Crustal and Petroleum Framework of the Beaufort- Mackenzie Basin as Interpreted from 9-km, long-offset ArcticSPANTM 2-D Seismic Data

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Summary

The BeaufortMackenzie basin in Arctic Canada is a very petroliferous province which is still in the early stages of exploration. Almost three decades of exploration have resulted in 48 significant oil and gas discoveries with total resources estimated to be 1.7 billion barrels (277 million cubic meters) of oil and 11.7 trillion cubic feet (332 billion cubic meters) of natural gas (Chen and others, 2007). Although no significant production exists as yet in the area, according to the USGS (2006), mean undiscovered resources in the basin *outside* of the deep-water area are estimated at 14.5 billion barrels of oil and natural-gas liquids (2.3 billion cubic meters and 86.6 trillion cubic feet of non-associated and associated gas respectively, or a total of 2.32 trillion cubic meters.

Despite all the previous work that has taken place in the area, significant questions regarding the basin architecture and petroleum system, especially in water depths greater than 200 meters, remain. Because these questions might be barricades to realizing the full potential of this basin, industry has shown interest in supporting basin "scale seismic" acquisition in the area. In response, ION Geophysical (GX Technology) acquired 3,534 km of 2-D long-offset seismic data in the area in late 2006 (Phase I). The program was 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 interpretation of these data has allowed us to regionally map the ocean-continent boundary, the top of the MOHO discontinuity as well as to identify the major stratigraphic sequences formed since the opening of the Canada Basin. Our SPAN data has also provided an excellent view of the sedimentary and crustal structure of the deep water as some of data extends into depths of 1,500 m or more. Building on the success of Phase I, another 5,561 km of data was acquired in 2007 with the same parameters (Phase II) (Figure 1).

Highlights of the interpretation include: 1) Offshore Mackenzie Delta system is underlain by a very thick wedge of sediments, almost 15 km thick in places; 2) Extending to water depths of almost 2 km, complex folds, faults and thrusts have formed as a result of interaction among compressive folding, wrenching, extension, inversion and gravity-induced loading, essentially all operating approximately at the same time within various segments of this region; 3) Our data has allowed us to map the ocean/continent boundary in the area; and 4) Besides "normal" oceanic and continental crusts, we have mapped an area underlain by "anomalous" crust, buried under the thickest sedimentary section in the basin.