Bathymetry of Lake Ontario

National Geophysical Data Center
National Environmental Satellite, Data, and Information Service
Boulder, Colorado

Great Lakes Environmental Research Laboratory
Office of Oceanic and Atmospheric Research
Ann Arbor, Michigan

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This map is intended to depict lake floor topography, and is not to be used for navigation.
Lake floor feature names have been approved by the U.S. Board on Geographic Names.

Depth in Meters

0 12 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228 240 252

km
0 30

Scale 1:275,000
Transverse Mercator Projection
2 meter contour intervals

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Small Rounded Basin at Charity Shoal

A small equidimensional circular depression 1000 meters in diameter, with a continuous encircling rim, coincides with the feature referred to as Charity Shoal on nautical charts. An elongated ridge extends southwest from the feature, resembling the tail of a crag-and-tail feature common to some drumlin fields. The basin is slightly deeper than 18 meters and the rim rises to depths of 2-6 meters. The origin of the feature remains unknown. Although a sinkhole in the limestone terrane is a possibility, an origin related to a meteor crater, that was subsequently glaciated, seems more likely. Aeromagnetic mapping by the Geological Survey of Canada revealed a negative magnetic anomaly over Charity Shoal, which is a characteristic feature of simple impact craters (Pilkington and Grieve, 1992).

km
0 5
Scale 1:65,000
Transverse Mercator Projection

Depth in Meters
0 5 10 15 20 25 30 35 40 45 50

76 32'W 76 30'W 76 28'W
44 04'N
44 02'N
44 00'N

76 26.4'
44 4.2'
44 0.498'
76 31.998'

Scotch Bonnet and Point Petre Ridges

Seismic sections show that the Scotch Bonnet and Point Petre Ridges are underlain by bedrock highs; at one location the Scotch Bonnet Ridge is bounded on the northwest by a 25 meters escarpment (Anderson and Lewis, 1975; Forsyth, et al., 1994). Valleys also interpreted as bedrock features extend NE-SW, paralleling the two main ridges and lying between and adjacent to these ridges (Hutchinson, et al., 1993). These features are lineated in the same direction as faults and bedrock lineations occurring to the northeast in Ontario in the distinct NE-SW fabric of the Grenville basement rocks (Forsyth, et al, 1994). The Scotch Bonnet Ridge lies on the northward extension of the Clarendon-Lynden Fault system in New York (Hutchinson, et al., 1979). A channel (Scotch Bonnet Gap) which breaches the Scotch Bonnet Ridge connects the Mississauga and Genesee Basins near the deep axis of the lake. Deep connections also occur between the Niagara and Mississauga Basins and the Genesee and Rochester Basins (Genesee Gap).

West and East Kingston, Galloo, and Stony Basins

Several small shallow basins with intervening ridges occur in the northeastern extremity of Lake Ontario, all having depths of generally less than 40 meters. The bathymetry exhibits a preferred orientation of NE-SW, and appears to be largely a water-covered extension of the topography occurring northeast of the lake. The basins were probably produced by glaciation followed by some sedimentary infilling and topographic smoothing. Bedrock, consisting of Ordovician limestones and shales, lies at or near the surface beneath the ridges and shoals separating the basins. (Sly and Prior, 1984).

Lake Margin Topography

Around the perimeter of the lakefloor, the high energy of water circulation has evidently prevented the deposition of postglacial muds, except in sheltered areas (Thomas et al., 1972). Strongly linear bathymetric features displaying the imprint of glaciation, or of exhumation of bedrock topography and structure, occur at intervals along almost all of the lakeshore. Study of bottom sediment types off the western lakeshore between Niagara and Oshawa revealed that extensive areas of exposed bedrock, boulder pavement, sand deposits, and glacial drift occur here (Rukavina, 1969; Rukavina, 1976). Apparently in most areas around the lake perimeter, Quaternary sediments are relatively thin or absent, and bedrock exposures are common, possibly reflecting the effects of subglacial erosion and subsequent abrasion by lacustrine waves and currents.

