



## Neotectonic evolution of the Brazilian northeastern continental margin based on sedimentary facies and ichnology<sup>☆,☆☆</sup>



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### ABSTRACT

Quaternary post-Barreiras sediments are widespread along Brazil's passive margin. These deposits are well exposed in the onshore Paraíba Basin, which is one of the rift basins formed during the Pangean continental breakup. In this area, the post-Barreiras sediments consist of sandstones with abundant soft-sediment deformation structures related to seismicity contemporaneous with deposition. The trace fossils *Thalassinoides* and *Psilonichmus* are found up to 38 m above modern sea level in sandstones dated between 60.0 ( $\pm 1.4$ ) and 15.1 ( $\pm 1.8$ ) ka. The integration of ichnological and sedimentary facies suggests nearshore paleoenvironments. Such deposits could not be related to eustatic sea-level rise, as this time coincides with the last glaciation. Hence, an uplift of 0.63 mm/yr, or 1.97 mm/yr if sea level was 80 m lower in the last glaciation, would have been required to ascend the post-Barreiras sediments several meters above the present-day sea level during the last 60 ka. This would suggest that the post-rift stage of the South American eastern passive margin may have experienced tectonic reactivation more intense than generally recognized. Although more complete data are still needed, the information presented herein may play an important role in studies aiming to decipher the Quaternary evolution of this passive margin.

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### Introduction

Neogene and Quaternary deposits are geographically widespread along the northern and northeastern continental passive margins of Brazil, where they occur as thin sedimentary successions known as the Barreiras Formation (Miocene) and post-Barreiras sediments (late Quaternary) (Rossetti et al., 2012). The latter deposits, initially included in the Barreiras Formation, have been the focus of increasing scientific interest, given their importance for reconstructing the tectono-sedimentary evolution of the Brazilian continental margin (Bezerra et al., 2008; Rossetti et al., 2011a, b, 2012; Balsamo et al., 2013). Despite this relevance, the post-Barreiras sediments remain poorly known. For instance, details of the depositional environments have not been presented, which is partly due to their overall massive sandy nature. In general, these strata have been more commonly attributed to aeolian

environments (Rossetti et al., 2001). However, most of these deposits are poorly sorted and highly bioturbated, which do not conform to deposition entirely by aeolian processes. It is probable that the post-Barreiras sediments include deposits formed in a wide variety of environments, which remain to be characterized in detail (Rossetti et al., 2011a,b).

The post-Barreiras sediments are particularly well represented in outcrops of the Paraíba Basin, an area of the northeastern Brazilian continental margin formed during the breakup of Pangea (Matos, 1992). In this region, such deposits contain an abundance of soft-sediment deformation structures related to tectonic activity contemporaneous with or shortly after deposition (Rossetti et al., 2011b). Rossetti et al. (2011b) attributed the post-Barreiras sediments exposed in the Paraíba Basin to intense seismic activity related to late Quaternary tectonic reactivation. This would have created space to accommodate sedimentation in areas that previously experienced long-term erosion. However, Rossetti et al. (2011b) focused solely on the description and interpretation of deformation structures, and questions remain about the environmental context in which these seismites were formed. There is no paleoenvironmental information concerning these deposits beyond a succinct reference to nearshore trace fossils made by Rossetti et al. (2011b).

