

Short communication

A pelomedusoid (Testudines, Pleurodira) plastron from the Lower Cretaceous of Alagoas, Brazil



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ABSTRACT

The oldest records of crown-Pleurodira turtles were from the Aptian (Lower Cretaceous) of northeastern Brazil and northern Africa. Recently, a new side-necked turtle was reported from the Morro do Chaves Formation, Sergipe-Alagoas Basin, Brazil, extending the First Occurrence Datum of that crown-clade to the Barremian. Here, we report a partial panpelomedusoid plastron from the shales of that same stratigraphic unit, which may represent a previously undescribed taxon. Its small size, loose sutures, and the strong constriction in the xiphiplastra, suggest that it corresponds to a juvenile individual.

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1. Introduction

The oldest panpleurodiran turtle (Joyce et al., 2004), *Caribemys oxfordiensis* de la Fuente and Iturralde-Vinent, 2001, was recorded from the Oxfordian (Upper Jurassic) of the Jagua Formation, western Cuba, suggesting a Tethyan origin for this lineage. The crown-group Pleurodira, on the other hand, had its oldest record in the Aptian deposits of Gadoufaoua, Niger (Broin, 1980; Joyce et al., 2013) and the Aptian–Albian (Lower Cretaceous) Santana Formation, northeastern Brazil, with four taxa, *Araripemys barretoii* Price, 1973 (Meylan, 1996; Meylan and Gaffney, 1991), *Euraxemys essweini* Gaffney, Tong and Meylan, 2006, *Cearachelys placidoi* Gaffney, Campos and Hirayama, 2001, and *Brasillemys josai* Lapparent de Broin, 2000. Recently, the first side-necked turtle from the Lower Cretaceous (Barremian) Morro do Chaves Formation (Fig. 1) was reported in abstracts (Gallo et al., 2009; Romano and Gallo, 2012; Romano et al., 2012) based on a partial skull and shell. It was interpreted as a Podocnemoidea, and as the oldest known Pelomedusoides (Romano and Gallo, 2012), but these claims cannot be reproduced yet, as no formal description is available. Here, we describe another turtle specimen from the Morro do Chaves Formation (Fig. 2) composed of a partial plastron.

1.1. Geological setting

The Sergipe-Alagoas Basin, located in northeastern Brazil (Fig. 1), has been divided into five super-sequences (Campos Neto et al., 2007). The “Rift” Super-Sequence extends from the Berriasian to the Aptian, and comprises the Feliz Deserto, Penedo, Barra de Itiúba, Morro do Chaves, Coqueiro Seco, Poção, and Maceió formations (Campos Neto et al., 2007). The age of the Morro do Chaves Formation was recently considered late Barremian based on palynomorphs (Antonioli et al., 2009). It is composed of coquinoid carbonates and shales, deposited in a lacustrine or near-shore environment (Campos Neto et al., 2007).

Institutional Abbreviations – **INPA-H**, Coleção de Herpetologia do Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil; **LPRP**, Laboratório de Paleontologia da Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brazil; **MCP**, Museu de Ciências e Tecnologia da PUCRS, Porto Alegre, RS, Brazil; **MPEG**, Museu Paraense Emílio Goeldi, Belém, PA, Brazil; **UERJ**, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.

2. Systematic paleontology

Testudines Batsch, 1788

Pleurodira Cope, 1865

Pelomedusoides Broin, 1988

Gen. et sp. indet.

Figs. 2 and 3A

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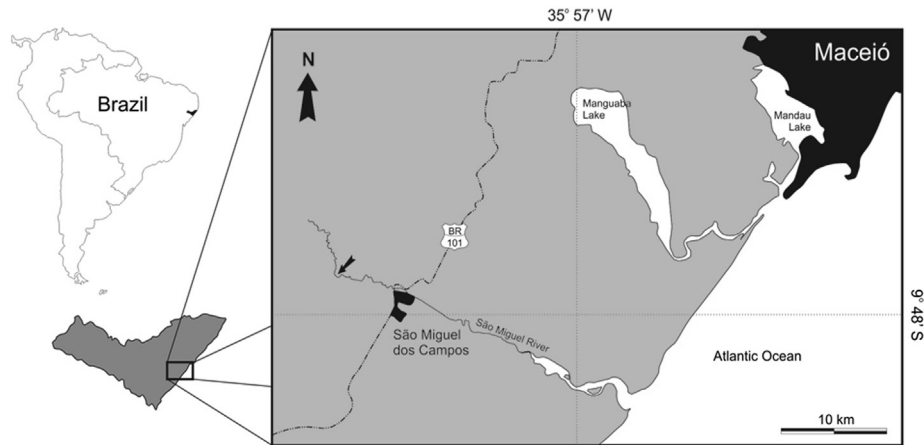


Fig. 1. Location map showing the site (black arrow) where MCP 4721PV was found (highlighted from an Alagoas State map, northeastern Brazil). Urban areas in black; main road (BR 101) indicated by dotted lines.

