Current Research (2000) Newfoundland Department of Mines and Energy
Geological Survey, Report 2000-1, pages 75-99

RECENT HIGH-DENSITY LAKE-SEDIMENT AND WATER SURVEYS IN CENTRAL LABRADOR

J.W. McConnell
Geophysics, Geochemistry and Terrain Sciences Section

ABSTRACT

During 1998, high-density lake-sediment and water-geochemical surveys were conducted in four areas of central Labrador. Samples were collected from 940 sites in areas regarded as prospective for Ni, Cu, and possibly Au mineralization. The Wilson Lake area has high values of Ni and Cu in the lake sediment, and in several known sulphide occurrences, but has been little explored; it is underlain by paragneiss and mafic gneiss. The Seal Lake area, which is underlain by mafic volcanic and high-level intrusive and clastic sedimentary rocks, has been extensively explored for Cu and has many known prospects; the present survey expands the focus of previous exploration activity. The Harp Lake area is mainly underlain by anorthosite and related rocks. The area surveyed is distinguished by having elevated values of Cu and Ni in reconnaissance lake-sediment data. Over 23 sulphide occurrences are already known within the survey boundary. The Pants Lake intrusion area contains the best known analogue of Voisey's Bay-style mineralization in Labrador. The Ni–Cu–Co mineralization is widespread, occurring in the basal portion of the layered, sheet-like, gabbroic Pants Lake intrusion. Results of the current high-density lake surveys identify, in addition to most known mineral occurrences in the four areas, several watersheds without known mineralization. The Wilson Lake area contains a strong elongate Ni anomaly. The Seal Lake area has several lakes that have high Cu content in water and/or sediment without known mineralization. The Harp Lake area survey identifies three lakes having anomalous Cu in sediment and two areas that have anomalous Ni content in water without corresponding known mineralization. Two new exploration target areas are identified in the Pants Lake survey area. An area with several samples of lake water having high Ni values is outside the main exploration area and an adjacent pair of lakes having anomalous Au and Sb is located several kilometres to the east of the base-metal exploration area in a region underlain by Archean gneiss.

INTRODUCTION

The four areas surveyed hold potential for base-metal and gold mineralization and several mineral occurrences are known from all areas. The Wilson Lake area has Cu and pyrite mineralization and is distinguished by elevated levels of Cu and Ni in the regional lake-sediment data. Portions of the Seal Lake area were intensively explored for Cu during the 1950s and 1970s during which time many mineral discoveries were made. The current survey expands the focus of the exploration area to the surrounding region. The Harp Lake area received most of its exploration activity during the 1970s and again briefly following the discovery of the Voisey's Bay deposit in 1994. As the best known Labrador analogue of Voisey's Bay-type mineralization, the Pants Lake intrusion (PLI) area has received rigorous exploration attention, but only for Ni–Cu–Co. The present survey encompasses all the PLI and a wide area beyond.

The present high-density survey is designed to provide a sufficient level of detail to focus follow-up exploration. In addition to the lake-sediment data, a large suite of water analyses including base metals gives a second level of data. This report describes the geology, sampling and analytical methods, provides a variety of statistical summaries and tools, and presents six maps of element distribution in sediment and water and an accompanying interpretation. More complete discussion and presentation, as well as the data in digital format, is being published this spring.

LOCATION, ACCESS AND PHYSIOGRAPHY

The lake survey was conducted over four areas in central Labrador in parts of NTS map areas 13E/6, 7, 9 and 10, 13K/5, 13 and 14, 13L/4 and 16, 13M/1, 8 and 9 and 13N/4, 5 and 12 (Figure 1). Access to most of the areas is practical only by float plane or helicopter, although the Trans-Labrador highway transects the southern part of the Wilson Lake area; air services are available in Goose Bay.

The terrain is moderately rugged and relief is about 200 m in the Wilson Lake area, 300 m in the Seal Lake area and

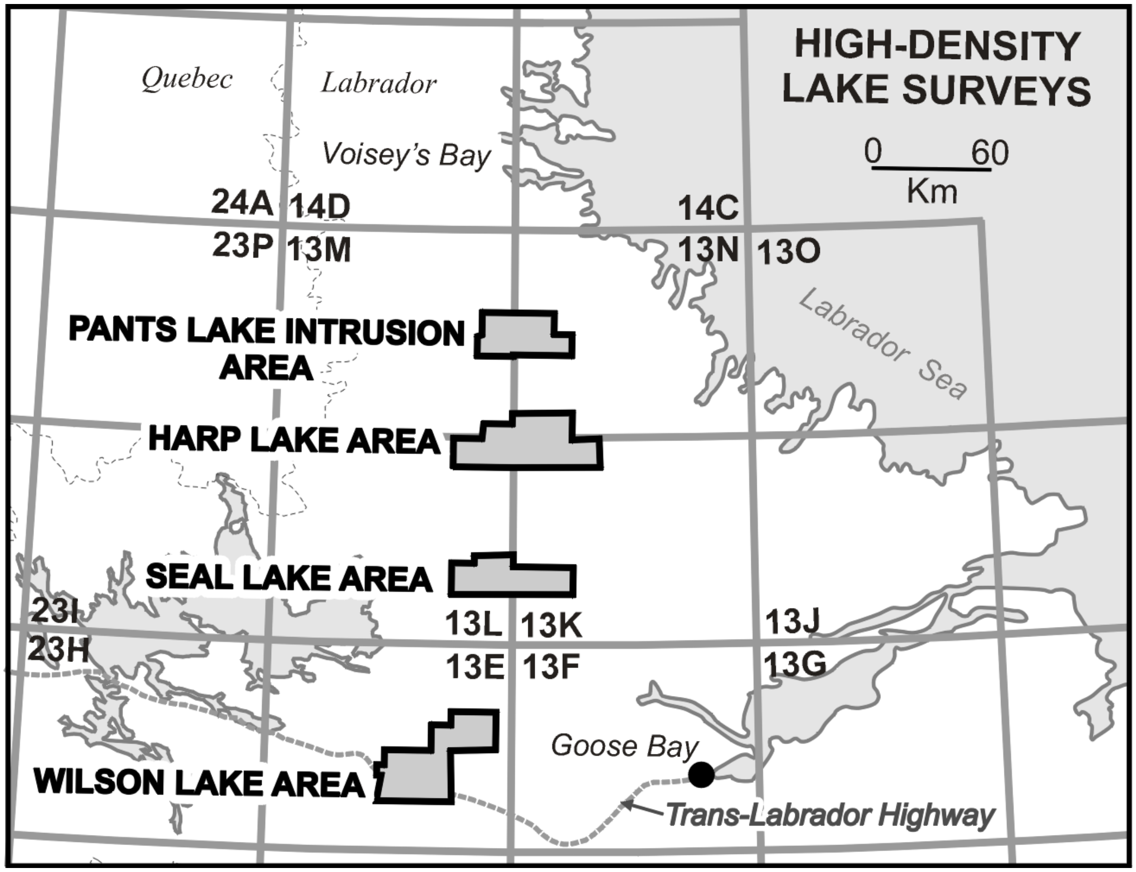

Figure 1. *Location of survey areas.*

600 m in the Harp Lake and PLI areas. Forest cover is widespread and often thick in the southern two areas and a little sparse in the PLI area, particularly at the higher elevations, but quite thin in the Harp Lake area. Lake density is high, affording relatively uniform sampling coverage in most parts of the survey areas.

PREVIOUS GEOCHEMICAL SURVEYS

Lake-sediment and water sampling was undertaken in these areas from 1978 to 1983 by the Geological Survey of Canada (GSC) jointly with the Newfoundland Department of Mines and Energy, as part of a project of complete regional-scale sampling of Labrador. Samples were collected at an average density of 1 per 13 km^2. The data from these surveys were released as five Open-File reports that include data listings of about 42 analyses for each sediment sample and 3 analyses for water samples, descriptions of analytical procedures and 1:250 000-scale maps of sample locations and gold distributions. The Wilson Lake area has anomalous Ni in lake sediment in the 1982 reconnaissance survey (Friske *et al.*, 1993a). The Seal Lake area includes numerous Cu showings and moderate enrichment in Ni and Cu in the regional lake survey (Friske *et al.*, 1993b, c). The Harp Lake area includes several Cu and Ni showings and is anomalous in Ni in the regional survey (Friske *et al.*, 1993b, c, d, e). The reconnaissance data from the PLI area, a recently recognized Ni–Cu–Co mineralized district, has several lakes having anomalous Ni (Friske *et al.*, 1993d, e).

GEOLOGY AND MINERALIZATION

Wilson Lake Area

The area is underlain by the Grenville Province consisting predominantly of 1680- to 1660-Ma metasedimentary and mafic gneiss at amphibolite to granulite facies (Wardle *et al.*, 1997). Minor granitoid intrusives of the Trans Labrador batholith and more extensive mafic intrusives (gabbro norite and lesser diorite) are also found. The area has received minor exploration attention and several mineral indications or showings are known in the surveyed area including 8 Cu and 12 pyrite (Geological Survey of Newfoundland and Labrador, 1999).

Seal Lake Area

This area is located within the Central Mineral Belt and is underlain by Mesoproterozoic rocks of the Seal Lake Group including siltstone, shale, quartzite, subaerial basalt flows and gabbro sills that have been regionally metamorphosed to greenschist facies (Wardle, 1993). There are over 230 instances of Cu mineralization in the surveyed area (Geological Survey of Newfoundland and Labrador, 1999). Mineralization commonly occurs as chalcocite, bornite, native copper and chalcopyrite. Several of the more thoroughly explored prospects note the presence of anomalous silver values. Most of the exploration for these occurrences took place in the 1950s by Frobisher Ltd. and later in the 1970s by Brinex Ltd. Little work has taken place since the release of the regional-lake sediment data for the area. The most comprehensive summary of the nature of the Seal Lake Group geology and associated mineralization is that of Brummer and Mann (1961). They note that the mineralization occurs in quartz–carbonate veins and/or shear zones, mostly within amygdaloidal basalt, diabase and clastic (meta)sedimentary rocks including quartzite, shale, slate, argillite and phyllite. Wilton (1996) regards the copper mineralization to have been the result of a single mineralizing event, in which copper-rich fluids penetrated zones of weakness such as shear zones and contacts during Grenville deformation.

Harp Lake Area

Most of the survey area is underlain by early Mesoproterozoic rocks of the Harp Lake Intrusive Suite. Aside from marginal granitoid and gabbroic phases, the interior of the complex consists mainly of two units, both of which include anorthosite, leuconorite, and leucogabbro (Emslie, 1980). These units are distinguished by the presence or absence of olivine. The olivine-bearing unit also contains leucotroctolite. The eastern portion around Shapio Lake is underlain by Archean tonalitic to granodioritic gneiss.

Prior to the discovery of the Voisey's Bay deposit, most exploration and discovery of sulphide occurrences in this region was done between 1970 and 1973 by Kennco Explorations Ltd. (Emslie, 1980) with additional exploration in the 1990s by Falconbridge Canada Ltd. (Osmond, 1992; McLean, 1994; Olshevfsky, 1996). Over 23 occurrences of Cu mineralization are known in the survey area; Ni (in pentlandite) is reported as a minor commodity in nearly all of them (Geological Survey of Newfoundland and Labrador, 1999). Several new showings were discovered in the post-Voisey's Bay staking rush and exploration. These are still being compiled and are not yet available on the current version of the Geological Survey's Mineral Occurrence Data system. Kerr and Smith (*this volume*) discuss several of these as well as previously known occurrences. Most of the mineralization consists of disseminated chalcopyrite, pyrrhotite and minor pentlandite in anorthosite, leucogabbro and leucotroctolite; they recognize two types of deposits – nickel dominated and copper dominated.

Pants Lake Intrusion Area

The survey area is transected by the Nain–Churchill boundary. Most of the area is within the Churchill Province and is underlain predominantly by Paleoproterozoic metasedimentary and granitoid gneisses. These are intruded by the PLI, a Mesoproterozoic layered, sheet-like gabbroic body having three major units. The area to the east of the boundary is underlain by Archean tonalitic to granodioritic gneiss that has been intruded by Mesoproterozoic granitoid and anorthosite affiliates of the Nain Plutonic Suite and peralkaline granite of the Flowers River igneous suite. The Ni–Cu–Co sulphide mineralization is confined to the basal portion of the PLI where it is widespread although varying in amount and metal content. Sulphide mineralogy is typically pyrrhotite–chalcopyrite–pentlandite. Kerr (1999) reports that unpublished U–Pb dates make the intrusion contemporaneous with the Reid Brook intrusion, host to the Voisey's Bay deposits.

