PATTERNS OF METAL ENRICHMENT IN VEGETATION IN RELATION TO GEOLOGY AND GOLD MINERALIZATION: STAR LAKE AREA, SASKATCHEWAN

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ABSTRACT

Biogeochemical surveys of differing scales have provided regional and detailed information on the chemistry of the substrate within a 150 km² area in the La Ronge gold belt. Outer bark of black spruce (Picea mariana) and twigs of shrub alder (Alnus crispa) were collected from approximately 600 sites and analyzed for 35 elements. Kriging of the data has been employed to display areas where there is enrichment of gold and associated elements.

A computer-generated model to predict areas favourable for gold mineralization revealed several areas considered worthy of closer examination. Further sampling of the same species plus Labrador tea (Ledum groenlandicum) has indicated a spatial relationship among gold, molybdenum and cesium in areas where mineralization is known, and in others where none has yet been discovered.

Labrador tea growing in a bog near the Jasper gold deposit indicates a strong Au, Co, W, Th and U association which may reflect the nature of the mineralizing fluids. All samples of Labrador tea within the 1 km² area surveyed around the Jasper deposit have above background enrichment in gold.

At 'Nameless' Lake gold enrichment in three vegetation types suggests the local presence of gold mineralization.

INTRODUCTION

Over the past fifty years, biogeochemical studies have firmly established that gold and other metals can accumulate in some plant species, and that each species has its own chemical characteristics. Literature reviews of the application of biogeochemistry to gold exploration have been compiled by Brooks (1982), Erdman and Olsen (1985), and Dunn (1989). The extensive and powerful root systems of plants absorb to varying degrees those elements encountered in the substrate, depending on the requirements and tolerances of a plant species. Chemical information obtained from the analysis of plants may be different from that of a soil: the roots integrate the geochemical signature of several cubic metres of various soil horizons, the contained groundwaters, and locally the bedrock. Hence, biogeochemistry can be considered a holistic approach to geochemical exploration.

The relationship of metal accumulations to zones of mineralization is not always obvious. One complicating factor is that local physiochemical conditions may give rise to abnormal accumulations of metals in some plants. For example, in some environments large diffuse biogeochemical zones of metal enrichments occur; elsewhere a biogeochemical anomaly may be directly above its source, or displaced - either by groundwater movements, glacial dispersion, or both.

To further our understanding of the regional and local patterns of metal enrichments observed in common trees and shrubs of the forest-covered La Ronge belt, multi-element studies have been conducted. In addition to simple plots of the data, studies have been made of the spatial relationship of metal enrichment in the vegetation to bedrock geology, structure, and mineral occurrences. This has been achieved by making use of a geographic information system (GIS) to overlay several data sets. The system software used in this study is SPANS, manufactured by Tydac Corporation, Ottawa.

THE STUDY AREA - ITS GEOLOGICAL AND PHYSICAL ENVIRONMENT

The 150 km^2 study area is located in the Precambrian Shield 115 km northeast of La Ronge (Figure 1), in a region of forested, rolling hills. The dominant tree is black spruce (*Picea mariana*) interspersed with shrub alder *(Alnus crispa)*, and Labrador tea *(Ledum groenlandicum)*. The alder dominates recent burn areas, since it is a pioneer species which fixes nitrogen in the ground to provide the appropriate chemical environment for forest development. Jack pine (*Pinus banksiana*) and some white spruce (*Picea glauca*) occur with the black spruce in well-drained areas. Alder is generally absent from the scattered stands of trembling aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*). Boggy areas are common and the numerous lakes and streams constrained the orientation of the sampling traverses.

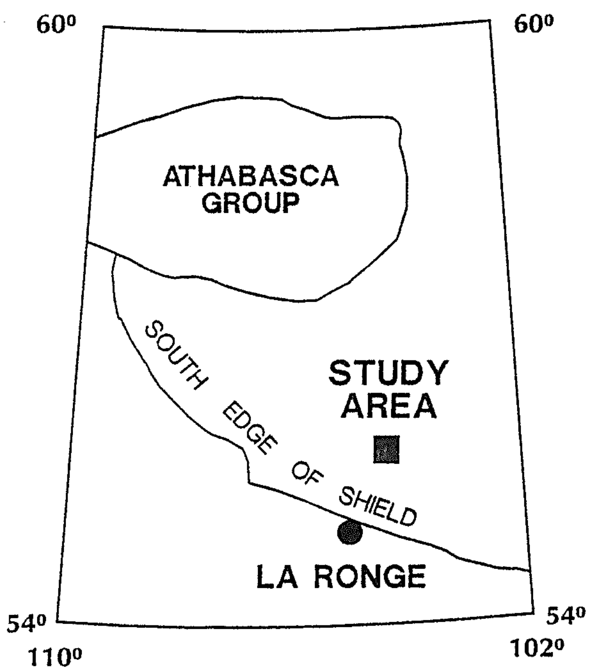


Figure 1 - Location of study area.

The survey area lies mostly within the La Ronge Domain. Bedrock comprises mainly mafic to intermediate metavolcanic and derived metasedimentary rocks that are intruded by felsic plutons, and one gabbroic pluton at Neyrinck Lake (Figure 2). Most of the felsic plutons have granitic centres which grade outward through granodiorite and monzonite to diorite at their margins. Shear zones are common and a major tectonic zone along McLennan Lake defines the southeastern limit of the La Ronge Domain. Detailed accounts of the geology of the area are given by Thomas (1984, 1985), Harper (1986), Lewry (1983, 1984), Poulsen *et al.* (1987), and Ames *et al.* (1987).

Within the limits of the regional biogeochemical survey there are several zones of gold mineralization, including the Star and Jolu (including the Rod Zone) gold mines (Figure 3). The gold is commonly associated with pyrite and pyrrhotite in quartz veins emplaced within shear zones cutting felsic plutons. Native gold is rare at some sites (Star Lake), but common at others (Jolu). Other associated minerals include molybdenite, cobaltite, sphalerite, galena, and rare tellurides (e.g. bismuth).

THE SURVEYS

Surveys were conducted on three occasions: a) an orientation phase in August, 1985; b) a reconnaissance phase in June, 1986; and c) a follow-up and 'in-fill' phase, which included areas not sampled previously, in June of 1988.

The three most common species, black spruce, shrub alder, and Labrador tea, provided the biogeochemical sample media. Spruce bark and alder twigs were obtained at most sample sites, and Labrador tea (twigs) was added for some local surveys.

Sampling procedures involved scraping loose scales of bark from the black spruce, and snipping about 50 cm lengths of twigs (approximately the last three years of growth) from the alders. Consistency in sampling is critical because of the variations in chemistry that occur in the bark profile and different twig ages. For example, gold and arsenic are more highly concentrated in the outer than the inner bark of most conifers (Dunn, 1988). Therefore, if inner bark is included with some samples, analytical data from such composite tissues cannot be compared with those of outer bark only. In the case of alder twigs, molybdenum concentrates in the new growth, whereas barium accumulates in old tissue. Consequently, if two years growth is collected at one site, and 10 years at the next, major differences in the content of some elements will be due to inconsistencies in sampling and not to mineralization.

