Natural Resources

Mines Branch

COMPLETE GEOCHEMICAL DATA FOR DETAILED-SCALE LABRADOR LAKE SURVEYS, 1978-2005

J.W. McConnell

Open File LAB/1465

St. John's, Newfoundland
April, 2009

NOTE

DISCLAIMER

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GEOLOGICAL SURVEY NEWFOUNDLAND AND LABRADOR 1864

St. John's, Newfoundland
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ABSTRACT

The report provides all analytical data, and selected field data, obtained from the twelve detailed-scale lake-sediment and lake-water surveys conducted in Labrador by the Newfoundland and Labrador Geological Survey during the period 1978 to 2005. About 6300 samples were collected at an average site density of one per 4-5 km^2. By comparison, regional lake data have a site density of approximately one per 15 km^2. These data are particularly suitable for displaying in a geographic information system or for performing statistical analyses.

Although most of these data have been released previously as individual reports by survey, there are also many new data provided, particularly for some of the early surveys.

INTRODUCTION

This report releases all geochemical lake-sediment and lake-water data collected from detailed-scale lake surveys conducted in Labrador by the Newfoundland and Labrador Geological Survey, during the period 1978 to 2005. Most of the data have been released previously in various open-file reports. However, as new analytical methods became available, some samples were re-analyzed for additional elements and some of these data have not been released previously.

LOCATION AND DESCRIPTION OF SURVEYS

The surveys encompass many areas of Labrador. Their locations are shown in Figure 1. Twelve lake-sediment and water surveys were conducted during the period 1978 to 2005. The survey date, numbers of sites sampled and principal target elements are summarized in Table 1. Previously unreleased data from additional analytical methods that are included in this report are also noted.

SAMPLE COLLECTION PROCEDURES

Sediment and water samples were obtained using a float-equipped 206-B Jet Ranger helicopter that touched down on the surface of lakes. Samples of lake water were collected before the sediment sampler was dropped to avoid water contamination. Samples were collected in purified Nalgene bottles. These were filled by immersing the bottles about 40 cm below the lake surface. Prior to sampling, the bottles were acid leached in the laboratory, and washed with distilled and de-ionized water.

Collection of sediment involved dropping a weighted, steel, tubular sampler fitted with a nylon rope for retrieval. A butterfly valve in the bottom of the tube opened upon impact with the sediment and closed upon retrieval, trapping the contained sediment. Samples were stored in water-resistant Kraft paper bags. Markings on the rope permitted determination of the sample depth. Other observations made during sampling included coordinates of the site, the nature of vegetation surrounding the lake, sediment colour, texture and composition and water colour.

Additionally, approximately one site in 20 was sampled in duplicate. These site duplicate samples were collected about 50 m apart. In general, smaller lakes were sampled in these surveys than was the case for the regional surveys, in which the objective had been to obtain a broader geochemical perspective. Normally, the centre of the lake (or if apparent from the air, the central basinal portion of the lake) was sampled. On some deep lakes (>20-25 m), no sample was retrieved in lake centres and a sample from a shallower site closer to shore was obtained. Sampling of a typical site took about one minute between touchdown and takeoff.

SAMPLE PREPARATION AND ANALYSES

PREPARATION

Lake sediments were partially air-dried in the field prior to shipping to the Departmental Laboratory for final oven-drying at 40°C. The samples were then disaggregated using a mortar and pestle before

