REGIONAL AND PROPERTY-SCALE APPLICATION OF LAKE SEDIMENT GEOCHEMISTRY IN THE SEARCH FOR BURIED MINERAL DEPOSITS IN THE SOUTHERN NECHAKO PLATEAU AREA, BRITISH COLUMBIA (93C, E, F, K, L)

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INTRODUCTION AND OBJECTIVES

The purpose of the Interior Plateau lake sediment studies program is to improve the existing geochemical database of the Nechako Plateau area of the northern Interior to better assess the mineral potential of the region, thus increasing the possibility of significant new discoveries. Stream sediments are the preferred sampling medium for reconnaissance scale Regional Geochemical Surveys (RGS) over most of British Columbia, but lake sediments are a more appropriate geochemical medium in the Nechako Plateau, which is characterized by subdued topography and an abundance of lakes. Mineral exploration here has been limited, in part, by extensive drift and forest cover, poor bedrock exposure and a barren Tertiary volcanic cover.

Lake sediment geochemistry can be an effective tool to delineate both regional geochemical patterns and anomalous metal concentrations related to potentially economic deposits (Hoffman, 1976; Coker *et al.*, 1979; Cook and Jackaman, 1994b), but most prior Canadian lake sediment geochemical studies have focused on Shield and Appalachian environments where there are considerable differences in climate, physiography and surficial geology relative to the Cordillera. Publicly funded regional lake sediment surveys have been conducted primarily in central and Atlantic Canada. These, covering an area of 1.2 million square kilometres (Friske, 1991) and run to the standards of the Geological Survey of Canada's National Geochemical Reconnaissance (NGR) program, have provided a wealth of high-quality geochemical data for mineral exploration, and contributed to the discovery of deposits such as the Strange Lake yttrium-zirconium-beryllium deposit in Labrador (McConnell and Batterson, 1987). In contrast, regional lake sediment surveys in British Columbia, jointly undertaken by the British Columbia Geological Survey Branch and the Geological Survey of Canada, have until recently been restricted to relatively small areas of NTS map sheets 93E (Whitesail Lake) and 93L (Smithers) in the west-central Interior (Johnson *et al.*, 1987a, b), and 104N (Atlin) in the Teslin Plateau. There is consequently tremendous potential for the effective use of lake sediment geochemistry in central British Columbia, both for reconnaissance and detailed mineral exploration. Many regional surveys have been conducted, including those of Spilsbury and Fletcher (1974), Hoffman (1976) and Gintautas (1984). Exploration industry regional lake sediment surveys, such as those of Rio Tinto Canadian Exploration Limited (Coker *et al.*, 1979) have covered large tracts of central British Columbia and led to the discovery of numerous base and precious metal prospects. Nevertheless, there is little regional geochemical data available in the public domain, and few orientation studies and case histories have been conducted to formulate exploration models for the area. These studies are important for the successful application of lake sediment geochemistry surveys at both reconnaissance and property scales. Field surveys, emphasizing both site-specific methods development studies and regional inventory, were conducted during 1992-1995 as part of the Canada - British Columbia Mineral Development Agreement (MDA). This paper outlines program objectives and summarizes the results of fieldwork performed. Primary objectives of the program were three-fold:

- Evaluate the effectiveness of lake sediment geochemistry in reflecting the presence of adjacent mineral deposits, hence its usefulness as a sample medium for regional geochemical surveys of the area.
- Design and conduct effective regional lake sediment surveys in the northern Interior Plateau, particularly in 1:250 000 NTS map areas 93F (Nechako River), 93K (Fort Fraser) and 93C (Anahim Lake), where RGS coverage is lacking.
- Design more effective follow-up lake sediment geochemical studies to better trace regional geochemical anomalies back to their buried sources within lake watersheds.

LAKE SEDIMENTS AND THEIR USE IN MINERAL EXPLORATION

Geochemical dispersion of gold and other metals into lake basins typically occurs in ground water, stream water, or a combination of the two. The metals subsequently accumulate in sediments within lake basins of varied size, depth, physiography and hydrology. These sediments consist of organic gels, organic and inorganic sediments (Jonasson, 1976). Organic gels, or gyttja, are mixtures of particulate organic matter, inorganic precipitates and mineral matter (Wetzel, 1983). They are mature green-grey to black homogenous sediments characteristic of deep-water basins. Organic sediments are immature mixtures of organic gels, organic debris and mineral matter occurring in shallow water and near drainage inflows (Jonasson, 1976). Inorganic sediments, by contrast, are mixtures of mineral particles with little organic matter. Of the three, organic gels are most suitable as a geochemical exploration medium; deep-water basins where they accumulate have been favoured as ideal sites for regional geochemical sampling (Friske, 1991).

Lake sediment composition is influenced by bedrock geology, surficial geology, climate, soils, vegetation, presence of mineral occurrences and limnological factors. Sediment geochemistry in the Nechako Plateau, as in other areas of Canada, generally reflects bedrock variations (Hoffman, 1976; Gintautas, 1984). It also reflects the presence of nearby mineral prospects such as the Mac porphyry molybdenum prospect (Cope and Spence, 1995), base metal prospects near Capoose Lake (Hoffman, 1976; Hoffman and Fletcher, 1981) and Chutanli Lake (Mehrtens, 1975; Mehrtens *et al.*, 1972), and the presence of epithermal precious metal prospects such as the Wolf (Dawson, 1988; Andrew, 1988), Fawn (Hoffman and Smith, 1982) and Tsacha (Cook *et al.*, 1995) occurrences. The temperature and oxygen content of lake waters in northern temperate regions may stratify during the warm summer months, overturning with seasonal changes in the spring and fall. Of such thermally stratified, or dimictic, lakes, eutrophic lakes are those small nutrient-rich lakes with high organic production and almost complete oxygen depletion with increasing depth. Conversely, oligotrophic lakes are deep, large, nutrient-poor lakes with low organic production and a much more constant oxygen content with depth. Polymictic or unstratified lakes are relatively shallow and are not thermally stratified. In all, Earle (1993) has recognized nine such limnological classes in the Nechako Plateau.

Trophic status of a lake may influence interpretation of the sediment geochemistry. Earle (1993) and Hoffman and Fletcher (1981) have shown that there are distinct geochemical differences between the sediments of eutrophic and oligotrophic lakes, particularly with respect to the abundance of organic matter and of hydrous oxides of iron and manganese. Both may scavenge trace elements, and their abundance in lake sediments is largely influenced by water productivity, oxygen stratification in the water column and the rate of clastic sedimentation (Gintautas, 1984). Generally, high organic matter content is characteristic of eutrophic lakes, while precipitates of hydrous iron and manganese oxides are products of more oxygen-rich conditions within larger oligotrophic lakes. The effects of within-lake limnological variations on these constituents and, in particular, on the transport and accumulation of trace elements, has been summarized for southern Shield regions (Timperley and Allan, 1974). Cordilleran lakes, however, have received little attention.

LOCATION AND GEOLOGY OF THE STUDY REGION

The study region lies between 124° and 127°W longitude in central British Columbia (Figure 1), and is bounded by Vanderhoof on the east and Houston on the west. It extends northward from the Clisbako River to the Babine and Stuart lakes area. Most of the region, centred on the Nechako River map area (NTS 93F), is within the Nechako Plateau, the northernmost subdivision of the Interior Plateau (Holland, 1976), although its southern limit extends onto the Fraser Plateau. The low and rolling terrain generally lies between 1000 and 1500 metres elevation. The area is thickly forested, and bedrock is obscured by an extensive surficial cover of predominantly till and glaciofluvial outwash. Further information on the glacial history and deposits of the Nechako Plateau are provided by Levson and Giles (1995; 1996, this volume), Giles and Levson (1994) and Giles *et al.* (1995).

Geology of this part of the Interior Plateau is outlined by Diakow *et al.* (1996, this volume). The study region covers parts of the Stikine Terrane and, to a lesser extent, the Cache Creek and Quesnel terranes. Here, volcanic and sedimentary rocks of the Lower and Middle Jurassic Hazelton Group are intruded by Late Jurassic and Tertiary plutons (Tipper, 1963; Diakow *et al.*, 1993, 1994, 1995a, b). These strata are unconformably overlain by Eocene volcanics of the Ootsa Lake Group, Oligocene-Miocene volcanics of the Endako Group, and Miocene-Pliocene Chilcotin Group basalt flows. Metallogeny and mineral deposits of the area are outlined by Schroeter and Lane (1994) and Lane *et al.* (1996, this volume). Porphyry molybdenum, porphyry copper-molybdenum and, in particular, epithermal gold deposits are the main mineral exploration targets in the region.

FIELD AND LABORATORY METHODS

SCOPE OF FIELD STUDIES

The lake sediment program comprised three main components, each addressing a specific objective: (1) a series of orientation studies in the vicinity of known mineral prospects (Cook, 1993a, b; 1995); (2) ongoing regional lake sediment surveys (Cook and Jackaman, 1994a, b; Cook *et al.*, 1995); and (3) follow-up studies of regional lake sediment anomalies (Cook and Luscombe, 1995). Detailed geochemical studies of 25 lakes in 18 different areas were conducted over the course of the project (Photos 1 and 2), and ongoing regional lake sediment coverage of approximately eight 1:50 000 NTS map areas has been completed.

ORIENTATION STUDIES ADJACENT TO BASE AND PRECIOUS METAL PROSPECTS

Orientation studies of 17 Interior Plateau lakes at 11 localities (Figure 1) were conducted during the period July to September, 1992 to evaluate the suitability of lake sediments as a sample medium for regional geochemical surveys of the area. A total of 625 sediment samples were

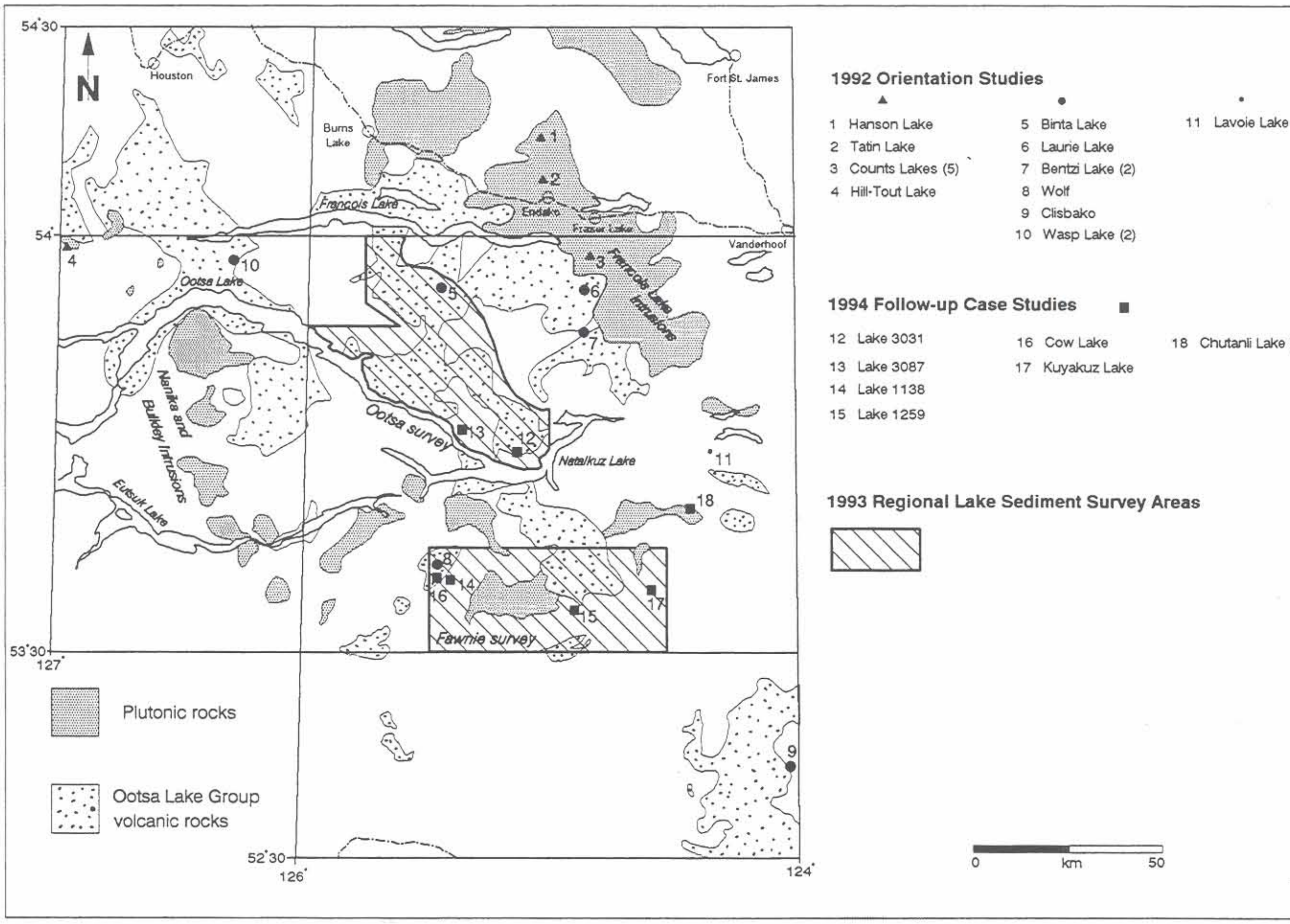


Figure 1. Locations of lake sediment orientation studies and case studies in the Nechako Plateau and adjoining regions of central British Columbia, showing their relation to Eocene-Jurassic plutonic rocks and Eocene volcanic rocks of the Ootsa Lake Group. Locations of regional lake sediment surveys of Cook and Jackaman (1994b) are outlined. Geology modified from Tipper *et al.* (1979).

collected at 437 sites (Table 1). The lakes are characteristic of a range of limnological environments (eutrophic, mesotrophic, oligotrophic, unstratified) above two contrasting geological rock types. These units, areally extensive and of considerable economic interest, are:

- Jura-Cretaceous and Late Cretaceous plutonic rocks of the Francois Lake and Bulkley plutonic suites, respectively, hosting porphyry molybdenum and copper-molybdenum deposits and occurrences.

- Eocene Ootsa Lake Group volcanic rocks, hosting epithermal gold-silver occurrences.

The program design was based partly on recommendations of Earle (1993). Lakes within each geological grouping were chosen on the basis of documented trophic status (Balkwill, 1991), proximity to known mineral occurrences, exploration industry lake sediment data, road access and, in a few cases, available RGS copper and gold lake sediment geochemistry (Johnson *et al.*, 1987a) from adjoining NTS map area 93E. One lake underlain by typically barren Miocene-Pliocene Chilcotin basalt, Lavoie Lake, was also surveyed as a "background" lake.

Francois Lake Intrusives and Related Rocks

Three lakes above the Jura-Cretaceous Francois Lake intrusive suite adjacent to the Hanson Lake, Ken and Nithi Mountain molybdenum occurrences were sampled. The fourth lake is adjacent to quartz monzonite, probably of the Late Cretaceous Bulkley intrusions hosting the Dual copper-molybdenum occurrence. The Francois Lake plutonic suite, comprised predominantly of quartz monzonite, contains a major porphyry molybdenum deposit and many occurrences. The most significant is the Endako orebody west of Fraser Lake, where molybdenite occurs in east trending subparallel quartz veins (Kimura *et al.*, 1976). The Bulkley plutonic suite, a northwesterly belt of granodiorite and quartz monzonite stocks in the western part of the study area (Figure 1), defines one of the four subparallel belts of plutonic rocks known to host porphyry copper-molybdenum deposits in west-central British Columbia (Carter, 1981).

Ootsa Lake Group

Three of the surveyed lakes are adjacent to the Clisbako, Wolf and Holy Cross epithermal gold-silver prospects (Table 1). These lakes are above Eocene continental volcanic rocks of the Ootsa Lake Group, which are exposed in two broad areas of the study region. The first, where most of the orientation and case study areas are located, extends from the Nechako River to the southwest side of Francois Lake (Figure 1); the second, smaller, area is west of Quesnel

Photo 1. Wolf Pond, looking to the northwest.

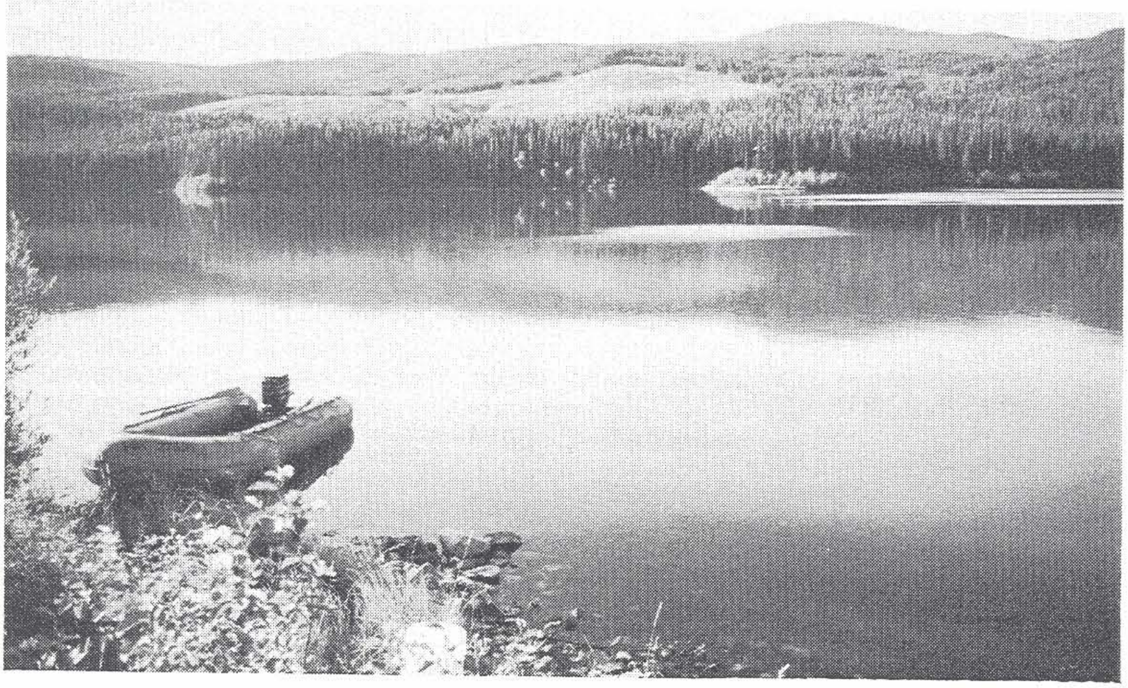


Photo 2. Hanson Lake, looking to the south.

