-PV-0228-P, a complete rostrum originally referred to *Platyops* Barberena and Daemon 1974; UFRGS-PV-0229-P, posterior part of the the skull (lacking nasal, premaxilla, and part of the maxillae) and two hemimandibles; UFRGS-PV-0230-P, fragment of the left posterior part of the skull. Yet, there are at least seven additional cranial remains that may be attributed to the taxon, these include: UFRGS-PV-0224-P, almost complete skull (lacking its anterior part, nasal and premaxilla) and hemimandibles; UFRGS-PV-0225-P, small skull and hemimandibles, lacking their anterior extremities; UFRGS-PV-0240-P, anterior tip of a right hemimandible; UFRGS-PV-0243-P, two small slender hemimandibles; UFRGS-PV-0248-P, middle portion of a right hemimandible; UFRGS-PV-0320-P, posterior left portion of skull, associated with post-cranial remains; LPRP/USP-0011, left hemimandible also with post-cranial remains.

Although partial, these specimens together allow the assessment of the entire cranial morphology of *A. cosgriffi*. *Contra* Barberena (1998) a postorbital-parietal contact is seen in the holotype (UFRGS-PV-0227-P), which also has no postfrontal-supratemporal articulation. Likewise, both the paratype UFRGS-PV-0230-P and a probable juvenile specimen (UFRGS-PV-0225-P) show the supratemporal taking part of the otic notch and the tabular separated from the squamosal. The affinities of *A. cosgriffi* within Temnospondyli are controversial. Both the holotype and UFRGS-PV-0228-P possess Archegosauridae *sensu* Schoch and Milner (2000) apomorphies such as the maxilla extending ahead of the choana and excluding the premaxilla from the choanal margin, a double anterior palatal fenestra, and a long row of vomerine teeth medial to the choana. Likewise, some Rhinesuchidae *sensu* Schoch and Milner (2000) traits as a deeply recurved cheek in occipital view, a deep otic notch with subparallel margins, a posterolaterally constricted prefrontal, and a caudally expanded tabular horn that lacks dermal sculpturing are also seen in *A. cosgriffi* specimens. Moreover, the extensive parasphenoid/pterygoid suture is typical of stereospondyls. Indeed, a more detailed descriptive work can help defining *A. cosgriffi* affinities. FAPESP process – 2009/54656-9.

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PRESENCE OF AN "ANILIOID" SNAKE FROM THE LATE CRETACEOUS OF ADAMANTINA FORMATION, BRAZIL

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The "Anilioidea", a group of basal alethinophidians considered by some authors to be a paraphyletic group, is comprised of taxa that retain certain lizard-like features and are as well specialized to fossorial habits. The Brazilian "anilioid" fossil record is relatively diverse but represented by undescribed vertebrae from the Late Cretaceous Adamantina Formation (Bauru Group), as well as three genera from the Late Paleocene of São José de Itaborí (Itaboraí Basin). Here we present new vertebral material of "Anilioidea", obtained at a roadside of rural road that connects Monte Alto and Taiaçu municipalities, where outcrop rocks of the Late Cretaceous Adamantina Formation (Turonian–Santonian). The same area also provided crocodyliforms (*Montealtosuchus arrudacamposi* Carvalho, Vasconcellos and Tavares, 2007) and some remains of undetermined titanosaur sauropods. The material MPMA 16-0008-08 includes seven small to middle-sized precloacal vertebrae inserted on matrix. They are composed by three articulated posterior trunk vertebrae, two articulated vertebrae and two disarticulated mid-trunk vertebrae. The new "anilioid" snake is characterized by the following combination of characters: general depressed aspect, a clearly depressed neural arch, prominent and strongly inclined zygapophyses, short prezygapophyseal process, a shallow median notch in the posterior border of the neural arch, a centrum that is not markedly widened anteriorly and the absence of paracotylar foramina. Although this work is preliminary, the new material is not a madtsoiid snake or *Najash rionegrina* (Apesteguía and Zaher, 2006) by the absence of paracotylar foramina, also distinguish from them by the presence of strongly inclined zygapophyses and prezygapophyseal process. It contributes to greater knowledge about the group in the Cretaceous of South America, where relationships among the fossil taxa are still unclear.

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ARROYO DEL VIZCAÍNO, UN SITIO CON MEGAFAUNA Y EVIDENCIAS DE PRESENCIA HUMANA A CASI 30.000 AÑOS A.P.

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Durante el verano de 1997, una intensa sequía permitió la exposición del cauce del Arroyo del Vizcaíno, cerca de la localidad de Sauce, Departamento de Canelones, Uruguay. El fondo de ese arroyo está constituido por un limo arenoso en el que se encontraron una gran cantidad de restos óseos, la mayoría de los cuales pertenecientes al perezoso gigante del género *Lestodon* Gervais 1855. En uno de esos restos, una clavícula en buen estado de conservación, presentaba marcas que fueron interpretadas como realizadas por herramientas humanas (Arribas *et al.*, 2001), debido a sus características morfológicas, su asociación a zonas de inserción muscular y su orientación claramente bimodal, ya que las dos direcciones predominantes de esas marcas se disponen en forma casi perpendicular una con respecto a la otra. Años después, una costilla de ese yacimiento y la propia clavícula con modificaciones fueron datadas con una antigüedad de 28.200 ± 230 y 29.050 ± 290 años A.P. (Fariña y Castilla, 2007). En marzo de 2011 se retomaron las excavaciones. Un total de 200 ejemplares fueron colectados en esta oportunidad. Aquí presentamos algunos de los resultados obtenidos. Se analiza, a partir de este estudio preliminar unos 80 huesos con

marcas, la hipótesis de que éstas sean el resultado de procesamiento humano. Asimismo, se muestra un hueso largo con evidencias de fractura longitudinal. También se explora la proporción de las regiones anatómicas representadas en el contexto de esta hipótesis y lo mismo es válido para la explicación del agente deposicional involucrado. Finalmente se presentan tres nuevas dataciones sobre colágeno de huesos con diversos métodos y también sobre un fragmento de madera encontrado, todas las cuales arrojaron fechas congruentes con las obtenidas anteriormente ya publicadas. Si el desarrollo de la investigación logra llevar los indicios al estatus de pruebas o evidencias, este sitio se transformaría en el más antiguo de América con testimonios de presencia humana (ver, entre otros, Dillehay, 2000; Waters *et al.,* 2011) e interacción entre humanos y megafauna, exigiendo una revisión de los modelos más aceptados del poblamiento humano para el Nuevo Mundo.

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THE OCCURRENCE AND GEOLOGICAL IMPLICATIONS OF THE FIRST CRETACEOUS FAUNA FROM LA RIOJA, ARGENTINA

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The Cretaceous terrestrial ecosystems in Argentina are well known especially from Patagonia, namely the Neuquén, Colorado, Somuncurá-Cañadón Asfalto, San Jorge, and Austral basins. Conversely, the northwestern continental Cretaceous basins are virtually unknown besides the rift basin of the Salta Group. Bodenbender (1911) named the "Estratos de Los Llanos" a suite of sedimentary units scattered throughout the La Rioja Province with an Upper Cretaceous age. However subsequent authors correlated these strata with Cenozoic outcrops, a dating that prevailed (see Ezpeleta *et al.*, 2006) until fragmentary dinosaur eggshells were discovered in the Sanagasta (Tauber, 2007). Following this discovery, the age of this locality was reverted to the previous Bodenbender's Cretaceous dating (Grellet-Tinner and Fiorelli, 2010). The 2007–2010 Sanagasta–Tama Project was spearheaded to carry out geo-paleontologic field works in the poorly known Los Llanos Formation, La Rioja province, NW Argentina. The main goal of the project was to explore and thoroughly investigate the Sanagasta neosauropod dinosaur nesting site (Grellet-Tinner and Fiorelli, 2010) and correlate it with other outcrops to better understand the paleontology and paleoenvironments of the Formation. Recent field work led to the identification of numerous fossil localities, with specimens ranging from fragmentary bones to semi-articulated skeletons. The aim of this communication is to report the discovery of a new Cretaceous fossiliferous deposit at the type locality for Los Llanos Formation. The locality offers a diverse Cretaceous terrestrial fauna that consists of turtles, crocodyliforms, and a variety of dinosaurs. A Notosuchia crocodyliform is represented by diagnostic rostral and teeth characters shared with *Notosuchus terrestris* Woodward 1896 and *Sphagesaurus huenei* Price 1950, typical Cretaceous taxa from Gondwana (Fiorelli and Calvo, 2008). Dinosaurs are represented by titanosaurs and several fragmentary theropod taxa. The paleo-fauna assemblage is very similar to others reported in the Cretaceous Neuquén and Baurú Basins. The Los Llanos Formation exposures in the area are characterized by a succession of paleosols, composed by quartz sandstone with sparry cement. Paleosols display typical structures (*e.g.* calcareous nodules, laminar gypsum, rhizocretions and micro-silica sinter) typical of aridisols with calcitic horizons formed in hot and semi-arid climates. Bioturbations, burrows, and pupal chambers (in ephemeral lake facies) are also ubiquitous. The presence of isolated sandy river channels (main fossil-bearing) indicates the occurrence of ephemeral rivers. In conclusion, this study with the research at the Sanagasta site resolve the longstanding geological debate about the relative age of the sedimentary basins from the Sierras Pampeanas by offering definitive geological and paleontological evidence of a Cretaceous age for the Los Llanos Formation.

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TÉCNICAS DE RESTAURACIÓN DE FÓSILES. CASO: HÚMERO HOLOTIPO DE *PANAMERICANSAURUS SCHROEDERI* Calvo y Porfiri 2010

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Durante los trabajos de campo de extracción de los restos de un dinosaurio saurópodo en el año 2003, se comprobó que el espécimen se encontraba en mal estado de preservación debido al alto porcentaje de humedad existente en el área En pos de su inmediata preservación se procedió a recubrir la totalidad de su superficie con el compuesto laca nitrocelulósica-thinner. Una evaluación realizada tiempo después en los materiales rescatados, se comprobó que en el húmero (1,11 mts. de longitud), los problemas de humedad aún persistían, ya que se produjo un cambio de apariencia en su estructura interna mostrándose un desprendimiento de la capa externa muy significativo. Ante la gravedad de los hechos se inició un minucioso trabajo de restauración con el propósito de realizar un secado interno acelerado. Para ello, fue necesario, como primera medida, eliminar la capa protectora de laca nitrocelulósica-thinner. Concluida esta primera etapa, se comenzó a infiltrar, en pequeñas dosis y mediante el uso de jeringas alcohol etílico (etanol) al 96% con el objeto de evaporar la humedad interna. En un lapso de 3 (tres) semanas, la cantidad de etanol inyectada fue de 2 (dos) litros. Seguidamente se decidió dejarlo en reposo durante otras 3 (tres) semanas más manteniéndolo en un lugar cálido y seco. Esta metodología de trabajo permitió la restauración definitiva del húmero y el secado interno en forma acelerada para evitar el deterioro lento que habría terminado con la destrucción del fósil. En suma, el uso de alcohol etílico en el secado de los huesos de vertebrados podría ser una alternativa interesante para eliminar por completo los restos de humedad interna recuperando así el estado original de los mismos.

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PRELIMINARY ANALISYS OF CROWN FORMATION TIME AND LIFE HISTORY VARIABLES IN ARCHAIC UNGULATES FROM SOUTH AMERICA

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The pattern of tooth growth and eruption among mammals were considered as useful tools for phylogenetic analysis and identification of life history traits. Several studies in primates indicated that there is a high correlation among crown formation times (CFT) and several life history traits, particularly body mass and brain size (Macho, 2001). Among archaic ungulates, CFT are known for the Paleocene and Eocene laurasic archaic ungulates *Meniscotherium* Cope, 1874 and two species of *Phenacodus* Cope, 1873 (Dirks *et al.*, 2009), but at present no information is available from bunodont South American native ungulates. Here we analyzed an histological enamel section of the paracone of one right upper molar of *Ernestokokenia nitida* Ameghino, 1901 (Mammalia, Didolodontidae) from the Paleocene and Eocene of Patagonia, Argentina, and compared the results with the available information of CFT of bunodont mammals. The timing of crown formation was inferred considering the periodicity (P), which is the number of cross-striations, and indicates enamel daily growth increments; and striae of Retzius (SR) which account for longer increment periods. Depending whether the SR contact or not the enamel surface, the paracone section was divided in a lateral and cuspal part respectively. The daily secretion rate (DSR) was determined as the average distance between cross-striations. In the cuspal part DSR was obtained for the inner, middle and outer section, and the CFT was determined by dividing the prism length by DSR. The CFT of the lateral part was calculated by multiplying number of SR by P. The preliminary results indicate for *E. nitida* a P of 3, DSR of 3.8 (outer) and 3.0 (middle) and a CFT of 0.75 years. A mean value for *E. nitida* body mass was inferred in 4.74 kg using several dental measures following the equations of Scarano *et al.* (2011). Compared with primates of similar body mass *E. nitida* shows a faster time to form and grow their molars. This CFT values is similar to the observed in taxa with similar ecological roles, represented by Laurasic archaic ungulates, which in contrast, are five times larger (*i.e. Phenacodus intermedius* Granger, 1915 and *Phenacodus trilobatus* Cope, 1882). This analysis raises questions about the relationships between CFT, body mass, and ecological roles in basal ungulates, which seem not to follow those suggested for primates.

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DINOSAURS OF THE MATO GROSSO STATE, BRAZIL, AND NEW SAUROPOD (SAURISCHIA) RECORDS FROM THE ARAGUAIANA MUNICIPALITY REGION, UPPER PART OF THE ARAGUAIA RIVER VALLEY

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Dinosaur fossils in the Mato Grosso state, Brazil, are known since the second half of the XIX century. The first material described was recovered from the Morro do Cambambe region, northeast of Cuiabá. The referred material consists on incomplete postcranial remains, possibly belonging to Sauropoda, whose current repository is unknown. After that, several dinosaur materials have been recovered in the same location, as well as in the vicinity of the Tesouro municipality, towards the southwestern part of the state. Both regions are located in the geological context of the Bauru Basin (Upper Cretaceous) and are commonly referred as belonging to the Marilia Formation, although new studies attempt to redefine the Upper Cretaceous stratigraphy of Mato Grosso (Weska, 2006). In the region of Cambambe, many postcranial remains of Sauropoda have been recovered, as well as isolated teeth of Theropoda (Abelisauroidea and Maniraptora). Some authors have identified the postcranial sauropod material as belonging to Titanosauria and could relate some of the specimens to *Gondwanatitan faustoi* Kellner and Azevedo 1999 (Franco-Rosas *et al.*, 2004). Still in the Cambambe area, in the Roncador Farm, skeletal remains of a large Theropoda Abelisauroidea were excavated by Price in the 1960s, and described in 2002 as a new species named *Pycnonemosaurus nevesi* Kellner and Campos 2002. Fragmented Sauropoda remains were also found in the Roncador Farm, and could be attributed to some sort of Titanosauria. In the Tesouro region, two main sites on the margins of the Confusão Creek, have provided abundant Sauropoda material. These can also be referred as belonging to Titanosauria due to the procelic nature of caudal vertebrae. Other Mesozoic sedimentary contexts of Mato Grosso include the Upper Jurasic–Lower Cretaceous Botucatu Formation (Paraná Basin), and the Lower Cretaceous Parecis Group (Parecis Basin). Dinosaur's records were not yet recovered in these units, although remains of terrestrial crocodyliformes were referred to the Salto das Nuvens Formation, Parecis Group (Marconato, 2006). The new material we present here (P/N 001 e 002, under custody of the Academia de Letras, Cultura e Arte of Barra do Garças, MT) are made up of a distal portion of a humerus and a middle portion of a tibia recovered from the bed of the Araguaia River during mining activities near the city of Araguaiana. Two additional bone fragments were also recovered in the same area decades ago, but rely solely on photographic records. According to the regional geology, the material in question belongs to a stratum of the Marília Formation exposed just below a Quaternary deposit excavated by the river. The prospect potential of the Mato Grosso state is promising, but is little explored due to the lack of established research institutions near the fossil sources. Moreover, there is the logistical difficulty of conducting fieldwork in the area, which is wide and devoid of a well defined sedimentary study.

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ENAMEL MICROSTRUCTURE OF THEROPOD TEETH: A CHARACTERIZATION OF SPECIMENS FROM THE CRETACEOUS OF PATAGONIA

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Enamel is the mineralized tissue that covers the amniote teeth, whose microstructure is constituted by apatite microcrystals arranged in a particular order (Sander, 1999; Stokosa, 2005). In mammals, these microcrystals are organized in such a way that they form prism-like structures (Sander, 1999). The mammalian enamel can be easily observed under polarized light. Conversely, the enamel of reptiles (including dinosaurs) is not prismatic, and therefore can only be observed through scanning electron microscope (SEM) (Sander, 1999, 2000; Hwang, 2005; Stokosa, 2005). Observations on theropod enamel have been mainly performed for Laurasian taxa (*e.g.*, *Tyrannosaurus*, *Velociraptor*, *Troodon*, Sander, 1999; Stokosa, 2005) and only a few Gondwanan taxa (*e.g.*, *Carcharodontosaurus*, *Spinosaurus*, Buffetaut *et al.*, 1986). Recent research has revealed that, despite the convergence observed in the microstructure of theropod enamel, many monophyletic groups have characteristic types of enamel and, therefore, enamel microstructure can be phylogenetically informative, at least at the family level (Hwang, 2005). A characterization of isolated teeth from the Cerro Barcino Formation (Aptan–Albian?) of Chubut Province, that have morphological similarities with abelisaurid, carcharodontosaurid, and dromaeosaurid teeth, is here presented, complementing previous studies on

Gondwanan taxa. Additionally, the enamel microstructure of *Tyrannotitan chubutensis* Novas, De Valais, Vickers-Rich and Rich, 2005 is also presented here. In isolated teeth that morphologically resemble either abelisaurid or carcharodontosaurid teeth, the microcrystals are arranged in columns in the basal half of the enamel and in a parallel arrangement along the outer half, with incremental lines, as the enamel microstructure of tyrannosaurid and carcharodontosaurid teeth. The enamel of isolated teeth morphologically similar to dromaeosaurid teeth is mainly constituted by parallel crystals, in some cases also showing incremental lines, as the microstructure of troodontids and dromaeosaurids. The enamel of *Tyrannotitan* is columnar, as in *Carcharodontosaurus*, but in contrast to the latter, incremental lines predominate in the basal half. Thus, studies based on enamel microstructure are important not only to complement studies of theropod teeth, but also to identify the phylogenetic affinities of isolated theropod teeth found in Cretaceous units of Gondwana.

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NEW DINOSAUR REMAINS FROM THE BAJADA COLORADA FORMATION (BERRIASAN-–VALANGINIAN): NOTES ON THE EARLIEST CRETACEOUS DINOSAURS FROM THE NEUQUEN BASIN, PATAGONIA, ARGENTINA

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Patagonia yielded one of the best samples worldwide of Late Cretaceous terrestrial tetrapods, especially in Gondwanan continents. However, despite few but successful efforts (*e.g.*, Salgado and Bonaparte, 1991; Bonaparte *et al.*, 2006), most of its Early Cretaceous outcrops remain virtually unexplored, especially in northern Patagonia. The Bajada Colorada Formation (Berriasan-–Valanginian), whose sedimentites crops out in northwestern Patagonia, Neuquén Province, represents the most basal Cretaceous continental unit in the Neuquén Basin. The first dinosaur records from this unit were briefly communicated by Apesteguía and Bonaparte (2004), consisting in a sauropod dorsal vertebra referred to a diplodocoid and a fragmentary theropod femur with tetanuran affinities. Here we report new findings, consisting in a tooth and a cervical neural arch assigned to a theropod dinosaur, as well as a complete mid-caudal vertebra assigned to a sauropod. The tooth is labiolingually compressed, with mesial and distal serrated carinae and a slightly eight-shaped transversal basal section. The mesial carina is limited to the distal medium height of the crown. This dental morphology resembles that of basal tetanurans. The cervical neural arch is characterized by long, laminar, and anteroventrally projected diapophyses, and anterodorsally projected prezygapophyses, resulting in an "X-shaped" form in anterior view. These traits resemble those present in cervical vertebrae of abelisaurids. On the other hand, the complete mid caudal vertebra present an amphiplathyan centrum with strongly concave ventral surfaces and pronounced lateral borders. The neural arch shows elevated pillars located on the mid-anterior portion of the centrum. While prezygapophyses are anterodorsally projected, the laminar neural spine points upwards and backwards, being connected by well developed spinoprezygapophyseal laminae. Despite the overall morphology of this vertebra resembles that of basal macronarian sauropods, its centrum resembles that of diplodocids (*e.g.*, *Diplodocus* Marsh, 1878). These materials were found in close association with fragmentary remains of vertebrae, long bones and a poorly-preserved coracoid. More efforts are necessary in order to understand the faunal components that followed the Jurassic fauna of Patagonia and how Late Cretaceous faunas arose. This new record contributes to increase the knowledge of basal Cretaceous assemblages of Patagonia.

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EREMOTHERIUM LAURILLARDI: A IMAGEM DAS DOENÇAS NO PLEISTOCENO DO ESTADO DO ESPÍRITO SANTO,

BRASIL

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Há cerca de dez anos, um exame inicial sobre o acervo paleomastozoológico da coleção de Paleovertebrados do Museu Nacional / Universidade do Rio de Janeiro indicou a necessidade de um estudo mais aprofundado de diversos exemplares que apresentam alterações morfológicas. Erros de identificação podem ocorrer em trabalhos descritivos de morfologia, dentre eles a descrição de patologias ou alterações tafonômicas como morfologia própria de cada elemento e, por extensão, de cada indivíduo (Ferigolo, 1987; McDonald, 1989). A distinção e o diagnóstico de tais elementos ultrapassam o conhecimento científico e atingem o âmbito da curadoria de coleções osteológicas, auxiliando na forma como os exemplares devem ser protegidos, manuseados e armazenados. Devido a sua fragilidade, que fica mais acentuada devido a traumas, doenças ou mesmo modificações ósseas decorrente de senilidade, tais exemplares fósseis requerem um tratamento diferenciado por parte do curador. Foram analisados no presente estudo exemplares da espécie *Eremotherium laurillardi* (Lund) que provem de afloramentos situados na Serra do Gironda, Distrito de Itaóca, Pleistoceno do Estado do Espírito Santo.Foram encontrados ao todo 179 exemplares que apresentaram algum tipo/grau de sinal patológico. 32 elementos vertebrais estão catalogados sob o mesmo número de tombo (MN 3859-V). Em 30 deles foram observados sinais que indicam algum tipo de processo patológico como espessamento do osso cortical em corpos vertebrais formando "pilares ou colunas", osteófitos acompanhando as facetas articulares, remodelação óssea em distintos pontos vertebrais, e sinais de estresse muscular e processo degenerativo. Assim como os exemplares vertebrais, 176 fragmentos de costela também estão catalogados sob o mesmo número (MN 3860-V). Desses, 101 elementos exibem sinais de labiamento nas facetas articulares, marcas de estresse mecânico, neoformação e remodelação óssea (sugerindo periostite em vários graus de intensidade), osteófitos, calo ósseo decorrente de fratura e sinais indicativos de infecção. Além desses exemplares foram observadas alterações ósseas patológicas em: clavícula esquerda MN 3862-V (neoformação óssea na superfície cortical), úmero direito MN 3866-V (grande número de osteófitos e remodelação óssea na articulação distal), rádio direito MN 3867-V (ampla quantidade de osteófitos na região articular distal e intenso crescimento e remodelação óssea na região da diáfise), tálus esquerdo MN 3875-V (osteocondrite dissecante), calcâneos direitos MN 3878-V e MN 3880-V (intensa remodelação/neoformação óssea) e falanges I e II, dedo III, do pé direito MN 3884-V (grande crescimento ósseo na base da falange ungueal com superfície bastante rugosa e anquilose com as falanges I e II). O conjunto de sinais encontrados nos exemplares analisados sugere como hipóteses de diagnóstico: fraturas traumáticas, esforço (estresse) muscular, inflamação, infecção e senilidade.

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OSTEODERM HISTOLOGY OF CINGULATES (MAMMALIA, XENARTHRA) FROM THE LATE PLEISTOCENE OF THE INTERTROPICAL REGION OF BRAZIL

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During the late Pleistocene, several cingulate species coexisted in the Brazilian intertropical region, some probably endemic. They are known mostly by isolated osteoderms, carapace fragments and caudal tube. This work presents anatomical microstructure descriptions of osteoderms from four Brazilian cingulates – the glyptodonts *Panochthus greslebini* Castellanos, 1941, *Panochthus jaguaribensis* Moreira, 1965, *Glyptotherium* sp. and *Pachyarmatherium brasiliense* Porpino, Fernicola e Bergqvist, 2009 – based on paleohistological sections in order to provide additional characters for species diagnosis and shed further light on their phylogenetic relationships. *Pachyarmatherium brasiliense* lacks derived characters shared by glyptodonts and pampatheres, such as extensive bone remodeling, fibers arranged in large bundles and undeveloped layers of compact bone in relation to the layer of trabecular bone. These offer additional support for excluding *Pachyarmatherium* from glyptodonts, as suggested by a recent cladistic analysis (Porpino *et al.,* 2009). The osteoderms of the Brazilian Glyptodontinae share histological feature states with *Glyptotherium floridanus* Simpson, 1929 in contrast to *Glyptodon* Owen, 1839, which reinforces its recent assignment assignment to *Glyptotherium* Osborn, 1903. The histological pattern of the osteoderm from *P. greslebini* matches the one observed in other species of within *Panochthus* Burmeister, 1866 (*e.g.*, *Panochthus frenzelianus* Ameghino, 1889). In contrast, the presence of thicker layers of compact bone, the pattern and size of resorption areas, and the absence of randomly-oriented lateral fiber bundles and of an intermediary region between the layer of compact and trabecular bone support the exclusion of *Panochthus jaguaribensis* from the genus *Panochthus*, as previously proposed (Moreira, 1971). These results highlight the relevance of histological osteoderm characters to cingulated systematics, though further analyses based on broader osteoderm sampling are needed to corroborate the conclusions obtained here.

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LOS GLYPTODONTIDAE PALAEHOPLOPHORINI (MAMMALIA, XENARTHRA, CINGULATA) DE LA FORMACIÓN PUERTO MADRYN (MIOCENO TARDÍO) EN PENÍNSULA VALDÉS (CHUBUT, ARGENTINA)

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Los Palaehoplophorini Hoffstetter, 1958 (Mayoense-Huayqueriense) son uno de los grupos de gliptodontes más diverso del Mioceno tardío (Scillato-Yané, 1986). Esta tribu está representada por *Palaehoplophorus* Ameghino, 1883, *Protoglyptodon* Ameghino, 1885, *Pseudoeuryurus* Ameghino, 1889, *Clamyphractus* Castellanos, 1940, *Aspidocalyptus* Cabrera, 1939 y *Palaehoplophoroides* Scillato-Yané y Carlini, 1998. Todos los primeros registros ocurren en el Mioceno tardío extrapatagónico, a excepción de los dos más antiguos (Mioceno medio) y australes (suroeste de Chubut): *Palaehoplophoroides rothi* Scillato-Yané y Carlini, 1998 (Formación El Pedregoso, 12.2 Ma) y *Palaehoplophorus meridionalis* Ameghino, 1904 (Formación Río Mayo, 11.8 Ma). Recientemente se han recuperado nuevos restos de Palaehoplophorini en los niveles superiores de la Formación Puerto Madryn (Mioceno tardío), aflorantes en Península Valdés (Chubut), los cuales constituyen el tercer registro de la tribu para Patagonia. Los osteodermos recuperados (AC5FS1-4, AC12FS, MPEF-PV 2531 y 2532) presentan caracteres en común con osteodermos exhumados en el "conglomerado osífero" (Mioceno tardío, base de la Formación Ituzaingó) en Entre Ríos (MACN 2684, 2715, 2718 y 4099). Dichos caracteres son: una hilera interna de figuritas periféricas menores y una hilera de forámenes conspicuos que rodean a una figura central amplia, y una hilera externa de figuritas periféricas mayores que rodea a las anteriores. Estos caracteres, ausentes en las especies conocidas de Palaehoplophorini indicarían una nueva especie de *Palaehoplophorus*. Por último, la presencia de este taxón en los niveles superiores de la Formación Puerto Madryn es consistente con la edad Huayqueriense propuesta por Dozo *et al.* (2010) para la fauna de vertebrados continentales de dicha formación. PIP 2011-13 (MTD).

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DECONSTRUCTING HATEG: THE FIRST EVIDENCE OF REPRODUCTIVE ADAPTATION TO "ISLAND EFFECT" OF A DWARF CRETACEOUS ROMANIAN TITANOSAUR, WITH EMBRYONIC INTEGUMENT *IN OVO*

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The Cretaceous vertebrate assemblages of Romania are famous for geographically endemic dwarfed dinosaur taxa (Benton *et al.*, 2010; Csiki *et al.*, 2010). We report the first complete egg clutches of a dwarf lithostrotian from Toteşti, Romania, and its reproductive adaptation to the "island effect". The eggs were discovered in sequential sedimentary layers of the Maastrichtian Sânpetru Formation (Smith *et al.*, 2002; Van Itterbeeck *et al.*, 2004). The repartition of 11 homogenous clutches in successive strata indicates philopatry by the same dinosaur species, which laid clutches averaging four ~12 cm diameters eggs. The eggs and eggshells display overwhelming shared characters with the material from egg-bearing level 4 of the Auca Mahuevo Patagonian lithostrotian nesting site (Grellet-Tinner *et al.*, 2004). The shared oological characters between Haţeg and its mainland relatives suggest a highly conservative reproductive template, while the nest decrease in egg numbers per clutch may reflect an adaptive trait to a smaller body size due to the "island effect". Microscopic embryonic integument with bacterial evidences was recovered in one egg. The millimeter-size embryonic integument already displays a pebbled surface consisting of micron size, non-overlapping tubercles, implying that this epidermal ornamentation developed at an early embryological stage and its preservation was microbially induced (Briggs, 2003). The combined presence of the lithostrotian egg and its embryo in the Early Cretaceous Gobi (Grellet-Tinner *et al.*, 2011) coupled with the oological similarities between the Haţeg and Auca Mahuevo oological material evidence that several titanosaur species migrated from Gondwana through the Haţeg Island before or during the Aptian/Albian (Gheerbrant and Rage, 2006) and suggests that this Island might have had episodic land bridges with the rest of the European archipelago and Asia deep into the Cretaceous.

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THE CENOZOIC AMERICAN TAPIRS: PHYLOGENY AND BIOGEGRAPHY

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The earliest records of genus *Tapirus* Brisson, 1762 in North America are late Miocene. The genus appeared in South America from immigrant of the faunistic events the Great American Biotic Interchange (GABI). A phylogenetic analysis was performed in order to elucidate the relationships of American fossil species and extant species, with a total of 51 characters and 18 terminal taxa including the outgroups (five species of Tapiridae). We consider as terminal taxa the living species of the genus *Tapirus*; three Miocene species from North America [*T. johnsoni* Schultz *et al.*, 1975; *T. webbi* Hulbert, 2005; and *T. polkensis* (Olsen, 1960)]; three Pliocene–Pleistocene species from North America [*T. lundeliusi* Hulbert, 2010; *T. haysii* Leidy, 1859; and *T. veroensis* Sellards, 1918]; and three South American fossil taxa [*T. mesopotamicus* Ferrero & Noriega, 2007; *T. rondoniensis* Holanda *et al.*, 2011; and *T. cristatellus* Winge, 1906]. The multistate characters were codified as unordered. A single most parsimonious tree (MPT) was obtained by exhaustive searching, using the TNT program, with 110 steps under equal weights, consistency index (CI) of 0.47 and a retention index (RI) of 0.67. *T. pinchaque* is group sister of Neotropical fossil, extant tapirs and derived North American species. The clade composed by (*T. mesopotamicus* (*T. terrestris*, *T. rondoniensis*)) diverges from clade composed by (*T. cristatellus* (*T. indicus* (*T. bairdii* (*T. polkensis* (*T. lundeliusi* (*T. veroensis*, *T. haysii*)))))). Our result is consistent with a paraphyletic hypothesis for South American tapirs, since *T. pinchaque*, *T. terrestris, T. mesopotamicus, T. rondoniensis* and *T. cristatellus* do not form a monophyletic group. The result from phylogenetical analysis suggests a close relationship between the South American tapirs and *T. webbi,* which supports the hypothesis of a dispersal event from North America to South America during the Miocene. Moreover, our data indicate a second dispersal event from South America to North America, possibly from a form closely related to *T. cristatellus,* which would have resulted to the derived forms of southeast North America.

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NEW FOSSIL-BEARING OUTCROPS OF THE TRIASSIC (CARNIAN) OF SOUTHERN BRAZIL, AND ITS BIOSTRATIGRAPHIC SIGNIFICANCE

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The Santa Maria Supersenquence (Santa Maria Fm.) is a Meso–Neotriassic sequence that crops out on the central region of Rio Grande do Sul state (Zerfass *et al.*, 2003). It preserves a diverse fauna, that occur in four biozones: the *Dinodontosaurus* Assemblage Zone (AZ), *Santacruzodon* AZ, *Hyperodapedon* AZ and *Riograndia* AZ (listed from base to top). The opening of a new road (RSC153) in the region of Vera Cruz municipality exposed a series of new outcrops, some of them fossiliferous. The most significantly collected taxon is the rhynchosaur *Hyperodapedon* Huxley 1859, which identifies the *Hyperodapedon* AZ (Carnian, Soares *et al.,* 2011; IUGS, 2009). These levels are succeeded, through a tectonic contact, by the Early Cretaceous aeolian sandstones of the Botucatu Fm. and/or the lavas of Serra Geral Fm, evidencing the existence of a gap that would correspond to the upper levels of the Santa Maria Supersequence (where the *Riograndia* AZ occurs). The new fossiliferous outcrops consist mainly of massive or laminated red mudstones. In some levels the mudstone is excavated and filled with fine sandstone with cross-bedded stratification and mudstone intraclasts, interpreted as fluvial channels filling facies. In one of the outcrops, one of these erosive levels reveals a change in the fossil content. The lower portion of the outcrop (below the erosive horizon) preserved fossils of *Hyperodapedon*. Above this level, occurs an intraformational basal conglomerate, followed by a sandstone lens, succeeded by a new deposit of massive mudstone. In these upper levels, no rhynchosaurs were found, and traversodontid cinodonts (cf. *Exaeretodon* Cabrera, 1943) begin to occur. This same faunal change is observed in the Ischigualasto Fauna of Argentina (Ischigualasto-Villa Unión Basin), where rhynchosaurs predominate at the base of the package, being later succeeded by an *Exaeretodon* predominance at the top (Martinez *et al.*, 2011). Oliveira and Schultz (2007) suggested the occurrence of this same faunistic change based on the fossil content of some outcrops from Agudo municipality that revealed a predominance of *Exaeretodon* regarding to *Hyperodapedon*. The Vera Cruz outcrops not only support this proposition but also shows that minor discordances can occur inside the Brazilian Triassic AZs. This fact, besides the gap identified at the top of the Santa Maria Supersequence at the studied area, reinforced the hypothesis of an active tectonic activity controlling the deposition (and the erosion) of the Triassic sedimentation in southern Brazil. In this context, it could be possible that the *Hyperodapedon* AZ must be split into two, with the creation of an *Exaeretodon* AZ in its upper portion. Nevertheless, a formal proposal should only be made after additional mapping work in the region, allowing the decisive characterization of these different faunal levels. IUGS, 2009. International Stratigraphic Chart.

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NEW MATERIALS FROM SNAKES (LEPIDOSAURIA, SQUAMATA) FROM THE MIOCENE OF VENEZUELA

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The recent findings of Miocene squamates in northern South America has increased our knowledge as well provided new systematic and

palaeoenvironmental data. In the northwestern Falcón State near Urumaco Municipality, Venezuela, outcrop the Socorro and Urumaco Formations, which hosts diverse terrestrial, freshwater, estuarine and marine faunal associations including a diverse vertebrate fauna (Sánchez-Villagra and Aguilera, 2006). Head *et al.* (2006) described the first records of fossil snakes of Venezuela, belonging to the probable basal alethinophidian snake *Colombophis* (Hsiou *et al.*, 2010) and undetermined Boidae. Later, Hsiou and Albino (2010) re-evaluated some boid materials of Head *et al.* (2006) and attributed such vertebrae to *Eunectes* sp. and cf. *Eunectes*. Here we report new snake vertebral remains from the Middle–Late Miocene of Venezuela (Socorro and Urumaco Formations). Some of the new snake vertebrae can be also referred to the extant boid snake *Eunectes* sp. (Late Miocene of Urumaco Formation), whereas the other materials belong to *Colombophis portai* Hoffstetter and Rage, 1997 (Middle Miocene of Socorro Formation). These new records reinforce the idea that the squamate assemblage found in northern South America has ecological similarities with the Miocene faunas of La Venta (Colombia), Urumaco (Venezuela), and Acre (Brazil) (Hsiou and Albino, 2009, 2010; Hsiou *et al.*, 2009, 2010).

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YOUNGEST RECORD OF THE BOID SNAKE *CHUBUTOPHIS* IN THE MIOCENE OF SOUTHWESTERN AMAZONIA

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One of the most relevant South American Neogene vertebrate assemblages is known from the Solimões Formation of Acre and Amazonas states in southwestern Brazilian Amazonia. Its squamate association from the Late Miocene demonstrates extensive affinities with other Miocene faunas of northern South America (*e.g.*, La Venta in Colombia, Urumaco in Venezuela). Here we report a new vertebra of the boid snake *Chubutophis* Albino 1993, which is a genus previously known only for the Middle–Late Eocene of Patagonia (Argentina). The new specimen was collected at the border between Peruvian and Brazilian Amazonia, in the "False Acre VI" locality, Acre River. It is assigned to *Chubutophis* based mainly on the following combination of vertebral characters: large size; neural arch high and wide; neural spine anteroposteriorly oriented; zygosphene thick, rather narrower than cotyle; prezygapophyseal articular facets dorsally inclined; prezygapophyseal process strongly reduced; paradiapophyses large, robust and elevated; centrum very short; shallow subcentral grooves; hipapophyses or haemal keel anteriorly indistinct, only prominent posteriorly; and presence of paracotylar foramen. This record implies the survival of this Eocene genus until at least the Late Miocene of northern South America. The tropical climate in this area would have been favorable for the living of large boid snakes such as *Chubutophis* and *Eunectes* (Hsiou and Albino, 2009), due to the development of a large fluvial megafan complex characterized by open areas and forest galleries along rivers, swamps, and shallow lakes, similar to that seen currently in the Pantanal wetland (Latrubesse *et al.,* 2010).

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A NEW RECORD OF A DICYNODONT (THERAPSIDA, ANOMODONTIA) FROM THE LATE PERMIAN OF THE RIO GRANDE DO SUL STATE (RIO DO RASTO FORMATION), SOUTHERN BRAZIL

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The dicynodonts are an exclusively herbivorous group of therapsids. Fossil materials of this lineage have been found in continental deposits from Late Permian to Late Triassic, with only one occurrence of Cretaceous age (Thulborn and Turner, 2003). The wide morphological diversity and abundance as well as its geographic and stratigraphic distribution made dicynodonts one of the most successful therapsid groups (King, 1990). In the southern Brazilian Triassic, a material tentatively assigned to dicynodont was found in the Sanga do Cabral Formation [*Procolophon* Assemblage Zone (AZ)/Induan/Olenekian]. In the Santa Maria Formation (*Dinodontosaurus* AZ/Ladinian) three genera are known: *Dinodontosaurus* Romer, 1943, *Ischigualastia* Cox, 1962, and *Stahleckeria* Huene, 1935. *Jachaleria* Bonaparte, 1970 was recorded in the Caturrita Formation (*Riograndia* AZ/Norian). In comparison with the Triassic dicynodonts, Brazilian Permian forms are still scarce. There is only one Late Permian (Guadalupian–early Lopingian) occurrence from the Rio do Rasto Formation of the Paraná State that comprises some cranial and mandibular fragments assigned to *Endothiodon* Owen, 1876 (Barberena and Araújo, 1975). The present contribution

represents the first record of a Permian dicynodont from the Rio do Rasto Formation of the Rio Grande do Sul State (late Wordian–Capitanian). The specimen was found in Boqueirão Farm outcrop, located near the São Gabriel municipality. It is an almost complete specimen, with skull (length = 9.5 cm) and post cranial materials associated. A preliminary shows that the new specimen differs from *Endothiodon* in having a caniniform process without tusks. Besides these characteristics, the new specimen shows: a massive and relatively flat snout; paired small nasal bosses; a caniniform process like a smooth continuation of the palatal rim which does not bear an anterior notch and presence of a mandibular fenestra in the lower jaws. This suite of features suggests that UNIPAMPA PV 00317 might represent a new taxon. More detailed anatomic study will be developed aiming to elucidate the taxonomy and phylogenetic position of this fossil within the Dicynodontia clade.

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AN AZHDARCHOID LOWER JAW (PTEROSAURIA, PTERODACTYLOIDEA) FROM THE PORTEZUELO FORMATION (CRETACEOUS), NEUQUÉN GROUP, PATAGONIA, ARGENTINA

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Except for the deposits of the Lower Cretaceous Santana Group of northeastern Brazil and the Lagarcito Formation of San Luis, Argentina, the pterosaur record in South America can be considered rare and limited to incomplete and mostly isolated specimens. In the last decade a new quarry named Futalognko, situated some 90 km northwest of the Neuquén city in Argentina has yielded an extensive amount of fossils, including mostly dinosaur material. They were collected in the Portezuelo Formation of the Río Neuquén Subgroup, (Neuquén Group) formed during the Late Cretaceous (Turonian–Coniacian). Some pterosaur material has also been found but consisted of isolated postcranial bones. Here we report a lower jaw from that deposits which is housed at the Centro Paleontológico Lago Barreales (CePaLB), of the Universidad del Comahue (MUCPv-1137). This specimen, one of the few pterosaurs cranial material recovered from Argentina so far, is partially compressed, a common feature of pterosaur material, with the tip of the dentary and the posterior end of the mandibular rami broken. The total preserved length is 259 mm, with the bone cortex very thin and deformed in some areas, particularly on the proximal portion. No alveoli were observed. Most of the lower jaw is formed by the dentaries that are fused forming a long mandibular symphysis, occupying between 70 and 75% of the preserved length of the lower jaw. The posterior end of the symphysis is deep, more than in most other toothless pterosaurs. The dorsal surface of the posterior end of the mandibular symphysis shows two well-developed bony ridges each bordered by a laterally deep sulcus which has not been reported in any flying reptile before. A small ventral crest in the middle portion of the lower jaw could be identified. The symphyseal region does not form a symphyseal shelf as observed in the Pteranodontidae and the Nyctosauridae. The mandibular symphysis MUCPv-1137 differs from the thalassodromins *Thalassodromeus* Kellner and Campos, 2002 and *Tupuxuara* Kellner and Campos, 1988 by being deeper at the posterior end of the symphysis, where mandibular rami bifurcate. The shape of the ventral crest differs from the ones observed in the Tapejarinae such as *Sinopterus* Wang and Zhou 2002 and *Tapejara* Kellner 1989 and its basic morphology differs from the Chaoyangopteridae. This specimen can be allocated to the Azhdarchoidea and based on morphology and stratigraphy (see Kellner, 2010), represents a new taxon possible referable to the Azhdarchidae. This material is one of the few records of those flying reptiles that inhabited terrestrial ecosystems.

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REAPPRAISAL OF THE RODENT *MYOCASTOR* KERR, 1792 (RODENTIA: HYSTRICOGNATHI) FROM THE BRAZILIAN QUATERNARY – PRELIMINARY DATA

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The caviomorph rodent *Myocastor* Kerr, 1792 includes, at least, six species recorded in the South American Quaternary: *M. coypus* (Molina, 1782) [the only living taxon], *M. columnaris* Rusconi, 1929, *M. minor* Rusconi, 1929, *M. priscus* (Gervais and Ameghino, 1880), *M. obesus gracilis* Rusconi, 1929 and "*M. perditus*" (Ameghino, 1902), this one with uncertain validity (see Cartelle & Lessa, 1989). Up to now, fossil remains of *M. coypus* have been reported for Brazil, from Minas Gerais and Bahia karsts (late Pleistocene/Holocene) (Winge, 1887; Cartelle & Lessa, 1989); and from the continental shelf (Pleistocene) of Rio Grande do Sul State (RS), southern region (Rodrigues & Ferigolo, 2004). The discovery of new remains from Pleistocene beds of southern Brazil motivated a research program to review the material previously assigned to *Myocastor* from this country, as well as, to describe these new remains. Until now, we compared the fossil remains with 28 skulls of different ontogenetic stages of the living taxon. This first approach recognized several specimens (skull, dentaries and isolated teeth) from RS assigned preliminary to *Myocastor* sp. One skull (MCN-PV 9712) recovered from Touro Passo Formation (upper Pleistocene) shows differences in relation to *M. coypus*: the palate is more flat and slightly widen in the area between both M3; and the ventral zygomatic roots of maxilla are more robust. Other remains from the continental shelf (MCN-PV 9719; 9720; 9722) and Sanga da Cruz locality (MCN-PV 10070) (late Pleistocene) are similar to *M. coypus.* These records represent the first mention of *Myocastor* in the continental Pleistocene beds from RS. The specimens from Bahia State (late Pleistocene/Holocene) are represented by cranial (MCL 7140/1; 7141; 7142) and postcranial remains (MCL 7140/2-27; 7127; 7128). They were assigned to *M. coypus* by Cartelle and Lessa (1989). However, these authors pointed some differences in comparison to the living taxon: suture frontonasal oblique and rectilinear; zygomatic arch less ventrally projected; mastoid process posteriorly oriented. The data here reported are preliminary and the material needs a comparison with more fossil and recent specimens.

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NEW FINDINGS OF FOSSIL MAMMALS FROM THE EARLY MIOCENE CERRO BANDERA FORMATION (NEUQUÉN PROVINCE, ARGENTINA). BIOCHRONOLOGICAL AND PALEOBIOGEOGRAPHICAL CONSIDERATIONS

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The Cerro Bandera Formation is a Miocene continental succession exposed in isolated areas at the centre-East of Neuquén Province, Northwestern Patagonia, Argentina (Leanza and Hugo, 1997). The sequence is 45 m thick, composed by primary and reworked pyroclastic deposits and scant sandstone levels, filling local paleovalleys excavated on Late Cretaceous and Paleocene rocks (Leanza and Hugo, 1997; Kramarz *et al.*, 2005). Based upon its faunal content, this unit was referred to the Colhuehuapian SALMA (early Miocene) (Kramarz *et al.*, 2005). Here we report a new mammal association derived from two new localities of the Cerro Bandera Formation situated at the northeastern slope of the Barda Negra (Zapala Department). The specimens are housed at Museo "Prof. Dr. Juan A. Olsacher", Zapala. Mammals from Loc. A (39°0′06.3S–69°40′54.3″) come from whitish-greyish tuffaceous levels, about six meters from the base of the stratigraphic section exposed in the area. Those from Loc. B (39°02′26.21″S–69°40′53.36″W) derive from similar rocks located about 25 meters from the exposed base. In contrast to other previously studied localities (Kramarz *et al.*, 2005), the new ones provided more abundant and more complete remains. Many of the taxa newly recorded in both localities support a Colhuehuapian age [*e.g.*, *Colpodon* Burmeister, 1885 (Notoungulata)]. However, the same deposits also provided some few taxa that are not represented in the typical Colhuehuapian and younger mammal associations from Central Patagonia, but in the immediately older Deseadan SALMA (late Oligocene) [*e.g.*, *Cephalomys* Ameghino, 1897 (Rodentia), Archaeohyracidae (Ameghino, 1897) (Notoungulata)]. Although further studies and absolute datings are necessary, these new findings suggest that the Cerro Bandera mammal assemblage would document the survival in northern Patagonia of some mammals that already became extinct in central and southern Patagonia before the early Miocene. As an alternative interpretation, the Cerro Bandera assemblage would represent a transitional association between the typical Deseadan and Colhuehuapian faunas, corresponding to a pre-Colhuehuapian age, hitherto recorded anywhere else in South America.

