

Tectonic Framework and Regional Seismic Expression of Exploration Plays, Canadian Beaufort Sea

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The Beaufort Sea covers the Arctic passive margin of Canada from the U.S. border NE to M'Clure Strait north of Banks Island. Meso-Cenozoic clastic deposits of this margin locally exceed 15 km thickness and are highly prospective as confirmed by major discoveries in the offshore Mackenzie Delta. Over the past 4 years we have acquired over 16,000 km of regional 2D PSDM 40 km deep seismic data that provide a synoptic regional tectonic-stratigraphic framework for exploration plays in this huge and structurally diverse continental margin. The tectonic framework of the margin displays extensional structures everywhere but also is marked by zones of wrench faulting and compression. The principle exploration plays are:

1. Beaufort Foldbelt-Compressional anticline and growth anticline-syncline traps (Paleocene-Oligocene);
2. Tarsiut-Amauligak Pull-Apart (TAP)-Growth rollover and half-graben traps with associated unconformities and internal clastic facies changes (Oligocene);
3. TAP Wrench Structures-Transpressional and transtensional traps in wrench zones (Jurassic-Oligocene);
4. Taglu Style Structures-Jurassic to Oligocene age normal and growth fault traps linked to onshore Tuktoyaktuk Peninsula, mostly involving older Paleozoic strata;
5. Banks Island Margin-Growth extensional traps both detached and deep-seated, (Jurassic-Pliocene) and related combination stratigraphic traps with slope facies.

All plays are operative in shallow to deep (>1000 m) water and above continental and oceanic crust. Exploration discovery history to date demonstrates that a very effective petroleum system exists in the S part of the study area including high quality multiple source and reservoir rocks, widespread maturation, vertical migration, large traps, and good seals. Major play risk is the extrapolation of favorable stratigraphy from well control in the Mackenzie Delta area far to the N into the Banks Island margin. Direct hydrocarbon indicators, gas chimneys and mud volcanoes support such extrapolation. Major prospect risks are interpreted to be timing of structure, seal integrity, and oil vs. gas retention. Recent resource assessment of the Beaufort-Mackenzie portion of the margin (including onshore areas) by the Geological Survey of Canada indicates mean probable ultimate recoverable resources of 22 Billion BOE for the Canadian Beaufort margin. Our data help establish the wide extent and diverse structural character of plays for the entire perimeter of the Beaufort Sea.