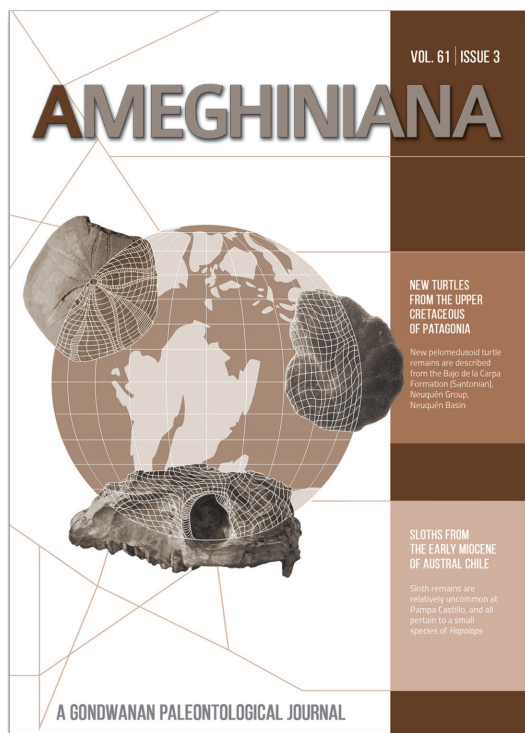




PELOMEDUSOID TURTLES FROM THE BAJO DE LA CARPA FORMATION (SANTONIAN, UPPER CRETACEOUS), RÍO NEGRO PROVINCE, PATAGONIA, ARGENTINA

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PLEASE SCROLL DOWN FOR ARTICLE

NEW TURTLES FROM THE UPPER CRETACEOUS OF PATAGONIA

New pelomedusoid turtle remains are described from the Bajo de la Carpa Formation (Santonian), Neuquén Group, Neuquén Basin

SLOTHS FROM THE EARLY MIOCENE OF AUSTRAL CHILE

Sloth remains are relatively uncommon at Pampa Castillo, and all pertain to a small species of *Hapalops*

PELOMEDUSOID TURTLES FROM THE BAJO DE LA CARPA FORMATION (SANTONIAN, UPPER CRETACEOUS), RÍO NEGRO PROVINCE, PATAGONIA, ARGENTINA

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Abstract. The fossil record of pleurodiran turtles in the Cretaceous of Patagonia is diverse throughout all basins, with Pelomedusoides being scarce compared to the Chelidae. In this article, new records of pelomedusoids are reported from the Bajo de la Carpa Formation (Santonian) at the La Bonita site, Río Negro Province, Argentina. Two specimens are described and referred to Podocnemidoidea by the combination of the following features: posterior marginals not extending over the costals, a straight xiphiplastron with rounded tips, short and U-shaped anterior lobe, a rhomboidal entoplastron, and a humeral-pectoral sulcus that crosses the entoplastron. The observed variability of the pelomedusoid plastron in the specimens recorded in the Neuquén Group shows that these new specimens present a new scute scheme. Evaluating the diversity observed in the Cretaceous pelomedusoids in the Neuquén Group, three stages of their evolution are defined. A first stage in the Cenomanian where the Bothremydidae appear, a second stage in the late Turonian–Coniacian interval where the Bothremydidae and Podocnemidoidea coexist, and a final stage in the Santonian–Campanian where only the Podocnemidoidea persist and increase the diversity and abundance of morphotypes.

Key words. Podocnemidoidea, Upper Cretaceous, Patagonia, Plastron variability, Diversity.

Resumen. TORTUGAS PELOMEDUSOIDES DE LA FORMACIÓN BAJO DE LA CARPA (SANTONIANO, CRETÁCICO SUPERIOR) DE LA PROVINCIA DE RÍO NEGRO, PATAGONIA, ARGENTINA. Los registros fósiles de tortugas Pleurodira en el Cretácico de Patagonia son diversos a lo largo de todas las cuencas, siendo los Pelomedusoides escaso en comparación con los Chelidae. En este artículo se dan a conocer nuevos registros de pelomedusoides de la Formación Bajo de la Carpa (Santoniano) en el sitio La Bonita, Provincia de Río Negro, Argentina. Se describen dos especímenes y se asignan a Podocnemidoidea por la combinación de las siguientes características: escudos marginales posteriores que no se extienden sobre las costales, un xifiplastrón recto con sus extremos posteriores redondeados, un lóbulo anterior, corto y en forma de U, un entoplastrón romboidal y un surco humeral-pectoral que atraviesa el entoplastrón. La variabilidad observada en el plastrón de pelomedusoides en los ejemplares registrados en el Grupo Neuquén muestra que estos nuevos ejemplares presentan un nuevo esquema de escudos. Evaluando la diversidad observada en pelomedusoides cretácicos en el Grupo Neuquén se definen tres etapas en su evolución. Una primera etapa en el Cenomaniano donde aparecen los Bothremydidae; una segunda etapa en el intervalo Turoniano–Coniaciano tardío donde conviven los Bothremydidae y Podocnemidoidea, y una etapa final en el Santoniano–Campaniano donde solo los Podocnemidoidea persisten y aumentan la diversidad y abundancia de morfotipos.

