Evolution of fractures in a fold-and-thrust belt and the associated deformed foreland basin: an example from the northeastern Brooks Range and the eastern Colville Basin, Alaska

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Rocks exposed at the surface of a fold-and-thrust belt record a complex fracture history that reflects a wide range of structural environments. These rocks provide a record of fracture formation during several stages of the advance of the fold-and-thrust belt into the basin: while flat-lying in the foreland, during fold-and-thrust deformation, and during late- to post-deformational uplift and unroofing. The proposed study focuses on Pre-Mississippian to Lower Cretaceous sedimentary rocks exposed along a N-S transect across the front of the northeastern Brooks Range fold-and-thrust belt into the adjacent Colville Basin. This project has important implications for basin evolution because it will provide information about how fractures vary as a result of changing stratigraphic and structural position.

Several different types of data will be used in this project to characterize fractures and constrain the timing and conditions under which they formed. Along the transect, folds, faults, and other map-scale features will be mapped (1:25,000) and attitudes will be measured. These data will be evaluated with a focus on the relative ages and possible genetic relationships of fractures to host structures. Outcrop data will be combined with seismic reflection and well data from the Colville Basin to provide a picture of the structure at different structural levels across the fold-and-thrust belt. Existing and new apatite and zircon fission-track data will constrain the timing of uplift, and petrographic analysis will constrain the relative ages of fractures. Fluid inclusions from fracture fill will be analyzed and used to better understand the temperature and pressure conditions as well as fluid compositions during fracturing and fracture filling. Thermal data (vitrinite reflectance and conodont alteration index) and all other data will be integrated on balanced cross sections to constrain the thermal conditions at different structural levels.

By integrating these different data sets, this study will provide knowledge of the timing and conditions of fracturing in sediments as they are incorporated into this fold-and-thrust belt. The quantitative model will then be a useful tool for predicting fracture evolution in similar settings.