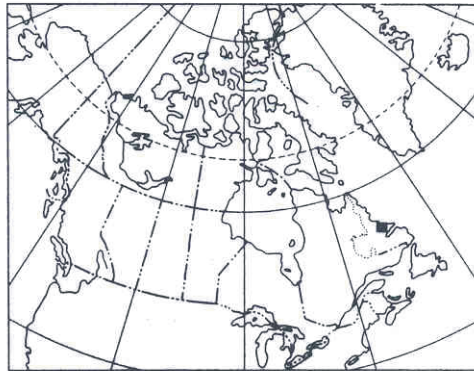


GEOLOGICAL SURVEY OF CANADA OPEN FILE 1636 (REV. 1989)
NEWFOUNDLAND OPEN FILE LAB 767
(Parts of 13I, 13J, 13K, 13N and 13O)
CANADA-NEWFOUNDLAND MINERAL DEVELOPMENT AGREEMENT (1984-1989)

**REGIONAL LAKE SEDIMENT AND WATER
GEOCHEMICAL RECONNAISSANCE DATA,
EAST-CENTRAL LABRADOR**



INDEX MAP

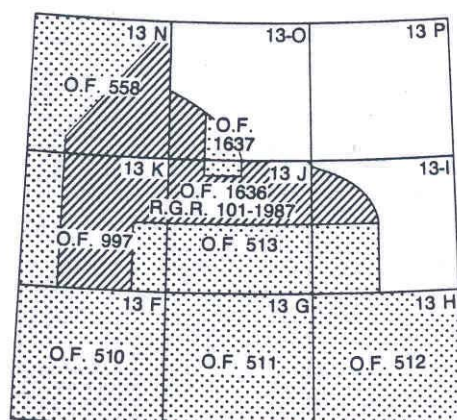
| | |
|-----------------------------|---|
| Project Director: | E.H.W. Hornbrook |
| Project Coordinator: | P.W.B. Friske |
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Hornbrook, E.H.W. and Friske, P.W.B.

1989: National Geochemical Reconnaissance Lake Sediment and Water Data, East-Central Labrador (Parts of 13I, 13J, 13K, 13N and 13O) Geological Survey of Canada Open File 1636 (Rev. 1989)

**NATIONAL GEOCHEMICAL RECONNAISSANCE
LAKE SEDIMENT AND WATER GEOCHEMICAL DATA
LABRADOR 1988
GSC OPEN FILE 1636 (REV. 1989), NGR 101-1988, LAB 767
PARTS OF NTS 13I, 13J, 13K, 13N AND 13O**



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX
TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS
SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE
ET INDEX DES CARTES ATTENANTES PUBLIÉES PAR
LA COMMISSION GÉOLOGIQUE DU CANADA

Open File 1636 (Rev. 1989) represents a contribution to the Canada – Newfoundland Mineral Development Agreement (1984-1989), 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, LABRADOR 1988, GSC OF 1636 (REV. 1989), NGR 101-1988, NFLD OF LAB 767; PARTS OF NTS 13I, 13J, 13K, 13N AND 13O

Geological Survey of Canada Open File 1636 (Rev. 1989), Newfoundland Department of Mines and Energy Open File LAB 767

Regional Lake Sediment and Water Geochemical Reconnaissance Data, Central Labrador, consisting of parts of NTS 13I, 13J, 13K, 13N and 13O

INTRODUCTION

Open File 1636 (Rev. 1989) contains revised data for gold, with summary and element statistics not included in Open File 1636. The original file contained new data for gold and 25 other elements from re-analysis by instrumental neutron activation of lake sediments collected from areas in east-central Labrador in 1977, 1978 and 1983. Analytical data selected from GSC Open Files 513, 558 and 997 for up to 16 elements in sediments, as well as uranium, fluoride and pH values of concomitant waters are also included in this open file.

