Fracture evolution in a Fold-and-Thrust Belt and the Associated Deformed Foreland Basin: An Example from the Northeastern Brooks Range and Colville Basin, Alaska

Andrea L. Strauch[1] [ftaml@uaf.edu], **Catherine L. Hanks**[1], **Wesley K. Wallace**[1], **Paul B. O'Sullivan**[2], **Thomas M. Parris**[3]
[1]Tectonics & Sedimentation Research Group, Department of Geology & Geophysics, University of Alaska, 900 Yukon Drive, Fairbanks, Alaska 99775
[2]Apatite to Zircon, Inc. 1075 Matson Road, Viola, Idaho 83872
[3]Petro-Fluid Solutions, 236 Shady Lane, Lexington, KY 40511

Detailed structural mapping, geochronology and geothermometry along a surface to subsurface transect in the northeastern Brooks Range fold-and-thrust belt and foreland Colville basin provide insight into how fractures developed as host rocks were incorporated into fold-and-thrust deformation. Detailed mapping of pre-Mississippian to Lower Cretaceous rocks constrains the structural setting and relative timing of fracture formation. Fluid inclusion analysis, thermal maturity indicators, and fission-track thermochronology provide limits on the timing and conditions during deformation and fracture formation and filling. Homogenization temperatures for two filled fracture sets (striking N-S and E-W) that formed prior to or during deformation indicate that each set filled near maximum temperatures as estimated from vitrinite reflectance values (~170-180 °C). Crack seal textures and bent fibers in quartz and calcite cements provide evidence for syn-deformational precipitation of fill minerals. These filled fractures occur in units below the Lower Cretaceous Unconformity but are not present in overlying units. Two younger sets of unfilled fractures (also striking N-S and E-W) were probably not buried to the extent of the filled sets and did not reach conditions conducive to mineral precipitation. Zircon fission-tracks were not reset in any of the samples from the study area, suggesting the host rock did not exceed temperatures of ~250 °C or depths greater than ~10 km (assuming a geothermal gradient of 25 °C/km). Apatite fission-track data, however, indicate that folds now exposed at the surface south of the present range front formed at ~60 Ma, followed by a deeper, basement-involved thrusting at ~45 Ma and farther north at ~25 Ma.