

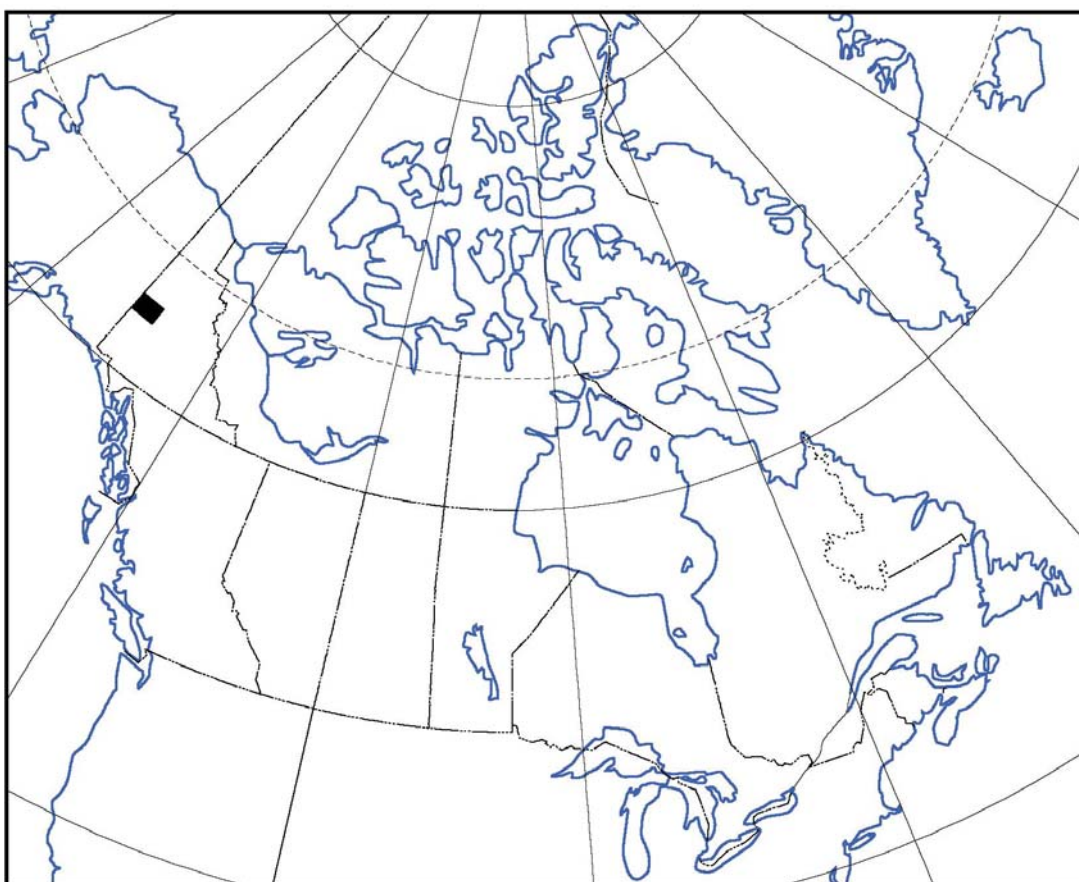


GEOLOGICAL SURVEY OF CANADA OPEN FILE 1364

**EXPLORATION AND GEOLOGICAL SERVICES DIVISION (EGSD), YUKON
INDIAN AND NORTHERN AFFAIRS CANADA OPEN FILE 2001-13(D)**

REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL RECONNAISSANCE DATA WEST-CENTRAL YUKON TERRITORY

NTS 115N (East) & 115O



Friske, P.W.B., Day, S.J.A., and McCurdy, M.W. (2001); Regional Stream Sediment and Water Geochemical Reconnaissance Data, West-Central Yukon Territory (NTS 115N (East) and 115O); Geological Survey of Canada Open File 1364 / Exploration and Geological Services Division Open File 2001-13(D)

