DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1103
HUTCHINSON AND WOLD—GEOLOGICAL AND GEOPHYSICAL
DATA SOURCES, LAKE ONTARIO
SHEET 1 OF 2

LAKE ONTARIO SEISMICS

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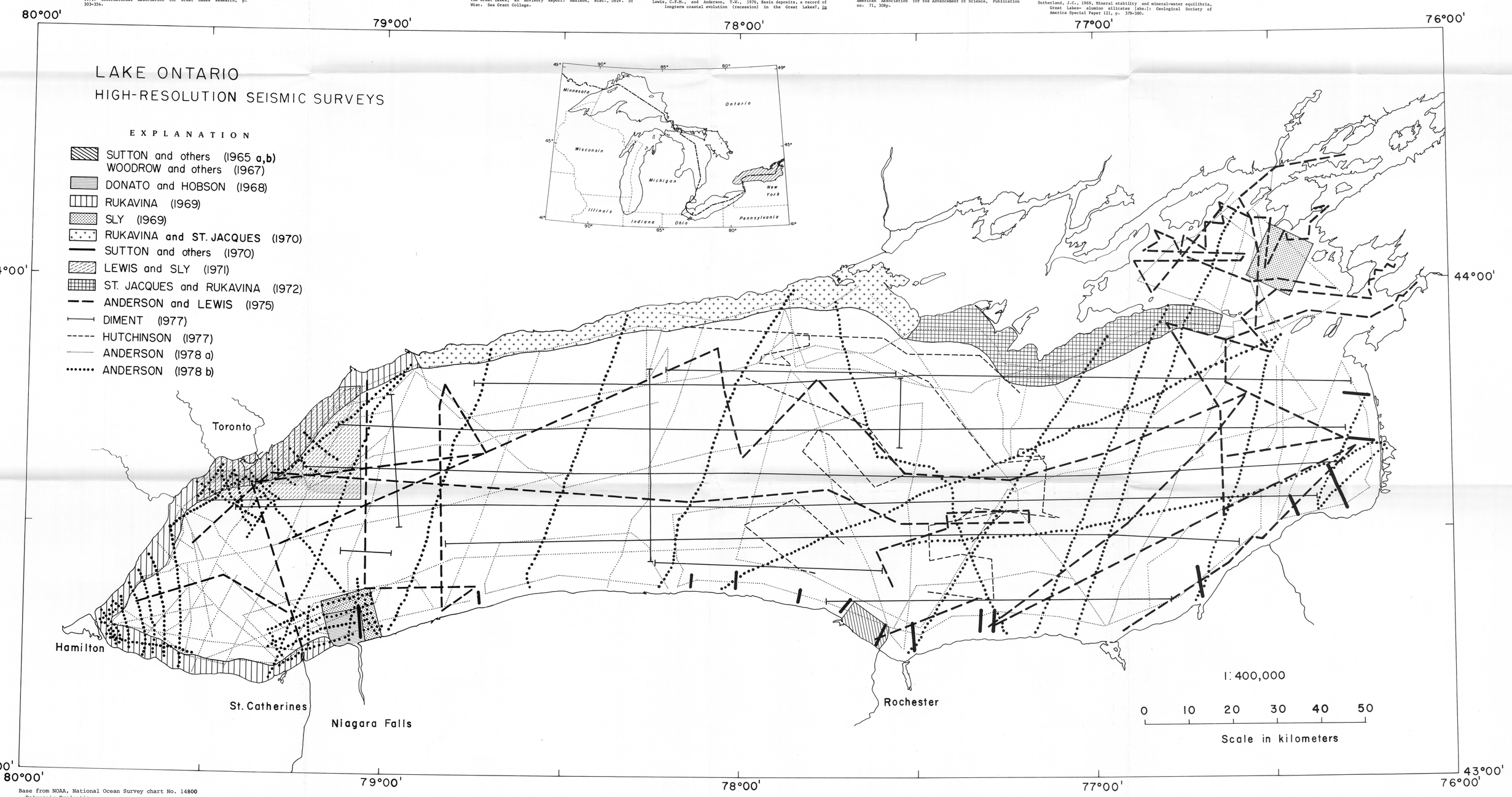

