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The Outboard of the Campos Basin: 3D Seismic Interpretation, Restoration, and Implications for Frontier Exploration

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Introduction

The outboard structural domain of the Campos Basin has been the focus of several exploration campaigns between 2020 and 2025. Most wells have proven a working petroleum system; however, many questions remain regarding its evolution, including the timing and process of deposition and subsequent burial. While conceptual and numerical models have advanced our understanding of rift evolution and salt tectonics, direct observations linking the well-known inboard domain to the outboard domain are still scarce. This study uses 3D seismic interpretation and restoration techniques to constrain the spatial and temporal evolution of the rift and sag phases as well as salt dynamics. Implications for the petroleum systems of the outboard Campos Basin, where rules of the inboard domain may no longer apply, are discussed.

Method and/or Theory

The methodology integrates 3D seismic interpretation with structural restoration to reconstruct tectono-stratigraphic evolution of the studied area. Key stratigraphic intervals—including basement, rift, and sag sequences were mapped in addition to interpreted post salt horizons and analyzed using seismic facies and isopach maps. Volcanic intrusions were identified and interpreted within the broader tectonic context. Structural restoration techniques were applied to model the kinematic evolution of the basin, determine the timing relationships between faulting and sedimentation, and restore the original geometry of pre- and syn-rift sequences. Salt accumulation was modeled in the context of margin collapse events. Available well data were used to calibrate depositional environments and validate seismic interpretations, ensuring a robust reconstruction of tectonic, stratigraphic, and thermal processes. Seismic interpretation was carried out to identify the spatial and temporal distribution of rift and sag sequences across the outboard domain. Particular attention was given to differences between proximal and distal areas. This integrated approach facilitated a comprehensive understanding of the characterization of petroleum system elements in the outboard region of Campos Basin.

Results and Conclusions

Seismic interpretation and restoration reveal systematic thinning of rift and sag units toward the distal outboard, suggesting strong thermal gradients and magmatic influence during early rifting. The data also indicate abrupt subsidence followed by thick salt deposition, driven by rapid thermal decline. A key observation is the time-equivalence between the inboard intra-sag and the outboard top-rift horizons, supporting a diachronous tectono-stratigraphic evolution and reinforcing the notion of tectonic compartmentalization along the margin. This study reveals that rift-related tectonism did not cease simultaneously across the Campos Basin. While sag deposition had already begun in the inboard, the outboard was still undergoing active rifting. This diachronous evolution has direct implications for petroleum system. By integrating seismic interpretation and restoration workflows, we propose a refined tectono-stratigraphic model for the outboard area of Campos Basin - highlighting the roles of magmatism, thermal gradients, and salt tectonics in shaping the basin's evolution. These findings not only reduce exploratory risk but also challenge traditional models, offering new perspectives for frontier exploration in deep-water Brazil.