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Seismic imaging of a transform segment of the Maranhão-Barreirinhas-Ceará margin, NW Brazil

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The structure of the North-East equatorial Brazilian margin was investigated during the MAGIC (Margins of brAzil, Ghana and Ivory Coast) seismic experiment, a project conducted by IFREMER (Institut Francais de Recherche pour l'Exploration de la Mer), UnB (University of Brasilia), FCUL (Faculdade de Ciências da Universidade de Lisboa) and Petrobras. The survey consists of 5 deep seismic profiles totaling 1900 km of marine multi-channel seismic reflection and wide angle acquisition with 143 deployments of short-period OBS's from the IFREMER pool. Three of the profiles were extended into land using Land Seismic Stations (LSS) from the Brazilian pool at a total of 50 points. This study focuses on the MC1 and MC5 wide-angle profiles: MC5 spans NW-SE 720 km in length, from the São Paulo Double Fracture Zone to the Borborema-Cearà margin. MC-1 spans parallel east of MC5, 360 km in length, in the presumed oceanic domain. Our main objective is to understand the fundamental processes which lead to the thinning and finally to the breakup of the continental crust in a specific context of a pull-apart system with two strike-slip borders.

The experiment was devised to obtain the 2D structure along the profiles from joint pre-stack depth migration of the reflection data, and tomography and forward modeling of the OBS records. Along the MC1/MC5 wide-angle transects, 5 major sectors are identified:
- the São Paulo Double Fracture Zone and the volcanic line associated to the southern São Paulo strike-slip zone presenting a 4.5 km thick volcano-sedimentary basin on top of a 5.5 km thick basement;
- the intermediate domain, formed by the 4.5 km thick Basin III, the 7.5 km thick Basin II (interleaved by a 0.5-1 km thick volcanic layer), and the 5.5 km thick Basin I composing the continental slope. While the crust remains about 6 km thick, its acoustic velocity evolves from two-layer typical (4.8-6 km/s and 6.1-6.8 km/s) beneath Basin III to two-layer high velocity (6.1-6.8 km/s and 7.2-7.4 km/s) beneath Basin II and I, interpreted as exhumed lower continental crust;
- to the east, the oceanic crust, evolves to an 2 layers crust 5 km thick, characterized by typical oceanic crustal velocities and also overlain by 5.5 km of sedimentary deposits, spanning between the two main fracture zones that fringe the Maranhão-Barreirinhas-Ceará segment;
- the 50 km wide necking zone, forming the Parnaiba Platform and associated Ceará Basins, where the upper and lower crust thin abruptly;
- the Medio Coreaù and Ceará Central thrust belt, where the unthinned continental crust thickness reaches 32 km.

Keywords: North-East equatorial Brazil, transform margin, deep seismic structure