Sediment Thickness of the Greater Toronto & Oak Ridges Moraine Areas, southern Ontario

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Scale 1:200 000

Map Index

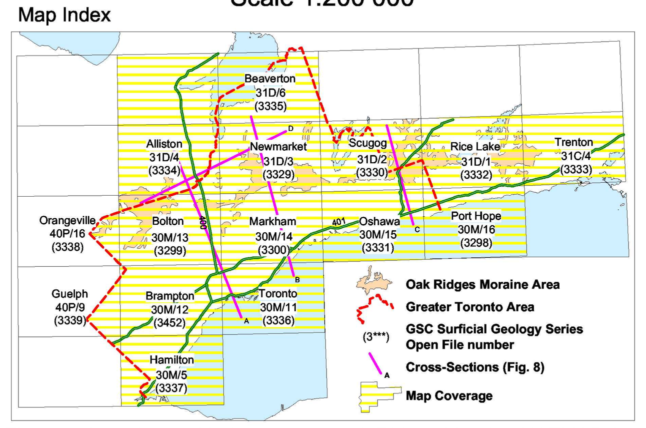

Figure 1. Location and index map for Oak Ridges Moraine NATMAP Area

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Introduction

The Geological Survey of Canada and the Ontario Geological Survey are mapping the surficial geology of the Oak Ridges Moraine and Greater Toronto areas in three dimensions (Fig.1). Surface mapping has been completed (e.g. Sharpe et al. 1997) and subsurface thematic, structural surface (e.g. Brennand et al. 1998), and isopach (thickness) maps are being produced. This map provides a sediment thickness estimate for the complete surficial sediment sequence above bedrock (e.g. Fig 2). The intent of these maps is to provide a geological summary and GIS digital database for hydrogeologists, land planners and engineers, amongst others, in the area.

Map Production

The sediment thickness map is a derivative surface produced by subtracting the bedrock surface DEM (Fig. 3) from the surface topographic DEM (Fig. 4). The bedrock surface DEM was produced from a compilation of subsurface data sources (Table 1) and interpolated to a 100 m grid resolution (Brennand et al. 1998). The topographic surface DEM was produced from the National Topographic Database (Geomatics, Natural Resources Canada), 1:50 000 digital elevation vectors and produced at a 30 m grid resolution (Kenny, 1997). A raster overlay operation between the two digital elevation models was completed at a grid resolution of 100 m using Vertical Mapper™. The resulting grid was enhanced and displayed in MapInfo®/Vertical Mapper™.

Use of This Map

This map is intended for regional applications at a scale of 1:200,000. The data density used for the original bedrock map (Brennand et al. 1998) precludes this map being used at a site investigation scale. All efforts have been taken to ensure the highest level of data integrity; however, it is important to recognize limitations in some of the original datasets (Table 1) regarding location accuracy and geological interpretations (Russell et al. 1996; Kenny et al. 1997).

Discussion

The strong topographic surface effect (e.g. modern river valleys) visible in this map results from the contrast in resolution between the bedrock and topographic surface DEMs (Fig. 3 and 4). Sediment thickness patterns at a scale of less than ~1 km are predominately attributable to surface landforms (river valleys, drumlins). Broader, lower frequency signatures are attributable to both regional scale landforms (Oak Ridges Moraine, Fig. 4), and bedrock features (e.g. Niagara Escarpment, Laurentian Channel). A contoured version of the map highlights regional trends in the sediment thickness (Fig.5). An histogram of sediment thickness illustrates the frequency distribution (Fig. 6).

In areas of thick sediment accumulation, and in non-agricultural rural areas where well density is low, the bedrock surface is based on a small number of isolated points. In an attempt to quantify the difference between the extent of sediment thicknesses intercepted in boreholes and the portrayal on this map, the the drilled length of the deepest borehole per square km has been plotted as a percentage of the total derived sediment thickness (Fig. 7).

A number of triangulation artifacts are visible in the surface. These appear as truncated patterns (e.g., west of Barrie) or bulls-eyes (e.g., south of Maple, north of Markham). These are related to (i) a sparse point dataset, resulting in long distances of interpolation for the bedrock surface, or (ii) isolated deep wells that have been verified for location and logging errors.

