1989 REGIONAL GEOCHEMICAL SURVEY, SOUTHERN VANCOUVER ISLAND AND LOWER MAINLAND* (92B, 92C, 92F & 92G)

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KEYWORDS: Regional Geochemical Survey, reconnaissance stream sampling, moss-mat sediment, stream sediment, stream water, Victoria, Cape Flattery, Alberni, Vancouver.

INTRODUCTION

Three Regional Geochemical Surveys covering southern Vancouver Island and Lower Mainland were conducted by the Geological Survey Branch in 1989 (Figure 6-1-1) Map sheets covered are: Victoria (92B), Cape Flattery (92C), Alberni (92F) and Vancouver (92G). Approximately 2430 paired sediment and water samples were collected over 25 000 square kilometres at an average density of one site every 10.5 square kilometres. As in 1988, moss-mat sediment samples were obtained on Vancouver Island (1397 sites), stream sediments were collected on the mainland (1033). The following report highlights mineral potential and survey parameters of the 1989 RGS program and a brief description of orientation studies conducted in preparation for the 1990 program.

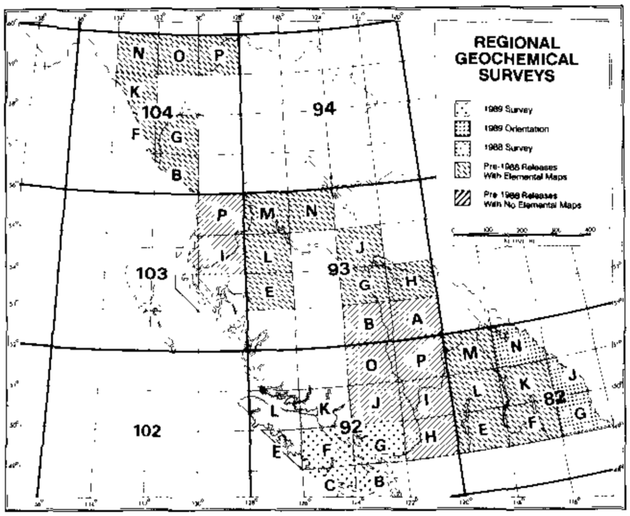

Figure 6-1-1. Current status of British Columbia *Regional Geochemical Survey program.*

HIGHLIGHTS

Some of the oldest mining camps in British Columbia are located on southern Vancouver Island and the Lower Mainland, for example, the Brittania and Tyee-Lenora massive sulphide deposits. The high number of past and present producers, volume of exploration activity and discovery of numerous new prospects attest to the high potential of the area which, until this year, lacked systematic geochemical coverage. Innovations introduced in 1988 (Gravel and Matysek, 1989) proved highly successful and were incorporated in the 1989 program. Potentially, moss-mat sediment sampling on southern Vancouver Island may permit merging of 1988 and 1989 surveys resulting in a contiguous 2800-site database covering all the major lithologies. New developments in 1989 include:

- Establishing a three-year analytical contract ensuring greater continuity in sample results;
- Preparation of three stream-sediment standards for monitoring quality and continuity between surveys; and
- Lowering the detection limit for silver to 0.01 ppm, thereby improving its usefulness as a pathfinder.

SURVEY AREA FEATURES

GEOLOGY AND PHYSIOGRAPHY

Understanding local geology and physiography is essential for informed interpretation of RGS results. A geological underlay (Roddick *et al.*, 1976) on element plots and surficial geology maps (Fulton *et al.*, 1982) are provided within RGS packages for this purpose. An abridged description of geology and physiography based on studies by Holland (1964), Muller (1977) and Massey and Friday (1988, 1989) is given in Table 6-1-1 and Figure 6-1-2.

Southern Vancouver Island is underlain by Insular Belt rocks comprising mid-Paleozoic to mid-Tertiary volcanics and sediments representing island arc and back-arc basin sequences. Accreted onto the southwestern margin is a sliver of trench and slope volcanics and sediments belonging to the Pacific Belt. Intermediate to felsic plutons intruded Insular rocks during the Jurassic and Tertiary periods. Tertiary intrusions in the Pacific Belt are of mafic composition. The physiography of southern Vancouver Island is dominated by the Vancouver Island Ranges with the Nanaimo Lowlands bordering the southern and eastern coast.

Granitic to dioritic intrusions of Jurassic to Eocene age containing elongated pendants of Triassic to Cretaceous metavolcanics and metasediments constitute the Coast plutonic complex underlying most of the Mainland. The Coast complex is represented physiographically by the Coast Mountains and the Georgia Lowlands. Tertiary sediments form the Fraser Lowlands.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

TABLE 6-1-1 Abridged Description of Physiography and Geology of 1989 RGS Project Area

