Stream Geochemical Survey Sample Reanalysis, Terrace and Prince Rupert Map Areas, Western British Columbia (NTS 103I, part of 103J)

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Introduction

The reanalysis of archived stream sediment samples by inductively coupled plasma mass spectrometry (ICP-MS) is accepted as a cost-effective means of obtaining new and improved regional geochemical information. This technique provides a significant upgrade from the atomic absorption spectroscopy (AAS) method routinely used for federal and provincial government-funded, reconnaissance-scale drainage sediment surveys conducted before 1999. The use of ICP-MS not only provides a wide range of new analytical information at improved detection limits but also offers greater data compatibility with laboratory methods currently being employed.

Recognizing the advantages associated with this type of initiative, Geoscience BC in partnership with the Terrace Economic Development Authority (TEDA), the Regional District of Kitimat Stikine through the Northern Development Initiative Trust (NDIT) and the KT Industrial Development Society (KTIDS) provided funding for the recovery and analyses of 2382 stream sediment pulps. This material originated from a 1978 geochemical survey conducted in the Terrace and Prince Rupert areas (NTS map sheets 103I and part of 103J; Figure 1).

Results of the Terrace and Prince Rupert Geochemical Survey Sample Reanalysis Project is expected to stimulate mineral exploration by presenting new high-quality geochemical information for an area that is considered to have good potential for future discoveries of precious- and base-metal deposits. The region has an active mining and exploration background with several past-producing mines, such as the Edye Pass mine (MINFILE 103J 015; MINFILE, 2008) and the M&K mine (MINFILE 103I 062). Historical metal recovery for the entire region is estimated to include 680 kg of gold, 550 kg of silver, 71 000 kg of copper, 42 000 kg of lead and 4000 kg of zinc (MINFILE, 2008). Project results will also significantly enhance existing geochemical data and other available geoscience information

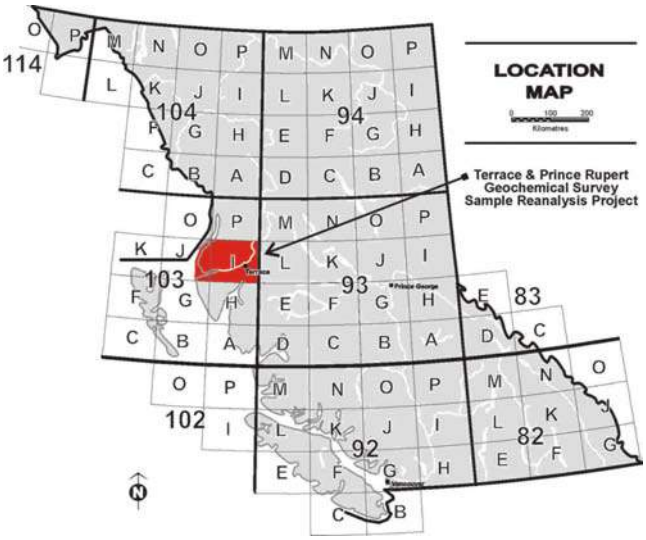

Figure 1. Location of the study area in western British Columbia.

as well as complement new exploration initiatives. Potential long-term economic benefits could also be generated from increased mineral exploration and deposit discoveries.

Project History

Originally conducted in 1978 by the Geological Survey of Canada (GSC) as part of their National Geochemical Reconnaissance (NGR) program, the Terrace and Prince Rupert survey included the collection of stream sediment and water samples from 2128 sites covering an area of 17 500 km^2 (Figure 2). The results of the survey were released in 1981 (Ballantyne et al., 1981) and included analytical data for only 13 metals (Table 1) in the stream sediment samples. By design, portions of samples from these government-funded regional geochemical surveys were saved on the understanding that advances in laboratory methods would provide opportunities to further develop the federal and provincial geochemical databases.

In the early 1990s, as part of the BC Regional Geochemical Survey (RGS) program and in co-operation with the GSC, over 24 000 archived sample pulps were reanalyzed by instrumental neutron activation analysis (INAA) for gold and a range of pathfinder metals and rare earth elements

