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Tectonic Segmentation During Rifting of the Brazil Equatorial Margin

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The margins bounding the Equatorial Atlantic were formed during the Cretaceous due to the breakup of Gondwana. Rifting led to the development of sedimentary basins between West Africa and South America. We have used a grid of ~10,000 km of 2D seismic data to investigate the crustal structure along ~600 km of the NE Brazilian margin, containing the eastern Ceará and Potiguar Basins. The dataset is provided by the Brazilian National Agency of Petroleum (ANP).

We have interpreted fault structure and sediment units and mapped key horizons (top synrift, top basement, and Moho), across the entire seismic grid to produce surface and thickness maps of the main units. The basement thickness, synrift thickness, and Moho structure maps revealed that the margin tectonic structure is divided into three main tectonic domains: the Southern, Central, and Northern segments. The Southern Segment is characterized by abrupt lateral basement thinning and steep faults forming a main fault system indicating strike-slip kinematics. In contrast, main extension in the Central and Northern Segments is associated with normal faulting kinematics. These two segments represent different styles of faulting because the focalization of the extensional deformation is decoupled and occurred farther outboard along the Central Segment. The Northern Segment displays a comparatively thinner basement and thicker synrift deposits across much of the margin, compared to the Central Segment. These differences appear to imply that crustal extension occurred at different rates.

The three segments are separated by tectonic boundaries defined in seismic images by abrupt lateral changes in basement structure. The main segments may also contain sub-segments where changes in structure are more subdued. The imaged segment boundaries form a consistent linear structure visible from under the continental shelf to the deep-water basin. Their geometry indicates the evolution over time of continental segmentation during rifting. Furthermore, the orientation of these boundaries is similar for all segments supporting that they approximately correspond to flow lines indicating the opening direction during rifting. Most segment boundaries

during rifting spatially correlate with fracture zones on the oceanic plate, indicating a relationship between continental tectonic segmentation and oceanic magmatic segmentation. We propose that the tectonic segmentation of the margin appeared during Barremian-Aptian time as a lithospheric-scale response of the mode of deformation caused by a change in plate kinematics that imposed a change in opening direction.