SURFICIAL GEOLOGY

The entire area was glaciated during the last (late Wisconsinan) glacial period. Detailed surficial geological mapping has not been conducted in any of the four areas but regional studies indicate that most ice movement was east to northeast (Thompson and Klassen, 1986). Till is the dominant glacial deposit, commonly 1 to 2 m thick over crystalline terrane and marginally thicker in areas of supracrustal rocks in the Seal Lake area (Klassen and Thompson, 1993). Within the survey areas, narrow, ribbon-shaped deposits of glaciofluvial sand and gravel underlie portions of major river valleys including parts of the Naskaupi (Seal Lake area) and Adlatok (PLI area) rivers.

SAMPLE COLLECTION

A total of 957 lake-sediment and water samples were collected from 940 sites. Duplicate samples were collected about 50 to 100 m apart at 18 of these sites to check the representativeness of the sampling program. Generally, smaller lakes were sampled in this survey than was the case for the reconnaissance survey, in which the objective had been to obtain a more regional geochemical perspective. Normally, the centre of the lake (or if apparent from the air, the central basinal portion of the lake) was sampled. In some deep lakes (>25 m), no sample was retrieved in lake centres and a sample from a shallower site closer to shore was obtained. The collection procedure involves landing a float-equipped 206-B Jet Ranger helicopter on the lake surface and first obtaining a sample of near-surface water by immersing and filling a purified, 250 mL Nalgene bottle. Prior to sampling, the bottles are acid leached in the laboratory, and washed with distilled and deionized water. A sediment sample is obtained

Table 1. Analytical methods for lake-sediment samples

ELEMENTS	METHOD	DIGESTION/ PREPARATION
Ag1, As1, Au1, Ba1, Br1, Ce1, Co1, Cr1, Cs1, Cu1, Fe1, Hf1, La1, Lu1, Mo1, Na1, Ni1, Rb1, Sb1, Sc1, Sm1, Ta1, Tb1, Th1, U1, W1, Yb1, Zn1, Zr1	Neutron Activation Analysis (INAA)	5 to 10 g in shrink-wrapped vial (total analysis)
Al2, Ba2, Be2, Ca2, Cd2, Ce2, Co2, Cu2, Dy2, Fe2, Ga2, K2, La2, Li2, Mg2, Mn2, Na2, Nb2, Ni2, Pb2, Rb2, Sc2, Sr2, Ti2, V2, Y2, Zn2*, Zr2*	Inductively Coupled Plasma Emission Spectroscopy (ICP-ES)[1]	$HF-HClO_4-HCl$ (total digestion)
Cr2, Mo2	Atomic Absorption Spectroscopy (AA)[1]	$HF-HClO_4-HCl$ (total digestion)
Loss-on-ignition (LOI)	Gravimetric using muffle furnace raised to 500° C	

* Indicates preferred method of analysis.

[1] Finch (1998)
[2] Wagenbauer *et al.* (1983)

by dropping a weighted tubular sampler fitted with a nylon rope for retrieval. A butterfly valve in the bottom of the tube opens upon impact with the sediment and closes upon retrieval, trapping the contained sediment. Samples are stored in water-resistant Kraft paper bags. Water depths were also noted. Other observations made during sampling include GPS coordinates of site, elevation, the nature of vegetation surrounding the lake, sediment colour, composition and water colour.

SAMPLE PREPARATION AND ANALYSES

Preparation

Lake sediments were partially air-dried in the field prior to shipping to the laboratory for final oven-drying at 40° C. The samples were then disaggregated by mortar and pestle before being screened through a 180 micron stainless-steel sieve. The fine fraction was retained for chemical analyses. To monitor analytical precision, five percent of the samples were randomly selected, split and included as blind duplicates in all analytical procedures. Water samples were stored in a cool environment prior to shipping to St. John's. At the laboratory, waters were filtered using a 0.45 µm millipore filter apparatus.

Analyses

Lake sediments were analyzed for 46 unique elements plus loss-on-ignition using three different methods. In addition, 13 of these elements were analyzed by a second method for a total of 60 separate determinations. The methods of analyses are tabulated in Table 1. Elements, which were analyzed by two methods, one of which gives preferable results for reasons of improved detection limit or precision, are distinguished by an asterisk. To enable the user to readily distinguish the method of analysis for a given element, a suffix is attached to the element symbol when used in tables and figures. All analyses, except INAA, were performed in the geochemical laboratory of the Department of Mines and Energy. INAA analyses were done by Becquerel Laboratories. The key to the suffixes is as follows:

1. Neutron activation analysis (INAA).
2. ICP-ES (or AA) after $HF-HClO_4-HCl$ digestion.

In the foregoing, "ICP-ES" refers to inductively coupled plasma-emission spectrometry; "AA" is atomic absorption spectrophotometry. Thus, Zn2 is zinc analyzed by ICP-ES/$HF-HClO_4-HCl$ whereas Zn1 is zinc analyzed by INAA.

Lake water was analyzed for conductivity, pH, SO_4 and 22 elements using the methods noted in Table 2.

DATA QUALITY

To ensure the reliability of the analytical data, three means of determining data accuracy and precision were

Table 2. Analytical methods for lake-water samples

ANALYSIS	METHOD	PREPARATION
pH	Corning combination pH electrode	None
Conductivity	Corning conductivity sensor	None
Ca, Fe, K, Mg, Mn, Na, Si, SO_4	ICP-emission spectroscopy[1]	Filtration (0.45 µm) and HNO_3 acidification
Al, Ba, Be, Co, Cr, Cu, Li, Mo, Ni, P, Sr, Ti, Y, Zn	ICP ultrasonic nebulizer[1]	Filtration (0.45 µm) and HNO_3 acidification
F	Fluoride-ion specific electrode with digital ion analyser[2]	

[1] Finch (1998)

employed. During sample collection, 17 pairs of site-duplicates were obtained to give an appreciation of within-lake data variation. At the analytical stage, a standard of known composition was inserted within every batch of 20 samples and a sample split, or laboratory duplicate, was similarly included. For sediments, international reference standards composed of lake-sediment material were used, notably LKSD-1, LKSD-2, LKSD-3 and LKSD-4. For water, standards used were both naturally occurring water and synthetic standards created in the laboratory to predetermined compositions. The results of these standards were monitored and found generally to be satisfactory.

DESCRIPTION AND DISCUSSION OF RESULTS

STATISTICAL ANALYSIS

Summary Statistics

To quantify the range and distribution characteristics of the element populations, summary statistics have been calculated for the sediment and water data for each of the four areas and a selection of these are tabulated in Tables 3 to 6, respectively. The geometric means as well as arithmetic means are given because most element populations are more nearly log-normal than normal.

Histograms of Analytical Data

Histograms of data from each of the four areas are found in Figures 2 to 6. For sediment these include Cr1, Cu2 and Ni2 (Figure 2), Mg2, U1 and Zn2 (Figure 3) and Fe2, Mn2 and LOI (Figure 4). For water, these include Cu, Ni and conductivity (Figure 5) and Ca, Mg and pH (Figure 6). Histograms provide a quick graphical view of the shape of the population distribution of an element or variable; in particular, they illustrate the relationship between extremely high values and the main population. Note that the X axis in each case is a log scale.

Correlation Analysis

Tables 7 to 10 list Spearman correlation coefficients of selected elements and variables analyzed in sediment. Correlation coefficients show the strength of inter-element associations; i.e. the tendency for pairs of elements to vary sympathetically (positive correlations) or inversely (negative correlations) with each other in a given sample population. For example, if gold is associated with arsenopyrite in an area, this relationship may show as a positive correlation between Au and As. Iron and manganese (hydr)oxides frequently act as significant scavenging agents for many metals in lake sediments. For some elements, this may be so extreme as to require normalizing, or even outright rejection, of the data involved. For practical purposes, correlations of $<|0.6|$ generally do not call for adjustment of values when dealing with scavenging agents like Fe and Mn. That is, enough of the element signal is present that satisfactory results may be obtained by considering only the raw values. For elements with coefficients $>|0.6|$, procedures such as regression analysis may be employed to minimize the component of the signal due to scavenging. Lake size, depth and organic content of the sediment as measured by loss-on-ignition can also influence the chemical composition of the sediment.

Table 3. Wilson Lake area: summary statistics for selected lake-sediment and lake-water data; sediment data in ppm and water data in ppm unless otherwise indicated (N=305)

Element	Median	Mean (Arithmetic)	Mean (Logarithmic)	Standard Deviation (Arithmetic)	Standard Deviation (Logarithmic)	Minimum	Maximum
<u>Lake sediment:</u>							
As1	0.6	0.7	0.5	0.49	0.33	<0.5	3.3
Au1, ppb	<1	0.5	0.5	0.2	0.06	<1	2
Cd2	0.2	0.3	0.2	0.17	0.28	<0.2	1.0
Co2	9	14	10	14	0.36	1	98
Cr1	42	51	38	38	0.35	<10	300
Cu2	17	22	17	21	0.33	1	221
Fe1, wt.%	1.6	2.2	1.6	2.03	0.37	0.2	15.7
Fe2, wt.%	1.79	2.40	1.70	2.11	0.38	0.16	15.61
La2	48	49	44	22	0.21	10	153
LOI, wt.%	31.9	32.8	30.2	11.75	0.21	1.7	72.8
Mg2, wt.%	0.23	0.28	0.22	0.20	0.29	0.03	1.40
Mn2	259	558	275	1488	0.45	18	20843
Mo2	<1	1.0	0.8	1.0	0.28	<1	9
Ni2	17	21	17	15	0.24	6	109
Pb2	4	5	4	3	0.32	1	20
Sb1	<0.1	0.0	0.0	0.05	0.33	<0.1	0.2
Ti2	1261	1489	1202	982	0.29	161	5560
U1	1.6	2.2	1.7	2.58	0.26	0.5	35.8
Zn2	54	61	55	30	0.21	9	188
<u>Lake water:</u>							
Ca, ppm	0.37	0.42	0.37	0.21	0.22	0.07	1.61
Cr	<1	0.6	0.6	0.21	0.12	<1	2
Cu	1	1	1	0.83	0.22	<1	11
Fe	46	72	48	73.3	0.40	5	554
K, ppm	0.1	0.1	0.1	0.08	0.25	<0.1	0.5
Mg, ppm	0.35	0.39	0.35	0.19	0.18	0.09	1.50
Mn	2	2.6	2.1	1.93	0.29	<1	14
Na, ppm	0.28	0.30	0.28	0.16	0.18	0.02	2.39
Ni	1	2.0	1.3	1.66	0.40	<1	8
SO4, ppm	<0.1	<0.1	<0.1	0	0.00	<0.1	<0.1
Zn	0.4	1.42	0.5	4.75	0.48	<0.3	57.9
Conductivity, µS	9.37	9.77	9.55	2.48	0.11	4.51	20.40
pH	6.28	**	6.24	**	0.28	4.85	6.94
Lake area (km2)	0.06	0.11	0.06	0.23	0.41	0.01	0.50
Lake depth (m)	5	5.8	4.2	4.3	0.39	0.5	24

** pH is defined as a logarithmic value.

In the Wilson Lake area, the presence of Fe/Mn scavenging is strongly suggested in Table 7 by correlation coefficients between Fe1 and Co2 (0.86), Cr1 (0.67), La (0.74) and Zn2 (0.80). Coefficients of these metals with manganese are similar. A correlation between Cu1 and Ni2 (0.66) suggests a bedrock cause. The variation in Cu is partly explained by depth (0.70). LOI shows a strong inverse relationship with Mg and Ti. Gold has no significant correlation with other metals or physical parameters.

