



Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
Mineral Resources Division
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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

PENTICTON (NTS 82E)

STREAM SEDIMENT AND WATER GEOCHEMICAL DATA

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

MEMPR BC RGS 29
GSC OPEN FILE 2354

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 82E. Penticton

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

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INTRODUCTION

Open File package BC RGS 29 / GSC 2354, a joint federal-provincial initiative, contains new data for gold and 25 other elements obtained by re-analyzing stream sediments collected in 1976 from the Penticton map-sheet area (NTS 82E). Also included are the original analytical data from GSC Open File 409 published in 1979 for 10 elements in sediments, and uranium, fluoride and pH values in concomitant waters.

The original reconnaissance survey was undertaken in 1976 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. In 1990, under the MEMPR RGS Archive Program, the samples collected in 1976 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 STREAM SEDIMENT AND WATER SURVEY

E.H.W. Hornbrook directed GSC activities and *A. Sutherland Brown, N.C. Carter* and *P.A. Christopher* 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 : Semco, 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)
Atomic Energy of Canada, Ltd., Ottawa. (U in Sediments)
Bondar-Clegg, Ltd., North Vancouver. (U in Waters)
J.J. Lynch (GSC) and W.M. Johnson (MEMPR)

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 29 / GSC 2354 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.
- 39 - 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^{1/4}" 1.2 Mb (high density) floppy diskette containing data files in ASCII format.

SURVEY DESCRIPTION

PHYSIOGRAPHY, GEOLOGY AND MINERAL POTENTIAL

The Pentiction map sheet covers an area of approximately 16,600 square kilometres. Okanagan Lake, in the western half of the map sheet, divides the region into two physiographic units; in the east, the rugged topography of the Okanagan Highland, and to the west, the more subdued relief of the Thompson Plateau (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. Within the Okanagan Valley, extensive sequences of glaciolacustrine sediments blanket the valley floor and lower slopes.

The Pentiction map area is underlain by rocks ranging from late Proterozoic to Eocene in age. Near the western boundary of the map sheet lies the transition between the Intermontane and Omineca belts. In the Omineca belt, high-grade metamorphic rocks of the Shuswap Complex and middle Jurassic to late Cretaceous-age intrusive rocks predominate. Intermontane belt rocks exposed within the map sheet consist mainly of unmetamorphosed to sub-greenschist grade volcanic and sedimentary rocks of Mississippian to upper Triassic age with intrusions which are generally comagmatic with the volcanics (Thompson and Cook, 1981). The geological base map (Figure 1 and Table A-1 in Appendix A) used for Open File RGS 29 is from Okulitch and Woodsworth (1977).

Examples of mineral occurrences found within the map sheet are:

- Vein Ag, Pb, Zn (Beaverdell)
- Skarn Cu, Au (Phoenix)
- Porphyry Cu, Mo (Brenda)
- Vein Au, Ag (Dusty Mac)

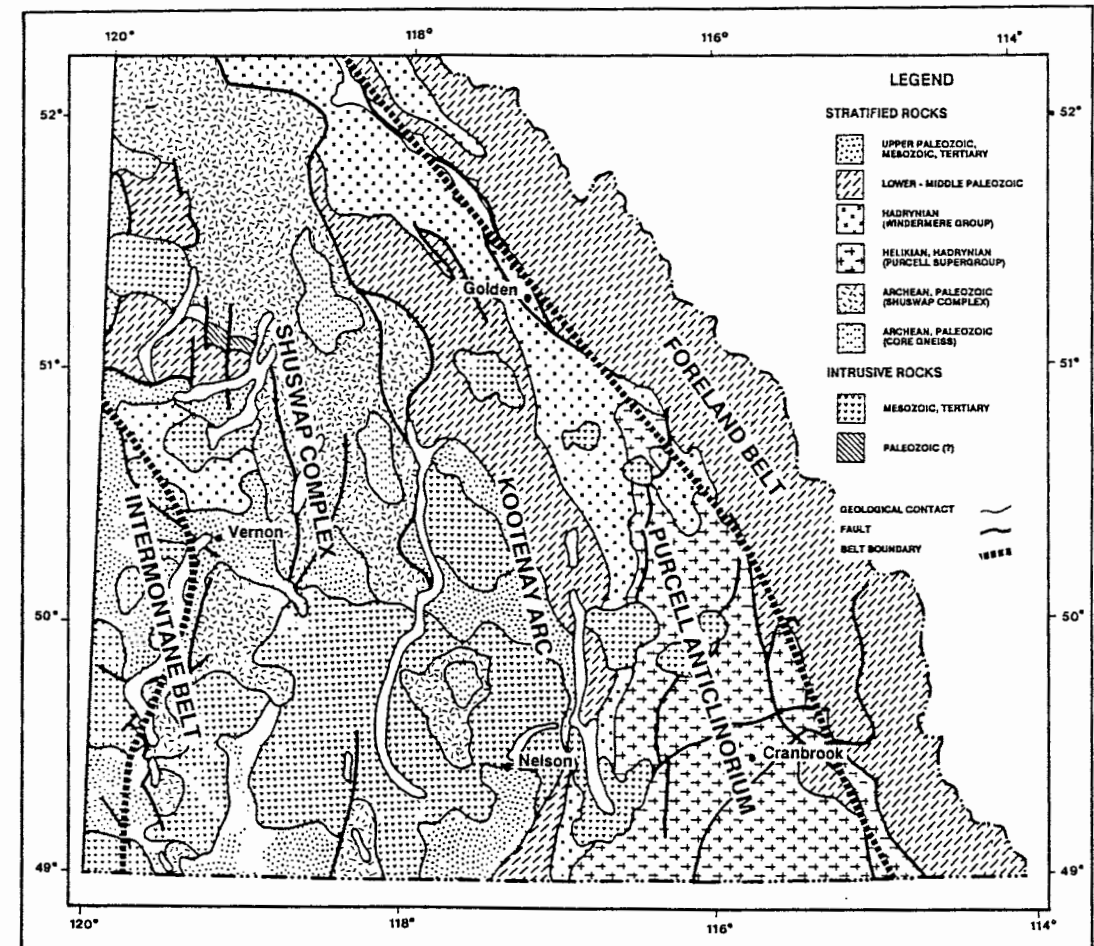


FIGURE 1 Generalized geology map of southeast British Columbia

SAMPLE COLLECTION - 1976

Helicopter and truck-supported sample collection was carried out during the summer of 1976 over the 16,600 square kilometre survey area. Stream sediment and water samples were systematically collected from 1542 sites for an average density of 1 site per 10.8 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

