Peltephilidae and Mesotheriidae (Mammalia) from late Miocene strata of Northern
Chilean Andes, Caragua

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ABSTRACT

Until now, only one Cenozoic fossil mammal from the Chilean Precordillera (Arica and Parinacota Region) has been reported, *Caraguatypotherium munozi* (Mesotheriidae: Notoungulata). In this study, we describe a fourth specimen of *C. munozi* and a new armadillo species, *Epipeltephilus caraguensis* (Peltephilidae: Cingulata), both collected from a new site closer to the fossiliferous outcrops of the Caragua area (Serravallian – Tortonian). *E. caraguensis* differs from other members of the family in having: two sulci in the articular surface of the mobile osteoderm; having a tubular, rough and raised anterior edge; a conspicuous transverse depression; and four widely spaced foramina. This taxon represents the youngest known peltephilid from intermediate latitudes and indicates a wide geographic distribution (Patagonia to Central Andes) of the family just prior to its extinction. The new mesothere specimen is 19% larger than previous records. The revision of the dental features of *C. munozi* allowed the identification of an ambiguous trait in its original diagnosis, i.e. an enamel fracture was misinterpreted with the presence of a posterior sulcus on the talonid of the m3, suggesting that further taxonomic and systematic revision for the Caragua mesothere is necessary. Although the fossil record from the Caragua area is still scarce, mesotheriines seem to be abundant at this latitude, just as has been observed at several early to late Miocene sites such as Chucal (Chile), Cerdas and Nazareno (Bolivia), as well as in southern regions such as Arroyo Chasicó and Mendoza (Argentina). The presence of a new peltephilid species in Caragua sustains the hypothesis of provincialism during the Miocene in intermediate latitudes. Our findings also provide further support for probable faunal movements between intermediate and higher latitudes rather than to lower ones.

Keywords: South America; Cenozoic Mammals; SALMA; Chilean Precordillera;
Andean uplift.

1. Introduction

The northernmost Chilean record of Cenozoic mammals is relatively poor. Despite some efforts in the last two decades, only few studies have been carried out in this region (Bargo and Reguero, 1989; Salinas et al., 1991; Charrier et al., 1994, 2005; Flynn et al., 2002, 2005; Charrier et al., 2008, 2015; Croft et al., 2004, 2007, 2008). Currently, the most representative locality is Chucal (Chucal Formation) in the Western Cordillera, which has been dated as early Miocene (*ca.* 19 to 17.5 Ma) and includes a diverse mammalian fossil record composed of peltephilids, dasypodids, glyptodontids, mesotheriids, hegetotheriids, toxodontids, litopterns, and chinchillid rodents along with some anuran amphibians (Muñoz, 1991; Charrier et al., 1994, 2005; Flynn et al., 2002; Bond and García, 2002; García et al., 2004; Croft et al., 2004, 2006, 2007, 2008). Remarkably, half of these species are endemic to this locality (*sensu* Croft et al., 2004; Flynn et al., 2005; Charrier et al., 2015).

Another site of interest in the northern Chilean Andes is Caragua, located in the Precordillera about 50 km northwest of Chucal (Fig. 1). The site exposes *ca.* 11 Ma sandstones assigned to the late Miocene Huaylas Formation (Salas et al., 1966; García et al., 2004, 2011; Flynn et al., 2005, but see further discussion in the geological setting section), i.e. ~7 Ma younger than Chucal. The Caragua site has provided well-preserved remains, including articulated bones of three specimens of an endemic mesotheriid known as *Caraguatypotherium munozi* (Bargo and Reguero, 1989; Salinas et al., 1991; Flynn et al., 2005).

Both Chucal and Caragua localities have paleogeographic relevance in the context of the last significant Andean uplift and the climatic changes (from semiarid to hyperarid conditions) that occurred at different latitudes of South America during the Miocene (e.g. Hinojosa and Villagrán, 1997; Ortiz-Jaureguizar and Cladera, 2006; Potter and Szatmari, 2009). Such changes may have contributed to the high faunal diversities seen in the South American Cenozoic mammal record at low ($\sim 0^{\circ}$ - 17° S; e.g. Kay and Madden, 1997; Sánchez-Villagra et al., 2010), intermediate ($\sim 18^{\circ}$ - 35° S; e.g. Croft et al., 2009, 2016) and high latitudes ($\sim 36^{\circ}$ - 52° S; e.g. Paterson and Pascual, 1972; Madden et al., 2010; Vizcaíno et al., 2012).

Here we present the description of fossil materials from a new site located south of the Caragua locality, which include a new species of Peltephilidae and an additional specimen of Mesotheriidae. We also provide an updated stratigraphic and chronological setting for the Caragua fossil record. This allowed us to further document faunal diversity in northern Chile during the late Miocene, thereby highlighting the paleontological potential of the Caragua area.

2. The Caragua geological setting and fossil location

The Caragua area is located on the western flank of the Altiplano, at the boundary of the Precordillera and the Western Cordillera, in the Copaquilla basin, at approximately 2,900 m a.s.l., where late Cenozoic continental volcanic and sedimentary successions are exposed, with some of them strongly deformed (Fig. 1). These successions have mainly been grouped into the Oxaya, Lupica and Huaylas formations, the “Remains of middle Miocene volcanoes” (RMMV) and the Lauca Ignimbrite (Salas et al., 1966; Salinas et al., 1991; Muñoz and Charrier, 1996; García et al., 1996, 2004, 2011, 2012; Wörner et al., 2000; García and Hérail, 2005). In the Precordillera to the west, the

Oxaya Formation is composed mainly of late Oligocene-early Miocene (25-17 Ma) thick welded rhyolitic tuffs, which are overlaid in erosional unconformity by *ca.* 15 to 12 Ma andesitic lavas of the RMMV (Figs. 1 and 2). Both successions dip gently to the east (up to 10°) and are unconformably covered by late Miocene fluvial sandstones and gravels assigned to the Huaylas Formation (*sensu* García et al., 1996, 2004, 2011, 2012; García and Hérail, 2005). The Huaylas Formation is covered in erosional unconformity by the late Pliocene Lauca Ignimbrite (Figs. 1 and 2). On its eastern border, the Huaylas Formation is cut by an east-dipping reverse fault that uplifted the folded-faulted rocks of the RMMV, which in turn overlie in angular unconformity the Lupica Formation. This last formation is largely exposed in the Western Cordillera and composed of late Oligocene-early Miocene (25 -18 Ma) andesitic to rhyolitic volcanic rocks and alluvial and lacustrine rocks.

