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Origin of bonebeds in Quaternary tank deposits

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ABSTRACT

Tank deposits are an exceptional type of fossiliferous deposit and bear a remarkably fossil record of the Pleistocene megafauna of South America, particularly of Brazil. The taphonomy of vertebrate remains preserved in this type of environmental context was clearly driven by climate, similarly to most of the Quaternary continental fossil record. The formation of the vertebrates fossil record in tank deposits was influenced by the climate seasonality typical of arid climate. The taphonomic history of most tank deposits is a consequence of this seasonality and, as a result, the paleoecological data preserved in their fossil assemblages is reliable with respect to paleobiological and paleoenvironmental settings of the Quaternary ecosystems of the Brazilian Intertropical Region (BIR). Other tank deposits experienced an unusual taphonomic history that, besides climate, was affected by recurrent events of reworking produced by the depositional agents dominant in the surrounding alluvial plains. The conclusions obtained here concerning the main taphonomic settings and formative processes that characterize fossil vertebrate assemblages of tank deposits will help further studies aimed to recover information on the paleoecology of Quaternary fauna collected in such deposits by allowing a better understanding of their time and spatial resolutions and other potential biases.

1. Introduction

Tank deposits – one of the most singular type of fossiliferous deposit in South America – are small sedimentary bodies of Quaternary age that fill natural depressions (called natural tanks) on basement rocks in northeastern Brazil (Araújo-Júnior et al., 2013a). These sedimentary bodies are usually stratified and fossiliferous, preserving remains of diverse representatives of the Quaternary megafauna, such as huge ground sloths, glyptodonts, mastodons, toxodonts, saber-toothed cats and macraucheniids (Paula-Couto, 1980; Mabesoone et al., 1990; Bergqvist et al., 1997; Cartelle, 1999). In some cases, megafaunal remains are associated with few fossils of small- to mid-sized mammals, crocodiles, lizards, birds and anurans (Araújo-Júnior and Moura, 2014). The genesis of these deposits has been interpreted as deposited in contexts of debris flows and flash floods (Mabesoone et al., 1990; Araújo-Júnior et al., 2013a, 2015).

Tank deposits provide some of the best evidences for understanding paleoenvironments and paleoecology of the Brazilian Intertropical Region (BIR) during the Quaternary. However, these deposits have preserved different paleoecological snapshots from ancient vertebrate communities and their associated ecosystems (Araújo-Júnior et al., 2011a), and these differences only began to be scrutinized in the last decade by taphonomy-based studies (Santos et al., 2002; Alves et al., 2007; Silva, 2008; Araújo-Júnior et al., 2013a, 2013b, 2015).

Currently, tank deposits are the most taphonomically studied type of vertebrate-bearing deposit in Brazil, but some studies have revealed a wide range of variation in the preservational patterns in their fossil concentrations (Araújo-Júnior et al., 2013a, 2013b, 2015; Araújo-Júnior and Moura, 2014). Therefore, a comparative taphonomic analysis among tank deposits would be crucial to better delineate the main taphonomic processes and pathways that led to these perceived differences in the preservation of vertebrate remains in such deposits.

Here we present the results of a regional-scale taphonomic analysis seeking to describe and explain the variation in

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taphonomic and paleoecological signatures among tank deposits, shedding light on the origin of the bonebeds preserved in this environmental context and its implications for the paleoecology of Quaternary of BIR.

2. Material and methods

Fossil assemblages of tank deposits from five paleontological sites located at different sections of BIR (Fig. 1) were analyzed seeking for common patterns and distinctive features: (i) Jirau Paleontological Site (JI; 3°21′23″S 39°42′20″W); (ii) João Cativo Paleontological Site (JC; 3°30′17″S 39°40′24″W); (iii) Campo Alegre Paleontological Site (CA; 7°15′18.55″S 36°44′26.35″W); (iv) Curimatãs Paleontological Site (CM; 7°07′36″S 36°07′48″W); and (v) Lage Grande Paleontological Site (LG; 8°25′27″S 36°43′20″W). Although a large amount of tank deposits (approximately 36; see Fig. 1 of Araújo-Júnior, 2016) have been excavated in Brazil during the last 80 years, a few ones experienced a controlled excavation, including those analyzed in this study.

The material analyzed in this work consists of all identifiable specimens recovered in previous excavations (CA NISP = 331; CM NISP = 118; LG NISP = 230; JC NISP = 556; JI NISP = 1405). They are housed at Museu Nacional, Rio de Janeiro City, Brazil, and Museu de Pré-história de Itapipoca, Itapipoca City, Brazil. Their faunal lists are presented in Appendix A. All fossil specimens (NISP = 2640) recovered from those tank deposits were evaluated in order to recognize and interpret taphonomic features, providing a consistent background for comparative analyses and to infer the paleoenvironmental conditions related to their origin.

