

# **A Qualitative Evaluation of Oil and Gas Potential of the Deh Cho Territory**

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## **ABSTRACT**

The C.S. Lord Northern Geoscience Centre's petroleum geoscience group has undertaken a petroleum potential evaluation of the Deh Cho territory for the Deh Cho Land Use Planning Committee (DCLUPC). At the time of this writing, a draft report had been produced that presented a qualitative evaluation (in relative terms) of petroleum potential. The draft report includes an overview of geology, stratigraphy, known hydrocarbon occurrences, descriptions of established and conceptual plays in the Deh Cho territory, as well as the evaluation methodology and a discussion of results. The report draws heavily on previous studies of hydrocarbon potential (National Energy Board of Canada, 1996; Reinson et al., 1993; Canadian Gas Potential Committee, 2001); general petroleum geology overviews and pool studies (e.g., Morrell, 1995; Meding, 1994); and regional geological works (e.g., MacLean and Morrow, 2001; Meijer Drees, 1993; Morrow et al., 2002). Report appendices include exploration well and production information, along with educational materials on petroleum geology and the industry in general. An *ArcView* project and accompanying GIS-ready data files of the potential mapping results were provided to the DCLUPC for use in their land use planning exercises. The report will be made available to the public in the near future through the C.S. Lord Northern Geoscience Centre as an NWT Open File.

The Deh Cho territory in southwestern NWT includes parts of two major geological provinces: the Cordillera and the Interior Platform. A foundation of Precambrian crystalline and sedimentary rocks underlies both the Interior Platform and Cordillera, although these "basement" rocks are also involved in Cordilleran deformation. The Cordillera encompasses the Mackenzie Mountains and related components; dominantly Paleozoic and Mesozoic rocks that were uplifted, faulted, folded and generally deformed during the Laramide orogeny (Late Cretaceous to early Tertiary). The Interior Platform comprises gently dipping, largely undeformed sedimentary rocks of Paleozoic and Mesozoic age. The pre-Cretaceous sedimentary rocks of both provinces were deposited in marine conditions on the margin of the ancestral North American continent. The Cretaceous sedimentary rocks were largely sourced from erosion of the newly uplifted mountains, and deposited under both marine and non-marine conditions. A mantle of unconsolidated glacial deposits overlies much of the Interior Platform bedrock, and discontinuous glacial deposits occur through the Cordillera.

The Cordillera and Interior Platform have been further subdivided into a number of domains or exploration areas. The exploration areas within Deh Cho territory

are: Selwyn Fold Belt, Mackenzie Mountains, Mackenzie Plain, Franklin Mountains, Great Bear Plain, Great Slave Plain, and Liard Plateau.

At the time of writing, 419 hydrocarbon wells had been drilled in Deh Cho territory. Most of these were new-field wildcat wells; that is, their objective was to discover a new hydrocarbon field. Of these wells, 127 hydrocarbon occurrences have been documented, amounting to some 30% of all the wells. These occurrences ranged from minor oil streaks or gas bubbles observed in drilling mud to economically productive wells. Currently production in Deh Cho territory consists of natural gas from Fort Liard region and gas with oil from the Cameron Hills. Several other significant discoveries have been made that have not been developed.

In the Deh Cho territory, the Middle and Upper Devonian shales are prolific source rocks for gas in the west and oil with gas in the east. Potential reservoir rocks in the subsurface include sandstones (especially Cretaceous and Mississippian), dolostones (particularly Devonian) and limestones. A wide variety of stratigraphic and structural traps can occur in the subsurface of Deh Cho territory, and are mainly related to basement features, stratigraphic facies and subcrop limits, and Laramide folds.

This study of petroleum potential focused on the definition of hydrocarbon plays, and determining their extent. Twenty plays were identified in Deh Cho territory; 9 established (with known discoveries) and 11 conceptual (geologically possible, some with associated hydrocarbon occurrences). Some of the established plays have discoveries only south of 60°N latitude. Established plays generally have more information associated with them, having been tested by more wells. The established plays contribute to a higher ranking due to their association with known hydrocarbon occurrences and the attendant increased amount of information. A summary polygon map of relative petroleum potential was created by simply overlaying play areas and summing the number of established and conceptual plays in a given area (*Fig. 1*). Rankings of low to very high potential were made according to play number and type criteria, as set out in *Table 1*.

The area with the highest potential for hydrocarbons lies across the south and includes the Liard Plateau and the Great Slave Plain. This is not surprising, as the southern Great Slave Plain falls within the prolific Western Canadian Sedimentary Basin. In the Great Slave Plain, significant plays are associated with the Middle Devonian carbonate barrier complex, and northeast trending reactivated basement faults. There are additional plays throughout the Paleozoic and Mesozoic successions. In the Liard Plateau and adjacent Great Slave Plain, Laramide structures are important in forming structural traps in a setting analogous to the Foothills plays of northeastern British Columbia and Alberta. The northern part of the Great Slave Plain has less potential as the Middle Devonian carbonate barrier complex gives way to a shale basin, but there are opportunities in Lower Paleozoic rocks here (e.g., Siluro-Ordovician and Lower

Devonian platform carbonates). The Great Bear and Mackenzie plains have similar geology to Great Slave Plain, and have much of the same potential, but are even less explored. The mountain areas (Mackenzie Mountains, Franklin Mountains, and Selwyn Fold Belt) have the lowest relative potential for containing hydrocarbons.