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DELAYED DENTAL ERUPTION IS NOT A SHARED CHARACTERISTIC OF AFROTHERIAN MAMMALS AND SOUTH AMERICAN NATIVE UNGULATES

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In a recent paper, Agnolin and Chimento (2011) claimed that the endemic South American "ungulates" Notoungulata, Astrapotheria, and possibly Pyrotheria, are closely related to Afrotheria by sharing a late replacement of deciduous cheek teeth. This statement was based on: (1) the usual occurrence within these groups of individuals with deciduous and permanent teeth; (2) the impossibility of discriminating adults or senile individuals of these groups (with permanent premolars erupted) from juveniles (with deciduous premolars), when using the length/width ratio of cheek teeth to evaluate the total size of an individual; and (3) the retention of at least dP1–dP3 in adult or senile specimens of *Parastrapotherium* Ameghino 1895. More recently, Billet and Martin (2011) demonstrated categorically that there is no delayed dental eruption relative to skull growth in notoungulates, except in a few late-diverging lineages. Herein we critically examine the presumed existence of delayed dental eruption in astrapotheres, pyrotheres and xenungulates and the assumptions on which this was based. In most eutherians the DP4/4 is usually replaced before the eruption of M3/3, thus the coexistence of deciduous and permanent teeth (*e.g.* DP4/4 and M1/1) does not necessarily indicate that the permanent cheek teeth finished erupting after adult body size was reached. Among taxa where no juveniles are known, the eruption of P4/4 before the M3/3 can be inferred in adults when P4/4 is more worn than M3/3). The ontogenetic stage of astrapotheres, pyrotheres and xenungulates cannot be inferred though length/width ratio of molars because they are brachydont and their size is defined before eruption. In the only known specimen of the pyrothere *Griphodon peruvianus* Anthony 1924 with dp4, m1 and encrypted p3-4, the mesial part of alveolus of m2 is as deep as the p4, suggesting that both teeth would have erupted almost simultaneously, before the m3. In *Astrapotherium magnum* Burmeister 1879 (the only astrapothere in which the complete ontogenetic series is known) the p4 also erupted before m3. The timing of dental eruption relative to jaw growth in this species indicates that specimens with less than 90% adult jaw length have more than 60% of permanent cheek teeth, as seen in the YPM PU 15332, whereas afrotherian specimens of 95% adult jaw length have much less than 60% of permanent cheek teeth (Asher and Lehmann, 2008). In all known adult specimens of *Parastrapotherium* Ameghino the cheek teeth formula is unmistakably P3-4/3-4, M1-3/1-3 (Kramarz and Bond, 2008), and in no known astrapothere are the deciduous premolars retained in adult stages as was claimed by Agnolin and Chimento (2011). In the xenungulates *Carodnia vieirai* Paula Couto 1952 and *Etayoa bacatensis* Villaroel 1987, the P4/4 shows more wear than M3/3. Consequently, we conclude that there is no evidence of delayed dental replacement in astrapotheres, pyrotheres and xenungulates that could support afrotherian affinities for these mammals.

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TETRAPOD BURROWS IN THE EARLY MIDDLE TRIASSIC TARJADOS FORMATION, ARGENTINA: ORGANISM RESPONSES IN SEMI-ARID SEASONAL CLIMATES

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Large burrows are recorded in the early Middle Triassic Tarjados Formation, at Talampaya National Park, La Rioja province, Argentina. Facies analysis indicates that they are preserved in sandbars of ephemeral fluvial systems developed under a semi-arid seasonal climate. The structures are mostly recorded in longitudinal cross-section and consist of a mold of an opening, a main ramp and a terminal chamber. The main ramp is 8 to 14 cm in height, 49 to 63 cm deep with an inclination of 30° to 45°, and up to 130 cm in length. We studied the burrow dimensions, the overall architectural morphology, and the presence of surficial marks to compare them with other large burrows of both invertebrate and vertebrate origin. As a result, the Tarjados burrows are interpreted as produced by tetrapods, and the possible tracemaker was identified using: (1) body fossils preserved within other Upper Permian and Triassic burrows, (2) functional morphology of anatomically

defined burrowers, and (3) records of putative burrowers in stratigraphically equivalent outcrops. The analysis suggests that the Tarjados structures were most-likely produced by non-mammalian cynodonts. Comparison with other Upper Permian and Triassic tetrapod burrows allowed the identification of three generalized morphological groups: (1) burrow network complexes, (2) helical burrows, and (3) simple inclined burrows, each of which represents different behaviors. In Gondwana, the environmental and climatic context in which Lopingian (Upper Permian) and Early–Middle Triassic burrows are preserved suggest that aridity and seasonality played a fundamental role in the evolution of burrowing behavior, at least among therapsid.

A NEW ABELISAURID SPECIMEN, INCLUDING A PARTIAL SKULL, FROM THE "MIDDLE" CRETACEOUS OF CENTRAL PATAGONIA

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Abelisaurid ceratosaurs were the most diverse, abundant, and geographically widespread large-bodied theropods in the Gondwanan landmasses at the end of the Cretaceous. Nevertheless, the initial stages of this important carnivorous dinosaur radiation remain insufficiently understood, with most Early and "middle" Cretaceous abelisaurids being represented by fragmentary or only briefly described fossils. We report a new abelisaurid partial skeleton (Universidad Nacional de la Patagonia "San Juan Bosco" Paleontología de Vertebrados [UNPSJB-PV] 1003) from the Estancia Laguna Palacios in south-central Chubut Province, central Patagonia, Argentina. Recovered from the middle Cenomanian–Turonian Lower Member of the Upper Cretaceous Bajo Barreal Formation, UNPSJB-PV 1003 preserves most of the caudal half of the skull (braincase, left lacrimal, and both postorbitals, frontals, parietals, and squamosals), both dentaries, isolated teeth, the partial sacrum, 21 caudal vertebrae, at least two dorsal ribs and 14 haemal arches, the incomplete left scapula, and much of the right tarsus and pes. Within Abelisauridae, the new skeleton probably pertains to a basal member of the clade, as evidenced by its retention of several plesiomorphic characters (*e.g.*, minimal cranial ornamentation; fenestra between lacrimal, postorbital, and frontal; dorsoventrally thin frontal; lack of awl-like, proximally-directed projection at lateral end of proximal caudal transverse process; mediolaterally slender metatarsal III). Furthermore, the specimen exhibits a number of probable autapomorphies (rounded prominence bordered caudally by mediolaterally-oriented groove on caudolateral part of dorsal surface of frontal; low, acute caudomedial tuberosity on dorsal surface of frontal, bordering "caudal median fossa"; and proximal caudal transverse processes abruptly expand in proximodistal dimension well medial to their lateral extremes), suggesting that it belongs to a previously-unrecognized taxon. The probable abelisaurid *Xenotarsosaurus bonapartei* Martínez *et al.,* 1986 has already been recorded in the Bajo Barreal Formation; unfortunately, however, no elements of the only known specimen overlap with UNPSJB-PV 1003, precluding direct comparisons between them. The proximal-most preserved caudal vertebra of the Laguna Palacios specimen does differ in several regards from that of another abelisaurid partial skeleton from this formation (Martínez *et al.*, 2004). Interestingly, the sacrum and metatarsal III of the new skeleton are marked by shallow, subparallel grooves that probably correspond to feeding traces left by other archosaurs. Given that most of the shed tooth crowns discovered at the site are referable to Abelisauridae, it is possible that UNPSJB-PV 1003 was scavenged by other representatives of its clade, and perhaps even cannibalized (as has been documented in the Malagasy abelisaurid *Majungasaurus crenatissimus* [Depéret 1896] Lavocat 1955; Rogers *et al.*, 2003). The Bajo Barreal skeleton therefore sheds light on the sequence of character acquisition in abelisaurid evolution, and may also lend insight into the paleoecology of basal members of this key group.

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MASIAKASAURUS-LIKE TEETH FROM THE ALCÂNTARA FORMATION, SÃO LUÍS BASIN (CENOMANIAN), NORTHEASTERN BRAZIL

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The Alcântara Formation (Early Cenomanian, São Luís Basin), outcrops at the northern shore of Maranhão State, Northeastern Brazil, and yielded an exceptional record of vertebrates collected mainly from the Laje do Coringa bone bed, located at Ilha do Cajual, Alcântara municipality. Theropods are well represented, especially by isolated teeth and fragmentary bone remains. Among the genera identified to date, some are referable to those from Northern African Albian–Cenomanian strata: the tetanuran *Spinosaurus*, which may be the same form considered recently as a new species, *Oxalaia quilombensis*, Kellner, Azevedo, Machado, Carvalho and Henriques, 2011. *Carcharodontosaurus* and some remains attributed to controversial genera or of uncertain systematic affinities (Medeiros *et al.*, 2007). Velociraptorinae dinosaurs may possibly be present in the Northern Brazilian Cenomanian community, as evidenced by its peculiar teeth. Sauropod, crocodilians, pterosaurs, fishes, chelonians and plants remains, as well as ornithopod,

sauropod and theropod ichnofossils are recorded from the Alcântara Formation. The present study describes 9 teeth of a predatory dinosaur unknown in Western Gondwana. Some of the specimens show a long and distally curved profile, slightly laterally compressed and elliptical to subcircular basal cross section with texturized distal surface. The mesial carena is deflected lingually and the distal one is deflected labially; both are faintly serrated. This set of dental features is found uniquely in the Malagasy genus *Masiakasaurus* from the Late Cretaceous, Maastrichtian. The material presented here may demonstrate the occurrence in Alcântara Formation of a bizarre and rare group of theropods, referred to the Noasauridae clade. Isolated teeth, nonetheless, are not enough to make more specific assertions on how close the Brazilian form would be related to *Masiakasaurus* itself. Anyway, the discovery of these teeth gives important information concerning noasaurid biogeography in Gondwana, which must be taken into account in forthcoming interpretations.[*Bolsista CAPES]

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FIRST RECORD OF FOSSIL FISHES (SILURIFORMES, PIMELODIDAE) FROM CHUÍ CREEK (LATE PLEISTOCENE), SOUTHERN BRAZIL

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Chuí Creek, located in the coastal plain of southern Rio Grande do Sul state, Brazil, is known by the presence of several mammalian fossils preserved in Pleistocene sediments exposed along its banks (Lopes *et al.*, 2005). Here is presented the first record of fossil fishes found in these sediments. The fossils belong to the Collection of Museum Coronel Tancredo Fernandes de Mello, in the town of Santa Vitória do Palmar and consisto of three operculi (catalog numbers MCTFM-PV0874/0875 and 0877), one frontal bone (MCTFM-PV0872), one fragmentary sphenotic or pterotic (MCTFM-PV0873) and a dentary (MCTFM-PV0876). The cranial elements and two opercles were found disarticulated but associated, and the dentary was found associated to several disarticulated fragments and a partial mammalian rib. The third opercle was found associated to several fragments of mammal remains including a partial skull of a pampathere and an osteoderm of a dasypodid. The specimens are related to the family Pimelodidae which encompasses freshwater catfishes. The morphology indicates affinities with the genus *Pimelodus* La Cepède, 1803. In the coastal area of Rio Grande do Sul, two living species are known, *P. clarias* La Cepède, 1803 and *Parapimelodus valenciennesi* Lütken, 1874 (Vieira *et al.*, 2003). The presence of freshwater fishes associated to mammalian remains reinforces the idea that the latter were preserved in a Pleistocene fluvial system.

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FIRST RECORD OF NEURYURUS AMEGHINO, 1889 (XENARTHRA, GLYPTODONTIDAE) IN CHUÍ CREEK AND A COMPARISON BETWEEN GLYPTODONTID FAUNAS FROM SOUTHERN BRAZIL AND THE MESOPOTAMIAN REGION OF ARGENTINA

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The Chuí Creek exposed near the ridge between Santa Vitória do Palmar City and Hermenegildo Beach (33°35′26.39″S–53°20′22.11″W) contains one of the best records of late Pleistocene (Lujanian Age/Stage) mammals found in Brazil.The deposits along this creek show beach facies at the base, characterized by middle grained sandstone, overlapped by a thick layer of muddy sandstone, probably fluvial or lagoonal in its origin, where there are the mammal fossils. Here is reported the first record of *Neuryurus* Ameghino 1889 from this locality, represented by an isolated osteoderm. The specimen was found among dredged sediments; it is dark-colored and well-preserved, complete and without signs of abrasion. The exposed surface is rugose and bears pilose foramina, which is typical of the genus. Besides *Neuryurus*, other glyptodon-

tids found in Chuí Creek include *Glyptodon* Owen 1839, *Panochthus* Burmeister 1866 and *Doedicurus* Burmeister 1874. All specimens are represented by isolated osteoderms and partial carapaces; the most abundant genus is *Glyptodon*, followed by *Panochthus*, while *Doedicurus* is very scarce and *Neosclerocalyptus* Paula Couto 1957 absent. This palaeofaunal association and its frequency of records are quite similar to that observed in the late Pleistocene of the Mesopotamian region, and different from the Pampean region, where *Neosclerocalyptus* is one of the most frequent glyptodont. In this sense, it is interesting to remark that *Neosclerocalyptus* (very frequent in the Pampean region but very scarce in the Mesopotamian region and absent in southern Brazil) is one of the most clearly Pleistocene genus adapted to cold and arid/semiarid environments. In turn, Glyptodon seems to have an important ecological tolerance since it is very frequent in the three mentioned regions and it appear associated to both pampean and intertropical taxa. The close resemblance between the southern Brazil and the Mesopotamian region certainly shows a similar palaeoclimatic pattern during, at least, late Pleistocene and corroborates the proposal of a close paleobiogeographic relation between southern Brazil, Argentine Mesopotamia and northern Uruguay.

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AN UNUSUAL AND AMAZING NOTOUNGULATE FROM THE MIOCENE OF CORDILLERA FRONTAL OF SAN JUAN PROVINCE, ARGENTINA

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The Manantiales Basin is located in Los Patos valley, in the Cordillera Frontal of San Juan province. The thick Neogene deposits exposed along the Los Patos river, between Las Hornillas and Horcajo, was defined by Mirré (1966) as the Chinches Formation. This sedimentary succession, more than 2000 m thick, has been divided into seven members, and their ages have been inferred by radiometric and magnetostratigraphic studies. Abundant fossil mammals (marsupials, Xenarthra, four families of notoungulates, litopterns and six groups of rodents) were reported by López *et al.* (in press) from two different levels of the lowest third of the Chinches Formation. The faunal assemblages of both levels were referred to the Santacrucian SALMA (late early Miocene) and are relevant because they have an intermediate latitudinal location between Miocene faunas from Patagonia and the Altiplano (Chile and Bolivia). Here we describe three specimens of associated crania (approximately 45 mm length) and mandibles, housed in the Museo de Ciencias Naturales of San Juan province, from the lowest fossil-bearing horizon. The remains belong to adult specimens (erupted M3/3) of unusual notoungulate (?typotherian) with a high and very short rostrum that curiously more resembles that of groeberiida marsupials than rodent-like notoungulates. The specimens resemble interatheriine interatheriids in having: hypsodont lower and upper cheek teeth with cement; bilobed M1-2 with a well defined lingual sulcus and slightly undulated ectoloph; lower molars with subcircular trigonid and talonid of similar size. However, this taxon has unusual features such as: (1) incomplete dentition (I1/2 C0/0 P3/2 M3/3) but without diastema; (2) hypsodont and hypertrophied I1; (3) i1 distinctly smaller than i2 and positioned anterior and closely appressed to i2; (4) a peculiar flat shelf on the ventral side of the symphysis; (5) two foramina in the inner side of the symphysis (?subalveolar fossa); and (6) well developed incisive and palatine foramina. These unique characters may argue for a new lineage of notoungulates that represents a new adaptive type for South American native ungulates.

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THE COTYLAR FOSSA IS NOT A COMMON SYNAPOMORPHY TO LINK AFROTHERIAN MAMMALS AND SOUTH AMERICAN NATIVE UNGULATES

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The cotylar fossa was defined as an anterior extension of the medial malleolar facet of the astragalus that deepens into a cup and receives the condylar articular surface developed on the tibial medial malleolus (MacPhee, 1994). This character was considered as a reliable afrotherian synapomorphy (Tabuce *et al.*, 2007), and later as a synapomorphy shared by most Afrotheria, Notoungulata, Astrapotheria and Xenungulata (Agnolin and Chimento, 2011). Here we analyze tarsal remains of representatives from all South American native ungulate groups, and compare them with extant afrotherians. The state of cotylar fossa of the malleolar facet is extremely variable among Notoungulata. Is absent in basal taxa as *Pleurostylodon* (Isotemnidae), and in *Homalodotherium* (Homalodotheriidae). In *Miocochilius, Protypotherium* and *Interatherium* (Interatheriidae) the medial malleolar facet is vertical. In contrast, in *Nesodon* (Toxodontidae) the neck of the astragalus is extremely reduced and the head is almost in contact with the trochlea, the malleolar facet is well developed and extends over the head forming a depression comparable to a cotylar fossa. In Astrapotheria and Pyrotheria the astragalar morphology is modified since the more graviportal lifestyle. In *Parastrapotherium* and *Liarthrus* (Astrapotheriidae) there is a structure comparable to a cotylar fossa, but is absent in the astragali assigned to the basal astrapotheriid *Trigonostylops* (Trigonostylopidae). In *Pyrotherium* (Pyrotheriidae) there is a long and thin medial facet without a cotylar fossa. In Xenungulata, *Carodnia* (Carodniidae) has a prominent posteromedial protuberance of the astragalus, a broad and flat head, somewhat medially oriented, which together forms a medial groove in the talus, but is improbable that this could be homologous to a cotylar fossa. In *Macrauchenia* (Litopterna, Macraucheniidae) the malleolous of the tibia is not extended over the medial side of the astragalus and no cotylar fossa is present. However in South American "condylarths", considered as not related to afrotherian mammals (Agnolin and Chimento, 2011), the astragali presumably assigned to *Lamegoia, Paulacoutoia* and *Didolodus* (Didolodontidae) have a well developed cotylar fossa. Summarizing, the cotylar fossa is absent in most native ungulates groups or in their stem taxa. The cotylar fossa could not be considered as a character to link native ungulates with afrotherians. In fact, this character was convergently developed in non-afrotherians, as in primates, macropodid marsupials, laurasic "condylarths" as *Meniscotherium* and some dinocerates as *Probathyopsis*.

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MAMÍFEROS NEÓGENOS, CUENCA DEL RÍO QUINTO, SAN LUIS, ARGENTINA

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En la cuenca del Río Quinto (piedemonte austral de Sierra de San Luis), se expone una sucesión sedimentaria dominada por arenas limosas y calcretes en la base y limos arenosos en el techo, de tonos pardo rojizos, macizos y estratificados, moderadamente consolidados a consolidados, y niveles bioturbados. Por los antecedentes asignada al Neógeno, y su paleoambiente corresponde a un piedemonte y planicie aluvial, con sistema fluvial y llanura de inundación con procesos edáficos. Las asociaciones de paleomamíferos nos permiten vincular las diferentes facies reconocidas a los Pisos/Edades sudamericanos basados en Biozonas. Se analizaron las asociaciones de mamíferos correspondientes a cuatro localidades: 1)Arroyo La Petra (33°16′S–65°56′W): *Lagostomus (Lagostomopsis)* sp., *Pseudotypotherium* sp., *Oxyodontherium zeballosi* Ameghino 1883; 2)Comandante Granville (33°26′S–65°50′W): *Doellotatus* cf. *D. praecursor* Rovereto 1914, *Vetelia perforata* Scillato-Yané, 1979, *Chorobates villosissimus* Rovereto 1914, *Eosclerocalyptus* sp., *Prodolichotis* sp., *Pseudotypotherium subinsigne* Rovereto 1914; 3)Puente Fraga (33°26′S–65°47′W): *Doellotatus inornatus* Rovereto 1914, *Macroeuphractus retusus* Ameghino, 1887, *Eosclerocalyptus* cf. *E. Proximus* Moreno y Mercerat 1891, *Actenomys priscus* Owen 1840, *Paleocavia impar* Ameghino 1889, *Pithanotomys* sp., *Paedotherium typicum* Ameghino 1887, *Paedotherium bonaerense* Ameghino 1887, *Pseudotypotherium* sp.; 4)Cantera Díaz Nogarol (33°29′S–65°44′W): *Doellotatus chapalmalensis* Bordas 1933, *Macroeuphractus retusus*, *Macrochorobates chapalmalensis* Ameghino 1908, *Actenomys priscus*, *Lagostomus (Lagostomopsis)* sp., *Dolicavia minuscula* Ameghino 1908, *Pithanotomys* sp., *Eucoelophorus* cf. *E. chapadmalensis* Ameghino 1908, *Paedotherium typicum*, *Paedotherium bonaerense*, *Tremacyllus impressus* Ameghino 1887. Los resultados obtenidos indican una edad Miocena tardía (Huayqueriense) para Arroyo La Petra y Comandante Granville, vinculados a la base de la Fm. Río Quinto, mientras que los estratos cuspidales de esta ultima, correspondientes a las faunas de Puente Fraga y Cantera Díaz Nogarol, son asignados al intervalo Montehermosense-Chapadmalalense (Plioceno temprano-tardío) sin que permitan discriminar entre una y otra edad.Las observaciones taxonómicas con faunas de similar antigüedad de Buenos Aires señalan una conexión zoogeográfica entre las regiones subandina y pampeana durante el Neógeno tardío y una relativa uniformidad paleoambiental y paleoclimática para el intervalo Huayqueriense–Chapadmalalense (Mioceno tardío–Plioceno tardío), con el predominio de ambientes abiertos y condiciones áridas a semiáridas, en un clima templado-cálido.

TRAZAS DE INSECTOS ASOCIADAS A RESTOS DE CORAZAS DE GLYPTODONTIDAE EN EL PLEISTOCENO TARDÍO DE

LA PROVINCIA DE CÓRDOBA, ARGENTINA

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La presencia de trazas fósiles relacionadas con la acción de los organismos osteófagos es de importancia porque representan una fuente de datos climáticos y tafonómicos, además de constituir un interesante ejemplo de interacción trófica. En este trabajo se dan a conocer los primeros registros de trazas fósiles en restos óseos del Pleistoceno tardío de la provincia de Córdoba, los que se encontraron asociados a corazas de distintos géneros de gliptodontes. Las primeras se encontraron en los tubos caudales y en placas de los anillos caudales de diferentes ejemplares de *Neosclerocalyptus* Paula Couto 1957 procedentes de sitios paleontológicos de la laguna Mar Chiquita, cuya asociación faunística ha sido asignada al Pleistoceno tardío-Holoceno temprano por Cruz y Luna (2010), mientras que las demás se encuentran en placas de la coraza dorsal de *Panochthus* Burmeister, 1867 procedentes del Valle de Punilla (La Cumbre), en el ámbito serrano de la provincia de Córdoba. La morfología de las mismas comprende formas ovoides excavadas en la superficie del hueso, con marcas arqueadas superpuestas en su interior, referibles a la acción de las mandíbulas de los organismos durante la producción de esta estructura. Otras de las trazas se desarrollan en superficie como surcos sinuosos como así también túneles en el interior de los huesos con longitudes y profundidades diferentes. La morfología de la mayor parte de éstas se corresponde con las del icnogénero *Cubiculum ornatus* Roberts, Rogers and Foreman 2007 que ha sido referido a cámaras pupales de coleópteros derméstidos, además de otras morfologías que difieren y podrían corresponderse con nuevos icnogéneros.

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CORTADA DE GRASSO, NUEVA LOCALIDAD CON MAMÍFEROS FÓSILES EN EL PLEISTOCENO TARDÍO – HOLOCENO TEMPRANO DE LA PROVINCIA DE CÓRDOBA, ARGENTINA

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La localidad fosilífera de Cortada de Grasso comprende una secuencia de unidades estratigráficas interpretadas, la mayor parte, como depósitos de cauce y llanuras de inundación del sistema fluvial del Río Xanaes o Segundo en la provincia de Córdoba. Estas unidades, que se encuentran expuestas en un profundo barranco al este de la localidad de Despeñaderos, han sido correlacionadas litoestratigráficamente con la Formación Río Primero (Pleistoceno Superior – Holoceno inferior). Los niveles fosilíferos se encuentran en las secciones basales de la secuencia, en capas de composición limosa a limoarenosa donde se intercalan lentes de sedimentos limoarcillosos verdosos con rizoconcreciones y bioturbación. De los mismos se han recuperado materiales referibles a *Eutatus* cf. *E. seguini* Gervais, 1867; *Pampatherium typum* Ameghino, 1875; *Neosclerocalyptus* sp., cf. Neuryurini Hofstetter, 1958, *Panochthus* sp., *Glyptodon reticulatus* Owen, 1845; *Megatherium* sp., *Ducysion gymnocercus* (Fischer, 1814); *Toxodon* sp. y *Lama* cf. *Lama guanicoe* Müller, 1776. También se registra en estos niveles una estructura elíptica, de 1.5 m de diámetro, excavada en los niveles limoarenosos, cuyo relleno se encuentra conformado por arcillas laminadas en niveles de 0.5 a 0.8 cm. Las características de esta, permiten interpretarla como una crotovina referible, por sus dimensiones, a perezosos del grupo de los milodóntidos. Considerando el registro de los taxones identificados a nivel específico y el esquema bioestratigráfico de referencia para el cenozoico superior de la región pampeana (Cione y Tonni, 1999, 2005), la asociación faunística es propia de los Pisos/Edades Bonaerense - Lujanense (Pleistoceno tardío-Holoceno temprano), siendo necesario nuevos registros y dataciones para precisar esta interpretación bioestratigráfica.

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PRIMER REGISTRO DE ICNITAS EN EL PLEISTOCENO DE LA PROVINCIA DE CÓRDOBA, ARGENTINA

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En el año 2010 el Sr. Julio Gonzalez, vecino de la localidad de Almafuerte, Departamento Tercero Arriba, Córdoba, observó a orillas del río Ctalamochita un afloramiento con huellas fósiles. Constituye el primer hallazgo paleoicnológico de la provincia y representa el quinto registro icnológico de mamíferos Pleistocenos en América del Sur. Como medida de conservación y preservación se realizaron calcos de yeso y se extrajeron todos los restos expuestos. Los materiales se encuentran depositados en el Museo de Ciencias Naturales "Dr. Arturo U. Illia" de la provincia de Córdoba (MCNC-PR-20 al 22; MCNC-PV-271 al 273). Las improntas están conservadas en epirelieve cóncavo en el techo de una capa de cenizas volcánicas retransportadas, con una granulometría entre limos gruesos y arenas muy finas, de colores grisáceos blanquecinos y poco consolidados. El nivel se ubica en una secuencia fluvial dominada por facies de planicies de inundación y canales someros, donde las cenizas están dispuestas como relleno de un canal fluvial muy extenso y de escasa profundidad. Aunque no se han realizado dataciones absolutas sobre los horizontes portadores, por sus relaciones estratigráficas se los considera del Pleistoceno Tardío. El hallazgo se hizo sobre una superficie de 90 x 140 cm aproximadamente, donde queda expuesta una rastrillada compuesta por cuatro huellas y dos improntas aisladas. Todas son de tamaño mediano, didáctilas y paraxónicas, con marcas de las pezuñas bien definidas, lo que permite afirmar que son huellas verdaderas.Tres se atribuyen a manos y tres a pies, con medidas promedios de 8,5 cm de longitud y 7 cm de ancho. Tienen poca profundidad, presentan el contorno en general bien definido, los surcos interdigitales levemente marcados y sin estructuras de colapso, lo que sugiere que se formaron en un sedimento firme, con un contenido relativamente bajo de agua. El conjunto presenta un arreglo donde se distinguen dos direcciones de desplazamiento diferentes, una hacia el Este y otra hacia el Noreste. El análisis morfológico y morfométrico permite asignarlas a la icnoespecie *Lamaichnum guanicoe* Aramayo y Manera de Bianco, 1987, atribuidas a *Lama guanicoe* Müller, 1776 por los autores (1987). La presencia de esta especie estaría indicando la existencia de áreas abiertas de pastizales y estepas en la localidad de Almafuerte durante el Pleistoceno Tardío, confirmando lo señalado por Carignano (1999).

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MIDDLE PERMIAN-MIDDLE TRIASSIC AMPHIBIAN EVOLUTION AND IMMIGRATION IN THE KAROO BASIN, SOUTH AFRICA

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The Karoo Basin (Mid. Permian-Mid. Triassic) fossil assemblage gives paleontologists a unique opportunity to analyze the effects of the end-Paleozoic mass extinction on terrestrial organisms. Temnospondyl amphibians are the second most abundant fossil group present in the Karoo. Here, immigration into the basin is contrasted with local speciation events based on ghost lineages derived from a large-scale species-level phylogenetic analysis of Temnospondyli that includes 87 taxa and 328 morphological characters. Because this phylogenetic analysis includes globally distributed taxa and is not limited to species within the Karoo Basin, local speciation events can be differentiated from immigration based on sister group relationships, occurrence, and sedimentological data. Results show speciation within the Karoo prior to the beginning of the *Tapinocephalus, Lystrosaurus,* and *Cynognathus* Assemblage Zones. Immigration into the Karoo Basin is greatest at the *Dicynodon-Lystrosaurus* Assemblage Zone boundary, but also occurs within subzone A of the *Cynognathus* Assemblage Zone. Results show that at a global scale the subclade Stereospondyli is experiencing the largest speciation event within the clade's history clade, one that even overshadowed elevated extinction levels. The event lasted from the Changsingian to the Anisian, peaking in the early Induan. These elevated rates of speciation, extinction, and immigration suggest that from the Changsingian to the Anisian temnospondyl lineages were highly opportunistic in niche accommodation, while also under increased environmental stress and susceptibility to extinction.

ICNITAS DE LA FORMACIÓN TACUAREMBÓ (JURÁSICO TARDÍO – CRETÁCICO TEMPRANO): NUEVOS HALLAZGOS

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Se comunican dos nuevos hallazgos de icnitas de dinosaurios en facies de interduna del Miembro Batoví (Miembro Inferior) de la Formación Tacuarembó, Cuenca Norte del territorio uruguayo, del cual también se extraen los fósiles de cuerpo que representan una típica asociación fosilífera del Jurásico Tardío-Cretácico Temprano (Soto *et al.*, 2010; Perea *et al.,* 2009; Soto and Perea, 2008). En un caso, las nuevas icnitas se hallan en el mismo afloramiento que el primer registro de huellas de tetrápodos conocido para Uruguay (Mesa *et al.*, 2010) (afloramiento sobre la Ruta 26, al E de la ciudad de Tacuarembó). Se trata de 12 huellas, asignables a un saurópodo por su morfología y tamaño. Son huellas circulares, con un diámetro promedio de 104 cm y con sus bordes definidos por el desarrollo de crenulaciones y coloración anaranjada dada por la presencia de algún tipo de óxido. Se hallan bastante afectadas por los procesos de edafización, rellenas de un sedimento friable y limoso diferente a la arenisca en la que se encuentran. Las medidas de paso oblicuo y zancada tomadas en forma preliminar muestran un patrón, indicando que se trata de un rastro dejado por un mismo individuo. El otro hallazgo se halla en un desmonte artificial a unos 100 m al NW del sitio anterior. Se trata de un área de unos 24 m por 3 m, en la que pueden observarse como mínimo unas diez huellas en un muy pobre estado de preservación. Los bordes de las huellas se encuentran muy deteriorados, prácticamente no apreciándose crenulaciones como las de los casos anteriores. La gran mayoría pueden asignarse a saurópodos por su morfología subcircular (a veces incluso arriñonada) a circular. En general, presentan diámetros entre 40 a 50 cm. También se observan perturbaciones en los estratos sedimentarios que podrían corresponder a huellas de menor porte (unos 8 cm). No pudo diferenciarse hasta el momento un patrón que permita establecer la cantidad de pistas presentes, ya que la disposición de las huellas parece ser azarosa, a veces incluso superponiéndose. [El presente trabajo es una contribución a los Proyectos ANII-FCE 2009-2843 y CSIC-UdelaR C028-348].

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UTILIZACIÓN DE BARNIZ SINTÉTICO Y ALCOHOL ETÍLICO (ETANOL) EN REEMPLAZO DE LACA NITROCELULÓSICA Y THINNER, PARA LA PRESERVACIÓN DE FÓSILES DE VERTEBRADOS

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En Paleontología se usan fortalecedores para reforzar piezas deterioradas y para ello es común la utilización del compuesto formado por laca nitrocelulósica diluida en thinner. Sin embargo, ambos componentes poseen una alta toxicidad lo que implica un riesgo para la salud, tanto en la inhalación como por el contacto y absorción en la piel. El presente resumen propone utilizar una alternativa menos nociva recurriendo al alcohol etílico (etanol) como diluyente. El uso de alcohol etílico para diluir la laca nitrocelulósica no obtuvo los resultados esperados, ya que la mezcla no se manifestó de manera homogénea. Por ello se decide sustituir la laca nitrocelulósica por el barniz sintético, lo que permitió observar que el alcohol etílico (etanol) actuaba correctamente como disolvente. Se realizaron tres pruebas variando el porcentaje de alcohol al 50%, 60% y 80%. Los resultados obtenidos en las tres proporciones antes descriptas, brindan una sustancia homogénea con una muy buena solubilidad. Sin embargo, es importante destacar que en la muestra con alcohol al 80% la apariencia final de la mezcla ofrece una coloración translúcida, lo cual lo convierte en un producto altamente aconsejable para su uso en restauración de fósiles.

USO DEL ACIDO ACÉTICO EN LA PREPARACIÓN DE MATERIAL DE VERTEBRADOS FÓSILES

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Luego de diferentes campañas de extracción efectuadas en el año 2009 en la costa norte del Lago Barreales (Neuquén, Patagonia Argentina), fue colectado un notable material fósil referible a un dinosaurio terópodo megaraptórido de mediano tamaño. El estrato fosilífero estaba compuesto por areniscas rojizas y grisáceas, correspondientes a la Formación Portezuelo del Grupo Neuquén (Cenomaniano-Turoniano). El material, una vez trasladado al laboratorio del Centro Paleontológico del Lago Barreales, fue inicialmente preparado mediante remoción mecánica y química, este último compuesto por ácido clorhídrico y agua oxigenada. Con la intención de mejorar la remoción del sedimento y en colaboración con los laboratorios químicos de la UADE (Universidad Argentina de Empresas), fue testeado un método alternativo que consistió en un tratamiento de inmersión de rocas con restos fósiles durante un período de dos horas en una mezcla de ácido acético en solución 100%, al 30%, al 25% y al 20%. Luego de una evaluación exhaustiva de cada uno de los productos finales obtenidos se comprobó que el mejor resultado se consiguió en la mezcla que poseía una solución al 25% de ácido acético en agua destilada.

VARIAÇÕES INTRAESPECÍFICAS NO CARPO E NO METACARPO DE MASTODONTES EM UMA LOCALIDADE DO NORDESTE DO BRASIL

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O conhecimento das variações intraespecíficas permite melhor definir uma espécie, reconhecer seus limites e identificar com mais segurança espécies próximas. Foram analisados os ossos atribuídos a mastodontes, entre fósseis pleistocênicos coletados por um dos autores (HA), em São Bento do Una, Pernambuco, Brasil, em 2003, e depositados no Museu de História Natural de Taubaté, SP, Brasil. O material procede de uma única coleta, da mesma cacimba. Foram examinados 38 elementos carpais e metacarpais, atribuídos a *Stegomastodon waringi* Holland 1920, e comparados entre si, consistindo em dois escafoides, dois semilunares, quatro piramidais, dois pisiformes, três trapézios, três trapezoides, cinco capitatos, seis hamatos, um metacarpal I, dois metacarpais II, dois metacarpais III, dois metacarpais IV e quatro metacarpais V. A análise morfológica comparativa do material indica grande variação intraespecífica entre os ossos homólogos. Os ossos semilunar e piramidal foram os que apresentaram menor variação. Em contrapartida, os escafoides, trapézios, trapezoides e metacarpais V, apresentaram diferenças morfológicas notáveis. As variações de tamanho foram desprezadas. No escafoide, as superfícies articulares para o capitato e o trapezoide podem ou não ser bem delimitadas pela presença de um profundo sulco; estas mesmas superfícies articulares variam amplamente também nas suas extensões. No trapézio, a superfície articular para o trapezoide, varia bastante quanto a sua extensão (área articular); pode ser ligeiramente côncava ou ligeiramente convexa e pode estar posicionada na face medial ou deslocada plantarmente; a extremidade da superfície articular com o metacarpal I pode ou não ser prolongada em direção plantar. O trapezoide apresenta uma ampla superfície articular com o capitato que pode ser contínua ou dividida por um sulco, resultando em duas superfícies articulares separadas. O metacarpal V tem em sua extremidade proximal as superfícies articulares para o hamato e para o piramidal, que podem formar entre si um ângulo obtuso ou agudo; a superfície articular com o piramidal pode ainda ser dividida em duas facetas (dorsal e ventral) ou pode formar uma única faceta contínua; os dois exemplares de metacarpais também apresentam notável diferença na proporção comprimento/largura da diáfise. Diferenças intraespecíficas nos mastodontes sul-americanos podem contribuir com a definição mais precisa dos táxons que aqui habitaram, porém necessitam ser melhor conhecidas.

Holland, W.J. 1920. Fossil mammals collected at Pedra Vermelha, Bahia, Brazil, by Gerald A Waring. *Annals Carnegie Museum* 13: 224–232.

LOS VERTEBRADOS FÓSILES DEL ARROYO PERICO FLACO, PLEISTOCENO-HOLOCENO DEL DEPARTAMENTO DE SORIANO, URUGUAY

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La colección del Museo Paleontológico Alejandro Berro, se encuentra establecida en la ciudad de Mercedes (Departamento de Soriano, Uruguay) posee alrededor de unas 4000 piezas fósiles. La mayoría de éstas fueron colectadas principalmente en los Departamentos de Soriano y Río Negro, región de gran riqueza fosilífera de acuerdo a sus antecedentes históricos (Berro, 1929; Perea, 1993). En el marco del proyecto "Reacondicionamiento y actualización del Museo Berro (Mercedes, Soriano)" financiado por la Comisión Sectorial de Investigación Científica (CSIC), se realizó una revisión exhaustiva de todos los materiales fósiles (Ubilla *et al.,* 2010) donde se constató que un gran número de estos fueron colectados en las inmediaciones del Arroyo Perico Flaco, próximo a su desembocadura en el Río Negro (Departamento de Soriano). Dentro del conjunto faunístico analizado existen numerosos elementos de abolengo Sudamericano pertenecientes a los órdenes: Xenarthra, Rodentia, Notoungulata, Litopterna, Phorusrhacidae (Montenegro *et al.,* 2010) y Testudines. También se encuentran un gran número de linajes inmigrantes procedentes de Norte América, entre ellos Canidae, Felidae, Ursidae, Gomphotheriidae, Camelidae, Cervidae, Equidae y Tayassuidae. A lo largo del proyecto "Nuevos aportes al conocimiento de la geología y paleontología del Departamento de Soriano 2010", nuevamente financiado por la CSIC, se realizaron excursiones al mencionado paraje, donde nuevos materiales se colectaron. Estos fósiles fueron exhumados de sedimentos areno-arcillosos de color verdoso, blanquecino y pardo-rojizo con una potencia variable entre 1,5 y 4m, asignables a la Formación Dolores de edad Pleistoceno Tardío - Holoceno Temprano. Se tomaron muestras para efectuar un tamizado rotup y se confeccionó un perfil estratigráfico. Las observaciones realizadas en campo corroboran las descripciones litológicas realizadas por Alejandro Berro en el catálogo del Museo (Berro, 1929). La determinación y descripción a nivel específico de algunos restos, así como la realización de estudios sedimentológicos detallados (ej.: difracción de rayos X) nos permitirá obtener más información acerca de este importante yacimiento fosilífero y efectuar comparaciones bioestratigráficas con asociaciones faunísticas similares en otras localidades.

Berro, A.C. 1929. *Catálogo de cuatro pequeñas colecciones paleontológicas del Uruguay (Formación Pampeana).* Marzoa y Cia., Mercedes, 12 p.

Montenegro, F., Jones, W., Lecuona, G., Toriño, P., Batista, A., García, G. y Ubilla, D. 2010. Nuevos aportes al conocimiento de los Phorusrhacinae (Aves, Phorusrhacidae) del Pleistoceno Tardío de Uruguay. *10º Congreso Argentino de Paleontología y Bioestratigrafía, 7º Congreso Latinoamericano de Paleontología* (La Plata), *Resúmenes*, p.

Perea, D. 1993. Una fauna local lujanense (Pleistoceno Superior) del Departamento de Río Negro, Uruguay. *Boletín de la Sociedad Zoológica Del Uruguay* 8:

340-347.

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FIRST PTEROSAUR RECORD FOR THE BARREMIAN OF THE SERGIPE-ALAGOAS BASIN, NORTHEASTERN BRAZIL

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The Araripe basin, with a rich diversity of forms, along with the Paraiba and Reconcavo basins include the only sediments which have yielded pterosaur fossils in Brazil. Here we report for the first time, the occurrence of pterosaurs in the Sergipe-Alagoas Basin, in northeastern Brazil. The fossil material was collected in sediments of the Morro do Chaves Formation (Sergipe-Alagoas Basin) cropping out in São Miguel dos Campos municipality, Alagoas State, northeastern Brazil. The continental gray shales of the Morro do Chaves Formation were deposited in a lacustrine environment during the Barremian-Aptian of the (Campos Neto *et al.,* 2007). The pterosaur remains are made up of detached cranial and postcranial bones, and were found associated to abundant fishes, ostracods and plants. Among the remains, an anterior fragment of mandible with teeth stands out measuring 50.7mm long and 6 mm depth, and presenting a small crest. The preserved teeth are represented by fragments of 3 or 4 anterior large teeth (at least 12 mm) which are followed by 8 smaller (approximately 2 mm), slightly curved ones. The larger teeth are elliptical in cross-section and have no carinae; all teeth are ornamented with ridges. Further preparation and studies will reveal the systematic affinities of this material which seems represent a small individual, with about 30 cm of wing span. This record extends the chronostratigraphic range of pterosaurs to the Barremian and broadens their distribution area in Brazil.

Campos-Neto, O.P.A., Lima, W.S. and Cruz, F.E.G. 2007. Bacia de Sergipe-Alagoas. *Boletim de Geociências da Petrobras* 15: 405-415.

THE SOUTH AMERICAN LOWLAND GOMPHOTHERE (MAMMALIA, PROBOSCIDEA, GOMPHOTHERIIDAE): TAXONOMY, PHYLOGENY AND BIOGEOGRAPHY

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The South American gomphotheres were classified in three genera and three species. Two biogeographic corridors are recognized for their dispersion in South America: *Cuvieronius hyodon* (Fischer, 1814) was found mainly by the highlands and western to the Andes, and *Stegomastodon platensis* (Ameghino, 1888) and *Haplomastodon waringi* (Holland, 1920), in lowlands. The aim of the present study is to review the taxonomy, systematic and biogeography of the South American lowland gomphotheres. We analyzed a large sample of specimens, which included crania, teeth and postcrania from several localities in Brazil, Ecuador, Colombia, Venezuela, Argentina and Uruguay. We review the diagnostic characters proposed and found that they are variable in both species, when large samples are considered. In this way, there is no support for more than one South American lowland gomphothere species, which shows a significant morphological variation in some characters. After a taxonomic review, a new combination name, *Notiomastodon platensis* (Ameghino, 1888), is validated. The cladistics analysis resulted on four most parsimonious trees. The family Gomphotheriidae (Hay, 1922) is paraphyletic. The species *N. platensis* positioned as the sister taxon of a clade composed by *Stegomastodon* (Pohlig, 1912) spp. (represented here only by Central and North American taxa) and *C. hyodon.* These results disagree with several previous studies, in which the South American gomphotheres is a monophyletic clade. The South American gomphotheres are mainly recorded for the Pleistocene, although there are few records from the Miocene and Pliocene. These records together with our phylogenetic results suggest that the ancestor of the clade, which includes the South American gomphotheres, should be originated in North America until the late Miocene. Moreover, the South American gomphotheres had two independent biogeographic histories. A first arrival might have occurred during the short land connection between Central and South Americas, during the Miocene, and a second arrival during a much longer period, in the Great American Biotic Interchange (Pliocene/Pleistocene). However, the lack of gomphothere records between late Miocene and late Pliocene in South America is still an unexplained issue.

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Hay, O.P. 1922. Further observations on some extinct elephants. *Proceedings of the Biological Society of Washington* 35: 97-102.

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OS PERISSSODACTYLA, ARTIODACTYLA E LIPTOTERNA (MAMMALIA) FÓSSEIS ENCONTRADOS NAS CAVERNAS DE AURORA DO TOCANTINS, REGIÃO NORTE DO BRASIL

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A ordem Ungulata representa um grupo parafilético de mamíferos, que "compartilham" adaptações não homólogas à herbivoria. É o grupo de maior sucesso entre os herbívoros, com uma excepcional diversidade em termos morfológicos, adaptativos e geográficos. Em 2009 e 2011, foram realizadas Expedições Paleontológicas pelo Laboratório de Mastozoologia da Unirio (Lamas) a fim de estudar a riqueza paleontológica das cavernas de Aurora do Tocantins (estado do Tocantins, região Norte do Brasil). Suas rochas são formações calcárias de idade neo-proterozóica, porém suas cavernas têm idade muito mais recente. Ao longo de milhares de anos essas rochas sofreram a ação das aguas ácidas, que corroeram o carbonato de cálcio, moldando-as e dando origem às cavernas existentes atualmente. Essa ação hídrica constante foi o que contribuiu para que a região se tornasse um local de grande importância paleontológica, pois, durante anos, carrearam para dentro das cavernas carcaças de animais, além de terem funcionado como armadilhas naturais que ao acaso aprisionavam e encurralavam os animais que as utilizavam como refúgio. Esta contribuição pretende inventariar previamente os fósseis de ungulados pleistocênicos encontrados em três cavernas: a Gruta dos Moura, o Buraco do Junior e outra, ainda não cadastrada pela Sociedade Brasileira de Espeleologia (SBE), que denominaremos aqui de gruta "sem nome". Os fósseis foram coletados a partir da metodologia '*picking*'. Foram identificados fósseis de ungulados pertencentes a quatro famílias: Tayassuidae Palmer, 1897, Cervidae Goldfuss, 1820, Tapiridae Burnett, 1830 e Macraucheniidae Gervais, 1855. Entre os tayassuideos, foram encontrados restos de *Tayassu pecari* (Link, 1795), *Tayassu tajacu* (Linnaeus, 1758) y *Catagonus stenocephalus* (Lund in Reinhardt, 1880). Os cervídeos são aqui representados pelos táxons: *Mazama americana* (Erxleben, 1777), e *Odoicoleus* sp. A família Tapiridae está representada por *Tapirus terrestris* (Linnaeus, 1758) e a família Macraucheniidae está representada pela espécie *Xenorhinotherium bahiense* (Cartelle y Lessa, 1988). Ainda que estes sejam resultados prévios, as identificações já feitas nos dão ideia de quão diversificada foi a fauna pleistocênica de ungulados no local.