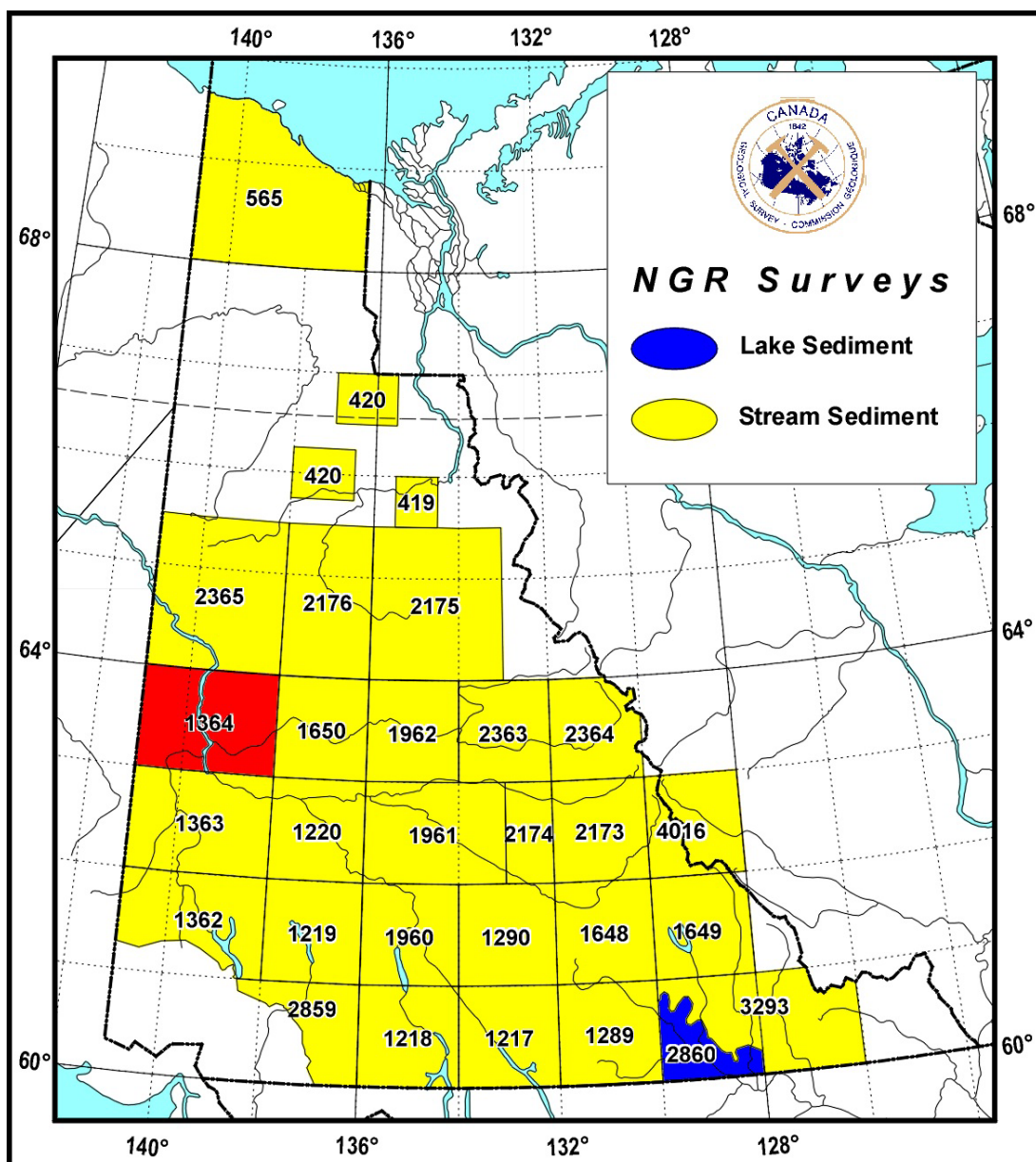


Fig. A. Areas of Yukon covered by geochemical surveys, showing current GSC open file numbers

