

**Seismic Analysis of the Umiat Basin,
NPRA, North Slope, Alaska**



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Abstract

A biostratigraphically age-constrained restoration of 2D seismic profiles from the Umiat Basin suggests evidence for a Late Paleozoic dextral sense shear zone recorded on the North Slope. Prior work on the North Slope displays a northwest-southeast splay in basement fault trends along an ocean-continent transition in the mid-crustal sub-surface (Umiat anomaly). The dextral sense of displacement agrees with prior work on the Devonian-Permian rift axis in the Hanna Trough, offshore the present west coast of Arctic Alaska. The NW-SE trend of several basins on the North Slope (Meade, Ikpikpuk, and Umiat) corresponds with right-stepping structural features in a dextral transtensional shear. The Umiat Basin contains enigmatic fault propagation fold features related to localized, low-angle transtensional inversion. Recent literature suggests that strain partitioning either via low angle transtension or propagation of a bend/step through a transtensional shear zone may result in localized inversions along intrabasinal structures. Episodes of faulting are recorded in cores, from the Inigok 1 well and Ikpikpuk 1 well, as well as 2D seismic profiles. 2D restorations of the Umiat Basin's early genesis supports Late Devonian-Early Permian strike slip displacement accommodated along both basin margin normal faults and an intrabasinal, NW-SE integrated set of dextral sense shear. The basin's architecture is largely influenced by a previously weakened, cryptic-lithospheric boundary within the Arctic Alaska terrane. Timing for the Umiat Basin's formation coincides with the Ellesmerian Orogeny and suggests that the two events are systematically related. Positive uplift recorded in the basin center is not a result of a change in regional stress field. Rather transtensional strain partitioning is shown to cause local stress field inversions. This work proposes that the Ellesmerian Orogeny, previously thought to be Middle Devonian- Late Mississippian in age, is recorded from the Late Devonian-Early Permian on the North Slope of Arctic Alaska. Additionally, it may be inferred from recent 4D analogue modelling of transtensional pull-apart basins that the dextral shear accommodated approximately 60 km of offset.