REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL DATA

GOLDEN, BRAZEAU LAKE, CANOE RIVER AND MOUNT ROBSON, SOUTHEASTERN BRITISH COLUMBIA
(NTS 82N, 83C, 83D and 83E)

Geoscience BC Contribution Number GBC018

Geoscience BC
Report 2006-5

Ministry of Energy, Mines
and Petroleum Resources
Mining and Minerals Division
GeoFile 2006-12

July 2006

REGIONAL STREAM SEDIMENT AND WATER GEOCHEMICAL DATA

GOLDEN, BRAZEAU LAKE, CANOE RIVER AND MOUNT ROBSON,
SOUTHEASTERN BRITISH COLUMBIA
(NTS 82N, 83C, 83D and 83E)

Table of Contents

1.0 INTRODUCTION

This report summarizes the results of the 2005 regional geochemical survey (“RGS”) conducted by CME Managing Consultants Inc. (“CME”) in southeastern British Columbia, Canada at the request of Geoscience BC.

The 2005 RGS program was carried out between August 26 and October 25, 2005. Samples were collected from a total of 1,409 sites from a survey area of approximately 21,560 square kilometers.

Included within this report are sample collection, preparation and analysis protocols, presentation of results in digital and hardcopy format.

2.0 SURVEY AREA

The area surveyed covers southeastern British Columbia from 51° to 53° north latitude and 116° to 120° west longitude (Figure 1). Sampling was not undertaken in National or Provincial Parks.

The stream sediment and water survey was undertaken within map sheets 82N (Golden), 83C (Brazeau Lake), 83D (Canoe River) and 83E (Mount Robson). Base camps were established in Valemount, Golden, Mica Creek, Blue River and Revelstoke. The sample preparation laboratory was established in Valemount for the entire survey.

3.0 REGIONAL SETTING

3.1 PHYSIOGRAPHY

From east to west, the study area consists of the Rocky Mountains, the Rocky Mountain Trench, Columbia Mountains and the Quesnel and Shuswap Highlands (Holland, 1976). The Quesnel and Shuswap Highlands make up a small portion of the study area as they occur in the southwestern corner of map sheet 83D. The Columbia Mountains, from north to south consist of the Cariboo, Monashee, Selkirk and Purcell Mountains.