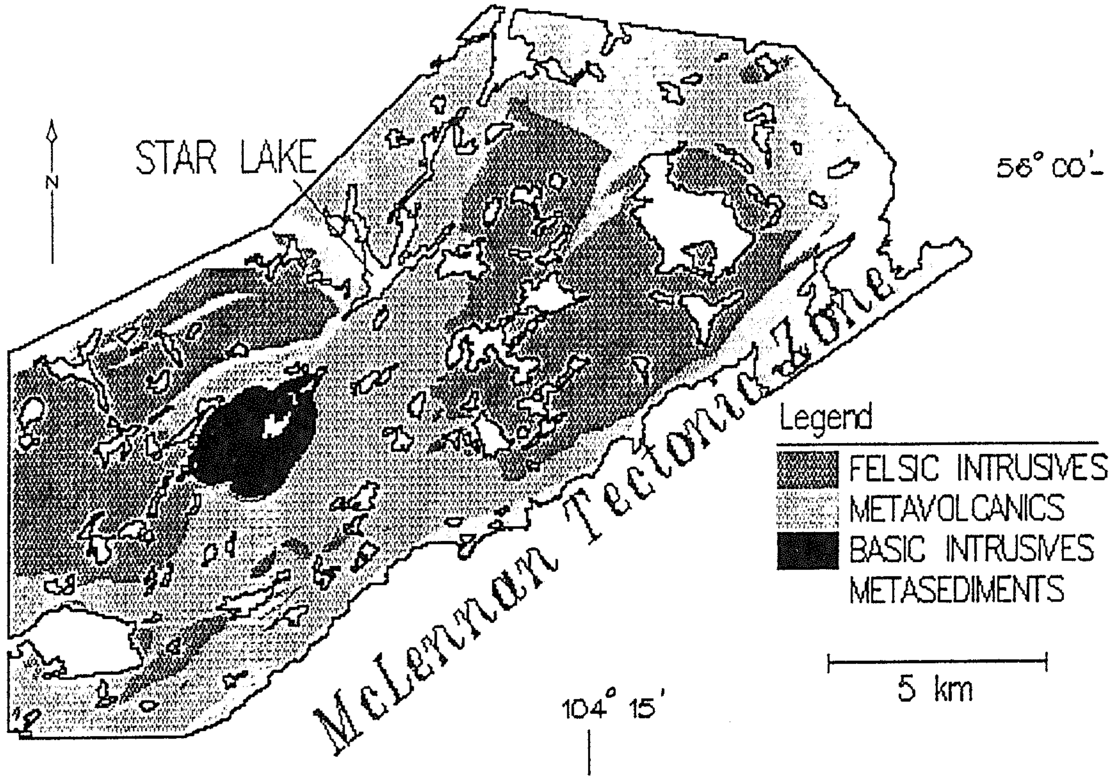


Figure 2 - Geology (simplified) of the Star Lake area. (After Thomas, 1984, 1985; Harper, 1985; Ames et al., 1987, Poulsen et al., 1987).

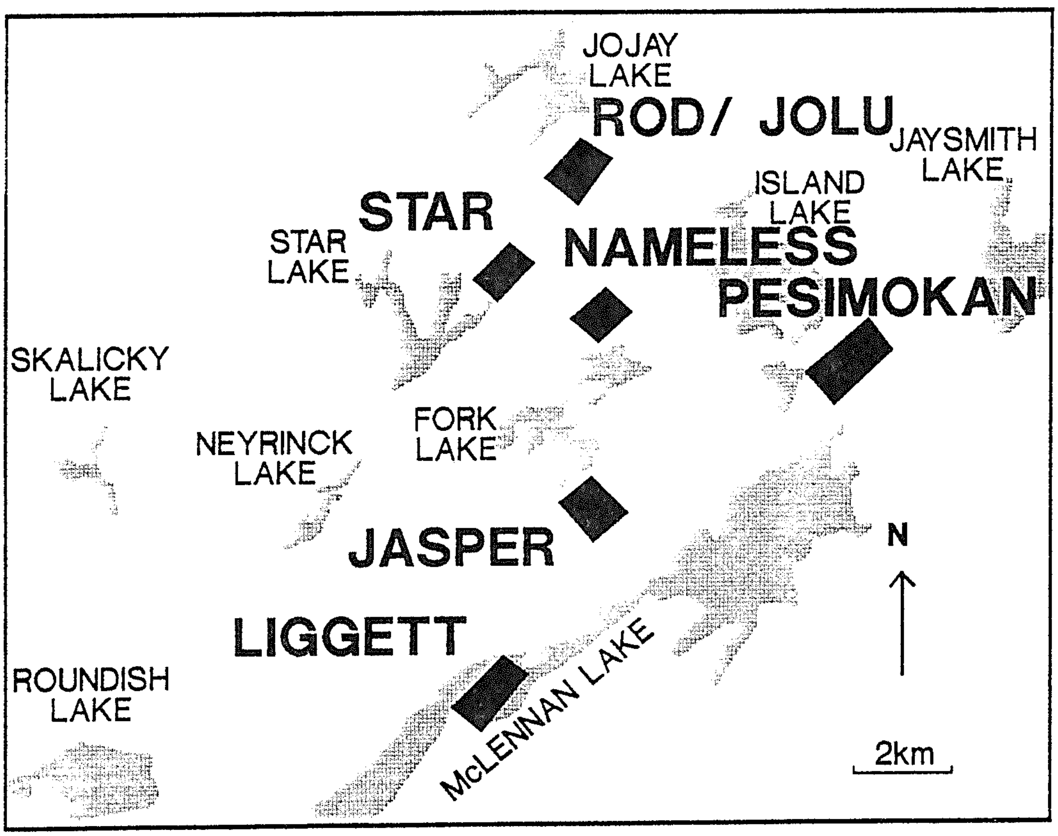


Figure 3 - Locations of mines and zones studied in detail.

Collecting Labrador tea involved snipping all the above ground parts, similar in appearance, of plants because it is impractical to determine and collect the same number of years of twig growth. Consequently, some variability of gold among Labrador tea samples may be attributable to the collection of different ages of twig growth. In alder twigs gold is fairly evenly distributed; therefore, by analogy most of the variation in gold content of Labrador tea is probably related to the gold content of the growth environment, and not to differences in the age of twigs.

Sample Preparation

Samples were air dried for several weeks, and the foliage separated from the twigs. The twigs were ashed in a kiln at 470°C overnight. Bark scales needed no preparation prior to ashing. Ash samples weighing between 0.5 and 1 g were accurately weighed and encapsulated for 35 element analysis by instrumental neutron activation (INAA). All data presented are concentrations in ash.

Orientation Phase - 1985

The first biogeochemical studies in this area were undertaken in 1985 prior to any mine development, and therefore prior to any possible contamination of the forest by mine workings. At that time the Jolu mine was just a prospect known as the Rod Zone, and the Star Lake mine consisted of proven reserves from diamond drilling. The Jasper gold mineralization had not yet been discovered.

Samples collected in the vicinity of the Star Lake gold mineralization yielded gold concentrations in alder twigs and spruce bark that are only slightly above background for the area. However, near the A-zone mineralization that subcropped beneath a bog, several plant species yielded anomalous gold concentrations, notably Labrador tea with over 100 ppb Au (Table 1). Background for all common plant species in the area is from <5 to 20 ppb Au in ash. Although the spruce bark has only 16 ppb Au, subsequent studies showed this to be about five times the regional background.

Table 1 - Gold content of ashed vegetation from 50 m south of gold mineralization that subcropped beneath a bog at Star Lake. Samples collected in August, 1985, prior to mine development.

	Au (ppb)
Labrador Tea (*Ledum groenlandicum*) - twig	110
Labrador Tea (*Ledum groenlandicum*) - leaf	36
River Alder (*Alnus rugosa*) - twig	42
River Alder (*Alnus rugosa*) - leaf	23
Dwarf Birch (*Betula glandulosa*) - twig	18
Dwarf Birch (*Betula glandulosa*) - leaf	22
Black Spruce (*Picea mariana*) - bark	16
Black Spruce (*Picea mariana*) - twig	7

At the time of the 1985 study, the quartz-hosted gold of the Rod Zone was projected to extend beneath a moist forested area, underlain by glacial deposits of uncertain thickness. Spruce bark samples were collected at a number of sites along this trend, and several proved to contain extremely high concentrations of gold (up to 690 ppb Au). A few samples of alder twigs from the same sites contain only a few times normal background levels of gold (maximum of 34 ppb Au; background for this area is 10 ppb), but contain local enrichment of molybdenum (61 ppm; background <2 ppm), and cobalt (28 ppm; background 5 ppm). Subsequently, Mahogany Minerals Inc. drilled in the vicinities of four of the bark anomalies, and intersected gold mineralization in each hole. A summary of the drill results, thickness of glacial overburden, and gold concentrations in the spruce bark is given in Table 2. This area is now the site of the Jolu mine.

Table 2 - Relationship of anomalous concentrations of gold in ashed spruce bark to grades of underlying gold mineralization along the Rod Zone. Drill hole data courtesy of G. Burrill.

Gold (ppb) in Ashed Spruce Bark	Overburden Thickness	Drill Results
230	1 m	Near main trench.
120	1 m	Erratic mineralization: 1 m of 0.85 oz/ton (25 ppm) Au at depth of 50 m.
690	2.5 m	Subcropping mineralization - 0.11 oz (3 ppm) Au over 60 cm.
450	1 m	Subcropping mineralization - 0.3 - 0.7 oz/ton (10 - 22 ppm) Au over 4 m.
200	3 m	Mineralization, locally over 1 oz/ton (30 ppm), at shallow depth.

Background levels of Au in ashed spruce bark are, in this area, <5 ppb

Reconnaissance Survey - 1986

Given the encouraging results from the Rod Zone, a larger survey was undertaken the following year to collect samples from about 600 sites at 200 m intervals (Figure 4). Traverses were made throughout an area of 150 km^2 that extended from the MacLean Lake metasediments in the southeast, across the metavolvanics and plutons of the La Ronge Domain, and into the Crew Lake metasediments in the northwest. As noted earlier, the sampling grid was uneven because of the presence of many lakes, streams and bogs.

