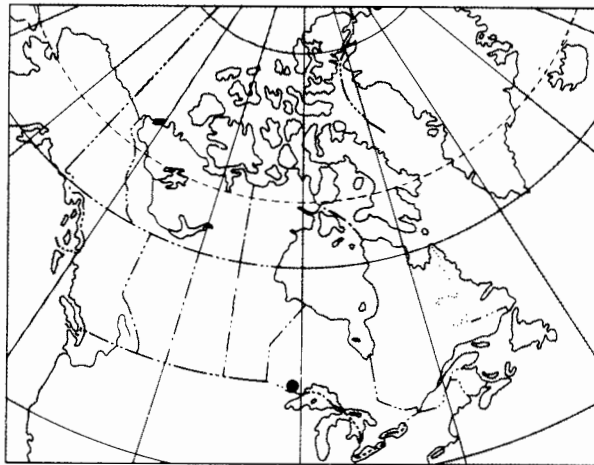


**GEOLOGICAL SURVEY OF CANADA OPEN FILE 2180
(NTS 52B)
CANADA-ONTARIO MINERAL DEVELOPMENT AGREEMENT (1985-1990)**

**REGIONAL LAKE SEDIMENT AND WATER
GEOCHEMICAL RECONNAISSANCE DATA
NORTHWESTERN ONTARIO**



INDEX MAP

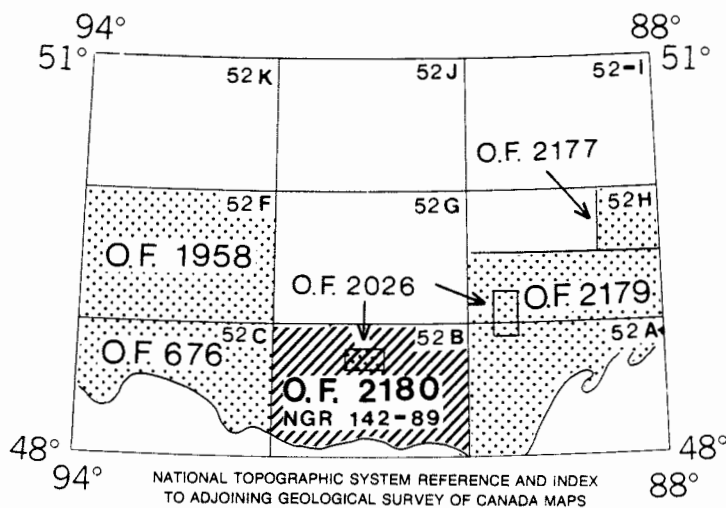
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1990: National Geochemical Reconnaissance Lake Sediment and Water Data, Northwestern Ontario (NTS 52B) Geological Survey of Canada Open File 2180

August, 1990

**NATIONAL GEOCHEMICAL RECONNAISSANCE
LAKE SEDIMENT AND WATER GEOCHEMICAL DATA
ONTARIO 1990
GEOLOGICAL SURVEY OF CANADA OPEN FILE 2180, NGR 142-1989
NTS 52B**



Open File 2180 represents a contribution to the Canada - Ontario Mineral Development Agreement (1985-1990), a subsidiary agreement under the Economic and Regional Development Agreement. This project was funded and managed by the Geological Survey of Canada.

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REGIONAL LAKE SEDIMENT AND WATER GEOCHEMICAL DATA, ONTARIO 1990, GSC OPEN FILE 2180, NGR 142-1989; NTS 52B

INTRODUCTION

Open File 2180 contains new data for gold and 25 other elements obtained by re-analyzing lake sediments collected in 1979 from an area in northwestern Ontario. Original analytical data selected from Open File 675 (published in 1980) for 11 elements plus loss-on-ignition in sediments, and uranium, pH and fluoride values in concomitant waters, are also included in this open file.

The original reconnaissance surveys were carried out by the Geological Survey of Canada in conjunction with the Ontario Ministry of Natural Resources under the terms of the Canada-Ontario Agreement on a Uranium Reconnaissance Program. Contract and technical support costs were financed by the Province of Ontario. Analyses of archive samples for Open File 2180 were undertaken under the Canada - Ontario Mineral Development Agreement (1985-1990).