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NOTABLE HALLAZGO DE ANUROS FÓSILES EN SCARRITT POCKET (CHUBUT, ARGENTINA): HACIA UN CONOCIMIENTO MÁS COMPLETO DE LA BATRACOFAUNA PATAGÓNICA DURANTE EL OLIGOCENO

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Una campaña realizada recientemente a la localidad deseadense de Scarritt Pocket, en el centro de la provincia de Chubut, ha provisto una notable colección de anuros fósiles. Han sido colectados alrededor de sesenta ejemplares, entre adultos y larvas (renacuajos). Los mismos son representantes de al menos dos taxones. Uno de ellos constituye el mismo taxón que fuera asignado al género viviente *Eupsophus* Fitzinger en base a material colectado en esta localidad en la década de 1930 (Schaeffer, 1949). Si bien esta asignación ya había sido puesta en duda (Lynch, 1971; Nicoli, 2010), el nuevo material provee información anatómica adicional que amplía las diferencias entre este taxón fósil y las especies vivientes de *Eupsophus*, aportando además caracteres significativos para su asignación. Aunque los nuevos especimenes aún se encuentran en preparación es evidente que, tal como fuera observado en el material colectado previamente en la localidad, son representantes de un anuro con el cráneo muy osificado pero sin ornamentación, una región anteorbital notablemente amplia (largo mayor a 1/3 del largo total del cráneo) y nasales en contacto medial. Asimismo, los restos de esfenoetmoides dan cuenta de un neurocráneo ancho en la región interorbital, cubierto por frontoparietales también anchos, en mutuo contacto a lo largo de toda su extensión y con márgenes oblicuos lateroposteriormente dirigidos. El nuevo material evidencia además que este anuro poseía pterigoides en contacto con nasales y palatinos, palatinos cercanos medialmente, con cresta odontoidea y extremo lateral expandido y falanges terminales levemente abultadas en sus extremos. Se suman a estos restos numerosos especímenes de una rana de pequeño tamaño que no se encontraba representada hasta el momento en la localidad. La misma poseía frontoparietales angostos, al menos en su porción anterior, y muy separados medialmente, definiendo una amplia fontanela frontoparietal. Asimismo, se han hallado varios especímenes presuntamente representantes de este mismo taxón, con pocos elementos craneanos preservados, huesos largos no osificados en los extremos y pelvis con iliones perpendiculares a la columna, lo que sugiere que se trata de renacuajos. Este notable hallazgo amplía nuestro conocimiento de los anuros de esta localidad al tiempo que provee novedosa evidencia acerca

de la batracofauna de Patagonia durante el Oligoceno lo que, en el contexto del escaso registro fósil de anuros, representa un excepcional aporte al conocimiento de la historia de la rica batracofauna sudamericana actual.

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THE RECORD OF *OPISTHODACTYLUS* AMEGHINO 1891 (AVES, RHEIFORMES) FROM THE LATE MIOCENE OF NORTHWESTERN ARGENTINA

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The monotypic genus *Opisthodactylus* was initially placed in its own family, Opisthodactylidae (Ameghino, 1895), but later transferred to Rheidae Bonaparte 1849 due to its strong resemblance with living rheas (Patterson and Kraglievich, 1960; Tonni and Tambussi, 1986). The type species, *Opisthodactylus patagonicus* Ameghino 1891, is restricted to the Santacrucian (Early-middle Miocene) beds of Patagonia. This poorly described taxon was based on very fragmentary materials which are deposited at the British Museum of Natural History, including three incomplete distal ends of tarsometatarsi and a distal tibiotarsus among other bones. In this contribution we report a well preserved specimen belonging to *Opisthodactylus* sp. which comes from the "Araucanense medio" levels at the Santa María valley (= Yocavil) in Tucumán Province (*sensu* the original label of its collector, A. Castellanos). Although the available information about the stratigraphic provenance does not follow the modern rock nomenclature, the bearing fossil horizon can be correlated with the Andalhuala Formation (Castellanos, 1946; Marshall and Patterson, 1981; Bossi and Muruaga, 2009). The referred materials (MUFYCA-647) are housed at the Museo Florentino y Carlos Ameghino (Instituto de Fisiografía y Geología, Rosario) and include associated elements of both hind limbs (right femur, both tibiotarsi and tarsometatarsi, and six pedal phalanges). The specimen is assigned to *Opisthodactylus* sp. by sharing similar dimensions, robustness, and the following characters with the type materials: distal end of tarsometatarsus broadened, with marked spread of trochleae II and IV; articular facets of trochleae III and IV transversally widened and markedly grooved; shaft depressed dorso-ventrally above the level of trochleae; prominence for attachment of internal ligament continuous with that for transverse ligament on distal tibiotarsus; tendinal groove deep and ending proximally. More detailed studies will probably support the erection of a new species. The finding will contribute to emend the generic diagnosis and to bring additional phylogenetic information. In addition, this record extends the biochron of *Opisthodactylus* from Santacrucian to Huayquerian age (Late Miocene). Likewise, the presence of a younger probable new species of *Opisthodactylus* in Tucumán Province has an important paleobiogeographic significance that must be evaluated to understand the natural history of neogene rheids of Argentina.

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THE MORPHOLOGY AND EARLY EVOLUTION OF THE AVIAN STERNUM

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The presence of an ossified sternum is highly variable among basal birds and closely related non-avian theropod dinosaurs (O'Connor *et al.*, 2011). A sternum is absent in every known specimen of the most basal bird, *Archaeopteryx* Meyer 1861, and non-ornithuromorph birds lack many features of this element often associated with flight (*i.e.* large keel), raising fundamental questions about the flight mechanics in basal taxa (Wellnhofer and Tischlinger, 2004; Nudds and Dyke, 2010; O'Connor *et al.*, 2011). Across Mesozoic Aves, and among their closely related non-avian dinosaurian relatives, the wide range of known morphologies hints at the evolutionary history of the development of the modern sternum. We review the preserved sterna of Mesozoic birds and their close dinosaurian relatives and discuss the likely sequence of sternal ossification. From the inferred phylogenetic positions of taxa with known sternal morphologies, we can hypothesize the sequence in which the presence of ossified sternal *anlage* evolved within Aves. The fossil record of enantiornithines is complete enough for us to hypothesize a generalized ossification pattern that was likely unique to this clade. Although many features of the adult avian sternum are considered homologous between clades, the *anlage* from which some features ossify in enantiornithines must have differed greatly from that seen in

living birds. Comparison to the known development of the sternum in living birds suggests that both ossification patterns and the diverse morphologies of this element seen in neornithines evolved within the crown clade of Aves. Nevertheless, the basic shape of the modern avian sternum was present by the Late Cretaceous, with Early Cretaceous ornithurines possessing nearly modern morphologies.

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NUEVOS APORTES AL CONOCIMIENTO DEL PISO/EDAD HUAYQUERIENSE (MIOCENO TARDÍO) DEL CURSO INFERIOR DEL ARROYO CHASICÓ, PROVINCIA DE BUENOS AIRES, ARGENTINA

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Pese a los notables avances alcanzados en la última década en lo referente a la paleontología y bioestratigrafía del Huayqueriense (Mioceno tardío) del sudoeste de la provincia de Buenos Aires (Cione y Tonni, 2005; Deschamps, 2005; Oliva *et al.*, 2010), el conocimiento que se tiene de este Piso/Edad para el curso inferior del Arroyo Chasicó es relativamente escaso (Cione y Tonni, *op. cit.*). En la presente contribución se dan a conocer los resultados obtenidos del estudio de aproximadamente 500 ejemplares inéditos provenientes de "Arenas Blancas" (38°34'S; 62°58'O), localidad tipo de la Biozona de *Macrochorobates scalabrinii* (Tonni *et al.*, 1998), que incrementan de manera significativa la biodiversidad de mamíferos documentada para este sitio. La fauna descubierta comprende hasta el momento 24 taxones, correspondientes a 12 familias de origen sudamericano: CINGULATA: Dasypodidae: *Chasicotatus ameghinoi, Vetelia perforata, Macrochorobates scalabrinii, Chorobates* cf. *C. villosissimus*, *Proeuphractus* sp.; Pampatheriidae: *Scirrotherium* sp., *Kraglievichia* sp., *Vassalia* sp.; Glyptodontidae: *Eosclerocalyptus* cf. *E. tapinocephalus*, *Plohophorus paranensis,* Palaehoplophorini indet., Lomaphorini indet.; TARDIGRADA: Mylodontidae: cf. *Simomylodon*; RODENTIA: Caviidae: *Orthomyctera* sp., *Prodolichotis* sp.; Chinchillidae: *Lagostomus (Lagostomopsis)* sp.; Hydrochoeriidae: *Cardiatherium chasicoense*; LITOPTERNA: Proterotheriidae: *Neobrachytherium* cf. *N. ullumense*; Macraucheniidae: *Oxyodontherium zeballosi*; NOTOUNGULATA: Hegetotheriidae: *Paedotherium minor*; Mesotheriidae: *Typotheriopsis* sp., *Pseudotypotherium subinsigne*; Toxodontidae: *Calchaquitherium* sp.; *Hemixotodon* cf. *H. chasicoensis*. Un análisis bioestratigráfico preliminar, en el cuál se comparó detenidamente la asociación hallada con aquellas correspondientes a doce localidades neógenas de la República Argentina: Sección Seminario (Fm. Saldungaray) y Quequén Salado (Fm. Irene) (provincia de Buenos Aires); Cerro Patagua, Cerro La Bota, Laguna Chillhué, Naicó, Bajo Giulliani, Salinas Grandes de Hidalgo, Barrancas Coloradas, El Guanaco y Caleufú (Fm. Cerro Azul; provincia de La Pampa); barrancas del Río Paraná ("Conglomerado Osífero" de la Fm. Ituzaingó; provincia de Entre Ríos), permitió asignar los níveles sedimentarios de "Arenas Blancas" al Huayqueriense temprano, respaldando las hipótesis previas de Cione y Tonni (*op. cit.*); la evidencia disponible indica para estos depósitos una mayor antigüedad respecto del Miembro superior de la Formación Río Negro (= Formación Los Salitrales), aflorante en esa misma región en el "Corte de Decauville", al que se le asigna tentativamente una edad Huayqueriense tardía en base a la presencia del roedor *Xenodontomys simpsoni* Kraglievich (ver Verzi *et al.*, 2008).

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FILOGENIA MORFOLÓGICA DE LA FAMILIA ECHIMYIDAE (HYSTRICOMORPHA, OCTODONTOIDEA)

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Echimyidae Gray, 1825 (ratas espinosas y coipos) es la familia más diversa de roedores histricomorfos sudamericanos (caviomorfos) y la que posee más rico registro fósil. Las hipótesis de relaciones entre sus especies son inestables, debido en gran medida a que la variación morfológica es frecuentemente redundante, especialmente a nivel dentario. En el presente trabajo se brindan resultados de un análisis filogenético de equímidos extintos (Eoceno tardío?-Holoceno) y vivientes utilizando una matriz de caracteres cráneo-mandibulares y dentarios (modificada de Olivares, 2009). Los análisis se realizaron con TNT 1.1 (Goloboff *et al.*, 2008a, b) e incluyeron especies de cinco de las seis subfamilias de Echimyidae reconocidas tradicionalmente, y octodóntidos, abrocómidos y caprómidos vivientes como grupos externos. Se recuperaron dos clados mayores; uno de ellos resultó integrado por eumisopinos fosoriales vivientes (tribu Euryzygomatomyini Emmons, 2005) y especies extintas del Mioceno tardío de La Pampa y Pleistoceno tardío-Holoceno de Brasil; en el clado restante, eumisopinos terrestres y especies extintas relacionadas del Mioceno tardío-Plioceno se agruparon con miocastorinos (equiminos ((caprómidos-dactilominos) (†adelfominos))). El adelfomino †*Maruchito* Vucetich *et al.*, 1993 (Mioceno medio) se vinculó con

equiminos vivientes. *Capromys* Desmarest, 1822 se dispuso como grupo hermano de dactilominos, y este clado se agrupó con los †adelfominos †*Eodelphomys* Frailey y Campbell, 2004 (Eoceno tardío?), †*Paradelphomys* Patterson y Pascual, 1968 (Mioceno temprano), †*Stichomys* Ameghino 1887 y †*Adelphomys* Ameghino 1887 (Mioceno temprano superior). Por fuera de Echimyidae, †*Spaniomys* Ameghino 1887 (Mioceno temprano superior) formó un clado fuertemente sustentado con Abrocomidae Miller y Gidley 1918, lo que representa el primer testimonio del origen de esta última familia. Aunque los resultados obtenidos son sólo parcialmente consistentes con filogenias morfológicas y moleculares previas, son coincidentes en la necesidad de redefinir los agrupamientos de nivel subfamiliar dentro de Echimyidae. Por otro lado, la edad y la posición filogenética de los fósiles analizados, los cuales integran el *crown group* de la familia, sugieren que el inicio de la diversificación de los Echimyidae actuales es notablemente antiguo.

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AN INVERSE POLARITY OF EVENTS: PALEONTOLOGICAL DATA AND THE PROPER INFERENCE OF GENE EXPRESSION AT THE EVOLUTIONARY ORIGIN OF MANDIBULAR AND PHARYNGEAL TEETH

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In recent papers, it has been argued that genes expressed in the teeth of pharyngeal jaws of teleosts represent an ancestral network for tooth formation, including the expression of *Hox* genes in posterior pharyngeal arches. A "core" portion of this network was proposed to have been partially co-opted afterwards in evolution, upon the origin of mandibular teeth, where no Hox genes are expressed (Fraser *et al.,* 2009; Fraser *et al.,* 2010). The inference that pharyngeal teeth evolved before mandibular teeth is based on the presence of tooth-like structures on the pharyngeal arches of the thelodont agnathan *Loganellia scotica* Traquair, 1898 (Smith and Coates, 2001; Smith, 2003). Thelodonts may be related to jawed fishes, but no teeth are found in the pharyngeal region of other agnathans considered closer to gnathostomes, such as Osteostraci and Pituriaspida. Early lineages of jawed fishes successively closer to Osteichthyes also lack pharyngeal teeth: placoderms, chondrichthyans and acanthodians. Of these, only chondrichthians and acanthodians present undisputed teeth, which appear only on the mandibular arch. The pharyngeal region in these groups only presents other odontodes such as denticles and gill rakers. This condition is the best inference for an ancestor of Osteichthyes, and identifies the mandibular arch as the ancestral site of tooth formation. Teeth in the pharyngeal region only appear in osteichcthyans (basal sarcopterygians and actinopterygians) on bony tooth plates set upon pharyngeal arches, and upon the gill rakers (Nelson, 1969). Pharyngeal jaws, with teeth directly inserted into the pharyngeal arches, evolved only within teleosts (Lauder, 1983). The simplest inference is that teeth first evolved in absence of *Hox* gene expression. *dlx* genes (Borday-Birraux *et al.,* 2006) and *eve-1* (Debias-Thibaud *et al.,* 2007), which are expressed in the mandibular and pharyngeal jaw teeth (but not in gill rakers) were probably expressed first in mandibular teeth, and were thereafter co-opted in the origin of pharyngeal dentitions.

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FIRST RECORD OF *DUSICYON AVUS* BURMEISTER, 1866 (CARNIVORA, CANIDAE) IN THE FOSSILIFEROUS DEPOSITS OF CHUÍ CREEK (LATE PLEISTOCENE), SOUTHERN BRAZIL

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Fossils of carnivores are scarce in Pleistocene deposits of Rio Grande do Sul State, southern Brazil. The only canids recorded so far include *Dusicyon* cf. *avus* Burmeister, 1866 and *Theriodictis* Mercerat, 1891, they come from fossiliferous deposits of the continental shelf (Rodrigues *et al.*, 2004) and *Protocyon troglodytes* Lund, 1842 (Oliveira *et al.*, 2005) in Chuí Creek. Here is reported the first record of *D. avus* in Chuí Creek. The specimen belongs to the collection of Museu Coronel Tancredo Fernandes de Mello (catalog number MCTFM-PV0867), in the town of Santa Vitória do Palmar. It is represented by a fragment of a right dentary containing the M_1, M_2 and the alveolus of the M_3. The dentary bears a shallow longitudinal depression on its lingual side; the cusps of M_1 and M_2 are much worn, exposing the dentine. The size of the specimen and the large lower carnassial (M_1) allow to assign it to *D. avus*. The specimen was collected in a sandstone layer deposited in a meandering fluvial environment that also contains fossils of several other Pleistocene mammalian taxa of Lujanian Stage/Age (Lopes *et al.*, 2005). The new finding increases the known diversity of carnivores from Chuí Creek and corroborates the presence of *D. avus* during the Lujanian in Southern Brazil.

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THE PRESENCE OF *RHINELLA ARENARUM* (BUFONIDAE, ANURA) IN THE UPPER PLEISTOCENE OF BUENOS AIRES PROVINCE: THE IMPORTANCE OF CONSIDERING THE INTRASPECIFIC VARIATION

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Herein we report on the presence of *Rhinella arenarum* Hensel 1867 from La Larga (Isla *et al.,* 2010), a new Lujanian (Late Pleistocene) fossil site near Daireaux, Buenos Aires province. This record consists of disarticulated, but associated, well-preserved cranial and postcranial remains that belong to a single individual (Museo Municipal de Ciencias Naturales "Lorenzo Scaglia", Mar del Plata, M-5119). Because the remains have some features that are not present in *R. arenarum* according to the literature (*e.g.*, groove for the occipital artery partially covered; Martin, 1972; Pramuk, 2006; Maciel *et al.*, 2010), an analysis of the intraspecific variation in this extant taxon was carried out. Both quantitative and qualitative characters were scrutinized in around 30 adult individuals, which were skeletonized for this purpose. This study revealed that some characters are fairly constant whereas others, such as the extent of cranial ornamentation, are highly variable. This analysis made evident that all the apparently incongruous features present in the fossil material from La Larga variably occur whithin one living population of *R. arenarum* and, hence, this taxon is polymorphic for them. In this regard, it is noteworthy that this variation was not considered in recent phylogenetic studies, such as in the character concerning the dorsal exposure of the sphenethmoid (Pramuk, 2006; Maciel *et al.*, 2010). The new find represents the first confident fossil record of *R. arenarum.* In conclusion, this work emphasizes the importance of considering intraspecific variation whenever possible, as this leads to a more rigorous approach to the identification of fossil specimens and tests the taxonomic value of different osteological characters (Bever, 2005).

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PRIMER REGISTRO DE ROEDORES (HYSTRICOGNATHI) EN LA LOCALIDAD DE PUNTA NAVA (OLIGOCENO TARDÍO), PATAGONIA, ARGENTINA

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El presente trabajo tiene como objetivo dar a conocer el primer registro de roedores en el área de Punta Nava. Este lugar es ampliamente reconocido por poseer una fauna de mamíferos asignable a la Edad-mamífero Deseadense, donde uno de los taxa más característicos es *Pyrotherium* Ameghino, 1888 (Tornoüer, 1903; Ameghino, 1906). Los niveles fosilíferos se localizan en el noreste de la provincia de Santa Cruz, en estratos de la Formación Sarmiento. Los mismos suprayacen, en discordancia erosiva, a los depósitos de la Formación Koluel-Kaike (Eoceno inferior-medio) e infrayacen, también en discordancia erosiva, a la Formación Chenque (Oligoceno superior-Mioceno inferior). El material fósil consiste en alrededor de 50 fragmentos mandibulares, maxilares y dentarios de roedores que se encuentran depositados en el Museo Regional Padre Molina (Río Gallegos, Santa Cruz). Entre los roedores hallados se registran los siguientes taxa: Octodontoidea Simpson 1945: *Deseadomys arambourgi* Wood y Patterson, 1959, *Platypittamys* Wood, 1949; Chinchilloidea Bennett 1833: *Cephalomys arcidens* Ameghino, 1897, *Scotamys*?; Cavioidea Fischer de Waldheim, 1817: *Asteromys punctus* Ameghino, 1897, y *Chubutomys simpsoni* Wood y Patterson, 1959. Todos estos roedores son exclusivos de la Edad-mamífero Deseadense y están presentes en las localidades clásicas Cabeza Blanca (Chubut) y/o La Flecha (Santa Cruz). Como en otras faunas deseadenses de roedores, el taxón más abundante es *Cephalomys* Ameghino, 1897. Se destacan en este estudio: (1) la abundancia de especímenes asignables a *A. punctus*, que hasta el momento se conocía sólo por dos fragmentos mandibulares (el holotipo proveniente de Cabeza Blanca y un ejemplar hallado en Laguna de Los Machos, Chubut), (2) el primer registro de *Platypittamys* fuera de *Scarrit Pocket*, localidad tipo del género, y (3) ausencia de especímenes asignables a Erethizontoidea, presentes en todas las localidades deseadenses conocidas en Patagonia con registro abundante de roedores. La sección de estudio se compone esencialmente de tobas y fangolitas, con conglomerados subordinados. El análisis de facies sedimentarias permitió definir depósitos de canal y de planicie de inundación, vinculadas probablemente a un sistema fluvial de moderada a alta sinuosidad. La fauna de mamíferos registrada se restringe a las facies de tobas finas y fangolitas, desarrolladas en la planicie de inundación. La coexistencia de formas braquiodontas e hipsodontas sugeriría la presencia de praderas boscosas. La ausencia de eretizontoideos, propios de ambientes arbóreos, podría deberse a defectos del registro.

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VIEJAS TECNICAS DE RECONSTRUCCIONES PARA NUEVOS PROBLEMAS

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Desde los inicios de la paleontología de vertebrados se vienen elaborando reconstrucciones artísticas de los principales descubrimientos realizados, a modo de acercar la disciplina al público en general de un modo más atractivo y apasionante, llenando salas de museos y en la modalidad actual de las muestras itinerantes que recorren el mundo. Muchos han mejorado las técnicas utilizadas para estos trabajos. Nuevos materiales mas versátiles han ido reemplazado las técnicas escultóricas que se venían utilizando desde el renacimiento, muchas van quedando en el olvido, siendo incluso menospreciadas por los técnicos de esta época que desconocen algunas cualidades únicas de materiales comunes y corrientes como yeso, arcilla o poliestireno. El presente trabajo, buscará rescatar una antigua técnica de modelado y molde utilizada durante el año 2011 en la reconstrucción de un esqueleto de prosaurópodo de 20mts., llevada a cabo por el autor para el portal del Parque Temático Talampaya, en La Rioja, Argentina. Si bien se reconoce la practicidad de los nuevos y numerosos materiales en el mercado, cabe recordar que, siendo la mayoría importados, se escapan a los presupuestos estándares de trabajo, tiempos de fraguado de los mismos y complejos procesos de preparación generan una serie de complicaciones y demoras a la hora de plasmar una escultura, que por los volúmenes generalmente

manejados, requieren de una gran cantidad de materiales, personal cualificado para su realización y un cronograma de trabajo ajustado. La técnica utilizada denominada por las escuelas de bellas artes como "molde perdido" permite realizar moldes de un esqueleto de 20mts. De largo en un tiempo mucho menor que con las siliconas tradicionales, con una serie de modificaciones en la técnica, estos moldes de yeso pueden tener la misma durabilidad de copiado que los realizados en otros materiales estándares, otra de sus ventajas es la sencilla preparación de los mismos, y la aceleración de los procesos de modelado de las piezas en poliestireno, las cuales se texturiza símil fósil con yeso. De estos moldes rígidos, el vaciado (la pieza final a exhibir) se realiza en la tradicional resina poliéster, cuidando no dejar que cumpla su ciclo de fraguado completo, se desmolda y se arman las piezas sobre un armazón de hierro estructural y se culmina la obra con una patina en esmalte sintético y barniz con filtro U.V. para su final ensamblado en exteriores.

PHYLOGENETIC RELATIONSHIPS OF THE EXTINCT CARDIOMYINES (RODENTIA, CAVIOIDEA, HYDROCHOERIDAE)

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The crown group of Cavioidea *s.s.* (Patterson and Wood, 1982) comprises caviids [caviines and dolichotines] and hydrochoerids. The latter encompasses the gigantic semiacuatic capybaras, the small and rock dweller Mocos, and the extinct cardiomyines a group of large rodents that share with the hydrochoerines ever-growing cheek teeth with accessory fissures on lingual (lowers) and labial (uppers) walls, enlarged M3 and p4, and a broad palate. In spite of these similarities cardiomyines were classically classified as caviids. However, Pérez (2010), and Vucetich and Deschamps (in press) considered cardiomyines as more closely related to hydrochoerines. Cavioids also includes the extinct "eocardiids" which are the stem group of Cavioidea *s.s.*, plus the extant dasyproctids and cuniculids. In order to test the phylogenetic position of the cardiomyines in the context of the cavioids, a cladistic analysis was performed. The matrix (modified of Pérez and Vucetich, 2011) includes 87 morphological characters and 28 taxa of Cavioidea. An equally weighted parsimony analysis was conducted using TNT 1.1 (Goloboff *et al.,* 2008a, b), performing a heuristic search of 100 Wagner tree replicates followed by TBR and considering some multistate characters as additives. The parsimony analysis resulted in 105 most parsimonious trees of 270 steps (CI=0,474; RI=0,679). The strict consensus shows that *Procardiomys martinoi* Pascual, 1961, *Cardiomys cavinus* Ameghino 1885, and *Caviodon* Ameghino, 1885 form a polytomy with hydrochoerins. This node is supported by five unambiguous sinapomorphies: 1) Absent constriction of the apex in each lobe, 2) shape of the m1-m2, in oclussal view formed by triangular lobes with wide base, 3) mesopterigoid fosae at the level of posterior prisms of M3, 4) squamosal process curved, and 5) 6–7 lobes in M3. Mocos is the sister group of this clade. When the position of conflictive taxa was ignored, the reduced consensus show cardiomyines grouped as a monophyletic taxa, more closely related to the hydrochoerines than to the caviines. The clade of cardiomyines is supported by two unambiguous sinapomorphies: 1) length of the upper diastema shorter than molariform series, and 2) location of the notch for the insertion of the tendon of the m. masseter medialis pars infraorbitalis with respect to the toothrow, between p4-m1. As an additional result, the Mara placed in a more basal position than the clade formed by caviines + (Moco + (cardiomyines + hydrochoerines) in opposition to Rowe *et al.* (2010).

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A NEW HYPOTHESIS FOR THE TAPEJARIDAE PHYLOGENY

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The Tapejaridae *sensu* Kellner and Campo,s 2007 is a group of edentulous pterodactyloid pterosaurs with considerable fossil record only on Cretaceous strata from northeastern Brazil and China. The monophyly of this taxon is subject of considerable debate among researchers, some of them regarding the Tapejaridae as paraphyletic with respect to Azdharchidae Nessov 1984, composing the taxon Neoazhdarchia Unwin 2003. Here we propose a new data matrix of 19 taxa and 22 characters in order to test the monophyly of the Tapejaridae and the internal relationships of this taxon. Three Dsungaripteridae Young 1964 taxa forms successive outgroups, the ingroup including Azhdarchidae, Tapejaridae and Chaoyangopteridae Lü *et al.,* 2008 taxa. The present study includes all described Tapejaridae *sensu* Kellner and Campos 2007 species, except *Tupuxuara longicristatus* Kellner and Campos 1988, due to its incompleteness. The phylogenetic analysis was performed using TNT v. 1.1. The study resulted in only one most parsimonious tree of 37 steps (CI = 0.83, RI = 0.9). The most parsimonious tree suggests the monophyly of the Tapejaridae, supported by three synapomorphies (instead of the 5 previously proposed). The Thalassodrominae and the Tapejarinae Kellner & Campos 2007 were also recovered as monophyletic taxa. In our analysis, the Chaoyangopteridae *sensu* Lü *et al.,* 2008 is a clade within Tapejaridae.

ON A NEW PTEROSAUR STERNUM FROM ROMUALDO FORMATION (LOWER CRETACEOUS, ARARIPE BASIN, NORTHEASTERN BRAZIL)

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Recently, a new pterosaur specimen was collected at the concretion-bearing levels of the Romualdo Formation (?Albian) of Araripe Basin and donated to the collection of the Laboratório de Paleontologia - Universidade Federal do Ceará (LPUFC-R-003). The precise locality and stratum where the concretion was found is unknown. The specimen, an almost complete sternum, is partially embedded on a calcareous concretion and has its dorsal surface completely covered by sediment. Pterosaur sterna have been generally found only in articulated skeletons or as isolated elements, what could reflect taphonomic *bias*, since the sternal anatomy and density makes this element most susceptible to water transportation. So far, only three pterosaur sterna were described for the Santana Group, two of them coming from the Romualdo Formation and belonging to the anhanguerids *Anhanguera piscator* Kellner and Tomida 2000 and *Anhanguera spielbergi* Veldmeijer 2003. The third one is associated to a partially articulated tapejarid from Crato Formation. The specimen described herein has 94,5 mm of preserved length and 62,80 mm width. It bears a well-developed cristopine where, in ventral view, is originated a massive sternal keel (which in our specimen is broken antero-ventrally). The keel becomes shallower towards the mid-caudal part of the bone, where the sternum expands in a broad plate. The sternal plate, excluding the cristopine, is longer than wide, differing from the morphologies observed in *A. piscator* and *A. spielbergi*. The dorso-laterally oriented articular facets for the coracoids are symmetrical and situated on each side of the cristopine. The lateral margins of the sternal plate are eroded and no rib articulation processes are discernible. The new specimen, although similar to *A. piscator* and *A. spielbergi* in some aspects, differs from these taxa mainly on the morphology of the sternal plate. Although sternal anatomy may be relevant to pterosaur taxonomy, with distinct diagnostic features between clades, these elements has been seldom described in detail and has, nowadays, only limited use on the main data matrices proposed for pterosaur phylogenetic studies. An accurate study of these bones, therefore, could improve our knowledge on pterosaur anatomy and relationships.

NEW REMAINS OF *LESTODON ARMATUS* GERVAIS 1855 (TARDIGRADA, MYLODONTIDAE) FROM THE PLEISTOCENE OF RIO GRANDE DO SUL STATE, BRAZIL

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In South America the subfamily Lestodontinae Ameghino, 1889 was represented in the Late Miocene – Early Pliocene of Venezuela and Argentina. During the Pleistocene the subfamily was represented by two genera: *Lestodon* Gervais, 1855 and *Ocnotherium* Lund, 1842, the last one considered endemic of Intertropical Brazil. *Lestodon* comprises three species: *L. armatus* Gervais, 1855 recorded in Argentina, Uruguay, Brazil, Bolivia and Paraguay, *L. trigonidens* Gervais, 1873 known for Argentina and Brazil, and *L. australis* Kraglievich, 1934, which occurs only in Argentina. In the Pleistocene of Brazil, *L. trigonidens* was recorded in Rio Grande do Sul (RS), São Paulo (SP) and Acre (AC) states, being the last one doubtful. *Lestodon armatus* was recorded for Pleistocene localities of RS, and has been considered an abundant taxon found in municipalities of Pantano Grande, Rio Pardo, Santa Vitória do Palmar and Osório; while *L. trigonidens* was only referred to São Gabriel Municipality. The new material comprises incomplete skulls (MCN-PV 109, 9659, 30108) and fragments of dentaries (MCN-PV 1440, 9658, 30109, 30110) deposited in the Coleção of Paleovertebrados of the Museu de Ciências Naturais of Fundação Zoobotânica of the Rio Grande do Sul. The specimens came from the coastal region of Santa Vitória do Palmar, Hermenegildo Beach, and were tentatively assigned to *L. armatus*, according to the following characters: acute and convergent frontoparietal crest determining a narrow sagittal plane, digastric fossa concave and lateroposteriorly oriented, nuchal crest projecting laterally, alveolus of M_1 triangular or oval-shaped. According to previous studies (Bargo, 2001) there are two valid species *L. armatus* (= *L. trigonidens*) and *L. australis*, however, these studies did not include material from Brazil; so that, remains assigned to *L. trigonidens* and *L. armatus* still remain without further studies since Paula- Couto (1943,

1973). Although the fossil material presented is insufficient for more accurate taxonomic results, a revision of this group is still needed, mainly including the material from south, southeast and northeast Brazil. [Support CNPq/ProSul 490299/2008-3]

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A NEW CRETACEOUS MEGARAPTORAN (THEROPODA: TETANURAE) SKELETON FROM NORTHERN PATAGONIA

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We report on a new skeleton of a medium-sized theropod dinosaur that was discovered by a team from the Universidad Nacional del Comahue in September of 2008. The specimen comes from the Upper Cretaceous (Turonian-Coniacian) Portezuelo Formation of the Neuquén Group as exposed on the northern coast of Lago Barreales in Neuquén Province, northern Patagonia, Argentina. The skeleton was recovered only 3 km from the Futalognko site, where the giant titanosaurian sauropod *Futalognkosaurus dukei* Calvo, Porfiri, González-Riga and Kellner, 2007, the dromaeosaurid theropod *Unenlagia paynemili* Calvo, Porfiri and Kellner, 2004, and the most complete described specimen of the megaraptoran theropod *Megaraptor namunhuaiquii* Novas 1998; Calvo, Porfiri, Veralli, Novas and Poblete, 2004, were found. The new skeleton includes the complete left dentary, two isolated teeth, an articulated series of seven cervical and three cranial dorsal vertebrae and associated ribs, seven additional dorsal vertebrae, proximal and middle caudal vertebrae, distally incomplete pubis and ischium, and the left femur. The dentary is rostrocaudally elongate and lacks a rostroventral expansion, as in the Australian megaraptoran *Australovenator wintonensis* Hocknull, White, Tischler, Cook, Calleja, Sloan and Elliott, 2009. The teeth possess denticles on only the distal carina, as in the southern Patagonian megaraptoran *Orkoraptor burkei* Novas, Ezcurra and, Lecuona 2008. In the middle cervical vertebrae, the centra exhibit single, elliptical, craniocaudally elongate lateral pneumatic foramina ("pleurocoels"), and the neural spine is low and laterally compressed. These characters resemble the conditions in *Megaraptor* and another Argentinean megaraptoran, *Aerosteon riocoloradensis* Sereno, Martinez, Wilson, Varricchio, Alcober and Larsson, 2008. Some dorsal vertebrae have centra with large and simple pneumatic foramina, while in others, these foramina are divided by a septum. The preserved proximal caudal vertebra is gently amphicoelous with two strongly developed laminae ventral to each transverse process, as in *Megaraptor* and *Orkoraptor*. On the right side of the centrum, there is a large pneumatic foramen, while on the left side there are two smaller but still well developed foramina. Pneumatic foramina also occur in the proximal caudal centra of *Aerosteon*, *Megaraptor*, and *Orkoraptor*. The centrum of a middle caudal vertebra is amphicoelous and lacks pneumatic foramina. The femur is substantially more robust than those of *Australovenator* and the Japanese megaraptoran *Fukuiraptor kitadaniensis* Azuma and Curri,e 2000. In summary, the new specimen constitutes one of the most complete, best-preserved skeletons of Megaraptora yet discovered, and displays particularly strong similarities to the South American genera *Aerosteon*, *Megaraptor*, and *Orkoraptor.* Ongoing study of the specimen promises to significantly enhance our understanding of this enigmatic theropod clade. [Funding by: Universidad Nacional del Comahue I-155, Proyecto Dino, and the Edward O'Neil Field Fund of Carnegie Museum of Natural History].

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A NEW RHYNCHOCEPHALIAN FROM THE UPPER TRIASSIC (CARNIAN) OF SOUTHERN BRAZIL, AND THE OLDEST RECORD OF A SOUTH AMERICAN SPHENODONT

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Rhynchocephalia Günther, 1867 is a lepidosaurian clade that includes the extant *Sphenodon* and all its fossil relatives. Sphenodonts are lizard-like reptiles, recognized as the sister group of Squamata (Benton, 1985), whose most ancient records are recognized from the Carnian or Late Norian of Great Britain (Fraser and Benton, 1989) and readily achieved a cosmopolitan distribution. Until now, *Clevosaurus brasiliensis* Bonaparte and Sues 2006 was the oldest sphenodont record from South America (Arantes *et al.*, 2009), being abundant in the top of the Santa Maria 2 Supersequence, of Norian age (Zerfass *et al.*, 2003; ICS, 2009). Recent field work at the Linha Bernardino outcrop, in Candelária municipality, Rio Grande do Sul State, Brazil, resulted in the collection of three new tetrapod specimens. The material consists of three different fragmented specimens kept in the collection of the Aristides Carlos Rodrigues Municipal Museum, Candelária, under the

numbers MMACR PV-027-T, MMACR PV-028-T and MMACR PV-029-T, respectively. They consist on: a fragmented maxilla and premaxilla associated with part of the mandible; a dentary fragment; and a sequence of three mandibular teeth. Despite of the fragmentary condition of the material, the dentition is very well preserved. The premaxilla possesses only one large acrodont tooth. The preserved portion of the maxilla possesses an anterior row of six subpleurodont teeth that alternate in size, and a posterior row of seven significantly larger acrodont teeth. The first mandibular tooth is twice as large as most of the other ones, being followed by significantly smaller teeth, that gradually increase in size posteriorly. All teeth surfaces are smooth, showing no ornamentation. As the same outcrop also yielded *Exaeretodon* specimens, that pertain to the *Hyperodapedon* Assemblage Zone (Soares *et al.*, 2011), we consider the sediments from Linha Bernardino outcrop as as Carnian in age (Zerfass *et al.*, 2003; ICS, 2009). According to this correlation, the new material presented herein would remain as the most ancient record for sphenodonts in South America. The material, which differs in many aspects from other known sphenodonts, is currently under comparative study, and may constitute a new taxon. Additionally, the widespread distribution of sphenodonts in Great Britain (Fraser & Benton, 1989), North America (Heckert, 2004), and South America (this work) for the Carnian age, reinforces the idea that the origin of the group is still older.

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THE PHYLOGENETIC RELATIONSHIPS OF THE EARLY PERMIAN MESOSAURID PARAREPTILES

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The mesosaurids (Parareptilia: Proganosauria) are small-sized Permian amniotes, distinct by their adaptations to the aquatic habit (*e.g.*, paddle-like limbs and laterally depressed tail with high neural spines). The group comprises three taxa: *Mesosaurus tenuidens* (Gervais, 1864), *Stereosternum tumidum* (Cope, 1886) and *Brazilosaurus sanpauloensis* (Shikama and Ozaki, 1966). Although known for more than a century, the mesosaurids are still considered an enigmatic group (Modesto, 1999; 2006; Tsuji and Müller, 2009), and many aspects regarding to this group remain poorly studied. Indeed, the vast majority of phylogenetic investigations including mesosaurids tend to merge the three taxa and refer to them merely as Mesosauridae. Marconato (2001 – M.Sc. Thesis, unpublished), attempted to assess the relationships among the mesosaurid taxa, but reported many obstacles to a robust conclusion (Marconato and Bertini, 2002). Tsuji and Müller (2009), in a wide phylogenetic analysis of the Parareptilia, included the three mesosaurid taxa separately in a tree, but obtained a politomic Mesosauridae clade. To deal with the problem of the mesosaurid relationships, a new phylogenetic approach was conducted, based on the 137 characters matrix of Müller and Tsuji (2007). Five new characters were added to the analysis (ratio of maximum skull length/maximum skull width, caudal neural spine height, rib width, presence of rib overlying, and ratio of height/width of the largest teeth). The analysis included 28 taxa with the three mesosaurid genera taken separately. Mesosaurids formed a monophyletic group (supported by four state changes) at the base of Parareptilia, termed Proganosauria, following Baur (1887). *Mesosaurus* and *Stereosternum* form a group within Proganosauria (also supported by four state changes), termed Mesosauridae, resurrecting the original group composition proposed by Baur (1889). The phylogeny pointed *Brazilosaurus* as the most primitive mesosaurid, agreeing with the preliminary hypothesis of Marconato (2001), and placed Proganosauria as the most basal parareptilian group, reinforcing the data from latest phylogenetic approaches.

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A NEW TEMNOSPONDYL SKULL AND ITS IMPLICATIONS IN THE SUGGESTED PERMO-TRIASSIC AGE OF THE BUENA VISTA FORMATION OF URUGUAY

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Temnospondyli is the best represented group in the fluvial deposits of the Permo-Triassic Buena Vista Formation (northeast Uruguay). Herein, we describe a new taxon represented by a partially complete skull, lacking snout, tabular horns and part of the postero-lateral skull area. As other components of the Buena Vista Formation (the Colonia Orozco fauna), this temnospondyl displays a mosaic-like feature, including plesiomorphic and derived features present in rhinesuchids, lydekerinids as well as in rhytidosteids stereospondyls, conferring to it a generalized morphology. The large size and general skull outline with orbits positioned slightly posterior to the skull midpoint, the presence of a pterygoid-vomer contact and a small basioccipital forming the base of the occipital condyles allied it to rhinesuchids, while other characters present in the new taxon are commonly found in lydekkerinids, as the sensory sulci encroaching the lacrimal, although lacking a step-like lacrimal flexure; the otic notch not deeply incised; the enlarged and round posttemporal fossa; the reduced palatine tooth row behind the palatine tusks; the corpus of the pterygoid slightly ornamented and the presence of an interorbital hollowing. This combination of primitive and derived characters is frequently found in the components of the Colonia Orozco fauna, which could thus be transitional between Permian and Triassic tetrapod communities from elsewhere (Piñeiro *et al.*, 2007). However, placement of the PTB in the Uruguayan sequence that includes the Buena Vista and the underlying Yaguarí formations have been difficult because of the lack of clear faunal correlations with South African and Russian successions, where this boundary has been established (Ward *et al.*, 2005; Newell *et al.*, 2010). On the other hand, transitional tetrapods associated to the PTB in the Russian Platform, as in the Vyazniki community, could be equivalent to the Buena Vista fauna (Piñeiro and Ubilla, 2003). Phylogenetic, sedimentological and geochronological data suggest that the Uruguayan fauna could represent the changes produced at the PTB following the greatest extinction event. If this scenario is correct, tetrapod survivorship rates across the PTB would change substantially, concerning particularly that of temnospondyls.

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SEXUAL DIMORPHISM IN LIVING AND FOSSIL PLAINS VISCACHAS (RODENTIA, CAVIOMORPHA, CHINCHILLIDAE) OF ARGENTINA: A QUALITATIVE APPROACH

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Despite being one of the most sexually dimorphic living rodents, there have been few morphological studies of sexual dimorphism of the plains viscacha, *Lagostomus maximus* (Desmarest, 1817). We compared the skull morphology of adult males and females of this species in order to recognize anatomical characters that allow discriminating adults of each sex. Preliminary results indicate differentiation between adult males and females in several skull features such as: 1- development and length of temporal and sagittal crests, 2- length of the parietals in relation to their width, 3- size of the area of origin of the temporal muscles. The morphology observed in adult males of the living species was also identified in fossil specimens of *Lagostomus maximus* (Holocene of Buenos Aires Province), *Lagostomus cavifrons* Ameghino, 1889 (Pleistocene of Buenos Aires and Santa Fe Provinces) and *Lagostomus (Lagostomopsis) incisus* (Ameghino, 1888) (Pliocene of Buenos Aires Province). The possible presence of sexual dimorphism in a Pliocene species of *Lagostomus* Brookes, 1828 suggests that social behaviors such as polygyny (males mating with multiple females) and male-male competition, both related to male-biased sexual size dimorphism and observed in the living *L. maximus*, were already established in the genus by that time. This evidence is also important for interpreting the systematics of Neogene chinchillids.

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UN NUEVO TOXODONTIDAE (MAMMALIA, NOTOUNGULATA) DEL NEÓGENO DE LA QUEBRADA DE HUMAHUACA, PROVINCIA DE JUJUY, ARGENTINA

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En esta contribución se describe un nuevo Toxodontidae proveniente de la Formación Maimará (Mioceno tardío, Jujuy, Argentina). Este toxodóntido representa el primer registro de notoungulado para esta unidad. El ejemplar pertenece a la colección Peirano, depositada en el Museo de Geología Mineralogía y Paleontología, Instituto de Geología y Minería de la Universidad Nacional de Jujuy, está representado por un fragmento mandibular con la porción sinfisaria con todos los incisivos y parte de la hemimandíbula derecha con la serie premolar/molar completa. Los rasgos que permiten distinguir a este espécimen como un nuevo taxón son: sínfisis telescopada, fuerte procumbencia de los incisivos (ángulo mentoniano bajo), i3 hipertrofiado y profundamente implantado, mentón aquillado, estrechamiento sinfisario muy marcado y leve divergencia de la sínfisis. Del análisis comparativo con otros toxodóntidos del Mioceno tardío/Pleistoceno de América del Sur resulta que el ejemplar de Maimará comparte rasgos de su morfología mandibular y dentaria con *Xotodon* y *Mixotodon*. La presencia de este nuevo toxodóntido en el Neógeno de la Quebrada de Humahuaca incrementa nuestro conocimiento sobre la radiación de los notoungulados euhipsodontes en el Noroeste de Argentina. Asimismo, este espécimen aporta nueva información para comprender las primeras fases del intercambio biótico con América del Norte y las posibles rutas de dispersión.

ANÁLISE DA VARIABILIDADE MORFOLÓGICA E BIOMÉTRICA EM *COLBERTIA MAGELLANICA* (MAMMALIA, NOTOUNGULATA) DA BACIA DE ITABORAÍ, RIO DE JANEIRO, BRASIL (ITABORAIENSE)

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Paula-Couto (1978) observou a existência de variabilidade biométrica em *Colbertia magellanica* (Price and Paula-Couto, 1950), inicialmente supondo a presença de uma nova espécie, mas em seguida atribuindo-a a dimorfismo sexual. Neste trabalho foram analisados fragmentos de maxila, mandíbula e molares isolados originalmente atribuídos a esta espécie, depositados nas coleções do Departamento Nacional de Produção Mineral (DNPM) e Museu Nacional (MN), ambas no Rio de Janeiro/RJ e no American Museum of Natural History (AMNH), em Nova Iorque, com o fim de quantificar a variação biométrica e morfológica dos molares desta espécie. Foram analisados todos os espécimes previamente classificados como *C. magellanica*: 26 mandíbulas e treze maxilas do DNPM; 31 mandíbulas, cinco maxilas e 72 dentes isolados do MN e duas mandíbulas e onze maxilas do AMNH. Para a análise biométrica foram extraídas medidas de comprimento e largura dos dentes, calculados o coeficiente de variação (CV), desvio padrão (DP) e testada à normalidade dos resultados pelo teste e Shapiro-Wilk W. Após observar o material, constataram-se variações morfológicas nas seguintes estruturas: cúspide acessória no trigonido e cingulido vestibular (m1-3); crístida entoconido-hipoconido e flexido distal entre o hipoconulido e hipoconido (m3); cíngulo lingual, centrocrista e flexo entre metacone/metástilo e paracone/parástilo (M1-2); cíngulo lingual e cúspule distal ao protocone (M3). O resultado destas análises evidenciou: (1) o CV de variação ficou abaixo de 13%, mas os valores da área do m3 não apresentaram distribuição normal; (2) molares superiores com maior variação biométrica no comprimento e molares inferiores na largura; (3) molares superiores do MN apresentam um maior CV e DP em relação aos dentes das outras coleções, o mesmo não acontecendo nos molares inferiores, nos quais a variação de tamanho não está atrelada a uma coleção; (4) a inclusão dos dentes isolados aumenta a variabilidade, sugerindo uma classificação parcialmente equivocada; (5) a cúspide acessória no trigonido, quando presente,

ocorre em toda a série molar. A relevância desta feição, como caráter diagnóstico, ainda carece de ser mais avaliada, uma vez que não está associada a um padrão de tamanho. Em síntese, *C. magellanica* possui grande plasticidade morfológica, mas distribuída aleatoriamente por dentes de diferentes tamanhos e nas diferentes coleções, não suportando, neste momento, a existência de outra espécie ou dimorfismo sexual. Este trabalho alerta para um maior cuidado na definição de espécies sobre pequenas diferenças morfológicas e/ou biométricas.

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FIRST INCREMENTAL LINES OF VON EBNER ANALYSIS IN THEROPOD DINOSAUR AND CROCODILIAN TEETH FROM CENTRAL BRAZIL (BAURU GROUP, LATE CRETACEOUS)

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Theropod and crocodilian teeth from Turonian-Santonian Adamantina Formation (Bauru Group) exhibit growth lines. Dental enamel of theropod dinosaurs and crocodilians is the most highly mineralized tissue of tetrapods from Bauru Group, Central Brazil, which consists mainly of submicroscopic crystals of hydroxyapatite, and undergoes little diagenetic alteration through time. The deposition of dental enamel reflects incremental growth and these incremental lines of enamel have been extensively used to investigate the temporal and spatial patterns of tooth development in living and fossil vertebrate fossils. Intact shed teeth of one Theropoda indet., Abelisauridae indet. and Crocodylomorpha indet. from Pontal do Triângulo Mineiro region (Minas Gerais state) and São Paulo state were selected for histological examination. All specimens belong and are housed at Laboratório de Geologia, Curso de Geografia, *Campus* do Pontal, Universidade Federal de Uberlândia. All studied teeth exhibit dentine growth lines which are morphologically similar to the incremental lines of von Ebner (lines laminations bearing in some extant amniotes). Dentine deposition occurs throughout tooth development and counts of cyclically deposited lines. The Bauru Group specimens exhibit the characteristic von Ebner features of alternating opaque zones and transparent laminae under polarized light comparable with extant Laurasian crocodilian and theropod teeth studied by Erickson (1996). Therefore, Brazilian study suggests that the mentioned Late Cretaceous taxa shared same dentine deposition in both hemispheres.

