



The Hudson Bay and Foxe basins project is in its fourth and final year. It is part of the Geological Survey of Canada (GSC) Geomapping for Energy and Minerals (GEM) program. In Manitoba, the Hudson Bay Basin is represented by the Paleozoic carbonate succession of the Hudson Bay Lowland (HBL) in the northeastern corner of the province. (Figure 1)



O<sub>BCR</sub> Bad Cache Rapids Gp. Attawapiskat Fm. TR Stooping River Fm. Kennco No. 2 Stratigraphic test hole or mineral exploration (Ru Kenogami River Fm. (upper) SER Ekwan River Fm. borehole with available S<sub>SR</sub> Severn River Fm. core in Winnipeg

Figure 1: Hudson Bay Lowland in northeastern Manitoba, showing the location of cores available; insert is the project areas for the GEM Hudson Bay and Foxe Basins Project.



Overall, the RockEval 6<sup>™</sup> analyses resulted in the recognition of a fair number of samples having moderate to good source rock potential, but most of them are considered thermally immature (Figure 4, 5 and 6). One sample (106-11-HBL-WB-7) from the Red Head Rapids Formation has yielded 8.44 wt.% total organic carbon (TOC; sample shown in Figure 5c and outlined in Figure 6a), thus is considered a true oil shale, and confirms the extension of previously found oil shale units in Nunavut (Figure 7; Zhang, 2008) and northern Ontario (Figure 8; Armstrong and Lavoie, 2010). Evidence of oil generation and migration are seen in the core in the form of (1) live oil shows from shale samples submersed in acetone (Figure 9), (2) bituminous residue along open vertical fractures (Figure 10), and (3) oil staining in porous carbonate units (Figure 11). Figure 2 shows the locations of the source rocks and evidence for oil migration.





CENTIMETRES









Figure 8: Oil shale of the Boas River Formation along Asheweig River, northern Ontario. The Boas River Formation is only officially recognized in Ontario, and occurs as the uppermost unit of the Ordovician Bad Cache Rapids Group.

# Oil shale and reservoir rocks of the Hudson Bay Lowland, northeastern Manitoba

### M.P.B. Nicolas<sup>1</sup>, D. Lavoie<sup>2</sup> and D.K. Armstrong<sup>3</sup>

<sup>1</sup>Manitoba Geological Survey, Winnipeg, Manitoba, Canada <sup>2</sup>Geological Survey of Canada, Québec, Québec, Canada <sup>3</sup>Ontario Geological Survey, Sudbury, Ontario, Canada





Figure 7: (a) Oil shale beds within the Red Head Rapids Formation, northern Hudson Bay, Cape Donovan, Southampton Island, Nunavut; (b) close up of bed in (a). c) Paper-thin oil shale laminae (indicated with arrows) in the Red Head Rapids Formation in west-central Southampton Island (between Sixteen Mile and Rocky brooks).



For northeastern Manitoba, the best reservoirs are likely in the Upper Ordovician to Lower–Middle Devonian succession. In that interval, two main types of reservoirs can be envisaged:

1) HTD documented in the Ordovician succession near Churchill (Figure 12; Nicolas and Lavoie, 2009; Lavoie et al., 2011) and postulated in the Lower Silurian carbonate rocks (Figure 15; Nicolas and Lavoie, 2012) and; locations shown in Figure 2.

2) lower Silurian reefs of the Attawapiskat Formation which have only recently been shown to be locally highly porous (Figure 16; Ramdoyal, 2012). Figure 17 shows Attawapiskat Formation patch reefs outcropping i northern Ontario along the Severn River (Armstrong, 2011); locations shown in Figure 2.







Figure 15: Core photograph showing potential HTD in the Severn River Formation in the Houston Oils et al. Comeault Prov. No. 1 well at a depth of 411.8 m; scale is in centimetres.







## **MIGRATED OIL**





**Figure 10**: Bituminous residue along an open vertical fracture in MH unit 3 of Manitoba Hydro Conawapa Axis B - C292 core (Nicolas and Lavoie, 2012).



Figure 11: Core photograph showing oil staining in the Severn River Formation of the Houston Oils et al. Comeault Prov. No. 1 well at a depth of 415.4 m; scale in centimetres.



The results that were collected to date support an active hydrocarbon system in the Hudson Bay Basin. As detailed in Nicolas and Lavoie (2012), the Hudson Bay Basin has all the required elements for successful hydrocarbon exploration including confirmed basinal distribution of source rocks, adequate maturation rank of the Silurian and Ordovician succession, HTD and Silurian reefs to provide the reservoirs, and faults and stratigraphic relationships to provide the potential traps.

The re-assessment of the Hudson Bay Basin using modern technology, and viewing old and new data through a modern lens has proven to be a successful venture. What was once thought as a large area without hydrocarbon potential has now been transformed into a highly prospective frontier area worth of industry investment. Exploration in the north brings a significant positive economic impact and development to northern communities, and with Manitoba's coastal location, including a deepwater port at Churchill and rail line to major markets, successful hydrocarbon exploration in the Hudson Bay Basin would benefit all of Manitoba.

### **Acknowledgments**

The authors wish to thank G. Benger, V. Varga and R. Unruh and the summer students from the Manitoba Geological Survey Rock Preparation and Core Storage Facility for their help in locating available core and preparing it for viewing The authors like to acknowledge the GSC-Calgary Geochemistry Laboratory, A.D. McCracken of the GSC-Calgary paleontology laboratory, and E. Asselin of the GSC-Québec paleontology laboratory for analyzing the samples and providing

reliable technical support.





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This poster was presented at:

Manitoba Mines and Minerals Convention U. Ontario Winnipeg, MB, Canada November 15-17, 2012