TABLE 1
SUMMARY LISTING OF LAKES SURVEYED

ORIENTATION STUDIES: 1992

Bedrock Lithology	Lake Name	NTS	Easting	Northing	Trophic Status	Lake Size (km^2)	Max. Sample Depth (m)	Sediment Sites	Sediment Samples	Temperature and Oxygen Profiles	Adjacent Mineral Occurrences
Eocene - Jurassic	Hanson	93K03	365500	6012300	Unstratified	1 to 5	7	44	62	5	Hanson Lake (Mo, Cu)
Plutonic Rocks	Tatin	93K03	365000	6001000	Oligotrophic	1 to 5	22	38	52	6	Ken (Mo, Cu)
(Cu, Mo)	Hill-Tout	93E14,15	630750	5981000	Mesotrophic	0.25 to 1	14	52	74	5	Dual (Cu, Mo)
	Counts (5)	93F15	379450	5980000	Eutrophic	0.25 to 1	12	63	99	9	Nithi (Mo)
			379850	5979750							
			381300	5980250							
			383300	5980200							
			382750	5979550							
Eocene	Binta	93F13,14	337000	5972500	Oligotrophic	> 5	> 40	37	50	3	*None*
Ootsa Lake Group	Bentzi (2)	93F15	376950	5959750	Mesotrophic	1 to 5	35	66	92	7	Holy Cross (Au,Ag,Cu,Zn)
Volcanic Rocks			372550	5959350							
(Au, Ag)	Laurie	93F15	376000	5971500	Eutrophic	1 to 5	22	25	35	5	*None*
	Wolf	93F03	335477	5897395	Eutrophic	< 0.25	8	7	12	1	Wolf (Au, Ag)
	Clisbako	93C09	429500	5841950	-	1/4 to 1	10.5	40	57	3	Clisbako (Au, Ag)
	Wasp (2)	93E 16	678350	5978200	-	1/4 to 1	6	13	19	1	*None*
			677800	5977400							
Miocene-Pliocene Volcanic Rocks	Lavoie	93F08	410000	5927100	Unstratified	1 to 5	9	52	73	4	*None*
							Total:	**437**	**625**	**49**	

FOLLOW-UP CASE STUDIES: 1994

	Lake Name	NTS	Easting	Northing	Trophic Status	Lake Size (km^2)	Max. Sample Depth (m)	Sediment Sites	Sediment Samples	Temperature and Oxygen Profiles	Adjacent Mineral Occurrences
Drainage Lakes	Kuyakuz	93F02	393510	5888934	Unstratified	> 5	16	68	94	3	*None*
	Cow	93F03	335683	5893966	Unstratified*	1 to 5	15	50	68	-	*None*
Seepage Lakes	Lake 3031	93F06	359566	5928408	Eutrophic	< 0.25	5.5	13	17	4	*None*
	Lake 3087	93F11	341085	5935677	Eutrophic	< 0.25	7.5	24	32	5	*None*
	Lake 1138	93F03	341174	5894518	Unstratified	< 0.25	3.5	15	21	1	*None*
	Lake 1259	93F02	374503	5886097	Unstratified	< 0.25	3	17	23	1	*None*
CH Area Study	Chutanli	93F08	403000	5911800	Unstratified	1 to 5	10	50	70	7	CH (Mo, Cu)
	CH-1	93F07	398250	5911400	Unstratified	< 0.25	6	19	25	4	CH (Mo, Cu)
	CH-2	93F07	398850	5911950	Unstratified	< 0.25	4	9	12	2	CH (Mo, Cu)
							Total:	**265**	**362**	**27**	

Note: Where lakes were surveyed as part of a group (*e.g.* Counts Lakes), individual lake UTMs are shown, but summary data is for the group. Trophic status of Cow Lake (*) from data of Coombes (1986). Names of seepage lakes are from regional site locations of Cook and Jackaman (1994b). All UTM data are zone 10 with exceptions of Hill-Tout and Wasp lakes (Zone 9).

between the Chilcotin and West Road rivers (Duffell, 1959; Tipper, 1963). The Ootsa Lake Group comprises a differentiated succession of andesitic to rhyolitic flows and pyroclastic rocks. Sedimentary rocks, although not common, are interspersed throughout the sequence. Potassium-argon ages of approximately 50 Ma have been obtained for the Ootsa Lake Group (Diakow and Koyanagi, 1988; Andrew, 1988). Interest in the precious metal potential of the Ootsa Lake Group has increased in recent years. The Wolf and Clisbako epithermal prospects (Figure 1), described in more detail later in this paper, are both hosted by this volcanic succession.

REGIONAL LAKE SEDIMENT GEOCHEMISTRY SURVEYS

Helicopter-supported regional lake sediment and water collection was conducted in three parts of the Nechako River (NTS 93F) and Fort Fraser (NTS 93K) map areas during the Interior Plateau Project. The Fawnie survey (237 sites) and the Ootsa survey (224 sites) were carried out by GSB personnel during the period June-September, 1993. A centre-lake sediment and water sample were systematically collected at each site from a float-equipped Bell 206 helicopter. Average sampling density was approximately 1 site per 7.9 square kilometres in the Fawnie area versus 7.4 square kilometres in the Ootsa area (Table 2). Further details are provided by Cook and Jackaman (1994a, b). Regional geochemical coverage of the northeast part of the Fort Fraser map area (NTS 93K/9, 10, 15, 16) was completed in October 1995. Results of this, the Pinchi Lake survey (413 sites), have not yet been released.

The Fawnie survey area (NTS map areas 93F/02 and 03) covers about 1860 square kilometres in the southern part of the Nechako Plateau (Figure 1). The area, recently remapped by Diakow *et al.* (1994, 1995a), is underlain largely by a volcanic succession with interspersed fossil-bearing sediments of Early and Middle Jurassic age. These rocks are intruded by Jura-Cretaceous quartz monzonite and granodiorite of the Capoose batholith and locally unconformably overlain by Eocene felsic volcanics of the Ootsa Lake Group. Metallogeny and mineral deposits of the Fawnie area are outlined by Schroeter and Lane (1994).

TABLE 2
SUMMARY OF NECHAKO PLATEAU LAKE SEDIMENT SURVEYS: 1993-1995

Survey	NTS	Area (square km)	Sampling Density	Sites	Samples
Fawnie	93F/2,3	1862.6	7.9	237	251
Ootsa	93F/6,11,12,13,14 (parts thereof)	1650	7.4	224	238
Pinchi Lake	93K/9,10,15,16	3584.2	8.7	413	438
Totals:		7096.8	8.1	874	927

Note: Sampling density is in sites per square kilometre. Results of Pinchi Lake survey not yet released.

The Ootsa survey area (parts of NTS map areas 93F/06,11,12,13 and 14) lies to the north of the Fawnie area and covers about 1650 square kilometres south of Burns Lake. The irregular shaped area, bounded by Ootsa and Natalkuz lakes of the Nechako Reservoir in the south and Francois Lake in the north (Figure 1), is centred on a northwest-trending belt of Eocene felsic volcanic rocks (Tipper, 1963) that underlie about 65 to 70% of the area. Other units, the Oligocene-Miocene Endako Group and older Mesozoic successions, are less extensively exposed. Detailed bedrock mapping has been restricted to the southernmost part of this area (Diakow *et al.,* 1993). Exploration for bulk-tonnage epithermal precious metal deposits has been ongoing in the Ootsa survey area since the 1980s, and a brief summary of exploration prospects, compiled from assessment reports, is provided by Cook and Jackaman (1994b).

FOLLOW-UP CASE STUDIES OF ANOMALOUS WATERSHEDS

Case studies of nine lakes in seven localities (Figure 1) were conducted during July to September 1994, to determine the most appropriate methods of locating the potential sources of elevated sediment metal concentrations within lake watersheds. A total of 362 sediment samples were collected at 266 sites (Table 1). Earlier orientation studies were designed, in part, to guide the design and implementation of regional geochemical surveys. This, more advanced, component of the project examined sampling and interpretive strategies for more effective follow-up surveys of anomalous watersheds.

The main objective was to characterize differences in sediment metal distribution patterns between two types of lakes, seepage lakes and drainage lakes, both of which commonly occur in the Nechako Plateau. Earlier results (Cook, 1995) indicated that differences in metal distribution patterns and geochemical signatures between lakes might be related to differing watershed characteristics: in particular, to differences in metal input and accumulation between lakes with differing ground water and stream water flow patterns. Seepage and drainage lakes have been described by Wetzel (1983). Seepage lake basins receive predominantly ground water seepage or spring input below the lake surface, but lack significant stream outflow. Water loss in these lakes, other than that due to evaporation, is restricted to seepage back into ground water. For purposes of this study, lakes and ponds lacking significant stream inflows were included in this category. Drainage lakes lose water by stream flow from an outlet. In the context of this study, they include those lakes with relatively large watersheds receiving water from both surface influents and subsurface seepage. Influx of suspended particulate matter, both mineral and organic, in stream waters into drainage lakes is a major difference between these and seepage lakes. There is a certain amount of overlap between the two lake types, however, as ground waters play a major role in transporting metals to all lake basins (Hoffman and Fletcher, 1981). For example, Boyle (1994) has further subdivided lakes into six varieties on the basis of varying ground water and surface water input. The case studies include:

- Four small seepage lakes and ponds.
- Two large drainage lakes (Kuyakuz Lake; Cow Lake).
- Three lakes and ponds, near the CH porphyry copper-molybdenum prospect (MINFILE 093F 004). These were surveyed to complement earlier orientation studies (Cook, 1993a) and ongoing joint glacial dispersal studies of the Geological Survey Branch (Giles *et al.*, 1995) and the University of New Brunswick (O'Brien *et al.*, 1995; Weary *et al.*, 1995).
- Seepage and drainage lakes were chosen on the basis of apparent flow type and regional lake sediment geochemistry results (Cook and Jackaman, 1994b). All six contain elevated concentrations of gold and associated elements such as arsenic, antimony and/or molybdenum in centre-lake or centre-basin sediments. The four seepage lakes span a range of physiographic environments and include both eutrophic and unstratified variants; their identifiers (Table 1, Figure 1) are their site location numbers from Cook and Jackaman (1994b).

SAMPLE COLLECTION

SEDIMENTS AND WATERS

Orientation and Case Studies

Systematic collection of lake sediments and waters, and measurement of temperature and dissolved oxygen content of the water column, were conducted at each lake surveyed during orientation and follow-up case studies (Table 1). Sediments were sampled from a zodiac or canoe with a Hornbrook-type torpedo sampler (Photo 3). Standard sampling procedures, as discussed by Friske (1991), were used. Samples were placed in large (5" x 6") kraft paper bags and sample depth, colour, composition and odour recorded at each site. Sites were located along profiles traversing deep and shallow-water parts of main basins and sub-basins, and at all stream inflows. The number of sites on each lake (Table 1) ranged from a minimum of seven in small ponds, to a maximum of 69 in larger lakes such as Kuyakuz Lake, in order to evaluate the relationship between trace element patterns and bathymetry, organic matter content, drainage inflow and outflow, sediment texture and mineral prospect location.

An unbalanced nested sampling design, similar to that described by Garrett (1979), was used to assess case study sampling and analytical variation. A modified version of the Regional Geochemical Survey sampling scheme, devised for this purpose, has been described by Cook (1993a). Each block of twenty samples comprises twelve routine samples, five field duplicate samples to assess sampling variability, two blind duplicate samples to determine analytical precision, and one control reference standard to monitor analytical accuracy.

Regional Geochemical Surveys

Samples collected during the regional lake sediment surveys were obtained with a Hornbrook-type torpedo sampler (Photos 3 and 4). On the basis of results of the orientation studies, the regional lake sediment surveys incorporate some departures from standard lake sediment sampling strategies used elsewhere in Canada for the National Geochemical Reconnaissance (NGR) program (Friske, 1991; Friske and Hornbrook, 1991), particularly pertaining to overall site density and the number of sites sampled in each lake.

First, every lake in the survey areas was sampled, rather than sampling only a selection of lakes at a fixed density (*i.e.*, one site per 13 km^2). Even sediment in small ponds may contain anomalous metal concentrations revealing the presence of nearby mineralization, as at the Wolf prospect (Cook, 1995). In practice, some small ponds were not sampled due to unfavourable landing conditions. Samples were not collected from the centres of very large and deep lakes (10 km^2, 40 m deep) such as Tsacha, Uncha, Binta and Lucas lakes in the Nechako River map area, nor from reservoir areas such as Ootsa or Cheslatta lakes, which have been altered by the creation of the Nechako Reservoir. Organic soils from swamps and bogs were also avoided.

Secondly, centre-lake sediment samples were collected following standard NGR procedure, but sediment from the centres of all major known or inferred sub-basins was also collected to investigate the considerable trace element variations which may exist among sub-basins of the same lake. Consequently, up to five sites were sampled in some of the larger lakes in the Fawnie and Ootsa surveys. Lake bathymetry maps in unpublished reports of the Fisheries Branch, B.C. Ministry of Environment, Lands and Parks (Balkwill, 1991) were consulted prior to sampling several of the larger lakes, to assist in site selection.

Centre-lake water samples were collected from near the surface of all regional survey lakes, and from near the surface and bottom of all case study lakes. Surface water samples were, in both cases, collected in 250-millilitre polyethylene bottles from approximately 15 centimetres beneath the surface. Bottom waters were collected with a Van Dorn sampler 1 to 2 metres above the sediment-water interface. Complete details of bottle preparation and water collection procedures are given by Cook and Jackaman (1994b) for regional surveys, and by Cook (1993a) and Cook and Luscombe (1995) for orientation and case studies.

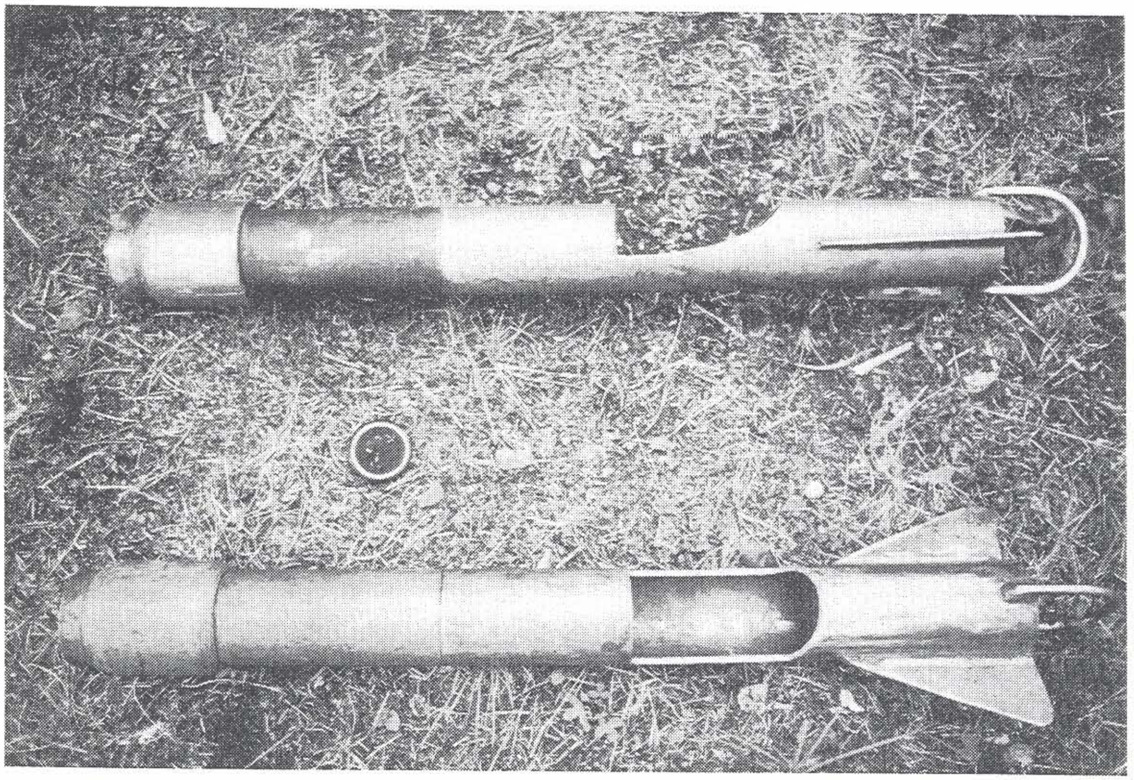


Photo 3. Hornbrook-type lake sediment samplers.

Photo 4. Regional lake sediment sampling in the Fawnie survey area.

Dissolved Oxygen and Temperature Measurements

Water column profiles of dissolved oxygen content (ppm) and temperature (°C) were measured as part of each case study to verify pre-existing Fisheries Branch data (*i.e.*, Burns, 1978), to determine the trophic status of smaller lakes for which no data are otherwise available, and to investigate the variability of these measurements within separate sub-basins of individual lakes. No dissolved oxygen or temperature measurements were conducted during regional geochemical surveys.

