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ONTARIO GEOLOGICAL SURVEY

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Multidisciplinary Followup of pH Observations in Lakes North and East of Lake Superior District of Algoma

by

J.A.C. Fortescue, M. Dickman, and J. Terasmae

1984

Ontario Geological Survey

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E.G. Pye, Director
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FOREWORD

Effects of acid precipitation on the environment are studied by scientists of many disciplines. This report is concerned with relationships between the geological substrate of lake catchment areas and the geochemistry of waters and lake sediments. The overall objective of this study is to provide a multidisciplinary research base which can be used for the development of regional geochemical survey methods which include an environmental as well as a mineral exploration component. Survey methods of this type are required to produce the geochemical map of Ontario.

Traditional geochemical surveys at the regional scale were aimed at producing maps for use by scientists engaged in mineral exploration. One of the parameters measured in such surveys carried out to the north and east of Lake Superior between 1977-80 was the pH of lake waters. The research described in this report developed from a close study and interpretation of this map in relation to the general problem of acid rain. This interpretation led to a multi-disciplinary followup study involving 20 specially selected lakes which was described in the first report in this series (OGS OFR No. 5342).

This report describes activities of the followup team in the second and third years of the research program. In 1981 the focus of the project was on the study of 20 lakes located in 5 sets, each set being underlain by a different geological substrate in the catchment area. The aim being to establish if the top lake in each set was likely to be more susceptable to the effects of acid rain than those further down in the lake series. The 1981 field program

was organized in a similar way to that carried out during the previous year with planning centered on a generalized conceptual model and uniform sets of geochemical, limnological and palynological data and information being collected from each lake. The 1982 field program was on a smaller scale with ten lakes studied. The theme of this research was verification and standardization of methods used to study lake waters and sediments in order to establish a technique for regional geochemical surveying which would include both a mineral exploration and an environmental (i.e. acid rain study) component.

All concerned have been surprized at the effectiveness of the three years of multidisciplinary followup study which have resulted from this research. The field projects generated a workshop atmosphere which led to close cooperation between team members in the field work which laid the foundations for close cooperation during the laboratory and writeup stages of the project. As a result, the research led to a new technique of geochemical survey mapping and, as a bonus, a method for the measurement of the paleo-pH of lakes which is of considerable importance to acid rain studies when they are considered in relation to the geological substrate.

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* All chapters were read by all three members of the team. Resulting comments were incorporated by writers of individual sections who are identified by their initials. General sections were the result of team efforts with general editing by J.F.

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ABSTRACT

In 1980, the Ontario Geological Survey mounted a followup project to investigate in detail relationships between data obtained from regional geochemical surveys and environmental problems related to acid rain in the Wawa area northeast of Lake Superior. This involved a multidisciplinary team including two geochemists, a limnologist and a palynologist who worked very closely together as a team. Information and data collected during this project is included in Fortescue et. al. (1981) which is an Open File Report (No. 5342) which is in two parts and totals 500 pages.

In 1981 and 1982, a similar team led by J. Fortescue and including Professors M. Dickman and J. Terasmae from Brock University continued the multidisciplinary research project. In 1981, the team studied each of five series of four lakes including the top lake in a catchment area and three downstream. The prime objective was to determine the series giving some acid, some neutral and some alkaline catchment areas. In 1982, the project was aimed at standardization and verification of geochemical, limnological and palynological data gathering techniques and associated interpretative methods. This report is in two parts. Part I describes details of the interdisciplinary research during the two projects and Part II includes data and information on lakes studied and related information. The objective of the report is to provide research workers and students information concerning lakes in the Wawa area suitable as a starting point for more detailed research and to provide information for those planning future regional geochemical surveys.

The following conclusions were drawn from the 2 year study: -

(1) Lakes located in the same catchment area have very similar pH regardless of the general pH of the catchment area due to underlying geological conditions.

(2) The multielement geochemical signature for lake sediments in cores taken from each lake series is similar from lake to lake and unique for a particular lakes series catchment area.

(3) When suitably calibrated the diatom inferred pH approach to the study of the pH history of lakes in post-*Ambrosia* time is important in the study of effects of acid precipitation on lakes. Further research is required before this type of study can be applied on a regional scale.

(4) A preliminary study of relationships between the palynological and geochemical patterns in deep lake sediment cores (i.e. including material laid down during the period since the ice departed from the area) suggests relationships between changes in plant cover types and changes in the level of elements in the lake sediment. If true, this finding could be combined with diatom inferred pH studies and provide information on pH changes in lakes during times of climatic change.

(5) The research has resulted in the development of a rapid multi-element technique of chemical analysis suitable for regional geochemical mapping in areas where lakes have either acid or alkaline pH of their waters.

(6) The study suggests that non humic lakes with low alkalinity (10 mg/l as $CaCO_3$) are most likely to turn acid due to acid rain.

(7) Lakes which are turning acid were found in limestone terrain owing to a cacoon effect whereby the organic matter associated with the lake insulates the lake from the limestone-rich substrate.

(8) The signatures in the inferred pH method (using diatoms) due to acid rain are unlike the signatures due to smelter operations, forest fires or logging. Subtle changes in the diatom flora of lakes due to each of these four causes occur in lakes with both low and high acidity.

(9) Diatom inferred pH studies, when properly calibrated, can be used to estimate the pH history of a lake when no pH data on lake waters is available.

(10) Palynological measurements on lake sediment cores can establish the Ambrosia rise level in most, but not all, lakes in the Wawa area.

(11) A combination of Ambrosia rise information in lake sediment cores, a simple interpretation of catchment area geology from air photographs combined with a brief helicopter flyby along a lake margin cannot be used to predict the susceptability of a catchment area to acid rain. More complex studies are required.

(12) No clearcut relationship was discovered between the diatom inferred pH history of a lake and the vertical element abundance patterns for elements in the same sediment during post-Ambrosia time.

MULTIDISCIPLINARY FOLLOWUP OF pH OBSERVATIONS IN LAKES NORTH AND EAST OF LAKE SUPERIOR

DISTRICT OF ALGOMA

PARTS I AND II

by

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MULTIDISCIPLINARY FOLLOWUP OF LAKE pH OBSERVATIONS IN LAKE NORTH AND EAST OF LAKE SUPERIOR, DISTRICT OF ALGOMA

PART I

1.0 INTRODUCTION AND APPROACH

General Introduction

The problem of acid precipitation in Ontario was succinctly described as follows: -

> "Some of Ontario's most beautiful lakes - those set among rocky outcrops in insoluble bedrock - are most vulnerable to acidification. In a drainage basin, head-water lakes are the most susceptible because their incoming waters have least exposure to buffering action by soils and sediments. They can become acidic within a few years. Lakes in the middle of a susceptible watershed may last a decade and lakes lying on sizeable deposits of glacial sediments can have sufficient buffering capacities to hold out a long time, if not indefinitely." (Anonymous 1979, p.5)

Studies by Likens (1976) and Shaw (1979) have demonstrated that acid precipitation, created by the long range transport of air pollutants, is falling along the east shore of Lake Superior. Our problem was to design and complete a project which would bridge a gap between the information obtained from regional geochemical surveys on the one hand and the detailed investigation of the acid precipitation problem by limnologists, chemists and their co-workers on the other. Data from a series of regional geochemical maps of the north shore of Lake Superior (O.G.S. Open File Maps P.1805 to

P.1818 (1978), P.1819 to P.1832 (1978), and maps 80016 to 80031 (1979) including maps 80000 to 80015 (1979) provided a general background to the acid precipitation problem - together with the investigation by Coker and Shilts (1979).

The 1980 investigation in this series (O.G.S. OFR No. 5342) was aimed at the relationships between limnology, palynology and geochemistry in a series of 20 lakes located within a 20km x 100km strip of country near Wawa, Ontario. The lakes were selected on the basis of the regional geochemical mapping program data. Together the 20 lakes formed a "gradient" in pH from pH 4.5 to pH 8.0. Our study was planned to produce exactly the same set of observations from each lake studied in order that detailed comparisons could be made from lake to lake in the series. Similarly, comparisons could also be made with the geochemical data collected during the regional surveys completed several years previously. Before the 1981 followup study is described it is of interest to review findings from the 1980 study upon which the 1981 study is based.

Findings from the 1980 Followup Study (O.G.S./OFR No. 5342)

1) Verification of the Regional Geochemical Data

It was found that the pH pattern for 19 of the 20 lakes studied was the same in 1980 as in 1978. The pH values in each lake were different in the two years owing to within season and season to season effects. The exception, Lake D (pH 5.9 in 1978, pH 5.5 in 1980) is in the pH range where acid precipitation may be expected to affect lakewater pH relatively easily. This pH verification study is an important link between regional surveys and followup investigation.

2) pH and Alkalinity of Lake Waters and Geological Substrate

It was found that a general relationship exists between the pH of lake waters and the geological substrate of lake basins. For example, alkalinity was low in granitic areas and exceptionally high in areas of carbonate rich glacial deposits. More important, a decrease in pH and alkalinity of lake waters observed along the 20 lake gradient was as predicted from limnological theory-accompanied by an increase in SO_4. Small lakes at high elevations tended to have the lowest pH within a given area. Softwater lakes with low pH were either clear or brown due to humic substances.

3) Limnological, Palynological and Geochemical Information from Lake Sediment Cores

Comparisons of the diatom flora found in lake bottom sediments in the 20 lakes studied in 1980 indicated that the remains of these organisms relate to lakewater pH. This suggested that a paleo-pH indicator method might be evolved using detailed studies of diatom test populations in lake sediment cores. If proven, a "paleo-pH indicator" of this type could be used to establish pH gradients in lakes, both before and after the advent of modern man in North America.

Lake sediment core palynology provided a marker for the time man's activities began to affect the area north of Lake Superior. This was based on the *Ambrosia* pollen rise [Webb and McAndrews (1976)]. The geochemical abundance of elements in pre-*Ambrosia* segments of the lake sediment cores was found to be relatively stable within each lake. Each lake was found to have a unique "geochemical signature" based on the abundance of several elements considered as a group. Experiments with using the KK (Clarke of Concentration) as a measure of geochemical abundance in lake sediment cores were successful. An advantage of this approach is that it facilitates realistic comparison between patterns for several elements in a lake sediment core (or cores).

Objectives of the 1981 Multidisciplinary Followup Investigation

1) Verification of Regional Geochemical Survey Data
   a) To discover if there is an advantage in making studies of small lakes at high elevations when regional geochemical studies are planned for environmental purposes.

2) pH and Alkalinity of Lake Waters and Geological Substrate
   a) To discover if there is an advantage in making studies of small lakes at high elevations in order to identify lakes which are likely to become acid in the near future.

3) <u>Study of Lake Sediment Cores</u>

a) To discover if there is an advantage in making studies of small lakes at high elevations for testing a diatom based "Paleo-pH index" to estimate lake pH changes in pre and post-*Ambrosia* time with special reference to effects of forest fires and logging.

b) To use long sediment cores to establish vegetation cover type evolution in lake sediment cores in pre-*Ambrosia* time extending to several thousand years before the present.

c) To use lake sediment core geochemistry to study affects of changes in climate (as evidenced by the pollen record) on the mobility of chemical elements from drainage basin to lake sediment. This study also involves long cores.

d) To use short cores (50 cm; pre-*Ambrosia*) to study changes in the abundance of elements with time in the same lake and with increasing drainage basin area in a series of connected lakes which form a "staircase".

Figure 1:1 is a conceptual model for the selection of sites required for the 1981 multidisciplinary followup investigation.

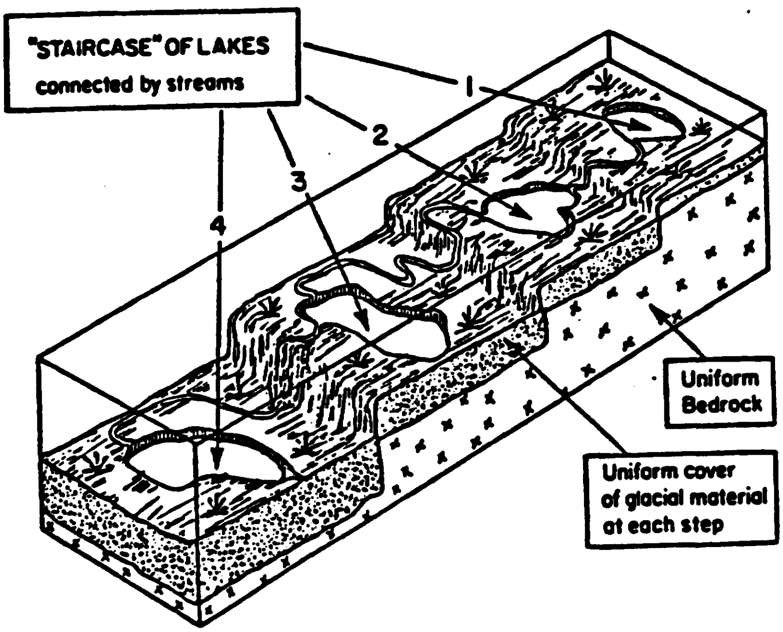

Figure 1:1 Conceptual model of a hypothetical lake staircase suitable for study of the importance of small lakes at high elevations in relation to acid precipitation studies.

The principal consideration in the choice of lake systems for study was the pH of the headwater lake. An ideal series of sites would involve headwater lakes with pH of 4.0, pH 5.0, pH 6.0, pH 7.0 and pH 8.0. The second constraint was the size and bathymetric parameters of the lake basins chosen for inclusion in the study. The keynote here is uniformity designed to provide comparable sets of geochemical, limnological and palynological information. Another constraint was that the lake staircases would be selected in areas of prior regional geochemical surveys so that the information collected in the 1981 and 1980 followup investigations would be available for study in relation to the regional geochemical surveys.

A departure from the 1980 approach to lake sediment core collection was the incorporation of "long cores" in the 1981 sampling program. In the ideal case lake sediment cores from lake bottom to mineral matter associated with the formation of the lake (as a result of ice melting and associated phenomena) were required from the top lake in each lake staircase (Lake 1, Figure 1:1).

In general the limnological investigations of surface waters, lake waters and biota and the biota of lake sediment cores was planned to be identical with that in the 1980 sampling program except for a few refinements - for example, the inclusion of more elements in the chemical analysis of lake surface waters.

Palynology of the short cores was planned to be identical with that for the 1980 followup study. In the case of the long cores pollen study would include the whole core, although below 50cm the intervals between pollen samples would be greater than 2.5cm.

The geochemical observations on the short cores (i.e. 50 cm) were planned to be identical with those in the 1980 study except that silicon would be included with the major elements and strontium, thorium and cobalt were dropped from the trace element list for technical reasons based on the 1980 experience.

The degree of uniformity of the principal landscape parameters considered when a staircase of lakes is selected for study are included in Figure 1:2. This list was used as a guide during the selection process and may also be used during appraisal of the staircase data included in Part II of this report.

Parameter	Lakes in Staircase			
	(1)	(2)	(3)	(4)
Lakewater pH	Increases			
Lakewater Alkalinity	Increases			
Lake Area	Similar			
Lake Depth	Similar			
Plant Cover Types Around Shoreline	Uniform			
Relief Around Shore-line	Decreases			
Surficial Cover	Increases in area and depth			
Bedrock	Uniform lithnology and geochemistry in area including all four lake basins			
Pollution	Effects of airborne pollution relatively uniform for all four lakes			

Figure 1:2 Listing of the variation in the principle paraments in a hypothetical lake staircase suitable for inclusion in the 1981 Followup Level study in the Wawa area.

Objectives of the 1982 Multidisciplinary Followup Investigation

The general theme of the 1982 project was verification and standardization of the multidisciplinary approach which evolved during the past two years in relation to the broader problem of geochemical surveying. Future geochemical surveys (based on lake waters and lake sediments) should be designed to serve the purposes of both mineral exploration and environmental study. Our experience during 1980 and 1981 indicated that a phased approach the regional geochemical surveys was desirable for environmental purposes. In 1982 this aspect of the work was explored further.

Specific Objectives of the 1982 Project

1) To standardize a method of sampling lake sediment cores suitable for use in geochemical, diatom and pollen studies, and to verify the method on a suite of selected lake sediment cores.

2) To verify lake water and lake sediment core geochemical, diatom and palynological data collected from cores of lakes studied previously in the 1980 or 1981 projects.

3) To verify geochemical data obtained from duplicate cores collected from two specially selected, adjacent lakes.

4) To study lake sediment geochemistry, diatoms and palynology in cores from special environments in the Wawa area, one in a natural setting in a lake in Michipocoten Island and the other in a lake tailings pond from a long established mine operation where the pH of the lake water was known to be less than pH 4.0.

5) To examine a number of small lakes with pH of less than 5.5 in the Wawa area.

6) To carry out a preliminary surficial geological study within selected lake basins.

   No general conceptual model was required for this activity because each of the specific objectives required an independent small scale study contributing to the whole.

ACKNOWLEDGEMENTS

The followup study was funded wholly by the Ontario Ministry of Natural Resources as part of the co-ordinated program of studies into acid precipitation and related effects in Ontario. The regional geochemical survey upon which this followup study was based, was produced as part of the joint federally funded Federal/ Provincial uranium reconnaissance program.

The scientific team responsible for this investigation program are indebted to a large number of individuals for their advice, consulation and material support during the life of the project. The following persons are identified as having given particular assistance to the study.

In Wawa, S. Kerr and H. Thomas, fish and wildlife specialists at the district office of the Ministry of Natural Resources, provided active support in many ways. In particular, their advice on the choice of certain lakes for study, their loan of scientific instruments and the loan of cold storage facilities for the water and lake sediment samples was most appreciated by the team.

Analytical work on the lake surface water samples was completed under the director of Dr. C. Chan of the Geoscience laboratory of the Ontario Geological Survey. Dr. Chan was able to provide very rapid processing of the samples under the most rigorous of quality control conditions.

Support in the form of typing, drafting, data compilation and computer processing was provided by the staff of the Geophysics/ Geochemistry Section. In particular, Mrs. F.M. Chu was responsible

to the team for detailed preparation of Parts I and II of this report.

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Summary of Methods

The same general approach to the collection of interdisciplinary integrated limnological, palynological, geological and geochemical data from lakes used in the 1980 study [Fortescue et. al. (1981) Pt. I] was used in 1981 and 1982. The observations taken in 1981 were as follows for the 20 lakes in the five staircases studied.

Limnology (M.D.)

At each lake two sets of information on water were collected. One involved the surface water of the lake and was largely chemical. The other involved the entire vertical water column. The surface water was studied for pH, alkalinity, calcium and sulphate (as in the 1980 study) as well as for a number of other chemical elements. It was expected that the pH would increase as one descended down a staircase and that this would be accompanied by a corresponding increase in alkalinity. The water column investigation in each lake included the measurement of colour, transparency (i.e. Secchi depth), temperature, dissolved oxygen and specific conductivity at one metre intervals from the top to the bottom of the lake. Because of the encouraging results from diatom/pH studies completed in 1980 [Fortescue et. al. (1981) Pt. I, p. 81] special attention to this aspect of the study was afforded in the 1981 study. In particular, lake sediment cores were sectioned at 1 cm intervals in the field for the first 20 cm in order to obtain a more detailed record of changes in the diatoms during post-*Ambrosia* and immediately pre-*Ambrosia* time.

During planning the 1982 study a simple method of subsampling lake sediment cores in the field was considered which would supply material for limnological (diatom), palynological *Ambrosia* rise determination and geochemical study from the same core. Eventually this involved collection of samples at 0.5 cm intervals for the first 5 cm of a core in order to provide a detailed diatom geochemical history of the lake in post-*Ambrosia* time; sampling at 1 cm intervals from 5 cm - 20 cm to provide material for diatom geochemistry study and palynology (i.e. determination of the location of the *Ambrosia* rise) and sampling at 5 cm intervals from 20 cm - 50 cm to obtain samples for mineral exploration purposes from pre-*Ambrosia* time material.

More Detailed Limnological Investigations

Higher Aquatic Plants - Higher aquatic plants of acid lakes the world over share certain common characteristics. In these lakes, the macrophytes are generally species poor and their growth rates are suboptimal (Nilssen 1980). Such acid lakes are frequently characterized by the absence of water lilies (*Nuphar* spp.), pond weeds (*Potamogeton* spp.) and water milfoils (*Myriophyllum* spp.). Mosses (especially *Drepanocladus*, *Fontinalis* & *Sphagnum*), as well as higher plants, (*Lobelia*, *Juncus* and filamentous green algae such as *Mougeotai* spp.), increase in relative abundance as lakes acidify (Grahn et. al. 1974, Nilssen 1980).

Fish - The alternation of a lake's fish population due to lake acidification affects the species composition of the lake's zooplankton and benthos which in turn will affect the lake's phytoplankton. Thus, lake acidification affects the entire food chain. One of the most striking changes which accompanies lake acidification is the shift in fish composition and abundance (Nilssen 1980). The rapid disappearance of salmonids from acidifying lakes has been well documented (Beamish and Harvey 1972, Beamish 1974). Aluminum ions may accumulate on the gill lamellae of fish in acidified lakes until toxic levels are reached (Drescoll et. al. 1980). Ultimately, the lake is left with a few percids and minnows and even these are not invulnerable to acidification (Almer 1972).

Although it was not planned to take fish inventories during this study, some lakes in the region had been previously investigated by the Ontario Ministry of Natural Resources fish and wildlife personnel. Wherever possible, this information is included in our report. As lakes acidify, vertebrate predators disappear (i.e. fish and amphibians) and invertebrate predators such as Chaoborus play a larger and larger role in the lake's predator-prey interactions. This may account for the reduced abundance of Cyclopoid copepods in acid lakes (Nilssen 1980).

Bearing in mind these considerations, it was planned to examine the zooplankton faunas in the lakes chosen for study to discover if they could be used as reliable indicators of acid precipitation effects.

Zooplankton - Typically, acid lakes can be characterized by their lack of Daphnia. Daphnia is intolerant of low pH (Strom 1926).

Pelagic cyclopoids are also rare in acid lakes (Roff and Keviatowaki 1977). Conversely, Nilssen (1974) has shown that a number of littoral and semi-littoral zone species become more and more prominent as a lake acidifies. Some examples are Bosmina longispina, Diaphanosoma brachyurum, Scapholeberis muronata, Heterocope saliens and Chydorus sphaericus. The trend was also observed in Canada north of Lake Huron by Sprules (1975), who noted that the small planktonic copepod, Diaptomus minutus, increased in relative abundance as pH fell. Simultaneously, total zooplankton density and diversity declined with continued acidification. The latter pattern was also observed by Carter (1971) and Salazkin (1971).

Phytoplankton - In our study, a survey of the phytoplankton from depth integrating samplers taken in each of the twenty lakes on a single date in June was planned in order to determine whether any pH dependent pattern in species composition was a function of lake pH. Only the dominant species from each of the algal divisions were included in these analyses.

As a result of the experience in 1980 and 1981, the 1982 limnological program was focused on the diatom paleo-pH indicator. Consequently, during the 1982 project only physiochemical measure ments were made on the water column and no detailed studies of the lakewater biota, were included.

Geology and Geography of the Lake Basins (J.F.)

A followup level study of the type described here is focused largely on the waters and sediments of lakes. Time does not allow for detailed bedrock geological and surficial geological observations to be made at each lake, however desirable such information might be. Nevertheless, it is important to include general information on the geology and geography of the lakes studied.

In both the 1981 and 1982 studies the following parameters were considered of interest: -

a) NTS coordinates of the sampling point in each lake.
b) The elevation of the lake surface above sea level.
c) Lake depth at sampling point.
d) Lake area.
e) Lake catchment area estimates from contours on 1:50,000 scale maps.
f) General bedrock lithology and structure.
g) General information of surficial deposits.
h) Distance from the margin of Lake Superior in the prevailing wind direction (southwest) as a possible indicator of acid precipitation - if lake is within 10 km of Lake Superior.

Several writers (e.g. Shilts and Farrell 1982) have stressed the importance of knowing the carbonate content of glacial materials which occur in drainage basins and in buried valleys which underlie lakes in the Canadian Shield, in order to estimate the potential buffering power of particular lakes. We believe that such studies should be prefaced by a knowledge of the surficial materials within a basin and beneath lake waters. Consequently, during the 1982 field project an attempt was made to discover if air photo interpretation combined with a brief fly-by of a lake shore and surrounding basin, was a feasible approach to the selection of lake basins for more detailed study along these lines later.

Palynology (J.T.)

The problem of acid precipitation as it affects lakes north of Lake Superior has two aspects of the present state of a lake (as studied by the limnological investigation) and the past conditions of the lake, as studied by palynology and other disciplines. The palynology study of the staircase lake sets was planned at three levels: -

a) The description of the *Ambrosia* pollen rise to be used as an indicator of sedimentation rate in the last 100 years.
b) The description of the 50 cm long lake sediment cores to provide a detailed palynological record of the vegetation in the vicinity of the lakes.
c) The description of cores over 50 cm long to provide a record of vegetation and its changes over the period of time since the lake was formed some 9,000 years ago. (The plan was to collect "one long core from lake (2)" (see Figure 1:1) in each series.)

Experience in 1980 and 1981 indicated that at the present state of our knowledge of relationships between the pollen record and descriptive geochemistry of lake sediment cores (to a depth of 50 cm), it is not possible to link palynological information to geochemical information in relation to the pH history of a lake. Consequently, for the 1982 project the palynology input was reduced to include the determination of the *Ambrosia* peak in the 5 cm - 20 cm core depth only.

Descriptive Geochemistry of the Lake Sediment Cores (J.F.)

The 1981 study plan called for a similar study of lake sediment core geochemistry to that made in the 1980 study, except that each lake would have observations made at 1 cm intervals from 0 to 20 cm. Unfortunately, for technical reasons beyond the control of the team, such a plan could not be fully implemented. Instead, a threefold approach was adopted involving: 1) the determination of elements in the 0 - 20 cm portion of the top cores of each staircase and in selected cores from two other staircases; 2) the determination of elements and L.O.I. in 2.5 cm segments of all 20 cores from the staircase lakes at depths from 20 cm to 50 cm (or the bottom of the core); and 3) the determination of elements and L.O.I. in the long cores. If successful, the long core study should indicate the changes in lake sediment geochemistry associated with the whole sequence of post-glacial time (i.e. 9,000 yrs ±).

The following parameters were selected for study in the 1981 lake sediment core segments: -

a) Wet weight of 1.0 cm and 2.5 cm segments of core.

b) Dry weight of 2.5 cm segments of core.

c) Loss on ignition (L.O.I.).

d) Element abundance in the dried core material.

   i) Major elements (Si, Al, Ca, Mg, K, Na, Fe, Mn, P, Ti, Zr).

   ii) Minor elements (Cu, Cr, Ni, U, V).

   iii) Elements of interest in relation to acid precipitation (As, Pb, Zn and Hg).

As in the 1980 followup study, the KK (i.e. Clarke of Concentration) unit (Table 1:1) has been used in order to compare the behaviour of chemical element abundance levels in sediment cores. The Clarke of an element (K), is its abundance in the Earth's Crust as estimated by geochemists. The Clarke of Concentration (KK) is the estimate for the abundance of element X in a core segment divided by its Clarke. The advantage of this approach is that it always relates the level of an element to its Clarke, thus facilitating computations of multielement data in relation to general descriptive geochemistry (Fortescue 1981, Fortescue et. al. 1982b).

Because of the very small samples in the 0 - 20 cm (1 cm interval) samples, it was only possible to determine Al, C, Mg, K, Na, Fe, Mn, P, Ti, Zr, Cu, Cr, Ni, Pb, V and Zn (simultaneously by ICP) in these samples.

The 1982 project was similar to that in 1980 and 1981, except that a new method of core subsampling better fitted to the multidisciplinary study of effects of acid rain on lake sediments was introduced.

Element	0.01k(ppm)	0.1K(ppm)	K(ppm)
Si	2,730	27,300	273,000
Al	836	8,360	83,600
Fe	633	6,220	62,200
Mn	10.6	106	1,060
K	184	1,840	18,400
Na	227	2,270	22,700
Mg	276.4	2,764	27,640
Ca	466	4,660	46,600
P	11.2	112	1,120
Ti	63.2	632	6,320
Zr	1.62	16.2	162
As	.018	.18	1.8
Cr	1.22	12.2	122
Cu	.68	6.8	68
Hg	.86	8.6ppb	86ppb
Ni	.99	9.9	99
Pb	.13	1.3	13
U	.023	.23	2.3
V	1.36	13.6	136
Zn	.76	7.6	76

Table 1:1 Clark Values for Elements included in the Followup Project from Ronov and Yaroskevskiy (1972).

SUMMARY

The 1981 followup investigation was planned to include systematic and integrated study of five lake staircases (of four lakes each) selected to include studies in areas of low, medium and high pH.

As in the 1980 project, a uniform set of limnological, palynological and geochemical data obtained in the field was to be combined with general geological and geographical information in order to provide information pertinent to the problem of acid precipitation in the area north and east of Lake Superior.

The actual observations planned for the 1981 followup project are listed on Table 2:1 (Chapter 2.0).

The 1982 followup investigation was aimed at verification and standardization of methods to be used in future regional geochemical surveys designed to provide data for mineral exploration and environmental purposes.

2.0 Choice of Field Areas and Methods

Introduction

The conceptual model (Figure 1:1) was used as a guide for the choice of the five field areas included in the 1981 field program. Another consideration was the geological substrate of the staircase of lakes, because the 1980 study has demonstrated the importance of this factor in determining the pH and alkalinity of lakes in the Wawa area. The methods used for the 1981 study were generally similar to those described for the 1980 study [Fortescue et. al. (1981)].

The verification and standardization studies included in the 1982 field project, involved a more flexible approach to the selection of lakes for study. For example, some lakes were chosen for verification purposes on the basis of data obtained in 1980, or 1981, while others were included for within lake and lake to lake verification studies. Also in 1982, the general procedures in limnology were simplified and the process of lake sediment coring was standardized to include the collection of limnological (diatom study), palynological (*Ambrosia* rise) and geochemical samples from the same core.

This chapter describes the reasons for the choice of particular field areas for the 1981 and 1982 field projects, as well as the methods used for the examination of the lakes, lake waters and lake sediment cores which were used in the projects.

Choice of Field Areas 1981 Study

The location of the five lake staircases included in the 1981 study are indicated on Figure 2:1. The plan was to study two lake staircases in areas where the pH of lake waters was known to be relatively low; one lake staircase where the lake waters were neutral (i.e. pH±7.0); and another where the lake waters were alkaline due to a limestone substrate. A fifth lake staircase was located in the fume kill area of the Wawa smelter in order to examine the current, and historical, features of this man modified environment. The original plan called for long cores to be collected from one lake in each of the five staircases and to examine the relationships between the climatic change since glaciation (as evidenced by the pollen record) and the geochemical record (as evidenced by the descriptive geochemistry of the lake sediment). Unfortunately, it was not possible to collect a long core from the Wawa fume kill lakes or from the acid lake staircases due to access problems associated with the transport of bulky coring equipment by helicopter. Otherwise, long cores were obtained from the alkaline lake and the neutral lake. Doc Greg lake (Figure 2:1, which according to S. Kerr, was the lake with the lowest pH which was highway accessable), was sampled to obtain a long core from an accesible lake with relatively low pH.

The geological substrate, pH and alkalinity of waters of lakes in the five staircases studied in 1981 are summarized on Table 2:1. In general, it was found that the lakes did not systematically increase in pH from the top downwards as might be expected. Instead, each lake staircase tended to have similar pH and alkali-

GEOLOGICAL SUBSTRATE	LAKE	pH	ALKALINITY mg/$CaCO_3$
U	1	6.52	8.75
(greenstone)	2	6.90	32.50
	3	6.96	16.60
	4	6.94	13.95
W	1	6.70	13.25
(greenstone in	2	6.91	13.50
smelter plume)	3	6.92	15.50
	4	7.34	18.25
X	1	5.02	1.20
(gneiss)	2	4.82	0.70
	3	4.95	1.15
	4	5.18	1.15
Y	1	8.07	84.50
(calcareous drift)	2	7.90	113.50
	3	7.62	63.50
	4	7.97	108.50
Z	1	5.17	1.25
(gneiss)	2	5.59	1.90
	3	5.28	1.30
	4	5.64	2.00

Table 2:1 Summary of the geological features, pH and alkalinity lake water data for the staircase lakes studied in 1981 (from Thomson 1981).

nity and all four lakes taken together appeared more typical of the environment which they were chosen to represent individually. This observation focused attention on the need to examine the pH/alkalinity relationships of lakes prior to their selection for detailed study as components of systems.

Choice of Field Areas 1982 Study

Prior to the commencement of the 1982 field project, air photographs for a series of 20 lakes were studied. Some of these lakes were selected on the basis of the regional pH maps. The

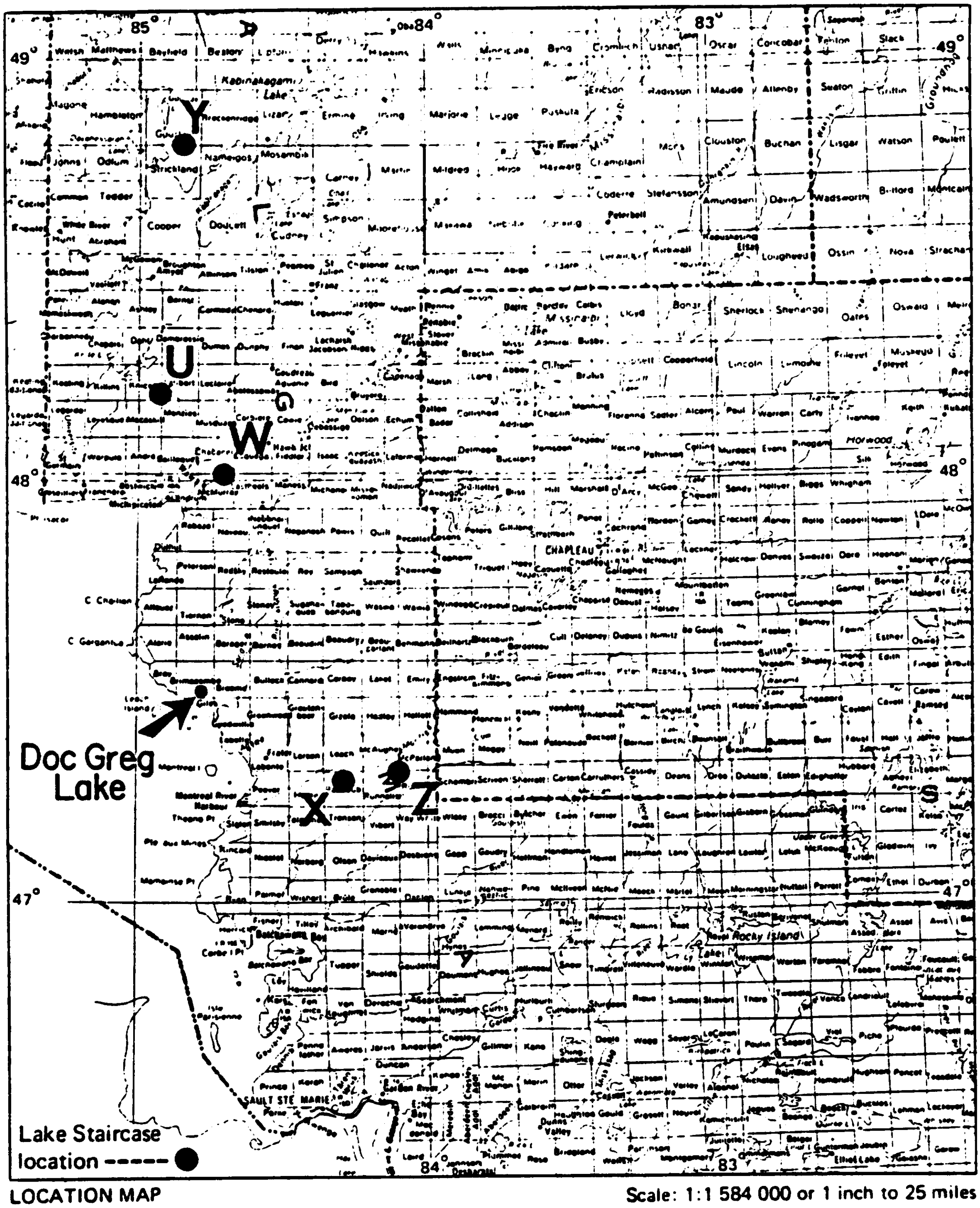

Figure 2:1 Location of the lake staircase systems and Doc Greg Lake included in the 1981 study (from Thomson 1981).

remainder were selected on the basis of data from an unpublished report by S. Kerr (1982), which described pH and alkalinity of a number of lakes in the vicinity of Wawa. Unfortunately, several of these lakes have multiple basins and consequently were considered unsuitable for verification and standardization purposes.

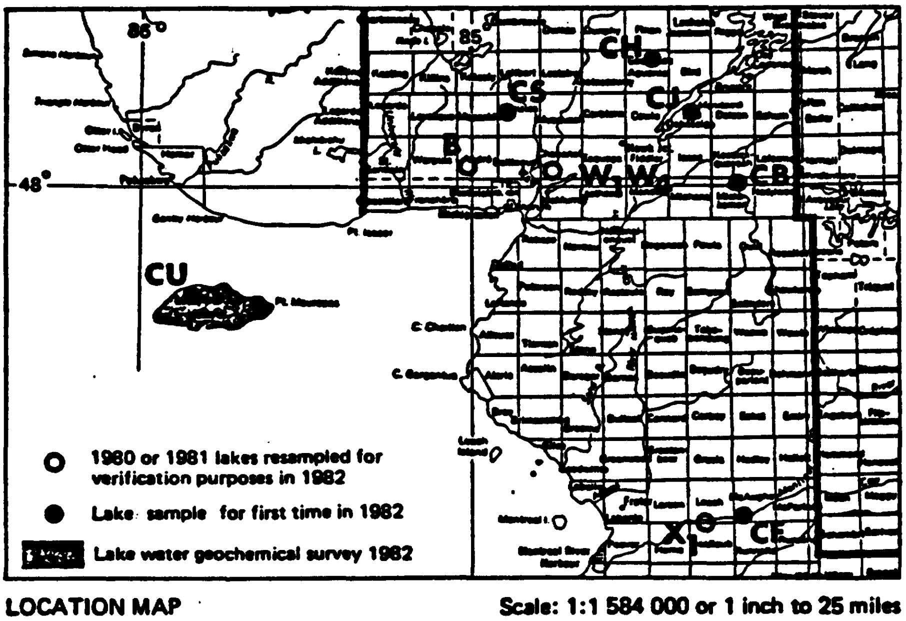

Figure 2:2 Location of the lakes studied during 1982 (from Fortescue et. al. 1982a).

The lakes studied in 1982 are listed on Figure 2:2. Lake B (1980) and lakes X_1, W_1 and W_4 (1981) were resampled in 1982 for purposes of verification. These studies involved diatom studies, Ambrosia pollen and descriptive geochemistry. All cores sampled during 1982 were subsampled in the field using the multidisiplinary approach designed to obtain samples for limnology, palynology and descriptive geochemistry simultaneously.

Other lakes were selected for the following reasons: Lake CF is located near the 1981 X and Y staircases and has a low pH. Lakes CS and CJ were also small lakes with a relatively low pH. A replication study involving two cores from each of two adjacent lakes was carried out at Lake CB. Two other lakes were chosen for comparative purposes. Lake CH was a tailings pond with a pH (from

Lake	pH		Alkalinity MEQ/L		SO_4 ppm		Ca ppm	
	1980/1	1982	1980/1	1982	1980/1	1982	1980/1	1982
Lake B(1980)	5.02	5.19	.032	.050	9.0	*	1.5	1.8
Lake X_1(1981)	5.02	5.57	.024	.043	-	10	1.4	2.2
Lake W_1(1981)	6.70	6.88	.265	.332	57	38	21.0	21.6
Lake W_4(1981	7.34	7.69	.305	.469	53	42	21.4	24.2
Lake CF(1982)	-	5.42	-	.041	-	8	-	1.6
Lake CS(1982)	-	6.63	-	.115	-	11	-	4.4
Lake CJ(1982)	-	6.44	-	.122	-	11	-	3.6
Lake CB_1(1982)	-	4.92	-	.050	-	6	-	.4
Lake CB_2(1982)	-	5.05	-	.026	-	-	-	.6
Lake CH(1982 Tailings Pond	-	3.25	-	- **	-	207	-	23.8
Lake CU Michipocoten Island	-	6.08	-	.043	-	-	-	2.0

*Detection limit 5 ppm
**Not detected owing to low pH

Table 2:2 Lake water data from lakes studied in 1982 (from Fortescue et. al. 1982a).

the regional survey) of 3.1 -- the lowest recorded in the whole regional geochemical survey. Lake CU was located for comparative purposes on Michipocoten Island where a lake water survey was completed. (This will be described in a later report in this series.)

Choice and Description of Methods

General The integrated limnological, palynological and geochemical methods which were chosen for inclusion in the 1980 study (Fortescue et. al. 1981) where used with little modification for the 1981 study. In 1982 several changes were made in order to make the methodology more standardized and suitable for routine operations in geochemical surveys of the future. In this section, methods used during both years are described discipline by discipline.

LIMNOLOGY (M.D.)

General Introductory Statement

Over the past decades numerous lakes near Wawa, Ontario have acidified (Kerr 1980, 1981 and 1982). This has been accompanied by a catastrophic decrease in the diversity and abundance of game fish in these lakes (Kerr 1981, 1982). A causal relationship is generally assumed to exist between the increase in acidity of a lake and the decrease in its biotic diversity. The acidification rate of lakes is most pronounced in granite and gneiss bedrock basins where carbonates are rare. In other areas where carbonates occur in

the bedrock (as in the vicinity of the smelter plume at Wawa) and in
the bedrock (as in the vicinity of the smelter plume at Wawa) and in
the areas where the surficial material is calcareous, the acidification process is often of minimal importance.

The five staircases of lakes selected for study during the 1981 project were designed to offer a variety of pH, alkalinity and biotic conditions. In order to maintain a uniform data set for limnology during 1980 and 1981 field investigations, the same methods were used throughout with some minor additions and small changes.

In 1982, the methods were simplified and standardized to some extent. In particular the study of the microbiota of the lakes was less intensive and the collection of samples from lake sediment cores was standardized to obtain more detailed information regarding the diatom record in post-*Ambrosia* time. These changes are described fully below.

Description of limnological methods

Field Surveys (1981 & 1982) A standardized technique for lake water temperature, specific conductivity, and dissolved oxygen was applied from a helicopter which was positioned at the centre of the main basin of each lake sampled. Depth profiles were taken at 1 m intervals. Temperature measurements were made using a Brock University high sensivity thermister. A model 33 YSI specific conductivity meter and a model 51A YSI dissolved oxygen meter were used for conductivity and dissolved oxygen profiles. These data were plotted for each lake as a function of lake depth (Part II, Section 1, Page 4 and 5).

Lake Water Sampling (1981 & 1982) Phytoplankton was sampled by extracting water samples using a depth integrating water sampler (Figure 2:3). The depth integrating sampler was designed at Brock University to fill at a constant rate regardless of its depth in the water column. A standard glass bottle (2.5 liter capacity) was used as the sample receptacle. The remainder of the sampler consisted of harness for the bottom and a weight (Figure 2:3). The water enters the bottle via 6.5 mm I.D. silicone, tubing which passes through a silicone rubber stopper and connects to a hollow stainless steel tube which releases the water just above the bottom of the receptacle.

As the water enters, the air in the acid bottle escapes via the outflow tube fitted with a one way polythene check value which prevents water from entering via the outflow. This valve is secured to the stainless steel frame at a point 25 cm above the inflow port. This provides a constant hydrostatic head between inflow and outflow, making the filling rate independent of the absolute pressure (depth).

The sample from the integrated sampler was transferred partly to each of three containers for later processing. One litre was transferred to a plastic bottle for Utermohl sedimentation; 1 litre was transferred to a plastic container for storage at 4°C and shipment to the Ontario Ministry of Natural Resources water testing laboratory in Toronto; and a part of the remaining 0.3 litre was transferred to a 250 ml glass B.O.D. bottle for field analysis of pH and alkalinity. The remainder was discarded.

In Toronto, the water samples were analysed using standard methods for TIP alkalinity and pH, Ca, SO_4, and several other elements using M.O.E. recommended techniques. TIP alkalinity titrations were also carried out in Wawa during 1982 to permit verification of the Toronto lab results. This is reported in the section dealing with water quality verification (Chapter 3.0).

<u>Secchi Transparency and Lake Turbidity</u> An elaborate review of Secchi disc transparency and the factors affecting light attenuation and scattering in lakes is provided by Hutchinson (1957 p.399-410). In general, the Secchi disc visibility is more highly correlated with the number of particles suspended in the water than with the size of the particles. For this reason, no attempt was made to correlate total algal biomass with Secchi transparency. Although a turbidometer was available to us, its size and time consuming calibration procedures made its use in the helicopter impractical. Thus, in clear water lakes, Secchi transparency values are intended as a crude correlate with lake turbidity. Water colour was estimated using the Secchi disk at 1 metre in 1981. Brown water lakes were also tested for Secchi transparency. In 1982, the Forel Uhle colour test (APHA 1979) was carried out and subsequently, APHA Colour and Secchi transparency were correlated for brown water lakes.

<u>Phytoplankton</u> After Lugol's IKI solution (Lind 1974) had been added to the one litre sample removed from the depth integrating sampler, the phytoplankton was permitted to settle. After 2 days the top 750 ml of phytoplankton-free supernatent was siphoned off with a "U" shaped siphon and the remaining concentrate was transferred to a 250 ml glass B.O.D. bottle. After 24 hours the top 200 ml was siphoned off from the B.O.D. bottle and the remaining concentrate was transferred to a labelled vial.

Enumeration was carried out using a Leitz-inverted plankton microscope equipped with Nomarski and phase contrast optics. Five

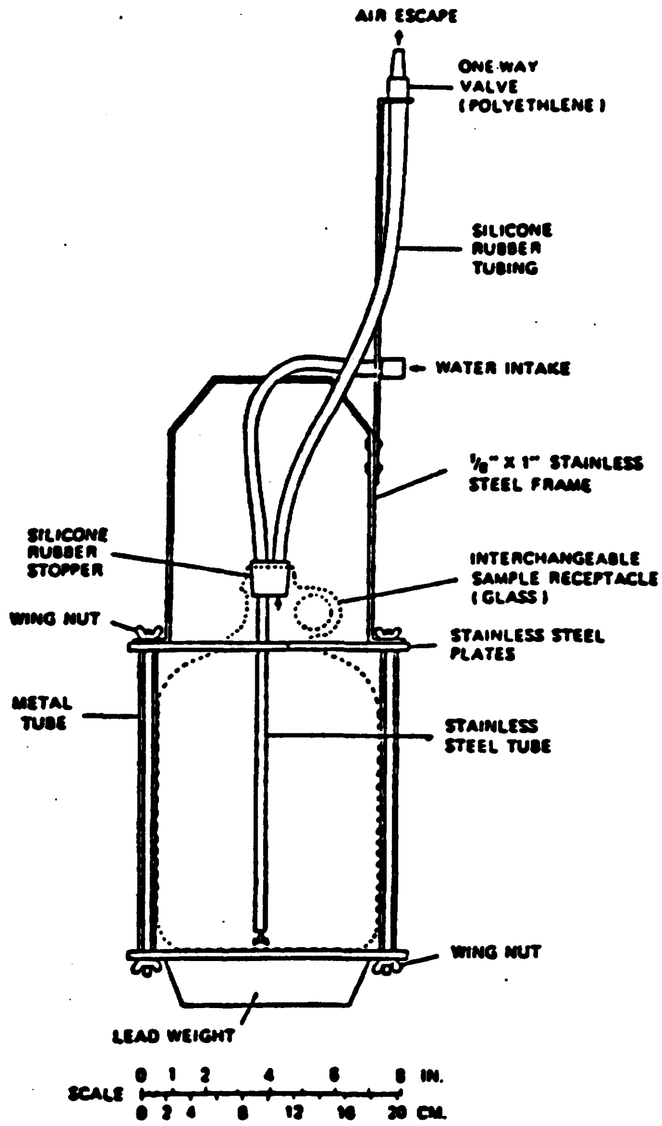

Figure 2:3 Depth integrating water sampler.

ml of the concentrate was placed in an Utermohl styled sedimentation tube and after 24 hours the bottom of the entire chamber was scanned at low power in search of large (rare) species. A minimum count of 500 cells was carried out on each of two replicates. If estimates for a species deviated substantially between these two replicate counts, a third replicate was made.

Algae were classified by their relative abundance according to the method of Andrews (1972). This was done by categorizing the algae as dominant where the species was always numerous within the field of view at 400X magnification (coded as No. 5); abundant where the species was numerous in most fields (coded as No. 4); frequent where at least one specimen was found in every two to five fields of view (coded as No. 3); moderate where several specimens were found on the "slide" (coded as No. 2); and rare where only one or two specimens were found on the "slide" (coded as No. 1). A detailed estimate of the absolute algal density was felt to be unwarranted at this stage of the study. The reasons for this are laid out by Andrews (1972) and Lohmann (1972).

The following references were used in the algal identification: Bradbury and Winter (1976), Cleve-Euler (1951-55), Duthie and Screenivasa (1972), Duthie and Mannadi Rani (1967), Foged (1964), Hustedt (1930), Patrick and Reimer (1966 and 1972), Prescott (1962) and Yan (1979).

Sediment Diatom Analyses In general, the surface sediments of lakes contain a time integrated sample of the seasonal succession of certain thick walled algae including diatoms which have settle there (Kovio and Ritchie 1978). Thus, surface sediment analysis appears to provide a more representative sample of the total seasonal diatom succession than samples from a series of plankton tows taken throughout the year (Berge, 1980).

Sediment diatoms were estimated by determining their abundance in the top centimetre of each K-B core as described below.

1. Core Sampling:

During the July 1981 field session, 21 short sediment cores were collected from 21 experimental staircase lakes. Sediment cores were collected from the deepest sites on most lakes using a K-B gravity corer (Brinkhurst et. al. 1969). The corer was equipped with a plexiglass coring tube (internal diameter 4.5 cm). The coring device was carefully lowered into the soft lake sediment to avoid disturbing the core stratigraphy. These sediment cores were extruded by using a hydraulic extrusion system and sections were made at 1 cm intervals. The extrusion system used in this study was found to be very useful for fine sectioning with a negligible amount of vertical contamination in sediment samples. After sectioning, samples were placed in prelabelled polythene whirl packs. In 1982, the top 5 cm were sectioned at 0.5 cm intervals.

2. Sediment Digestion and Diatom Preparation:

An acid digestion technique was used for cleaning the diatoms. Small amounts of lake sediments (0.3 to 0.5 g) were placed into 100 ml beakers and 25 ml of concentrated sulfuric acid was added to each beaker. The beakers were heated to boiling under a fume hood for about 30 minutes. During the digestion, samples were stirred using a spatula to avoid the accumulation of sediment on the bottom of the beakers. When the digestion of organic matter was visibly completed, the beakers were removed from the heating element and a small amount (0.3 - 0.5 gm) of potassium dichromate was added to each beaker to avoid any remaining organic matter.

After digestion, samples were washed into centrifuge tubes with distilled water and centrifuged for 2 minutes at 6,000 rpm. The supernatant fluid was carefully decanted and the pellet was resuspended in distilled water. This rinsing process was repeated three times to remove all the acid. After the final wash, the diatoms were transferred to labelled plastic vials and distilled water was added to give a final volume of 25 ml for each sample.

The diatom concentration in each sample was examined under the microscope and a further dilution was often made before placing the solution in the Battarbee plate (Battarbee, 1973). The above dilution was necessary to avoid the overlapping of diatom frustules, which may cause problems during identification and counting.

Four coverslips were placed into 4 cavities in the base of the Battarbee plate before filling it with the sample. Battarbee plates should be placed on a horizontal surface which is free from vibrations. To avoid the floatation of cover slips during the filling of the Battarbee plate, a small drop of distilled water was placed in each coverslip cavity before placing the coverslips in them. A measured volume (generally 5 to 7 ml) of well mixed (homogeneous) sample was then poured into each Battarbee plate. After placing the sample in the plates, they should not be disturbed until the evaporation is completed. After 3-4 days when all the water had evaporated, the diatom coated coverslips were removed and mounted on glass slides using Permount mounting media.

3. <u>Diatom Identification and Counting</u>:

Diatom identification was based on Hustedt (1930), Hubber-Pestalozzi (1942), Cleve-Euler (1951-1955), Patrick and Reimer (1966, 1975), Foged (1979), Gerloff and Cholnoky (1970) and Germain (1981).

Eight hundred or more diatom frustules were counted for each sample under oil immersion (1,000 X magnification) using a Leitz inverted microscope.

An average sample had between 40 and 50 diatom species. By counting 800 diatom frustules, the counts for the rarer taxa became more reliable. Therefore, it follows that a 20 cm long core analysed at 1 cm intervals necessitated a count of 16,000 diatoms.

4. <u>Dry Weight Corrected Counts of Diatom Frustules</u>:

A method of calculating the number of diatoms per mg dry sediment weight was devised during this study. The dry weight of each acid digested sample was indirectly calculated prior to sediment digestion. A small amount of wet sediment was taken from preweighed total wet sediment samples and the wet weight of the sediment which had been digested was calculated by reweighing the total wet sediment. The main sample was then dried in a drying oven for 24 hours at a temperature of 90-95°C. The dried samples were allowed to cool at room temperature and weighed to determine the dry weight of each sample. On this basis the dry weight of the sediment used in diatom preparation was calculated.

A known volume of sample was taken by pipette from each vial and placed in Battarbee plates. After drying, the area of each Battarbee plate was calculated and the sediment dry weight on each coverslip was determined (Battarbee 1972).

After counting eight hundred or more diatom frustules, the dry weight of the sediment was calculated on the basis of the area covered in counting. Next, the number of different diatom species per mg dry sediment weight was calculated.

The procedure for representing the number of each diatom species per mg dry sediment weight can be better explained with the help of the following example: for a core top sediment sample (0 - 1 cm) of Z_1 lake, 0.972 mg dry sediment (suspended in distilled water) was used in filling the Battarbee plate. Since the total area of the Battarbee plate was 57.75 cm^2, the dry weight on each 22 mm X 22 mm = 484 mm^2 coverslip would be 0.0818 mg. Under the microscope (1,000X) 838 diatom frustules were counted from an area of 11.88 mm^2, hence the dry sediment weight for this area would be 0.0020 mg. In this sample 115 *Navicula subtillissima* frustules were counted from the total of 838 diatom frustules. The number of *Navicula subtillissima* frustules in 1 mg dry sediment would be 57,000 for this sample.

Zooplankton Analysis In order to determine whether the species composition of the Copepods, Cladocera and/or rotifers changed in a predictable manner along a gradient of pH (4-8), zooplankton samples were collected from the centre of each of the lakes in the Wawa study. Vertical tows were taken using a Birge-Juday closing net (68 um mesh size). Net phytoplankton were also estimated from these samples. The net was repeatedly towed vertically from the base of the photic zone (estimated at 2X the Secchi depth) to the lake's surface until the distance towed equalled 10 m (133 litres of water passed through the net during the 10 m tow). The net diameter was 12 cm.

The zooplankton were enumerated by placing 1 ml of the 20 ml concentrate on a glass depression slide and counting all the individuals of each taxa on the slide. This procedure was repeated after the entire set of twenty-one samples had been counted. Where the two total zooplankton estimates varied by more than 25% of one another, a third, and if necessary, a fourth slide was counted. Zooplankton densities for each taxa are, therefore, felt to be within 25% of the sample mean. Additional rigor was not felt to be justified for the purposes of this followup level survey, because samples at only one point in time and one point in each lake's basin permit only a limited degree of generalization, no matter how carefully they are counted.

The methods of Roff and Kwiatkowski (1977), De Costa and Janicki (1978) as well as Sprules (1975), were followed in attempting to estimate zooplankton density. Taxonomic identification was based on Ruttner-Kolisko (1974) and these were confirmed by Dr. Herbert Fernando (Biology Dept.) Waterloo University, Waterloo, Ontario.

Littoral Vegetation In order to determine the presence or absence of selected aquatic macrophytes along the shores of each lake, the helicopter flew at low levels around the perimeter of each of the smaller lakes. In addition, inflatable raft sorties on some of the lakes permitted a better estimate of the macrophyte species composition. These data must be viewed as a first order approximation, as only the larger water lilies, rushes, sedges and pond weeds were noted.

ACKNOWLEDGEMENTS In 1981, Kit Yung and Sushil Dixit extruded and sectioned each of the lake sediment K-B and Livingston cores. In 1982, this task was performed by John Ciolfi, Dave Wadge and Mary Ann Leland. Sushil Dixit and Wendy Cox prepared the diatom slides for each of the surface sediment samples for the 21 lakes and for selected cores. Sushil Dixit prepared the log alpha surface sediment calibration curve, which was used to calculate down core diatom inferred pH. John Ciolfi analyzed the diatoms at 1 cm intervals (1 - 20 cm) in cores X_1, and U_1 and W_1. Alain Baril analyzed the diatoms in core U_4. Wendy Cox analyzed the diatoms in cores Y_1 & Y_4. Kit Yung analyzed the diatoms in parts of W_1 and in all of Z_1, and Z_4. Sushil Dixit analyzed the diatoms in parts of W_1, U_1 and all of X_4. Steve Kerr (Kerr 1981) provided field assistance and morphometric maps while Ian Thomson provided field and organizational assistance for the project. We are grateful to all of the above, for without their help this multidisciplinary study would never have been completed.

GEOLOGY AND GEOGRAPHY (J.F.)

The general geological setting of the lakes included in the 1981 study was taken into consideration when the staircases were chosen for study. Areas were selected in such a way that the catch-Thus, the X series of lakes were located in granitic terrain, the U series and the W series in greenstone terrain and the Y series in an area of relatively thick calcareous drift (Figure 2:2, Pt. II, Section 1). In order to select a second set of lakes with relatively low pH, it was necessary to locate the Z series in an area to the south of the Montreal River underlain by greenstone and some granitic rocks (Figure 2:2, Pt. II, Section 1).

With respect to surficial geology, the simplest case was the Y series of lakes which are in relatively thick glacial material rich in limestone. Elsewhere, the staircases were located in areas with variable drift cover with respect to thickness and lithology. For example, the W series are in an area of bedrock outcrops which are clearly evident on the photographs (Pt. II, Section 1, Page W-2). The surficial features in the vicinity of the U, X and Z series of lakes (Pt. III, Section 1, Page U-2, X-2 and Z-2) were more difficult to describe. (This type of study was made more difficult by the unavailability of air photographs of the areas selected for study at the time the field work was conducted).

This problem was solved for the 1982 field project by having preliminary air photo interpretations made for lakes of interest for investigation prior to the actual choice of sample lakes made. The air photo interpretations were later verified (for the lakes selected for study) by helicopted fly-by's of the lake shores and drainage basin limits. Time did not allow for ground verification of the surficial geological maps so obtained. (See Part II, Section 4).

Geological and Geographical Methods

General information for lake staircases (1981) and individual lakes (1982) is assembled and tabulated in Section 1 (1981) and Section 4 (1982) of Part II of this report. This information was collected as follows: -

NTS coordinates were taken from 1:50,000 scale topographic maps.
Elevation of lakes was estimated from 1:50,000 scale topographic maps.
Lake depth at sampling point was measured during the water sampling procedure.
Lake area was estimated from 1:50,000 scale topographic maps.
Lake catchment area was estimated from 1:50,000 scale topographic maps.
The bedrock geology was obtained from OGS geological compilation maps. Map 2220 and Map 2108 both at a scale of 1:253,400 supplimented by observations made in the field.

Surficial geology was derived from field observation during the sampling process or, in the 1982 study only, by air photo interpretation (See above).

PALYNOLOGY (J.T.)

The collection of lake sediment cores for detailed palynological study is usually a relatively slow procedure. It involves the bathymetric mapping of a lake prior to the selection of a site for coring from a raft. In 1981-82 this procedure was used for only three lakes. They were Y_1, U_3 (Furnival Lake) and Doc Greg, all of which were sampled in 1981.

In the 1980 study (Fortescue et. al. 1981), a second method of collection of lake sediment cores was described which was developed especially for this project. The objective was to collect cores 50 cm or longer (in the minimum of time), from each lake using a helicopter. The feasibility of using a simple gravity corer to do this was proven during the 1980 study, although the use of a helicopter made the sampling operation somewhat difficult. The great advantage of using the helicopter is that cores can be collected from lakes which could be reached in no other way. A disadvantage is that the lack of a prior bathymetric survey rules out sample collection from the most favourable location in some lakes. In 1981, twenty lakes were cored in duplicate, using the gravity corer and a further 10 lakes were similarly sampled in 1982. In 1982, a field headquarters method of core subsampling was used, which was designed to fill the needs of palynology, limnology (diatom study) and descriptive geochemistry from the same core. This approach, which provided subsamples for the establishment of the *Ambrosia* rise, involved 15 samples taken at 1 cm intervals, from 5 cm to 20 cm deep in the core. Otherwise, the methods used to identify and describe pollen were the same as used in 1980.

Our experience has shown that for the collection of long cores for detailed palynological work (covering the time from when lake basins were established to the present), a bathymetric study (after the selection of a lake basin on the basis of air photographs) is essential. If cores are collected for multidisciplinary purposes involving environmental considerations,it is practical to collect 50 cm cores from a helicopter. Such cores are useful for the determination of the depth of the *Ambrosia* rise under favourable conditions. Cores of this type cannot be used for the preparation of detailed pollen diagrams from lake basins developing over periods of time greater than a few hundred years.

Palynology Methods

Field Methods Two adjacent sediment cores were collected with a gravity corer using a 5 cm diameter acrylic resin tube about 2 m long, which was launched from the float of a helicopter. Cores in plastic tubes were sealed with rubber stoppers and vinyl tape. At the field base the tubes were shortened by cutting off the top (unused) part of the tube, because the cores seldom exceeded 1 m in length. This facilitated the transport of the cores to laboratory storage. All cores were kept cool in the field prior to transport to the laboratory.

Long cores were collected from lakes accessible by road. The coring was extended to inorganic sediment (presumably of early postglacial age) in order to obtain a palynological record covering all of postglacial time. The long cores were taken with a piston corer from a coring raft in one metre long core segments at the same site using a casing which extended from the raft down into the sediment.

Laboratory Methods In the laboratory, the short cores were frozen prior to subsampling, extruded, and cut into 2.5 cm segments for the 1981 study. The subsamples were then crushed, a small portion removed for palynological analysis and the remainder placed in plastic vials. The samples were then freeze-dried and the wet weight, dry weight and vial weight were recorded. All sample vials were properly labelled, packaged and submitted for chemical analysis as described in the following section.

The subsampling of the long cores differed from that just described. The unfrozen 1 m lengths of core were extruded and 5 cm long segments were freeze-dried (as described above) after a small portion for palynology study had been taken. The dried portion was submitted for chemical analysis.

The chemical preparation of the palynological samples, preparation of slides for microscopic work and counting of pollen followed routine procedures that are well described by Faegri and Iversen (1975) and by Moore and Webb (1978). The data obtained from the slides were plotted in the form of pollen diagrams (see Part II, Section 1 individual lake sections, page 14 to 19). The palynology of the long cores is discussed in Chapter 4.0.

GEOCHEMISTRY OF LAKE SEDIMENT CORES (J.F.)

The purpose of the lake sediment geochemistry was to describe patterns in the vertical distribution of elements in lakes which might be related to the effects of acid rain in post-*Ambrosia* time, or to changes in lake conditions during the past several hundred years.

The 1981 lake sediment core geochemical program had three parts. One part was designed to relate directly to the diatom inferred paleo-pH study; another part was concerned with the uniformity of lake geochemical conditions in each set of staircase lakes in pre-*Ambrosia* time which directly relates to mineral exploration; while the third part was concerned with the description of geochemical patterns in the long cores from glacial times to the present. In 1982, attention was paid to the standardization of the lake sediment coring and subsampling procedure. Verification of the geochemical signatures, from year to year and within the same lake, was also included in the study. In 1980, some difficulty was experienced with the data derived from chemical analysis of lake sediment core segments. This problem intensified in 1981 when a large number of samples were ruined during the freeze-drying process by one contractor, and certain difficulties with another contractor resulted in 275 samples having to be reanalysed. Consequently, for the 1982 project, special attention was paid to the organization of the contract work to obviate the difficulties experienced during previous years. As in the case of the 1980 study, all chemical data for 1981 and 1982 lake sediment cores (in ppm and KK units) are listed in Part II of this report. The 1981 0-20 cm data and 0-20 cm core data are listed in Section 1, while the long core data are listed in Section 2. In Section 3, data for replicates of reference standards (incorporated in the batches of unknowns) are included. These provide detailed information on the performance of the analytical methods.

The 1982 program of chemical analysis was organized as follows, in order to ensure as far as possible that the chemical data would be as reliable as possible under routine contract conditions of the type selected for the 1980 and 1981 lake sediment core subsamples.

a) A preliminary discussion between the Contractor and the O.G.S. laboratory workers was held in order to establish the "rules of the game". It was decided that preliminary tests of the extraction and determination procedures were required to formalize the techniques, and that these should be completed in both laboratories prior to the commencement of the work.

b) After the preliminary research was completed and the techniques agreed upon by both parties, the analytical program was commenced in five parts:

Part I Analysis of the lowest core segments from the 1982 lake sediment cores (each sample 5 cm of core, 6 samples per core). The performance of the techique was then checked on standards included in the sample batch and on the replicated segments of each core.

A total of 20 samples were selected for analysis in each laboratory and 20 replicates from the original extractions were rerun.

Batch I was completed prior to commencement of Part II.

Part II Analysis of the 1 cm interval core segment material from lakes 2 and 3 of the 1981 W and Z series.

These samples were analysed as for Batch I.

Part III Analysis of the 1 cm core segments for the 1982 cores (see Figure 2:4) was carried out.

These samples were analyzed as for Batch I.

Part IV Analysis of the 0.5 cm segment material from the 1982 cores (using a 100 mg sample weight instead of a 250 mg sample weight used in Parts I, II, and III).

These samples were analyzed as for Batch I.

Part V Analysis of samples within the four batches for purposes of verification of data of particular importance in the diatom study.

These samples were analyzed as for Batch I.

Otherwise, the program was run as for the 1981 material, except that in the 1982 program U, As, Si and Hg were deleted in order to focus upon the single ICP/AA technique.

Lake Sediment Geochemistry Methods

Subsampling Details of the collection, subsampling and drying of the subsamples of lake sediment core material were described above, with the exception of the subsampling procedure adopted during 1982 which was as follows: -

The vinyl binding at the bottom of a core tube was removed together with the rubber cork inserted during sampling. Immediately, a stopper was inserted into the tube (the stopper was a snug fit inside the tube). The core tube was then secured in a wooden stand and was clamped firmly in a convenient position. A small automobile hydraulic jack was then placed below the stopper and a length of dowel rod was fitted to connect the top of the jack to the bottom of the stopper. The rubber cork at the top of the sample tube was then removed and the layer of water above the core was carefully removed by a siphon tube. The automatic jack was then activated to move the top of the core material level with the top of the sampling tube. A 2 inch O.D. acrylic tube segment exactly 0.5 cm thick, was then placed on the top rim of the sampling tube. The jack was activated to move the top surface of the core to exactly fill it. The small tube ring was then removed and the first 0.5 cm of core material was removed with a plastic scraper. Each resulting subsample was divided into two parts; one for diatom study and the other for geochemistry. This procedure was conducted for nine other samples, completing the subsampling of the first 5 cm of the core. The next 15 cm of core was similarly subsampled using a 1 cm thick acrylic ring. Finally, the core below 20 cm was subsampled in 5 cm segments using a ring of this depth. All subsamples for geochemical study were placed in plastic vials. Those for palynology and limnology (diatom) study adopted for the 1982 study is illustrated in Figure 2:4.

<u>1981 Chemical Analysis</u> The 1981 lake sediment core subsamples were subjected to chemical analysis using the following procedures: -

1) Loss on Ignition: A 250 mg portion of the dry sample was heated to 1,000°C for three hours, cooled in a dessicator and weighed. The loss on ignition was then calculated. (This test was not completed on the 0 - 20 cm samples owing to the small amount of material available.)

2) Element Abundance: Long core and pre-<u>Ambrosia</u> 1981 samples were subjected to <u>five types</u> of chemical analysis in order to determine their content of Al, Fe, Mn, Mg, Ca, K, Na, P, Ti, Zr, Cu, Cr, Ni, V, Zn, Pb, As, U, Hg*.

<u>The first 16 of this list</u> of elements were determined simultaneously using an ICP technique after a nitric/hydrofluoric/perchloric digestion was employed (which was taken to dryness). The resulting residue was redissoved in 5 ml of 0.5 N hydrochloric acid with suffi-

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* Chemical analysis was completed under contract to Technical Service Laboratories, 1301 Fewster Drive, Mississauga, Ontario who should be contacted to obtain further details of the determination methods used.

Depth cm			Geochemical Sample (Black/vial)	Limnology Sample (Blue/bag)	Palynology Sample (Green/bag)
0.00	-	0.5	..*A	A	
0.05	-	1.0	B	B	
1.0	-	1.5	C	C	
1.5	-	2.0	D	D	
2.0	-	2.5	E	E	
2.5	-	3.0	F	F	
3.0	-	3.5	G	G	
3.5	-	4.0	H	H	
4.0	-	4.5	I	I	
4.5	-	5.0	J	J	
5.0	-	6.0	K	K	K
6.0	-	7.0	L	L	L
7.0	-	8.0	M	M	M
8.0	-	9.0	N	N	N
9.0	-	10.0	O	O	O
10	-	11	P	P	P
11	-	12	Q	Q	Q
12	-	13	R	R	R
13	-	14	S	S	S
14	-	15	T	T	T
15	-	16	U	U	U
16	-	17	V	V	V
17	-	18	W	W	W
18	-	19	X	X	X
19	-	20	Y	Y	Y
20	-	25	ZA		
25	-	30	ZB		
30	-	35	ZC		
35	-	40	ZD		
40	-	45	ZE		
45	-	50	ZF		

* Each lake in the 1982 project is identified by two code letters which always preceed the letters listed here.

Figure 2:4 Multidisciplinary subsampling plan for short lake sediment cores collected during the 1982 study.

cient 0.5 N hydrochloric acid added to make the sample and solution weigh 10 g. After mixing, a part of this solution was used for ICP analysis.

Uranium was determined on 5 ml of the ICP solution. This was extracted with 0.5 ml of ethyl acetate solution added to a platinum dish which contained 1 g of Na_2CO_3 - K_2CO_3 - $LiCO_3$ flux. The mixture was fused at 600°C for 5 minutes. The fluorescence of the resulting bead was measured and compared with similar beads for standards carried through all steps of the procedure.

Arsenic was detected using 250 mg of sample digested in 4:1 nitric/perchloric acid at 90°C and later taken to dryness. The residue was then dissolved in 0.5 N HCl and diluted to 10 ml. The method was calibrated using synthetic standards and checked using international standards. Hydride generation using 4% sodium borohydride as the reductant and argon as carrier gas allows determination of As on an IL257 AA spectrometer.

Silica was determined by a gravimetric procedure.

Mercury was determined using a 250 mg sample. This was dissolved in HNO_3/ H_2SO_4 and reduced with $SnCl_2$. The resulting mixture is aerated (with air) into an absorption tube for cold vapour determination on an AA spectrometer.

1982 Chemical Analysis The 1982 lake sediment core material was freeze-dried and 250 mg (or 100 mg) subsamples subjected to chemical analysis as follows: -

1) Extraction: 250 mg of sample is dry ashed at 425°C for 90 minutes. The ash is dissolved in 8 ml HNO_3:$HClO_4$:HF(5:4:1) and slowly evaporated to dryness on a hot plate. The residue is taken up in 1 ml concentrated hydrochloric acid and diluted x 100 in 0.5 N hydrochloric acid.

2) Determination: Ca, Mg, Fe, Mn, K, Na, Al, Ba, V, P, Co, Zr, Ti, Cr and Cu are determined simultaneously by an ICP technique. Pb, Zn, Cu and Ni are determined by Atomic Absorption (AA).

SUMMARY

Methods for the study of lake waters and lake sediment cores during the 1981 and 1982 studies have been described. In general, it was found practical to integrate the inputs from the different disciplines to use the helicopter time as effectively as possible. In our opinion, the subsampling of lake sediment cores in the field in order to provide sample material for limnology, palynology and geochemistry, saves time and increases the effectiveness of multi-disciplinary studies of this type.

3.0 DESCRIPTION OF LIMNOLOGICAL AND SURFICIAL GEOLOGICAL OBSERVATIONS 1981/82

Introduction

Although the prime objective of the interdisciplinary research completed in 1981/82 was to relate the findings of the limnological, geochemical, palynological and geological activities, a large volume of unidisciplinary information was also gathered as a part of the two summer programs and their winter follow on laboratory investigations. The aim of this chapter is to provide an opportunity for the inclusion of such information which was gathered during the limnological and surficial geological investigations. The interdisciplinary theme is resumed in Chapter 4 where the interdisciplinary information regarding the long cores is described and in Chapter 5 where the geochemical, palynological and limnological findings from the staircase lakes (1981) study are described. In Chapter 6, the interdisciplinary approach to verification of data based largely on the 1982 material is included. In Chapter 7, summaries of the findings of the two years research are accompanied by general discussion and a list of conclusions to the work.

SURFICIAL GEOLOGY SUMMARY (J.T.)

Introduction

As a part of the 1982 program, an attempt was made to provide surficial geological maps of lake basins from an interpretation of air photographs prior to the field work and to verify such maps by fly-bys and ground inspection of selected sites. The work was concentrated on the 20 1980 lakes, staircase W of the 1981 program and on lakes selected for study during 1982. The investigation included attempts to discover sediment type and distribution within the catchment areas for lakes and general observations of the nature of the basins and their hydrological characteristics. Although it was clear from the 1980 study that the production of surficial geological maps for lake basins was impractical in the time available for the Wawa study this investigation was completed in order to discover if any information pertinent to the acid rain problem could be obtained on the basis of photogeology and fly-bys.*

Methods

Provisional surficial geological maps were prepared from a study of the air photographs of 30 lakes prior to the commencement of the field work. An attempt was then made to verify the features on the maps using the helicopter for a 3 day period. Some samples of glacial materials were collected from the vicinity of lakes which were accessible. Although an attempt was made to obtain material characteristic of particular sediment types, it soon became apparent that such sampling on the scale required was not feasible in the time available. After the field work, final interpretations of the surficial deposits within each basin were made and surficial maps

* It was unfortunate that Professor Terasmae was unable to participate in the fieldwork in 1982 which obviated any contribution which he might have made to the solution of this problem based on his extensive experience of the study of glacial lakes.

drawn for each lake basin. Lakes having relatively large basins were mapped only in the immediate area of the lake. It was assumed that proximal sediments would be potentially more significant.

Results

The surficial geological map units represent the dominant sediment type in each catchment area. Surficial sediments throughout the region tended to be thin and discontinuous. Six units were defined:

1. Rock - Areas with significantly more bare rock slopes than covered by surficial sediments. Localized pockets of till commonly occur between rock knobs.
2. Till/Rock - Discontinuous cover of till of variable thickness. Rock outcrops are common.
3. Till - The dominant cover is till with only localized areas of bare rock. Generally, sediments are at least 1 metre in thickness.
4. Sand & Gravel - Primarily glaciofluvial outwash sediments found in fans, terraces and plains.
5. Sand & Silt - Glaciolacustrine sediments generally associated with glacial Lake Ojebway-Barlow.
6. Organics - Marsh and swamp deposits of variable thickness.

Discussion

This type of rapid surficial mapping provides a first approxi-

LAKE	PHYSICAL PROPERTIES OF DRAINAGE SYSTEM: Lake Morphology: Simple	Lake Morphology: Complex	Relative Flowthrough: Minor	Relative Flowthrough: Major	Relative Drainage Basin Size: Small	Relative Drainage Basin Size: Medium	Relative Drainage Basin Size: Large	Relative Relief: Low	Relative Relief: Medium	Relative Relief: High	Logging	SEDIMENTOLOGICAL PROPERTIES: Surficial Cover Type: [1]Rock	[2]Till /Rock	[3]Till	[4]Sand & Gravel	[5]Sand & Silt	[6]Organics	Dominant Surficial Cover Type	Potential Significance of Surficial Cover	pH
1980	Chain Lakes																			
A		X		X			X			X		X	X			X	X	2	YES	5.0
B	X			X		X				X		X	X				X	1	NO	5.0
C	X		X		X				X		X	X		X			X	1	YES	5.4
D		X	X		X				X			X		X				1	NO	5.5
E		X		X			X		X				X				X	2	YES	6.5
F		X		X			X		X			X	X				X	2	YES	7.1
G		X		X			X		X			X	X		X		X	2	YES	7.1
H		X		X			X		X		X	X	X	X		X	X	3	YES	7.0
I	X		X		X				X		X		X					2	YES	6.7
J		X		X			X		X			X	X				X	1	NO	6.7
K		X	X		X				X			X	X				X	1	NO	7.0
L		X		X			X		X			X	X		X		X	2	YES	6.9
M	X			X			X			X		X					X	1	NO	6.9
N		X	X		X				X			X	X				X	1	NO	6.7
O	X		X		X				X			X	X				X	1	NO	6.9
P	X		X			X			X			X	X				X	2	YES	7.1
Q	X		X			X			X				X			X	X	2	YES	6.9
R	X		X		X				X			X	X					1	NO	7.3
S	X		X			X		X						X		X	X	5	YES	7.9
T	X			X			X	X				X				X	X	5	YES	8.2
1981	Staircase																			
W 1	X		X		X				X		)	X			X			4	YES	
2	X		X			X			X		) PLUME	X			X			4	YES	
3	X		X			X			X		) KILL	X	X		X			4	YES	
4	X			X			X		X		)	X	X		X			4	YES	
1982																				
CB-1	X		X		X				X				X				X	2	YES	
CB-2	X		X		X				X			X	X				X	2	YES	
CF	X		X			X			X			X	X			X		2	YES	
CH	X		X			X			X			X	X				X	2	NO	
CJ		X	X			X		X					X	X				3	YES	
CS	X		X		X			X					X					2	YES	

Table 3:1 Summary of the physical, hydrological and sedimentological factors studied. Logging has also been included because of its dramatic effects on the surficial cover.

mation regarding the distribution of the six land cover types within each drainage basin. Such information, although of potential importance for comparative purposes, is clearly of little direct relevance to the problem of acid rain. This is because generalizations regarding the nature and volume of surficial sediments in relation to the features of the lake which they surround are not possible from observations collected during a few hours or days.

But in spite of this, some lakes do show similarities, for example Lakes S and T (1980 project) are both dominated by silty sands related to glacial Lake Ojebway-Barlow. As predicted from the lake selection process, the lakes in the W staircase (1981) have similar surficial conditions within their catchment area because they are in an outwash plain where the sediments are dominated by sands and gravels. For the other 22 lakes examined, simple generalizations of this type clearly do not hold and further work would be required to establish relationships between them.

In the consideration of the potential significance of surficial sediments in a lake system in terms of the acid rain problem, a knowledge of the content of carbonate in the sediment is essential. Closely allied to this is a knowledge of the depth of the sediment, the groundwater conditions and the degree of compaction of the sediment. For this reason, a deposit which is localized but carbonate-rich is potentially more significant in terms of the buffering of the lake than extensive, carbonate-poor deposits. Consequently, the collection of a very few grab samples of sediments from a lake basin cannot be relied upon to represent the true level of carbonate in the surficial materials of the catchment area.

Because of these complexities, direct correlations between the pH and any of the surficial sediment types mapped are not to be expected. The pH of a lake results from a combination of geological, physical, biological and chemical processes occurring in the lake and its drainage basin. For a total understanding of the causes of lake pH, all of these processes must be considered. Because such considerations are clearly outside the scope of this investigation the main benefit to the study of acid rain in the Wawa area of the surficial geological maps which were prepared is to guide others to lakes which have been studied to some extent and might be suitable for more intensive studies of the type just described.

Conclusions

From the viewpoint of regional geochemical surveying, it is clearly not practical to provide information on the surficial deposits of lake catchment areas during the survey activity by spending a few minutes at each lake. To prepare a surficial geological map of a catchment area suitable for the detailed interpretation of the cause of lake pH would require a multidisciplinary activity lasting several months.

LIMNOLOGICAL OBSERVATIONS IN RELATION TO THE ACID RAIN PROBLEM (M.D.)

A. LAKE WATER CHEMISTRY

Lake pH

The five staircase lake series were ranked according to the pH of the lake waters. Two were acid ("X" pH 4.4 - 4.9) ("Z" pH 4.8 - 5.6), two were neutral ("U" pH 6.3 - 7.1) ("W" pH 6.6 - 7.2), and one was alkaline ("Y" pH 7.8 - 8.2). Thus, the whole range from pH 4.4 to 8.2 is considered although there are not, of course, lakes with pH values at regular intervals throughout the range.

If this pH scheme of classifying lakes is compared with their classification based on surface water conductivity, it is evident that both schemes are similar. The X and Z lakes displayed the lowest conductivities and the lowest pH. The U and W lakes were intermediate and the Y lakes displayed both the highest pH as well as the highest conductivity.

Temperature

Temperature was measured in mid-summer in each of the study lakes. The vertical temperature profiles (Part II, Section 2) were based on temperature measurements taken at one meter intervals.

The lakes at the top of the five watersheds (U, W, X, Y and Z) were all characteristically unstratified and shallow, with the single exception of Lake Z_1, which was thermally stratified.

Hypolimnetic Temperatures

The hypolimnion was defined as, that body of water below the thermocline where temperature no longer decreased by more than one degree celcius per meter. A hypolimnion occurred only in the 10 deeper lakes: U_3 (9 - 10 m), U_4 (6 - 7 m), U_5 (9 - 10 m), W_2 (5 - 6 m), X_3 (5 - 6 m), X_4 (7 - 8 m), Z_2 (5 - 6 m), Z_3 (6 - 7 m), Z_4 (6 - 7 m), Z_5 (9 - 10 m). The value in parentheses indicates the depth of the top of the hypolimnion.

Specific Conductivity

The total electrolyte concentration at 1 m depth intervals was estimated by using a Y.S.I. Model 33 Conductivity meter. Each value was corrected to 25°C and recorded (Part II). As noted earlier, the temperature corrected surface water conductivities ranged between a low of 20 micromhos/cm in Lake Z_1 to a high of 221 micromhos/cm in Lake Y_4.

Lake Classification Based on Conductivity

Lakes U_1 to U_5 ranged from 40-54 micromhos/cm surface conductivity. Lakes X_1 to X_4 ranged from 21-25 micromhos/cm, and Lakes Z_1 to Z_5 ranged from 20-28 micromhos/cm. Thus the U, X and Z lakes were classified as low conductivity (soft water) lakes.

Lakes W_2 to W_4 and Y_1 to Y_4 were hard water lakes in which the specific conductivity ranged from 135 to 221 micromhos/cm. Lake W_1

was intermediate between the soft and hard water lakes with a specific conductivity of 79 micromhos/cm.

Headwater Lake Conductivity

The lowest conductivity was typically associated with the headwater lakes, for example, Lakes U_1, W_1 and Z_1. Lakes X_1 and Y_1 were exceptions to this rule, as their conductivity was slightly higher than lakes X_3 and Y_3 respectively. The reasons for this are likely related to the lack of uniformity in the underlying soils and bedrock in these watersheds. The same conclusion would also explain the large discrepancy between the conductivity of lake W_1 and W_2. This is examined further in Chapter 3.0, Section B (1981 Water Chemistry Statistical Results: Lake pH) (Page 60).

Dissolved Oxygen (D.O.)

Those lakes with the lowest hypolimnetic D.O. were generally the brown water lakes (Part II). Only three lakes displayed anaerobic hypolimnia. In addition, Lakes Z_2 and Z_5 were both nearly anaerobic. As noted previously, nearly all of the headwater lakes were too shallow to thermally stratify (the single exception was the 6 m deep Lake Z_1). As a result, the unstratified headwater lakes were reaerated by surface water circulation throughout the summer. In addition, all of the Y lakes were too shallow to stratify. These Y lakes often had algae and moss growing on the bottom. The oxygen production from these plants was often sufficient to offset the oxygen lost to benthic decomposers. In one case, Lake Y_4, supersaturation of D.O. was observed at the lake's bottom.

Supersaturation of Dissolved Oxygen

Half of the study lakes were supersaturated with dissolved oxygen (D.O.) at depths which were near their thermoclines. The maximum D.O. depth is given in parentheses. Lakes U_3 (6 m), U_5 (4 m), W_2 (4-5 m), X_2 (3 m), X_4 (4-6 m), Y_2 (3 m), Y_4 (2 m, bottom), Z_2 (3 m), Z_4 (4-5 m), and Z_5 (5 m), were all supersaturated with dissolved oxygen (Part II). This phenomenon was referred to as a positive heterograde condition by Aberg and Rodhe (1942) and was a result of both oxygen production by metalimnetic algae and the warming of the hypolimnion, thereby decreasing D.O. solubility. This warming of the epi- and metalimnion (which gives a temporary D.O. supersaturation), was more pronounced in humic lakes than clear water lakes.

Hypolimnetic Dissolved Oxygen

Most of the shallow study lakes (< 10 m) were unstratified and dissolved oxygen from aerated surface waters was continuously being mixed to the lake's bottom. Because such lakes were thermally unstratified, they had (by definition) no hypolimnia. For this reason, hypolimnetic D.O. was defined in such lakes (only for purposes of comparison) as the D.O. concentration just above the lake's bottom at the maximum depth of the sampling site.

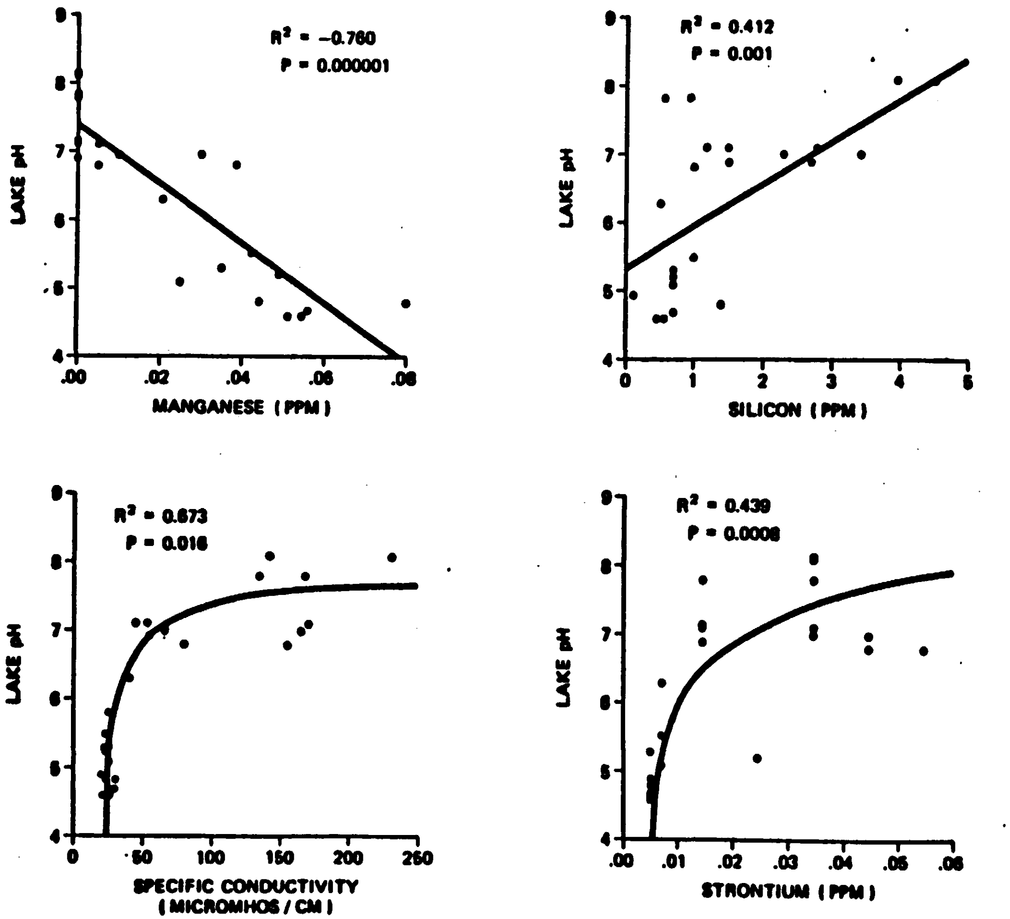


Figure 3:1 Correlations for staircase lakes.

A: pH/Mn
B: pH/Si
C: pH/Conductivity
D: pH/Sr

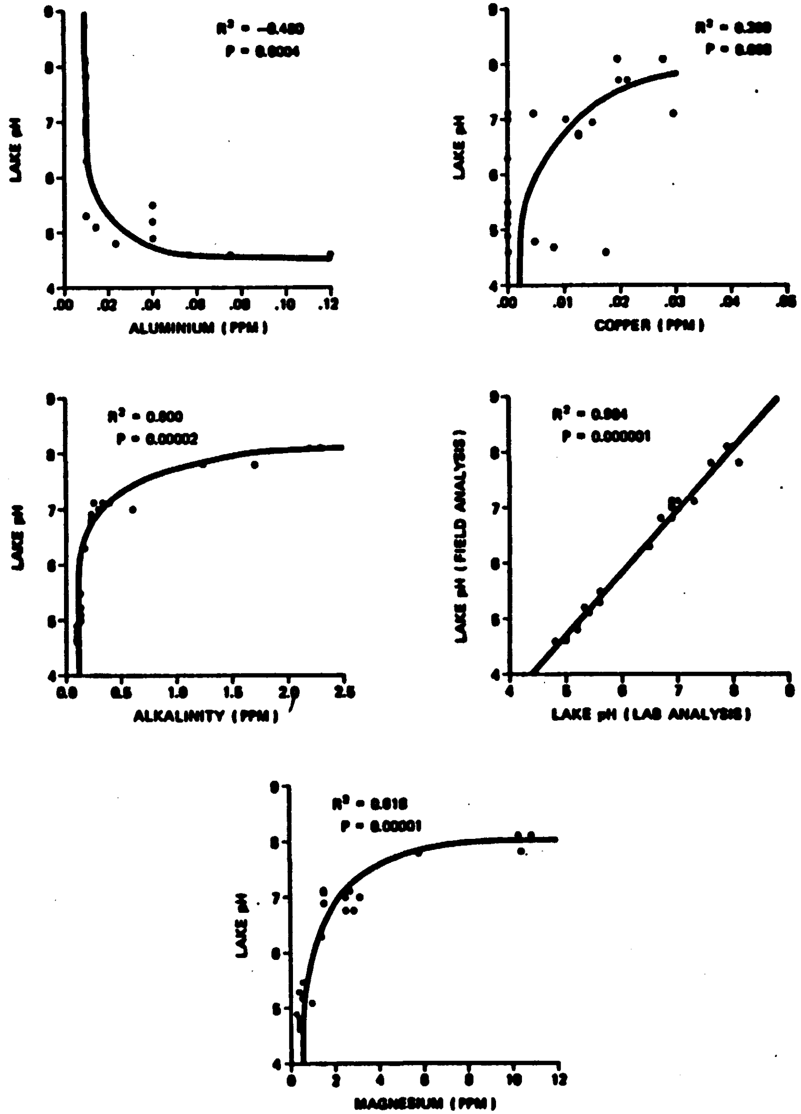


Figure 3:2 Correlations for staircase lakes.

A: pH/Al
B: pH/Cu
C: pH/alkalinity
D: pH/lab pH
E: pH/Mg

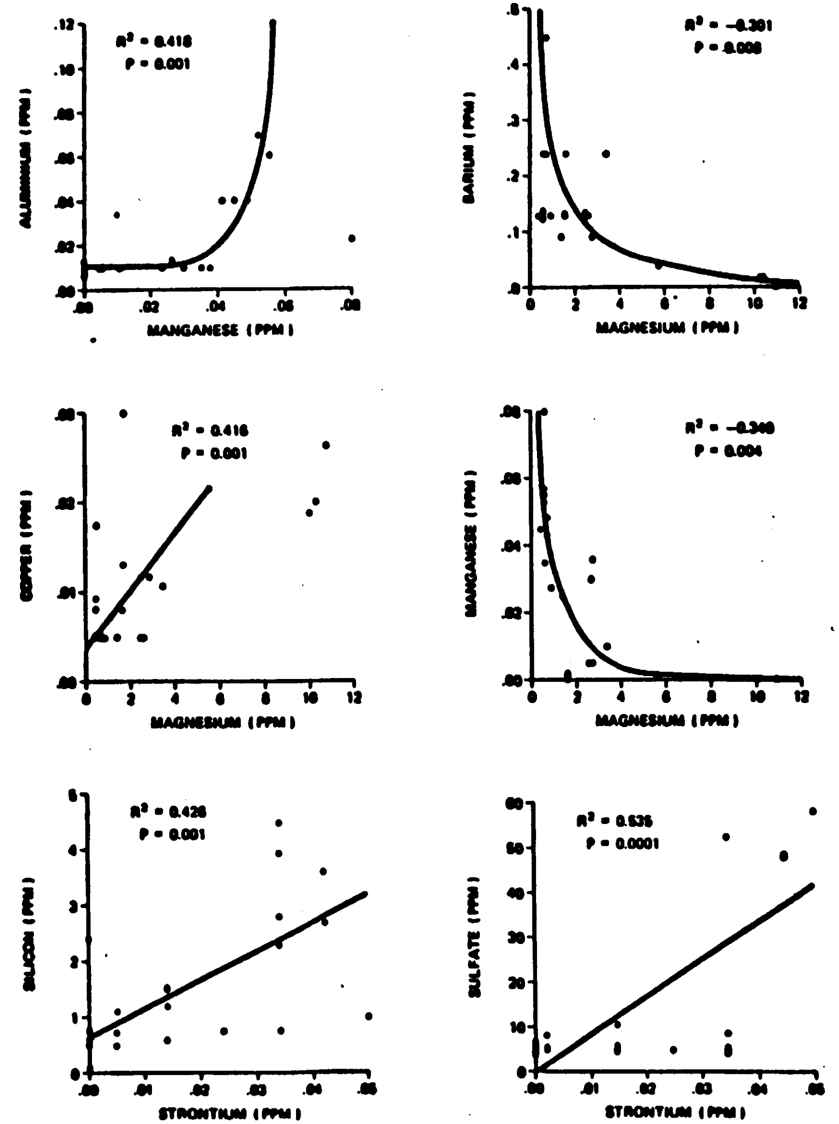


Figure 3:3 Correlations for surface waters (staircase lakes) base metals.

A:	A1/Mn	D:	Mn/Mg
B:	'Mn	E:	Si/Sr
C:	Cu/Mg	F:	SO_4/Sr

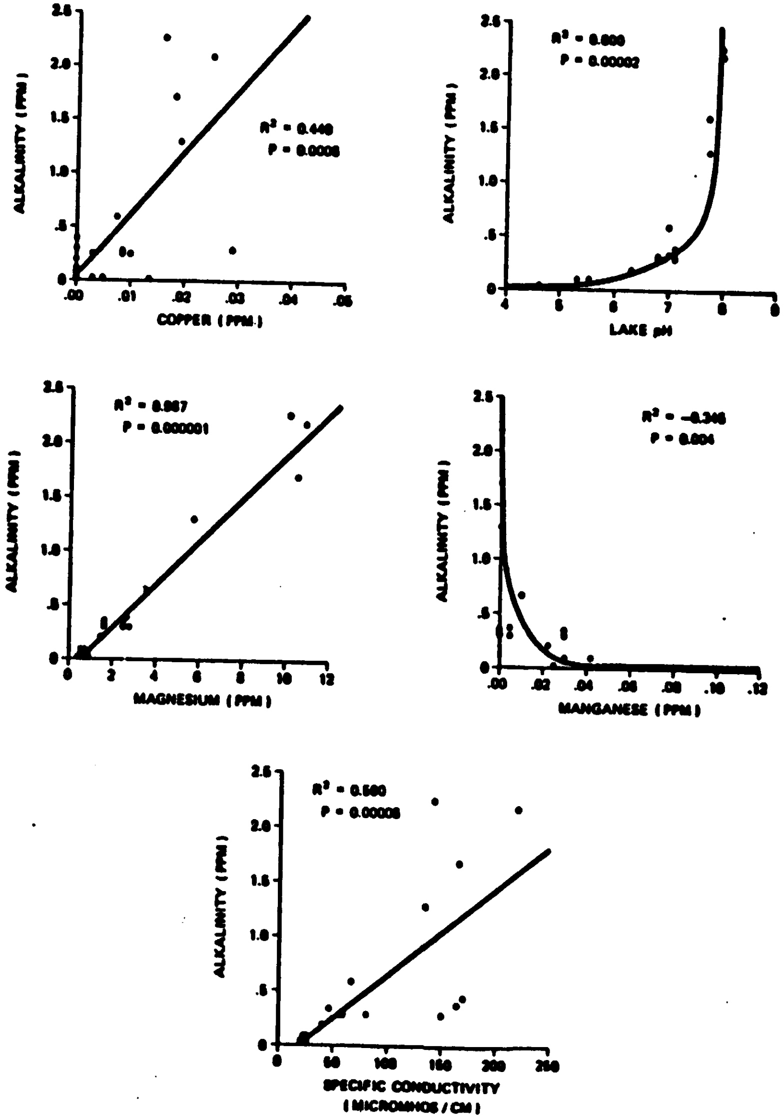


Figure 3:4 Correlations for surface waters (staircase lakes) alkalinity.

A:	Al/Cu	D:	Al/Mn
B:	Al/pH	E:	Al/Speci..c Conductivity
C:	Al/Mq		

The relationship between hypolimnetic D.O. and lake productivity has been well established in the literature (Hutchinson 1957). Those lakes with the lowest concentrations of electrolytes (i.e. low specific conductivity) frequently had the lowest productivity and therefore the highest hypolimnetic D.O. This relationship is evident in figures displaying significant correlations with lake conductivity (Figs. 3:7 A-F).

Lake Location

The relationship betwen lake latitude and longitude (expressed in terms of their Universal Transmercator Units Position) and specific conductivity was unexpected (Fig. 3:7 A and B, R^2=.39, R^2=.63). In general, the amount of electrolytes in the water (specific conductivity) increased as one progressed from south to north and west to east (Fig. 3:7 A and B). The major exception was a group of five Easterly lakes (X_1-X_5) with low specific conductivity (Fig. 3:7 B). No attempt was made to fit a line to this relationship.

Lake Elevation

The elevation of the 22 Wawa study lakes ranged from 320 to 500 m above mean sea level (Figs. 3:9 A-D). Lakes at high elevation were frequently brown coloured or humic (colour 3 on a scale of 1-5) (Fig. 3:9 A, R^2=.30).

Total dissolved sulfate and lake elevation were exponentially and negatively correlated (Fig. 3:6 C, R^2=-.68). Below a pH of 4.8, sulfate replaced bicarbonate as the dominant anion in the Wawa study lakes (Fortescue et al 1981). The fact that this relationship (pH and SO_4^{-2}) was exponential and that the higher the lake's elevation (Fig. 3:9 B), the lower its pH, leads one to anticipate the observed negative exponential relationship between sulfate and lake elevation (Fig. 3:6 C).

Lake Order

Lake order was positively correlated with lake elevation by definition. A first order lake was defined as one with no lakes above. A second order lake, therefore, received its water from a first order lake, etc. As expected, the smaller a lake's area, the shallower it was likely to be. First order lakes were typically small, shallow ponds (Fig. 3:6 A and B). As noted previously, these first order ponds displayed the lowest pH and alkalinity and therefore appeared to be the most susceptible to acid precipitation.

Lake Colour

The humic lakes were typically small *Sphagnum*-rich ponds. These ponds were generally more frequent at the top of a lake staircase than at the bottom. Consequently, they were found at higher elevation (on the average) than the clear water lakes. These humic lakes, with the exception of the Y watershed lakes, had low pH, low silicon and low specific conductivity (Figs. 3:9 B, C and D).

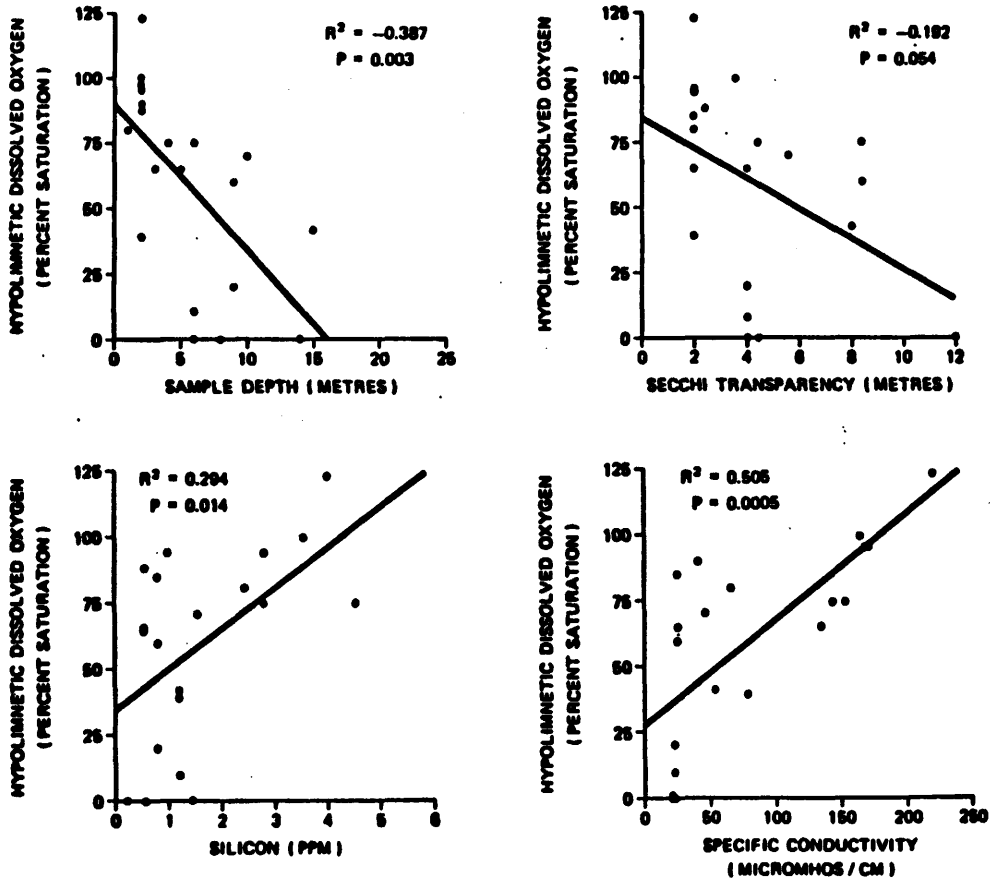


Figure 3:5 Correlations for surface waters (staircase lakes) hypolimnetic dissolved oxygen.

A: D.O./Sample depth
B: D.O./Secchi transparency
C: D.O./Si
D: D.O./Specific conductivity

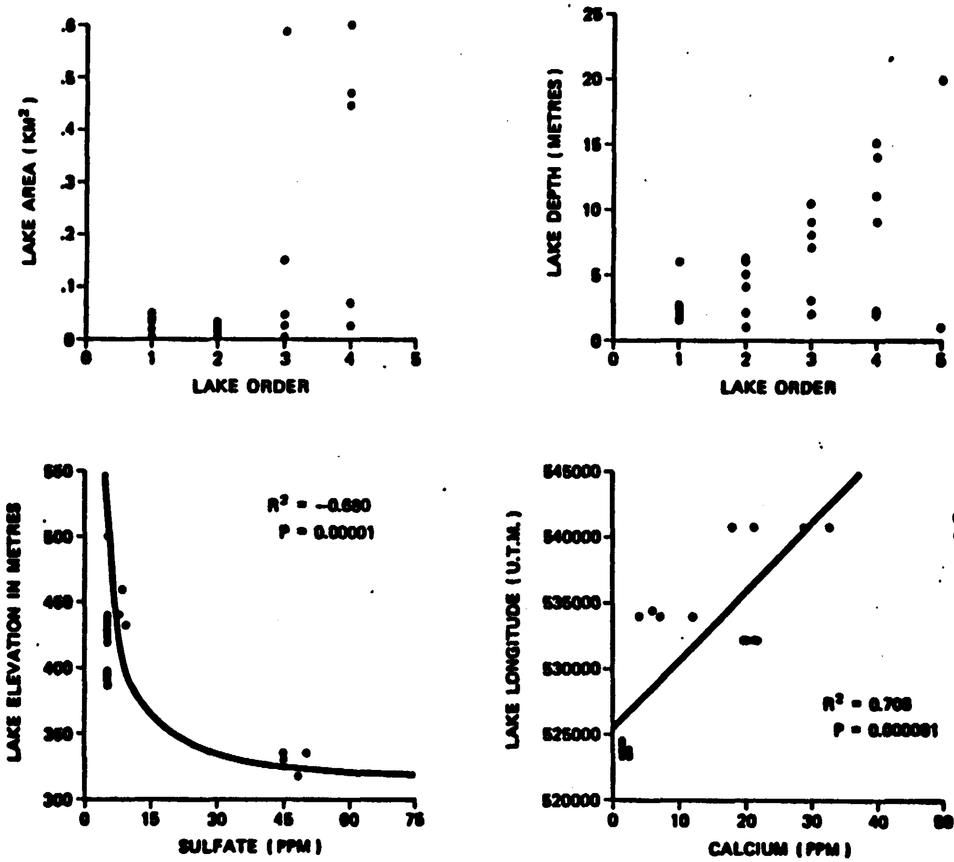


Figure 3:6 Correlations for surface waters (staircase lakes) alkalinity.

A: Lake area/Lake order
B: Lake depth/Lake order
C: Lake elevation/sulfate
D: Lake longitude/calcium

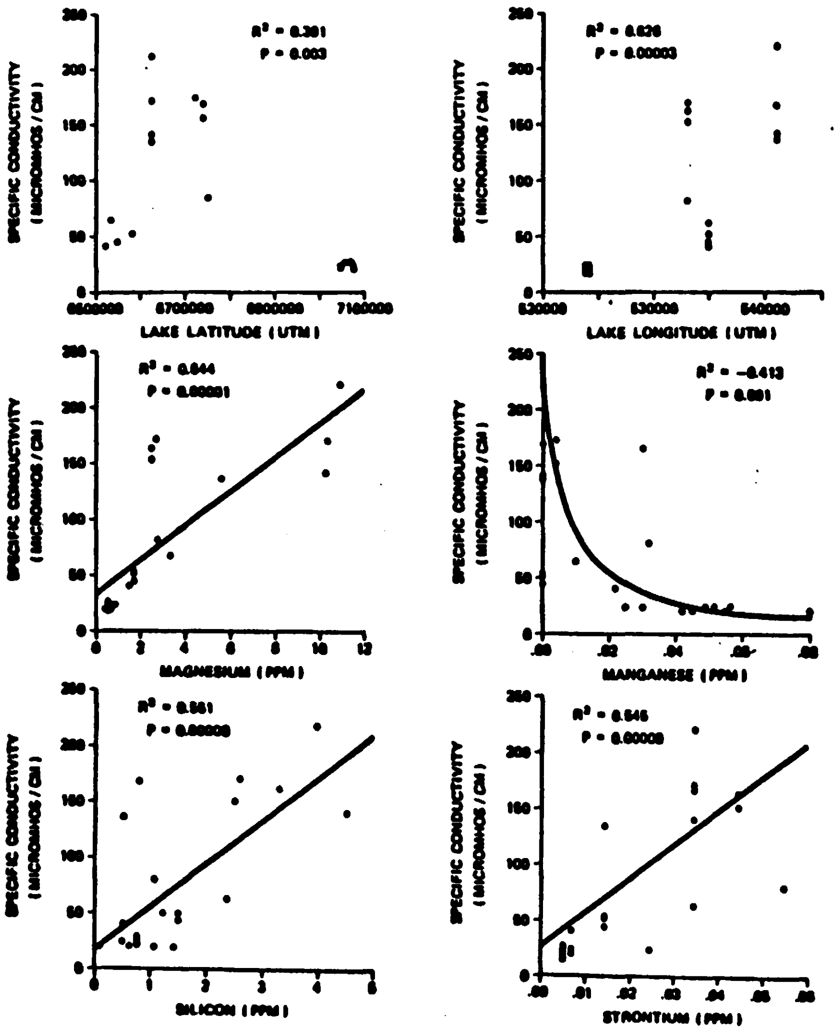


Figure 3:7 Correlations for staircase lakes.

A: Specific conductivity/altitude
B: Specific conductivity/lake longitude
C: Specific conductivity/Mg
D: Specific conductivity/Mn
E: Specific conductivity/Si
F: Specific conductivity/Sr

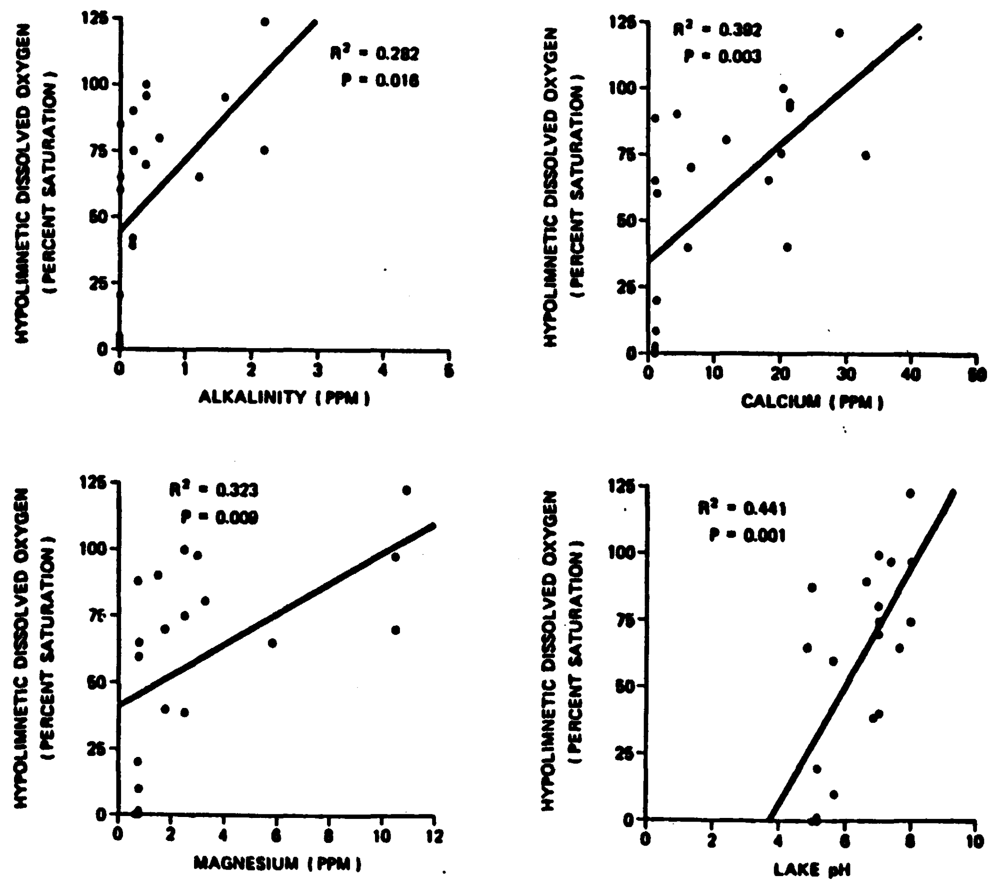


Figure 3:8 Correlations for staircases hypolimnetic D.O.

A: D.O./Alkalinity
B: D.O./Ca
C: D.O./Mg
D: D.O./Lake pH

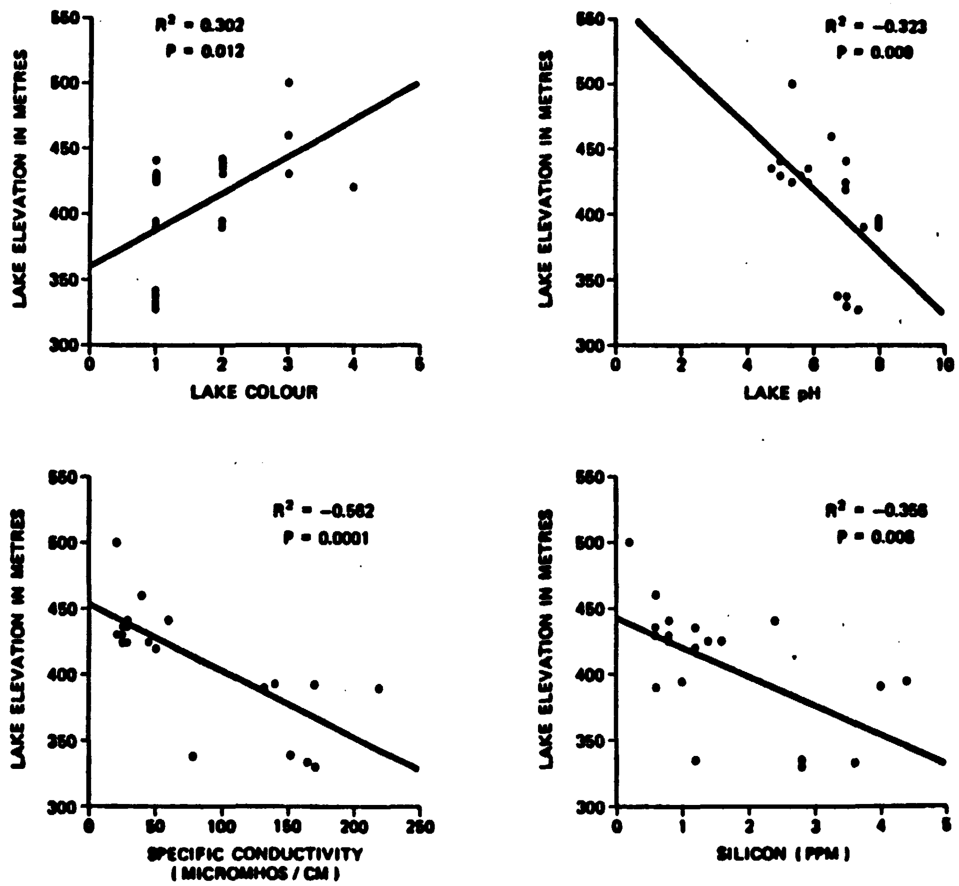


Figure 3:9 Correlations for surface waters (staircase lakes) lake elevation.

A: Elevation/Lake colour
B: Elevation/lake pH
C: Elevation/Specific conductivity
D: Elevation/Silicon

Secchi Transparency and Colour

In general, the more humic (brown) the water, the lower its Secchi. Lakes X_2 and X_3 were only slightly humic, but they were so shallow that particulate matter from their littoral zone was resuspended by wind action. This substantially reduced the clarity of the water. The lowest Secchi (1.8 m) was obtained in Lake W_3 which was only 2 m deep. Resuspension of bottom sediments by wind mixing was assumed to be the major reason for the lack of transparency in this and other shallow lakes.

B. 1981 WATER CHEMISTRY STATISTICAL RESULTS

Lake Alkalinity

A positive exponential relationship was observed when alkalinity was regressed against pH (Fig. 3:4 B, R^2=.60). Above a pH of 7, a relatively large increase in alkalinity was correlated with a small increase in pH (Fig. 3:4 B).

Alkalinity was also positively correlated with the amount of dissolved oxygen (D.O.) in the lake's hypolimnion (Fig. 3:8 A, R^2=.28). Lakes with low alkalinity had low hypolimnetic D.O. This relationship is typically ascribed to the positive correlation between lake productivity and alkalinity (Hutchinson 1957). At alkalinities above 1 mg/l, the algal biomass was significantly greater than in those lakes displaying low alkalinity (0-0.5 mg/l). The decomposition of algal cells at the bottom of a lake reduces the D.O., thereby resulting in a reduction in hypolimnetic D.O. Thus, all else being equal, the greater the primary productivity within a lake, the lower its hypolimnetic D.O. In a sense, hypolimnetic D.O. can be used as a crude yard stick of lake productivity (Charlton 1980). Lakes of similar morphometry with high primary productivity display low mid-summer hypolimnetic D.O. (i.e. the more eutrophic the lake, the greater the rate of decomposition of organic matter in its basin).

Lake pH

In general, the lower a lake's pH, the lower the level of Ba, Al*, Mn, and P and the higher the dissolved Mg, Cu, Si and Sr. Alkalinity was linearly correlated with specific conductivity, magnesium and copper (Fig. 3:4 E, C and A; R^2=-.56, R^2=.97, R^2=.45, respectively). The lower a lake's alkalinity, the lower its concentration of Mg and Cu. Heavy metals such as Mn, which precipitate from solution at alkalinities above 0.1 ppm (Kramer 1979), were inversely correlated with alkalinity (Fig. 3:4 D, R^2=-.35). The shape of the relationship between Mn and alkalinity resembled a negative exponential with an inflection point at 0.1-0.2 ppm $CaCO_3$ alkalinity.

Estimates of lake pH are typically plagued by the problem that field meters are less reliable than lab meters. Unfortunately, the time needed to get samples from the field to the lab may result in a shift in pH. To reduce the magnitude of this shift, the samples were stored in the dark at 4°C until they were analyzed in the lab,

*Aluminum was of significant interest due to its effect on fish mortality. See Kerr (1981) and Cronan and Schofield (1979).

four to ten days after being withdrawn from the lake. Although a significant correlation existed between the lab and the field estimates of pH (Fig. 3:2 D, R^2=0.984), there was a consistent increase of 0.5 pH by the time pH was measured in the lab. This discrepancy was not due to differences between the lab and field meters, as the same standards gave comparable results on the two sets of meters. Thus, it would appear that a shift in pH occurred in the water samples before they could be analyzed in the lab. The loss of carbon dioxide from solution may have caused a part of the observed increase in pH. Therefore, lake pH values in this report refer only to those measured in the field.

Acid lakes are characterized by their relatively high concentrations of sulfate. Sulfate replaces bicarbonate in these lakes as the major anion (Wright and Gjessing 1976; Dickman *in* Fortescue *et.al.* 1981).

Once the bicarbonate buffering capacity of a lake has been overcome by inputs of acid precipitation, the lake's pH shifts rapidly from 6.3 to 5.5, as would be expected from any acid-base titration. This fact explains why so few of the Wawa area lakes had a pH within the 5.5 - 6.3 range (Figs. 3:2 B and C; Part II, Section 1, pp. X-1, Z-1, U-1, W-1, and Y-1).

Below a pH of 5.5, another buffering system which depends on weak organic acids such as fulvic and humic acids, comes into play. This buffering system is less effective than the bicarbonate system in damping large fluctuations in pH following acid precipitation events. According to Dickson (1975) lakes which display a pH of less than 5.5 are particularly prone to episodic inputs of acid precipitation.

WATERSHED MOBILIZATION OF SELECTED ELEMENTS

Wawa area acid lakes displayed elevated levels of barium, aluminum and manganese. Since precipitation contains only negligible amounts of these three elements (Galloway et al 1976), the relatively high concentrations in these acid lakes may represent their dissolution and mobilization (following acid precipitation events) from the watersheds of these same lakes. Aluminium, is found in precipitation in negligible levels. However it can be leached from the watershed by acidic precipitation. Aluminum occurred at abnormally high concentrations in the acid lakes studied (Fig. 3:2 A). This is consistent with the observations of Galloway et al (1976) who showed that manganese and aluminum concentrations were low ("impoverished") in the surface sediments of their Adirondack study lake but high in the water column of this lake. This was ascribed to leaching by acid rain.

Manganese and aluminum concentrations in acidic precipitation is typically quite low. However, it was present along with maganese at significantly higher concentrations in the acid lakes than in the neutral and alkaline lakes (Figs. 3:1 and 3:2). Thus, it would appear that acid precipitation greatly enhanced their mobilization and leaching rate.

ATMOSPHERIC ENRICHMENT OF SELECTED ELEMENTS

A second group of elements, strontium, silicon, copper and magnesium, were positively correlated with lake pH and alkalinity [Table 3:1; Fig. 3:2 B and E, Fig. 3:1 B and D (R^2=.36, .62, .41 and

.44 respectively)]. We believe that these elements were enriched in the atmosphere due to increased atmospheric emission from the combustion of fossil fuels and from the sintering of iron. A number of these elements have been reported by Galloway and Likens (1979) as being enriched in the atmosphere relative to their crustal abundances.

NON-LINEAR RELATIONSHIPS

Nine significant correlations between lake pH and dissolved electrolytes were observed for the 22 staircase lakes. The great majority were nonlinear. Because the correlation coefficients (Figs. 3:2 to 3:9) were generated by Pearson-ranked correlation formulae, there was no assumption of linearity. The lack of linearity in the correlations with lake pH is worthy of comment. Specific conductivity, strontium, magnesium, alkalinity and copper all share the same general exponential non-linear pattern [Figs. 3:1 C and D, Figs. 3:2 E, C and B (R^2=.67, .44, .62, .60 and .36 respectively)]. At low pH (4.4-5.6), a large shift in pH resulted in only a small increase in the concentrations of each of these five parameters. Conversely, above a pH of 7, a relatively small shift in pH resulted in a large change in the above parameters. This pattern is characteristic of a pH titration curve. Below a certain pH, one can add a relatively large amount of alkaline material without effecting a major shift in pH. However, once the "surplus" hydrogen ions are used up, the addition of a relatively small amount of alkaline material will result in a large shift in pH. This results in a non-linear relationship with the negative logarithm of the effective hydrogen ion concentration. This same lack of linearity was evident in the relationship between three of the six pairs of base metals (Fig. 3:3 A to F). Two of these non-linear relationships, barium and magnesium, and manganese and magnesium, were inversely correlated, while aluminum and manganese were positively correlated (Figs. 3:3 B, D and A, R^2=-.30, R^2=-.35, R^2=.42). Silicon and sulfate, on the other hand, were linear and positively correlated with strontium levels in the twenty-two staircase study lakes (Figs. 3:3 E and F, R^2=.43, R^2=.54). Copper and magnesium were also positively correlated (Fig. 3:3 C, R^2=.42).

C. PRINCIPLE COMPONENT ANALYSIS OF PHYSICAL-CHEMICAL PARAMETERS

Principle component analysis permits an assessment of each of the major variables which we measured (Fig. 3:10). In this particular analysis, variance for the twenty-two study lakes was best expressed by two major axes: 1) lake and basin area, and 2) pH. Those points which were located near the centre of these axes (i.e. within the 95% confidence limit circle) were not statistically significant ($P < 0.05$) with respect to the two axes. Correlation coefficients were calculated for each of the 24 variables and 22 staircase study lakes. This resulted in a contingency table with 288 paired combinations (Table 3:2).

Numerous statistical correlations were noted when the relationships between pH, water chemistry and several physical-morphometric factors were examined (Table 3:2). Those correlations which were significant at the $P \leq 0.05$ level were plotted, and the plots were grouped into 8 major categories as previously discussed: 1) pH

(Fig. 3:1 and 3:2); 2) specific conductivity (Fig. 3:7); 3) hypolimnetic dissolved oxygen (Fig. 3:5); 4) physical-morphometric factors (Fig. 3:6); 5) base metal relationships (Fig. 3:3); 6) alkalinity (Fig. 3:4); 7) elevation (Fig. 3:9); and 8) interactions (Fig. 3:8). Sample depth, lake area and basin area were all significantly intercorrelated. This was represented on the vertical axes in Figure 3:10. Lakes with high pH were high in calcium, magnesium, alkalinity, specific conductivity and copper. Low pH lakes were positively correlated with high concentrations of aluminum and manganese in their water columns (Fig. 3:10). Although each of these paired correlations were previously discussed, the use of principle component analysis permits the simultaneous comparison of each of the 24 variables. From this analysis, certain <u>groups</u> of factors can be recognized.

The high correlation between axis 1 and aluminum and axis 2 with Ba and Mg (Fig. 3:10), was due to differences in levels of those variables between watersheds. Aluminum concentrations were generally low in the neutral and alkaline watersheds U, W and Y, and higher in X and Z. Barium levels are very low in watershed X and high elsewhere. The situation is not as clear cut concerning magnesium, as the concentration of this chemical was lowest in watershed X and Z, highest in Y and intermediate in U and W (Fig. 3:10).

Principle Coordinate Analysis of Physical-Chemical Parameters

Analyses based on similarity martices were used to define lake clusters. First, similarities betweeen lakes were measured using

	Calcium (ppm)	Lake Area (km^2)	Dissolved Oxygen (per cent saturation)	Lake Colour (Pearl Uhle Colour Units)	Depth at Sample Point (m)	Basin Area (km^2)	Secchi Depth (m)	Alkalinity (ppm)	Sulfate (ppm)	pH	Conductivity Temperature (25°C) Corrected (micromhos/cm)	Barium (ppm)	Aluminum (ppm)	Zinc (ppm)	Manganese (ppm)	Boron (ppm)	Phosphorus (ppm)	Copper (ppm)	Magnesium (ppm)	Silicon (ppm)	Strontium (ppm)	Lake Location North (UTM) North Latitude	Lake Location East (UTM) West Longitude	Lake Elevation Above Mean Sea Level (m)
Calcium (ppm)	X	-.5133 *	.6519 ***	-.2879	-.4134	-.1426	-.3931	.9340 ***	.4543 *	.9099 ***	.9334 ***	-.5500 **	-.8100 ***	-.2182	-.7781 ***	.5520 *	-.3359	.4552 *	.9449 ***	.6926 ***	.8037 ***	-.3564 *	.7273 ***	-.7230 ***
Lake Area (km^2)		.021 X	.001 -.3247	.074 .1130	.056 .6206 **	.549 .5251 *	.070 .5192 *	.001 -.5017 *	.034 -.0151	.001 -.4453 *	.001 -.4340	.008 .3170	.001 .2186	.329 .2309	.001 .3515	.013 -.5718 **	.126 .1406	.033 -.3366	.001 -.6234 **	.001 -.1563	.001 -.4905 *	.011 -.1807	.001 -.5006 *	.001 .1674
Dissolved Oxygen (per cent saturation)			.162 X	.635 -.2369	.004 -.4942 *	.017 -.2065	.019 -.5305 **	.024 .6214 **	.949 .3623	.049 .6190 **	.055 .6734 ***	.173 -.2749	.353 -.5400 **	.327 -.0160	.129 -.5255 *	.008 .2693	.532 -.2132	.147 .3596	.003 .6191 **	.510 .0901 *	.028 .5226 *	.446 -.5662 **	.022 .5292 *	.481 -.3770
Lake Colour (Pearl Uhle Colour Units)				.344 X	.018 .3073 *	.302 -.0523	.005 .1022	.002 -.3045	.097 -.4474 *	.002 -.2720	.001 -.3067	.216 .2302	.009 .3315	.941 -.3246	.012 .0766	.226 -.3664	.341 .0964	.180 -.1910	.002 -.3584	.021 -.4666 *	.013 -.3055	.000 .1750	.016 -.1520	.181 .5510 *
Depth at Sample Point (m)					.044 X	.027 .6343 **	.619 .6646 ***	.160 -.3100	.037 -.3303	.221 -.1777	.051 -.3413	.303 .2800	.132 .1202	.140 .0309	.735 .0508	.094 -.3056	.669 -.2995	.395 .0083	.101 -.4317 *	.029 -.0655	.076 -.3575	.459 .3257	.520 -.3719	.012 .1203
Basin Area (km^2)						.003 X	.001 .4060	.160 .0180	.133 -.3031	.429 .0001	.088 -.1099	.194 .1136	.370 -.0424	.091 -.0508	.022 -.1265	.076 -.3283	.176 -.3723	.971 0.000	.045 -.1016	.772 .1062	.102 -.2717	.161 .0113	.106 -.0910	.587 -.1734
Secchi Depth (m)							.075 X	.937 -.3031	.095 -.2508	.737 -.2922	.645 -.3025	.634 .2292	.059 .1101	.032 .3363	.595 .0069	.158 -.2002	.106 .1418	- -.2163	.670 -.4725 *	.432 -.0153	.247 -.3599	.962 -.2603	.703 .3590	.465 .1045
Alkalinity (ppm)								.078 X	.245 .3001	.187 .9597 ***	.133 .8600 ***	.305 -.5130 *	.626 -.8330 ***	.126 -.3206	.701 -.8678 ***	.372 .5027 *	.529 -.3920	.334 .5243 *	.026 .9331 ***	.946 .6446 ***	.100 .7550 ***	.251 -.6975 ***	.119 .8213 ***	.661 -.5622 *
Sulfate (ppm)									.175 X	.001 .2414	.001 .4502 *	.015 -.0747	.001 -.4889	.146 .1065	.001 -.1371	.017 .3074	.071 -.2644	.012 -.0343	.001 .3413	.001 .3745	.001 .6106 **	.001 -.3559	.001 .1492	.018 -.4337 *
pH										.279 X	.032 .8564 ***	.741 -.5087 *	.021 -.8440 ***	.637 .2923	.543 -.9206 ***	.164 .3983	.234 -.4236 *	.079 .5590 ***	.120 .9003 ***	.066 .6363 ***	.003 .7126 ***	.124 -.6700 ***	.530 .8061 ***	.056 -.6424 **
Conductivity Tempr (25°C) Corrected (micromhos/cm)											.001 X	.016 -.5079 *	.001 -.7660 ***	.187 -.0694	.001 -.7330 ***	.066 .4171	.049 -.3201	.007 .5000	.001 .9006 **	.001 .6725 ***	.001 .8294 ***	.001 -.6054 **	.001 .7229 ***	.002 -.7642 ***
Barium (ppm)												.016 X	.001 .4736 *	.759 .1929	.001 .4470 *	.053 -.1390	.146 .2009	.018 -.4366 *	.001 -.5446 ***	.001 -.0701	.001 -.3035	.005 .4754 *	.001 -.6655 ***	.001 .4627 *
Aluminum (ppm)													.026 X	.390 .1614	.037 .8156 ***	.537 -.3249	.370 .4091 *	.042 -.3559	.009 -.7673 ***	.730 -.5630 **	.170 -.6865 ***	.034 .7234 ***	.001 -.6677 ***	.040 .6116 **
Zinc (ppm)														.473 X	.001 .2660	.108 .0752	.021 .3397	.104 -.3100	.001 -.3300	.006 .0026	.001 -.1340	.001 .3297	.001 -.4449 *	.004 -.0927
Manganese (ppm)															.230 X	.739 -.3160	.122 .3103	.140 -.5701 **	.123 -.7073 ***	.991 -.4098 *	.550 -.5584 **	.156 .7389 ***	.049 -.8243 ***	.690 .5067 *
Boron (ppm)																.152 X	.149 -.0162	.006 .1305	.001 .4395 *	.021 .4437 *	.007 .5016 *	.001 -.1271	.001 .2205	.023 -.1805
Phosphorus (ppm)																	.043 X	.563 -.3696	.041 -.4145	.039 -.3742	.017 -.4054	.593 .4273	.332 .3970	.446 .4730 *
Copper (ppm)																		.225 X	.055 .5774 ***	.006 .3120	.061 .3221	.060 -.4799 *	.003 .7112 ***	.035 -.2800
Magnesium (ppm)																			.005 X	.156 .6311 **	.144 .8486 ***	.032 -.6745 **	.001 .8509 ***	.218 -.6327 **
Silicon (ppm)																				.002 X	.001 .6930 ***	.001 -.3971	.001 .4276	.003 -.6602 **
Strontium (ppm)																					.001 X	.003 -.4350	.060 .5598 *	.002 -.7170 ***
Lake Location North (UTM) North Latitude																						.055 X	.010 -.8514 ***	.001 .2560
Lake Location East (UTM) West Longitude																							.001 X	.276 -.0261
Lake Elevation Above Mean Sea Level (m)																								.063 X

TABLE 3:2 Wawa Lakes Physical-Chemical Factor Pearson Correlation Contingency Table Probability (P) Values are Given Below the Non-Parametric Correlation Co-Efficients for Each Paired Relationship.*

(n = 30)

*Moderately (**) and highly (***) significant correlations are boxed.

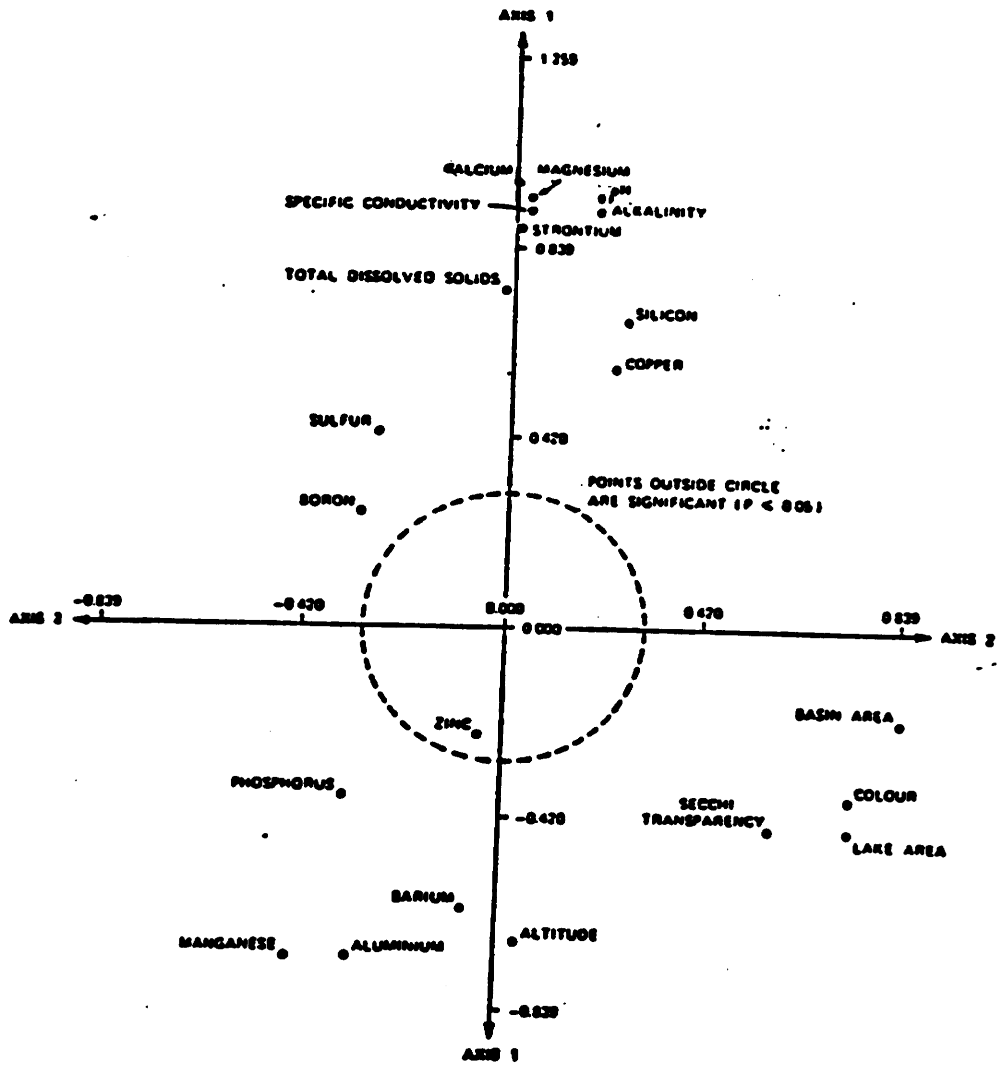


Figure 3:10 Principle Component Analysis of Physical-Chemical Parameters p<.05.

the Steinhaus' coefficient, described in Motyka et al (1950), whose formula is the following for any given lake pair:

$$S = 2W/A+B$$

Where W represents the summation of the minimum densities* of each species, defined as the density of the species in the sample where it is scarcest; A and B are the respective summations of all species' densities in each of the samples compared.

The association matrix "S" was used in two different sets of clustering methods. Two approaches were used. In the first approach an attempt was made to define very restrictive lake clusters. In order to do that, four different hierarchical clustering methods were used: single linkage (Sneath, 1957), complete linkage (Sorensen, 1948), weighted clustering (WPGMA in Sneath and Sokal, 1973) and flexible clustering using the algorithm defined by Lance and Williams (1966, 1967). The latter, flexible clustering, was calculated using values for j, k, m, and n of 0.625, 0.625, -0.25 and 0 respectively. The similarity value chosen to define clusters corresponded to the level given the same lake clusters regardless of the method used. In a second, less restrictive approach, flexible clustering alone was used as a basis of defining the groups of lakes.

In both approaches, the results were superimposed over the position of the lakes upon the surface formed by the two first axes extracted by principal coordinate analysis (Gower, 1966). This was performed using acetate transparencies in order to describe more accurately the pattern of variation among the lakes.

Interpretation of the results consisted of defining the characteristics of each cluster. This was done by using a series of contingency tables. This method permitted detection of significant relations between physical chemical parameters and species densities within each of the lake groups.

Significance was measured by a t-test. As a prerequisite to the building of contingency tables, the continuous values taken by both physical chemical parameters and species density had to be divided into classes. Rather than do this arbitrarily, a method based on information theory was used to maximize the information content [measured in bits by the Shannon formula (1948)], between

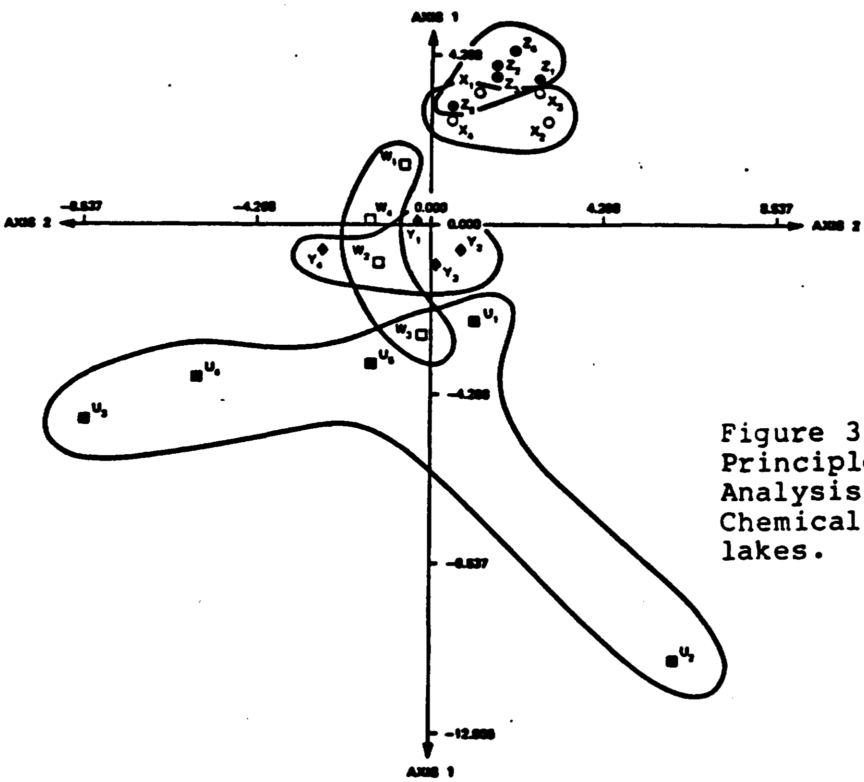


Figure 3:11
Principle Component
Analysis of Physical/
Chemical grouping by
lakes.

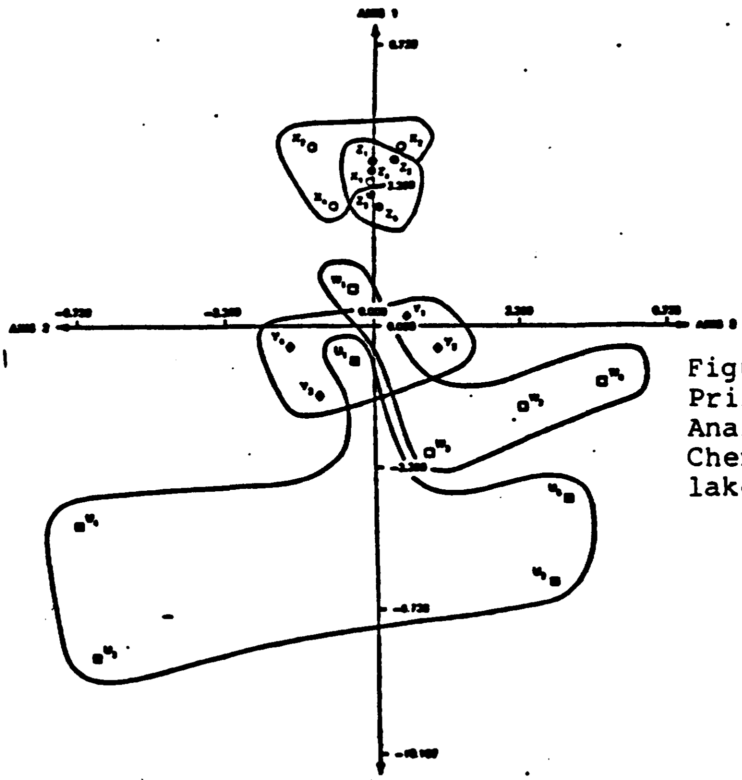


Figure 3:12
Principle Co-ordinate
Analysis of Physical/
Chemical grouping by
lakes.

the lake groups and the chosen class intervals (Legendre & Legendre, in preparation).

