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Turtles from the Mata Amarilla Formation (Cenomanian), Santa Cruz, Argentina: The southernmost record of *Prochelidella* spp. (Pleurodira: Chelidae)

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TURTLES FROM THE MATA AMARILLA FORMATION (CENOMANIAN), SANTA CRUZ, ARGENTINA: THE SOUTHERNMOST RECORD OF *PROCHELIDELLA* SPP. (PLEURODIRA: CHELIDAE)

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Abstract. The fossil record of Cretaceous turtles in Santa Cruz Province is scarce. Turtles have been reported from the Mata Amarilla Formation (Cenomanian), the Cerro Fortaleza Formation (Campanian–Maastrichtian), and the Chorrillo Formation (early Maastrichtian). In this contribution, we examined all the turtle remains recovered from six localities in the Mata Amarilla Formation, nearby Mata Amarilla farm (Santa Cruz Province, Argentina). These fossils are housed at the "Padre Molina" Museum in Río Gallegos, Santa Cruz. Most of the carapace and plastral remains are conferred to an indeterminate small species of cf. *Prochelidella* sp., while the remaining fragments are attributed to a mid-sized species of an indeterminate Chelidae. *Prochelidella* spp. is a group of turtles distributed in Chubut, Río Negro, Neuquén, and Mendoza provinces, ranging from the Aptian to the Maastrichtian, with two main gaps (late Albian and Coniacian–Santonian). The recognition of cf. *Prochelidella* sp. in the Austral-Magallanes Basin extends the geographic range of this group more than 500 km south to the previously known southernmost record of *Prochelidella, Pr. argentinae*, from the Golfo San Jorge Basin (Chubut, Argentina).

Key words. Southern Patagonia. Cretaceous. Pleurodira. Chelidae. Shell fragments. Geographic range.

Resumen. TORTUGAS DE LA FORMACIÓN MATA AMARILLA (CENOMANIANO), SANTA CRUZ, ARGENTINA: EL REGISTRO MÁS AUSTRAL DE *PROCHELIDELLA* SPP. (PLEURODIRA: CHELIDAE). El registro fósil de tortugas del Cretácico en la provincia de Santa Cruz es escaso. Se han reportado tortugas de la Formación Mata Amarilla (Cenomaniano), de la Formación Cerro Fortaleza (Campaniano–Maastrichtiano) y de la Formación Chorrillo (Maastrichtiano temprano). En esta contribución examinamos todos los restos de tortugas recuperados de seis localidades en la Formación Mata Amarilla, cerca de la estancia Mata Amarilla (provincia de Santa Cruz, Argentina). Estos fósiles se encuentran en el Museo "Padre Molina" en Río Gallegos, Santa Cruz. La mayoría de los restos, consistentes en restos de caparazón y plastrón, se confieren a una pequeña especie indeterminada de *Prochelidella*, mientras que los fragmentos restantes se atribuyen a una especie de tamaño medio de un Chelidae indeterminado. *Prochelidella* spp. es un grupo de tortugas distribuidas en las provincias de Chubut, Río Negro, Neuquén y Mendoza, que se extienden temporalmente desde el Aptiano hasta el Maastrichtiano, con dos hiatos principales (Albiano tardío y Coniaciano–Santoniano). El reconocimiento de cf. *Prochelidella* sp. en la Cuenca Austral-Magallanes extiende el rango geográfico de este grupo 500 km más al sur del registro más austral previamente conocido de *Prochelidella, Pr. argentinae*, de la Cuenca del Golfo San Jorge (Chubut, Argentina).

Palabras clave. Patagonia meridional. Cretácico. Pleurodira. Chelidae. Fragmentos de caparazón. Distribución geográfica.

THE FOSSIL record of Cretaceous turtles in Santa Cruz Province (southern Patagonia, Argentina) is scarce (Fig. 1.1). Goin *et al.* (2002) reported 1,650 shell fragments of turtles from Mata Amarilla Formation (Cenomanian), but only 100 were identifiable. These materials were referred to chelid turtles based on the presence of a pelvic girdle sutured to the shell, carapace-plastron connection through pegs and sockets, costo-peripheral fontanelles, and the presence of a cervical

scute in the nuchal plate. According to these authors, at least two species belonging to *Phrynops* and *Chelus* groups (*sensu* Broin & de la Fuente, 1993) were recognized. One species is represented by small specimens (carapace length *circa* 10 cm) and nuchal plates slightly wider than long, like in juvenile individuals of *Phrynops* spp. (Goin *et al.*, 2002). The other species is bigger (carapace length 25–30 cm) with plastral projections well developed as in *Chelus fimbriata* (Goin *et al.*, 2002). Probably, there is a third species represented by peripheral plates of moderate size, like *Phrynops* spp. (Goin *et al.*, 2002). Lately, Novas *et al.* (2008) mentioned the presence of fragmentary turtle remains in the Cerro Fortaleza Formation (Campanian–Maastrichtian)—before considered Pari Aike Formation by Feruglio (1938)—. Recently, Moyano-Paz *et al.* (2022) described some remains identified as Hydromedusinae indet. and to Meiolaniformes indet. from the Chorrillo Formation (Maastrichtian).

The first Cretaceous chelid taxa from Patagonia were named in the publications of de la Fuente *et al.* (2001) and Lapparent de Broin & de la Fuente (2001). After these publications, several chelid taxa were described (see a synthesis in de la Fuente *et al.*, 2014 and Maniel & de la Fuente, 2016). Among them, the Cretaceous *Prochelidella* spp. is the most diverse and widespread taxon from Patagonia (Fig. 2). Several specimens of this genus were cited or described: *Pr. cerrobarcinae* from Cerro Barcino Formation (Aptian), Chubut (de la Fuente *et al.*, 2011); *Prochelidella* indet. from Lohan Cura Formation (early Albian), Neuquén (Lapparent de Broin & de la Fuente, 2001; de la Fuente, 2007; Maniel & de la Fuente, 2016); *Prochelidella* indet. from Candeleros Formation (early Cenomanian), Neuquén (Lapparent de Broin & de la Fuente, 2001; Maniel & de la Fuente, 2016); *Prochelidella* sp. from Candeleros Formation (early Cenomanian), Río Negro (de la Fuente, 2007); *Pr. argentinae* from Bajo Barreal Formation (late Cenomanian), Chubut (Lapparent de Broin & de la Fuente, 2001); *Pr. buitreraensis* from Candeleros Formation (late Cenomanian), Río Negro (Maniel *et al.*, 2020); *Pr. portezuelae* from Portezuelo Formation (Turonian), Neuquén (de la Fuente, 2003); and cf. *Prochelidella* sp. from Lonchoche Formation (Campanian–Maastrichtian), Mendoza (Previtera & González Riga, 2008) and from Los Alamitos and Allen formations (Campanian–Maastrichtian), Río Negro (Lapparent