Palabras clave. Podocnemidoidea, Cretácico Superior, Patagonia, Variabilidad del plastrón, Diversidad.

PELOMEDUSOIDS are composed of 35 extant species distributed over Africa and South America (TTWG, 2021). According to Gaffney *et al.* (2006, 2011), this peculiar clade includes six families: four extinct (Ararypemydidae, Euraxemydidae, Bothremydidae, and Peiopemydidae), and two others with extant representatives (Podocnemididae and Pelomedusidae). The pelomedusoid remains from Patagonia are scarce in comparison with the Chelidae (de la Fuente, 2007; de la Fuente *et al.*, 2014; Maniel & de la Fuente, 2016), with only two named taxa: *Portezueloemys patagonica* (de la Fuente, 2003) from the Portezuelo Formation (Turonian–Coniacian), and *Elkanemys pritchardi* (Maniel *et al.*, 2021a) from the

Candeleros Formation (Cenomanian). However, when the fossil record of South America is considered, more than 40 species of Podocnemididae (stem-Podocnemididae, Podocnemididae) are recognized (Gaffney *et al.* 2011; Ferreira *et al.* 2018). In the Cretaceous layers of Patagonia, some specimens are published, Broin and de la Fuente (1993) are the first to mention the presence of this group for one locality (Embalse Río Colorado). After, de la Fuente (1993), de la Fuente (2003), and Maniel *et al.* (2021a) described and referenced three pelomedusoid taxa that are the only taxa known from the Cretaceous of Patagonia.

The aim of this paper is to describe new specimens referred to as Podocnemidoidea from the Bajo de la Carpa Formation (Fig. 1), evaluate the plastral variability of the Patagonian Pelomedusoides, and increase the knowledge of this clade, which is poorly known to the Cretaceous of Patagonia.

Institutional abbreviations. MAU, Museo Argentino Urquiza, Rincón de los Sauces, Neuquén Province, Argentina; MCF, Museo Carmen Funes, Plaza Huincul, Neuquén Province, Argentina; MMCH, Museo Municipal de Villa El Chocón "Ernesto Bachmann", Villa El Chocón, Neuquén Province, Argentina; MPCA, Museo Provincial Carlos Ameghino, Cipolletti, Río Negro Province, Argentina; MUC, Museo Universidad Nacional del Comahue, Neuquén Province, Argentina.

Anatomical abbreviations. ABD, abdominal scute; AN, anal scute; Ax pl, axillary buttress; En, entoplastron; Ep, epiplastron; EX, extragulars scute; FE, femoral scute; GU, gular scute; HU, humeral scute; Hyo, hyoplastron; Hyp, hypoplastron; In pl, Inguinal buttress; Is sc, ischiadic scar; M, marginal scute; Me, mesoplastra; P, pleural scute; Pb sc, pubic scar; PE, pectoral scute; Ph, peripherals; V, vertebral scute; Xi, xiphiplastron.

MATERIALS AND METHODS

Material

The material described here is housed in the collection of the Museo Paleontológico Carlos Ameghino under the collection numbers MPCA-PV 431 and 432. MPCA-PV 431 preserves only the peripheral bones corresponding to the end of the bridge and the posterior series and the left xiphiplastron attached to the posterior fragment of the left hypoplastron. MPCA-PV 432 preserves the anterior lobe of a plastron comprising epiplastra, the entoplastron, and hyoplastra.

SYSTEMATIC PALAEONTOLOGY

TESTUDINES Batsch, 1788

PLEURODIRA Cope, 1865

PELOMEDUSOIDES Cope, 1868

PODOCNEMIDOIDEA Cope, 1868

Gen. et sp. nov.

Figures 2, 3

Material. MPCA-PV 431 (Fig. 2). The left posterior lobe of the shell is preserved, where only one partially preserved costal (8th), a fragment of the suprapygal, and the peripheral bones corresponding to the end of the bridge plus the posterior series are recognized. The plastral fragment corresponding to the left xiphiplastron is attached to the posterior fragment of the left hypoplastron (the fragment that contacts the midline is also missing from the latter). MPCA-PV 432 (Fig. 3). The anterior lobe of a plastron comprises epiplastra, the entoplastron, and hyoplastra. The presence of mesoplastra can be determined by the contour and the suture that the hyoplastra reveals on their posterolateral margin.

Geographic occurrence. This material comes from the hill called "La Bonita" (39° 38' 15" S; 68° 32' 25" W) next to Cerro Policia town, NW of the Province of Río Negro, Argentina (Fig.1).

Stratigraphic occurrence. The specimen comes from the Bajo de la Carpa Formation, Neuquén Group. This Formation has been assigned to the Santonian (Garrido, 2010).