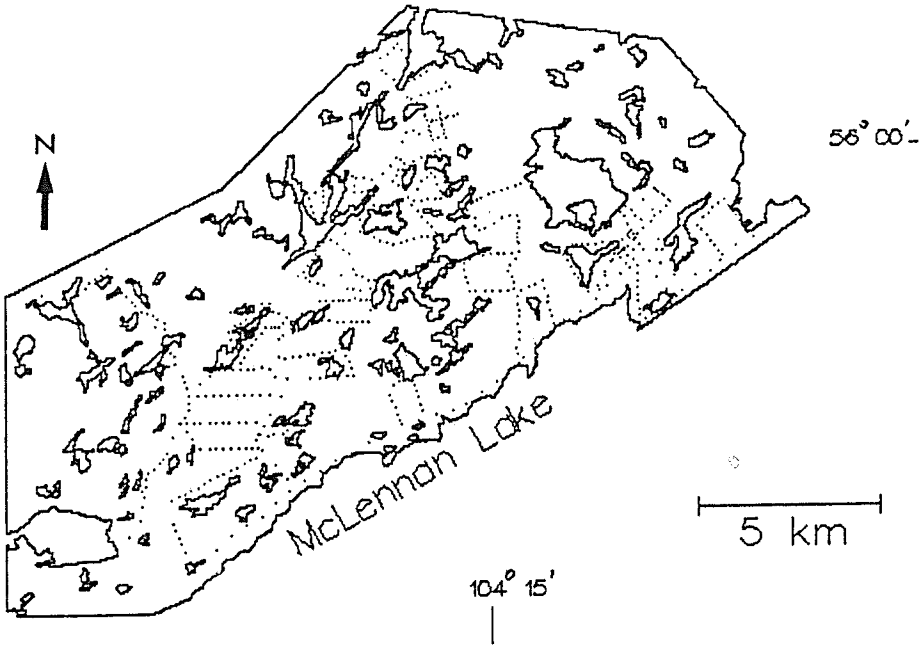


Figure 4 - Reconnaissance survey sample locations.

Data Interpolation

In view of the irregular spacing of sample locations, some care was necessary to ensure reliable interpolation of the data. This problem may occur in biogeochemical studies when a species is absent from part of the survey area, either as a result of environmental differences, or because of forest fires. Consequently, various interpolation schemes were investigated, and it was found that kriging (Clark, 1979) was suitable for plotting the data. Kriging also produces an estimate of the error associated with each interpolated value (i.e. the kriging variance). This value is useful for spatial modelling, since it allows the identification of unreliable estimates (George and Bonham-Carter, 1989).

Raw data values were reclassified into seven percentile classes, using thresholds ranging from the 50th to the 98th percentile, prior to interpolation by kriging. This transformation minimizes variance due to analytical noise, and enhances the differentiation of anomalous from background values. Kriging produces interpolated estimates along a regular grid of points distributed throughout the entire study area, including zones where no samples were taken. Since extrapolation into areas far from sample locations is probably meaningless, spatial limits were imposed on the extent of extrapolation from original sample points. This was implemented on the GIS system by restricting extrapolation to areas where the error associated with each kriged estimate was below a set threshold distance from the actual sample point. This distance was 500 m for the reconnaissance study, and 100 m for the detailed studies.

Results

Once the data file is set up, it becomes a routine process to examine the distribution patterns of any element in any medium contained within the file. Only four of the elements analyzed (arsenic, molybdenum, cesium and gold) will be highlighted here.

Arsenic

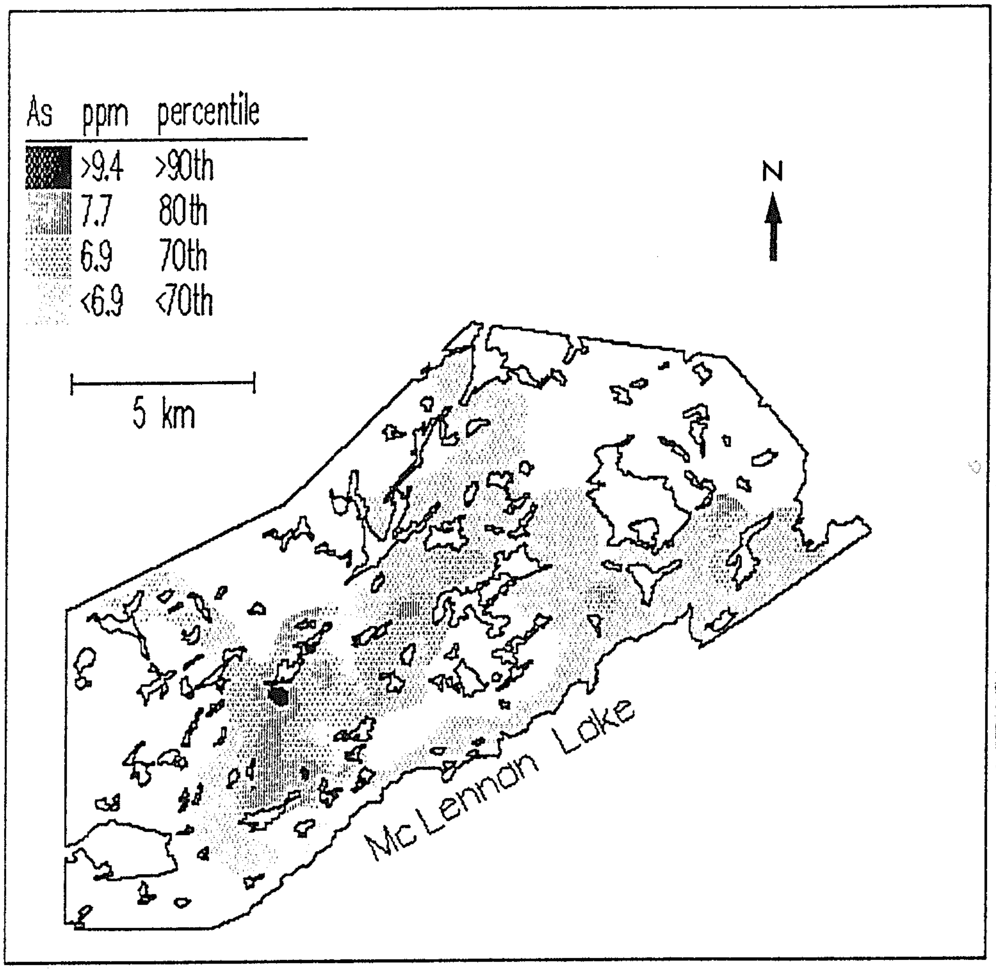
The pattern derived from arsenic in spruce bark (Figure 5) shows that the highest concentrations occur in trees on the gabbroic rocks of the Neyrinck pluton (marked as 'basic intrusives' on Figure 2), and southward into the metavolcanics. Other isolated anomalies of lower magnitude occur farther to the east. In general, the arsenic concentrations are quite low throughout the study area. There is no indication that the distribution patterns might assist in locating gold mineralization, which is to be expected since a gold-arsenopyrite association is not known in this region.

Molybdenum

The map of molybdenum in alder twigs (Figure 6) indicates that the highest concentrations occur near the northeastern end of McLennan Lake. The raw data from this area shows that many samples have molybdenum concentrations that are considerably higher than the background of <5 ppm, with a maximum concentration of 130 ppm Mo. The source of this enrichment has not yet been located in this area of poor exposure. It is noteworthy that at the Jolu mine gold mineralization is associated with molybdenite, hence there may be a similar association in this area.

Cesium

Cesium is a rare alkali metal which is normally present in ashed vegetation in concentrations of <1 ppm Cs. It is, therefore, surprising that concentrations in the alder twigs are locally over 100 ppm Cs. Notable enrichment occurs in many samples from the granitic core of the Star Lake pluton, located just east of Star Lake (Figures 2 and 7). This 'granitic' association suggests that the Cs may be derived from the micas where it commonly substitutes for potas-



Weaker gold anomalies occur in zones of known mineralization, such as Star Lake and the Jolu Mine (Figure 3); however, the biogeochemical response in alder is subdued at these two localities because, prior to surface stripping, the subcropping mineralization occurred beneath bogs or moist woodland. In such environments gold uptake by alder is weak, whereas Labrador tea has the greatest gold concentrations. This emphasizes a significant point - that metal enrichments vary in different species according to the nature of the environment. Therefore, by considering the metal patterns of several species there is an improved chance of locating mineralized areas.

Figure 5 - Arsenic in outer bark of black spruce (kriged data).

sium. Locally there also seems to be a spatial relationship between cesium and gold enrichment in the vegetation. Only rarely have cesium minerals been identified in gold deposits: at Hemlo the extremely rare cesium-bearing mineral galkhaite has been reported (Harris, 1986). Cesium has also been found in steams emanating from several volcanic centres in the North Island of New Zealand. One of the authors (CED) collected vegetation growing close to the Champagne Pool in New Zealand, and found 140 ppm Cs in ashed tissue that also contains 1000 ppb Au, 86 ppm As, and 270 ppm Sb. Cesium enrichment was found at each of the six localities in New Zealand where vegetation was collected.

