



Province of British Columbia  
Ministry of Energy, Mines and Petroleum Resources  
Mineral Resources Division  
Geological Survey Branch  
Environmental Geology Section



Energy, Mines and  
Resources Canada  
Géologie, Mines et  
Ressources Canada  
Geological Survey of Canada  
Commission géologique du Canada



# BRITISH COLUMBIA REGIONAL GEOCHEMICAL SURVEY

## SEYMOUR ARM (NTS 82M)

### STREAM SEDIMENT AND WATER GEOCHEMICAL DATA

P.F. Matysek, W. Jackaman, J.L. Gravel, S.J. Sibbick, S. Feulgen

Canada - British Columbia  
Mineral Development Agreement (1985 - 1990)

MEMPR BC RGS 33  
GSC OPEN FILE 2358

**Canadian Cataloguing in Publication Data**

Main entry under title:  
British Columbia regional geochemical survey

Cover title.  
Publisher varies: 1976?-1990, Geological Survey  
Branch, Applied Geochemistry; 1991- , Geological  
Survey Branch, Environmental Geology Section.  
Co-published by Geological Survey of Canada,  
Resource Geophysics and Geochemistry Division.  
"MEMPR BC RGS 21", etc.  
"GSC O.F. 2038", etc.  
"Canada-British Columbia Mineral Development  
Agreement (1985-1989)"  
Description based on: NTS 92E (1988)  
Partial contents: NTS 82M. Seymour Arm  
ISBN 0-7718-8833-3 (set)

1. Geochemistry - British Columbia. 2. Geochemistry  
- British Columbia - Maps. 3. Geology, Economic - British  
Columbia. 4. Geology, Economic - British Columbia -  
Maps. I. British Columbia. Geological Survey Branch.  
Applied Geochemistry. II. British Columbia.  
Environmental Geology Section. III. Geological Survey of  
Canada. Resource Geophysics and Geochemistry Division.  
IV. Canada/British Columbia Mineral Development  
Agreement.

QE515.B74 1989                    551.9'09711                    C89-092173-3

VICTORIA  
BRITISH COLUMBIA  
CANADA  
  
JUNE 1991

**TABLE OF CONTENTS**

**INTRODUCTION .....3**

**ACKNOWLEDGEMENTS .....3**

    1976/1977 STREAM SEDIMENT AND WATER SURVEY .....3

    1990 RGS ARCHIVE PROGRAM .....3

**OPEN FILE FORMAT .....3**

**SURVEY DESCRIPTION .....4**

    PHYSIOGRAPHY, GEOLOGY AND MINERAL POTENTIAL ....4

    SAMPLE COLLECTION - 1976/1977 .....5

    SAMPLE PREPARATION - 1976/1977 .....5

    SAMPLE PREPARATION - 1990 .....5

    SAMPLE ANALYSIS - 1976/1977 .....5

    SAMPLE ANALYSIS - 1990 .....5

**RGS DATA EVALUATION .....5**

    SUMMARY STATISTICS .....6

    PRECISION ESTIMATES OF SELECTED ELEMENTS .....6

    ESTIMATION OF REGIONAL AND SAMPLE SITE ELEMENTAL  
    CONCENTRATION VARIABILITY .....7

    COMPARISON OF INAA VERSUS AAS TECHNIQUES .....9

    BASE AND PRECIOUS METAL ANOMALY RATING METHOD 10

    COMMENTS ON THE INTERPRETATION OF GOLD DATA ...11

**REFERENCES .....11**

**LIST OF TABLES AND FIGURES**

**TABLE 1 Thompson and Howarth Precision Estimates .....7**

**TABLE A-1 Geology Legend of Map Area .....A 2**

**TABLE A-2 Guide for Field Observations .....A 3**

**TABLE A-3 1976/1977 Routine RGS Analytical Methods .....A 4**

**TABLE A-4 1990 INAA Detection Limits .....A 4**

**FIGURE 1 Generalized Geology of Southeast British Columbia ..4**

**FIGURE 2A Variance Components for Selected Elements .....8**

**FIGURE 2B F Ratios for Selected Elements .....8**

**FIGURE 3A Comparison of INAA versus AAS Results for Ni ....10**

**FIGURE 3B Comparison of INAA Versus AAS Results for Fe ....10**

**LIST OF APPENDICES**

**APPENDIX A: Field Observations and Analytical Data .....A 1**

**APPENDIX B: Analytical Duplicate Data .....B 1**

**APPENDIX C: Statistical Summary .....C 1**

**APPENDIX D: Sample Evaluation Charts .....D 1**



## INTRODUCTION

Open File package BC RGS 33 / GSC 2358, a joint federal-provincial initiative, contains new data for gold and 25 other elements obtained by re-analyzing stream sediments collected in 1976 and 1977 from the Seymour Arm map-sheet area (NTS 82M). Also included are the original analytical data from GSC Open File 516 published in 1978 for 11 elements in sediments, and uranium, fluoride and pH values in concomitant waters.

The original reconnaissance survey was undertaken in 1976 and 1977 by the Geological Survey of Canada (GSC) in conjunction with the British Columbia Ministry of Energy, Mines and Petroleum Resources (MEMPR) under the Canada-British Columbia Uranium Reconnaissance Program. Funds for the determination of mercury were provided by Fisheries and Environment Canada for samples collected in 1977 only. In 1990, under the MEMPR RGS Archive Program, the samples collected in 1976 and 1977 were analysed by instrumental neutron activation (INAA). This initiative was funded in part by the Canada/British Columbia Mineral Development Agreement (1985-1990).

Analytical results and field observations from these regional geochemical surveys are used to build both a provincial and national geochemical database for resource assessment, mineral exploration, geological mapping and environmental studies. Sample collection, preparation and analytical methods are closely monitored to ensure consistency and conformance to national standards.

## ACKNOWLEDGEMENTS

### 1976/1977 STREAM SEDIMENT AND WATER SURVEY

*E.H.W. Hornbrook* directed GSC activities and *N.C. Carter* directed MEMPR activities.

Contracts were let to the following companies for sample collection, preparation and analysis and were managed by staff of the GSC or MEMPR.

**COLLECTION :** Stokes Exploration Management Ltd., Vancouver, B.C.  
*S.B. Ballantyne (GSC) and T.E. Kalnins (MEMPR)*

**PREPARATION :** Golder Associates, Ottawa.  
*J.J. Lynch (GSC)*

**ANALYSIS :** Chemex Laboratories Ltd., Vancouver. (Sediments / Waters)  
Atomic Energy of Canada, Ltd., Ottawa. (U in Sediments)  
*J.J. Lynch (GSC)*

## 1990 RGS ARCHIVE PROGRAM

The RGS Archive Program was managed by Geological Survey Branch staff of the British Columbia Ministry of Energy Mines and Petroleum Resources.

*P.F. Matysek* coordinated the operational activities of contract and MEMPR staff. *W. Jackaman* coordinated and prepared the production of the open-file. *S.J. Sibbick* and *J.L. Gravel* provided analysis and interpretation of the data. *S. Feulgen* provided computer processing support.

**PREPARATION :** Rob Phillips, Ottawa, Ont.

**ANALYSIS :** Becquerel Laboratories, Mississauga, Ont.

## OPEN FILE FORMAT

Open File RGS 33 / GSC 2358 includes a data booklet, map booklet and a floppy diskette.

The data booklet provides details of the sample collection, preparation and analysis programs plus data listings, statistics and interpretations.

The map booklet consists of :

- 4 - 1: 100 000 scale sample location maps.
- 1 - 1: 500 000 scale sample location clear mylar overlay and map.
- 1 - 1: 500 000 scale bedrock geology clear mylar overlay and map.
- 1 - 1: 500 000 scale surficial geology map.
- 40 - 1: 500 000 scale symbol and value maps for individual elements in stream sediments and waters.
- 1 - 1: 500 000 base metal anomaly map.
- 1 - 1: 500 000 precious metal anomaly map.

A 5<sup>1/4</sup>" 1.2 Mb (high density) floppy diskette containing data files in ASCII format.

## SURVEY DESCRIPTION

### PHYSIOGRAPHY, GEOLOGY AND MINERAL POTENTIAL

The Seymour Arm map sheet covers an area of approximately 15,400 square kilometres. The Shuswap Highlands dominate the physiography of the western half of the map sheet, whereas ranges of the Monashee Mountains and Selkirk Mountains compose the eastern half of the map area (Holland, 1976).

Surficial materials (Map 3, *after* Fulton *et al.*, 1984) consist of widespread deposits of till and colluvium on slopes and till and glaciofluvial sediments within valleys.

The Seymour Arm map area is underlain by rocks ranging in age from Archean to Eocene. In the east, Hadrynian to Mesozoic age rocks of the Kootenay Arc, a north-trending arcuate structural zone, are separated from the Shuswap Metamorphic Complex by the Columbia River fault. High grade metamorphic rocks of the Shuswap Complex underlie approximately fifty percent of the map sheet. Lower Paleozoic sediments are found in the southwestern corner of the map area and are intruded by Cretaceous quartz monzonites to granites. The geological base map (Fig. 1 and Table A-1 in Appendix A) used for Open File RGS 33 is from Okulitch and Woodsworth (1977).