Analytical results and field observations are used to build a national geochemical data base for resource assessment, mineral exploration, geological mapping and environmental studies. Sample collection and preparation procedures and analytical methods are strictly specified and carefully monitored to ensure consistent and reliable results regardless of the area, the year or the analytical laboratory.

CREDITS

E.H.W. Hornbrook directed the surveys.

P.W.B. Friske coordinated the operational activities of contract and Geological Survey of Canada staff.

Contracts were let to the following companies for sample preparation and reanalysis and were managed by the following staff of the Regional Geochemical Studies section:

Collection (1977):	Marshall Macklin Monaghan Toronto, Ontario E.H.W. Hornbrook, W.B. Coker
Preparation (1977):	Golder Associates Ottawa, Ontario J.J. Lynch
Analysis (1977):	Chemex Labs Vancouver, British Columbia Barringer Research Toronto, Ontario Atomic Energy of Canada Ottawa, Ontario J.J. Lynch
Preparation (1990):	Bondar-Clegg & Company Ottawa, Ontario J.J. Lynch
Analysis (1990):	Bondar-Clegg and Company Ottawa, Ontario J.J. Lynch

M. McCurdy edited open files and coordinated production.

A.C. Galletta managed the digital geochemical data and provided computer processing support.

The personal computer data base and software programs used for data entry, verification, processing and presentation in the publication of reports were designed and programmed by Harry Gross, Geochemical Data Manager for the Exploration Geochemistry Subdivision.

Sample location, gold value and symbol-trend maps were plotted by staff at the Geological Survey of Canada. Pat Doyle, C.C. Durham and Rob Phillips provided technical assistance.

DESCRIPTION OF SURVEY AND SAMPLE MANAGEMENT

Helicopter-supported sample collection was carried out during the summer of 1979. Lake sediment and water samples were collected at an average density of one sample per 13 square kilometres throughout the 14,250 square kilometres of the northwestern Ontario survey.

Sample site duplicate samples were routinely collected in each analytical block of twenty samples.

Field observations were recorded on standard forms used by the Geological Survey of Canada (Garrett, 1974).

The sample site positions were marked on appropriate 1:250 000 scale NTS maps in the field. These maps were digitized at the Geological Survey in Ottawa to obtain the sample site UTM coordinates.

In Ottawa, field dried samples were air-dried, crushed and ball-milled. The minus 80 mesh (177 micron) fraction was obtained and used for subsequent analyses. At this time, control reference and blind duplicate samples were inserted into each block of twenty sediment samples. For the water samples, only control reference samples were inserted into the block. There were no blind duplicate water samples.

The sample site coordinates were checked as follows: a sample location map was produced on a Versatec plotter using the digitized coordinates; the original sample location map produced in the field was then overlain on the Versatec map; the two sets of points were checked for coincidence. The dominant rock types in the lake catchment basins were identified on appropriate geological maps used as the bedrock geological base on NGR maps.

Thorough inspections of the field and analytical data were made to check for any missing information and/or gross errors.

Quality control and monitoring of the geochemical data was undertaken by a standard method used by the Exploration Geochemistry Subdivision at the Geological Survey of Canada.

ANALYTICAL PROCEDURES

Instrumental Neutron Activation Analysis (INAA)

The weighed sample (generally 10 to 40 g) is irradiated epithermally for 20 minutes in a neutron flux with an approximate density of 1×10^{11} neutrons/cm²/second. Counting begins seven days after irradiation. The counting time is somewhat variable (6 to 11 minutes) and is matrix dependent. Counting is done on a germanium-lithium co-axial counter. The counting data is accumulated on a VAX computer and is subsequently converted to concentrations. Numerous international reference samples are irradiated with each batch of routine samples. Elements determined by INAA analyses include: Na, Sc, Cr, Fe, Co, Ni, Zn, As, Se, Br, Rb, Zr, Mo, Ag, Cd, Sn, Sb, Te, Cs, Ba, La, Ce, Sm, Eu, Tb, Yb, Lu, Hf, Ta, W, Ir, Au, Th, and U. The sample weight is also reported. Data for Zn, Se, Zr, Ag, Cd, Sn, Te, and Ir are not published because of inadequate detection limits and/or precision.