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ELECTRON SPIN RESONANCE DATING OF *STEGOMASTODON WARINGI* AND TOXODONTINAE TEETH FROM LAGOA DO RUMO, BAIXA GRANDE, BAHIA, BRAZIL

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Late Quaternary fossils from the extinct South American megafauna are relatively common in Brazilian's Northeast region. Although more than 160 records related to that mammals discovered at caves, paleolacrustine deposits, and mainly inside depressions in weathered crystalline rocks called "tanque" or "cacimba", few geochronological studies were conducted in these mammal's fossils from the Brazilian's Northeast deposits. The fossiliferous deposit, a "tanque" located at Lagoa do Rumo, Baixa Grande, Bahia State, Brazil, studied in this work has two distinct levels. The basal bed consists in a thick packaged of fossiliferous breccia, supported by very poorly sorted clast and bioclast, where fossils are chaotically disposed in the layer. The superior stratum is an organic-rich mudstone, without any presence of macrofossils. In the fossiliferous layer fossils of Pilosa, Cingulata, Proboscidea and Toxodontinae were discovered. Teeth of *Stegomastodon waringi* Holland 1920 (AMEPR1) and Toxodontinae (AMEPR2 and AMEPR3) were selected for ESR dating. A fraction of enamel and dentine of a tooth AMEPR1 were removed using a Dremel diamond saw operating at low rotation under water irrigation to prevent heating. This fraction and the remaining teeth (AMEPR2 and AMEPR3) were thermally treated by freezing in liquid nitrogen and thawing at room temperature to separate the enamel from dentine (Kinoshita *et al.*, 2008). Enamel samples were subjected to acid treatment (HCl) 1:5 in an ultrasonic bath for extraction of layer on both sides of approximately 250µm. After drying, the enamel was ground manually in an agate mortar until particle reach diameter φ <0.5mm. Ten aliquots of enamel of each tooth of about 70mg were irradiated with different doses, ranging from 0 to 1.2kGy. The spectrum of original enamel and irradiated aliquots were recorded in a Jeol FA200 X-Band spectrometer. The intensity of peak-to-peak of g^ dosimetric signal was measured to construct the dose-response curve. The Equivalent Dose (De) was determined through exponential fitting. Samples of enamel, dentine and associated soil of each tooth were subjected to Neutron Activation Analysis (NAA) to

determine the concentration of U, Th and K. The conversion of De into age was performed using ROSY ESR Dating program (Brennan *et al.*, 1999) giving 50 ± 10 ka B.P. for AMEPR1, 43 ± 8 ka B.P. for AMEPR2, and 9 ± 2 ka B.P. for AMEPR3. These results show a significant time averaging between 30ka and 50ka years in the fossil assemblage from Lagoa do Rumo. The result obtained in the sample AMPER3, 9 ± 2 ka B.P., is the youngest age obtained directly from a megafauna's fossil from the late Quaternary in the Brazilian's Northeast region. The dating of more samples found in this region will allow a better time and space understanding of that fauna.

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DESARROLLO ONTOGENÉTICO EN EL ROEDOR GIGANTE *ISOSTYLOMYS* KRAGLIEVICH, 1926 (RODENTIA, DINOMYIDAE, EUMEGAMYINAE).

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Los Dinomyidae (Peters, 1873) Alston, 1876, constituyen una de las tres familias de roedores gigantes registradas en Sudamérica. Pese a su amplia distribución geográfica y gran diversidad taxonómica, el conocimiento del grupo es limitado debido a que la mayoría de las especies han sido descritas en base a material fragmentario (Rinderknecht *et al.*, 2011). En esta comunicación presentamos información integrada a partir de ejemplares adultos y juveniles asignados a la subfamilia Eumegamyinae Kraglievich, 1932, pertenecientes al Museo Nacional de Historia Natural de Montevideo (MNHN). Los restos fueron exhumados en sedimentos pelíticos de la Formación Camacho en la localidad de Arazatí, Departamento de San José, Uruguay. La Formación Camacho está conformada por depósitos correspondientes a uno o varios eventos transgresivos acaecidos durante el Mioceno tardío y ha sido correlacionada en base a su contenido fósil a la Edad Mamífero Huayqueriense (Perea y Martínez 2004). MNHN 2187 consta del cráneo y mandíbula asociados de un ejemplar adulto gigantesco, previamente reportado por Bostelmann *et al.*, (2008). MNHN 2687 incluye ambas ramas mandibulares asociadas al calcáneo derecho de un ejemplar juvenil, el primero en ser reconocido como tal para la subfamilia Eumegamyinae. La disposición, número y patrón de unión en los lofos dentales permiten asignar todos estos restos al género *Isostylomys* Kraglievich, 1926. A partir del estudio comparado de los ejemplares, se puede señalar que la configuración dental en *Isostylomys* permanecía prácticamente invariable durante gran parte del desarrollo ontogenético. La posibilidad de identificar con certeza restos de ejemplares fósiles en diferentes estadíos de desarrollo permite proponer la sinonimia de las especies incluidas previamente en el género, erigidas únicamente a partir de diferencias en el tamaño, validando de esta forma una única especie: *Isostylomys laurillardi* Kraglievich, 1926. En base a estas conclusiones se revisan las anteriores hipótesis sobre los cambios ontogenéticos ocurridos en Eumegamyinae, se discute la validez de la subfamilia Gyriabrinae Kraglievich, 1930 y se comentan las consecuencias derivadas de esta propuesta para la taxonomía y sistemática de los Dinomyidae.

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IS *LIAONINGOPTERUS GUI* A BASAL ANHANGUERID PTEROSAUR?

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Fossils of anhanguerid or anhanguerid-like pterosaurs are known exclusively in the Cretaceous, being present in almost all continents. Most nominal species come from the Albian Romualdo Formation in Brazil, but others have been unearthed from deposits in England, the USA, Morocco, China, and possibly Mongolia. In the Jiufotang Formation of China, *Liaoningopterus gui* Wang and Zhou, 2003 is, so far, the only anhanguerid, being formally known by only its holotype. Recent claims have proposed that *Liaoningopterus* concerns a species basal to *Anhanguera* Campos and Kellner, 1985 and *Tropeognathus* Wellnhofer, 1987, both anhanguerid genera known from the Romualdo Formation of Brazil. Such claims are of biogeographic interest, especially as both units share other faunistic elements. Lü and Ji (2006) used a modified version of the matrix by Kellner (2004), adding 17 Liaoning pterosaurs known by then. *Liaoningopterus gui* was found as a basal anhanguerid, in a sister-group relationship with *Anhanguera* and *Tropeognathus*. According to their codings, *Liaoningopterus* differs from the other anhanguerids in the possession of a straight dorsal margin of the skull (ch. 1.0), which was coded as wave-like (ch. 1.2) in *Anhanguera* and *Tropeognathus*; *Tropeognathus* would have a comparatively broad lower jaw (ch. 2.1), instead of laterally compressed as used by Kellner (2004); *Liaoningopterus* would have the rostrum low with a straight or concave dorsal outline (ch. 16.1), while *Anhanguera* and *Tropeognathus* it would possess the anterior region of rostrum high, but antorbital region flat (ch. 16.3); *Liaoningopterus* would have teeth confined to the anterior part of the jaws (ch. 36.2), while in *Anhanguera* and *Tropeognathus* the teeth would be evenly distributed along the jaws (ch. 36.0); and *Liaoningopterus* would have peg-like teeth, in a number of 15 or less on each side of the jaws (ch. 41.1), while *Anhanguera* and *Tropeognathus* would not present peg-like teeth (ch. 41.0). First-hand analysis of the holotype of *Liaoningopterus gui* (IVPP V13291), however, demonstrates that it is remarkably similar to the species of *Anhanguera* and shows that these different codings are mistaken; instead, *Liaoningopterus gui* should have identical codings to *Anhanguera* in all of the above-mentioned characters, such that the view that it concerns a basal anhanguerid is no longer supported. Furthermore, *Tropeognathus* possesses a laterally compressed, instead of a broad, lower jaw. The only other phylogenetic analysis including *Liaoningopterus gui* was made by Andres and Ji (2008), who did not recover it as a basal anhanguerid, but rather in a trichotomy with *Tropeognathus* and the species of *Anhanguera*, the latter forming a clade. To this point, a basal position of *Liaoningopterus* in relation to *Anhanguera* and *Tropeognathus* cannot be supported. Description of new, more complete specimens and the inclusion of other anhanguerids in phylogenetic analyses may prove useful to further address this issue and offer better support to biogeographic proposals.

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PRELIMINARY SURVEY OF THE CARNIVORES (MAMMALIA, CARNIVORA) OF THE LATE PLEISTOCENE/HOLOCENE FROM NORTHERN BRAZIL

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The diversity of extinct and living Carnivora in South America is the result of a migratory event (The Great American Biotic Interchange) of several lineages throughout the Pliocene-Pleistocene boundary. In this contribution, we identified the Carnivora fossils found in two caves, Gruta dos Moura and unnamed cave, both located at the municipality of Aurora do Tocantins, Tocantins State, Northern Brazil (12°42'47"S; 46°24'28"W). All the material was prepared and subsequently identified by direct comparisons to fossil and extant specimens from museum collections in Brazil and Argentina. Current specialized literature was also used to confirm identifications. The Felidae records were found on both caves and included *Panthera onca* Linnaeus 1758 and *Puma concolor* Linnaeus 1771 – the former was represented by an almost complete skeleton, a pair of upper and lower canines, two fragments of left mandible with p2 and p3, one fragment of left mandible with p4, and one fragment of right P4 (all belonging to different individuals) and the latter by one left m1. Also, from the Gruta dos Moura came one left mandible bearing a canine and the complete molar series of a Canidae indet. Moreover, a Procyonidae Fischer von Waldheim 1817 isolated lower molar and a Mustelinae indet right fragmented mandible with p4 and m1 were recorded from the unnamed cave. Other unidentified fragments of Carnivora were collected from the same caves. Further comparisons will be conducted to a more detailed identification. Through the comparative analysis, teeth of P. onca from Aurora do Tocantins were observed to be larger than the extant species of South America. [This study is part of the project "Os mamíferos fósseis do Quaternário do estado do Tocantins: diversidade e aspectos paleoambientais" and financially supported by CNPq (process number 401812/2010-3)].

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THE EVOLUTION OF SKULL IN PELOMEDUSOID TURTLES (TESTUDINES: PLEURODIRA)

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Pelomedusoides is the largest group of side-necked turtles and comprises five families. Recent discoveries reveled a more complex and extensive evolutionary history to this hyperfamily than had been realized and most of the information available lies on taxa with diverse cranial morphology. We performed a geometric morphometric analysis to describe quantitatively the skull morphology evolution in Pelomedusoides. A set of 65 bi-dimensional landmarks were defined in order to represent the morphology of the cranium in three views: dorsal, ventral and lateral. The landmark coordinates were collected in 28 selected species of Pelomedusoides (including members of the five families) and then Procrustes superimposed in order to remove differences of position, scale, and orientation, leaving only differences in shape. These adjusted characters were combined into a single data matrix used in a Cluster analysis. After that, the cluster of maximum similarity (a phenetic tree) was compared to the phylogeny of Pelomedusoides, pointing some conformity in the data generally, i.e.: a huge agreement between clusters and clades of the phylogeny. However, it is also evident that some species are very different in overall morphology and might represent super specialized morphotypes. These are the cases of bothremidid *Labrostochelys* Gaffney, Tong & Meylan, 2006 and podocnemidid *Dacquemys* Williams, 1954 that seems to be morphotypes very distinct from the other Pelomedusoides. Moreover, two apparently overall cranial morphological convergence were detected: (1) Euraxemydidae Gaffney, Tong and Meylan, 2006 were clustered with "basal" podocnemidids *Bauruemys* Kischlat, 1994 and *Peiropemys* Gaffney, Meylan, Wood, Simons and Campos, 2011 plus the extant *Podocnemis erythrocephala* (Spix, 1824); (2) the "basal" bothremydids Kurmademydinae Gaffney, Tong and Meylan, 2006 and Cearachelyini Gaffney, Tong and Meylan, 2006 were clustered with Pelomedusidae Cope, 1868 and *Araripemys* Price, 1973. Besides these possible convergences of forms, it was detected other clusters represented exclusively by extinct species. So, it is also possible to conclude that, based on cranial overall morphology, extinct Pelomedusoides may have occupied more diverse niches that extant groups have nowadays. [This work was partially supported by Brazilian National Research Council (CNPq) (scholarship #142330/2006-0, grant to Pedro Romano)].

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ALGUNAS CONSIDERACIONES BIOGEOGRÁFICAS Y BIOCRONOLÓGICAS DE LA FAUNA DE LA FM. EL GALLO, BAJA CALIFORNIA, MÉXICO

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En el año de 2004 se retomó el estudio de los sedimentos continentales de la Fm El Gallo, de edad cretácica tardía, enfatizando el trabajo de tamizado para recuperar microvertebrados. Algunos de los descubrimientos más importantes incluye restos de un Boreoteiiodeo poliglifanodontino, un tiranosauroideo y restos de mamíferos (Montellano *et al.*, 2008; Peecook *et al.*, 2010). En este trabajo se describe los microvertebrados (no mamíferos) de una localidad. Se identificaron los siguientes grupos y se determinó su abundancia relativa: Rajiformes 1%, Lepisosteiformes 1%, Elopiformes 9%, Allocaudata 1%, Anura 17% Testudines 1%, Squamata 8%, Crocodylia 49% y Terópodos (sin aves) 11%, Aves 2%. Destaca la presencia de la familia Albanerpetontidae, la abundancia de cocodrilos juveniles y de elementos postcraneales de anuros; así como la abundancia relativa de *Troodon* Leidy, 1856 y *Richardoestesia* Currie, Rigby y Sloan 1990, dentro de los terópodos; y

la probable presencia de la familia Atoposauridae. Este contenido faunístico es acorde con un ambiente fluvial. Para el Cretácico Tardío en Norteamérica se reconocen dos unidades NALMA: Juditiano (79-74Ma) y el Lanciano (70-65Ma), existiendo un hiatus conocido como "Edmontoniano", que faunísticamente no está bien caracterizado. Con base en la edad absoluta de El Gallo (74.87±0.05 a 73.59±0.09Ma) esta corresponde a la base del "Edmontoniano" (Cifelli *et al.*, 2004). Para comprobar esta hipótesis y si el provincialismo faunístico se cumple, se comparó el contenido faunístico de otras formaciones cretácicas tardías de Norteamérica contra lo encontrado en El Gallo. Se realizaron diversos análisis (PAE, PAE-PCE, UPGMA), concluyendo que la biota de El Gallo resulta peculiar, ya que comparte más taxa con formaciones lancianas y juditianas de otras latitudes, principalmente del centro y norte, que con la Formación Aguja (Texas) como se esperaría. No se obtuvieron resultados contundentes para decir que El Gallo puede representar el NALMA "Edmontoniano", pero se puede apoyar la idea que fue un periodo de transición entre el Juditiano y el Lanciano, en el cual hubo una reorganización de las faunas de vertebrados terrestres, por ejemplo géneros que durante el Juditiano se encontraban en el sur o en el norte, en el Lanciano están presentes en ambas latitudes. Por último, la singular asociación faunística de El Gallo sugiere el inicio de un aislamiento geográfico del resto de Norteamérica occidental, mediante un proceso de vicarianza, ocasionado por las incipientes cordilleras producto de las orogenias Servier y Laramide.

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PALEOECOLOGY OF THEROPODS FROM ROMUALDO FORMATION (LOWER CRETACEOUS, NORTHEAST BRAZIL)

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Here we analyze the diversity of theropods from the Lower Cretaceous Romualdo Formation, Northeast Brazil with an ecological approach. Supposing the absence or rarity of herbivorous dinosaurs in this formation, Naish *et al.* (2004) proposed intraguild predation and exploit of carcasses as mechanisms capable of sustaining the theropod diversity. They also considered that the compsognathid coelurosaur *Mirischia asymmetrica* Naish *et al.,* 2004 could have been an analogous of varanid lizards, also consuming vegetation. However, the skulls of other compsognathids show adaptations only for carnivory and their gut contents include solely small vertebrates. As a small maniraptoriform coelurosaur, *Santanaraptor placidus* Kellner 1999 should have also fed on small vertebrates and invertebrates. So both coelurosaurs should have been small predators whose habitat might have included almost all areas where they could find their preys or carcasses for an eventual scavenging. In the other hand, the spinosaurs skulls show adaptations to piscivory, which is in agreement with the fossil record, and it was also proposed semi-aquatic habits for them based on isotopic data. So the Romualdo spinosaurs *Irritator challengeri* Martill *et al.,* 1996 and *Angaturama limai* Kellner and Campos 1996 might have been associated to water bodies, where they could catch fishes. However, a pterosaur vertebra with a spinosaurid teeth embedded in it from this Brazilian formation is evidence that these predators could have fed also on terrestrial preys, at least eventually, so we do not dismiss active predation on terrestrial prey or scavenging for them. Finally, it seems that the Santana Formation theropod diversity may be better understood based on the occupation of different niches by two distinct guilds: the coelurosaur one, formed by small, more terrestrial predators, and the spinosaur one, composed by big, semi-aquatic predators that fed on fishes and other prey items, including one.

Naish, D., Martill, D.M. and Frey, E. 2004.Ecology, Systematics and Biogeographical Relationships of Dinosaurs, Including a New Theropod, from the Santana Formation (?Albian, Early Cretaceous) of Brazil. *Historical Biology:* 16: 57-70.

ON THE SUPPOSED ABSENCE OF HERBIVOROUS DINOSAURS IN ROMUALDO FORMATION (LOWER CRETACEOUS, NORTHEAST BRAZIL)

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Here we review the hypotheses about the supposed absence of herbivorous dinosaur taxa in Lower Cretaceous Romualdo Fomation, Araripe Basin, Northeast Brazil. Until now only theropods were found in this formation. The presence of herbivorous dinosaurs in other Early Cretaceous basins of Northeast Brazil is confirmed by many ornithopod and sauropod footprints. Some paleoecological factors could have precluded the presence of herbivores in Romualdo paleoenvironment (Machado and Kellner, 2006), like scarcity of vegetation or aridity. However, the majority of the paleoecological factors should have been very similar in most paleoenvironments throughout Gondwana, including those where herbivores were already found, as Saharan Africa and Northeast Brazil were inside the same climate

region. Another fact against the aforementioned paleoecological proposition is that Botucatu Formation paleoenvironment, considered one of the biggest paleodeserts ever found, was inhabited by ornithopods mainly of small body sizes (Leonardi *et al.*, 2007). Thus, at least small ornithopods should be expected to have inhabited Santana paleoenvironment. A taphonomic approach to explain the absence of herbivores fossil record in Santana was proposed by Naish *et al.* (2004). They speculated that the less pneumatized skeletons of herbivores would arrive less often and more damaged at the depositional environment if these animals inhabited hinterlands. In favor of this idea it is the fact that spinosaurs, which are supposed to have had semi-aquatic habits (Amiot *et al.*, 2010), have the most common dinosaur fossil record in Santana Formation. Actually, bony remains of ornithopods and sauropods have not yet been recovered in Northeast intracratonic basins, which had a similar origin related to the opening of South Atlantic Ocean. So we consider that a more robust taphonomic approach should be performed in order to understand the absence of bony remains of herbivorous dinosaurs not only in Santana Formation, but in all other Northeast Brazil intracratonic basins.

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ASSESING THE AGE OF LOS COLORADOS FORMATION, ISCHIGUALASTO -VILLA UNION BASIN, ARGENTINA. TEMPORAL IMPLICATIONS FOR COLORADIAN FAUNA

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The Ischigualasto – Villa Union basin was developed over the Triassic in the Southwestern quarter of Pangea. This basin hosts some globally recognized paleontological sites for the Late Triassic, highlighting not only the huge number of specimens collected, but also the diversity of taxa present in the different associations. The youngest faunal association of the basin, located in the upper section of Los Colorados Formation is composed of pseudosuquids ("rauisichids, sphenosuchids and protosuchids"), avemetarsalians (sauropodomorph and theropod dinosaurs), tritylodontid cynodonts and quelonids (Bonaparte 1971; 1978; Rogers *et al*, 1995). The unusual composition of this association made it earn the name "Coloradense" in the way of distinguishes it from others (Bonaparte, 1973). The age of Los Colorados Formation has been assigned, based in this faunal association, to the Late Triassic, possibly reaching the Jurassic (Bonaparte, 1973; Martínez, 2002). However, so far no one has produced dating with methods with high temporal resolution (*e.g.*, radiometric dating). As a consequence, this faunal association has not been included in faunal global compilations (*e.g.*, Simms and Ruffel, 1989; Tanner *et al.*, 2004). We present preliminary results of a magnetostratigraphic study developed in the southern outcrops of the Los Colorados Formation. For this, 60 paleomagnetic sample sites over 600 mts were survey. A consistent and statistically reliable component was measured that preserves the primary remanent magnetization, oriented SSW and down for reverse polarity and NNE and up for normal polarity in different sites. The magnetostratigraphic column obtained was correlated with the magnetostratigraphic pattern section of the Late Triassic GPTS from the Newark basin, U.S., (Kent *et al.,* 1995; Kent and Olsen, 1999). According to the preferred polarity correlation, the Los Colorados section can be correlated with the temporal section between the magnetozones E7r and E14n from the GPTS. This means that Los Colorados Formation started its deposition nearly 227 Ma and ended around 215 Ma. Through the magnetostratigraphic correlation, the stratigraphic section which is equivalent to the fossiliferous beds of Coloradian is dated between 217 – 215 Ma. This age disagrees with the classical estimate for this paleofauna and positions it in "Medial" Norian according to GTS 2009. This result suggests that the biotic turnover cited in South America (*e.g.* Benton, 1986) took place earlier than predicted.

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VARIAÇÃO INTRA-ESPECÍFICA EM VERTEBRADOS RECENTES E FÓSSEIS: IMPORTÂNCIA PARA A TAXONOMIA E SISTEMÁTICA

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Uma das contribuições mais importantes de Darwin foi reconhecer que a variação individual, tal como percebida pelos criadores de animais e plantas domésticas, oferecia um modelo da natureza da variação em espécies selvagens, ou seja: a seleção artificial como um modelo para a seleção natural. Em seu contato com os criadores ele percebeu que as variações individuais observadas não eram direcionadas ou adaptativas, mas sim "ao acaso", produzindo em algumas instâncias caracteres do interesse destes criadores, que eram então selecionados (Darwin, 1868). Existe uma amplitude de variação individual também dentro de populações selvagens e, dentro deste contexto, a observação de variação estrutural continua sendo uma das principais fontes de caracteres e estados de caracteres em estudos de taxonomia e sistemática. No entanto, por falta de estudos com extensas coleções de espécimes – preferivelmente de uma mesma população – pouco ainda se sabe sobre a variabilidade intra-específica em vertebrados (Hallgrimsson e Hall, 2005). Como a identificação de complexos morfologicamente variáveis permite o diagnóstico de táxons bem definidos, a identificação, descrição e quantificação de caracteres individualmente variáveis torna-se fundamental para a correta identificação da variação taxonômica. O não reconhecimento de prováveis casos de variação intra-específica é um problema ainda mais comum no estudo de vertebrados fósseis, o que pode se refletir em diagnoses equivocadas e, subseqüentemente, em um grande número de sinonímias. O estudo da variação intra-específica observada em táxons recentes provê um controle crítico para o reconhecimento do mesmo tipo de variação em táxons fósseis, de modo que estudos integrando dados anatômicos disponíveis para vertebrados fósseis e recentes são indispensáveis (Grande, 2004; Leal e Brito, 2007). Buscando adicionar dados a esse debate, apresentamos os padrões de variação intra-específica encontrados no esqueleto caudal de quatro espécies de teleósteos basais: o fóssil *Cladocyclus gardneri* Agassiz, 1841 (Ichthyodectiformes), e os recentes *Osteoglossum ferreirai* Kanazawa, 1966, *Arapaima gigas* Schinz, 1822 (Osteoglossomorpha) e *Elops saurus* Linnaeus, 1766 (Elopomorpha).

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LOS CAMELIDAE (MAMMALIA, ARTIODACTYLA) DEL PLEISTOCENO DE ECUADOR

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La Familia Camelidae es de origen holártico y algunos representantes ingresaron a America del Sur durante el Gran Intercambio Biótico Americano, a partir del Plioceno tardío. A pesar de que su registro fósil sudamericano es abundante, ciertas cuestiones taxonómicas y biogeográficas todavía permanecen sin esclarecer. Por esta problemática, se desarrolló un amplio estudio de revisión de los Camelidae sudamericanos. La presente contribución tiene como objetivo presentar algunas consideraciones acerca de los materiales fósiles de Camelidae provenientes de Ecuador. El material analizado está depositado en la Colección de Paleontología del Museo de Historia Natural "Gustavo Orces", de la Escuela Politécnica Nacional (EPN), Quito, Ecuador. Los camélidos de Ecuador fueron estudiados por Branco (1883), Spillmann (1931), y Hoffstetter (1948, 1952), quién los determinó como *Palaeolama reissi* Branco 1883, *P. crassa* Hoffstetter 1952 y *P. aequatorialis* Hoffstetter

1952. Después de la revisión del material y su comparación con especímenes de otras regiones de America del Sur, se concluye que el material atribuido por aquellos autores a *Palaeolama reissi* y *P. crassa*, pertenecen a *P. weddelli* Gervais 1855, coincidiendo con lo mencionado por Webb (1974). Esta sinonimia se debe a que los especímenes de Ecuador presentan, así como los de *P. weddelli* descriptos para Bolivia, los huesos largos más robustos y una dentición de mayor tamaño que las demás especies de *Palaeolama*. El material descripto por Hoffstetter (1952) como *P. aequatorialis* es asignado en esta oportunidad a *P. major* (Liais, 1872), ya que presenta surcos que separan los lobos y lóbulos más profundos y estrechos que en *P. weddelli*, estilos vestibulares e estilidos linguales muy marcados. Todo esto, así como el tamaño de los dientes, es muy similar a los especímenes de esta especie del Norte y Nordeste de Brasil. De esta manera, se consideran válidas para Ecuador solamente las especies *P. weddelli* y *P. major*. Esta nueva clasificación permite realizar ciertas inferencias biogeográficas, pues es posible observar que *P. weddelli*, aparentemente, fue una forma que ha habitado regiones más montañosas, ya que fue encontrada en la región andina de Bolivia, Ecuador y posiblemente Perú. A su vez, se amplia la distribución geográfica de *P. major*, ya que previamente se la consideraba una especie típicamente de la región más septentrional de Sudamérica.

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ISCHIGUALASTO DINOSAURS: TAXONOMY, TEMPORAL RANGE AND RELATIONSHIPS

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Dinosaurs are limited to the lower one-third of the Ischigualasto Formation and include one ornithischian, *Pisanosaurus* Casamiquela 1967, and at least six saurischians (*Eoraptor* Sereno *et al.* 1993, *Panphagia* Martínez and Alcober 2009, *Chromogisaurus* Ezcurra 2010, *Herrerasaurus* Reig 1963, *Sanjuansaurus* Alcober and Martínez 2010, *Eodromaeus* Martínez *et al.,* 2011). *Pisanosaurus* is probably correctly interpreted as a heterodontosaurid on the basis of new evidence, although questions remain regarding the association of some postcranial bones. We interpret *Eoraptor*, *Panphagia*, and *Chromigisaurus* as sauropodomorphs, the former two genera linked by several features to more derived sauropodomorphs. We regard herrerasaurids (*Herrerasaurus*, *Sanjuansaurus* and *others*) and *Eodromaeus* as successively more derived basal theropods, as supported by several cranial and postcranial apomorphies. We compare recent competing phylogenetic hypotheses for early dinosaurs, measuring the extent and phylogenetic effect of differences in character selection and character-state scores. Both character selection and character-state scoring play major roles. To achieve greater consensus than currently exists, morphology-based phylogenetics will need to acknowledge and measure character selection and generate more testable and comparable characters.

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UNIQUE SOFT TISSUE PRESERVATION IN LIZARD SPECIMENS FROM THE EARLY CRETACEOUS OF BRAZIL

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The Mesozoic record of lizards is considerably sparse when compared to other fossil vertebrates, especially in the Gondwanic derived continents. This is due to, among other reasons, their extremely delicate skeletons, subject to considerable taphonomic biases. Here we report three yet undescribed specimens (all housed at the Museu Nacional/UFRJ) from the Early Cretaceous (Aptian) Crato Formation of the Araripe Basin, northeast Brazil. These provide not only a rich amount of new osteological data, but also a rare quality of soft tissue preservation. The technique of photography under ultraviolet light allowed the identification of bone sutures, muscle striation marks and some other soft tissues impressions. On the ventral side of MN 4817-V, granulated scales in the neck region, arms and trunk laterals were observed, with rhomboid scales on the trunk's medial portion. The musculature is preserved on portions of the ventral lower jaw; the *M. puboischiotibialis,* next to the femur, which allows the flexion of the crus and adduction of the thigh, along with muscles probably belonging to the Caudal Group, due to their association with the caudal transverse processes; finally, on the left arm, there are some of the antibrachial dorsal muscles (digital extensors). Specimen MN 7233-V has granular scale marks around the neck and yet unidentified soft tissue at the pelvic region. Specimen MN 7234-V exhibits the whole body contour, as well as soft tissue impressions around the pelvic girdle, hind limbs and tail, interpreted as bundles of connective tissue. To our knowledge the new specimens are the best preserved Mesozoic lizards from South America recorded so far. They constitute a significant opportunity to establish a better understanding of the terrestrial Cretaceous squamate fauna of this continent and provide a rare insight into the soft tissue anatomy of extinct lizards.

O EFEITO DA HERANÇA EVOLUTIVA NA ADAPTAÇÃO À VIDA AQUÁTICA EM MESOSAURIDAE BAUR 1889.

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Quando se estuda a estrutura de qualquer organismo, fóssil ou não, comumente procura-se atribuir significado adaptativo a todas as feições de sua anatomia. Entretanto muitas características são o resultado de uma herança, provinda de algum ancestral, ou algum tipo de "subproduto" da forma pela qual o organismo evoluiu. Em Mesosauridae, observam-se certos estados, aparentemente adaptativos, que poderiam, na realidade, corresponder a condições ancestrais. Teriam surgido antes da linhagem em questão ter adquirido seus hábitos semi-aquáticos e, talvez, possam vir a ser interpretados como exaptações. Podem-se observar falanges distais curtas, achatadas dorso-ventralmente, por vezes reduzidas ou com a extremidade distal apresentando contorno aproximadamente arredondado. Dependendo do modelo adotado para o ancestral, estes e outros traços, observados nas demais falanges e metatarsos, poderiam ser vistos como o produto da especialização dos membros destes animais ao nado. Este ancestral, por exemplo, poderia ter exibido falanges distais mais alongadas, achatadas lateralmente e pontiagudas, ou seja garras, como vistas em tantos "répteis" modernos. Da mesma forma seria possível especular que os longos processos laterais vistos nas primeiras vértebras caudais (provavelmente costelas pós-sacrais fusionadas a cada centrum vertebral), teriam evoluído em associação com o desenvolvimento dos músculos responsáveis por mover a cauda de um lado para o outro e, portanto, impulsionar o animal dentro da água. Entretanto condições semelhantes podem ser observadas nos esqueletos de outros tetrápodes paleozóicos, como é o caso de *Seymouria sanjuanensis* Vaughn 1966 (Berman *et al.*, 2000); *Orobates pabsti* Berman 2004 (Berman *et al.*, 2004); *Moradisaurus grandis* Taquet 1969 (O'Keefe *et al.*, 2005); *Oromycter dolesorum* Reisz, 2005 e *Owenetta kitchingorum* Reisz 2002 (Reisz e Scott, 2002), sendo que nenhuma destas formas está relacionada à hábitos aquáticos.

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REANALYSIS OF THE SKULL OF *ELACHISTOSUCHUS HUENEI* BY X-RAY COMPUTED TOMOGRAPHY

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The small reptile *Elachistosuchus* Janensch, 1949 from the Upper Triassic of Germany is of uncertain phylogenetic position, having been regarded both as a pseudosuchian archosaur (Janensch, 1949) and as a sphenodontid lepidosaur (Walker, 1966). Parts of the specimen MB. R. 4520 were scanned using high-resolution X-Ray computed tomography, which helped revealing internal structures of the skull, as well as new bone elements hidden within the matrix. Tooth implantation is of thecodont type, for there are sockets for the teeth. They are homogeneous with single cusps and slightly curved backwards. The frontals have well developed descending processes, forming a tube-like structure. These are covered by the pre-frontals, which extend downwards until the floor of the orbit, forming its anterior border internally. The presence of a lachrymal is doubtful, because this area is damaged on both sides, but a small part of it may be preserved on the left one, as revealed by the scans. If true, then the lachrymal was reduced, covering the pre-frontal partially and not contacting the frontal. Palatines, pterygoids and vomers bear rows of denticles. The lower jaw is much damaged posteriorly, but the scans revealed that the angular dominates much of the posterior region. The splenial forms most of the lingual wall of the anterior half of the lower jaw., reaching until the symphysis, but it is hard to ascertain whether it takes part in it or not. The adductor fossa is quite shallow and slightly dorsally oriented. By the overall preservational state of the skull, the destruction or reallocation of an articulated piece would certainly bring damage to the other, corresponding bone, and as the end of the posterior ramus of the jugal is intact, it indicates that it ended freely, leaving the lower temporal bar partially open. In piece number II, the scans revealed a totally hidden interclavicle with possibly associated clavicles and an unidentified long bone. The interclavicle is T-shaped, bearing no anterior process and has a widened plate-like area in the intersection among the processes. Due to its very plesiomorphic characters, any statement on the affinities of *Elachistosuchus* affinities remains speculative at the moment and should not be done without a proper phylogenetic analysis. The scanning of the remaining available material is planned for sometime soon.

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LOS MAMÍFEROS DEL PLEISTOCENO DEL VALLE DE TARIJA (BOLIVIA): DIVERSIDAD Y PALEOAMBIENTES

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El Valle de Tarija ha sido escenario de varias expediciones paleontológicas desde comienzos del S.XVII (ver Marshall y Sempere, 1991). Gran parte de los fósiles colectados durante dichos trabajos de campo carecen de datos geográficos y estratigráficos precisos. Las unidades fosilíferas de Tarija fueron tradicionalmente correlacionadas con el "Ensenadense y Bonaerense", "Belgranense", "Ensenadense" o "Lujanense *s.l.*" de la región pampeana (RP, Argentina; ver Tonni *et al.*, 2009). Como parte de un proyecto de cooperación entre el Museo Nacional Paleontológico-Arqueológico de Tarija (MNPA, Bolivia) y la Universidad Nacional de La Plata (Argentina), realizamos dos campañas al Valle de Tarija (2007 y 2011), en las cuales tomamos muestras para realizar dataciones absolutas (ESR, TL, Ar/Ar) y colectamos nuevos restos fósiles que forman parte de la colección del MNPA. Nuestros estudios muestran que en la paleofauna de Tarija se destaca una alta frecuencia de registros de pampatéridos, gonfotéridos, équidos, hidroquéridos y tapíridos; con menor frecuencia se registran dasipódidos, gliptodóntidos, megatéridos, milodóntidos, cánidos, úrsidos, félidos, camélidos, tayasuidos, miocastóridos, cávidos, octodóntidos, equímidos y eretizóntidos; por último, son escasos los restos de macrauquénidos y toxodóntidos. Llamativamente, hasta el presente no se han registrado cérvidos. De los numerosos taxones endemitas descriptos para Tarija, al menos cuatro de ellos (*Megatherium tarijense* Gervais y Ameghino 1880, *Scelidodon tarijensis* Gervais y Ameghino 1880 y *Arctotherium tarijense* Ameghino 1902; otros como *A. wingei* Ameghino, 1902) se registran también en otros afloramientos pleistocenos de América del Sur. Coltorti *et al.* (2007) indican que toda la secuencia de Tarija tiene una antigüedad pleistocena tardía; sin embargo, la ausencia de información estratigráfica para los fósiles colectados previamente, sumado a la presencia de algunos taxones extintos durante el Pleistoceno Medio en la RP, impide aceptar esta propuesta sin antes realizar nuevas dataciones y colecta de fósiles con control estratigráfico preciso. Paleoambientalmente, los sedimentos de Tarija corresponden a ambientes de llanuras de inundación con alternancia de cursos de agua meandrosos de energía variable; la presencia de tapíridos, miocastóridos, hidroquéridos y eretizóntidos sugieren la predominancia de climas cálidos y húmedos. Estos nuevos estudios planeados con estricto control estratigráfico, permitirán no sólo ampliar el conocimiento de la paleomastofauna de Tarija y su edad; sino también establecer su comparación con otros yacimientos fosilíferos cuaternarios de América del Sur.

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UN NUEVO *REIGECHIMYS* (RODENTIA, ECHIMYIDAE) DE LA FORMACIÓN CERRO AZUL (MIOCENO TARDÍO, LA PAMPA, ARGENTINA)

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El género *Reigechimys* del Mioceno tardío de la Formación Cerro Azul (La Pampa, Argentina) es uno de los Echimyidae con mayor simplificación oclusal en sus molares. Incluye dos especies, *Reigechimys plesiodon* Verzi, Vucetich y Montalvo, 1994 y *Reigechimys octodontiformis* Verzi, Vucetich y Montalvo, 1994. La última es más derivada que *R. plesiodon* en la menor permanencia ontogenética del mesofléxido/fosétida. La revisión de los ejemplares recuperados del afloramiento de la Formación Cerro Azul en Bajo Giuliani permitió reconocer una morfología aún más derivada que la de *R. octodontiformis*. Esta muestra (N=10) incluye individuos juveniles y adultos que permiten evaluar variabilidad ontogenética. Los m1-2 carecen de mesofléxido/mesofosétida por lo que la morfología oclusal bilobulada que caracteriza a los adultos de *R. octodontiformis* está presente desde estadíos ontogenéticos muy tempranos en esta nueva serie; en relación con este carácter, el lóbulo anterior de esos molares es más estrecho que en las otras especies. Este mayor grado de simplificación oclusal está relacionado con una mayor hipsodoncia. Los molares de los ejemplares de Bajo Giuliani poseen coronas más altas que los especímenes con morfología oclusal equivalente de *R. plesiodon* y *R. octodontifomis.* Desde el punto de vista biocronológico, el estado evolutivo del nuevo cronomorfo sustenta la hipótesis de que los niveles de Bajo Giuliani son más modernos que los portadores de *R. plesiodon* en Laguna Chillué y *R. octodontiformis* en Salinas Grandes de Hidalgo.

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A NEW FOSSIL VERTEBRATE LOCALITY IN THE TACUAREMBÓ FORMATION, LATE JURASSIC-EARLY CRETACEOUS OF URUGUAY

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We communicate recent discoveries of vertebrate remains in the Batoví Member of the Tacuarembó Formation (Kimmeridgian-Hauterivian; Perea *et al.*, 2009), Tacuarembó province (Uruguay). The new locality (Bidegain Quarry) has yielded remains of dipnoans, actinistians and theropods, described below. The fossils are abundant and spatially dispersed, and are found both in a 0,5 m-thick bed of medium- to coarse-grained, laminated, greenish sandstone, and in the overlying 1.5 to 2 m-thick bed of fine-grained, massive, pink sandstone. Six dipnoan tooth-plates, in some cases still attached to the prearticular or pterygopalatine bones, were found. Most specimens are straight triangle-shaped and bear seven acute ridges which radiate from the mesiolingual angle, and are thus attributable to the ceratodontiform "Ceratodus" *tiguidiensis* (Tabaste, 1963). This species, typical from the Late Jurassic-Early Cretaceous of Saharan Africa and 'middle' Cretaceous of Brazil, was already reported from other Uruguayan localities (Soto and Perea, 2010). A specimen comprising a basisphenoid and partial parietonasal shield of the large freshwater actinistian *Mawsonia* (Woodward *in* Mawson y Woodward, 1907) was also found. It represents one of the few articulated remains found so far in the unit and confirms the identification of the genus, early described on the basis of ornamented skull bone fragments (Soto *et al.*, 2010). *Mawsonia* is known from the Late Jurassic-'middle' Cretaceous of Brazil and the Early Cretaceous-'middle' Cretaceous of Saharan Africa. A third remarkable finding consists of nine shed theropod teeth. With the exception of a specimen interpreted as a rostral crown, they are elongated, symmetrical, strongly labiolingually compressed, and distally curved. Both carinae are serrated (with mesial and distal denticles of approximately the same size) and follow the midline of the crown. Enamel is conspicuously wrinkled. One of the crowns measure about 80 mm in height, making it the largest tooth crown ever found in the unit, which undoubtedly belonged to a very large-sized carnivorous dinosaur. The morphological features, although not conclusive, suggest affinities either with ceratosaurids (already reported from this unit; Soto and Perea, 2008) or basal tetanurans (i.e. megalosaurids and carcharodontosaurids). The remains from this new locality improve our understanding of the vertebrate assemblage of the Tacuarembó Formation. Moreover, they preserve features almost unknown in other specimens from the unit such as dipnoan jaw bones, denticles in dipnoan tooth-plates, and mesial denticles in theropod teeth. [This is a contribution to projects ANII-FCE-2007-110 and CSIC-UdelaR-C028-348].

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COUNTING STEPS FOR DIFFERENT HYPOTHESES OF DIGIT IDENTITY IN TETANURAE

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Tetanurans theropods are traditionally considered to have functional digits I, II, and III, having undergone Lateral Digit Reduction (LDR). A recent publication (Xu *et al.*, 2009) argued instead for Bilateral Digit Reduction (BDR) in Tetanurae, identifying their digits as II, III, IV. cuantitative analysis of morphological evidence was presented to argue that BDR was only six character transformations longer than LDR, and equal to LDR when traits were considered unordered. We cross-examined Xu et al's data matrixes of manual traits (the "dynamic traits") for 10 taxa with relevant phylogenetic positions, for which reasonable published descriptions of hand materials are available. For these taxa, only 46 of 120 characters (38,3%) in Xu's LDR matrix, and 55 of 120 in the BDR matrix (45,8%) recorded any evolutionary change. All other characters were invariant and/or inapplicable. Within the significant traits, we found 40 coding mistakes (for example: coding 2 phalanges for digit II of *Limusaurus*, instead of 3 as actually present). We also identified 17 new characters for BDR, and 7 for LDR, that were overlooked by Xu et al 2009. We carried out quantitative analysis including our newly identified characters along with all potentially relevant characters used by Xu *et al.,* 2009. We also added the basalmost tetanurans *Xuanhanosaurus* and "*Szechuanosaurus" zigongensis,* which are mysteriously absent from the analysis by Xu *et al.* (2009). Because phylogenetic relationships of the 12 taxa used are well-supported by non-manual traits (Xu *et al.,* 2009), we mapped the evolution of manual traits onto this phylogeny: (*Herrerasaurus*, (*Eodromaeus* (*Coelophysis* (*Dilophosaurus* ((*Ceratosaurus*, *Limusaurus*) (*Xuanhanosaurus* (*Szechuanosaurus,* ((*Sinraptor*, (*Acrocanthosaurus, Allosaurus*)) (*Guanlong, Archaeopteryx*))))))))). Characters were defined and coded for LDR and BDR scenarios, producing two distinct data matrixes. To count steps implied by each hypothesis, we used PAUP* 4.0b10 to make an exhaustive search for each matrix, while at the same time constricting the entire topology of the tree. This procedure delivers a single tree indicating the number of steps implied. The BDR matrix implied 111 steps, 26 steps more than the 85 steps of the LDR hypothesis. Character optimization reveals that the BDR hypothesis implies a large "clustering" of morphological changes at the Tetanurae node, ranging from at least 11 changes (DELTRAN) to as many as 21 (ACCTRAN). At the same node, changes required by LDR range from 4 (DELTRAN) to 5 (ACCTRAN). Excluding *Limusaurus* from the analysis had no effect on the BDR-LDR distance (26 steps), against claims that this taxon supports BDR. Alternative phylogenetic arrangements, such as a monophyletic *Coelophysis+Dilophosaurus*, or switching *Xuanhanosaurus* for *Szechuanosaurus* as the basalmost tetanuran, had little effect on the superiority of LDR (BDR-LDR=25 and 23, respectively). We conclude that Xu et al (2009) used inadequate morphological data for crucial taxa. Our re-analysis of these taxa reveals strong support for LDR.

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THE DEVELOPMENT OF THE SEMILUNATE CARPAL FROM EARLY MANIRAPTORA TO MODERN BIRDS

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The homology of the carpal elements in the adult chicken (*Gallus gallus* Linnaeus 1758) continues to be debated. This is due in part to the high degree of fusion of elements in the carpometacarpus of adult modern birds (Neornithes Gadow, 1893). In early dinosaurs, distal carpals I and II are not fused (Sereno *et al.*, 1993; Santa Luca, 1980). In coelurosaurian theropods, these two bony elements are fused into a single flat element covering the proximal ends of digits I and II. In Maniraptora Gauthier (1986) like *Deinonychus* Ostrom (1969), these fused distal carpals became a half-moon shaped unit thus described as the "semilunate" carpal, a synapomorphy of Maniraptora. In the development of *Gallus gallus* Linnaeus 1758, we observed that at day 6 of incubation, a halfmoon-shaped carpal element covers the proximal end of metacarpal II. At day 10 it fuses to the proximolateral surface of metacarpal I. This halfmoon-shaped element develops exclusively from distal carpal II and does not fuse to any cartilaginous element of distal carpal I, which is absent. Later in development (day 14) the semilunate and ulnare fuse, and finally are incorporated to the carpometacarpus (day 21). Histological series of wing sections confirm this description. We additionally observed carpal elements through days 5-17 of incubation of the Chilean Tinamou *Nothoprocta perdicaria* Kittlitz (1830), a paleognathous bird with plesiomorphic wing morphology. As in the chicken, the semilunate carpal originates from distal carpal II. In early Maniraptora Gauthier 1986, the large semilunate developed as a composite bone, from fused distal carpals I and II. A derived condition evolved in the lineage of modern birds, where the semilunate develops exclusively from distal carpal II. In the Jurassic maniraptoran *Anchiornis* Xu *et al.* (2009), a similar derived condition is found, in which; the semilunate is apparently composed only of distal carpal II. We emphasize how the evolution of embryological differences

did not intervene with the adult phenotypic outcome of a large, halfmoon-shaped unit covering the proximal ends of metacarpals I and II.