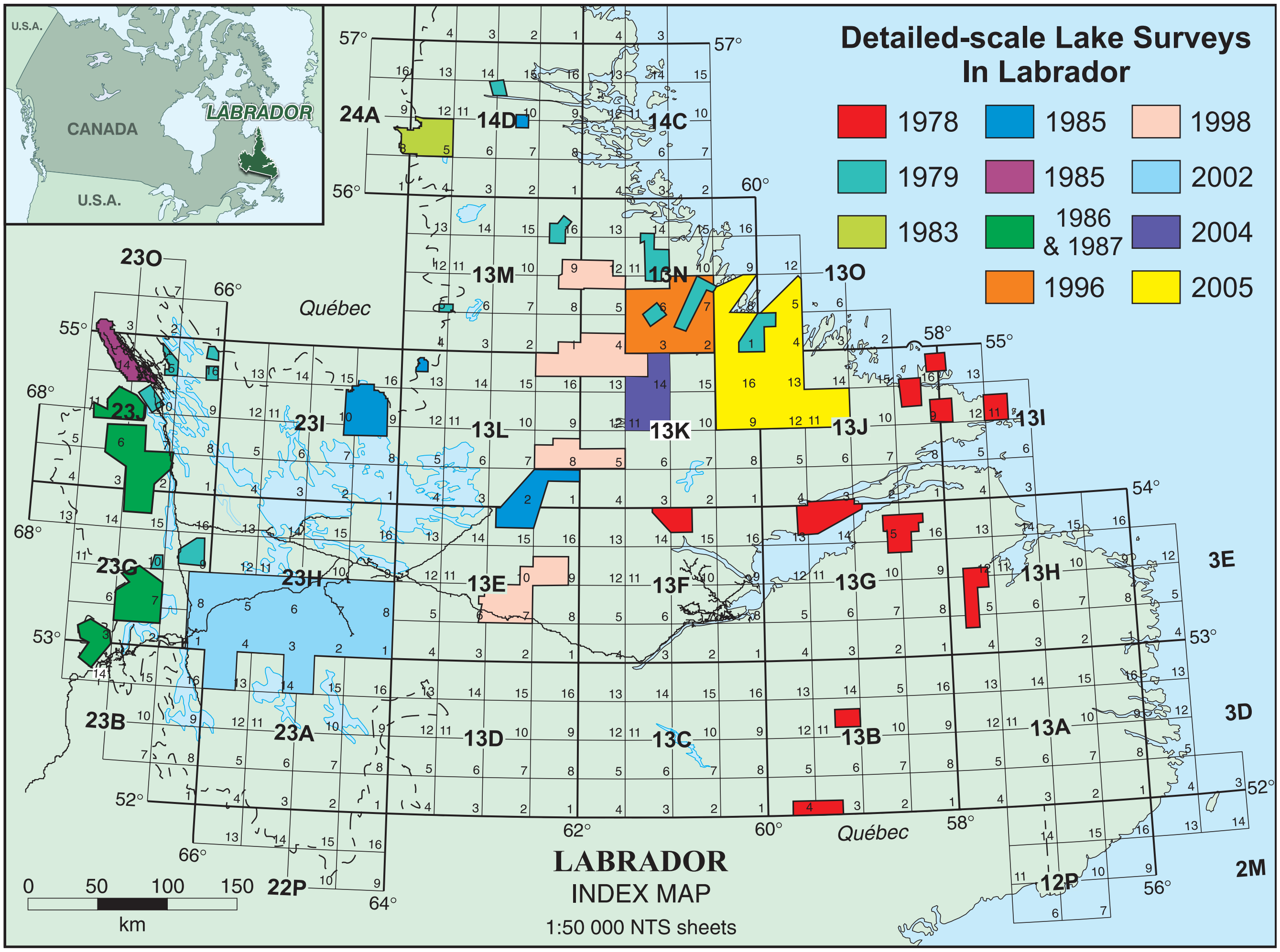

Figure 1. *Locations of survey areas.*

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 filtration apparatus.

ANALYSES

Lake sediment was analyzed using up to ten methods for a large suite of elements plus loss-on-ignition (Table 2). 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 most tables.

Lake water was analyzed by several methods for a large suite of elements; these vary by survey. The methods used for the water analyses are summarized in Table 3.

Table 1. Date, location and description of surveys

Survey Date	NTS Areas (all or part of)	Sites Sampled	Principal Target Elements	New Data
1978[1]	13B03, 13B04, 13B11,13F14, 13F15, 13G09, 13G10, 13G13, 13G14, 13G15, 13G16, 13H04, 13H05, 13H12, 13I11, 13I12, 13I13, 13J03, 13J09, 13J16	702	U	ICP-ES and INAA
1979[2]	13M04, 13M05, 13M06, 13M09, 13M16, 13N01, 13N02, 13N03, 13N06, 13N07, 13N11, 13N14, 13O04, 14D10, 14D11, 23G09, 23G10, 23G15, 23J02, 23J09, 23J10, 23J15, 23J16	777	U, Cu, Ni and Zn	ICP-ES and INAA
1983[3,4]	14D05 and 24A08	101	U and rare-earth and associated elements	none
1985[4]	13E15, 13L01, 13L02, 13L13, 14D05, 14D07, 14D10, 23I07, 23I08, 23I09, 23I10	404	U and rare-earth and associated elements	INAA
1985[5]	23O03, 23J10, 23J11, 23J14, 23J15	218	Au and associated elements	Fe, Mn and Zn in water
1986[6]	23G07, 23J02, 23J03, 23J06, 23J07, 23J10, 23J11	473	Au	ICP-ES
1987[6]	23B14, 23G02, 23G03, 23G07, 23G15, 23J02, 23J06, 23J11	592	Au	ICP-ES
1996[7]	13N02, 13N03, 13N06, 13N07	579	Au and base metals	none
1998[8]	13E06, 13E07, 13E09, 13E10, 13K05, 13K13, 13K14, 13L01, 13L08, 13L16, 13M01, 13M08, 13M09, 13N04, 13N05, 13N12	938	Ni, Cu, Co (Au, Pt and Pd)	none
2002[9]	23A13, 23A14, 23A15, 23G01, 23G08, 23H01, 23H02, 23H03, 23H04, 23H05, 23H06, 23H07, 23H08	506	Cu, Ni, Pt and Pd	none
2004[10]	13K11 and 13K14	259	U, Cu and Ni	none
2005[11]	13J11, 13J12, 13J13, 13K09, 13K16, 13N01, 13N04	775	U	none

