

The Mackenzie Corridor, Northern Mainland, Canada: A Comprehensive Assessment of Conventional Petroleum Potential

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Summary

The Mackenzie Corridor, an area encompassing Proterozoic and Phanerozoic sedimentary successions along the proposed route of the Mackenzie Valley pipeline, constitutes a significant petroleum frontier province in Canada's north. The area under study comprises the northern extension of the prolific Western Canada Sedimentary Basin. The Geological Survey of Canada has recently completed its first comprehensive exploration play-based quantitative petroleum assessment analysis of the region, the results of which are the subject of this presentation.

Introduction

Canada's northern mainland basin is separable into two distinct geological terrane-types: the relatively undeformed platform succession underlying the plains area of Northwest Territories (the Interior Platform) and the deformed fold and thrust belt of the Cordillera in western Northwest Territories and eastern Yukon (the Northern Foreland Belt). A total of 62 oil and gas mature, immature and conceptual exploration plays have been defined and mapped in the study area, which extends from play areas straddling the provincial-territorial boundary at the 60th parallel, northward to, but not including, the Mackenzie Delta. Sufficient information was available to complete quantitative probabilistic resource analyses for the majority of plays.

Method

All plays were defined on the basis of reservoir or reservoirs in which oil and/or natural gas were expected to accumulate. All aspects of the hydrocarbon system affecting each play such as source, seal, maturation, trap-style, timing and exploration risks were also defined. Oil and gas play maps were then constructed to define the limits of preserved petroleum accumulations. Once the play maps were completed, compilation of all relevant petroleum data needed to perform volumetric probabilistic analyses for immature and conceptual plays and discovery process techniques for mature plays was undertaken. Probabilistic statistical analyses produced in-place play potential volumes, individual undiscovered pool size estimates, and the number of pools expected to occur in each play. Matching techniques were used to determine the ranks of discovered pool sizes to individual pool size volumes.

Example

The Cambrian clastic gas play in the Interior Platform geological province occurs in the Colville Hills area and is an established immature play with 7 gas discoveries: Tedji Lake, Tweed Lake, Bele, Nogha, West Nogha and Lac Maunoir in the Mount Clark Formation as well as a small gas discovery at Tweed Lake in the Mount Cap Formation. There are also numerous additional wells with gas flows from DSTs. A possible gas source may occur in underlying Proterozoic sediments. The Cambrian reservoir is also an oil play, since an oil-prone source rock has been identified in algal-rich shales in the Mount Cap Formation. The recent discovery of oil in Cambrian clastics at Lac Maunoir C-34 (drilled in 2004) confirms and establishes the oil play (Price and Enachescu, 2009). The gas play covers an area of close to 144,000 square kilometers (Figure 1). Seal is excellent due to overlying thick Saline River evaporite strata along with Mt. Cap shales, providing top and lateral seal. Trapping styles range from flower structures, and roll-over anticlines in grabens, to stratigraphic pinchouts and onlap traps against basement highs. Principal exploration risks include adequate reservoir, source, and communication with source at the prospect-level.

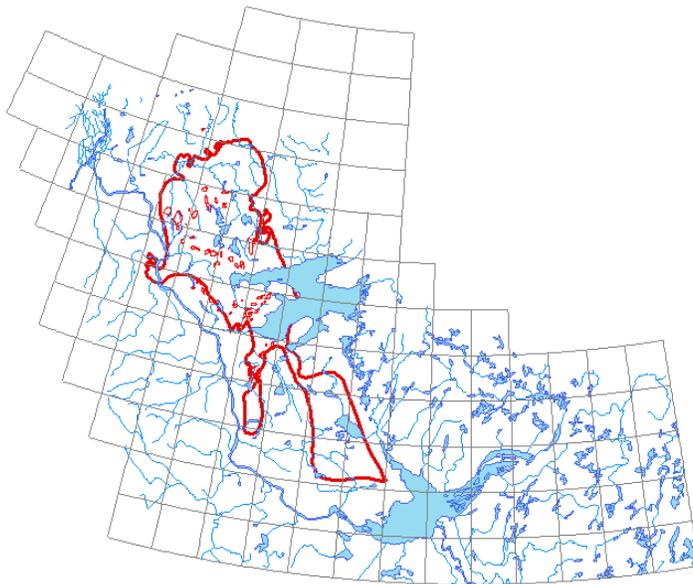


Figure 1: Play map of Cambrian clastic gas play, Interior Platform, Northwest Territories. Closures derived from seismic time-structure maps available in National Energy Board files (Lemieux et al., 2008).

