Evolution and Timing of Fractures and Related Map-scale Structures of the Central Brooks Range Fold-and-Thrust Belt, Northern Alaska

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Fractures form in foreland basin units during their progressive incorporation into a fold-and-thrust belt and during subsequent uplift. These fracture systems can contain useful information about the evolution of migration pathways and fractured reservoirs. Preliminary work along a surface to subsurface transect in the central Brooks Range reveals the presence of three different structural regimes based on fracture density, fracture distribution, and cooling dates from apatite and zircon fission track thermochronometry (AFT and ZFT). The southernmost field area and first structural regime, along Tiglukpuk Creek, is a large asymmetric, overturned anticline that represents the top of an anticlinal stack within the Lisburne Limestone. Fractures here occur in multiple sets of both filled and unfilled fractures with a very high fracture density.

The Fortress Mountain Formation and The Nanushuk Group represent the second structural regime. Within the Fortress Mountain Formation, structures form ~symmetric, open folds in units with highly variable lithology. Fractures sets within the Fortress Mountain Formation are unfilled and more variable due to lithologic heterogeneity. The resistant units of the Nanushuk Group form the Tuktu Escarpment north of the Torok Formation. The Nanushuk forms broad (kilometer scale), open folds that are structurally detached from the underlying and mechanically weaker Torok Formation. Similar to the Fortress Mountain Formation, fractures sets in the Nanushuk contain no fill of any kind, a finding that may be related more to lithology than structural or stratigraphic position. AFT cooling dates from both the Fortress Mountain and Nanushuk are consistent with the timing of regional fold-and-thrust related uplift at ~60 Ma.

The third regime is The Torok Formation seen along Autumn Creek. The Torok forms small-scale (meters to tens of meters) folds and faults within mechanically weak mudstone, siltstone and shale units. Within the Torok, south-vergent structures, consistent with a zone of back thrusting, are common. Filled and unfilled fracture sets were surveyed in rare coherent sandy units. AFT cooling dates for the Torok are also consistent with regional uplift dates of ~100 Ma. ZFT ages in all three regimes represent pre-deposition ages indicating that the units never reached temperatures high enough to thermally reset zircons (~225°C). Future research will include additional fission track sampling, fluid inclusion from filled fractures for thermal information, seismic and well log data and the integration of data on a balanced and reconstructed cross section.