Examples of mineral occurrences found within the survey area are:

- Stratabound Ag, Pb, Zn, Au (Samatosum)
- Stratabound Cu, Zn, Ag (Goldstream)
- Skarn W (Silence Lake)

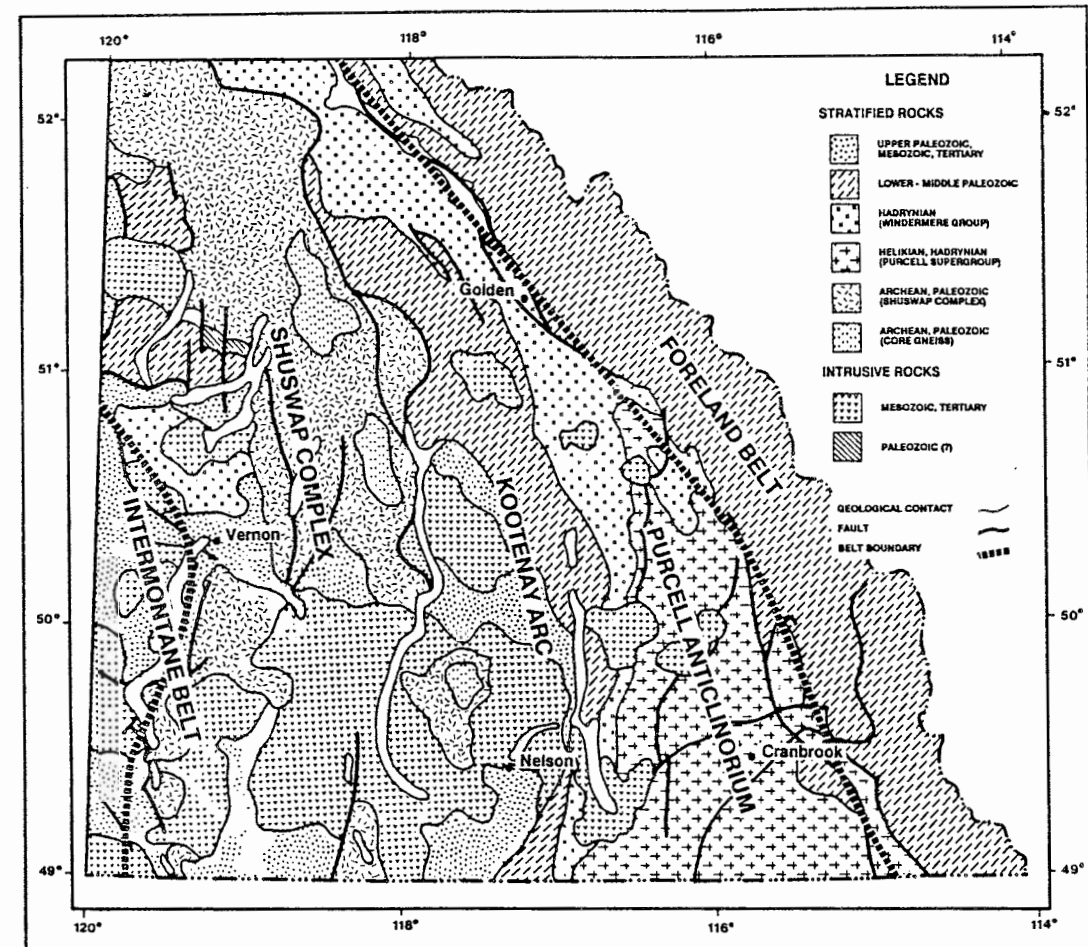


Figure 1 Generalized geology map of southeast British Columbia

## **SAMPLE COLLECTION - 1976/1977**

Helicopter and truck-supported sample collection was carried out during the summer of 1976 and 1977 over the 15,400 square kilometre survey area. Stream sediment and water samples were systematically collected from 1151 sites for an average density of 1 site per 13.4 square kilometres. Field duplicate samples were routinely collected in each analytical block of twenty samples.

Fine grained stream sediments (< 1mm) weighing 1-2 kg were obtained from the active (subject to annual flooding) stream channel and placed in kraft bags. Unfiltered water samples were collected in 250 ml bottles, precautions were taken to exclude suspended solids when possible. Field observations regarding sample media, sample site and local terrain (Table A-2) were recorded.

## **SAMPLE PREPARATION - 1976/1977**

Field dried sediment samples were shipped to Golder Associates, in Ottawa, Ontario for final processing. The samples were air-dried and the -80 mesh (<177 microns) fraction was obtained and ball-milled for subsequent analyses. Quality control reference standards and blind duplicates were inserted into each analytical block of twenty sediment samples. Any -80 mesh sediment remaining after analyses was archived for future studies.

## **SAMPLE PREPARATION - 1990**

The archived -80 mesh stream sediment pulps were retrieved for instrumental neutron activation analysis from the Geological Survey of Canada warehouse in Ottawa. New quality control reference standards were inserted into each analytical block of twenty samples. Existing analytical and field site duplicates contained within the samples sequences were checked and verified.

## **SAMPLE ANALYSIS - 1976/1977**

In 1976, Chemex Laboratories (North Vancouver) analysed sediment samples for: copper, cobalt, iron, lead, manganese, molybdenum, nickel, silver and zinc. Mercury was determined in addition to the above suite on sediment samples collected in 1977. Uranium in stream sediments was determined by Atomic Energy of Canada (Ottawa). Water samples were analyzed for fluorine, uranium, and pH by Chemex Laboratories. Table A-3 summarizes analytical methods, specifications and reported detection limits for the various determinations. Concentrations below the reported detection limit were assigned a value equivalent to one-half of the detection limit.

## **SAMPLE ANALYSIS - 1990**

Becquerel Laboratories (Mississauga), carried out instrumental neutron activation analysis (INAA) of archived stream sediment samples. Samples weighing 20 grams on average were epithermally irradiated for twenty minutes in a neutron flux of  $10^{11}$  neutrons/cm<sup>2</sup>/sec. After a decay period of approximately one week, gamma-ray emissions for the elements of interest were measured using a gamma-ray spectrometer with a high resolution, coaxial germanium detector. Counting time was approximately fifteen minutes per sample. Counting data was compiled on a computer and later converted to concentrations. Numerous international reference samples were irradiated within each analytical batch. Sediments were analysed for antimony, arsenic, barium, bromine, cerium, cesium, chromium, cobalt, gold, hafnium, iron, lanthanum, lutetium, molybdenum, nickel, rubidium, samarium, scandium, sodium, tantalum, terbium, thorium, tungsten, uranium, ytterbium and zirconium. Concentrations below the reported detection limit were assigned a value equivalent to one-half of the detection limit.

## **RGS DATA EVALUATION**

The ability to discriminate real trends related to geological and geochemical causes from those that result from spurious factors such as sampling and analytical errors is of considerable importance in the success of geochemical data interpretation. An estimate of the reproducibility (precision) allows the quantification of variation due to sampling and analysis, and is an integral part of the evaluation of geochemical data. Estimates of analytical precision and trace element variability within and between sample sites can be determined by utilizing analytical duplicate and field duplicate data.

In order to make these assessments, control reference standard materials and analytical duplicates are routinely inserted to monitor and assess precision and accuracy of analytical results. Each analytical batch of twenty sediment and water samples consists of :

- 17 - Routine samples
- 1 - Field duplicate sample collected adjacent to one of the 17 routine samples (Listed in Appendix A - Field observations and analytical data).
- 1 - Quality control reference standard sample containing sediment of certified element concentrations and known reproducibility.
- 1 - Analytical duplicate sample; a subsample from one of the 17 routine samples (Listed in Appendix B).

## SUMMARY STATISTICS

Univariate statistics are presented in Appendix C for element concentrations within stream sediments and waters in order to establish some measure of the range of background levels and thresholds. Statistics were calculated for the total data set and on subsets (N>10) based on lithological units underlying the sample site.

Statistics determined include: minimum and maximum values; range; mode; median; arithmetic and logarithmic means, standard deviations and coefficients of variation; as well as percentile values. Depending upon the element the distribution of element values are also graphically displayed as logarithmic or arithmetic histograms. Please note, these calculations do not include the second values from analytical and field duplicate pairs.

## PRECISION ESTIMATES OF SELECTED ELEMENTS

Precision estimates for selected elements were calculated using 211 analytical duplicate pairs from RGS 30, 31 and 33 (NTS 82F, 82K and 82M) using the Thompson and Howarth (1973, 1976, 1978) method. Analytical duplicate INAA data for 82K are listed in Appendix B.

Briefly, their method involves dividing 50 or more analytical duplicate pairs (x1, x2) into groups with narrow concentration ranges. For each group, the median value of absolute differences between duplicate pairs (|x1-x2|) is used as an estimation of the standard deviation (s), whereas the mean value of all the duplicate pair means (x1+x2)/2 is used as an estimation of the average concentration. Repetition of this procedure for a successive group of concentration ranges obtains a set of corresponding mean concentration and standard deviation estimates for the entire range of data. Linear regression of the estimates provides slope and intercept values from which precision of the dataset can be calculated using the equation:

$$P_c = 200(K/c + S_o)$$

where  $S_o$  (coefficient of slope) is the standard deviation at zero concentration and  $K$  (intercept) is a constant. This linear function has been determined in many practical cases (Matysek and Sinclair, 1984) to be a satisfactory model for the expression of variation.

Precision estimates for INAA elements were calculated as follows:

Step 1. A list of duplicate means and corresponding absolute differences were calculated.

Step 2. The list was sorted in increasing order of concentration means.

