



Province of British Columbia
Ministry of Energy Mines and Petroleum Resources

Mineral Resources Division
Geological Survey Branch
Applied Geochemistry

1988 BRITISH COLUMBIA REGIONAL GEOCHEMICAL SURVEY

STREAM SEDIMENT AND WATER GEOCHEMICAL DATA

NTS 92L/102I - ALERT BAY/CAPE SCOTT

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Canada - British Columbia Mineral Development Agreement (1985 - 1989)

MEMPR BC RGS 23



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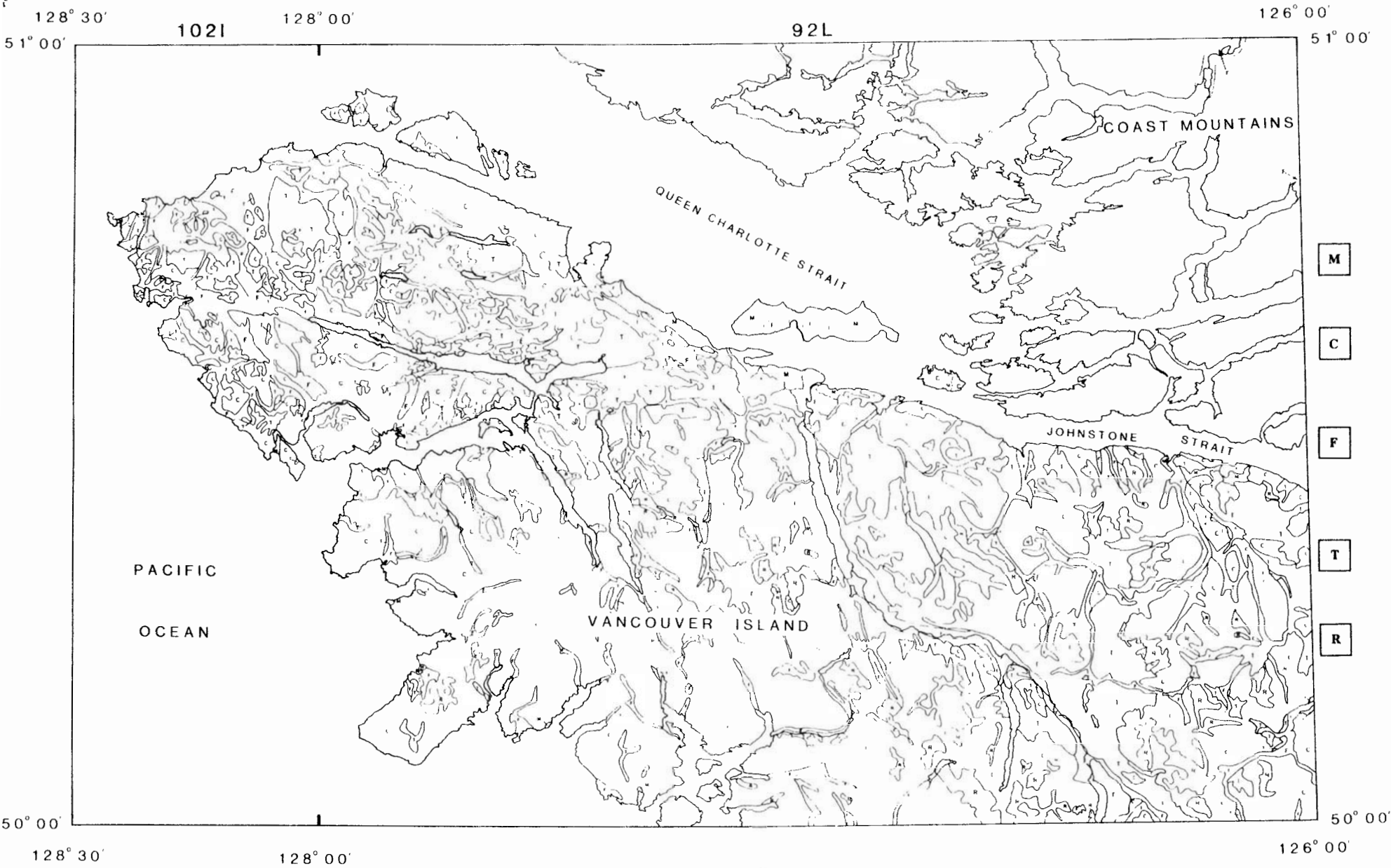
Geological Survey of Canada
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GSC O.F. 2040

1988 Regional Geochemical Survey
92L/102I - Alert Bay/Cape Scott

British Columbia Regional Geochemical Survey - RGS 23
Geological Survey of Canada Open File 2040

<u>Table of Contents</u>	<u>Page</u>	<u>Table of Contents</u>	<u>Page</u>
Introduction	2	List of Field Observations and Analytical Results	16
Credits	2	Statistical Summary of Total Data Set	80
1988 RGS Program Modifications	2	Statistical Summary of Data by Geological Formation	83
Geology and Mineral Potential	2	Sample Evaluation Charts	134
Sampling Program	3	Table 1. Sample Distribution	4
Field Processing and Sample Preparation Program	3	Table 2. Geology of Alert Bay/Cape Scott Map Sheet	9-10
Analytical Program	3	Table 3. Reference Guide for Field Observations	12
Symbol and Value Map Presentation	3	Table 4. Methods and Specifications for Sample Analysis	13-14
Comments Regarding the Interpretation of Gold Results	4	Table 5. Correlation Coefficients and Regression Line Values for Paired Moss-mat and Stream Sediment Check Samples	7
Interpretation of Moss-Mat Sediment Results	5	Figure 1. Surficial Geology of Alert Bay/Cape Scott Map Sheet	1
Orientation Surveys	5	Figure 2. Dispersion Patterns for Copper, Arsenic and Gold in Paired Moss-mat Sediment and Stream Sediment Samples for McKay Creek on Vancouver Island.	7
1988 RGS Check Samples	6		
Possible Mechanism for Heavy Mineral Entrapment	6		
Conclusion	6		
Acknowledgements	6	Figure 3. Scatter Diagrams Comparing Elemental Concentrations in Paired Moss-Mat Sediment and Stream Sediment Check Samples	8
References	15		



