

GEOLOGICAL SURVEY OF CANADA

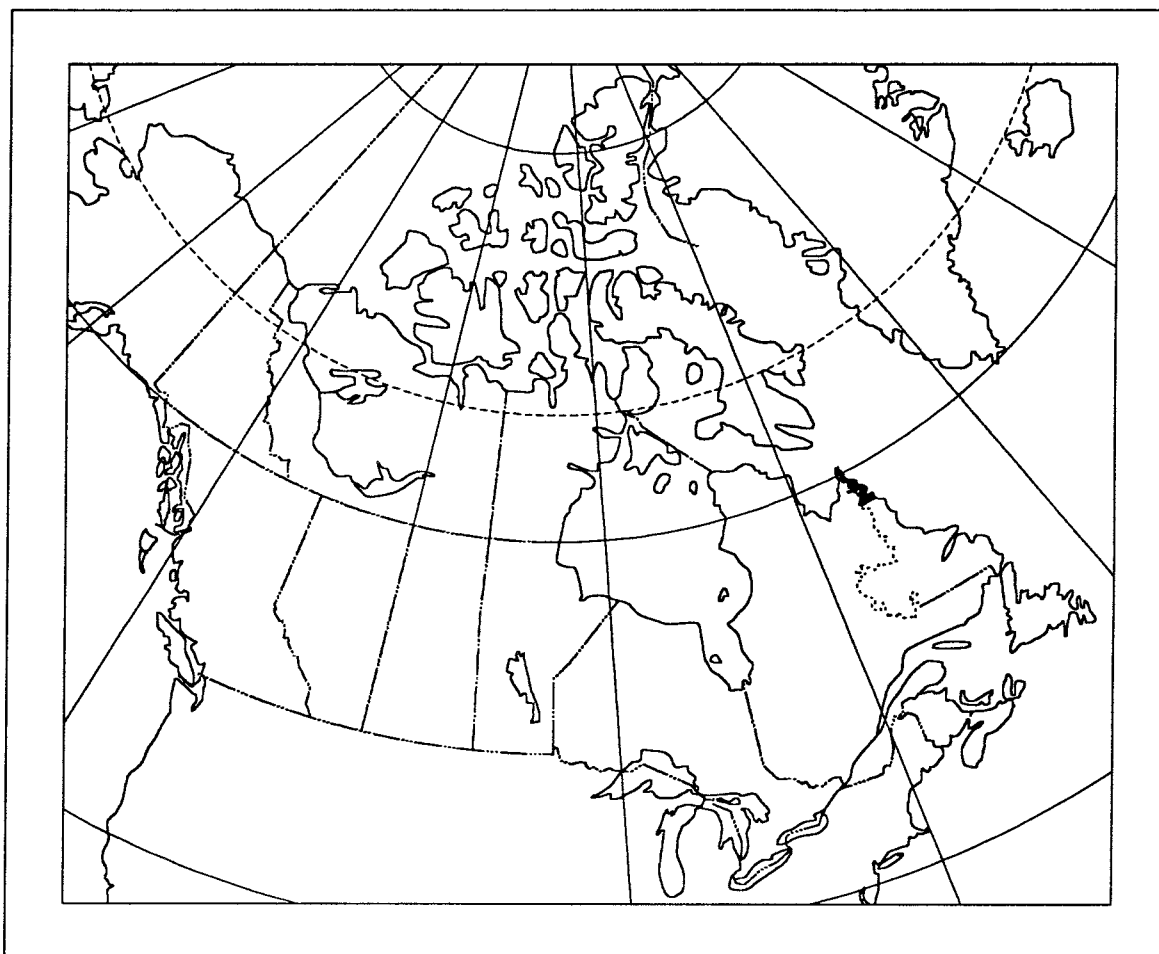


COMMISSION GÉOLOGIQUE DU CANADA

**GEOLOGICAL SURVEY OF CANADA OPEN FILE 2794
(NTS 14M AND PARTS OF 14L, 24I, 24P, AND 25A)**

**CANADA - NEWFOUNDLAND COOPERATION AGREEMENT
ON MINERAL DEVELOPMENT (1990-1994)**

**REGIONAL STREAM SEDIMENT AND WATER
GEOCHEMICAL RECONNAISSANCE DATA
NORTHERN LABRADOR**



Friske, P.W.B., McCurdy, M.W., Gross, H., Day, S.J., Balma, R.G., Lynch, J.J., Durham, C.C. (1994):
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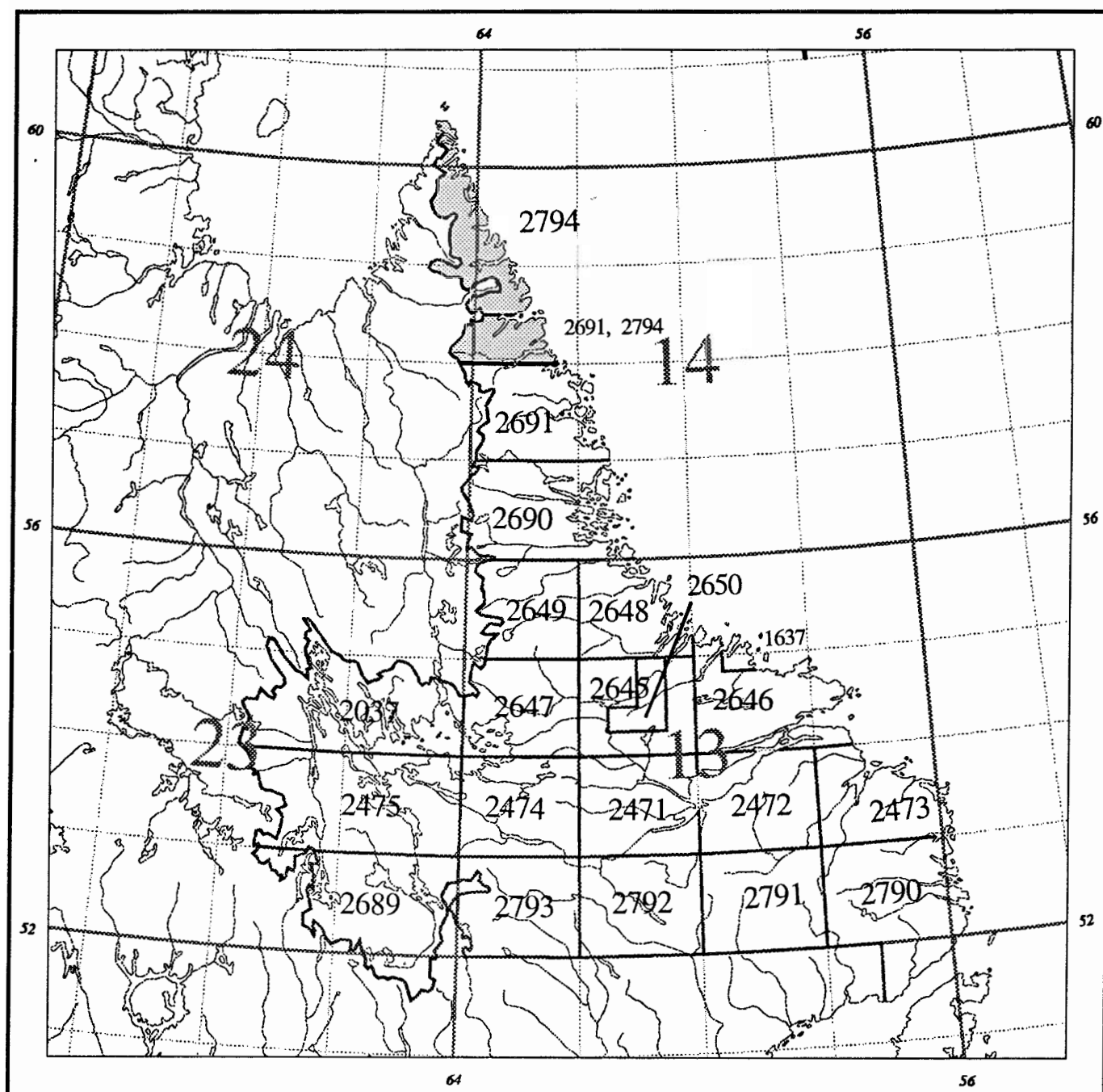


Natural Resources
Canada

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NATIONAL GEOCHEMICAL RECONNAISSANCE
STREAM SEDIMENT AND WATER GEOCHEMICAL DATA
NEWFOUNDLAND 1994
GEOLOGICAL SURVEY OF CANADA OPEN FILE 2794
NTS 14M AND PARTS OF 14L, 24I, 24P, AND 25A



**National Topographic System reference and index to adjoining
geochemical reconnaissance surveys**

Open File 2794 represents a contribution to the Canada – Newfoundland Cooperation Agreement on Mineral Development (1990–1994), a subsidiary agreement under the Economic and Regional Development Agreement. This project was managed by the Geological Survey of Canada.

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GSC OPEN FILE 2794

REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL DATA, LABRADOR NTS 14M and parts of 14L, 24I, 24P, and 25A

INTRODUCTION

Open File 2794 contains data for gold and 25 other elements obtained by re-analyzing lake sediments collected in 1986 from 1 244 sites in northern Labrador. Original analytical data selected from Open File 1354 (published in 1987) for 20 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 (GSC) in conjunction with the Newfoundland Department of Mines and Energy under the terms of the Canada - Newfoundland Mineral Development Program (1984-1989).