References: [1]McConnell (1979); [2]McConnell (1980); [3]McConnell and Batterson (1987); [4]McConnell (1988); [5]Butler (1988); [6]Butler and McConnell (1989); [7]McConnell (1999); [8]McConnell (2000); [9]McConnell (2005); [10]McConnell et al. (2007); [11]McConnell and Ricketts (2008).

Table 2. Analytical methods for lake-sediment samples

Numeric Suffix	Elements	Method	Digestion/Preparation/ External Laboratory
1. eg. Au1	(Ag), As, Au, Ba, Br, Ca, Ce, Co, Cr, Cs, Eu, Fe, Hf, La, Lu, Mo, Na, Nd, (Ni), (Rb), Sb, Sc, Sm, (Sr), Ta, Tb, Th, U, W, Yb, (Zn), (Zr)	Instrumental Neutron Activation Analysis (INAA)	5 to 10 g in shrink-wrapped vial/Becquerel or Actlabs
2. eg. Fe2	Al, (As), Ba, Be, Ca, Cd, Ce, Co, Cr, Cu, Dy, Fe, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni*, P, Pb, Rb*, Sc, Sr*, Ti, V, Y, Zn*, Zr*	Inductively Coupled Plasma-Emission Spectrometry (ICP-ES)	HF-$HClO_4$-HCl (total digestion)
3. eg. Fe3	Ag, Ba, Be, Cd, Cu, Co, Cu, Fe, Li, Mn, Ni, Pb, Sr, Zn	Atomic Absorption Spectrophotometry (AAS)	HNO_3-HCl (aqua regia)
5. Mo5	Mo	Atomic Absorption Spectrophotometry (AAS)	$HNO_3/HCl/Al^{3+}$
6. Ag6	Ag	Atomic Absorption Spectrophotometry (AAS)	HNO_3
8. U8	U	Delayed Nuclear Activation	Neutron Activation Services
9. F9	F	Ion-selective electrode	
25. eg. Cr25	Cr and Zr	Inductively Coupled Plasma-Emission Spectrometry (ICP-ES)	$LiBO_2$ fusion
26. U26	U	Neutron Activation	Atomic Energy Canada Ltd.
27. eg. Pt27	Au, Pd and Pt	Fire Assay-ICP-Mass Spectrometry	Actlabs

Note: (Element) indicates a lesser quality analysis. Use alternate analysis indicated by *.

DATA QUALITY

To ensure the reliability of the analytical data, three means of determining data accuracy and precision were employed. During sample collection, pairs of sediment samples and pairs of water samples were obtained from lakes at the rate of approximately one per twenty sites. Analyses of these site duplicates give an appreciation of within-lake data variation. The duplicate samples were taken about 50 m apart.

Table 3. Analytical methods for lake-water samples

Numeric Suffix	Elements/Variables	Method	Preparation/External Laboratory
1. eg. Few1	Ca, Fe, K, Mg, Mn, Na, Si, SO_4	Inductively Coupled Plasma-Emission Spectrometry[1]	Filtration (0.45 µm) and HNO_3 acidification
2. eg. Cuw2	Al, Ba, Be, Co, Cr, Cu, Li, Mo, Ni, P, Pb, Sr, Ti, V, Y, Zn	Inductively Coupled Plasma-Emission Spectrometry-ultrasonic nebulizer[1]	Filtration (0.45 µm) and HNO_3 acidification
3. eg. Cuw3	Al, As, Ba, Be, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Fe, Gd, Ho, In, La, Li, Lu, Mn, Mo, Nd, Ni, Pb, Pr, Rb, Re, Se, Sm, Sr, Tb, Th, Ti, Tl, Tm, U, V, Y, Yb, Zn	Inductively Coupled Plasma-Emission Mass Spectrometry	Filtration (0.45 µm) and HNO_3 acidification
9. Fw9	F	Ion-selective electrode	
10. Uw10	U	Fluorometry	Bondar-Clegg
12. Znw12	Zn	Dithizone/colorimetric	
	conductivity	Corning conductivity sensor	
	pH	Corning combination pH electrode	
	heavy metals	Colorimetric	

[1] Finch, C.J. (1998)

At the analytical stage, a sample split, or laboratory duplicate, was inserted within every batch of 20 samples and a standard of known composition was similarly included. For sediment, international reference standards composed of lake-sediment material were used, notably LKSD-1, LKSD-2, LKSD-3 and LKSD-4. For water, standards used consisted of both naturally occurring water and synthetic standards created in the laboratory to predetermined compositions. The results of these standards were monitored to ensure analytical accuracy and precision.