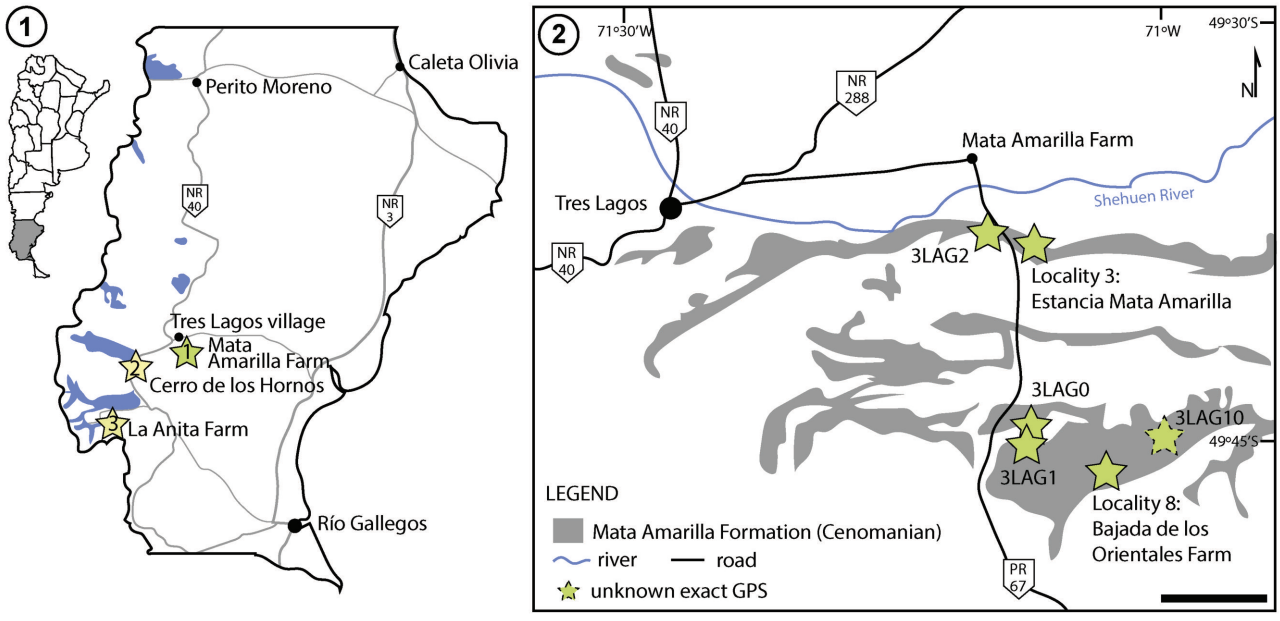

Figure 1. Map showing the Cretaceous fossil record of turtles from the Santa Cruz Province and fossiliferous localities of the Mata Amarilla Formation. **1,** three fossiliferous localities from the Cretaceous with turtle remains known from Santa Cruz Province; **2,** map showing the outcrops of the Mata Amarilla Formation with the fossiliferous localities with turtle remains. Abbreviations: **1,** Mata Amarilla farm, Mata Amarilla Formation (Cenomanian) (Goin *et al.*, 2002); **2,** Cerro de los Hornos locality, Cerro Fortaleza Formation (Campanian–Maastrichtian) (Novas *et al.*, 2008); **3,** La Anita farm, Chorillo Formation (early Maastrichtian) (Novas *et al.*, 2019); **NR,** national road; **PR,** provincial road. Scale bar= 7 km.

de Broin & de la Fuente, 2001; de la Fuente, 2007; Maniel *et al.*, 2020). To this extended list, we can add likely most of the specimens here described from Mata Amarilla Formation.

Here, we describe turtle specimens recovered from the lower section of the Mata Amarilla Formation (Cenomanian) of the Austral-Magallanes Basin (Santa Cruz Province, Argentina) housed at the "Padre Molina" Museum in Río Gallegos, Santa Cruz province (Otero & Novas, 2022). Two species of side-necked chelid turtles of different sizes are recognized: a small species conferred to cf. *Prochelidella* sp. and a larger species referred to Chelidae indet. The significance of the presence of the genus *Prochelidella* in the Austral-Magallanes Basin is discussed.

Institutional Abbreviations. DNPM-DGM, Departamento Nacional de Produçao Mineral, Divisao de Geología e Mineralogia, Rio de Janeiro, Brazil; **MCZ,** Museum of Comparative Zoology at Harvard University, Cambridge, United States of America; **MNHN-P,** Paleontological collection, Museum National d'Histoire Naturelle, Paris, France; **MNRJ,** Museu Nacional-Universidade do Rio de Janeiro, Rio de Janeiro, Brazil; **MPM-PV,** Museo Regional Provincial "Padre Jesus Molina", Río Gallegos, Argentina; **FMNH,** Field Museum of Natural History, Chicago, United States of America; **USNM,** Smithsonian National Museum of Natural History, Washington DC, United States of America; **ZSM,** Zoology Collection, Zoologische Staatssammlung München, Munich, Germany.

GEOLOGICAL SETTING

The Austral-Magallanes Basin is located in southern Argentina and Chile and contains a siliciclastic stratigraphic record ranging from the Late Jurassic to the Neogene (Cuitiño *et al.*, 2019). This basin covers an extended area of approximately 230,000 km^2 in southern Patagonia and Tierra del Fuego and it is limited to the east by the Deseado Massif (Varela *et al.*, 2012a). According to several authors (*e.g.*, Biddle *et al.*, 1986; Robbiano *et al.*, 1996; Kraemer *et al.*, 2002; Peroni *et al.*, 2002; Ramos, 2002; Rodriguez & Miller, 2005) the geological history of the Austral-Magallanes Basin is characterized by three main tectonic stages. These phases are: the rift stage, the stage of thermal subsidence, and the foreland stage. At the last stage, and between the middle Cenomanian and lower Coniacian, a deformation event took place. According to Varela (2011, 2015), the onset of the compressional phase in the middle sector of the Austral-Magallanes Basin is denoted by the west to east progradation of the fluvial-estuarine facies of the Mata Amarilla Formation.