Regional geochemical surveys have been carried out by the GSC in Labrador since 1977. A total of 21 open files are available that provide complete coverage of Labrador. Areas surveyed, with associated open file numbers, are shown in Figure 1. Figure 2 illustrates geochemical coverage across Canada. Data from all open files are available on 3.5 or 5.25 inch diskettes, or in the original published form.

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, 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

P.W.B. Friske coordinated the activities of contract and GSC staff under the reanalysis program.

E.H.W. Hornbrook directed the original survey.

Contracts were let to the following companies for sample collection, preparation, original analyses and reanalyses and were managed by Geological Survey of Canada staff as follows:

Collection: MPH Consulting, Ltd.
Toronto, Ontario
P.W.B. Friske, H.R. Schmitt (GSC)

Preparation: Golder Associates
Ottawa, Ontario
J.J. Lynch (GSC)

Analysis (1986): Chemex Labs Ltd.
North Vancouver, British Columbia

Bondar-Clegg & Company
Gloucester, Ontario

Barringer-Magenta Labs (Alta.) Ltd.
Calgary, Alberta

J.J. Lynch (GSC)

Preparation (1992): Bondar-Clegg & Company
Ottawa, Ontario
J.J. Lynch, D.J. Ellwood (GSC)

Analysis (1992): Becquerel Laboratories
Mississauga, Ontario
J.J. Lynch (GSC)

M. McCurdy edited open files and coordinated open file production.

H. Gross provided computer processing support.

C.C. Durham, S.J. Day, S. Carberry, and R.G. Balma provided technical assistance.

DESCRIPTION OF SURVEY AND SAMPLE MANAGEMENT

Helicopter-supported sample collection was carried out during the summer of 1986. Stream sediment and water samples were collected at an average density of one sample per 10.2 km² throughout the 12 634 square kilometres covered by the 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).

Site positions were marked on 1:250 000 scale NTS maps in the field and later digitized at the Geological Survey in Ottawa to obtain Universal Transverse Mercator (UTM) coordinates. The dominant rock types in the stream catchment basins were identified on appropriate geological maps used as the bedrock geological base on NGR maps.

In Ottawa, field-dried samples were air-dried and sieved through a minus 80 mesh (177 micron) screen before milling in ceramic ball mills. This 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. Additional stream sediment material required for INAA analyses was taken from archive storage. Particle reduction was accomplished using a ceramic puck mill.

Analytical data from labs were monitored for reliability with standard methods used by the Applied Geochemistry Subdivision at the GSC.