Step 3. The mean concentration and the median difference between pairs for the first group of 11\* stream sediments were determined, respectively.

Step 4. Step 3 was repeated for each successive group of 11 stream sediment analytical pairs ignoring any remainder less than 11\*.

Step 5. The linear regression of the median differences on the means was calculated. The resultant intercept and coefficient of the calculated line are multiplied by 1.048 and were used to estimate precision.

*\*Note: Groups of 9 and 13 pairs were used on occasion to improve the regression line fit.*

Precision estimates were determined for Ba, Ce, Fe, La, Rb, Sm, Sc, Th and U only. This particular suite of elements was selected on the following basis:

- Their distributions approximated a Gaussian (normal) curve
- The majority of their concentrations were well above their detection limits.

Precision estimates were not determined for elements characterized by non-Gaussian distributions. These distributions are recognized when the following conditions arise:

- Element abundances are dependent on rare grains
- Concentration levels are near or at the detection limit
- Data contains outliers



### RESULTS

Precision estimates obtained from the Thompson and Howarth method are presented in Table 1. Only elements whose correlation coefficients (R-values) were significantly different from zero are listed. Precision estimates calculated by the Thompson and Howarth method for 9 different elements at different concentration levels averaged 16.8% at the 50th percentile, 16.1% at the 80th percentile and 15.6% at the 95th percentile (Table 1).

Studies tailored to the evaluation of error in stream sediment surveys such as Plant (1971), Chork (1977) and Fletcher (1981) generally concluded:

- The combined variability due to local variation and analytical error ranged from 10-25% of the total error.
- Precision ranges of 10-15% at the 95% confidence level are generally encountered and considered acceptable for laboratory variability in most exploration programmes.

Precision estimates determined for these elements are of similar magnitude to those observed from other regional geochemical surveys.

**TABLE 1 Thompson and Howarth precision estimates**

ELEMENT	MIN	MAX	INTER	SLOPE	R-VALUE	50TH	PREC	80TH	PREC	95TH	PREC
Barium	100	6120	15.833	0.0442	0.6058	660	14.29%	1000	12.58%	1500	11.48%
Cerium	10	1250	3.207	0.05811	0.7412	100	18.90%	170	16.13%	310	14.35%
Iron	0.2	18	0.053	0.071	0.7063	3.4	18.15%	4.6	17.30%	6.2	16.67%
Lanthanum	5	1160	1.244	0.0545	0.8309	60	15.77%	99	14.06%	180	12.87%
Rubidium	5	270	1.153	0.0668	0.6776	88	16.75%	120	16.02%	150	15.61%
Samarium	0.5	150	-0.12	0.0969	0.8973	8.7	17.42%	13.3	18.42%	22.5	19.19%
Scandium	0.6	63.1	0	0.0916	0.8229	11	19.20%	15	19.20%	21.3	19.20%
Thorium	0.5	488	0.252	0.0546	0.9113	15	14.97%	27.3	13.38%	60.4	12.32%
Uranium	0.5	452	-0.121	0.0943	0.9725	6.1	15.61%	14	17.95%	38.3	19.10%

### ESTIMATION OF REGIONAL AND SAMPLE SITE ELEMENTAL CONCENTRATION VARIABILITY

#### INTRODUCTION

Variations in element concentrations of stream sediments are due to regional variation (ie. diverse lithologies, mineralization and influences of the surficial environment) and sample site variation (ie. sampling and analytical variability). Regional and sample site variance components were determined for 15 elements from 68 field duplicate pairs. Selected elements include Ag, Cu, Zn, Pb, Co, Ni, Fe, Mn (1976/1977 data) and Au, As, Sb, Cr, Mo, W, U (1990 data).

#### METHOD

The estimate of variance components was based on field duplicate data. Since the RGS samples are derived from a variety of lithologies and drainages containing mineral occurrences, log transformation of the data was necessary to approximate normal distributions.

- 1) Calculate  $VC_{site}$  by taking the sum of the squared differences between samples in field duplicate pairs and average the sum over the number of pairs (Mean Sum of Squares).

$$(1) VC_{site} = MSQ_{site} = \sum (x_i - \mu_i)^2 / n$$

where  
 $x_i$  = 1st and 2nd samples of each field duplicate pair  
 $\mu_i$  = mean for each duplicate pair  
 $n$  = number of duplicate pairs

- 2) Calculate the total variance ( $VC_{total}$ ) by taking the sum of squared differences for all samples in field duplicate pairs and dividing by the number of samples less 1.

$$(2) VC_{total} = MSQ_{total} = \sum (x_j - \mu_j)^2 / N-1$$

where  
 $x_j$  = all samples in field duplicate pairs  
 $\mu_j$  = mean of all samples in field duplicate pairs  
 $N-1$  = number of samples in field duplicate pairs less 1

- 3) Calculate  $VC_{regional}$  by subtracting  $VC_{site}$  from  $VC_{total}$ .

$$(3) VC_{regional} = VC_{total} - VC_{site}$$

4) Equate variance components to percentages by dividing each component (regional and site) by the total and multiply by 100.

$$(4) \quad VC_{\text{regional}} = \frac{VC_{\text{regional}}}{VC_{\text{total}}} * 100$$

To determine if geochemical trends reflect actual regional variation or are an artifact of sample site variation, F ratios can be calculated between MSQ<sub>regional</sub> and MSQ<sub>site</sub>;

$$F \text{ Ratio}(v1, v3) = \frac{MSQ_{\text{regional}}}{MSQ_{\text{site}}}$$

where  $MSQ_{\text{regional}} = \sum \{ (x_i - \mu_i)^2 - (x_j - \mu_j)^2 \} / n - 1$

$$v1 = n - 1 = \text{degrees of freedom for } MSQ_{\text{regional}}$$

$$v3 = n = \text{degrees of freedom for } MSQ_{\text{site}}$$

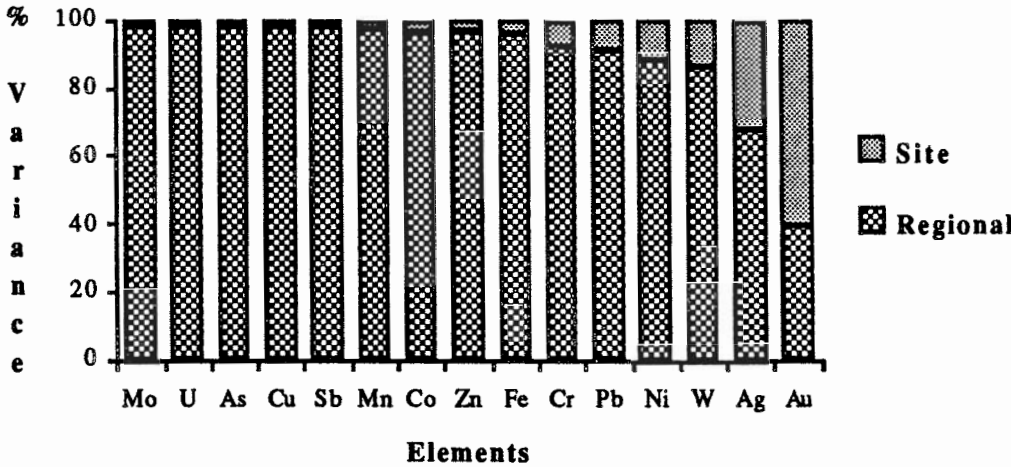
Calculated F ratios greater than the critical F ratio (obtained from F tables at the 95% confidence level) indicate that regional variation exceeds sample site variation. Under these circumstances observed regional geochemical trends are not considered to be artefacts of sampling or analytical methods.

**RESULTS**

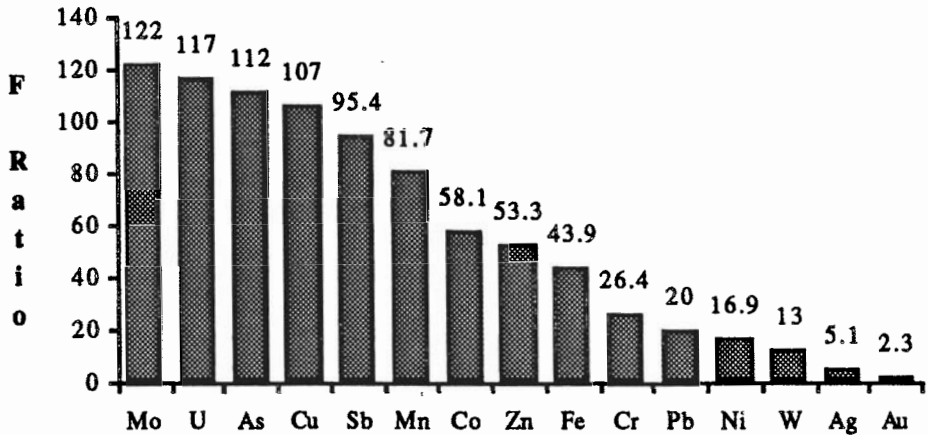
Figure 2a presents site and regional variation components. Some general similarities are noted:

- In general, most of the selected elements show low sample site variability (<20%). As a result a high measure of confidence is given to observed elemental regional trends.
- Elements displaying high sample site variance components (>20%) suffer from either nugget effect (Au) or characterized by numerous near detection limit values (Ag). Observed geochemical trends for these elements should be treated with less confidence.

Figure 2b presents F ratios for the selected elements, F<sub>crit</sub> at the 95% confidence limit for given degrees of freedom is 1.50. All elements surpass this value.