Fluvial gravels, sandstones and siltstones crop out in the Caragua area and have been assigned to the lower and middle sections of the Huaylas Formation (Salas et al., 1966; García et al., 1996, 2004); the lower gently dipping (up to 10°ENE) section has been informally defined as “Caragua beds” (Salinas et al., 1991) in which previous fossil remains have been found (Figs. 1 and 2; Bargo and Reguero, 1989; Salinas et al., 1991; Flynn et al., 2005). The Caragua beds are respectively exposed over a surface of less than 0.5 km² and comprise up to 120 m thick of brown, gray, red and green sandstones, gravels and mudstones. Clasts are up to 20 cm in diameter and the cement of the sandstones is calcareous. The fossiliferous sandstones are situated in the lower part of the section and disposed in tabular beds (0.1 to 3 m in thickness) with mudstone intercalations, massive texture and rounded lithic fragments up to 5 cm in diameter.

The new fossils presented here were recovered from a new site located about 2.5 km south of Caragua, at 18° 29' 2.3"S, 69° 34' 20.5"W (WGS-1984; Fig. 1). Here, the

middle section of the Huaylas Formation is disposed horizontally and in angular unconformity over the lower section (Fig. 2). The middle section of the Huaylas Formation is widely exposed, up to 250 m thick and composed of semi-consolidated gravels and sandstones with thin intercalations of mudstones and a ≤ 4 m thick ash rhyodacitic layer, the Caragua-Tignamar tuff (García et al., 2004). These sedimentary deposits are well stratified, brown, green, gray and light-blue in color and form centimetric to meter scale tabular and lenticular beds. The gravels are clast-supported, poorly classified, with paleochannels and a sandy matrix. The clasts have diameter less than 50 cm (exceptionally up to 3 m), are often imbricated and predominantly spherical, and correspond to metamorphic, volcanic (andesitic to rhyolitic) and calcareous lacustrine sedimentary rocks.

The fossil mammals found in this new site and described in the present study were hosted in tabular and cross-bedded (low angle) sandstones with intercalations of mudstones, stratigraphically located *ca.* 30 m below the Caragua-Tignamar tuff.

With respect to age constraints, a middle Miocene east-dipping andesitic lava is exposed 8.5 km to the NW of the Caragua area, overlaying the Oxaya Formation by erosional unconformity and underlying the middle section of the Huaylas Formation by angular unconformity. This lava yielded a K-Ar whole rock age of 11.7 ± 0.7 Ma (Fig. 2; García et al., 2004; García and Hérail, 2005), a late middle Miocene, Serravallian-Tortonian? age (Cohen et al., 2015). Two Ar-Ar ages have been obtained for the Caragua-Tignamar tuff, in the Caragua area; 11.4 ± 0.5 Ma on biotite and 10.6 ± 1.1 Ma on amphibole (Figs. 1 and 2). The three available biotite Ar-Ar determinations in the Caragua and Tignamar areas have generated a mean weighted age of 10.7 ± 0.3 Ma, which is the more reliable value for volcanic extrusion and deposition (Wörner et al., 2000; García et al., 2004; García and Hérail, 2005) and it corresponds to a late Miocene, Tortonian age (Cohen et

al., 2015). In the Lauca Ignimbrite, several Ar-Ar ages have indicated mean ages of 2.7 Ma on sanidine and 2.9 Ma on biotite (Wörner et al., 2000; García et al., 2004, 2012). Thus, the lower and middle sections of the Huaylas Formation, which contains the mammalian fossils, can be restricted to the late Miocene (Tortonian), and its oldest beds may correspond to the late middle Miocene (Serravallian-Tortonian boundary).

Fig. 1. Location of the study area within South America (left) and geological map of the Caragua area in northernmost Chile (right), showing the distribution of the stratigraphic units, the mammal fossil localities (red stars 1, 2 and 3) and biotite and amphibole available Ar-Ar ages on the Caragua-Tignamar tuff (black triangle: coordinates in WGS-1984 Datum; geology based on García et al., 2004). Fossil locality 1 was reported by Bargo and Reguero (1989) and Salinas et al. (1991); locality 2 was reported by Flynn et al. (2005); Fossil locality 3 is for first time reported here.

Fig. 2. Representative stratigraphic columns of the Miocene to Pliocene units in the Copaquilla and Caragua areas, showing mean thicknesses, main lithologies, available isotopic ages and mammal fossil locations (modified from García et al., 2004). Isotopic ages are from Wörner et al. (2000), García et al. (2004) and García & Hérail (2005). Copaquilla locality is situated 10 km northwest of Caragua. Abbreviations: Remains of middle Miocene volcanoes (R.M.M.V.); Caragua beds (C.B.).

3. Material and Methods

Several fossils exposed on the surface were collected by RB, MTC, KM and AC during a survey in the locality of Caragua in early 2006. The material consists of four complete and well-preserved osteoderms of one specimen of Peltephilidae associated with postcranial remains, which include teeth, a zygomatic arch, undetermined osteoderms and possible ulnar fragments (SGO-PV 21102). In addition, mandibular and postcranial fragments of one specimen of Mesotheriidae were also collected (SGO-PV 21101). The material described here is stored in the Colección Paleontológica de Vertebrados of the MNHN, Santiago, Chile.

3.1. Reference materials

Taxonomic identification and description are based on anatomical comparisons with the following reference materials: Peltephilidae: seven carapace osteoderms of *Peltephilus*

strepens Ameghino 1887 (MACN A-771); four carapace osteoderms of *Peltephilus*
pumilus Ameghino 1887 (MACN A-866-869); two carapace osteoderms of *Peltephilus*
depressus Ameghino 1897 (MACN A-12016, type); five carapace osteoderms of
Peltephilus granosus Ameghino 1902 (MACN A-12019, type); two carapace
osteoderms of *Peltephilus nanus* Ameghino 1898 (MACN A-7958-7959, type); one
carapace osteoderm of *Peltephilus protervus* Ameghino 1897 (MACN A-12020, type);
two carapace osteoderms of *Peltephilus giganteus* Ameghino 1894 (MACN A-4891-
4900, type); three carapace osteoderms of *Peltecoelus praelusci* Ameghino 1902
(MACN A-12022, type); two osteoderms of cf. *Peltephilus* sp. (SGO-PV 4111; SGO-
PV 5150); and several carapace osteoderms of *Epipeltephilus recurvus*? Ameghino
1904 (MLP 91-IX-7-14; MLP 16-2). Photographic materials from literature were also
included for peltephilids: three fixed osteoderms of the holotype and additional referred
material of *Epipeltephilus kanti* González-Ruiz, Scillato-Yané, Krmpotic, Carlini 2012
(MLP 92-XI-19-7, holotype; MLP 28-X-11-66; MMP 339-M) (Fig. 2 in González-Ruiz
et al., 2012); three osteoderms of cf. *Peltephilus* sp. (UF 93515) (Fig. 7.3B in Shockey
and Anaya, 2008); articulated and disarticulated osteoderms of Peltephilidae gen. et sp.
nov. (UF 225047 - UATF-V-001982) (Croft et al., 2009, 2016). Mesotheriinae:
Holotype and referred material of *Caraguatypotherium munozi* (SGO-PV 22500 ex-
4004 in Buldrini et al., 2015; MLP 86-VII-10-1) (Flynn et al., 2005).
The taxonomy and nomenclature used in this study follow McKenna and Bell (1997)
and González-Ruiz et al. (2013a), while the geochronologic system and related South
American Land Mammal Ages (SALMAs) follow Cohen et al. (2015), Ogg et al. (2016)
and Flynn and Swisher (1995).