PHYSIOGRAPHY

AREA	UNIT	SUBUNIT	LOCATION	QUATERNARY GEOLOGY	DESCRIPTION
VANCOUVER ISLAND	Coastal Trough	Nanaimo Lowland	East coastal margin and southern tip	Thin till and colluvium on low hills, thick glaciofluvial deposits along coastal margin	Rolling hills below 600 m a.s.l., ridges separated by narrow valleys, box-like canyons in incised overburden along coast
VANCOUVER ISLAND	Insular Mountains	Vancouver Island Ranges	NW trending range forming core of island	Colluvium on steep slopes and summits, till on lower slopes (glacio-)fluvial deposits in valleys	Very rugged, U-Shaped valleys, 2200 m peaks near Buttle Lake, summit elevations decrease to SE, dissected Tertiary surface
VANCOUVER ISLAND	Insular Mountains	Estevan Coastal Plain	3 km wide strip along west coast	Mantle of bedrock derived colluvium, (glacio-)fluvial sediments, till, marine deposits along coast	Flat and featureless to low rolling hills, rock cliffs and platforms, pocket beaches
VANCOUVER ISLAND	Insular Mountains	Fiordland	Peninsulas and islands along west coast	Colluvium on steep slopes and summits, till on lower slopes	Land rises abruptly to 600 - 900 m a.s.l., rounded and timbered hilltops
VANCOUVER ISLAND	Insular Mountains	Alberni Basin	8 x 40 km basin around Port Alberni	Moderate to thick till and (glacio-)fluvial deposits, some marine sediments	low lying (below 300 m a.s.l.) and low relief, fault bounded on east side by Beaufort Range
MAINLAND	Coastal Trough	Georgia Lowland	3 - 15 km strip along west coast	Thin colluvium and till on summits and slopes, broad U-shaped valleys with thick fluvial deposits	Tertiary erosional surface rising gently to the east with increasing dissection, 600 m contour marks divide with Coast Mountains
MAINLAND	Coastal Trough	Fraser Lowland	South of Coast Mountains, forms Fraser valley	Thick glacio-fluvial, fluvial and marine deposits	Depositional environment since mid-Tertiary (4500 m thick), wide flat valleys separate low (<300 m) hills cored by overburden or bedrock
MAINLAND	Coast Mountains	Pacific Ranges	Adjacent to Georgia Lowland 125-160 km wide belt	Barren summits, colluvium and till slopes, thick (glacio-) fluvial deposits in valleys	Incision of Tertiary surface increases eastward until completely eroded leaving jagged peaks and U-shaped valleys

GEOLOGY

VANCOUVER ISLAND

Stratified rocks

Name	Age	Description
Metchosin Group	Eocene	Pillow basalt
Nanaimo Group	Upper Cretaceous	Epiclastic sandstone, shale, conglomerate
Leech River Group	Jurassic and Cretaceous	Metasediments and metavolcanics, greywacke, phyllite, schist
Westcoast Gneiss Complex	Jurassic	Gneiss, metaquartzite, marble, agmatite, amphibolite
Bonanza Group	Lower Jurassic	Andesitic to rhyolitic lavas, tuff breccia
Vancouver Group		
Parsons Bay Formation	Upper Triassic	Calcareous siltstone, shale, limestone, greywacke, conglomerate, breccia
Quatsino Formation	Upper Triassic	Limestone, marble
Karmutsen Formation	Upper Triassic	Basaltic pillow lava, breccia, minor limestone
Sicker Group (including Buttle Lake Group)	Devonian to Pennsylvanian	Lower (Sicker) contains basaltic to rhyolitic volcanics. Upper (Buttle) composed of clastic and carbonate sediments

VANCOUVER ISLAND

Plutonic Rocks

Name	Age	Description
Sooke plutonic suite	Tertiary	Augite gabbro
Tertiary intrusions	Early to mid-Tertiary	Quartz diorite to quartz monzonite, includes Catface plutonic suite
Island plutonic suite	Middle Jurassic	Granite, granodiorite, quartz monzonite, quartz diorite, gneissic diorite

MAINLAND

Stratified Rocks

Name	Age	Description
Gambier Group	Upper Cretaceous	Greenstone, volcanic breccia argillite, minor conglomerate, limestone and schist; includes Fire Lake Group
Vancouver Group		
Karmutsen Formation	Upper Triassic	Basaltic pillow lava, breccia and minor limestone
Metamorphics	Paleozoic to Triassic	Amphibolite, schist, quartzite, minor crystalline limestone, greenstone

Plutonic Rocks

Name	Age	Description
West Coast Complex	Cretaceous to early Tertiary	Quartz monzonite, granodiorite, quartz diorite, diorite, gabbro