**Figure 2a Variance Components for selected elements**



**Figure 2b F ratios for selected elements**

## COMPARISON OF INAA VERSUS AAS TECHNIQUES

Several elements (Co, Fe, Mo and Ni) were determined by both atomic absorption spectroscopy (AAS) and by instrumental neutron activation analysis (INAA). Concentration variations observed between original (AAS) and subsequent (INAA) results are due largely to the analytical methods. AAS requires dissolution of the sample with acids prior to analysis. Aqua regia, a combination of hydrochloric and nitric acids, was primarily used to dissolve RGS sediment samples. Gold and sulphide minerals are dissolved, whereas silicates and some oxides (*ie.* magnetite) are only partially digested. Conversely, INAA does not require sample digestion prior to analysis. Concentrations determined by INAA generally represent the *total* content of that element in the sample. Due to this difference between methods, INAA generally reports slightly higher concentrations than *aqua regia* - AAS.

Figures 3a and 3b represent a comparison of the two techniques for iron and nickel, using data from RGS 30 (NTS 82F). In both cases, INAA gives higher results. A strong correlation is noted for nickel ( $r = .958$ ); slightly higher INAA results are due to the presence of minute quantities of nickel within the lattices of silicates (*ie.* feldspars). Iron, however, demonstrates substantial concentration differences between analytical methods and a weaker correlation ( $r = .646$ ), likely due to the presence of variable amounts of magnetite and hematite commonly found in stream sediment samples.

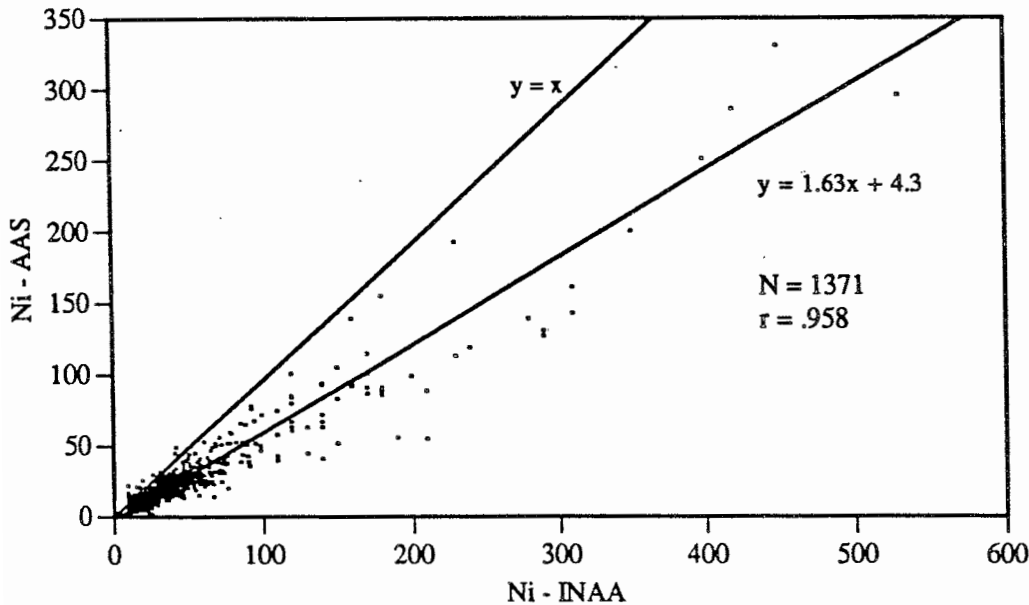


Figure 3a Scatterplot comparing INAA versus AAS results for Ni

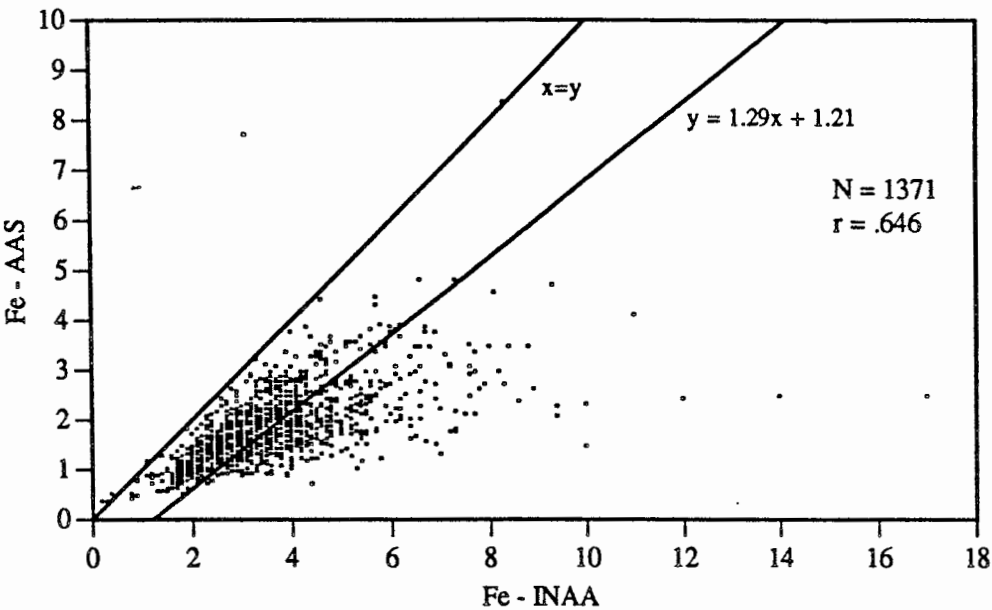


Figure 3b Scatterplot comparing INAA versus AAS results for Fe

## BASE AND PRECIOUS METAL ANOMALY RATING PROCEDURE

### INTRODUCTION

Stream sediments collected downstream from mineralized sources commonly exhibit enhanced concentrations for a particular suite of elements. An interpretive technique has been developed that reduces the data set and highlights stream sediment sites characterized by anomalous, multi-element signatures associated with particular mineral deposits. As an example of this methodology, sample evaluation charts and 1:500 000 scale anomaly maps have been produced which outline areas considered to have high base metal and precious metal potential.

### METHODOLOGY

#### Data Subsetting on underlying geological formation

Analytical results for stream sediment samples typically reflect the underlying geology found within the drainage basins. Considerable variability in element concentrations exist between different lithologies. This variability must be considered in order to distinguish anomalous samples from background concentrations. Consequently, analytical data was initially subset on the basis of underlying lithology of the sample site. To better estimate element variability within lithologies, data from adjoining survey areas (RGS 27, 28, 29, 30, 31, 32, 33) were also included.

#### Threshold Calculations - Sample Evaluation Charts - Anomaly Maps

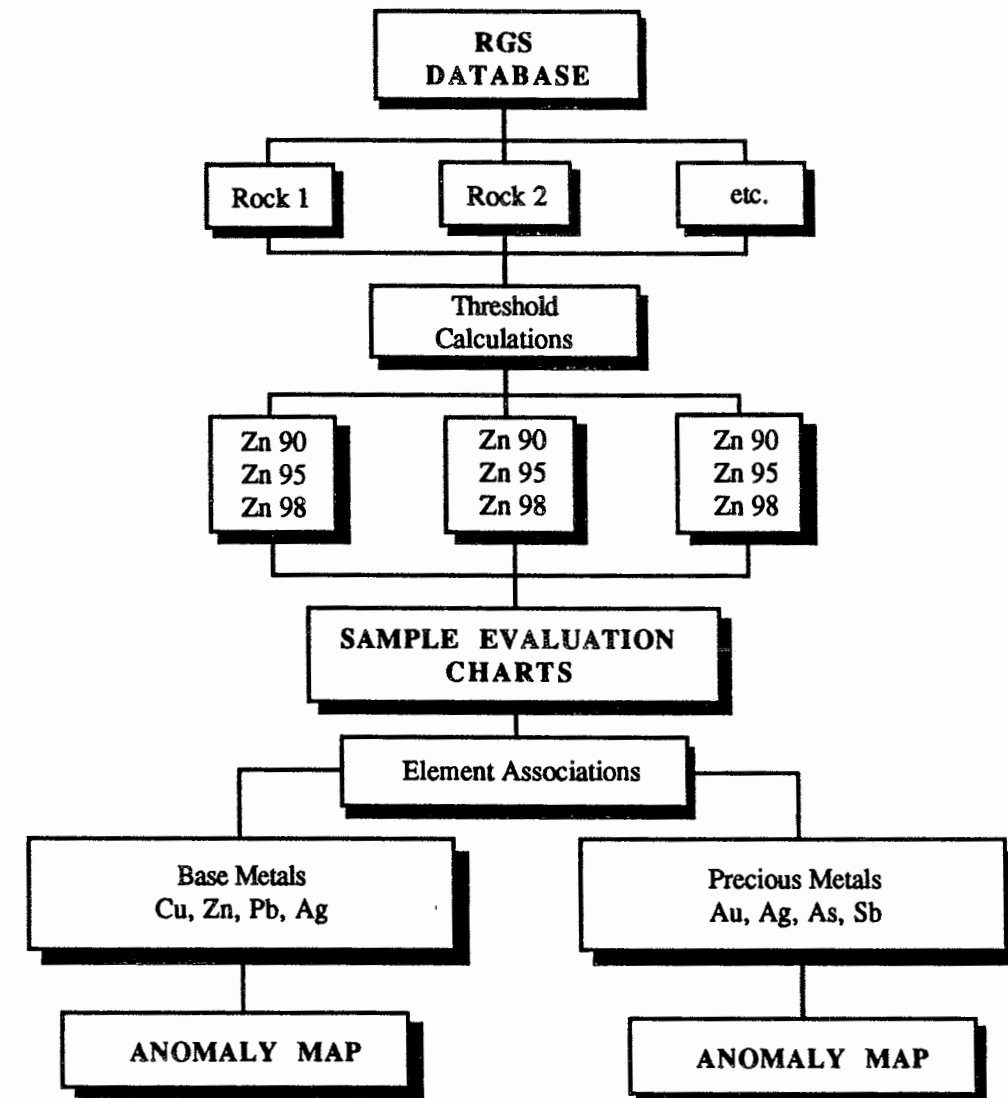
In order to assess the anomalous nature of individual samples, the 90th, 95th and 98th percentiles were calculated for lithologies having 10 or more sample sites and are provided in a threshold table (Appendix D).

