

## NELSON (NTS 082F) SAMPLE REANALYSIS (ICP-MS)

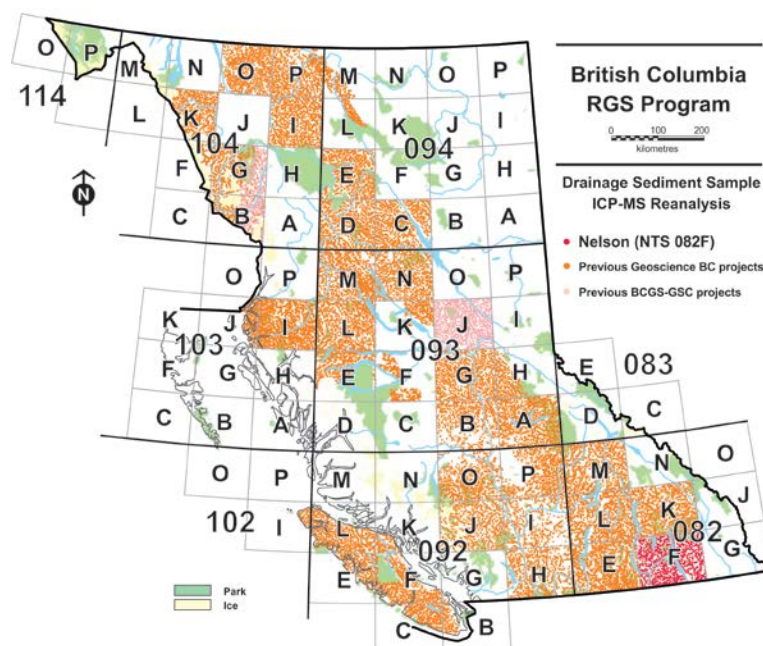
### Geoscience BC Report 2013-09

**Data Files:** GBC Report 2013-09.PDF & GBC Report 2013-09.XLS

**Release Date:** March 2013

#### PROJECT SUMMARY

Ongoing efforts by government-funded agencies to update and maintain the geochemical database established by the British Columbia Regional Geochemical Survey (BCRGS) and the National Geochemical Reconnaissance (NGR) programs have produced one of the most comprehensive collections of field information and multi-element analytical data in Canada (Jackaman, 2011; Jackaman and Lett, 2013). The database has benefitted from a series of large-scale reanalysis initiatives that have been sponsored by Geoscience BC since 2007 (Figure 1). Recognized as a cost-effective means of updating information collected during older government funded regional geochemical surveys, these programs have significantly improved the BC geochemical database by providing a wide range of new analytical information at improved detection levels plus greater data compatibility with analytical methods currently being employed. Geoscience BC Report 2013-09 presents ICP-MS results for stream sediment samples collected during the original 1977 Nelson RGS program.



**Figure 1.** Locations of ICP-MS reanalysis work

(Abbreviations: BCGS, British Columbia Geological Survey; GSC, Geological Survey of Canada; ICP-MS, inductively coupled plasma-mass spectrometry; RGS, Regional Geochemical Survey).

## PROJECT METHODS

The Nelson regional geochemical survey was conducted in 1977 and included the collection of 1394 stream sediment samples. In co-operation with the BC Geological Survey (BCGS) and Natural Resources Canada (NRCan), samples saved from the survey work were retrieved from storage facilities in Ottawa. A total of 1554 drainage-sediment and quality-control samples were subsequently delivered to Acme Analytical Laboratories Ltd. (Vancouver, BC) and analyzed by an ultra-trace aqua-regia digestion (0.5 g) ICP-MS technique for 53 elements (Table 1). Table 1 provides a complete listing of the analytes and associated method detection levels.

ICP-MS results have been provided in the Microsoft® Excel (XLS) file GBC REPORT 2013-09.XLS. The data have been carefully checked for analytical quality using blind duplicate samples and control reference material. Reanalysis data determined to be complete and accurate were merged with sample site location information acquired from the original survey publication (Lett, 2005). Routine comparison of the original determinations with the ICP-MS analyses for elements such as copper, lead, nickel and zinc, identified inconsistencies in some samples. As a result, ICP-MS data for 382 samples have been removed from the data set until further investigations can be completed.