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PRIMER REGISTRO DE *CHELONOIDIS* SP. (TESTUDINES: TESTUDINIDAE) EN EL PLEISTOCENO DEL PARAGUAY

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El registro fósil de vertebrados pleistocénicos en el Paraguay, permanece aún poco estudiado. Existen algunas publicaciones muy dispersas (Vellard, 1934 fide Eckel, 1959; Harrington, 1956; Hoffstetter, 1978; Carlini y Tonni, 2000), donde se mencionan restos fósiles provenientes de sedimentos principalmente de origen fluvial, de la Región Occidental (Chaco) y zonas cercanas. Estos fósiles son en su gran mayoría de mamíferos, siendo una excepción la mención de restos aislados de Crocodylidae y Testudinidae, provenientes de Areemb´y, Departamento Central (Carlini *et al.*, 1998). No existe información clara sobre la edad de los sedimentos con fósiles en la zona de influencia de los ríos Paraguay y Pilcomayo (Bajo Chaco), región de donde proceden los restos de tortugas estudiados, ya que se menciona a este conjunto como Cuaternario Indiferenciado o Pleistoceno (Proyecto PAR 86), sin una división más precisa.En la localidad de Ganadera Montelindo, sobre el Río Montelindo (Bajo Chaco, Dpto. de Presidente Hayes) se descubrieron los primeros restos asociados e identificables a nivel genérico de una tortuga fósil para el Paraguay. Los restos fueron recuperados en un área de aproximadamente 1 m2 y corresponden a distintas placas periféricas, una pigal, varias placas costales, un probable fragmento de pilar inguinal plastral y otros fragmentos indeterminados de una tortuga terrestre (Familia Testudinidae Batsch) asignable al género *Chelonoidis Fitzinger, siendo el tamaño aproximado del caparazón dorsal del ejemplar de unos 40 cm. La ausencia de caracteres diagnósticos en las placas preservadas impide su asignación a alguna de las especies actuales de testudinidos [Ch. carbonaria (Spix) o Ch. chilensis (Gray)] que se distribuyen en el Chaco Paraguayo.*

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REVISITING THE ALLEGED RECORD OF CARCHARODONTOSAURIDAE (THEROPODA: ALLOSAUROIDEA) FROM THE UPPER CRETACEOUS BAURU GROUP, BRAZIL

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Carcharodontosauridae is a clade of large to giant mid-Cretaceous theropods whose derivate taxa have a Gondwanic distribution (Argentina and northern Africa), but basal members also occurred in Laurasian landmasses (Spain, China, USA), besides northern Africa. The most recent carcharodontosaurid comes from the Turonian of China, whereas the oldest record comes from the Barremian of Spain. The confident South American record ranged from Aptian to Turonian times. The monophyly of the Carcharodontosauridae is supported by a plethora of characters. Among these, the presence of teeth with compressed crowns bearing marginal and high enamel crenulations (wrinkles) has been treated traditionally by several authors as a keystone to diagnose this family, and to recognize new occurrences based on isolated teeth. However, current studies have demonstrated how variable and widespread this feature is among theropods, such as Spinosauroidea, Tyrannosauroidea, and Abelisauridae (*e.g.*, Brusatte *et al.,* 2007).

Unfortunately such unsupported practice is still common in the treatment of several records of isolated theropod teeth from the Upper Cretaceous Bauru Group of southeastern Brazil. Therefore, we reanalyzed a collection of 20 isolated teeth from the Campanian-Maastrichtian Adamantina Formation of São Paulo (UFRJ-DG 379-Rd - Alfredo Marcondes) and Minas Gerais State (MMR/UFU-PV 005 - Prata municipality) and from the Maastrichtian Serra da Galga Member of the Marília Formation in Minas Gerais State (CPP 124, 127, 129a, 152, 156, 197, 199, 200, 208, 216, 241, 375/1, 376, 447-449, 474, 475 – Peirópolis locality, Uberaba municipality). This is a heterogeneous collection, with teeth ranging from 6 to 68mm in crown height, wrinkles being present as high-relief or as weakly marked crenulations, arched or straight in orientation, at the mesial and/or distal carinae and on the lingual or on both sides. Such teeth also vary in the morphology of the denticles, from chisel-like (almost all) to lanceolate (CPP-127, 200, 208, 375/1, 475), and in the degree of posterior curvature of the crown, from absent to moderate. The degree of bucco-lingual compression is also quite variable. Although most teeth show fore-aft basal length around two times its basal width, some teeth (MMR/UFU-PV 005, CPP-447) have sub-rounded basal cross-section. All these teeth were previously described in the literature as Carcharodontosauridae uniquely due to the presence of wrinkles. Due to the lack of unambiguous diagnosable dental features, we consider the assignment of those Campanian-Maastrichtian teeth to a typical Cenomanian group, the Carcharodontosauridae, questionable, avoiding in this way to assume an almost 20 million years hiatus based upon so feeble evidence. Moreover, the presence of well marked wrinkles in the abelisaurid *Skorpiovenator bustingorryi* Canale *et al.,* 2009 (Late Cenomanian–Early Turonian, Huincul Formation, Argentina) suggests the attribution of the re-studied teeth to Abelisauridae as a more plausible hypothesis, given the unambiguous osteological record of Abelisauridae in the Bauru Group (Novas *et al.*, 2008).

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OSTEOLOGICAL INDICATORS OF PREHENSILITY IN THERIA AND THE IDENTIFICATION OF PREHENSILITY IN FOSSIL TAXA

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Prehensility evolved at least seven times convergently within Theria (Marsupialia + Placentialia). Although there have been numerous studies of prehensility in the past, the vast majority of these studies were focused on the acquisition of prehensility within a single order of mammals (predominantly the primates). Here an exemplar taxon for each independent acquisition of prehensility is examined in conjunction with a close non-prehensile relative. This, coupled with features previously suggested in the literature, generated a variety of phylogenetically independent osteological indicators of prehensility. Examples of such indicators are: tail length relative to body length, sacral morphology, relative length of different sections in a traditional tripartite tail division, and robusticity of distal vertebrae. It is found that many of these features, especially those concerning the entire tail or the more proximal regions, demonstrate a graduation between prehensile and non-prehensile forms, but there is no clear boundary between the two tail types. The distal region of the tail offers a much clearer signal, with only prehensile taxa possessing both well-developed distal transverse processes and an increase in the robusticity of distal vertebrae. These features, found to clearly demonstrate prehensility, can be ascertained in fossil taxa for which complete, or almost complete, tails are preserved. The utility of these osteological parameters is demonstrated on a fossil specimen of uncertain affinity to living placental orders from the Green River fossil site of Wyoming, USA.

UNA NUEVA ESPECIE DE TORTUGA AFIN AL CLADO MEIOLANIIDAE DEL DANIANO (PALEOCENO) DE LA FORMACION SALAMANCA EN PUNTA PELIGRO (PATAGONIA, ARGENTINA)

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Restos craneanos (MACN PV CH 2017) de una tortuga hallados en niveles danianos (Paleoceno) de la Formación Salamanca (Punta Peligro, Chubut) se identifican aquí como una nueva especie afín al clado Meiolaniidae. Los Meiolaniidae son un grupo extinto de tortugas terrestres, con cuernos y estuche caudal característicos del Eoceno de Patagonia y del Neógeno de Australasia. Estudios filogenéticos previos sugieren que el grupo hermano de los Meiolaniidae está conformado por especies del Cretácico Inferior y Superior de Asia, Europa, Australia y América del Sur. Estos análisis muestran un importante gap en el registro fósil entre el Campaniano-Maastrichtiano (último registro del grupo hermano) y el Eoceno (primer registro de Meiolaniidae). Este gap se comienza a llenar con el descubrimiento de esta nueva tortuga. Esta nueva especie comparte con el clado Meiolaniidae y con su grupo hermano la presencia de las siguientes sinapomorfías: frontal formando parte de la órbita, proceso pterigoideo externo recto y sin proceso vertical y pterigoides ubicado por debajo del basiesfenoides dejando un escalón entre ambos huesos. El estudio de esta nueva especie permite indagar sobre temas poco explorados en la evolución de las tortugas como lo es la evolución de los escudos craneanos, la biogeografía de los Meiolaniidae y grupos afines y la supervivencia de ambos a la ex-

tinción Cretácico-Paleógena. Por otro lado brinda más información sobre temas muy discutidos como lo es la evolución de la circulación carotídea en las tortugas.

SHORT-SNOUTED SKULL, MANDIBLE, AXIAL AND APENDICULAR SKELETON MATERIALS OF TEMNOSPONDYLI AMPHIBIANS (RIO DO RASTO FORMATION, PARANÁ BASIN, BRAZIL)

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The Rio do Rasto Formation is included on the Passa Dois Group of Paraná Basin (Meso/Neopermian), represented on Paraná, Santa Catarina and Rio Grande do Sul states of Brazil. On Paraná State, tetrapods described to this formation include the long-snouted temnospondyl amphibian *Australerpeton cosgriffi* Barberena 1998 and another short-snouted temnospondyl, not formally described, beyond the dicynodont *Endothiodon* Owen, 1976. These fossils are related to Serra do Cadeado Local Fauna. The materials presented here were collected on the PR-090 highway, between Sapopema and São Jerônimo da Serra municipalities, at Paraná State, and belong to the Morro Pelado Member. The materials consist of skull, mandible fragment, an intercentrum, a rib and a probable clavicle. The skull (UFPR 0150 PV) has a triangular shape, rounded on its extremities, with approximately 21 cm in length. In palatal view, it is possible to observe the pterygoid and the teeth in transversal section on pre-maxila. In dorsal view, there are dermical ornamentations. The mandible (UFPR 0164 PV) is complete on its proximal portion, but incomplete on its distal. This material has approximately 23 cm in length, where it is possible to observe a well preserved conical and sharped teeth. These teeth are complete, being around 5 mm in length. The intercentrum (UFPR 0172 PV) presents a half-moon shape, with faces dorsally concave and ventrally convex, with 1,5 cm in width. The incomplete rib (UFPR 0165 PV) is elongated and slender, with around 6 cm in length and 2 cm in width. The keel-shaped uncinate process is preserved on the distal portion. Another incomplete material probably corresponds to a clavicle (UFPR 0166 PV). This has approximately 9 cm in length and 6 cm width, with an ellipsoid shape. Part of the clavicle was missed during the collection process, although is still possible to visualize the typical radial ornamentation in ventral view. The intercentrum, rib and clavicle were collected in a lower level from where the skull and mandible were found. The shape of the skull and bones, as well as their ornamentations, allow to correspond these specimens to temnospondyl amphibians. The skull corresponds to the second occurrence of short-snouted amphibian on Serra do Cadeado Local Fauna, being the first occurrence on this outcrop. The incomplete mandible could correspond to a long-snouted amphibian similar to *Australerpeton cosgriffi* Barberena 1998, whose occurrence has been reported on this outcrop (Ramos and Vega, 2011). The study of temnospondyl amphibians helps on the biostratigraphic studies of Paraná Basin and its correlation with the Karoo Basin in Africa.

Barberena, M.C. 1998. *Australerpeton cosgriffi* n.g., n.sp., a Late Permian Rhinesuchoid amphibian from Brazil. *Anais da Academia Brasileira de Ciências* 70: 125-137.

Owen, R. 1876. *Descriptive and Illustrated catalogue of the fossil Reptilia of South África in the Aollection of British Museum*. Trustees of the British Museum, London, 86 p.

Ramos, B.D. and Vega, C.S. 2011. Temnospondil remains fron the late Permian Rio do Rasto Formation (Paraná Basin) of Brazil. *Revista Brasileira de Paleontologia* 14: 67-74.

NUEVOS RESTOS DE *THALASSOCNUS* (NOTHROTHERIIDAE, THALASSOCNINAE) DEL NEÓGENO DE LA FORMACIÓN BAHÍA INGLESA, REGIÓN DE ATACAMA, NORTE DE CHILE

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Nuevos restos de *Thalassocnus* (Nothrotheriidae, Thalassocninae) (Muizon and Mc Donald, 1995; Muizon *et al.,* 2004) son reportados en el Neógeno de Chile. Material depositado en el Museo Nacional de Historia Natural con acrónimo SGO.PV 1133, proviene de la localidad "Arenas de Caldera", asignada al Mioceno Superior (Tortoniano) según Walsh y Suárez, 2005 comprende dos fémures asignados preliminarmente a *Thalassocnus* sp. Otro material depositado en el Museo Paleontológico de Caldera bajo el acrónimo MPC- SPN2 se haya compuesto por abundantes huesos asociados incluyendo un cráneo aún en etapa de preparación. Se reconocen 25 vértebras, un complejo radio-ulna, 4 costillas, una porción de cintura pélvica y un par de extremidades inferiores que indican la presencia de a lo menos dos individuos diferentes. Se recuperaron 4 falanges ungueales y un dentario aislado. El complejo articular radio-ulnar presenta una morfología intermedia entre *T. littoralis* Mc Donald y Muizon y *T. natans* Muizon y McDonald mientras que los dos fémures disponibles muestran una notable afinidad con los de la especie *T. natans* Muizon y Mc Donald. Material referido como *Thalassocnus* sp. (Canto *et al.,* 2008) fue asignado al Mioceno Superior sin embargo la presencia de los tiburones crono-indicadores *Carcharodon carcharias* Linnaeus y *Prionace glauca* Linnaeus sugiere una edad Plioceno (Suárez y Marquardt, 2003). El hallazgo de *Pliopontos littoralis* Muizon, con un rango de edad Mioceno-Plioceno plantea la necesidad de nuevas dataciones y acotar el esquema bioestratigráfico sugerido por la selacofauna. Los fósiles aquí reportados constituyen los

restos más completos de *Thalassocnus* hasta ahora conocidos en Chile.

Canto, J., Salas-Gismondi, R., Cozzuol, M. y Yánez, J. 2008. The aquatic sloth *Thalassocnus* (Mammalia, Xenarthra) from the Late Miocene of north-central Chile: biogeographic and ecological implications. *Journal of Vertebrate Paleontology* 28: 918–922.

Muizon, C. de. y Mc Donald, H.G. 1995. An aquatic sloth from the Pliocene of Peru. *Nature* 375: 224–227.

Muizon, C. de, McDonald H., Salas R. y Urbina M. 2004. The youngest species of the sloth *Thalassocnus* and a reassessment of the relationships of the sloths (Mammalia: Xenarthra). *Journal of Vertebrate Paleontology* 24: 387–397.

Suárez, M.E. y Marquardt, C. 2003. Revisión preliminar de las faunas de peces elasmobranquios del Mesozoico y Cenozoico de Chile y comentarios sobre su valor cronoestratigráfico. *Congreso Geológico Chileno* (Concepción) No. 10, Sección temática 3, CD-rom

Walsh, S.A. y Suárez, M. 2005. First post–Mesozoic record of Crocodyliformes from Chile. *Acta Palaeontologica Polonica* 50: 595–600.

FIRST RECORD OF A NEOSELACHIAN SHARK IN THE JURASSIC OF CHILE

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Fossil sharks (Elasmobranchii) are known in Chile since the Permic (Brietkreutz, 1986). A unique Triassic report from lacustrine beds of the Chinches Formation in northern Chile is known (Suárez and Bell, 1992). There is a gap in the record since no Jurassic shark has been reported from the Jurassic; however, sharks are known from the Early Cretaceous Apeleg Formation in southern Chile (Bell and Suárez, 1997). Sharks become abundant during the Upper Cretaceous and especially during the Cenozoic with several occurrences since the Eocene to Pliocene (Suárez and Marquardt, 2003). Here we report the first record of a Jurassic shark in Chile recovered from Tithonian levels of the Lo Valdes Formation (Central Andes). The material comprises a single but well preserved tooth housed in the MNHN de Santiago, with the number SGO-PV-6574. The specimen presents a massive main cusp flanked by two and three cusplets on each side, and exhibit several very well developed enamel ridges. The outline of the root is U-shaped being rather flat in basal view. The surface of the root is covered by several and irregular-shaped foraminae. The morphology of the specimen clearly differs from all known Jurassic hybodonts and accommodate better amongthe Synechodondiformes (Duffin and Ward, 1993). Klug (2008) established this order comprising three families of sharks since the Triassic to Middle Jurassic: Orthacodontidae, Palaeospinacidae, and Pseudonotidanidae as well as two more taxa with uncertain systematic status. The tooth shows clear affinities with the Late Triassic neoselachian of the genus *Rhomphaiodon* from the Rethic of England (Duffin, 1993). The absence of a high crown with exclusively lingual ridges and lack of hexanchiform-like crown suggests that the Chilean tooth could be a paleospinacid. We follow Cuny and Risnes (2005) considering that detailed analysis of enameloid microstructure is needed to establish if the specimen represent a new taxon.

Bell, C.M. and Suárez, M. 1997. The Lower Cretaceous Apeleg Formation of the Aisén basin, Southern Chile. Tidals and bar deposits of an epicontinental sea. *Revista Geológica de Chile* 24: 203-225.

Brietkreutz, C. 1986. Das Paläozoikum in den Kordilleren Nordchiles (21º-25º). *Geotektonische Forschungen* 70: I-II: 1-88.

Cappetta, H. 1987. Handbook of Paleoichthyology. Volume 3b: *Chondrichthyes II. Mesozoic and Cenozoic Elasmobranchii.* Gustav Fischer Verlag, Stuttgart, New York.

Cuny, G. and Risnes, S. 2005. The enameloid microstructure of the teeth of synechodontiform sharks (Chondrichthyes: Neoselachii). *Journal of Vertebrate Palaeontology* 3: 8-19.

Duffin, C.C.J. 1993. Late Triassic sharks teeth (Chondrichthyes, Elasmobranchii) from Saint-Nicolas-de-Port (north-east France). *Professional Paper, Belgian Geological Survey* 264: 7–32.

Duffin, C.J. and Ward, D.J. 1993. The Early Jurassic Palaeospinacid sharks of Lyme Regis, southern England. Belgian *Geological Survey, Professional Paper* 264: 53-102

Klug, S. 2008. The Late Jurassic neoselachian *Macrourogaleus* Fowler, 1947 is a palaeospinacid shark (Elasmobranchii; Synechodontiformes). *Acta Geologica Polonica* 58: .229-234.

Suárez, M. and Bell, C. 1992. Triassic rift-related sedimentary basins in northern Chile (24°-29°S). *Journal of South American Earth Sciences* 6: 109-121.

Suárez, M.E. and Marquardt, C. 2003. Revisión preliminar de las faunas de peces elasmobranquios del Mesozoico y Cenozoico de Chile y comentarios sobre su valor cronoestratigráfico. *Congreso Geológico Chileno* (Concepción) No. 10, Sección temática 3, CD ROM.

NUEVOS HALLAZGOS DE CROTOVINAS DE GRANDES MAMÍFEROS EN EL NEÓGENO DE LA PROVINCIA DE CÓRDOBA

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Se registraron cinco nuevas localidades con crotovinas atribuidas a grandes mamíferos, tanto en la región serrana (Panaholma, Los Morteritos, Athos Pampa y Huerta Grande) como en la llanura de la provincia de Córdoba (Corralito), especialmente distribuidas en la región serrana (entre los 457 y 1600 msnm). Estas estructuras tienen diámetros que varían entre 0,50 y 2 m de diámetro transversal horizontal, pero predominan las de 1 a 1,5 m, con contornos circulares, elípticos y subtriangulares. Entre los tipos de relleno que no se han descripto hasta el presente para estas estructuras, se destacan

los ortoconglomerados monolíticos compuestos por paraclastos. En el relleno de estas crotovinas se registraron bioclastos atribuidos a *Eutatus seguini* Gervais, 1867 (Cingulata) y *Myocastor* sp. Kerr, 1792 (Rodentia). Del análisis de estas estructuras se infiere que: 1) el registro abarca desde el Mioceno tardío-Plioceno temprano (Formación Brochero, Panaholma) hasta el Holoceno temprano (*Cordobense* o su equivalente: la Formación La Invernada); 3) las crotovinas de esta última unidad fueron rellenadas en etapas previas al inicio de la pedogénesis que originó el suelo actualmente productivo; 4) en la región serrana se registraron crotovinas en facies de canal (Los Morteritos) y de conos aluviales (Huerta Grande); 5) El carácter discordante del relleno de crotovinas adyacentes indica que en determinados sitios hubo hasta tres ciclos de generación de estas estructuras (Athos Pampa); 6) En períodos de aridez la mayor actividad bioerosiva se habría producido en sitios con mayor humedad, relacionados con depósitos fluviales (Corralito).

Gervais, P. 1867. Sur une nouvelle colection d'ossements fossiles de mammife` res recueille´ par M. Fr. Seguin dans la Confe´de´ ration Argentine. *Comptes rendus des séances de l'Académie des Sciences* 65: 279–282.

Kerr, R. 1792. The Animal Kingdom, or Zoological System of the Celebrated Sir Charles Linnaeus. J. Murray and R. Faulder, London, 644 p.

APTITUD FOSORIAL DE *MYLODON DARWINI* OWEN 1840 (XENARTHRA, TARDIGRADA, MYLODONTIDAE)

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En trabajos previos se ha propuesto, como parámetro para estimar la potencialidad de excavar que tienen algunos mamíferos, al índice de aptitud fosorial (*Index of fossorial ability*: IFA), obtenido como la relación longitud del olécranon/(longitud total de la ulna-longitud del olécranon). Este índice fue calculado en perezosos terrestres (*Lestodon* Gervais, 1855; *Glossotherium* Owen, 1840, *Scelidotherium* Owen, 1840; *Megatherium* Cuvier, 1796) considerados los tres primeros como potenciales productores de grandes crotovinas. El hallazgo de nuevos materiales asignados a *Mylodon darwini* Owen, 1840, permitió estimar la capacidad fosorial para esta especie, utilizando este índice como criterio. Entre los materiales se encuentran el cráneo, mandíbula, vértebras cervicales, toracales y huesos de las extremidades, procedente de una terraza fluvial depositada durante el Pleistoceno Tardío-Holoceno temprano (Lujanense), sobre el margen norte del río Anisacate, departamento Santa María de la provincia de Córdoba. Se calculó el IFA para *Mylodon darwini*, obteniendo un valor de 0,44. El valor de este índice es inferior al obtenido por otros autores para los demás mylodóntidos citados (*Glossotherium, Scelidotherium* y *Lestodon;* IFA: 0,56; 0,54 y 0,52, respectivamente) y superior al de *Megatherium* (IFA: 0,26), que tuvo una estructura más apta para desarrollar velocidad más que fuerza en los miembros delanteros. Por tal motivo interpretamos que la capacidad de *Mylodon* para excavar madrigueras era moderada con respecto a los demás mylodóntidos citados; esto podría explicar la frecuencia de hallazgos de restos de este perezoso en aleros y cavernas naturales, como en la Patagonia austral, donde se demostró que las utilizaba como guarida.

Cuvier, G. 1796. Notice sur le squelette d'une très grande espèce de quadrupède inconnue jusqu'á présent, trouvé au Paraguay, et déposé au Cabinet d'Histoire Naturelle de Madrid. . *Magasin Encyclopédique: ou Journal des Sciences, des Lettres et des Arts* 1: 303-310; 2: 227-228.

Gervais, P. 1855. Recherches sur les mammifères fossils de l´Amérique méridionale. *Annales des Sciences Naturelles, Zoologie* 3: 330–338.

Owen, R. 1840. *Zoology of the Voyage of H.M.S. "Beagle". Part 1, Fossil Mammalia*. Smith, Elder & co., London, p. 63-73.

APORTES A LA PALEONTOLOGÍA Y BIOESTRATIGRAFÍA DE LA FORMACIÓN MONTE HERMOSO (BUENOS AIRES, ARGENTINA)

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Farola Monte Hermoso es un clásico yacimiento fosilífero del Neógeno de Argentina y constituye la localidad tipo de la Formación Monte Hermoso (Zavala, 1993). En esta unidad se identificaron niveles de llanura de inundación y de canal fluvial, los cuales fueron incluidos en las biozonas de *Trigodon gaudryi* (Piso/Edad Montehermosense) y *Neocavia depressidens* (Piso/Edad Chapadmalalense inferior) (Cione y Tonni, 2005) respectivamente, en base a las diferencias de su contenido faunístico. En este trabajo, se dan a conocer los avances y resultados obtenidos, a partir de un análisis detallado de los materiales recuperados en cada uno de los niveles de dicha formación. Se recolectaron más de 600 nuevos ejemplares, con un exhaustivo control de su procedencia estratigráfica y se analizaron también los materiales de colecciones antiguas que contaban con datos precisos de procedencia. La asociación evaluada está constituida por Osteichthyes (Siluriformes, Trichomycteridae, Percichthydae y Characidae), Amphibia (Ceratophryidae y Bufonidae y), Reptilia (Chelonii, Teiidae y Colubridae), Aves (Cariamidae, Tinamidae, Phorusrhacidae y Anseriformes) y Mammalia. Estos últimos son los más abundantes y comprenden diversas familias: Didelphidae y Sparassocynidae (Didelphimorphia), Argyrolagidae (Polydolopimorphia), Octodontidae, Hydrochoeridae, Chinchillidae, Caviidae, Cricetidae y Echimyidae (Rodentia), Hegetotheriidae, Mesotheriidae y Toxodontidae (Notoungulata), Proterotheriidae y Macraucheniidae (Litopterna) y Pampatheriidae, Glyptodontidae Dasypodidae y Mylodontidae (Xenarthra). Se destaca el hallazgo de taxones poco frecuentes en esta unidad, cuya evaluación resulta de interés desde el punto de vista biocronológico, entre los que se encuentran diversos taxa de roedores y marsupiales. A estos se agregan nuevos registros, como los de los peces de la Familia Characidae, aves del Orden Anseriformes y un anuro de la Familia Ceratophryidae. Además, se recuperaron varios taxa en niveles diferentes a los citados clásicamente y otros cuya procedencia era, hasta el momento, dudosa o incierta. Las evidencias taxonómicas obtenidas en el marco de este estudio no reflejan variaciones faunís-

ticas importantes, entre los distintos niveles que constituyen la Formación Monte Hermoso, que impliquen diferencias cronológicas significativas y que justifiquen una división en dos unidades bioestratigráficas diferentes. Esto permite discutir la validez de las biozonas involucradas y, por lo tanto, plantear una reevaluación del esquema propuesto para esta unidad.

Cione, A.L. y Tonni, E. 2005. Bioestratigrafía basada en mamíferos del Cenozoico superior de la provincia de Buenos Aires, Argentina. En: R.E. de Barrio, R.O. Etcheverry, M.F. Caballé y E. Llambías (Eds.), *Geología y Recursos Minerales de la Provincia de Buenos Aires*. *16° Congreso Geológico Argentino* (La Plata), *Actas* 11: 183-200.

Zavala, C. 1993. Estratigrafía de la localidad de Farola Monte Hermoso (Plioceno-Reciente), Provincia de Buenos Aires. *12° Congreso Geológico Argentino y 2° Congreso de Exploración de Hidrocarburos* (Mendoza), *Actas* 2: 228-235.

PRIMERAS EXPERIENCIAS DE TURISMO PALEONTOLÓGICO EN URUGUAY

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Dentro del denominado Turismo Científico, el Turismo Paleontológico es una modalidad de creciente desarrollo en varios países de Latinoamérica. Uruguay cuenta con algunos antecedentes sobre esta temática desarrollados en los últimos años, dos de ellos bien documentados a partir del año 2009. Estos últimos se tratan de experiencias piloto llevadas a cabo por jóvenes estudiantes, financiadas por la Agencia Nacional de Investigación e Innovación (ANII): *"Turismo Paleontológico en Uruguay: Un recurso inexplorado"* (desarrollado en la ciudad de Colonia del Sacramento y alrededores, entre 2009 y 2010), y *"Mercedes: Punto clave en Ecoturismo Paleontológico"* (tomando a la ciudad de Mercedes y localidades vecinas del Departamento de Soriano como centro de actividades, entre 2010 y 2011). A través de estas experiencias se implementaron pequeños circuitos paleontológicos locales constituidos por Museos y afloramientos vecinos, que fueron visitados por grupos de docentes, estudiantes de enseñanza media, operadores turísticos y público en general. La selección de las localidades se realizó en base a su potencial turístico, teniendo en cuenta aspectos tales como distancias, accesibilidad, riqueza de fósiles y paisajes. A lo largo de estas actividades, el público objetivo fue receptor y a la vez evaluador del servicio, con el aporte de sus propias impresiones y una visión crítica altamente positiva. Más aún, en la gran mayoría de los testimonios recabados, el público dejó en evidencia una notoria avidez por la temática de las propuestas y una gran satisfacción por las experiencias desarrolladas, así como el deseo de poder repetirlas en una futura ocasión. El balance positivo que se desprende de estos antecedentes, sumado a la demanda del público, ha llevado a que actualmente se esté desarrollando una nueva experiencia, con un circuito a nivel nacional que incluye a los Departamentos de Colonia y Soriano, a los cuales se agregan Cerro Largo y Tacuarembó, abarcando así una gran parte del territorio uruguayo. La actividad realizada en cada localidad consiste en una visita a sus Museos, que a través de sus colecciones reflejan la diversidad y tradición paleontológica de la región, resultando en una instancia de familiarización con los materiales fósiles y un entendimiento de la historia geológica de la zona comprendida. Posteriormente se efectúan visitas guiadas a yacimientos próximos, con el propósito de observar a los fósiles en su contexto geológico natural y acercar al público al trabajo de campo del paleontólogo, haciéndolo partícipe también de las tareas de búsqueda. En lo referente a la edad y naturaleza de los sitios seleccionados, vale la pena destacar que en su conjunto estos abarcan desde sedimentos pérmicos conteniendo restos de mesosaurios y xiloflora, hasta yacimientos con restos de megafauna cuaternaria, pasando por "paleo-desiertos" mesozoicos, paleosuelos con abundantes icnofósiles de insectos, y rocas marinas miocenas. En síntesis, un recorrido por los últimos 300 millones de años del pasado geológico de Uruguay.

NUEVO REGISTRO DE ESTRUCTURAS DE PROTECCIÓN ACCESORIAS EN *GLYPTODON* OWEN, 1839 (MAMMALIA, CINGULATA, GLYPTODONTIDAE)

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A pesar de que los gliptodontes han sido objeto de atención en numerosas publicaciones desde la primera mitad del Siglo XIX, existen varios aspectos de su anatomía que aún resultan poco conocidos, particularmente en lo referente al dermatoesqueleto. Un ejemplo de ello es la escasa información existente sobre la presencia de huesos dérmicos en las regiones del cuerpo no protegidas por el escudo cefálico, la coraza o los anillos caudales. En este sentido, apenas en los últimos años se ha documentado de manera fehaciente la presencia de osteodermos para las extremidades, la región ventral-púbica y el rostro en ejemplares de *Glyptodon*, y la presencia de osteodermos "accesorios" articulando directamente con los bordes de la coraza y/o del escudo cefálico (ver referencias). Dada la escasez de estos registros, la colecta y preparación de nuevos ejemplares demandan una especial atención, en busca de estos elementos óseos tan particulares. En este trabajo se presenta un nuevo ejemplar de *Glyptodon clavipes* Owen, 1839 del Pleistoceno tardío de Uruguay. Este incluye la coraza casi completa, partes de anillos caudales y varios restos del endoesqueleto, junto a numerosos osteodermos de morfología muy particular, no correspondiente con la de los conocidos clásicamente para el exoesqueleto (Museo Paleontológico "Alejandro Berro". Mercedes: MPAB 4083). Entre estos elementos se encuentran cientos de pequeños osículos irregulares, hallados dispersos en el interior de la coraza. Más de un centenar fueron colectados en la zona de la apertura cefálica y muestran similitud con los descritos para el rostro de *G. munizi* Ameghino, 1881 (Soibelzon *et al.*, 2006). El resto incluye

lotes de osículos de posición incierta, aunque varios resultan similares a los descritos para la región ventral y púbica de *G. reticulatus* Owen, 1845 (Tauber & Di Ronco, 2000). Tal como se ha propuesto, probablemente la mayoría de estos osículos no articulaba directamente, sino que estarían próximos entre sí e incluidos en la dermis, como en armadillos y algunos perezosos extintos. Evidentemente, su presencia contribuiría al endurecimiento del cuero en las regiones no protegidas por el resto del exoesqueleto. Por otra parte, cerca de la apertura cefálica fueron hallados varios osteodermos desarticulados de gran tamaño, incluyendo 10 pares simétricos de tubérculos cónicos rugosos, muy similares a los que forman una fila imbricada en la apertura cefálica de *G. reticulatus* y *G. munizi* (Zurita *et al.*, 2010), y a los que articulan con el borde posterior del escudo cefálico en esta última especie (Soibelzon *et al.*, 2006). Probablemente, la presencia de esos tubérculos otorgaría una mayor protección a nivel nucal. Por último, en la cara interna de los bordes de la coraza se detectaron pequeños osteodermos irregulares ocupando espacios entre placas, un carácter que hasta ahora sólo había sido observado para *G. munizi* (Zurita *et al.*, 2010).

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PALEOENVIRONMENTAL INTERPRETATION FROM EXPERIMENTAL TAPHONOMY

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Fossil elasmobranch teeth from the Late Cretaceous Judith River Formation (JRF) (Campanian) of north-central Montana show variable states of preservation. Material comes from two sites, the Woodhawk Bonebed (WH) and the Power Plant Ferry Bonebed (PPF), that are approximately 3 kilometers apart. The sites consist of the same shoreface deposits and are of the same stratigraphic horizon, with nearly identical faunal diversity including shark and ray teeth, dermal denticles and centra, teleost teeth, and archosaur remains (ex. crocodile teeth). Both sites include ca. 16 identifiable taxa of mostly lamniform and rajiform elasmobranchs, differing only in 2-3 species. Subtle differences between the sites are expressed in details of faunal abundances, overall quantity of fossil elements, and styles of preservation. Fossil teeth of *Archaeolamna kopingensis* (Davis) were chosen from each site to assess the range of taphonomic preservation because of: a. their abundance, b. the initial observed range of preservational states from pristine to broken, and c. were of sufficiently large size to be used for this study. The teeth from the WH have a greater abundance and a wider range of preservation, whereas the PPF teeth show less abundance with more uniform preservation but with a near bimodal distribution or grouping at the extreme ends. This suggests localized areas of variable energy, with WH representing a higher energy environment bringing in specimens from farther offshore and mixing them with local material, and abrading the specimens to a higher degree than those preserved at PPF, where the material reflects a more autochthonous origin. This creates a mixture of marine and estuarine fossils, which in turn produces mixed interpretations of the geology and paleontology of the JRF. These observations prompted a series of taphonomic experiments on modern elasmobranch teeth intended to serve as a proxy for simulating the post-shedding fate (wear and abrasion) of the teeth. Experiments consisted of tumbling modern sand tiger shark teeth, *Carcharias taurus* Rafinesque, in a mixture of saltwater and sediment from the WH. Visual changes in the teeth were qualitative as well as quantifiable, with statistically significant (*e.g.* using Significance correlation and Student's t-tests) changes seen in height, width, and mass. Experiments show that when unaltered elasmobranch teeth are tumbled for up to 1000 hours, the cusps, cusplets, and roots are progressively lost in a predictable manner. The pattern seen in the tumbled modern shark teeth allows for interpreting the taphonomic state of comparable teeth in the fossil record. This study reveals intrinsic links between paleodiversity, taphonomy, and the paleoenvironment and is likely applicable to other sites with discrete lag deposits and also produces a preliminary taphonomic scale to assess worn fossil elements, namely elasmobranch teeth.

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A BASAL MONACHINE SEAL FROM THE MIDDLE MIOCENE OF THE PISCO FORMATION, PERU

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True seals (Phocidae Gray, 1821) are currently restricted to polar and subtropical regions in both Northern and Southern Hemispheres. This distribution pattern is usually held to be consistent with its evolutionary history, in which an early radiation into two subfamilies – the "northern" Phocinae Gray, 1821 and the "southern" Monachinae Trouessart, 1897 – is recognized in most morphological and molecular studies, although another alternative arrangement has been suggested (*i.e.* Wyss, 1988). The oldest records of these subfamilies are represented by the monachine *Monotherium*? *wymani* (Leidy, 1853) and the phocine *Leptophoca lenis* True, 1906 both from the Middle Miocene of the eastern

coasts of North America (Deméré *et al.*, 2003), but the subsequent historical biogeography of monachine seals is still contentious (Fyler *et al.*, 2005). One of the lowermost layers of the Pisco Formation (about 14 Myr; DeVries, *pers. comm.*, 2011) exposed at Correviento locality in the Ocucaje area (Ica region, South Central Peru) has yielded a plenty of phocid materials, and among them a humerus bearing monachine features. MUSM 448 is a left humerus with: (1) deltopectoral crest extended distally down the shaft ending at the medial epicondyle, (2) poorly developed supinator ridge, (3) the greater tuberosity slightly higher than the lesser tuberosity, and (4) presence of an entepicondilar foramen. While this last feature is only present in living phocines, it is also shared by basal monachines. This material resembles that of the relatively coeval *Monotherium*? *wymani*, although the latter is more robust and has a wider separation of the tuberosities. The presence of this taxon in the east coast of the South Pacific reveals an early southward migration, and enhances the real importance of the western coasts of South America in the evolutionary history of seals, especially considering the long standing presence of monachines in this region since the Middle Miocene to the late Pliocene (Muizon and DeVries, 1985).

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THE EARLIEST KNOWN PINNIPED FROM THE SOUTHERN HEMISPHERE

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Pinnipeds are a group of secondarily aquatic carnivores represented today by the walrus, seals and sea lions. The oldest pinnipeds – nested basal within the Pinnipedimorpha – such as *Enaliarctos* Mitchell and Tedford, 1973 date from the late Oligocene (27-23 Ma) of the western coasts of North America. This suggests that their early evolution occurred in the North Pacific basin, and a recent finding in the Canadian archipelago suggests an Arctic origin (Rybczynski *et al.*, 2009). Here we report the discovery of a basal pinniped collected by one of the authors (MU) in rocks of the late Oligocene to early middle Miocene Chilcatay Formation (Dunbar *et al.*, 1990). This unit is exposed at the Zamaca locality (Ica Region, South Central Peru) and characterized by an unconformity strewn with large boulders of black igneous rock and cobbles indicating the lower layers of this formation (~23 Myr). The specimen (MUSM 1919) is a proximal fragment of a left femur including the capitulum, greater and lesser trochanters and a portion of the shaft. This material has the typical anteroposteriorly flattened shape of pinnipeds and shows the following features: (1) a well developed rounded *fovea capitis femoris*, (2) presence of a noticeable lesser trochanter posteromedially placed, (3) a deep trochanteric fossa, but not united to the lesser trochanter by a ridge, and (4) in anterior view, a faintly pronounced ridge extending distally from the greater trochanter. These features resemble those of pinnipedimorphs (*i.e. Enaliarctos*, *Pinnarctidion* Barnes 1979) although a genus assignment is difficult to assess because of the scarcity of the material. Nevertheless, MUSM 1919 has a nearly absent femoral neck making its proximal side close to the midline, and thus changing the angle between the shaft and the capitulum. This condition may have an effect on hind limb locomotion. Furthermore, the distal end of the lesser trochanter has a slightly projection which extends distally and disappears progressively. Both features are inconsistent with other already described femora. This discovery depicts an unknown early radiation of basal pinnipeds from the North Pacific basin into the eastern South Pacific prior to the Early Miocene. Its presence in this region suggests that this group arose and spread rapidly during the Late Oligocene as climate conditions shifted because of the onset of glaciation. Marine transgression-regression events related to these changes might have played a critical role in the adaptive radiation and biogeographic patterns of pinnipeds (Kohno, 2010) by modifying coastal environments. A variation in these habitats strongly influences pinnipeds distribution due to its close relationship as has been shown in living populations.

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CARACTERIZACIÓN MORFOLÓGICA DEL ESQUELETO DE *NOTOPITHECUS* AMEGHINO, 1897 (NOTOUNGULATA, INTERATHERIIDAE)

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El género *Notopithecus* Ameghino, 1897 es el mejor conocido entre los géneros tradicionalmente agrupados bajo el nombre Notopithecinae Ameghino, 1897 en la Familia Interatheriidae Ameghino, 1887 y, hasta el presente, no se conocen cráneos tan completos ni esqueleto asociado para los otros géneros de este grupo. Los estudios previos han descrito en detalle la morfología craneana de *Notopithecus*, pero nunca han caracterizado el esqueleto apendicular. En la presente contribución se da a conocer el espécimen más completo de este género, MPEF 1113 (Museo Paleontológico Egidio Feruglio, Trelew), que incluye el cráneo y parte del esqueleto postcraneano, con casi todos los elementos en posición anatómica: numerosas vértebras en conexión, escápula, húmero, radio, fémur, tibia, fíbula, calcáneo, astrágalo, metápodos y falanges. La mayoría de ellos se describen por primera vez para los notopitecinos. El húmero y el astrágalo son relativamente más pequeños y presentan ligeras diferencias con respecto del holotipo MACN A10822 (Museo Argentino de Ciencias Naturales, Buenos Aires). El astrágalo se caracteriza por tener el cuello y la polea inclinados medialmente; la tróclea es trapezoidal, cuya cara lateral sobrepasa a la medial y la superficie articular es suavemente convexa. Estos rasgos lo diferencian del astrágalo MACN A10834, depositado junto a un maxilar de *Notopithecus*, lo que indicaría que ambos ejemplares no corresponden al mismo taxón. Respecto de los interatéridos deseadenses, el húmero es muy distinto y mucho más chico que en *Eopachyrucos* Ameghino, 1901 (MAMC-27, Museo de Arqueología de Canelones, Uruguay) y el radio se diferencia notoriamente de *Federicoanaya* Hitz *et al.*, 2008 (MNHN-Bol-V-004500, Museo Nacional de Historia Natural, La Paz, Bolivia) por tener el extremo proximal comprimido anteroposteriormente y la articulación para la ulna muy bien desarrollada y saliente en todo el borde posterior.

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MORPHOLOGICAL PHYLOGENY AND DIVERGENCE TIMES OF THE OCTODONTIDAE (RODENTIA, HYSTRICOMORPHA)

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The family Octodontidae Waterhouse, 1839 (Degus, Coruros, Viscacha-rats, Tuco-tucos) comprises an assemblage of living South American rodents of southern origin, with essentially fossorial to subterranean habit. The boundaries and age of the family and subordinate taxa in the fossil record remain controversial. A phylogenetic analysis (parsimony analysis by implicit enumeration using TNT 1.1, Goloboff *et al.*, 2008a, b) of living and extinct Octodontoidea, including living Echimyidae as outgroups, was performed on a matrix of craniomandibular and dental characters (partially based on Verzi, 2001, 2008). The modified Stratigraphic Manhattan Measure (MSM*, Pol and Norell, 2001) was used both to assess the fit between the stratigraphic record and the resulting phylogeny and to optimize divergence times. The analysis resulted in a single tree in which Octodontidae was monophyletic (and strongly supported), and so were the sister clades Octodontinae Waterhouse, 1839 and Ctenomyinae Lesson, 1842. The tree topology for the living genera is consistent with molecular phylogenies (Gallardo and Kirsch, 2001; Honeycutt *et al.*, 2003), except for the position of *Octodontomys* Palmer, 1903 within the Octodontinae. Stem Ctenomyinae included extinct genera previously assigned to the family Echimyidae Gray, 1825. Estimated divergence times suggested a Deseadan age (late Oligocene, >25 Ma) for the Octodontinae-Ctenomyinae dichotomy, and temporally extended stem groups for each of these clades. Differentiation (recognized by the independent acquisition of molar euhypsodonty) and subsequent branching of the modern Octodontinae and Ctenomyinae would have occurred at different times in these clades during the Huayquerian (late Miocene), occurring earlier in Octodontinae. Among the Ctenomyinae, a more recent split (early Pliocene) would have given rise to the living *Ctenomys* Blainville, 1826. The most recent Octodontinae divergences at the genus level, estimated to have occurred during the Montehermosan (early Pliocene, ca. 5 Ma), corresponded to the fossorial mesic-adapted representatives. These results suggest a timing of the Octodontinae-Ctenomyinae split similar to molecular estimates and much older than previously assumed from fossils, whereas the more recent divergences of Octodontinae are older than those inferred using molecular evidence.

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CONSIDERACIONES ESTRATIGRÁFICAS SOBRE EL REGISTRO FÓSIL DE *ARCTOHERIUM TARIJENSE* AMEGHINO 1902 (CARNIVORA, URSIDAE) EN EL PLEISTOCENO TARDÍO DE SANTA FE, ARGENTINA

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El registro más antiguo de osos Tremarctinae se remonta al Mioceno tardío (NALMA Hemphilliense) de América del Norte (Kurtén, 1967, Soibelzon *et al.*, 2005, Soibelzon y Schubert, 2011). En América del Sur, el registro más antiguo corresponde al Pleistoceno temprano (Piso/Edad Ensenadense) con *Arctotherium angustidens* Gervais y Ameghino en la Región Pampeana, Buenos Aires (Soibelzon, 2004, Soibelzon *et al.*, 2005). En la provincia de Santa Fé los restos de Tremarctinae, asignados a *Arctotherium tarijense* Ameghino y *Arctotherium* sp., fueron ubicados en el Pleistoceno medio (Piso/Edad Bonaerense) y en el Pleistoceno tardío respectivamente (Soibelzon, 2004, Soibelzon *et al.* 2005) debido a la imprecisa procedencia estratigráfica de los materiales. El objetivo de la siguiente comunicación es analizar y discutir la procedencia estratigráfica de los materiales descriptos para la provincia y la antigüedad cronológica de los niveles portadores. El reestudio de los materiales junto a análisis tafonómicos, estratigráficos y sedimentológicos sugiere que los niveles portadores corresponden a los de la Formación Tezanos Pinto. Estos niveles se atribuyen al miembro superior, depositados por acción eólica en condiciones climáticas áridas a semiáridas (Iriondo, 1980) y su edad es referida al Pleistoceno tardío-Holoceno temprano (IS2) de acuerdo a edades de termoluminiscencia establecidas entre 14000 y 8000 años AP. (Kröhling, 1999). Esta Formación pertenece a una unidad morfoestructural denominada bloque San Guillermo (Kröhling e Iriondo, 2003) de composición sedimentológica homogénea. Este sistema geomorfológico se encuentra conformado por gruesos y extensos mantos de loess que no han sido afectados por la dinámica de grandes sistemas fluviales durante el Cuaternario. La monotonía de los depósitos de limo eólico de la Fm. Tezanos Pinto sólo se encuentra interrumpida por niveles de paleosuelos o depósitos palustres intercalados, representando estadios de estabilidad sedimentaria o transporte hídrico de baja energía, debido al desarrollo de períodos de mejoramiento climático (Iriondo y Kröhling, 1995).

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EVOLUCIÓN DEL ESMALTE EN MOLARES DE ROEDORES OCTODONTOIDEA (CAVIOMORPHA) DEL OLIGOCENO TARDÍO-MIOCENO MEDIO DE PATAGONIA

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Entre los roedores Hystricognathi sudamericanos, los Octodontoidea representan la superfamilia más diversificada tanto morfológica como taxonómicamente desde sus registros más tempranos. Desde el Mioceno tardío hasta la actualidad se reconocen dos de los linajes principales, Echimyidae Gray, 1825 y Octodontidae Waterhause, 1839; sin embargo, las relaciones de estos con los representantes del Oligoceno-Mioceno medio no son claras. La asignación de los taxones basales a una familia en particular es una tarea compleja ya que poseen morfologías dentarias muy similares y con caracteres generalizados. El objetivo de este trabajo es analizar la evolución del esmalte en molares de Octodontoidea basales sobre una hipótesis filogenética construida con caracteres cráneo-dentarios (Arnal *et al.*, 2010). Los dos tipos de esmalte que se desarrollan en este grupo [esmalte radial (RE) y bandas de Hunter-Schreger (HSB)] se combinan en tres patrones de disposición espacial. En todos los taxones braquiodontes (incluido el *outgroup*) el RE ocupa la porción apical de la corona y el borde externo de la capa de esmalte, y las HSB se disponen internas a éste. Desde el Mioceno temprano (Colhuehuapense) los taxones con hipsodoncia leve presentan el RE interno a las HSB, conservando los ejemplares con poco o ningún desgaste la capa apical de RE, como ocurre en el clado Acaremyidae Wood, 1949 +*Acarechimys* Patterson y Wood, 1982. Los parafiléticos "Adelphomyinae" Patterson y Pascual, 1968 hipsodontes del Mioceno temprano cuspidal (Santacrucense) presentan un patrón de tres capas en el cual el RE rodea interna y externamente a las HSB. Se reconoce un patrón plesiomórfico vinculado a molares braquiodontes de taxones no relacionados. La adquisición secundaria de RE vinculada a la hipsodoncia aparece de manera independiente en distintos linajes de octodontoideos. Estos resultados son consistentes con lo observado en otros caviomorfos con distintos grados de hipsodoncia, sugiriendo que estos cambios aparecen en respuesta a distintos requerimientos funcionales (Verzi *et al.*, 2004; Vieytes, 2003; Vieytes, 2010).

