TREK PROJECT

Reconnaissance Biogeochemical Survey using Spruce-Tops in the West Road (Blackwater) River Area

Fraser Plateau, British Columbia

GEOSCIENCE BC REPORT 2016-05

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INTRODUCTION

The TREK project is designed to promote mineral exploration in underexplored parts of the Interior Plateau, British Columbia. This is accomplished through the assembly of high-quality integrated geoscience data that can be used to advance the understanding of the economic geology in a region with potential to host porphyry copper, porphyry molybdenum and epithermal gold deposits. Historically, exploration activities within the region have been hindered by Neogene Chilcotin Group basalt flows and extensive glacial drift that obscure the underlying, and potentially prospective, bedrock units. To address these difficulties, the TREK project combines information from ground geochemical, airborne geophysical and geological initiatives to provide a foundation for more advanced resource development in this important region (Clifford and Hart, 2014).

The data compilation derived from over 4500 geochemical samples including lake and stream sediment, water, till and biological materials, is one of the highest quality and most comprehensive geochemical datasets currently available (Jackaman et al., 2015; Sacco and Jackaman, 2015). Although vast regions within the TREK study area have been covered by previous geochemical surveys, several key tracts of prospective ground still have limited or no geochemical coverage. These areas are characterized by thick vegetation cover, few lakes and limited road networks, which significantly limits the types of survey techniques that can be applied. To address this problem, a helicopter-supported, spruce-top twig-and-needle survey was conducted in 2015 to test the feasibility of this type of approach and generate new geochemical information that can be used to help locate hidden mineralization.

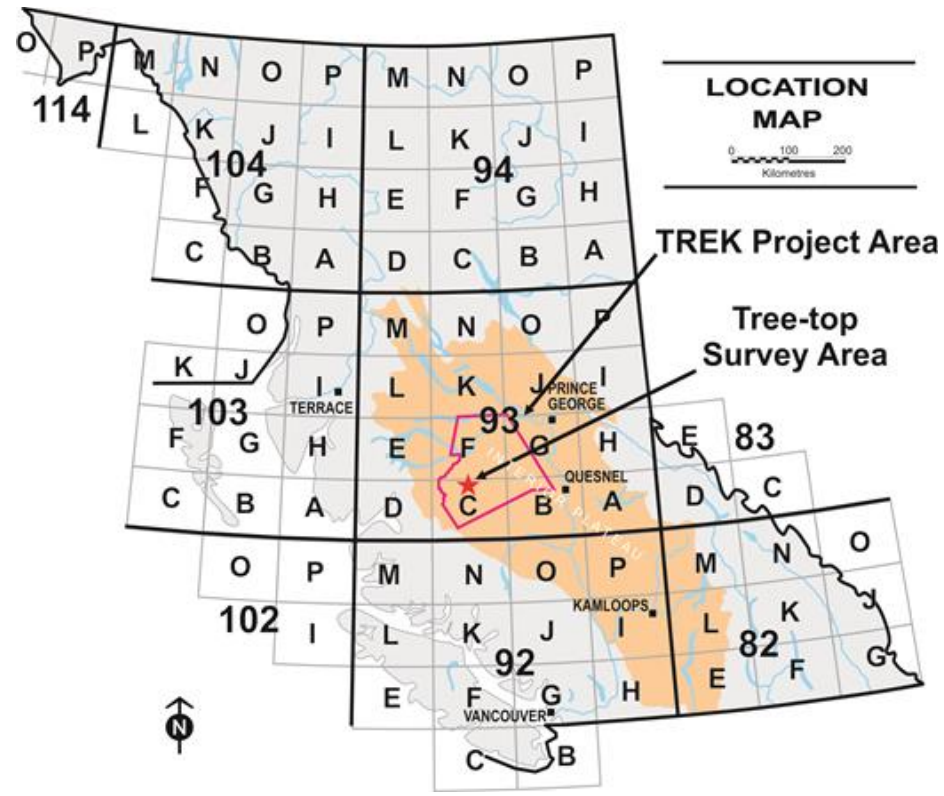

Figure 1. Biogeochemical survey area, Interior Plateau, British Columbia.

2105 BIOGEOCHEMICAL SURVEY

The 2015 biogeochemical survey area is located 40 km north of Anahim Lake within the Fraser Plateau and extends north from the Itcha and Ilgachuz mountain ranges to the West Road (Blackwater) River Basin. This area is characterized by gentle north-facing slopes that are blanketed with glacial drift and dissected by streams that flow into the flat-floored valley. Interspersed throughout the 1000 km^2 survey area are stands of lodgepole pine (*Pinus contorta*), white spruce (*Picea glauca*) and Engelmann spruce (*Picea engelmannii*). A hybrid species of white and Engelmann spruce (known as Interior spruce) is also common in the central Interior. Fortunately, these spruce species have very similar chemical characteristics (C. Dunn, pers. comm., 2015). Wetland features and sedge grass meadows are common. Evidence of beetle-killed pine, recent forest fires and regeneration from previous forest fires was also observed. Access roads do not currently extend into the survey area, but forest service roads are located immediately to the east and north.