Base from NOAA, National Ocean Survey chart No. 14800
Polyconic Projection

A bibliography of various geological and geophysical data sources was compiled as part of an overall effort to evaluate the status of research on the Great Lakes. We hope that such a summary will be a catalyst for additional work and be an aid in planning future work. Our presentation has two forms: maps showing the locations of the different data types and a bibliography which lists the references from the maps and additional relevant papers. The charts shown in this map summarize the data sources for Lake Ontario.

The physical task of compiling the vast amount of published papers and unpublished reports and theses necessarily limited our objectives; we include only studies dealing with the lake proper. No attempt was made to summarize the investigations over surrounding land areas or to list the innumerable beach studies conducted by investigators at various universities and State and Federal agencies. Nor did we include studies dealing only with the water column (limnological work).

A few comments should be made concerning our guidelines in compiling the bibliography. We included all references we found (excepting beach and limnological studies). We included abstracts only when no follow-up paper occurred; we included both theses and resulting publications. Publically accessible data which have not been open-filed or published are referenced as a personal communication which shows the date when we obtained the data and the location where the data are available for public inspection.

We divided the bibliography into basic topics: seismic reflection surveys, magnetic surveys, gravity surveys and sampling surveys. Some references are listed under more than one section. We also created a "General" reference section which lists those papers that are relevant but do not fit the above categories. Finally, we found the following sources extremely useful in our compilation.

1. Existing bibliographic publications:

Publication	Source
Great Lakes Research Checklist	Great Lakes Commission 2200 Bonisteil Blvd. Ann Arbor, MI. 48105
Publication of the International Association of Great Lakes Research	Dr. Merv D. Palmer IAGLR Treasurer c/o Water Res. Br. Ontario Ministry of the Envir. 135 St. Clair Ave, West Toronto, Ontario M4V 1P5 Canada
Bibliography of Current Research on Geology of the Lake Superior Region	Dr. M.M. Kehlenbeck Dept. of Geology Lakehead University Thunder Bay, Ontario P7B 5E1 Canada
Bibliography of Published Geologic Papers and Unpublished Theses of the Great Lakes and their drainage basins, 1950 thru 1958	Zumberge, J.H., 1960, in Proceedings 3rd Conference on Great Lakes Research, Ann Arbor, Michigan, 1960 Univ. of Mich. Publication #4 p. 51 - 59
Microfilms of Theses: Great Lakes Research Checklist	University Microfilms P.O. Box 1346 Ann Arbor, MI. 48106

2. Journals and Proceedings:

Journal of Great Lakes Research (Volume 1, published in 1975).

Proceedings of the Conference on Great Lakes Research (21 conferences held thru 1978).

Proceedings of Annual Meeting of the Institute on Lake Superior Geology (24 meetings held thru 1978).

3. Navigation and bathymetry chart indices:

Nautical Chart Catalog 4 (U.S. Great Lakes and adjacent waterways).	Available from: NOAA, Distribution Division (944) National Ocean Survey Riverdale, MD. 20840
Information Bulletin 1 (Canadian Nautical Charts, Great Lakes and adjacent waterways)	Available from: Canadian Hydrographic Service Distribution Office Dept. of the Environment 1675 Russell Rd. P.O. Box 8080 Ottawa, Ontario K1G 3H6 Canada

4. Principal Organizations involved in Great Lakes Geological Studies:

Argonne National Laboratory 9800 S. Cass Avenue Argonne, IL. 60439	Department of the Army Coastal Engineering Research Center Kingman Building Fort Belvoir, VA. 22060
Canada Center for Inland waters 867 Lakeshore Rd. P.O. Box 5050 Burlington, Ontario L7R 4A6	Great Lakes Research Division University of Michigan Ann Arbor, MI. 48106

We have several explanatory comments for the charts. The data have been grouped together according to the type of survey: seismic reflection, gravity magnetic or sampling. The large-scale maps are compiled on standard polyconic projections which overlay either National Ocean Survey charts or Canadian Hydrographic Service bathymetry maps. The small maps are half-scale reductions of the same projection.