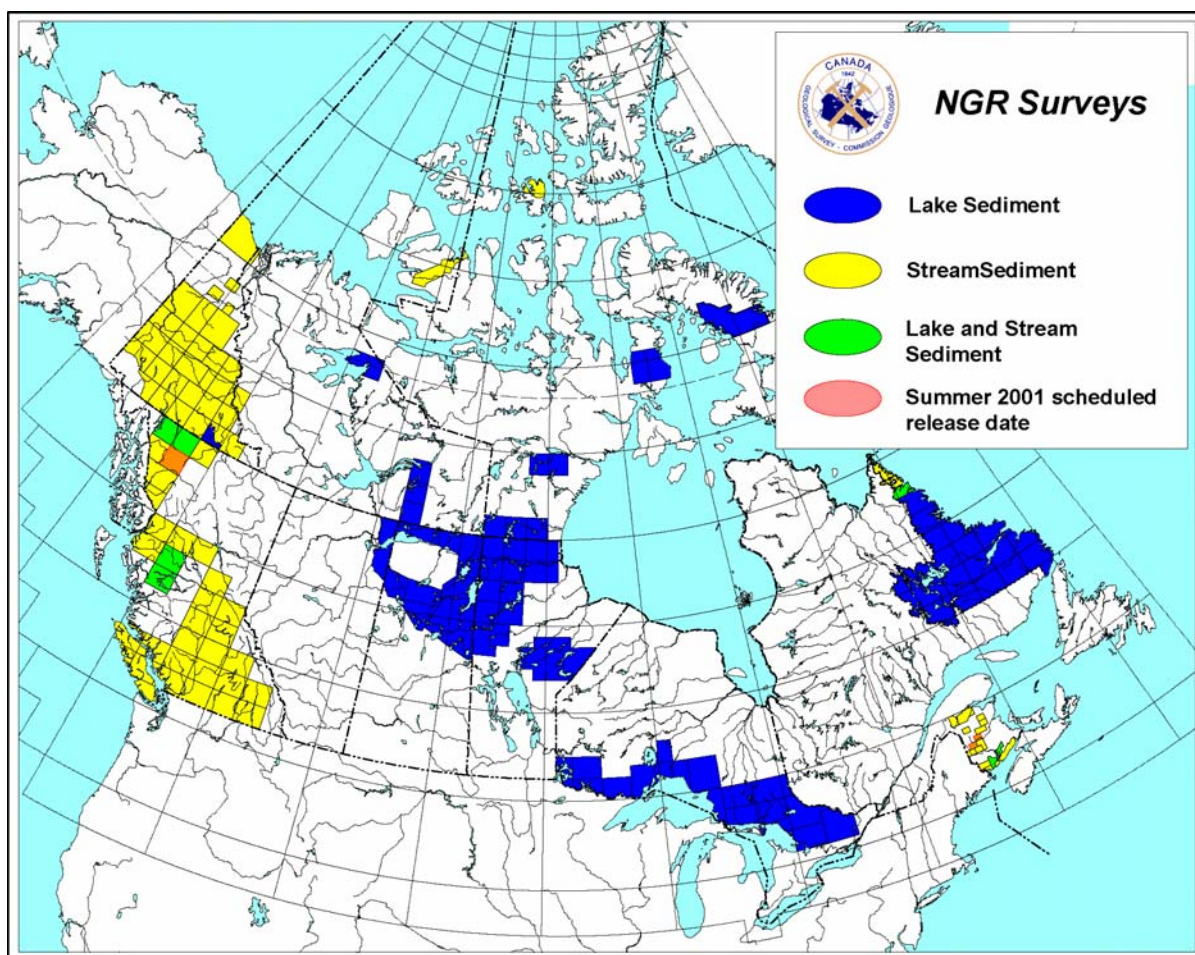


Fig. B. Drainage surveys to National Geochemical Reconnaissance standards.

GSC Open File 1364

EGSD Open File 2001-13(D)

REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL RECONNAISSANCE DATA (NTS 115N(EAST), 115O), WEST-CENTRAL YUKON TERRITORY

INTRODUCTION

The reconnaissance survey was undertaken by the Geological Survey of Canada in conjunction with the Department of Indian Affairs and Northern Development, and the Government of Yukon under the Canada-Yukon Mineral Development Agreement (1985-1989).

CREDITS

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

P.W.B. Friske coordinated the operational activities of the contracting and Geological Survey of Canada staff throughout the survey.

Contracts let for collection, sample preparation and analysis were the responsibility of, and were supervised and/or monitored by the staff of the Exploration Geochemistry Subdivision as follows:

Collection:

- Monaghan Delph Miller Ltd., Don Mills, Ontario
- E.H.W. Hornbrook, P.W.B Friske

Preparation:

- Golder Associates, Ottawa, Ontario
- J.J. Lynch

Analysis:

- Bondar - Clegg And Company Ltd., Ottawa
- Barringer Magenta Laboratories (Alberta) Ltd., Calgary, Alberta (waters)
- Chemex Labs Ltd., North Vancouver, B.C. (Gold)
- J.J. Lynch, D.J. Ellwood

H.R. Schmitt coordinated open file production.

