Introduction

The Hudson Bay and Foxe Basins Project is in its second year. It is part of the Geological Survey of Canada Geo-mapping for Energy and Minerals (GEM) program, whose energy side aims to study the hydrocarbon potential of these Phanerozoic sedimentary basins. In Manitoba, the Hudson Bay Basin is represented by the Paleozoic carbonate succession of the Hudson Bay Lowlands (HBL) in the northeastern corner of the province (**Figure 1**). Project activities this year included core logging, a core workshop and a field trip, together with various laboratory analyses, including biostratigraphy and organic geochemistry.

Core logging

This summer, the Manitoba Geological Survey (MGS) and the Geological Survey of Canada (GSC) examined 17 geotechnical cores from Manitoba Hydro's core repository in Gillam; the core suites came from three sites on the Nelson River: the Conawapa Axis B, Conawapa Axis DX and Gillam Island site. These sites and the locations of the geotechnical cores are shown in **Figure 2**. The MGS also logged 14 drillhole core from petroleum wells, mineral exploration drillholes and stratigraphic test holes in the HBL. This information will be used to build a stratigraphic framework from which to base a 3D model of the HBL.

Preliminary results from the core logging indicate a more complex stratigraphy than expected. Stratigraphic correlations are difficult because there is evidence of complex relationships, including facies changes and missing formations, and questions arise when outcrop descriptions (particularly type sections) do not match core descriptions for the same unit. Biostratigraphy is used to help decipher some stratigraphic issues.

Stratigraphy

Manitoba Hydro has developed an internal, informal stratigraphic nomenclature to describe the sedimentary units observed in the vicinity of their sites (**Figure 3**). These units are not based on formational or member breaks, but rather on lithological and textural changes, since Manitoba Hydro's cores were drilled for geotechnical purposes. The correlation of the Manitoba Hydro cores to other cores in the HBL allowed formations to be assigned to the Manitoba Hydro units. Nicolas and Lavoie (2010) discusses the Manitoba Hydro stratigraphy in detail.

Figure 3 is the Paleozoic stratigraphic column for the HBL in northeastern Manitoba. Index photographs from most of the formations are shown. **Figure 4** shows index photos for the Ordovician MH units 2, 3, 4, 5A, 5B, 5C-6, 7 and 8 from the Manitoba Hydro Conawapa Axis B sites. MH unit 1 is the Precambrian crystalline rock and can be seen in the index photos of Figure 3.

Devonian
Stooping River Formation
Sogepet Aquit Kaskattama Prov. No.1

Devonian
Kenogami River Formation (upper)
Sogepet Aquit Kaskattama Prov. No. 1

Silurian
Kenogami River Formation (middle)
Sogepet Aquit Kaskattama Prov. No.1

Silurian
Kenogami River Formation (lower)
Sogepet Aquit Kaskattama Prov. No.1

Silurian
Attawapiskat Formation
Sogepet Aquit Kaskattama Prov. No.1

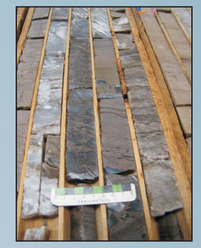
Silurian
Ekwan River Formation
Sogepet Aquit Kaskattama Prov. No.1

Hudson Bay Basin Paleozoic Stratigraphy

Period	Series	System/ stage		Hudson Bay Lowlands northeastern Manitoba	Manitoba Hydro Conawapa units (Axis B)
DEVONIAN	Lower	Eifelian	Couvinian	Moose River Formation	
				Kwataboahegan Formation	
		Emsian	Dalejan	Stooping River Formation	
			Zlichovian		
		Siegenian	Pragian		
		Gedinnian	Lochkovian	Kenogami River Formation: upper	
SILURIAN	Lower	Pridolian		Kenogami River Formation: middle	
		Ludlovian		Kenogami River Formation: lower	
		Wenlockian		Attawapiskat Formation	
		Llandoverian	U	Ekwan River Formation	
			M	Severn River Formation	
			L		
ORDOVICIAN	Upper	Gamachian			
		Ashgillian	Richmondian	Red Head Rapids Formation	8
				Churchill River Group: Chasm Creek Formation	7, 5C-6, 5B, 5A, 4a,b
				Churchill River Group: Caution Creek Formation	
			Maysvillian		
	Caradocian		Edenian	Bad Cache Rapids Group: Surprise Creek Formation	
				Bad Cache Rapids Group: Portage Chute Formation: Member 2	3
				Bad Cache Rapids Group: Portage Chute Formation: Member 1	2
PRECAMBRIAN					1B, 1A