The study area (Fig. 1.2) is located, approximately, 20 km south of Mata Amarilla farm (49° 34' 54" S; 71° 11' 04" W) and to the east of Tres Lagos village in the south of Shehuen river (Santa Cruz Province, Argentina). In this area, Mata Amarilla Formation crops out. This lithostratigraphic unit is composed by gray and blackish siltstone and claystone, alternating with banks (measuring between 1 and 10 m) constituted by whitish and yellowish-gray-fine to medium-grained sandstone deposited in littoral and continental paleoenvironments (Russo & Flores, 1972; Russo *et al.*, 1980; Arbe, 1989, 2002; Poiré *et al.*, 2004; Varela *et al.*, 2011, 2012a, 2012b, 2018). Based on facies analyses, Varela (2011) divided the Mata Amarilla Formation into three sections. The lower facies consists of fine-grained sediments with paleosol development interbedded with laminated shales and coquinas (Varela *et al.*, 2011, 2012a; Griffin & Varela, 2012). The fossil turtles were found in these lower facies. The middle section of the Mata Amarilla Formation was dated using U-Pb at 96.2±0.7 Ma, which corresponds to the middle Cenomanian. Besides, after Varela *et al.* (2012a: fig. 8) the onset of the foreland stage is considered to clearly coincide with the deposition of the lower section of the Mata Amarilla Formation (Cenomanian, ~100 Ma in age). In this sense, a tuff from the upper part of the underlying Piedra Clavada Formation has been dated as the latest late Albian (101±0.9 Ma; Poiré *et al.*, 2017).

The fossil record of the Mata Amarilla Formation is composed by a diverse assemblage of palynomorphs (64 species) characteristic of the Early Cretaceous Patagonian assemblage with a relatively scarcity of angiosperm pollen (Santamarina *et al.*, 2020), the cycadal *Zamuneria amyla* (Martínez *et al.*, 2017), a podocarp-dominated fossil forest (Varela *et al.*, 2016), angiosperms flora (Iglesias *et al.*, 2007), fulguroid and coleopter insects (Petrulevičius *et al.*, 2014), 13 mollusk taxa (Griffin & Varela, 2012), the dipnoan *Atlantoceratodus iheringi* (Cione *et al.*, 2007), hybodontiform and neoselachian chondrichthyans, "holostean" and teleostean neopterygians (Goin *et al.*, 2002), elasmosaurid

plesiosaurs (O'Gorman & Varela, 2010), crocodylians, chelid turtles, a carcharodontosaur theropod (Novas *et al.*, 1999), sauropods, a basal ornithopod (Coria & Salgado, 1996), and several mammaliaforms (Martin *et al.*, 2022).

SYSTEMATIC PALEONTOLOGY

TESTUDINES Batsch, 1788
PAN-CHELIDAE Joyce *et al.*, 2004, (2021)

cf. ***Prochelidella*** sp.
Figures 2–3

Referred material. MPM-PV 1157a–d, four costal 1; MPM-PV 1157e, pygal bone; MPM-PV 1157f, entoplastron; MPM-PV 1157g–o, xiphiplastral fragments; MPM-PV 1218a, nuchal bone; MPM-PV 1218b, neural bone; MPM-PV 1218d–g, peripheral bones (f, left peripheral 1); MPM-PV 1218h–l, costal bones; MPM-PV 1218r–v, costal bones; MPM-PV 1219a, peripheral bone; MPM-PV 1228b, costal bone; MPM-PV 1228c, neural bone; MPM-PV 23054, left costal 1; MPM-PV 23055, neural; MPM-PV 23056, suprapygal; MPM-PV 23057, entoplastron.

Localities. Specimens were found in six different localities (Fig. 1.2), located nearby Mata Amarilla farm (49° 34′ 54″ S; 71° 11′ 04″ W), Bajada de los Orientales farm, and Tres Lagos village, south Shehuen river (Santa Cruz Province, Argentina) (Goin *et al.*, 2002: fig. 1; Varela *et al.*, 2012a: fig. 3, localities 2 and 8).

Horizon. Lower section of the Mata Amarilla Formation, Cenomanian (early Late Cretaceous) (Varela *et al.*, 2012a).

Description

Carapace (Fig. 2). Nuchal bone. Two nuchal bones are preserved in the sample (MPM-PV 1218a and 1228a; Fig. 2.1–2.2). Although none of them is complete, we can estimate that the nuchal bone is wider than long as in *Prochelidella argentina* and *Pr. portezuelae* (Lapparent de Broin & de la Fuente, 2001: fig. 3; de la Fuente, 2003: figs. 1–2). The cervical scute is present. It is trapezoidal in shape, being longer than wide as in *Pr. cerrobarcinae* (de la Fuente *et al.*, 2011: fig. 2a–b) and in *Pr. buitreraensis* (Maniel *et al.*, 2020: fig. 4A).

Neurals. MPM-PV 1218b might represent a neural 1 (Fig. 2.3). It is an elongate neural, longer than wide with rounded edges as the neural 1 of *Pr. cerrobarcinae* (de la Fuente *et al.*, 2011: fig. 2a), *Pr. portezuelae* (de la Fuente, 2003: figs. 1–2), and other extant chelids with continuous anterior neural series such as *Chelus fimbriata* (MCZ 146145), *Phrynops geoffroanus* (USNM 306646), and *P. hilarii* (USNM 5410). A sulcus crosses horizontally on the posterior half of the dorsal surface of the plate. This might represent the sulcus separating vertebral scutes 1 and 2. MPM-PV 1228c is a neural hexagonal in shape with short sides anteriorly (Fig. 2.4). It is an even neural (no sulcus crossing it) and could represent neural 4 or 6.

Suprapygal. There is a posterior part of the suprapygal bone (MPM-PV 23056) preserved (Fig. 2.5). The suprapygal was covered by vertebral 5 and the anterior part of both marginals 12, contrary to *Pr. cerrobarcinae* where the marginals 12 do not extend over the suprapygal bone.

Pygal. There is a pygal bone (MPM-PV 1157e) but it is not complete (Fig. 2.6). The sulcus separating both marginals 12 is present along the midline of the plate.