Fossil assemblages were evaluated following classical vertebrate taphonomy methods (Behrensmeyer, 1978, 1991; Shipman, 1981; Frison and Todd, 1986; Lyman, 1994; Rogers et al., 2007). Taphonomic attributes evaluated were: (i) physical integrity (complete, partial or fragment); (ii) degree of disarticulation (articulated or disarticulated); (iii) desiccation marks (weathering stages of Behrensmeyer, 1978; from 0 to 5); (iv) degree of abrasion (according to Shipman, 1981; no abrasion, moderate abrasion, heavy abrasion); (v) tooth marks (presence/absence); (vi) trample marks (presence/absence); (vii) anthropogenic signs (presence/absence); and (viii) bioclastic sorting according to the three groups of Fluvial Transport Index (FTI groups of Frison and Todd, 1986).

Furthermore, correspondence and cluster analyses (Q- and R-

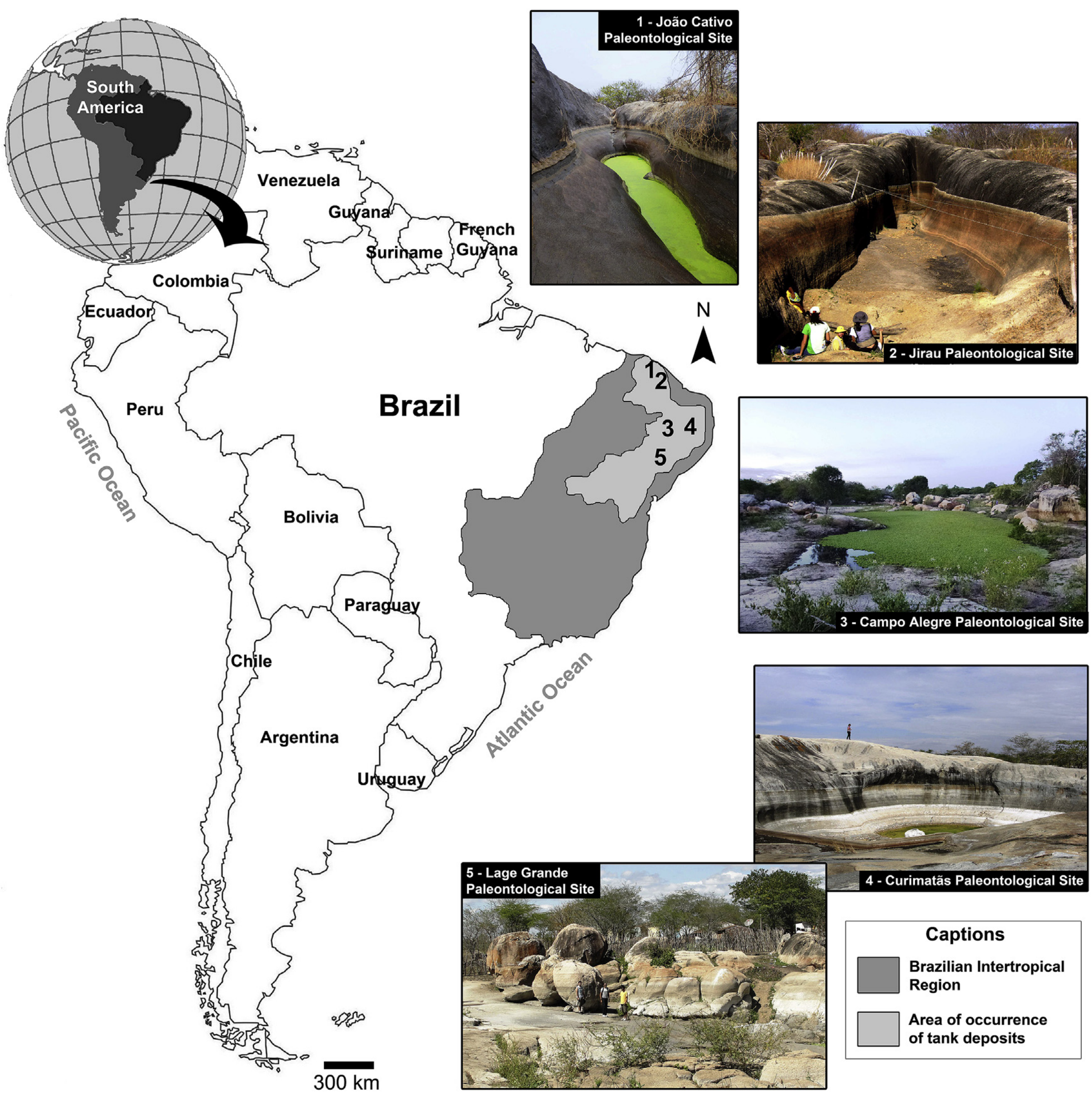

Fig. 1. Location map of the paleontological sites of Brazilian Intertropical Region evaluated in this study.