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Biogeochemical signatures of the area around the MAX molybdenum mine, southern British Columbia

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Abstract: A biogeochemical orientation survey was conducted in the vicinity of the MAX molybdenum mine, prior to mine development. A veneer of glacial till has left few outcrops of the underlying sheared Palaeozoic metasedimentary rocks. Western redcedar (*Thuja plicata* — ‘cedar’) was selected as the principal sample medium, with subalpine fir (*Abies lasiocarpa*) collected at higher elevations where cedar was absent. Data obtained from analysis for 53 elements in dry cedar foliage obtained from 109 sample stations found that trace-element concentrations were similar to those typical of cedar foliage, with the notable exception of high Mo (up to 30 times normal background levels of 0.5 ppm). Three zones with elevated levels of Mo in cedar were identified: a) around the original MAX showing; b) 1 km to the northeast; c) 700 m to the east-southeast. Subsequent drilling has confirmed previously unknown Mo mineralization at the most northerly of these anomalies. Lead, cadmium, silver and bismuth found in cedar delineate the Lucky Boy Ag-Pb-Zn prospect and a zone of weak Au and pathfinder elements occurs farther east.

Résumé : Nous avons mené un levé d’orientation biogéochimique dans le voisinage de la mine de molybdène MAX, avant sa mise en valeur. En raison de la présence d’un placage de till glaciaire, il existe peu d’affleurements des roches métasédimentaires cisailées du Paléozoïque qui forment le substratum. Nous avons choisi comme milieu d’échantillonnage principal le thuya géant de Californie (*Thuja plicata*) et, dans les zones de haute altitude d’où il est absent, le sapin subalpin (*Abies lasiocarpa*). L’analyse pour 53 éléments du feuillage sec du thuya prélevé à 109 stations a montré des concentrations d’éléments traces analogues à celles normalement trouvées dans le feuillage du thuya, à l’exception notable des fortes teneurs en Mo (qui peuvent dépasser jusqu’à 30 fois le niveau du bruit de fond de 0,5 ppm). Nous avons identifié trois zones de concentrations élevées de Mo dans le thuya : a) autour de l’indice original de la mine MAX, b) à 1 km au nord-est et c) à 700 m à l’est-sud-est. Des forages subséquents ont confirmé l’existence d’une minéralisation de Mo auparavant inconnue, au site de l’anomalie la plus au nord. Le plomb, le cadmium, l’argent et le bismuth contenus dans les échantillons de thuya permettent de délimiter le prospect de Ag-Pb-Zn de Lucky Boy et une zone de faible anomalie en Au et éléments traceurs est présente plus loin à l’est.

INTRODUCTION AND LOCATION

The MAX molybdenum mine (MAX) was known as the Trout Lake deposit until acquired by Roca Mines Ltd. in 2004. It is located 60 km southeast of Revelstoke, British Columbia (Fig. 1) and the staked ground comprises 45 km² in the Revelstoke Mining Division (NTS map sheet 82 K/12E).

EXPLORATION AND MINING HISTORY

The first claims staked in the MAX property area were the Lucky Boy and Copper Chief (polymetallic veins Ag-Pb-Zn±Au with skarn-hosted W; BC MINFILE #082KNW003 and 082KNW004) in 1897 and 1901, focusing on silver-bearing quartz veins. Shipments of assorted ore from the Lucky Boy were 450 tonnes (t), with a further 20 t of tungsten ore mined in 1942. In the early 1950s, Major Explorations Limited carried out surface exploration on tungsten-bearing skarns. Although molybdenite was reported as early as 1917, it was not until 1969 that a subsidiary of Scurry Rainbow Oil Limited (Cascade Moly Mines Limited) optioned a claim group covering the area discussed in this report. Newmont Mining Ltd. optioned the property in 1975 and entered into

the joint venture with Esso Minerals Canada in 1976. Surface exploration and drilling was undertaken until 1982 when there was a drop in the price of Mo resulting in a cessation of exploration activities. During this period, underground excavation included an adit, crosscuts and drifts at a depth of up to 500 m below the surface showing for a total distance of over 2000m. In 1997 claims expired in the central portion of the property covering the molybdenum deposit, and the ground was staked by Emerald Gold Mines Inc. In 2004 Roca Mines acquired the entire property.

GEOLOGY

The MAX property lies near the north end of the Kootenay Arc in tightly folded, strongly sheared, Paleozoic metasedimentary rocks. The reported commodities are molybdenum, tungsten, lead, zinc, and copper. The MAX mine is located in the area covered by NTS map sheet 082 K/12E, at a latitude of 50° 38' 11" N and longitude of 117° 36' 10" W (UTM zone 11 [NAD83], northing 5609545, easting 457374). A detailed description of the property is provided in the British Columbia Ministry of Energy, Mines and Petroleum Resources 'MINFILE' No. 082KNW087 (<http://minfile.gov.bc.ca/Summary.aspx?minfilno=082KNW087>) where it is reported that there is porphyry Mo (Low F- type), W skarn; and polymetallic veins Ag-Pb-Zn±Au.



Figure 1. Location map of study area.

Molybdenite mineralization is associated with a small Cretaceous granodiorite stock. A technical report on the property summarizes the geology:

A pipe-like mineralized body has been traced by extensive diamond drilling from its small surface exposure on a mountain ridge downward to where it swells out into a substantial deposit. At 500m below the surface showing, the Newmont-Esso joint venture drove a long adit to the deposit, and carried out drifting and crosscutting within it. Radiating diamond drill holes from underground delineated the central portion of the deposit, where its extent at that horizon is about 200 by 300m. Deeper exploratory drilling showed the body developed a steep south-westerly plunge below the adit level. Mineralization was traced as deep as 1000 m below surface where it remains open to extension. Molybdenite (MoS_2) is the only mineral of economic importance in this deposit. Along with pyrite and pyrrhotite, the total sulphide content is 1 to 2%, but runs as high as 10 to 15% in the higher grade zones. Molybdenite is mainly present along the margins of veins in a quartz stockwork. In the higher grade zones (>1% MoS_2) it is strongly disseminated in micro-fractured intrusive bodies accompanied by large quartz veins and intense quartz flooding. The vein stockwork is best developed in and around the margins of the intrusive and its dyke-like apophyses. The centre of the large granodiorite mass is virtually devoid of veining and mineralization. Faulting is evident in and around the deposit, some probably pre-mineralization.

A strong post-mineral fault bounds the east side of the deposit. Several long inclined diamond drill holes from surface into the central portion of the deposit produced exceptional results. For example, [one hole] averaged 0.408% MoS_2 over 271 m. Following that up, three more intersections in the same vicinity obtained averages of 0.225 to 0.443% over lengths of 276 to 349m. Within these long intersections were a number of 10 to 30m lengths of better grade material in the 0.5 to 1.0% range plus a few high grade ones, the best of which was 23m of 3.077%. The latter contained the highest individual sample of 1.5m containing 7.19%. The later underground program showed these to be in the largest of the five zones comprising the deposit, where dyking, veining, faulting is most intense. The mineralization continues to depth to the southwest. (Macauley, 2004).

Figure 2 shows the geology of the area and the location of the biogeochemical survey.

TOPOGRAPHY, VEGETATION, AND OVERBURDEN

The area under discussion in this paper is heavily forested terrain with little outcrop above the cover of glacial till. The hillside slopes steeply to the northeast. At levels up to an elevation of 1800 m the biogeoclimatic zone is that of interior cedar-hemlock. Here, the dominant tree species are western redcedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*), with some white spruce (*Picea glauca*) /Engelmann spruce (*Picea engelmannii*) hybrids. Also present are red alder, poplar, maple, and yew. This assemblage gives way at higher elevations to a subalpine zone dominated by sub-alpine fir (*Abies lasiocarpa*) and Engelmann spruce forest.

Overburden in the survey area comprises glacially transported and residual sediments. Trenching and road-building have shown it to range from half a metre in thickness near the ridge in the southwest to more than two metres over large areas, almost completely concealing the bedrock. Beneath a layer of litter and humus, the loamy soil comprises up to 15 cm of a light grey leached horizon (A2), underlain by a similar thickness of rusty to medium-brown B horizon, developed on brown to yellow-brown till.

SAMPLE COLLECTION

Previous work elsewhere on the uptake of various metals by trees has indicated that the alder and cedar are the species present in the survey area that have the capability of accumulating the highest levels of Mo. Alder is erratically distributed (mostly in lower level valleys), and so the western redcedar was selected as the principal sample medium.

Traverses were conducted up the steep slopes and samples collected mostly at 50 m intervals. Figure 3 shows the locations of all cedar samples.

At each sample station, 25 cm lengths of cedar twigs with attached foliage were collected. Each sample comprised 5 to 7 twigs of similar diameter that were snipped from around the circumference of a single tree using Teflon-coated anvil-type pruning snips (Fig. 4).