Gold

The plot of gold in alder twigs (Figure 8) shows that the highest concentrations occur in the east where no economic orebody is known. The spatial relationship of this zone of gold enrichment in alder to that of molybdenum is striking, suggesting a gold-molybdenum association in the substrate.

Relationship of Gold Anomalies to Geology and Structure

Figure 9 was produced using SPANS by superimposing plots of gold greater than the 90th percentile (for both alder twigs and spruce bark) on locations of known shear zones in felsic plutons. The McLennan Tectonic Zone was excluded from this basic computer model. These constraints were selected because of the proven occurrence of gold in sheared plutons in this area. The result is a prediction map indicating several areas considered favourable for gold mineralization, which provided a guide for follow-up work. Close examination of the raw data showed that some of these areas (e.g. west of Island Lake [Figure 3]) resulted from single samples that had gold concentrations close to the 90th percentile of one sample medium; therefore, they were not investigated in follow-up surveys. Others, however, had several samples with relatively high gold concentrations. One of these, 'Nameless' Lake, was selected for closer examination.

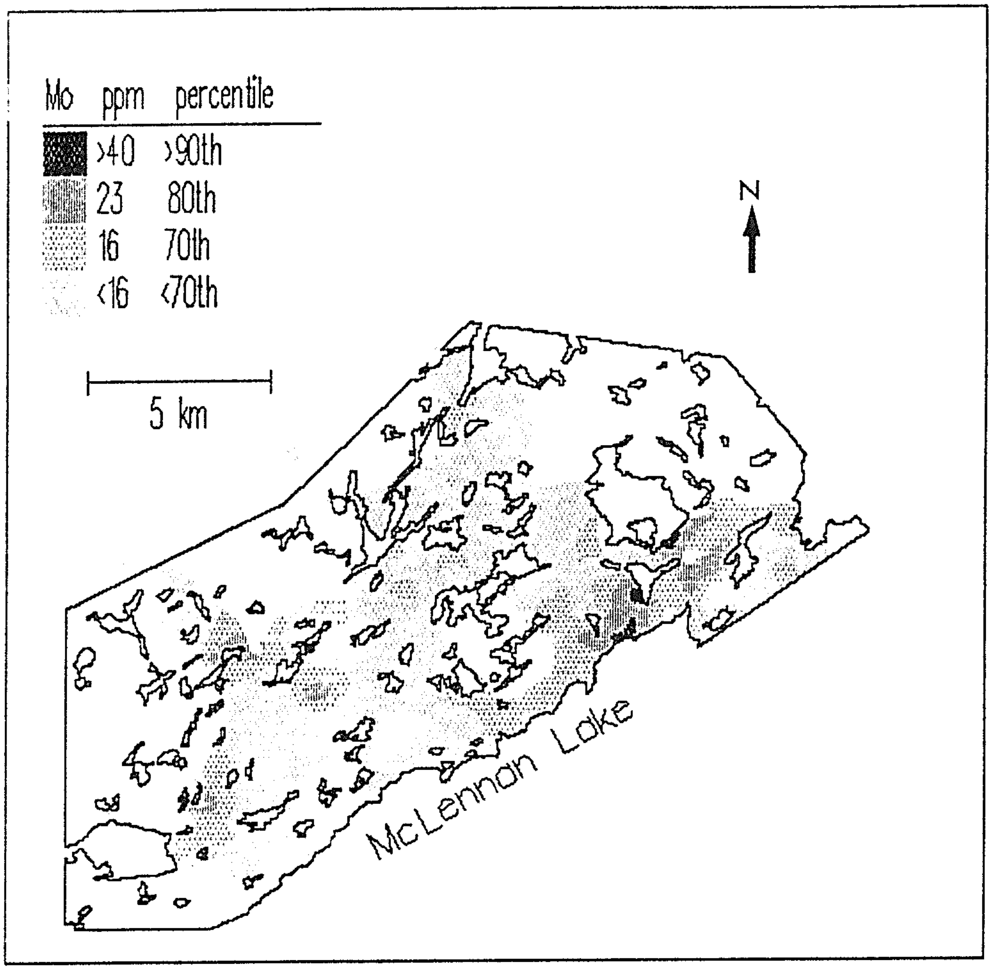


Figure 6 - Molybdenum in alder twigs (kriged data).

Detailed And Follow-up Surveys - June 1988

The 1988 survey involved revisiting several areas with gold enrichment in the vegetation to conduct more detailed sampling and surface investigations. Subsequent to the completion of the 1986 survey, the Jasper gold deposit was discovered in an area from which no samples had been taken, therefore investigations were extended into this area (Figure 3).

Liggett Bay

At Liggett Bay on the south shore of McLennan Lake (Figure 3), several samples from the 1986 survey yielded gold concentrations up to 50 ppb in spruce bark. No information was available on the bedrock or structure of this area so it did not appear on our constrained computer-generated model (Figure 9), but it did warrant a brief visit. A single grab sample of a coarse pegmatite outcrop contained 23 ppb Au (about 10 times the normal background level of gold in pegmatite). The analyses of several new samples of vegetation suggest that there is slight enrichment of Au, As, and Zn in the area, but no indication of economic grades of mineralization.

Pesimokan Lake

To the east of Pesimokan Lake (Figure 3), resampling of an area which had previously yielded gold enrichment in many alder samples (Figure 8, and Dunn, 1986, 1987) reconfirmed that enrichment occurs close to the contact between the Island Lake Pluton and the McLennan Tectonic Zone. Local enrichments of As, Cs, Co, W, Se, Ni, and especially Mo are associated with gold in alders.

Figure 10 shows computer plots of kriged data for gold, molybdenum and cesium in alder samples obtained during the follow-up survey. (The ragged outlines of the lakes are a function of the magnification of the digitized regional scale map). Maximum concentrations of the three elements are 80 ppb Au, 140 ppm Mo, and 43 ppm Cs. Although there is little overlap of anomalous areas, the spatial relationship of the elements indicates a possible metallogenic association related to a mineralizing event.

Rock samples were collected from this vicinity by a GSC geophysics crew the previous year, during an investigation of a pronounced linear magnetic anomaly. They were found to contain several percent magnetite intergrown with pyrite, pyrrhotite, chalcopyrite and molybdenite (B.W. Charbonneau, personal communication) and analyses indicate up to 3000 ppb Au.

From recent drilling in the area there appears to be a broad area of disseminated mineralization which is reflected in the vegetation as moderate concentrations of several metals. Approximately 2 km west of this anomalous zone, in an area of little outcrop,

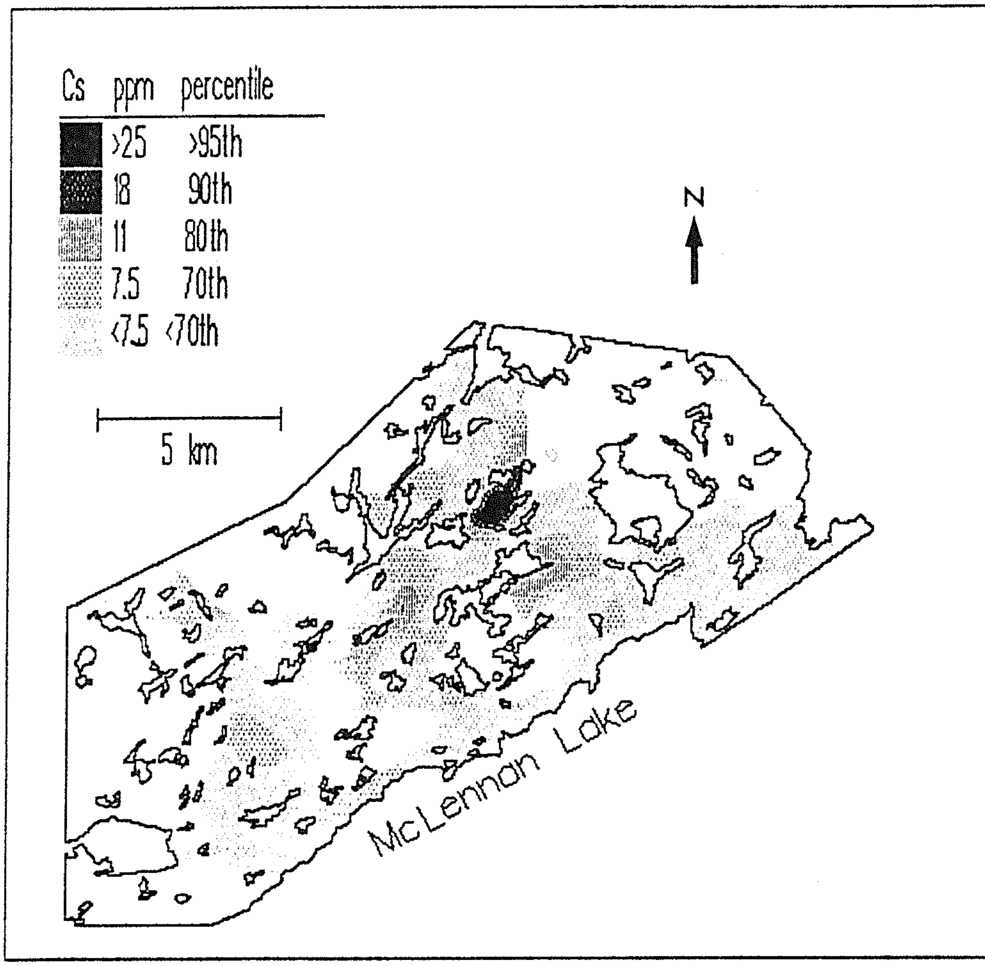


Figure 7 - Cesium in alder twigs (kriged data).