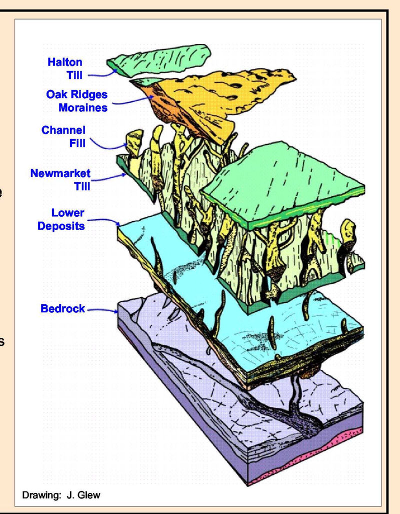
Different sediment thicknesses are associated with particular geologic terrains. Thin drift is associated with the Niagara Escarpment and cuesta, and occurs below: (i) the Halton Till plain south of the west Humber River (c.f. Sharpe et al., 1997); (ii) the drumlinized and channeled areas at the northern edge of the Paleozoic terrain; and (iii) the Iroquois Lake plain, along the north shore of Lake Ontario (Brennand, 1998). Thick drift is present in the Laurentian Channel, and occurs below the Oak Ridges Moraine and the drumlinized uplands west of Lake Simcoe (Fig. 5). Sediment thickness variations are highlighted by a series of north-south cross-sections, and an east-west cross-section traverses the Laurentian Channel (Fig. 8).

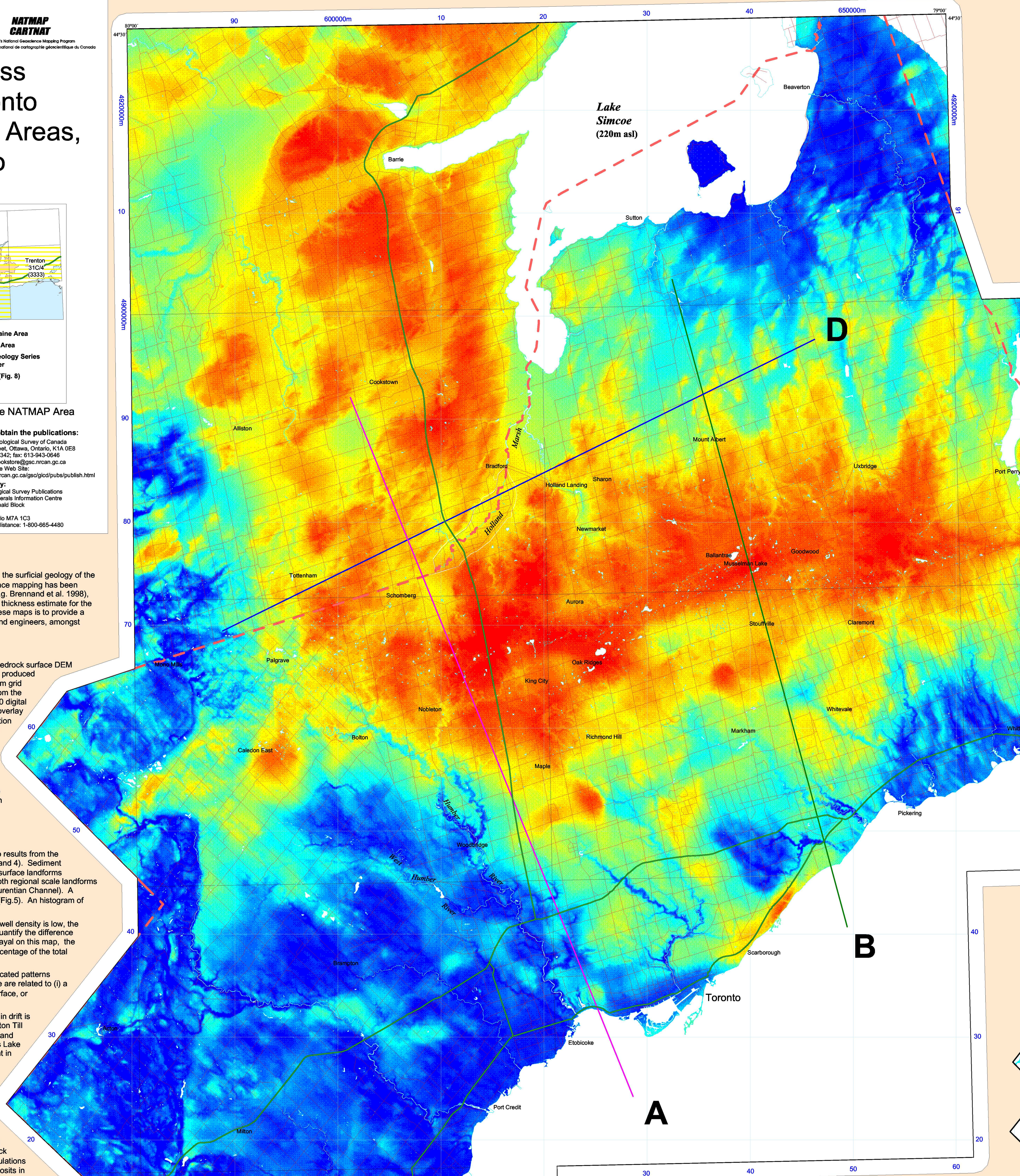
The composition of the sediment package can be regionally defined (Fig. 2; Sharpe et al., 1996), but some units are locally absent. Borehole data (Barnett, 1993; Sharpe et al. 1994) indicate that areas of thick sediment underlying the Oak Ridges Moraine generally consist of two to four of these regionally defined stratigraphic packages. Exceptions are recognized along tunnel channel axes where channel fill sands of the Oak Ridges Moraine extend to bedrock (Pugin et al. 1996; Barnett et al. 1998; Russell et al. 1998). Thick sediment accumulations west of Lake Simcoe consist of lower deposits and Newmarket Till. The lower deposits in the geological model (Fig. 2) comprise a number of local units recognized along the Scarborough Bluffs (Karrow, 1967) and in isolated boreholes and outcrops (e.g. Don, Scarborough and Thorncliffe formations, Sunnybrook Till).