DATA DESCRIPTION

The data are included as Excel files on the CD. A selection of field data and all analytical lake-sediment data are in file "OF_LAB_1465_field_and_lake_sediment_data.xls". Similar field data and all analytical water data are in file "OF_LAB_1465_field_and_lake_water_data.xls". The variables are described and data formats explained for the Excel files in Appendices 3 and 4.

ACKNOWLEDGMENTS

Over the many years these surveys were conducted, several dozen students from Memorial University provided field and office support. Jim Butler conducted two of the surveys, Jerry Ricketts assisted in two and conducted another and Shirley McCuaig provided the field leadership in another. Chris Finch provided or coordinated many of the analyses. Another veteran, Wayne Tuttle, provided invaluable logistical support throughout the period. Martin Batterson reviewed the manuscript and Dave Leonard drafted the figure. All are thanked for their contributions.

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APPENDIX 3

Descriptions and formats of field and analytical variables for Excel file "OF-"LAB1465_field_and_lake_sediment_data.xls" on enclosed CD-ROM

1. List of Variables

fldnum	labnum	samptype	sampyear	subnum	sitedup	utmzone	utmeast
utmnorth	nts	area_km2	depth_m	veg	colour	comp	Ag1
Ag3	Ag6	Al2	As1	As2	Au1	Au27	Ba1
Ba2	Ba3	Be2	Be3	Br1	Ca1	Ca2	Cd1
Cd2	Cd3	Ce1	Ce2	Co1	Co2	Co3	Cr1
Cr2	Cr25	Cs1	Cu2	Cu3	Dy2	Eu1	F9
Fe1	Fe2	Fe3	Ga2	Hf1	K2	La1	La2
Li2	Li3	LOI	Lu1	Mg2	Mn2	Mn3	Mo1
Mo2	Mo5	Na1	Na2	Nb2	Nd1	Ni1	Ni2
Ni3	P2	Pb2	Pb3	Pd27	pH_sed	Pt27	Rb1
Rb2	Sb1	Sc1	Sc2	Se1	Sm1	Sr1	Sr2
Sr3	Ta1	Tb1	Th1	Th2	Ti2	U1	U26
U8	V2	W1	Y2	Yb1	Zn1	Zn2	Zn3
Zr1	Zr2	Zr25					

2. Description of Field and Lake-Sediment Analytical Variables

FIELD VARIABLES

VARIABLE	DESCRIPTION
fldnum	Field number (fldnum is common to both water and sediment files and can be used to match /merge the two files)
labnum	Laboratory number (labnum is common to both water and sediment files and can be used to match /merge the two files)
samptype	Sample type
sampyear	Year of sampling
subnum	Last 4 digits of fldnum
sitedup	Site duplicate
utmzone	UTM zone number
utmeast	UTM easting (m)
utmnorth	UTM northing (m)
nts	1:50 000 scale NTS map
area_km2	Lake area (km2)
depth_m	Sample depth (m)
veg	Vegetation around lake
colour	Sediment colour
comp	Sediment composition

ANALYTICAL VARIABLES

VARIABLE	NAME	DESCRIPTION
Ag1	silver	ppm; INAA
Ag3	silver	ppm; Aqua Regia/AA
Ag6	silver	ppm; HNO_3; AA
Al2	aluminum	wt.%; $HC1O_4$-HF-HCl; ICP
As1	arsenic	ppm; INAA
As2	arsenic	ppm; $HC1O_4$-HF-HCl; ICP
Au1	gold	ppb; INAA
Au27	gold	ppb; FA-ICP-MS; Actlabs
Ba1	barium	ppm; INAA
Ba2	barium	ppm; $HC1O_4$-HF-HCl; ICP
Ba3	barium	ppm; Aqua Regia/AA
Be2	beryllium	ppm; $HC1O_4$-HF-HCl; ICP
Be3	beryllium	ppm; Aqua Regia/AA
Br1	bromine	ppm; INAA
Ca1	calcium	wt.%; INAA
Ca2	calcium	wt.%; $HC1O_4$-HF-HCl; ICP
Cd1	cadmium	ppm; INAA
Cd2	cadmium	ppm; $HC1O_4$-HF-HCl; ICP
Cd3	cadmium	ppm; Aqua Regia/AA
Ce1	cerium	ppm; INAA
Ce2	cerium	ppm; $HC1O_4$-HF-HCl; ICP
Co1	cobalt	ppm; INAA
Co2	cobalt	ppm; $HC1O_4$-HF-HCl; ICP
Co3	cobalt	ppm; Aqua Regia/AA
Cr1	chromium	ppm; INAA
Cr2	chromium	ppm; $HC1O_4$-HF-HCl; ICP
Cr25	chromium	ppm; $LiBO_2$ fusion; ICP-ES
Cs1	cesium	ppm; INAA
Cu2	copper	ppm; $HC1O_4$-HF-HCl; ICP
Cu3	copper	ppm; Aqua Regia/AA
Dy2	dysprosium	ppm; $HC1O_4$-HF-HCl; ICP
Eu1	europium	ppm; INAA
F9	fluoride	ppm; ion-selective electrode
Fe1	iron	wt.%; INAA
Fe2	iron	wt.%; $HC1O_4$-HF-HCl; ICP
Fe3	iron	wt.%; Aqua Regia/AA
Ga2	gallium	ppm; $HC1O_4$-HF-HCl; ICP
Hf1	hafnium	ppm; INAA
K2	potassium	wt.%; $HC1O_4$-HF-HCl; ICP
La1	lanthanum	ppm; INAA
La2	lanthanum	ppm; $HC1O_4$-HF-HCl; ICP