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BRIEF REVIEW OF THE MONOPHYLY OF THE TAPEJARIDAE (PTERODACTYLOIDEA, PTEROSAURIA)

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The Tapejaridae comprises a clade of large and small pterodactyloid pterosaurs that have been found in Early Cretaceous deposits of Brazil, China, and Morocco. The first specimens of the group were registered in strata of the Santana Group (northeastern Brazil), where most of the diversity of the clade is found. Recently, Kellner and Campos (2007) splited the large tapejarids into the clades Thalassodrominae, comprising *Thalassodromeus* Kellner and Campos, 2002 and *Tupuxuara* Kellner and Campos, 1988, and Tapejarinae, including the smaller members of the group. Cladistic analyses of pterosaurs with representatives of azhdarchids, tapejarines, and thalassodromines have consistently united them into a single, clade, the Azhdarchoidea, with unambiguous synapomorphies (Lü *et al.*, 2006). Although the monophyly of those sub-groups have been directly or indirectly acknowledged, there is some discussions if the large tapejarids (Thalassodrominae) are more closely related to the Azhdarchidae than to the Tapejarinae, forming a clade named Neoazhdarchia (Lü *et al.*, 2008). Another hypothesis nests chaoyangopterids (a group often related to the Azhdarchidae in the literature) within the Tapejaridae, closer to the Tapejarinae than to the Thalassodrominae (Pinheiro *et al.,* 2011). In addition, some authors proposed that the thalassodromine *Tupuxuara* is closer to the Azhdarchidae than to *Tapejara wellnhoferi* Kellner, 1989 and other tapejarids (Unwin, 2003; Martil and Naish, 2006). Therefore, the inclusivity of Tapejaridae in the literature ranges from only the genus *Tapejara* Martill and Naish 2006, a clade with tapejarines and thalassodromines (Kellner and Campos, 2007), or a possible group including chaoyangopterines, tapejarines, and thalassodromines (Pinheiro *et*

al., 2011). An asian origin and posterior dispersion to South America was suggested to tapejarines (Pinheiro *et al.*, 2011). If expanded to the other Tapejaridae as a whole, this hypothesis can shed some light in the internal organization of the clade.

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THE HIGHEST SAUROPOD TRACKSITE IN THE WORLD, LOWER CRETACEOUS, PERU

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The record of sauropod tracks during the Cretaceous in South America is scarce. Just a few sites in Argentina, Brazil and Chile have been discovered and published; among them, the two ichnotaxa *Sauropodichnus giganteus* Calvo, 1991 and *Titanopodus mendozensis* González Riga and Calvo, 2009 were described in detail. Here, we present the first Cretaceous sauropod tracksite in Peru. The dinosaur tracks are situated in the Pariatambo Formation (Early to Middle Albian) at Yanashalla locality, 70 km SE of Huaraz city. The main outcrop includes more than 25 tracks. At least one trackway could be recognized, that includes two pes and two manus prints. The pes tracks are oval in shape with the longest axis directed anteromedially. The pes width is 58 cm. and its length 55 cm. They show four toe impressions with rounded ends. The manus track area is oval in shape, and wider (51 cm.) than longer (39 cm.). The pes pace angulation is 110 degrees and the manus pace angulation is 120/125 degrees. The internal border of the manus and pes tracks is closer to the contacts with the midline, showing that this is a medium-gauge track sauropod. According to the track morphology and trackway evidence, the sauropod that walked on this shallow carbonate environment close to the Pacific coast, was probably diplodocid/rebbachisaurid-like. Today, this sauropod tracksite is placed on a vertical wall at 4,840 meters above the sea level, being the highest dinosaur tracksite on the Southern continents.

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A NEW MARSUPIAL (MAMMALIA, DIDELPHIMORPHIA) FROM THE QUATERNARY OF NOTHERN BRAZIL

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On the basis of upper and lower molars, we describe a new genus and species of a small marsupial, closely related to the enigmatic *Hyladelphys* Voss, Lunde and Simmons, 2001, described from French Guiana, Peru and Brazil. The material comes from the Pleistocene-? Holocene limestones of a cave in Aurora do Tocantins, State of Tocantins in Northern Brazil. In absence of radiometric data for the sediments, a tentative age of the fauna is inferred on the basis of the associated taxa (*Pachyarmatherium* Downing and White, 1995). In order to determine the phylogenetic relationship of the new taxon within Didelphimorphia (*sensu* Voss and Jansa, 2009), a cladistic analysis was carried out. Although the new taxon has a number of autapomorphies, some derived features are consistent with its assignment to the Didelphimorphia, among which a transversely well-developed stylar shelf, absence of paraconule and reduced anterior cingulum. The new taxon differs from the living and extinct members of the Didelphoidea in having linear centrocrista, M2 larger than M3, absence of conules, deeper ectoflexus in M2, postparacrista and premetacrista subequal in length, absence of anterior cingulum and strong reduction of stylar cusps. However, in most Didelphimorphia the centrocrista is V-shaped, although with variations, and show a clear difference in height between the paracone and the metacone. In most of its features, the new taxon resembles the living enigmatic genus *Hyladelphys*. They share synapomorphies such as the presence of a linear centrocrista, similarly sized paracone and metacone, reduction of stylar cusps, convex labial faces of paracone and metacone and well developed prefossid in the first lower molar. However, it differs from *Hyladelphys* in

having more bunoid teeth, deeper ectoflexus in M2, protocone less developed, eccentric and very low, stronger reduction of stylar cusps and smaller M4. These features are suggestive of insectivorous-frugivorous feeding habits. *Hyladelphys* has more developed posmetacrista, which is suggestive of it having a more insectivorous diet when compared to the new taxon.

Jansa, S.A. and Voss, R.S. 2005. Phylogenetic relationships of the marsupial genus *Hyladelphys* based on nuclear gene sequences and morphology. *Journal of Mammalogy* 86: 853–865.

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EVALUATING HABITATS AND FEEDING HABITS THROUGH ECOMORPHOLOGICAL FEATURES IN GLYPTODONTS (MAMMALIA, XENARTHRA)

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Glyptodonts are very peculiar extinct mammals of the New World that vanished as part of the great end-Pleistocene extinction of continental mammals. The goal of this study is to evaluate ecomorphological variables in glyptodonts from different ages (Miocene to Pleistocene), clades, and sizes, with the purpose of inferring their habitats and feeding habits. The analyses include estimation of body masses and three variables: dental occlusal surface area (OSA), relative muzzle width (RMW) and hypsodonty index (HI). The major deviations from the correlation between OSA and body mass are recorded in two of three taxa larger than 1000 kg: *Panochthus* Burmeister, 1866 and *Doedicurus* Burmeister, 1874. The first lies markedly above the regression line and the latter well below, suggesting that these two forms resulted from divergent evolutionary pathways. RMW allows the distinction of two main groups: the small-sized Early Miocene propalaehoplophorids were selective feeders, while the larger post-Miocene forms were more bulk feeders. The Pleistocene *Glyptodon* Owen, 1839 appears as an exception, implying a reversion to a selective feeding behavior. The relation between RMW and HI allows discriminating feeding niche partitioning in glyptodonts. Among the early Miocene propalaehoplophorids, *Eucinepeltus* Ameghino, 1891 would have been a highly selective feeder in relatively closed environments, *Propalaehoplophorus* Ameghino, 1887 a highly selective feeder in moderately open habitats, and *Cochlops* Ameghino, 1889 a less selective feeder in moderately open habitats. Among the large Pliocene and Pleistocene taxa, *Neuryurus* Ameghino, 1889 and *Neosclerocalyptus* Paula Couto, 1957 were probably bulk feeders in relatively open environments, while *Panochthus* and *Doedicurus* were bulk feeders in open environments. Alternative interpretations can be assessed for *Glyptodon*: it was a more selective feeder in closer habitats, or had a different feeding behavior, browsing on specific plants at higher levels from the ground, and/or a specialized physiology. The late Miocene and Pliocene forms (*Hoplophractus* Cabrera, 1939, *Eosclerocalyptus* Ameghino, 1919, and *Urotherium* Castellanos, 1926) were probably intermediate between the Miocene and the Pleistocene ones.

THE LARGEST THICK SHELLED GIANT TORTOISE (TESTUDINES: TESTUDINIDAE) FROM SOUTH AMERICA

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The thickened shelled "giant" tortoises is a land turtle morphotype recognized by Pritchard and Trebbau (1984) to include "a large array of widely distributed tortoises with maximum carapace length of about 120 cm, found on most continents (except Australia and Antarctica) and many continental islands". This parataxonomic category of tortoises is characterized by thickened dorsal carapace and unreduced plastron, and it is regarded as an entirely extinct group. In this contribution, the largest specimen referred to this morphotype is reported. This specimen (MHRSP 177) was exhumed in 1952 from Urundel Formation (upper Pleistocene; ca. 36-8.5 ka; Iriondo, 1993, 2010) at La Matanza locality, Quitilipi Department, Chaco Province, Argentina. Its generic assignation to *Chelonoidis* Fitzinger is based on the absence of cervical scale and an undivided supracaudal scale. The peripheral bones I, II, and III anteriorly projected, absence of pleural gibes, and a great development of vertebral gibes suggest that this specimen would belong to a new species. In addition, the dorsal profile is more clearly convex than that observed in other thickened shelled species of this genus. The carapace length of MHRSP 177 is 140 cm, the carapace height is 77 cm and the thickest peripheral bones ranges between 10 and 15 cm. These measurements suggest that La Matanza specimen is the largest known South American tortoise.

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A LATEST PLEISTOCENE-EARLY HOLOCENE PALAEOFAUNAL ASSOCIATION IN NORTHERN ARGENTINA

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One of the most important palaeofaunistic associations from northern Argentina has been recovered from the cliff of the Bermejo River, Formosa province, Argentina (Zurita *et al.*, 2009). All the recorded taxa constitute typical Pleistocene Pampean megafauna, except for the intertropical cingulate *Holmesina paulacoutoi* (Cartelle and Bohorquez, 1985). This fossiliferous level has approximately six meters and it belongs to the Río Bermejo Formation. The recorded taxa are Xenarthra, Proboscidea, Carnivora, Artiodacyla, Notoungulata, including in total more than 14 genera. A Recent C^{14} dating taken from material recovered in the middle section of this fossiliferous level indicates an age of 9570±90 BP (LP-2389). If this dating is

correct, this site represents the first early Holocene palaeofaunistic association from northern Argentina. Most of the taxa suggest the presence of open palaeoenvironments. Among the remarkable aspects of this paleofaunistic association it could be mentioned that within the Cingulata Glyptodontidae, the only two recorded genus are *Glyptodon* Owen, 1839 and *Neosclerocalyptus* Paula Couto, 1957, while it is noteworthy the absence of the others typical Pampean Pleistocene genera, especially *Panochthus* Burmeister, 1866. In addition, the presence of the intertropical Xenarthra *H. paulacoutoi*, apparently coeval with the Pampean taxa (including the other pampatheriid species, *Pampatherium typum*), raises some questions about the ecological tolerance of this taxon. Furthermore, we provide for this association the first latest Pleistocene-early Holocene records of the teleostei cf. *Synbranchus marmoratus* (Synbranchiformes, Synbranchidae), represented by several well preserved precaudal vertebrae. Previous records of this taxon correspond to the early-late Pleistocene ("Belgranense") of the Quequén Salado river, Buenos Aires province (Cione and Barla, 1997; Pardiñas *et al.*, 1996). Nowadays, *Synbranchus marmoratus* has a very wide distribution in South America, which includes the Bermejo river basin.

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ON THE TAXONOMIC STATUS OF SOME GLYPTODONTIDAE (MAMMALIA, CINGULATA) FROM THE PLEISTOCENE OF SOUTH AMERICA

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The anatomical and taxonomic knowledge of some groups of Glyptodontidae Gray 1869 is still very poor. In addition, a strict typological/morphological taxonomic criterion was used in recognizing many taxa, especially during the second half of the 19th century and the first of the 20th century. This particular situation resulted in a clear overestimation of diversity, mainly with respect to the South American glyptodonts. In this scenario, the aim of this contribution is to analyze the taxonomic status of some Glyptodontinae Gray, 1869 through a precise comparative study with well characterized taxa. The main results show that *Pseudothoracophorus* Castellanos, 1951 (*P. depressus* Ameghino 1881) and *Chlamydotherium* Bronn, 1838, one species of *"Boreostracon"* Simpson 1929 (*B. corondanus* Castellanos 1958), and one species of *Glyptodon* Owen, 1839 (*G. falkneri* Ameghino, 1889), actually represent juvenile specimens referable to *Glyptodon*; in the same way, *Neothoracophorus* Ameghino, 1889 (*N. elevatus* Nodot, 1857) could be related either to *Glyptodon* or *Glyptotherium* Osborn, 1903. Another species, *Heteroglyptodon genuarioi* Roselli, 1976 presents an almost identical morphology compared with the recognized species of *Glyptodon* (*eg. G. munizi* Ameghino, 1881). In this sense, the diagnostic characters described for *Glyptodon perforatus* Ameghino, 1889, a taxon with biostratigraphic relevance since it is characteristic of the Lujanian Age/Stage (late Pleistocene–early Holocene), are also present in other species of *Glyptodon*, especially *G. reticulatus* and *G. clavipes* Owen, 1839, two very frequent taxa in southern South America.

PECES FÓSILES DE LOS CONTINENTES DE GONDWANA

Coordinador: DRA. GLORIA ARRATIA

PRIMARY CONTROL ON SPECIES RICHNESS IN OSTARIOPHYSAN FISHES: SAMPLING IN TIME AND SPACE

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Disparity in species richness across the tree of life is one of the most striking and pervasive features of biological diversity. While

some clades are exceptionally diverse, most clades are species poor. The number of species in a clade at a given time horizon is a function of net rates of diversification (speciation minus extinction), clade age, and external limits to clade growth (regional carrying capacity). When cladal diversity expanding or contracting (*i.e.*, is in a non-equilibrium condition) rates of net diversification and clade age exert the primary controls on species richness. When cladal diversity in a state of (quasi-) equilibrium, external limits to clade growth (*e.g.*, species-density) emerge as the primary controls on species richness. Here I examine patterns of diversification in the Ostariophysi, the most species-rich clade of continental (freshwater) fishes on Earth. With > 9,300 species Ostariophysi constitutes almost one third of all known fish species globaly and perhaps one in six of all vertebrate species. Ostariophysan diversity is even more remarkable considering that freshwater systems (rivers, lakes and streams) contain less than 0.007% of the world's liquid water supply. *What were the conditions that promoted the origins of such an extraordinary number of distinct evolutionary lineages*? Extant ostariophysan fishes inhabit all the major continental blocks except Antarctica, and continental freshwater have served as an exceptional crucible for the formation and maintenance of ostariophysan species diversity. Based on biogeographic and phylogenetic data Ostariophysi is inferred to have originated on Pangaea during the Jurassic, and to have undergone its early diversification during the time of the late Mesozoic global greenhouse and continental fragmentation. Patterns of diversity in ostariophysan fishes differ substantially among regions and clades. Neotropical freshwaters are especially diverse, containing more than half of the Earth's freshwater fishes (> 5,700 species) and perhaps 10% of all extant vertebrate species. These results of this study suggest that the exceptional species richness in Neotropical freshwaters is in large part relictual, retaining a relatively intact Late Cretaceous-Paleogene greenhouse diversity. By comparison the ichthyofaunas of many other continental blocks (North America, Eurasia, Africa, Madagascar, India, Australia-New Zealand), are relatively depauperate, having experienced extensive extinctions in the Cenozoic. In other words, Neotropical fish species diversity is highly saturated, net diversification is dependent on species-richness, species and species groups are relatively ancient, and rates of speciation and extinctions are relatively balanced. By contrast, ichthyofaunas of the most other continents are undersaturated, intrinsic diversification is positive and recent, and rates of speciation and immigration exceed rate of extinctions. Analyses of extant and fossil ostariophysan datasets seperately and in combination show the importance of fossils in biogeographic studies at broad spatial (intercontinental) and temporal (>100 MY) scales. At these scales extinction is highly non-random spatially and by taxon, and also strongly influences net rates of diversification.

THE ICHTHYIODECTIFOMES OF GONDWANA

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The order Ichthyodectiformes involves an extinct group of 25 nominal genera and about 40 nominal species. Although middle Jurassic-Cretaceous fossils belonging to this group started to be described since the 18th century, its singularity and natural condition was recently established by Bardack and Sprinkle (1969). Despite the increasing number of studies on systematic and phylogeny of Ichthyodectiformes, mainly on Cretaceous members, results still show some deep problems some of which are related to the Jurassic taxa that are less known than the Cretaceous ones. Although for a long time the knowledge of Ichthyodectiformes know from Gondwana was limited to few genera, today they involve the large part of this group including *Antarctithrissops* Arratia, Scasso, and Kiessling, 2004; *Africathrissops* Taverne, 2010; *Verraesichthys* Taverne, 2010; *Ogunichthys* Alvarado-Ortega and Brito, 2010; *Cladocyclus* Agassiz, 1841; *Chiromystus* Cope, 1885, (including *Itaparica* Santos, 1986), *Eubiodectes* Hay, 1903, *Heckelichthys* Taverne, 2008; *Proportheus* Jeakel, 1909; *Coyoo* Lee and Bartholomai, 1987; *Xiphactinus* Leidy, 1870; *Saurodon* Hays, 1830; and probably *Thrissops* Agassiz, 1833, and *Ichthyodectes* Cope, 1870.Recent studies on Ichthyodectiformes from South America, Africa, Australia, Antarctica, and the western Tethys Sea domain that also includes marine Jurassic and Cretaceous representatives from Mexico, reveals new data to achieve a better understanding of the taxonomical pattern of the Ichthyodectiformes in this part of the world. Although a work still in progress, the taxonomical studies on these Gondwanan fishes are providing new information and clues for a better understanding on the evolution and biogeography of this large order of Mesozoic fishes.

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ORIGIN AND EARLY DIVERSIFICATION OF TELEOSTEI, THE LARGEST CLADE AMONG VERTEBRATES

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The Teleostei, the largest living fish group had a modest beginning, presumably in the Late Triassic, with a few 'pholidophoriform' species inhabiting Europe and Asia. Ten genera are known from the Early Jurassic when the "true" teleosts [*Leptolepis coryphaenoides* (Bronn, 1830) plus more advanced teleosts] appeared, setting the beginning of an extraordinary radiation throughout the Mesozoic, especially in the Late Jurassic with over 40 genera. Together with the notable diversification, the distribution of teleosts became worldwide. It is during the Late Jurassic when some of the modern teleostean lineages arose, *e.g.*, elopomorphs and euteleosts. However, all Jurassic species had, apparently, a restricted geographical distribution and lived a few million years. None of the Jurassic species have been recovered in the Cretaceous, so that

replacements of species have operated through time; it is unknown how many events are involved up today (Arratia, 2004). The monophyly of the apomorphy-based Teleostei is weakly supported at the node of *Pholidophorus s.str.* (*Ph. bechei* Agassiz, 1844) plus more advanced teleosts, but it is strongly supported at the next node of the "true" teleosts. The stem-based group or Teleosteomorpha is weakly supported by a few, highly homoplastic characters. The possible stem-group taxa are still unclear and studies in progress are revealing that most taxa interpreted as the oldest teleosts in the past, including many 'pholidophoriforms', belong somewhere within the Holostei. The phylogenetic relationships of this highly diversified group are not resolved yet. The phylogenetic position of certain groups may change depending whether the database is morphological or molecular. Among the crown-group, the elopomorphs (with a fossil record of about 150 My) stand as the most basal teleostean group followed by the osteoglossomorphs (with a fossil record of about 140 My), ostarioclupeomorphs, and euteleosts when fossil and recent taxa are considered. When only recent taxa are included in the analysis, the osteoglossomorphs occupy the basal position. However, new molecular evidence also supports the elopomorphs as the basal group. Furthermore, there are major disagreements about the monophyly and interrelationships of some groups (*e.g.*, elopomorphs, ostarioclupeomorphs) depending on morphological or molecular evidence. There are major disagreements also between the fossil record and the divergence age proposed by molecular studies for most major teleostean lineages, including the taxon Teleostei Mueller. 1845. Different phylogenetic hypotheses as well as disagreements between ages of the oldest records of Teleostei (or of some lineages) versus molecular ages of divergence will be discussed as well as some of the synapomorphies supporting the stem-based, apomorphy based, and crown-group-based teleosts.

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THE ROLE OF THE SOUTH FOR CROSSOGNATHIFORMS AND OTHER BASAL TELEOSTS, AND INTERCONTINENTAL ROUTES IN THE PAST

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A significant part of the fossil record of Teleostei and of its oldest members has been recovered in the Northern Hemisphere, especially in Europe. In addition, that has provided most of the available information on the group and its oldest fossils until the middle of the 20th century. *Leptolepis coryphaenoides* (Bronn, 1830) plus more advanced teleosts branch almost at the base of the apomorphy-based Teleostei. That node is supported by a high number of synapomorphies (Arratia, 1999); it is one of the most strongly supported nodes in the evolutionary history of Teleostei. The Leptolepidiformes, a non-monophyletic group, includes among others the family Leptolepididae *s. str.*, with the type-species *L. coryphaenoides* and a few other *Leptolepis* and *Proleptolepis* species. Among basal teleosts, the crossognathiforms and the ichthyodectiforms are more advanced teleostean groups than *L. coryphaenoides*. Members of the genus *Leptolepis* Agassiz, 1832 as well as *Proleptolepis* Nybelin, 1974, are represented by delicate specimens of a few centimeters maximum length. They are traditionally known from the European Liassic. However, many specimens of *Proleptolepis*-like forms have been recovered in the Sinemurian of northern Chile and a new leptolepid in the middle-late Callovian to early Kimmeridgian of the Latady Group in Antarctica. These findings provide a different understanding of the distribution of these groups. The latter occurrence represents the most austral teleost recovered in Jurassic strata worldwide. The knowledge of the large order Crossognathiformes that traditionally was interpreted as a Cretaceous taxon extending into the Paleogene, has recently been challenged by new findings and new interpretations that extend its age and geographical distribution to the Jurassic with the presence of *Chongichthys* Arratia, 1982 and varasichthyids in the Oxfordian of northern Chile and of *Bavarichthys* Arratia and Tischlinger, 2010, in the Late Jurassic of Germany (Arratia and Tischlinger, 2010). The oldest ichthyodectiforms were considered Northern Hemisphere taxa represented by Early to Late Jurassic species. Ichthyodectiforms have also been recovered recently in the Late Jurassic of Antarctica (see Arratia and Hikuroa, 2010, for references). Thus, some major groups of basal teleosts that were interpreted as Northern Hemisphere taxa, are present in the most austral regions of the Southern Hemisphere almost at the same time. Except the ichthyodectiforms, the other basal teleosts mentioned here do not show morphologies characteristic of fast swimmers or good swimmers, a fact that opens questions about their possible dispersal in the past and the use of new intercontinental connections between the Tethys and the Paleo-Pacific in the Jurassic. Possible explanations and interpretations will be presented and discussed.

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GONDWANAN ASPIDORHYNCHIDS AND THEIR BIOGEOGRAPHICAL DISTRIBUTION

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The Aspidorhynchidae is a widely distributed clade of Mesozoic neopterygians comprising four nominal genera: *Aspidorhynchus* Agassiz, 1833, *Belonostomus* Agassiz, 1834, *Vinctifer* Jordan, 1919, and *Richmondichthys* Bartholomai, 2004, as well as an indeterminate example from the Upper Cretaceous of Chile (Arratia and Schultze, 1999) that is morphologically distinct from the other taxa. In terms of presence/absence data for the Gondwanan fossil record, the historical biogeography of the aspidorhynchids can be summarized as follows: *Aspidorhynchus* is known from the Upper Jurassic of Antarctica. *Belonostomus* is present in the Upper Jurassic of Argentina, Lower Cretaceous of Venezuela, Brazil and Upper Cretaceous of Morocco and South America (Venezuela, Chile, Argentina). *Vinctifer* occurs in the Lower Cretaceous of South America (Colombia, Venezuela, Brazil) while *Richmondichthys* is restricted to the Lower Cretaceous of Queensland, Australia. Occurrences of *Aspidorhynchus* and *Belonostomus* in the Upper Jurassic of Antarctica and Argentina can be interpreted as a migration through the Hispanic corridor (Hallam, 1983). Aspidorhynchid distribution in Gondwana suggests the following: *Vinctifer* was endemic to the southern and western Tethys, being a typical Early Cretaceous (Aptian–Albian) clade, found in shallow marginal platform settings along the northwestern margin of South America, i.e., present-day Venezuela and Colombia, as well as in a widespread epicontinental sea that extended southward from the shallow waters of the Caribbean Tethys onto the South American continent and is represented today by several Brazilian basins such as the Parnaíba, Araripe, Tucano, and Sergipe-Alagoas basins (Brito, 1997; Maisey, 2000). *Richmondichthys* is here considered as a junior synonym of *Vinctifer*. *Belonostomus* is known from the Early Cretaceous (Albian) Apon Formation of Venezuela, from the ?Cenomanian of Morocco, and from the Cenomanian–Santonian La Luna Formation, Venezuela, the Upper Cretaceous Coli Toro Formation, Argentina, and the Campanian–Maastrichthian Quiriquina Formation in Chile. Occurrences of *Belonostomus* in the Albian of Venezuela, ?Cenomanian of Morocco, and the mid-Cretaceous of Mexico are interpreted as a distribution along shallow coastal waters of the Tethys. The presence of *Belonostomus* in northeastern Brazil, during the Early Cretaceous (Aptian–Albian), is explained by the epicontinental sea extending further onto the South American continent. The presence of *Belonostomus* (cf. *B. longirostris*) in the Late Cretaceous of Venezuela, Chile and Argentina is evidence for a marine connection along the Pacific marginal platform, between North and South America.

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INTERCONTINENTAL CONNECTIONS DURING THE CRETACEOUS AND TERTIARY

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The distribution of the Lower Cretaceous (Aptian–Albian) South American fish fauna presents a major component with a Tethys Sea origin. This fauna, widely distributed in the northern part of South America (Venezuela, Colombia, and Brazil), is also found in Mexico and Morocco and represents a shallow marginal platform fauna that dispersed southward from the shallow waters of the Caribbean Tethys onto the South American continent. The Upper Cretaceous marine fauna clearly shows two separate biotas which were associated to the proto-South Atlantic and the Pacific oceans. The composition of the first one, found in the Brazilian coastal basins and in North Africa during the Cenomanian–Turonian can be explained by the formation of the Trans-Saharan seaway, which established a marine connection between the Tethys and the South Atlantic across the northern part of Africa; the second one, represented in the Late Cretaceous of Venezuela, Chile, and Argentina is proposed as an evidence for a connection along the Pacific marginal platform, between North and South America. There is still, in the Upper Cretaceous, a freshwater fauna component that represents the origin of the Neotropical fauna. The relative importance of this fauna is increased, especially during the Tertiary, by a number of marine taxa that colonize fresh waters over more than one continent.

PRELIMINARY TAPHONOMIC ANALYSIS OF MIDDLE MIOCENE FOSSIL FISHES FROM THE ANTA FORMATION (QUEBRADA DE LA YESERA, SALTA PROVINCE, ARGENTINA)

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The fossil fishes from Quebrada de la Yesera come from the basal beds of the Anta Formation (Metán Subgroup of the Orán Group) cropping out along the right bank of the Río Las Conchas, located 25 km NW of Cafayate (26°00′S–65°43′W), Salta Province. At this locality, the Anta Formation begins with a basal transgressive bed of well-sorted conglomerates overlain by a sequence of lacustrine cycles of siltstones and sandstones with a facial arrangement indiating a shallowing cycle. The fish remains occur at the base of the Anta For-

mation, in silty mudstone levels. In the present contribution 96 specimens were examined, all of them preserved in a flattened condition concordant with the bedding surface. The most common taxa in the assemblage are clupeids and cichlids (60% and 29% of specimens respectively), and to a lesser extent cynodontids, characids, cyprinodontiforms and sciaenids. In general, the remains of fossil fish are very well preserved. About 50% of these are complete skeletons and 41% are body fragments. Most specimens have articulated skeletons and some of them have slightly displaced skull bones or ribs; only 11% are disarticulated or dispersed. Scales are very well preserved; they are usually *in situ* and in some cases detached either from the abdominal or the caudal region. In most complete specimens the vertebral spine is straight (60%), but slightly arched (27%) or broken vertebral spines (11%) are common; only one specimen has a combination of the last two. Articulated skeletons with *in situ* scales and fin rays indicate an early interruption of the post mortem decay processes. Fishes with detached scales and bones in proximity to the rest of the skeleton indicates that partially disarticulated skeletons reached the bottom as complete bodies after death and the disintegration processes occurred at the place of burial. Detached bones and scales close to the skull or abdominal region are characteristic of decay processes caused by microorganisms, but this could be also be caused by scavengers. Arched axial skeletons are caused by natural post-mortem contraction of muscles, while splitting of the vertebral spine could be a natural consequence of *post-mortem* bending or caused by impact of the carcass against the substrate. Fish remains from the Anta Formation are predominantly complete skeletons or body fragments with articulated bones with *in situ* scales and fin rays well preserved. This is the most common pattern of preservation, present in almost 65% of specimens of the assemblage; it agrees with the pattern expected for an undisturbed and quiet lacustrine environment.

PRESENCIA DEL GÉNERO *XIPHACTINUS* LEIDY, 1870 (TELEOSTEI: ICHTHYODECTIFORMES) EN LA FORMACION LA LUNA, CRETÁCICO SUPERIOR DE LOS ANDES DE TRUJILLO, VENEZUELA OCCIDENTAL

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El género *Xiphactinus* Leidy, 1870, está incluido dentro del orden de los Ichthyodectiformes, un grupo extinto y basal de primitivos peces teleósteos, que aparecieron en el Jurasico Medio, momento en el cual comenzó su diversificación, hasta alcanzar un gran desarrollo en el Cretácico Tardío (Bardack y Sprinkle, 1969; Patterson y Rosen, 1977). El género *Xiphactinus* se corresponde a un grupo peces muy activos, de hábitos predadores, con tamaños que oscilaban entre los cuatro y seis metros de longitud; los mismos habitaron los mares del Cretácico Tardío, y su registro fósil era solo conocido en sedimentos marinos de Asia, Australia, Europa y Norteamérica (Bardack, 1965; Schwimmer *et al.*, 1997). En la presente contribución, se da a conocer el registro del género *Xiphactinus* en rocas del Cretácico Superior de Venezuela, provenientes de la Formación la Luna (Cenomaniano-Campaniano), específicamente del Miembro la Aguada (Cenomaniano) en los Andes de Trujillo. El material referenciado proviene de una cantera de rocas calcáreas para la fabricación de cemento, y los restos pertenecen a un solo ejemplar de *Xiphactinus*, correspondiéndose a elementos craneales y postcraneales articulados, referidos a premaxilares, dentarios y vertebras abdominales. El espécimen fue extraído y preparado a partir de un fragmento de caliza de alta dureza, y en la actualidad el material se encuentra depositado en la Colección de Paleontología del Museo Tulene Bertoni, de la Ciudad de Valera, Venezuela. Características morfológicas del ejemplar, tales como la presencia de una sola hilera de dientes en el dentario, premaxilar y maxilar, con una sección dentada recta en este último, al igual que el tamaño, número y la forma hipertrofiada de algunos dientes, permiten incluirlo en el grupo de los *Xiphactinus*, ya que estos caracteres son diagnósticos del género. La presencia *Xiphactinus* en el Cretácico superior de Venezuela incrementa el conocimiento sobre la paleoictiofauna de esta región (Aguilera, 2010), constituyendo el primer registro para el Mesozoico de América del Sur, lo que amplía la distribución paleobiogeográfica del género a nivel mundial.

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CRANIAL OSTEOLOGY OF CHONDROSTEAN FISHES FROM THE LA CANTERA FORMATION, UPPER APTIAN, SAN LUIS, ARGENTINA

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The La Cantera Formation is a lacustrine lithostratigraphic unit belonging to the El Gigante Group. These rocks contain a rich Early Cretaceous (Late Aptian) fossil fauna. Among the fishes, primitive actinopterygians appear to be dominant. Actinopterygians are represented by chondrosteans and neopterygians. The chondrosteans were originally described as *Coccolepis* Agassiz, a palaeonisciform included in the Family Coccolepidae (Spinuzza, 1986). More recently, it was suggested that these fishes may belong to non-Acipenseriformes rather than to *Coccolepis* (López-Arbarello *et al.*, 2002). Revision of new fossil specimens and osteological comparisons support an assignment to the series Chondrostei (Müller, 1844; Grande and Bemis,

1996). Anatomical characters supporting such an assigment are: fusion of maxilla, premaxilla and dermopalatines; anterior symphysis of palatoquadrate; supraoccipital bone absent; inclined, bar-shaped preopercle; interopercle absent; maxilla with postorbital expansion; wide contact of maxilla with preopercle and unable of movement by itself. Postcranial characters are: absence of ossification of vertebral centra, heterocercal caudal fin; caudal endoskeleton with undifferentiated hypurals; and lack of scales. The specimens studied can be separated into at least two groups showing very remarkable differences in the arrangement and size of teeth. Because of the low occurrence of these forms in Gondwana and especially in inland freshwater environments and their sparse distribution during the Cretaceous, these chondrosteans could represent new taxa as they cannot be presently included in any currently known taxa. It is expected that further detailed studies including postcranial elements will provide a more accurate placement within this large and complex group of fishes.

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NEOGENE MARINE AND CONTINENTAL ICHTHYOFAUNA IN SOUTHERN SOUTH AMERICA: EVOLUTION, BIOGEOGRAPHY, EXTINCTIONS AND PSEUDOEXTINCTIONS

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Two biogeographic units are generally recognized in the present shelf area of Argentina: the Magellanic and Argentine provinces. The two provinces differ in their fossil record. The evolution of these provinces during the Neogene was characterized by migrations, extinctions, pseudoextinctions, and perhaps even speciation events. Marine vertebrate assemblages with similarities to the Argentine fauna were already present in the Miocene, whereas no associations similar to those of the Magellanic fauna have been found in South America before the Pleistocene. Two major successive marine transgressions flooded Patagonia during the Miocene: the "Patagoniense" (early Miocene) and the "Entrerriense" (middle to late Miocene). We analyze three rich fossil assemblages formed during these transgressions. The absence of Magellanic Miocene vertebrate assemblages is consistent with the hypothesis of a more southern distribution of the cold temperate fauna at that time. In Patagonia, as in other regions, an increased number of living groups appeared from the early to late Miocene. The late Miocene aquatic mammals had a modern aspect, and some of the fish species are still living in the South Atlantic Ocean. In this contribution we stress that warm temperate fishes and a high diversity of penguins are found together at the base of the Gaiman Formation. We hypothesize that penguins were adapted to live in warmer waters than those of the latest Cenozoic and the Recent. Finally, we recall that many taxa became extirpated because of the global temperature drops of the late Cenozoic. However, some fishes which were extirpated only from the Atlantic Ocean are discussed here. The Neotropical Region is the area with the highest species richness of continental fish in the world. The region was divided into two major ichtyogeographic units by some authors: the Austral and Brazilian subregions. Most of the diversity is concentrated in the Brazilian Subregion. The Austral subregion is one of the areas with the lowest species richness. The region was greatly affected by the Andean tectonism, the dramatic climatic changes of the latest Cenozoic, and the widespread marine trangressions. However, allowing for some exceptions, the major Brazilian and Austral subregions have a deep temporal identity. The Austral ichthyofauna appears more closely related to West Gondwanan faunas (*e.g.*, Australia and New Zealand) and the Brazilian ichthyofauna to African faunas. Extinctions and pseudoextintions occurred in the area as well as changes in the communities.

AN OVERVIEW OF HYOBODONTIFORMES FROM BRAZIL WITH A DESCRIPTION OF TWO NEW TAXA

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Hybodontiforms sharks have an almost worldwide distribution, and were common and diverse during the Mesozoic, ranging through Europe, North America, and Asia. Enigmatically, hybodontiforms appear scarce in South American during this time. In Brazil, three nominal species of Hybodontiformes have been described, *i.e.*, *Hybodus florencei* Moraes Rego, 1936, from the Permian of the Corumbataí Formation, Paraná Basin; *Acrodus nitidus* Woodward, 1888, from the Lower Cretaceous of the Ilhas Formation (Bahia Group), Recôncavo Basin; *Tribodus limae* Brito and Ferreira, 1989 from the Lower Cretaceous of the Santana Formation, Araripe Basin. Recently, two families of Hybodontiformes (*e.g.*, Hybodontidae Owen, 1846, and Lonchidiidae Herman, 1977) were recorded from the pre-rift/rift lacustrine Missão Velha Formation in the Araripe Basin. The new material consists in disarticulated remains, such as oral teeth, cephalic spines, dorsal fin spines and dermal denticles and will be here presented for the first time.

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CO-OCCURRENCE OF CHONDRICHTHYAN ORDERS IN PALEOZOIC WESTERN GONDWANA

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Currently, the South American Paleozoic chondrichthyan orders include Petalodontiformes, Eugeneodontiformes, Orodontiformes, Symmoriiformes, Ctenacanthiformes, Xenacanthiformes, Hybodontiformes, and Bradyodonti. The uncertain Anachronistidae is here treated at the same level of the other taxa for simplification. They occur in Brazil, Bolivia, Argentina and Chile in deposits of deltaic, marine and freshwater environments. The aim of the present work was to assess the similarity of the chondrichthyan faunas in Paleozoic geological formations of Western Gondwana (South America). The occurrence of chondrichthyan orders in these formations was analyzed by means of Hierarchical Agglomerative Clustering Analysis (HAC). The *Jaccard* similarity coefficient and the *Unweigthed pair-group average* (UPGA) were used as an agglomerative method for the construction of dendrograms showing the co-occurrence of chondrichthyan groups in the different geological formations. It was possible to verify that the Terezina and Irati formations present a 67% similarity, and they cluster with Pedra de Fogo Formation at 63% similarity. These three formations cluster with the Rio do Rasto Formation at around 43% and with the Itaituba Formation at 33% similarity. Another cluster observed includes the Pimenteiras, Rio Bonito and Manacapuru formations, but the similarity coefficient is only 21%. The scantiness of the fossil record in the other geological formations is revealed in the analysis by the isolated clusters at lower similarity indexes. The assessment of the co-occurrence of Chondrichthyes in the sedimentary basins studied showed that the Paraná and Parnaíba basins are the most similar with a similarity index of 57%, and these are grouped with the Amazonas basin at 35% similarity. This cluster shows a higher similarity with the Copacabana Formation in Bolivia than with the El Jarillal Formation (Argentina) and the Cerro 1584 Formation (Chile). The occurrence of at least two species in both Pedra de Fogo and Irati formations corroborates a chondrichthyan-based bioestratigraphic correlation between these strata. These records suggest that the connection between the Paraná and Parnaíba basins, as broadly suggested in the literature, may have continued also during the Permian.

SELECTED CLUPEOMORPHS FROM NORTHEASTERN BRAZIL AND THE INTERRELATIONSHIPS OF ELLIMMICHTHYIFORMES

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The Brazilian Cretaceous is very rich in deposits containing vertebrate remains, particularly of clupeomorph fishes. Some taxa, however, have been omitted, excluded, or used with controversial anatomical interpretations in most recent cladistic analyses (*e.g.*, Chang and Maisey, 2003; Zaragueta-Bagils, 2004; Alvarado-Ortega *et al*., 2008). This is the case of *Scutatuspinosus itapagipensis* Santos and Correa, 1985, *Codoichthys carnavalii* Santos, 1994, and *Ellimma cruzi* Santos, 1990. Thus, after reviewing the osteology of those taxa a parsimony analysis was performed with PAUP v4. b10, considering 50 unordered and unweighted osteological characters from selected 15 ellimmichthyiform-like taxa (*i.e.*, *Codoichthys carnavalii*, *Scutatuspinosus itapagipensis*, *Ellimma cruzi*, *Diplomystus dentatus* Cope, 1877, *D. shengliensis* Zhang, Zhou and Qing, 1985, *Ellimma branneri* (Jordan, 1910), *Ellimmichthys longicostatus* (Cope, 1886), *Ellimmichthys goodi* (Eastman, 1912), *Armigatus brevissimus* (Blainville, 1818), *Armigatus namourensis* Forey, Yi, Patterson and Davies, 2003, *Triplomystus noorae* Forey, Yi, Patterson and Davies, 2003, *Triplomystus applegatei* Ortega and Damián, 2008, *Paraclupea chetungensis* Sun, 1956, *Rhombichthys intocabilis* Khallouffi, Zaragueta-Bagils and Lelievere, 2010, and *Tycheroichthys dunveganensis* Hay, Cumbaa, Murray and Plint, 2007. *Elops saurus* L., 1766 and two basal clupeiforms (*i.e.*, *Pseudoellimma gallae* Figueiredo, 2009 and *Santanaclupea silvasantosi* Maisey, 1993) were used to polarize characters. The analysis yielded eight trees with 128 steps, a consistency index (CI) of 0.515 and retention index (RI) of 0.613. After obtaining a majority consensus and applying bootstrap, we noted values indicating to support Ellimmichthyiformes (96), Paraclupeidae (71), *Armigatus* (80), *Ellimmichthys* (85) clades. According to our results *Codoichthys carnavalii* belongs to Ellimmichthyiformes and seems to be related to

the *Armigatus* clade. *Ellimma cruzi* appears not closely related to *Ellimma brannei,* but close to *Rhombichthys intocabilis* suggesting generic replacement. The obtained consensus tree shows *S. spinosus* as the most basal Paraclupeidae and that this family includes *Ellimmichthys longicostatus*, *Ellimmichthys goodi, Tycheroichthys dunveganensis Triplomystus noorae*, *Ellimma branneri Paraclupea chetungensis*, *Ellimma cruzi, Triplomystus applegatei*, and *Rhombichthys intoccabilis*.

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PHYLOGENETIC RELATIONSHIPS OF THE ELOPOMORPH FISH *PARAELOPS CEARENSIS* SILVA SANTOS, 1971, REVISITED: EVIDENCES FROM NEW SPECIMENS

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The phylogenetic relationships of *Paraelops cearensis* Silva Santos, 1971, an elopomorph fish from the Lower Cretaceous of the Santana Formation (Araripe Basin) were reviewed based on new complete and informative specimens. New data on neurocranium, hyobranchial apparatus, and caudal fin endoskeleton were provided. A cladistic analysis was conducted based on the data matrix of Forey and Maisey (2010), which was slightly modified to include the Cretaceous and Paleocene taxa *P. cearensis* Silva Santos, 1971, *Farinichthys gigas* Gallo and Figueiredo, 2002 (Paleocene of Northeastern Brazil), and *Bullichthys santanensis* Mayrinck, Brito and Otero, 2010 (Albian of Northeastern Brazil). The new matrix, with 27 taxa and 74 characters, was used for reassessment of elopomorph relationships. The analysis produced 12 equally parsimonious trees (L = 181 steps; CI = 0.4475; RI = 0.6656, in which the strict consensus was applied. As a result, Elopomorpha appears as a clade supported by a single synapomorphy (posterior opening of mandibular sensory canal lying medially or posterior). Albuloidei (= albulids of Forey and Maisey, 2010) is diagnosed by the presence of a metapterygoid cup/fenestra. *Paraelops* appears as the basal taxon of the Elopoidei clade, which also includes *Elops* Linnaeus, *Ichthyemidion* Poyato-Ariza, 1995, and *Megalops* Valenciennes, 1847, in an unresolved trichotomy. This clade is supported by two synapomorphies: presence of elongate jaws with numerous villiform teeth and, by optimisation, first ossified pleural rib occurring on fourth or more posterior centrum.

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RELATIONSHIPS BETWEEN THE PALEOICHTHYOFAUNAS FROM BRAZIL AND AFRICA DURING THE CRETACEOUS

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The origin of the sedimentary basins from the Eastern Brazilian and the Western African margins is related to the breakup of Western Gondwana from the Late Jurassic to the Early Cretaceous, which ended with the opening of the South Atlantic Ocean (SAO). The traditional hypothesis states that the opening spread from South to North, being Pelotas (Brazil) and Walvis (Africa) the first basins to be formed. In contrast, Souza-Lima (2006) proposed that the formation of the proto-SAO occurred from the Late Jurassic, firstly in Northeastern (NE) Brazil and Africa and later opening to the North and South. Long-term sea-level fluctuations (from the Jurassic to the Cretaceous) indicate that both continents were occupied by marine environments since Early Mesozoic. The marine transgressions also contributed to the connections between SAO and Tethys Sea across the North Africa during the Cretaceous. The Cretaceous marine paleoichthyofauna from the Brazilian coastal basins is abundant and diversified. The record of the marine enchodontids in the Late Barremian of NE Brazil sustains the Souza-Lima (2006) hypothesis. In Africa, Taverne (1976) described the clupeoid *Nolfia kwangoensis* in the Cenomanian of the Congo Basin, which can be correlated with *N. riachuelensis* Figueiredo, 2009 from the Aptian of the Sergipe-Alagoas Basin. The dercetid *Cyranichthys ornatissimus* (Taverne, 1987), also from the Congo Basin, was correlated with *Brazilodercetis longirostris* Figueiredo and Gallo, 2006 from

the Turonian of the Pelotas Basin. Jebel Tselfat is a remarkable Cenomanian marine fossiliferous locality in Morocco, including groups with transatlantic correlation, such as dercetids and enchodontids, both occurring in Pelotas and Sergipe-Alagoas basins. Also, in Jebel Tselfat, occurs the otophysans *Clupavus maroccanus* Arambourg, 1968, whose equivalent in NE Brazil is *C. brasiliensis* Silva Santos, 1985.In order to accomplish a biogeographical reconstruction of the Cretaceous using methods of Historical Biogeography, Gallo *et al.* (2007) analyzed the worldwide distribution patterns of Turonian marine biotas in Southern and Northern Brazil, Northwestern Africa, Europe, and North America, using a panbiogeographical approach. The generalized tracks showed two separate biotas associated with the proto-South Atlantic and the proto-North Atlantic oceans. Following the same point of view, Silva and Gallo (2007) accomplished a PAE to analyze the distribution of Enchodontoidei occurring strictly in the Cenomanian of Brazil, Africa, Asia, Europe, and North America. Two areas of endemism were delimited: Morocco + Southern Italy, representing the North African region of the Tethys Ocean; and Lebanon + Israel, the mid-Tethyan Ocean.

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GANOID SCALES OF "PHOLIDOPHORIFORMS" (ACTINOPTERYGII) FROM THE LA CANTERA FORMATION, LOWER CRETACEOUS, SAN LUIS, ARGENTINA

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The fish fauna from La Cantera Formation (Late Aptian of San Luis, Argentina), is represented by an assembly of chondrosteans and neopterygian fishes. Both groups have been poorly studied and consequently are in need of detailed examination. The neopterygians were previously assigned to the pholidophoriforms based mainly on their small size and the presence of scales and bones covered with ganoine. However, these characters are highly homoplasic among actinopterygians. Additionally, the so-called order Pholidophoriformes Berg is not a monophyletic group (Arratia, 2000) and is currently under revision by G. Arratia; consequently, it is cited here as "Pholidophoriformes". As it has been demostrated, scales of fishes –either their arrangement and/or morphology– can provide valid taxonomic and phylogenetic information for different taxa. The main goal of the present work is to study the scales of the "pholidophoriforms" from the La Cantera Formation, as a potential tool to help clarifying their taxonomic assignement and possible relationships. For this purpose the macro- and micromorphology of the scales of one of the "pholidophoriform" groups (*e.g.*, MHIN-UNSL-GEO-V523 and fragmentary specimens) of the La Cantera Formation have been studied. The studied fishes have rhombic ganoid scales arranged in about eight rows along the flank. The scales decrease in size but the number of rows increases caudally. Additionally, a serie of modified scales or scutes or ridge scales is present along the dorsal margin of the body. Scales from the dorso-lateral flank region have smooth posterior margins and smooth surfaces with a few irregularly placed tubercle-like elements observed under scanning electronic microscope. Their histological structure was investigated under petrographic microscope, showing lepisosteid-type scales in wich multiple ganoin layers directly overlie the surface of the bony basal plate (Schultze 1966; 1996; Siré *et al.*, 2009). Furthermore, the scales present all the lepisosteid features (Schultze, 1966) as for instance, canaliculi of Williamson, osteocytes, Sharpey's fibers and simple channels. The lepisosteid-type scales are found in a wide variety of actinopterygians including among others "pholidophoriforms", aspidorhynchiforms (*Belonostomus* Agassiz), halecomorphs (*e.g.*, *Caturus* Agassiz, *Furo* Gistl), macrosemiiforms (*e.g.*, *Macrosemius* Agassiz, *Propterus* Agassiz), semionotiforms (*e.g., Lepidotes* Agassiz) studied by Schultze (1966) and other authors. The external morphology of the scales of La Cantera neopterygians is characterized by flat, smooth surfaces and posterior margins and a microstructure that is common to a broad variety of actinopterygians that seems to be unsuitable as taxonomic tools; however, the presence of a dorsal process in the scutes placed between the cranium and the dorsal fin suggest the presence of a semionotiform.