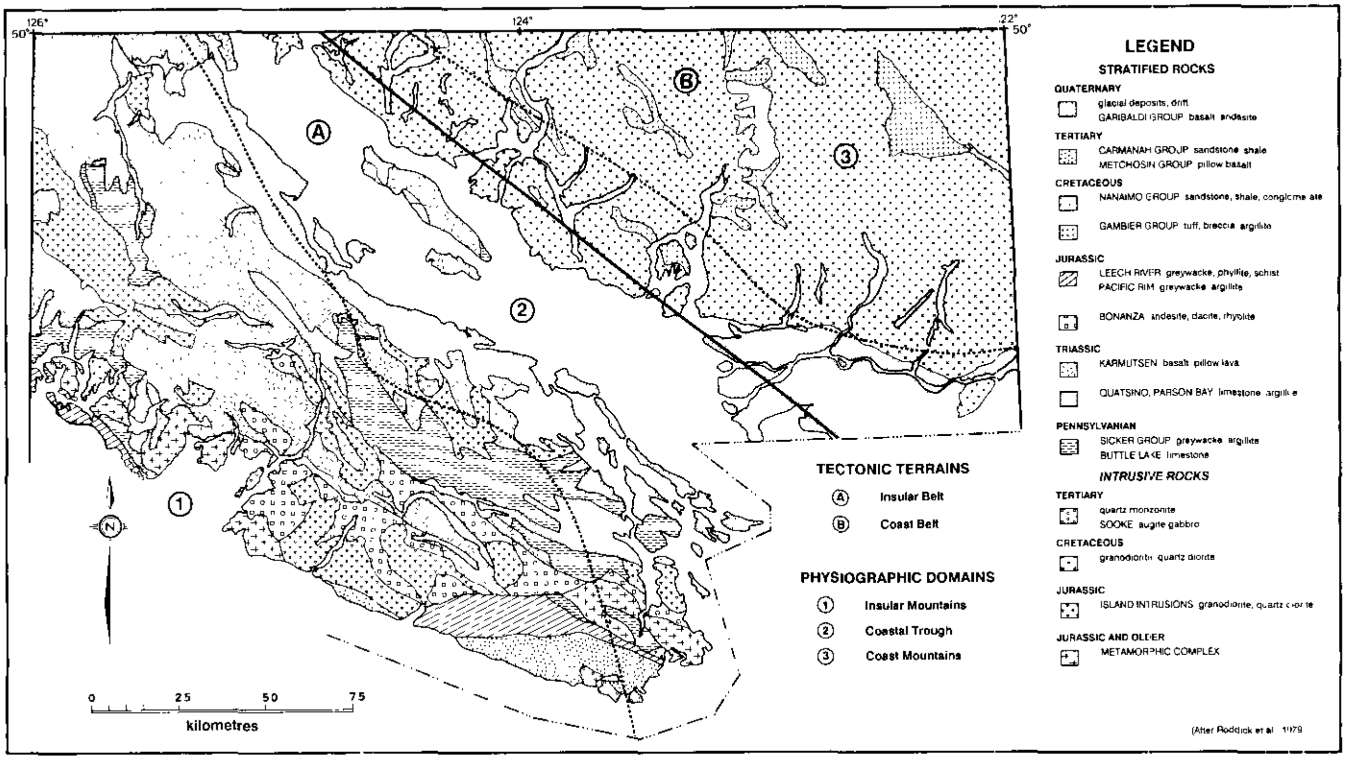

Figure 6-1-2. Geology and physiography of 1989 Regional Geochemical Survey area.

Mineralization and Exploration Potential

The style of mineralization found in the 1990 RGS-release area can be divided into four broad categories: massive sulphides, porphyries, quartz veins and skarns. Table 6-1-2, based on a compilation of work by Muller and Carson (1969) and numerous property studies by ministry geologists, subcategorizes these deposits giving type examples, commodities, hostrock and related intrusions.

Mineral potential is very high as attested by 21 past producers including Brittania, a world class massive sulphide deposit of 47 *million tonnes grading 1.1 per cent* copper, 0.3 per cent zinc, 0.03 per cent lead, 3.4 grams silver and 0.3 gram gold per tonne. A study of local mining history from the turn of the century to the present reveals two periods of activity separated by the Great Depression in the 1930s. Spurred by World War II and the rebuilding of industrial nations during the 1950s and 1960s, local mining reached its peak. At times upwards of eight mines were in operation. Mining activity has dropped sharply since 1975 where today, only the massive sulphide deposit at Buttle Lake is in operation. There are however, 17 potential producers located in the program area. Notable deposits in this class include Catface and Gambier Island, both copper ± molybdenum porphyries in the 200 million tonne range and Lara, a copper-lead-zinc massive sulphide prospect with approximately 500 000 tonnes of indicated reserves.

Exploration trends, based on assessment reports filed with the Ministry of Energy, Mines and Petroleum Resources, show a marked increase in activity over the 5-year period examined (Table 6-1-3). From 1984 to 1988 the number of reports increased by 75 per cent from 96 to 168 while the nature of the work matured. Eighty per cent of work completed in 1984 was grassroots exploration compared to 40 per cent in 1988. The prime mineral target also changed during this period, from near equal concentration on massive sulphides (40 per cent) and precious metal quartz-vein systems (50 per cent) in 1984, to predominantly the latter (20 per cent *versus* 65 per cent) in 1988. The pattern of exploration however, remained fairly constant as Sicker Group rocks are favourable hosts for either deposit type. Frequently the

