PGE Stream Sediment Geochemistry in British Columbia

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KEYWORDS: *Geochemical surveys, PGE's, platinum, palladium, Giant Mascot mine.*

INTRODUCTION

There are few published studies describing the application of regional drainage sediment surveys for platinum group elements (PGE's) in British Columbia. Orientation surveys by Fletcher (1989) and by Cook and Fletcher (1993) revealed that platinum tends to concentrate in the magnetic heavy mineral fraction and the finer grain sizes of stream sediment. These conclusions are partly based on research by Cook (1991) along Grasshopper Creek that drains the Tulameen ultramafic complex. This complex is an Alaskan-type ultramafic intrusion where platinum group (except palladium) minerals are associated with massive chromitite segregations within the dunite core of the complex (Nixon and Hammack, 1991). Platinum in Grasshopper Creek sediment ranged from 8 to 91 ppb whereas in moss mat sediment platinum levels did not exceed 47 ppb (Cook and Fletcher 1993). Concentrations in the sediment along the stream profile were found to be higher at slope breaks suggesting mainly physical dispersion of platinum. Physical transport has also been proposed by Cawthorn, (2001) using platinum:palladium:gold ratios to explain the relationship of stream sediment anomalies to platinum mineralization in the Merensky Reef, South Africa. While recent studies in B.C. have focused on the geochemical behaviour of PGE's in soil and vegetation over platinum-rich copper sulphide mineralization (Dunn, Hall and Nixon, 2000) there have been no published stream geochemical orientations involving PGE's.

A stream geochemical survey was conducted in the Cogburn Creek - Stulkawhits Creek area (Figure 1) during 2001 to expand the knowledge of platinum group element dispersal. The objective of this work is to establish the most effective sample media (stream sediment, moss sediment, heavy mineral) and pathfinder element association for mafic-ultramafic hosted suphide-bearing platinum mineralization. In addition, archived sediment samples (- 80 mesh fraction) from previous regional geochemical surveys in different parts of B.C. (Figure 1) were also analysed for platinum and palladium to identify potentially new PGE-mineralized targets. Both orientation survey and RGS archive sample reanalysis are a contribution to a multi-disciplinary initiative to better understand the occurrence and discovery of PGE's in B.C.

FIELD STUDY AREA DESCRIPTION

PHYSIOGRAPHY

The Cogburn Creek drainage is located in the Lillooet Mountain Range approximately 21 kilometres north of Harrison Hot Springs. The study area, roughly 500 km2 between Harrrison Lake and the Fraser River, covers the Cogburn, Settler, Talc, Emory and Stulkawhits (Texas) creek watersheds (Figure 2). Physiography is typical of the Coast Mountains with high, irregular, steeply sloping mountains dissected by large, steep-sided valleys. Mean annual temperature for the major valleys is 6.5°C and annual precipitation ranges from 1500 mm to 3400 mm at higher elevations. Vegetation on lower-elevation slopes (< 900 m above sea level) consists of Douglas-fir, western hemlock, western red cedar, amabilis fir and birch. The under-story comprises willow, alder and several shrub species, including abundant devils club. At higher elevation (> 900 m above sea level) vegetation is largely mountain hemlock and amabilis fir.

A predominantly dendritic drainage pattern reflects erosion of bedrock and geological structures. Second and third order streams are fast flowing, typically have steep gradients (10 - 15°) and shoot-to-pool profiles. Stream sediment consists mainly of gravel to boulder size material, al-

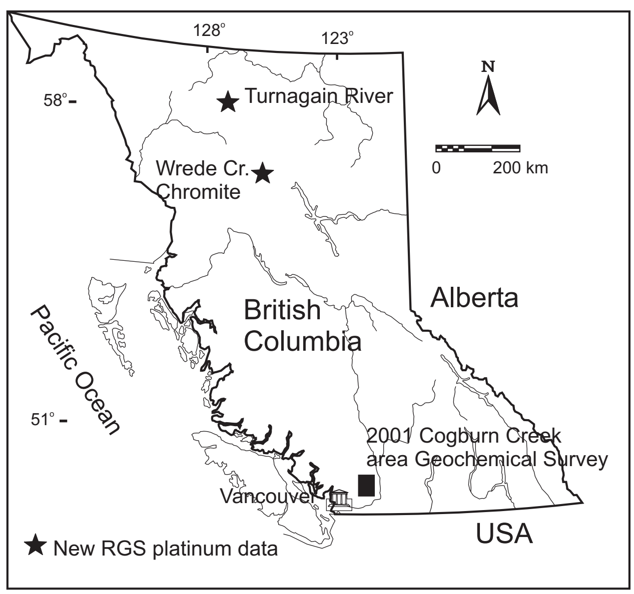

Figure 1. Location of the geochemical survey and re-analysed archive samples.

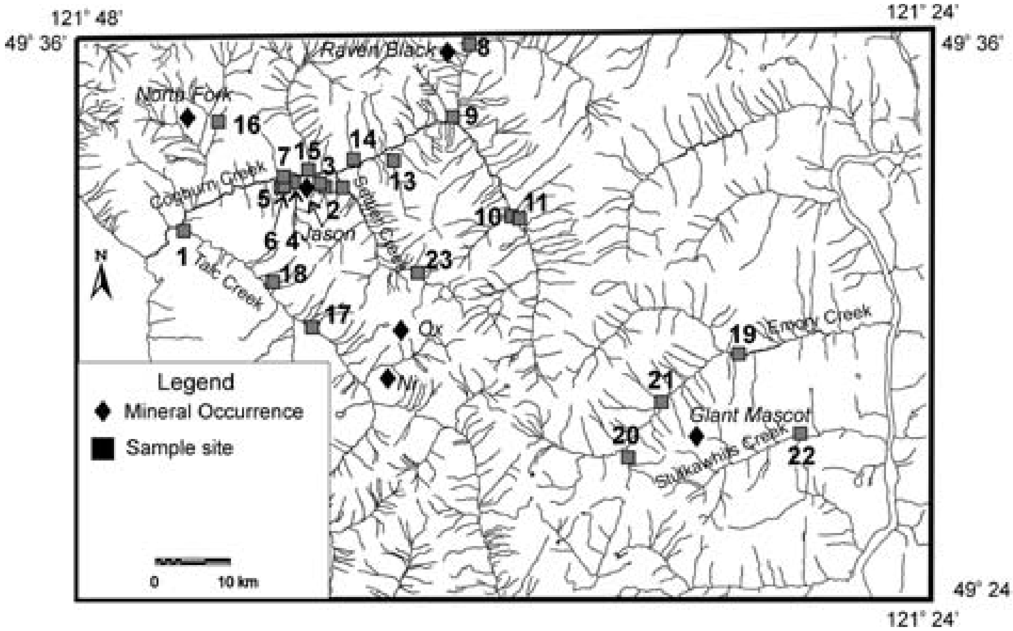

Figure 2. Location of sample stations in the Cogburn Creek-Giant Mascot area.

though sand and silt can be found on scattered channel bars especially where water flow has decreased. Moss is abundant on boulders and logs.

GEOLOGY AND MINERAL DEPOSITS

Bedrock geology has been described previously by Monger (1989), by Ash (2001) and by Pinsent (2001) and will be only briefly outlined in this paper. Proterozic to Paleozoic age metavolcanic and metadiorite (Baird diorite) are the oldest rocks found in the area. These are succeeded by Carboniferous age shale and schist (Cogburn Group), Triassic age arenaceous metasediment (Settler Schist) and by early Cretaceous shale, phyllite, schist and metadiorite (Slollicum Schist). These rocks have been intruded by middle Cretaceous dunite, peridotite, pyroxinite, hornblendite, gabbro and diorite, by middle to late Cretaceous quartz diorite-granodiorite and by Tertiary age granite, tonalite and quartz diorite. Geological structures are parallel east dipping thrust faults, and four other distinct fault systems. Bedrock is covered by surficial sediments in the lower part of valleys. Larger valleys (*e.g.* Cogburn Creek) contain alluvium and a complex of fluvio-glacial silt, sand and gravel. Valley sides are covered by basal till, colluviated till, colluvium and talus.

