

Detailed Geologic Mapping in the Kavik River Area, Eastern North Slope, Alaska: New Constraints on Stratigraphy and Structural Style

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The northeastern salient of the Brooks Range provides a unique opportunity to examine all three major depositional megasequences in northern Alaska. Recent detailed geologic mapping (1:63,360-scale) of >600 square miles in the Kavik River area, north and west of ANWR, have improved our understanding of the stratigraphic and structural evolution of the eastern North Slope. These results bear on the evolution of the petroleum system, including the region's two undeveloped gas discoveries (Kemik and Kavik fields).

Stratigraphic units with exploration significance were examined in more detail in concert with geologic mapping. The Jurassic - Lower Cretaceous Kingak Shale includes a distinctive coarsening upward succession near the top that commonly forms a conspicuous "shoulder" beneath the overlying resistant rib of Hauterivian Kemik Sandstone. This regressive character may presage the regionally significant Lower Cretaceous unconformity (LCU). The Kemik Sandstone exhibits several different facies associations: 1) bioturbated siltstone and very fine sandstone, 2) thick-bedded fine sandstone with higher energy sedimentary structures and ichnofauna (e.g. skolithos), and 3) a very thin (0-2 m) sandstone interval rich in shale rip-up clasts. Controls on the distribution of these facies are unclear, but likely reflect a more complex paleogeography than previously assumed. The southernmost Brookian rocks in the map area include an enigmatic mid(?) to Upper Cretaceous sandstone-rich succession, informally termed the "Juniper Creek sandstone". This sequence may be correlative with other isolated deep-water sandstones that thin and fine abruptly to the north, including the Bathtub graywacke, Arctic Creek facies, and the Gilead sandstone. The youngest strata in the map area belong to the Sagavanirktok Formation and record as many as three distinct tongues of rapidly prograding shallow marine and nonmarine facies. These topset intervals were previously known largely from subsurface data and are interpreted to record major Late(?) Paleocene exhumation in the Brooks Range.

Three structural cross sections integrate surface observations with available 2-D seismic data to arrive at a robust characterization of Tertiary deformation in the map area. To the south, Ellesmerian rocks are deformed in large detachment folds. Farther north, the deformation style is controlled by multiple detachment levels, above which complex smaller folds and faults locally develop. The competent Kemik Sandstone forms a series of duplexes that are clearly visible in seismic data; surface exposures indicate these commonly consist of low displacement "broken folds". However, seismic data suggest as many as three thrust sheets may involve the Kemik, each with several kilometers of

structural overlap. This shortening likely predates the steeper, basement-involved reverse faults, such as the Shublik Mountains and Kavik faults.