Structural Geometry of the Big Bend Anticline, Brooks Range Foothills, Alaska

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The Brooks Range foothills of northern Alaska extend from the northern mountain front far into the foreland basin deposits of the Colville basin. Detailed information on the geology of the foothills is limited; however, they are of significant interest for oil and gas exploration. This project combines detailed surface mapping (1:25,000) with interpretation of aerial photos and satellite imagery of the Big Bend anticline in order to reconstruct its surface and subsurface geometry and interpret its kinematic evolution. This project has been done in conjunction with Alaska Division of Geological and Geophysical Surveys (DGGS) detailed mapping in the surrounding region and a study of the Umiat oilfield by the University of Alaska and Renaissance Alaska.

The project area surrounds the Big Bend of the Chandler River 33 km southeast of Umiat airstrip and covers approximately 10 km2. The structure of the foothills is a low-taper triangle zone or passive-roof duplex within Brooks Range foreland basin deposits. The dominant structures are detachment folds locally cut by thrust faults. The variable vergence of the folds and thrust faults is consistent with the gentle dip of the basal detachment and the low taper of the triangle zone.

The mechanical stratigraphy of the area consists of a competent unit between two incompetent units. The Torok Formation includes incompetent distal shelf, slope and basin shale, mudstone and thin-bedded, fine-grained sandstone layers. The overlying competent Nanushuk Formation consists of nonmarine and proximal shelf sandstone and conglomerate. The overlying incompetent Seabee Formation is composed of shale, mudstone, and fine-grained sandstone.

The structure of the area consists of an east-trending anticline with a hinge that branches westward. A forward thrust has broken through the anticline along the hinge to the east and near the southern hinge west of the branch point. A backthrust in the northern forelimb is associated with the branch of the hinge and terminates eastward near the branch point. Multiple northwest-striking right-lateral faults are present in the anticline south limb as well as in the syncline between branches in the hinge and commonly define drainage patterns.

The 1:25,000-scale geologic map from this project will be combined with available surface, well, seismic and thermochronology data to project the structure into the subsurface in three dimensions. The results will provide an analog for other anticlines in the region that will be applicable for oil and gas exploration. The results of this project will also be used to test Remote Predictive Mapping (RPM) in cooperation with BLM.