The survey area is underlain by Hazelton Group and Ootsa Lake Group rocks, and Chilcotin Group volcanic rocks. Several developed prospects that contain Au, Ag, Zn, Pb and Cu mineralization are located in the region. The Blackwater-Davidson intermediate sulphidation epithermal Au-Ag deposit (NTS 093F/02; MINFILE 093F 037; BC Geological Survey, 2015) is located 15 km north of the survey area, and the 3Ts polymetallic Ag–Pb–Zn±Au deposit (NTS 093F/03; MINFILE 093F 068) is situated on the northern survey boundary. No recorded mineral occurrences exist within the survey area south of West Road (Blackwater) River.

FIELD METHODS

Field survey methods, sample preparation and analysis protocols guiding the 2015 biogeochemical survey were based on previous field surveys, orientation investigations and detailed research (Dunn, 1995, 2007). During a six-day period in June 2015, a 1000 km^2 area was surveyed using predetermined flight-lines along an offset grid with 1500 m spacing between sample sites. A total of 421 side-branch samples, comprising 1 kg of twigs, needles and cones, were systematically collected near the tops of 399 healthy spruce trees (Figure 2).

The target spruce trees were healthy, 80–100 years old, 20–25 m tall and commonly extended 2–3 m above a lower canopy of lodgepole pine, which typically showed effects of the mountain pine beetle infestation. A recent forest fire in the northern part of the survey area and several immature patches of forest regeneration limited the availability of spruce for a small number of the predetermined sites.

Navigation along the predetermined flight lines and the recording of sample site location co-ordinates were completed using tablet based mapping and GPS computer programs.

Figure 2. Helicopter-supported spruce-top collecting of distal side-branch samples consisting of twigs, needles and cones.

Sample preparation and Analysis

After collection, each 1 kg sample was systematically processed in the field prior to shipment to the commercial laboratory. Cones were removed and the branches were trimmed to include only 5–7 years of growth. Each of the field-processed samples weighed approximately 500 g and were delivered to the Bureau Veritas Commodities laboratory (Vancouver, BC). After the samples were oven dried at 60°C, the twigs and needles were separated. The twigs were macerated to 1 mm size and a 1 g split digested in HNO_3 then aqua-regia and analyzed for 53 elements by inductively coupled plasma–mass spectrometry (ICP-MS). A 50 g split of dry needles were reduced to ash at 475°C and approximately 0.25 g of ash material was analyzed for 53 elements plus rare-earth elements by ICP-MS following aqua-regia digestion. A complete list of elements and analytical detection limits for both macerated twigs and ashed needles is provided in Tables 1 and 2.

Quality Control

In addition to the laboratories in-house quality-control procedures, independent quality control for monitoring the reliability of the biogeochemical data includes the routine analysis of field duplicate and analytical duplicate samples and control reference standards. Results of duplicate sample analyses determine sampling and analytical variability whereas reference standard data measure the accuracy and precision of the analytical methods. For each batch of 20 sequential samples, one field duplicate (taken at a randomly selected sample site), one analytical duplicate (a sample split during the lab preparation process) and one reference standard are included in the geochemical analyses. Certified reference standards for plant materials are not readily available; however, ash and spruce twig control samples with known element concentrations were included to monitor the precision of the analytical results (C. Dunn, pers. comm., 2015).

Data for several elements have not been fully integrated in this report because of inadequate detection limits and/or precision. In addition, some elements (e.g. Au and Ga in ashed needles) are showing slightly elevated values along sample sequences. These element values are generally very low and may reflect detection level issues related to sample weights and/or heterogeneity (J. Sader, pers. Comm., 2016).

Table 1. Elements determined in macerated twigs by ICP-MS and their detection limits used for this program. Abbreviations: ppm, parts per million; ppb, parts per billion; pct, percent.

