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Duane A. Pankhurst¹ (1) University of Houston, Houston, TX

Class I AVO Analysis in a North Texas Mid-Continent Reservoir

The objective of this study is to identify by-passed hydrocarbons through amplitude variation with offset (AVO) modeling. Located in north Texas, a high-resolution (10-90 Hz) 3D seismic data set was studied. Approximately 17 sq. mi of this data set will be the focus of this research. At the producing horizon, high impedance sands are encased in lower impedance shales that exhibit Class I (dim out) AVO behavior.

Seismic acquisition parameters include source-receiver offsets of approximately 8000 ft. Additional data are 42 well logs, 30 of which are in digital .las format; some wells include dipole sonic measurements. Also, core and fluid samples will be analyzed and calibrated to log and AVO responses. The producing horizons are approximately 4000 ft deep, providing an opportunity to evaluate prestack gathers at offsets, at or near, two times the depth. When examining common depth point (CDP) gathers at large offsets, positive (+) reflectivities associated with Class I AVO anomalies tend to reduce in amplitude (dim), and in some cases pass the zero crossing and reverse polarity. At further offsets, amplitudes tend to increase in negative (-) amplitude and brighten with offset. This condition is analogous to Class IIp (phase reversal) behavior.

Dimming amplitude environments are the hardest anomaly to recognize and validate. However, by evaluating pre-stack gathers at far offsets, Class IIp behavior may be exhibited. Since brightening events are easier to observe than dimming events, using this novel technique is an alternative methodology when working in the Class I AVO environment.