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

Chemex Laboratories (North Vancouver), analysed sediment samples for: copper, cobalt, iron, lead, manganese, molybdenum, nickel, silver and zinc. Uranium in stream sediments was determined by Atomic Energy of Canada (Ottawa). Water samples were analyzed for fluorine, uranium, and pH by Bondar-Clegg (North Vancouver). 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/cm²/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 169 analytical duplicate pairs from RGS 29 and 32 (NTS 82E and 82L) using the Thompson and Howarth (1973, 1976, 1978) method. Analytical duplicate INAA data for 82E are listed in Appendix B.

Briefly, their method involves dividing 50 or more analytical duplicate pairs (x_1 , x_2) into groups with narrow concentration ranges. For each group, the median value of absolute differences between duplicate pairs ($|x_1 - x_2|$) is used as an estimation of the standard deviation (s), whereas the mean value of all the duplicate pair means $(x_1 + x_2)/2$ 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, Br, Ce, Cr, 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 10 different elements at different concentration levels averaged 16% at the 50th, 80th and 95th percentiles (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	50	Prec	80	Prec	95	Prec
Barium	100	4000	-8.04	0.0767	0.5948	990	14.4%	1300	14.8%	1700	15.1%
Bromine	0.5	265	0.14	0.0558	0.7282	4.7	17.9%	12	14.1%	31	12.6%
Cerium	10	1500	-1.27	0.0982	0.9305	93	17.7%	170	19.0%	330	19.8%
Chromium	5	2040	3.432	0.067	0.9221	94	21.7%	190	17.8%	410	15.8%
Lanthanum	5	905	-2.58	0.1284	0.9368	58	17.6%	120	22.4%	202	24.2%
Rubidium	5	320	0.927	0.0627	0.6364	82	15.5%	110	14.9%	140	14.5%
Samarium	0.5	120	-0.05	0.0712	0.8736	8.1	13.6%	13.5	14.1%	23.8	14.5%
Scandium	0.5	42.5	0.253	0.0535	0.8098	11	16.0%	16	14.5%	21.6	13.7%
Thorium	0.5	352	-0.21	0.0879	0.9362	13	15.1%	27.6	16.9%	61.6	17.7%
Uranium	0.4	353	-0.1	0.0818	0.9367	6.2	13.9%	13	15.6%	27.2	16.4%

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 86 field duplicate pairs. Selected elements include Ag, Cu, Zn, Pb, Co, Ni, Fe, Mn (1976 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
 μ_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
 μ_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_{regional} and MSQ_{site} ;

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

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 (<10%). As a result a high measure of confidence is given to observed elemental regional trends.
- Elements displaying high sample site variance components (>10%) suffer from either extreme 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_{crit} at the 95% confidence limit for given degrees of freedom is 1.50. All elements surpass this value.

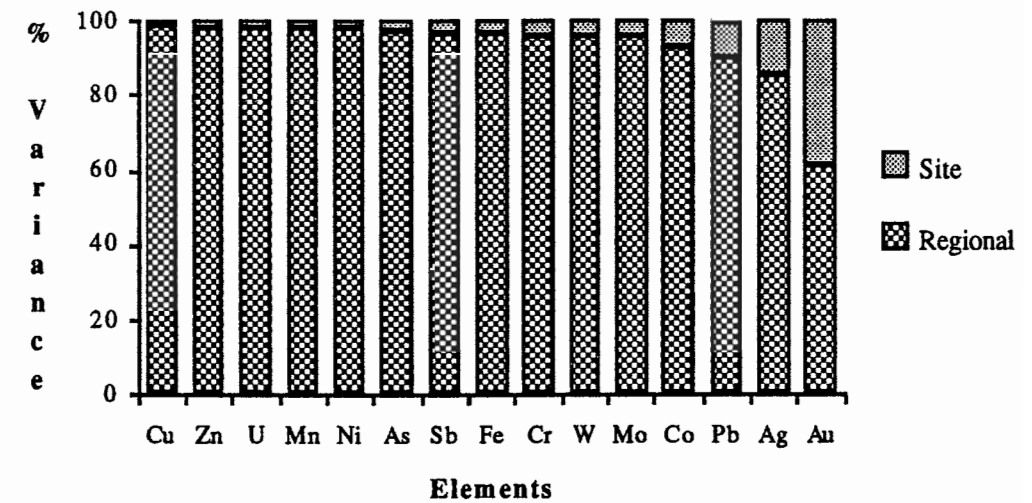


Figure 2a Variance Components for selected elements

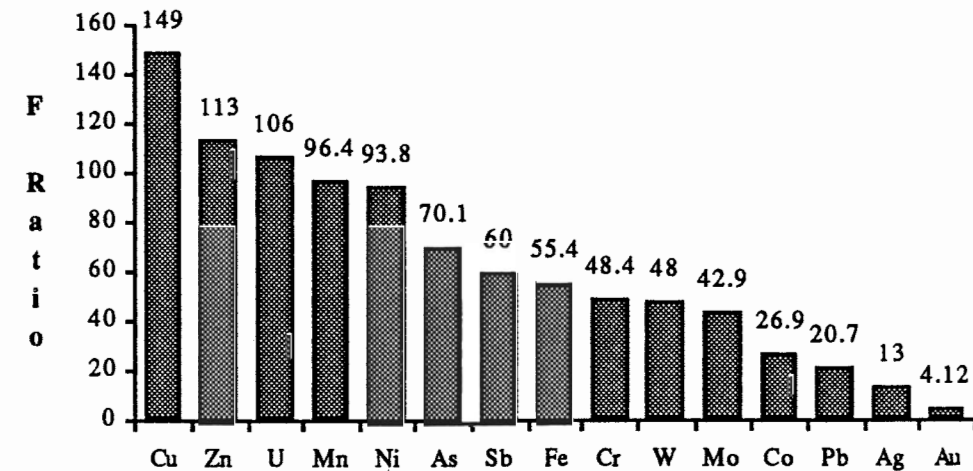


Figure 2b F ratios for selected elements

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 nickel and iron, 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.

