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Seal and Reservoir Characterization of Upper Slope Fan Lithofacies: Example of High-Frequency Variability

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Abstract

Conventional cores of a lowstand sequence (interpreted as a slope fan) reveal fine-scale variability within potential seal and reservoir units and provide insights concerning depositional process, sedimentation rates, and stratigraphic compartmentalization, which are below wire-line log and seismic resolution. The lower cored interval consists of dark gray to black foraminiferal shale representing slow (hemipelagic to hemi-turbiditic) deposition during a highstand. This maximum flooding shale is a major correlation marker because of its distinct gamma ray signature; it has an erosional upper contact (sequence boundary). This erosional contact is overlain by stacked, fining-upward stratal packages consisting of: deformed, argillaceous, fine-grained sandstones; sandy mudstones; and very silty gray shales. The sand-prone units consist of thinly interstratified shale, siltstone, and sandstone interpreted as blocks of levee deposits that probably slumped into channels. The interstratified sandy mudstones represent thin debris flows. Compartmentalization by numerous shale laminations and clay smears (along micro-faults) is conspicuous. The character of this argillaceous slope-fan reservoir is interpreted as poor (< 10% porosity). Results of high-pressure mercury capillary injection analysis reveal excellent seal character (10% non-wetting saturation > 10,000 psia) is exhibited by that shales below the sequence boundary. In contrast, silty shales and argillaceous siltstones from the overlying lowstand units have moderate to poor seal potential. Seal character is related to shale texture and fabric, content of detrital silt, early marine diagenesis (carbonate cementation), and stratigraphic position. These data provide a compelling argument for textural control of seal character induced by high-frequency sedimentary cycles.

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