

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

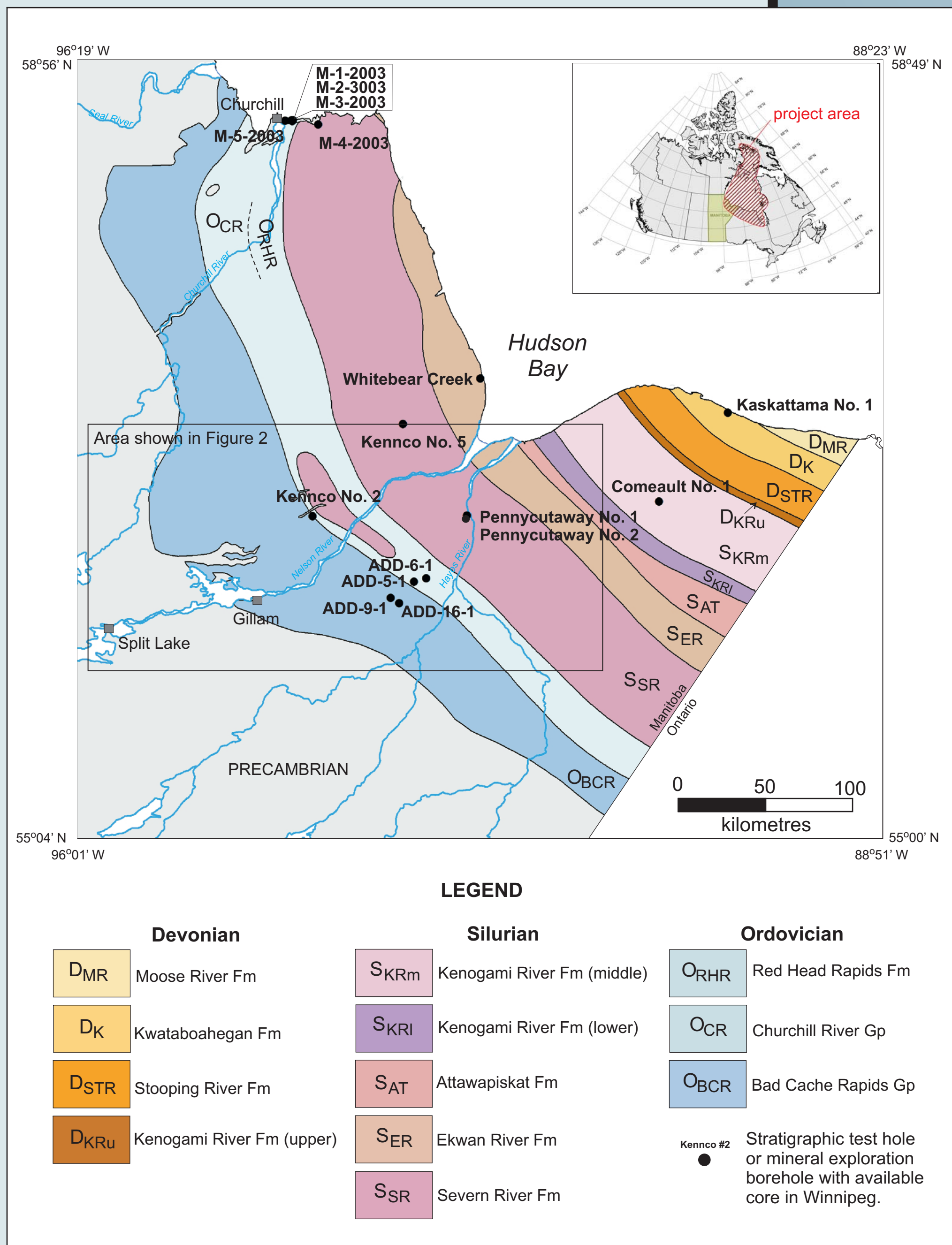
This summer, the Manitoba Geological Survey (MGS) and the Geological Survey of Canada (GSC) examined 17 geotechnical cores from Manitoba Hydro's core repository in Gillam; the core suites came from three sites on the Nelson River: the Conawapa Axis B, Conawapa Axis DX and Gillam Island site. These sites 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 units 1 is the Precambrian crystalline rock and can be seen in the index photos of Figure 3.



