

Fossil Xenarthra of the Early Miocene Santa Cruz Formation of Sierra Baguales, Magallanes, Chile: diversity and biogeographic affinities.

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INTRODUCTION

Xenarthrans (armadillos, anteaters, sloths, and relatives) are common elements of the Early Miocene Pansantacrucean faunas of Patagonia, mostly because of their vast fossil record which displays many morphological particularities. In Sierra Baguales, Magallanes, extensive stratigraphic work undertaken by our team has identified exposures of the continental Santa Cruz Formation, from which more than 23 fossil vertebrate species - most of them mammals - have been identified (Bostelmann *et al.*, in press). This diversity includes at least 5 xenarthrans, on which a brief review is presented here. Regional affinities between these species and other Early Miocene fossil assemblages of Patagonia are also discussed.

MATERIALS AND METHODS

Stratigraphic studies and fossil collection were conducted at two localities within the Santa Cruz Formation deposits, located in the northeastern corner of Sierra Baguales: the Morro Bayo and the recently discovered Arenales Altos zones (Fig. 1). Taxonomic identifications were made following the classic literature, recent reviews and direct comparison with scientific collections. The lithostratigraphic, geochronologic, and taphonomic attributes of the fossil assemblage are described in detail in Bostelmann *et al.* (in press).

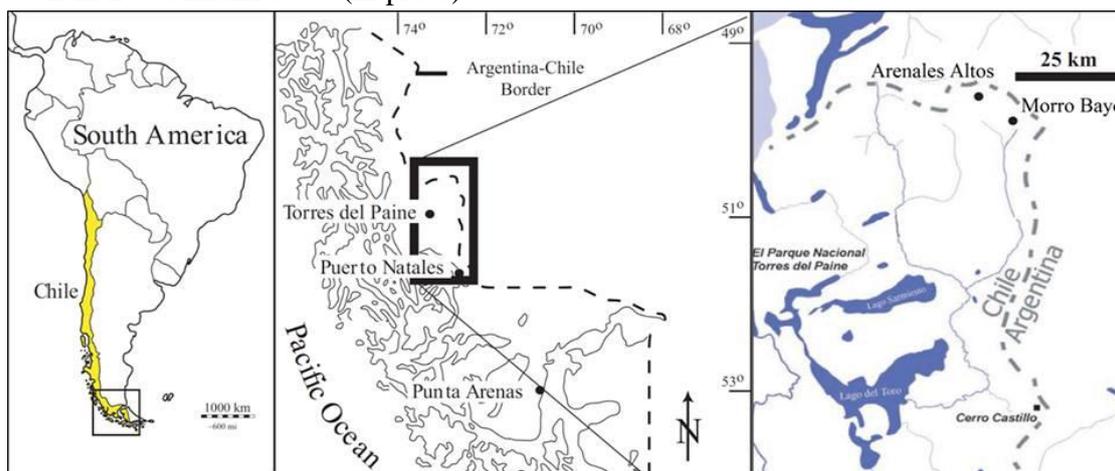


Figure 1: Study area with localities mentioned in the text.

RESULTS

The Cenozoic sedimentary sequence at Sierra Baguales forms part of the western exposures of the Andean foreland basin. The Santa Cruz Formation crops out in the stratigraphically highest part of this sequence, as part of a monoclinical structure in the fold-and-thrust belt. The continental synorogenic deposits concordantly overlie the

marine units of the Estancia 25 de Mayo Formation, representing the beginning of the main terrestrial deposition after the withdrawal of the “Patagonian” sea in the area. The depositional environment is interpreted as a meandering river system, with point bars and ephemeral floodplain lakes (Bostelmann *et al.*, in press). A direct zircon date of 18.23 Ma in the higher part of the Morro Bayo is concordant with the age indicated by the fossil assemblage, bracketed between 19 – 18 Ma. The identified fossil xenarthrans include members of the Orders Cingulata (armadillos and glyptodonts) and Pilosa (sloths).

Sloth remains are mostly composed of fragmentary, unassociated postcranial bones, but some cranio-mandibular materials offer better and more diagnostic characters (Fig. 2 A-C). Morphological differences and the size distribution of the remains show the existence of at least two different species, one medium and the other small. The occurrence of megalonychid sloths, as previously suggested by Bostelmann *et al.* (in press), is confirmed by the recent discovery of a rostral (anterior) portion of a cranium (Fig. 2A) at the Arenales Altos locality. The externally-projected triangular-shaped caniniforms, separated from the rest of the teeth by a marked diastema, and the sub-elliptical to quadrangular sections of the molariforms, indicate similarities with the well-known Santacrucian genus *Eucholoeops*, and also the lesser-known enigmatic *Pseudortotherium australis* from the Lago Argentino region (Scillato-Yané, 1981). A small dentary with three broken molariforms collected at Morro Bayo, is here assigned to an unknown genus, probably close to the *Pelecycodon-Hapalops* lineage.