similar metal associations with slightly higher concentrations (350 ppm Mo, 110 ppb Au) occur in the alder, suggesting an extension of this mineralized zone (i.e. the main area of gold enrichment indicated in Figure 8).

Jasper Pond

Soon after the completion of the 1986 survey, gold mineralization was discovered by the Saskatchewan Mining Development Corporation (now Cameco) near Jasper Pond (Figure 3), in an area not covered by the survey. Here the bedrock consists of felsic to intermediate rocks of the Island Lake Pluton, intruded by mafic dykes, and disrupted by northeast-trending shear zones. Labrador tea samples collected by Cameco from close to the zone of gold mineralization soon after its discovery were found to be highly enriched in gold (up to 700 ppb Au) (V. Sopuck, personal communication).

As part of the 1988 infill program, samples of spruce bark, alder twigs and Labrador tea were collected at approximately 100 sites within a 1.5 x 1 km area (Figure 11). High levels of gold (up to 779 ppb) in Labrador tea from the bog immediately north of the discovery outcrop confirmed Cameco's observations. Multi-element INAA provided new information on the chemical environment, and demonstrated that there are interesting enrichments of other elements in the Labrador tea. Table 3 shows the range of concentrations for several elements that are enriched relative to common background levels. Of note are the high concentration factors for Au, Co, Th, U and W. This association provides a good indication of the chemical nature of the mineralizing fluids from simple low-cost analyses of a few vegetation samples.

Plots of the kriged gold data from Labrador tea and spruce bark (Figure 11) both indicate the strong enrichment of gold in the southwest corner of the map. The Labrador tea map (Figure 11a) indicates a

Table 3 - Element concentrations in ashed twigs of Labrador tea from 9 sites in a bog adjacent to the north side of the discovery outcrop of gold mineralization at Jasper Pond.

	Range	$\overline{X}$	Background	Concentration Factor
Au (ppb)	38 - 289	129	20	6
As (ppm)	2 - 4	3	2	1.5
Co (ppm)	5 - 65	25	5	5
Cr (ppm)	12 - 37	25	10	2.5
Th (ppm)	1 - 3.6	1.8	.2	9
U (ppm)	<.1 - 3.3	1.4	<.1	>15
W (ppm)	<1 - 22	7 3	<1	>7

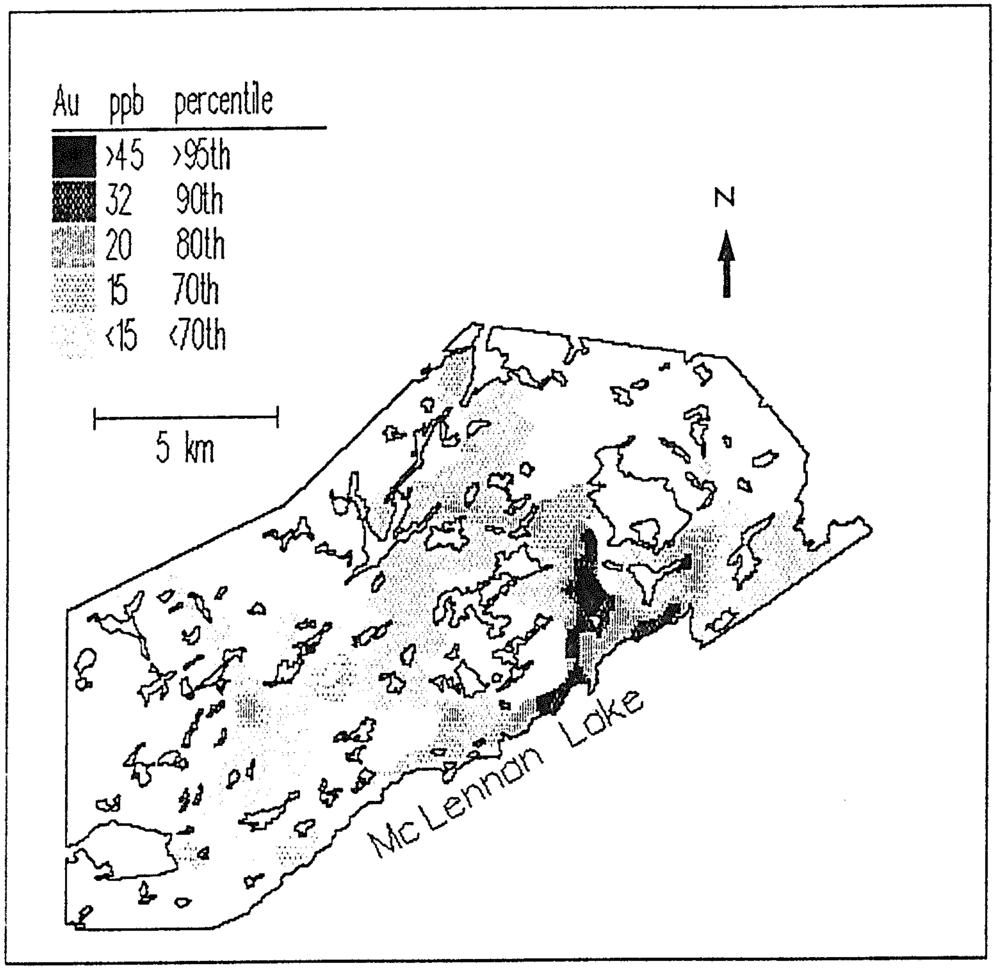


Figure 8 - Gold in alder twigs (kriged data).

The entire Jasper survey area has gold enrichment in Labrador tea covering at least 1 km^2, providing a broad target for a reconnaissance style biogeochemical survey.

'Nameless' Lake

The 'Nameless' Lake area (Figure 3) was selected for study because it was predicted by the computer analysis model of the 1986 data as being favourable for gold mineralization (Figure 9). No samples were collected from the north side of the lake in the original survey. The bedrock here is granodiorite and monzonite of the Star Lake Pluton, intercalated with lesser amounts of mafic igneous rocks (Figure 12a). There is a wedge of felsic tuff adjacent to 'Nameless' Lake and a mylonitic zone beneath 'Pointy' Lake.

second zone of gold enrichment in a boggy area about 500 m to the northwest, trending (along a shear zone) toward Broeder Lake. This zone is not apparent on the spruce bark map (Figure 11b), presumably because of the lack of sensitivity of spruce bark to the presence of gold in wet areas. The bark map does, however, indicate a second area of relative gold enrichment northeast of Jasper Pond where drier conditions prevail.

The multi-element data base for the three species obtained from this area provides additional information on the chemical environment. Along the shear zone north of Jasper Pond, delineated by gold in Labrador tea, alder twigs yield strong enrichments of Cs, Rb, Sr and Ni (with local enrichment of Au, Mo, and Co). The spruce bark at these sites reveals a Au, As, and Cr association. The nickel probably originates from the mafic dykes that are characteristic of the Star Lake pluton. The frequent association of gold, cesium and molybdenum in alder is again evident.

The three types of vegetation collected all contain anomalous levels of gold. Labrador tea (Figure 12b) contains up to 460 ppb Au, with the average gold concentration being appreciably higher than the average from the Jasper bog. Except for a weak enrichment of As (4 ppm) and Th (1 ppm), the other elements have close to background concentrations.

Gold and arsenic are enriched in the spruce bark (Figure 12c), with concentrations up to 60 ppb Au and 14 ppm As. Alder shows the same pattern for gold with up to 93 ppb Au at the northern sites (Figure 12d), but arsenic concentrations are only a few ppm above background, because alder establishes a barrier to arsenic uptake. Although cesium is not enriched in the immediate vicinity, there is strong cesium enrichment a short distance to the north (Figure 7).