Detailed information on data structure, abbreviations and field observation codes has been provided in Appendix A. In addition, code definitions have been included as a tab in the XLS file.

**Table 1.** List of elements and associated detection levels from ICP-MS analysis using aqua-regia digestion, Nelson NTS map area.  
(Abbreviations: ppm, parts per million; ppb, parts per billion; pct, percent)

Element		Detection Levels	Units	Element		Detection Levels	Units
Gold	Au	0.2 to 100000	ppb	Selenium	Se	0.1 to 100	ppm
Silver	Ag	2 to 100000	ppb	Strontium	Sr	0.5 to 10000	ppm
Aluminum	Al	0.01 to 10	pct	Tellurium	Te	0.02 to 1000	ppm
Arsenic	As	0.1 to 10000	ppm	Thorium	Th	0.1 to 2000	ppm
Boron	B	20 to 2000	ppm	Titanium	Ti	0.001 to 5	pct
Barium	Ba	0.5 to 10000	ppm	Thallium	Tl	0.02 to 1000	ppm
Bismuth	Bi	0.02 to 2000	ppm	Uranium	U	0.05 to 2000	ppm
Calcium	Ca	0.01 to 40	pct	Vanadium	V	2 to 10000	ppm
Cadmium	Cd	0.01 to 2000	ppm	Tungsten	W	0.05 to 100	ppm
Cobalt	Co	0.1 to 2000	ppm	Zinc	Zn	0.1 to 10000	ppm
Chromium	Cr	0.5 to 10000	ppm	Beryllium	Be	0.1 to 1000	ppm
Copper	Cu	0.01 to 10000	ppm	Cerium	Ce	0.1 to 2000	ppm
Iron	Fe	0.01 to 40	pct	Cesium	Cs	0.02 to 2000	ppm
Gallium	Ga	0.1 to 100	ppm	Germanium	Ge	0.1 to 100	ppm
Mercury	Hg	5 to 50000	ppb	Hafnium	Hf	0.02 to 1000	ppm
Potassium	K	0.01 to 10	pct	Indium	In	0.02 to 1000	ppm
Lanthanum	La	0.5 to 10000	ppm	Lithium	Li	0.1 to 2000	ppm
Magnesium	Mg	0.01 to 30	pct	Niobium	Nb	0.02 to 2000	ppm
Manganese	Mn	1 to 10000	ppm	Rubidium	Rb	0.1 to 2000	ppm
Molybdenum	Mo	0.01 to 2000	ppm	Rhenium	Re	1 to 1000	ppb
Sodium	Na	0.001 to 5	pct	Tin	Sn	0.1 to 100	ppm
Nickel	Ni	0.1 to 10000	ppm	Tantalum	Ta	0.05 to 2000	ppm
Phosphorus	P	0.001 to 5	pct	Yttrium	Y	0.01 to 2000	ppm
Lead	Pb	0.01 to 10000	ppm	Zirconium	Zr	0.1 to 2000	ppm
Sulphur	S	0.02 to 5	pct	Platinum	Pt	2 to 100000	ppb
Antimony	Sb	0.02 to 2000	ppm	Palladium	Pd	10 to 200000	ppb
Scandium	Sc	0.1 to 100	ppm				

## ACKNOWLEDGEMENTS

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## REFERENCES

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## *Disclaimer*

*While every effort has been taken to ensure the accuracy of the information in this release package, the data is provided in an 'as-is' basis, without any warranty, guarantee or representation of any kind, whether expressed or implied. It is the responsibility of the user to check the facts before entering any financial or other commitment based upon this information.*

## Appendix A

### NELSON (NTS 082F) SAMPLE REANALYSIS (ICP-MS)

#### Geoscience BC Report 2013-09

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Digital data file *GBC Report 2013-09.XLS* includes new ICP-MS analytical results plus all previously published field information and analytical data. Initially conducted in 1977, the joint federal-provincial regional geochemical survey included the collection of 1394 stream sediment and 1382 stream water samples from 1318 sites. At this time, the sediment samples were analyzed for 13 metals (silver, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, tin, zinc, tungsten and uranium). Water samples were determined for pH, uranium and fluoride. Also included in this package are INAA results from a previous joint BCGS-GSC reanalysis initiative completed in the early 1990s (Jackaman et al., 1991).

