



## **New Insights into a Potential Major Petroleum Province off Banks Island, Canadian Arctic Passive Margin, from BeaufortSPAN™ 2-D Seismic Data**

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Because of its thick sediment wedge and obvious structures, most of the exploration focus in Arctic Canada has been devoted to the Beaufort-Mackenzie Delta. Almost three decades of exploration in that area have resulted in 48 conventional oil and gas discoveries both onshore and offshore, thus establishing the presence of a “world class” petroleum province. But looking northeast, the contiguous Canadian Arctic Passive Margin (CAPM) offshore from Banks Island remains largely unsurveyed by modern seismic methods and un-tested by exploratory drilling. Consideration of the improvements in sea-ice conditions and advances in seismic technology, as well as the proximity to the Mackenzie Delta and geological analogy with the petroliferous Alaskan conjugate passive margin, therefore prompt our new regional studies. The Banks Island continental margin clearly deserves serious consideration as an attractive exploratory target.

To expand the knowledge of the basin architecture, ION Geophysical (GX Technology) has acquired more than 4,000 km of 2-D long-offset reconnaissance seismic data in the area in three seasons since 2006 as a part of the BeaufortSPAN™ program (Helwig, Kumar and Dinkelman, this meeting). The seismic lines are located parallel and perpendicular to the Banks Island margin and in the Amundsen Gulf to the south. Cognizant of deep-water potential, the lines extend as far as possible offshore as permitted by ice conditions and environmental considerations. The SPAN™ programs have been designed to image down to the base of the crust with a 9-km long cable, 18-second recording, and final depth processing (Prestack Depth Migration) to 40 km. The seismic data are interpreted together with collected gravity-magnetic data to regionally map the ocean-continent boundary and the top of MOHO discontinuity, and tied to existing well data wherever possible to identify the major stratigraphic sequences. Thus the study is designed to image the entire crust and basin architecture, and the seismic resolution within exploration depths (down to 8 km or so) is excellent, revealing details of structural and stratigraphic features (Dinkelman and others, 2008).

Seismic interpretation identifies large structures and a classic passive margin sedimentary prism underlying the Banks Island margin, having all the components of the known significant petroleum systems of the Arctic passive margin, i.e. reservoir, source, seal, traps and timely migration. The Late Mesozoic-Tertiary sedimentary wedge is 8-10 km thick at the shelf edge and upper slope *outside* the boundaries of the Mackenzie Delta along the Banks Island margin. Although well calibration is available only from the inner

parts of the delta (water depth < 50 m), long-distance correlation of major reflection horizons enables interpretation of the Mesozoic-Tertiary stratigraphy along the entire CAPM. In addition, Paleozoic and Proterozoic reflectors under the Banks Island shelf can be correlated to the stratigraphy under the Tuk Peninsula shelf and underlying Banks Island, where limited well control is available for the Paleozoic intervals. Although Cenozoic compressional structures like those seen in the delta area are absent here, rollover anticlines associated with normal faults located on the middle and lower slope are imaged. Additionally, strike lines parallel to the slope show a complex of Oligocene/ Miocene channels, slumps, and interchannel facies, generally associated with slope deposits. The maturation kitchen and drainage area of the Upper Cretaceous and Lower Tertiary source rocks that generate the hydrocarbons in the Mackenzie Delta are reasonably inferred to extend into the Banks Island area.

The Banks Island segment of the margin covers approximately 27,000 square miles (70,000 Km<sup>2</sup>), approximately the same in size as the offshore Mackenzie Delta. The United States Geological Survey has assessed mean undiscovered, technically recoverable resource in their “Canada Passive Margin” Assessment Unit (including the Banks Island area) at 2.4 billion barrels of oil and 7.8 trillion cubic feet of gas (Houseknecht and Bird, 2008). The new geophysical data and interpretations bolster the promise of exploration in the Canadian Arctic Passive Margin and suggest that current assessments might not recognize the full potential of the area. We hope that this study catalyzes additional activity to evaluate the petroleum potential of the Banks Island margin.

## References

Dinkelman, M., Kumar, N., Helwig, J., Emmet, P, and Granath, J., 2008, Highlights of Petroleum and crustal framework of the Beaufort-Mackenzie Basin: Key results from BeaufortSPAN™ East Phases I and II surveys: Canadian Society of Exploration Geophysicists (CSEG) Recorder, September 2008, p. 22-25.

Houseknecht, David and Bird, Kenneth, 2008, Geology and petroleum potential of rifted margins of the Canada Basin (abstract): 33<sup>rd</sup> International Geological Congress, Oslo.

Helwig, J., Kumar, N., and Dinkelman, M. G., 2009, Canada’s Beaufort-Mackenzie Submarine Foldbelt: Fresh Look at a Frontier Giant Petroleum System with the BeaufortSPAN™ 40-Km PSDM Survey: CSPG CSEG CWLS Convention (this meeting).