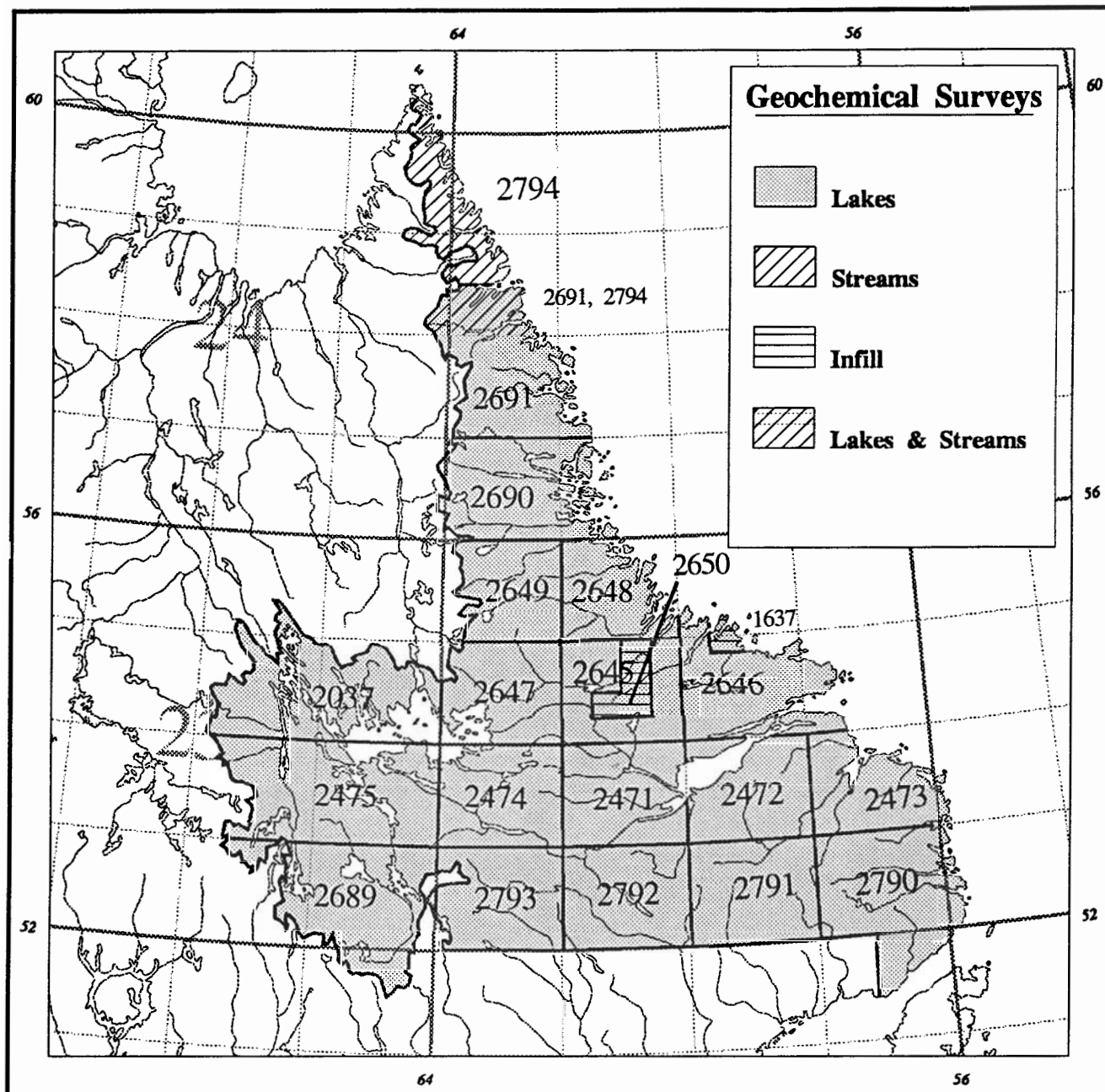


Fig. 1. Areas of Labrador covered by geochemical surveys, showing current GSC open file numbers.