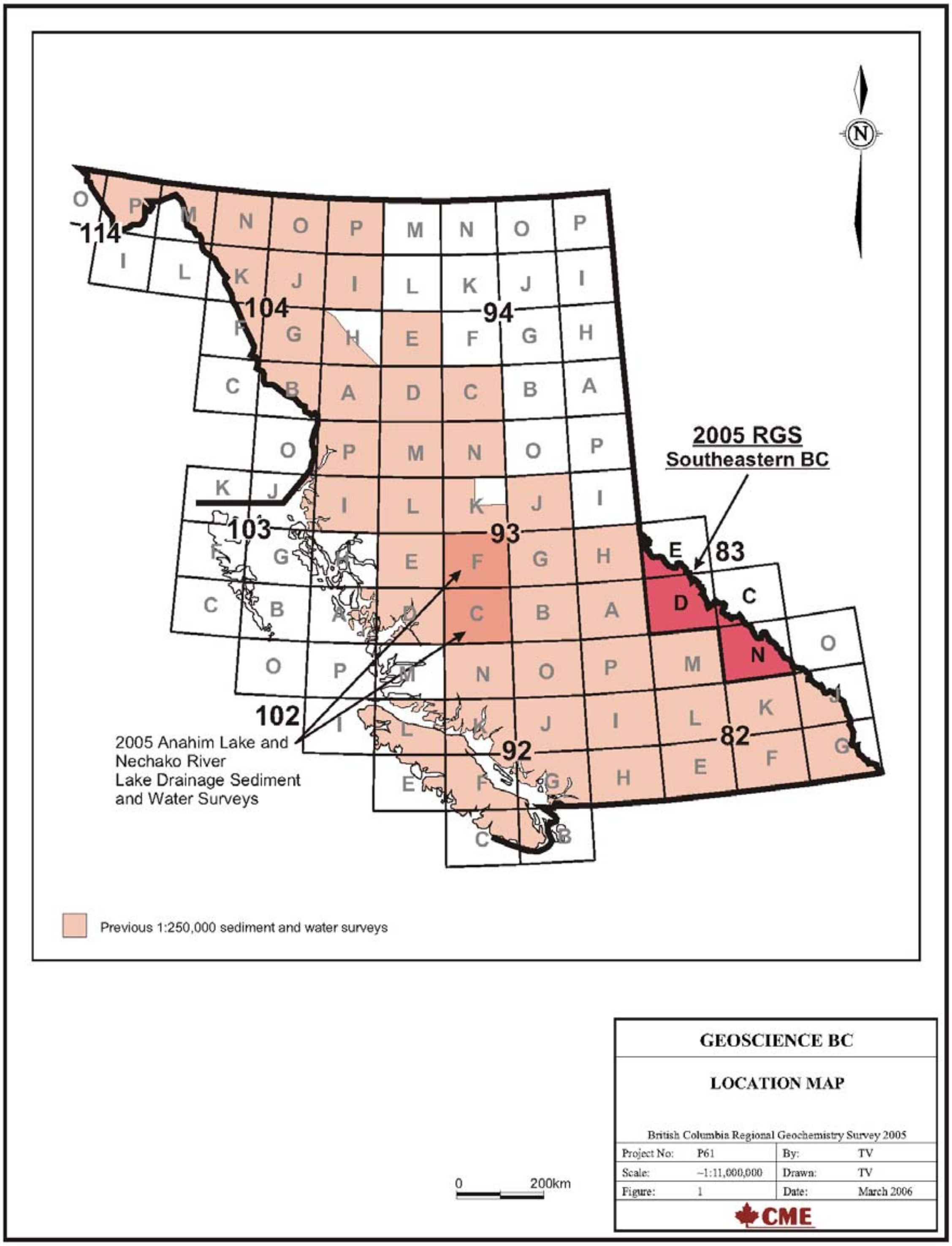
Both the Rocky and Columbia Mountains are glaciated and consist of extremely rugged terrain. Massive and bold sharp peaks are separated by deep and narrow valleys. Peaks and ridges are predominantly exposed bedrock and typically range between 2,500 to 3,000 metres in elevation. The steeply sloping valley sides are covered with talus and colluvium and the valley bottoms with alluvium and till.