Description

MPCA-PV 431

Shell. These bones shell do not present any ornamentation patterns. The left posterior peripheral bone 6 is highly fragmented. In this peripheral, the sulcus that delimits the sixth and seventh marginal scutes can be identified. The posterior peripheral bones 7 to 11 are complete, allowing their contacts to be observed. The peripheral bones 7 and 8 are the largest with a sub rectangular contour, while peripherals 9, 10, and 11 decrease in size and become narrower. In ventral view, a fragment of the costal 8 is recognized. The lateral fragment of the left costal 8 is preserved contact with peripherals 9 and 10. The left fragment of the suprapygal bone is preserved contact to peripheral 11.

The costo-peripheral suture is located more medial than the pleuro-marginal sulcus, consequently the marginal scutes are restricted to the peripheral bones. The ninth marginal scute would be the widest of the posterior lobe of the carapace; the last marginal scutes (the 10th and 11th) are square.

Plastron. The left posterior lobe is preserved, however the hypoplastron is not complete, and the midline is not preserved. The external margin of the posterior lobe is

straight. In the external view, the hypoplastron presents the abdominal-femoral sulcus, which crosses the bone at the level of the inguinal pillar. In visceral view, the left inguinal pillar is recognized in position, although only its

lowest part is preserved. Its angle allows us to infer a shell that protrudes from the contour of the plastron. The xiphiplastron has a straight external margin. In the external view, the femoral-anal sulcus which runs along the bone at



Figure 1. Location map. 1. General map of Patagonia. The square represents the area of study. 2. Regional map of Neuquén and Río Negro Provinces. The red square represents the La Bonita site. Images from Landsat/Copernicus 2018. 3. La Bonita site. Dashed line, Area of La Bonita; blue circle, La Bonita hill where the turtles were recovered. Images from CNES/Airbus 2023. Google Earth, accessed January 2024.

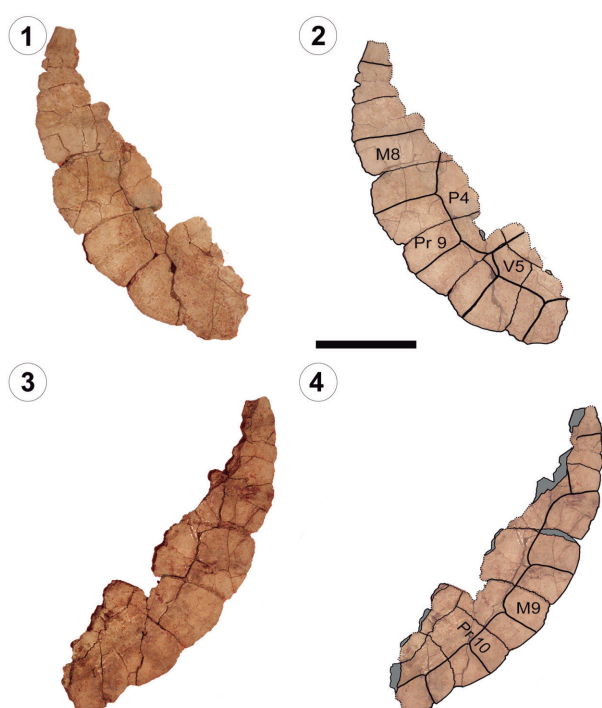


Figure 2. Carapace of MPCA-PV 431. 1. Photograph of the external view. 2. Drawing over the photograph in an external view. 3. Photograph of the visceral view. 4. Drawing over the photograph in a visceral view. Scale bar equals 5 cm.

the level of the pubic scar, can be seen. In the visceral view, both the pubic and the ischiadic scars are observed. The pubic scar, with an elliptical contour, preserves part of the pubis. Unfortunately, the fragmentary nature of the pubis does not reveal any diagnostic character. The ischiadic scar, triangular in outline, located well posterior in the bone and close to the midline, does not preserve any element of the ischium. The anal notch is angular, and the xiphiplastral tip is short and rounded.

MPCA-PV 432

Plastron. The anterior plastral lobe has anterolateral margins that diverge towards the axillary notch, giving the lobe a “U” shape. The axillo-inguinal distance appears to be greater than the length of the anterior lobe. The epiplastra are preserved, although the left one is broken. They are small and contact each other in the midline, enclosing the entoplastron below. The entoplastron is rhomboidal; the epiplastra and the hyoplastra delimit it. The hyoplastra are almost entirely preserved and are

