Geology and Petroleum Potential of the Rifted Margins of Arctic Alaska and the Chukchi Borderland

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The northern margin of Arctic Alaska and the eastern margin of the Chukchi borderland were uplifted rift shoulders during Jurassic - Early Cretaceous opening of the Canada basin. The Alaska rifted margin is mantled by a thick prism of Cretaceous - Cenozoic sediment derived from the Chukotka magmatic belt, the Brooks Range, and the fold-thrust belts associated with those orogens and delivered by sediment dispersal systems that traversed the Colville foreland basin. In contrast, the rifted margin of the Chukchi borderland was not deeply buried because it was tectonically isolated from those sediment dispersal systems.

The Colville basin during the Cretaceous accommodated much of the sediment shed from the orogens before the depositional systems overstepped the rift shoulder and prograded onto the Alaska rifted margin. The time lag between rifting and accumulation of the sediment prism resulted in potential source-rock deposition across much of the Alaska rifted margin and southern Canada basin. Stratigraphic and geochemical data south of the rift shoulder, paleogeographic reconstructions, and global sea-level history suggest three potential source-rock intervals: Lower Cretaceous (pre-Albian), Upper Cretaceous (Turonian), and lower Paleogene. Burial history modeling indicates favorable timing for generation from all three intervals beneath the Alaska rifted margin, where an active petroleum system has been documented.

Once the rift shoulder was overstepped by depositional systems emanating from orogenic highlands, rapid sediment accumulation on the rifted margin was accommodated by listric growth-faults. Facies include relatively coarse-grained sandstone, particularly in Paleogene sequences deposited during reactivation of uplift along the Brooks Range, and interbedded mudstone. Thus, favorable reservoir and seal facies are present in a spectrum of growth-fault and stratigraphic trapping geometries.

Along the eastern margin of Arctic Alaska, the Brooks Range tectonic front during the Paleogene impinged on the rifted-margin sediment prism and formed a still-active fold-thrust belt in growth-faulted Cenozoic strata. Most exploration around the rim of the Canada basin has focused on structures in this deformed margin and ~1.5 BBO and ~10 TCFG have been discovered in the Mackenzie delta of Canada and the eastern Alaska Beaufort shelf. Additional contractional structures occur in a gravity fold belt that may be present along the entire Alaska margin.