

Mapping Massive (up to 500 m) Sandstones in Intraslope Subbasins with a Machine-Learning Enhanced Workflow: Guadalupe A Section, Lower Wilcox, South-Central Texas Coast

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Abstract

We studied deep (down up to 6000 m) Lower Wilcox strata (Guadalupe A) immediately above Midway Shale using a 1000 km² 3D seismic volume and sparse deep well data (wireline logs) in DeWitt and Goliad counties. Several wells that penetrate whole or part of the section reveal sands as thick as 500 m. However, seismic facies and amplitude maps, and seismic inversion are not able to disclose the sign and extent of the massive sand distribution in the intraslope basins in the area. A new workflow that incorporates machine learning with seismic lithology and geomorphology was tested for quantitative mapping of sandstone thickness and net-to-gross ratio. The procedure is a significant update to current qualitative seismic stratigraphic and seismic attribute approaches for better geologic and reservoir prediction with higher resolution and accuracy.

The Guadalupe A section off the shelf edge is infamously difficult to interpret using seismic data because of deep burial, complex structure (growth faults and shale ridges), and low data frequency (20 Hz) and resolution (50 m at 4000 m/s). The value of machine learning approach is shown by improved correlation between wireline-log calculated lithology (sand/shale content) and seismic impedance. In addition to excellent fit to training wells, the results expressed good tie to gamma ray and shale volume curves at blind test wells, ensuring a high confidence level for stratigraphic and depositional interpretation.

This study resulted in the recognition and description of multiple thick (up to 1000 m) intraslope subbasins formed during Lower Wilcox time. Numerous sandy channels and fans are recognized on sandstone thickness maps. Collective sandstone thickness in multiple units can be as thick as 500 m in large areas. Existence of those massive sand accumulations in sizable slope zone has not been reported before, which hopefully will spark new debates on how they were transported there.