Dissolved oxygen and temperature profiles were measured at one to five sites on each lake using a YSI Model 57 oxygen meter with cable probe. Measurements were generally made, at 1-metre intervals, in the centre of all major sub-basins to a maximum depth of 29 metres, and at two near-shore sites. The instrument was calibrated for elevation and air temperature prior to measurement at each lake, and data collected only during the afternoon period so as to standardize measurement conditions. A total of 66 profiles comprising 822 pairs of measurements were surveyed; 49 profiles in 1992 and a further 27 profiles in 1994 (Table 1). Measurements generally corroborated prior Fisheries Branch data at most lakes, although considerable within-lake variations were encountered between separate sub-basins and channels. Results from a few lakes surveyed in late 1992 (*e.g.*, Clisbako, Wasp) were inconclusive due to the onset of cold weather in early fall. No profile data are given here; readers should consult Cook (1995) for selected profile data from some lakes adjacent to epithermal prospects.

SAMPLE PREPARATION AND ANALYSIS

Lake sediment samples were initially field dried and, when sufficiently dry to transport, shipped to a commercial laboratory for final drying at 40ºC. Complete details of sample preparation procedures and analytical methods are outlined by Cook (1993) and Cook and Luscombe (1995) for orientation and case studies, and by Cook and Jackaman (1994b) for regional surveys. Briefly, the entire dry sediment sample, to a maximum of 250 grams, was pulverized to approximately -150 mesh in a ceramic ring mill. Two analytical splits were taken from the pulverized material. The first 30-gram subsample was submitted to Activation Laboratories, Ancaster, Ontario for determination of gold and 34 additional elements by instrumental neutron activation analysis (INAA).

The second subsample, in the case of orientation and case studies, was submitted to Acme Analytical Laboratories, Vancouver, for determination of zinc, copper, lead, silver, arsenic, molybdenum, iron, manganese and 22 additional elements, plus loss on ignition, by inductively coupled plasma - atomic emission spectrometry (ICP-AES) following an aqua regia digestion. In the case of 1993 regional surveys, the second subsample was submitted to Can-Tech (formerly Barringer Magenta) Laboratories Inc., Calgary, for analysis for zinc, copper, lead, nickel, cobalt, silver, manganese, arsenic, molybdenum, iron, mercury, antimony, cadmium, bismuth and vanadium by atomic absorption spectroscopy (AAS) as per standard RGS procedures. Loss on ignition (LOI) was also determined. Blind duplicates and appropriate ranges of copper and gold-bearing standards were inserted into each of the analytical suites as part of a rigourous quality control program to monitor analytical precision and accuracy.

Lake waters obtained during orientation and case studies were filtered through 0.45-micron filters and analyzed for a variety of trace and major element suites by inductively coupled plasma - atomic emission spectrometry (ICP-AES) and inductively coupled plasma - mass spectrometry (ICP-MS) techniques (Cook, 1993; Cook and Luscombe, 1995). Sulphate and pH were also determined. Fawnie area regional lake waters, sampled as a pilot study to determine the usefulness of multi-element regional lake water geochemistry, were filtered through 0.45-micron MSI filters and analyzed for trace and major elements by inductively coupled plasma - atomic emission spectrometry (ICP-AES). Sulphate and pH were also determined. In contrast, unfiltered Ootsa area regional lake waters were analyzed for the standard RGS water analytical suite (pH, uranium, fluoride, sulphate) only.

RESULTS AND DISCUSSION

Highlights of results of orientation studies, regional surveys, and follow-up case studies are presented here. These represent only part of the work done, and additional results will be presented in future papers.

ORIENTATION STUDIES

Summary statistics for selected elements from all orientation lakes surveyed (Table 1) are provided in Table 3. Lakes in seven areas are immediately adjacent to known mineral prospects (Table 1). Elevated metal concentrations in sediments from each of these lakes reflect the presence of epithermal gold and porphyry molybdenum or copper-molybdenum mineralization. Selected results for four lakes are shown here: the Wolf and Clisbako epithermal precious metal prospects, and the Ken and Hanson Lake porphyry molybdenum prospects. Cook (1995) and Cook and Jackaman (1994b) should be consulted for further details.

EPITHERMAL PRECIOUS METAL PROSPECTS

The Wolf pond, located about 100 kilometres south-southwest of Fraser Lake, is a small eutrophic pond (max. depth: 4.5 m), approximately 60 by 35 metres in dimension. It is situated within a narrow intermontane bog in the rugged uplands of the Entiako Spur of the Fawnie Range. There is no stream input into the pond, inferring a groundwater source for contained metals. Clisbako Lake, located about 100 kilometres west of Quesnel, is a small single-basin lake (max. depth: 9 m) of unknown trophic status about 700 metres long. Two streams drain into the lake from the west and the south, defining a watershed of about 14 square kilometres.

TABLE 3
SUMMARY STATISTICS FOR SELECTED ELEMENTS: ORIENTATION STUDIES

		Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Cr (ppm)	Mn (ppm)	Fe (%)	As (ppm)	Cd (ppm)	Au (ppb) INAA	As (ppm) INAA	Sb (ppm) INAA	Fe (%) INAA	La (ppm) INAA	Ce (ppm) INAA	LOI (%)
Plutonic Rocks																				
HANSON LAKE (N=44)	Mean	8.36	60.48	9.20	117.18	0.40	30.75	9.64	37.52	584.05	3.55	13.41	0.52	3.11	14.29	0.78	3.89	32.30	51.73	26.5
	Median	**7**	**65.5**	**9**	**122**	**0.35**	**32**	**10**	**40**	**601.5**	**3.78**	**13**	**0.5**	**3**	**14**	**0.8**	**3.925**	**32.5**	**53.5**	**27.5**
	S.D.	8.08	15.19	3.02	24.27	0.22	6.97	1.82	8.78	136.56	0.81	7.76	0.18	2.53	8.25	0.14	0.81	6.09	9.85	5.9
	Variance	65.21	230.86	9.10	589.27	0.05	48.56	3.31	77.09	18649.72	0.66	60.20	0.03	6.38	68.01	0.02	0.66	37.05	97.04	34.5
	C.V.	96.55	25.12	32.77	20.72	54.63	22.66	18.87	23.40	23.38	22.83	57.86	33.88	81.14	57.70	18.69	20.95	18.85	19.04	22.2
	Minimum	1	25	2	60	0.1	13	4	11	274	1.46	2	0.2	1	6.2	0.4	1.93	17	29	5.4
	Maximum	55	83	15	158	0.8	44	13	51	985	4.92	57	0.9	14	62	1.1	5.4	44	70	33.8
TATIN LAKE (N=38)	Mean	8.63	33.71	5.08	70.03	0.14	15.50	5.39	21.61	770.42	2.20	2.58	0.30	1.71	4.50	0.66	2.31	42.95	49.97	32.0
	Median	**8**	**35**	**4.5**	**77.5**	**0.1**	**17**	**6**	**22.5**	**697.5**	**2.02**	**2**	**0.3**	**1**	**4.4**	**0.65**	**2.12**	**47**	**54.5**	**34.1**
	S.D.	4.19	10.84	2.31	22.81	0.06	4.42	1.92	7.50	326.90	1.18	0.92	0.16	1.21	1.76	0.16	1.12	14.35	15.84	9.8
	Variance	17.59	117.40	5.32	520.40	0.00	19.55	3.70	56.25	106863.28	1.38	0.84	0.03	1.45	3.11	0.03	1.26	205.89	250.84	95.6
	C.V.	48.59	32.14	45.40	32.58	45.20	28.53	35.68	34.71	42.43	53.44	35.64	54.44	70.51	39.19	24.25	48.51	33.41	31.69	30.5
	Minimum	1	1	2	17	0.1	4	1	4	195	0.44	2	0.2	1	1.6	0.2	0.53	12	14	3.4
	Maximum	23	49	11	98	0.3	22	11	44	2198	5.16	5	1	5	9.6	1	4.94	63	76	45.6
COUNTS LAKES (5) (N=63)	Mean	48.59	46.29	14.54	114.54	0.27	17.67	7.65	23.29	259.54	1.94	4.24	0.71	2.11	5.57	1.09	2.09	24.11	39.40	19.7
	Median	**42**	**44**	**10**	**109**	**0.2**	**17**	**7**	**23**	**244**	**1.65**	**3**	**0.6**	**1**	**4.1**	**1.1**	**1.9**	**22**	**38**	**18.3**
	S.D.	41.08	22.45	21.92	37.23	0.26	4.80	2.30	5.28	78.39	0.89	2.69	0.54	1.63	3.57	0.19	0.84	7.74	8.93	9.2
	Variance	1687.86	503.92	480.35	1386.32	0.07	23.03	5.30	27.85	6145.64	0.79	7.25	0.29	2.65	12.72	0.04	0.70	59.84	79.76	85.2
	C.V.	84.56	48.50	150.74	32.51	96.83	27.17	30.08	22.66	30.21	45.97	63.53	75.61	77.09	64.02	17.26	39.96	32.08	22.67	47.0
	Minimum	4	12	4	56	0.1	10	4	11	130	1.1	2	0.2	1	2.3	0.7	1.22	13	24	5.4
	Maximum	165	94	167	236	1.2	28	12	36	586	6.7	12	2.8	9	22	1.5	6.97	44	65	48.7
HILL-TOUT LAKE (N=52)	Mean	2.27	102.90	11.15	295.79	1.07	26.00	28.83	14.54	2436.42	3.91	7.23	2.02	4.65	9.68	1.41	3.86	17.79	27.94	33.1
	Median	**2**	**101.5**	**10**	**317**	**0.8**	**25**	**26.5**	**14**	**625**	**2.83**	**5**	**1.95**	**4.5**	**9.4**	**1.5**	**2.665**	**18.5**	**28**	**34.1**
	S.D.	1.25	27.20	4.75	90.14	0.59	7.72	16.48	3.11	8380.23	2.55	6.46	1.07	2.64	4.62	0.38	2.64	3.95	6.92	5.8
	Variance	1.57	739.85	22.56	8124.60	0.35	59.53	271.64	9.67	70228226.13	6.51	41.79	1.14	6.98	21.32	0.14	6.95	15.58	47.90	33.8
	C.V.	55.27	26.43	42.59	30.47	55.23	29.68	57.17	21.38	343.96	65.20	89.40	53.07	56.75	47.73	26.58	68.37	22.19	24.77	17.5
	Minimum	1	22	2	146	0.3	12	8	10	140	1.3	2	0.2	1	2.7	0.6	1.39	10	15	12.8
	Maximum	8	151	24	462	3	65	73	24	59655	10.96	31	5.3	12	23	2.3	12	25	44	42.1
Ootsa Lake Volcanics																				
BINTA LAKE (N=37)	Mean	6.46	30.68	12.68	85.62	0.10	20.89	8.14	22.27	777.86	2.11	14.19	0.26	2.59	12.55	2.12	2.28	30.11	52.97	26.0
	Median	**7**	**34**	**8**	**87**	**0.1**	**21**	**8**	**23**	**690**	**2.16**	**13**	**0.2**	**2**	**12**	**1.6**	**2.35**	**30**	**54**	**29.4**
	S.D.	2.65	8.74	30.93	17.59	0.02	4.89	2.03	4.51	326.74	0.66	7.03	0.10	1.85	5.74	2.86	0.58	6.01	10.33	8.8
	Variance	7.03	76.39	956.61	309.52	0.00	23.93	4.12	20.37	106759.34	0.44	49.44	0.01	3.41	32.93	8.20	0.34	36.15	106.64	77.4
	C.V.	41.06	28.49	244.00	20.55	16.01	23.42	24.95	20.27	42.00	31.47	49.55	39.01	71.22	45.71	135.01	25.46	19.97	19.49	33.8
	Minimum	1	6	2	48	0.1	11	5	13	243	1.2	5	0.2	1	5.3	1.2	1.38	19	37	3.7
	Maximum	11	43	195	135	0.2	31	14	32	1594	4.53	39	0.5	7	34	19	4.22	48	88	36.5
LAURIE LAKE (N=25)	Mean	2.84	16.44	6.76	57.72	0.20	7.32	4.60	10.36	291.60	1.20	6.56	0.22	2.04	7.52	1.46	1.31	22.48	36.84	25.2
	Median	**3**	**21**	**7**	**64**	**0.2**	**8**	**5**	**11**	**272**	**1.03**	**6**	**0.2**	**1**	**7.2**	**1.5**	**1.15**	**22**	**37**	**31.2**
	S.D.	1.84	9.30	1.45	16.27	0.09	2.70	0.87	2.51	81.01	0.39	2.93	0.05	2.34	2.38	0.33	0.34	1.29	3.06	15.4
	Variance	3.39	86.51	2.11	264.79	0.01	7.31	0.75	6.32	6563.00	0.15	8.59	0.00	5.46	5.67	0.11	0.11	1.68	9.39	235.8
	C.V.	64.83	56.57	21.47	28.19	47.68	36.94	18.83	24.27	27.78	32.71	44.68	23.34	114.51	31.64	22.46	25.76	5.76	8.32	61.0
	Minimum	1	2	3	31	0.1	2	3	6	189	0.77	2	0.2	1	4.3	0.9	0.88	21	31	2.6
	Maximum	10	32	9	90	0.4	12	6	15	484	2.19	12	0.4	12	14	2.2	2.05	26	45	41.5