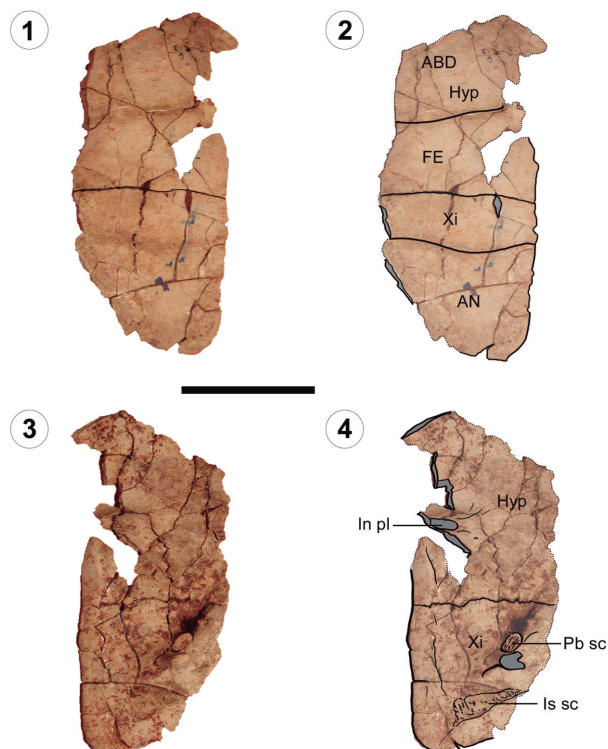


Figure 3. Plastron of MPCA-PV 431. 1. Photograph of the external view. 2. Drawing over the photograph in external view. 3. Photograph of the visceral view. 4. Drawing over the photograph in visceral view. Scale bar equals 5 cm.

more significant elements. On the external surface, the sulci that delimit the gular, extragulars, humerals, pectorals, and abdominals scute are preserved. The scheme presented by the anterior scutes is simple: a narrow gular scute enters the anterior third of the entoplastron, and two small extragular scutes on the epiplastra. The inter-abdominal sulcus is larger than the inter-pectoral sulcus, and this, in turn, is larger than the inter-humeral sulcus. The humeral-pectoral sulcus is displaced towards the anterior margin of the hyoplastra and enters the entoplastron in the posterior third. The pectoral-abdominal sulci are located more posteriorly in the hyoplastron and seem to not enter the mesoplastra. In the visceral view, the sutures are clearly distinguished; they are sigmoid, and there is no evidence of the entoplastral ridge for muscle insertion. Also in visceral view, both pillars are recognized, which are tall and slightly inclined anterolaterally. From the shape and position of the pillars, it can be inferred that the internal cavity of the individual would be quite large, and its shell would be bulging at the anterior margin.

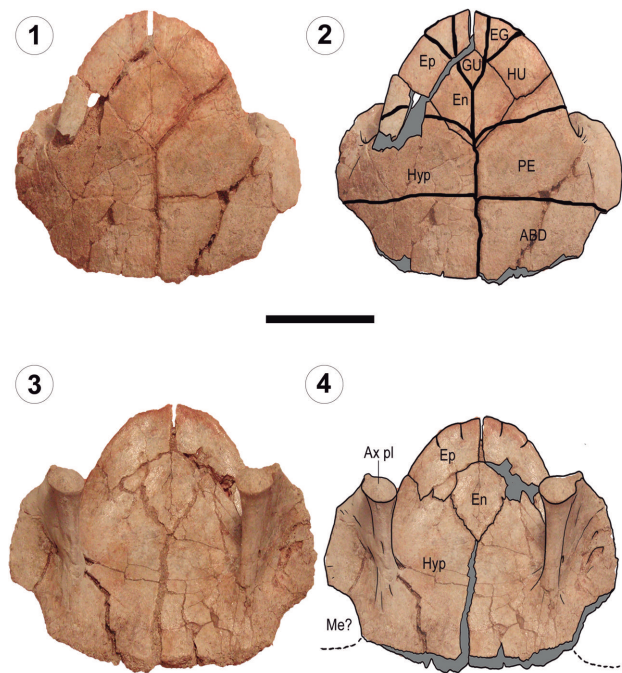


Figure 4. Plastron of MPCA-PV 432. 1. Photograph of the external view. 2. Drawing over the photograph in a ventral view. 3. Photograph of the visceral view. 4. Drawing over the photograph in a visceral view. Scale bar equals 5 cm.

DISCUSSION

Comparisons with Late Cretaceous pelomedusoids from Patagonia

The pelomedusoid remains are scarce in the Cretaceous of Patagonian, recognizing only three species (*Elkanemys pritchardi*, *Portezueloemys patagonica*, and MPCA-PV 7049). *Elkanemys pritchardi* and *Portezueloemys patagonica* were recovered from the lower sections of the Neuquén Group (Cenomanian–Early Coniacian). Meanwhile, according to de la Fuente (1993), MPCA-PV 7049 was found in the Río Colorado subgroup or Bajo de la Carpa Formation (following Garrido, 2010). Here we present a gen et sp. nov. represented by two specimens (MPCA-PV 431 and MPCA-PV 432) also recovered from the Bajo de la Carpa Formation