Institutional Abbreviations. SGO-PV, Colección Paleontológica de Vertebrados, Museo Nacional de Historia Natural (MNHN), Santiago, Chile; MLP, División Paleontología de Vertebrados, Museo de La Plata, La Plata, Argentina; MACN A, Colección Nacional Ameghino, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina; MMP, Museo Nacional de Ciencias Naturales de Mar del Plata “Lorenzo Scaglia”, Mar del Plata, Argentina; UF, Florida Museum of Natural History, Gainesville, Florida, United States.

3.2. Anatomical description

Osteoderms are localized mineralizations of the integumentary system that form part of the vertebrate exoskeleton (Hill, 2006; Vickaryous and Hall, 2006). In mammals, only cingulates exhibit osteoderms that cover the top of the head (cephalic shield), trunk (dorsal carapace) and tail (caudal sheet), as occurs in extant dasypodid armadillos (Vickaryous and Hall, 2006; Krmpotic et al., 2009). Some extinct mylodontids (Pilosa) also present osteoderms, but these are freely distributed and isolated within the skin, not forming a dorsal shield (Hill, 2006). Osteoderms have a dorsal (external) surface exhibiting a wide range of structures and designs, including longitudinal elevations, foramina and articular regions (Fig. 3). The articular surface is located on the anterior (cranial) side and corresponds to the overlap between two successive osteoderms. Foramina are relatively large (1–2 mm, sometimes bigger) round areas historically associated with hair follicles, whereby they are also referred to as “piliferous foramina” or “pits for hair follicle” (Hill, 2006; Krmpotic et al., 2009, 2012). Other small pits may appear over the external surface but are sparse and irregularly distributed on the ventral (internal) surface. These pits are referred as neurovascular foramina (Hill, 2006). Unfortunately, to our knowledge, there is no description of a complete exoskeleton for

peltephilids, although González-Ruiz et al. (2013b) described an almost complete section of the cephalic and dorsal carapace. Similarly, Croft et al. (2016) describe articulated osteoderms from the cephalic and postcranial carapace regions. These studies indicate that peltephilids had a similar arrangement of their osteoderms to that occurring in most extant armadillos, i.e. including a mobile section and another fixed section (González-Ruiz et al., 2013a, b). Several authors (Scott, 1903; Scillato-Yané, 1977, 1982; González-Ruiz et al., 2013a) have recognized peltephilid osteoderms as pertaining to one of these two sections. Considering that the general morphology of peltephilid osteoderms resembles that of current armadillos (i.e. having an “articular” surface), it is likely that some degree of overlap also occurs in the peltephilid exoskeleton (e.g. Scott, 1903; Vizcaíno and Fariña, 1997; González-Ruiz et al., 2013a). The osteoderms described in this work pertain to both the fixed and the mobile (overlapping) sections (Hill, 2006). An important feature of the peltephilid osteoderms is the conspicuous ornamentation present on its external surface in most of its species. This ornamentation is made of pits and interconnected ridges, forming deep or shallow depressions (e.g. Montoya-Sanhueza, 2008; Croft et al., 2016). These structures vary in the degree of prominence respect to the plane of the external surface, as well as in orientation (e.g. Croft et al., 2016). In this study, we describe these structures as “clefts” (Fig. 3), which can be either highly noticeable or shallow, usually resulting in the former case in a very rugose surface. This trait differs from the “surface roughness” suggested by previous authors which used it to describe the external surface of peltephilids (e.g. Gonzalez et al., 2012). Similar ornamental structures have been described and quantified in the skull and osteoderms of crocodilians (e.g. Clarac et al., 2015), which make these structures potentially valuable for further research on the systematics and biology of peltephilids. Other osteoderm features and terminology are

based on Hill (2006), Vickaryous and Hall (2006), Croft et al. (2007), Montoya-Sanhueza (2008), Krmpotic et al. (2009) and González-Ruiz et al. (2013a).

Fig. 3. Schematic representation of a peltephilid osteoderm (based on SGO-PV 21102A). Osteoderm in lateral (A), external (B) and internal (C) view, showing some of the most relevant features for taxonomic determination. The articular surface (AS) is characteristic in osteoderms from the mobile section of the carapace. Abbreviations: anterior (a); clefts (Cl); foramina (F); marginal (MLE) and central longitudinal (CLE) elevation; neurovascular foramina (NF); posterior (p); sulcus (S); transversal depression (TD); vascular pits (VP).

In mesotheriids (as with other mammals), the anterior, posterior, internal and external portions of a tooth are referred as mesial, distal, lingual and labial, respectively (Cerdeño and Montalvo, 2001; Croft et al., 2004). Lower jaw teeth are indicated by lowercase letters (i/c/p/m), while upper jaw teeth are indicated by capital letters. Tooth positions are numbered consecutively from the mesial (anterior) end of the tooth row. Sulci are enamel grooves forming typical features in occlusal view. The terminology

used to diagnose mesotheriids is based on Cerdeño and Montalvo (2001), Croft et al. (2004), Flynn et al. (2005) and Cerdeño et al. (2012). Dental and osteoderm measurements were taken using a Mitutoyo digital caliper (0.01 mm). Photographic material was analyzed using the image analysis software IMAGE PRO PLUS 4.5 (Media Cybernetics, Silver Spring, USA). Five measurements were obtained with this software: Total osteoderm area (O.Ar, mm²), Osteoderm length and width (mm), Foramen diameter (max.), and distance between the horizontal (Hp) and vertical (Vp) pair of foramina (mm).

