



British Columbia Geological Survey  
Geological Fieldwork 1997

## Regional Geochemistry Program

# REGIONAL GEOCHEMICAL SURVEY PROGRAM: REVIEW OF 1997 ACTIVITIES

By Wayne Jackaman, Stephen Cook and Ray Lett

**KEYWORDS:** Applied geochemistry, stream sediments, lake sediments, till, mineral exploration, multi-element, reconnaissance-scale, Regional Geochemical Survey.

## INTRODUCTION

British Columbia's Regional Geochemical Survey (RGS) program is a valuable source of high-quality baseline geochemical information. The program supports the exploration and development of B.C.'s mineral resources by providing geochemical results from reconnaissance-scale surveys that are used to map regional geochemical trends, assist mineral potential evaluations and aid regional metallogenic studies and geologic interpretations.

Since 1976, the RGS program has conducted stream sediment and water surveys in over forty 1:250 000 NTS map areas (Figure 30-1). In addition, several lake sediment and water surveys and numerous geochemical research studies have been completed. At present, the RGS database contains analytical determinations, field observations and sample location information for 41 981 stream sediment and water sample sites and 2343 lake sediment and water sample sites. All components of sample collection, preparation and analysis are closely monitored to ensure consistency and conformance to standards set by the National Geochemical Reconnaissance (NGR) Program.

This report provides a summary of 1997 geochemical data releases for British Columbia, and outlines new projects initiated during the 1997 field season. During 1997, new geochemical data was published for stream sediment and water surveys conducted in the McConnell Creek (NTS 94D) and Toodoggone River (NTS 94E) map areas. In addition, lake sediment and water geochemical data was released for surveys completed in the Pinchi Lake area of the Nechako Plateau (parts of NTS 93K) as part of the federal-provincial Nechako NATMAP project, and for the Gataga River area of the northern Kechika Trough (parts of NTS 94M and 104P). Results of a lake sediment and water survey covering the Babine porphyry belt (parts of NTS 93L and 93M) as part of the NATMAP project are scheduled to be released in January 1998. Till geochemical data for two survey areas in the Babine Lake and Adams Plateau area were also released this year.

Project activities during 1997 included a reconnaissance-scale stream sediment and water program in the Mesilinka River (NTS 94C) area of north-central British Columbia, plus regional till surveys and other geochemical studies conducted as part of multi-disciplinary mapping and mineral resource programs in the Nechako-Babine and Eagle Bay regions (Figure 30-1).

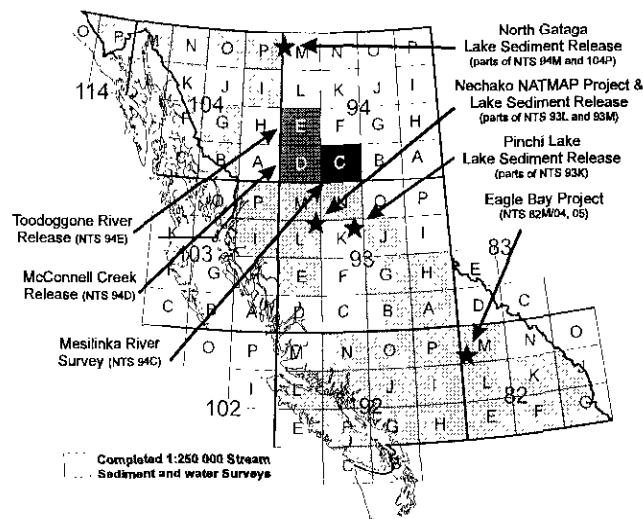


Figure 30-1. Location map of RGS and related projects.

## STREAM SEDIMENT SURVEYS

### McConnell Creek and Toodoggone River RGS Data Releases

Reconnaissance-scale RGS programs were completed in the McConnell Creek (NTS 94D) and Toodoggone River (NTS 94E) 1:250 000 map areas in September, 1996. This region is well known for its geological and metallogenic diversity and is considered to have high potential for additional discoveries of gold-copper porphyry, gold silver epithermal, skarn, vein and basaltic copper deposits.

Stream sediment samples, stream water samples and field observations were systematically collected from 1885 sites over a total area of 18 500 square kilometres. Survey results were released as Open File B.C. RGS 45 and 46 on July 10, 1997. Immediately following the release over 750 claim units were staked by exploration companies and prospectors targeting the numerous base and precious metal anomalies identified in the data packages (Jackaman, 1997a,b).

