National Geochemical Reconnaissance Surveys in the B.C. Cordillera to Target and Attract Mineral Exploration

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INTRODUCTION

This paper highlights the publication of new regional stream sediment and water geochemical information and also provides details of surveys completed during the 2001 field season (Figure 1). As part of the National Geochemical Reconnaissance (NGR) program, results from a 1:250 000 reconnaissance-scale survey covering the Dease Lake (NTS 104J) map sheet were published, and a new survey was completed in the Bella Coola (NTS 93D) and parts of the Laredo Sound (NTS 103A) map sheets. Funded by the Corporate Resource Inventory Initiative (CRII), results of a survey covering the Ecstall Greenstone Belt (parts of NTS 103H and 103I) were released, and a sample collection program was completed in the Triumph Bay area (parts of NTS 103H).

NGR SURVEYS

The British Columbia Ministry of Energy and Mines (MEM) has been involved in reconnaissance-scale stream sediment and water surveys since 1976. This joint federal-provincial initiative was originally referred to as the Uranium Reconnaissance Program (URP). In 1978 the provincial program was renamed the Regional Geochemical Survey (RGS) and in 1987 the Province began to independently administer surveys conducted in British Columbia. As part of Canada's NGR program, the B.C. RGS continues to maintain sample collection, preparation and analytical standards established by the Geological Survey of Canada. The current database covers close to 70 percent of the province and contains field and analytical information for over 46,000 sample sites. Survey results are used by industry to pinpoint exploration opportunities and by government for resource management, land-use planning and environmental assessments.

DEASE LAKE DATA RELEASE

In July, new field and analytical results for 963 sediment and water samples collected in the Dease Lake (NTS 104J) map sheet were published (Jackaman and Friske, 2001). Stream sediment samples were analysed for more than 40 constituents (Table 1), including base and precious metals, pathfinder and rare earth elements. Water samples were analyzed for pH, uranium, fluoride and sulphate. In addition, 213 stream water samples were analysed for over 40 trace and major elements.

Survey results identified numerous multi-element anomalies including polymetallic volcanogenic massive sulphide (Table 2) and copper-gold porphyry (Table 3) deposits (Lefebure *et al*., 2002). Although the data clearly highlights existing mining camps, many anomalies do not coincide with any recorded mineral occurrence or exploration activity. To the northeast, sediment samples collected from streams draining rocks of the Cache Creek Terrane report elevated levels of zinc, copper and barium values combined with high silver, antimony, selenium and cadmium. These VMS targets are found in rocks that may be related to the intraoceanic arc which hosts the Kutcho Creek (MINFILE 104I 60) massive sulphide deposit (Mihalynuk and Cordey, 1997). Several copper-gold anomalies that appear to be related to Triassic granodiorite intrusions have also been identified in the southern part of the map sheet. A region of known potential, these areas are prime exploration

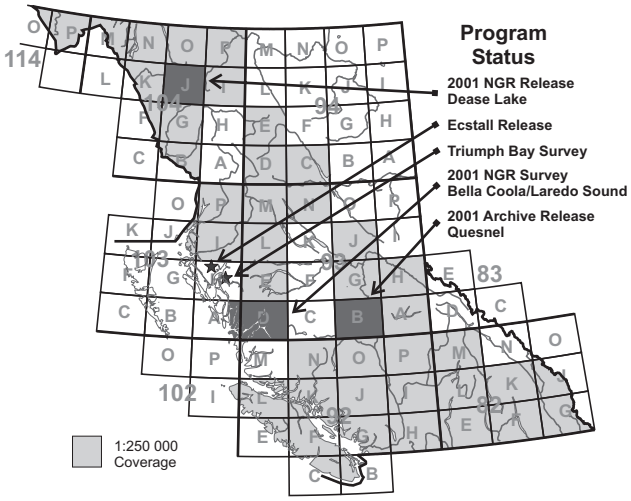

Figure 1. Location map of surveys.