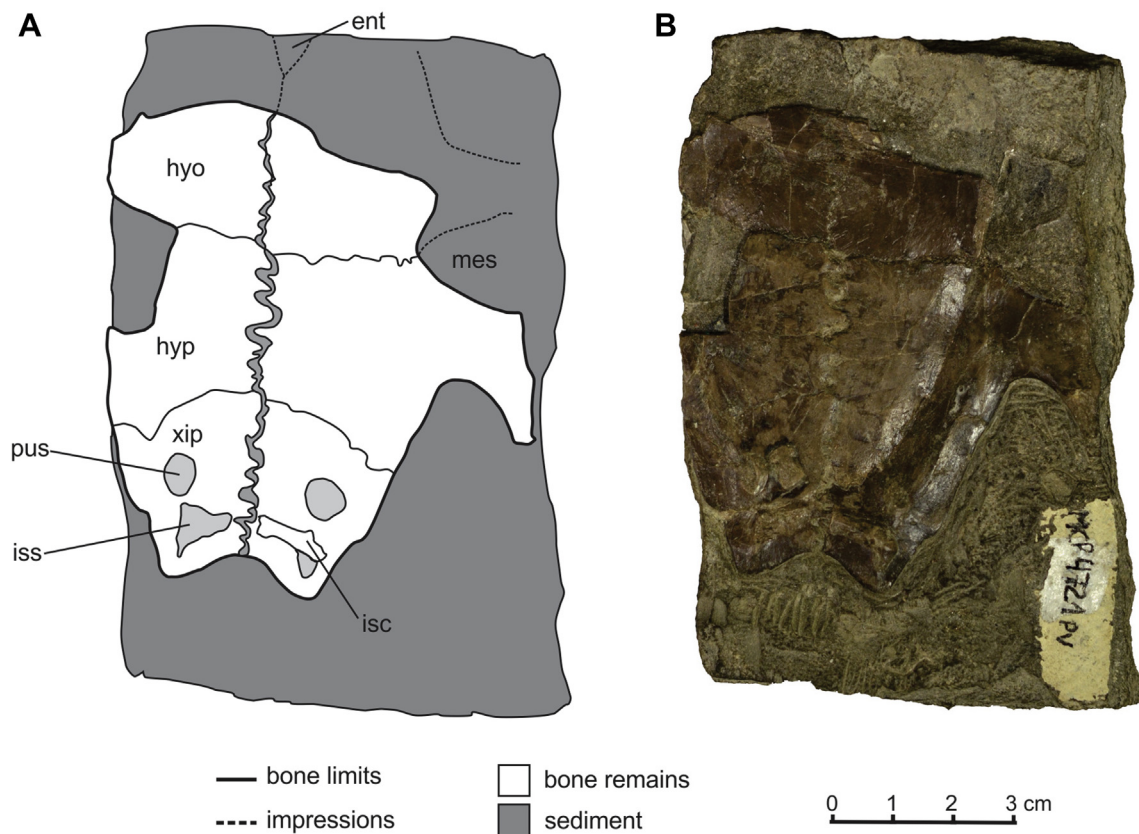


Fig. 2. MCP 4721PV visceral surface of the plastron: Outline drawing (A) and photograph (B). Abbreviations: **ent**, entoplastron; **hyo**, hyoplastron; **hyp**, hypoplastron; **isc**, ischium; **iss**, ischiadic scar; **pus**, pubic scar; **mes**, mesoplastron; **xip**, xiphiplastron.

Referred material. MCP 4721PV, caudal portion of a plastron including fragments of both hyoplastra, both hypoplastra (the left incomplete), both xiphiplastra, and impressions of the right mesoplastron, the lateral edge of the right hyoplastron, and the caudal edge of the entoplastron (Figs. 2 and 3A).