### 1997 Mesilinka River RGS Program

During July and August, a truck and helicopter supported sample collection program was conducted in the

Mesilinka River (NTS 94C) 1:250 000 map area. Over the 13 500 square kilometre survey area stream sediment, stream water and field observations were collected from 1008 sample sites at an average density of 1 site every 12 square kilometres.

Stream sediment samples will be analyzed for precious and base metals, pathfinder and rare earth elements (Table 30-1). Water samples are being analyzed for pH, fluoride, uranium and sulphate. Survey results are scheduled to be released in July, 1998.

## LAKE SEDIMENT SURVEYS

### Pinchi Lake and North Gataga Data Releases

Geochemical data from two lake sediment surveys in central British Columbia were released in 1997. Results of the Pinchi Lake survey (413 sites; Cook *et al.*, 1997a), in the Fort St. James area of the Nechako Plateau, were released in January, while results of the North Gataga survey (445 sites; Cook *et al.*, 1997b) in the northern Kechika Trough were released in August. The surveys are joint projects of the Geological Survey Branch and the Geological Survey of Canada.

The Pinchi Lake survey area straddles the Pinchi fault zone between the Quesnel and Cache Creek terranes. Geochemical results of this survey, a contribution to the Nechako NATMAP Project, outline prospective new areas for porphyry gold-copper and molybdenum mineralization. Maximum element concentrations of up to 65 ppm molybdenum (median: 4 ppm), 250 ppm copper (median: 50 ppm), 650 ppm nickel (median: 35 ppm), 17 ppb gold (median: 2 ppb), 316 ppm arsenic (median: 5.9 ppm) and 8.4 ppm antimony (median: 0.8 ppm) in lake sediments were recorded. The North Gataga survey covers an area of Devonian-Ordovician siliciclastic and carbonate rocks which are prospective for sedimentary-exhalative (sedex) zinc-lead-barite deposits. This survey, together with a stream sediment geochemical survey (Jackaman *et al.*, 1996) that covered more mountainous terrain to the south, complement recent bedrock mapping in the Kechika Trough by Ferri *et al.* (1997, in press). Maximum concentrations of 6600 ppm zinc (median: 112 ppm), 30 ppm lead (median: 4 ppm), 3100 ppm barium (median: 680 ppm), 100 ppm molybdenum (median: 6 ppm), 500 ppm nickel (median: 16 ppm), 28 ppb gold (median: 1 ppb) and 9 ppm antimony (median: 0.7 ppm) occur in lake sediments of this area.

### New Data Release: Babine Porphyry Belt

Results of a lake sediment geochemical survey of the Babine porphyry belt (Cook *et al.*, 1998) are to be released at the Cordilleran Roundup in January 1998. The Babine survey (332 sites) was conducted in June 1996 in conjunction with bedrock mapping, surficial geology mapping and till geochemistry programs of the Nechako NATMAP Project. The survey area is centred on northern

Table 30-1.

## ROUTINE STREAM SEDIMENT AND WATER ANALYTICAL SUITE

Element		Analytical Method	Detection Limit	Unit
Antimony	Sb	AAS-H/INAA	0.2/0.1	ppm
Arsenic	As	AAS-H/INAA	0.2/0.5	ppm
Barium	Ba	INAA	50	ppm
Bismuth	Bi	AAS-H	0.2	ppm
Bromine	Br	INAA	0.5	ppm
Cadmium	Cd	AAS	0.2	ppm
Cerium	Ce	INAA	3	ppm
Cesium	Cs	INAA	1	ppm
Chromium	Cr	INAA	5	ppm
Cobalt	Co	AAS/INAA	2/1	ppm
Copper	Cu	AAS	2	ppm
Fluorine	F	ION	40	ppm
Gold	Au	INAA	2	ppb
Hafnium	Hf	INAA	1	ppm
Iron	Fe	AAS/INAA	0.02/0.01	%
Lanthanum	La	INAA	0.5	ppm
Lead	Pb	AAS	2	ppm
Loss on Ignition	LOI	GRAV	0.1	%
Lutetium	Lu	INAA	0.05	ppm
Manganese	Mn	AAS	5	ppm
Mercury	Hg	AAS	10	ppb
Molybdenum	Mo	AAS/INAA	2/1	ppm
Nickel	Ni	AAS/INAA	2/20	ppm
Rubidium	Rb	INAA	5	ppm
Samarium	Sm	INAA	0.1	ppm
Scandium	Sc	INAA	0.1	ppm
Silver	Ag	AAS	0.2	ppm
Sodium	Na	INAA	0.01	%
Tantalum	Ta	INAA	0.5	ppm
Terbium	Tb	INAA	0.5	ppm
Thorium	Th	INAA	0.2	ppm
Tungsten	W	INAA	1	ppm
Uranium	U	INAA	0.5	ppm
Vanadium	V	AAS	5	ppm
Ytterbium	Yb	INAA	0.2	ppm
Zinc	Zn	AAS	2	ppm
pH (Waters)	pH	GCE	0.1	
Uranium (Waters)	UW	LIF	0.05	ppb
Fluoride (Waters)	FW	ION	20	ppb
Sulphate (Waters)	SO 4	TURB	1	ppm

