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Geophysical, Geological, and Geodynamic Insights into the Northeastern Brazilian Rifted Margin

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The northeastern Brazilian rifted margin exhibits a diverse range of extensional structures, from failed onshore and offshore rifts and basins to South Atlantic seafloor spreading and continental breakup, making it an ideal natural laboratory for studying rifted margins.

Previous studies on the northeastern Brazilian rifted margin present conflicting interpretations of the basement structure in the Camamu, Almada, Jequitinhonha, Jacuípe, Sergipe, and Alagoas basins. Proposed models include: (a) hyperextended continental crust transitioning directly to oceanic crust; (b) hyperextended continental crust with exhumed lower crust and an immediate switch to oceanic crust; (c) hyperextended continental crust, exhumed mantle, and a direct transition to oceanic crust; and (d) hyperextended continental crust transitioning to proto-oceanic crust and then to normal oceanic crust. Additionally, there is ongoing debate about whether the Sergipe-Alagoas and Jequitinhonha-Almada-Camamu basins are magma-poor or more magmatic than previously thought.

The lithosphere in northeastern Brazil comprises diverse tectonic units, ranging from cratons to orogenic belts, which have undergone multiple orogenic deformations and metamorphic events. This structural and compositional heterogeneity likely exerted a first-order geologic control on the evolution of rifts, basin boundaries, and crustal structures during the opening of the South Atlantic. Analyses of basement rocks, structural trends (e.g., foliation, shear zones, and faults), and contact relationships between geologic units suggest significant geological influences on rift development.

To address these conflicting interpretations, this study adopts a thermo-mechanical approach using a newly developed numerical modeling technique, Kinedyn, which integrates seismic reflection profiles with geodynamic models. The results are expected to resolve discrepancies in previous studies and provide a more realistic reconstruction of rift evolution in the northeastern Brazilian rifted margin.