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NATIONAL GEOCHEMICAL RECONNAISSANCE
STREAM SEDIMENT AND WATER SURVEY
CENTRAL NEW BRUNSWICK

(NTS 21J/02 EAST and 21J/07)



Pronk, A.G., Boldon, R., Friske, P.W.B., McCurdy, M.W., Day, S.J.A.

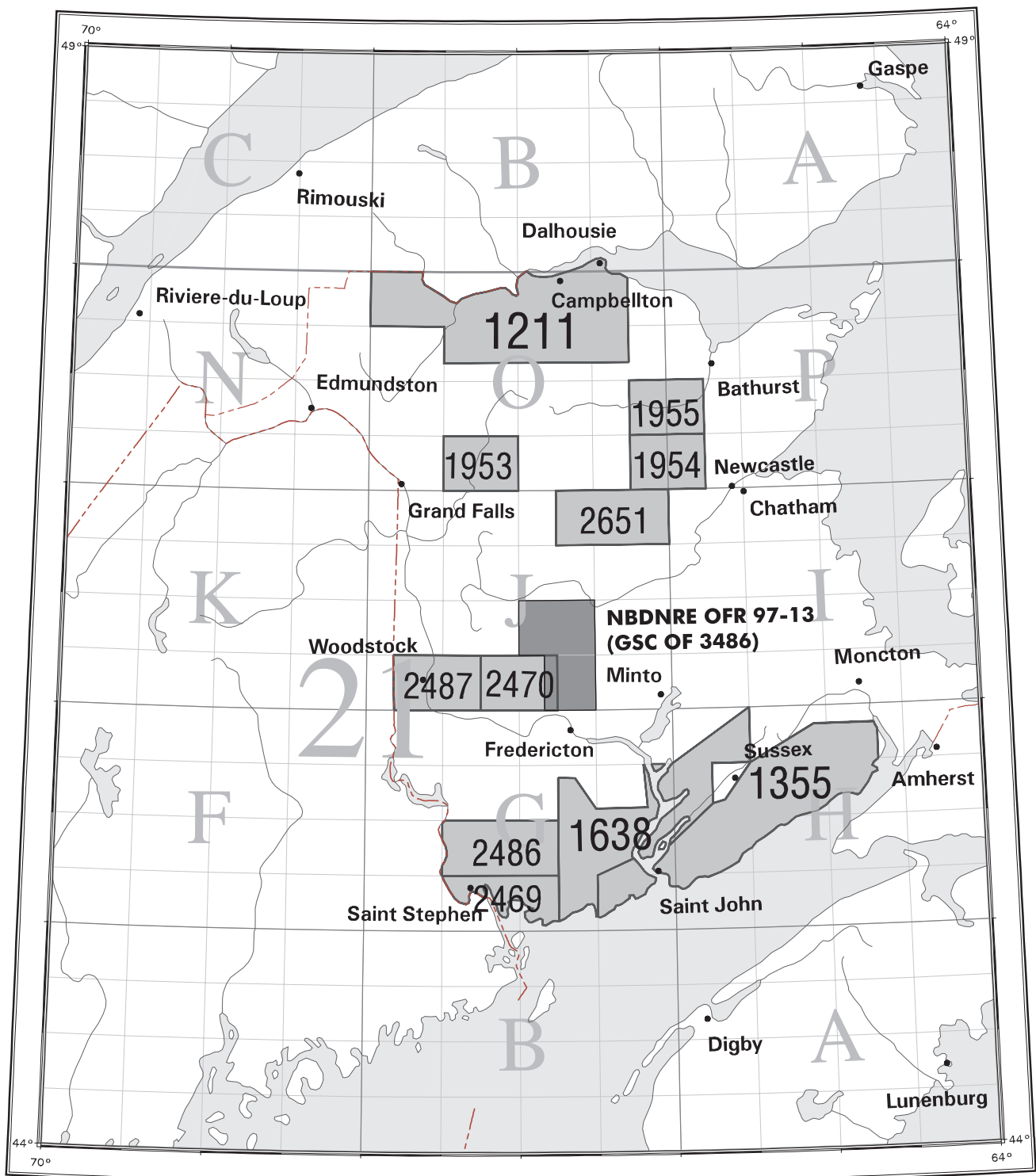
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23 October 1997

NATIONAL GEOCHEMICAL RECONNAISSANCE
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CENTRAL NEW BRUNSWICK
1997

GEOLOGICAL SURVEY OF CANADA OPEN FILE 3486
NTS 21J/02 EAST AND 21J/07

NEW BRUNSWICK DEPARTMENT OF NATURAL RESOURCES AND ENERGY
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Areas of New Brunswick covered by National Geochemical Reconnaissance surveys,
with open file numbers.