AAS atomic absorption spectroscopy  
 AAS-H hydride generation AAS  
 AAS-F flameless AAS  
 GCE glass combination electrode  
 LIF laser-induced fluorescence  
 INAA instrumental neutron activation analysis  
 GRAV weight differential  
 ION specific ion electrode  
 TURB turbidimetric

Babine Lake, immediately east of Smithers, and covers all or part of six 1:50,000 scale map areas. This area includes the past-producing Bell and Granisle copper mines as well as exploration prospects such as the Hearne Hill, Nak, Morrison and Lennac Lake porphyry copper deposits.

## TILL SURVEYS

### Eagle Bay and Babine Data Releases

Till geochemical data for two areas in central B.C. were released during 1997. Regional data for a survey of

the Adams Plateau area (Adams Lake Plateau and North Barriere Lake areas; NTS 82M/4, 5) of the Shuswap Highland (Bobrowsky *et al.*, 1997) in southern B.C. was released in April. In addition, regional till geochemical data for a part of the Babine porphyry belt (Old Fort Mountain map area; NTS 93M/1), was released via the internet in May (Levson *et al.*, 1997a).

### **1997 Till Geochemical Surveys**

Till geochemical surveys were conducted in two areas during 1997: the Adams Plateau area (Bobrowsky *et al.*, this volume), and the Ootsa Lake-Nechako River area (Levson *et al.*, this volume). Results of the two surveys will complement previous till geochemical studies just released in the Eagle Bay and Nechako-Babine areas, respectively.

## **OTHER GEOCHEMICAL PROJECTS**

### **Massive Sulphide Geochemical Pathfinders Project**

Geochemical sampling initiated in 1996 (Sibbick *et al.*, 1997) and completed in 1997 (Lett *et al.*, this volume) was designed to study the geochemical expression of typical Kootenay terrane soil, till and vegetation. Soil, till, rock, tree bark and twig samples were obtained for eight target areas in conjunction with regional till geochemical surveys in the Eagle Bay area (NTS 82M/4, 5; 92P/1, 8; Bobrowsky *et al.*, 1997a,b; this volume). The study areas are Birk Creek, Cam Claims, Harper property, Homestake Mine, Samatosum Mine, Spar property and Win Property. Samples were analysed for up to 50 elements by thermal neutron activation, aqua regia digestion-inductively coupled plasma emission spectroscopy and aqua regia digestion-ultrasonic nebulizer inductively coupled plasma emission spectroscopy. A small number of soil and till samples from the Harper and Homestake areas were also analysed for up to 70 elements using enzyme leach-inductively coupled plasma mass spectroscopy. The lower detection limits obtainable with aqua regia digestion-ultrasonic nebulizer inductively coupled plasma emission spectroscopy reveal arsenic, bismuth, silver, selenium and mercury variations that improve the effectiveness of till and soil geochemistry for detecting different types of massive sulphide and gold mineralization.