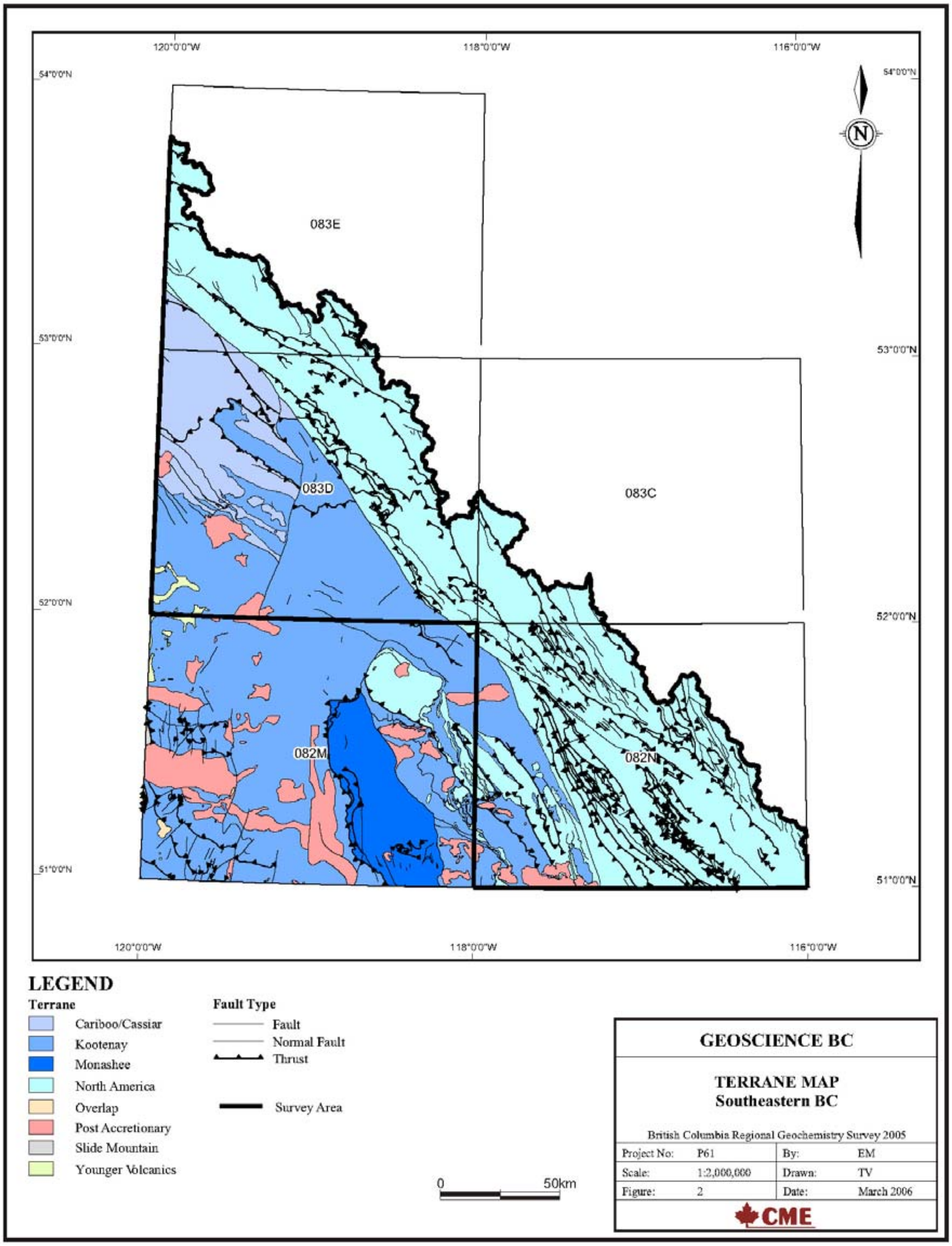
3.2 GEOLOGY

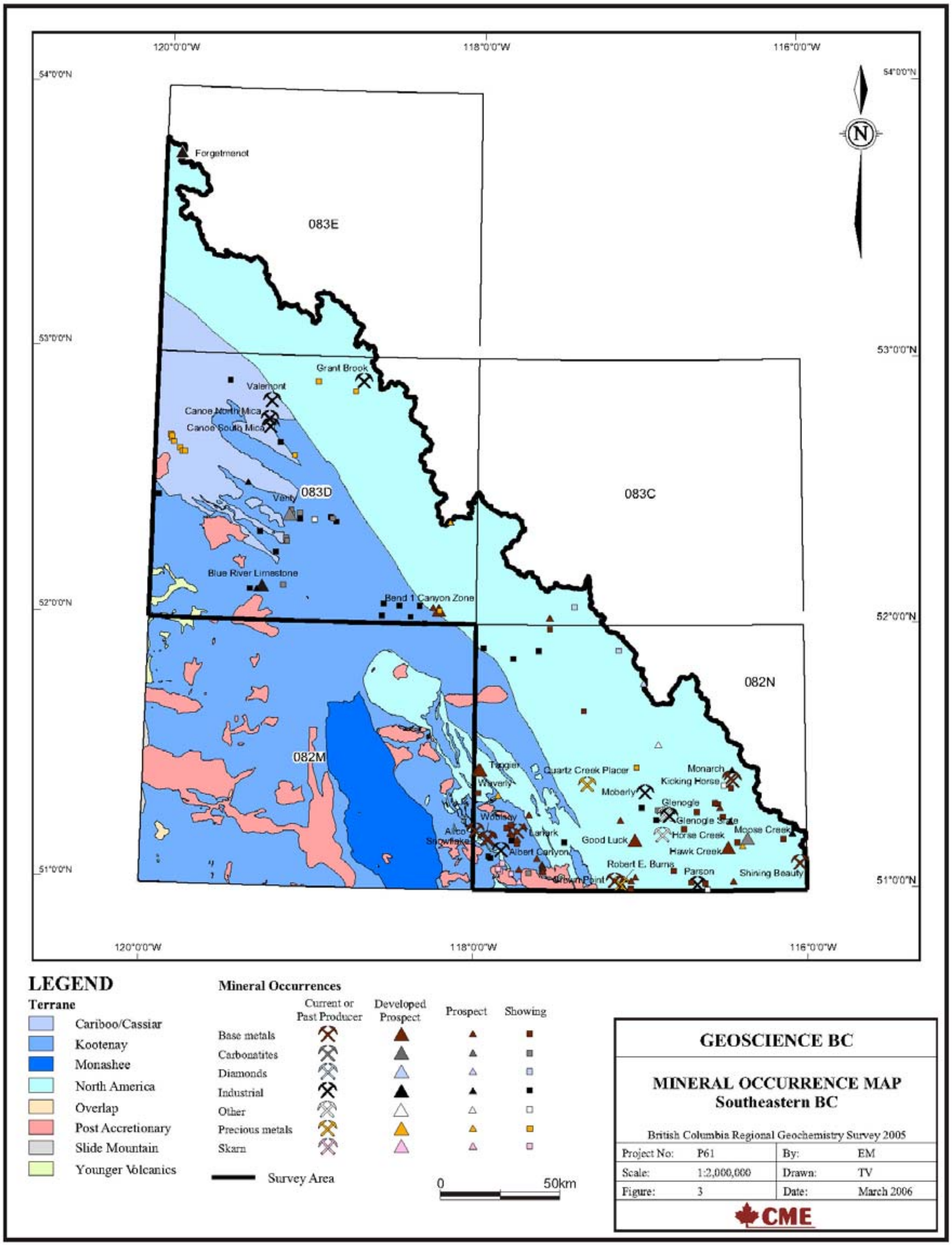
The survey area includes parts of two of the five structurally and physiographically distinct belts that constitute the Canadian segment of the North American Cordillera. These are the Foreland Belt to the east and the Omineca Belt to the west.