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TABLE 1
ANALYTICAL SUITE OF ELEMENTS

Element	Detection	Units	Method
Aluminum	0.01	%	ICPMS
Antimony	0.02/0.1	ppm	ICPMS / INAA
Arsenic	0.1/0.5	ppm	ICPMS / INAA
Barium	0.5/50	ppm	ICPMS / INAA
Bismuth	0.02	ppm	ICPMS
Bromine	0.5	ppm	INAA
Cadmium	0.01	ppm	ICPMS
Calcium	0.01/1	%	ICPMS / INAA
Cerium	5	ppm	INAA
Cesium	0.5	ppm	INAA
Chromium	0.5/2	ppm	ICPMS / INAA
Cobalt	0.1/5	ppm	ICPMS / INAA
Copper	0.01	ppm	ICPMS
Europium	1	ppm	INAA
Gallium	0.2	ppm	ICPMS
Gold	0.2/2	ppb	ICPMS / INAA
Hafnium	1	ppm	INAA
Iron	0.01/0.2	%	ICPMS / INAA
Lanthanum	0.5/2	ppm	ICPMS / INAA
Lead	0.01	ppm	ICPMS
Lutetium	0.2	ppm	INAA
Magnesium	0.01	%	ICPMS
Manganese	1	ppm	ICPMS
Mercury	5	ppb	ICPMS
Molybdenu	0.01	ppm	ICPMS
Nickel	0.1	ppm	ICPMS
Phosphorus	0.001	%	ICPMS
Potassium	0.01	%	ICPMS
Rubidium	5	ppm	INAA
Samarium	0.1	ppm	INAA
Scandium	0.1/0.2	ppm	ICPMS / INAA
Selenium	0.1	ppm	ICPMS
Silver	2	ppb	ICPMS
Sodium	0.001/0.02	%	ICPMS / INAA
Strontium	0.5	ppm	ICPMS
Sulphur	0.02	%	ICPMS
Tantalum	0.5	ppm	INAA
Tellurium	0.02	ppm	ICPMS
Terbium	0.5	ppm	INAA
Thallium	0.02	ppm	ICPMS
Thorium	0.1/0.2	ppm	ICPMS / INAA
Titanium	0.001	%	ICPMS
Tungsten	0.2/1	ppm	ICPMS / INAA
Uranium	0.1/0.2	ppm	ICPMS / INAA
Vanadium	2	ppm	ICPMS
Ytterbium	2	ppm	INAA
Zinc	0.1/50	ppm	ICPMS / INAA
Fluorine	10	ppm	ION
Loss on	0.1	%	GRAV
Fluoride	20	ppb	ION
Sulphate	1	ppm	TURB
Uranium	0.05	ppb	LIF
pH (waters)	0.1		GCE

targets for new porphyry deposits. Some of these sites were staked immediately following the release, but many important anomalies reflecting VMS, porphyry and other exploration targets remain open (Figure 2).

The Dease Lake survey was funded in part by the Geological Survey of Canada Targeted Geoscience Initiative (TGI) and the B.C. Geological Survey Branch.

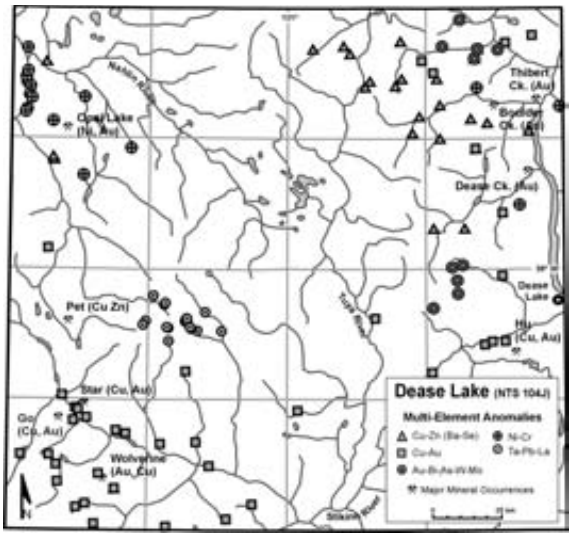

Figure 2. Location map of muli-element anomalies.