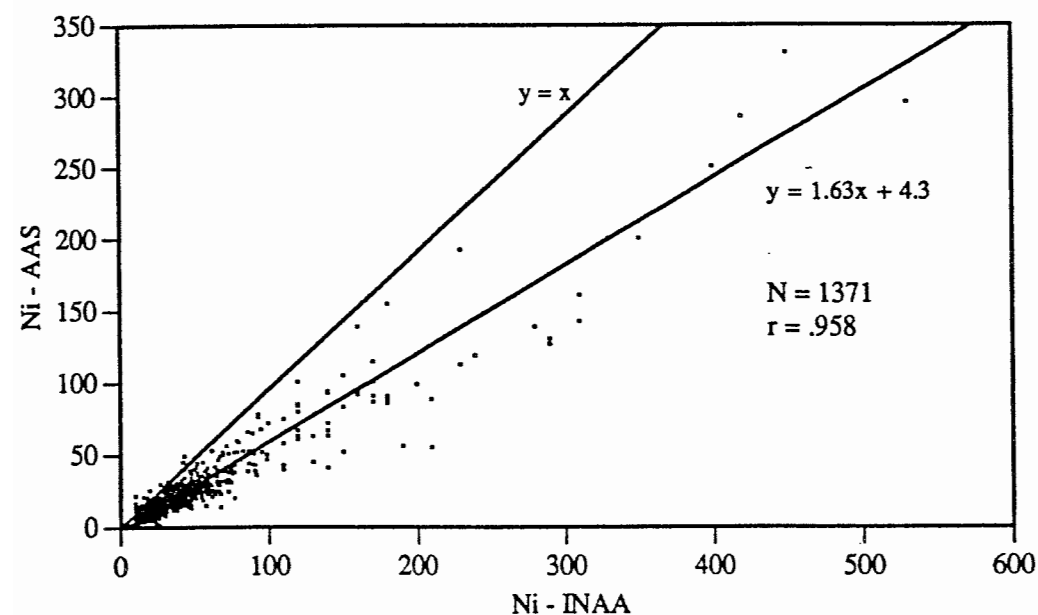


Figure 3a Scatterplot comparing INAA versus AAS results for Ni

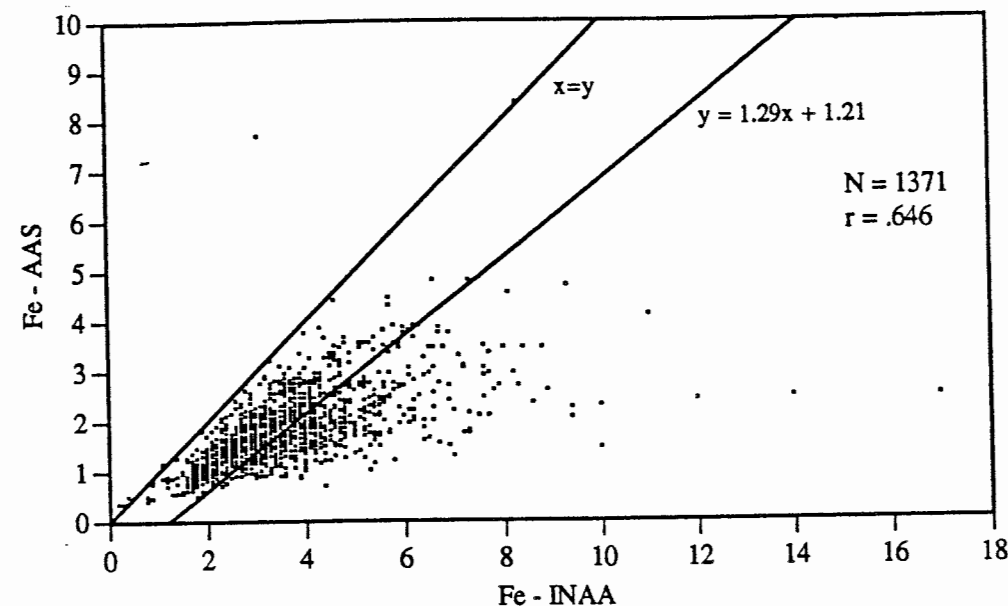


Figure 3b Scatterplot comparing INAA versus AAS results for Fe

BASE AND PRECIOUS METAL ANOMALY RATING METHOD

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

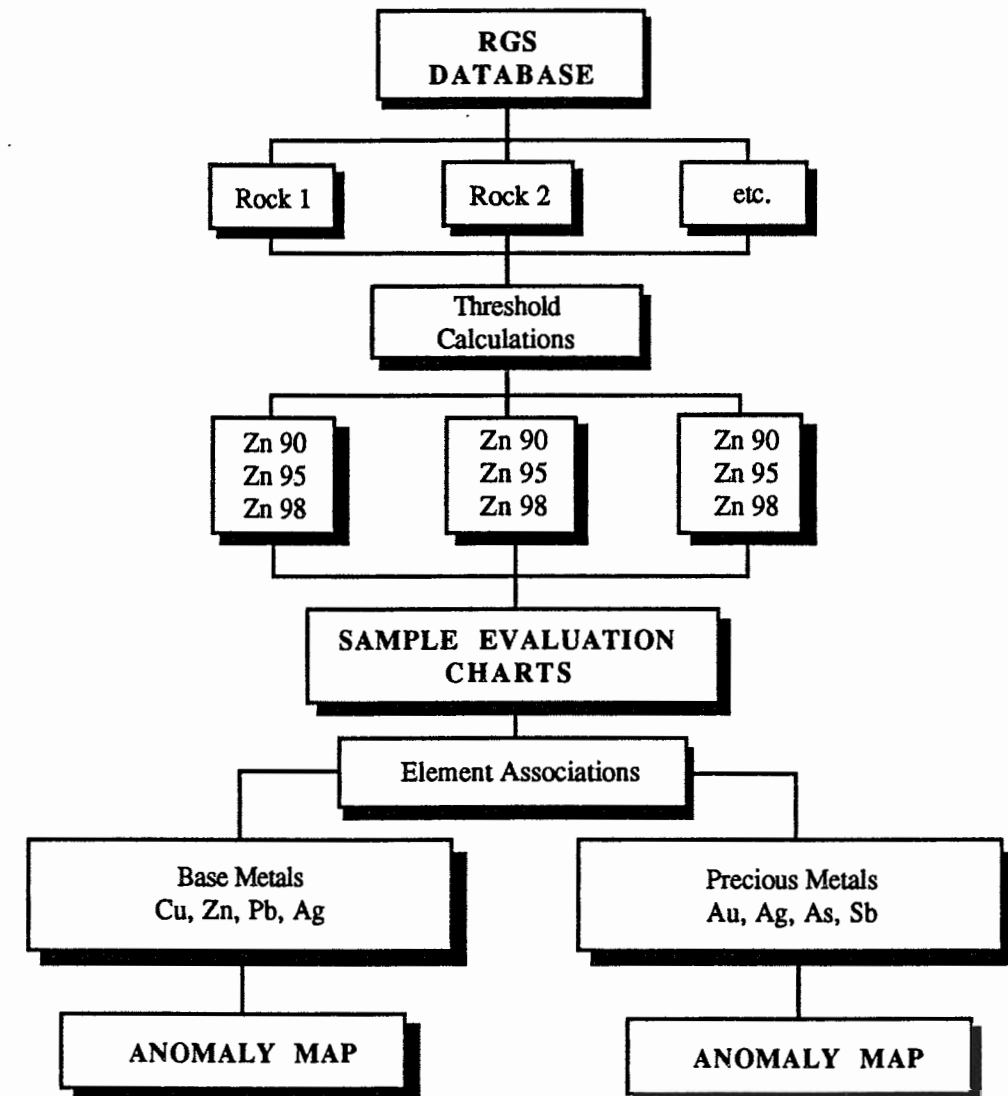
In order to assess the anomalous nature of individual samples, the 90th, 95th and 98th percentiles were calculated for lithologies having 10 or more sample sites and are provided in a threshold table (Appendix D).

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/cm³). 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⁻), thiosulphate (S₂O₃⁻²) or cyanide (CN⁻) 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

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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
<u>STRATIFIED ROCKS</u>		<u>STRATIFIED ROCKS</u>		<u>INTRUSIVE ROCKS</u>	
CENOZOIC		PALEOZOIC		MESOZOIC - CENOZOIC	
TERTIARY		CARBONIFEROUS - PERMIAN		CRETACEOUS AND/OR TERTIARY	
MIocene - PLIOCENE				LATE CRETACEOUS AND/OR EARLY TERTIARY	
mITv	basalt, plateau lava, minor sediments COLUMBIA R. Lavas	PPT	argillite, quartzite, greenstone, limestone, conglomerate THOMPSON Assemblage (including CACHE CK.- eastern facies), CHAPPERON, KOBALU and ANARCHIST Groups; MT. ROBERTS Fm.	KTm	CORYELL INTRUSIONS: monzonite, monzodiorite; lesser syenite, diorite, granodiorite, quartz monzonite
EOCENE - OLIGOCENE				MESOZOIC	
eoTv	basalt, andesite, volcanoclastic and flow rocks, minor sediments KAMLOOPS and PHOENIX Groups; SANPOIL Volcanics, KLONDIKE MTN. and O'BRIEN CK. Fms.	PPcc	limestone, greenstone, chert, argillite CACHE CK. Group (western-type facies)	CRETACEOUS	
