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Assessing the Exploration Potential of Mid-Upper Cretaceous Sedimentary Fairways of Equatorial Brazil

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Introduction

Recently refocused exploration interests in the Equatorial basins of Brazil have highlighted the deepwater potential for the region. Drilling results from the Anhangá deepwater well in 2024 highlights the potential of a deeper early drift and passive margin hydrocarbon kitchen in the region. In this study we focus on the Mid and Late Cretaceous stratigraphic sequences of the equatorial basins between the St Paul and the Four-North Fracture Zones. These sedimentary basins cover approximately 100,000 km², with water depths from 100 meters to greater than 4,000 meters. Seventy percent of the basin has water depths greater than 1,500 meters and is largely un-explored for oil and gas. To date, the 2011 Harpia Pama discovery, confirming the prospectivity of a distal kitchen, is the only well to test the deepwater region. Seismic data from the deepwater basins of Brazil's Equatorial Margin record a widely varied history of stratigraphic infill. Mapped and interpreted seismic data reveal extensive play fairways here that have analogous features to discoveries made on the conjugate margin of Equatorial Africa.

Method and/or Theory

In the study area we utilized approximately 240,000 km of 2D and 50,000 km² of 3D seismic data for the Mid and Late Cretaceous depositional fairway assessments. Published well details and field data were utilized to understand the contributing petroleum system elements. Additionally, a suite of instantaneous and structurally enhancing seismic attributes were calculated to extract details from the subsurface data. The cross referencing of attributes and seismic facies permits the identification of potential reservoir units associated with focused reservoir trends in the basins.

Results and Conclusions

Since the opening of the Equatorial Atlantic Ocean, the accumulation of passive margin sediments within the Pará-Maranhão Basin reaches a maximum 6.5 km in thickness. Seismic data show evidence of Tertiary volcanic activities that have penetrated the underlying Cretaceous units in various locations. Buried volcanic edifices and seamounts are widespread. Interpretation of seismic data in the Amapá and Pará-Maranhão Basins indicate focused, along-strike cross-sections of Cretaceous channel facies. In 3D data, the Amapá deepwater deposits show a long-lived cyclic nature of meandering and chute-like channels extending to the north, that pre-date the Amazon River sediments. The calculated spectral decomposition attribute response indicates that these are sand-rich units sourced from the early drainage basin of the Oiapoque River. To the southeast, Cretaceous drainage of the Brazilian Shield to the marginal Pará-Maranhão Basin resulted in mid- and base- of slope units resembling channel facies in 2D seismic data. Attribute responses also indicate the likelihood of clastic reservoir presence in these deep-water positions that pre-date the Cenozoic magmatic events.

In this analysis, we show deepwater reservoir potential likely charged by Cenomanian-Turonian (C-T) source rocks. Evidence of high TOC (Total Organic Content) shale units have been identified in the region and on the conjugate margin. Continued exploration, particularly in the deepwater domain, will show the prospectivity of basins as prolific oil and gas producers.