Using the calculated thresholds, individual samples were assigned the following anomaly ratings :

- an anomaly rating of 1 for concentrations  $\geq$  90th but  $<$  95th percentile,
- an anomaly rating of 2 for concentrations  $\geq$  95th but  $<$  98th percentile,
- an anomaly rating of 3 for concentrations  $\geq$  98th percentile.

Sample evaluation charts (Appendix D) graphically display the anomaly rating for individual elements. In addition, the summed element ratings provide a measure of the anomalous multi-element nature of each sample. Samples must have a minimum rating of 3 to be included in the chart. Anomaly maps produced from the sample evaluation charts highlight the spatial relationships between anomalous samples.

Utilizing the above technique, sample evaluation charts and anomaly maps have been generated to aid the user in identifying potential base metal and precious metal targets. The element suite used for the identification of base and precious metal multi-element anomalies include Cu - Zn - Pb - Ag and Au - Ag - As - Sb, respectively.



# COMMENTS ON THE INTERPRETATION OF GOLD DATA

Understanding gold geochemical data from regional stream sediment surveys requires an understanding of the chemical and physical characteristics of gold in the surficial environment.

Gold is a soft, malleable element of high density (19.3 g/cm<sup>3</sup>). Under normal conditions it is chemically inert, most commonly occurring in native form (pure Au) or as electrum (alloyed with silver). Sub-micron sized gold is often bound to clays, adsorbed onto Fe-Mn oxides or contained within organic colloids. At normal surface temperatures, gold will dissolve under rare conditions of high oxidation potential and high acidity where ions such as chloride (Cl<sup>-</sup>), thiosulphate (S<sub>2</sub>O<sub>3</sub><sup>-2</sup>) or cyanide (CN<sup>-</sup>) are present. Normal background concentrations for gold in bedrock vary, but are generally less than 5 ppb. Background levels encountered for stream sediments seldom exceed 10 ppb and commonly are near the detection limit of 1 ppb.

Under normal conditions, gold occurs as rare, discrete particles. In many instances a geochemical subsample may or may not contain a gold grain. This is known as the 'nugget effect'. Generally, larger geochemical sample sizes are required to minimize the nugget effect and more accurately represent gold concentrations. (Clifton *et al.*, 1969; Harris, 1982). Neutron activation analyses for the 1990 RGS Archive program utilized samples weighing on average 20 grams.

Follow-up investigations of gold anomalies should be based on careful consideration of related geological and geochemical information and an understanding of the variability of gold geochemical data. 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. Analysis of field duplicates and blind (subsample) duplicates will increase the reliability of gold results, allowing for improved data interpretation.

Presentation of gold data within the map booklet differs from other elements as follows:

- Analytical duplicate pairs are listed in brackets following the initial determination.
- Results for field duplicate pairs are listed separated by a slash "/".
- Symbol size represents the highest value in field duplicate and blind duplicate analytical pairs.

• Possible variations in map format presentation:

+ .....	Data < 50th percentile
+ 77.....	Single analysis > 95th percentile
+ 103(42)...	Analytical duplicate pair
+ 103/42....	Field duplicate pair

# 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.

Chork, C.Y. (1977): Seasonal, Sampling and Analytical Variations in Stream Sediment Surveys; *Journal of Geochemical Exploration*, Vol 7, pp. 31-47.

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 Fluorine in Rocks and Soils, Using an Ion Selective Electrode; *U.S. Geological Survey*, Paper 700C, pp. C186-188.

Fletcher, W.K. (1981): Analytical Methods in Exploration Geochemistry; *Handbook of Exploration Geochemistry*, in G.S. Govett, Editor, Elsevier Sci. Pub. Co., Vol. 1, New York, New York, 255 pp.

Fulton, R.J., Rutter, N.W. and Shetsen, I. (1984) Surficial Geology, Kootenay Lake, British Columbia-Alberta; *Geological Survey of Canada*, Open File 1084.

Harris, J.F. (1982): Sampling and Analytical Requirements for Effective use of Geochemistry in Exploration for Gold; Precious Metals in the Northern Cordillera; in Symposium proceedings, A.A., Levinson, Editor; *Association of Exploration Geochemists and Geological Association of Canada, Cordilleran Section*, pp. 53-67.

Holland, S.S. (1976): Landforms of British Columbia, a Physiographic Outline; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Bulletin 48.

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.

Matysek, P.F. and Sinclair, A.J. (1984): Statistical Evaluation of Duplicate Samples, Regional Geochemical Surveys 92H, 92I and 92J, British Columbia; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Geological Fieldwork 1983, Paper 1984-1, pp. 186-196.

- Okulitch, A.V. and Woodsworth, G.J., (1977): Geology of the Kootenay River Map Sheet; *Geological Survey of Canada*, Open File 481.
- Plant, J. (1971): Orientation Studies on Stream Sediment Sampling for a Regional Geochemical Survey in Northern Scotland, *Institute of Mining and Metallurgy, Trans.*, Vol 80, pp. B324-345.
- Rose, A.W., Hawkes, H.E. and Webb, J.S. (1979): Geochemistry in Mineral Exploration; *Academic Press, London*, Second Edition, 657 pp.
- Thompson, M. and Howarth, R.J. (1973): The Rapid Estimation and Control of Precision by Duplicate Determinations; *Analyst*, Vol 98, pp. 153-166.
- \_\_\_\_\_, (1976): Duplicate Analysis in Geochemical Practice (2 parts); *Analyst*, Vol 101, pp. 690-709.
- \_\_\_\_\_, (1978): A New Approach to the Estimation of Analytical Precision; *Journal of Geochemical Exploration*, Vol. 9, pp 23 - 30.

# **1991 Regional Geochemical Survey**

## **RGS 33**

### **SEYMOUR ARM - NTS 82M**

#### **APPENDIX A**

#### **Field Observations and Analytical Data**

---

Notes : Values less than detection limit recorded as 1/2 detection limit value.

**Table A-1 Reference Guide for Geological Formations (after Okulitch and Woodsworth, 1977)**

Formation	Description	Formation	Description	Formation	Description
<b><u>STRATIFIED ROCKS</u></b>		<b><u>STRATIFIED ROCKS</u></b>		<b><u>INTRUSIVE ROCKS</u></b>	
<b>MESOZOIC</b>		<b>PALEOZOIC</b>		<b>MESOZOIC</b>	
TRIASSIC - JURASSIC		LOWER CAMBRIAN		CRETACEOUS	
TJs shale, argillite, limestone, conglomerate, schist, sandstone NICOLA, SLOCAN, ROSSLAND and YMIR Groups; SICAMOUS and ARCHIBALD Fms.		IEs quartzite, limestone, phyllite, argillite HAMILL and GOG Group; EAGER, BADSHOT, MOHICAN, DONALD, RENO, LAIB & QUARTZITE RANGE Fms.; Maitlen Phyllite, Emerald & Reeves Limestone Members		EARLY AND/OR MID-CRETACEOUS	
<b>PALEOZOIC</b>		<b>PROTEROZOIC - PALEOZOIC</b>		EKqm quartz monzonite, granite; lesser granodiorite, quartz diorite	
DEVONIAN-MISSISSIPPIAN		PPns paragneiss, schist, amphibolite, marble, orthogneiss, pegmatite SHUSWAP Metamorphic Complex		EKgd granodiorite, quartz diorite; lesser quartz monzonite	
DMs greenstone, pillow lava, limestone, shale SLIDE Mtn. Group; FENNELL and GUYET Fms.		PPgn gneissic granitoid rocks, layered gneiss Core Zones of Thor-Odin and Frenchman's Cap Domes, SHUSWAP Metamorphic Complex		JURASSIC	
CAMBRIAN-DEVONIAN (PELITIC FACIES)		<b>PROTEROZOIC</b>		MIDDLE AND/OR LATE JURASSIC	
EDp Devonian: Limestone shale STARBIRD, Mt. FORSTER, HARROGATE and CEDARED Fms.		HADRYNIAN (WINDERMERE)		Jqm quartz monzonite, lesser granodiorite	
Ordovician-Silurian: limestone BEAVERFOOT Fm.		Hs sandstone, conglomerate, limestone, grit, minor volcanic rocks MIETTE and HORSETHIEF Ck. Groups; TOBY, SHEDROOF and MONK Fms.; IRENE and LEOLA Volcanics; SILVER Ck. and CHASE Fms. near Shuswap Lake		<b>PALEOZOIC</b>	
Ordovician: sandstone, shale MT. WILSON and GLENOGLE Fms.				LATE PALEOZOIC (MAINLY)	
Upper Cambrian-Ordovician: limestone, shale MCKAY GROUP				Pub ultramafic rocks; peridotite, serpentinite	
Middle Cambrian: shale, limestone CANTON CK., OTTERTAIL, JUBILEE and CHANCELLOR Fms.				MIDDLE AND/OR LATE PALEOZOIC (?)	
LOWER PALEOZOIC				Pgd ADAMANT PLUTON; granodiorite, quartz monzonite	
IPs argillite, limestone, schist, phyllite, greenstone LARDEAU Group; BROADVIEW, EAGLE BAY, NELWAY, ACTIVE and METALINE Fms.; Ledbetter Slate, Grass Mtn. Sequence				Pmz ADAMANT PLUTON; monzonite, monzodiorite	
				Pgdn granodiorite, quartz monzonite, quartz diorite, gneiss, migmatite	
				DEVONIAN	
				Dg gneissic granitic rocks MT. FOWLER Batholith, CLACHNACUDAINN Gneiss	



