INVESTIGATION OF TREE SAP AS A SAMPLE MEDIUM FOR REGIONAL GEOCHEMICAL EXPLORATION IN GLACIAL SEDIMENT COVERED TERRAINS: A CASE HISTORY FROM THE ENDAKO AREA, NORTH-CENTRAL BC

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Introduction

This work was undertaken as a Geoscience BC funded study to determine if tree sap could provide a useful and possibly unique geochemical signal to buried mineralization (Heberlein et al. 2015). Congealed sap samples were collected in two sampling campaigns (September 2013 and May 2014) from the surfaces of more than 100 white spruce trees from over an area of 1000 km^2 surrounding the Endako Mo mine at a nominal sample spacing of 3 km. For comparison, soil pH measurements were made, and Ah soils were collected at the same locations. Lodgepole pine sap was also obtained from a few sites in order to compare the spruce sap chemistry with that of pine. An additional database of element concentrations in pine bark collected in the 1990s from the same general area also was available for comparison (Dunn & Hastings 1998 a, b, c and d). Work by others in Finland and Siberia (Kyuregyan & Burnutyan, 1972; Harju & Huldén 1990), as well as a recent Geoscience BC survey over the Woodjam Cu porphyry deposit (Heberlein et al. 2013), demonstrated a strong positive response of both commodity and pathfinder elements in spruce sap over blind or buried mineralization. Whereas previous analytical work was undertaken at research institutes, a new generation high-sensitivity ICP-MS is now available commercially, allowing method development to determine ultra-low (sub-ppb) concentrations of a wide range of elements at modest cost.

Methodology

A sampling strategy was developed to efficiently collect clean sap samples, which are critical to the process. The samples were sent to Actlabs, Ancaster, for analytical method development. After experimenting with many digestion methods, it was concluded that the optimal method involved initial dissolution of the sap in methanol followed by 0.45 µm filtration to remove contaminants. Filtered sap was then allowed to dry and the reconstituted material was re-dissolved in nitric-

perchloric acid. Analysis was carried out by an Agilent 7700 ICP-MS. This instrument minimizes normal ICP-MS interferences from oxides or chlorides using the dual gas/no gas modes.

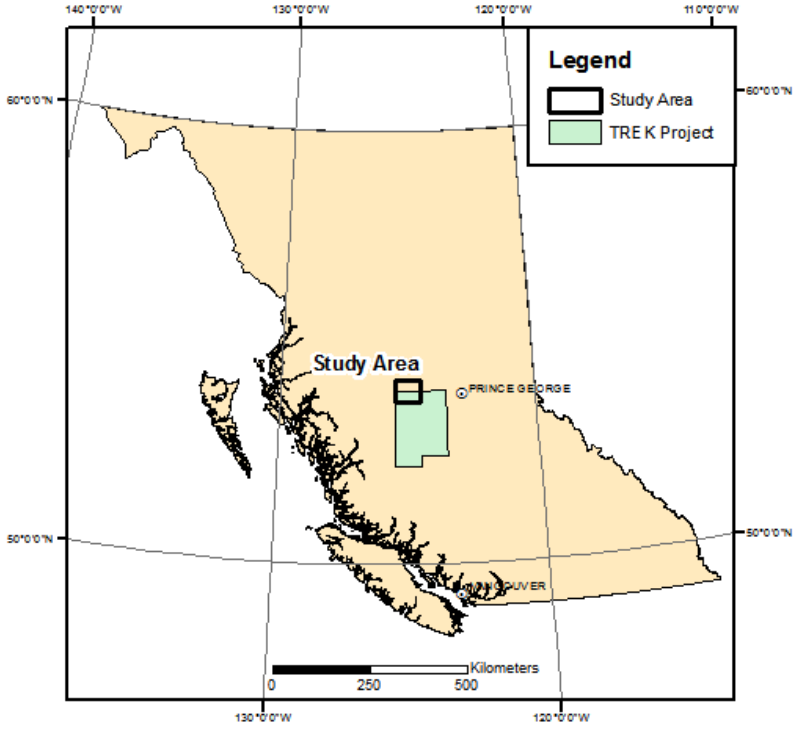

Figure 1. Location Map showing the Geoscience BC TREK Project and the survey area.

Results

Data from field duplicate sample pairs showed that for elements with concentration levels close to the detection limit the analytical precision was poor. However, for elements with concentrations well above detection levels precision was considerably improved and meaningful plots of the data could be made for some elements. This was especially true for Mo, the principal element of interest (Figure 2) and several pathfinder and major elements, including Re, Bi, U, REE, Th, K, Rb, P, Na, Mn, Cs, Ag and Sr. An example of the REE response is shown by Eu in Figure 3. Consequently focus is on elements which are highly anomalous at sites around the mine over a surrounding area of approximately 50 km^2. Background to anomaly contrast was similar in saps, Ah horizon soil and pine bark. Sap samples from the vicinity of Mo mineralization near Nithi Mountain did not produce a discernible response for Mo, but anomalies for Bi and W were detected close to the known mineralization. It is concluded that sample spacing was too coarse to clearly define the small mineral occurrences.

