Analysis and Classification of Seismic Attributes in Vacuum Field, Lea County, New Mexico

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Limited seismic data quality and complex tectonics make for less than ideal interpretation conditions. However, modern geometric attributes including coherence, coherent energy gradients, and curvature have shown to be effective in showing the lateral extents of subtle and small-scale geologic features not usually visible in conventional seismic sections. These geometric attributes are better suited than some older generation seismic attributes as they work on the full data volume and eliminate the need for pre-picked horizons for them to be implemented. We have applied these attributes to improve reservoir characterization of the Vacuum Field area, where seismic data quality is a significant factor in interpretation.

Workflows using geometric attributes to aid in the visualization and mapping structure and stratigraphy are well established. However, little has been done to tie these newer attributes directly to reservoir properties. We therefore apply two well-established workflows used in estimating porosity from more conventional seismic attributes such as reflection envelope and frequency. In the first workflow, we determine which attributes are independent and classify the geometric attributes without well control (unsupervised learning) to obtain an enhanced image of the reservoir. In a subtle variation of this workflow called supervised learning, we find classes that correspond to lithologies seen in the well control. In the second workflow, we correlate these new attributes to well logs and production to obtain a transform from the spatially well-sampled attribute data to predict the log properties throughout the reservoir. In both workflows, we compare the results of these predictions to those obtained by conventional attributes alone, and validate the results through well control that was not used in the training process.

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