Costals. Odd and even costals are preserved (Fig. 2.7–2.19). Odd costals preserve the sulci between vertebral scutes and between vertebrals and pleurals. In even costals, there is a sulcus between pleural scutes. In dorsal view, costal 1 was covered by vertebrals 1 and 2 and pleural 1 as indicated by the preserved sulci (MPM-PV 23054; Fig. 2.7). It appears that vertebral 1 is narrower than vertebral 2. On the visceral surface, the scar for the axillary buttress is observed. The axillary buttress seems to extend half of the width of the costal as in *Pr. buitreraensis*, whereas in *Pr. portezuelae* the axillary buttress extends up to the first lateral third of costal 1. A short scar for the thoracic rib 1 is preserved.

There are two costals very small, denoting juvenile specimens in the sample (MPM-PV 1218k–l; Fig. 2.12–2.13).

There is one remain recognized as costal 8 (MPM-PV 1228b; Fig. 2.19). In dorsal view, the sulci between vertebrals 4 and 5 and between vertebrals and pleural 4 are preserved. In visceral view, the iliac scar is preserved.

Peripherals. Several peripherals are preserved (MPM-PV 1218a–d, 1219a; Fig. 2.20–2.23) both free and bridge peripherals. Marginal scutes covered peripheral bones only,

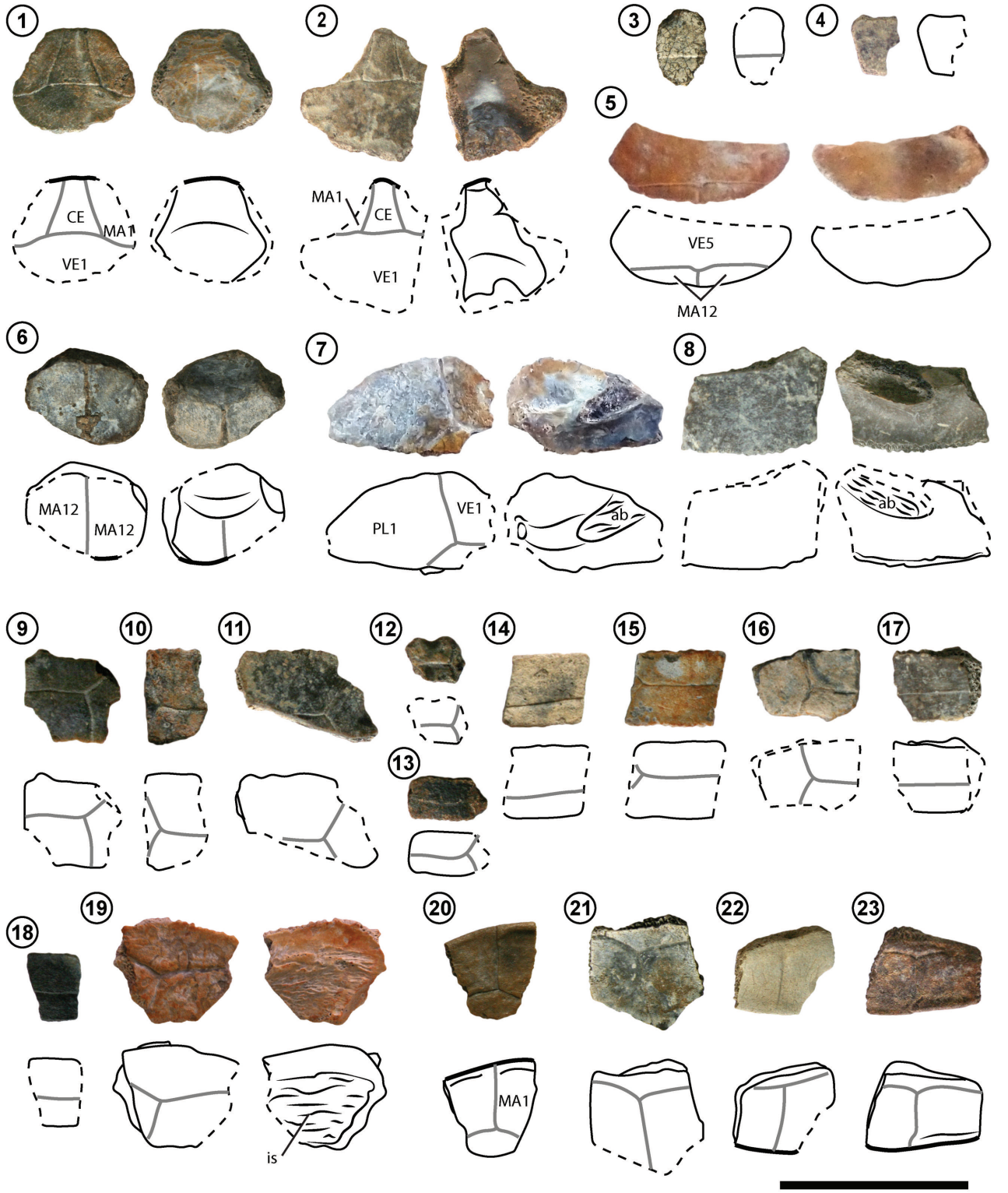

Figure 2. Carapacial remains of cf. ***Prochelidella*** sp. from the Mata Amarilla Formation (Cenomanian), Santa Cruz, Argentina. **1, MPM-PV 1218a**, nuchal in dorsal and ventral views; **2, MPM-PV 1228a**, nuchal in dorsal and ventral views; **3, MPM-PV 1218b**, neural 1; **4, MPM-PV 1228c**, even neural; **5, MPM-PV 23056**, suprapygal; **6, MPM-PV 1157e**, pygal in dorsal and ventral views; **7, MPM-PV 23054**, left costal 1; **8, MPM-PV 1157a**, right costal 1 in dorsal and visceral views; **9–13, MPM-PV 1218h–l**, odd costals in dorsal view; **14–18, MPM-PV 1218r–v**, even costals; **19, MPM-PV 1228b**, left costal 8 in dorsal and visceral views; **20, MPM-PV 1218f**, left peripheral 1; **21, MPM-PV 1218d**, peripheral; **22, MPM-PV 1218g**, peripheral; **23, MPM-PV 1219a**, peripheral. Abbreviations: **ab,** axillar buttress; **CE,** cervical scute; **is,** iliac scar; **MA,** marginal scute; **PL,** pleural scute; **VE,** vertebral scute. Dotted lines indicate broken borders. Thick lines indicate carapace external rim. Scale bar= 3 cm.

except the marginals 12 that covered the posterior part of the suprapygal (MPM-PV 23056; Fig. 2.5–2.6). Pleural scutes reached peripheral plates as well. Bridge peripherals have pegs to receive the tips of the ribs (dorsal) and the tips of the hyo-hypoplastron (ventral), showing that the connection between the plastron and the carapace was weak.