		PALEOZOIC (AND OLDER?)		EARLY AND/OR MID-CRETACEOUS	
eoTs	sandstone, conglomerate, tuff KAMLOOPS Group; KISHENEHN, KETTLE R. and SOPHIE MTN. Fms.	Pns	orthogneiss, foliated and massive granitic rocks, paragneiss, schist, minor amphibolite and marble OKANAGAN Metamorphic and Plutonic Complex	EKgd	granodiorite, quartz diorite; lesser quartz monzonite
MESOZOIC				JURASSIC	
TRIASSIC - JURASSIC				MIDDLE AND/OR LATE JURASSIC	
TJv	greenstone, tuff, augite, sediments NICOLA and ROSSLAND Groups; ELISE and ARCHIBALD Fms.	Pgn	orthogneiss OKANAGAN Metamorphic and Plutonic Complex	Jqm	quartz monzonite, lesser granodiorite
				Jg	granodiorite, quartz diorite, lesser quartz monzonite
				PALEOZOIC	
				LATE PALEOZOIC (MAINLY)	
				Pub	ultramafic rocks; peridotite, serpentinite

Table A-2 Reference Guide for Field Observations

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

METHODS OF SAMPLE ANALYSIS

1976 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 HNO₃ for 30 minutes at 90°C. 1 ml concentrated HCl was added and the digestion was continued at 90°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.

Mo was determined by AAS 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 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 10¹² neutrons/cm²/sec. Each sample was irradiated for 60 seconds. Following a 20-second delay, the sample was counted with 6 BF₃ detector tubes embedded in paraffin for 60 seconds.

U in water was determined by a fluorometric method. Uranium was initially preconcentrated by evaporation. The residue was fused with a mixture of Na₂CO₃, K₂CO₃ 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.

