CONTROVERSIES ON THE EVOLUTION OF THE RECÔNCAVO-TUCANO-JATOBÁ RIFT

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Summary

Introduction

In the last two decades, reflecting similar controversies worldwide, the following points have been debated on the tectonic evolution of the Recôncavo-Tucano-Jatobá rift, an aborted branch of the Lower Cretaceous Eastern Brazilian margin: (1) the degree of basement control on the rift architecture, not fully understood along some major faults; (2) the time of rifting onset, placed at or before the deposition of a thick wedge pilled up near the main rift border; (3) the direction of rift opening, if oblique or orthogonal to the main structural trends of the rift; (4) the kinematics along the main transfer zones, an issue where the controversy increases according to the amount of data; (5) the sense of propagation of the rift border, if toward or away from the footwall; (6) the existence of a basal detachment beneath the rift, which has not been imaged on a recently shot deep seismic line; (7) the significance of inverse faulting, related either to inversion tectonics or transpression along transfer faults; (8) the genesis of the unconformity between syn-rift and post-rift; generally correlated to the break up unconformity; (9) the mechanism of uplift that led to the present level of rift exhumation. In this contribution, because of space limitations, only items (2), (3), and (9) will be discussed.

General Setting

The rift developed during the opening of the South Atlantic Ocean, evolving as an aborted branch of the Eastern Brazilian continental margin. It occupies an area of about 46,500 km^2 near the Brazilian northeastern coast, comprising a series of basins and sub-basins trending between N-NNE with a sharp termination oriented ENE at its northern end (Fig. 1). The Tucano basin, the largest one, is divided into three sub-basins termed South, Central and North Tucano. The Recôncavo and Jatobá basins are subdivided into structural compartments. Although there are good exposures of pre- and syn-rift sediments close to the rift borders and along the main streams, almost three-quarters of the rift is covered either by post-rift sediments of the Marizal Formation, or by Tertiary cover of the Barreiras Group.

Rifting Onset

Onset of rifting probably occurred during the Berriasian (about 144 Ma) and is inferred to have lasted about 24 m.y. (Barremian). The sediments are correlatable with those in basins located along the Atlantic margins of South America (Sergipe-Alagoas, Camamu and Almada basins) and Africa (Gabon Basin).

The beginning of rifting is a matter of controversy in the area (Magnavita, 1996; Da Silva, 1996). Traditionally, the syn-rift phase has been marked by the first appearance of syn-tectonic conglomerates (locally more than 2,000 m thick) that constitutes part of the rift border system. However, the conglomerates just indicate the beginning of pulsating tectonism along the main rift borders (Magnavita, 1996). Because the rate of subsidence was greater than sediment input, a starved-basin phase resulted, and black shales were deposited ir a relatively long and narrow depression present in the Recôncavo and South Tucano basins.

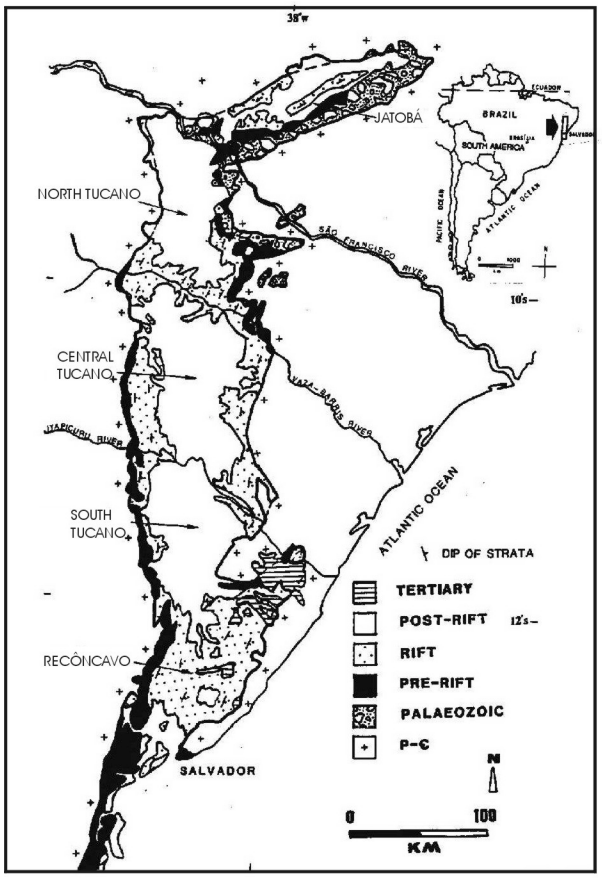

Fig. 1: Distribution of outcrops of pre-rift, sin-rift and post-rift sediments in the Recôncavo-Tucano-Jatobá rift.

Rift Opening

This model was based on the recognition of two tectonic phases in the region: the first in the Berriasian, when E-W extension across the Recôncavo-Tucano-Jatobá Rift and adjacent basins would have been accommodated through sinistral motion along the Pernambuco/Ngaoundere lineament (Fig. 2a), when the northern block would have stayed relatively fixed with respect to the southern, as evidence suggests that it was the last portion of South America to separate from Africa. The second phase would be related to the propagation of the South Atlantic opening (Fig. 2b). Assuming northward propagation in the earliest Aptian, relative clockwise rotation of South America with respect to Africa would cause NW-SE oriented shear in the region. Further ocean opening transferred the extension to the Atlantic margin, isolating the rift, which, in turn, started its post-rift evolution, marked by slow

thermal subsidence and diverse phases of erosion and final exhumation.