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REGIONAL STREAM SEDIMENT AND WATER DATA, CENTRAL NEW BRUNSWICK
NTS 21J/02, 21J/07**

INTRODUCTION

This open file presents analytical and statistical data for 36 elements in sediments from 755 sites collected in 1992 from central New Brunswick. Loss-on-ignition in sediments, and uranium, fluoride, and pH values in waters from these sites are included in this report. The New Brunswick Department of Natural Resources and Energy (NB DNRE), Mineral Resources Division managed the reconnaissance surveys.

Analytical results and field observations are used to build a national geochemical database 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.

Regional geochemical surveys have been carried out since 1985 in New Brunswick under the National Geochemical Reconnaissance program. A total of 12 open files have been published or are in publication, covering approximately 21 500 km² (Fig. 1).

Data from all open files are available on 3.5 or 5.25 inch diskettes and in the original published form, from:

Geological Survey of Canada Bookstore
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Ottawa, Ontario K1A 0E8

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Toll-Free: 1-888-252-4301
Fax: (613) 943-0646

This open file will be available from the above source and from:

Publications, Mineral Resources Division
New Brunswick Department of Natural Resources and Energy (NBDNRE)
P.O. Box 6000
Fredericton, New Brunswick E3B 5H1

Tel: (506) 453-2206

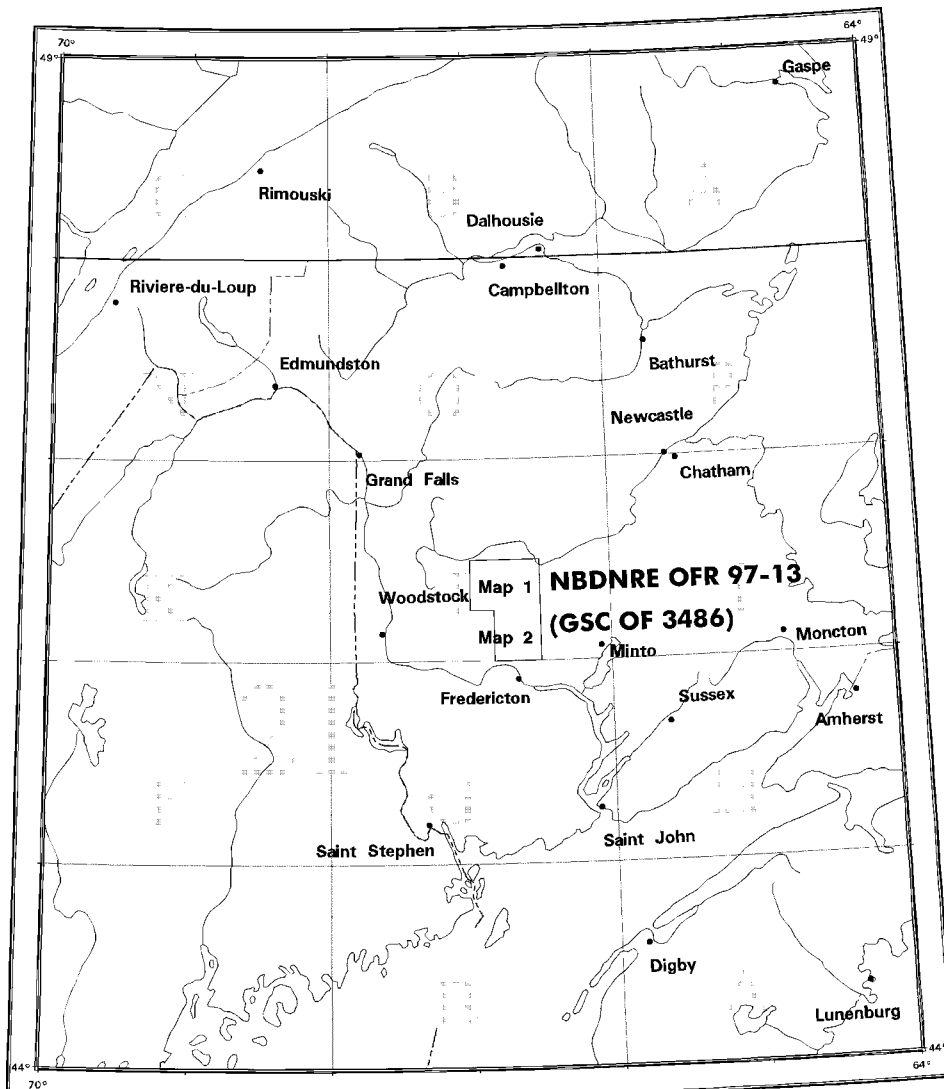


Figure 1. Study area in central New Brunswick.

CREDITS

Toon Pronk directed the survey, coordinating the field activities of New Brunswick geological survey staff. P.W. Friske directed the open file preparation.

Contracts were let to the following companies for sample collection, preparation, and analysis, and were managed by staff as follows:

Collection: Toon Pronk and Rex Boldon
NB DNRE

Preparation: Rex Boldon
NB DNRE

Analysis: Barringer Laboratories (Alberta), Ltd.
Calgary, Alberta

Becquerel Laboratories, Ltd.
Mississauga, Ontario

Chemex Laboratories, Ltd.
North Vancouver, British Columbia

J.J. Lynch (GSC)

M. McCurdy edited open files and coordinated production.

S.W. Adcock provided software support for map production and data listings.

Rex Boldon and Jason Ross provided technical assistance.

DESCRIPTION OF SURVEY AND SAMPLE MANAGEMENT

Sediments and waters were collected during the summer and fall of 1992. Sample sites were distributed over the 1 650 km² survey area at an average of one sample per 2 km².

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 1:50 000 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.

Field-dried samples were air-dried and sieved through a minus 80 mesh (177 micron) screen before milling in ceramic-lined puck mills. 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.