TABLE 6-1-2 Common Deposit Types and Associated Geological Environment

DEPOSIT CLASS	DEPOSIT SUBCLASS	TYPE DEPOSIT	COMMODITIES	HOST ROCK	INTRUSIONS
Massive Sulphide	Volcanogenic Massive Sulphide	Buttle Lake, Brittania	Pb, Zn, Cu (Au)	Felsic flows in upper Sicker Group, Gambier and Fire Lake Group pendants in Coast Complex, Harrison Lake Formation	None
	Magmatic Massive Sulphide	Tofino Nickel	Ni, Fe, Cu (Pt, Pd)	Karmutsen Formation	Feeder zone for Karmutsen volcanics
Porphyry	Cu±Mo Porphyry	Gambier Is., Catface	Cu, Mo		Tertiary "Catface" quartz diorite
	Cu±Mo±Au Stockwork	Mount Washington	Cu, Au, Mo	Karmutsen Formation, Sicker Group,	Early tertiary quartz diorite
Quartz Veins	Epi & meso-thermal Au-qtz veins	Mount Washington, Ashloo	Au, Ag, Cu, As, Sb, Au, Ag	Bonanza Group, Sicker Group Karmutsen Formation, Intrusives	Early tertiary quartz diorite
	Gold in qtz shears	Debbie	Au, Cu, Ag	Sicker Group, Bonanza Group Leech River Group; along Tertiary shear zones	
	Gold in sulphide veins	Thistle	Au, Cu	Upper Duck Lake Formation in Sicker Group; along Tertiary shear zones	
Skarns	*Iron-gold* skarns	*Yellow Kid*	*Fe* (Cu, Au)	*Karmutsen Formation,* Quatsino Formation	*Jurassic Island* plutonic suite
	Copper skarns	Blue Grouse	Cu (Ag, Au)	Bonanza Group	Island Intrusions Flds-por dikes
	Basemetal skarns	Cambrian-Chieftain	Cu, Zn, Ag (Au, Mo)	Limestone member Gambier Group	Quartz diorite of Coast plutonic complex