The original reconnaissance surveys were undertaken by the Geological Survey of Canada in conjunction with the Newfoundland Department of Energy and Mines under the Canada-Newfoundland agreement on a Uranium Reconnaissance Program (1976-1982) and Canada-Newfoundland Cooperative Mineral Program (1982-1984). Analyses of archived samples for Open File 1636 were funded under the Canada - Newfoundland Mineral Development Agreement (1984-1989).

The data base of the survey contributes to a national geochemical reconnaissance which is used for resource assessment, mineral exploration and geological mapping. Regional survey sample collection and preparation procedures, analytical methods and repeatability of results are therefore strictly specified and controlled. In this way, consistent data can be systematically obtained in different areas in different years from different analytical laboratories.

CREDITS

E.H.W. Hornbrook directed the survey and archived analysis programs.

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 collection, preparation and analysis and were managed by the following staff of the Exploration Geochemistry Subdivision:

Collection: Marshall Macklin Monaghan Ltd., Toronto, Ontario
E.H.W. Hornbrook
Y.T. Maurice
N.G. Lund

Preparation: Golder Associates, Ottawa, Ontario
J.J. Lynch

Analysis: Bondar-Clegg and Company Ltd., Ottawa (1988) - sediments
Chemex Labs Ltd., Vancouver (1977, 1978, 1983) - sediments
Atomic Energy of Canada, Ltd., Ottawa (1977, 1978) - U
Barringer-Magenta Limited, Toronto (1977, 1978) - waters
Acme Analytical Laboratories Limited, Toronto (1983) - waters

M. McCurdy and H.R. Schmitt coordinated and edited open files production.

A.C. Galletta and D. Wright managed the digital geochemical data and provided computer processing support. Computing services were provided by the Computer Science Centre, EMR. The plotting was done by Canada Lands Data Systems staff at Environment Canada, Hull, Quebec.

H. Gross developed microcomputer software to produce data listings and summary statistics.

J. Yelle and F. Williams of the Geological Information Division supervised the preparation of open file base maps by Cartography Unit A-2.

M. McCurdy, S. Cook, C.C. Durham, M.A. Blondin and A.A. Mills-McCurdy provided technical support and editing assistance.

DESCRIPTION OF SURVEY AND SAMPLE MANAGEMENT

Helicopter-supported sample collection was carried out during the summer of 1977, 1978 and 1983.

Lake sediment and water samples were collected at an average density of one sample per 13 square kilometres throughout the 17 000 square kilometres of the central Labrador survey.

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

The field data were recorded on standard lake sediment field cards (Rev. 74) used by the Geological Survey of Canada (Garrett, 1974).

In Ottawa, field dried samples were air-dried, crushed, ball milled and sieved. The minus 80 mesh (177 micron) fraction was 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.

On receipt, field and analytical data were processed with the aid of computers.

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.

The sample site coordinates were checked as follows: a sample location map was produced on a Calcomp 1051 drum plotter using the digitized coordinates; the field contractor's sample location map was then overlaid with the Calcomp 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 5 to 10 g) is irradiated for 20 minutes in a neutron flux with an approximate density of 5.3×10^{11} neutrons/square cm/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 INA 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. 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, Fe, Cd, and As a 1 gram sample was reacted with 6 mL of a mixture of 4 M 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, Fe and Cd were determined by atomic absorption spectroscopy using an air-acetylene flame. Background corrections were made for Pb, Ni, Co, Ag and Cd.

Arsenic was determined in 1978 and 1983 by atomic absorption using a hydride evolution method wherein the hydride (AsH₃) is evolved and passed through a heated quartz tube in the light path of an atomic absorption spectrophotometer. The method is described by Aslin (1976). Detection limit = 1 ppm.

Molybdenum and vanadium were determined by atomic absorption spectroscopy using a nitrous oxide acetylene flame. A 0.5 gram 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 was continued at 90° C for an additional 90 minutes. After cooling, 8 mL of 1250 ppm Al solution were added and the sample solution was diluted to 10 mL before aspiration. Detection limit = Mo - 2 ppm; V - 5 ppm.