In the environment of the MAX molybdenum mine, this amount of twig growth typically has a maximum diameter of 4 to 5 mm. Consistency in twig diameter is quite critical, because many of trace elements are concentrated in the bark part of the twig, while the woody tissue (the cortex) has lower concentrations of most elements. Consequently, unless there is a consistency in the diameters of the twigs that are collected, any analysis of twig tissue can result in variability among samples simply because of the differing ratios of woody tissue to bark. Such inconsistency in sampling can be likened to mixing populations of A horizon and B horizon soil and expecting to obtain meaningful data despite the substantial differences in composition of the two media. For the

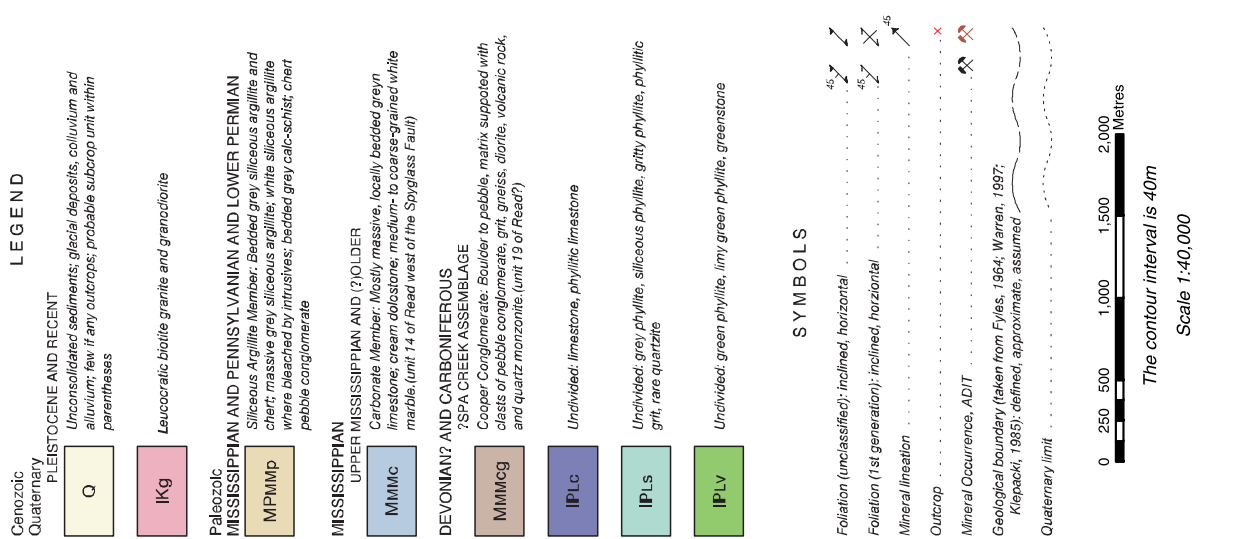


Figure 2. Geological map showing the extent of the biogeochemical survey area (dashed line, long black dashes, see Fig. 3).

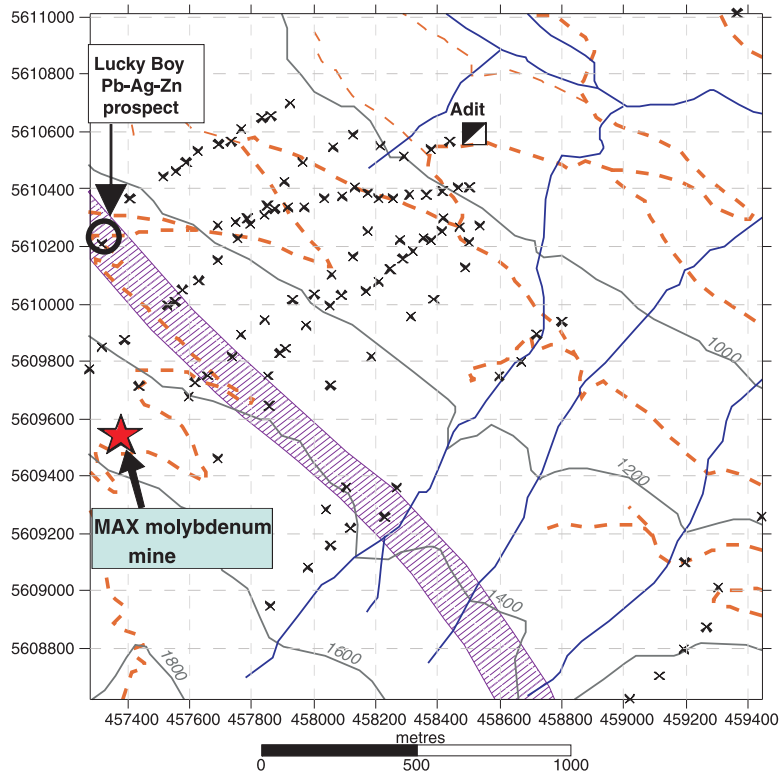


Figure 3. Location of cedar samples collected for the biogeochemical study (black x). Dashed lines are trails. Red star indicates location of original surface showing. Location of Figure 3 is shown in Figure 2. Hachured zone indicates unit mapped as carbonate-rich.



Figure 4. a) Typical sample of western redcedar foliage collected for analysis. b) Dried foliage separated from the twig tissue. Pen for scale.

current survey the potential problems that might ensue were not of particular significance because the foliage, and not the twigs, was to be targeted for analysis. However, as a general principle it is wise to follow this practice of consistency in sampling in order to minimize factors controlling metal accumulations that might simply be related to plant growth.

Unseparated twigs and foliage were placed into a porous polypropylene bag (Hubco Sentry II) and sent to laboratories in the Victoria area for several stages of processing prior to chemical analysis. The samples were dried at 75°C for 24 hours in their original bags in order to remove all moisture. This temperature is convenient but not critical and could be anywhere between 60°C (at which temperature drying would take much longer) and 100°C (above which Hg may start to partially volatilise). Tests have indicated that little or none of the Hg contained within plant structure is lost until between 120 and 150°C (Dunn, 2007). By drying at 75°C, the chemical integrity of the plant tissues is not affected with respect to the inorganic components which constitute the targets for an exploration biogeochemical survey.

Once fully dried, the green foliage readily separates from the woody tissue of the twigs (Fig. 4). For this survey the foliage was the medium selected for milling to a fine powder prior to sending them to Acme Labs (Vancouver) for analysis. A 1 g portion was digested in nitric acid, followed by aqua regia and the concentrations of 53 elements determined by ICP-MS (inductively-coupled plasma mass spectrometry).

Whereas the cedar was the primary sample medium, tissues from a few additional species were obtained for comparative purposes (e.g. western hemlock and shrub alder), and for providing some survey data for the area of higher elevation to the south where cedar is no longer present and sub-alpine fir and Engelmann spruce are dominant. For these species, the foliage was collected and processed in a similar manner. Bark samples were scraped from the tree with a hardened steel paint-scraper. Sample-preparation procedures and analysis followed the same procedures as for the foliage. Table 1 summarizes the sample collection.

Figure 5 shows typical growth of subalpine fir in the survey area. Five to seven years of growth is at about the point along the twig where the colour changes from pale to medium brown. A similar amount of growth was collected from the other species.

Figure 6 shows the locations where the cedar and subalpine fir foliage samples were collected. From the distribution of the sample sites and the elevation contours, it is clear that the transition from cedar to subalpine fir occurs at approximately 1500 m. Other species and tissues were collected from selected locations at which either the cedar or fir foliage was obtained.

RESULTS

Quality control

Quality control was monitored on several levels:

- Sample preparation duplicates: after every 20th sample a duplicate of that sample was prepared and submitted for a separate analysis
- Laboratory duplicates: duplicate analyses were undertaken by the analytical laboratory at a frequency of 1 in 33 samples, because samples were analyzed in trays of 33 samples.
- Control Reference Materials (CRMs) of known composition: six controls were inserted 'blind' by the authors and another four were inserted by the laboratory as part of their systematic quality-control procedures.

A measure of the reproducibility is the Relative Standard Deviation (RSD), expressed as a percentage. For most elements the RSD was less than 10%. The only elements to exhibit consistently poor precision (RSD >25%) were Au, Ga, Ge and Hf. There were 22 elements that were at or below detection in the cedar foliage: Ag, Al, As, Au, Be, Bi, Ga, Ge, Hf, In, Na, Nb, Pd, Pt, Re, Ta, Te, Th, Tl, U, V and W.

Table 2 shows all the data obtained for the CRMs. For most elements the accuracy and precision were excellent, as witnessed by the low RSD. At concentrations close to detection the RSD is inferior to that at higher concentrations. The generally poor precision for Au is largely a function of the low Au concentration in nearly all samples (<1 ppb): this is the typical variability that must be expected for Au at this level using this instrumentation. This appears to be a function of the well known 'nugget' effect that is experienced in other sample media. In the vegetation this is probably because Au is known to nucleate within plant structures as crystalline grains, usually <1 µm in diameter (Fig. 7)

In total, of the elements determined, almost half were either present at concentrations that were too low to be determined by the analytical method, or their precision was inadequate for further consideration. Fortunately, data for most of the elements of particular interest (e.g. base metals, Mo, Hg) in the study area were present at concentrations well above detection, and the analytical precision of these data was excellent.

