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Mono Frequency Overburden Normalization Approach Application Revealing the Stratigraphic Permian Gas Prospectivety in Saudi Arabia.

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ABSTRACT

Three fields in Saudi Arabia were appraised using the Mono Frequency Spectral Decomposition (Mono FSD) method to verify the gas detection capability of the technique in Permian carbonates. A significant objective of the study was to integrate the unconventional Mono FSD application results with other conventional seismic attributes to unlock new potential stratigraphic hydrocarbon sweet spots in the same Permian reservoirs. Wells in field "A" proved gas from logs and well tests in the Permian reservoir interval, while a well in field "B" exhibited no gas shows in the same interval. A flank well in field "C" showed gas on logs and from well tests in the same Permian reservoir interval but a crestal well did not, implying a stratigraphic component in the hydrocarbon trapping mechanism.

The amplitude spectrum of gas bearing reservoirs commonly diminishes at the high frequencies more rapidly than that of water-wet reservoirs. Therefore, incremental Mono FSD volumes from 5 to 30 Hz were generated to detect gas accumulations but the results have not agreed with the offshore wells for fluid detection due to large differences in the reservoir burial depth between the three fields. Overburden normalization in the Mono frequency domain approach was required to resolve the depth issue.

Seismic RMS amplitude, inverted seismic acoustic impedance, and overburden normalized Mono FSD ratio maps were generated over the Permian reservoir interval. The RMS amplitude map exhibited fairly high amplitudes at fields "B" and "C" but relatively lower amplitudes at field "A". The inverted acoustic impedance map revealed low impedance at field "A" and the north flanks of fields "B" and "C", suggesting lithofacies variations from tight reservoir rocks at the crest of fields "B" and "C" to porous rocks on the flanks. The overburden normalized Mono FSD ratio map showed sweet spots at field "A" and the north flanks of fields "B" and "C", while it dimmed at the crest of field "B". The integrated analysis indicated that the overburden normalized Mono FSD and inverted acoustic impedance maps mutually supported gas detection and porosity prediction. In conclusion, the integration of seismic attributes maps and overburden normalized Mono FSD ratio maps led to the identification of prospective locations with good reservoir porosity and presence of gas within the Permian carbonates in the Arabian Gulf, offshore Saudi Arabia.