Several gneissic bodies crop out adjacent to and along the Rocky Mountain Trench. To the east of the Rocky Mountain Trench, lithologies of the Main Ranges form an imbricate thrust package of Hadrynian to Triassic metasediments and sediments of the Ancestral North American Craton (Mountjoy, 1993).

To the west of the Rocky Mountain Trench in the Canoe River and Mount Robson map-areas are the Kootenay and Cassiar/Cariboo terranes of the Omineca Belt (Figure 2). Lithologies of the Kootenay Terrane include Hadrynian Horsethief Creek Group and the overlying Kaza and Cariboo groups (Mountjoy, 1993). The Cassiar/Cariboo Terranes include Upper Proterozoic to Upper Triassic passive continental margin sediments displaced along the Rocky Mountain Trench transcurrent


N
114
104
94
103
93
83
102
92
82
2005 RGS
Southeastern BC
2005 Anahim Lake and
Nechako River
Lake Drainage Sediment
and Water Surveys
Previous 1:250,000 sediment and water surveys
0
200km
GEOSCIENCE BC
LOCATION MAP
British Columbia Regional Geochemistry Survey 2005
Project No: P61
By: TV
Scale: ~1:11,000,000
Drawn: TV
Figure: 1
Date: March 2006
CME


120°0'0"W
118°0'0"W
116°0'0"W
54°0'0"N
53°0'0"N
52°0'0"N
51°0'0"N
N
083E
083D
083C
082M
082N
LEGEND
Terrane
Cariboo/Cassiar
Kootenay
Monashee
North America
Overlap
Post Accretionary
Slide Mountain
Younger Volcanics
Fault Type
Fault
Normal Fault
Thrust
Survey Area
0
50km
GEOSCIENCE BC
TERRANE MAP
Southeastern BC
British Columbia Regional Geochemistry Survey 2005
Project No: P61
By: EM
Scale: 1:2,000,000
Drawn: TV
Figure: 2
Date: March 2006
CME


120°0'0"W
118°0'0"W
116°0'0"W
54°0'0"N
53°0'0"N
52°0'0"N
51°0'0"N
N
083E
083D
083C
082M
082N
Forgetmenot
Grant Brook
Valemont
Canoe North Mica
Canoe South Mica
Verity
Blue River Limestone
Bend 1 Canyon Zone
Tregier
Waverly
Quartz Creek Placer
Monarch
Kicking Horse
Moberly
Glenogle
Glenogle Slate
Moose Creek
Wolsley
Alco
Snowflake
Lanark
Good Luck
Horse Creek
Hawk Creek
Albert Canyon
Robert E. Burns
Parson
Shining Beauty
Crown Point
LEGEND
Terrane
Cariboo/Cassiar
Kootenay
Monashee
North America
Overlap
Post Accretionary
Slide Mountain
Younger Volcanics
Mineral Occurrences
Current or Past Producer
Developed Prospect
Prospect
Showing
Base metals
Carbonatites
Diamonds
Industrial
Other
Precious metals
Skarn
Survey Area
0
50km
GEOSCIENCE BC
MINERAL OCCURRENCE MAP
Southeastern BC
British Columbia Regional Geochemistry Survey 2005
Project No: P61
By: EM
Scale: 1:2,000,000
Drawn: TV
Figure: 3
Date: March 2006
CME

