

Petroleum Resource Potential of the Canada (Amerasian) Basin rift margin of the Beaufort-Mackenzie Basin, Arctic Canada

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Summary

The Canadian portion of the Canada (Amerasian) Basin rift margin of the eastern Beaufort-Mackenzie Basin extends from the Mackenzie Delta to offshore Banks Island and beyond (Figure 1). The southern onshore part of the rift margin is a proven hydrocarbon province, with seven significant discoveries, predominantly gas in structural traps of Mesozoic-Cenozoic clastic and Paleozoic carbonate reservoirs. A comprehensive study of marine reflection seismic data, including seismic inversion and spectral decomposition, and geological modeling and statistic inference based on machine learning techniques, provides insights into possible oil and gas occurrences and a petroleum system model for the offshore northern part of the rift margin. Combined with other geological constraints, our study suggests that the offshore rift margin becomes more oil-prone northward and may have significant petroleum resource potential. This paper illustrates the geological and geophysical evidence of potential petroleum occurrences, petroleum system model and oil and gas resource estimates in the offshore rift margin.

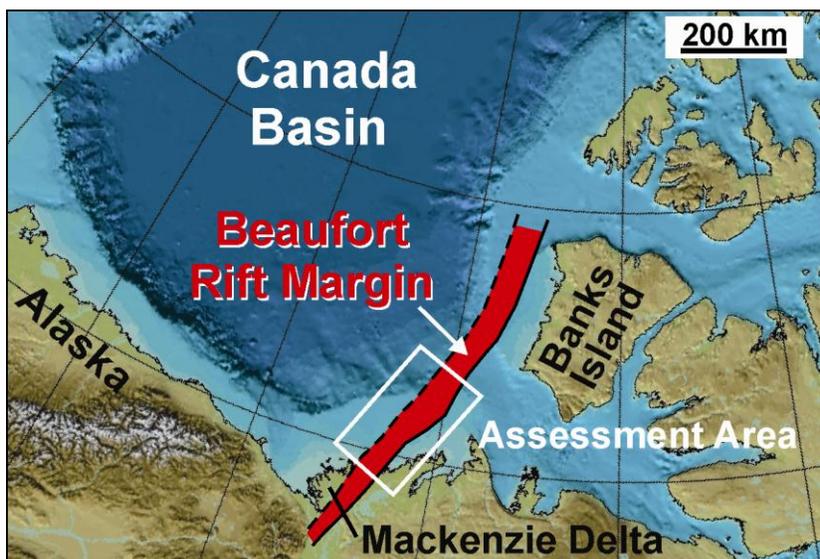


Figure 1. Location of Beaufort-Mackenzie rift margin and petroleum assessment study area.

Petroleum system model

Known petroleum source rocks in the region include gas-prone shales in the Jurassic-Lower Cretaceous syn-rift succession and marine oil-prone shales in the Upper Cretaceous post-rift succession. The Upper Cretaceous source rocks are immature or marginal mature in the southwestern part of the rift margin, but are predicted to have maturation levels within the oil generation window in the northeastern part of the margin due to increased burial depths. The Jurassic-Lower Cretaceous source rocks in the offshore rift margin would have reached maturation levels that vary from the gas-generation window to over-mature. Interpretation of marine reflection seismic data indicates various traps are present in the Tertiary to Paleozoic sedimentary succession. Prospective plays include a structure play of roll-over anticlines and fault-block structures in Cenozoic strata, a stratigraphic play with traps formed in Tertiary submarine fan and channel complexes, and a combined structure-stratigraphic play in the Mesozoic-Paleozoic succession. Seismic attributes from acoustic inversion and spectral decomposition show geophysical anomalies that are likely associated with presence of oil and gas accumulations. Calibrated with well logs from previous exploration wells with significant discoveries, the seismic attributes are integrated with geological data to construct a petroleum system model that provides the basis for better understanding the essential geological factors that control petroleum generation, migration and entrapment and form a framework for a new petroleum resource assessment in the offshore rift margin.

Resource potential

Three conventional petroleum plays are identified and quantitatively assessed for petroleum resource potential in the offshore rift margin. The preliminary results indicate a high oil and gas resource potential in the region. The estimated oil potential ranges from 2.9 to 7.9 billion barrels (Bbls) of recoverable oil with a mean of 5.2 Bbls. The estimated natural gas resource varies from 7.2 TCF to 18.8 TCF with a mean of 15.6 TCF recoverable. Of the three assessed plays, the Tertiary structure play has the highest oil and gas potential. In the offshore rift margin plays, the largest undiscovered fields contain estimated mean recoverable volumes of 750 Mbbbls oil and 2.4 Tcf natural gas. This study also indicates that prospective rift-margin plays extend northward to offshore Banks Island where the resource potential remains to be evaluated.