Principle coordinate analysis is based on analyses of a similarity matrix while principle component analysis is based on a covariance matrix. The same data set was subjected to both methods of analysis and only those relationships which were common to both were discussed.

The results of principle coordinate analysis differ slightly from those of principle component analysis. The loading of axis 2 became more highly associated with morphometric factors (such as lake and basin area), while axis 1 was largely related to pH and water chemistry associated factors (Fig. 3:12).

A high positive loading on axis one, was associated with high pH, alkalinity, calcium, magnesium, specific conductivity, high total dissolved solids, silicon, copper and sulfate. Conversely, high concentrations of aluminum, barium and manganese were associated with low pH, calcium, alkalinity, etc., as well as high elevation (Fig. 3:12).

The second axis (axis 2) explained a relatively small percentage of the total variance between lakes (14%) as previously noted. Axis 2 was correlated with morphometric factors such as lake depth, area and basin area. To a lesser degree Secchi transparency, total phosphorus concentration and lake colour were also associated with axis 2.

By superimposing Fig. 3:12 on top of Fig. 3:10 it was possible to make some generalizations about the major water chemistry factors associated with the clustering of the 22 study lakes. The Y lakes were associated with the highest pH, calcium, alkalinity, specific conductivity and magnesium concentrations. The W lakes as well as Lake U_2 were more intermediate with a pH ranging from 6.8 to 7.1 (Part II, Section 1, pp. X-1, Z-1, U-1, W-1 and Y-1). The remaining U lakes (pH ranged from 6.3 to 6.9) were more affected by lake morphometry (axis 2) than any of the other study lakes. Lakes U_{3-5}, as well as Lakes Z_5 and X_4 were the largest of the study lakes, hence their high loading on the positive side of axis 2.

The Z and X lakes displayed the lowest pH (4.6-5.6) and the highest aluminum, manganese and barium concentrations. These were also the lakes with the highest elevations (Part II, Section 1, pp.2-1 and X-1).

Staircase effects (i.e. differences from the top to the bottom of any particular watershed of lakes) were not apparent from these two figures, even though elevation was a significant correlate of axis 1. A similar comparison can be made for Figs. 3:11 and 3:12 (Principle Component Analysis). Although the X and Z watersheds are closely correlated in both the principle coordinate analysis and the principle component analysis, the pattern of lakes within the U watershed differs substantially. Otherwise, the two statistical approaches appear to support one another.

In conclusion, two separate methods of data analysis were used in this study:

1) Principle Coordinate Analysis which is based on a similarity matrix; and
2) Principle Component Analysis which is based on a covariance matrix.

Both methods of analysis confirmed the general pattern between axis 1 (water chemistry factors) and axis 2 (morphometric factors). However, principle coordinate analysis was slightly more powerful in discriminating between lake clusters than was principle component analysis.

D. SUMMER PHYTOPLANKTON IN THE STAIRCASE LAKES NORTH OF LAKE SUPERIOR

The relationship between phytoplankton species composition and relative abundance in each of the 22 staircase lakes was analyzed using principle coordinate and principle component analysis.

Principle Coordinate Analysis and The Calculation of Similarity Matrices

The lake clusters were defined by the species which they shared in common. Using the flexible linkage model (Lance & Williams, 1966 & 1967) it was possible to create a cluster hierarchy (Fig. 3:13). Those lakes connected by the longest lines displayed the greatest differences in terms of their phytoplankton species assemblages. Thus, Lakes Z_3 and U_2 were the most dissimilar in terms of their species assemblages. This same type of information can be represented by principle component analysis (Fig. 3:14). Based on phytoplankton species assemblage, the 22 lakes cluster into 2 main groups; the acid lakes, X and Z, and the neutral and alkaline lakes, U, W and Y (Fig. 3:14).

LAKE CLUSTERING BASED ON ZOOPLANKTON ANALYSIS

The PCA of the log-transformed zooplankton data separated the lakes into 3 groups: X, Z and Y-W-U. The extreme position of Lake

Y_1 seems to be a result of the unusually high abundance of Conochiloides sp* in this lake. As previously noted, Lake Z_5 (Doc Greg Lake) occupies a separate watershed, therefore it was not surprising to see it separated out from the other Z lakes.

The analysis of the log transformed zooplankton data separated the watersheds according to their zooplankton species composition. However, only around 19% of the total variance was explained by the first axis and 15% by the second.

Zooplankton and phytoplankton densities in each of the 22 study lakes sampled in 1981 are archived in the Biological Studies Department, Brock University, St. Catharines, Ontario, L2S 3A1.

SURFACE SEDIMENT DIATOMS FROM THE STAIRCASE LAKES

The Relationship Between Diatom Inferred pH and Observed pH

During the period June 1981 to July 1982, 28 lakes were sampled and cored with a K-B gravity corer. The location of many of these lakes is displayed in Fig. 3:13. The surface sediments (0-0.5 cm) of each of these lakes was removed from the top of the core. Diatoms in these sediments were then counted so that the abundance of each of the diatom taxa could be recorded. Less than 13% of the total were unidentified. Diatoms were assigned pH indicator status after a careful evaluation of 61 references compiled by Beaver (1981). Due to their scarcity, the number of acidobiontic and

* According to John Gilbert (1982) Conochiloides becomes abundant in eutrophic lakes or in lakes where the more efficient filter feeders such as the clodocera and to a lesser extent the Copepods, have dropped in abundance. The Y lakes were the most eutrophic of the lot.

alkalobiontic taxa, which are excellent indicators of pH, were weighted by multiplying their relative abundance by five (Nygaard 1956). The resulting quotient (weighted relative abundance of acid/alkaline diatoms) was logged (base 10) and referred to as log alpha (Nygaard 1956).

Surface sediment and downcore diatom species composition and abundance data were archived. These data are available by writing to M. Dickman, Biological Sciences, Brock University, St. Catharines, Ontario, Canada, L2S 3A1. A list of each of the 320 diatom taxa which we encountered is included as an Appendix in Part II, Section 5(A) of this report.

The 25 most common diatom taxa from the 28 study lakes (Algoma District) were compared using butterfly diagrams constructed by Dixit (Fig. 3:14) to represent the relative abundance of each taxa in lakes of varying pH.

Roughly a third of the 25 common diatom taxa occurred in a variety of lakes irrespective of the lake's pH. These diatoms were referred to as pH indifferent. Their presence was ignored in the calculation of diatom inferred pH. The remaining two-thirds of the diatom taxa were pH sensitive indicators and these were classified into five categories.

1. Acidobiontic - taxa which were most abundant below a pH of 6.
2. Acidophilic - taxa which were most abundant below a pH of 7.
3. Circumneutral - taxa which were most abundant between a pH of 6 and 8.
4. Alkalophilous - taxa which were most abundant above a pH of 7.
5. Alkalobiontic - taxa which were most abundant above a pH of 8.

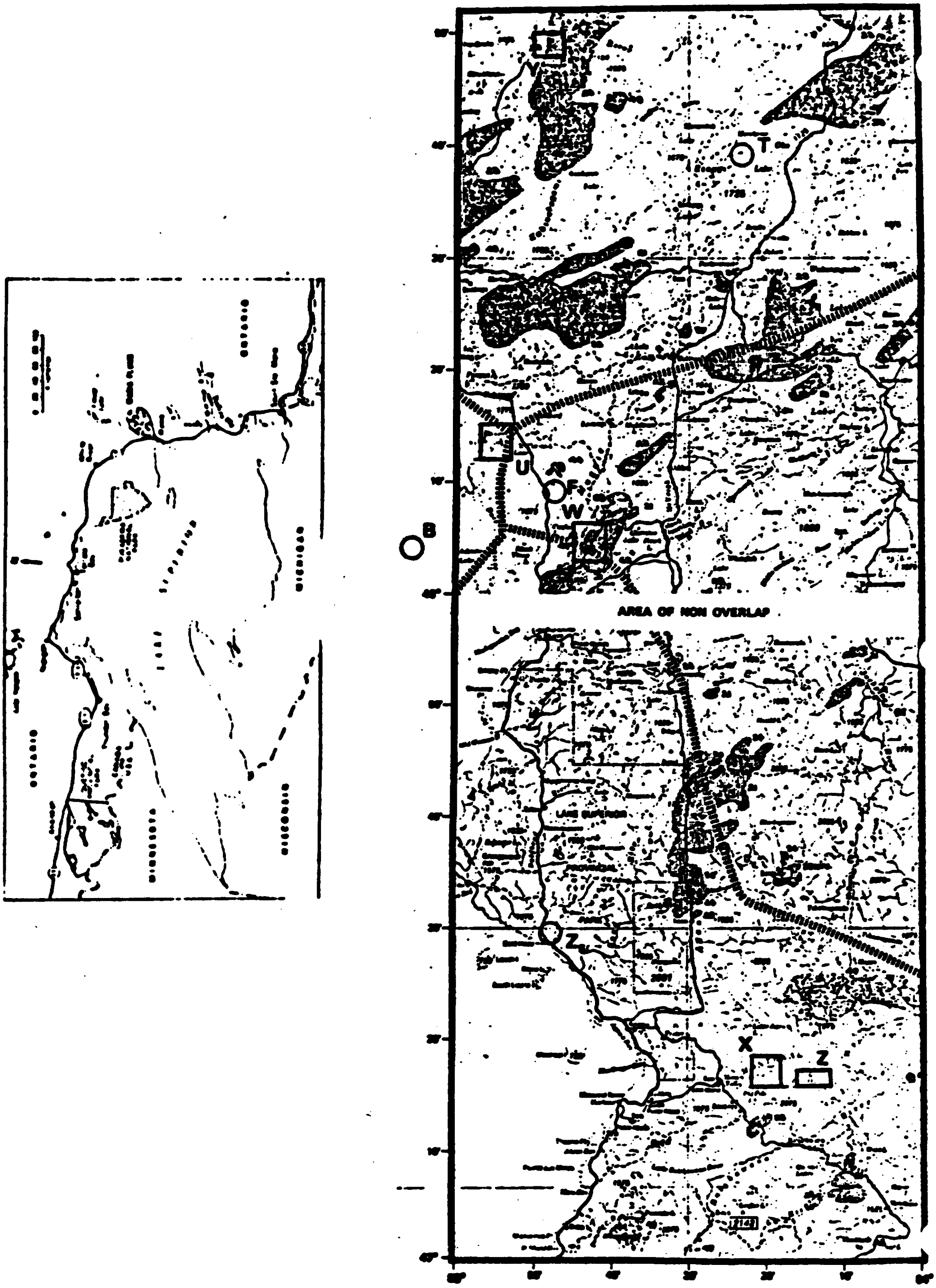


Figure 3:13 Location of staircase lakes and Lakes B, F, and T.

Assignment of pH Indicator Status

The assignment of pH indicator status to each diatom taxon was made on the basis of the literature (e.g. Beaver, 1981) and not on the basis of our observation of their distribution in the 28 study lakes. The reason for this is simple. By using the literature to assign pH indicator status to each species we were able to compare our results with other workers who had assigned their indicator status on the same basis (Fig. 3:15).

It should be noted that only two of the 25 taxa in Figure 3:14 differ significantly from the status assigned to them in the published literature. According to Beaver (1981), *Cyclotella comta* is assigned circumneutral status by the majority of authors publishing on its pH indicator status. Our data (Fig. 3:15) suggest that, at least in the Algoma district, it behaves more like an acidophilous species. *Anomoeneis vitrea* is an example of a species which appears to behave as a circumneutral taxa in the Algoma area (Fig. 3:15) although it is most frequently classified in the literature as an alkalophilous species (Beaver 1981).

Stepwise multiple regression analysis was used to compare the pH indicator status of each of the common diatoms with the observed lake pH in which each taxa was most frequently found. These analyses indicated that with only 2 exceptions (ie. those noted above), the indicator status of the 25 commonest diatoms in the Algoma Region was consistent with that described in Beaver (1981).

Regional Differences Between Log Alpha

Because log alpha has been the most commonly employed index to date, it can be employed in a comparison between geographical regions of Europe and North America. In the Algoma area north of Lake Superior, the relationship between observed pH and log alpha was Y = 6.57 - 0.82 log (Table 3:3) where Y is defined as the diatom inferred pH. In comparisons with other studies the slope of the regression line (b) ranged from a low of 0.46 (Nygaard 1956) to a high of 0.82 (Dickman et. al. 1983) (Table 3:3). The Y intercept ranged from a low of 6.34 (Norton et. al. 1981) to a high of 6.97 (Nygaard 1956).

Differences in slope and intercept displayed in the regression equations in Table 3:1 indicated that lakes of identical pH in one part of the world are represented by pH indicator diatom assemblages

Equation	Source	# of Lakes Sampled	Location
Y _ 6.62-0.65 log	Davis and Berge 1980	29	Norway
Y _ 6.71-0.81 log	Merilainen 1967	12	Finland
Y _ 6.97-0.46 log	Nygaard 1956	13	Denmark
Y _ 6.63-0.81 log	Del Prete & Schofield 1981	7	Central New England
Y _ 6.34-0.75 log	Norton et al 1981	31	Northern New England
Y _ 6.57-0.82 log	Present Study	28	North of Lake Superior

Table 3:3 Equations for surface sediment diatom log alpha (abcissa) vs observed lake pH (ordinate) based on our estimates of both of these parameters from published figures in Norton et al (1981).

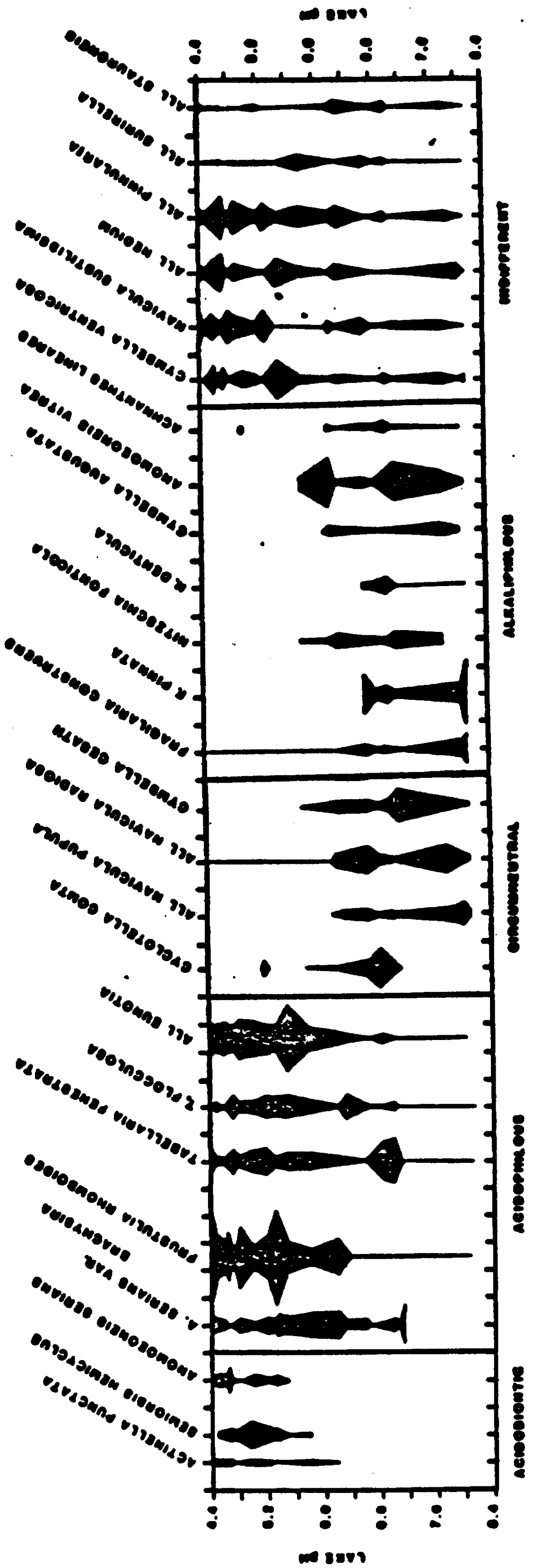


Figure 3:14 The dominant diatoms of the Wawa study lakes and their relative abundance in relation to lake pH.

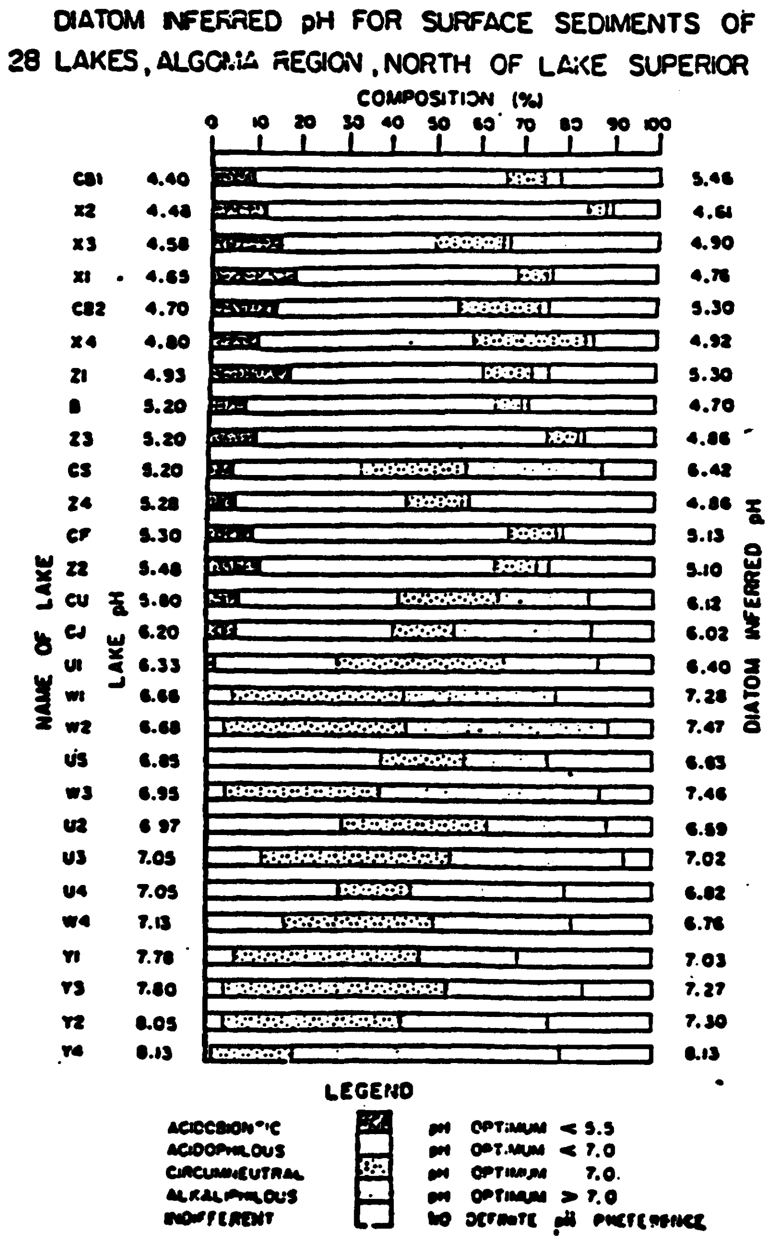


Fig. 3:15 Diatom Inferred pH for Surface Sediments of the Wawa Study Lakes (1981 and 1982).

which differ slightly in either species composition or relative abundance from those in other areas. Therefore, diatom inferred pH should be based on a calibration curve generated from the relationship between surface diatoms and lake pH in the region of study.

Calibration Curve for Diatom Inferred pH

Once the relationship between the actual observed pH in each of the study lakes and their surface sediment log alpha has been determined (Fig. 3:16), it is possible to convert log alpha to a diatom inferred pH using the equation from the regression line. From this relationship* it was possible to infer the pH of any lake from its surface sediment diatom species composition.

The observed pH and the surface sediment diatom inferred pH (for all lakes cored in 1980 and 1981) is represented in Fig. 3:17. The dashed lines running parallel to the solid black regression line represent ± 0.5 of a pH unit from the regression line. Thirteen of the 41 study lakes (32%) fell outside these limits. The reasons for this are described below in the section entitled 'Diatom Inferred pH Verification Study'.

The Relationship Between Diatom Inferred pH and Observed pH

Two things are evident from an analysis of Figure 3:17.1) Very few lakes were found with an observed pH of 5.5 - 6.5. Thus, once a lake's buffering capacity has been consumed by acid inputs, its pH appears to rapidly drop below 5.5. 2) Estimates of lake pH for many of the humic and slightly humic lakes based on their diatom species composition were lower than their observed pH (Fig. 3:17). This would indicate that the accuracy of our downcore diatom inferred pH profiles could be improved by constructing a special calibration

* $Y = 6.57 - [(\log \text{alpha})(0.824)]$

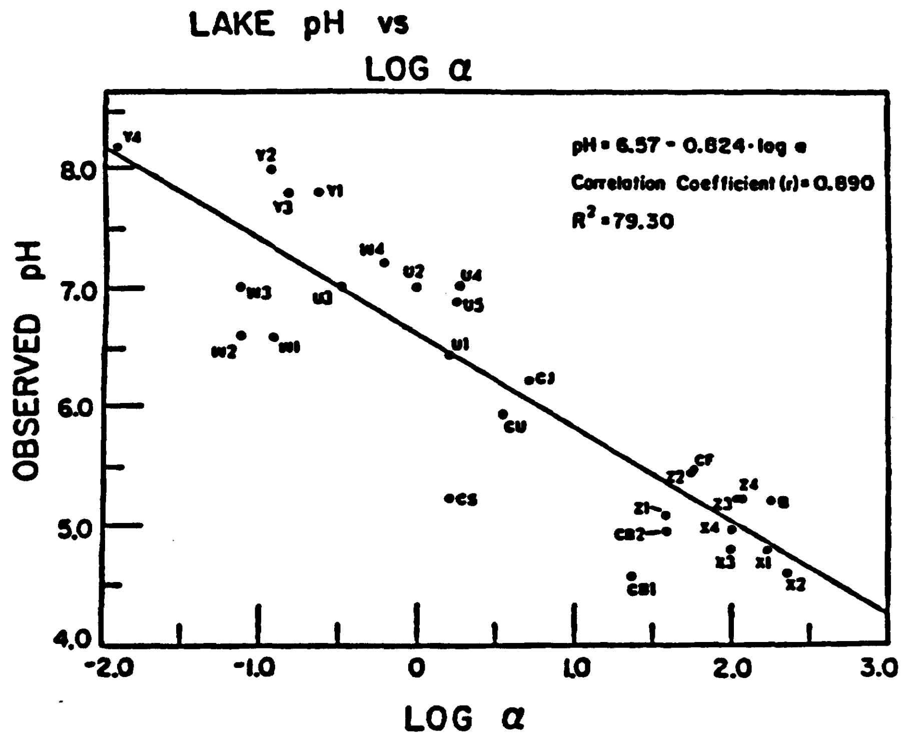


Figure 3:16 Diatom inferred pH VS. observed pH for the 28 staircase lakes studied in 1981 and 1982 near Wawa, Ontario.

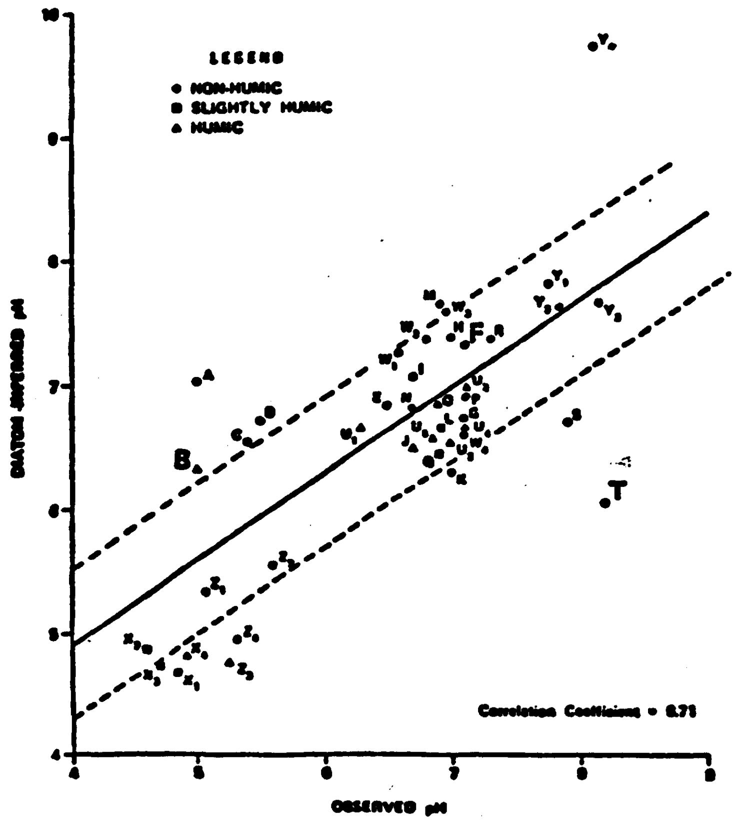


Figure 3:17 Diatom Inferred pH VS. Observed pH Wawa Lakes 1980 and 1981.

curve for humic lakes. This will be carried out by John Ciolfi in his thesis research.

DOWNCORE PROFILES FOR DIATOM INFERRED pH IN LAKES NEAR WAWA, ONTARIO

The diatom inferred pH was estimated for each 1 cm segment of the 20 cm long lake sediment cores*. The method of estimating diatom inferred pH was described in the methods section of this report.

Five watersheds were studied. These were designated U, W, X, Y, and Z. The lake from the top of a watershed was labelled as 1 (i.e. Lake U_1) while the lake from the bottom of the watershed was labelled as 4 (i.e. Lake U_4). Lakes 1 and 4 from each watershed were analyzed for diatom inferred pH. The results of these analyses are represented in ten figures, which are discussed in alphabetical order by watershed, in the following section.

In each figure, the zero core depth value represents the pH of the surface waters of the lake. Each figure also includes the Ambrosia pollen horizon established by Terasmae (details are included in this report). The greater the rate of lake sedimentation, the lower (deeper) the Ambrosia rise.

Estimates of Precision

The precision of the diatom inferred pH technique was estimated by giving coded replicate slides of sediment diatoms (from the same depth for the same core) to three individuals who were identifying

* In 1980 2.5 cm intervals were adopted, while in 1982 the top 5 cm of each core was sectioned at 0.5 cm intervals.

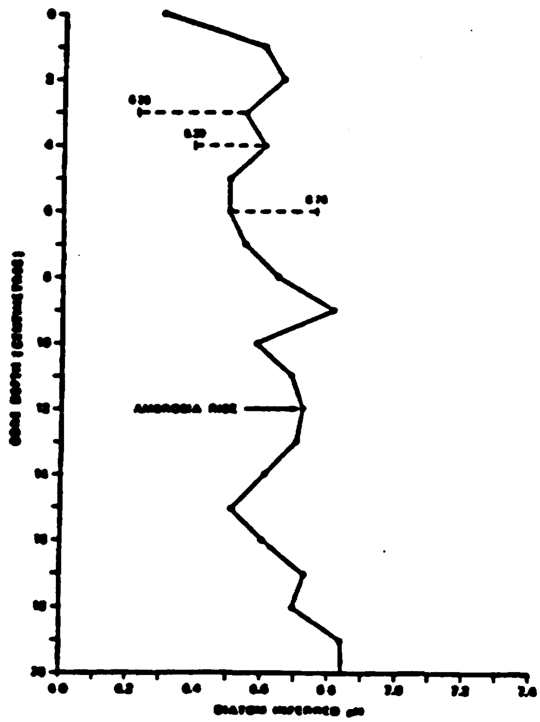


Figure 3:18 Diatom Paleo pH data for Lake U_1.

the diatoms and estimating their abundance as part of their M.Sc. theses (Yung, Dixit and Ciolfi). Selected slides were coded so that the individual making the count was unaware of the core depth that the sample represented (800 diatom frustules were counted per slide).

The dashed horizontal lines in the downcore diatom inferred pH profiles represent ranges established from replicate slides taken from the same core. Thus, at a depth of 3 cm in Lake U_1, the diatom inferred pH was 6.57. A count of an additional 800 diatom frustules, from another replicate slide prepared for the same depth, yielded a diatom inferred pH of 6.26 (Fig. 3:18).

The results of these replicate tests were plotted up in the following manner. Where only a single replicate was counted, a simple dashed horizontal line was constructed which connected the initial estimate of diatom inferred pH with its replicate value. Where a second replicate was counted, the standard error was calculated and the variance was indicated using a solid horizontal line (e.g. Lake W_1, Fig. 3:19). The solid horizontal line was drawn with the mean of the three counts at its center.

The mean diatom inferred pH for any particular depth and core was generally within plus or minus three tenths of a pH unit of the estimated diatom inferred pH. This was an improvement of two tenths of a pH unit over the 1980 study when only 600 diatom frustules were counted per replicate.

1982 Verification Series

In 1981 and 1982, Lakes W_1 and B were recored in order to determine whether their downcore diatom inferred pH pattern would be comparable with the initial core.

Lake W1 Verification

The downcore diatom inferred pH profiles for Lake W_1 (1981 and 1982) were very similar. A single discrepancy between a depth of 3 to 4 cm (Fig. 3:19) was attributed to either differential compaction or sediment focusing. Otherwise all variation in the 1982 core diatom inferred pH was less than 10% of the 1980 downcore results (Fig. 3:19).

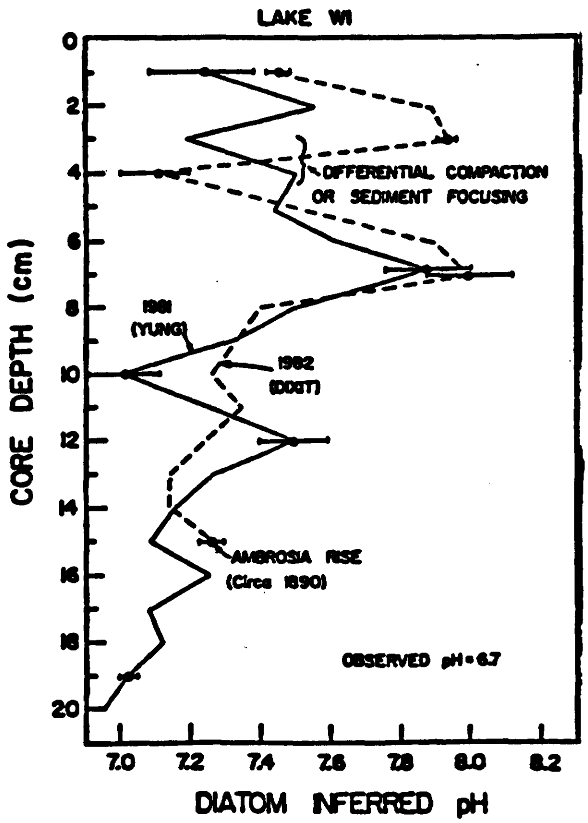


Figure 3:19 Diatom Paleo pH data for Lake W_1.

<u>Lake X1 Verification</u>

In Lake X_1, a single discrepancy between the two downcore profiles was noted at a core depth of 7 - 9 cm of the core diatom inferred pH profile (Fig. 3:36). This discrepancy of six tenths of a pH unit, exceeded the allowable 10% variation associated with our diatom counting error.

The relative abundance of centric diatoms (e.g. <u>Melosira</u>, <u>Stephanodiscus</u> and <u>Cyclotella</u>) increased in this portion of the core (7-9 cm). Centric diatoms are notoriously difficult to identify because the inner portion of the valve breaks in half (Fig. 3:23). As long as the remaining fragment is equal to or larger than one half the original, it is counted if it is still identifiable (as is the case with the SEM of Cyclotella michiganiana from Lake Y_1, Fig. 3:23). Unfortunately, many of the empty rings and broken valves are not identifiable. In my opinion, an influx of broken or empty centric diatoms at 7-9 cm which were counted by one individual and ignored by the other resulted in the observed discrepancy.

Lake B Verification

In Lake B, Cox (1980) reported all the empty "rings" as Cyclotella species while Ciolfi (1982) reported only the identifiable filled rings. Since these centric diatoms are predominantly alkalophilous, they become less abundant as the lake's pH drops. Thus, the two data sets (1980 and 1982) converge above 3 cm as the pH of Lake B fell (Fig. 3:20). To determine which data set (1980 vs. 1982) was the more correct, the Lake B results were compared with those of the nearby Lake CS (Fig. 3:53). Both Lakes B and CS had a 1982 observed pH of 5.2 and both lakes are undergoing rapid acidification (Figs. 3:24 and 3:53).

In Lake CS, nearly all the "rings" were identified and the resulting diatom inferred pH below 3 cm ranged between 7 and 7.4. Thus, it would appear that the 1980 analyses of Lake B (diatom inferred pH below 3 cm of 6.2-6.9) would be consistent with the Lake CS downcore pH interpretation. However, the large number of empty diatom rings in the sediments of Lake B below 3 cm makes it impossible to say for sure which ring forms were pH indifferent and which were alkalophilous.

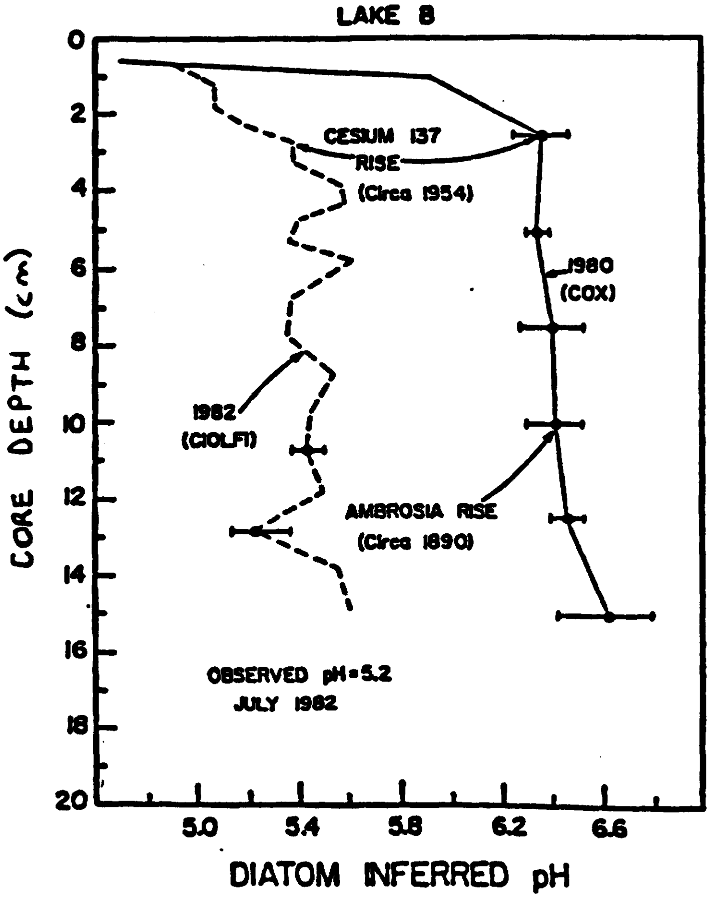


Figure 3:20 Diatom Paleo pH data (1980 and 1982) for Lake B.

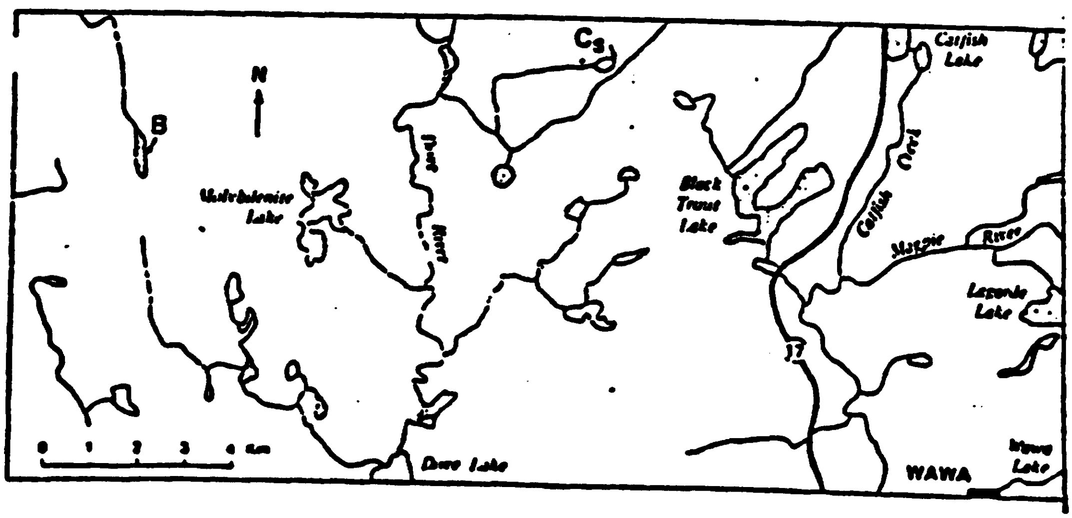


Figure 3:21 Lakes 'B' and 'CS' were located roughly 20 and 15 km northwest (upwind) of the Algoma sintering plant near Wawa, Ontario.

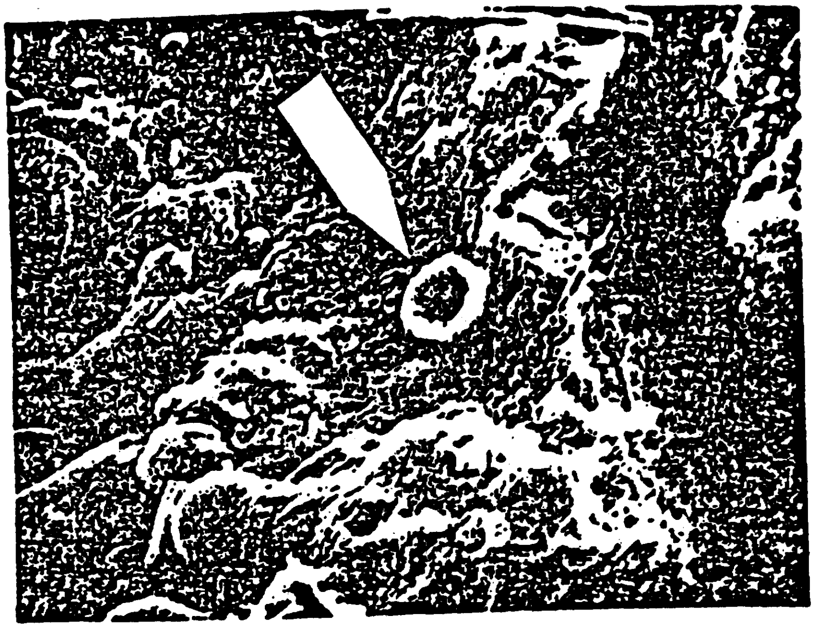


Figure 3:22 S.E.M. of an empty ring of a centric diatom. The absence of the center of the ring makes positive identification impossible (magnification = 1,000 X).

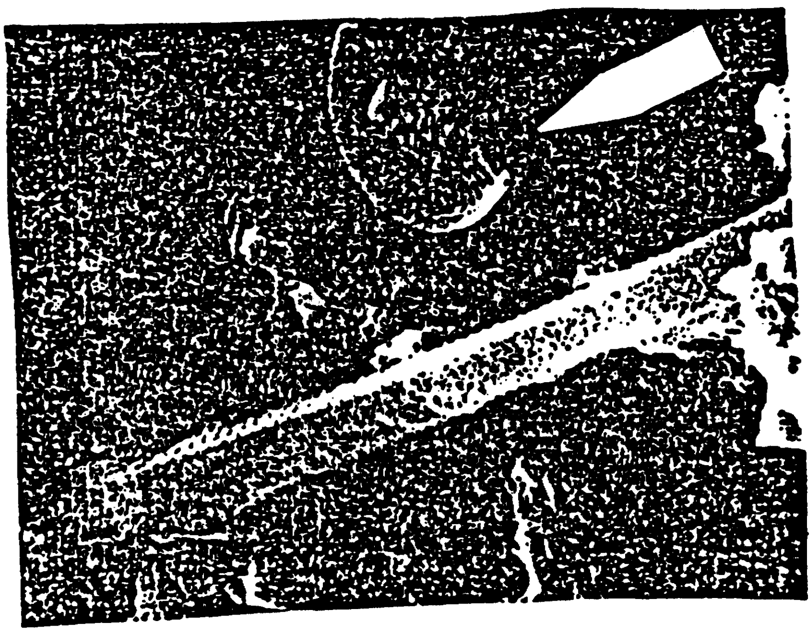


Figure 3:23 S.E.M. of a broken ring of a centric diatom. The central portion is intact making it possible to identify this broken diatom (magnification = 2,000 X).

Lake U_1 Verifications

Lake U_1 was cored in 1980 and the diatoms in the core were concentrated and counted by W. Cox. The lake was recorded in 1981 and the diatoms in this second core were concentrated and counted by S. Dixit. The results of these two independent analyses are represented in Fig. 3:25. The two downcore diatom inferred pH profiles agree quite well (to within plus or minus two tenths of a pH unit). The smaller confidence intervals (horizontal bars) associated with Mr. Dixit's analyses were the result of his larger sample sizes (800 - 1,000 diatoms per sample depth verses 600 for Cox in 1980). Nevertheless, the agreement in the downcore pH pattern is good.

Thus, diatom inferred pH based on 800 - 1,000 diatoms counted per sample will permit estimates of lake pH within ±0.2 of a pH unit. Greater accuracy and precision is possible if the number of diatoms counted is increased. However, in our opinion, the time and cost of increasing the number of diatoms counted was not justified.

Lake Verification Conclusions

In conclusion, the verification study indicated that where large numbers of broken centric diatoms occur (e.g. in Y and T lake watersheds), pH estimates may vary as much as 0.8 of a pH unit. Thus, the downcore diatom inferred pH for the alkaline Y lakes and Lake T must be interpreted very cautiously.

When observed lake pH is compared with the diatom inferred pH for the same lake based on surface sediments diatoms, the best estimates of diatom inferred pH are those which include all the centric diatoms as alkalophilous taxa even where positive identification is impossible.

In this study, only those diatoms which could be positively identified (roughly 87% of the total), were used to calculate diatom inferred pH. This is acceptable in lakes where alkalinities were low and the relative abundance of the centric diatoms is low. However, in the Y and T watershed lakes, the large number of broken centric diatoms necessitates another approach. These data should be reworked so that all the centric diatom pieces greater than half a frustule in size are counted, even if their identification to species cannot be ascertained.

Apart from the above difficulty associated with samples in which there are a large percentage of broken centric diatoms (i.e. empty rings), the verification study of lakes X_1, B and U_1 indicated a close agreement in downcore pH patterns in the independently analyzed cores.

DOWNCORE DIATOM INFERRED pH

Lake B

The surface water in Lake B had a pH of 5.0 in June, 1981 and 5.2 in June 1982. The surface sediments (0-1 cm, Fig. 3:24) of this lake had a diatom inferred pH of 4.8. At a depth of 2.5 cm (circa 1954, Fig. 3:24), the diatom inferred pH was nearly 6.3. Thus, there is every indication that the lake has acidified over the last thirty years. The largest shift in pH occurred after the Cs-137 rise (circa 1954). This rapid shift in pH was interpreted as an indication that the buffering capacity of the lake had recently been overwhelmed by an influx of acid material. In 1982, Lake B was recored and the diatoms in the new core were counted as part of the 1982 verification study (see 'Lake B Verification').

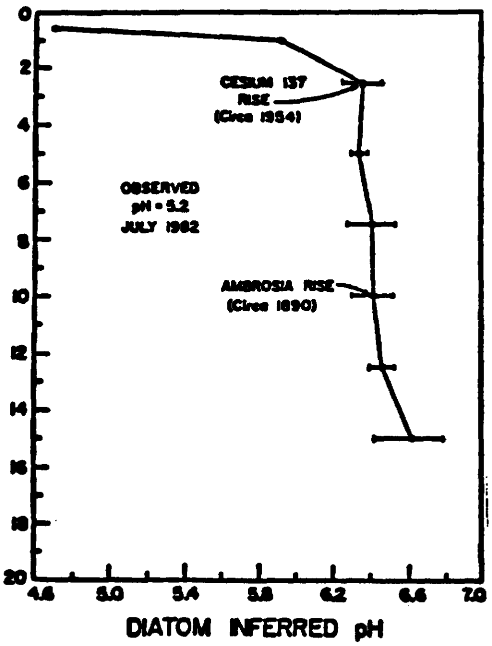


Figure 3:24 Diatom inferred pH for Lake "B", Ontario.

STAIRCASE WATERSHED LAKES

<u>U Watershed Lakes</u>

Diatom inferred pH over the length of the core from Lake U_1 ranged between 6.3 to 6.9. No significant change in diatom inferred pH occured downcore in this well buffered lake. However, between a depth of 8 to 10 cm in both Lake U_1 and U_4 (Figs. 3:25 and 3:27) a similar diatom inferred pH pattern was observed, indicating the

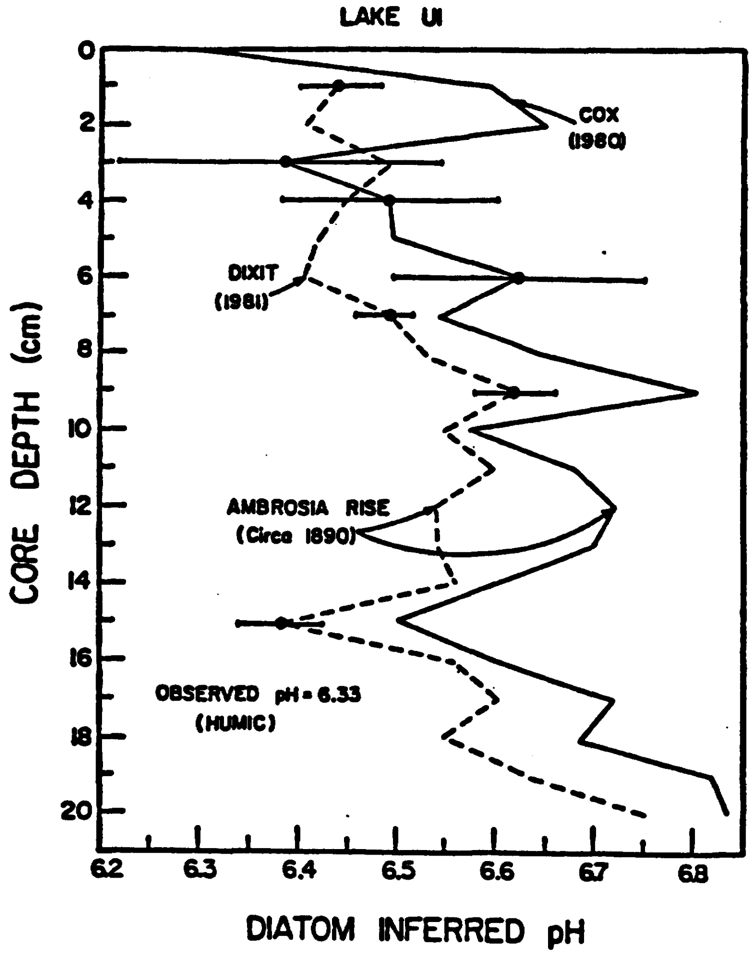


Figure 3:25 Diatom Inferred pH data (1980 and 1981) for Lake U_1.

possibility that some watershed-wide event had occurred at this time (circa 1930-1940). The logging history of this watershed (Fig. 3:26) was compiled from information supplied by Sumi (1982). In 1935 to 1945, Abitibi logged a considerable portion of the U Lakes watershed (Fig. 3:26). It is tempting to speculate that the observed shift in diatom inferred pH was a result of the logging impact on lake pH. It is also tempting to speculate that the size of the shift between diatom inferred pH at 1 cm and the observed lake pH at 0 cm might be a result of the watershed's 1977-78 logging history (Fig. 3:26).

The fact that these shifts in diatom inferred pH were not larger in magnitude attests to the well buffered characteristics of these two lakes (alkalinity 175 and 179 milligrams/l respectively).

The rate of sedimentation of these two U watershed lakes was similar, as indicated by their similar Ambrosia horizon depths at 11 and 12 cm respectively. (Figs. 3:25 and 3:27).

Lake U3

Lake U_3 had a relatively large surface area (0.58 km^2) and watershed area (4.25 km^2). The maximum depth at the sampling site was 10 meters. At the present time the lake has a pH of 7.1 and posesses substantial buffering capacity (alkalinity = 166 milli-equivalents/l).

The lakeshore bedrock geology of Lake U_3 was dominated by greenstone. On the east side of the lake, surficial deposits of glacial overburden were evident (Terasmae in Fortescue et al, 1982).

The downcore pH profile of Lake U_3 was represented by a very stable diatom inferred pH pattern (Fig. 3:29). During the last 100-140 years, the lake's pH changed very little. In the 20 cm long sediment core from this lake, the highest diatom inferred pH was recorded at 14 cm (pH 7.2) and the lowest pH occurred at 19 cm (pH 6.9).

No major variations were seen in the downcore distribution of dominant pH indicator diatoms. Alkalophilous diatoms dominated downcore. The major alkalophilous taxa found were Cyclotella meneghiniana, Fragilaria construens var. venter, F. pinnata, Melosira granulata, and Achnanthes lancelolata. Circumneutral diatoms, particularly Cyclotella comta, were identified as the second most abundant group of diatoms in the lake. Acidobiontic diatoms were virtually absent in the U_3 lake sediment.

Lake W1

The W lakes are all located in the Wawa fume kill area. Lake W_1 is at the top of the staircase of four "W" study lakes. The surface area of Lake W_1 is 0.02 km^2, with a watershed area of 0.19 km^2. The maximum depth at the sampling site was 2.3 meters. The lake's bedrock geology was characterized by greenstone and a small portion of the watershed was covered by surficial deposits of carbonate-rich glacial tills.

Contrary to other neutral pH lakes (e.g. U_1 and U_3), the diatom inferred pH of Lake W_1 fluctuated greatly (pH 7.1 to 8.0) in the post-Ambrosia lake sediments (Fig. 3:30). The fluctuations were greatest in the top 8 cm (i.e. during the last 80 years). The pre-Ambrosia diatom inferred pH levels (12 to 15 cm remained fairly constant and ranged between pH 7.1 and 7.3. The alkalophilous diatoms dominated this lake's diatom population. The major alkalophilous taxa were Achnanthes linearis, Anomoeoneis vitrea, Fragilaria pinnata, Nitzschia fonticola and Rhopalodia parallela. Circumneutral diatoms also contributed a major portion of the diatom population. The common circumneutral diatoms were Cymbella cesatii, Navicula pupula, N. radiosa, and Stauroneis phoenicentron. Acidophilous diatoms remained at lower levels. Tabellaria fenestrata and Anomoeoneis serians var. brachysira were the only noteworthy acido-

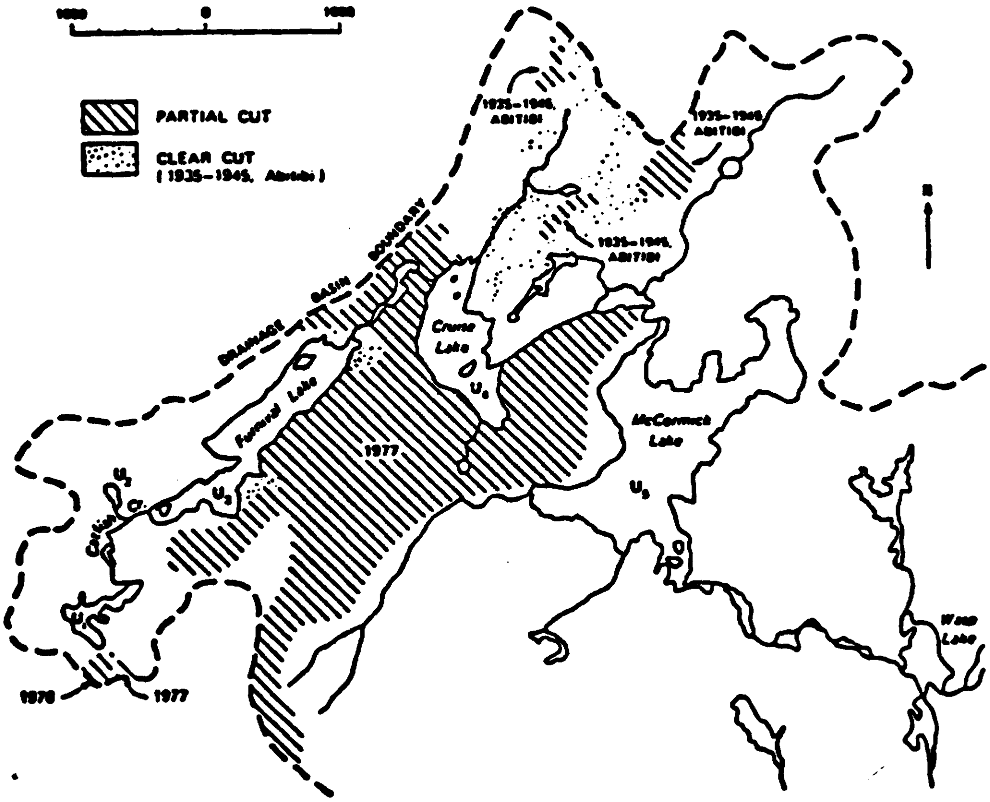


Figure 3:26 Fire and Logging History U lake watershed.

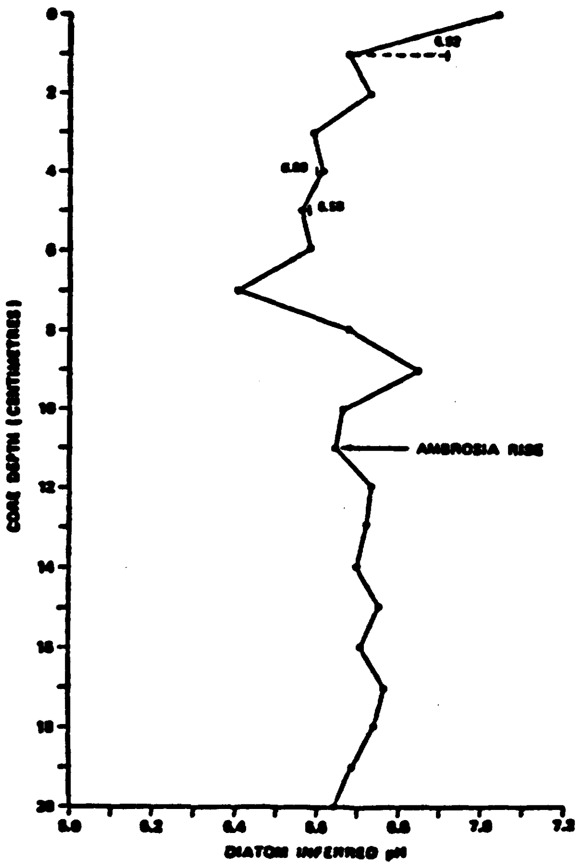


Figure 3:27 Diatom Paleo pH data for Lake U_4.

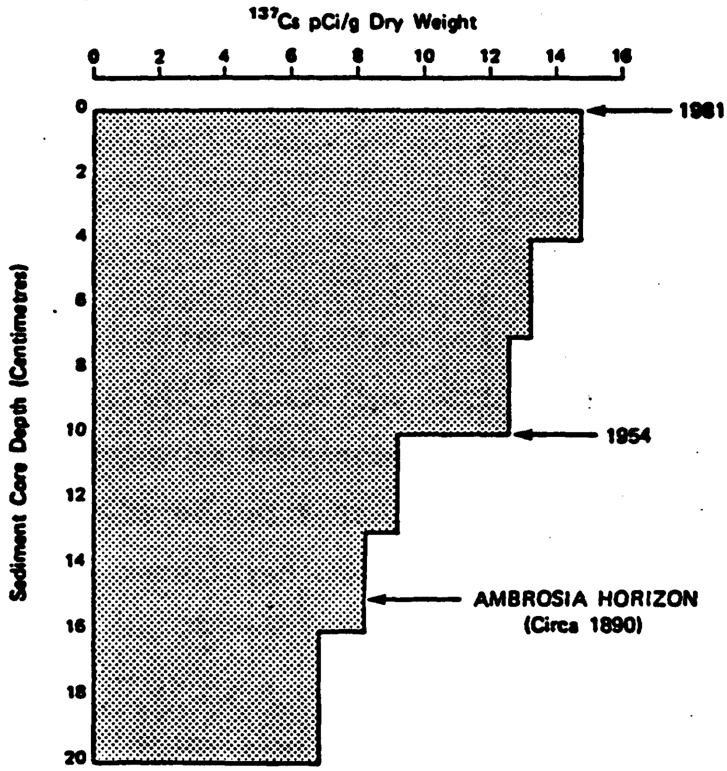


Figure 3:28 Cesium-137 concentrations in the top 20 cm of sediment taken from Lake U_3.

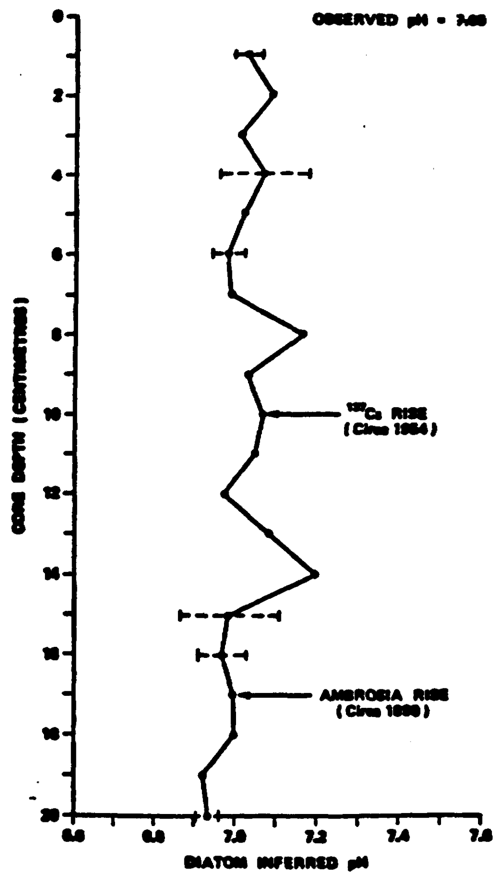


Figure 3:29 Diatom Inferred pH data for Lake U_3.

philous diatom taxa. Acidobiontic and alkalobiontic diatoms were not observed in the sediments of Lake W_1.

Lake W4

Between 1909 and 1920 open pit burning operations occurred at the Magpie Iron Mine (Anonymous 1957 and Stewart 1982). These operations resulted in an areal fumigation and subsequent deforestation (Gordon and Gorham 1963). Localized fires in the fumigated tree-kill area were frequent (Donnelly and Harrington 1978).

The enormous shift in the diatom inferred pH between 17 and 13 cm in Lake W_4 (and the lesser shift between 8 and 6 cm in Lake W_1) was attributed to these watershed disturbances (Figs. 3:30 and 3:31).

In the case of W_4, the fire and fumigation history following the start up of the Magpie Iron Mine in 1909 appears to have been sufficient to overcome the lake's buffering capacity, as indicated by a shift in pH from its initial range (pH 7.3-8.2) to a lower pH regime (pH 6.5-6.7, Fig. 3:31).

In 1939, the Wawa Algoma Sintering Company began sintering siderite ($FeCO_3$) upwind of the W watershed lakes (Anonymous 1957). Weizman (1980) estimated that currently between 250,000 and 300,000 tons of SO_2 are discharged annually from this plant (1979-80 study). Sintering of siderite releases a fine limestone ash (sinter flux) into the atmosphere which helps to counteract the impact of the SO_2 released at the same time (Stewart 1982). Snow samples analyzed by Mr. Stewart from sites located immediately downwind of the sintering plant had only slightly depressed pH

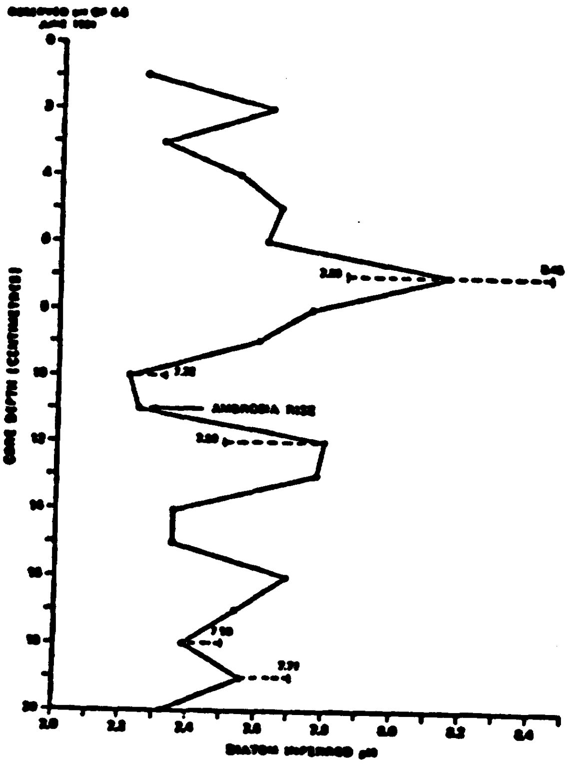
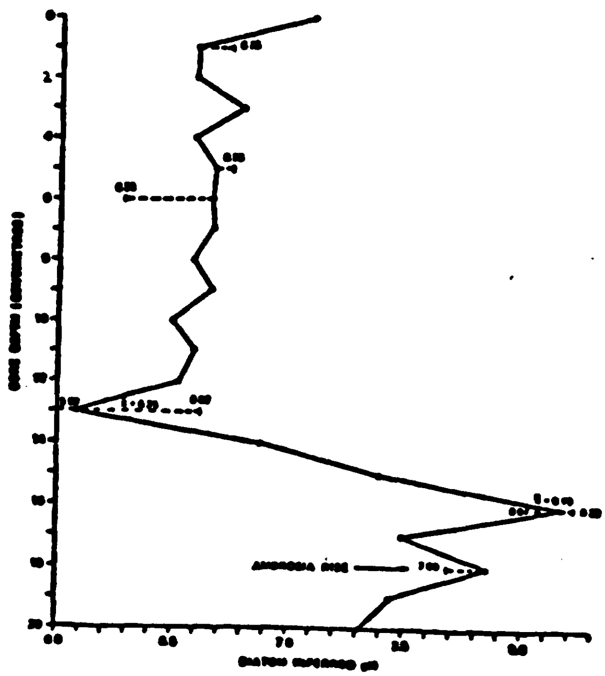


Figure 3:30 Diatom Paleo pH Data for Lake W_1.

Figure 3:31 Diatom Paleo pH Data for Lake W_4.



(4.5-5.5). These same samples displayed elevated levels of iron, aluminum and manganese, as would be expected from siderite sintering.

Despite the quantities of SO_2 being received by this watershed, Lake W_4 (over a core depth of 1-12 cm) remains remarkably stable in terms of its new diatom inferred pH equilibrium level (pH 6.5 - 6.8, Fig. 3:31). Lake W_1, on the other hand, has decreased in pH over the recent past (Fig. 3:30). This follows an apparent major disturbance at 9 cm (circa 1940) when Algoma ore began sintering large quantities of siderite (Gordon & Gorham, 1963).

X WATERSHED LAKES

Lake X1

Lake X_1 was located in close proximity to Lake CF, just south of the Montreal River in Raaflaub Township. This lake had a maximum depth of 2 metres. Lake X_1 was long, narrow and parts of the shoreline revealed granitic outcrops. Muskeg dominated the lake's eastern end. Aquatic plants were generally rare due to the granitic shoreline. The lake was surrounded by spruce and pine.

John Ciolfi's analyses indicated that a significant decrease in diatom inferred pH has occurred over approximately the last 50 years in this lake. The diatom inferred pH dropped from 5.3 at a depth of 8.0-9.0 cm, to 4.5 at a depth 0-1.0 cm (Figs. 3:32 and 3:36). Between these two depths the pH consistantly decreases with increased proximity to the surface. The increased influx of acidic precipita-

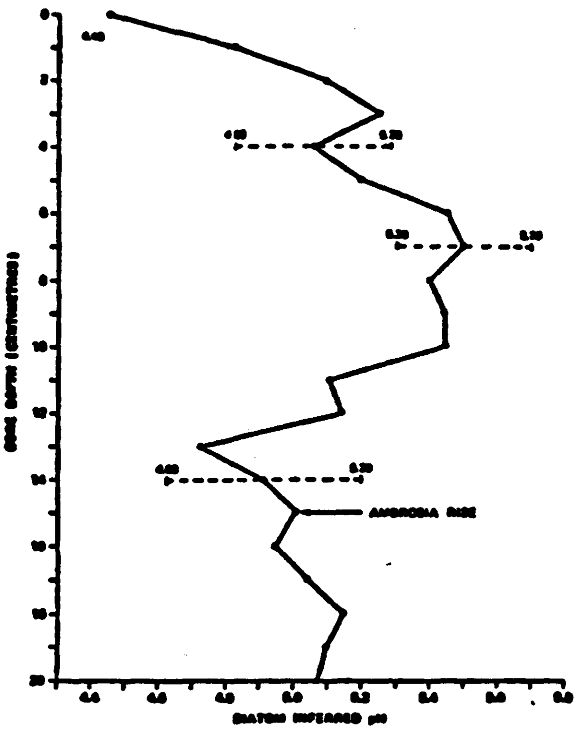


Figure 3:32 Diatom Paleo pH Data for Lake X_1 (1982).

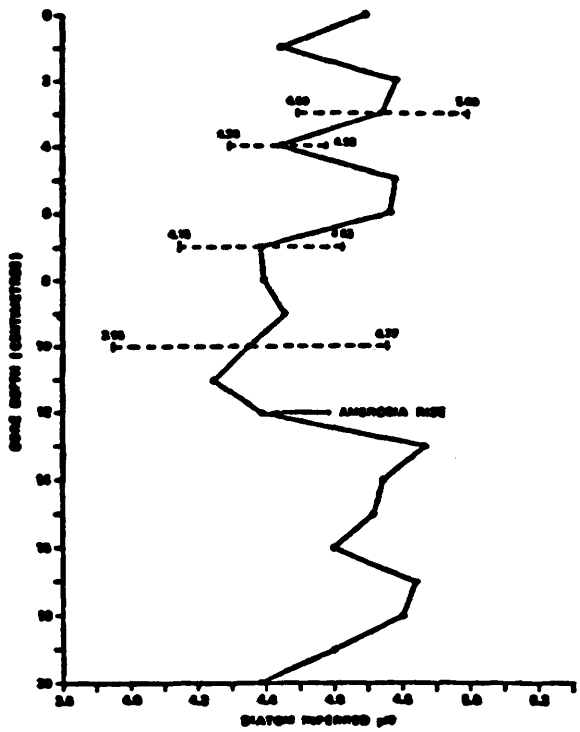


Figure 3:33 Diatom Paleo pH Data for Lake X_4 (1982).

tion in the recent past (Coker and Shilts, 1979) may have been partly responsible for this gradual decrease in lake pH.

In the top 4.0 cm there was a gradual increase in acidobiontic species composed mainly of Anomoeneis serians and Semiorbis hemicyclus. A concomitant decrease in alkalophilous taxa also occurred.

The Ambrosia rise (circa 1890) was very faint at 15 cm in Lake X_1 (Fig. 3:35). At a core depth of 12 - 13 cm (circa 1910-1920) the diatom inferred pH suddenly began to increase. This increase was sustained until the diatom inferred pH reached 5.4 at 7 cm (Fig. 3:35). The trend of increasing diatom inferred pH began around 1915 in both Lakes X_1 and X_4.

According to W.L. Oliphant (1982), 6,355 cords of spruce and balsam were logged in the early 1900's within Raaflaub Township near the X lakes watershed. The determination of the exact location is apparently impossible because the early records only indicate which township was logged (Oliphant, Personal Communication). However, had the logging occurred outside the X lakes watershed, it would have had negligible effect, as fires which were outside a lake's watershed failed to leave the characteristic "fire signature" in the sediment core of lakes within adjacent watersheds.

Prior to 1957, a small fire was reported in the watershed of Lake X_1 (Fig. 3:34, Oliphant 1982). Even though the fire was physically closer to Lake X_4 than X_1, the topography was such that the burned area drained primarily into Lake X_1 and not X_4. As a result, a characteristic fire "signature" was observed at the 4 cm depth in X_1 but not in X_4 (Figs. 3:32 and 3:33).

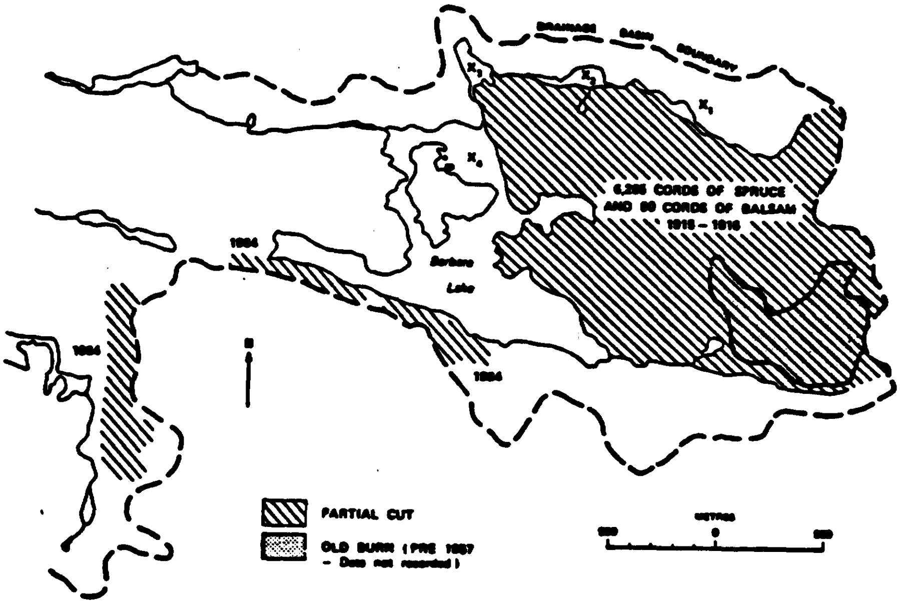
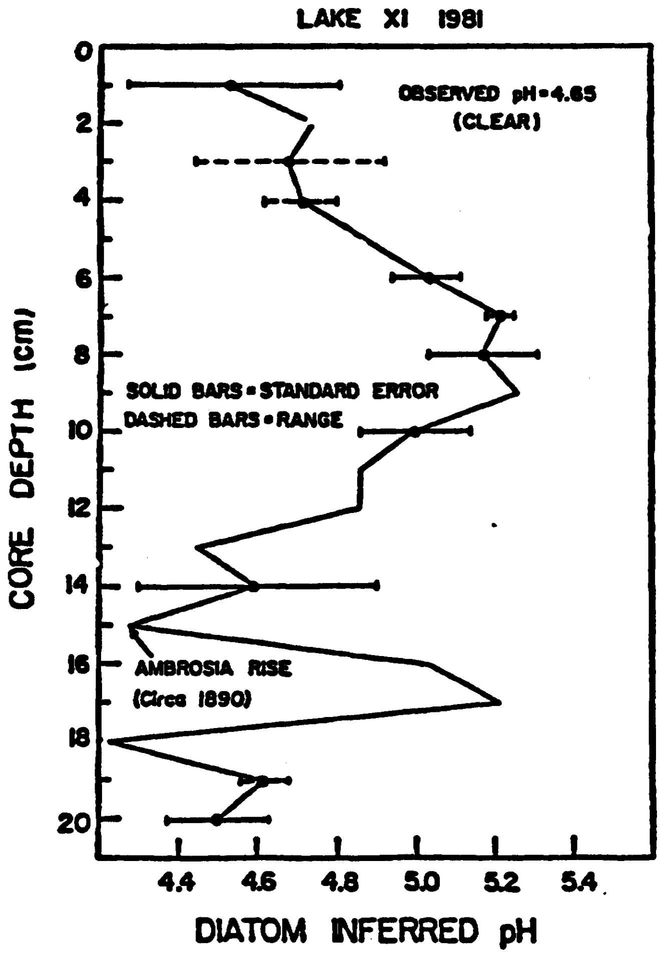


Figure 3:34 Fire and logging history of X lake watershed.

Figure 3:35
Diatom Inferred
pH data for Lake
X_1 (1981).



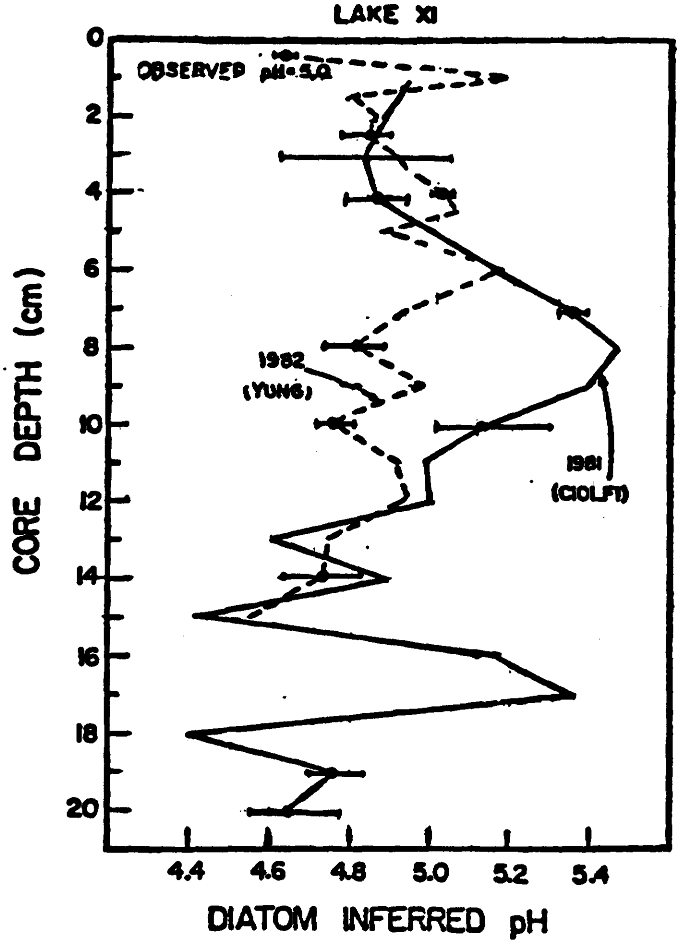


Figure 3:36 Diatom Inferred pH data for Lake X_1 (1981 and 1982).

The analysis of the 4 cm depth sample from X_1 for charcoal particles remains to be performed. The presence of charcoal would clearly establish the case for a cause-effect relationship between the "fire signature" characterized in Figure 3:32 and a fire event. We will not be undertaking an analysis of the 4 cm sample from Lake X_1 for charcoal particles as the logical next step in this search for essential corroborating information because funding is not available and because Dr. F. Ford has indicated to me (personal communication) that charcoal particle determination downcore is not definitive.

The reduction in diatom inferred pH in the top 3 cm of Lake X_1 may reflect the impact of acid precipitation. The diatom inferred pH technique provides us with the opportunity to compare surface pH estimates with those calculated downcore. In the case of Lake X_1 the observed pH during the summer of 1981 (pH 4.5) was lower than at any other time during the approximately 200 year history of the lake (as represented by its 20 cm long sediment core). There is some indication, therefore, that lake X_1 has undergone rapid acidification as a result of "acid rain". However, the statistically significant reduction in diatom inferred pH near the lake's surface (i.e. over the last 30 or 40 years) may also reflect the "recovery" phase of a logging or fire event in the lake's watershed, as well as the impact of acid precipitation. The absence of a shift (reduction) in diatom inferred pH in recent sediments from the nearby Lake X_4 (Fig. 3:33) indicates that the recent downcore shift in diatom inferred pH in Lake X_1 is largely the result of its revegetation following the pre- 1957 forest fire. The litter layer in this region is quite acidic (pH 4.5, Oliphant 1982). In addition, the replacement or renewal of the litter layer serves to reduce the amount of percolation of rain water into the underlying carbonate-rich overburden. Thus, downcore reductions in diatom inferred pH cannot always be ascribed to long range transport of acid precipitation (LRTAP). A comparison of the 1982 (Fig. 3:32) and 1981 (Fig. 3:35) downcore pH profile for lake X_1 (Fig. 3:36) is discussed on page 85 of this report. Recent (unpublished) results by Dr. Mary Thomson of C.C.I.W. indicate that SO_2 released by industry in Sault Ste. Marie is contributing to the acidification of the lakes in the Z and X watershed area.

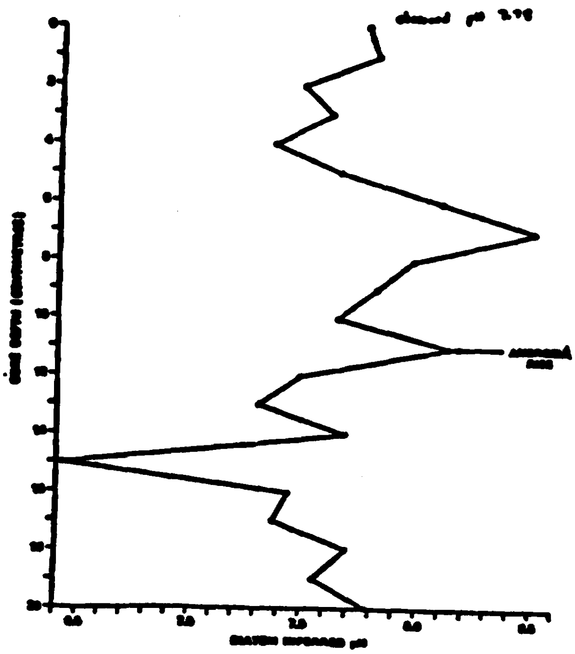


Figure 3:37 Diatom Paleo pH Data for Lake Y_1.

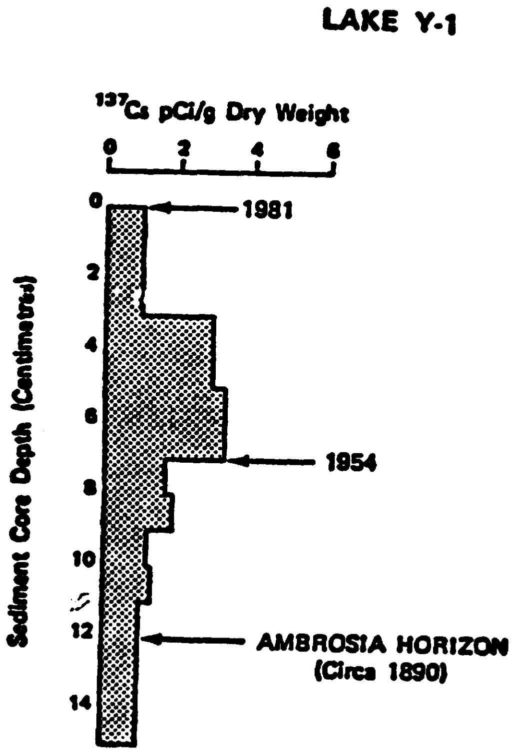


Figure 3:38 Cesium-137 concentrations in the top 20 cm of sediment taken from Lake Y_1.

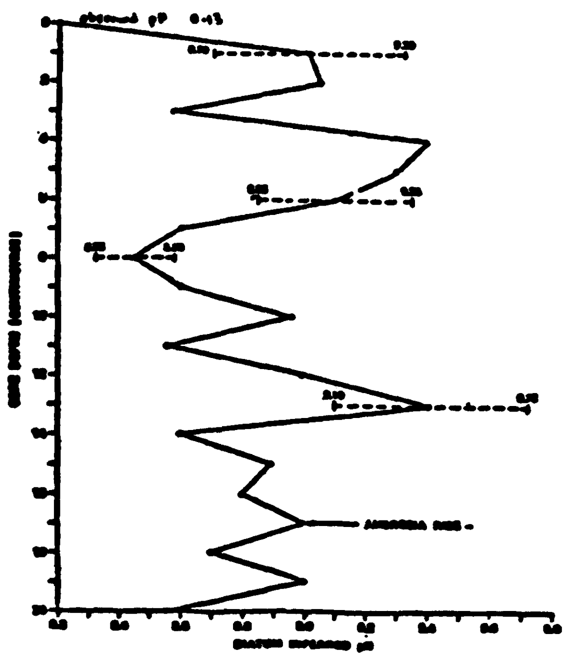


Figure 3:39 Diatom Paleo pH Data for Lake Y_4.

Y Watershed Lakes

Alkaline lakes such as those found in the Y watershed are difficult to analyze for diatom inferred pH for two reasons. First, many of the diatoms in the sediments of the Y lakes were broken or empty rings (Fig. 3:23). This was discussed on page 85. Second, the alpha index does not appear to provide valid estimates of diatom inferred pH for lakes whose pH is consistently above a pH of 8.0. This is because the alpha index appears to be overly sensitive to small changes in the number of acidophilic diatoms in the presence of large numbers of alkaline indicator diatoms. The large shift in diatom inferred pH at 15 cm, for example, was the result of only a slight increase in the number of acidophilous diatoms (Fig. 3:37). Above a pH of 8.0, the number of acid indicator diatoms drops so low that only a very few are found in counting 800 frustules. Because the alpha index is based on the ratio of acid to alkaline diatoms, the presence of only a few acidophilic taxa on a slide which is dominated by alkalophilous taxa will result in large variations in the estimate of diatom inferred pH. In addition (as noted previously), the abundance of numerous centric diatoms in which the central valve has been dissolved or broken out leaving only an empty "ring" (Fig. 3:23), makes it impossible to identify to species these empty rings. Although most centric diatoms are alkalophilous, some are also pH indifferent or circumneutral indicators. Thus, our ability to estimate the pH of a lake where there are many empty centric diatom "rings", or where acidophilic taxa are extremely rare, is problematic.

These problems can be overcome in part by:

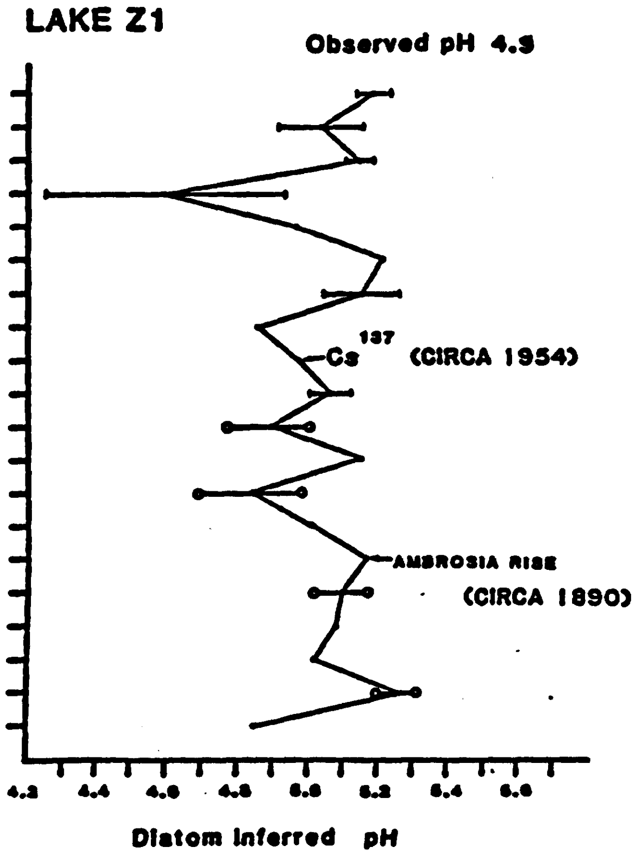


Figure 3:40 Diatom paleo pH data for Lake Z_1. Cesium - 137 (circa 1954) and Lead - 210 Analysis (Fig. 3:44) were also carried out for this core.

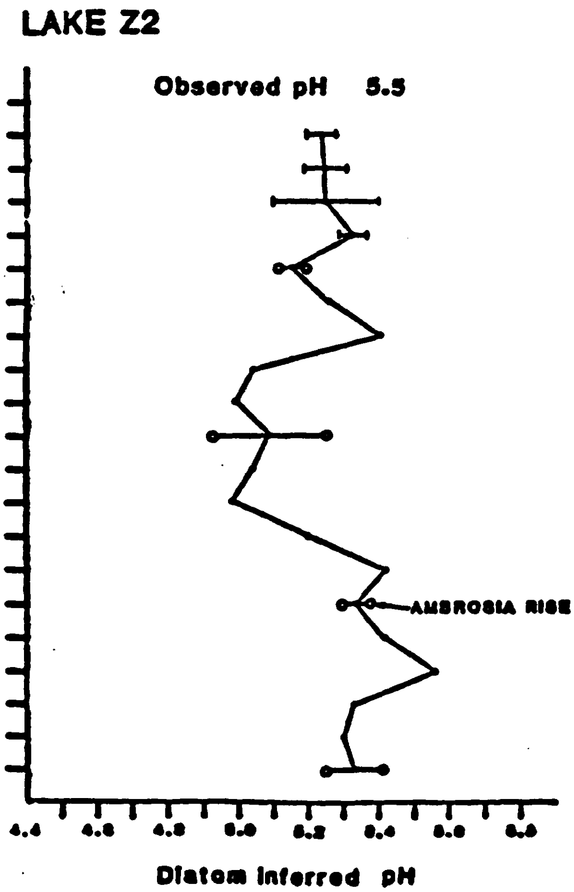


Figure 3:41 Diatom paleo pH data for Lake Z_2. Ambrosia rise (circa 1890) at 15 cm is based on Fig. Z_2 in Part II, Section 1, pg. Z-14.

1) Counting all the empty rings and assigning them an alkalophilic/non-alkalophilic frequency, proportional to the ratio of the identified full rings. This assumes that the breakage and valve dissolution frequencies of the alkalophilous and non-alkalophilous centric diatoms are similar. Although there is no evidence to support this assumption, it has been shown in the verification section of this report for Lake B, that ignoring the unidentifiable empty rings results in a larger discrepancy than when they are all counted as alkalophilous taxa (p. 86, Fig. 3:20).

2) The second problem can be remedied by counting a much larger number of diatom frustules. By increasing the total count, the number of acidophilic taxa becomes more reliable and the estimate of log alpha becomes both more repeatable and more precise.

Thus, alkaline lakes or lakes where there is a high frequency of empty centric rings, reduces the precision and accuracy of diatom inferred pH estimates unless special steps are taken to overcome the problems discussed above.

Z Watershed Lakes

This was the only watershed in which a complete "staircase" of four lakes were cored and analyzed for diatom inferred pH. A combination of Lead 210, Cesium 137, *Ambrosia* pollen dating and diatom downcore analyses were carried out on the cores from one or more of the lakes in this watershed. It would appear from these analyses that the humic Lake Z_1 has been acid over the last

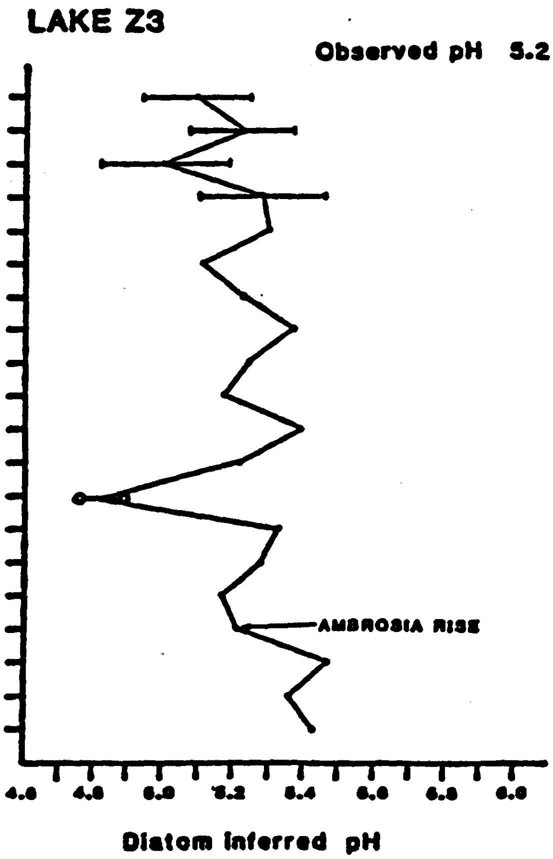


Figure 3:42 Diatom paleo pH data for Lake Z_3. *Ambrosia* rise (circa 1890) was based on Fig. Z_3 Part II, Section 1, p. Z-15. Lead analysis (Fig. 3:45) was also carried out for this lake.

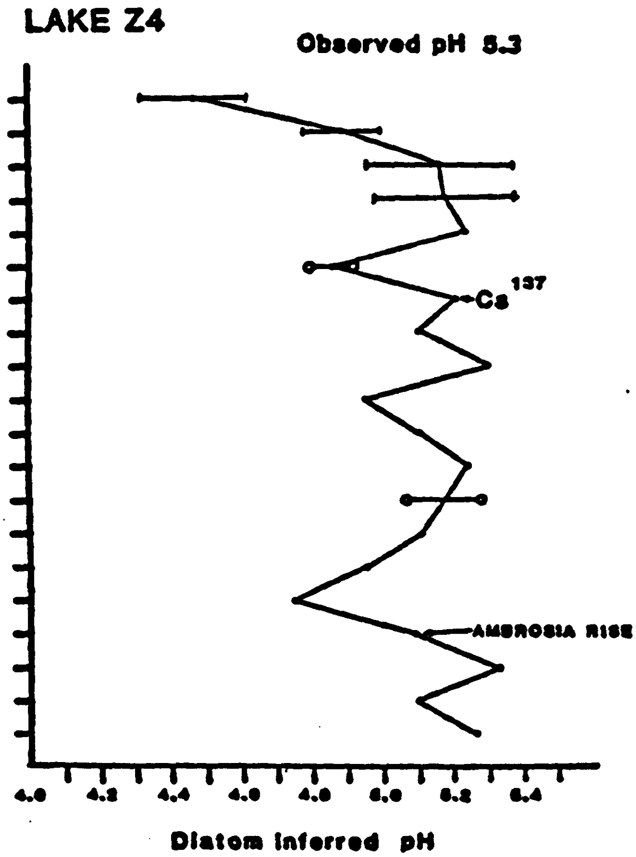


Figure 3:43 Diatom paleo pH data for Lake Z_4. *Ambrosia* rise (circa 1890) was based on Fig. Z_4, Part II, Section 1, p. Z-15. Cesium - 137 (circa 1954) based on Fig. 3:47.

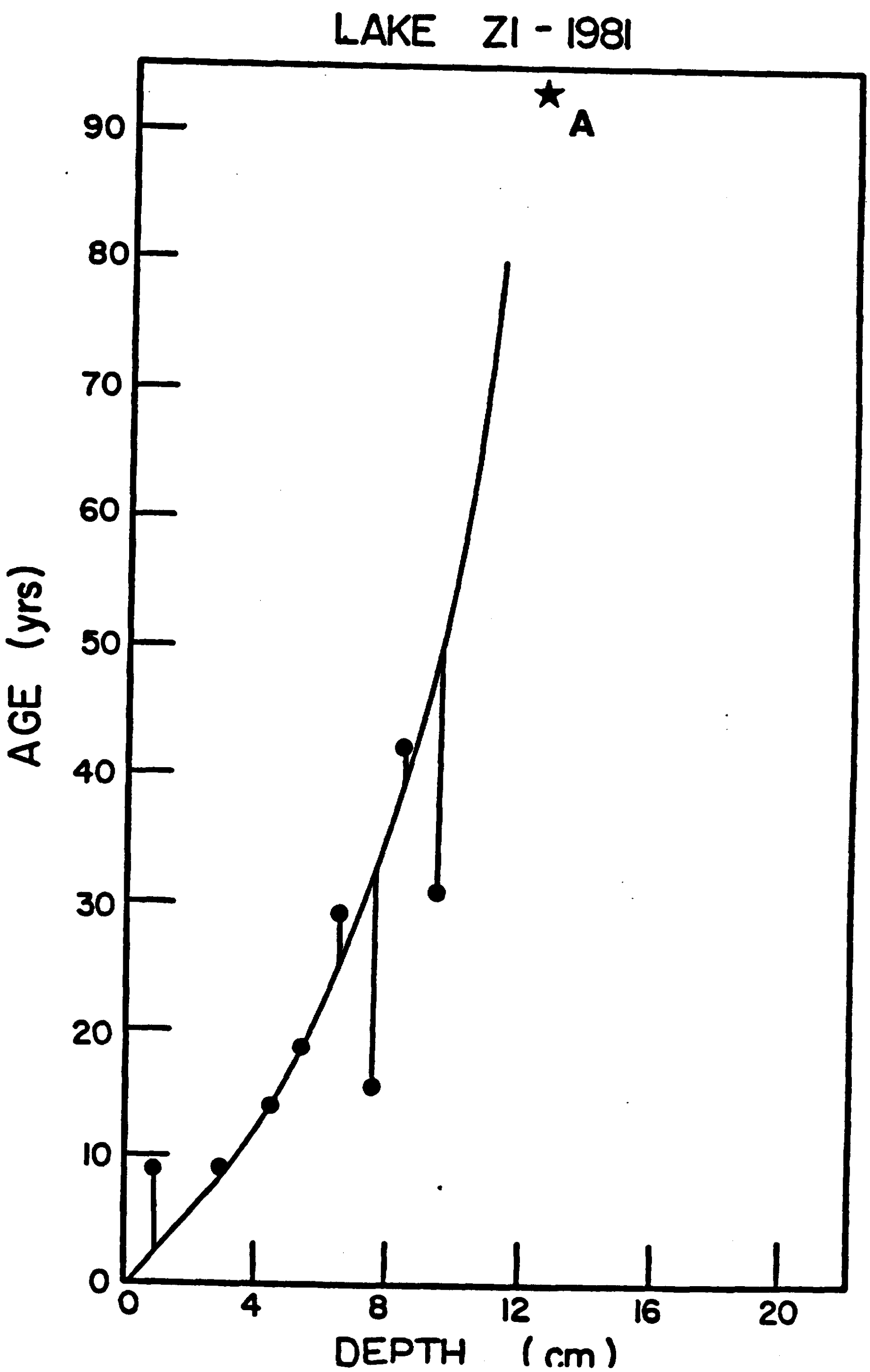


Figure 3:44 Lead - 210 concentrations (black dots) and Ambrosia pollen rise (star) circa 1890 for Lake Z_1. vertical links represent the deviations between the lead 210 concentrations and the eye fitted curve.

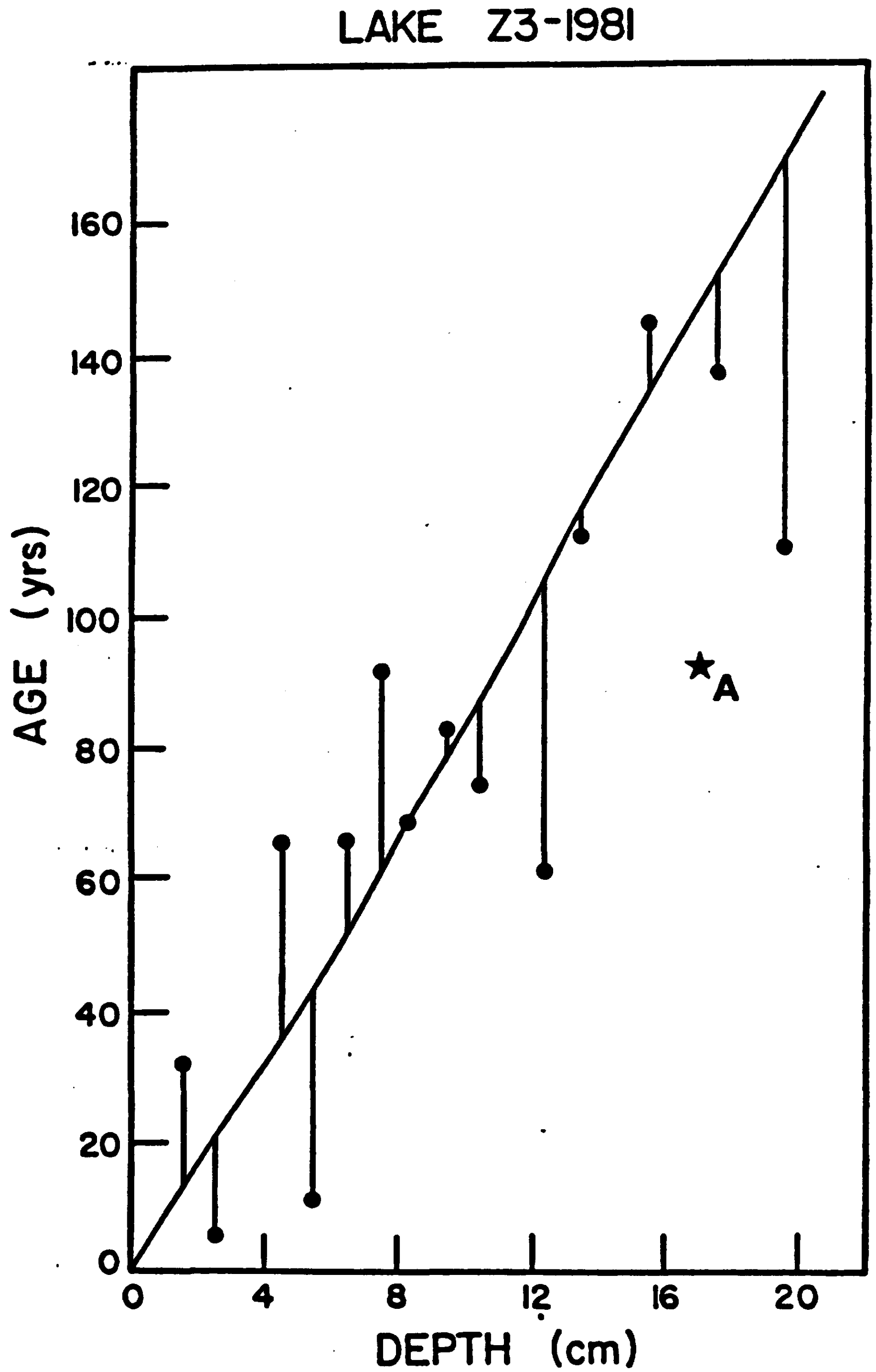


Figure 3:45 Lead - 210 concentrations (black dots) and <u>Ambrosia</u> pollen rise (star) circa 1890 for Lake Z3. Vertical lines represent the deviations between lead 210 concentrations and the eye fitted curve.

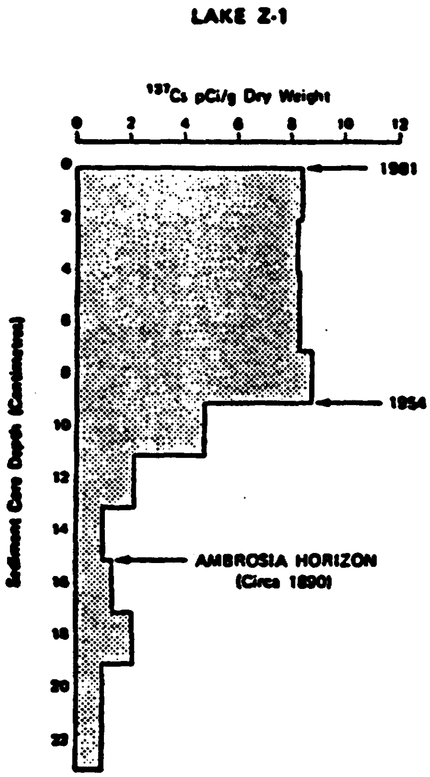


Figure 3:46 Cesium 137 concentrations in the top 22 cm of sediment from a core taken at the center of Lake Z_1.

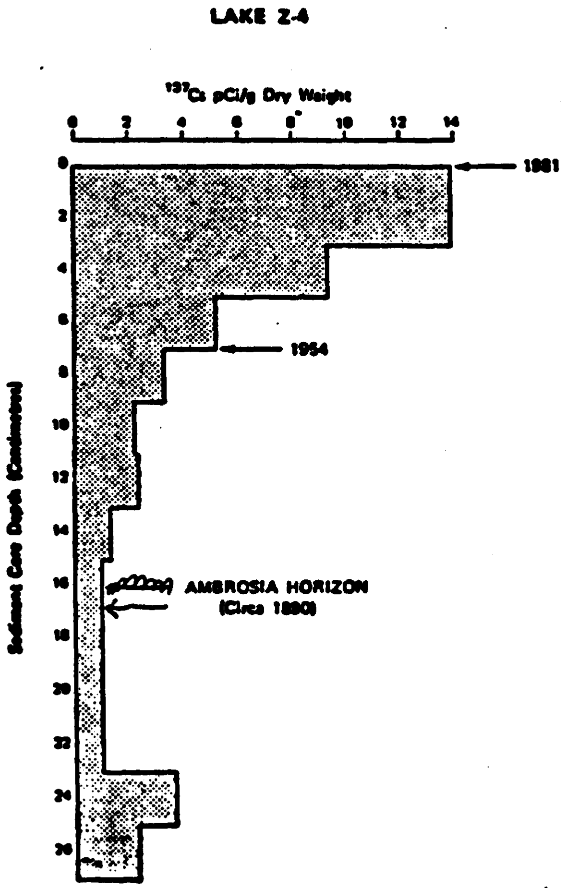


Figure 3:47 Cesium 137 concentrations in the top 26 cm of sediment from a core taken at the center of Lake Z_4.

century. Diatom inferred pH in Lake Z_1 ranged from a low of 4.8 to a high of 5.6 in post-*Ambrosia* time (Fig. 3:40).

Lake Z_2 was the smallest of the four lakes in this staircase of descending lakes. Its surface area was only 1.5 km^2. It displayed the highest observed pH (pH 5.5) and the second highest alkalinity in this staircase system. Aerial photographs revealed that it also had a fairly extensive "muskeg" development along the east side of the lake. The diatom inferred pH profile of this humic lake indicated that its pH ranged between a high of 5.9 and a low of 5.1 over the last century. During the last 30-40 years, diatom inferred pH in Lake Z_2 (Fig. 3:41) has held relatively constant (5.4-5.7). The observed pH of the lake during the summer of 1981 was 5.5.

The diatom inferred pH profile of the humic Lake Z_3 does not appear to show any specific temporal trend (Fig. 3:42). The infer-

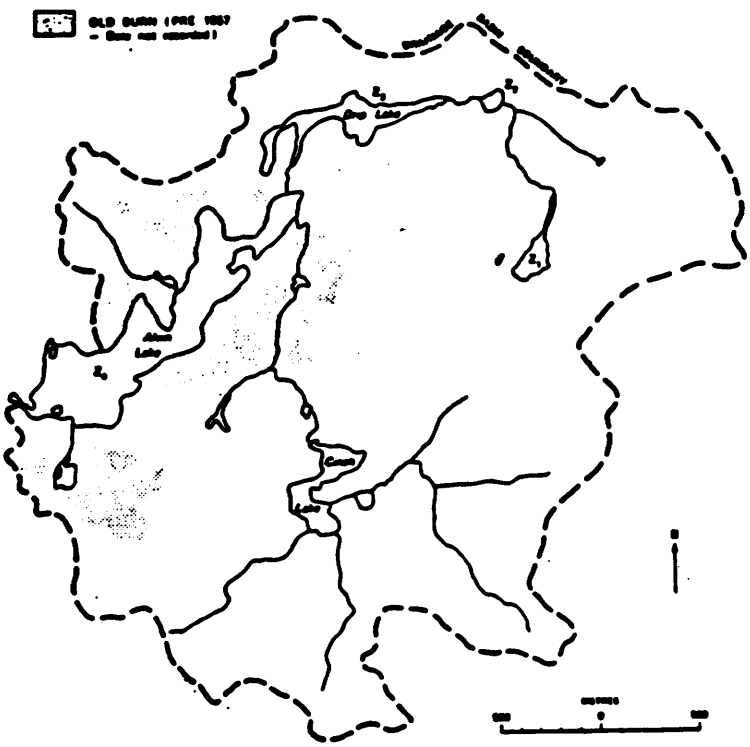


Figure 3:48 Fire and logging history Z lake watershed.

red pH fluctuated between pH 5.3 and pH 5.0 over the last 20 years. Small variations in lake pH may have resulted from lake water level fluctuations due to beaver dams. Beaver activity can also seriously disturb the surface sediments of a lake. Such disturbances may contribute to deeper sediment mixing of surface sediment diatoms complicating the interpretation of diatom inferred pH. Evidence of beaver activity was noted in two of the Z lakes (Z_1 and Z_3).

Lake Z_4 occupies the bottom lake of the staircase and is the largest of the four lakes. It is also the only lake in the Z series which is not humic. A trend in decreasing diatom inferred pH over the last 20 years is evident only in this lake (Fig. 3:43) where diatom inferred pH has dropped from 5.2 in the early 1960's to 4.5 in the early 1980's. This leads us to believe that the humic substances present in the three brown water lakes (Z_1-Z_3) may be significant in establishing a low pH buffer system which controls their acidity. Only Lake Z_4, which was not humic, appears to be undergoing acidification. The same conclusions were reached by Mr. Kit Yung (M.Sc. Thesis in preparation) in his analysis of Lake Z_4.

Aluminum has been shown by Cronan & Scholfield (1979) to increase in concentration at low pH. A reduction in aluminum concentration in the sediments of Lake Z_4 during recent years (Part II, Section 1) can, therefore, be used to support the interpretation that this lake has indeed become more acid over the last three decades.

DOWNCORE SIGNATURES

Forest Fire Impact

Information about the size and location of fires for the period 1917-1978 (Figs. 3:26 and 3:34) has been compiled by Donnelly and Harrington (1978). A major resume of fire history studies has also been compiled by M.E. Alexander (1979).

The impact of a fire on a lake is reflected in the changes which occur in its diatom species composition and diatom inferred pH. These changes are most striking in unbuffered shield lakes. Details concerning the buffering capacity and alkalinity of each of the study lakes are provided in this report.

Forest fires alter the litter layer, which in turn alters the ion binding capacity of the deeper layers on the forest floor. Disturbances such as forest fires and logging characteristically result in the release (by erosion) of carbonates from the unleached soil layers until a new equilibrium situation is established (Fortescue and Terasmae, Personal Communication). This results in an immediate but small increase in lake pH which is followed by a larger increase in pH as rapidly growing grasses, shrubs and trees such as willows, poplars and birches colonize the disturbed soils. In time, these trees are outcompeted (in the Algoma area) by the slower growing needleiferous taxa (e.g. pine, hemlock and spruce). The decomposition products of the needles of these trees are typically much lower in pH than deciduous trees. As a result, soil pH drops and lake pH follows. In time, the lake pH reaches that of its predisturbance levels. Another reason for the increase in lake pH shortly after a fire is due, secondarily, to the influx of nutrients into a lake following a fire. These nutrients increase algal production which increases lake pH as carbonic acid is removed from the water by the algae.

Thus, a characteristic diatom inferred pH "signature" can be associated with fires within a lake's watershed. The "signature" consists of an increase, followed by a gradual decrease in diatom inferred pH. This signature will be large in cases of major fires and disturbances in poorly or moderately buffered lakes (e.g. Lakes W_1 and W_4). The fire "signature" will be small in amplitude in the case of small fires associated with well buffered lakes (e.g. Lakes U_1 and U_4, Figs. 3:25 and 3:27).

Following the open pit burning of iron-rich ores by the Magpie Iron Mining operation in 1909-1920, fires spread over the fumigated areas downwind of the open pits. Therefore, the fire signature of Lakes W_1 and W_4 differ from the norm because the fumekill area did not revegetate. Nevertheless, an exaggerated fire signature was found just above the circa 1980 Ambrosia rise (Figs. 3:30 and 3:31).

Pre-Ambrosia disturbances included in the diatom inferred pH stratigraphy at 20 cm in Lake X_4 are far more difficult to interpret, simply because Donnelly and Harrington's fire history extends back only to 1917. However, on occasion older records for the area such as those of Alexander Mackenzie, do record forest fires in our study area. "Large areas of the Lake Superior shore northeast of Michipocoten Bay were devastated by fire" at the time of Mackenzie's 1972 visit to the area (Turcott, 1962).

Logging Impact

The logging signature and the fire signature are nearly indistinguishable in terms of the shape of their diatom inferred pH downcore profile. There is an initial increase in pH followed by a gradual reduction in diatom inferred pH (compare the 4 and 12 cm signatures in Lake X_1, Fig. 3:32). A faint logging signature also appears in Lakes U_1 and U_4 at the 8-10 cm (Figs. 3:25 and 3:27) depth.

Unfortunately, the number of lakes for which we have good fire and logging histories and diatom inferred pH profiles, is too small to permit much generalization at this time.

Logging history in the watersheds of the study lakes proved to be much more difficult to track down than the fire history. Mr. John Sellers, District Manager of the Sault Ste. Marie District, Ministry of Natural Resources, reported on the basis of his district's Timber Agent books that some cutting took place in the X and Z watershed areas over the period 1903-1908 as well as 1933 to 1968. In addition, Mr. Lorne Nicholson (Ministry of Natural Resources) reported that this area was logged by Abitibi Price in the 1920's. The township in the area of Lake X_4 is Raaflaub township. The cutting history in this area is confusing, because up to about 1979 some of the tree species in this area were privately owned while others were owned by the Crown. According to Mr. Sellers, the area may have been cut for pine in the early 1970's. At present, most of the area is privately owned by the Algoma Central Railway (Len Oliphant, 1982). Comments and maps provided by each of the above and by C.K. Sumi (1982) were compiled for each of the study lake watersheds. Three of these maps are included with this report.

The 1982 Lake Series (Lakes CB2, CF & CS)

Lake CB_2, with a depth of only 2 meters, was not stratified in June and presumably mixed from top to bottom throughout the summer. The lake was located in Mishokomon Township, east of Wawa. This lake had approximately the same surface area as Lake X_1. Aquatic vegetation was sparse, but some sedges were present.

The diatom inferred downcore pH profile for Lake CB_2 indicated that little shift in historical pH has occurred over the last 100 years. This is not surprising as the lake is very humic (55 Pt-Co units). Its diatom inferred pH values fluctuated between 5.5 at a core depth of 4.0 - 4.5 cm, and 5.2 at a core depth of 1.0 - 1.5 cm (Fig. 3:47). The downcore percentage composition of acidobiontic, acidophilous, alkalophilous, indifferent, and circumneutral taxa do, however, show some interesting trends. The acidobiontic taxa (Anomoeoneis serians, Eunotia exigua, and Semiorbis hemicylus) became slightly more abundant at shallow core depths (e.g. 0 - 2.0 cm). This was offset, however, by a concomitant increase of alkalophilous taxa.

Acidophilous taxa were dominated by the genera Frustulia, Pinnularia, and Tabellaria. These genera also increased slightly above 5.0 cm, to a maximum of 35%.

pH indifferent diatoms remained low in abundance in the upper sediments and increased gradually downcore. Alkalophilous and circumneutral taxa remained relatively constant throughout the top 5

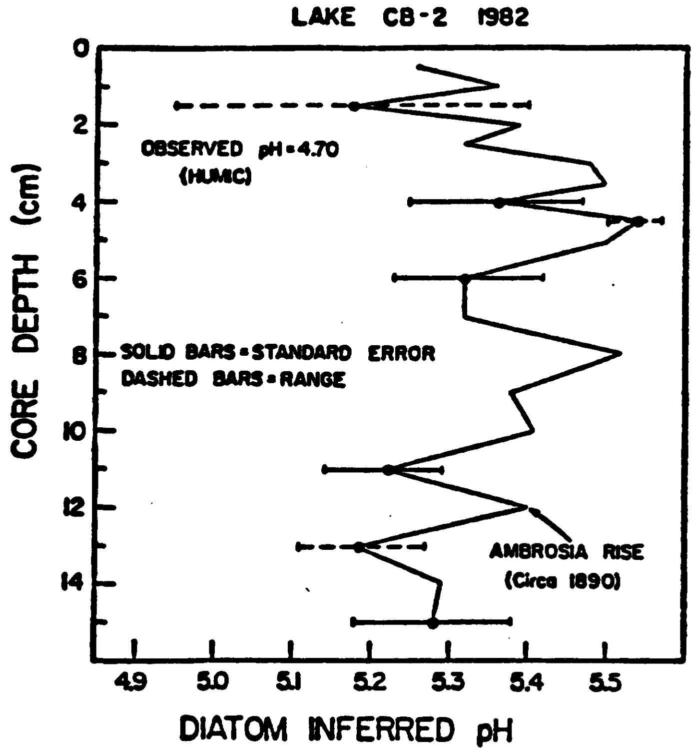


Figure 3:49 Diatom Inferred pH data for Lake CB_2 (1982).

cm increasing slightly at 1.0, 2.0 and 4.5 cm. The diatom inferred pH increased from 5.3 at the surface (0-0.5 cm), to 5.5 at a depth of 3.0-3.5 cm. The pH fluctuated widely between these depths, however, and no significant increase with depth was noted (Fig. 3:49).

The observed pH of Lake CB_2 was 4.7 and the alkalinity of the lake was 16.5 milliequivalents/l or 0.8 mg of $CaCO_3$/l. It would appear that a lake with such a low buffering capacity would be highly susceptible to the long range transport of acidic precipitation (LRTAP). Although the acidobiontic and acidophilous diatoms increased in abundance in the upper sediments of this lake, their increase was offset by increased alkalophilous taxa at 1.0, 2.0 and

4.5 cm over the last 30 years. The lake contains humic and fulvic acids which react with calcium and other cations to form salts which buffer the lake (albeit at low pH) against known inputs of atmospheric deposition of acidic precipitation. This was also noted in the discussion of the Z lakes watershed.

LAKE CF

Lake CF was the only study lake which contained laminated sediments. This lake was located in the Algoma District, just south of the Montreal River. The lake had a maximum depth of 7.2 m and a relatively low pH of 5.3 (June 1982). The lake's alkalinity (107.6 milliequivalents/l or 5.4 mg of $CaCO_3$/l), although not as low as that found in Lake CB_2, was still relatively low in comparison with the other Algoma District lakes.

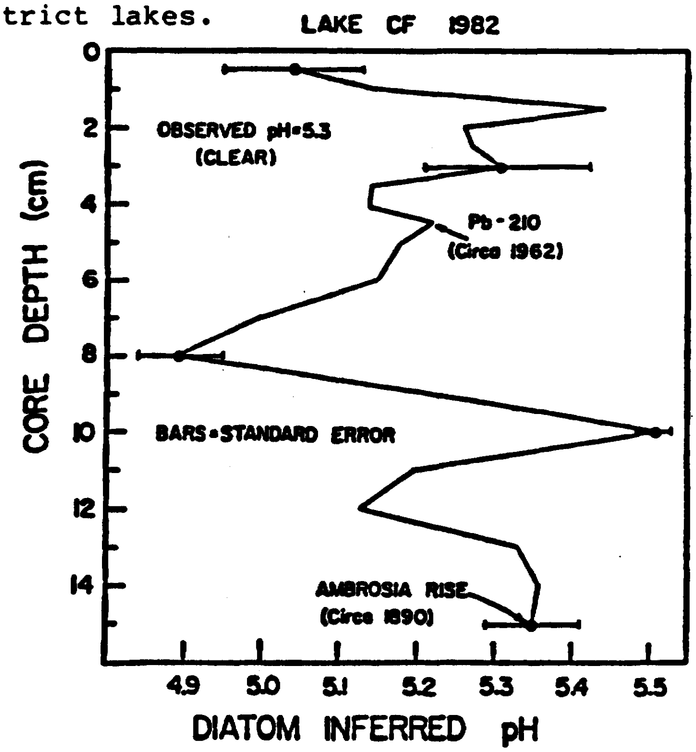


Figure 3:50 Diatom paleo pH for Lake CF. Lead-210 analysis (Fig. 3:53) and Ambrosia markers were used to estimate sedimentation rate.

Figure 3:51 Light lamina from Lake CF were dominated by diatoms S.E.M. magnification of 2,000 X.

Figure 3:52 Dark lamina from Lake CF were dominated by organic debris and numerous Mallomonas scales and spines. S.E.M. magnification of 2,000 X.

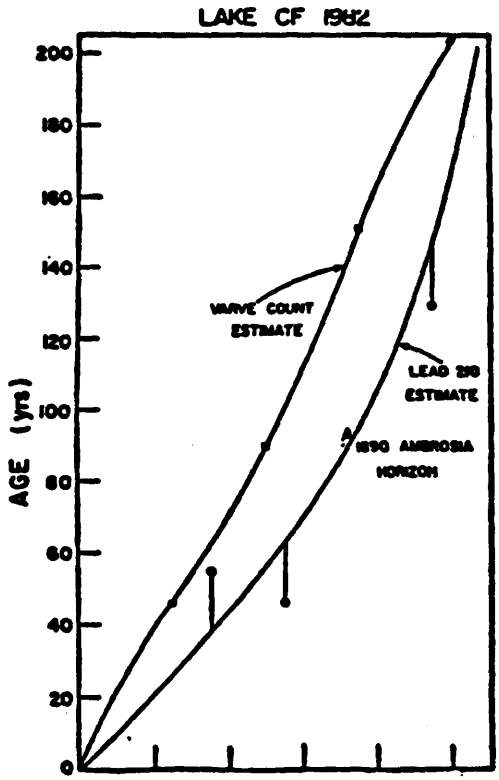


Figure 3:53 Lead 210 concentrations (black dots) and <u>Ambrosia</u> pollen rise (A) circa 1890 for Lake CF. The 3 vertical lines represent the deviations between lead 210 concentrations and the eye fitted curve. The uppermost eyefitted curve was constructed from counts of the number of varves in the core. However, bubble formation obscured some of the varves.

Spruce dominated the terrestrial vegetation surrounding the lake. Like Lake X_1, Lake CF was narrow and protected from wind by the spruce stands and some granitic outcrops.

Shifts in pH ranging from 4.9 at a core depth of 8 cm, to a pH of 5.5 at a core depth of 10.0 cm were observed in the downcore diatom inferred pH profile of this lake (Fig. 3:50). A Fire and Logging History should be undertaken before attempting to interpret these shifts in diatom inferred pH.

Lamina Structure

Scanning electron micrographs were made of the light and dark coloured microlamina from the Lake CF core. Light lamina (Fig. 3:51 displayed a higher frequency of diatom frustules than did the dark lamina. Mallomonas scales and decomposed organic material (Fig. 3:52) comprised the major component of the dark coloured microlaminae.

Ambrosia and Lead-210 age estimates were in close agreement, while the estimates of age based on varve counts failed to correspond with the former two (Fig. 3:53). Gas bubbles which formed on the inner walls of the plastic core tube and those which formed between the microlamina may have obscured the fine laminae (Ca 0.5 mm) causing this discrepancy. Replicate counts could not be made due to gas bubble induced disturbances of the microlamina which occurred as soon as the cores warmed to air temperature (circa 20°C).

Lake CS

Lake CS occupies a small basin with a surface area of only 0.09 km^2. This clear water lake occupies a watershed of only 1.8 km^2. The maximum depth at the sampling site was 11 meters. The observed lake pH was 5.2 and the alkalinity was 10 mg/l as $CaCO_3$. The lake bedrock geology was dominated by greenstone and granite.

The lake's downcore pH profile (Fig. 3:54) remained relatively stable (pH 7.1 to 7.3) between 16 cm (circa 1890) and 5 cm (circa 1954). Above 5 cm the diatom inferred pH of the lake fell significantly (P 0.01) from pH 7.1 to 6.4. Thus, during the last 25 - 30 years the lake's pH dropped almost 2 pH units.

From a 2.5 cm core depth to the surface of the core, the acidobiontic diatom population density of Actinella punctata, Anomoeoneis serians, Eunotia exigua, and E. bacterians rapidly increased. The major acidophilous diatom taxa Anomoeoneis serians var. brachysira, Frustulia rhomboides, Tabellaria fenestrata and numerous members of the Eunotia group also increased during the last 30 years. Simultaneously, the alkalophilous diatoms in this lake decreased in the top 3 cm (Fig. 3:54). Near the top of the core (0 - 1 cm depth) and at 8.0 cm, the relative frequency of acidobiontic diatoms such as Tabellaria binalis, Semiorbis hemicyclus and Anomoeneis serians increased.

Eighty-seven light and dark couplets (varves) were counted in the top 6.5 cm of this core (Fig. 3:53). The Ambrosia rise (circa 1890) occurred at a core depth of 14.5 cm. The major alkalophilous forms were Anomoeoneis vitrea, Cyclotella meneghiniana, Fragilaria construens, and F. crotonensis.

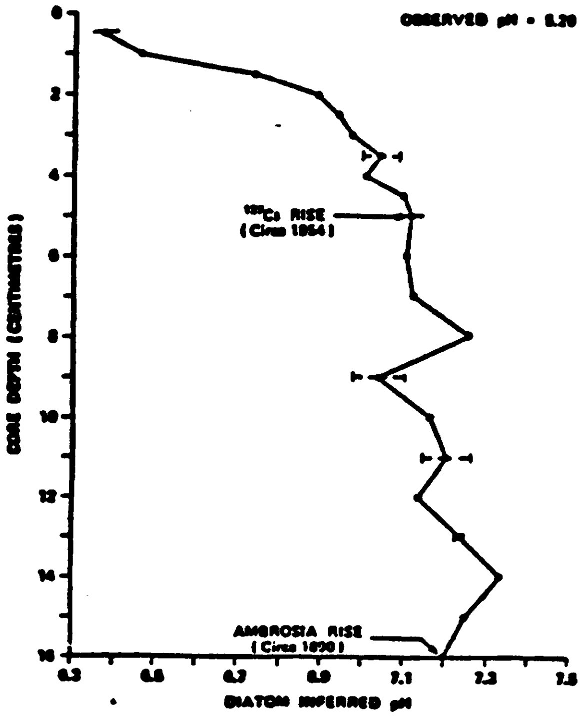


Figure 3:54 Diatom paleo pH for Lake CS. The pattern is indicative of a lake undergoing rapid acidification.

Thus, there is reasonable evidence based on diatom inferred pH that Lake CS has been undergoing rapid acidification during the last 25 - 30 years. The present pH of this lake (pH 5.2) is significantly lower than at any time during the last century (Fig. 3:54). Both Lakes CS and B (Figs. 3:54 and 3:24) are believed to be influenced by SO_2 discharges from the Wawa Sintering operation located less than 10 km from Lake CS (Fig. 3:54). This is also evident from the downcore sediment chemistry profiles which are discussed in Chapter 5.0.

4.0 1981 (LONG CORE) STUDY (J.T. and J.F.)

Introduction

Long lake sediment cores were collected from three lakes in the project area. Doc Greg Lake south of Wawa on the Trans Canada Highway was chosen to represent an acid lake; Furnival Lake (Lake U_3, 1981) was chosen to represent a near neutral lake and Lake Y_1 was chosen to represent a lake located in limestone terrain. The long cores are referred to as GL, UL and YL respectively. The location of the lakes is indicated on Figure 2:1 and details of Lakes U_3 and Y_1 occur on Part II (Section 1). Doc Greg Lake was chosen because it is accessible by road in contrast to more acid lakes further south which were not.

Sampling

The sediment cores were collected with a piston corer and storage, subsampling, and palynological and geochemical preparation of subsamples followed the same procedures as used for the short cores, with some modification of the sampling interval below 50 cm depth. None of the long sediment cores were frozen prior to subsampling.

The length of the cores depended upon the physical limitations of the coring device. Unfortunately it could not penetrate to dense glacial sediments in all cases. For example, in Doc Greg Lake and in Lake YL. It is believed that glacial sediments were reached by the UL core.

Palynological Studies (J.T.)

Pollen diagrams for all three cores (Figure 4:1, 4:2, and 4:3) were compared with previously published pollen diagrams for the same general region (Terasmae, 1967, Saarnisto, 1975) and they show a similar palynostratigraphic sequence of changes through post-glacial time. One pollen diagram (Saarnisto, 1975) for Alfie's Lake south of Wawa has been reproduced here for comparison.

The palynostratigraphic sequence (pollen zones) proposed by Saarnisto have been used for reference and the present forest cover of the project area has been described elsewhere in this report (Part II, Section 1). Briefly, the principal features and changes of vegetation during post-glacial time are as follows, beginning with the oldest pollen zone (W.I).

Spruce Pollen Zone (W.I) The zone is dominated by spruce (*Picea*) pollen, reaching 60%. Pine (*Pinus banksiana* and/or *P. resinosa*) is the next important tree pollen. Poplar (*Populus*) pollen can be found in this zone. Non-tree Pollen (NAP) is rather insignificant in abundance butmay increase downwards in this zone. The upper boundary of this zone (dated in Alfie's Lake at 9210 ± 100 yrs BP (G.S.C.-1852) in marked by a steep decline in spruce and rise in birch (*Betula*) pollen.

Birch Pollen Zone (W.II) In this zone birch pollen is dominant, rising up to 40%. Pine pollen is well represented and white pine (*P. strobus*) pollen becomes more abundant towards the top of this zone. *Abies* (balsam fir) and *Larix* (tamarack) pollen is consistently present. The upper boundary of this zone is defined by a decline in birch pollen and a rise in pine pollen. The age ofthe upper zone boundary is about 7,000 years.

Pine Pollen Zone (W.III) This zone is characterized by the dominance of pine pollen and the age of the upper boundary of this zone is about 6,000 years.

Birch and Spruce Zone (W.IV) This zone is tentatively divided intofour subzones:

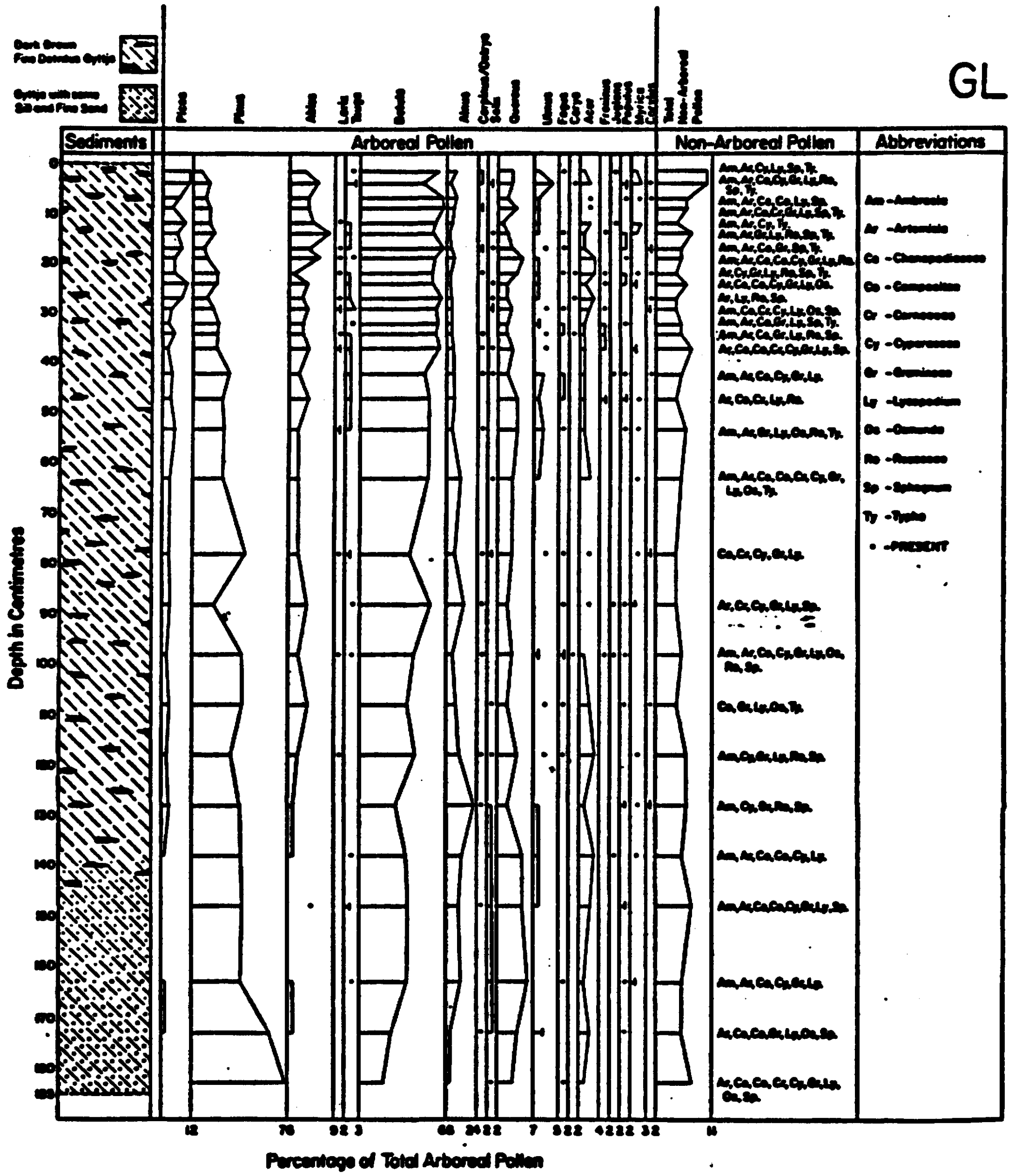


Figure 4:1 Pollen diagram for Doc Greg Lake. Extends into the pine zone at about 6,000 yrs. B.P.

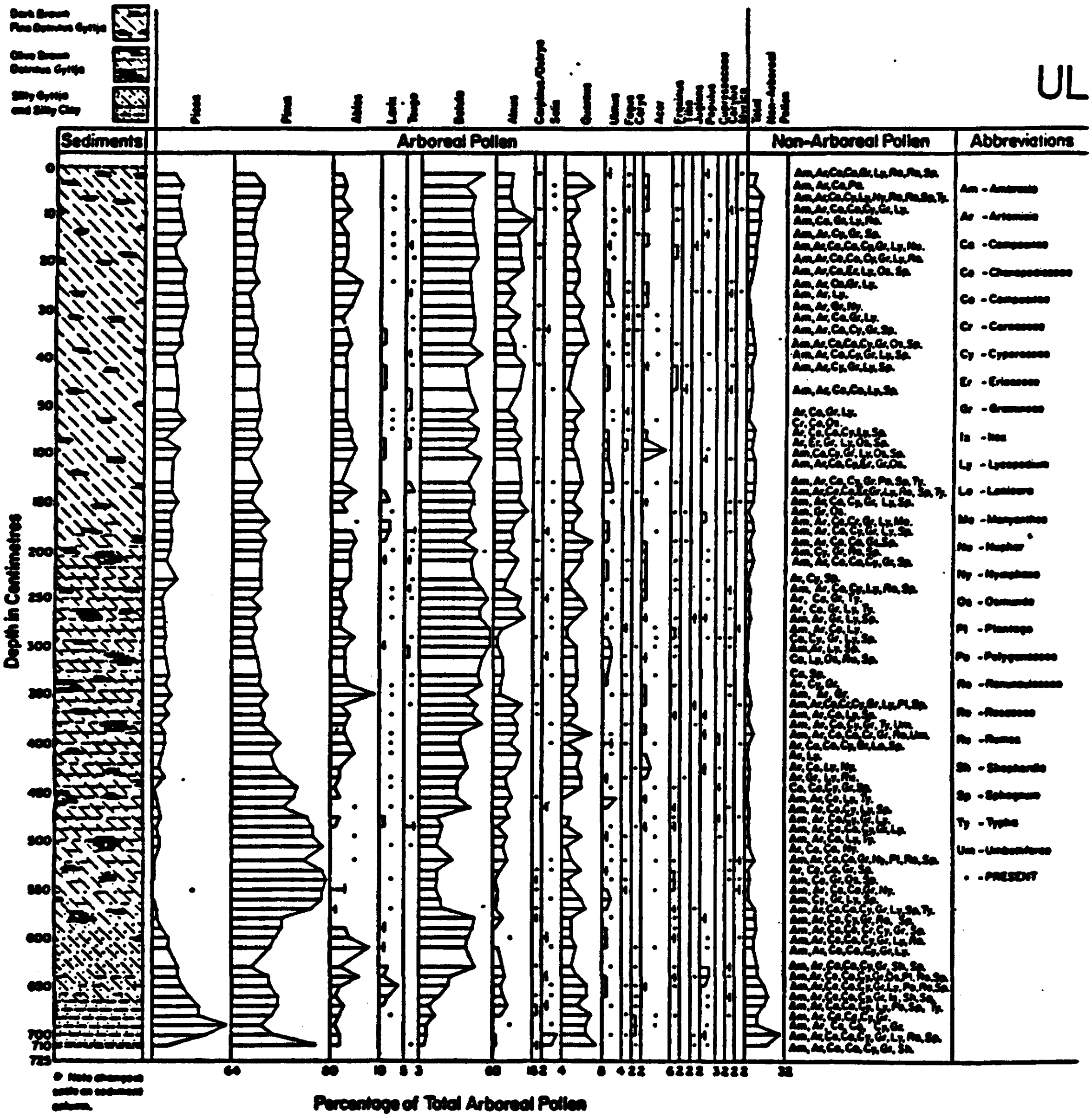


Figure 4:2 Pollen diagram for core UL from Furnival Lake. Note the similarity between the patterns at this lake and those described for Alfie's Lake by Saarnisto, 1975 (Figure 4:4).

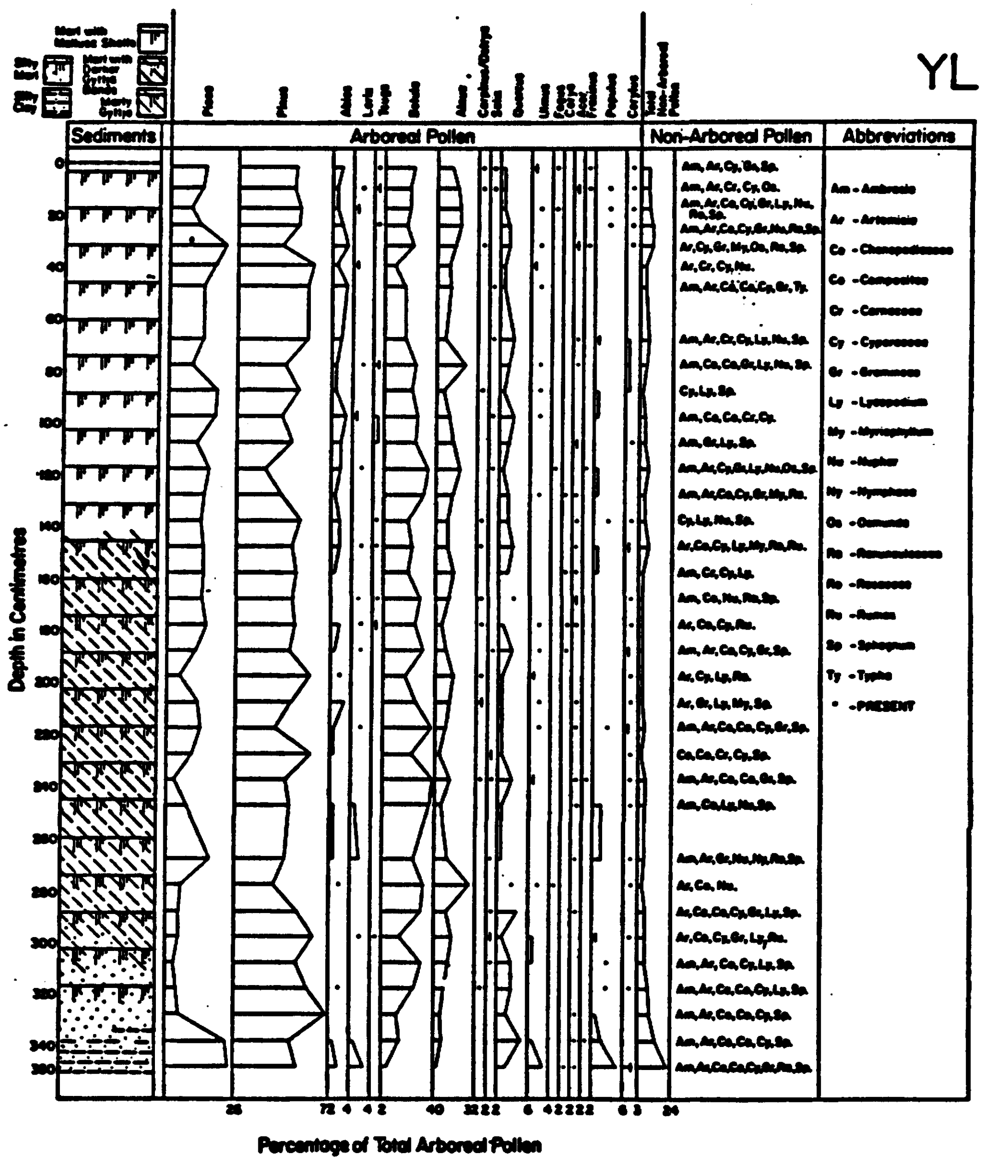


Figure 4:3 Pollen diagram for Lake YL. Extends down to the pine zone about 6,500 yrs. B.P.

W.IVa - characterized by declining percentages of pine pollen.
W.IVb - begins with a rise of birch pollen percentage.
W.IVc - begins with a rise of spruce pollen.
W.IVd - characterized by a rather weak rise of Ambrosia pollen.

If a constant sedimentation rate is assumed then the boundary between W.IVa and W.IVb is about 5,000 yrs., and W.IVb and W.IVc have a boundary at about 3,000 yrs. The subzone W.IVd probably covers the last 100 years.

Conclusion

On the basis of the above outlined palynostratigraphy and available radiocarbon dates, it can be postulated that the base of the pollen diagram from lake UL has an age of approximately 9,500 yrs. Clearly, this core reached the spruce pollen zone (WI).

The oldest sediments (base of the pollen diagrams) reached in lakes YL and GL might be in the pine zone and the ages of the oldest cored sediments are about 6,500 and 6,000 years respectively.

Descriptive Geochemistry Studies (J.F.)

So far palynology has been the main tool for the study of environmental change, as evidenced in lake sediment cores. One objective of our investigation was to explore the relationship between descriptive geochemistry and palynology of lake sediment cores. It was argued that if the patterns for one, or more, chemical elements in the lake sediment material mimicked those obtained for pollen of specific tree species, then an alternative method of dating such sediments might be evolved.

Samples of all three long cores, taken from the same intervals as those used for the palynological investigation, were subjected to

ICP chemical analysis as described in Chapter II. Data for copper and calcium from the Furnival Lake (UL) core are included on Figure 4:5 together with palynological data for Picea, Pinus and Betula obtained from Figure 4:2. Also included on Figure 4:5 are data for the palynostratigraphic sequence (pollen zones) proposed by Saarnisto (included in the pollen diagram) from Alfie's Lake. Data from the other two cores was subject to technical difficulties with the analytical methods and is not discussed here.

The data on Figure 4:5 is interpreted as followed. The calcium content of the sediment material increased in the spruce zone (W.1) and then decreased sharply in the birch zone (W.2). A slower decrease in calcium in the core occurred in zone W.3 (Pine). Since then, there has been a gradual increase in calcium in the lake sediment material with a sharp decrease in the surface samples. The pattern for copper (Figure 4:5) is almost opposite to that for calcium. In order to provide independent evidence on the validity of the data, the samples for the lower part of the core were analyzed twice for copper with very similar results (Figure 4:5 dotted line.). The substantial increase in copper content during W.2 and W.3 may indicate the presence of a mineral deposit in the lake basin, otherwise the content of copper is relatively constant and does not have a pronounced gradient during W.4 time like calcium.

The geochemical patterns for aluminium, manganese, magnesium, iron and titanium are plotted on Figure 4:6 again in relation to the Picea, Pinus and Betula data for Furnival Lake and the interpretation of the Saarnisto palynostratigraphic zones. Also on Figure 4:6, patterns for copper and calcium are included for comparison.

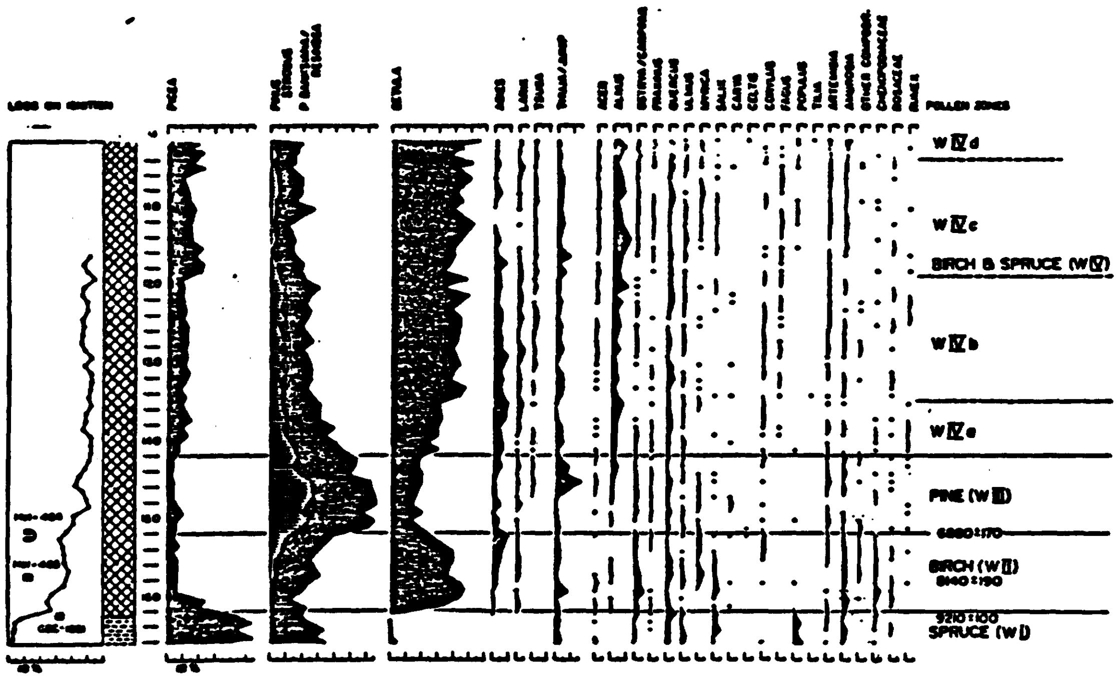


Figure 4:4 Pollen diagram for Alfie's Lake (from Saarnisto, 1975).

