Extension and Inversion in the Brooks Range Orogen and Colville Foreland Basin, Northern Alaska

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ABSTRACT

Proterozoic and Lower Paleozoic basement (Franklinian) of the Brooks Range Orogen was extended in Late Devonian to Early Mississippian times along northwest-trending faults, leading to deposition of thick sequences of Upper Devonian to Lower Mississipian coarse clastics of the Kanayut and Kekituk formations, and local volcanism. Extension faults impacted the distribution of units and facies in the latest Franklinian time (Late Devonian) and in Ellesmerian time (Mississippian to Jurassic). Proximal Mississippian rift clastics of the Nuka Formation are characterized by turbidite beds with granule conglomerates containing clasts of feldspar and carbonate, which are largely crinoid-bryozoan wacke-packstones, and minor volcanic clasts. Crustal shortening initiated in the Middle Jurassic with obduction of the oceanic Angayucham terrane over Arctic North America. Inversion of Kekituk depocentres beneath the Colville Foreland Basin affected the stratigraphic section up to the Jurassic Kingak Formation, suggesting a possible link between terrane accretion and inversion. These, and similar inversion structures beneath the Brooks Range Foothills, provide an analog for inversion of the Upper Devonian Kanayut conglomerate depocentres exposed near the Brooks Range front. In the Inner Foothills, large doubly plunging overturned anticlines cored by Mississippian strata are carried to surface by thrusts that are demonstrated to have very little stratigraphic throw, on the order of only 100-200m. Their geometry and displacement are considered analogous to inversion structures of the northeastern British Columbia Foothills. Brooks Range shortening is associated with a pulse of foreland basin development recorded by deposition of the Berriasian to Hauterivian Okpikruak and Barremian to Albian Fortress Mountain formations in the Colville Basin. Proximal to one such inversion structure, the Okpikruak contains anomalous tectonic blocks of probable Mississippian carbonate that may have been calved from the footwall during displacement, indicating the time of inversion.

Neocomian shortening was followed by Late Albian to Cenomanian and younger extension in the central and southern Brooks Range. Rocks of this age in the Colville Basin include the marine to non-marine sandstones of the Nanushuk Formation. The Nanushuk is distributed in SW-NE trending depocentres, with overall thinning northward away from the Neocomian deformation front. Seismic data suggest that the southernmost thicks of Nanushuk were deposited in asymmetric subbasins controlled by faults that sole in the underlying Torok shales (Albian), which form an important detachment horizon for Tertiary shortening in the Brooks Range Foothills.