Atomic Absorption Spectroscopy (AAS) and Other Analyses

For the determination of Zn, Cu, Pb, Ni, Co, Ag, Mn, As and Fe, a 1 g sample was reacted with 6 mL of a mixture of 4M HNO₃ and M HCl in a test tube overnight at room temperature. After digestion, the test tube was immersed in a hot water bath at room temperature and brought up to 90° C and held at this temperature for 2 hours with periodic shaking. The sample solution was then diluted to 20 mL with metal-free water and mixed. Zn, Cu, Pb, Ni, Co, Ag, Mn and Fe were determined by atomic absorption spectroscopy using an air-acetylene flame. Background corrections were made for Pb, Ni, Co and Ag.

Arsenic was determined by atomic absorption using a hydride evolution method wherein the hydride (AsH₃) was evolved and passed through a heated quartz tube in the light path of an atomic absorption spectrophotometer. The method is described by Aslin (1976).

Molybdenum was determined by atomic absorption spectroscopy using a nitrous oxide acetylene flame. A 0.5 g sample was reacted with 1.5 mL concentrated HNO₃ at 90° C for 30 minutes. At this point 0.5 mL concentrated HCl was added and the digestion continued at 90° C for an additional 90 minutes. After cooling, 8 mL of 1250 ppm Al solution were added and the sample solution diluted to 10 mL before aspiration.

Loss-on-ignition was determined using a 500 mg sample. The sample, weighed into 30 mL beaker, was placed in a cold muffle furnace and brought up to 500° C over a period of 2 -3 hours. The sample remained at this temperature for 4 hours and was then allowed to cool to room temperature for weighing.

Uranium was determined using a neutron activation method with delayed neutron counting. A detailed description of the original method is provided by Boulanger *et al.* (1975). In 1979, modifications related to the irradiation and counting times were introduced. In brief, a 1 gram sample was weighed in a 7 dram polyethylene vial, capped and sealed. The irradiation

was provided by the Slowpoke reactor with an operating flux of 10^{12} neutrons/cm²/second. The samples were pneumatically transferred from an automatic loader to the reactor, where each sample was irradiated for 20 seconds. After irradiation, the samples were again transferred pneumatically to the counting facility where, after a 10 second delay, the sample was counted for 20 seconds with six BF₃ detector tubes embedded in paraffin. Following counting, the samples were automatically ejected into a shielded storage container. Calibration was carried out twice a day as a minimum, using natural materials of known uranium concentration.

Water Analyses

Uranium was determined by fission track analysis. 225 mL of water was acidified with 3 mL concentrated HNO₃. After a two week waiting period to ensure total dissolution of precipitated uranium, a 5 microlitre aliquot of the sample was removed, placed on a polycarbonate tape and dried. The tape was irradiated in a nuclear reactor at McMaster University for 1 hour at a flux of 10^{13} neutrons/sq cm/sec. The irradiated tape was etched with 25% NaOH solution and the fission tracks were counted with an optical counter fitted to a microscope. The number of tracks was proportional to the uranium concentration. Each tape contained its own calibration standards, blanks and sample duplicates.

Hydrogen ion activity (pH) was measured with a Beckman combination electrode and a Model 401 Orion specific ion meter.

Fluoride in lake water samples was determined using an Orion fluoride electrode and a Model 401 Orion specific ion meter. Prior to measurement, an aliquot of the sample was mixed with an equal volume of a modified TISAB (total ionic strength adjustment buffer) solution. The modification consisted of adding 60 mL of 8 M KOH solution to the buffer. This permitted the reanalysis of fluoride in acidified water samples when required. When this analysis was required, acidified standard solutions were used for calibration.

Table 1 provides a summary of analytical data and methods.