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

D.J. Ellwood developed software to raster plot open file value, symbol and regional trend maps. The plotting was done by Canada Lands Data Systems staff at Environment Canada, Hull Quebec.

M. Mccurdy and S. Cook processed incoming and outgoing materials, supplies and samples.

Computing, plotting, and open file text laser printing services, were provided by the Computer Science Center, E.M.R.

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

Helicopter and truck 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 13 square kilometers throughout the 16,600 square kilometers of the western Yukon survey area.

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

In Ottawa, field dried samples were air-dried, sieved through an 80 mesh screen and ball milled. The ball milled 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 field data were recorded by the field contract staff on standard stream water and sediment field cards (rev. 74) 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.

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 stream 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

For the determination of Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe, Cd, and As, a 1 gram sample was reacted with 3 ml conc. HNO₃ 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 30 minutes with periodic shaking. 1ml conc. HCl was added and heating was 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.

As was determined by atomic absorption using a hydride evolution method wherein the hydride (AsH₃) is evolved, 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 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.

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.

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.

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 1gram sample was weighed into a 7 dram polyethylene vial, capped and sealed. The irradiation was provided by the Slowpoke reactor with an operating flux of 5^{10} neutrons/sq.cm./sec. The samples were pneumatically transferred from an automatic loader to the reactor, where each sample was irradiated for 20 seconds. After irradiation, the sample was again transferred pneumatically to the counting facility where after a 10 second delay the sample was counted for 20 seconds with six helium detector tubes embedded in paraffin. Following counting, the samples were automatically ejected into a shielded storage container. Calibration was carried out once a day as a minimum, using natural materials of known uranium concentration.

Fluorine was determined in stream sediments 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 1 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 resulting solution should be from 5.5 to 6.5. The fluoride content of the test solution was then measured using a fluoride ion electrode. Standard solutions contain sodium carbonate and citric acid in the same quantities as the sample solution. A detection limit of 40 ppm was achieved.

Gold was determined usually on a 10 gram stream sediment sample; depending on the amount of sample available, lesser weights were sometimes used. This resulted in a variable detection limit: 1 ppb for a 10 gram sample, 2 for a 5 gram 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 1 hour, cooled for 4 hours, and counted by gamma ray spectrometry. Calibration was carried out using standard and blank beads.

Tungsten was determined as follows: a 0.2 gram sample of stream sediment was fused with 1 gram K₂S₂O₇ in a rimless test tube at 575°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°C. After the soluble material had completely dissolved, the insoluble material was allowed to settle and an aliquot of 5 ml was transferred to another test tube. 5 ml of 20% SnCl₂ solution were then added to the sample aliquot, mixed and heated for 10 minutes at 85°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 was then heated for 4-6 hours at 80-85°C in a hot water bath. The test 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).

Tin in stream sediments was determined as follows: a 200 mg sample was heated with NH₄I; the sublimed SnI₄ was dissolved in acid and the tin determined by atomic absorption spectrometry.

Antimony was determined in stream sediments as described by Aslin, 1976). A 500 mg sample was placed in a test tube; 3 ml concentrated HNO₃ and 9 ml concentrated HCl are added and the mixture was allowed to stand overnight at room temperature. The mixture was heated slowly to 90°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 test solution was removed and 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 gram sample was heated with 5 ml conc. HF, 5 ml conc. HClO₄ and 2 ml conc. HNO₃ to fumes of HClO₄; 3 ml of conc. HClO₄ were added and heated to light fumes; 5 ml of water were 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.

Fluoride in stream 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 solution (total ionic strength adjustment buffer). The TISAB II buffer solution was prepared as follows: 58 gm NaCl and 5 gm CDTA (cyclohexylene dinitrilo acetic acid) were dissolved in a mixture of 50 ml metal free water and 57 ml glacial acetic acid. The solution was cooled to room temperature and the pH adjusted to between 5.0 and 5.5 by the slow addition of 5M NaOH solution. The solution was cooled and diluted to 1 liter in a volumetric flask.

