

## **Kinematic evolution of truncated asymmetric folds in the eastern Brooks Range fold-and-thrust belt, Alaska**

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Geometric analyses provide insights into the kinematic development of map-scale folds and thrust sheets in the eastern Brooks Range fold-and-thrust belt, south of the continental divide thrust front. The overall structural style is defined by a series of map-scale hangingwall anticlines imbricately stacked via south-dipping thrusts. The three-dimensional character of the map-scale folds and faults is well constrained because of the excellent outcrop exposure and the implementation of surveying methods for the collection of fold geometry data.

The thrust sheets strike east-northeast and dip gently to moderately towards the south-southeast. Each thrust sheet typically contains a map-scale, truncated anticline at its leading edge and consists of the Lisburne Group (limestone) and the stratigraphically overlying Sadlerochit Group (shale/sandstone). In addition, each thrust sheet includes a transition from a hangingwall flat at the base of the anticline backlimb to a hangingwall ramp near the anticline hinge. The hangingwall anticlines trend east-northeast and typically possess a parasitically folded, overturned, and truncated forelimb and a long and planar upright backlimb. Fold vergence is to the north, and the axial surfaces are inclined moderately to gently to the south. North-vergent, asymmetric parasitic folds in the Lisburne Group suggest that the map-scale folds are also asymmetric, although this cannot be determined explicitly for the anticlines with the thrust-truncated forelimbs.

The hangingwall anticlines are interpreted as detachment folds that were truncated by thrust faults. The following evidence supports this hypothesis: (1) the competency contrast between the Lisburne Group (competent unit) and the stratigraphically underlying Mississippian Kayak Shale (incompetent unit) favors detachment folding, although the Kayak Shale is not exposed, (2) detachment folds composed of the Lisburne Group and Kayak Shale are prevalent to the north of the study area, and (3) both footwall synclines in the Lisburne Group as well as Kayak Shale in the cores of anticlines are exposed along strike to the east and west.

The thrust faults appear preferentially to breach the folds in the anticline forelimb and/or adjacent syncline hinge. This is indicated by the prevalence of truncated forelimbs in contrast to long, flat, relatively undeformed backlimbs. In general, the forelimbs appear to have accumulated more strain during deformation because they are either visibly truncated by thrust faults or deformed by numerous parasitic folds. Steeply southwest-dipping normal faults truncate the thrust sheets and associated hangingwall anticlines. The normal faults may be a consequence of late-stage extension associated with the general north-northeast shortening responsible for thrust-emplacement and fold truncation.

A different structural style occurs locally south of the range front. Here an unbroken, asymmetric anticline in the Lisburne Group contains numerous parasitic folds in the backlimb, and the axial surface dips steeply to the south. Adjacent to and north of this fold, several minor thrusts, including one that ends in a syncline, may represent the core of a fault-propagation anticline.