Tectonostratigraphy of the Paracuru Formation and its implications for hydrocarbon trapping: deepwaters of Icaraí sub-basin, Ceará, Brazilian Equatorial Margin

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Abstract

The Brazilian Equatorial Margin (BEM) exhibits unique structural and sedimentary characteristics, accompanied by peculiar geodynamics and a promising petroleum system. Within the BEM basins, the Ceará Basin presents compressive and extensional domains. Within the compressive domain lies the Icaraí sub-basin, laterally adjacent to the Mundaú sub-basin, a region of great petroleum interest due to discoveries in the BEM, Guyana-Suriname, and the African counterpart. Therefore, the present study aims to identify the main stratigraphic sequences and tectonic structures of the Paracuru Formation in the Icaraí sub-basin. Additionally, it seeks to explore their relationship with petroleum-related elements, including potential structural traps, and to assess the influence of the Romanche Fracture Zone and the Transbrasiliano Lineament. For this purpose, biostratigraphic data from four pioneering wells drilled in deepwaters were used in conjunction with a depth-migrated seismic volume using the FWI method, covering an area of approximately 1433 km², to describe the stratigraphic and structural components better. The 3D cube was acquired, processed, and provided by the PGS, while the wells dataset was provided by the National Agency of Petroleum, Natural Gas and Biofuels (ANP). The top surface of the Paracuru Formation was mapped, and subsequently, the attributes of sweetness, RMS amplitude, variance, dip magnitude, and dip azimuth were generated and interpreted. A series of folds and reverse faults were identified in the Aptian to Albian sequences, with some folds further north occurring in the Cenomanian. Generally, the folds tend to be discordant with the overlying strata and become tighter and smaller towards the northwest (a region related to brittle reactivations of the Transbrasiliano Lineament - TL and Romanche Fracture Zone - RFZ), with a larger fold in the central region and a few smaller folds to the southeast. The folds concentrated in the northwest exhibit steep inclinations due to high dip azimuth values and display distinct features compared to the rest of the area due to tectonics. Thus, it was possible to correlate the intensity of the folds with the basin's history, identify structures suitable for hydrocarbon trapping, and highlight the influence of continental and oceanic fracture zones in understanding the basin's evolution during the development of the Equatorial Margin.