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Characterization of the Magnetic Structural Framework of the Tacutu Basin (Brazil–Guyana)

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Introduction

The Tacutu Basin is an intracontinental rift basin located perpendicular to the border between Brazil (Roraima) and Guyana. Covering an area of approximately 12,500 km² and extending about 300 km in a NE-SW direction, it represents an important geological structure formed during the Mesozoic fragmentation of Gondwana. The basin is characterized as an aborted rift (aulacogenic) associated with the reactivation of the Central Guiana Belt. This study addresses a significant gap in the tectonic history of the region by integrating interpretations of magnetic data from the Brazilian and Guyanese sectors of the basin. This integration provides a continuous view of subsurface structures, including faults and tectonic lineaments. This comprehensive approach allows the identification of structural patterns that cross the international border, offering a more accurate view of the basin's structural framework. In addition, the Tacutu Basin is considered a frontier area for hydrocarbon exploration, with limited data availability. In the Brazilian portion, only two wells have been drilled, both dry and with no evidence of hydrocarbons. In contrast, the Guyanese sector has had some exploration success. Joint magnetic data in both regions could reveal structural continuations generated during the formation of this unique basin.

Method and/or Theory

This study used a geophysical approach to characterize the structural framework of the Tacutu Basin, using aeromagnetic data from Brazil and Guyana. By combining these datasets with geological maps, the research improved the interpretation of the characteristics of the subsoil throughout the basin. Magnetic data processing involved advanced enhancement techniques, including Reduction to Equator (RTE), which is essential for reducing distortions at low magnetic latitudes and positioning anomalies over their sources. The First Vertical Derivative (Dz) was applied for structural analysis, facilitating the identification and mapping of predominant tectonic lineaments. The Total Horizontal Gradient (THG) filter was used to delineate magnetic domains, correlating them with lithological units and geological structures. In addition, Source Parameter Imaging (SPI) provided qualitative estimates of the depth of the magnetic basement.

Results and Conclusions

The results revealed a complex architecture for the basin, with distinct magnetic patterns between the Brazilian and Guyanese portions, reflecting structural variations. Analysis using SPI confirmed the characteristic asymmetrical geometry of a hemigraben, with depocenters reaching up to 8 km in depth in central Brazil. Using Dz, it was possible to identify the predominant NE-SW magnetic lineaments, inherited from the structures of the Central Guiana Belt. Magnetic domains were mapped, corresponding to different lithological units, based on the interpretations obtained by the GHT. Integrating these filters with the surface geology allowed the structural framework of the basin to be interpreted.