Among types of mineralization found in the area are copper-nickel sulphides known to be PGE enriched such as the Giant Mascot mine (MINFILE 92HSW 004), Besshi-type copper-zinc massive sulphides (*e.g.* the North Fork occurrence, MINFILE 92HSW 070) and the OX, a copper-gold-silver skarn (MINFILE 92HSW 081). The PGE enriched copper-nickel sulphides are associated with ultramafic (peridotite, olivine pyroxinite, hornblendite, gabbro) intrusive rocks. At the Giant Mascot mine sulphide ore grading 0.77 percent nickel and 0.34 percent copper was found to contain up to 4 ppm platinum-palladium and 8 ppm gold. Ultramafic rocks, similar to those at Giant Mascot, have also been mapped in Cogburn, Settler and Talc watersheds (Pinsent, 2001; Ash, 2001).

SURVEY METHODOLOGY

The survey was carried out to establish the geochemical expression of platinum mineralization in different drainage sample types (*e.g.* moss mat sediment) at an average density of 1 sample per 12 square kilometres. This density is typical of a routine regional stream geochemical survey (RGS) carried out in B.C. Consequently, samples were taken from creeks draining catchments covering 10 - 15 square kilometres and especially from areas where a previous RGS (Jackaman and Matysek, 1989) had detected anomalous nickel and copper levels in the sediment. More detailed stream sampling was conducted near known PGE-bearing sulphide mineralization.

SAMPLE COLLECTION

Stream sediment, moss mat sediment and water samples were collected in August 2001 from tributaries of major creeks including those draining known copper-nickel sulphide mineralization (*e.g.* Giant Mascot Mine, Jason Claims). A total of 23 stream water, 25 stream sediment and 25 moss mat samples (including two field duplicates) were collected from 19 sites in 92H 5 and 12, (Cogburn Creek area), 4 sites in 92H 6 and 11 (Seaton and Stulkawhits Creeks). Locations of the sampling stations are shown in Figure 2. Fifteen bulk sediment samples were also taken at selected stations for preparation of a heavy mineral fraction. These bulk samples were collected in a higher energy stream environment (typically a coarse gravel deposit) by wet-sieving sufficient material through an 18 mesh (<1 millimetre) nylon screen to recover 10 kilograms of <1 millimetre sized sediment. Wet sieving usually required an hour to obtain 10 kilograms of the <1 millimetre fraction and this material was then stored in a heavy-duty plastic bag.

Between 2 to 5 kg of fine-textured sediment, typical of material collected during a regional survey, was taken, generally from the sandy part of a bar in the stream channel, and stored in a high wet strength Kraft paper bag. Live moss (1-2 kg) containing trapped sediment, collected from the surface of boulders or logs in the active stream above the water level, was also stored in Kraft bags. Abundant moss was found at almost all of the stations. Water samples were collected by filling a 125 millilitre high-density polyethylene bottle after previously rinsing the bottle with the stream water.

Where possible the sample stations were chosen upstream from known anthropogenic disturbances such as bridges or culverts or logged areas. During regional sampling where a stream flowed through an obviously disturbed area every effort was made to locate the sample site in an undisturbed riparian zone or where secondary timber growth had stabilized the terrain. Field observations about sample media, sample site, local terrain and float geology were recorded.

SAMPLE PREPARATION

Fine-textured sediment and moss mat sediment samples were prepared in the B.C. Geological Survey Branch Laboratory, Victoria, B.C. The samples were air dried and the - 18 mesh (< 1 mm) recovered by gently disagregating the sediment or by pounding moss mats before dry sieving through a 1 mm stainless steel screen. One half of the 1 mm fraction was then screened to - 80 ASTM mesh (<0.177 mm) and a half screened to - 230 mesh (<0.063mm). Control reference material and analytical duplicate samples were inserted into each analytical block of twenty sediment samples at the Geological Survey Branch Laboratory in Victoria. Any remaining - 80 and -230 mesh sediment was archived for future analyses.

SAMPLE ANALYSIS

The – 80 and –230 mesh stream sediment and moss mat sediment samples with quality control samples were analysed at ACME analytical (Vancouver) for 37 trace and minor elements by a combination of inductively coupled mass spectroscopy (ICP-MS) and inductively coupled plasma emission spectroscopy (ICP-ES) following aqua regia digestion. Platinum, palladium, gold and rhodium in the two fractions of the field survey samples and in the – 80 mesh fraction of archived regional survey samples were also determined at ACME analytical by lead fire assay collection followed by ICP-MS finish. Selected - 80 mesh fraction samples were also analysed for gold and 35 trace elements at ActLabs (Ancaster, Ontario) by instrumental neutron activation analysis (INAA). Table 1 lists detection limits reported for elements determined by the methods described above. Water samples were analysed for pH and sulphate in the Geological Survey Branch laboratory (Victoria). The pH of water samples was measured using a combination glass-reference electrode (GCE) and sulphate was determined by a barium sulphate suspension turbidimetric method (TURB). The detection limit for sulphate is 10 ppm.

TABLE 1
DETECTION LIMITS FOR INSTRUMENTAL NEUTRON ACTIVATION (INAA), INDUCTIVELY COUPLED PLASMA MASS SPECTROSCOPY (ICP-MS), INDUCTIVELY COUPLED PLASMA EMISSION SPECTROSCOPY (ICP-ES) AND FIRE ASSAY- INDUCTIVELY COUPLED PLASMA MASS SPECTROSCOPY FINISH (FA-ICPMS)

Element	Symbol	Method	Detection Limit	Unit
Aluminium	Al	ICP-ES	0.01	%
Antimony	Sb	INAA/ICP-MS	0.1/0.02	ppm
Arsenic	As	INAA/ICP-MS	0.5/0.1	ppm
Barium	Ba	INAA/ICP-MS	50/0.5	ppm
Bismuth	Bi	ICP-MS	0.02	ppm
Bromine	Br	INAA	0.5	ppm
Cadmium	Cd	ICP-MS	0.01	ppm
Calcium	Ca	INAA/ICP-ES	1/0.01	%
Cerium	Ce	INAA	3	ppm
Cesium	Cs	INAA	1	ppm
Chromium	Cr	INAA/ICP-MS	5/0.5	ppm
Cobalt	Co	INAA/ICP-MS	1/0.1	ppm
Copper	Cu	ICP-MS	2/0.01	ppm
Europium	Eu	INAA	0.2	ppm
Gold	Au	INA/ICP-MS	2/0.2	ppb
Hafnium	Hf	INAA	1	ppm
Iron	Fe	INAA/ICP-ES	0.01/0.01	%
Lanthanum	La	INAA	0.5/0.5	ppm
Lead	Pb	ICP-MS	0.01	ppm
Lutetium	Lu	INAA	0.05	ppm
Manganese	Mn	ICP-MS	01-May	ppm
Magnesium	Mg	ICP-ES	0.01	%
Mercury	Hg	ICP-MS	5	ppb
Molybdenum	Mo	ICP-MS	2/0.01	ppm
Neodymium	Nd	INAA	5	ppm
Nickel	Ni	ICP-MS	1/0.1	ppm
Platinum	Pt	FA-ICPMS	0.1	ppb
Paladium	Pd	FA-ICPMS	0.5	ppb
Rubidium	Rb	INAA	15	ppm
Rhodium	Rh	FA-ICPMS	5	ppb
Sulphur	S	FA-ICPMS	0.01	%
Samarium	Sm	INAA	0.5	ppm
Scandium	Sc	INAA	0.1/0.1	ppm
Selenium	Se	INAA	5/0.1	ppm
Silver	Ag	ICP-MS	0.2/0.002	ppm
Sodium	Na	INAA	0.01/0.001	%
Tantalum	Ta	INAA	0.5	ppm
Terbium	Tb	INA	0.5	ppm
Tellurium	Te	ICP-MS	0.02	ppm
Thallium	Tl	ICP-MS	0.02	ppm
Thorium	Th	INAA	0.2	ppm
Tungsten	W	INAA/ICP-MS	1.0/0.2	ppm
Uranium	U	INAA/ICP-MS	0.5/0.1	ppm
Vanadium	V	ICP-MS	2	ppm
Ytterbium	Yb	INAA	0.2	ppm
Zinc	Zn	INAA/ICP-MS	50/0.1	ppm