ELEMENT		METHOD DETECTION		UPPER LIMIT	
Silver	Ag	2	ppb	100000	ppb
Aluminum	Al	0.01	pct	10	pct
Arsenic	As	0.1	ppm	10000	ppm
Gold	Au	0.2	ppb	100000	ppb
Boron	B	1	ppm	2000	ppm
Barium	Ba	0.1	ppm	10000	ppm
Bismuth	Bi	0.02	ppm	2000	ppm
Calcium	Ca	0.01	pct	40	pct
Cadmium	Cd	0.01	ppm	2000	ppm
Cobalt	Co	0.01	ppm	2000	ppm
Chromium	Cr	0.1	ppm	10000	ppm
Copper	Cu	0.01	ppm	10000	ppm
Iron	Fe	0.001	pct	40	pct
Gallium	Ga	0.1	ppm	1000	ppm
Mercury	Hg	1	ppb	100000	ppb
Potassium	K	0.01	pct	10	pct
Lanthanum	La	0.01	ppm	10000	ppm
Magnesium	Mg	0.001	pct	30	pct
Manganese	Mn	1	ppm	10000	ppm
Molybdenum	Mo	0.01	ppm	2000	ppm
Sodium	Na	0.001	pct	10	pct
Nickel	Ni	0.1	ppm	10000	ppm
Phosphorus	P	0.001	pct	5	pct
Lead	Pb	0.01	ppm	10000	ppm
Sulphur	S	0.01	pct	10	pct
Antimony	Sb	0.02	ppm	2000	ppm
Scandium	Sc	0.1	ppm	100	ppm

ELEMENT		METHOD DETECTION		UPPER LIMIT	
Selenium	Se	0.1	ppm	100	ppm
Strontium	Sr	0.5	ppm	10000	ppm
Tellurium	Te	0.02	ppm	1000	ppm
Thorium	Th	0.01	ppm	2000	ppm
Titanium	Ti	1	ppm	100000	ppm
Thallium	Tl	0.02	ppm	1000	ppm
Uranium	U	0.01	ppm	2000	ppm
Vanadium	V	2	ppm	10000	ppm
Tungsten	W	0.1	ppm	100	ppm
Zinc	Zn	0.1	ppm	10000	ppm
Beryllium	Be	0.1	ppm	1000	ppm
Cerium	Ce	0.01	ppm	2000	ppm
Cesium	Cs	0.005	ppm	2000	ppm
Germanium	Ge	0.01	ppm	100	ppm
Hafnium	Hf	0.001	ppm	1000	ppm
Indium	In	0.02	ppm	1000	ppm
Lithium	Li	0.01	ppm	2000	ppm
Niobium	Nb	0.01	ppm	2000	ppm
Palladium	Pd	2	ppb	100000	ppb
Platinum	Pt	1	ppb	100000	ppb
Rubidium	Rb	0.1	ppm	2000	ppm
Rhenium	Re	1	ppb	1000	ppb
Tin	Sn	0.02	ppm	100	ppm
Tantalum	Ta	0.001	ppm	2000	ppm
Yttrium	Y	0.001	ppm	2000	ppm
Zirconium	Zr	0.01	ppm	2000	ppm

Table 2. Elements determined in ashed needles by ICP-MS and their detection limits used for this program. Abbreviations: ppm, parts per million; ppb, parts per billion; pct, percent.