4. Systematic Paleontology

Class MAMMALIA Linnaeus 1758

Superorder XENARTHRA Cope 1889

Order CINGULATA Illiger 1811

Superfamily DASYPODOIDEA Gray 1821

Family PELTEPHILIDAE Ameghino 1894

Comments: This extinct family of armadillos is mainly known by remains of their particular skull and bony exoskeleton (Gaudin and Wible, 2006; Croft et al., 2007; González-Ruiz et al., 2012). Phylogenetic analyses have shown peltephilids to be the sister group of Cingulata (e.g. Abrantes and Bergqvist, 2006; Gaudin and Wible, 2006; Billet et al., 2011). Peltephilidae differs principally from Dasypodidae in having a robust skull with a U-shaped dental arcade, beveled canine-like teeth, a short rostrum, and a pair of horn-like nasal osteoderms (Ameghino, 1894; Scillato-Yané, 1977; Gaudin and Wible, 2006). The morphology and ornamentation of osteoderms have been used as diagnostic features for Peltephilidae (Bordas, 1936; Scillato-Yané, 1977; González-Ruiz

et al., 2012), as well as in other cingulates, e.g. Dasypodidae (e.g. Vizcaíno et al., 2003, 2006; Krmpotic et al., 2009) and Glyptodontidae (e.g. Fernicola and Porpino, 2012). Compared to other dasypodoid osteoderms, those of peltephilids are generally wider (not so elongate), bear a very rough external surface exhibiting 2-4 large foramina, and have a relatively small overlapping section (articular surface) between osteoderms (Vizcaíno and Fariña, 1997; González-Ruiz et al., 2013a). Much of peltephilid taxonomy and systematics is based on osteoderm morphology and skull features, which have resulted in the recognition of 13 species distributed in five genera (Scillato-Yané, 1980; McKenna & Bell, 1997; Croft et al., 2007; González-Ruiz, 2010; González-Ruiz et al. 2013a). Recently, González-Ruiz (2010) and González-Ruiz et al. (2012) have clarified in part the taxonomic status of peltephilids. Peltephilids show a long temporal distribution, spanning from the early Eocene (Riochican SALMA) to the late Miocene (Chasicuan SALMA) (Carlini et al., 2005; González-Ruiz et al., 2012) (Table 1; Fig. 4). Most of the fossil record of peltephilids comes from Argentinian high latitude localities (e.g. González-Ruiz 2010) and secondarily from intermediate latitudes of Bolivia (e.g. Oiso, 1991; Shockey and Anaya, 2008; Croft et al., 2009, 2016) (Table 1; Fig. 4). In addition to the material presented in this study, two isolated peltephilid osteoderms (cf. *Peltephilus* sp.) have been described from Chucal (Croft et al., 2007) (Table 1; Fig. 4). Bostelmann et al. (2012) mentioned a potential new Peltephilidae from southern Chile, but these fossils are represented by a few undescribed isolated osteoderms. Here we describe one of the youngest records of the family at low-intermediate latitudes (*ca.* 11 Ma, Mayoan SALMA).

Table 1.

328

329 Fig. 4. Scatter plot showing temporal versus latitudinal distribution of Peltephilidae. See
330 Table 1 for data origin. Abbreviations: *Peltephilus* (*Pp*), *Peltecoelus* (*Pc*).

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332 *Epipeltephilus* Ameghino 1904

333

334 **Type specie.** *Epipeltephilus recurvus* Ameghino 1904 (see details in González-Ruiz,
335 2010; González-Ruiz et al. 2012).

336

337 *Epipeltephilus caraguensis* new species

338 (Table 2-3; Figs. 4-7)

339

340 **Etymology:** From “*caragua*” in reference to the Caragua locality in the Chilean
341 Precordillera, where this species was discovered, and “-ensis,” third-declension

adjective indicating derivation from a place. The species epithet *caraguensis* is considered masculine, in (presumed) agreement with *Epipeltephilus*.

Holotype: SGO-PV 21102: Four osteoderms of the dorsal carapace, with SGO-PV 21102A being from a mobile band, and SGO-PV 21102B-D probably from the fixed section (Fig. 5). SGO-PV 21102E: Fragmentary cranial and postcranial remains, most likely from the same individual includes two fragmentary teeth crowns, one broken osteoderm (from cephalic or dorsal carapace), a left zygomatic arch and fragments of an ulna (Fig. 6).

Table 2.

Fig. 5. Osteoderms of *Epipeltephilus caraguensis* in external (left), internal (central), and lateral (right) views. A) SGO-PV 21102A; B) SGO-PV 21102B; C) SGO-PV 21102C; and D) SGO-PV 21102D. Scale bars: 5 mm.

Fig. 6. Associated material of *Epipeltephilus caraguensis* SGO-PV 21102E: A) Fragmented tooth crown showing the labial surface (top) and transversal section at the base (bottom); B) Left zygomatic arch in dorsal (left) and ventral (right) view; C) Cranial osteoderm in dorsal (top) and ventral (bottom) view; D) ?Ulnar fragments in lateral (top) and medial (bottom) view. Scale bars: 10 mm.

Type Locality and Horizon: New site located at 2.5 km SE of the confluence of the Quebrada Belén and Quebrada Lupica (18°29'2.3"S, 69°34'20.5"W) in tabular and cross-bedded (low angle) sandstones with intercalations of mudstones deposited in the lower and middle sections of the Huaylas Formation. Age constraints indicate a late Miocene, Tortonian age for this site.

Diagnosis: The osteoderms of this species are morphologically different from any other peltephilid: i) the mobile osteoderm has two sulci in the articular surface (Fig. 5A, see anatomical description below); ii) they show a tubular, rough and raised anterior edge (Fig. 5B-D) not present in other peltephilids; iii) the mobile osteoderm is larger (anteroposterior length: 28.2 mm) than any other *Epipeltephilus* spp. (max. 23.9 mm in *E. recurvus?*), and represents one of the largest osteoderms within the family (Fig. 7); iv) the presence of a conspicuous rough area with ample clefts forming the transverse depression above the figure formed by the foramina (Fig. 5A-C), which is not present in other *Epipeltephilus* spp.; and v) the quadrilateral figure formed by the four foramina is widely spaced (~3.5 mm), and is not clustered as observed in other peltephilids with four foramina, probably as the result of the prominent central longitudinal elevation that divides the figure (Fig. 5A-D).

Table 3.

Fig. 7. Scatterplot of length vs. area of mobile osteoderms of Peltephilidae. See Tables 1 and 3 for detailed data.

Anatomical description: The general size among *E. caraguensis* osteoderms does not vary greatly, particularly in anteroposterior length. The transverse depression has clefts oriented parallel to the anteroposterior axis of the osteoderm. In general, the foramina have circular to subcircular shape. The internal surface is in general smooth (except SGO-PV 21102D), with small and irregularly spaced neurovascular foramina (~0.35-0.4 mm). In general, borders are rough with noticeable pits, ridges and denticles, except the anterior edge, which has an even texture. The contact with subsequent osteoderms may prevent the development of these features on the anterior edge. The longitudinal elevations are quite similar in prominence among the osteoderms (except SGO-PV 21102D). In general, the horizontal pair of foramina has a larger spacing (3.5 mm in

average) than those of the vertical pair (1.3 mm in average) (Table 2). There are some variations in morphology among these osteoderms as detailed below.

SGO-PV 21102A (Fig. 5A and 7). This is the largest mobile osteoderm found in Caragua (Table 2; Fig. 5A and 7). It also corresponds to one of the largest osteoderm from the dorsal carapace ever found in peltephilids (Table 1 and 3, Fig. 7). The articular surface is similar to that observed in dasypodids, although it is much thinner and irregular in form (wavy), being about one-quarter (6 mm) of its total length. This feature is quite distinctive among the described mobile osteoderms of Peltephilidae (González-Ruiz et al., 2012, 2013a). In the articular surface, two distal sulci extend transversely, each one inclining slightly down toward the lateral edges. The general shape of this osteoderm is quite symmetrical and shows a constant thickness in lateral view.