TABLE 3 CONTINUED

BENTZI LAKE (N=58)	Mean	3.41	51.31	4.16	96.86	0.21	14.26	9.34	16.31	1561.81	2.83	10.10	0.28	2.59	12.70	1.77	3.08	21.78	41.66	31.4
	Median	**4**	**53**	**4**	**93.5**	**0.2**	**14.5**	**9**	**17.5**	**549.5**	**2.17**	**8.5**	**0.2**	**1**	**12**	**1.7**	**2.635**	**22**	**43**	**35.9**
	S.D.	1.88	25.13	1.71	25.21	0.13	4.46	2.22	4.01	3527.71	2.27	7.92	0.18	2.08	5.26	0.55	2.04	3.95	8.08	13.2
	Variance	3.55	631.38	2.94	635.56	0.02	19.91	4.93	16.08	12444715.03	5.17	62.80	0.03	4.32	27.65	0.30	4.15	15.58	65.28	175.5
	C.V.	55.15	48.97	41.27	26.03	60.64	31.30	23.76	24.58	225.87	80.28	78.43	63.68	80.34	41.41	30.96	66.10	18.13	19.40	42.2
	Minimum	1	9	2	39	0.1	5	5	5	257	1.56	2	0.2	1	2.5	0.5	1.42	12	22	4.2
	Maximum	8	100	7	143	0.6	23	15	23	18752	11.64	35	1.3	9	27	3.4	11.8	28	54	49.2
UNNAMED LAKE (N=8) (Bentzi Lake Area)	Mean	7.88	41.38	3.13	63.38	0.10	15.38	5.00	13.50	659.00	1.17	3.50	0.24	1.75	4.50	1.83	1.25	9.50	15.25	71.2
	Median	**7.5**	**46.5**	**3**	**67.5**	**0.1**	**15**	**4.5**	**9.5**	**606.5**	**1.02**	**2.5**	**0.2**	**1**	**4.5**	**1.95**	**1.06**	**7.5**	**10**	**80.1**
	S.D.	4.02	13.02	0.99	16.28	0.00	5.32	2.73	10.52	224.39	0.47	1.85	0.11	1.49	0.84	0.40	0.60	6.37	12.76	24.8
	Variance	16.13	169.41	0.98	265.13	0.00	28.27	7.43	110.57	50351.43	0.22	3.43	0.01	2.21	0.71	0.16	0.36	40.57	162.79	613.7
	C.V.	50.99	31.46	31.71	25.69	0.00	34.58	54.51	77.89	34.05	39.66	52.90	44.66	85.03	18.74	21.87	47.93	67.05	83.66	34.8
	Minimum	1	21	2	32	0.1	8	2	6	325	0.71	2	0.2	1	3.5	1	0.81	5	8	10.3
	Maximum	15	53	5	82	0.1	27	11	38	1033	1.9	6	0.5	5	6	2.2	2.6	25	46	83.2
WOLF POND (N=7)	Mean	15.86	54.29	7.86	230.43	1.61	15.71	9.43	16.29	262.71	2.41	35.57	0.53	32.57	37.31	1.60	2.26	27.29	53.86	51.1
	Median	**18**	**71**	**8**	**306**	**2.2**	**21**	**14**	**21**	**302**	**3.37**	**47**	**0.5**	**43**	**47**	**2**	**2.91**	**37**	**75**	**52.3**
	S.D.	5.27	26.48	4.91	131.18	0.99	10.24	7.35	8.44	157.28	1.83	31.68	0.26	18.55	30.58	0.99	1.66	17.70	33.26	7.7
	Variance	27.81	701.24	24.14	17208.29	0.98	104.90	53.95	71.24	24735.90	3.34	1003.62	0.07	344.29	935.09	0.99	2.75	313.24	1106.14	59.2
	C.V.	33.26	48.78	62.54	56.93	61.26	65.18	77.90	51.83	59.87	75.97	89.06	48.50	56.97	81.95	62.08	73.48	64.86	61.75	15.1
	Minimum	9	22	2	90	0.5	2	1	7	87	0.4	2	0.2	11	6.1	0.4	0.44	8	16	40.7
	Maximum	23	81	16	372	2.6	26	17	24	511	4.73	83	0.9	56	80	2.7	4.12	46	88	64.1
CLISBAKO LAKE (N=40)	Mean	3.03	33.55	3.63	89.20	0.12	50.50	11.43	26.05	785.80	2.64	24.45	0.25	8.88	25.63	3.47	2.89	16.73	30.18	46.0
	Median	**3**	**35.5**	**2**	**99.5**	**0.1**	**52**	**12**	**27.5**	**745**	**2.69**	**24**	**0.2**	**9**	**25.5**	**3.1**	**3.15**	**17**	**30**	**50.3**
	S.D.	1.35	11.76	3.18	22.24	0.06	13.37	2.53	6.14	279.26	0.89	7.21	0.10	3.77	8.00	1.18	0.86	4.21	7.51	16.9
	Variance	1.82	138.41	10.14	494.52	0.00	178.77	6.40	37.69	77986.73	0.79	51.95	0.01	14.21	63.94	1.38	0.74	17.69	56.35	286.6
	C.V.	44.60	35.07	87.83	24.93	50.58	26.48	22.15	23.57	35.54	33.72	29.48	39.87	42.48	31.19	33.96	29.89	25.15	24.88	36.8
	Minimum	1	8	2	54	0.1	22	6	16	369	0.95	7	0.2	1	9.3	2.1	1.14	8	15	7.1
	Maximum	6	59	20	130	0.4	74	16	35	1745	4.86	46	0.6	16	49	6.2	4.72	24	44	70.5
WASP LAKE (N=8)	Mean	1.00	33.50	5.50	118.13	0.20	21.13	6.13	16.38	204.50	1.54	4.63	0.40	3.13	6.05	1.90	1.96	23.75	44.00	45.8
	Median	**1**	**32.5**	**5.5**	**119**	**0.15**	**21.5**	**6**	**17**	**195.5**	**1.62**	**4.5**	**0.35**	**3**	**5.95**	**1.75**	**1.865**	**22**	**42**	**42.2**
	S.D.	0.00	3.78	1.93	7.06	0.12	3.00	0.99	2.62	23.83	0.27	2.45	0.16	1.96	1.41	0.26	0.58	2.43	5.53	12.2
	Variance	0.00	14.29	3.71	49.84	0.01	8.98	0.98	6.84	567.71	0.07	5.98	0.03	3.84	2.00	0.07	0.33	5.93	30.57	148.7
	C.V.	0.00	11.28	35.04	5.98	59.76	14.19	16.18	15.97	11.65	17.50	52.88	40.09	62.70	23.36	13.49	29.40	10.25	12.57	26.6
	Minimum	1	29	3	107	0.1	15	4	10	181	0.92	2	0.2	1	3.6	1.7	0.91	22	38	33.7
	Maximum	1	42	9	127	0.4	25	7	18	243	1.74	10	0.7	7	7.8	2.3	2.56	27	51	74.2
UNNAMED POND (N=5) (Wasp Lake Area)	Mean	1.00	32.80	2.60	111.80	0.14	23.00	4.20	10.60	102.00	0.86	2.00	0.66	3.20	3.26	1.02	0.90	16.80	25.40	58.1
	Median	**1**	**34**	**2**	**110**	**0.1**	**24**	**4**	**10**	**86**	**0.85**	**2**	**0.6**	**4**	**3.3**	**1**	**0.89**	**18**	**26**	**56.3**
	S.D.	0.00	4.09	0.89	6.02	0.05	4.12	0.45	1.52	36.65	0.08	0.00	0.13	1.64	0.38	0.11	0.13	2.17	3.91	3.9
	Variance	0.00	16.70	0.80	36.20	0.00	17.00	0.20	2.30	1343.50	0.01	0.00	0.02	2.70	0.15	0.01	0.02	4.70	15.30	15.1
	C.V.	0.00	12.46	34.40	5.38	39.12	17.93	10.65	14.31	35.94	9.07	0.00	20.33	51.35	11.80	10.74	13.98	12.90	15.40	6.7
	Minimum	1	28	2	107	0.1	16	4	9	79	0.77	2	0.5	1	2.7	0.9	0.74	14	20	54.1
	Maximum	1	37	4	122	0.2	27	5	13	166	0.98	2	0.8	5	3.7	1.2	1.09	19	29	63.2
Chilcotin Volcanics LAVOIE LAKE (N=52)	Mean	2.54	25.21	3.23	86.48	0.14	42.60	9.25	25.25	310.69	1.79	3.35	0.24	1.96	5.32	0.80	2.08	10.06	19.62	43.2
	Median	**2**	**24**	**3**	**85**	**0.1**	**45**	**9**	**26**	**294.5**	**1.85**	**2**	**0.2**	**1**	**5.1**	**0.75**	**2.14**	**9**	**17.5**	**46.7**
	S.D.	1.72	11.69	1.42	30.06	0.08	15.86	2.46	7.09	105.95	0.63	2.17	0.08	1.49	2.05	0.26	0.53	3.87	7.32	17.0
	Variance	2.96	136.72	2.02	903.55	0.01	251.50	6.07	50.31	11225.04	0.40	4.70	0.01	2.23	4.19	0.07	0.29	15.00	53.61	288.3
	C.V.	67.77	46.38	44.04	34.76	58.60	37.23	26.64	28.09	34.10	35.12	64.80	34.39	76.19	38.49	32.04	25.72	38.50	37.33	39.3
	Minimum	1	7	2	35	0.1	17	4	11	150	0.73	2	0.2	1	2.3	0.3	0.91	4	9	9.7
	Maximum	12	51	7	163	0.4	67	13	37	848	3.16	14	0.5	5	12	1.7	3.29	20	38	73.6

The Wolf (MINFILE 093F 045) and Clisbako (093C 016) gold-silver prospects are both in Eocene volcanic rocks of the Ootsa Lake Group. The Wolf prospect, a low sulphidation adularia-sericite epithermal deposit, is hosted by rhyolite flows, tuffs and subvolcanic rhyolite porphyry (Andrew, 1988; Schroeter and Lane, 1994). It comprises five mineralized zones, one of which (the Lookout zone) lies within the Wolf pond watershed. Here, mineralization occurs in northerly trending quartz-carbonate veins; other zones occur as siliceous stockworks and hydrothermal breccias (Schroeter and Lane, 1994), which are typically bordered by zones of argillic or sericitic alteration. The Clisbako prospect is a low-sulphidation adularia-sericite epithermal prospect in basaltic to rhyolitic tuffs and flows exhibiting intense silicification and argillic alteration. Gold occurs in quartz stockwork and silicified breccia zones. Several alteration zones have been identified (Dawson, 1991), although not all lie within the Clisbako Lake watershed. The largest, the South, Central and North zones, have exposed strike lengths of up to 450 metres (Schroeter and Lane, 1992). Gold concentrations up to 1076 ppb, as well as elevated concentrations of mercury, arsenic and antimony were reported by Dawson (1991).

Abundance of Gold and Other Elements

Elevated concentrations of gold, arsenic and other elements occur in sediments of Wolf pond and Clisbako Lake. Relative gold distributions are shown by the boxplots in Figure 2. Maximum gold concentrations in Wolf pond and Clisbako Lake are 56 ppb and 16 ppb, respectively; median gold concentrations are 43 ppb and 9 ppb. Maximum arsenic concentrations are 83 ppm (median: 47 ppm) in Wolf pond, and 46 ppm (median: 24 ppm) in Clisbako lake. These concentrations are considerably greater than the regional background of 1 ppb gold and 2-4 ppm arsenic, as determined from results of nearby regional lake sediment surveys (*i.e.*, Cook and Jackaman, 1994b). Wolf pond also contains elevated concentrations of zinc (median: 306 ppm), molybdenum (median: 18 ppm) and silver (median: 2.2 ppm). It exhibits a much more diverse multi-element geochemical signature than Clisbako Lake sediment, which contains elevated concentrations of only antimony (median: 3.1 ppm) in addition to gold and arsenic. Analytical data for selected elements from sites within these lakes has been given by Cook (1995).

Spatial Distribution of Gold

Centre-lake sediments may, but do not necessarily, contain the highest gold concentrations in Interior Plateau lakes. Evidence from this and other studies (Coker *et al.*, 1982; Fox *et al.*, 1987) suggests that gold may also be concentrated in near-shore organic-rich sediments, particularly near drainage inflows. Gold distribution patterns in these sediments may, if present, not only reflect the presence of mineralization, but also indicate the general direction to it relative to the lake. Distribution of gold, arsenic and other elements in tiny Wolf pond is relatively uniform, with greatest concentrations occurring in the central, deepest, part of the small basin (Figure 3). The restricted size of the watershed (km^2) makes the source area relatively easy to discern. In Clisbako Lake, however, the locations of known altered and mineralized zones are revealed by gold distribution patterns present in sediment at stream and groundwater inflows (Figure 4A). Here, gold distribution patterns are more strongly influenced by possible source areas and high organic matter content (Figure 4B) than simply by basin depth. Three groupings of sediment sites contain at least 10 ppb gold. Two of these, at stream inflows, indicate the presence of up-drainage argillic alteration and/or mineralized zones; the third, on the southwest side of the lake, has an unknown

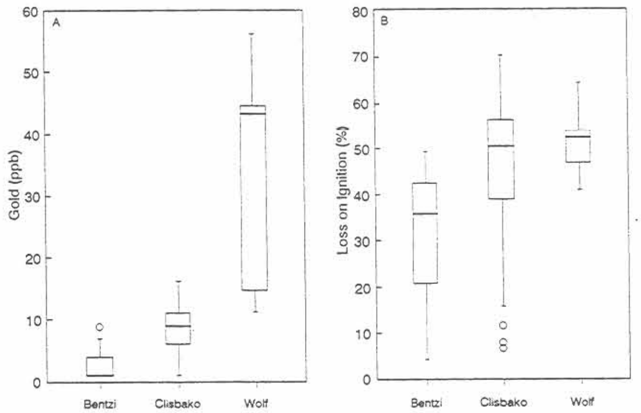


Figure 2. Boxplots showing variations in (A) gold (ppb); and (B) loss on ignition (%) in sediments of Bentzi Lake (n=58), Clisbako Lake (n=40) and Wolf pond (n=7). Median concentrations are denoted by the bold line in each box; 50% of the data for each lake lies within the box.

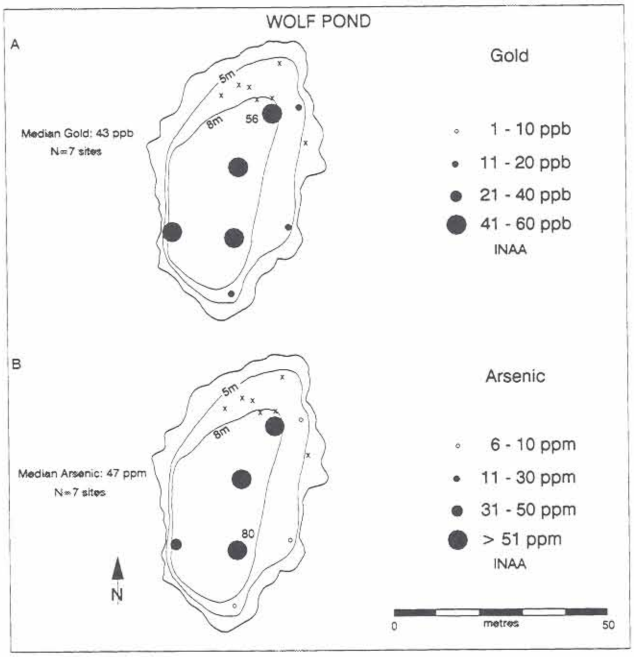


Figure 3. Distribution of (A) gold (ppb) and (B) arsenic (ppm) in Wolf pond sediment. Contours denote sample depth (metres), not lake depth. Sites where no sample could be obtained are denoted by an 'x'. Refer to Cook (1995) for local geology and locations of mineralized zones.

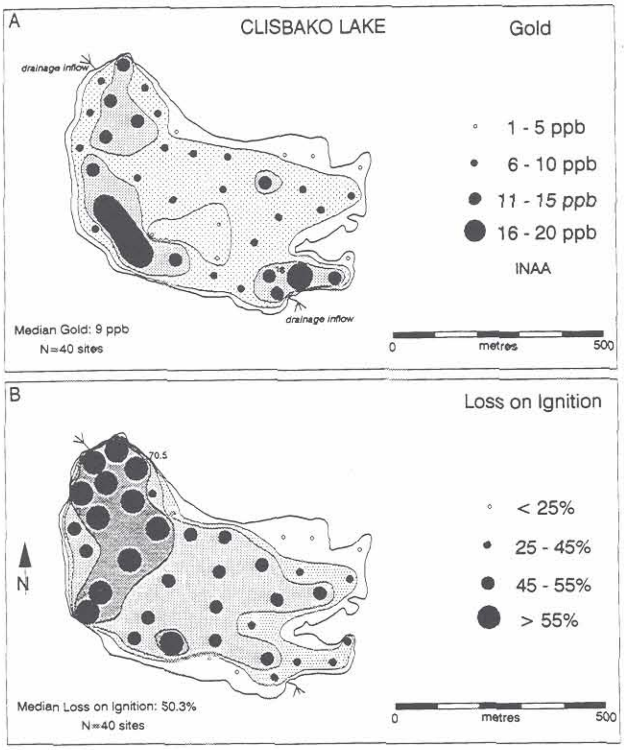


Figure 4. Distribution of (A) gold (ppb) and (B) loss on ignition (%) in Clisbako Lake sediment. Creeks entering the lake from both the south and northwest drain epithermal alteration and/or mineralized zones of Dawson (1991).

source. Gold concentrations in centre-lake sediments of Clisbako Lake (4-8 ppb) are relatively low, but are nevertheless regionally anomalous relative to a 1 ppb background.

Implications for Exploration

These results, and those of Cook (1995), indicate that gold concentrations of 4 ppb or greater in centre-lake sediments may reflect the presence of adjacent epithermal gold occurrences. Lower gold concentrations are generally indistinguishable from background values due to sampling and analytical variability. Similar conclusions were reported from Newfoundland by Davenport and McConnell (1988), who considered gold concentrations greater than 4 ppb to represent anomalies, and those greater than 8 ppb to be strong anomalies. The subtle level of gold anomalies in lake sediment cannot be over emphasized. For example, sediment in a lake adjacent to the large Hemlo gold deposits in northern Ontario was reported by Friske (1991) to contain only 6 ppb gold in an area with a background of less than 1 ppb.

PORPHYRY MOLYBDENUM PROSPECTS

Tatin Lake, located approximately 6 kilometres north of Endako village and Highway 16, is a large (4-5 km long) east-trending lake with a maximum depth of about 19 metres. A wide range of limnological conditions exist in its component sub-basins, ranging from eutrophic regimes in the eastern and western sub-basins to mesotrophic-oligotrophic regimes in the main basin and channel. The lake receives weak stream drainage from the north and northwest. Hanson Lake, about 12 kilometres north of Tatin Lake, is 3 kilometres long and unstratified, with a single basin (max. depth: 7 m). It is part of the Shovel Creek drainage system, and receives only seasonal stream drainage from the north and south. Walsh (1977) and Burns and Philip (1977) should be consulted for additional bathymetric information on Tatin and Hanson Lake, respectively.

Tatin and Hanson lakes are situated within and adjacent to units of the Francois Lake intrusive suite which host porphyry molybdenum mineralization. The Ken molybdenum-copper prospect (MINFILE 093K 002), on the northwest side of Tatin Lake, comprises quartz-molybdenite stockwork mineralization associated with potassic and argillic alteration of the Casey quartz monzonite (Lodder and Godfrey, 1969). The Hanson Lake showing (MINFILE 093K 081), located on a ridge about 2.5 kilometres south of Hanson Lake, is a poorly developed molybdenite-pyrite-chalcopyrite stockwork associated with weak chlorite, kaolinite and sericite alteration (Kimura, 1978). A second mineralized area, the Han prospect (MINFILE 093K 078) and associated properties, is located to the north and northwest of Hanson Lake. Here, pyrite, chalcopyrite, sphalerite and minor galena occur in disseminations and veins within a breccia zone along the contact of two phases of the Francois Lake suite. Extensive polymetallic soil geochemical anomalies have been reported from this area (Kimura, 1972; Chapman, 1989).

Abundance of Molybdenum and Other Elements

Elevated molybdenum concentrations occur in sediments of both Tatin (max: 23 ppm) and Hanson (max: 55 ppm) lakes. Median molybdenum concentrations are 8 ppm and 7 ppm, respectively. These concentrations exceed the regional background of, in most cases, 1 to 2 ppm molybdenum in lake sediments from parts of adjacent NTS map areas 93E (Whitesail Lake; Johnson *et al.*, 1987a), 93L (Smithers; Johnson *et al.*, 1987b) and 93F (Nechako River; Cook and Jackaman, 1994b; Table 4). Significantly, molybdenum concentrations in Tatin and Hanson lakes also exceed the mean molybdenum content (1 ppm) of lake sediments reported for a portion of the Francois Lake intrusions by Hoffman and Fletcher (1976).

Although median molybdenum concentrations are similar, concentrations of several other elements are considerably greater in Hanson than Tatin Lake. Relative to Tatin Lake, Hanson Lake sediment contains approximately two times the copper (median: 65.5 ppm), chromium (median: 40 ppm) and nickel (median: 32 ppm), more than three times

TABLE 4
MEDIAN AND RANGE OF SELECTED ELEMENTS IN RGS CENTRE-LAKE SEDIMENTS: FAWNIE AND OOTSA SURVEY AREAS
(NTS 93F - NECHAKO RIVER)

Survey		Au (ppb) *INAA*	As (ppm) *INAA*	Sb (ppm) *INAA*	Mo (ppm) *INAA*	Cu (ppm) *AAS*	Zn (ppm) *AAS*
FAWNIE	**Median**	**1**	**5.8**	**0.8**	**2**	**27**	**80**
237 sites	Range	(1-256)	(0.5-57)	(0.1-3.5)	(1-17)	(7-397)	(15-366)
OOTSA	**Median**	**1**	**8.1**	**1.4**	**1**	**29**	**85**
224 sites	Range	(1-13)	(1.3-110)	(0.3-12)	(1-20)	(11-57)	(16-1036)

Survey		Fe (%) *AAS*	As (ppm) *AAS*	Ag (ppm) *AAS*	Mo (ppm) *AAS*	Mn (ppm) *AAS*	L.O.I. (%)
FAWNIE	**Median**	**1.40**	**2.1**	**0.2**	**5**	**260**	**50.6**
237 sites	Range	(0.10-8.50)	(0.2-35)	(0.1-1.8)	(1-22)	(34-4150)	(4.7-96.1)
OOTSA	**Median**	**1.40**	**2.7**	**0.2**	**5**	**285**	**47**
224 sites	Range	(0.20-8.20)	(0.3-73)	(0.1-0.6)	(1-34)	(50-3050)	(10.7-90.2)

the silver (median: 0.35 ppm), and four to six times the arsenic (median: 13 ppm). Median iron (3.78%) and zinc concentrations (122 ppm) are also greater than those of Tatin lake; in the case of iron, this is probably due to the unstratified water column and more oxygen-rich conditions prevailing in Hanson sediment. In contrast, uranium (INAA; median: 67 ppm) and thorium (INAA; median: 18 ppm) are enriched in Tatin Lake sediments, where they far exceed regional background. Median organic matter content, expressed as percent loss on ignition (LOI), is also greatest in Tatin Lake sediment (median: 34.1%).