Plastron (Fig. 3). Entoplastron. There are two complete entoplastra preserved (MPM-PV 1157f, 23057; Fig. 3.1–3.2). MPM-PV 1157f has a tear-drop shape (Fig. 3.1), being longer than wide as in *Pr. cerrobarcinae* (de la Fuente *et al.*, 2011: fig. 4a–b) and *Pr. portezuelae* (de la Fuente, 2003: figs. 2–3). It was covered by the gular scute that reaches almost the posterior end of the entoplastron in contrast to the condition in *Pr. cerrobarcinae* and *Pr. portezuelae*. Besides, the left extragular reached the entoplastron, but not the right one. This lack of symmetry in the anterior part of the plas-

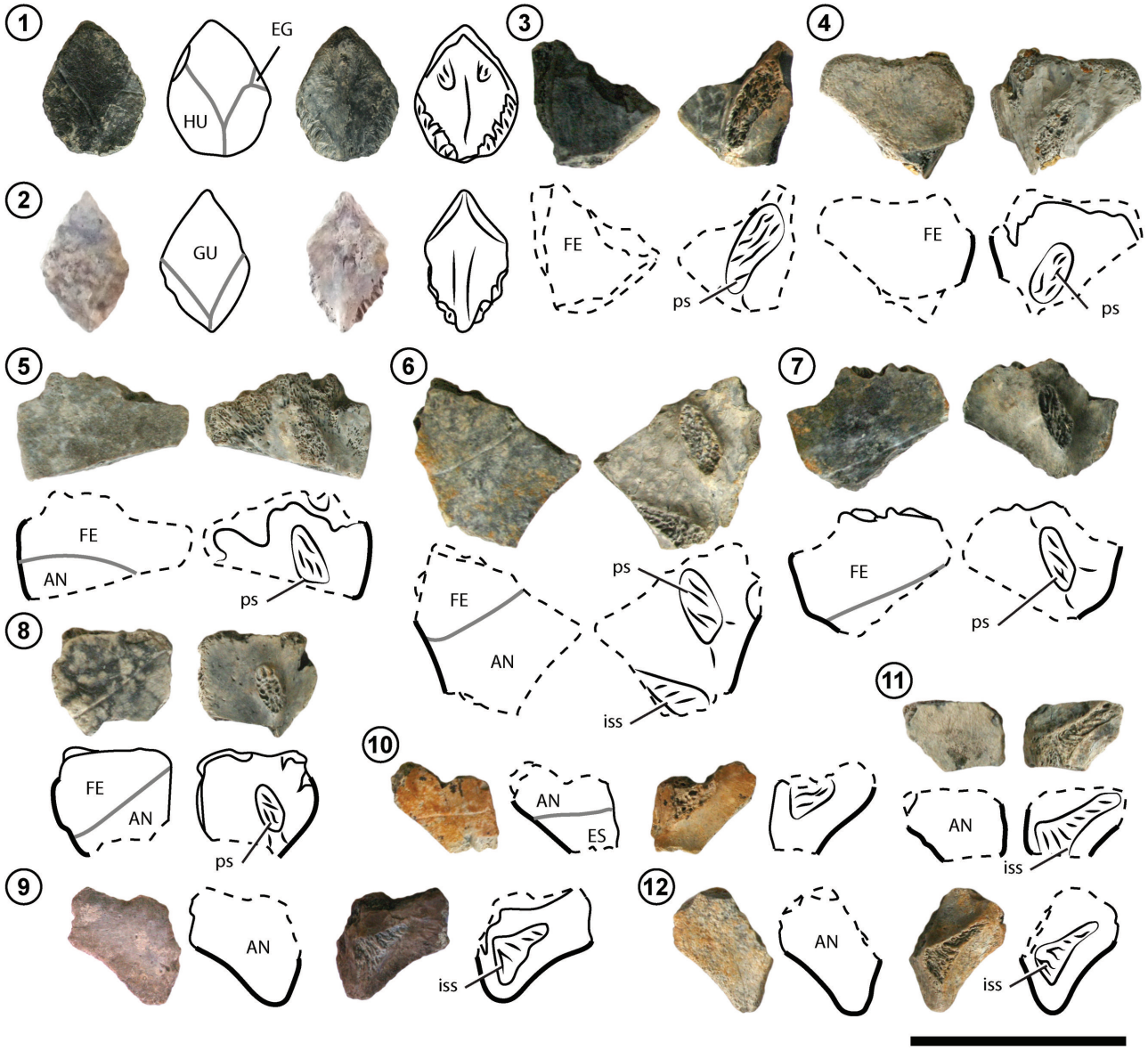

Figure 3. Plastral remains of cf. ***Prochelidella*** sp. from the Mata Amarilla Formation (Cenomanian), Santa Cruz, Argentina. **1, MPM-PV 1157f**, entoplastron in ventral and visceral views; **2, MPM-PV 23057**, entoplastron in ventral and visceral views; **3–4, MPM-PV 1157g–h**, left xiphiplastra; **5–8, MPM-PV 1157i–l**, right xiphiplastra; **9, MPM-PV 1228e**, left xiphiplastral tips; **10–12, 1157m–o**, left xiphiplastral tips. Abbreviations: **AN,** anal scute; **EG,** extragular scute; **ES,** extra scute; **FE,** femoral scute; **GU,** gular scute; **HU,** humeral scute; **iss,** ischium scar; **ps,** pubic scar. Dotted lines indicate broken borders. Thick lines indicate plastral external rim. Scale bar= 3 cm.

tron might suggest an anomaly in the scute pattern. The second entoplastron (Fig. 3.2), MPM-PV 23057 is slightly different from MPM-PV 1157f. MPM-PV 23057 is rhomboidal, longer than wide with straight borders. The gular scute almost reached the posterior end of the entoplastron, and there are no signs that the extragular reached the entoplastron. Due to the fragmentary nature of the specimens collected until now in the Mata Amarilla Formation, we tentatively assigned both morphotypes of entoplastra to cf. *Prochelidella* sp. New material might help to elucidate if both entoplastra correspond to the same species (representing intraspecific variation) or if they belong to different species (interspecific variation).