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) was 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

PRESENTATION OF GOLD DATA AND COMMENTS REGARDING INTERPRETATION OF RESULTS

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 samples which reflect the actual concentration level at a given site.

Understanding 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:

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 ensures 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. Au typically occurs at low concentrations in the ppb range. Au concentrations of a few ppm may represent economic deposits. Background levels encountered for stream and centre-lake sediments seldom exceed 10 ppb, and commonly are near the detection limit of 1 ppb.

The many foregoing factors can result in a particle sparsity effect wherein very low concentrations of Au are heterogeneously distributed in the surficial environment. Hence, a major problem facing the geochemist is obtaining 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. If the Au is present in a metallic state, ball milling may not reduce its particle size significantly because of its malleability.

between the addition of the Fluran and the actual reading was incorporated into this method. In practice, 500 microlitres 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 microlitre aliquots of either 55 or 550 ppb U were used). All readings were taken against a sample blank.

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

1. For each block of twenty samples:
 - A) Random insertion of a standard reference sample to monitor and control analytical accuracy and long-term precision,
 - B) Collection of a field duplicate (two samples separately collected from one site) to monitor sampling variance,
 - C) Analysis of a second subsample (blind duplicate) from one sample to monitor and control short-term precision;
2. For both stream sediments and lake sediments, repeat analyses on a second subsample are performed for all samples having values that are statistically above approximately the 90th percentile of the total data set; within the survey area
3. For lake sediments only, repeat analysis on a second subsample was 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 highly variable than in samples with a higher LOI content.

Au data presentation, statistical treatment and the value map format are somewhat different than for other elements. Au data listed in this open file includes initial analytical results, values determined from repeat analyses, together with sample weights and corresponding detection limits for all analyzed samples. The gold histogram, statistical parameters, and regional trend map are determined using the following data population selection criteria:

- 1) Only the first value of a repeat analysis is utilized;
- 2) Au values determined from sample weights less than 10g are excluded.
- 3) Au values less than the detection limit (<1ppb) for 10g samples are set to 0.5 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.

ACKNOWLEDGEMENTS

Digital cartography and final digital compilation by Paul Stacey, Map - IT, Ottawa, ON.

REFERENCES

- Aslin, G.E.M.** (1976) The Determination Of Arsenic And Antimony In Geological Materials By Flameless Atomic Absorption Spectrophotometer 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: Proc. Of The 7th Annual Symp. Of Canadian Mineral Analysts. Thunder Bay, Ontario, Sept. 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. C186-188.
- 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, Geol. Surv. Can. Paper 79-1a, p. 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.
- Hornbrook, E.H.W. and Friske, P.W.B.** (1987) Regional stream sediment and water geochemical reconnaissance data, Yukon Territory, NTS 115N (East) and 115O; Geological Survey of Canada Open File 1364, 149 p., 25 maps.
- 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.
- Quin, B.F. And Brooks, R.R.** (1972) The Rapid Determination Of Tungsten In Soils, Stream Sediments, Rocks and Vegetation. Anal. Chim. Acta. 58 pp 301-309.

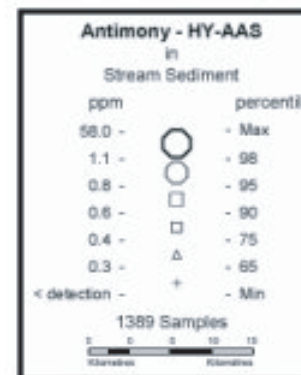
FIELD RECORD	DEFINITION	TEXT CODE
NTS Map Sheet	National Topographic System (NTS); lettered quadrangle (1:250 000 or 1:50 000 scale)	115N, 115O
Sample Number	Remainder of sample number: Year Field crew Sample sequence number.....	86 1, 3 001-999
Replicate Status	Replicate status; relationship of the sample to others within the survey: Routine sample site..... First of a site duplicate pair..... Second of a site duplicate pair.....	0 1 2
Latitude NAD 83	Geographic co-ordinate system (Datum = NAD83) digitized sample location latitude	
Longitude NAD 83	Geographic co-ordinate system (Datum = NAD83) digitized sample location longitude	
UTM Zone	Universal Transverse Mercator (UTM) co-ordinate system zone; Datum = NAD83, Zone 7	
UTM Easting NAD 83	UTM Easting in metres (NAD83)	
UTM Northing NAD 83	UTM Northing in metres (NAD83)	
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..... Acidified water sample collected with routine sediment and water sample	SedOnly SpgSedOnly HvMnCn Strm GrWat Sed/Water SpgSep/Sed Sed/Water/Acid
Stream Width (m)	Stream width in metres	
Stream Depth (m)	Stream depth in metres	
Contamination	Contamination, human or natural: None Possible Probable Definite..... Mining activity Industrial sources Agricultural..... Domestic or household..... Forestry activities..... Burned areas	- Possible Probable Definite Mining activity Industry Agricuilt Domestic Forestry Burned areas
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)	Alluvial Colluvial Till Glacial Outwash Bare Rock Talus, Scree Organics
Water Colour	Water colour; the general colour and suspended load of the sampled water: Clear Brown transparent White cloudy	Clear Brown, transparent White, cloudy