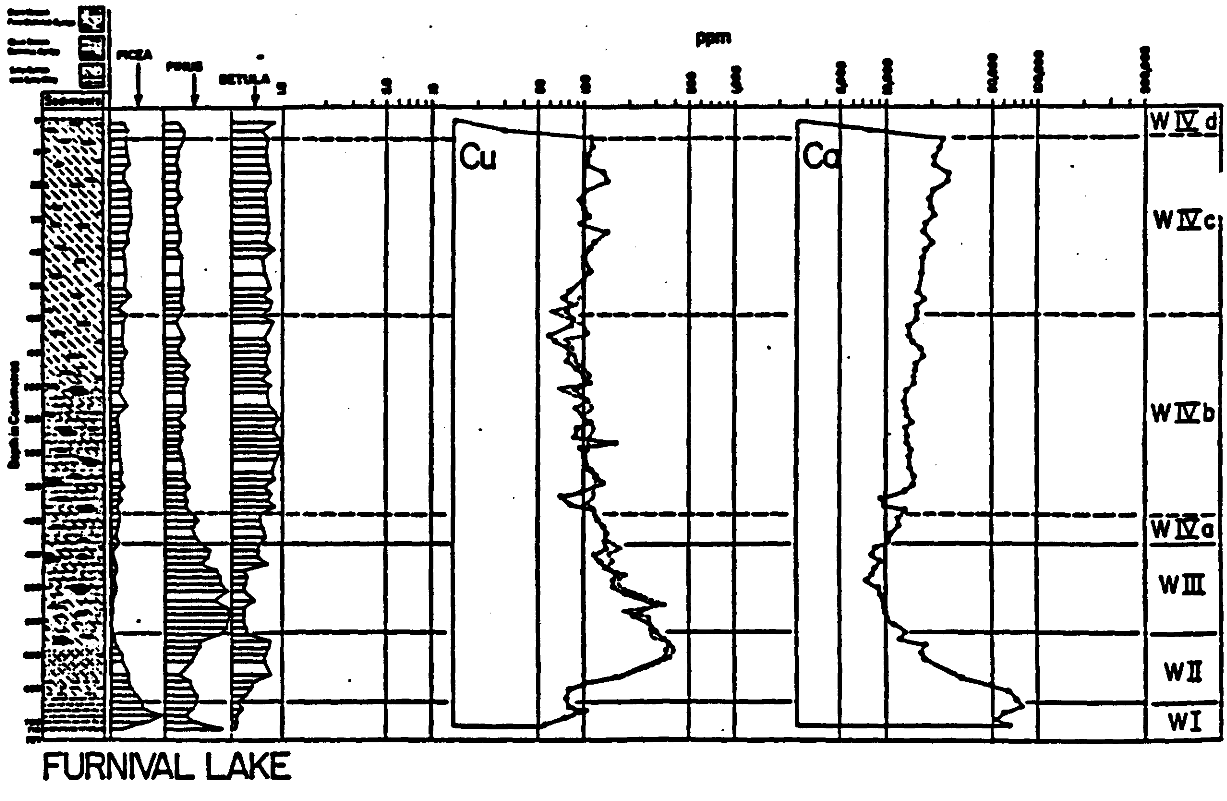


Figure 4:5 Pollen diagrams for Lake UL showing the general relationship between the pollen patterns and the content of copper and calcium in the sediment material.

It should be noted that the data for the elements has been smoothed somewhat in order to obtain the patterns without the noise which was apparent on the detailed plot for copper (Figure 4:5).

Conclusions

The application of descriptive geochemistry to the palynostratigraphic zones and the pollen data for Furnival Lake appears to provide an independent check on the environmental change in the lake basin during the past 9,500 years. Although analytical difficulties prevented a very detailed interpretation of the data, the feasibility of the approach has been clearly demonstrated. The geochemical implications of the patterns in relation to changes in plant cover type have yet to be explored.

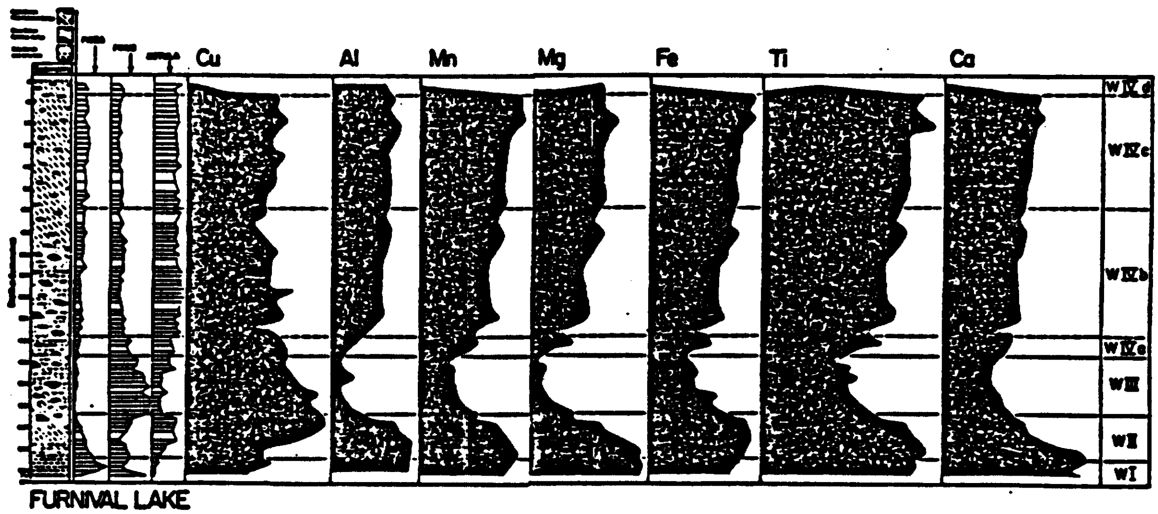


Figure 4:6 Summarized curves for Pollen and geochemical data for Furnival Lake (U_3).

5.0 DESCRIPTIVE GEOCHEMISTRY OF LAKE SEDIMENT MATERIAL

1981 Project

The 20 lake sediment cores (collected from each of the four lakes in the five staircases) were subjected to two types of subsampling and chemical analysis. The 0 - 20 cm portion of each core was divided into 1 cm segments and each was subjected to ICP chemical analysis for Al, Fe, Ca, Mg, Na, K, Ti, P, Mn, Zr, Cr, Ni, Zn, Cu and Pb. Interpendent palynological investigations determined the Ambrosia rise level in each core and chemical data for segments above this level were averaged in order to obtain estimates for the "post-Ambrosia" content of elements in the cores. The core from 20 - 50 cm was segmented at 5 cm intervals in each core. These subsamples were analysed for the elements listed above by ICP plus As, U and Hg, which were done by a different technique. In order to obtain an estimage of the "pre-Ambrosia" level of elements in the cores, the data from the 13 segments was averaged*. Comparisons were then made of the lake to lake multielement geochemical signatures and the staircase to staircase geochemical signatures in pre- and post-Ambrosia time.

Performance of the Analytical Methods (J.F.)

Data from the post-Ambrosia segments from the ICP was suitable for manipulation without modification (Table 5:1). The performance

*In certain data sets, less than 13 samples were included for reasons described below.

for the first 9 elements (Table 5:1) was quite acceptable, with a coefficient of variation of less than 10% for 20 replicates. Similar data for chromium, zirconium and copper was slightly more noisy with coefficients of variation below 15%. The remaining elements, vanadium, nickel, zinc and lead had much higher coefficients of variation, which indicate that caution should be observed when interpreting data for them from the sediment cores.

With respect to the pre-Ambrosia data, the problem of quality control is more complicated. The data for reference standard replicates for the first analysis was found to be unacceptable (Table 5:2) for zirconium, iron, nickel, chromium, copper and lead. Consequently, the analyses were repeated with the performance data shown as "Second Analysis" on Table 5:2.

ELEMENT	MEAN (ppm)	RANGE (ppm)	C/V
Al	31,936	27,260 - 33,287	4.02 %
Fe	9,510	8,547 - 10,286	5.63 %
Ca	7,621	6,798 - 8,720	6.61 %
Mg	2,602	2,384 - 3,239	7.34 %
Na	5,292	4,603 - 6,217	5.98 %
K	3,173	2,940 - 3,340	3.40 %
Ti	1,068	932 - 1,183	7.12 %
P	774	625 - 815	5.04 %
Mn	157	149 - 171	5.78 %
Zr	30	24 - 35	10.32 %
V	25	2 - 52	58.81 %
Cr	26	22 - 35	12.55 %
Ni	19	8 - 51	50.18 %
Zn	85	55 - 139	20.21 %
Cu	22	17 - 33	13.77 %
Pb	22	17 - 30	28.49 %

Table 5:1 Quality control data for 20 replicates of reference standard XZ concealed within the batch of post-Ambrosia unknowns.

ELEMENT	FIRST ANALYSIS			SECOND ANALYSIS		
	n	mean	c/v	n	mean	c/v
Aluminium	17	34,811	5.6 %	20	28,209	14.6 %
Calcium	17	7,281	10.3 %	20	5,462	21.6 %*
Zirconium	17	36	15.7 %	20	37	15.8 %
Iron	17	12,390	135.3 %*	20	8,554	14.3 %*
Manganese	17	144	11.3 %	20	140	11.45%
Potassium	17	3,246	13.1 %	20	6,007	41.8 %*
Sodium	17	5,312	12.2 %	20	4,965	10.3 %
Magnesium	17	2,395	9.7 %	20	2,985	8.8 %
Titanium	17	926	11.8 %	20	967	10.0 %
Phosphorus	17	852	5.0 %	20	864	10.5 %
Nickel	17	42	55.2 %*	20	27	100.0 %*
Chromium	17	28	39.0 %	20	31	28.4 %*
Copper	17	16	22.5 %	20	23	102.0 %*
Zinc	17	72	7.9 %	20	77	33.3 %*
Lead	17	26	19.0 %	20	22	47.2 %*

*includes extreme values

Table 5:2 Summary of data for replicate analyses of reference standard XZ concealed in batches of unknown deep core samples.

ELEMENT	FIRST ANALYSIS			SECOND ANALYSIS		
	n	mean	c/v	n	mean	c/v
Calcium	17	7,281	10.3 %	18	5,434	16.7 %
Zirconium	17	36	15.7 %	19	38	13.2 %
Iron	16	8,203	10.5 %	19	8,721	11.2 %
Potassium	17	3,246	13.1 %	18	6,439	34.0 %
Nickel	14	38	41.9 %	18	20	79.3 %
Chromium	14	27	25.9 %	18	29	18.8 %
Copper	17	16	22.5 %	19	21	11.7 %
Zinc	17	72	7.9 %	17	68	21.0 %
Lead	17	26	19.0 %	14	20	26.6 %

Table 5:3 Revised summary for replicate analyses of reference standard XZ concealed in batches of unknown deep core samples.

At this point it was realized that the poor performance of the analytical method might be detected by inspection of the individual listings for elements. This led to a rejection of extreme values (either high or low) followed by recalculation of the coefficients of variation (Table 5:3). Although the performance for all elements improved with the removal of the extreme values, it still was not equal to that for the post-_Ambrosia_ sample performance test listed in Table 1. Clearly the problem was not in the samples but in the laboratory technique. It was concluded that the pre-_Ambrosia_ data from the unknowns could be used for interpretation if the extremely high (or low) values were excluded. This procedure was justified, because of the relative uniformity of content of elements in lake sediment cores between 20 cm and 50 cm in depth in the Wawa area (Fortescue et al, 1981, Part II). Hence, all data for the pre-_Ambrosia_ core material discussed in this section is calculated from data, from which extreme values have been removed, using the same technique which was used to produced Table 5:3 data from Table 5:2.

Multielement Geochemical Signatures for Staircase Lakes

The staircase lake study affords a good opportunity to compare pre-_Ambrosia_ with post-_Ambrosia_ multielement geochemical signatures under a variety of conditions which may be classified as follows: -

a) Pre-_Ambrosia_ within staircase signatures

b) Pre-_Ambrosia_ staircase to staircase signatures

c) Post-_Ambrosia_ within staircase signatures

d) Pre-/Post-_Ambrosia_ signature comparisons a)

Element	X_1			X_2			X_3			X_4		
	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V
Si	1.03	0.99 - 1.07	2.2	0.76	0.65 - 0.87	10.1	0.83	0.76 - 0.90	5.5	0.84	0.70 - 0.96	10.8
Al	0.40	0.36 - 0.45	5.2	0.34	0.27 - 0.43	15.7	0.45	0.35 - 0.53	10.5	0.41	0.39 - 0.46	5.0
Fe	0.10	0.09 - 0.11	3.9	0.11	0.09 - 0.14	12.8	0.15	0.13 - 0.19	12.7	0.11	0.11 - 0.14	9.3
Ca	0.13	0.12 - 0.14	6.4	0.09	0.08 - 0.11	8.6	0.19	0.16 - 0.23	11.8	0.08	0.07 - 0.09	5.3
Mg	0.08	0.08 - 0.09	4.7	0.06	0.05 - 0.07	8.2	0.13	0.11 - 0.17	14.2	0.04	0.04 - 0.04	4.1
Na	0.18	0.15 - 0.02	9.5	0.10	0.06 - 0.21	22.8	0.35	0.27 - 0.52	21.4	0.05	0.03 - 0.08	30.3
K	0.19	0.16 - 0.21	6.4	0.12	0.10 - 0.20	11.1	0.19	0.15 - 0.23	14.7	0.08	0.07 - 0.09	7.3
Ti	0.14	0.12 - 0.15	5.6	0.12	0.09 - 0.13	11.0	0.19	0.14 - 0.22	10.8	0.08	0.07 - 0.11	12.6
P	0.66	0.62 - 0.71	4.1	1.18	0.70 - 1.31	6.4	0.50	0.39 - 0.61	14.8	0.61	0.57 - 0.63	3.6
Mn	0.09	0.08 - 0.10	4.9	0.07	0.06 - 0.08	10.3	0.17	0.14 - 0.20	12.5	0.16	0.14 - 0.18	8.4
Zr	0.19	0.14 - 0.22	11.2	0.13	0.09 - 0.17	20.1	0.22	0.16 - 0.30	19.6	0.09	0.07 - 0.13	21.3
V	0.32	0.22 - 0.41	23.2	0.22	0.07 - 0.33	41.5	0.29	0.21 - 0.38	15.9	0.37	0.27 - 0.46	18.0
Cr	0.16	0.14 - 0.19	8.0	0.21	0.15 - 0.27	23.2	0.22	0.14 - 0.32	28.6	0.23	0.21 - 0.25	7.1
Ni	0.07	0.04 - 0.09	22.5	0.16	0.01 - 0.28	63.5	0.05	0.01 - 0.11	81.6	0.12	0.08 - 0.19	30.5
Zn	0.76	0.74 - 0.86	9.1	0.65	0.42 - 0.87	24.4	0.57	0.47 - 0.70	13.9	0.91	0.58 - 1.22	22.6
Cu	0.22	0.16 - 0.29	15.4	0.27	0.18 - 0.34	15.7	0.21	0.16 - 0.25	12.2	0.24	0.21 - 0.31	12.9
Pb	1.08	0.85 - 1.23	10.9	0.77	0.62 - 1.08	18.5	0.85	0.54 - 1.38	31.1	0.92	0.85 - 1.15	10.3
U	1.78	1.39 - 2.13	10.9	1.83	1.13 - 2.74	25.3	1.22	0.48 - 2.30	40.7	1.87	1.30 - 2.26	15.0

b)

Element	Z_1			Z_2			Z_3			Z_4		
	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V
Si	0.84	0.58 - 0.93	11.7	0.91	0.68 - 1.05	9.8	0.65	0.59 - 0.71	5.5	0.83	1.02 - 0.86	5.3
Al	0.45	0.28 - 0.50	12.3	0.51	0.41 - 0.60	12.9	0.52	0.50 - 0.55	3.2	0.50	0.52 - 0.41	12.3
Fe	0.09	0.08 - 0.10	6.4	0.17	0.13 - 0.21	15.2	0.14	0.12 - 0.16	7.8	0.18	0.20 - 0.14	8.8
Ca	0.16	0.13 - 0.18	8.1	0.24	0.17 - 0.31	19.8	0.16	0.13 - 0.17	8.2	0.19	0.23 - 0.14	13.5
Mg	0.09	0.06 - 0.10	11.9	0.15	0.11 - 0.19	27.1	0.09	0.07 - 0.12	16.4	0.12	0.15 - 0.10	13.7
Na	0.19	0.17 - 0.22	9.2	0.66	0.46 - 1.13	31.7	0.22	0.13 - 0.30	26.2	0.50	0.72 - 0.32	27.0
K	0.18	0.13 - 0.20	9.7	0.23	0.14 - 0.32	26.5	0.13	0.11 - 0.16	11.2	0.24	0.32 - 0.17	18.6
Ti	0.15	0.12 - 0.17	12.4	0.21	0.17 - 0.26	14.8	0.17	0.21 - 0.15	10.9	0.20	0.16 - 0.22	10.4
P	0.86	0.73 - 0.95	6.3	0.71	0.64 - 0.84	9.5	1.48	1.27 - 1.69	8.4	0.61	0.48 - 0.74	15.5
Mn	0.08	0.07 - 0.10	14.5	0.20	0.15 - 0.24	14.1	0.11	0.09 - 0.13	10.4	0.22	0.25 - 0.17	10.0
Zr	0.24	0.22 - 0.27	5.9	0.40	0.27 - 0.48	14.0	0.27	0.33 - 0.20	16.7	0.42	0.32 - 0.52	15.0
V	0.33	0.25 - 0.38	10.5	0.29	0.22 - 0.35	14.4	0.31	0.21 - 0.38	14.6	0.35	0.29 - 0.42	13.7
Cr	0.21	0.16 - 0.28	18.7	0.30	0.21 - 0.39	20.7	0.36	0.27 - 0.46	16.9	0.32	0.17 - 0.92	67.7
Ni	0.27	0.20 - 0.39	20.5	0.14	0.05 - 0.29	56.0	0.49	0.03 - 0.93	78.8	0.22	0.14 - 0.37	39.4
Zn	0.93	0.88 - 1.03	4.5	0.49	0.33 - 0.59	14.2	0.61	0.51 - 0.70	9.0	0.67	0.51 - 0.97	22.7
Cu	0.29	0.22 - 0.34	16.3	0.19	0.15 - 0.25	15.5	0.47	0.41 - 0.57	11.8	0.24	0.18 - 0.29	17.7
Pb	1.00	0.85 - 1.15	9.8	1.15	0.85 - 1.38	14.5	1.08	0.85 - 1.46	14.3	0.46	0.08 - 0.77	39.0
U	1.61	1.26 - 1.83	14.9	0.87	0.70 - 1.26	19.5	1.00	0.74 - 1.13	12.7	0.87	0.57 - 1.35	23.2

c)

Element	U_1			U_2			U_3			U_4		
	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V
Si	0.46	0.37 - 0.53	12.2	0.68	0.60 - 0.74	5.6	0.58	0.47 - 0.66	10.0	0.62	0.56 - 0.70	7.0
Al	0.13	0.12 - 0.15	5.9	0.20	0.16 - 0.22	9.4	0.34	0.32 - 0.37	3.9	0.44	0.42 - 0.47	3.5
Fe	0.06	0.05 - 0.07	7.3	0.09	0.07 - 0.11	14.4	0.23	0.20 - 0.29	10.4	0.34	0.32 - 0.37	3.7
Ca	0.22	0.18 - 0.25	9.0	0.22	0.18 - 0.26	9.7	0.35	0.30 - 0.39	10.8	0.30	0.28 - 0.32	4.7
Mg	0.05	0.04 - 0.06	5.6	0.10	0.08 - 0.11	10.5	0.29	0.25 - 0.38	11.8	0.27	0.25 - 0.29	4.4
Na	0.04	0.03 - 0.04	6.6	0.13	0.10 - 0.14	11.2	0.22	0.20 - 0.25	5.7	0.26	0.24 - 0.32	9.8
K	0.09	0.08 - 0.11	8.8	0.14	0.11 - 0.18	12.9	0.17	0.15 - 0.20	10.9	0.18	0.16 - 0.20	5.9
Ti	0.07	0.06 - 0.08	9.9	1.05	0.08 - 0.13	13.6	0.19	0.16 - 0.22	6.5	0.24	0.22 - 0.26	4.9
P	0.49	0.44 - 0.53	6.4	0.35	0.31 - 0.39	6.1	0.80	0.75 - 0.88	5.0	1.52	1.44 - 1.59	3.1
Mn	0.07	0.05 - 0.08	10.6	0.08	0.06 - 0.09	11.7	0.24	0.21 - 0.26	5.7	0.87	0.73 - 0.94	6.9
Zr	0.08	0.06 - 0.09	15.45	0.15	0.11 - 0.17	12.2	0.25	0.22 - 0.35	14.6	0.31	0.29 - 0.33	4.8
V	0.07	0.03 - 0.10	34.5	0.10	0.07 - 0.13	14.8	0.27	0.18 - 0.30	13.4	0.26	0.21 - 0.31	14.8
Cr	0.17	0.14 - 0.22	10.6	0.33	0.26 - 0.42	13.8	0.75	0.60 - 0.93	12.5	0.87	0.70 - 1.10	12.0
Ni	0.32	0.13 - 0.47	33.67	0.49	0.27 - 0.68	26.9	0.80	0.65 - 1.04	14.7	0.55	0.46 - 0.64	10.8
Zn	0.83	0.71 - 1.17	14.8	0.60	0.47 - 0.71	12.1	1.28	1.20 - 1.40	5.5	1.79	1.67 - 1.87	3.9
Cu	0.34	0.24 - 0.37	70.2	0.63	0.46 - 0.75	14.6	1.24	1.13 - 1.34	5.0	0.71	0.54 - 0.82	11.8
Pb	1.46	1.00 - 2.00	24.07	0.69	0.46 - 0.85	15.7	1.15	0.85 - 1.46	17.8	1.39	1.15 - 1.62	10.2
U	0.52	0.30 - 0.70	23.08	1.35	0.74 - 1.83	17.9	1.22	0.83 - 1.52	17.6	0.70	0.52 - 0.78	12.8

Table 5:4 Multielement data for pre-Ambrosia lake sediment core material from staircases a) X, b) Z, and c) U.

d)

Element	W_1			W_2			W_3			W_4		
	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V
Si	0.43	0.35 - 0.50	13.2	0.74	0.60 - 0.83	8.5	0.50	0.40 - 0.57	14.4	0.003	0.003 - 0.004	15.3
Al	0.18	0.15 - 0.20	7.9	0.30	0.26 - 0.32	6.3	0.16	0.12 - 0.20	19.1	0.04	0.03 - 0.05	18.2
Fe	0.08	0.06 - 0.10	15.9	0.20	0.15 - 0.26	12.9	0.18	0.15 - 0.25	15.6	0.02	0.01 - 0.02	19.1
Ca	0.37	0.30 - 0.41	9.6	0.32	0.28 - 0.36	9.3	0.26	0.24 - 0.29	5.8	6.50	5.02 - 7.80	13.7
Mg	0.07	0.06 - 0.09	10.6	0.17	0.16 - 0.21	8.8	0.09	0.07 - 0.11	17.4	0.06	0.05 - 0.07	14.7
Na	0.11	0.08 - 0.14	14.1	0.20	0.17 - 0.24	10.4	0.11	0.09 - 0.13	13.5	0.05	0.05 - 0.06	8.8
K	0.11	0.10 - 0.13	7.0	0.18	0.15 - 0.22	12.0	0.10	0.71 - 0.12	15.2	0.04	0.03 - 0.05	23.9
Ti	0.09	0.07 - 0.10	11.2	0.16	0.13 - 0.19	11.6	0.09	0.07 - 0.12	19.4	0.02	0.01 - 0.02	26.2
P	0.37	0.33 - 0.40	5.7	0.01	0.48 - 0.56	5.3	0.01	0.49 - 0.58	5.5	0.05	0.04 - 0.07	17.0
Mn	0.08	0.06 - 0.11	20.7	0.18	0.14 - 0.23	16.2	0.18	0.12 - 0.23	16.9	0.06	0.05 - 0.07	12.5
Sr	0.14	0.12 - 0.19	14.0	0.25	0.17 - 0.30	16.5	0.11	0.10 - 0.14	12.2	0.03	0.02 - 0.06	40.0
V	0.18	0.13 - 0.21	12.6	0.24	0.20 - 0.29	10.3	0.15	0.13 - 0.18	9.8	0.07	0.05 - 0.11	29.8
Cr	0.26	0.16 - 0.37	20.7	0.48	0.23 - 0.68	25.0	0.19	0.13 - 0.27	28.8	0.12	0.07 - 0.16	29.6
Ni	0.22	0.02 - 0.42	54.6	0.52	0.19 - 0.90	39.2	0.08	0.02 - 0.17	76.3	0.47	0.27 - 0.75	37.3
Zn	0.84	0.66 - 1.12	12.4	0.86	0.75 - 0.97	9.3	1.01	0.87 - 1.13	6.4	0.43	0.34 - 0.54	16.4
Cu	1.28	1.12 - 1.49	7.6	2.34	2.02 - 2.74	9.7	1.10	0.85 - 1.41	14.9	0.70	0.05 - 0.80	10.0
Pb	0.70	0.31 - 0.85	22.2	1.00	0.62 - 1.38	25.3	1.92	1.31 - 2.92	26.9	0.92	0.69 - 1.15	14.8
U	0.17	0.13 - 0.22	14.3	1.17	0.04 - 0.91	19.4	0.44	0.17 - 0.65	39.3	0.30	0.13 - 0.52	57.1

e)

Element	Y_1			Y_2			Y_3			Y_4		
	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V	Mean KK	Range	C/V
Si	0.02	0.01 - 0.02	16.2	0.08	0.04 - 0.10	28.7	0.33	0.25 - 0.38	13.5	0.02	0.02 - 0.03	11.6
Al	0.09	0.07 - 0.11	12.6	0.11	0.09 - 0.14	15.3	0.21	0.16 - 0.23	8.1	0.08	0.07 - 0.10	14.7
Fe	0.02	0.02 - 0.03	17.5	0.06	0.04 - 0.08	20.3	0.08	0.06 - 0.10	11.6	0.06	0.05 - 0.07	13.9
Ca	5.42	4.08 - 6.39	17.2	0.45	0.35 - 0.56	14.1	0.31	0.24 - 0.38	11.8	4.62	3.13 - 5.63	14.9
Mg	0.10	0.07 - 0.12	18.4	0.08	0.05 - 0.10	21.5	0.09	0.08 - 0.11	11.0	0.08	0.07 - 0.09	7.2
Na	0.06	0.05 - 0.08	12.4	0.06	0.05 - 0.09	20.6	0.13	0.09 - 0.17	14.2	0.04	0.03 - 0.05	19.0
K	0.08	0.07 - 0.10	9.3	0.08	0.07 - 0.10	15.0	0.16	0.13 - 0.18	10.0	0.06	0.05 - 0.08	21.6
Ti	0.02	0.02 - 0.03	15.2	0.03	0.01 - 0.06	48.6	0.11	0.08 - 0.12	10.7	0.03	0.02 - 0.04	26.5
P	0.21	0.18 - 0.26	13.7	0.59	0.51 - 0.67	8.3	0.48	0.43 - 0.53	5.0	0.29	0.23 - 0.35	11.9
Mn	0.05	0.03 - 0.06	17.6	0.03	0.02 - 0.05	17.7	0.06	0.05 - 0.07	10.3	0.13	0.10 - 0.16	16.7
Sr	0.06	0.04 - 0.07	17.6	0.07	0.05 - 0.09	19.3	0.18	0.12 - 0.22	15.1	0.12	0.04 - 0.17	30.3
V	0.15	0.10 - 0.23	24.4	0.41	0.27 - 0.56	22.1	0.29	0.12 - 0.43	42.4	0.29	0.15 - 0.48	39.9
Cr	0.05	0.01 - 0.07	50.1	0.22	0.07 - 0.30	33.7	0.16	0.12 - 0.21	16.1	0.08	0.05 - 0.13	32.6
Ni	0.10	0.02 - 0.18	60.4	0.18	0.02 - 0.36	73.8	0.17	0.10 - 0.34	38.4	0.20	0.07 - 0.29	34.6
Zn	0.54	0.49 - 0.61	7.0	1.17	0.82 - 1.45	17.8	0.96	0.88 - 1.16	7.9	0.54	0.40 - 0.76	24.5
Cu	0.12	0.09 - 0.19	28.6	0.25	0.15 - 0.44	35.7	0.25	0.18 - 0.34	17.6	1.43	1.09 - 1.97	20.5
Pb	2.15	2.00 - 2.46	5.3	0.69	0.15 - 1.38	68.9	0.92	0.69 - 1.23	22.7	2.08	1.85 - 2.54	10.3
U	0.04	0.04 -	0.0	0.13	0.04 - 0.26	64.0	1.57	1.39 - 1.83	10.1	1.04	0.74 - 1.35	20.4

f)

Element	Staircase X				Staircase Z				Staircase U				Staircase W				Staircase Y			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Si	0	-	+	+	0	+	-	+	0	+	-	+	0	+	-	-	0	+	+	-
Al	0	-	+	-	0	+	+	-	0	+	+	+	0	+	-	-	0	+	+	-
Fe	0	+	+	-	0	+	-	-	0	+	+	+	0	+	-	-	0	+	+	-
Ca	0	-	+	-	0	+	-	+	0	0	+	-	0	-	-	+	0	-	-	+
Mg	0	-	+	-	0	+	-	+	0	+	+	-	0	+	-	-	-	-	+	-
Na	0	-	+	-	0	+	-	+	0	+	+	+	0	+	-	-	0	0	+	-
K	0	-	+	-	0	+	-	+	0	+	+	+	0	+	-	-	0	0	+	-
Ti	0	-	+	-	0	+	-	+	0	+	-	+	0	+	-	-	0	+	+	-
P	0	+	-	+	0	-	+	-	0	-	+	+	0	-	-	+	0	+	-	-
Mn	0	-	+	-	0	+	-	+	0	+	+	+	0	+	0	-	0	-	+	+
Sr	0	-	+	-	0	+	-	+	0	+	+	+	0	+	-	-	0	+	+	-
V	0	-	+	+	0	-	+	+	0	+	+	-	0	+	-	-	0	+	-	0
Cr	0	+	+	+	0	+	-	-	0	+	+	+	0	+	-	-	0	+	-	-
Ni	0	+	-	+	0	-	+	-	0	+	+	-	0	+	-	-	0	+	-	+
Zn	0	-	-	+	0	-	+	+	0	-	+	-	0	+	+	-	0	+	-	+
Cu	0	+	-	+	0	-	+	-	0	-	+	-	0	+	-	-	0	+	0	+
Pb	0	-	+	+	0	+	-	-	0	-	+	+	0	+	-	-	0	-	+	-
U	0	+	-	+	0	-	+	-	0	+	-	-	0	+	-	-	0	+	+	-

Table 5:5 Multielement data for pre-*Ambrosia* lake sediment core material from staircases d) W and e) Y and f) summary of concentration gradients for all 5 staircases.

a) Pre-Ambrosia within staircase signatures

The pre-Ambrosia (20 - 50 cm depth) geochemical data for 18 elements are listed in full on Tables 5:4 and 5:5. Because each estimate is an average of 9 - 13 individual analyses, the range and coefficient of variation can be included for each result. In general, the performance of the analytical method for the unknowns is similar to that for the standards in Table 5:2 and for some elements in Table 5:3.

When the experiment was planned, it was expected that the level of element X in the pre-*Ambrosia* core material would either increase or decrease from lake to lake in each four lake staircase. Consequently, a summary diagram (Table 5:5) was drawn showing the level in the top lake of each series as an "0" with a plus or minus, to denote the variation in level down the staircase. In fact, no lake series included an element which consistantly decreased from lake to lake. Chromium increased from lake to lake in staircase X and U. Aluminium, iron, sodium, potassium, manganese and zirconium also increased from lake to lake in the U staircase, although the significance of these observations may be minimal in relation to the problem of acid rain. It was concluded that the pre-*Ambrosia* geochemical gradients were not well enough defined for comparisons in relation to acid rain effects in the post-*Ambrosia* period to be meaningful on a lake to lake basis.

b) Pre-Ambrosia staircase to staircase signatures

Mean values and concentration ranges for 18 elements in pre-*Ambrosia* lake sediment core material derived from all four lakes in each staircase, are plotted on Figure 5:1. This figure demonstrate the utility of using the KK unit scale combined with the Clarke data for each element. In this figure, the elements of interest are listed in decreasing order in the Earth's crust. The signature diagram drawn in this way provided multielement data in a simple way on a logical display scheme.

In Figure 5:1, the precision for all elements in each of the five staircases is apparent from an inspection of the patterns. Generally, the signatures for Lakes X, Z and Y staircases were slightly more precise than those for U and W (with respect to specific elements). Mean values for silicon (and to a lesser extent aluminium) decreased with increasing pH of the lake staircases. The calcium content of lakes in staircases X, Z and U was both low and within relatively close limits. The calcium in the W and Y lakes was clearly influenced by the formatin of marl as a secondary precipitate with this element reaching over 5 KK in each lake system. In direct contrast to calcium, magnesium was relatively low in all lake systems within close limits. Phosphorus was found to be an element which was variable from lake to lake within the same staircase and from one substrate to another. In general, the phosphorus content of the sediments decreased with increasing pH. Manganese and iron were relatively low in content and showed low variation during pre-*Ambrosia* time. The greatest variation in content, within and between staircases, occurred with the trace elements chromium, nickel, zinc, copper, lead and uranium. As expected, uranium decreased with increasing pH. Lead was slightly higher in the X lakes than elsewhere. Zinc values in the five lake series were around 1 KK, with a fairly large concentration range.

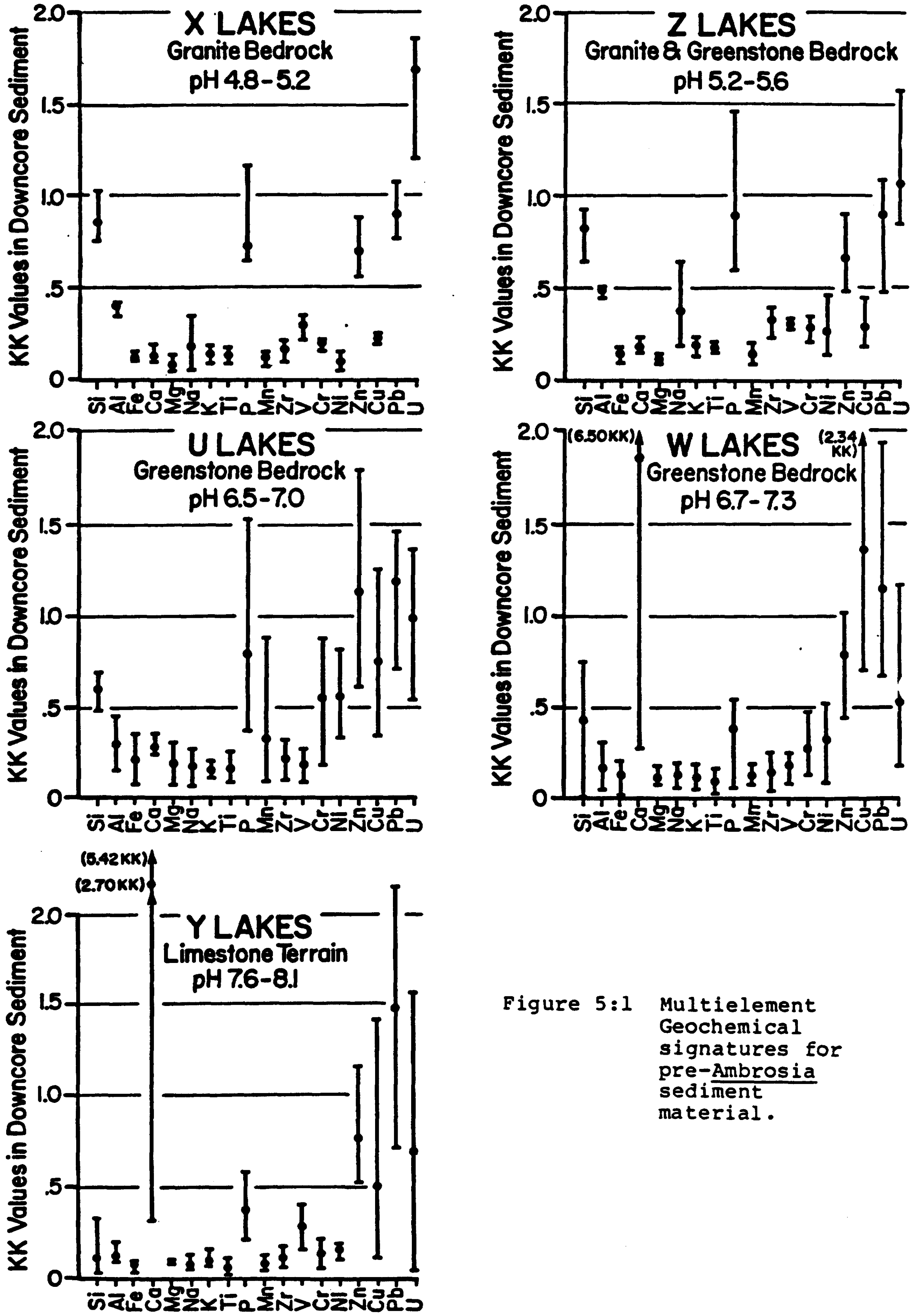


Figure 5:1 Multielement Geochemical signatures for pre-*Ambrosia* sediment material.

Copper was high in the W series of lakes, suggesting that copper mineralization may occur in the greenstones of the area. In summary, the amount and distribution of all of the 18 elements listed on Figures 5:4 and 5:5 follow patterns which could be predicted from the abundance data for the rock types upon which they occur. The exception is calcium, which has been preferentially precipitated in the lake systems with high pH.

c) Post-Ambrosia within staircase comparisons

Two lake staircases were selected for post Ambrosia within staircase comparisons. The Z staircase was selected as an example of a series of lakes with relatively low pH and alkalinity which might very well have gone acid in post-*Ambrosia* time due to the effects of acid rain or some other effect of man's activity. The W series of lakes was included because of the known and documented environmental events which occurred in the area due to the presence and operation of the Wawa smelter in post-*ambrosia* time.

Within staircase comparisons in the Z lakes

Data for the paleo pH, *Ambrosia* rise and the distribution of 17 elements in 0-20 cm depth samples from cores from Lakes Z_1, Z_2, Z_3 and Z_4 are included on Figure 5:2. This diagram provides an overview of the data from which several important observations can be made:-

a) The sedimentation rate in the four lakes in post-*Ambrosia* time has been relatively constant as evidenced by the horizontal arrows on the "Diatom inferred pH panels of Figure 5:2."
b) The pH of Lakes Z_1, Z_2 and Z_3 as evidenced by the diatoms has remained relatively constant in post-*Ambrosia* time. More specifically, in Lake Z_1, the pH has tended to go towards neutrality during this time in contrast to Lakes Z_2 and Z_3 which have tended to go slightly acid (Figure 5:2).
c) The pH of Lake Z_4 has fluctuated slightly in post-*Ambrosia* time and in the recent past (i.e. 0-2 cm) has gone acid from pH of around 5 to around 4.5. This is a significant shift which is likely to be due to acid rain.

Because Z_4 is a relatively large, clear lake, (see Part II, page Z_3) the shift in pH is considered quite significant and the problem is to discover which elements in these samples participate in a change in level of content parallel with the paleo pH change evidenced by the diatoms. A close examination of the Z_1 data (Figure 5:2) indicates a slight shift in pH from 5.5 to 5.4 in the topmost sample in the lake and in Lake Z_3, there is a similar shift from 5.2 to 5.1. These pH changes, especially that in Lake Z_3 might also be expected to provide evidence for a relationship between pH change and change in abundance of chemical elements in the core segments.

In general, the element data in the lake sediment cores can be divided into a series of groups based on the observed behaviour in relation to the pH shifts just discussed:-

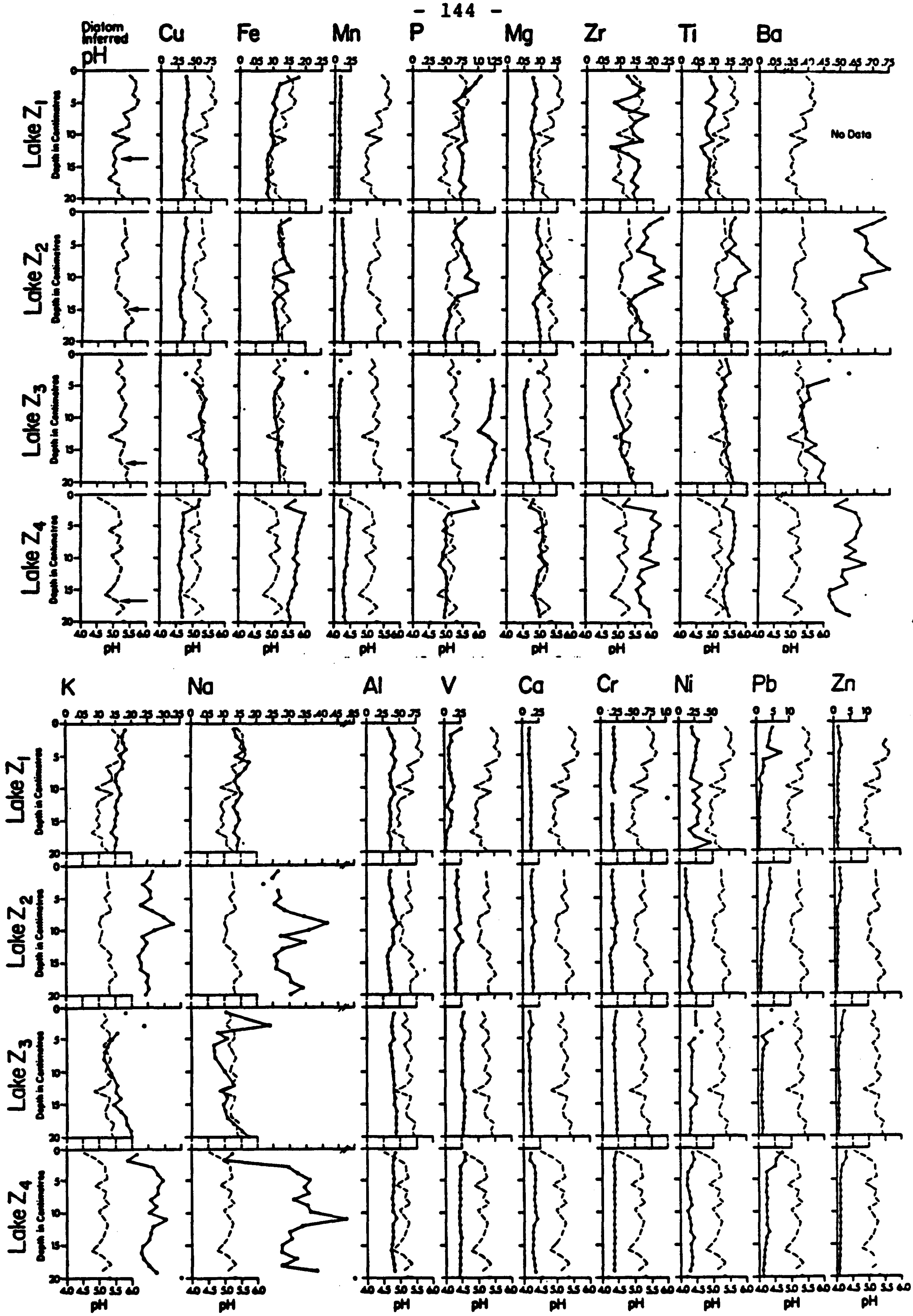


Figure 5:2 The vertical distribution for chemical elements in lake sediments from the Z series of lakes combined with plots of the diatom inferred pH.

Group I <u>Elements unaffected by the pH changes</u> (see Figure 5:2)
Calcium
Chromium
Aluminium

Group II <u>Elements decreased by the pH changes</u> (see Figure 5:2)

Iron	Titanium
Manganese	Barium
Magnesium	Sodium
Zirconium	Potassium

Group III <u>Elements increased by pH changes</u> (see Figure 5:2)
Phosphorus
Copper
Nickel

Group IV <u>Elements which normally increase in post-Ambrosia time (see Figure 5:2)</u>
Lead
Zinc

It should be noted that these trends are in KK values, not ppm and that the scales on the panel graphs on Figure 5:2 are not identical for all elements.

In summary, the overview of the diatom inferred pH, palynological and geochemical data in Figure 5:2 provides a general guide to the performance of the methods and, in particular, allows for the geochemical data to be examined at a glance on a lake to lake and element to element basis. The plot includes points which appear erratic plotted as isolated points which are not joined up to the rese in a series. For example, the data for the top two core segments in Lake Z_3.

Apart for supposed acid rain effects the variation of level of most elements in the vicinity of 10 cm depth in Lakes Z_2 and Z_4 should be noted which may indicate a change in sedimentation material and rate. For example, in Lake Z_2 zirconium, titanium and barium plus sodium and potassium all increase at the 10 cm depth. A similar but less well marked change pattern in concentration occurs in Z_4. The absence of this multielement signature in Lakes Z_1 and Z_3 suggests that the cause is local rather than regional.

It was concluded that in order to confirm relationships between diatom inferred pH and changes in the content of an element (or elements) in core segments in lakes similar to those in the Z series likely to be affected by acid rain, a sampling spacing of less than 1 cm would be required in order to confirm the pattern giving rise to the four groups described above.

<u>Within staircase comparisons in the W lakes</u>

Data for the paleo pH, <u>Ambrosia</u> rise and the distribution of 17 elements in the 0-20 cm depth samples from cores from Lakes W_1, W_2, W_3, and W_4 are included in Figure 5:3. This diagram also provides an overview of the data from which several observations can be made: -

a) The sediment rate in the four lakes in post-<u>Ambrosia</u> time has been more variable than in the Z series of lakes (Figure 5:2) probably due to the disturbance of the landscape in the catchment areas as a result of the Wawa smelter operation. This observation is based on data from 2 of the four lakes only.

b) The pH of Lake W_1 has remained relatively constant during post-Ambrosia time in contrast to that of Lake W_4 which has shifted dramatically from around pH 8.0 to pH 6.0 as a result of the smelter operation which commenced about a third of the way through post-Ambrosia time. As in the previous observation the validity for pH is based on two, not four lakes.

c) The remarkable shift in pH of Lake W_4 is almost certainly due to the effects of the Wawa smelter operation. This is clearly an extreme anthropogenic effect.

The data on Figure 5:3 are plotted in KK units which provide a suitable basis for interelement pattern comparisons. It is interesting that as the pH of the lakes has become more acid, the content of copper in the sediment has decreased significantly. As expected, the content of iron and manganese has increased due to fallout from the smelter. The level of phosphorus, magnesium, lead and zinc has also tended to increase as the smelter operation has dominated the environment whereas the other elements have generally remained at the same concentration level with short term fluctuations for specific elements, particularly in Lakes W_3 and W_4. The identification of group behaviour of elements just described for the Z series of lakes is not as well defined in the W lake series. This is likely to be related to the more basic geochemical environment of the W lakes.

It is concluded that the W series of lakes provide a special environment for the detailed study of the details of the relationship between pH change and element content of lake waters and sediments. Such detailed study is beyond the scope of the research described in this report.

d) Pre-/Post-Ambrosia comparisons

The average values for pre- and post-Ambrosia material provide a convenient opportunity to compare signatures before and after man's entry into the Wawa area. Pre- and post-Ambrosia data for the top lake in each series have been listed on Tables 5:6 and displayed graphically in Figure 5:4.

An important finding resulting from inspection of Table 5:6 is that except for iron, manganese, lead and zinc, none of the 18 elements studied varied by more than 0.5 KK between pre- and post-Ambrosia time. Closer inspection reveals that the iron and manganese values included here are directly related to the Wawa smelter fallout and are clearly an anthropogenic effect. We conclude therefore, that in the five top lakes considered, only lead and zinc are enriched to a significant extent during post-Ambrosia time.

It follows from this conclusion, that zinc and probably lead may be artifically enriched to an unknown extent, if a grab sampler instead of a core sampler is used, when geochemical surveying based on lake sediments is carried out. For this reason it is recommended that in the future, a core sampler be used for geochemical surveying

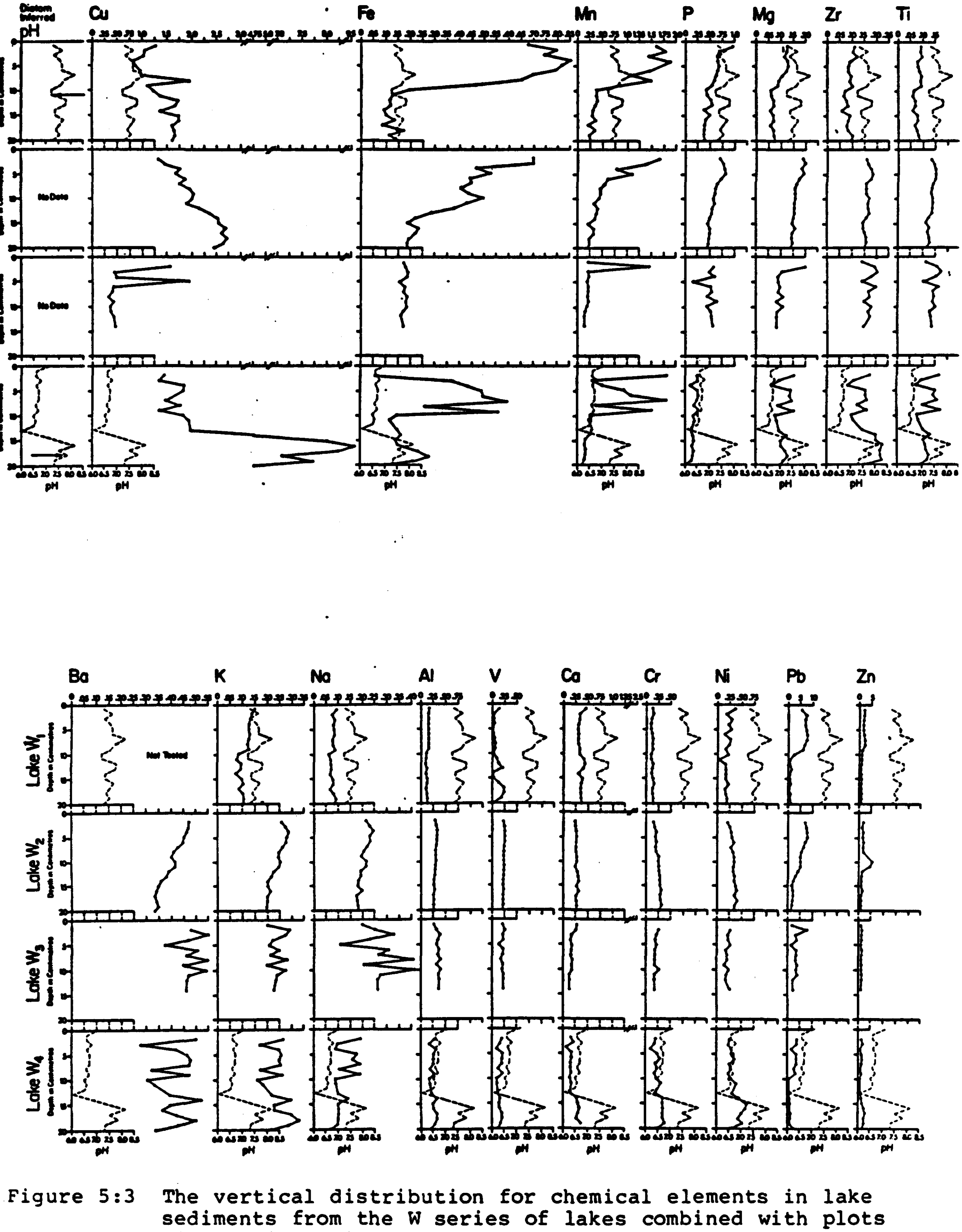


Figure 5:3 The vertical distribution for chemical elements in lake sediments from the W series of lakes combined with plots of the diatom inferred pH.

and two samples extracted from each core. One sample would be from the 0 - 5 cm depth and include post-Ambrosia sediment, while the other would be from 20 - 50 cm for pre-Ambrosia material.

Another recommendation which stems from this aspect of the investigation, is the desirability of precise and accurate data for lead and zinc, because these are the only two which normally have an "anthropogenic" increase in lake sediment cores.

Element	X_1		(1)-(2)	S_1		(1)-(2)	U_1		(1)-(2)	W_1		(1)-(2)	Y_1		(1)-(2)
	(1) Pre Ambrosia	(2) Post Ambrosia	Post-Pre	(1) Pre Ambrosia	(2) Post Ambrosia	Post-Pre	(1) Pre Ambrosia	(2) Post Ambrosia	Post-Pre	(1) Pre Ambrosia	(2) Post Ambrosia	Post-Pre	(1) Pre Ambrosia	(2) Post Ambrosia	Post-Pre
Si	1.03	-	-	0.84	-	-	0.46	-	-	0.43	-	-	0.02	-	-
Al	0.04	0.333	0.29	0.45	0.396	-0.05	0.13	0.142	0.01	0.18	0.155	-0.03	0.09	0.063	-0.03
Fe	0.10	0.109	0.01	0.09	0.107	0.02	0.06	0.089	0.03	0.08	0.673	0.59	0.02	0.061	0.04
Mn	0.09	0.083	-0.01	0.08	0.085	0.01	0.07	0.118	0.05	0.08	1.369	1.29	0.05	0.158	0.12
K	0.19	0.145	-0.05	0.18	0.165	-0.02	0.09	0.103	0.01	0.11	0.126	0.02	0.08	0.100	0.02
Na	0.18	0.136	-0.04	0.19	0.148	-0.04	0.04	0.049	0.01	0.11	0.081	-0.03	0.06	0.030	-0.03
Mg	0.08	0.069	-0.01	0.09	0.079	-0.01	0.05	0.067	0.02	0.07	0.107	0.04	0.10	0.108	0.01
Ca	0.13	0.129	-0,001	0.16	0.110	-0.05	0.22	0.249	0.03	0.37	0.325	-0.05	5.42	6.075	0.66
P	0.66	0.608	-0.05	0.86	0.802	-0.06	0.49	0.742	0.25	0.37	0.646	0.28	0.21	0.536	0.33
Ti	0.14	0.130	-0.01	0.15	0.135	-0.02	0.07	0.066	-0.004	0.09	0.088	-0.002	0.02	0.032	0.01
Zr	0.19	0.138	-0.05	0.24	0.137	-0.10	0.08	0.066	-0.014	0.14	0.098	-0.04	0.06	0.039	-0.02
As	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cr	0.16	0.302	0.14	0.21	0.256	-0.05	0.17	0.292	0.12	0.26	0.120	-0.14	0.05	0.082	0.03
Cu	0.22	0.277	0.06	0.29	0.364	0.07	0.34	0.426	0.09	1.28	1.128	-0.15	0.12	0.375	0.26
Hg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ni	0.07	0.193	0.12	0.27	0.263	-0.01	0.32	0.308	-0.01	0.22	0.235	0.02	0.10	0.175	0.08
Pb	1.08	1.231	0.15	1.00	2.484	1.48	1.46	3.532	2.07	0.70	6.446	5.75	2.15	1.500	-0.65
U	1.78	-	-	1.61	-	-	0.52	-	-	0.17	-	-	0.04	-	-
V	0.32	0.120	-0.20	0.33	0.110	-0.22	0.07	0.177	0.11	0.18	0.127	-0.05	0.15	0.129	-0.02
Zn	0.76	4.903	4.14	0.93	1.504	0.57	0.83	3.546	2.72	0.84	1.889	1.05	0.54	1.424	0.88

*Post-Pre = POST MINUS PRE

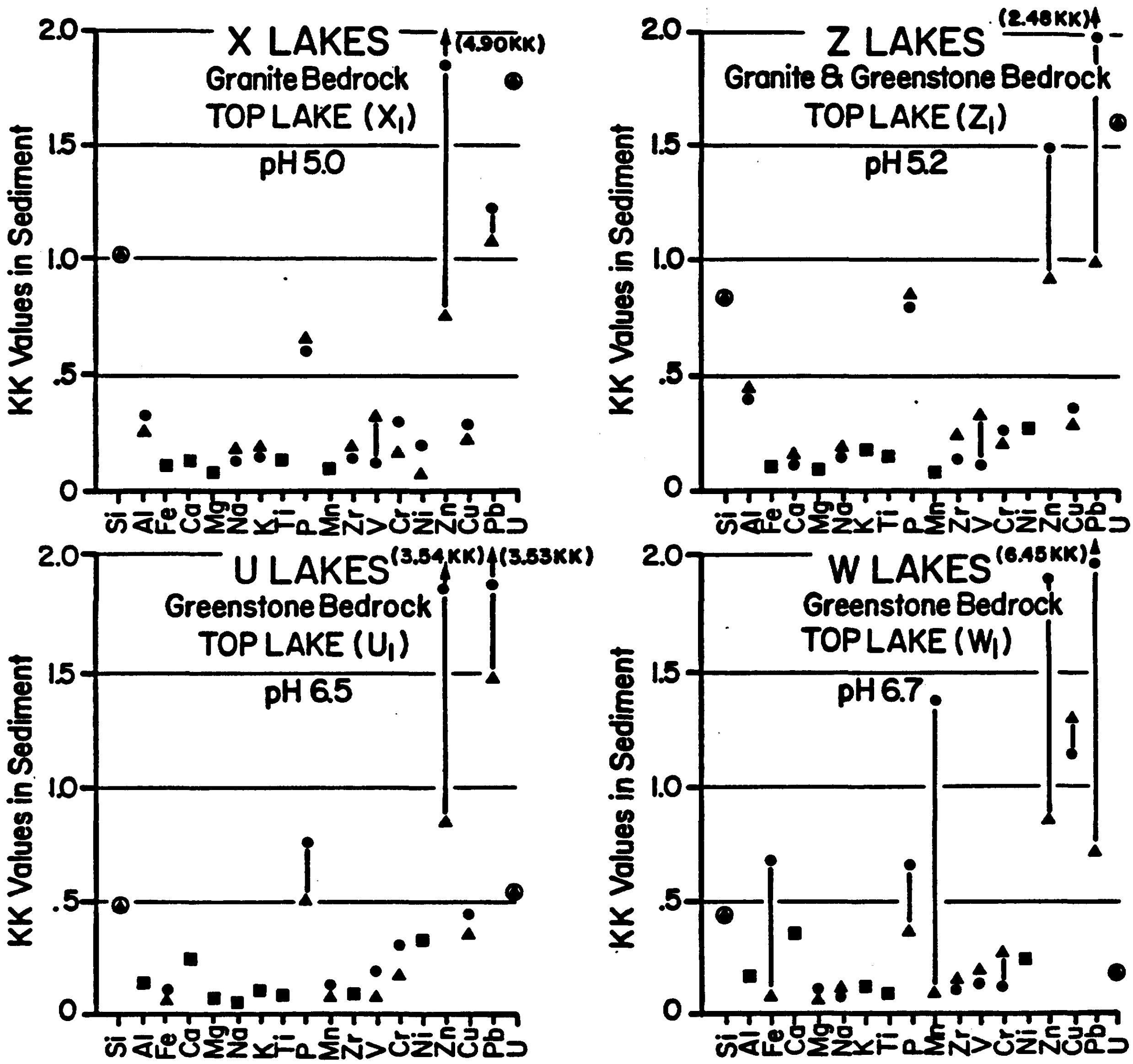
Table 5:6 Pre- and post-Ambrosia geochemical data for top lakes.

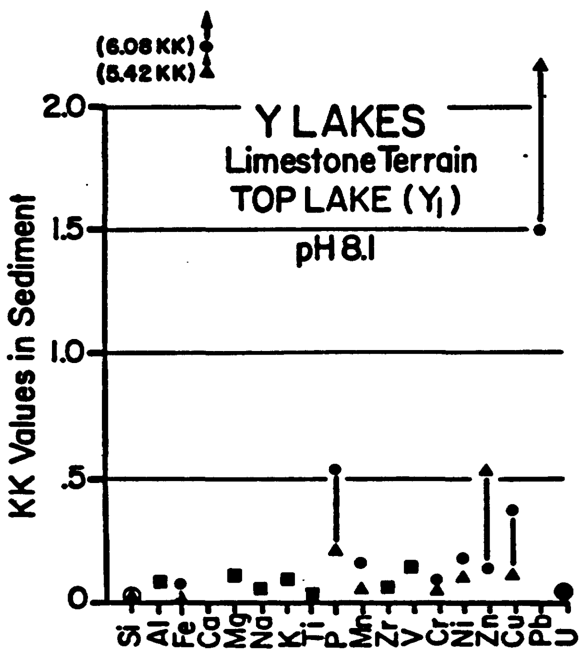
Summary

The data on the tables and figures in the preceding section are listed in full in Part II. The purpose of the section was to draw attention to general relationships which occur within each core, lake staircase series and within the five lake systems as a whole.

Conclusion

The detailed study of 0-20 cm core segments together with general study of down core material from the 20 lakes included in the 1981 study provides firm guidelines for the design of future regional geochemical surveys and a starting point for more detailed research of the geochemistry of the lakes included in the study.





LEGEND:

- Average Post *Ambrosia* ●
- Average Pre *Ambrosia* ▲
- Pre *Ambrosia* Data Only ◉
- Pre and Post *Ambrosia* Points Identical ■

Figure 5:4 The pre- and post-*Ambrosia* multielement geochemical signatures for the staircase lakes.

Downcore Descriptive Geochemistry

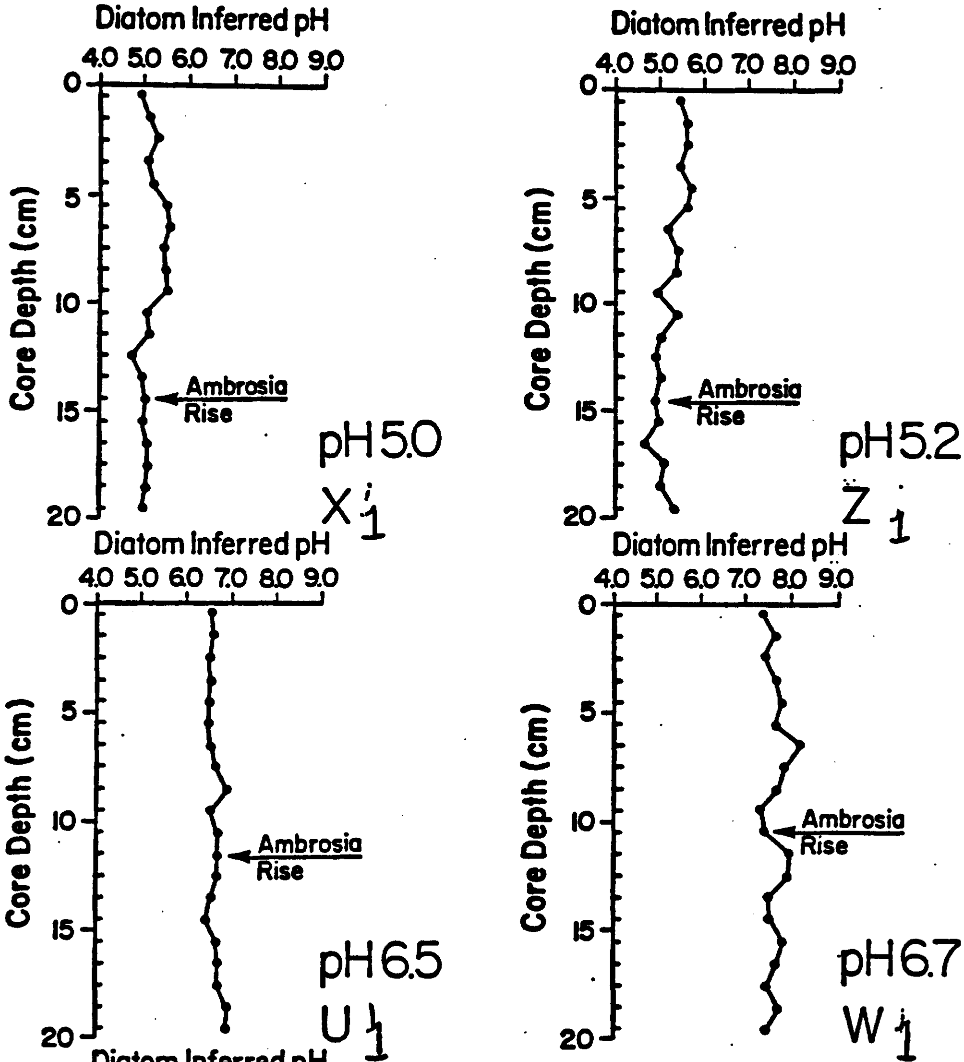
The paleo-pH indicator data described in Chapter 3 was later supplimented with descriptive geochemistry using the exact same samples. In each staircase, the headwater lake was studied and related to the paleo-pH data on a series of diagrams (Figures 5:6 - 5:12). The level of Ambrosia rise and the paleo-pH data alone are listed separately on (Figure 5:5). Unlike the scales chosen for the description of paleopH data in the previous section (in Figure 5:5), all data is plotted to the same scale for purposes of direct comparison with the patterns obtained from the geochemistry. very generally, the paleopH patterns show a slight decrease in pH with depth in Lakes X_1, Z_1, U_1 and W_1, with a constant pH in Lake Y_1 (Figure 5:5). Details of the variation in paleo-pH within each core in relation to local conditions were discussed in the previous section.

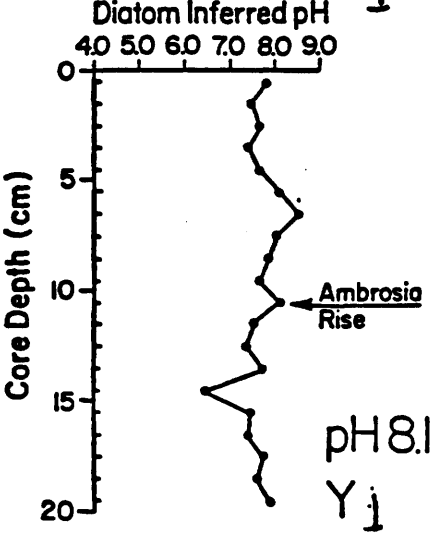
Calcium

The calcium of the lake sediment material might be expected to vary in post-Ambrosia time due to disturbance of the lakes. Such disturbance might be due to one or more of the following: -

beaver activity
forest fires
logging and associated disturbance of the landscape
acidrain

Of these, beaver activity is likely to be associated with the smaller lakes such as Y_1. Forest fire and logging events in the



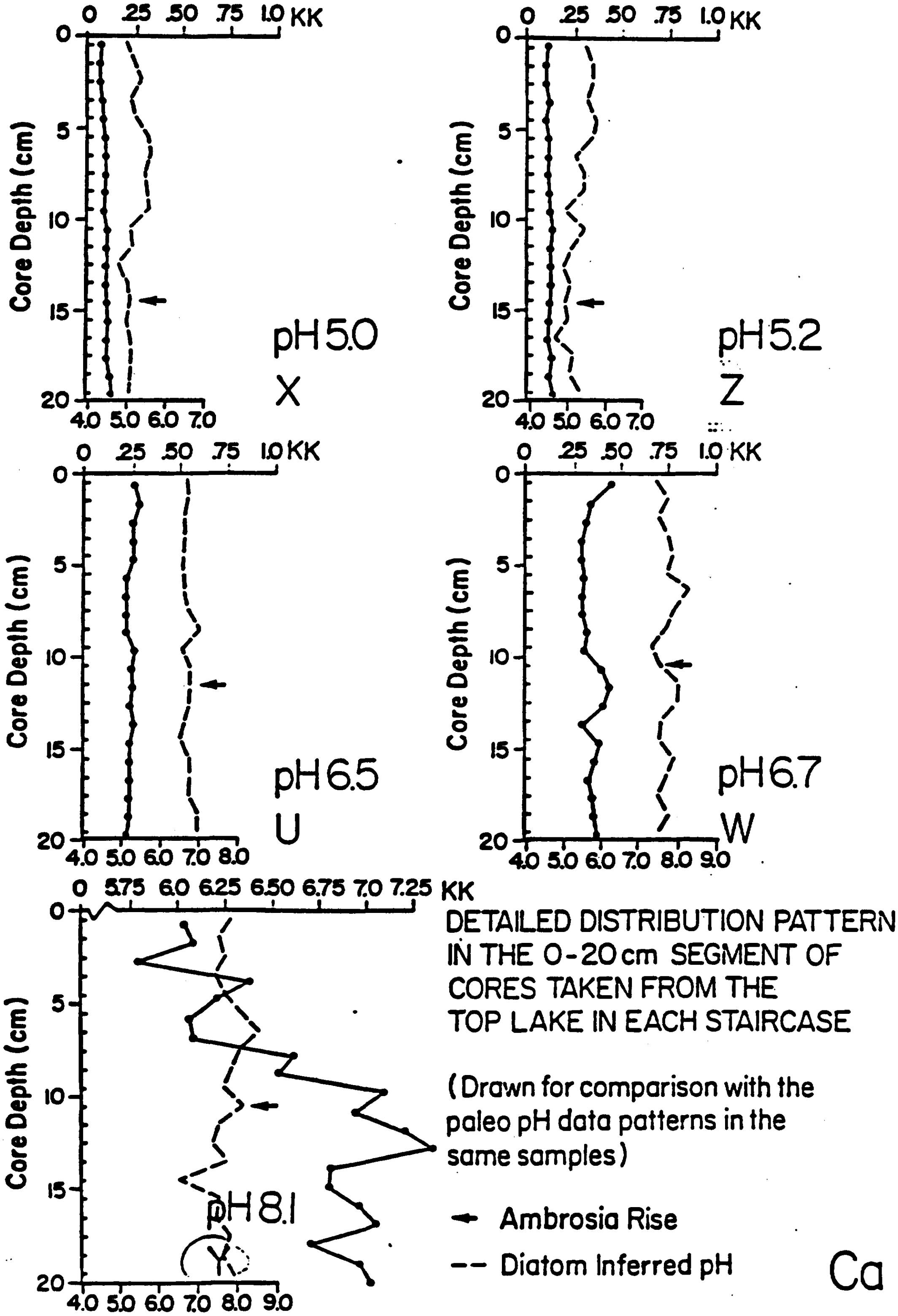


DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE

PALEO pH

(based on the study of diatoms)

Figure 5:5



0 .25 .50 .75 1.0 KK
Core Depth (cm)
0 5 10 15 20
4.0 5.0 6.0 7.0
pH 5.0
X
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH 5.2
Z
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
0 5.75 6.0 6.25 6.50 6.75 7.0 7.25 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
Ambrosia Rise
Diatom Inferred pH
Ca

Figure 5:6

five staircase areas have been discussed in relation to paleo-pH in the previous section. Acid rain effects are likely to be most marked in the upper levels of the core material.

When the calcium patterns are considered in relation to these variables (Figure 5:6) the lakes are clearly in three groups. One includes Lakes X_1 and Z_1, in which there is minimal calcium (circa 0.125 KK) with a very slight gradual increase with depth. The second includes lakes U_1 and W_1 with intermediate pH, where the calcium level is between 0.25 - 0.05 KK. The pattern for Lake U_1 is interesting, in that between a depth of 8 and 10 cm the paleo-pH curves were interpreted as varying due to a logging and landscape disturbance between 1935 and 1945. Four points on the calcium curve are distinctly lower during this time period (Figure 5:6). This suggests, but does not prove a relationship. In Lake W_1, the paleo-pH curve is variable due to the effects of the smelter operation at Wawa (Figure 5:5) which is accompanied by an uniform calcium level. It is interesting that as the pH tends to decline in the 0 - 5 cm part of the core, there is an <u>increase</u> in the calcium content. Otherwise, an increase in calcium followed by a decrease in the element was associated with increasing pH in pre-<u>Ambrosia</u> time. The level of calcium in Lake Y_1 which belongs to a third group involving the precipitation of marl in the lake by chemical precipitation. The calcium pattern indicates a decrease in marl towards the lake water/sediment interface in post-<u>Ambrosia</u> time, although it is doubtful if this is associated with any of the four variables listed above.

It is concluded that the general level of calcium is associated with the pH of lake waters during post-<u>Ambrosia</u> time. Large amounts of secondary calcium carbonate occur in a lake with a pH of 8.1 (6 - 7.25 KK), intermediate levels (0.25 - 0.50 KK) are found in lakes in the 6.5 - 6.7 range and low levels (less than 0.25 KK) are found in lakes in the pH 5.0 - 5.2 range. This suggests, but does not prove a relationship between lake sediment calcium content and alkalinity in post-*Ambrosia* time. In Lake U_1 there appears to be a relationship between variation in paleo-pH (due to logging activity) with slightly lower calcium content of the core material.

Iron and Manganese

The descriptive geochemical data for iron and manganese are included on Figures 5:7 and 5:8. With respect to iron, the level was around 0.1 KK in the acid lakes (X_1 and Z_1). In both lakes the level of the element increased sharply in the top 3 cm of the core. In the core from Lake X_1, an increase in pH was found in the 8 - 12 cm core segments, which was tentatively explained by logging activity. This is accompanied by an increase followed by a decrease in the level of iron (Figure 5:7). The complex paleo-pH pattern in Lake Z_1 is mimicked by the iron pattern (Figure 5:7). The level of manganese in Lakes X_1 and Z_1 is uniformly low.

The data for Lakes U_1 and W_1 for iron and manganese provided a clear demonstration of man's effect on the environment. The iron pattern in Lake U_1 is similar to that for calcium, except that the variability is slightly greater. Manganese in this lake was found to be relatively constant at about 0.125 KK, except for a slight increase in the top 4 cm. The data for Lake W_1 showed a slightly higher content of iron (0.125 KK) and manganese (0.25 KK) than in

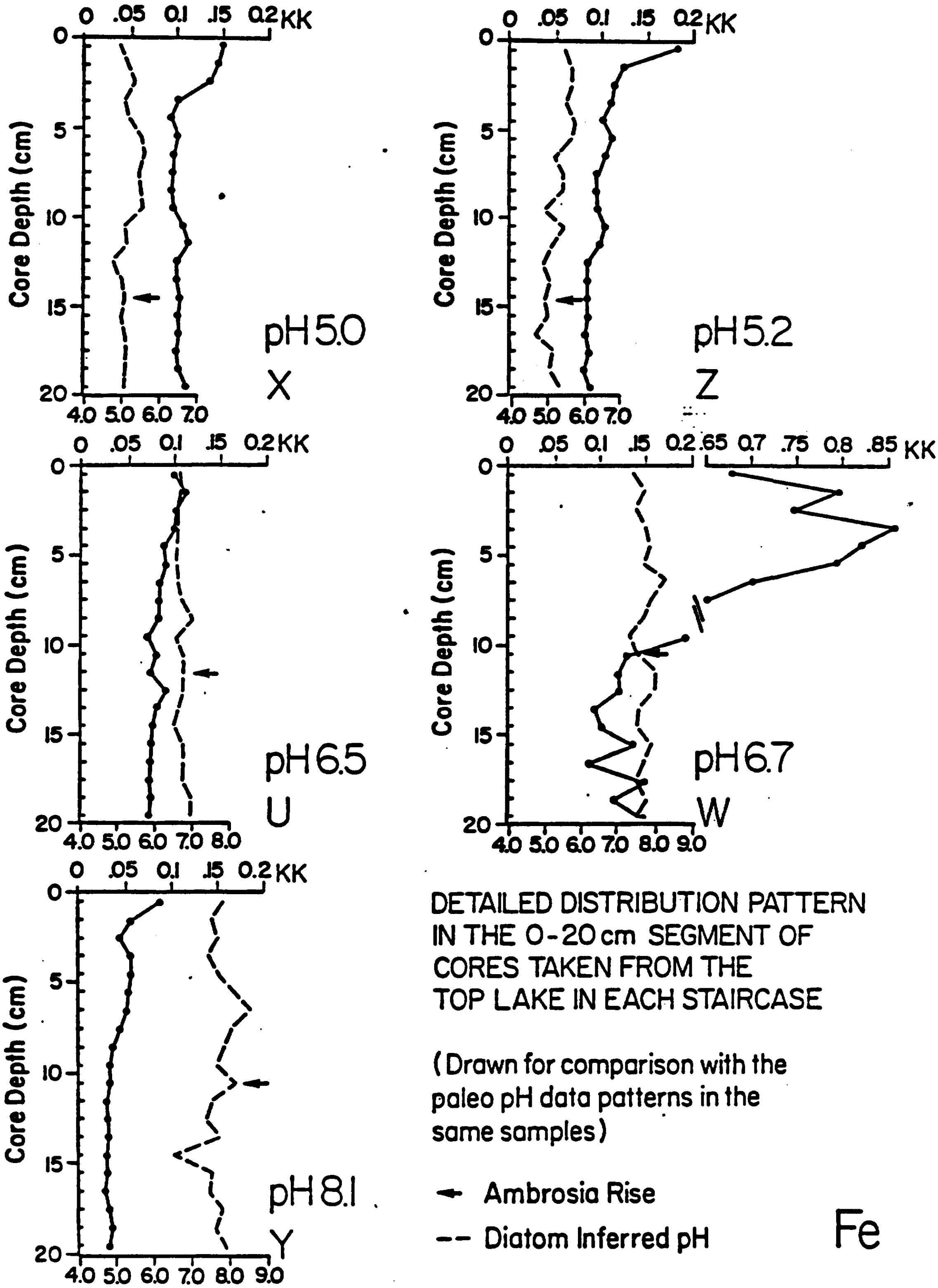

0 .05 0.1 .15 0.2 KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH 5.0
X
pH 5.2
Z
.65 0.7 .75 0.8 .85 KK
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
Ambrosia Rise
Diatom Inferred pH
Fe

Figure 5:7

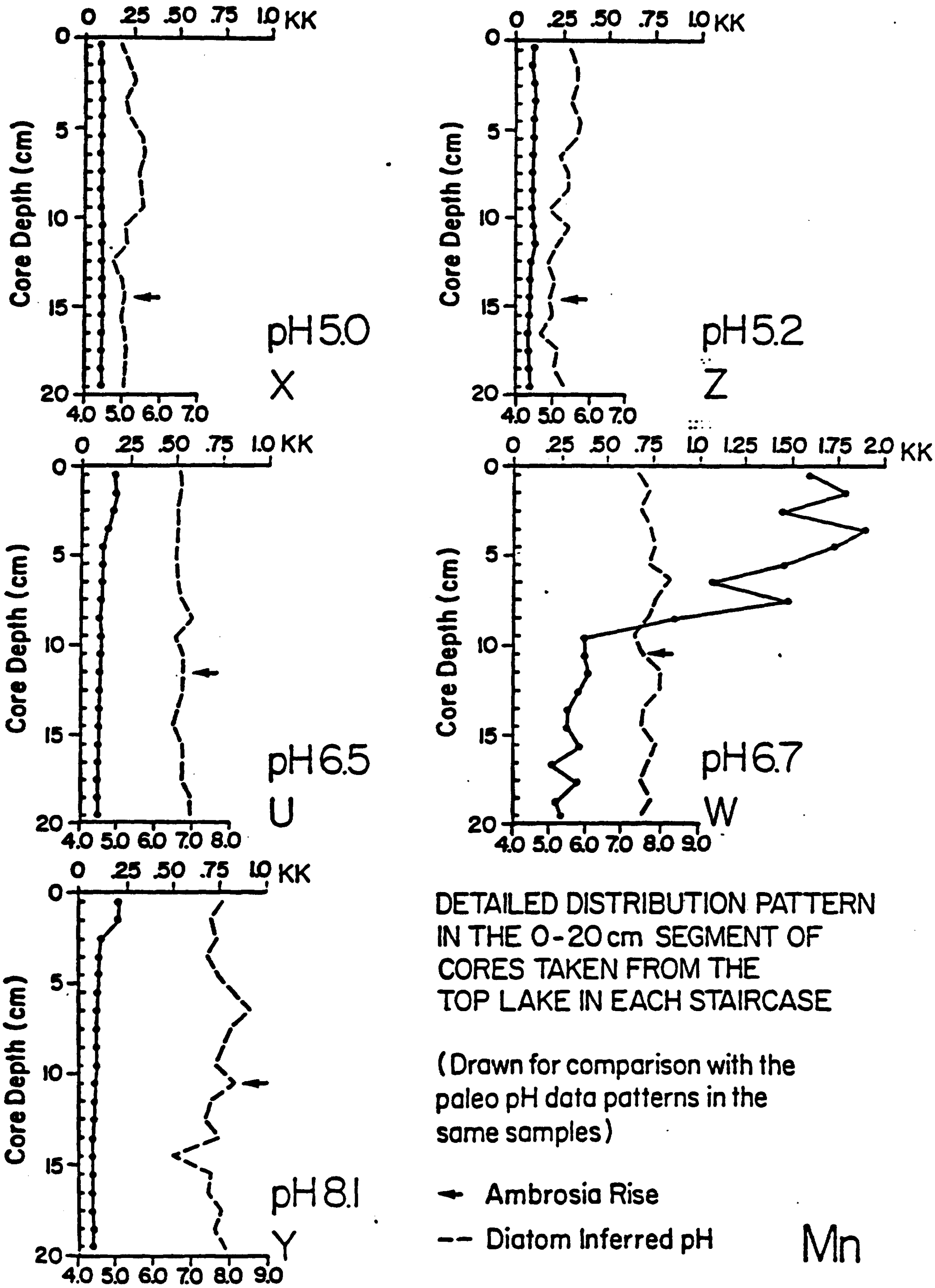

0 .25 .50 .75 1.0 KK
Core Depth (cm)
0
5
10
15
20
4.0 5.0 6.0 7.0
pH 5.0
X
pH 5.2
Z
0 .25 .50 .75 1.0 1.25 1.50 1.75 2.0 KK
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
Ambrosia Rise
Diatom Inferred pH
Mn

Figure 5:8

Lake U_1 in pre-Ambrosia time. Soon after the Ambrosia rise there was a sharp increase in the level of both elements (iron to 0.8 KK and manganese to 1.75 KK), caused by fallout from the Wawa smelter which commenced operation in 1909. Both elements showed a steady increase to a depth of some 4 cm in the core and then a decline (Figures 5:7 and 5:8). The content of manganese in Lake Y_1 was similar to that in Lake U_1 except for a slightly larger surface enrichment in the top 2 cm interval. The iron pattern is similar to that for manganese with a slight decrease at 3 cm.

Magnesium

In the low pH Lakes X_1 and Z_1, there was found to be a gradual slight decrease of the magnesium level in the vicinity of 0.75 KK (Figure 5:9). In Lake X_1, the curve mimicked that of calcium with respect to the level change due to logging operations. In Lake Z_1 the magnesium curve was more noisy than that for calcium.

The magnesium curves for the neutral lakes were also more noisy than those for calcium. In Lake U_1 a sharp decrease in magnesium level is associated with a similar decrease in paleo-pH. In Lake W_1 magnesium, unlike calcium, increased significantly during post-Ambrosia time.

In Lake Y_1 the magnesium remained relatively constant at around 0.1 KK for the whole 20 cm length of the core.

Aluminium

The element was highest in the acid lakes (circa 0.75 KK), intermediate in the neutral lakes and low in the alkaline lakes.

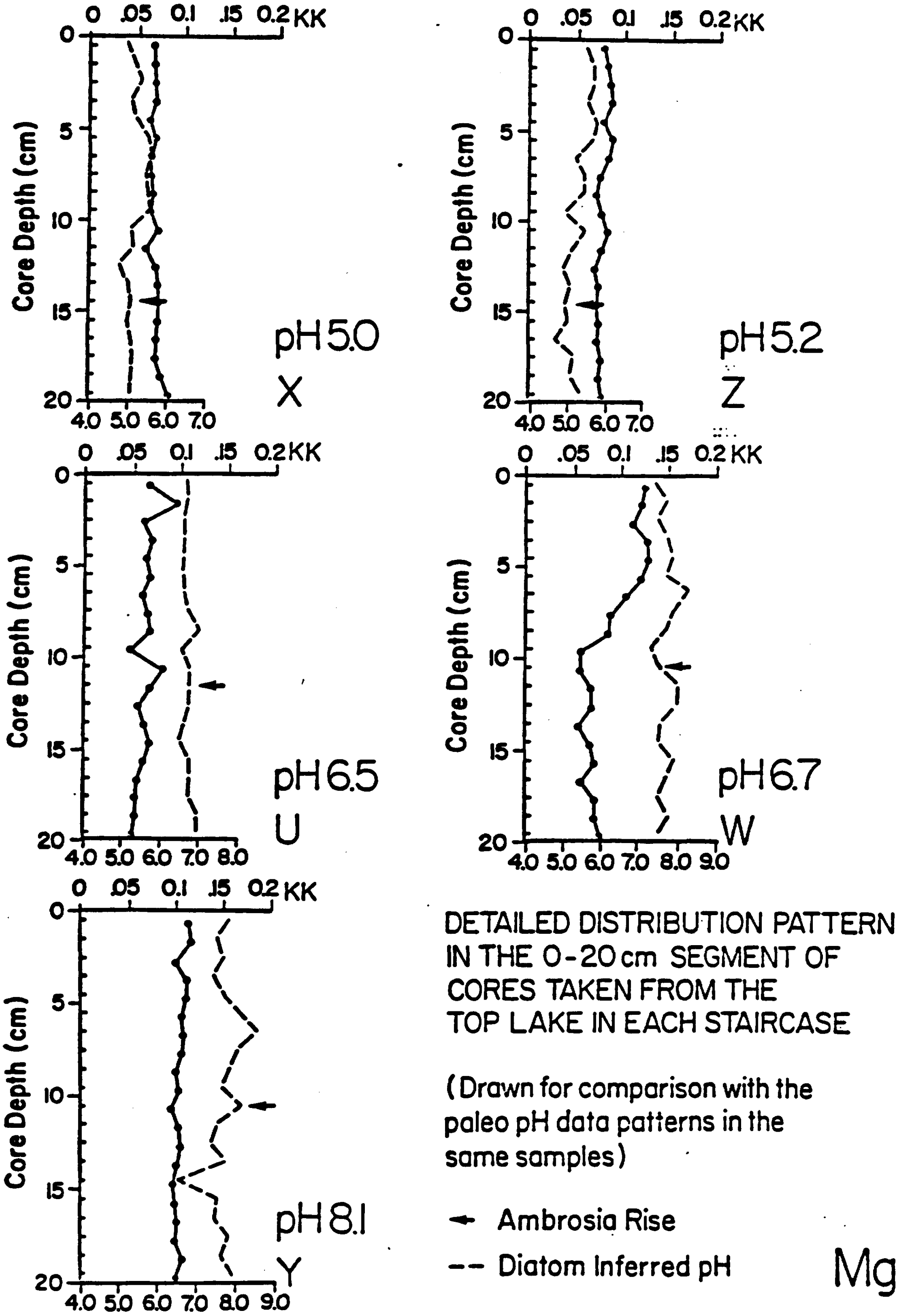

0 .05 0.1 .15 0.2 KK
Core Depth (cm)
0
5
10
15
20
4.0 5.0 6.0 7.0
pH 5.0
X
0 .05 0.1 .15 0.2 KK
Core Depth (cm)
pH 5.2
Z
4.0 5.0 6.0 7.0
pH 6.5
U
4.0 5.0 6.0 7.0 8.0
pH 6.7
W
4.0 5.0 6.0 7.0 8.0 9.0
pH 8.1
Y
4.0 5.0 6.0 7.0 8.0 9.0
DETAILED DISTRIBUTION PATTERN
IN THE 0-20 cm SEGMENT OF
CORES TAKEN FROM THE
TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the
paleo pH data patterns in the
same samples)
Ambrosia Rise
-- Diatom Inferred pH
Mg

Figure 5:9

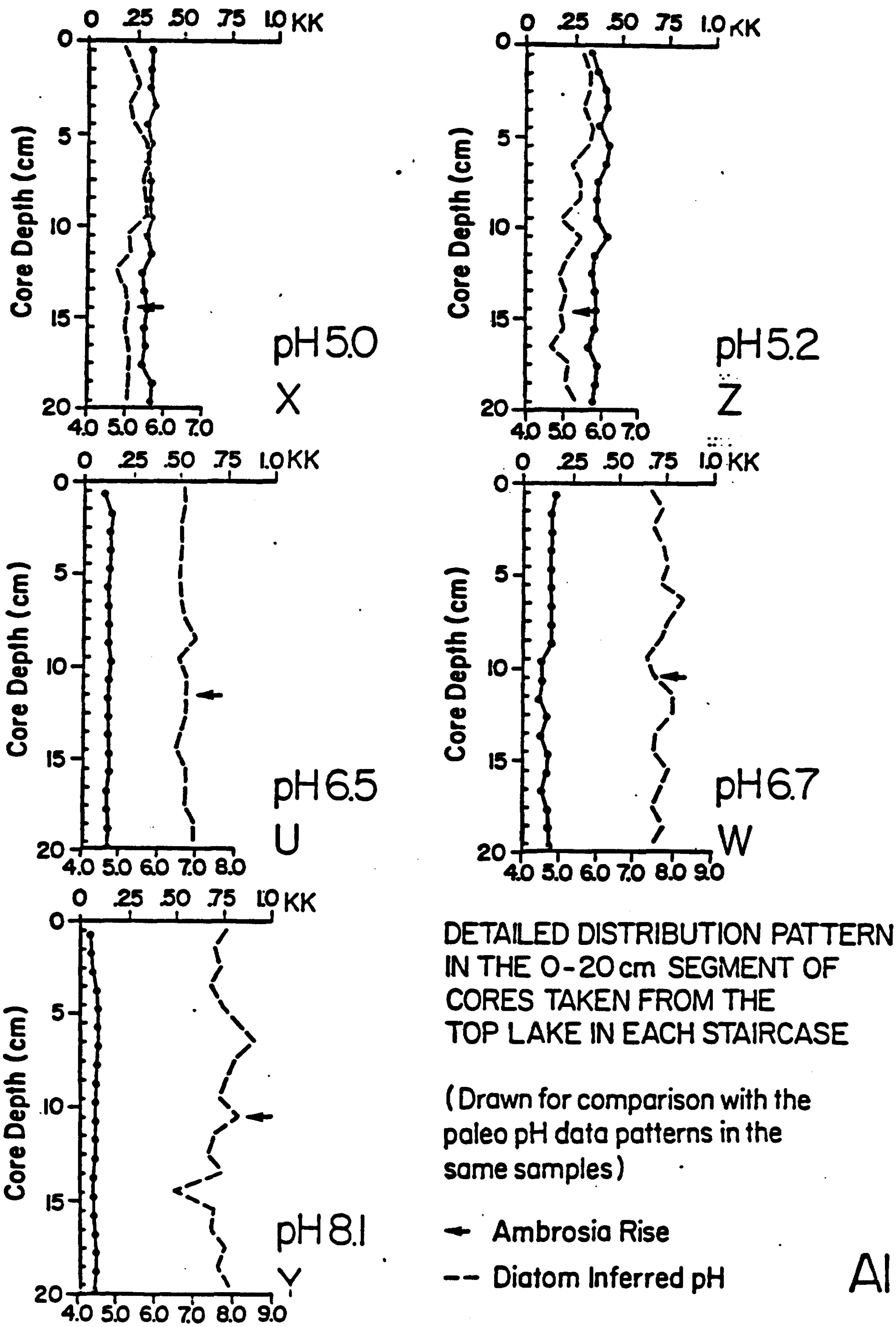

0 .25 .50 .75 1.0 KK
Core Depth (cm)
0
5
10
15
20
4.0 5.0 6.0 7.0
pH 5.0
X
pH 5.2
Z
pH 6.5
U
4.0 5.0 6.0 7.0 8.0
pH 6.7
W
4.0 5.0 6.0 7.0 8.0 9.0
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
Ambrosia Rise
Diatom Inferred pH
AI

Figure 5:10

The element is uniformly distributed in Lakes Y_1 and U_1 with a slight, but consistant increase in the upper part of W_1 (i.e. post-*Ambrosia*). Aluminium values in the two acid lakes, X_1 and Z_1, were slightly more variable compared with those in Lakes U_1 and Y1. The data for aluminium is plotted on Figure 5:10.

Potassium and Sodium

These elements are taken together because, in spite of their similar chemical behaviour, they have a distinctly different geochemical behaviour owing to the incorporation of significant amounts of potassium in secondary products of weathering.

The potassium patterns are shown on Figure 5:11 and sodium on similar. As in the case of aluminium, the data for Lakes X_1 and Z_1 are more noisy than for U_1 and Y_1, which suggest a sampling and/or an analytical problem. Compared with sodium, the level of potassium is higher in the post-*Ambrosia* material from core W_1 suggesting an increase in secondary minerals associated with the defoliation of the catchment area by fume kill. It is worth noting that potassium and sodium as well as calcium, decreased towards the top of core Y_1, which also may indicate a sampling problem.

Sodium and potassium are the first two elements in the series which include "erratic high" values within the set. The 12 cm sample in core X_1 is "low" in both elements, which may relate to the logging activity in the area mentioned above, or may be an analytical artifact. This cannot be, because all the sample was used up in the analysis.

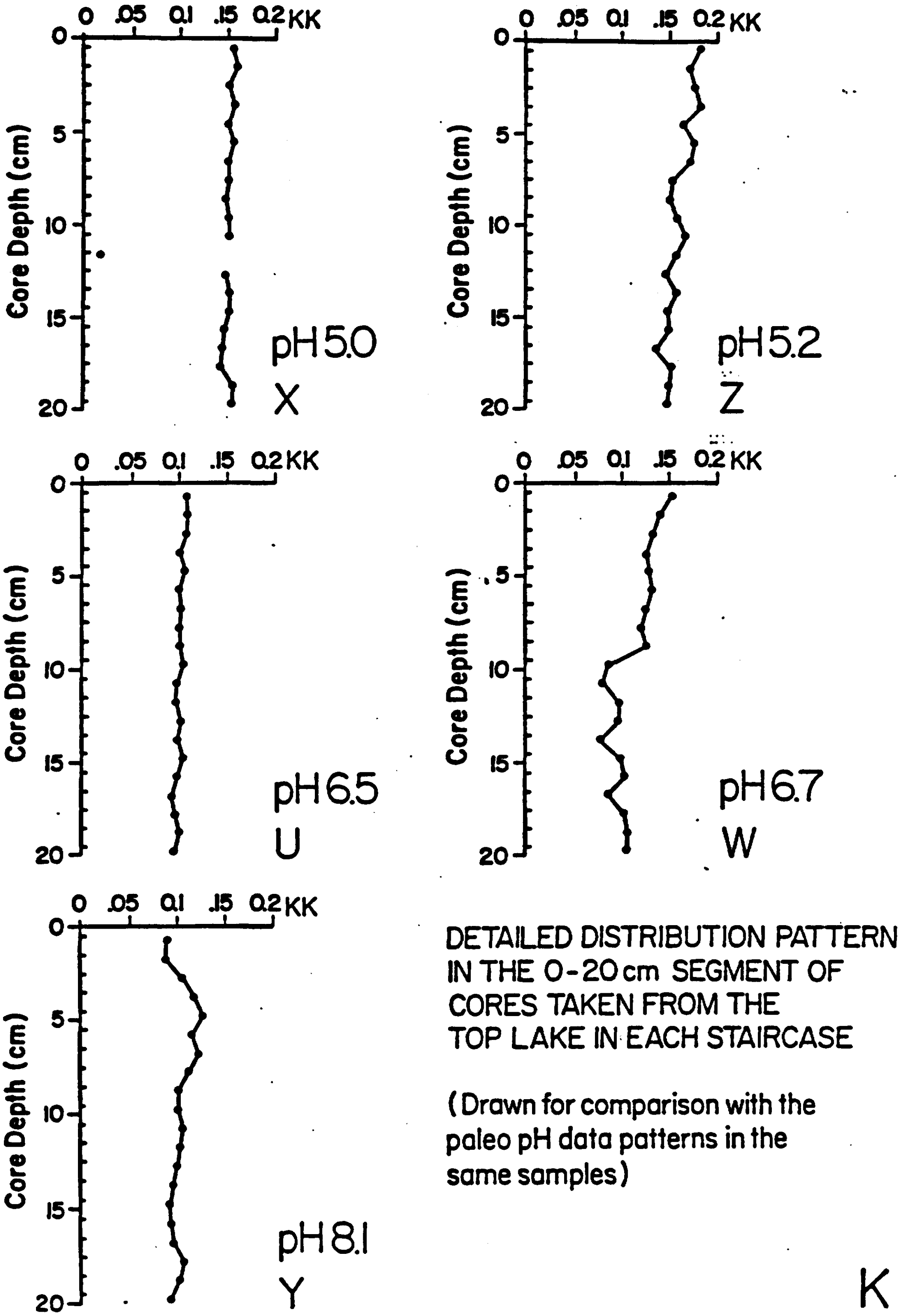
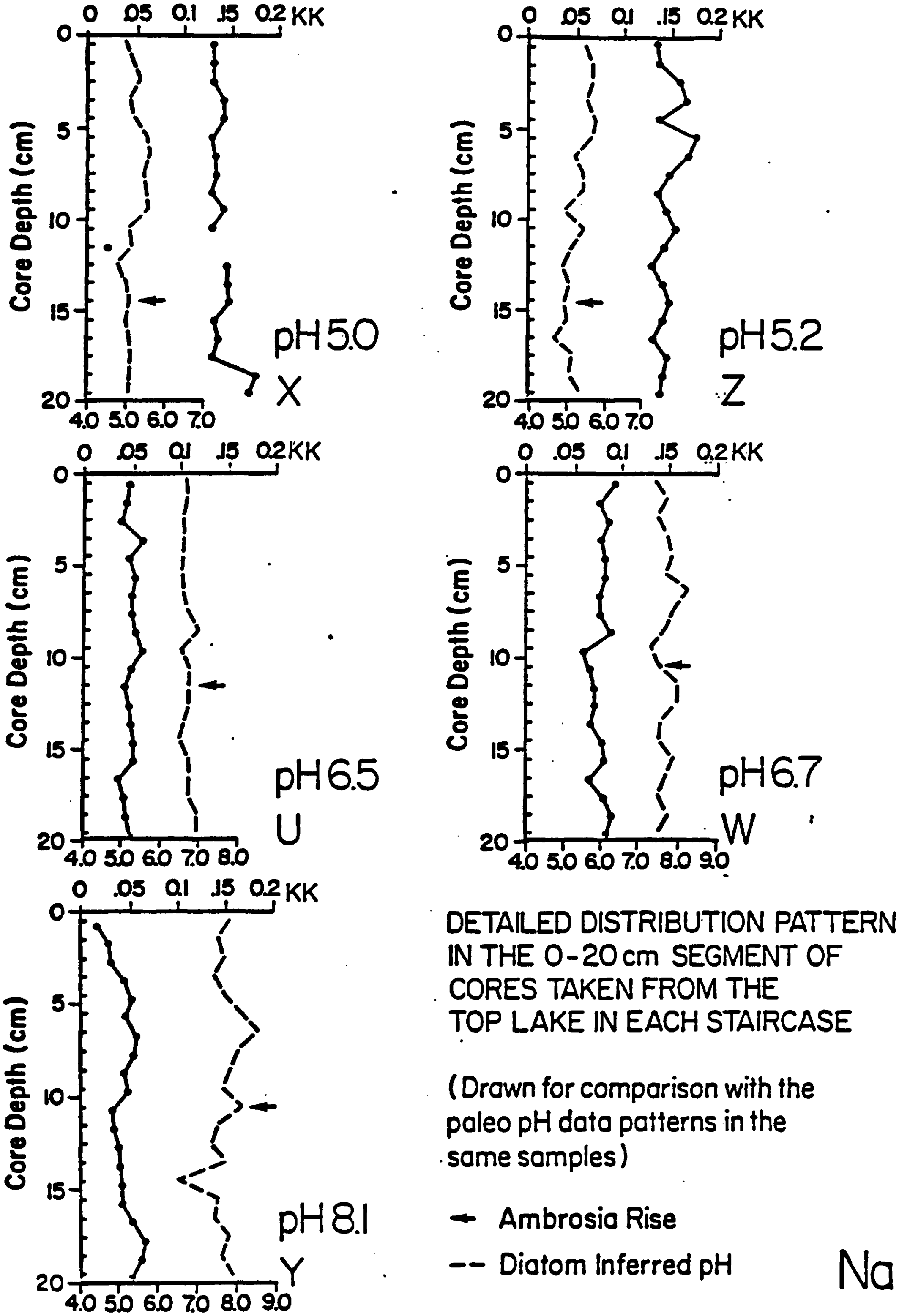

0 .05 0.1 .15 0.2 KK
Core Depth (cm)
0
5
10
15
20
pH 5.0
X
pH 5.2
Z
pH 6.5
U
pH 6.7
W
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN
IN THE 0-20 cm SEGMENT OF
CORES TAKEN FROM THE
TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the
paleo pH data patterns in the
same samples)
K

Figure 5:11



DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE

(Drawn for comparison with the paleo pH data patterns in the same samples)

Figure 5:12

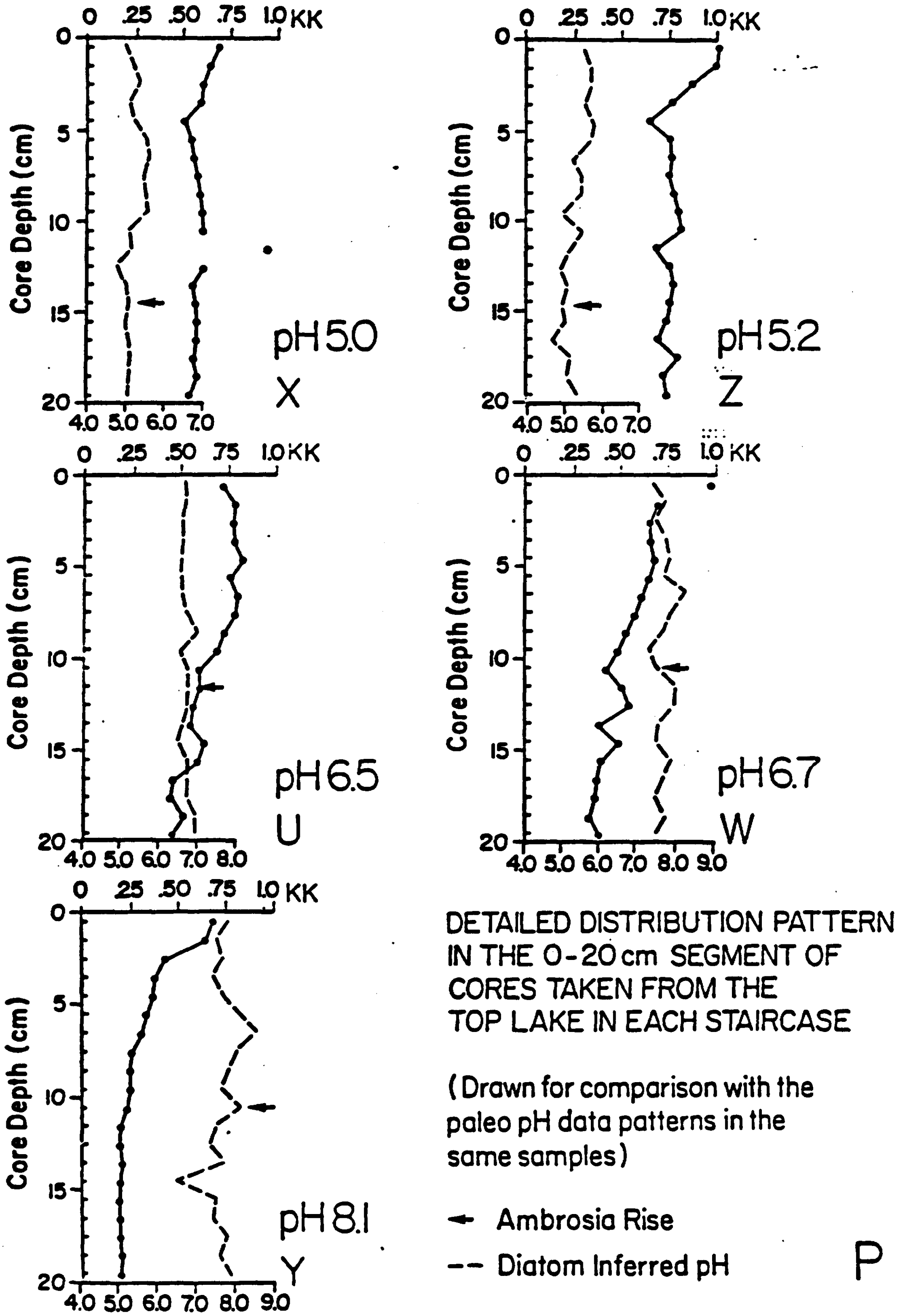
Phosphorus

The general pattern for this element (in all cores) is an increase in content from the bottom to top of a core, with the greatest increase in the top four samples from cores X_1, Z_1 and Y_1, and the top 10 cm in cores U_1 and W_1 (Figure 5:13). The level of phosphorus in the acid and neutral lakes was between 0.50 KK and 0.75 KK (in the lower parts of the cores), while Lake Y_1 displayed a level of around 0.25 KK.

The phosphorus data included two "erratic highs": one of 1.0 KK, in the same sample of core X_1 as the lows were located; the other, also of 1.0 KK, in the topmost sample of core W_1. Otherwise, the data is relatively free from noise, which may indicate these two data points are real.

Zirconium and Titanium

In soils, these two elements are used to measure effects of weathering, because they are chemically inert in the soil environment. Consequently, they are discussed together here. Both elements have similar patterns (Figure 5:14 and 5:15) in all five lakes. In general, the zirconium and titanium levels are highest in the acid lakes, lower in the neutral lakes and lowest in the alkaline lake (Figure 5:14 and 5:15). The data for the two elements indicates that two landscape events took place in post-*Ambrosia* time in Lake Z_1 and one event in Lake X_1. Interesting enough, both elements have slightly higher values in Lake U_1 during post-*Ambrosia* time involving one sample for zirconium and two for titanium. This



0 .25 .50 .75 1.0 KK
Core Depth (cm)
0
5
10
15
20
4.0 5.0 6.0 7.0
pH 5.0
X
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH 5.2
Z
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
← Ambrosia Rise
-- Diatom Inferred pH
P

Figure 5:13

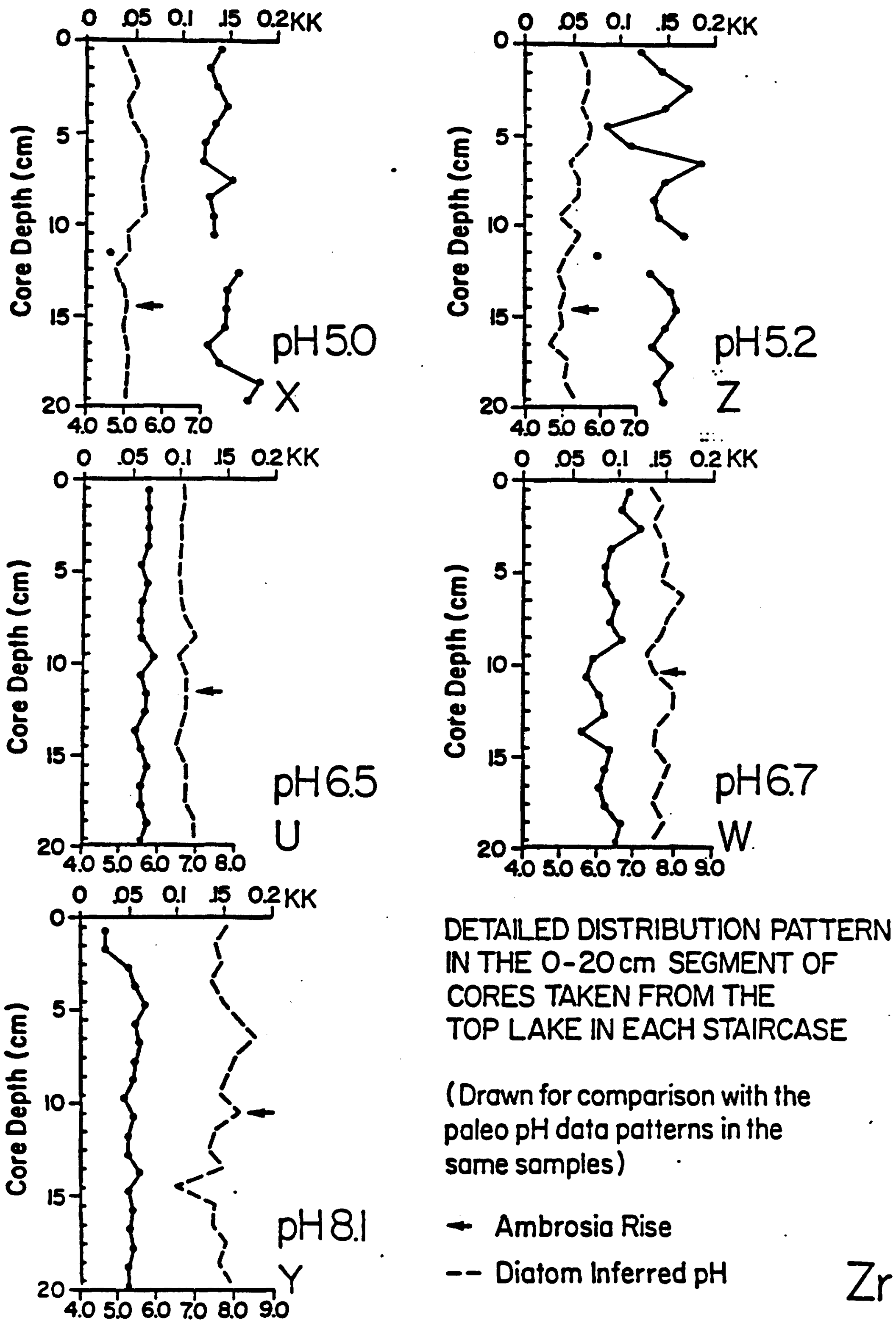

0 .05 0.1 .15 0.2 KK
Core Depth (cm)
0
5
10
15
20
4.0 5.0 6.0 7.0
pH 5.0
X
pH 5.2
Z
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN
IN THE 0-20 cm SEGMENT OF
CORES TAKEN FROM THE
TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the
paleo pH data patterns in the
same samples)
Ambrosia Rise
-- Diatom Inferred pH
Zr

Figure 5:14

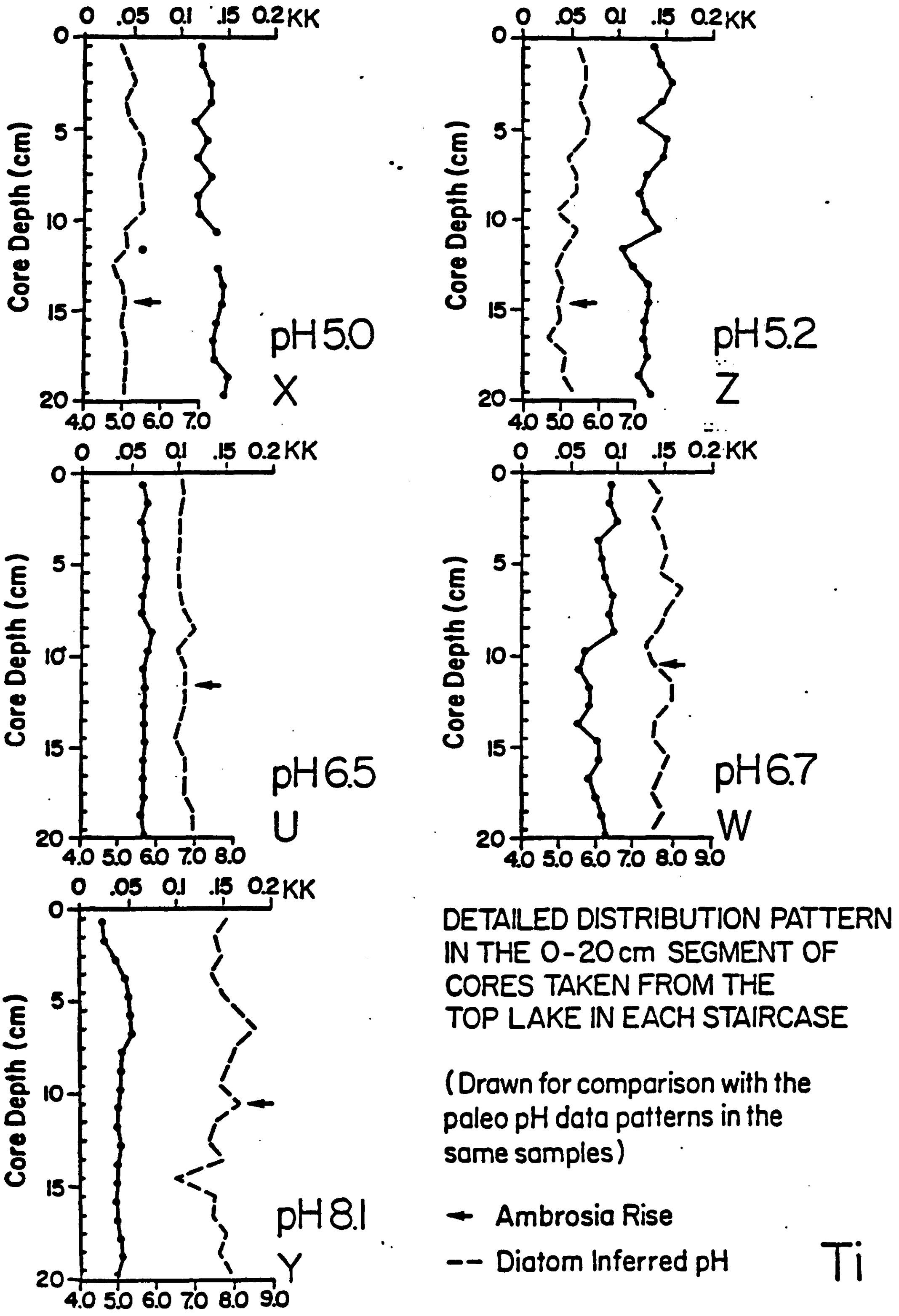

0 .05 0.1 .15 0.2 KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH 5.0
X
pH 5.2
Z
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
Ambrosia Rise
Diatom Inferred pH
Ti

Figure 5:15

may relate to the logging event which was discussed in relation to the calcium pattern for core U_1.

Two erratic values were observed for zirconium and one for titatnium. In core X_1, the same sample that was erratic for sodium, potassium and phosphorus, was low for zirconium and titanium. An additional low value for zirconium was found in core Z_1. If these values are correct, it suggests that when logging occurs, there is a marked increase in sedimentation which dilutes the zirconium and titanium along with the sodium and potassium, while enhancing the phosphorus. Verification of this hypothesis is required at other lakes whose history in post-Ambrosia time is well documented.

Copper, Lead and Zinc

Patterns for these three elements are plotted on Figures 5:16, 5:17 and 5:21. With respect to the acid lakes, the copper was relatively noisy and low in content; the lead was less noisy than copper and increased from a very low level, to around 5.0 KK in the top 5 cm of the cores; and zinc tended to be at a low level in core Z_1, unlike core X_1 in chich zinc decreased after a small peak at a depth of 12 cm in post-Ambrosian time.

In the neutral lakes, the patterns varied from element to element and from core to core. Except for the top sample, the level of copper was constant at 0.5 KK in core U_1. The level of lead in this core decreased gradually from 5.0 KK at the surface, to 2.5 KK in pre-Ambrosia time. The zinc in core U_1 was constant at 0.15 KK except for three erratic high values, one of which was as high as 20 KK (Figure 5:22). In core W_1, there was a slight increase in zinc

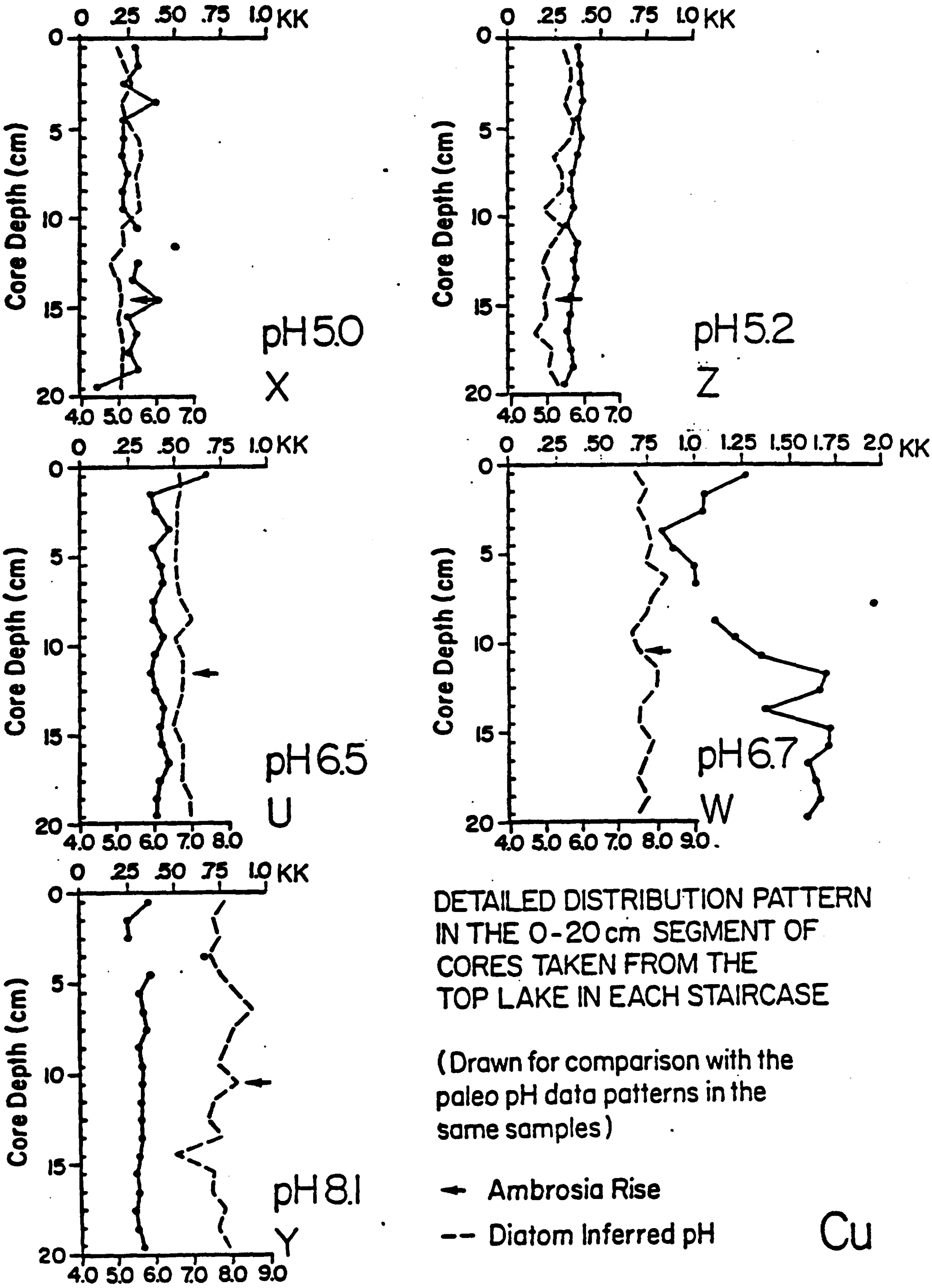
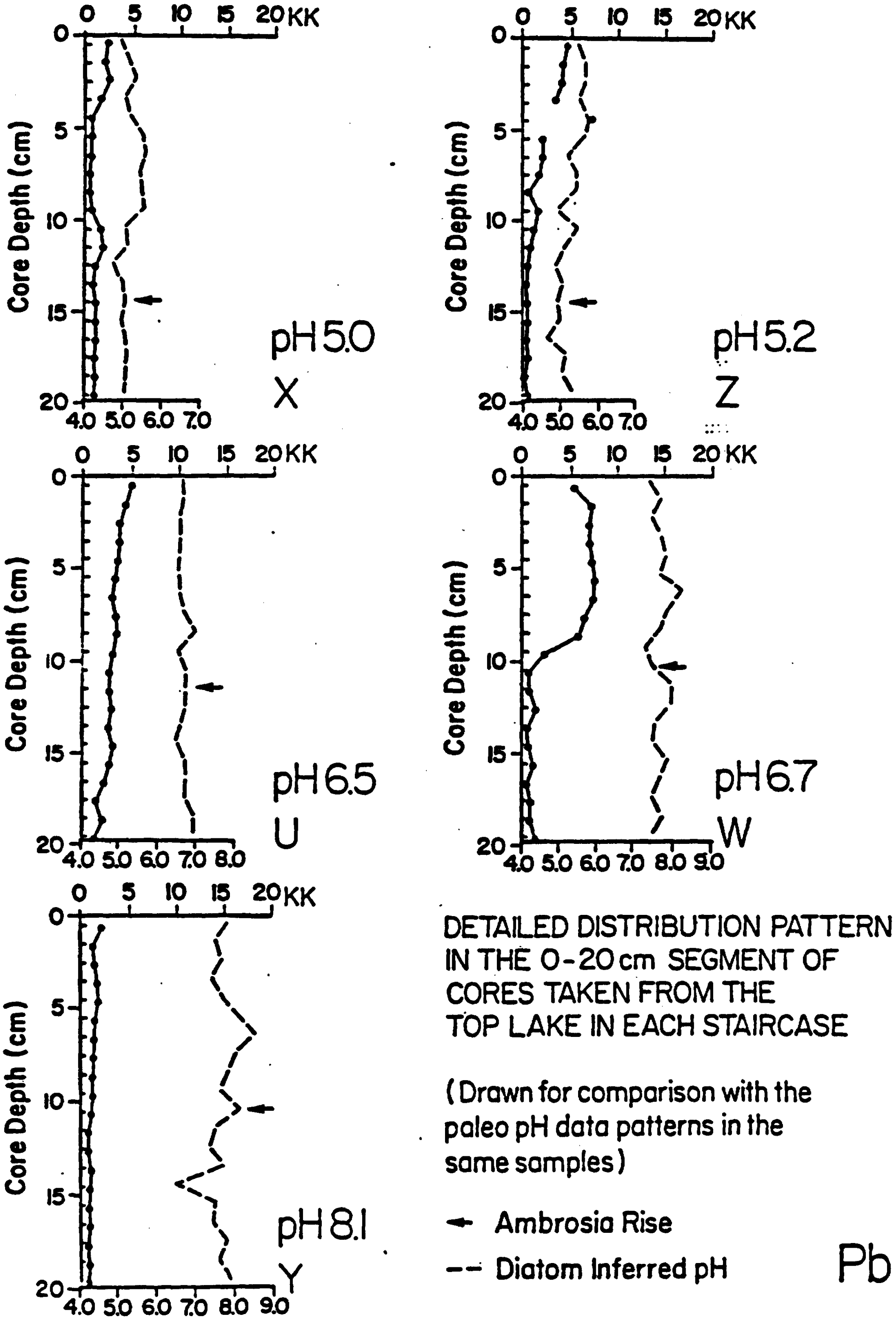

0 .25 .50 .75 1.0 KK
Core Depth (cm)
0 5 10 15 20
4.0 5.0 6.0 7.0
pH 5.0
X
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH 5.2
Z
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0
pH 6.5
U
0 .25 .50 .75 1.0 1.25 1.50 1.75 2.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH 6.7
W
0 .25 .50 .75 1.0 KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH 8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
Ambrosia Rise
-- Diatom Inferred pH
Cu

Figure 5:16



0 5 10 15 20KK
Core Depth (cm)
0 5 10 15 20
4.0 5.0 6.0 7.0
pH5.0
X
pH5.2
Z
4.0 5.0 6.0 7.0 8.0
pH6.5
U
4.0 5.0 6.0 7.0 8.0 9.0
pH6.7
W
pH8.1
Y
DETAILED DISTRIBUTION PATTERN
IN THE 0-20cm SEGMENT OF
CORES TAKEN FROM THE
TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the
paleo pH data patterns in the
same samples)
Ambrosia Rise
Diatom Inferred pH
Pb

Figure 5:17

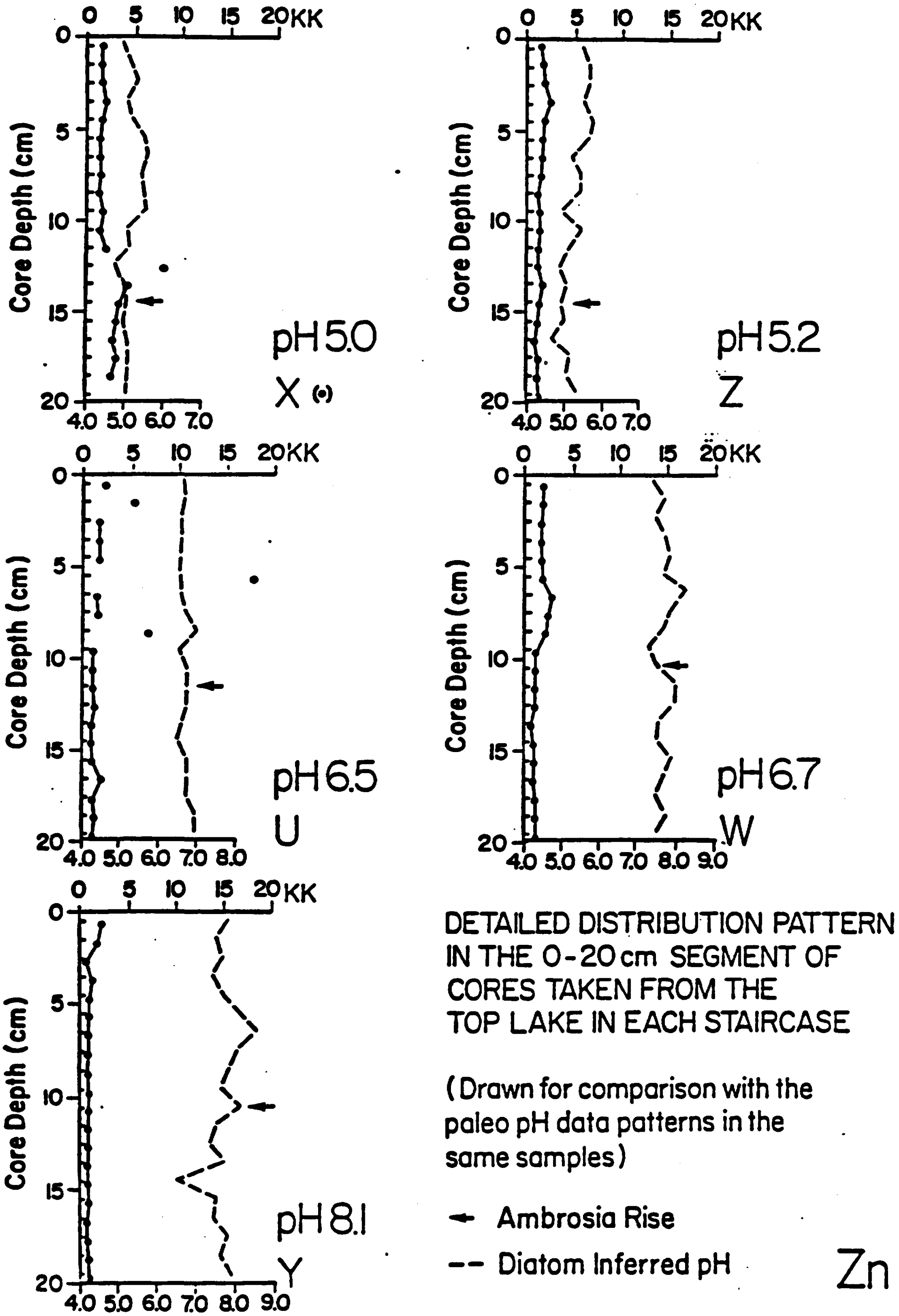

0 5 10 15 20KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH5.0
X (•)
0 5 10 15 20KK
Core Depth (cm)
4.0 5.0 6.0 7.0
pH5.2
Z
0 5 10 15 20KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0
pH6.5
U
0 5 10 15 20KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH6.7
W
0 5 10 15 20KK
Core Depth (cm)
4.0 5.0 6.0 7.0 8.0 9.0
pH8.1
Y
DETAILED DISTRIBUTION PATTERN IN THE 0-20 cm SEGMENT OF CORES TAKEN FROM THE TOP LAKE IN EACH STAIRCASE
(Drawn for comparison with the paleo pH data patterns in the same samples)
← Ambrosia Rise
-- Diatom Inferred pH
Zn

Figure 5:18

associated with the start of smelter operations. This activity caused a five-fold increase in lead content to 5.0 KK. Copper (surprisingly enough) showed a decrease in content from around 1.75 KK to less than 1.0 KK during the time the smelter has been in operation (Figure 5:17).

In the alkaline lake, all three elements were present at around 0.25 KK with slight enrichment in the surface sample. An erratic high for copper of 0.35 KK was found at 4 cm below the surface.

General Conclusions

The chemical data discussed in this section was obtained from small (50 - 100 mg) samples of lake sediment core material simultaneously, using an ICP technique. In general, the data is remarkably precise as evidenced by the smooth curves for many of the elements of interest.

The data is clearly suitable for: -

a) Detecting variation in levels of calcium associated with lakes of acid, neutral or alkaline pH,

b Detecting airborne fallout of iron, manganeous and other elements from a nearby iron sintering plant,

c) Detecting small variations in element patterns which may be due to "post-*Ambrosia* environmental changes" and

d) Detecting short term variations in patterns which appear to be related to logging and other local environmental changes.

The paleo-pH data provides a most valuable independent check on the interpretation of the patterns, particularly with respect to d) above.

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6.0 VERIFICATION OF RESULTS (1982 STUDY)

Introduction

The 1980 and 1981 studies provided useful information regarding gross and subtle relationships in geochemistry, limnology and palynology of lake sediments and waters on a lake to lake basis. Although comparisons of this type are clearly important for regional geochemical surveys, it is also important to discover our ability to reproduce our results in both time and space. Consequently, the third project in the series was focused on data verification. As a byproduct of the verification process, relationships between lake paleo pH, as evidenced by diatoms and lake sediment geochemistry were examined in detail in order to investigate the possibility of using geochemical abundance data as a guide to the pH history of lakes.

Verification of Water Sampling and Chemical Analysis

The 1980 study of 20 lakes located along a "pH gradient" neatly demonstrated the relationships between the pH of lake waters collected during the 1978 regional survey and the 1980 study (Figure 6:1).

It is evident that in 19 out of 20 lakes, the pH as measured in 1978 was approximately half a unit more acid than in 1980. The exception (Lake D) was a lake where a change in pH due to lake acidification might be expected. Otherwise, the data demonstrates clearly the

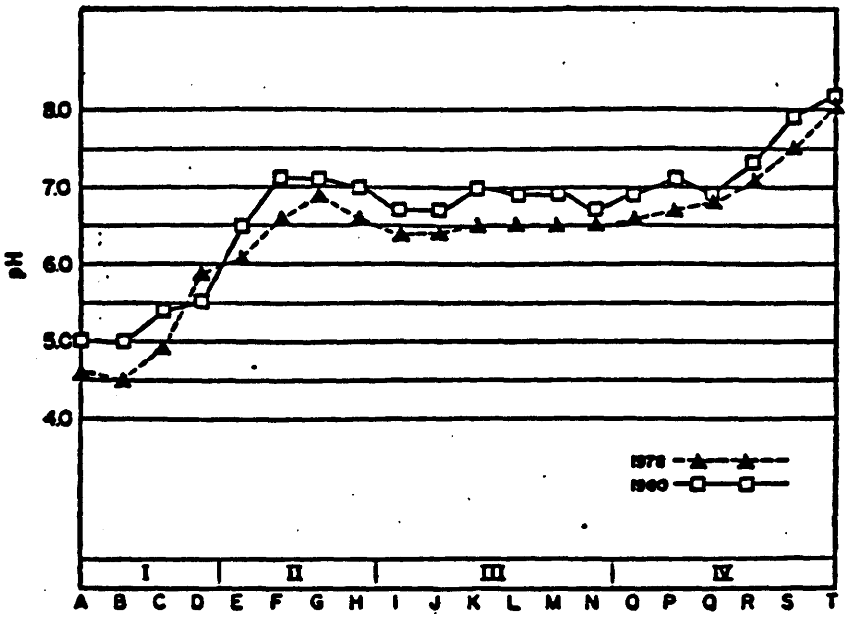


Figure 6:1 The pH of lake waters collected from the 20 lakes included in the 1980 Wawa study in 1978 and 1980 (from Fortescue et.al. 1981, p.91).

reproducibility of the pH pattern in the data even though the values are different. The variation in the values is probably explained by seasonal variations in pH of lakewaters of the region of the time of year of sampling the lakes in the two studies.

A more detailed comparison of data on the geochemistry of waters was carried out in Lakes B (1980), W_1 (1981), W_4 (1981) and X_1 (1981) which were resampled in 1982 (Table 6:1). In this case, pH, alkalinity and calcium content of the waters were compared. It is interesting that the pH of the lakes was similar for the two samplings in all four lakes, the alkalinity was of the same order of magnitude and the calcium content was similar in Lakes B and W_4 with pH of 5.0 and 7.3 and varied by a factor of 2 in Lakes W_1 and X_1 with pH of 6.7 and 5.0. This suggests, but does not prove, that the calcium level in lake waters is independent of pH. It is concluded that pH is the most stable parameter for regional geochemical mapping, with calcium levels second and alkalinity third in reliability. Alkalinity and conductivity were more highly correlated than alkalinity and pH or Ca according to our contingency table. This conclusion is predicted on theoretical grounds.

LAKE	pH		ALKALINITY Meq/L		Ca ppm	
	1981	1982	1981	1982	1981	1982
B*	5.0	5.19	.330	.500	1.5	1.8
W_1	6.7	6.88	.265	.332	57.0	21.6
W_4	7.3	7.69	.365	.469	21.4	24.2
X_1	5.0	5.57	.024	.043	1.4	2.2

* First sampled in 1980, not 1981.

Table 6:1 Lakewater chemical data from four lakes sampled in each of two years (from Fortescue et.al. 1982a, p.163).

The determination of alkalinity in a field laboratory has not up to now been practical in regional geochemical surveying. Because it is simpler to have laboratory measurements made in Toronto, a comparison was made between alkalinity data obtained from an experimental field laboratory and from the laboratory in Toronto (Table

Lake Name	Conductivity (micromhos/cm)	Alkalinity (millieq./l) Field/Grans	Labs (OGS)	
CU	20	.0078	-	
CF	23	.011	-	
CB_1	23	.032	.052	
B	27	.051	.050	
X_1	28	.073	.043	(1981)
			.024	(1982)
CJ	45	.074	.122	
CS	46	.310	.115	
W_4	161	.417	.469	
W_1	166	.485	.532	

Table 6:2 Conductivity, field and laboratory alkalinity data for water samples from lakes included in the 1982 study.

6:2). These data, which are accompanied by conductivity data, indicate that because the laboratory alkalinity data tends to indicate a higher value, the field data is likely to be more correct. This is because as carbon dioxide is lost from the water sample its alkalinity increases. Note that the variation between the field and laboratory alkalinity values varies from lake to lake.

In summary, pH alkalinity and calcium content was measured in the same lake waters sampled one or more years apart. From the viewpoint of regional geochemical surveying, pH was clearly the most reliable measurement of the three. Although pH patterns were stable, the values were found to vary over a period of 2 years probably due to seasonal effects. It was concluded that for regional geochemical surveys, the order of importance of the parameters was: 1) pH, 2) alkalinity (done as soon after sampling as possible), and 3) calcium content.

Performance of the Analytical Method for Lake Sediments (1982) (J.F., B.D.)

As a part of the verification process, attention was focused on the performance of the analytical method used for the 1982 samples, which also included segments from the 1981 (0-20 cm) core segments from Lakes W_2, W_3, W_4 and Z_2, Z_3 and Z_4.

Experience with assessment of the performance of analytical methods used for the chemical analysis of the segments of lake sediment cores (see page 135) in 1981 led to a research project designed to increase the effectiveness of the methods while, at the same time, allowing for a minimal amount of extra effort by the analyst. The important point here is that for future regional geochemical surveys, which may involve thousands of lake sediment samples, analytical methods must be effective, rapid, reliable and cost effective. The performance study carried out on the 1982 analyses was designed to assess these factors. Both the 1981 and the 1982 analyses were completed under contract to Technical Service Laboratories, 1301 Fewster Drive, Mississauga, Ontario, L4W 1A2.

We found that the problem of quality control of the 1981 samples was more complex than at first apparent. With the 1982 batch of samples, a three step procedure was initiated in order to check out in detail the different steps of the method. The steps were: -

1) A dialogue between the contractor's staff and the Geoscience laboratory staff at O.G.S. regarding the different stages in the analytical method was completed during the procedure resulting in the choice of an analytical method.

2) Batches of unknown samples (including quality control standards) were subjected to visual appraisal and repeat determinations were requested on the 10% of the samples which appeared to require checking.

3) Using a statistical technique developed for quality control in exploration geochemistry the precision of the analysis of the unknowns was estimated throughout the working range on the basis of data from duplicate analyses of at least 50 samples.

STEP 1

The performance of the ICP multielement technique used on the 1981 samples was considered not to realize the potential of the approach for reasons discussed in Chapter 5 (page 135). Accordingly, prior to the commencement of the 1982 analytical program, a series of meeting and interlaboratory check analyses were arranged between the O.G.S. geoscience laboratory and the contracting laboratory. These led to generally accepted modification of the extraction technique and a detailed interlaboratory study of the ICP and AA determination techniques selected for the 1982 program. In general, it was found that when the level of an element was over 10 times the detection limit, the data for a sample was acceptable. At lower concentration levels, the performance of the determination techniques varied from element to element. After five trys, the extraction technique selected was as follows: -

> A subsample of 250 mg of freeze dried lake sediment material is dry ashed at 425°C in a muffle furnace in a 50 ml pyrex beaker.
>
> The resulting ash is transferred to a teflon beaker with 8 ml of a 5:4:1 HNO_3:$HClO_4$:HF mixture and taken to dryness off a hot plate.
>
> The residue is then dissolved by warming the residue with 25 ml of 0.5 N HCl.

As an example of the study of the detail of the performance of the determination technique, let us consider the element lead. It was found to be the most difficult to obtain good data from and is also an element of considerable environmental importance.

Along with the other elements, lead was determined by multi-element ICP analyses carried out in both laboratories. Lead in the 1982 samples was also determined by AA in both laboratories as a check because the performance of the lead line in the O.G.S., ICP was not considered reliable for the levels determined. The data for the interlaboratory checks are listed on Table 6:3. The agreement is clearly acceptable for the two AA's and the TSL ICP/O.G.S. AA.

Similar or better, correlation coefficients to those listed on Table 6:3 were obtained from the same type of interlaboratory tests carried out for the other elements which established a general confidence in the instrumental determination techniques.