LEGEND

- M** **MARINE SEDIMENTS:** Includes raised off-shore deposits of clayey silt and littoral deposits of sands and gravel which may overlay off-shore sediments.
- C** **COLLUVIAL SEDIMENTS:** Areas of colluvial sediments generally less than 5 m thick, includes colluvial blankets and talus deposits, mudflow fans, rockslide debris and avalanche fans. May include some rock outcrops.
- F** **FLUVIAL SEDIMENTS:** Fluvial and/or fluvial glacial sediments usually consisting of mixtures of sand and gravel. Recent fluvial landforms include floodplains, deltas and alluvial fans. Fluvial glacial landforms consist of kames, eskers, kame terraces, and outwash plain and terraces.
- T** **TILL:** Areas of till less than 5 m thick. May include till blankets and constructional landforms such as hummocky or gently rolling till plains and drumlins.
- R** **BEDROCK:** Areas consisting of bedrock or bedrock covered by less than 10 cm of unconsolidated materials; includes pockets of shallow colluvium and/or till (<1 m).

Legend and map modified from Howes (1981)

SURFICIAL GEOLOGY 92L & 102I



Introduction

Open File package *BC RGS 23/GSC 2040* (Alert Bay/Cape Scott - NTS 92L/102I) is one of three regional geochemical open files covering northern Vancouver Island and the adjacent mainland which were sampled in 1988. Open File *BC RGS 23* presents the results of moss-mat sediment, stream sediment and water analyses for 22 elements.

The reconnaissance survey was undertaken by the Geological Survey Branch of the Ministry of Energy, Mines and Petroleum Resources with funding supplied in part under the Canada/British Columbia Mineral Development Agreement (1985-1989).

Open File package *BC RGS 23* consists of a data booklet and a set of 30 maps. The maps include (1) 1:250 000 scale and (5) 1:100 000 scale sample location maps plus (24) 1:250 000 scale symbol and value maps for analyzed elements, loss-on-ignition and pH of stream waters. The data is also available on floppy diskette.

This data booklet contains a description of the 1988 Regional Geochemical Survey (RGS) program, data listings, statistical summaries and sample evaluation charts. A full discussion of the RGS program is given by Gravel and Matysek (1989), descriptions on moss-mat sampling can be found in Matysek and Day (1988) and Matysek et al. (1989).

Credits

Contracts were let to the following companies on a technically acceptable and competitive bid basis and were managed by the staff of the Applied Geochemistry Subsection:

COLLECTION: ■ McElhanney Engineering Services Ltd., Surrey, B.C.
PROCESSING: ■ Kamloops Research and Assay Ltd., Kamloops, B.C.
ANALYSIS: ■ Chemex Labs Ltd., North Vancouver, B.C. (sediment)
■ Barringer Magenta Laboratories Ltd., Calgary, Alta. (water)
DATA ENTRY: ■ Data Makers, Victoria, B.C.

APPLIED GEOCHEMISTRY STAFF

- P.F. Matysek : directed the survey
- J.L. Gravel : coordinated staff and contract operations
- W. Jackaman : coordinated and edited open file production
- S. Pattenden : provided general assistance to the program

1988 RGS Program Modifications

1. Collection of **moss-mat sediments** on Vancouver Island and stream sediments on the mainland.
2. Precious metal pathfinder elements **chromium and bismuth** were added to RGS analytical suite.
3. **Sample evaluation charts** based on sample media, underlying lithologies and percentiles are provided in the data booklets.
4. **Addition of specific field observations** on stream channel characteristics and moss mat parameters such as position in stream, host, thickness and colour.
5. **Element histograms and surficial geology maps** have been transferred to the data booklet from the maps to facilitate use in the field.
6. **Statistics** used for elemental maps and the statistical summary were **calculated separately for the two sampling media**.
7. Symbol and value maps were not produced for those elements where greater than 98% of the samples had concentrations less than or equal to their respective detection limits.

Geology and Mineral Potential

The Alert Bay/Cape Scott map sheet covers approximately 12 000 km² comprising northern Vancouver Island and a small segment of the mainland (Fig. 1). Thin till and colluvium cover the Insular Mountains in the southern half of the map sheet; thicker till, fluvio-glacial and marine sediments occupy the Coastal Trough in the northern half (Howes, 1981). Underlying Vancouver Island are volcanic and sedimentary rocks of Pennsylvanian to Jurassic age belonging to the Sicker, Vancouver and Bonanza Groups intruded by plutons of Jurassic to Tertiary age (Table. 2). The Coast Complex, composed of felsic intrusives, predominates on the mainland. Geological underlay for the open file maps used GSC map 1552A (Muller and Roddick, 1980). Typical mineral occurrences are: copper-molybdenum-gold stockworks (Island Copper), mesothermal gold veins (Zeballos gold camp), copper skarns (Coast Copper), iron (Zeballos Iron) and lead-zinc skarns (Zip) (Muller et al. 1974). Assessment reports for the years 1981 to 1987 indicate the general level of activity has been moderate to low (Gravel and Matysek, 1989).