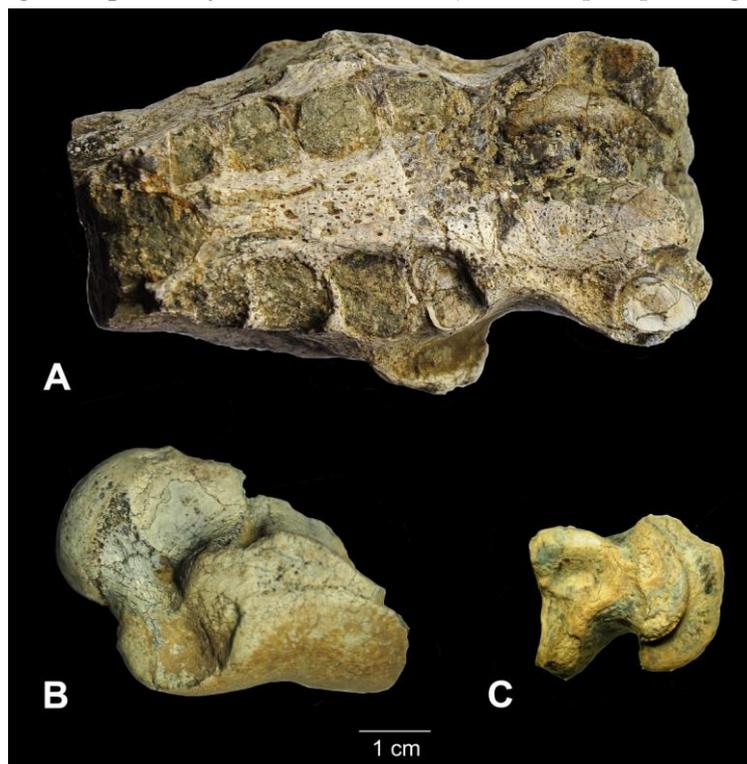


Figure 2: Selected skeletal elements of the Sierra Baguales fossil sloths. A) Anterior portion of the skull of a yet undetermined Megalonychidae, in palatal view. B) Isolated astragalus, in lateral view. C) Metacarpal III?, in lateral view.

The remaining skeletal elements are composed of isolated caudal vertebrae, astragalus (Fig. 2B), metacarpals, and phalanges (Fig. 2C), which also support the occurrence of at least two different species. Unfortunately, this kind of material tends to be common within the sloth lineages, and does not allow a definite taxonomic characterization.

Fossil Cingulata recovered at Sierra Baguales include two Eutatini (subfamily Euphractinae), one Stegotheriini (subfamily Dasypodinae), and one glyptodont (subfamily Propalaeophorinae). The preserved remains are mostly formed by disarticulated elements of the carapace, known as osteoderms (Fig. 3A-D).

A dozen isolated osteoderms from the upper strata of Morro Bayo feature common attributes with the well-known genus *Proeutatus* (Fig. 3A). The presence of defined figures and the absence of a prominent ridge in the central figure suggest similitude with both *Proeutatus lagena* and *P. oenophorum*. González Ruiz (2010) alludes to the complex taxonomic condition of both species, stating that they can only be differentiated through discrete cranial characters, not observable in the type series. The absence of more diagnostic materials prevents any specific assignment for the Magallanian specimens. The second and far more abundant eutateine is characterized by an associated cranio-mandibular fragment and two dozen isolated osteoderms from the middle portion of Morro Bayo (Fig. 3B). This is also the most common Xenarthra collected in Sierra Baguales, with isolated osteoderms and a few postcranial fragments recovered from many stratigraphic horizons. General characteristics of this form includes: 1) very small size; 2) short rostrum, 3) sub-parallel upper dental series with 9 teeth; 4) an elliptical first molariform, separated from the rest of the dental series by a short diastema, 5) bilobed, and sub-triangular to elliptical M2-M9. The osteoderms are smooth and punctuated, with an external ornamentation consisting of a wide, piryform central figure bearing a central ridge, all surrounded by three to four antero-lateral peripheral figures (Fig. 3B). The general morphology of this species suggests a direct resemblance to the genus *Proeutatus*, but its extremely small size and the osteoderm ornamentation distinguish the Sierra Baguales materials from all previously named species of the genus. We favor the recognition of a new species of *Proeutatus* for this intriguing, small eutateine.

