

A new titanosaur from the Lower Cretaceous of Brazil



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ABSTRACT

Here we describe a new record of a sauropod dinosaur from the Lower Cretaceous (Hauterivian–Barremian) Rio Piranhas Formation, Sousa Basin, NE Brazil. Dinosaur fossil bones from this deposit were unknown until now. Thus, the discovery of a sauropod fibula from this locality is highly significant. Our discovery represents an indeterminate titanosaur and the earliest stratigraphic occurrence of this group in central Gondwana. When compared to chronocorrelate titanosaur trackmakers of this geological unit, this fossil specimen appears substantially smaller. Histological analysis of the fibula suggests that this is a relatively young individual (approximately 40–50% adult body size) that had passed its most rapid phase of early juvenile growth, but had not yet attained somatic maturity. Thus, the fibula recovered is from a young individual rather than from a small-bodied adult titanosaur.

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1. Introduction

Despite the considerable number of Lower Cretaceous continental sedimentary deposits in Brazil, body fossil remains of Early Cretaceous dinosaurs have only been formally documented in the Aptian–Albian Araripe and São Luís-Grajaú basins (Kellner and Campos, 1996; Martill et al., 1996; Kellner, 1999; Medeiros and Schultz, 2002; Sues et al., 2002; Carvalho et al., 2003; Naish et al., 2004; Medeiros, 2006; Castro et al., 2007; Bittencourt and Langer, 2011; Kellner et al., 2011; Lindoso et al., 2012; Faria et al., 2015). Curiously though, dinosaur footprints from the Lower Cretaceous of Brazil are pervasive (e.g. Leonardi, 1980; Leonardi, 1989; Carvalho et al., 1993; Leonardi, 1994; Carvalho, 1996; Carvalho and Kattah, 1996; Leonardi and Carvalho, 1999; Carvalho, 2001; Leonardi and Carvalho, 2002; Leonardi and Santos, 2004; Dentzien-Dias et al., 2007; Scheffler and Silva, 2007; Fernandes et al., 2011).

Dinosaur tracks from Rio do Peixe Basin complex are especially well known, and include those of theropods, sauropods, ornithopods and a possible thyreophoran. To date, none of the dinosaur

tracks are associated with any skeletal remains. Thus, the extreme rarity of bone material in this succession makes the discovery of the fibula especially noteworthy. Given the rich trace fossil assemblages in the Rio do Peixe basin complex; it is evident that a diverse dinosaur community was established in this area throughout the Early Cretaceous.

Here we describe a sauropod fibula collected from Rio Piranhas Formation, Sousa Basin, Brazil. This is the first dinosaur skeletal element described from the Rio do Peixe basin complex and it is also the oldest record of a sauropod from Brazil. This finding expands the possibility for new dinosaur discoveries in the Lower Cretaceous strata of the Rio do Peixe basins and broadens our knowledge of dinosaurs from central Gondwana.

2. Geological setting

The Sousa Basin (Upper Jurassic–Lower Cretaceous), located in Paraíba State, is included in the Rio do Peixe Basin Complex (Fig. 1). Well known as a megatracksite in South America, its vertebrate ichnocoenosis include chelonian and crocodyliform traces (Campos et al., 2010), and hundreds of dinosaur tracks, mostly ascribed to theropods, sauropods and ornithopods (Leonardi, 1979; Carvalho, 1996; Leonardi and Carvalho, 2002; Leonardi and Santos, 2004;

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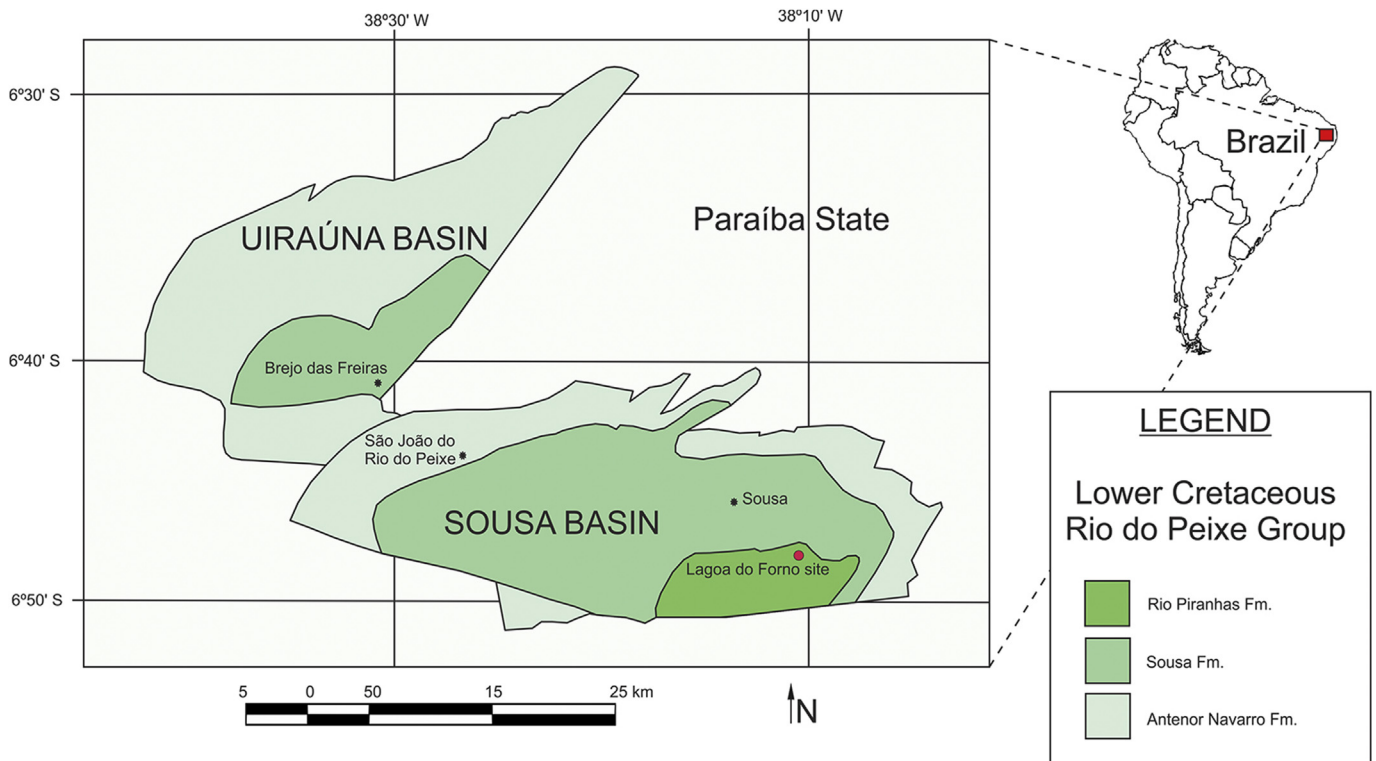