SGO-PV 21102B (Fig. 5B). Compared to SGO-PV 21102A, it is 2.8 mm shorter but has a similar appearance (Table 2). This osteoderm lacks a well-defined articular surface, although it has a tubular, rough, and raised anterior edge instead. This edge is ~3 mm wide and has a uniform thickness, form and size throughout its transversal extent. It is unknown if this narrow tubular structure has a particular function, i.e. if its shape is solely related to a narrower overlap with other osteoderms and/or to the fact that the osteoderm belongs to a different region within the carapace. The uniform thickness seen in lateral view may indicate a scarce degree of overlapping though, since in extant dasypodids non-overlapping osteoderms do not sharpen posteriorly, e.g. *Chaetophractus villosus* (Krmptotic et al., 2009). The border of the right side is more irregular than the left one, resulting in an asymmetric shape. This may suggests a more marginal location of the osteoderm within the carapace when compared to the more

symmetrical shape of SGO-PV 21102A. Both, this and SGO-PV 21102A have a S-shaped profile in lateral view.

SGO-PV 21102C (Fig. 5C). This piece is slightly smaller than the previous osteoderms (Table 2). Its distal border is broken. The tubular anterior edge (2 mm) is less protuberant and rough than that of SGO-PV 21102B. The edges of this fossil are eroded and less rough than previous osteoderms. It is asymmetric in shape, inclined slightly toward the left side. This is a less curved osteoderm (lateral view). This osteoderm sharpen towards the posterior region.

SGO-PV 21102D (Fig. 5D). This is the smallest and narrowest osteoderm of the set (Table 2). It seems broken at the left posterior corner. The tubular anterior edge is 3 mm in width. The borders of this material are quite rough, more than the observed in the other osteoderms. The right edge is convex. No well-defined transverse depression is observed. The central and lateral elevations ridges are far more prominent than in previous osteoderms. The internal surface is rough. The lateral view evidences a flat osteoderm, being thicker in the middle portion (1.5 mm wide, 5 mm thick).

Comparative description: The material is excluded from Dasypodidae due to the presence of a very rough external surface exhibiting foramina and longitudinal elevations, along with an irregular and relatively thin articular section. Compared to other species of *Epipeltephilus*, the present material is larger (Table 3; Fig. 7), but similarly, it displays a rough external surface with three noticeable longitudinal elevations. *E. recurvus*, one of the most recent (Mayoan) and largest peltephilid from high latitudes (Lago Blanco, Chubut), was described on the basis of cranial and

mandibular fragments. Due to the lack of osteoderms referred to *E. recurvus*, it cannot be properly compared with the Caragua material. Nevertheless, several sets of osteoderms have been associated to this same type locality and formation (Río Mayo Formation), being assigned to *E. recurvus*? (González-Ruiz et al., 2012); a pair of osteoderms (MLP 91-IX-7-14) from Cerro Guenguel shares some characteristics with those of Caragua (i.e. four foramina and rough external surface), although they differ in size. Thus, *E. recurvus*? has thicker and smaller osteoderms (Table 3; Fig. 7) and lacks of a wide transverse depression above the foramina when compared to the Caragua material. In contrast, *E. kanti* has only two foramina, possibly three in mobile osteoderms (González-Ruiz et al., 2012, but see Discussion section). Furthermore, some osteoderms of *E. kanti* show a pronounced rough and denticular anterior edge and lack a conspicuous transverse depression. The foramina in *E. kanti* form a clustered quadrilateral figure, which contrasts with the wider pattern of the Caragua material. Croft et al. (2016) recently described a peltephilid (Peltephilidae, gen. et sp. nov.) from Cerdas (Bolivia) based on a set of articulated and disarticulated osteoderms (UATF-V-001982). They differ from those of the Caragua taxon in being smaller (~25%) and having only two foramina on the external surface, though they resemble the morphology (number of foramina and ornamentation/surface roughness) of *E. kanti*. The longitudinal elevations are relatively more pronounced in *E. kanti*, but similar to those of *E. recurvus*? and the new taxon described by Croft et al. (2016). These elevations are much less marked in *Peltephilus* (*Pp.*) and *Peltecoelus* (*Pc.*) (González-Ruiz et al., 2012). Thus, *E. caraguensis* differs from *Pp. giganteus*, *Pp. pumilus*, *Pp. strepens* and *Pp. protervus* due to the presence of more pronounced longitudinal elevations. Other species (*Pc. praelucens*, *Pp. depressus*, *Pp. granosus* and *Pp. nanus*) do not show longitudinal elevations (González-Ruiz et al., 2012). With respect to the number of foramina, the

Caragua material differs from all other peltephilids, except *Pp. strepens* and *E. recurvus?* in having four central foramina, ~1 mm in diameter on both mobile and fixed osteoderms. Only *Pp. strepens* and *E. recurvus?* display four foramina on their external surface. Nevertheless *Pp. strepens* usually shows only two foramina in osteoderms from the mobile region (Table 1), and its osteoderms are thicker than that of the Caragua taxon.

Order NOTOUNGULATA Roth, 1903

Suborder TYPOTHERIA Zittel, 1893

Family MESOTHERIIDAE Alston, 1876

Subfamily MESOTHERIINAE Alston, 1876

Comments: Two subfamilies have traditionally been recognized within the Mesotheriidae, Trachytheriinae and Mesotheriinae. Trachytheriines are early members of the family showing a wide paleobiogeographic distribution (from Peru to Patagonia) (Croft et al., 2004; Billet et al., 2008; Cerdeño, 2014). Mesotheriines constitute a more geographically restricted but diverse group, comprising 20 recognized species in nine genera (Francis 1965; Croft et al., 2004; Cerdeño et al., 2012). They extend from the early Miocene (Colhuehuapian/Santacrucian SALMAs) (Croft et al., 2004; Cerdeño, 2007; Paz et al., 2011) until the early Pleistocene (Ensenadan SALMA) (Ameghino, 1906). They represent a common and abundant component of both Chilean and Bolivian Altiplano faunas (Croft et al., 2004; Flynn et al., 2005; Billet et al., 2008; Townsend and Croft, 2010). However, they are absent in diversified faunas from high latitudes, such as Patagonia and equatorial regions, such as Brazil, Colombia, and Venezuela (Reguero and Castro, 2004; Croft et al., 2004, 2008). They have a rodent-like skull, with a

dentition mainly characterized by open tooth roots in somatically mature individuals (euhypsodont), large upper incisors, a diastema in the upper and lower jaws (without I2-P2/i3-p3, but see Cerdeño and Schmidt, 2013) and trilobed superior molars, among other features (Francis, 1965; Villarroel, 1974; Cerdeño and Montalvo, 2001; Croft et al., 2004; Flynn et al., 2005; Cerdeño et al., 2012). Adult dental formula is I1C0P2M3/i2c0p1m3 (Francis 1965; Cerdeño and Montalvo 2001; Cerdeño et al., 2012). Flynn et al. (2005, p. 62) mistakenly reported it as I1C0P2M3/i2c0p2m3.