Scavenging by Fe/Mn oxides is also evident in the Seal Lake area (Table 8) but a strong sympathetic relationship

Table 4. Seal Lake area: summary statistics for selected lake-sediment and lake-water data; sediment data in ppm and water data in ppm unless otherwise indicated (N=184)

Element	Median	Mean (Arithmetic)	Mean (Logarithmic)	Standard Deviation (Arithmetic)	Standard Deviation (Logarithmic)	Minimum	Maximum
Lake sediment:							
As1	2.5	4.3	2.7	8.08	0.38	<0.5	89.1
Au1, ppb	<1	0.6	0.5	0.4	0.12	<1	3
Cd2	0.4	0.5	0.4	0.33	0.32	<0.2	2.0
Co2	13	19	14	19	0.29	3	129
Cr1	40	40	35	17	0.25	<10	76
Cu2	39	60	42	102	0.33	5	1273
Fe1, wt.%	2.4	2.7	2.1	2.08	0.32	0.3	14.7
Fe2, wt.%	2.70	2.88	2.24	2.12	0.33	0.27	14.25
La2	52	64	56	38	0.21	16	275
LOI, wt.%	30.6	28.8	23.4	13.69	0.33	1.7	84.2
Mg2, wt.%	0.33	0.41	0.32	0.34	0.29	0.06	3.50
Mn2	434	1239	479	3264	0.50	40	29014
Mo2	5	8.0	4.7	9.2	0.47	0.5	57
Ni2	18	19	18	7	0.15	8	63
Pb2	7	8	7	7	0.28	1	70
Sb1	0.2	0.1	0.1	0.09	0.44	<0.1	0.5
Ti2	1519	2035	1660	1304	0.29	358	5640
U1	4.1	6.5	4.2	12.52	0.36	0.9	160.0
Zn2	85	100	87	61	0.21	30	538
Lake water:							
Ca, ppm	2.33	3.33	2.24	3.51	0.39	0.06	22.53
Cr	<1	<1	<1	0	0.00	<1	1
Cu	<1	1	1	1.59	0.23	<1	21
Fe	17	24	17	25.8	0.37	<10	205
K, ppm	0.1	0.2	0.1	0.07	0.21	<0.1	0.5
Mg, ppm	0.50	0.55	0.50	0.24	0.19	0.08	2.09
Mn	<1	1.6	1.3	1.51	0.23	<1	13
Na, ppm	0.48	0.50	0.48	0.15	0.14	0.13	1.07
Ni	2	2.7	2.0	2.06	0.36	<1	12
SO4, ppm	<0.1	0.2	0.1	0.21	0.24	<0.1	1.9
Zn	0.2	0.8	0.5	1.52	0.44	<0.3	16.7
Conductivity, µS	25.30	30.67	25.70	20.04	0.26	5.35	126.30
pH	6.99	**	6.97	**	0.37	4.85	8.30
Lake area (km2)	0.06	0.12	0.07	0.15	0.44	0.01	1.39
Lake Depth (m)	7	7.5	6.0	4.3	0.33	0.5	20

** pH is defined as a logarithmic value.

between Cu and Ni, noted above, is not. LOI has an inverse relationship with Mg and Ti similar to that seen in the Wilson Lake area. There are no significant correlations with Au.

In the Harp Lake area (Table 9), Fe/Mn scavenging appears to be less of a problem with only cobalt being strongly correlated, r=0.79 for Fe1. Copper and Ni are correlated (0.61) suggesting a bedrock association. Ti2 and Cr2 are extremely strongly correlated (0.86) and inversely correlated with LOI (−0.70 and −0.61) respectively. Together, these suggest that these two metals are being carried into the lakes as detrital rather than dissolved phases. Gold has only a weak correlation with one element, U1 (0.28).

Table 5. Harp Lake area: summary statistics for selected lake-sediment and lake-water data; sediment data in ppm and water data in ppm unless otherwise indicated (N=257)

Element	Median	Mean (Arithmetic)	Mean (Logarithmic)	Standard Deviation (Arithmetic)	Standard Deviation (Logarithmic)	Minimum	Maximum
Lake sediment:							
As1	<0.5	0.3	0.3	0.26	0.24	<0.5	2.3
Au1, ppb	<1	0.5	0.5	0.3	0.10	<1	3
Cd2	0.2	0.2	0.2	0.15	0.27	<0.2	0.9
Co2	13	15	13	11	0.22	2	111
Cr1	25	26	21	15	0.32	<10	61
Cu2	9	12	9	10	0.32	1	87
Fe1, wt.%	1.7	1.9	1.5	1.4	0.33	0.2	12.9
Fe2, wt.%	1.94	2.12	1.58	1.57	0.37	0.07	14.52
La2	14	15	14	7	0.19	2	43
LOI, wt.%	25.7	25.6	24.0	8.71	0.17	7.2	55.6
Mg2, wt.%	0.49	0.56	0.45	0.34	0.31	0.06	1.76
Mn2	219	309	200	510	0.36	25	4935
Mo2	1	1.3	1.0	1.7	0.29	0.5	22
Ni2	24	25	22	12	0.21	5	72
Pb2	<1	2	1	1	0.22	<1	7
Sb1	<0.1	<0.1	<0.1	0		<0.1	<0.1
Ti2	1181	1339	1023	873	0.36	94	4127
U1	0.5	0.6	0.4	0.52	0.30	0.1	4.1
Zn2	54	55	52	16	0.14	17	104
Lake water:							
Ca, ppm	1.68	1.78	1.58	0.8	0.21	0.32	4.82
Cr	<1	<1	<1	0.04	0.03	<1	1
Cu	1	1	1	0.66	0.19	<1	9
Fe	11	15	10	15.4	0.34	<10	101
K, ppm	<0.1	<0.1	<0.1	0.04	0.13	<0.1	0.4
Mg, ppm	0.53	0.59	0.51	0.32	0.24	0.11	1.90
Mn	<1	<1	<1	1.55	0.17	<1	18
Na, ppm	0.51	0.52	0.49	0.18	0.16	0.17	1.12
Ni	<1	1.0	0.7	0.92	0.28	<1	7
SO4, ppm	<0.1	<0.1	<0.1	0	0.00	<0.1	<0.1
Zn	<0.3	0.86	0.3	4.48	0.41	<0.3	70.2
Conductivity, µS	19.80	21.14	19.50	8.01	0.17	6.05	55.00
pH	7.12	**	7.11	**	0.19	6.44	7.52
Lake area (km2)	0.03	0.05	0.03	0.06	0.37	0.01	0.44
Lake Depth (m)	4	5.1	3.8	3.7	0.36	0.5	22

** pH is defined as a logarithmic value.

In the PLI area (Table 10), Fe/Mn scavenging is problematical only for Co (r=0.73 with Fe1). Titanium and Cr1 are strongly correlated in the PLI area as well and also negatively correlated with LOI (–0.76 and –0.58 respectively). Noteworthy is the correlation of Au with Sb (0.41) and a weaker one with As (0.16). Antimony is associated with Au in some types of deposits and may be useful as a pathfinder element where Au analyses are erratic or near detection limit.

Table 6. PLI area: summary statistics for selected lake-sediment and lake-water data; sediment data in ppm and water data in ppm unless otherwise indicated (N=188)

Element	Median	Mean (Arithmetic)	Mean (Logarithmic)	Standard Deviation (Arithmetic)	Standard Deviation (Logarithmic)	Minimum	Maximum
Lake sediment:							
As1	0.5	1.8	0.5	14.21	0.43	<0.5	195.0
Au1, ppb	<1	0.6	0.5	0.5	0.13	<1	6
Cd2	0.3	0.4	0.3	0.32	0.35	<0.2	1.8
Co2	11	18	13	21	0.32	3	184
Cr1	23	24	19	14	0.34	<10	69
Cu2	12	16	13	11	0.28	2	70
Fe1, wt.%	2.3	2.8	2.2	2.17	0.30	0.3	15.1
Fe2, wt.%	2.42	3.13	2.45	2.34	0.30	0.26	16.03
La2	75	87	76	57	0.22	20	555
LOI, wt.%	25.6	25.2	21.9	11.84	0.27	2.3	79.4
Mg2, wt.%	0.28	0.33	0.27	0.20	0.29	0.05	0.87
Mn2	285	473	263	1041	0.41	8	10407
Mo2	4	7.9	4.0	14.2	0.48	0.5	132
Ni2	14	19	15	19	0.26	6	165
Pb2	8	8	7	4	0.26	1	16
Sb1	<0.1	0.04	0.02	0.11	0.25	<0.1	1.2
Ti2	1289	1623	1259	1092	0.33	117	4939
U1	2.3	5.3	2.8	14.22	0.38	0.4	143.0
Zn2	81	90	83	41	0.18	25	284
Lake water:							
Ca, ppm	0.95	1.03	0.89	0.51	0.24	0.13	2.73
Cr	<1	<1	<1	0.11	0.04	<1	2
Cu	1	1	1	0.39	0.16	<1	3
Fe	31	45	30	42.2	0.40	<10	260
K, ppm	0.1	0.1	0.1	0.07	0.25	<0.1	0.4
Mg, ppm	0.39	0.42	0.39	0.19	0.19	0.09	1.24
Mn	1	1.6	1.4	1.21	0.23	<1	9
Na, ppm	0.46	0.47	0.45	0.17	0.17	0.17	0.88
Ni	2.0	2.5	1.8	1.8	0.38	<1	11
SO4, ppm	<0.1	0.2	0.1	0.28	0.26	<0.1	2.4
Zn	0.6	0.8	0.6	1.12	0.34	<0.3	13.9
Conductivity, µS	13.79	14.77	14.13	4.91	0.14	5.31	33.60
pH	6.75	**	6.71	**	0.19	6.00	7.10
Lake area (km2)	0.05	0.24	0.06	1.22	0.54	0.01	14.49
Lake Depth (m)	5	5.7	4.5	3.5	0.34	0.5	20

** pH is defined as a logarithmic value.

ELEMENT DISTRIBUTION IN LAKE SEDIMENT AND WATER

Distributions of representative elements from each area are shown as symbol plots (*see* Figures 7 to 12). The geological base used in these figures is derived from the 1:1 000 000 scale map of Wardle *et al.* (1997). The intervals used in the symbol maps of Ni and Cu in sediment were chosen by examining the respective cumulative frequency plots (*see* Figures 7 and 9) and selecting suitable inflection points. The inflection points separate natural groupings, or subpopulations, within the overall distribution. For Au in sediment