Ledges and Channels in the Mississauga Basin

In the deep axis of the Mississauga Basin from 146-182 meters depth, there are several ledges of a few meters relief, separated by scarplets that trend north to south. These features step down from west to east toward the deepest point in the basin. Although the origin of the ledges is not known, they might have formed on the eroded edges of a succession of gently dipping strata which are characterized by bed-to-bed variation in resistance to erosion. Rudimentary valleys and channels of only a few meters relief are superimposed on the ledges and appear to represent a drainage pattern. Formation of the ledges could have been the result of the erosional action of Wisconsin glaciation and/or subglacial meltwater floods, acting against the differential resistance to erosion and layered aspect of the sedimentary strata (probably Trenton Limestone; Sanford and Baer, 1981) underlying the lake floor.

Duck-Galloo Ridge, Simcoe Island Channel, Saint Lawrence Channel, and Black River Channel

At the southern rim of the East Kingston, Galloo, and Stony Basins there occurs a series of broad low ridges which individually trend NE-SW, but which coalesce to form a complex ridge extending from the west near Prince Edward Point, Ontario to the east near Stony Point, New York. This feature has a relief ranging from 20-30 meters and is asymmetrical, with steep northeast facing scarps, and gently sloping surfaces facing southwest toward the main basin of Lake Ontario. The cuesta features seen here are gently rounded to flat on top, and several are capped by islands, the principal of which are Main Duck, Galloo, and Stony Islands. The Simcoe Island, Saint Lawrence, and Black River Channels are incised through the Duck-Galloo Ridge and extend NE-SW across the above mentioned basins. All three channels broaden out at the southern margin of the Duck-Galloo Ridge. This was probably the location of the Lake Ontario shoreline in early postglacial time, and the three channels were probably the main outflow channels for the lake at this time (Anderson and Lewis, 1985).

Basin Bathymetry of Lake Ontario

New bathymetry has revealed the presence of a small basin between the Mississauga and Rochester Basins and we have given it the new name, Genesee Basin. The four axial basins, separated by three ridges, occupying the floor of Lake Ontario are from west to east the Niagara, Mississauga, Genesee, and Rochester Basins. North of the Niagara River mouth and to the west, in the subtly defined Niagara Basin (which barely exhibits topographic closure), the deep axis of the lake is about midway between north and south shores. Farther east, the axial depths of the other three basins lie well toward the southern edge of the lake, giving the lake a distinct asymmetry in its north-south profile. This asymmetry is related to the bedrock configuration underneath the lake floor, and its differential resistance to glacial erosion (Hutchinson, et al., 1993). Gently southward dipping, erosion-susceptible shales and redbeds of the Middle and Upper Ordovician Utica Formation, Lorraine Group (Blue Mountain and Georgian Bay Formations in Ontario), and Queenston Formation, overlie southward-dipping erosion-resistant limestones of the Middle Ordovician Trenton Group (Cobourg and Lindsay Formations in Ontario).

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Preparation and Supporting Data of the New Bathymetry

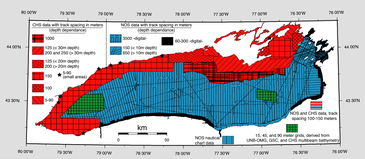
This poster is the third in a series of five depicting the bathymetry of the Great Lakes - the other two being Lake Michigan (1996) and Lake Erie (1998). Preparation of Lake Erie and Lake Ontario bathymetry was a collaborative effort between scientists at the NOAA National Geophysical Data Center (NGDC), the NOAA Great Lakes Environmental Research Laboratory, the Canadian Hydrographic Service, the University of Colorado Cooperative Institute for Research in Environmental Sciences, and the University of Michigan Cooperative Institute for Limnology and Ecosystems Research. A CD-ROM containing Lake Ontario bathymetry, with formats compatible with various computing systems and geographic information systems, includes screen imagery and a summary of geomorphology.