Caraguatypotherium munozi Flynn et al., 2005

(Table 4; Figure 6)

Holotype: Originally, Salinas et al. (1991) described a mesotheriid (*Typotheriopsis* sp.) from the Caragua locality under the institutional code SGO-PV 4004. This material consists of a skull with part of the mandible, the anterior part of the appendicular skeleton and articulated vertebrae. Posteriorly, Flynn et al. (2005) carried out a systematic review of this and other referred materials from Caragua, erecting a new genus and species (*Caraguatypotherium munozi*), using SGO-PV 4004 as the holotype. However, this institutional code was previously used by other authors to describe a different typothere (see Buldrini et al., 2015). Buldrini et al. (2015) rectifies this situation by providing a new institutional code for *C. munozi* (now SGO-PV 22500).

Referred material: MLP 86-VII-10-1, right mandibular fragment with m1-3 (Bargo and Reguero, 1989); SGO-PV 4056, partial left maxilla with P4 and alveolus for P3, and associated postcranial elements (Flynn et al., 2005); SGO-PV 21101 (this work), a partial left hemimandible with m1 fragmented inside the alveolus (Fig. 8B), a partial

right hemimandible with m1-m2 (Fig. 8C), ribs, vertebrae and an articulated but fragmented forelimb (distal condyle of the humerus, metacarpals, carpals and fissured ungual phalanges). This material is currently under preparation for further study.

Locality and Horizon: New site located at 2.5 km SE of the confluence of the Quebrada Belén and Quebrada Lupica (18°29'2.3"S, 69°34'20.5"W) in tabular and cross-bedded (low angle) sandstones with intercalations of mudstones deposited in the lower and middle sections of the Huaylas Formation. Age constraints indicate a late Miocene, Tortonian age for this site. Previous material comes from at least two localities in the Caragua area, the north side of Quebrada Belén with geographic coordinates ~18°25'S, 69°35'W (Bargo and Reguero, 1989) and ~18°28'S, 69°34'W (Salinas et al., 1991), plus the material recovered by Flynn et al. (2005) from "Loc. C-ALT-01-1" (Loc. JJF 9-5-01-1; S 18°27.829', W 69°34.647') (see details in Flynn et al., 2005).

Description: SGO-PV 21101: The right mandibular fragment has a complete m1 and a fragmentary m2 lacking the posterior portion of the talonid (Fig. 8C). The left mandibular portion shows a m1 without an exposed crown. This tooth is comparable with the right m1. The talonids of p4-m2 are all wider than the trigonids, although barely so in m2 (Flynn et al., 2005). The p4 shows a longer (but narrow) trigonid, whereas m3 has a longer talonid in mesotheriines (see Fig. 8A and 9) (Cerdeño and Montalvo, 2001; Flynn et al., 2005). Considering the measurements from the lower jaw (Table 4), this specimen is slightly larger (about 19%) than the largest specimen previously reported by Flynn et al. (2005).

551 Table 4.

552

553 Fig. 8. Occlusal view of the new mandibular remains of *Caragatypotherium munozi*
554 (SGO-PV 21101). A) Schematic representation of the lower dentition in Mesotheriinae
555 (modified from Cerdeño and Montalvo, 2001). B) Fragment of left hemimandible with
556 m1. C) Fragment of right hemimandible with m1-m2. Respective locations of these
557 molars are indicated in the dental scheme placed between the photographs.

558

Fig. 9. Third lower molars (m3) of *Caraguatypotherium munozi*. A) Detail of the right m3 of the holotype SGO-PV 22500. B) Detail of the right m3 of the specimen MLP 86-VII-10-1. Note the presence of an anterior sulcus (aS) in the lingual side of the talonid (TI) and the absence of a distally located sulcus, but instead a fracture (Fr) in the cement (C) and enamel (E) layers of both specimens. Abbreviations: Dentine (D), Trigonid (Tr).

5. Discussion

The Peltephilidae and Mesotheriinae from Caragua and Chucal (~18-19°S, late and early Miocene, respectively) constitutes the unique formally described records of such groups in Chile (Croft et al., 2007; Flynn et al., 2005; this study).

The new species *Epipeltephilus caraguensis* represents the northernmost and one of the youngest peltephilids known in the continent. From an anatomical point of view, and with the exception of the cephalic osteoderms, there are not complete records of the dorsal carapace in peltephilids. Therefore, the carapace morphology of this group is still unknown. González-Ruiz et al. (2013b) described a semi complete carapace of an early Miocene peltephilid which shows 27 mobile bands in the dorsal shield and four bands in the anterior region of the pelvic shield. However, these authors do not describe the morphology of such osteoderms. It is most likely that the largest osteoderm of *E. caraguensis* belongs to a mobile band. The three others pertain to the fixed section of the carapace, although the presence of a tubular structure in the cranial edge of these osteoderms may indicate some degree of overlap between osteoderms or even a mobile unknown joint within the carapace. For this reason, the existence of a different unknown region in the carapace of peltephilids cannot be discarded. Respect to the variation in osteoderm morphology in *E. caraguensis*, this may be associated with differential disposition (central or lateral) of the osteoderms within the carapace. Regarding the number of foramina in peltephilids, some authors have mentioned 4 (Ameghino, 1897) and 2-3 (González-Ruiz et al., 2012) for *Peltephilus depressus*. Our observations of the type specimen *Pp. depressus* suggest that the small foramen, the one located up between the two big ones (Figure 3I in González-Ruiz et al., 2012), does not represent a true foramen due to its small size and irregular shape within the transverse depression. Its occurrence is more probably related to a fracture or a cleft in the external surface.

Because the systematics of this group of cingulates is based mostly in osteoderm morphology, further research should focus on assessing the functional significance of osteoderm structure (e.g. transversal depression, longitudinal elevations, number and location of foramina, degree of ornamentation, osteoderm curvature), accompanied by greater collection efforts.

The presence of *E. caraguensis* during the late Miocene in northern Chile indicates a wide geographic distribution of the family near the time of their extinction.

