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Simultaneous Inversion of Spectrally-Broadened 3D Seismic Data: A Case Study for the Olmos Unconventional Play, South Texas

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The primary objective of this work was to identify sweet spots in the unconventional tight sand reservoir of the Olmos formation using pre-stack simultaneous inversion. The second objective was to compare the original seismic data with high resolution seismic data, along with the resulting simultaneous inversions. High-resolution seismic data is the result of sparse layer inversion method applied to the original pre-stack seismic data. This method inverts the frequency spectrum for layer thickness and enables the detection and resolution of thin beds below tuning thickness.

Simultaneous inversion is a process which generates P impedance, S impedance, and density at the same time. The P impedance volume generated from the original seismic lacked sufficient vertical resolution to image thin beds (~ 25-30 ft/ 7.6-9 m) within the productive interval of the Olmos formation. High resolution seismic was used to address this challenge. The process of spectral layer inversion improved the resolution from about 98 feet to 47 feet. At this resolution, two additional horizons can be mapped to separate individual porosity zones within the productive Olmos interval.

Using the impedance volume generated from the high resolution seismic, we were able to map a new low impedance anomaly within the study area. This new anomaly correlates with the lower high porosity zone associated with better Olmos production, and should provide new potential for field development.

This approach could also be very useful in many plays throughout the Permian Basin.