Athabasca Oil Sands: Mega-trap Geometry and Timing

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Summary

The location and extent of the Athabasca oil sands have been known from direct observation since before even the first descriptions by the Geological Survey of Canada (GSC 1875, 1882). However, the geometry and timing of development of the hydrocarbon trap have remained elusive because the original trap has been destroyed by Laramide flexural loading of the West Canadian foreland basin during the Late Cretaceous and Paleocene. Therefore only a very minor area of bitumen lies within structural closure present-day; the original trap extent is preserved because the oil was biodegraded to immobile bitumen before the trap was destroyed.

Using a combination of well and outcrop data, it is possible to reconstruct the late Cretaceous overburden horizons beyond the limit of present-day erosion. Sequential restoration of the extrapolated horizons reveals the existence of a mega-trap at the top of the Wabiskaw/McMurray reservoir in the Athabasca area during the Late Cretaceous. The mega-trap is a major 4-way anticline with dimensions 300 km by 100 km and maximum amplitude of 80 m. The south-eastern margin of the trap shows good conformance to the bitumen edge over a distance of 150 km. However, the north-eastern area of the Athabasca oil sands is located in a more elevated position above the spill point of the structural closure. A stratigraphic (onlap) trap onto the Canadian Shield is inferred to explain this arrangement; this is supported by the presence of bitumen outliers preserved within basement rocks further to the north-east. The trap restoration has implications for the timing of hydrocarbon charge and the distribution of top lean zones (paleo gas caps).

References

Geological Survey of Canada, 1875. Map showing the route travelled by Prof. John Macoun M.A. from the forks of the Peace and Smoky Rivers to Carlton House Saskatchewan River. GSC Open File 0112.

Geological Survey of Canada, 1882. Map of part of the Athabasca River to illustrate Dr Bell's exploration. GSC Open File 0173.