

The Devonian ‘Caprock’ succession beneath the Oil Sands in northeastern Alberta; Core data from shallow sub-horizontal boreholes

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The Muskeg River Mine is operated by Shell and part of the Athabasca Oil Sands Project, a joint venture between Shell Canada (60%), Chevron Canada Limited (20%) and Marathon Oil Sands LP (20%). The Muskeg River Mine sits on Shell’s Lease 13 (Twp 95, Rges 9-10W4), about 75 kilometres north of Fort McMurray.

In October, 2010 Shell’s mining operations were impacted by an inflow of saline water through a hydraulic conduit at the base of mining operations in the south east corner of the Muskeg River Mine (MRM), in an area referred to as Cell 2A. As operations excavated down to the unconformity surface (at an elevation of 188 m ASL) additional water inflow was observed at a rate higher than that normally expected from the Basal McMurray aquifer.

The composition of the water indicated that the water was flowing from the Devonian Prairie aquifer approximately 100 metres beneath the bottom of the mine pit with total dissolved solids (TDS) being measured at 38,000 mg/l (saline).

In response to this event, Shell initiated a deep Devonian drilling program (Devonian Geoscience Program, DGP) commencing in December 2010 over oil sand Lease 13 to proactively identify and characterize possible hydraulic conduits in the Middle Devonian strata beneath the bitumen-bearing McMurray Formation. Initial results were reported at an earlier core conference (Mahood et al., 2012)

The Devonian stratigraphic succession in this portion of northeast Alberta comprises approximately 300 metres of sediments belonging primarily to the Elk Point Group.

This exhibit will focus on a drilling program initiated in early 2013 to attempt to identify the vertical conduit linking the deeper Devonian Prairie aquifer to the mine floor in the vicinity of Cell 2A. In the vicinity of the inflow event, a series of technically challenging, shallow sub-horizontal boreholes were drilled from the edge of Cell 2A extending out beneath to the area of the inflow. These wells were drilled at 26 degrees from the horizontal and were completely cored, packer tested and logged.

Three sub-horizontal boreholes were then completely cored, tested and logged to TD. The boreholes penetrated the Waterways, Slave Point and Watt Mountain formations, terminating at or close to the top of the Prairie Evaporite Formation. In all, a total of over 500 metres of core was recovered from these wellbores, portions of which will constitute this core display.

Acknowledgements

Drilling results along with information derived from Shell’s Devonian Geoscience Program (DGP), will be used to proactively identify and mitigate against similar events in the exploitation of this oil sands resource, and is supporting ongoing work of the Devonian Aquifer Work Group within Canada’s Oil Sands Innovation Alliance (COSIA).

References

Mahood, R., Verhoef, M., and Stoakes, F.A., 2012. Paleozoic stratigraphic framework beneath the Muskeg River Mine (Twp 95, Rge 9-10W4): Controls and constraints on present day hydrogeology. Core display and abstract at the Geoconvention 2012: Vision, CSPG-CSEG-CWLS Convention, Core Conference. ERCB Core Research Centre, Calgary Alberta May 2012, p. 65-72.