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Internal Report

Qikiqtait Proposed Protected Area Hydrocarbon Assessment

H.M. King, C.J. Lister, L.E Kung, K. Dewing

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Executive Summary

Natural Resources Canada (NRCan) has been tasked under the Marine Conservation Targets program with evaluating the hydrocarbon resource potential in areas identified as potential marine protection areas. As part of this initiative, Fisheries and Oceans Canada (DFO) requested that NRCan conduct a qualitative petroleum resource assessment for the proposed Qikiqtait Marine Protected Area in eastern Hudson Bay. This report provides a summary the results of the qualitative petroleum resource assessment for the Qikiqtait area, based on a larger study of eastern Hudson Bay published by NRCan's Geological Survey of Canada (Hanna et al., 2019).

The qualitative petroleum potential map (Figure 1) indicates very low to no potential for hydrocarbon deposits in the proposed Qikiqtait Marine Protected Area. This region is underlain by thick Proterozoic sedimentary, low-grade metamorphic, and igneous rocks that were deformed into folds during the Trans-Hudson Orogeny about 1.8 billion years ago. The very old age of the rocks, and the high temperatures they would have encountered during the Trans-Hudson Orogeny, make the potential for preserved oil or gas in this region very low. The proposed protected area overlaps slightly with Paleozoic rocks of the Hudson Platform on its western edge. Paleozoic strata in this area are considered too thin to have any hydrocarbon potential.

Mineral resources identified onshore, that may extend offshore include: limestone, lead, zinc, nickel, copper, iron, fluorite, barite, silver, gold, coal, chromite, lithium, granite carving stone, and micro-diamonds. Viability of offshore mineral resources requires that a regulatory framework is established allowing offshore mineral mining in Canada.

INTRODUCTION

An assessment of the hydrocarbon potential of eastern Hudson Bay was published in Geological Survey of Canada Open File 8344 (Hanna et al., 2019). That publication reviewed and integrated data from previous resource assessments, scientific literature, and geoscience databases to interpret and map petroleum system elements and regional petroleum plays. A qualitative assessment of the petroleum potential in the region was produced by mapping the probability of each petroleum system element (source, reservoir, trap, seal), and combining the results into a colour-shaded map indicating the hydrocarbon potential from high (green) to low (red). The assessment methodology is from Lister et al. (2018).

GEOLOGIC SETTING

The proposed Qikiqtait Marine Protected Area is underlain by the Hudson Platform and Belcher geological basins (Figure 2).

The Belcher Basin contains Proterozoic rocks unconformably overlying Archean igneous and metamorphic basement rocks. It is the oldest sedimentary basin in Hudson Bay, containing several thousand metres of carbonate, clastic, and igneous rocks. The Belcher Basin is preserved as part of an arcuate continent-continent plate tectonic collision zone created during the Paleo-Proterozoic Trans-Hudson mountain-building event that stretched from Greenland to the northern United States about 1.8 billion years ago (similar in scale to the modern Himalayan Orogeny). The sedimentary deposits of the Belcher Basin underwent episodes of burial and structural deformation resulting in the tight anticline-syncline pairs that give the Belcher Islands their distinctive shape. The rocks exposed at surface were once deeply buried, but have been exhumed by extensive erosion in the intervening 1.8 billion years.

Two conceptual hydrocarbon plays in the Belcher Basin are where organic-rich black shale of the lower Omarolluk Formation was heated and charged reservoirs in the overlying upper Omarolluk and Loaf formations, either at the crests of anticlines or within an overall dipping homocline. However, these rocks were buried 1.8 billion years ago and any petroleum that might have been generated likely escaped during further tectonic movement and erosion of anticlines. For comparison, the oldest known oil is about 1.3-1.4 billion years old, and the oldest commercial oil production is from rocks younger than 1 billion year (Craig et al., 2013).

Hudson Platform in eastern Hudson Bay contains limestone deposited during Ordovician time (~460-440 million years ago). These strata were deposited in shallow water settings and are dominated by lime mudstone, but may locally contain small reefs. An organic-rich black shale is known from Southampton Island, but geological mapping indicates that it is eroded within the Qikiqtait Proposed Protected Area. The Hudson Platform is about 1.3 kilometres thick in the centre of Hudson Bay, but is likely no more than a few hundred metres thick within the proposed Qikiqtait Marine Protected Area. Modelling of possible hydrocarbon generation in the Hudson Platform (Appendix C of Hanna et al., 2018) indicates that the limit of hydrocarbon generation lies to the northwest of the proposed protected area.

