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Structure of the Red Dog District, Western Brooks Range, Alaska

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Abstract

The Red Dog district of the western Brooks Range of northern Alaska, which includes the sediment-hosted Zn-Pb-Ag ± Ba deposits at Red Dog, Su-Lik, and Anarraaq, contains one of the world's largest reserves of zinc. This paper presents a new model for the structural development of the area and shows that understanding the structure is crucial for future exploration efforts and new mineral discoveries in the district. In the Red Dog district, a telescoped Late Devonian through Jurassic continental passive margin is exposed in a series of subhorizontally stacked, internally imbricated, and regionally folded thrust sheets. These sheets were emplaced during the Middle Jurassic to Late Cretaceous Brookian orogeny and subsequently were uplifted by late tectonic activity in the Tertiary. The thrust sheet stack comprises seven tectonostratigraphically distinct allochthonous sheets, three of which have been subject to regional and detailed structural analysis. The lowermost of these is the Endicott Mountains allochthon, which is overlain by the structurally higher Picnic Creek and Kelly River allochthons. Each individual allochthon is itself internally imbricated into a series of tectonostratigraphically coherent and distinct thrust plates and subplates. This structural style gives rise to duplex development and imbrication at a range of scales, from a few meters to tens of kilometers. The variable mechanical properties of the lithologic units of the ancient passive margin resulted in changes in structural styles and scales of structures across allochthon boundaries. Structural mapping and analysis of the district indicate a dominant northwest to west-northwest direction of regional tectonic transport. Local north to north-northeast transport of thrust sheets is interpreted to reflect the influence of underlying lateral and/or oblique ramps, which may have been controlled by inherited basin margin structures. Some thrust-sheet stacking patterns suggest out-of-sequence thrusting. The west-northwest–east-southeast–trending Wrench Creek and Sivukat Mountain faults were previously interpreted to be strike-slip faults, but this study shows that they are Tertiary (Eocene?) late extensional faults with little or no lateral displacement.

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