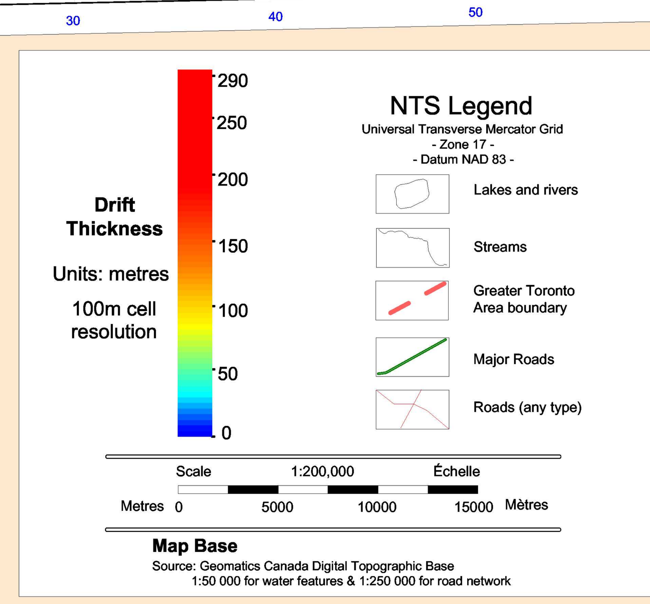
Geologic Model

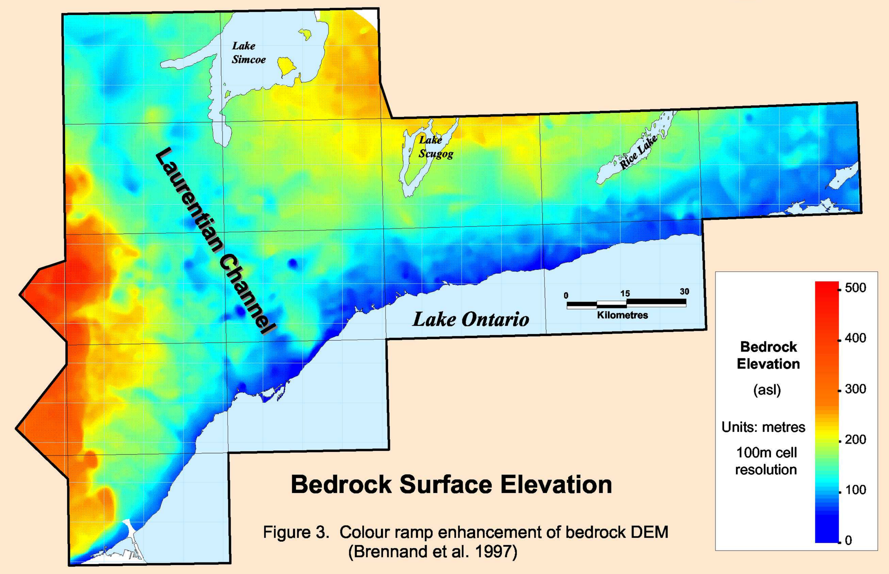
Figure 2. Conceptual geologic model of the GTA area showing the six major stratigraphic elements.

A conceptual geologic model of the area presents six geologic elements; four sedimentary packages and two major erosional surfaces (bedrock and Newmarket channels). All four stratigraphic packages (Lower Deposits, Newmarket Till, Oak Ridges Moraine & Channel Fill and Halton) packages represent aquifer and non-aquifer (aquitard) sediments. The ORM and related channel fills along with lower deposits are the major water-bearing strata in the ORM and GTA region. This model best applies to Markham and Newmarket mapsheets (Figure 1).



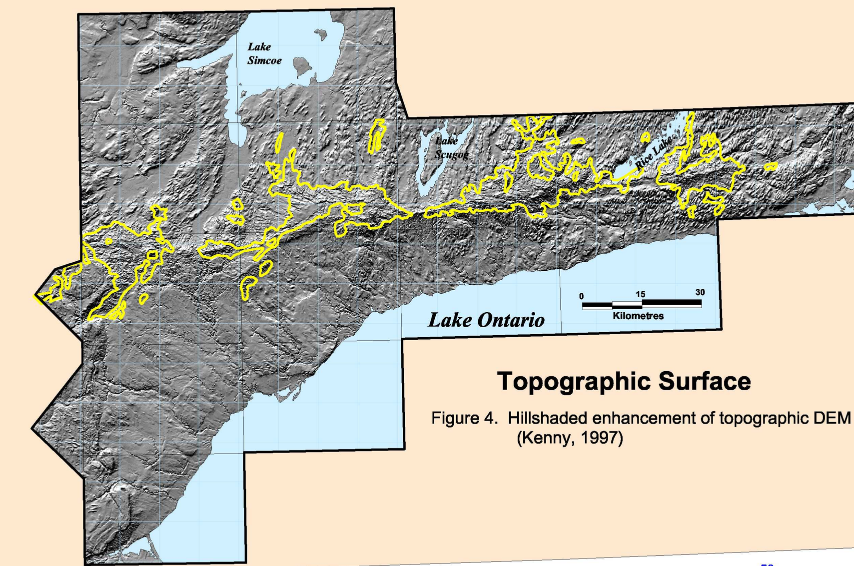






Bedrock Surface Elevation

Figure 3. Colour ramp enhancement of bedrock DEM (Brennand et al. 1997)



Topographic Surface

Figure 4. Hillshaded enhancement of topographic DEM (Kenny, 1997)

Data Sources

Ontario Ministry of Environment - Water Wells
UGAIS (GSC & OGS)
Ontario Geological Survey (Field Points & Boreholes)
Ministry of Transportation Ontario
Geolgical Survey of Canada (Field Points & Boreholes)
Interim Waste Authority
Consumers Gas Ltd.
Ontario Ministry of Natural Resources
Low Level Radioactive Waste Management Org.
Independent Consultants
Eldorado Nuclear Ltd.
Siting Task Force Secretariat, NRCan
Simcoe County
Regional Municipality of Durham
Regional Municipality of Peel
Northumberland County
Regional Municipality of York
University of Guelph