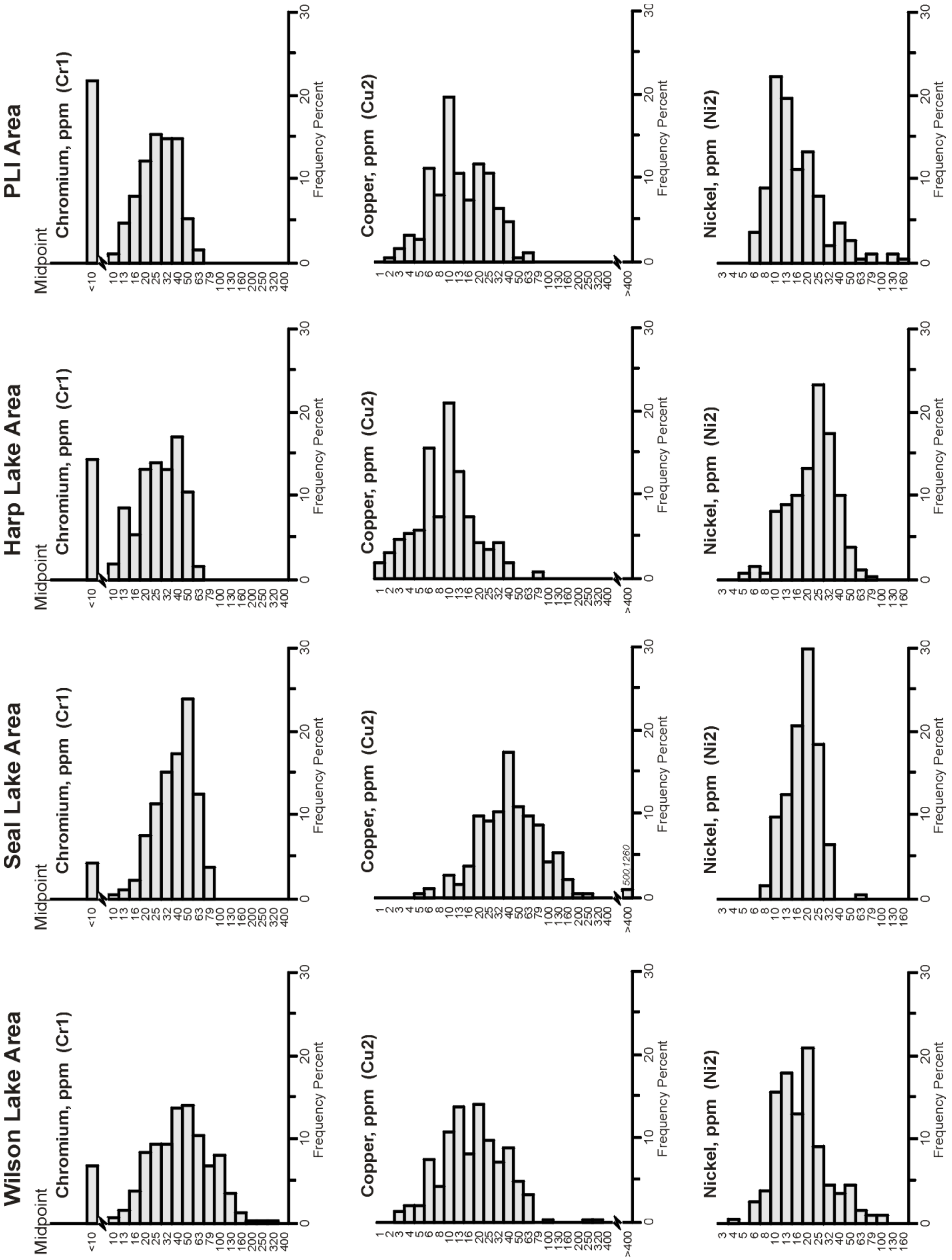

Figure 2. *Histograms of chromium, copper and nickel in lake sediment, by area.*

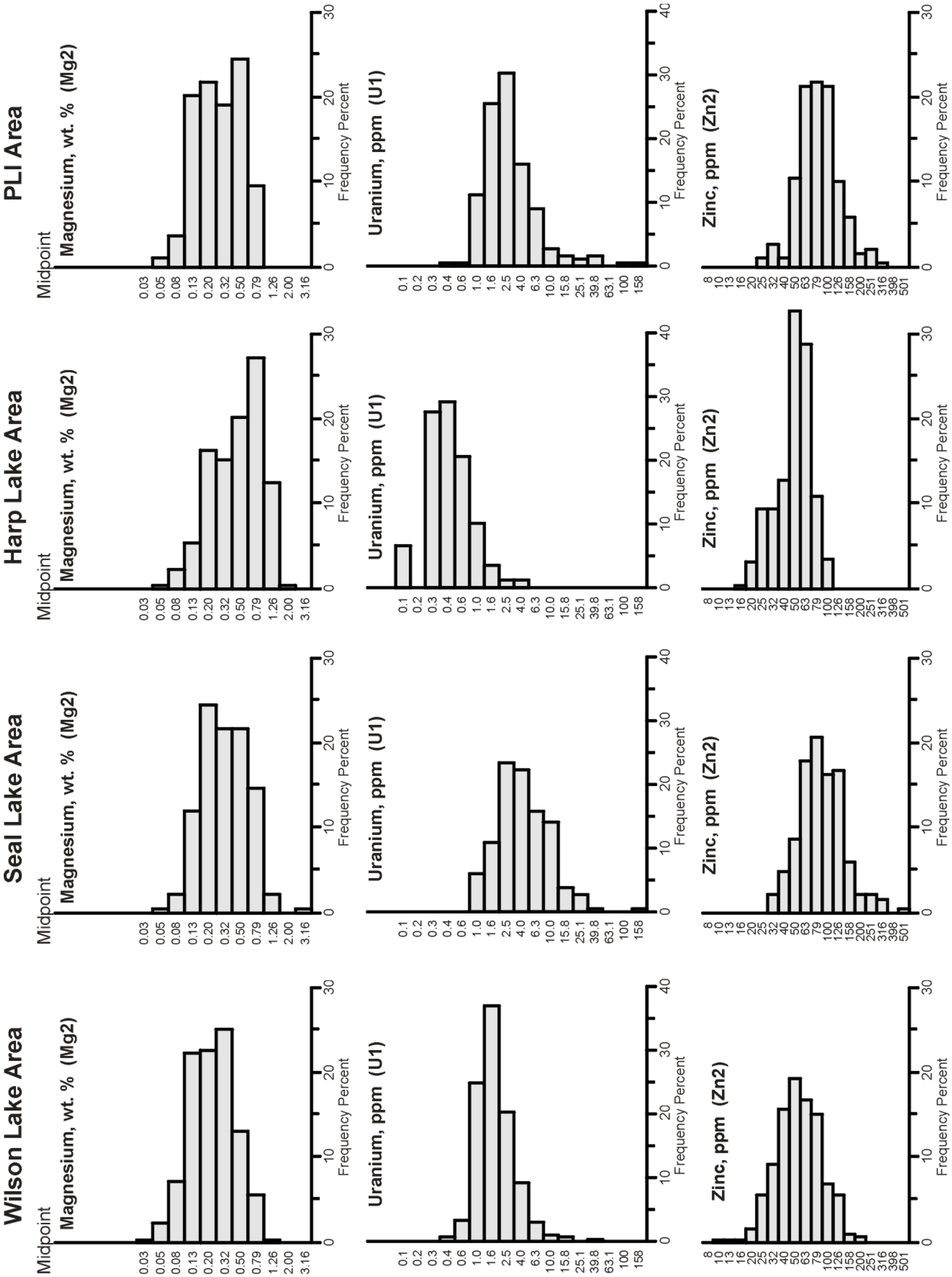

Figure 3. *Histograms of magnesium, uranium and zinc in lake sediment, by area*

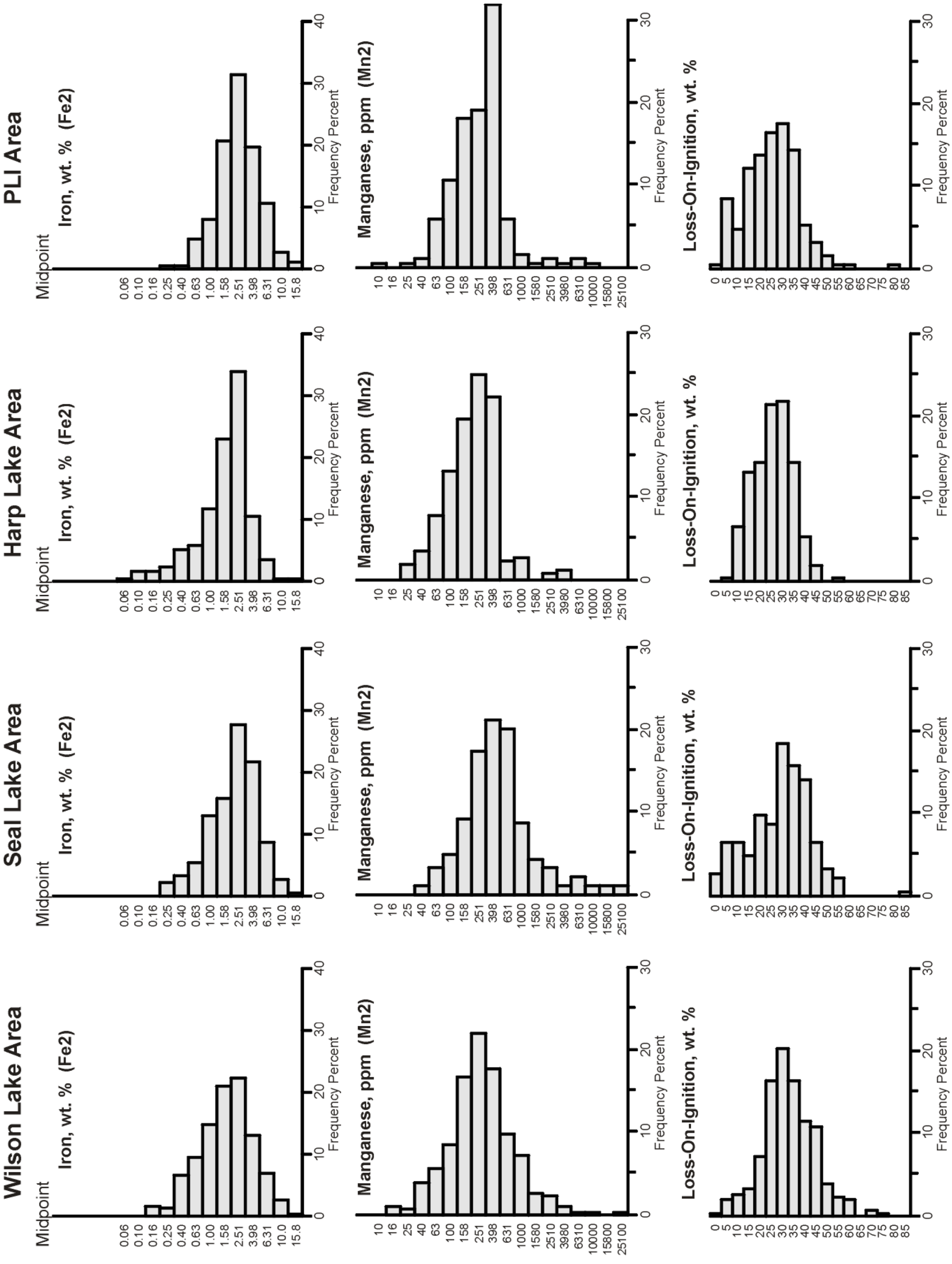

Figure 4. *Histograms of iron, manganese and loss-on-ignition in lake sediment, by area.*

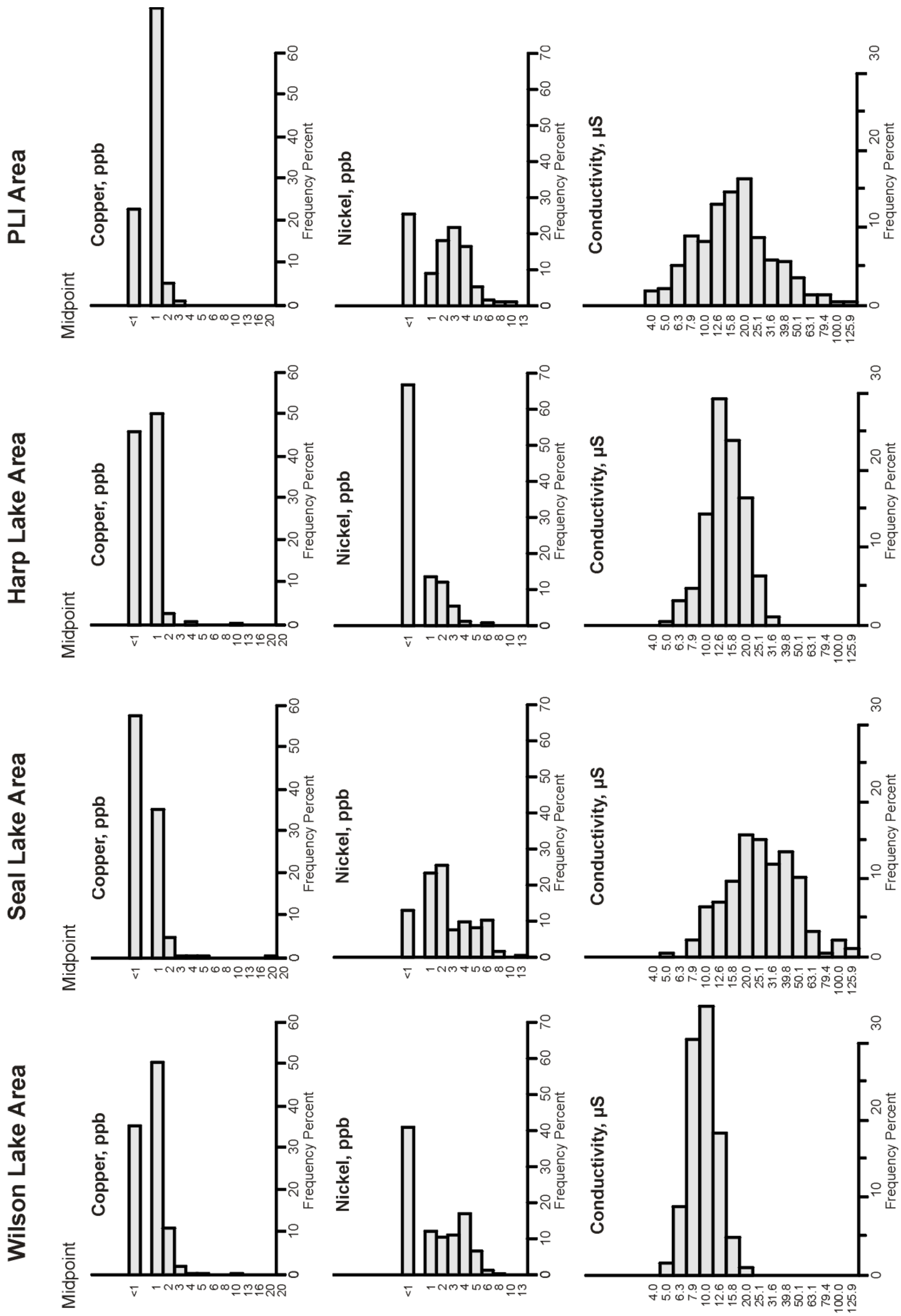

Figure 5. *Histograms of copper, nickel and conductivity in lake water, by area.*