The following comments provide additional information on the file structure and data composition of the digital data file *GBC Report 2013-09.XLS*.

- Data file structure has been standardized to accommodate all possible data reporting options for all completed surveys. As a result, data compiled by various government funded regional geochemical programs may not include information for all fields listed in the XLS file. Unless otherwise noted, missing analytical data is reported as a '-1' and missing field information is listed as a blank cell.
- Analytical results reported at less than the contract lab's listed detection level (DL) have been reported at the DL. As noted above, missing data is listed as a '-1'.
- New ICPMS results are also provided as reported by the lab. Data reported at less than the MDL is preceded by a '<' sign and missing data has been left blank.
- Although efforts have been made to include all samples from the target survey area, there may be gaps in the final analytical data set due to missing archive material.
- For more detailed descriptions regarding sample collection methods, analytical techniques and element detection levels refer the original published report at:

URL <<http://www.empr.gov.bc.ca/Mining/Geoscience/Geochemistry/Pages/default.aspx>>

## DATA FILE FORMAT

The XLS file includes the following six (6) tabs:

1. ORIGINAL FIELD DATA: all original recorded site location information and observations.
2. ORIGINAL LAB DATA all original survey analytical data in sediments and waters.
3. SEDIMENT INAA DATA: all INAA data in sediments.
4. *New SEDIMENT ICPMS DATA1*: all ICP-MS data in sediments, less than DL set to DL.
5. *New SEDIMENT ICPMS DATA2*: all ICP-MS data in sediments, as reported by lab.
6. CODES: explanation of codes and abbreviations.

Table 2 lists the sample site identification and location attributes provided in the first 21 data fields for each XLS data TAB. The various analytical data summarized in Tables 3 to 5 are listed starting at field 22.

**Table 2.** Common data fields provided for each XLS data TAB.

Field	Name	Description
1	IDORDER	Sequential order of data records in the compilation.
2	REPORT	Report designation of original published data.
3	NAME	NTS map name of survey area.
4	TYPE1	Survey type: STRM = stream.
5	TYPE2	Survey scale: RGS = regional, TS = targeted.
6	MASTERID	Unique ID number listed for each data record.
7	MAP250	National Topographic System (NTS) 1:250,000 scale map underlying site.
8	MAP50	National Topographic System (NTS) 1:50,000 scale map underlying site.
9	MAP20	National Topographic System (NTS) 1:20,000 scale map underlying site.
10	YEAR	Year sample was collected.
11	ID	Unique sample site ID.
12	STATUS	Identifies the collection of multiple samples from a single site.
13	UTMZ	Site location UTM zone.
14	UTME83	Site location UTM easting (NAD83).
15	UTMN83	Site location UTM northing (NAD83).
16	LAT	Latitude (decimal degrees) calculated from NAD83 UTM coordinates.
17	LONG	Longitude (decimal degrees) calculated from NAD83 UTM coordinates.
18	ELEV	Site elevation in metres.
19	STRAT	Underlying geology at sample site (field STRAT1 from Massey et al., 2005).
20	LAB	Analytical laboratory conducting listed sediment analysis.
21	MTHD	Primary sediment analytical method used.

