

Core-based Interpretation of Parasequence Stratigraphy within the Cretaceous Nanushuk Formation, Umiat, Alaska

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The Umiat reservoir, located along Colville River on the southeastern boundary of the National Petroleum Reserve-Alaska, consists of shallow accumulations of light oil in folded sandstones of the Cretaceous Nanushuk Formation. A new facies analysis of cores from 11 wells led to the recognition of three distinct parasequences in the Umiat subsurface that roughly correspond to various informal units within the Nanushuk Fm. This preliminary interpretation, based on the distribution of facies associations, stratal geometries, and stacking patterns, conforms to established sequence stratigraphic models and published regional sequence stratigraphic interpretations. Beginning at the bottom of the Nanushuk Fm., the Lower Grandstand interval contains the top of the lowest parasequence, which is at least 300 ft thick and consists of upward coarsening shoreface and deltaic facies. A thin flooding surface or correlative surface separates the lowest parasequence from a thinner 100 ft-thick parasequence also located within the Lower Grandstand. Both of the Lower Grandstand parasequences have upward coarsening, progradational stacking patterns with corresponding upward increases in horizontal permeability. A major flooding surface associated with the informally named Shale Barrier follows a thin transgressive surface above the Lower Grandstand that forms the base of the third parasequence. This upper parasequence transitions from the marine mudstones of the Shale Barrier to distal shoreface and deltaic deposits of the Upper Grandstand and the marginal marine to non-marine Chandler interval. The largely aggradational parasequence is over 750 ft thick, and though there is insufficient evidence for a sequence boundary in the cores, it is possible that this "parasequence" actually represents a separate sequence. The significant change in parasequence thickness is related to a major increase in accommodation in the middle of the Nanushuk Fm., just above the Lower Grandstand interval at Umiat. The top of the Nanushuk Fm. is poorly represented in the Umiat cores, but the sequence stratigraphic significance of the transgressive Ninuluk (upper Nanushuk Fm.) and overlying Seabee Formations is described in previous studies of the Umiat anticline. Observations at the Colville Incision outcrop to the west of Umiat confirm these trends. At Umiat there is minimal lateral variation within Nanushuk Fm. parasequences in the subsurface, though there is the potential for small stratigraphic traps within the Upper Grandstand and Chandler intervals. Variation between parasequences shows that the reservoir characteristics of Nanushuk Fm. topsets in the central North Slope are directly related to accommodation and progradation, which affect unit thickness and upward coarsening in deltaic and shoreface depositional systems.