faults (Wheeler *et al*, 1988). East of the Rocky Mountain Trench is the Foreland Belt represented by the Rocky Mountains. In this area the Foreland Belt consists primarily of a sequence of quartzites, carbonates and pelites from the Hadrynian Miette Group through the Lower Cambrian Gog Group to the Middle Cambrian Chancellor Group (MINFILE 083D001).

Hadrynian rocks on both sides of the Rocky Mountain Trench have been intensely deformed by at least three folding events and have been affected by Barrovian metamorphism (~160 Ma-60 Ma, Crowley *et al*, 2000) ranging in grade from biotite to sillimanite zones (Mountjoy, 1993).

In the Golden area, west of the trench is the Purcell Anticlinorium. Within the Purcell Anticlinorium, a thick succession of Proterozoic (i.e. Horsethief Creek and Miette groups) and Paleozoic (Hamill, Lardeau and Gog groups; Eager, Badshot, Mohican, Donald, Reno, Laib, Quartzite Range formations) miogeoclinal rocks has been deformed by imbricate thrust faults, normal faults, complex folds, and widespread penetrative deformation (Owsiacki, 1993).

3.3 MINERALIZATION

In the Canoe River and Brazeau Lake map-areas, the majority of known mineral occurrences are located adjacent to or west of the Rocky Mountain Trench and consist primarily of industrial mineral occurrences (Figure 3). Precious and base metal occurrences are not abundant throughout the area. Industrial mineral occurrences of mica and kyanite with lesser garnet and beryllium are generally hosted in the Semipelite-Amphibolite unit of the Hadrynian Horsethief Creek Group (Mountjoy, 1993).

Several small alkaline ultramafic diatremes, intruding Upper Cambrian carbonate strata, have been discovered and explored in the Bush River area for microdiamonds (Mountjoy, 1993). A number of carbonatite and nepheline syenite layers occur within the Semipelite- Amphibolite unit of the Horsethief Creek Group in the Monashee Mountains. These have been examined for their vermiculite, uranium, niobium and tantalum potential.

The documented occurrences in the Golden map-area are evenly distributed on both sides of the Rocky Mountain Trench. Approximately two-thirds of the total occurrences are comprised of lead-silver-zinc-(copper-gold) replacement-type deposits hosted primarily in carbonate rocks, and lead-silver-zinc-(gold-copper-tungsten) quartz veins in metasediments, chiefly slates, graphitic slates, schists and argillites Industrial mineral occurrences comprise the remaining one-third of the total occurrences in the Golden map-area. (Owsiacki, 1993).

4.0 2005 RGS PROGRAM

4.1 FIELD OPERATIONS

4.1.1 Sample Collection

Field operations were conducted from base camps established in Valemount, Golden, Mica Creek, Blue River and Revelstoke. Sample collection, data recording, drying, packing and shipping were in accordance with standards set by Geoscience BC.

In general, sample sites were restricted to primary and secondary drainages having catchment basins of less than 10 square kilometres. Contaminated or poor-quality sample sites were avoided by choosing an alternative stream or sampling a minimum of 50 metres upstream from the identified problem.

Sediment samples were placed in labelled 8” x 14” 6 mil polyethylene (“PE”) bags. Sample tags were place in each PE bag prior to tie-locking the bag for security. In areas of low silt, two bags of sediment were collected. Water samples were collected in labelled 250 ml HDPE bottles provided by Eco Tech Laboratory Ltd. (“Eco Tech Labs”) of Kamloops, BC. Field observations regarding sample media, sample site and location were recorded on waterproof sheets in the field and later entered into a master database back in the office. GPS readings were also taken at each sample site whenever possible using a Garmin GPS 60 handheld receiver.

Sample collection commenced on August 28 and ended on October 23, 2005. The first day was reserved for orientation and security protocols lead by the Project Manger.

A Hughes 500D helicopter operated by Prism Helicopters of Pit Meadows, BC, was used for the entire helicopter sampling portion of the program. Helicopter sampling was undertaken from September 9 to October 10 and again on October 18 and 19.