QUALITY CONTROL

Reliable data interpretation depends on discriminating between real geochemical trends and those variations introduced by sampling and analysis. Control reference standards and analytical duplicates were therefore routinely inserted into the batches of stream sediment and moss sediment samples submitted for commercial analysis to measure the accuracy and precision. The standard National Geochemical Reconnaissance (NGR) and Regional Geochemical Survey (RGS) quality control procedures were used in this project and are based on the analysis of a block of 20 samples. Each block comprises:

- Seventeen routine sediment or water samples,
- One field duplicate sample collected adjacent to one of the routine samples,
- One control reference standard containing known element concentrations.

The location of control reference samples within each batch of samples was selected before sampling, whereas field duplicate sites were chosen randomly during fieldwork. Field duplicate samples were generally collected 2-3 metres apart from the same type of material and stream environment.

THE PRECISION AND ACCURACY OF STREAM AND MOSS SEDIMENT DATA

Element variations in stream and moss sediment can reflect changes in regional geology (bedrock geochemistry, surfical geochemistry, presence of mineralization), within-site variations (combined sampling, analytical and sample preparation variation) or analytical precision alone. Good analytical precision is of little value if the combined sample preparation and collection error is larger than the regional geochemical variation (Fletcher, 1981). Analytical accuracy and precision for gold, platinum and palladium by fire assay and ICP-MS finish was estimated from replicate data for CANMET standard reference material WGB-1 (Bowman, 1994). This standard was included during routine analyses of archived RGS samples and samples collected during the field survey. Results for replicate analyses of this standard are shown in Table 2. Mean values for gold, platinum and palladium in WGB-1 fall within the ranges recommended by CANMET. Platinum precision, expressed as percent relative standard deviation (%RSD), is 16 percent indicating that at 5 ppb the platinum values can be expected to vary between 6.5 and 3.5 ppb in 19 determinations out of 20. Mean and percent relative standard deviation (%RSD) of duplicate analyses of platinum, palladium and other elements in a GSB standard are listed in Table 3. Percent RSD values for most trace elements (*e.g.* Cu, Ni, Co) are less than 6 percent. However, the platinum and palladium precision (%RSD) falls in the 20 to 35 percent range.

A rigorous statistical analysis of duplicate sample data is not feasible because only two field and three analytical duplicates were analysed. Therefore, analytical variation between duplicates is illustrated in Table 4 by the mean and percent difference for selected elements in the - 80 and -230 mesh fractions of two duplicate analytical, stream sediment

TABLE 2
ACCURACY AND PRECISION FOR CANMET STANDARD REFERENCE MATERIAL WGB-1

Sample	Au-ppb	Pt-ppb	Pd-ppb	Rh-ppb
557680	1	5.6	13.8	0.33
953293	4	4.1	10.8	
107060	2	4.8	15.9	0.15
Mean	2	4.8	13.5	0.24
% RSD	65	16.0	19.0	53
CANMET	2.9+/-1.1	6.1+/1.6	13.9+/-2.1	0.32

TABLE 3
ANALYTICAL PRECISION FOR AN INTERNAL GSB STANDARD

Element	Unit	Mean	%RSD
Ag	ppb	51.5	4.1
Al	%	1.6	11.1
As	ppm	5.8	0.0
Au	ppb	16.5	124.3
Au	ppb	2.25	28.3
Ba	ppm	68.75	1.7
Bi	ppm	0.04	0.0
Ca	%	0.86	0.8
Cd	ppm	0.14	10.1
Co	ppm	24.6	0.6
Cr	ppm	75.2	1.1
Cu	ppm	59	1.7
Fe	%	4.51	3.0
Ga	ppm	5.05	4.2
Hg	ppb	31.5	6.7
K	%	0.15	4.9
La	ppm	7.7	5.5
Mg	%	1.38	0.5
Mn	ppm	850	0.3
Mo	ppm	0.5	5.7
Na	%	0.02	4.6
Ni	ppm	39.95	3.0
P	%	0.16	3.4
Pb	ppm	3.68	5.0
Pd	ppb	3.45	34.8
Pt	ppb	12.9	24.1
Rh	ppb	0.13	32.6
S	%	0.03	28.3
Sb	ppm	0.6	5.9
Sc	ppm	4.15	1.7
Se	ppm	0.15	47.1
Sr	ppm	45.95	2.0
Te	ppm	0.02	0.0
Th	ppm	1.05	6.7
Ti	%	0.08	5.9
Tl	ppm	0.04	20.2
U	ppm	0.3	0.0
V	ppm	136	4.2
Zn	ppm	58.25	5.5

and moss sediment samples. The percent difference is given by the expression ABS(X1-X2)/(X1+X2)/2)*100 where X1 and X2 are the first and second analysis of the duplicate sample pair. Large differences (>100%) generally reflect mean concentrations close to detection limit, especially for gold, platinum and palladium. Analytical duplicate sample (ADUP) differences for most elements in the -230 mesh fraction are typically smaller than in the -80 mesh fraction. Similarly, the percent difference for elements is smaller in the -230 mesh fractions of the field duplicate (FDUP) moss mat sediment samples compared to the -80 mesh fraction of the field duplicate stream sediment samples. This pattern could be explained by more uniform distribution of elements in finer grained sediment captured by the moss.