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		
Uranium	0.2 ppm	1 g	NADNC	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

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 10¹¹ neutrons/cm²/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

1976 Field Observations and Analytical Results

																	Water			Stream Sediment													
MAP	SAMPLE ID	UTM ZONE	UTM EAST	UTM NORTH	STA	MED	FM	WAT COL	FLW	SED PPT	CON	SED COMP	STRM WDT	STRM DPTH	BNK	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	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			
82E04	761002	11	316133	5434624		6	EKgd	0	1	N	N	120	0.6	15	C	1406	170	2.70	7.8	1	11	0.30	1	190	2	4	0.1	1.7	15				
82E04	761003	11	314693	5434969		6	Pgn	0	1	N	N	121	0.9	15	C	1406	180	0.84	7.7	7	26	1.20	4	310	1	19	0.1	1.9	49				
82E04	761004	11	313429	5431601		1	Jg			N	N	120	1.2		C	1406				11	45	1.35	5	405	1	36	0.1	1.7	59				
82E04	761005	11	311402	5430880		1	Jg			N	N	111	0.9		C	1406				10	41	1.70	6	585	2	23	0.1	2.5	66				
82E04	761006	11	310382	5431478		1	Jg			N	N	211	0.6		C	1406				9	87	2.10	10	735	1	7	0.1	3.7	86				
82E04	761007	11	310780	5436010		1	Jg			N	N	021	0.6		C	1406				8	35	1.10	4	525	1	18	0.1	1.8	50				
82E04	761008	11	313054	5436597		1	EKgd			N	N	031	0.6		C	1406				1	18	0.40	1	345	3	6	0.1	2.6	16				
82E04	761009	11	314728	5436877		6	Pgn	0	1	N	P	121	1.5	15	C	1406	215	6.10	8.1	9	20	1.20	1	280	1	25	0.1	2.6	34				
82E04	761010	11	315320	5436211		1	EKgd			N	N	022	0.6		C	1406				1	23	0.45	6	190	2	7	0.1	2.3	25				
82E04	761011	11	309042	5436885		1	Jg			N	N	211	0.9		C	1506				4	44	0.50	3	210	4	16	0.1	1.9	24				
82E04	761012	11	307506	5436452		1	Jg			N	P	021	1.5		T	1506				10	48	1.35	4	520	2	28	0.1	1.3	67				
82E04	761013	11	307580	5435736		1	Jg			N	P	111	1.5		T	1506				13	43	1.65	5	430	2	28	0.1	1.3	87				
82E04	761014	11	305534	5431216		1	Jg			N	N	210	0.9		T	1506				14	36	2.25	4	490	1	26	0.1	2.3	54				
82E04	761015	11	303541	5433791		1	Jg			N	N	121	0.6		C	1506				10	27	2.00	10	690	1	11	0.1	3.9	70				
82E04	761016	11	300813	5439171		6	PPcc	0	1	R	N	120	0.3	15	C	1506	215	26.00	8.2	7	31	1.05	3	305	5	26	0.1	15.7	46				
82E04	761017	11	300407	5436836		6	Jg	0	3	N	N	121	1.5	15	T	1506	82	1.60	8.1	5	12	1.50	3	540	1	3	0.1	9.8	46				
82E04	761019	11	299834	5433433	1	6	Jg	0	4	N	N	301	4.6	76	C	1506	42	0.44	7.9	4	17	1.75	2	450	5	7	0.1	16.8	47				
82E04	761020	11	299834	5433433	2	6	Jg	0	4	N	N	301	4.6	76	C	1506	38	0.60	7.7	4	15	1.95	3	530	5	8	0.1	20.3	49				
82E04	761022	11	297742	5437255		6	Jg	0	3	N	N	301	0.9	15	C	1506	115	0.48	7.7	2	13	1.50	1	395	1	5	0.1	13.7	37				
82E04	761023	11	297534	5440047		6	Jg	0	3	N	N	121	1.2	30	T	1506	38	0.12	7.7	4	6	1.60	1	225	1	4	0.1	7.5	25				
82E04	761024	11	297649	5433383		6	Jg	0	4	N	N	211	6.1	46	C	1606	30	0.50	7.6	3	28	1.75	1	525	8	3	0.1	20.2	60				
82E04	761025	11	297719	5433761		6	Jg	0	3	N	N	211	2.4	30	C	1606	44	1.60	7.5	3	5	1.85	1	425	1	5	0.1	19.4	42				
82E04	761026	11	298284	5433351		6	Jg	0	3	N	N	121	3.0	30	C	1606	38	0.78	7.7	3	6	1.45	1	255	1	16	0.1	6.2	26				
82E04	761027	11	300044	5440903		6	Jg	0	2	N	N	121	1.2	15	C	1606	78	0.86	8.0	9	29	1.55	1	325	1	17	0.1	3.9	32				
