The Plateau Fault as a Hydrocarbon Play: Likely or Not?

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Summary

The Plateau Fault was proposed in the early 1980s as a possible, large-scale structural trap for natural gas in the Mackenzie Mountains (Cecile et al., 1982). The viability of the Plateau Fault as a conceptual play hinges crucially on: whether the Plateau Fault is a low-angle thrust fault; the availability of appropriate source and reservoir rocks; and a thermal history conducive to production and preservation of hydrocarbons. If all these factors can be shown to converge favourably, then the Plateau Fault could constitute a significant conceptual play.

Collaboration between the Geological Survey of Canada (Mackenzie Corridor Project) and Northwest Territories Geoscience Office (Sekwi Mountain Project) has led to a new study of the Plateau Fault and its hydrocarbon potential. This has involved field work, laboratory analysis, and compilation of archival data. Attention has focused particularly on Wrigley Lake (NTS 95M) map area, where geological map patterns suggest the Plateau Fault has developed the greatest structural overlap over its footwall. Salient results of this research touch on source rock potential, thermal maturity, reservoir units, and structural relationships.

No likely source rocks have been identified below the Canol Formation (Devonian). Proterozoic units and units of the lower Paleozoic Mackenzie Platform succession yield TOC values that uniformly are less than 2% and commonly are much lower. Further west, shale intervals in the Selwyn Basin succession (Road River Group) yield slightly higher TOC values, but are overmature (see below). The Canol Formation and overlying Imperial Formation, both of which are shale-dominated units, yield higher TOC values and may have remaining source potential; they currently are being studied by W. Zantvoort of the Northwest Territories Geoscience Office.

The most reliable and extensive source of thermal-maturity data for the Mackenzie Mountains is colour-alteration data from conodonts and palynomorphs. Compilation of such data from GSC Paleontological Reports indicates that Silurian to Mississippian strata east of the continental divide and north of latitude 63º N—including those in Wrigley Lake map area—are overmature with respect to oil production but may have potential to generate and preserve dry gas. Rocks further west (i.e., in Selwyn Basin) and south are overmature with respect to oil and gas.

A number of units are potential reservoirs, notably porous carbonate units of the Mackenzie Platform succession. Several such units (including Arnica and Hume formations, as well as zones of Manetoe Facies dolomitization) are stained by solid hydrocarbons and presumably were reservoirs during their history. However, the Canol Formation is separated from most of the Mackenzie Platform succession by the shale-rich Headless (lower Hume) Formation, which is expected to act as a seal against downward migration of hydrocarbons. The most likely reservoirs thus are porous intervals within carbonates of the Nahanni (upper Hume) Formation (i.e., the unit immediately beneath the Canol Formation) or sandstone beds within the Imperial Formation.

Based on these data, the most promising scenario for a Plateau Fault structural trap would be one in which the Nahanni, Canol, and Imperial formations are preserved in significant volumes beneath a very shallowly dipping thrust sheet. Detailed mapping within Wrigley Lake map area suggests that the Plateau Fault may be a low-angle thrust. However, structural relationships at the leading edge of the thrust constrain the fault geometry such that even a low-angle thrust can be expected to cut downsection to the southwest through much of the Mackenzie Platform succession—to the level of Silurian or even Cambrian strata—within about 5 km of the leading edge. Preservation of significant volumes of Nahanni, Canol, or Imperial formations beneath the fault is thus unlikely.

In summary, structural data support the view that the Plateau Fault probably is a low-angle thrust (in Wrigley Lake map area, at least). Those data also point to a fault geometry that, when combined with the absence of known sub-Canol source rocks, effectively rules out a Plateau Fault hydrocarbon play.

Reference

Cecile, M.P., Cook, D.G., and Snowdon, L.R., 1982, Plateau Overthrust and its hydrocarbon potential, Mackenzie Mountains, Northwest Territories. Current Research, Part A, Geological Survey of Canada, Paper **82-1A**, 89-94.