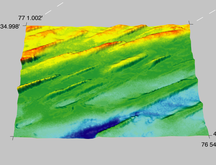
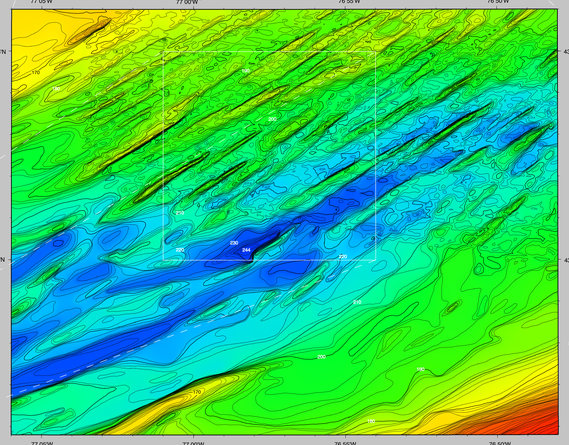
The entire historic hydrographic sounding data base from the U.S. and Canada, originally collected for nautical charting purposes, was used to create a complete and accurate representation of Lake Ontario bathymetry. The U.S. data primarily came from the NOS Hydrographic Survey Data, U.S. Coastal Waters CD-ROM Set (Version 4.0, Data Announcement 98-MGG-03) referred to as the NOS -digital- data in the map below. This and other bathymetric sounding data collected by the **U.S. National Ocean Service's (NOS) Coast Survey** and the **U. S. Army Corps of Engineers** was employed to construct bathymetric contours at 1 meter intervals from 1-10 meters depth and 2 meter intervals at depths greater than 10 meters. Compilation scales ranged from 1:10,000 to 1:50,000. Bathymetric sounding data collected by the **Canadian Hydrographic Service (CHS)** were employed to construct bathymetric contours at 1 meter intervals and compilation scales ranging from 1:1,000 to 1:30,000. Digitization of the bathymetric contours, merging of the bathymetric contour data sets, poster construction, and preparation of a CD-ROM, were accomplished at the NGDC. Multibeam bathymetric data collected by the **University of New Brunswick's Ocean Mapping Group (UNB-OMG)**, with support of the **Geological Survey of Canada (GSC)** and the CHS, were kindly made available in gridded form. In the two areas where multibeam bathymetric data were available, no other bathymetric data were used in the compilations. In some areas all available Canadian and U. S. bathymetric sounding data, collected at different times on different survey expeditions, were used to derive the contours.

The U.S. coastline used was primarily the GLERL Medium Resolution Vector Shoreline dataset (Lee, 1998). Where needed for more coverage, the NOS Medium Resolution Vector Shoreline for the Conterminous U.S. (1994) dataset was used. Coastlines from the CHS bathymetric sounding data field sheets were used to complete the Canadian coastline.

As seen in the diagram below, the density of data varies greatly from one region to another. The areas with 650 meters track spacing or more contain low data density, and areas with track spacing of 300 meters or less contain high data density. The multibeam bathymetric data are of very high data density, and the NOS nautical chart data have very low data density. More data in the present low data density areas would not only better verify existing contours but also show more details of bottom topography (as illustrated on the main map if high data density and low data density areas are compared).

DATA COVERAGE



Sculptured Parallel Ridges in the Rochester Basin

A series of distinct NE-SW ridges occupy the floor of Lake Ontario's deepest basin, the Rochester Basin. These ridges, having a relief of 15-25 meters and a natural spacing of 250-1000 meters, are remarkable in their linear aspect and uniform width. Most have relatively flat tops with steep side slopes, some of which are steeper to the northwest, others to the southeast, and some are symmetrical in cross-profile. Seismic and sediment core data suggest that many of the ridges coincide with the underlying relief of glacial landforms beneath the lake sediment (Hutchinson, et al., 1993). Resemblance exists between these features and grooved topography occurring in onshore drumlin fields north of the lake, as noted by Lewis (1997). Some of the Rochester Basin ridges are also abruptly truncated on their rounded northeastern ends, opposing the direction of ice advance, a distinct feature observed in drumlin fields. An alternate interpretation has been proposed for the ridges, namely, that the side slopes of the ridges have resulted from faulting (Thomas, et al., 1993). The parallel ridges of the Rochester Basin trace an arc from NE-SW to nearly east-west, which suggests they were formed by subglacial flow following the changing trend of the southern side of the basin, as if flow was deflected westward by the massive bulk of the Allegheny Plateau to the south. The relative roles of ice and meltwater floods in forming these ridges is a topic of continuing research.