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Pelotas Basin on the Rise: A New Frontier for Global Exploration

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Abstract Summary

The Pelotas Basin is emerging as one of the world's most promising regions for hydrocarbon exploration. This paper examines the impact of the recent exploration successes in its geological conjugate, the Namibian Orange Basin, where multibillion-barrel discoveries have been made over the past four years. Seismic interpretation shows that the exploration success in the Orange Basin is particularly significant in addressing key uncertainties related to source rock and reservoir presence within the Early Cretaceous target intervals of the Pelotas Basin. Like the Orange Basin, quantitative interpretation techniques have shown potential AVO anomalies, providing valuable guidance for prospect identification.

Introduction

The Pelotas Basin, located offshore southeastern Brazil, is gaining increasing attention as a high-potential frontier for hydrocarbon exploration. This renewed interest has been catalysed by multibillion-barrel discoveries in its geological conjugate across the South Atlantic—the Namibian sector of the Orange Basin. While the Pelotas Basin remains underexplored, with limited well data and sparse legacy geophysical coverage, recent advancements in seismic acquisition and processing (Figure 1) have significantly improved regional imaging, allowing for more confident geological interpretation.

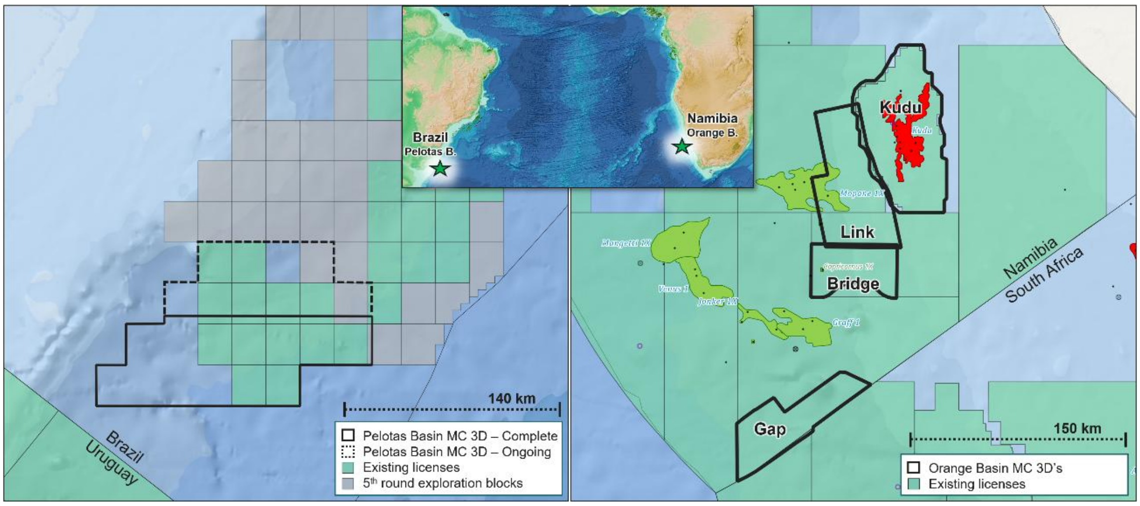

Figure 1: Location of the Pelotas Basin (left) in relation to Orange Basin (right) showing overview of licenses, fields and existing and ongoing MC 3D seismic surveys.

Recent industry activity reflects growing confidence in Pelotas Basin exploration. This momentum is evident in the successful 2024 licensing round and the strong interest in Brazil's ongoing 5th Cycle of the Permanent Offer. Key to this optimism is the recognition of geological parallels between the Orange and Pelotas basins. Both share a common tectono-stratigraphic evolution linked to the break-up of Western Gondwana.

The exploration successes in the Orange Basin with discoveries such as Graff, Venus, Jonker, La Rona, Mangeti, Lesedi, Mopane and Capricornus highlight the potential of Cretaceous plays. Similar depositional environments, source rock characteristics, and trap geometries suggest that the Pelotas Basin could follow a comparable trajectory. Understanding the shared petroleum systems and leveraging recent geophysical insights is central to unlocking the Pelotas Basin’s untapped potential.