TABLE 4
MEAN AND PERCENT DIFFERENCE FOR ANALYTICAL AND FIELD DUPLICATE SAMPLE DATA

Sample	Type	Ag[2] ppb	Au[2] ppm	Au[1] ppb	Co[2] ppm	Cr[2] ppm	Cu[2] ppm	Fe[2] %	La[2] ppm	Mg[2] %	Ni[2] ppm	Pd[1] ppb	Pt[1] ppb	Rh[1]- ppb
107021 -80	Moss	22	0.7	-1	10.6	55.2	23.55	1.68	3.6	1.03	60.4	-0.5	0.5	0.23
107036 -80	Moss	22	0.5	4	11.0	54.7	23.97	1.70	4.2	1.04	69.7	1.9	0.7	0.09
% Difference	**ADUP**	**0**	**33**	**333**	**4**	**1**	**2**	**1**	**15**	**1**	**14**	**343**	**33**	**88**
107021 -230	Moss	29	1.5	1	13.3	70.2	29.15	1.96	5.4	1.17	74.3	-0.5	1.4	0.09
107036 -230	Moss	25	1.5	68	13.3	67.7	30.15	1.98	5.5	1.17	83.7	2.3	1.3	-0.05
% Difference	**ADUP**	**15**	**0**	**194**	**0**	**4**	**3**	**1**	**2**	**0**	**12**	**311**	**7**	**700**
107034 -80	Sed.	17	1.5	-1	10.2	41.2	23.82	1.55	2.9	0.97	53.4	2.7	0.7	-0.05
107035 -80	Sed.	20	0.4	1	11.1	44.5	25.82	1.65	3.6	0.98	57.9	2.3	1.0	-0.05
% Difference	**FDUP**	**16**	**116**	**0**	**8**	**8**	**8**	**6**	**22**	**1**	**8**	**16**	**35**	**0**
107036 -80	Moss	22	0.5	4	11.0	54.7	23.97	1.70	4.2	1.04	69.7	1.9	0.7	0.09
107037 -80	Moss	19	1.0	2	10.6	52.0	23.53	1.67	3.6	1.03	66.7	1.3	1.1	-0.05
% Difference	**FDUP**	**15**	**67**	**67**	**4**	**5**	**2**	**2**	**15**	**1**	**4**	**38**	**44**	**700**
107036 -230	Moss	25	1.5	68	13.3	67.7	30.15	1.98	5.5	1.17	83.7	2.3	1.3	-0.05
107037 -230	Moss	28	0.8	3	13.0	66.4	30.2	1.96	5.2	1.15	81.0	1.7	1.4	-0.05
% Difference	**FDUP**	**11**	**61**	**183**	**2**	**2**	**0**	**1**	**6**	**2**	**3**	**30**	**7**	**0**
107041 -80	Sed.	31	0.9	-1	7.4	33.5	31.14	0.90	1.9	0.41	31.6	-0.5	0.8	-0.05
107056 -80	Sed.	28	0.7	-1	8.3	35.1	27.17	0.96	2.0	0.44	35.5	0.8	0.9	-0.05
% Difference	**ADUP**	**10**	**25**	**0**	**11**	**5**	**14**	**6**	**5**	**7**	**12**	**867**	**12**	**0**
107041 -230	Sed.	29	0.8	-1	8.9	42.0	31.81	1.01	2.3	0.45	36.3	-0.5	0.6	-0.05
107056 -230	Sed.	34	1.7	-1	9.4	45.2	34.11	1.09	2.6	0.50	36.9	0.8	1.1	-0.05
% Difference	**ADUP**	**16**	**72**	**0**	**5**	**7**	**7**	**8**	**12**	**11**	**2**	**867**	**59**	**0**
107056 -80	Sed.	28	0.7	-1	8.3	35.1	27.17	0.96	2.0	0.44	35.5	0.8	0.9	-0.05
107057 -80	Sed.	29	0.6	-1	8.8	39.3	31.64	1.02	2.3	0.47	36.6	-0.5	0.7	-0.05
% Difference	**FDUP**	**4**	**15**	**0**	**6**	**11**	**15**	**6**	**14**	**7**	**3**	**867**	**25**	**0**
107056 -230	Sed.	34	1.7	-1	9.4	45.2	34.11	1.09	2.6	0.50	36.9	0.8	1.1	-0.05
107057 -230	Sed.	36	1.0	-1	10.6	49.8	35.3	1.18	2.7	0.54	40.6	0.7	1.0	-0.05
% Difference	**FDUP**	**6**	**52**	**0**	**12**	**10**	**3**	**8**	**4**	**8**	**10**	**13**	**10**	**0**
107058 -80	Moss	24	0.2	2	7.7	34.5	34.97	1.08	2.4	0.47	36.2	0.7	0.9	-0.05
107059 -80	Moss	22	0.7	-1	8.1	34.9	30.71	1.11	2.6	0.49	39.6	-0.5	0.8	0.13
% Difference	**FDUP**	**9**	**111**	**600**	**5**	**1**	**13**	**3**	**8**	**4**	**9**	**1200**	**12**	**450**
107058 -230	Moss	29	0.6	-1	9.3	41.6	31.41	1.18	3.3	0.52	39.7	-0.5	0.9	-0.05
107059 -230	Moss	28	1.1	-1	9.1	42.7	32.38	1.16	3.3	0.51	40.2	-0.5	0.8	0.16
% Difference	**FDUP**	**4**	**59**	**0**	**2**	**3**	**3**	**2**	**0**	**2**	**1**	**0**	**12**	**382**

Elements identified with [1] by fire assay and ICP-MS finish; elements identified with [2] by aqua regia digestion and ICP-MS finish

COGBURN CREEK-GIANT MASCOT MINE ORIENTATION SURVEY - RESULTS

An examination of element data reveals that elevated platinum, palladium, copper, nickel, gold and lanthanum values occur together in stream and moss mat sediments. Element values and statistics (median, maximum value, 95 percentile) for the –80 and –230 mesh fractions of moss and stream sediment samples are listed in Tables 5 and 6. Plots showing elements in the two size fractions of the stream and moss sediment at percentiles from 25 to 98 are shown in Figure 3. These plots reveal that the relative concentration of elements in samples generally follows the order: moss -230 mesh> moss -80 mesh> sediment -230 mesh > sediment > 80 mesh. However, the difference between 95 percentile platinum and palladium levels in the -80 mesh fraction of moss sediment compared to the - 230 mesh is small (< 10 ppb). The highest platinum (95.8 ppb) detected by the survey actually occurs in the - 80 mesh fraction of the sediment from a small, steep, slow flowing stream (station 6) on the Jason claims. A chalcopyrite occurrence has been identified close to this creek during previous geological mapping and geochemical surveys on these claims (Haughton, 2001). The -230 mesh of the moss sediment from this site has lower platinum (76 ppb), but the highest palladium (18.6 ppb) found in the survey. This sediment also has up to 345 ppm nickel and 229 ppm copper. The -230 mesh fraction of moss sediment from Stulkawhits Creek downstream from the Giant Mascot mine (station 22) contains the second highest platinum (89.2 ppb) and palladium (10 ppb). Lower levels (68 ppb Pt) occur in the -80 mesh of the stream sediment. Copper and nickel show a reverse trend and are highest in the - 80 mesh of the moss sediment. Weakly anomalous (> 5 ppb) platinum levels are present in the - 230 mesh fraction of moss sediment from Emory Creek. The highest gold detected during the survey (2491 ppb) also occurs in Emory Creek in the -80 mesh fraction of the moss at station 21. Distribution of platinum in the -230 mesh of the moss sediment is shown in Figure 4.

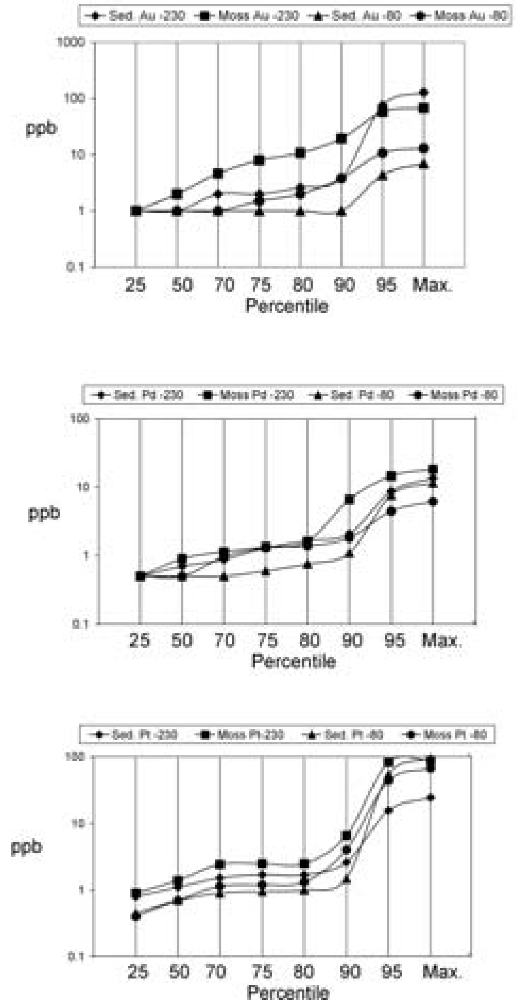

Figure 3. Percentile plots for gold, palladium, platinum and gold in -80 and -230 mesh fractions of stream and moss sediments.

ARCHIVED RGS STREAM SEDIMENT SAMPLES - RESULTS

WREDE CHROMITE NTS 94D/09

Sixteen RGS archive samples (- 80 mesh fraction) from streams draining the Wrede Creek Chromite occurrence (MINFILE 094D 026) were analysed for platinum, palladium and gold by lead fire assay collection followed by ICP-MS finish and for 35 trace elements including chromium, copper, cobalt, nickel and vanadium by ICP-ES following hydrofluoric-perchloric-nitric-hydrochloric acid digestion. The Wrede Creek chromite occurrence (Figure 1) is hosted in a Late Triassic Alaskan-type ultramafic body intruded into middle Triassic to lower Jurassic Takla Group volcanics of the Quesnel Terrane. Mineralization consists of rare chromite grains and blebs within the dunite core of the ultramafic body (Nixon and Hammack, 1991).

