

# Comparison of Highstand and Lowstand (SED) Deltaic Deposits in the Brookian Sequence, North Slope, Alaska: Implications for Predicting Reservoir Presence and Quality

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## Abstract

Roughly 30% of global oil accumulations are found within deltaic deposits. Despite advances in our understanding of these reservoirs, uncertainty exists in predicting internal architecture, connectivity, and rock properties due to the wide variability of deltaic systems. During marked sea-level fall (forced regression) deltas can migrate to the shelf-edge forming “shelf-edge deltas” (SEDs), placing reservoir-quality sands in contact with organic shales- a favorable configuration for petroleum accumulations. Our understanding of deltaic deposits is biased toward highstand deltas (HSD), and it is not clear how sedimentary processes, and associated reservoirs in SEDs differ from HSDs. This study compares and contrasts HSD vs. SED deposits in the Brookian sequence in the AK North Slope to reduce the exploration and drilling risk of reservoir presence and quality. Several recent discoveries near Brookian paleo-shelf-edges, including Pikka, Willow, and Horseshoe, suggest that SED deposits constitute significant oil and gas reserves on the North Slope. This study highlights key differences in HSD and SED deposits with: 1) detailed core description using a semi-quantitative method of categorizing depositional processes (Ainsworth, 2011), 2) 2D and 3D seismic interpretation as well as 3D seismic attributes (RMS amplitude, variance) to identify HSD vs. SED deposits and their geometries, 3) well log interpretation where core is unavailable. The Fish Creek Test Well #1 core (positioned in a lowstand SED) shows evidence

of wave, tide, and fluvial energy, with a strong fluvial dominance, wave influence and tide affect. In this well, only the fluvial-dominated strata are oil-stained while hummocky cross-bedded strata are tightly cemented. In contrast, the Umiat #18 well (positioned in a HSD or mid-shelf delta) shows a wave dominance with river influence and tide affect. In this well, higher poro-perm values and oil staining exist in both wave- and fluvial-dominated strata except when bioturbated. In summary, preliminary data from this study suggest that depositional energies, and thus reservoir properties, are variable within Brookian deltaic deposits, but favor fluvial and wave dominance. Future interpretation of core and seismic data aims to delineate other key differences between HSDs and SEDs to improve our understanding of the external controls and variability within Brookian delta deposits.