**Table A-2 Reference Guide for Field Observations**

Column	Definition and Descriptions	Column	Definition and Descriptions	Column	Definition and Descriptions
<b>MAP</b>	1:50 000 NTS map sheet number	<b>SED COL</b>	Sediment Colour: B = Black                      R = Red G = Grey-Blue              T = Tan-Brown O = Olive-Green          W = White-Buffer P = Pink                      Y = Yellow	<b>CHL PTN</b>	Channel Pattern: S=Shoots-Pools      M=Meandering B=Braided              D=Disturbed
<b>SAMPLE ID</b>	Sample number			<b>ELEV</b>	Elevation: in metres
<b>UTM ZONE</b>	UTM Zone Number			<b>PHY</b>	Physiography: H=Hilly                      P=Plateau L=Lowland                  S=Swamp M=Mature                   Y=Youthful mountains
<b>UTM EAST</b>	UTM East Coordinate	<b>SED PPT</b>	Sediment Precipitate: N = None (otherwise same as SED COL)	<b>DRN</b>	Drainage Pattern: D=Dendritic                  H=Herringbone G=Glacially                  I=Interrupted deranged                  R=Rectangular
<b>UTM NORTH</b>	UTM North Coordinate	<b>CON</b>	Contamination: N = None                      D = Domestic P = Possible                  F = Forestry A = Agricultural          M = Mining		
<b>STA</b>	Replicate Sample Status: 0 = Routine Sample 1 = 1st Field Duplicate 2 = 2nd Field Duplicate 8 = Blind Duplicate 9 = Control Reference	<b>SED COMP</b>	Sediment Composition: estimate of Sand-Fines-Organic content 0 = Absent 1 = Minor (<1/3 of total) 2 = Moderate (>1/3 but <2/3) 3 = Major (>2/3 of total)		
<b>MED</b>	Sample Media Collected: 1 = Stream Sediment only 6 = Stream Sediment & Water 7 = Moss-Mat Sediment only 8 = Moss-Mat Sediment & Water	<b>STRM WPTH</b>	Stream Width: in metres	<b>TYP</b>	Stream Type: P=Permanent                  S=Seasonal
<b>FORMATION ROCK TYPE AGE</b>	{ see Table A-1 }	<b>STRM DPTH</b>	Stream Depth: in centimetres	<b>ODR</b>	Stream Order: 1=Primary                      3=Tertiary 2=Secondary                  4=Quaternary
		<b>BNK</b>	Bank Composition: A = Alluvium                  R = Rock C = Colluvium                  S = Talus G = Outwash                  T = Till O = Organic                   U = Unknown	<b>SRC</b>	Stream Source: G=Groundwater              S=Spring runoff M=Melt water                  U=Unknown
<b>WAT COL</b>	Water Colour: 0 = Colourless      2 = White Cloudy 1 = Brown Clear    3 = Brown Cloudy	<b>BNK PPT</b>	Bank Precipitate: N = None (otherwise same as SED COL)		
<b>FLW</b>	Water Flow Rate: 0 = Stagnant              3 = Fast 1 = Slow                      4 = Torrent 2 = Moderate	<b>CHL BED</b>	Channel Bed: B = Boulders                  S = Gravel-Sand F = Silt-Clay                  O = Organics		

## METHODS OF SAMPLE ANALYSIS

### 1976/1977 Program

Co, Cu, Fe, Pb, Mn, Ni, Ag and Zn were determined as follows: a one gram sample was reacted with 3 ml of concentrated  $\text{HNO}_3$  for 30 minutes at  $90^\circ\text{C}$ . 1 ml concentrated HCL was added and the digestion was continued at  $90^\circ\text{C}$  for an additional 90 minutes. The sample solution was then diluted to 20 ml with metal free water and mixed. Concentrations were determined by AAS using an air-acetylene flame. Background corrections were made for Pb, Ni, Co and Ag.

For Hg, a 0.5 gram sample was reacted with 20 ml concentrated  $\text{HNO}_3$  and 1 ml concentrated HCl for 10 minutes at room temperature and for 2 hours at  $90^\circ\text{C}$  in a hot water bath. After digestion, the sample solutions was cooled and diluted to 100 ml with metal free water. Mercury present in the solution was reduced to the elemental state by the addition of 10 ml of 10% W/V  $\text{SnSO}_4$  in  $\text{H}_2\text{SO}_4$ . Resultant mercury vapour was then flushed by a stream of air into an absorption cell mounted in the light path of an atomic absorption spectrometer. Absorption measurements were made at 253.7 NM.

Mo was determined by AAS using a nitrous oxide - acetylene flame. A 0.5 gram sample was reacted with 1.5 ml concentrated  $\text{HNO}_3$  at  $90^\circ\text{C}$  for 30 minutes. At this point 0.5 ml concentrated HCl was added and the digestion continued for an additional 90 minutes. After cooling, 8 ml of 1250 ppm Al solution was added and the sample solution diluted to 10 ml before aspiration into the AAS.

U in sediments was determined using instrumental neutron activation analysis (INAA) with delayed neutron counting. A 1 gram sample was sealed into a 7-dram polyethylene vial. Irradiation was provided by a Slowpoke Reactor with an operating flux of  $10^{12}$  neutrons/ $\text{cm}^2$ /sec. Each sample was irradiated for 60 seconds. Following a 20-second delay, the sample was counted with 6  $\text{BF}_3$  detector tubes embedded in paraffin for 60 seconds.

Element	Detection Limits	Sample Weight	Determination Method	
Cobalt	2 ppm	1 g	AAS	Atomic Absorption Spectrophotometry
Copper	2 ppm			
Iron	0.02 pct			
Lead	2 ppm			
Manganese	5 ppm			
Nickel	1 ppm			
Silver	0.2 ppm			
Zinc	2 ppm			
Molybdenum	2 ppm	0.5 g		
Mercury	10 ppb			
Uranium	0.2 ppm	1 g	NA DNC	Neutron Activation
pH - water	0.1 pH unit	25 ml	GCE	Fisher Accumet pH meter
U - water	0.05 ppb	5 ml	LIF	Fluorometric Method
F - water	20 ppb	25 ml	ION	Fluorine Ion Specific Electrode

Table A-3 1976/1977 Routine RGS Analytical Methods

U in water was determined by a fluorometric method. Uranium was initially preconcentrated by evaporation. The residue was fused with a mixture of  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$  and NaF in a platinum dish. After cooling, the fluorescence of the fused pellet was measured using a Turner Fluorometer.

F in water was determined using a specific ion electrode. An aliquot of the sample was mixed with an equal volume of TISAB II solution (total ionic strength adjustment buffer). Fluoride content was measured using a Corning 101 Electrometer with an Orion Fluoride Electrode.

For the determination of pH an aliquot of water was transferred to a clean dry beaker. pH was measured using a Fisher Accumet pH Meter.

### 1990 Archive Program

Becquerel Laboratories (Mississauga), Ltd. carried out instrumental neutron activation analysis (INAA) of archived stream sediment sample splits. Samples weighing 20 grams on average were irradiated epithermally for twenty minutes in a neutron flux of  $10^{11}$  neutrons/ $\text{cm}^2$ /sec. After a decay period of approximately one week, gamma-ray emissions for the elements of interest were measured using a gamma-ray spectrometer with a high resolution, coaxial germanium detector. Counting time was approximately fifteen minutes per sample. Counting data was compiled on a computer and later converted to concentrations. Numerous international reference samples were irradiated within each analytical batch.

Sediments were analyzed for antimony, arsenic, barium, bromine, cerium, cesium, chromium, cobalt, gold, hafnium, iron, lanthanum, lutetium, molybdenum, nickel, rubidium, samarium, scandium, sodium, tantalum, terbium, thorium, tungsten, uranium, ytterbium and zirconium. Concentrations below the reported detection limit were assigned a value equivalent to one-half of the detection limit. Detection limits for these elements are listed in Table A-4.