QUESNEL ARCHIVE DATA RELEASE

Ongoing since 1991, the RGS Archive program has re-analyzed over 21,000 stream sediment samples by instrumental neutron activation analysis (INAA) for gold and 25 other metals. These sediment samples were saved from reconnaissance-scale stream sediment and water surveys conducted from 1976 to 1985. At this time, RGS open files only presented analytical data for a limited number of metals (*e.g.* zinc, copper, lead, nickel, cobalt, silver, manganese, iron, molybdenum and uranium). To date, new INAA data for nineteen 1:250 000 NTS map sheet areas have been published.

In May of this year, archive data was released for the Quesnel (NTS 93B) map sheet (Jackaman, 2001). Conducted in 1980, the Quesnel reconnaissance-scale stream sediment and water survey included a total of 757 sediment samples and 750 water samples collected from 715 sites over a 14,000 square kilometre area (Figure 3).

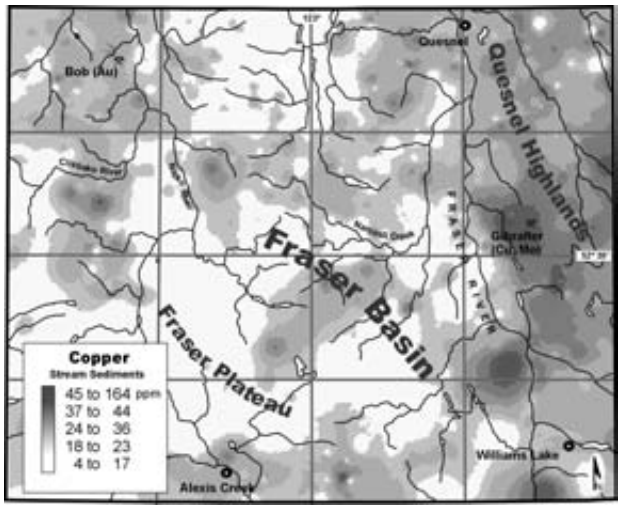

Figure 3. Distribution of copper in the Quesnel map sheet.

TABLE 2
TOP RATED CU-ZN-BA-SE TARGETS

Map	ID	Cu ppm ICPMS	Zn ppm ICPMS	Ba ppm INAA	Se ppm ICPMS
104J15	1056	96.79	204.1	2000	5.8
104J08	1091	62.69	168.6	950	2.4
104J09	1135	68.91	213.7	2800	1.7
104J15	1144	86.55	236.0	990	7.8
104J15	1147	38.15	256.0	1100	3.6
104J15	1148	38.62	253.0	980	3.7
104J15	1167	108.07	418.3	2500	3.4
104J16	1172	186.73	126.5	1200	13.4
104J16	1174	106.12	261.9	1800	2.2
104J16	1197	616.47	46.1	810	7.6
104J15	1218	61.16	443.1	1900	2.8
104J16	1245	38.14	200.0	3800	2.5
104J15	1262	100.49	132.6	1600	4.5
104J15	1263	89.80	195.6	2400	1.3
104J16	1278	68.98	185.3	2500	1.9
104J16	1295	35.24	241.6	2100	1.4
104J09	1297	384.12	140.0	800	8.0
104J12	1418	100.16	150.3	1600	2.0
104J12	1422	88.74	155.3	2600	1.7
104J12	1423	89.83	157.8	2600	2.0
104J10	1437	84.50	153.9	1800	1.2
104J10	1438	53.56	249.0	900	0.6
104J15	1472	48.23	189.2	1300	2.8
104J14	3002	35.54	208.6	1000	1.0
104J04	3229	730.99	491.5	680	2.1
104J04	3231	272.63	126.4	1000	1.1
104J04	3249	464.87	101.8	580	1.0
104J03	3266	142.75	109.2	1200	1.2
104J08	3384	51.20	211.5	810	0.9
104J01	3451	59.23	197.7	880	0.5

