Advancing the Utility of the British Columbia Regional Geochemical Survey Database Using Indicator Minerals Derived from a Regional Bulk Stream-Sediment Survey, Boundary District, South-Central British Columbia (NTS 082E)

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INTRODUCTION

Government-funded, reconnaissance-scale regional geochemical surveys (RGS) have been routinely conducted in BC since 1976. During this time, silt-sediment samples have been collected from more than 55,000 sites distributed throughout the province. The BC Geological Survey (BCGS), the Geological Survey of Canada (GSC) and Geoscience BC (GBC) continue to support new field surveys and the reanalysis of archived samples. The resulting RGS database has evolved into a comprehensive collection of field information plus accompanying multi-element analytical data. It continues to be recognized as an important resource for supporting mineral-exploration activities.

Although RGS coverage is extensive and the resulting database has great utility, there remain opportunities for improvement. Gaps in coverage include a small number of regions that have not been surveyed and, more notably, areas that have a limited density of existing sample sites. In these situations deficiencies relate to original survey parameters established by the GSC that specified reconnaissance-scale densities to be one sample site every 13 km^2. The targeting of first- and second-order drainages at this scale often result in partial coverage of the areas surveyed. In addition, using conventional silt sampling at the outlets of larger drainage basins potentially misrepresents the geochemical information generated due to the influence of sediment dilution and greater lithological variations within the stream catchment.

To examine how to resolve these gaps in the RGS database, a modified RGS sampling strategy that integrates the collection of ***bulk stream-sediment samples and derived mineralogical information***, plus trace-metal data, has been included as part of a new regional stream-sediment survey conducted in the Boundary District in south-central BC (Figure 1).

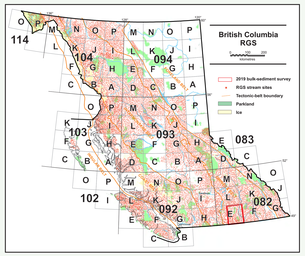

Figure 1. Distribution of RGS sample sites and location of the 2019 bulk-sediment survey.

Photo 1. Bulk sediment sampling.

Photo 2. Conventional silt sampling.

PROJECT OBJECTIVES

Indicator minerals derived from bulk sediments collected at the outlets of large drainage basins can effectively detect potential mineral deposits at far greater distances upstream than conventional silt sampling. Extending the length of detectable mineral-dispersion trains enables the use of significantly fewer, strategically located bulk-sediment sample sites. Processing bulk-sediment material captures gold and sulphide mineral grains, plus potential oxide- and silicate-mineral indicators. Interpreting the abundance of these mineral grains and their morphological characteristics provides information about potential economic mineralization associated with precious- and base-metal deposit types that may exist upstream from a sample site in a drainage basin.

Collecting bulk sediments at a density of one site per 100 km^2 is routinely used as part of the GSC'S current National Geochemical Reconnaissance (NGR) program and has been successful in detecting a variety of ore-deposit types. In BC, indicator-mineral methods are included as part of regional till surveys but are not yet fully integrated into regional silt-sediment programs.

Conducting a bulk-sediment sampling program in an area that was previously covered by a government-funded RGS program will:

1) demonstrate that this method can improve existing geochemical coverage;

2) can add valuable mineralogical information to the existing RGS database;

3) can enable relatively larger areas to be effectively assessed for mineral deposits; and

4) is complementary to other exploration initiatives.

In addition, this survey strategy targets considerably fewer sample sites, allowing for significant cost savings when compared to conventional infill methods that require greater sample-site densities and, more commonly, helicopter support.

PROJECT LOCATION & DESCRIPTION

The project area is focused on the east half of NTS 082E and covers approximately 10,000 km^2 (Figure 2). It is in the Columbia Mountain physiographic region. The west edge of the survey area includes part of the Okanagan Highland and extends east through the Monashee Mountains, past Lower Arrow Lake and into the Selkirk Mountains. Mountain peaks up to 2000 m in elevation are common and are drained by the Kettle and Granby rivers.