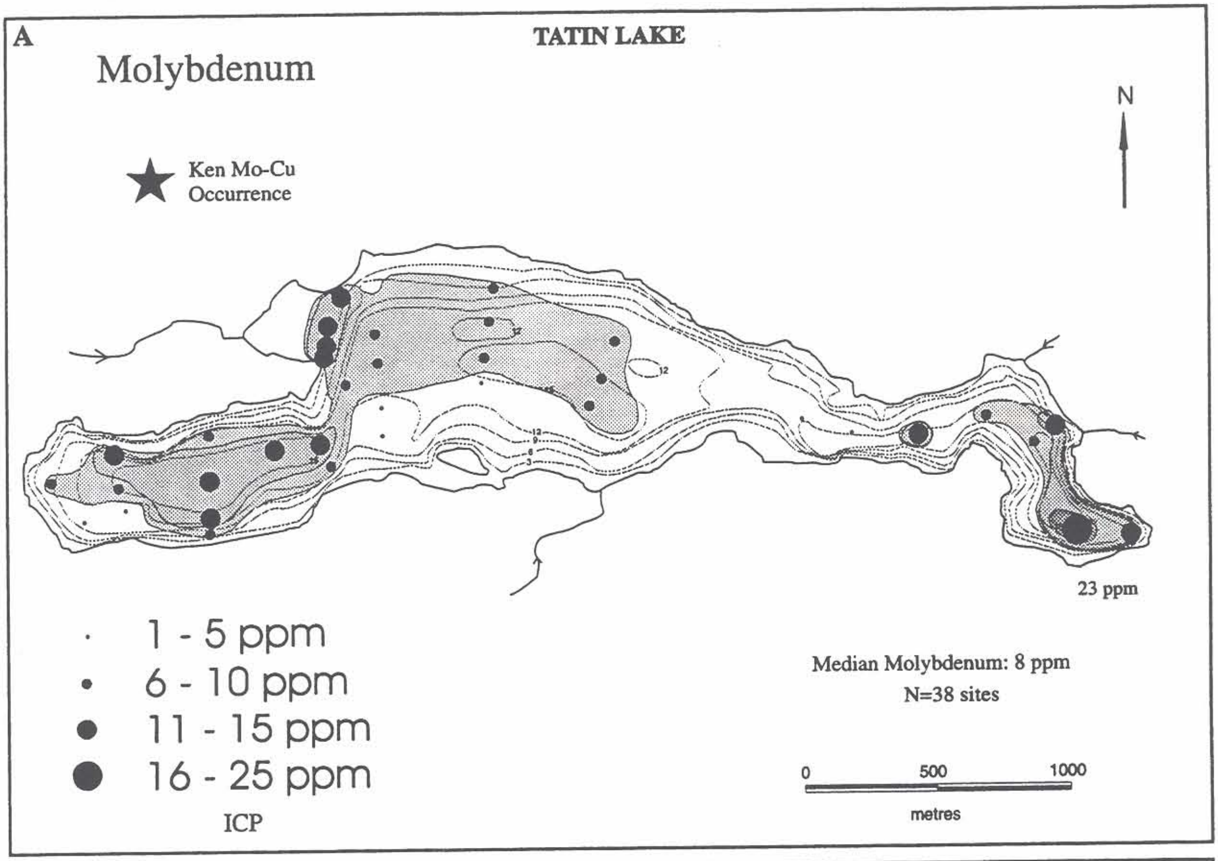
Spatial Distribution of Molybdenum

Median molybdenum concentrations in Tatin and Hanson lakes are relatively similar, but there are considerable differences in its spatial distribution within sediments of the two lakes. Patterns vary with limnological variations between basins, organic matter content, and basin morphometry. For example, molybdenum is concentrated in centre-basin sediments of unstratified Hanson Lake, and in eutrophic sub-basins and some near-shore sediments of predominately mesotrophic-oligotrophic Tatin Lake. Tatin Lake, with the widest range of limnological environments, also has the most complex molybdenum geochemical patterns (Figure 5A) and the widest range of LOI, iron and manganese values.

Tatin Lake molybdenum distribution patterns are zoned, with the highest concentrations occurring in the western end of the lake near the Ken occurrence rather than in sediment of the main centre-lake basin. The most significant molybdenum concentrations occur in three areas: (1) near-shore shallow-water organic sediments (12-14 ppm) at the mouth of a small bay near the prospect, (2) western sub-basin gyttja (up to 14 ppm), and (3) eastern sub-basin gyttja, where the highest molybdenum concentration in the lake (23 ppm) was obtained, although its source is unknown. The considerable between-basin molybdenum variations in Tatin Lake sediments are particularly pronounced in profundal centre-basin sediments. For example, centre-basin sediment of the western sub-basin contains 12 ppm molybdenum versus 7 ppm and 23 ppm in the main basin and eastern sub-basin, respectively.

There is a close association between distribution of molybdenum and LOI (organic matter), particularly in the western end of the lake where high molybdenum concentrations occur in both near-shore organic sediments and centre-basin gyttjas (Figure 5A). In the former case, sediment from four shallow-water sites (1-1.5 m of water) largely comprises immature, poorly decomposed organic matter with the highest LOI values (43.1-45.6%) in Tatin lake. Distribution of molybdenum is roughly inverse to that of iron and manganese. Molybdenum exhibits an inverse relationship with the two, regardless of LOI values. For example, elevated iron (max: 5.16%) and manganese (max: 2198 ppm) values are concentrated in profundal sediments of the relatively oxygen-rich mesotrophic centre basin and oligotrophic channel, and at some near-shore sites, where molybdenum concentrations are relatively low. Conversely, iron and manganese are least common in the relatively oxygen-poor eutrophic sub-basins and near-shore organic sediments where elevated molybdenum values predominate. Nevertheless, there is little difference in sediment LOI values between the two basins (Figure 5B). Iron and manganese have similar distribution patterns in Tatin Lake sediment, but manganese is the more uniformly distributed; manganese concentrations of 500 to 1000 ppm vary little between sub-basins, regardless of trophic regime.

In Hanson Lake, metal distributions are relatively uniform and typically within narrow ranges. Molybdenum concentrations of at least 6 ppm are, for example, widely distributed throughout most of Hanson Lake sediment beneath the 4-metre depth contour (Figure 6A). Manganese in particular shows little variation, with nearly all sediment beneath the 4-metre contour containing 501 to 750 ppm. There are distinct differences, however, between (1) molybdenum, copper and LOI distributions in Hanson Lake sediment, and (2) those for iron and zinc. Elevated molybdenum, copper and LOI values are associated with centre-lake sediments. Elevated molybdenum concentrations of 11 to 18 ppm are particularly closely associated with profundal sediments in central and south-central Hanson Lake, where they closely correspond with elevated organic matter content (LOI 30%). Isolated sites with elevated concentrations of 16 ppm and 55 ppm molybdenum occur along the southwest and northeast margins of the lake, respectively, but no lake-margin zonation patterns are apparent. In contrast, zinc (Figure 6B) and iron exhibit distinct lake- margin zonation patterns. Elevated iron concentrations greater than 3%, and rather undistinguished zinc values greater than 110 ppm, are widely distributed beneath the 4 metre contour. However, zones of elevated iron (4%) and zinc (130 ppm) rim the northwest side of Hanson Lake, forming similar shaped zonation patterns within the sediment. These near-shore zones have no apparent association with sediment organic matter or the profundal basin. They are, however, located immediately down slope from extensive soil zinc anomalies



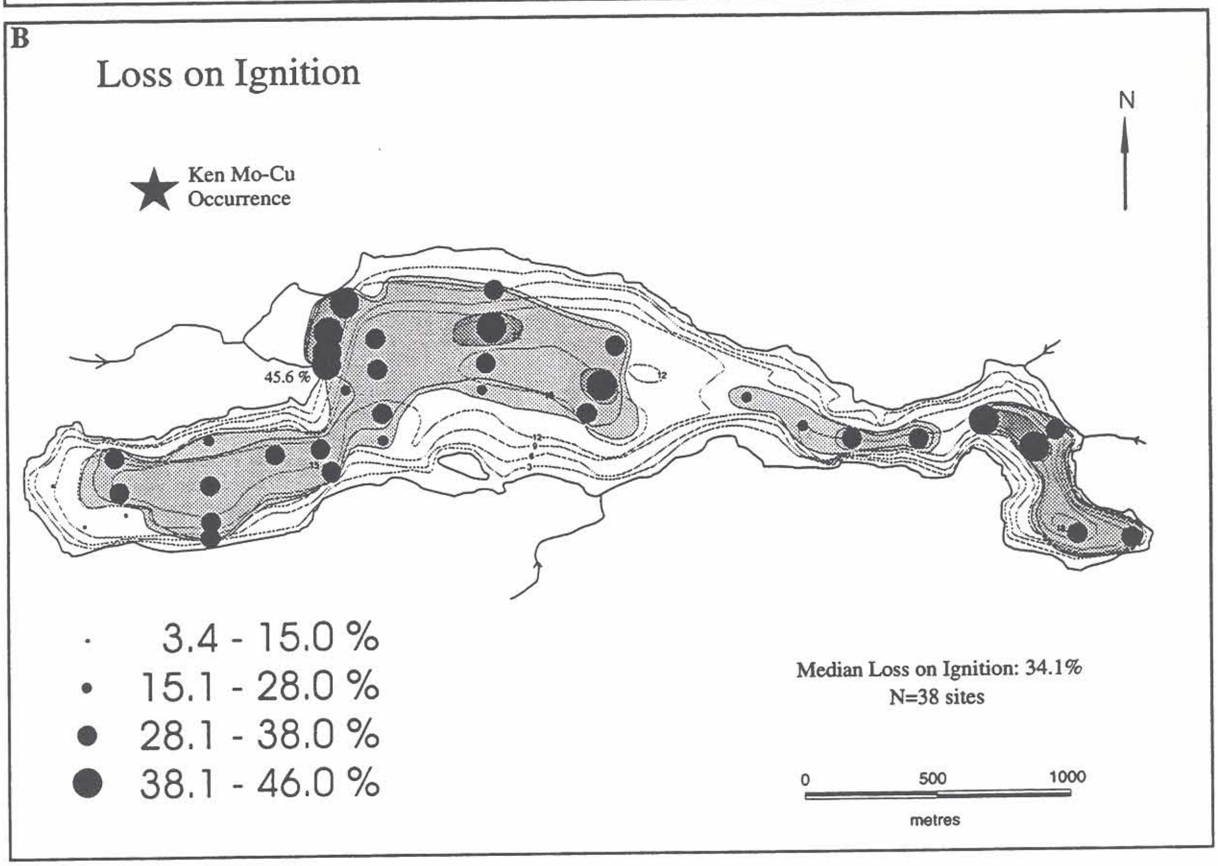


Figure 5. Distribution of (A) molybdenum (ppm) and (B) loss on ignition (%) in Tatin Lake sediment. Bathymetry after Walsh (1977).

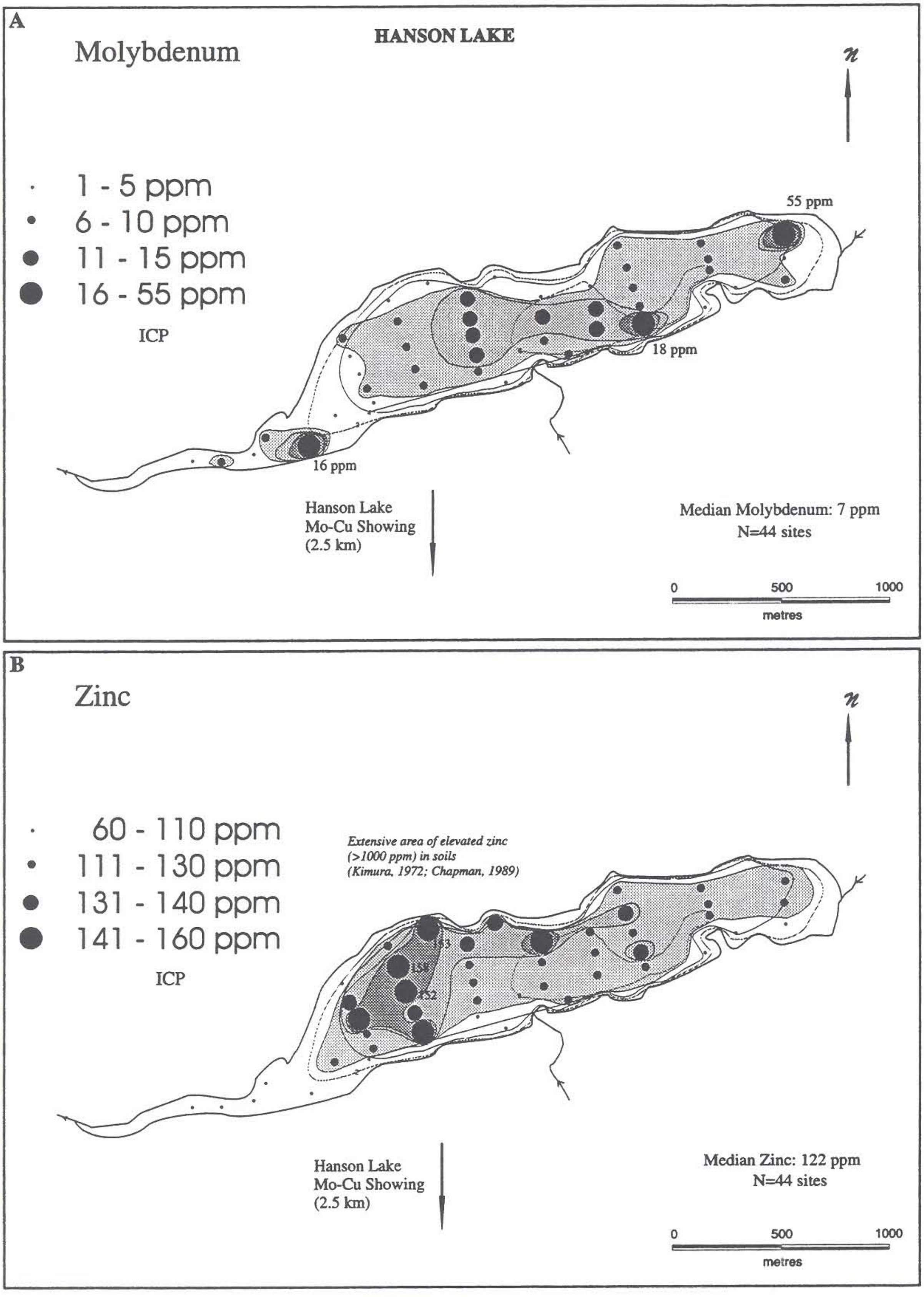


Figure 6. Distribution of (A) molybdenum (ppm) and (B) zinc (ppm) in Hanson Lake sediment. Bathymetry after Burns and Philip (1977).

(Kimura, 1972; Chapman, 1989), suggesting that these metals are of local hydromorphic origin and overprint the dominant geochemical pattern of Hanson Lake sediment.

Limnology, basin morphometry and organic matter content (as expressed by LOI) all appear to play roles in controlling the distribution of molybdenum and related elements in sediments. Friske (1995), in a study of Tatin Lake sediment cores, similarly concluded that limnological variations are an important factor in the accumulation of certain trace elements, particularly iron and manganese.

Implications for Exploration

Results here show that molybdenum concentrations of at least 12 ppm in centre-basin sediments reflect the presence of adjacent porphyry molybdenum prospects. In the case of Tatin Lake, only 6 ppm molybdenum is present in the main centre-lake basin. Among other examples, data reported by Mehrtens (1975) and Mehrtens *et al.* (1972) indicate that 25 ppm molybdenum in sediment of a small hilltop pond, and only 9 ppm in a small base-of-slope lake, outlined the location of stockwork molybdenum mineralization and associated soil anomalies at the Chutanli prospect in the Nechako Range. Mehrtens *et al.* (1972) also stated that, in this particular example, lake sediment geochemistry was a more cost-effective method of geochemical exploration than detailed stream sediment sampling. Molybdenum concentrations of 16 ppm and 24 ppm in two small lakes led to the discovery of the Mac porphyry molybdenum prospect (Cope and Spence, 1995). At the Gibraltar porphyry copper-molybdenum deposit south of the Nechako Plateau, sediment of lakes directly down slope and down drainage from the ore zones contain 10 to 32 ppm molybdenum (Coker *et al.*, 1979); a lake above one of the ore zones contains 42 ppm molybdenum.

The existence of near-shore, in addition to centre-lake and centre-basin, molybdenum anomalies in sediment of large lakes (*e.g.*, Tatin Lake) has important implications for the implementation of both regional and property-scale lake sediment geochemical surveys in the Nechako Plateau. Previous recommendations for gold exploration (Cook, 1995; Cook and Jackaman, 1994b), regarding regional sampling of all sub-basins and follow-up sampling of near-shore organic sediments at drainage inflows, are equally applicable to molybdenum exploration. Near-shore sampling is impractical for regional surveys covering large areas. It is, however, an effective property-scale exploration method, and will be discussed later in the paper.