In the past years, some additional Patagonian Cretaceous pelomedusoids remains have been mentioned or described in several abstracts (Maniel & de la Fuente, 2017; Maniel *et al.*, 2021b; Jannello & Maniel, 2021; Sardá *et al.*, 2022; Gutiérrez *et al.*, 2022; Sardá & Maniel, 2023), and Doctoral Thesis (Maniel, 2016). These additional remains come from the Portezuelo, Plottier, Bajo de la Carpa, and

Anacleto formations, increasing the morphological diversity known for the Cretaceous pelomedusoids. The studied materials are compared with other specimens from the Bajo de la Carpa Formation exhibiting a different morphological scheme (Fig 5). MPCA-PV 432 shows an equidimensional rhomboidal contour (36 mm x 39 mm) as well as MPCA-PV 7049 (54 mm x 53 mm) but is different in MAU-PV-CO 477 (50 mm x 38 mm). Still, the epiplastron/entoplastron length ratio is different in MPCA-PV 432 (0.41), MAU-PV-CO 477 (0.36), and MPCA-PV 7049 (0.29). Also, the plastral formula in MPCA-PV 432 is $G > PE > HU$ meanwhile, in MPCA-PV 7049, it is $ABD > FE > AN > G = PE > HU$ differing in the humeral/gular length ratio (0.55 vs 0.62), humeral/pectoral length ratio (0.7 vs. 0.62), and pectoral/gular length (0.78 vs 1). The plastral formula in MAU-PV-CO 477 is $ABD > PE = G > HU$, with a humeral/gular length of 0.73, humeral/pectoral length ratio of 0.89, and pectoral/gular length ratio of 0.81. In MAU-CO-PV 477, the anterior plastral lobe presents a different ratio (0.64); meanwhile, MPCA-PV 7049 (0.49) exhibits similar conditions to MPCA-PV 432 (0.51). Other specimens referred to Podocnemididae indet. are recovered from the Anacleto Formation (MAU-PV-LI 552 and MCF-PVPH-707). Both preserve the posterior region of the plastron as well as MPCA-PV 431. In MPCA-PV 431, the lateral edge of the xiphiplastron is straight, converging to the posterior. Meanwhile, in MAU-PV-LI 552, this lateral edge is slightly curved and constricted in the posterior region of the xiphiplastron. Another features that can be compared is the anal scute. The anal scute in MPCA-PV 431 is bigger than in MCF-PVPH 707. Also, the suture between hypoplastron/xiphiplastron is straight in MPCA-PV 431, differing from the anteriorly converging suture in MAU-PV-LI 552 and the posterior converging suture in MCF-PVPH 707.

Comparisons with other named taxa

The specimen MPCA-PV 431 has specific characteristics that resemble some extant podocnemidids. The costo-peripheral suture/pleuro-marginal sulci relationship observed in this specimen is shared with the following species of *Podocnemis*, *P. vogli*, *P. erythrocephala*, and *P. unifilis* and presents some differences with *P. expansa*, in which case the sutures are practically coincident (Pritchard, 1984).

The biggest element of the marginal series in the described material is found in the 9th scute, as in *Bauruemys elegans* and Podocnemididae, except in the species *Peltocephalus dumeriliana*, whose most considerable element is the 11th scute (Pritchard, 1984). The marginal scutes in MPCA-PV 431 are concave dorsally as in Podocnemididae (Pritchard, 1984).

The plastron presents some differences, with those of *Podocnemis expansa* and *Podocnemis erythrocephala* which have anterior and posterior lobes of equal size. The anterior lobe of the plastron in MPCA-PV 432 is U-shaped, with the anterolateral margins diverging towards the axillary notch, a character that it shared with the extinct species *Portezueloemys patagonica* and *Bauruemys elegans*. The divergence is much more pronounced in the latter (Matiazzi, 2007), and with the extant species *Podocnemis vogli* and *Podocnemis expansa*. On the other hand, *Peltocephalus dumeriliana* has a lateral margin that is much less extended posterolaterally (Pritchard, 1984). The restriction of the extragular scutes to the epiplastra is a character that this specimen shares with the Podocnemididae family (de la Fuente, 1993). However, the pattern of gular and extragular scutes varies among the known species. In *Podocnemis expansa*, for example, the extragulars are small, and the gular is narrower at the anterior end (Pritchard, 1984). The humeral-pectoral sulcus in *Podocnemis expansa* crosses the entoplastron in a more anterior region than in the described specimen. The pattern in *Peltocephalus dumeriliana* presents very large extragulars that enclose a very small gular, which practically does not enter the entoplastron. The humeral-pectoral sulcus in *Peltocephalus dumeriliana* crosses the entoplastron in its posterior region (Pritchard, 1984), but closer to the edge than in the specimen MPCA-PV 432. The inter-abdominal sulcus in the extant genera of the family Podocnemididae would not seem to be the largest since in *Peltocephalus dumeriliana* it is, in fact, smaller than the inter-femoral and even smaller than the inter-pectoral, while in *Podocnemis expansa*, there is no doubt that the inter-femoral sulcus and the inter-pectoral sulcus are much larger than the inter-abdominal sulcus (Pritchard, 1984). *Portezueloemys patagonica* presents the same simple scheme of gular-extragular scutes (de la Fuente, 2003) as the specimen MPCA-PV 432. Also, in the species described from the Portezuelo Formation, a humeral-pectoral sulcus