VARIABLE	NAME	DESCRIPTION
Li2	lithium	ppm; $HC1O_4$-HF-HCl; ICP
Li3	lithium	ppm; Aqua Regia/AA
LOI	loss-on-ignition	wt.%; loss-on-ignition
Lu1	lutetium	ppm; INAA
Mg2	magnesium	wt.%; $HC1O_4$-HF-HCl; ICP
Mn2	manganese	ppm; $HC1O_4$-HF-HCl; ICP
Mn3	manganese	ppm; Aqua Regia/AA
Mo1	molybdenum	ppm; INAA
Mo2	molybdenum	ppm; $HC1O_4$-HF-HCl; ICP
Mo5	molybdenum	ppm; HNO_3/HCl/A13+/AA
Na1	sodium	wt.%; INAA
Na2	sodium	wt.%; $HC1O_4$-HF-HCl; ICP
Nb2	niobium	ppm; $HC1O_4$-HF-HCl; ICP
Nd1	neodymium	ppm; INAA
Ni1	nickel	ppm; INAA
Ni2	nickel	ppm; $HC1O_4$-HF-HCl; ICP
Ni3	nickel	ppm; 4M HNO_3-1M HC1; AAS
P2	phosphorous	ppm; $HC1O_4$-HF-HCl; ICP
Pb2	lead	ppm; $HC1O_4$-HF-HCl; ICP
Pb3	lead	ppm; Aqua Regia/AA
Pd27	palladium	ppb; FA-ICP-MS; Actlabs
pH_sed	pH	pH of sediment by indicator paper
Pt27	platinum	ppb; FA-ICP-MS; Actlabs
Rb1	rubidium	ppm; INAA
Rb2	rubidium	ppm; $HC1O_4$-HF-HCl; AAS
Sb1	antimony	ppm; INAA
Sc1	scandium	ppm; INAA
Sc2	scandium	ppm; $HC1O_4$-HF-HCl; ICP
Se1	selenium	ppm; INAA
Sm1	sumarium	ppm; INAA
Sr1	strontium	ppm; wt.%; INAA
Sr2	strontium	ppm; HC1O4-HF-HCl; ICP
Sr3	strontium	ppm; Aqua Regia/AA
Ta1	tantalum	ppm; INAA
Tb1	terbium	ppm; INAA
Th1	thorium	ppm; INAA
Th2	thorium	ppm; $HC1O_4$-HF-HCl; ICP
Ti2	titanium	ppm; $HC1O_4$-HF-HCl; ICP
U1	uranium	ppm; INAA
U26	uranium	ppm; neutron activation; AECL
U8	uranium	ppm; NAS; nuclear activation
V2	vanadium	ppm; $HC1O_4$-HF-HCl; ICP
W1	tungsten	ppm; INAA

VARIABLE	NAME	DESCRIPTION
Y2	yttrium	ppm; $HC1O_4$-HF-HCl; ICP
Yb1	ytterbium	ppm; INAA
Zn1	zinc	ppm; INAA; Actlabs
Zn2	zinc	ppm; $HC1O_4$-HF-HCl; ICP
Zn3	zinc	ppm; Aqua Regia/AA
Zr1	zirconium	ppm; INAA
Zr2	zirconium	ppm; $HC1O_4$-HF-HCl; ICP
Zr25	zirconium	ppm; $LiBO_2$ fusion; ICP-ES