Mercury was determined by the Hatch and Ott Procedure with some modifications. The method is described by Jonasson et al. (1973). A 0.5 gram sample was reacted with 20 mL concentrated HNO₃ and 1 mL concentrated HCl in a test-tube for 10 minutes at room temperature prior to 2 hours of digestion with mixing at 90° C in a hot water bath. After digestion, the sample solutions were cooled and diluted to 100 mL with metal-free water. The Hg present was reduced to the elemental state by the addition of 10 mL 10% w/v SnSO₄ in M H₂SO₄. The Hg vapour was then flushed by a stream of air into an absorption cell mounted in the light path of an atomic absorption spectrophotometer. Absorption measurements were made at 253.7 nm. Detection limit = 10 ppb.

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 was left at this temperature for 4 hours, then allowed to cool to room temperature for weighing. Detection limit = 1.0 pct.

Uranium was determined using a neutron activation method with delayed neutron counting. A detailed description of the

method is provided by Boulanger et al. (1975). In brief, a 1 gram sample is weighed into a 7 dram polyethylene vial, capped and sealed. The irradiation is provided by the Slowpoke reactor with an operating flux of 10^{12} neutrons/sq cm/sec. The samples are pneumatically transferred from an automatic loader to the reactor, where each sample is irradiated for 60 seconds. After irradiation, the sample is again transferred pneumatically to the counting facility where after a 10 second delay the sample is counted for 60 seconds with six BF3 detector tubes embedded in paraffin. Following counting, the samples are automatically ejected into a shielded storage container. Calibration is carried out twice a day as a minimum, using natural materials of known uranium concentration. Detection limit = 0.2 ppm.

Fluoride in lake water samples was determined using a fluoride electrode. Prior to measurement an aliquot of the sample was mixed with an equal volume of TISAB II buffer solution (total ionic strength adjustment buffer). The TISAB II buffer solution is prepared as follows: to 50 mL metal-free water add 57 mL glacial acetic acid, 58 gm NaCl and 4 gm CDTA (cyclohexylene dinitrilo tetraacetic acid). Stir to dissolve and cool to room temperature. Using a pH meter, adjust the pH between 5.0 and 5.5 by slowly adding 5 M NaOH solution. Cool and dilute to one litre in a volumetric flask. Detection limit = 20 ppb.

Hydrogen ion activity (pH) was measured with a combination glass-calomel electrode and a pH meter.

Uranium in waters was determined by a laser-induced fluorometric method using a Scintrex UA-3 uranium analyser. A complexing agent, known commercially as fluran and composed of sodium pyrophosphate and sodium monophosphate (Hall, 1979) is added to produce the uranyl pyrophosphate species which fluoresces when exposed to the laser. Since organic matter in the sample can cause unpredictable behaviour, a standard addition method was used. Further, there have been instances at the GSC where the reaction of uranium with fluran is either delayed or sluggish; for this reason an arbitrary 24 hour time delay between the addition of the fluran and the actual reading was incorporated into this method. In practice 500 μ L of fluran solution were added to a 5 mL sample and allowed to stand for 24 hours. At the end of this period fluorescence readings were made with the addition of 0.0, 0.2 and 0.4 ppb U. For high samples the additions were 0.0, 2.0 and 4.0 (20 μ L aliquots of either 55 or 550 ppb U were used). All readings were taken against a sample blank. Detection limit = .05 ppb (1983).