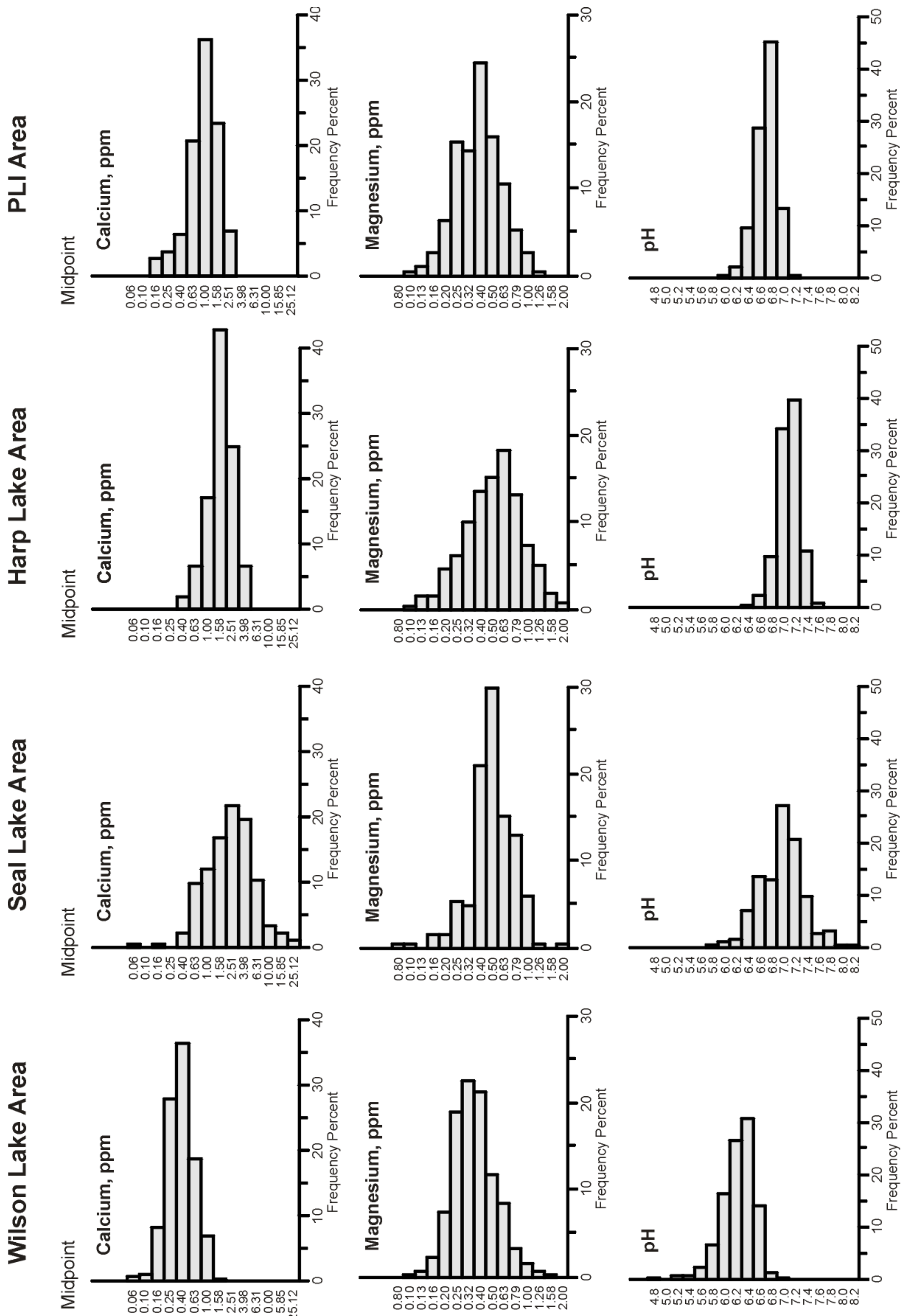

Figure 6. *Histograms of calcium, magnesium and pH in lake water, by area.*

Table 7. Wilson Lake area: Spearman correlation coefficients for selected elements and variables in lake sediment (N=305)

	As1	Au1	Cr1	Cu2	Fe1	Mg2	Mn2	Ni2	Pb2	Zn2	Lake Area	Depth	LOI
As1	**1.00**	-0.05	0.42	0.35	0.53	0.31	0.45	0.23	0.36	0.44	0.24	0.29	0.01
Au1	-0.05	**1.00**	-0.08	-0.03	-0.09	-0.09	-0.09	-0.11	-0.07	-0.08	0.05	0.01	0.03
Co2	0.42	-0.10	0.58	0.56	0.86	0.45	0.85	0.52	0.43	0.82	0.42	0.40	-0.12
Cr1	0.42	-0.08	**1.00**	0.55	0.67	0.68	0.64	0.67	0.40	0.63	0.32	0.48	-0.04
Cu2	0.35	-0.03	0.55	**1.00**	0.57	0.20	0.50	0.52	0.03	0.68	0.32	0.70	0.35
Fe2	0.51	-0.09	0.64	0.53	0.99	0.47	0.87	0.38	0.45	0.79	0.44	0.47	-0.16
La1	0.50	-0.04	0.60	0.73	0.74	0.43	0.71	0.37	0.28	0.75	0.48	0.56	0.04
Mg2	0.31	-0.09	0.68	0.20	0.47	**1.00**	0.57	0.47	0.68	0.42	0.23	0.12	-0.47
Mn2	0.45	-0.09	0.64	0.50	0.87	0.57	**1.00**	0.36	0.50	0.76	0.42	0.45	-0.29
Mo2	0.47	-0.02	0.43	0.42	0.61	0.42	0.61	0.29	0.44	0.60	0.31	0.37	-0.18
Ni2	0.23	-0.11	0.67	0.52	0.41	0.47	0.36	**1.00**	0.18	0.61	0.25	0.24	0.21
Pb2	0.36	-0.07	0.40	0.03	0.43	0.68	0.50	0.18	**1.00**	0.26	0.15	0.02	-0.51
Sb1	0.42	-0.06	0.35	0.14	0.38	0.53	0.46	0.17	0.53	0.28	0.09	0.03	-0.43
Ti2	0.39	-0.06	0.62	0.19	0.54	0.89	0.64	0.19	0.71	0.36	0.23	0.22	-0.51
U1	0.43	-0.08	0.62	0.49	0.49	0.45	0.43	0.45	0.33	0.50	0.25	0.38	-0.04
Zn2	0.44	-0.09	0.63	0.68	0.80	0.42	0.76	0.61	0.26	**1.00**	0.50	0.45	0.06
LOI	0.01	0.03	-0.04	0.35	-0.12	-0.48	-0.30	0.20	-0.51	0.06	-0.09	0.32	**1.00**

Note: Correlations >|0.13| are significant at the 99% confidence level.

Table 8. Seal Lake area: Spearman correlation coefficients for selected elements and variables in lake sediment (N=184)

	As1	Au1	Cr1	Cu2	Fe1	Mg2	Mn2	Ni2	Pb2	Zn2	Lake Area	Depth	LOI
As1	**1.00**	0.10	0.44	0.19	0.56	0.42	0.54	0.32	0.32	0.35	0.26	0.37	-0.19
Au1	0.10	**1.00**	0.15	0.09	0.06	0.08	0.04	0.11	0.08	0.14	-0.03	0.05	0.05
Co2	0.49	0.06	0.47	0.44	0.83	0.29	0.79	0.60	0.43	0.64	0.28	0.54	-0.12
Cr1	0.44	0.15	**1.00**	0.29	0.63	0.68	0.62	0.47	0.68	0.51	0.34	0.44	-0.46
Cu2	0.19	0.09	0.29	**1.00**	0.40	0.09	0.34	0.43	0.22	0.44	0.08	0.56	0.17
Fe2	0.55	0.05	0.61	0.39	0.99	0.46	0.86	0.53	0.57	0.63	0.44	0.61	-0.32
La1	0.20	0.10	0.43	0.45	0.41	0.03	0.48	0.14	0.59	0.74	0.26	0.42	0.19
Mg2	0.42	0.08	0.68	0.09	0.48	**1.00**	0.42	0.46	0.60	0.21	0.19	0.24	-0.74
Mn2	0.54	0.04	0.62	0.34	0.86	0.42	**1.00**	0.42	0.58	0.70	0.48	0.62	-0.29
Mo2	0.50	0.06	0.44	0.50	0.68	0.24	0.67	0.44	0.36	0.58	0.27	0.52	0.00
Ni2	0.32	0.11	0.47	0.43	0.52	0.46	0.42	**1.00**	0.33	0.45	0.26	0.37	-0.24
Pb2	0.32	0.08	0.68	0.22	0.58	0.60	0.58	0.33	**1.00**	0.63	0.21	0.34	-0.36
Sb1	0.55	0.10	0.56	0.25	0.50	0.63	0.48	0.29	0.48	0.30	0.28	0.32	-0.41
Ti2	0.31	0.07	0.71	0.15	0.54	0.93	0.48	0.45	0.65	0.24	0.26	0.30	-0.74
U1	0.67	0.15	0.50	0.22	0.49	0.41	0.51	0.18	0.44	0.42	0.34	0.35	-0.19
Zn2	0.35	0.14	0.51	0.44	0.62	0.21	0.70	0.45	0.63	**1.00**	0.33	0.48	0.02
LOI	-0.19	0.05	-0.46	0.17	-0.31	-0.74	-0.29	-0.24	-0.36	0.02	-0.35	-0.01	**1.00**

Note: Correlations >|0.17| are significant at the 99% confidence level.

and Ni and Cu in water, too few samples had detectable values to create meaningful cumulative frequency plots, hence intervals were selected more subjectively.

Wilson Lake Area

The distribution of Ni is shown in Figure 7. Most of the highest value samples form a loose cluster within a small

Table 9. Harp Lake area: Spearman correlation coefficients for selected elements and variables in lake sediment (N=257)

	As1	Au1	Cr1	Cu2	Fe1	Mg2	Mn2	Ni2	Pb2	Zn2	Lake Area	Depth	LOI
As1	**1.00**	0.06	0.07	0.06	0.08	0.00	0.11	0.01	0.22	0.22	0.20	0.19	0.09
Au1	0.06	**1.00**	-0.09	0.15	-0.01	-0.11	0.00	-0.07	0.05	-0.01	0.02	0.10	0.03
Co2	0.11	0.01	0.54	0.63	0.79	0.64	0.75	0.70	0.05	0.56	0.05	0.20	-0.27
Cr1	0.07	-0.09	**1.00**	0.44	0.59	0.81	0.68	0.58	0.21	0.46	-0.13	-0.27	-0.61
Cu2	0.06	0.15	0.44	**1.00**	0.52	0.41	0.51	0.61	0.01	0.36	0.16	0.30	-0.08
Fe2	0.08	0.00	0.57	0.51	0.99	0.60	0.78	0.52	0.25	0.64	0.07	0.16	-0.32
La1	0.23	0.02	0.46	0.27	0.19	0.34	0.35	0.18	0.47	0.49	0.15	-0.13	-0.20
Mg2	0.00	-0.11	0.81	0.41	0.60	**1.00**	0.70	0.78	0.20	0.46	-0.16	-0.30	-0.71
Mn2	0.11	0.00	0.68	0.51	0.77	0.70	**1.00**	0.57	0.20	0.68	0.10	0.11	-0.49
Mo2	0.18	0.10	0.42	0.39	0.63	0.45	0.63	0.34	0.20	0.54	0.10	0.16	-0.28
Ni2	0.01	-0.07	0.58	0.61	0.53	0.78	0.57	**1.00**	0.07	0.42	-0.07	-0.14	-0.43
Pb2	0.22	0.05	0.21	0.01	0.23	0.20	0.20	0.07	**1.00**	0.36	-0.10	-0.18	-0.12
Ti2	0.02	-0.09	0.86	0.34	0.56	0.92	0.69	0.63	0.31	0.46	-0.21	-0.39	-0.70
U1	0.21	0.28	0.17	0.18	0.10	0.03	0.20	-0.09	0.26	0.25	0.21	0.05	-0.04
Zn2	0.22	-0.01	0.46	0.36	0.62	0.46	0.68	0.42	0.36	**1.00**	0.23	0.07	-0.23
LOI	0.09	0.03	-0.61	-0.08	-0.31	-0.71	-0.49	-0.43	-0.12	-0.23	0.22	0.40	**1.00**

Note: Correlations >|0.14| are significant at the 99% confidence level.