ELEMENT		METHOD DETECTION		UPPER LIMIT		ELEMENT		METHOD DETECTION		UPPER LIMIT	
Silver	Ag	2	ppb	100000	ppb	Uranium	U	0.1	ppm	2000	ppm
Aluminum	Al	0.01	pct	10	pct	Vanadium	V	2	ppm	10000	ppm
Arsenic	As	0.1	ppm	10000	ppm	Tungsten	W	0.1	ppm	100	ppm
Gold	Au	0.2	ppb	100000	ppb	Zinc	Zn	0.1	ppm	10000	ppm
Boron	B	1	ppm	2000	ppm	Beryllium	Be	0.1	ppm	1000	ppm
Barium	Ba	0.5	ppm	10000	ppm	Cerium	Ce	0.1	ppm	2000	ppm
Bismuth	Bi	0.02	ppm	2000	ppm	Cesium	Cs	0.02	ppm	2000	ppm
Calcium	Ca	0.01	pct	40	pct	Germanium	Ge	0.1	ppm	100	ppm
Cadmium	Cd	0.01	ppm	2000	ppm	Hafnium	Hf	0.02	ppm	1000	ppm
Cobalt	Co	0.1	ppm	2000	ppm	Indium	In	0.02	ppm	1000	ppm
Chromium	Cr	0.5	ppm	10000	ppm	Lithium	Li	0.1	ppm	2000	ppm
Copper	Cu	0.01	ppm	10000	ppm	Niobium	Nb	0.02	ppm	2000	ppm
Iron	Fe	0.01	pct	40	pct	Palladium	Pd	10	ppb	100000	ppb
Gallium	Ga	0.1	ppm	1000	ppm	Platinum	Pt	2	ppb	100000	ppb
Potassium	K	0.01	pct	10	pct	Rubidium	Rb	0.1	ppm	2000	ppm
Lanthanum	La	0.5	ppm	10000	ppm	Rhenium	Re	1	ppb	1000	ppb
Magnesium	Mg	0.01	pct	30	pct	Tin	Sn	0.1	ppm	100	ppm
Manganese	Mn	1	ppm	10000	ppm	Tantalum	Ta	0.05	ppm	2000	ppm
Molybdenum	Mo	0.01	ppm	2000	ppm	Yttrium	Y	0.01	ppm	2000	ppm
Sodium	Na	0.001	pct	5	pct	Zirconium	Zr	0.1	ppm	2000	ppm
Nickel	Ni	0.1	ppm	10000	ppm	Dysprosium	Dy	0.02	ppm	2000	ppm
Phosphorus	P	0.001	pct	5	pct	Erbium	Er	0.02	ppm	2000	ppm
Lead	Pb	0.01	ppm	10000	ppm	Europium	Eu	0.02	ppm	2000	ppm
Sulphur	S	0.02	pct	10	pct	Gadolinium	Gd	0.02	ppm	2000	ppm
Antimony	Sb	0.02	ppm	2000	ppm	Holmium	Ho	0.02	ppm	2000	ppm
Scandium	Sc	0.1	ppm	100	ppm	Lutetium	Lu	0.02	ppm	2000	ppm
Selenium	Se	0.1	ppm	100	ppm	Neodymium	Nd	0.02	ppm	2000	ppm
Strontium	Sr	0.5	ppm	10000	ppm	Praseodymium	Pr	0.02	ppm	2000	ppm
Tellurium	Te	0.02	ppm	1000	ppm	Samarium	Sm	0.02	ppm	2000	ppm
Thorium	Th	0.1	ppm	2000	ppm	Terbium	Tb	0.02	ppm	2000	ppm
Titanium	Ti	0.001	pct	5	pct	Thulium	Tm	0.02	ppm	2000	ppm
Thallium	Tl	0.02	ppm	1000	ppm	Ytterbium	Yb	0.02	ppm	2000	ppm

SUMMARY

Extending geochemical coverage for the TREK project area has required innovative approaches to meet the challenge of accessing locations to collect appropriate sample material. Ongoing research supports the effectiveness of biogeochemistry, and combined with advances in analytical methods, has established these types of surveys as valid exploration options for generating geochemical information. In addition, helicopter supported tree-top programs can be an economic method to quickly acquire samples over large inaccessible areas.

Coniferous trees such as spruce are useful as a biogeochemical sample medium since they can tolerate and maintain significant concentrations of trace elements. Extracted from underlying materials such as soil, overburden, groundwater and bedrock, elements are absorbed and transported throughout the tree including twigs and needles where elements can be locally concentrated. Analytical data derived from the analysis of tree-top samples that that have been systematically collected and prepared can be used to identify point-source anomalies and geochemical trends (Dunn and Hastings, 1999).

Biogeochemistry is a complex science that involves the interaction of many organic and inorganic processes. To be successful, the Interpretation of analytical results must consider the chemical relationships and mechanisms associated with the uptake and the concentrating of individual elements.

DATA PRESENTATION

Information compiled in this report includes field and analytical results from macerated twig and ashed needle samples collected as part of the TREK project. Field observations and analytical results from this work have been determined to be complete and accurate. A selection of the data is presented in the following appendices, with complete listings in digital data files:

Appendix A:

This section lists recorded field observations and raw analytical data for the 2015 spruce-top biogeochemical survey. Also included are calculated ashed needle ICP-MS values leveled to a dry weight (ASH YIELD). Definitions for field observation codes and abbreviations are provided at the beginning of the section.

Appendix B:

This section presents summary statistics determined from the 2015 data set for individual elements determined by ICP-MS. Refer to notes at the beginning of the section for specific details on the methods used.

Appendix C:

This section includes a sample location map, bedrock and surficial geology map, airborne geophysical maps plus proportional symbol and gridded image maps for a selection of metals in twigs by ICP-MS and ashed needle ICP-MS values leveled to a dry weight.

The image maps were created using an inverse distance weighting method. Colour depicted on the gridded images and proportional symbol size reflects data ranges that are based on percentiles calculated from the data sets (Appendix B). Maximum symbol size is assigned to highest values. Portraying high values with larger symbols and bright colours helps highlight regional geochemical trends and areas that may host anomalous results.

Digital Data:

The data summary presented in this package is not considered exhaustive. In order to accommodate more detailed assessments, raw digital data files for each data set have been included in Microsoft® Excel (XLS) format. Refer to the README.PDF file for details on the data files.

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Preparation: Bureau Veritas Commodities Canada Ltd., Vancouver, BC

Analysis: Bureau Veritas Commodities Canada Ltd., Vancouver, BC

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