Instrument Type	Number of Samples	Range	Correlation
ICP (both labs)	19	0-40 ppm	-0.089
AA (both labs)	21	15-60 ppm	0.888
TSL ICP / OGS AA	20	10-90 ppm	0.963

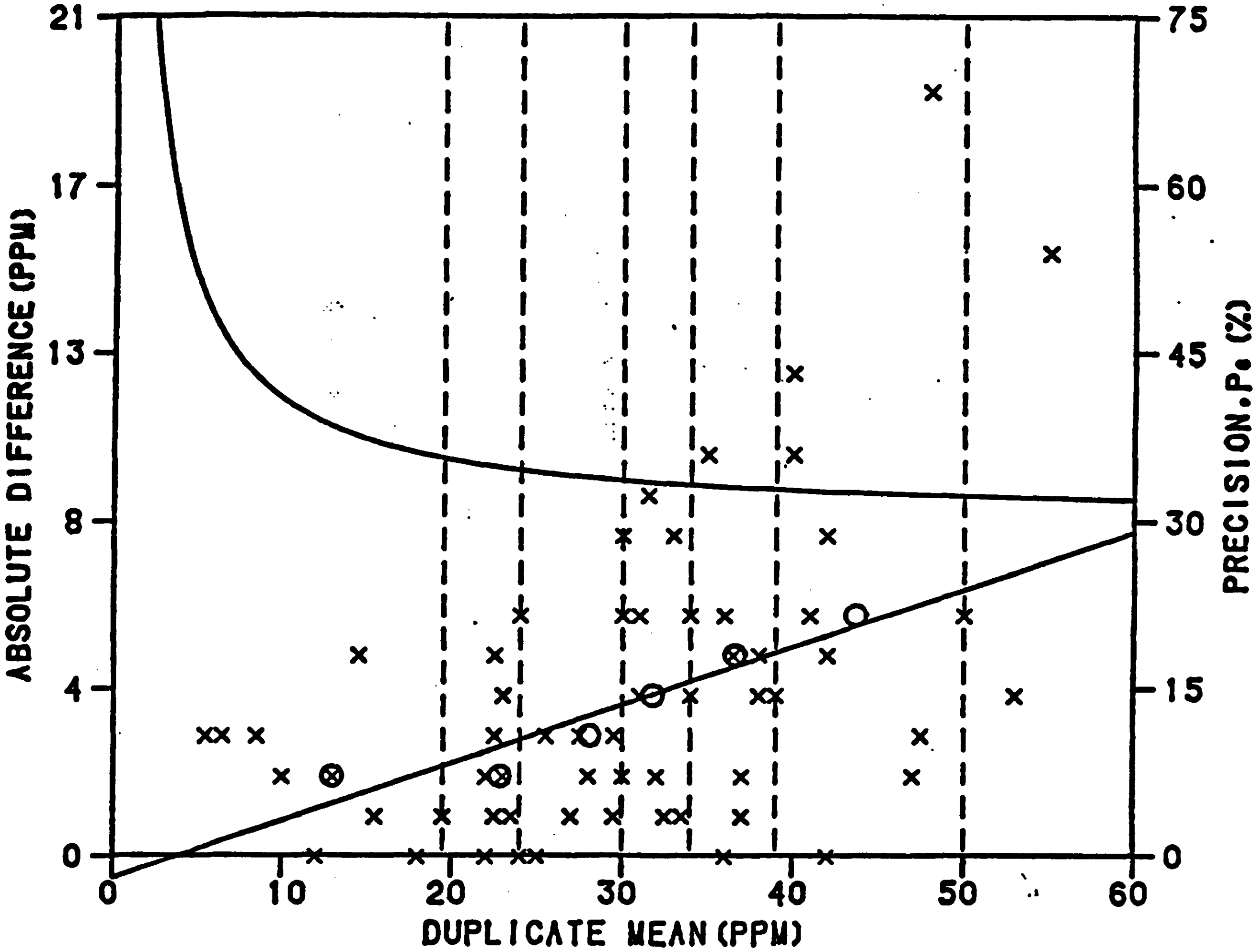
Table 6:3 Performance of methods for the determination of lead in two laboratories. Tests carried out on the same extraction solutions.

STEP 2

In order to examine the interlaboratory performance of the approach, further samples were spotted for determination in the O.G.S. labs from data listings from TSL during the analysis of the batches of unknowns. Other sample data spotted as being erratic was also rechecked by the contractor in his laboratory. In general, if the erratic values were reproduced (which was rare), they were accepted, otherwise the data more in line with adjacent sample was included. The analytical program was divided up into five batches each of which included between 100 and 200 samples. Approximately 10% of the sample solutions were rerun either by TSL or O.G.S.

STEP 3

Data listings corrected as a result of step 2 were subjected to a statistical test of performance described by Fletcher (1981). This estimates the precision of the analysis for each element using 50 or more pairs of duplicates of unknown samples distributed throughout the whole five batches of samples. Fletcher (1981) listed the procedure for the statistical analysis as follows: -



LEGEND

DATA POINT	X
INTERVAL MEAN	O
SLOPE	0.144
INTERCEPT	-0.550
CORR. COEFF.	0.946
OGS DL	1.500

Figure 6:2 ICP analysis for Zirconium duplicate pair difference $[X_1-X_2]$ versus mean value $(X_1-X_2)/2$ and the precision percent variation with the mean concentration.

1) From the duplicate analyses obtain a list of the means $(X_1+X_2)/2$ and absolute differences $|X_1-X_2|$.

2) Arrange the list in increasing order of concentration means.

3) From the first 11 results, obtain the mean concentration and median difference for that group.

4) Repeat this for each successive group of 11 results, ignoring any remainder less than 11.

5) Calculate, or obtain graphically, the linear regression of the median differences on the means and multiply the intercept and coefficient by 1.048 (i.e. 1/0.954) to obtain $_0$ and k, respectively.

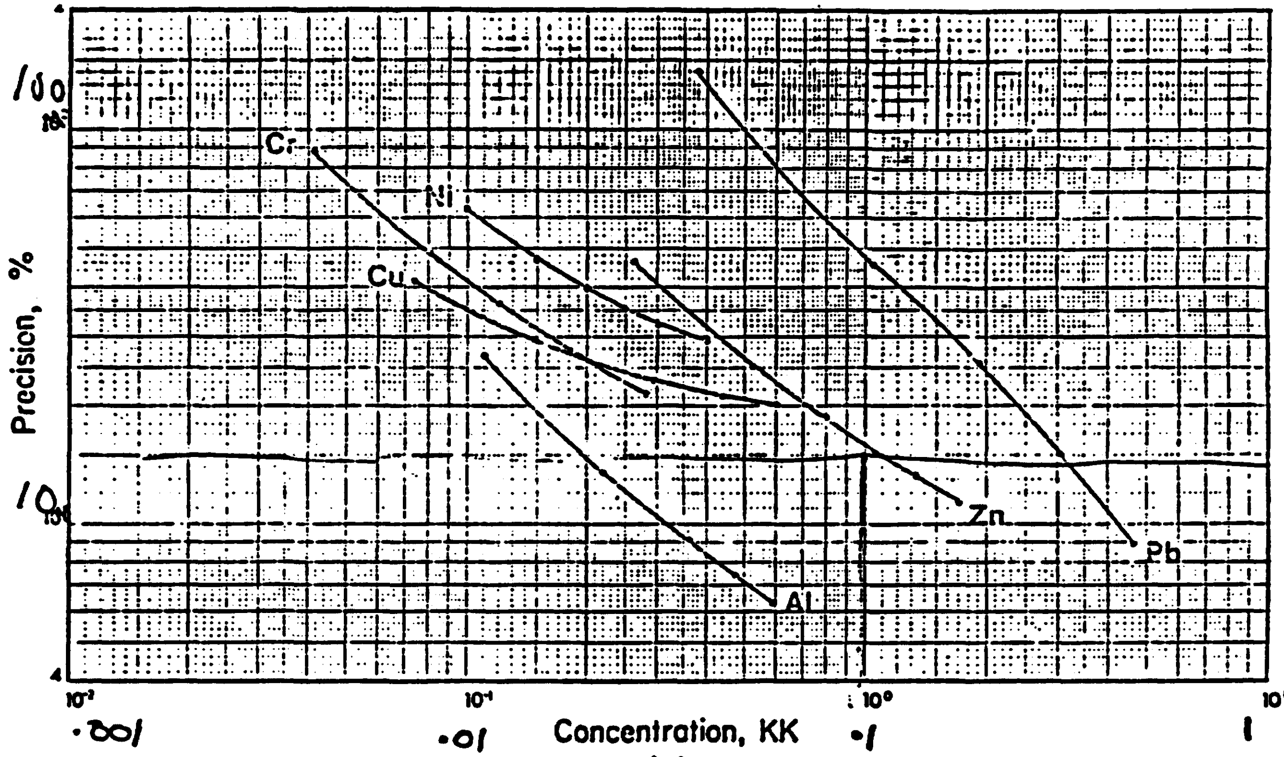
As an example of the variation of $_c$ with c for the determination of zirconium in lake sediment samples, based on duplicates is shown on Figure 6:2. From the regression $_c = {}_0 + kc\ P_c$ the overall analytical precision is given by: -

$$P_c = \frac{2\ _0}{c} + 2k$$

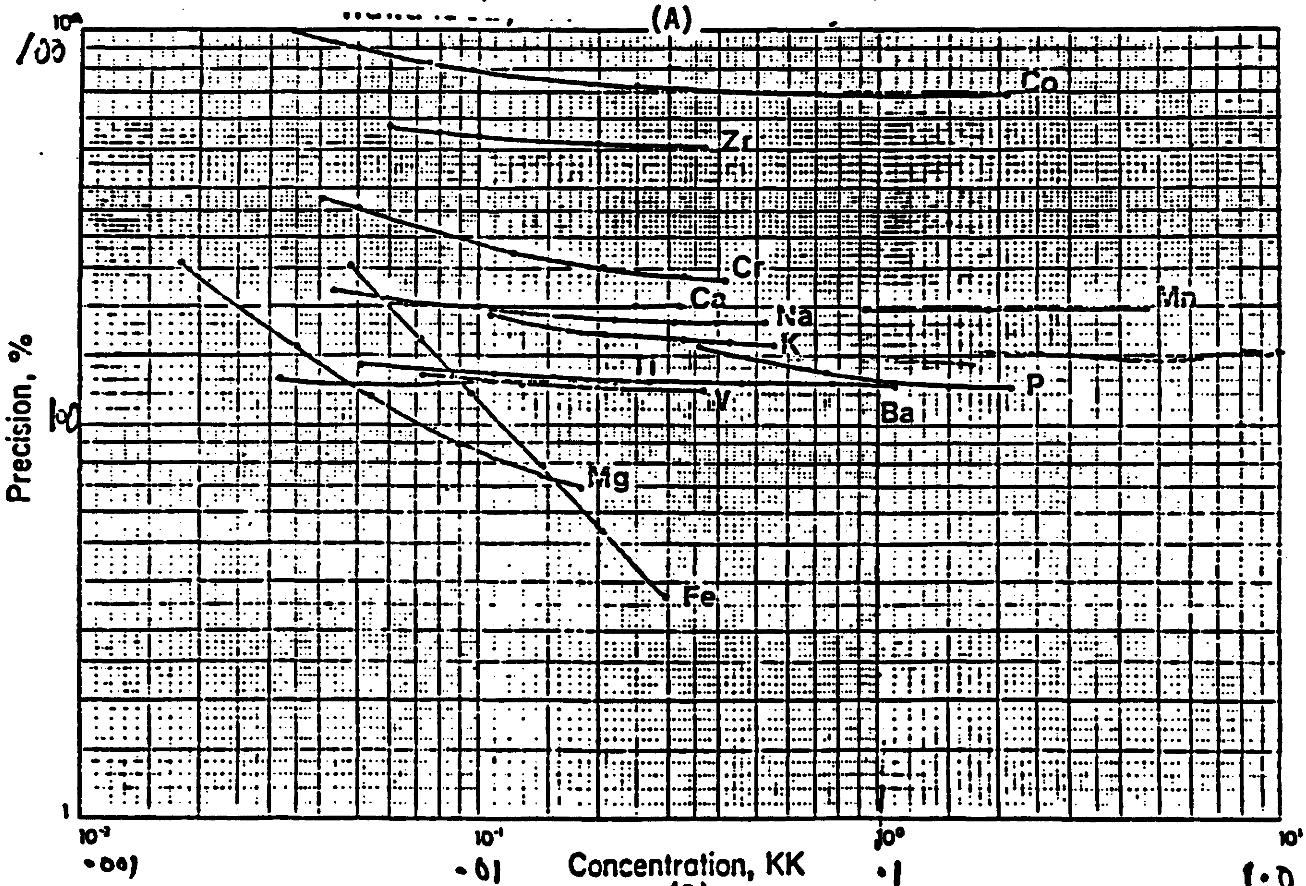
If we consider a precision of 15% or better at a level of 0.10 KK to be the minimum requirement for the performance of the analytical method, then it is evident that most elements approach these limits. In fact, Co, Zr and Cr are the three poorest elements and this evaluation tends to be conservative. It is concluded therefore, that even with a rather crude evaluation, the performance of the multielement analytical method is approaching that required for most elements and exceeded by several (Figure 6:3). Note that the precision of the data for most elements in Figure 6:3B is remarkably uniform over the concentration range studied in the case of lead (and other elements) included in Figure 6:3A, the precision is more variable with concentration.

Although this approach to the estimation of precision has great promise for the evaluation of the performance of multielement analytical methods, our use of the technique revealed several limitations which may be removed by careful planning. The analytical data subset for element X (i.e. zirconium on Figure 6:2) suffers from a variation in cell concentration. For example, between 18 and 38 ppm there are four cells whereas there are only two between 0 and 18 ppm and 38 and 60 ppm. The inadequate sample density below 20 ppm leads to a poor estimation of the precision near the detection limit of the method and a conservative appraisal overall. For example, where the mean ppm is less than 20 ppm, the precision rises sharply from around 30% to close to 75%. A uniform sample density in each cell would almost certainly reduce the slope and intercept of the precision increase line. A more even cell spacing would also be likely to improve the regression line to give a zero, or slightly positive intercept. Another consideration is that in the cells between 20 and 30 ppm (Figure 6:2) circles below the regression line indicate better performance than the overall precision estimate would suggest. These limitations were evident on most of the plots for other elements included in the analytical program.

Figure 6:2 provides information on the precision for one element only. In multielement work, it is desirable to be able to see at a glance the precision for many elements. When KK units are used as a basis for pattern recognition, comparison and combination. Consequently, a plot showing the performance of all or several elements provides a guide to the validity of comparisons.



(A)



(B)

Figure 6:3 Precision/Concentration graphs for elements of interest.

On Figure 6:3A, percent precision/concentration of element in KK plots for Al, Cu, Cr, Ni, Zn and Pb are given for comparison and on Figure 6:3B similar data for 12 other elements are given. All these lines suffer to some extent from being too conservative owing to a lack of uniformity in the choice of abundance cell limits. However, the potential for this approach to the estimation of multielement instrumental analysis performance is clearly evident.

Summary

Careful interlaboratory preparatory work led to modifications in the techniques of chemical analysis used in the 1982 compared with the 1981 analyses. In particular, the effectiveness and reliability of the extraction technique was improved and after careful checking, the performance of the instrumental methods of analysis was also established. Using a statistical technique, the percent precision of the chemical analyses was established based on the data obtained from over 50 duplicate analyses of lake sediment material. Although the statistical approach was limited somewhat by the enforced choice of abundance cell limits, it seems clear that in the future, a selection of 50 sets of duplicate analyses of unknowns drawn from cells of equal content increase over the whole range of concentration encountered for each element should lead to an effective statement of the performance of the analytical methods which can be graphed and related directly to the interpretative procedures adopted for the lake sediment sample data. It should be noted that some errors in the analytical data were traced to human error which could be eliminated by careful planning and sequencing of the samples included in the analytical program. Very minor errors were detected during the sample data processing.

An Overview of the Geochemistry of the 1982 Lake Sediment Cores

Ten lake sediment cores collected from lakes with a pH in the range 3.3 to 7.7 were selected for comparative study and verification of data. All these cores were collected using the sampler developed in 1980 and the subsampling technique described in Chapter 2 of this report. Details of the chemical analyses of the cores are given in Part II Section 3. In this section we are concerned with the mean and coefficient of variation for each of the three different types of data obtained from each core. These are: -

The whole core (35 subsamples) (0-50 cm depth).

The lower core material (6 samples) (20-50 cm depth).

The surface samples (10 samples) (0-5 cm depth).

The "whole core" material is similar to that collected by the grab sampler during the URP program in the later 1970's. The "lower core" material is representative of the pre-*Ambrosia* material of the core suitable for baseline information for mineral appraisal or environmental purposes and the "surface sample" material is representative of post-*Ambrosia* material.

Let us consider the data for Ca, Mg, K, Al, Fe, Mn, Ti, Zr, Ba, Cu, Pb and Zn which are listed on a series of similar tables (Tables 6:4 to 6:10).

Because Ca is an element whose content in lake waters is related to their pH and Mg is an element which does not have this role, a comparison of the behaviour patterns of both elements in lower core and surface samples is of interest in relation to the problem of acid rain effects on lakes. More specifically, one might expect that the level of calcium in the post-*Ambrosia* sediment to

CORE CODE	WHOLE CORE MEAN (KK)	WHOLE CORE C/V (%)	0-5 CM[1] MEAN (KK)	0-5 CM[1] C/V (%)	20-50 CM[2] MEAN (KK)	20-50 CM[2] C/V (%)	LAKEWATER PH
Ca							
CH	0.055	33.6	0.038	47.0	0.074	-	3.3
CB_3	0.129	12.4	0.131	7.3	0.139	19.6	5.1
CB_2	0.125	11.7	0.125	9.9	0.141	11.4	5.1
B	0.185	24.8	0.140	24.6	0.156	5.8	5.2
X_1	0.078	9.3	0.073	6.8	0.080	14.6	5.6
CU	0.097	19.2	0.079	23.7	0.108	6.5	6.1
CJ	0.133	7.6	0.129	3.8	0.129	3.8	6.4
CS	0.168	11.8	0.160	18.8	0.156	2.0	6.6
W_1	0.281	18.2	0.309	9.1	0.234	5.5	6.7
W_4	0.191	13.2	0.206	2.3	0.210	18.7	7.7
Mg							
CH	0.039	35.2	0.026	46.4	0.070	-	3.3
CB_3	0.075	22.6	0.082	3.5	0.097	17.4	5.1
CB_2	0.079	23.1	0.084	4.3	0.106	12.3	5.1
B	0.140	23.3	0.104	23.7	0.139	17.3	5.2
X_1	0.057	11.6	0.054	2.9	0.069	8.1	5.6
CU	0.051	17.3	0.054	19.5	0.057	6.4	6.1
CJ	0.068	14.8	0.060	6.1	0.085	4.1	6.4
CS	0.084	11.5	0.082	18.7	0.086	2.1	6.6
W_1	0.070	39.0	0.098	22.3	0.054	10.7	6.7
W_4	0.121	29.1	0.169	8.5	0.102	8.0	7.7

Table 6:4 Levels of Calcium and Magnesium in each of 10 cores collected during the 1982 project (KK units).

show a sharp decrease if the pH of the lake had become lower compared with the pre-Ambrosia material. A glance at Table 6:4 confirms this trend in the cores with a pH lower than 6.1, apparently confirming this supposition. However, when the Mg data listing is examined, the same trend is evident suggesting that this effect is related to the core as a whole and not to effects of acid rain on calcium only.

In general, the levels for these two elements in the ten cores are within the limits of the analytical method when the lower core data is compared with the whole core data suggesting that either material could have been used. More specifically, the levels for neither Ca nor Mg are independent of the pH of the lake waters and are probably due to the geology of the catchment area. The very close levels for Ca and Mg in the two cores from the same catchment area (i.e. CB) confirm the reliability of the geochemical data obtained by averaging the results of subsamples.

CORE CODE	WHOLE CORE		0-5 CM [1]		20-50 CM [2]		LAKEWATER PH
	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	
K							
CH	0.092	34.1	0.071	49.0	0.136	-	3.3
CB_3	0.279	25.6	0.311	5.0	0.361	22.6	5.1
CB_2	0.299	24.8	0.284	3.9	0.426	14.7	5.1
B	0.320	16.3	0.276	16.0	0.280	5.2	5.2
X_1	0.172	10.1	0.155	2.6	0.182	14.1	5.6
CU	0.156	23.5	0.186	19.0	0.161	8.3	6.1
CJ	0.152	18.7	0.120	9.2	0.196	4.3	6.4
CS	0.222	15.6	0.240	22.1	0.216	4.4	6.6
W_1	0.115	36.0	0.125	10.5	0.120	56.1	6.7
W_4	0.270	23.8	0.352	4.5	0.244	7.9	7.7
Al							
CH	0.144	36.9	0.095	46.2	0.169	-	3.3
CB_3	0.295	23.7	0.337	4.8	0.367	18.3	5.1
CB_2	0.304	19.6	0.310	6.1	0.393	11.7	5.1
B	0.444	13.3	0.378	13.7	0.458	9.3	5.2
X_1	0.323	9.6	0.293	4.9	0.330	12.9	5.6
CU	0.331	15.8	0.293	21.7	0.388	2.8	6.1
CJ	0.254	7.6	0.233	6.3	0.276	1.6	6.4
CS	0.410	11.3	0.404	19.7	0.406	2.0	6.6
W_1	0.121	20.9	0.136	4.4	0.124	17.8	6.7
W_4	0.270	21.5	0.343	4.3	0.239	7.2	7.7

Table 6:5 Levels of Potassium and Aluminium in each of 10 cores collected during the 1982 project (KK units).

Both potassium and aluminium (Table 6:5) are elements which might be expected to be sensitive to lake pH changes through time, particularly post-Ambrosia time. Potassium because it participates in the synthesis of secondary phyllosilicates and aluminium because it is known to vary in solubility with changes in pH (Kramer 1981). An inspection of Table 7:5 shows no drastic change in levels between surface and lower core samples for either element and in fact, the patterns are quite similar to those which were obtained for calcium and magnesium (Table 6:4). There are some variations for example, the surface and lower core means for potassium and aluminium in core CB_2 are different (K 0.284 and 0.426 KK and Al 0.310 and 0.393 KK) but in general, the results are similar from level to level in the same core. The use of the KK scale enables cross comparisons to be made between elements in a simple way regardless of concentration. For example, in the samples from catchment CB, the data for the four elements is as follows: -

	Whole		Lower		Surface	
	CB_3	CB_2	CB_3	CB_2	CB_3	CB_2
Ca	0.129	0.125	0.139	0.141	0.131	0.125
Mg	0.075	0.079	0.097	0.106	0.082	0.082
K	0.279	0.299	0.361	0.426	0.311	0.284
Al	0.295	0.304	0.367	0.393	0.337	0.310

Table 6:6 Means for four elements in two cores collected from the same catchment area (KK units).

The data on Table 6:6 provides a good example of the performance of the complete analytical procedure including sampling, subsampling, chemical analysis and data processing.

Let us now consider iron and manganese data. Because core CH was taken from a tailings pond, its values for iron are atypical. Similarly because Lakes W_1 and W_4 are in the fume kill area of the Wawa smelter, their values for these two elements have also been affected by man's activities. Otherwise, the data for these two elements follows the pattern set by calcium, magnesium, potassium and aluminium. There are some minor variations for example, the iron level in the surface samples from X_1 (pH 5.6) was 0.100 KK compared with 0.080 KK in the lower core material. As expected, the iron values in CH (0.989 KK), W_1 (0.480 KK) and W_4 (0.337 KK) are high in the whole core although relatively low in the lower core material (Table 6:7). (It should be noted that the mean value for the whole core included data from the samples taken between 5 and 20 cm.)

The next pair of elements are usually considered to be relatively conservative in the surficial environment and to move in mineral particles rather than in solution or attached to organic matter. These are titanium and zirconium. The fact that these elements show a pattern similar to those already discussed suggests that the lower

CORE CODE	WHOLE CORE		0-5 CM [1]		20-50 CM [2]		LAKEWATER PH
	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	
Fe							
CH	0.989	152.9	2.095	94.7	0.280	-	3.3
CB_3	0.078	23.5	0.091	4.4	0.095	18.2	5.1
CB_2	0.084	24.6	0.095	6.7	0.110	13.3	5.1
B	0.204	19.3	0.162	17.2	0.202	18.5	5.2
X_1	0.082	19.6	0.100	16.3	0.080	11.1	5.6
CU	0.202	21.2	0.250	10.0	0.164	3.8	6.1
CJ	0.099	9.5	0.099	9.0	0.112	5.1	6.4
CS	0.205	25.4	0.266	19.8	0.164	4.1	6.6
W_1	0.408	82.0	0.812	9.3	0.080	5.6	6.7
W_4	0.337	62.0	0.611	11.9	0.184	20.2	7.7
Mn							
CH	0.312	18.9	0.279	26.0	0.397	-	3.3
CB_3	0.075	23.2	0.077	4.5	0.098	23.4	5.1
CB_2	0.080	25.0	0.080	4.5	0.114	14.9	5.1
B	0.149	19.0	0.118	20.3	0.155	14.8	5.2
X_1	0.059	9.1	0.062	4.6	0.063	12.1	5.6
CU	0.284	16.6	0.326	16.9	0.260	9.6	6.1
CJ	0.108	36.0	0.134	45.5	0.101	3.6	6.4
CS	0.308	14.9	0.326	16.9	0.255	11.8	6.6
W_1	0.598	94.7	1.194	41.1	0.124	39.2	6.7
W_4	0.586	103.7	1.303	45.8	0.167	67.6	7.7

Table 6:7 Levels of Iron and Manganese in each of 10 cores collected during the 1982 project (KK units).

concentrations in the surface samples compared with the lower core samples, results from the type of organic matter present. Thus the degree of compaction of the sample material and the geochemical inputs to the lakes are not thought to be the source of variation.

The repeatability of the titanium/zirconium data in the two cores from the CB catchment area is not quite as good as that for the major elements discussed previously. Two logical reasons for this are i) the possibility of these two elements being in particulate matter within the sample material, reducing homogeneity and ii) the irregularity of input of these elements from the catchment area. In general, Table 6:7 provides information on the performance of the methods used for these two elements.

The data for barium and copper (Table 6:9) have patterns similar to those discussed previously for the major elements although the performance of the analytical method resembles that for the other trace elements discussed here.

Two elements which are generally considered to be affected by man's activities in the environment in post-Ambrosia time are lead and zinc. Mean values for the content of these two elements in the 10 cores are listed on Table 6:10. In general there is, as expected a higher level of these elements in the surface samples compared with the down core material (Table 6:10). An exception is the level of zinc in Lake CH which is lower in the surface material, probably owing to the unusual conditions due to the mine tailings. The very high lead in cores CU and CS surface samples should be noted, although the lower core material was found to have normal levels of this element. In general, our data confirm that grab samples of lake sediment may provide higher values for lead and zinc than the

CORE CODE	WHOLE CORE		0-5 CM [1]		20-50 CM [2]		LAKEWATER PH
	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	
Ti							
CH	0.034	43.7	0.030	69.6	0.066	-	3.3
CB_3	0.146	32.8	0.176	3.6	0.207	16.1	5.1
CB_2	0.161	29.8	0.186	3.3	0.224	13.9	5.1
B	0.202	15.4	0.175	20.3	0.216	13.2	5.2
X_1	0.095	17.1	0.100	5.0	0.119	6.5	5.6
CU	0.089	25.4	0.099	20.4	0.110	7.6	6.1
CJ	0.076	18.1	0.079	4.7	0.100	4.1	6.4
CS	0.107	17.3	0.119	17.0	0.122	3.6	6.6
W_1	0.053	25.8	0.062	5.3	0.058	19.1	6.7
W_4	0.142	44.6	0.228	5.0	0.115	8.4	7.7
Zr							
CH	0.071	19.6	0.064	24.6	0.104	-	3.3
CB_3	0.176	30.5	0.203	4.5	0.245	18.2	5.1
CB_2	0.189	28.3	0.196	6.3	0.270	17.7	5.1
B	0.245	20.2	0.188	19.3	0.242	8.5	5.2
X_1	0.114	14.6	0.114	7.7	0.135	8.7	5.6
CU	0.137	20.7	0.144	19.9	0.166	11.1	6.1
CJ	0.160	10.5	0.148	14.7	0.178	4.7	6.4
CS	0.130	13.0	0.137	14.5	0.143	6.3	6.6
W_1	0.082	19.6	0.087	7.4	0.083	12.7	6.7
W_4	0.176	27.5	0.230	6.1	0.192	9.5	7.7

Table 6:8 Levels of Titanium and Zirconium in each of 10 cores collected during the 1982 project (KK units).

CORE CODE	WHOLE CORE		0-5 CM [1]		20-50 CM [2]		LAKEWATER PH
	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	
Ba							
CH	0.207	54.6	0.120	68.0	0.238	-	3.3
CB_3	0.462	22.2	0.487	5.2	0.615	14.8	5.1
CB_2	0.497	26.5	0.460	5.2	0.735	12.7	5.1
B	0.626	13.3	0.542	15.8	0.657	9.1	5.2
X_1	0.470	7.7	0.444	3.1	0.504	11.2	5.6
CU	0.407	21.5	0.481	20.1	0.421	4.4	6.1
CJ	0.521	8.1	0.521	4.6	0.579	1.8	6.4
CS	0.456	13.3	0.481	20.1	0.473	2.8	6.6
W_1	0.215	22.7	0.240	12.6	0.227	20.7	6.7
W_4	0.452	22.3	0.571	4.5	0.465	7.4	7.7
Cu							
CH	0.473	57.3	0.730	37.0	0.544	-	3.3
CB_3	0.242	24.1	0.277	16.1	0.274	22.2	5.1
CB_2	0.235	18.7	0.272	8.5	0.225	13.4	5.1
B	0.287	75.1	0.411	72.6	-	-	5.2
X_1	0.260	16.9	0.279	10.0	0.306	18.9	5.6
CU	0.537	23.4	0.461	13.1	0.634	17.3	6.1
CJ	0.450	17.0	0.369	7.9	0.546	12.8	6.4
CS	0.412	14.9	0.452	15.2	0.453	9.1	6.6
W_1	0.790	30.6	0.642	14.9	-	-	6.7
W_4	1.308	30.8	0.889	14.2	-	-	7.7

Table 6:9 Levels of Barium and Copper in each of 10 cores collected during the 1982 project (KK units).

lower core material. In general, the patterns for lead and zinc were as expected, although detailed examination of individual results are required to describe the patterns in post-Ambrosia time in any one lake (see below).

Except for the zinc in the lower core material of core CB_2, the values for lead and zinc in the CB cores were similar for lead and zinc and indicate that the performance of the analytical methods provides similar information to that supplied for the other elements in the 1982 cores.

CORE CODE	WHOLE CORE		0-5 CM [1]		20-50 CM [2]		LAKEWATER PH
	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	MEAN (KK)	C/V (%)	
Pb							
CH	1.837	51.1	2.369	11.6	1.000	-	3.3
CB_3	1.714	43.9	2.292	28.5	0.910	15.0	5.1
CB_2	2.292	66.1	3.830	34.5	0.435	24.3	5.1
B	2.022	54.4	3.130	37.6	0.987	13.8	5.2
X_1	1.508	62.8	2.546	37.1	0.474	31.6	5.6
CU	6.115	94.8	13.231	21.7	0.923	26.8	6.1
CJ	1.277	40.9	1.776	17.6	1.359	14.9	6.4
ÇS	5.387	115.5	13.208	40.4	0.807	14.3	6.6
W_1	4.390	64.6	7.669	2.8	0.910	17.9	6.7
W_4	2.094	58.5	3.223	11.2	0.871	34.4	7.7
Zn							
CH	1.560	83.0	0.815	76.2	0.894	-	3.3
CB_3	1.183	16.7	1.314	5.5	1.263	18.8	5.1
CB_2	1.133	17.6	1.192	14.8	0.818	13.2	5.1
B	1.584	34.0	2.048	36.2	1.242	10.4	5.2
X_1	1.057	33.5	1.465	21.9	0.739	13.3	5.6
CU	2.400	63.7	4.155	29.1	1.342	9.1	6.1
CJ	0.955	29.6	1.297	13.0	0.649	3.6	6.4
CS	2.453	69.0	4.664	27.3	1.219	2.0	6.6
W_1	1.438	42.8	2.027	8.9	0.743	11.4	6.7
W_4	1.085	20.7	1.273	6.7	1.028	14.0	7.7

Table 6:10 Levels of Lead and Zinc in each of 10 cores collected during the 1982 project (KK units).

Summary

Verification experiments on the sampling, subsampling, chemical analysis, data processing and interpretation of lake sediment geochemical data have been summarized. In general, the performance of the analytical approach demonstrates that replicate sediment core analyses provide a stable basis for the description of the geochemistry of lake sediment cores and that the cores reflect unique geochemical signatures for each catchment area.

Relationships Between the Geochemistry and Paleo pH of the 0-5 cm Lake Sediment Cores

In order to examine in detail relationships between the paleo pH data obtained from diatoms and the geochemical data in post-*Ambrosia* time, the top 5 cm of selected cores were sampled at 0.5 cm intervals in the 1982 project. Some idea of the data obtained from this procedure may be obtained from Figure 6:4 in which geochemical data from two cores collected within the same catchment area are displayed side by side.

It is clear from Figure 6:4 that the within core relationships for individual elements and the general levels from core to core are easily reproducible except for zinc and lead. It is interesting that the zinc values decline slightly as the sediment-water interface is reached compared with lead which shows a marked increase during the whole time period. It is also interesting to note that calcium shows a straight decline in level in each of the cores towards the bottom of the lake whereas phosphorus shows an increase. In general, the data verify the patterns for elements to a significant degree.

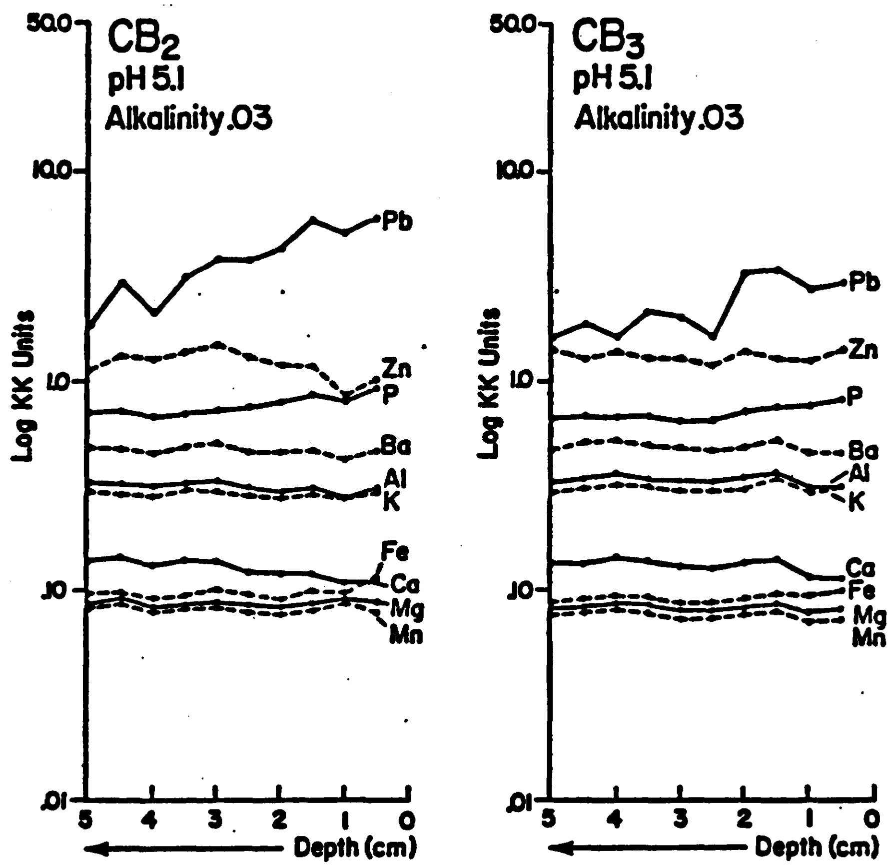


Figure 6:4 The levels of elements in two lake sediment cores (0-5 cm depth) taken from the CB catchment area in 1982.

An attempt to relate the calcium levels in the 0-5 cm core segments to the data for paleo pH in the cores was unsuccessful and no simple relationship was apparent when the data were listed or graphed.

On Figure 6:5, data are plotted for eight cores from lakes ranging in pH from 3.3 to 7.7 using the same procedure as in Figure 6:4. Several points of interest emerge from a comparison of the geochemical patterns in these cores.

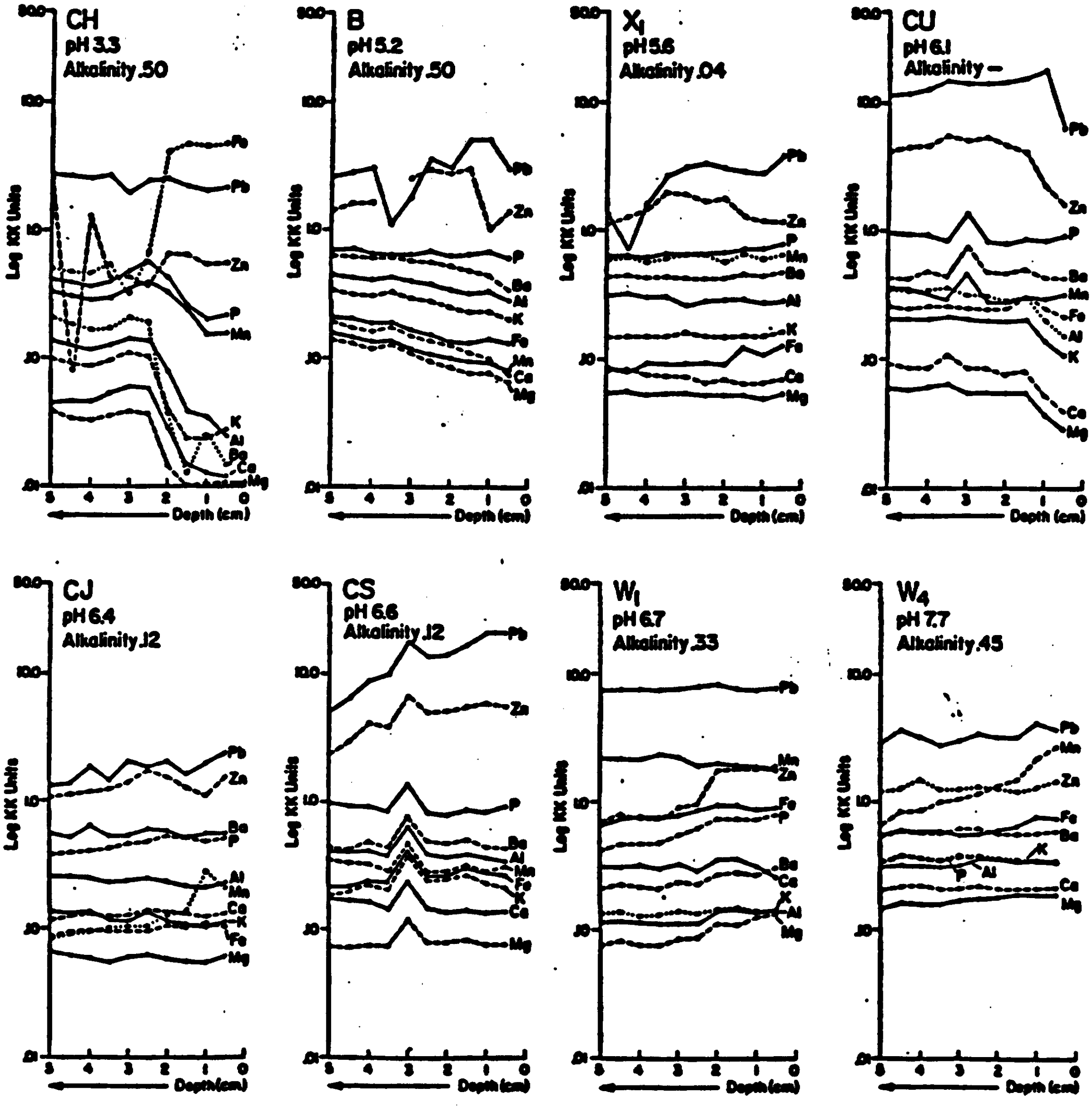


Figure 6:5 The levels of elements in eight lake sediment cores (0-5 cm depth) taken from the Wawa area during 1982.

a) In CH, which is a tailings pond from an iron mine, the bright red colour of the surface of the sediment is reflected in the high iron values in the top 2.5 cm of the core. It is interesting that the lead pattern in the core does not show an increase (as in Figure 6:4) although there is some increase in the zinc associated with the increased level of iron. The other elements decreased substantially in the top 2.5 cm of the core suggesting that the precipitation of the red layer of secondary iron oxide diluted the input of other elements substantially.

b) It is interesting that in core B all elements except lead and zinc declined at the same rate towards the sediment/ water interface. This suggests that the sediment is decreasing in organic matter content from the surface to a depth of 5 cm at a relatively uniform rate. This is reflected in the moisture loss data for the core which was 97.29% in the surface sample and 88.96% at a depth of 5 cm with a uniform gradient in between. The loss on ignition data is inconclusive. With respect to lead and zinc, both show an increase in content towards the lake bottom with a sharp decrease near the water sediment interface.

c) The patterns for X_1 are very similar to those for Lake CB discussed above, except that iron increased slightly near the water/sediment interface. The difference between the calcium and magnesium curves is relatively small although slightly greater than in core B. In general, the lead and zinc curves are similar to those for the CB cores.

d) The CU core from Michipocoten Island is characterized by having high lead and zinc which peaks within 2 cm of the water/sediment interface. It is interesting to note that iron, aluminium, potassium, calcium and magnesium all decrease sharply in the top centimeter of the core but manganese, barium and phosphorus do not show this trend.

e) The patterns found in Lake CJ resemble those for Lake X_1 although the zinc level is higher. The sharp increase in manganese in the top 2 cm in Lake CJ may be significant.

f) In Lake CS, the relatively high lead and zinc values tend to dominate the patterns for other elements. A general comparison between the data from Lakes B and CS can be made except that in Lake CS there is a single sample with high values in all elements at 3 cm depth. This is likely to be due to an inhomogeniety in the core material and not an analytical artifact.

g) The patterns for W_1 are interesting because the levels of lead and zinc are uniform throughout the core. The patterns for the other elements are less stable than in some of the other cores. For example, manganese increases towards the sediment water interface and calcium decreases. In general, the iron level is only slightly higher than in some of the other cores.

h) In Lake W_4, the patterns for all elements except manganese indicate a uniform level of the content in the five centimetre length of core. The manganese concentration increases uniformly throughout the core, although the cause of this gradient is unknown.

In summary, a detailed plot for the content of ten elements in a series of 8 cores in the depth range from the sediment water interface to 5 cm provided an overview of the patterns for elements during post-Ambrosia time. The data confirms that the analytical method (sampling and chemical analysis) is suitable for a study of this type. As expected, the levels of the elements vary from core to core and each core has a characteristic vertical distribution pattern for all elements. In general, the elements with the exception of zinc, lead and manganese, have stable patterns within the pH range from 5.2 to 7.7. The core CH, from the tailings pond, has a different family of patterns for the elements due to the large amount of iron in the sediment.

It is concluded that there is no simple relationship between the level of elements in the top 5 cm of cores and the pH of the lakes from which the cores were collected. Although the data for calcium alone from core B would indicate this relationship exists, when data for the other elements is plotted (as well as calcium), it is seen that the values for all elements follow the same pattern, which is clearly not related to pH.

Another attempt to discover a relationship between the paleo pH and the calcium levels in the 0-5 cm cores was made by normalizing the data for calcium and potassium to magnesium (Table 6:11). Six

DEPTH	Ca (KK)	Mg (KK)	Ca/Mg (KK)	K (KK)	K/Mg (KK)	Paleo PH
CH Lakewater pH 3.3						
0.5	0.013	0.012	1.09	0.028	2.47	
1.0	0.013	0.010	1.30	0.025	2.40	
1.5	0.016	0.010	1.50	0.025	2.37	N O
2.0	0.028	0.015	1.86	0.040	2.67	
2.5	0.058	0.037	1.54	0.105	2.77	
3.0	0.060	0.039	1.53	0.114	2.89	D A T A
3.5	0.053	0.037	1.46	0.096	2.63	
4.0	0.046	0.033	1.38	0.088	2.63	
4.5	0.047	0.034	1.36	0.090	2.59	
5.0	0.050	0.039	1.29	0.099	2.54	
CB_2 Lakewater pH 5.1						
0.5	0.110	0.086	1.27	0.296	3.43	5.70
1.0	0.106	0.091	1.64	0.275	3.03	5.80
1.5	0.119	0.083	1.44	0.282	3.37	5.60
2.0	0.117	0.080	1.46	0.270	3.36	5.80
2.5	0.120	0.081	1.48	0.274	3.39	5.70
3.0	0.136	0.086	1.58	0.296	3.53	5.90
3.5	0.137	0.083	1.63	0.300	3.57	5.90
4.0	0.128	0.080	1.60	0.271	3.38	5.80
4.5	0.144	0.090	1.59	0.284	3.15	5.90
5.0	0.139	0.085	1.63	0.294	3.45	5.90
B Lakewater pH 5.2						
0.5	0.076	0.068	1.12	0.200	2.95	4.92
1.0	0.104	0.078	1.34	0.235	3.06	4.99
1.5	0.114	0.078	1.45	0.230	2.94	5.00
2.0	0.126	0.086	1.46	0.245	2.86	5.07
2.5	0.135	0.096	1.40	0.278	2.89	5.20
3.0	0.148	0.111	1.34	0.289	2.89	5.20
3.5	0.176	0.130	1.35	0.328	2.63	5.32
4.0	0.161	0.123	1.30	0.248	2.63	5.32
4.5	0.174	0.131	1.32	0.315	2.59	5.22
5.0	0.193	0.138	1.39	0.340	2.54	5.23
X_1 Lakewater pH 5.6						
0.5	0.071	0.054	1.31	0.164	3.03	
1.0	0.068	0.051	1.34	0.149	2.93	4.68
1.5	0.068	0.053	1.27	0.154	2.90	
2.0	0.070	0.053	1.32	0.155	2.91	4.72
2.5	0.068	0.053	1.29	0.154	2.90	
3.0	0.073	0.055	1.32	0.161	2.91	4.70
3.5	0.075	0.054	1.40	0.153	2.86	
4.0	0.076	0.054	1.41	0.154	2.84	4.79
4.5	0.083	0.057	1.45	0.155	2.72	
5.0	0.080	0.055	1.45	0.152	2.74	4.86
W_1 Lakewater pH 6.7						
0.5	0.257	0.133	1.93	0.145	1.09	
1.0	0.312	0.125	2.49	0.138	1.10	7.34
1.5	0.357	0.119	2.99	0.144	1.20	
2.0	0.349	0.121	2.89	0.140	1.15	7.72
2.5	0.282	0.087	3.22	0.118	1.34	
3.0	0.324	0.086	3.75	0.118	1.37	7.57
3.5	0.291	0.076	3.83	0.110	1.45	
4.0	0.311	0.077	4.01	0.114	1.47	7.30
4.5	0.308	0.082	3.76	0.117	1.42	
5.0	0.307	0.076	4.03	0.116	1.52	7.47
W_4 Lakewater pH 7.7						
0.5	0.207	0.181	1.47	0.337	1.86	
1.0	0.207	0.185	1.12	0.344	1.86	6.60
1.5	0.201	0.186	1.08	0.349	1.88	
2.0	0.201	0.179	1.12	0.354	1.98	6.60
2.5	0.210	0.177	1.19	0.373	2.11	
3.0	0.204	0.168	1.21	0.372	2.21	6.80
3.5	0.201	0.158	1.27	0.346	2.19	
4.0	0.214	0.156	1.37	0.359	2.30	6.70
4.5	0.211	0.159	1.33	0.369	2.32	
5.0	0.201	0.140	1.43	0.320	2.28	6.70

Table 6:11 Data listings for calcium, magnesium and potassium and paleo pH in the 0-5 cm segments of six lake sediment cores collected during 1982.

lakes with pH of their waters from 3.3 to 7.7 were chosen for inclusion in this experiment. Five of these lakes included data for paleo pH, Lakes CB_2 and B at 0.5 cm intervals and Lakes X_1, W_1 and W_4 at 1 cm intervals (Table 6:11). It was concluded that there was no valid geochemical gradient for calcium in Lakes CB_2 and B which could be the result of changes in lake pH during the recent past, although the data pattern for both calcium and magnesium shows an apparent gradient.

Summary and Conclusions

The standardization of sample collection and analytical techniques for waters and lake sediments during the 1982 project resulted in a much better performance than in 1981 or 1980. In addition to the work on the methods, a statistical technique was adopted for future use in quality control of lake sediment geochemical data on the basis of preliminary tests on the 1982 data set. The lake sediment geochemical data obtained during 1982 was processed to provide information on the reliability of the data for "whole core" "pre-*Ambrosia*" and "post-*Ambrosia*" core segment material. It was concluded that the data was close to the limit of effectiveness of the combined AA/ICP rapid technique and that the data obtained was suitable for regional geochemical surveying for both mineral appraisal and environmental purposes. Detailed study of the 0-5 cm core segments of cores from which paleo pH data was available failed to establish any simple relationship between the paleo pH and the calcium levels in lakes which have gone acid in post-*Ambrosia* time.

7.0 GENERAL DISCUSSION AND CONCLUSIONS

LIMNOLOGY (M.D.)

Introduction

In this report, details of research completed in the 1981 and the 1982 projects have been given. In this chapter, a general discussion of the limnological, palynological and geochemical findings of the various aspects of the research are given and general conclusions drawn regarding the role the research can play in future regional geochemical surveys based on lake sediments.

The findings of the various limnological investigations during 1981/2 are described first followed by a very general statement regarding the palynological investigation. The summary ends with a discussion of the findings of the geochemical investigations in 1981 and 1982 and how these relate to the activities of the other disciplines.

GENERAL DISCUSSION OF THE LIMNOLOGICAL INVESTIGATIONS

Acid Rain Trajectory Studies

Acid rain trajectory studies are frequently based on composite precipitation samples. However, these precipitation data are of limited value according to Miller et. al. (1978). The characterization of acidic precipitation events using a single trajectory may be misleading because a storm system typically involves the "inflow of air from many directions through convergence in the vicinity of the cyclonic cell" (Kurtz & Scheider, 1980). To add to this complication, it must be recognized that acidic precipitation is a complex amalgam of rainout and washout processes occurring at many atmospheric levels possessing different directions of air flow (Ibid). For these reasons, numerous workers have turned to small lake watersheds as composite samplers.

The sediments at the bottom of a lake record the total annual input of organic and inorganic compounds released to the sediments each year. In a sense, lakes act as time integrating composite precipitation collectors. Their interactions with the surrounding terrain makes them ideal experimental systems for acid rain studies.

Water Chemistry

Twenty lakes were sampled in 1981. The results of their physical-chemical factor analysis based on a Pearson correlation contingency table (Table 3:1), indicated that lakes located near the top of a watershed (i.e. first order lakes) were typically smaller, shallower and lower in pH and alkalinity than lakes at the bottom of the same watersheds. A similar pattern has been confirmed in the nearby Turkey Lakes (Floyd Elder, 1982, Personal Communication).

undergoing rapid acidification. It was also the only one in the watershed which was not humic.

Sulphuric acid formed from the oxidation and hydrolysis of the airborne pollutant, sulphur dioxide, is the most important anthropogenic pollutant affecting the pH of lakes north of Lake Superior (Galloway et.al. 1976). As expected, those lakes north of Lake Superior which were most affected by acid precipitation were located in bedrock basins of low solubility (eg. gneissic and granitic basins), or were ombrotrophic (i.e. insulated from the underlying substrate as a result of their thick organic-rich "cocoons", (Fig. 7:1). The ombrotrophic lakes were typically surrounded by Sphagnum moss and their water colour was that of weak tea. These brown water, or humic, lakes were less sensitive to acid rain than the clear water lakes, as indicated by the lack of change in their downcore diatom inferred pH profiles.

Calibrated Lake Study

The present study is the first to use diatom indicator species to estimate the rate of lake acidification in the area north of Lake Superior. However, researchers at the Canada Center for Inland Waters and at Waterloo University are currently preparing manuscripts on this same subject. When carefully calibrated in the study area in which it is used, this technique has proved to be a valuable tool in estimating the rate of lake acidification in areas where no long term pH records exist.

In the Algoma district, four of the seventeen lakes (24%) which we cored and analyzed for diatom inferred paleo pH were undergoing rapid acidification. Two of these, lakes B and CS, were located within 20 km of a major sulfur emitter (the Algoma sintering plant at Wawa which releases roughly 300,000 tons of SO_2 per year, (approximately one tenth of that emitted by Inco in Sudbury). The other two lakes which appeared to be undergoing rapid acidification, Lakes X_1 and Z_4, were located nearly 100 km from the sintering plant. Because only negligible amounts of SO_2 from the Algoma sintering plant in Wawa reaches these lakes (Weizman 1982), it was concluded that other sources of acid rain were also responsible for their acidification. Recent studies by Dr. M. Thomson of the Canada Centre for Inland Waters, indicate that these X and Z watershed lakes may be affected by SO_2 emissions from Sault Ste. Marie.

Acid Indicator Diatoms

Acid indicator (acidobiontic and acidophilic) diatoms such as Anomoeoneis serians, Actinella punctata and Semiorbis hemicyclus, increased in relative abundance as a lake acidified. Simultaneously, the number of alkaline indicator diatom species such as Synedra delicatissima, Cymbella cestaii and Achnanthes minutissima, decreased.

Vaughan et al (1982) concluded as we did, that the diatoms in lakes possessing more than 10 mg/l $CaCO_3$ alkalinity, were much less affected by acid rain than those in lakes of lower alkalinity. In other words, major shifts in diatom species composition were restricted to lakes with alkalinities below 10 mg/l. This was true unless there had been a fire, logging event or major change in lake level* within the watershed. In these latter cases, even well buffered lakes with alkalinities far above 10 mg/l were affected. However, when diatom species composition shifted as a result of fire, logging or beaver activities, it always returned to its previous (pre-disturbance) composition within a few decades. Furthermore, this downcore shift in diatom species composition and diatom inferred pH provided a "signature" which characterized the type of disturbance which had caused it (i.e. beaver vs. fire or logging disturbances).

Acid rain induced shifts in lake pH resulted in another type of characteristic signature. When a recent reduction in diatom infer-

Figure 7:1 Lake CF - A varved ombrotrophic lake with muskeg and sphagnum development encircling the entire lake.

*Changes in lake water level were frequently associated with beaver activity.

red pH resulted in pH levels which were lower than any previously observed over post-Ambrosia time (i.e. over the last 100 years), it was concluded that acid rain was the most likely factor.

Fish Stocking and Lake Acidification

There is a tendency to conclude that a lake's fish stocking record can be used to infer something about the lake's pattern of acidification. For example, a lake stocked with trout is frequently referred to as undergoing acidification if the trout have since disappeared. Thus, in lakes where pH and alkalinity are low, there has been a tendency to ascribe the failure of an introduced fish population to lake acidification. Before this conclusion can be accepted, however, an alternate hypothesis must be disproved (i.e. that the lake wasn't already low in alkalinity and pH for natural reasons at the time the introductions were made). Unfortunately, records of introductions of fish before 1970 rarely included any information about the pH and alkalinity of the lakes into which the fish were introduced.

Species Richness and Dominant Diatoms

The surface sediments of the 5 neutral U watershed lakes (pH 6.2 to 7.1) contained 127 diatom taxa, more than were found in any of the other watersheds. This high species richness was due, in part, to the presence of a variety of acid, circumneutral and alkaline indicator diatoms. In addition, the U watershed lakes spanned the greatest size and pH range, making them far more heterogeneous than the other watersheds.

The other group of neutral lakes, the W watershed lakes, had 97 diatom taxa in their surface sediments (76% of the number found in the U lakes). The lower species richness of the W lakes was associated with stresses related to their position in the plume-kill area. Their similar pH, 6.6 - 7.1, and their similar size and morphometry also contributed to lower habitat diversity. Achnanthes minutissima, Anomoeoneis serians var brachysira, Cymbella cesatii, Fragilaria pinnata, Navicula cf. peregrina, Nitzschia fonticola, and Synedra delicatissma were the dominant diatoms in the W staircase lakes.

The Acid Lakes

The acidic watersheds X and Z, had the lowest species richness of any of the watersheds (71 and 80 taxa respectively). This is consistent with the general observation that acid lake biotic diversity is low due to the ecological stress associated with low pH (Yan & Stokes 1978, Almer et al. 1974).

The dominant taxa in the X lakes were the acid indicator and circumneutral diatoms: Anomoeoneis serians, Eunotia incisa, Eunotia pectinalis, Frustulia rhomboides, Navicula subtilissima, Pinnularia maior, Semiorbis hemicyclus, and Tabellaria spp.

The dominant species in the Z lakes were very similar to those of the X lakes, but included a few others such as the acidobiontic taxa Actinella punctata, Eunotia arcus, Pinnularia biceps, and Stenopterobia intermedia.

The Alkaline Lakes

There were 102 diatom taxa in the surface sediments of the 4 alkaline Y watershed lakes (pH 7.8 - 8.2). Numerous alkalophilous and a few alkalobiontic taxa, as well as several circumneutral taxa, formed the dominant diatom assemblage in these alkaline lakes. The dominant species were Cymbella angustata, an alkalobiontic indicator (Hustedt 1937); the alkalophilic diatoms Cymbella minuta and Synedra radians; and three circumneutral species, Navicula radiosa var. parva, N. radiosa var. tenella and N. radiosa var. radiosa. Another common diatom, Navicula vulpina, had no pH indicator value assigned to it (Hustedt 1937).

We concluded, that the diatom inferred pH technique (when carefully calibrated in the study area in which it is used) is a valid method of estimating the rate of lake acidification in lakes where no long term pH records are available.

PALYNOLOGY

General Discussion (J.T.)

As a general rule, the fossil pollen found in sediments of small lakes reflects the vegetation in the surrounding area commonly some tens of kilometres in diameter. In addition, some pollen is derived from aquatic vegetation within the lake, near-shore vegetation (for example, muskeg around lake), and also from distant sources.

The bulk of pollen is dispersed by wind, although some pollen is transported by streams, surface water runoff, and insects. It must be remembered, furthermore, that plant species vary greatly in terms of their pollen production. Therefore, species with high pollen production (for example, pine) are overrepresented by their percentages in the pollen diagram as compared with their abundance in the vegetation, whereas species with low pollen production are underrepesented by their percentages in the pollen diagram. Pollen of a number of plant species will not be found as fossil at all. Because of this, percentages of pollen in a diagram do not necessarily imply equal percentage composition of species in the "parent" vegetation.

The construction of pollen diagrams for this study involved the following basic principles. In each sample, a total of 200-300 tree pollen (arboreal pollen) were counted. This total count comprises the "basic sum", and all percentages in the pollen diagram are calculated with reference to this basic sum, i.e. the total number of tree pollen counted equals 100%. The non-tree pollen (non-arboreal pollen, NAP) counted at the same time is also expressed as a percentage of this basic sum.

The Ambrosia (ragweed) pollen found in the top 10-15 cm of lake sediment cores is presumed to be derived from distant sources by atmospheric transport, probably from areas south of Lake Superior. There is no obvious major source of Ambrosia pollen in the immediate study area that is forested and has no agriculturally cleared land.

According to Rowe (1959) the study area is in the Superior Section (B.9) of the Boreal Forest Region where forests are quite variable, ranging from mixed types with luxuriant shrub undergrowth to floristically poor, single species coniferous types. A relatively stable mixed forest of white spruce (Picea glauca), balsam fir (Abies balsamea), white birch (Betula papyrifera), and aspen (Populus tremuloides) is characteristic of the deep, medium-textured valley soils. On till slopes and the tops of low hills, the same associations of species are found but with birch more prominent and some black spruce (Picea mariana) also appearing. Here, mountain ash (Sorbus decora) is conspicuous as a tall shrub or small tree. The higher, more rocky elevations, and sand and gravel in the valleys bear jack pine (Pinus banksiana) and white birch, with black spruce of poor form. Silts and sands in wet lowlands, where muskeg is common, are characterized by spruce, tamarack (Larix laricina), white cedar (Thuja occidentalis), and other common species of peatland plants.

This forest section has been subject to forest fires apparently throughout postglacial time and fires have favoured an increase in the proportion of aspen, white birch and pine.

Some more southern tree species are present occasionally, including white pine (Pinus strobus), red pine (Pinus resinosa), black ash (Fraxinus nigra), sugar maple (Acer saccharum) and yellow birch (Betula lutea).

The forest cover described above is generally indicated by all pollen diagrams. There are a few pollen grains of southern species of trees present in some pollen assemblages, probably derived from the same source areas as the Ambrosia pollen.

It should be noted that because of the great distance of the study area from the sources of Ambrosia pollen, the "Ambrosia pollen rise" in our pollen diagrams is not as distinct as in the southern

Great Lakes region. Furthermore, the postulated disturbance of surface sediment in some lakes makes the *Ambrosia* rise even less distinct, and coupled with apparently low sedimentation rates the "fuzzy" *Ambrosia* rise can become only marginally useful as a time marker in some lakes. Small lake size and high landscape relief make this particular problem even more serious.

Conclusions

From the viewpoint of acid precipitation, the palynological investigation was of considerable importance because it enabled us to distinguish between pre- and post-*Ambrosia* lake sediment material in the cores studied. This in combination with data for wet weight, dry weight and loss on ignition led us to postulate a uniform sedimentation condition in the lakes during both pre- and post-*Ambrosia* time.

The series of detailed pollen diagrams provide a data base for study of detailed relationships between the pollen deposition and the chemical element deposition in the sediment.

The remoteness of the study areas from the *Ambrosia* pollen sources makes the use of the *Ambrosia* rise as a stratigraphic time marker difficult because of the indistinct nature of the *Ambrosia* rise at least in some pollen diagrams and this is clearly a limiting factor in the use of palynological information as support for other studies that require this kind of a time marker.

GENERAL DISCUSSION OF THE GEOCHEMICAL STUDIES (J.F.)

The geochemical research involves a discussion of the data from lake sediments obtained from the staircase lakes during 1981, information on the long core studies in 1981, the methodology revisions made for the 1982 chemical analysis and the verification studies completed during 1982.

The 1981 Staircase Lake Investigation

In spite of problems with the methods of chemical analysis described in detail at the beginning of Chapter 5, it was found useful to consider the multielement data from the staircase lakes from several points of view. Using geochemical signatures based on KK units, the Pre-*Ambrosia* within staircase signatures were compared; the Pre-*Ambrosia* staircase to staircase signatures were compared; the Post-*Ambrosia* staircase to staircase signatures were compared and some Pre/Post-*Ambrosia* geochemical signatures were compared.

The Pre-*Ambrosia* within staircase comparisons failed to describe significant geochemical gradients for elements from lake to lake within the staircases as expected. In general, the lakes from the same catchment area tended to have the same level of elements within the cores and these differences were close to the limit of the methods [Table 5 (Bottom)]. Only one staircase was found to have a lake to lake gradient effect. This was the U series where, for example the zirconium values for lakes 1-4 were 0.08 KK, 0.15 KK, 0.25 KK, and 0.31 KK respectively. Even here not all elements had this trend, for example, the values for calcium in lakes 1-4 were 0.22 KK, 0.22 KK, 0.35 KK, 0.30 KK respectively.

The Pre-Ambrosia staircase to staircase comparisons (Figure 6) were interesting because each staircase was found to have a characteristic geochemical signature. For many elements, especially the major elements, the precision of the four results was often around 0.25 KK. As might be expected, the spread of the minor elements was greater with variations of over 0.5 KK common within the same staircase. In general, the behaviour of calcium in the alkaline lakes was atypical and very high values due to the precipitation of marl were present in the W and Y series of lakes.

Two series of lakes, the Z staircase representing an area which is likely to have gone acid due to acid rain and the W staircase located in the Wawa smelter plume were selected for a detailed examination of the geochemistry of cores laid down in Post-Ambrosia time. Detailed examination of the Z lake paleo pH curves indicated that the pH was similar in all four lakes in Post-Ambrosia time except in Lake Z_4 where the pH has gone from around 5 to 4.5 in the recent past (i.e. 0-2 cm). The palynological data indicates that the sedimentation rate in all four lakes has been similar in Post-Ambrosia time. A detailed examination of vertical distribution patterns for 15 elements in this lake series suggested that the behaviour of elements was: 1) unaffected by pH changes (eg. Ca, Cr, Al); 2) decreased by pH changes in the lake (eg. Fe, Mn, Mg, Zr, Ti, Ba); 3) increased with pH changes (eg. P, Cu, Ni); or 4) showed a normal increase associated with Post-Ambrosia time (eg. Pb, Zn). In general, these variations were relatively small except those in 4). Unfortunately, no paleo pH information was available for lakes W_2

and W_3. Lake W_1 was found to have a variable pH during Post-Ambrosia time in contrast to Lake W_4 which showed one major shift from around pH 8 to pH of 6.5 associated with the emplacement of the Wawa smelter in 1909. It is of considerable interest that a sharp decrease in copper accompanied this change of lake pH and that subsequent to the emplacement of the smelter, the iron and manganese in Lake W_4 increased sharply. These changes are slightly less well marked in the other three lakes in the series. Otherwise, the vertical distribution patterns for the elements are quite similar from lake to lake. In general, it is concluded that the behaviour of elements in acid lakes or lakes which are turning acid is more unstable than in lakes with an alkaline or neutral reaction.

An inspection of Pre- and Post-Ambrosia levels for 18 elements in the top lakes of each series indicated that for most elements values were within 0.5 K for the whole core. Exceptions to this rule were V, Zn and Pb in the X lakes; V, Zn and Pb in the Z lakes; P, Zn and Pb in the U lakes; Fe, Mn (anthropogenic due to the smelter), P, Zn and Pb in the W lakes and Ca, P, Zn and Pb in the Y lakes. As mentioned above, the increase of Pb and Zn in Post-Ambrosia sediment is almost universal in the Wawa area and is thought to be due to atmospheric fallout.

In summary, the 1981 staircase lake geochemical data sets provided a rare opportunity to study in detail the levels of elements in lakes situated within the same general catchment area. In general, down core and lake to lake variations within the same staircase were within 0.5 KK for most elements with several notable exceptions including Ca in lakes with secondary calcium carbonate and Pb and Zn in the surface samples of cores.

each set of lakes had a characteristic geochemical signature which was directly related to the geological conditions except in the Wawa plume area where effects of fallout were observed in Post-*Ambrosia* material.

The 1981 Deep Core Investigation

The study of the lake sediments for mineral appraisal usually concerns the material in the top 50 cm of the sediment which is collected by a grab sampler, or in our case, a corer. One aspect of lake sediment core descriptive geochemistry which has been little explored and which might be of considerable interest in relation to the acid rain problem concerns effects of natural changes in pH of a lake during Pre-*Ambrosia* time. Previous work at Alfie's Lake near Wawa (Saarnisto 1975) indicated that at least four major changes in vegetation cover types have occurred in the area since the ice melted in the area some 9,000 years ago. Consequently, one of the objectives of the 1981 project was to study the palynology of deep cores collected from one lake in each of the staircase series. In practice, owing to technical problems, only one long core was collected. This was from Lake U_3.

In spite of problems with chemical analysis of the core material, it was possible to obtain data for the abundance of elements within the deeper parts of this core as well as a pollen diagram which checked well with that obtained previously at Alfie's Lake. Generalized geochemical patterns for Cu, Al, Mn, Mg, Fe, Ti and Ca (Figure 4:6) showed that significant changes of abundance of all these elements occurred with changing plant cover types soon after the commencement of sedimentation. In particular, it was apparent that less Al, Mn, Mg, Fe, Ti and Ca and Cu were related to an increase of Pinus pollen in the sediment.

It was concluded that under favourable conditions, changes in plant cover types associated with changes in the palynological column are reflected in changes in the abundance of certain elements in the sediment material. Clearly this offers an opportunity for research into the relationship between plant cover type change, diatom flora change and geochemical change in the time since the Wisconsin ice sheet retreated from the Canadian Shield.

Changes in Geochemical Methodology for the 1982 Study

Experience with the multielement data during 1980 and 1981 indicated that research was required to realize fully the potential of ICP multielement instrumental analysis as applied to lake sediment core material. Changes in the extraction procedure, together with strict quality control involving two laboratories resulted in considerably more reliable chemical data being obtained from the 1982 samples. Experiments with an appropriate statistical technique provided a starting point for the statistical control of multielement data throughout the range of values required for a lake sediment survey.

Also in 1982, the method of lake sediment core subsampling was made more effective and refined in order to collect samples at 0.5 cm intervals if required. Another change was the use of a large freeze dryer which facilitated and speeded up the sample preparation procedure.

In summary, changes made to the geochemical methods for the 1982 study were successful in raising the level of reliability of the chemical analysis to that required in order to solve the research problems, particularly those involving the determination of many elements in samples representing 0.5 cm segments of Post-Ambrosia core material.

Verification Studies Completed in 1982

Attention was paid to the verification of the pH patterns for lakes included in the 1978 regional geochemical survey and resampled in 1980. This showed that the pattern is verified from year to year although the actual values for the pH of lake waters differed by half a unit (higher) in 1980 compared with 1978. A comparison of pH, alkalinity and calcium content of waters in a small number of lakes sampled in 1981 and 1982 indicated that pH was the most reproducible parameter with calcium levels second and alkalinity measurements third. A further test indicated that as might be expected, field laboratory alkalinity data is preferable to alkalinity determined in Toronto after the conclusion of the field project.

The detailed method of subsampling lake sediment cores combined with the increase in performance of the methods of chemical analysis provided a unique opportunity to study in detail the performance of the geochemical techniques on a wide variety of lake sediment cores collected during 1982. Element by element comparisons for averaged data for whole cores (0-50 cm, 35 samples), lower core material (20-50 cm, 6 samples) and surface samples (0-5 cm, 10 samples) taken from ten lakes showed that the data were remarkably consistant for almost all elements. Exceptions were P, Zn and Pb which were found to be accumulated in post-Ambrosia samples from most lakes. A detailed study of the repeatability of patterns for 10 elements in two cores taken from different lakes in the same catchment area provided information on the degree to which verification of lake sediment core geochemical data can be expected using the methods described in this report. A comparison of element abundances of elements in 10 subsamples of post-Ambrosia core material in each of 8 lakes selected to include a pH range from 3.3 to 7.7 did not reveal any geochemical patterns which could be directly matched with paleo pH data obtained from diatoms. Graphs of this data did reveal how each lake develops a characteristic pattern for the distribution of elements in the top 5 cm of the core which tends to be followed by all elements except P, Zn and Pb, and, in some case manganese. In general, the geochemical verification of data in lake sediment cores was generally better than 0.5 KK and often better than 0.20 KK.

Attempts to relate the calcium content of lake sediment to paleo pH data obtained from the diatom study were generally inconclusive and variation in the element levels in the acid lakes were similar to those in neutral or alkaline lakes. Apparent decreases in calcium levels at the top of the cores in some lakes were apparently related to the nature of the core material and not to changes in pH. Normalization of calcium data to magnesium data and normalization of potassium data by magnesium data indicates similar patterns for these two elements (i.e. calcium and potassium) in both acid and alkaline lakes which would not have been the case if acid rain has significantly affected levels of calcium in the cores. Statistical analysis of the lake sediment core geochemical data obtained during 1982 is planned for the future.

GENERAL CONCLUSIONS

1) Lakes in staircase series either of acid or alkaline reaction do not always have the top lake, the most acid member of the series. Indeed in some series of this type, all lakes were found to have a very similar pH. Nevertheless, there was a statistically significant correlation (P 0,01) between lake elevation and pH.
2) The geochemical signature of lakes within the same catchment area based on the patterns for over 10 elements in each of four lakes are relatively constant and tend to be unique to that catchment area.
3) When suitably calibrated, the paleo pH based on diatoms can be a sensitive indicator of pH changes in lakes particularly in post-<u>Ambrosia</u> time for catchment areas with acid lakes.
4) A combination of palynology (i.e. pollen diagrams) and geochemistry of deep lake sediment cores which record the evolution of a lake since the departure of the ice 9,000-13,000 years ago suggests that changes in plant cover types are accompanied by significant and consistant changes in the level of elements in the sediment material. This relation requires further testing because if it is true, it could provide information leading to the prediction of changes in lake sediment abundance geochemistry due to acid rain effects.
5) A methodology for the determination of 15 elements in lake sediment cores has been developed suitable for geoscience oriented regional geochemical mapping. The effectiveness of this approach has been verified in lakes of the Wawa area ranging in Ph from acid to alkaline.

Conclusions from Limnology

6) Non humic lakes with low alkalinity (10 mg/l as $CaCO_3$) are most likely to turn acid due to acid rain.
7) Even limestone terrain lakes may be found which are acidifying owing to a cocoon effect whereby the organic matter insulates the lake from the limestone rich substrate upon which it is located.
8) Disturbance of lakes due to forest fires or other natural events or man made disturbances such as logging or smelter operations affects the diatom flora in subtle ways in alkaline lakes with high alkalinity as well as in acid lakes with low alkalinity. The signatures of such disturbances are characteristic and differ from changes in the diatom flora brought about by acid rain. Consequently, it is now possible to interpret some paleo pH diatom indicator downcore "signatures".
9) Data from the paleo pH indicator diatoms can help establish whether the lack of fish in a lake in pre-*Ambrosia* time was associated with recent (20-30 year) acidifications. More generally, the diatom inferred pH indicators can be used to establish the pH history of lakes in historic time where no pH data is available.

Conclusions from Palynology

10) The main value of palynological investigations in relation to the problem of acid rain is that under favourable conditions they can distinguish between pre- and post-*Ambrosia* time. Because of the remoteness of the source of the *Ambrosia* pollen

and because some lakes have been disturbed, the exact location of the *Ambrosia* rise cannot be located in all lake sediment cores from the area north and east of Lake Superior.

11) A knowledge of the palynology of lake sediments laid down in post-*Ambrosia* time plus a simple interpretation of air photographs of a catchment area followed by a helicopter flyby cannot be used to predict the susceptability of a catchment area to the effects of acid rain. More complex studies are required.

Conclusions from Geochemistry

12) The staircase lake model provided an opportunity to verify the geochemical data from lake sediment cores collected within the same general catchment area. In general, the lake to lake within lake verifications were good and the analytical technique designed to detect them worked well.

13) No clearcut relationship was found between the paleo pH curve in lakes affected by acid rain and the abundance of elements in the sediment. The apparent relationship between calcium, alkalinity and paleo pH in some cores was not found to be generally valid.

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PART II

INFORMATION AND DATA COLLECTED DURING THE 1981/1982 PROJECTS

INTRODUCTION

Part II contains information and data listings for geographical, geological, limnological, palynological and geochemical observations made on the lakes studied during the 1981 and 1982 field projects. The former project has to do with the five series of staircase lakes which were studied in 1981 and the latter with standardization and verification techniques completed during the 1982 field season. Laboratory data for geochemistry of the samples of waters and lake sediments is also included together with information on the performance of the methods of chemical analysis which were applied to the samples.

The data and information in Part II is organized in the following sections: -

Section I	1981 Descriptive and Geochemical Data.
Section II	1981 Performance of the method of chemical analysis on lake sediment material.
Section III	1982 Descriptive and Geochemical Data.
Section IV	1981 Data obtained from the Long Cores.
Section V	List of Diatom Species Studied (1981/2).
Section VI	Bathymetric Maps for certain lakes studied in 1981.

Where required, details of the organization of particular sections are given prior to the listing of the data and information.

THE MULTIDISCIPLINARY TEAM

The 1981 and 1982 projects were designed by J.A.C. Fortescue as follow-on projects to the 1980 study at Wawa carried out by the Ontario Geological Survey Multidisciplinary Team which has already been described (Fortescue et. al. 1981).

In 1981, the fieldwork was completed by a team led by J.A.C. Fortescue including Professors Mike Dickman and J. Terasmae from Brock University, St. Catharines, Ontario. During the winter of 1981-2 detailed study of the biological material was completed by Professors Dickman and Terasmae and the chemical analysis of the waters and lake sediments was completed at the Geoscience Laboratories of the Ontario Geological Survey (waters) and under contract by the Technical Service Laboratories of Toronto (lake sediments). The assembly of the data for Part II was carried out at the Ontario Geological Survey, Geophysics/Geochemistry Secton under the direction of J.A.C. Fortescue and M. Dickman by Mrs. F. Chu and Mrs. E. Boni. The drafting of the Figures was done by Mrs. A. Duic and the typing of the text on the micom was completed by Miss C. Beckett. Processing of the chemical data for listing in Part II was completed by A. Nakashima.

In the 1982 study, fieldwork was again completed by a team led by J.A.C. Fortescue. As in previous years, Professor M. Dickman was responsible for the limnological aspects of the project and Mrs. Leyland deputized for Professor Terasmae for palynological and Quaternary field studies and sample collection owing to the absence of Professor Terasmae. Further assistance in the field was

provided by R.B. Barlow and D. Wadge. The assembly of the information and data for the 1982 study was completed by the same team as in the previous year except that Miss B. Dalziel assisted in the compilation of the geochemical results.

SECTION 1

1981 DESCRIPTIVE AND GEOCHEMICAL DATA

STAIRCASE LAKES	X SERIES	X_1	X_2	X_3	X_4
	Z SERIES	Z_1	Z_2	Z_3	Z_4
	U SERIES	U_1	U_2	U_3	U_4
	W SERIES	W_1	W_2	W_3	W_4
	Y SERIES	Y_1	Y_2	Y_3	Y_4

SECTION 1 - CONTENTS

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SECTION 1 - CONTENTS

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SECTION 1 - CONTENTS

*Lake Code is inserted.

	X_1	X_2	X_3	X_4
UTM Coordinates of Lake: Zone	16	16	16	16
N	5239600	5239800	5239800	5239400
E	702750	702250	701700	701700
Elevation of Lake above sea level	439 m	437 m	434 m	430 m
Lake depth at sampling point	2 m	5 m	8 m	14 m
Lake area	0.045 km^2	0.025 km^2	0.04 km^2	0.63 km^2
Lake catchment area	0.70 km^2	1.10 km^2	1.25 km^2	4.51 km^2
Bedrock geology	"granite"	"granite"	"granite"	"granite"
Surface water chemistry: pH	5.0	4.8	5.0	5.2
alkalinity (mg/ℓ $CaCO_3$)	1.20	0.70	1.15	1.15
Ca (ppm)	1.4	1.2	1.2	1.2
SO_4 (ppm)	5.0	5.0	5.0	5.0
Ambrosia level	25 cm	12.5 cm	10 cm	6 cm

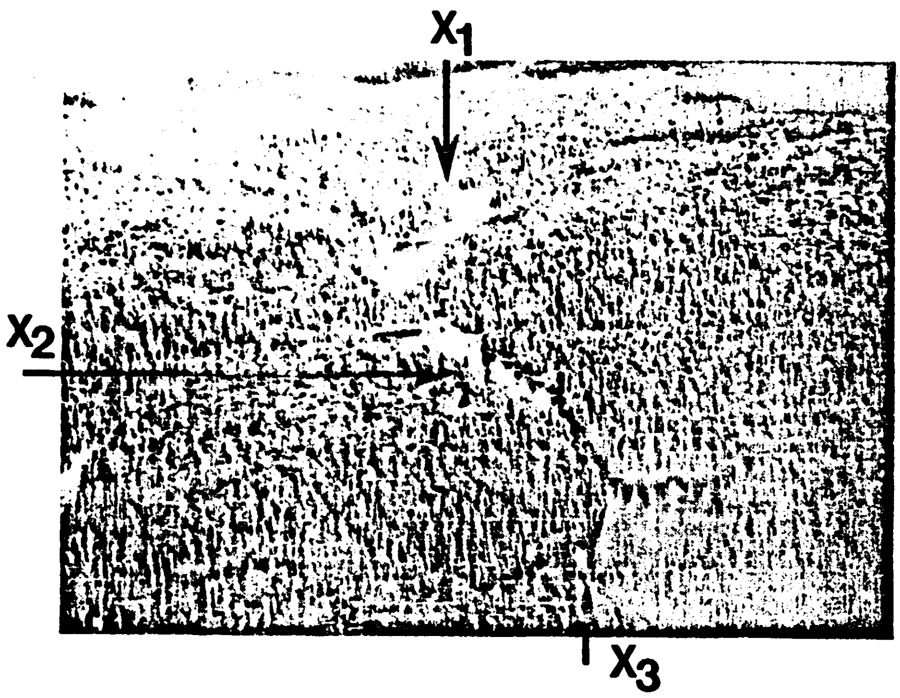
LAKE STAIRCASE "GRANITE"

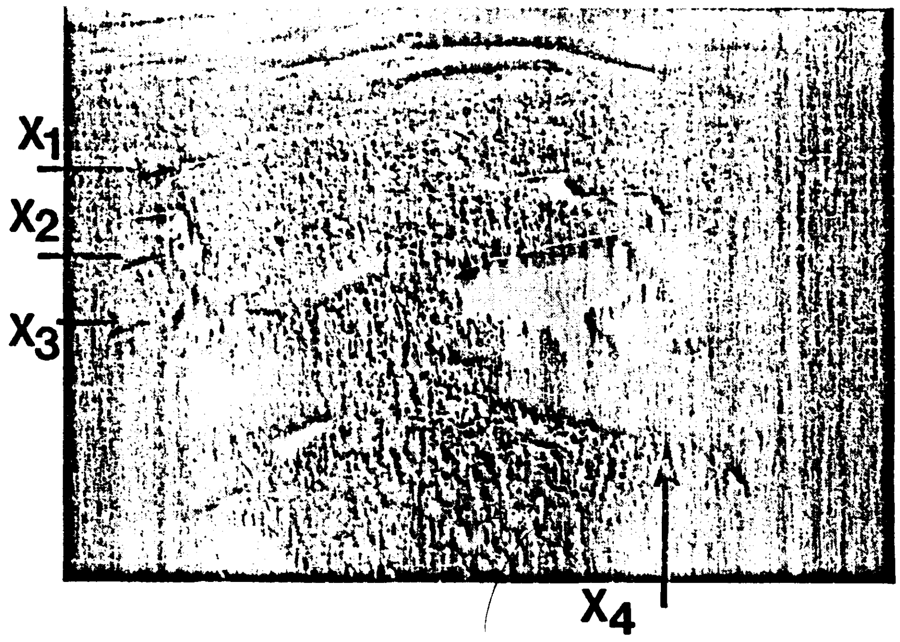
X SERIES

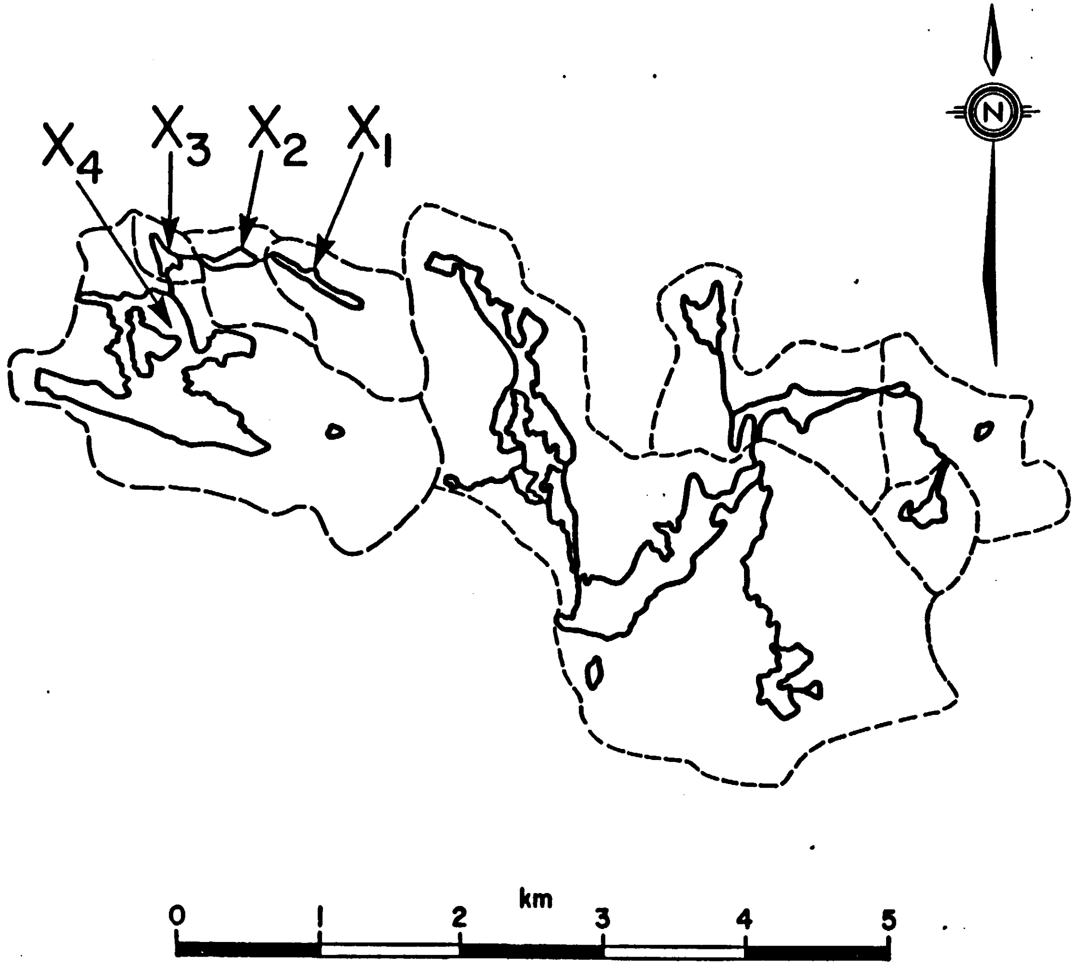
LAKE	X_1	X_2	X_3	X_4
pH	5.0	4.8	5.0	5.2

OBLIQUE AIRPHOTOGRAPHS OF LAKES

X -2







Lake X-1 is a long, narrow rock basin with muskeg at the eastern end. Part of the shoreline is bedrock. Surficial deposits are of minor importance in the watershed.

Lake X-2 is very close to Lake X-1 and it is also a rock basin. There is some muskeg at the inflow (east) end. Morphometry appears rather simple and the lake has one small rock island. Surficial deposits are of minor importance and discontinuous in the watershed.

Lake X-3 is a small rock basin with one small rock island. Morphometry may have some complexity. No muskeg around the lake. Surficial deposits are of minor importance in the watershed.

Lake X-4 (Barbara Lake) is a medium size rock basin with complex morphometry and several islands. Shoreline is predominantly rocky and partly sand and gravel. Surficial deposits are discontinuous in the watershed.

GENERAL DESCRIPTION OF THE STAIRCASE SYSTEM

Lake	Parameter		
	pH range at surface	Colour	Secchi Depth(m)
X_1	4.50-4.90	slightly humic	Secchi visible on bottom
X_2	4.40-4.80	slightly humic	2
X_3	4.45-4.70	slightly humic	2
X_4	4.70-4.90	clear	6

Dissolved Oxygen (Percent Saturation)

Depth (m)	X_1	X_2	X_3	X_4
0	100	100	100	100
1	93	100	86	100
2	86	99	73	100
3		101	43	100
4		95	20	124
5		65	16	116
6			7	104
7			3	82
8			0	69
9				58
10				28
11				16
12				8
13				0
14				0

Temperature °C

Depth (m)	X_1	X_2	X_3	X_4
0	26	26	26	25
1	25	25	26	25
2	25	22	19	24
3		17	13	23
4		15	11	20
5		13	9	15
6			8	12
7			5	9
8			4	8
9				7
10				6
11				5
12				5
13				5
14				5

<u>Lake X1</u>

This shallow (2 m) first order lake failed to demonstrate the characteristic pH pattern exhibited by most other first order lakes; i.e. pH typically increases as one progresses from first to second to third order lakes. In this watershed, however, pH was fairly constant from first to fourth order lakes. Only in lake X4 which was substantially larger than X1, X2 and X3 did pH increase slightly from 4.5 to 4.8. X4 was also the only study lake in this watershed which was not humic.

In watersheds U, Z and W, specific conductivity increased with increasing lake order. Again, the X watershed was an exception, since conductivity was similar (21-25 micromhos/cm) in all four lakes.

High rocky shorelines surrounded much of lake X1, protecting it from the wind. These granite outcrops minimized the littoral zone and consequently aquatic plants were rare. Sedges, alder and cedars comprised the major shoreline vegetation.

Phytoplankton was dominated by the loricate flagellate, <u>Dinobryon bavaricum</u> and the zooplankton was dominated by the loricate rotifer, <u>Keratella cochlearis</u>, which reached an unusually high density of 230 organisms per litre. As a result, zooplankton biomass greatly exceeded phytoplankton biomass in this lake.

Lake X2

This shallow lake (5 m) was thermally stratified between 2 and 3 meters depth indicating a high degree of protection from the wind. Secchi transparency (2 m) was minimal as a result of the humic discolouration of the water (4 on a scale of 5). Dissolved oxygen dropped rapidly to 65% saturation, as one approached the lake's bottom.

A distinct water line about 1 m above the water level in the lake was visible on the granitic outcrops surrounding the lake's margins. It is possible that a beaver dam, now no longer in existence, was responsible for this high water line.

The yellow water lilies in this lake were both sparse and stunted in size. The presence of large amounts of bladder wort, Utricularia americana, indicated that the primary producers in X2 may have been nitrogen limited. Marginal vegetation included labrador tea, myrica gale and sedges. Behind these were scattered clumps of white birch and white spruce with the black spruce dominating in the muskeg-rich depressions.

Lake X3

Although this third order lake was deeper (8 m) than those above it in this watershed, it was well protected from the wind and stratified at 2 m. Oxygen concentrations fell to zero near the bottom and conductivity (80 micromhos/cm) jumped to four times its surface levels (21). Secchi and colour were identical to X2.

As with X2 the yellow water lilies in this lake were both rare and stunted. Marginal vegetation was similar to X2 as well with slightly more cedar and maple however. Bladder wort and quill wort (Isoetes) were common on the lake's bottom. Zooplankton (primarily rotifers) were far more abundant than phytoplankton (primarily Chlorophytes). The predatory insect larvae (Chaoborus) was observed in the zooplankton net hauls. Predatory rotifers (Asplanchna) were also common in these net hauls.

Lake X4

This was the only X study lake which was not humic. As a result, Secchi transparency (6 m) was three times greater than in any of the others. The lake was supersaturated with oxygen at 4 m (125%) and anaerobic on the bottom indicating that it wasn't as oligotrophic as we first assumed. As in the case of X2, a waterline was visible approximately 1 m above the lake's present level. However, in the case of X4, the broken remains of a beaver dam were observed at the outlet.

White pine, white and black spruce, cedar, alder, birch and a few tamaracks were all observed around the margins of this acid lake (pH 4.8). A rocky shoreline prevented the establishment of higher aquatic plants. However, the lake's outlet was dominated by sedges, myrica gale and labrador tea, typical lowland bog species.

The chrysophyte, Uroglenopsis americana, dominated the sparse phytoplankton. Rotifers dominated the lake's zooplankton, primarily Keratella cochlearis. Predatory insect larvae, Chaoborus, were also common as they were in X3, where zooplankton biomass also exceeded phytoplankton biomass

Temperature Corrected (to 25°C) Conductivity

Depth (m)	X_1	X_2	X_3	X_4
0	25	24	21	22
1	25	26	24	22
2	29	27	28	25
3		29	32	23
4		31	32	28
5		35	39	27
6			53	30
7			63	29
8			80	29
9				32
10				32
11				33
12				33
13				33
14				52

PHYTOPLANKTON	X1	X2	X3	X4
BACILLARIOPHYTA				
ACHNANTHES MINUTISSIMA	2	2	2	-
ACTINELLA PUNCTATA	-	1	-	-
ANOMOEONEIS SERIANS	-	-	1	-
ASTERIONELLA FORMOSA	-	2	2	-
COSCINODISCUS SP.	1	-	-	-
CYMBELLA MINUTA	-	2	-	-
EUNOTIA ARCUS	1	-	-	-
EUNOTIA PECTINALIS	1	-	-	-
FRUSTULIA RHOMBOIDES	2	1	2	-
NAVICULA RADIOSA	1	2	-	-
NAVICULA SP.	2	-	2	-
NEIDIUM IRIDIS	-	-	2	1
PINNULARIA SP.	-	-	1	-
SURIRELLA LINEARIS	-	1	-	-
SURIRELLA SP.	-	-	2	-
TABELLARIA FENESTRATA	2	3	1	-
TABELLARIA FLOCCULOSA	1	-	1	2
AVERAGE	(1.4)	(1.8)	(1.6)	(1.5)

PHYTOPLANKTON	X1	X2	X3	X4
CHLOROPHYTA				
ARTHRODESMUS EXTENSUS	-	2	-	-
BINUCLEARIA CF. TATRANA	-	-	2	-
CHLAMYDOMONAS SP.	-	2	-	-
DOCIDIUM UNDULATUM	-	1	-	-
EUASTRUM HUMEROSUM	-	1	-	-
HYALOTHECA NEGLECTA	2	1	-	-
MOUGEOTIA CF. CALCAREA	2	-	3	-
MOUGEOTIA SP.	3	2	3	-
NETRIUM DIGITUS	-	1	-	-
SCENEDESMUS SP.	-	1	-	-
SELENASTRUM MINUTUM	3	-	-	-
TRIPLOCERAS GRACILE	-	3	2	2
AVERAGE	(2.5)	(1.6)	(2.5)	(2.0)

PHYTOPLANKTON	X1	X2	X3	X4
CHRYSOPHYTA				
DINOBRYON BAVARICUM	5	4	2	3
DINOBRYON DIVERGENS	3	3	2	3
DINOBRYON VANHOEFFENII	-	-	2	-
EPIPYXIS SP.	2	-	-	-
MALLOMONAS CF. PRODUCTA	3	-	-	-
MALLOMONAS PSEUDOCORONATA	4	4	2	2
MALLOMONAS SP.	-	3	-	-
UROGLENOPSIS AMERICANA	-	-	-	3
AVERAGE	(3.6)	(3.5)	(2.0)	(2.8)

PHYTOPLANKTON	X1	X2	X3	X4
CRYPTOPHYTA				
CRYPTOMONAS EROSA	3	4	3	1
RHODOMONAS LACUSTRIS	-	4	3	2
RHODOMONAS SP.	-	-	3	-
AVERAGE	(3.0)	(4.0)	(3.0)	(1.5)

PHYTOPLANKTON	X1	X2	X3	X4
CYANOPHYTA				
CHROOCOCCUS DISPERSUS	-	-	-	1
CYANARCUS HAMIFORMIS	4	-	-	-
MERISMOPEDIA PUNCTATA	-	2	1	-
MERISMOPEDIA TENUISSIMA	3	3	2	2
RHABDODERMA CF. SIGMOIDES	4	-	-	-
AVERAGE	(2.7)	(2.5)	(1.5)	(1.5)

PHYTOPLANKTON	X1	X2	X3	X4
PYRROPHYTA				
CERATIUM HIRUNDINELLA	-	1	-	-
GYMNODINIUM SP.	-	4	3	-
PERIDINIUM INCONSPICUUM	-	3	3	3
PERIDINIUM LIMBATUM	-	-	-	2
AVERAGE	(---)	(2.7)	(3.0)	(2.5)

Comments

Surprisingly little overlap existed between the species composition of the two acid lake watersheds "X" & "Z". This was confirmed by the clear separation of these two watersheds in principle coordinate analysis. The presence of more humic lakes in the "Z" watershed may account in part for this curious lack of common species. Dinoflagellates (pyrrophyta) were only abundant in the clear water acid lakes. This may explain why Dr. Norman Yan's study (1979) of the clear water Sudbury lakes reported dinoflagellates as the dominant taxa while the more humic Wawa lakes were not good habitats for them and fewer are reported.

ZOOPLANKTON	X1	X2	X3	X4
ZOOPLANKTON TO PHYTOPLANKTON BIOMASS RATIO	Z<P	Z<P	Z<P	Z<P
CILIOPHORA				
STROMBIDIUM CF. VIRIDIS	20.0	-	-	-
VORTICELLA SP.	-	1.0	-	-
TOTAL	20.0	1.0	-	-
CLADOCERANS				
ACROPERUS HARPAE	-	-	-	1.0
ALONA GUTTATA	-	2.0	-	-
BOSMINA LONGIROSTRIS	10.0	9.0	4.0	13.0
CHYDORUS BICORNUTUS	-	-	-	1.0
CHYDORUS SPHAERICUS	-	-	-	1.0
DIAPHANOSOMA BRACHYURUM	5.0	2.0	4.0	2.0
HOLOPEDIUM GIBBERUM	-	-	-	4.0
POLYPHEMUS PEDICULUS	4.0	12.0	3.0	10.0
TOTAL	19.0	25.0	11.0	32.0
COPEPODS				
COPEPODITES AND NAUPLII	120.0	30.0	50.0	44.0
CYCLOPS BICUSPIDATUS	1.0	5.0	5.0	1.0
DIAPTOMUS MINUTUS	55.0	15.0	11.0	27.0
MESOCYCLOPS EDAX	-	10.0	8.0	2.0
TOTAL	176.0	60.0	74.0	74.0
INSECTA				
ACILIUS SULCATUS	-	-	-	4.0
CHAOBORUS	-	-	2.0	2.0
CHIRONOMUS	1.0	1.0	-	-
TOTAL	1.0	1.0	2.0	6.0
ROTIFERS				
ASPLANCHNA BRIGHTWELLI	2.0	10.0	28.0	22.0
CHROMOGASTER SP.	1.0	-	70.0	-
KERATELLA COCHLEARIS	230.0	297.0	195.0	400.0
POLYARTHRA VULGARIS	-	-	18.0	15.0
TRICHOCERCA CYLINDRICUM	15.0	15.0	4.0	4.0
TOTAL	248.0	322.0	315.0	441.0

COMMENTS

Daphnididae were absent from all the X lakes and all but 2 of the Z lakes indicating a possible causal relationship between low pH and an inability of these cladocera to reproduce.

Diatom Species	pH category	X1 Number Counted	X1 Relative Frequency (%)	X2 Number Counted	X2 Relative Frequency (%)	X3 Number Counted	X3 Relative Frequency (%)	X4 Number Counted	X4 Relative Frequency (%)
Achnanthes minutissima	ind	2	.23	6	.76	6	.74	2	.25
Actinella punctata	acb	18	2.10	10	1.27	17	2.11	2	.25
Anomoeoneis serians	acb	92	10.75	36	4.56	49	6.08	4	.50
Anomoeoneis serians var. brachysira	acb	6	.70	40	5.07	24	2.98	45	5.60
Asterionella formosa	alp					2	.25		
Cyclotella comta	ind	2	.23						
Cymbella amphicephala	alp			2	.25				
Cymbella hauckii	alp	2	.23	2	.25	5	.62		
Cymbella hebridica	acp	11	1.29						
Cymbella lunata	-	1	.17					2	.25
Cymbella minuta	-	9	1.05			18	2.23	4	.50
Cymbella pusilla	acp	6	.70	22	2.79	6	.74	18	2.24
Cymbella ventricosa	alp			7	.89	66	8.19	5	.62
Cymbella sp.	-	12	1.40						
Eunotia arcus	acp	5	.58	11	1.39	4	.50	8	1.00
Eunotia bactriana	acb	6	.70			6	.74		
Eunotia bidentula	-	4	.47	2	.25	16	1.99	2	.25
Eunotia bigibba	-			1	.13			1	.12
Eunotia carolina	-	2	.23						
Eunntia curvata	acp			7	.89	10	1.24		
Eunotia elegans	acp	6	.70	5	.63	8	.99	2	.25
Eunotia exigua	acp	2	.23						
Eunotia flexuosa	acp			4	.51	12	1.49	17	2.12
Eunotia gibbosa	-	10	1.17	2	.25	2	.25	84	10.46
Eunotia incisa	acp	13	1.52	13	1.65	12	1.49	2	.25
Eunotia monodon	acp	4	.47	1	.13				
Eunotia naegelli	acp	1	.17	6	.76	9	1.12	5	.62

SURFACE SEDIMENT DIATOMS

X -9

SURFACE SEDIMENT DIATOMS (CONT'D)

X-10

Diatom Species	pH category	X1 Number Counted	X1 Relative Frequency (%)	X2 Number Counted	X2 Relative Frequency (%)	X3 Number Counted	X3 Relative Frequency (%)	X4 Number Counted	X4 Relative Frequency (%)
Eunotia pectinalis	acp	8	.93	5	.63	13	1.61	2	.25
Eunotia pectinalis var. minor	acp	6	.70	4	.51	10	1.24		
Eunotia pectinalis var. ventricosa	acp	2	.23	1	.13				
Eunotia praerupta	acp	11	1.29	2	.25				
Eunotia serra	alp	2	.23			2	.25	3	.37
Eunotia triodon	acp	3	.35					7	.87
Eunotia vanheurckii	acp			6	.76				
Fragilaria constricta	acp	7	.82						
Frustulia rhomboides	acp	130	15.19	123	15.59	81	10.05	149	18.57
Frustulia rhomboides var. saxonica	acp								
Gomphonema grunowii	-	2	.23						
Melosira distans	acp	134	15.65	45	5.70			2	.25
Navicula elginensis	-			7	.89				
Navicula elginensis var. rostrata	-							4	.50
Navicula notha	-			2	.25	2	.25		
Navicula peticolasii	-	2	.23						
Navicula radiosa	ind					2	.25		
Navicula radiosa var. parva	ind					1	.12		
Navicula subtilissima	acp	21	2.45	34	4.31	108	13.40	77	9.59
Navicula sp.	-	6	.70			1	.12		
Neidium affine	ind	40	4.67	28	3.55	48	5.96	15	1.87
Neidium bisulcatum	ind					2	.25		
Neidium iridis var. ampligomphus	ind	48	5.61	11	1.39	14	1.74	2	.25
Neidium iridis var. subundulatum	ind	8	.93						
Nitzschia palea	ind			4	.51	25	3.10	208	25.90

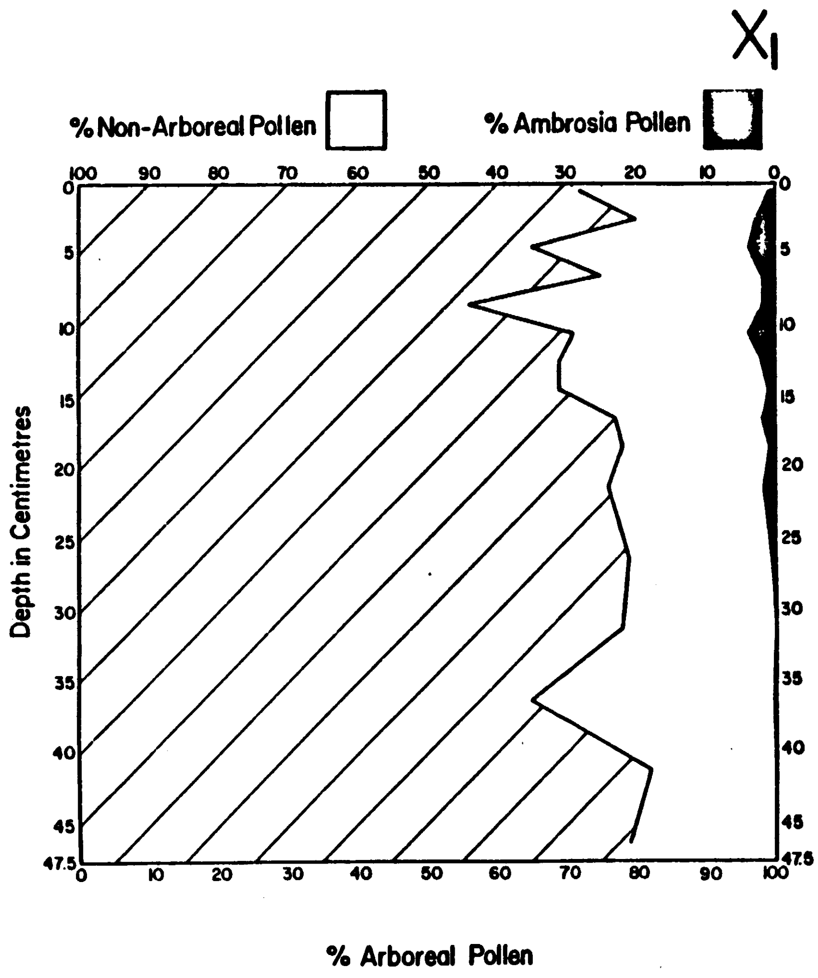
Diatom Species	pH category	X1 Number Counted	X1 Relative Frequency (%)	X2 Number Counted	X2 Relative Frequency (%)	X3 Number Counted	X3 Relative Frequency (%)	X4 Number Counted	X4 Relative Frequency (%)
Pinnularia abaujensis	ind	10	1.17	3	.38	9	1.12		
Pinnularia abaujensis var. linearis	ind	4	.47						
Pinnularia abaujensis var. rostrata	ind	2	.23			7	.87	4	.50
Pinnularia abaujensis var. subundulata	ind	5	.58			6	.74	6	.75
Pinnularia biceps	acp	7	.82	39	4.94	22	2.73	16	1.99
Pinnularia brebissoni	-	10	1.17	2	.25			4	.50
Pinnularia maior	acp	33	3.86	12	1.52	16	1.99	3	.37
Pinnularia mesolepta	acp					3	.37		
Pinnularia microstauron	ind							2	.25
Pinnularia viridis	alp	2	.23						
Semiorbis hemicyclus	acb	35	4.09	18	2.28	34	4.22	40	4.98
Stauroneis anceps	ind	2	.23			8	.99		
Stauroneis phoenicenteron	ind	4	.47						
Stenopterobia intermedia	acb			4	.51	17	2.11	8	1.00
Surirella linearis	ind	6	.70	2	.25				
Surirella linearis var. constricta	ind	7	.82	1	.13				
Tabellaria binalis	acb	5	.58	22	2.79	25	3.10	35	4.36
Tabellaria fenestrata	acp	48	5.61	220	27.88	66	8.19	11	1.37
Tabellaria flocculosa	acp	18	2.10	35	4.44	12	1.49	2	.25
Multiplication Factor (to give # diatoms/mg. dry wt.)		615		747		1011		3358	

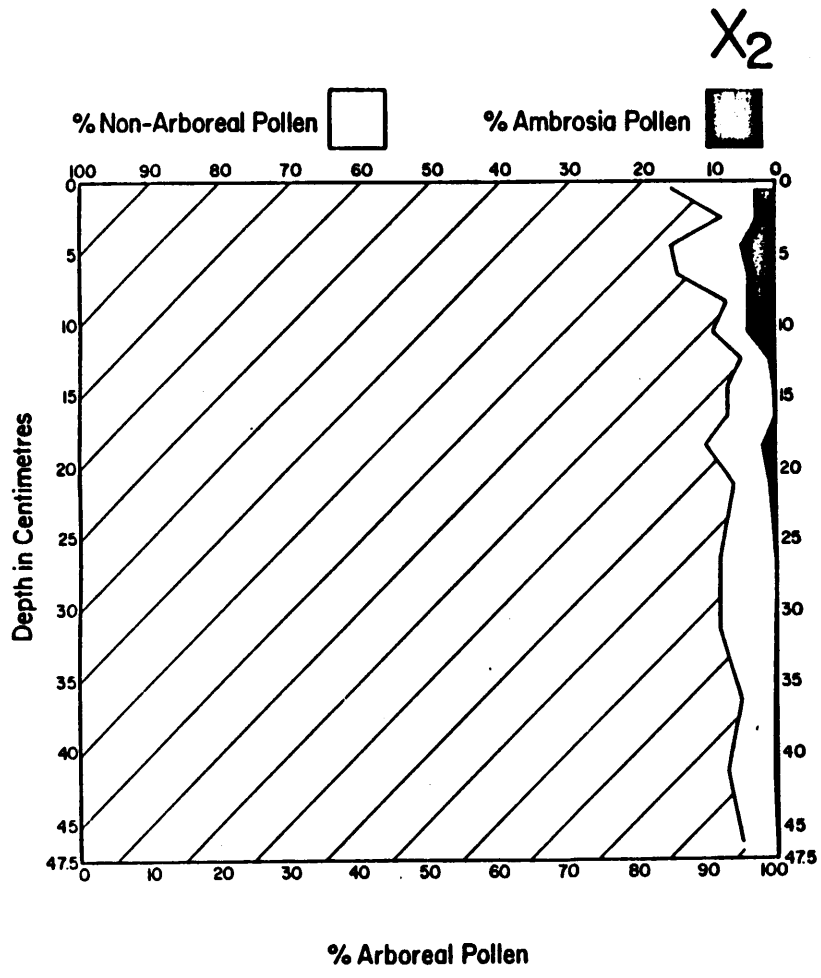
SURFACE SEDIMENT DIATOMS (CONT'D)

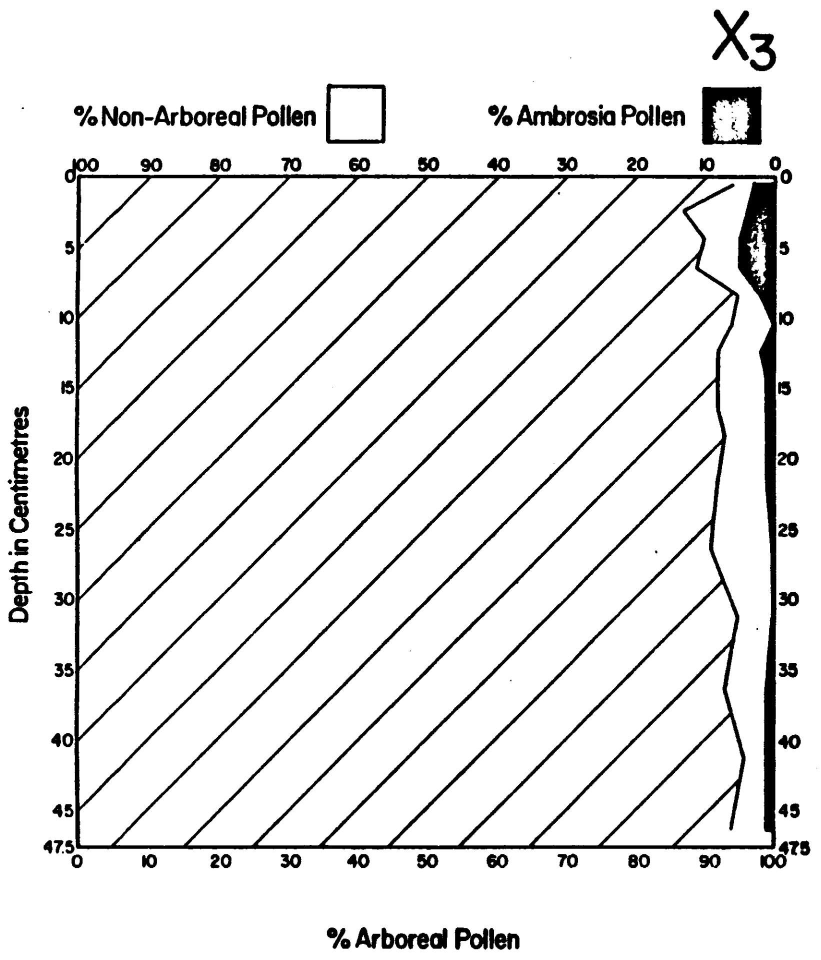
SURFACE SEDIMENT DIATOMS (CONT'D)

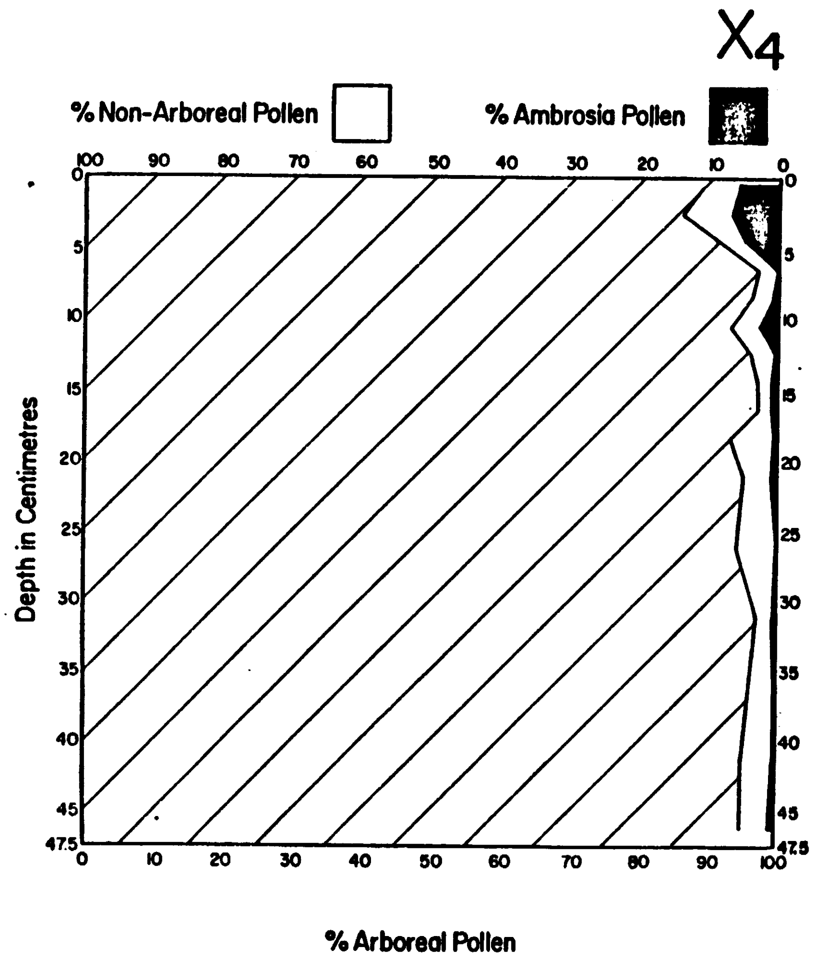
Descriptions of the downcore diatoms are included in Part I, Chapter III. A complete species list of the diatoms studied during the 1981 field and laboratory study is included in Section 5 of this part of the report (Part II)

AMBROSIA RISE DIAGRAMS



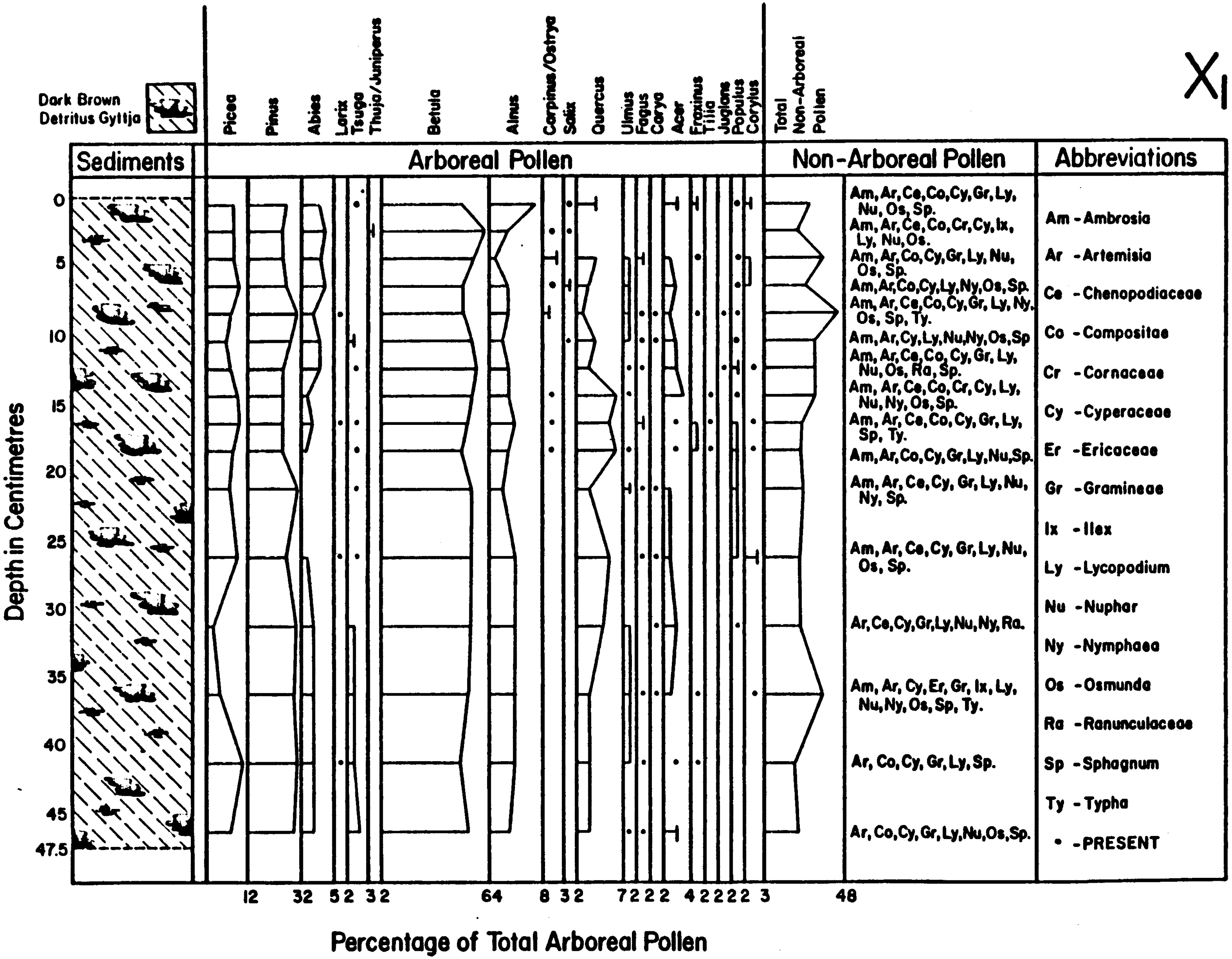


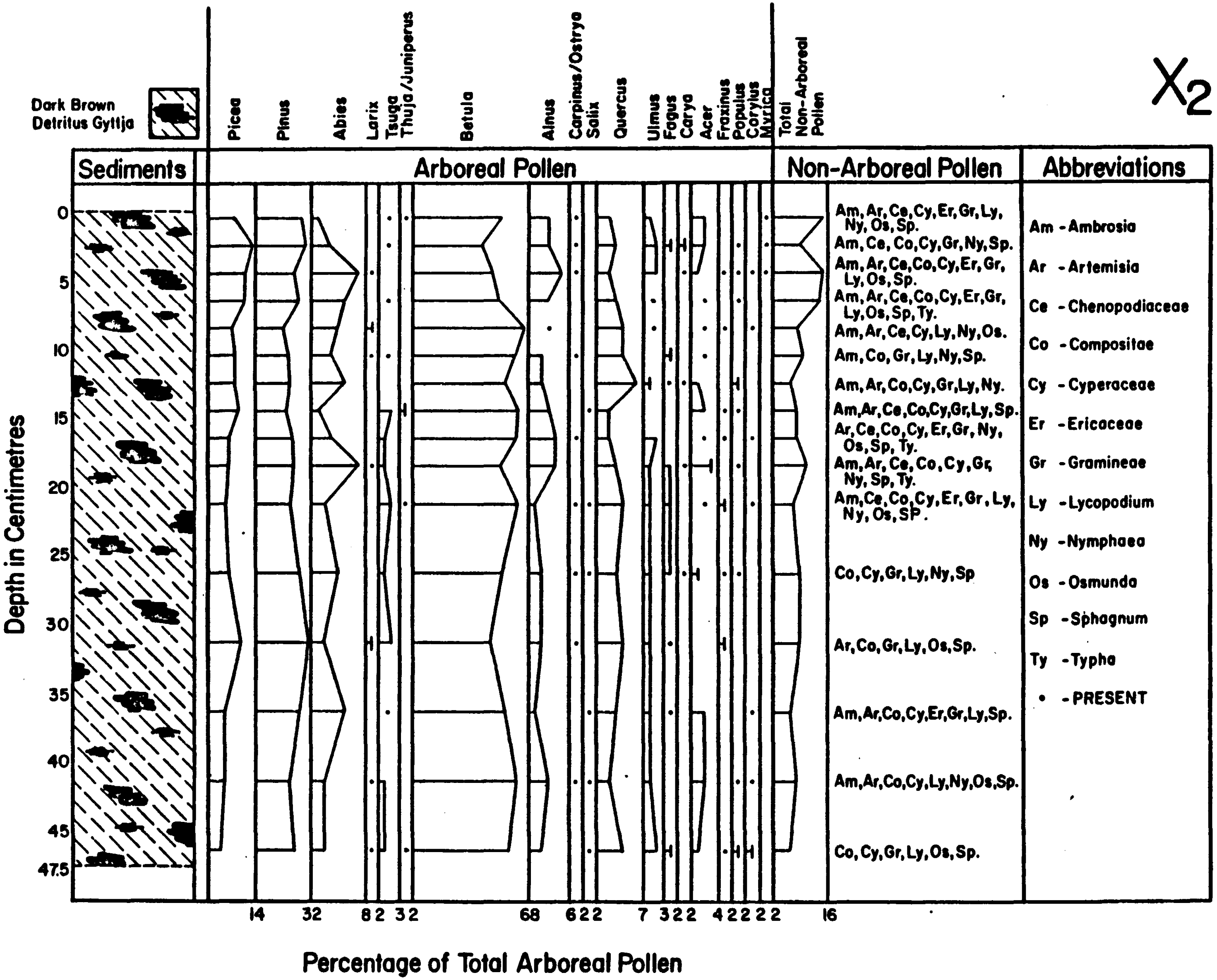




AMBROSIA RISE DIAGRAMS (CONT'D)

POLLEN DIAGRAM

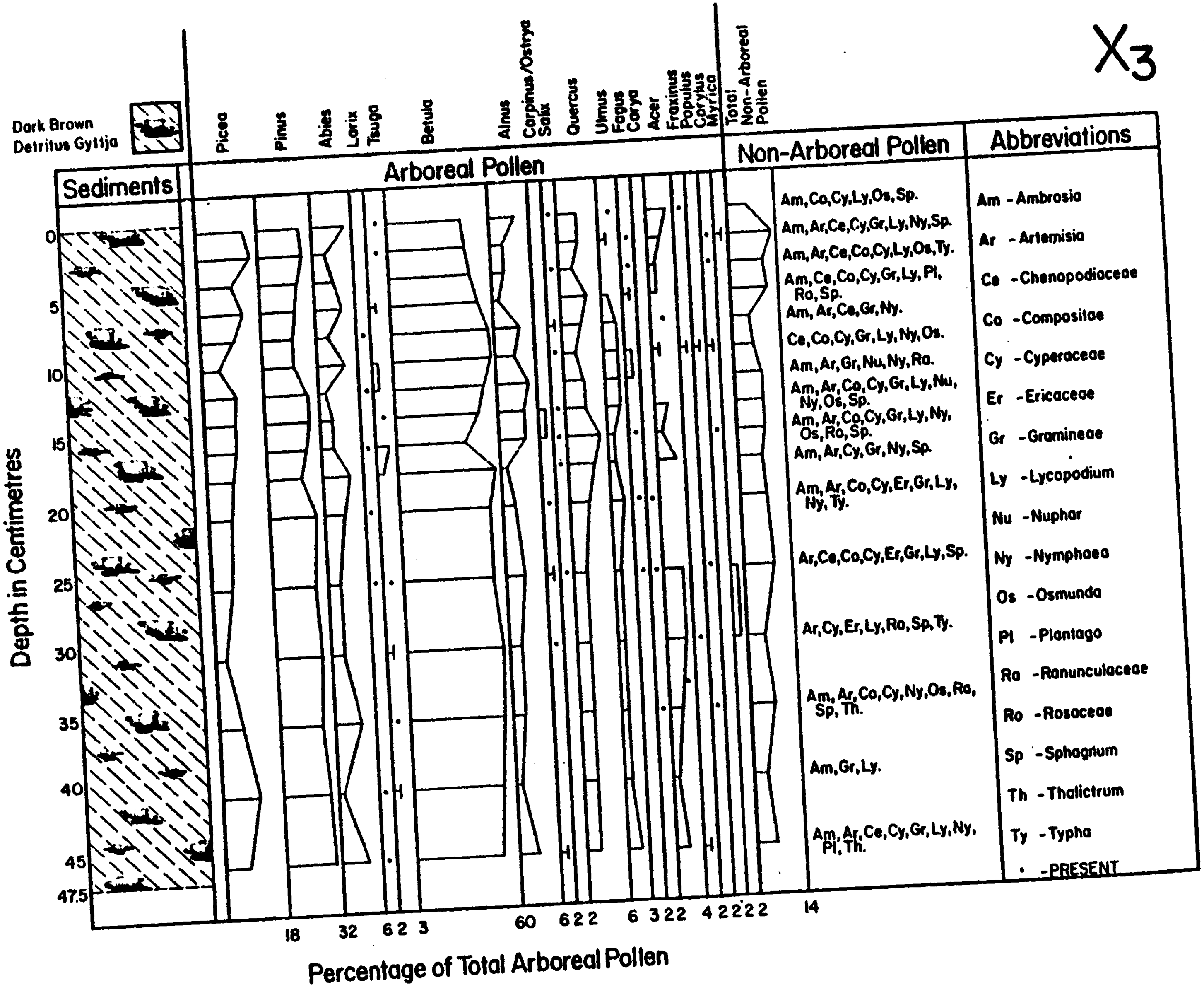


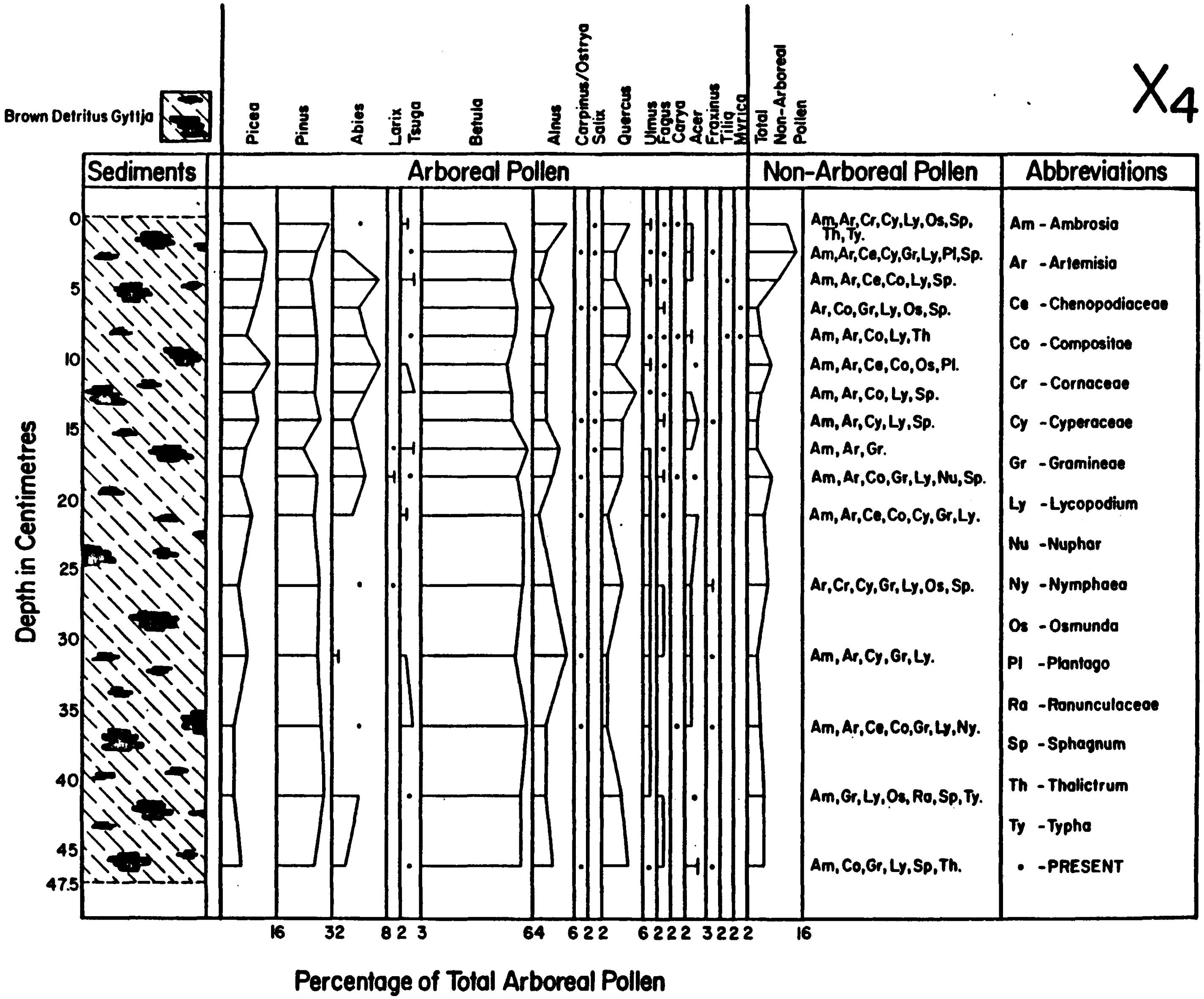


POLLEN DIAGRAM

POLLEN DIAGRAM

X -18





POLLEN DIAGRAM

X-21

TOP 20 cm (LAKE X_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
850	X - 1 - 1	******	28734.	9410.	79.	2870.	2966.	1874.	3195.	766.	768.	23.	850
851	X - 1 - 2	******	28237.	9012.	79.	2950.	2993.	1875.	3224.	727.	777.	21.	851
852	X - 1 - 3	******	28651.	8456.	77.	2800.	2994.	1882.	3249.	694.	834.	22.	852
853	X - 1 - 4	******	30829.	6391.	88.	2880.	3235.	1901.	3788.	654.	842.	24.	853
854	X - 1 - 5	******	27620.	5841.	84.	2780.	3247.	1781.	3634.	578.	755.	22.	854
856	X - 1 - 6	******	28777.	6332.	90.	2860.	3008.	1883.	4220.	608.	820.	20.	856
857	X - 1 - 7	******	27268.	5979.	87.	2760.	3065.	1781.	4238.	633.	756.	20.	857
858	X - 1 - 8	******	29091.	5970.	86.	2790.	3158.	1788.	4433.	647.	846.	25.	858
859	X - 1 - 9	******	28070.	5920.	83.	2710.	2964.	1801.	4370.	667.	756.	21.	859
860	X - 1 - 10	******	28708.	6079.	84.	2800.	3280.	1772.	4305.	685.	756.	22.	860
862	X - 1 - 11	******	27077.	6664.	95.	2820.	2926.	1939.	4966.	688.	880.	22.	862
863	X - 1 - 12	******	28527.	7129.	85.	302.	508.	1702.	5008.	1081.	375.	4.	863
864	X - 1 - 13	******	24834.	6320.	89.	2750.	3401.	1913.	4816.	693.	892.	26.	864
865	X - 1 - 14	******	25412.	6389.	92.	2820.	3361.	2013.	4960.	627.	925.	24.	865
866	X - 1 - 15	******	27166.	6537.	96.	2820.	3400.	2022.	5274.	648.	917.	24.	866
868	X - 1 - 16	******	26459.	6388.	91.	2730.	3083.	1987.	5328.	652.	881.	24.	868
869	X - 1 - 17	******	27031.	6451.	92.	2670.	3146.	1966.	5582.	654.	869.	21.	869
870	X - 1 - 18	******	25844.	6329.	89.	2640.	3012.	1945.	5434.	645.	878.	23.	870
871	X - 1 - 19	******	29261.	6501.	94.	2880.	4068.	2103.	5839.	656.	963.	30.	871
872	X - 1 - 20	******	28895.	7001.	96.	2890.	3903.	2302.	6144.	620.	937.	28.	872

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
850	X - 1 - 1	*******	0.34371	0.15129	0.07453	0.15598	0.13066	0.06780	0.06856	0.68393	0.12152	0.14198	850
851	X - 1 - 2	*******	0.33776	0.14489	0.07453	0.16033	0.13185	0.06784	0.06918	0.64911	0.12294	0.12963	851
852	X - 1 - 3	*******	0.34272	0.13595	0.07264	0.15217	0.13189	0.06809	0.06972	0.61964	0.13196	0.13580	852
853	X - 1 - 4	*******	0.36877	0.10275	0.08302	0.15652	0.14251	0.06878	0.08129	0.58393	0.13323	0.14815	853
854	X - 1 - 5	*******	0.33038	0.09391	0.07925	0.15109	0.14304	0.06444	0.07906	0.51607	0.11946	0.13580	854
856	X - 1 - 6	*******	0.34422	0.10180	0.08491	0.15543	0.13251	0.06813	0.09056	0.54286	0.12975	0.12346	856
857	X - 1 - 7	*******	0.32617	0.09613	0.08208	0.15000	0.13502	0.06444	0.09094	0.56518	0.11962	0.12346	857
858	X - 1 - 8	*******	0.34798	0.09598	0.08113	0.15163	0.13912	0.06469	0.09513	0.57768	0.13386	0.15432	858
859	X - 1 - 9	*******	0.33577	0.09518	0.07830	0.14728	0.13057	0.06516	0.09378	0.59554	0.11962	0.12963	859
860	X - 1 - 10	*******	0.34340	0.09773	0.07925	0.15217	0.14449	0.06411	0.09238	0.61161	0.11962	0.13580	860
862	X - 1 - 11	*******	0.32389	0.10714	0.08962	0.15326	0.12890	0.07015	0.10657	0.61429	0.13924	0.13580	862
863	X - 1 - 12	*******	0.34123	0.11461	0.08019	0.01641	0.02238	0.06158	0.10747	0.96518	0.05934	0.02469	863
864	X - 1 - 13	*******	0.29706	0.10161	0.08396	0.14946	0.14982	0.06921	0.10335	0.61875	0.14114	0.16049	864
865	X - 1 - 14	*******	0.30397	0.10272	0.08679	0.15326	0.14806	0.07283	0.10644	0.55982	0.14636	0.14815	865
866	X - 1 - 15	*******	0.32495	0.10510	0.09057	0.15326	0.14978	0.07315	0.11318	0.57857	0.14509	0.14315	866
868	X - 1 - 16	*******	0.31650	0.10270	0.08585	0.14837	0.13581	0.07189	0.11433	0.59214	0.13940	0.14815	868
869	X - 1 - 17	*******	0.32334	0.10371	0.08679	0.14511	0.13859	0.07113	0.11979	0.58393	0.13750	0.12963	869
870	X - 1 - 18	*******	0.30914	0.10175	0.08396	0.14348	0.13269	0.07037	0.11661	0.57589	0.13892	0.14198	870
871	X - 1 - 19	*******	0.35001	0.10452	0.08868	0.15652	0.17921	0.07609	0.12530	0.58571	0.15237	0.18519	871
872	X - 1 - 20	*******	0.34563	0.11256	0.09057	0.15707	0.17194	0.08329	0.13185	0.55357	0.14826	0.17284	872

TOP 20 cm (LAKE X_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

TOP 20 CM (LAKE X_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

X -24

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
850	X - 1 - 1	****	17.0	19.0	*****	11.	30.0	****	16.0	105.	850
851	X - 1 - 2	****	19.0	20.0	*****	22.	27.0	****	24.0	106.	851
852	X - 1 - 3	****	18.0	16.0	*****	10.	31.0	****	7.0	107.	852
853	X - 1 - 4	****	19.0	26.0	*****	20.	23.0	****	2.0	145.	853
854	X - 1 - 5	****	17.0	15.0	*****	19.	8.0	****	2.0	113.	854
856	X - 1 - 6	****	18.0	15.0	*****	8.	10.0	****	40.0	87.	856
857	X - 1 - 7	****	17.0	15.0	*****	12.	7.0	****	42.0	85.	857
858	X - 1 - 8	****	17.0	16.0	*****	15.	6.0	****	19.0	92.	858
859	X - 1 - 9	****	18.0	15.0	*****	22.	5.0	****	2.0	82.	859
860	X - 1 - 10	****	19.0	15.0	*****	24.	9.0	****	25.0	114.	860
862	X - 1 - 11	****	21.0	20.0	*****	26.	21.0	****	36.0	101.	862
863	X - 1 - 12	****	24.0	34.0	*****	34.	26.0	****	4.0	137.	863
864	X - 1 - 13	****	60.0	21.0	*****	24.	16.0	****	2.0	613.	864
865	X - 1 - 14	****	38.0	20.0	*****	23.	12.0	****	2.0	326.	865
866	X - 1 - 15	****	32.0	28.0	*****	27.	15.0	****	32.0	261.	866
868	X - 1 - 16	****	35.0	18.0	*****	21.	16.0	****	5.0	233.	868
869	X - 1 - 17	****	29.0	20.0	*****	20.	15.0	****	22.0	206.	869
870	X - 1 - 18	****	31.0	19.0	*****	19.	13.0	****	18.0	241.	870
871	X - 1 - 19	****	29.0	20.0	*****	14.	15.0	****	15.0	188.	871
872	X - 1 - 20	****	259.0	5.0	*****	15.	15.0	****	10.0	****	872

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
850	X - 1 - 1	****	0.1393	0.279	****	0.111	2.308	****	0.118	1.382	850
851	X - 1 - 2	****	0.1557	0.294	****	0.222	2.077	****	0.176	1.395	851
852	X - 1 - 3	****	0.1475	0.235	****	0.101	2.385	****	0.051	1.403	852
853	X - 1 - 4	****	0.1557	0.382	****	0.202	1.769	****	0.015	1.908	853
854	X - 1 - 5	****	0.1393	0.221	****	0.192	0.615	****	0.015	1.487	854
856	X - 1 - 6	****	0.1475	0.221	****	0.081	0.769	****	0.294	1.145	856
857	X - 1 - 7	****	0.1393	0.221	****	0.121	0.538	****	0.309	1.118	857
858	X - 1 - 8	****	0.1393	0.235	****	0.152	0.462	****	0.140	1.211	858
859	X - 1 - 9	****	0.1475	0.221	****	0.222	0.385	****	0.015	1.079	859
860	X - 1 - 10	****	0.1557	0.221	****	0.242	0.692	****	0.184	1.500	860
862	X - 1 - 11	****	0.1721	0.294	****	0.263	1.615	****	0.265	1.329	862
863	X - 1 - 12	****	0.1967	0.500	****	0.343	2.000	****	0.029	1.803	863
864	X - 1 - 13	****	0.4918	0.309	****	0.242	1.231	****	0.015	8.066	864
865	X - 1 - 14	****	0.3115	0.294	****	0.232	0.923	****	0.015	4.289	865
866	X - 1 - 15	****	0.2623	0.412	****	0.273	1.154	****	0.235	3.434	866
868	X - 1 - 16	****	0.2869	0.265	****	0.212	1.231	****	0.037	3.066	868
869	X - 1 - 17	****	0.2377	0.294	****	0.202	1.154	****	0.162	2.711	869
870	X - 1 - 18	****	0.2541	0.265	****	0.192	1.000	****	0.132	3.171	870
871	X - 1 - 19	****	0.2377	0.294	****	0.141	1.154	****	0.110	2.474	871
872	X - 1 - 20	****	2.1230	0.074	****	0.152	1.154	****	0.074	54.079	872

TOP 20 CM (LAKE X_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

LAKE SEDIMENT CORE WEIGHT DATA

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

X-26

X1

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
292	X - 1 - 1	32.56	5.63	32.9	82.7	X - 1 - 7	37.28	6.71	34.6	82.0	298
293	X - 1 - 2	35.93	5.88	34.0	83.6	X - 1 - 8	37.48	6.76	33.9	82.0	299
294	X - 1 - 3	38.67	5.97	36.2	84.6	X - 1 - 9	33.34	6.11	34.0	81.7	300
295	X - 1 - 4	37.10	6.22	36.0	83.2	X - 1 - 10	32.45	6.08	33.6	81.3	301
296	X - 1 - 5	34.76	6.18	34.8	82.2	X - 1 - 11	32.60	6.28	32.9	80.7	312
297	X - 1 - 6	37.46	6.68	34.8	82.2	X - 1 - 12	34.86	6.55	33.9	81.2	313

X2

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
315	X - 2 - 1	28.82	2.57	43.6	91.0	X - 2 - 7	33.08	2.77	50.0	91.6	334
316	X - 2 - 2	30.93	2.86	34.6	90.8	X - 2 - 8	36.31	2.88	51.9	92.1	322
317	X - 2 - 3	20.45	2.16	40.1	89.4	X - 2 - 9	29.13	2.57	43.3	91.2	323
318	X - 2 - 4	32.16	2.62	48.1	91.9	X - 2 - 10	30.05	2.66	50.2	91.2	324
319	X - 2 - 5	34.86	2.78	46.6	92.0	X - 2 - 11	32.63	3.25	38.2	90.0	325
333	X - 2 - 6	31.65	2.65	52.9	91.6	X - 2 - 12	41.08	3.97	39.7	90.3	326

X3

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
336	X - 3 - 1	16.36	1.97	33.7	88.0	X - 3 - 7	12.36	2.57	29.4	79.2	342
337	X - 3 - 2	17.60	2.16	35.7	87.7	X - 3 - 8	18.64	4.27	30.8	77.1	343
351	X - 3 - 3	12.74	1.77	29.5	86.1	X - 3 - 9	17.30	4.33	33.9	75.0	344
352	X - 3 - 4	12.51	1.93	32.6	84.6	X - 3 - 10	18.38	4.32	31.9	76.5	345
340	X - 3 - 5	16.13	2.25	39.2	86.1	X - 3 - 11	15.66	3.96	64.2	74.7	346
341	X - 3 - 6	12.63	1.81	37.0	85.7	X - 3 - 12	19.24	4.17	38.0	78.3	347

X4

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
354	X - 4 - 1	19.30	3.05	34.6	84.2	X - 4 - 7	15.06	2.15	35.7	85.7	360
355	X - 4 - 2	18.01	2.84	35.6	84.2	X - 4 - 8	10.43	2.24	35.4	78.5	361
375	X - 4 - 3	19.28	2.93	35.9	84.8	X - 4 - 9	16.41	2.73	35.5	83.4	362
376	X - 4 - 4	14.57	2.50	37.3	82.8	X - 4 - 10	14.64	2.57	34.0	82.5	363
358	X - 4 - 5	16.29	2.77	34.0	83.0	X - 4 - 11	13.93	1.25	37.6	91.0	364
359	X - 4 - 6	18.19	2.90	34.8	84.1	X - 4 - 12	*****	*****	****	****	***

