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Seismic Facies Analysis of the Albian-Turonian in the Potiguar Basin Using Seismic Attributes and Machine Learning

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Introduction

Recent hydrocarbon discoveries in Guinea and other areas of Africa underscore the significant potential of the Brazilian Equatorial Margin (BEM), suggesting the existence of analogous petroleum systems. This scenario has heightened both scientific and economic interest in the region. Within the promising context of the BEM, this study focuses on the Potiguar Basin, renowned for its prolific petroleum system, which has been explored onshore for over 50 years. However, despite recent discoveries of hydrocarbon reserves in deep waters, submarine channel systems remain poorly understood. This work aims to delineate different facies using seismic stratigraphy principles combined with seismic attributes to identify factors influencing depositional system characteristics. The study seeks to infer the petroleum system context within the Albian-Turonian interval of the Potiguar Basin, improving the understanding of key sedimentary features and their geological controls.

Method and/or Theory

This research employed a depth-migrated seismic volume extending to approximately 10 km depth, along with data from two pioneering deep-water wells, including lithostratigraphic information. Through well-to-seismic integration, the horizons corresponding to the Albian and Turonian were mapped. Subsequently, the Alagamar Member to Turonian interval was interpreted using Petrel software. To enhance the visualization of sedimentary features, three seismic attributes were extracted using AASPI software: Sobel Filter (edge detection), GLCM (texture analysis), and RMS Amplitude (energy attribute). Finally, these attributes were integrated using unsupervised machine learning methods - GTM (Geological Time Mapping) and SOM (Self-Organizing Map) - to perform seismic facies clustering and better visualize the evolution of the channel system. All processing was conducted using AASPI software.

Results and Conclusions

The results revealed linear, highly confined channel systems, structurally controlled by faults, with no evidence of lobes, avulsions, or levees. The channels exhibit a NW-SE orientation, bounded by faults that likely promoted flow confinement. Additionally, lag-like facies were identified in the central channel areas, potentially representing important reservoirs. The integrated application of seismic stratigraphy and attribute analysis, supported by SOM and GTM, proved effective for delineating different facies in the Potiguar Basin. These findings provide valuable insights into the factors controlling the basin's depositional architecture, significantly advancing the understanding of its petroleum system and supporting exploration assessments in this promising region of the Brazilian Equatorial Margin.