REGIONAL GEOCHEMICAL SURVEYS

Studies elsewhere in Canada (Fox *et al.*, 1987; Davenport and McConnell, 1988; Rogers, 1988; Chapman *et al.*, 1990) have shown lake sediment geochemistry to be an effective gold exploration method. However, results of some studies in the Canadian Shield (Fox *et al.*, 1987; Coker *et al.*, 1982) concluded reconnaissance-scale (one site per 6 to 13 km^2) lake sediment exploration for gold to be inadequate for locating anomalous areas, and suggested that one to three samples per lake be collected. In Newfoundland, Davenport and Nolan (1991) considered a density of at least one site per 4 square kilometres to be necessary to ensure the detection of all significant near-surface gold mineralization. Exploration recommendations for the use of lake sediment geochemistry in the search for epithermal gold deposits in the northern Interior of British Columbia (Cook and Jackaman, 1994b) will not be repeated here. However, orientation study results support the detailed sampling approach. Regional lake sediment geochemistry is most effective if every lake in the survey area is sampled, a strategy used in the Fawnie, Ootsa and recently completed Pinchi Lake surveys. The high concentrations of gold and other elements in Wolf pond sediment, which led to the discovery of the Wolf prospect (Dawson, 1988), illustrate the importance of sampling even very small lakes.

Regional lake sediment geochemistry results for the Fawnie and Ootsa survey areas have been given by Cook and Jackaman (1994b), and summary statistics for selected elements are shown in Table 4. Briefly, survey results corroborate previously known lake sediment anomalies (*e.g.*, Wolf and Fawn/Gran prospects), enlarge potential target areas adjacent to currently known prospects (*e.g.*, Wolf), and outline new areas for further exploration (*e.g.*, Tsacha prospect). Gold and arsenic results for the Fawnie and Ootsa survey areas are shown in Figures 7 and 8, respectively, and are briefly summarized here to highlight geochemical patterns of interest to explorationists. Further details on these and other elements are given by Cook and Jackaman (1994b). Where applicable, unit designations of Diakow *et al.* (1994, 1995a) are used to identify geological units in the Fawnie survey area.

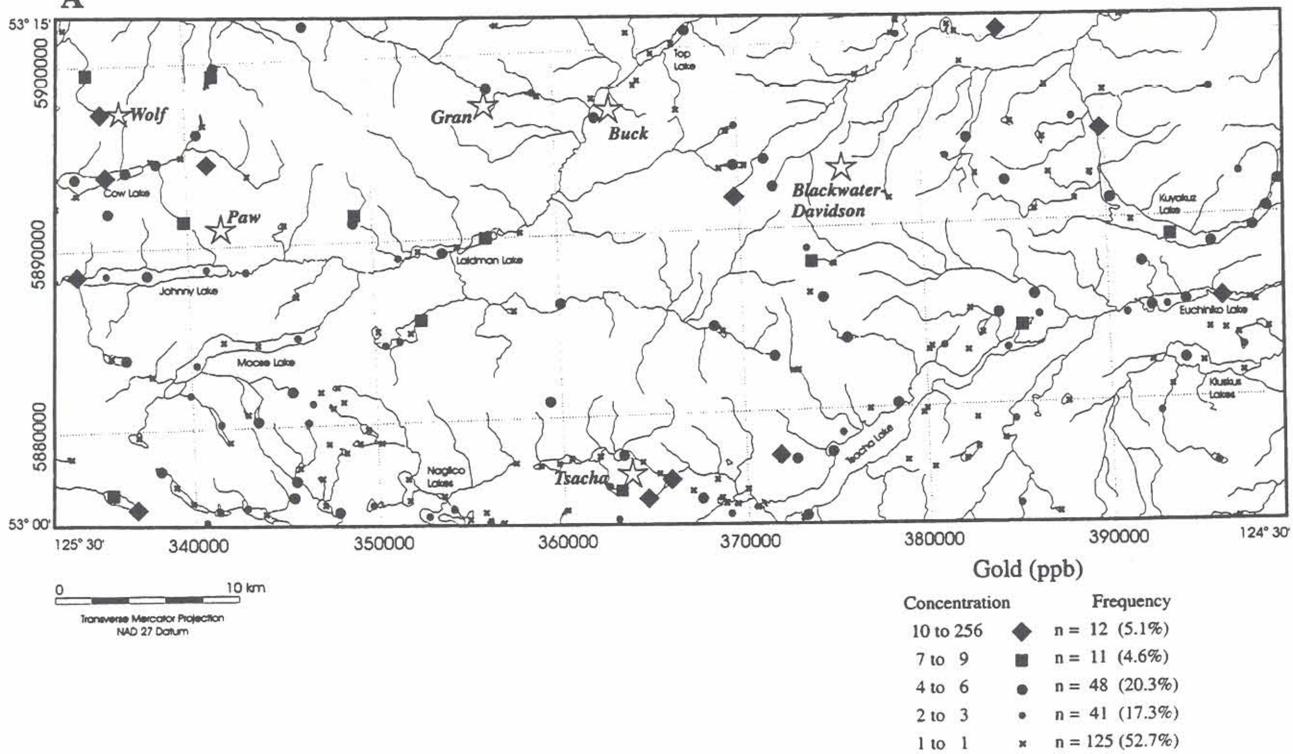
FAWNIE SURVEY

Background gold concentrations, as expressed by the median value, are 1 ppb for both Fawnie and Ootsa survey areas. In the Fawnie area, elevated gold concentrations (90th percentile: 6 ppb; maximum: 256 ppb) are associated with watersheds underlain by Middle Jurassic Hazelton Group rocks of the Naglico formation and, to a lesser extent, Eocene Ootsa Lake Group volcanics. Gold concentrations of at least 6 ppb occur at 33 sites (Figure 7), and particular attention is directed toward two areas where groupings of sites with high gold concentrations occur, (1) the Wolf Prospect - Johnny Lake area, and (2) the Tommy Lakes area:

In the Wolf prospect - Johnny Lake area in the northwest part of the survey area, elevated gold values in lake sediments draining both Eocene and Jurassic rocks considerably enlarge the potential target area for epithermal gold deposits. High gold concentrations occur in lake sediments on the northeast and northwest margins of the Eocene rhyolitic extrusive and intrusive rocks mapped by Diakow *et al.* (1994), and in sediment of Wolf pond (45 ppb) adjacent to the Wolf prospect as previously documented by Cook (1995). However, elevated gold concentrations also occur in parts of Cow Lake (69 ppb) and Johnny Lake (51 ppb) south of the Eocene volcanic centre, and in small lakes to the southeast (up to 256 ppb) where watersheds are under-

Fawnie Survey (93F/02,03)

A



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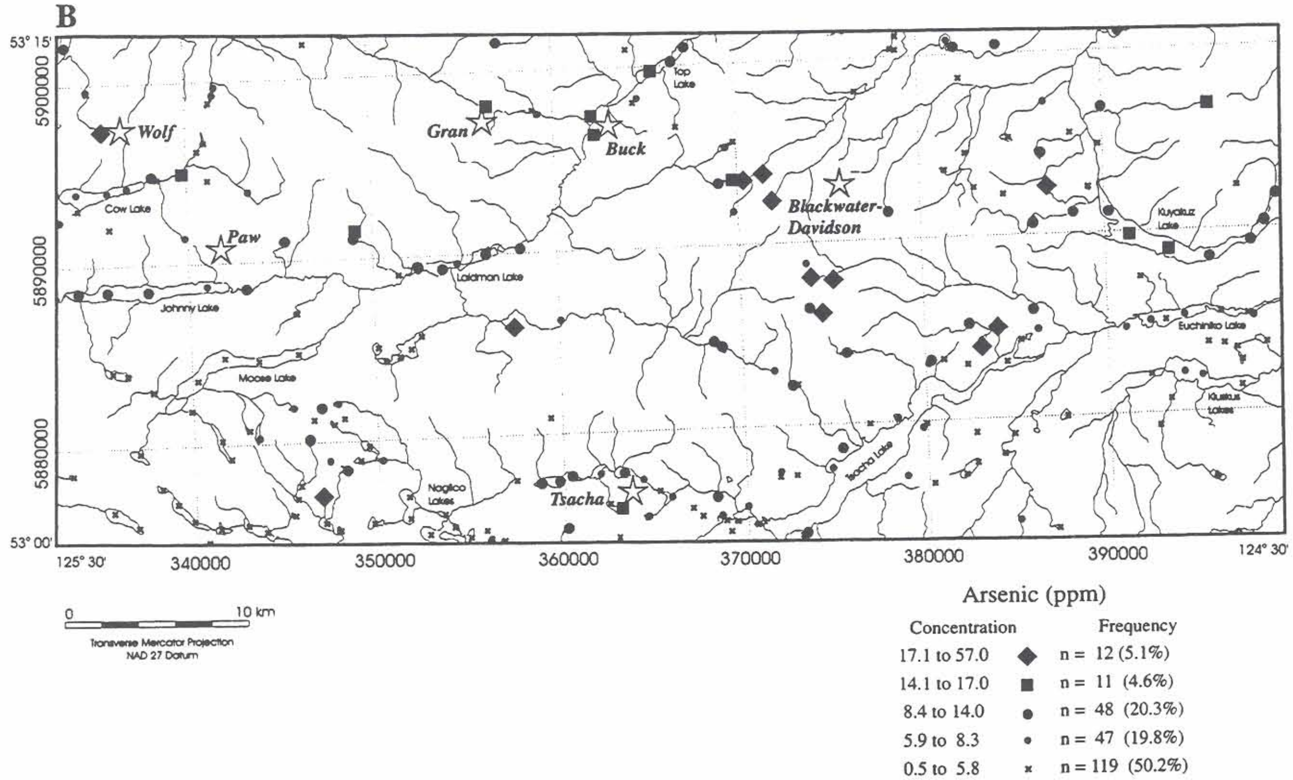

Figure 7. Regional distribution of (A) gold (ppb) and (B) arsenic (ppm) in lake sediments of the Fawnie survey area (237 sites). Significant mineral prospects are shown in italics. Refer to Diakow *et al.* (1994, 1995a, 1996) for geology of the survey area. Distribution maps of additional elements are given by Cook and Jackaman (1994b).

lain predominantly by poorly exposed basalt flows of the Naglico formation (map unit Nb).

In the Tommy Lakes area, located west of Tsacha Lake and immediately north of the Blackwater River in the southeast corner of NTS 93F/3, elevated sediment gold values occur in lakes floored by Early to Middle Jurassic rhyolitic rocks. Three small adjacent lakes southeast of the Tommy Lakes contain high gold values of 8 to 256 ppb. They pinpoint the location of the Tsacha gold prospect (MINFILE 093F 055), first reported (as the Tommy prospect) by Diakow *et al.* (1994) and subsequently staked by Teck Corporation. Watersheds of these lakes are underlain predominantly by Naglico formation volcanic sandstone, siltstone and conglomerate (Ns1) and rhyolitic lithic and ash flow tuffs (Nr) along the northern margin of Tertiary felsite sills and dikes. Elevated gold concentrations in bedrock and till from this area have been reported by Diakow *et al.* (1994) and Levson *et al.* (1994), respectively Lane and Schroeter (1997-2, this volume) should be consulted for further details on the Tsacha prospect.

The median arsenic (INAA) concentration in Fawnie lake sediments is 5.8 ppm. Elevated arsenic concentrations (90th percentile: 14.1 ppm; maximum: 57 ppm) are most common in lakes within the Fawnie Range, where several sites delineate a northwest-trending zone extending from Top Lake to the eastern end of Tsacha Lake. This zone is underlain predominantly by Ootsa Lake Group and lesser Hazelton Group rocks, and by a buried plutonic body inferred from aeromagnetic data (Diakow *et al.*, 1995a). Coincident elevated antimony concentrations are also present. Elsewhere, elevated arsenic concentrations also occur at, among other areas, Wolf pond adjacent to the Wolf prospect (site 1142), one of the lakes adjacent to the Tsacha property (site 1215), and in central Kuyakuz Lake (site 1170); coincident elevated gold concentrations (>90th percentile; at least 7 ppb) are also present at each of these sites. Sediment at Wolf pond is distinguished by a multi-element gold-arsenic-silver-zinc-molybdenum-mercury geochemical signature, but sediment in the four lakes encircling the Tsacha prospect has few similarities other than elevated gold and, to a lesser extent, copper concentrations. Elevated arsenic, zinc and lead concentrations occur in one lake (site 1215) near the Tsacha prospect, and elevated mercury in another, but the area lacks an overall multi-element geochemical signature of what are generally known as pathfinder elements.

Cook *et al.* (1995) provide a comparative case study of regional lake sediment and till geochemistry results from the Fawnie Creek map area (NTS 93F/3), in the western part of the Fawnie survey area. Here, five of seven known mineral prospects were outlined by regional lake sediment geochemistry data of Cook and Jackaman (1994b), using combinations of seven elements (Au, As, Sb, Zn, Cu, Pb and/or Mo >95th percentile). Geochemical data for these lakes are shown in Table 5. The five prospects are the Wolf, Fawn (Gran), Buck, Paw and Tsacha (Tommy) occurrences. Only the relatively minor Malaput and Fawn-5 prospects, neither of which is located near a lake, were undetected by the regional lake sediment geochemistry survey. Till and lake sediment geochemistry also outlined several additional potential targets in the area.

OOTSA SURVEY

Median gold concentrations in the Ootsa survey, as in the Fawnie area, are 1 ppb. There are far fewer lakes in the Ootsa survey area with high gold concentrations (90th percentile: 5 ppb; maximum: 13 ppb), but many with moderately elevated gold values; more than 25% of the sites contain at least 4 ppb gold (Figure 8). These are concentrated in two general areas, both of which are in the southern part of the survey area between Cheslatta Lake and the Nechako Reservoir: (1) the Yellow Moose Lake area, and (2) the Bird - Davidson lakes area.

The Yellow Moose Lake region, where a zone of elevated gold concentrations extends west-northwesterly along the north side of the Nechako Reservoir from roughly Yellow Moose Lake to the Saunders Hill area, encompasses the most extensive grouping of elevated gold values in the Ootsa survey area. Anomalous and roughly coincident concentrations of arsenic, antimony, molybdenum, mercury, copper, zinc, sulphate (water) and fluoride (water) are also present. Among these sites is the lake (site 3031) with the highest gold (13 ppb) and arsenic (110 ppm) concentrations detected in the Ootsa survey area; this is also the only site with coincident gold, arsenic and antimony concentrations above the 90th percentile. Bedrock in the southern part of this area (Diakow *et al.*, 1993) consists primarily of rhyolite and dacite flows of the Ootsa Lake Group, and rare exposures of the Hazelton Group.

Elevated gold and arsenic concentrations up to 10 ppb and 21 ppm, respectively, occur in a series of lakes within an east-trending valley, extending from the west end of Bird Lake to Davidson Lake. These lakes receive drainage from both the north and south.

FOLLOW-UP CASE STUDIES

Summary statistics for selected elements from all follow-up case study lakes (Table 1) are shown in Table 6. Interpretation of case study results is preliminary. Some relationships are nevertheless evident in drainage lake (*e.g.*, Kuyakuz Lake) and seepage lake (*e.g.*, lakes 3031 and 3087) geochemistry which should prove useful in designing more effective geochemical follow-up programs to regional survey results in the northern Interior.

DRAINAGE LAKES

Kuyakuz Lake is a large, relatively shallow (max. depth: 14 m) unstratified lake. Molybdenum (median: 4.5 ppm) and arsenic (median: 9.2 ppm) zonation patterns in the sediment may indicate a possible direction to buried mineralization within the lake watershed. These patterns occur in the western end of the main lake basin, adjacent to a stream inflow draining an area west of the lake (Figure 9). Molybdenum and arsenic concentrations here reach 12 and 20 ppm, respectively. Gold (median: 1 ppb) and zinc (median:

TABLE 5
TRACE ELEMENT GEOCHEMICAL SIGNATURES OF LAKE SEDIMENTS ADJACENT TO KNOWN MINERAL PROSPECTS, FAWNIE SURVEY AREA.