Table 1. Borehole and seismic sources used for development of bedrock surface. (see Brennand et al. 1997)

Depth Frequency Histogram

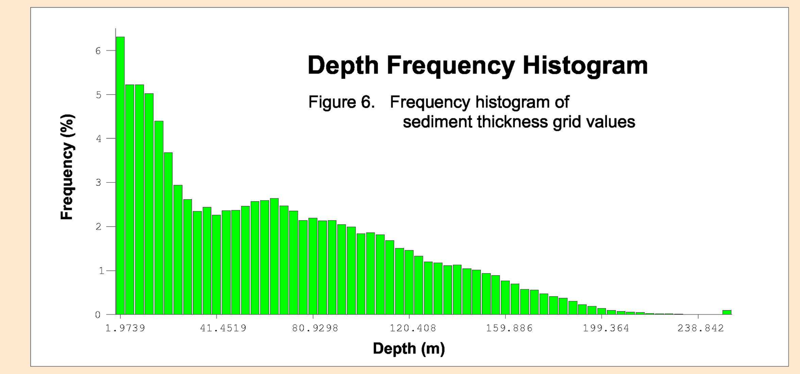


Figure 6. Frequency histogram of sediment thickness grid values

Contoured Sediment Thickness

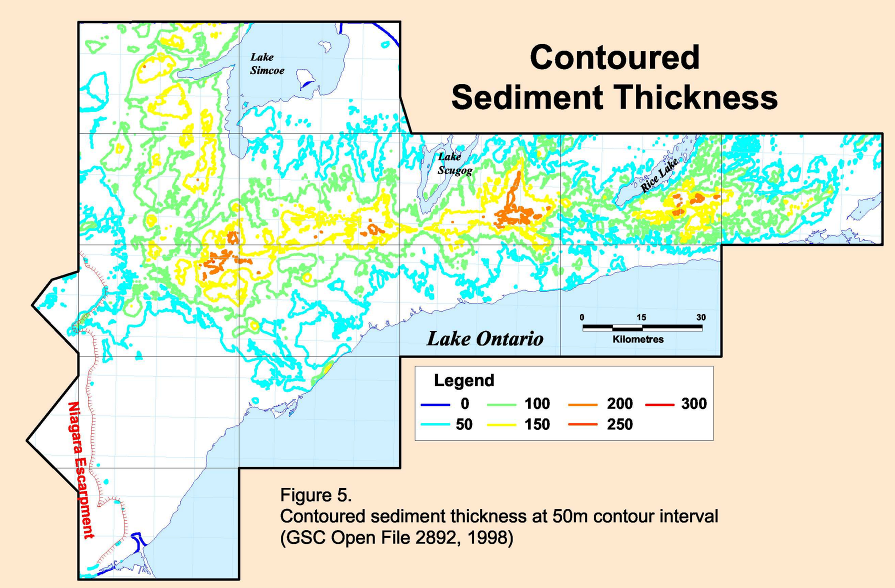


Figure 5. Contoured sediment thickness at 50m contour interval (GSC Open File 2892, 1998)