Figure 12e summarizes the data by ranking the sites according to the gold concentrations in the three plant species. Sites in the first rank are those where

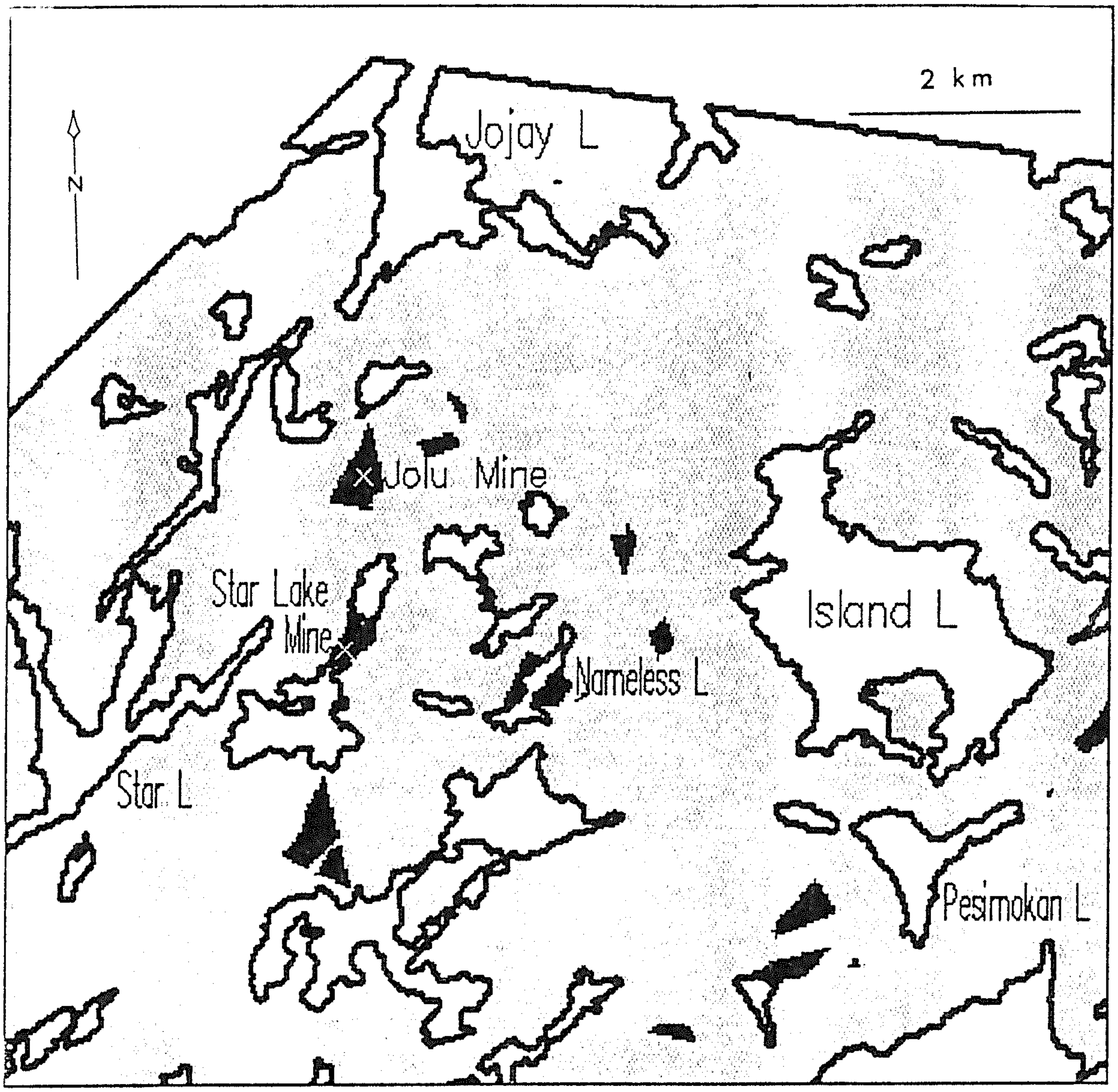


Figure 9 - Prediction map of zones favourable for gold exploration (black areas).

two sample media have gold concentrations that fall in the highest category (Figures 12b, c, and d), and the remaining vegetation type falls in the second category; rank '2' sites are those where all sample media have gold concentrations in the second category, or one medium in the top category and two in the second; and rank '3' sites have only two sample media in the top two categories. The highest concentrations occur in the northerly sites where high concentrations of gold also occur in heavy mineral concentrates (HMC) derived from the till. The range of HMC is from 30 to 4790 ppb, with gold grain counts from zero to 35 grains per bulk till sample (V. Sopuck, personal communication).

Of six holes drilled by Cameco beneath 'Pointy' Lake, four penetrated the mylonite, but only one intersected gold mineralization. The biotote-rich mylonite contains minor pyrite and a 10 cm-thick quartz vein with massive pyrite, 3-5% galena and minor sphalerite. A core sample from this zone contains over 2000 ppb Au and 42 ppm Ag. A small mylonitic zone in the southwestern part of the study area also yielded 2000 ppb Au.

There is, therefore, tangible evidence that gold is present in the bedrock, but the weight of geochemical evidence is such that either there is more significant gold mineralization in the area yet to be discovered, or there are peculiar unexplained environmental conditions which have given rise to the biogeochemical gold anomalies. The former seems more likely since there is no known process that can give rise to such high levels of gold in vegetation in

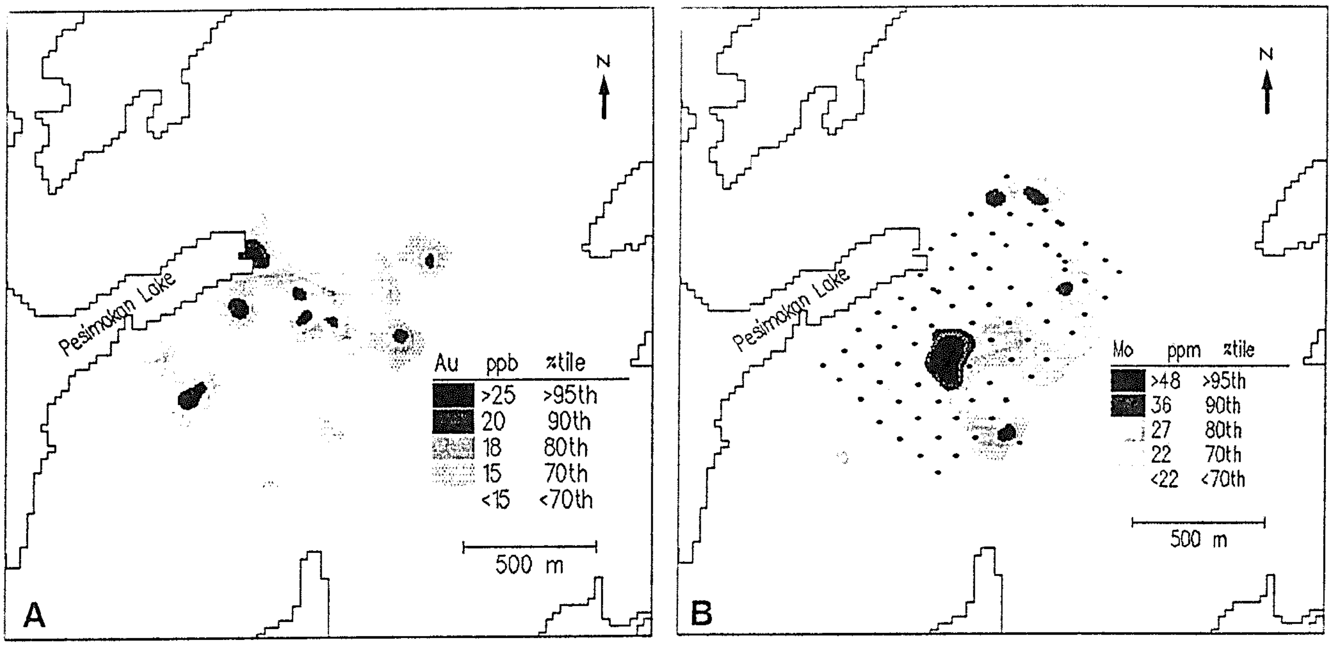
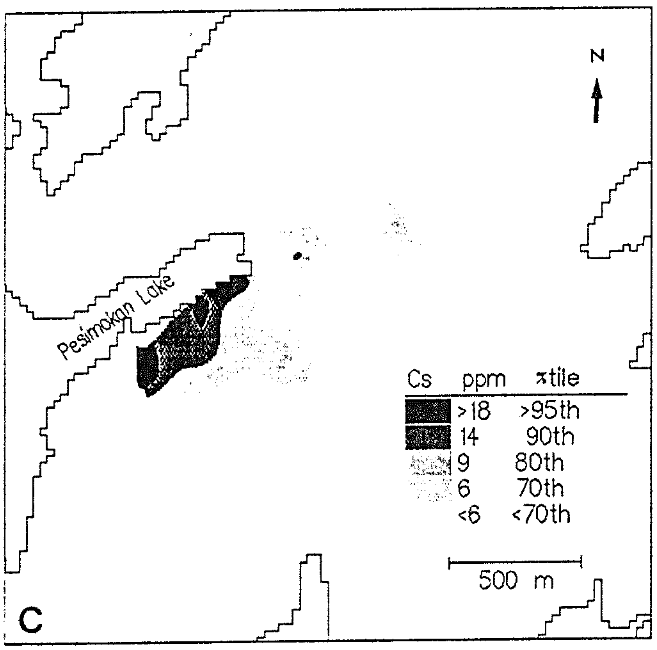


Figure 10 - Pesimokan Lake: a) Au, b) Mo And c) Cs in alder twigs



the absence of appreciable gold enrichment in the substrate.