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

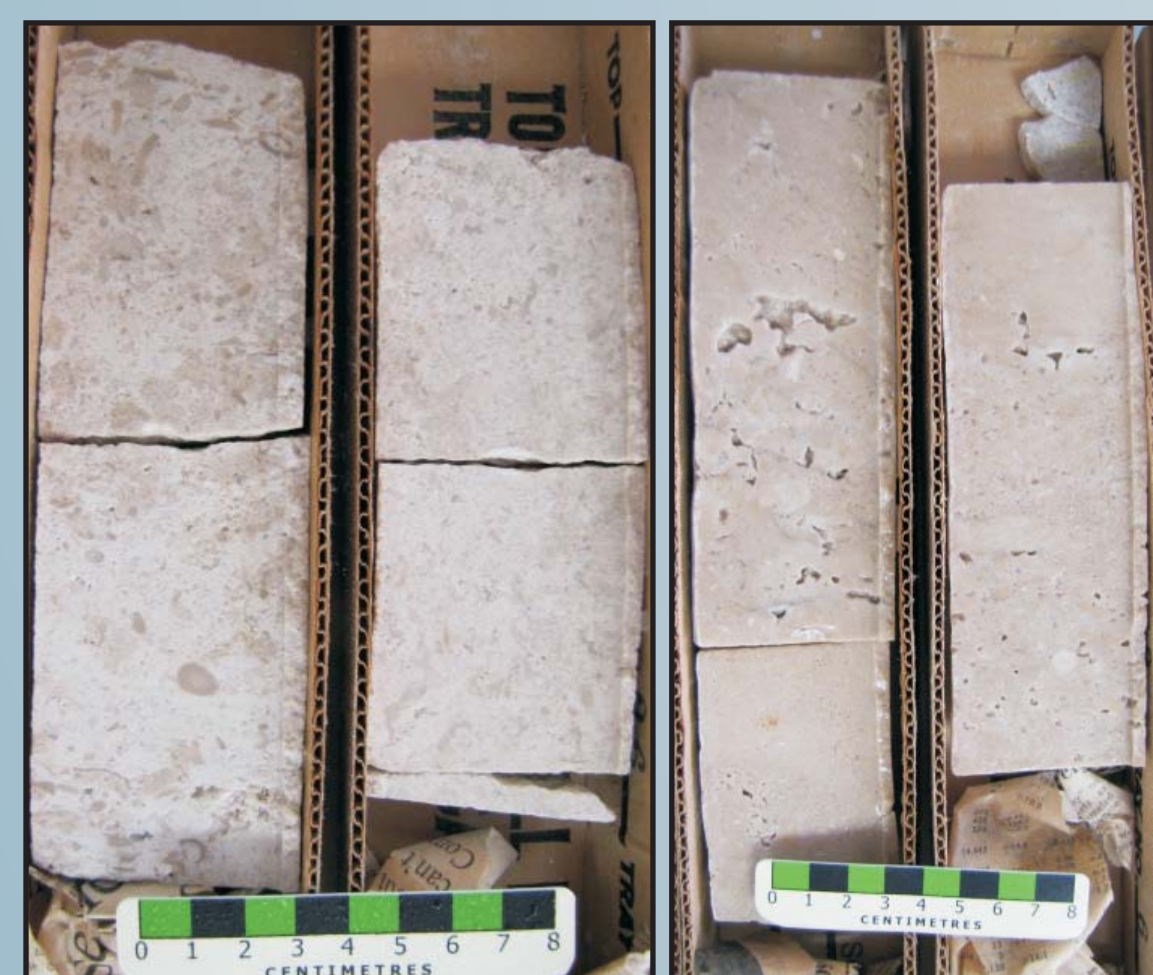
Devonian Kenogami River Formation (upper)
Sogepet Aquit Kaskattama Prov. No. 1



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 Ekwon 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	Eifellian	Moose River Formation		
			Kwataboahagan Formation		
		Emsian	Dalejan	Stooping River Formation	
			Zlichovian		
		Siegenian	Pragian		
	Gedinnian	Lochkovian	upper		
	SILURIAN	Lower	Pridolian	Kenogami River Formation	middle
lower					
Lower		Wenlockian	Attawapiskat Formation		
			Ekwon River Formation		
		Llandoveryian	Severn River Formation		
Upper		Ashgillian	Richmondian	Churchill River Group	
				Chasm Creek Formation	8 7 5C-6 5B 5A 4a,b
	Maysvillian	Edenian	Surprise Creek Formation		
			Portage Chute Formation	Member 2 3 Member 1 2	
	Caradocian				
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 - G12

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
Kenno No. 5



Precambrian weathered and unweathered granite
Manitoba Hydro Conawapa Axis DX Dx1000

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 biostratigraphic 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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References

Nicolas, M.P.B. and Lavoie, D. 2010: Hudson Bay and Foxe Basins Project: update on a Geo-mapping for Energy and Minerals program (GEM) initiative, northeastern Manitoba (part of NTS 54); in Report of Activities 2010, Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, p. - .
 Norris, A. W. 1993: Hudson Platform - Geology; in Chapter 8 in Sedimentary Cover of the Craton in Canada, D. F. Stott and J. D. Aitken (eds.), Geological Survey of Canada, (also Geological Society of America, The Geology of North America, v. D-1).
 Zhang, S. and Barnes, C. R. 2007: Late Ordovician-Early Silurian conodont biostratigraphy and thermal maturity, Hudson Bay Basin, Bulletin of Canadian Petroleum Geology, v. 55, p. 179-216.