## ANALYTICAL ATTRIBUTES

**Table 3.** Standardized Format for Original Sediment and Water Analytical Data XLS TAB.

Field	Element	Method	Units	Field	Element	Method	Units		
22	Gold (1st Analysis)	Au1	FA	ppb	37	Lead	Pb	AAS	ppm
23	Gold (Repeat)	Au2	FA	ppb	38	Antimony	Sb	AAS-H	ppm
24	Silver	Ag	AAS	ppm	39	Selenium	Se	AAS-H	ppm
25	Arsenic	As	AAS-H	ppm	40	Tin	Sn	AAS	ppm
26	Barium	Ba	XRF	ppm	41	Uranium	U	NAD	ppm
27	Bismuth	Bi	AAS-H	ppm	42	Vanadium	V	AAS	ppm
28	Cadmium	Cd	AAS	ppm	43	Tungsten	W	CLR	ppm
29	Cobalt	Co	AAS	ppm	44	Zinc	Zn	AAS	ppm
30	Chromium	Cr	AAS	ppm	45	Fluorine	F	AAS	ppm
31	Copper	Cu	AAS	ppm	46	Loss on Ignition	LOI	GRV	pct
32	Iron	Fe	AAS	pct	47	pH (water)	pH	GCE	
33	Mercury	Hg	AAS-F	ppb	48	Uranium (water)	U	LIF	ppb
34	Manganese	Mn	AAS	ppm	49	Fluoride (water)	F	ION	ppb
35	Molybdenum	Mo	AAS	ppm	50	Sulphate (water)	SO4	TRB	ppm
36	Nickel	Ni	AAS	ppm	51	Conductivity (water)	CND	GCE	uS

**Table 4.** Standardized Format for Sediment INAA Data XLS TAB.

Field	Element		Method	Units	Field	Element		Method	Units
22	Gold (1st Analysis)	Au1	INAA	ppb	43	Neodymium	Nd	INAA	ppm
23	Gold (Repeat)	Au2	INAA	ppb	44	Nickel	Ni	INAA	ppm
24	Silver	Ag	INAA	ppm	45	Rubidium	Rb	INAA	ppm
25	Arsenic	As	INAA	ppm	46	Antimony	Sb	INAA	ppm
26	Barium	Ba	INAA	ppm	47	Scandium	Sc	INAA	ppm
27	Bromine	Br	INAA	ppm	48	Selenium	Se	INAA	ppm
28	Calcium	Ca	INAA	pct	49	Samarium	Sm	INAA	ppm
29	Cadmium	Cd	INAA	ppm	50	Tin	Sn	INAA	ppm
30	Cerium	Ce	INAA	ppm	51	Strontium	Sr	INAA	ppm
31	Cobalt	Co	INAA	ppm	52	Tantalum	Ta	INAA	ppm
32	Chromium	Cr	INAA	ppm	53	Terbium	Tb	INAA	ppm
33	Cesium	Cs	INAA	ppm	54	Tellurium	Te	INAA	ppm
34	Europium	Eu	INAA	ppm	55	Thorium	Th	INAA	ppm
35	Iron	Fe	INAA	pct	56	Titanium	Ti	INAA	ppm
36	Hafnium	Hf	INAA	ppm	57	Uranium	U	INAA	ppm
37	Mercury	Hg	INAA	ppm	58	Tungsten	W	INAA	ppm
38	Iridium	Ir	INAA	ppb	59	Ytterbium	Yb	INAA	ppm
39	Lanthanum	La	INAA	ppm	60	Zinc	Zn	INAA	ppm
40	Lutetium	Lu	INAA	ppm	61	Zirconium	Zr	INAA	ppm
41	Molybdenum	Mo	INAA	ppm	62	Sample Weight	Wt	GRV	g
42	Sodium	Na	INAA	pct					