Analytical data from labs were monitored for reliability with standard methods used by the Applied Geochemistry Subdivision at the Geological Survey of Canada.

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 is reacted with 3 mL concentrated HNO₃ in a test tube overnight at room temperature. After digestion, the test tube is 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 is added and heating continues for another 90 minutes. The sample solution is then diluted to 20 ml with metal-free water and mixed. Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe and Cd are determined by atomic absorption spectroscopy using an air-acetylene flame. Background corrections are made for Pb, Ni, Co, Ag, and Cd.

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

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

Loss-on-ignition is determined using a 500 mg sample. The sample, weighed into a 30 ml beaker, is placed in a cold muffle furnace and brought up to 500 degrees C over a period of two to three hours. The sample is held at this temperature for four hours, then allowed to cool to room temperature for weighing.

Fluorine is determined as described by Ficklin (1970). A 250 mg sample is sintered with 1 gram of a flux consisting of two parts by weight sodium carbonate and one part by weight potassium nitrate. The residue is then leached with water. The sodium carbonate is neutralized with 10 ml 10% (w/v) citric acid and the resulting solution is 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 is measured using a fluoride ion electrode. Standard solutions contain sodium carbonate and citric acid in the same quantities as the sample solution.

Tin in stream sediments is 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). E.P. Welsch and T.T. Chao (1976) describe the method.

Water Analyses

Fluoride in water samples is determined using a fluoride electrode. Prior to measurement, an aliquot of the sample is 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 g NaCl and 4 g 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 liter in a volumetric flask. Detection limit = 20 ppb.

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

Uranium in waters is 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, 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 is used. Further, the reaction of uranium with Fluran can be delayed or sluggish; for this reason an arbitrary 24 hour time delay between the addition of the Fluran and the actual reading is incorporated into this method. In practice, 500 microliters of Fluran solution are added to a 5 ml sample and allowed to stand for 24 hours. At the end of this period fluorescence readings are made with the addition of 0.0, 0.2 and 0.4 ppb U. For high samples the additions are 0.0, 2.0 and 4.0 (20 microliter aliquots of either 55 or 550 ppb U are used). All readings are taken against a sample blank.

A summary of analytical methods and detection limits is provided in Table 1.