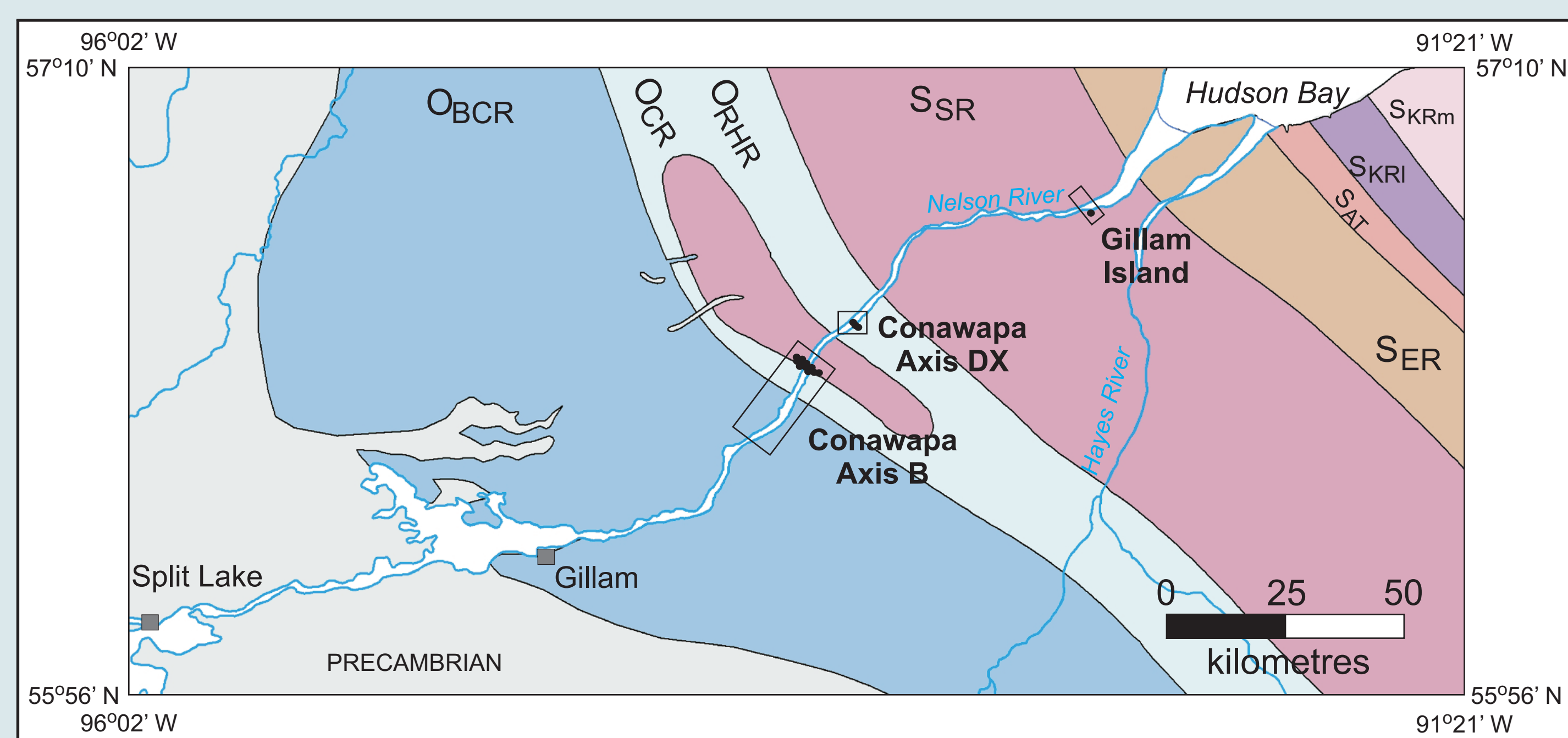


Figure 2: Locations of the Manitoba Hydro Conawapa Axis B, Conawapa Axis DX and Gillam Island sites (rectangular boxes), and the cores examined this year (black circles); see Figure 1 for geological legend.

Figure 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.