Table 10. PLI Lake area: Spearman correlation coefficients for selected elements and variables in lake sediment (N=188)

	As1	Au1	Cr1	Cu2	Fe1	Mg2	Mn2	Ni2	Pb2	Zn2	Lake Area	Depth	LOI
As1	**1.00**	0.16	0.06	0.36	0.37	-0.15	0.14	0.28	0.01	0.46	0.27	0.29	0.26
Au1	0.16	**1.00**	-0.06	0.00	-0.05	-0.08	-0.09	0.04	-0.09	-0.03	0.00	-0.03	0.04
Co2	0.39	-0.05	0.24	0.58	0.73	0.10	0.55	0.53	0.29	0.60	0.28	0.27	-0.05
Cr1	0.06	-0.06	**1.00**	0.15	0.43	0.76	0.70	0.10	0.72	0.21	0.14	-0.11	-0.58
Cu2	0.36	0.00	0.15	**1.00**	0.45	-0.05	0.32	0.49	0.18	0.62	0.43	0.46	0.20
Fe2	0.38	-0.06	0.41	0.44	0.99	0.20	0.70	0.09	0.54	0.68	0.40	0.38	-0.19
La1	0.22	-0.10	0.29	0.49	0.61	0.14	0.44	-0.07	0.48	0.64	0.33	0.36	0.01
Mg2	-0.15	-0.08	0.76	-0.05	0.22	**1.00**	0.60	0.10	0.74	0.05	0.00	-0.35	-0.75
Mn2	0.14	-0.09	0.70	0.32	0.71	0.60	**1.00**	0.09	0.75	0.44	0.37	0.12	-0.55
Mo2	0.39	-0.05	0.24	0.39	0.69	0.08	0.45	0.05	0.35	0.69	0.46	0.40	-0.05
Ni2	0.28	0.04	0.10	0.49	0.10	0.10	0.09	**1.00**	0.00	0.33	0.10	-0.03	0.06
Pb2	0.01	-0.09	0.72	0.18	0.56	0.74	0.75	0.00	**1.00**	0.27	0.13	-0.05	-0.57
Sb1	0.34	0.41	-0.08	-0.02	-0.03	-0.05	-0.11	0.15	-0.10	0.09	-0.07	-0.03	0.06
Ti2	-0.18	-0.10	0.78	-0.07	0.27	0.97	0.63	-0.03	0.80	0.06	-0.01	-0.30	-0.76
U1	0.35	-0.10	0.26	0.40	0.36	0.15	0.36	-0.05	0.32	0.46	0.36	0.25	-0.04
Zn2	0.46	-0.03	0.21	0.62	0.66	0.05	0.44	0.33	0.27	**1.00**	0.50	0.38	0.03
LOI	0.26	0.04	-0.58	0.20	-0.18	-0.75	-0.55	0.06	-0.57	0.03	-0.11	0.28	**1.00**

Note: Correlations >|0.17| are significant at the 99% confidence level.

area of NTS map area 13E/6 and the western part of NTS map area 13E/7. The area is mapped as being underlain by pelitic, migmatitic and metasedimentary gneiss. The highest Ni value and sample (109 ppm) is located about 10 km north of the cluster near two Cu occurrences, however, the distribution of Cu (not shown) is more erratic than that of Ni. Some of the higher values do occur in the cluster of highest Ni values (J. McConnell, unpublished data). The

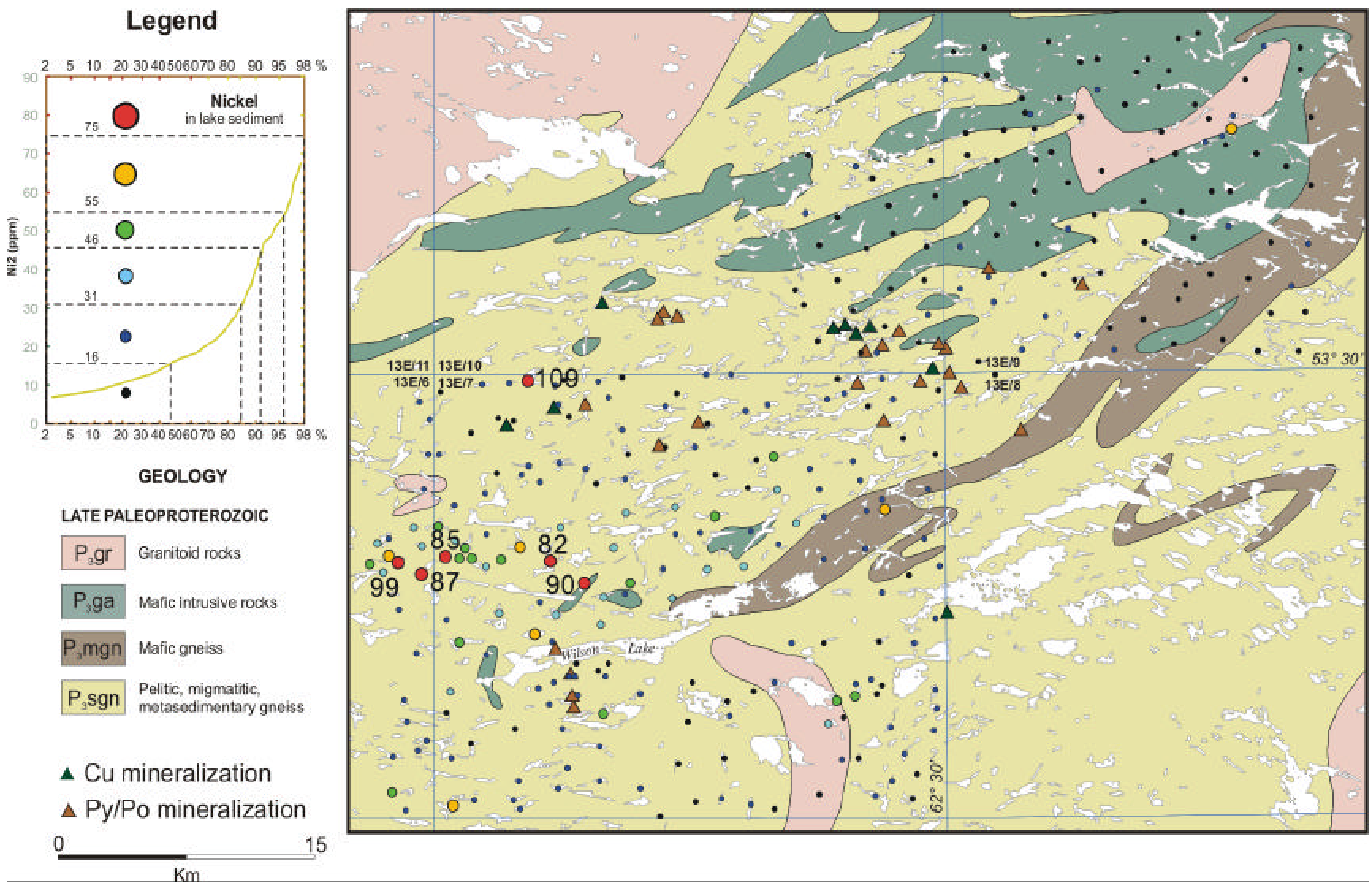

Figure 7. *Nickel in lake sediment, Wilson Lake area (Unit descriptors in legend taken from Wardle* et al., *1997.)*

single highest Cu value (221 ppm) is from a pond of near the west end of Wilson Lake and about 1 km south. It is adjacent to a pyrite occurrence shown in Figure 7.

Seal Lake Area

The distribution of Cu in water is shown in Figure 8. Many occurrences of Cu are known in the area, most of which are associated with basalt and several with gabbro–diabase and clastic rocks. The distribution of Cu in water forms broad patterns. Most of the northwest part of the area has less-than-detection-limit values. An exception is a 21 ppb sample in NTS map area 13L/9; Cu mineralization is known to occur in the same basalt unit, 3 km to the north-northwest from this site. Most of the water samples from the lakes overlying the basalt unit south of Seal Lake have 1 to 2 ppb Cu, the same unit that hosts most of the Cu mineralization. Lakes overlying the gabbro and sedimentary units between Seal and Wuchusk lakes also have elevated Cu including two lakes with 2 ppb and one with 3 ppb. Only six Cu occurrences are known in this area, which falls outside of the main prospecting zone examined in the 1950s and 1970s. Significant mineralized areas located about 5 km south of the western half of Seal Lake are reflected by samples with 2 to 5 ppb Cu. Also of interest, is an area in the southeast corner of NTS map area 13K/5, north of the Thomas River that has three samples having 2 ppb Cu. The two easterly most of these also have very high Cu in sediment (243 and 1271 ppm).

Harp Lake Area

The known Cu–Ni mineralization in the surveyed portion of the Harp Lake Intrusive Suite (HLIS) and the adjacent orthogneiss to the east, is well reflected in the lake-sediment and water geochemistry. Of the 20 occurrences shown in Figures 9 and 10, all but five have anomalous or high Cu (>23 ppm) in lake sediment collected from lakes located within 2 km of the mineralization (Figure 9). In addition, three areas are highlighted that have no occurrences known to the MODS database. One is a 41 ppm lake sample, overlying Archean orthogneiss on the eastern border of the HLIS near Shapio Lake. Copper mineralization occurs in gneiss a few kilometres to the south and is reflected in the lake-sediment geochemistry. Another high lake (34 ppm Cu) is found on the southern edge of the area in NTS map area 13K/13. Although two occurrences of Cu mineralization are located 3 and 5 km to the north and northeast, neither would account for the anomaly. The third lake (32 ppm Cu) with no known mineralization is located near the northern edge of NTS map area 13K/13.

The distribution of Ni in lake water shows a strong zonal pattern that is only partially correlative with known Cu mineralization (Figure 10). Mineralization south of the western end of Harp Lake appears to be reflected by high Ni values (2 to 7 ppb), although the highest sample is quite removed from known mineralization. Three occurrences in central NTS map area 13K/13 are reflected by 2 to 6 ppb Ni. An interesting region of lakes having high Ni in water values is located in NTS map area 13N/4. Most of the survey's 3 ppb Ni lakes and two 4 ppb lakes are found here but only one Cu occurrence and one pyrrhotite–Cu is known. Another area of interest is located on the eastern edge of the HLIS in NTS map area 13K/14 where a cluster of four lakes having 2 ppb and one lake having 3 ppb are found.

Pants Lake Intrusion Area

The locations of known Ni mineralization in the intensively explored area focussed on the PLI, are clearly reflected in the lake water geochemistry of Ni (Figure 11). The background level of Ni in water is also very high here, when compared to the other three areas with 25 percent of the lakes having Ni values ≥4 ppb. The Harp Lake area, in contrast, has fewer than 2 percent of lakes having values in the 4 ppb range. Of additional interest is an area of high Ni values in the western part of NTS map area 13N/12. The area is mapped as underlain by granite and granodiorite and is not considered to have received close exploration attention. The lake sediments in this area are not anomalous in nickel whereas most of the sediment from lakes, near known mineralization, do have high values. One possible explanation of the high values in water would be a shallow sill of PLI that yields a high groundwater flux of Ni but has insufficient outcrop to have produced a glacially derived source of metal for incorporation in the lake sediments.

The distribution of gold in sediment (Figure 12) presents an interesting exploration target. Two lakes located 6 km southeast of Sarah Lake and underlain by granitoid rocks have Au values of 6 and 4 ppb. In addition, these lakes have the highest and third highest Sb values, respectively, found in this survey. The lakes also have elevated values of As. Both of these metals are commonly associated with certain types of Au deposits. Five other lakes in the PLI area have detectible gold including a 3 ppb sample in NTS map area 13M/8 and a 2 ppb sample in NTS map area 13N/12, which has elevated As (1.0 ppm). Two lakes in NTS map area 13M/9 have 2 ppb Au in their sediment and modestly elevated As (0.6 and 1.0 ppm).

