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Colored Inversion Technique for Mapping Gas bearing Pre-Rift Fluvial-Eolian Tight-Sand Reservoir in Biriba Field, Reconcavo Basin, Northeast Brazil

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Introduction

Hydrocarbon-bearing tight reservoirs often present interpretation challenges, especially in mature onshore fields where seismic data is usually limited to 3D post-stack time-migrated (PSTM) volumes. Conventional techniques like amplitude extraction and well-log correlation are often insufficient to reliably define sand bodies or guide well placement. Biriba Field, 81 km northeast of Salvador in the Recôncavo Basin (northeastern Brazil), exemplifies this challenge. Operated by PetroReconcavo S.A. since 2021 as part of the Miranga Cluster, it produces from Barremian–Tithonian fluvial-eolian sands with porosity between 5–20% and permeability from 1–500 mD. Despite the typical NE–SW depositional trend of Pre-Rift fluvial sands (Destro et al., 2003), negative amplitude anomalies extracted from the 3D PSTM volume showed fragmented, incoherent patterns. These results did not correlate well with gas production and failed to support effective drilling and reservoir stimulation strategies. To address this, a deterministic colored inversion (Lancaster & Whitcombe, 2000) was applied to enhance the seismic-petrophysical relationship—particularly acoustic impedance, a known proxy for lithology and fluid content.

Method

A deterministic colored inversion was performed using S&P Global Kingdom® software, following the method by Lancaster & Whitcombe (2000). Input data included a reprocessed 3D PSTM seismic volume (R0027_MERGE_MG_BT_REC_57) from the REATE database and logs from legacy and recent wells with compressional, shear sonic, and density logs. Steps included: (1) well-to-seismic ties via synthetic seismograms; (2) wavelet extraction and validation; (3) log conditioning and relative acoustic impedance calculation; (4) execution of colored inversion; and (5) extraction of minimum impedance between the top and bottom of the pre-rift section. Initially, impedance maps from the legacy wells guided the placement of two new wells. With data from the latest wells, the wavelet and inversion volume were updated, producing a refined map for future drilling.

Conclusions

The acoustic impedance volume successfully highlighted NE–SW-trending anomalies that matched the depositional patterns of the Agua Grande and Sergi Formations. These anomalies showed strong well-to-seismic ties and led to the drilling of two productive gas/condensate wells. Cased Hole Formation Tests confirmed initial reservoir pressures exceeding 4500 psi, permeability below 1 mD, and porosity under 10%—typical of tight reservoir conditions. The study demonstrated that seismic inversion can overcome the limitations of conventional amplitude analysis in mature fields, serving as a reliable tool to derisk drilling locations and optimize production strategies in tight sand environments.