Element	Detection Limits	Element	Detection Limits
Gold	2 ppb	Molybdenum	1 ppm
Antimony	0.1 ppm	Nickel	10 ppm
Arsenic	0.5 ppm	Rubidium	5 ppm
Barium	100 ppm	Samarium	0.5 ppm
Bromine	0.5 ppm	Scandium	0.5 ppm
Cerium	10 ppm	Sodium	0.1 pct
Cesium	0.5 ppm	Tantalum	0.5 ppm
Chromium	5 ppm	Terbium	0.5 ppm
Cobalt	5 ppm	Thorium	0.5 ppm
Hafnium	1 ppm	Tungsten	2 ppm
Iron	0.2 pct	Uranium	0.2 ppm
Lanthanum	5 ppm	Ytterbium	2 ppm
Lutetium	0.2 ppm	Zirconium	200 ppm

Table A-4 1990 INAA Detection Limits



																								Water			Stream Sediment												
MAP	SAMPLE ID	UTM ZONE	UTM EAST	UTM NORTH	STA	MED	FM	WAT COL	FLW	SED COL	SED PPT	CON	SED COMP	STRM WDT	STRM DPTH	BNK PPT	PHY	DRN	TYP	ODR	SRC	DATE	FW 20 ppb ION	UW 0.05 ppb LIF	pH 0.1 GCE	Co 2 ppm AAS	Cu 2 ppm AAS	Fe 0.02 pct AAS	Pb 2 ppm AAS	Mn 5 ppm AAS	Hg 10 ppb AAS-F	Mo 2 ppm AAS	Ni 2 ppm AAS	Ag 0.2 ppm AAS	U 0.2 ppm NADNC	Zn 2 ppm AAS	:DL :Unit :Mthd		
82M03	761002	11	348629	5653511		6	LPs	0	3		N	P	121	2.4	30	A						2907	30	0.02	7.8	20	37	3.15	13	720		3	47		2.7	91			
82M03	761003	11	345685	5652357		6	LPs	0	4		N	P	211	2.4	30	C						2907	40	0.05	8.0	15	33	2.60	10	485		1	29		2.6	58			
82M03	761004	11	345267	5652981		6	LPs	0	3		N	P	210	4.6	46	C						2907	42	0.02	7.9	13	24	2.20	14	335		1	23		3.8	51			
82M04	761005	11	315059	5657181		6	LPs	0	2		N	N	022	1.2	15	A						2907	28	0.02	7.6	5	75	0.80	55	800		3	11	0.6	13.8	178			
82M04	761006	11	314752	5657724		6	LPs	0	1		N	P	022	0.6	15	A						2907	30	0.02	7.3	14	27	2.85	20	630		1	23	0.1	2.0	85			
82M03	761008	11	338490	5656415		6	LPs	0	3		N	N	310	3.7	30	T						3107	38	0.02	7.6	24	52	3.80	20	750		2	55	0.1	1.5	79			
82M03	761009	11	340053	5657580		6	LPs	0	3		N	P	121	2.4	46	A						3107	28	0.02	7.5	22	49	3.80	10	760		1	51	0.1	1.8	95			
82M03	761010	11	340332	5659817		6	LPs	0	3		N	P	121	1.5	15	T						3107	28	0.16	7.4	23	47	3.85	13	990		2	60	0.1	2.6	90			
82M03	761011	11	340444	5660589	1	6	LPs	0	3		N	P	220	1.5	30	T						3107	26	0.02	7.4	24	44	3.90	11	880		1	53	0.1	2.7	85			
82M03	761012	11	340444	5660589	2	6	LPs	0	3		N	P	220	1.5	30	T						3107	26	0.02	7.3	23	44	3.90	13	830		1	51	0.1	2.5	83			
82M03	761013	11	337438	5658508		6	LPs	0	3		N	N	310	1.2	15	C						3107	34	0.05	7.8	25	50	3.65	27	1010		2	60	0.1	1.8	94			
82M03	761014	11	333483	5658126		6	LPs	0	3		N	N	121	0.9	15	A						3107	48	0.74	8.0	15	25	2.20	17	460		1	28	0.1	2.1	63			
82M03	761015	11	334489	5659788		6	LPs	0	3		N	N	031	1.5	15	C						3107	30	0.12	8.0	18	41	3.00	9	510		1	40	0.1	2.0	57			
82M03	761016	11	335764	5660514		6	LPs	0	3		N	N	211	3.0	46	T						3107	28	0.02	7.8	14	27	2.50	8	570		1	31	0.1	3.3	57			
82M03	761017	11	336312	5659807		6	LPs	0	3		N	N	211	2.4	30	C						3107	30	0.02	7.8	24	49	3.95	9	625		1	51	0.1	2.8	81			
82M03	761018	11	338120	5662605		6	Dg	0	2		N	N	310	1.8	15	T						3107	34	0.10	7.7	15	33	2.65	7	395		1	35	0.1	8.5	68			
82M03	761019	11	339708	5664030		6	Dg	0	3		N	N	121	1.5	15	T						3107	26	0.16	7.6	9	19	2.25	7	335		1	22	0.1	17.5	51			
82M03	761020	11	341523	5665139		6	Dg	0	3		N	N	121	2.4	30	T						3107	22	0.02	7.4	10	20	2.10	5	350		1	23	0.1	11.6	54			
82M03	761022	11	343936	5664680		6	Dg	0	2		N	N	121	1.8	15	A						3107	40	0.10	7.6	23	77	4.40	15	765		2	50	0.1	2.5	85			
82M03	761023	11	345108	5667774	1	6	PPns	0	2		N	P	121	0.9	15	A						3107	38	0.30	7.5	13	22	2.65	7	470		1	31	0.1	15.4	60			
82M03	761024	11	345108	5667774	2	6	PPns	0	2		N	P	121	0.9	15	A						3107	40	0.34	7.5	13	22	2.75	5	470		1	31	0.1	14.6	60			
82M03	761025	11	345899	5668490		6	PPns	0	2		N	P	121	1.2	15	T						3107	38	0.12	7.8	14	26	2.85	5	560		1	28	0.1	6.2	56			
82M03	761026	11	339879	5662889		6	Dg	0	3		N	N	121	3.0	15	C						3107	24	0.02	7.6	16	32	2.90	5	505		1	34	0.1	2.4	55			
82M03	761027	11	329811	5664694		6	LPs	0	3		N	P	211	0.6	15	A						0108	28	0.10	7.4	13	21	2.15	7	475		1	30	0.1	2.6	44			
82M03	761028	11	331115	5667884		6	LPs	0	2		N	N	121	0.9	15	A						0108	22	0.10	7.4	19	27	2.80	13	820		1	72	0.1	3.6	76			
82M03	761029	11	331529	5668999		6	LPs	0	2		N	P	211	0.9	15	A						0108	22	0.24	7.8	6	17	1.60	3	430		1	15	0.1	4.7	46			
82M03	761030	11	332253	5670082		6	Dg	0	2		N	N	211	1.5	15	A						0108	10	0.16	7.7	7	12	1.55	3	360		1	14	0.1	5.4	40			
82M03	761031	11	336608	5670726		6	PPns	0	4		N	N	211	2.4	46	T						0108	10	0.12	7.5	9	21	2.00	7	505		1	22	0.1	6.8	50			
82M03	761032	11	339690	5672083		6	PPns	0	3		N	N	211	2.7	30	A						0108	10	0.16	7.2	8	11	1.70	6	610		1	17	0.1	14.0	57			
82M03	761033	11	339322	5671132		6	PPns	0	3		N	N	310	3.0	30	A						0108	10	0.12	7.0	7	7	1.50	3	520		1	15	0.1	9.4	46			
82M03	761034	11	338451	5670610		6	PPns	0	3		N	N	121	1.8	15	A						0108	10	0.16	7.0	8	8	1.20	2	465		1	12	0.1	10.6	29			
82M03	761035	11	338400	5671600		6	PPns	0	2		N	N	130	1.2	15	A						0108	28	0.10	6.6	5	9	1.20	5	190		1	12	0.1	7.4	33			
82M03	761036	11	338314	5672101		6	PPns	0	3		N	N	112	3.0	30	A						0108	10	0.10	6.7	9	20	2.20	10	575		2	18	0.1	13.8	78			
82M03	761037	11	333036	5674295		6	PPns	0	2		R	P	121	1.8	15	A						0108	28	0.34	6.7	4	7	0.95	2	230		1	8	0.1	6.2	33			
82M03	761039	11	331032	5675048		6	PPns	0	2		N	P	211	3.0	30	A						0108	30	0.16	7.1	9	22	1.80	4	560		1	19	0.1	7.1	60			
82M03	761040	11	331133	5671801		6	Dg	0	2		N	P	121	0.9	15	T						0108	26	0.16	6.9	11	22	1.90	5	380		1	21	0.1	2.7	46			
82M03	761042	11	332389	5672662		6	Dg	0	3		N	P	121	1.2	15	A						0108	30	0.24	7.4	6	11	1.25	3	200		1	12	0.1	16.2	29			
82M03	761043	11	329128	5660584		6	LPs	3	3		N	P	121	0.9	15	A						0208	30	0.42	7.8	13	26	1.95	10	755		1	26	0.1	1.9	49			
82M03	761044	11	330756	5663320		6	LPs	0	3		N	P	210	4.6	46	A						0208	30	0.42	7.8	19	30	2.90	8	515		1	36	0.1	6.3	59			
82M03	761046	11	328488	5668691		6	LPs	0	3		N	N	121	3.7	30	C						0208	36	0.16	7.5	15	29	2.40	7	605		1	36	0.1	3.3	65			