82E04	761028	11	297429	5442058		6	Jg	0	4	N	N	211	4.6	61	C	1606	34	0.16	8.0	19	45	3.65	3	500	1	37	0.1	2.5	69				
82E04	761030	11	296410	5441911	1	6	Jg	0	4	N	N	211	6.1	46	C	1606	34	0.56	7.6	9	33	2.60	1	425	2	17	0.1	10.5	53				
82E04	761031	11	296410	5441911	2	6	Jg	0	4	N	N	211	6.1	46	C	1606	44	0.38	8.1	8	30	2.20	1	400	2	17	0.1	10.3	50				
82E04	761032	11	296524	5441383		6	Jg	0	4	N	N	211	4.6	61	C	1606	30	0.68	7.9	5	13	1.90	1	345	1	2	0.1	12.7	28				
82E04	761033	11	297537	5448870		6	PPcc	0	3	N	N	211	0.9	30	C	1606	34	0.28	8.1	12	58	1.45	4	400	1	22	0.1	0.9	46				
82E04	761034	11	297610	5447752		6	PPcc	0	3	N	N	121	0.9	30	C	1606	38	0.56	8.1	4	17	0.50	1	220	4	15	0.1	0.8	24				
82E04	761035	11	292698	5451523		6	PPcc	0	3	N	N	112	3.0	61	C	1706	34	0.20	8.0	21	56	3.05	7	760	1	72	0.1	4.1	88				
82E04	761036	11	292712	5452598		6	PPcc	0	3	N	P	211	3.0	61	A	1706	260	24.20	8.2	25	57	3.90	13	700	1	73	0.1	3.0	102				
82E04	761037	11	289796	5452959		6	PPcc	0	2	N	N	112	1.5	15	A	1706	42	0.14	8.0	17	87	2.50	7	910	1	34	0.1	2.4	74				
82E04	761038	11	286379	5454898		6	PPcc	0	3	N	N	112	1.5	30	A	1706	34	0.10	8.0	15	152	2.20	10	960	2	31	0.1	5.2	87				
82E04	761039	11	281409	5447410		6	PPcc	0	2	N	N	211	0.9	15	A	1706	135	0.50	7.9	15	48	2.65	2	570	1	43	0.1	3.2	74				
82E04	761040	11	286714	5456034		6	PPcc	0	3	N	N	211	3.0	30	C	1706	42	0.14	8.0	21	70	3.40	6	850	1	37	0.1	1.5	77				
82E04	761042	11	293495	5456945		6	PPcc	0	3	N	N	021	0.9	15	C	1706	260	0.88	8.2	10	37	1.50	6	320	2	29	0.1	1.8	68				
82E04	761043	11	296879	5457318	1	6	PPcc	0	1	N	P	121	0.9	15	C	1706	360	2.10	8.4	8	18	1.55	8	960	1	13	0.1	4.0	49				
82E04	761044	11	296879	5457318	2	6	PPcc	0	1	N	P	121	0.9	15	C	1706	345	2.40	8.1	8	19	1.70	9	1050	1	13	0.1	3.9	52				
82E04	761045	11	300123	5454172		6	PPcc	0	2	N	N	310	1.5	15	C	1706	320	3.00	8.3	11	38	2.25	8	425	1	30	0.1	3.9	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
82E04	761002	11	316133	5434624		6	EKgd	2	0.2	1.0	300	29.0	18	0.6	7	5	1	0.9	11	0.2	1	10	26	1.6	3.4	0.7	0.5	0.5	2.4	2	1.8	2	200	19.294	
82E04	761003	11	314693	5434969		6	Pgn	6	0.4	3.9	850	10.0	48	2.6	66	14	6	3.2	40	0.2	1	23	61	4.9	12.0	2.2	1.3	0.6	7.6	2	2.4	2	210	27.301	
82E04	761004	11	313429	5431601		1	Jg	5	0.4	7.1	750	24.0	40	2.1	77	25	4	3.7	35	0.2	1	50	51	4.7	13.0	1.9	1.5	0.6	5.6	2	2.1	2	200	34.148	
82E04	761005	11	311402	5430880		1	Jg	4	0.6	9.3	1000	12.0	52	3.0	81	25	5	4.8	44	0.2	1	34	79	5.4	15.0	2.3	1.5	0.7	6.6	2	3.1	2	200	38.309	
82E04	761006	11	310382	5431478		1	Jg	8	0.7	8.0	790	2.5	73	4.2	36	34	5	7.5	64	0.2	1	22	110	8.2	20.5	2.5	1.5	1.1	9.2	2	4.4	2	410	22.341	
82E04	761007	11	310780	5436010		1	Jg	3	0.4	7.2	690	25.0	36	1.5	59	19	3	2.8	25	0.2	1	27	43	3.5	9.1	1.6	1.0	0.5	4.2	2	2.0	2	200	31.153	
82E04	761008	11	313054	5436597		1	EKgd	3	0.2	1.5	280	71.4	14	4.9	14	5	1	0.9	8	0.2	1	10	12	1.2	2.7	0.5	0.5	1.9	2	2.5	2	200	19.593		
82E04	761009	11	314728	5436877		6	Pgn	13	0.6	8.9	790	6.3	67	1.4	100	20	6	3.7	42	0.2	1	39	43	6.2	12.0	1.8	2.1	0.9	6.0	2	3.1	2	500	48.563	
82E04	761010	11	315320	5436211		1	EKgd	7	0.3	1.9	340	33.0	22	1.8	20	5	2	1.1	14	0.2	1	10	25	2.0	3.8	0.8	0.5	0.5	3.4	2	2.6	2	200	24.006	
82E04	761011	11	309042	5436885		1	Jg	6	0.3	3.3	160	80.2	11	2.3	73	7	1	1.1	6	0.2	1	24	6	1.0	3.0	0.3	0.5	0.5	1.0	2	2.1	2	200	17.440	