Sampling Program

A total of 1140 sites were sampled for moss-mat sediment, stream sediment and stream water at a density averaging 1 site per 10.5 km² (Table 1). Seventy-eight percent of the samples were collected by truck and boat; the remaining samples (22%) were collected by helicopter. Moss-mat sediment samples weighing 1-2 kg were scraped from boulders and logs found within the active stream channel and placed in large kraft-paper sample bags. To prevent contamination, moss mats growing on or near the banks and on decomposed logs and friable boulders were avoided. Stream sediment samples were collected from low energy sites and consisted of 2-4 kg of sand size and finer inorganic material. Water samples were collected in 250 ml nalgene bottles. Observations regarding sample material, sample site and the surrounding area were recorded (Table 3) in the field. Aluminum identification tags measuring 5 cm x 10 cm were inscribed with an RGS sample number and stapled to a nearby tree at each sample site. Numerous field checks were conducted by staff geochemists to monitor, control and assess sample collection procedures.

Field Processing and Sample Preparation Program

Field processing of the sediment samples was completed at a central depot located in Campbell River. Samples were initially dried on open-air racks and then in a heated shed (<50°C). Moss-trapped sediment was liberated from plant fibres by pounding dried samples with a wooden mallet. All samples were then sieved to -18 mesh (-1 mm) to reduce sample weight and assess fines content. Sample quality checks were run by routinely sieving 1 sample in each block of 20 to -80 mesh (<177 microns), plus any samples suspected of low fines content. Samples containing less than 30 gm, the minimum amount needed for the RGS analytical determinations, were rejected and new samples collected. Only 12 samples sites were revisited due to poor sample quality from the 2739 total sites sampled during the 1988 RGS program

Field prepared samples were shipped to the contracted sample preparation laboratory for further sieving to -80 mesh. At this time, control reference samples and blind duplicate samples were inserted into each block of 20 sediment samples. For the water samples, only control reference samples were inserted into the block.

Analytical Program

Sediment samples were sent to Chemex Labs Ltd. for analysis of antimony, arsenic, barium, bismuth, cadmium, chromium, cobalt, copper, fluorine, gold, iron, lead, manganese, mercury, molybdenum, nickel, silver, tin, tungsten, uranium, zinc and organic matter by loss on ignition. Prior to analysis for tin and tungsten, a 10 gm subsample was crushed to -150 mesh to reduce the rare particle effect. Water samples were shipped to Barringer Magenta Laboratories for determination of pH, fluorine ion and uranium content. The methods and specifications for analysis of each element are given in Table 4. Geological Survey of Canada quality control procedures were used to ensure that analytical data satisfy National Geochemical Reconnaissance standards.

Symbol and Value Map Presentation

- Sample locations were digitized and verified from the sample collection contractor's field maps by Applied Geochemistry staff.
- On the sample location maps field duplicates are represented by the following system : first field duplicate sample number / second field duplicate sample number. Elemental concentrations for field duplicates are averaged on the value and symbol maps.
- Percentiles were calculated on the raw data for each sample medium. Symbol sizes on the map are based on the 50th, 75th, 90th and 95th percentile. Analytical determinations are listed adjacent to symbols for all samples exceeding the 75th percentile.
- Symbol and value maps were not produced for those elements if less than 2% of the sample concentrations were above detection limit. Samples exhibiting elevated concentrations for these elements are highlighted separately in the data listing section.

Table 1. Sample Distribution					
Map Sheet	Moss Mat	Strm Seds	Total Sites	Area km ²	Density km ² /Site
92L01	97	0	97	985	10.2
92L02	99	0	99	980	9.9
92L03	94	0	94	800	8.5
92L04	41	0	41	320	7.8
92L05	74	0	74	770	10.4
92L06	95	0	95	950	10.0
92L07	84	0	84	955	11.4
92L08	89	2	91	900	9.9
92L09	39	39	78	730	9.3
92L10	9	0	9	120	13.3
92L11	33	0	33	640	19.3
92L12	91	0	91	890	9.8
92L13	39	0	39	400	10.3
92L14	0	12	12	365	30.4
92L15	18	51	69	610	8.8
92L16	9	52	61	800	13.1
102I09	51	0	51	550	10.8
102I16	22	0	22	240	10.9
Total	984	156	1140	12005	10.5

Comments Regarding the Interpretation of Gold Results

The following discussion reviews the format used to present the gold geochemical data and outlines some important points to consider when interpreting the data. This discussion is included in recognition of the special geochemical behavior and mode of occurrence of gold in nature and the resultant difficulties in obtaining and analyzing samples which reflect the actual concentration level at a given site. Understanding gold geochemical data from regional stream sediments requires an appreciation of the unique chemical and physical characteristics of gold and its mobility in the surficial environment. Key properties that distinguish the geochemical behavior of gold from most other elements include:

- 1) Gold occurs most commonly in the native form. It is chemically and physically resistant and a high proportion of the metal is dispersed in micron-sized particulate form. Gold's high specific gravity results in heterogeneous distributions, especially in stream sediments.
- 2) Gold typically occurs at low concentrations in the ppb range. Gold concentrations of a few ppm may represent economic deposits. Background levels encountered for stream and moss-mat sediments seldom exceed 10 ppb, and commonly are near the detection limit of 1 ppb.