enters the entoplastron in its posterior third; the humeral-pectoral sulcus does not enter the mesoplastron, and an inter-abdominal sulcus is larger than the inter-pectoral sulcus (the latter unknown for MPCA-PV 432). *Bauruemys elegans* presents some differences with the specimen MPCA-PV 432. On the visceral side, it has a marked entoplastral ridge, which in *Peltocephalus dumeriliana* is not very pronounced and in the specimen MPCA-PV 432 and in *Podocnemis expansa* is absent. On the external side, the humeral-pectoral sulcus crosses the entoplastron in the middle, while in MPCA-PV 432 this sulcus crosses more posteriorly. The humeral-pectoral sulcus in *Bauruemys elegans* also enters the epiplastron, as in *Podocnemis expansa*. In specimen MPCA-PV 432, the epiplastra are not crossed by the humeral-pectoral sulcus.

The angle of the posterior lobe of specimen MPCA-PV 431 allows us to infer that this is not the case but rather like those of *P. vogli* and *P. unifilis*, which have posterior lobes that are longer than wide (Pritchard, 1984). The anal notch presents similarities with the genus *Podocnemis*, which presents angular notches, although the degree of angularity varies within the group (Pritchard, 1984). *Portezueloemys patagonica* and *Elkanemys pritchardi* presents a posterior plastral lobe with straight and medially inclined lateral margins that is also observed in the MPCA-PV 431 specimen. *Bauruemys elegans* presents a straight hypoplastron-xiphiplastron contact (Matiazzi, 2007), meanwhile in *Elkanemys pritchardi* the contact is convex. In the specimen MPCA-PV 431, this contact is sigmoid. The inguinal buttress of *Bauruemys elegans* is projected similarly to what is observed in the hypoplastron of the specimen MPCA-PV 431 and among current podocnemidids. The abdomino-femoral sulcus observed in *Bauruemys elegans*, *Elkanemys pritchardi*, and *Portezueloemys patagonica* crosses the hypoplastron at the level of the inguinal process as in specimen MPCA-PV 431. The femoral-anal sulcus that crosses the xiphiplastral bone in *Elkanemys pritchardi*, *Bauruemys elegans*, *Podocnemis* spp., and *Peltocephalus dumeriliana* presents a straight sulcus that elongated in a "V" shape (Maniel *et al.*, 2021a; Matiazzi, 2007), unlike the specimen MPCA-PV 431 and *Portezueloemys patagonica* where the sulcus is concave elongated in a "W" shape. The pubic scar with a narrow, elliptical contour oriented posterolaterally is also present in *Elkanemys pritchardi*,