Conceptual hydrocarbon plays in the marginal part of the Hudson Platform are limited to small fault offsets and associated hydrothermal dolomite. The lack of a known source rock in the area, and the lack of sufficient burial to have generated hydrocarbons makes the presence of hydrocarbon deposits within rocks of the Hudson Platform on the western side of the Qikiqtait Proposed Protected Area unlikely.

The only indication of hydrocarbons in the region are dark spots on RADARSAT images of the sea surface (Figure 2). Dark spots may result from oil slicks, but can also result from other factors such as algae or seaweed. Dark spots have been identified near the boundary between the Belcher Basin and the Hudson Platform (Decker et al., 2013). Replication of these indirectly identified dark features could be attempted from multiple RADARSAT passes. This would give a better indication of whether they are repeating oil slicks or transient biological features.

MINERAL POTENTIAL

Mineral resources were identified through scientific papers, industry press releases, and interpretation of geologic maps. The Belcher Islands contain a marble quarry that has supplied over 50 tonnes of quality stone to local carvers (Nunavut Mineral Exploration, Mining and Geoscience publication, 2016) and active iron exploration leases (Haig Inlet Iron Project) that covers over 230 km² of the Belcher Islands. The Haig Inlet Iron Project has an indicated resource of 230 million tonnes of iron ore (at a cut off grade of 35.17%, Canadian Ore Bodies, 2017). There is low potential for geothermal energy development in the offshore area near the Belcher Islands (Appendix B, Hanna et al., 2019).

CONCLUSIONS

The hydrocarbon potential of the Qikiqtait Proposed Protected Area is very low due to the extremely old age of the sedimentary rocks in the region.

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FIGURES

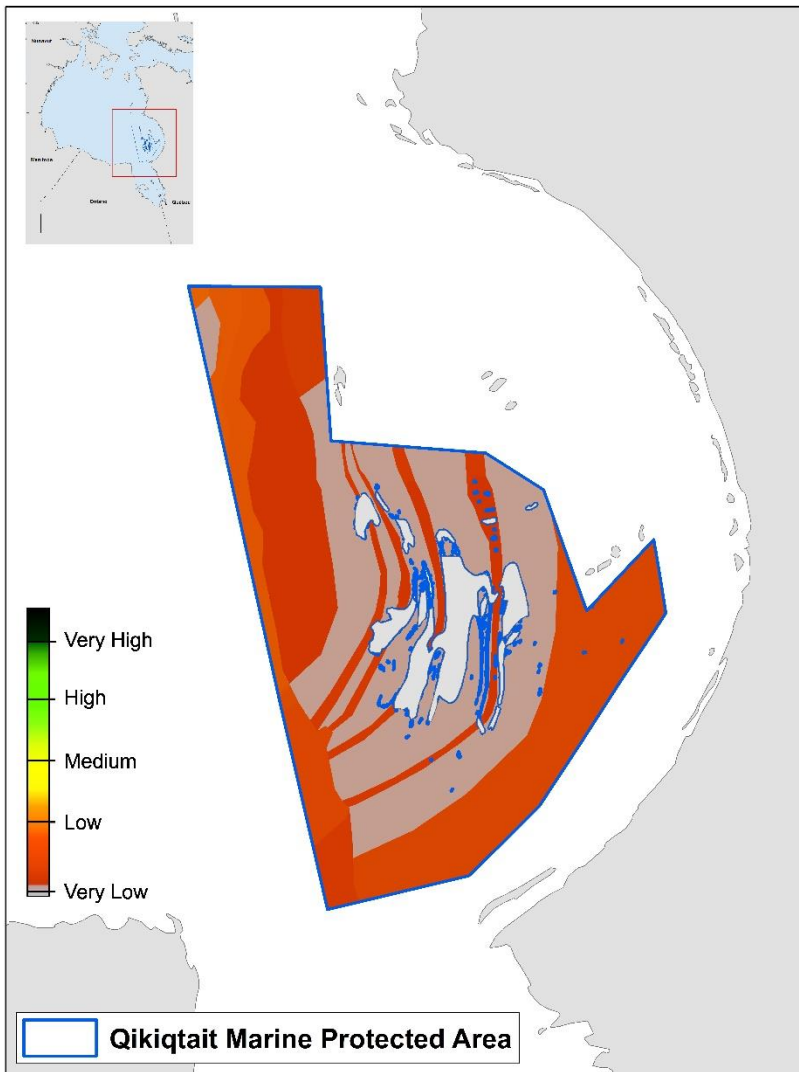


Figure 1. Qualitative map showing the hydrocarbon potential in the Qikiqtait Marine Protected Area. Grey is very low potential, and red is very low to low potential.