In some cases, more than one author has published studies of parts or all of the same survey. To accomodate this on the legends, we listed the earliest reference which describes the total survey first and subsequent references alphabetically. We then organized the legends chronologically by the earliest reference. In papers dealing with sampling, it was not always clear whether some samples came from the same survey, or from identical locations in later surveys. These have been grouped together. The legends do not reference theses unless follow-up papers were not published. For heavy density sampling surveys, we show the study area as a shaded portion on the chart.

We caution the reader that the charts we show are not scrupulously accurate. The data were plotted as carefully as possible, but location errors arising from enlarging small scale maps in journals are inevitably present. Where we could obtain large scale maps from authors, these were utilized and referenced as a personal communication.

We feel that we have listed the bulk of the publicly available data but we suspect other sources exist that were not readily available. For instance, it is apparent in some of the reports that additional cores and bottom samples (not shown on our charts) have been collected by the Great Lakes Research Division of the University of Michigan, Argonne National Laboratory, and Canada Center for Inland Waters. Many M.S. theses are not always microfilmed at University Microfilms. Some published reports are now out of print. We hope that, if additional public data are available, investigators will let us know the purpose of the studies, type of data, location, publications, and availability of these data, so that we might update this summary. If any errors are found in our compilation we would like to know about these as well.

Lake Ontario Data Summary

The data summarized below correspond to each chart and are a first-order attempt to show the reader more specifically what types of data were collected in each survey. The references are grouped together as on the maps. An asterik (*) before the reference indicates that it appears elsewhere in the same table with a different type of data. Where authors have used data from part of a survey, the full quantity is listed next to the first reference and the amount each author(s) used is listed in parentheses. For example, if a piston core survey shows the quantity 5 (3), that means five locations are shown on the map but this author(s) used only 3.

1. Seismic Reflections Surveys

The Seismic Chart shows approximately 10,000 km of high resolution seismic reflection track lines. This includes 1500 km of air gun data and 4800 km of Boomer** or Uniboom** tracks. The remaining 3000 km of track lines are fathometer data.

Type of Data	Quantity - km	Reference
Fathometer	90 90	Sutton and others (1965a,b) Woodrow and others (1967)
Transit sonar	45	Donato and Hobson (1968)
Fathometer	not given (400-500 ?)	Rukavina (1969)
Fathometer Side scan sonar	not given	Sly (1969)
Fathometer	550	Rukavina and St. Jacques (1970)
Fathometer	90	Sutton and others (1970)
Fathometer Boomer**	90	Lewis and Sly (1971)
Fathometer	430	St. Jacques and Rukavina (1972)
Fathometer Air gun	1500	Anderson and Lewis (1975)
Fathometer	1400	Diment (1977)
3.5 khz Uniboom**	440	Hutchinson (1977)
Boomer**	2900	Anderson (1978a)
Boomer**	1400	Anderson (1978b)

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II. Gravity Surveys

The Gravity Surveys Chart for Lake Ontario includes 188 bottom gravimeter stations and approximately 1400 km of shipboard gravity data collected with a sea gravimeter (Diment, 1977). The shipborne values were averaged over a real time interval of 3.5 minutes during collection.

Gravity Surveys-Chart Summary

Type of Data	Quantity	Reference
Bottom Gravimeter	=145	Canada, Department of Energy, Mines and Resources (1971a)
Bottom Gravimeter	20	Canada, Dept. of Energy, Mines and Resources (1971b)
Bottom Gravimeter	23	Revetta and Diment (1971)
Shipborne Gravity	=1400 km averaged over =3.5 minute interval	Diment (1977)

III. Magnetic Surveys

The Magnetic Surveys Chart for Lake Ontario shows 1700 km of ship towed proton precession magnetometer track lines.