Archived sediment samples from two creeks draining the occurrence have more than 11 ppb platinum (Figure 5), up to 2000 ppm chromium and 700 ppm nickel. These results are also compared to instrumental neutron activation (INAA) and aqua regia-AAS RGS survey data (Jackaman, 1997). The presence of chromite in the sediment is indicated by the high INAA chromium compared to lower hydrofluoric-perchloric-nitric-hydrochloric acid digestion-ICP-ES values (Table 7). Nickel levels in samples by the two methods are similar and most likely reflect nickel in olivine weathered from the dunite core of the ultramafic body.

TURNAGAIN RIVER COMPLEX NTS 104I/07

Fifty five RGS archive samples (- 80 mesh fraction) from around the Turnagain River complex were also analysed for platinum, palladium and gold by lead fire assay collection followed by ICP-MS finish. The samples are from a stream draining the Turn nickel occurrence and from a belt of Cache Creek rocks to the south.

TABLE 5
STREAM SEDIMENT AND MOSS MAT SEDIMENT STATISTICS FOR THE - 80 MESH FRACTION

Sample	Stn.	Type	Ag[2]	Au[1]	Au[2]	Cr[2]	Cu[2]	Fe[2]	La[2]	Mg[2]	Ni[2]	Pd[1]	Pt[1]	Rh[1]
			ppb	ppb	ppb	ppm	ppm	%	ppm	%	ppm	ppb	ppb	ppb
107022 -80	1	Sed.	43	-1	1.2	160.5	47.37	2.84	1.5	3.75	291.0	0.7	1.0	-0.05
107023 -80	1	Moss	34	2	0.8	180.3	43.49	3.14	1.7	3.53	297.3	1.5	4.4	0.15
107024 -80	2	Sed.	31	-1	5.8	59.1	82.77	1.62	1.6	0.71	66.2	-0.5	0.7	-0.05
107025 -80	2	Moss	27	1	5.6	59.3	72.82	1.71	1.6	0.67	64.3	-0.5	0.7	-0.05
107026 -80	3	Sed.	20	1	1.8	140.4	146.64	2.23	1.6	1.96	160.5	-0.5	1.5	-0.05
107027 -80	3	Moss	28	1	1.7	146.1	174.11	2.25	2.0	1.80	176.8	0.8	2.6	-0.05
107028 -80	4	Sed.	21	-1	0.9	66.3	55.78	1.83	2.0	1.52	106.0	-0.5	0.8	-0.05
107029 -80	4	Moss	15	-1	1.3	87.6	50.18	2.22	1.9	1.83	122.8	0.6	1.2	-0.05
107030 -80	5	Sed.	37	1	1.9	80.6	56.65	2.21	3.3	1.47	115.2	-0.5	1.4	0.15
107031 -80	5	Moss	42	-1	0.7	88.4	59.31	2.15	4.2	1.36	104.9	-0.5	1.4	-0.05
107032 -80	6	Sed.	84	7	5.1	125.9	188.63	2.08	2.0	1.50	261.9	11.6	95.8	0.17
107033 -80	6	Moss	84	3	21.0	134.8	192.52	2.36	2.5	1.60	294.0	6.2	13.3	0.40
107034 -80	7	Sed.	17	-1	1.5	41.2	23.82	1.55	2.9	0.97	53.4	2.7	0.7	-0.05
107036 -80	7	Moss	22	4	0.5	54.7	23.97	1.70	4.2	1.04	69.7	1.9	0.7	0.09
107039 -80	8	Sed.	22	-1	1.1	39.8	16.94	1.91	3.9	0.82	19.1	-0.5	0.3	-0.05
107040 -80	8	Moss	22	-1	0.6	32.6	13.86	1.78	5.5	0.63	16.8	-0.5	0.3	0.09
107042 -80	9	Sed.	18	-1	0.6	34.7	15.98	1.93	4.0	0.66	16.9	-0.5	0.2	-0.05
107043 -80	9	Moss	18	1	0.7	26.6	14.64	1.89	6.0	0.48	13.3	-0.5	0.2	-0.05
107044 -80	10	Sed.	24	-1	0.3	49.9	24.71	1.99	4.5	0.85	23.3	-0.5	0.6	-0.05
107045 -80	10	Moss	31	-1	0.3	41.8	20.91	1.67	3.7	0.68	19.4	-0.5	0.3	-0.05
107046 -80	11	Sed.	9	-1	-0.2	44.8	17.14	1.31	3.8	0.61	34.5	-0.5	0.7	-0.05
107047 -80	11	Moss	23	-1	0.7	65.5	23.43	1.72	4.3	0.79	49.1	-0.5	0.6	-0.05
107048 -80	12	Sed.	34	-1	0.4	86.9	37.15	2.32	4.3	1.90	155.1	0.5	0.6	-0.05
107049 -80	12	Moss	28	-1	0.5	84.6	31.64	2.07	4.1	1.77	143.6	1.4	1.2	0.20
107050 -80	13	Sed.	30	-1	0.6	52.6	29.76	1.92	4.9	0.89	28.4	-0.5	0.4	0.35
107051 -80	13	Moss	19	-1	0.5	38.9	21.72	1.54	4.8	0.66	20.6	-0.5	0.4	0.06
107052 -80	14	Sed.	36	-1	0.9	47.7	28.46	1.82	2.1	0.88	31.1	-0.5	0.4	-0.05
107053 -80	14	Moss	40	-1	0.6	43.8	28.01	1.66	2.3	0.74	30.1	-0.5	0.4	-0.05
107054 -80	15	Sed.	23	-1	0.7	38.7	24.81	1.44	3.6	0.73	40.7	-0.5	0.4	-0.05
107055 -80	15	Moss	19	-1	1.0	43.0	20.92	1.36	3.4	0.60	38.0	-0.5	0.3	-0.05
107056 -80	16	Sed.	28	-1	0.7	35.1	27.17	0.96	2.0	0.44	35.5	0.8	0.9	-0.05
107058 -80	16	Moss	24	2	0.2	34.5	34.97	1.08	2.4	0.47	36.2	0.7	0.9	-0.05
107062 -80	17	Sed.	75	1	1.1	82.4	22.21	2.34	2.8	2.26	190.2	-0.5	0.9	0.17
107063 -80	17	Moss	43	8	1.7	90.5	22.53	2.88	3.1	2.39	203.9	-0.5	0.9	0.13
107064 -80	18	Sed.	25	-1	0.7	59.7	63.10	2.10	2.7	1.36	75.9	1.1	1.0	-0.05
107065 -80	18	Moss	25	-1	0.9	65.5	67.83	2.22	2.9	1.21	66.7	1.4	1.0	-0.05
107066 -80	19	Sed.	28	-1	0.6	37.4	29.65	1.58	4.1	1.53	79.4	-0.5	0.8	-0.05
107067 -80	19	Moss	24	-1	0.8	42.1	28.13	1.56	4.9	1.54	77.6	-0.5	0.3	0.50
107068 -80	20	Sed.	36	1	0.9	123.2	143.09	3.38	2.6	5.31	396.4	1.1	1.5	0.40
107069 -80	20	Moss	30	13	1.4	97.8	101.52	3.09	3.9	4.68	324.6	1.2	1.1	-0.05
107070 -80	21	Sed.	22	-1	0.4	37.3	30.82	1.55	3.2	2.02	101.5	-0.5	0.5	0.30
107071 -80	21	Moss	936	-1	2491.7	46.0	31.76	1.71	4.2	1.98	102.0	-0.5	0.6	0.31
107072 -80	22	Sed.	31	-1	0.2	33.7	41.70	1.32	5.2	0.63	83.1	-0.5	0.4	-0.05
107073 -80	22	Moss	55	-1	1.7	39.2	100.58	1.63	5.8	0.79	188.8	2.3	68.1	-0.05
107074 -80	23	Sed.	33	-1	1.3	45.0	23.93	1.89	4.8	0.75	31.5	-0.5	0.8	-0.05
107075 -80	23	Moss	28	-1	0.8	45.8	23.40	1.78	4.4	0.71	35.0	-0.5	0.4	0.06
Median			28	-1	0.8	51.3	30.29	1.86	3.5	1.01	72.8	-0.5	0.7	-0.05
Maximum			936	13	2491.7	180.3	192.52	3.38	6.0	5.31	396.4	11.6	95.8	0.50
90%ile			49	2.5	3.5	130.4	122.31	2.60	4.9	2.33	276.5	1.7	2.1	0.31
95%ile			82	6	5.8	144.7	167.24	3.04	5.4	3.70	296.5	3.0	11.0	0.39

