

Brookian Sequence Stratigraphic Framework of the Northern Colville Foreland Basin, Central North Slope, Alaska

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ABSTRACT

This study presents detailed regional well and seismic correlations through the Brookian sequence of the northern Colville basin - Barrow Arch province just south of the major producing oil fields of the central North Slope, Alaska. The well log cross transect extends 261.4 km (162.4 mi) from the Clover 1 well in the northeastern National Petroleum Reserve - Alaska (NPRA) on the west to the Stinson 1 well in Beaufort Sea state waters near the Arctic National Wildlife Refuge (ANWR) on the east. The section traverses a zig-zag path from west to east, from proximal to more distal settings along depositional dip. At least seven horizons (A-G) are recognized as recording regionally significant changes in relative sea level (transgressive flooding surfaces, lowstand sequence boundaries, or surfaces of composite origin) that exerted fundamental control on distribution of lithofacies through time. These surfaces subdivide the Lower Cretaceous through Neogene foreland basin succession into primary genetic units (I-VII) made up of time-equivalent topset, foreset, and bottomset facies that typically span across formation boundaries as defined on the basis of lithostratigraphic criteria (e.g., Mull and others, 2003; Molenaar and others, 1987). Most of the rock volume within these cycles was deposited during phases of pronounced east- and northeast-directed progradation or vertical aggradation; major retrogradational (transgressive flooding) episodes are represented mainly by condensed sections. Three of the key lowstand sequence boundaries are interpreted from seismic and well data to exhibit significant submarine scour, attributable to mass failure events initiated on the upper slope, traction currents on the basin-floor, and perhaps other processes. Seismic records across the modern Beaufort Sea shelf margin exhibit a variety of recent and modern features clearly linked to analogous mass transport and sea-floor erosion, attesting to its probable significance in Brookian sequence architecture through time. Striking differences between transient submarine geomorphologic elements and their more muted appearance in the subsurface are important reminders that the vagaries of geologic preservation may mask locally important controls on the deposition and distribution of reservoir sandstones and other facies.