The foregoing factors can result in a particle sparsity or "Nugget Effect", wherein very low concentrations of gold are heterogeneously distributed in the surficial environment. Hence, a major problem facing the explorationist is obtaining a representative sample. In general, the lower the concentration of gold, the larger the sample size required to reduce uncertainty over whether subsample analytical values truly represent actual values. Conversely, as gold concentrations increase, the number of gold particles to be shared in random subsamples increases and the variability of results decreases (Clifton et al., 1969; Harris, 1982).

The limited amount of material collected during the rapid, reconnaissance-style regional surveys and the need to analyze for a broad spectrum of elements, precludes the use of a significantly large sample weight for the gold analyses (usually 10 grams). Consequently, results from these analyses tend to be highly variable and qualitative rather than quantitative. To evaluate and monitor the sampling and analytical variability which are inherent in the analysis of gold in geochemical media, the following control methods are currently employed:

- 1) For each block of twenty samples:
 - a) random insertion of a standard reference sample to monitor and control analytical accuracy and long-term precision;
 - b) collection of a field duplicate (two samples collected separately from one site) to monitor sampling variance; and
 - c) analysis of a second subsample (blind duplicate) from one sample to monitor and control short-term precision.

2) Repeat analyses are performed on:

- a) samples exceeding the 95th percentile for gold;
- b) samples exhibiting low gold concentrations and anomalous concentrations in one or more pathfinder elements (As, Cu, Pb, Zn, Sb, Hg); and
- c) samples exhibiting a significant concentration difference between the first and repeat analysis.

Presentation of gold data within the booklet and on the symbol and value map differ from other elements as follows:

1) Summary Statistics

- a) Only the initial gold value was used.
- b) Gold values less than the variable detection limit were set to 1 ppb.

2) Symbol and Value Gold Map

- a) Repeat analyses are listed in brackets following the initial determination.
- b) Symbol size represents an average of the initial and repeat analyses.
- c) Second repeat analyses are not included.
- d) Possible variations in map format presentation:
 - + Data < 50th percentile
 - + 27..... Single analysis > 75th percentile
 - + 27(42).... Initial and first repeat analysis

In summary, geochemical follow-up investigations should be based on a careful consideration of all geological and geochemical information, and especially a thorough appraisal of gold geochemical data and its variability. In some cases, prospective follow-up areas may be indirectly identified by pathfinder element associations in favorable geology, although an anomalous gold response due to natural variability may be lacking. Once an anomalous area has been identified, field investigations should be designed to include detailed geochemical follow-up surveys and collection of large representative samples. Subsequent repeat subsample analyses will increase the reliability of results and permit a better understanding of natural variability which can then be used to improve sampling methodology and interpretation.

Interpretation of Moss-Mat Sediment Results

Orientation Surveys

Conventional stream sediment sampling in cool humid mountainous environments is severely hampered in high-energy streams by the lack of fine sediment. The problem is magnified in west-coast rainforests where stream drainage is highly efficient. In these environments, more than 4 kilograms of coarse-grained sediment must often be collected to provide enough sample material to satisfy RGS analytical requirements.

Orientation surveys (Matysek and Day, 1988) were conducted on northern Vancouver Island prior to the 1988 RGS program. Several sample media types were evaluated to determine the sampling method which would optimize logistical parameters such as time taken to collect a sample, without compromising geochemical parameters such as contrast and dispersion length. Initial results suggested that moss-mat sediments offered the best balance between cost effectiveness and ability to identify real geochemical trends.

Further studies were undertaken along several streams draining both mineralized and background areas on northern Vancouver Island to compare geochemical dispersion characteristics for moss-mat versus conventional stream sediments (Matysek et al., 1989). At McKay Creek, which drains the Mt. Washington copper-gold deposit, paired moss-mat sediment and stream sediment samples were collected at 500 metre intervals along a 5½ kilometre reach of the stream (Fig. 2). Both media produced similar concentrations and dispersion patterns for copper, arsenic and other base metals. In contrast, gold displayed a marked enrichment in moss-mat samples. At the lower-most sample station located furthest from the mineral occurrence, gold concentration in moss-mat sediment is up to 3 orders of magnitude greater than the matching stream sediment. Similar trends were obtained from other creeks draining fine-grained gold deposits. Relative to stream sediment results, moss-mat sediments are characterized by improved contrast and longer dispersion trains. Given these results, moss-mat sediments were collected exclusively on northern Vancouver Island for the 1988 RGS program.

1988 RGS Check Samples

A framework of reference was needed by which to compare the results of moss-mat sediments collected in the 1988 RGS program with conventional stream sediments. Stream sediment "check" samples were therefore collected at one in every twenty moss-mat sample sites (96 in total).

On average, moss-mat sediments yielded 4-5 times the amount of -80 mesh material relative to stream sediment check samples. A 1-2 kg moss-mat sample would produce a minimum of 100 gm of sieved material.

Comparison of concentrations for those elements which are typically hydromorphically dispersed such as copper, zinc, nickel, cobalt, arsenic and manganese show excellent correlation between sample types (Fig. 2). The correlation coefficient value r varies from a low of 0.79 for arsenic to a high of 0.96 for copper (Table 5). Relative elemental concentrations are also similar for both sample media types as evidenced by clustering of points around the unity line on the scatter diagrams.

Elements dispersed as heavy minerals (chromium, uranium, iron, vanadium, mercury and gold) exhibit enrichment in moss-mat sediment (Fig. 3). Regression lines were plotted as dashed lines for these elements. The degree of enrichment can be measured by the decreasing slope of the regression line. In general, correlation is seen between the specific gravity of the most commonly occurring mineral form for each element and the degree of enrichment (Table 5). Chromite with a specific gravity of 3.5 to 4.1 gm/cm³ is weakly enriched. Gold, having a specific gravity of 15.5 to 19.4 gm/cm³ is strongly enriched. Mercury, having a specific gravity of 8.2 gm/cm³ in the form of cinnabar, is only moderately enriched.