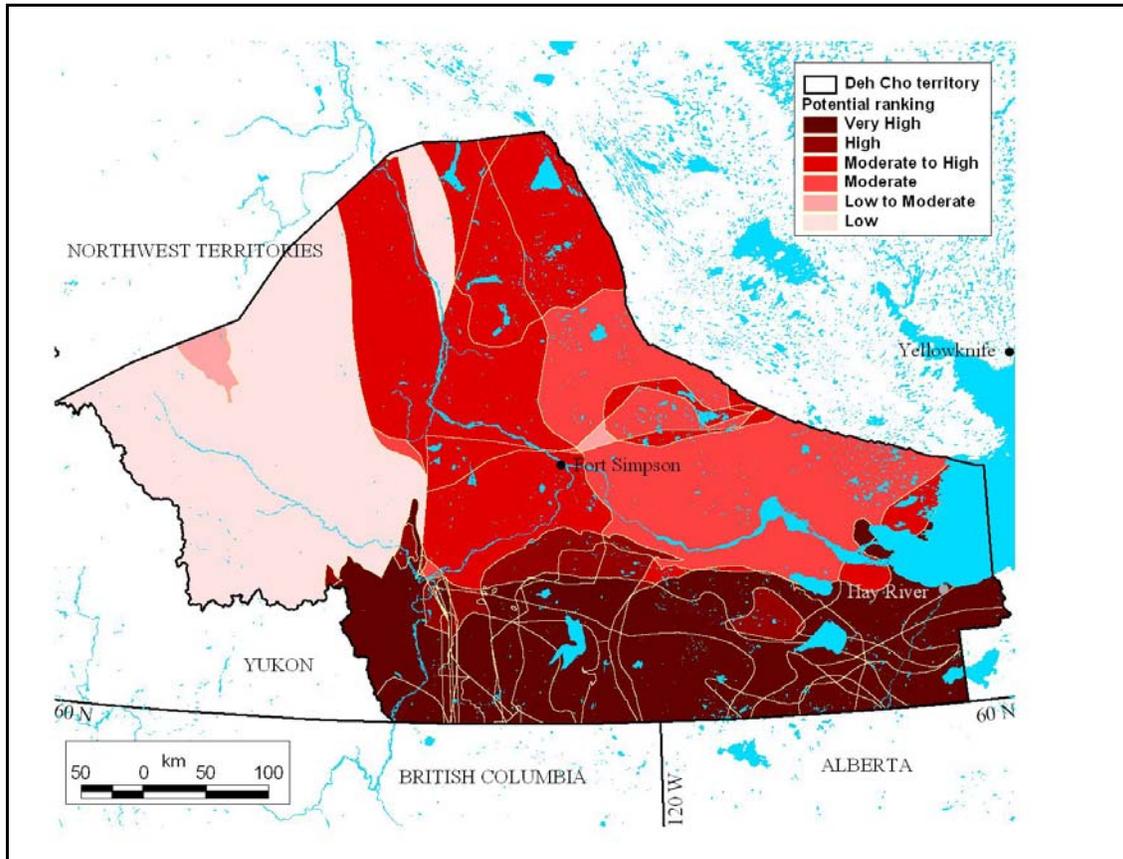


Fig. 1. Draft of the composite hydrocarbon potential map of the Deh Cho territory.

POTENTIAL RANKING	CONFIDENCE RANKING			
	<i>Significant hydrocarbon accumulations are known</i>	<i>Known hydrocarbon occurrences</i>	<i>Indications of hydrocarbons may or may not be known.</i>	
	<b>Rank 1:</b> Significant reliable information	<b>Rank 2:</b> Moderate amount of information	<b>Rank 3:</b> Some information	<b>Rank 4:</b> Very little and/or unreliable information
<b>Rank A - Very High:</b> Geological environment is favourable for oil and/or gas. At least two plays are established, with closures identified and mapped.	A1	A2	A3	n/a
<b>Rank B - High:</b> Geological environment is favourable for oil and/or gas. Multiple plays (at least 3) with closures identified and mapped. At least one play is established.	B1	B2	B3	B4
<b>Rank C - Moderate to High:</b> Geological environment is favourable for oil and/or gas. At least 3 plays. Closures identified and mapped for at least one play.	C1	C2	C3	C4
<b>Rank D - Moderate:</b> Geological environment is favourable for oil and/or gas. At least 2 plays. High probability of blind structural / stratigraphic closures.	D1	D2	D3	D4
<b>Rank E - Low to Moderate:</b> Geological environment is favourable for oil and/or gas. At least one conceptual play. High probability of blind structural / stratigraphic closures.	E1	E2	E3	E4
<b>Rank F - Low:</b> Geological environment is favourable for gas. Significant probability of blind structural / stratigraphic closures.	F1	F2	F3	F4
<b>Rank G - Very Low:</b> Unfavourable geological conditions.	G1	G2	G3	n/a
<b>Rank H - Not Assessed:</b>	n/a	n/a	H3	H4

Table 1. Hydrocarbon potential evaluation system used in this study. Individual polygon areas are given a ranking based on their placement in the matrix of potential vs. confidence criteria. Rankings unlikely to be used are designated n/a.

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