LAKE SEDIMENT CORE WEIGHT DATA

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

X -27

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

X-28

X1

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
292	X - 1 - 1	288900.	33834.	6201.	96.	3690.	3777.	2216.	5605.	736.	959.	35.	292
293	X - 1 - 2	290900.	30349.	5949.	86.	3320.	3299.	2183.	5395.	690.	754.	22.	293
294	X - 1 - 3	284500.	32050.	6174.	98.	3000.	3445.	2168.	5647.	747.	868.	31.	294
295	X - 1 - 4	288500.	32441.	6022.	93.	3310.	3942.	2230.	5850.	715.	866.	34.	295
296	X - 1 - 5	277500.	31840.	6350.	99.	3440.	4015.	2310.	6132.	701.	888.	29.	296
297	X - 1 - 6	270400.	35173.	6298.	98.	3660.	4272.	2359.	6250.	774.	876.	31.	297
298	X - 1 - 7	281400.	31929.	6278.	97.	3170.	3979.	2299.	6161.	726.	853.	30.	298
299	X - 1 - 8	282800.	32814.	6344.	99.	3430.	4011.	2350.	6229.	711.	898.	30.	299
300	X - 1 - 9	271500.	34886.	5801.	90.	3350.	4039.	2148.	5743.	765.	813.	34.	300
301	X - 1 - 10	282200.	34196.	6189.	96.	3440.	4171.	2280.	6242.	734.	819.	28.	301
312	X - 1 - 11	279400.	36924.	6806.	105.	3850.	4701.	2498.	6754.	795.	843.	23.	312
313	X - 1 - 12	279500.	33045.	6457.	100.	3470.	4551.	2461.	6529.	711.	845.	33.	313
MEAN		281458.	33290.	6239.	96.	3428.	4017.	2292.	6045.	734.	857.	30.	
COEF VAR		2.2	5.2	3.9	4.9	6.4	9.5	4.7	6.4	4.1	5.6	11.2	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
292	X - 1 - 1	1.05824	0.40471	0.09969	0.09057	0.20034	0.16639	0.08017	0.12028	0.65714	0.15174	0.21605	292
293	X - 1 - 2	1.06557	0.36303	0.09564	0.08113	0.18043	0.14533	0.07898	0.11577	0.61607	0.11930	0.13580	293
294	X - 1 - 3	1.04212	0.38337	0.09926	0.09245	0.16304	0.15176	0.07844	0.12118	0.66696	0.13734	0.19136	294
295	X - 1 - 4	1.05678	0.38805	0.09682	0.08774	0.17989	0.17366	0.08068	0.12554	0.63839	0.13703	0.20983	295
296	X - 1 - 5	1.01648	0.38086	0.10209	0.09340	0.18696	0.17687	0.08357	0.13159	0.62589	0.14051	0.17901	296
297	X - 1 - 6	0.99048	0.42073	0.10125	0.09245	0.19891	0.18819	0.08535	0.13412	0.69107	0.13861	0.19136	297
298	X - 1 - 7	1.03077	0.38193	0.10093	0.09151	0.17228	0.17529	0.08318	0.13221	0.64821	0.13497	0.18519	298
299	X - 1 - 8	1.03590	0.39251	0.10199	0.09340	0.18641	0.17670	0.08502	0.13367	0.63482	0.14209	0.18519	299
300	X - 1 - 9	0.99451	0.41730	0.09326	0.08491	0.18207	0.17789	0.07771	0.12324	0.68304	0.12864	0.20988	300
301	X - 1 - 10	1.03370	0.40904	0.09950	0.09057	0.18696	0.18374	0.08249	0.13395	0.65536	0.12959	0.17284	301
312	X - 1 - 11	1.02344	0.44167	0.10942	0.09906	0.20924	0.20709	0.09038	0.14494	0.70982	0.13339	0.17284	312
313	X - 1 - 12	1.02381	0.39528	0.10381	0.09434	0.18859	0.20048	0.08904	0.14011	0.63482	0.13370	0.20370	313
MEAN		1.03098	0.39821	0.10031	0.09096	0.18628	0.17695	0.08292	0.12972	0.65513	0.13557	0.18776	
COEF VAR		2.2	5.2	3.9	4.9	6.4	9.5	4.7	6.4	4.1	5.6	11.2	

X2

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
315	X - 2 - 1	208800.	36233.	6304.	100.	3630.	4763.	2374.	6288.	789.	836.	33.	315
316	X - 2 - 2	248500.	31308.	6294.	81.	2580.	3327.	1839.	4452.	1347.	766.	23.	316
317	X - 2 - 3	225700.	30762.	6228.	79.	2520.	2671.	1819.	4090.	1270.	805.	23.	317
318	X - 2 - 4	191700.	23953.	5593.	68.	2060.	2117.	1567.	3924.	1301.	640.	16.	318
319	X - 2 - 5	205400.	23826.	6326.	76.	2310.	2516.	1694.	4464.	1198.	726.	15.	319
333	X - 2 - 6	177500.	25875.	6687.	78.	2180.	2389.	1751.	4620.	1468.	794.	24.	333
334	X - 2 - 7	193500.	22338.	5599.	67.	2030.	2010.	1491.	4128.	1290.	596.	22.	334
322	X - 2 - 8	183400.	24846.	6062.	59.	1940.	1287.	1518.	3647.	1703.	704.	15.	322
323	X - 2 - 9	212600.	30824.	6542.	75.	2600.	2685.	1757.	4347.	1669.	831.	27.	323
324	X - 2 - 10	193300.	26173.	6788.	85.	2190.	2939.	1904.	4953.	1336.	847.	24.	324
325	X - 2 - 11	238300.	35164.	7956.	107.	3550.	4581.	2455.	6019.	1454.	1078.	34.	325
326	X - 2 - 12	219200.	31999.	8573.	119.	3210.	4749.	2647.	6537.	1252.	1244.	36.	326
MEAN		208158.	28608.	6579.	83.	2558.	3003.	1901.	4789.	1340.	822.	24.	
COEF VAR		10.1	15.7	12.8	20.3	22.4	36.3	19.3	19.3	16.8	20.9	26.2	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
315	X - 2 - 1	0.76484	0.43341	0.10135	0.09434	0.19728	0.20982	0.08589	0.13494	0.70446	0.13228	0.20370	315
316	X - 2 - 2	0.91026	0.37450	0.10119	0.07642	0.14022	0.14656	0.06653	0.09554	1.20268	0.12120	0.14198	316
317	X - 2 - 3	0.82674	0.36797	0.10013	0.07453	0.13696	0.11767	0.06581	0.08777	1.13393	0.12737	0.14193	317
318	X - 2 - 4	0.70220	0.28652	0.08992	0.06415	0.11196	0.09326	0.05669	0.08421	1.16161	0.10127	0.09877	318
319	X - 2 - 5	0.75238	0.28500	0.10170	0.07170	0.12554	0.11084	0.06129	0.09579	1.06964	0.11487	0.09259	319
333	X - 2 - 6	0.65018	0.30951	0.10751	0.07358	0.11848	0.10524	0.06335	0.09914	1.31071	0.12563	0.14915	333
334	X - 2 - 7	0.70879	0.26720	0.09002	0.06321	0.11033	0.08855	0.05394	0.08858	1.15178	0.09430	0.13590	334
322	X - 2 - 8	0.67179	0.29720	0.09746	0.05566	0.10000	0.05670	0.05492	0.07826	1.52054	0.11139	0.09259	322
323	X - 2 - 9	0.77875	0.36871	0.10518	0.07075	0.14130	0.11828	0.06357	0.09328	1.49018	0.13149	0.16667	323
324	X - 2 - 10	0.70806	0.31307	0.10913	0.08019	0.11902	0.12947	0.06889	0.10629	1.19286	0.13402	0.14815	324
325	X - 2 - 11	0.87289	0.42062	0.12791	0.10094	0.19293	0.20181	0.08882	0.12916	1.29821	0.17057	0.20988	325
326	X - 2 - 12	0.80293	0.38276	0.13783	0.11226	0.17446	0.20921	0.09577	0.14028	1.11786	0.19684	0.22222	326
MEAN		0.76248	0.34221	0.10578	0.07814	0.13904	0.13228	0.06879	0.10277	1.19620	0.13010	0.15021	
COEF VAR		10.1	15.7	12.8	20.3	22.4	36.3	19.3	19.3	16.8	20.9	28.2	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

X -29

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

X3

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
336	X - 3 - 1	244300.	35431.	8650.	150.	3120.	6184.	3294.	7494.	613.	1100.	26.	336
337	X - 3 - 2	246300.	39500.	8922.	154.	3190.	6642.	3530.	8182.	673.	1140.	37.	337
351	X - 3 - 3	226800.	37688.	8953.	173.	3100.	7739.	3618.	8247.	573.	1236.	35.	351
352	X - 3 - 4	225700.	39826.	8663.	169.	3790.	7308.	3403.	8205.	659.	1226.	44.	352
340	X - 3 - 5	217900.	36525.	8807.	155.	2970.	6719.	3308.	8300.	627.	1078.	27.	340
341	X - 3 - 6	234400.	37856.	10604.	186.	3580.	9746.	4082.	9683.	537.	1168.	34.	341
342	X - 3 - 7	232000.	43940.	11754.	215.	4220.	13684.	4803.	10790.	494.	1351.	36.	342
343	X - 3 - 8	222200.	43235.	11243.	214.	4000.	12051.	4476.	10710.	540.	1390.	46.	343
344	X - 3 - 9	206700.	40783.	9302.	197.	4130.	12450.	3896.	8979.	435.	1196.	43.	344
345	X - 3 - 10	214500.	38133.	9290.	194.	4090.	11764.	3852.	9452.	451.	1167.	42.	345
346	X - 3 - 11	108200.	29568.	7782.	163.	2880.	7580.	2993.	8247.	385.	899.	31.	346
347	X - 3 - 12	210500.	32309.	8015.	159.	2810.	6958.	3123.	7820.	460.	1048.	28.	347
MEAN		215792.	37900.	9332.	177.	3490.	9069.	3698.	8842.	538.	1167.	36.	
COEF VAR		16.0	10.5	12.7	12.5	14.7	28.6	14.2	11.8	16.9	10.8	19.6	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
336	X - 3 - 1	0.89487	0.42382	0.13907	0.14151	0.16957	0.27242	0.11918	0.16082	0.54732	0.17405	0.16049	336
337	X - 3 - 2	0.90220	0.47249	0.14344	0.14528	0.17337	0.29260	0.12771	0.17558	0.60536	0.18038	0.22840	337
351	X - 3 - 3	0.83077	0.45081	0.14394	0.16321	0.16848	0.34093	0.13090	0.17697	0.51161	0.19557	0.21605	351
352	X - 3 - 4	0.82674	0.47639	0.13928	0.15943	0.20598	0.32194	0.12312	0.17607	0.58839	0.19399	0.27160	352
340	X - 3 - 5	0.79817	0.43690	0.14159	0.14623	0.16141	0.29599	0.11968	0.17811	0.55982	0.17057	0.16667	340
341	X - 3 - 6	0.85861	0.45282	0.17048	0.17547	0.19457	0.42934	0.14768	0.20779	0.47946	0.18481	0.20988	341
342	X - 3 - 7	0.84982	0.52560	0.18897	0.20283	0.22935	0.60282	0.17377	0.23155	0.44107	0.21377	0.22222	342
343	X - 3 - 8	0.81392	0.51717	0.18076	0.20189	0.21739	0.53088	0.16194	0.22983	0.48214	0.21994	0.29630	343
344	X - 3 - 9	0.75714	0.48783	0.14955	0.18585	0.22446	0.54846	0.14096	0.19268	0.38839	0.18924	0.27778	344
345	X - 3 - 10	0.78571	0.45614	0.14936	0.18302	0.22228	0.51924	0.13936	0.20283	0.40268	0.18465	0.25926	345
346	X - 3 - 11	0.39634	0.35368	0.12511	0.15377	0.15652	0.33392	0.10829	0.17697	0.34375	0.14225	0.19136	346
347	X - 3 - 12	0.77106	0.38647	0.12886	0.15000	0.15272	0.30652	0.11299	0.16781	0.41071	0.16582	0.17284	347
MEAN		0.79045	0.45334	0.15003	0.16737	0.18967	0.39950	0.13380	0.18975	0.48006	0.18459	0.22274	
COEF VAR		16.0	10.5	12.7	12.5	14.7	28.6	14.2	11.8	16.9	10.8	19.6	

X4

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZN PPM	DATA CODE
354	X - 4 - 1	214400.	70435.	34330.	1360.	19960.	14132.	12608.	3404.	1926.	4510.	132.	354
355	X - 4 - 2	213100.	38217.	8469.	234.	2100.	1297.	1456.	3809.	694.	673.	17.	355
375	X - 4 - 3	191100.	33241.	7258.	186.	1440.	1512.	1143.	3911.	673.	482.	21.	375
376	X - 4 - 4	247800.	36132.	7390.	190.	1430.	1749.	1175.	3950.	693.	450.	20.	376
358	X - 4 - 5	218900.	33215.	6813.	166.	1630.	1068.	1110.	3855.	691.	480.	13.	358
359	X - 4 - 6	211500.	32308.	6536.	183.	1410.	863.	1111.	3856.	647.	474.	12.	359
360	X - 4 - 7	206300.	32553.	6992.	183.	1430.	801.	1166.	4281.	635.	524.	12.	360
361	X - 4 - 8	267800.	34333.	6713.	168.	1650.	898.	1135.	3929.	662.	479.	13.	361
362	X - 4 - 9	221400.	35125.	6049.	135.	1470.	889.	1065.	3768.	711.	478.	13.	362
363	X - 4 - 10	263300.	34392.	6356.	149.	1350.	816.	1042.	3646.	702.	462.	13.	363
364	X - 4 - 11	257100.	35266.	6620.	156.	1320.	715.	1058.	3796.	701.	453.	14.	364
***	X - 4 - 12	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
MEAN		228427.	37747.	9411.	285.	3199.	2249.	2188.	3828.	794.	860.	25.	
COEF VAR		10.8	27.7	84.0	119.8	165.8	167.7	150.7	5.3	45.2	134.3	132.9	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZN KK	DATA CODE
354	X - 4 - 1	0.78535	0.84252	0.55193	1.28302	1.08478	0.62256	0.45615	0.07305	1.71964	0.71361	0.81481	354
355	X - 4 - 2	0.78059	0.45714	0.13616	0.22075	0.11413	0.05714	0.05268	0.08174	0.61964	0.10649	0.10494	355
375	X - 4 - 3	0.70000	0.39762	0.11669	0.17547	0.07826	0.06661	0.04135	0.08178	0.60089	0.07627	0.12963	375
376	X - 4 - 4	0.90769	0.43220	0.11881	0.17925	0.07772	0.07705	0.04251	0.08476	0.61875	0.07120	0.12346	376
358	X - 4 - 5	0.80183	0.39731	0.10953	0.15660	0.08859	0.04705	0.04016	0.08273	0.61696	0.07595	0.08025	358
359	X - 4 - 6	0.77473	0.38646	0.10508	0.17264	0.07663	0.03802	0.04020	0.08275	0.57768	0.07500	0.07407	359
360	X - 4 - 7	0.75568	0.38939	0.11241	0.17264	0.07772	0.03529	0.04219	0.09187	0.56696	0.08291	0.07407	360
361	X - 4 - 8	0.98095	0.41068	0.10793	0.15849	0.08967	0.03956	0.04106	0.08431	0.59107	0.07579	0.08025	361
362	X - 4 - 9	0.81099	0.42016	0.09725	0.14623	0.07989	0.03916	0.03853	0.08086	0.63482	0.07563	0.08025	362
363	X - 4 - 10	0.96447	0.41139	0.10219	0.14057	0.07337	0.03595	0.03770	0.07824	0.62679	0.07310	0.08025	363
364	X - 4 - 11	0.94176	0.42184	0.10643	0.14717	0.07174	0.03150	0.03828	0.08146	0.62599	0.07168	0.08642	364
***	X - 4 - 12	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
MEAN		0.83673	0.45152	0.15131	0.26844	0.17386	0.09908	0.07916	0.08214	0.70901	0.13615	0.15713	
COEF VAR		10.8	27.7	84.0	119.8	165.8	167.7	150.7	5.3	45.2	134.3	132.9	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

X-31

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

XI

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
292	X - 1 - 1	2.8	19.0	11.0	5.	8.	15.	3.9	50.0	60.	292
293	X - 1 - 2	4.1	19.0	12.0	5.	6.	15.	3.7	49.0	61.	293
294	X - 1 - 3	2.3	44.0	15.0	5.	8.	16.	3.8	51.0	62.	294
295	X - 1 - 4	1.8	18.0	15.0	11.	7.	14.	4.1	55.0	62.	295
296	X - 1 - 5	1.2	18.0	15.0	16.	6.	15.	3.2	54.0	52.	296
297	X - 1 - 6	3.9	17.0	15.0	5.	12.	14.	4.1	56.0	65.	297
298	X - 1 - 7	2.5	19.0	20.0	5.	9.	16.	4.2	33.0	64.	298
299	X - 1 - 8	1.0	20.0	15.0	5.	6.	15.	4.5	33.0	63.	299
300	X - 1 - 9	1.0	19.0	13.0	5.	7.	9.	4.5	40.0	53.	300
301	X - 1 - 10	0.8	23.0	18.0	5.	5.	7.	4.7	35.0	49.	301
312	X - 1 - 11	0.8	28.0	16.0	5.	9.	11.	4.9	30.0	56.	312
313	X - 1 - 12	1.0	20.0	15.0	5.	4.	12.	4.0	30.0	52.	313
MEAN		1.9	22.0	15.0	6.	7.	13.	4.1	43.0	58.	
COEF VAR		58.8	32.7	15.4	51.9	28.2	20.9	10.9	23.2	9.1	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
292	X - 1 - 1	1.556	0.156	0.162	0.058	0.081	1.15	1.696	0.368	0.789	292
293	X - 1 - 2	2.278	0.156	0.176	0.058	0.061	1.15	1.609	0.360	0.803	293
294	X - 1 - 3	1.278	0.361	0.221	0.058	0.081	1.23	1.652	0.375	0.816	294
295	X - 1 - 4	1.000	0.148	0.221	0.128	0.071	1.08	1.783	0.404	0.816	295
296	X - 1 - 5	0.667	0.148	0.221	0.186	0.061	1.15	1.391	0.397	0.684	296
297	X - 1 - 6	2.167	0.139	0.221	0.058	0.121	1.08	1.783	0.412	0.855	297
298	X - 1 - 7	1.389	0.156	0.294	0.058	0.091	1.23	1.826	0.243	0.842	298
299	X - 1 - 8	0.556	0.164	0.221	0.058	0.061	1.15	1.957	0.243	0.829	299
300	X - 1 - 9	0.556	0.156	0.191	0.058	0.071	0.69	1.957	0.294	0.697	300
301	X - 1 - 10	0.444	0.189	0.265	0.058	0.051	0.54	2.043	0.257	0.645	301
312	X - 1 - 11	0.444	0.230	0.235	0.058	0.091	0.85	2.130	0.221	0.737	312
313	X - 1 - 12	0.556	0.164	0.221	0.058	0.040	0.92	1.739	0.221	0.684	313
MEAN		1.074	0.180	0.221	0.075	0.073	1.02	1.797	0.316	0.766	
COEF VAR		58.8	32.7	15.4	51.9	28.2	20.9	10.9	23.2	9.1	

X2

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
315	X - 2 - 1	4.0	33.0	12.0	10.	12.	10.	4.3	45.0	59.	315
316	X - 2 - 2	3.5	18.0	19.0	15.	20.	10.	3.2	45.0	43.	316
317	X - 2 - 3	4.1	29.0	16.0	5.	1.	10.	3.4	51.0	40.	317
318	X - 2 - 4	0.1	21.0	15.0	5.	10.	8.	4.3	38.0	48.	318
319	X - 2 - 5	1.0	18.0	18.0	5.	28.	8.	2.6	36.0	32.	319
333	X - 2 - 6	0.8	28.0	21.0	5.	62.	8.	5.4	10.0	89.	333
334	X - 2 - 7	0.1	17.0	16.0	5.	1.	4.	4.1	10.0	33.	334
322	X - 2 - 8	1.0	52.0	23.0	5.	168.	12.	2.8	18.0	64.	322
323	X - 2 - 9	0.1	40.0	18.0	10.	280.	12.	4.9	4.0	44.	323
324	X - 2 - 10	1.0	30.0	17.0	5.	26.	14.	6.3	34.0	66.	324
325	X - 2 - 11	0.1	30.0	20.0	10.	28.	16.	5.2	28.0	60.	325
326	X - 2 - 12	2.8	22.0	17.0	11.	16.	10.	4.0	34.0	88.	326
MEAN		1.5	28.2	17.7	8.	54.	10.	4.2	29.4	56.	
COEF VAR		98.1	34.9	15.7	43.6	148.6	29.5	25.3	50.4	33.0	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
315	X - 2 - 1	2.222	0.270	0.176	0.116	0.121	0.77	1.870	0.331	0.776	315
316	X - 2 - 2	1.944	0.148	0.279	0.174	0.202	0.77	1.391	0.331	0.566	316
317	X - 2 - 3	2.278	0.238	0.235	0.058	0.010	0.77	1.478	0.375	0.526	317
318	X - 2 - 4	0.056	0.172	0.221	0.058	0.101	0.62	1.870	0.279	0.632	318
319	X - 2 - 5	0.556	0.148	0.265	0.058	0.283	0.62	1.130	0.265	0.421	319
333	X - 2 - 6	0.444	0.230	0.309	0.058	0.626	0.62	2.348	0.074	1.171	333
334	X - 2 - 7	0.056	0.139	0.235	0.058	0.010	0.31	1.783	0.074	0.434	334
322	X - 2 - 8	0.556	0.426	0.338	0.058	1.697	0.92	1.217	0.132	0.842	322
323	X - 2 - 9	0.056	0.328	0.265	0.116	2.828	0.92	2.130	0.029	0.579	323
324	X - 2 - 10	0.556	0.246	0.250	0.058	0.263	1.08	2.739	0.250	0.868	324
325	X - 2 - 11	0.056	0.246	0.294	0.116	0.283	1.23	2.261	0.206	0.789	325
326	X - 2 - 12	1.556	0.180	0.250	0.128	0.162	0.77	1.739	0.250	1.158	326
MEAN		0.861	0.231	0.260	0.088	0.549	0.78	1.830	0.216	0.730	
COEF VAR		98.1	34.9	15.7	43.6	148.6	29.5	25.3	50.4	33.0	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS).

X-33

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

X3

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
336	X - 3 - 1	2.8	18.0	13.0	15.	1.	10.	2.7	42.0	38.	336
337	X - 3 - 2	3.0	23.0	14.0	10.	1.	12.	11.0	34.0	36.	337
351	X - 3 - 3	5.6	37.0	15.0	5.	11.	9.	2.4	41.0	44.	351
352	X - 3 - 4	1.0	32.0	17.0	5.	11.	10.	2.9	36.0	53.	352
340	X - 3 - 5	1.2	20.0	13.0	5.	20.	14.	5.3	40.0	42.	340
341	X - 3 - 6	2.8	32.0	12.0	10.	22.	16.	2.7	34.0	38.	341
342	X - 3 - 7	2.9	17.0	11.0	5.	4.	18.	4.1	42.0	40.	342
343	X - 3 - 8	2.8	18.0	12.0	5.	1.	16.	3.2	52.0	38.	343
344	X - 3 - 9	5.5	62.0	14.0	5.	14.	7.	1.1	46.0	51.	344
345	X - 3 - 10	1.5	30.0	13.0	5.	7.	8.	1.5	42.0	40.	345
346	X - 3 - 11	3.8	39.0	13.0	5.	8.	8.	1.6	33.0	54.	346
347	X - 3 - 12	3.8	33.0	16.0	5.	1.	9.	2.8	28.0	42.	347
MEAN		3.1	30.1	13.6	7.	8.	11.	3.4	39.2	43.	
COEF VAR		46.1	40.4	12.2	46.8	84.4	31.1	73.4	15.9	13.9	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
336	X - 3 - 1	1.556	0.148	0.191	0.174	0.010	0.77	1.174	0.309	0.500	336
337	X - 3 - 2	1.667	0.189	0.206	0.116	0.010	0.92	4.783	0.250	0.474	337
351	X - 3 - 3	3.111	0.303	0.221	0.058	0.111	0.69	1.043	0.301	0.579	351
352	X - 3 - 4	0.556	0.262	0.250	0.058	0.111	0.77	1.261	0.265	0.697	352
340	X - 3 - 5	0.667	0.164	0.191	0.058	0.202	1.08	2.304	0.294	0.553	340
341	X - 3 - 6	1.556	0.262	0.176	0.116	0.222	1.23	1.174	0.250	0.500	341
342	X - 3 - 7	1.611	0.139	0.162	0.058	0.040	1.38	1.783	0.309	0.526	342
343	X - 3 - 8	1.556	0.148	0.176	0.058	0.010	1.23	1.391	0.332	0.500	343
344	X - 3 - 9	3.056	0.508	0.206	0.058	0.141	0.54	0.478	0.338	0.671	344
345	X - 3 - 10	0.833	0.246	0.191	0.058	0.071	0.62	0.652	0.309	0.526	345
346	X - 3 - 11	2.111	0.320	0.191	0.058	0.081	0.62	0.696	0.243	0.711	346
347	X - 3 - 12	2.111	0.270	0.235	0.058	0.010	0.69	1.217	0.206	0.553	347
MEAN		1.699	0.247	0.200	0.078	0.085	0.88	1.496	0.288	0.566	
COEF VAR		46.1	40.4	12.2	46.8	84.4	31.1	73.4	15.9	13.9	

X4

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
354	X - 4 - 1	6.5	56.0	26.0	5.	29.	39.	3.0	110.0	100.	354
355	X - 4 - 2	4.9	29.0	19.0	5.	10.	12.	4.3	48.0	80.	355
375	X - 4 - 3	3.1	50.0	14.0	5.	25.	11.	5.2	57.0	63.	375
376	X - 4 - 4	0.1	27.0	14.0	5.	16.	11.	5.1	55.0	52.	376
358	X - 4 - 5	0.8	31.0	16.0	*****	14.	11.	4.2	55.0	80.	358
359	X - 4 - 6	6.5	30.0	15.0	5.	13.	11.	4.4	62.0	44.	359
360	X - 4 - 7	5.5	31.0	21.0	5.	8.	11.	4.2	58.0	74.	360
361	X - 4 - 8	4.0	28.0	17.0	*****	8.	11.	5.0	49.0	70.	361
362	X - 4 - 9	0.1	26.0	16.0	10.	9.	11.	3.6	39.0	48.	362
363	X - 4 - 10	7.8	28.0	15.0	5.	10.	15.	4.2	37.0	93.	363
364	X - 4 - 11	2.8	25.0	16.0	*****	19.	12.	3.7	36.0	82.	364
***	X - 4 - 12	****	*****	*****	*****	****	****	****	*****	****	***
MEAN		3.8	32.8	17.2	6.	15.	14.	4.3	55.1	71.	
COEF VAR		67.1	29.8	20.0	29.4	46.1	56.5	15.0	35.1	24.2	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
354	X - 4 - 1	3.611	0.459	0.382	0.058	0.293	3.00	1.304	0.809	1.316	354
355	X - 4 - 2	2.722	0.238	0.279	0.058	0.101	0.92	1.870	0.353	1.053	355
375	X - 4 - 3	1.722	0.410	0.206	0.058	0.253	0.85	2.261	0.419	0.829	375
376	X - 4 - 4	0.056	0.221	0.206	0.058	0.162	0.85	2.217	0.404	0.684	376
358	X - 4 - 5	0.444	0.254	0.235	*****	0.141	0.85	1.826	0.404	1.053	358
359	X - 4 - 6	3.611	0.246	0.221	0.058	0.131	0.85	1.913	0.456	0.579	359
360	X - 4 - 7	3.056	0.254	0.309	0.058	0.081	0.85	1.826	0.426	0.974	360
361	X - 4 - 8	2.222	0.230	0.250	*****	0.081	0.85	2.174	0.360	0.921	361
362	X - 4 - 9	0.056	0.213	0.235	0.116	0.091	0.85	1.565	0.287	0.632	362
363	X - 4 - 10	4.333	0.230	0.221	0.058	0.101	1.15	1.826	0.272	1.224	363
364	X - 4 - 11	1.556	0.205	0.235	*****	0.192	0.92	1.609	0.265	1.079	364
***	X - 4 - 12	******	*****	******	*****	*****	******	*****	*****	*****	***
MEAN		2.126	0.269	0.253	0.065	0.148	1.08	1.854	0.405	0.940	
COEF VAR		67.1	29.8	20.0	29.4	46.1	56.5	15.0	35.1	24.2	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

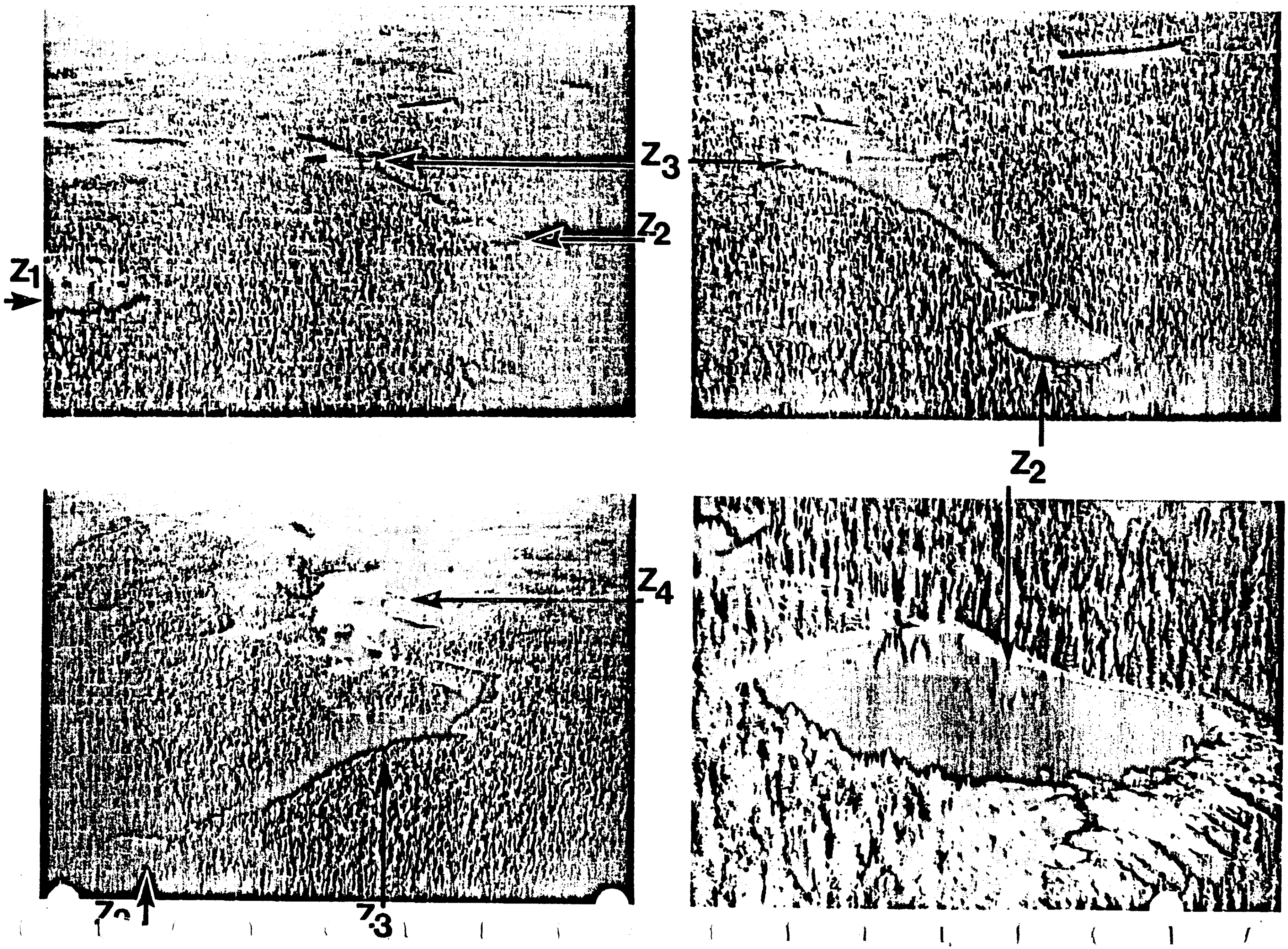
X-35

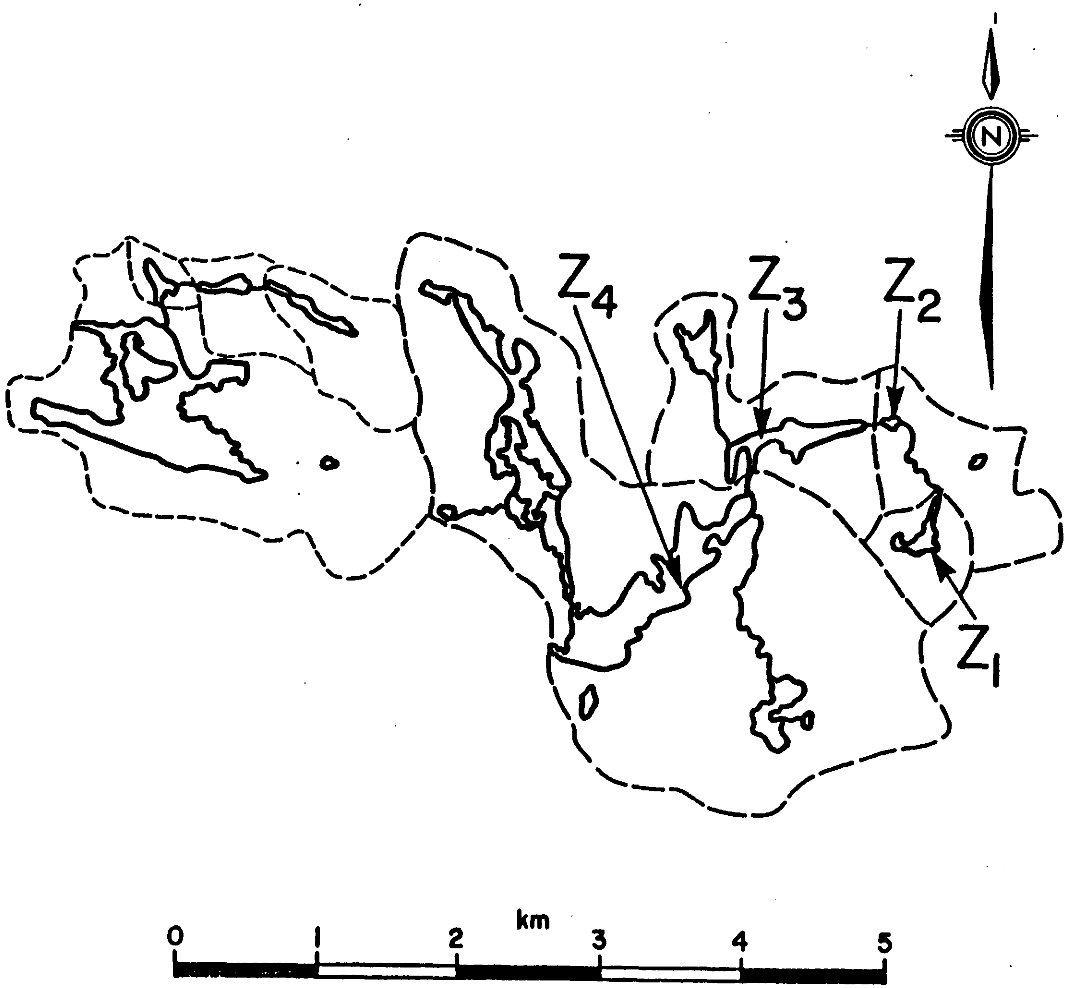
	Z_1	Z_2	Z_3	Z_4
UTM Coordinates of Lake: Zone	16	16	16	16
N	5238000	5238850	5238700	5238200
E	707100	706850	706200	705800
Elevation of Lake above sea level	500 m	437 m	434 m	430 m
Lake depth at sampling point	6 m	6 m	9 m	9 m
Lake area	0.04 km^2	0.015 km^2	0.015 km^2	0.47 km^2
Lake catchment area	0.37 km^2	1.31 km^2	2.74 km^2	9.46 km^2
Bedrock geology	greenstone	greenstone	greenstone/ "granite"	greenstone/ "granite"
Surface water chemistry: pH	5.2	5.6	5.3	5.6
alkalinity (mg/ℓ $CaCO_3$)	1.25	1.90	1.30	2.00
Ca (ppm)	1.4	1.6	1.6	1.6
SC_4 (ppm)	5.0	5.0	5.0	5.0
Ambrosia level	15 cm	15 cm	5 cm	20 cm

LAKE STAIRCASE
GREENSTONE / "GRANITE"

Z SERIES

LAKE	Z_1	Z_2	Z_3	Z_4
pH	5.2	5.6	5.3	5.6


Z1
Z3
Z2
Z3
Z2
Z4
Z3



Lake Z-1 is a small rock basin, with a fairly complex shoreline and morphometry. No muskeg development around the lake. Shoreline is rocky and surficial deposits are discontinuous in the watershed.

Lake Z-2 is a small rock basin, with simple morphometry. Some muskeg has developed around the lake shore, especially the inflow end. Surficial deposits are of minor importance in the watershed.

Lake Z-3 is a rock basin of irregular, elongated shape and probably has a fairly complex morphometry. No muskeg development around the shoreline. Surficial deposits are of minor importance in the watershed.

Lake Z-4 (Alvin Lake) is a complex rock basin with complex morphometry. Shoreline is rocky and the lake has several rock islands. No muskeg development around the shoreline. Surficial deposits are of minor importance in the watershed.

GENERAL DESCRIPTION OF THE STAIRCASE SYSTEM

Z -3

Lake	Parameter		
	pH range at surface	Colour	Secchi Depth(m)
Z_1	4.80-5.05	humic	2.2
Z_2	5.35-5.60	slightly humic	2.8
Z_3	5.15-5.25	humic	2.8
Z_4	5.25-5.30	clear	4.2

Dissolved Oxygen (Percent Saturation)

Depth (m)	Z_1	Z_2	Z_3	Z_4
0	100	100	100	100
1	100	100	100	100
2	100	100	100	100
3	75	130	100	100
4	18	74	100	127
5	7	16	82	113
6	0	7	75	100
7			50	100
8			35	80
9			20	61
10				
11				
12				
13				
14				
15				
16				

Temperature °C

Depth (m)	Z_1	Z_2	Z_3	Z_4
0	24	25	25	25
1	23	24	25	25
2	21	19	24	25
3	18	14	18	24
4	14	11	14	21
5	10	8	10	14
6	8	7	8	11
7			7	10
8			6	9
9			5	8
10				
11				
12				
13				
14				
15				
16				

<u>Lake Z1</u>

The Z lakes (pH = 4.8-5.6) were more acidic than all but the X lakes. Lakes Z1 and Z2 were the shallowest of the bunch and both were well protected from the wind as indicated by their shallow thermoclines (2 m).

Specific conductivity in the Z lakes was low (20-28 micromhos/cm) and with the exception of Z4, increased slightly as one progressed down the staircase of this watershed.

Lakes Z1-Z3 were all humic and displayed the characteristic heterograde dissolved oxygen depth profile of such lakes, reaching very low oxygen tensions near the bottom of each of these lakes. By way of contrast, the clear water lake Z4 at a similar depth (9 m) had 61% saturation.

Maple, birch and white spruce dominated the high ground around the lake, while black spruce, alder and cedar dominated the lower areas. The immediate shoreline of the lake was dominated by labrador tea and myrica gale.

The phytoplankton was dominated by <u>Dinobryon vanhoeffenii</u> while the zooplankton was dominated by the copepod, <u>Diaptomus minutus</u> and the rotifer, <u>Polyarthra vulgaris</u>.

Lake Z2

Only lakes Z2 and Z4 displayed metalimnetic supersaturation of dissolved oxygen (130 and 127% respectively). In most other respects, however, Z2 was similar to Z1. In terms of its surrounding vegetation, Z2 had slightly fewer white pine and slightly more black spruce. The phytoplankton of Z1 was less abundant than Z1 although species composition was similar. The zooplankton differed, however, as rotifers, primarily Trichocerca and Keratella dominated instead of copepods. Zooplankton biomass greatly exceeded phytoplankton biomass in Z2.

A beaver dam was observed in this lake and four unusually large, 2 mm long, unidentified copepods (possibly Diaptomus oregonensis) were observed in the sediment cores at the mud-water interphase.

Lake Z3

Lakes Z2 and Z3 were both humic with identical Secchi depth transparencies (2.8 m). Both lakes had rocky shore lines with poorly developed littoral zone vegetation, e.g. a few yellow water lilies, and the bladder wort, Utricularia were all that were noted. Terrestrial vegetation was also similar in both drainage basins, i.e. Z2 and Z3.

Uroglenopsis americana dominated the phytoplankton of Z3 while it was common but not dominant in Z2. Rotifers Kellicottia and Keratella and copepods, primarily Diaptomus miutus, dominated the zooplankton in Z3.

Lake Z4

This clear water lake (Secchi = 5.2 m) had a higher algal biomass than any of the other Z watershed study lakes. Uroglenopsis was again the dominant alga with another chrysophyte, Synura, as a subdominant. Zooplankton species composition and relative abundance was similar to Z1.

Lakes Z2 and 4 both had small beaver houses (no beaver dams were observed) near their outlets. Both also had rocky shorelines with evidence of substantially higher water levels on the rocks fringing these lakes. These rock outcrops were so frequent in the watershed of Z4 that very little muskeg development was evident. As a result, birch and white spruce were far more common in Z4 than in the higher elevation lakes. Why Sphagnum and the associated muskeg appear to be better developed in the higher elevation lakes is difficult to say. Possibly the lower pH of these higher elevation lakes is a stimulus for Sphagnum development or vice versa.

Temperature Corrected (to 25°C) Conductivity

Depth (m)	Z_1	Z_2	Z_3	Z_4
0	20	23	25	20
1	21	22	25	22
2	24	25	28	23
3	25	27	26	24
4	25	29	31	27
5	32	31	30	27
6	58	53	31	30
7			33	30
8			33	32
9			47	56
10				
11				
12				
13				
14				
15				
16				

PHYTOPLANKTON	Z1	Z2	Z3	Z4
BACILLARIOPHYTA				
ACTINELLA PUNCTATA	-	-	1	-
ASTERIONELLA FORMOSA	2	1	-	-
FRUSTULIA RHOMBOIDES	-	1	-	-
PINNULARIA SP.	-	-	-	1
TABELLARIA FENESTRATA	3	4	3	4
TABELLARIA FLOCCULOSA	-	-	1	-
AVERAGE	(2.5)	(2.0)	(1.7)	(2.5)

CHLOROPHYTA				
ARTHRODESMUS EXTENSUS	1	-	-	-
BAMBUSINA SP.	3	4	3	3
CHLAMYDOMONAS (PALMELLOID)	-	-	3	-
CLOSTERIUM SETACEUM	-	-	1	-
CLOSTERIUM SP.	-	1	-	-
DOCIDIUM UNDULATUM	1	-	-	-
GLOEOCYSTIS GIGAS	-	-	-	1
HYALOTHECA CF. DISSILIENS	-	3	-	-
HYALOTHECA MUCOSA	-	2	-	-
MICRASTERIAS RADIATA	-	1	-	1
MICROSPORA SP	2	-	-	-
MOUGEOTIA CF. CALCAREA	-	-	3	2
MOUGEOTIA SP.	3	2	-	-
NETRIUM DIGITUS	-	2	-	-
OOCYSTIS CF. NATANS	1	-	-	-
PLEUROTAENIUM TRABECULA	-	2	-	-
SCENEDESMUS SP.	-	1	-	-
SPHAEROCYSTIS CF. SCHROETERI	-	3	-	3
SPIROGYRA SP.	-	1	-	1
STAURASTRUM ARACHNAE	1	-	2	1
STAURASTRUM DICKIEI	-	-	-	1
TRIPLOCERAS GRACILE	1	2	1	1
TRIPLOCERAS VERTICILLATUM	-	1	-	1
XANTHIDIUM SP.	-	-	-	3
AVERAGE	(1.6)	(1.9)	(2.2)	(1.6)

PHYTOPLANKTON	Z1	Z2	Z3	Z4
CHRYSOPHYTA				
CHRYSOSPHAERELLA LONGISPINA	-	-	2	1
DINOBRYON BAVARICUM	3	-	-	3
DINOBRYON DIVERGENS	-	-	-	-
DINOBRYON VANHOEFFENII	5	-	-	4
MALLOMONAS CF. TONSURATA	2	-	-	-
MALLOMONAS GLOBOSA	-	-	1	-
SPINIFEROMONAS SP.	-	3	4	4
STIPITOCOCCUS SP.	3	-	-	-
SYNURA SP.	-	-	-	3
AVERAGE	(3.5)	(3.0)	(2.3)	(3.0)

CRYPTOPHYTA				
CRYPTOMONAS EROSA	-	-	-	1
CRYPTOMONAS SP.	2	-	-	-
AVERAGE	(2.0)	(---)	(---)	(1.0)

CYANOPHYTA				
APHANOCAPSA GREVILLEI	2	-	-	-
COELOSPHAERIUM SP.	2	-	-	-
GLOEOCAPSA RUPESTRIS	-	-	3	-
LYNGBYA SP.	1	-	-	-
MERISMOPEDIA CF. GLAUCA	-	-	1	-
MERISMOPEDIA PUNCTATA	1	-	-	-
MERISMOPEDIA TENUISSIMA	-	-	2	1
AVERAGE	(1.5)	(---)	(2.0)	(1.0)

PYRROPHYTA				
CERATIUM HIRUNDINELLA	2	-	-	-
GLENODINIUM SP.	2	-	-	-
PERIDINIUM INCONSPICUUM	3	2	-	2
PERIDINIUM LIMBATUM	-	-	-	-
PERIDINIUM SP.	-	-	-	1
AVERAGE	(2.3)	(2.0)	(---)	(1.5)

Comments

Chrysomonads, particularly Dinobryon, Mallomonas, Chrysosphaerella and Uroglenopsis dominated in the acid lakes ("X" & "Z"). This was also true of the 1980 samples (Fortescue et al 1981 p. 77). Green algae (Chlorophyta) and diatoms (Bacillariophyta) displayed the greatest species richness in the summer phytoplankton samples of the "X" & "Z" (low pH) watershed lakes.

ZOOPLANKTON	Z1	Z2	Z3	Z4
ZOOPLANKTON TO PHYTOPLANKTON BIOMASS RATIO	Z>P	Z<P	Z>P	Z>P
CILIOPHORA				
HALTERIA SP.	4.0	-	-	-
STROMBIDIUM CF. VIRIDIS	-	-	-	10.0
TOTAL	4.0	-	-	-
CLADOCERANS				
BOSMINA LONGIROSTRIS	2.0	5.0	25.0	10.0
CHYDORUS SPHAERICUS	1.0	-	-	-
DAPHNIA PULEX	-	-	2.0	-
DIAPHANOSOMA BRACHYURUM	-	15.0	5.0	5.0
HOLOPEDIUM GIBBERUM	5.0	5.0	-	5.0
POLYPHEMUS PEDICULUS	15.0	-	-	-
TOTAL	23.0	35.0	32.0	20.0
COPEPODS				
COPEPODITES AND NAUPLII	22.0	25.0	30.0	35.0
CYCLOPS BICUSPIDATUS	2.0	10.0	5.0	-
DIAPTOMUS MINUTUS	35.0	10.0	25.0	5.0
MESOCYCLOPS EDAX	5.0	5.0	5.0	5.0
TOTAL	64.0	50.0	65.0	45.0
INSECTA				
ACILIUS SULCATUS	5.0	2.0	-	-
TOTAL	5.0	2.0	-	-
ROTIFERS				
ASPLANCHNA BRIGHTWELLI	-	41.0	5.0	-
CHROMOGASTER SP.	20.0	40.0	5.0	5.0
CONOCHILOIDES SP.	-	-	-	-
CONOCHILUS SP.	20.0	40.0	25.0	20.0
KELLICOTIA LONGISPINA	-	-	60.0	-
KERATELLA COCHLEARIS	48.0	170.0	134.0	35.0
POLYARTHRA VULGARIS	5.0	50.0	-	-
TRICHOCERCA CYLINDRICUM	-	80.0	18.0	10.0
TRICHOCERCA SIMULUS	5.0	-	-	-
TOTAL	98.0	421.0	247.0	70.0

COMMENTS

Other copepod taxa occurred at low densities (less than one per litre) and were not included in this survey.

There were some indications that the cyclopoid copepods (predominantly predatory species) were rare relative to the herbivorous copepod Diaptomus minutus in both the X and Z acid lake watersheds.

Diatom Species	pH category	Z1 Number Counted	Z1 Relative Frequency (%)	Z2 Number Counted	Z2 Relative Frequency (%)	Z3 Number Counted	Z3 Relative Frequency (%)	Z4 Number Counted	Z4 Relative Frequency (%)
Achnanthes linearis	alp	18	2.29						
Achnanthes minutissima	ind			4	.56	6	.77	7	.88
Achnanthes flexella	ind	4	.51						
Actinella punctata	ach	9	1.14	6	.84	15	1.94	5	.63
Anomoeoneis follis	ind	5	.64						
Anomoeoneis serians	ach	30	3.81	17	2.38	22	2.84	4	.50
Anomoeoneis serians var. brachysira	acp			36	5.03	93	12.00	40	5.00
Anomoeoneis vitrea	alp	1	.13			2	.26		
Amphora ovalis	alp	1	.13						
Asterionella formosa	alp	3	.38					6	.75
Cymbella cesatii	ind					4	.52		
Cymbella hauckii	alp			28	3.92	3	.39	1	.13
Cymbella hustedtii	-	6	.76						
Cymbella lunata	-							1	.13
Cymbella microcephala	ind					6	.77		
Cymbella minuta	-	42	5.34						
Cymbella pusilla	acp	14	1.78	7	.98	4	.52	8	1.00
Cymbella sp.	-			19	2.66	10	1.29	7	.88
Epithemia sp.	-	3	.38						
Eunotia arcus	acp	19	2.41	12	1.68	2	.26	1	.13
Eunotia bactriana	ach	7	.89	4	.56	2	.26	2	.25
Eunotia bidentula	-			2	.28	10	1.29	1	.13
Eunotia curvata	acp	8	1.02	4	.56	2	.26	1	.13
Eunotia elegans	acp	6	.76			6	.77	3	.38
Eunotia exiqua	acp			8	1.12			1	.13
Eunotia flexuosa	acp	7	.89	14	1.96	10	1.29	14	1.75
Eunotia gibbosa	-	2	.25			3	.39	79	9.88
Eunotia glacialis	alp	5	.64						
Eunotia incisa	-	4	.51	24	3.36	27	3.48		

SURFACE SEDIMENT DIATOMS

SURFACE SEDIMENT DIATOMS (CONT'D)

Z -10

Diatom Species	pH category	Z1 Number Counted	Z1 Relative Frequency (%)	Z2 Number Counted	Z2 Relative Frequency (%)	Z3 Number Counted	Z3 Relative Frequency (%)	Z4 Number Counted	Z4 Relative Frequency (%)
Eunotia meisteri	acp	2	.25						
Eunotia naegelii	acp	15	1.91	2	.28	5	.65	7	.88
Eunotia pectinalis	acp	10	1.27	53	7.41	16	2.06	1	.13
Eunotia pectinalis var. minor	acp			19	2.66	13	1.68		
Eunotia pectinalis var. ventricosa	acp			18	2.52				
Eunotia perpusilla	acp					2	.26		
Eunotia praerupta	acp	15	1.91	5	.70				
Eunotia rostellata	acp	5	.64						
Eunotia sorra	alp			4	.56			2	.25
Eunotia tautoniensis	-	3	.38					2	.25
Eunotia vanheurckii	acp			8	1.12	6	.77	1	.13
Fragilaria constricta	acp	9	1.14	4	.56	4	.52		
Fragilaria virescens	ind					5	.65		
Frustulia rhomboides	acp	53	6.73	77	10.77	155	20.00	187	23.38
Frustulia rhomboides var. capitata	acp	2	.25					135	16.88
Frustulia rhomboides var. saxonica	acp							8	1.00
Gomphonema gracile	ind			7	.98	2	.26		
Gomphonema intricatum	alp	2	.25						
Melosira distans	acp			28	3.92	18	2.32		
Melosira distans f. clinostriata	acp	7	.89						
Navicula capitata	alp	2	.25						
Navicula explanata	alp		.					1	..13
Navicula notha	-			4	.56	5	.65	3	.38
Navicula radiosa	ind	8	1.02	4	.56	10	1.29		
Navicula radiosa var. parva	ind					2	.26		
Navicula subtilissima	acp	115	14.61	7	.98	44	5.68	74	9.25
Navicula sp.	-	3	.38	5	.70	2	.26		
Navicula pupula var. rectangularis	ind	1	.13						

Diatom Species	pH category	Z1 Number Counted	Z1 Relative Frequency (%)	Z2 Number Counted	Z2 Relative Frequency (%)	Z3 Number Counted	Z3 Relative Frequency (%)	Z4 Number Counted	Z4 Relative Frequency (%)
Neidium affine	ind	12	1.53	46	6.43	6	.77	8	1.00
Neidium bisulcatum	ind					2	.26		
Neidium iridis	ind	15	1.91						
Neidium iridis var. amphigomphus	ind	2	.25	28	3.92			2	.25
Neidium iridis var. ampliatum	ind							1	.13
Neidium sacoense	-			2	.28				
Nitzschia acicularis	alp	3	.38						
Nitzschia fonticola	alp					2	.26		
Nitzschia palea	ind	25	3.18	4	.56	10	1.29	29	3.63
Pinnularia abaujensis	ind	12	1.53	11	1.54	4	.52	2	.25
Pinnularia abaujensis var. rostrata	ind	24	3.05	6	.84				
Pinnularia abaujensis var. subundulata	ind	4	.51	6	.84			1	.13
Pinnularia biceps	acp	9	1.14	5	.70	2	.26	8	1.00
Pinnularia gibba	-			11	1.54	2	.26		
Pinnularia lata	acp	2	.25						
Pinnularia maior	acp	7	.89	15	2.10	8	1.03	3	.38
Pinnularia microstauron	ind	6	.76			4	.52	5	.63
Pinnularia braunii	-			10	1.40				
Semiorbis hemicyclus	acb	89	11.31	3	.42	7	.90	48	6.00
Stauroneis anceps	ind			4	.56	6	.77		
Stauroneis anceps f. gracilis	ind	7	.89						
Stauroneis phoenicenteron	ind			2	.28	5	.65		
Stauroneis phoenicenteron f. gracilis	ind	3	.38			2	.26		
Stauroneis livingstonii	-							2	.25
Stauroneis acuta	alp	2	.25						
Stauroneis intermedia	acb	7	.89	4	.56	16	2.06	12	1.50
Surirella linearis	ind	6	.76	5	.70	2	.26		
Surirella linearis var. constricta	ind	1	.13	2	.28	2	.26	1	.13

SURFACE SEDIMENT DIATOMS (CONT'D)

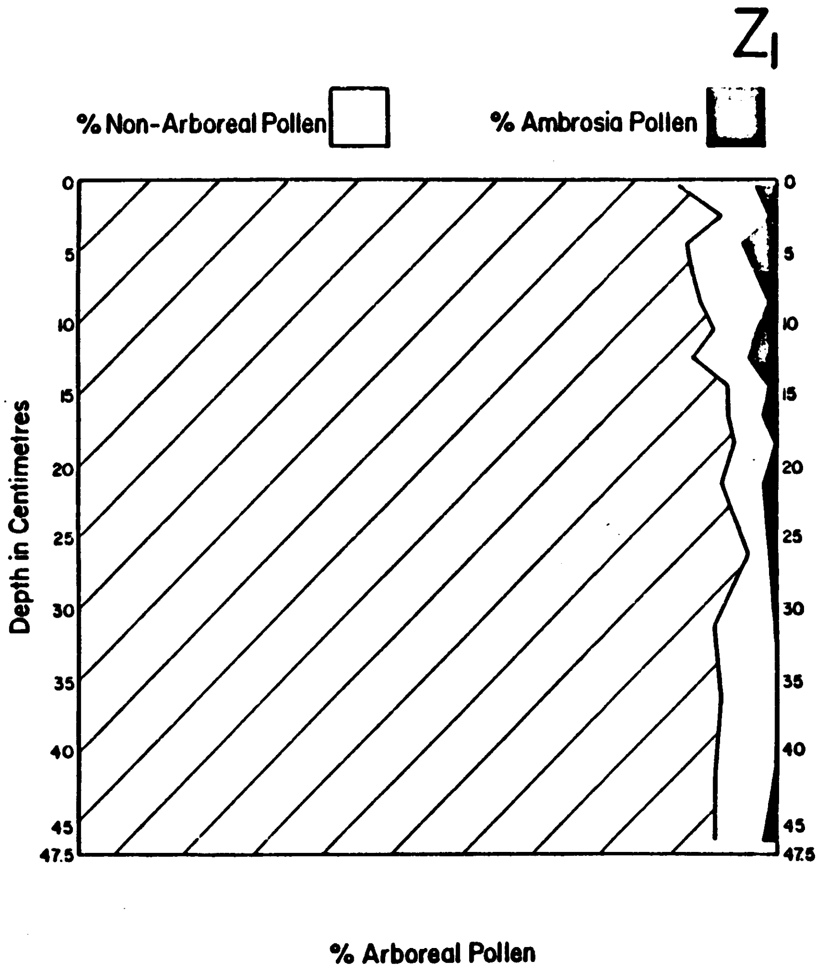
Z -11

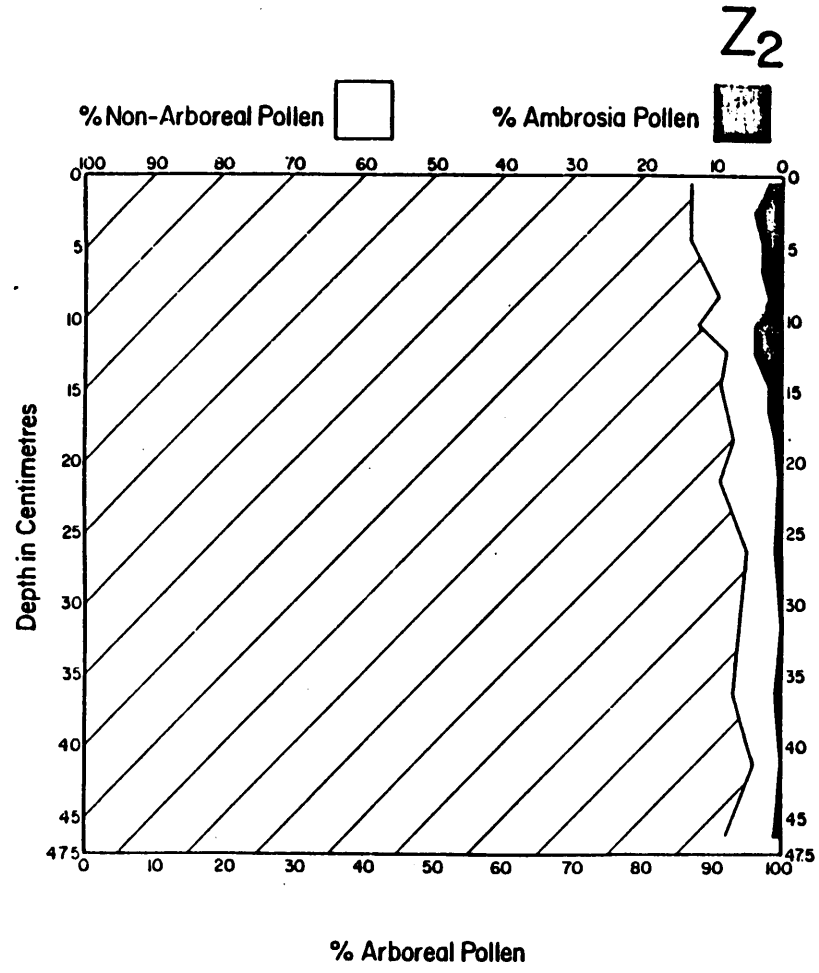
SURFACE SEDIMENT DIATOMS (CONT'D)

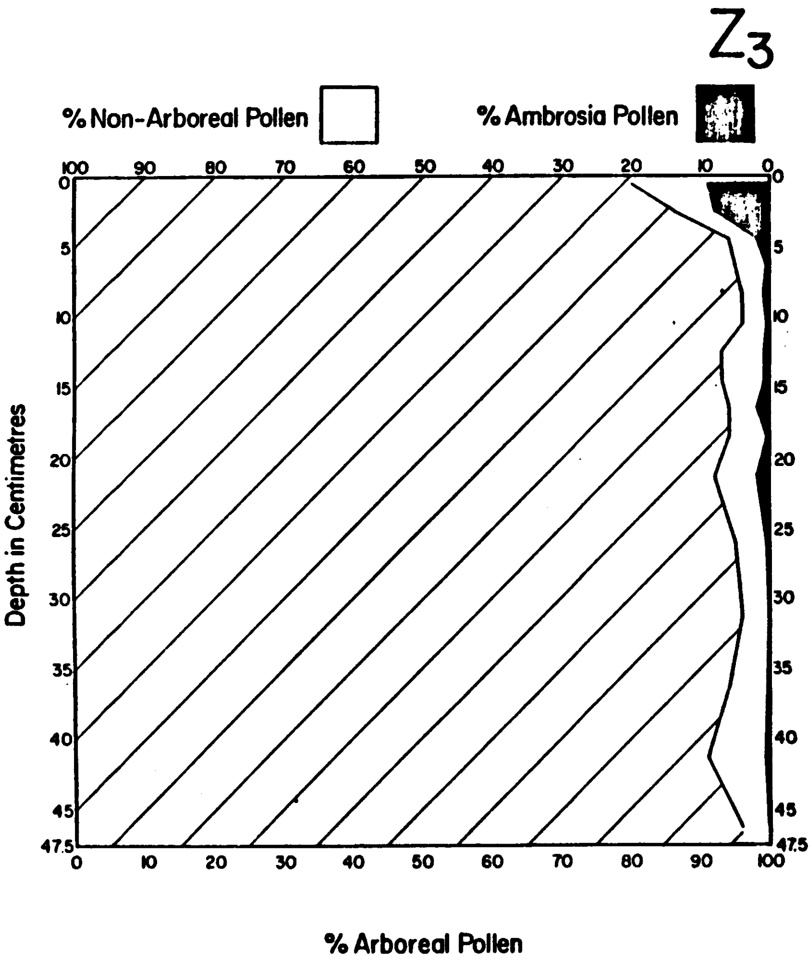
Z-12

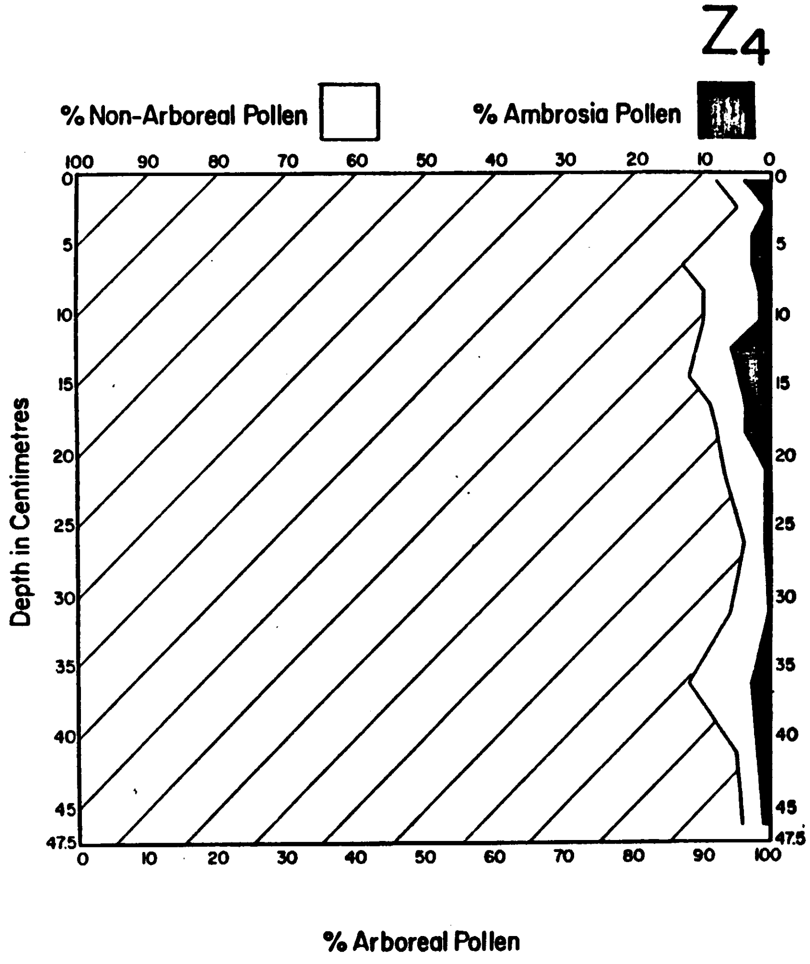
Diatom Species	pH category	Z1 Number Counted	Z1 Relative Frequency (%)	Z2 Number Counted	Z2 Relative Frequency (%)	Z3 Number Counted	Z3 Relative Frequency (%)	Z4 Number Counted	Z4 Relative Frequency (%)
Synedra delicatissima	-			4	.56	6	.77		
Tabellaria binalis	acb	12	1.53	1	.14	6	.77	5	.63
Tabellaria fenestrata	acp	66	8.39	59	8.25	84	10.84	3	.38
Tabellaria flocculosa	acp	30	3.81	57	7.97	83	10.71	67	8.38
Multiplication Factor (to give # diatoms/mg. dry wt.)		2007		2051		842		369	

Descriptions of the downcore diatoms are included in Part I, Chapter III. A complete species list of the diatoms studied during the 1981 field and laboratory study is included in Section 5 of this part of the report (Part II)


Z1
% Non-Arboreal Pollen
% Ambrosia Pollen
Depth in Centimetres
0
5
10
15
20
25
30
35
40
45
47.5
% Arboreal Pollen


Z2
% Non-Arboreal Pollen
% Ambrosia Pollen
100
90
80
70
60
50
40
30
20
10
0
Depth in Centimetres
0
5
10
15
20
25
30
35
40
45
47.5
% Arboreal Pollen



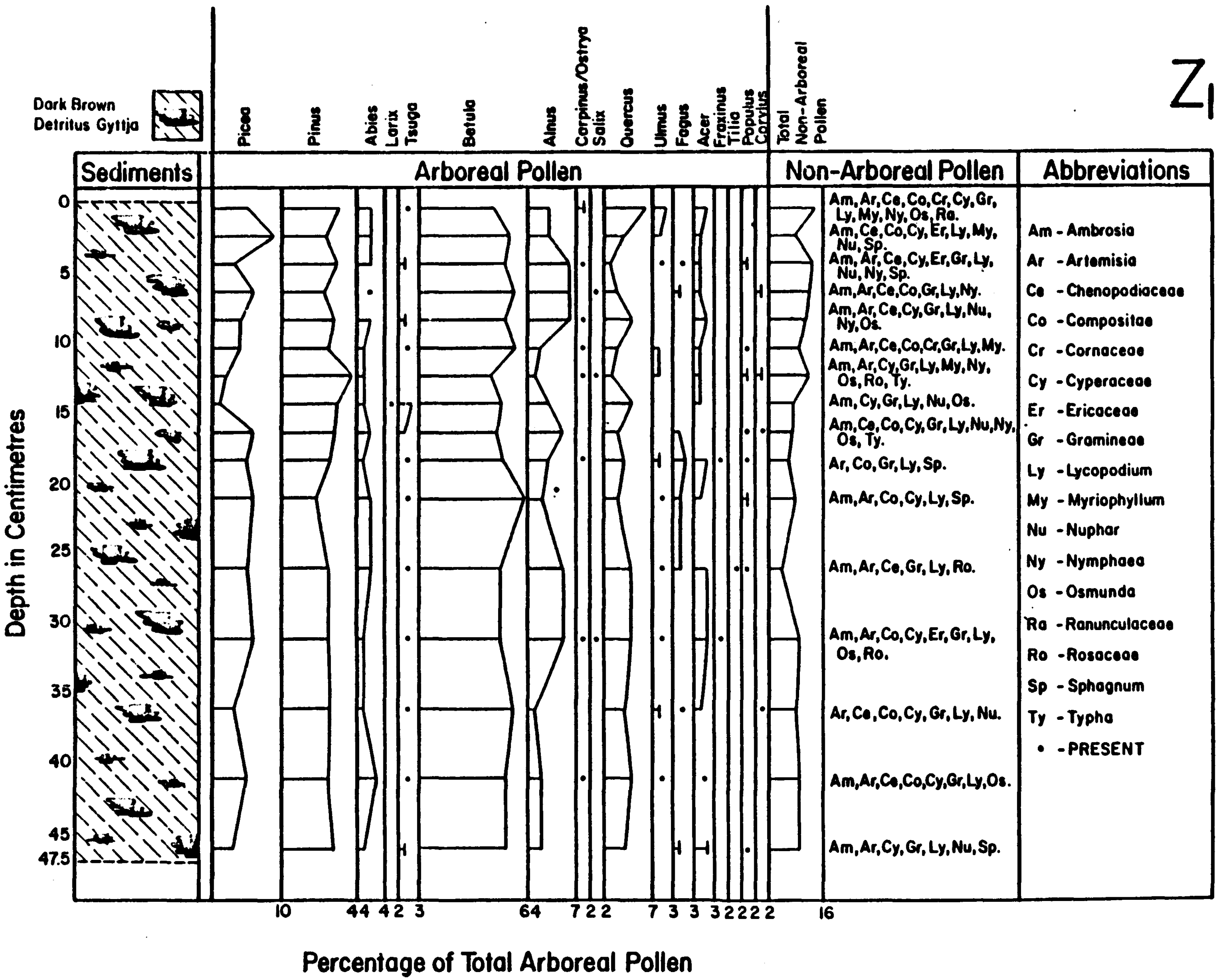


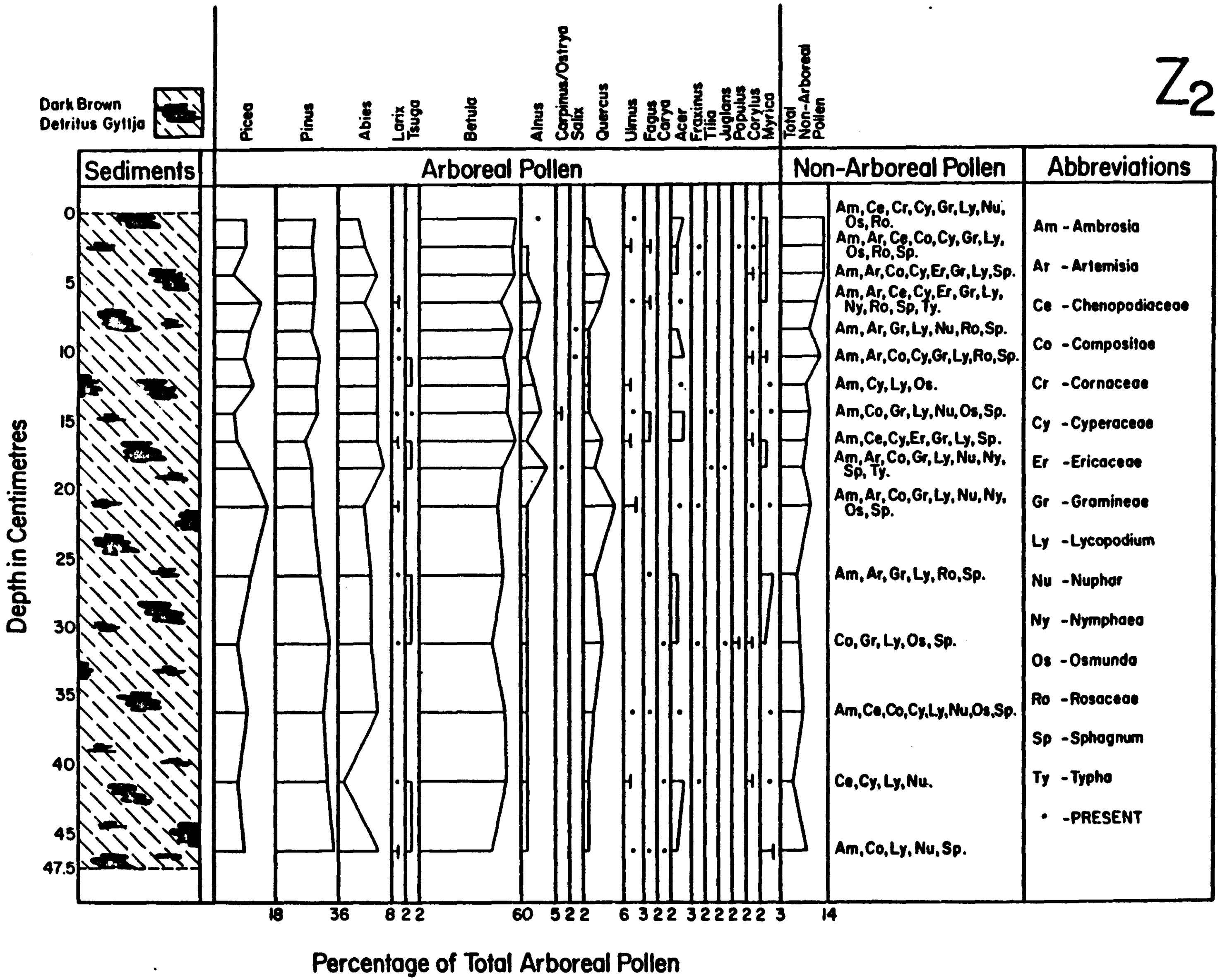
Z -15

AMBROSIA RISE DIAGRAMS (CONT'D)

POLLEN DIAGRAM

Z -16



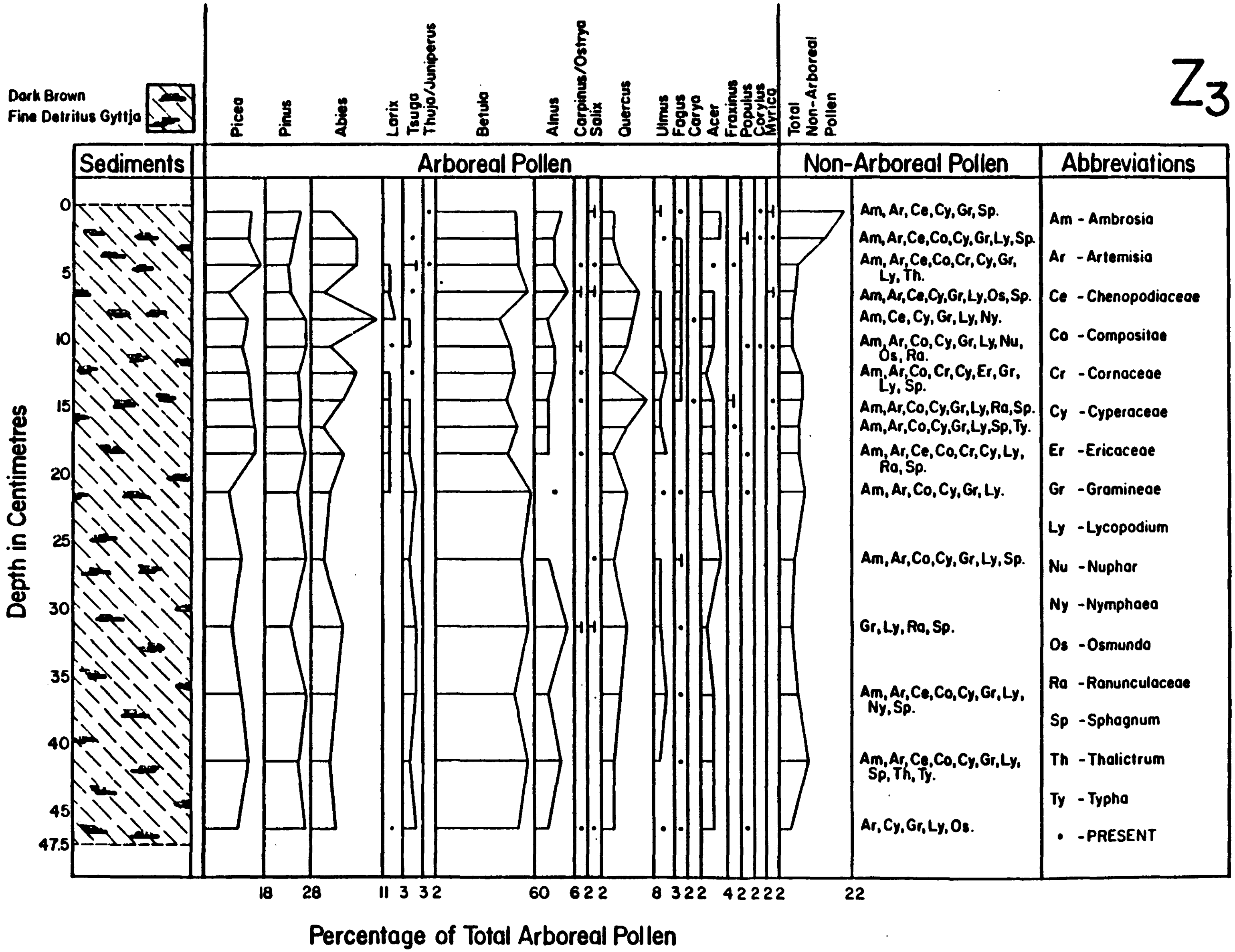


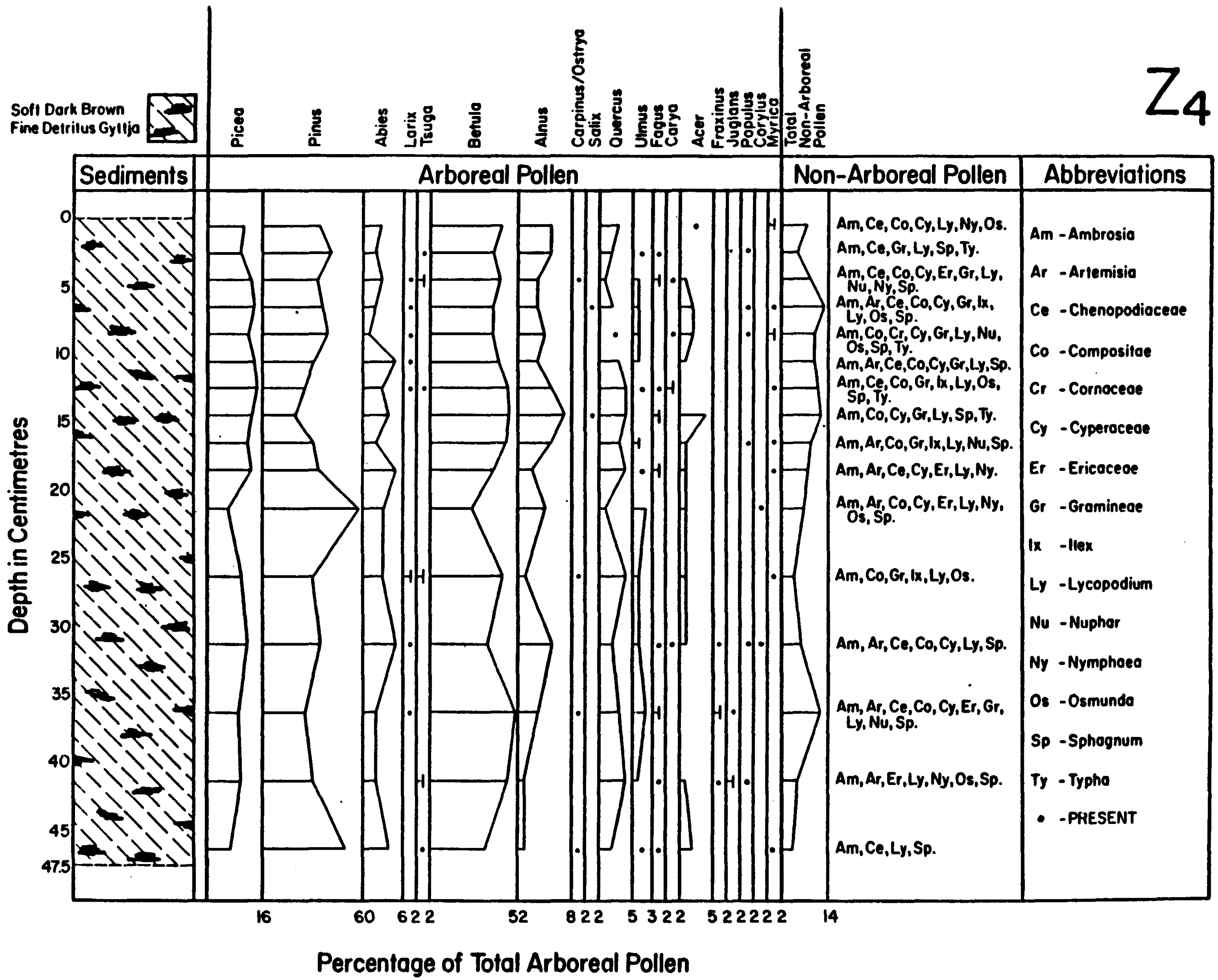
Z -17

POLLEN DIAGRAM

Z -17

POLLEN DIAGRAM





POLLEN DIAGRAM

Z-19

Z-20

Z -20

Z-21

Z-21

TOP 20 CM (LAKE Z_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

Z-22

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
826	Z - 1 - 1	******	29292.	11139.	93.	3330.	3018.	2167.	4916.	1165.	866.	20.	826
827	Z - 1 - 2	******	31726.	7530.	94.	3140.	3130.	2221.	4337.	1089.	905.	23.	827
828	Z - 1 - 3	******	35634.	6985.	95.	3220.	3584.	2335.	4421.	979.	988.	23.	828
829	Z - 1 - 4	******	36379.	6786.	98.	3360.	3718.	2392.	4992.	861.	924.	24.	829
830	Z - 1 - 5	******	32732.	6248.	89.	3020.	3110.	2174.	4425.	727.	788.	14.	830
832	Z - 1 - 6	******	37359.	6854.	97.	3220.	4008.	2390.	5050.	852.	958.	18.	832
833	Z - 1 - 7	******	35862.	6510.	91.	3160.	3779.	2295.	5077.	864.	927.	30.	833
834	Z - 1 - 8	******	31677.	5832.	83.	2830.	3362.	2067.	4772.	848.	830.	24.	834
835	Z - 1 - 9	******	31564.	5887.	85.	2770.	3070.	2008.	5388.	878.	785.	22.	835
836	Z - 1 - 10	******	31796.	5930.	86.	2920.	3307.	2145.	5378.	866.	804.	23.	836
838	Z - 1 - 11	******	36345.	6408.	92.	3060.	3524.	2290.	5975.	920.	900.	27.	838
839	Z - 1 - 12	******	31370.	6157.	105.	2890.	3261.	2143.	5624.	786.	677.	12.	839
840	Z - 1 - 13	******	29980.	5325.	80.	2740.	2986.	1961.	5758.	852.	743.	20.	840
841	Z - 1 - 14	******	31349.	5227.	79.	2880.	3215.	2086.	5845.	870.	846.	25.	841
842	Z - 1 - 15	******	31562.	5194.	76.	2770.	3379.	2018.	5614.	852.	843.	26.	842
844	Z - 1 - 16	******	31187.	5315.	77.	2760.	3195.	2060.	5630.	835.	820.	24.	844
845	Z - 1 - 17	******	29061.	5199.	74.	2550.	3008.	1999.	5578.	809.	810.	22.	845
846	Z - 1 - 18	******	32385.	5395.	78.	2840.	3359.	2149.	5884.	898.	840.	25.	846
847	Z - 1 - 19	******	31229.	5124.	75.	2810.	3277.	2054.	5716.	818.	786.	23.	847
848	Z - 1 - 20	******	30758.	5524.	79.	2730.	3192.	2153.	5992.	831.	864.	24.	848

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
826	Z - 1 - 1	*******	0.35038	0.17908	0.08774	0.18098	0.13295	0.07840	0.10549	1.04018	0.13703	0.12346	826
827	Z - 1 - 2	*******	0.37950	0.12106	0.08868	0.17065	0.13789	0.08035	0.09307	0.97232	0.14320	0.14198	827
828	Z - 1 - 3	*******	0.42624	0.11230	0.08962	0.17500	0.15789	0.08448	0.09487	0.87411	0.15633	0.17284	828
829	Z - 1 - 4	*******	0.43516	0.10910	0.09245	0.18261	0.16379	0.08654	0.10712	0.76875	0.14620	0.14815	829
830	Z - 1 - 5	*******	0.39153	0.10045	0.08396	0.16413	0.13700	0.07865	0.09496	0.64911	0.12468	0.08642	830
832	Z - 1 - 6	*******	0.44688	0.11019	0.09151	0.17500	0.17656	0.08647	0.10837	0.76071	0.15158	0.11111	832
833	Z - 1 - 7	*******	0.42897	0.10466	0.08585	0.17174	0.16648	0.08303	0.10895	0.77143	0.14668	0.18519	833
834	Z - 1 - 8	*******	0.37891	0.09376	0.07830	0.15380	0.14811	0.07478	0.10240	0.75714	0.13133	0.14815	834
835	Z - 1 - 9	*******	0.37756	0.09465	0.08019	0.15054	0.13524	0.07265	0.11562	0.78393	0.12421	0.13580	835
836	Z - 1 - 10	*******	0.38033	0.09534	0.08113	0.15870	0.14568	0.07760	0.11541	0.79107	0.12722	0.14198	836
838	Z - 1 - 11	*******	0.43475	0.10302	0.08679	0.16630	0.15524	0.08285	0.12822	0.82143	0.14241	0.16667	838
839	Z - 1 - 12	*******	0.37524	0.09899	0.09906	0.15707	0.14366	0.07753	0.12069	0.70179	0.10712	0.07407	839
840	Z - 1 - 13	*******	0.35861	0.08561	0.07547	0.14891	0.13154	0.07095	0.12356	0.76071	0.11756	0.12346	840
841	Z - 1 - 14	*******	0.37499	0.08404	0.07453	0.15652	0.14163	0.07547	0.12543	0.77679	0.13386	0.15432	841
842	Z - 1 - 15	*******	0.37754	0.08350	0.07170	0.15054	0.14885	0.07301	0.12047	0.76071	0.13339	0.16049	842
844	Z - 1 - 16	*******	0.37305	0.08545	0.07264	0.15000	0.14075	0.07453	0.12082	0.74554	0.12975	0.14815	844
845	Z - 1 - 17	*******	0.34762	0.08359	0.06981	0.13859	0.13251	0.07232	0.11970	0.72232	0.12816	0.13580	845
846	Z - 1 - 18	*******	0.38738	0.08674	0.07358	0.15435	0.14797	0.07775	0.12627	0.80179	0.13291	0.15432	846
847	Z - 1 - 19	*******	0.37355	0.08238	0.07075	0.15272	0.14436	0.07431	0.12266	0.73036	0.12437	0.14198	847
848	Z - 1 - 20	*******	0.36792	0.08881	0.07453	0.14837	0.14062	0.07789	0.12858	0.74196	0.13671	0.14815	848

TOP 20 CM (LAKE Z_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

TOP 20 CM (LAKE Z_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

Z-24

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
826	Z - 1 - 1	****	25.0	25.0	*****	22.	62.0	****	36.0	106.	826
827	Z - 1 - 2	****	25.0	26.0	*****	23.	55.0	****	14.0	124.	827
828	Z - 1 - 3	****	26.0	26.0	*****	31.	53.0	****	16.0	143.	828
829	Z - 1 - 4	****	26.0	27.0	*****	28.	43.0	****	10.0	177.	829
830	Z - 1 - 5	****	25.0	25.0	*****	27.	95.0	****	10.0	130.	830
832	Z - 1 - 6	****	27.0	26.0	*****	27.	26.0	****	11.0	127.	832
833	Z - 1 - 7	****	24.0	25.0	*****	23.	28.0	****	10.0	116.	833
834	Z - 1 - 8	****	22.0	23.0	*****	22.	24.0	****	14.0	111.	834
835	Z - 1 - 9	****	21.0	23.0	*****	19.	9.0	****	16.0	87.	835
836	Z - 1 - 10	****	22.0	24.0	*****	34.	20.0	****	20.0	98.	836
838	Z - 1 - 11	****	26.0	22.0	*****	22.	14.0	****	18.0	96.	838
839	Z - 1 - 12	****	126.0	25.0	*****	31.	10.0	****	14.0	82.	839
840	Z - 1 - 13	****	21.0	24.0	*****	23.	8.0	****	6.0	81.	840
841	Z - 1 - 14	****	22.0	25.0	*****	32.	5.0	****	15.0	122.	841
842	Z - 1 - 15	****	22.0	23.0	*****	28.	6.0	****	15.0	100.	842
844	Z - 1 - 16	****	22.0	23.0	*****	29.	7.0	****	13.0	69.	844
845	Z - 1 - 17	****	21.0	22.0	*****	16.	6.0	****	4.0	75.	845
846	Z - 1 - 18	****	22.0	23.0	*****	24.	8.0	****	4.0	84.	846
847	Z - 1 - 19	****	24.0	24.0	*****	47.	5.0	****	2.0	81.	847
848	Z - 1 - 20	****	23.0	22.0	*****	17.	7.0	****	2.0	97.	848

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
826	Z - 1 - 1	****	0.2049	0.368	****	0.222	4.769	****	0.265	1.395	826
827	Z - 1 - 2	****	0.2049	0.382	****	0.232	4.231	****	0.103	1.632	827
828	Z - 1 - 3	****	0.2131	0.382	****	0.313	4.077	****	0.118	1.882	828
829	Z - 1 - 4	****	0.2131	0.397	****	0.283	3.308	****	0.074	2.329	829
830	Z - 1 - 5	****	0.2049	0.368	****	0.273	7.308	****	0.074	1.711	830
832	Z - 1 - 6	****	0.2213	0.382	****	0.273	2.000	****	0.081	1.671	832
833	Z - 1 - 7	****	0.1967	0.368	****	0.232	2.154	****	0.074	1.526	833
834	Z - 1 - 8	****	0.1803	0.338	****	0.222	1.846	****	0.103	1.461	834
835	Z - 1 - 9	****	0.1721	0.338	****	0.192	0.692	****	0.118	1.145	835
836	Z - 1 - 10	****	0.1803	0.353	****	0.343	1.538	****	0.147	1.289	836
838	Z - 1 - 11	****	0.2131	0.324	****	0.222	1.077	****	0.132	1.263	838
839	Z - 1 - 12	****	1.0328	0.368	****	0.313	0.769	****	0.103	1.079	839
840	Z - 1 - 13	****	0.1721	0.353	****	0.232	0.615	****	0.044	1.066	840
841	Z - 1 - 14	****	0.1803	0.368	****	0.323	0.385	****	0.110	1.605	841
842	Z - 1 - 15	****	0.1803	0.338	****	0.283	0.462	****	0.110	1.316	842
844	Z - 1 - 16	****	0.1803	0.338	****	0.293	0.538	****	0.096	1.171	844
845	Z - 1 - 17	****	0.1721	0.324	****	0.162	0.462	****	0.029	0.987	845
846	Z - 1 - 18	****	0.1803	0.338	****	0.242	0.615	****	0.029	1.105	846
847	Z - 1 - 19	****	0.1967	0.353	****	0.475	0.385	****	0.015	1.066	847
848	Z - 1 - 20	****	0.1885	0.324	****	0.172	0.538	****	0.015	1.270	848

TOP 20 cm (LAKE Z_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

Z -25

LAKE SEDIMENT CORE WEIGHT DATA

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z-26

Z1

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
378	Z - 1 - 1	24.78	2.01	36.0	92.0	Z - 1 - 7	29.89	2.75	33.6	90.8	384
379	Z - 1 - 2	31.49	2.58	36.3	91.3	Z - 1 - 8	33.70	3.13	33.9	90.7	385
380	Z - 1 - 3	26.08	2.20	36.7	91.6	Z - 1 - 9	29.05	2.81	32.2	90.3	386
381	Z - 1 - 4	27.27	2.61	37.2	90.4	Z - 1 - 10	33.71	3.53	36.5	89.5	387
382	Z - 1 - 5	14.75	1.42	35.5	90.4	Z - 1 - 11	28.34	2.83	32.9	90.0	388
383	Z - 1 - 6	27.83	2.68	34.7	90.4	Z - 1 - 12	29.52	2.99	33.2	89.9	389

Z2

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
399	Z - 2 - 1	38.88	6.52	27.3	83.2	Z - 2 - 7	33.01	5.57	28.5	83.1	405
400	Z - 2 - 2	33.74	5.37	28.3	84.1	Z - 2 - 8	39.78	6.71	30.3	83.1	406
401	Z - 2 - 3	35.96	5.50	31.5	84.7	Z - 2 - 9	45.15	7.87	28.2	82.6	407
402	Z - 2 - 4	31.55	5.99	27.6	81.0	Z - 2 - 10	45.05	8.91	27.3	80.2	408
403	Z - 2 - 5	33.90	7.10	22.6	79.1	Z - 2 - 11	44.50	13.02	12.9	70.7	413
404	Z - 2 - 6	34.27	5.88	35.7	82.8	Z - 2 - 12	52.28	18.83	9.5	88.3	414

Z3

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
416	Z - 3 - 1	14.25	2.58	41.8	81.9	Z - 3 - 7	15.13	2.70	42.4	82.2	422
417	Z - 3 - 2	13.70	2.48	45.5	81.9	Z - 3 - 8	13.13	2.45	46.9	81.3	423
418	Z - 3 - 3	12.98	2.46	43.1	81.0	Z - 3 - 9	11.89	2.33	48.3	80.4	424
419	Z - 3 - 4	13.97	2.45	47.0	82.5	Z - 3 - 10	11.87	2.37	47.8	80.0	425
420	Z - 3 - 5	15.60	2.55	50.0	83.7	Z - 3 - 11	14.33	2.56	49.8	82.1	426
421	Z - 3 - 6	14.82	2.56	46.4	82.7	Z - 3 - 12	*****	*****	50.8	****	430

Z4

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
433	Z - 4 - 1	18.10	4.54	20.1	74.9	Z - 4 - 7	18.99	4.60	18.2	75.8	439
434	Z - 4 - 2	19.30	3.79	30.5	80.4	Z - 4 - 8	15.83	3.73	21.2	76.4	440
435	Z - 4 - 3	19.75	4.44	19.7	77.5	Z - 4 - 9	15.77	3.62	24.1	77.0	441
436	Z - 4 - 4	19.65	4.00	25.2	79.6	Z - 4 - 10	21.20	4.09	28.3	80.7	442
437	Z - 4 - 5	15.77	3.58	25.2	77.3	Z - 4 - 11	17.40	4.00	26.3	77.0	443
438	Z - 4 - 6	15.44	4.07	21.3	73.6	Z - 4 - 12	17.20	4.02	26.7	76.6	444

LAKE SEDIMENT CORE WEIGHT DATA

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

Z -27

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z1

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
378	Z - 1 - 1	247000.	35662.	5362.	77.	2960.	3750.	2211.	6418.	900.	781.	36.	378
379	Z - 1 - 2	249000.	23262.	5157.	73.	2460.	3754.	1607.	6112.	817.	1565.	37.	379
380	Z - 1 - 3	255000.	39612.	5298.	75.	3400.	5055.	2446.	6889.	922.	763.	39.	380
381	Z - 1 - 4	236100.	38425.	5608.	79.	3210.	4390.	2455.	7331.	960.	816.	35.	381
382	Z - 1 - 5	243000.	39424.	5504.	75.	3440.	4558.	2307.	7052.	1018.	892.	36.	382
383	Z - 1 - 6	232600.	38165.	5548.	78.	3440.	3815.	2353.	7184.	965.	878.	75.	383
384	Z - 1 - 7	236700.	39327.	6231.	108.	3770.	4800.	2754.	7947.	949.	1090.	66.	384
385	Z - 1 - 8	246600.	39850.	5639.	96.	3530.	4771.	2473.	7290.	975.	1013.	43.	385
386	Z - 1 - 9	191500.	40186.	6172.	110.	3320.	4308.	2643.	7899.	1010.	1090.	39.	386
387	Z - 1 - 10	233700.	35278.	5224.	88.	3390.	4461.	2252.	6792.	914.	890.	36.	387
388	Z - 1 - 11	213900.	39092.	5696.	91.	3140.	4372.	2458.	7315.	979.	991.	37.	388
389	Z - 1 - 12	158900.	41506.	6203.	99.	3480.	4482.	2667.	8171.	1060.	1056.	36.	389
MEAN		228667.	37482.	5637.	87.	3295.	4376.	2386.	7200.	956.	985.	43.	
COEF VAR		11.7	12.3	6.4	14.5	9.7	9.2	11.9	8.1	6.3	21.0	29.2	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
378	Z - 1 - 1	0.90476	0.42658	0.08621	0.07264	0.16087	0.16520	0.07999	0.13773	0.80357	0.12358	0.22222	378
379	Z - 1 - 2	0.91209	0.27825	0.08291	0.06887	0.13370	0.16537	0.05614	0.13116	0.72946	0.24703	0.22340	379
380	Z - 1 - 3	0.93407	0.47383	0.08518	0.07075	0.18478	0.22269	0.08549	0.14783	0.82321	0.12073	0.24074	380
381	Z - 1 - 4	0.86484	0.45963	0.09016	0.07453	0.17446	0.19339	0.08882	0.15732	0.85714	0.12911	0.21605	381
382	Z - 1 - 5	0.89011	0.47158	0.08849	0.07075	0.18696	0.20079	0.08347	0.15133	0.90893	0.14114	0.23457	382
383	Z - 1 - 6	0.85201	0.45652	0.08920	0.07358	0.16696	0.16806	0.08513	0.15416	0.86161	0.13892	0.46296	383
384	Z - 1 - 7	0.86703	0.47042	0.10018	0.10189	0.20489	0.21145	0.09964	0.17054	0.84732	0.17247	0.40741	384
385	Z - 1 - 8	0.90330	0.47667	0.09064	0.09057	0.19185	0.21018	0.08947	0.15644	0.87054	0.16028	0.26543	385
386	Z - 1 - 9	0.70147	0.48069	0.09923	0.10377	0.18043	0.18978	0.09562	0.16951	0.90179	0.17247	0.24074	386
387	Z - 1 - 10	0.85604	0.42199	0.08399	0.08302	0.18424	0.19652	0.08148	0.14575	0.81607	0.14032	0.22222	387
388	Z - 1 - 11	0.78352	0.46761	0.09158	0.08585	0.17065	0.19260	0.08493	0.15697	0.87411	0.15680	0.22640	388
389	Z - 1 - 12	0.58205	0.49648	0.09973	0.09340	0.18913	0.19744	0.09649	0.17534	0.94643	0.16709	0.22222	389
MEAN		0.83761	0.44835	0.09062	0.08247	0.17908	0.19279	0.08631	0.15451	0.85335	0.15592	0.26595	
COEF VAR		11.7	12.3	6.4	14.5	9.7	9.2	11.9	8.1	6.3	21.0	29.2	

Z2

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
399	Z - 2 - 1	241600.	38159.	8050.	155.	3080.	10402.	3121.	7930.	722.	1044.	63.	399
400	Z - 2 - 2	233100.	41533.	9365.	204.	4430.	11511.	3502.	9059.	752.	1124.	61.	400
401	Z - 2 - 3	252800.	35052.	8297.	167.	2660.	8139.	3109.	8016.	736.	1083.	44.	401
402	Z - 2 - 4	256800.	49418.	11543.	220.	6150.	13956.	4521.	11400.	799.	1502.	78.	402
403	Z - 2 - 5	256800.	48674.	12225.	235.	5650.	14899.	4991.	12580.	720.	1529.	66.	403
404	Z - 2 - 6	233000.	40832.	1075.	209.	3770.	10533.	4040.	10460.	940.	1381.	63.	404
405	Z - 2 - 7	249000.	34410.	8904.	172.	2820.	8000.	3401.	8490.	760.	1215.	53.	405
406	Z - 2 - 8	246200.	42176.	10882.	219.	4000.	11541.	4226.	10620.	839.	1402.	61.	406
407	Z - 2 - 9	187000.	46908.	11761.	233.	5190.	13565.	4613.	11780.	924.	1623.	73.	407
408	Z - 2 - 10	247500.	49868.	12935.	258.	5820.	15643.	5118.	13840.	780.	1658.	74.	408
413	Z - 2 - 11	285600.	57028.	11701.	230.	5380.	21694.	4604.	13310.	477.	1272.	59.	413
414	Z - 2 - 12	282600.	64569.	11775.	217.	7110.	25539.	5093.	14380.	410.	1272.	67.	414
MEAN		247667.	45719.	9876.	210.	4672.	13785.	4195.	10989.	738.	1342.	64.	
COEF VAR		9.8	18.7	31.2	14.1	29.3	36.5	17.1	19.8	20.2	14.8	14.0	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
399	Z - 2 - 1	0.88498	0.45645	0.12942	0.14623	0.16739	0.45824	0.11292	0.17017	0.64464	0.16519	0.38889	399
400	Z - 2 - 2	0.85385	0.49681	0.15056	0.19245	0.24076	0.50709	0.12670	0.19440	0.67143	0.17735	0.37654	400
401	Z - 2 - 3	0.92601	0.41928	0.13339	0.15755	0.14457	0.35855	0.11248	0.17202	0.65714	0.17136	0.27160	401
402	Z - 2 - 4	0.94066	0.59112	0.18558	0.20755	0.33424	0.61480	0.16357	0.24464	0.71339	0.23766	0.48148	402
403	Z - 2 - 5	0.94066	0.58222	0.19654	0.22170	0.30707	0.65634	0.18057	0.26996	0.64286	0.24193	0.40741	403
404	Z - 2 - 6	0.85348	0.48842	0.01728	0.19717	0.20489	0.46401	0.14616	0.22446	0.83929	0.21951	0.38889	404
405	Z - 2 - 7	0.91209	0.41160	0.14315	0.16226	0.15326	0.35242	0.12305	0.16219	0.67857	0.19225	0.32716	405
406	Z - 2 - 8	0.90183	0.50450	0.17495	0.20660	0.21739	0.50841	0.15289	0.22790	0.74911	0.22184	0.37654	406
407	Z - 2 - 9	0.68498	0.56110	0.18908	0.21981	0.28207	0.59758	0.16690	0.25279	0.82500	0.25680	0.45062	407
408	Z - 2 - 10	0.90659	0.59651	0.20796	0.24340	0.31630	0.68912	0.18517	0.29700	0.69643	0.26234	0.45679	408
413	Z - 2 - 11	1.04615	0.68215	0.18812	0.21698	0.29239	0.95568	0.16657	0.28562	0.42589	0.20127	0.36420	413
414	Z - 2 - 12	1.03516	0.77236	0.18931	0.20472	0.38641	1.12507	0.18426	0.30858	0.36607	0.20127	0.41358	414
MEAN		0.90720	0.54688	0.15878	0.19803	0.25389	0.60728	0.15177	0.23581	0.65915	0.21235	0.39197	
COEF VAR		9.8	18.7	31.2	14.1	29.3	36.5	17.1	19.8	20.2	14.8	14.0	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

Z-29

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z3

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
416	Z - 3 - 1	189000.	46226.	10165.	138.	4850.	6767.	3316.	7750.	1427.	1337.	53.	416
417	Z - 3 - 2	188400.	44030.	7756.	108.	2560.	6680.	2330.	6413.	1586.	1009.	50.	417
418	Z - 3 - 3	194500.	45212.	9304.	127.	3620.	6572.	2766.	7924.	1559.	1191.	50.	418
419	Z - 3 - 4	183800.	41674.	7735.	96.	2380.	4380.	2100.	6190.	1625.	958.	37.	419
420	Z - 3 - 5	165200.	44496.	8190.	104.	2480.	4281.	2107.	6810.	1862.	992.	38.	420
421	Z - 3 - 6	177800.	42699.	8493.	124.	2870.	5261.	2387.	7539.	1561.	1109.	51.	421
422	Z - 3 - 7	179100.	42642.	8897.	131.	2650.	5871.	2648.	8176.	1461.	1106.	52.	422
423	Z - 3 - 8	181000.	43626.	9112.	128.	2530.	4676.	2478.	7830.	1741.	1116.	45.	423
424	Z - 3 - 9	176300.	44784.	8221.	113.	2330.	4447.	2113.	7029.	1759.	997.	42.	424
425	Z - 3 - 10	166600.	41892.	8406.	114.	2290.	3884.	2117.	7145.	1637.	995.	40.	425
426	Z - 3 - 11	161700.	41745.	8180.	107.	2000.	3039.	1956.	6910.	1727.	931.	33.	426
430	Z - 3 - 12	170200.	43698.	8364.	110.	1940.	2929.	1922.	7103.	1894.	939.	32.	430
MEAN		177800.	43560.	8569.	117.	2708.	4899.	2353.	7239.	1655.	1057.	44.	
COEF VAR		5.5	3.2	7.8	10.4	28.3	26.2	16.4	8.2	8.4	10.9	16.7	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
416	Z - 3 - 1	0.69231	0.55294	0.16342	0.13019	0.26359	0.29811	0.11997	0.16631	1.27411	0.21155	0.32716	416
417	Z - 3 - 2	0.69011	0.52667	0.12469	0.10189	0.13913	0.29427	0.08430	0.13762	1.41607	0.15965	0.30354	417
418	Z - 3 - 3	0.71245	0.54081	0.14958	0.11981	0.19674	0.28952	0.10007	0.17004	1.39196	0.18845	0.30364	418
419	Z - 3 - 4	0.67326	0.49849	0.12436	0.09057	0.12935	0.19295	0.07598	0.13283	1.45089	0.15153	0.22840	419
420	Z - 3 - 5	0.60513	0.53225	0.13167	0.09811	0.13478	0.18859	0.07623	0.14614	1.66250	0.15696	0.23457	420
421	Z - 3 - 6	0.65128	0.51075	0.13654	0.11698	0.15598	0.23176	0.08636	0.16178	1.39375	0.17547	0.31481	421
422	Z - 3 - 7	0.65604	0.51007	0.14304	0.12358	0.14402	0.25363	0.09580	0.17545	1.32232	0.17500	0.32099	422
423	Z - 3 - 8	0.66300	0.52184	0.14650	0.12075	0.13750	0.20599	0.08965	0.16910	1.55446	0.17658	0.27778	423
424	Z - 3 - 9	0.64579	0.53569	0.13217	0.10660	0.12663	0.19590	0.07645	0.15084	1.57054	0.15775	0.25926	424
425	Z - 3 - 10	0.61026	0.50110	0.13514	0.10755	0.12446	0.17110	0.07659	0.15333	1.46161	0.15744	0.24691	425
426	Z - 3 - 11	0.59231	0.49934	0.13151	0.10094	0.10870	0.13388	0.07077	0.14828	1.54196	0.14731	0.20370	426
430	Z - 3 - 12	0.62344	0.52270	0.13447	0.10377	0.10543	0.12903	0.06954	0.15242	1.69107	0.14853	0.19753	430
MEAN		0.65128	0.52106	0.13776	0.11006	0.14719	0.21581	0.08514	0.15534	1.47760	0.16719	0.26903	
COEF VAR		5.5	3.2	7.8	10.4	28.3	26.2	16.4	8.2	8.4	10.9	16.7	

Z4

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
433	Z - 4 - 1	273200.	51616.	10767.	238.	5180.	16446.	3618.	1149.	564.	1236.	80.	433
434	Z - 4 - 2	238200.	38698.	9700.	201.	3040.	9033.	2642.	7837.	731.	1005.	57.	434
435	Z - 4 - 3	253300.	48194.	10928.	226.	4400.	15323.	3627.	10930.	625.	1231.	79.	435
436	Z - 4 - 4	260600.	34099.	11407.	222.	4160.	8366.	3258.	8966.	807.	1192.	68.	436
437	Z - 4 - 5	248500.	40088.	12235.	239.	3890.	8996.	3431.	8868.	765.	1344.	56.	437
438	Z - 4 - 6	258800.	46896.	12019.	249.	5850.	14461.	4239.	12350.	612.	1387.	71.	438
439	Z - 4 - 7	277100.	45520.	11680.	245.	5510.	14466.	4035.	12060.	538.	1333.	62.	439
440	Z - 4 - 8	268500.	38044.	11177.	236.	3890.	10774.	3376.	9918.	577.	1187.	52.	440
441	Z - 4 - 9	246200.	35915.	10938.	223.	4050.	8382.	3260.	8995.	585.	1174.	39.	441
442	Z - 4 - 10	235500.	38019.	8577.	175.	3340.	7278.	2514.	6457.	786.	990.	63.	442
443	Z - 4 - 11	155200.	44501.	10993.	244.	4710.	9847.	3330.	8292.	833.	1317.	73.	443
444	Z - 4 - 12	151900.	43945.	11552.	268.	5000.	10605.	3512.	8675.	803.	1397.	84.	444
MEAN		238917.	42128.	10998.	231.	4418.	11165.	3404.	8708.	686.	1233.	65.	
COEF VAR		16.8	12.3	8.8	10.0	18.6	27.0	13.7	32.2	15.5	10.4	19.2	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
433	Z - 4 - 1	1.00073	0.61742	0.17310	0.22453	0.28152	0.72449	0.13090	0.02466	0.50357	0.19557	0.49383	433
434	Z - 4 - 2	0.87253	0.46289	0.15595	0.18962	0.16522	0.39793	0.09559	0.16818	0.65268	0.15902	0.35185	434
435	Z - 4 - 3	0.92784	0.57648	0.17569	0.21321	0.23913	0.67502	0.13122	0.23455	0.35804	0.19478	0.48765	435
436	Z - 4 - 4	0.95438	0.40788	0.18339	0.20943	0.22609	0.36855	0.11787	0.19240	0.72054	0.18861	0.41975	436
437	Z - 4 - 5	0.91026	0.47952	0.19670	0.22547	0.21141	0.39630	0.12413	0.19030	0.68304	0.21266	0.34568	437
438	Z - 4 - 6	0.94799	0.56096	0.19323	0.23491	0.31793	0.63705	0.15336	0.26502	0.54643	0.21946	0.43827	438
439	Z - 4 - 7	1.01502	0.54450	0.18778	0.23113	0.29946	0.63727	0.14598	0.25860	0.48036	0.21092	0.38272	439
440	Z - 4 - 8	0.98332	0.45507	0.17969	0.22264	0.21141	0.47463	0.12214	0.21283	0.51518	0.13782	0.32099	440
441	Z - 4 - 9	0.90183	0.42961	0.17585	0.21038	0.22011	0.36925	0.11794	0.19303	0.52232	0.13576	0.24074	441
442	Z - 4 - 10	0.86264	0.45477	0.13789	0.16509	0.18152	0.32062	0.09096	0.13856	0.70179	0.15665	0.38889	442
443	Z - 4 - 11	0.56850	0.53231	0.17674	0.23019	0.25598	0.43379	0.12048	0.17794	0.74375	0.20839	0.45062	443
444	Z - 4 - 12	0.55641	0.52566	0.18572	0.25283	0.27174	0.46718	0.12706	0.18616	0.71696	0.22104	0.51852	444
MEAN		0.87515	0.50392	0.17681	0.21745	0.24013	0.49184	0.12314	0.18687	0.61205	0.19506	0.40329	
COEF VAR		16.8	12.3	8.8	10.0	18.6	27.0	13.7	32.2	15.5	10.4	19.2	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

Z-31

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z1

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
378	Z - 1 - 1	0.1	26.0	15.0	5.	43.	13.	4.0	43.0	72.	378
379	Z - 1 - 2	1.8	19.0	357.0	5.	20.	12.	3.9	34.0	67.	379
380	Z - 1 - 3	2.0	21.0	17.0	5.	23.	12.	4.7	48.0	71.	380
381	Z - 1 - 4	0.1	34.0	17.0	5.	72.	13.	3.3	41.0	72.	381
382	Z - 1 - 5	0.1	26.0	16.0	5.	32.	13.	4.2	48.0	73.	382
383	Z - 1 - 6	0.1	19.0	16.0	5.	25.	12.	3.5	41.0	78.	383
384	Z - 1 - 7	0.1	45.0	23.0	5.	29.	15.	3.2	46.0	69.	384
385	Z - 1 - 8	0.1	32.0	22.0	5.	27.	11.	4.2	50.0	67.	385
386	Z - 1 - 9	0.1	29.0	20.0	5.	39.	12.	2.9	48.0	69.	386
387	Z - 1 - 10	0.1	26.0	23.0	5.	25.	15.	3.9	41.0	67.	387
388	Z - 1 - 11	1.0	28.0	23.0	5.	20.	9.	3.0	47.0	73.	388
389	Z - 1 - 12	2.0	41.0	23.0	5.	25.	6.	3.1	51.0	74.	389
MEAN		0.6	28.8	47.7	5.	32.	12.	3.7	44.8	71.	
COEF VAR		124.9	27.0	195.8	0.0	43.9	19.8	14.9	10.5	4.5	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
378	Z - 1 - 1	0.056	0.213	0.221	0.058	0.434	1.00	1.739	0.316	0.947	378
379	Z - 1 - 2	1.000	0.156	5.250	0.058	0.202	0.92	1.696	0.250	0.882	379
380	Z - 1 - 3	1.111	0.172	0.250	0.058	0.232	0.92	2.043	0.353	0.934	380
381	Z - 1 - 4	0.056	0.279	0.250	0.058	0.727	1.00	1.435	0.301	0.947	381
382	Z - 1 - 5	0.056	0.213	0.235	0.058	0.323	1.00	1.826	0.353	0.961	382
383	Z - 1 - 6	0.056	0.156	0.235	0.058	0.253	0.92	1.522	0.301	1.026	383
384	Z - 1 - 7	0.056	0.369	0.338	0.058	0.293	1.15	1.391	0.336	0.908	384
385	Z - 1 - 8	0.056	0.262	0.324	0.058	0.273	0.85	1.826	0.368	0.882	385
386	Z - 1 - 9	0.056	0.238	0.294	0.058	0.394	0.92	1.261	0.353	0.908	386
387	Z - 1 - 10	0.056	0.213	0.338	0.058	0.253	1.15	1.696	0.301	0.882	387
388	Z - 1 - 11	0.556	0.230	0.338	0.058	0.202	0.69	1.304	0.346	0.961	388
389	Z - 1 - 12	1.111	0.336	0.338	0.058	0.253	0.46	1.348	0.375	0.974	389
MEAN		0.352	0.236	0.701	0.058	0.320	0.92	1.591	0.330	0.934	
COEF VAR		124.9	27.0	195.8	0.0	43.9	19.8	14.9	10.5	4.5	

Z2

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
399	Z - 2 - 1	2.2	30.0	10.0	5.	38.	14.	0.8	40.0	37.	399
400	Z - 2 - 2	2.0	144.0	11.0	5.	15.	14.	1.6	31.0	39.	400
401	Z - 2 - 3	0.1	76.0	12.0	15.	14.	12.	1.6	30.0	37.	401
402	Z - 2 - 4	0.1	47.0	12.0	14.	46.	18.	1.9	41.0	41.	402
403	Z - 2 - 5	0.1	46.0	16.0	5.	7.	18.	1.6	45.0	42.	403
404	Z - 2 - 6	0.1	35.0	13.0	5.	17.	16.	2.2	43.0	40.	404
405	Z - 2 - 7	0.1	28.0	14.0	5.	7.	15.	2.1	39.0	25.	405
406	Z - 2 - 8	1.0	74.0	14.0	5.	29.	8.	2.9	32.0	38.	406
407	Z - 2 - 9	0.1	36.0	17.0	5.	7.	11.	2.3	41.0	45.	407
408	Z - 2 - 10	0.1	46.0	13.0	10.	27.	15.	1.8	46.0	41.	408
413	Z - 2 - 11	0.8	36.0	5.0	5.	14.	13.	1.7	44.0	32.	413
414	Z - 2 - 12	0.1	26.0	4.0	5.	5.	14.	1.8	48.0	31.	414
MEAN		0.6	52.0	11.8	7.	19.	14.	1.9	40.0	37.	
COEF VAR		131.9	61.2	31.9	51.8	67.7	19.3	26.0	14.4	14.2	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
399	Z - 2 - 1	1.222	0.246	0.147	0.058	0.384	1.08	0.348	0.294	0.487	399
400	Z - 2 - 2	1.111	1.180	0.162	0.058	0.152	1.08	0.696	0.228	0.513	400
401	Z - 2 - 3	0.056	0.623	0.176	0.174	0.141	0.92	0.696	0.221	0.487	401
402	Z - 2 - 4	0.056	0.385	0.176	0.163	0.465	1.38	0.826	0.301	0.539	402
403	Z - 2 - 5	0.056	0.377	0.235	0.058	0.071	1.38	0.696	0.331	0.553	403
404	Z - 2 - 6	0.056	0.287	0.191	0.058	0.172	1.23	0.957	0.316	0.526	404
405	Z - 2 - 7	0.056	0.230	0.206	0.058	0.071	1.15	0.913	0.287	0.329	405
406	Z - 2 - 8	0.556	0.607	0.206	0.058	0.293	0.62	1.261	0.235	0.500	406
407	Z - 2 - 9	0.056	0.295	0.250	0.058	0.071	0.85	1.000	0.301	0.592	407
408	Z - 2 - 10	0.056	0.377	0.191	0.116	0.273	1.15	0.783	0.333	0.539	408
413	Z - 2 - 11	0.444	0.295	0.074	0.058	0.141	1.00	0.739	0.324	0.421	413
414	Z - 2 - 12	0.056	0.213	0.059	0.058	0.051	1.08	0.783	0.353	0.408	414
MEAN		0.315	0.426	0.173	0.081	0.190	1.08	0.808	0.294	0.491	
COEF VAR		131.9	61.2	31.9	51.8	67.7	19.3	26.0	14.4	14.2	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z-33

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z3

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
416	Z - 3 - 1	0.8	33.0	30.0	5.	10.	15.	2.3	47.0	49.	416
417	Z - 3 - 2	4.5	36.0	28.0	5.	3.	15.	2.5	29.0	39.	417
418	Z - 3 - 3	1.5	33.0	30.0	5.	9.	8.	2.4	52.0	44.	418
419	Z - 3 - 4	4.0	25.0	30.0	5.	7.	7.	2.6	44.0	43.	419
420	Z - 3 - 5	1.0	41.0	35.0	5.	20.	11.	2.5	49.0	44.	420
421	Z - 3 - 6	3.5	46.0	29.0	5.	169.	13.	2.0	39.0	51.	421
422	Z - 3 - 7	5.8	46.0	28.0	5.	152.	16.	1.8	33.0	53.	422
423	Z - 3 - 8	0.1	56.0	37.0	5.	110.	15.	1.7	39.0	45.	423
424	Z - 3 - 9	2.5	42.0	29.0	*****	76.	9.	2.6	42.0	51.	424
425	Z - 3 - 10	4.0	45.0	31.0	*****	72.	13.	2.3	42.0	46.	425
426	Z - 3 - 11	2.2	55.0	39.0	*****	92.	19.	2.4	42.0	44.	426
430	Z - 3 - 12	5.8	46.0	37.0	5.	34.	13.	2.5	44.0	41.	430
MEAN		3.0	42.0	31.9	5.	63.	13.	2.3	41.8	46.	
COEF VAR		61.8	20.7	11.8	0.0	89.1	26.4	12.7	14.6	9.0	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
416	Z - 3 - 1	0.444	0.270	0.441	0.058	0.101	1.15	1.000	0.346	0.645	416
417	Z - 3 - 2	2.500	0.295	0.412	0.058	0.030	1.15	1.087	0.213	0.513	417
418	Z - 3 - 3	0.833	0.270	0.441	0.058	0.091	0.62	1.043	0.382	0.579	418
419	Z - 3 - 4	2.222	0.205	0.441	0.058	0.071	0.54	1.130	0.324	0.566	419
420	Z - 3 - 5	0.556	0.336	0.515	0.058	0.202	0.85	1.087	0.360	0.579	420
421	Z - 3 - 6	1.944	0.377	0.426	0.058	1.707	1.00	0.870	0.287	0.671	421
422	Z - 3 - 7	3.222	0.377	0.412	0.058	1.535	1.23	0.783	0.243	0.697	422
423	Z - 3 - 8	0.056	0.459	0.544	0.058	1.111	1.15	0.739	0.287	0.592	423
424	Z - 3 - 9	1.389	0.344	0.426	*****	0.768	0.69	1.130	0.309	0.671	424
425	Z - 3 - 10	2.222	0.369	0.456	*****	0.727	1.00	1.000	0.309	0.605	425
426	Z - 3 - 11	1.222	0.451	0.574	*****	0.929	1.46	1.043	0.309	0.579	426
430	Z - 3 - 12	3.222	0.377	0.544	0.058	0.343	1.00	1.087	0.324	0.539	430
MEAN		1.653	0.344	0.469	0.058	0.635	0.99	1.000	0.308	0.603	
COEF VAR		61.8	20.7	11.8	0.0	89.1	26.4	12.7	14.6	9.0	

Z4

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
433	Z - 4 - 1	5.0	37.0	16.0	5.	16.	9.	1.3	49.0	39.	433
434	Z - 4 - 2	3.0	38.0	16.0	5.	14.	8.	0.3	42.0	39.	434
435	Z - 4 - 3	1.8	23.0	12.0	5.	13.	8.	2.0	43.0	48.	435
436	Z - 4 - 4	4.5	25.0	13.0	5.	28.	7.	1.8	52.0	62.	436
437	Z - 4 - 5	4.5	112.0	20.0	5.	26.	6.	2.0	54.0	56.	437
438	Z - 4 - 6	3.5	40.0	13.0	5.	37.	5.	2.0	57.0	41.	438
439	Z - 4 - 7	1.8	28.0	12.0	5.	8.	1.	1.5	55.0	43.	439
440	Z - 4 - 8	2.8	211.0	18.0	5.	15.	4.	2.5	57.0	43.	440
441	Z - 4 - 9	4.5	21.0	15.0	5.	7.	6.	2.2	49.0	50.	441
442	Z - 4 - 10	1.2	29.0	20.0	5.	14.	10.	1.7	39.0	90.	442
443	Z - 4 - 11	1.5	208.0	18.0	5.	64.	24.	2.1	40.0	73.	443
444	Z - 4 - 12	2.0	263.0	18.0	5.	31.	26.	3.1	41.0	69.	444
MEAN		3.0	86.3	15.9	5.	23.	10.	1.9	48.2	54.	
COEF VAR		43.4	99.2	17.7	0.0	67.5	76.9	34.7	13.7	28.4	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
433	Z - 4 - 1	2.778	0.303	0.235	0.058	0.162	0.69	0.565	0.360	0.513	433
434	Z - 4 - 2	1.667	0.311	0.235	0.058	0.141	0.62	0.130	0.309	0.513	434
435	Z - 4 - 3	1.000	0.189	0.176	0.058	0.131	0.62	0.870	0.316	0.632	435
436	Z - 4 - 4	2.500	0.205	0.191	0.058	0.283	0.54	0.783	0.382	0.316	436
437	Z - 4 - 5	2.500	0.918	0.294	0.058	0.263	0.46	0.870	0.397	0.737	437
438	Z - 4 - 6	1.944	0.328	0.191	0.058	0.374	0.38	0.870	0.419	0.539	438
439	Z - 4 - 7	1.000	0.230	0.176	0.058	0.081	0.08	0.652	0.404	0.566	439
440	Z - 4 - 8	1.556	1.730	0.265	0.058	0.152	0.31	1.097	0.419	0.566	440
441	Z - 4 - 9	2.500	0.172	0.221	0.058	0.071	0.46	0.957	0.360	0.658	441
442	Z - 4 - 10	0.667	0.238	0.294	0.058	0.141	0.77	0.739	0.287	1.184	442
443	Z - 4 - 11	0.833	1.705	0.265	0.058	0.646	1.85	0.913	0.294	0.961	443
444	Z - 4 - 12	1.111	2.156	0.265	0.058	0.313	2.00	1.348	0.301	0.908	444
MEAN		1.671	0.707	0.234	0.058	0.230	0.73	0.815	0.354	0.716	
COEF VAR		43.4	99.2	17.7	0.0	67.5	76.9	34.7	13.7	28.4	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Z-35

TOP 20 cm (LAKE Z_2 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

Z -36

DATA CODE	SAMPLE I.D.	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DATA CODE
545	Z - 2 - 1	29583.	9566.	125.	4891.	6094.	2573.	7642.	888.	545
546	Z - 2 - 2	29207.	7546.	124.	4740.	5686.	2494.	6741.	773.	546
547	Z - 2 - 3	28165.	7315.	125.	4326.	4955.	2457.	6146.	707.	547
548	Z - 2 - 4	30783.	7735.	137.	4723.	6037.	2639.	6805.	746.	548
550	Z - 2 - 5	32003.	8180.	142.	4784.	6166.	2800.	7034.	835.	550
551	Z - 2 - 6	30263.	8150.	148.	4191.	5772.	2256.	7506.	822.	551
552	Z - 2 - 7	33133.	8478.	149.	4815.	6447.	2850.	7285.	910.	552
553	Z - 2 - 8	35453.	9152.	159.	5520.	7878.	3142.	7795.	951.	553
555	Z - 2 - 9	39607.	10207.	188.	6049.	9529.	3678.	9119.	985.	555
556	Z - 2 - 10	32911.	6491.	148.	5038.	8372.	2908.	6787.	903.	556
557	Z - 2 - 11	32816.	8830.	165.	4243.	6173.	2779.	7520.	1103.	557
558	Z - 2 - 12	34557.	9236.	163.	4481.	7846.	3072.	8246.	1096.	558
560	Z - 2 - 13	28795.	7454.	139.	4274.	6256.	2533.	6410.	772.	560
561	Z - 2 - 14	26064.	6411.	126.	4035.	5819.	2220.	6026.	692.	561
562	Z - 2 - 15	26993.	6756.	125.	4143.	5927.	2445.	6397.	621.	562
563	Z - 2 - 16	27108.	6849.	134.	4129.	5849.	2471.	6285.	640.	563
565	Z - 2 - 17	28859.	7118.	129.	4544.	6656.	2614.	6629.	595.	565
566	Z - 2 - 18	29337.	7161.	140.	4471.	6888.	2646.	6921.	570.	566
567	Z - 2 - 19	30617.	7431.	134.	4612.	7764.	2784.	7260.	540.	567
568	Z - 2 - 20	29038.	7285.	141.	4430.	6824.	2780.	6928.	565.	568
MEAN		30764.6	7867.5	142.0	4621.9	6646.9	2707.0	7074.1	785.7	
COEF VAR		10.4	13.3	11.4	10.4	16.2	11.9	10.4	21.4	

DATA CODE	SAMPLE I.D.	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DATA CODE
545	Z - 2 - 1	0.35386	0.15379	0.11792	0.26582	0.26846	0.09309	0.16399	0.79286	545
546	Z - 2 - 2	0.34937	0.12132	0.11698	0.25761	0.25048	0.09023	0.14466	0.69018	546
547	Z - 2 - 3	0.33690	0.11760	0.11792	0.23511	0.21828	0.08889	0.13189	0.63125	547
548	Z - 2 - 4	0.36822	0.12436	0.12925	0.25668	0.26595	0.09548	0.14603	0.66607	548
550	Z - 2 - 5	0.38281	0.13151	0.13396	0.26000	0.27163	0.10130	0.15094	0.74554	550
551	Z - 2 - 6	0.36200	0.13103	0.13962	0.22777	0.25427	0.08162	0.16107	0.73393	551
552	Z - 2 - 7	0.39633	0.13630	0.14057	0.26168	0.28401	0.10311	0.15633	0.81250	552
553	Z - 2 - 8	0.42408	0.14714	0.15000	0.30000	0.34705	0.11368	0.16727	0.84911	553
555	Z - 2 - 9	0.47377	0.16410	0.17736	0.32875	0.41978	0.13307	0.19569	0.87946	555
556	Z - 2 - 10	0.39367	0.10436	0.13962	0.27380	0.36881	0.10521	0.14564	0.80625	556
557	Z - 2 - 11	0.39254	0.14196	0.15566	0.23060	0.27194	0.10054	0.16137	0.98482	557
558	Z - 2 - 12	0.41336	0.14849	0.15377	0.24353	0.34564	0.11114	0.17695	0.97857	558
560	Z - 2 - 13	0.34444	0.11984	0.13113	0.23228	0.27559	0.09164	0.13755	0.68929	560
561	Z - 2 - 14	0.31177	0.10307	0.11887	0.21929	0.25634	0.08032	0.12931	0.61786	561
562	Z - 2 - 15	0.32288	0.10862	0.11792	0.22516	0.26110	0.08846	0.13727	0.55446	562
563	Z - 2 - 16	0.32426	0.11011	0.12642	0.22440	0.25767	0.08940	0.13487	0.57143	563
565	Z - 2 - 17	0.34520	0.11444	0.12170	0.24696	0.29322	0.09457	0.14225	0.53125	565
566	Z - 2 - 18	0.35092	0.11513	0.13208	0.24299	0.30344	0.09573	0.14852	0.50893	566
567	Z - 2 - 19	0.36623	0.11947	0.12642	0.25065	0.34203	0.10072	0.15579	0.48214	567
568	Z - 2 - 20	0.34734	0.11712	0.13302	0.24076	0.30062	0.10058	0.14867	0.50446	568
MEAN		0.36800	0.12649	0.13401	0.25119	0.29281	0.09794	0.15180	0.70152	
COEF VAR		10.4	13.3	11.4	10.4	16.2	11.9	10.4	21.4	

TOP 20 cm (LAKE Z_2 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

Z -37

TOP 20 cm (LAKE Z_2 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

Z -38

DATA CODE	SAMPLE I.D.	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DATA CODE
545	Z - 2 - 1	1018.0	37.0	248.0	22.0	25.0	10.0	51.0	27.0	110.0	545
546	Z - 2 - 2	930.0	31.0	232.0	21.0	24.0	10.0	50.0	28.0	138.0	546
547	Z - 2 - 3	927.0	28.0	209.0	22.0	26.0	11.0	53.0	24.0	140.0	547
548	Z - 2 - 4	929.0	30.0	222.0	23.0	25.0	10.0	49.0	28.0	160.0	548
550	Z - 2 - 5	1034.0	28.0	225.0	24.0	24.0	9.0	42.0	25.0	120.0	550
551	Z - 2 - 6	896.0	25.0	223.0	21.0	23.0	12.0	42.0	29.0	118.0	551
552	Z - 2 - 7	1079.0	33.0	229.0	25.0	22.0	11.0	31.0	28.0	67.0	552
553	Z - 2 - 8	1174.0	33.0	238.0	28.0	23.0	14.0	31.0	31.0	65.0	553
555	Z - 2 - 9	1292.0	38.0	251.0	30.0	23.0	18.0	26.0	33.0	71.0	555
556	Z - 2 - 10	1113.0	31.0	219.0	25.0	22.0	19.0	22.0	23.0	65.0	556
557	Z - 2 - 11	1037.0	27.0	216.0	26.0	24.0	19.0	23.0	30.0	70.0	557
558	Z - 2 - 12	1042.0	30.0	224.0	27.0	21.0	21.0	23.0	37.0	56.0	558
560	Z - 2 - 13	818.0	24.0	197.0	20.0	19.0	19.0	17.0	26.0	65.0	560
561	Z - 2 - 14	786.0	21.0	184.0	18.0	20.0	17.0	16.0	21.0	59.0	561
562	Z - 2 - 15	883.0	24.0	187.0	18.0	20.0	16.0	14.0	21.0	47.0	562
563	Z - 2 - 16	828.0	25.0	186.0	19.0	20.0	14.0	13.0	22.0	46.0	563
565	Z - 2 - 17	902.0	27.0	191.0	20.0	24.0	18.0	11.0	22.0	40.0	565
566	Z - 2 - 18	895.0	27.0	196.0	20.0	23.0	15.0	11.0	22.0	39.0	566
567	Z - 2 - 19	906.0	31.0	198.0	20.0	23.0	16.0	10.0	22.0	41.0	567
568	Z - 2 - 20	903.0	29.0	192.0	21.0	25.0	19.0	11.0	23.0	42.0	568
MEAN		969.6	28.9	213.3	22.5	22.8	14.9	27.3	26.1	77.9	
COEF VAR		12.8	14.5	9.6	14.7	8.4	25.0	54.6	16.5	47.8	

DATA CODE	SAMPLE I.D.	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DATA CODE
545	Z - 2 - 1	0.1611	0.2284	0.6359	0.1803	0.3676	0.1010	3.9231	0.1985	1.4474	545
546	Z - 2 - 2	0.1472	0.1914	0.5949	0.1721	0.3529	0.1010	3.8462	0.2059	1.8158	546
547	Z - 2 - 3	0.1467	0.1728	0.5359	0.1803	0.3824	0.1111	4.0769	0.1765	1.8421	547
548	Z - 2 - 4	0.1470	0.1852	0.5692	0.1885	0.3676	0.1010	3.7692	0.2059	2.1053	548
550	Z - 2 - 5	0.1636	0.1728	0.5769	0.1967	0.3529	0.0909	3.2308	0.1838	1.5789	550
551	Z - 2 - 6	0.1418	0.1543	0.5718	0.1721	0.3382	0.1212	3.2308	0.2132	1.5526	551
552	Z - 2 - 7	0.1707	0.2037	0.5872	0.2049	0.3235	0.1111	2.3846	0.2059	0.8816	552
553	Z - 2 - 8	0.1858	0.2037	0.6103	0.2295	0.3382	0.1414	2.3846	0.2279	0.8553	553
555	Z - 2 - 9	0.2044	0.2346	0.6436	0.2459	0.3382	0.1818	2.0000	0.2426	0.9342	555
556	Z - 2 - 10	0.1761	0.1914	0.5615	0.2049	0.3235	0.1919	1.6923	0.1691	0.8553	556
557	Z - 2 - 11	0.1641	0.1667	0.5538	0.2131	0.3529	0.1919	1.7692	0.2206	0.9211	557
558	Z - 2 - 12	0.1649	0.1852	0.5744	0.2213	0.3088	0.2121	1.7692	0.2721	0.7368	558
560	Z - 2 - 13	0.1294	0.1481	0.5051	0.1639	0.2794	0.1919	1.3077	0.1912	0.8553	560
561	Z - 2 - 14	0.1244	0.1296	0.4718	0.1475	0.2941	0.1717	1.2308	0.1544	0.7763	561
562	Z - 2 - 15	0.1397	0.1481	0.4795	0.1475	0.2941	0.1616	1.0769	0.1544	0.6184	562
563	Z - 2 - 16	0.1310	0.1543	0.4769	0.1557	0.2941	0.1414	1.0000	0.1618	0.6053	563
565	Z - 2 - 17	0.1427	0.1667	0.4897	0.1639	0.3529	0.1818	0.8462	0.1618	0.5263	565
566	Z - 2 - 18	0.1416	0.1667	0.5026	0.1639	0.3382	0.1515	0.8462	0.1618	0.5132	566
567	Z - 2 - 19	0.1434	0.1914	0.5077	0.1639	0.3382	0.1616	0.7692	0.1618	0.5395	567
568	Z - 2 - 20	0.1429	0.1790	0.4923	0.1721	0.3676	0.1919	0.8462	0.1691	0.5526	568
MEAN		0.1534	0.1787	0.5471	0.1844	0.3353	0.1505	2.1000	0.1919	1.0257	
COEF VAR		12.8	14.5	9.6	14.7	8.4	25.0	54.6	16.5	47.8	

TOP 20 cm (LAKE Z_2 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

Z -39

TOP 20 cm (LAKE Z_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

Z -40

DATA CODE	SAMPLE I.D.	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DATA CODE
570	Z - 3 - 1	34022.	8528.	97.	3378.	2416.	1927.	4517.	1116.	570
571	Z - 3 - 2	****	****	****	****	****	****	****	****	571
572	Z - 3 - 3	31370.	12665.	263.	4406.	5388.	2525.	6351.	786.	572
573	Z - 3 - 4	31889.	8194.	107.	2873.	1775.	1668.	4255.	1256.	573
574	Z - 3 - 5	33610.	7002.	89.	2563.	2406.	1721.	5145.	1373.	574
576	Z - 3 - 6	29346.	6819.	93.	2301.	1432.	1458.	4164.	1272.	576
577	Z - 3 - 7	30743.	6684.	86.	2155.	1508.	1460.	4489.	1339.	577
578	Z - 3 - 8	31402.	6659.	84.	2118.	1573.	1492.	4679.	1334.	578
579	Z - 3 - 9	****	****	****	****	****	****	****	****	579
581	Z - 3 - 10	33413.	6869.	65.	2455.	2264.	1634.	4758.	1321.	581
582	Z - 3 - 11	****	****	****	****	****	****	****	****	582
583	Z - 3 - 12	35553.	7354.	84.	2845.	2866.	1853.	4681.	1171.	583
584	Z - 3 - 13	34747.	7357.	87.	2795.	2183.	1861.	4757.	1303.	584
586	Z - 3 - 14	36760.	7699.	85.	3074.	2395.	1967.	5047.	1408.	586
587	Z - 3 - 15	35385.	7199.	81.	2684.	2139.	1718.	5015.	1387.	587
588	Z - 3 - 16	38001.	7806.	88.	3016.	2332.	1885.	5257.	1403.	588
589	Z - 3 - 17	37938.	8029.	90.	3340.	2437.	2046.	5345.	1341.	589
591	Z - 3 - 18	36885.	7814.	91.	3359.	2831.	2056.	5489.	1311.	591
592	Z - 3 - 19	37276.	7945.	97.	3540.	3433.	2194.	5634.	1285.	592
593	Z - 3 - 20	37784.	8015.	97.	3669.	3941.	2294.	6024.	1247.	593
MEAN		34477.9	7802.2	99.1	2974.9	2548.2	1868.2	5035.7	1273.7	
COEF VAR		7.8	17.1	42.3	19.6	37.3	15.4	11.6	11.2	

DATA CODE	SAMPLE I.D.	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DATA CODE
570	Z - 3 - 1	0.40696	0.13711	0.09151	0.18359	0.10643	0.06972	0.09693	0.99643	570
571	Z - 3 - 2	*****	*****	*****	*****	*****	*****	*****	*****	571
572	Z - 3 - 3	0.37524	0.20362	0.24811	0.23957	0.23736	0.09135	0.13629	0.70179	572
573	Z - 3 - 4	0.38145	0.13174	0.10094	0.15614	0.07819	0.06035	0.09131	1.12143	573
574	Z - 3 - 5	0.40203	0.11257	0.08396	0.13929	0.10599	0.06226	0.11041	1.22589	574
576	Z - 3 - 6	0.35103	0.10963	0.08774	0.12505	0.06308	0.05275	0.08936	1.13571	576
577	Z - 3 - 7	0.36774	0.10746	0.08113	0.11712	0.06643	0.05282	0.09633	1.19554	577
578	Z - 3 - 8	0.37562	0.10706	0.07925	0.11511	0.06930	0.05398	0.10041	1.19107	578
579	Z - 3 - 9	*****	*****	*****	*****	*****	*****	*****	*****	579
581	Z - 3 - 10	0.39968	0.11043	0.06132	0.13342	0.09974	0.05912	0.10210	1.17946	581
582	Z - 3 - 11	*****	*****	*****	*****	*****	*****	*****	*****	582
583	Z - 3 - 12	0.42528	0.11823	0.07925	0.15462	0.12626	0.06704	0.10045	1.04554	583
584	Z - 3 - 13	0.41563	0.11828	0.08208	0.15190	0.09617	0.06733	0.10208	1.16339	584
586	Z - 3 - 14	0.43971	0.12378	0.08019	0.16707	0.10551	0.07116	0.10830	1.25714	586
587	Z - 3 - 15	0.42327	0.11574	0.07642	0.14587	0.09423	0.06216	0.10762	1.23839	587
588	Z - 3 - 16	0.45456	0.12550	0.08302	0.16391	0.10273	0.06820	0.11281	1.25268	588
589	Z - 3 - 17	0.45380	0.12908	0.08491	0.18152	0.10736	0.07402	0.11470	1.19732	589
591	Z - 3 - 18	0.44121	0.12563	0.08585	0.18255	0.12471	0.07438	0.11779	1.17054	591
592	Z - 3 - 19	0.44589	0.12773	0.09151	0.19239	0.15123	0.07938	0.12090	1.14732	592
593	Z - 3 - 20	0.45196	0.12886	0.09151	0.19940	0.17361	0.08300	0.12927	1.11339	593
MEAN		0.41241	0.12544	0.09345	0.16168	0.11225	0.06759	0.10806	1.13724	
COEF VAR		7.8	17.1	42.3	19.6	37.3	15.4	11.6	11.2	