82E04	761012	11	307506	5436452		1	Jg	6	0.4	6.6	510	90.8	25	1.3	81	21	2	3.4	17	0.2	1	45	24	2.8	11.0	0.9	0.9	0.5	2.5	2	1.4	2	200	20.874	
82E04	761013	11	307580	5435736		1	Jg	81	0.6	6.4	690	22.0	43	1.6	120	30	3	5.3	31	0.2	1	44	39	4.9	18.0	1.5	1.6	0.7	4.1	2	1.6	2	200	30.913	
82E04	761014	11	305534	5431216		1	Jg	8	1.1	13.0	1100	1.7	74	2.3	140	34	6	6.7	46	0.3	1	60	70	7.7	20.0	2.4	1.9	1.2	7.5	2	3.1	2	410	41.454	
82E04	761015	11	303541	5433791		1	Jg	2	1.0	7.2	880	2.0	45	3.1	68	26	6	5.6	40	0.2	1	17	82	5.6	19.0	2.6	1.4	0.7	9.1	2	5.0	2	200	35.284	
82E04	761016	11	300813	5439171		6	PPcc	11	1.7	14.0	690	30.0	30	10.0	42	15	1	2.9	21	0.2	6	29	58	2.6	8.4	1.1	0.8	0.5	6.1	2	20.0	2	200	26.508	
82E04	761017	11	300407	5436836		6	Jg	16	1.0	5.9	510	15.0	65	5.2	28	12	7	5.5	47	0.2	1	10	95	6.8	12.0	2.6	1.6	1.2	14.0	2	11.0	2	420	29.804	
82E04	761019	11	299834	5433433	1	6	Jg	2	0.3	2.2	620	9.2	50	4.5	42	10	10	6.4	40	0.2	6	10	81	7.0	10.0	2.4	1.8	1.0	13.0	2	22.5	2	260	24.703	
82E04	761020	11	299834	5433433	2	6	Jg	13	0.4	2.8	630	7.6	53	6.1	52	11	11	6.6	39	0.2	6	10	92	6.9	10.0	2.2	1.6	0.8	14.0	3	27.3	2	370	22.615	
82E04	761022	11	297742	5437255		6	Jg	10	1.2	5.0	530	16.0	62	6.0	33	13	8	5.6	47	0.2	1	10	100	7.1	12.0	2.8	1.7	1.3	14.0	2	17.0	3	440	31.267	
82E04	761023	11	297534	5440047		6	Jg	6	0.6	2.4	630	3.9	77	3.4	32	14	11	6.9	51	0.2	1	10	100	8.5	11.0	3.2	2.2	1.4	12.0	2	10.0	3	530	31.699	
82E04	761024	11	297649	5433383		6	Jg	2	0.2	0.5	620	15.0	51	4.5	21	10	5	4.2	36	0.2	13	10	79	5.3	10.0	3.2	1.3	1.1	7.6	2	28.5	2	310	27.188	
82E04	761025	11	297719	5433761		6	Jg	2	0.7	3.0	430	7.5	77	4.4	45	13	12	7.9	51	0.2	1	10	89	7.9	13.0	2.5	2.3	1.5	17.0	2	25.7	3	560	30.743	
82E04	761026	11	298284	5433351		6	Jg	2	0.4	1.5	670	4.1	72	3.0	76	12	9	5.6	47	0.3	1	24	93	8.2	12.0	3.0	1.9	1.3	11.0	2	7.9	3	500	39.963	
82E04	761027	11	300044	5440903		6	Jg	3	1.2	5.1	680	2.7	48	5.6	110	24	6	5.1	40	0.2	1	36	100	5.9	19.0	3.1	1.5	0.9	10.0	2	5.4	2	200	25.648	
82E04	761028	11	297429	5442058		6	Jg	12	1.3	18.0	750	6.7	63	5.9	110	44	6	7.6	51	0.2	1	71	69	7.9	20.0	2.2	2.5	1.1	7.9	3	3.1	2	350	26.021	
82E04	761030	11	296410	5441911	1	6	Jg	28	1.0	10.0	790	10.0	61	8.5	61	25	10	7.6	51	0.2	5	35	88	8.6	15.0	2.0	2.3	1.2	20.4	8	14.0	2	280	18.216	
82E04	761031	11	296410	5441911	2	6	Jg	12	0.9	10.0	760	8.6	67	7.8	65	25	9	7.9	54	0.2	5	31	88	8.1	17.0	2.3	2.4	1.2	22.0	9	13.0	2	430	17.996	
82E04	761032	11	296524	5441383		6	Jg	9	0.7	4.7	550	6.2	73	6.1	25	12	9	7.4	45	0.2	3	10	110	7.3	10.0	2.7	2.1	1.3	17.0	7	14.0	2	430	29.236	
82E04	761033	11	297537	5448870		6	PPcc	6	0.7	5.8	270	225.0	33	3.7	64	22	2	3.4	20	0.2	1	31	21	3.1	9.5	0.9	0.9	0.6	1.9	2	1.1	2	200	8.587	
82E04	761034	11	297610	5447752		6	PPcc	2	0.3	2.3	100	63.4	10	1.5	28	6	1	0.8	5	0.2	1	15	5	1.0	1.9	0.1	0.5	0.5	0.5	2	0.7	2	200	15.081	
82E04	761035	11	292698	5451523		6	PPcc	9	1.7	34.0	660	34.0	45	7.2	170	43	3	5.9	35	0.2	1	100	49	5.2	18.0	1.5	1.4	0.8	5.9	2	4.5	2	200	18.041	
82E04	761036	11	292712	5452598		6	PPcc	29	2.6	48.0	760	25.0	61	5.5	190	45	4	6.5	39	0.2	1	100	63	5.5	20.0	1.5	1.6	0.8	6.9	2	3.4	2	200	14.687	
82E04	761037	11	289796	5452959		6	PPcc	10	1.7	51.8	1100	90.1	27	10.0	86	25	1	3.9	15	0.2	1	49	32	2.9	16.0</										