Xiphiplastron. There are several remains identified as xiphiplastral (MPM-PV 1157g–o; Fig. 3.3–3.12). Xiphiplastra were covered by femoral and anal scutes. In visceral view, the scars for the suture of the pubis and ischium are preserved. The anal notch is present and U-shaped. The tip of the xiphiplastron is rounded in contrast to more acute tips of *Pr. cerrobarcinae* (de la Fuente *et al.*, 2011: fig. 5a–d), and the ischiadic scar reaches the tip as in *Pr. portezuelae* (de la Fuente, 2003: figs. 1, 2, 4) or in extant *Chelus fimbriata* (DNPM-DGM 38RR). Conversely, in other extant chelids (*e.g.*, *Acanthochelys radiolata* (MNRJ 3803), *Mesoclemmys tuberculata* (DNPM-DGM 140RR), *Phrynops geoffroanus* (MNRJ 24997), *Platemys platycephala* (MNHN-P-1910-39)) the ischiadic scar does not extend into the xiphiplastral tips. There is one xiphiplastron, MPM-PV 1157m, that shows scutes anomalies. There is an extra scute present evidenced by the presence of sulci in the tip of the xiphiplastron.

PAN-CHELIDAE indet.

Figure 4

Referred material. MPM-PV 1157p, entoplastron; MPM-PV 1157q–r, xiphiplastral tips; MPM-PV 1218c–d, neural bones; MPM-PV 1218m, left costal 1; MPM-PV 1218n–o, odd costals; MPM-PV 1218p–q, even costals; MPM-PV 23053, nuchal; MPM-PV 23055, even neural.

Localities. Different localities (Fig. 1.2) located 20 km southern Mata Amarilla farm (49° 34′ 54′′ S; 71° 11′ 04′′ W) and to the east Tres Lagos village, southern Shehuen river (Santa Cruz Province, Argentina) (Goin *et al.*, 2002: fig.1; Varela *et al.*, 2012a: fig. 3, locality 2).

Horizon. Lower section of the Mata Amarilla Formation, Cenomanian (early Late Cretaceous) (Varela *et al.*, 2012a).

Description

Carapace. These specimens are bigger than those recognized as cf. *Prochelidella* sp.

Nuchal. The anterior part of a nuchal bone (MPM-PV 23053; Fig. 4.1). The cervical scute was present. It is trapezoidal in shape, longer than wide, with its anterior border much narrower than the posterior.

Neural. Five even neurals are preserved (MPM-PV 1218c, 1228d, 23055, 23058, and 23059). Four of them are broken, so their shape cannot be determined. Only one neural is complete (MPM-PV 23055; Fig. 4.4–4.5). This neural is hexagonal, with short anterior borders and longer than wide. This neural could represent a neural 3 or 5.

Costals. There are some even and odd costal bones in the same sample (Fig. 4.5–4.9). Among odd costals, a costal 1 is identified. In dorsal view, costal 1 (MPM-PV 1218m; Fig. 3.5) is covered by vertebrals 1 and 2 and pleural 1. In visceral view, thoracic rib 2 is present. In the odd costals, the sulci between vertebral scutes and between vertebrals and pleural scutes are present (MPM-PV 1218n–o; Fig. 4.6–4.7). In even costals the sulcus between pleural scutes is present (MPM-PV 1218p–q; Fig. 4.8–4.9).

Plastron. One entoplastron and two xiphiplastral tips are preserved (Fig. 4.10). The entoplastron (MPM-PV 1157p) is rhomboidal, being longer than wide. The entoplastron in *Chelus fimbriata* (ZSM 8-1930) is also rhomboidal, but is bell-shaped in several extant South American chelids (*e.g.*, *Acanthochelys*, *Phrynops* spp.). The gular scute covers only the anterior half of the entoplastron. There are two xiphiplastral tips in the sample (Fig. 4.11–4.12). Both xiphiplastral tips show long ischiadic scars, almost reaching the tip of the plate as in extant *Chelus fimbriata* (FMNH 22113), however, there are some differences between them. Specimen MPM-PV 1157q has a pointed tip (Fig. 4.11), while MPM-PV 1157r has a rounded tip (Fig. 4.12).

DISCUSSION

At least two side-necked chelid turtles are recognized in the lower section of the Mata Amarilla Formation. Both

species have the pelvic girdle sutured to the shell, loose carapace-plastron connection through pegs and sockets, and costo-peripheral fontanelles. One of them is moderated in size (carapace length estimated in 25–30 cm), and it is attributed to Pan-Chelidae indet., whereas the other one is small (carapace length estimated in 10–15 cm). The latter is