Figure 3: Stratigraphy of the Hudson Bay Lowlands, with correlations to the Manitoba Hydro units; Ordovician System/Stages from Zhang and Barnes (2007) and Silurian System/Stages from Norris (1993); photographs from most of the formations are shown.

Silurian
Severn River Formation
Manitoba Hydro Gillam Island - GI2



Ordovician
Red Head Rapids Formation
Houston Oils et al. Comeault Prov. No. 1

Ordovician
Churchill River Group
Merland et al. Whitebear Creek Prov.

Ordovician
Bad Cache Rapids Group, Portage Chute Formation, Member 2
Manitoba Hydro Conawapa Axis B
06-CD-44

Ordovician
Bad Cache Rapids Group, Portage Chute Formation, Member 1
Kennco No. 5

Precambrian
weathered and unweathered granite
Manitoba Hydro Conawapa Axis DX
Dx1000

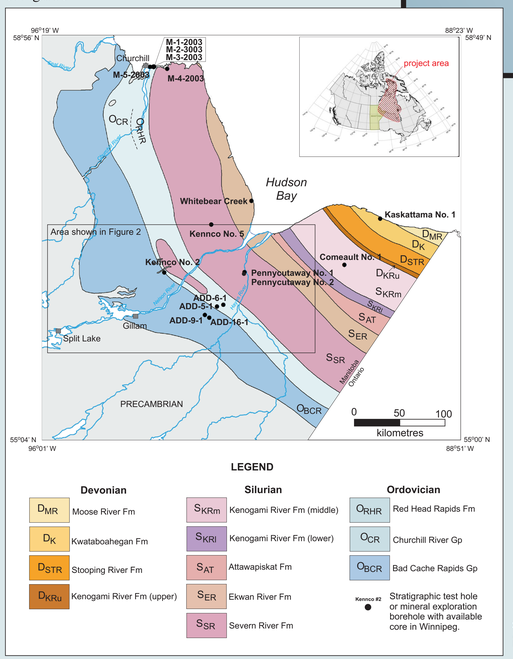


Figure 1: Hudson Bay Lowlands in northeastern Manitoba, showing the location of the cores available; inset is the project area for the GEM Hudson Bay and Foxe Basins Project.

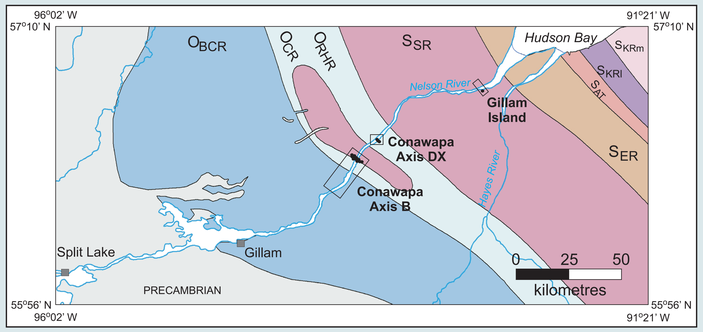


Figure 2: Locations of the Manitoba Hydro Conawapa Axis B,Conawapa Axis DX and Gillam Island sites (rectangular boxes), and the cores examined this year (black circles); see Figure 1 for geological legend.