This region was targeted for this study for the following reasons:

1) historical Au and Ag (plus Cu, Pb and Zn) mining camps hosted within a prospective geological setting continue to support an active exploration community;

2) other locally focused geoscience initiatives are ongoing, including an extensive geological mapping and mineral-evaluation program funded by Geoscience BC;

3) the area offers ample opportunities to access sites using a well-developed highway and forest-service-road infrastructure;

4) the mountainous terrain contains abundant, well-defined stream drainages suitable for regional geochemical stream-sediment surveys and is typical of many areas in BC; and

5) a previous government-funded RGS program was completed in the area in 1976 and sample reanalysis in 1991 and 2009.

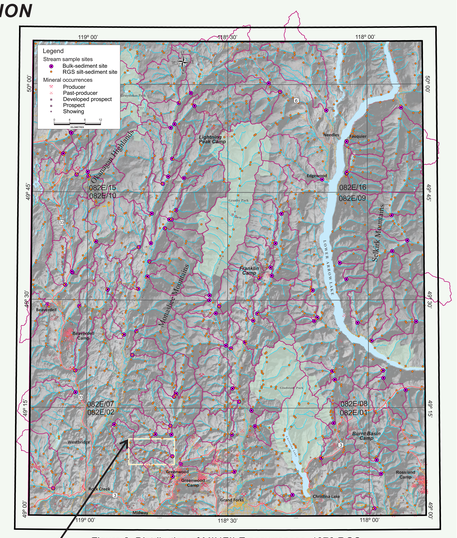

Figure 2. Distribution of MINFILE occurrences, 1976 RGS silt-sediment sample sites and new bulk-sediment sites.

WALLACE CREEK EXAMPLE

Figure 3 illustrates a typical distribution of nine silt-sediment sample sites accessed during the 1976 RGS program. As part of the 2019 study, a single bulk-sediment sample (ID 1092) was collected at the outlet of the 38 km^2 Wallace Creek drainage basin. Six of the RGS sites are at the outlets of small first- or second-order tributaries that have an average basin area of 2.5 km^2, and three sites located on the main stem of Wallace Creek drain areas of 20, 31 and 38 km^2. The PEN Zn-Ag-Pb-Cu prospect (NTS 082E/02; MINFILE 082ESE118; BC Geological Survey, 2019) and CM Cu showing (NTS 082E/02; MINFILE 082ESE196) are located in the drainage, and underlying geology is from Höy (2019). Table 1 provides details on the percentage coverage of each bedrock unit found within the Wallace Creek drainage basin.

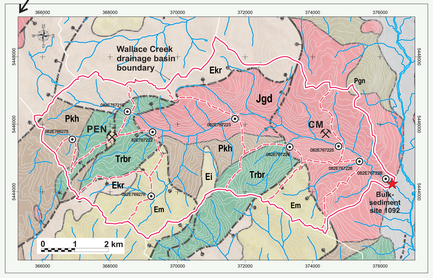

Figure 3. Distribution of previously collected RGS silt-sediment sample sites and their relationship to a 2019 bulk-sediment sample collected at the main stem outlet of Wallace Creek.

Table 1. Percent coverage of mapped bedrock geology located in the Wallace Creek drainage basin.

GEOLOGY	DESCRIPTION	COVERAGE (%)
Ei	CENOZOIC-PALEOGENE-Eocene - Alkalic intrusions: syenite, diorite, rhomb porphyry, quartz monzonite (in part equivalent to mEc)	1.5
Em	CENOZOIC-PALEOGENE-Eocene - Penticton Group: Marron Formation: trachyte, alkali basalt, tuff; minor shale or slate	16.9
Ekr	CENOZOIC-PALEOGENE-Eocene - Penticton Group: Kettle River Formation: sandstone, conglomerate; feldspathic grit, minor shale, tuff	13.7
Jgd	MESOZOIC-Early? to Middle Jurassic - Nelson intrusions: granodiorite, granite, minor diorite; locally porphyritic	37.4
Trbr	MESOZOIC-Late Triassic - Brooklyn Formation: massive greenstone, mafic volcanics; chert and limestone; related intrusions	16.7
Pkh	PALEOZOIC-Late Devonian to Early Permian - Knob Hill Complex: mafic volcanic rocks, chert, argillite, greenstone	13.8
Pgn	AGE UNKNOWN - Paragneiss; schist - quartzite; minor amphibolite, marble	0.1

Photo 3. Bulk sediment site 1092: a) sample pit, and b) bar-head sample site.