Locality and Horizon. The specimen was collected at the site “Mina IV” or “Santa Teresa” (9°45′34″S; 36°09′16″W), from the shales of the Morro do Chaves Formation, Barremian (Lower Cretaceous) of the Sergipe-Alagoas Basin (Antonioli et al., 2009); 800 m northwest of the “Ato!” or “CIMPOR” cement plant, about

5 km northwest of the town of São Miguel dos Campos-AL, Brazil (Fig. 1).

Description. The plastron is preserved still imbedded in the bearing rock, with the visceral surface exposed. The caudal plastral lobe seems slightly longer than the estimated length of both the cranial lobe and the bridge area. The caudal edge of the entoplastron reveals a V-shaped suture with the hyoplastra. This resembles the condition in most pleurodire, differing from the arrow-shaped entoplastron of *Araripemys barretoii* (Meylan, 1996) and *Laganemys tenerensis* Sereno and ElShafie, 2012. The

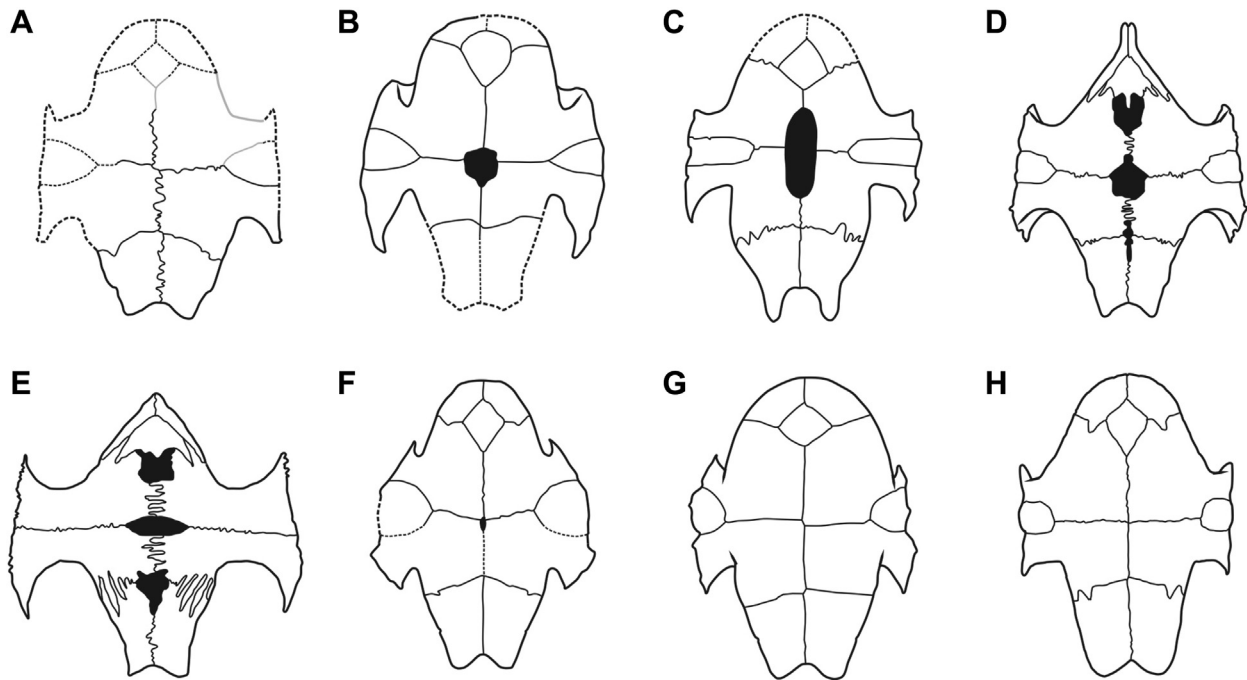


Fig. 3. Pleurodire plastrons showing bone sutures: interpretative drawing of MCP 4721PV (A), *Caribemys oxfordiensis* modified from de La Fuente and Iturralde-Vinent (2001) (B), *Yaminuechelys maior* modified from Bona and de La Fuente (2005) (C), *Laganemys tenerensis* modified from Sereno and ElShafie (2012) (D), *Araripemys barretoii* modified from Meylan (1996) (E), *Euraxemys essweini* modified from Gaffney et al. (2006) (F), *Cearachelys placidoi* modified from Gaffney et al. (2001) (G), and *Bauruemys elegans* reconstruction based on LPRP/USP 0202, LPRP/USP 0362, and LPRP/USP 0363 (H). Full lines = bone edges; gray lines = impressions of bone edges; dotted lines = missing edges.