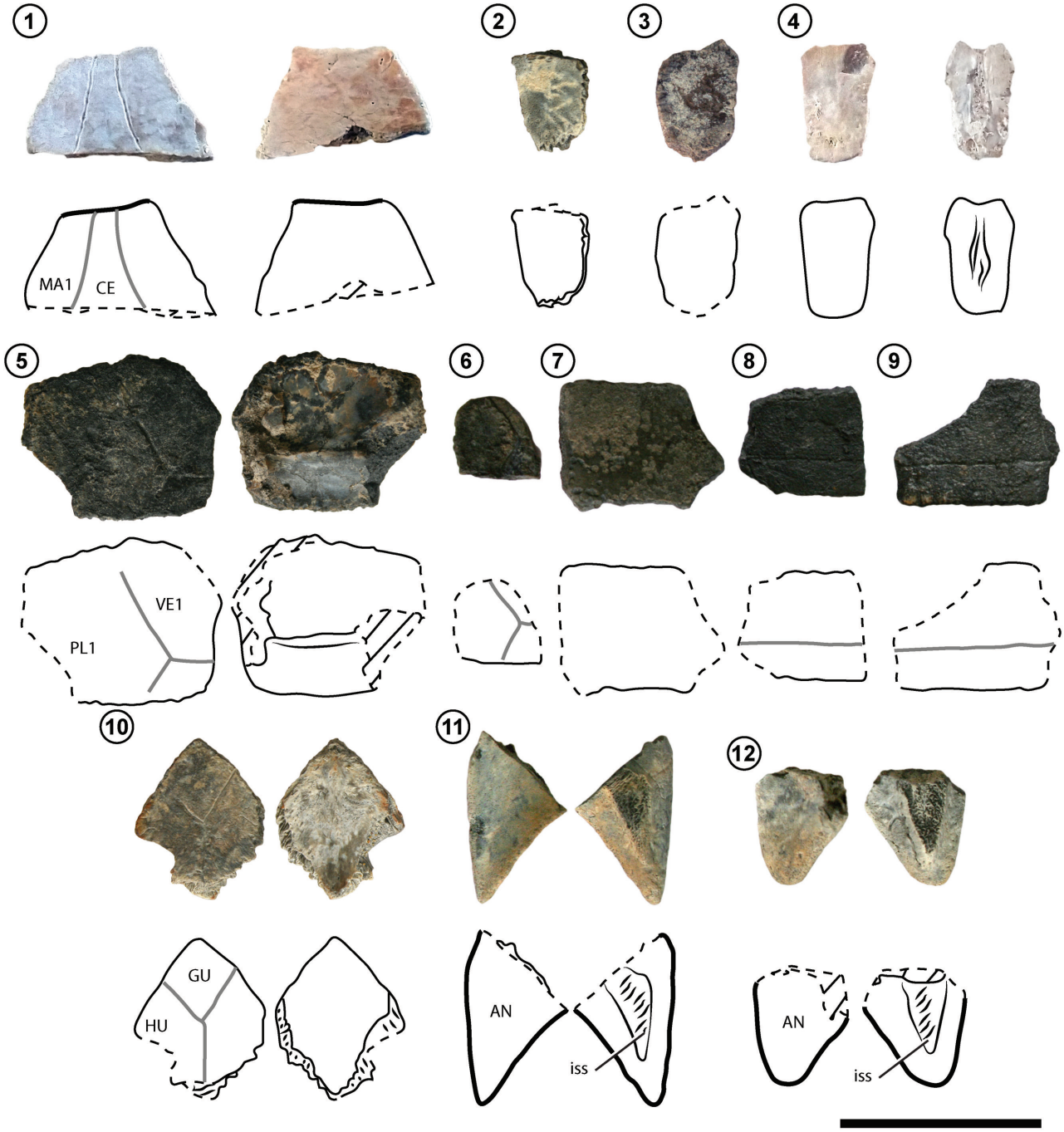

Figure 4. Chelidae indet. from the Mata Amarilla Formation (Cenomanian), Santa Cruz, Argentina. **1, MPM-PV 23053**, nuchal in dorsal and visceral views; **2, MPM-PV 1218c**, neural bone; **3, MPM-PV 1218d**, neural bone; **4, MPM-PV 23055**, neural bone in dorsal and visceral views; **5, MPM-PV 1218m**, left costal 1 in dorsal and visceral views; **6–7, MPM-PV 1218n–o**, odd costals; **8–9, MPM-PV 1218p–q**, even costals; **10, MPM-PV 1157p**, entoplastron in ventral and visceral views; **11, MPM-PV 1157q**, right xiphiplastral tip in ventral and visceral views; **12, MPM-PV 1157r**, right xiphiplastral tip in ventral and visceral views. Abbreviations: **AN,** anal scute; **CE,** cervical scute; **GU,** gular scute; **HU,** humeral scute; **iss,** ischium scar; **MA,** marginal scute; **PL,** pleural scute; **VE,** vertebral scute. Scale bar= 3 cm.

conferred to the genus *Prochelidella* sp. by the proportion of the nuchal bone (wider than long), the trapezoidal shape of the cervical scute, the small size, and the smooth dorsal surface of the plates. The cheloniofauna found in the Mata Amarilla Formation together with the extinct fauna mentioned in the introduction, is consistent with the Limayan tetrapod assemblage (Leanza *et al.*, 2004) assigned to the Cenomanian–early Turonian.

Based on Maniel *et al.* (2020) cladistic analysis, *Prochelidella* is a monophyletic group of the crown-clade Chelidae (contrary to Maniel & de la Fuente, 2016; de la Fuente *et al.*, 2017; Holley *et al.*, 2020). *Prochelidella* spp. shows an extended temporal distribution across the Cretaceous of three patagonian basins (Neuquén, Golfo San Jorge, and Somuncurá-Cañadón Asfalto), ranging from the Aptian to the Campanian–Maastrichtian, showing two main gaps: (1) a late Albian gap and (2) a Coniacian–Santonian gap (Fig. 5). The genus *Prochelidella* has four named species, three of them only known by postcranial remains (*Pr. argentinae*, Lapparent de Broin & de la Fuente,