Z -41

TOP 20 cm (LAKE Z_3 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

Z -41

TOP 20 CM (LAKE Z_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

Z -42

DATA CODE	SAMPLE I.D.	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DATA CODE
570	Z - 3 - 1	840.0	20.0	179.0	27.0	41.0	23.0	57.0	39.0	185.0	570
571	Z - 3 - 2	****	****	****	****	****	****	****	****	****	571
572	Z - 3 - 3	924.0	30.0	202.0	24.0	27.0	24.0	94.0	33.0	130.0	572
573	Z - 3 - 4	770.0	16.0	176.0	24.0	34.0	33.0	58.0	39.0	138.0	573
574	Z - 3 - 5	840.0	16.0	152.0	26.0	42.0	22.0	19.0	38.0	75.0	574
576	Z - 3 - 6	732.0	13.0	154.0	22.0	43.0	14.0	37.0	35.0	72.0	576
577	Z - 3 - 7	724.0	13.0	156.0	24.0	48.0	20.0	23.0	35.0	48.0	577
578	Z - 3 - 8	752.0	14.0	146.0	24.0	45.0	18.0	22.0	36.0	46.0	578
579	Z - 3 - 9	****	****	****	****	****	****	****	****	****	579
581	Z - 3 - 10	819.0	16.0	149.0	25.0	42.0	****	17.0	37.0	47.0	581
582	Z - 3 - 11	****	****	****	****	****	****	****	****	****	582
583	Z - 3 - 12	873.0	19.0	151.0	26.0	46.0	18.0	15.0	36.0	62.0	583
584	Z - 3 - 13	860.0	17.0	151.0	26.0	42.0	16.0	19.0	40.0	84.0	584
586	Z - 3 - 14	902.0	18.0	163.0	27.0	44.0	26.0	15.0	42.0	77.0	586
587	Z - 3 - 15	839.0	17.0	151.0	26.0	45.0	24.0	16.0	40.0	56.0	587
588	Z - 3 - 16	889.0	18.0	165.0	27.0	48.0	16.0	15.0	40.0	55.0	588
589	Z - 3 - 17	918.0	20.0	174.0	27.0	46.0	16.0	17.0	40.0	56.0	589
591	Z - 3 - 18	930.0	21.0	172.0	27.0	48.0	17.0	20.0	39.0	54.0	591
592	Z - 3 - 19	966.0	22.0	168.0	28.0	50.0	15.0	20.0	38.0	48.0	592
593	Z - 3 - 20	1017.0	23.0	171.0	28.0	47.0	15.0	18.0	37.0	44.0	593
MEAN		858.5	18.4	163.5	25.8	43.4	19.8	28.4	37.9	75.1	
COEF VAR		9.3	22.0	8.7	6.3	12.6	25.3	74.2	6.0	51.0	

DATA CODE	SAMPLE I.D.	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DATA CODE
570	Z - 3 - 1	0.1329	0.1235	0.4590	0.2213	0.6029	0.2323	4.3846	0.2868	2.4342	570
571	Z - 3 - 2	****	****	****	****	****	****	****	****	****	571
572	Z - 3 - 3	0.1462	0.1852	0.5179	0.1967	0.3971	0.2424	7.2308	0.2426	1.7105	572
573	Z - 3 - 4	0.1218	0.0988	0.4513	0.1967	0.5000	0.3333	4.4615	0.2868	1.8158	573
574	Z - 3 - 5	0.1329	0.0988	0.3897	0.2131	0.6176	0.2222	1.4615	0.2794	0.9868	574
576	Z - 3 - 6	0.1158	0.0802	0.3949	0.1803	0.6324	0.1414	2.8462	0.2574	0.9474	576
577	Z - 3 - 7	0.1146	0.0802	0.4000	0.1967	0.7059	0.2020	1.7692	0.2574	0.6316	577
578	Z - 3 - 8	0.1190	0.0864	0.3744	0.1967	0.6618	0.1818	1.6923	0.2647	0.6053	578
579	Z - 3 - 9	****	****	****	****	****	****	****	****	****	579
581	Z - 3 - 10	0.1296	0.0988	0.3821	0.2049	0.6176	****	1.3077	0.2721	0.6184	581
582	Z - 3 - 11	****	****	****	****	****	****	****	****	****	582
583	Z - 3 - 12	0.1381	0.1173	0.3872	0.2131	0.6765	0.1818	1.1538	0.2647	0.8158	583
584	Z - 3 - 13	0.1361	0.1049	0.3872	0.2131	0.6176	0.1616	1.4615	0.2941	1.1053	584
586	Z - 3 - 14	0.1427	0.1111	0.4179	0.2213	0.6471	0.2626	1.1538	0.3088	1.0132	586
587	Z - 3 - 15	0.1328	0.1049	0.3872	0.2131	0.6618	0.2424	1.2308	0.2941	0.7368	587
588	Z - 3 - 16	0.1407	0.1111	0.4231	0.2213	0.7059	0.1616	1.1538	0.2941	0.7237	588
589	Z - 3 - 17	0.1453	0.1235	0.4462	0.2213	0.6765	0.1616	1.3077	0.2941	0.7368	589
591	Z - 3 - 18	0.1472	0.1296	0.4410	0.2213	0.7059	0.1717	1.5385	0.2868	0.7105	591
592	Z - 3 - 19	0.1528	0.1358	0.4308	0.2295	0.7353	0.1515	1.5385	0.2794	0.6316	592
593	Z - 3 - 20	0.1609	0.1420	0.4385	0.2295	0.6912	0.1515	1.3846	0.2721	0.5789	593
MEAN		0.1358	0.1137	0.4193	0.2112	0.6384	0.2001	2.1810	0.2785	0.9884	
COEF VAR		9.3	22.0	8.7	6.3	12.6	25.3	74.2	6.0	51.0	

TOP 20 cm (LAKE Z_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

Z -43

TOP 20 cm (LAKE Z_4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

Z -44

DATA CODE	SAMPLE I.D.	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DATA CODE
594	Z - 4 - 1	35500.	10519.	121.	3926.	2743.	2202.	4767.	1044.	594
596	Z - 4 - 2	34064.	8883.	109.	3422.	2180.	1890.	4134.	1127.	596
597	Z - 4 - 3	32696.	12544.	267.	4846.	6619.	2770.	7025.	623.	597
598	Z - 4 - 4	32629.	12263.	252.	5128.	7313.	2851.	7245.	540.	598
599	Z - 4 - 5	34396.	11848.	238.	5438.	8184.	3012.	7826.	584.	599
600	Z - 4 - 6	33925.	11297.	231.	5193.	7839.	2985.	7566.	563.	600
602	Z - 4 - 7	34002.	11175.	237.	5146.	8090.	3021.	7839.	561.	602
603	Z - 4 - 8	31913.	10874.	233.	4722.	7035.	2756.	7266.	581.	603
604	Z - 4 - 9	33140.	11120.	231.	5034.	8025.	2925.	7908.	522.	604
606	Z - 4 - 10	32898.	10342.	211.	4665.	8218.	2810.	7886.	510.	606
607	Z - 4 - 11	37335.	11372.	223.	5563.	10629.	3327.	8954.	455.	607
608	Z - 4 - 12	33373.	10920.	176.	4883.	7697.	2721.	7077.	546.	608
609	Z - 4 - 13	33263.	10694.	172.	4733.	6791.	2508.	6366.	568.	609
611	Z - 4 - 14	33607.	10745.	172.	4676.	6932.	2506.	6423.	583.	611
612	Z - 4 - 15	31811.	10219.	153.	4334.	6227.	2340.	6064.	575.	612
613	Z - 4 - 16	31267.	10080.	150.	4205.	6182.	2335.	6086.	585.	613
614	Z - 4 - 17	32216.	9511.	165.	4378.	7227.	2424.	6830.	572.	614
616	Z - 4 - 18	33527.	9444.	168.	4614.	6224.	2591.	7365.	552.	616
617	Z - 4 - 19	35796.	9712.	163.	5075.	9106.	2710.	7828.	541.	617
618	Z - 4 - 20	50204.	9884.	181.	6470.	19151.	3818.	12622.	269.	618
MEAN		34378.1	10672.3	192.6	4822.5	7620.6	2725.1	7253.8	595.0	
COEF VAR		11.3	8.7	22.6	12.9	42.3	15.0	22.7	30.0	

DATA CODE	SAMPLE I.D.	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DATA CODE
594	Z - 4 - 1	0.42464	0.16912	0.11415	0.21337	0.12084	0.07967	0.10230	0.93214	594
596	Z - 4 - 2	0.40746	0.14281	0.10283	0.18598	0.09604	0.06838	0.08871	1.00625	596
597	Z - 4 - 3	0.39110	0.20167	0.25189	0.26337	0.29159	0.10022	0.15075	0.55625	597
598	Z - 4 - 4	0.39030	0.19715	0.23774	0.27870	0.32216	0.10315	0.15547	0.48214	598
599	Z - 4 - 5	0.41144	0.19048	0.22453	0.29554	0.36053	0.10897	0.16794	0.52143	599
600	Z - 4 - 6	0.40580	0.18162	0.21792	0.28223	0.34533	0.10800	0.16236	0.50268	600
602	Z - 4 - 7	0.40672	0.17966	0.22358	0.27967	0.35639	0.10930	0.16822	0.50089	602
603	Z - 4 - 8	0.38173	0.17482	0.21981	0.25663	0.30991	0.09971	0.15592	0.51875	603
604	Z - 4 - 9	0.39641	0.17878	0.21792	0.27359	0.35352	0.10582	0.16970	0.46607	604
606	Z - 4 - 10	0.39352	0.16627	0.19906	0.25353	0.36203	0.10166	0.16923	0.45536	606
607	Z - 4 - 11	0.44659	0.18283	0.21038	0.30234	0.46824	0.12037	0.19215	0.40625	607
608	Z - 4 - 12	0.39920	0.17556	0.16604	0.26538	0.33907	0.09844	0.15187	0.48750	608
609	Z - 4 - 13	0.39788	0.17193	0.16226	0.25723	0.29916	0.09074	0.13661	0.50714	609
611	Z - 4 - 14	0.40200	0.17275	0.16226	0.25413	0.30537	0.09067	0.13783	0.52054	611
612	Z - 4 - 15	0.38051	0.16429	0.14434	0.23554	0.27432	0.08466	0.13013	0.51339	612
613	Z - 4 - 16	0.37401	0.16206	0.14151	0.22853	0.27233	0.08448	0.13060	0.52232	613
614	Z - 4 - 17	0.38536	0.15291	0.15566	0.23793	0.31837	0.08770	0.14657	0.51071	614
616	Z - 4 - 18	0.40104	0.15183	0.15849	0.25076	0.27419	0.09374	0.15805	0.49286	616
617	Z - 4 - 19	0.42818	0.15614	0.15377	0.27582	0.40115	0.09805	0.16798	0.48304	617
618	Z - 4 - 20	0.60053	0.15891	0.17075	0.35163	0.84366	0.13813	0.27086	0.24018	618
MEAN		0.41122	0.17158	0.18174	0.26209	0.33571	0.09859	0.15566	0.53129	
COEF VAR		11.3	8.7	22.6	12.9	42.3	15.0	22.7	30.0	

TOP 20 cm (LAKE Z_4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

Z -45

TOP 20 cm (LAKE Z_4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

Z -46

DATA CODE	SAMPLE I.D.	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DATA CODE
594	Z - 4 - 1	883.0	21.0	201.0	27.0	42.0	18.0	94.0	42.0	212.0	594
596	Z - 4 - 2	816.0	18.0	187.0	25.0	40.0	21.0	70.0	40.0	216.0	596
597	Z - 4 - 3	1010.0	34.0	212.0	23.0	25.0	17.0	66.0	31.0	135.0	597
598	Z - 4 - 4	1012.0	32.0	215.0	23.0	25.0	11.0	32.0	30.0	92.0	598
599	Z - 4 - 5	1033.0	38.0	218.0	24.0	24.0	11.0	33.0	31.0	81.0	599
600	Z - 4 - 6	1043.0	33.0	214.0	23.0	23.0	10.0	34.0	30.0	77.0	600
602	Z - 4 - 7	1027.0	33.0	212.0	23.0	24.0	12.0	31.0	30.0	79.0	602
603	Z - 4 - 8	1003.0	32.0	198.0	22.0	25.0	15.0	35.0	31.0	84.0	603
604	Z - 4 - 9	998.0	31.0	211.0	22.0	22.0	17.0	31.0	30.0	75.0	604
606	Z - 4 - 10	927.0	27.0	200.0	21.0	22.0	11.0	32.0	29.0	78.0	606
607	Z - 4 - 11	1007.0	36.0	222.0	22.0	20.0	13.0	33.0	29.0	72.0	607
608	Z - 4 - 12	890.0	28.0	198.0	22.0	22.0	16.0	46.0	30.0	81.0	608
609	Z - 4 - 13	873.0	26.0	195.0	23.0	24.0	15.0	44.0	31.0	108.0	609
611	Z - 4 - 14	896.0	29.0	200.0	23.0	23.0	20.0	32.0	32.0	104.0	611
612	Z - 4 - 15	831.0	25.0	181.0	21.0	22.0	16.0	29.0	31.0	72.0	612
613	Z - 4 - 16	850.0	27.0	180.0	21.0	22.0	16.0	25.0	31.0	73.0	613
614	Z - 4 - 17	861.0	27.0	185.0	21.0	23.0	17.0	24.0	31.0	62.0	614
616	Z - 4 - 18	885.0	31.0	190.0	21.0	24.0	17.0	20.0	31.0	51.0	616
617	Z - 4 - 19	935.0	32.0	204.0	22.0	24.0	14.0	20.0	31.0	53.0	617
618	Z - 4 - 20	1055.0	29.0	284.0	12.0	22.0	9.0	22.0	29.0	36.0	618
MEAN		941.7	29.4	205.3	22.0	24.9	14.8	37.6	31.5	92.0	
COEF VAR		8.2	15.9	10.6	12.4	22.2	22.0	48.5	10.4	49.6	

DATA CODE	SAMPLE I.D.	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DATA CODE
594	Z - 4 - 1	0.1397	0.1296	0.5154	0.2213	0.6176	0.1818	7.2308	0.3088	2.7895	594
596	Z - 4 - 2	0.1291	0.1111	0.4795	0.2049	0.5882	0.2121	5.3846	0.2941	2.8421	596
597	Z - 4 - 3	0.1598	0.2099	0.5436	0.1885	0.3676	0.1717	5.0769	0.2279	1.7763	597
598	Z - 4 - 4	0.1601	0.1975	0.5513	0.1885	0.3676	0.1111	2.4615	0.2206	1.2105	598
599	Z - 4 - 5	0.1634	0.2346	0.5590	0.1967	0.3529	0.1111	2.5385	0.2279	1.0658	599
600	Z - 4 - 6	0.1650	0.2037	0.5487	0.1885	0.3382	0.1010	2.6154	0.2206	1.0132	600
602	Z - 4 - 7	0.1625	0.2037	0.5436	0.1885	0.3529	0.1212	2.3846	0.2206	1.0395	602
603	Z - 4 - 8	0.1587	0.1975	0.5077	0.1803	0.3676	0.1515	2.6923	0.2279	1.1053	603
604	Z - 4 - 9	0.1579	0.1914	0.5410	0.1803	0.3235	0.1717	2.3846	0.2206	0.9868	604
606	Z - 4 - 10	0.1467	0.1667	0.5128	0.1721	0.3235	0.1111	2.4615	0.2132	1.0263	606
607	Z - 4 - 11	0.1593	0.2222	0.5692	0.1803	0.2941	0.1313	2.5385	0.2132	0.9474	607
608	Z - 4 - 12	0.1408	0.1728	0.5077	0.1803	0.3235	0.1616	3.5385	0.2206	1.0658	608
609	Z - 4 - 13	0.1381	0.1605	0.5000	0.1885	0.3529	0.1515	3.3846	0.2279	1.4211	609
611	Z - 4 - 14	0.1418	0.1790	0.5128	0.1885	0.3382	0.2020	2.4615	0.2353	1.3684	611
612	Z - 4 - 15	0.1315	0.1543	0.4641	0.1721	0.3235	0.1616	2.2308	0.2279	0.9474	612
613	Z - 4 - 16	0.1345	0.1667	0.4615	0.1721	0.3235	0.1616	1.9231	0.2279	0.9605	613
614	Z - 4 - 17	0.1362	0.1667	0.4744	0.1721	0.3382	0.1717	1.8462	0.2279	0.8158	614
616	Z - 4 - 18	0.1400	0.1914	0.4872	0.1721	0.3529	0.1717	1.5385	0.2279	0.6711	616
617	Z - 4 - 19	0.1479	0.1975	0.5231	0.1803	0.3529	0.1414	1.5385	0.2279	0.6974	617
618	Z - 4 - 20	0.1669	0.1790	0.7282	0.0984	0.3235	0.0909	1.6923	0.2132	0.4737	618
MEAN		0.1490	0.1818	0.5265	0.1807	0.3662	0.1495	2.8961	0.2316	1.2112	
COEF VAR		8.2	15.9	10.6	12.4	22.2	22.0	48.5	10.4	49.6	

TOP 20 CM (LAKE Z_4 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

Z -47

	U_1	U_2	U_3	U_4
UTM Coordinates of Lake: Zone	16	16	16	16
N	5341800	5341900	5341850	5343100
E	652300	652800	653650	655400
Elevation of Lake above sea level	463 m	439 m	430 m	422 m
Lake depth at sampling point	2 m	1 m	10 m	16 m
Lake area	0.04 km^2	0.015 km^2	0.58 km^2	0.46 km^2
Lake catchment area	0.32 km^2	0.86 km^2	4.25 km^2	7.38 km^2
Bedrock geology	greenstone	greenstone	greenstone	greenstone
Surface water chemistry: pH	6.5	6.9	7.0	6.9
alkalinity (mg/ℓ $CaCO_3$)	8.75	32.50	16.60	13.95
Ca (ppm)	4.2	12.2	7.4	6.2
SO_4 (ppm)	8.3	7.9	10.6	5.0
Ambrosia level	12.5 cm	12.5 cm	12.5 cm	7 cm

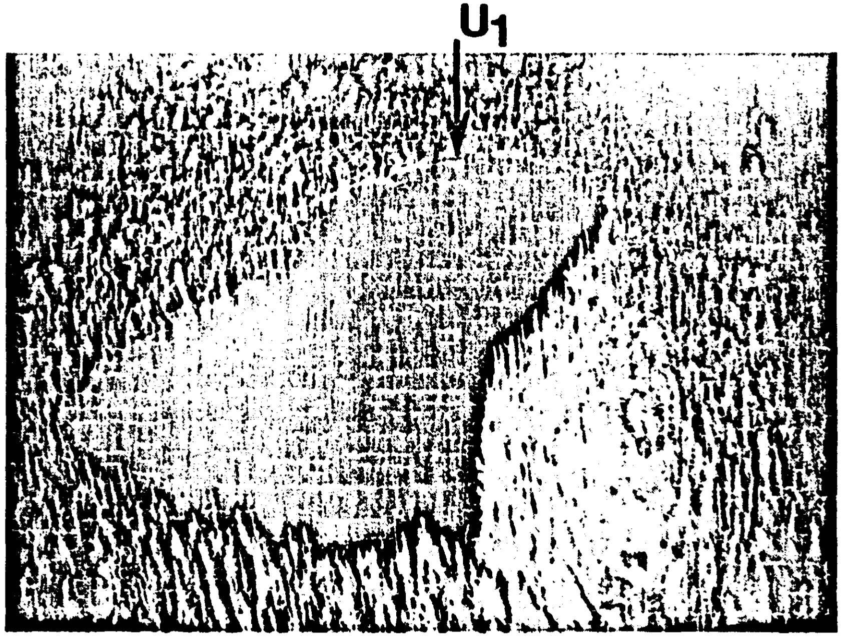
LAKE STAIRCASE
GREENSTONE

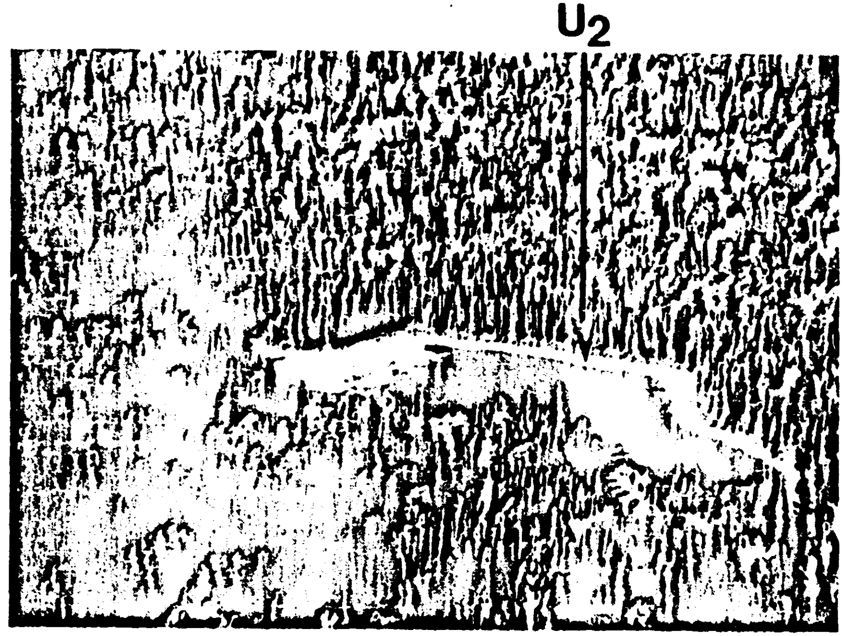
U SERIES

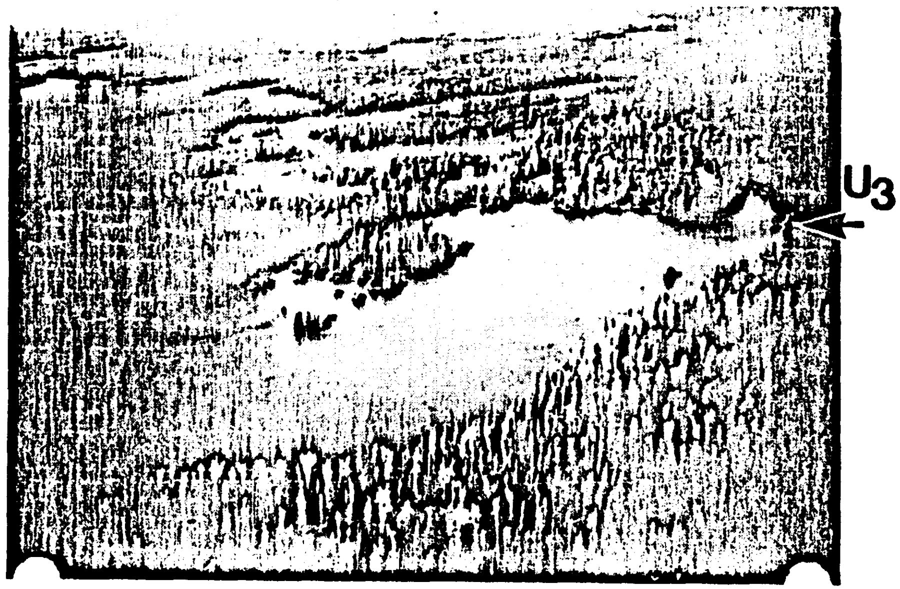
LAKE	U_1	U_2	U_3	U_4
pH	6.5	6.9	7.0	6.9

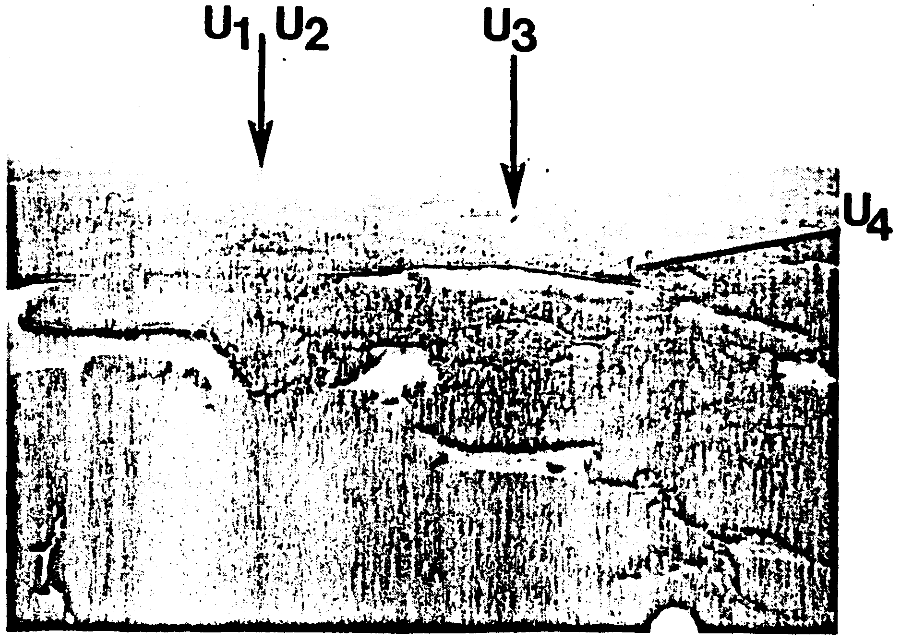
OBLIQUE AIRPHOTOGRAPHS OF LAKES

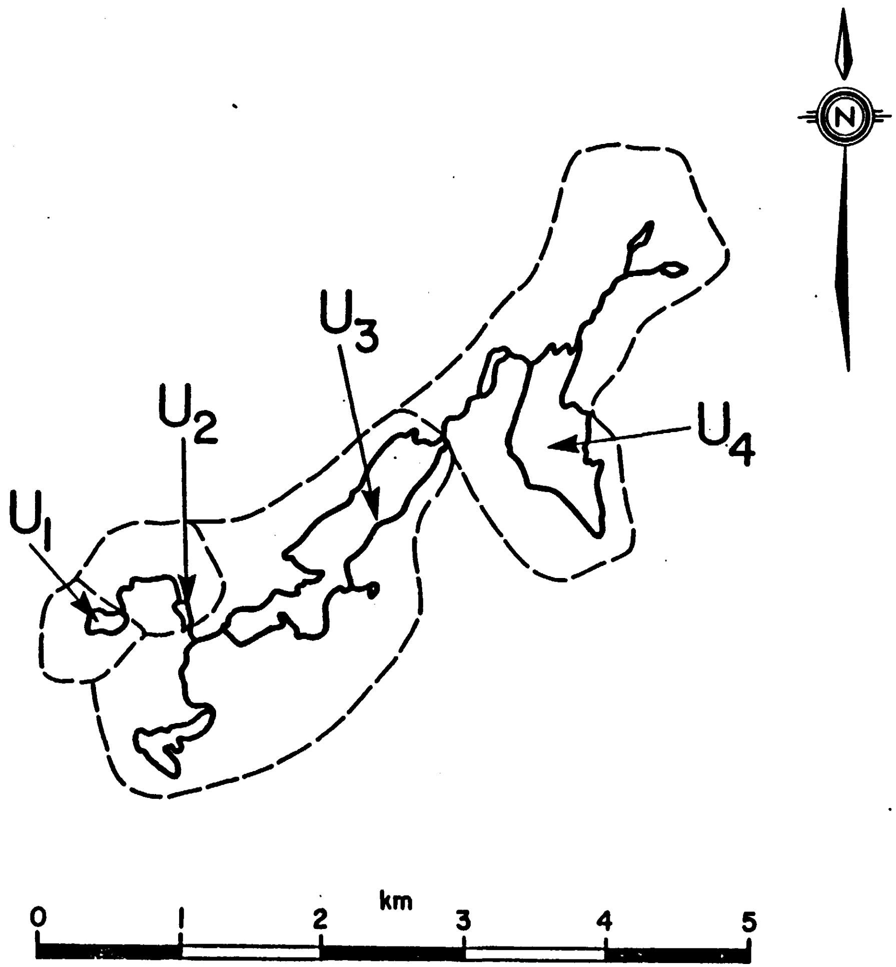
U-2











<u>Lake U-1</u> is in a thickly drift covered area. The basin has a simple morphometry and there is no rock outcrop along the shoreline. Surficial deposits (sand and gravel) appear to be continuous around the lake.

<u>Lake U-2</u> is a small, elongated basin in sand and gravel. The morphometry appears to be simple, and there is some muskeg at the north (inflow) end of the lake. The lake is shallow and has a bouldery shoreline.

<u>Lake U-3</u> (Furnival Lake) is a large, elongated rock basin with complex shoreline and several islands. Morphometry is also complex, and the lake shore is mostly bedrock and partly sand and gravel. No extensive muskeg along shoreline. Surficial deposits occur predominantly on the east side of the lake.

<u>Lake U-4</u> (Cruise Lake) is a medium size rock basin with a few islands. It has a deep central basin and a smaller basin in the south end of the lake. There is some muskeg at the north end of the lake and surficial deposits (sand and gravel) are common in the watershed.

GENERAL DESCRIPTION OF THE STAIRCASE SYSTEM

Lake	Parameter		
	pH range at surface	Colour	Secchi Depth(m)
U_1	6.30-6.35	humic	7.2
U_2	6.95-7.00	very humic	Secchi visible on bottom at 1.5 m
U_3	7.00-7.10	slightly humic	7.8
U_4	7.00-7.10	very humic	4.0

Lake U1

This shallow (2m) first order lake had low pH (6.3) and low specific conductivity (40 micromhos/cm). The lake was unstratified and therefore mixed to the bottom. This resulted in a substantial amount of particulate material suspended in the lake's water column. The high suspended solid load coupled with the humic condition of the lake (4 on a scale of 1-5) resulted in one of the lowest Secchi readings (1.2m) of the staircase study lakes.

The shoreline around the lake was dominated by cedar and where muskeg had developed, particularly near the lake's inlet and outlet, myrica gale (Myrica) and black spruce dominated. Aquatic plants in the lake's littoral and marginal zones were rare. Sedges, a few yellow water lilies (Nuphar) and a few wild irises were all that was noted during the brief sampling interval provided by the helicopter's fifteen minute sojourn there.

Lake U2

This pond was less acid than U1, pH = 7.0, colour = 3 and conductivity = 67. Like U1, it was thermally unstratified. The pond was surrounded by black spruce dominated muskeg and the majority of the paper birch (*Betula papyrifera*) that were seen on high ground around the pond were dead. Marginal vegetation around the edge of the pond was dominated by sedges. A few water lilies were observed in the littoral zone which extended across the entire length and width of the pond's bottom. The pond's maximum depth was estimated at approximately 2 m. The Secchi disc was visible on the pond's bottom in 1.5 m at the sampling site.

Dissolved Oxygen (Percent Saturation)

Depth (m)	U_1	U_2	U_3	U_4
0	100	100	100	100
1	100	106	100	100
2	88		91	100
3			93	98
4			85	95
5			84	99
6			105	95
7			94	92
8			92	84
9			77	82
10			69	81
11				77
12				78
13				68
14				60
15				49
16				42
17				
18				
19				
20				

Temperature °C

Depth (m)	U_1	U_2	U_3	U_4
0	25	26	23	23
1	25	25	23	23
2	25		22	23
3			20	21
4			17	17
5			16	14
6			15	12
7			13	10
8			9	9
9			7	8
10			6	8
11				7
12				7
13				7
14				6
15				5
16				5
17				
18				
19				
20				

Lake U3

Furnival Lake (U3) was 10 m deep at the sampling site. Maximum depth was 65 metres (Figure). Lake pH was neutral (7) and specific conductivity ranged from 48 at the surface to 80 micromhos/cm at the bottom. A weak thermocline was observed between 7 and 8 m and the lake was well oxygenated to the bottom.

The lake was slightly humic (2 on a scale of 1-5). Secchi transparency (2.5 m) exceeded U1 and U2 where algal standing crop and humic content were higher.

The terrestrial vegetation was similar to U2, however on higher ground, white spruce replaced black spruce as the dominant tree. The littoral zone was surveyed by canoe which provided a more complete listing of the dominant biota. Horsetails (*Equisetum fluviatile*), myrica gale (*Myrica*), alder (*Alnus*), white and yellow water lilies (*Nymphea* and *Nuphar* respectively), labrador tea (*Ledum*) as well as the pond weeds *Potamogeton robbensii*, *P. amplifolius* and, to a lesser extent, *P. natans* were scattered in sparse clumps in the shallow (1-2 m) littoral zone around the edge of the lake.

Planorbid snails (*Helisoma*) and physid snails were common on the rocks. Numerous large clams (*Anodonta* ?) abounded in the lake's shallow soft sediments (*Algal gyttja*). This was littered with chironomid cases and burrows. Ephemeropteran exuvia, probably *Ephemerella*, were found floating in the surface film in quiet back waters. Caddis fly cases (Trichoptera) clung to most of the submerged rocks and a few crayfish were observed near their base.

Phytoplankton biomass exceeded zooplankton biomass in each of the previously described U watershed study lakes. Although phytoplankton was very abundant in U1 it was only moderate in lakes U2 - U4.

Lake U4

Cruise Lake (U4) was 74 m deep according to the morphometric maps provided us by Steve Kerr of the Ontario Ministry of Natural Resources, Wawa District (Figure). The thermocline was located between 6 and 7 m and specific conductivity was 55 at the surface and 80 at the bottom.

The water was quite humic, 4 on a scale of 1 to 5, with a Secchi of 2 m. The lake's shoreline was dominated by granitic outcrops. As a result of the large rocky areas, the littoral zone vegetation was minimal.

Temperature Corrected (to 25°C) Conductivity

Depth (m)	U_1	U_2	U_3	U_4
0	40	66	46	53
1	35	68	49	53
2	47		64	53
3			66	49
4			63	50
5			59	50
6			66	52
7			57	51
8			59	37
9			63	34
10			76	31
11				29
12				28
13				26
14				24
15				80
16				
17				
18				
19				
20				

PHYTOPLANKTON

U-6

PHYTOPLANKTON	U1	U2	U3	U4
BACILLARIOPHYTA				
ACHNANTHES FLEXELLA	-	-	2	-
ACHNANTHES MINUTISSIMA	-	3	-	-
AMPHORA OVALIS	-	1	-	-
AMPHORA SP.	-	3	-	-
ASTERIONELLA FORMOSA	-	-	1	3
CYCLOTELLA SP.	2	-	2	2
CYCLOTELLA STELLIGERA	-	-	3	-
CYMBELLA CF. CISTULA	-	2	-	-
CYMBELLA LUNATA	2	2	-	-
CYMBELLA MINUTA	-	3	-	-
CYMBELLA SP.	-	3	-	-
DIPLONEIS FINNICA	-	-	-	-
EUNOTIA PECTINALIS	-	2	2	-
FRAGILARIA CAPUCINA	-	3	-	-
FRAGILARIA CROTONENSIS	-	2	2	3
GOMPHONEMA CF. LANCEOLATUM	-	2	-	-
GOMPHONEMA SP.	-	2	-	-
MELOSIRA ITALICA	-	3	-	2
MELOSIRA SP.	-	2	3	2
NAVICULA RADIOSA	-	2	-	-
NAVICULA SP.	2	-	2	1
NITZSCHIA SP.	-	3	-	-
PINNULARIA CF. ABAUJENSIS	-	-	-	-
PINNULARIA CF. MESOLEPTA	-	-	-	-
PINNULARIA SP.	2	-	-	-
RHIZOSOLENIA SP.	1	-	-	-
STAURONEIS ANCEPS	1	1	-	-
SURIRELLA SIGMOIDEA	-	-	1	-
SURIRELLA SP.	-	1	-	-
SYNEDRA DELICATISSIMA	3	4	-	2
SYNEDRA RADIANS	1	3	-	-
TABELLARIA FENESTRATA	1	3	4	3
TABELLARIA FLOCCULOSA	3	2	-	-
AVERAGE	(1.9)	(2.4)	(2.2)	(2.3)

PHYTOPLANKTON	U1	U2	U3	U4
CHLOROPHYTA				
ANKISTRODESMUS FALCATUS	1	-	-	-
BOTRYOCOCCUS BRAUNII	-	-	-	3
COELASTRUM SP.	-	2	-	-
COSMARIUM SP.	-	2	-	2
CRUCIGENIA RECTANGULARIS	2	-	2	-
DESMIDIUM BAILEYI	-	-	2	-
EUASTRUM CF. BINALE	-	2	-	-
EUASTRUM CRASSUM	1	-	-	-
GLOEOCYSTIS GIGAS	-	3	-	-
GLOEOCYSTIS SP.	-	3	-	-
GONATOZYGON SP.	-	2	-	-
MICRASTERIAS RADIATA	-	1	-	-
OEDOGONIUM SP.	-	1	-	-
OOCYSTIS PUSILLA	3	3	-	-
PEDIASTRUM BORYANUM	-	-	1	-
PEDIASTRUM TETRAS	3	-	-	-
SCENEDESMUS CF. BIJUGA	-	1	-	-
SCENEDESMUS QUADRICAUDA	-	2	-	-
STAURASTRUM ANATINUM	-	-	-	2
STAURASTRUM ARCTISCON	-	-	-	1
STAURASTRUM CF. PARADOXUM	2	-	-	-
STAURASTRUM DICKIEI	-	-	1	-
STAURASTRUM LEPTOCLADUM	1	-	4	1
TETRAEDRON MINIMUM	3	-	3	-
XANTHIDIUM ANTILOPAEUM	1	-	-	-
AVERAGE	(1.9)	(2.0)	(2.2)	(1.8)

PHYTOPLANKTON	U1	U2	U3	U4
CHRYSOPHYTA				
CHROMULINA SP.	2	3	-	3
CHRYSOCHROMULINA SP.	-	4	3	-
CHRYSOSPHAERELLA LONGISPINA	1	-	-	5
DINOBRYON BAVARICUM	3	-	-	-
DINOBRYON DIVERGENS	-	3	5	4
EPIPYXIS SP.	-	-	-	1
MALLOMONAS CF. ALPINA	-	3	-	-
MALLOMONAS CF. CAUDATA	-	-	-	3
MALLOMONAS PSEUDOCORONATA	4	-	-	-
MALLOMONAS SP.	3	-	2	2
UROGLENOPSIS AMERICANA	-	-	5	5
AVERAGE	(2.6)	(3.3)	(3.8)	(3.3)

PHYTOPLANKTON	U1	U2	U3	U4
CRYPTOPHYTA				
CRYPTOMONAS EROSA	2	3	3	3
RHODOMONAS SP.	-	-	-	3
AVERAGE	(1.5)	(3.0)	(3.5)	(3.5)
CYANOPHYTA				
ANABAENA SP.	-	-	2	2
APHANOCAPSA ELACHISTA	-	-	-	3
APHANOCAPSA GREVILLEI	3	3	-	-
CHROOCOCCUS DISPERSUS	-	-	4	4
CHROOCOCCUS GIGANTEUS	-	2	-	-
CHROOCOCCUS SP.	1	2	-	-
COELOSPHAERIUM NAEGELIANUM	-	-	1	-
DACTYLOCOCCOPSIS ACICULARIS	2	-	2	2
DACTYLOTHECE SP.	2	-	-	-
GLOEOCAPSA RUPESTRIS	2	-	-	-
GLOEOTRICHIA ECHINULATA	-	-	3	-
GOMPHOSPHAERIA LACUSTRIS	2	3	3	3
LYNGBYA CF. VERSICOLOR	-	2	-	-
LYNGBYA SP.	-	2	-	-
MERISMOPEDIA PUNCTATA	-	3	-	-
MERISMOPEDIA TENUISSIMA	2	-	1	3
MICROCYSTIS AERUGINOSA	2	2	3	3
MICROCYSTIS FLOS-AQUAE	5	5	3	-
OCHROMONAS SP.	1	3	4	4
OSCILLATORIA TENUIS	-	-	2	2
RHABDODERMA SP	-	-	-	-
SYNECHOCYSTIS SP	-	-	-	-
AVERAGE	(2.3)	(2.7)	(2.4)	(2.8)
EUGLENOPHYTA				
TRACHELOMONAS SP.	-	-	3	-
AVERAGE	(---)	(---)	(3.0)	(---)

PHYTOPLANKTON	U1	U2	U3	U4
PYRROPHYTA				
CERATIUM CAROLINIANUM	-	2	-	-
CERATIUM HIRUNDINELLA	2	-	5	-
GLENODINIUM SP.	2	2	-	-
GYMNODINIUM SP.	1	3	-	-
PERIDINIUM INCONSPICUUM	3	2	-	-
PERIDINIUM SP.	-	-	3	-
AVERAGE	(2.0)	(2.3)	(4.0)	(---)

Comments

Although the green algae and diatoms remained relatively rich in terms of their number of taxa, the cyanophyta (blue green algae) increased in both species richness and total abundance in the neutral lakes "U" & "W". This was particularly true of the "U" lakes where the number of blue green algal taxa increased 3 fold from 7 in the acid lakes to 21 in the neutral lakes. Thus cyanophyta make a far greater contribution to the algal community in the neutral and alkaline lakes while the chrysophytes make a larger relative contribution in the acid lakes.

ZOOPLANKTON

ZOOPLANKTON	U1	U2	U3	U4
ZOOPLANKTON TO PHYTOPLANKTON BIOMASS RATIO	Z ≪ P	Z<P	Z<P	Z<P
CILIOPHORA				
HALTERIA SP.	19.0	-	-	-
TOTAL	19.0			
CLADOCERANS				
ALONA AFFINIS	-	2.0	3.0	-
ALONELLA EXIGUA	-	2.0	2.0	-
BOSMINA LONGIROSTRIS	15.0	-	5.0	5.0
CHYDORUS FAVIFORMIS	-	-	1.0	-
CHYDORUS PIGER	-	1.0	1.0	-
DAPHNIA PULEX	-	-	5.0	15.0
DIAPHANOSOMA BRACHYURUM	45.0	-	-	-
HOLOPEDIUM GIBBERUM	-	-	-	-
POLYPHEMUS PEDICULUS	-	-	-	1.0
TOTAL	60.0	5.0	12.0	21.0
COPEPODS				
COPEPODITES AND NAUPLII	12.0	16.0	27.0	112.0
CYCLOPS BICUSPIDATUS	55.0	-	10.0	20.0
DIAPTOMUS MINUTUS	70.0	12.0	5.0	5.0
MESOCYCLOPS EDAX	15.0	-	-	5.0
TOTAL	152.0	28.0	42.0	142.0
INSECTA				
CHAOBORUS	-	-	3.0	3.0
GYRINIDAE	-	-	0.2	-
TOTAL	-	-	3.2	3.0
MISCELLANEOUS				
ACTINOSPHAERIUM SP.	-	-	3.0	3.0
TOTAL	-	-	3.0	3.0
ROTIFERS				
ASPLANCHNA BRIGHTWELLI	-	-	-	4.0
CONOCHILUS SP.	-	-	10.0	-
KELLICOTIA LONGISPINA	320.0	12.0	4.0	15.0
KERATELLA COCHLEARIS	85.0	15.0	2.5	-
POLYARTHRA VULGARIS	-	-	4.5	10.0
TRICHOCERCA CYLINDRICUM	-	14.0	-	2.0
TOTAL	405.0	41.0	21.0	31.0

COMMENTS

In each of the lakes of this watershed, rotifer density was greater than copepod density which was greater than cladoceran density. Zooplankton abundance for each of these groups was greater in the headwater lake than in any of the others. This pattern was not repeated, however, in the other neutral staircase watershed (i.e. W1-W4).

Diatom Species	pH category	U1 Number Counted	U1 Relative Frequency (%)	U2 Number Counted	U2 Relative Frequency (%)	U3 Number Counted	U3 Relative Frequency (%)	U4 Number Counted	U4 Relative Frequency (%)
Achnanthes affinis	alp	12	1.48					10	1.57
Achnanthes deflexa	alp							15	2.36
Achnanthes exigua	alp			4	.46	8	1.00		
Achnanthes flexella	ind	5	.62	15	1.73	3	.37		
Achnanthes lanceolata	alp					2	.25		
Achnanthes linearis	alp			17	1.96				
Achnanthes microcephala	ind	31	3.81	13	1.50	10	1.25		
Achnanthes minutissima	ind	17	2.09	12	1.38	22	2.75		
Achnanthes pinnata	alp							26	4.09
Amphipleura pellucida	alp			1	.12				
Amphora ovalis	alp	9	1.11	2	.23	5	.62		
Anomoeoneis follis	ind			2	.23	15	1.87		
Anomoeoneis seriana var. brachysira	acb	22	2.71	75	8.64	14	1.75		
Anomoeoneis vitrea	alp	18	2.29	99	11.41	20	2.50		
Asterionella formosa	alp							8	1.26
Caloneis ventricosa	alp	2	.25	3	.35				
Cocconeis placentula	alp			2	.23	1	.13		
Cyclotella bodanica	alp			2	.23	30	3.75	8	1.26
Cyclotella comta	ind	11	1.35	2	.23	168	20.97	35	5.51
Cyclotella meneghiniana	alp	13	1.60	1	.12	13	1.62	8	1.26
Cyclotella stelligera	alp							7	1.10
Cyclotella angustata	alb			13	1.50				
Cymbella cesatii	ind	22	2.71	93	10.71	11	1.37		
Cymbella cistula	ind			12	1.38	3	.37		
Cymbella cistula var. gibbosa	ind			2	.23				
Cymbella cuspidata	alp	9	1.11			5	.62		
Cymbella hustedtii	-							1	.16
Cymbella lunata	-	3	.37	18	2.07	10	1.25	6	.94
Cymbella microcephala	ind			22	2.53	8	1.00		
Cymbella minuta	ind	5	.62	25	2.88	20	2.50	6	.94
Cymbella muelleri	alp			2	.23				
Cymbella ventricosa	alp	27	3.32						

SURFACE SEDIMENT DIATOMS

SURFACE SEDIMENT DIATOMS (CONT'D)

U-10

Diatom Species	pH category	U1 Number Counted	U1 Relative Frequency (%)	U2 Number Counted	U2 Relative Frequency (%)	U3 Number Counted	U3 Relative Frequency (%)	U4 Number Counted	U4 Relative Frequency (%)
Diploneis finnica	-			2	.23	10	1.25		
Epithemia adnata	alb							2	.31
Epithemia argus var. alpestris	alp					6	.75		
Eunotia arcus	acp	6	.74						
Eunotia curvata	acp							2	.31
Eunotia elegans	acp							1	.16
Eunotia flexuosa	acp	8	.98	2	.23	3	.37	1	.16
Eunotia gibbosa	-								
Eunotia glacialis	-	3	.37						
Eunotia incisa	acp							2	.31
Eunotia naegelii	acp			2	.23				
Eunotia pectinalis	acp	5	.62						
Eunotia pectinalis var. minor	acp							1	.16
Eunotia pectinalis var. ventricosa	acp					1	.12		
Eunotia praerupta	acp	2	.25	3	.35	1	.12	2	.31
Eunotia vanheurckii	acp								
Fragilaria breviatriata	-			9	1.04	5	.62		
Fragilaria construens	alp	13	1.60	5	.58	15	1.87	7	1.10
Fragilaria construens var. binodis	ind							2	.31
Fragilaria construens var. venter	alp							5	.79
Fragilaria leptostauron var. dubia	alp							3	.47
Fragilaria pinnata	alp			16	1.84	28	3.50	5	.79
Fragilaria pinnata var. intercedens	alp							1	.16
Fragilaria virescens	ind							6	.94
Fragilaria rhomboides	acp	19	2.38	11	1.27			1	.16
Fragilaria rhomboides v. amphipleuroides	-							1	.16
Gomphonema acuminatum	alp	3	.37	2	.23	1	.12	1	.16
Gomphonema angustatum	alp								
Gomphonema intricatum	alp	2	.25						
Gomphonema subtile	ind			2	.23	3	.75		
Melosira distans	acp			28	3.23	91	11.36	97	15.28
Melosira distans var. lirata	acp							32	5.04
Melosira italica	alp			19	2.19	87	10.86		
Melosira italica var. subarctica	alp							55	8.66
Melosira sp.	-	35	4.31						

Diatom Species	pH category	U1 Number Counted	U1 Relative Frequency (%)	U2 Number Counted	U2 Relative Frequency (%)	U3 Number Counted	U3 Relative Frequency (%)	U4 Number Counted	U4 Relative Frequency (%)
Navicula aurora	alp					1	.12		
Navicula bicephala	-			2	.23	4	.50		
Navicula capitata	alp	14	1.72						
Navicula cryptocephala	alp			4	.46			4	.63
Navicula elginensis var. rostrata	-	6	.74			4	.50		
Navicula gottlandica	-			6	.69				
Navicula hustedtii	-	8	.98						
Navicula jaernefeltii	acp							3	.47
Navicula minima	alp							1	.16
Navicula notha	-	5	.62	9	1.04	5	.62		
Navicula cf. peregrina	-	28	3.44						
Navicula pupula var. capitata	ind			6	.69	8	1.00		
Navicula pupula var. mutata	-							2	.31
Navicula pupula var. rectangularis	ind	27	3.32			6	.75		
Navicula pseudoscutiformis	-							4	.63
Navicula radiosa	ind	44	5.41	10	1.15	8	1.00		
Navicula radiosa var. parva	ind			20	2.30	7	.87	2	.31
Navicula radiosa var. tenella	ind							1	.16
Navicula subtilissima	acp	22	2.71	4	.46			1	.16
Neidium affine	ind	12	1.48	6	.69	5	.62		
Neidium affine var. amphirhynchus	ind			2	.23	4	.50		
Neidium hitchcockii	ind					2	.25		
Neidium iridis	ind	23	2.83	2	.23	4	.50		
Neidium iridis var. amphigomphus	ind								
Nitzschia acicularis	alp							1	.16
Nitzschia denticula	alp			17	1.96	20	2.50		
Nitzschia denticula var. curta	alp							1	.16
Nitzschia fonticola	alp	37	4.55	22	2.53	17	2.12	6	.94
Nitzschia intermedia	-	12	1.48						
Nitzschia kutzingiana	alp			8	.92			3	.47
Nitzschia linearis	alp			9	1.04				
Nitzschia oregana	-							1	.16
Nitzschia palea	ind	15	1.85	16	1.84	2	.25		
Nitzschia gracilis	-							3	.47

SURFACE SEDIMENT DIATOMS (CONT'D)

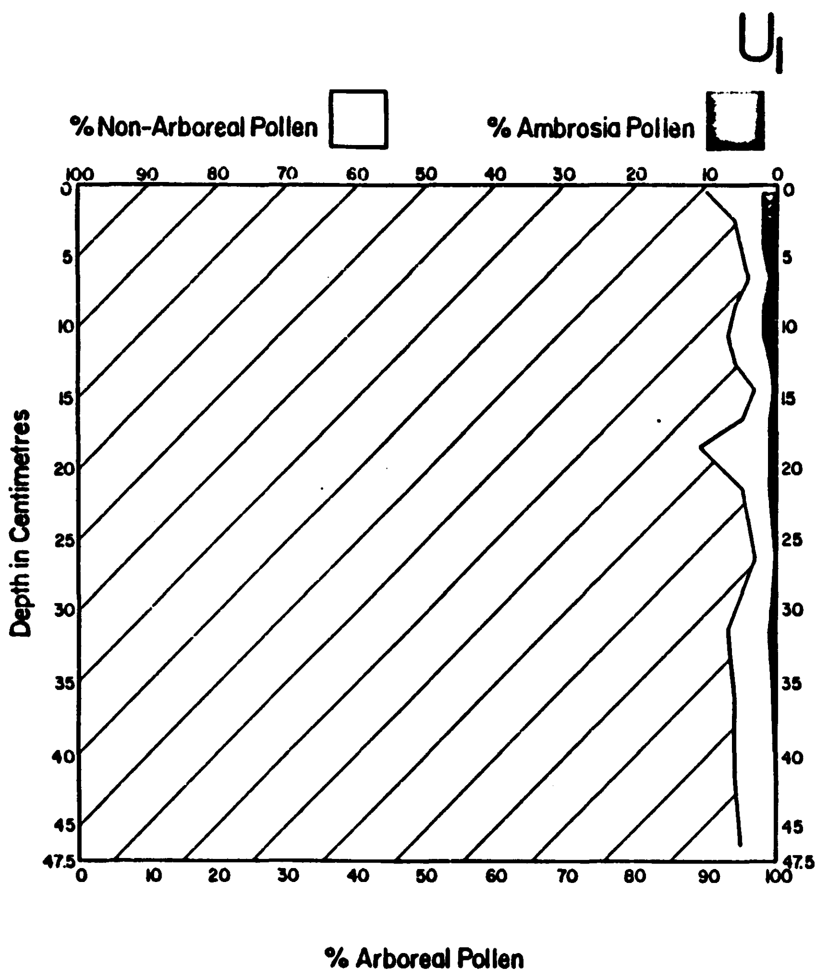
SURFACE SEDIMENT DIATOMS (CONT'D)

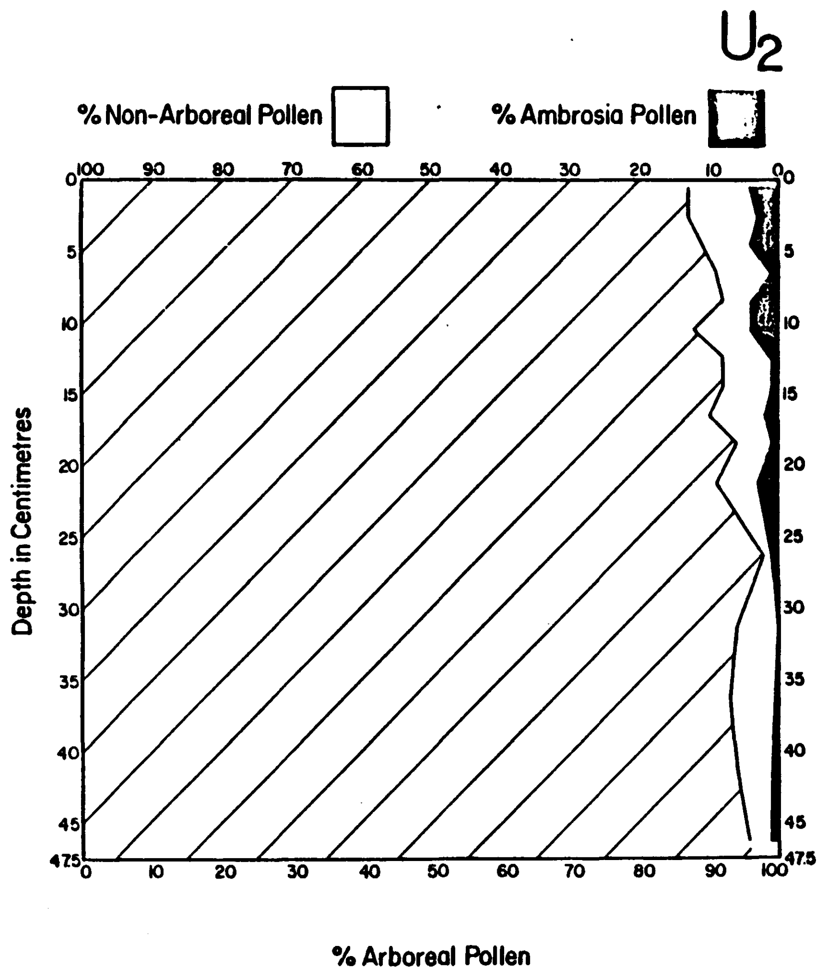
Diatom Species	pH category	U1 Number Counted	U1 Relative Frequency (%)	U2 Number Counted	U2 Relative Frequency (%)	U3 Number Counted	U3 Relative Frequency (%)	U4 Number Counted	U4 Relative Frequency (%)
Pinnularia abaujensis	ind	10	1.23						
Pinnularia abaujensis var. rostrata	ind	7	.86						
Pinnularia abaujensis var. subundulata	ind			4	.46	2	.25		
Pinnularia acuminata var. bielawskii	alp					2	.25		
Pinnularia biceps	acp	39	4.80	3	.35	1	.12		
Pinnularia divergens	acp	3	.37	6	.69				
Pinnularia divergentissima	-							1	.16
Pinnularia maior	acp	26	3.20	8	.92	14	1.75	1	.16
Pinnularia mesolepta	acp								
Pinnularia nodosa	acp							1	.16
Pinnularia rupestris	-							1	.16
Pinnularia stauroptera	-								
Pinnularia substomatophora	-							1	.16
Semiorbis hemicyclus	acb	8	.98	1	.12	1	.12		
Stauroneis anceps	ind			2	.23	3	.37	1	.16
Stauroneis anceps f. linearis	ind	8	.98						
Stauroneis phoenicenteron	ind	40	4.92	15	1.73	3	.37		
Stenopterobia intermedia	acp	6	.74			2	.25		
Surirella linearis	ind	2	.25			2	.25	2	.31
Surirella linearis var. constricta	ind	4	.49						
Synedra acus	ind			8	.92				
Synedra delicatissima	-	9	1.11	10	1.15				
Synedra radians	alp			14	1.61				
Synedra ulna	alp							1	.16
Tabellaria fenestrata	acp	21	2.58	65	7.49	45	5.62	211	33.20
Tabellaria flocculosa	acp	68	8.36	51	5.88	10	1.25	29	4.60
Multiplication Factor (to give # diatoms/mg. dry wt.)		834		625		861		547	

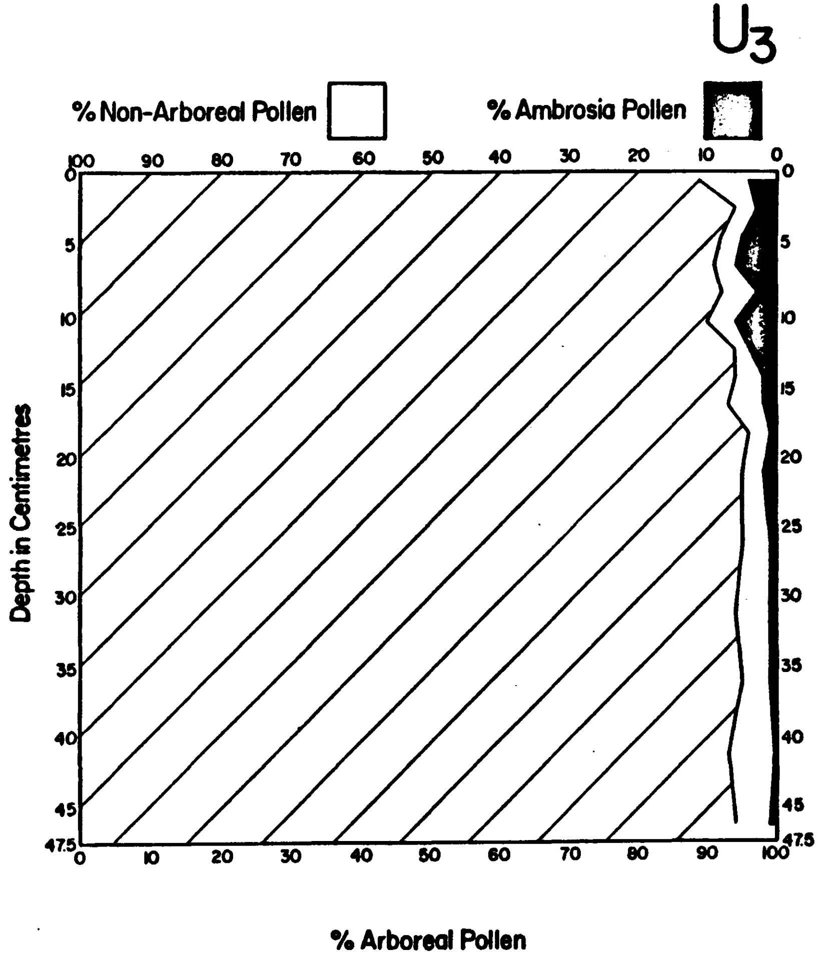
Descriptions of the downcore diatoms are included in Part I, Chapter III. A complete species list of the diatoms studied during the 1981 field and laboratory study is included in Section 5 of this part of the report (Part II)

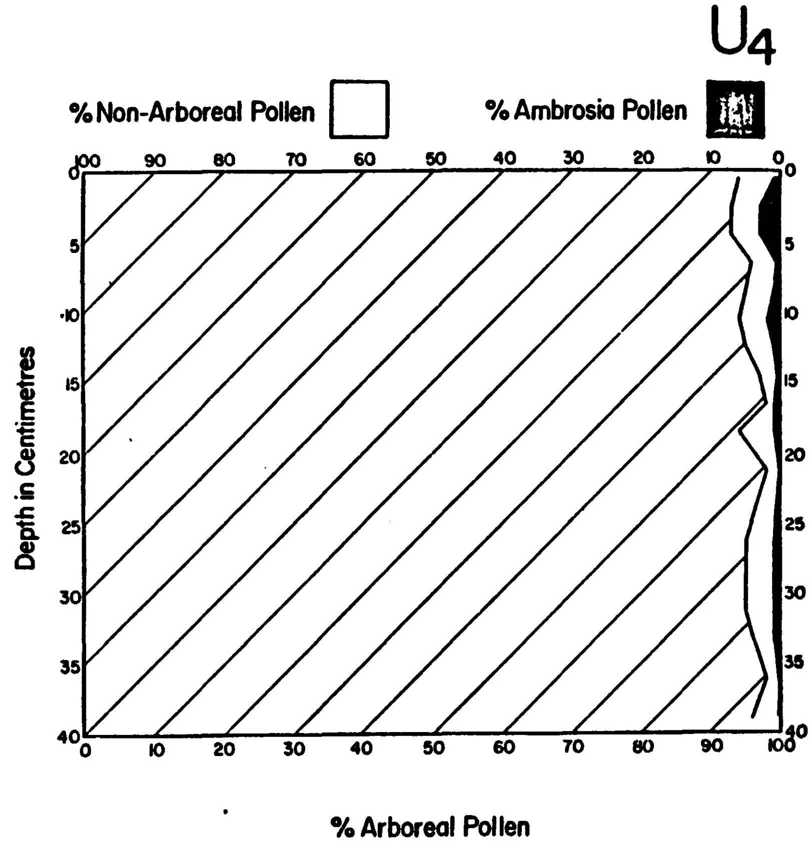
AMBROSIA RISE DIAGRAMS

U-14







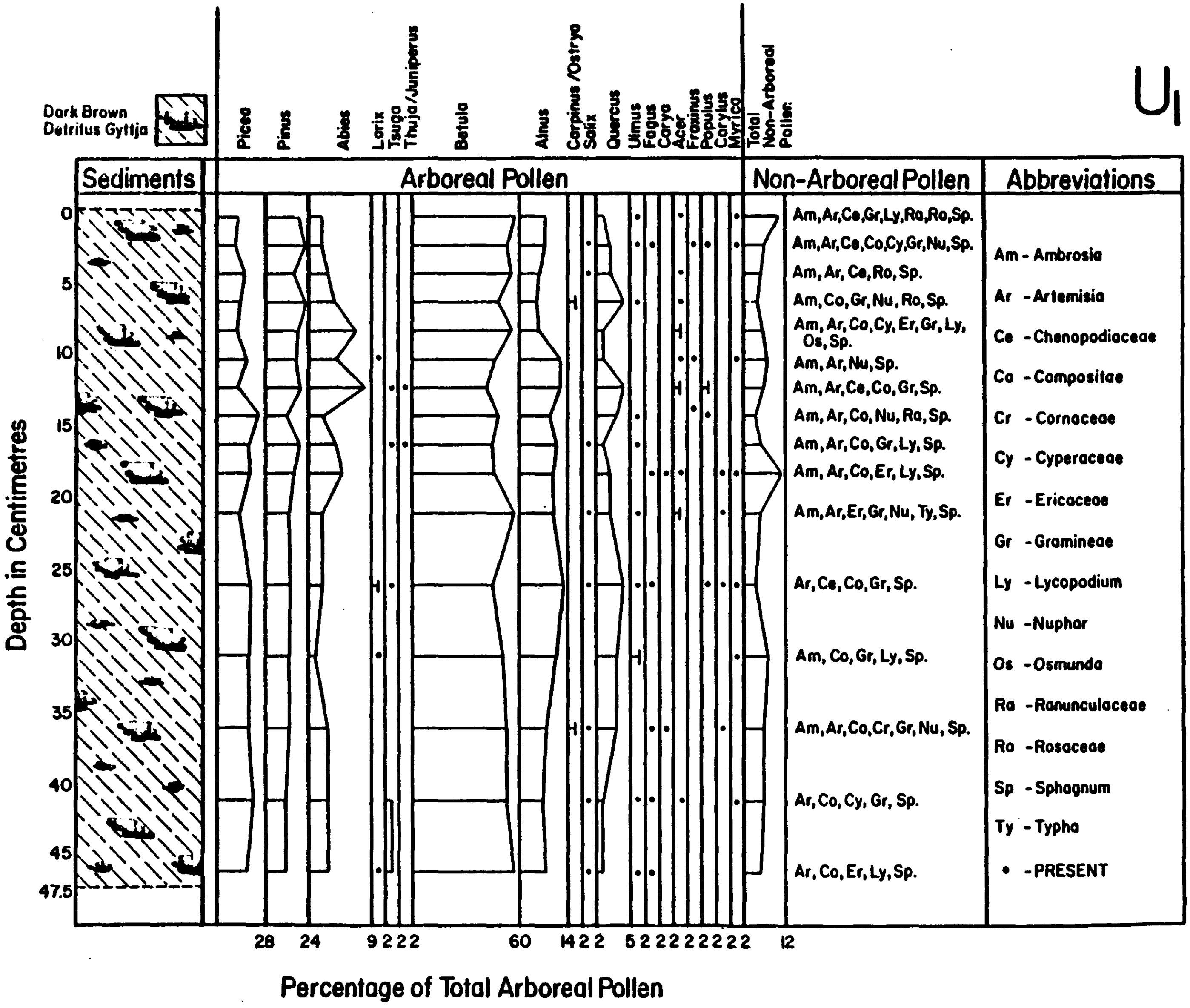


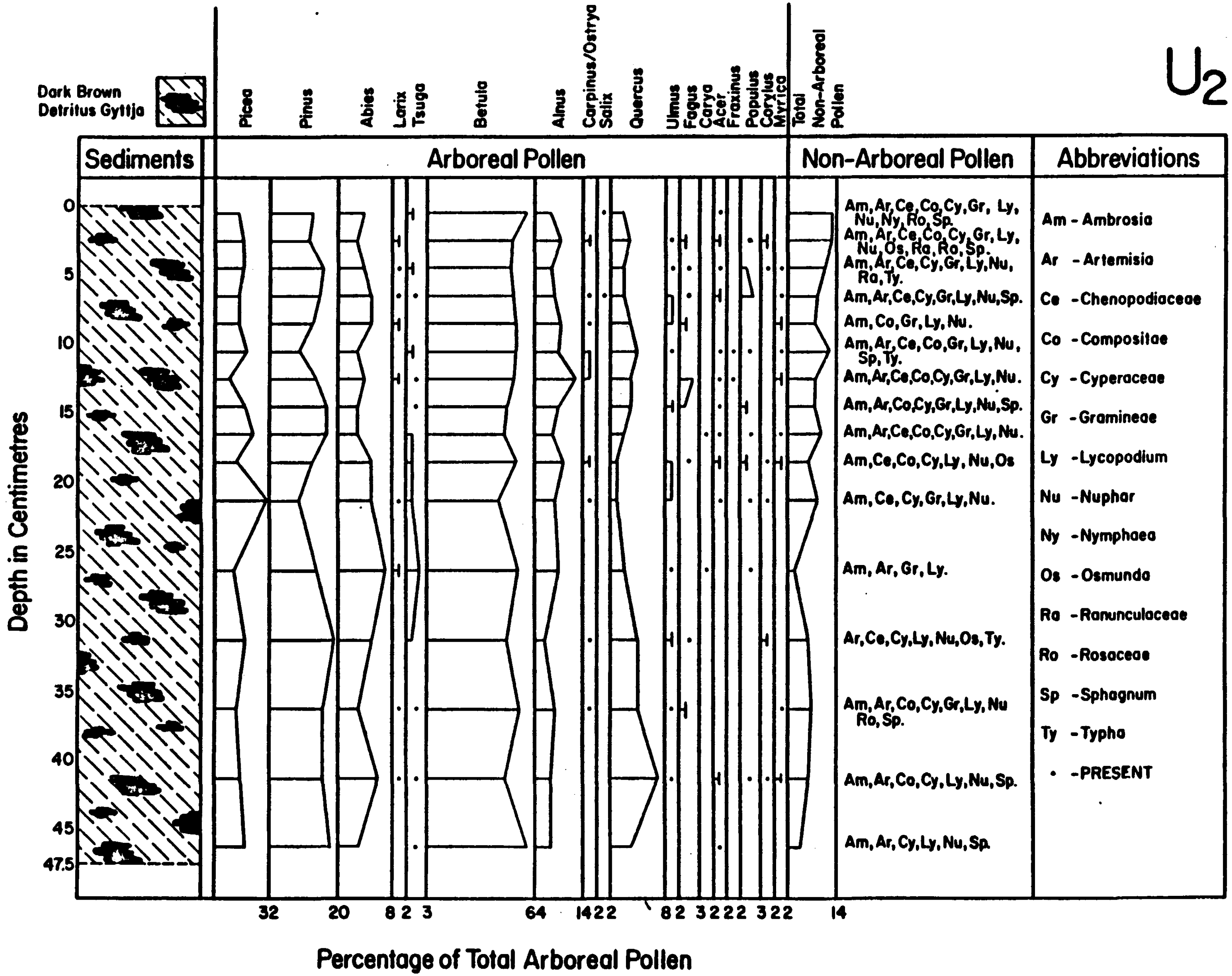
U-15

AMBROSIA RISE DIAGRAMS (CONT'D)

U-1Γ

POLLEN DIAGRAM

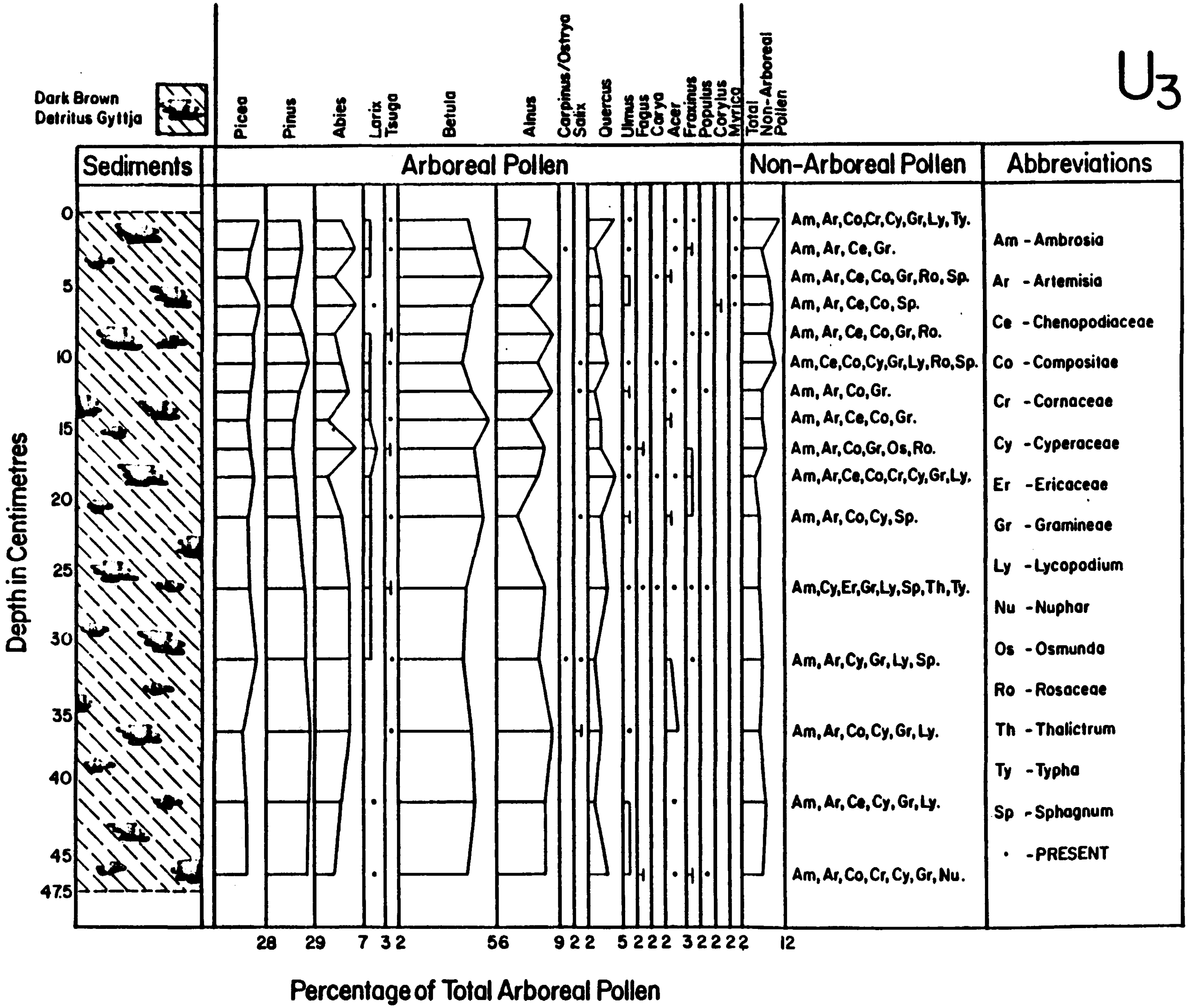


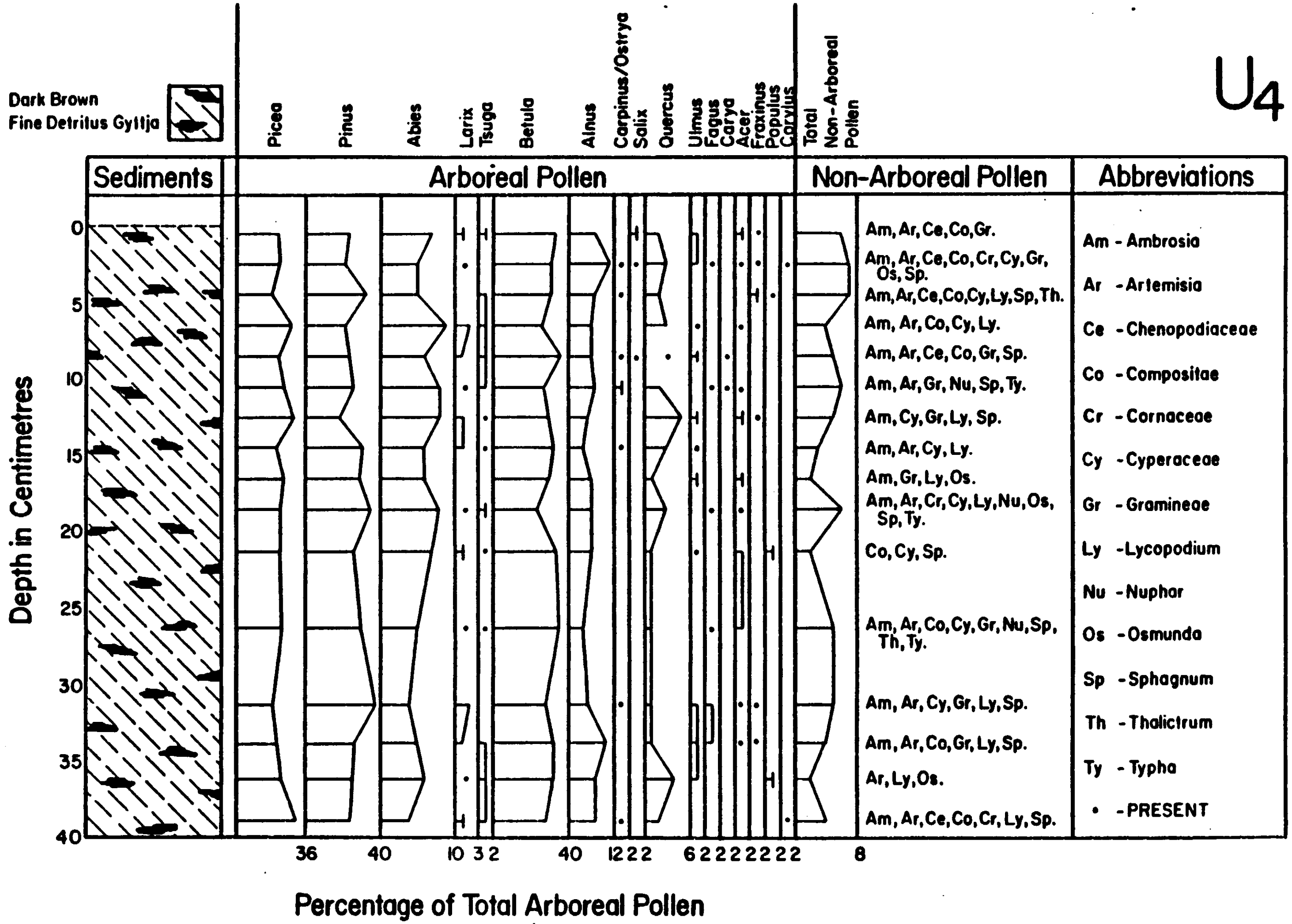


POLLEN DIAGRAM

U-17

POLLEN DIAGRAM





POLLEN DIAGRAM

U-20

U-20

U-21

U-21

TOP 20 cm (LAKE U_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

U-22

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
802	U - 1 - 1	******	10233.	6213.	179.	1997.	1030.	1818.	12367.	808.	401.	11.	802
803	U - 1 - 2	******	13107.	6884.	187.	1997.	962.	2616.	13367.	880.	432.	11.	803
804	U - 1 - 3	******	11882.	6327.	160.	1970.	870.	1629.	12061.	872.	389.	11.	804
805	U - 1 - 4	******	12053.	6272.	134.	1861.	1362.	1931.	11994.	883.	413.	11.	805
806	U - 1 - 5	******	11885.	5476.	120.	1937.	1028.	1725.	11679.	928.	424.	10.	806
808	U - 1 - 6	******	11406.	5621.	113.	1850.	1225.	1824.	10711.	843.	419.	11.	808
809	U - 1 - 7	******	11567.	5203.	108.	1890.	1095.	1629.	10658.	911.	408.	10.	809
810	U - 1 - 8	******	12030.	5193.	104.	1850.	1110.	1789.	10682.	887.	395.	10.	810
811	U - 1 - 9	******	11976.	5285.	95.	1850.	1187.	1870.	10269.	828.	470.	10.	811
812	U - 1 - 10	******	12748.	4550.	105.	1930.	1355.	1317.	11897.	773.	441.	12.	812
814	U - 1 - 11	******	11383.	5045.	100.	1810.	1093.	2273.	11552.	681.	416.	10.	814
815	U - 1 - 12	******	11741.	4694.	99.	1800.	969.	1875.	11776.	677.	425.	11.	815
816	U - 1 - 13	******	11200.	5662.	100.	1880.	1052.	1569.	11267.	645.	413.	11.	816
817	U - 1 - 14	******	11195.	5138.	100.	1822.	1111.	1736.	11803.	619.	425.	9.	817
818	U - 1 - 15	******	11766.	4867.	99.	1904.	1116.	1864.	11234.	704.	426.	10.	818
820	U - 1 - 16	******	11837.	4836.	94.	1823.	1172.	1670.	11240.	669.	414.	11.	820
821	U - 1 - 17	******	10485.	4739.	90.	1742.	861.	1506.	10906.	530.	414.	10.	821
822	U - 1 - 18	******	10848.	4203.	82.	1800.	950.	1489.	10952.	507.	420.	10.	822
823	U - 1 - 19	******	11069.	4509.	83.	1860.	1011.	1494.	10992.	586.	407.	11.	823
824	U - 1 - 20	******	10733.	3913.	76.	1800.	1068.	1395.	10669.	516.	413.	10.	824

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
802	U - 1 - 1	*******	0.12240	0.09989	0.16887	0.10853	0.04537	0.06577	0.26539	0.72143	0.06345	0.06790	802
803	U - 1 - 2	*******	0.15678	0.11068	0.17642	0.10853	0.04238	0.09465	0.28685	0.78571	0.06835	0.06790	803
804	U - 1 - 3	*******	0.14213	0.10172	0.15094	0.10707	0.03833	0.05894	0.25882	0.77857	0.06155	0.06790	804
805	U - 1 - 4	*******	0.14417	0.10084	0.12642	0.10114	0.06000	0.06986	0.25738	0.78839	0.06535	0.06790	805
806	U - 1 - 5	*******	0.14217	0.08804	0.11321	0.10527	0.04529	0.06241	0.25062	0.82857	0.06709	0.06173	806
808	U - 1 - 6	*******	0.13644	0.09037	0.10660	0.10054	0.05396	0.06599	0.22985	0.75268	0.06630	0.06790	808
809	U - 1 - 7	*******	0.13836	0.08365	0.10189	0.10272	0.04824	0.05894	0.22371	0.81339	0.06456	0.06173	809
810	U - 1 - 8	*******	0.14390	0.08349	0.09811	0.10054	0.04890	0.06472	0.22923	0.79196	0.06250	0.06173	810
811	U - 1 - 9	*******	0.14325	0.08497	0.08962	0.10054	0.05229	0.06766	0.22036	0.73929	0.07437	0.06173	811
812	U - 1 - 10	*******	0.15249	0.07315	0.09906	0.10489	0.05969	0.04765	0.25530	0.69018	0.06978	0.07407	812
814	U - 1 - 11	*******	0.13616	0.08111	0.09434	0.09837	0.04815	0.08224	0.24790	0.60804	0.06582	0.06173	814
815	U - 1 - 12	*******	0.14044	0.07547	0.09340	0.09783	0.04269	0.06784	0.25270	0.60446	0.06725	0.06790	815
816	U - 1 - 13	*******	0.13397	0.09103	0.09434	0.10217	0.04634	0.05677	0.24178	0.57589	0.06535	0.06790	816
817	U - 1 - 14	*******	0.13391	0.08260	0.09434	0.09902	0.04394	0.06281	0.25328	0.55268	0.06725	0.05556	817
818	U - 1 - 15	*******	0.14074	0.07825	0.09340	0.10348	0.04916	0.06744	0.24107	0.62857	0.06741	0.06173	818
820	U - 1 - 16	*******	0.14159	0.07775	0.08868	0.09908	0.05163	0.06042	0.24120	0.59732	0.06551	0.06790	820
821	U - 1 - 17	*******	0.12542	0.07619	0.08491	0.09467	0.03793	0.05449	0.23403	0.47321	0.06551	0.06173	821
822	U - 1 - 18	*******	0.12976	0.06757	0.07736	0.09783	0.04185	0.05387	0.23502	0.45268	0.06646	0.06173	822
823	U - 1 - 19	*******	0.13240	0.07249	0.07830	0.10109	0.04454	0.05405	0.23588	0.52321	0.06440	0.06790	823
824	U - 1 - 20	*******	0.12839	0.06291	0.07170	0.09783	0.04705	0.05047	0.22895	0.46071	0.06535	0.06173	824

TOP 20 CM (LAKE U_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

U-23

TOP 20 CM (LAKE U_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

U-24

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
802	U - 1 - 1	****	63.0	45.0	*****	52.	63.0	****	27.0	172.	802
803	U - 1 - 2	****	54.0	25.0	*****	65.	54.0	****	18.0	380.	803
804	U - 1 - 3	****	17.0	27.0	*****	24.	47.0	****	16.0	101.	804
805	U - 1 - 4	****	34.0	31.0	*****	93.	50.0	****	68.0	115.	805
806	U - 1 - 5	****	16.0	26.0	*****	21.	46.0	****	30.0	103.	806
808	U - 1 - 6	****	117.0	29.0	*****	23.	44.0	****	8.0	****	808
809	U - 1 - 7	****	12.0	30.0	*****	8.	39.0	****	18.0	77.	809
810	U - 1 - 8	****	15.0	26.0	*****	12.	45.0	****	26.0	92.	810
811	U - 1 - 9	****	55.0	27.0	*****	13.	46.0	****	28.0	607.	811
812	U - 1 - 10	****	15.0	30.0	*****	27.	42.0	****	9.0	75.	812
814	U - 1 - 11	****	14.0	27.0	*****	17.	38.0	****	16.0	72.	814
815	U - 1 - 12	****	15.0	25.0	*****	11.	37.0	****	24.0	74.	815
816	U - 1 - 13	****	15.0	27.0	*****	23.	39.0	****	26.0	81.	816
817	U - 1 - 14	****	24.0	30.0	*****	15.	35.0	****	24.0	67.	817
818	U - 1 - 15	****	16.0	29.0	*****	29.	40.0	****	29.0	65.	818
820	U - 1 - 16	****	15.0	29.0	*****	27.	36.0	****	13.0	68.	820
821	U - 1 - 17	****	16.0	32.0	*****	20.	28.0	****	32.0	139.	821
822	U - 1 - 18	****	15.0	29.0	*****	18.	17.0	****	14.0	71.	822
823	U - 1 - 19	****	16.0	28.0	*****	29.	26.0	****	14.0	78.	823
824	U - 1 - 20	****	16.0	27.0	*****	25.	15.0	****	16.0	71.	824

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
802	U - 1 - 1.	****	0.5164	0.662	****	0.525	4.846	****	0.199	2.263	802
803	U - 1 - 2	****	0.4426	0.368	****	0.657	4.154	****	0.132	5.000	803
804	U - 1 - 3	****	0.1393	0.397	****	0.242	3.615	****	0.118	1.329	804
805	U - 1 - 4	****	0.2787	0.456	****	0.939	3.846	****	0.500	1.513	805
806	U - 1 - 5	****	0.1311	0.382	****	0.212	3.538	****	0.221	1.355	806
808	U - 1 - 6	****	0.9590	0.426	****	0.232	3.385	****	0.059	17.974	808
809	U - 1 - 7	****	0.0984	0.441	****	0.081	3.000	****	0.132	1.013	809
810	U - 1 - 8	****	0.1230	0.382	****	0.121	3.462	****	0.191	1.211	810
811	U - 1 - 9	****	0.4508	0.397	****	0.131	3.538	****	0.206	7.987	811
812	U - 1 - 10	****	0.1230	0.441	****	0.273	3.231	****	0.066	0.987	812
814	U - 1 - 11	****	0.1148	0.397	****	0.172	2.923	****	0.118	0.947	814
815	U - 1 - 12	****	0.1230	0.368	****	0.111	2.846	****	0.176	0.974	815
816	U - 1 - 13	****	0.1230	0.397	****	0.232	3.000	****	0.191	1.066	816
817	U - 1 - 14	****	0.1967	0.441	****	0.152	2.692	****	0.176	0.882	817
818	U - 1 - 15	****	0.1311	0.426	****	0.293	3.077	****	0.213	0.855	818
820	U - 1 - 16	****	0.1230	0.426	****	0.273	2.769	****	0.096	0.895	820
821	U - 1 - 17	****	0.1311	0.471	****	0.202	2.154	****	0.235	1.829	821
822	U - 1 - 18	****	0.1230	0.426	****	0.182	1.308	****	0.103	0.934	822
823	U - 1 - 19	****	0.1311	0.412	****	0.293	2.000	****	0.103	1.026	823
824	U - 1 - 20	****	0.1311	0.397	****	0.253	1.154	****	0.118	0.934	824

TOP 20 cm (LAKE U_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

U-25

LAKE SEDIMENT CORE WEIGHT DATA

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

U-26

U1

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
532	U - 1 - 1	24.14	1.17	64.1	95.2	U - 1 - 7	26.24	1.73	62.8	93.4	538
533	U - 1 - 2	27.14	1.49	63.5	94.5	U - 1 - 8	36.09	1.93	63.3	94.7	539
534	U - 1 - 3	23.51	1.37	62.5	94.2	U - 1 - 9	34.55	1.88	63.5	94.6	540
556	U - 1 - 4	20.24	1.29	63.1	93.9	U - 1 - 10	33.81	1.77	64.0	94.8	541
557	U - 1 - 5	26.81	1.62	63.4	94.0	U - 1 - 11	23.19	1.56	62.8	93.3	542
537	U - 1 - 6	29.95	1.62	63.2	94.6	U - 1 - 12	22.79	1.73	61.6	92.4	543

U2

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
561	U - 2 - 1	36.85	3.19	39.5	91.3	U - 2 - 7	15.68	1.62	37.5	89.7	567
562	U - 2 - 2	24.69	2.32	38.7	90.6	U - 2 - 8	29.09	2.97	38.4	89.8	568
563	U - 2 - 3	23.04	2.26	39.8	90.2	U - 2 - 9	24.36	2.64	37.6	89.2	569
564	U - 2 - 4	25.68	2.57	39.1	90.0	U - 2 - 10	27.86	2.90	37.0	89.6	578
565	U - 2 - 5	29.83	2.86	38.1	90.4	U - 2 - 11	25.88	3.02	9.6	88.3	579
566	U - 2 - 6	31.78	3.13	38.2	90.2	U - 2 - 12	31.11	3.29	37.4	89.4	572

U3

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
581	U - 3 - 1	16.09	2.16	****	86.7	U - 3 - 7	15.03	2.02	46.7	86.6	587
582	U - 3 - 2	12.40	1.90	****	84.7	U - 3 - 8	14.09	1.97	47.9	86.0	607
583	U - 3 - 3	11.18	1.79	50.2	84.0	U - 3 - 9	10.87	1.80	49.2	83.4	608
584	U - 3 - 4	12.99	1.95	****	85.0	U - 3 - 10	13.98	2.01	****	85.6	590
585	U - 3 - 5	15.93	2.09	49.1	86.9	U - 3 - 11	16.42	2.12	46.9	87.1	591
586	U - 3 - 6	14.22	2.06	48.5	85.5	U - 3 - 12	24.26	2.55	47.6	89.5	592

U4

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
610	U - 4 - 1	16.47	2.96	36.5	82.0	U - 4 - 7	28.53	4.01	35.9	85.9	616
611	U - 4 - 2	16.86	3.06	37.1	81.6	U - 4 - 8	13.98	2.81	37.0	79.9	617
612	U - 4 - 3	17.09	2.94	37.5	82.8	U - 4 - 9	*****	*****	****	****	***
613	U - 4 - 4	18.80	3.15	37.2	83.2	U - 4 - 10	*****	*****	****	****	***
614	U - 4 - 5	13.48	2.91	36.2	78.4	U - 4 - 11	*****	*****	****	****	***
615	U - 4 - 6	15.96	2.76	37.5	82.7	U - 4 - 12	*****	*****	****	****	***

LAKE SEDIMENT CORE WEIGHT DATA

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

U-27

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

U1

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
532	U - 1 - 1	140200.	11282.	3670.	83.	1560.	914.	1417.	11620.	567.	491.	14.	532
533	U - 1 - 2	142100.	11234.	3441.	76.	1640.	918.	1429.	9592.	558.	457.	14.	533
534	U - 1 - 3	138200.	11771.	4090.	88.	1690.	950.	1412.	10310.	594.	512.	15.	534
556	U - 1 - 4	88000.	12274.	3962.	80.	1970.	986.	1413.	11130.	592.	442.	14.	556
557	U - 1 - 5	112900.	9587.	3364.	71.	1410.	743.	1173.	8592.	477.	330.	10.	557
537	U - 1 - 6	130200.	11860.	3617.	78.	1550.	899.	1361.	9896.	575.	442.	13.	537
538	U - 1 - 7	144100.	11318.	3557.	77.	1600.	921.	1395.	1011.	544.	437.	13.	538
539	U - 1 - 8	114300.	10882.	3445.	73.	1580.	902.	1371.	9836.	532.	421.	12.	539
540	U - 1 - 9	87700.	10786.	3572.	74.	1580.	937.	1442.	1077.	522.	465.	13.	540
541	U - 1 - 10	94400.	10954.	3346.	67.	1380.	889.	1393.	1016.	531.	421.	13.	541
542	U - 1 - 11	110700.	11219.	3506.	69.	1590.	895.	1507.	1050.	535.	445.	14.	542
543	U - 1 - 12	101200.	10608.	3077.	56.	1580.	993.	1330.	9396.	493.	405.	12.	543
MEAN		117000.	11148.	3554.	74.	1594.	912.	1387.	7044.	543.	439.	13.	
COEF VAR		17.5	5.9	7.3	10.6	8.8	6.6	5.6	61.2	6.4	9.9	9.6	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
532	U - 1 - 1	0.51355	0.13495	0.05900	0.07830	0.06478	0.04026	0.05127	0.24936	0.50625	0.07769	0.08642	532
533	U - 1 - 2	0.52051	0.13438	0.05532	0.07170	0.08913	0.04044	0.05170	0.20534	0.49821	0.07231	0.08642	533
534	U - 1 - 3	0.50623	0.14080	0.06576	0.08302	0.09185	0.04185	0.05109	0.22124	0.53036	0.08101	0.09259	534
556	U - 1 - 4	0.32234	0.14682	0.06370	0.07547	0.10707	0.04344	0.05112	0.23884	0.52857	0.06994	0.08642	556
557	U - 1 - 5	0.41355	0.11468	0.05408	0.06698	0.07663	0.03273	0.04244	0.18438	0.42589	0.05222	0.06173	557
537	U - 1 - 6	0.47692	0.14187	0.05815	0.07358	0.08424	0.03960	0.04924	0.21236	0.51339	0.06994	0.08025	537
538	U - 1 - 7	0.52784	0.13538	0.05719	0.07264	0.08696	0.04057	0.05047	0.02170	0.48571	0.06915	0.08025	538
539	U - 1 - 8	0.41868	0.13017	0.05539	0.06887	0.08587	0.03974	0.04960	0.21107	0.47500	0.06661	0.07407	539
540	U - 1 - 9	0.32125	0.12902	0.05743	0.06981	0.08587	0.04128	0.05217	0.02311	0.46607	0.07358	0.08025	540
541	U - 1 - 10	0.34579	0.13103	0.05379	0.06321	0.07500	0.03916	0.05040	0.02180	0.47411	0.06661	0.08025	541
542	U - 1 - 11	0.40549	0.13420	0.05637	0.06509	0.08641	0.03943	0.05452	0.02253	0.47768	0.07041	0.08642	542
543	U - 1 - 12	0.37070	0.12689	0.04947	0.05283	0.08587	0.04374	0.04812	0.20163	0.44018	0.06408	0.07407	543
MEAN		0.42857	0.13335	0.05714	0.07013	0.08664	0.04019	0.05018	0.15115	0.48512	0.06946	0.08076	
COEF VAR		17.5	5.9	7.3	10.6	8.8	6.6	5.6	61.2	6.4	9.9	9.6	

U2

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
561	U - 2 - 1	162500.	14706.	4699.	71.	2220.	2449.	2473.	9750.	425.	546.	20.	561
562	U - 2 - 2	180300.	13021.	4204.	61.	2050.	2130.	2187.	8562.	373.	482.	17.	562
563	U - 2 - 3	188800.	16091.	4578.	75.	2720.	2717.	2319.	9342.	424.	572.	22.	563
564	U - 2 - 4	195000.	15531.	4700.	73.	2340.	2759.	2479.	9324.	379.	610.	23.	564
565	U - 2 - 5	190200.	16302.	5308.	82.	2780.	2855.	2718.	10320.	397.	704.	26.	565
566	U - 2 - 6	188700.	18358.	5817.	86.	3230.	3221.	2862.	10710.	433.	738.	27.	566
567	U - 2 - 7	177900.	16792.	5935.	85.	2780.	2919.	2829.	10530.	371.	705.	25.	567
568	U - 2 - 8	180600.	16726.	5628.	86.	2920.	3137.	2763.	10030.	350.	692.	24.	568
569	U - 2 - 9	174700.	17930.	6519.	98.	2820.	3246.	3104.	11700.	389.	810.	26.	569
578	U - 2 - 10	202800.	18500.	6285.	87.	2300.	3204.	3109.	10960.	413.	646.	25.	578
579	U - 2 - 11	316200.	17734.	6575.	85.	2170.	3149.	3235.	11860.	386.	682.	21.	579
572	U - 2 - 12	186100.	17788.	6377.	90.	2620.	3165.	3262.	11730.	399.	752.	26.	572
MEAN		195317.	16623.	5552.	82.	2596.	2917.	2778.	10402.	395.	662.	24.	
COEF VAR		19.3	9.4	14.4	11.7	12.9	11.2	12.4	9.7	6.1	13.6	12.2	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
561	U - 2 - 1	0.59524	0.17591	0.07555	0.06698	0.12065	0.10789	0.08947	0.20923	0.37946	0.08639	0.12346	561
562	U - 2 - 2	0.66044	0.15575	0.06759	0.05755	0.11141	0.09604	0.07912	0.18373	0.33304	0.07627	0.10494	562
563	U - 2 - 3	0.69158	0.19248	0.07360	0.07075	0.14783	0.11969	0.08390	0.20047	0.37857	0.09051	0.13580	563
564	U - 2 - 4	0.71429	0.18578	0.07556	0.06387	0.13804	0.12154	0.08909	0.20009	0.33839	0.09652	0.14198	564
565	U - 2 - 5	0.69670	0.19500	0.08534	0.07736	0.15109	0.12577	0.09834	0.22146	0.35446	0.11139	0.16049	565
566	U - 2 - 6	0.69121	0.21959	0.09352	0.08113	0.17554	0.14189	0.10355	0.22583	0.38661	0.11677	0.16667	566
567	U - 2 - 7	0.65165	0.20086	0.09542	0.08019	0.15109	0.12859	0.10235	0.22597	0.33125	0.11155	0.15432	567
568	U - 2 - 8	0.66154	0.20007	0.09048	0.08113	0.15870	0.13819	0.09996	0.21524	0.31250	0.10949	0.14815	568
569	U - 2 - 9	0.63993	0.21447	0.10481	0.09245	0.15326	0.14300	0.11230	0.25107	0.34732	0.12816	0.16049	569
578	U - 2 - 10	0.74286	0.22129	0.10105	0.08208	0.12500	0.14115	0.11248	0.23519	0.36875	0.10222	0.15432	578
579	U - 2 - 11	1.15824	0.21213	0.10571	0.08019	0.11793	0.13372	0.11704	0.25451	0.34464	0.10791	0.12963	579
572	U - 2 - 12	0.68168	0.21278	0.10252	0.08491	0.14239	0.13943	0.11802	0.25172	0.35625	0.11599	0.16049	572
MEAN		0.71545	0.19884	0.08926	0.07697	0.14108	0.12849	0.10052	0.22321	0.35260	0.10468	0.14506	
COEF VAR		19.3	9.4	14.4	11.7	12.9	11.2	12.4	9.7	6.1	13.6	12.2	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK
(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

U3

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZN PPM	DATA CODE
581	U - 3 - 1	*******	28209.	14066.	242.	2660.	4756.	7658.	16570.	921.	1039.	37.	581
582	U - 3 - 2	*******	26696.	15183.	250.	2690.	4810.	7897.	17200.	866.	1152.	39.	582
583	U - 3 - 3	158700.	29002.	15364.	256.	3400.	4894.	8182.	17162.	954.	1130.	38.	583
584	U - 3 - 4	*******	27401.	15461.	253.	2950.	5072.	8355.	17890.	866.	1192.	40.	584
585	U - 3 - 5	163300.	29084.	16030.	263.	3330.	5621.	8576.	18270.	913.	1224.	39.	585
586	U - 3 - 6	150300.	28335.	15370.	254.	2930.	4920.	8406.	17690.	894.	1211.	37.	586
587	U - 3 - 7	178800.	27788.	17734.	268.	2960.	4578.	10588.	17630.	845.	1206.	36.	587
607	U - 3 - 8	127600.	29678.	12969.	232.	3410.	5052.	7128.	14280.	946.	1220.	48.	607
608	U - 3 - 9	141900.	30832.	12954.	230.	3480.	5316.	7256.	13962.	980.	1192.	56.	608
590	U - 3 - 10	*******	27858.	12610.	268.	2660.	4638.	6983.	13860.	861.	1259.	35.	590
591	U - 3 - 11	173200.	29075.	13118.	274.	3160.	4873.	7261.	14060.	856.	1360.	38.	591
592	U - 3 - 12	163300.	29771.	13339.	275.	3710.	5069.	7482.	14150.	841.	1310.	36.	592
MEAN		157138.	28644.	14517.	255.	3112.	4958.	7981.	16060.	895.	1208.	40.	
COEF VAR		10.0	3.9	10.4	5.7	10.9	5.7	11.8	10.8	5.0	6.5	14.6	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZN KK	DATA CODE
581	U - 3 - 1	*******	0.33743	0.22614	0.22830	0.14457	0.20952	0.27706	0.35558	0.82232	0.16440	0.22840	581
582	U - 3 - 2	*******	0.31933	0.24410	0.23585	0.14620	0.21189	0.28571	0.36910	0.77321	0.18228	0.24074	582
583	U - 3 - 3	0.58132	0.34691	0.24701	0.24151	0.18478	0.21559	0.29602	0.36828	0.85179	0.17880	0.23457	583
584	U - 3 - 4	*******	0.32776	0.24857	0.23368	0.16033	0.22344	0.30228	0.38391	0.77321	0.18861	0.24691	584
585	U - 3 - 5	0.59817	0.34789	0.25772	0.24811	0.18098	0.24762	0.31027	0.39206	0.81518	0.19367	0.24074	585
586	U - 3 - 6	0.55055	0.33894	0.24711	0.23962	0.15924	0.21233	0.30412	0.37961	0.79821	0.19161	0.22840	586
587	U - 3 - 7	0.65495	0.33239	0.28511	0.25283	0.16087	0.20167	0.38307	0.37833	0.75446	0.19082	0.22222	587
607	U - 3 - 8	0.46740	0.35500	0.20850	0.21887	0.18533	0.22256	0.25789	0.30644	0.84464	0.19304	0.29630	607
608	U - 3 - 9	0.51978	0.36880	0.20826	0.21698	0.18913	0.23413	0.26252	0.29961	0.87500	0.18861	0.34568	608
590	U - 3 - 10	*******	0.33323	0.20273	0.25283	0.14457	0.20432	0.25264	0.29742	0.76875	0.19921	0.21605	590
591	U - 3 - 11	0.63443	0.34779	0.21090	0.25849	0.17174	0.21467	0.26270	0.30172	0.76429	0.21519	0.23457	591
592	U - 3 - 12	0.59817	0.35611	0.21445	0.25943	0.20163	0.22330	0.27069	0.30365	0.75089	0.20728	0.22222	592
MEAN		0.57559	0.34263	0.23338	0.24096	0.16911	0.21842	0.28875	0.34464	0.79933	0.19113	0.24640	
COEF VAR		10.0	3.9	10.4	5.7	10.9	5.7	11.8	10.8	5.0	6.5	14.6	

U4

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
610	U - 4 - 1	160800.	37462.	20914.	774.	3170.	5349.	7232.	13430.	4670.	1403.	52.	610
611	U - 4 - 2	172800.	37452.	20037.	879.	3320.	5816.	6828.	12810.	1701.	1436.	50.	611
612	U - 4 - 3	192200.	36120.	20833.	935.	3580.	5351.	7147.	13630.	1697.	1493.	48.	612
613	U - 4 - 4	164400.	36537.	21764.	972.	3570.	5503.	7519.	14360.	1716.	1548.	48.	613
614	U - 4 - 5	171300.	35568.	20705.	924.	2950.	5941.	7276.	13720.	1662.	1476.	47.	614
615	U - 4 - 6	158300.	37909.	21375.	951.	3260.	6205.	7460.	14030.	1751.	1518.	51.	615
616	U - 4 - 7	151500.	38989.	22851.	994.	3410.	7244.	7981.	15060.	1780.	1653.	54.	616
617	U - 4 - 8	176600.	34750.	21126.	908.	3400.	6053.	7067.	13330.	1607.	1454.	47.	617
***	U - 4 - 9	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
***	U - 4 - 10	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
***	U - 4 - 11	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
***	U - 4 - 12	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
MEAN		168488.	36848.	21201.	917.	3333.	5933.	7314.	13796.	2073.	1498.	50.	
COEF VAR		7.0	3.5	3.7	6.9	5.9	9.8	4.4	4.7	47.4	4.9	4.8	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
610	U - 4 - 1	0.58901	0.44811	0.33624	0.73019	0.17228	0.23564	0.26165	0.28820	4.16964	0.22199	0.32099	610
611	U - 4 - 2	0.63297	0.44799	0.32214	0.82925	0.18043	0.25621	0.24703	0.27489	1.51875	0.22722	0.30864	611
612	U - 4 - 3	0.70403	0.43206	0.33494	0.88208	0.19457	0.23573	0.25857	0.29249	1.51518	0.23623	0.29630	612
613	U - 4 - 4	0.60220	0.43705	0.34990	0.91698	0.19402	0.24242	0.27203	0.30815	1.53214	0.24494	0.29630	613
614	U - 4 - 5	0.62747	0.42545	0.33288	0.87170	0.16033	0.26172	0.26324	0.29442	1.48393	0.23354	0.29012	614
615	U - 4 - 6	0.57985	0.45346	0.34365	0.89717	0.17717	0.27335	0.26990	0.30107	1.56339	0.24019	0.31481	615
616	U - 4 - 7	0.55495	0.46638	0.36738	0.93774	0.18533	0.31912	0.28875	0.32318	1.58928	0.26155	0.33333	616
617	U - 4 - 8	0.64689	0.41567	0.33965	0.85660	0.18478	0.26665	0.25568	0.28605	1.43482	0.23006	0.29012	617
***	U - 4 - 9	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
***	U - 4 - 10	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
***	U - 4 - 11	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
***	U - 4 - 12	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
MEAN		0.61717	0.44077	0.34085	0.86521	0.18111	0.26135	0.26461	0.29606	1.85089	0.23697	0.30633	
COEF VAR		7.0	3.5	3.7	6.9	5.9	9.8	4.4	4.7	47.4	4.9	4.8	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

U-31

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

U|

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
532	U - 1 - 1	9.0	27.0	25.0	*****	45.	26.	1.2	11.0	61.	532
533	U - 1 - 2	5.8	27.0	22.0	5.	117.	23.	2.9	11.0	66.	533
534	U - 1 - 3	9.0	51.0	25.0	18.	161.	36.	2.9	8.0	89.	534
556	U - 1 - 4	6.0	19.0	22.0	5.	13.	24.	1.4	14.0	72.	556
557	U - 1 - 5	5.0	49.0	16.0	5.	27.	23.	1.3	13.0	54.	557
537	U - 1 - 6	7.0	18.0	23.0	5.	37.	18.	1.6	7.0	66.	537
538	U - 1 - 7	7.0	19.0	24.0	5.	35.	21.	1.4	8.0	62.	538
539	U - 1 - 8	5.5	17.0	21.0	5.	33.	16.	1.1	6.0	60.	539
540	U - 1 - 9	6.0	18.0	24.0	5.	46.	13.	1.6	9.0	56.	540
541	U - 1 - 10	9.0	23.0	25.0	*****	42.	16.	0.9	4.0	58.	541
542	U - 1 - 11	4.5	20.0	24.0	5.	22.	14.	3.6	6.0	59.	542
543	U - 1 - 12	4.5	21.0	22.0	19.	19.	13.	0.7	14.0	54.	543
MEAN		6.5	25.8	22.8	8.	51.	20.	1.7	9.3	63.	
COEF VAR		24.8	43.9	10.6	70.2	90.6	31.8	50.7	34.5	14.8	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
532	U - 1 - 1	5.000	0.221	0.368	*****	0.455	2.00	0.522	0.081	0.803	532
533	U - 1 - 2	3.222	0.221	0.324	0.058	1.182	1.77	1.261	0.081	0.868	533
534	U - 1 - 3	5.000	0.418	0.368	0.209	1.828	2.77	1.261	0.059	1.171	534
556	U - 1 - 4	3.333	0.156	0.324	0.058	0.131	1.85	0.609	0.103	0.947	556
557	U - 1 - 5	2.778	0.402	0.235	0.058	0.273	1.77	0.565	0.096	0.711	557
537	U - 1 - 6	3.889	0.148	0.338	0.058	0.374	1.38	0.696	0.051	0.868	537
538	U - 1 - 7	3.889	0.156	0.353	0.058	0.354	1.62	0.609	0.059	0.816	538
539	U - 1 - 8	3.056	0.139	0.309	0.058	0.333	1.23	0.478	0.044	0.789	539
540	U - 1 - 9	3.333	0.148	0.353	0.058	0.465	1.00	0.696	0.066	0.737	540
541	U - 1 - 10	5.000	0.189	0.368	*****	0.424	1.23	0.391	0.029	0.763	541
542	U - 1 - 11	2.500	0.164	0.353	0.058	0.222	1.08	1.565	0.044	0.776	542
543	U - 1 - 12	2.500	0.172	0.324	0.221	0.192	1.00	0.304	0.103	0.711	543
MEAN		3.625	0.211	0.335	0.090	0.519	1.56	0.746	0.068	0.830	
COEF VAR		24.8	43.9	10.6	70.2	90.6	31.8	50.7	34.5	14.8	

U2

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
561	U - 2 - 1	4.5	66.0	34.0	5.	139.	9.	2.4	14.0	38.	561
562	U - 2 - 2	6.0	40.0	31.0	5.	49.	8.	2.3	14.0	36.	562
563	U - 2 - 3	4.5	63.0	37.0	5.	40.	11.	3.5	13.0	41.	563
564	U - 2 - 4	4.0	37.0	39.0	5.	55.	11.	3.6	16.0	42.	564
565	U - 2 - 5	4.5	36.0	43.0	5.	34.	8.	4.2	11.0	47.	565
566	U - 2 - 6	0.1	32.0	49.0	5.	27.	10.	3.0	17.0	50.	566
567	U - 2 - 7	9.0	38.0	49.0	5.	55.	6.	2.9	15.0	43.	567
568	U - 2 - 8	1.2	51.0	43.0	5.	34.	8.	1.7	10.0	45.	568
569	U - 2 - 9	5.5	40.0	51.0	5.	61.	10.	1.8	13.0	71.	569
578	U - 2 - 10	4.0	94.0	45.0	5.	64.	9.	2.7	20.0	65.	578
579	U - 2 - 11	3.5	47.0	48.0	5.	67.	10.	2.9	21.0	50.	579
572	U - 2 - 12	8.0	37.0	50.0	5.	61.	8.	3.3	13.0	54.	572
MEAN		4.6	48.4	43.2	5.	59.	9.	2.9	14.8	49.	
COEF VAR		51.9	35.5	14.6	0.0	48.7	15.7	24.7	21.5	20.8	

PPM

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
561	U - 2 - 1	2.500	0.541	0.500	0.058	1.404	0.69	1.043	0.103	0.500	561
562	U - 2 - 2	3.333	0.328	0.456	0.058	0.495	0.62	1.000	0.103	0.474	562
563	U - 2 - 3	2.500	0.516	0.544	0.058	0.404	0.85	1.522	0.096	0.539	563
564	U - 2 - 4	2.222	0.303	0.574	0.058	0.556	0.85	1.565	0.118	0.553	564
565	U - 2 - 5	2.500	0.295	0.632	0.058	0.343	0.62	1.826	0.081	0.618	565
566	U - 2 - 6	0.056	0.262	0.721	0.058	0.273	0.77	1.304	0.125	0.658	566
567	U - 2 - 7	5.000	0.311	0.706	0.058	0.556	0.46	1.261	0.110	0.566	567
568	U - 2 - 8	0.667	0.418	0.632	0.058	0.343	0.62	0.739	0.074	0.592	568
569	U - 2 - 9	3.056	0.328	0.750	0.058	0.616	0.77	0.783	0.096	0.934	569
578	U - 2 - 10	2.222	0.770	0.662	0.058	0.848	0.69	1.174	0.147	0.855	578
579	U - 2 - 11	1.944	0.385	0.706	0.058	0.677	0.77	1.261	0.154	0.658	579
572	U - 2 - 12	4.444	0.303	0.735	0.058	0.616	0.62	1.435	0.096	0.711	572
MEAN		2.537	0.397	0.635	0.058	0.594	0.69	1.243	0.108	0.638	
COEF VAR		51.9	35.5	14.6	0.0	48.7	15.7	24.7	21.5	20.8	

KK

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

U-33

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

U-34

U3

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
581	U - 3 - 1	8.5	73.0	77.0	*****	64.	18.	3.4	33.0	91.	581
582	U - 3 - 2	9.0	82.0	79.0	*****	77.	16.	2.7	37.0	91.	582
583	U - 3 - 3	4.0	82.0	82.0	*****	70.	18.	2.1	36.0	94.	583
584	U - 3 - 4	5.5	84.0	86.0	*****	78.	14.	1.9	34.0	96.	584
585	U - 3 - 5	6.0	90.0	87.0	*****	86.	17.	4.1	39.0	100.	585
586	U - 3 - 6	3.5	99.0	86.0	*****	126.	14.	2.6	37.0	94.	586
587	U - 3 - 7	4.0	183.0	86.0	*****	147.	11.	2.9	41.0	97.	587
607	U - 3 - 8	2.5	89.0	79.0	*****	64.	19.	3.3	29.0	105.	607
608	U - 3 - 9	6.4	114.0	84.0	*****	122.	14.	3.5	24.0	106.	608
590	U - 3 - 10	5.0	106.0	91.0	*****	86.	14.	2.8	39.0	91.	590
591	U - 3 - 11	4.2	98.0	89.0	*****	81.	12.	2.3	39.0	105.	591
592	U - 3 - 12	2.0	100.0	87.0	5.	103.	11.	2.1	40.0	98.	592
MEAN		5.0	100.0	84.3	5.	92.	15.	2.8	35.7	97.	
COEF VAR		41.1	27.4	5.0	0.0	27.8	17.8	22.7	13.4	5.5	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
581	U - 3 - 1	4.722	0.598	1.132	*****	0.646	1.38	1.478	0.243	1.197	581
582	U - 3 - 2	5.000	0.672	1.147	*****	0.778	1.23	1.174	0.272	1.197	582
583	U - 3 - 3	2.222	0.672	1.206	*****	0.707	1.38	0.913	0.265	1.237	583
584	U - 3 - 4	3.056	0.689	1.265	*****	0.788	1.08	0.826	0.250	1.263	584
585	U - 3 - 5	3.333	0.738	1.279	*****	0.869	1.31	1.783	0.287	1.316	585
586	U - 3 - 6	1.944	0.811	1.265	*****	1.273	1.08	1.130	0.272	1.237	586
587	U - 3 - 7	2.222	1.500	1.265	*****	1.485	0.85	1.261	0.301	1.276	587
607	U - 3 - 8	1.389	0.730	1.162	*****	0.646	1.46	1.435	0.213	1.382	607
608	U - 3 - 9	3.556	0.934	1.235	*****	1.232	1.08	1.522	0.176	1.395	608
590	U - 3 - 10	2.778	0.869	1.338	*****	0.869	1.08	1.217	0.287	1.197	590
591	U - 3 - 11	2.333	0.803	1.309	*****	0.818	0.92	1.000	0.287	1.382	591
592	U - 3 - 12	1.111	0.820	1.279	0.058	1.040	0.85	0.913	0.294	1.289	592
MEAN		2.806	0.820	1.240	0.058	0.929	1.14	1.221	0.262	1.281	
COEF VAR		41.1	27.4	5.0	0.0	27.8	17.8	22.7	13.4	5.5	

U4

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPd	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
610	U - 4 - 1	5.0	85.0	37.0	5.	133.	17.	2.0	41.0	127.	610
611	U - 4 - 2	2.4	103.0	42.0	5.	63.	20.	1.6	42.0	141.	611
612	U - 4 - 3	5.0	134.0	50.0	5.	161.	17.	2.4	37.0	139.	612
613	U - 4 - 4	3.0	106.0	52.0	5.	55.	17.	1.8	37.0	130.	613
614	U - 4 - 5	5.2	111.0	49.0	5.	58.	15.	1.6	29.0	131.	614
615	U - 4 - 6	4.2	100.0	51.0	10.	49.	17.	1.2	28.0	139.	615
616	U - 4 - 7	5.0	103.0	56.0	5.	56.	17.	1.7	31.0	137.	616
617	U - 4 - 8	5.0	108.0	46.0	5.	45.	21.	1.4	31.0	142.	617
***	U - 4 - 9	****	*****	*****	*****	****	****	****	*****	****	***
***	U - 4 - 10	****	*****	*****	*****	****	****	****	*****	****	***
***	U - 4 - 11	****	*****	*****	*****	****	****	****	*****	****	***
***	U - 4 - 12	****	*****	*****	*****	****	****	****	*****	****	***
MEAN		4.3	106.3	47.9	6.	78.	18.	1.7	34.5	136.	
COEF VAR		23.1	12.0	11.8	29.4	53.0	10.2	20.1	14.8	3.9	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
610	U - 4 - 1	2.778	0.697	0.544	0.058	1.343	1.31	0.870	0.301	1.671	610
611	U - 4 - 2	1.333	0.844	0.618	0.058	0.636	1.54	0.696	0.309	1.855	611
612	U - 4 - 3	2.778	1.098	0.735	0.058	1.626	1.31	1.043	0.272	1.829	612
613	U - 4 - 4	1.667	0.869	0.765	0.058	0.556	1.31	0.783	0.272	1.711	613
614	U - 4 - 5	2.889	0.910	0.721	0.058	0.586	1.15	0.696	0.213	1.724	614
615	U - 4 - 6	2.333	0.820	0.750	0.116	0.495	1.31	0.522	0.206	1.829	615
616	U - 4 - 7	2.778	0.844	0.824	0.058	0.566	1.31	0.739	0.228	1.803	616
617	U - 4 - 8	2.778	0.885	0.676	0.058	0.455	1.62	0.609	0.228	1.868	617
***	U - 4 - 9	******	*****	******	*****	*****	******	*****	*****	*****	***
***	U - 4 - 10	******	*****	******	*****	*****	******	*****	*****	*****	***
***	U - 4 - 11	******	*****	******	*****	*****	******	*****	*****	*****	***
***	U - 4 - 12	******	*****	******	*****	*****	******	*****	*****	*****	***
MEAN		2.417	0.871	0.704	0.065	0.783	1.36	0.745	0.254	1.786	
COEF VAR		23.1	12.0	11.8	29.4	53.0	10.2	20.1	14.8	3.9	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

U-35

		W_1	W_2	W_3	W_4
UTM Coordinates of Lake:	Zone	16	16	16	16
	N	5327850	5327800	5327200	5326700
	E	670850	670500	670350	669950
Elevation of Lake above sea level		337 m	334 m	331 m	328 m
Lake depth at sampling point		2 m	6 m	2 m	2 m
Lake area		0.02 km^2	0.02 km^2	0.02 km^2	0.07 km^2
Lake catchment area		0.19 km^2	0.39 km^2	0.90 km^2	1.56 km^2
Bedrock geology		greenstone	greenstone	greenstone	greenstone
Surface water chemistry:	pH	6.7	6.9	6.9	7.3
	alkalinity (mg/ℓ $CaCO_3$)	13.25	13.50	15.50	18.25
	Ca (ppm)	21.0	19.8	20.0	21.4
	SO_4 (ppm)	57.0	50.0	50.0	53.0
Ambrosia level		11 cm	11 cm	18 cm	---

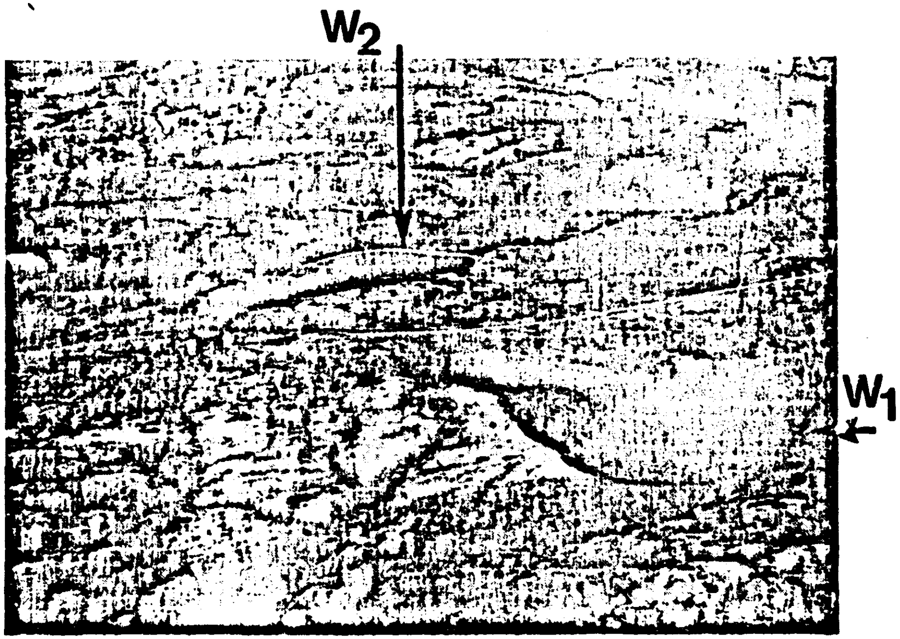
LAKE STAIRCASE
GREENSTONE
(IN WAWA SMELTER PLUME)

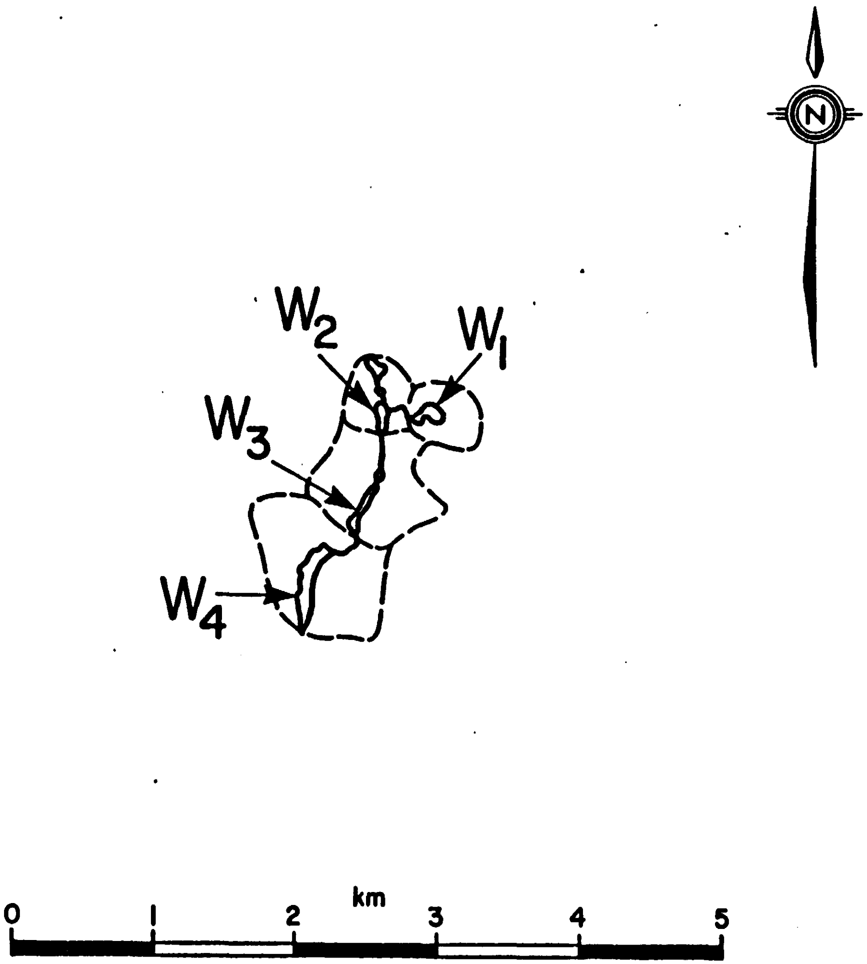
W SERIES

LAKE	W_1	W_2	W_3	W_4
pH	6.7	6.9	6.9	7.3

OBLIQUE AIRPHOTOGRAPHS OF LAKES

W -2





Lake W-1 is a small rock basin with simple morphometry. There is no muskeg or forest around the lake, and surficial deposits (sand and gravel) cover a small part of the watershed.

Lake W-2 is a rock basin with one island and relatively simple morphometry. There is no muskeg or forest around the lake, and surficial deposits (sand and gravel) cover a considerable part of the watershed and comprise most of the shoreline.

Lake W-3 is a small, long and narrow rock basin. The lake is shallow and occupies a channel in sand and gravel that partly fills the rock basin. Railroad runs along the east side of the lake, and there is minor muskeg at the inflow (north) end.

Lake W-4 is a long, narrow rock basin on the east side of the Magpie River delta. The lake is very shallow and the southern end is in the delta sands and gravels. Railroad runs along the east side of the lake that occupies a channel in the delta ground.

GENERAL DESCRIPTION OF THE STAIRCASE SYSTEM

W-3

Lake	Parameter		
	pH range at surface	Colour	Secchi Depth(m)
W_1	6.00-6.70	clear	Secchi visible on bottom
W_2	6.75-6.80	clear	4.2
W_3	6.90-6.95	clear	1.8
W_4	7.10-7.15	clear	Secchi visible on bottom

Lake W1

The W and U watershed lakes ranged in pH from 6.0 to 7.2 and their Secchi transparency ranged from 1.8 to 7.8. All the W lakes were clear water lakes while the U series were all humic. All "W" lakes were located in the Wawa fume-kill area. The lack of Sphagnum muskeg probably accounts for their lack of humic substances (Brown water) in their basins.

W1, W3 and W4 were all shallow ponds (2 m) without thermal stratification. W2 which was 6 m deep stratified between 3 and 4 m. Surface water specific conductivity was lowest in W1 (79 micromhos/cm).

The Secchi disc was visible on the pond's bottom (2.3 m) and the colour of the water was a greenish beige but not truly humic. A moss other than Sphagnum (possibly Drapanocladus sp.) covered about 20% of the shoreline. The remaining shoreline was dominated by rock outcrops. Surface pH was 6.7 due in part to the high concentrations of siderite (iron carbonate) in the surrounding rocks.

Low lying areas were colonized by myrica gale, alder and willow. Large trees were virtually absent due to the fume-kill conditions. The higher aquatic plants were dominated by yellow and white water lilies, cattails (Typha), watershield (Brassenia), water pond weeds (Potamogeton species), aquatic mosses (possibly Drapanocladus), Sagittaria, pickerelweed (Pontederia), spurweed (Sparganium), Scirpus, grasses, sedges (Carex) and horse tails (Equisetum fluviatile).

The phytoplankton samples were dominated by filamentous green algae (Mougeotia and Spirogyra) while the zooplankton was dominated by Bosmina longirostris and cyclopoid copepods. Rotifers were rare.

Dissolved Oxygen (Percent Saturation)

Depth (m)	W_1	W_2	W_3	W_4
0	100	100	100	100
1	100	100	100	100
2	40	100	69	96
3		100		
4		138		
5		142		
6		75		

Temperature °C

Depth (m)	W_1	W_2	W_3	W_4
0	23	21	21	20
1	23	21	21	20
2	22	20	21	20
3		20		
4		14		
5		12		
6		11		

Temperature Corrected (to 25°C) Conductivity

Depth (m)	W_1	W_2	W_3	W_4
0	79	153	165	171
1	79	160	165	171
2	95	160	213	182
3		163		
4		172		
5		177		
6		192		

Lake W2

This shallow lake (6 m) was the only one of the four W study lakes which was thermally stratified (3-4 m). Dissolved oxygen was higher on the bottom (142% supersaturation, 14.8 mg/1) than at the surface (8.8 mg/1). Although the rock-lined shores prevented macrophytes from establishing there, a dense moss mat stretched out over much of the lake's bottom. Secchi transparency was probably greater than reported (4.5 m) in this and the other lakes but helicopter induced surface waves made Secchi depth estimation difficult. We do feel, however, that our Secchi values are comparable for all the study lakes even though they are lower than expected.

The phytoplankton of W2 was dominated by the dinoflagellate, Ceratium hirundinella, and the diatom, Synedra delicatissima. Zooplankton was sparse and rotifier dominated (e.g. Trichocerca and Keratella were the only common forms). Cyclops bicuspidatus was also noted at low densities.

Lake W3

This third order 2 m deep pond occupied an intermediate position along the pH and specific conductivity continua in this watershed. As expected, pH increased with lake order from a pH of 6.5 in W1 to 6.8 in W2, 6.9 in W3 and 7.2 in W4. Specific conductivity followed a similar pattern of increase with lake order (W1=79, W2=153, W3=165 and W4=171). The reasons for this are detailed in the discussion section of this report.

Pond W3 was unusual in the sense that it was located within 100 m of the Algoma Central railway tracks. With few exceptions the other ponds and lakes were isolated from roads, tracks and cottages to minimize localized anthropogenic effects.

The littoral zone of W3 was restricted to the pond's outlet as other parts of the pond were fringed with rock outcrops. Grasses, sedges and yellow water lilies dominated the outlet littoral area. Terrestrial vegetation was similar to that described for W1.

The pond's zooplankton was dominated by cyclopoid copepods and the cladoceran, Bosmina longirostris. Diatoms dominated the sparse phytoplankton of this pond and zooplankton biomass exceeded phytoplankton biomass.

Lake W4

This shallow (2 m deep) clear pond (the Secchi disc was visible on the pond's bottom) was very similar to pond W3 with the exception that Nitella was far more common. In both ponds the zooplankton was dominated by copepods and rotifers were unusually rare. Zooplankton again exceeded phytoplankton biomass.

Gammarids were common at the sediment-water interphase and the sediment cores taken from the W watershed ponds using a gravity corer were longer (60-91 cm) than most of the other lakes and ponds (mean core length was about half this value). W watershed pond sediments were comprised of a flocculent algal gyttja which permitted excellent penetration of the gravity corer.

Terrestrial vegetation around W4 did not differ appreciably from that described for W1.

PHYTOPLANKTON

PHYTOPLANKTON	W1	W2	W3	W4
BACILLARIOPHYTA				
ACHNANTHES FLEXELLA	-	3	-	3
ACHNANTHES MINUTISSIMA	3	2	1	3
ACHNANTHES SP.	-	-	4	-
AMPHORA SP.	-	-	1	-
ANOMOEONEIS VITREA	-	2	2	-
ASTERIONELLA FORMOSA	4	-	-	-
CYCLOTELLA SP.A	1	2	-	4
CYCLOTELLA STELLIGERA	-	2	2	-
CYMBELLA SP.	-	-	4	-
DIATOMA VULGARE	-	1	-	-
EUNOTIA ARCUS	1	-	-	-
EUNOTIA SP.	-	-	4	2
FRAGILARIA CAPUCINA	-	2	3	-
FRAGILARIA CROTONENSIS	2	2	3	-
FRUSTULIA RHOMBOIDES	1	2	-	-
MELOSIRA SP.	1	-	-	-
NAVICULA RADIOSA	1	1	-	-
NAVICULA SP.	-	1	-	2
NITZSCHIA CF. DISSIPATA	-	2	4	-
NITZSCHIA CF. SIGMOIDEA	-	-	1	-
PINNULARIA CF. BICEPS	-	-	2	-
PINNULARIA SP.	-	-	1	-
RHIZOSOLENIA SP.	1	1	-	-
SURIRELLA SP.	1	-	-	4
SYNEDRA DELICATISSIMA	1	5	4	4
SYNEDRA RADIANS	2	5	3	4
TABELLARIA FENESTRATA	3	2	2	-
TABELLARIA FLOCCULOSA	-	-	1	-
AVERAGE	(1.7)	(2.2)	(2.5)	(3.3)

CHLOROPHYTA				
CHLAMYDOMONAS SP.	2	-	-	-
DICTYOSPHAERIUM SP.	-	3	-	-
GLOEOCYSTIS SP.	2	-	-	-
GOLENKINIA RADIATA	-	1	-	-
MICRASTERIAS SP.	-	-	1	-
MOUGEOTIA SP.	4	-	-	-
OEDOGONIUM VULGARE	-	-	-	2
OOCYSTIS PUSILLA	-	-	-	1
PEDIASTRUM BORYANUM	-	2	-	1
PEDIASTRUM TETRAS	-	-	2	-
SCENEDESMUS CF. BIJUGA	1	-	-	-
SCENEDESMUS QUADRIACAUDA	1	2	3	-
SPIROGYRA SP.	4	-	-	-
AVERAGE	(2.3)	(2.0)	(2.0)	(1.3)

PHYTOPLANKTON	W1	W2	W3	W4
CHRYSOPHYTA				
CHRYSOCHROMULINA SP.	-	3	3	-
CHRYSOSPHAERELLA LONGISPINA	1	-	-	-
DINOBRYON BAVARICUM	4	2	1	-
DINOBRYON DIVERGENS	3	-	2	-
MALLOMONAS CF. CAUDATA	-	1	-	-
MALLOMONAS SP.	-	-	3	-
OCHROMONAS SP.	-	-	2	-
SYNURA SP.	3	-	-	-
UROGLENOPSIS AMERICANA	-	2	-	-
AVERAGE	(2.8)	(2.0)	(2.3)	(---)

CRYPTOPHYTA				
CRYPTOMONAS EROSA	1	2	3	-
CRYPTOMONAS OVATA	3	-	-	-
RHODOMONAS LACUSTRIS	3	-	-	-
AVERAGE	(2.3)	(2.0)	(2.5)	(---)

CYANOPHYTA				
ANABAENA SP.	-	-	-	1
CHROOCOCCUS DISPERSUS	3	-	4	3
GLOEOCAPSA CF. PUNCTATA	1	-	-	-
MICROCYSTIS AERUGINOSA	3	-	-	-
MICROCYSTIS LIMNETICUM	2	-	-	-
PHORMIDIUM CF. MINNESOTENSIS	2	-	-	-
AVERAGE	(2.2)	(---)	(4.0)	(2.0)

EUGLENOPHYTA				
TRACHELOMONAS CF. CHARKOWIENSIS	-	1	-	-
AVERAGE	(---)	(1.0)	(---)	(---)

PHYTOPLANKTON	W1	W2	W3	W4
PYRROPHYTA				
CERATIUM HIRUNDINELLA	1	4	2	-
GYMNODINIUM SP.	2	-	2	1
PERIDINIUM INCONSPICUUM	-	3	-	-
PERIDINIUM SP.	-	2	-	-
PERIDINIUM SP.	-	1	-	-
AVERAGE	(1.5)	(2.5)	(2.0)	(1.0)

Comments

The "W" watershed lake staircase was intermediate, in terms of species composition, between the neutral "U" lakes and the alkaline "Y" lakes. Principle component analysis confirmed this pattern. The species combination P.C.A. Clustering of the "W", "U" & "Y" lakes were all overlapping.

ZOOPLANKTON

W-8

ZOOPLANKTON	W1	W2	W3	W4
ZOOPLANKTON TO PHYTOPLANKTON BIOMASS RATIO	Z<P	Z<P	Z=P	Z<P
CILIOPHORA				
HALTERIA SP.	5.0	-	-	-
TOTAL	5.0	-	-	-
CLADOCERANS				
DAPHNIA PULER	-	10.0	1.0	10.0
BOSMINA LONGIROSTRIS	20.0	3.0	25.0	6.0
CHYDORUS SPHAERICUS	3.0	-	-	-
TOTAL	23.0	13.0	26.0	16.0
COPEPODS				
COPEPODITES AND NAUPLII	80.0	45.0	140.0	78.0
CYCLOPS BICUSPIDATUS	15.0	-	1.0	-
DIAPTOMUS MINUTUS	-	10.0	5.0	127.0
MESOCYCLOPS EDAX	10.0	20.0	1.0	-
TOTAL	105.0	75.0	147.0	205.0
ROTIFERS				
ASPLANCHNA BRIGHTWELLI	40.0	20.0	-	-
CHROMOGASTER SP.	5.0	-	1.0	-
KELLICOTIA LONGISPINA	-	60.0	-	-
KERATELLA COCHLEARIS	5.0	-	-	2.0
TRICHOCERCA CYLINDRICUM	2.0	-	2.0	4.0
TOTAL	52.0	80.0	3.0	6.0

COMMENTS

Copepod and rotifer abundance was inversely related in this watershed and in the X & Y watersheds. This was not the case in the U lakes. Copepod densities were similar and moderate in all the Z lakes.

