

Hanna and Her Sisters: Structural Inheritance in the Chukchi Sea, Alaska

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ABSTRACT

The main tectonic element of the U.S. Chukchi shelf is the Hanna Trough (HT), a north-south failed rift that accommodated more than 10 km of Carboniferous-Jurassic syn-rift and post-rift (sag) strata, buried beneath >2 km of Cretaceous and Cenozoic foreland deposits. Interpretation of over 100,000 line-km of reprocessed 2D, time-migrated, seismic-reflection data documents that the HT area has been the focus of deformation and a significant structural boundary from at least early Devonian to Paleogene time, and perhaps to the present day. The HT is flanked by high-standing crustal blocks or platforms of mostly pre-Carboniferous basement. The Chukchi Platform on the west comprises mainly seismically opaque basement and is characterized by significant magnetic highs. The Arctic Platform on the east comprises well stratified basement whose internal geometry clearly defines a pre-Carboniferous, thin-skinned fold-and-thrust belt, striking parallel with the HT, that accommodated west-east (present coordinates) shortening. Below the basal detachment are well-imaged parallel strata of probable lower Paleozoic to Neoproterozoic age. Carboniferous rifting of the HT apparently was localized along the contrast in basement character and structure between the Chukchi and Arctic Platforms. Many rift-phase normal faults detach along pre-Carboniferous thrust faults, and others cut across stratigraphy in the basement. The entire section is cut by north-south striking strike-slip faults of likely late Cretaceous to Paleogene age, localized in the HT. Apparent vertical offset can be over 1 km on steeply dipping faults that cannot be easily followed to depth but appear to localize above older rifts, suggesting reactivation of rift-phase normal faults. Several inverted highs of a similar age are present in the Arctic Platform with the most significant displayed in the North Chukchi High. Clear east-west striking, deep, crustal-involved thrusts contribute to north-south contraction in the area; these resulted in uplift of the pre-Carboniferous section to essentially the seafloor in places. Notably, the North Chukchi High also has a significant positive magnetic anomaly. The fact that differences in the seismic character and potential field response of the basement are associated may indicate different crustal affinities across the HT. Thus the region around the HT has been the focus of at least 3 distinctly different, crustal-scale deformational events in the last 400 Ma.