Mineral Prospe	MINFILE	Lake or Area	NTS	*RGS Identifier*	Au (ppb) *INAA*	As (ppm) *INAA*	As (ppm) *AAS*	Sb (ppm) *INAA*	Sb (ppm) *AAS*	Mo (ppm) *INAA*	Mo (ppm) *AAS*	Cu (ppm) *AAS*	Zn (ppm) *AAS*	Pb (ppm) *AAS*	Ag (ppm) *AAS*	Hg (ppb) *AAS*	Fe (%) *AAS*	Mn (ppm) *AAS*	Ce (ppm) *INAA*	La (ppm) *INAA*	LOI (%)	Sulfate in water (ppm)	pH	Reference
Epithermal Gold																								
1) Wolf	93F045	Wolf Pond	93F/03	*931143*	**45**	**44**	**26.0**	**2.3**	**1.6**	**13**	**15**	**66**	**324**	6	**1.8**	**270**	2.70	338	**85**	**37.0**	51.5	12	7.10	Dawson (1991)
2) Tsacha	93F055	Tommy Lakes	93F/03	*931083*	4	10	5.3	1.0	0.5	2	7	**66**	84	5	0.2	**170**	1.90	495	24	14.0	46.0	3	7.92	Cook *et al.*
(Tommy)		area	93F/02	*931084*	**256 (970)**	7.8	5.9	0.8	0.3	4	5	36	66	4	0.1	40	1.70	510	15	7.2	49.3	3	8.00	(1995)
		(4 lakes)	93F/03	*931089*	**44 (26)**	7.7	1.5	1.1	0.4	7	9	50	90	1	0.1	50	1.60	309	9	4.9	73.1	7	8.14	
			93F/03	*931215*	8 (7)	15	5.5	1.4	0.6	5	6	43	**159**	**9**	0.2	40	2.30	836	28	12.0	66.3	5	8.27	
3) Fawn (Gran)	93F043	Square Lake	93F/03	*931158*	5	17	8.2	**2.5**	**1.8**	1	3	**67**	**366**	**61**	0.2	10	**3.70**	646	51	26.0	15.7	11	7.79	Hoffman & Smith (1982)
Base Metals																								
4) Buck	93F050	South of Top Lake	93F/03	*931112*	5	17	**8.6**	1.3	0.7	1	4	21	86	7	0.1	20	3.10	362	40	21.0	9.8	8	7.92	Cook *et al.* (1995)
5) Paw	93F052	East of Cow	93F/03	*931127*	9 (7)	8	3.6	0.9	0.4	3	6	**77**	109	2	0.2	50	1.90	224	13	9.5	57.1	15	7.89	Cook *et al.*
		Lake *(2 lakes)*	93F/03	*931138*	256 (1)	5.1	1.8	0.8	0.3	**17**	**20**	**95**	**198**	8	0.2	80	1.70	185	14	6.6	52.0	**44**	7.82	(1995)
Fawnie Survey				Median:	1	5.8	2.1	0.8	0.3	2	5	27	80	2	0.2	80	1.40	260	20	11	50.6	4	7.91	Cook &
(NTS 93F/02, 03)				x:	6.4	7.7	3.3	0.9	0.4	3.6	6.1	30.6	87.5	3.1	0.2	84.8	1.62	387	23.8	12.7	47.9	7.2	7.91	Jackaman
				±1s:	*24.9*	*6.6*	*3.8*	*0.5*	*0.4*	*3.2*	*3.8*	*27.5*	*47.2*	*4.9*	*0.1*	*45.4*	*1.16*	*439*	*17.4*	*9.0*	*19.5*	*15.0*	*0.30*	(1994)
				95th pct:	9	17	8.5	1.8	0.9	10	14	56	155	8	0.4	160	3.60	1140	53	28	78.2	20		
				99th pct:	69	43	22.0	2.7	1.8	15	19	77	324	20	0.5	210	5.30	2020	85	39	86.9	62		

Trace element geochemistry signatures in lake sediments adjacent to known mineral prospects, Fawnie survey area, central British Columbia

Analytical results of gold re-runs are given in brackets.
Highlighted values indicate that analytical result for that element is > 95th percentile for the entire Fawnie survey area (n=237 sites); LOI, pH and gold which does not re-run are excluded.

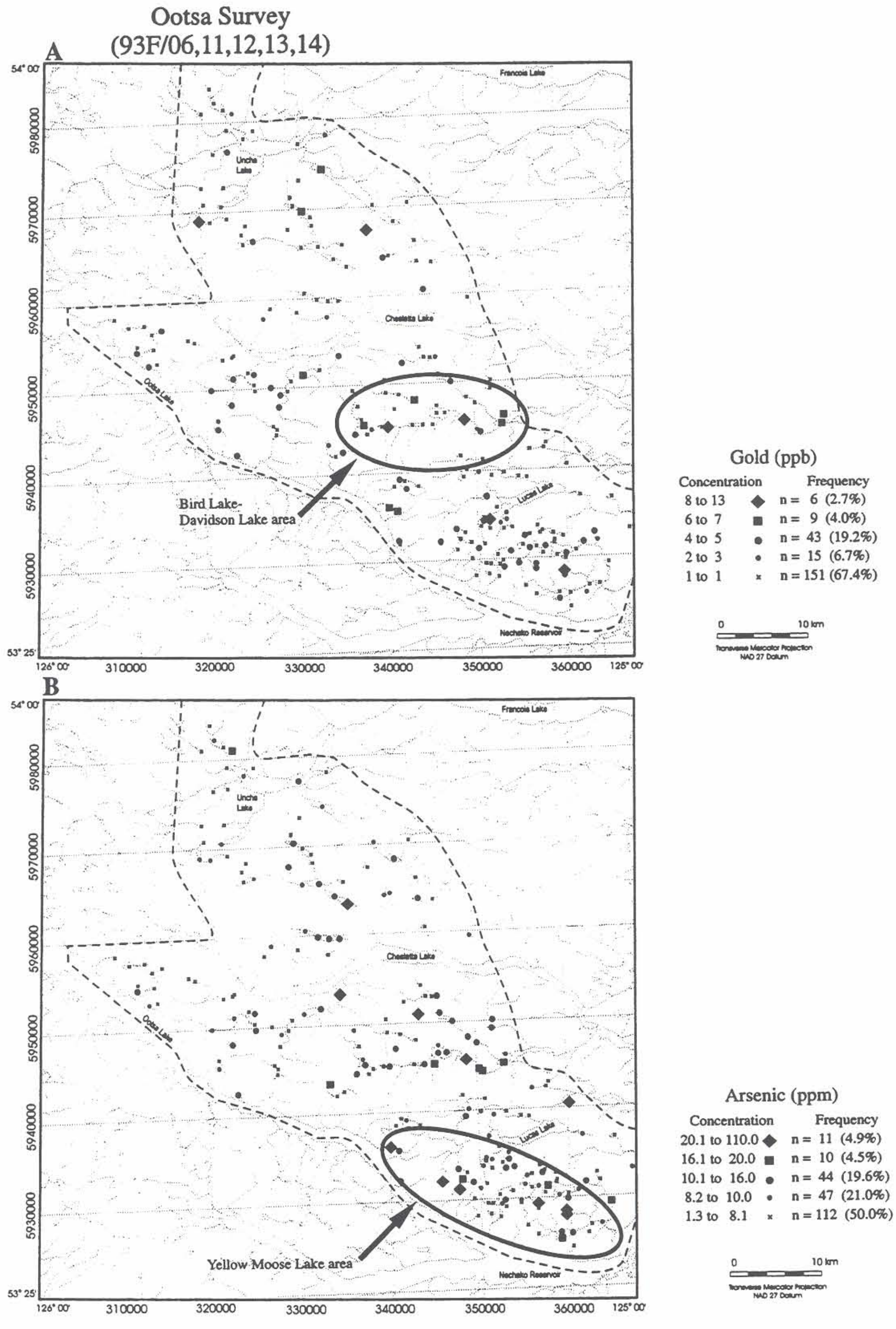

Figure 8. Regional distribution of (A) gold (ppb) and (B) arsenic (ppm) in lake sediments of the Ootsa survey area (224 sites). Refer to Cook and Jackaman (1994b) for generalized geology and distribution maps of additional elements.

TABLE 6
FOLLOW-UP CASE STUDIES: SUMMARY STATISTICS FOR SELECTED ELEMENTS

		Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Cr (ppm)	Mn (ppm)	Fe (ppm)	As (ppm)	Cd (ppm)	Au (ppb) INAA	As (ppm) INAA	Sb (ppm) INAA	Fe (%) INAA	La (ppm) INAA	Ce (ppm) INAA	LOI (%)
Drainage Lakes																				
KUYAKUZ	Mean	7.56	19.59	4.63	88.65	0.16	17.90	4.31	13.99	381.97	1.85	6.09	0.26	1.75	9.17	0.91	2.15	11.41	20.76	47.3
LAKE	**Median**	**7**	**21.5**	**5**	**93.5**	**0.1**	**19**	**4**	**15**	**337**	**1.90**	**6**	**0.2**	**1**	**9.15**	**1**	**2.2**	**11**	**21**	**46.9**
(N=68)	S.D.	4.34	9.08	2.18	29.70	0.08	4.49	1.92	4.63	130.36	0.56	2.68	0.09	1.41	2.97	0.34	0.71	4.13	7.83	19.7
	Variance	18.85	82.37	4.77	881.96	0.01	20.12	3.68	21.45	16994.72	0.32	7.19	0.01	1.98	8.81	0.11	0.50	17.05	61.38	387.6
	C.V.	57.43	46.33	47.16	33.50	49.49	25.07	44.52	33.11	34.13	30.53	44.03	35.21	80.43	32.37	37.37	32.96	36.19	37.73	41.6
	Minimum	1	1	2	39	0.1	7	1	5	201	0.51	2	0.2	1	3.3	0.2	0.63	5	7	3.0
	Maximum	19	36	10	156	0.4	25	9	22	800	3.69	15	0.5	7	20	1.6	3.93	20	36	84.1
COW LAKE	Mean	7.66	26.42	5.46	82.16	0.24	11.66	5.42	14.98	457.20	2.16	2.84	0.32	2.74	6.25	0.68	2.58	17.38	35.58	30.6
(N=50)	**Median**	**8**	**31.5**	**5**	**88.5**	**0.25**	**12**	**5**	**16**	**461**	**2.20**	**2**	**0.3**	**1**	**6.5**	**0.7**	**2.565**	**17**	**34.5**	**35.1**
	S.D.	4.06	14.41	2.14	21.68	0.10	3.19	1.33	3.91	67.68	0.46	1.13	0.13	2.58	1.54	0.16	0.52	3.36	7.26	13.2
	Variance	16.47	207.60	4.58	470.10	0.01	10.15	1.76	15.33	4579.92	0.21	1.28	0.02	6.65	2.38	0.03	0.27	11.26	52.78	175.2
	C.V.	52.99	54.54	39.20	26.39	42.35	27.32	24.47	26.13	14.80	21.16	39.84	41.62	94.08	24.72	24.01	20.10	19.31	20.42	43.3
	Minimum	1	1	2	22	0.1	6	3	5	299	0.93	2	0.2	1	2.4	0.1	1.1	7	17	3.3
	Maximum	13	47	13	120	0.5	17	11	21	607	3.25	7	0.7	12	9.3	0.9	3.94	30	59	56.8
Seepage Lakes																				
LAKE 3031	Mean	9.85	23.23	11.92	158.23	0.35	13.54	5.77	12.08	523.15	1.94	79.77	0.46	5.46	76.62	5.38	2.00	55.31	105.46	53.6
(N=13)	**Median**	**10**	**24**	**8**	**166**	**0.3**	**14**	**6**	**13**	**559**	**2.07**	**74**	**0.5**	**5**	**72**	**5.6**	**1.99**	**57**	**110**	**52.6**
	S.D.	1.21	3.96	13.71	28.27	0.12	1.98	1.42	2.22	144.37	0.88	36.60	0.17	2.22	33.88	0.79	0.91	12.72	23.43	5.2
	Variance	1.47	15.69	188.08	799.03	0.01	3.94	2.03	4.91	20843.64	0.78	1339.53	0.03	4.94	1148.09	0.62	0.83	161.73	548.77	26.6
	C.V.	12.33	17.05	115.02	17.86	33.86	14.65	24.67	18.35	27.60	45.38	45.88	37.04	40.68	44.23	14.61	45.38	22.99	22.21	9.6
	Minimum	7	16	3	103	0.2	8	3	7	233	0.69	34	0.2	1	36	3.1	0.75	30	61	47.6
	Maximum	11	28	56	197	0.7	16	8	15	683	3.11	142	0.7	9	130	6.1	3.19	70	130	62.8
LAKE 3087	Mean	6.21	31.00	5.88	49.54	0.31	19.38	4.04	16.29	137.54	1.17	8.50	0.29	2.92	9.85	5.29	1.46	30.88	52.00	50.4
(N=24)	**Median**	**6**	**32**	**6**	**45.5**	**0.3**	**20.5**	**4**	**16**	**142**	**1.11**	**8**	**0.3**	**1.5**	**9.7**	**5.15**	**1.42**	**31**	**52**	**51.6**
	S.D.	2.59	7.49	1.23	16.68	0.12	4.03	1.04	3.59	22.90	0.29	3.64	0.09	2.41	3.38	1.36	0.32	3.63	5.65	10.4
	Variance	6.69	56.17	1.51	278.09	0.01	16.24	1.09	12.91	524.26	0.09	13.22	0.01	5.82	11.42	1.85	0.10	13.16	31.91	107.4
	C.V.	41.67	24.18	20.88	33.66	36.93	20.80	25.77	22.06	16.65	24.95	42.77	31.30	82.70	34.32	25.72	21.81	11.75	10.86	20.6
	Minimum	2	16	4	26	0.1	12	3	11	98	0.8	4	0.2	1	5.1	3.2	0.98	23	39	33.8
	Maximum	12	44	8	78	0.5	26	6	27	173	1.74	16	0.5	8	17	8.9	2.12	38	64	70.5
LAKE 1138	Mean	18.33	33.40	2.80	140.13	0.22	13.27	2.33	4.67	206.87	1.38	2.00	1.71	1.87	4.33	0.81	1.45	6.07	12.33	60.1
(N=15)	**Median**	**20**	**32**	**3**	**141**	**0.2**	**14**	**2**	**4**	**194**	**1.25**	**2**	**1.5**	**1**	**4.2**	**0.8**	**1.29**	**5**	**12**	**59.8**
	S.D.	4.61	9.63	0.86	17.47	0.13	2.40	0.72	1.54	72.09	0.49	0.00	1.02	1.41	0.59	0.25	0.59	2.28	4.82	8.9
	Variance	21.24	92.83	0.74	305.12	0.02	5.78	0.52	2.38	5196.27	0.24	0.00	1.03	1.98	0.34	0.06	0.34	5.21	23.24	78.8
	C.V.	25.14	28.85	30.78	12.47	60.01	18.12	31.02	33.07	34.85	35.76	0.00	59.53	75.40	13.50	30.89	40.50	37.62	39.09	14.8
	Minimum	10	23	2	106	0.1	9	1	3	101	0.76	2	1	1	3.2	0.6	0.82	3	6	45.5
	Maximum	24	62	5	169	0.5	18	3	8	325	2.48	2	5	5	5.1	1.6	2.73	10	21	75.5
LAKE 1259	Mean	34.06	26.88	6.71	101.47	0.44	18.82	2.88	11.65	101.18	1.77	59.82	1.66	2.35	58.49	2.69	1.81	22.94	19.06	37.8
(N=17)	**Median**	**12**	**25**	**6**	**101**	**0.4**	**18**	**2**	**11**	**97**	**0.67**	**11**	**1.5**	**1**	**14**	**2**	**0.77**	**20**	**17**	**36.1**
	S.D.	90.19	10.21	3.96	28.61	0.24	5.82	3.02	4.70	34.39	4.53	188.33	0.41	2.40	175.77	2.68	4.39	14.11	9.72	8.6
	Variance	8133.56	104.24	15.72	818.51	0.06	33.90	9.11	22.12	1182.65	20.53	35467.90	0.17	5.74	30894.54	7.19	19.26	199.06	94.43	74.5
	C.V.	264.80	37.98	59.13	28.20	56.24	30.93	104.72	40.38	33.99	256.05	314.81	24.68	101.85	300.52	99.56	241.86	61.50	50.99	22.8
	Minimum	9	18	3	73	0.2	11	1	6	55	0.29	8	1.3	1	9.3	1.6	0.38	10	10	30.6
	Maximum	384	58	18	197	1.2	37	14	27	191	19.31	790	2.8	9	740	13	18.8	73	52	65.8

TABLE 6 CONTINUED

		Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Cr (ppm)	Mn (ppm)	Fe (%)	As (ppm)	Cd (ppm)	Au (ppb) INAA	As (ppm) INAA	Sb (ppm) INAA	Fe (%) INAA	La (ppm) INAA	Ce (ppm) INAA	LOI (%)
CH Study Area CHUTANLI LAKE (N=50)	Mean	5.58	27.42	7.10	74.10	0.17	13.42	4.50	14.80	446.66	1.86	41.20	0.35	4.14	36.92	1.56	1.81	11.42	24.36	34.4
	Median	**4**	**26**	**7**	**75.5**	**0.1**	**13**	**4.5**	**15**	**446.5**	**1.86**	**39.5**	**0.3**	**3**	**30**	**1.4**	**1.535**	**11**	**23.5**	**39.7**
	S.D.	4.09	11.22	2.53	24.39	0.10	4.66	1.59	7.07	150.05	0.67	24.70	0.17	6.11	22.32	0.64	0.84	5.26	10.29	11.8
	Variance	16.70	125.88	6.38	594.66	0.01	21.76	2.54	49.92	22514.15	0.45	609.92	0.03	37.35	498.31	0.41	0.71	27.64	105.91	139.1
	C.V.	73.23	40.92	35.57	32.91	56.66	34.76	35.42	47.74	33.59	35.99	59.94	48.78	147.61	60.46	41.01	46.62	46.03	42.25	34.3
	Minimum	1	8	2	11	0.1	5	1	2	200	0.31	8	0.2	1	8.2	0.6	0.33	2	6	3.3
	Maximum	22	44	13	109	0.4	22	7	30	969	3.48	150	0.8	34	130	2.8	3.6	21	40	47.3
LAKE CH-1 (N=19)	Mean	1.58	34.05	3.32	235.47	0.23	9.95	3.32	10.58	142.26	0.91	2.00	0.62	2.89	2.39	0.73	0.94	8.05	16.63	59.4
	Median	**2**	**34**	**3**	**239**	**0.2**	**10**	**3**	**11**	**129**	**0.93**	**2**	**0.6**	**3**	**2.4**	**0.7**	**0.93**	**7**	**15**	**61.7**
	S.D.	0.51	3.26	1.25	17.61	0.10	0.71	0.67	1.35	40.22	0.15	0.00	0.17	1.73	0.47	0.14	0.17	1.87	4.06	9.0
	Variance	0.26	10.61	1.56	310.15	0.01	0.50	0.45	1.81	1617.65	0.02	0.00	0.03	2.99	0.22	0.02	0.03	3.50	16.47	80.9
	C.V.	32.13	9.56	37.69	7.48	43.80	7.09	20.24	12.73	28.27	16.15	0.00	27.74	59.72	19.52	18.82	17.69	23.22	24.40	15.2
	Minimum	1	29	2	207	0.1	9	2	8	94	0.68	2	0.4	1	1.2	0.5	0.67	6	12	34.2
	Maximum	2	39	6	264	0.4	11	5	13	249	1.2	2	1	6	3.4	1.1	1.23	12	25	68.7
LAKE CH-2 (N=9)	Mean	11.67	22.33	3.33	79.33	0.12	9.67	2.67	7.56	366.22	1.07	27.56	0.44	2.89	28.00	0.77	1.08	5.56	13.33	71.6
	Median	**9**	**22**	**3**	**76**	**0.1**	**10**	**3**	**8**	**303**	**1.1**	**14**	**0.5**	**1**	**16**	**0.7**	**1.09**	**5**	**12**	**76.7**
	S.D.	6.80	2.74	1.58	17.10	0.04	1.66	0.71	1.42	128.10	0.26	21.16	0.18	2.62	18.03	0.20	0.28	2.55	6.00	11.0
	Variance	46.25	7.50	2.50	292.50	0.00	2.75	0.50	2.03	16410.19	0.07	447.78	0.03	6.86	325.25	0.04	0.08	6.53	36.00	121.8
	C.V.	58.29	12.26	47.43	21.56	36.08	17.15	26.52	18.85	34.98	24.38	76.79	40.74	90.67	64.41	26.09	25.86	45.99	45.00	15.4
	Minimum	6	19	2	56	0.1	7	2	6	226	0.73	10	0.2	1	13	0.5	0.72	3	6	51.2
	Maximum	26	27	7	106	0.2	12	4	10	555	1.49	58	0.8	8	55	1.1	1.51	10	23	80.0