CONCLUSIONS

The results of the four high-density geochemical lake surveys include the following:

1. In the Wilson Lake area, a large area of lakes having high Ni in sediment is identified. In addition, isolated

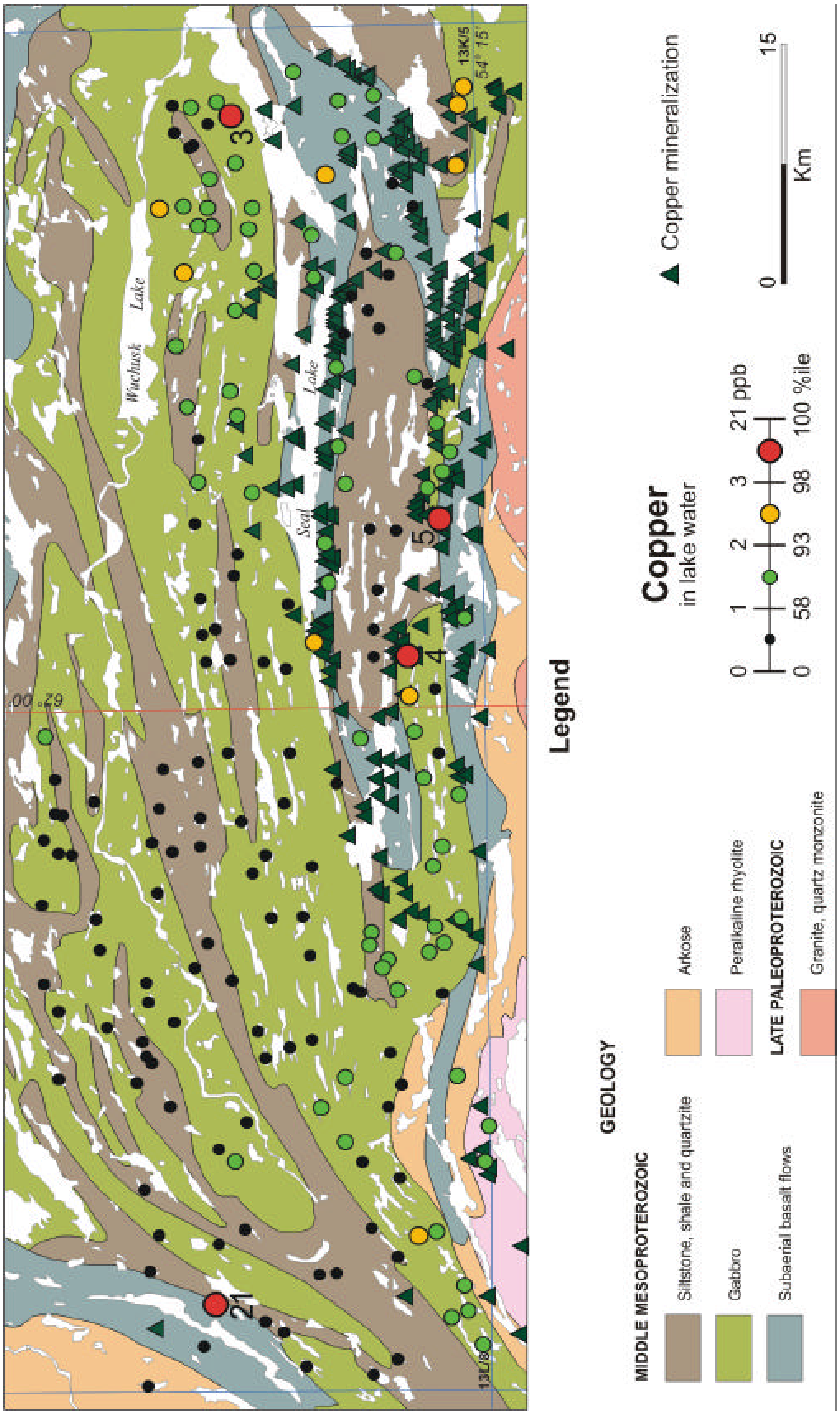

Figure 8. *Copper in lake water, Seal Lake area*

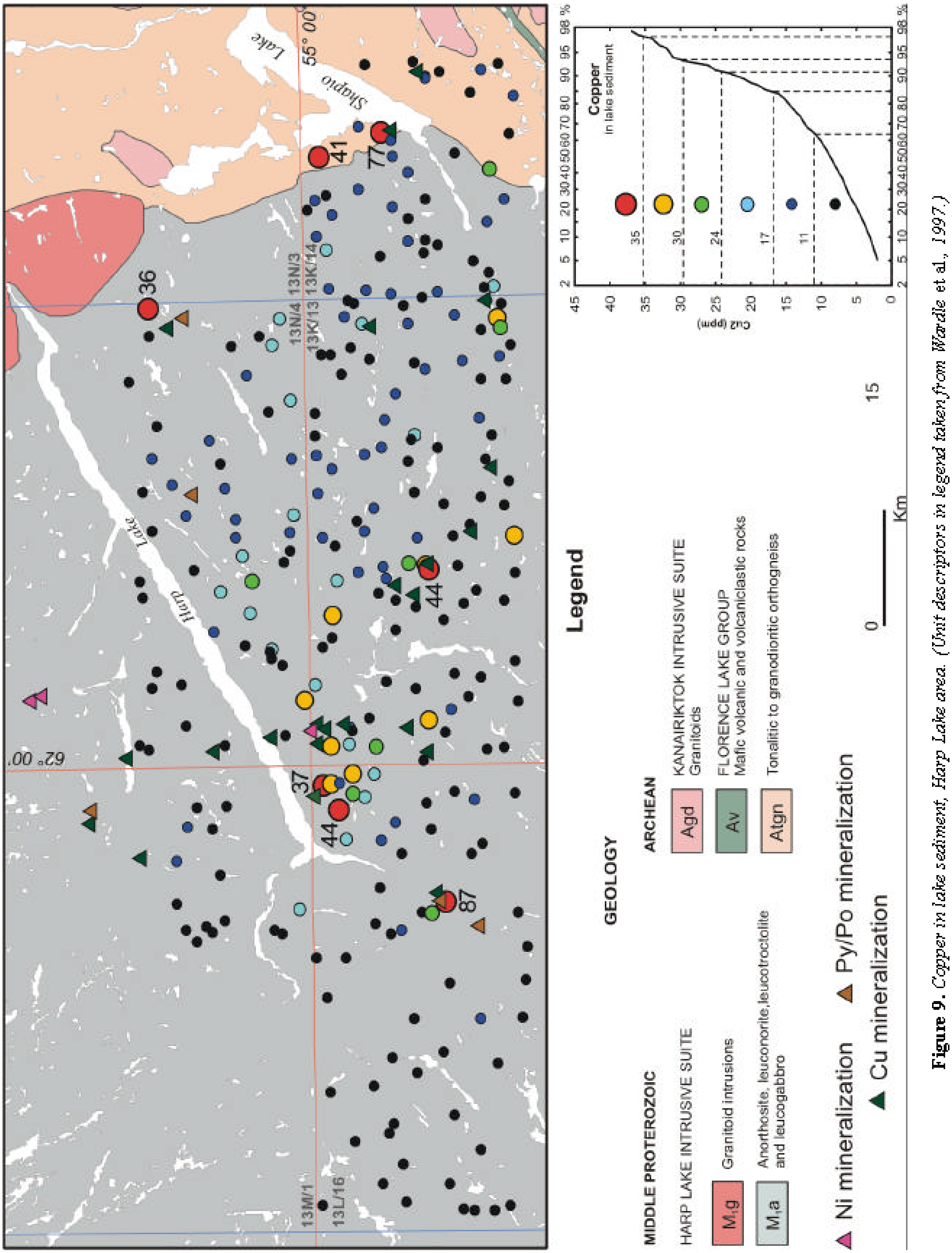

Figure 9. *Copper in lake sediment, Harp Lake area. (Unit descriptors in legend taken from Wardle et al., 1997.)*

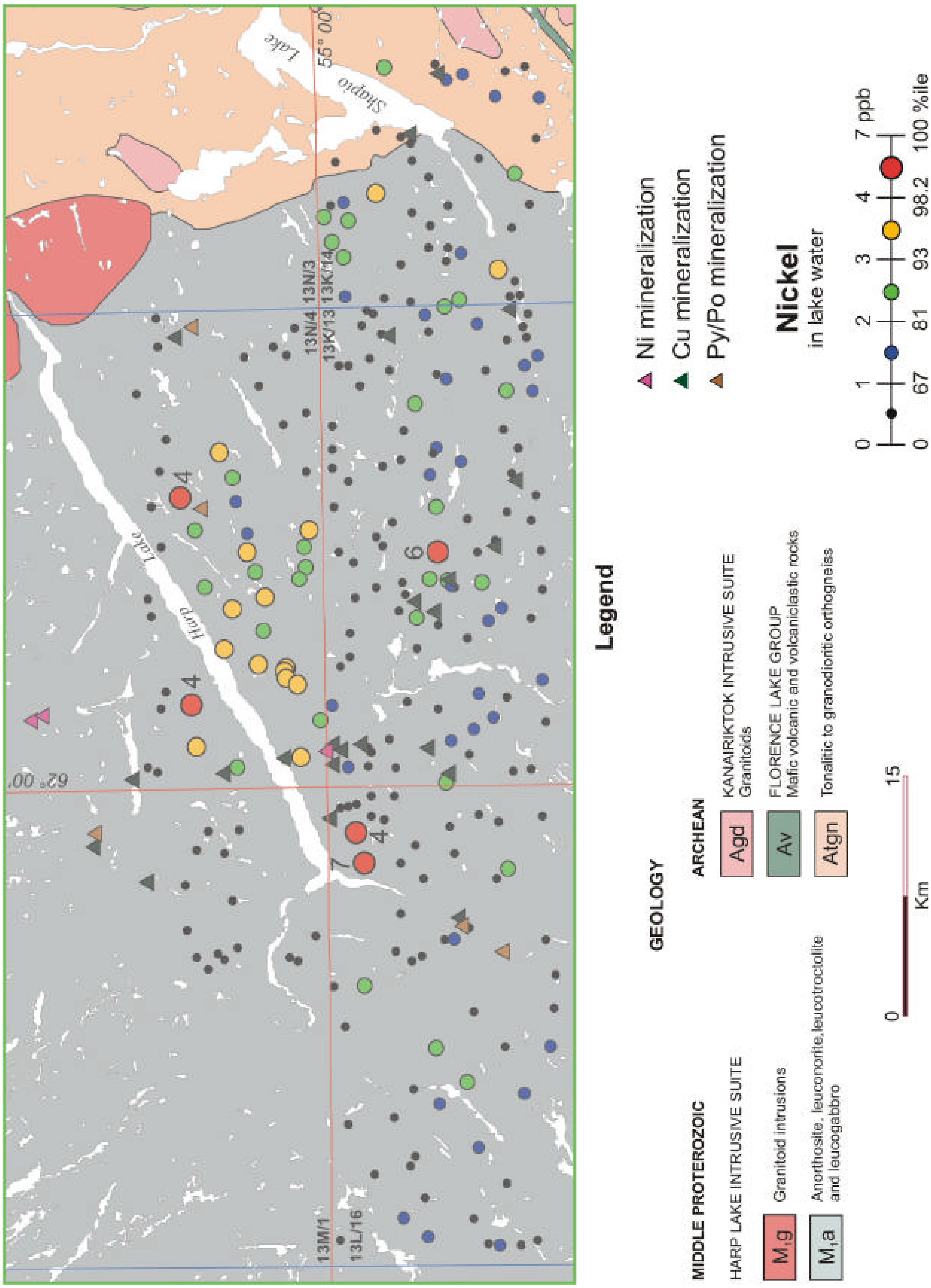

Figure 10. *Nickel in lake water, Harp Lake area (Unit descriptors in legend taken from Wardle et al., 1997.)*