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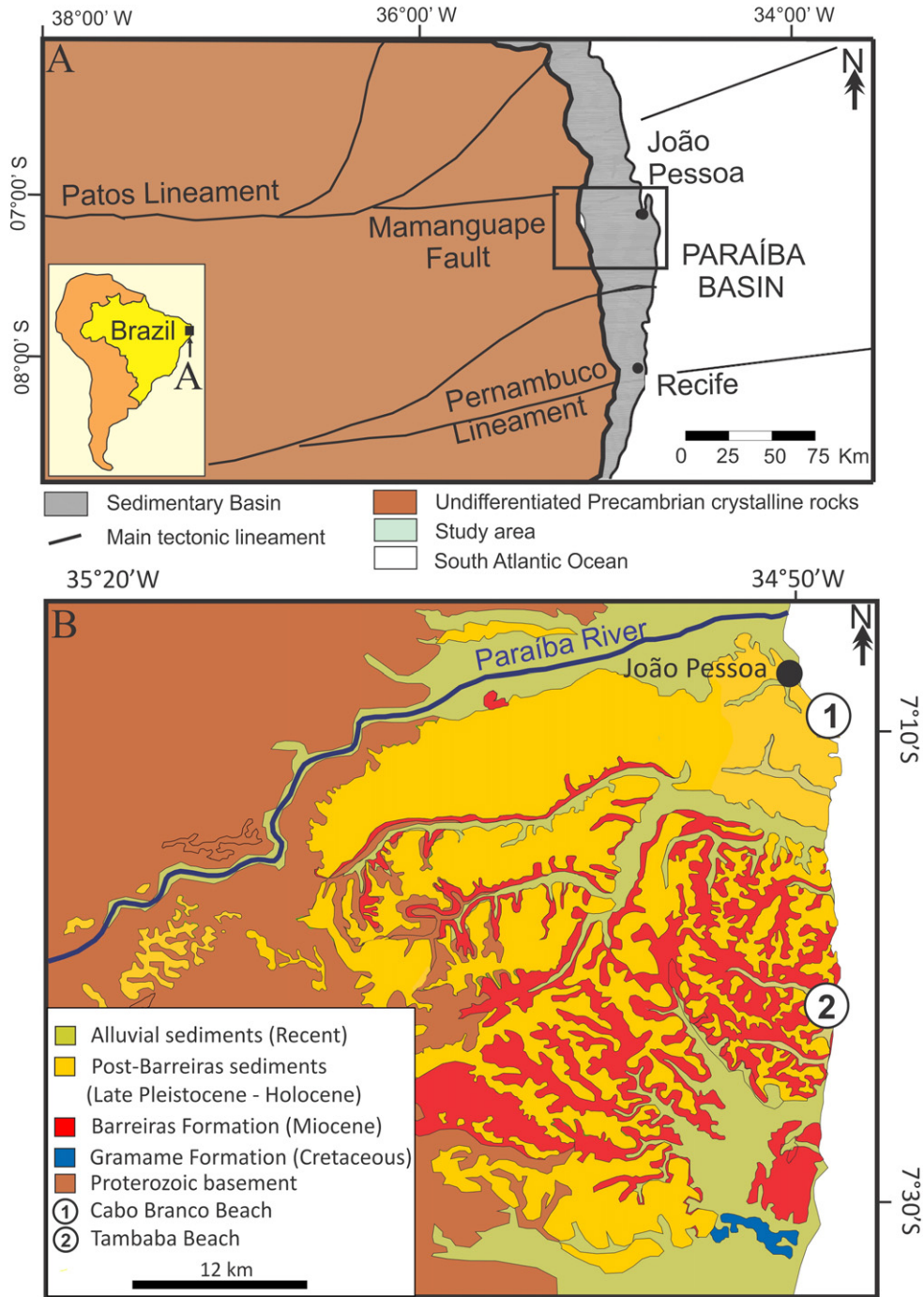
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Although not investigated in detail, previous publications recorded highly bioturbated beds in the post-Barreiras sediments of Paraíba Basin (Rossetti et al., 2011a, b, 2012). Considering the generally scarce presence of physical sedimentary structures, trace fossils might be an important proxy to clarify the sedimentary environments of this unit, and discern its evolution within the context of sea-level fluctuations. Additionally, because these deposits contain seismites, they have the potential to help characterize tectonic events during the last stages of development of the Brazilian continental margin. This issue has been of increasing interest for investigation because, as opposed to the generally accepted model of post-rift stable passive margins, numerous studies have demonstrated that this region of Brazil recorded significant

tectonic activity during the Neogene, which seems to have continued even into the Holocene (Bezerra and Vita-Finzi, 2000; Bezerra et al., 2008; Ferreira et al., 2008; Moura-Lima et al., 2011; Rossetti et al., 2011a, b, 2012; Balsamo et al., 2013). The precise timing and intensity of these events, however, are questions that remain to be answered.

**Geological framework**

The Paraíba Basin is the last marginal rift formed during the opening of the South Atlantic Ocean in Late Jurassic and Early Cretaceous time (Matos, 1992). Granite, migmatite and gneiss belonging to the Precambrian Borborema Province form the basement of this basin, which is



**Figure 1.** Location map of the study area in northeastern Brazil. A) Generalized geological map with location of the study area in the Paraíba Basin, between the Mamanguape and the Pernambuco tectonic lineaments. Box locates the study area. B) Detailed geological map with location of the studied sections (modified from Rossetti et al., 2011a).

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