[1] tire assay - ICP-MS finish [2] aqua regia digestion - ICP-MS

TABLE 6
STREAM SEDIMENT AND MOSS MAT SEDIMENT STATISTICS FOR THE - 230 MESH FRACTION

Sample	Stn.	Type	Ag[2]	Au[2]	Au[1]	Cr[2]	Cu[2]	Fe[2]	La[2]	Mg[2]	Ni[2]	Pd[1]	Pt[1]	Rh[1]
			ppb	ppb	ppb	ppm	ppm	%	ppm	%	ppm	ppb	ppb	ppb
107022 -230	1	Sed.	59	1.2	128	125.5	56.94	2.72	1.6	2.86	244.3	1.0	1.4	-0.05
107023 -230	1	Moss	44	1106.5	2	166.7	46.26	2.67	1.8	3.55	307.4	1.5	2.5	0.20
107024 -230	2	Sed.	69	6.8	3	77.6	121.89	2.44	2.6	0.89	105.7	0.8	1.1	-0.05
107025 -230	2	Moss	40	3.1	2	73.5	105.75	2.26	2.5	0.79	81.9	0.8	1.2	-0.05
107026 -230	3	Sed.	44	2.2	2	214.2	223.76	3.14	2.6	2.34	235.2	1.7	2.8	-0.05
107027 -230	3	Moss	45	2.0	3	205.8	244.54	2.96	3.0	2.05	248.5	1.1	2.0	-0.05
107028 -230	4	Sed.	29	1.3	2	86.8	71.45	2.22	3.2	1.51	132.3	0.8	1.2	0.13
107029 -230	4	Moss	23	1.0	2	110.4	65.37	2.46	3.2	1.78	144.6	1.1	2.3	0.11
107030 -230	5	Sed.	59	0.9	2	97.4	65.92	2.55	4.3	1.58	138.3	0.5	1.7	0.16
107031 -230	5	Moss	57	1.1	2	102.6	72.78	2.46	5.6	1.42	118.8	0.7	2.5	-0.05
107032 -230	6	Sed.	75	23.7	9	164.5	222.01	2.71	3.5	1.67	310.7	13.6	24.5	0.29
107033 -230	6	Moss	75	7.2	12	181.1	229.13	2.83	3.9	1.68	345.4	18.3	76.0	0.91
107035 -230	7	Sed.	34	2.1	-1	62.1	34.72	2.13	5.1	1.19	74.8	3.7	1.0	0.18
107036 -230	7	Moss	25	1.5	68	67.7	30.15	1.98	5.5	1.17	83.7	2.3	1.3	-0.05
107039 -230	8	Sed.	56	0.9	-1	40.1	26.01	2.08	7.5	0.73	22.6	-0.5	0.5	-0.05
107040 -230	8	Moss	56	3.1	-1	38.7	24.12	2.15	7.9	0.69	21.9	1.7	0.6	-0.05
107042 -230	9	Sed.	59	3.6	-1	40.1	25.16	2.16	7.2	0.71	22.7	2.2	-0.1	-0.05
107043 -230	9	Moss	32	0.7	-1	33.5	20.68	2.04	7.7	0.57	18.3	0.9	-0.1	-0.05
107044 -230	10	Sed.	38	0.7	-1	59.9	32.70	2.23	4.9	0.95	27.3	-0.5	0.8	-0.05
107045 -230	10	Moss	26	0.7	-1	52.5	28.18	2.04	4.9	0.84	24.2	0.6	0.6	0.24
107046 -230	11	Sed.	26	1.0	1	96.7	35.83	2.68	6.2	1.21	65.4	1.6	1.7	-0.05
107047 -230	11	Moss	36	0.7	7	81.1	29.68	1.95	5.8	0.89	59.4	1.2	1.4	0.13
107048 -230	12	Sed.	53	1.2	-1	107.6	46.99	2.80	5.6	1.98	167.7	1.7	1.7	0.47
107049 -230	12	Moss	39	0.9	-1	99.4	37.90	2.34	5.4	1.82	158.6	0.9	1.3	0.06
107050 -230	13	Sed.	35	0.4	-1	59.6	35.27	2.11	6.6	0.95	32.2	-0.5	0.5	0.19
107051 -230	13	Moss	29	0.6	-1	48.0	27.79	1.80	6.8	0.77	26.1	-0.5	0.4	0.06
107052 -230	14	Sed.	90	1.0	-1	57.0	46.85	2.23	4.2	0.93	42.8	-0.5	0.2	-0.05
107053 -230	14	Moss	88	1.1	-1	46.6	40.50	1.94	4.2	0.74	37.0	-0.5	0.4	-0.05
107054 -230	15	Sed.	33	1.5	-1	41.9	28.40	1.55	5.4	0.75	42.7	-0.5	0.9	-0.05
107055 -230	15	Moss	25	1.2	2	54.6	27.09	1.68	6.1	0.73	45.9	7.7	2.5	-0.05
107056 -230	16	Sed.	34	1.7	-1	45.2	34.11	1.09	2.6	0.50	36.9	0.8	1.1	-0.05
107058 -230	16	Moss	29	0.6	-1	41.6	31.41	1.18	3.3	0.52	39.7	-0.5	0.9	-0.05
107059 -230	16	Moss	28	1.1	-1	42.7	32.38	1.16	3.3	0.51	40.2	-0.5	0.8	0.16
107062 -230	17	Sed.	73	1.5	4	96.6	29.87	2.77	4.1	2.32	217.4	-0.5	0.9	0.20
107063 -230	17	Moss	54	1.8	21	95.9	28.37	2.77	3.9	2.23	206.3	-0.5	1.8	0.20
107064 -230	18	Sed.	24	0.8	-1	58.5	68.03	2.14	2.9	1.21	65.9	0.7	0.9	-0.05
107065 -230	18	Moss	26	1.6	-1	65.1	72.79	2.35	3.2	1.22	65.1	1.1	1.3	0.09
107066 -230	19	Sed.	57	1.0	-1	46.5	37.83	1.72	5.2	1.02	76.8	0.6	0.8	0.11
107067 -230	19	Moss	30	0.5	45	46.6	31.74	1.50	7.5	0.97	64.4	-0.5	7.2	0.11
107068 -230	20	Sed.	59	1.5	-1	133.4	175.01	3.48	4.9	3.70	419.2	0.8	1.9	0.38
107069 -230	20	Moss	41	2.0	9	111.7	136.59	3.14	6.8	3.50	348.1	1.1	4.2	0.13
107070 -230	21	Sed.	40	0.4	-1	49.7	39.84	1.69	5.1	1.37	95.5	-0.5	4.4	-0.05
107071 -230	21	Moss	42	1.4	-1	56.7	41.35	1.80	6.7	1.37	94.5	-0.5	2.4	0.15
107072 -230	22	Sed.	34	1.0	-1	35.3	46.27	1.45	7.0	0.57	87.5	0.6	1.3	-0.05
107073 -230	22	Moss	41	3.7	13	43.5	84.96	1.70	8.8	0.66	132.0	10.0	89.2	2.02
107074 -230	23	Sed.	43	1.0	3	52.3	30.72	2.19	5.7	0.86	36.3	-0.5	0.8	-0.05
107075 -230	23	Moss	46	1.9	-1	52.7	31.20	2.06	5.7	0.83	41.8	-0.5	0.9	-0.05
Median			41	1.2	-1	59.9	37.90	2.16	5.1	1.02	76.8	0.8	1.3	-0.05
Maximum			90	1106.5	128	214.2	244.54	3.48	8.8	3.70	419.2	18.3	89.2	2.02
90%ile			71	3.6	12.4	145.8	152.00	2.80	7.3	2.30	272.1	2.9	4.3	0.30
95%ile			75	7.1	38	176.8	223.20	3.10	7.6	3.31	335.0	9.3	19.3	0.44

