Cretaceous Research 44 (2013) 112–121

Contents lists available at SciVerse ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

Preservation of dinosaur tracks induced by microbial mats in the Sousa Basin (Lower Cretaceous), Brazil

Ismar de Souza Carvalho [a,*], Leonardo Borghi [a], Giuseppe Leonardi [b]

[a] Universidade Federal do Rio de Janeiro, Instituto de Geociências, Departamento de Geologia, Av. Athos da Silveira Ramos, 274, Cidade Universitária, Ilha do Fundão, 21910-200 Rio de Janeiro, RJ, Brazil
[b] Institut Cavanis, Kinshasa-Ngaliema, The Democratic Republic of the Congo

ARTICLE INFO

Article history:
Received 21 January 2013
Accepted in revised form 8 April 2013
Available online 11 May 2013

Keywords:
Dinosaur tracks
Microbial mats
Sousa Basin

ABSTRACT

Dinosaur footprints and tracks in the Sousa Basin (Lower Cretaceous, Brazil) occur in at least 37 localities, in distinct stratigraphic positions. Footprints are rare in the Antenor Navarro (lower) and Rio Piranhas (upper) formations, where lithofacies analyses point to sedimentation in ancient alluvial fan to fluvial braided palaeoenvironments. In the Sousa Formation, the generally finer grain sized sediments rendered them more suitable for footprint preservation, where lithofacies analyses point to sedimentation in warm, small/shallow and temporary lakes, swamps and meandering fluvial palaeoenvironments. Microbially induced sedimentary structures are observed in many of the fine-grained lithofacies where dinosaur tracks are also found, and the large number of these tracks in the Sousa Basin (particularly in the Sousa Formation, Lower Cretaceous) may be related to the role of the mats in their preservation. Observations on recent microbial mats show that footprint morphology is related to the mat thickness and to the water content of the mat and the underlying sediment. In dry mats, generally poorly defined or no footprints are produced, while in saturated ones the imprints are well-defined, sometimes with well-defined displacement rims. The formation of well-defined displacement rims around the prints of large dinosaurs occurs in thick, plastic, moist to water-unsaturated microbial mats on top of moist to water-unsaturated sediment. These aspects are commonly observed in the tracks of the Passagem das Pedras site in the Sousa Basin. The footprint consolidation and its early lithification probably occurred due the existence of microbial mats that allowed a more cohesive substrate, preventing the footprints from erosion. The sediments were initially stabilized by early cementation and by the mat fabric over the tracks. Successive flooding, and subsequent sediment influx allowed the large number of layers with dinosaur tracks and sedimentary structures.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

The intracratonic basins of Northeast Brazil were sites of Cretaceous sedimentation, which origin and development were controlled by fault reactivation that affected the Precambrian basement, showing a SW-NE orientation determined by the structures and competent supracrustal rocks within the Borborema Province (Lima Filho et al., 1999; Mabesoone, 1994; Valença et al., 2003). These sedimentary basins, are known in the literature as the intracontinental basins of Northeast Brazil (Ponte, 1992), showing great similarities in their origin and evolution (Fig. 1). They are the consequence of the tectonic movements which resulted in the separation of South America and Africa.

In this context, the Rio do Peixe basin complex is comprised of the Sousa, Uiraúna-Brejo das Freiras, Vertentes and Pombal basins, four intracratonic basins of Northeast Brazil (Fig. 2). These basins are related to a synrift context. Seismic sections presented by Córdoba et al. (2008) allowed a better view of the three-dimensional architecture of the Rio do Peixe basin complex. The combination of the present erosion level and the geometry of the main faults highlights the existence of different half-grabens (i.e., Pombal, Sousa, Brejo das Freiras). Their sedimentary filling (apart from Caenozoic deposits) defines the Rio do Peixe Group, lithostratigraphically comprising the Antenor Navarro (upper alluvial fans/braided channels), Sousa (mid shallow lacustrine/floodplain) and Rio Piranhas (lower alluvial fans/braided channels) formations. Based on the structural style and petrographic-diagenetic features, Córdoba et al. (2008) inferred larger original dimensions for this basin and similar counterparts in the region, which were reduced (with exposure of the crystalline basement highs) by the significant

* Corresponding author. Tel.: +55 21 2598 9405.
E-mail addresses: ismar@geologia.ufrj.br, ismarufrj@gmail.com (I.S. Carvalho).

