

Gravity Modeling and Seismic Reflection Study of the Barreirinhas and Ceara Basins of Northern Equatorial Brazil to Determine Upper Plate–Lower Plate Origins across the Romanche Fracture Zone and Implications for Hydrocarbon Prospectivity

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ABSTRACT

The Barreirinhas and Ceara Basins of offshore northern equatorial Brazil cover a combined area of approximately 105,000 km² and form the northern and southern flanks, respectively, of the Romanche Fracture Zone (RFZ). The RFZ is a linear fracture zone with an average width of approximately 16 km that extends over 4500 km from offshore northern equatorial Brazil to its conjugate margin near offshore Ghana and Togo/Benin. The Barreirinhas Basin exhibits characteristics of a less-extended, upper plate margin including a steeper and more abrupt continental margin and high free-air gravity reflecting a shallower and thicker basement and thick sedimentary fill. In contrast, the Ceara Basin south of the RFZ exhibits characteristics of a more-extended, lower plate margin including a gently sloping and wider continental slope and a low free-air gravity reflecting a deeper basement and thinner sedimentary infill. The conjugate margins in West Africa are reversed over the RFZ; lower plate Ghana faces upper plate Barreirinhas and upper plate Togo/Benin faces lower plate Ceara. Lower plate margins, such as the proposed Ghana and Ceara margins, have been found to be more suitable environments for hydrocarbons due to greater sedimentary thicknesses, wider fairways, and higher heat flows than upper plate margins. This conclusion is supported by the 2007 discovery of the Jubilee Field within the lower plate Ghana margin and the 2012 discovery in the Pecem deepwater well within the lower plate Ceara margin. The Barreirinhas is a frontier basin with several small gas wells and no deepwater discoveries to date. Gravity transects across both basins were made parallel to the RFZ and validated with existing seismic refraction and reflection data to show variations in extension that is supportive of the upper plate–lower plate hypothesis.

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