median suture between the pair of hypoplastra and xiphiplastra is strongly sinuous/interdigitated, as in *Araripemys barretoii* and *Laganemys tenerensis*, but seems less tightly sutured than in these taxa, perhaps revealing the juvenile condition of the specimen. The plastron bears no fontanelles along the median line, differing from *Araripemys barretoii* and *Laganemys tenerensis*, as well as some extinct chelids, e.g. *Yaminuechelys gasparinii* de la Fuente, Lapparent de Broin and Manera de Bianco, 2001, and *Y. maior* Bona and de la Fuente, 2005, and basal panpleurodires, e.g. *Notoemys laticentralis* Cattoi and Freiburg, 1961, *Caribemys oxfordiensis*, and *Platycheilus oberndorferi* Wagner, 1853 (Bräm, 1965; de la Fuente and Iturralde-Vinent, 2001).

The mesoplastron is small, cuneiform, and laterally displaced. It differs from the longer than wide mesoplastra of *Euraxemys essweini* (Gaffney et al., 2006), from the much wider cuneiform mesoplastra of extinct chelids, e.g. *Prochelidella cerrobarcinae* de la Fuente, Umazano, Sterli and Carballido, 2011, and *Yaminuechelys gasparinii* (de la Fuente et al., 2001), and from the rounded mesoplastra of bothremydids and podocnemids, such as *Cearachelys placidoi* (Gaffney et al., 2001) and *Portezueloemys patagonica* de la Fuente, 2003. In contrast, it resembles the mesoplastra of some basal pleurodires (Fig. 3), e.g. *Caribemys oxfordiensis* and *Notoemys laticentralis* (de la Fuente and Iturralde-Vinent, 2001; Lapparent de Broin et al., 2007). The bridge is cranio-caudally short, composed by the hypoplastral, mesoplastral, and hypoplastral bones, and nearly horizontal. This reveals a dorsoventrally flattened shell, as in *Araripemys barretoii*, *Laganemys tenerensis*, and *Yaminuechelys gasparinii*, differing from the verticalized bridge more common among pleurodires, e.g. *Bauruemys elegans* (Suárez, 1969) and *Prochelidella portezuelae* de la Fuente, 2003. The axillar and inguinal buttresses are not preserved.

The lateral margins of the xiphiplastra are not strongly concave as in some basal pleurodires, e.g. *Notoemys laticentralis* (Lapparent de Broin et al., 2007), and chelids, e.g. *Yaminuechelys maior* (Bona and de la Fuente, 2005). Instead, it resembles the condition in *Euraxemys essweini* (Gaffney et al., 2006), *Cearachelys placidoi* (Gaffney et al., 2001), *Laganemys tenerensis* (Sereno and ElShafie, 2012), and *Elochelys convenarum* Laurent, Tong and Claude, 2002, which bear a subtle constriction at the caudal portion of the xiphiplastra, as also found in extant taxa, e.g. *Podocnemis sextuberculata* Cornalia, 1849. Yet, the constriction in MCP 4721PV is more strongly marked, as seen in some chelids, e.g. *Phrynops williamsi* Rhodin and Mittermeier, 1983 and *Platemys macrocephala* Rhodin, Mittermeier and McMorris, 1984, as well as in the ?*Galianemys* specimen AMNH 30550 (Gaffney et al., 2006, Fig. 274) and “*Stereogenys*” *libyca* Andrews, 1903 (Gaffney et al., 2011, Fig. 85). Likewise, a similar xiphiplastral constriction is found in juvenile/subadult specimens (Fig. 4) of *Podocnemis expansa* (Schweigger, 1812), again suggesting that the described specimen is not fully grown. The four “pleurodiran” xiphiplastral scars for the pelvic bones are preserved in MCP 4721PV. The rounded pubic scars differ from the “pill-shaped”, “narrow diagonal suture” typical of pleurodires (Gaffney et al., 2006, pg. 641), and may prove to be autapomorphic. A fragment of the ischium is preserved on the right side, whereas the free left ischiadic scar is V-shaped (*sensu* Gaffney et al., 2006) and larger than the pubic scar, as seen in most pleurodires.