1976 Field Observations and Analytical Results

																	Water			Stream Sediment												
MAP	SAMPLE ID	UTM ZONE	UTM EAST	UTM NORTH	STA	MED	FM	WAT COL	FLW	SED PPT	CON	SED COMP	STRM WDT	STRM DPTH	BNK	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	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		
82E04	761046	11	310435	5447237		6	PPT	0	2	N	N	121	1.2	15	C	1806	190	1.30	8.1	4	29	0.45	5	195	6	16	0.1	1.4	30			
82E04	761047	11	310475	5445955		6	PPT	0	2	N	P	211	1.2	15	C	1806	180	0.70	7.9	9	25	1.10	3	325	2	28	0.1	1.4	48			
82E04	761048	11	311185	5443947		6	PPT	0	3	N	N	220	1.5	15	C	1806	64	1.20	8.0	18	42	2.85	3	750	1	70	0.1	1.8	54			
82E04	761049	11	310497	5439990		1	PPT			N	N	211	0.9		T	1806				8	44	0.90	6	430	2	28	0.1	2.7	60			
82E04	761050	11	302515	5441614		6	PPcc	0	1	N	N	121	0.9	15	C	1806	245	1.80	7.8	22	59	3.30	2	730	3	48	0.1	1.0	71			
82E04	761051	11	301441	5449606		1	PPT			N	N	211	2.4		C	1806				17	47	2.30	4	610	2	56	0.1	1.8	80			
82E04	761052	11	301527	5452046		6	PPT	0	1	N	N	220	1.5	15	C	1806	215	12.60	7.9	9	28	1.10	10	305	2	37	0.1	4.3	66			
82E04	761053	11	303084	5453579		1	PPT			N	N	310	1.5		C	1806				8	37	1.35	6	420	1	22	0.1	4.7	56			
82E04	761054	11	304140	5454494		6	PPT	0	1	N	N	220	1.5	15	C	1806	155	9.10	8.4	6	24	1.10	3	295	1	16	0.1	4.4	41			
82E04	761055	11	303610	5447907		6	PPT	0	2	N	N	121	3.0	15	C	1806	100	1.10	8.0	16	35	2.75	1	560	1	60	0.1	1.7	92			
82E04	761057	11	303707	5447405		6	PPT	0	3	N	N	211	3.0	15	C	1806	62	0.46	8.3	19	39	3.00	2	680	2	50	0.1	2.0	70			
82E04	761058	11	309663	5450458		6	PPT	0	2	N	P	121	1.5	15	A	1806	130	1.50	8.2	5	16	0.75	4	195	1	12	0.1	1.9	33			
82E04	761059	11	311599	5455340		6	EKgd	0	1	N	P	111	0.9	15	C	1806	170	7.10	8.3	6	27	0.85	3	265	1	7	0.1	3.7	30			
82E04	761060	11	313440	5456694		6	eoTv	0	2	N	P	211	1.2	61	T	1906	530	14.60	8.2	1	12	2.50	1	125	5	2	0.1	3.5	16			
82E04	761062	11	316606	5452068		6	EKgd	0	1	N	P	121	1.2	15	T	1906	560	5.50	8.0	3	9	1.05	3	270	1	8	0.1	3.9	35			
82E03	761063	11	318210	5453141		6	EKgd	0	1	N	N	211	0.6	15	C	1906	1300	9.10	8.3	1	5	6.00	2	100	1	4	0.1	3.0	21			
82E03	761064	11	319329	5451818		1	EKgd			N	N	220	1.5		T	1906				2	7	8.00	1	125	1	4	0.1	5.1	23			
82E03	761065	11	317995	5451993		6	EKgd	0	1	N	N	121	1.5	15	C	1906	560	7.80	8.5	2	3	0.65	1	340	1	3	0.1	3.5	18			
82E03	761066	11	318232	5440892		6	Pgn	1	2	N	N	121	4.6	46	A	1906	130	0.58	7.8	2	5	8.00	1	170	1	4	0.1	5.8	19			
82E03	761067	11	319804	5437516		1	Pgn			N	N	220	1.2		T	1906				3	16	0.95	1	220	1	7	0.1	8.7	33			
82E03	761068	11	319489	5438359		6	Pgn	0	0	N	N	211	0.6	9	A	1906	280	2.80	7.8	4	10	0.95	2	230	1	7	0.1	5.0	30			
82E04	761069	11	317372	5439050		6	Pgn	1	2	N	P	211	4.6	46	A	1906	200	0.46	7.9	2	5	0.75	1	160	1	4	0.1	4.3	18			
82E03	761070	11	321038	5445355		6	Pgn	0	1	N	N	121	1.2	15	T	1906	270	3.00	7.8	3	9	0.90	1	165	1	5	0.1	12.3	20			
82E12	761071	11	295460	5487543	1	6	Jg	1	3	N	N	211	3.0	61	A	2006	36	0.20	7.1	5	9	1.75	1	260	1	6	0.1	8.6	35			
82E12	761072	11	295460	5487543	2	6	Jg	1	3	N	N	211	3.0	61	A	2006	26	0.30	7.0	5	8	1.85	1	260	1	6	0.1	7.6	35			
82E12	761073	11	295835	5487805		6	Jg	1	3	N	N	121	3.0	61	A	2006	56	0.76	7.1	4	11	1.45	2	350	1	6	0.1	7.8	36			
82E12	761074	11	295332	5489491		6	Jg	1	3	N	N	121	3.7	30	C	2006	50	0.72	7.0	4	9	1.30	2	300	2	5	0.1	7.0	29			
82E12	761076	11	293554	5489306		6	Jg	1	3	N	P	211	2.4	30	A	2006	26	0.60	7.2	5	10	1.80	2	390	2	5	0.1	10.2	36			
82E12	761077	11	293723	5489896		6	Jg	1	3	N	P	022	1.5	15	A	2006	46	0.66	7.0	5	12	1.45	4	390	1	7	0.1	9.9	34			
82E12	761078	11	293951	5491189		6	Jg	1	3	N	P	121	1.8	30	A	2006	50	0.86	7.0	6	17	1.45	3	395	1	8	0.1	9.6	42			
82E12	761079	11	297430	5488165		6	Jg	1	3	N	N	121	4.6	46	C	2006	66	0.82	7.3	5	15	1.50	3	425	1	8	0.1	7.9	41			
82E12	761080	11	296634	5490884		6	Jg	1	3	N	N	121	4.6	46	C	2006	62	1.40	7.0	5	13	1.40	3	355	1	8	0.1	8.1	38			
82E12	761082	11	296936	5491347		6	Jg	0	1	N	N	112	0.9	30	C	2006	290	3.10	8.2	3	9	1.30	1	1050	5	2	0.1	18.1	29			
82E12	761083	11	294046	5495634		6	eoTv	0	2	N	N	211	1.2	15	T	2006	270	2.20	7.8	3	27	1.25	2	315	1	13	0.1	15.6	25			
82E12	761084	11	293298	5496340		6	eoTv	0	1	N	P	022	0.9	15	C	2106	370	6.10	8.2	4	26	0.90	3	420	1	4	0.1	3.0	30			
82E12	761085	11	294102	5497828	1	6	Jg	0	1	N	N	121	0.9	15	C	2106	380	4.00	8.2	4	14	1.15	1	475	1	5	0.1	3.6	26			
82E12	761086	11	294102	5497828	2	6	Jg	0	1	N	N	121	0.9	15	C	2106	400	3.50	8.2	3	14	1.20	1	415	1	5	0.1	4.0	26			
82E12	761087	11	286994	5493603		6	Jg	1	4	N	N	211	3.0	76	C	2106	30	0.26	8.0	5	9	1.75	1	665	1	5	0.1	6.5	31			
82E12	761088	11	288921	5494246		6	Jg	1	3	N	N	121	1.5	30	A	2106	54	0.70	7.4	5	16	1.60	2	430	2	5	0.1	19.6	24			
82E12	761089	11	288865	5494784		6	Jg	1	4	N	N	211	4.6	61	C	2106	32	0.36	7.3	6	10	1.85	17	615	2	8	0.1	6.5	33			