Recent Work on the Hydrocarbon Potential of the Plateau Fault, Mackenzie Mountains, Northwest Territories

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Background

As part of the Geological Survey of Canada's Secure Canadian Energy Supply Program, petroleum resource-related studies are being conducted on the Plateau Fault, Mackenzie Mountains (Northwest Territories, Canada). In general, the Mackenzie Mountains have been viewed as a poor prospect for hydrocarbon exploration due to breaching of structural traps and presumed over-maturity with regard to hydrocarbon generation. The Plateau Fault may provide a notable exception to these generally poor prospects. This large-scale structure, originally mapped by Gabrielse et al. (1973), was suggested as a potential, large-scale hydrocarbon trap by Cecile et al. (1982).

The hydrocarbon potential of the Plateau Fault depends critically upon the fault's structural style, which is controversial. Cecile and Cook (1981; also Cecile et al., 1982) interpreted it as a shallow-dipping thrust sheet with a prospectively large area of Paleozoic reservoir rocks trapped beneath. By contrast, Gordey (1981) considered it to be a steep reverse fault with little or no potential for trapping Paleozoic reservoirs in the footwall.

Field Program

During 2006, GSC personnel conducted a short season of field studies around the Plateau Fault in Wrigley Lake map area (NTS 95M). Detailed mapping was undertaken in central Wrigley Lake map area, west of Hayhook Lake, where exposures of the fault's leading edge permitted examination of leading-edge complications. This study area is located midway between the published cross-sections of Cecile and Cook (1981) and Gordey (1981). Additional localities were visited to aid in characterization of map units and to collect samples for organic geochemistry (maximum burial temperatures and source-rock potential).

Results to Date

Each of the published interpretations of the structural style of the Plateau Fault makes predictions with respect to field relationships and map pattern. For example, a steep fault (Gordey, 1981) cutting obliquely up through strata will preserve an oblique angle between strata in the hangingwall and the fault plane. It should also show some variability in the map units preserved in the immediate hangingwall, as a function of erosion level (mountain peaks versus valleys). Conversely, the long hangingwall flat of Cecile and Cook (1981) requires a consistent level of detachment within one map unit regardless of erosion level, as well as evidence of the fault plane following parallel to strata in the hangingwall. Field relationships along the leading edge of the Plateau Fault in central Wrigley Lake map area showed a consistent level of detachment within the “gypsum formation” of the Proterozoic Little Dal Group. The trace of the fault surface also parallels measured bedding orientations in hangingwall strata. These features suggest development of a shallow-dipping thrust fault that is consistent with the Cecile and Cook (1981) interpretation. Structural complications along the leading edge also reveal shallow-dipping faults, at various scales, that may be indicative of the overall structural style of the Plateau Fault. Map compilation and cross-section construction are underway to test the geometry of the fault and estimate the magnitude of displacement over Paleozoic strata in the footwall.

Data from organic geochemistry suggest that the Canol and Imperial formations are the most promising source rocks (W. Zantvoort, personal communication, 2007); these may be the only map units with significant total organic carbon values in the region. Data from organic geochemistry and palynomorph thermal alteration indices indicate Tmax values well within the dry gas zone. Regional stratigraphic studies point to potential reservoir rocks in Cambrian sandstone or Silurian to Devonian carbonates. These units are known to occur in the footwall of the Plateau Fault, but their exact distribution is still being refined.

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