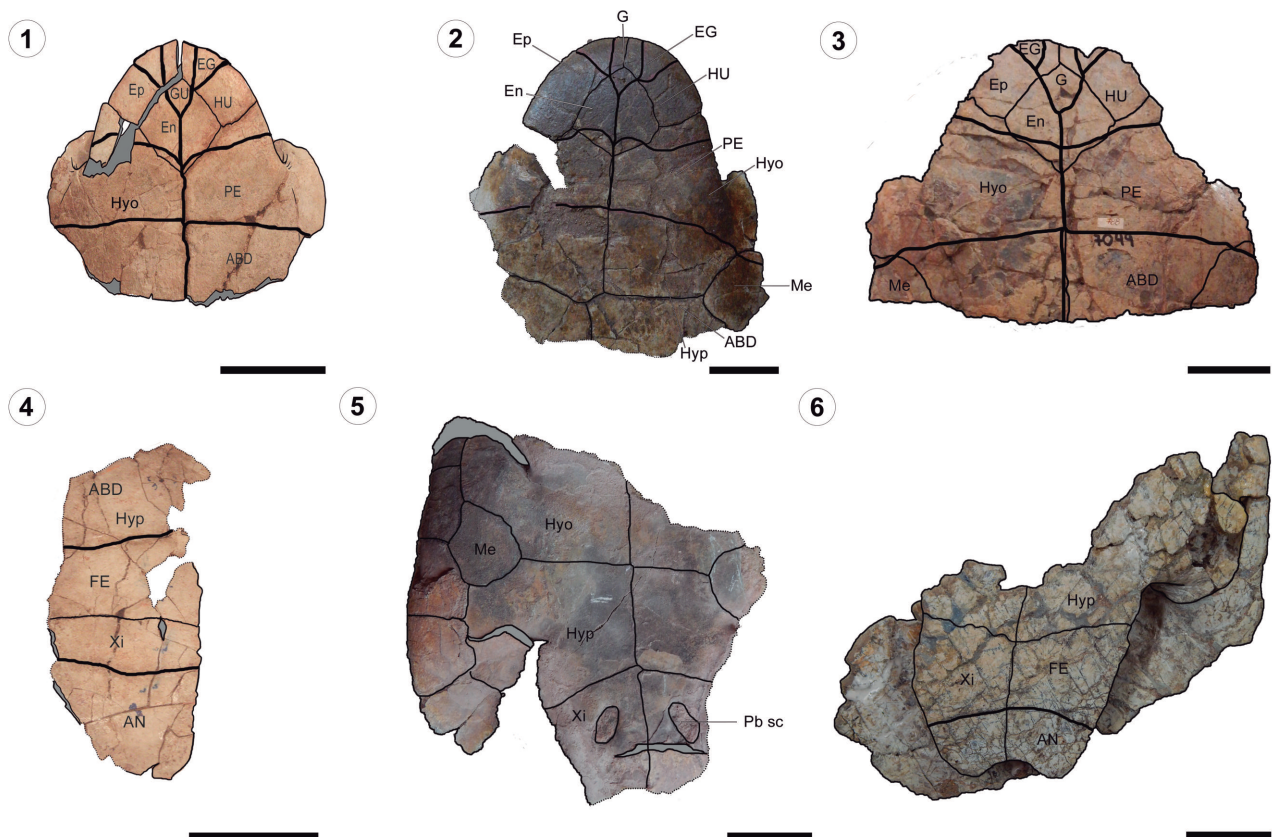


Figure 5. Comparison of plastra from the Bajo de la Carpa Formation. 1. MPCA-PV 432. 2. MAU-CO-PV 477. 3. MPCA 7049. 4. MPCA-PV 431. 5. MAU-LI-PV 552. 6. MCF-PVPH 707. Scale bar equals 5 cm.

Bauruemys elegans, *Podocnemis expansa*, and *Peltocephalus dumeriliana*. The ischiadic scar in *Bauruemys elegans*, *Peltocephalus dumeriliana*, and *Podocnemis unifilis* has a subtriangular contour and a position on the xiphiplastron very similar to that observed in specimen MPCA-PV 431. In contrast, *Elkanemys pritchardi* presents a narrower scar with an elongated lateral extreme of the ischiadic suture.

Diversity of Pelomedusoides in the Late Cretaceous of the Neuquén Group (Neuquén Basin)

The Neuquén Group was deposited during the Late Cretaceous of Patagonia in the interval Cenomanian–Campanian. According to Garrido (2010), nine formations are recognized from bottom to top: Candeleros, Huincul, Cerro Lisandro, Portezuelo, Los Bastos, Sierra Barrosa, Plottier, Bajo de la Carpa, and Anacleto. The records of turtles in the Neuquén Group are summarized in Broin and de la Fuente (1993), de la Fuente (2007), de la Fuente *et al.* (2014), Maniel and de la Fuente (2016), Maniel (2016) and Maniel (2021). The pelomedusoides have been recognized

in the Candeleros Formation by the presence of the Bothremydidae *Elkanemys pritchardi* (Maniel *et al.*, 2021a) found near Villa El Chocón, Neuquén Province. This taxon is the most ancient record of a Pelomedusoides in Patagonia and extends the paleobiogeographic range of this extinct family known in the north region of South America. Pelomedusoid remains are recognized neither in the Huincul or the Cerro Lisandro formations. On the other hand, at the Portezuelo Formation de la Fuente (2003) described *Portezueloemys patagonica* as a Podocnemidinura. This taxon represents the most ancient record in Patagonia of a Podocnemidinura and constitutes the oldest evidence of the coexistence in the same site of Chelidae and Pelomedusoides. At 80 km northeast, the Lago Los Barreales area exhibits an important extension of the Portezuelo Formation that has a diverse fauna of tetrapods, including several remains of Pelomedusoides. Oliveira *et al.* (2008) mentioned a specimen belonging to Podocnemidoidea composed of cranial and postcranial remains. The authors considered that it was a different taxon from *Portezueloemys patagonica*. Recently,

an important number of Pelomedusoides (at least 17 specimens) was recovered from the Baal site (Sardá *et al.*, 2022, Sardá & Maniel, 2023). Those specimens have been recognized as a new taxon with a neural series similar to that known for *Elkanemys pritchardi*. These assumptions allow the recognition of at least two different lineages of Pelomedusoides in the Portezuelo Formation. As in the Huincul and Cerro Lisandro formations, in the Los Bastos and the Sierra Barrosa formations, no records of Pelomedusoides are described. In the Plottier Formation, a specimen (MAU-PV-PH 418) was mentioned by Maniel *et al.* (2021b) as cf. *Elkanemys* is based on the presence of the peculiar arrangement in the neural series, as described for *Elkanemys pritchardi*. The records in the Bajo de la Carpa and Anacleto formations are more abundant, but no taxon has been nominated yet. From the Planicie de Banderitas, near Loma de la Lata, Neuquén Province, de la Fuente (1993) described a new Podocnemididae composed of a carapace