3. Discussion

It is possible to assign MCP 4721PV to the Panpleurodira clade, because it possesses xiphiplastral scars, indicating a sutural articulation between the pelvis and the shell, and lacks the medial contact between mesoplastra (Joyce, 2007). The absence of medial plastral fontanelles suggests that it is also not an Araripemydidae,

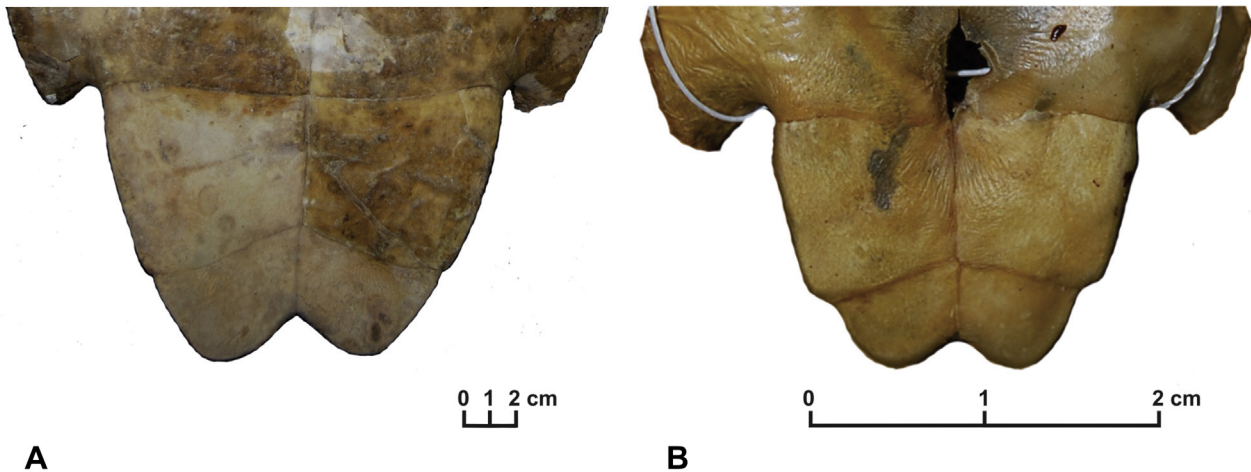


Fig. 4. Caudal portion of the plastron of *Podocnemis expansa*. Adult, INPA-H 31022 (A) and juvenile, MPEG 0454 (B).

nor a basal member of Panpleurodira, whereas the combination of small cuneiform lateral mesoplastra and almost equal sized plastral bridges and posterior lobes (de la Fuente et al., 2011) excludes MCP 4721PV from Chelidae. These traits, along with the shape of the mesoplastra, suggest a Panpelomedusoides affinity (França and Langer, 2005; Romano et al., 2012). Yet, there are no preserved characters suggesting a closer relation to any pelomedusoid subgroups.

Although no autapomorphic characters were identified, the general morphology of MCP 4721PV is not alike that of any other known panpelomedusoid, suggesting that it may represent a previously undescribed taxon. In comparison to the other known fossil turtle from of the Sergipe-Alagoas Basin, UERJ.MC 2, preliminary described in three congress abstracts (Gallo et al., 2009; Romano and Gallo, 2012; Romano et al., 2012), MCP 4721PV has a less rounded mesoplastron and a cranio-caudally shorter xiphiplastron. Nevertheless, this is not accepted as strong evidence that these belong to different species. A detailed description of UERJ.MC 2 may clarify this question, but, the loose sutures, the small size (around 100 mm, vide Gaffney et al., 2011, Table 4, for comparisons), and the strong caudal constriction in the xiphiplastra suggest that the specimen described here may correspond to a juvenile/subadult. Obviously, it is not possible to guarantee that MCP 4721PV corresponds to a juvenile/subadult of the same taxon as UERJ.MC 2, although this is likely given their same provenance.

Finally, the assignment of MCP 4721PV to crown-Pleurodira has key implications for fossil calibrations of divergence dating analyses among turtles. Recently, Joyce et al. (2013) employed *Teneremys lapparenti* Broin, 1980, a panpelomedusoid from the Aptian of Gadoufaoua, Niger, as the oldest uncontroversial crown-Pleurodira, establishing a late Aptian minimum constraint for the age-of-origination estimate of the clade. With the record of MCP 4721PV, this dating should be extended to the top of the Barremian, implying an older origin for Pleurodira.

4. Concluding remarks

The specimen described here represents the oldest record of a panpelomedusoid turtle alongside UERJ.MC 2, both from the Barremian Morro do Chaves Formation. This implies an older origin for Pleurodira, previously estimated as late Aptian. Although a new taxon was not erected based on this specimen, its morphology does not agree to that of any previously described panpelomedusoid. Conversely, its small size, loose sutures and strong caudal

constriction in the xiphiplastra suggests that it represents a juvenile/subadult.

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