TABLE 3
TOP RATED CU-AU-AG TARGETS

Map	ID	Cu ppm ICPMS	Au ppb INAA	Ag ppb INAA
104J07	1086	166.52	<2	54
104J04	1105	161.25	6	175
104J16	1152	64.77	250	176
104J16	1172	186.73	8	2598
104J16	1193	150.95	100	151
104J16	1194	213.33	<2	102
104J16	1197	616.47	<2	509
104J16	1232	115.57	34	131
104J09	1297	384.12	6	354
104J04	3107	256.56	6	74
104J04	3111	159.89	10	90
104J03	3150	155.31	11	303
104J04	3155	175.26	12	180
104J04	3156	273.28	15	193
104J04	3213	321.20	4	79
104J04	3225	691.46	14	453
104J04	3229	730.99	140	643
104J04	3231	272.63	20	189
104J04	3242	129.53	20	158
104J04	3243	134.46	19	81
104J04	3244	138.35	22	95
104J04	3249	464.87	130	324
104J03	3262	138.07	58	205
104J03	3266	142.75	21	331
104J03	3273	38.84	260	51
104J08	3375	160.71	4	82
104J01	3432	200.43	<2	73
104J03	3437	162.84	<2	83
104J02	3471	19.78	140	33
104J06	3479	32.75	349	23

BELLA COOLA/LAREDO SOUND SURVEY

In cooperation with the Geological Survey of Canada (GSC), a new reconnaissance-scale stream sediment and water survey was completed in the Bella Coola (NTS 93D) and Laredo Sound (NTS 103A) map sheets. Truck, boat and helicopter supported sampling was conducted during July and August, 2001. A total of 1060 stream sediment and water samples were collected from 1003 sites at an average density of 1 site every 12 square kilometres.

Stream sediment samples are being analysed by aqua-regia inductively coupled plasma-mass spectroscopy (ICP-MS) and instrumental neutron activation analysis (INAA). Table 1 lists the elements and associated detection limits. Water samples are being analyzed for pH, uranium and fluoride. Additional 125 millilitre water samples collected from 232 sites will be analyzed for trace and major elements. Quality data is maintained by monitoring analytical variation with sample duplicates and control reference standards.

This survey is being funded in part by the Geological Survey of Canada Targeted Geoscience Initiative (TGI) and the B.C. Geological Survey Branch. Results will be published in 2002.

DETAILED GEOCHEMICAL SURVEYS

These surveys are designed to provide baseline regional geochemical data that can be used in the evaluation of the mineral potential of the target areas. Funded under the provincial government's Corporate Resource Inventory Initiative (CRII), these surveys are part of the Ministry of Energy and Mines' contribution to the North Coast Land and Coastal Resource Management Plan (NCLCRMP). Although this work does not cover complete 1:250 000 map sheets the sampling and analyses are carried out to NGR standards and the data are incorporated into the provincial geochemical database.

ECSTALL RELEASE

In May, new field and analytical data for 219 sediment and water samples collected in the Ecstall Greenstone Belt (parts of NTS 103H and 103I) were published (Jackaman, 2001). The report included results for over 48 different metals in stream sediments and pH, uranium, fluoride and sulphate in stream waters (Table 1). A number of sediment samples exhibited anomalous concentrations of copper, lead, zinc, silver and gold (Figure 3). These results clearly