STATISTICS

Element concentrations

In general, the trace-element concentrations are similar to those typical of cedar foliage from elsewhere. Table 3 shows some basic statistical parameters on the composition of the cedar foliage.

Table 4 compares the analyses of cedar foliage from the vicinity of the Mt. Polley Cu/Mo/Au porphyry (central British Columbia) with the MAX data set. This table compares the 50th and 90th percentiles and the maximum values.

Elements for which there are significant differences (well in excess of 100% higher) are highlighted by borders around the higher numbers (90th percentile, only). From this it is apparent that at Mt. Polley Au, Cu, Fe, and Sn are enriched, whereas around the MAX, Mo, Pb, Cs, and Rb (and to a lesser degree Ni) are more concentrated.

PLOTS

Maps were plotted using the software program 'Surfer' (v. 8) available from Golden Software Inc., Denver, CO. Data were kriged prior to plotting. Kriging is a regression technique used in geostatistics to approximate or interpolate data. Ideally for kriging, sample points should be evenly spaced on a grid so that contoured values are not extrapolated into areas with no sample control. Since this was designed as an orientation survey with logistical and financial constraints, sampling was not extended over an even grid. Consequently, in order that false extrapolations are not shown, areas around the margins of the map with no samples have been blanked

Table 1. Summary of sample collection and the tissues processed and analyzed

Species	Latin binomial	Tissue	No. of samples
Western redcedar	<i>Thuja plicata</i>	foliage	109
Western redcedar	<i>Thuja plicata</i>	outer bark	1
Subalpine fir	<i>Abies lasiocarpa</i>	foliage	27
Subalpine fir	<i>Abies lasiocarpa</i>	outer bark	24
Engelmann spruce	<i>Picea engelmannii</i>	foliage	27
Engelmann spruce	<i>Picea engelmannii</i>	outer bark	4
Western hemlock	<i>Tsuga heterophylla</i>	foliage	4
Western hemlock	<i>Tsuga heterophylla</i>	outer bark	27
Sitka alder	<i>Alnus sitchensis</i>	foliage	3
TOTAL			226



Figure 5. Typical subalpine fir foliage (approximately seven years of growth).

out. Note, however, that areas in the southeastern quadrant have limited data control and have not been blanked out between the widely spaced traverses. For the purposes of this study this does not appear to have introduced any significant 'false positive anomalies', but additional sampling in these areas would probably modify the overall picture.

Each map has been prepared in a similar manner of gradational colours following a spectrum from red for highest values, through orange, yellow, green, blue, pale mauve, and

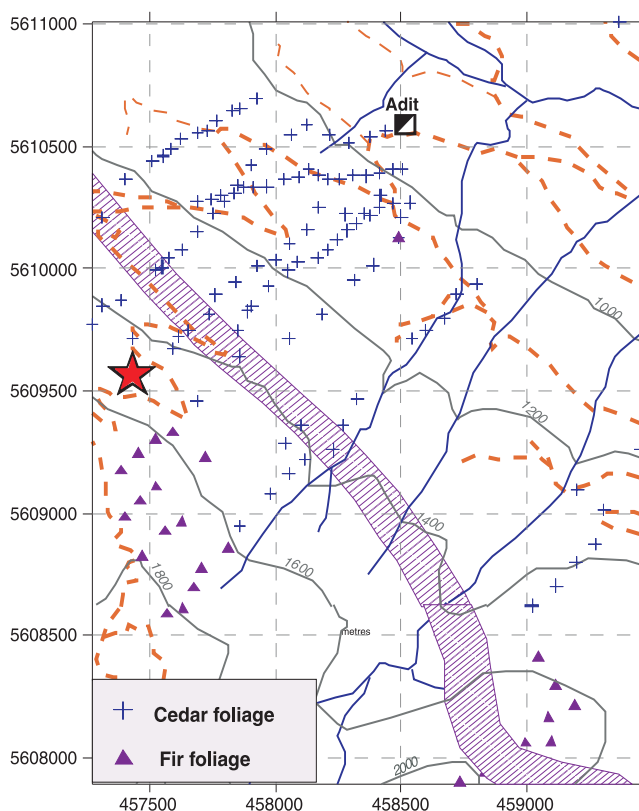


Figure 6. Locations of all the cedar and subalpine fir samples. Refer to Figure 3 for legend.

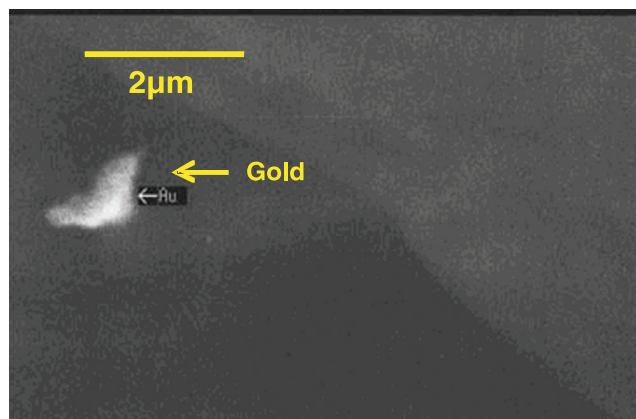


Figure 7. Crystalline gold within mountain hemlock bark – back-scatter image (from Dunn, 1995, 2007).

Table 2. Quality control. Control Reference Materials (CRMs) inserted as blind controls (V6) and by the laboratory (V14).

CRM	Species	Tissue	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	
			ppb	%	ppm	ppb	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppb	ppm	%	ppm	ppm	%	ppm	ppm	
			2	0.01	0.1	0.2	1	0.1	0.1	0.02	0.01	0.01	0.01	0.01	0.1	0.005	0.01	0.001	0.1	0.01	0.001	1	0.02	0.01	0.01	0.01	0.001	1	0.01	
			Blind control																											
V6	Jack pine	twigs	16	0.05	0.4	0.9	10	9.9	-0.1	0.02	0.84	0.24	1.83	0.4	3.6	0.033	8.8	0.08	0.2	0.01	0.011	30	-0.02	0.1	0.82	0.42	0.117	48	0.26	
V6	Jack pine	twigs	15	0.05	0.6	0.9	11	10.1	-0.1	0.02	0.83	0.28	1.89	0.45	3.7	0.034	7.8	0.078	0.2	0.02	0.012	40	-0.02	0.1	0.91	0.35	0.124	44	0.26	
V6	Jack pine	twigs	15	0.05	0.4	0.8	11	9.3	-0.1	0.02	0.77	0.23	1.84	0.41	3.4	0.03	8.4	0.075	0.2	0.02	0.011	38	-0.02	0.09	0.83	0.36	0.122	45	0.26	
V6	Jack pine	twigs	15	0.05	0.4	0.8	10	8.8	-0.1	0.02	0.78	0.29	1.75	0.42	3.8	0.031	7.6	0.085	0.2	0.03	0.013	38	-0.02	0.09	0.85	0.37	0.123	47	0.28	
V6	Jack pine	twigs	15	0.05	0.5	1.8	13	9.9	-0.1	0.02	0.76	0.26	1.87	0.41	3.6	0.034	7.6	0.081	0.2	0.02	0.009	41	-0.02	0.1	0.89	0.44	0.129	45	0.32	
V6	Jack pine	twigs	15	0.05	0.6	0.3	10	9.8	-0.1	0.02	0.76	0.26	2	0.4	3.7	0.033	7.6	0.079	0.2	0.03	0.01	29	-0.02	0.11	0.86	0.37	0.127	45	0.27	
			Average																											
			15	0.05	0.48	0.9	11	9.6	-0.1	0.02	0.79	0.26	1.86	0.42	3.6	0.033	8.0	0.080	0.2	0.02	0.011	36	-0.02	0.10	0.86	0.39	0.124	46	0.28	
			Std. Deviation																											
			0.4	0.00	0.10	0.5	1.2	0.5	0.02	0.04	0.02	0.08	0.02	0.1	0.002	0.5	0.003	0	0.01	0.007	5	0	0.01	0.03	0.04	0.004	1.5	0.02		
			RSD %																											
			3	0	20	53	11	5	0	82	5	9	4	5	4	5	6	4	0	35	13	14	0	8	4	9	3	3	9	
			Target value																											
			15	0.04	0.37	0.8	10	8.9	-0.1	-0.02	0.734	0.23	1.6	0.39	3.3	0.029	7.5	0.074	0.13	0.02	0.009	35	-0.02	0.09	0.73	0.33	0.110	41	0.24	
			Lab in-house control																											
V14	Mtn hemlock	needles	28	0.16	12.0	12.6	21	1.4	-0.1	0.1	0.69	0.24	0.06	0.86	1.1	0.033	4.9	0.019	0.1	-0.01	-0.001	60	-0.02	0.54	0.04	0.14	0.084	2296	0.05	
V14	Mtn hemlock	needles	27	0.16	11.5	13.9	17	1.5	-0.1	0.1	0.69	0.22	0.06	0.76	1	0.031	5.2	0.017	0.1	-0.01	-0.002	56	-0.02	0.51	0.03	0.11	0.078	2130	0.06	
V14	Mtn hemlock	needles	24	0.16	11.9	7.8	18	1.5	-0.1	0.1	0.65	0.22	0.06	0.87	1.2	0.035	5.2	0.017	0.1	0.01	0.001	54	-0.02	0.5	0.03	0.12	0.079	2109	0.07	
V14	Mtn hemlock	needles	26	0.15	12.2	9.3	19	1.5	-0.1	0.1	0.74	0.24	0.06	0.83	1.1	0.035	5.1	0.018	0.1	0.02	0.001	54	-0.02	0.56	0.04	0.1	0.085	2295	0.06	
			Average																											
			26	0.16	11.9	10.9	19	1.5	-0.1	0.1	0.69	0.23	0.06	0.83	1.1	0.034	5.1	0.018	0.1	-0.01	0.001	56	-0.02	0.53	0.035	0.12	0.082	2208	0.06	
			Std. Deviation																											
			2	0.01	0.29	2.8	2	0.05	0	0	0.04	0.01	0	0.05	0.08	0.002	0.1	0.001	0	0.001	3	0	0.03	0.006	0.02	0.004	1.02	0.01		
			RSD%																											
			7	3	2	26	9	3	0	5	5	5	0	6	7	6	2	5	0	0	168	5	0	5	16	15	4	5	14	
			Target value																											
			27	0.14	9.38	5.7	15	1.4	-0.1	0.08	0.68	0.20	-0.01	0.68	1.3	0.025	4.9	0.013	-0.1	-0.01	0.001	50	-0.02	0.48	-0.01	0.29	0.080	2012	0.06	