Method and/or Theory

To evaluate hydrocarbon potential in the Pelotas Basin, a combined approach of seismic interpretation and Quantitative Interpretation (QI) techniques using recently acquired and processed 3D seismic was applied. A key focus of this study is the use of Amplitude Versus Offset (AVO) analysis to assess reservoir and fluid presence. Strong AVO sensitivity in the Orange Basin—driven by contrasts in P-wave velocity, S-wave velocity, and density—has demonstrated the value of this method for lithology and fluid discrimination. Leveraging this, we applied a simplified Extended Elastic Impedance (EEI) methodology (Whitcombe et al., 2002), using pre-conditioned angle stacks to compute AVO intercept and gradient based on Shuey’s two-term approximation (Shuey et al., 1985). These attributes were projected to a chi angle of 27° (rEEIχ27), following the approach of Went et al. (2025), as optimal for siliciclastic reservoir and fluid discrimination in this setting.

The 3D seismic data in Pelotas Basin were acquired with a 10-streamer, triple-source configuration using 8–10 km offsets to ensure broad angle coverage and support full waveform inversion (FWI) for accurate velocity modelling. Processing incorporated sparse-inversion deblending, wavelet estimation, 3D de-ghosting, and advanced multiple attenuation including curvelet-domain subtraction and high-resolution radon techniques to preserve AVO fidelity. These steps were critical to ensure reliable inputs for quantitative interpretation workflows.

Results

Newly acquired 3D seismic data from the Pelotas Basin highlight strong geological parallels with the Orange Basin, reinforcing its hydrocarbon potential. A comparison of seismic sections from both basins shown in Figure 2 reveals key indicators of Aptian source rock presence, with strong soft seismic signatures on top of the break-up unconformity suggesting the presence of marine shales like those proven in the Orange Basin. This strengthens confidence in the

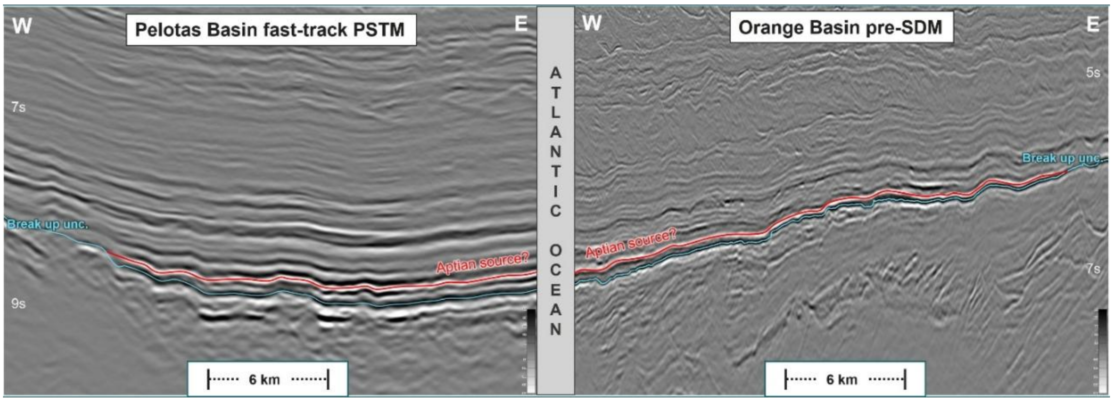

Figure 2: Dip lines at a similar scale from Pelotas Basin full stack fast-track 3D (left) and the Orange Basin full stack pre-SDM (right).

presence of a viable petroleum system and helps mitigate one of the primary exploration risks in the Pelotas Basin.

AVO analysis further supports the presence of reservoir intervals in the Pelotas Basin. By using a simplified Extended Elastic Impedance (EEI) approach, AVO intercept and gradient projections were computed at a chi angle of 27° (rEEI χ 27) to optimize sand-shale differentiation. Figure 3 (left) compares seismic dip lines from both basins, with rEEIχ27 attributes overlaid, highlighting AVO Class 2/3 anomalies at key target intervals.