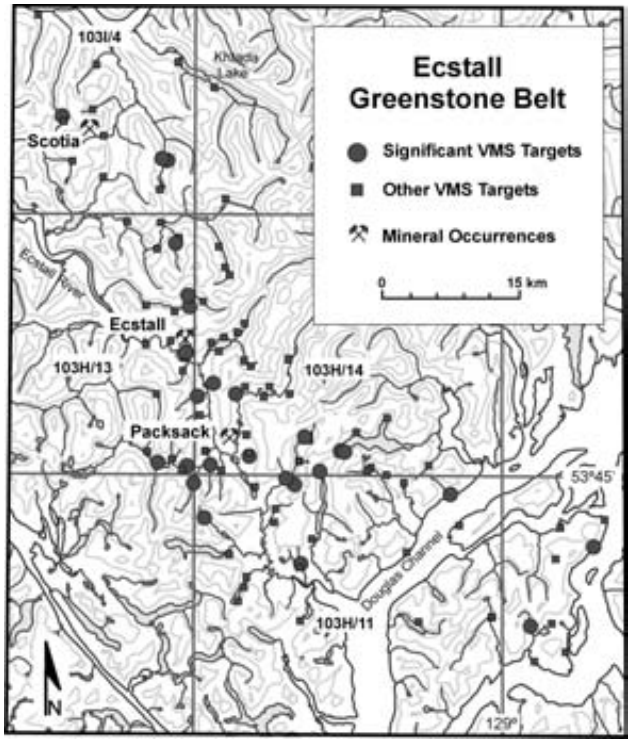

Figure 4. Location map of VMS targets in the Ecstall Belt.

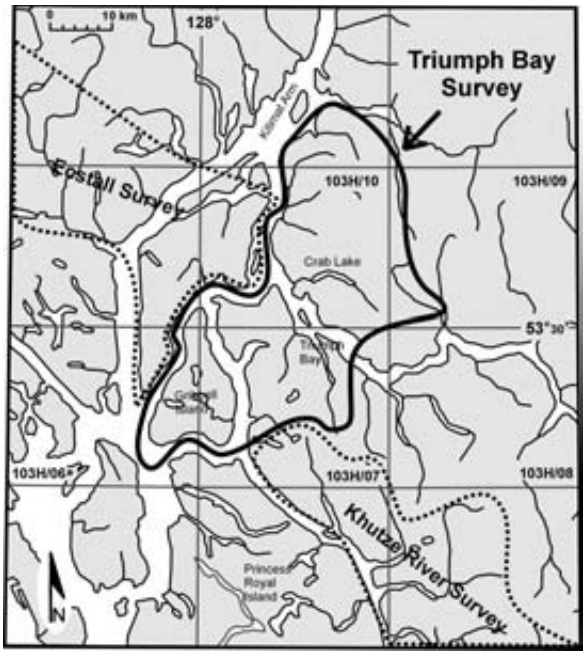

Figure 5. Location map of North Coast surveys.

identify areas of known mineralization (Alldrick, 2001; Alldrick and Jackaman, 2002) and outline new regions that may be of interest to mineral explorationists looking for new VMS deposits.

The geochemical signature of samples collected downstream from several known VMS mineral occurrences are shown in Table 4. These samples are anomalous in one or more of the listed metals relative to the Ecstall data set (Table 5) and when compared to the total provincial geochemical database. Table 6 lists the top rated sample sites that are not associated with any recorded mineral occurrence or historical mineral exploration activity and exhibit a multi-element signature characteristic of VMS deposits.

Overall, survey results clearly highlight the high mineral potential of this belt. It can be shown that geochemical data for copper, lead, zinc, silver and gold detect known mineral occurrences, enlarge target areas for currently known prospects and outline new prospective areas for VMS deposits.

TRIUMPH BAY SURVEY

In support of previous work completed in the region, the Triumph Bay project covered un-surveyed ground immediately south of the Ecstall survey and north of the Khutze River survey (Jackaman and Pinsent, 2000). Helicopter supported sampling was conducted in late August, 2001. A total of 208 stream sediment and water samples were collected from 196 sites at an average density of 1 site every 7 square kilometres. This area contains mineral deposit environments favourable for the discovery of massive sulphides and gold bearing quartz veins. Results are scheduled to be published in 2002.