PRESENTATION AND INTERPRETATION OF GOLD DATA

The following general discussion reviews the format used to present the gold geochemical data and outlines some important points to consider when interpreting this data. This discussion is included in recognition of the special geochemical behaviour and mode of occurrence of gold in nature and the resultant difficulties in obtaining and analyzing samples which reflect the actual concentration level at a given site.

Samples that have gold values that are statistically above approximately the 90th percentile, or those with LOI values below 10%, are normally analysed again in accordance with standard NGR procedures. There will be no repeat data published in Open File 2179 or Open File 2180 however, as insufficient material remained after the initial analyses.

To correctly interpret gold geochemical data from regional stream sediment or lake sediment surveys requires an appreciation of the unique chemical and physical characteristics of gold and its mobility in the surficial environment. Key properties of gold that distinguish its geochemical behaviour from most other elements include (Harris, 1982):

- 1) Gold occurs most commonly in the native form which is chemically and physically resistant. A significant proportion of the metal is dispersed in micron-sized particulate form, and the high specific gravity of gold results in heterogeneous distribution, especially in stream sediment and clastic-rich (low LOI) lake sediment environments. Gold distribution appears to be more homogeneous in organic-rich fluvial and lake sediments.
- 2) Gold typically occurs at low concentrations in the ppb range. Whereas gold concentrations of only a few ppm may represent economic deposits, background levels encountered from stream and centre-lake sediments seldom exceed 10 ppb, and commonly are near the detection limit of 2 ppb.

These factors result in a particle sparsity effect wherein very low concentrations of gold are heterogeneously enriched in the surficial environment. Hence, a major problem facing the geochemist is to obtain a representative sample. In general, in areas where concentrations of gold in sediments are low, and/or grain sizes of the gold present relatively high, proportionally larger samples are required to reduce the uncertainty between subsample analytical values and actual values. Conversely, as actual gold concentrations increase or grain size decreases, the number of gold particles to be shared in random subsamples increases and variability of results decreases (Clifton *et al.*, 1969; Harris, 1982). The limited amount of material collected during the rapid, reconnaissance-style regional surveys and the need to analyze for a broad spectrum of elements, precludes the use of a significantly large sample weight for the gold analyses. Therefore, to obtain representative samples, grain size is reduced by sieving and ball milling of the dried sediments.

The following control methods are currently employed to evaluate and monitor the sampling and analytical variability which are inherent in the analysis of gold in geochemical media:

- (1) For each block of 20 samples:
 - (a) random insertion of a standard reference sample to control analytical accuracy and long-term precision;
 - (b) collection of a field duplicate (two samples from one site) to measure sampling variance;
 - (c) analysis of a second subsample (blind duplicate) from one sample to measure and control short-term precision.

In summary, geochemical follow-up investigations for gold should be based on a careful consideration of all geological and geochemical information, and especially

a careful appraisal of gold geochemical data and its variability. In some instances, prospective follow-up areas may be indirectly identified by pathfinder element associations in favourable geology, although a complementary gold response due to natural variability may be lacking. Once an anomalous area has been identified, field investigations should be designed to include detailed geochemical follow-up surveys and collection of large representative samples. Subsequent repeat subsample analyses will increase the reliability of results and permit a better understanding of natural variability which can then be used to improve sampling methods and interpretation.

FIELD DATA LEGEND

Table 2 describes the field and map information appearing on the following pages preceding the analytical data for each sample site.

REFERENCES

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- Jonasson, I.R., Lynch, J.J. and Trip, L.J.** (1973) Field and laboratory methods used by the Geological Survey of Canada in geochemical surveys; No. 12, *Mercury in Ores, Rocks, Soils, Sediments and Water*, *Geol. Surv. Can. Paper 73-21*.