COMPARISON OF DATA PRODUCED BY TWO METHODS

The data listed in A-1 to A-60 allows users to make a comparison of data generated by two different analytical methods for a couple of elements. Before attempting such a comparison some caution should be exercised.

The 'wet chemistry' data for Co and Fe were obtained by AAS using a partial extraction (HNO_3 and HCl). The data for these elements obtained by INAA produces 'total' data. Hence, the 'wet chemistry' data will likely be somewhat lower than the INAA data.

PRESENTATION AND INTERPRETATION OF GOLD DATA

The following 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.

The correct interpretation of geochemical gold 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 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 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, areas where concentrations of gold in sediments are low, and/or grain sizes of the gold present relatively high require proportionally larger samples 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, sieving and ball milling of the dried sediments reduce grain size.

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.

Table 1. Summary of Analytical Data and Methods

ELEMENT		DETECTION LEVEL		METHOD
<u>SEDIMENTS:</u>				
Ag	Silver	0.2	ppm	AAS
As	Arsenic	0.5	ppm	INAA
Au	Gold	2	ppb	INAA
AuWt	Sample Weight	0.01	g	-
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	CV-AAS
La	Lanthanum	2	ppm	INAA
LOI	Loss-on-ignition	1.0	pct	GRAV
Lu	Lutetium	0.2	ppm	INAA
Mn	Manganese	5	ppm	AAS
Mo	Molybdenum	2	ppm	AAS
Na	Sodium	0.02	pct	INAA
Ni	Nickel	2	ppm	AAS
Pb	Lead	2	ppm	AAS
Rb	Rubidium	5	ppm	INAA
Sb	Antimony	0.1	ppm	INAA
Sc	Scandium	0.2	ppm	INAA
Sm	Samarium	0.1	ppm	INAA
Sn	Tin	1	ppm	FUS
Ta	Tantalum	0.5	ppm	INAA
Tb	Terbium	0.5	ppm	INAA
Th	Thorium	0.2	ppm	INAA
U	Uranium	0.2	ppm	INAA
V	Vanadium	5	ppm	AAS
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
- CV-AAS - cold vapour / atomic absorption spectrometry
- FUS - fusion
- GCM - glass Calomel electrode and pH meter
- GRAV - gravimetry
- INAA - Instrumental Neutron Activation Analysis
- ISE - ion selective electrode
- LIF - laser-induced fluorescence

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, pathfinder element associations in favourable geology may indirectly identify prospective follow-up areas, although an 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.

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Table 2. Field Observations Legend

FIELD RECORD	DEFINITION	TEXT CODE
MAPSHEET	National Topographic System (NTS); lettered quadrangle (1:250 000 or 1:50 000 scale)	21J/02, 21J/07
SAMPLE ID	Remainder of sample number: Year of collection..... Field crew Sample sequence number	92 1,3,5,7,9,0 001-999
REP STAT	Replicate status; relationship of the sample to others within the survey: Routine sample site First of a site duplicate pair..... Second of a site duplicate pair	00 10 20
UTM	Universal Transverse Mercator UTM co-ordinate system; digitized sample location co-ordinates	
ZN	Zone (7 to 22)	14
EASTING	UTM Easting in metres	
NORTHING	UTM Northing in metres	
ROCK UNIT	Major rock type of stream catchment area: Pennsylvanian Grey to olive green sandstone and conglomerate; minor green and red siltstone, shale, and sandstone White and grey quartz-pebble conglomerate and sandstone Mississippian and/or Pennsylvanian Buff, green, and red mottled felsic tuff interbedded with siltstone, sandstone, and conglomerate Greyish black, amygdaloidal, plagioclase-phyric basalt locally containing analcime; minor olivine-phyric basalt Red sandstone, conglomerate, and breccia; minor red siltstone, shale, and mudstone; minor buff to grey calcareous, quartz-pebble conglomerate and sandstone Lower to Middle Devonian Pink to grey, medium-grained, equigranular muscovite-biotite granite; minor garnet, tourmaline and beryl-bearing granite and pegmatite Pink to grey, medium-grained, equigranular to megacrystic biotite granite locally varying to hornblende-biotite granite and granodiorite Green to grey, medium-grained, subophitic to ophitic gabbro Silurian Kingsclear Group Green and maroon greywacke and slate Grey quartzose greywacke, grey lithic greywacke, grey slate, black pyritiferous slate, and minor grey calcareous slate Lower to Middle Ordovician Tetagouche Group (upper part) Lithic greywacke, grey siltstone, and slate; minor grey calcareous siltstone and maroon slate Buff to grey aphanitic rhyolite, porphyritic rhyolite, and crystal tuff (interbedded in part with Unit Os2) Green and maroon ferromanganiferous slate and chert, grey to black graphitic slate and chert; minor green and grey greywacke; minor felsic and mafic tuff Cambrian to Ordovician Tetagouche Group (lower part) Olive green to grey quartzose greywacke interbedded with green, grey and maroon slate and siltstone; minor grey calcareous siltstone and green quartzite-pebble conglomerate	Ps5 Ps1 MPt MPmv MPs1 Df4 Df3 Dm Ss3 Ss2 Os3 Ofv Os2 Cos
ROCK AGE	Stratigraphic age of dominant rock type in catchment basin: Pennsylvanian	