Table 2. (cont.)

CRM	Species	Tissue	Na	Nb	Ni	P	Pb	Pd	Pt	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	Tl	U	V	W	Y	Zn	Zr	
			%	ppm	ppm	%	ppm	ppb	ppb	ppm	ppb	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	
			0.001	0.01	0.1	0.001	0.01	2	1	0.1	1	0.01	0.02	0.1	0.1	0.02	0.5	0.001	0.02	0.01	1	0.02	0.01	2	0.1	0.001	0.1	0.01		
			Blind control																											
V6	Jack pine	twigs	0.009	0.07	3.2	0.043	16.8	-2	-1	1.1	1	0.05	0.06	0.2	0.2	0.14	32	0.001	-0.02	0.1	23	-0.02	0.07	2	-0.1	0.43	46	0.34		
V6	Jack pine	twigs	0.009	0.08	2.9	0.045	17.2	-2	-1	1.2	-1	0.05	0.06	0.3	0.3	0.17	37	0.002	-0.02	0.13	26	0.02	0.07	2	-0.1	0.52	38	0.38		
V6	Jack pine	twigs	0.008	0.07	3.1	0.041	15.5	-2	-1	1.1	-1	0.05	0.06	0.3	0.2	0.18	33	0.002	-0.02	0.12	23	-0.02	0.06	-2	-0.1	0.44	37	0.35		
V6	Jack pine	twigs	0.009	0.07	3.1	0.045	17.0	-2	-1	1.1	-1	0.03	0.07	0.3	0.2	0.18	34	0.003	-0.02	0.11	25	-0.02	0.06	3	-0.1	0.47	38	0.33		
V6	Jack pine	twigs	0.01	0.07	3.2	0.051	17.7	-2	-1	1.2	-1	0.07	0.07	0.3	0.2	0.17	41	0.003	-0.02	0.1	25	-0.02	0.07	3	-0.1	0.53	39	0.35		
V6	Jack pine	twigs	0.009	0.07	2.9	0.048	17.9	-2	-1	1.1	1	0.06	0.06	0.3	0.3	0.17	36	0.001	-0.02	0.1	25	-0.02	0.06	2	-0.1	0.46	35	0.33		
			Average																											
			0.009	0.07	3.1	0.046	17.0	-2	-1	1.1	-1	0.05	0.06	0.3	0.23	0.17	35	0.002	-0.02	0.11	25	-0.02	0.0650	-2	-0.1	0.47	39	0.35		
			Std. Deviation																											
			0.001	0.00	0.1	0.004	0.8	0	0	0.1	0.01	0.01	0.04	0.05	0.01	0.3	0.001	0	0.01	0	0.01	1	0.01	0.01	0.01	0.04	4	0.02		
			RSD %																											
			7	6	4	8	5	0	0	5	0	26	8	14	22	9	8	45	0	11	5	0	8	0	100	8	10	5		
			Target value																											
			0.008	0.07	3.0	0.042	16.1	-2	-1	0.98	-1	0.06	0.05	0.2	0.25	0.133	33	0.002	-0.02	0.10	21	-0.02	0.06	-2	-0.1	0.41	34	0.29		
			Lab in-house control																											
V14	Mtn hemlock	needles	0.002	0.01	1.5	0.106	0.82	-2	-1	1.9	1	0.07	0.06	0.2	0.3	0.04	7.5	-0.001	-0.02	-0.01	9	0.04	-0.01	-2	-0.1	0.024	15	0.04		
V14	Mtn hemlock	needles	0.002	0.01	1.4	0.096	0.92	-2	-1	1.8	-1	0.07	0.06	0.1	0.1	0.2	7	-0.001	-0.02	-0.01	7	0.04	-0.01	-2	-0.1	0.02	15	0.04		
V14	Mtn hemlock	needles	0.002	0.01	1.5	0.089	0.94	-2	-1	2.1	-1	0.08	0.06	0.1	0.1	0.07	6.5	-0.001	-0.02	-0.01	8	0.04	-0.01	-2	-0.1	0.024	16	0.05		
V14	Mtn hemlock	needles	0.002	0.01	1.4	0.107	0.94	-2	-1	1.9	-1	0.09	0.08	0.2	0.2	0.05	7.3	-0.001	-0.02	-0.01	9	0.04	-0.01	-2	-0.1	0.022	16	0.04		
			Average																											
			0.002	0.01	1.5	0.100	0.91	-2	-0.5	1.9	-0.5	0.08	0.07	0.2	0.18	0.09	7.1	-0.001	-0.02	-0.01	8	0.04	-0.01	-2	-0.1	0.023	15.6	0.04		
			Std. Deviation																											
			0	0	0.1	0.009	0.06	0	0	0.1	0.01	0.01	0.1	0.10	0.07	0.4	0	0	0	0	0	0	0	0	0	0	0.002	0.5	0.01	
			RSD %																											
			0	0	4	9	6	0	0	7	12	15	38	55	83	6	0	0	0	0	12	0	0	0	0	0	8.5	3	12	
			Target value																											
			-0.002	0.01	1.3	0.100	0.89	-2	-1	1.8	-2	0.05	0.04	0.2	0.12	0.08	5.7	-0.001	-0.02	-0.01	7	0.03	-0.01	-2	-0.1	0.003	16.3	0.03		

Table 3. Statistics on the analysis of dry cedar foliage from the survey area.

