Eagle Plain, Northern Yukon, Canada: An Update on Conventional Petroleum Resource Potential of the Basin

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Summary

A significant petroleum frontier province in Canada's north is the Eagle Plain Basin in northern Yukon. Recent work in the region conducted by the Geological Survey of Canada connected with the Geomapping for Energy and Minerals program contributed new data and interpretation, as well as identified new conceptual exploration petroleum plays in the Basin. These new play concepts prescribed a need to re-evaluate the petroleum potential of the basin, the results of which are the subject of this presentation.

Introduction

The intermontane compressional Eagle Plain Basin lies within the mountainous and deformed Northern Yukon Fold Complex geological province in the northern mainland of Canada. A total of 21 oil and gas immature and conceptual exploration plays have been defined and mapped in the study area. Sufficient information was available to complete quantitative probabilistic resource analyses for the majority of plays.

Method

All petroleum exploration plays were defined on the basis of reservoir within which oil and/or natural gas were expected to accumulate. Plays were further defined by petroleum trap-type including structural, stratigraphic, or a combination of the two. All aspects of the petroleum system affecting each play such as source, seal, thermal maturity, trap-style, and timing were considered in terms of adequacy of forming oil or gas accumulations. Oil and gas play fairway 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 was undertaken. These 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 Chance sandstone stratigraphic gas play occurs in southeastern Eagle Plain where the middle clastic member of the Hart River Formation subcrops beneath the sub-Mesozoic unconformity. Trap configurations include unconformity subcrops and updip facies changes. It is an established immature

play with three discoveries; the three gas pools occur in separate sandstone layers in the Chance oil and gas field. There are also additional wells outside the field exhibiting sustained gas flows from DSTs. The likely gas as well as oil source for the play occurs in the underlying organic-rich shale succession of the Ford Lake Formation. Average TOC and HI values are 1.6% and 88 mg HC/g TOC, respectively. The rock is considered to have fair to good gas and some oil potential (Link et al., 1989). The play covers an area of 250,000 hectares (Figure 1).
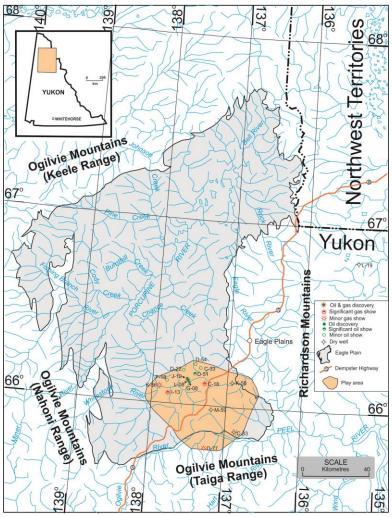

Figure 1: Chance sandstone stratigraphic gas play

Seal is efficient due to overlying thick shale successions of the Albian Whitestone River Formation. Lateral seal is also provided by well-cemented Hart River limestone members. Principal exploration risks include adequate reservoir and closure at the prospect-level.

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 in the play area 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 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.
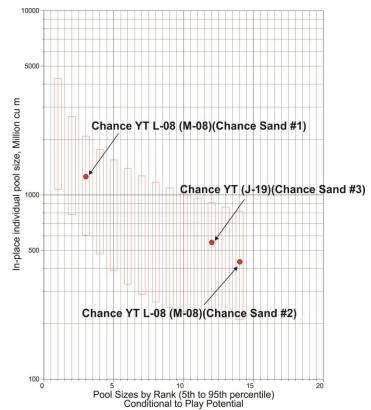

Figure 2: Pool-size-by-rank plot of the Chance sandstone stratigraphic gas play, Eagle Plain.

The largest predicted pool size ranges from 1072 to 4290 million cubic metres in-place (P95 and P5, respectively). Median volume for this pool is 2105 million cubic metres. In this analysis, the gas pool in sand #1 in the Chance YT L-08 well matches with the third-ranked pool. Similarly, Chance YT J-19 (Chance Sand #3) matches most closely with the 12th largest pool and Chance YT L-08 (Chance Sand #2) with the 14th largest. According to this prediction, two larger undiscovered gas pools than the largest discovered accumulation remain to be found in this play. The mean prediction for the total number of pools in the play is 14.

In-place play potential ranges from 3.9 to 24.6 billion cubic metres in-place. Mean play potential is predicted to be 12.6 billion cubic metres.

Conclusions

A comprehensive petroleum resource potential study has been completed in the Eagle Plain Basin of northern Yukon. Sufficient data was available in the majority of 21 defined plays established throughout the stratigraphic column from Ordovician to Cretaceous age to predict their oil and gas endowment. This major study will provide important information for stakeholders involved in evaluating land-use and moratorium issues, and petroleum industry companies in pursuing future exploration opportunities.

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

Link, C.M., Bustin, R.M., and Snowdon, L.R., 1989. Petroleum source potential and depositional setting of Phanerozoic strata in northern Yukon and northwestern District of Mackenzie; Bulletin of Canadian Petroleum Geology, v. 37, no. 3, p. 293-315.

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