Percent Sediment Thickness Known

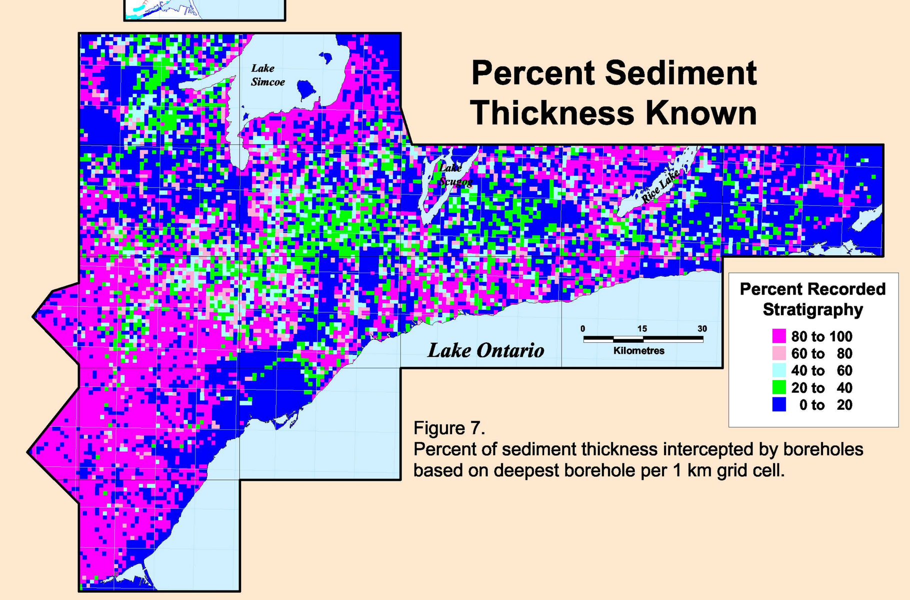


Figure 7. Percent of sediment thickness intercepted by boreholes based on deepest borehole per 1 km grid cell.

Sediment Thickness Cross-Sections

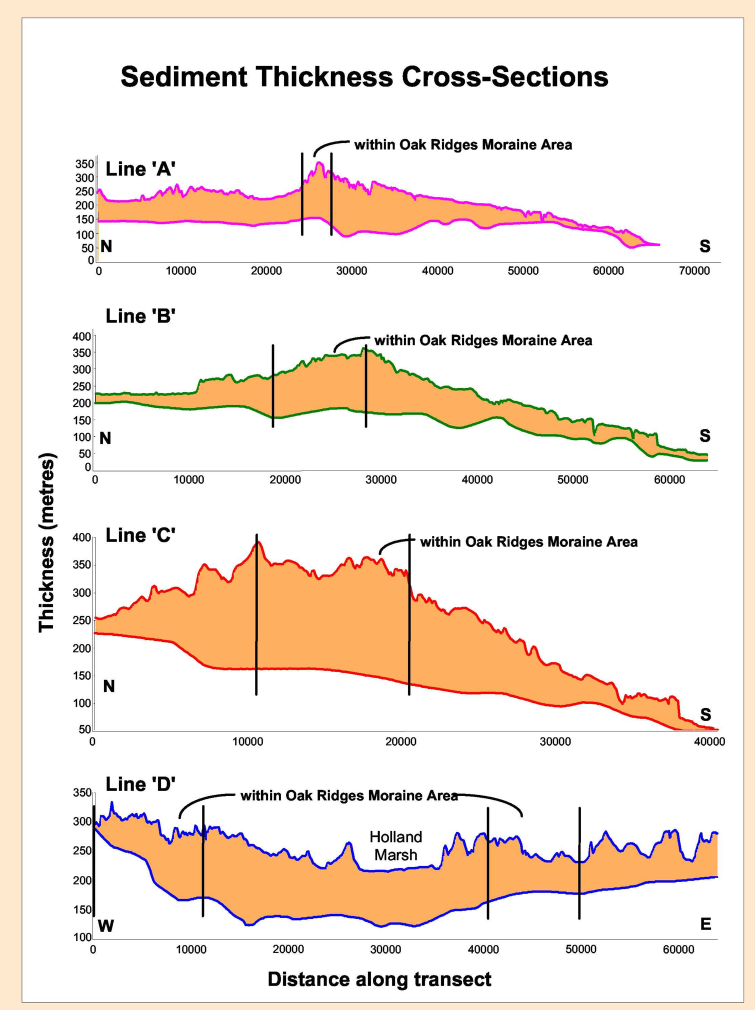


Figure 8. Sediment thickness cross-sections, vertical exageration of 1:35.

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Vertical Mapper 1997: Version 1.1, Northwood Geoscience.

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Regional Municipalities of Peel and York,
University of Ottawa, Department of Geology.

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Notes:

GSC Open File maps printed on demand at 400 dpi resolution as electrosatic plots (ie. Synergy Colorwriter).

Projection of the main map and Figures 3&4 is Universal Transverse Mercator, datum NAD 83 Zone 17. Surrounding maps, Figures 5&7, are displayed in a Latitude & Longitude coordinate system.

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