		N	Mean	Standard deviation	Minimum	Percentiles						Maximum	
						Valid	25	50	60	70	80		90
Ag	ppb	109	5	20	1	2	2	3	3	3.4	5	8	217
Al	%	109	0.005	0	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01
As	ppm	109	0.09	0.052	0.05	0.05	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Au	ppb	109	0.22	0.27	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.5	2.2
B	ppm	109	9	4.4	3	6	9	9	10	12	13	17	31
Ba	ppm	109	17	12	1.9	8.8	14	17	20	25	38	44	64
Be	ppm	109	0.05	0	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Bi	ppm	109	0.01	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05
Ca	%	109	1.099	0.275	0.49	0.94	1.055	1.108	1.202	1.314	1.464	1.644	1.81
Cd	ppm	109	0.02	0.024	0.005	0.01	0.02	0.02	0.03	0.03	0.04	0.06	0.21
Ce	ppm	109	0.04	0.027	0.02	0.03	0.035	0.04	0.05	0.05	0.07	0.1	0.18
Co	ppm	109	0.04	0.022	0.01	0.023	0.03	0.04	0.04	0.05	0.06	0.08	0.14
Cr	ppm	109	1.7	0.21	1.2	1.6	1.7	1.8	1.8	1.84	1.9	2	2.8
Cs	ppm	109	0.043	0.057	0.003	0.012	0.021	0.028	0.036	0.069	0.106	0.167	0.396
Cu	ppm	109	2.04	0.48	1.06	1.68	2.01	2.08	2.23	2.40	2.68	2.80	3.98
Fe	%	109	0.005	0.003	0.002	0.004	0.004	0.005	0.005	0.005	0.007	0.008	0.022
Ga	ppm	109	0.05	0.008	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1
Ge	ppm	109	0.009	0.005	0.005	0.005	0.01	0.01	0.01	0.01	0.02	0.02	0.03
Hf	ppm	109	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.004
Hg	ppb	109	18	7	5	14	17	19	21	24	28	32	40
In	ppm	109	0.01	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
K	%	109	0.42	0.077	0.24	0.37	0.42	0.44	0.46	0.48	0.527	0.54	0.69
La	ppm	109	0.03	0.02	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.07	0.1
Li	ppm	109	0.09	0.65	0.005	0.01	0.03	0.03	0.031	0.04	0.06	0.12	6.9
Mg	%	109	0.074	0.018	0.038	0.062	0.073	0.078	0.082	0.087	0.098	0.103	0.133
Mn	ppm	109	234	211	40	103	174	206	259	336	444	639	1336
Mo	ppm	109	3.1	3.6	0.2	0.74	1.63	2.24	3.22	5.01	8.72	13.2	16.0
Na	%	109	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003
Nb	ppm	109	0.006	0.002	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.02
Ni	ppm	109	1.8	1.38	0.05	0.73	1.4	1.8	2.1	2.8	3.7	4.7	7.7
P	%	109	0.11	0.025	0.058	0.091	0.112	0.115	0.122	0.129	0.146	0.154	0.195
Pb	ppm	109	0.16	0.26	0.01	0.06	0.09	0.11	0.14	0.19	0.31	0.4	2.26
Pd	ppb	109	1	0.3	1	1	1	1	1	1	2	2	2
Pt	ppb	109	0.6	0.2	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1
Rb	ppm	109	4.2	3.5	0.5	2	3.5	4.1	4.9	6.2	8.6	11	26
Re	ppb	109	0.56	0.16	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1
S	%	109	0.07	0.019	0.01	0.05	0.07	0.07	0.08	0.08	0.097	0.1	0.12
Sb	ppm	109	0.04	0.06	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.09	0.53
Sc	ppm	109	0.19	0.07	0.05	0.13	0.2	0.2	0.2	0.2	0.3	0.3	0.4
Se	ppm	109	0.16	0.07	0.05	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Sn	ppm	109	0.013	0.007	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.023	0.05
Sr	ppm	109	42	16	9.3	31	40	43	48	51	65	75	97
Ta	ppm	109	0.001	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Te	ppm	109	0.01	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Th	ppm	109	0.006	0.002	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.02
Ti	ppm	109	5.7	1.8	3	4	6	6	7	7	8	8	12
Tl	ppm	109	0.01	0.004	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04
U	ppm	109	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.06
V	ppm	109	1.01	0.1	1	1	1	1	1	1	1	1	2
W	ppm	109	0.05	0.02	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2
Y	ppm	109	0.01	0.01	0.003	0.006	0.008	0.009	0.011	0.012	0.024	0.033	0.053
Zn	ppm	109	11	10	5.8	8.2	10	11	12	13	15	17	109
Zr	ppm	109	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.07

Table 4. Comparison of element concentrations in cedar foliage from the MAX survey area with those from south of Mt. Polley (shaded).

		MaxMoly	Mt.Polley	MaxMoly	Mt.Polley	MaxMoly	Mt.Polley	MaxMoly	Mt.Polley
		N	N	Percentiles				Maximum	Maximum
				50	50	90	90		
Ag	ppb	109	46	2	3	5	4	217	6
Al	%	109	46	0.005	0.005	0.005	0.006	0.01	0.010
As	ppm	109	46	<0.1	<0.1	0.2	0.13	0.3	0.30
Au	ppb	109	46	0.1	0.5	0.4	2.7	2.2	5.0
B	ppm	109	46	9	16	13	23	31	29
Ba	ppm	109	46	14	25	38	51	64	63
Be	ppm	109	46	<0.1	<0.1	0.05	<0.1	<0.1	<0.1
Bi	ppm	109	46	<0.02	<0.02	<0.02	<0.02	0.05	0.05
Ca	%	109	46	1.055	1.150	1.464	1.530	1.81	1.660
Cd	ppm	109	46	0.02	0.03	0.04	0.06	0.21	0.07
Ce	ppm	109	46	0.035	0.06	0.07	0.10	0.18	0.11
Co	ppm	109	46	0.03	0.06	0.06	0.08	0.14	0.10
Cr	ppm	109	46	1.7	2.1	1.9	2.3	2.8	2.5
Cs	ppm	109	46	0.021	0.016	0.106	0.035	0.396	0.065
Cu	ppm	109	46	2.01	5.3	2.68	7.6	3.98	11.0
Fe	%	109	46	0.004	0.012	0.007	0.020	0.022	0.023
Ga	ppm	109	46	<0.1	<0.1	<0.1	<0.1	<0.01	<0.1
Ge	ppm	109	46	0.01	<0.01	0.02	0.01	0.03	0.01
Hf	ppm	109	46	0.001	0.002	0.002	0.004	0.004	0.006
Hg	ppb	109	46	17	23	28	33	40	42
In	ppm	109	46	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
K	%	109	46	0.42	0.530	0.527	0.679	0.69	0.770
La	ppm	109	46	0.02	0.04	0.05	0.07	0.1	0.08
Li	ppm	109	46	0.03	0.03	0.06	0.11	6.9	0.38
Mg	%	109	46	0.073	0.102	0.098	0.126	0.133	0.147
Mn	ppm	109	46	174	159	444	345	1336	412
Mo	ppm	109	46	1.63	1.2	8.72	2.5	16.0	10.1
Na	%	109	46	0.001	0.002	0.002	0.002	0.003	0.003
Nb	ppm	109	46	0.005	0.01	0.01	0.03	0.02	0.07
Ni	ppm	109	46	1.4	1.2	3.7	2.2	7.7	3.6
P	%	109	46	0.112	0.123	0.146	0.163	0.195	0.187
Pb	ppm	109	46	0.09	0.09	0.31	0.14	2.26	0.58
Pd	ppb	109	46	<2	<2	<2	<2	<2	<2
Pt	ppb	109	46	<1	<1	<1	<1	<1	<1
Rb	ppm	109	46	3.5	2.1	8.6	3.9	26	9.5
Re	ppb	109	46	<1	<2	1	<2	1	2.0
S	%	109	46	0.07	0.070	0.097	0.130	0.12	0.160
Sb	ppm	109	46	0.02	0.02	0.06	0.06	0.53	0.34
Sc	ppm	109	46	0.2	0.2	0.3	0.3	0.4	0.3
Se	ppm	109	46	0.2	0.2	0.2	0.2	0.3	0.3
Sn	ppm	109	46	0.01	0.03	0.02	0.08	0.05	0.32
Sr	ppm	109	46	40	60	65	92	97	117
Ta	ppm	109	46	<0.002	<0.002	0.001	<0.002	0.001	0.0
Te	ppm	109	46	<0.02	<0.02	0.01	<0.02	0.01	<0.02
Th	ppm	109	46	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Ti	ppm	109	46	6	8.0	8	10.3	12	12.0
Tl	ppm	109	46	<0.02	<0.02	0.01	<0.02	0.04	<0.02
U	ppm	109	46	<0.01	<0.01	0.005	<0.01	0.06	<0.01
V	ppm	109	46	<2	<2	<2	<2	2	<2
W	ppm	109	46	<0.1	<0.1	<0.1	<0.1	0.2	0.3
Y	ppm	109	46	0.008	0.03	0.024	0.05	0.053	0.06
Zn	ppm	109	46	10	12	15	15	109	21
Zr	ppm	109	46	0.02	0.05	0.03	0.07	0.07	0.68

white for lowest concentrations. Some elements (e.g. As and Au) have low concentrations and so a more limited spectrum of colours has been selected. These are 'image' maps in the Surfer nomenclature. Colour changes have been adjusted to the percentile intervals and, depending on the distribution of the data population for each element, have been trimmed to an appropriate percentile level. For example, data for all plots are trimmed to the 95th percentile, which is an appropriate cut-off for the cedar sample population of 109 samples. By so doing, extreme values do not unduly distort the contour patterns of the remainder of the data set, because all values greater than the 95th percentile are given the same colour code. The colour change from green to blue represents about the 70th percentile. Above the colour code bar to the right of each plot, the maximum value can be found. In addition to the gradational contours, each map has sample sites, drainage, elevation contours and a UTM grid superimposed on it.

For selected elements, a 3D surface relief map has been prepared in addition to the image plots in order to illustrate the relative amplitudes (arithmetic) of element concentrations. For example, a kriged plot of Pb prepared as an image map shows an area in the northwest (around the Lucky Boy prospect) that has anomalous Pb (Fig. 8) and a lesser anomaly in the southeast. However, from the surface plot shown alongside, this anomaly is put into perspective with respect to its amplitude compared to the values returned from samples over the remainder of the survey area.