TABLE 1. Summary of Analytical Data and Methods

ELEMENT	DETECTION LEVEL	METHOD
SEDIMENTS:		
Zn Zinc	2 ppm	AAS
Cu Copper	2 ppm	AAS
Pb Lead	2 ppm	AAS
Ni Nickel	2 ppm	AAS
Co Cobalt	2 ppm	AAS
Ag Silver	0.2 ppm	AAS
Mn Manganese	5 ppm	AAS
As Arsenic	1 ppm	HY-AAS
Mo Molybdenum	2 ppm	AAS
Fe Iron	0.02 pct	AAS
U Uranium	0.5 ppm	NADNC
LOI Loss-on-ignition	1 pct	GRAV
Na Sodium	0.02 pct	INAA
Sc Scandium	0.2 ppm	INAA
Cr Chromium	20 ppm	INAA
Fe Iron	0.2 pct	INAA
Co Cobalt	5 ppm	INAA
Ni Nickel	10 ppm	INAA
As Arsenic	0.5 ppm	INAA
Br Bromine	0.5 ppm	INAA
Rb Rubidium	5 ppm	INAA
Mo Molybdenum	1 ppm	INAA
Sb Antimony	0.1 ppm	INAA
Cs Cesium	0.5 ppm	INAA
Ba Barium	50 ppm	INAA
La Lanthanum	2 ppm	INAA
Ce Cerium	5 ppm	INAA
Sm Samarium	0.10 ppm	INAA
Eu Europium	1 ppm	INAA
Tb Terbium	0.5 ppm	INAA
Yb Ytterbium	2 ppm	INAA
Lu Lutetium	0.2 ppm	INAA
Hf Hafnium	1 ppm	INAA
Ta Tantalum	0.5 ppm	INAA
W Tungsten	1 ppm	INAA
Th Thorium	0.2 ppm	INAA
U Uranium	0.2 ppm	INAA
Wt Weight	0.01 g	-
Au Gold	2 ppb	INAA
WATERS:		
F-W Fluoride	20 ppb	ISE
pH Hydrogen ion activity	- -	GCM
U-W Uranium	0.01 ppb	FTA

- AAS - atomic absorption spectrometry
- FTA - fission track analysis
- GCM - glass Calomel electrode and pH meter
- GRAV - gravimetry
- HY-AAS - atomic absorption using hydride evolution
- INAA - Instrumental Neutron Activation Analysis
- ISE - ion selective electrode
- LIF - laser-induced fluorescence
- NADNC - neutron activation, delayed neutron counting

TABLE 2. Field Observations Legend

FIELD RECORD	DEFINITION	TEXT CODE
MAP SHEET	National Topographic System (NTS): lettered quadrangle (1:250 000 or 1:50 000 scale) Part of sample number	052B
SAMPLE ID	Remainder of sample number: Year Field crew Sample sequence number	79 1 or 3 001-999
REP STAT	Replicate status; the relationship of the sample to others within the analytical block of 20: Routine regional sample First of field duplicate Second of field duplicate	00 10 20
UTM	Universal Transverse Mercator (UTM) Coordinate System; digitized sample location coordinates.	
ZN	Zone (7 to 22)	
EASTING	UTM Easting in metres	
NORTHING	UTM Northing in metres	
ROCK UNIT	Major rock type of catchment area: diabase argillite chert granite granite gneiss ultramafic conglomerate greywacke acid extrusive basic extrusive nepheline = foyaite	DIBS ARGL CHRT GRNT GRNG UMFC CGLM GRCK AEXV BEXV NPLS
LAKE AREA	The area of the water body sampled: Pond 1/4 to 1 square kilometre 1 to 5 square kilometres greater than 5 square kilometres	pond .25-1 1-5 >5
LAKE DEPTH	Distance in feet from the surface of the lake to the bottom	0 - 99
TERRAIN RELIEF	Relief of lake catchment basin: Low Medium High	Lo Med Hi
SAMPLE CONT.	Contamination; human or natural: None Work Camp Fuel Gossan	- Wo Ca Fu Go

FIELD RECORD	DEFINITION	TEXT CODE
SAMPLE COLOUR	Sediment sample colour; up to two colours may be selected: Tan Yellow Green Grey Brown Black	Tn Yl Gn Gy Br Bk
SUSP MATL	Suspended matter in water: None Heavy Light	- Hvy Lgt
Miscellaneous	Refers to missing data in any field no sample material for analysis parts per million parts per billion percent weight (of sample) gram	* ns ppm ppb pct Wt gm