	Mississippian and/or Pennsylvanian Lower to Middle Devonian Silurian..... Lower to Middle Ordovician..... Cambrian to Ordovician.....	33 30 25 20 15 14
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 metres	
STREAM DEPTH	Stream depth in metres	
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 BareRock TalScr Organic
WATER COLOUR	Water colour; the general colour and suspended load of the sampled water: Clear Brown transparent White cloudy..... Brown cloudy.....	Clear BnTrans WhCldy BnCldy
STREAM FLOW	Water flow rate: Stagnant Slow..... Moderate Fast..... Torrential	Stagnt Slow Modert Fast Torrrnt
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:	

	<p>Column 1 >0.125 mm (sand) Column 2 <0.125 mm (fines - organic silt, clay) Column 3 organic material</p> <p>Amount of size fraction: sum of amounts = 3 4 5</p> <p>Absent 0 0 0..... Minor <33% 25% 20% Medium 33-67% 50% 40% Major >67% 75% 60%</p>	
BOTTOM PCPT	<p>Precipitate or stain; the presence of any coatings on pebbles, boulders or stream bottoms:</p> <p>None Red-brown White or buff Black Yellow Green Grey Pink Buff to brown</p>	<p>- Rd-Bn Wh-Bf Black Yellow Green Grey Pink Bf-Bn</p>
BANK PCPT	<p>Distinctive precipitate, stains or weathering on rocks in immediate area of catchment basin or stream bank:</p> <p>None Red, brown (eg. Fe)..... White, buff (eg. CO₃, 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)</p>	<p>- Rd-Bn Wh-Bf Black Yellow Green Blue Pink</p>
STREAM PHYSIOG	<p>General physiography of the drainage basin:</p> <p>Plain..... Muskeg, swampland..... Peneplain, plateau..... Hilly, undulating Mountainous, mature..... Mountainous, youthful (precipitous)</p>	<p>Plain Swamp Penpln Hill Moun/M Moun/Y</p>
STREAM DRAINAGE	<p>Drainage pattern:</p> <p>Poorly defined, haphazard Dendritic Herringbone Rectangular Trellis Discontinuous shield type (chains of lakes) Basinal..... Others.....</p>	<p>Poor Dendrc Herrbn Rectln Trellis Discnt Closed Other</p>
STREAM TYPE	<p>Stream type:</p> <p>Undefined Permanent, continuous Intermittent, seasonal Re-emergent, discontinuous</p>	<p>Undfnd Permnt Intermit Re-emerg</p>
STREAM CLASS	<p>Classification based on proximity to source:</p> <p>Undefined Primary Secondary Tertiary..... Quaternary.....</p>	<p>Undfnd Pri'ary Sec'ary Ter'ary Qua'ary</p>
STREAM SOURCE	<p>Source of water:</p> <p>Unknown..... Groundwater..... Snow melt or spring run-off Recent precipitation..... Ice-cap or glacier meltwater</p>	<p>Unknown Ground Sp'gMelt RecRain Glacier</p>
Miscellaneous	<p>Missing data in any field</p>	<p>-</p>

	no sample material for analysis	ns
	parts per million	ppm
	parts per billion	ppb
	percent.....	pct
	weight (of sample)	Wt
	gram	gm