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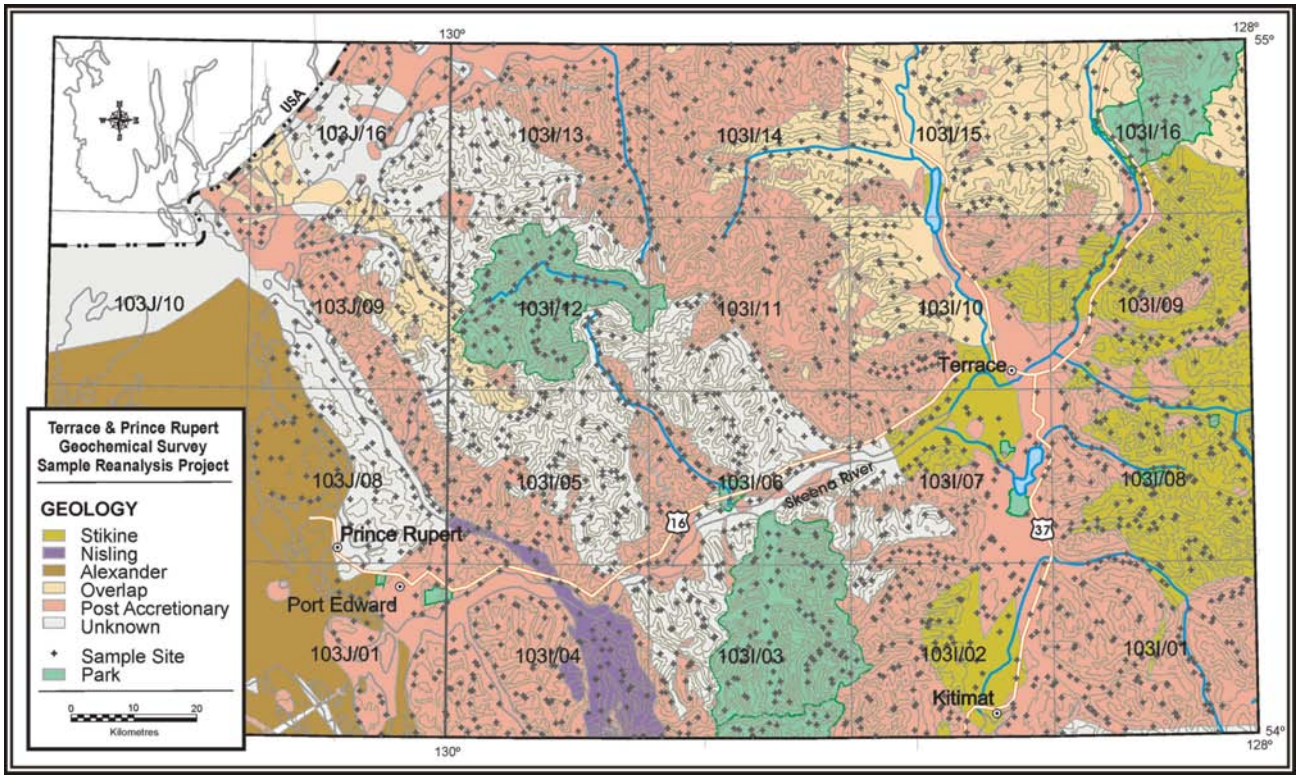

Figure 2. Geology of the Terrace and Prince Rupert map areas with the distribution of sample sites (*after* Massey et al., 2005; Ballantyne et al., 1981).

(Table 2). This province-wide initiative provided access to important new analytical information at improved detection limits and has significantly enhanced the utility of the provincial geochemical database (Jackaman et al., 1992). INAA results for the Terrace and Prince Rupert samples were released in 1995 (BC Ministry of Energy, Mines and Petroleum Resources, 1995). The work generated renewed interest in the areas surveyed and stimulated increased exploration activity.

More recently, saved NGR and RGS sample pulps are being reanalyzed by ICP-MS. The BC Geological Survey (BCGS), in co-operation with the GSC, funded the reanalysis of 1152 stream sediment samples from the McLeod Lake map sheet (Lett and Bluemel, 2006). As part of Geoscience BC's QUEST initiative, reanalysis results for a total of 3976 drainage sediment pulps, from around the Prince George area, were released to the public in January 2008 (Jackaman and Balfour, 2008; Geoscience BC, 2008). A total of 4160 stream and lake samples, from the White Sail Lake and Smithers area, have been reanalyzed as part of the QUEST-West project (Jackaman et al., 2009). The current Terrace and Prince Rupert reanalysis work will also contribute to this effort of providing up-to-date analytical information for previously surveyed areas within the province.

Table 1. List of elements and associated detection limits from published atomic absorption spectroscopy (AAS) analysis (Ballantyne et al., 1981).

Element	Detection limit	Units
Arsenic	0.5	ppm
Cobalt	2	ppm
Copper	2	ppm
Iron	0.02	%
Lead	2	ppm
Manganese	5	ppm
Mercury	10	ppb
Molybdenum	1	ppm
Nickel	2	ppm
Silver	0.2	ppm
Tungsten	1	ppm
Uranium	0.5	ppm
Zinc	2	ppm

Project Methodology

Drainage sediment pulps from previous NGR and RGS programs are currently stored at facilities in Ottawa and Victoria. The collections are maintained by Natural Resources Canada (NRCan) and the BCGS, respectively. Samples are stored in plastic containers organized by NTS map sheet designation and in order of sample identification numbers. Opportunely, the archive also includes original analytical duplicate and control reference samples that can be used to monitor and assess the accuracy and precision of any subsequent analytical work. On average, up to 30 g of the –80 mesh (180 µm) sediment fraction is available but, in

Table 2. List of elements and associated detection limits from published instrumental neutron activation analysis (INAA; BC Ministry of Energy, Mines and Petroleum Resources, 1995).