Possible Mechanism of Heavy Mineral Entrapment

Moss mats are commonly found on the top and downstream faces of boulders and logs. The mats are submerged during floods caused by heavy precipitation or spring runoff. During these events fine-grained heavy minerals will be carried in suspension and trapped by perched moss mats. Sediment is likely deposited in two manners; a) gravity deposition by reduction of water turbulence over the mat much like the grid in a sluice box and b) filter deposition as sediment-laden waters pass through the dense growth of moss fronds much like a coffee filter. Enrichment in heavy minerals appears to be a dynamic process between gravity deposition and flushing of the mat. At high flood stages, water

velocity over the mat may allow deposition of only high density minerals. As the flood wanes, decrease in flow velocity allows progressive trapping of lighter minerals. During the next flood, some of these lighter minerals may be flushed from the mat resulting in a concentration of high density minerals such as gold, magnetite and chromite.

Conclusions

In humid mountainous environments, the collection of moss-mat sediments offers several advantages over conventional stream sediments:

1. Moss-mats are easily located and sampled.
2. Moss-mats provide 4 - 5 times more -80 mesh sediment for RGS analyses.
3. Elements transported hydromorphically exhibit similar concentrations and dispersion characteristics to stream sediments.
4. High density minerals are enriched relative to stream sediments, with the degree of enhancement apparently related to the specific gravity of the mineral.

Overall, the detection of gold or other heavy mineral deposits within drainage systems will be improved due to higher concentrations and longer dispersion trains.

Acknowledgements

The authors wish to recognize the Geological Survey of Canada for their continued cooperation in the RGS program. Their work on GSC Open File 1649 has been a valuable source of ideas which we have used in the development of our new format. The authors also wish to thank Pamap Graphics Ltd. of Victoria for the speedy development of software required to produce the statistics in this booklet.

TABLE 5 Correlation Coefficients and Regression Line Values for Paired Moss-mat and Stream Sediment Check Samples					
ELEMENT	Corr. Coef.	Regression Line		Heavy Mineral	Spec. Grav. gm/cm ³
		Slope	Y intercept		
COPPER*	0.96	0.96	0.06	nil	nil
ZINC*	0.91	0.96	0.06	nil	nil
NICKEL	0.83	0.93	3.02	nil	nil
COBALT	0.88	0.91	2.16	nil	nil
ARSENIC*	0.81	0.69	0.35	nil	nil
MANGANESE*	0.85	0.95	0.09	nil	nil
CHROMIUM	0.81	0.80	11.28	chromite	3.5 - 4.1
URANIUM	0.84	0.75	0.22	zircon	4.7
IRON	0.51	0.44	2.29	magnetite	5.1 - 5.2
VANADIUM	0.64	0.52	112.54	magnetite	5.1 - 5.2
MERCURY*	0.65	0.65	0.63	cinnabar	8.2
GOLD*	0.32	0.26	0.37	gold	15.5-19.4
* Corr. Coef. and Regression calculated using log values.					