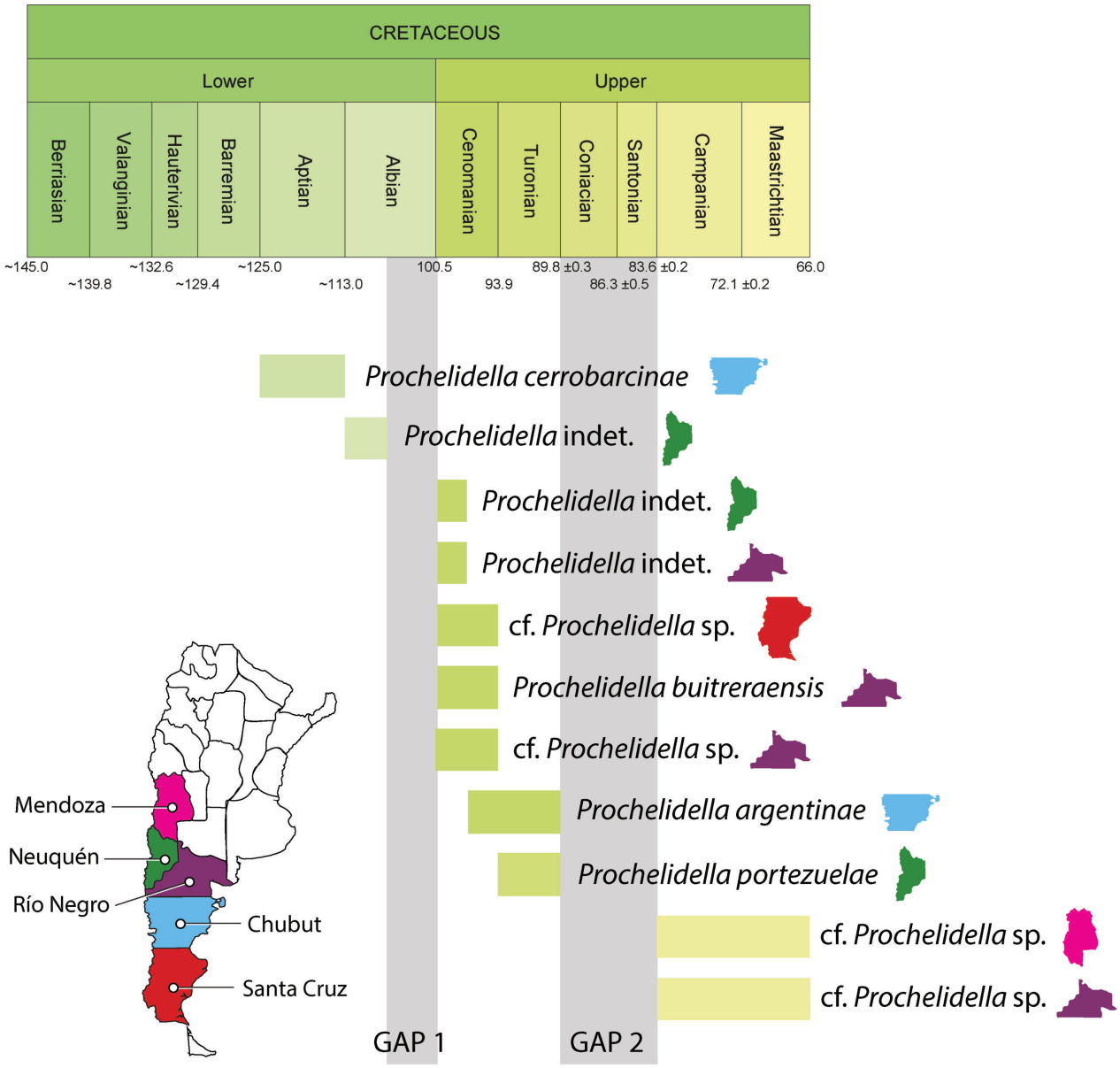

Figure 5. Stratigraphic and geographic distribution of ***Prochelidella*** spp. in the Cretaceous in Argentina.

2001; *Pr. portezuelae*, de la Fuente, 2003; and *Pr. cerrobarcinae*, de la Fuente *et al.*, 2011) and only one is known by cranial and postcranial remains (*Pr. buitreraensis*, Maniel *et al.*, 2020). The record of cf. *Prochelidella* sp. in the Austral-Magallanes Basin extends the distribution of *Prochelidella* to a new basin and its geographic range 500 km south from the previously known southernmost record of *Prochelidella*, *Pr. argentinae* (Golfo San Jorge Basin). Besides, the Mata Amarilla turtles represent the southernmost record of turtles during the early Late Cretaceous in South America. Targeted fieldworks to this stratigraphic unit might produce more complete findings and might bring valuable information about the evolution and diversity of turtles in the southern tip of South America.

The Mata Amarilla Formation in the Austral-Magallanes Basin records at least two species of pleurodiran turtles: cf. *Prochelidella* sp. and the Pan-Chelidae indet. In the same context, at estancia Ocho Hermanos in Golfo San Jorge Basin in Bajo Barreal Formation, Lapparent de Broin & de la Fuente (2001) describe *Pr. argentinae* and *Bonapartemys bajobarrealis*, two pan-chelid species. The Bajo Barreal Formation is assigned to late Cenomanian–Turonian according to Ibiricu *et al.* (2020). Also, two species of pleurodiran turtles are recognized in the Candeleros Formation in the Neuquén Basin, coming from different localities, *Pr. buitreraensis* from "La Buitrera" locality and *Elkanemys pritchardi* close to El Chocón village. *Prochelidella buitreraensis* is a Pan-Chelidae and, based on its morphology, we suggest it is closely related to the cf. *Prochelidella* sp. from the Mata Amarilla Formation. The latter is a Cearachelyinii bothremydid, which constitutes the most ancient record of this group in Patagonia (Maniel *et al.*, 2021). The Candeleros Formation is assigned to the Cenomanian according to Garrido (2010). Furthermore, in the Portezuelo Formation (Turonian according to Garrido, 2010), *Pr. portezuelae* and *Portezueloemys patagonica* (another Pelomedusoides) were described by de la Fuente (2003). On the other hand, the Cerro Barcino Formation pleurodiran turtle record is restricted to *Pr. cerrobarcinae*. The age of this formation is late Aptian accordingly to Krause *et al.* (2020). According to the pleurodiran records observed in the patagonian basins the Cenomanian–Turonian range represents the highest diversity peak of *Prochelidella* spp. (Fig. 5) and document the first records of moderate-sized forms of Pan-Chelidae (*Bonapartemys bajobarrealis* and Pan-Chelidae indet.) and Pelomedusoides (*Elkanemys pritchardi* and *Portezueloemys patagonica*).

CONCLUSIONS

The fossil record of Cretaceous turtles in Santa Cruz Province is spotty. In this contribution, we examined all the turtle remains recovered from six localities in the Mata Amarilla Formation, nearby Mata Amarilla farm (Santa Cruz Province, Argentina). Most of the smaller carapace and plastral remains are conferred to an indeterminate species of cf. *Prochelidella* sp. based on the small size, the smooth surface of the plates, the characteristics of the nuchal plate (wider than long), the presence of a trapezoidal, longer than wide cervical scute, and the presence of a tear-drop entoplastron. The remaining fragments are attributed to a mid-sized species of an indeterminate Pan-Chelidae with no ornamentation and rhomboidal entoplastron (longer than wide).

Prochelidella spp. is a group of turtles distributed in Chubut, Rio Negro, Neuquén, and Mendoza provinces, ranging from the Aptian to the Maastrichtian. The fossil record of *Prochelidella* spp. shows two main gaps: (1) late Albian gap and (2) Coniacian–Santonian gap. The recognition of cf. *Prochelidella* spp. in the Austral-Magallanes Basin extends the geographic range of this group more than 500 km south to the previously known southernmost record of *Prochelidella* (*Pr. argentinae* from the Golfo San Jorge Basin, Chubut).

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