CONCLUSIONS

The evidence presented suggests that multi-element reconnaissance style biogeochemical studies can assist in identifying areas of metal enrichment in the substrate that may be of economic interest. Computer modelling of the data, using a GIS system, can assist in the interpretation of the data and in providing focus for more detailed investigations.

Gold mineralization can be located directly by drilling high order biogeochemical anomalies, such as the high enrichment of gold in spruce bark from trees in the vicinity of the Rod Zone. Prior to drilling, however, careful consideration should be given to as many geological parameters as possible: in the case of the Rod Zone, geological mapping indicated that a gold-bearing quartz zone probably extended beneath tills, and the biogeochemical survey helped to focus on gold-bearing parts of that zone.

Data interpretation is not always a simple task, because slight enrichment of gold in vegetation may be related to weak near-surface enrichment of gold in the bedrock, or to deep-seated mineralization of more significance. Furthermore, each species has its own chemical characteristics and ability to concentrate elements. One species, such as black spruce, may give a good response to gold in the substrate in one environment (e.g. woodland), but a weak response in another (e.g. bogs). By adopting a multi-element, multi-species approach a comprehensive picture of the nature of underlying mineralization can be obtained.

By analogy with patterns of metal enrichment observed in plants near known gold mineralization at the Jasper deposit, it seems probable that other gold deposits are present in the study area, particularly to the northwest of 'Nameless' Lake.

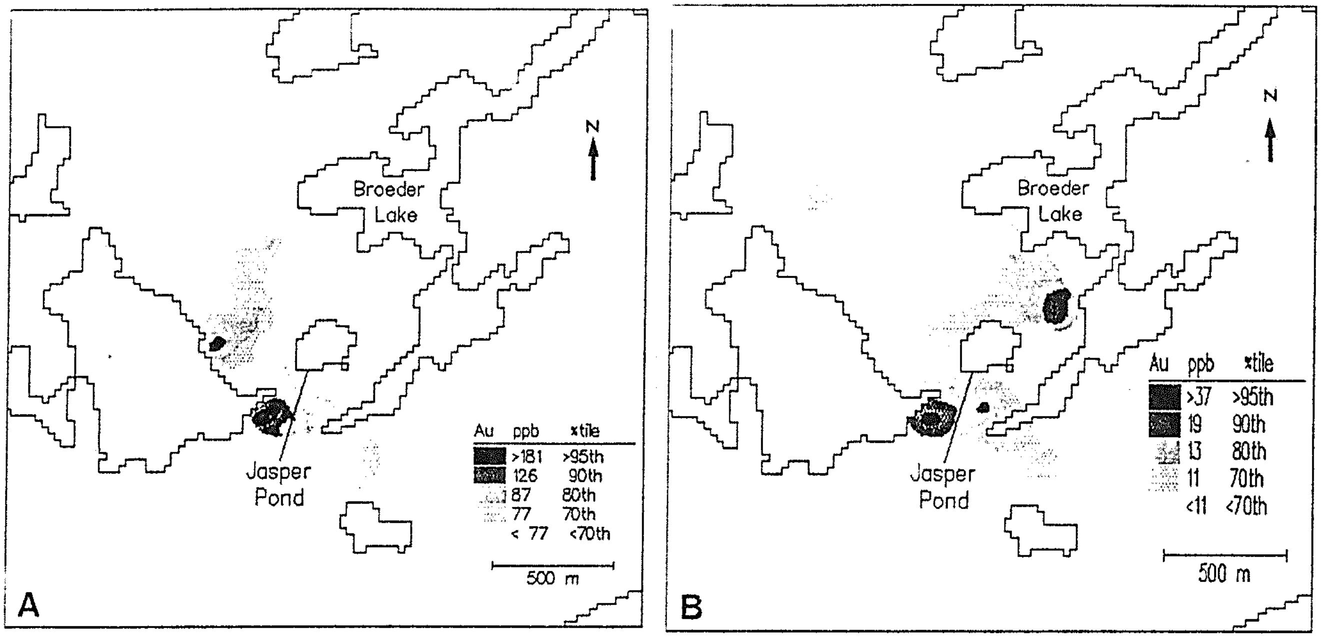


Figure 11 - Au in a) Labrador tea and b) spruce bark (kriged data).

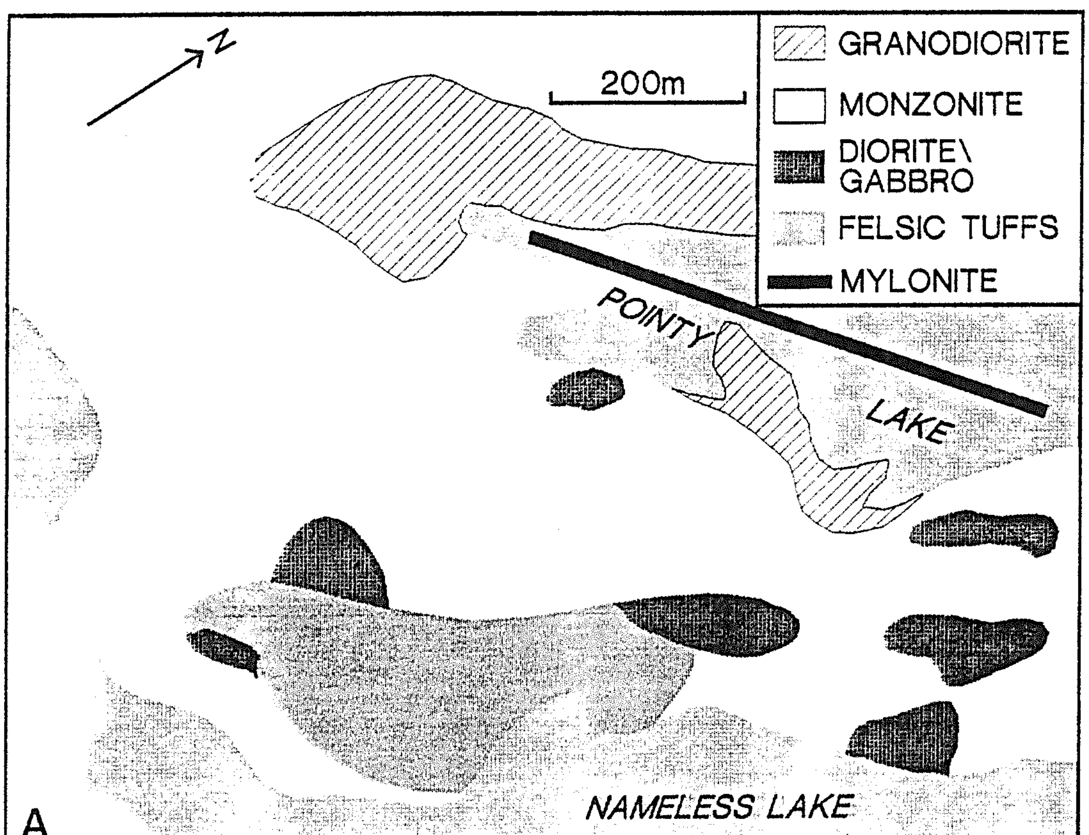
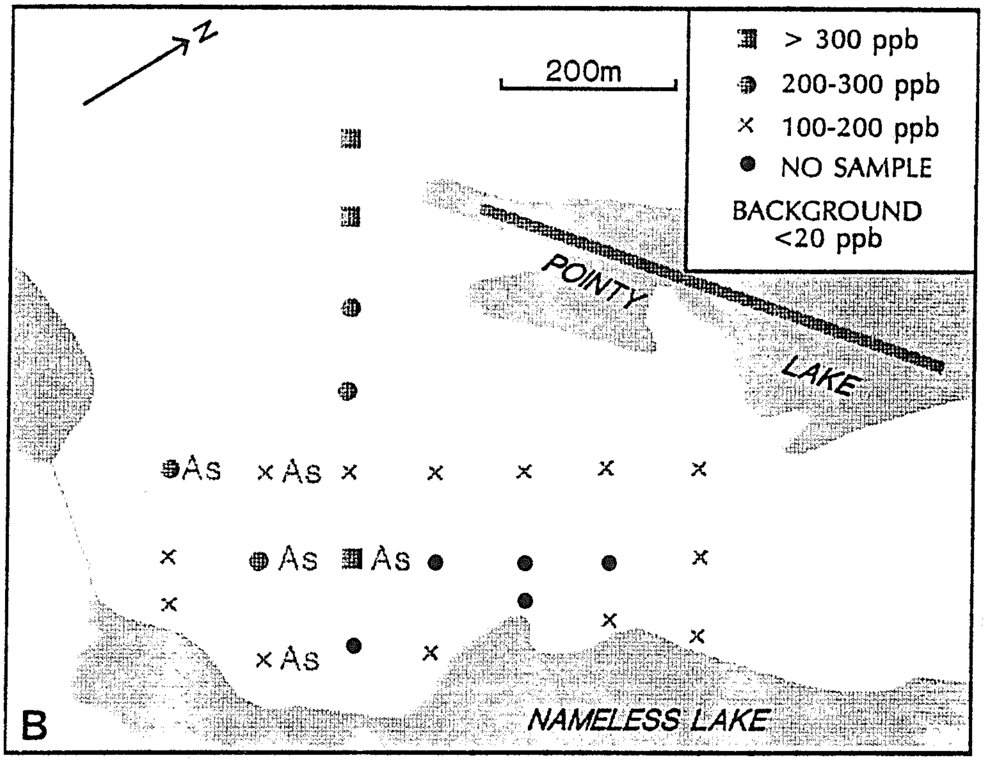