Element	Detection limit	Units
Antimony	0.1	ppm
Arsenic	0.5	ppm
Barium	100	ppm
Bromine	0.5	ppm
Cerium	5	ppm
Cesium	10	ppm
Chromium	5	ppm
Cobalt	5	ppm
Gold	2	ppb
Hafnium	1	ppm
Iron	0.2	%
Lanthanum	5	ppm
Lutetium	0.2	ppm
Molybdenum	1	ppm
Nickel	10	ppm
Rubidium	5	ppm
Samarium	0.5	ppm
Scandium	0.5	ppm
Sodium	0.1	%
Tantalum	0.5	ppm
Terbium	0.5	ppm
Thorium	0.5	ppm
Tungsten	2	ppm
Uranium	0.2	ppm
Ytterbium	2	ppm
Zirconium	200	ppm

some cases, samples may be missing or there is insufficient material remaining in the storage vials.

Geoscience BC, with support from NRCan and the BCGS, was provided access to the Terrace and Prince Rupert samples stored in Ottawa. A 1 to 2 g portion of archived stream sediment sample was carefully extracted from storage containers. Material from each vial was independently split and transferred to a Ziploc® bag labelled with the sample's original unique identification number. Once secured for shipping, the recovered material was delivered to Acme Analytical Laboratories Ltd. (Vancouver). At the lab, each sample was analyzed for 53 elements by ICP-MS analysis using an aqua regia digestion. A complete list of the elements and associated detection limits are provided in Table 3.

The resulting data was carefully checked for analytical quality using inserted blind duplicate and control reference samples. When the information was determined to be complete and accurate, the data was digitally merged with original sample site location information, AAS and INAA analytical results and field observations. This data compilation was prepared for public distribution in digital and hard copy formats and is scheduled to be released by Geoscience BC in December 2008.

Table 3. List of elements and associated detection limits from inductively coupled plasma mass spectrometry (ICP-MS) analysis using an aqua regia digestion, Terrace and Prince Rupert map areas.

Element	Detection limit	Units
Aluminum	0.01	%
Antimony	0.02	ppm
Arsenic	0.1	ppm
Barium	0.5	ppm
Beryllium	0.1	ppm
Bismuth	0.02	ppm
Boron	20	ppm
Cadmium	0.01	ppm
Calcium	0.01	%
Cerium	0.1	ppm
Cesium	0.02	ppm
Chromium	0.5	ppm
Cobalt	0.1	ppm
Copper	0.01	ppm
Gallium	0.1	ppm
Germanium	0.1	ppm
Gold	0.2	ppb
Hafnium	0.02	ppm
Indium	0.02	ppm
Iron	0.01	%
Lanthanum	0.5	ppm
Lead	0.01	ppm
Lithium	0.1	ppm
Magnesium	0.01	%
Manganese	1	ppm
Mercury	5	ppb
Molybdenum	0.01	ppm
Nickel	0.1	ppm
Niobium	0.02	ppm
Palladium	10	ppb
Phosphorus	0.001	%
Platinum	2	ppb
Potassium	0.01	%
Rhenium	1	ppb
Rubidium	0.1	ppm
Scandium	0.1	ppm
Selenium	0.1	ppm
Silver	2	ppb
Sodium	0.001	%
Strontium	0.5	ppm
Sulphur	0.02	%
Tantalum	0.05	ppm
Tellurium	0.02	ppm
Thallium	0.02	ppm
Thorium	0.1	ppm
Tin	0.1	ppm
Titanium	0.001	%
Tungsten	0.1	ppm
Uranium	0.1	ppm
Vanadium	2	ppm
Yttrium	0.01	ppm
Zinc	0.1	ppm
Zirconium	0.1	ppm

Project Summary

The primary objective of the Terrace and Prince Rupert Geochemical Survey Sample Reanalysis Project is to stimulate mineral exploration interest in the region by providing the mining and exploration community with new, high-quality analytical information. To accomplish this, a total of 2380 archived sample pulps from a regional geochemical survey completed in the region almost 30 years ago have been reanalyzed by ICP-MS. The resulting geochemical data compilation will provide local miners and prospectors with over 90 elements in stream sediments for each of the 2128 sample sites at an average density of one site every 8 km^2. In addition, the work will complement ongoing efforts by the BCGS and GSC to develop a comprehensive collection of geochemical information for the province. The provincial geochemical database includes analytical information for approximately 65 000 sample sites and covers over 70% of BC (Lett, 2005).

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