**Table 5.** Standardized Format for Sediment ICP-MS Data XLS TABS 1 and 2.

Field	Element	Method	Units	Field	Element	Method	Units		
22	Gold	Au	ICPMS	ppb	49	Selenium	Se	ICPMS	ppm
23	Silver	Ag	ICPMS	ppb	50	Strontium	Sr	ICPMS	ppm
24	Aluminum	Al	ICPMS	pct	51	Tellurium	Te	ICPMS	ppm
25	Arsenic	As	ICPMS	ppm	52	Thorium	Th	ICPMS	ppm
26	Barium	Ba	ICPMS	ppm	53	Titanium	Ti	ICPMS	pct
27	Bismuth	Bi	ICPMS	ppm	54	Thallium	Tl	ICPMS	ppm
28	Boron	B	ICPMS	ppm	55	Uranium	U	ICPMS	ppm
29	Calcium	Ca	ICPMS	pct	56	Vanadium	V	ICPMS	ppm
30	Cadmium	Cd	ICPMS	ppm	57	Tungsten	W	ICPMS	ppm
31	Cobalt	Co	ICPMS	ppm	58	Zinc	Zn	ICPMS	ppm
32	Chromium	Cr	ICPMS	ppm	59	Beryllium	Be	ICPMS	ppm
33	Copper	Cu	ICPMS	ppm	60	Cerium	Ce	ICPMS	ppm
34	Iron	Fe	ICPMS	pct	61	Cesium	Cs	ICPMS	ppm
35	Gallium	Ga	ICPMS	ppm	62	Germanium	Ge	ICPMS	ppb
36	Mercury	Hg	ICPMS	ppb	63	Hafnium	Hf	ICPMS	ppm
37	Potassium	K	ICPMS	pct	64	Indium	In	ICPMS	ppm
38	Lanthanum	La	ICPMS	ppm	65	Lithium	Li	ICPMS	ppm
39	Magnesium	Mg	ICPMS	pct	66	Niobium	Nb	ICPMS	ppm
40	Manganese	Mn	ICPMS	ppm	67	Palladium	Pd	ICPMS	ppb
41	Molybdenum	Mo	ICPMS	ppm	68	Platinum	Pt	ICPMS	ppb
42	Sodium	Na	ICPMS	pct	69	Rhenium	Re	ICPMS	ppb
43	Nickel	Ni	ICPMS	ppm	70	Rubidium	Rb	ICPMS	ppm
44	Phosphorus	P	ICPMS	pct	71	Tin	Sn	ICPMS	ppm
45	Lead	Pb	ICPMS	ppm	72	Tantalum	Ta	ICPMS	ppm
46	Sulphur	S	ICPMS	pct	73	Yttrium	Y	ICPMS	ppm
47	Antimony	Sb	ICPMS	ppm	74	Zirconium	Zr	ICPMS	ppm
48	Scandium	Sc	ICPMS	ppm					

**Table 6.** Abbreviation Definitions.

Code	Description	Code	Description
AAS	atomic absorption spectroscopy	GCE	glass combination electrode
AAS-F	flameless AAS	LIF	laser-induced fluorescence
AAS-H	hydride generation AAS	ION	specific ion electrode
XRF	x-ray fluorescence	TRB	turbidimetric
CLR	colourimetrically	GRV	gravimetric (weight difference)
NAD	neutron activation, delayed neutron counting	ppm	parts per million
FA	fire assay	ppb	parts per billion
INAA	instrumental neutron activation analysis	pct	percent
ICPMS	inductively coupled plasma mass spectroscopy	g	gram

## EXPLANATION OF CODES FOR FIELD OBSERVATIONS – STREAM SITES

### SAMPLE MATERIAL (MAT):

- |                     |                        |
|---------------------|------------------------|
| 1 - Stream Sediment | 6 - Water and Sediment |
|---------------------|------------------------|

### STREAM SOURCE (SORC):

- |                 |                        |
|-----------------|------------------------|
| 0 – Unknown     | 2 - Spring Run-off     |
| 1 – Groundwater | 3 - Glacier Melt Water |

### STREAM ORDER (ORDR):

- |               |                |
|---------------|----------------|
| 0 – Undefined | 3 - Tertiary   |
| 1 – Primary   | 4 - Quaternary |
| 2 – Secondary |                |

### STREAM TYPE (TYPE):

- |               |                 |
|---------------|-----------------|
| 0 – Undefined | 2 - Seasonal    |
| 1 – Permanent | 3 - Re-emergent |