Magnetic Surveys - Chart Summary

Type of Data	Quantity - km	Reference
Ship towed proton precession magnetometer	1400	Diment (1977)
Ship towed proton precession magnetometer	300	Hutchinson (1977)

IV. Sampling Surveys

The variety and amount of sampling surveys which have been completed in Lake Ontario make a concise summary difficult. Many authors have studied different aspects of the same core. Some authors have analyzed only a portion of the cores collected in a large survey. Where cores have been used by several authors or more than one core has been collected in an identical location, only one symbol has been used.

From the eighteen surveys included on the Generalized Sampling Chart, about 1300 surface grab samples, nearly 300 short gravity cores (up to 4m long) and forty one piston cores (up to 21m long) were collected. The samples shown on the Specialized Surveys-Chart include approximately 430 surface grab samples, 130 gravity cores (up to 2m long) and 10 piston cores (up to 16m long).

Generalized Sampling-Chart Summary

Type of Data	Quantity	Reference
Surface samples	not given	Kindle (1925)
Surface samples and gravity cores	160	Lewis and McNeely (1967)
Surface samples	480	Rukavina (1969)
Surface samples	262 (262) (73) (91) (91) (262) (262)	Thomas (1969b) Kemp (1971) McAndrews (1972) McAndrews and Power (1973) Thomas (1972) *Thomas and others (1972a,b)
Piston Cores (up to 16m)	6	*Thomas and others (1972a,b)
Surface samples	134	Rukavina and St. Jacques (1970)
Surface samples Shore Samples	371 73	Sutton and others (1970, 1974) Selleck (1974)
Gravity core Piston core (17m)	1 1	Duthie and Sreenivasa (1971) Kemp and Mudrochova (1972) Schroeder and Bada (1976)
Surface samples Shore samples	105 53	St. Jacques and Rukavina (1972)
Gravity cores	5	Kemp and others (1974)
Surface samples Gravity cores Piston cores (up to 21m long)	57 68 27	Anderson and Lewis (1975) Lewis and Anderson (1976)
Gravity cores	39	Kemp and Harper (1976)

Review of Data

The amount of published data dealing with the geology of Lake Ontario is voluminous. The physical properties of the uppermost unconsolidated lacustrine sediments have been well studied in the litterature. For example, the acoustic stratigraphy, trace element distribution, palynology and the pollen stratigraphy are well documented.

Relatively little is presently known about the properties of the deeper lacustrine sediments, particularly the provenance and age of the underlying tills. The configuration of the Paleozoic bedrock flooring the lake has not been studied and the nature of the Precambrian basement and deep crustal structure are primarily speculative. Refraction seismic surveys and air gun reflection surveys would yield information on the deeper section, but to date have not been attempted in the Lake. Proprietary multi-channel reflection data have been collected but are not publically available.

Very little is known about the lake magnetically compared to the surrounding land areas. The magnetic data are either from widely spaced track lines or in unpublished form as compared to aeromagnetic maps surrounding most of the lake. A paleomagnetic stratigraphy has not been published. Little interpretive work has resulted from either the magnetic or gravity surveys.

Considering the detail with which the Late Wisconsin geology and history of the Great Lakes Region is known, the late glacial history of Lake Ontario is still heavily based on land information. For example, the extensive seismic reflection, surface sampling and coring programs have failed to regionally outline the boundaries of the pre-modern Lake Ontario low water stage, nor provide an explanation for the linear bathymetric features which occur in the deepest part of the Lake in its eastern basin.

Side-scan sonar work could shed light on these issues beyond the presently available seismic and sampling information. Ultimately, the dense coverage of geological and geophysical data has not greatly improved our knowledge of the origin of the lake basin.

LAKE ONTARIO GEOLOGICAL AND GEOPHYSICAL DATA SOURCES

By

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1979

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