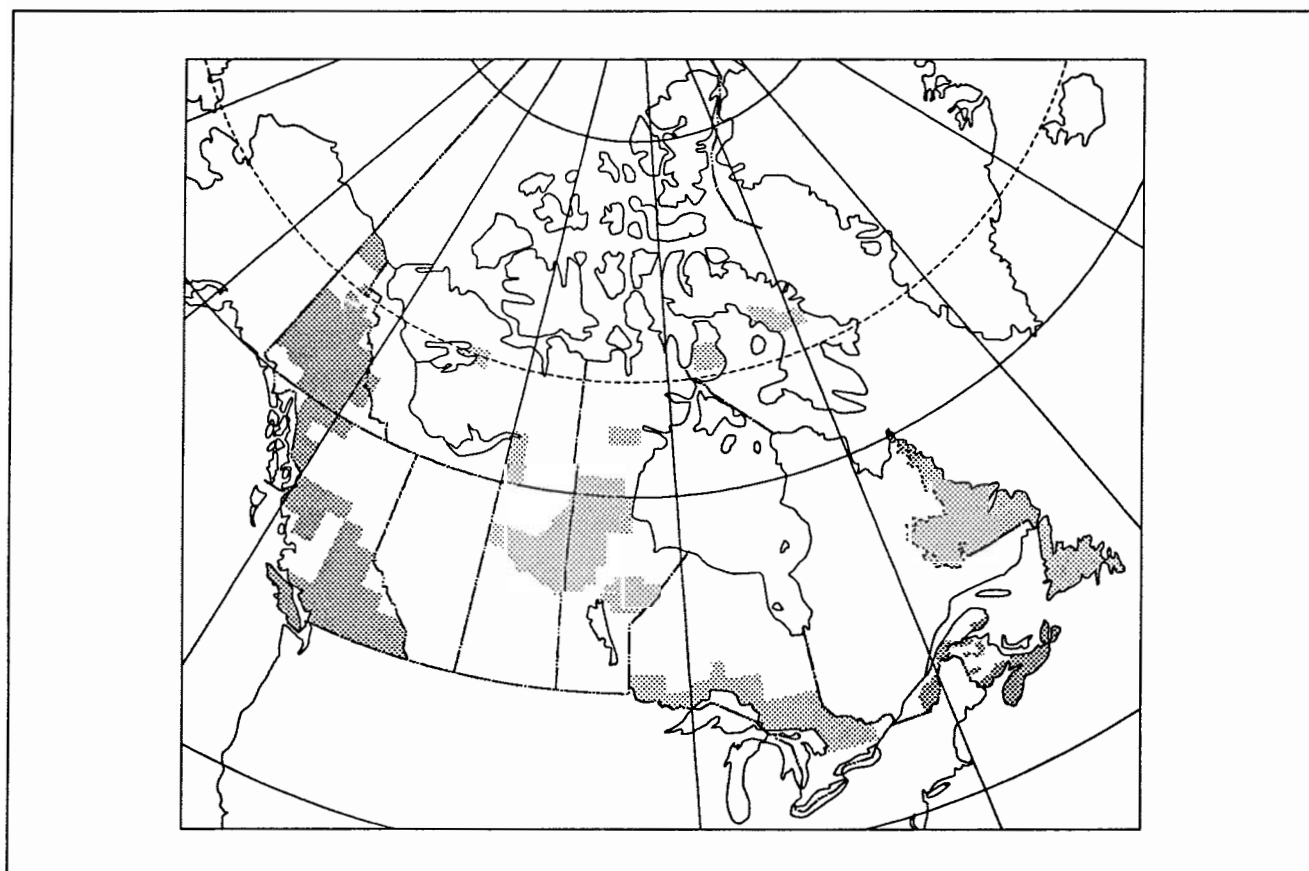


Fig. 2. Drainage surveys to National Geochemical Reconnaissance standards.

ANALYTICAL PROCEDURES

Instrumental Neutron Activation Analysis (INAA)

Weighed and encapsulated samples are packaged for irradiation along with internal standards and international reference materials. Samples and standards are irradiated together with neutron flux monitors in a two-megawatt pool-type reactor. After a seven day decay period, samples are measured on a high resolution germanium detector. Computer control is achieved with a Microvax II computer. Typical counting times are 500 seconds. Elements determined by INAA include: Ag, As, Au, Ba, Br, Cd, Ce, Co, Cr, Cs, Eu, Fe, Hf, Ir, La, Lu, Mo, Na, Ni, Rb, Sb, Sc, Se, Sm, Sn, Ta, Tb, Te, Th, U, W, Yb, Zn, and Zr. The sample weights are also reported. Data for Ag, Cd, Ir, Se, Sn, Te, Zn, and Zr 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, and Cd, a 1 gram sample was reacted with 3 ml concentrated HNO_3 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 degrees C and held at this temperature for 30 minutes with periodic shaking. One ml of concentrated HCl was added and heating continued for another 90 minutes. 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 by atomic absorption using a hydride evolution method wherein the arsenic was evolved as AsH_3 and passed through a heated quartz tube in the light path of an atomic absorption spectrophotometer. The method is described by Aslin (1976).

Molybdenum and vanadium were determined by atomic absorption spectroscopy using a nitrous oxide acetylene flame. A 0.5 g sample was reacted with 1.5 ml concentrated HNO_3 at 90 degrees C for 30 minutes. At this point 0.5 ml concentrated HCl was added and the digestion continued at 90 degrees 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.

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 HNO_3 and 1 ml concentrated HCl in a test tube for 10 minutes at room temperature prior to two hours of digestion at 90 degrees C in a hot water bath with periodic mixing. 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 SnSO_4 in M H_2SO_4 . 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.

Loss-on-ignition was determined using a 500 mg sample. The sample, weighed into a 30 ml beaker, was placed in a cold muffle furnace and brought up to 500 degrees C over a period of two to three hours. The sample was held at this temperature for four hours, 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 brief, a 1 gram sample was weighted into a 7 dram polyethylene vial, capped, and sealed. The irradiation was provided by the Slowpoke reactor with an operating flux of 5×10^{11} 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, each sample was counted for 20 seconds with six helium detector tubes imbedded in paraffin. Following counting, samples were automatically ejected into a shielded storage container. Calibration was carried once a day as a minimum, using natural materials of known uranium concentration.

Fluorine was determined as described by Ficklin (1970). A 250 mg sample was sintered with 1 gram of a flux consisting of two parts by weight sodium carbonate and one part by weight potassium nitrate. The residue was then leached with water. The sodium carbonate was neutralized with 10 ml 10% (w/v) citric acid and the resulting solution was diluted to 100 ml with water. The pH of the solution should range from 5.5 to 6.5. The fluoride content of the test solution was measured using a fluoride ion electrode. Standard solutions contained sodium carbonate and citric acid in the same quantities as the sample solution.

Gold was usually determined on a 10 g sediment sample: depending on the amount of sample available, lesser weights were sometimes used. This resulted in a variable detection limit; 2 ppb for a 5 g sample, 1 ppb for a 10 g sample... The sample was fused to produce a lead button, collecting any gold in the sample, which was cupelled in a muffle furnace to produce a silver (dore) bead. The silver beads were irradiated in a neutron flux for one hour, cooled for four hours, and counted by gamma ray spectrometry. Calibration was carried out using standard and blank beads.