### PHYSIOGRAPHY (PHYS):

- |                        |                         |
|------------------------|-------------------------|
| 0 - Lowland Plain      | 3 - Hilly, Undulating   |
| 1 - Muskeg, Swamp      | 4 - Mountains, Mature   |
| 2 - Peneplain, Plateau | 5 - Mountains, Youthful |

### DRAINAGE PATTERN (DRNP):

- |                    |                        |
|--------------------|------------------------|
| 0 - Poorly Defined | 4 - Interrupted        |
| 1 – Dendritic      | 5 - Glacially Deranged |
| 2 – Herringbone    | 6 - Basinal            |
| 3 – Rectangular    | 7 - Other              |

### CONTAMINATION (CONT):

- |              |                 |
|--------------|-----------------|
| 0 - None     | 5 - Industrial  |
| 1 - Possible | 6 - Agriculture |
| 2 - Probable | 7 - Domestic    |
| 3 - Definite | 8 - Forestry    |
| 4 - Mining   | 9 - Burned      |

STREAM WIDTH (WDTH): Width of the stream at the sample site in metres.

STREAM DEPTH (DPTH): Depth of the stream at the sample site in centimetres.

STREAM FLOW RATE (FLOW): Visual estimate of stream flow velocity.

- |              |             |
|--------------|-------------|
| 0 - Stagnant | 3 – Fast    |
| 1 - Slow     | 4 - Torrent |
| 2 - Moderate |             |

### STREAM WATER COLOUR (WTRC):

- |                  |                  |
|------------------|------------------|
| 0 - Colourless   | 3 - Brown Cloudy |
| 1 - Brown, Clear | 4 - Other        |
| 2 - White Cloudy |                  |



## EXPLANATION OF CODES FOR FIELD OBSERVATIONS – STREAM SITES Continued

### BANK TYPE (BANK):

0 - Unknown	4 - Glacial Outwash
1 - Alluvial	5 - Bare Rock
2 - Colluvial	6 - Talus, Scree
3 - Till	7 - Organic

BANK PRECIPITATE (BNKP): Presence of stain, weathering on rocks surrounding the sample site.

0 - None, otherwise same codes as sediment colour.

SEDIMENT COMPOSITION (COMP): Bulk composition of sand\clines\organics.

0 - Absent	2 - Medium 33-67%
1 - Minor < 33%	3 - Major >67%

SEDIMENT COLOUR (SEDC): General colour of collected sediment.

1 - Red	5 - Green
2 - White, Buff	6 - Gray, Blue
3 - Black	7 - Pink
4 - Yellow	8 - Tan, Brown

SEDIMENT PRECIPITATE (SEDP): Presence of any coatings on the sample or on streambed materials at the sample site.

0 - None, otherwise same codes as sediment colour.

### CHANNEL BED (CBED):

1 - Boulders	3 - Sand and Gravels
2 - Fine Sand to Clay	4 - Organics

### CHANNEL PATTERN (CPTN):

1 - Shoots and Pools	3 - Meandering
2 - Braided	4 - Disturbed

DATE (DATE): Day and month sample collected.

## EXPLANATION OF CODES FOR FIELD OBSERVATIONS – OTHER

The following additional information was generated for each sample record by overlaying the sample site location point file with various digital polygons using simple GIS routines.

ECO REGION NAME: Major physiographic & minor macroclimatic variation, from Ecoregion Classification of BC.

ECO SECTION NAME: Minor physiographic/macroclimatic variation, from Ecoregion Classification of BC.

ZONE NAME: Major biogeoclimatic zone, from Biogeoclimatic Ecosystem Classification of BC.

SUB ZONE NAME: Minor biogeoclimatic zone, from Biogeoclimatic Ecosystem Classification of BC.

TECTONIC BELT: Geological feature underlying sample site, from Massey et al., 2005.

TERRANE: Geological feature underlying sample site, from Massey et al., 2005.

STRAT NAME: Geological feature underlying sample site, from Massey et al., 2005.

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