

Mackenzie – Liard Valley Hydrocarbon Basins, NWT

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ABSTRACT

The Mackenzie - Liard area of the mainland Northwest Territories (NWT) is underlain by a series of superimposed sedimentary basins formed over the last billion years. Many of these basins have established hydrocarbon systems in which stacked reservoir rocks, trap seals and source rocks have been identified. The area includes the southern NWT where oil and gas pipelines are presently operating. It also includes the route of the gas pipeline from the Mackenzie Delta south to Alberta that is in the planning stages. The valleys of the Mackenzie and Liard Rivers run the length of this vast area.

A six to ten kilometres thick section of unmetamorphosed sedimentary rocks forms a complex, locally folded and thrust-faulted, Proterozoic Basin. Analogous Proterozoic basins in eastern Siberia and Australia may provide hints at undiscovered NWT hydrocarbon potential (Taylor, 1992). The Proterozoic rocks are virtually unknown in the NWT subsurface. Only a few wells have touched the top of the Proterozoic section below the sub-Cambrian angular unconformity. A useful regional map showing the seismic time structure on the sub-Cambrian angular unconformity surface and the Proterozoic subcrop has been released as an open file by MacLean and Cook (1997).

The overlying Cambrian is an evaporite basin with thick halite deposits. Natural gas has flowed on drill stem tests from discovery wells in the Cambrian basal Mount Clark Sandstone reservoir at the Colville Hills. The Northern Oil and Gas Directorate (NOGD) (1995) attributes gas reserves of 400 BCF to the discovery wells at Colville. The gas prospective Mount Clark Formation can be traced over a large area north and south of Great Bear Lake.

The overlying Ordovician - Silurian section has excellent source and reservoir rocks. Oil was recovered from the Franklin Mountain dolomite at the East MacKay B-45 well west of Great Bear Lake. Oil is trapped in the Franklin Mountain against the pre-Cretaceous angular unconformity on the western flank of the Keele Arch. The oil recovered on drill stem test was 22.4° API gravity (0.9194 g/ml). Geochemical analyses (Earnshaw and Grant, 1992) indicate that the oil originates from shale source rocks in the overlying Cretaceous. To date no hydrocarbons have been discovered in the younger Mount Kindle Formation. It covers a large area in the NWT mainland subbasin and few wells penetrate it.

Knowledge of the Devonian section benefits from active exploration dating in the NWT from the Devonian Kee Scarp reef Oil discovery at Norman Wells in 1921, and rejuvenated in 1947 by the oil discovery in Devonian reef rock at Leduc in

Central Alberta. The Norman Wells oil field has estimated ultimate recoverable reserves of 235 million barrels (NOGD, 1995). Oil production in 2001 was close to 9 million barrels. Production is expected to continue until about 2020. The Pointed Mountain Middle Devonian Nahanni gas field recovered 315 billion cubic feet of gas from 1972 before production was suspended in 2001. 12 other Devonian gas pools with reserves totaling 600-700 BCF have been discovered in the southern NWT. Of these, the Liard gas field has been on production since 2001 and the Cameron Hills gas field went on production March 29, 2002. Production of Cameron Hills Devonian oil is scheduled for 2003.

A number of Mississippian and younger rocks are hydrocarbon producers or are prospective reservoirs. Recently gas production is taken from the Mattson and Fantasque Formations at Fort Liard. Gas has been discovered in the fluvial facies of the Basal Cretaceous Chinkeh at Arrowhead in the Great Slave Plain.

The Mackenzie-Liard area, while effectively a northern continuation of the Western Canada Sedimentary Basin, it is a different hydrocarbon province in which early hydrocarbon generation requires early trapping and/or remigration into later traps. An existing pipeline infrastructure—the Duke Gas, Shiha Gas, and the Enbridge Oil pipelines—means that, in several areas of the Mackenzie Liard, exploration is proceeding in advance of large gas pipeline projects planned to run the length of the Mackenzie corridor.

References

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