Table 1 provides a summary of analytical data and methods

TABLE 1. Summary of Analytical Data and Methods

| Element | Detection level (1977,1978/1983) | Detection level (1988) | Method(s) |
|----------------------|----------------------------------|------------------------|------------|
| <u>SEDIMENTS:</u> | | | |
| Zn Zinc | 2 ppm | | AAS |
| Cu Copper | 2 ppm | | AAS |
| Pb Lead | 2 ppm | | AAS |
| Ni Nickel | 2 ppm | 20 ppm | AAS/INAA |
| Co Cobalt | 2 ppm | 5 ppm | AAS/INAA |
| Ag Silver | 0.2 ppm | | AAS |
| Mn Manganese | 5 ppm | | AAS |
| As Arsenic | 1 ppm | 0.5 ppm | AAS/INAA |
| Mo Molybdenum | 2 ppm | 1 ppm | AAS/INAA |
| Fe Iron | 0.02 pct | 0.2 pct | AAS/INAA |
| Hg Mercur | 10 ppb | | AAS |
| LOI Loss-on-ignition | 1.0 pct | | GRAV |
| U Uranium | 0.5 ppm | 0.2 ppm | NADNC/INAA |
| F Fluorine | 40 ppm | | ISE |
| V Vanadium | 5 ppm | | AAS |
| Cd Cadmium | 0.2 ppm | | AAS |
| Sb Antimony | 0.2 ppm | 0.1 ppm | INAA |
| Na Sodium | | 0.02 pct | INAA |
| Sc Scandium | | 0.2 ppm | INAA |
| Cr Chromium | | 20 ppm | INAA |
| Br Bromine | | 0.5 ppm | INAA |
| Rb Rubidium | | 5 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 | | 0.05 ppm | INAA |
| Eu Europium | | 1 ppm | INAA |
| Tb Terbium | | 0.5 ppm | INAA |
| Yb Ytterbium | | 2 ppm | INAA |
| Lu Lutecium | | 0.2 ppm | INAA |
| Hf Hafnium | | 1 ppm | INAA |
| Ta Tantalum | | 0.5 ppm | INAA |
| W Tungsten | | 1 ppm | INAA |
| Au Gold | | 2 ppb | INAA |
| Th Thorium | | 0.2 ppm | INAA |
| <u>WATERS:</u> | | | |
| F Fluoride | 20 ppb | | ISE |
| pH | | | GCM |
| U Uranium (1977/78) | 0.01 ppb | | FT |
| U Uranium (1983) | 0.05 ppb | | LIF |
| wt Test weight | | ± 0.01 g | |

- AAS - Atomic absorption spectrometry
- INAA - Instrumental neutron Activation Analysis
- GRAV - Gravimetry
- ISE - Ion selective electrode
- GCM - Glass Calomel electrode and pH meter
- LIF - Laser-induced fluorescence
- NADNC - Neutron Activation delayed neutron counting
- FT - Fission track analyses

PRESENTATION AND INTERPRETATION OF GOLD DATA

The following discussion reviews the format used to present the Au 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 Au in nature and the resultant difficulties in obtaining and analyzing which reflect the actual concentration level at a given site.

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

- (1) Au occurs most commonly in the native form which is chemically and physically resistant. A high proportion of the metal is dispersed in micron-sized particulate form. Gold's high specific gravity results in heterogeneous distribution, especially in stream sediment and clastic-rich (low LOI) lake sediment environments. Au distribution appears to be more homogeneous in organic-rich fluvial and lake sediment environments.
- (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 1 ppb.

These factors result in a particle sparsity effect wherein very low concentrations of Au are heterogeneously enriched in the surficial environment. Hence, a major problem facing the geochemist is to obtain a representative sample. In general, the lower the actual concentration of Au the larger the sample size, or the smaller the grain size required to reduce uncertainty over whether subsample analytical values truly represent actual values. Conversely, as actual Au concentrations increase or grain size decreases, the number of Au particles to be shared in random subsamples increases and the 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 Au analyses. Therefore, to the extent that sample representivity can be increased, sample grain size is reduced by sieving and ball milling of all samples.

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

- (1) For each block of twenty 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 control sampling variance;
 - (c) analysis of a second subsample (blind duplicate) from one sample to control short-term precision.
- (2) For both stream sediments and lake sediments, routine repeat analyses on a second subsample are performed for all samples having values that are statistically above approximately the 90th percentile of total data set.
- (3) For lake sediments only, a routine repeat analysis on a second subsample is performed on those samples with LOI values below 10%, indicating a large clastic component. On-going studies suggest that the Au distribution in these samples is more likely to be variable than in samples with a higher LOI content.