	Trellis Discontinuous shield type (chains of lakes) Basinal Others	Trellis Discont Shield Type Closed Other
Stream Type	Stream type: Undefined Permanent, continuous..... Intermittent, seasonal Re-emergent, discontinuous	Undfnd Permanent Intermit Re-emerg
Stream Class	Classification based on proximity to source: Undefined Primary Secondary Tertiary..... Quaternary.....	Undefined Primary Secondary Tertiary Quaternary
Water Source	Source of water: Unknown..... Groundwater..... Snow melt or spring run-off Recent precipitation..... Ice-cap or glacier meltwater	Unknown Groundwater Spring Melt Recent Precipitation Meltwater

Element	Detection Limit and Units	Analytical Method
Ag	0.2 ppm	Silver by atomic absorption spectroscopy
As	1 ppm	Arsenic by hydride evolution-atomic absorption spectroscopy
Au	1 ppb	Gold by fire assay preconcentration-neutron activation
Au-R	1 ppb	Gold repeat analysis by fire assay preconcentration - neutron activation
Ba	40 ppm	Barium by atomic absorption spectroscopy
Cd	0.2 ppm	Cadmium by atomic absorption spectroscopy
Co	2 ppm	Cobalt by atomic absorption spectroscopy
Cu	2 ppm	Copper by atomic absorption spectroscopy
F	40 ppm	Fluorine by specific ion electrode (ppm)
Fe	0.02 pct	Iron by atomic absorption spectroscopy
Hg	10 ppb	Mercury by flameless spectroscopy
LOI	1 pct	Loss on ignition by weight difference
Mn	5 ppm	Manganese by atomic absorption spectroscopy
Mo	2 ppm	Molybdenum by atomic absorption spectroscopy
Ni	2 ppm	Nickel by atomic absorption spectroscopy
Pb	2 ppm	Lead by atomic absorption spectroscopy
Sb	0.2 ppm	Antimony by hydride evolution-atomic absorption spectroscopy
Sn	1 ppm	Tin by atomic absorption spectroscopy
U	0.5 ppm	Uranium by neutron activation – delayed neutron counting
V	5 ppm	Vanadium by atomic absorption spectroscopy
W	2 ppm	Tungsten by colorimetry using dithiol
Zn	2 ppm	Zinc by atomic absorption spectroscopy
pH	-	pH by combination glass-calomel electrode
F_W	20 ppb	Fluoride in waters by specific ion electrode
U-W	0.05 ppb	Uranium in waters by laser induced fluorescence



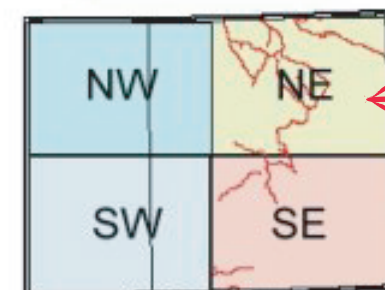
G.S.C. Open File 1364
E.G.S.D. Open File 2001-13(D)
N.T.S. 115N & 115O - Yukon, 2001



clickable link leads to
tabular statistics

Antimony Stats
Periodic Table

clickable link leads to
periodic table



Areas of the small map seen here are
clickable to view individual site labels.
Click the area of interest