Figure 12a - 'Nameless Lake' geology (modified from map compiled by D. Chan - personal communication from Cameco).



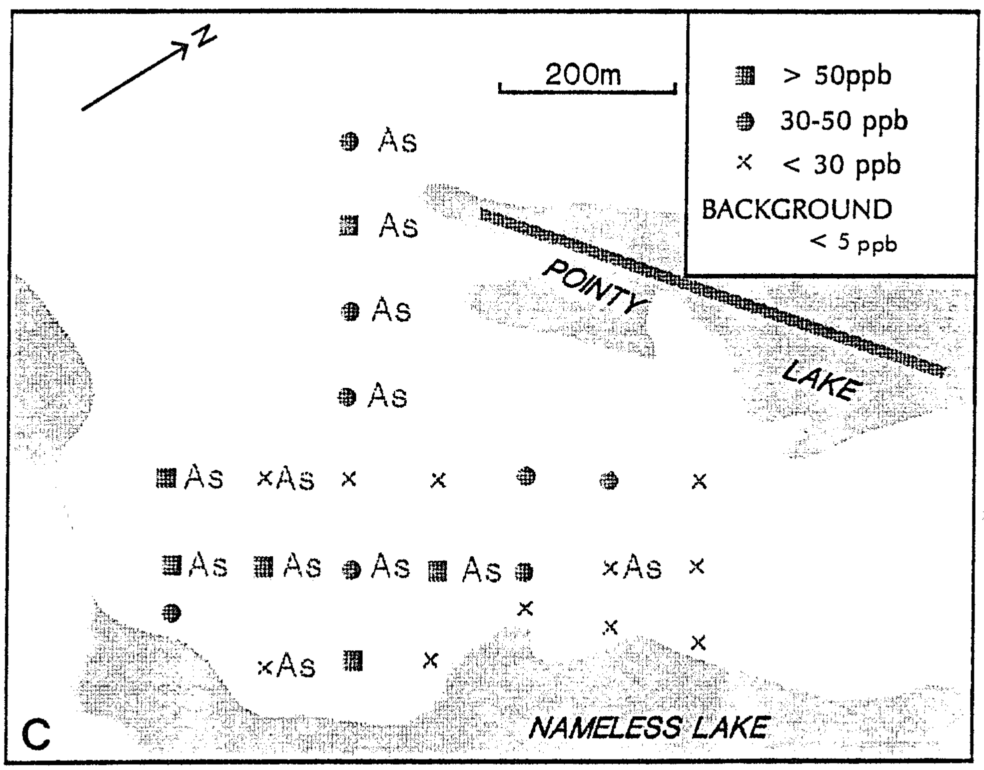


Figure 12 - 'Nameless Lake': b) gold in Labrador tea twigs, c) gold in black spruce outer bark.

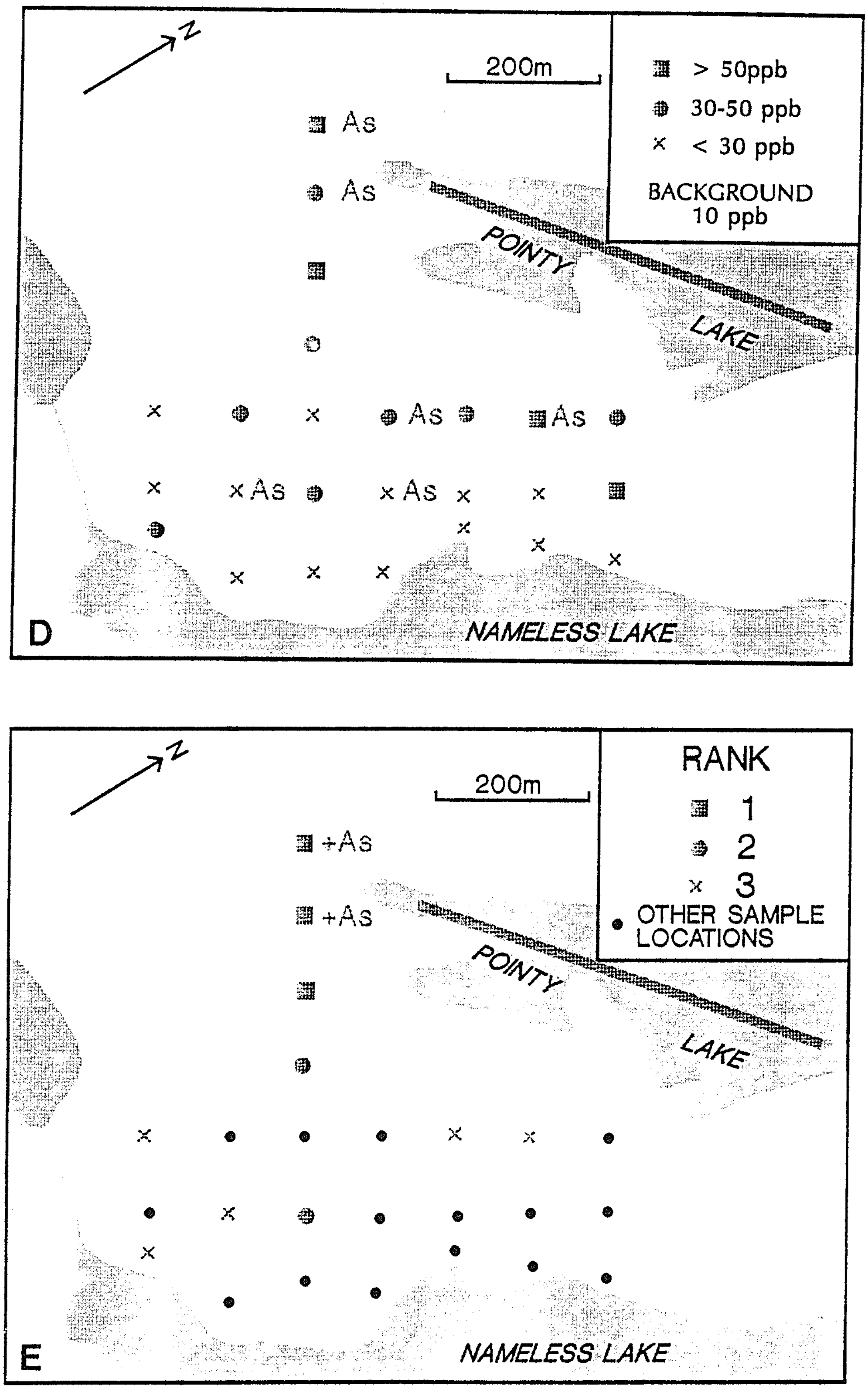


Figure 12 - 'Nameless' Lake: d) gold in alder twigs, e) gold in the three vegetation sample media, ranked in order of decreasing gold concentrations and anomaly coincidence.

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