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Gravity and magnetic structure of the Alagoas Basin border fault (NE-Brazil): implications for understanding the Precambrian tectonic inheritance

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Introduction

The Alagoas Basin, formed in the Mesozoic, during the opening of the South Atlantic Ocean, is a part of a larger system, called the Sergipe-Alagoas Basin, which corresponds to the Gabon Basin in the African continent. The tectonic fabric of the Precambrian basement of the Borborema Province strongly controlled the evolution of this system. During its evolution, sedimentary filling occurred along the rift and post-rift phases. This study investigates, through potential geophysical data, the border fault formed in the rift phase, aiming to investigate its connections with structures and geological domains of the adjacent basement.

Methods

Geological Survey of Brazil (SGB) contracted the magnetic data in airborne geophysical projects, with flight lines at a height of 100 m, spaced 500 m apart in the N-S direction. Within the Alagoas Basin, PETROBRÁS surveyed gravity data in the 1960s and 1970s. In the adjacent crystalline basement, the Geological Survey of Brazil, the Federal University of Rio Grande do Norte, and the Brazilian Institute of Geography and Statistics surveyed gravity data since 1980s. This study homogenized all data with reference to the Brazilian Fundamental Gravity Network. The calculation of the Bouguer anomalies in relation to the sea level considered a rock layer with a density of 2.67 g/cm³. Quantitative modeling of the geophysical data implemented direct and inverse methods.

Results and Conclusions

The Alagoas Basin border fault extends for approximately 100 km in the NE-SW direction. Due to Cenozoic sedimentation, much of this Mesozoic structure is inaccessible to conventional geological mapping. However, by gravity and magnetic data interpretations, it was possible to investigate this fault along its entire length, showing its continuity in the NE-SW direction, with truncations in the NW-SE direction, and inflection to N-S near the Maragogi high.

In the gravity data, the border fault is located on the axis of the pairing of negative and positive anomalies, produced by sedimentary and crystalline rocks, respectively. The anomalous set has an amplitude of around 100 mGal, which reflects the density contrast between the two types of rocks, whose 2.5D direct modeling indicated sedimentary thicknesses of up to 6 km. In the magnetic data, the border fault is characterized by a dipolar anomaly (~300 nT) that marks the contrast in magnetic properties between the sedimentary and crystalline rocks. The application of Werner deconvolution modeled the dip parameters and magnetic susceptibilities of the structure.

Correlation of the geophysical data with the regional geological tectonic context, provided evidence that the growth of the border fault resulted from the reactivation of shear zones that structure the Sergipano belt in the collision of the São Francisco craton with the Pernambuco-Alagoas terrain. The data also indicated a strong tectonic control of the basement at the border fault ends in the Japoatã-Penedo high to the southwest and in the Maragogi high to the northeast. As a hypothesis and by preliminary correlations between geological and geophysical data, the border fault may be a reactivation of the São Miguel do Aleixo shear zone.