[1] tire assay - ICP-MS finish [2] aqua regia digestion - ICP-MS

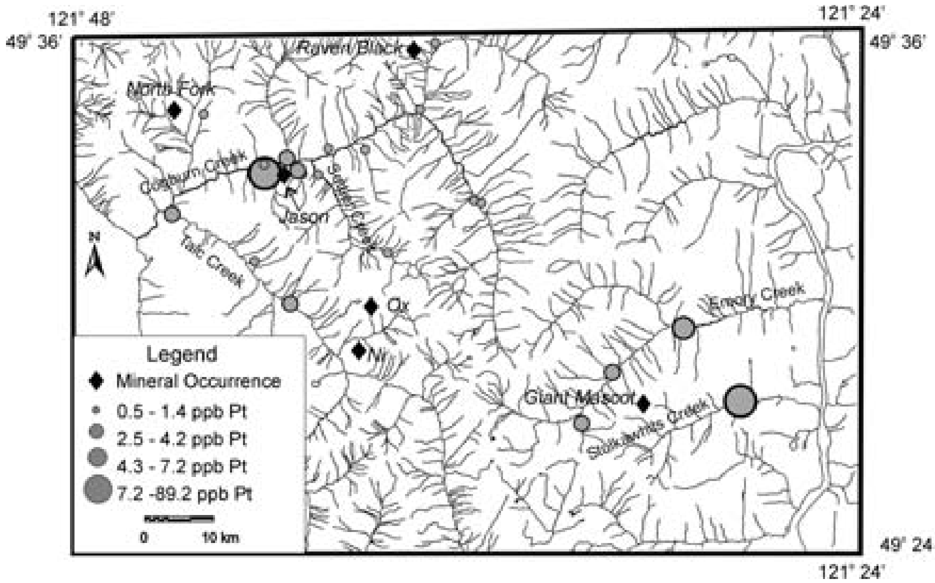

Figure 4. Platinum in -230 mesh fraction of moss sediment in the Cogburn Creek-Giant Mascot mine area.

The Turn (Discovery) (MINFILE 104I 014) prospect is hosted in an Alaskan-type ultramafic intrusive complex consisting of a dunite core enclosed in peridotite, pyroxene-rich peridotite, and olivine pyroxenite. The peripheral ultramafic rocks contain disseminated pyrrhotite, pentlandite, chalcopyrite and bornite with chromite, ilmenite and magnetite. The complex is intruded in the Late Triassic into upper Paleozoic and/or Triassic metavolcanic and metasedimentary rocks (Nixon and Hammack, 1991).

The area south of the Turnagain River is underlain by Cache Creek terrane argillites, chert arenites, limestones and greenstones. Several ultramafic-related mineral deposits, including Letain asbestos (MINFILE 104I 006), occur in Late Mississippian to Permian serpentinized peridotite, dunite, and diorite. No PGE occurrence has been found associated with these ultramafic rocks although chromite showings are common in the Cache Creek Terrane. Possible volcanic massive sulphide (VMS) mineralization, east of the Turnagain River, is represented by the Bow galena-sphalerite occurrence (MINFILE 104I 078). This occurs in lower Ordovician to Devono-Mississippian siliceous mudstone of the Road River Group.

An archive sediment sample (104I953313) from Turnagain creek close to the Turn occurrence has 8.2 ppb platinum (Figure 6), 7.3 ppb palladium and 269 ppm nickel. Another sample (104I953308) from a creek to the west of the Turn has 11.7 ppb palladium. Other creeks within the belt of ultramafic rock in the Cache Creek assemblage to the south also have elevated platinum and palladium in the sedi-

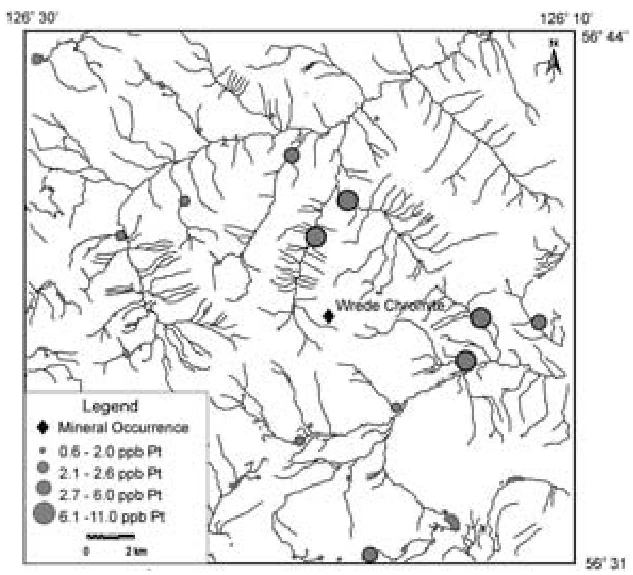

Figure 5. Platinum in RGS samples, Wrede chromite deposit area.

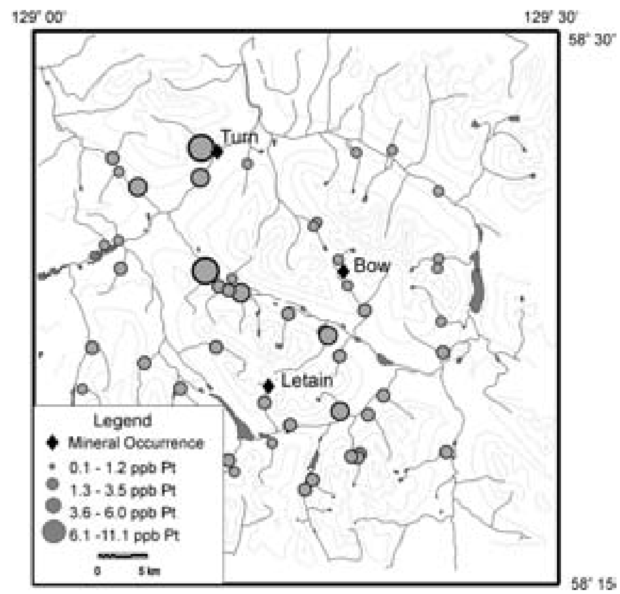

Figure 6. Platinum in RGS samples, Turnagain River area.