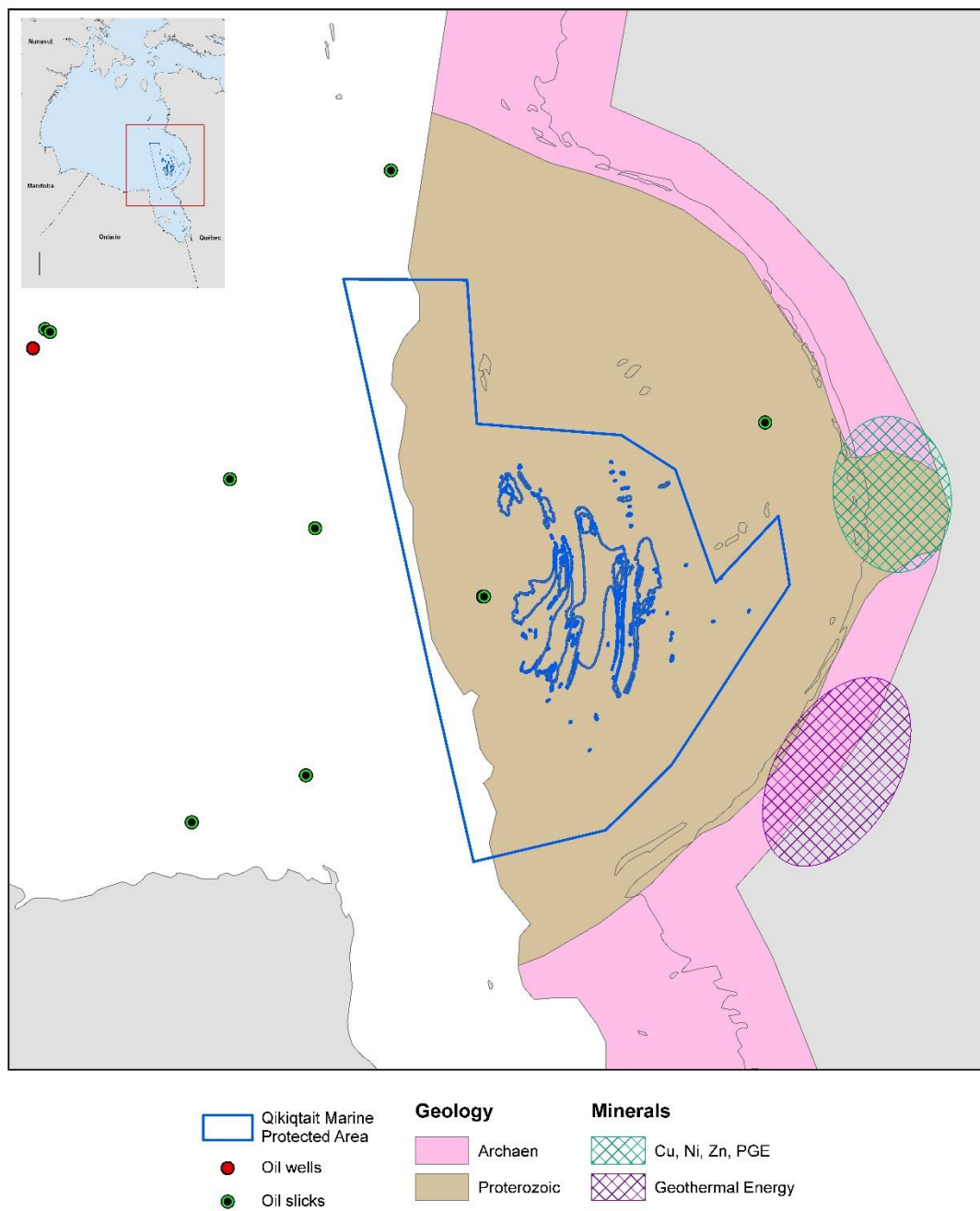


Figure 2. The Qikiqtait Marine Protected Area is primarily underlain by Proterozoic strata. Paleozoic strata (white) are present at the very western side of the marine protected area. Paleozoic strata are very thin at the edge of the basin and have very low hydrocarbon potential. Points marked “oil slicks” are interpreted from Radarsat images where ripples are suppressed (Decker et al., 2013). While they may be oil slicks, suppressed ripples can have other causes such as algae in the water.