GUIDE TO MEANING OF NUMERIC FIELD VARIABLE VALUES

VARIABLE	NUMERIC VALUE	MEANING
samptype	2	lake sediment only
	5	lake sediment and water
	7	lake water
sitedup	0	routine single sample
	1	1st of site dup. pair
	2	2nd of site dup. pair
veg	1	forest
	2	bog
	3	mixed bog & forest
	4	barren (>25% rock)
	5	burned
	6	rock and forest
	7	tundra (<25% rock)
colour	1	tan-yellow
	2	brown
	3	brown, jelly-like
	4	chocolate-brown
	5	greenish brown
	6	green
	7	grey
	8	black
	10	orange
	13	grey-brown
	14	other
comp	1	clastic, fine grained
	2	clastic, coarse grained

VARIABLE	NUMERIC VALUE	MEANING
	3	organic ooze
	4	granular oganic
	5	organic, peaty

3. Data formats of field and analytical variables

84 variables and 6601 cases

Field Data Variables

VARIABLE	VARIABLE TYPE	COLUMN WIDTH	NO. DECIMALS
fldnum	Numeric	7	0
labnum	Numeric	7	0
samptype	Numeric	1	0
sampyear	Numeric	4	0
subnum	Numeric	4	0
sitedup	Numeric	1	0
utmzone	Numeric	2	0
utmeast	Numeric	6	0
utmnorth	Numeric	7	0
nts	String	5	
area_km2	Numeric	8	2
depth_m	Numeric	5	1
veg	Numeric	1	0
colour	Numeric	2	0
comp	Numeric	1	0

Analytical Variables

Ag1	Numeric	5	1
Ag3	Numeric	3	2
Ag6	Numeric	5	1
Al2	Numeric	5	2
As1	Numeric	5	1
As2	Numeric	3	0
Au1	Numeric	5	1
Au27	Numeric	5	1
Ba1	Numeric	5	0
Ba2	Numeric	5	0
Ba3	Numeric	5	0
Be2	Numeric	4	1
Be3	Numeric	4	2

VARIABLE	VARIABLE TYPE	COLUMN WIDTH	NO. DECIMALS
Br1	Numeric	5	1
Ca1	Numeric	4	1
Ca2	Numeric	5	2
Cd1	Numeric	5	1
Cd2	Numeric	4	1
Cd3	Numeric	4	1
Ce1	Numeric	5	0
Ce2	Numeric	4	0
Co1	Numeric	5	0
Co2	Numeric	4	0
Co3	Numeric	4	0
Cr1	Numeric	5	0
Cr2	Numeric	4	0
Cr25	Numeric	3	0
Cs1	Numeric	5	1
Cu2	Numeric	4	0
Cu3	Numeric	4	0
Dy2	Numeric	5	1
Eu1	Numeric	5	1
F9	Numeric	5	0
Fe1	Numeric	5	2
Fe2	Numeric	6	2
Fe3	Numeric	5	2
Ga2	Numeric	4	0
Hf1	Numeric	5	1
K2	Numeric	5	2
La1	Numeric	5	0
La2	Numeric	4	0
Li2	Numeric	5	1
Li3	Numeric	3	0
LOI	Numeric	4	1
Lu1	Numeric	6	2
Mg2	Numeric	5	2
Mn2	Numeric	6	0
Mn3	Numeric	6	0
Mo1	Numeric	5	1
Mo2	Numeric	5	1
Mo5	Numeric	4	0
Na1	Numeric	6	2
Na2	Numeric	5	2
Nb2	Numeric	3	0
Nd1	Numeric	3	0
Ni1	Numeric	5	0

VARIABLE	VARIABLE TYPE	COLUMN WIDTH	NO. DECIMALS
Ni2	Numeric	4	0
Ni3	Numeric	4	0
P2	Numeric	5	0
Pb2	Numeric	3	0
Pb3	Numeric	4	0
Pd27	Numeric	7	1
pH_sed	Numeric	3	1
Pt27	Numeric	7	1
Rb1	Numeric	5	0
Rb2	Numeric	3	0
Sb1	Numeric	6	2
Sc1	Numeric	5	1
Sc2	Numeric	5	1
Se1	Numeric	5	1
Sm1	Numeric	5	1
Sr1	Numeric	4	2
Sr2	Numeric	4	0
Sr3	Numeric	4	0
Ta1	Numeric	5	1
Tb1	Numeric	5	1
Th1	Numeric	5	1
Th2	Numeric	3	0
Ti2	Numeric	5	0
U1	Numeric	5	1
U26	Numeric	5	1
U8	Numeric	6	2
V2	Numeric	4	0
W1	Numeric	5	1
Y2	Numeric	3	0
Yb1	Numeric	5	1
Zn1	Numeric	4	0
Zn2	Numeric	4	0
Zn3	Numeric	5	0
Zr1	Numeric	5	0
Zr2	Numeric	4	0
Zr25	Numeric	5	0

APPENDIX 4

Descriptions and formats of field and analytical variables for Excel file “OF-”LAB1465_field_and_lake_water_data.xls” on enclosed CD-ROM