Tungsten was determined as follows: a 0.2 g sample of sediment was fused with 1 g $\text{K}_2\text{S}_2\text{O}_7$ in a rimless test tube at 575 degrees C for 15 minutes in a furnace. The cooled melt was then leached with 10 ml concentrated HCl in a water bath heated to 85 degrees C. After the soluble material had completely dissolved, the insoluble material was allowed to settle

and an aliquot of 5 ml transferred to another test tube. Five ml of 20% SnCl_2 solution were then added to the sample aliquot, mixed, and heated for 10 minutes at 85 degrees C in a hot water bath. A 1 ml aliquot of dithiol solution (1% dithiol in iso-amyl acetate) was added to the test solution and the test solution then heated for 4 - 6 hours at 80 to 85 degrees C in a hot water bath. This solution was then removed from the hot water bath, cooled and 2.5 ml of kerosene added to dissolve the globule. The colour intensity of the kerosene solution was measured at 630 nm using a spectrophotometer. The method is described by Quin and Brooks (1972). Detection level = 2 ppm.

Tin in stream sediments was determined by heating a 200 mg sample with NH_4I : the sublimed SnI_4 is dissolved in acid and the tin determined by atomic absorption spectrometry after solvent extraction of the tin into methyl isobutyl ketone containing trioctylphosphine oxide (TOPO). The method is described by E.P. Welsch and T.T. Chao.

Antimony was determined as described by Aslin (1976). A 500 mg sample was placed in a test tube; 3 ml concentrated HNO_3 and 9 ml concentrated HCl were added and the mixture allowed to stand overnight at room temperature. The mixture was heated slowly to 90 degrees C and maintained at this temperature for at least 90 minutes. The solution was cooled and diluted to 10 ml. A 400 microlitre aliquot of this solution was diluted to 10 ml with 1.8M HCl . The antimony in an aliquot of this dilute solution was then determined by hydride evolution-atomic absorption spectrometry.

Barium was determined as follows: a 0.25 g sample was heated with 5 ml concentrated HF , 5 ml concentrated HClO_4 , and 2 ml concentrated HNO_3 to fumes of HClO_4 . Three ml of concentrated HClO_4 were added and heated to light fumes. Five ml of water were then added and the solution was transferred to a calibrated test tube and diluted to 25 ml with water. Barium was determined by atomic absorption spectroscopy using a nitrous oxide acetylene flame.

Water Analyses

Uranium in waters was determined by a laser-induced fluorometric method using a Scintrex UA-3 uranium analyzer. A complexing agent, known commercially as Fluran and composed of sodium pyrophosphate and sodium monophosphate (Hall, G.E.M., 1979) was added to produce the uranyl pyrophosphate species, which fluoresces when exposed to the laser. Since organic matter in the sample could cause unpredictable behaviour, a standard addition method was used. Further, the reaction of uranium with Fluran may either be 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 microlitres 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 uranium. For samples with higher concentrations, the

additions were 0.0, 2.0, and 4.0 ppb uranium (20 μl aliquots of 55 or 550 ppb U were used). All readings were taken against a sample blank.

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

Fluoride in 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 was prepared as follows: to 50 ml metal-free water were added 57 ml glacial acetic acid, 58 g NaCl and 4 g CDTA (cyclohexylene dinitrilo tetraacetic acid). The solution was stirred to dissolve and cooled to room temperature. Using a pH meter, the pH was adjusted to between 5.0 and 5.5 by slowly adding 5 M NaOH solution. The solution was cooled and diluted to one litre in a volumetric flask.

Table 1 provides a summary of analytical data and methods.

COMPARISON OF DATA PRODUCED BY TWO METHODS

The data listed in II-1 to II-81 allows users to make a comparison of data generated by two different analytical methods for a number of elements. Before attempting such a comparison some caution should be exercised.

1. The original data for Ni, Co, As, Mo, Sb, and Fe were obtained by AAS using a partial extraction (HNO_3 and HCl). The data for these elements obtained on re-analysis are by INAA, which produces 'total' data. Hence, the original data will likely be somewhat lower than the INAA data.
2. The data for U, Au, and Ba were derived by a 'total' method, both originally and on re-analysis.
3. The sample preparation for the original analyses differed from the preparation employed for the re-analysis. Originally, a portion of the collected sample was prepared. Prior to re-analysis all of the remaining original sample was prepared and bottled. As a result, most of the original data were obtained from a different split of the unprepared sample than that which was used for re-analysis. Disagreement between original and re-analyzed data for some elements might be attributed to heterogeneity of the two different splits used for the two analyses.