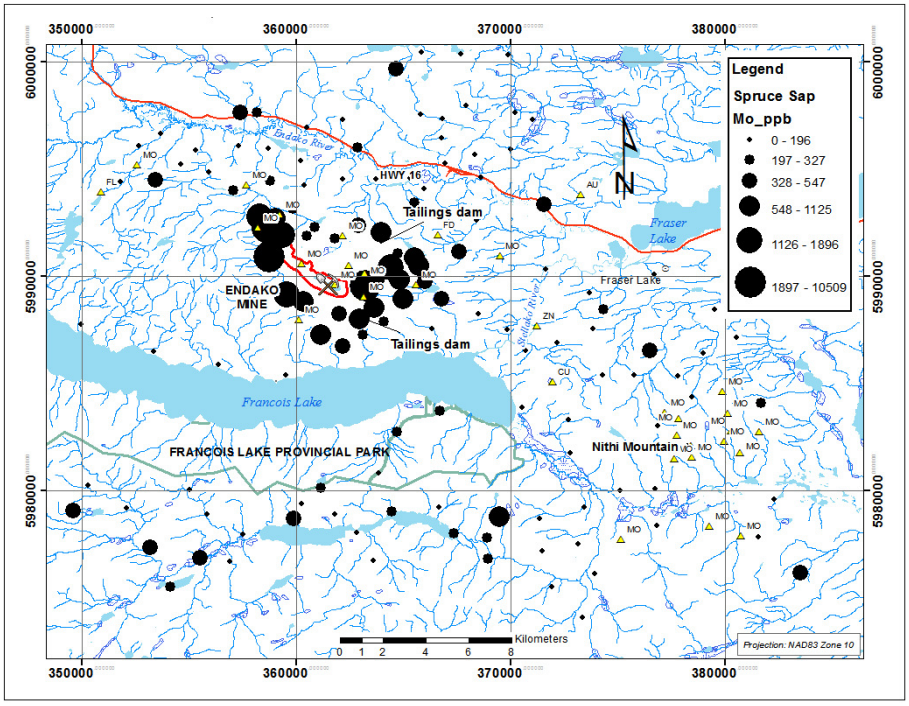

Figure 2. Molybdenum in white spruce sap. Red outline indicates the position of the Endako Mo deposit.

A comparison of sap compositions from adjacent spruce and pine trees at 5 sample stations indicated similar concentrations of some elements, but consistent differences in others. It is concluded that the data from the two species could not be integrated or levelled without first obtaining much larger sample populations for comparison.

Comparisons of element distribution patterns in spruce sap, Ah horizon soils and a collection of pine bark samples collected 15 years ago showed that Mo, U, Th and REE displayed broadly similar patterns in all media, but with slightly better defined signatures in the spruce sap. Tungsten in Ah and pine bark delineated the mine area well, but not as well in sap.

Soil pH readings from Ae or B horizon material collected at each sap sample location showed a robust H+ response surround the Endako ore body and extending for distances of up to 1.2 km to the northwest, 3.4 km to the east and 1.6 km to the south. Highest values were peripheral to a K radiometric anomaly that defines the extent of potassic alteration. The halo of high H+ values is interpreted to indicate the extent of the pyrite halo around the margins of the porphyry Mo system. The sap Mo response coincides spatially with these features.

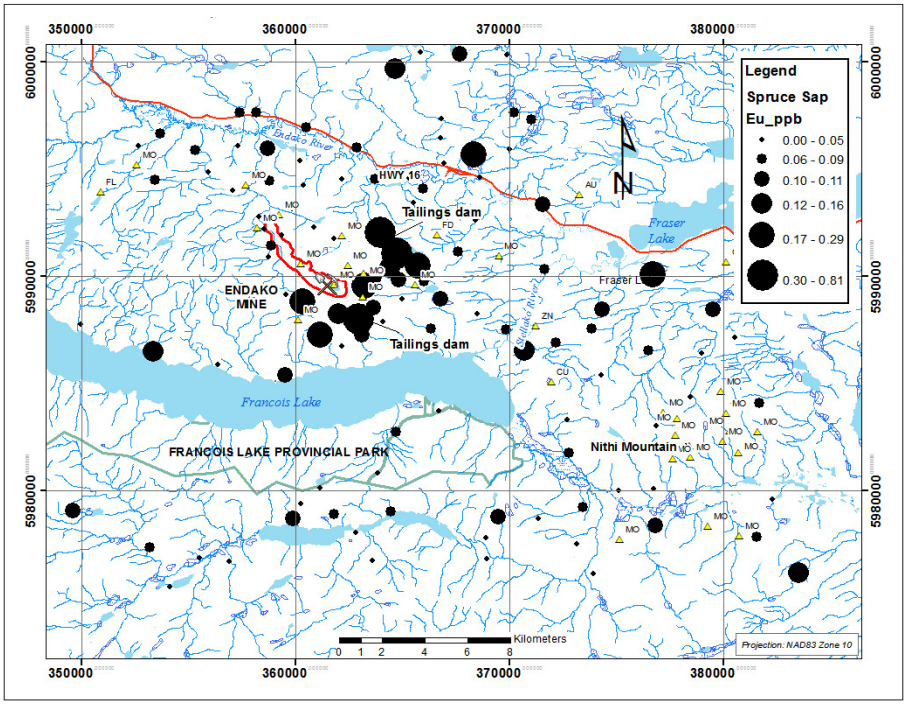

Figure 3. Europium in white spruce sap. Red outline indicates the position of the Endako Mo deposit.

Conclusions

It is concluded that if appropriate sampling protocols are followed spruce sap is an effective sample medium for regional scale exploration for porphyry Mo mineralization and there seems no impediment to using this method with other styles of mineralization. Spruce sap is easy to collect and can be submitted for analysis with no further preparation required. Element concentrations are mostly in the ppb range and so precision is likely to be inferior to that usually obtained from the analysis of soils or live vegetation. However, in areas of suspected contamination the sap might be a preferred sample medium since it is recently formed and derives its chemical signature from deep in the ground. Furthermore the digestion procedure developed for this project further excludes potential dust contamination from the analytical sample. The congealed sap contains the geochemical signature of essential elements that are surplus to the trees' metabolic function as well as pathfinder elements that perform no known function in plant growth and health, and so become readily exuded.

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