Fig. 1. Sousa Basin location and geology. Sousa Basin comprises an area of approximately 770 km². Lagoa do Forno locality (where the fossil herein described was collected) is indicated in red. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Leonardi and Carvalho, 2007). Invertebrate ichnofossils are also present, and include tracks and burrows of arthropods and annelids (Fernandes and Carvalho, 2001; Carvalho, 2004). Body-fossils are rare and generally small, only occurring in the Sousa Formation. They comprise bivalves, ostracods, conchostraceans, plant fragments, palynomorphs, fish scales and crocodylomorph bone fragments (Maury, 1934; Braun, 1969; Silva, 1971; Tinoco and Katoo, 1975; Carvalho and Carvalho, 1990; Carvalho, 2000; Leonardi and Carvalho, 2002; Leonardi and Carvalho, 2007). Until now, no dinosaur bones were recovered in the lithostratigraphic units of the Sousa Basin context.

The Rio do Peixe Basin Complex evolved during a transcurrent fault system displacement at the beginning of the drifting of South America–Africa (Lima-Filho et al., 1999). Mabeoone (1972) and Mabeoone and Campanha (1973) proposed the first formal lithostratigraphic subdivision of the Cretaceous in Sousa Basin, and the neighboring Uiraúna/Brejo das Freiras, and Pombal basins. These authors subdivided it in the Antenor Navarro, Sousa, and Rio Piranhas formations. The Antenor Navarro and Rio Piranhas formations are composed of immature clasts, including breccias and conglomerates near the margins of the basin. Towards the basin-depocenter, however, conglomeratic and fine sandstones, sometimes intercalated with siltstones and shales are commonly found. The Sousa Formation is composed mostly of reddish sandstones, siltstones, mudstones and carbonate nodules, yet marls also occur.

The Antenor Navarro Fm. deposition is generally associated with upper alluvial fans and a braided or anastomosing river system. Sousa Fm., in contrast, may have accumulated in shallow lakes, meandering rivers and alluvial plain environments, while the lithology of the Rio Piranhas Formation points to sedimentation in lower alluvial fans and possibly braided channels (Carvalho, 2000; Carvalho et al., 2013).

In 1970, a stratigraphic survey of the Sousa Basin was conducted at Lagoa do Forno site, only a few dozen meters from where the

bone herein described was found. The borehole, with a depth of 1005.7 m hit the crystalline basement and went through the three units recognized in the basin (DNPM, 1970). From bottom to top, the borehole drilled 15.85 m of crystalline rocks (86.20 m of Antenor Navarro Fm., 799.75 m of Sousa Fm. sediments, and 103.95 m of Rio Piranhas Fm. conglomerates and sandstones). The drilling lithologic profile can be seen in Fig. 2, associated with the main tetrapods found on each unit.

The palynological assemblages associated to Sousa Basin fossil content are characteristic of the Rio da Serra (Berriasian–Hauterivian) and Aratu (lower Barremian) local stages (Lima and Coelho, 1987; Regali, 1990).

3. Materials and methods

The specimen studied was originally curated at the Laboratório de Paleontologia (PALEOLAB), Departamento de Geologia, Centro de Tecnologia e Geociências of the Universidade Federal de Pernambuco (DGEO-CTG-UFPE), but it is now under care of the paleontological museum of ‘Vale dos Dinossauros’ park, in Sousa, Paraíba.

3.1. Sauropod size estimate from local tracksites

In an attempt to compare the fibula (DGEO-CTG-UFPE 7517) with its chronocorrelate trackmakers, sauropod sizes were estimated from several ichnospecimens recovered from the same area.

Total length measurements and segment proportions estimated from limb bones show considerable variation interspecifically in Titanosauria, and such estimates should be used with caution or be avoided (Lacovara et al., 2014). In this work, hip height measures (cm) were chosen for comparison between Sousa’s ichno and corporeal fossil fauna. Estimates of the height at the hip joint from sauropod tracks are well known in dinosaur paleontology since it

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