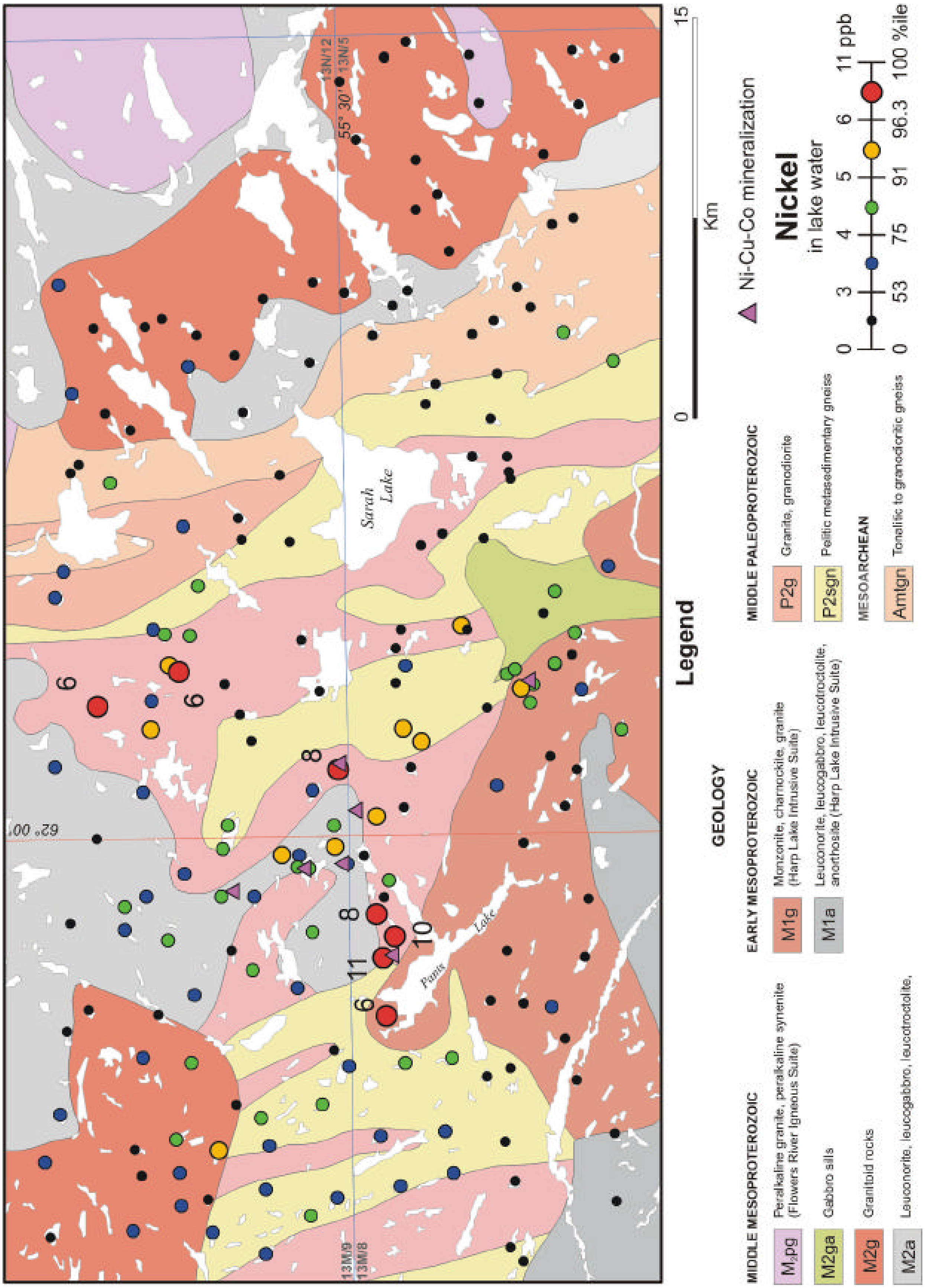

Figure 11. *Nickel in lake water, Pants Lake intrusion area. (Unit descriptors in legend taken from Wardle et al., 1997.)*

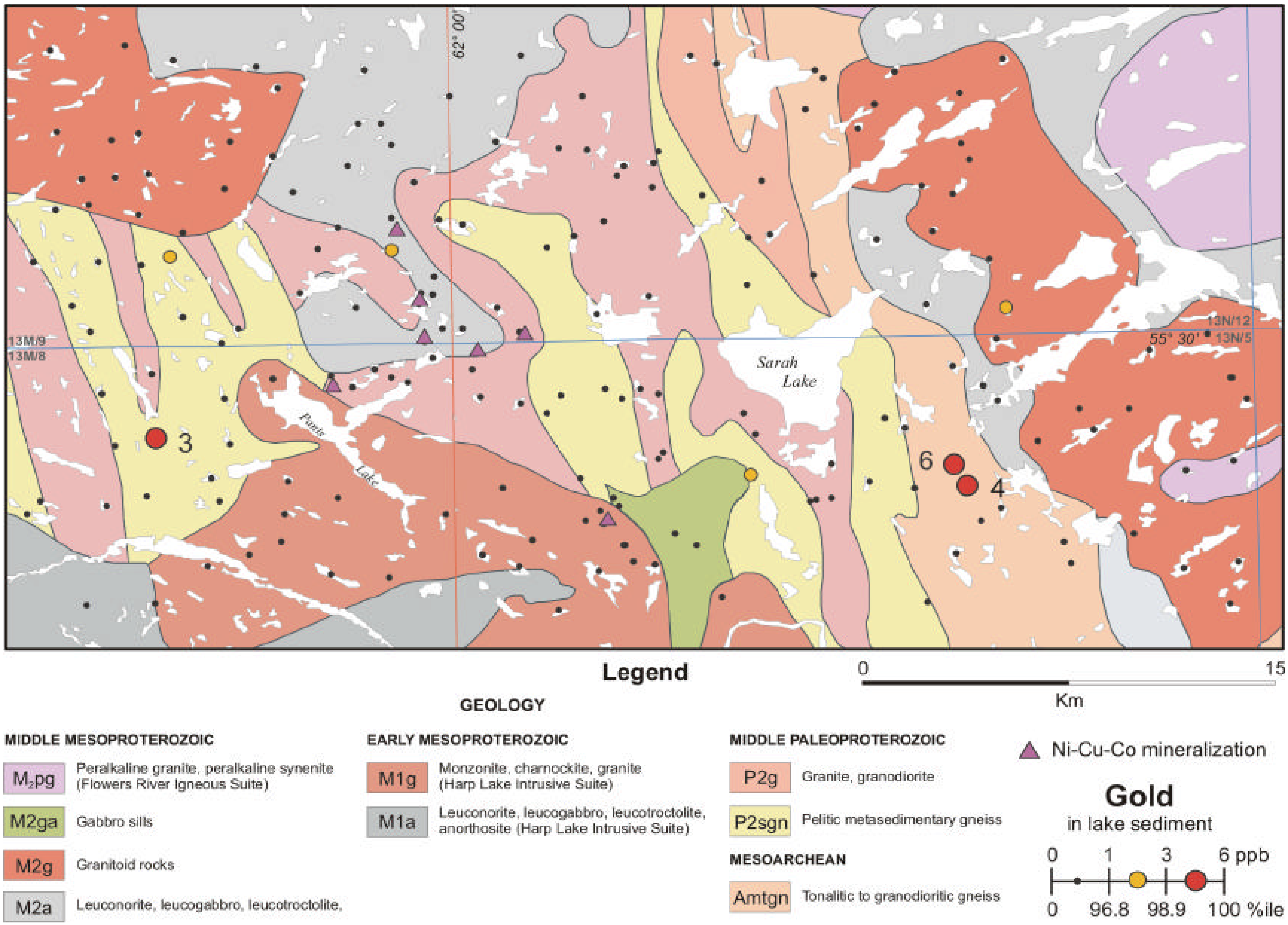

Figure 12. *Gold in lake sediment, Pants Lake intrusion area. (Unit descriptors in legend taken from Wardle* et al., *1997.)*

lakes with anomalous Ni and Cu in sediment are found. The single highest Cu value is from a lake near an outcrop with pyrite mineralization.

2. In the Seal Lake area, most lakes near known Cu mineralization have high values of Cu in water. As well, an area north of the main exploration region has high levels of Cu in water, and to a lesser extent, in sediment. The sample with the highest value of Cu in water is from a lake remote from known mineralization.

3. In the Harp Lake survey area, most known occurrences of Cu–Ni and Cu mineralization can be identified by high values of Cu in sediment in nearby lakes. In addition to the known occurrences, three lakes remote from known mineralization have anomalous Cu in sediment. Nickel in water also is effective in delineating known mineralized zones. As well, two areas without known mineralization are highlighted by anomalous Ni.

4. Background values of Ni in lake water are much higher in the PLI area than elsewhere. The Ni values in water effectively identify known Ni–Cu–Co mineralization in this intensively explored area. Of interest too, is an area in the northwest part of NTS map area 13N/12 that has several lakes containing high values of Ni in water. This latter area is underlain by granitoid rocks and has not been explored or mapped in detail. Another unexpected result in the PLI area is a cluster of two samples having anomalous Au and Sb in sediment, several kilometres to the east of the base-metal exploration area in a region underlain by Archean tonalitic to granodioritic gneiss.

ACKNOWLEDGMENTS

For excellent assistance in the field and providing good company on rainy days, the author thanks Jennifer Butt, Natalie Lippa and Steve Power. For very competent helicopter service and for volunteer service to the camp, the author thanks pilot, Glenn Smith.

REFERENCES

Brummer, J.J. and Mann, E.L.
1961: Geology of the Seal Lake area, Labrador. Geological Society of America Bulletin, Volume 72, pages 1361-1382.

Emslie, R.F.
1980: Geology and petrology of the Harp Lake Complex, Labrador: an example of Elsonian Magmatism. Geological Survey of Canada, Bulletin 293, 136 pages.

Finch, C.J.
1998: Inductively coupled plasma-emission spectrometry (ICP-ES) at the Geochemical Laboratory. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey, Report 98-1, pages 179-193.

Friske, P.W.B., McCurdy, M.W., Gross, H., Day, C.J., Lynch, J.J. and Durham, C.C.
1993a: Regional lake sediment and water geochemical data, central Labrador (NTS 13E). Geological Survey of Canada, Open File 2474, 140 pages and 1 map.

1993b: Regional lake sediment and water geochemical data, central Labrador (NTS 13K). Geological Survey of Canada, Open File 2645, 136 pages and 1 map.

1993c: Regional lake sediment and water geochemical data, central Labrador (NTS 13L). Geological Survey of Canada, Open File 2647, 131 pages and 1 map.

1993d: Regional lake sediment and water geochemical data, eastern Labrador (NTS 13N). Geological Survey of Canada, Open File 2648, 121 pages and 1 map.

1993e: Regional lake sediment and water geochemical data, west-central Labrador (NTS 13M). Geological Survey of Canada, Open File 2649, 131 pages and 1 map.

Geological Survey of Newfoundland and Labrador
1999: Mineral occurrence - mineral deposit data system (MODS). http://www.geosurv.gov.nf.ca/mindep/mods.html

Kerr, A.
1999: Mafic rocks of the Pants Lake intrusion and related Ni–Cu–Co mineralization in north-central Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey, Report 99-1, pages 215-253.

Kerr, A. and Smith, J.
This volume: Magmatic Ni–Cu sulphide mineralization in the Harp Lake Intrusive Suite, central Labrador.

Klassen, R.A. and Thompson, F.J.
1993: Glacial history, drift composition and mineral exploration, central Labrador. Geological Survey of Canada, Bulletin 435, 76 pages.

McClean, S.
1994: Report on prospecting and lithogeochemical surveys, Harp Lake properties, Labrador. Falconbridge Canada Ltd. Unpublished assessment report submitted to Newfoundland Department of Mines and Energy.

Olshevsky, K.
1996: Report on rock geochemistry sampling and petrographic study on licences 411M, 413M, 414M, 415M, 458M, and 459M, Harp Lake property, Labrador. Falconbridge Canada Ltd. Unpublished assessment report submitted to Newfoundland Department of Mines and Energy.

Osmond, R.
1992: Report on prospecting and lithogeochemical surveys, Harp Lake properties, Labrador. Falconbridge Canada Ltd. Unpublished assessment report submitted to Newfoundland Department of Mines and Energy.

Thompson, F.J. and Klassen, R.A.
1986: Ice flow directions and drift composition, central Labrador. *In* Current Research, Part A. Geological Survey of Canada, Paper 86-1A, pages 713-717.

Wagenbauer, H.A., Riley, C.A. and Dawe, G.
1983: Geochemical Laboratory. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 83-1, pages 133-137.

Wardle, R.J.
1993: Geology of the Naskaupi River Region, central Labrador (13NW), 1:500 000 scale. Newfoundland Department of Mines and Energy, Geological Survey Branch, Map 93-16.

Wardle, R.J., Gower, C.F., Ryan, A.B., Nunn, G.A.G., James, D.T. and Kerr, A.
1997: Geological map of Labrador, 1:1 000 000 scale. Newfoundland Department of Mines and Energy, Geological Survey, Map 97-07.

Wilton, D.H.C.
1996: Metallogeny of the Central Mineral Belt and adjacent Archean basement, Labrador. Geological Survey of Newfoundland and Labrador, Mineral Resource Report 8, 178 pages.