METHODS & SPECIFICATIONS

Sample collection, sample processing and analytical methods are based on protocols developed by the GSC's NGR program. Accredited laboratories with previous experience of BC RGS and NGR program requirements have been selected for sample preparation and analysis. These guidelines ensure that portions of collected materials can be incorporated into existing GSC and BCGS archives, and survey results can be included as part of the provincial and national geochemical databases.

A total of 98 bulk sediment samples, 104 conventional silt samples and 98 pebble samples were collected at 98 stream sites draining areas that averaged 45 km^2. At each site, a 12–15 kg bulk sample of sediment was collected from a single 50–75 cm deep, hand-dug pit located at the upstream end of mid-channel or side-channel bars or from mid-channel boulder traps. The material was obtained by wet-sieving coarse-grained sands and gravel using a US Sieve Series 10-mesh (2 mm) sieve and capturing the less than 10 mesh size grains in a 20 litre plastic pail lined with a polyethylene sample bag. Conventional silt samples were also collected from the active stream channel. An approximately 2 kg sample of fine-grained material was recovered and placed in a synthetic cloth bag. In addition, 50 large pebbles acquired from the oversized material during the sieving process were placed in a synthetic cloth bag. Standard field observations, photographs and location co-ordinates were recorded.

Bulk-sediment samples will be processed by Overburden Drilling Management Limited (Nepean, Ontario). The samples will be progressively reduced by a range of processing techniques to concentrate gold and base-metal indicators. Potential oxide and silicate indicators of massive-sulphide deposits will be visually identified, counted and hand-picked.

Sediment pulps processed to minus 80 mesh (177 um) will be analyzed by Bureau Veritas Commodities Laboratory (Vancouver, BC) for minor and trace elements by ICP-MS following aqua-regia digestion (53 elements). Total gold determinations plus 35 elements by INAA will be provided by Maxxam Analytics, a Bureau Veritas Group company. Loss-on-ignition (LOI) will also be determined. Control reference and duplicate samples are inserted randomly into each batch of 20 samples. Pebble samples will be sorted and catalogued to provide information on the lithology of bedrock sources found up- stream from the sample site.

Photo 4. a) upstream end of a mid-channel bar, b) a mid-channel boulder trap, c) hand excavation, of pit at head of bar, d) bulk sediment and silt-sediment samples, and e) pebble sample.

SUMMARY

Incorporating bulk stream-sediment sampling into government-funded RGS programs has been identified for effectively maintaining strict design requirements and program objectives while reducing overall collection costs. There are numerous opportunities to apply this survey technique in BC, including regions where RGS programs have not been previously conducted and areas where nominal sample-site densities may have undervalued mineral assessments or inadvertently misrepresented geochemical results.

Guided by NGR specifications, older first-pass RGS programs typically collected conventional silt-sediment samples at an average sample-site density of one site every 13 km^2. Although first- and second-order drainages were targeted, larger drainages were also sampled. Widely spaced sample sites leave large areas unrepresented. The geochemical results from samples collected at the outlet of large drainages could also be adversely affected by dilution of anomalous sediment and by complex bedrock and surficial geology that may limit the extent of element dispersal.

This project has been designed to demonstrate the application of this method in the ongoing development of the BC RGS database. It is expected that acquiring indicator minerals from a relatively small number of strategically located sample sites will improve overall geochemical coverage and enhance the detection and interpretation of mineral dispersion. Applying this technique to other regions of the province can further the utility of the existing RGS database as an exploration tool for the discovery of hidden mineralization, and be accomplished economically.

Final Report Release Date: Spring 2020

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REFERENCE

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