Figure 9 shows that near the adit there are slightly elevated levels of Au. Values reach only one order of magnitude above background, but there are several sites with slightly elevated values. Coincident with the Au and upslope are elevated levels of Sb and Cu. The Sb is present, too, in association with mineralization at the Lucky Boy Pb-Ag-Zn prospect in the northwest. Antimony levels are quite low, but

there is geochemical enrichment relative to elsewhere in the survey area. The As, however, exhibits very subtle enrichment that flanks the Au. Sulphur follows the upslope trend of the Sb anomaly and is similarly enriched farther to the south, partly in association with the Cu. Potassium shows a somewhat different distribution pattern that is only partly coincident with S. This may be because K is an essential element to plant metabolism. As a result, K is not usually a useful element in biogeochemical exploration.

Figure 10 shows anomalous concentrations of Pb, Cd, Ag, and Bi on the west side of the map near the site of the Lucky Boy Pb-Ag-Zn prospect. The Cd is shown instead of Zn because Zn is an essential element for plant metabolism and so quite high concentrations are commonly present in plant structures. Zinc and Cd are commonly associated in nature, but Cd is not an essential element for plants. It can, however, be passively taken up through root systems and elevated concentrations tend to better reflect zones of Zn enrichment than Zn itself. The presence of Bi at Lucky Boy does not appear to have been reported in the literature, but its presence in the plant structure would indicate a typical skarn association. A relatively carbonate-enriched zone has been mapped through this area.

Figure 11 shows results for the element of greatest importance for this area — molybdenum. The figure presents an image map, and two surface-relief maps. The latter two are shown from different aspects: the first is viewed from above with illumination from the northwest, and tilted at an angle of 45°, and the second is viewed from the southwest with illumination from the northwest. The last of these plots shows the location of the recently developed MAX Moly mine and two areas of anomalous Mo concentrations in the cedar foliage for which the source was unknown at the time of the survey.

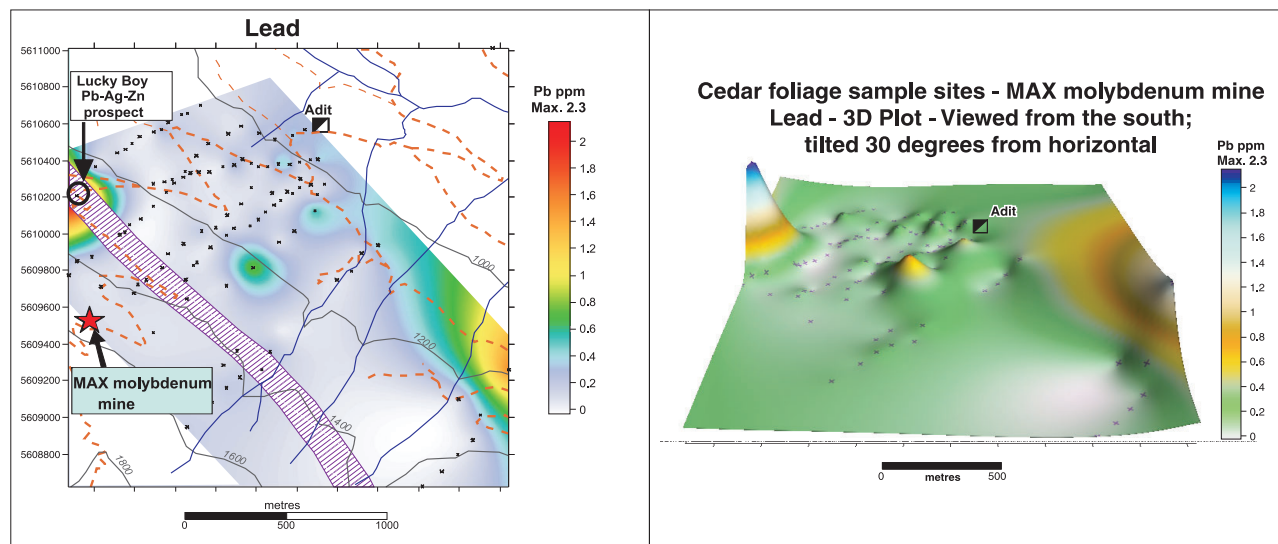


Figure 8. Lead in dry cedar foliage — two perspectives

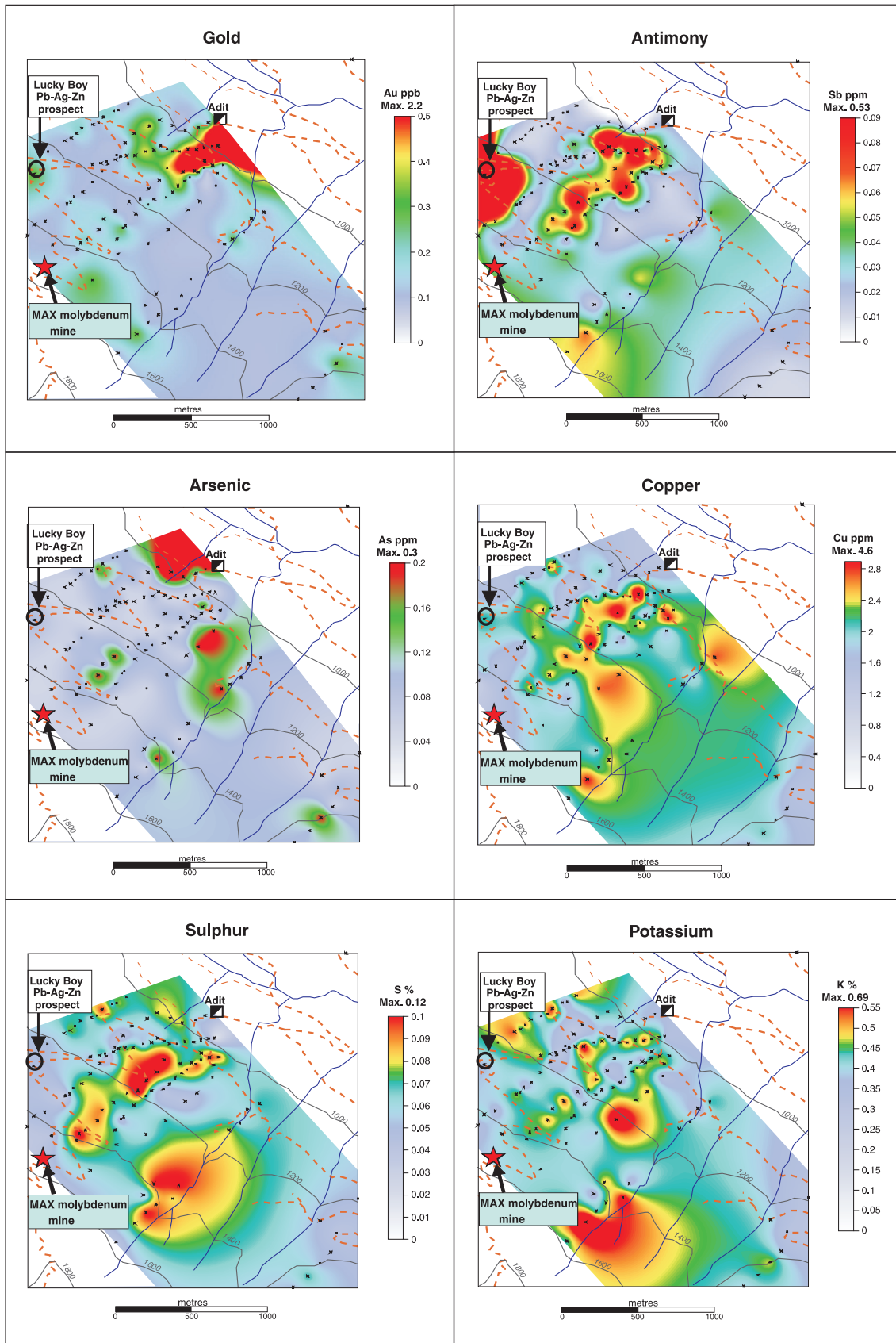


Figure 9. Au, Sb, As, Cu, S and K in dry cedar foliage.

Sampling was undertaken before mining operations at the MAX commenced, and the survey did not extend as far as the proposed mine site. However, the survey outlined the response to MAX mineralization and identified two other anomalies of similar intensity (Fig. 11). The magnitude of these anomalies is about 30 times normal background levels of Mo in plant tissue (Markert, 1994), and more than 10 times the local background for Mo in cedar foliage (i.e. the median value).

OTHER SPECIES AND TISSUES

As noted earlier, at higher elevations subalpine fir becomes the dominant species and except for a narrow zone where both cedar and fir are present, a change of species to sample becomes a requirement in order to continue a survey

into higher elevations. Since this was designed as an orientation survey, species other than cedar were collected on an opportunistic basis.