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UNEXPECTED APPEARANCE OF ADVANCED NEOTELEOSTS IN THE CRETACEOUS AND THE CONTROVERSY BETWEEN FOSSIL RECORD AND MOLECULAR CLOCK

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The occurrence of advanced percomorphs (Cottiformes, Agonidae) in the Albanian/Cenomanian of Mexico places the appearance of higher euteleosts –or neoteleosts– between the Late Jurassic and the end of the Early Cretaceous. This is evidence of an accelerated diversification of advanced teleosts in the Early Cretaceous. The first "true" teleosts (*e.g.*, *Leptolepis coryphaenoides* (Bronn, 1830)) with cycloid scales, two hypohyals, ossified autocentral vertebrae, etc. occur in the Early Jurassic. Even though there is a dense fossil record, no "true" teleost has been found in deposits earlier than the Lower Jurassic. The accepted basal teleosts, *Pholidophorus latiusculus* Agassiz, 1832 and *Ph. bechei* Agassiz, 1844 (occurring in the Late Triassic and Early Jurassic, respectively) have rhombic scales, surangular bone, no ossified vertebrae, etc., and look like other sister groups of "true" teleosts. Independently whether these *Pholidophorus* Agassiz, 1832, are basal teleosts or not, this contradicts molecular clock data that postulate that teleosts go back to the Paleozoic, and teleosts such as the ostariophysans go back to the Permian. In the Middle-early Late Jurassic, teleost taxa (Crossognathiformes, Ichthyodectiformes, and others) restricted only to the Jurassic and/or Cretaceous appear. Only during the Late Jurassic do modern teleosts or basal crown-group teleosts such as elopiforms, ostariophysans and protacanthopterygians enter the fossil record. Consequently, it should be expected that other basal crown-group teleosts such as osteoglossomorphs and clupeomorphs will be found in Upper Jurassic deposits based on their relationships to elopomorphs and ostariophysans. The stepwise occurrence of higher teleostean taxa indicates a discontinued kind of evolution with an accelerated speciation process from early teleosts in the Early Jurassic to fossil higher taxa in the Middle Jurassic, to basal crown-group teleosts in the Late Jurassic and to neoteleosts in the late Early Cretaceous. The two last appearances of high numbers of higher taxa are connected with the two modern highest radiations within teleosts (in cypriniforms among ostariophysans and perciforms among neoteleosts). In contrast to molecular analyses, the appearance of higher teleostean lineages from the most basal taxa to most advanced modern taxa is constrained to a time span of 100 million years.

ON THE OUTSTANDING FISH FAUNAS OF THE MUHI QUARRY (ALBIAN-CENOMANIAN) OF MEXICO

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The Muhi quarry of Hidalgo is a Late Cretaceous locality discovered twelve years ago in central Mexico. The outcrop belongs to the El Doctor Formation of Albian–Cenomanian age, representing an open sea shelf to deep shelf margin environment (Bravo-Cuevas *et al.*, 2009), fromo which numerous invertebrates and fishes have been collected. Because the outcro has been so recently discovered, the real diversity it contains remains uncertain, even though new specimens are collected every year. Invertebrates include an enormous number of planktonic crinoids and echinoderm spines, and scarce ammonites and crustaceans. Fishes are represented by a few sharks (*Squalicorax* sp. and *Ptychodus* sp.), rays, and a large diversity of actinopterygians [lepisosteiforms, aspidorhynchiforms, tselfatiiforms, crossognathiforms, (pachyrhizodontids), ichthyodectiforms, elopiforms, clupeiforms, basal euteleosts, aulopiforms (ichthyotringids, dercetids, halecids, enchodontids), acanthomorphs, cottiforms (agonids) and tetraodontiforms], most of them not described yet. According to the paleogeographical position of the quarry, the fauna lived at a latitude of about 24°N, which does not correspond to any of the Gondwanan continents; however, , the Muhi quarry fish fauna shows closer affinities with those of Africa (Morocco and Lebanon) than to northern faunas. After break-up of Gondwanan and the aperture of the Atlantic Ocean during the Early Jurassic, the Gulf of Mexico and the Proto-Caribbean marine seaway permitted the diversification of marine life along the extended platforms and epicontinental seas of Mexico. This can be observed in the more than 20 different fish taxa of the Muhi quarry, most of them new to science, suggesting a particular differentiation process of the fauna in this part of Mexico. During the Albian and Cenomanian the epicontinental seas reached their maximum flooding, almost covering all of the country, and only a few islands were exposed in the southern portion. Diverse paleoenvironmental conditions are observed in the Muhi deposit, which are also stated by the mixing of taxa coming from different environments. Moreover the fish assemblage is composed by adults and juvenile specimens of various taxa, which furthermore suggest that at least some species lived near the site of deposition that may correspond to a nursery. The main importance of this Cretaceous quarry lies in the fact that most of the taxa represent new species. Some groups such as ichthyotringids and agonids appear to have had a worldwide distribution**.** The presence of agonids also suggests an earlier occurrence of advanced teleost groups during the Early–Late Cretaceous (González-Rodríguez and Schultze, 2010).

Bravo-Cuevas, V. M., González-Rodríguez, K., Esquivel-Macías, C., and Fielitz, C. 2009. Advances on Stratigraphy and Paleontology of the Muhi Quarry from the Mid-Cretaceous (Albian-Cenomanian) of Hidalgo, Central México. *Boletín de la Sociedad Geológica Mexicana* 61: 155–165.

González-Rodríguez, K., and Schultze, H.-P. 2010. A fossil agonid (Actinopterygii, Teleostei Percomorphacea) from the Albian-Cenomanian of Mexico. In: K. González-Rodríguez and G. Arratia, (Comps.), *Fifth International Meeting on Mesozoic Fishes. Global Diversity and Evolution*. Museo del Desierto, Saltillo, Coahuila, México. Abstract Book and Field Guides, p. 50.

"PHOLIDOPHORUS" ARGENTINUS DOLGOPOL DE SAEZ ,1939, AN ASPIDORHYNCHIDAE (ACTINOPTERYGII, ASPIDORHYNCHIFORMES) FROM THE VACA MUERTA FORMATION (UPPER JURASSIC) OF NEUQUÉN PROVINCE, ARGENTINA

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The order Pholidophoriformes Berg, 1940, was erected on the basis of several characters that are considered primitive or incorrect today. Consequently, "pholidophoriforms" are not considered monophyletic. The "pholidophoriforms" included numerous genera and species around the world that range in age from the Triassic to Cretaceous. The genus *Pholidophorus* Agassiz, 1832, was created to include two species from the Triassic of Seefeld in Austria. Characters used to define the genus included caudal fin with nearly equal lobes, large rhomboid scales, general body shape, vertebral patterns, etc. what caused that the genus became a "catch all" diagnosed by plesiomorphic or invalid traits. Recently, Arratia (2000) studied the phylogenetic relationships of certain specimens previously assigned to Pholidophoriformes and the definition of the genus *Pholidophorus*. In this study, she analyzed, among other characters, the structure of the scales of several Late Jurassic specimens from Germany. The author found some important differences in the type, ornamentation, and structure of the scales. Several putative "Pholidoforiformes" were reported from Argentina: **"***?Pholidophorus" dentatus* Rusconi, 1946, and *"Pholidophorus" vallejensis* Rusconi, 1947, from the Triassic continental deposits of the Potrerillos Formation in Mendoza Province; *Pholidophorus argentinus* Dolgopol de Saez, 1939, from the Jurassic marine deposits of the Vaca Muerta Formation in Neuquén Province, and several "pholidophorids" indet. from the Cretaceous continental deposits of the La Cantera Formation in San Luis Province. The diverse Jurassic marine fish fauna from Argentina is currently under study by the first author. As part of this study the holotype of *"Pholidophorus argentinus"* (housed in the La Plata Museum; MLP 39-VI-30-4) is redescribed. It consists of a caudal skeleton and posterior portion of the body preserved mainly as an impression. The study is based on the type material and a cast of this specimen. The distal part of the caudal rays are lost, some of them are not very well preserved, and many are broken and disarticulated. Dolgopol de Saez assigned this specimen to the genus *Pholidophorus* based on a combination of characters that were posteriorly revised by one of us (AC) concluding that this specimen does not present any diagnostic character to be recognized as different species or even to allow an assignment to the genus *Pholidophorus,* assigning it instead to Halecomorphi indet. Our results reveal that the combination of structures such as number of basal fulcra, number of principal and precurrent [= procurrent] caudal rays, patterns of ramification of rays, form and type of scales among others) clearly resemble those of aspidorhynchiforms and consequently we interpret this specimen as an aspidorhynchiform.

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Dolgopol de Saez, M. 1939. Noticias sobre peces fósiles argentinos. *Notas del Museo de La Plata* 2: 423-432.

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MARINE FISHES FROM THE EL MINISTERIO QUARRY, LOS CATUTOS MEMBER (UPPER JURASSIC, VACA MUERTA FORMATION), NEUQUEN BASIN, ARGENTINA. A PRELIMINARY TAPHONOMIC APPROACH

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Los Catutos Member is a stratigraphic set composed by lithographic limestones interbedded with marls (rhythmites). At El Ministerio quarry (type locality of the Los Catutos Member) the deposits reach a maximum thickness of 70 m. They were deposited in an open and shallow sea (*c.* 30-50 m depth) during the middle to late Tithonian, and were assigned to a transitional-outer ramp. El Ministerio quarry is located near Zapala, Neuquén Province. It carries a rich fossil concentration in which, among the vertebrates, fishes are predominant. Marine reptiles are also found. Among macroinvertebrates, ammonoids are the most common taxa (five ammonites zones were recognized), among microinvertebrates, the planktonic ones (radiolarians and foraminifers) are predominant. Benthic organisms (*e.g.* echinoderms, ostracods, gastropods) are scarce. Diffuse bioturbation is present in some banks. Water conditions were inferred as warm-temperate, and the micritic/clastic input rate was high. The distance to the shoreline was 100 km, without evidence of reef development. In the present contribution, we analyze 61 specimens from the lithographic limestones of El Ministerio quarry. We found that pachycormiforms are predominant (43% of specimens), followed by semionotiforms (13%), and aspidorhynchids (13%). Only 10% are represented by halecomorphs (caturid-like), teleost-like and "pholidophorid"-like, and

the remaining 21% are indeterminate actinopterygians. About 67% of specimens correspond to body fragments, 25% to complete skeletons, and 8% to isolate bones. Fishes are found articulated (39%), partly disarticulated (36%), disarticulated but associated (23%) and rarely scattered but associated (2%). Among partly disarticulated specimens, 27% have disarticulated skull bones, 9% have disarticulated bones and scales in the abdominal region and 14% a combination of both. About 62% of the fishes have scales preserved; most of them (58%) show *in situ* scales. Most of the fishes lie with their symmetry plane parallel to the bedding plane (64%). In those fishes with preserved vertebral spine, deformation of the axial skeleton is variable (straight, 53%; arched, 27%; S-shaped, 7%; broken, 7%). Almost 47% of specimens show articulated fins (mainly caudal and pectorals). No signs of scavenging were observed. Interpretation of the data set reveals that the specimens with articulated or partly articulated skeletons, with preserved fins and scales (mostly *in situ*), suggest a short to very short time of residence on the substrate, and a lack of bottom currents and early cessation of decay. Detached bones or scales near the skull or even the thoroughly disarticulated abdominal region are considered to be caused by bacterial decay. This involves the carcasses remaining longer on the seafloor uncovered by sediments than did the articulated ones. Besides, only few specimens experienced flotation and subsequent disarticulation (*e.g.,* detached skulls with the symmetry plane perpendicular to the bedding plane, dispersed bones). Most fishes have no signs of post-mortem deformation of the vertebral spine; few specimens present arched skeletons due to a natural post-mortem condition. In sum, taphonomic features of the fossil assemblage indicate that the fishes were deposited in a quiet disaerobic bottom in absence of scavengers, in which rapid burial and early interruption of decay processes allowed the good preservation of fossils. We infer that they were possibly coeval and that the association is autochthonous.

THE FOSSIL DIPNOAN FAUNAS OF SOUTH AMERICA, AUSTRALIA AND AFRICA: COMPARISONS AND CONTRASTS

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Lungfish, once world wide in distribution in marine waters of the Devonian are now confined to three continents of the Southern Hemisphere, Australia, Africa and South America. Despite gaps in the fossil record, and the disparate histories of these three continents since separation in the late Triassic, the story of the three genera of living lungfish, *Protopterus* (Owen, 1839) in Africa, *Lepidosiren* (Fitzinger, 1837) in South America, and *Neoceratodus* (de Castelnau, 1876) in Australia can be traced without difficulty. Derived from the three major groups of lungfish in the late Permian, *Ctenodus* (Agassiz, 1838), *Sagenodus* (Owen, 1867) and *Gnathorhiza* (Cope, 1883), the story of lungfish in the Southern Hemisphere is to a certain extent the story of the continents and the way that deserts formed. Lungfish classified mainly in *Ceratodus* (Agassiz, 1838), *Asiatoceratodus* (Vorobyeva, 1967) and *Ptychoceratodus* (Jaekel, 1926) were once common in Triassic and Cretaceous deposits of northern Africa, now the Sahara desert (Tabaste 1968), and *Protopterus*, appearing in the Cretaceous of northern Africa, and rare at that time (Schultze, 1992), survived to inhabit rivers and lakes across the middle of the continent, where it is both common and competitive. South America has a range of early Mesozoic lungfish, including *Ceratodus*, *Asiatoceratodus* and *Ptychoceratodus*, and some found only in South America (Soto and Perea, 2010), with *Lepidosiren*, first appearing in the Tertiary and the only surviving lungfish on this continent (Schultze, 1992), making the most of the large river systems and extensive wetlands that have survived in South America. As in the land masses that eventually formed Africa and South America, *Ceratodus*, *Asiatoceratodus* and *Ptychoceratodus* were found in Australia in the Triassic (Kemp, 1998), and many of these species lived in parts of Australia that are now deserts. Records of lungfish are well known in this continent, and *Neoceratodus* and closely related genera radiated into eastern Australia while the climate was suitable (Kemp, 1997). Central and Northern Australia had eleven species, and all but one died out as the continent became more arid. Despite the continued existence of large river systems such as the Murray/Darling, and northern rivers like the Gregory, both of which had lungfish in the late Tertiary, only one species of *Neoceratodus* has survived, and this is confined to rivers and lakes in the southeast corner of Queensland.

Kemp, A. 1997. A revision of Australian Mesozoic and Cenozoic lungfish of the family Neoceratodontidae (Osteichthyes: Dipnoi) with a description of four new species. *Journal of Paleontology* 71: 713-733.

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Soto, M., and Perea D 2010. Late Jurassic *lungfishes (Dipnoi) from Uruguay, with comments on the systematics of Gondwanan ceratodontiforms. Journal of Vertebrate Paleontology* 30: 1049–1058, July 2010

Tabaste, N. 1963. Study of fish remains from the Cretaceous of the Sahara. *Melanges Ichthylogique* 68: 438-481.

THE LARGEST KNOWN CHONDRICHTHYAN CEPHALIC SPINE PLATE (UPPER PERMIAN OF BRAZIL)

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Isolated shark remains have been found worldwide in both marine and continental rocks possibly dating as far back as the Late Ordovician (Young, 1997), but the oldest articulated skeleton was found in the Early Devonian (Miller *et al.*, 2003). Sharks are important as palaeoen-

vironmental proxies and provide valuable biostratigraphic data for global correlation. The chondrichthyan remains dealt here were collected from a railroad cut in the Serra do Cadeado area (Paraná, Brazil), at S 24º 00' 17" and W 51º 06' 49", along with a temnospondyl occiput and associated intercentra, in rocks of the late Permian Rio do Rasto Formation, Paraná Basin. These include a cephalic spine plate, cartilage remains, and cladodont teeth. The nearly complete, multicuspid, cephalic spine plate is 130 long and 60 mm wide. This is the largest cephalic spine plate know to date and includes a broad, ovoid base and at least 30 cusps, most of which are partially broken. The cusps are circular in section and strongly curved, presumably caudally. They are ornamented with fine, straight to slightly curved ridges, which radiate from the top of the cusps. Irregular, large pores perforate the crown-base junction. The cusps are progressively larger towards the inferred middle-caudal portion of the plate, reaching approximately 20 mm in height. The general morphology of the spine, except for its much larger size and greater number of teeth, is reminiscent of those described for the Paleozoic sharks *Onychoselache* (Coates and Gess, 2007) and *Hamiltonichthys* (Maisey, 1989), and for the Mesozoic chondrichthyan *Egertonodus* (Patterson, 1966), all of which belong to the Hybodontiform lineage. A size comparison of the new material with cephalic spines of *Hamiltonichthy*s suggests that the Brazilian shark could have reached two meters in length.

Coates, M., and Gess, R.W. 2007. A new reconstruction of Onychoselache traquiri, comments on early chondrichthyan pectoral girdles and hybodontiform phylogeny. *Palaeontology* 50(6):1421-1446.

Maisey, J. 1989. *Hamiltonichthys mapesi*, g. & sp. nov. (Chondrichthyes; Elasmobranchii), with comments on elasmobranch systematics. *American Museum Novitates* 2931:1-42.

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THE WORLD'S FIRST CLADE OF GIANT MARINE SUSPENSION-FEEDERS: A PALAEOBIOGEOGRAPHICAL REVIEW OF THE PACHYCORMIFORMES.

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Pachycormiformes have traditionally been known from the three major Western European Jurassic fish localities – the Early Jurassic Toarcian of Holzmaden (*e.g., Euthynotus* Wagner, *Pachycormus* Agassiz, *Saurostomus* Agassiz); the Middle Jurassic Callovian of eastern England and north west France (*Leedsichthys* Woodward, *Hypsocormus* Wagner); the Upper Jurassic Tithonian of Solnhofen (*e.g., Asthenocormus* Woodward, *Orthocormus* Weitzel). There was little to indicate any Cretaceous presence of these animals beyond *Protosphyraena* Leidy in the USA and England. As such, the palaeogeographic value of Pachycormiformes was, until very recently, regarded as being very low, especially for global perspectives. However, recent reassessments of specimens and new finds have led to an improved awareness of diversity and presence. From a provincial presence of limited taxa, diversities in those same three Western European sources have increased (*Ohmdenia* Hauff jr. in the Toarcian of Holzmaden, *Martillichthys* Liston in the Callovian, *Pseudoasthenocormus* Lambers in the Tithonian of Solnhofen) and previously misidentified specimens from other realms (*e.g.,* Bajocian oolite) have broadened our Jurassic understanding. This has clarified the presence of two large clades within the Pachycormiformes – colloquially referred to as 'tusked' and 'toothless' – with end-members of barracuda-like predators and whale-like suspension feeders. It has led to some Maastrichtian specimens previously identified as *Protosphyraena* ('end-member' representatives of the tusked Pachycormiformes) to be recognized as part of the edentulous tribe (*Bonnerichthys* Friedman, Shimada, Martin, Everhart, Liston, Maltese & Triebold), indicating that both of these tribes survived to the end of the Mesozoic era. Further representatives of the toothless tribe have been recognized in the Cretaceous of Western and Central Tethys: a further edentulous specimen, *Rhinconichthys* Friedman, Shimada, Martin, Everhart, Liston, Maltese & Triebold, has also been found in the Cenomanian, a potentially related taxon in the Albian of southern France, and also in the Turonian of Mexico at Vallecillo. As well as other minor Laurasian presences, *Neopachycormus* Taverne from the Cenomanian of Burma is likely to be from the tusked tribe. Gondwanan occurrences of Pachycormiformes have – as is commonly the case with other actinopterygians – been fewer in number and diversity, with nothing reported from India, Africa or Antarctica. Those so far known are of a lost specimen of *Pachycormus* from the Callovian-Oxfordian of Cerritos Bayos and the edentulous *Leedsichthys* from the Oxfordian in Antofagasta of Chile, as well as tusked representatives: the reidentified Tithonian *Notodectes argentinus* Dolgopol de Saez of the black marls of the Neuquén-Mendoza Basin Argentina, an individual from the Aptian of Colombia, and *Australopachycormus* from the Albian of western Queensland. These last few but important specimens give us the beginnings of a glimpse of the dispersal and vicariance events involved in the spread of Pachycormiformes between Laurasia and Gondwana.

PALEOICHTHYOFAUNA OF THE SOLIMÕES FORMATION, MIOCENE OF SOUTH AMERICA

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The diversity of the Neotropical ichthyofauna, mainly in the Amazon region, is amazing in number of species and in morphological variety. However, its understanding has been limited because of the fragmented knowledge of the phylogenetic relationships among the groups and by the lack of information about the diversity of the taxa. The origin of this modern ichthyofauna has been strongly associated to the

uplift of the Andes during the Cenozoic; for this reason, a better knowledge of the fossil ichthyofauna will allow us to assess the influence of these changes in the biodiversity over time, resulting in the modern ichthyofaunal composition. Fossil-fish components from the Neogene (Miocene–Pliocene, 23-2 Ma) of the Amazon region are still poorly described. Only four taxa of fossil fish have been described so far: *Lepidosiren megalos* Santos, 1987, *Acregoliath rancii* Richter, 1989, *Paleohoplias assisbrasiliensis* Bocquentin and Negri, 2003, and *Phractocephalus acreornatus* Aguilera, Bocquentin, Lundberg and Maciente, 2008. This project proposes a morphological and systematic study of the fossil fishes collected at nine sites where the Solimões Formation is exposed (Acre Basin) in the states of Acre and Amazonas, Brazil. The material is deposited in the fossil collection of the Universidade Federal do Acre (UFAC) in Rio Branco and Cruzeiro do Sul cities. The fossil material is made up of about 400 lots which include isolated fragments and elements of the cranium and post cranium, such teeth, dental plates, spines, vertebrae, scales, and otoliths, belonging to different groups: Siluriformes (Pimelodidae, Pseudopimelodidae, Doradidae, Loricariidae and Callichthyidae), Characiformes (Characidae, Serrasalmidae, Anostomidae and Erythrinidae), Osteoglossiformes (Arapaimidae), Acregoliathidae and Dipnoi (Lepidosirenidae). The study of these fossils will contribute for a better knowledge of the phylogenetic relationships and biogeography of the Amazonian ichthyofauna. The relationships of the fossils with the modern Amazonian fauna document the origin and evolution of the Neotropical ichthyofauna.

Aguilera, O.A., Bocquentin, J., Lundberg, J.G., and Maciente, A. 2008. A new cajaro catfish (Siluriformes, Pimelodidae: *Practocephalus*) from the Late Miocene of Southwestern Amazonia and its relationship to †*Phractocephalus nassi* of the Urumaco Formation. *Paläontologische Zeitschrift* 82: 231-245.

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Richter, M. 1989. Acregolithidae (Osteichthyes, Teleostei), a new family of fishes from the Cenozoic of Acre State, Brazil. *Zoologica Scripta* 18: 311-319.

Silva Santos, R. 1987. *Lepidosiren megalos* n. sp. do Terciário do Estado do Acre-Brasil. *Anais da Academia Brasileira de Ciências* 59: 375-384.

A NEW SPECIES OF *TEOICHTHYS* (ACTINOPTERYGII: HOLOSTEI: OPHIOPSIDAE) FROM THE TLAYÚA QUARRY (LOWER CRETACEOUS, ALBIAN), PUEBLA, CENTRAL MEXICO

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Teoichthys Applegate, 1988, is a neopterygian fish genus belonging in the family Ophiopsidae, which together with the family Ionoscopidae are considered to form the order Ionoscopiformes. Ophiopsids are known by four genera and thirteen nominal species. This family has a temporal range from the Triassic to the Early Cretaceous and is distributed throughout Europe, Africa, and North and South America. In Mexico, ophiopsids are known since 1988, when S. Applegate described *Teoichthys kallistos* Applegate, 1988, from the Lower Cretaceous lithographic limestones of the Tlayúa Formation. New specimens of ophiopsids from this locality were recently discovered. This new material was compared with other ophiopsids and is here presented as a new species of *Teoichthys*. *Teoichthys* sp. nov. can be promptly placed within ophiopsids by the presence of a massive lacrimal, deeper than long ganoid scales, and the lateral line extending onto the caudal fin. This new species resembles the type species *Teoichthys kallistos* by the presence of an outline predorsal elevation and a mosaic of suborbital bones, while it differs from *T. kallistos* by the size and position of the dorsal fin and body proportions. The systematic position of *Teoichthys* will be discussed.

FOSSIL AND EXTANT SOUTH AMERICAN LEPIDOSIRENID LUNGFISHES

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Recent dipnoan fishes are represented in South America by one species – *Lepidosiren paradoxa* Fitzinger, 1837 – belonging to the family Lepidosirenidae. *Lepidosiren paradoxa* exhibits a wide geographical distribution, extending from the North of the continent to central Argentina. The family Lepidosirenidae presents a relatively poor fossil record in South America, being restricted to the Upper Cretaceous of Peru and Bolivia, and the Tertiary of Brazil, Argentina, and Colombia. Most of the fossil record is composed of tooth plates, with the exception of one partially articulated skull originally described as *Lepidosiren megalos* Santos, 1987, which is currently lost, and a reported but still undescribed partially preserved skull assigned to the recent species *L. paradoxa* (Lundberg, 1997) from the La Venta Formation (Miocene of Colombia). The relationships between living populations of *Lepidosiren paradoxa* were investigated by molecular phylogenetic analysis and morphological and morphometric comparisons. The validity of a second nominal fossil species – *L. megalos* – was tested by comparison of dental plates assigned to this species with those of *L. paradoxa.* Molecular phylogenetic analyses agreed on a sister group relationship of the specimens collected in the Parana-Paraguay Basin with those from Amazon and Approuague basins. Morphological comparisons and morphometric analyses of external, cranial, and dental plate measurements were unable to demonstrate the existence of these two major clades observed in the molecular analysis. The validity of the nominal species *Lepidoseiren megalos* was rejected on the basis of the results of morphometric examination of dental plates. One of the syntypes of *L. paradoxa* was identified in the collection of the NMW (Machado *et al.*, 2010).

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A SOUTH AMERICAN EOCENE NEOTROPICAL CICHLID FAUNA (TELEOSTEI, PERCIFORMES)

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Cichlids are teleost fishes found chiefly in freshwater. It is one of the major vertebrate families with more than 1500 species, being one of the most speciose families of percoid fishes. Due to this and also to the ecological and evolutionary features, cichlids are among the most widely studied fishes. Contrasting with this effervescence of the modern forms is the scarce fossil record. Fossil cichlids are known from Africa, Europe, Central and South America, and the Near East. In South America, cichlids are recorded for the Oligocene-Miocene of Brazil and Miocene and Eocene of Argentina. The Lumbrera Formation is a Eocene continental unit divided into lower Lumbrera and upper Lumbrera, and cropping out in the northwestern Argentina. Besides the records of unidentified remains of siluriforms and cyprinodontiforms, detached dental plates of *Lepidosiren paradoxa* Fitzinger, 1837, were the only fish remains described from this formation (Fernández *et al*., 1973). Recently, a small cichlid assemblage was collected from a fossiliferous level of the lower Lumbrera known as 'Faja Verde' the depositional environment of which was interpreted as a perennial low-energy freshwater lake surrounded by low relief vegetated areas which were sporadically flooded. The age of the Faja Verde Lake was estimated on the basis of regional considerations, fossil record, and an absolute U/Pb zircon date, which all together pointed to a Lower Eocene age (49 Ma). Based on this collection, three cichlid species were described in the last few years: *Proterocara argentina* Malabarba *et al*., 2006, *Gymnogeophagus eocenicus* Malabarba *et al*., 2010, and *Plesioheros chauliodus* Perez *et al*., 2010. Together they comprise the oldest record of American cichlids and attest to the early lineage diversification of this family. Phylogenetic analyses revealed that these cichlid species nested in the modern Geophagini and Heroini clades. The presence of synapomorphies and/or the appearance of modern genera indicate an extensive differentiation from the basal cichlid lineages and a morphological conservatism since at least the early Eocene (49 Ma). This differentiation must have taken time evidencing that the origin of the group long predates the minimum age provided by the fossils that could be in the Cretaceous. The occurrence of Eocene fossils in the geographical area corresponding to the distribution of the modern related lineages suggests that the patterns of distribution and endemism of the Neotropical fish fauna have a very old history in the continent.

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Malabarba, M.C., Malabarba, L.R., and Del Papa, C. 2010. *Gymnogeophagus eocenicus* (Perciformes: Cichlidae), an Eocene cichlid from the Lumbrera Formation in Argentina. *Journal of Vertebrate Paleontology* 30: 341-350.

Malabarba, M.C., Zuleta, O.D. and Del Papa, C. 2006. *Proterocara argentina*, a new fossil cichlid from the Lumbrera Formation, Eocene of Argentina. *Journal of Vertebrate Paleontology* 26: 267-275.

Perez, P.A., Malabarba, M.C., and Del Papa, C. 2010. A new genus and species of Heroini (Perciformes: Cichlidae) from the early Eocene of southern South America. *Neotropical Ichthyology* 8: 631-642.

MACROEVOLUTIONARY VIEWS ON THE ORIGIN AND DIVERSIFICATION OF THE AUSTRAL ICHTHYOFAUNAS: THE ABANICO BASIN HYPOTHESIS

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Current biogeographic hypotheses on South American freshwater fishes are restricted mainly to those from the northern and eastern seabords, with special emphasis on the diversification of Amazonian fishes. However, the ichthyofauna west of the Andes has received little attention, despite of its systematic importance as a relictual and endemica fauna. Several authors consider Andean uplift as the main cause of diversification; nonetheless, updated information on tectonic and palaeogeographic evolution of the Central Andes provides a suitable evolutionary context. With such new information, along with existing and new systematic, molecular and fossil data data in a range of taxa allows us to propose a hypothesis of geological refuge. An extensive intra-arc extensional basin developed between ~27° - >39° South –the Abanico Basin– may have played an important role in the diversification of the Austral fauna since the late Eocene through the Miocene. This basin may have provided refuge and favorable conditions to tropical and temperate freshwater fish faunas, some of them tater becoming extinct at this latitude. Subsequent tectonic inversion of the basin and the final uplift of the Andes Cordillera triggered the fluvial incision

and the final development of present-day watersheds. Current biogeographic patterns, geological mechanisms and putative dispersal routes that would explain these patterns are discussed. The available temporal estimates of fossils, the molecular clock, and the palaeogeographic context altogether, suggests a) glaciations earlier than the Plio-Pleistocene that affected the wildlife primarily at the population level, and b) the evolution and diversification of much of the Austral ichthyofauna before the Pliocene.

SOBRE UM ESPÉCIME DE PALAEONISCIFORMES PROVENIENTE DA SERRA DO CADEADO, PR, FORMAÇÃO RIO DO RASTO, PERMIANO SUPERIOR DA BACIA DO PARANÁ, BRASIL

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Dentre as localidades fossilíferas da Formação Rio do Rasto conhecidas no estado do Paraná, destaca-se a Serra do Cadeado. Entre os municípios de Mauá da Serra e Ortigueira, no quilometro 313 da BR 376, destaca-se o afloramento conhecido informalmente como "Monjolo", no qual foram coletados anfíbios temnospôndilos, diversos exemplares de peixes paleonisciformes, entre os quais o exemplar que será aqui apresentado. O espécime LPRP/USP-0043 corresponde a um indivíduo praticamente completo, faltando apenas parte da região caudal. O exemplar está comprimido lateralmente, podendo esta ser uma característica do organismo ou um artefato da fossildiagênese. O espécime tem cerca de 12 cm de comprimento e 6 cm de altura, na porção medial do corpo, desconsiderando as nadadeiras. A região craniana possui aproximadamente 2,7 cm de comprimento e 3,2 cm de altura. Muitos dos ossos cranianos estão deslocados entre si, principalmente na região rostral. A série opercular foi preservada, necessitando, porém, de uma melhor preparação mecânica para evidenciação de suturas. O aparelho maxilo-mandibular está parcialmente preservado, portando dentes cônicos. Quanto às nadadeiras, as ventrais encontram-se bem preservadas, especialmente as peitorais, que se encontram praticamente completas, com desgaste apenas das margens. Já a nadadeira dorsal não está completamente preservada, evidenciando-se apenas as porções mais basais dos raios. O corpo é coberto por escamas rômbicas, cobertas por ganoína, caracterizando-o como paleonisciforme. As escamas, em sua maioria, encontram-se bem preservadas e articuladas. As exceções são as que deveriam compor as porções caudais, bem como escamas fulcrais. É visível que o espécime LPRP/USP-0043 possui o corpo alto e comprimido (*deep-bodied*), assemelhando-se ao exemplar descrito por Dias (1996). Mas, em comparação a *Rubidus pascoalensis* Richter 2002, ou, aos morfótipos de Palaenisciformes (Vega-Dias *et al.*, 2000) provenientes da Formação Rio do Rasto, a forma corporal é distinta. Enquanto as primeiras são fusiformes, o espécime apresentado é aproximadamente ovoide. Devido ao padrão morfológico *deep-bodied*, e à organização das nadadeiras, relaciona-se o exemplar a Família Platysomidae, necessitando, porém, de maiores estudos filogenéticos. Este espécime corresponde ao paleonisciforme melhor preservado, proveniente da Formação Rio do Rasto (PR), fornecendo novos dados sobre a diversidade aquática no Permiano superior brasileiro.

Dias, E.V. 1996. New fish (Actinopterygii, Platysomidae) from the Upper Permian of Paraná Basin, Brazil. *Ameghiniana* 33: 463.

Richter, M. 2002. A ray-finned fish (Osteichthyes) from the Late Permian of the state of Santa Catarina (Paraná Basin) Southern Brazil. *Revista Brasileira de Paleontologia* 3: 56–61.

Vega-Dias, C., Dias, E. V., e Ricther, M. 2000. Actinopterygian remains from the Rio do Rasto Formation, Upper Permian of the Paraná Basin, Brasil. *Acta Geologica Leopoldensia* 51: 21-31.

A PERMIAN SEMIONOTIFORM FISH (OSTEICHTHYES/ACTINOPTERYGII/ NEOPTERYGII) FROM BRAZIL

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Semionotiforms have been characterized among other features by anterior infraorbital bones (lacrimals), premaxilla with long nasal process, several suborbital bones, and dorsal ridge scales with posterior spine. Previously, these fishes have been undoubtedly reported only from Mesozoic rocks, including those from the Early Triassic of central Europe and France (Lopez-Arbarello *et al.*, 2008), considered to date as the oldest records of the group (López-Arbarello and Alvarado-Ortega, 2011). On the other hand, all previously described semionotids from Brazil come from Late Jurassic to Late Cretaceous rocks (Gallo and Brito, 2004). Here we report the first Palaeozoic semionotiform fish from anywhere in the world. Two nearly complete fish and 13 fragmentary specimens were collected in 2010 in the State of Maranhão, Northeastern Brazil and are housed in the Laboratório de Paleontologia, FFCLRP-USP, Ribeirão Preto. They come from continental greyish sandstones of the Pedra do Fogo Formation. This stratigraphic unit contains distinct facies, ranging from early to latest Permian and representing near-shore and transitional palaeoenvironments. The new genus and species reaches at least 250 mm in total length and differs from previously known semionotiform fishes by a unique combination of characters that includes elongated frontals and parietals, three anterior infraorbitals (lacrimal) bones (the anteriormost being the largest), a mosaic of at least eight suborbital bones, dentigerous maxilla, three su-

praorbital bones, dentary with straight ventral margin, large circular orbit forming a quarter of the skull-length and dorsal ridge scales with spine-like processes twice as long as the scales themselves. The trunk scales are smooth, rhombic and serrated, showing peg-and-socket articulation and an anterodorsal process that comprises a third of the length of the scale. One scale was sectioned, revealing that it is composed of three distinct tissues: bone, dentine, and ganoine. The thick basal layer of lamellar cellular bone is traversed by parallel Williamson canals. Dentine is arranged in regularly spaced odontodes underneath the ganoine, which is made up of 8-9 individual layers. The presence of odontodes along the entire length of the scale is typical of lower actinopts and contrasts with the histological structure of semionotiform scales (Thomson and McCune, 1984), where odontodes, if present, are found only in the early growth stages of the scales, being therefore confined to their central region (Richter and Smith, 1995). The affinities of this new taxon with previously described semionotiforms are discussed.

Gallo, V., and Brito, P.M. 2004. An overview of the Brazilian semionotids. In: Arratia, G. & Tintori, A, (eds.). *Mesozoic Fishes 3 – Systematics, Paleoenvironments and Biodiversit.* Verlag Dr. Pfeil, Munich, p. 253-264.

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RESOLVING THE TAXONOMY OF "*THARRIAS*" *FERUGLIOI*, A LATE JURASSIC BASAL TELEOST (ACTINOPTERYGII) FROM PATAGONIA

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The Late Jurassic basal teleost *"Tharrias" feruglioi* Bordas, 1942, is very well represented in the Cañadón Calcáreo Formation in central Chubut (Argentina) by dozens of juvenile and adult specimens. The species has been erroneously assigned to *Tharrias* (the original publication included a misspelling of the name), a genus erected for *Tharrhias araripes* Jordan and Branner, 1908, a gonorynchiform from the Cretaceous Santana Formation of Brazil. *"T". feruglioi* is certainly not a gonorynchiform because of the lack of: reduced parietal bones; a first neural arch especially enlarged, contacting the occipital margin with an extensive, tight joint, and epicentral bones (Wiley and Johnson, 2010). Besides, the proposition held by Bocchino (1978), that *"T". feruglioi* should be placed in the genus *Leptolepis*, is also rejected here. Unlike *Leptolepis* (*sensu* Nybelin, 1974) *"T". feruglioi* lacks a suborbital and a second supraorbital bones. Referral to the family Leptolepidae *sensu stricto* is here also denied as well. Recently, Arratia and Hikuroa

(2010) proposed three uniquely derived characters that support this family: vertebrae with thin and smooth autocentra, autocentra and chordacentra not constricting the notochord, and lack of cavities for adipose tissue in the walls of the autocentra. In contrast, *"T". feruglioi* has vertebrae with thick, sculptured autocentra that strongly constrict the notochord. In addition, *Luisiella inexcutata* Bocchino, 1967, the other teleostean taxon described for the Cañadón Calcáreo Formation, is considered here a junior synonym of *"T". feruglioi*. Consequetly, *"T". feruglioi* should be moved to the genus *Luisiella* as *Luisiella feruglioi* nov. comb. and, pending a comprehensive cladistics analysis, it should remain as Teleostei *incertae sedis*.

Arratia, G., and Hikuroa, D.C. 2010. Jurassic fishes from the Latady Group, Antarctic Peninsula, and the oldest teleosts from Antarctica. *Journal of Vertebrate Paleontolology* 30: 1331–1342.

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LOS PECES FÓSILES CENOMANIANOS DE CHIAPAS, MEXICO, Y SU IMPORTANCIA TAXONÓMICA Y BIOGEOGRÁFICA

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A principios del presente siglo se descubrieron dos localidades, El Espinal y El Chango, portadoras de peces fósiles en los yacimientos cenomanianos del Grupo Sierra Madre. Estas localidades se ubican en las cercanías de Tuxtla Gutiérrez, Chiapas, México. Desde su descubrimiento se le reconoció por el excelente estado de conservación de sus fósiles, amplia diversidad y abundancia, pero sobre todo por presentar una asociación ictiológica singular. Por esto, desde el año 2003 se ha mantenido un esfuerzo continuo en los estudios geológicos y paleontológicos en torno a estas localidades, identificándose distintos grupos de peces (Alvarado-Ortega et al., 2009), plantas, crustáceos, bivalvos y amonites.La asociación de peces fósiles de estas dos localidades mexicana llena un vacío en el registro de peces cenomanianos al sur de América del Norte. Su estudio ha comenzado a revelar datos importantes para abordar entender de manera más completa los patrones de diversidad taxonómica y distribución biogeográfica de los peces cenomanianos. En esta asociación se cuenta con formas afines aquellos taxones previamente descritos para localidades de la misma edad distribuidas en Europa, América del Sur y norte de África, incluyendo a los grupos Ophiopsidae, Macrosemiidae, Pycnodontiformes (*Nursallia* Blot 1987), Ichthyodectiformes (*Prymnetes* Cope, 1871) Clupeiformes, Aulopiformes (*Sauroramphus* Heckel, 1850; *Enchodus* Agassiz, 1835), Ellimmichthyiformes (*Ellimmichthys* Jordan, 1919; *Triplomystus* Forey, Yi, Patterson, and Davis, 2003) y Aipichthyiodea.

Alvarado-Ortega, J., Ovalles-Damián, E. y Blanco-Piñon, A. 2009. The fossil from the Sierra Madre Formation, Ocozocoautla, Chiapas, Souther Mexico. *Paleontologia Electronica* 12: 1-22

PECES FOSILES SILURIFORMES DEL CUATERNARIO DE LA REGION CHAQUEÑA, PROVINCIA DE SANTA FE, ARGENTINA

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El Cuaternario de la provincia de Santa Fe ha brindado hasta el momento sólo mamíferos (Ameghino, 1889; Frenguelli, 1928; Noriega *et al.*, 2010; Vezzosi, 2008; Vezzosi, *et al.*, 2009). El objetivo de la presente comunicación es dar a conocer un elenco de armados, bagres y viejas de agua dulce cuaternarios (Siluriformes) procedentes del centro de la provincia de Santa Fe. Los niveles aflorantes en el área del hallazgo, innominados desde el punto de vista formacional, se encuentran sobre la margen izquierda del río Salado (30º48′33,60″S–60º49′52,00″O) y presentan dos facies areno-limosas de estructura laminar. Los depósitos portadores corresponderían a una antigua faja fluvial de río Salado, con ambientes pantanosos y zonas elevadas. Hasta tanto se profundicen los estudios se prefiere asignar los sedimentos portadores al Pleistoceno superior, teniendo en cuenta que infrayacen a la Formación Tezanos Pinto (Pleistoceno superior–Holoceno inferior) (Iriondo, 1980). Los materiales se encuentran depositados en la colección del Museo Provincial de Ciencias Naturales "Florentino Ameghino" (MFA-PV). El estudio de los restos recuperados permitió la identificación de los siguientes taxones: cf. *Pterodoras granulosus* Valenciennes, 1821 (Doradidae Günther, 1864) (espinas pectorales y fragmentos de cráneo); cf. *Pimelodus maculatus* Lacepède, 1803 (Pimelodidae Lundberg y Littmann, 2003) (espinas pectorales) y cf. *Hypostomus* Lacepède, 1803 (Loricariidae Gill, 1872) (espina dorsal y pectoral). Los géneros mencionados actualmente se distribuyen en las cuencas de los ríos Paraná, Uruguay, Paraguay y Río de la Plata. Además de estos hallazgos, los estudios paleontológicos actualmente en curso permitirán incrementar el conocimiento de la diversidad paleofaunística cuaternaria de esta región, así como su significación bioestratigráfica, paleoambiental y paleogeográfica.

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Günther, A. 1864. *Catalogue of the Fishes in the British Museum, vol. 5. Catalogue of the Physostomi, Containing the Families Siluridae, Characinidae, Haplochitonidae, Sternoptychidae, Scopelidae, Stomiatidae in the Collection of the British Museum*. Trustees of the British Museum, Londres, 455 p.

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Noriega, J.I., Ferrero, B.S., Brunetto, E., Schmidt, G.I., Vezzosi, R.I., Brandoni, D., Gottardi, M.G., Diederle, J. y Vallone, E.R. 2010. La paleontología de vertebrados en la región litoral. *75ª Reunión de Comunicaciones Científicas de la ACNL* (Santa Fe)*, Libro de Resúmenes* p. 2.

Vezzosi, R.I. 2008. Nuevos aportes al conocimiento de la diversidad de vertebrados fósiles cuaternarios en la provincia de Santa Fe. *74ª Reunión de Comunicaciones Científicas de la ACNL* (Santa Fe), *Libro de Resúmenes,* p. 16.

Vezzosi, R.I., Schmidt, G.I. y Brunetto, E. 2009. Un Proterotheriinae (Proterotheriidae: Mammalia) en el Pleistoceno tardío-Holoceno temprano (Lujanense) de Santa Fe. *24as Jornadas Argentinas de Paleontología de Vertebrados* (San Rafael, Mendoza), *Libro de Resúmenes*, p. 62.

MAWSONIID COELACANTHS OF GONDWANA

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Thirteen genera and twenty species of mawsoniid coelacanths have been recognized from the upper Permian to Lower Cretaceous in Europe, India, China, North and South America, and Africa (Forey, 1998; Yabumoto, 2002, 2008). Among these genera, the phylogenetic relationships of *Diplurus* Newberry, 1878, and *Chinlea* Schaeffer, 1967, from North America, *Mawsonia* Woodward, 1907, from South America and Africa, *Axelrodichthys* Maisey, 1986, and *Parnaibaia* Yabumoto, 2008, from South America were relatively resolved. Three genera and eight species have been described from Gondwana. *Mawsonia gigas* was described by Woodward (1907) on the basis of several skull bones recovered in Bahia (Brazil), whereas *Mawsonia brasiliensis* was described based on an almost complete specimen from the Santana Formation of Araripe (Brazil) (Yabumoto, 2002). Other four species of *Mawsonia* were described from Africa. These are *M. tegamensis* Wenz, 1975, from the Aptian of Niger; *M. ubangiana* Casier, 1961, from the Neocomian bed in Zaire; *M. lavocati* Tabaste, 1963, from the Albian beds in Morocco, and *M. libyca* Weiler, 1935, from the Albian of Egypt. Some African species of the genus *Mawsonia* should be reexamined in the future because the descriptions of thespecies are based on fragments of isolated bones. *Axelrodichthys araripensis* was described on the basis of almost complete specimens from the Santana Formation by Maisey (1986). *Parnaibaia maranhaoensis* was described on the basis of four specimens from the Pastos Bons Formation, Parnaíba Basin (Brazil) (Yabumoto, 2008) and is considered as Late Jurassic in age. The interpretation for the evolution of mawsoniid coelacanths from Western part of Laurasia and Gondwana based on phylogenetic analysis and Triassic–Cretaceous paleogeography indicates that *Chinlea* probably lived in both North and South America, which formed a major part of Pangea during the Late Triassic. After the division of Laurasia and Gondwana in the Late Jurassic, *Parnaibaia* arose in what is now South America. In the late Early Cretaceous, during the break-up of the western part of Gondwana, *M. gigas*, *M. brasiliensis* and *Axelrodichthys araripensis* appeared in South America, while several species of *Mawsonia* arose in Africa.

Brito, P.M., and Gallo, V. 2002. A new pleuropholid, *Gondwanapleuropholis longimaxillaris* n.g., n.sp. (Actinopterygii: Teleostei) from the Jurassic of North East Brazil. *Comptes Rendus Palevol* 2002: 697- 703.

Forey, P.L. 1998. *History of the Coelacanth Fishes*. Chapman and Hall, London, 419 p.

Maisey, J.G. 1986. Coelacanths from the Lower Cretaceous of Brazil. *American Museum Novitates* 2866: 1-30.

Woodward, A.S. 1907. On the Cretaceous formation of Bahia (Brazil), and on vertebrate fossils collected therein. II. The vertebrate fossils. *Quarterly Journal of the Geological Society of London* 63: 131-139.

Yabumoto, Y. 2002. A new coelacanth from the Early Cretaceous of Brazil (Sarcopterygii, Actinistia). *Paleontological Research* 6: 343-350.