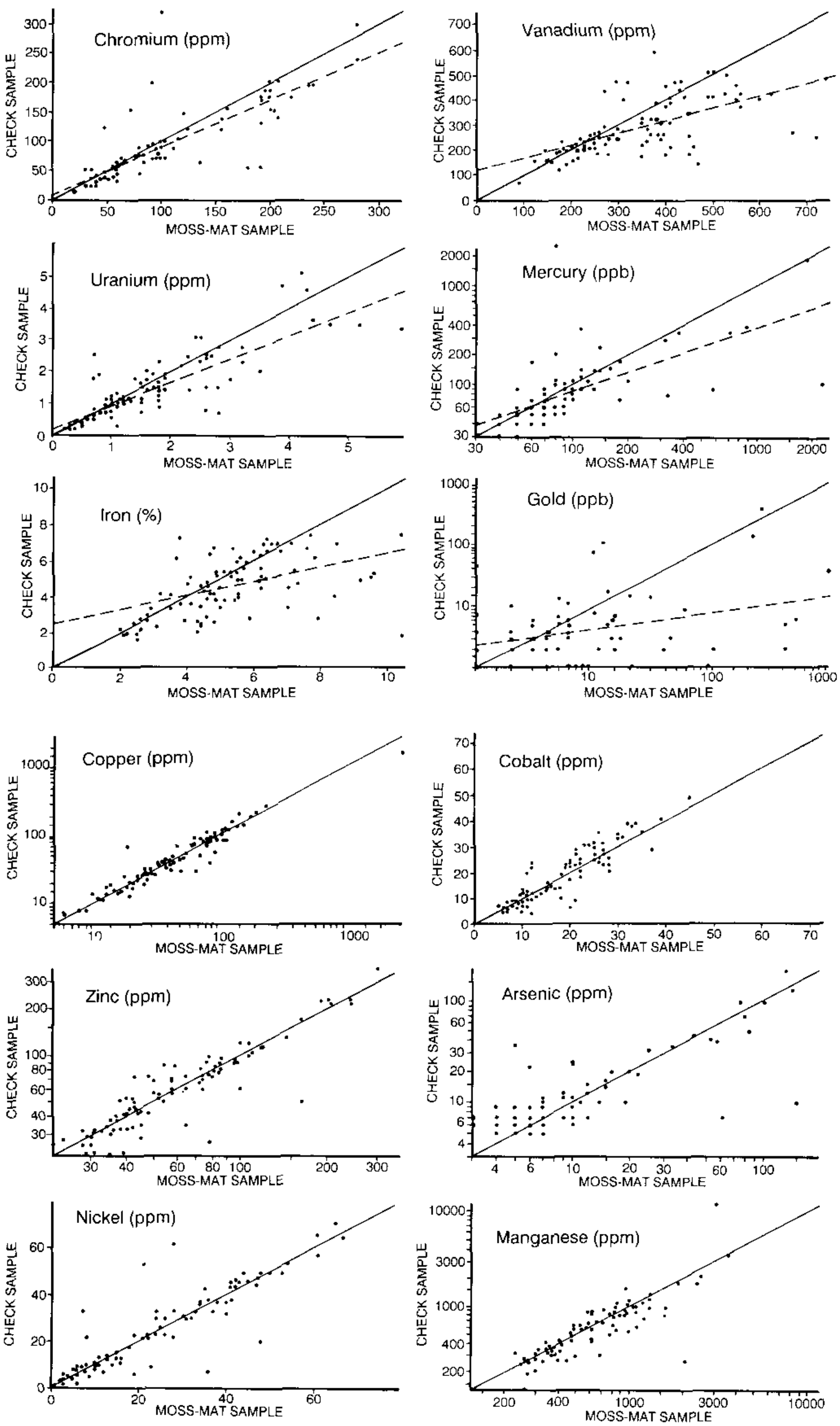

Figure 6-1-3. Scatter diagrams comparing concentrations of elements dispersed hydromorphically (copper, zinc, nickel, cobalt, arsenic and manganese) and elements dispersed as heavy minerals (chromium, uranium, iron, vanadium, mercury and gold) in 96 paired stream-sediment check samples and moss-mat sediment samples. Solid sloped lines are the unity lines, points plotting along them are sample pairs having equal elemental concentrations. Sloped dashed lines are least squares regression lines (After Matysek *et al.*, 1989.)

TABLE 6-1-3
Five-Year Compilation of Exploration Work in 1989 RGS Area Based on Assessment Reports

NTS MAP SHEET	1984 TYPE	a	b	c	d	1985 TYPE	a	b	c	d	1986 TYPE	a	b	c	d	1987 TYPE	a	b	c	d	1988 TYPE	a	b	c	d
92B	11MS	7	3	1		8MS	3	3	2		15MS	6	4	5		10MS	5	3	2		11MS	2	5	3	1
	3QV	2		1		6QV	5	1			5QV	3	2			19QV	14	2	3		15QV	9	2	3	1
						1SK		1			1SK		1												
92C	2MS	2				5MS	1	3	1		3MS	3				3MS	3				8MS	2	6		
	2PO	2				2PO	1	1			1PO			1		1PO	1				13QV	7	3	3	
	10QV	9	1			11QV	9	1	1		12QV	5	6	1		10QV	6		4		4SK		1	3	
	2SK	2				1SK		1			7SK	6	1			2SK	2								
92F	15MS	11	1	3		19MS	10	6	3		14MS	10	4			11MS	7	3	1		9MS	4	2	3	
	26QV	22	3	1		1PO	1				44QV	33	6	5		54QV	30	10	14		70QV	20	23	27	
	8SK	7	1			32QV	19	6	6	1	14SK	7	2	5		14SK	10	3	1		17SK	7	7	3	
						10SK	9	1																	
92G	9MS	9				5MS	4		1		8MS	3	3	2		6MS	3	2	1		6MS	2	2	2	
	8QV	7		1		4QV	2		2		2PO	1		1		6QV	3	1	2		12QV	7	3	2	
						1SK		1			9QV	6	1	2							3SK	3			
TOTAL	96	80	9	7		106	64	25	16	1	135	83	30	22		136	84	24	28		168	63	54	49	2

LEGEND

Deposit Type (TYPE)

MS = Massive Sulphide
PO = Cu-Mo Porphyry,
QV = Au-Quartz Veins
SK = Au-Fe-Cu-Pb-Zn Skarn

Exploration Activity

a = Grassroots: prospecting, minor (<$10K) ground surveys
b = Intermediate: mapping, moderate (>$10K) ground surveys
c = Advanced: drilling, trenching, extensive (>$50K) surveys
d = Development: Underground development, surface stripping for open pits, ore definition drilling, etc.

Example:

NTS MAP SHEET	1984 TYPE	a	b	c	d
92B	11MS	7	3	1	

Interpretation:
In 1984 on map sheet *92B*, eleven assessment reports were filed for properties with massive sulphide potential, of which seven were at the grassroots stage, three were at the intermediate stage and one was at the advanced stage.

emphasis on deposit type was seen to shift on the same property. Several factors can be sited as having influenced exploration patterns, overriding most of these was flow-through funding of junior resource companies with their main emphasis on gold-bearing deposits. Events over the past 2 years in mineral markets (lower gold prices and higher base metal prices) and federal government policy changes (structure of flow-through funding) could erode the number of claims worked in the near future, with emphasis returning to polymetallic deposits.

Subsequent to the 1990 RGS release, primary exploration targets will undoubtedly be polymetallic massive sulphide deposits and precious metal quartz veins with activity centred upon Sicker Group uplifts and Coast Complex pendants. Secondary targets will be epithermal vein systems related to Tertiary intrusions and various gold-bearing skarns associated with Vancouver Island and Bonanza Group rocks. The following deposit types have received less general attention but are well worth noting and may form the basis of exploration programs extending from searches of the RGS database:

- Tofino Nickel:
  - A magmatic massive sulphide deposit containing copper, nickel and platinum group metals.
  - Believed to be hosted by an ultramafic intrusive phase of the Karmutsen volcanics.
  - May represent feeder zones for flood basalts similar to Russian deposits at Noril'sk.
- Ashlu:
  - Mesothermal precious metal quartz vein systems with tellurides and PGM values.
  - Hosted by granodiorite phase of Coast plutons.

