Targeting Post-Rift Stratigraphic Traps in the Ceara and Potiguar Basins

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Abstract

Recent oil and gas discoveries in the Potiguar Basin of the Equatorial Margin of Brazil have highlighted the region's potential to become a prolific hydrocarbon province (Figure 1). Wildcat discoveries on the conjugate margins and the notable wells of the Guyana/Suriname Basin indicate an elevated level of regional prospectivity for the Ceará and Potiguar Basins. In contrast to recent years, exploration in the basins has primarily targeted syn-rift reservoirs in the shallow water setting. The 2024 Anhangá ultra-deep-water discovery (Figure 1) was the first reported discovery to successfully find oil in early post-rift turbidites. In this post-rift analysis, we identify extensive deepwater paleo-depositional fairways that could be prospective targets.

The use of 29,000 km^2 of 3D and circa 95,000 km of 2D depth-migrated seismic data was employed to locate and identify clastic channel and levee complexes, fans and turbidites in the basins. The application of structure-enhancing and instantaneous seismic attributes was necessary to accurately identify these seismic facies. Attribute volume generation permits a detailed assessment of the data combined with published stratigraphic ages from well results.

The tectonic evolution of the conjugate sedimentary basins of the Equatorial Atlantic between South America and West Africa began in the Early Cretaceous by the forming of a series of alternating rift and transform margin segments (Antobreh et al., 2009). Between transforms, varying degrees of oblique rifting created a series of right-lateral, isolated pull-apart basins along the margin (Antobreh et al., 2009; Mullin et al, 2018). Cretaceous rifting continued until the eventual formation of an incipient mid-ocean ridge that connected the marine waters of the Central and South Atlantic Oceans across the Equatorial region. In this deep-water marine, post-rift setting two separate source rocks intervals have been identified in well data (de Souza et al., 2021). The mid-late Cretaceous Uruburetama Mbr has a max total organic carbon (TOC) of 1.94% and an interval of the Itapajé Mbr with a max TOC 3.39% (de Souza et al., 2021). These high-quality organic-rich units were deposited in anoxic conditions during Cretaceous high-stand systems tracts, followed by deposition of reservoir units of the early drift phase low-stand (Dickson et al., 2016). Seismic data show extensive channel development along strike and likely represent granite-rich reservoir material originating from the onshore Borborema Province (Figure 1).

Figure 2 is an example of coalescing Cretaceous channels, where a strike-oriented channel intersects a dip-oriented channel system which continued to extend into deeper waters. The application of seismic attributes such as smoothed similarity, sweetness and trace envelope assists in identifying and discerning seismic facies that represent reservoir intervals in the basins.

Continued progression to exploration targets in deep-water that aim post-rift stratigraphic plays that are analogous to the conjugate margin discoveries will reveal the Ceara and Potiguar Basins as a prolific hydrocarbon province.

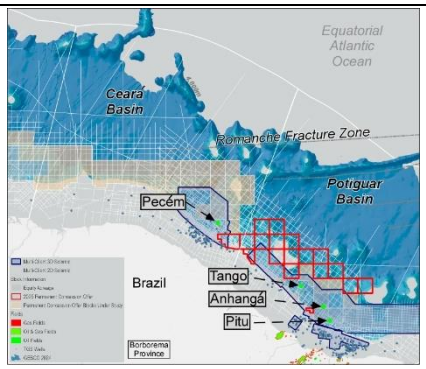

Figure 1: Location of the Ceará and Potiguar Basins, offshore Brazil. Recent discoveries (green dots) in the basins, 2025 Permanent Offer Blocks (red) and seismic data used for this analysis are highlighted.

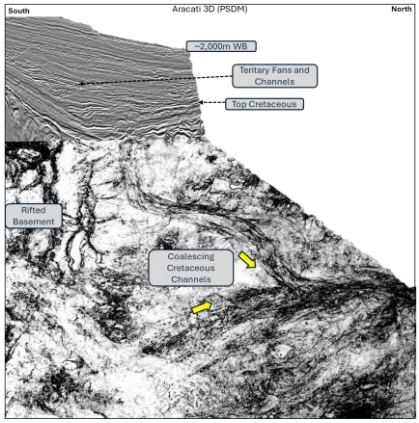

Figure 2: Combined Aracati 3D Depth slice (smoothed similarity attribute) and vertical section PSDM amplitudes. Depth slice shows location of east-west channel coalescing with south-north channel complex.