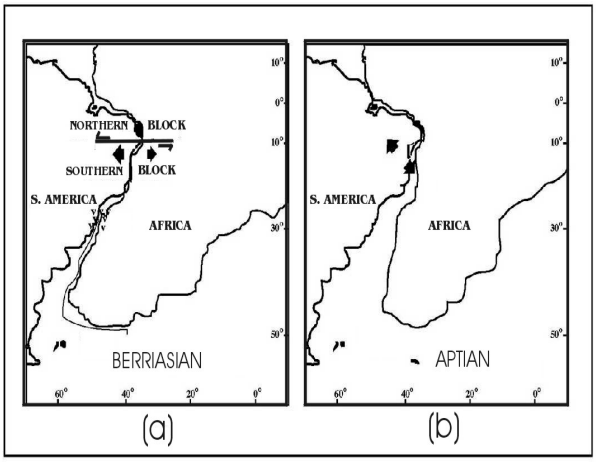

Fig. 2: Rift opening according to the double rift model (Magnavita, 1992).

Subsidence, Uplift and Erosion

The lack of a significant post-rift section in the rift has been related either to differential stretching of the lithosphere due to simple-shear (Ussami *et al.*, 1986), to continuous vertical and lateral heat loss after uniform stretching of the lithosphere (Milani and Davison, 1988), or removal of the sedimentary register after regional massive erosion (Magnavita *et al.*, 1994). In fact, vitrinite reflectance data indicate more than 1.5 km of erosion in the Recôncavo Basin (Daniel *et al.*, 1989). Also, the truncation of the sedimentary section toward the flexural border suggests that the rift occupied a much broader area than presently preserved (Magnavita, 1992). Interpretation of recently acquired deep seismic reflection line indicates that there is no evidence for a detachment beneath the rift.

The subsidence and uplift occurred during two main periods (Fig. 3). The first phase of uplift probably happened at the end of rifting, possibly as a consequence of elastic rebound of the continental break up; the second, probably in Early Tertiary (Oligocene), indicated by generalized peneplanation in northeastern Brazil (King, 1956; Bigarella, 1975). In average, the basin is about 200 meters topographically higher than the surrounding basement, indicating a tectonic inversion after post-rift subsidence.

The cause for the Tertiary uplift was related by Magnavita *et al.* (1994) to magmatic underplating due to long-lived magmatism associated with the Atlantic opening. This is corroborated by the small but widespread occurrence of volcanic and intrusive rocks throughout the northeastern Brazil. Although small amount of extension was probably the cause of absence of magmatism within the rift, basic dikes in the basement along an 80 km-long magnetic anomaly. Another possibility for this regional uplift might be related to a long wave-length of a positive area of a flexed lithosphere. This could be explained by the differential subsidence caused by the thermal cooling of the Atlantic oceanic crust enhanced by the flexural eastward tilting produced by the load of the offshore sedimentary section, which would be compensated by flexural uplift as the margin subsided in the Tertiary.

More recently, this Tertiary uplift has been related to intraplate stress because of plate convergence along the Andean margin (Lima, oral communication).

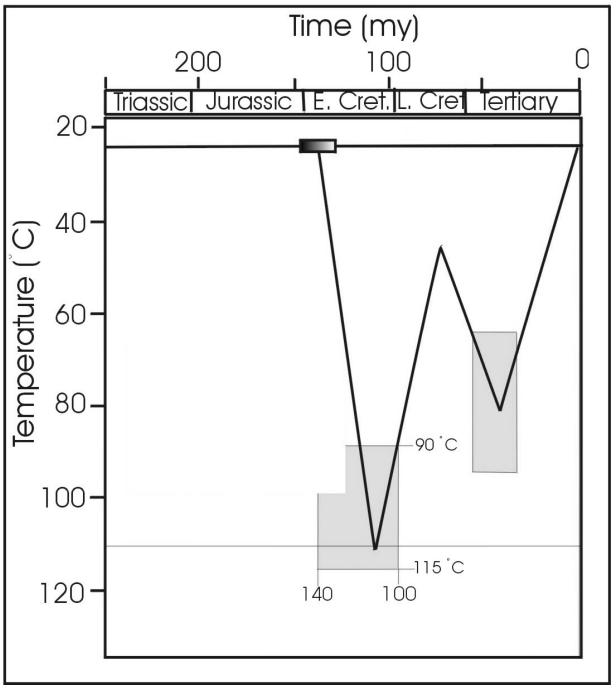

Fig. 3: Main periods of subsidence and uplift in the Recôncavo-Tucano-Jatobá rift with basis on apatite fission track.

Conclusions

Many controversies have arisen on the tectonic evolution of the Recôncavo-Tucano-Jatobá rift. In this paper, we summarized four of the main controversial issues, named (1) the direction of rift opening, if oblique or orthogonal to the main structural trends of the rift; (2) the time of rifting onset, placed at or before the deposition of a thick wedge pilled up near the main rift border, (3) the existence of a basal detachment beneath the rift, which has not been imaged on a recently shot deep seismic line, and (4) the mechanism of uplift that led to the present level of rift exhumation. Apparently, the next century will see more discussion on these issues and other not discussed in this paper.

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