Interestingly, this species does not seem to be related to other peltephilids from closer localities such as Cerdas, Nazareno and Chucal (e.g. Oiso, 1991; Croft et al., 2007, 2009, 2016). The Caragua osteoderms more closely resemble the *Epipeltephilus* morphotype from both intermediate and higher latitudes from Argentina (Bordas 1936; González et al., 2012; Croft et al., 2016) (Fig. 4). Peltephilids were apparently more diversified in Patagonia (Table 1, Fig. 4) (e.g. Bordas, 1936; Scillato-Yané, 1977; Vizcaíno et al., 2006, 2012; Garrido et al., 2012; González-Ruiz 2010; González-Ruiz et al., 2012, 2013a), especially during Santacrucian time (early Miocene), rather than older (Carlini et al., 2005; Shockey and Anaya, 2008; Gaudin and Croft, 2015) or younger sites (Scillato-Yané, 1977; González-Ruiz et al., 2012, 2013a) (Fig. 4). The youngest fossils of the family, *Epipeltephilus kanti* (Chasicóan, 9-10? Ma), come from Arroyo Chasicó (Buenos Aires Province), and is about 1 or 2 Ma younger than the Caragua peltephilid.

It remains a curiosity that the Quebrada Honda locality in Bolivia, which is slightly older than Caragua and well sampled, has not provided peltephilid specimens, despite including a wide range of xenarthrans (e.g. Gaudin and Croft, 2015). As noted by Croft (2007), Quebrada Honda differs in many aspects from other Miocene mammal sites in South America: its fauna seems more similar to the high latitude fauna of Collón-Curá

(Langhian) in Patagonia than to the chronologically equivalent La Venta fossil site in Colombia (Serravallian). For this reason, Croft (2007) suggested that migrational barriers were in place between low and intermediate latitudes during the early and/or middle Miocene. Similarly, the presence of peltephilids in the Caragua area suggests that migrational pathways between intermediate and high latitudes occurred (see discussion below), but not toward low latitudes.

The present study recognizes a fourth specimen of *Caraguatypotherium munozi*, which corresponds to a single individual slightly larger than the three previous records (Flynn et al., 2005) (Table 4). Whether *C. munozi* represents a species derived from higher latitudes is uncertain. It has been hypothesized that trachytheriines went “pseudo-extinct” from Patagonian faunas during the late Oligocene as a result of a northward migration (Reguero and Castro, 2004). However, during this time, trachytheriines were also present in intermediate latitudes (Mendoza) forming part of mixed faunas including Patagonian, endemic and one Bolivian species (Salla) (Cerdeño, 2014). The presence of Colhuehuapian – Santacrucian mesotheriids at similar latitudes around Mendoza (~32°S; Cerdeño, 2007; López et al., 2011; Paz et al., 2011) may indicate a southern origin of Mesotheriinae (respect to the Altiplano faunas) and a quick northward migration with subsequent rapid diversification for this group. Where this diversification event occurred is still uncertain. The report of several basal mesotheriines in intermediate latitudes (e.g. Croft et al., 2004; Townsend and Croft, 2010) supports a possible diversification of mesotheriids during the early Miocene (Croft et al., 2004). Thus, some degree of geographic connection clearly occurred between these regions during the Miocene (Cerdeño et al., 2006; Cerdeño, 2007; López et al., 2011). Under this scenario, *C. munozi* may constitute either: i) a species derived from early Miocene mesotheriids of adjacent areas (e.g. Chucal), or ii) a species originated from subsequent (secondary)

642 migration from southern regions (higher intermediate latitudes from Argentina) toward
643 the north. This second hypothesis would be consistent with the occurrence of
644 peltephilids in Caragua as a result of possible connection between intermediate and high
645 latitudes, although the occurrence of these groups in Caragua may also be the result of
646 differential (and asynchronous) migratory patterns related to the vagility of each one of
647 these species.

648 What is clear, the absence of mesotheriids and peltephilids in equatorial latitudes likely
649 indicates the existence of strong biogeographic barriers or ecologic constraints during
650 the Miocene towards the north (Croft et al., 2004; Cerdeño et al., 2006; Cerdeño, 2007),
651 but a different Andean topography (low altitude) towards the south, which may allowed
652 faunal connections with intermediate latitudes.

653 The finding of new remains of *C. munozi* allowed a reconsideration of some dental
654 diagnostic traits of this species. A distinctive character of *C. munozi* is the presence of
655 two lingual sulci in the m3 talonid; the most conspicuous of these sulci forms a
656 bilobular section in m3 whereas the other sulcus is located at the distal portion of the
657 m3. According to Flynn et al. (2005, p. 62, 64), the m3 of *C. munozi* is characterized by
658 “two pronounced lingual sulci in the talonid of the m3”; “a pronounced internal enamel
659 sulcus appears on the lingual side of the m3 talonid. The m3 talonid sulcus is
660 observable on both the crown and the lingual wall of enamel, forming pillar-like lingual
661 lobes (the anterior spans approximately one-third the lingual length of the talonid and
662 the posterior the remaining two-thirds). An additional lingual sulcus, much less
663 pronounced, is present near the posteriormost extent of the talonid”. However, a
664 reexamination of SGO-PV 22500 and MLP 86-VII-10-1 calls into question the validity
665 of the character differentiating *C. munozi* from other mesotheriines. Although one of
666 these sulci is indeed observed, the posteriormost one is not clearly identifiable. Despite

fragmentation in the terminal portion of the m3 of both reference specimens (holotype and referred material), we did not observe a true distal sulcus in the talonid but rather a fracture, which is curiously presented in both specimens. As Cerdeño et al. (2012) recently pointed out for *Plesiotypotherium casirensense* (the most complete mesotheriine ever found), the cementum in lower dentitions covers the entire tooth. This it means that any groove or sulcus observed in the external surface of the tooth must also follow a similar shape underneath the cement layer, i.e. the enamel layer must also show an invagination or sulcus. However, the enamel layer underneath the distal “sulcus” suggested for *C. munozi* does not show any concavity that may indicate a real sulcus. This was thoroughly verified in the left and right mandibles of the holotype and referred material, respectively (Fig. 9). Thus, the single dental feature that differentiated *C. munozi* from the rest of all mesotheriids (Flynn et al., 2005) is here questioned. This may have important consequences for the phylogenetic position of *C. munozi* within Mesotheriidae, and hence a reexamination of its diagnosis is needed.

6. Conclusions

Here we documented a new fossiliferous site from the Chilean Precordillera, which is placed in a higher stratigraphical position (Tortonian) and southern than previous reports for the Caragua area (Serravallian – Tortonian). A new peltephilid species, *Epipelpephilus caraguensis* is presented and differs from other peltephilids in having: two sulci in the articular surface of the mobile osteoderm; a tubular, rough and raised anterior edge; a conspicuous transverse depression; and four widely spaced foramina. This taxon, along with *E. kanti* (high latitude), is one of the most recent records of the family (intermediate latitude). The examination of the dental features of *C. munozi* resulted in the refutation of one of its main diagnostic characters, the presence of a

posterior sulcus in the talonid of the m3. This may have important implications for the taxonomy and systematics of this taxon. At the moment, the presence of an endemic mesothere and a new peltephilid species in Caragua support the hypothesis of provincialism for intermediate latitudes, and point out the faunal connections between this area and those of higher latitudes, rather than to those of lower latitudes. Further research should focus on i) understanding the osteoderm morphology (form and function), ii) reassessment of the systematics and phylogenetic position of *C. munozi*, and iii) expanding paleontological and systematic exploration of the Huaylas Formation and surrounded areas in order to precisely document their paleogeographic relationship with other Cenozoic localities.

