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Beyond Conventional Inversion: The Impact of High-Frequency FWI on Porosity Prediction

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Introduction

With the rapid evolution of velocity optimization methods in seismic processing and imaging, seismic reservoir characterization must evolve to leverage the high-resolution velocity data now available.

Traditional deterministic inversion methods, which rely on a low-frequency model cut typically between 5-8 Hz and rely on medium-to-high frequency content from deconvolved amplitudes, are increasingly being challenged by the dynamic updates provided by Full Waveform Inversion (FWI) workflows. This study investigates the integration of absolute and high-frequency velocity information into the reservoir characterization workflow and identifies the frequency threshold beyond which conventional migrated data becomes more informative.

Method and/or Theory

This study focuses on a pre-salt region in the Santos Basin with multiple wells. FWI-derived velocity was compared with P-wave velocity logs from wells, calculating correlation coefficient across different frequency bands. Additionally, the correlation between these well logs and velocities obtained from conventional inversion workflows within the same frequency range was assessed.

It was also used the FWI velocity combined with a colored inversion from the FWI-image to rapidly estimate the porosity from the pre-salt section from classification. These results are then compared with porosity estimates from a legacy inversion based on older seismic acquisition.

Results and Conclusions

A low-pass filter applied to the well velocity logs at 20 Hz revealed a strong correlation with FWI velocity, which also showed a high correlation with well-derived porosity. Porosity classification based on FWI data demonstrated a higher correlation with actual well porosity compared to reservoir properties derived from the legacy inversion.

These findings highlight the potential of FWI-enhanced workflows to improve reservoir property prediction and characterization accuracy.