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Tectono-Stratigraphic Evolution of the Mundaú Sub-basin, Ceará Basin: Insights from Ultra to Deep-Waters

Kauê Pereira (UNIVERSIDADE FEDERAL DO CEARÁ), Ian Cerdeira (Federal University of Ceará), William Lima, David Vasconcelos, Karen Leopoldino Oliveira (Federal University of Ceará)

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Introduction

The growing interest in the Brazilian Equatorial Margin (BEM) has driven technological advances, reinforcing its strategic and exploratory importance. This region stands out as one of the most promising frontiers in the country due to significant oil and gas discoveries and geological similarities with conjugate margins in Africa, which increases expectations regarding its petroleum potential. However, the tectono-stratigraphic complexity of the BEM still requires more in-depth studies. In this scenario, the Ceará Basin, located in the BEM, records various tectonic and stratigraphic events, reflecting both extensional and compressional regimes throughout its evolution. This study aims to interpret a 3D seismic volume of the Mundaú Sub-basin, based on the horizons of the Paracuru and Mundaú formations, in addition to the Trairi member and the Marco 800 horizon. The goal is to identify and characterize igneous features, and analyze seismic attributes that assist in understanding the area's main structural and geomorphological characteristics.

Method and/or Theory

A depth-migrated 3D seismic volume was used in this study, provided by the company TGS and processed using the Full Waveform Inversion (FWI) method, which offered greater fidelity in reflector imaging and improved resolution of subsurface structures. Based on the interpreted horizons, seismic attributes such as RMS amplitude, Sweetness, Dip, and Azimuth were applied to complement the structural and geomorphological analysis. The identified igneous features were mapped and classified based on their geometry, occurrence pattern, and their relationship with different geological ages, allowing a more detailed analysis of their distribution and geodynamic context.

Results and Conclusions

The interpretation of the main seismic horizons allowed the identification of significant structural features, such as normal and reverse faults, as well as thrusts, associated with both extensional and compressional tectonic regimes. These features indicate the superposition of distinct geological events. Folding structures appear to be discordant with the overlying strata and are mainly concentrated in packages below the Cenomanian, becoming tighter and smaller towards the eastern portion of the sub-basin. Additionally, igneous intrusions with varied morphologies were identified, and their spatial distribution contributed to inferences about their genesis and possible structural control. High Dip Azimuth values observed in certain areas further support the evidence of intense tectonic deformation. The integration of these observations with the interpreted seismic horizons enabled the inference of different stress regimes throughout the basin's evolution, allowing for a preliminary separation of the tectono-stratigraphic events that shaped the Mundaú Sub-basin and enhancing the understanding of its geodynamic history.