Table 1. Summary of Analytical Data and Methods

ELEMENT		DETECTION LEVEL		METHOD
<u>SEDIMENTS:</u>				
Ag	Silver	0.2	ppm	AAS
As	Arsenic	1	ppm	HY-AAS
As	Arsenic	0.5	ppm	INAA
Au	Gold	1	ppb	FA
Au	Gold	2	ppb	INAA
AuWt	Sample Weight	0.01	g	-
Ba	Barium	40	ppm	AAS
Ba	Barium	50	ppm	INAA
Br	Bromine	0.5	ppm	INAA
Cd	Cadmium	0.2	ppm	AAS
Ce	Cerium	5	ppm	INAA
Co	Cobalt	2	ppm	AAS
Co	Cobalt	5	ppm	INAA
Cr	Chromium	20	ppm	INAA
Cs	Cesium	0.5	ppm	INAA
Cu	Copper	2	ppm	AAS
Eu	Europium	1	ppm	INAA
F	Fluorine	40	ppm	ISE
Fe	Iron	0.02	pct	AAS
Fe	Iron	0.2	pct	INAA
Hf	Hafnium	1	ppm	INAA
Hg	Mercury	10	ppb	AAS
La	Lanthanum	2	ppm	INAA
LOI	Loss-on-ignition	1	pct	GRAV
Lu	Lutetium	0.2	ppm	INAA
Mn	Manganese	5	ppm	AAS
Mo	Molybdenum	2	ppm	AAS
Mo	Molybdenum	1	ppm	INAA
Na	Sodium	0.02	pct	INAA
Ni	Nickel	2	ppm	AAS
Ni	Nickel	10	ppm	INAA
Pb	Lead	2	ppm	AAS
Rb	Rubidium	5	ppm	INAA
Sb	Antimony	0.2	ppm	HY-AAS
Sb	Antimony	0.1	ppm	INAA
Sc	Scandium	0.2	ppm	INAA
Sm	Samarium	0.1	ppm	INAA
Sn	Tin	1	ppm	SX-AAS
Ta	Tantalum	0.5	ppm	INAA
Tb	Terbium	0.5	ppm	INAA
Th	Thorium	0.2	ppm	INAA
U	Uranium	0.2	ppm	INAA
U	Uranium	0.2	ppm	NADNC
V	Vanadium	5	ppm	AAS
W	Tungsten	2	ppm	COL
W	Tungsten	1	ppm	INAA
Yb	Ytterbium	1	ppm	INAA
Zn	Zinc	2	ppm	AAS
<u>WATERS:</u>				
F-W	Fluoride	20	ppb	ISE
pH	Hydrogen ion activity	-	-	GCM
U-W	Uranium	0.05	ppb	LIF

- | | |
|--------|---|
| AAS | - atomic absorption spectrometry |
| COL | - colorimetry |
| FA | - fire assay |
| 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 |
| SX-AAS | - solvent extraction/atomic absorption spectrometry |

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 analyzed again in accordance with standard NGR procedures. The correct interpretation of 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 (Harris, 1982) include:

- 1) Gold occurs most commonly in the native form which is chemically and physically resistant. A significant proportion of the metal is dispersed in a micron-sized particulate form, and the high specific gravity of gold results in a heterogeneous distribution, especially in stream sediment and elastic-rich (low LOI) lake sediment environments. In organic-rich fluvial and lake sediments, gold distribution appears to be more homogeneous.
- 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 in 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 or depleted 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 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 and analytical variance;
 - (c) analysis of a second subsample (blind duplicate) from one sample to measure and control short-term precision or analytical variance.

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 analogous 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

- Aslin, G.E.M. (1976) The determination of arsenic and antimony in geological materials by flameless atomic absorption spectrophotometry; *Journal of Geochemical Exploration*, Vol. 6, pp. 321-330.
- Boulanger, A., Evans, D.J.R. and Raby, B.F. (1975) Uranium analysis by neutron activation delayed neutron counting; *Proceedings of the 7th Annual Symposium of Canadian Mineral Analysts*, Thunder Bay, Ontario, September 22-23, 1975.
- Clifton, H.E., Hunter, R.E., Swanson, F.J., and Phillips, R.L. (1969) Sample size and meaningful gold analysis; *U.S. Geological Survey Professional Paper 625-C*.
- Ficklin, W.H. (1970) A rapid method for the determination of fluoride in rocks and soils, using an ion selective electrode; *U.S. Geol. Surv. Paper 700C*, pp. 186-188.

- Friske, P.W.B. and Hornbrook, E.H.W. (1991)** Canada's National Geochemical Reconnaissance Program; *in* Transactions of the Institution of Mining and Metallurgy, Section B; Volume 100, p. 47-56.
- Garrett, R.G. (1974)** Field data acquisition methods for applied geochemical surveys at the Geological Survey of Canada; Geol. Surv. Can. Paper 74-52.
- Hall, G.E.M. (1979)** A study of the stability of uranium in waters collected from various geological environments in Canada; *in* Current Research, Part A, Geological Survey of Canada Paper 79-1A, pp. 361-365.
- Harris, J.F. (1982)** Sampling and analytical requirements for effective use of geochemistry in exploration for gold; *in* Levinson, A.A., Editor, Precious Metals in the Northern Cordillera, proceedings of a symposium sponsored by the Association of Exploration Geochemists and the Cordilleran Section of the Geological Association of Canada, pp. 53-67.
- 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.
- Quinn, B.F. and Brooks, R.R. (1972)** The rapid determination of tungsten in soils, stream sediments, rocks, and vegetation; Anal. Chim. Acta., Vol. 58, pp. 301-309.
- Welsch, E.P. and Chao, T.T. (1976)** Determination of trace amounts of tin in geological materials by atomic absorption spectrometry; Anal. Chim. Acta., Vol. 82, pp. 337-342.