and plastron partially preserved. Another record from Bajo de la Carpa Formation is recorded at Cerro Overo and La Invernada sites, north of Neuquén Province near Rincón de los Sauces. The presence of four specimens (MAU-PV-CO 476, MAU-PV-CO 477, MAU-PV-LI 552, MAU-PV-LI 553) with at least three different morphotypes allows for an increase in the diversity of this group (Maniel, 2016; Maniel & de la Fuente, 2017). Finally, at the Sierra Barrosa site, one specimen (MCF-PVPH 707) recovered from the Anacleto Formation is recorded. This specimen is mentioned as a Podocnemidoidea indet. being the most austral record of a Podocnemidoidea in the Anacleto Formation (Maniel, 2016).

The material described here (MPCA PV 431 and MPCA PV 432) comes from the Bajo de la Carpa Formation, increasing the diversity of the Pelomedusoides from the Neuquén Group and allowing the recognition of an important peak of diversity and abundance in the late Late Cretaceous at Bajo de la Carpa Formation (Table 1). Also,

TABLE 1. Specimens of Pelomedusoids from Patagonia

	Systematic	Species name (or indet.)	Formation	Site	Citation
MAU-PV-CO 476	Podocnemidoidea	indet.	Bajo de la Carpa	Cerro Overo	Maniel and de la Fuente (2017)
MAU-PV-CO 477	Podocnemidoidea	indet.	Bajo de la Carpa	Cerro Overo	Maniel and de la Fuente (2017)
MAU-PV-LI 552	Podocnemidoidea	indet.	Bajo de la Carpa	La Invernada	Maniel and de la Fuente (2017)
MAU-PV-LI-553	Podocnemidoidea	indet.	Bajo de la Carpa	La Invernada	Maniel and de la Fuente (2017)
MAU-PV-PH 418	Bothremydidae	cf. <i>Elkanemys</i>	Plottier	Puesto Hernandez	Maniel <i>et al.</i> (2021b)
MCF-PV-PH-707	Podocnemidoidea	indet.	Anacleto	Sierra Barrosa	Maniel (2016)
MCF-PV-PH-338	Podocnemidinura	<i>Portezueloemys patagonica</i>	Portezuelo	Sierra del Portezuelo	de la Fuente (2003)
MCF-PV-PH-339	Podocnemidinura	<i>Portezueloemys patagonica</i>	Portezuelo	Sierra del Portezuelo	de la Fuente (2003)
MPCA PV 7049	Podocnemididae	gen et sp nov.	Bajo de la Carpa	Planicie de Banderitas	de la Fuente (1993)
MPCA PV 431	Podocnemidoidea	gen et sp nov.	Bajo de la Carpa	La Bonita	This work
MPCA PV 432	Podocnemidoidea	gen et sp nov.	Bajo de la Carpa	La Bonita	This work
MMCH-PV 73	Bothremydidae	<i>Elkanemys pritchardi</i>	Candeleros	Villa El Chocón	Maniel <i>et al.</i> (2021a)
MUC-PV 2219	Bothremydidae	cf. <i>Elkanemys</i>	Portezuelo	Lago Barreales	Sardá and Maniel (2023)

the revision of the diversity in the Neuquén Group allows us to propose a first step in the evolution of this group, led by the arrival of the Bothremydidae clade in the Cenomanian. A second stage during the Turonian–Coniacian where the presence of a Podocnemidoidea lineage together with the Bothremydidae until the late Coniacian–early Santonian, when the last one disappears. Finally, the third stage, where the Podocnemidoidea continues increasing the abundance and morphological diversity until the end of the Neuquén Group in the Campanian. Also, two gaps are recognized, one in the Late Cenomanian–Early Turonian and another in the middle Coniacian, but it is necessary to conduct more field works in these formations to corroborate this condition.

CONCLUSIONS

Two new specimens referred to Podocnemidoidea are described from the Bajo de la Carpa Formation. The following features allow to include them within Podocnemidoidea: the costo-peripheral suture/pleuro-marginal sulcus, a straight xiphiplastron with rounded xiphiplastral tip, an anterior short and U-shaped lobe, a rhomboidal entoplastron, and a humeral-pectoral sulcus that crosses the entoplastron.

A comparison with other pelomedusoid remains recovered from Neuquén Group point out that the specimens of La Bonita represents a different morphotype.

The diversity of Pelomedusoides from the Neuquén Group shows three different stages of their evolution: (1) the appearance of the Bothremydidae clade in the Cenomanian; (2) the coexistence of Bothremydidae and Podocnemidoidea from the Late Turonian until the late Coniacian; (3) the continuity of Podocnemidoidea increased the diversity and abundance from the Santonian until the late Campanian.

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