



A new record of a Scelidotheriine ground sloth (*Xenarthra*, *Mylodontidae*) from Central Brazil: Quaternary cave stratigraphy, taxonomy and stable isotopes

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ABSTRACT

An upper fourth molariform of a Scelidotheriine ground sloth is reported from Carneiro Cave, which is located in the karstic region of Serra da Mesa (Goiás). In this limestone cave the tooth was found at the base of a depositional sequence, associated with a 2 m thick debris flows deposit, which is covered by the lowest carbonate crust – dated at approximately 200,000 yr BP. Detailed morphological description, stable isotope data and stratigraphic context are provided. This represents the first megafauna record for this region of Central Brazil, where this record is found in direct association with a diverse microvertebrate fauna.

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1. Introduction

Karstic deposits from Brazil are well known for yielding rich mammalian paleofaunas (Hubbe et al., 2011). However, stratigraphic control at the sites has been almost non-existent (Paula Couto, 1973; Auler et al., 2006), exceptions being sites examined and described in two unpublished doctoral theses, namely Piló (1998) and Laureano (2014). Efforts to provide geologic age control for these fossils, either by the use of ¹⁴C or other methods, have been included in very few studies in Brazil (Auler et al., 2006).

Brazilian cave deposits were often described as lacking stratigraphy or internal sedimentological structures, which seem to have caused scientists to ignore cave deposits completely during the 19th and 20th centuries. The perception that caves lack stratigraphy or other means of

dating the deposits resulted in the conclusion that geologic ages could not be established and used for correlating the fossil records throughout South America, especially to the abundant fossil deposits of Argentina. This problem is especially acute for ground-sloth records, particularly the Scelidotheriine sloths (Miño-Boilini and Carlini, 2009).

Here we report a molariform tooth of a Scelidotheriine ground sloth (Scelidotheriinae) found at the base of a stratigraphic column in Carneiro Cave, which is part of the karstic region of Serra da Mesa (Goiás), located in the central portion of the Brazilian continental land-mass (Fig. 1).

2. The karst of Serra da Mesa

The region of Serra da Mesa is located in a central portion of the Cerrado Domain. In Pre-colonial time (before 1500 CE), this savanna-like ecosystem covered an area of approximately 200 million hectares, distributed over the Brazilian Midwest; it is presently the second largest biome in South America, ranging from sea level to 1800 m (Ratter et al.,

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Fig. 1. Map of the South American continent with Brazil outlined and the region of Serra da Mesa plotted; and a photo of the landscape of Serra da Mesa (Cerrado).

1997). The topography of Serra da Mesa is characterized by moderate elevation (~700 m), smooth-slopes with narrow tabletops abruptly ending in valleys. As seen in Fig. 1, the present vegetation is Brazilian savanna, displaying dense grasslands with sparse shrubs and small trees, and also having areas of seasonally dry forests and wet fields along streams with riparian forests. Data obtained from nearest weather stations show that Serra da Mesa has high temperatures (average annual temperature ranging between 21 and 25 °C) throughout the year and 1400 to 1800 mm/yr with high seasonality, and about 70% of the annual precipitation occurring between November and the autumnal equinox in March (Nimer, 1979; Assad and Evangelista, 1994). Although efforts are being undertaken to describe climatic fluctuations during the Quaternary at Serra da Mesa, no published data are presently available. Therefore, it is unknown how the present savanna of this region changed throughout the late Pleistocene and Holocene.

Carneiro Cave is one of hundreds of caves in the karst of Serra da Mesa, which awaits further speleological explorations and paleontological examination. Nossa Senhora Aparecida Cave is the region's only other site where paleontological studies have been undertaken (Salles et al., 1999). Preliminary evaluations are that Serra da Mesa has the potential for significant paleoecological contributions to the Quaternary history of Central Brazil. The Carneiro Cave stratigraphic sequence is described below.

3. Geological setting and stratigraphic sequence

As part of the Section Tocantins / Goiás from the Bambuí Group, a neoproterozoic succession of limestones and siliciclastic rocks (Karmann and Sánchez, 1979), Serra da Mesa has not been formally described, aside from the preliminary publication of Salles et al. (1999). Although there are presently efforts to compile its main speleological systems and their associated Quaternary deposits, we focus exclusively on the limestone Carneiro Cave (13°48.780'S; 48°30.838'W) and on its

megafauna record that is associated with abundant microvertebrate fossils.

Carneiro Cave is located in the Municipality of Campinaçu, a few kilometers NW of the artificial reservoir of Serra da Mesa, approximately 30 km from the town of Campinaçu. The main opening of the cave (Fig. 2) is situated near the top of a smooth slope with approximately 50 m of relief; a stream flows east into the reservoir. As illustrated in Fig. 3, the first gallery of the cave has a constant width that extends more than 10 m until the ceiling decreases from 3 m high to less than 1 m. Eventually, the passage opens into the main gallery that is within total darkness (sands and clays washed into the cave system from higher elevations cause this constriction). The main gallery floor is approximately rectangular, with a total area of ~200 m². The excavation is located in this gallery a few meters after the restriction and is 4 × 4 m. The details of the excavation procedures and related stratigraphy will be described elsewhere (Ramos et al., in prep.). Approximately 1000 kg of sediment have been sampled and screen-washed and have yielded the majority of the small bone fragments. The following is a brief overview of the stratigraphic section.

The upper 3 m of the stratigraphic profile contain three distinct sedimentary units (Fig. 4). With an approximately 2 m thickness, the lower unit includes micaceous sandy muds, with scattered limestone and quartzite pebbles, cobbles, and matrix-supported breccias on the upper portion, which yielded the *Scelidotheriine* sloth tooth. Above the base of the micaceous sediments are two breccias within poorly sorted sands and muds. The breccias contain pebble to boulder size quartz and limestone clasts that have no preferred orientation. At the top of the upper breccia there is a calcite bed ~2.5 cm thick (Fig. 4, recognized as CC1) and which extends laterally as part of a flowstone apparently covering the entire paleo-floor of the gallery, observed as a continuous layer on three excavation faces (on the fourth, just as traces on the exposed gallery's wall).

These flowstones are formed by calcite deposition by water films that require relatively high mean discharge derived from fissure or

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