Data such as closure areas, net pay thicknesses, porosities, water saturations, gas compositions, reservoir temperatures and pressures were compiled in order to determine a range of pool sizes in the play area. The probability distribution for the number of prospects was obtained by counting the number of closures on the Cambrian succession and using extrapolation techniques to take into account both areal apportionment and prospects that are too small or subtle to be interpreted because of seismic grid density or quality. Exploration risk of appropriate geological risk factors at a play or prospect-level was also determined.

After volumetric probabilistic statistical analysis, the gas potential for the play, the expected number of pools and the size of each of these pools were determined. The pool-size-by-rank plot (Figure 2) illustrates the range of sizes of the top ranked pools in the play.

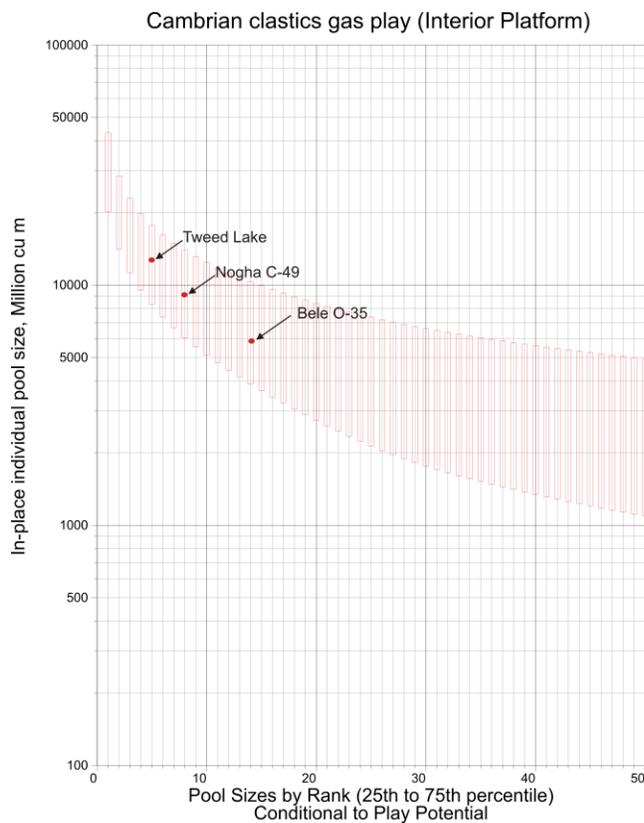


Figure 2: Pool-size-by-rank plot of the 50 largest predicted pools in the Cambrian clastic gas play in the Interior Platform, northern mainland, Canada.

The largest predicted pool size ranges from 20180 to 43190 million cubic metres in-place (P75 and P25, respectively). Median volume for this pool is 29683 million cubic metres. In this analysis, the Tweed Lake, Mount Clark discovery matches with the fifth-ranked pool. Similarly, Nogha C-49 matches most closely with the 8th largest pool and Bele O-35 with the 14th largest. According to this prediction, four larger undiscovered gas pools than the previously largest discovered accumulation (Tweed Lake) remains to be found in this play. The mean prediction for the total number of pools in the play is 139.

In-place play potential ranges from 96.3 to 1181.9 billion cubic metres in-place. Median play potential is predicted to be 306.6 billion cubic metres.

Conclusions

A comprehensive petroleum resource potential study has been completed in the Mackenzie Corridor region of Northwest Territories. Sufficient data was available in the majority of 62 defined plays established throughout the stratigraphic column from Proterozoic to Cretaceous age to predict their oil and gas endowment. This major study will provide important information for stakeholders involved in the proposed construction of the Mackenzie Valley natural gas pipeline with respect to petroleum potential adjacent or proximal to its proposed route.

Disclaimer

This study is a work in progress. Results presented in this abstract have not gone through a formal peer-review process and are subject to change prior to final publication.

References

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