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Comparative paleohistology in osteoderms of Pleistocene *Panochthus* sp. Burmeister, 1886 and *Neuryurus* sp. Ameghino, 1889 (Xenarthra, Glyptodontidae)

Comparaison paléohistologique entre les ostéodermes du Pléistocène Panochthus *sp. Burmeister, 1886 et* Neuryurus *sp. Ameghino, 1889 (Xenarthra, Glyptodontidae). Handled by Lars van den Hoek Ostende*

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ABSTRACT

Xenarthran osteoderms are integumentary bones with high fossilization potential presenting a high degree of morphological and histological diversity. Here, new data on the osteoderms histology of two glyptodonts, *Panochthus* and *Neuryurus* are presented. The poor spatial organization of the mineralized fibers and a large trabecular area in the middle zone identified in *Neuryurus* indicate a different bone pattern than the one found in *Panochthus*, which is mainly characterized by a middle zone with less spongiosa. Through the Bone Profiler program, the degree of compactness of the specimens was obtained, with about 70% for *Neuryurus* sp. and approximately 90% for *Panochthus* sp., showing the difference in bone pattern. These values confirm the visible difference in the histological patterns of these taxa, especially in the middle zone. This work demonstrates the microstructural variation studied in osteoderms and shows the importance of paleohistology as a starting point for a better understanding of extinct taxa.

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R É S U M É

Les ostéodermes de xénarthres sont des os tégumentaires avec un haut potentiel de fossilisation, présentant un haut degré de diversité morphologique et histologique. Dans cet article sont présentées de nouvelles données sur l'histologie des ostéodermes à partir de deux glyptodontes, *Panochthus* et *Neuryurus*. L'organisation spatiale médiocre des fibres minéralisées et un grand espace trabéculaire dans la zone médiane identifiée dans le *Neuryurus* indiquent une structure d'os différente de celle de *Panochthus*, qui se caractérise principalement par une zone médiane moins spongieuse. Grâce au programme Bone Profiler, on a obtenu le degré de compacité des spécimens, avec environs 70 % pour *Neuryurus* sp. et approximativement 90 % pour *Panochthus* sp., montrant la différence dans la structure de l'os. Ces valeurs confirment la différence visible dans les structures histologiques de ces taxons, en particulier dans la zone médiane. Ce travail démontre la variation de microstructure étudiée dans les ostéodermes, et montre l'importance de la paléohistologie comme point de départ pour une meilleure compréhension des taxons éteints.

Mots clés :
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1. Introduction

Xenarthra is one of the four major clades of placental mammals and has a rich fossil record throughout the Cenozoic era, comprising many fossils and extant forms (Carrol, 1988; Hoffstetter, 1982; Patterson and Pascual, 1968; Paula Couto, 1979; Simpson, 1948). The group includes armadillos, pampatheres and glyptodonts, sloths and anteaters (Fig. 1), divided into two orders: Pilosa Flower, 1882 (sloths and anteaters) and Cingulata Illiger, 1811 (armadillos, pampatheres, and glyptodonts) (McKenna and Bell, 1997; Reis et al., 2011).

The Order Cingulata is a taxonomically distinct and complex group, traditionally divided into two superfamilies: Dasypodoidea (Dasypodidae) and Glyptodontoidea (Pampatheriidae and Glyptodontidae) (McKenna and Bell, 1997). The glyptodonts form a group of cingulates with an extensive stratigraphic distribution (Zurita et al., 2009) ranging from the late Eocene (McKenna and Bell, 1997) to the early Holocene (Cione et al., 2003), reaching a diversity of over 65 genera and 220 species (McKenna and Bell, 1997).

Among the enormous diversity of glyptodonts, we have chosen two problematic Pleistocene taxa: *Neuryurus* Ameghino, 1889 and *Panochthus* Burmeister, 1866. The genus *Neuryurus* is a very problematic taxon since its fossil record is very scarce and because it is difficult to identify due to their poor morphological characterization (Zurita et al., 2009). Therefore, it is commonly confused with *Panochthus* in northeastern Brazil. The only well-characterized species is *Neuryurus rudis* (Gervais, 1878), limited to the Ensenadan Age/Stage (early-middle Pleistocene) of the Pampean region in Argentina (Zurita and Ferrero, 2009; Zurita et al., 2009). Zamorano et al. (2014) recognize six valid species of *Panochthus*, with only two species described from the Brazilian Northeast (Porpino et al., 2014): *P. jaguaribensis* Moreira, 1965 and *P. greslebini* Castellanos, 1942.

Since osteoderms have been the most frequent and abundant fossil elements in the record of Cingulata (Carlini and Zurita, 2010), the arrangement and morphology of their osteoderms have also been used as a source of taxonomic information (Krmpotic et al., 2009; (Vickaryous and Hall, 2006). Studies such as Hill (2006); Wolf (2007); Chávez-Aponte et al. (2008); Krmpotic et al. (2009); Wolf et al. (2011) and Da Costa Pereira et al. (2014) show that the characteristics of osteoderm anatomical microstructure are also relevant to the study of evolutionary relationships and could provide diagnostic characters to differentiate species.

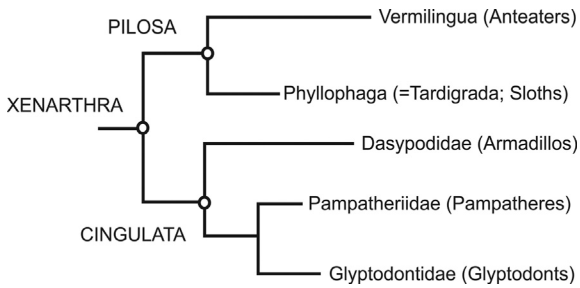

Fig. 1. Cladogram showing hypothesized phylogenetic relationships among major groups of Xenarthra (Modified from Hill, 2006).
Fig. 1. Cladogramme montrant les relations phylogénétiques hypothétiques entre les principaux groupes de xénarthres. (Modifié d'après Hill, 2006.)

Nowadays, there is a significant increase in microanatomical and ultrastructural research applied to fossil groups (Chinsamy et al., 2013; Nakajima et al., 2014; de Ricqlès, 2006, 2011; Straehl et al., 2013; Vickaryous and Sire, 2009; Woodward et al., 2014). Methodological advances, such as the Bone Profiler program (Girondot and Laurin, 2003), have supported the paleohistology research also in the quantitative aspect. The Bone Profiler program provides a possibility to standardize the method used to analyze bone segments and can model a bone compactness profile to test biological hypotheses.

Paleohistological studies of the Cingulata osteoderms have appeared regularly in the last decade (Chávez-Aponte et al., 2008; Da Costa Pereira et al., 2014; Hill, 2006; Wolf, 2007; Wolf et al., 2011); however, some taxa, such as *Neuryurus*, remain unstudied demonstrating the need for more paleohistological data of armored mammals. Here, we use paleohistological techniques, including