1. List of Variables

fldnum	labnum	samptype	sampyear	subnum	sitedup	utmzone	utmeast
utmnorth	nts	area_km2	depth_m	veg	conduct	pH_w	hvymtl_w
Alw2	Asw2	Asw3	Baw2	Baw3	Bew2	Bew3	Caw1
Cdw3	Cew3	Cow2	Cow3	Crw2	Crw3	Csw3	Cuw2
Cuw3	Dyw3	Erw3	Euw3	Fw9	Few1	Few3	Gdw3
How3	Inw3	Kw1	Law3	Liw2	Liw3	Luw3	Mgw1
Mnw1	Mnw3	Mow2	Mow3	Naw1	Ndw3	Niw2	Niw3
Pw2	Pbw2	Pbw3	Prw3	Rbw3	Rew3	Sew3	Siw1
Smw3	SO4w1	Srw2	Srw3	Tbw3	Thw3	Tiw2	Tiw3
Tlw3	Tmw3	Uw10	Uw3	Vw2	Vw3	Yw2	Yw3
Ybw3	Znw12	Znw2	Znw3				

2. Description of Field and Lake-Water Analytical Variables

FIELD VARIABLES

VARIABLE	DESCRIPTION
fldnum	Field sample number (fldnum is common to both water and sediment files and can be used to match /merge the two files)
labnum	Laboratory sample number (labnum is common to both water and sediment files and can be used to match /merge the two files)
samptype	Sample type
sampyear	Year of sampling
subnum	Last 4 digits of fldnum
sitedup	Site duplicate
utmzone	UTM zone number
utmeast	UTM easting (m)
utmnorth	UTM northing (m)
nts	1:50 000-scale NTS map
area_km2	Lake area (km2)
depth_m	Sample depth (m)
veg	Vegetation around lake

ANALYTICAL VARIABLES

VARIABLE	NAME	DESCRIPTION
conduct	conductivity	water conductivity (µS); Corning meter
pH_w	pH of water	pH of water; Corning meter
hvymtl_w	heavy metals	ppb; colorimetric
Alw2	aluminum	ppb; ICP-USN
Asw2	arsenic	ppb:ICP-USN-H_2O_2
Asw3	arsenic	ppb; ICP-MS direct
Baw2	barium	ppb; ICP-USN
Baw3	barium	ppb; ICP-MS direct
Bew2	beryllium	ppb; ICP-USN
Bew3	beryllium	ppb; ICP-MS direct
Caw1	calcium	ppm; ICP-ES
Cdw3	cadmium	ppb; ICP-MS direct
Cew3	cerium	ppb; ICP-MS direct
Cow2	cobalt	ppb; ICP-USN
Cow3	cobalt	ppb; ICP-MS direct
Crw2	chromium	ppb; ICP-USN
Crw3	chromium	ppb; ICP-MS direct
Csw3	cesium	ppb; ICP-MS direct
Cuw2	copper	ppb; ICP-USN
Cuw3	copper	ppb; ICP-MS direct
Dyw3	dysprosium	ppb; ICP-MS direct
Erw3	euridyium	ppb; ICP-MS direct
Euw3	europium	ppb; ICP-MS direct
Fw9	fluoride	ppb; ion-selective electrode
Few1	iron	ppb; ICP-ES
Few3	iron	ppb; ICP-MS direct
Gdw3	gadolinium	ppb; ICP-MS direct
How3	holmium	ppb; ICP-MS direct
Inw3	indium	ppb; ICP-MS direct
Kw1	potassium	ppm; ICP-ES
Law3	lanthanum	ppb; ICP-MS direct
Liw2	lithium	ppb; ICP-USN
Liw3	lithium	ppb; ICP-MS direct
Luw3	lutetium	ppb; ICP-MS direct
Mgw1	magnesium	ppm; ICP-ES
Mnw1	manganes	ppb; ICP-ES
Mnw3	manganes	ppb; ICP-MS direct
Mow2	molybdenum	ppb; ICP-USN
Mow3	molybdenum	ppb; ICP-MS direct
Naw1	sodium	ppm; ICP-ES
Ndw3	neodymium	ppb; ICP-MS direct