TABLE 7
GEOCHEMISTRY OF RGS SAMPLES FROM THE WREDE CHROMITE DEPOSIT AREA

	1311	1314	1337	1338	1339	1342	1343	3373	3374	3375	3376	3378	3382	3383	3384	3385
As-AA	4.7	10.0	9.5	2.7	4.3	7.9	1.0	5.0	16.0	3.2	2.6	7.5	5.2	10.0	11.0	2.2
As-HF	9	8	11	-5	-5	9	-5	-5	14	5	-5	-5	5	13	12	-5
As-NA	4.9	12.0	12.0	4.3	5.7	8.9	0.5	5.4	13.0	4.3	4.2	9.2	4.7	8.9	14.0	3.3
Au-MS	5	7	1	3	2	5	2	1	4	2	7	10	6	12	8	13
Au-NA	16	25	42	46	41	14	11	2	2	38	2	36	9	12	21	17
Ba-HF	367	546	342	246	223	381	235	177	940	694	392	421	258	450	437	579
Ba-NA	370	420	370	270	300	470	370	330	1300	740	390	460	320	500	380	550
Co-AA	20	21	26	46	38	23	16	55	17	7	11	17	55	23	24	9
Co-HF	29	24	32	60	56	31	42	75	21	19	17	23	71	33	33	18
Co-NA	21	18	29	50	46	24	44	56	18	19	15	20	56	24	37	15
Cr-AA	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Cr-HF	185	103	526	937	643	169	183	810	169	348	106	151	680	158	157	131
Cr-NA	170	110	1200	2300	1300	160	220	2000	160	340	100	130	1500	140	220	100
Cu-AA	73	66	47	76	103	94	116	40	36	42	49	80	153	140	142	77
Cu-HF	78	73	43	77	107	94	127	42	44	45	60	95	166	153	149	91
Fe-AA	2.30	3.50	3.40	3.50	3.40	3.20	1.60	4.10	3.20	1.70	3.70	2.40	4.50	3.50	3.70	2.00
Fe-HF	5.5	5.11	4.78	6.3	6.88	5.79	6.18	5.36	4.77	8.45	5.33	5.14	6.56	6.48	6.56	5.61
Fe-NA	5.06	4.78	4.88	6.42	6.84	5.69	8.49	5.45	4.86	9.19	5.35	4.90	6.66	5.82	8.66	5.10
La-HF	-2	-2	27	-2	-2	-2	-2	8	44	27	12	17	-2	2	-2	17
La-NA	7.7	9.7	43.0	12.0	6.8	9.0	8.2	22.0	60.0	23.0	9.2	11.0	5.9	11.0	16.0	14.0
LOI	5.2	8.4	9.7	5.7	3.2	6.5	1.9	4.9	20.2	6.8	17.2	6.8	6.1	4.1	4.3	4.8
Mg-HF	3.1	2.32	4.92	11	9.02	2.81	5.52	14.68	1.27	2.27	1.73	2.64	10.58	2.93	2.94	2.28
Mn-AA	361	736	479	430	499	615	178	529	336	225	341	433	755	473	490	178
Mn-HF	1140	1211	828	1085	1357	1319	1320	951	527	1056	865	1122	1441	1231	1246	1020
Ni-AA	33	25	213	430	245	27	37	660	41	21	16	27	425	32	33	15
Ni-HF	51	30	220	461	288	44	89	705	57	58	25	43	479	50	47	34
Ni-NA	20	20	190	400	260	86	20	540	20	120	20	20	290	20	20	20
Pd-MS	2.5	2.5	1.1	2.7	4.2	2.7	4.3	1.3	0.6	1.9	1.6	3.0	4.0	3.8	5.7	2.9
Pt-MS	2.3	1.8	4.8	9.9	11.3	2.6	4.4	11.4	0.6	2.0	2.1	2.2	6.1	3.4	3.8	1.6
V-AA	65	97	17	31	55	62	64	22	14	53	106	61	77	98	102	59
V-HF	264	221	117	182	275	253	289	88	118	348	244	220	206	298	305	236
Y-HF	17	18	14	10	12	18	15	7	7	19	11	16	10	15	15	16
Zr-HF	24	24	48	22	19	19	29	28	65	16	15	19	16	21	21	18

ment. These include sample 104I953294 with 13.7 ppb palladium and 104I953297 with 11.1 ppb platinum.

CONCLUSIONS

The -230 mesh fraction of moss sediment from Stulkawhits Creek downstream from the Giant Mascot nickel-copper sulphide mine contains 89.2 ppb platinum and 10 ppb palladium. In general, platinum and palladium appear to be concentrated in the -230 mesh fraction of moss sediment. However, high platinum values (up to 96 ppb) can also occur in the - 80 mesh fraction of stream sediments. A lead fire assay-inductively coupled plasma mass spectroscopy (ICP-MS) technique allows low (6-10 ppb) platinum and palladium levels to be confidently detected in stream and moss sediments.

Re-analysis of RGS archive samples for platinum and palladium by this method has identified anomalies related to known Alaskan-type ultramafic intrusives and also in areas where no platinum mineralization has been reported.

Only copper and nickel appear to be associated with platinum and palladium in drainage and moss sediment from streams draining sulphide mineralization. Because there are few pathfinders future exploration for new PGE-rich sulphide deposits should integrate existing geological, geophysical data to define target areas for geochemical surveys.

COMPLETION OF THE SAMPLE ANALYSIS

Only data for platinum and palladium and elements determined by aqua regia ICP-MS or hydrofluoric-perchloric-nitric-hydrochloric acid digestion ICP-ES are reported in this paper. The results of INAA and heavy mineral concentrate analysis will be presented in a later publication.

REFERENCES

Ash, C. (2001): Geological of the Cogburn-Settler Creek area, 92H/07; in Fieldwork 2001; *B.C. Ministry of Energy and Mines; Paper 2002-1.*

Cook, S.J. and Fletcher, W.K. (1993): Distribution and behavior of platinum in soils, sediments and waters of the Tulameen ultramafic complex, southern British Columbia, Canada; *Journal of Geochemical Exploration*, Vol. 46, pages 279-308.

Cook, S.J. (1991): Distribution and behavior of platinum in soils of the Tulameen ultramafic complex, southern British Columbia: Applications to Geochemical Exploration for Chromitite-associated platinum deposits. Unpublished M.Sc. Thesis, *The University of British Columbia*, 1991.

Bowman, W.S. (1994): Certified reference materials, Canadian Certified Reference Materials Project (CCRMP); CCRMP publication 94-1E.

Cawthorn, R.G. (2001): A stream sediment geochemical re-investigation of the discovery of the platiniferous Merensky Reef, Bushveld Complex; *Journal of Geochemical Exploration*, Volume 72, pages 59-69.

Dunn, C.E., Hall, G.E.M and G. Nixon (2000): Orientation study of surface geochemical methods to assist in the exploration of platinum group metals in the Whiterocks Mountains Alkalic complex, near Kelowna, British Columbia (82L/4); *in* Geological Fieldwork 2000, *B.C. Ministry of Energy and Mines*, Paper 2001-1, pages 223-229.

Fletcher, W.K. (1989): Preliminary investigation of platinum content of soils and sediments, southern British Columbia (82E/9, 92H/7. 10, 92I14); *in* Geological Fieldwork, 1988; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1989-1, pages 607-610.

Fletcher, W.K. (1981): Analytical Methods in Geochemical Prospecting; Handbook of Exploration Geochemistry, Volume 1, Govett, G.V.S., Editor, *Elsevier*, 255 pages.

Haughton, D.R. (2001): Geological, geochemical and geophysical assessment report on the Jason Claim Group, NTS 92H/12; *B.C. Ministry of Energy and Mines*, Assessment Report 26519.

Jackaman, W. and Matysek, P.F. (1989): British Columbia Regional Geochemical Survey, NTS 92H - Hope. BC RGS 39/GSC 2665.

Jackaman, W. (1997): British Columbia Regional Geochemical Survey, NTS 94D -McConnell Creek. BC RGS 45.

Monger, J.W.H (1989): Geology of the Hope area, B.C., *Geological Survey of Canada*; Map 41-1989.

Nixon, G.T. and J.L.Hammack (1991): Metallogeny of ultramafic-mafic rocks in British Columbia with emphasis on the platinum-group elements; in Ore Deposits, tectonics and Metallogeny in the Canadian Cordillera, W.J.McMillan, Editor; *Ministry of Energy, Mines and Petroleum Resources*, Paper 1991-4, pages 125-161.

Pinsent, R. (2001): Ni-Cu-PGE potential of the Giant Mascot-Cogburn ultramafic-mafic bodies, Harrison-Hope area, SW British Columbia, 92H; in Fieldwork 2001; *B.C. Ministry of Energy and Mines, Paper 2002-1.*