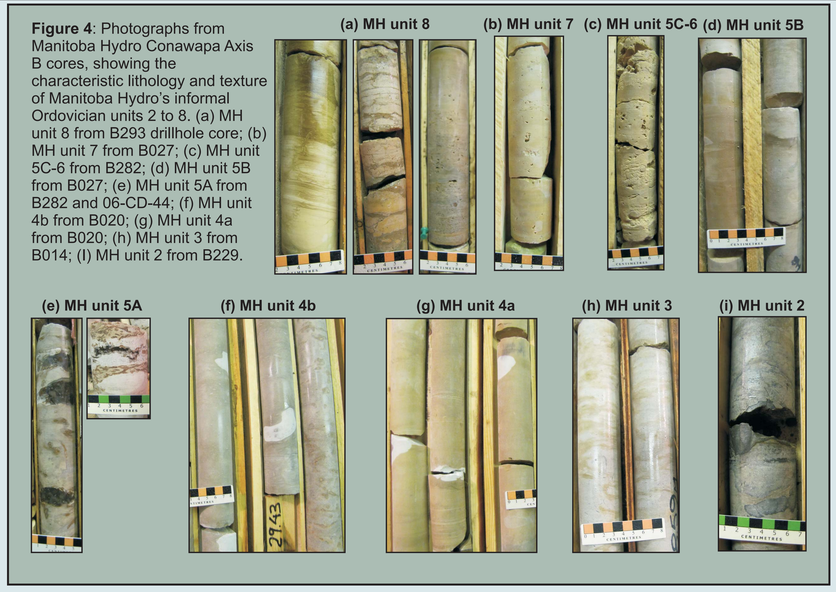


Figure 4: Photographs from Manitoba Hydro Conawapa Axis B cores, showing the characteristic lithology and texture of Manitoba Hydro's informal Ordovician units 2 to 8. (a) MH unit 8 from B293 drillhole core; (b) MH unit 7 from B027; (c) MH unit 5C-6 from B282; (d) MH unit 5B from B027; (e) MH unit 5A from B282 and 06-CD-44; (f) MH unit 4b from B020; (g) MH unit 4a from B020; (h) MH unit 3 from B014; (I) MH unit 2 from B229.

Hydrocarbon systems evidence

Evidence for a hydrocarbon system, such as bituminous residues and oil staining was found. In some of the Conawapa cores, bituminous residues are present along open fractures, as shown in **Figure 5**. Oil staining in the Comeault core was also found, and is shown in **Figure 6**. These bituminous residues and oil staining indicate that a hydrocarbon system was active at a poorly constrained stage of basin evolution; however, whether hydrocarbons were locally produced or have undergone long-range migration from the centre of the basin is uncertain. Bituminous residues were identified in Silurian rocks from the Manitoba Hydro Gillam Island cores, as well as in Ordovician rocks in MH units 2, 3, 4, and 5A from the Manitoba Hydro Conawapa Axis B cores, but seem most common in MH unit 3 (Member 2 of the Portage Chute Formation). The bituminous residue and oil stained samples of the Conawapa cores and Comeault core will be analyzed by Rock Eval™.

Figure 5: Bituminous residue along an open vertical fracture in MH unit 3 of Manitoba Hydro Conawapa Axis B - C292 core.

Figure 6: Oil staining in the Severn River Formation in the Houston Oils et al. Comeault Prov. No. 1 core.

Economic considerations

A good comprehension of the stratigraphy of the HBL and how it correlates and changes across the basin is critical in understanding the geological evolution and, in turn, the economic potential of the Hudson Bay Basin. New biostratgraphic data are being acquired and will help resolve stratigraphic correlations, whereas organic geochemistry will help characterize potential hydrocarbon source rocks.

A modern synthesis and solid understanding of the architecture and nature of potential hydrocarbon systems of the Hudson Bay and Foxe basins aims to promote hydrocarbon exploration in this region. Manitoba's primary advantage is that it manages the only deepwater port in northern waters at Churchill. Exploration activities resulting in hydrocarbon production, development and related infrastructure would therefore provide a source for significant economic growth and stimulus in northern Manitoba.

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Paleozoic stratigraphy of the Hudson Bay Lowlands, northeast Manitoba
by M.P.B. Nicolas (MGS) and D. Lavoie (GSC-Quebec)
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