A total of 1,409 sample sites were sampled. A breakdown of the number of sample sites by mapsheet is as follows:

- 612 sites within the Golden map-area - 82N (Figure 4);
- 42 sites within the Brazeau Lake map-area - 83C (Figure 5);
- 603 sites within the Canoe River map-area - 83D (Figure 6); and,
- 152 sites within the Mount Robson map-area - 83E (Figure 7).

A total of 33 sites had no flowing water so only stream sediment material was collected.

The surveys covered approximately 21,560 square kilometres at an average density of approximately one sample site per 15 square kilometres. Sampling was not undertaken in National or Provincial parks. Approximately 7% of the survey area is covered by glaciers and icefields.

4.1.2 Sample Preparation

The sample preparation facility (“preplab”) was established in Valemount. During the sampling of 83D and 83E area, water and sediment samples were delivered daily at the preplab. When the sampling crew stayed in Golden, BC to sample the 82N and 83C areas, sample shipments were delivered once every 4 - 6 days.

The water samples, collected in 250 ml HDPE bottles, were sorted and kept in the motel room and each week’s accumulation of samples were forwarded, complete with QC samples, to Eco Tech Labs.

Field samples (sediments) - weighing from 1.5 to 3.5 kg, mostly between 2.5 and 3.0 kg (after drying) – were delivered in PE bags (8” x 14”, 6 mil) and sealed with a tie lock (cable tie), and transferred to aluminum pans (cake/baking pans 20x20x5cm and 30x23x5cm). Sometimes, when the sampler deemed it necessary, two field samples (bag 1/2 and 2/2) were collected at a sample site to assure sufficient silt (-80 mesh). All samples were placed in the dryer and rotated according to the rate at which they dried (about 40 samples a day.) Almost all field samples were soaking wet.

After drying, the samples were sifted through -10 mesh (1.70 mm) and -80 mesh (0.18 mm) 8” stainless steel T.S. Tyler sieves. The sifters discarded the +10 mesh, returned the +80 –10 mesh to the original PE bags in which the field samples were delivered and labelled “oversize fraction”, and packaged the -80 mesh in 4” x 7” kraft tin-tie bags. (The oversize fraction has been stored in 49 rice sacks ~ 1000 kg.) The sifter(s) always aimed to sieve > 50 g silt material (- 80 mesh). The sieves were cleaned between each sample with an air compressor (125 psi). Aluminum drying pans were cleaned with damp terry cloths (clean towels), supplied by the hotel.

The silt samples were weighed and recorded each day. If a silt sample weighed < 50 g, additional sampling (“retake” of the insufficient sample site) was collected and combined (rolled on Cute-rite wax paper) with the original silt. This always resulted in sufficient silt samples, i.e., > 50 g.

Occasionally, large field samples that had an abundance of silt were not sifted in their entirety, as this would have brought about too much silt that would not have fitted, > 400 g, into the 4x7” kraft bag. The sifter was able to estimate that quite well.

All silt samples were sorted and kept in the Dry Manager’s room until the completion of the RGS program. Quality control (QC) samples were inserted after all the field samples were sifted to confirm completeness of sample number series. Blind duplicates, taken from within each continuous sample series of 20 and positioned at the beginning of that series, were split from the first field duplicate, or if < 100g, the second. Failing that, a silt sample > 100 g within that group of 20 would become the blind duplicate.

A standard reference sample (SRM) was inserted in each set of 20 continuous series of samples. The SRM consisted of two bottles 2 kg each - Red Dog #28 and #62 - supplied by Ray Lett of BCEMPR. The random positioning of the reference sample within each series of 20 was pre-selected by the Project Manager.

The SRM Red Dog #28, after the contents was rolled on paper for 15 minutes, covered the sample series 83D051, 83D052, 83C051, and 82N051001–1088. SRM Red Dog #62 covered 82N051089–1531, 83E051, 82N052 and 83D053. The quantity of the SRM of each bottle made it impractical to roll and combine them.

The QC samples of the water samples came from motel’s tap water (both blind duplicate and reference sample). On the day before shipping the samples to the lab the QCs were drawn from the tap and inserted. The date of filling the QC bottles for each shipment (4) was noted on the CME’s sample submission sheets, to detect possible variation of Valemount tap water. Valemount water comes directly from Swift Creek after filtering and chlorination – no fluoridation, however.