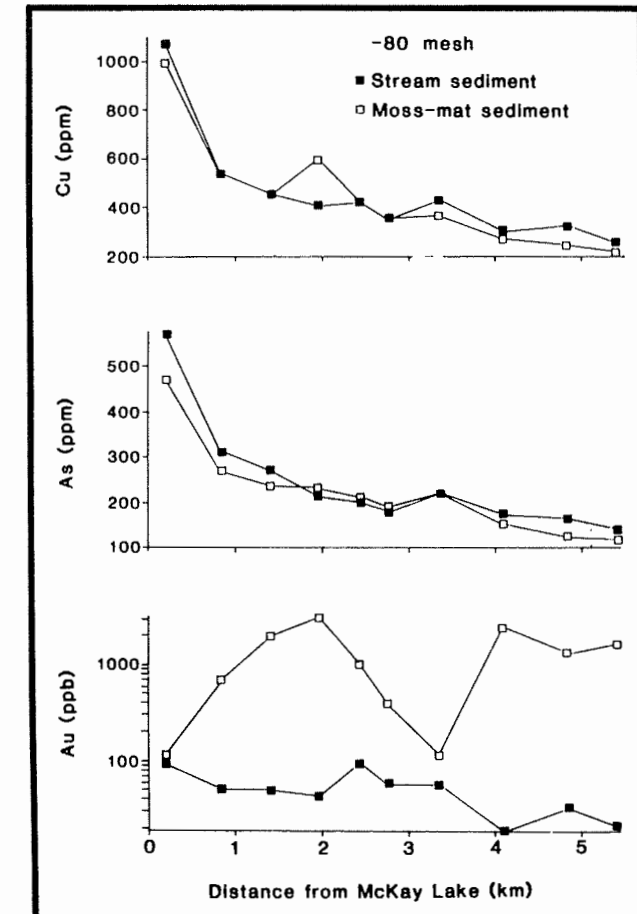
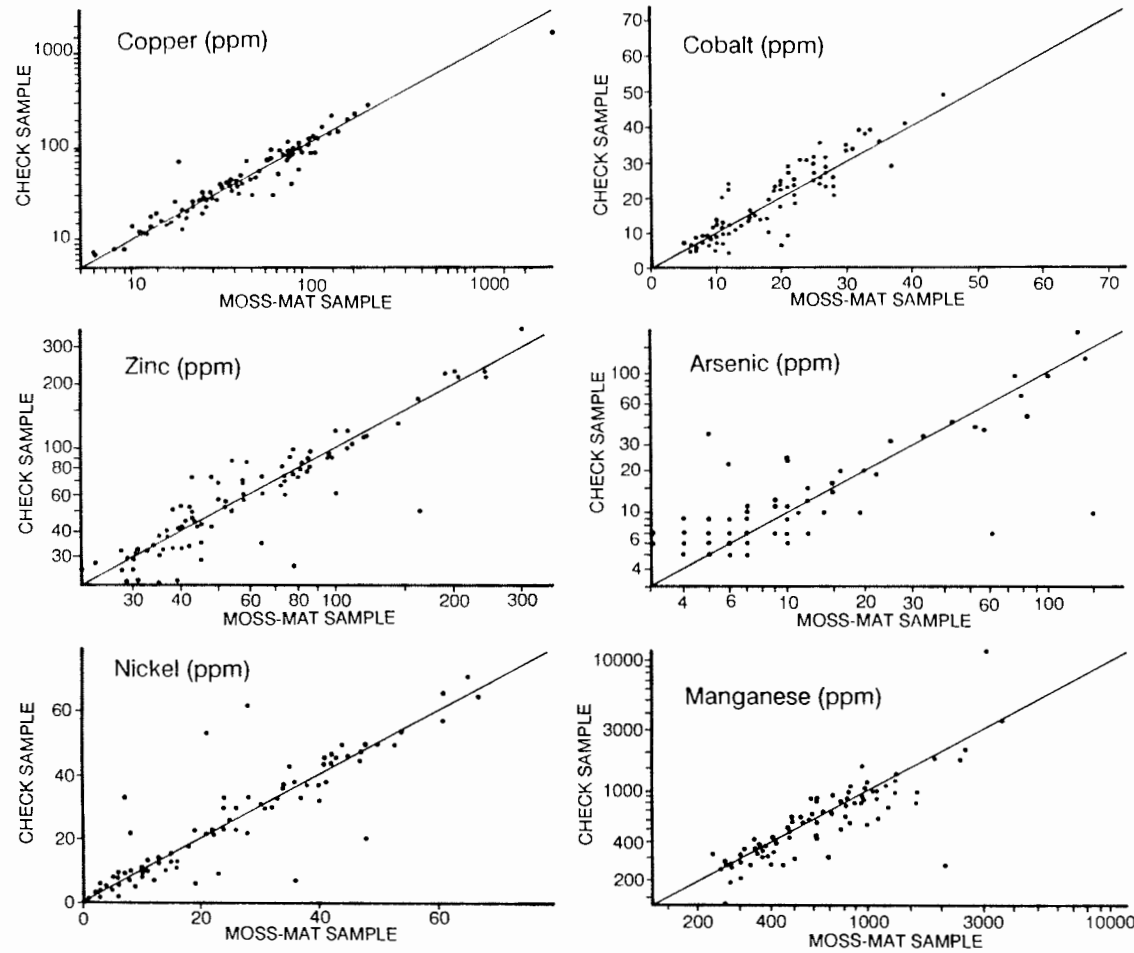


Figure 2.

Down stream dispersion patterns for copper, arsenic and gold in moss-mat sediment and conventional stream sediment in McKay Creek, central Vancouver Island.

