Tectono-Stratigraphic Evolution of the U.S. Chukchi Basin

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Sedimentation patterns in the Chukchi Basin were largely influenced by both basin and plate-tectonic scale events that often reactivated the earliest, basement-rooted fault grain. Using plate tectonic reconstructions, fault timing, and stratigraphic interpretations, a tectono-stratigraphic framework was derived to divide the three post-Franklinian tectonic mega-sequences into two phases:

1) The Sverdrup Association (Late Devonian to Early Jurassic). During the initial tectono-stratigraphic phase, the Chukchi and Sverdrup basins were juxtaposed and shared a similar evolutionary pattern. Basement-rooted faults led to the opening of deep north-south trending (modern day coordinates) Ellesmerian rift half-grabens along mainly west dipping faults. Sedimentation patterns varied from Devonian/Carboniferous thick asymmetric half-graben fills, Carboniferous to Mid-Permian carbonate deposits, and a series Late Permian to Early Jurassic shoreface sands, siltstones, and shales, mostly sourced from the northeast. In the Early Jurassic, uplift of the Chukchi platform that led to the establishment of a westerly sediment source into the basin also created one of the major tectonic unconformities (Jurassic Unconformity) within the basin.

2) The North Slope Association (Mid-Jurassic to recent) delineates a time, when the tectonic evolution of the Chukchi resembled the North Slope province. The first major tectonic event of this phase was the Beaufort rifting. Rifting was coupled with the establishment of a series of east-west trending faults, the uplift of the Barrow Arch rift shoulder, and the associated tectonically-driven Lower Cretaceous Unconformity in the northeastern Chukchi basin. Despite the emergence of the northeastern sediment source, the western source area persisted throughout the Neocomian Epoch. The final significant tectono-stratigraphic episode within phase two was the emergence of the Herald Arch/Brooks Range to the south / southwest of the basin, resulting in the deposition of a thick sequence of alluvial to deep-marine foreland deposits from south to north. Tectonic loading of the upper crust created a large-scale inversion in the late Cretaceous and the formation of the third major tectonic unconformity, the Mid-Brookian Unconformity. Inversion relaxation during the early Tertiary initiated renewed widespread accommodation space that was filled mostly from the west, likely due to continued uplift of the Herald Arch.