Diatom Species	pH category	W1 Number Counted	W1 Relative Frequency (%)	W2 Number Counted	W2 Relative Frequency (%)	W3 Number Counted	W3 Relative Frequency (%)	W4 Number Counted	W4 Relative Frequency (%)
Achnanthes affinis	alp	15	1.88					30	4.25
Achnanthes biasolettiana	-							18	2.55
Achnanthes delicatula	alp							5	.71
Achnanthes detha	-							6	.85
Achnanthes exigua	alp	9	1.13			6	.75	6	.85
Achnanthes flexella	ind	8	1.00	8	.97	19	2.37	13	1.84
Achnanthes lacunarum	-	19	2.38					64	9.07
Achnanthes lanceolata	alp	16	2.00	4	.48	8	1.00	1	.12
Achnanthes linearis	ind			6	.73	36	4.49	3	.42
Achnanthes microcephala	ind	15	1.88	8	.97			70	9.92
Achnanthes minutissima	ind	19	2.38	17	2.06	54	6.74		
Amphora ovalis	alp	10	1.25	12	1.45	14	1.75	1	.14
Anomoeoneis follis	ind			3	.36				
Anomoeoneis seriana	acb							2	.28
Anomoeoneis seriana var. brachysira	acb	25	3.13	4	.48	8	1.00	104	14.73
Anomoeoneis vitrea	alp	25	3.13	18	2.18	27	3.37	91	12.89
Anomoeoneis zellensis	-					2	.25	50	7.08
Caloneis ventricosa	alp	1	.13	2	.24				
Cyclotella comta	ind			109	13.21	14	1.75	1	.14
Cyclotella meneghiniana	alp	6	.75	12	1.45	21	2.62	5	.71
Cymatopleura solea	alp			2	.24				
Cymbella cesatii	ind	35	4.38	12	1.45	30	3.75	44	6.23
Cymbella cistula	ind	5	.63	4	.48	11	1.37	3	.42
Cymbella cuspidata	ind	2	.25			1	.12		
Cymbella delicatula	alb							7	.99
Cymbella helvetica	alp	19	2.38					15	2.12
Cymbella hustedtii	-	2	.25			2	.25		

SURFACE SEDIMENT DIATOMS

SURFACE SEDIMENT DIATOMS (CONT'D)

W -10

Diatom Species	pH category	W1 Number Counted	W1 Relative Frequency (%)	W2 Number Counted	W2 Relative Frequency (%)	W3 Number Counted	W3 Relative Frequency (%)	W4 Number Counted	W4 Relative Frequency (%)
Cymbella lunata	-	14	1.75	3	.36	4	.50	1	.14
Cymbella microcephala	alp			6	.73	7	.87	7	.99
Cymbella minuta	ind			6	.73	11	1.37		
Cymbella minuta var. latens	ind					2	.25		
Cymbella perpusilla	-							2	.28
Cymbella ventricosa	ind	27	3.38	4	.48	2	.25	23	3.26
Denticula cf. elegans f. valida	alp			11	1.33	6	.75	25	3.54
Diatoma tenue var. elongatum	-			20	2.42				
Diploneis finnica	-					2	.25		
Diploneis oculata	alp							1	.14
Diploneis sp.	-			8	.97	4	.50		
Eunotia pectinalis	acp	1	.13						
Eunotia praerupta	acp							11	1.56
Fragilaria bicapitata	-			2	.24				
Fragilaria construens	alp			7	.85	20	2.50	2	.28
Fragilaria construens var. venter	alp			11	1.33	22	2.75		
Fragilaria crotonensis	-	15	1.88	6	.73			2	.28
Fragilaria lapponica	-					2	.25		
Fragilaria pinnata	alp	123	15.38	129	15.63	106	13.23	3	.42
Fragilaria vaucheriae	alp			7	.85	19	2.37		
Fragilaria virescens	alp	7	.88	6	.73	2	.25	5	.71
Frustulia rhomboides	acp			1	.12	2	.25		
Gomphonema accuminatum	ind			1	.12	4	.50	1	.14
Gomphonema affine	alb					3	.37		
Gomphonema dichotomum	alb			1	.12	2	.25		
Gomphonema intricatum	alp					2	.25		

Diatom Species	pH category	W1 Number Counted	W1 Relative Frequency (%)	W2 Number Counted	W2 Relative Frequency (%)	W3 Number Counted	W3 Relative Frequency (%)	W4 Number Counted	W4 Relative Frequency (%)
Gomphonema intricatum var.dichotomiforme	alp							23	3.26
Navicula bacillum	ind	28	3.50						
Navicula capitata	alp			6	.73	5	.62		
Navicula cuspidata	alp					4	.50		
Navicula elginensis var. rostrata	-	6	.75	7	.85	2	.25		
Navicula gottlandica	-			15	1.82	35	4.37		
Navicula ludloviana	-			21	2.55				
Navicula notha	-	9	1.13	18	2.18	23	2.87		
Navicula cf. peregrina	-	58	7.25	2	.24			3	.42
Navicula pupula	ind							1	.14
Navicula pupula var. capitata	ind			2	.24	19	2.37		
Navicula pupula var. rectangularis	ind			3	.36	2	.25	4	.57
Navicula radiosa	ind	104	13.00	13	1.58	7	.87	2	.28
Navicula radiosa var. parva	ind			6	.73	5	.62	12	1.70
Navicula subtilissima	acp	46	5.75			3	.37	7	.99
Navicula vanheurckii	-					2	.25		
Neidium affine	ind	18	2.25	1	.12	2	.25		
Neidium iridis	ind	1	.13	2	.24	1	.12	3	.42
Nitzschia acicularis	alp	2	.25			2	.25	1	.14
Nitzschia amphibia	alp	4	.50					3	.42
Nitzschia denticula	alp	1	.13	23	2.79	48	5.99	1	.14
Nitzschia fonticola	alp	22	2.75	13	1.58	22	2.75	1	.14
Nitzschia hantzschiana	-	12	1.50	10	1.21			1	.14
Nitzschia intermedia	-	1	.13	2	.24				
Nitzschia palea	ind	7	.88			17	2.12		
Nitzschia sinuta	-					10	1.25	1	.14
Pinnularia abaujensis	ind	4	.50						
Pinnularia abaujensis var. rostrata	ind	•				2	.25	5	.71
Pinnularia biceps	acp	1	.13			4	.50		

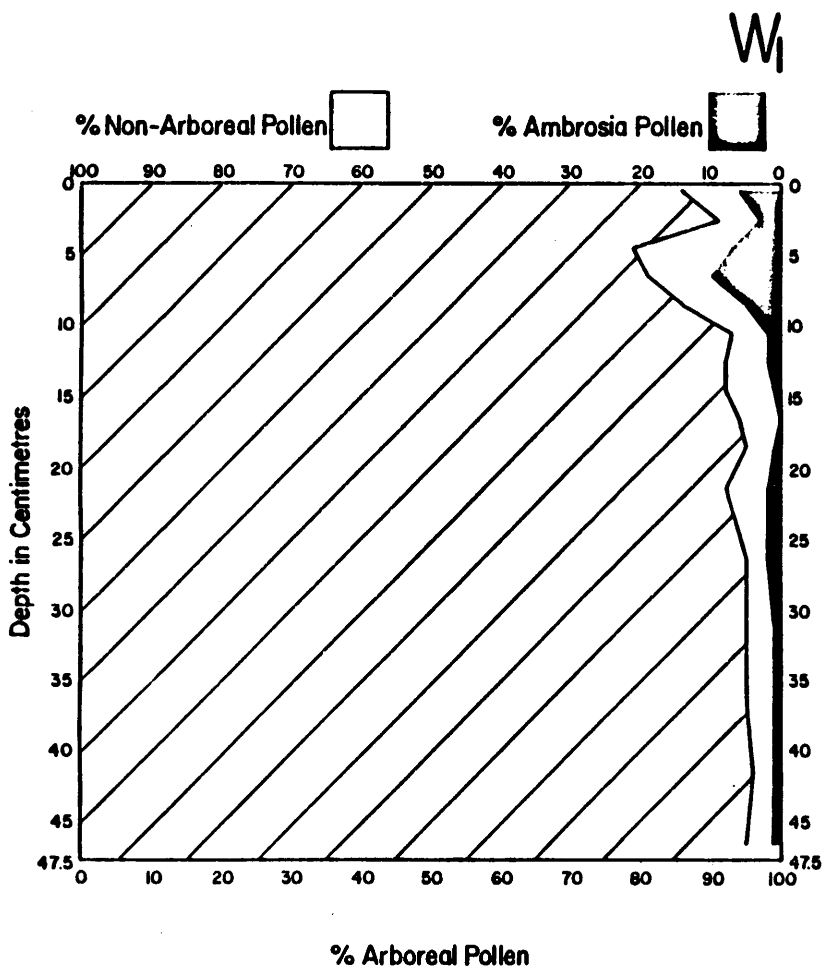
SURFACE SEDIMENT DIATOMS (CONT'D)

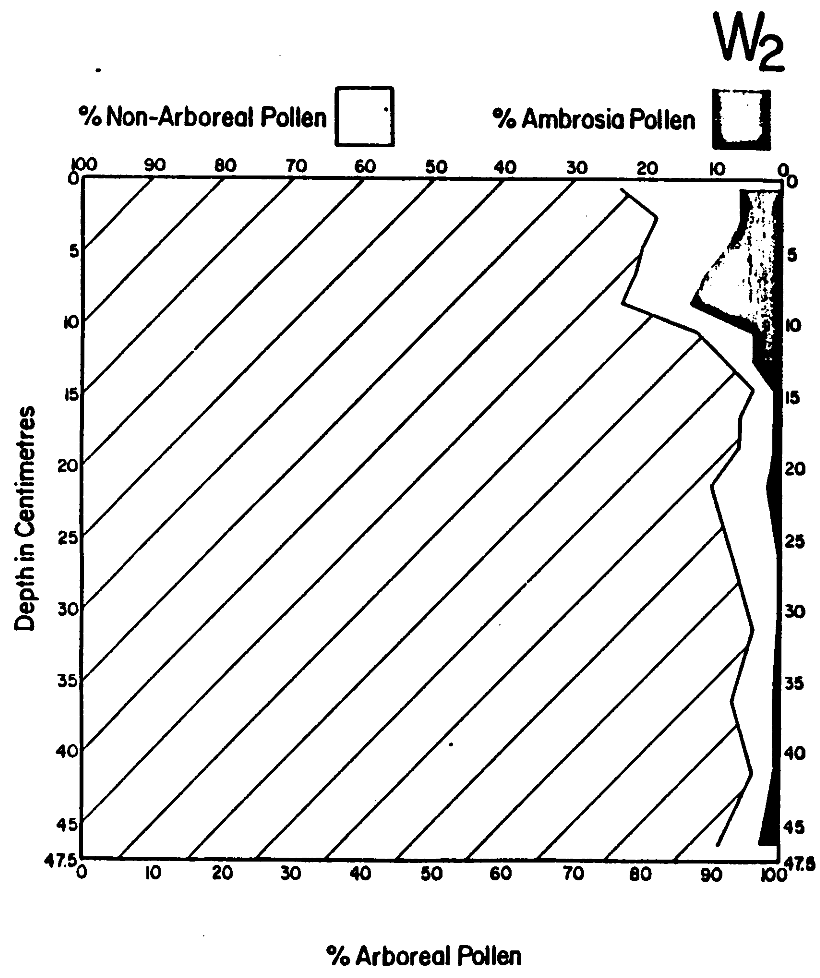
SURFACE SEDIMENT DIATOMS (CONT'D)

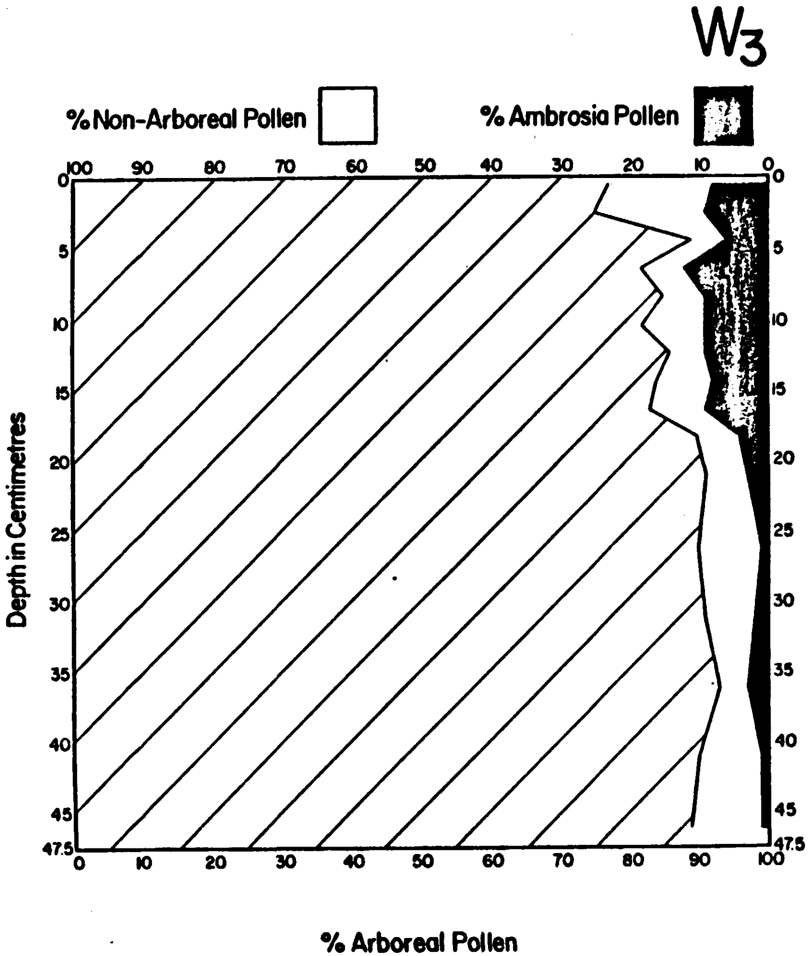
Diatom Species	pH category	W1 Number Counted	W1 Relative Frequency (%)	W2 Number Counted	W2 Relative Frequency (%)	W3 Number Counted	W3 Relative Frequency (%)	W4 Number Counted	W4 Relative Frequency (%)
Pinnularia formica	-			3	.36	2	.25		
Pinnularia latevittata	-	1	.13						
Pinnularia maior	acp	2	.25	6	.73	15	1.87		
Pinnularia mesolepta	acp			13	1.58	4	.50		
Rhopalodia parallela	alb	10	1.25	4	.48				
Stauroneis anceps f. linearis	ind			2	.24	6	.75		
Stauroneis livingstonii	-					2	.25		
Stauroneis phoenicenteron	ind	11	1.38	9	1.09	12	1.50	1	.14
Surirella cf. biseriata var. constricta	alp	13	1.63	6	.73	6	.75	1	.14
Surirella linearis	ind	1	.13	2	.24	12	1.50		
Synedra delicatissima	-	6	.75	71	8.61	19	2.37	9	1.27
Synedra radians	alp			24	2.91	5	.62		
Synedra rumpens var. fragilarioides	-					3	.37		
Tabellaria fenestrata	acp	9	1.13	6	.73	8	1.00	4	.57
Tabellaria flocculosa	acp			63	7.64	10	1.25	1	.14
Multiplication Factor (to give # diatoms/mg. dry wt.)		910		329		611		12581	

Descriptions of the downcore diatoms are included in Part I, Chapter III. A complete species list of the diatoms studied during the 1981 field and laboratory study is included in Section 5 of this part of the report (Part II)

AMBROSIA RISE DIAGRAMS



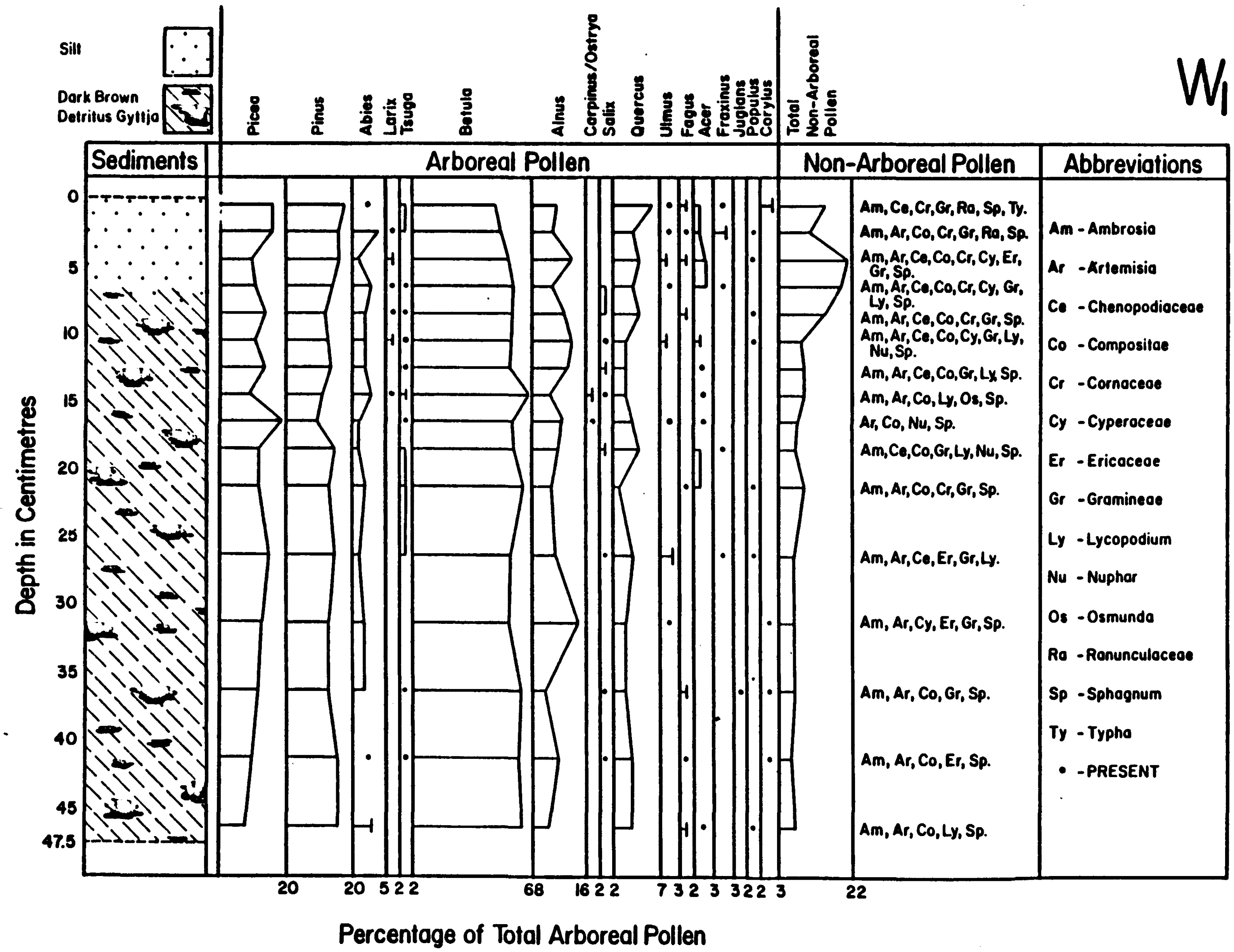


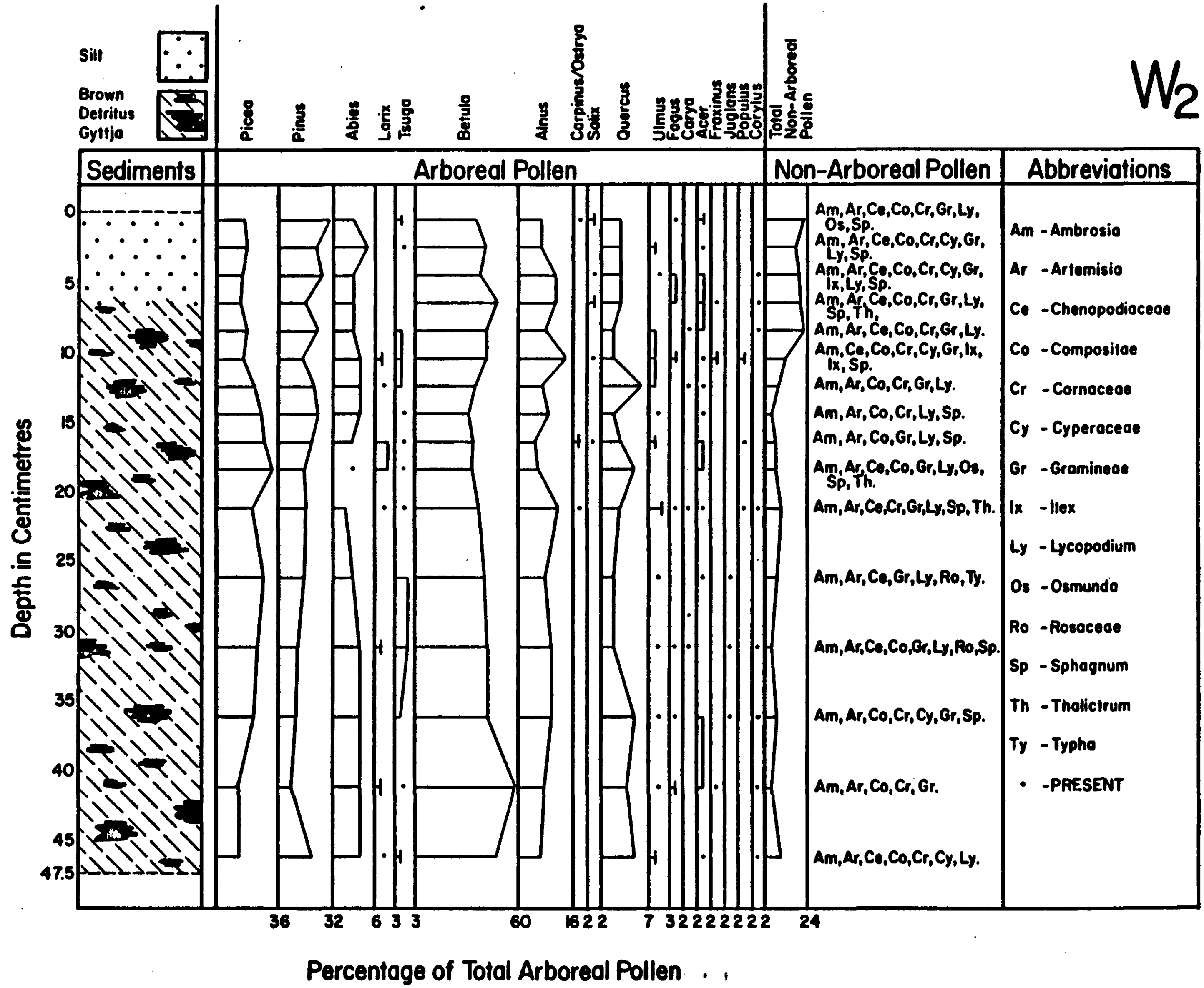


AMBROSIA RISE DIAGRAMS (CONT'D)

POLLEN DIAGRAM

W -16

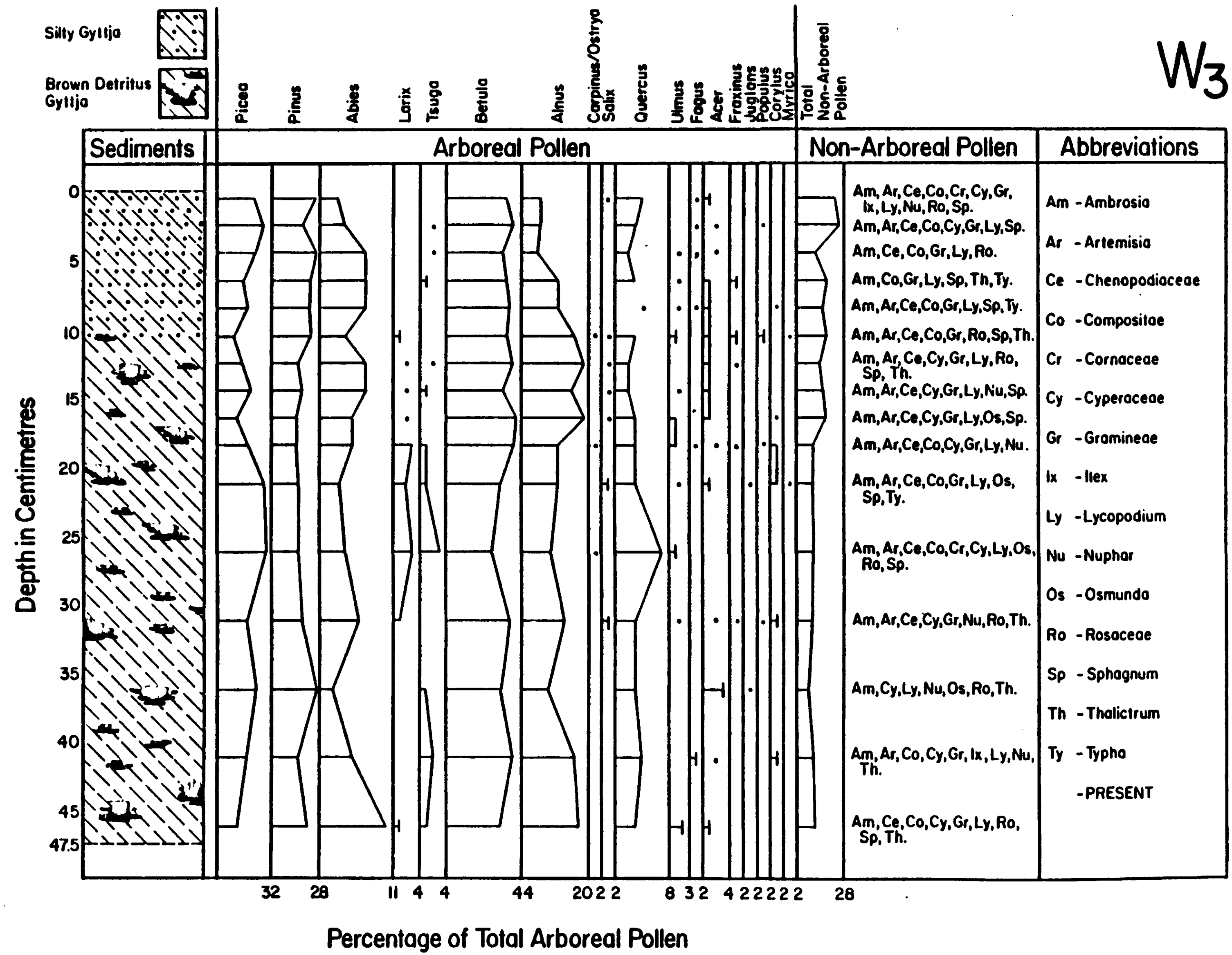




POLLEN DIAGRAM

POLLEN DIAGRAM

W -18



W -19

POLLEN DIAGRAM

W -19

W -20

W -21

TOP 20 cm (LAKE W_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

W -22

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
874	W - 1 - 1	******	14526.	42200.	1695.	2760.	2120.	3447.	20794.	1078.	593.	18.	874
875	W - 1 - 2	******	13188.	49431.	1896.	2541.	1732.	3397.	15697.	777.	581.	17.	875
876	W - 1 - 3	******	13402.	46328.	1535.	2430.	1960.	3158.	15142.	730.	629.	20.	876
877	W - 1 - 4	******	12631.	53039.	1998.	2310.	1838.	3517.	13978.	742.	508.	15.	877
878	W - 1 - 5	******	13164.	50835.	1822.	2320.	1908.	3544.	13702.	763.	524.	14.	878
880	W - 1 - 6	******	13317.	49157.	1536.	2380.	1929.	3316.	14117.	730.	549.	14.	880
881	W - 1 - 7	******	13588.	43388.	1134.	2310.	1733.	2849.	13964.	695.	600.	16.	881
882	W - 1 - 8	******	13012.	40451.	1569.	2200.	1764.	2449.	13966.	659.	575.	15.	882
883	W - 1 - 9	******	13527.	31607.	915.	2310.	1999.	2356.	15097.	595.	605.	17.	883
884	W - 1 - 10	******	9081.	11975.	414.	1580.	1408.	1571.	15058.	470.	413.	12.	884
886	W - 1 - 11	******	9132.	8006.	401.	1440.	1539.	1630.	18996.	489.	382.	11.	886
887	W - 1 - 12	******	7961.	7414.	422.	1764.	1636.	1930.	20396.	578.	455.	13.	887
888	W - 1 - 13	******	10691.	7464.	369.	1750.	1653.	1914.	19083.	606.	452.	14.	888
889	W - 1 - 14	******	9152.	5900.	316.	1424.	1550.	1530.	14290.	418.	382.	10.	889
890	W - 1 - 15	******	11462.	6284.	298.	1809.	1803.	1872.	18049.	557.	500.	15.	890
892	W - 1 - 16	******	11602.	8412.	377.	1920.	1877.	1947.	17090.	453.	515.	14.	892
893	W - 1 - 17	******	9769.	5371.	230.	1610.	1516.	1649.	16136.	423.	445.	13.	893
894	W - 1 - 18	******	10958.	9155.	367.	1892.	1877.	1948.	16437.	415.	495.	14.	894
895	W - 1 - 19	******	11746.	6983.	243.	1960.	2078.	1955.	16790.	399.	531.	17.	895
896	W - 1 - 20	******	11707.	9113.	271.	1950.	1920.	2084.	17627.	425.	562.	16.	896

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
874	W - 1 - 1	*******	0.17376	0.67846	1.59906	0.15000	0.09339	0.12471	0.44622	0.96250	0.09383	0.11111	874
875	W - 1 - 2	*******	0.15775	0.79471	1.78868	0.13810	0.07630	0.12290	0.33685	0.69375	0.09193	0.10494	875
876	W - 1 - 3	*******	0.16031	0.74482	1.44811	0.13207	0.08634	0.11425	0.32494	0.65179	0.09953	0.12346	876
877	W - 1 - 4	*******	0.15109	0.85272	1.88490	0.12554	0.08097	0.12724	0.29996	0.66250	0.08038	0.09259	877
878	W - 1 - 5	*******	0.15746	0.81728	1.71887	0.12609	0.08405	0.12822	0.29403	0.68125	0.08291	0.08642	878
880	W - 1 - 6	*******	0.15929	0.79031	1.44906	0.12935	0.08498	0.11997	0.30294	0.65179	0.08687	0.08642	880
881	W - 1 - 7	*******	0.16254	0.69756	1.06981	0.12554	0.07634	0.10308	0.29966	0.62054	0.09494	0.09877	881
882	W - 1 - 8	*******	0.15565	0.65034	1.48019	0.11957	0.07771	0.08860	0.29970	0.58839	0.09098	0.09259	882
883	W - 1 - 9	*******	0.16181	0.50815	0.86321	0.12554	0.08806	0.08524	0.32397	0.53125	0.09573	0.10494	883
884	W - 1 - 10	*******	0.10862	0.19252	0.39057	0.08587	0.06203	0.05684	0.32313	0.41964	0.06535	0.07407	884
886	W - 1 - 11	*******	0.10923	0.12871	0.37830	0.07826	0.06780	0.05897	0.40764	0.43661	0.06044	0.06790	886
887	W - 1 - 12	*******	0.09523	0.11920	0.39811	0.09587	0.07207	0.06983	0.43768	0.51607	0.07199	0.08025	887
888	W - 1 - 13	*******	0.12788	0.12000	0.34811	0.09511	0.07282	0.06925	0.40951	0.54107	0.07152	0.08642	888
889	W - 1 - 14	*******	0.10947	0.09486	0.29811	0.07739	0.06828	0.05535	0.30663	0.37321	0.06044	0.06173	889
890	W - 1 - 15	*******	0.13711	0.10103	0.28113	0.09832	0.07943	0.06773	0.38732	0.49732	0.07911	0.09259	890
892	W - 1 - 16	*******	0.13878	0.13524	0.35566	0.10435	0.08269	0.07044	0.36674	0.40446	0.08149	0.08642	892
893	W - 1 - 17	*******	0.11685	0.08635	0.21698	0.08750	0.06678	0.05966	0.34627	0.37768	0.07041	0.08025	893
894	W - 1 - 18	*******	0.13108	0.14719	0.34623	0.10283	0.08269	0.07048	0.35273	0.37054	0.07832	0.08642	894
895	W - 1 - 19	*******	0.14050	0.11227	0.22925	0.10652	0.09154	0.07073	0.36030	0.35625	0.08402	0.10494	895
896	W - 1 - 20	*******	0.14004	0.14651	0.25566	0.10598	0.08458	0.07540	0.37826	0.37946	0.08892	0.09877	896

TOP 20 cm (LAKE W_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

TOP 20 cm (LAKE W_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
874	W - 1 - 1	****	16.0	86.0	*****	36.	72.0	****	18.0	150.	874
875	W - 1 - 2	****	18.0	72.0	*****	18.	96.0	****	5.0	149.	875
876	W - 1 - 3	****	13.0	70.0	*****	29.	91.0	****	44.0	136.	876
877	W - 1 - 4	****	12.0	56.0	*****	22.	91.0	****	58.0	129.	877
878	W - 1 - 5	****	12.0	59.0	*****	28.	95.0	****	20.0	135.	878
880	W - 1 - 6	****	15.0	66.0	*****	14.	99.0	****	2.0	145.	880
881	W - 1 - 7	****	16.0	67.0	*****	26.	98.0	****	6.0	174.	881
882	W - 1 - 8	****	15.0	133.0	*****	23.	87.0	****	8.0	170.	882
883	W - 1 - 9	****	16.0	75.0	*****	16.	78.0	****	8.0	163.	883
884	W - 1 - 10	****	13.0	83.0	*****	21.	31.0	****	4.0	65.	884
886	W - 1 - 11	****	12.0	92.0	*****	2.	10.0	****	12.0	76.	886
887	W - 1 - 12	****	17.0	117.0	*****	16.	11.0	****	18.0	78.	887
888	W - 1 - 13	****	15.0	114.0	*****	17.	17.0	****	28.0	84.	888
889	W - 1 - 14	****	14.0	93.0	*****	17.	9.0	****	2.0	58.	889
890	W - 1 - 15	****	17.0	118.0	*****	16.	9.0	****	3.0	71.	890
892	W - 1 - 16	****	20.0	118.0	*****	22.	15.0	****	18.0	76.	892
893	W - 1 - 17	****	16.0	109.0	*****	15.	7.0	****	32.0	69.	893
894	W - 1 - 18	****	16.0	112.0	*****	16.	12.0	****	33.0	78.	894
895	W - 1 - 19	****	18.0	113.0	*****	19.	11.0	****	26.0	79.	895
896	W - 1 - 20	****	18.0	109.0	*****	17.	18.0	****	2.0	78.	896

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
874	W - 1 - 1	****	0.1311	1.265	****	0.364	5.538	****	0.132	1.974	874
875	W - 1 - 2	****	0.1475	1.059	****	0.182	7.385	****	0.037	1.961	875
876	W - 1 - 3	****	0.1066	1.029	****	0.293	7.000	****	0.324	1.789	876
877	W - 1 - 4	****	0.0984	0.824	****	0.222	7.000	****	0.426	1.697	877
878	W - 1 - 5	****	0.0984	0.868	****	0.283	7.308	****	0.147	1.776	878
880	W - 1 - 6	****	0.1230	0.971	****	0.141	7.615	****	0.015	1.908	880
881	W - 1 - 7	****	0.1311	0.985	****	0.263	7.538	****	0.044	2.289	881
882	W - 1 - 8	****	0.1230	1.956	****	0.232	6.692	****	0.059	2.237	882
883	W - 1 - 9	****	0.1311	1.103	****	0.162	6.000	****	0.059	2.145	883
884	W - 1 - 10	****	0.1066	1.221	****	0.212	2.385	****	0.029	1.118	884
886	W - 1 - 11	****	0.0984	1.353	****	0.020	0.769	****	0.088	1.000	886
887	W - 1 - 12	****	0.1393	1.721	****	0.162	0.846	****	0.132	1.026	887
888	W - 1 - 13	****	0.1230	1.676	****	0.172	1.308	****	0.206	1.105	888
889	W - 1 - 14	****	0.1148	1.368	****	0.172	0.692	****	0.015	0.763	889
890	W - 1 - 15	****	0.1393	1.735	****	0.162	0.692	****	0.022	0.934	890
892	W - 1 - 16	****	0.1639	1.735	****	0.222	1.154	****	0.132	1.000	892
893	W - 1 - 17	****	0.1311	1.603	****	0.152	0.538	****	0.235	0.908	893
894	W - 1 - 18	****	0.1311	1.647	****	0.162	0.923	****	0.243	1.026	894
895	W - 1 - 19	****	0.1475	1.662	****	0.192	0.846	****	0.191	1.039	895
896	W - 1 - 20	****	0.1475	1.603	****	0.172	1.385	****	0.015	1.026	896

TOP 20 CM (LAKE W_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

W -25

LAKE SEDIMENT CORE WEIGHT DATA

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

W-26

W1

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
451	W - 1 - 1	31.82	3.53	64.1	88.9	W - 1 - 7	33.97	3.89	52.0	88.6	457
452	W - 1 - 2	33.67	3.90	57.7	88.4	W - 1 - 8	35.12	3.93	53.7	88.8	458
453	W - 1 - 3	31.61	3.86	57.9	87.8	W - 1 - 9	42.28	4.45	57.6	89.5	459
454	W - 1 - 4	33.90	4.07	56.6	85.0	W - 1 - 10	36.85	4.25	59.3	88.5	460
455	W - 1 - 5	30.47	3.80	54.7	87.5	W - 1 - 11	35.34	4.30	56.6	87.8	461
456	W - 1 - 6	34.60	4.01	54.7	88.4	W - 1 - 12	37.60	4.18	56.1	88.9	462

W2

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
472	W - 2 - 1	27.42	4.70	29.6	82.9	W - 2 - 7	35.91	5.85	31.6	83.7	473
473	W - 2 - 2	31.35	5.08	27.2	83.8	W - 2 - 8	36.00	5.80	33.6	83.9	479
474	W - 2 - 3	26.36	4.58	30.4	82.6	W - 2 - 9	30.45	5.17	32.2	83.0	480
475	W - 2 - 4	37.43	5.76	28.8	84.6	W - 2 - 10	35.90	5.84	34.7	83.7	487
476	W - 2 - 5	31.45	5.43	26.0	82.7	W - 2 - 11	37.50	6.12	35.4	83.7	488
477	W - 2 - 6	34.20	5.82	27.9	83.0	W - 2 - 12	32.14	5.70	31.4	82.3	483

W3

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
490	W - 3 - 1	18.22	0.47	54.2	97.4	W - 3 - 7	19.49	0.50	50.0	97.4	496
491	W - 3 - 2	11.01	0.82	****	92.6	W - 3 - 8	19.73	0.54	****	97.3	497
492	W - 3 - 3	15.53	0.38	56.7	97.6	W - 3 - 9	21.66	1.20	54.6	94.5	498
493	W - 3 - 4	13.99	0.30	****	97.9	W - 3 - 10	15.11	0.63	33.3	95.8	518
494	W - 3 - 5	14.30	0.30	****	97.9	W - 3 - 11	16.78	0.71	53.5	95.8	519
495	W - 3 - 6	19.07	0.44	58.4	97.7	W - 3 - 12	16.92	0.79	52.5	95.3	501

W4

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
523	W - 4 - 1	13.62	3.15	47.6	76.9	W - 4 - 7	21.36	8.64	47.0	59.6	529
524	W - 4 - 2	18.47	6.14	44.7	66.8	W - 4 - 8	26.25	10.41	47.2	60.3	530
525	W - 4 - 3	17.37	6.50	45.8	62.6	W - 4 - 9	*****	*****	****	****	***
526	W - 4 - 4	16.36	6.20	46.4	62.1	W - 4 - 10	*****	*****	****	****	***
527	W - 4 - 5	17.37	6.81	47.4	60.8	W - 4 - 11	*****	*****	****	****	***
528	W - 4 - 6	21.59	8.63	46.4	60.0	W - 4 - 12	*****	*****	****	****	***

LAKE SEDIMENT CORE WEIGHT DATA

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

W-27

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

W1

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
451	W - 1 - 1	104800.	14297.	6368.	232.	2020.	2319.	2034.	16290.	438.	525.	23.	451
452	W - 1 - 2	116100.	15675.	5267.	164.	2070.	2690.	2111.	17940.	450.	620.	35.	452
453	W - 1 - 3	112900.	16013.	5362.	142.	2130.	2810.	2217.	19060.	429.	614.	30.	453
454	W - 1 - 4	118200.	15545.	4862.	115.	2140.	2744.	1976.	16650.	404.	527.	25.	454
455	W - 1 - 5	118000.	15415.	4714.	101.	2170.	2726.	2091.	17650.	403.	580.	25.	455
456	W - 1 - 6	135000.	14328.	4218.	78.	1960.	2381.	1830.	15450.	404.	502.	21.	456
457	W - 1 - 7	141600.	12312.	3611.	60.	1850.	1883.	1614.	13680.	374.	434.	20.	457
458	W - 1 - 8	141900.	13520.	4080.	63.	1940.	2081.	1768.	15020.	400.	481.	20.	458
459	W - 1 - 9	114400.	14795.	4560.	70.	2080.	2536.	1980.	17010.	421.	533.	20.	459
460	W - 1 - 10	96300.	16060.	5033.	78.	2230.	2956.	2202.	19140.	437.	593.	25.	460
461	W - 1 - 11	100600.	16860.	5360.	77.	2420.	3276.	2242.	17100.	399.	636.	27.	461
462	W - 1 - 12	97100.	15199.	6284.	87.	1960.	2672.	2428.	18890.	373.	629.	20.	462
MEAN		116408.	15002.	4977.	106.	2081.	2590.	2041.	16990.	411.	556.	24.	
COEF VAR		13.2	7.9	15.9	46.4	7.0	14.1	10.6	9.6	5.7	11.2	18.5	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
451	W - 1 - 1	0.38388	0.17102	0.10238	0.21887	0.10978	0.10216	0.07359	0.34957	0.39107	0.08307	0.14198	451
452	W - 1 - 2	0.42527	0.18750	0.08468	0.15472	0.11250	0.11850	0.07637	0.38498	0.40179	0.09810	0.21605	452
453	W - 1 - 3	0.41355	0.19154	0.08621	0.13396	0.11576	0.12379	0.08021	0.40901	0.38304	0.09715	0.18519	453
454	W - 1 - 4	0.43297	0.18594	0.07817	0.10849	0.11630	0.12088	0.07149	0.35730	0.36071	0.08339	0.15432	454
455	W - 1 - 5	0.43223	0.18439	0.07579	0.09528	0.11793	0.12009	0.07565	0.37876	0.35982	0.09177	0.15432	455
456	W - 1 - 6	0.49451	0.17139	0.06781	0.07264	0.10652	0.10489	0.06621	0.33155	0.36071	0.07943	0.12963	456
457	W - 1 - 7	0.51868	0.14727	0.05805	0.05660	0.10054	0.08295	0.05839	0.29356	0.33393	0.06867	0.12346	457
458	W - 1 - 8	0.51978	0.16172	0.06559	0.05943	0.10543	0.09167	0.06397	0.32232	0.35714	0.07611	0.12346	458
459	W - 1 - 9	0.41905	0.17697	0.07331	0.06604	0.11304	0.11172	0.07164	0.36502	0.37589	0.08434	0.12346	459
460	W - 1 - 10	0.35275	0.19211	0.08092	0.07358	0.12120	0.13022	0.07967	0.41073	0.39018	0.09383	0.15432	460
461	W - 1 - 11	0.36850	0.20167	0.08617	0.07264	0.13152	0.14432	0.08111	0.36695	0.35625	0.10063	0.16667	461
462	W - 1 - 12	0.35568	0.18181	0.10103	0.08208	0.10652	0.11771	0.08784	0.40536	0.33304	0.09953	0.12346	462
MEAN		0.42640	0.17944	0.08001	0.09953	0.11309	0.11407	0.07385	0.36459	0.36696	0.08800	0.14969	
COEF VAR		13.2	7.9	15.9	46.4	7.0	14.1	10.6	9.6	5.7	11.2	18.5	

W2

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
472	W - 2 - 1	223500.	22229.	11842.	219.	3230.	3364.	4358.	13030.	560.	854.	30.	472
473	W - 2 - 2	226700.	22102.	13177.	212.	3020.	3866.	4473.	13310.	537.	847.	27.	473
474	W - 2 - 3	198500.	26477.	15831.	245.	3270.	4763.	5664.	16650.	630.	1188.	40.	474
475	W - 2 - 4	214800.	25266.	13375.	211.	2670.	4491.	5102.	14780.	614.	1141.	40.	475
476	W - 2 - 5	226100.	24939.	12641.	174.	3130.	4434.	4797.	13300.	616.	1020.	48.	476
477	W - 2 - 6	163700.	24012.	11347.	171.	3190.	3950.	4349.	14190.	632.	945.	46.	477
478	W - 2 - 7	205800.	44111.	20568.	292.	5370.	7745.	7957.	28150.	1150.	1752.	84.	478
479	W - 2 - 8	188200.	26180.	11152.	143.	3370.	4063.	4298.	14150.	622.	876.	45.	479
480	W - 2 - 9	197100.	36925.	9401.	162.	4120.	5367.	2767.	8248.	917.	1092.	44.	480
487	W - 2 - 10	200000.	24701.	12376.	170.	3240.	4171.	4794.	16280.	588.	1097.	40.	487
488	W - 2 - 11	198000.	66604.	42075.	1462.	19300.	12149.	14854.	40520.	2116.	4823.	156.	488
483	W - 2 - 12	196200.	26360.	12300.	167.	3910.	4177.	4810.	16450.	626.	992.	36.	483
MEAN		203217.	30826.	15507.	302.	4818.	5253.	5685.	17422.	801.	1386.	53.	
COEF VAR		8.5	40.3	54.5	116.4	91.7	44.2	52.6	47.4	53.8	76.6	64.0	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
472	W - 2 - 1	0.81868	0.26590	0.19039	0.20660	0.17554	0.17022	0.15767	0.27961	0.50000	0.13513	0.18519	472
473	W - 2 - 2	0.83040	0.26438	0.21185	0.20000	0.16413	0.17031	0.16183	0.28562	0.47946	0.13402	0.16667	473
474	W - 2 - 3	0.72711	0.31671	0.25452	0.23113	0.17772	0.20982	0.20492	0.35730	0.56250	0.18797	0.24691	474
475	W - 2 - 4	0.78681	0.30222	0.21503	0.19906	0.14511	0.19784	0.18459	0.31717	0.54821	0.18054	0.24691	475
476	W - 2 - 5	0.82821	0.29831	0.20323	0.16415	0.17011	0.19533	0.17355	0.28541	0.55000	0.16139	0.29630	476
477	W - 2 - 6	0.59963	0.28722	0.18243	0.16132	0.17337	0.17401	0.15734	0.30451	0.56429	0.14953	0.28395	477
478	W - 2 - 7	0.75385	0.52764	0.33068	0.27547	0.29185	0.34119	0.28788	0.60408	1.02678	0.27722	0.51852	478
479	W - 2 - 8	0.68938	0.31316	0.17929	0.13491	0.18315	0.17899	0.15550	0.30365	0.55536	0.13861	0.27778	479
480	W - 2 - 9	0.72198	0.44169	0.15114	0.15283	0.22391	0.23643	0.10011	0.17700	0.81875	0.17278	0.27160	480
487	W - 2 - 10	0.73260	0.29547	0.19897	0.16038	0.17609	0.18374	0.17344	0.34936	0.52500	0.17358	0.24691	487
488	W - 2 - 11	0.72527	0.79670	0.67645	1.37924	1.04891	0.53520	0.53741	0.86953	1.88929	0.76313	0.96296	488
483	W - 2 - 12	0.71868	0.31531	0.19775	0.15755	0.21250	0.18401	0.17402	0.35300	0.55893	0.15696	0.22222	483
MEAN		0.74438	0.36873	0.24931	0.28522	0.26187	0.23142	0.20569	0.37385	0.71488	0.21924	0.32716	
COEF VAR		8.5	40.3	54.5	116.4	91.7	44.2	52.6	47.4	53.8	76.6	64.0	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK
(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

W-29

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

W3

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
490	W - 3 - 1	109900.	9804.	12438.	338.	1520.	2096.	2006.	11290.	626.	450.	16.	490
491	W - 3 - 2	*******	8997.	11427.	325.	1380.	2135.	2102.	12937.	620.	455.	10.	491
492	W - 3 - 3	55700.	10566.	15308.	358.	1760.	2436.	2350.	12360.	640.	544.	16.	492
493	W - 3 - 4	*******	9070.	10180.	234.	1300.	2000.	1974.	11240.	558.	448.	14.	493
494	W - 3 - 5	*******	10172.	8620.	190.	1440.	2320.	2126.	12460.	616.	478.	16.	494
495	W - 3 - 6	74800.	11204.	10436.	204.	1720.	2500.	2702.	13452.	606.	594.	16.	495
496	W - 3 - 7	116200.	13086.	13322.	242.	1940.	2892.	2934.	12894.	652.	698.	18.	496
497	W - 3 - 8	*******	12979.	10337.	178.	1640.	2549.	2928.	12790.	594.	663.	20.	497
498	W - 3 - 9	149100.	14136.	10527.	191.	1880.	2808.	3093.	54540.	554.	740.	22.	498
518	W - 3 - 10	248400.	15600.	9251.	167.	2140.	2866.	3327.	11850.	556.	769.	17.	518
519	W - 3 - 11	151800.	16867.	9898.	193.	2700.	3059.	3675.	12720.	566.	865.	20.	519
501	W - 3 - 12	156900.	16508.	7116.	127.	2370.	2903.	3083.	11440.	577.	763.	21.	501
MEAN		132850.	12416.	10738.	229.	1816.	2547.	2692.	15831.	597.	623.	17.	
COEF VAR		41.8	22.1	19.4	30.8	22.2	13.5	20.3	73.8	5.5	22.6	18.5	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
490	W - 3 - 1	0.40256	0.11727	0.19997	0.31887	0.08261	0.09233	0.07258	0.24227	0.55893	0.07120	0.09877	490
491	W - 3 - 2	*******	0.10762	0.18371	0.30660	0.07500	0.09405	0.07605	0.27762	0.55357	0.07199	0.06173	491
492	W - 3 - 3	0.20403	0.12639	0.24611	0.33774	0.09565	0.10731	0.08502	0.26524	0.57143	0.08608	0.09877	492
493	W - 3 - 4	*******	0.10849	0.16367	0.22075	0.07065	0.08911	0.07142	0.24120	0.49821	0.07089	0.08642	493
494	W - 3 - 5	*******	0.12167	0.13869	0.17925	0.07826	0.10220	0.07692	0.26738	0.55000	0.07563	0.09877	494
495	W - 3 - 6	0.27399	0.13402	0.16778	0.19245	0.09348	0.11013	0.09776	0.28867	0.54107	0.09399	0.09877	495
496	W - 3 - 7	0.42564	0.15653	0.21418	0.22830	0.10543	0.12740	0.10615	0.27670	0.58214	0.11044	0.11111	496
497	W - 3 - 8	*******	0.15525	0.16619	0.16792	0.08913	0.11229	0.10593	0.27446	0.53036	0.10491	0.12346	497
498	W - 3 - 9	0.54615	0.16909	0.16924	0.18019	0.10217	0.12370	0.11190	1.17039	0.49464	0.11804	0.13580	498
518	W - 3 - 10	0.90989	0.18660	0.14873	0.15755	0.11630	0.12626	0.12037	0.25429	0.49643	0.12168	0.10494	518
519	W - 3 - 11	0.55604	0.20176	0.15913	0.18208	0.14674	0.13476	0.13296	0.27296	0.50536	0.13687	0.12346	519
501	W - 3 - 12	0.57473	0.19746	0.11441	0.11981	0.12880	0.12789	0.11154	0.24549	0.51518	0.12073	0.12963	501
MEAN		0.48663	0.14851	0.17264	0.21596	0.09869	0.11220	0.09738	0.33972	0.53311	0.09854	0.10597	
COEF VAR		41.8	22.1	19.4	30.8	22.2	13.5	20.3	73.8	5.5	22.6	18.5	

W4

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
523	W - 4 - 1	16900.	12298.	4399.	108.	2580.	1668.	1992.	233700.	109.	441.	16.	523
524	W - 4 - 2	4200.	9542.	3321.	86.	2100.	1503.	1815.	268400.	73.	352.	12.	524
525	W - 4 - 3	3500.	7777.	2628.	74.	1760.	1350.	1647.	271200.	61.	288.	9.	525
526	W - 4 - 4	1000.	4249.	1438.	60.	980.	1174.	1352.	299500.	50.	137.	6.	526
527	W - 4 - 5	700.	2647.	874.	50.	530.	1046.	1242.	303500.	44.	65.	4.	527
528	W - 4 - 6	900.	2711.	928.	58.	600.	1076.	1426.	347800.	45.	75.	3.	528
529	W - 4 - 7	700.	3335.	1271.	59.	630.	1133.	1545.	336900.	50.	99.	4.	529
530	W - 4 - 8	700.	3043.	1305.	66.	600.	1091.	1527.	363600.	49.	100.	4.	530
***	W - 4 - 9	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
***	W - 4 - 10	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
***	W - 4 - 11	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
***	W - 4 - 12	*******	******	******	*****	******	******	******	*******	******	*****	*****	***
MEAN		3575.	5700.	2021.	70.	1223.	1255.	1568.	303075.	60.	195.	7.	
COEF VAR		145.5	60.7	59.7	25.5	61.8	17.0	14.7	13.7	34.2	69.6	60.4	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
523	W - 4 - 1	0.06190	0.14711	0.07072	0.10189	0.14022	0.07348	0.07207	5.01502	0.09732	0.06978	0.09877	523
524	W - 4 - 2	0.01538	0.11414	0.05339	0.08113	0.11413	0.06621	0.06567	5.75966	0.06518	0.05570	0.07407	524
525	W - 4 - 3	0.01282	0.09303	0.04225	0.06981	0.09565	0.05947	0.05959	5.81974	0.05446	0.04557	0.05556	525
526	W - 4 - 4	0.00366	0.05083	0.02312	0.05660	0.05326	0.05172	0.04891	6.42704	0.04464	0.02166	0.03704	526
527	W - 4 - 5	0.00256	0.03166	0.01405	0.04717	0.02880	0.04608	0.04493	6.51287	0.03929	0.01028	0.02469	527
528	W - 4 - 6	0.00330	0.03243	0.01492	0.05283	0.03261	0.04740	0.05159	7.46352	0.04018	0.01137	0.01852	528
529	W - 4 - 7	0.00256	0.03989	0.02043	0.05566	0.03424	0.04991	0.05590	7.22961	0.04464	0.01560	0.02469	529
530	W - 4 - 8	0.00256	0.03640	0.02098	0.06226	0.03261	0.04806	0.05525	7.80257	0.04375	0.01582	0.02469	530
***	W - 4 - 9	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
***	W - 4 - 10	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
***	W - 4 - 11	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
***	W - 4 - 12	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	***
MEAN		0.01310	0.06818	0.03248	0.06592	0.06644	0.05529	0.05674	6.50375	0.05368	0.03080	0.04475	
COEF VAR		145.5	60.7	59.7	25.5	61.8	17.0	14.7	13.7	34.2	69.6	60.4	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

W-32

W1

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
451	W - 1 - 1	25.0	29.0	83.0	5.	19.	14.	0.4	20.0	85.	451
452	W - 1 - 2	12.0	68.0	88.0	5.	180.	11.	0.4	25.0	64.	452
453	W - 1 - 3	5.0	36.0	94.0	5.	42.	9.	0.3	24.0	63.	453
454	W - 1 - 4	2.5	45.0	82.0	5.	25.	7.	0.5	25.0	63.	454
455	W - 1 - 5	1.0	35.0	88.0	5.	18.	11.	0.5	25.0	62.	455
456	W - 1 - 6	0.1	26.0	79.0	5.	9.	1.	1.2	22.0	58.	456
457	W - 1 - 7	0.1	39.0	76.0	5.	160.	4.	0.5	20.0	50.	457
458	W - 1 - 8	0.1	30.0	93.0	5.	39.	9.	0.4	26.0	63.	458
459	W - 1 - 9	0.1	20.0	85.0	5.	2.	9.	0.4	26.0	61.	459
460	W - 1 - 10	0.1	34.0	90.0	5.	29.	8.	0.5	29.0	72.	460
461	W - 1 - 11	0.1	29.0	89.0	5.	19.	9.	0.4	24.0	67.	461
462	W - 1 - 12	4.5	124.0	101.0	13.	64.	9.	0.4	18.0	65.	462
MEAN		4.2	42.9	87.3	6.	51.	8.	0.5	23.7	64.	
COEF VAR		168.8	63.0	7.6	39.0	110.5	38.0	45.1	12.6	12.4	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
451	W - 1 - 1	13.889	0.238	1.221	0.058	0.192	1.08	0.174	0.147	1.118	451
452	W - 1 - 2	6.667	0.557	1.294	0.058	1.818	0.85	0.174	0.184	0.842	452
453	W - 1 - 3	2.778	0.295	1.382	0.058	0.424	0.69	0.130	0.176	0.829	453
454	W - 1 - 4	1.389	0.369	1.206	0.058	0.253	0.54	0.217	0.184	0.829	454
455	W - 1 - 5	0.556	0.287	1.294	0.058	0.182	0.85	0.217	0.184	0.816	455
456	W - 1 - 6	0.056	0.213	1.162	0.058	0.091	0.08	0.522	0.162	0.763	456
457	W - 1 - 7	0.056	0.320	1.118	0.058	1.616	0.31	0.217	0.147	0.658	457
458	W - 1 - 8	0.056	0.246	1.368	0.058	0.394	0.69	0.174	0.191	0.829	458
459	W - 1 - 9	0.056	0.164	1.250	0.058	0.020	0.69	0.174	0.191	0.803	459
460	W - 1 - 10	0.056	0.279	1.324	0.058	0.293	0.62	0.217	0.213	0.947	460
461	W - 1 - 11	0.056	0.238	1.309	0.058	0.192	0.69	0.174	0.176	0.882	461
462	W - 1 - 12	2.500	1.016	1.485	0.151	0.646	0.69	0.174	0.132	0.855	462
MEAN		2.343	0.352	1.284	0.066	0.510	0.65	0.214	0.174	0.848	
COEF VAR		168.8	63.0	7.6	39.0	110.5	38.0	45.1	12.6	12.4	

W2

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
472	W - 2 - 1	2.8	63.0	145.0	5.	178.	8.	0.1	33.0	66.	472
473	W - 2 - 2	4.5	139.0	137.0	13.	102.	10.	3.0	30.0	59.	473
474	W - 2 - 3	5.5	98.0	157.0	5.	69.	15.	2.4	39.0	63.	474
475	W - 2 - 4	6.6	62.0	152.0	5.	67.	12.	2.7	35.0	66.	475
476	W - 2 - 5	4.4	28.0	148.0	5.	40.	16.	2.4	34.0	72.	476
477	W - 2 - 6	2.5	102.0	158.0	5.	44.	14.	2.4	29.0	60.	477
478	W - 2 - 7	13.0	83.0	312.0	5.	57.	24.	4.1	64.0	111.	478
479	W - 2 - 8	10.0	65.0	172.0	5.	28.	9.	2.7	33.0	57.	479
480	W - 2 - 9	5.5	46.0	20.0	5.	19.	24.	3.2	30.0	74.	480
487	W - 2 - 10	8.0	66.0	179.0	5.	63.	18.	2.5	35.0	74.	487
488	W - 2 - 11	1.0	55.0	28.0	5.	132.	47.	2.4	113.0	103.	488
483	W - 2 - 12	5.5	51.0	186.0	20.	53.	16.	2.1	27.0	60.	483
MEAN		5.8	71.5	149.5	7.	73.	18.	2.5	41.8	72.	
COEF VAR		55.2	39.9	47.7	65.3	60.6	57.0	35.3	55.8	23.1	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
472	W - 2 - 1	1.556	0.516	2.132	0.058	1.798	0.62	0.043	0.243	0.868	472
473	W - 2 - 2	2.500	1.139	2.015	0.151	1.030	0.77	1.304	0.221	0.776	473
474	W - 2 - 3	3.056	0.803	2.309	0.058	0.899	1.15	1.043	0.287	0.829	474
475	W - 2 - 4	3.667	0.508	2.235	0.058	0.677	0.92	1.174	0.257	0.869	475
476	W - 2 - 5	2.444	0.230	2.176	0.058	0.404	1.23	1.043	0.250	0.947	476
477	W - 2 - 6	1.389	0.836	2.324	0.058	0.444	1.08	1.043	0.213	0.789	477
478	W - 2 - 7	7.222	0.680	4.588	0.058	0.576	1.85	1.783	0.471	1.461	478
479	W - 2 - 8	5.556	0.533	2.529	0.058	0.283	0.69	1.174	0.243	0.750	479
480	W - 2 - 9	3.056	0.377	0.294	0.058	0.192	1.85	1.391	0.221	0.974	480
487	W - 2 - 10	4.444	0.541	2.632	0.058	0.636	1.38	1.087	0.257	0.974	487
488	W - 2 - 11	0.556	0.451	0.412	0.058	1.333	3.62	1.043	0.831	1.355	488
483	W - 2 - 12	3.056	0.418	2.735	0.233	0.535	1.23	0.913	0.199	0.789	483
MEAN		3.208	0.586	2.199	0.080	0.734	1.37	1.087	0.308	0.948	
COEF VAR		55.2	40.0	47.7	65.3	60.6	57.0	35.3	55.8	23.1	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

W3

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
490	W - 3 - 1	19.0	16.0	58.0	*****	2.	42.	0.1	22.0	76.	490
491	W - 3 - 2	16.0	32.0	67.0	*****	42.	38.	0.1	20.0	76.	491
492	W - 3 - 3	21.0	18.0	68.0	*****	2.	40.	0.1	28.0	86.	492
493	W - 3 - 4	17.0	16.0	60.0	*****	2.	28.	0.4	14.0	66.	493
494	W - 3 - 5	12.5	18.0	68.0	*****	2.	28.	1.1	18.0	82.	494
495	W - 3 - 6	11.5	16.0	76.0	*****	8.	24.	0.5	12.0	78.	495
496	W - 3 - 7	15.0	22.0	76.0	*****	4.	34.	1.5	24.0	80.	496
497	W - 3 - 8	16.0	53.0	75.0	*****	113.	19.	1.0	18.0	72.	497
498	W - 3 - 9	19.0	26.0	79.0	*****	11.	23.	1.3	21.0	75.	498
518	W - 3 - 10	19.5	33.0	90.0	*****	15.	17.	1.0	21.0	76.	518
519	W - 3 - 11	15.5	138.0	96.0	*****	17.	18.	1.3	21.0	82.	519
501	W - 3 - 12	11.0	29.0	87.0	*****	16.	12.	0.5	24.0	78.	501
MEAN		16.1	34.8	75.0	*****	20.	27.	0.7	20.3	77.	
COEF VAR		19.2	94.3	14.9	******	155.0	34.9	66.6	20.7	6.4	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
490	W - 3 - 1	10.556	0.131	0.853	*****	0.020	3.23	0.043	0.162	1.000	490
491	W - 3 - 2	8.889	0.262	0.985	*****	0.424	2.92	0.043	0.147	1.000	491
492	W - 3 - 3	11.667	0.148	1.000	*****	0.020	3.08	0.043	0.206	1.132	492
493	W - 3 - 4	9.444	0.131	0.882	*****	0.020	2.15	0.174	0.103	0.868	493
494	W - 3 - 5	6.944	0.148	1.000	*****	0.020	2.15	0.478	0.132	1.079	494
495	W - 3 - 6	6.389	0.131	1.118	*****	0.081	1.85	0.217	0.088	1.026	495
496	W - 3 - 7	8.333	0.180	1.118	*****	0.040	2.62	0.652	0.176	1.053	496
497	W - 3 - 8	8.889	0.434	1.103	*****	1.141	1.46	0.435	0.132	0.947	497
498	W - 3 - 9	10.556	0.213	1.162	*****	0.111	1.77	0.565	0.154	0.987	498
518	W - 3 - 10	10.833	0.270	1.324	*****	0.152	1.31	0.435	0.154	1.000	518
519	W - 3 - 11	8.611	1.131	1.412	*****	0.172	1.38	0.565	0.154	1.079	519
501	W - 3 - 12	6.111	0.238	1.279	*****	0.162	0.92	0.217	0.176	1.026	501
MEAN		8.935	0.285	1.103	*****	0.197	2.07	0.322	0.149	1.016	
COEF VAR		19.2	94.3	14.9	******	155.0	34.9	66.6	20.7	6.4	

W4

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
523	W - 4 - 1	6.0	32.0	116.0	5.	33.	13.	0.3	15.0	59.	523
524	W - 4 - 2	10.0	19.0	67.0	5.	51.	10.	0.3	14.0	41.	524
525	W - 4 - 3	6.0	20.0	54.0	5.	65.	15.	0.5	12.0	35.	525
526	W - 4 - 4	6.0	9.0	50.0	5.	28.	9.	0.2	9.0	37.	526
527	W - 4 - 5	6.0	14.0	43.0	5.	74.	12.	1.2	7.0	27.	527
528	W - 4 - 6	8.0	6.0	50.0	5.	27.	11.	1.1	7.0	26.	528
529	W - 4 - 7	8.0	33.0	42.0	5.	171.	12.	1.2	7.0	28.	529
530	W - 4 - 8	8.0	11.0	42.0	5.	42.	13.	1.1	10.0	36.	530
***	W - 4 - 9	****	*****	*****	*****	****	****	****	*****	****	***
***	W - 4 - 10	****	*****	*****	*****	****	****	****	*****	****	***
***	W - 4 - 11	****	*****	*****	*****	****	****	****	*****	****	***
***	W - 4 - 12	****	*****	*****	*****	****	****	****	*****	****	***
MEAN		7.3	18.0	58.0	5.	61.	12.	0.7	10.1	36.	
COEF VAR		19.2	52.6	40.1	0.0	72.3	14.8	57.1	29.8	27.7	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
523	W - 4 - 1	3.333	0.262	1.706	0.058	0.333	1.00	0.130	0.110	0.776	523
524	W - 4 - 2	5.556	0.156	0.985	0.058	0.515	0.77	0.130	0.103	0.539	524
525	W - 4 - 3	3.333	0.164	0.794	0.058	0.657	1.15	0.217	0.088	0.461	525
526	W - 4 - 4	3.333	0.074	0.735	0.058	0.283	0.69	0.087	0.066	0.487	526
527	W - 4 - 5	3.333	0.115	0.632	0.058	0.747	0.92	0.522	0.051	0.355	527
528	W - 4 - 6	4.444	0.049	0.735	0.058	0.273	0.85	0.478	0.051	0.342	528
529	W - 4 - 7	4.444	0.270	0.618	0.058	1.727	0.92	0.522	0.051	0.368	529
530	W - 4 - 8	4.444	0.090	0.618	0.058	0.424	1.00	0.478	0.074	0.474	530
***	W - 4 - 9	******	*****	******	*****	*****	******	*****	*****	*****	***
***	W - 4 - 10	******	*****	******	*****	*****	******	*****	*****	*****	***
***	W - 4 - 11	******	*****	******	*****	*****	******	*****	*****	*****	***
***	W - 4 - 12	******	*****	******	*****	*****	******	*****	*****	*****	***
MEAN		4.028	0.148	0.853	0.058	0.620	0.91	0.321	0.074	0.475	
COEF VAR		19.2	52.6	40.1	0.0	72.3	14.8	57.1	29.8	27.7	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

W-35

TOP 20 cm (LAKE W_2 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

W -36

DATA CODE	SAMPLE I.D.	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DATA CODE
620	W - 2 - 1	****	****	****	****	****	****	****	****	620
621	W - 2 - 2	23812.	43606.	1756.	4733.	4894.	5101.	10968.	791.	621
622	W - 2 - 3	25796.	43699.	1489.	5040.	5245.	5382.	11208.	864.	622
623	W - 2 - 4	27627.	29054.	831.	5285.	5581.	5011.	11915.	888.	623
624	W - 2 - 5	26813.	32599.	1164.	5126.	5244.	5307.	12350.	914.	624
625	W - 2 - 6	27207.	27426.	636.	5086.	5304.	4753.	12111.	816.	625
627	W - 2 - 7	26145.	27664.	573.	4797.	5032.	4534.	11661.	725.	627
628	W - 2 - 8	24863.	25227.	485.	4519.	4691.	4331.	11966.	690.	628
629	W - 2 - 9	24675.	27049.	484.	4493.	4461.	4359.	12356.	677.	629
630	W - 2 - 10	25230.	30780.	454.	4629.	4938.	4358.	12566.	639.	630
632	W - 2 - 11	24293.	26603.	348.	4536.	4898.	4257.	10881.	654.	632
633	W - 2 - 12	23667.	23316.	427.	4136.	4425.	4232.	12990.	613.	633
634	W - 2 - 13	23379.	17428.	394.	3979.	4424.	4220.	13772.	594.	634
635	W - 2 - 14	21930.	13244.	368.	3697.	4166.	4125.	14450.	552.	635
637	W - 2 - 15	21889.	11296.	226.	3708.	4105.	3982.	12344.	504.	637
638	W - 2 - 16	23709.	14114.	333.	3905.	4509.	4278.	14292.	557.	638
639	W - 2 - 17	21141.	13338.	331.	3663.	3972.	3970.	11668.	564.	639
640	W - 2 - 18	21527.	10762.	250.	3655.	4030.	3881.	12366.	539.	640
642	W - 2 - 19	48152.	11139.	383.	****	****	4275.	15756.	431.	642
643	W - 2 - 20	21153.	11323.	200.	3581.	4146.	3814.	11608.	488.	643
MEAN		25421.5	23140.4	585.9	4364.9	4670.3	4430.0	12485.7	657.9	
COEF VAR		22.4	44.1	71.6	13.0	10.3	10.3	9.9	21.1	

DATA CODE	SAMPLE I.D.	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DATA CODE
620	W - 2 - 1	*****	*****	*****	*****	*****	*****	*****	*****	620
621	W - 2 - 2	0.28483	0.70106	1.65660	0.25723	0.21559	0.18455	0.23536	0.70625	621
622	W - 2 - 3	0.30856	0.70256	1.40472	0.27391	0.23106	0.19472	0.24051	0.77143	622
623	W - 2 - 4	0.33047	0.46711	0.78396	0.28723	0.24586	0.18130	0.25569	0.79286	623
624	W - 2 - 5	0.32073	0.52410	1.09811	0.27859	0.23101	0.19200	0.26502	0.81607	624
625	W - 2 - 6	0.32544	0.44093	0.60000	0.27641	0.23366	0.17196	0.25989	0.72857	625
627	W - 2 - 7	0.31274	0.44476	0.54057	0.26071	0.22167	0.16404	0.25024	0.64732	627
628	W - 2 - 8	0.29740	0.40558	0.45755	0.24560	0.20665	0.15669	0.25678	0.61607	628
629	W - 2 - 9	0.29516	0.43487	0.45660	0.24418	0.19652	0.15771	0.26515	0.60446	629
630	W - 2 - 10	0.30179	0.49486	0.42830	0.25158	0.21753	0.15767	0.26966	0.57054	630
632	W - 2 - 11	0.29059	0.42770	0.32830	0.24652	0.21577	0.15402	0.23350	0.58393	632
633	W - 2 - 12	0.28310	0.37486	0.40283	0.22478	0.19493	0.15311	0.27876	0.54732	633
634	W - 2 - 13	0.27965	0.28019	0.37170	0.21625	0.19489	0.15268	0.29554	0.53036	634
635	W - 2 - 14	0.26232	0.21293	0.34717	0.20092	0.18352	0.14924	0.31009	0.49286	635
637	W - 2 - 15	0.26183	0.18161	0.21321	0.20152	0.18084	0.14407	0.26489	0.45000	637
638	W - 2 - 16	0.28360	0.22691	0.31415	0.21223	0.19863	0.15478	0.30670	0.49732	638
639	W - 2 - 17	0.25288	0.21444	0.31226	0.19908	0.17498	0.14363	0.25039	0.50357	639
640	W - 2 - 18	0.25750	0.17302	0.23585	0.19864	0.17753	0.14041	0.26536	0.48125	640
642	W - 2 - 19	0.57598	0.17908	0.36132	*****	*****	0.15467	0.33811	0.38482	642
643	W - 2 - 20	0.25303	0.18204	0.18868	0.19462	0.18264	0.13799	0.24910	0.43571	643
MEAN		0.30408	0.37203	0.55273	0.23722	0.20574	0.16027	0.26793	0.58741	
COEF VAR		22.4	44.1	71.6	13.0	10.3	10.3	9.9	21.1	

TOP 20 cm (LAKE W_2 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

W -37

TOP 20 cm (LAKE W_2 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

W -38

DATA CODE	SAMPLE I.D.	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DATA CODE
620	W - 2 - 1	****	****	****	****	****	****	****	****	****	620
621	W - 2 - 2	857.0	26.0	184.0	19.0	90.0	21.0	92.0	30.0	111.0	621
622	W - 2 - 3	931.0	27.0	183.0	21.0	99.0	26.0	97.0	33.0	88.0	622
623	W - 2 - 4	960.0	29.0	180.0	26.0	121.0	28.0	101.0	35.0	120.0	623
624	W - 2 - 5	961.0	30.0	176.0	24.0	114.0	29.0	105.0	35.0	108.0	624
625	W - 2 - 6	953.0	29.0	175.0	26.0	128.0	33.0	92.0	35.0	125.0	625
627	W - 2 - 7	907.0	26.0	166.0	24.0	120.0	27.0	83.0	33.0	117.0	627
628	W - 2 - 8	873.0	26.0	160.0	25.0	135.0	32.0	70.0	32.0	124.0	628
629	W - 2 - 9	856.0	26.0	156.0	32.0	140.0	33.0	68.0	32.0	916.0	629
630	W - 2 - 10	883.0	28.0	162.0	31.0	138.0	34.0	66.0	32.0	402.0	630
632	W - 2 - 11	889.0	27.0	162.0	32.0	131.0	32.0	67.0	32.0	320.0	632
633	W - 2 - 12	870.0	27.0	152.0	33.0	148.0	32.0	55.0	32.0	102.0	633
634	W - 2 - 13	866.0	28.0	148.0	35.0	163.0	35.0	43.0	31.0	87.0	634
635	W - 2 - 14	821.0	26.0	140.0	35.0	174.0	34.0	33.0	30.0	83.0	635
637	W - 2 - 15	717.0	24.0	136.0	35.0	175.0	36.0	24.0	29.0	74.0	637
638	W - 2 - 16	798.0	24.0	145.0	38.0	185.0	39.0	29.0	31.0	122.0	638
639	W - 2 - 17	755.0	25.0	130.0	35.0	179.0	34.0	29.0	29.0	76.0	639
640	W - 2 - 18	803.0	26.0	133.0	36.0	186.0	41.0	26.0	30.0	79.0	640
642	W - 2 - 19	****	40.0	210.0	39.0	35.0	23.0	37.0	29.0	147.0	642
643	W - 2 - 20	740.0	25.0	131.0	35.0	169.0	34.0	18.0	29.0	68.0	643
MEAN		857.8	27.3	159.4	30.6	138.4	31.7	59.7	31.5	172.1	
COEF VAR		8.3	12.4	13.2	19.1	26.9	15.5	48.0	6.3	112.7	

DATA CODE	SAMPLE I.D.	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DATA CODE
620	W - 2 - 1	****	****	****	****	****	****	****	****	****	620
621	W - 2 - 2	0.1356	0.1605	0.4718	0.1557	1.3235	0.2121	7.0769	0.2206	1.4605	621
622	W - 2 - 3	0.1473	0.1667	0.4692	0.1721	1.4559	0.2626	7.4615	0.2426	1.1579	622
623	W - 2 - 4	0.1519	0.1790	0.4615	0.2131	1.7794	0.2828	7.7692	0.2574	1.5789	623
624	W - 2 - 5	0.1521	0.1852	0.4513	0.1967	1.6765	0.2929	8.0769	0.2574	1.4211	624
625	W - 2 - 6	0.1508	0.1790	0.4487	0.2131	1.8824	0.3333	7.0769	0.2574	1.6447	625
627	W - 2 - 7	0.1435	0.1605	0.4256	0.1967	1.7647	0.2727	6.3846	0.2426	1.5395	627
628	W - 2 - 8	0.1381	0.1605	0.4103	0.2049	1.9853	0.3232	5.3846	0.2353	1.6316	628
629	W - 2 - 9	0.1354	0.1605	0.4000	0.2623	2.0588	0.3333	5.2308	0.2353	****	629
630	W - 2 - 10	0.1397	0.1728	0.4154	0.2541	2.0294	0.3434	5.0769	0.2353	5.2895	630
632	W - 2 - 11	0.1407	0.1667	0.4154	0.2623	1.9265	0.3232	5.1538	0.2353	4.2105	632
633	W - 2 - 12	0.1377	0.1667	0.3897	0.2705	2.1765	0.3232	4.2308	0.2353	1.3421	633
634	W - 2 - 13	0.1370	0.1728	0.3795	0.2869	2.3971	0.3535	3.3077	0.2279	1.1447	634
635	W - 2 - 14	0.1299	0.1605	0.3590	0.2869	2.5588	0.3434	2.5385	0.2206	1.0921	635
637	W - 2 - 15	0.1134	0.1481	0.3487	0.2869	2.5735	0.3636	1.8462	0.2132	0.9737	637
638	W - 2 - 16	0.1263	0.1481	0.3718	0.3115	2.7206	0.3939	2.2308	0.2279	1.6053	638
639	W - 2 - 17	0.1195	0.1543	0.3333	0.2869	2.6324	0.3434	2.2308	0.2132	1.0000	639
640	W - 2 - 18	0.1271	0.1605	0.3410	0.2951	2.7353	0.4141	2.0000	0.2206	1.0395	640
642	W - 2 - 19	****	0.2469	0.5385	0.3197	0.5147	0.2323	2.8462	0.2132	1.9342	642
643	W - 2 - 20	0.1171	0.1543	0.3359	0.2869	2.4853	0.3434	1.3846	0.2132	0.8947	643
MEAN		0.1357	0.1686	0.4088	0.2506	2.0356	0.3206	4.5951	0.2318	2.2638	
COEF VAR		8.3	12.4	13.2	19.1	26.9	15.5	48.0	6.3	112.7	

W -39

TOP 20 CM (LAKE W_2 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

W -39

TOP 20 cm (LAKE W_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

W -40

DATA CODE	SAMPLE I.D.	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DATA CODE
644	W - 3 - 1	22166.	10875.	239.	3726.	4528.	4014.	12725.	508.	644
645	W - 3 - 2	26970.	44890.	1542.	5373.	5699.	5604.	11707.	658.	645
647	W - 3 - 3	33009.	11511.	236.	5093.	7450.	2946.	7459.	552.	647
648	W - 3 - 4	29438.	11064.	246.	4129.	5252.	2533.	6366.	674.	648
649	W - 3 - 5	19039.	9271.	211.	3852.	2494.	2542.	7965.	193.	649
650	W - 3 - 6	31527.	10932.	242.	4622.	6971.	2762.	7221.	593.	650
652	W - 3 - 7	29300.	10848.	228.	3980.	6069.	2532.	6831.	610.	652
653	W - 3 - 8	34776.	11421.	223.	5234.	9242.	3085.	8772.	515.	653
654	W - 3 - 9	28316.	11218.	246.	3705.	4644.	2365.	8037.	725.	654
655	W - 3 - 10	34700.	11432.	214.	5065.	9435.	3107.	8385.	509.	655
657	W - 3 - 11	31759.	10607.	170.	4471.	6248.	2389.	6049.	591.	657
658	W - 3 - 12	32129.	10529.	156.	4366.	5926.	2366.	5905.	601.	658
659	W - 3 - 13	****	****	****	****	****	****	****	****	659
660	W - 3 - 14	31395.	10710.	157.	4216.	5950.	2326.	5878.	638.	660
662	W - 3 - 15	****	****	****	****	****	****	****	****	662
663	W - 3 - 16	****	****	****	****	****	****	****	****	663
664	W - 3 - 17	****	****	****	****	****	****	****	****	664
665	W - 3 - 18	****	****	****	****	****	****	****	****	665
667	W - 3 - 19	****	****	****	****	****	****	****	****	667
668	W - 3 - 20	****	****	****	****	****	****	****	****	668
MEAN		29578.8	13485.2	316.2	4448.6	6146.8	2967.0	7946.2	566.7	
COEF VAR		15.1	67.4	112.4	12.6	29.3	29.8	25.7	22.1	

DATA CODE	SAMPLE I.D.	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DATA CODE
644	W - 3 - 1	0.26514	0.17484	0.22547	0.20250	0.19947	0.14522	0.27307	0.45357	644
645	W - 3 - 2	0.32261	0.72170	1.45472	0.29201	0.25106	0.20275	0.25122	0.58750	645
647	W - 3 - 3	0.39484	0.18506	0.22264	0.27679	0.32819	0.10658	0.16006	0.49286	647
648	W - 3 - 4	0.35213	0.17788	0.23208	0.22440	0.23137	0.09164	0.13661	0.60179	648
649	W - 3 - 5	0.22774	0.14905	0.19906	0.20935	0.10987	0.09197	0.17092	0.17232	649
650	W - 3 - 6	0.37712	0.17576	0.22830	0.25120	0.30709	0.09993	0.15496	0.52946	650
652	W - 3 - 7	0.35048	0.17441	0.21509	0.21630	0.26736	0.09161	0.14659	0.54464	652
653	W - 3 - 8	0.41598	0.18362	0.21038	0.28446	0.40714	0.11161	0.18824	0.45982	653
654	W - 3 - 9	0.33871	0.18035	0.23208	0.20136	0.20458	0.08556	0.17247	0.64732	654
655	W - 3 - 10	0.41507	0.18379	0.20189	0.27527	0.41564	0.11241	0.17994	0.45446	655
657	W - 3 - 11	0.37989	0.17053	0.16038	0.24299	0.27524	0.08643	0.12981	0.52768	657
658	W - 3 - 12	0.38432	0.16928	0.14717	0.23728	0.26106	0.08560	0.12672	0.53661	658
659	W - 3 - 13	*****	*****	*****	*****	*****	*****	*****	*****	659
660	W - 3 - 14	0.37554	0.17219	0.14811	0.22913	0.26211	0.08415	0.12614	0.56964	660
662	W - 3 - 15	*****	*****	*****	*****	*****	*****	*****	*****	662
663	W - 3 - 16	*****	*****	*****	*****	*****	*****	*****	*****	663
664	W - 3 - 17	*****	*****	*****	*****	*****	*****	*****	*****	664
665	W - 3 - 18	*****	*****	*****	*****	*****	*****	*****	*****	665
667	W - 3 - 19	*****	*****	*****	*****	*****	*****	*****	*****	667
668	W - 3 - 20	*****	*****	*****	*****	*****	*****	*****	*****	668
MEAN		0.35381	0.21680	0.29826	0.24177	0.27078	0.10734	0.17052	0.50597	
COEF VAR		15.1	67.4	112.4	12.6	29.3	29.8	25.7	22.1	

TOP 20 cm (LAKE W_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

W -41

TOP 20 CM (LAKE W_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

W -42

DATA CODE	SAMPLE I.D.	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DATA CODE
644	W - 3 - 1	728.0	23.0	136.0	36.0	173.0	36.0	20.0	29.0	72.0	644
645	W - 3 - 2	1008.0	31.0	188.0	32.0	107.0	30.0	101.0	35.0	99.0	645
647	W - 3 - 3	1113.0	35.0	215.0	27.0	30.0	21.0	42.0	30.0	88.0	647
648	W - 3 - 4	993.0	29.0	184.0	23.0	33.0	22.0	45.0	30.0	96.0	648
649	W - 3 - 5	663.0	23.0	147.0	26.0	132.0	29.0	16.0	18.0	66.0	649
650	W - 3 - 6	1040.0	32.0	198.0	23.0	29.0	17.0	44.0	31.0	95.0	650
652	W - 3 - 7	907.0	27.0	181.0	22.0	27.0	19.0	44.0	29.0	87.0	652
653	W - 3 - 8	923.0	28.0	214.0	23.0	22.0	20.0	41.0	25.0	86.0	653
654	W - 3 - 9	899.0	24.0	176.0	23.0	28.0	14.0	50.0	30.0	102.0	654
655	W - 3 - 10	975.0	29.0	212.0	34.0	24.0	28.0	43.0	29.0	92.0	655
657	W - 3 - 11	829.0	27.0	185.0	23.0	25.0	19.0	50.0	32.0	112.0	657
658	W - 3 - 12	865.0	28.0	181.0	23.0	29.0	17.0	41.0	32.0	98.0	658
659	W - 3 - 13	****	****	****	****	****	****	****	****	****	659
660	W - 3 - 14	880.0	24.0	180.0	22.0	31.0	26.0	40.0	32.0	87.0	660
662	W - 3 - 15	****	****	****	****	****	****	****	****	****	662
663	W - 3 - 16	****	****	****	****	****	****	****	****	****	663
664	W - 3 - 17	****	****	****	****	****	****	****	****	****	664
665	W - 3 - 18	****	****	****	****	****	****	****	****	****	665
667	W - 3 - 19	****	****	****	****	****	****	****	****	****	667
668	W - 3 - 20	****	****	****	****	****	****	****	****	****	668
MEAN		909.5	27.7	184.4	25.9	53.1	22.9	44.4	29.4	90.8	
COEF VAR		13.0	12.6	12.2	18.1	90.5	26.7	42.9	13.5	12.8	

DATA CODE	SAMPLE I.D.	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DATA CODE
644	W - 3 - 1	0.1152	0.1420	0.3487	0.2951	2.5441	0.3636	1.5385	0.2132	0.9474	644
645	W - 3 - 2	0.1595	0.1914	0.4821	0.2623	1.5735	0.3030	7.7692	0.2574	1.3026	645
647	W - 3 - 3	0.1761	0.2160	0.5513	0.2213	0.4412	0.2121	3.2308	0.2206	1.1579	647
648	W - 3 - 4	0.1571	0.1790	0.4718	0.1885	0.4853	0.2222	3.4615	0.2206	1.2632	648
649	W - 3 - 5	0.1049	0.1420	0.3769	0.2131	1.9412	0.2929	1.2308	0.1324	0.8684	649
650	W - 3 - 6	0.1646	0.1975	0.5077	0.1885	0.4265	0.1717	3.3846	0.2279	1.2500	650
652	W - 3 - 7	0.1435	0.1667	0.4641	0.1803	0.3971	0.1919	3.3846	0.2132	1.1447	652
653	W - 3 - 8	0.1460	0.1728	0.5487	0.1885	0.3235	0.2020	3.1538	0.1838	1.1316	653
654	W - 3 - 9	0.1422	0.1481	0.4513	0.1885	0.4118	0.1414	3.8462	0.2206	1.3421	654
655	W - 3 - 10	0.1543	0.1790	0.5436	0.2787	0.3529	0.2828	3.3077	0.2132	1.2105	655
657	W - 3 - 11	0.1312	0.1667	0.4744	0.1885	0.3676	0.1919	3.8462	0.2353	1.4737	657
658	W - 3 - 12	0.1369	0.1728	0.4641	0.1885	0.4265	0.1717	3.1538	0.2353	1.2895	658
659	W - 3 - 13	****	****	****	****	****	****	****	****	****	659
660	W - 3 - 14	0.1392	0.1481	0.4615	0.1803	0.4559	0.2626	3.0769	0.2353	1.1447	660
662	W - 3 - 15	****	****	****	****	****	****	****	****	****	662
663	W - 3 - 16	****	****	****	****	****	****	****	****	****	663
664	W - 3 - 17	****	****	****	****	****	****	****	****	****	664
665	W - 3 - 18	****	****	****	****	****	****	****	****	****	665
667	W - 3 - 19	****	****	****	****	****	****	****	****	****	667
668	W - 3 - 20	****	****	****	****	****	****	****	****	****	668
MEAN		0.1439	0.1709	0.4728	0.2125	0.7805	0.2315	3.4142	0.2161	1.1943	
COEF VAR		13.0	12.6	12.2	18.1	90.5	26.7	42.9	13.5	12.8	

TOP 20 cm (LAKE W_3 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

W -43

TOP 20 CM (LAKE W_4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

W -44

DATA CODE	SAMPLE I.D.	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DATA CODE
669	W - 4 - 1	****	****	****	****	****	****	****	****	669
670	W - 4 - 2	23542.	3772.	1920.	4965.	4418.	4323.	7573.	287.	670
672	W - 4 - 3	15283.	23191.	328.	3229.	2281.	2700.	9861.	300.	672
673	W - 4 - 4	26075.	13985.	521.	4670.	2098.	1831.	3372.	133.	673
674	W - 4 - 5	22940.	30687.	1002.	4791.	4069.	3927.	8443.	295.	674
675	W - 4 - 6	22528.	31015.	1149.	4633.	3705.	3804.	8425.	314.	675
676	W - 4 - 7	22492.	37043.	1908.	4747.	4165.	4110.	7514.	288.	676
678	W - 4 - 8	16527.	16458.	393.	3257.	2456.	2490.	7545.	212.	678
679	W - 4 - 9	23656.	34780.	1593.	4887.	4377.	4285.	8165.	315.	679
681	W - 4 - 10	15169.	9348.	338.	3069.	2074.	2188.	6908.	192.	681
682	W - 4 - 11	16434.	7515.	242.	3406.	2109.	2330.	8221.	225.	682
685	W - 4 - 12	****	****	****	****	****	****	****	****	685
686	W - 4 - 13	19760.	9395.	305.	4098.	2564.	2578.	7628.	161.	686
687	W - 4 - 14	28887.	10280.	267.	5507.	3271.	3435.	13317.	197.	687
688	W - 4 - 15	21810.	8903.	168.	4297.	2316.	2809.	14331.	204.	688
689	W - 4 - 16	22332.	10085.	146.	4269.	2395.	2844.	16149.	169.	689
691	W - 4 - 17	28953.	14557.	168.	5565.	2372.	3361.	14816.	198.	691
692	W - 4 - 18	28941.	17389.	161.	6098.	2365.	3607.	12807.	188.	692
693	W - 4 - 19	24867.	13355.	139.	5352.	2308.	3136.	16969.	159.	693
694	W - 4 - 20	18335.	6244.	91.	4060.	1708.	2656.	****	6.	694
MEAN		22140.6	16555.7	602.2	4494.4	2836.2	3134.1	16254.9	213.5	
COEF VAR		19.8	60.7	101.0	18.8	30.8	23.4	157.2	35.7	

DATA CODE	SAMPLE I.D.	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DATA CODE
669	W - 4 - 1	*****	*****	*****	*****	*****	*****	*****	*****	669
670	W - 4 - 2	0.28160	0.06064	1.81132	0.26984	0.19463	0.15640	0.16251	0.25625	670
672	W - 4 - 3	0.18281	0.37285	0.30943	0.17549	0.10048	0.09768	0.21161	0.26786	672
673	W - 4 - 4	0.31190	0.22484	0.49151	0.25380	0.09242	0.06624	0.07236	0.11875	673
674	W - 4 - 5	0.27440	0.49336	0.94528	0.26038	0.17925	0.14208	0.18118	0.26339	674
675	W - 4 - 6	0.26947	0.49863	1.08396	0.25179	0.16322	0.13763	0.18079	0.28036	675
676	W - 4 - 7	0.26904	0.59555	1.80000	0.25799	0.18348	0.14870	0.16124	0.25714	676
678	W - 4 - 8	0.19769	0.26460	0.37075	0.17701	0.10819	0.09009	0.16191	0.18929	678
679	W - 4 - 9	0.28297	0.55916	1.50283	0.26560	0.19282	0.15503	0.17521	0.28125	679
681	W - 4 - 10	0.18145	0.15029	0.31887	0.16679	0.09137	0.07916	0.14824	0.17143	681
682	W - 4 - 11	0.19658	0.12082	0.22830	0.18511	0.09291	0.08430	0.17642	0.20089	682
685	W - 4 - 12	*****	*****	*****	*****	*****	*****	*****	*****	685
686	W - 4 - 13	0.23636	0.15104	0.28774	0.22272	0.11295	0.09327	0.16369	0.14375	686
687	W - 4 - 14	0.34554	0.16527	0.25189	0.29929	0.14410	0.12428	0.28577	0.17589	687
688	W - 4 - 15	0.26089	0.14314	0.15849	0.23353	0.10203	0.10163	0.30753	0.18214	688
689	W - 4 - 16	0.26713	0.16214	0.13774	0.23201	0.10551	0.10289	0.34655	0.15089	689
691	W - 4 - 17	0.34633	0.23404	0.15849	0.30245	0.10449	0.12160	0.31794	0.17679	691
692	W - 4 - 18	0.34618	0.27957	0.15189	0.33141	0.10418	0.13050	0.27483	0.16786	692
693	W - 4 - 19	0.29745	0.21471	0.13113	0.29087	0.10167	0.11346	0.36414	0.14196	693
694	W - 4 - 20	0.21932	0.10039	0.08585	0.22065	0.07524	0.09609	2.58680	0.00536	694
MEAN		0.26484	0.26617	0.56808	0.24426	0.12494	0.11339	0.34882	0.19062	
COEF VAR		19.8	60.7	101.0	18.8	30.8	23.4	157.2	35.7	

TOP 20 cm (LAKE W4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

W -45

TOP 20 cm (LAKE W_4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

W -46

DATA CODE	SAMPLE I.D.	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DATA CODE
669	W - 4 - 1	****	****	****	****	****	****	****	****	****	669
670	W - 4 - 2	1074.0	29.0	195.0	26.0	97.0	26.0	50.0	29.0	100.0	670
672	W - 4 - 3	628.0	18.0	109.0	23.0	91.0	23.0	47.0	21.0	135.0	672
673	W - 4 - 4	474.0	14.0	164.0	13.0	125.0	29.0	21.0	13.0	53.0	673
674	W - 4 - 5	970.0	26.0	181.0	30.0	124.0	30.0	48.0	30.0	104.0	674
675	W - 4 - 6	922.0	26.0	187.0	36.0	189.0	36.0	46.0	29.0	114.0	675
676	W - 4 - 7	1006.0	27.0	185.0	26.0	99.0	26.0	48.0	29.0	103.0	676
678	W - 4 - 8	667.0	21.0	126.0	29.0	120.0	29.0	36.0	18.0	68.0	678
679	W - 4 - 9	1087.0	27.0	185.0	23.0	91.0	23.0	44.0	30.0	98.0	679
681	W - 4 - 10	510.0	17.0	119.0	28.0	124.0	28.0	9.0	15.0	59.0	681
682	W - 4 - 11	542.0	18.0	130.0	40.0	132.0	40.0	7.0	16.0	60.0	682
685	W - 4 - 12	****	****	****	****	****	****	****	****	****	685
686	W - 4 - 13	663.0	24.0	155.0	25.0	135.0	31.0	8.0	19.0	69.0	686
687	W - 4 - 14	833.0	33.0	204.0	44.0	326.0	45.0	11.0	25.0	87.0	687
688	W - 4 - 15	676.0	33.0	155.0	43.0	549.0	61.0	13.0	22.0	114.0	688
689	W - 4 - 16	704.0	37.0	142.0	45.0	649.0	58.0	8.0	22.0	175.0	689
691	W - 4 - 17	733.0	36.0	164.0	43.0	561.0	50.0	17.0	30.0	227.0	691
692	W - 4 - 18	807.0	36.0	195.0	43.0	484.0	43.0	14.0	31.0	173.0	692
693	W - 4 - 19	763.0	37.0	168.0	48.0	526.0	51.0	11.0	26.0	185.0	693
694	W - 4 - 20	564.0	25.0	132.0	34.0	326.0	27.0	32.0	20.0	134.0	694
MEAN		756.8	26.9	160.9	33.3	263.8	36.4	26.1	23.6	114.3	
COEF VAR		24.5	26.6	17.6	28.9	73.5	32.4	63.9	24.3	41.8	

DATA CODE	SAMPLE I.D.	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DATA CODE
669	W - 4 - 1	****	****	****	****	****	****	****	****	****	669
670	W - 4 - 2	0.1699	0.1790	0.5000	0.2131	1.4265	0.2626	3.8462	0.2132	1.3158	670
672	W - 4 - 3	0.0994	0.1111	0.2795	0.1885	1.3382	0.2323	3.6154	0.1544	1.7763	672
673	W - 4 - 4	0.0750	0.0864	0.4205	0.1066	1.8382	0.2929	1.6154	0.0956	0.6974	673
674	W - 4 - 5	0.1535	0.1605	0.4641	0.2459	1.8235	0.3030	3.6923	0.2206	1.3684	674
675	W - 4 - 6	0.1459	0.1605	0.4795	0.2951	2.7794	0.3636	3.5385	0.2132	1.5000	675
676	W - 4 - 7	0.1592	0.1667	0.4744	0.2131	1.4559	0.2626	3.6923	0.2132	1.3553	676
678	W - 4 - 8	0.1055	0.1296	0.3231	0.2377	1.7647	0.2929	2.7692	0.1324	0.8947	678
679	W - 4 - 9	0.1720	0.1667	0.4744	0.1885	1.3382	0.2323	3.3846	0.2206	1.2895	679
681	W - 4 - 10	0.0807	0.1049	0.3051	0.2295	1.8235	0.2828	0.6923	0.1103	0.7763	681
682	W - 4 - 11	0.0858	0.1111	0.3333	0.3279	1.9412	0.4040	0.5385	0.1176	0.7895	682
685	W - 4 - 12	****	****	****	****	****	****	****	****	****	685
686	W - 4 - 13	0.1049	0.1481	0.3974	0.2049	1.9853	0.3131	0.6154	0.1397	0.9079	686
687	W - 4 - 14	0.1318	0.2037	0.5231	0.3607	4.7941	0.4545	0.8462	0.1838	1.1447	687
688	W - 4 - 15	0.1070	0.2037	0.3974	0.3525	8.0735	0.6162	1.0000	0.1618	1.5000	688
689	W - 4 - 16	0.1114	0.2284	0.3641	0.3689	9.5441	0.5859	0.6154	0.1618	2.3026	689
691	W - 4 - 17	0.1160	0.2222	0.4205	0.3525	8.2500	0.5051	1.3077	0.2206	2.9868	691
692	W - 4 - 18	0.1277	0.2222	0.5000	0.3525	7.1176	0.4343	1.0769	0.2279	2.2763	692
693	W - 4 - 19	0.1207	0.2284	0.4308	0.3934	7.7353	0.5152	0.8462	0.1912	2.4342	693
694	W - 4 - 20	0.0892	0.1543	0.3385	0.2787	4.7941	0.2727	2.4615	0.1471	1.7632	694
MEAN		0.1198	0.1660	0.4125	0.2728	3.8791	0.3681	2.0085	0.1736	1.5044	
COEF VAR		24.5	26.6	17.6	28.9	73.5	32.4	63.9	24.3	41.8	

TOP 20 cm (LAKE W4 ONLY)
LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

W -47

	Y_1	Y_2	Y_3	Y_4
UTM Coordinates of Lake: Zone	16	16	16	16
N	5409150	5409200	5408650	5407500
E	658450	658100	657550	656800
Elevation of Lake above sea level	422 m	421 m	419	417
Lake depth at sampling point	2 m	4 m	3 m	2 m
Lake area	0.025 km^2	0.015 km^2	0.02 km^2	0.07 km^2
Lake catchment area	0.93 km^2	1.37 km^2	1.92 km^2	4.43 km^2
Bedrock geology	granite*	granite*	granite*	granite*
Surface water chemistry: pH	8.1	7.9	7.6	8.0
alkalinity (mg/ℓ $CaCO_3$)	84.50	113.50	63.50	108.50
Ca (ppm)	21.4	32.6	18.2	28.8
SO_4 (ppm)	5.0	5.0	5.0	5.0
Ambrosia level	5 cm	5 cm	10 cm	6 cm

*overlain by thick layer of calcarious drift

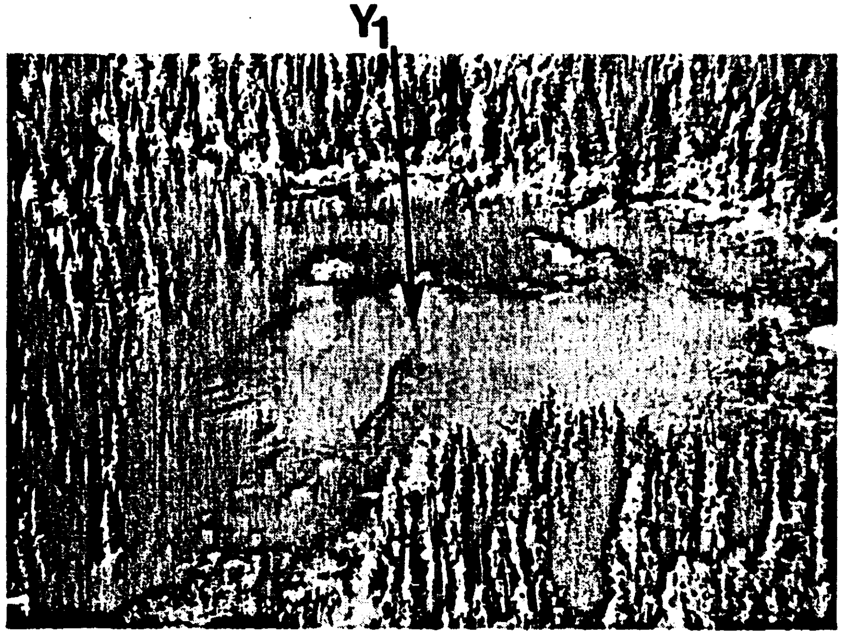
LAKE STAIRCASE
CALCARIOUS DRIFT

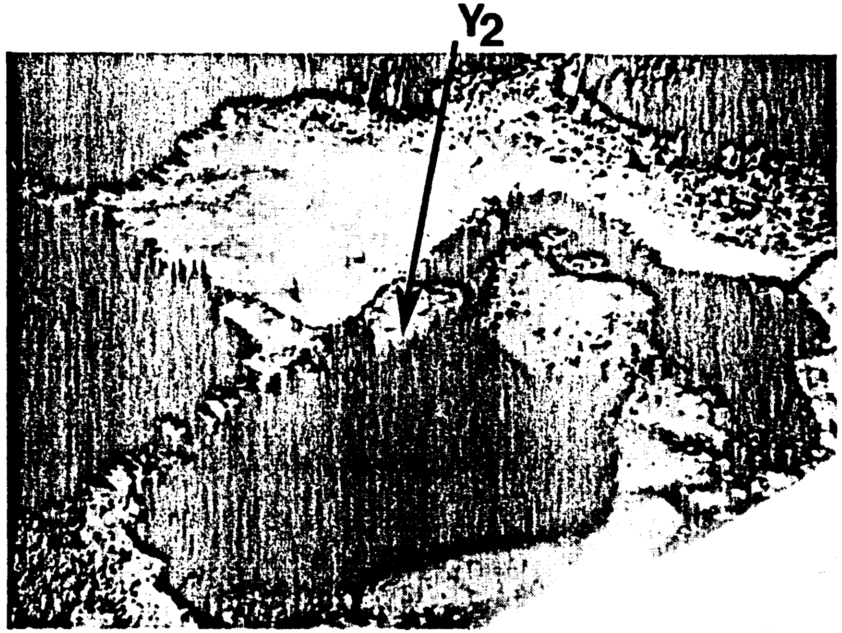
Y SERIES

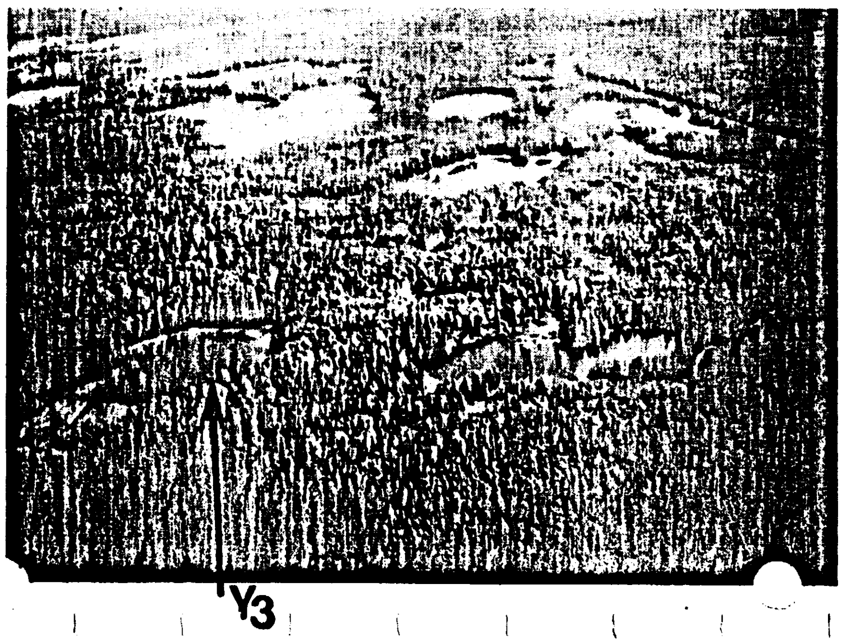
LAKE	Y_1	Y_2	Y_3	Y_4
pH	8.1	7.9	7.6	8.0

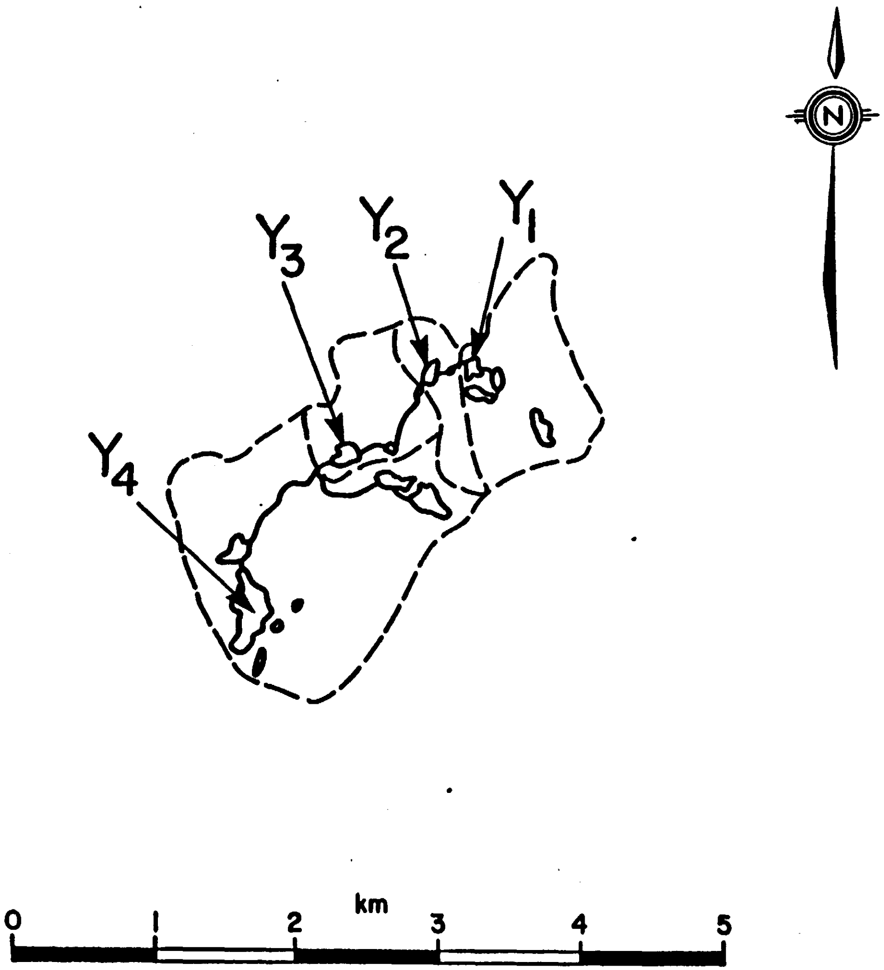
OBLIQUE AIRPHOTOGRAPHS OF LAKES

Y -2









Lake Y-1 is a small basin in glacial outwash sand and gravel, exposed in the pit adjacent to the lake. The lake is very shallow and has a luxuriant *Chara* growth on the bottom. Surficial deposits cover the watershed.

Lake Y-2 is a small basin in sand and gravel, close to Lake Y-1. The lake is shallow and has muskeg development around the shore. Surficial deposits cover the watershed and rock outcrop was not observed.

Lake Y-3 is also a small basin in glacial outwash sand and gravel. Ther is some muskeg development around the lake. Surficial deposits cover the watershed and no rock outcrop was observed.

Lake Y-4 is a slightly larger basin than Y-3 in outwash sand and gravel. The lake is shallow and has fairly extensive muskeg development around the shores. Surficial deposits cover the watershed and no rock outcrop was observed.

GENERAL DESCRIPTION OF THE STAIRCASE SYSTEM

Lake	Parameter		
	pH range at surface	Colour	Secchi Depth(m)
Y_1	7.75-7.80	clear	Secchi visible on bottom
Y_2	7.95-8.15	slightly humic	2.2
Y_3	7.75-7.85	slightly humic	Secchi visible on bottom
Y_4	8.10-8.15	clear	Secchi visible on bottom

<u>Pond Y1</u>

The Y series ponds were the most alkaline of the study lakes. Alkalinity ranged from 8.4 to 11.3 mg/l as $CaCo_3$, and pH ranged from 7.6to 8.1. As expected, the least alkaline and lowest pH of the Y staircase lakes was Y-1, a first order pond at the top of the watershed. Specific conductivity ranged from 170-178 and the Secchi disc was visible on the pond'sbottom in 1 m of water. Colour was 0 (clear) on a scale of 5 and dissolved oxygen was saturated to the bottom in this termally unstratified pond.

The macroalga, <u>Chara</u>, covered the bottom of the pond and <u>Potamogetonnatans</u> and <u>Nuphar</u> grew in sparse clumps near the shore. Filamentous greenalgae (<u>Zygnema</u> and <u>Spirogyra</u>) were associated with the <u>Chara</u> mat and horse-tails (<u>Esquisetum fluviatile</u>) were common along the pond's margin along withrushes (<u>Scirpus</u>) and bull rushes (<u>Phragmites</u>).

Black spruce with a scattering of white birch constituted the dominant (larger) terrestrial vegetation. This fen vegetation was in all likelihood responsible for the high frequency of moss associated desmids which were found in the lake's <u>Ceratium</u>-dominated phytoplankton. The small colonial rotifer,<u>Conochilus unicornis</u>, dominated the pond's zooplankton.

Dissolved Oxygen (Percent Saturation)

Depth (m)	Y_1	Y_2	Y_3	Y_4
0	100	100	100	100
1	100	100	97	104
2	96	96	93	121
3		109	65	
4		75		

Temperature °C

Depth (m)	Y_1	Y_2	Y_3	Y_4
0	24	23	24	23
1	24	22	23	23
2	24	21	23	23
3		18	22	
4		17		

Temperature Corrected (to 25°C) Conductivity

Depth (m)	Y_1	Y_2	Y_3	Y_4
0	168	142	135	221
1	168	142	137	226
2	181	242	137	236
3		246	154	
4		330		

Pond Y2

Pond Y2 was 4 m deep (Secchi 2.5 m) and, like Pond Y1, the shoreline of this high pH (8.1) lake was dominated by a fen muskeg. The lake was slightly humic (2 on a scale of 5) and thermally unstratified. Dissolved oxygen was actually higher near the lake's bottom (10 ppm, 109% saturation at 3 m) than at its surface (8.4 ppm).

Beaver were observed near the outlet of Y2 and cedar and black spruce were the common terrestrial vegetation at the pond's edge.

Ceratium and *Microcystis* were the dominant phytoplankton while Diaptomid copepods dominated the zooplankton. Phytoplankton exceeded zooplankton biomass in Y1 and Y4 while the reverse was true in Y2 and especially Y3 where zooplankton greatly exceeded phytoplankton standing crop.

Pond Y3

The pH (7.8) of this shallow (4 m) pond was actually lower than Y2 (8.1) as was its specific conductivity (135 vs. 220 micromhos/cm). The reasons for this have not been completely established. However, the thicker muskeg surrounding Y3 which contributed to its slight humic colour (2 on a scale of 5 Secchi = 2.5 m) may have acted to isolate the pond and its respective drainage area from the underlying carbonate-rich overburden. This example of the interaction between phytogenic and geological processes in establishing a lake's sensitivity to acid precipitation is worthy of further study.

Although both Y2 and Y3 have beaver dams near their outlets, the Y3 dam gave the appearance of being abandoned. Alder in Y3 replaced cedar in Y2 as the most common marginal zone higher plant. *Nuphar*, *Phragmites*, *Equisetum*, *Carex*, *Nymphea* and *Potamogeton natans* were all observed in the extensive littoral zone of this pond.

Two species of *Dinobryon* (*D. divergens* and *D. bavaricans*) dominated the moderately abundant phytoplankton of this pond. Rotifers (*Keratella*), Cladocera (*Bosmina* and *Ceriodaphnia*) and Cyclopoid copepods dominated the pond's abundant zooplankton.

Pond Y4

This shallow (2 m) fourth order pond was supersaturated with dissolved oxygen at its mud-water interface due to a dense mat of *Chara* which covered the entire bottom of this pond. The high pH (8.2) may in part reflect the high rate of consumption of free CO_2 by this marl producing macroalga. Specific conductivity ranged from 220 to 240 micromhos/cm and temperature (22-23°C) was similar from top to bottom.

The water was quite clear (0 on a scale of 5) and the Secchi disc was visible on the bottom of the pond (2 m).

Shore line vegetation was similar to Y3 with a slightly larger proportion of white spruce. The presence of the bladder wort *Utricularia* in this pond may indicate that its primary producers were nitrogen starved. This is a common condition of many muskeg-rich ponds. The absence of nitrogen fixing, blue-green algae with heterocysts was puzzling since other blue-greens, e.g. *Merismopedium tenuissima*, *Chroococcus dispersus* and *Microcystis* spp. were common in this pond. Phytoplankton biomass exceeded zooplankton biomass (primarily *Kellicottia* and *Asplanchna*) in this blue-green alga dominated pond.

PHYTOPLANKTON

PHYTOPLANKTON	Y1	Y2	Y3	Y4
BACILLARIOPHYTA				
AMPHORA SP.	-	-	1	-
ASTERIONELLA FORMOSA	2	-	-	-
CYCLOTELLA SP.	-	2	-	-
CYCLOTELLA STELLIGERA	-	1	-	4
CYMBELLA CF CISTULA	1	-	-	2
CYMBELLA LUNATA	-	-	-	2
CYMBELLA MINUTA	-	-	-	1
CYMBELLA SP.	-	2	-	-
EPITHEMIA SP.	-	-	1	-
EUNOTIA ARCUS	-	1	-	-
EUNOTIA PECTINALIS	1	-	-	-
FRAGILARIA CROTONENSIS	-	-	3	-
NAVICULA RADIOSA	3	-	2	-
NAVICULA SP.	-	2	2	-
NITZSCHIA SP.	-	1	-	3
PINNULARIA SP.	-	-	-	1
SURIRELLA SP.	-	-	1	-
SYNEDRA CF AMPHICEPHALA	2	1	-	-
SYNEDRA RADIANS	-	-	3	-
TABELLARIA FENENSTRATA	-	-	3	-
TABELLARIA FLOCCULOSA	1	2	1	-
AVERAGE	(1.6)	(1.6)	(1.9)	(2.2)

PHYTOPLANKTON	Y1	Y2	Y3	Y4
CHLOROPHYTA				
ANKISTRODESMUS FALCATUS	-	2	-	-
BOTRYOCOCCUS BRAUNII	2	-	-	-
BOTRYOCOCCUS CF. PROTUBERANS	-	-	3	-
COSMARIUM CF. BLYTII	1	-	-	-
COSMARIUM SP.	-	-	-	2
EUASTRUM BINALE	-	2	-	-
EUASTRUM SP.	1	-	-	-
GLOEOCYSTIS GIGAS	-	2	-	-
GONATOZYGON SP.	1	1	-	-
HYALOTHECA MUCOSA	-	2	-	-
MICRASTERIAS MAHABULESHWARENSIS	-	1	-	-
MICRASTERIAS RADIATA	-	2	-	-
MOUGEOTIA CF. CALCAREA	-	-	-	2
MOUGEOTIA SP.	-	3	-	-
OEDOGONIUM SP.	-	1	-	-
OOCYSTIS CF. BORGEI	1	-	-	-
OOCYSTIS CF. NATANS	-	-	2	-
PEDIASTRUM BORYANUM	-	-	1	-
PEDIASTRUM SP.	-	-	2	-
QUADRIGULA CF. CLOSTERIOIDES	-	-	1	-
SCENEDESMUS CF. ARCUATUS	1	-	-	-
SCENEDESMUS QUADRICAUDA	-	-	-	1
SPIROGYRA SP.	1	-	1	-
STAURASTRUM ARCTISCON	1	-	-	-
STAURASTRUM CF. SPICULIFERUM	1	-	-	-
STAURASTRUM LEPTOCLADUM	3	-	-	-
STAURASTRUM SP.	-	-	1	-
TETRAEDRON MINIMUM	2	-	-	-
XANTHIDIUM SP.	1	-	-	-
AVERAGE	(1.3)	(1.8)	(1.6)	(1.7)

CHRYSOPHYTA				
CHROMULINA CF. GLOBOSA	4	3	-	-
CHRYSOCHROMULINA SP.	4	3	-	-
CHRYSOSPHAERELLA LONGISPINA	-	-	-	1
DINOBRYON BAVARICUM	-	-	4	3
DINOBRYON DIVERGENS	-	-	4	-
MALLOMONAS CF. PRODUCTA	-	4	-	-
OCHROMONAS SP.	-	-	1	-
STIPITOCOCCUS SP.	3	-	-	-
UROGLENOPSIS AMERICANA	-	2	3	4
AVERAGE	(3.3)	(3.0)	(3.7)	(2.7)

PHYTOPLANKTON	Y1	Y2	Y3	Y4
CRYPTOPHYTA				
CRYPTOMONAS EROSA	-	3	-	-
RHODOMONAS LACUSTRIS	-	3	-	-
AVERAGE	(---)	(3.0)	(1.0)	(---)
CYANOPHYTA				
ANABAENA SP.	-	-	3	2
APHANOCAPSA ELACHISTA	2	2	-	-
APHANOTHECE CF. FLOS-AQUAE	-	-	4	-
CHROOCOCCUS DISPERSUS	-	2	3	4
CHROOCOCCUS GIGANTEUS	-	-	1	-
COELOSPHAERIUM NAEGELIANUM	-	-	3	-
GLOEOCAPSA CF. PUNCTATA	2	-	-	-
GOMPHOSPHAERIUM LACUSTRIS	2	-	1	-
LYNGBYA CF. EPIPHYTICA	1	2	-	-
MERISMOPEDIA PUNCTATA	-	-	2	-
MERISMOPEDIA TENUISSIMA	-	-	2	2
MICROCYSTIS AERUGINOSA	-	-	3	3
MICROCYSTIS FLOS AQUAE	-	4	-	3
OSCILLATORIA LIMNETICA	-	-	-	4
OSCILLATORIA SP.	-	-	2	-
PHORMIDIUM SP.	-	-	-	1
RHABDODERMA LINEARE	-	1	-	-
AVERAGE	(1.8)	(2.2)	(2.2)	(2.7)
PYRROPHYTA				
CERATIUM HIRUNDINELLA	-	4	3	6
GLENODINIUM SP.	-	2	-	2
GYMNODINIUM SP.	-	-	2	-
PERIDINIUM INCONSPICUUM	-	-	-	4
PERIDINIUM LIMBATUM	-	-	1	1
AVERAGE	(---)	(3.0)	(2.0)	(3.3)

Comments

These ponds are occasionally populated with filamentous algae such as Mougeotia cf. calcarea which indicates that this genus should not be used as an indicator of acid lakes without regard to species specific differences.

ZOOPLANKTON

ZOOPLANKTON	Y1	Y2	Y3	Y4
ZOOPLANKTON TO PHYTOPLANKTON BIOMASS RATIO	Z<P	Z<P	Z>>P	Z<P
CILIOPHORA				
HALTERIA SP.	25.0	15.0	-	5.0
STROMBIDIUM CF. VIRIDIS	-	-	-	5.0
VORTICELLA SP.	14.0	20.0	-	-
TOTAL	39.0	35.0	-	10.0
CLADOCERANS				
BOSMINA LONGIROSTRIS	-	34.0	32.0	25.0
DAPHNIA PULEX	2.0	-	1.0	-
DIAPHANOSOMA BRACHYURUM	22.0	-	4.0	-
HOLOPEDIUM GIBBERUM	4.0	7.0	5.0	-
POLYPHEMUS PEDICULUS	14.0	-	2.0	-
SIDA CRYSTALLINA	4.0	-	-	-
TOTAL	46.0	41.0	40.0	25.0
COPEPODS				
COPEPODITES AND NAUPLII	17.0	118.0	15.0	90.0
CYCLOPS BICUSPIDATUS	-	1.0	-	2.0
DIAPTOMUS MINUTUS	20.0	46.0	43.0	1.0
MESOCYCLOPS EDAX	-	-	5.0	-
TOTAL	37.0	165.0	63.0	93.0
INSECTA				
CHAOBORUS	1.0	-	-	-
GYRINIDAE	-	-	0.4	-
TOTAL	1.0	-	0.4	-
MISCELLANEOUS				
ACTINOSPHAERIUM SP.	25.0	-	-	1.0
HYDRACARINA SP.	2.0	-	-	-
TOTAL	27.0	-	-	1.0
ROTIFERS				
ASPLANCHNA BRIGHTWELLI	27.0	-	12.0	15.0
BRACHIONUS CALYCIFLORUS	1.0	-	-	-
CONOCHILOIDES SP.	211.0	14.0	21.0	1.0
KELLICOTIA LONGISPINA	-	21.0	-	-
KERATELLA COCHLEARIS	87.0	4.0	42.0	4.0
POLYARTHRA VULGARIS	-	-	-	2.0
TRICHOCERCA CYLINDRICUM	18.0	-	2.0	-
TOTAL	344.0	39.0	77.0	22.0

COMMENTS

The predatory dipteran larva, Chaoborus, was found only in the deeper thermally stratified lakes. It preyed largely on Cladocerans. Diaptomus oregonenosis was noted at low density (less than one per liter) in some of the "Y" alkaline lakes as well as in some neutral lakes but was never abundant enough to be considered "common".

Diatom Species	pH category	Y1 Number Counted	Y1 Relative Frequency (%)	Y2 Number Counted	Y2 Relative Frequency (%)	Y3 Number Counted	Y3 Relative Frequency (%)	Y4 Number Counted	Y4 Relative Frequency (%)
Achnanthes exigua var. heterovalva	alp			14	1.99	10	1.29	105	13.36
Achnanthes cf. exilis	alp	67	7.93						
Achnanthes lanceolata	alp							32	4.07
Achnanthes marginulata	ind			14	1.99	10	1.29	9	1.15
Achnanthes minutissima	ind			39	5.55	62	8.01	38	4.83
Achnanthes sp.	-								
Amphora ovalis	alp			9	1.28	11	1.42	28	3.56
Anomoeoneis seriana	acb	1	.12						
Anomoeoneis seriana var. brachysira	acb	38	4.50			4	.52		
Anomoeoneis vitrea	alp			22	3.13	75	9.69	13	1.65
Caloneis ventricosa	alp			5	.71	6	.78		
Cocconeis placentula	alp					2	.26		
Cyclotella antiqua	-			6	.65			2	.25
Cyclotella comta	ind			47	6.69	2	.26	2	.25
Cyclotella kutzingiana	-			9	1.28				
Cyclotella meneghiniana	alp			28	3.98			15	1.91
Cymbella affinis	-	1	.12						
Cymbella angustata	alb	49	5.80			11	1.42		
Cymbella cesatii	ind			17	2.42	42	5.43	8	1.02
Cymbella cistula	ind	9	1.07	9	1.28	2	.26		
Cymbella cistula var. gibbosa	ind	1	.12						
Cymbella cuspidata	alp					3	.39	1	.13
Cymbella cymbiformis	alp	6	.71	6	.85				
Cymbella hebridica	acp	3	.36						
Cymbella lunata	-	22	2.60	13	1.85	3	.39	2	.25
Cymbella microcephala	ind	1	.12	17	2.42	15	1.94	6	.76
Cymbella minuta	ind	8	.95	5	.71	10	1.29	15	1.91

SURFACE SEDIMENT DIATOMS

SURFACE SEDIMENT DIATOMS (CONT'D)

Y -10

Diatom Species	pH category	Y1 Number Counted	Y1 Relative Frequency (%)	Y2 Number Counted	Y2 Relative Frequency (%)	Y3 Number Counted	Y3 Relative Frequency (%)	Y4 Number Counted	Y4 Relative Frequency (%)
Cymbella minuta f. latens	ind			6	.85			19	2.42
Cymbella minuta var. silesiaca	ind	27	3.20					8	1.02
Cymbella muelleri	alp	23	2.72	3	.43				
Cymbella norvegica	-	12	1.42						
Cymbella pusilla	acp	8	.95	4	.57				
Epithemia adnata var. proboscidea	alp[2]	4	.47						
Epithemia turgida var. granulata	alp[2]	7	.83						
Eunotia pectinalis var. ventricosa	acp			5	.71	2	.26		
Eunotia septentrionalis	-	1	.12	1	.14				
Fragilaria brevistriata	-			34	4.84	11	1.42	62	7.89
Fragilaria construens	alp			7	1.00	3	.39	35	4.45
Fragilaria construens var. venter	alp	2	.24	19	2.70	19	2.45	45	5.73
Fragilaria lapponica	-					4	.52	32	4.07
Fragilaria leptostauron	alp			20	2.48	4	.52	50	6.36
Fragilaria pinnata	alp			46	6.54	37	4.78	113	14.38
Fragilaria pinnata var. intercedens	alp			2	.28				
Fragilaria pinnata var. trigona	alp			3	.43				
Fragilaria virescens	alp	4	.47						
Frustulia rhomboides	alp	1	.12	6	.65				
Denticula sp.	-	46	5.44						
Diploneis marginestriata	-							2	.25
Gomphonema acuminatum	alp			3	.43				
Gomphonema intricatum	alp	14	1.66	3	.43	2	.26		
Gomphonema truncatum	-					2	.26		
Gyrosigma attenuatum	-					2	.26	1	.13

Diatom Species	pH category	Y1 Number Counted	Y1 Relative Frequency (%)	Y2 Number Counted	Y2 Relative Frequency (%)	Y3 Number Counted	Y3 Relative Frequency (%)	Y4 Number Counted	Y4 Relative Frequency (%)
Mastogloia grevillei	-							7	.89
Melosira granulata	alp			12	1.71				
Navicula aurora	alp					5	.65		
Navicula bacillum	ind					2	.26		
Navicula capitata	alp			7	1.00	2	.26		
Navicula cryptocephala	alp	76	8.99			12	1.55	5	.64
Navicula cuspidata	alp					8	1.03	2	.25
Navicula elginensis	alp					3	.39		
Navicula gottlandica	-	3	.36	8	1.14	76	9.82	9	1.15
Navicula graciloides	alb	1	.12						
Navicula lanceolata	-							3	.38
Navicula mournei	-	2	.24	2	.28				
Navicula notha	-	1	.12	15	2.13	14	1.81	8	1.02
Navicula odiosa	-	79	9.35						
Navicula pupula var. capitata	ind			21	2.99	45	5.81	11	1.40
Navicula pupula var. rectangularis	ind	1	.12	42	5.97	10	1.29	3	.38
Navicula pusilla	acp			2	.28	3	.39		
Navicula radiosa	ind	74	8.76	20	2.84	15	1.94	2	.25
Navicula radiosa var. parva	ind	117	13.85	14	1.99	19	2.45	2	.25
Navicula radiosa var. tenella	ind	60	7.10	21	2.99	8	1.03		
Navicula subtilissima	acp	24	2.84	4	.57	2	.26		
Navicula tripunctata	alp	1	.12						
Navicula tuscula	alb							1	.13
Navicula vanheurckii	-	3	.36			7	.90		
Navicula variostriata	-	1	.12	2	.28				
Navicula cf. viridula	alp	1	.12						
Navicula vulpina	-	6	.71	6	.65	52	6.72	8	1.02
Navicula sp.	-	11	1.30					40	5.09
Neidium affine	ind			7	1.00	8	1.03	5	.64
Neidium bisulcatum	alb							4	.51

SURFACE SEDIMENT DIATOMS (CONT'D)

SURFACE SEDIMENT DIATOMS (CONT'D)

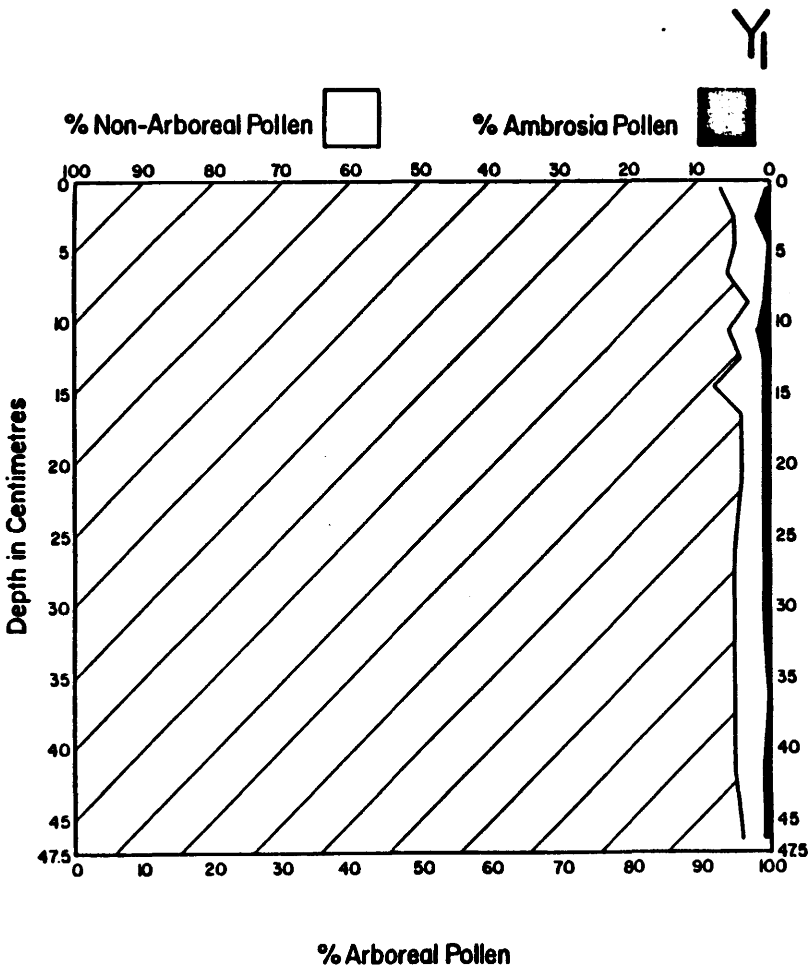
Y -12

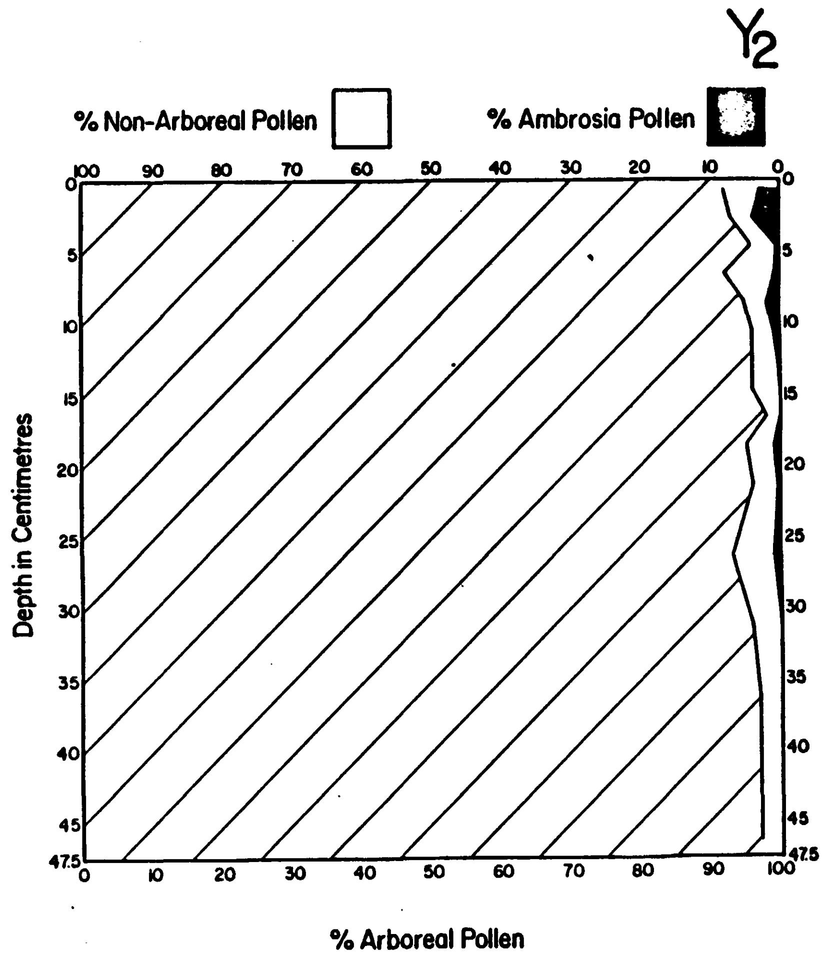
Diatom Species	pH category	Y1 Number Counted	Y1 Relative Frequency (%)	Y2 Number Counted	Y2 Relative Frequency (%)	Y3 Number Counted	Y3 Relative Frequency (%)	Y4 Number Counted	Y4 Relative Frequency (%)
Neidium hitchcockii	ind					2	.26		
Neidium iridis	ind	1	.12	28	3.98	6	.78	6	.76
Nitzschia denticula	alp							4	.51
Nitzschia fonticola	alp					26	3.36		
Nitzschia gracilis	-	8	.95			7	.90	2	.25
Nitzschia palea	ind			5	.71	19	2.45		
Nitzschia sinuata	-			6	.65			3	.38
Pinnularia abaujensis	ind					5	.65		
Pinnularia biceps	acp					6	.78		
Pinnularia hilseana	-	17	2.01	6	.65				
Pinnularia maior	acp					7	.90	1	.13
Pinnularia mesolepta	acp					2	.26		
Stauroneis anceps	ind			6	.65	7	.90	3	.38
Stauroneis phoenicenteron	ind			5	.71	14	1.81	1	.13
Surirella linearis	ind					2	.26	1	.13
Surirella linearis var. constricta	ind					2	.26	1	.13
Synedra delicatissima	-			15	2.13	4	.52	2	.25
Synedra radians	alp	1	.12	9	1.28	4	.52	2	.25
Tabellaria fenestrata	acp	2	.24	9	1.28	9	1.16	4	.51
Tabellaria flocculosa	acp			9	1.28	7	.90	3	.38
Multiplication Factor (to give # diatoms/mg. dry wt.)		1795		250		474		831	

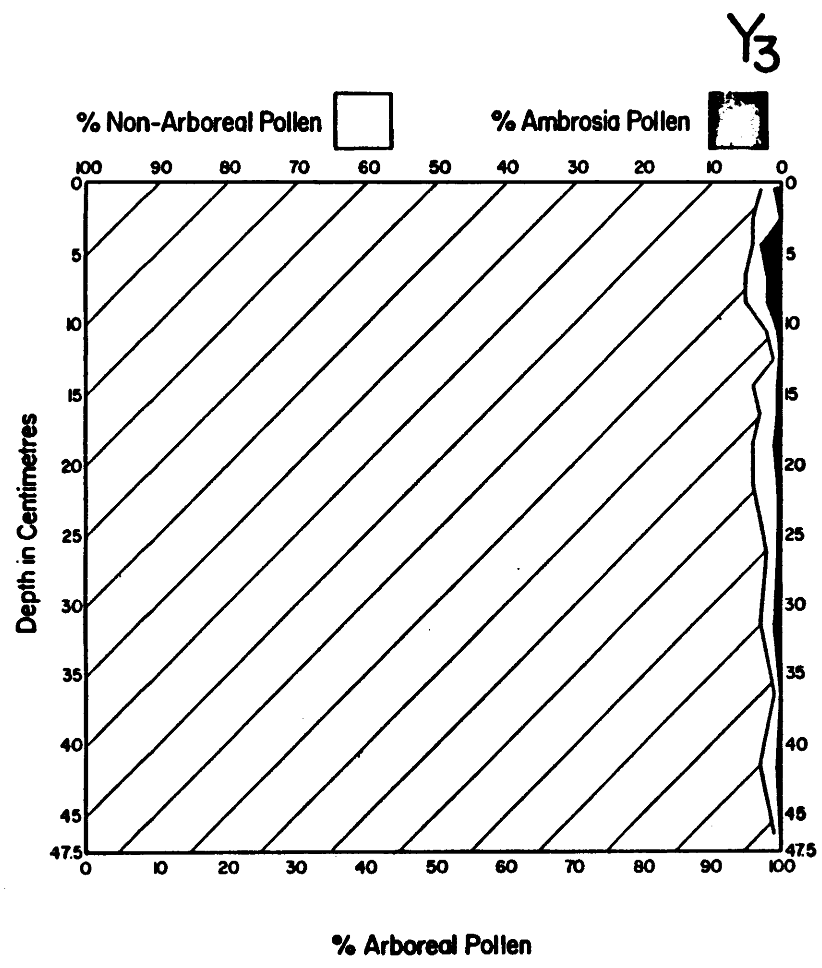
Descriptions of the downcore diatoms are included in Part I, Chapter III. A complete species list of the diatoms studied during the 1981 field and laboratory study is included in Section 5 of this part of the report (Part II)

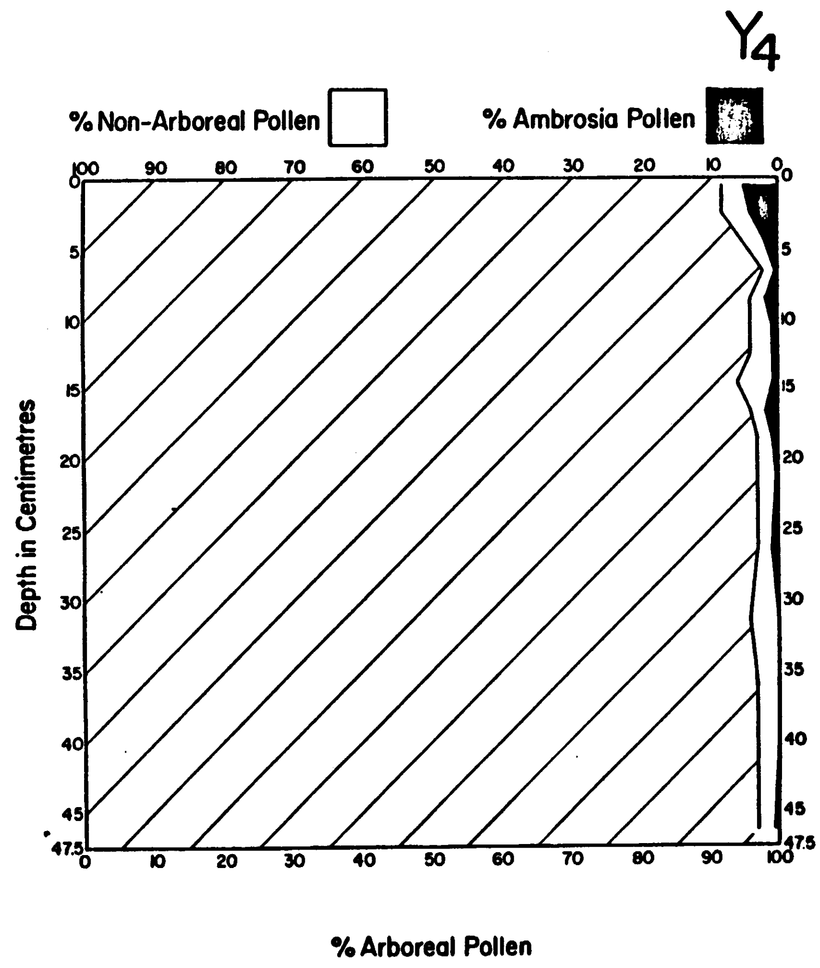
AMBROSIA RISE DIAGRAMS

Y -14





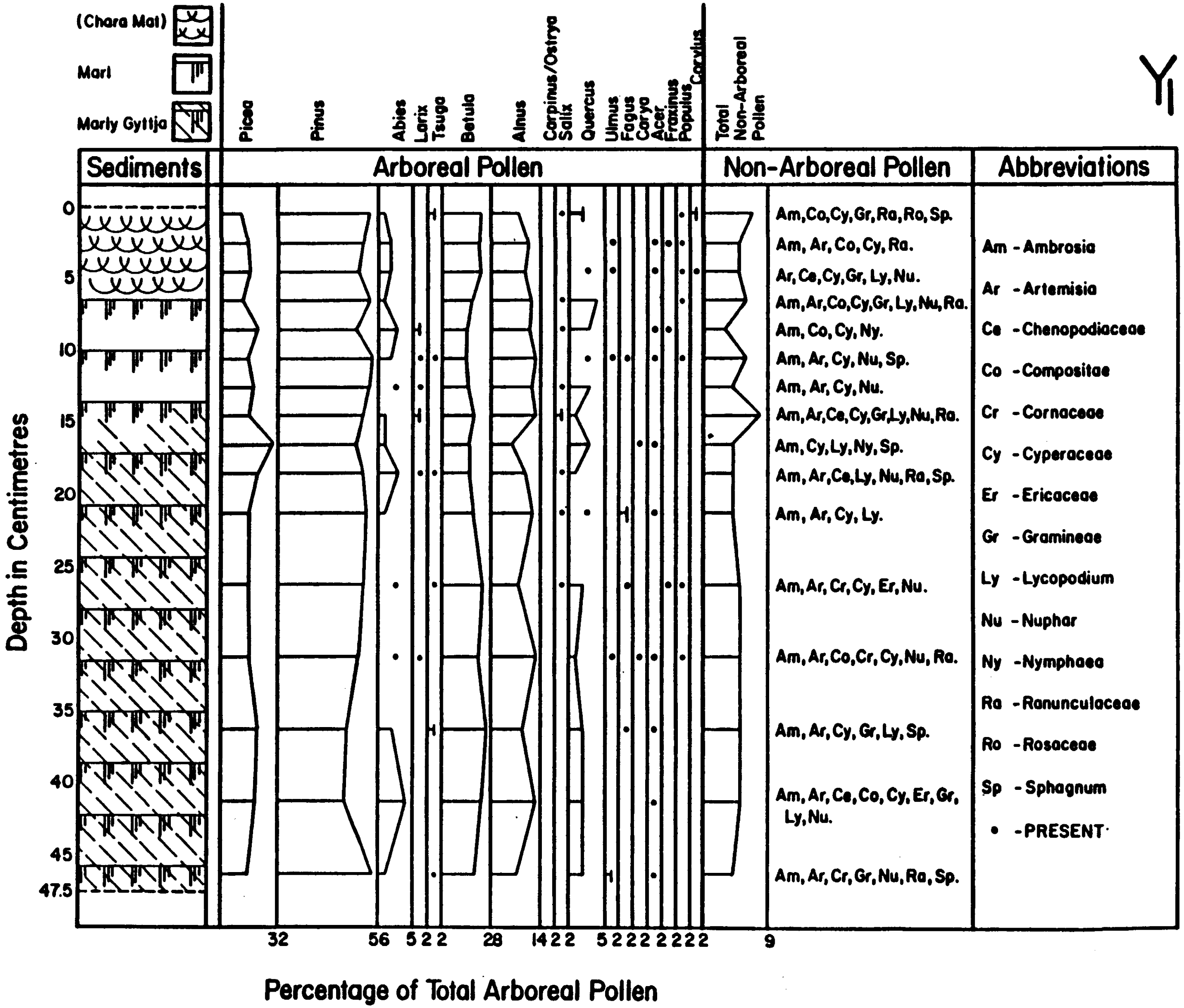


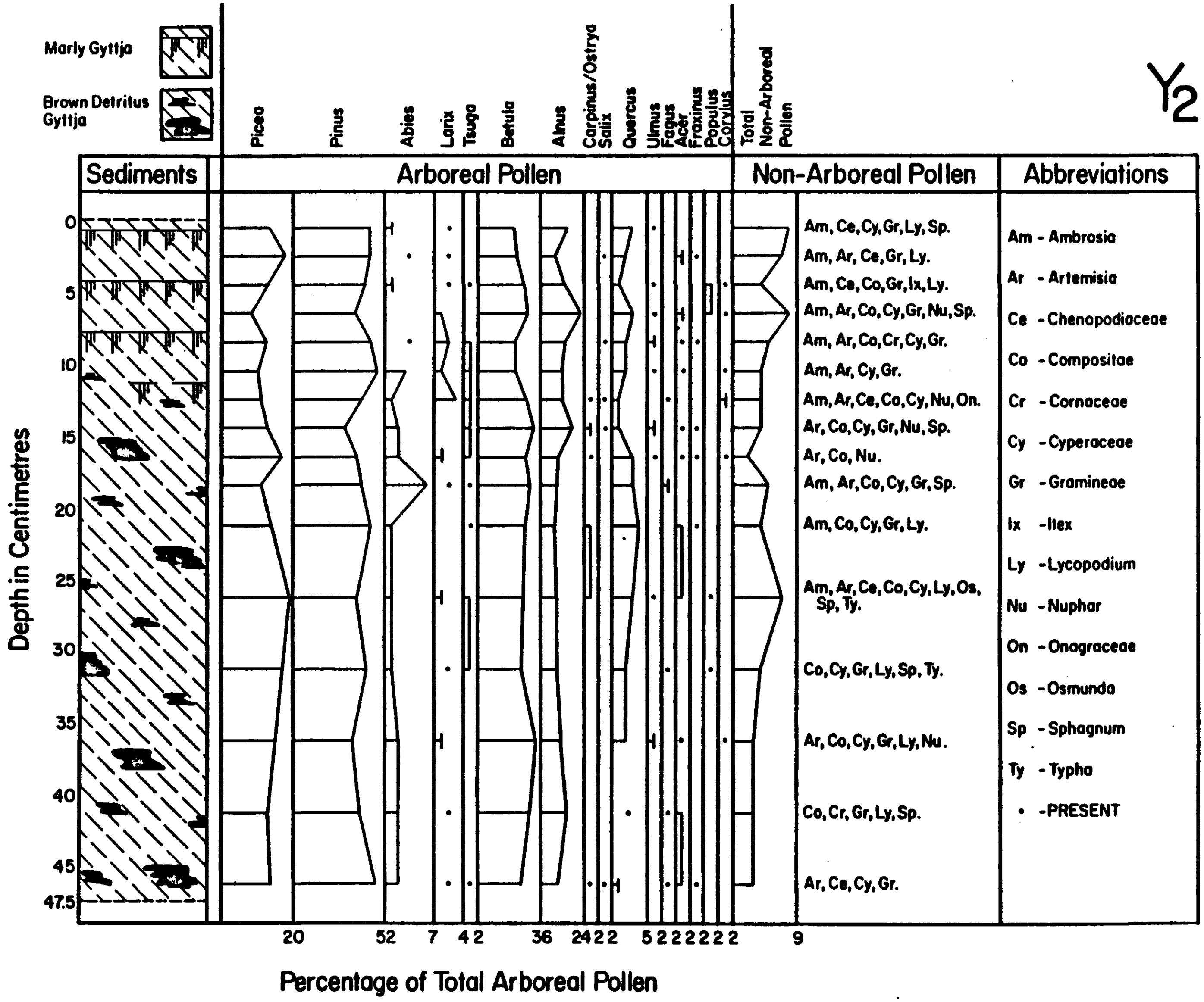


AMBROSIA RISE DIAGRAMS (CONT'D)

