Subsurface Mapping of Thin-Sand Reservoirs Using Seismic Texture and Narrow-Band Spectral Analysis Attributes Over "X" Oil Field, Offshore Niger Delta

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Abstract

The detection, mapping and characterization of thin-sand reservoirs constitute a significant hydrocarbon exploration problem in mature basins such as the Niger Delta where thin sands potentially contain huge prospects. This research aimed at subsurface imaging and characterization of thin-sand reservoirs in "X" Oil Field, Niger Delta using seismic texture and narrow-band spectral analyses attributes since these geometric attributes measure trace-to-trace variation and are sensitive to lateral changes in amplitude. Digital 3D seismic data and well logs were interpreted using OpendTect and RokDoc software. Structural and stratigraphic analyses were used to isolate the different hydrocarbon reservoirs. Narrow-band seismic spectral response and texture attributes was generated and used to characterize the subsurface reservoir properties such as texture, structure, lithology and fluid content. The data analyses and interpretation involved conventional seismic interpretation, volumetric analysis, texture analysis, spectral analysis, and instantaneous spectral analysis of the thin-sand reservoirs. Seismic textural analysis attributes deployed are energy and homogeneity while the spectral analysis attributes included dominant response frequency, average response frequency, and maximum spectral amplitude. The results showed that the seismic amplitude maps for the thin-sand have some features of high reflection strength but they are better defined on both textural and spectral attribute maps. The spectral attribute maps even described the channel present in the area of study as lenticular in shape, but with holes of shaly formation. This research work revealed the potential of application of both seismic texture and narrow-band spectral analysis as a powerful interpretation tool for mapping reservoirs thinner than one-quarter wavelength.