FIELD RECORD	DEFINITION	TEXT CODE
ROCK AGE	Stratigraphic age of dominant rock type in catchment basin: Cambrian and Earlier Paleohelikian and Earlier Neohelikian Aphebian and Earlier (?) Archean	08 06 06 05 02
SAMPLE TYPE	Sample material collected: Stream bed sediment only Spring or sediment seep Heavy mineral concentrate Stream water only Natural groundwater, spring seep Simultaneous stream sediment and water Simultaneous spring or seep water and sediment	SedOnly SpgSedOnly HvMnCn Strm GrWat Sed/Water SpgSep/Sed
STREAM WIDTH	Stream width in decimetres	
STREAM DEPTH	Stream depth in decimetres	
SAMPLE CONT.	Contamination, human or natural: None Possible Probable Definite Mining activity Industrial sources Agricultural Domestic or household Forestry activities Burned areas	- Possible Probable Definite Mining Industry Agricult Domestic Forestry Burn
BANK TYPE	Bank type; the general nature of the bank material adjacent to the sample site: Alluvial Colluvial (bare rock, residual or mountain soils) Glacial till Glacial outwash sediments Bare rock Talus scree Organic predominant (debris, peat, muskeg, swamp) ...	Alluv Colluv Till Outwash Bare Rk Tal/Scr Organic
WATER COLOUR	Water colour; the general colour and suspended load of the sampled water: Clear Brown transparent White cloudy Brown cloudy	Clear BnTrans WhCl'dy BnCl'dy
STREAM FLOW	Water flow rate: Stagnant Slow Moderate Fast Torrential	Stagnt Slow Modert Fast Torrint

FIELD RECORD	DEFINITION	TEXT CODE
SAMPLE COLOUR	Predominant sediment colour: Red-brown White-buff Black Yellow Green Grey, blue grey Pink Buff to brown Brown	Rd-Bn Wh-Bf Black Yellow Green Gy-Blu Pink Bf-Bn Brown
SAMPLE COMP.	Sediment composition; description of the bulk mechanical composition of the collected sample on a scale of 1 to 3, the total of the column must add up to 3 or 4 or 5: Size fractions are divided as follows: Column 1 >0.125 mm (sand) Column 2 <0.125 mm (fines - organic silt, clay) Column 3 organic material Amount of size fraction: sum of amounts = 3 4 5 Absent 0 0 0 0 Minor <33% 25% 20% 1 Medium 33-67% 50% 40% 2 Major >67% 75% 60% 3	
BOTTOM PCPT	Precipitate or stain; the presence of any coatings on pebbles, boulders or stream bottoms: None Red-brown White or buff Black Yellow Green Grey Pink Buff to brown	- Rd-Bn Wh-Bf Black Yellow Green Grey Pink Bf-Bn
BANK PCPT	Distinctive precipitate, stains or weathering on rocks in immediate area of catchment basin or stream bank: None Red, brown (eg. Fe) White, buff (eg. CO ₃ , Zn) Black (e.g. Fe, Mn, sulphides) Yellow (e.g. Pb, U, Fe, Mo, REE) Green (Cu, Ni, U, Mo, As, Fe) Bluish (Zn, P) Pink (Co, As)	- Rd-Bn Wh-Bf Black Yellow Green Blue Pink
STREAM PHYSIOG	General physiography of the drainage basin: Plain Muskeg, swampland Peneplain, plateau Hilly, undulating Mountainous, mature Mountainous, youthful (precipitous)	Plain Swamp Penpln Hill Moun/M Moun/Y

FIELD RECORD	DEFINITION	TEXT CODE
STREAM DRAINAGE	Drainage pattern: Poorly defined, haphazard Dendritic Herringbone Rectangular Trellis Discontinuous shield type (chains of lakes) Basinal Others	Poor Dendrc Herrbn Rectln Trellis Discnt Closed Other
STREAM TYPE	Stream type: Undefined Permanent, continuous Intermittent, seasonal Re-emergent, discontinuous	Undfnd Permnt Intermit Re-emerg
STREAM CLASS	Classification based on proximity to source: Undefined Primary Secondary Tertiary Quaternary	Undfnd Pri'ary Sec'ary Ter'ary Qua'ary
STREAM SOURCE	Source of water: Unknown Groundwater Snow melt or spring run-off Recent precipitation Ice-cap or glacier meltwater	Unknown Ground Sp'gMelt RecRain Glacier
Miscellaneous	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