ELEMENTS DISPERSED HYDROMORPHICALLY



ELEMENTS DISPERSED AS HEAVY MINERALS

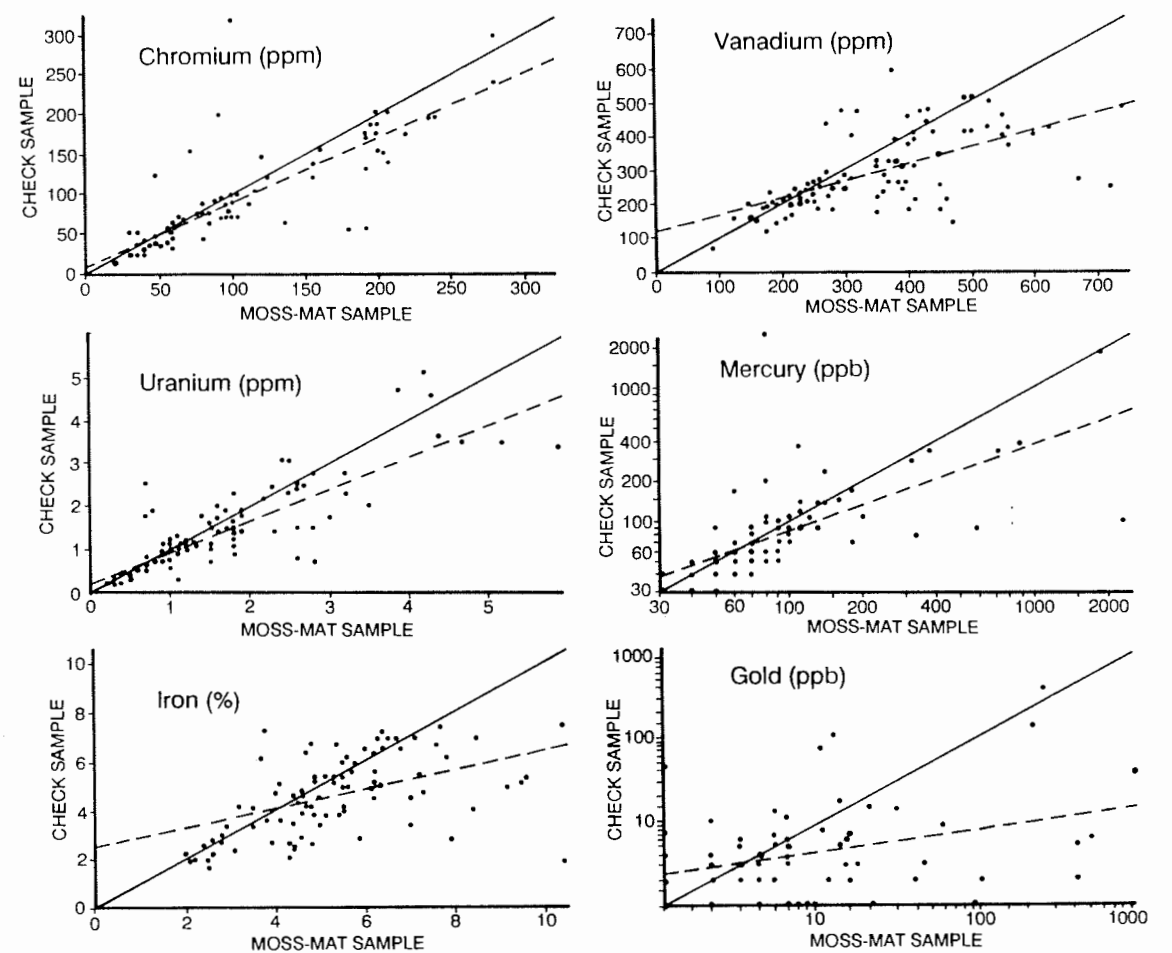


Figure 3. Scatter diagrams comparing concentrations of elements dispersed hydromorphically (copper, zinc, nickel, cobalt, arsenic and manganese) and elements dispersed as heavy minerals (chromium, uranium, iron, vanadium, mercury and gold) in 96 paired stream sediment check samples and moss-mat sediment samples. Solid sloped lines are the unity lines, points plotting along these lines are sample pairs having equal elemental concentrations. Sloped dashed lines are least squares regression lines.

Table 2. Geology of Alert Bay/Cape Scott Map Sheets - NTS 92L/102I

FORM- ATION	ROCK TYPE	AGE	DESCRIPTION	FORM- ATION	ROCK TYPE	AGE	DESCRIPTION	FORM- ATION	ROCK TYPE	AGE	DESCRIPTION
STRATIFIED ROCKS											
QUATERNARY				CRETACEOUS				TRIASSIC			
Pleistocene and Recent				Lower Cretaceous				Upper Triassic			
								Vancouver Group			
Qs	TILL	64	Alluvial and glacial deposits	lKL	GRCK	53	Longarm Formation: greywacke, conglomerate, siltstone	uTQ	LMSN	45	Quatsino Formation: limestone
TERTIARY				JURASSIC AND CRETACEOUS				Karmutsen Formation: basaltic lava, pillow lava, breccia, aquagene tuff, greenstone, minor limestone			
								Middle and Upper Triassic			
Ts	CGLM	57	Cobble conglomerate								
Miocene				Lower Jurassic				Ts			
								ARGL			
Tv	BSLT	61	Basaltic to dacitic lava, tuff, breccia, conglomerate					45			
CRETACEOUS				Bonanza Group				PENNSYLVANIAN			
								Sicker Group			
Upper Cretaceous				TRIASSIC							
				Upper Triassic							
								Vancouver Group			
uKs	SLSN	55	Sisquash Formation: shale, siltstone								
				1JHV				GRCK			
uKg	GRCK	55	Sisquash Formation: greywacke conglomerate, siltstone, coal					33			
Lower to Upper Cretaceous				Parson Bay Formation: calcareous siltstone, shale, limestone, greywacke, conglomerate, breccia				limestone			
Queen Charlotte Group											
1KQC	CGLM	55	Conglomerate, greywacke								
1KQS	SLSN	55	Siltstone, shale, greywacke								

Table 2. Geology of Alert Bay/Cape Scott Map Sheets - NTS 92L/102I

FORM- ATION	ROCK TYPE	AGE	DESCRIPTION	FORM- ATION	ROCK TYPE	AGE	DESCRIPTION	FORM- ATION	ROCK TYPE	AGE	DESCRIPTION
<u>VANCOUVER ISLAND</u>				<u>COAST MOUNTAINS AND ADJACENT ISLANDS</u>							
<u>PLUTONIC ROCKS</u>				<u>PLUTONIC ROCKS</u>				<u>METASEDIMENTARY AND METAVOLCANIC ROCKS</u>			
EOCENE				JURASSIC OR YOUNGER				(AGE NOT KNOWN)			
				Lower Jurassic or Younger							
Tg	DORT	59	Quartz diorite	fp	FLSP	48	Feldspar porphyry	mg	GRNS		Greenstone, amphibolite, chert, argillite, schist, hornfels
JURASSIC				Late Jurassic and Early Cretaceous				ma	ARGL		Argillite, quartzite, minor schist, and skarn
Jg	QRZD	47	Island Intrusions: quartz diorite, granodiorite, quartz monzonite, quartz-feldspar porphyry	JKgr	GRNT	51	Beta granite, minor quartz monzonite	ms	CHSC		Chlorite schist, biotite schist, grading into diorite complex
<u>METAMORPHIC ROCKS</u>				JKgd	GRDR	51	Granodiorite-tonalite, quartz diorite	ml	LMSN		Limestone, quartzite
JURASSIC AND OLDER				JKt	TNLT	51	Tonalite-quartz diorite, granodiorite				
PMdn	QRZD	47	West Coast Complex Quartz diorite, agmatite, gneiss, amphibolite	JKqd	QRZD	51	Quartz diorite-tonalite, diorite				
				JKd	DORT	51	Diorite, amphibolite gabbro-quartz diorite				
				JKdn	GNSS	51	Agmatite complexes, gneiss, stockwork, amphibolite, diorite-quartz diorite				
				JKgb	GBBR	51	Gabbro	(after Muller et al., 1974)			