Cedar foliage vs. subalpine fir foliage

Both cedar foliage and fir foliage were collected at only one sample station, hence no definitive statement can be made as to the relative abilities of these two tissues to accumulate metals. Observations on the multi-element composition of the two samples are (with relative concentrations in parentheses)

- Cedar foliage was relatively enriched in Ca (x3), REE (x5), Li (x3), Mo (x10), Pb (x5), and Sr (x6).
- Subalpine fir foliage was relatively enriched in Cu (x2), P (x2), and Zn (x5).

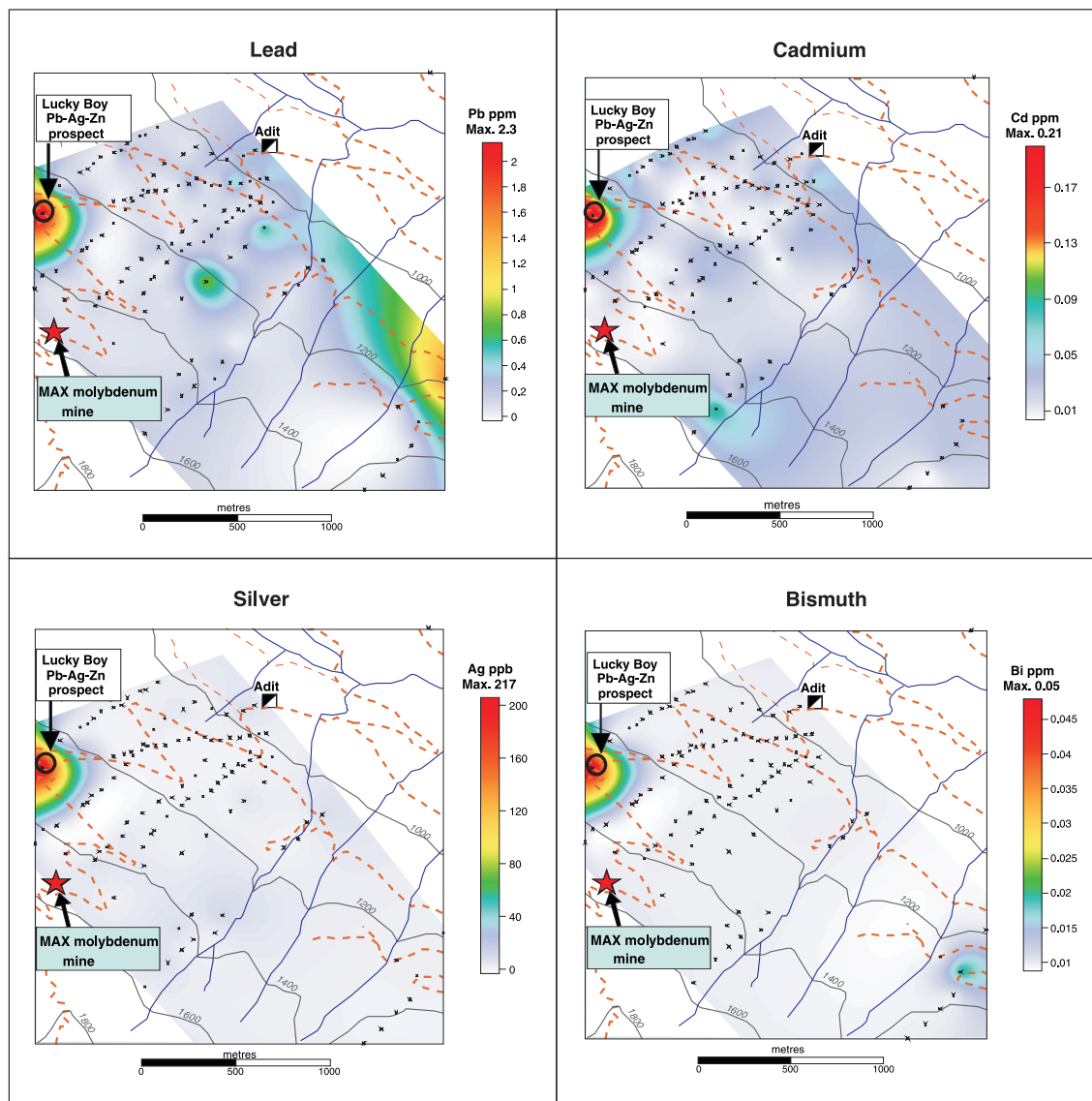


Figure 10. Anomalous levels of Pb, Cd, Ag and Bi in the west at the Lucky Boy prospect.

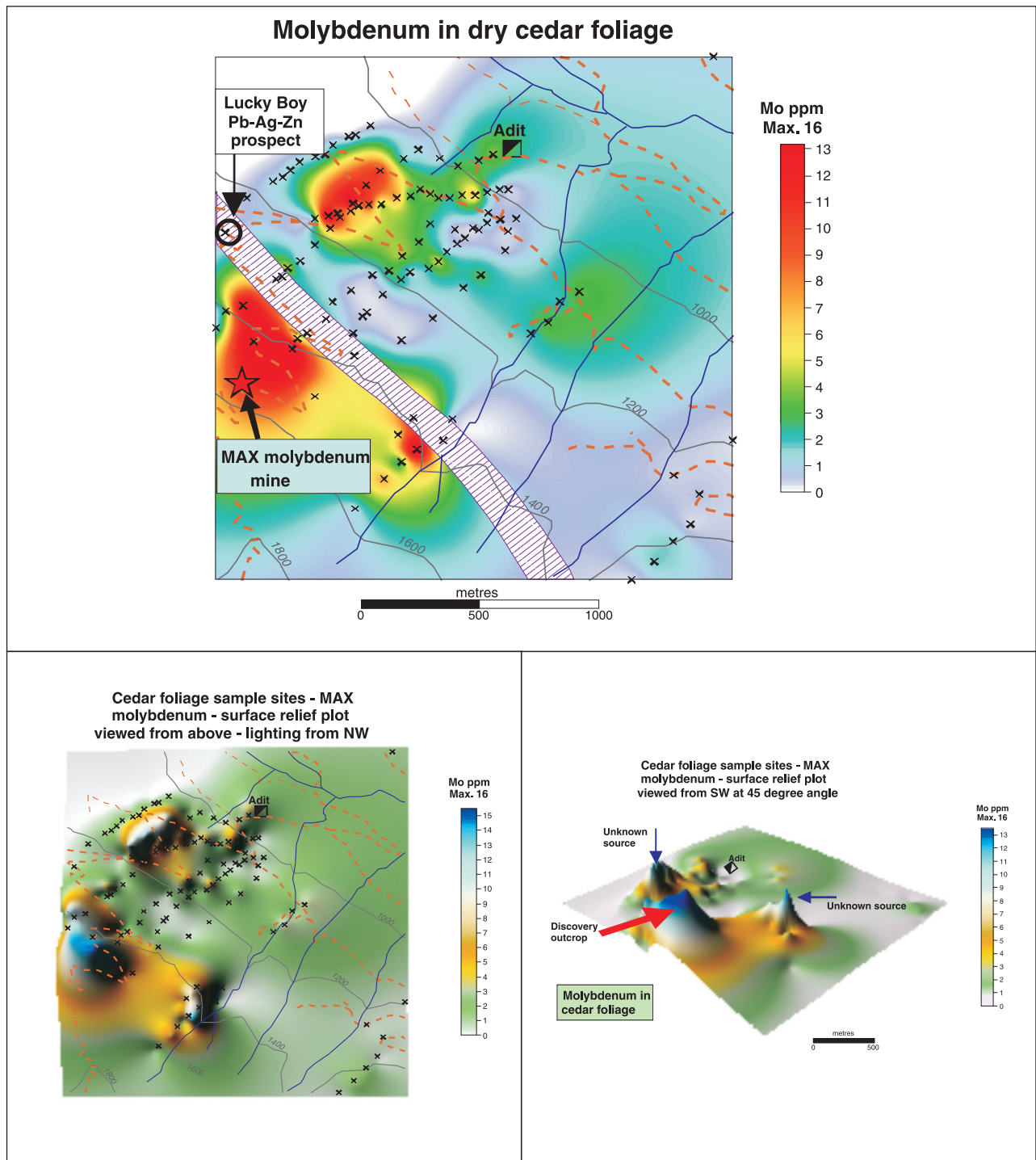


Figure 11. Mo in dry cedar foliage – 3 perspectives.

Cedar foliage vs. Engelmann spruce foliage

This comparison was made at two sample stations. Significantly higher concentrations were

- Cedar foliage was relatively enriched in Ca, Cr, Pb, and, in particular, Mo.
- Engelmann spruce foliage was more enriched in Ag, Ba, Cd, Co, Cs, Cu, Mg, Mn, Ni, Rb, and Zn.