Yabumoto, Y. 2008. A new Mesozoic coelacanth from Brazil (Sarcopterygii, Actinistia). *Paleontological Research* 12: 329 - 343.

VERTEBRADOS CAMPANIANOS Y MAASTRICHTIANOS EN PATAGONIA: DIVERSIDAD, FILOGENIAS, PALEOBIOLOGÍA Y ESCENARIOS PALEOAMBIENTALES

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FIRST GIANT PTEROSAUR FROM THE LATE CRETACEOUS OF SOUTH AMERICA

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South America has yielded abundant and diverse pterosaur remains from Early and early Late Cretaceous rocks from Brazil and Argentina (Codorniú and Gasparini, 2007). In contrast, the Late Cretaceous bone record of South American pterosaurs is still scarce and restricted to a handful of fragmentary specimens. We present here a partial dentary symphysis belonging to a large-sized azhdarchid pteranodontoid collected from the Maastrichtian Allen Formation at a fossil site located 90 km SE from General Roca, Río Negro Province, Argentina. Other fossils collected from the same horizon and locality include indeterminate fishes (isolated vertebrae, scales), fragmentary turtle shells, and plesiosaur remains. The preserved length of the dentary is 264 mm. It is elongated, transversely compressed, and toothless. Its external surface is longitudinally striated and highly vascularized by numerous small pits. The internal microstructure is composed of cancellous bone, as typically occurs in pterosaurs. As in most pterosaurs the bone cortex is very thin, being approximately 0.3 to 1.0 cm in thickness. A curious character is the high number (6 or more) of large slit-like lateral neurovascular foramina along the symphysis, and the deeply concave median groove at the bottom of the dentary symphysis. The dentary is referred to the Azhdarchidae (Nessov, 1984), a group of pterosaurs particularly abundant and diverse worldwide during the latest Cretaceous (Company *et al.*, 1999; Butler *et al.*, 2009). This clade comprises several species of long–necked pterosaurs ranging from 2.5 to 12 meters wing-span, thus including the largest known flying vertebrates, such as the gigantic *Quetzalcoatlus* and *Hatzegopteryx* (Kellner and Langston, 1996; Buffetaut *et al.*, 2002). The specimen here reported represents the first unambiguous evidence of a South American azhdarchid pterosaur, and represents the largest known pterosaurian recorded in this continent.

Butler, R. J., Barrett, P. M., Nowbath, S., and P. Upchurch. 2009. Estimating the effects of sampling biases on pterosaur diversity patterns: implications for hypotheses of bird/pterosaur competitive replacement. *Paleobiology* 35: 432-446.

Buffetaut, E., Grigorescu, D., and Z. Csiki. 2002. A new giant pterosaur with a robust skull from the Latest Cretaceous of Romania. *Naturwissenchaften* 89: 180-184.

Codorniú, L., and Z. Gasparini. 2007. Pterosauria. En: Gasparini, Z., Salgado, L., and R. Coria (Eds.), *Patagonian Mesozoic Reptiles*. Indiana University Press. Bloomington, p. 143-166.

Company, J., Ruiz-Omeñaca, J. I., and X. Pereda-Suberbiola. 1999. A long-necked pterosaur (Pterodactyloidea, Azhdarchidae) from the Upper Cretaceous of Valencia (Spain). *Geologie en Mijnbown* 78: 319-333.

Kellner, A. W. A., and W. Langston. 1996. Cranial remains of *Quetzalcoatlus* (Pterosauria, Azhdarchidae) from Late Cretaceous sediments of Big Bend National Park, Texas. *Journal of Vertebrate Paleontology* 16: 222-231.

Nessov, L. A. 1984. Pterosaurians and Birds of the Late Cretaceous of Central Asia. *Palaeontological Zhurnal* 1: 47–57.

SQUAMATANS FROM THE CAMPANIAN AND MAASTRICHTIAN OF PATAGONIA

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Several of the fossils squamatans informing about the diversity of the group in Gondwana come from Campanian and Maastrichtian rocks in Patagonia. Besides aquatic mosasaurs, lizards are represented only by a dentary of a Scincomorpha from the Anacleto Formation (Campanian) in Río Negro Province, therefore becoming the first record of a Scincogekkonomorpha lizard in the Cretaceous of South America. Regarding snakes, the youngest records of the basal Cretaceous snake *Dinilysia patagonica* come from the Anacleto Formation in Río Negro and Neuquén provinces. For the Campanian–Maastrichtian, snakes from the Allen Formation in Río Negro Province include remains of the madtsoiids *Alamitophis* Albino, 1986, and *Patagoniophis* Albino, 1986, and the anilioid *Australophis* Gómez *et al.*, 2008. The Los Alamitos Formation in Río Negro Province provided a diverse snake fauna, including the madtsoiids *Alamitophis argentinus* Albino, 1986, *Alamitophis elongatus* Albino, 1994, *Patagoniophis parvus* Albino, 1986, and *Rionegrophis madtsoioides* Albino, 1986, whereas the La Colonia Formation in Chubut Province contributed with *Alamitophis argentinus*, another probable madtsoiid, perhaps a boid, and an *incertae sedis* squamate that shows some similarities with the aquatic "dolichosaur" *Coniasaurus* Owen, 1850. Thus, the diversity of Campanian–Maastrichtian snakes at the moment is much larger than that of lizards and includes basal forms, relevant for the recognition of the evolutionary history of the group.

Albino, A. M. 1986. Nuevos Boidae Madtsoiinae en el Cretácico tardío de Patagonia (Formacíon Los Alamitos, Río Negro, Argentina). *IV Congreso Argentino de Paleontología y Bioestratigrafía* (Mendoza), *Resúmenes,* p. 15-21.

Albino, A. M. 1994. Una nueva serpiente (Reptilia) del Cretácico tardío de Patagonia. *Pesquisas* 21: 58-63.

Gómez, R. O., Báez, A. M. and G. W. Rougier. 2008. An anilioid snake from the Upper Cretaceous of northern Patagonia. *Cretaceous Research* 29: 481-488.

Owen, R. 1850. Description of the fossil reptiles of the chalk formation. In: F. Dixon (Ed.), *The Geology and Fossils in of the Tertiary and Cretaceous Formations of Sussex*. Longman, Brown, Green and Longman, London, p. 378-404.

LEPIDOSAURIOS FINICRETÁCICOS PATAGÓNICOS: UNA HISTORIA DE MADTSOIAS, LAGARTOS Y ESFENODONTES

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La composición actual de la fauna de lepidosaurios patagónicos refleja muy poco la del Mesozoico, pobremente conocida. La información más completa es de restos de los comienzos del Cretácico Tardío y contribuye a comprender la transición Mesozoico-Cenozoico (Apesteguía y Novas, 2003). Mientras grandes dinosaurios ornitisquios de origen norteamericano alcanzaban la Patagonia en el Campaniano, los tetrápodos pequeños eran demorados por los sucesivos brazos de ingresiones representados por el Mar de Pacha (que inundara la cuenca de Potosí) y el de Kawas (que inundara parte de la cuenca Neuquina). Aunque establecidos a fines del Campaniano, hay evidencias de avances previos desde principios del Campaniano (*i.e.*, Fm Anacleto, Armas y Sánchez, 2011). Mamíferos marsupiales como los polidolopimorfios formaron un linaje nativo en el norte de América del Sur (Goin *et al.*, 2006) y, del mismo modo, los lacertilios laurásicos habrían demorado su llegada. De la asociación coloradoense de tetrápodos provienen dos lepidosaurios: un esclerogloso de dentición subpleurodonte y unicuspidada y la aletinofidia basal *Dinilysia patagonica* (Smith Woodward, 1901). La asociación allenense, rica en serpientes, no proveyó material referible a lacertilios, aunque se suponen presentes tanto formas basales como los gecos, teidos, anfisbenas e iguánidos (desde el Jurásico, *contra* Nydam que supone a los Teiioidea ingresando en el Cretácico Temprano). Casi todos los linajes de serpientes no-macrostomadas estarían presentes, pero sólo se hallaron restos de anilioideas (Gómez *et al.*, 2008). Restos vertebrales de serpientes han sido incluidas en Madtsoidae. Sin embargo, este grupo solo incluye ciertamente a grandes serpientes del Eoceno, cuya posición filogenética oscila entre aletinofidias basales o macrostomadas basales (si son monofiléticas, ya que son diagnosticadas por plesiomorfías). No se han reportado incuestionables boidos ni cenofidios cretácicos. Con respecto a los esfenodontes, el norte patagónico ha dado al menos tres distintos, un pequeño esfenodontino terrestre y dos grandes, al menos uno posiblemente marino (Apesteguía, 2005) que habría pasado al Paleógeno. Entre los lepidosaurios del Cretácico terminal no se incluyen taxones laurásicos, por lo que podría deducirse que ellos fueron también detenidos por alguna barrera, tal vez los brazos de mar.

Apesteguía, S. 2005. A Late Campanian sphenodontid (Reptilia, Diapsida) from northern Patagonia. *Comptes Rendus de l'Académie des Sciences - Series IIA - Earth and Planetary Science (Palevol)* 4: 663–669.

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Armas, P. y M. L. Sánchez. 2011. Análisis estratigráfico secuencial de las formaciones Anacleto y Allen (Cretácico tardío) en el borde nororiental de Cuenca Neuquina, Argentina. *Andean Geology* 38: 119-155.

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PRESENCIA DE REPRESENTANTES DE LA FAMILIA ASPIDORHYNCHIDAE EN EL CRETÁCICO DEL CERRO BLANCO, YAMINUÉ, PROVINCIA DE RÍO NEGRO, ARGENTINA

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Se comunica la presencia de restos de Aspidorhynchidae Bleeker, 1859, en sedimentitas fluviales de la base del miembro medio de la Formación Allen (Campaniano–Maastrichtiano) del Cerro Blanco, Yaminué (Manera de Bianco, 1997). El material estudiado fue obtenido durante campañas realizadas entre 1976 y 1996 y está depositado en el Museo Municipal de Ciencias Naturales Carlos Darwin de Punta Alta. Los restos consisten en 14 fragmentos de escamas ganoideas (MPA-78-9-I-A) rectangulares (largo 5 a 15 mm) que en su superficie exterior exhiben una ornamentación compuesta por leves ondulaciones; un basioccipital (MPA10-I-A) (largo 23,5 mm, alto 14,6 mm) con la primera vértebra fusionada en su parte posterior; un fragmento de predentario (MPA-78-8-I-A) (largo 2,6 mm; ancho 0,86 mm), de sección transversal en V, cuyas superficies laterales muestran surcos muy marcados y que presenta tres filas de dientes, pequeños en las hileras laterales y más grandes y fracturados en la central; 8 fragmentos de premaxilares (MPA-78-8-I-A) (largo 2,8 mm a 4,2 mm) que presentan solo una fila de dientes. Fragmentos de predentarios y premaxilares con características similares asignados a *Belonostomus longirostris* Lambe, 1902 se han hallado en sedimentos marinos del Cretácico Superior de Chile (Brito y Suárez, 2003), de la Argentina (Casamiquela, 1992) y de América del Norte (Peng *et al.*, 2001). Se destaca para la presente localidad (Cerro Blanco de Yaminué) la recurrencia de restos de premaxilares y predentarios referibles al género *Belonostomus* Agassiz, 1834, correspondientes a individuos muy juveniles, lo que podría implicar la proximidad a áreas reproductivas y de cría de este taxón.

Agassiz, L. 1834 Abgerissene Bemerkungen iiber fossile Fische. *Neues Jahrbuch für Mineralogie Geognosie und Petrefakte-Kunde* 4: 377-90.

Brito, P. M. y M. E. Suárez. 2003. Late Cretaceous *Belonostomus* (Pisces, Actinopterygii, Aspidorhynchidae) from Algarrobo, Chile, with comments on aspidorhynchid paleodistribution in South America. *Revista Geológica de Chile.* 30: 117-127.

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earum recentiores reperiuntur, nec non speciebus Musei Bleekeriani Bengalensibus, Japonicis, Capensibus Tasmanicisque. Acta Societatis Regiae Scientiarum Indo-Neêrlandicae 6: 1-276.

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Peng, J., Russell, A. P. y D. B. Brickman. 2001. Vertebrate microsite assemblages (exclusive of mammals) from The Foremost and Oldman Formations of The Judith River Group (Campanian) of southeastern Alberta: an illustrated guide. *Provincial Museum of Alberta Natural History Occasional Paper* 25, 56 p

TORTUGAS DEL CAMPANIANO–MAASTRICHTIANO DE PATAGONIA

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La fauna de tortugas del Campaniano–Maastrichtiano de Patagonia está constituida por tortugas cercanamente relacionadas al extinto clado Meiolaniidae (tortugas terrestres de gran tamaño, con cuernos y estuche caudal) y por pleurodiras del clado viviente Chelidae, mientras que los Pelomedusoides Podocnemididae poseen registros dudosos en unidades litoestratigráficas campanianas. Los restos campaniano–maastrichtianos que se pueden atribuir a tortugas de los dos primeros grupos mencionados se han encontrado en las formaciones La Colonia (Chubut), Los Alamitos y Allen (Río Negro). Los análisis filogenéticos realizados hasta el momento muestran que tanto el linaje que conduce a los meiolaniidos como el de los quélidos no se extinguen en el límite Cretácico/Paleógeno, ya que los registros de ambos grupos se continúan en las sedimentitas paleógenas de la Formación Salamanca (Chubut), en las eocenas de la Formación Sarmiento (Cañadón Hondo), y en el caso de los quélidos, el registro se continua hasta la actualidad, pero ya en latitudes más bajas. Asimismo, la asociación de estos dos grupos se puede rastrear hasta el Cretácico Inferior (niveles aptiano–albianos de la Formación Cerro Barcino, Grupo Chubut) donde se han hallado las especies más antiguas atribuidas a cada uno de los clados mencionados. Una vez culminados los estudios de taxonomía alfa y filogenia de estos grupos, trabajos comparativos con fauna de tortugas de otras partes del mundo (*e.g.*, América del Norte), como así también estudios de requerimientos ecológicos de los quélidos actuales, podrán brindar una idea más acabada de cómo esta asociación tan bien representada en el Campaniano–Maastrichtiano de Patagonia sobrevivió a la extinción masiva que marcó el límite Cretácico/Paleógeno.

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Los restos de mosasaurios recuperados del Maastrichtiano de Patagonia (Argentina) son escasos en comparación con los registros del Hemisferio Norte, principalmente de América del Norte y Europa, pero particularmente significativos dado que contribuyen al conocimiento del patrón de distribución del grupo en el Hemisferio Sur (Gasparini *et al.*, 2001; Fernández *et al.*, 2008). Hasta el presente, los registros más elocuentes de mosasaurios provienen del Maastrichtiano tardío de la Formación. Jagüel aflorante en el norte de la provincia de Río Negro (Cuenca Neuquina, Argentina). Aunque fragmentarios, los restos exhumados de la Formación Jagüel documentan la presencia de mosasaurios mosasaurinos, representados por *Prognathodon* sp., *Mosasaurus* sp., *Mosasaurus* sp a*ff. M. hoffmanni* Mantell, 1829, y plioplatercarpinos representados por *Plioplatecarpus* sp (Fernández *et al.* 2008; Fernández y Gasparini, en prensa). Los restos más completos corresponden a este último taxón. En todos los casos el material recuperado incluye coronas dentarias, lo que permitió su identificación taxonómica a nivel genérico. En el caso del ejemplar referido a *Plioplatecarpus* sp., la combinatoria de caracteres que exhiben sus ramas mandibulares (particularmente la conformación de la fosa glenoidea y proceso retroarticular de la mandíbula) no permite referirlo a ninguna de las especies conocidas. No obstante, debido a la naturaleza fragmentaria del material, y a que el género se encuentra en revisión y consecuentemente la delimitación de especies aún no es clara, no se le propone un nuevo nombre específico para contener al material exhumado de la Formación Jagüel.

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DIVERSIDAD OOLÓGICA DE LA FORMACIÓN ALLEN, CRETÁCICO SUPERIOR PROVINCIA DE RÍO NEGRO: COMPARACIONES CON DIFERENTES OOESPECIES DEL RESTO DEL MUNDO

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Las localidades rionegrinas donde se realizaron los hallazgos son: Salitral Ojo de Agua y Bajo de Santa Rosa (Salgado *et al.*, 2007, 2009, Fernández *et al.*, 2009). En el primer sitio fueron registrados tres grandes grupos de cáscaras: 1) morfotipo estructural filiesferulítuco, 2) morfotipo estructural tuboesferulitico, y 3) morfotipo estructural ratite (Salgado *et al.*, 2007). En el Bajo de Santa Rosa fueron registrados sólo dos morfotipos estructurales: 1) filiesferulítico y 2) tuboesferulitico, este último con tres variantes a, b y c. Todas las cáscaras fueron estudiadas estadísticamente. Los parámetros de las cáscaras del morfotipo filiesferulítico mostraron tener una distribución normal. Se calcularon intervalos de confianza para sus respectivas medias poblacionales, con un nivel de confianza del 99%. Por otra parte, las cáscaras del morfotipo tuboesferulítico presentaron diferencias, distinguiéndose tres grupos. Al igual que para las muestras anteriores, se calcularon los intervalos de confianza para cada parámetro. Para el tercer tipo de cáscara, al no poseer una muestra amplia, se calcularon sólo las medias poblacionales de los parámetros. Las cáscaras del morfotipo filiesferulítico son referidas a la oofamila Faveoloolitidae Zhao y Ding, 1976, las del morfotipo tuboesferulítico, a la oofamilia Megaloolithidae Zhao, 1975, y sus tres tipos son comparables con *Megaloolithus cylindricus* Khosla y Sahni, 1995, *M. mamillare*, *M. siruguei* Vianey- Liaud, 1994, y *M. mohabeyi* Khosla y Sahni, 1995. El tercer grupo es referible a la oofamilia Elongatoolithidae Zhao, 1975.

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PIPID FROGS FROM THE LOS ALAMITOS FORMATION (CAMPANIAN–MAASTRICHTIAN) OF PATAGONIA: PHYLOGENY AND EVOLUTION

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Extant pipids comprise three distinct clades that inhabit freshwater environments in tropical regions of northern South America (Pipa Laurenti, 1768) and sub-Saharan Africa (hymenochirines and xenopodines). Nevertheless, the South American fossil record of the group documents greater taxonomic diversity and wider geographic distribution in Cretaceous and Paleogene times. Pipid remains from the Los Alamitos Formation (Campanian–Maastrichtian) of Patagonia were formerly considered as representing a taxon related to living xenopodines on the basis of frontoparietal and humerus morphologies (Báez, 1987; MACN-RN 159), although it has been acknowledged that this resemblance might be symplesiomorphic rather than apomorphic. However, the taxonomic placement of this fossil form has not been tested quantitatively, probably owing to the fragmentary nature of the material. Additional remains (pelvis, shenethmoid, vertebrae; MACN s/n) collected subsequently from the same unit, together with a more comprehensive phylogenetic framework for pipoids (*e.g.*, Báez and Púgener, 2003) allow us to reconsider the evolutionary relationships of this fossil pipid. A combined phylogenetic analysis including osteological as well as molecular data places the taxon from Los Alamitos as a stem-group xenopodine, in agreement with a previous opinion (Báez and Púgener, 2003). This result implies that crown-group xenopodines and the lineage represented by the fossils from Los Alamitos might have diverged at least in the mid-Cretaceous, prior to the final breakup of western Gondwana. The sphenethmoid of the pipid from Los Alamitos, as in most other anurans and in contrast with extant pipids, forms bony margins to the frontoparietal fenestra anteriorly and remains unfused to the underlying cultriform process of the parasphenoid. These features, which are also present in other extinct South American crown pipids (Báez and Púgener, 2003), point to a chondral origin of the anterior orbital region of the braincase and not to a membrane origin. The latter condition has been described for some extant pipids (*e.g.*, Trueb and Hanken, 1992) and considered a unique pipid condition (Trueb, 1996). According to the placement of these extinct taxa within the crown-group, two evolutionary scenarios with regards to this feature are proposed: 1) a lateral wall of the orbital braincase of mixed origin, chondral and membranous, was the ancestral condition for crown pipids or 2) the membrane bone formation in the orbital braincase appeared independently in different pipid lineages. In any case, the entire replacement of chondral bone with membrane bone in the lateral wall of the orbital braincase has occurred independently in pipines and xenopodines, constituting a remarkable example of parallel evolution in pipids. PICT 223/06

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HALLAZGO DE UN ESQUELETO DE PLESIOSAURIO ASOCIADO CON DIENTES DE SELACEOS EN LA FORMACIÓN EL CALAFATE (CRETÁCICO SUPERIOR) DE LA PROVINCIA DE SANTA CRUZ

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A fines de 2009 un equipo del Museo Argentino de Ciencias Naturales "B. Rivadavia" extrajo varios bloques de roca conteniendo gran parte del esqueleto articulado de un plesiosaurio preservado en la costa sur del Lago Argentino, en cercanías del aeropuerto de El Calafate, Provincia de Santa Cruz. El ejemplar (perteneciente a las colecciones del Museo "Padre Molina", Río Gallegos, Santa Cruz; Nº de colección de campo 1) proviene de la Fm. Calafate, Maastrichtiano, de niveles próximos al límite K/T. El esqueleto aún se encuentra en etapa de preparación, por lo que no es posible aportar mayores detalles de su anatomía. Sin embargo, la presencia de una depresión profunda en la línea media de los coracoides permite asignarlo a la familia Elasmosauridae Cope, 1869. El largo del esqueleto (desde el extremo de la cola hasta la base del cuello) es de aproximadamente 4 m; las paletas posteriores alcanzan 1,30 m de longitud y las vértebras dorsales miden 0,3 m de altura, lo que revela que se trata de un plesiosaurio de gran tamaño, comparable a *Mauisaurus* Hector, 1874. Restos asignados a este taxón han sido registrados en la Formación Allen (Maastrichtiano) en la Provincia de Río Negro (Gasparini *et al*., 2003), por lo que no sería improbable que ambas formas de Patagonia estén cercanamente emparentadas. Junto al esqueleto se hallaron numerosos dientes de seláceos del hexanquiforme *Notidanodon dentatus* Woodward, 1886, y de una especie indeterminada del esqualiforme *Squalus* Linnaeus, 1758. Desconocemos si esta asociación es producto de la depredación o carroñeo, o si el conjunto constituye una tanatocenosis natural. Ambos taxones de seláceos no estaban documentados en el Mesozoico de América del Sur, siendo estos sus primeros registros. La asociación de este elasmosáurido con *Notidanodon dentatus* y *Squalus* sp. amplía datos acerca de la fauna de vertebrados marinos Weddelianos, conocidos hasta el momento fundamentalmente por evidencias procedentes de formaciones del Campaniano–Maastrichtiano del norte de Patagonia (Río Negro), Antártida y Nueva Zelanda.

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SULCUSUCHUS ERRAINI GASPARINI Y SPALLETTI, 1990 (PLESIOSAURIA, POLYCOTYLIDAE): LONGIRROSTROS LITORALES EN PATAGONIA

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Los Polycotylidae son un clado de Plesiosauroidea cuyo registro se extiende desde el Aptiano hasta el Maastrichtiano. Aunque los registros de Polycotylidae provienen mayormente del Hemisferio Norte también han sido hallados en todos los continentes del Hemisferio Sur (Gasparini y Spalletti, 1990; Carpenter, 1996; Sato y Storrs, 2000; Druckemiller, 2002; Bardet *et al*., 2003; Kear, 2006; O'Keefe, 2008; D'Angelo *et al*., 2008). Los registros de policotílidos en América del Sur son particularmente escasos habiéndoselos registrado únicamente en Patagonia y en rocas del intervalo Campaniano superior–Maastrichtiano inferior (Gasparini y de la Fuente, 2000; Salgado *et al*., 2007). La revisión de los especímenes referidos al longirrostro *Sulcusuchus erraini* Gasparini y Spalletti, 1990, ha permitido profundizar en el conocimiento de la morfología de este peculiar taxón, ampliando la diagnosis y presentando un análisis filogenético que confirma su posición dentro de los Polycotylidae. Los restos de *Sulcusuchus erraini* provienen de niveles coetáneos de las Formaciones Coli Toro (Río Negro) y La

Colonia (Chubut) que son interpretados como correspondientes a ambientes de tipo marino marginal con fuerte influencia mareal y fluvial (Gasparini y Spalletti, 1990; Getino, 1995; González y Ardolino, 1996). La presencia de profundos surcos en los maxilares y dentarios, paralelos a la línea dentaria, con paredes con gran cantidad de poros permiten, entre otras evidencias, plantear la hipótesis de una capacidad sensorial especial que les habría permitido habitar zonas litorales en las que el continuo aporte de sedimentos desde el continente reducía la luminosidad de las aguas.

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SÍNTESIS DE LOS REPTILES MARINOS DEL CRETÁCICO SUPERIOR DE CHILE Y SUS RELACIONES EN EL CONTEXTO DE LA PROVINCIA BIOGEOGRÁFICA WEDDELLIANA

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El registro de reptiles marinos del Cretácico Superior de Chile proviene principalmente de unidades del centro y sur del país, cuyas edades corresponden al Maastrichtiano temprano (Algarrobo, Región de Valparaíso), Maastrichtiano indiferenciado (Chanco-Loanco, Región del Maule), Maastrichtiano medio-tardío (Isla Quiriquina y costa adyacente), y Maastrichtiano tardío (Cerro Castillo, Puerto Natales y Lago Parrillar, Región de Magallanes). En Algarrobo se han registrado plesiosaurios elasmosáuridos, mosasáuridos indeterminados, y tortugas *cf.* Dermochelyidae. A su vez, las localidades del Maule han proporcionado materiales de elasmosáuridos de al menos dos géneros distintos, junto a restos de mosasáuridos tylosaurinos y dientes de al menos dos morfotipos de mosasáuridos indeterminados, asociados a restos fragmentarios de tortugas presumiblemente marinas. De la Isla Quiriquina y costa adyacente, se han identificado dos géneros de elasmosáuridos, cuyas afinidades específicas deben aún ser determinadas, así como posibles plesiosaurios polycotylidos. Por otro lado, se registran restos aislados de tortugas marinas con un solo género identificado hasta ahora, así como fragmentos de chelonioideos de talla pequeña y restos de mosasáuridos indeterminados. Hasta ahora, el registro en Magallanes consta principalmente de plesiosaurios indeterminados provenientes de Cerro Castillo y Lago Parrillar, mientras que los elasmosáuridos han sido reconocidos en al menos dos localidades próximas a Puerto Natales. La diversidad de reptiles marinos en el entorno del Pacífico durante el Maastrichtiano muestra afinidades incluso a nivel de género con restos recuperados en Argentina, Antártica y Nueva Zelanda. Algunas localidades de Chile central han proporcionado restos de interés, principalmente tortugas y algunos plesiosaurios, mostrando afinidades morfológicas con taxa reconocidos previamente en Japón y América del Norte. El estudio de estas asambleas en Chile central es de especial relevancia, ya que incluye algunas de las localidades más septentrionales de la Provincia Biogeográfica Weddelliana, con influencia de elementos del norpacífico, indicando un importante potencial para la determinación de elementos endémicos, así como para entender la influencia de herpetofaunas del Hemisferio Norte en la diversidad del Pacífico durante fines del Cretácico Tardío.

SÍNTESIS PALEOBIOGEOGRÁFICA DE PECES CARTILAGINOSOS DEL CRETÁCICO SUPERIOR A LO LARGO DEL MARGEN SUROESTE DE AMÉRICA DEL SUR Y ANTÁRTICA

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En el margen suroeste de América del Sur se reconocen hasta ahora cinco unidades del Cretácico Superior con presencia de peces cartilaginosos (Chondrichthyes), todas restrictas a diferentes lapsos dentro del Maastrichtiano, con cuatro de ellas en Chile central y una en el extremo sur del país. Los afloramientos en Chile central muestran gran afinidad ambiental y faunística, y en conjunto, han permitido reconocer la presencia de dos familias de Squaliformes; un género de Squatiniformes; Lamniformes de al menos dos especies; Synechodontiformes *incertae sedis* de un sólo taxón; dos familias de Rajiformes; y Orectolobiformes indet. de características endémicas (Suárez *et al.*, 2003). Los hallazgos en el extremo sur de Chile han permitido complementar la paleobiogeografía del grupo, recuperándose cuatro taxa anteriormente reconocidos en Chile central durante el mismo lapso, y adicionalmente Lamniformes de la familia Cretoxyrhinidae todos provenientes de afloramientos equivalentes a la Formación Dorotea, asignada al Maastrichtiano tardío (Otero y Suárez, 2009). Los hallazgos de peces cartilaginosos del Cretácico Superior de Antártica han sido reconocidos principalmente en afloramientos de la Formación Santa Marta (Campaniano), en la Isla James Ross, y la Formación López de Bertodano (Maastrichtiano), expuesta en las islas Seymour y Vega. En el Campaniano, se ha señalado la presencia grandes vértebras referidas a tiburones Hybodontiformes, y posteriormente reasignadas por Richter y Ward (1991) a tiburones lamnoides indeterminados. Estos autores también dieron a conocer la presencia, en rocas de la misma edad, de la especie endémica *Chlamydoselachus thompsoni* Richter y Ward, 1991. En diferentes afloramientos del Maastrichtiano de Antártica, se ha reconocido la presencia de Hexanchiformes de al menos dos familias (Cione y Medina, 1987), así como Lamniformes Odontaspididae, y Holocephali de al menos dos familias diferentes (Martin y Crame, 2006; Stahl y Chatterjee, 1999).

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ESCENARIOS PALEOAMBIENTALES DURANTE EL CAMPANIANO–MAASTRICHTIANO EN EL NORTE DE PATAGONIA

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Durante el Cretácico Tardío, al ascenso global del nivel del mar se le superpusieron cambios tectónicos de escala regional que determinaron el comienzo de la fase compresiva en los Andes. Estos eventos, asociados con la ruptura del margen occidental de Gondwana y la consecuente migración de América del Sur hacia el oeste, provocaron el inicio de la primera transgresión del océano Atlántico en el norte de Patagonia. En sus comienzos (Campaniano tardío–Maastrichtiano temprano), la superficie cubierta por el mar no habría constituido un importante rasgo paleogeográfico. Durante el Maastrichtiano tardío se produjo la máxima expansión y la conexión entre las cuencas del Colorado y Neuquina, llegando la influencia marina hasta el pié de los Andes. Las rocas sedimentarias que registran estos eventos en el norte de Patagonia fueron estudiadas por numerosos autores desde fines del siglo XIX y están expuestas en el sur de Mendoza, centro-este y norte de Neuquén, suroeste de La Pampa, Río Negro y norte de Chubut. Durante las últimas décadas, surgió un renovado interés por las mismas debido a las numerosas concentraciones esqueletales de invertebrados y vertebrados que contienen, ofreciendo una excelente oportunidad para conocer las modificaciones sufridas por los ecosistemas en latitudes medias del Hemisferio Sur antes de las extinciones del límite Cretácico/Paleógeno. El análisis sedimentológico de más de veinte secciones estratigráficas ubicadas a lo largo de 800 km en sentido noroeste-sureste, permitió reconocer diferencias en el arreglo de facies y en los ambientes depositacionales. En el sur de Mendoza y norte de Neuquén, correspondiente al sector andino de la cuenca Neuquina, que presenta una posición de retroarco, elevadas pendientes y abundante aporte sedimentario, las sedimentitas contenidas en la Formación Loncoche alcanzan espesores de más de 200 m. Éstas consisten en facies clásticas, granodecrecientes, desde arenosas-conglomerádicas a predominantemente pelíticas y evaporíticas, de ambientes fluvio-deltaicos y lacustres con sectores que evidencian influencia marina. Las pelitas de plataforma de la Formación Jagüel, cuando presentes, tienen escaso desarrollo, predominando las calizas fosilíferas de ambiente marino somero de la Formación Roca. En el sector oriental de la cuenca, caracterizado por influencia cratónica, baja pendiente y reducido aporte sedimentario, las sedimentitas están contenidas en la Formación Allen y sector inferior de la Formación Jagüel. La primera presenta espesores que no superan los 80 m, con facies clásticas arenosas en la base a pelíticas y evaporíticas hacia el techo que evidencian un ambiente fluvial con episodios lacustres a marino-marginal o marino somero dominado por mareas. En este sector las pelitas de plataforma de la Formación Jagüel tienen gran desarrollo, conteniendo el límite Cretácico/Paleógeno. En los alrededores del macizo de Somuncurá, las sedimentitas están incluidas en las formaciones Allen y Arroyo Barbudo (Miembro Aguada Cecilio) (al norte), Coli Toro (al oeste), Los Alamitos (al este), La Colonia (al sureste) y Paso del Sapo y Lefipán (al suroeste). Las secciones presentan, en general, un predominio de facies arenosas en la base a pelíticas hacia el techo con intercalaciones de evaporitas y tobas. Los ambientes han sido interpretados como fluviales y lacustres con escasa influencia marina a francamente marinos. Debido al carácter saltuario de los afloramientos, los numerosos

cambios laterales de facies, la falta de edades absolutas y los diferentes ambientes tectónicos involucrados, la correlación cronoestratigráfica entre algunas de las unidades estratigráficas mencionadas, como así también entre los distintos niveles fosilíferos, es aún uno de los grandes problemas a resolver en la geología de Patagonia.

PALEOZOOLOGÍA DE LA FORMACIÓN ALLEN (CAMPANIANO–MAASTRICHTIANO) EN EL BAJO DE SANTA ROSA, PROVINCIA DE RÍO NEGRO, ARGENTINA

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Recientes avances en el conocimiento de los fósiles provenientes de la localidad de Bajo de Santa Rosa se basan en la identificación precisa de la procedencia estratigráfica de restos de vertebrados colectados previamente (Martinelli y Forasiepi, 2004) y de nuevos hallazgos. Los restos óseos se localizan en niveles arenosos medianos y finos intercalados en una secuencia de limolitas y arcilitas (Salgado *et al*., 2007a, 2007b). En general, se infiere un ambiente marino-marginal para toda la secuencia en esta localidad, con planicies costeras dominada por mareas, surcadas por ríos efímeros (Salgado *et al*., 2007a, 2007b). Existen cuatro niveles de areniscas finas, algunos con evidentes signos de bioturbación, portadores de huevos de dinosaurios de tipos megaloolitos y faveoloolitos. El más basal de esos niveles ha brindado restos de saurópodos, terópodos y hadrosáuridos. Por encima de esos cuatro niveles, uno de areniscas medias con estratificación entrecruzada en artesa ha revelado restos de invertebrados, peces, lagartos esfenodontes, tortugas, mamíferos, restos fragmentarios de dinosaurios y plesiosaurios colectados mediante el lavado y tamizado de sedimentos. En otros lugares, ese nivel de areniscas presenta restos bien conservados de dinosaurios, actualmente en estudio. Por encima, en algunos sectores, se presenta un nivel arenoso bioturbado con trazas fósiles que denota condiciones de mezcla. Este nivel (que ya correspondería a la subunidad superior de Salgado *et al*. (2007a) ha aportado restos de un plesiosaurio policotílido de indudables hábitos marinos.

Martinelli, A. G. y A. M. Forasiepi. 2004. Late Cretaceous vertebrates from Bajo de Santa Rosa (Allen Formation), Río Negro province, Argentina, with the description of a new sauropod dinosaur (Titanosauridae). *Revista del Museo Argentino de Ciencias Naturales* 6: 257-305.

Salgado, L. Coria, R., Magalhaes Ribeiro, C. M. Garrido, A., Rogers, R., Simón, M. E., Arcucci, A. B., Curry Rogers, K., Paulina Carabajal, A., Apesteguía, S., Fernández, M., García, R. A. y M. Talevi. 2007a. Upper Cretaceous dinosaur nesting sites of Río Negro (Salitral Ojo de Agua and Salinas de Trapalcó-Salitral de Santa Rosa), Northern Patagonia, Argentina. *Cretaceous Research* 28: 392-404.

Salgado, L., Parras, A. y Z. Gasparini. 2007b. Un plesiosaurio de cuello corto (Plesiosauroidea, Polycotylidae) del Cretácico Superior del norte de Patagonia. *Ameghiniana* 44: 349-358.

DINILYSIA PATAGONICA SMITH-WOODWARD, 1901 PROVENIENTE DEL CRETÁCICO SUPERIOR (SANTONIANO–CAMPANIANO) DE PATAGONIA, UN TAXÓN CRUCIAL EN EL DEBATE SOBRE EL ORIGEN DE LAS SERPIENTES

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Desde su descubrimiento a principios del siglo XX, *Dinilysia patagonica* Smith-Woodward, 1901 continúa siendo una pieza clave en la discusión sobre el origen y la evolución temprana de las serpientes. Debido a ello, se ha encarado el reestudio de los especímenes craneanos de esta especie (incluyendo tomografías de rayos-X de alta resolución), a fin de reconocer nuevos rasgos anatómicos. Este análisis ha arrojado nueva evidencia sobre la naturaleza transicional de este importante taxón fósil, aportando nuevas luces al debate sobre el origen de las serpientes. Nuevas plesiomorfías han sido reconocidas, como ser la ausencia de una lámina vertical en el nasal, disposición netamente lateral del prefrontal, contacto extenso entre el vomer y el palatino, piso del *recessus scalae tympani* formado por el basioccipital, y ausencia de un pilar endocraneano que separe el telencéfalo del mesencéfalo. También se reinterpretó la región ótica, confirmando la presencia de *crista circumfenestralis*, una importante sinapomorfía de las serpientes. Por último, pudieron reconocerse por primera vez para una serpiente fósil estructuras del endocráneo y del oído interno, indicando una estructura similar a la presente en serpientes actuales para ambas regiones craneanas. El análisis filogenético realizado con esta nueva información, indica que *Dinilysia patagonica* junto a *Najash rionegrina* Apesteguía y Zaher, 2006, constituyen los grupos hermanos sucesivos del resto de las serpientes actuales y fósiles, entre las que se encuentran las serpientes marinas cretácicas de Medio Oriente y los "Madtsoiidae" Indo-Australianos. Esto sugiere que las principales transformaciones anatómicas que promovieron el origen del grupo ocurrieron en ambientes terrestres, sugiriendo un escenario evolutivo en el que dichas transformaciones tuvieron como fuerza selectiva a la alternancia de hábitos de vida fosoriales-de superficie que se registraron a lo largo de la historia del grupo.

Apesteguia, S. y H. Zaher. 2006. A Cretaceous terrestrial snake with robust hindlimbs and a sacrum. *Nature* 440: 1037-1040.

Smith Woodward, A. 1901. On some extint reptiles from Patagonia, on the genera *Myolania*, *Dinilysia*, and *Genyodectes*. *Proceedings Zoological Society of London* 1: 169-184.

NEUROANATOMÍA DE LOS DINOSAURIOS DEL CRETÁCICO SUPERIOR DE PATAGONIA: UN ENFOQUE EN *AUCASAURUS GARRIDOI* CORIA, CHIAPPE Y DINGUS 2002 (THEROPODA, ABELISAURIDAE)

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Si bien el neurocráneo de *Aucasaurus* Coria, Chiappe y Dingus, 2002 (MCF-PVPH 236) se preservó de manera incompleta (Paulina Carabajal, 2009, en prensa), fue posible confeccionar un molde endocraneano parcial en látex que permitió realizar inferencias sobre su neuroanatomía. El largo del encéfalo, medido desde el foramen magno hasta la base del tracto olfatorio (foramen craneano I), es de 100 mm, pero alcanza los 160 mm incluyendo el tracto y los bulbos olfatorios. Presenta su ancho máximo anterodorsalmente al proceso flocular del cerebelo, en la zona de los lóbulos ópticos. El tracto olfatorio es largo y relativamente ancho, presentado un ancho máximo de unos 22 mm justo por detrás de los bulbos olfatorios. Las cavidades ocupadas por los bulbos están separadas por un septo óseo (mesetmoides) de 5mm de espesor transversal. Suaves marcas en la cara ventral del frontal estarían indicando que el tamaño real de los bulbos olfatorios propiamente dichos es menor que la cavidad que los contiene, como fuera mencionado para los tiranosáuridos (Ali *et al*., 2008). Los conductos de las venas cerebrales dorsales tienen 5 mm de diámetro, y son relativamente cortos en comparación con otros terópodos (Paulina Carabajal, en prensa). Estos desembocan posteriormente en un seno venoso sagital dorsal que supera levemente el nivel del cerebro anterior. El proceso flocular es anteroposteriormente comprimido y presenta una constricción que lo separa en dos lóbulos, siendo el dorsal el de mayor tamaño. Esta morfología se corresponde con un receso flocular en forma de ocho, presente además en *Abelisaurus comahuensis* Bonaparte y Novas, 1985 (Paulina Carabajal, en prensa). El volumen estimado de la cavidad endocraneana preservada es de aproximadamente 25 ml sin incluir el tracto y bulbos olfatorios, que constituyen aproximadamente otros 10 ml. Comparaciones con el abelisáurido *Majungasaurus crenatissimus* Depéret, 1896 (Sampson y Witmer, 2007), muestran un endocráneo de prácticamente las mismas proporciones, si bien en *Aucasaurus* se observa una flexura cerebral levemente más cerrada y un seno sagital dorsal menos desarrollado que en el terópodo de Madagascar.

Ali, F., Zelenitsky, D. K., Therrien, F. y D. B. Weishampel. 2008. Homology of the 'ethmoid complex' of tyrannosaurids and its implications for the reconstruction of the olfactory apparatus of non-avian theropods. *Journal of Vertebrate Paleontology* 28: 123-133.

Bonaparte, J. F. y F. E. Novas. 1985. *Abelisaurus comahuensis* n. gen. n. sp. Carnosauria del cretácico superior de Patagonia. *Ameghiniana* 21: 259-265.

Coria, R. A., Chiappe, L. M. y L. Dingus. 2002. A new close relative of *Carnotaurus sastrei* Bonaparte 1985 (Theropoda: Abelisauridae) from the Late Cretaceous of Patagonia. *Journal of Vertebrate Paleontology* 22: 460-465.

Depéret, C. 1896. Note sur les Dinosauriens Sauropodes et Théropodes du Crétacé supérieur de Madagascar. *Bulletin de la Société Géologique de France* 21: 176-194.

Paulina Carabajal, A. 2009. [*El neurocráneo de los dinosaurios Theropoda de la Argentina. Osteología y sus implicancias filogenéticas*. Tesis Doctoral, Universidad Nacional de La Plata, 540 p. Unpublished].

Paulina Carabajal, A. en prensa. Braincases of abelisaurid theropods from the upper Cretaceous of north Patagonia. *Palaeontology*.

Sampson, S. D. y L. M. Witmer. 2007. Cranofacial anatomy of *Majungasaurus crenatissimus* (Theropoda: Abelisauridae) from the Late Cretaceous of Madagascar. *Journal of Vertebrate Paleontology*, *Memoir* 8: 32-102.

VARIACIONES EN EL GRADO DE REMODELACIÓN ÓSEA DEL POSTCRÁNEO DE UN ELASMOSÁURIDO (PLESIOSAUROIDEA, ELASMOSAURIDAE) DE LA FORMACIÓN ALLEN (CAMPANIANO–MAASTRICHTIANO, CRETÁCICO SUPERIOR) DE RÍO NEGRO, ARGENTINA

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Las características microestructurales óseas son utilizadas como un indicador relativo del grado de maduración en plesiosaurios. No obstante, poco se conoce sobre la secuencia cronológica de maduración ósea de las distintas partes un mismo esqueleto. Para explorar dicha secuencia, se analizaron secciones delgadas de distintos elementos de un mismo esqueleto de un plesiosaurio elasmosáurido (Museo de la Universidad del Comahue MUC-Pv 92) exhumado de la Formación Allen (Campaniano-Maastrichtiano, Cretácico Superior) de Lago Pellegrini, Provincia de Río Negro (Argentina). La muestra consistió en secciones delgadas de costillas, vértebra caudal, huesos indeterminados de la cintura pélvica, extremo distal de un húmero, base y extremo distal de un proceso transverso y una falange. La microestructura ósea, en consistencia con las características macroestructurales del esqueleto, sugiere que se trata de un individuo subadulto. Si bien el tejido muestra signos de remodelación, estos no llegan a desarrollarse en la totalidad del hueso El análisis comparativo de las secciones correspondientes a distintos huesos demostró que las secciones correspondientes a la cintura pélvica, costilla, vértebra caudal y extremo distal del proceso transverso presentan mayor proporción de tejido compacto y un grado de remodelación menor que las secciones correspondientes a la base del proceso transverso y extremo distal del húmero. Los resultados obtenidos indican que, si bien la microestructura es un elemento indicativo del grado de maduración del individuo, para establecer estadios ontogenéticos es importante tomar muestras de la mayor cantidad de elementos óseos que sea posible y no basar la determinación en elementos aislados.

INTERPRETACIÓN PALEOAMBIENTAL Y CONTENIDO FÓSIL DE LA FORMACIÓN ALLEN (CAMPANIANO–MAASTRICHTIANO) EN LA LOCALIDAD DE EL ABRA, PROVINCIA DE RÍO NEGRO, ARGENTINA

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En la localidad de El Abra, ubicada en el sector norte del Macizo de Somun Curá, la Formación Allen representa una sucesión granodecreciente, formada predominantemente por areniscas medianas y finas, limolitas e intercalaciones de tufitas. En su tercio inferior contiene concentraciones de vertebrados e invertebrados fósiles que, en conjunto con el análisis sedimentológico, permiten mejorar el conocimiento sobre la fauna y los paleoambientes del Campaniano–Maastrichtiano en el norte de Patagonia. Se midieron y describieron dos secciones estratigráficas al este del camino que une las localidades de Ramos Mexía y Yaminué: El Abra 1 (40º45′2.52″S–67º09′50.46″O) y El Abra 2 (40º44′59.16″S–67º9′30.30″O), de 15,3 m y 40,4 m de espesor respectivamente. De base a techo se reconocieron dos asociaciones de facies que representan diferentes ambientes depositacionales. La asociación de facies A, de entre 15 y 17 m de espesor, está integrada por areniscas finas y medianas macizas o con estratificación entrecruzada planar y en artesa, e intercalaciones de limolitas y arcilitas cuyo espesor varía entre 0,10 m y 3 m. La misma se habría formado bajo condiciones de moderada a alta energía, produciéndose la depositación fundamentalmente por corrientes tractivas. La asociación de facies B, de unos 24 m de espesor, está formada por limolitas macizas o laminadas con delgadas intercalaciones de areniscas finas y medianas, tufitas y chonitas, depositadas en un ambiente de baja energía por procesos de decantación dominantes. El sector medio de la asociación de facies A presenta numerosos restos de troncos y escasos ejemplares de *Hydrobia*? sp., como asi también un nivel conteniendo *Diplodon bodenbenderi* Doello-Jurado, 1927, en posición de vida y ejemplares asignados a *Paleoanculosa bullia* (Ihering, 1907). También en esta asociación, en ambas secciones, se reconoce una arenita subarcósica con clastos líticos e intraclastos pelíticos de hasta 3 mm de diámetro, con abundantes restos de vertebrados, que presentan una selección de tamaño unimodal (2–4 mm). En esta última se reconocieron vértebras, espinas y dientes de peces, y tortugas Chelidae indet. La presencia de ejemplares *in situ* de *Diplodon bodenbenderi* indica ambientes dulceacuícolas. Los gasterópodos representan ambientes de agua dulce o de baja salinidad. En base a las asociaciones de facies y al contenido fósil, se interpreta que las sedimentitas de la Formación Allen en el área estudiada fueron depositadas en un ambiente continental fluvio-lacustre, el cual experimentó una disminución en la energía del agente de transporte y un aumento en el aporte de sedimentos volcaniclásticos hacia el techo.

Doello-Jurado, M. 1927. Noticia preliminar sobre los moluscos fósiles de agua dulce mencionados en el estudio de R. Wichmann "Sobre la facies lacustre Senoniana de los Estratos con dinosaurios y su fauna". *Boletín de la Academia Nacional de Ciencias en Córdoba* 30: 407-416.

Ihering, H. von (1907). Les mollusques fossiles du Tertiaire et du Crétacé Superieur de l'Argentine. *Anales del Museo Nacional de Buenos Aires, serie 3* 7: 1-611.

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