The last samples were sifted on October 24. The Dry Manager dropped off the entire 1,667 sediment shipment at Eco Tech Labs on October 25.

4.1.3 Sample Re-Collection

A total of 28 samples were found to contain less than 50 grams of –80 mesh material. These sample sites were revisited and additional material collected. Collection was undertaken by truck on September 26 and 27 and by helicopter on October 18 and 19.

4.2 ANALYTICAL PROCEDURES

Analysis on sediments included 37 elements by ICP-Mass Spectrometer (“ICP-MS”), 35 elements by Insrumental Neutron Activation Analysis (“INAA”), Fluorine, and loss-on-ignition (“LOI”). Water analysis included pH, Conductivity and Fluoride.

Eco Tech Labs performed all water analyses plus Fluorine and loss-on-ignition for sediments. Eco Tech Labs subcontracted the ICP-MS analysis to Acme Analytical Laboraties Ltd. of Vancouver, BC and the INAA analysis to Becquerel Laboratories of Mississauga, Ontario.

A brief description of the various analytical procedures is presented below.

4.2.1 pH

The pH of stream waters was determined using an electronic pH meter with glass electrode and automatic temperature compensator, with a resolution of 0.01 pH units. Meters were calibrated using NIST approved buffer solutions of 4, 7 and 10 pH.

4.2.2 Conductivity

Conductivity of stream waters was determined using a YSI Model 31 Conductivity Bridge from Yellow Springs Instruments Inc with an error not exceeding 1% or 1 µmhos/cm, whichever was greater. Meters were calibrated using standard reference solutions of 447 and 2270 µmhos/cm.

4.2.3 Fluoride - Water

A 50 ml sample was placed into a beaker and a digital pH meter equipped with a fluoride specific ion electrode inserted. A 50 ml Ioncal Buffer was added and the solution retested.

Table 1: Detection Limits, *ICP-MS*

Element	Detection Range
Ag	2 ppb to 100 ppm
Al	0.01% to 10%
As	0.1 ppm to 10,000 ppm
Au	0.2 ppb to 100 ppm
B	1 ppm to 2,000 ppm
Ba	0.5 ppm to 10,000 ppm
Bi	0.02 ppm to 2,000 ppm
Ca	0.01% to 40%
Cd	0.01 ppm to 2,000 ppm
Co	0.1 ppm to 2,000 ppm
Cr	0.5 ppm to 10,000 ppm
Cu	0.01 ppm to 10,000 ppm
Fe	0.01% to 40%
Ga	0.1 ppm to 100 ppm
Hg	5 ppb to 100 ppm
K	0.01% to 10%
La	0.5 ppm to 10,000 ppm
Mg	0.01% to 30%
Mn	1 ppm to 10,000 ppm
Mo	0.01 ppm to 2,000 ppm
Na	0.001% to 10%
Ni	0.1 ppm to 10,000 ppm
P	0.001% to 5 %
Pb	0.01 ppm to 10,000 ppm
S	0.02% to10%
Sb	0.02 ppm to 2,000 ppm
Sc	0.1 ppm to 100 ppm
Se	0.1 ppm to 100 ppm
Sr	0.5 ppm to 10,000 ppm
Te	0.02 ppm to 100 ppm
Th	0.1 ppm to 2,000 ppm
Ti	0.001% to 10%
Tl	0.02 ppm to 100 ppm
U	0.1 ppm to 2,000 ppm
V	2 ppm to 10,000 ppm
W	0.1 ppm to 100 ppm
Zn	0.1 ppm to 10,000 ppm

4.2.4 Loss-on-Ignition

Loss-on-ignition was determined using a 1 gram sample. The sample, weighed into a combustion boat, was placed in a 1050°C Blue M muffle furnace for one hour. The boats were removed from the furnace and cooled for 2 hours. The boats were re-weighed, and the difference was the loss-on-ignition.

4.2.5 Fluorine - Sediments

A 0.25 gram sample was placed into a disposable test tube. Approximately 1 gram of Na_2CO_3/KNO_3 was added to the test tube and mixed then placed into a muffle furnace at 700°C for 30 minutes. When cool, the sample melt was placed into a Teflon beaker and had 90ml R.O. water added and let sit for 1.5 hours. A 10 ml citric acid solution was added prior to analysis. Analysis was run using a digital pH meter equipped with a fluorine specific ion electrode.