Engelmann spruce foliage vs. bark

This comparison was made at two sample stations. Significantly higher concentrations were

- Spruce foliage was relatively enriched in Ag, Cd, K, Mg, Mn, Mo, Ni, P, S, and Ti.
- Spruce bark was more enriched in Ba, Ca, Pb, and, in particular, Hg.

Western hemlock foliage vs. bark

This comparison was made at two sample stations. Significantly higher concentrations were

- Hemlock foliage was relatively enriched in B, Ca, K, Mg, Mn, Mo, Ni, P, S, and Ti.
- Hemlock outer bark was more enriched in Ag, Al, Ba, Cs, Cu, Pb, REE and, in particular, Hg.

Subalpine fir foliage and bark

A more statistically significant comparison could be made between paired samples of subalpine fir foliage and bark. In general, there was a poor relationship in the elemental composition of the two tissues. The only elements to show consistent relationships were Cs and Sr (higher in the bark), Mn (higher in the foliage), and Tl (similar levels in both tissues). Whereas for some tissues from some species there is sometimes a consistent association, this is not the norm because each type of plant tissue has a different requirement for, and tolerance to, different chemical elements. This would be especially true for subalpine fir because it is difficult to obtain a consistent sample of fir bark without removing the entire bark profile, and for exploration it is the outer bark that is usually by far the more sensitive part for the accumulation of many elements. Since subalpine fir forms a thin skin around the tree it is impractical to collect and to maintain a consistent sample. By contrast, the scaly bark of most spruce and pine is easier and more consistent to collect. Although there are limitations to the collection of the fir bark, a comparison of the average compositions of foliage and bark from 16 trees provides a broad indication of which elements are the more concentrated in each type of

tissue. Table 5 summarizes these averages, and elements that are consistently higher (>2) in one tissue than the other are highlighted. Of note, are the following:

- Much higher levels in the bark of Ba, Cd, Co, Hg, and Pb.
- In the foliage it is the Mo and Ni that stand out as being enriched. Note that the single comparison of cedar foliage with fir foliage had considerably more Mo in the cedar, so that the data below indicate that fir bark has low sensitivity to Mo and would not be a good choice for a Mo biogeochemical survey.

Remarks

From these limited comparisons and the irregular sample populations of each tissue it is, however, possible to draw up a tentative table of guidelines of those sample media that are likely to be the preferred choice in the biogeochemical exploration for metals in this environment. Table 6 lists all the elements that were determined and indicates which media contain the highest concentrations of each — ranked from 1 being highest to 3 being the lowest. For a few elements with concentrations at or below detection (e.g. Be, In, Pd, Pt, Re) no entry is made, or only one or two tissue types yielded values above detection (e.g. As). For a few others (e.g. Li, S) more than one tissue is given an equal rank. From this table a few observations can be made:

- Mo concentrations are highest in the cedar foliage, with subalpine fir foliage ranking as the second best medium to collect.
- Hg is noticeably enriched in all bark samples
- Sitka alder foliage, although collected at only 3 sites, has the highest concentrations of many elements of relevance to mineral exploration — Cu, Cr, Ni, Pb, and ranks second for Co, Sb, and W.
- Subalpine fir bark appears relatively enriched in a number of elements. However, from a practical standpoint it would not be a preferred medium since it does not readily form a scaly bark and it is not easy to obtain a consistent sample medium unless the entire bark profile is sampled. This is not advisable since it permanently scars the tree.
- For a number of tissues ranked 1 or 2, there is commonly not a significant difference in the element content (e.g. Tl in subalpine fir bark and foliage). The foliage is usually the easier to collect and so it would normally be the preferred tissue to sample.

Clearly, a more comprehensive suite of comparisons is desirable, and the relative uptake of some metals may vary from one environment to the next. However, this first pass gives some broad guidelines for a biogeochemical sampling

Table 5. Comparison of elemental content of subalpine fir foliage with bark. Each pair of samples from the same tree.

		Subalpine Fir		Ratios	
		Needles	Bark	Needles:Bark	Bark:Needles
		16 trees		16 trees	
Ag	ppb	5	10	0.5	1.9
Al	%	0.02	0.01	2.1	0.5
As	ppm	-0.02	-0.04		
Au	ppb	-0.09	-0.15		
B	ppm	8	8	1.0	1.0
Ba	ppm	30	116	0.3	3.8
Be	ppm	-0.10	-0.10		
Bi	ppm	-0.02	-0.02		
Ca	%	0.56	0.75	0.7	1.3
Cd	ppm	0.13	0.92	0.1	7.3
Ce	ppm	0.03	0.06	0.5	2.2
Co	ppm	0.08	0.23	0.3	3.0
Cr	ppm	0.90	1.03	0.9	1.1
Cs	ppm	0.41	0.66	0.6	1.6
Cu	ppm	2.1	4.7	0.4	2.2
Fe	%	0.005	0.006	0.8	1.3
Ga	ppm	0.10	0.01		
Ge	ppm	0.002	0.001	1.5	0.7
Hf	ppm	0.001	0.001		
Hg	ppb	29	92	0.3	3.1
In	ppm	-0.02	-0.02		
K	%	0.369	0.176	2.1	0.5
La	ppm	0.02	0.04	0.5	1.9
Li	ppm	0.03	0.05	0.7	1.5
Mg	%	0.07	0.04	1.8	0.6
Mn	ppm	1915	925	2.1	0.5
Mo	ppm	0.28	0.08	3.4	0.3
Na	%	0.003	0.006	0.5	1.9
Nb	ppm	-0.01	-0.01		
Ni	ppm	1.54	0.44	3.5	0.3
P	%	0.15	0.06	2.7	0.4
Pb	ppm	0.27	1.71	0.2	6.4
Pd	ppb	-2.00	-2.00		
Pt	ppb	-1.00	-1.00		
Rb	ppm	12.8	12.4	1.0	1.0
Re	ppb	-1.00	-1.00		
S	%	0.09	0.04	2.2	0.5
Sb	ppm	0.06	0.04	1.5	0.7
Sc	ppm	0.19	0.14	1.4	0.7
Se	ppm	0.18	0.12	1.5	0.7
Sn	ppm	0.01	-0.01		
Sr	ppm	14	21	0.7	1.5
Ta	ppm	-0.001	-0.001		
Te	ppm	-0.02	-0.02		
Th	ppm	-0.01	-0.01		
Ti	ppm	7.4	4.7	1.6	0.6
Tl	ppm	0.23	0.24	1.0	1.0
U	ppm	-0.01	-0.01		
V	ppm	-2.00	-2.00		
W	ppm	-0.10	-0.10		
Y	ppm	0.02	0.02	1.2	0.8
Zn	ppm	30	36	0.8	1.2
Zr	ppm	0.03	0.04	0.7	1.5

Table 6. Ranking of species/tissues that yielded the highest concentrations of each element (entire data set).

	Foliage					Outer bark		
	A	B	C	D	E	F	G	H
<i>n</i>	109	27	27	4	3	24	4	27
Ag			1			2		3
Al		3		1				2
As								1
Au	2		1	3				3
B	1		3	2				
Ba			2			1	3	
Be								
Bi	2							1
Ca	1					2	3	
Cd				1		2		3
Ce	3				3	2		1
Co			3		2	1		
Cr	2				1	3		
Cs		3			1	2		
Cu			3		1	2		
Fe	3					2		1
Ga				1				
Ge	2		3					1
Hf	3					1		2
Hg						3	2	1
In								
K	3		2		1			
La					3		2	1
Li	1	2	3	3				
Mg		3		2	1			
Mn	3	2		1				
Mo	1	2						3
Na			3			1		2
Nb								1
Ni	2		3		1			
P			2	3	1			
Pb					1	3		2
Pd								
Pt								
Rb			3		1	2		
Re								
S	3	3		2	1			
Sb	1				2			3
Sc	2				1			3
Se								
Sn	2	1			3			
Sr	1		2			3		
Ta								
Te						2		1
Th	2							1
Ti	3			2	1			
Tl		2		3		1		3
U								
V								
W	2				2			1
Y		2				1		3
Zn		3	2				1	
Zr						1		2

survey in this part of southern British Columbia and surrounding areas. For Mo, cedar foliage is clearly the preferred sample medium.

Subsequent exploration

In mid-2008, Roca Mines drilled two drill holes, 100 m apart that targeted the northern biogeochemical anomaly, 600 m WSW from the adit. Their press report stated:

“The anomaly was identified during a survey funded and conducted by the Geological Survey of Canada’s (GSC) Targeted Geoscience Initiative – 3 (TGI-3) in late 2007. This anomaly was not previously identified because it lies beyond the historical limits of a soil-sampling grid and in an area without previous drilling.”

“Intense silicification, hornfelsing, locally strong quartz veining, and pervasive sericite alteration with trace molybdenite throughout”

“Reminiscent of the MAX resource itself where the extent of a relatively minor molybdenite mineralized zone on surface lies atop a large-scale mineralized deposit currently being mined.” Roca Mines press release, 12th August 2008, www.rocamines.com .”

Exploration is on-going.

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