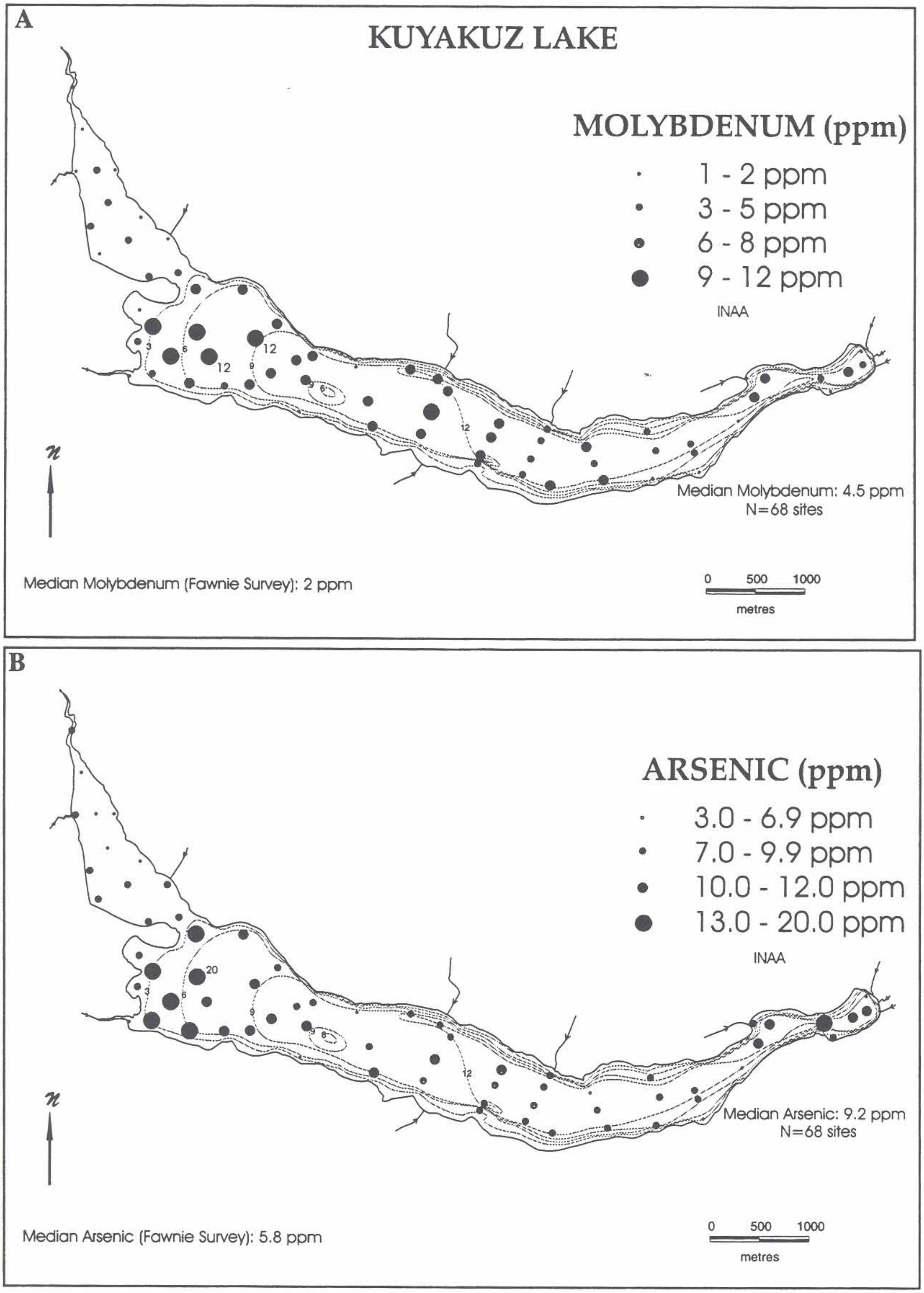

Figure 9. Distribution of (A) molybdenum (ppm) and (B)arsenic (ppm) in Kuyakuz Lake sediment. Bathymetry after Burns (1978).

93.5 ppm) have similar, if less pronounced, geochemical zonations, suggesting that the bedrock source of these metals lies to the west of the inflow. Drainage lakes, surveyed earlier during orientation studies, exhibit similar zoning patterns. They are interpreted here to represent the local accumulation of metals originating from down slope and down drainage hydromorphic dispersion from adjacent mineralization. Some examples include near-shore sediment zoning patterns in both single-basin lakes (*e.g.,* gold in Clisbako Lake; molybdenum in Hanson Lake) and multi-basin lakes (*e.g.,* molybdenum in Tatin Lake). As well, significant between-basin variations within multi-basin lakes (*e.g.,* molybdenum in Tatin Lake; gold in Bentzi Lake; copper in Hill-Tout Lake) are likely to be at least partly caused by the location of the mineralized area within the lake watershed.

SEEPAGE LAKES

Seepage lakes 3031 and 3087 are single-basin ponds and lakes lacking any significant stream inflows. They exhibit elevated gold (medians: 5 ppb and 1.5 ppb, respectively), arsenic (medians: 72 and 9.7 ppm) and antimony (medians: 5.6 ppm and 5.2 ppm) distributions (Figures 10 and 11) that are generally more homogenous than those in sediment of drainage lakes.

Conversely, lake 1259, near Tsacha Mountain in the Fawnie Range, exhibits characteristics of both seepage and drainage lakes. Although nominally a high-elevation seepage pond, it receives local stream drainage from the north and the sediment shows considerable variability for several elements (Table 6). For example, elevated concentrations of gold (median: 1 ppb), arsenic (median: 14 ppm), antimony (median: 2.0 ppm), silver (median: 0.4 ppm), zinc (median: 101 ppm) and lead (median: 6 ppm) are present in sediment at the mouth of the main stream inflow, possibly indicating the presence of up-stream mineralization. Extremely high concentrations of molybdenum (384 ppm), arsenic (740 ppm) and iron (18.8%) are also present locally at another site, perhaps denoting a spot where groundwater enters the oxygen-rich lake basin.

In general, regional geochemical results from a single site in seepage lakes are likely to be more representative of the sediment geochemistry, and that of the surrounding watershed, than a single site within drainage lakes. To illustrate, the coefficient of variation (C.V.) may be used as a measure of the relative variability of elements within each lake. Garrett *et al.* (1980) state that C.V. values of greater than 70% are indicative of non-normally distributed data. A perusal of C.V. data from most seepage lakes (lakes 3031, 3087, 1138; Table 6), and from small ponds and lakes (*e.g.,* Bentzi 2, Wasp) surveyed during orientation studies (Table 3) confirms that, for many elements, C.V. values are generally lower than those for either single-basin or multi-basin drainage lakes (*e.g.,* Clisbako, Bentzi and Kuyakuz Lakes). Results here are somewhat influenced by the number of near-shore samples, and are not entirely comparable to regional surveys where only centre-lake sediment is collected. Nevertheless, the greater geochemical heterogeneity of drainage lake sediment suggests that detailed sampling of these lakes may be more useful in determining a general direction toward mineralization during property-scale geochemical exploration surveys.

SUGGESTIONS FOR GEOCHEMICAL EXPLORATION

REGIONAL SURVEYS

Regional lake sediment geochemical surveys are most effective for precious and base metal exploration if every lake in the survey area is sampled. The presence, for exam-

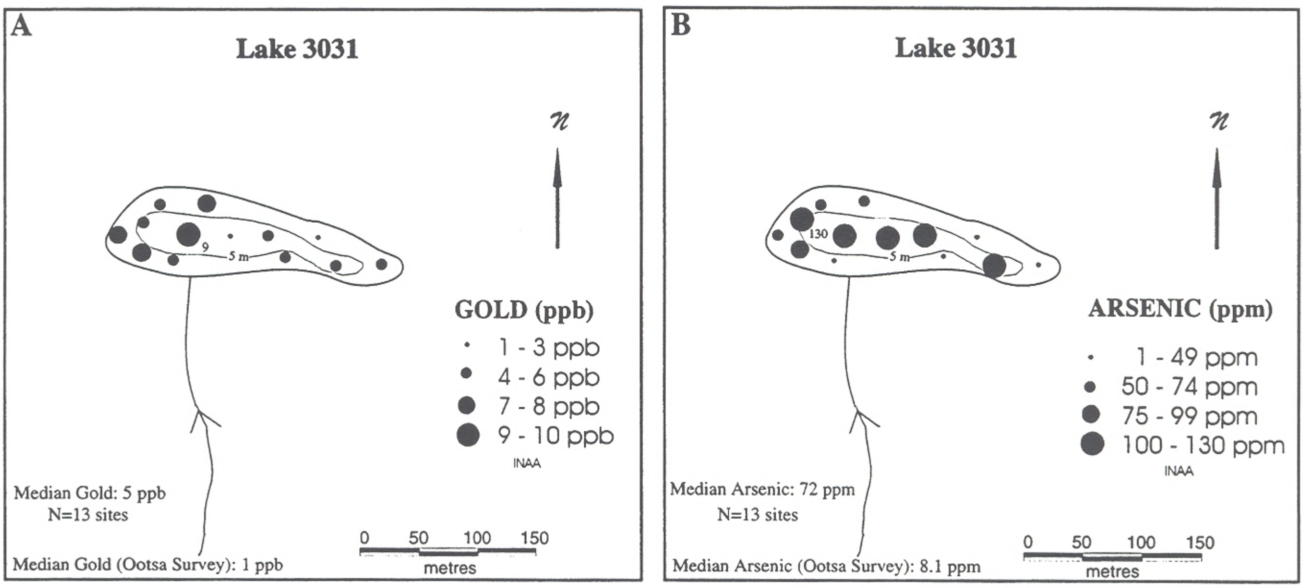

Figure 10. Distribution of (A) gold (ppb) and (B) arsenic (ppm) in lake 3031 sediment. The 5-metre contour denotes sample depth, not lake depth.

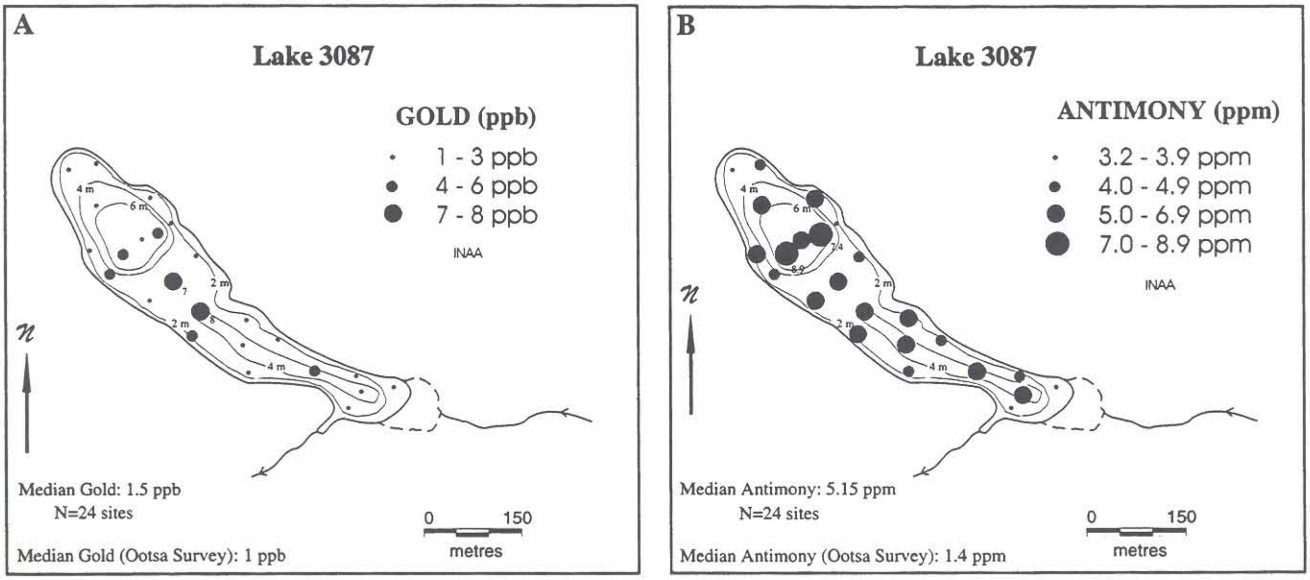

Figure 11. Distribution of (A) gold (ppb) and (B) antimony (ppm) in lake 3087 sediment. Contours denote sample depth (metres).

ple, of elevated molybdenum values in basins other than the main centre-lake basin of some lakes has important implications for the success of regional geochemical surveys, and sampling designs should be modified to accommodate this. Accordingly, a single centre-lake sample should be collected from the profundal basin of small lakes and ponds, and additional samples should be taken from the centres of major sub-basins. Cook and Jackaman (1994b) should be consulted for additional recommendations.

FOLLOW-UP SURVEYS

For property-scale exploration, different types of anomalous lakes (*i.e.,* drainage lakes *vs.* seepage lakes) require different follow-up exploration strategies. At a minimum, the original centre-basin site should always be resampled to verify the anomaly in the case of gold and other elements which are susceptible to the 'nugget effect'. Subsequently, detailed sediment sampling of anomalous drainage lakes should be conducted to map the presence of any metal zoning patterns. This should include the sampling of near-shore organic sediment from all sides of the lake and from near all stream inflows. General directions toward potential areas of buried mineralization within the watersheds of these lakes may be inferred from the orientation of any zoning patterns, as shown here for Clisbako, Tatin and Hanson lakes.

For seepage lakes, detailed sediment sampling may be a less useful tool for property-scale follow-up of regional geochemical anomalies, because of the more uniform distribution of metals within the sediment. Each case will be different, but centre-basin geochemical results here are likely to be more representative of the entire lake and watershed than any similar site within drainage lakes. Delineation of watershed boundaries, followed by surface prospecting and till geochemistry surveys, may be a more useful procedure in locating the possible source of the metals.

SUMMARY

Lake sediment geochemistry is an effective mineral exploration tool at several levels, from regional reconnaissance surveys to property-scale follow-up. Orientation studies show that trace and precious elements in lake sediments confirm the presence of adjacent mineral prospects in the northern Interior Plateau. Sediments at Wolf, Clisbako and other lakes, for example, reflect the presence of nearby epithermal precious metal deposits, containing maximum gold concentrations of 56 ppb and 16 ppb, respectively. These concentrations are far in excess of the regional background of 1 ppb gold in lake sediments. Similarly, lake sediments at Tatin and Hanson lakes, among others, reflect the presence of nearby porphyry molybdenum occurrences, containing maximum molybdenum concentrations of 23 ppm and 55 ppm, respectively. These concentrations also exceed regional background of 1 to 2 ppm molybdenum in lake sediments of adjacent map areas.

Bedrock geology influences regional geochemical patterns. On a more detailed scale within lakes adjacent to known prospects, orientation studies indicate that centre-lake sediments may, but do not necessarily, contain the highest gold and molybdenum concentrations. Shapes and locations of metal distribution patterns in lake sediment appear to be influenced by four closely related factors: (1) the location, within the watershed, of the mineral deposit relative to active ground water and stream water flow into the lake basin; variations in the organic matter content of the sediment; limnological factors, particularly in regard to limnological variations between basins; and basin morphometry. Notably, results here echo findings of Hoffman and Fletcher (1976) that limnological variability of Interior Plateau lakes does not obscure the existence of high metal values in sediments adjacent to known mineralization.

On the basis of orientation study results, two regional lake sediment geochemistry surveys were conducted in the Nechako River (NTS 93F) map area, and a third recently completed in the Fort Fraser (NTS 93K) map area. These surveys are ongoing contributions to the objective of completing RGS lake sediment coverage of the northern Interior Plateau. Results clearly demonstrate that regional lake sediment surveys are useful for detecting areas of prospective precious and base metal mineralization. They corroborate earlier lake sediment anomalies adjacent to known mineral prospects, enlarge target areas around known prospects, and outline new areas for further exploration. In addition, there is excellent potential for the use of lake sediment sampling in the follow-up of regional geochemical anomalies at a property scale. Results from several drainage lakes adjacent to epithermal and porphyry prospects show that some metal zoning patterns, in near-shore sediments and near drainage inflows, indicate general directions toward mineralization and alteration zones. Accordingly, detailed sediment sampling to map metal zoning patterns may be a useful tool in the follow-up of regional geochemical anomalies.

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