Au data presentation, statistical treatment and the value map format are different than for other elements. Au data listed in the open file may include initial analytical results, values determined from repeat analyses, together with sample weights and corresponding detection limits for all analyzed samples. The gold, statistical parameters and regional symbol trend plots are determined using only the first analytical value. Au values less than the detection limit (<2 ppb) for 10 g samples are set to 1.0 ppb.

On the value map, repeat analysis values, where determined (not field duplicates), are placed in brackets following the initial value. Sample weights used can be determined from the text. Following are possible variations in data presentation on a value map:

| | |
|----------|---|
| * | No data |
| + 27 | Single analysis |
| +27 (14) | Repeat analysis |
| + <1 | Single analysis, 10g sample, less than detection limit of 2 ppb |

In summary, geochemical follow-up investigations for Au 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 Au 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 methodology and interpretation.

LAKE SEDIMENT DATA LIST LEGEND

Table 2 lists both the field and map information which is recorded at each sample site and is listed in the accompanying data listings.

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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*, Geological Survey of Canada Paper 73-21.

TABLE 2. DATA LIST LEGEND

| FIELD RECORD | DEFINITION | TEXT CODE |
|--------------|--|--|
| MAP | National Topographic System (NTS): lettered quadrangle (1:250 000 scale) or (1:50,000 scale). Part of sample number. | 013I,013J, 013K,013N 013O |
| SAMPLE ID | Remainder of sample number: Year Field Crew Sample sequence number | 19xx 1, 3, 5, 7 001 - 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 types of lake atachment area: Garnet gneiss Granite gneiss Acid extrusive Quartzite Basic extrusive Gneiss Norite Anorthosite Granite Gabbro Hornblende gneiss Granodiorite gneiss Schist Quartz monzonite = adamellite Helikian/Aphebian Grenville Province Metaquartzite, greenstone Garnet-biotite paragneiss Paragneiss Churchill Province Quartzite, greenstone Nain Province Intermed. to acid volcanics Conglomerate, quartzite, slate Feldspathic quartzite, basic volcanics Slate, argillite, dolomite Archean Grenville Province Granitic gneiss, amphibolite Nain Province Mafic schists, ultrabasics Granitic gneiss, amphibolite INTRUSIVE ROCKS Helikian Diabasic olivine gabbro Gabbro, norite sills Adamellite suite Anorthosite suite Aphebian Granite to quartz diorite Granitic gneiss, amphibolite | GRGS GRNG AEXV ORTZ BEXV GNSS NORT ANRS GRNT GBBR HBDG GRDG SCST QZMZ HAGS HAGP HUGP NHWS VNHW NHWK PHLE,UPHE APE3 APE2 APE1,VAE1 ARCG AREV AREG NH17 NH16 PH13 PH11 APH7 APH5 |

TABLE 2 - Continued

| FIELD RECORD | DEFINITION | TEXT CODE |
|----------------|--|----------------------------------|
| ROCK AGE | Stratigraphic age of dominant rock type in catchment basin: Cambrian and earlier Helikian and/or Aphebian Aphebian Archean | 08 06 05 02 |
| LAKE AREA | The area of the water bod sampled: Pond ¼ to 1 sq. km 1 to 5 sq km greater than 5 sq km | POND .25 – 1 1 – 5 > 5 |
| LAKE DEPTH | Sample depth from surface of water body to lake bottom in meters | 1 - 999 |
| TERRAIN RELIEF | Relief of the lake catchment basin: Low Medium High | Lo Md Hi |
| SAMPLE CONT. | Contamination; human or natural None Work Camp Fuel Gossan | - Wo Ca Fu Go |
| 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 MATERIAL | Suspended matter in water: None Heavy Light | - Hvy Lgt |