### **Collection of New Control Reference Standard**

All geochemical samples submitted to contract laboratories for analytical work contain a range of control reference standards to monitor analytical accuracy. Ideally, the standards used in any given survey span a concentration range, from background to anomalous levels, for elements associated with target mineral deposits. In the case of lake sediments, a variety of in-house and certified CANMET control standards are used, but there is

a dearth of gold standards at appropriate concentration levels. Natural gold concentrations in most lakes are very low (generally about 1 ppb), and sediment standards with moderately high gold concentrations in the 10 ppb range are rare. Furthermore, artificially mixed and diluted standards generally yield imprecise and unsatisfactory results. To fulfill this requirement for an appropriate control standard, a bulk lake sediment sample was collected in August 1997 from Clisbako Lake, located approximately 100 kilometres west of Quesnel near Nazko in the Fraser Plateau. This lake is adjacent to the Clisbako epithermal gold prospect. Prior orientation studies here (Cook, 1997) identified elevated concentrations of gold (median: 9 ppb), arsenic (median: 25.5 ppm) and antimony (median: 3.1 ppm) in organic sediments. The standard was collected by repeatedly dropping a Hornbrook sampler from a zodiac anchored at several locations in the western part of the lake, where earlier work had identified particularly homogenous elevated gold concentrations in the 10-12 ppb range. Approximately 125 litres of wet sediment were obtained. When dry, the sediment will be disaggregated in a ceramic ringmill and mixed to create the standard.

### **RGS Interpretive Studies**

Several types of interpretive methods, including element sum ranking, may be used to interpret regional geochemical data. To assess the usefulness of element sum ranking in the search for volcanogenic massive sulphide (VMS) deposits in Carboniferous-Jurassic Cache Creek Group and Upper Triassic Kutcho Formation rocks in the Nechako NATMAP study area, this technique was used to identify RGS stream sediment sites with elevated combined copper-zinc-lead-silver data rankings in the western half of the Manson River (NTS 93N) map area. Sites were ranked, and two watersheds in the Takla Lake area within the top five percentiles of the combined data rankings were selected for follow-up investigations. A variety of geochemical media were sampled in an effort to verify and enhance the anomalies. Stream sediments, moss mats, stream waters and rock samples are presently being analyzed for trace elements by a variety of methods; results will be available in 1998.

### **Till Dispersal Studies**

Till dispersal studies in the vicinity of Babine porphyry belt copper prospects, initiated in 1996 in association with V. Levson (Levson *et al.*, 1997b), continued during 1997 near the Dorothy and Hearne Hill prospects. Till and profile sampling was conducted at these sites, as part of the Nechako NATMAP Project, to document glacial dispersal and investigate copper concentrations in various soil horizons. Studies were also previously conducted near the Nak, Trail Peak and Lennac prospects in the Babine belt. Results will be reported in 1998.

## Lake Sediment Orientation Studies: Hill-Tout Lake

Lake sediment orientation studies previously conducted at Hill-Tout Lake (Cook, 1997), near the Dual porphyry copper prospect south of Houston, identified large variations in sediment metal concentrations between the three distinct sub-basins of the lake. Additional fieldwork was conducted in 1997, as part of the Nechako NATMAP Project, to further investigate the stream sediment and water geochemical inputs to the lake basins. It is expected that this information will help to further refine regional geochemical exploration guidelines for lakes, such as Hill-Tout, which are located in the rugged western margin of the Nechako Plateau. As original water samples collected at the lake were analyzed by ICP-ES methods, additional surface and bottom-water samples were obtained for ICP-MS analysis, which yields superior data for relevant trace elements such as copper. An Open File report documenting sediment and water geochemistry, and implications for regional geochemical exploration, is currently being prepared (Cook and Wyatt, in preparation).