## 1990 Analytical Results

								Stream Sediment																											
MAP	SAMPLE ID	UTM ZONE	UTM EAST	UTM NORTH	STA	MED	FM	Au 2 ppb INAA	Sb 0.1 ppm INAA	As 0.5 ppm INAA	Ba 100 ppm INAA	Br 0.5 ppm INAA	Ce 10 ppm INAA	Cs 0.5 ppm INAA	Cr 5 ppm INAA	Co 5 ppm INAA	Hf 1 ppm INAA	Fe 0.2 % INAA	La 5 ppm INAA	Lu 0.2 ppm INAA	Mo 1 ppm INAA	Ni 10 ppm INAA	Rb 5 ppm INAA	Sm 0.5 ppm INAA	Sc 0.5 ppm INAA	Na 0.1 % INAA	Ta 0.5 ppm INAA	Tb 0.5 ppm INAA	Th 0.5 ppm INAA	W 2 ppm INAA	U 0.2 ppm INAA	Yb 2 ppm INAA	Zr 200 ppm INAA	Wt 0.001 g INAA	:DL :Unit :Mthd
82M03	761002	11	348629	5653511		6	LPs	2	0.2	3.0	880	6.2	95	3.2	280	29	4	5.1	43	0.4	1	68	70	7.4	18.0	1.8	1.6	1.2	8.7	2	2.8	2	300	18.830	
82M03	761003	11	345685	5652357		6	LPs	8	0.4	3.4	1000	0.5	130	2.7	190	24	3	4.8	50	0.2	1	46	91	8.5	17.0	2.3	1.6	1.3	12.0	2	2.8	2	230	30.680	
82M03	761004	11	345267	5652981		6	LPs	2	0.2	3.6	990	0.7	170	2.8	190	25	7	5.8	75	0.4	1	40	81	10.8	18.0	2.3	2.6	1.5	20.3	7	5.5	4	420	25.220	
82M04	761005	11	315059	5657181		6	LPs	2	0.7	2.9	200	20.0	71	5.0	54	11	2	1.7	91	0.2	1	21	27	21.9	8.8	1.1	0.5	3.4	5.1	2	16.0	8	200	3.170	
82M04	761006	11	314752	5657724		6	LPs	2	0.4	8.4	550	4.4	91	7.5	130	20	3	4.5	36	0.3	1	36	110	6.3	13.0	1.4	1.1	0.8	7.8	3	2.4	2	200	16.550	
82M03	761008	11	338490	5656415		6	LPs	4	0.4	4.0	740	1.3	110	2.8	290	39	3	7.2	43	0.3	1	95	48	8.1	23.1	1.8	1.7	1.2	7.0	2	1.6	2	260	17.970	
82M03	761009	11	340053	5657580		6	LPs	2	0.4	3.9	880	5.3	130	3.8	290	38	4	6.8	51	0.4	1	84	59	8.9	22.3	1.9	1.7	1.2	8.1	4	1.7	2	260	20.360	
82M03	761010	11	340332	5659817		6	LPs	2	0.5	6.7	780	8.0	110	4.1	250	33	4	5.5	49	0.3	1	98	88	8.5	16.0	1.0	1.8	1.3	11.0	2	3.0	2	450	16.070	
82M03	761011	11	340444	5660589	1	6	LPs	2	0.6	5.0	730	3.4	120	4.1	190	30	3	5.1	50	0.3	1	87	82	10.0	14.0	1.0	2.5	1.3	12.0	2	2.8	2	200	12.200	
82M03	761012	11	340444	5660589	2	6	LPs	2	0.6	5.9	880	2.6	160	4.5	250	37	5	6.5	65	0.4	1	88	89	11.2	19.0	1.2	2.8	1.4	14.0	5	3.2	2	430	32.820	
82M03	761013	11	337438	5658508		6	LPs	6	1.1	15.0	900	6.7	77	3.0	250	37	3	5.8	29	0.4	1	80	43	6.4	16.0	0.8	1.3	1.2	6.2	2	2.0	2	200	21.390	
82M03	761014	11	333483	5658126		6	LPs	2	0.3	4.1	610	3.3	99	2.3	190	26	3	6.2	42	0.5	1	43	53	7.7	16.0	1.4	1.6	1.1	8.2	2	2.4	2	210	25.240	
82M03	761015	11	334489	5659788		6	LPs	2	0.3	2.9	730	0.5	110	3.1	280	34	4	5.7	41	0.4	1	69	63	8.4	24.3	2.4	1.6	1.4	7.7	2	2.1	3	200	36.080	
82M03	761016	11	335764	5660514		6	LPs	2	0.2	2.7	820	0.8	160	2.5	180	24	5	4.2	68	0.4	1	58	80	10.9	14.0	2.0	2.1	1.5	18.0	2	5.0	3	320	28.910	
82M03	761017	11	336312	5659807		6	LPs	20	0.5	6.1	650	0.6	140	2.4	300	37	5	6.4	58	0.4	1	81	50	10.0	20.7	1.4	2.0	1.5	12.0	3	3.1	4	400	14.390	
82M03	761018	11	338120	5662605		6	Dg	2	0.2	2.4	650	2.4	260	4.7	210	20	5	4.0	110	0.3	1	61	96	15.7	15.0	1.5	1.6	2.2	35.1	2	8.9	4	300	6.990	
82M03	761019	11	339708	5664030		6	Dg	2	0.2	1.2	610	1.0	420	3.3	130	14	7	3.3	180	0.5	1	36	94	25.8	9.4	1.5	1.5	3.8	62.7	2	17.0	6	370	13.840	
82M03	761020	11	341523	5665139		6	Dg	2	0.1	1.1	850	3.7	240	3.7	160	18	6	3.6	100	0.2	1	46	100	16.2	11.0	1.6	2.2	2.2	35.1	2	14.0	3	390	17.760	
82M03	761022	11	343936	5664680		6	Dg	8	0.3	2.2	1000	5.4	120	12.0	310	40	4	7.9	50	0.4	1	86	110	9.0	27.9	2.0	1.8	1.4	11.0	5	3.3	3	290	31.490	
82M03	761023	11	345108	5667774	1	6	PPNs	2	0.1	1.0	1300	5.7	220	5.3	220	25	6	5.1	93	0.2	1	46	130	12.0	16.0	2.1	2.0	1.7	24.3	2	19.0	4	510	21.660	
82M03	761024	11	345108	5667774	2	6	PPNs	2	0.1	1.4	1300	5.4	230	5.3	210	23	6	5.0	95	0.2	1	43	120	12.4	16.0	2.0	2.0	1.6	24.8	2	18.0	4	360	18.100	
82M03	761025	11	345899	5668490		6	PPNs	2	0.1	0.6	1100	4.0	220	4.7	150	21	7	4.6	93	0.4	1	36	120	12.8	15.0	1.7	2.0	1.8	25.1	2	6.3	3	480	15.440	
82M03	761026	11	339879	5662889		6	Dg	2	0.4	2.2	910	1.4	120	3.4	220	29	4	5.6	49	0.4	1	55	60	7.5	19.0	2.1	1.8	0.9	10.0	2	2.7	2	340	19.540	
82M03	761027	11	329811	5664694		6	LPs	2	0.1	1.9	910	1.5	130	1.9	190	22	4	4.2	53	0.4	1	48	79	8.4	14.0	2.3	1.9	1.1	11.0	2	3.0	2	230	22.950	
82M03	761028	11	331115	5667884		6	LPs	2	0.2	2.6	740	7.7	110	1.9	300	31	4	4.9	48	0.3	1	91	73	7.5	14.0	1.9	1.6	1.1	11.0	2	3.7	3	390	9.580	
82M03	761029	11	331529	5668999		6	LPs	9	0.1	1.2	950	4.5	140	2.3	100	14	4	3.1	61	0.4	1	20	88	8.4	11.0	2.3	1.8	1.2	17.0	2	4.9	4	200	16.040	
82M03	761030	11	332253	5670082		6	Dg	2	0.1	2.4	910	3.3	160	2.5	110	13	5	3.1	65	0.4	1	23	86	9.2	11.0	2.2	1.8	1.3	20.0	2	6.8	4	370	22.700	
82M03	761031	11	336608	5670726		6	PPNs	2	0.2	2.1	1100	3.6	200	2.7	110	13	6	3.2	86	0.3	1	41	130	15.3	8.8	1.8	1.7	2.1	32.8	2	10.0	4	490	30.740	
82M03	761032	11	339690	5672083		6	PPNs	2	0.1	0.6	750	11.0	240	3.5	110	16	5	3.3	99	0.2	1	29	100	15.3	11.0	1.9	1.7	2.3	33.6	2	17.0	5	270	14.220	
82M03	761033	11	339322	5671132		6	PPNs	2	0.1	1.3	820	4.1	320	2.6	110	14	7	3.1	130	0.6	1	23	83	18.4	11.0	2.1	1.4	2.5	43.1	2	12.0	5	450	17.170	
82M03	761034	11	338451	5670610		6	PPNs	2	0.1	1.1	870	4.6	380	2.1	120	13	8	2.8	160	0.9	1	22	95	22.5	8.7	2.5	2.1	3.1	54.5	2	14.0	7	470	28.970	
82M03	761035	11	338400	5671600		6	PPNs	2	0.1	0.5	670	7.1	150	2.6	88	9	5	2.2	58	0.3	1	22	98	8.7	9.4	2.0	1.3	1.2	18.0	2	7.9	3	330	9.000	
82M03	761036	11	338314	5672101		1																													