To further assess potential reservoir presence, RMS amplitude extraction from the rEEIχ27 attribute was performed in a window within the main Cretaceous target interval above the break-up unconformity. Figure 3 (right) show that this analysis reveals high-amplitude, continuous reflections indicative of deepwater turbidite systems, slope channel complexes, and basin floor fans—reservoir types that have been successfully targeted in the Orange Basin.

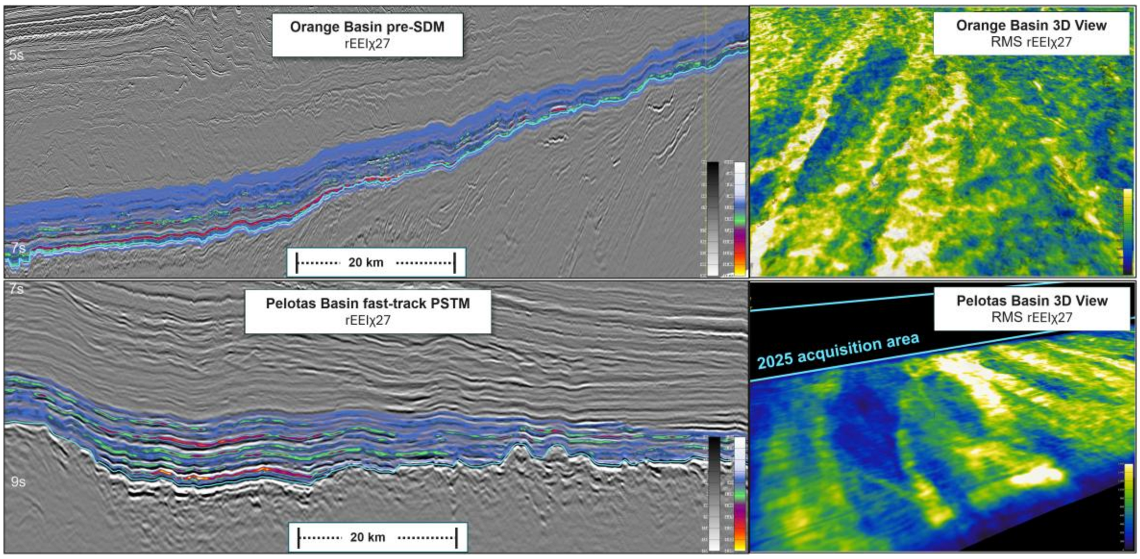

Figure 3: Left: Seismic dip lines in time from Orange Basin (top) pre-SDM full stack and Pelotas Basin (bottom) fast-track full stack. Overlain is the rEEIχ27 attribute highlighting potential AVO class II/III as a soft response at primary Cretaceous target level. Right: 3D view of approximately 500km^2 showing RMS rEEIχ27 at primary Cretaceous target interval for both basins.

Conclusions

This study highlights the Pelotas Basin as a compelling new frontier for hydrocarbon exploration, underpinned by strong geological and geophysical parallels with the highly successful conjugate Namibian Orange Basin. The integration of newly acquired 3D seismic data and quantitative interpretation techniques—particularly AVO analysis using extended elastic impedance (rEEIχ27)—has enhanced our understanding of the basin's subsurface prospectivity.

Seismic imaging reveals key indicators of mature source rock, effective reservoir development, and favourable trap geometries within the Early Cretaceous succession. The identification of Class II/III AVO anomalies aligned with deepwater turbidite systems strengthens the case for the presence of a working petroleum system in the Pelotas Basin, helping to de-risk one of the basin's primary uncertainties.

These insights, combined with recent licensing momentum and industry interest, suggest that the Pelotas Basin is well-positioned to deliver future exploration success and may mirror the trajectory of its conjugate counterpart across the South Atlantic.

Acknowledgments

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