## REFERENCES CITED

- Bobrowsky, P.T., Leboe, E.R., Dixon-Warren, A., Ledwon, A., MacDougall, D. and Sibbick, S.J. (1997): Till Geochemistry of the Adams Lake Plateau-North Barriere Lake Area (82M/4, 5); *B.C. Ministry of Employment and Investment*, Open File 1997-9, 26 pages.
- Paulen, R.C., Bobrowsky, P.T., Little, E.C., Prebble, A.C. and Ledwon, A. (1998): Drift Exploration in the Southern Kootenay Terrane; in *Geological Fieldwork 1997*, *B.C. Ministry of Employment and Investment*, Paper 1998-1, (this volume).
- Cook, S.J. and Wyatt, G.J. (in preparation): Sediment and Water Geochemistry of Hill-Tout Lake, Central British Columbia (93E/14, 15); *B.C. Ministry of Employment and Investment*, Open File.
- Cook, S.J. (1997): Regional and Property-Scale Application of Lake Sediment Geochemistry in the Search for Buried Mineral Deposits in the Southern Nechako Plateau Area, British Columbia (93C, E, F, K, L); in *Interior Plateau Geoscience Project: Summary of Geological, Geochemical and Geophysical Studies*, L.J. Diakow and J.M. Newell, Editors, *B.C. Ministry of Employment and Investment*, Paper 1997-2, pages 175-203.
- Cook, S.J., Jackaman, W., McCurdy, M.W., Day, S.J. and Friske, P.W.B. (1997a): Regional Lake Sediment and Water Geochemistry of part of the Fort Fraser Map Area, British Columbia (93K/9, 10, 15, 16); *B.C. Ministry of Employment and Investment*, Open File 1996-15, 33 pages.
- Cook, S.J., Jackaman, W., Friske, P.W., Day, S.J., Coneys, A.M. and Ferri, F. (1997b): Regional Lake Sediment and Water Geochemistry of the Northern Kechika Trough, British Columbia (94M/2, 3, 4, 5, 6, 12; 104P/8, 9, 10, 15, 16); *B.C. Ministry of Employment and Investment*, Open File 1997-15, 30 pages.
- Cook, S.J., Lett, R.E.W., Levson, V.M., Jackaman, W., Coneys, A.M. and Wyatt, G.J. (1998): Regional Lake Sediment and Water Geochemistry of the Babine Porphyry Belt, Central British Columbia (93L/9, 16; 93M/1, 2, 7, 8); *B.C. Ministry of Employment and Investment*, Open File 1997-17.
- Ferri, F., Rees, C., Nelson, J. and Legun, A. (1997): Geology of the Northern Kechika Trough (94L/14,15; 94M/3,4,5,6,12; 104P/8,9,15,16); *B.C. Ministry of Employment and Investment*, Open File 1997-14.
- Ferri, F., Rees, C., Nelson, J. and Legun, A. (in press): Geology of the Northern Kechika Trough; *B.C. Ministry of Employment and Investment*, Geoscience Map.
- Jackaman, W., Lett, R. and Sibbick, S. (1996): Geochemistry of the Gataga Mountain Area (Parts of 94L/7, 8, 9, 10, 11, 14, 15); *B.C. Ministry of Employment and Investment*, Open File 1996-18.
- Jackaman, W. (1997a): British Columbia Regional Geochemical Survey - McConnell Creek (94D); *B.C. Ministry of Employment and Investment*, BC RGS 45.
- Jackaman, W. (1997b): British Columbia Regional Geochemical Survey - Toodoggone River (94E); *B.C. Ministry of Employment and Investment*, BC RGS 46.
- Lett, R.E., Bobrowsky, P., Hoy, T. and Yeow, A. (1998): South Kootenay project: Geochemical Pathfinders for Massive Sulphide Deposits; in *Geological Fieldwork 1997*, *B.C. Ministry of Employment and Investment*, Paper 1998-1, (this volume).
- Levson, V.M., Cook, S.J., Huntley, D.H., Stumpf, A.J. and Hobday, J. (1997a): Preliminary Till Geochemistry - Old Fort Mountain Area (93M/1); *B.C. Ministry of Employment and Investment*, Open File 1997-18.
- Levson, V.M., Meldrum, D.G., Cook, S.J., Stumpf, A.J., O'Brien, E.K., Churchill, C., Coneys, A.M. and Broster, B.E. (1997b): Till Geochemical Studies in the Babine Porphyry Belt: Regional Surveys and Deposit-Scale Studies (93L/16, 93M/1, 2, 7, 8); in *Geological Fieldwork 1996*, Lefebure, D.V., McMillan, W.J. and McArthur, G., Editors, *B.C. Ministry of Employment and Investment*, Paper 1997-1, pages 457-466.
- Levson, V.M., Stumpf, A. and Stuart, A. (1998): Quaternary Geology Studies in the Smithers and Hazelton Map Areas (93L and M): Implications for Exploration; in *Geological Fieldwork 1997*, *B.C. Ministry of Employment and Investment*, Paper 1998-1, (this volume).
- Sibbick, S.J., Runnels, J.L. and R.E. Lett (1997): Eagle Bay Project Regional Hydrogeochemical survey and geochemical orientation studies in *Geological Fieldwork 1996*, Lefebure, D.V., McMillan, W.J. and McArthur, G., Editors, *B.C. Ministry of Employment and Investment*, Paper 1997-1, pages 423-426.