Seismic Attributes Illumination of the Woodford Shale, Arkoma Basin, Oklahoma

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The Woodford Shale formation of south-western Oklahoma is a hydrocarbon-rich shale that has served as the source rock for many Oklahoma oil and gas plays over the past century. Today, the Woodford Shale is an unconventional resource play similar in age and depositional environment to the Barnett Shale. Like the Barnett, the Woodford Shale contains a large amount of healed natural fractures, has very low permeability, and is amenable to production through hydraulic fracturing. The characterization of natural fracture intensity and orientation has a direct impact on horizontal well orientation and completion strategies.

Volumetric seismic attributes allow interpreters to map the structural deformation and subtle stratigraphic details that are not readily observable on seismic data. In our study, we used multi-trace geometric attributes and impedance volumes to investigate the fracture patterns in the Woodford Shale. Coherence allows us to map relatively large offset discrete faults that appear to have a wrench component, while structural curvature allows us to map more subtle folds and flexures. Low acoustic impedance anomalies have a strong correlation with structural lineaments given by curvature and coherence, strongly suggesting either natural fractures or diagenetic alteration. Analysis of the production data indicates that the best-producing wells correlate to zones associated with k2 most negative principal curvature (valley-shaped) anomalies and fractures from 30º and 60º to the North. The proximity of microseismic events to ridge/dome features suggests that the formation of ridge/dome features generated paleo-zones of structural weakness.