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045 Table 1. Main features of peltephilid osteoderms and their geographic provenance. Data is from the largest osteoderms recorded, in mm. Abbreviations:
046 Argentina (AR), Bolivia (BO), Chile (CL) and South American Land Mammal Age (SALMA).

Taxon	Osteoderm Features (mm)				Locality (Country)	Latitude (°S)	SALMA	Age (Ma)	Reference
	Type	Length (max.)	Width (max.)	max. N° Foramina					
cf. <i>Peltephilus</i> sp.	Mobile	16.1	-	2-3?	Salla (BO)	17	Deseadan	26	Shockey and Anaya, 2008
<i>Epipeltephilus caraguensis</i>	Fixed	25	20	4	Caragua, Arica (CL)	18	Mayoan	11	Montoya-Sanhueza, 2008; Montoya-Sanhueza and Moreno, 2008
	Mobile	28.2	19.2	4					
cf. <i>Peltephilus</i> sp.	Mobile	16.6	16.4	3	Chucal, Arica (CL)	19	Santacrucian	17	Croft <i>et al.</i> , 2007
Peltephilidae gen. et sp. nov.	Mobile	22	18	2	Cerdas, Potosí (BO)	20	Colloncuran	15-16	Croft <i>et al.</i> , 2009, 2016
cf. <i>Peltephilus</i> sp.	Fixed/Mobile?	-	-	2?	Nazareno (BO)	21	Colloncuran ?	15	Oiso, 1991
<i>Epipeltephilus kanti</i>	Fixed	29.5	27.1	2	Arroyo Chasicó, Buenos Aires (AR)	38	Chasicoan	9-10?	González-Ruiz <i>et al.</i> , 2012
	Mobile	24.6	16	2					
<i>Epipeltephilus recurvus</i> ?	Fixed	22.6	19	4	Lago Blanco, Chubut (AR)	45	Mayoan	11	González-Ruiz <i>et al.</i> , 2012
	Mobile	23.9	21.5	4					
<i>Peltecoelus praeluscens</i>	Fixed	25.8	23.4	3	Colhue-Huapi, Chubut (AR)	46	Colhuehuapi an	21	Scillato-Yané 1980
<i>Peltephilus granosus</i>	Fixed	23.3	13	2	Colhue-Huapi, Chubut (AR)	46	Colhuehuapi an	21	Scillato-Yané 1980
<i>Peltephilus protervus</i>	Mobile	35.8	22.3	2	Chubut (AR)	47.5	Deseadan	26	Scillato-Yané 1980
<i>Peltephilus depressus</i>	Mobile	26.2	19.7	2	Chubut (AR)	47.5	Deseadan	26	Scillato-Yané 1980
Peltephilidae indet.	-	-	-	-	Gran Barranca (AR)	48	Riochican	40	Carlini <i>et al.</i> , 2005
<i>Peltephilus nanus</i>	Fixed	7.2	8.7	2	Santa Cruz (AR)	48.5	Santacrucian	17	Scillato-Yané 1980
<i>Peltephilus giganteus</i>	Fixed	17.1	13.6	0	Santa Cruz (AR)	49.5	Santacrucian	17	Scillato-Yané 1980
<i>Peltephilus strepens</i>	Fixed	25.4	21.1	4	Santa Cruz (AR)	51	Santacrucian	17	Scillato-Yané 1980
	Mobile	27.1	19.3	2					
<i>Peltephilus pumilus</i>	Fixed	12.5	9.1	2	Santa Cruz (AR)	51	Santacrucian	17	Scillato-Yané 1980
	Mobile	15.8	11.9	2					

Table 2. Major osteoderm dimensions (in mm) of *Epipeltephilus caraguensis*.
 Thickness measurements were taken from anterior (a), middle (m), and posterior (p) sections in lateral view. (*) This osteoderm lacks the posterior part. Abbreviations: horizontal (Hp) and vertical (Vp) pairs of foramina.

SGO-PV	21102A	21102B	21102C	21102D	Mean
Osteoderm length	28.2	24.9	19.4	22.5	23.8
Osteoderm width	19.2	20.0	15.6	13.4	17.0
Osteoderm thickness (a/m/p)	5.2/5.4/2.6	3.7/4.2/2.5	3.5/4.3/2.4*	3.6/5.5/4.2	4/4.9/2.9
Foramen diameter (max.)	2.1	2.4	2.2	2.3	2.3
Foramina Hp (upper)	4.5	4.2	3.1	1.7	3.4
Foramina Hp (lower)	4.2	5.2	3.1	1.9	3.6
Foramina Vp (left)	1.6	1.4	1.2	1.2	1.4
Foramina Vp (right)	1.3	1.3	1.4	1.1	1.3

1069 Table 3. Total area (OAr in mm²) of mobile osteoderms in species of Peltephilidae. See
 1070 text and Table 1 for specimen references.

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Taxon	Specimen	OAr
<i>Epipeltephilus caraguensis</i>	SGO-PV 21102A	519.2
<i>Epipeltephilus kanti</i>	MMP 339-M	372
<i>Epipeltephilus recurvus?</i>	MLP 16-2	316.4
<i>Peltephilus strepens</i>	MACN A-771	506.5
<i>Peltephilus pumilus</i>	MACN A-866-870	174.2
<i>Peltephilus depressus</i>	MACN A-12016	466.2
<i>Peltephilus nanus</i>	MACN A 7959	43.1
<i>Peltephilus protervus</i>	MACN A-12020	669.8
cf. <i>Peltephilus</i> sp.	UF 93515	162.3
cf. <i>Peltephilus</i> sp.	SGO-PV 4111	217.1
Peltephilidae gen. et sp. nov.	UF 225047	346.2

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1086 Table 4. Measurements (in mm) of the lower teeth of *Caraguatypotherium munozi* from
 1087 the left/right sides.

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Specimen	Length	Width	
		Trigonid	Talonid
SGO-PV 21101 (This work)			
m1	16.5/17.2	7.1/7.7	7.5/8.6
m2	-	7.52	-
SGO-PV 22500 (Holotype)			
m1	13.9/13.3	5.6/5.9	6.4/6.9
m2	14.1/13.4	5.4/5.9	5.7/5.8
MLP 86-VII-10-1 (Referred material)			
m1	-/13.2	-/5.7	-/7.4
m2	-/12.8	-/5.7	-/6.2

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