Table 3. 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-Buff 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 Y=Youthful mountains	
UTM EAST	UTM East Coordinate	SED PPT	Sediment Precipitate: N = None (otherwise same as SED COL)			
UTM NORTH	UTM North Coordinate	CON	Contamination: N = None D = Domestic P = Possible F = Forestry A = Agricultural M = Mining			
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)	DRN	Drainage Pattern: D=Dendritic H=Herringbone G=Glacially I=Interrupted deranged R=Rectangular	
MED	Sample Media Collected: 1 = Stream Sediment only 6 = Stream Sediment & Water 7 = Moss-Mat Sediment only 8 = Moss-Mat Sediment & Water	STRM WDT	Stream Width: in metres	TYP	Stream Type: P=Permanent S=Seasonal	
FORMATION ROCK TYPE AGE	() Formation (see Table 2) underlying () sample site	STRM DPTH	Stream Depth: in centimetres	ODR	Stream Order: 1=Primary 3=Tertiary 2=Secondary 4=Quaternary	
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	SRC	Stream Source: G=Groundwater S=Spring runoff M=Melt water 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)	M O S S	HGHT	Height: above stream in metres
		CHL BED	Channel Bed: B = Boulders S = Gravel-Sand F = Silt-Clay O = Organics		COLR	Colour: L=light green D =Dark green B =Brown-black
					HLTH	Health: A = Alive D = Dead
					HOST	Host: 1=Rock 2=Friable Rock 3=Log 4=Decomposed Log
					THCK	Thickness of Mat: centimetres

Table 4. Methods and Specifications for Sample Analysis						
Element	Units	Detection Limits	Sample Weight	Digestion Technique	Determination Method	
Gold	ppb	1 ppb 2 ppb 4 ppb	10 gm 5 gm 2.5 gm	Fire Assay fusion	FA-NA	Neutron Activation on dore bead: detection limit doubles each time sample weight is halved
Cadmium Cobalt Copper Iron Lead Manganese Nickel Silver Zinc	ppm ppm ppm % ppm ppm ppm ppm ppm	0.2 ppm 2 ppm 2 ppm 0.02 % 2 ppm 5 ppm 2 ppm 0.2 ppm 2 ppm	1 gm	3 ml HNO ₃ let sit over- night, add 1 ml HCl in 90°C water bath for 2 hrs cool add 2 ml H ₂ O wait 2	AAS	Atomic Absorption Spectrophotometer using air- acetylene burner and standard solutions for calibration, background corrections made for Pb, Ni, Co, Ag, Cd.
Molybdenum	ppm	1 ppm	0.5 gm	Al solution added to above		
Barium Vanadium Chromium	ppm ppm ppm	10 ppm 5 ppm 5 ppm	1 gm	HNO ₃ -HCl-HF taken to dryness, hot HCl added to leach residue		
Bismuth Antimony	ppm ppm	0.2 ppm 0.2 ppm	2 gm	HCl - KClO ₂ digestion, KI added to reduce Fe, MIBK and TOPO for extraction	AAS	Organic layer analyzed by Atomic Absorption Spectrophotometry with background correction
Tin	ppm	1 ppm	1 gm	sintered with NH ₄ I, HCl & ascorbic acid leach	AAS	Atomic Absorption Spectrophotometry

Table 4. (Continued) Methods and Specifications for Sample Analysis						
Element	Units	Detection Limits	Sample Weight	Digestion	Determination Method	
Arsenic	ppm	1 ppm	0.5 gm	add 2 ml KI & dil. HCl to .8M HNO ₃ - .2M HCl	AAS-H	2 ml borohydride solution is added to produce AsH ₃ gas which is passed through heated quartz tube in the light path of Atomic Absorption Spectrophotometer (after Aslin, 1976)
Mercury	ppb	10 ppb	0.5 gm	20 ml HNO ₃ & 1 ml HCl	AAS-F	10% stannous sulphate added to evolve mercury vapour Atomic Absorption Spectrometer determination (after Jonasson et al., 1973)
Tungsten	ppm	1 ppm	0.5 gm	K ₂ SO ₄ fusion HCl leach	COLOR	colorimetric: reduced tungsten complexed with toluene 3,4 dithiol
Fluorine	ppm	40 ppm	0.25 gm	NaCO ₃ -KNO ₃ fusion H ₂ O H ₂ O leach	ION	Citric acid added and diluted with water, Fluorine determined with specific ion electrode (after Ficklin, 1970)
Uranium	ppm	0.5 ppm	1 gm	nil	NADNC	Neutron Activation with delayed neutron counting (after Boulanger et al., 1975)
LOI	%	0.1 %	0.5 gm	nil	GRAV	Sample ashed (500°C), weight difference measured
pH - water	pH unit	0.1	25 ml	nil	GCE	Glass-calomel electrode system
U - water	ppb	0.05 ppb	5 ml	nil	LIF	add .5 ml Fluran place in Scintrex UA-3 analyzer
F - water	ppb	20 ppb	25 ml	nil	ION	Fluorine measured by ion specific electrode

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