4.2.6 Induced Coupled Plasma Mass Spectrometry (ICP-MS)

A 15 gram sample was leached with 6 ml of a mixture of HCl, HNO_3 and distilled with demineralized water at 95°C for one hour. The sample solution was diluted to 20ml with 5% HCl and analyzed by ICP-MS. Elements determined by ICP-MS are listed in Table 1 along with their corresponding detection limits. Samples returning results lower than the detection limit are prefixed with a 'negative' symbol.

4.2.7 Instrumental Neutron Activation Analysis (INAA)

Weighed and encapsulated samples, normally 10 to 15 grams, were packaged for irradiation along with internal standards and international reference materials. Samples and standards were irradiated together with neutron flux monitors at the McMaster Nuclear Reactor. After a six day decay period, samples were measured with a high-resolution coaxial germanium detector. Typical counting times were 20 to 30 minutes. Elements determined by INAA are listed in Table 2 along with their corresponding detection limits. Samples returning results lower than the detection limit are prefixed with a 'negative' symbol.

5.0 DATA PRESENTATION

This data package has been prepared as a PDF document and presents survey results in three appendices that are described as follows:

Appendix 'A': Complete listing of site location information, field observations and analytical results. Table preceding the data listings define codes used for field observations.

Appendix 'B': Summary statistics for individual elements.

Appendix 'C': Sample location and a selection of element maps.

Raw digital data files have been included in XLS and DBF formats.

Table 2: Detection Limits, *INAA*

Element	DL	Unit
Antimony	0.1	ppm
Arsenic	0.5	ppm
Barium	50	ppm
Bromine	0.5	ppm
Calcium	1	%
Cerium	3	ppm
Cesium	1	ppm
Chromium	5	ppm
Cobalt	1	ppm
Europium	0.2	ppm
Gold	2	ppb
Hafnium	1	ppm
Iridium	5	ppb
Iron	0.01	%
Lanthanum	0.5	ppm
Lutetium	0.05	ppm
Mercury	1	ppm
Molybdenum	1	ppm
Neodymium	5	ppm
Nickel	20	ppm
Rubidium	15	ppm
Samarium	0.1	ppm
Scandium	0.1	ppm
Selenium	3	ppm
Silver	5	ppm
Sodium	0.01	%
Strontium	500	ppm
Tantalum	0.5	ppm
Terbium	0.5	ppm
Thorium	0.2	ppm
Tin	100	ppm
Tungsten	1	ppm
Uranium	0.5	ppm
Ytterbium	0.2	ppm
Zinc	50	ppm

6.0 ACKNOWLEDGMENTS

The 2005 survey was fully funded by Geoscience BC[1] (Contribution Number GBC018).

7.0 REFERENCES

BC Minfile (2005): 083D001 (Bend 1 Canyon Zone)

Crowley, J.L, Ghent, E.D., Carr, S.D., Simony, P.S., Hamilton, P.A. (2000): Multiple thermotectonic events in a continuous metamorphic sequence, Mice Creek area, southeastern Canadian Cordillera, in *Geological Materials Research*, v.2, n.2, p.1.

Holland, S.S. (1976): Landforms of British Columbia, a Physiographic Outline; *Ministry of Energy, Mines and Petroleum Resources*, Bulletin 48.

Mountjoy, K.J. (1993): Minfile Map NTS 083D and Part of 083C Canoe River and Brazeau, *BC Ministry of Energy and Mines and Petroleum Resources*, MINFILE digital data, 47 occurrences, posted Nov 2004, URL<www.em.gov.bc.ca/Mining/Geolsurv/Minfile/mapareas/83dccov.htm> [December 2004]

Owsiacki, G. (1993): Minfile Map NTS 082N and 082O (Part) Golden-Calgary, *BC Ministry of Energy and Mines and Petroleum Resources*, MINFILE digital data, 92 occurrences, posted Nov 2004, URL<www.em.gov.bc.ca/Mining/Geolsurv/Minfile/mapareas/82nocov.htm> [December 2004]

Wheeler, J.O., Brookfield, A.J., Gabrielse, H., Monger, J.W.H., Tipper, H.W., and Woodsworth, G.J. (1988): Terrane Map of the Canadian Cordillera, *Geological Survey of Canada*, Open File 1894.

---

[1] Geoscience BC
Suite 410-890 West Pender Street
Vancouver, BC V6C 1J9
604-662-4147