1989 SAMPLING PROGRAM

BACKGROUND

Use of moss mats as a sampling medium in RGS programs was initiated in 1988, solely on northern Vancouver Island. Findings from orientation studies (Matysek and Day, 1988) carried out the previous year showed the bedrock, climate and physiography of Vancouver Island restricted accumulation of fine-grained sediment (−80 mesh or −177 micron fraction) within stream channels. Moss mats were selected as a sampling medium due to their abundance in Vancouver Island stream beds and high concentration of fine-grained sediment.

Results from the 1988 RGS program were highly encouraging. In order to demonstrate the benefits of moss-mat sediment samples, check samples consisting of routine stream sediment were taken at one in every twenty moss-mat sample sites. A total of 96 check samples were collected. In general, moss-mat samples provided several advantages:

- On average, moss mats contain five times the amount of fine-grained sediment found in conventional samples at the same site, reducing the number of samples rejected due to insufficient sediment.
- Samplers find moss mats easier to locate and collect.
- Hydromorphically dispersed elements (copper, nickel, zinc, etc.) display near identical concentrations for the two media types (Figure 6-1-3).
- Elements which commonly form heavy detrital minerals (chromium, gold, etc.) are concentrated in moss mats, with a suggestion that the degree of enrichment is correlative to specific gravity (Figure 6-1-3).
- Reproducibility for elements prone to "nugget" effect, appears to increase for moss-mat samples, however, further testing is required.
- Moss mats suffer less from seasonal variability as they trap sediment only during floods when the mat is inundated, at this stage gold is liberated and mobilized from the various placer traps within the stream bed (W.K. Fletcher, personal communication, 1989).

Speculation on the nature of sediment trapping by moss mats, based on the above results, favours two controlling mechanisms:

(1) Filter trapping whereby fine sediment is caught in the dense growth of plant fibres as water passes through the mat; and

(2) Density sorting, a cyclical process whereby sediment deposited during a waning flood stage is selectively removed during the next waxing stage. The susceptibility of a mineral grain to removal is directly related to its specific gravity.

Given the above conditions, a fine-grained sediment will accumulate in which heavy minerals are concentrated preferentially to light minerals. Experiments are in progress to test this hypothesis.

SAMPLE COLLECTION

MPH Consulting Ltd. was contracted to carry out the 1989 RGS sampling program. The field crew consisted of five samplers and a party chief stationed in a mobile field camp. Ministry representation was maintained throughout the program, providing advice, crew training, site inspections and quality control. Sampling began on July 15 and was completed by September 20.

On Vancouver Island, moss-mat sediments and stream waters were sampled at 1397 sites while 1033 sites were sampled for stream sediment and water on the Lower Mainland (Table 6-1-4). For comparison, stream-sediment check samples (90 sites) were collected on Vancouver Island while moss-mat check samples (40 sites) were collected on the Mainland. Sites were restricted to primary and secondary drainages having catchment basins of less than 10 square kilometres. Streams in provincial parks and large municipalities such as Vancouver, Victoria and Nanaimo were avoided. In total, 2430 sites were sampled in 250 person-days, giving a sampling rate of 9.8 sites per sampler per day. Approximately 26 000 square kilometres were covered at an average density of 1 site every 10.7 square kilometres. Sixty per cent of sites were accessible by truck, trail-bike or boat, the remaining sites were reached by helicopter.

Sites were selected in pre-season by the authors, however, samplers were given flexibility to modify site locations based on accessibility and availability of samplable material.

TABLE 6-1-4 Sample Distribution in 1989 RGS Program Area

92B VICTORIA					
MAP SHEET	MOSS MATS	STREAM SEDS	TOTAL SITES	AREA Km^2	DENSITY SITES/Km^2
05	42	0	42	577	13.7
12	69	0	69	880	12.8
13	42	0	42	750	17.9
14	2	0	2	175	87.5
TOTAL	155	0	155	2382	15.4

92C CAPE FLATTERY					
MAP SHEET	MOSS MATS	STREAM SEDS	TOTAL SITES	AREA Km^2	DENSITY SITES/Km^2
08	18	0	18	215	11.9
09	113	0	113	976	8.6
10	52	0	52	392	7.5
11	4	0	4	25	6.3
13	4	0	4	43	10.8
14	29	0	29	300	10.3
15	119	0	119	968	8.1
16	105	0	105	963	9.2
TOTAL	444	0	444	3882	8.7

92F NANAIMO					
MAP SHEET	MOSS MATS	STREAM SEDS	TOTAL SITES	AREA Km^2	DENSITY Km^2/SITE
01	98	0	98	1003	10.2
02	99	0	99	972	9.8
03	111	0	111	953	8.6
04	50	0	50	523	10.5
05	82	0	82	636	7.8
06	95	0	95	713	7.5
07	42	0	42	808	19.2
08	2	3	5	285	57.0
09	0	18	18	478	26.5
10	8	5	13	383	29.5
11	88	0	88	690	7.8
12	24	0	24	210	8.7
13	49	0	49	452	9.2
14	39	0	39	792	20.3
15		9	9	223	24.8
16		87	87	808	9.3
TOTAL	787	122	909	9929	10.9

