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Progressive Fracturing and Folding During Burial, Deformation and Unroofing in the Northeastern Brooks Range, Alaska

The distribution, character and relative age of fractures in detachment-folded Carboniferous and Permian carbonate and clastic rocks in the northeastern Brooks Range of northern Alaska provide important constraints on the regional thermal and deformational history. While paleothermal indices in the host rock limit the conditions of folding to < 280º C, field, petrographic and fluid inclusion data suggest fractures formed repeatedly during deformation, at different temperatures and depths. The rocks probably initially entered the oil generation window (~100-150ºC) during Early Cretaceous subsidence and filling of the Colville basin due to thrust loading and erosion of the Brooks Range to the south. Regional fractures formed as a result of high pore pressures and low differential stresses ahead of the deformation front as it advanced northward into the basin during Paleocene time. Detachment folding began as previously undeformed rocks passed through the deformation front. Early folding was by flexural slip, with associated fracturing. Structural thickening during continued shortening resulted in deeper burial of the lower part of the deforming wedge so that early fold-related fractures were overprinted by penetrative strain during peak folding at temperatures up to ~280ºC. Later deformation eventually led to uplift and erosional unroofing. Late fold-related fractures formed at this time. Subsequent pervasive extension fractures formed at relatively shallow depths and low temperatures and are probably related to unroofing and/or regional stresses. A similar history would be expected in the foothills to the west of the northeastern Brooks Range, but less uplift and unroofing suggest less shortening and strain.