0195-6671/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.cretres.2013.04.004

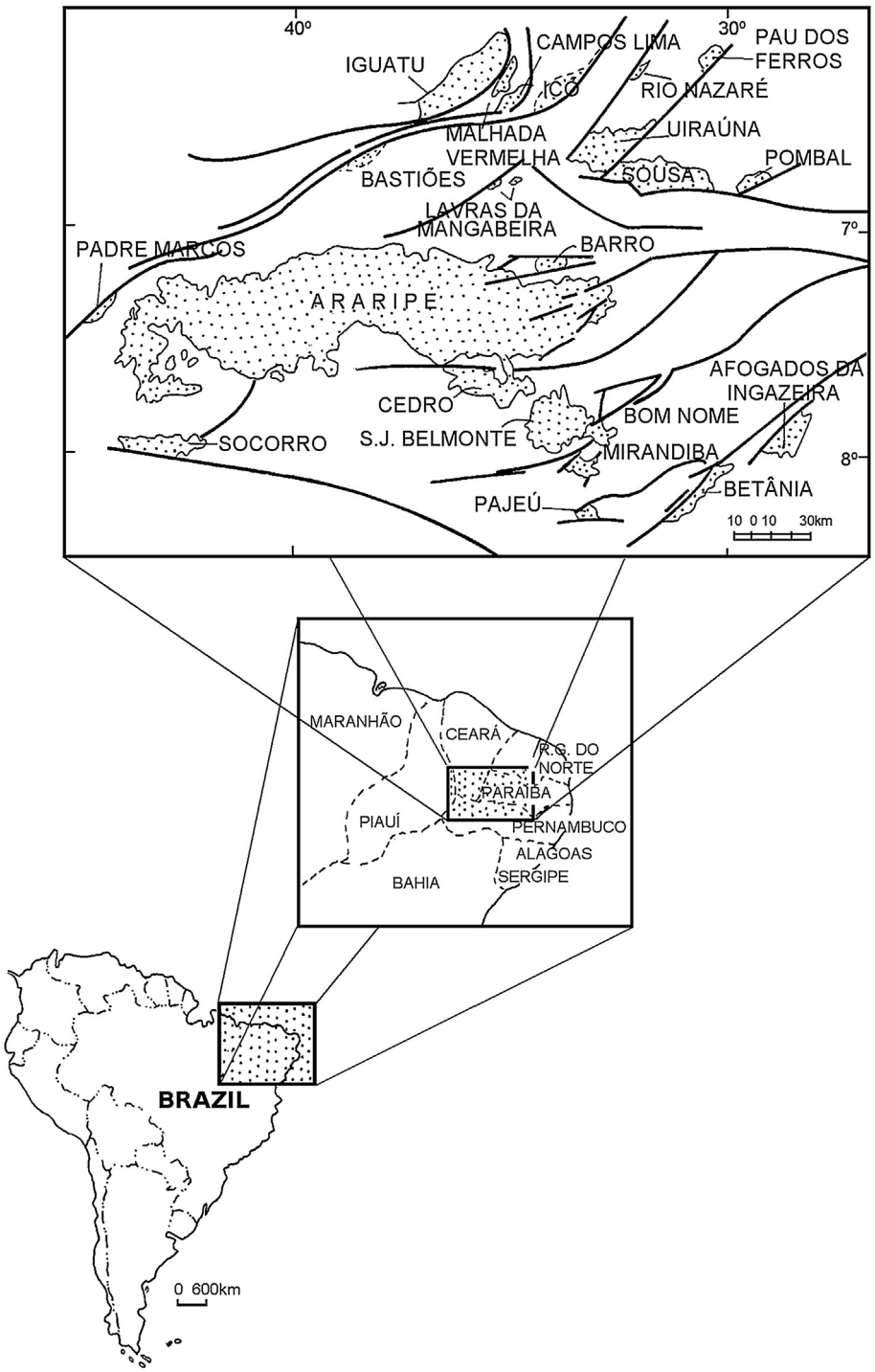

Fig. 1. Location map of the Sousa Basin among the Cretaceous NE basins of Brazil.

erosion that occurred in the late-and subsequent post-rift evolutionary stages.

During the early Mesozoic, a hot and arid climate was typical in the southern hemisphere (Lima, 1983). This is well-recognized throughout the widespread aeolian deposits along the Brazilian and African intracratonic basins. The connection between South America and Africa as a single, large continental block, did not permit a higher humidity in what was (at that time) the interior of a continent (Gondwana). With the break-up of the Gondwana and the initial establishment of a lacustrine and fluvial system in the new rifted basins, the climate gradually became more humid. These palaeoenvironmental changes are probably linked to the same tectonic events that drove the separation of South America and Africa and led to the origin of the South Atlantic Ocean.

Throughout the Early Cretaceous, hot climatic conditions were widespread, although there was probably a wide range of humidity conditions (Skelton, 2003). According to Petri (1983) and Lima (1983), during the earliest Cretaceous the climate was more humid in regions located to the south of the tropical domain

Download English Version:

https://daneshyari.com/en/article/4747236

Download Persian Version:

https://daneshyari.com/article/4747236

Daneshyari.com