92G VANCOUVER					
MAP SHEET	MOSS MATS	STREAM SEDS	TOTAL SITES	AREA Km^2	DENSITY SITES/Km^2
01	0	34	34	290	8.5
02	0	1	1	10	10.0
04	11	0	11	388	35.3
05	0	13	13	226	17.4
06	0	52	52	508	9.8
07	0	79	79	903	11.4
08	0	84	84	948	11.3
09	0	90	90	987	11.0
10	0	101	101	1008	10.0
11	0	102	102	891	8.7
12	0	79	79	905	11.5
13	0	108	108	918	8.5
14	0	85	85	1003	11.8
15	0	6	6	31	5.2
16	0	77	77	898	11.7
TOTAL	11	911	922	9914	10.8

	MOSS MATS	STREAM SEDS	TOTAL SITES	AREA Km^2	DENSITY Km^2/SITE
GRAND TOTALS	1397	1033	2430	26,107	10.7

Preparation of Samples

All samples were returned to a central depot within three days following collection, to avoid rotting. A drying and processing facility was built in Port Alberni for samples gathered on Vancouver Island. Mainland samples were shipped to Rossbacher Analytical Laboratory in Burnaby for processing.

Sediment sample drying was improved over last year by spreading each sample on large paper-lined trays which were stacked on mesh racks inside a drying shed. Average drying time was 2 to 3 days compared to 2 to 3 weeks needed last year when drying samples within their bags. Following drying, each sample was processed and inspected following methods outlined by Gravel and Matysek (1989).

Subsequent to field processing and inspection, samples were sent to Rossbacher Analytical Laboratory in Burnaby, British Columbia for final processing. A sediment sample processing routine was set-up for inspection, weighing, sieving and packaging of samples in preparation for analysis.

Blind duplicate and reference standard materials were inserted by Rossbacher in each sequence of twenty samples to monitor precision and accuracy of analytical results. In combination with field duplicates, it is possible to assess sample concentration variability due to geology (including mineralization), choice of sample site, subsampling, analytical digestion and determination methods, allowing us to distinguish between truly background and anomalous values.

Sample Analysis

Barringer Magenta Ltd. in Calgary, Alberta was chosen to analyze both water and sediment samples. Table 6-1-5 outlines analytical procedures for the various elements. These methods were employed in last year's survey with success. One minor modification has been introduced, a palladium inquart in the fire assay will permit the analysis of silver at a detection limit of 0.02 ppm or 20 ppb, 5 times lower than past surveys.

By maintaining consistent sampling, processing and analytical methods for the 1988 and 1989 surveys, sample results should be highly comparable. Recognizing continuity of most major lithological packages across the survey areas, merging databases will improve statistical inferences such as calculation of background and anomalous concentrations for various rock types.

Table 6-1-5. Methods and Specifications for Sample Analysis (after Matysek et al., 1989)

Element	Units	Detection Limits	Sample Weight	Digestion Technique	Determination Method	
Gold Silver	ppb ppm	1 ppb 10 ppb	10 g	Fire assay fusion - Palladium inquarting agent	FA-AA	Atomic adsorption spectrophotometry after digestion of doré bead by aqua regia
Cadmium Cobalt Copper Iron Lead Manganese Nickel Zinc	ppm ppm ppm % ppm ppm ppm ppm	0.2 ppm 2 ppm 2 ppm 0.02 % 2 ppm 5 ppm 2 ppm 2 ppm	1 g	3 ml HNO_3 let sit overnight, add 1 ml HCl in 90°C water bath for 2 hrs cool add 2 ml H_2O 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 g	Al added to above solution		
Barium Vanadium Chromium	ppm ppm ppm	10 ppm 5 ppm 5 ppm	1 g	HNO_3-HCl-HF taken to dryness, hot HCl added to leach residue		
Bismuth Antimony	ppm ppm	0.2 ppm 0.2 ppm	2 g	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 g	Sintered with NH_4I, HCl & ascorbic acid leach	AAS	Atomic absorption spectrophotometry
Arsenic	ppm	1 ppm	0.5 g	Add 2 ml KI & dil. HCl to 0.8M HNO_3 - .2M HCl	AAS-H	2 ml borohydride solution added to produce AsH_3 gas which is passed through heated quartz tube in the light path of atomic absorption spectrophotometer
Mercury	ppb	10 ppb	0.5 g	20 ml HNO_3 & 1 ml HCl	AAS-F	10% stannous sulphate added to evolve mercury vapour, Atomic Absorption Spect. determination
Tungsten	ppm	1 ppm	0.5 g	K_2SO_4 fusion HCl leach	COLOR	colorimetric: reduced tungsten complexed with toluene 3,4 dithiol
Fluorine	ppm	40 ppm	0.25 g	$NaCO_3$-KNO_3 fusion H_2O leach	ION	Citric acid added and diluted with water, Fluorine determined with specific ion electrode
Uranium	ppm	0.5 ppm	1 g	nil	NADNC	Neutron activation with delayed neutron counting
LOI	%	0.1 %	0.5 g	Ash sample at 500°C	GRAV	Weight difference
pH - water	pH unit	0.1	25 ml	nil	GCE	Glass-calomel electrode system
U - water	ppb	0.05 ppb	5 ml	Add 0.5 ml fluran solution	LIF	Place in Scintrex UA-3
F - water	*ppb*	*20 ppb*	*25 ml*	*nil*	*ION*	*Fluorine ion specific electrode*

RELEASE INFORMATION

Results of the 1989 program will be available to the public in three release packages; RGS-24 Victoria-Cape Flattery (NTS 92B-C), RGS-25 Alberni (92F) and RGS-26 Vancouver (92G).