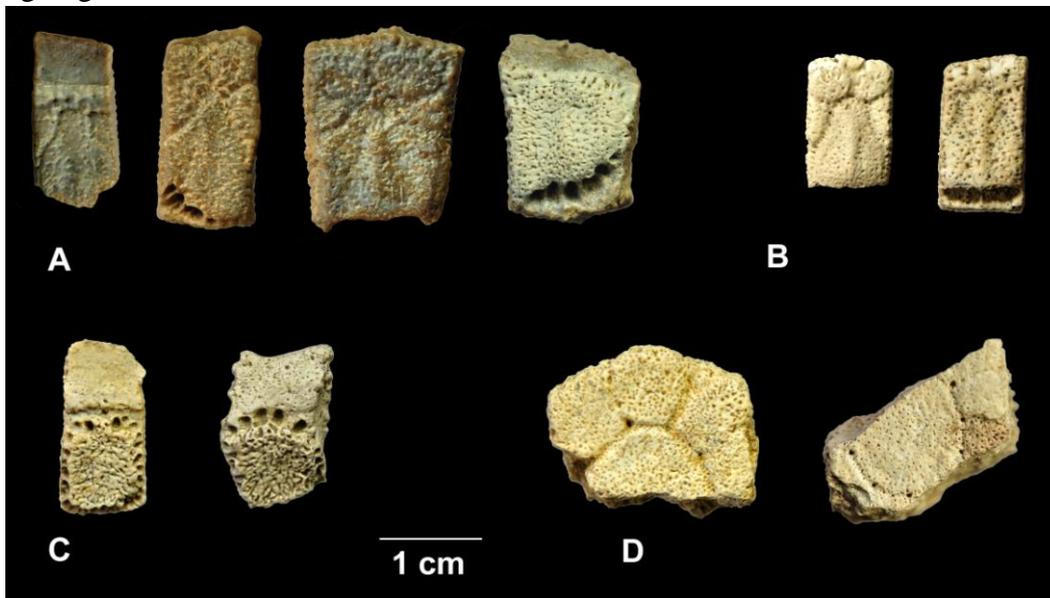


Figure 3: Selected diagnostic osteoderms of the Sierra Baguales fossil cingulates, in dorsal view. A) *Proeutatus* cf. *P. lagena* or *P. oenophorum*. Movable and fixed osteoderms. B) *Proeutatus* sp. nov. Fixed osteoderms. C) *Stegotherium notohippidensis*, movable and semi-movable osteoderms. D) Propalaeophorinae indet. Fragmentary fixed osteoderms.

At the Arenal Alto locality, more than 120 isolated osteoderms and a few associated postcranial bones have been identified as *Stegotherium notohippidensis* (Fig. 3C). Diagnostic characters of these osteoderms include: 1) smooth and punctuated surfaces lacking a raised medial ridge, with antero-lateral figures; and 2) anterior, lateral

and posterior rows of foramina marking the edges of the bone, larger than in the other members of the genus (González Ruiz and Scillato-Yané, 2009, Fig. 3C). The morphological variability observed in the collected specimens clearly represents different regions of the carapace, as stated previously by González Ruiz and Scillato-Yané (2009). At Morro Bayo, one isolated osteoderm also reveals the presence of this form. *Stegotherium notohippidensis* was initially recognized from stratigraphic horizons of the Santa Cruz Formation south of Lago Argentino. This report is the first mention on the occurrence of this species in the Chilean fossil record.

Finally, only three isolated osteoderms of the generally abundant members of the glyptodont subfamily Propalaehoplophorinae have been recovered from the upper levels of Morro Bayo. The fragmentary condition of these osteoderms, lacking specific characteristics, prevents the assignation of these materials to any known genus or species within this subfamily.

DISCUSSION AND CONCLUSION

While scant, the recovered fossil assemblage from Sierra Baguales is similar to the “Notohippidian” age faunas reported south of Lago Argentino, at Cerro Centinela and Estancias Quién Sabe and La Josefina (Scillato-Yané, 1981; González Ruiz and Scillato-Yané, 2009). Shared taxa between these localities include *Stegotherium notohippidensis*, *Proeutatus* sp. nov., and probably *Proeutatus lagena* or *P. oenophorum*. Future studies also could corroborate the similitude between the sloth species. Compared with the Santacrucian and Friasian age faunas, the Sierra Baguales/Lago Argentino fossil assemblage seems less diverse and cosmopolite. While it is almost certain that some of this difference could be related to the insufficient number of collected specimens, the close temporal proximity between Santacrucian and “Notohippidian” age faunas suggests that some degree of biogeographical differentiation could also be present.

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