TABLE 4
SEDIMENT DATA DOWNSTREAM FROM KNOWN MINERAL OCCURRENCES

MINFILE	ID	Cu ppm ICPMS	Pb ppm ICPMS	Zn ppm ICPMS	Ag ppb ICPMS	Au ppb INAA	Cd Ppm ICPMS	S % ICPMS	Se Ppm ICPMS
Ecstall	9106	125.99	14.07	139.8	304	10	0.57	0.14	0.9
Ecstall	9107	125.00	11.30	158.1	240	7	0.69	0.14	0.6
Strike	9145	74.96	11.88	88.7	99	5	0.13	0.17	1.0
Horsefly	9150	70.88	6.61	69.0	102	92	0.24	0.05	0.6
Ravine	9174	54.31	6.00	104.4	141	2	0.71	0.21	2.4
Steelhead	9179	90.71	3.98	117.2	167	22	0.89	0.10	1.5
Scotia	9038	21.33	9.57	80.1	48	2	0.24	0.05	0.4

TABLE 5
SUMMARY STATISTICS FOR VMS ELEMENTS

Map	Cu ppm ICPMS	Pb ppm ICPMS	Zn ppm ICPMS	Ag ppb ICPMS	Au ppb INAA	Cd ppm ICPMS	S % ICPMS	Se ppm ICPMS
N	228	228	228	228	228	228	228	228
Mean	33.93	3.66	51.85	73	2	0.14	0.05	0.72
Median	27.49	2.94	45.7	48	2	0.07	0.03	0.5
Mode	28.38	1.57	30.3	19	2	0.03	0.02	0.4
St Dev	28.52	3.19	27.87	117.13	11.04	0.20	0.04	1.32
Min	2.12	0.76	12.4	10	2	0.02	0.02	0.1
50th	27.49	2.94	45.7	48	2	0.07	0.03	0.5
70th	38.95	3.88	55.9	69	2	0.12	0.04	0.7
90th	71.01	6.15	83.8	132	7	0.31	0.09	1.1
95th	85.13	8.68	103.2	218	26	0.41	0.14	1.7
98th	104.92	11.88	139.8	287	37	0.57	0.18	2.4
Max	226.26	27.18	187.9	1563	92	2.00	0.33	18.3

TABLE 6
TOP RATED SITES EXHIBITING VMS SIGNATURES

Map	ID	Cu ppm ICPMS	Pb ppm ICPMS	Zn ppm ICPMS	Ag ppb ICPMS	Au ppb INAA	Cd ppm ICPMS	S % ICPMS	Se ppm ICPMS
103H13	9154	106.63	20.99	187.9	1563	70	2.00	0.33	18.3
103H13	9100	55.18	16.92	82.9	319	2	1.18	0.15	6.0
103H10	9230	79.37	20.64	151.2	229	8	0.33	0.04	1.0
103H14	9117	84.25	4.14	92.8	189	26	0.38	0.02	1.2
103H14	9130	71.01	4.84	94.8	218	2	0.31	0.02	2.1
103H14	9104	176.44	3.42	55.8	422	2	0.18	0.03	1.5
103H11	9158	38.92	6.22	72.1	241	64	0.17	0.12	2.8
103H11	9189	95.15	8.22	67.3	203	17	0.24	0.06	1.1
103H10	9410	32.12	3.90	150.5	258	2	1.05	0.18	3.2
103I04	9015	36.46	6.98	83.8	127	2	0.19	0.07	0.7
103I04	9022	226.26	2.63	41.4	50	2	0.04	0.03	0.3
103H14	9177	105.36	3.29	77.4	160	2	0.24	0.02	0.6
103H10	9234	40.22	11.02	52.8	92	2	0.13	0.03	0.5
103H14	9103	74.51	1.57	49.8	259	2	0.37	0.05	1.6
103H14	9165	41.33	1.33	107.1	177	2	0.17	0.02	1.5

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