- Hard copy release packages contain sample location (1:100 000 and 1:250 000 scale) and geochemical maps (1:250 000 scale for each element) together with a data booklet giving field and analytical results, summary statistics, anomaly ratings and discussion of methods and specifications.
- Digital format packages will consist of MS-DOS formatted, 5¼" floppy diskettes containing listings of field and analytical information, and discussion of methods and specifications. Sample location maps will be included.

Release of RGS-24, 25 and 26 is tentatively scheduled for late June or early July, with release centres in Nanaimo and Vancouver.

1989 RGS ORIENTATION PROGRAM

Orientation surveys were completed in the eastern Rocky Mountains in preparation for next year's RGS program; map sheets covered were: 82G Fernie, 82J Kananaskis Lakes and 82N Golden. Detailed stream sampling orientation programs provide data on:

- Basic reconnaissance to determine regional climatic and physiographic environments as controls on mineral dispersion;
- General accessibility of sites;
- Applicability of various sampling media in terms of availability and geochemical response in mineralized and unmineralized drainages; and
- Characteristics of type deposits and associated dispersion patterns in local drainages.

SAMPLING DESIGN

In total, 337 samples were collected from twelve streams draining known showings and nine background creeks (Table 6-1-6). Selection of mineralized stream drainages for detailed study was based on several criteria:

- Known mineral occurrence at or near the headwaters;
- Each deposit type represented by at least one detailed study;
- Stream length before entering a major valley must be at least 4 kilometres to demonstrate down-stream dispersion pattern; and
- Good access to permit sampling along the entire length of stream.

Optimum sampling and analysis parameters will be determined from these drainages by comparative testing of media types and size fractions (Table 6-1-7).

Background creeks were chosen where geology, size of catchment basin, physiography and climate matched mineralized creeks, thereby providing a framework for comparison. Within these drainage basins, duplicate moss-mat and stream-sediment samples, a bulk stream sediment and a heavy mineral concentrate sample were collected at a single site, typically 4 to 6 kilometres down-stream of the headwaters.

TABLE 6-1-6 1989 RGS Orientation Survey - Map Sheets 82G, 82J & 82N

STREAM NAME	NTS	Deposit Type	Commodity Elements	Pathfinder Elements	Samples Collected MM	SS	BS	HMC
Roche	82G	Stratabound	Cu	Au, Ag, Mo, U	17	17	5	2
Phillips	82G	Stratabound	Cu	Zn, Br	17	17	7	2
Maus	82G	Vein	Pb, Zn	Ag, Au	16	16	7	2
Rabbit Foot	82G	Stratabound	Pb, Zn	B	11	11	3	2
Boulder	82G	Vein	Au, Ag	Pb, Zn, Cu	12	12	4	1
Madias	82J	Vein	Zn, Pb, Ag, Au	As, Sb, Ba	3	4	1	3
Rock Canyon	82J	Carbonatite	F, REE	Same	18	18	8	2
McMurdo	82N	Vein	Pb, Zn, Au, Ag	Same	13	14	6	2
Albert Canyon	82N	Vein	W, Zn	Cu, Mo, B	3	3	2	1
Woolsey	82N	Vein	Pb, Zn, Ag	Au, Sn	11	12	4	1
Clabon	82N	Vein	Sn, Pb, Zn	Ag, Be	10	11	4	2
				Totals	131	135	51	20

MM = Moss Mat Sediment SS = Routine Stream Sediment BS = Unsieved Bulk Sediment
HMC = Sieved Bulk Sediment

Table 6-1-7 Orientation '89 Sample Pattern and Size Fractions for Detailed Study of Mineralized Creeks

MEDIA TYPE COLLECTED	STATION SPACINGS	SIZE FRACTIONS
Moss-mat & routine stream sediment	500 metres	-40 to +80 mesh and -80 mesh
Duplicate moss-mat and routine stream sediments	Uppermost and lowermost sites	-40 to +80 mesh and -80 mesh
Bulk Samples	1000 metres	-40 to +80 mesh, -80 to +150 mesh and -150 mesh
Heavy mineral concentrates	*lowermost sites*	*-80 mesh non-*magnetic

Samples were shipped to Acme Analytical in Vancouver for preparation and analysis by 30 element ICP emission spectroscopy. A split of each sample will also be analysed by neutron activation at Becquerel Lab in Ontario. The combined results will provide approximately 50 elements having acceptable detection limits and, information on speciation for those elements overlapping the two methods.

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