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Consequences of Multiple Phases of Tertiary Uplift and Erosion on the Thermal Evolution of Mesozoic Source Rocks, North Slope—Chukchi Sea, Alaska

The Brookian sequence of the North Slope - Beaufort Sea - Chukchi Sea area of Alaska comprises more than 7.5 km of Lower Cretaceous to Holocene clastics representing Brookian foredeep deposition. Northward advancement of Tertiary Stage II Brookian contraction resulted in basement-involved thrusting across the North Slope of Alaska causing uplift and exposure of the Brookian sequence. To study the effect of uplift on the timing of hydrocarbon generation, we have constructed a regional 3-D basin simulation using mapped horizons from 2-D seismic data. The amount and timing of erosion were incorporated by constructing removed section maps. These maps are constrained by integrating thermal maturity and apatite fission track data from wells with shale velocity data from seismic. These data indicate that at least two erosional episodes removed up to 3km of sediment. Paleogene erosion was focused along the Brookian foothills and the Meade Arch. The northeastward migration of the Paleocene shoreline records the loss of accommodation space due to the effects of uplift and sedimentation. Neogene erosion was restricted to the Chukchi Sea. The basin simulations suggest that initial hydrocarbon generation from Mesozoic source rocks took place during the Upper Jurassic. Peak generation was coincident with Brookian foredeep deposition during the Middle Cretaceous and the generation window migrated northward during foredeep subsidence. Most generation ceased during the Upper Cretaceous, although Tertiary generation follows the northeastward migration of the Paleocene shoreline. Recent generation is restricted the Neogene depocenter near the outlet of the modern Colville River.