VARIABLE	NAME	DESCRIPTION
Niw2	nickel	ppb; ICP-USN
Niw3	nickel	ppb; ICP-MS direct
Pw2	phosphorous	ppb; ICP-USN
Pbw2	lead	ppb; ICP-USN
Pbw3	lead	ppb; ICP-MS direct
Prw3	praseodymium	ppb; ICP-MS direct
Rbw3	rubidium	ppb; ICP-MS direct
Rew3	rhenium	ppb; ICP-MS direct
Sew3	selenium	ppb; ICP-MS direct
Siw1	silicon	ppm; ICP-ES
Smw3	samarium	ppb; ICP-MS direct
SO4w1	sulphate	ppm; ICP-ES
Srw2	strontium	ppb; ICP-USN
Srw3	strontium	ppb; ICP-MS direct
Tbw3	terbium	ppb; ICP-MS direct
Thw3	thorium	ppb; ICP-MS direct
Tiw2	titanium	ppb; ICP-USN
Tiw3	titanium	ppb; ICP-MS direct
Tlw3	thallium	ppb; ICP-MS direct
Tmw3	thulium	ppb; ICP-MS direct
Uw10	uranium	ppb; fluorometry; Bondar-Clegg
Uw3	uranium	ppb; ICP-MS direct
Vw2	vanadium	ppb; ICP-USN
Vw3	vanadium	ppb; ICP-MS direct
Yw2	yttrium	ppb; ICP-USN
Yw3	yttrium	ppb; ICP-MS direct
Ybw3	ytterbium	ppb; ICP-MS direct
Znw12	zinc	ppb; dithizone/colorimetric
Znw2	zinc	ppb; ICP-USN
Znw3	zinc	ppb; ICP-MS direct

GUIDE TO MEANING OF NUMERIC FIELD VARIABLE VALUES

VARIABLE	NUMERIC VALUE	MEANING
samptype	2	lake sediment only
	5	lake sediment and water
	7	lake water only
sitedup	0	routine single sample
	1	1st of site dup. pair
	2	2nd of site dup. pair

VARIABLE	NUMERIC VALUE	MEANING
veg	1	forest
	2	bog
	3	mixed bog & forest
	4	barren (>25% rock)
	5	burned
	6	rock and forest
	7	tundra (<25% rock)

3. Data formats of field and analytical variables

84 variables and 6601 cases

Field Data Variables

VARIABLE	VARIABLE TYPE	COLUMN WIDTH	NO. DECIMALS
fldnum	Number	7	0
labnum	Number	7	0
samptype	Number	1	0
sampyear	Number	4	0
subnum	Number	4	0
sitedup	Number	1	0
utmzone	Number	2	0
utmeast	Number	6	0
utmnorth	Number	7	0
nts	String	5	
area_km2	Number	8	2
depth_m	Number	5	1
veg	Number	1	0
colour	Number	2	0
comp	Number	1	0
conduct	Number	6	2

Analytical Variables

pH_w	Number	3	1
hvymtl_w	Number	3	0
Alw2	Number	4	0
Asw2	Number	3	0
Asw3	Number	5	3
Baw2	Number	4	1
Baw3	Number	4	1
Bew2	Number	5	2

VARIABLE	VARIABLE TYPE	COLUMN WIDTH	NO. DECIMALS
Bew3	Number	5	3
Caw1	Number	6	2
Cdw3	Number	5	3
Cew3	Number	5	3
Cow2	Number	5	1
Cow3	Number	4	2
Crw2	Number	5	1
Crw3	Number	4	2
Csw3	Number	5	3
Cuw2	Number	4	1
Cuw3	Number	4	2
Dyw3	Number	5	3
Erw3	Number	5	3
Euw3	Number	5	3
Fw9	Number	4	0
Few1	Number	6	0
Few3	Number	6	2
Gdw3	Number	5	3
How3	Number	5	3
Inw3	Number	5	3
Kw1	Number	4	2
Law3	Number	5	3
Liw2	Number	5	1
Liw3	Number	5	3
Luw3	Number	5	3
Mgw1	Number	6	2
Mnw1	Number	4	1
Mnw3	Number	4	2
Mow2	Number	5	1
Mow3	Number	4	2
Naw1	Number	6	2
Ndw3	Number	5	3
Niw2	Number	4	0
Niw3	Number	5	2
Pw2	Number	4	0
Pbw2	Number	4	1
Pbw3	Number	5	3
Prw3	Number	5	3
Rbw3	Number	5	3
Rew3	Number	5	3
Sew3	Number	5	3
Siw1	Number	5	2
Smw3	Number	5	3

VARIABLE	VARIABLE TYPE	COLUMN WIDTH	NO. DECIMALS
SO4w1	Number	5	2
Srw2	Number	5	1
Srw3	Number	4	1
Tbw3	Number	5	3
Thw3	Number	5	3
Tiw2	Number	5	1
Tiw3	Number	5	3
Tlw3	Number	5	3
Tmw3	Number	5	3
Uw10	Number	4	2
Uw3	Number	5	3
Vw2	Number	3	1
Vw3	Number	4	2
Yw2	Number	5	1
Yw3	Number	5	3
Ybw3	Number	5	3
Znw12	Number	3	0
Znw2	Number	6	1
Znw3	Number	5	2