POLLEN DIAGRAM

Y-16



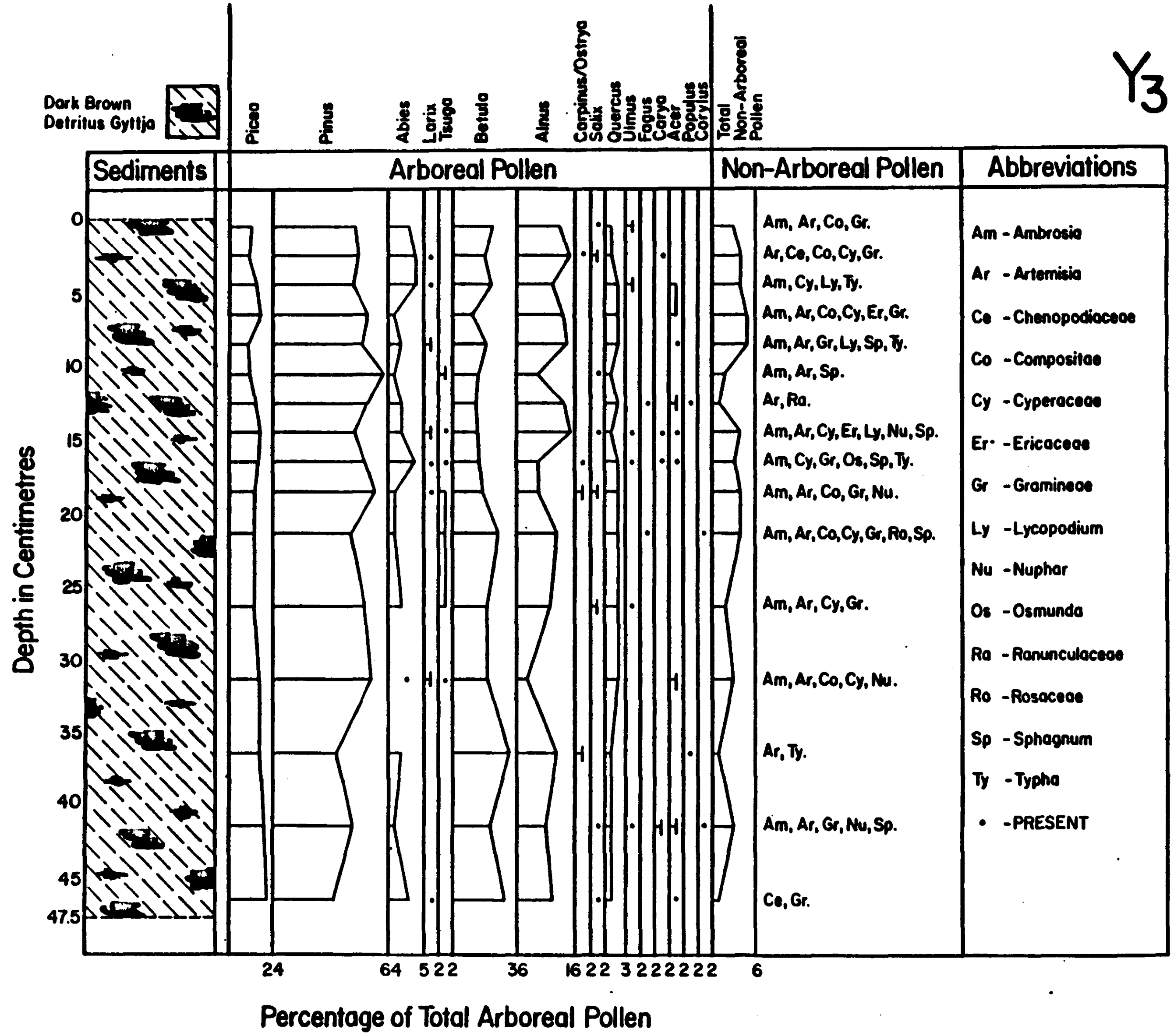


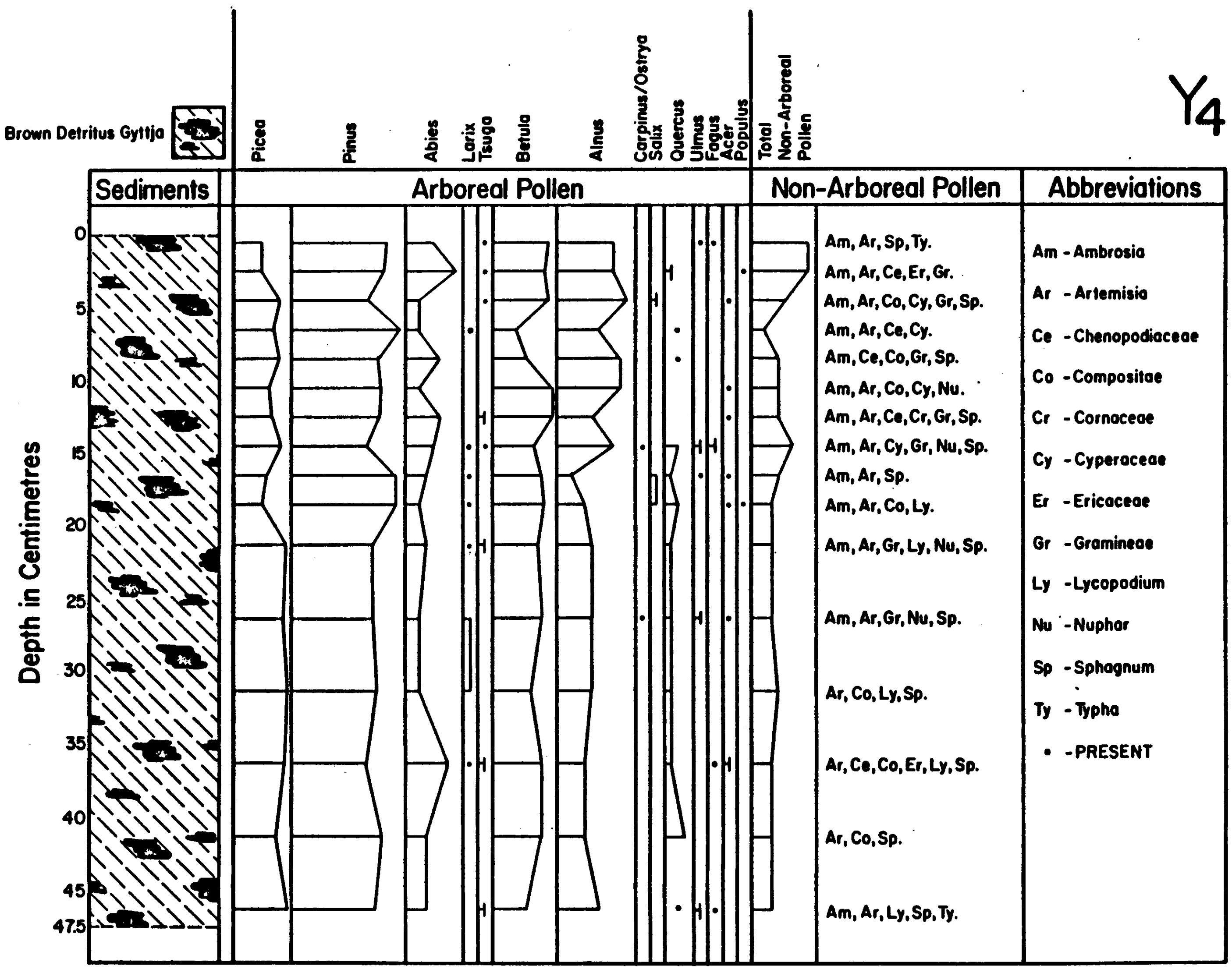
Y -17

POLLEN DIAGRAM

Y-17

POLLEN DIAGRAM





Percentage of Total Arboreal Pollen

POLLEN DIAGRAM

Y-19

Y-20

Y-20

Y-21 Y-21

TOP 20 cm (LAKE Y_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
898	Y - 1 - 1	******	4086.	5390.	218.	1640.	388.	3046.	281186.	772.	136.	4.	898
899	Y - 1 - 2	******	4214.	3508.	214.	1600.	616.	3178.	283244.	724.	154.	4.	899
900	Y - 1 - 3	******	5762.	2791.	122.	1920.	680.	2721.	270171.	485.	232.	8.	900
901	Y - 1 - 4	******	7063.	3506.	116.	2170.	1012.	3014.	297775.	422.	297.	9.	901
902	Y - 1 - 5	******	7861.	3583.	107.	2300.	1139.	3023.	289237.	419.	313.	11.	902
904	Y - 1 - 6	******	7331.	3327.	100.	2120.	1062.	2900.	282824.	376.	322.	9.	904
905	Y - 1 - 7	******	7566.	3246.	96.	2230.	1292.	2942.	283497.	345.	339.	10.	905
906	Y - 1 - 8	******	7017.	2846.	94.	2050.	1218.	2915.	308896.	299.	280.	9.	906
907	Y - 1 - 9	******	6050.	2325.	87.	1840.	1038.	2724.	304441.	276.	262.	9.	907
908	Y - 1 - 10	******	6248.	2174.	90.	1820.	1075.	2845.	330233.	274.	272.	7.	908
910	Y - 1 - 11	******	6147.	2112.	86.	1960.	739.	2620.	323581.	255.	252.	9.	910
911	Y - 1 - 12	******	6010.	1885.	80.	1880.	754.	2823.	335085.	219.	241.	8.	911
912	Y - 1 - 13	******	6138.	1945.	84.	1820.	868.	2914.	342836.	218.	258.	8.	912
913	Y - 1 - 14	******	5788.	1998.	79.	1730.	907.	2752.	318098.	236.	245.	10.	913
914	Y - 1 - 15	******	5663.	1805.	77.	1660.	938.	2653.	317131.	217.	241.	8.	914
916	Y - 1 - 16	******	5674.	1971.	78.	1710.	969.	2697.	324097.	216.	239.	9.	916
917	Y - 1 - 17	******	6127.	1849.	75.	1760.	1205.	2758.	328427.	207.	237.	8.	917
918	Y - 1 - 18	******	6825.	2071.	75.	1950.	1516.	2715.	312340.	218.	262.	9.	918
919	Y - 1 - 19	******	6878.	2275.	80.	1890.	1427.	2952.	324754.	229.	271.	8.	919
920	Y - 1 - 20	******	5872.	2145.	75.	1700.	1191.	2774.	327030.	218.	229.	8.	920

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
898	Y - 1 - 1	*******	0.04888	0.08666	0.20566	0.08913	0.01709	0.11020	6.03403	0.68929	0.02152	0.02469	898
899	Y - 1 - 2	*******	0.05041	0.05640	0.20189	0.08696	0.02714	0.11498	6.07820	0.64643	0.02437	0.02469	899
900	Y - 1 - 3	*******	0.06892	0.04487	0.11509	0.10435	0.02996	0.09844	5.79766	0.43304	0.03671	0.04938	900
901	Y - 1 - 4	*******	0.08449	0.05637	0.10943	0.11793	0.04458	0.10904	6.39002	0.37679	0.04699	0.05556	901
902	Y - 1 - 5	*******	0.09403	0.05760	0.10094	0.12500	0.05018	0.10937	6.20680	0.37411	0.04953	0.06790	902
904	Y - 1 - 6	*******	0.08769	0.05349	0.09434	0.11522	0.04678	0.10492	6.06918	0.33571	0.05093	0.05556	904
905	Y - 1 - 7	*******	0.09050	0.05219	0.09057	0.12120	0.05692	0.10644	6.08363	0.30804	0.05364	0.06173	905
906	Y - 1 - 8	*******	0.08394	0.04576	0.08868	0.11141	0.05366	0.10546	6.62867	0.26696	0.04430	0.05556	906
907	Y - 1 - 9	*******	0.07237	0.03738	0.08208	0.10000	0.04573	0.09855	6.53307	0.24643	0.04146	0.05556	907
908	Y - 1 - 10	*******	0.07474	0.03495	0.08491	0.09891	0.04736	0.10293	7.08654	0.24464	0.04304	0.04321	908
910	Y - 1 - 11	*******	0.07353	0.03395	0.08113	0.10652	0.03256	0.09479	6.94380	0.22768	0.03987	0.05556	910
911	Y - 1 - 12	*******	0.07189	0.03031	0.07547	0.10217	0.03322	0.10213	7.19066	0.19554	0.03813	0.04938	911
912	Y - 1 - 13	*******	0.07342	0.03127	0.07925	0.09991	0.03824	0.10543	7.35700	0.19464	0.04082	0.04938	912
913	Y - 1 - 14	*******	0.06923	0.03212	0.07453	0.09402	0.03996	0.09957	6.82614	0.21071	0.03877	0.06173	913
914	Y - 1 - 15	*******	0.06774	0.02902	0.07264	0.09022	0.04132	0.09598	6.80539	0.19375	0.03813	0.04938	914
916	Y - 1 - 16	*******	0.06787	0.03169	0.07358	0.09293	0.04269	0.09758	6.95487	0.19286	0.03782	0.05556	916
917	Y - 1 - 17	*******	0.07329	0.02973	0.07075	0.09565	0.05308	0.09978	7.04779	0.18482	0.03750	0.04938	917
918	Y - 1 - 18	*******	0.08164	0.03330	0.07075	0.10598	0.06678	0.09823	6.70257	0.19464	0.04146	0.05556	918
919	Y - 1 - 19	*******	0.08227	0.03658	0.07547	0.10272	0.06286	0.10680	6.96897	0.20446	0.04288	0.04938	919
920	Y - 1 - 20	*******	0.07024	0.03449	0.07075	0.09239	0.05247	0.10036	7.01781	0.19464	0.03623	0.04938	920

TOP 20 CM (LAKE Y_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-KK

Y-23

TOP 20 cm (LAKE Y_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM

Y-24

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
898	Y - 1 - 1	****	16.0	24.0	*****	46.	26.0	****	52.0	160.	898
899	Y - 1 - 2	****	8.0	16.0	*****	2.	14.0	****	2.0	142.	899
900	Y - 1 - 3	****	6.0	17.0	*****	5.	17.0	****	2.0	47.	900
901	Y - 1 - 4	****	10.0	45.0	*****	16.	21.0	****	14.0	84.	901
902	Y - 1 - 5	****	10.0	25.0	*****	11.	22.0	****	22.0	70.	902
904	Y - 1 - 6	****	8.0	21.0	*****	2.	18.0	****	9.0	61.	904
905	Y - 1 - 7	****	11.0	22.0	*****	21.	18.0	****	28.0	57.	905
906	Y - 1 - 8	****	8.0	23.0	*****	10.	17.0	****	3.0	57.	906
907	Y - 1 - 9	****	6.0	21.0	*****	4.	15.0	****	2.0	50.	907
908	Y - 1 - 10	****	10.0	22.0	*****	15.	16.0	****	2.0	62.	908
910	Y - 1 - 11	****	7.0	22.0	*****	10.	13.0	****	2.0	48.	910
911	Y - 1 - 12	****	6.0	22.0	*****	4.	8.0	****	2.0	52.	911
912	Y - 1 - 13	****	6.0	22.0	*****	1.	10.0	****	2.0	51.	912
913	Y - 1 - 14	****	6.0	22.0	*****	4.	12.0	****	2.0	49.	913
914	Y - 1 - 15	****	6.0	21.0	*****	5.	10.0	****	2.0	52.	914
916	Y - 1 - 16	****	7.0	19.0	*****	4.	10.0	****	2.0	57.	916
917	Y - 1 - 17	****	7.0	21.0	*****	8.	12.0	****	2.0	50.	917
918	Y - 1 - 18	****	6.0	19.0	*****	1.	10.0	****	2.0	49.	918
919	Y - 1 - 19	****	7.0	21.0	*****	6.	11.0	****	42.0	47.	919
920	Y - 1 - 20	****	7.0	22.0	*****	7.	10.0	****	46.0	46.	920

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
898	Y - 1 - 1	****	0.1311	0.353	****	0.465	2.000	****	0.382	2.105	898
899	Y - 1 - 2	****	0.0656	0.235	****	0.020	1.077	****	0.015	1.868	899
900	Y - 1 - 3	****	0.0492	0.250	****	0.051	1.308	****	0.015	0.613	900
901	Y - 1 - 4	****	0.0820	0.662	****	0.162	1.615	****	0.103	1.105	901
902	Y - 1 - 5	****	0.0820	0.368	****	0.111	1.692	****	0.162	0.921	902
904	Y - 1 - 6	****	0.0656	0.309	****	0.020	1.385	****	0.066	0.803	904
905	Y - 1 - 7	****	0.0902	0.324	****	0.212	1.385	****	0.206	0.750	905
906	Y - 1 - 8	****	0.0656	0.338	****	0.101	1.308	****	0.022	0.750	906
907	Y - 1 - 9	****	0.0492	0.309	****	0.040	1.154	****	0.015	0.658	907
908	Y - 1 - 10	****	0.0820	0.324	****	0.152	1.231	****	0.015	0.816	908
910	Y - 1 - 11	****	0.0574	0.324	****	0.101	1.000	****	0.015	0.632	910
911	Y - 1 - 12	****	0.0492	0.324	****	0.040	0.615	****	0.015	0.684	911
912	Y - 1 - 13	****	0.0492	0.324	****	0.010	0.769	****	0.015	0.671	912
913	Y - 1 - 14	****	0.0492	0.324	****	0.040	0.923	****	0.015	0.645	913
914	Y - 1 - 15	****	0.0492	0.309	****	0.051	0.769	****	0.015	0.684	914
916	Y - 1 - 16	****	0.0574	0.279	****	0.040	0.769	****	0.015	0.750	916
917	Y - 1 - 17	****	0.0574	0.309	****	0.081	0.923	****	0.015	0.658	917
918	Y - 1 - 18	****	0.0492	0.279	****	0.010	0.769	****	0.015	0.645	918
919	Y - 1 - 19	****	0.0574	0.309	****	0.061	0.846	****	0.309	0.618	919
920	Y - 1 - 20	****	0.0574	0.324	****	0.071	0.769	****	0.338	0.605	920

TOP 20 CM (LAKE Y_1 ONLY)

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-KK

Y -25

LAKE SEDIMENT CORE WEIGHT DATA

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Y-26

Y1

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
176	Y - 1 - 1	37.01	8.08	54.1	78.2	Y - 1 - 7	27.84	5.74	53.0	79.4	167
177	Y - 1 - 2	37.98	8.69	52.4	77.1	Y - 1 - 8	34.03	6.84	53.0	79.9	168
163	Y - 1 - 3	30.91	6.37	54.1	79.4	Y - 1 - 9	29.77	6.15	53.5	79.3	169
164	Y - 1 - 4	28.27	4.97	44.4	82.4	Y - 1 - 10	38.63	8.46	52.7	78.1	170
165	Y - 1 - 5	33.83	7.28	52.3	78.5	Y - 1 - 11	32.64	7.03	52.2	78.5	171
166	Y - 1 - 6	31.91	6.04	53.2	81.1	Y - 1 - 12	31.84	7.06	51.8	77.8	172

Y2

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
180	Y - 2 - 1	15.31	1.74	****	88.6	Y - 2 - 7	17.29	1.98	83.1	88.6	186
181	Y - 2 - 2	34.75	1.77	****	94.9	Y - 2 - 8	17.17	1.96	83.8	88.6	187
182	Y - 2 - 3	19.45	1.83	****	90.6	Y - 2 - 9	16.38	1.95	82.7	88.1	188
183	Y - 2 - 4	*****	*****	****	****	Y - 2 - 10	16.24	1.84	87.1	88.7	189
184	Y - 2 - 5	19.16	1.96	84.6	89.8	Y - 2 - 11	15.59	1.90	80.0	87.8	190
185	Y - 2 - 6	19.05	2.05	84.2	89.2	Y - 2 - 12	16.62	2.03	83.8	89.8	191

Y3

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
207	Y - 3 - 1	17.58	2.14	57.9	87.8	Y - 3 - 7	17.27	2.26	66.4	86.9	235
208	Y - 3 - 2	19.01	2.28	61.5	88.0	Y - 3 - 8	20.23	2.45	64.4	87.9	214
209	Y - 3 - 3	14.65	2.04	58.0	86.1	Y - 3 - 9	14.78	2.17	64.5	85.3	215
210	Y - 3 - 4	18.49	2.20	63.5	88.1	Y - 3 - 10	15.45	2.19	61.8	85.8	216
211	Y - 3 - 5	18.36	2.24	62.2	87.8	Y - 3 - 11	17.81	2.61	60.8	85.4	217
234	Y - 3 - 6	20.64	2.39	67.2	88.4	Y - 3 - 12	13.43	2.33	62.2	82.7	218

Y4

DATA CODE	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	SAMPLE I.D.	WET WT. G	DRY WT. G	L.O.I. %	H2O %	DATA CODE
237	Y - 4 - 1	16.56	1.59	54.2	90.2	Y - 4 - 7	16.72	1.69	53.7	89.9	243
238	Y - 4 - 2	7.69	0.89	53.1	88.4	Y - 4 - 8	15.07	1.20	59.2	92.0	244
239	Y - 4 - 3	10.82	1.35	51.4	87.5	Y - 4 - 9	11.16	0.72	62.2	93.6	245
240	Y - 4 - 4	11.99	1.22	54.2	89.8	Y - 4 - 10	13.64	0.99	59.3	92.7	246
241	Y - 4 - 5	8.03	0.74	****	90.8	Y - 4 - 11	8.03	0.89	55.8	88.9	257
242	Y - 4 - 6	11.52	1.09	53.8	90.5	Y - 4 - 12	13.61	2.24	55.3	83.5	258

LAKE SEDIMENT CORE WEIGHT DATA

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Y -27

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK
(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Y1

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
176	Y - 1 - 1	6300.	7363.	1293.	46.	1560.	1315.	2038.	190317.	281.	126.	6.	176
177	Y - 1 - 2	3500.	6977.	1319.	49.	1550.	1277.	2165.	211216.	232.	124.	7.	177
163	Y - 1 - 3	4800.	8355.	1751.	57.	1420.	1309.	2688.	253720.	293.	162.	11.	163
164	Y - 1 - 4	3000.	9389.	1787.	65.	1670.	1851.	3183.	295621.	329.	166.	10.	164
165	Y - 1 - 5	5700.	7600.	1905.	61.	1540.	1358.	3082.	296600.	217.	188.	10.	165
166	Y - 1 - 6	5600.	9289.	1659.	62.	1830.	1365.	3343.	297720.	261.	156.	9.	166
167	Y - 1 - 7	6200.	7345.	1659.	64.	1570.	1398.	3206.	331123.	241.	185.	10.	167
168	Y - 1 - 8	5600.	7298.	1530.	56.	1430.	1276.	2941.	293771.	216.	177.	9.	168
169	Y - 1 - 9	8900.	6252.	1404.	51.	1340.	1198.	2545.	270119.	204.	145.	7.	169
170	Y - 1 - 10	2700.	7455.	1416.	49.	1700.	1199.	2687.	280320.	199.	153.	8.	170
171	Y - 1 - 11	5600.	6542.	1154.	39.	1480.	1212.	2047.	199117.	206.	128.	10.	171
172	Y - 1 - 12	6800.	6776.	1008.	35.	1320.	1301.	1913.	190749.	199.	120.	11.	172
MEAN		5392.	7553.	1490.	53.	1534.	1338.	2653.	259199.	240.	153.	9.	
COEF VAR		30.7	12.6	17.5	17.6	9.3	12.4	18.4	18.1	17.0	15.2	17.6	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
176	Y - 1 - 1	0.02308	0.08807	0.02079	0.04340	0.08478	0.05793	0.07373	4.08405	0.25089	0.01994	0.03704	176
177	Y - 1 - 2	0.01282	0.08346	0.02121	0.04623	0.08424	0.05626	0.07833	4.53253	0.20714	0.01962	0.04321	177
163	Y - 1 - 3	0.01758	0.09994	0.02815	0.05377	0.07717	0.05767	0.09725	5.44463	0.26161	0.02563	0.06790	163
164	Y - 1 - 4	0.01099	0.11231	0.02873	0.06132	0.09076	0.08154	0.11516	6.34380	0.29375	0.02627	0.06173	164
165	Y - 1 - 5	0.02088	0.09091	0.03063	0.05755	0.08370	0.05982	0.11151	6.36481	0.19375	0.02975	0.06173	165
166	Y - 1 - 6	0.02051	0.11111	0.02667	0.05849	0.09946	0.06013	0.12095	6.38884	0.23304	0.02468	0.05556	166
167	Y - 1 - 7	0.02271	0.08786	0.02667	0.06038	0.08533	0.06159	0.11599	7.10564	0.21518	0.02927	0.06173	167
168	Y - 1 - 8	0.02051	0.08730	0.02460	0.05283	0.07772	0.05621	0.10640	6.30410	0.19286	0.02801	0.05556	168
169	Y - 1 - 9	0.03260	0.07478	0.02257	0.04811	0.07283	0.05278	0.09208	5.79655	0.18214	0.02294	0.04321	169
170	Y - 1 - 10	0.00989	0.08917	0.02277	0.04623	0.09239	0.05282	0.09721	6.01545	0.17768	0.02421	0.04938	170
171	Y - 1 - 11	0.02051	0.07825	0.01855	0.03679	0.08043	0.05339	0.07406	4.27290	0.18393	0.02025	0.06173	171
172	Y - 1 - 12	0.02491	0.08105	0.01621	0.03302	0.07174	0.05731	0.06921	4.09333	0.17768	0.01899	0.06790	172
MEAN		0.01975	0.09035	0.02396	0.04984	0.08338	0.05895	0.09599	5.56221	0.21414	0.02413	0.05556	
COEF VAR		30.7	12.6	17.5	17.6	9.3	12.4	18.4	18.1	17.0	15.2	17.6	

Y2

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
180	Y - 2 - 1	*******	9884.	1256.	26.	1700.	1284.	1892.	22614.	698.	60.	10.	180
181	Y - 2 - 2	*******	5904.	1312.	18.	1220.	1086.	1598.	17064.	676.	46.	8.	181
182	Y - 2 - 3	*******	5646.	1134.	14.	1200.	1106.	1370.	13160.	676.	1208.	8.	182
183	Y - 2 - 4	*******	******	******	*****	******	******	******	*******	******	*****	*****	183
184	Y - 2 - 5	24600.	7244.	2690.	32.	1400.	1272.	1946.	18810.	736.	198.	14.	184
185	Y - 2 - 6	27200.	7716.	2348.	30.	1460.	1370.	1514.	16468.	748.	172.	12.	185
186	Y - 2 - 7	22600.	8692.	3722.	36.	1420.	1176.	2170.	20020.	662.	268.	14.	186
187	Y - 2 - 8	13100.	9016.	3758.	36.	1720.	1398.	2328.	20192.	622.	260.	14.	187
188	Y - 2 - 9	12000.	8902.	4034.	48.	1880.	1658.	2470.	23700.	604.	356.	12.	188
189	Y - 2 - 10	4500.	7850.	4736.	40.	1740.	1544.	2410.	23878.	596.	316.	12.	189
190	Y - 2 - 11	19400.	10520.	4294.	36.	2280.	1930.	2666.	25892.	630.	260.	10.	190
191	Y - 2 - 12	28400.	11850.	3596.	44.	2500.	2088.	2770.	23124.	570.	120.	20.	191
MEAN		18975.	8475.	2989.	33.	1684.	1447.	2103.	20447.	656.	297.	12.	
COEF VAR		41.4	21.1	41.7	30.1	23.4	21.7	21.5	17.9	8.3	102.3	26.6	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
180	Y - 2 - 1	*******	0.11823	0.02019	0.02453	0.09239	0.05656	0.06845	0.48528	0.62321	0.00949	0.06173	180
181	Y - 2 - 2	*******	0.07062	0.02109	0.01698	0.06630	0.04784	0.05781	0.36618	0.60357	0.00728	0.04938	181
182	Y - 2 - 3	*******	0.06754	0.01823	0.01321	0.06522	0.04872	0.04957	0.28240	0.60357	0.19114	0.04938	182
183	Y - 2 - 4	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	183
184	Y - 2 - 5	0.09011	0.08665	0.04325	0.03019	0.07609	0.05604	0.07041	0.40365	0.65714	0.03133	0.08642	184
185	Y - 2 - 6	0.09963	0.09230	0.03775	0.02830	0.07935	0.06035	0.05478	0.35339	0.66786	0.02722	0.07407	185
186	Y - 2 - 7	0.08278	0.10397	0.05984	0.03396	0.07717	0.05181	0.07851	0.42961	0.59107	0.04241	0.08642	186
187	Y - 2 - 8	0.04799	0.10785	0.06042	0.03396	0.09348	0.06159	0.08423	0.43330	0.55536	0.04114	0.08642	187
188	Y - 2 - 9	0.04396	0.10648	0.06486	0.04528	0.10217	0.07304	0.08936	0.50858	0.53929	0.05633	0.07407	188
189	Y - 2 - 10	0.01648	0.09390	0.07614	0.03774	0.09457	0.06802	0.08719	0.51240	0.53214	0.05000	0.07407	189
190	Y - 2 - 11	0.07106	0.12584	0.06904	0.03396	0.12391	0.08502	0.09645	0.55562	0.56250	0.04114	0.06173	190
191	Y - 2 - 12	0.10403	0.14175	0.05781	0.04151	0.13587	0.09198	0.10022	0.49622	0.50893	0.01899	0.12346	191
MEAN		0.06951	0.10137	0.04806	0.03087	0.09150	0.06372	0.07609	0.43879	0.58588	0.04695	0.07520	
COEF VAR		41.4	21.1	41.7	30.1	23.4	21.7	21.5	17.9	8.3	102.3	26.6	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK
(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Y -29

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

Y3

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
207	Y - 3 - 1	153700.	17545.	5596.	74.	3060.	2971.	2855.	14260.	527.	690.	28.	207
208	Y - 3 - 2	155800.	17964.	5103.	66.	3380.	3040.	2587.	13269.	510.	669.	29.	208
209	Y - 3 - 3	98000.	16605.	4197.	52.	3300.	2584.	2150.	11267.	553.	551.	24.	209
210	Y - 3 - 4	69300.	13555.	4022.	56.	2450.	2060.	2208.	12963.	537.	533.	19.	210
211	Y - 3 - 5	156900.	15563.	4792.	61.	3060.	2494.	2382.	12962.	525.	600.	25.	211
234	Y - 3 - 6	92100.	16961.	432.	63.	2770.	2824.	2297.	12909.	590.	679.	29.	234
235	Y - 3 - 7	87100.	17844.	5140.	73.	2460.	3147.	2588.	13869.	555.	767.	31.	235
214	Y - 3 - 8	90100.	18780.	6120.	72.	2850.	3402.	3115.	16466.	544.	770.	35.	214
215	Y - 3 - 9	69200.	17579.	5700.	68.	2850.	3241.	2914.	17750.	517.	706.	29.	215
216	Y - 3 - 10	103300.	18902.	5547.	64.	3230.	3751.	2821.	15289.	508.	711.	35.	216
217	Y - 3 - 11	102100.	17503.	5285.	60.	2730.	3256.	2743.	14793.	481.	657.	32.	217
218	Y - 3 - 12	98300.	16740.	5061.	59.	2760.	3182.	2621.	14872.	542.	646.	30.	218
MEAN		106325.	17128.	4750.	64.	2908.	3004.	2607.	14222.	532.	665.	29.	
COEF VAR		28.5	8.1	29.9	10.3	10.0	14.2	11.0	11.8	5.0	10.7	15.1	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
207	Y - 3 - 1	0.56300	0.20987	0.08997	0.06981	0.16630	0.13088	0.10329	0.30601	0.47034	0.10918	0.17284	207
208	Y - 3 - 2	0.57070	0.21488	0.08204	0.06226	0.18370	0.13392	0.09360	0.28474	0.45536	0.10585	0.17901	208
209	Y - 3 - 3	0.35897	0.19862	0.06748	0.04906	0.17935	0.11824	0.07779	0.24178	0.49375	0.08718	0.14815	209
210	Y - 3 - 4	0.25385	0.16214	0.06466	0.05283	0.13315	0.09075	0.07988	0.27818	0.47946	0.08434	0.11729	210
211	Y - 3 - 5	0.57473	0.18616	0.07704	0.05755	0.16630	0.10987	0.08618	0.27815	0.46875	0.09494	0.15432	211
234	Y - 3 - 6	0.33736	0.20288	0.00695	0.05943	0.15054	0.12441	0.08310	0.27702	0.52679	0.10744	0.17901	234
235	Y - 3 - 7	0.31905	0.21344	0.08264	0.06887	0.13370	0.13863	0.09363	0.29762	0.49554	0.12136	0.19136	235
214	Y - 3 - 8	0.33004	0.22464	0.09839	0.06792	0.15489	0.14987	0.11270	0.35335	0.48571	0.12184	0.21605	214
215	Y - 3 - 9	0.25348	0.21028	0.09164	0.06415	0.15489	0.14278	0.10543	0.38090	0.46161	0.11171	0.17901	215
216	Y - 3 - 10	0.37839	0.22610	0.08918	0.06038	0.17554	0.16524	0.10206	0.32809	0.45357	0.11250	0.21605	216
217	Y - 3 - 11	0.37399	0.20937	0.08497	0.05660	0.14837	0.14344	0.09924	0.31723	0.42946	0.10396	0.19753	217
218	Y - 3 - 12	0.36007	0.20024	0.08137	0.05566	0.15000	0.14018	0.09483	0.31914	0.48393	0.10222	0.18519	218
MEAN		0.38947	0.20489	0.07636	0.06038	0.15806	0.13235	0.09431	0.30518	0.47537	0.10521	0.17798	
COEF VAR		28.5	8.1	29.9	10.3	10.0	14.2	11.0	11.8	5.0	10.7	15.1	

Y4

PPM

DATA CODE	SAMPLE I.D.	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
237	Y - 4 - 1	7100.	5759.	3400.	161.	930.	910.	2306.	221423.	355.	159.	24.	237
238	Y - 4 - 2	6900.	5492.	3480.	170.	870.	856.	2145.	237419.	303.	121.	23.	238
239	Y - 4 - 3	6000.	5606.	2883.	171.	880.	972.	2226.	262518.	284.	115.	22.	239
240	Y - 4 - 4	6900.	5967.	3587.	143.	1100.	1048.	2163.	242620.	304.	129.	27.	240
241	Y - 4 - 5	*******	5844.	3557.	120.	920.	880.	1999.	220620.	331.	133.	22.	241
242	Y - 4 - 6	7200.	5710.	3131.	129.	1180.	590.	1969.	209220.	140.	133.	6.	242
243	Y - 4 - 7	6300.	5608.	3257.	132.	1120.	669.	2171.	226319.	259.	130.	16.	243
244	Y - 4 - 8	9500.	7554.	4574.	106.	1490.	1091.	1956.	174529.	282.	224.	16.	244
245	Y - 4 - 9	10200.	7982.	4384.	104.	1510.	1139.	1946.	146028.	387.	221.	2.	245
246	Y - 4 - 10	13600.	8022.	4297.	128.	1800.	981.	2256.	179630.	372.	235.	2.	246
257	Y - 4 - 11	4900.	7289.	3726.	161.	1560.	751.	2216.	217727.	341.	208.	2.	257
258	Y - 4 - 12	5800.	6969.	4157.	220.	1360.	704.	2476.	245427.	314.	200.	25.	258
MEAN		7673.	6484.	3703.	145.	1227.	883.	2152.	215290.	306.	167.	16.	
COEF VAR		31.1	14.7	13.9	21.7	24.3	19.0	7.2	14.9	20.2	26.5	60.7	

KK

DATA CODE	SAMPLE I.D.	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
237	Y - 4 - 1	0.02601	0.06889	0.05466	0.15189	0.05054	0.04009	0.08343	4.75157	0.31696	0.02516	0.14815	237
238	Y - 4 - 2	0.02527	0.06569	0.05595	0.16038	0.04728	0.03771	0.07760	5.09483	0.27054	0.01915	0.14198	238
239	Y - 4 - 3	0.02198	0.06706	0.04635	0.16132	0.04783	0.04282	0.08054	5.63343	0.25357	0.01820	0.13580	239
240	Y - 4 - 4	0.02527	0.07138	0.05767	0.13491	0.05978	0.04617	0.07826	5.20644	0.27143	0.02041	0.16667	240
241	Y - 4 - 5	*******	0.06990	0.05719	0.11321	0.05000	0.03877	0.07232	4.73433	0.29554	0.02104	0.13580	241
242	Y - 4 - 6	0.02637	0.06830	0.05034	0.12170	0.06413	0.02599	0.07124	4.48970	0.12500	0.02104	0.03704	242
243	Y - 4 - 7	0.02308	0.06708	0.05236	0.12453	0.06087	0.02947	0.07855	4.85663	0.23125	0.02057	0.09877	243
244	Y - 4 - 8	0.03480	0.09036	0.07354	0.10000	0.08098	0.04806	0.07077	3.74526	0.25179	0.03544	0.09877	244
245	Y - 4 - 9	0.03736	0.09548	0.07048	0.09811	0.08207	0.05018	0.07041	3.13365	0.34554	0.03497	0.01235	245
246	Y - 4 - 10	0.04982	0.09596	0.06908	0.12075	0.09783	0.04322	0.08162	3.85472	0.33214	0.03718	0.01235	246
257	Y - 4 - 11	0.01795	0.08719	0.05990	0.15189	0.08478	0.03308	0.08017	4.67225	0.30446	0.03291	0.01235	257
258	Y - 4 - 12	0.02125	0.08336	0.06683	0.20755	0.07391	0.03101	0.08958	5.26667	0.28036	0.03165	0.15432	258
MEAN		0.02811	0.07755	0.05953	0.13719	0.06667	0.03888	0.07787	4.61995	0.27321	0.02648	0.09619	
COEF VAR		31.1	14.7	13.9	21.7	24.3	19.0	7.2	14.9	20.2	26.5	60.7	

LAKE SEDIMENT GEOCHEMICAL DATA: MAJOR ELEMENTS-PPM & KK

(20 cm - 50 cm CORE DEPTH: 2.5 cm SEGMENTS)

Y-31

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Y1

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
176	Y - 1 - 1	1.0	4.0	6.0	10.	18.	32.	0.1	17.0	43.	176
177	Y - 1 - 2	1.0	2.0	6.0	5.	2.	29.	0.1	23.0	38.	177
163	Y - 1 - 3	4.8	4.0	13.0	5.	9.	29.	0.1	20.0	46.	163
164	Y - 1 - 4	1.0	9.0	18.0	5.	17.	27.	3.1	7.0	42.	164
165	Y - 1 - 5	0.2	8.0	10.0	15.	8.	26.	0.1	6.0	41.	165
166	Y - 1 - 6	1.0	1.0	11.0	13.	5.	29.	0.1	22.0	43.	166
167	Y - 1 - 7	3.6	7.0	15.0	5.	4.	27.	0.1	7.0	39.	167
168	Y - 1 - 8	4.9	4.0	7.0	5.	7.	27.	0.1	19.0	38.	168
169	Y - 1 - 9	1.0	9.0	7.0	5.	30.	28.	0.1	18.0	38.	169
170	Y - 1 - 10	0.2	9.0	7.0	10.	39.	29.	0.1	31.0	38.	170
171	Y - 1 - 11	1.0	8.0	7.0	10.	33.	28.	0.1	29.0	44.	171
172	Y - 1 - 12	0.2	3.0	2.0	5.	18.	29.	0.1	14.0	37.	172
MEAN		1.7	5.7	9.1	8.	16.	28.	0.3	17.8	41.	
COEF VAR		100.2	50.1	47.2	45.4	74.7	5.3	236.9	44.2	7.0	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
176	Y - 1 - 1	0.556	0.033	0.088	0.116	0.182	2.46	0.043	0.125	0.566	176
177	Y - 1 - 2	0.556	0.016	0.088	0.058	0.020	2.23	0.043	0.169	0.500	177
163	Y - 1 - 3	2.667	0.033	0.191	0.058	0.091	2.23	0.043	0.147	0.605	163
164	Y - 1 - 4	0.556	0.074	0.265	0.058	0.172	2.08	1.348	0.051	0.553	164
165	Y - 1 - 5	0.111	0.066	0.147	0.174	0.081	2.00	0.043	0.044	0.539	165
166	Y - 1 - 6	0.556	0.008	0.162	0.151	0.051	2.23	0.043	0.162	0.566	166
167	Y - 1 - 7	2.000	0.057	0.221	0.058	0.040	2.08	0.043	0.051	0.513	167
168	Y - 1 - 8	2.722	0.033	0.103	0.058	0.071	2.08	0.043	0.140	0.500	168
169	Y - 1 - 9	0.556	0.074	0.103	0.058	0.303	2.15	0.043	0.132	0.500	169
170	Y - 1 - 10	0.111	0.074	0.103	0.116	0.394	2.23	0.043	0.228	0.500	170
171	Y - 1 - 11	0.556	0.066	0.103	0.116	0.333	2.15	0.043	0.213	0.579	171
172	Y - 1 - 12	0.111	0.025	0.029	0.058	0.182	2.23	0.043	0.103	0.487	172
MEAN		0.921	0.046	0.134	0.090	0.180	2.18	0.152	0.131	0.534	
COEF VAR		100.2	50.1	47.2	45.4	74.7	5.3	236.9	44.2	7.0	

Y2

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
180	Y - 2 - 1	1.0	2.0	10.0	*****	20.	18.	3.2	40.0	96.	180
181	Y - 2 - 2	0.2	1.0	1.0	*****	2.	10.	4.1	54.0	42.	181
182	Y - 2 - 3	4.8	1.0	2.0	*****	4.	12.	0.6	64.0	44.	182
183	Y - 2 - 4	****	*****	*****.	*****	****	****	****	*****	****	183
184	Y - 2 - 5	3.9	16.0	14.0	*****	16.	4.	0.6	36.0	104.	184
185	Y - 2 - 6	4.1	30.0	2.0	*****	32.	2.	0.2	56.0	62.	185
186	Y - 2 - 7	4.1	30.0	16.0	*****	28.	2.	0.4	56.0	76.	186
187	Y - 2 - 8	4.0	32.0	10.0	*****	124.	****	0.2	76.0	72.	187
188	Y - 2 - 9	2.8	34.0	18.0	*****	2.	372.	0.1	66.0	82.	188
189	Y - 2 - 10	4.0	36.0	30.0	*****	200.	200.	0.1	90.0	94.	189
190	Y - 2 - 11	5.8	8.0	20.0	*****	36.	42.	0.4	96.0	106.	190
191	Y - 2 - 12	1.0	30.0	16.0	*****	320.	18.	2.2	94.0	110.	191
MEAN		3.2	20.0	12.6	*****	71.	180.	1.1	66.2	81.	
COEF VAR		52.2	69.1	66.8	******	137.5	206.2	121.7	29.8	28.3	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
180	Y - 2 - 1	0.556	0.016	0.147	*****	0.202	1.38	1.391	0.294	1.263	180
181	Y - 2 - 2	0.111	0.008	0.015	*****	0.020	0.77	1.783	0.397	0.553	181
182	Y - 2 - 3	2.667	0.008	0.029	*****	0.040	0.92	0.261	0.471	0.579	182
183	Y - 2 - 4	******	*****	******	*****	*****	******	*****	*****	*****	183
184	Y - 2 - 5	2.167	0.131	0.206	*****	0.162	0.31	0.261	0.265	1.368	184
185	Y - 2 - 6	2.278	0.246	0.029	*****	0.323	0.15	0.087	0.412	0.816	185
186	Y - 2 - 7	2.278	0.246	0.235	*****	0.283	0.15	0.174	0.412	1.000	186
187	Y - 2 - 8	2.222	0.262	0.147	*****	1.253	100.00	0.087	0.559	0.947	187
188	Y - 2 - 9	1.556	0.279	0.265	*****	0.020	28.62	0.043	0.485	1.079	188
189	Y - 2 - 10	2.222	0.295	0.441	*****	2.020	15.38	0.043	0.662	1.237	189
190	Y - 2 - 11	3.222	0.066	0.294	*****	0.364	3.23	0.174	0.706	1.395	190
191	Y - 2 - 12	0.556	0.246	0.235	*****	3.232	1.38	0.957	0.691	1.447	191
MEAN		1.803	0.164	0.186	*****	0.720	13.85	0.478	0.487	1.062	
COEF VAR		52.2	69.1	66.8	******	137.5	206.2	121.7	29.8	28.3	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

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LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

Y3

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
207	Y - 3 - 1	1.0	21.0	16.0	*****	18.	16.	1.0	48.0	70.	207
208	Y - 3 - 2	2.8	18.0	16.0	*****	10.	14.	3.2	49.0	70.	208
209	Y - 3 - 3	1.2	14.0	13.0	*****	13.	13.	3.2	59.0	88.	209
210	Y - 3 - 4	0.1	22.0	18.0	*****	57.	13.	3.6	53.0	73.	210
211	Y - 3 - 5	0.1	16.0	12.0	*****	14.	16.	3.2	49.0	70.	211
234	Y - 3 - 6	5.0	22.0	19.0	17.	34.	6.	4.2	50.0	67.	234
235	Y - 3 - 7	4.5	23.0	20.0	*****	59.	7.	0.5	58.0	72.	235
214	Y - 3 - 8	2.8	25.0	23.0	14.	20.	10.	4.2	18.0	67.	214
215	Y - 3 - 9	4.7	19.0	19.0	*****	18.	10.	3.4	17.0	76.	215
216	Y - 3 - 10	4.1	24.0	18.0	*****	49.	9.	3.4	21.0	74.	216
217	Y - 3 - 11	4.7	22.0	14.0	12.	13.	9.	3.8	16.0	68.	217
218	Y - 3 - 12	2.5	17.0	16.0	*****	15.	9.	3.5	12.0	79.	218
MEAN		2.8	20.3	17.0	14.	27.	11.	3.1	37.5	73.	
COEF VAR		63.0	16.1	17.6	14.3	65.5	29.0	35.7	47.7	7.9	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
207	Y - 3 - 1	0.556	0.172	0.235	*****	0.182	1.23	0.435	0.353	0.921	207
208	Y - 3 - 2	1.556	0.148	0.235	*****	0.101	1.08	1.391	0.360	0.921	208
209	Y - 3 - 3	0.667	0.115	0.191	*****	0.131	1.00	1.391	0.434	1.158	209
210	Y - 3 - 4	0.056	0.180	0.265	*****	0.576	1.00	1.565	0.390	0.961	210
211	Y - 3 - 5	0.056	0.131	0.176	*****	0.141	1.23	1.391	0.360	0.921	211
234	Y - 3 - 6	2.778	0.180	0.279	0.198	0.343	0.46	1.826	0.368	0.882	234
235	Y - 3 - 7	2.500	0.189	0.294	*****	0.596	0.54	0.217	0.426	0.947	235
214	Y - 3 - 8	1.556	0.205	0.338	0.163	0.202	0.77	1.826	0.132	0.882	214
215	Y - 3 - 9	2.611	0.156	0.279	*****	0.182	0.77	1.478	0.125	1.000	215
216	Y - 3 - 10	2.278	0.197	0.265	*****	0.495	0.69	1.478	0.154	0.974	216
217	Y - 3 - 11	2.611	0.180	0.206	0.140	0.131	0.69	1.652	0.118	0.895	217
218	Y - 3 - 12	1.389	0.139	0.235	*****	0.152	0.69	1.522	0.088	1.039	218
MEAN		1.551	0.166	0.250	0.167	0.269	0.85	1.348	0.276	0.958	
COEF VAR		63.0	16.1	17.6	14.3	65.5	29.0	35.7	47.7	7.9	

Y4

PPM

DATA CODE	SAMPLE I.D.	AS PPM	CR PPM	CU PPM	HG PPB	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
237	Y - 4 - 1	3.5	12.0	77.0	10.	29.	25.	2.7	18.0	35.	237
238	Y - 4 - 2	7.0	8.0	74.0	*****	4.	26.	1.7	13.0	31.	238
239	Y - 4 - 3	4.7	9.0	83.0	11.	13.	28.	1.9	27.0	31.	239
240	Y - 4 - 4	4.5	10.0	97.0	*****	19.	29.	1.9	30.0	30.	240
241	Y - 4 - 5	11.0	12.0	93.0	*****	28.	24.	1.7	39.0	34.	241
242	Y - 4 - 6	1.0	16.0	*****	11.	25.	46.	0.5	20.0	369.	242
243	Y - 4 - 7	2.8	6.0	97.0	12.	23.	28.	2.8	29.0	31.	243
244	Y - 4 - 8	5.1	7.0	821.0	5.	15.	45.	3.1	35.0	50.	244
245	Y - 4 - 9	4.5	1.0	134.0	*****	19.	24.	2.5	59.0	48.	245
246	Y - 4 - 10	4.1	1.0	249.0	15.	5.	29.	2.8	25.0	53.	246
257	Y - 4 - 11	5.2	1.0	123.0	*****	4.	24.	2.9	60.0	45.	257
258	Y - 4 - 12	4.5	6.0	689.0	5.	7.	33.	2.3	65.0	58.	258
MEAN		4.8	7.4	361.0	10.	16.	30.	2.2	35.0	68.	
COEF VAR		48.0	61.9	137.3	34.5	56.2	24.4	31.5	47.7	134.4	

KK

DATA CODE	SAMPLE I.D.	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
237	Y - 4 - 1	1.944	0.098	1.132	0.116	0.293	1.92	1.174	0.132	0.461	237
238	Y - 4 - 2	3.889	0.066	1.088	*****	0.040	2.00	0.739	0.096	0.408	238
239	Y - 4 - 3	2.611	0.074	1.221	0.128	0.131	2.15	0.826	0.199	0.408	239
240	Y - 4 - 4	2.500	0.082	1.426	*****	0.192	2.23	0.826	0.221	0.395	240
241	Y - 4 - 5	6.111	0.098	1.368	*****	0.283	1.85	0.739	0.287	0.447	241
242	Y - 4 - 6	0.556	0.131	26.397	0.128	0.253	3.54	0.217	0.147	4.855	242
243	Y - 4 - 7	1.556	0.049	1.426	0.140	0.232	2.15	1.217	0.213	0.408	243
244	Y - 4 - 8	2.833	0.057	12.074	0.058	0.152	3.46	1.348	0.257	0.658	244
245	Y - 4 - 9	2.500	0.008	1.971	*****	0.192	1.85	1.087	0.434	0.632	245
246	Y - 4 - 10	2.278	0.008	3.662	0.174	0.051	2.23	1.217	0.184	0.697	246
257	Y - 4 - 11	2.889	0.008	1.809	*****	0.040	1.85	1.261	0.441	0.592	257
258	Y - 4 - 12	2.500	0.049	10.132	0.058	0.071	2.54	1.000	0.478	0.763	258
MEAN		2.681	0.061	5.309	0.115	0.161	2.31	0.971	0.257	0.894	
COEF VAR		48.0	61.9	137.3	34.5	56.2	24.4	31.5	47.7	134.4	

LAKE SEDIMENT GEOCHEMICAL DATA: MINOR ELEMENTS-PPM & KK

(20 CM - 50 CM CORE DEPTH: 2.5 CM SEGMENTS)

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SECTION 2

1981 Performance of Method

SECTION 2 - CONTENTS

REPLICATES OF STANDARD AS72BU
MAJOR ELEMENTS-PPM

2-1

DATA CODE	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
178	328300.	61809.	30426.	1036.	19500.	10600.	11050.	29650.	1897.	2466.	83.	178
236	239700.	65769.	32872.	1220.	11220.	13136.	12060.	32887.	1983.	3631.	107.	236
259	235200.	68386.	42705.	1582.	15360.	13436.	14980.	42364.	2052.	5299.	120.	259
291	339800.	63208.	36962.	1248.	20840.	12143.	13897.	35030.	1994.	3988.	137.	291
314	294500.	68983.	36006.	1270.	18740.	13887.	12976.	3515.	2037.	3253.	118.	314
335	241000.	63706.	35246.	1259.	19620.	11647.	12846.	34490.	1895.	3686.	100.	335
353	249000.	67175.	32758.	1314.	20000.	12320.	12176.	3256.	1903.	3925.	122.	353
377	332600.	70311.	34177.	1140.	20160.	14470.	12477.	33620.	2053.	3964.	169.	377
398	306300.	73126.	36900.	1459.	20300.	14586.	13718.	37127.	2169.	4825.	212.	398
415	202600.	66662.	31910.	1098.	7980.	13625.	11615.	30697.	1912.	3670.	161.	415
432	270500.	55722.	33732.	1252.	12960.	11018.	12123.	32403.	889.	3464.	106.	432
450	284300.	64828.	34572.	1302.	18820.	11713.	12328.	33130.	2023.	4573.	177.	450
471	242000.	62748.	36806.	1295.	18020.	11008.	13517.	36540.	1990.	3964.	112.	471
489	206100.	59465.	27010.	967.	5950.	11648.	9822.	25260.	1932.	315.	150.	489
522	288000.	59600.	35611.	1334.	10600.	10661.	12955.	34720.	1891.	4584.	133.	522
531	150000.	52932.	32170.	1224.	18100.	9695.	11576.	30900.	1688.	4318.	113.	531
560	287900.	67803.	33801.	1243.	20660.	12101.	12545.	33660.	2140.	3657.	125.	560
580	151400.	65720.	39672.	1365.	18600.	12126.	14170.	38310.	2092.	4017.	110.	580
609	301000.	64282.	34777.	1287.	20850.	12039.	12364.	33010.	2045.	4697.	165.	609
618	260900.	63884.	33212.	1441.	17220.	11417.	11775.	31160.	2048.	5197.	176.	618
627	270700.	62130.	34857.	1226.	19560.	11132.	12383.	33460.	1950.	3957.	127.	627
634	284400.	67551.	34464.	1227.	19220.	12377.	12443.	33190.	1986.	3883.	111.	634
644	304300.	66621.	32339.	1202.	18920.	12121.	11704.	31420.	1942.	3017.	94.	644
656	310700.	60709.	33173.	1228.	18520.	11366.	12064.	32140.	1840.	2771.	97.	656
668	315500.	65556.	38253.	1390.	19360.	12798.	13645.	36870.	1945.	3760.	113.	668
679	307300.	63908.	26241.	1003.	11310.	11446.	9696.	26020.	1887.	2747.	106.	679
MEAN	269385.	64331.	34256.	1254.	17015.	12097.	12419.	30955.	1930.	3763.	129.	
COEF VAR	18.39	6.66	9.85	10.70	24.43	9.75	9.44	28.00	11.92	25.99	23.79	

DATA CODE	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
178	1.203	0.739	0.489	0.977	1.060	0.467	0.400	0.636	1.694	0.390	0.512	178
236	0.878	0.787	0.528	1.151	0.610	0.579	0.436	0.706	1.771	0.575	0.660	236
259	0.862	0.818	0.687	1.492	0.835	0.592	0.542	0.909	1.832	0.836	0.741	259
291	1.245	0.756	0.594	1.177	1.133	0.535	0.503	0.752	1.780	0.631	0.846	291
314	1.079	0.825	0.579	1.198	1.018	0.612	0.469	0.075	1.819	0.515	0.728	314
335	0.883	0.762	0.567	1.188	1.066	0.513	0.465	0.740	1.692	0.583	0.617	335
353	0.912	0.804	0.527	1.240	1.087	0.543	0.441	0.070	1.699	0.621	0.753	353
377	1.218	0.841	0.549	1.075	1.096	0.637	0.451	0.721	1.833	0.627	1.043	377
398	1.122	0.875	0.593	1.376	1.103	0.643	0.496	0.797	1.937	0.763	1.309	398
415	0.742	0.797	0.513	1.036	0.434	0.600	0.420	0.659	1.707	0.561	0.994	415
432	0.991	0.667	0.542	1.181	0.704	0.485	0.439	0.695	0.794	0.548	0.654	432
450	1.041	0.775	0.556	1.228	1.023	0.516	0.446	0.711	1.806	0.724	1.093	450
471	0.886	0.751	0.592	1.222	0.979	0.485	0.489	0.784	1.777	0.627	0.691	471
489	0.755	0.711	0.434	0.912	0.323	0.513	0.355	0.542	1.725	0.050	0.926	489
522	1.055	0.713	0.573	1.258	0.576	0.470	0.469	0.745	1.688	0.725	0.821	522
531	0.549	0.633	0.517	1.155	0.984	0.427	0.419	0.663	1.507	0.683	0.698	531
560	1.055	0.811	0.543	1.173	1.123	0.533	0.454	0.722	1.911	0.610	0.772	560
580	0.555	0.786	0.638	1.288	1.011	0.534	0.513	0.822	1.868	0.636	0.679	580
609	1.103	0.769	0.559	1.214	1.133	0.530	0.447	0.708	1.626	0.743	1.019	609
618	0.956	0.764	0.534	1.359	0.936	0.503	0.426	0.669	1.829	0.822	1.066	618
627	0.992	0.743	0.560	1.157	1.063	0.490	0.448	0.718	1.741	0.626	0.784	627
634	1.042	0.808	0.554	1.158	1.045	0.545	0.450	0.712	1.773	0.614	0.685	634
644	1.115	0.797	0.520	1.134	1.028	0.534	0.423	0.674	1.734	0.477	0.560	644
656	1.138	0.726	0.533	1.158	1.007	0.501	0.436	0.690	1.643	0.438	0.599	656
668	1.156	0.784	0.615	1.311	1.052	0.564	0.494	0.791	1.737	0.595	0.698	668
679	1.126	0.764	0.422	0.946	0.615	0.504	0.351	0.558	1.685	0.435	0.654	679
MEAN	0.987	0.770	0.551	1.183	0.925	0.533	0.449	0.664	1.723	0.595	0.794	
COEF VAR	18.39	6.66	9.85	10.70	24.43	9.75	9.44	28.00	11.92	25.99	23.79	

REPLICATES OF STANDARD AS72BU
MAJOR ELEMENTS-KK

REPLICATES OF STANDARD AS72BU
MINOR ELEMENTS-PPM

DATA CODE	AS PPM	CR PPM	CU PPM	HG PPM	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
178	4.80	30.0	12.0	10.0	39.0	38.0	0.10	126.0	101.0	178
236	10.00	48.0	15.0	5.0	40.0	35.0	2.10	68.0	90.0	236
259	1.20	47.0	46.0	11.0	25.0	44.0	2.20	141.0	107.0	259
291	0.80	46.0	15.0	18.0	25.0	37.0	2.40	150.0	101.0	291
314	1.20	57.0	20.0	13.0	26.0	38.0	2.20	130.0	102.0	314
335	0.10	46.0	20.0	5.0	16.0	38.0	3.60	98.0	100.0	335
353	6.00	64.0	21.0	5.0	32.0	38.0	2.80	115.0	107.0	353
377	8.00	62.0	15.0	5.0	13.0	38.0	4.30	122.0	99.0	377
398	5.50	67.0	28.0	5.0	34.0	39.0	2.80	121.0	104.0	398
415	0.10	54.0	13.0	5.0	32.0	34.0	1.40	67.0	98.0	415
432	5.50	52.0	22.0	5.0	55.0	27.0	1.40	108.0	102.0	432
450	4.00	64.0	26.0	13.0	46.0	42.0	0.50	109.0	123.0	450
471	3.00	46.0	24.0	5.0	75.0	41.0	2.70	105.0	102.0	471
489	11.00	44.0	13.0	5.0	18.0	42.0	0.20	96.0	95.0	489
522	8.50	65.0	23.0	5.0	48.0	43.0	1.80	95.0	97.0	522
531	10.50	63.0	19.0	5.0	153.0	48.0	1.40	77.0	100.0	531
560	5.50	88.0	16.0	5.0	36.0	56.0	4.20	95.0	104.0	560
580	9.50	58.0	21.0	5.0	95.0	41.0	4.00	107.0	100.0	580
609	6.30	94.0	20.0	5.0	162.0	48.0	3.90	97.0	105.0	609
618	8.00	82.0	26.0	5.0	59.0	43.0	1.70	66.0	103.0	618
627	4.00	39.0	18.0	5.0	52.0	40.0	3.80	112.0	106.0	627
634	4.20	65.0	18.0	5.0	99.0	41.0	3.40	108.0	102.0	634
644	3.50	58.0	20.0	5.0	52.0	38.0	0.10	117.0	98.0	644
656	2.00	67.0	51.0	5.0	94.0	42.0	0.40	119.0	111.0	656
668	5.00	100.0	27.0	5.0	92.0	36.0	2.20	102.0	91.0	668
679	4.50	77.0	20.0	5.0	143.0	37.0	2.20	94.0	95.0	679
MEAN	5.10	60.9	21.9	6.5	60.0	40.2	2.22	106.3	101.7	
COEF VAR	61.68	27.14	40.30	51.64	69.11	13.12	57.70	18.38	6.30	

DATA CODE	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
178	2.667	0.246	0.176	0.116	0.394	2.923	0.043	0.926	1.329	178
236	5.556	0.393	0.221	0.058	0.404	2.692	0.913	0.500	1.184	236
259	0.667	0.385	0.676	0.128	0.253	3.385	0.957	1.037	1.408	259
291	0.444	0.377	0.221	0.209	0.253	2.846	1.043	1.103	1.329	291
314	0.667	0.467	0.294	0.151	0.263	2.923	0.957	0.956	1.342	314
335	0.056	0.377	0.294	0.058	0.162	2.923	1.565	0.721	1.316	335
353	3.333	0.525	0.309	0.058	0.323	2.923	1.217	0.846	1.406	353
377	4.444	0.508	0.221	0.058	0.131	2.923	1.870	0.897	1.303	377
398	3.056	0.549	0.412	0.058	0.343	3.000	1.217	0.890	1.368	398
415	0.056	0.443	0.191	0.058	0.323	2.615	0.609	0.640	1.289	415
432	3.056	0.426	0.324	0.058	0.556	2.077	0.609	0.794	1.342	432
450	2.222	0.525	0.382	0.151	0.465	3.231	0.217	0.801	1.618	450
471	1.667	0.377	0.353	0.058	0.758	3.154	1.174	0.772	1.342	471
489	6.111	0.361	0.191	0.058	0.182	3.231	0.087	0.706	1.250	489
522	4.722	0.533	0.338	0.058	0.485	3.308	0.783	0.699	1.276	522
531	5.833	0.516	0.279	0.058	1.545	3.692	0.609	0.566	1.316	531
560	3.056	0.721	0.235	0.058	0.364	4.306	1.826	0.699	1.368	560
580	5.278	0.475	0.309	0.058	0.960	3.154	1.739	0.767	1.316	580
609	3.500	0.770	0.294	0.058	1.636	3.692	1.696	0.713	1.362	609
618	4.444	0.672	0.382	0.058	0.596	3.308	0.739	0.485	1.355	618
627	2.222	0.320	0.265	0.058	0.525	3.077	1.652	0.824	1.421	627
634	2.333	0.533	0.265	0.058	1.000	3.154	1.478	0.794	1.342	634
644	1.944	0.475	0.294	0.058	0.525	2.923	0.043	0.860	1.269	644
656	1.111	0.549	0.750	0.058	0.949	3.231	0.174	0.875	1.461	656
668	2.778	0.820	0.397	0.058	0.929	2.769	0.957	0.750	1.197	668
679	2.500	0.631	0.294	0.058	1.444	2.846	0.957	0.691	1.250	679
MEAN	2.835	0.499	0.322	0.076	0.606	3.089	0.967	0.782	1.339	
COEF VAR	61.68	27.14	40.30	51.64	69.11	13.12	57.70	18.38	6.30	

REPLICATES OF STANDARD AS72BU
MINOR ELEMENTS-KK

2-4

REPLICATES OF STANDARD U-1981
MAJOR ELEMENTS-PPM

DATA CODE	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
162	212500.	19231.	9576.	193.	2640.	2697.	3084.	12837.	852.	608.	21.	162
213	146000.	17932.	9997.	206.	2130.	2499.	3220.	13190.	807.	658.	20.	213
248	143700.	18711.	9665.	211.	2700.	2648.	3105.	13433.	836.	733.	22.	248
285	215500.	17508.	9492.	200.	2460.	2568.	3111.	11740.	775.	670.	20.	285
321	198900.	16697.	8723.	186.	2350.	2436.	2988.	11340.	719.	652.	19.	321
357	172400.	16896.	8288.	181.	2360.	2249.	2764.	10780.	755.	598.	116.	357
392	158300.	19009.	9314.	227.	2350.	175.	3064.	12860.	839.	785.	25.	392
428	139900.	17894.	8714.	190.	1950.	2582.	2823.	1136.	775.	589.	25.	428
464	172900.	17934.	9481.	204.	2460.	2493.	3161.	12340.	813.	655.	20.	464
500	175900.	16723.	7964.	183.	2240.	2307.	2651.	10410.	756.	591.	16.	500
536	182100.	16012.	8291.	193.	2250.	2223.	2716.	10340.	744.	641.	19.	536
571	156700.	19882.	9483.	225.	2920.	2676.	3174.	12240.	883.	744.	23.	571
606	144200.	17567.	8216.	188.	2100.	2403.	2733.	10680.	824.	699.	32.	606
646	195300.	17858.	8323.	191.	2280.	2357.	2758.	10820.	769.	538.	15.	646
686	136000.	17643.	8577.	185.	2250.	2515.	2875.	10810.	778.	562.	19.	686
715	101300.	16775.	7768.	164.	1620.	2353.	2688.	10130.	759.	559.	20.	715
MEAN	165725.	17767.	8867.	195.	2316.	2324.	2932.	10943.	793.	643.	27.	
COEF VAR	18.03	5.68	7.62	8.07	12.67	24.64	6.59	25.08	5.50	10.75	87.65	

DATA CODE	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
162	0.778	0.230	0.154	0.182	0.143	0.119	0.112	0.275	0.761	0.096	0.130	162
213	0.535	0.214	0.161	0.194	0.116	0.110	0.116	0.283	0.721	0.104	0.123	213
248	0.526	0.224	0.155	0.199	0.147	0.117	0.112	0.288	0.746	0.116	0.136	248
285	0.789	0.209	0.153	0.189	0.134	0.113	0.113	0.252	0.692	0.106	0.123	285
321	0.729	0.200	0.140	0.175	0.128	0.107	0.108	0.243	0.642	0.103	0.117	321
357	0.632	0.202	0.133	0.171	0.128	0.099	0.100	0.231	0.674	0.095	0.728	357
392	0.580	0.227	0.150	0.214	0.128	0.008	0.111	0.276	0.749	0.124	0.154	392
428	0.512	0.214	0.140	0.179	0.106	0.114	0.102	0.024	0.692	0.093	0.154	428
464	0.633	0.215	0.152	0.192	0.134	0.110	0.114	0.265	0.726	0.104	0.123	464
500	0.644	0.200	0.128	0.173	0.122	0.102	0.096	0.223	0.675	0.094	0.099	500
536	0.667	0.192	0.133	0.182	0.122	0.098	0.098	0.222	0.664	0.101	0.117	536
571	0.574	0.238	0.152	0.212	0.159	0.118	0.115	0.263	0.788	0.118	0.142	571
606	0.528	0.210	0.132	0.177	0.114	0.106	0.099	0.229	0.736	0.111	0.198	606
646	0.715	0.214	0.134	0.180	0.124	0.104	0.100	0.232	0.687	0.085	0.093	646
686	0.498	0.211	0.138	0.175	0.122	0.111	0.104	0.232	0.695	0.089	0.117	686
715	0.371	0.201	0.125	0.155	0.088	0.104	0.097	0.217	0.678	0.088	0.123	715
MEAN	0.607	0.213	0.143	0.184	0.126	0.102	0.106	0.235	0.708	0.102	0.167	
COEF VAR	18.03	5.68	7.62	8.07	12.67	24.64	6.59	25.08	5.50	10.75	87.65	

REPLICATES OF STANDARD U-1981
MAJOR ELEMENTS-KK

REPLICATES OF STANDARD U-1981
MINOR ELEMENTS-PPM

2-7

DATA CODE	AS PPM	CR PPM	CU PPM	HG PPM	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
162	3.80	28.0	31.0	10.0	32.0	32.0	1.40	11.0	94.0	162
213	6.00	29.0	31.0	5.0	35.0	38.0	2.50	53.0	60.0	213
248	10.80	8.0	37.0	5.0	25.0	34.0	1.60	24.0	93.0	248
285	10.50	27.0	33.0	5.0	17.0	33.0	2.90	39.0	82.0	285
321	3.80	67.0	31.0	5.0	340.0	36.0	3.20	42.0	70.0	321
357	5.50	32.0	31.0	5.0	29.0	36.0	2.20	40.0	81.0	357
392	4.50	30.0	36.0	5.0	25.0	30.0	1.30	35.0	82.0	392
428	2.50	31.0	29.0	5.0	39.0	37.0	0.40	22.0	75.0	428
464	4.50	31.0	35.0	10.0	54.0	36.0	2.10	20.0	84.0	464
500	9.00	25.0	31.0	5.0	13.0	37.0	0.10	17.0	79.0	500
536	12.00	37.0	29.0	5.0	94.0	34.0	2.00	14.0	83.0	536
571	4.50	41.0	35.0	5.0	63.0	45.0	4.90	18.0	47.0	571
606	12.00	42.0	31.0	5.0	53.0	40.0	2.90	16.0	82.0	606
646	5.30	34.0	30.0	5.0	33.0	35.0	0.10	19.0	78.0	646
686	6.00	58.0	30.0	5.0	57.0	35.0	0.20	22.0	76.0	686
715	8.00	44.0	25.0	*****	91.0	24.0	0.20	20.0	76.0	715
MEAN	6.79	35.3	31.6	5.7	62.5	35.1	1.75	25.8	78.9	
COEF VAR	44.71	37.31	9.30	29.99	120.38	12.45	75.65	45.55	12.81	

DATA CODE	AS KK	CR KK	CU KK	MG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
162	2.111	0.230	0.456	0.116	0.323	2.462	0.609	0.081	1.237	162
213	3.333	0.238	0.456	0.058	0.354	2.923	1.087	0.390	1.053	213
248	6.000	0.066	0.544	0.058	0.253	2.615	0.696	0.176	1.224	248
285	5.833	0.221	0.485	0.058	0.172	2.538	1.261	0.287	1.079	285
321	2.111	0.549	0.456	0.058	3.434	2.769	1.391	0.309	0.921	321
357	3.056	0.262	0.456	0.058	0.293	2.769	0.957	0.294	1.066	357
392	2.500	0.246	0.529	0.058	0.253	2.308	0.565	0.257	1.079	392
428	1.389	0.254	0.426	0.058	0.394	2.846	0.174	0.162	0.987	428
464	2.500	0.254	0.515	0.116	0.545	2.769	0.913	0.147	1.105	464
500	5.000	0.205	0.456	0.058	0.131	2.846	0.043	0.125	1.039	500
536	6.667	0.303	0.426	0.058	0.949	2.615	0.870	0.103	1.092	536
571	2.500	0.336	0.515	0.058	0.636	3.462	2.130	0.132	0.618	571
606	6.667	0.344	0.456	0.058	0.535	3.077	1.261	0.118	1.079	606
646	2.944	0.279	0.441	0.058	0.333	2.692	0.043	0.140	1.026	646
686	3.333	0.475	0.441	0.058	0.576	2.692	0.087	0.162	1.000	686
715	4.444	0.361	0.368	*****	0.919	1.846	0.087	0.147	1.000	715
MEAN	3.774	0.289	0.464	0.066	0.631	2.702	0.761	0.189	1.038	
COEF VAR	44.71	37.31	9.30	29.99	120.38	12.45	75.65	45.55	12.61	

REPLICATES OF STANDARD U-1981
MINOR ELEMENTS-KK

REPLICATES OF STANDARD XZ
MAJOR ELEMENTS-PPM

DATA CODE	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
161	260500.	35264.	8138.	130.	2950.	5390.	2280.	7579.	865.	807.	36.	161
179	244800.	35175.	7761.	125.	3770.	5104.	2192.	6828.	854.	793.	35.	179
212	258800.	32254.	9818.	160.	2790.	4771.	2728.	8651.	808.	990.	29.	212
247	193300.	36912.	7057.	123.	2890.	6089.	1990.	6715.	911.	842.	34.	247
284	269000.	35703.	8727.	147.	3710.	7161.	2587.	8264.	860.	977.	37.	284
320	216000.	31071.	8196.	138.	3250.	4575.	2350.	7166.	740.	942.	36.	320
356	203700.	37360.	8568.	164.	4090.	5561.	2463.	7393.	867.	1015.	36.	356
391	224500.	38670.	8901.	171.	3710.	6296.	2675.	8003.	896.	1092.	44.	391
427	187300.	35106.	7897.	138.	3100.	5539.	2326.	7136.	830.	863.	45.	427
463	207500.	35110.	9958.	172.	3720.	5330.	2860.	8559.	895.	1052.	31.	463
499	216900.	31836.	6550.	122.	3080.	4727.	1952.	5772.	804.	789.	33.	499
535	194000.	32584.	8008.	150.	3450.	4823.	2314.	6578.	835.	1014.	36.	535
570	180300.	36109.	8534.	162.	3370.	4862.	2542.	7768.	907.	1087.	40.	570
605	188100.	34186.	7889.	145.	2810.	4970.	2289.	6817.	882.	1038.	49.	605
645	219800.	34727.	7768.	144.	3160.	4908.	2315.	7007.	818.	815.	26.	645
685	166600.	34497.	79380.	135.	2740.	5071.	2417.	6919.	847.	837.	32.	685
714	136700.	35230.	7479.	125.	2590.	5119.	2435.	6630.	868.	794.	33.	714
MEAN	209871.	34811.	12390.	144.	3246.	5312.	2395.	7281.	852.	926.	36.	
COEF VAR	16.23	5.57	135.34	11.33	13.06	12.21	9.69	10.27	4.98	11.82	15.71	

DATA CODE	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
161	0.954	0.422	0.131	0.123	0.160	0.237	0.082	0.163	0.772	0.128	0.222	161
179	0.897	0.421	0.125	0.118	0.205	0.225	0.079	0.147	0.762	0.125	0.216	179
212	0.948	0.386	0.158	0.151	0.152	0.210	0.099	0.186	0.721	0.157	0.179	212
247	0.708	0.442	0.113	0.116	0.157	0.268	0.072	0.144	0.813	0.133	0.210	247
284	0.985	0.427	0.140	0.139	0.202	0.315	0.094	0.177	0.768	0.155	0.226	284
320	0.791	0.372	0.132	0.130	0.177	0.202	0.085	0.154	0.661	0.149	0.222	320
356	0.746	0.447	0.138	0.155	0.222	0.245	0.089	0.159	0.774	0.161	0.222	356
391	0.822	0.463	0.143	0.161	0.202	0.277	0.097	0.172	0.800	0.173	0.272	391
427	0.686	0.420	0.127	0.130	0.168	0.244	0.084	0.153	0.741	0.137	0.278	427
463	0.760	0.420	0.160	0.162	0.202	0.235	0.103	0.184	0.799	0.166	0.191	463
499	0.795	0.381	0.105	0.115	0.167	0.208	0.071	0.124	0.718	0.125	0.204	499
535	0.711	0.390	0.129	0.142	0.188	0.212	0.084	0.141	0.746	0.160	0.222	535
570	0.660	0.432	0.137	0.153	0.183	0.214	0.092	0.167	0.810	0.172	0.247	570
605	0.689	0.409	0.127	0.137	0.153	0.219	0.083	0.146	0.787	0.164	0.302	605
645	0.605	0.415	0.125	0.136	0.172	0.216	0.084	0.150	0.730	0.129	0.160	645
685	0.610	0.413	1.276	0.127	0.149	0.223	0.087	0.148	0.756	0.132	0.198	685
714	0.501	0.421	0.120	0.118	0.141	0.226	0.088	0.142	0.775	0.126	0.204	714
MEAN	0.769	0.416	0.199	0.136	0.176	0.234	0.087	0.156	0.761	0.147	0.222	
COEF VAR	16.23	5.57	135.34	11.33	13.06	12.21	9.69	10.27	4.98	11.82	15.71	

REPLICATES OF STANDARD XZ
MAJOR ELEMENTS-KK

2-10

REPLICATES OF STANDARD XZ
MINOR ELEMENTS-PPM

2-11

DATA CODE	AS PPM	CR PPM	CU PPM	HG PPM	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
161	1.00	13.0	7.0	5.0	33.0	18.0	4.10	22.0	76.0	161
179	0.10	20.0	10.0	12.0	18.0	25.0	0.10	57.0	76.0	179
212	4.10	33.0	16.0	5.0	31.0	26.0	3.60	59.0	67.0	212
247	2.80	4.0	14.0	5.0	9.0	20.0	3.90	28.0	70.0	247
284	3.90	18.0	19.0	5.0	49.0	22.0	3.80	48.0	75.0	284
320	1.00	29.0	15.0	5.0	88.0	22.0	2.40	42.0	62.0	320
356	1.10	28.0	17.0	5.0	33.0	27.0	1.90	39.0	72.0	356
391	0.10	50.0	18.0	5.0	41.0	20.0	3.30	52.0	70.0	391
427	4.00	23.0	12.0	5.0	36.0	22.0	3.20	33.0	67.0	427
463	0.10	45.0	19.0	15.0	89.0	29.0	3.20	37.0	75.0	463
499	6.00	18.0	14.0	10.0	33.0	26.0	2.60	29.0	72.0	499
535	4.50	36.0	16.0	5.0	67.0	32.0	3.40	25.0	77.0	535
570	8.00	34.0	21.0	15.0	34.0	30.0	3.60	25.0	86.0	570
605	3.50	31.0	14.0	5.0	27.0	32.0	3.10	25.0	70.0	605
645	2.00	26.0	17.0	5.0	18.0	24.0	0.50	39.0	71.0	645
685	4.50	34.0	20.0	20.0	33.0	22.0	3.20	32.0	62.0	685
714	4.00	31.0	16.0	5.0	76.0	36.0	2.10	34.0	69.0	714
MEAN	2.98	27.8	15.6	7.8	42.1	25.5	2.82	36.8	71.6	
COEF VAR	73.03	39.43	22.45	60.01	55.21	19.00	38.83	30.29	7.87	

DATA CODE	AS KK	CR KK	CU KK	MG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
161	0.556	0.107	0.103	0.058	0.333	1.385	1.783	0.162	1.000	161
179	0.056	0.164	0.147	0.140	0.182	1.923	0.043	0.419	1.000	179
212	2.278	0.270	0.235	0.058	0.313	2.000	1.565	0.434	0.862	212
247	1.556	0.033	0.206	0.058	0.091	1.538	1.696	0.206	0.921	247
284	2.167	0.148	0.279	0.058	0.495	1.692	1.652	0.353	0.987	284
320	0.556	0.238	0.221	0.058	0.889	1.692	1.043	0.309	0.816	320
356	0.611	0.230	0.250	0.058	0.333	2.077	0.826	0.287	0.947	356
391	0.056	0.410	0.265	0.058	0.414	1.538	1.435	0.382	0.921	391
427	2.222	0.189	0.176	0.058	0.364	1.692	1.391	0.243	0.882	427
463	0.056	0.369	0.279	0.174	0.899	2.231	1.391	0.272	0.987	463
499	3.333	0.148	0.206	0.116	0.333	2.000	1.130	0.213	0.947	499
535	2.500	0.295	0.235	0.058	0.677	2.462	1.478	0.184	1.013	535
570	4.444	0.279	0.309	0.174	0.343	2.308	1.565	0.184	1.132	570
605	1.944	0.254	0.206	0.058	0.273	2.462	1.348	0.184	0.921	605
645	1.111	0.213	0.250	0.058	0.182	1.846	0.217	0.287	0.934	645
685	2.500	0.279	0.294	0.233	0.333	1.692	1.391	0.235	0.816	685
714	2.222	0.254	0.235	0.058	0.768	2.769	0.913	0.250	0.908	714
MEAN	1.657	0.228	0.229	0.090	0.425	1.959	1.228	0.271	0.942	
COEF VAR	73.03	39.43	22.45	60.01	55.21	19.00	38.83	30.29	7.87	

REPLICATES OF STANDARD XZ
MINOR ELEMENTS-KK

2-12

REPLICATES OF STANDARD XZ DUPLICATES
MAJOR ELEMENTS-PPM

2-13

DATA CODE	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
195	212200.	35290.	10855.	145.	2910.	5190.	3392.	9866.	848.	1086.	41.	195
196	242500.	36064.	10915.	147.	3260.	5166.	3211.	9889.	872.	1079.	37.	196
229	175600.	34618.	10282.	144.	3130.	5147.	2917.	9501.	866.	1045.	38.	229
230	183300.	33213.	10363.	146.	2670.	5054.	2904.	9420.	829.	1026.	34.	230
265	199200.	35042.	6518.	100.	3760.	5648.	1927.	10045.	848.	755.	37.	265
266	178200.	33975.	9407.	154.	3510.	5871.	2727.	9215.	836.	1037.	42.	266
302	270100.	37313.	9027.	156.	3700.	5599.	2561.	7710.	894.	905.	30.	302
303	261000.	37641.	8999.	153.	3630.	5422.	2577.	7953.	908.	919.	28.	303
338	238200.	35683.	8763.	149.	3350.	5257.	2565.	7560.	852.	992.	29.	338
339	225200.	32827.	7890.	132.	2890.	4943.	2309.	7004.	788.	895.	28.	339
373	79800.	34493.	8592.	149.	3600.	4909.	2523.	3844.	819.	969.	36.	373
374	226200.	35057.	8437.	144.	3370.	5126.	2466.	7360.	825.	898.	36.	374
409	218300.	34328.	8055.	135.	3380.	5259.	2323.	6864.	864.	872.	43.	409
410	207400.	34063.	7870.	131.	2690.	4997.	2276.	6956.	872.	848.	38.	410
445	143000.	36023.	8164.	151.	3200.	5479.	2414.	6822.	922.	992.	60.	445
446	139900.	33097.	7944.	150.	2990.	4860.	2400.	6912.	839.	1009.	60.	446
481	201000.	37699.	10625.	179.	4410.	5745.	3135.	8936.	913.	1159.	47.	481
482	216600.	26591.	12596.	165.	4110.	4276.	4887.	15370.	575.	1115.	45.	482
516	228900.	30644.	8629.	154.	4090.	4584.	2463.	7068.	766.	987.	34.	516
517	243300.	34560.	9836.	218.	3630.	5101.	2552.	7473.	871.	1022.	37.	517
552	205100.	21900.	6355.	142.	2550.	3080.	1560.	4578.	544.	557.	17.	552
553	179600.	35778.	8288.	149.	3810.	5192.	2446.	7221.	880.	946.	39.	553
588	200100.	20360.	6410.	121.	250.	168.	1502.	4027.	868.	508.	2.	588
589	217300.	20400.	6246.	121.	260.	100.	1412.	4036.	878.	509.	1.	589
624	135000.	34408.	8531.	148.	3170.	4927.	2533.	7172.	889.	909.	37.	624
625	196300.	32597.	8202.	137.	2810.	5189.	2374.	7254.	822.	880.	37.	625
663	244700.	34570.	8071.	146.	3180.	4916.	2252.	6780.	840.	861.	30.	663
664	229900.	30468.	8164.	149.	2650.	4382.	2242.	6898.	732.	865.	29.	664
702	148300.	32523.	7055.	119.	2550.	4571.	2121.	6427.	812.	735.	29.	702
703	144300.	29631.	7060.	118.	2320.	4196.	2106.	6167.	746.	727.	26.	703
MEAN	199683.	32695.	8605.	145.	3061.	4678.	2503.	7544.	827.	906.	34.	
COEF VAR	21.06	14.00	17.26	14.07	29.43	28.33	25.04	29.10	10.21	17.56	35.86	

DATA CODE	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
195	0.777	0.422	0.175	0.137	0.158	0.229	0.123	0.212	0.757	0.172	0.253	195
196	0.888	0.431	0.175	0.139	0.177	0.228	0.116	0.212	0.779	0.171	0.228	196
229	0.643	0.414	0.165	0.136	0.170	0.227	0.106	0.204	0.773	0.165	0.235	229
230	0.671	0.397	0.167	0.138	0.145	0.223	0.105	0.202	0.740	0.162	0.210	230
265	0.730	0.419	0.105	0.094	0.204	0.249	0.070	0.216	0.757	0.119	0.228	265
266	0.653	0.406	0.151	0.145	0.191	0.259	0.099	0.198	0.746	0.164	0.259	266
302	0.989	0.446	0.145	0.147	0.201	0.247	0.093	0.165	0.798	0.143	0.165	302
303	0.956	0.450	0.145	0.144	0.197	0.239	0.093	0.171	0.811	0.145	0.173	303
338	0.873	0.427	0.141	0.141	0.182	0.232	0.093	0.162	0.761	0.157	0.179	338
339	0.825	0.393	0.127	0.125	0.157	0.218	0.084	0.150	0.704	0.142	0.173	339
373	0.292	0.413	0.138	0.141	0.196	0.216	0.091	0.082	0.731	0.153	0.222	373
374	0.829	0.419	0.136	0.136	0.183	0.226	0.089	0.156	0.737	0.142	0.222	374
409	0.800	0.411	0.130	0.127	0.184	0.232	0.084	0.147	0.771	0.138	0.265	409
410	0.760	0.407	0.127	0.124	0.146	0.220	0.082	0.149	0.779	0.134	0.235	410
445	0.524	0.431	0.131	0.142	0.174	0.241	0.087	0.146	0.823	0.157	0.370	445
446	0.512	0.396	0.128	0.142	0.162	0.214	0.087	0.148	0.749	0.160	0.370	446
481	0.736	0.451	0.171	0.169	0.240	0.253	0.113	0.192	0.815	0.183	0.290	481
482	0.793	0.318	0.203	0.156	0.223	0.168	0.177	0.330	0.513	0.176	0.278	482
516	0.838	0.367	0.139	0.145	0.222	0.202	0.089	0.152	0.684	0.156	0.210	516
517	0.891	0.413	0.158	0.206	0.197	0.225	0.092	0.160	0.778	0.162	0.228	517
552	0.751	0.262	0.102	0.134	0.139	0.136	0.056	0.098	0.486	0.088	0.105	552
553	0.658	0.428	0.133	0.141	0.207	0.229	0.088	0.155	0.786	0.150	0.241	553
588	0.733	0.244	0.103	0.114	0.014	0.007	0.054	0.086	0.775	0.080	0.012	588
589	0.796	0.244	0.100	0.114	0.014	0.004	0.051	0.087	0.784	0.090	0.006	589
624	0.495	0.412	0.137	0.140	0.172	0.217	0.092	0.154	0.794	0.144	0.226	624
625	0.719	0.390	0.132	0.129	0.153	0.229	0.086	0.156	0.734	0.139	0.228	625
663	0.896	0.414	0.130	0.138	0.173	0.217	0.081	0.145	0.750	0.136	0.222	663
664	0.642	0.364	0.131	0.141	0.144	0.193	0.081	0.148	0.654	0.137	0.179	664
702	0.543	0.389	0.113	0.112	0.139	0.201	0.077	0.138	0.725	0.116	0.179	702
703	0.529	0.354	0.114	0.111	0.126	0.185	0.076	0.132	0.666	0.115	0.180	703
MEAN	0.731	0.391	0.138	0.137	0.166	0.206	0.091	0.162	0.739	0.143	0.213	
COEF VAR	21.06	14.00	17.26	14.07	29.43	28.33	25.04	29.10	10.21	17.56	35.86	

REPLICATES OF STANDARD XZ DUPLICATES
MAJOR ELEMENTS-KK

2-14

REPLICATES OF STANDARD XZ DUPLICATES
MINOR ELEMENTS-PPM

DATA CODE	AS PPM	CR PPM	CU PPM	MG PPM	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
195	1.10	24.0	16.0	10.0	15.0	25.0	3.10	67.0	67.0	195
196	4.10	25.0	14.0	5.0	14.0	24.0	2.10	78.0	70.0	196
229	1.50	20.0	11.0	10.0	12.0	20.0	4.30	41.0	68.0	229
230	1.00	34.0	15.0	10.0	92.0	20.0	2.60	33.0	65.0	230
265	5.00	7.0	8.0	5.0	14.0	27.0	3.30	49.0	78.0	265
266	3.80	14.0	14.0	5.0	13.0	26.0	3.80	28.0	72.0	266
302	1.10	27.0	16.0	10.0	6.0	21.0	3.40	45.0	65.0	302
303	2.40	26.0	16.0	5.0	6.0	22.0	2.90	47.0	77.0	303
338	3.00	7.0	14.0	5.0	1.0	22.0	3.10	36.0	66.0	338
339	2.80	14.0	11.0	5.0	18.0	22.0	4.70	40.0	64.0	339
373	1.80	21.0	17.0	5.0	18.0	18.0	2.30	29.0	76.0	373
374	4.00	22.0	15.0	5.0	18.0	21.0	2.60	39.0	75.0	374
409	0.10	31.0	13.0	5.0	38.0	23.0	4.00	42.0	76.0	409
410	2.20	27.0	13.0	5.0	18.0	21.0	2.40	37.0	71.0	410
445	3.50	48.0	12.0	5.0	90.0	29.0	3.30	30.0	74.0	445
446	1.50	55.0	16.0	5.0	19.0	30.0	3.00	35.0	74.0	446
481	0.10	48.0	23.0	5.0	23.0	26.0	1.70	32.0	76.0	481
482	4.50	55.0	146.0	5.0	37.0	13.0	2.20	26.0	60.0	482
516	4.00	23.0	17.0	5.0	11.0	26.0	0.40	30.0	68.0	516
517	0.80	310.0	16.0	5.0	9.0	29.0	2.50	31.0	69.0	517
552	3.50	317.0	9.0	5.0	13.0	20.0	1.90	18.0	44.0	552
553	3.50	36.0	13.0	10.0	38.0	34.0	2.40	32.0	66.0	553
588	2.20	57.0	21.0	5.0	45.0	25.0	4.30	25.0	66.0	588
589	2.90	47.0	20.0	5.0	36.0	26.0	3.70	23.0	66.0	589
624	1.60	43.0	11.0	5.0	76.0	25.0	4.30	27.0	74.0	624
625	3.50	40.0	15.0	5.0	63.0	23.0	4.20	25.0	70.0	625
663	3.00	118.0	16.0	5.0	102.0	20.0	1.30	33.0	62.0	663
664	2.50	119.0	16.0	5.0	29.0	17.0	2.50	27.0	58.0	664
702	4.00	35.0	17.0	5.0	74.0	23.0	2.70	40.0	65.0	702
703	3.50	31.0	13.0	5.0	144.0	23.0	0.50	32.0	59.0	703
MEAN	2.62	56.0	19.1	5.8	36.4	23.4	2.85	35.9	68.1	
COEF VAR	49.66	130.87	124.24	31.94	94.04	17.73	37.13	34.01	10.30	

DATA CODE	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
195	0.611	0.197	0.235	0.116	0.152	1.923	1.348	0.493	0.882	195
196	2.278	0.205	0.206	0.058	0.141	1.846	0.913	0.574	0.921	196
229	0.833	0.164	0.162	0.116	0.121	1.538	1.870	0.301	0.895	229
230	0.556	0.279	0.221	0.116	0.929	1.538	1.130	0.243	0.855	230
265	2.778	0.057	0.118	0.058	0.141	2.077	1.435	0.360	1.026	265
266	2.111	0.115	0.206	0.058	0.131	2.000	1.652	0.206	0.947	266
302	0.611	0.221	0.235	0.116	0.061	1.615	1.478	0.331	0.855	302
303	1.333	0.213	0.235	0.058	0.061	1.692	1.261	0.346	1.013	303
338	1.667	0.057	0.206	0.058	0.010	1.692	1.348	0.265	0.868	338
339	1.556	0.115	0.162	0.058	0.182	1.692	2.043	0.294	0.842	339
373	1.000	0.172	0.250	0.058	0.162	1.385	1.000	0.213	1.000	373
374	2.222	0.180	0.221	0.058	0.182	1.615	1.130	0.287	0.987	374
409	0.056	0.254	0.191	0.058	0.364	1.769	1.739	0.309	1.000	409
410	1.222	0.221	0.191	0.058	0.182	1.615	1.043	0.272	0.934	410
445	1.944	0.393	0.176	0.058	0.909	2.231	1.435	0.221	0.974	445
446	0.833	0.451	0.235	0.058	0.192	2.308	1.304	0.257	0.974	446
481	0.056	0.393	0.338	0.058	0.232	2.000	0.739	0.235	1.000	481
482	2.500	0.451	2.147	0.058	0.374	1.000	0.957	0.191	0.789	482
516	2.222	0.189	0.250	0.058	0.111	2.000	0.174	0.221	0.895	516
517	0.444	2.541	0.235	0.058	0.091	2.231	1.087	0.228	0.906	517
552	1.944	2.598	0.132	0.058	0.131	1.538	0.826	0.132	0.579	552
553	1.944	0.295	0.191	0.116	0.364	2.615	1.043	0.235	0.695	553
588	1.222	0.467	0.309	0.058	0.455	1.923	1.870	0.184	0.868	588
589	1.611	0.385	0.294	0.058	0.364	2.000	1.609	0.169	0.868	589
624	0.889	0.352	0.162	0.058	0.768	1.923	1.870	0.199	0.974	624
625	1.944	0.328	0.221	0.058	0.636	1.769	1.826	0.184	0.921	625
663	1.667	0.967	0.235	0.058	1.030	1.538	0.565	0.243	0.816	663
664	1.389	0.975	0.235	0.058	0.293	1.308	1.087	0.199	0.763	664
702	2.222	0.287	0.250	0.058	0.747	1.769	1.174	0.294	0.855	702
703	1.944	0.254	0.191	0.058	1.455	1.769	0.217	0.235	0.776	703
MEAN	1.454	0.459	0.281	0.068	0.368	1.797	1.239	0.264	0.896	
COEF VAR	49.66	130.87	124.24	31.94	94.04	17.73	37.13	34.01	10.30	

REPLICATES OF STANDARD XZ DUPLICATES
MINOR ELEMENTS-KK

2-16

REPLICATES OF STANDARD OF TOP LAKES
MAJOR ELEMENTS-PPM

2-17

DATA CODE	SI PPM	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	TI PPM	ZR PPM	DATA CODE
801	*******	27260.	9657.	171.	3340.	4603.	2788.	8186.	625.	1169.	24.	801
807	*******	33216.	9092.	153.	3220.	5356.	2521.	7290.	815.	1022.	30.	807
813	*******	31252.	8904.	149.	3080.	4816.	2437.	7267.	750.	1007.	29.	813
819	*******	32989.	9473.	161.	3250.	5481.	2621.	7655.	782.	1056.	28.	819
825	*******	32716.	9391.	156.	3340.	5242.	2597.	7560.	767.	1183.	29.	825
831	*******	31985.	9018.	150.	3220.	5055.	2475.	7200.	772.	956.	29.	831
837	*******	32967.	9660.	159.	3320.	5405.	2625.	7791.	761.	1004.	24.	837
843	*******	30976.	8589.	142.	3210.	5000.	2400.	6930.	755.	996.	29.	843
849	*******	31909.	8547.	141.	3230.	5263.	2388.	6798.	764.	963.	29.	849
855	*******	31067.	8687.	142.	3150.	5129.	2384.	6924.	751.	932.	30.	855
861	*******	32646.	10286.	170.	3250.	5212.	2723.	8129.	812.	1129.	32.	861
867	*******	31705.	10234.	170.	3210.	5135.	2773.	8052.	801.	1083.	28.	867
873	*******	33287.	9646.	156.	3160.	6217.	2511.	7397.	779.	1063.	35.	873
879	*******	32685.	9835.	162.	3100.	5386.	2580.	7624.	780.	1053.	30.	879
885	*******	32251.	10084.	163.	3120.	5474.	2579.	7496.	800.	1110.	32.	885
891	*******	32358.	9968.	163.	3150.	5339.	2633.	7743.	797.	1107.	34.	891
897	*******	30906.	9365.	151.	3140.	5305.	2414.	7187.	771.	1038.	34.	897
903	*******	32449.	10117.	167.	3070.	5648.	2714.	8230.	799.	1179.	33.	903
909	*******	31991.	9792.	161.	2950.	5354.	3239.	6242.	791.	1166.	35.	909
915	*******	32109.	9955.	161.	2940.	5411.	2638.	6720.	789.	1132.	34.	915
MEAN	*******	31936.	9510.	157.	3173.	5292.	2602.	7621.	774.	1068.	30.	
COEF VAR	******	4.02	5.63	5.78	3.40	5.96	7.34	6.61	5.04	7.12	10.32	

DATA CODE	SI KK	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	TI KK	ZR KK	DATA CODE
801	*****	0.326	0.155	0.161	0.182	0.203	0.101	0.176	0.558	0.185	0.148	801
807	*****	0.397	0.146	0.144	0.175	0.236	0.091	0.156	0.728	0.162	0.185	807
813	*****	0.374	0.143	0.141	0.167	0.212	0.088	0.156	0.670	0.159	0.179	813
819	*****	0.395	0.152	0.152	0.177	0.241	0.095	0.164	0.698	0.167	0.173	819
825	*****	0.391	0.151	0.147	0.182	0.231	0.094	0.162	0.703	0.167	0.179	825
831	*****	0.383	0.145	0.142	0.175	0.223	0.090	0.155	0.689	0.151	0.179	831
837	*****	0.394	0.155	0.150	0.180	0.238	0.095	0.167	0.679	0.159	0.148	837
843	*****	0.371	0.138	0.134	0.174	0.220	0.067	0.149	0.674	0.158	0.179	843
849	*****	0.382	0.137	0.133	0.176	0.232	0.086	0.146	0.682	0.152	0.179	849
855	*****	0.372	0.140	0.134	0.171	0.226	0.086	0.149	0.671	0.147	0.185	855
861	*****	0.391	0.165	0.160	0.177	0.230	0.099	0.174	0.725	0.179	0.198	861
867	*****	0.379	0.165	0.160	0.174	0.226	0.100	0.173	0.715	0.171	0.173	867
873	*****	0.398	0.153	0.147	0.172	0.274	0.091	0.159	0.696	0.168	0.216	873
879	*****	0.391	0.158	0.153	0.168	0.237	0.093	0.164	0.696	0.167	0.165	879
885	*****	0.386	0.162	0.154	0.170	0.241	0.093	0.161	0.714	0.177	0.198	885
891	*****	0.387	0.160	0.154	0.171	0.235	0.095	0.166	0.712	0.175	0.210	891
897	*****	0.370	0.151	0.142	0.171	0.234	0.087	0.154	0.688	0.164	0.210	897
903	*****	0.388	0.163	0.158	0.167	0.249	0.098	0.177	0.713	0.157	0.204	903
909	*****	0.383	0.157	0.152	0.160	0.236	0.117	0.177	0.706	0.184	0.216	909
915	*****	0.384	0.160	0.152	0.160	0.238	0.095	0.187	0.704	0.179	0.210	915
MEAN	*****	0.382	0.153	0.148	0.172	0.233	0.094	0.164	0.691	0.169	0.166	
COEF VAR	******	4.02	5.63	5.78	3.40	5.98	7.34	6.61	5.04	7.12	10.32	

REPLICATES OF STANDARD OF TOP LAKES
MAJOR ELEMENTS-KK

REPLICATES OF STANDARD OF TOP LAKES
MINOR ELEMENTS-PPM

2-19

DATA CODE	AS PPM	CR PPM	CU PPM	HG PPM	NI PPM	PB PPM	U PPM	V PPM	ZN PPM	DATA CODE
801	*****	35.0	33.0	*****	51.0	24.0	*****	44.0	84.0	801
807	*****	26.0	23.0	*****	32.0	18.0	*****	36.0	79.0	807
813	*****	33.0	19.0	*****	29.0	18.0	*****	24.0	65.0	813
819	*****	24.0	22.0	*****	12.0	20.0	*****	36.0	55.0	819
825	*****	26.0	22.0	*****	9.0	19.0	*****	24.0	80.0	825
831	*****	23.0	22.0	*****	20.0	13.0	*****	18.0	75.0	831
837	*****	23.0	21.0	*****	8.0	16.0	*****	7.0	102.0	837
843	*****	23.0	21.0	*****	13.0	13.0	*****	10.0	85.0	843
849	*****	22.0	20.0	*****	16.0	13.0	*****	40.0	83.0	849
855	*****	22.0	17.0	*****	17.0	10.0	*****	42.0	81.0	855
861	*****	27.0	26.0	*****	15.0	24.0	*****	22.0	105.0	861
867	*****	28.0	24.0	*****	18.0	26.0	*****	26.0	101.0	867
873	*****	24.0	22.0	*****	15.0	24.0	*****	22.0	77.0	873
879	*****	24.0	23.0	*****	19.0	26.0	*****	34.0	70.0	879
885	*****	26.0	21.0	*****	22.0	28.0	*****	2.0	82.0	885
891	*****	25.0	23.0	*****	12.0	29.0	*****	52.0	75.0	891
897	*****	25.0	22.0	*****	24.0	27.0	*****	32.0	139.0	897
903	*****	27.0	22.0	*****	15.0	30.0	*****	13.0	98.0	903
909	*****	25.0	20.0	*****	11.0	26.0	*****	5.0	81.0	909
915	*****	26.0	22.0	*****	22.0	30.0	*****	2.0	90.0	915
MEAN	*****	25.7	22.3	*****	19.0	21.7	*****	24.6	85.3	
COEF VAR	******	12.55	13.77	******	50.18	28.49	******	58.81	20.21	

DATA CODE	AS KK	CR KK	CU KK	HG KK	NI KK	PB KK	U KK	V KK	ZN KK	DATA CODE
801	*****	0.287	0.485	*****	0.515	1.846	*****	0.324	1.105	801
807	*****	0.213	0.338	*****	0.323	1.385	*****	0.265	1.039	807
813	*****	0.270	0.279	*****	0.293	1.385	*****	0.176	0.655	813
819	*****	0.197	0.324	*****	0.121	1.538	*****	0.265	0.724	819
825	*****	0.213	0.324	*****	0.091	1.462	*****	0.176	1.053	825
831	*****	0.189	0.324	*****	0.202	1.000	*****	0.132	0.987	831
837	*****	0.189	0.309	*****	0.081	1.231	*****	0.051	1.342	837
843	*****	0.189	0.309	*****	0.131	1.000	*****	0.074	1.118	843
849	*****	0.180	0.294	*****	0.162	1.000	*****	0.294	1.092	849
855	*****	0.180	0.250	*****	0.172	0.769	*****	0.309	1.066	855
861	*****	0.221	0.382	*****	0.152	1.846	*****	0.162	1.382	861
867	*****	0.230	0.353	*****	0.182	2.000	*****	0.206	1.329	867
873	*****	0.197	0.324	*****	0.152	1.846	*****	0.162	1.013	873
879	*****	0.197	0.338	*****	0.192	2.000	*****	0.250	0.921	879
885	*****	0.213	0.309	*****	0.222	2.154	*****	0.015	1.079	885
891	*****	0.205	0.338	*****	0.121	2.231	*****	0.382	0.987	891
897	*****	0.205	0.324	*****	0.242	2.077	*****	0.235	1.829	897
903	*****	0.221	0.324	*****	0.152	2.308	*****	0.096	1.289	903
909	*****	0.205	0.294	*****	0.111	2.000	*****	0.037	1.066	909
915	*****	0.213	0.324	*****	0.222	2.308	*****	0.015	1.184	915
MEAN	*****	0.211	0.327	*****	0.192	1.669	*****	0.181	1.123	
COEF VAR	******	12.55	13.77	******	50.18	28.49	******	58.81	20.21	

2-20

REPLICATES OF STANDARD OF TOP LAKES
MINOR ELEMENTS-KK

MEAN ERROR EVALUATED FOR MESS IN BATCH 2

ELEMENT	TRUE VALUE ppm ppm	BATCH 2	
		MEAN ERROR ppm	% RELATIVE MEAN ERROR
Pb	34	-0.1	0.3
Cu*	25.1	7	27.9
Zn*	191	-26.7	14.0
Ca	4817	-551	11.4
K	17571	-3555	20.2
Co	10.8	-2.4	22.2
Na	18548	-2905	15.7
Al	58375	-4778	8.2
Fe	30494	-5285	17.3
Mg	8685	-1256	14.5
P	637	-161	25.3
Pb*	34	6.6	19.4
V	72.4	-16.4	22.7
Zn	191	-48	25.1
Cu	25.1	-6.2	24.7
Mn	513	-113	22.0
Ni*	29.5	-7.8	26.4
Cr	71	-31.9	44.9
Ni	29.5	-7.8	26.4
Ti	5425	-3949	72.8

* Results from AA analysis. All others from ICP.

TOTAL ERROR EVALUATED FROM 31 BATCH 4 MESS SAMPLES

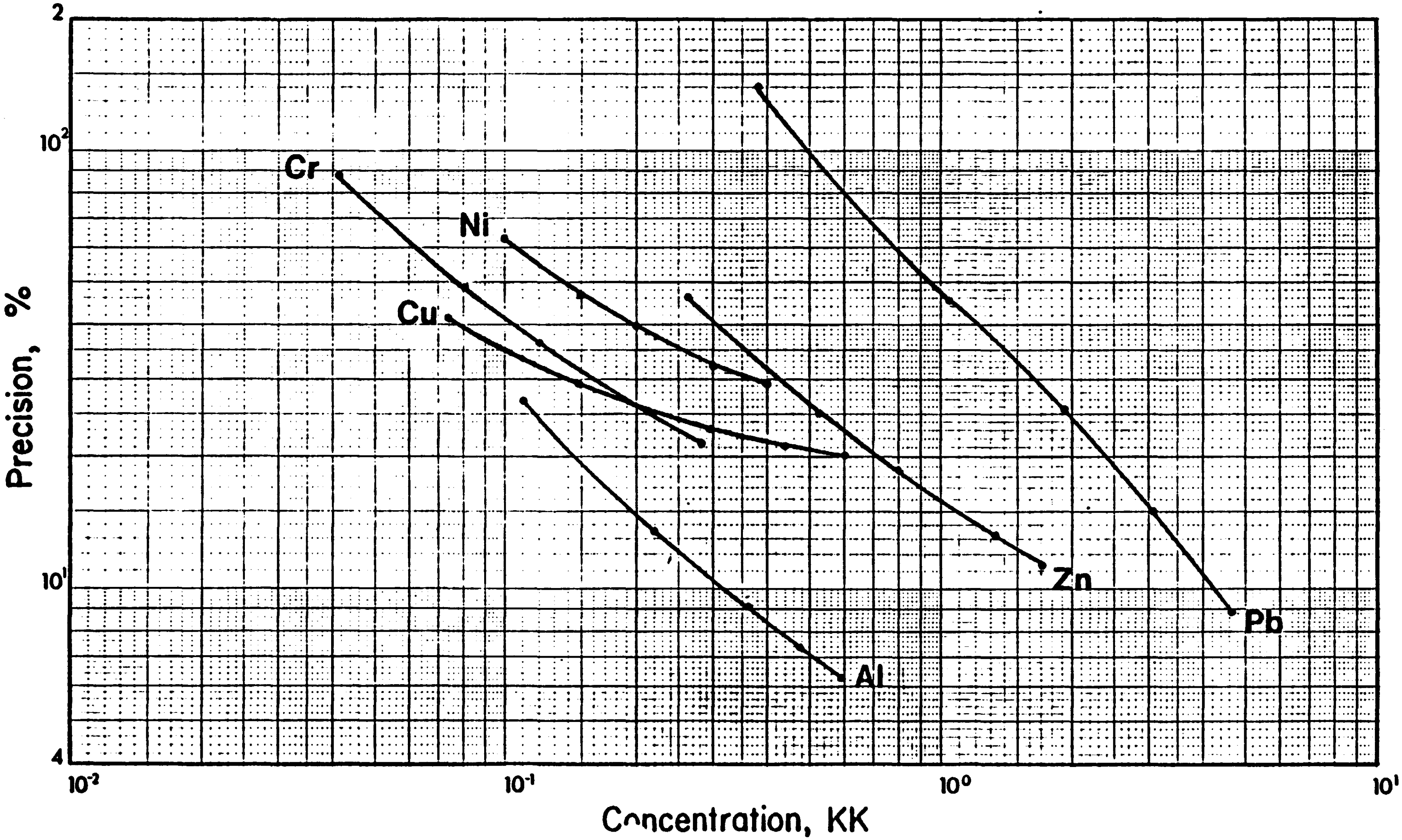
INSTRUMENT	ELEMENT	TRUE VALUE ppm	MEAN ppm	STANDARD DEVIATION	TOTAL ERROR %
ICP	Ca	4817	4260	293	23.7
	K	17571	15505	1149	24.8
	Na	18548	16047	1159	26.0
	Al	58375	50262	3877	27.2
	Mg	8685	7261	506	28.0
	Fe	30494	25554	1880	28.5
	P	637	527	42	30.4
	Co	10.8	9.4	1.1	33.3
	V	72.4	56.5	5.9	38.3
	Zn	191	145	13.8	38.6
	Mn	513	378	33	39.1
	Pb	34	34	7.4	43.5*
	Cu	25.1	19.0	2.6	45.0
	Cr	71	41	3.4	52.5
	Ti	5425	1466	107	76.9
	Ni	29.5	16.5	6.2	86.1
AA	Pb	34	27.7	7.2	60.9
	Cu	25.1	24.1	2.2	21.5
	Zn	191	177.2	9.5	47.5
	Ni	29.5	38.3	6.3	72.5

*

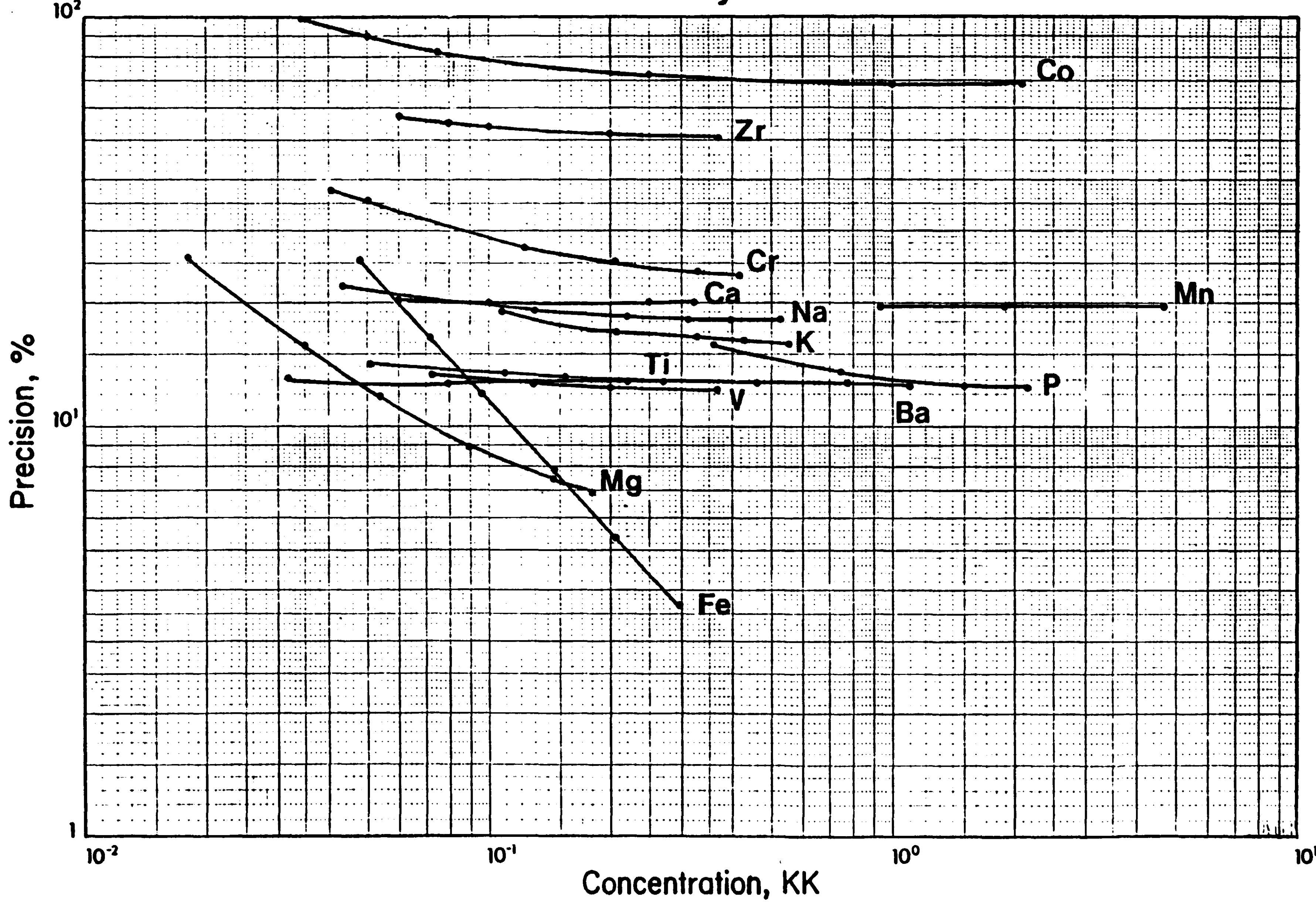
2-22

2-23

Precision of the Analytical Method



Precision of the Analytical Method



2-24

SECTION 3

1982 Descriptive and Geochemical Data

SECTION 3 - CONTENTS

*Lake Code is inserted.

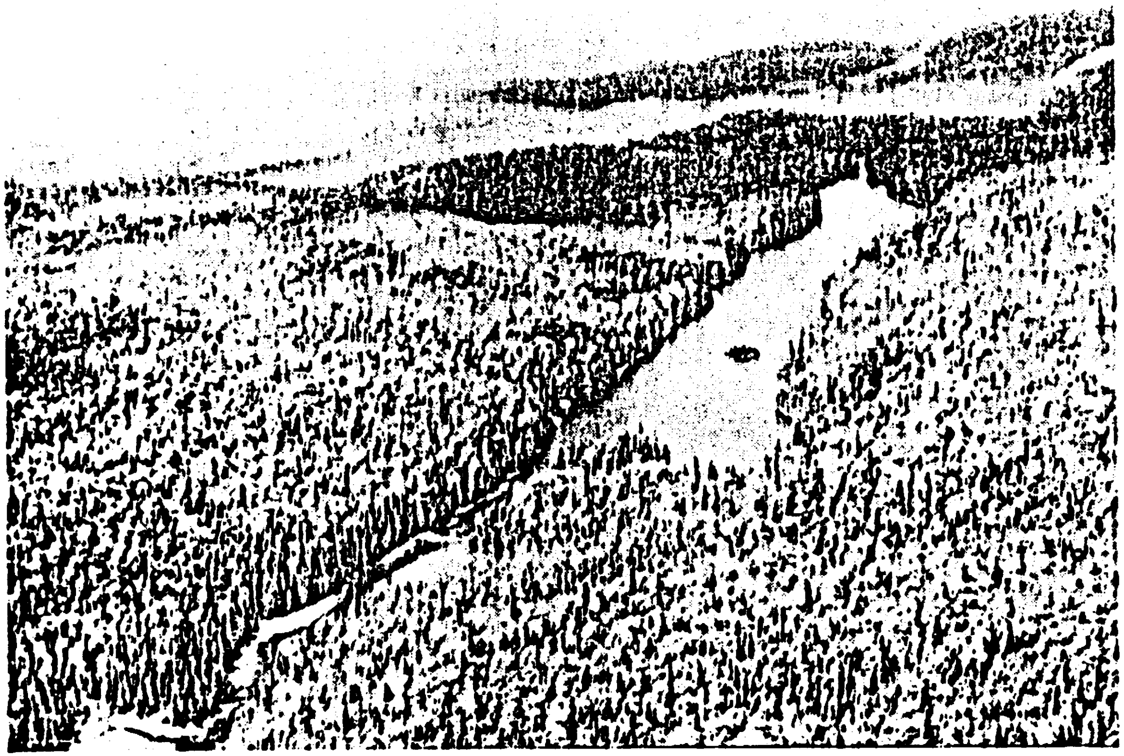
Verification Study
Previously Sampled in 1980

Lake B

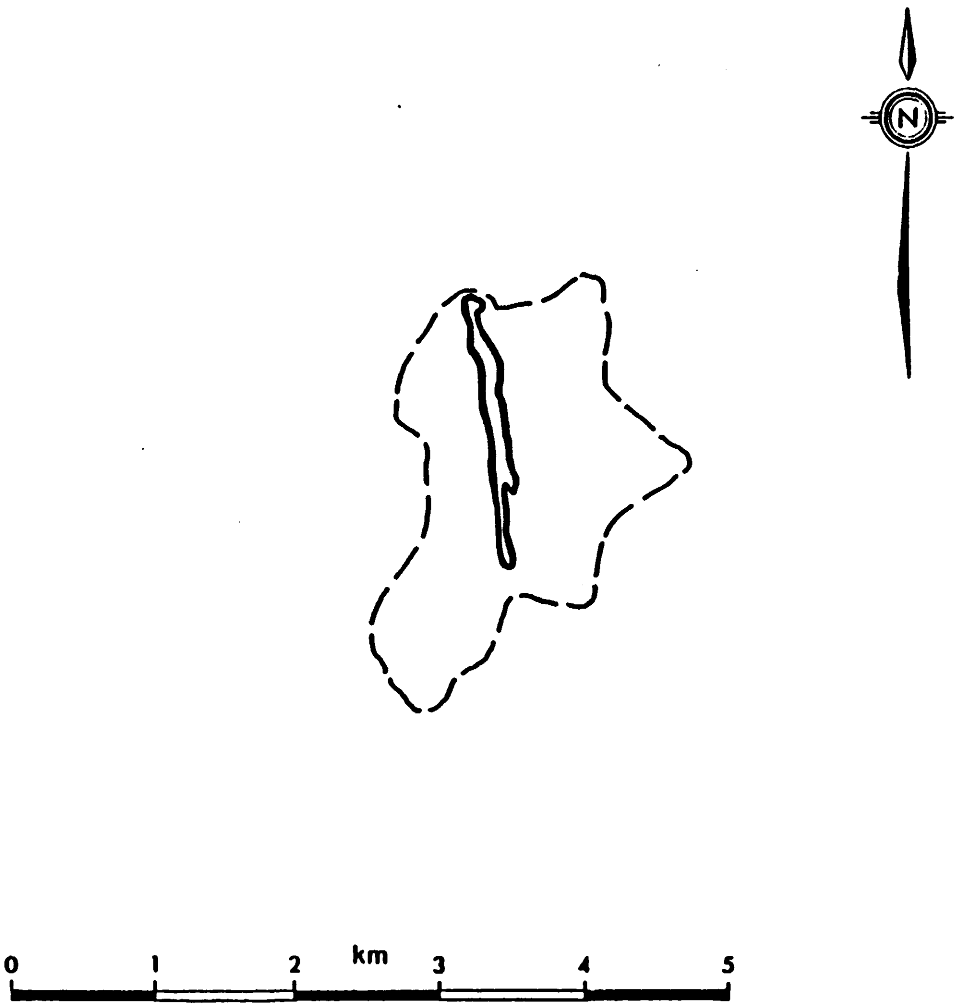
Alkalinity 0.50 Meq/L
pH 5.2

GENERAL SETTING AND DESCRIPTION

B -2



Lake B is a narrow, structural rock basin with steep slopes on both sides. Minor muskeg development has occurred at the south end of the lake owing to damming of inflow by beavers. Surficial deposits are present at both ends of the lake, and they are commonly absent on the rock uplands of the watershed.



GEOLOGICAL/GEOGRAPHICAL INFORMATION

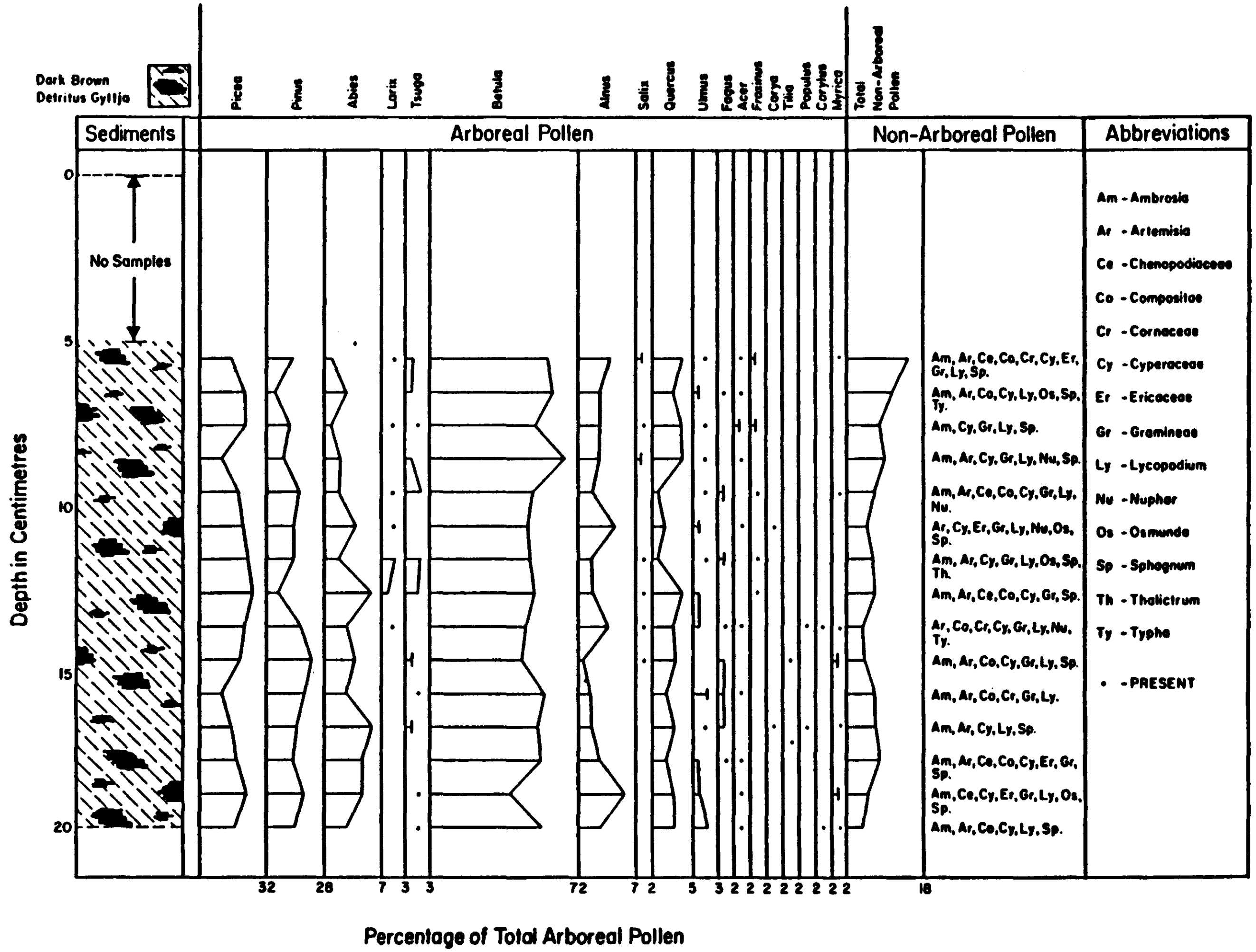
UTM Coordinates of the sample point	16-647889/5325010
Elevation of lake above sea level	406.5 m (1355 ft)
Lake depth at sampling point	3.8 m
Lake area	.25 sq km
Lake catchment area	3 sq km
Bedrock geology under lake basin	granite
Position of lake in staircase	2
Distance from south end of sampling strip	13 km

DETAILS OF LAKE WATER CHEMISTRY

B -4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		18.2	9.5/100	26
1		18.2	8.0/84	26
2		18.2	7.4/78	22
3	3	18.2	6.7/71	29
3.4		18.2	4.6/48	35

* Specific conductivity data are temperature-corrected (25°C).

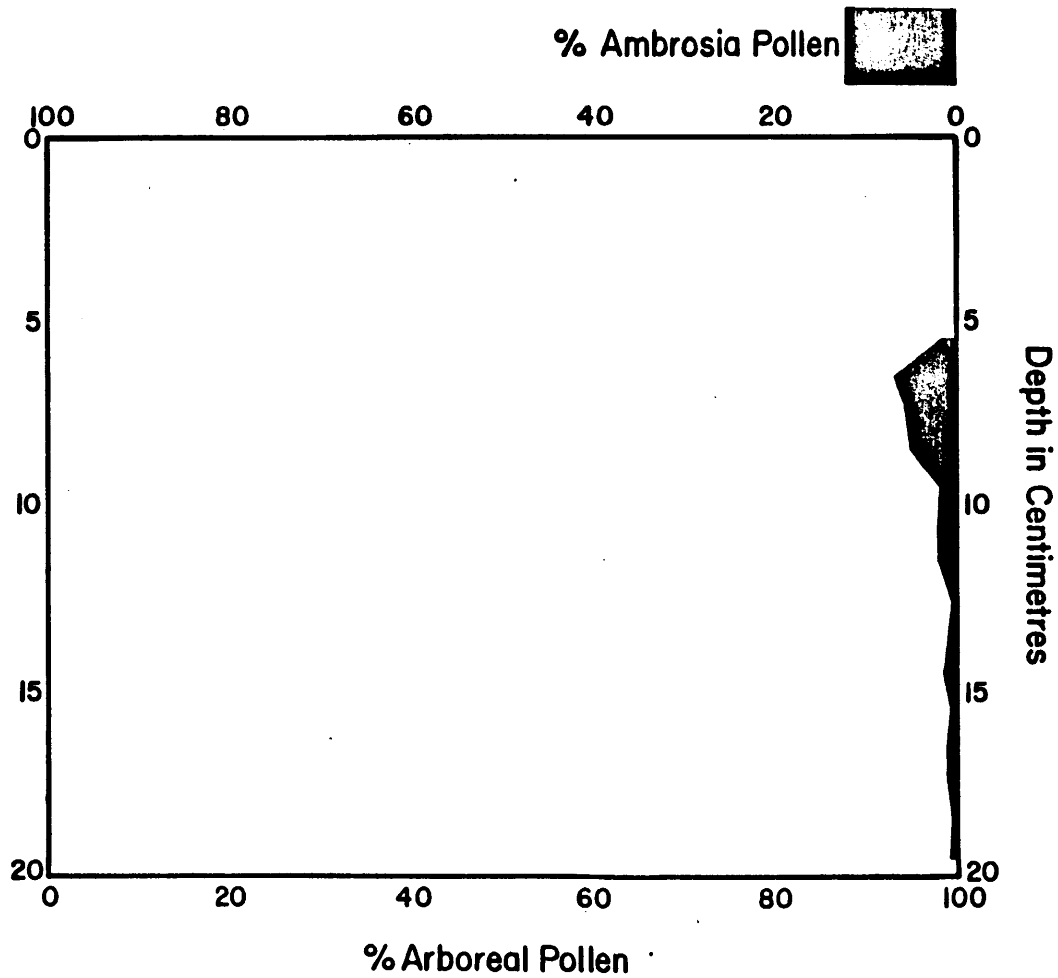


POLLEN DIAGRAM : LAKE SEDIMENT CORE

B -5

AMBROSIA RISE DIAGRAM

B -6



PALYNOLOGY NOTES NOT AVAILABLE

B -7

WEIGHT DATA (0-50 cm)

B -8

LAKE B

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
BA	3.44	.092	97.29	40
BB	2.125	.185	91.29	30
BC	3.42	.289	91.54	40
BD	2.898	.253	91.26	30
BE	3.219	.281	91.24	30
BF	3.811	.422	88.9	30
BG	3.223	.364	88.67	30
BH	3.462	.389	88.76	30
BI	2.697	.339	87.39	20
BJ	2.564	.282	88.96	30
BK	6.859	.756	88.96	36
BL	6.251	.717	88.53	32
BM	6.394	.765	88.02	36
BN	6.353	.799	87.42	36
BO	7.7	1.002	86.98	36
BP	6.357	.855	86.55	32
BQ	6.293	.772	87.71	36
BR	7.146	.989	86.14	36
BS	6.556	.879	86.59	32
BT	6.858	.962	85.95	32
BU	4.973	.71	85.7	32
BV	6.332	.933	85.26	36
BW	7.947	1.103	86.12	32
BX	6.39	.8	87.48	40
BY	6.423	.794	87.63	60
BZA	10.489	1.089	89.6	28
BZB	10.01	.84	91.6	40
BZC	10.809	1.379	87.23	44
BZD	10.46	1.452	86.11	32
BZE	9.75	1.538	84.21	32
BZF	10.789	2.256	79.08	36

B -9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

B -10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	BA	23650.	8375.	86.	3691.	3034.	1879.	3542.	680.	0.5
1.0	BB	27665.	8476.	101.	4329.	3689.	2163.	4891.	770.	1.0
1.5	BC	27218.	8153.	102.	4240.	3760.	2164.	5299.	720.	1.5
2.0	BD	29010.	8295.	109.	4512.	4147.	2373.	5852.	704.	2.0
2.5	BE	32260.	9341.	116.	5125.	4497.	2663.	6300.	772.	2.5
3.0	BF	32852.	10190.	126.	5325.	5639.	3065.	6907.	711.	3.0
3.5	BG	36054.	11706.	156.	6035.	6892.	3606.	8194.	713.	3.5
4.0	BH	33832.	11521.	140.	5485.	6486.	3403.	7481.	719.	4.0
4.5	BI	35908.	12541.	156.	5798.	6718.	3647.	8117.	784.	4.5
5.0	BJ	37705.	12658.	162.	6265.	7875.	3823.	8971.	752.	5.0
6.0	BK	37069.	14377.	163.	6526.	7278.	4183.	9317.	838.	6.0
7.0	BL	37857.	14048.	160.	6580.	7231.	4207.	9301.	864.	7.0
8.0	BM	39069.	15349.	181.	6545.	7851.	4529.	10268.	853.	8.0
9.0	BN	39803.	15750.	186.	6638.	8010.	4732.	10754.	851.	9.0
10.0	BO	40059.	15279.	186.	6682.	8395.	4767.	11055.	809.	10.0
11.0	BP	41170.	15169.	192.	7057.	8824.	4807.	11332.	828.	11.0
12.0	BQ	40994.	14696.	183.	6917.	8496.	4729.	10872.	877.	12.0
13.0	BR	40881.	14499.	182.	7013.	8436.	4698.	10874.	890.	13.0
14.0	BS	41512.	14628.	182.	6942.	8336.	4792.	10736.	901.	14.0
15.0	BT	42296.	14886.	182.	7295.	8668.	4855.	11173.	918.	15.0
16.0	BU	40912.	14058.	172.	6785.	7781.	4582.	10415.	948.	16.0
17.0	BV	39346.	12891.	160.	6296.	7096.	4089.	10187.	936.	17.0
18.0	BW	41630.	14673.	181.	7012.	8520.	4767.	11087.	963.	18.0
19.0	BX	41382.	13911.	185.	6691.	7466.	4417.	11062.	1051.	19.0
20.0	BY	41223.	13279.	169.	6063.	8543.	4358.	9664.	961.	20.0
25.0	BZA	40750.	15134.	191.	5050.	6038.	4503.	7895.	1061.	25.0
30.0	BZB	39289.	12464.	157.	4942.	6902.	3841.	6811.	1074.	30.0
35.0	BZC	30460.	7803.	116.	4764.	7490.	2443.	6753.	793.	35.0
40.0	BZD	39983.	12538.	164.	5455.	8592.	3994.	7085.	1112.	40.0
45.0	BZE	40285.	14049.	182.	5443.	8930.	4310.	7584.	984.	45.0
50.0	BZF	39145.	13647.	176.	5367.	9192.	4034.	7534.	979.	50.0
MEAN		37137.7	12722.1	158.2	5899.0	7123.0	3884.6	8623.0	865.0	
COEF VAR		13.3	19.3	19.0	16.3	23.6	23.3	24.8	13.7	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	BA	0.28289	0.13465	0.08113	0.20060	0.13366	0.06798	0.07601	0.60714	0.5
1.0	BB	0.33092	0.13627	0.09528	0.23527	0.16251	0.07826	0.10496	0.68750	1.0
1.5	BC	0.32557	0.13108	0.09623	0.23043	0.16564	0.07829	0.11371	0.64286	1.5
2.0	BD	0.34701	0.13336	0.10283	0.24522	0.18269	0.08585	0.12558	0.62857	2.0
2.5	BE	0.38589	0.15018	0.10943	0.27853	0.19811	0.09635	0.13519	0.68929	2.5
3.0	BF	0.39297	0.16383	0.11887	0.28940	0.24841	0.11089	0.14822	0.63482	3.0
3.5	BG	0.43127	0.18820	0.14717	0.32799	0.30361	0.13046	0.17584	0.63661	3.5
4.0	BH	0.40469	0.18523	0.13208	0.29810	0.28573	0.12312	0.16054	0.64196	4.0
4.5	BI	0.42952	0.20162	0.14717	0.31511	0.29595	0.13195	0.17418	0.70000	4.5
5.0	BJ	0.45102	0.20350	0.15283	0.34049	0.34692	0.13831	0.19251	0.67143	5.0
6.0	BK	0.44341	0.23114	0.15377	0.35467	0.32062	0.15134	0.19994	0.74821	6.0
7.0	BL	0.45283	0.22585	0.15094	0.35761	0.31855	0.15221	0.19959	0.77143	7.0
8.0	BM	0.46733	0.24677	0.17075	0.35571	0.34586	0.16386	0.22034	0.76161	8.0
9.0	BN	0.47611	0.25322	0.17547	0.36076	0.35286	0.17120	0.23077	0.75982	9.0
10.0	BO	0.47917	0.24564	0.17547	0.36315	0.36982	0.17247	0.23723	0.72232	10.0
11.0	BP	0.49246	0.24387	0.18113	0.38353	0.38872	0.17391	0.24318	0.73929	11.0
12.0	BQ	0.49036	0.23627	0.17264	0.37592	0.37427	0.17109	0.23330	0.78304	12.0
13.0	BR	0.48901	0.23310	0.17170	0.38114	0.37163	0.16997	0.23335	0.79464	13.0
14.0	BS	0.49655	0.23518	0.17170	0.37728	0.36722	0.17337	0.23039	0.80446	14.0
15.0	BT	0.50593	0.23932	0.17170	0.39647	0.38185	0.17565	0.23976	0.81964	15.0
16.0	BU	0.48938	0.22601	0.16226	0.36875	0.34278	0.16577	0.22350	0.84643	16.0
17.0	BV	0.47065	0.20725	0.15094	0.34217	0.31260	0.14794	0.21861	0.83571	17.0
18.0	BW	0.49797	0.23590	0.17075	0.38109	0.37533	0.17247	0.23792	0.85982	18.0
19.0	BX	0.49500	0.22365	0.17453	0.36364	0.32890	0.15980	0.23738	0.93839	19.0
20.0	BY	0.49310	0.21349	0.15943	0.32951	0.37634	0.15767	0.20738	0.85804	20.0
25.0	BZA	0.48744	0.24331	0.18019	0.27446	0.26599	0.16292	0.16942	0.94732	25.0
30.0	BZB	0.46996	0.20039	0.14811	0.26859	0.30405	0.13897	0.14616	0.95893	30.0
35.0	BZC	0.36435	0.12545	0.10943	0.25891	0.32996	0.08839	0.14491	0.70804	35.0
40.0	BZD	0.47827	0.20158	0.15472	0.29647	0.37850	0.14450	0.15204	0.99286	40.0
45.0	BZE	0.48188	0.22587	0.17170	0.29582	0.39339	0.15593	0.16275	0.87857	45.0
50.0	BZF	0.46824	0.21941	0.16604	0.29168	0.40493	0.14595	0.16167	0.87411	50.0
MEAN		0.44423	0.20453	0.14924	0.32060	0.31379	0.14054	0.18504	0.77235	
COEF VAR		13.3	19.3	19.0	16.3	23.6	23.3	24.8	13.7	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

B -11

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

B -12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	BA	765.0	24.0	136.0	25.0	85.0	30.0	39.0	18.0	106.0	0.5
1.0	BB	880.0	23.0	179.0	24.0	23.0	32.0	66.0	21.0	79.0	1.0
1.5	BC	866.0	22.0	189.0	25.0	22.0	31.0	66.0	20.0	233.0	1.5
2.0	BD	969.0	27.0	201.0	25.0	18.0	29.0	40.0	23.0	216.0	2.0
2.5	BE	1052.0	31.0	222.0	31.0	18.0	30.0	48.0	27.0	223.0	2.5
3.0	BF	1165.0	35.0	224.0	29.0	34.0	34.0	24.0	21.0	193.0	3.0
3.5	BG	1361.0	36.0	240.0	33.0	35.0	30.0	15.0	27.0	*****	3.5
4.0	BH	1238.0	32.0	237.0	28.0	19.0	37.0	39.0	25.0	123.0	4.0
4.5	BI	1354.0	38.0	241.0	38.0	15.0	40.0	36.0	25.0	123.0	4.5
5.0	BJ	1443.0	38.0	246.0	35.0	11.0	32.0	34.0	25.0	105.0	5.0
6.0	BK	1305.0	48.0	273.0	31.0	17.0	26.0	32.0	28.0	86.0	6.0
7.0	BL	1265.0	44.0	265.0	31.0	15.0	28.0	32.0	28.0	96.0	7.0
8.0	BM	1331.0	47.0	267.0	32.0	14.0	28.0	28.0	29.0	120.0	8.0
9.0	BN	1410.0	44.0	274.0	28.0	14.0	26.0	30.0	30.0	134.0	9.0
10.0	BO	1383.0	45.0	266.0	31.0	12.0	29.0	25.0	29.0	102.0	10.0
11.0	BP	1451.0	51.0	277.0	34.0	11.0	30.0	21.0	30.0	100.0	11.0
12.0	BQ	1354.0	46.0	265.0	35.0	12.0	28.0	17.0	30.0	105.0	12.0
13.0	BR	1401.0	48.0	265.0	35.0	13.0	30.0	20.0	30.0	117.0	13.0
14.0	BS	1360.0	50.0	260.0	32.0	13.0	30.0	15.0	31.0	114.0	14.0
15.0	BT	1389.0	46.0	271.0	35.0	12.0	29.0	24.0	32.0	108.0	15.0
16.0	BU	1317.0	46.0	255.0	35.0	14.0	28.0	14.0	31.0	123.0	16.0
17.0	BV	1226.0	44.0	242.0	32.0	16.0	28.0	15.0	29.0	88.0	17.0
18.0	BW	1372.0	50.0	259.0	35.0	16.0	35.0	19.0	32.0	95.0	18.0
19.0	BX	1319.0	44.0	247.0	35.0	15.0	29.0	22.0	31.0	113.0	19.0
20.0	BY	1514.0	37.0	230.0	32.0	14.0	18.0	17.0	26.0	118.0	20.0
25.0	BZA	1439.0	38.0	263.0	31.0	*****	15.0	14.0	25.0	110.0	25.0
30.0	BZB	1367.0	39.0	290.0	33.0	*****	14.0	11.0	28.0	*****	30.0
35.0	BZC	985.0	34.0	212.0	30.0	*****	17.0	15.0	28.0	91.0	35.0
40.0	BZD	1519.0	43.0	261.0	35.0	*****	23.0	14.0	30.0	101.0	40.0
45.0	BZE	1514.0	44.0	262.0	34.0	*****	21.0	10.0	30.0	83.0	45.0
50.0	BZF	1394.0	38.0	250.0	35.0	*****	20.0	13.0	28.0	87.0	50.0
MEAN		1280.9	39.7	244.2	31.7	19.5	27.6	26.3	27.3	120.4	
COEF VAR		15.4	20.2	13.3	11.1	75.1	21.6	54.4	13.2	34.0	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	BA	0.1210	0.1481	0.3487	0.2049	1.2500	0.3030	3.0000	0.1324	1.3947	0.5
1.0	BB	0.1392	0.1420	0.4590	0.1967	0.3382	0.3232	5.0769	0.1544	1.0395	1.0
1.5	BC	0.1370	0.1358	0.4846	0.2049	0.3235	0.3131	5.0769	0.1471	3.0658	1.5
2.0	BD	0.1533	0.1667	0.5154	0.2049	0.2647	0.2929	3.0769	0.1691	2.8421	2.0
2.5	BE	0.1665	0.1914	0.5692	0.2541	0.2647	0.3030	3.6923	0.1985	2.9342	2.5
3.0	BF	0.1843	0.2160	0.5744	0.2377	0.5000	0.3434	1.8462	0.1544	2.5395	3.0
3.5	BG	0.2153	0.2222	0.6154	0.2705	0.5147	0.3030	1.1538	0.1985	*****	3.5
4.0	BH	0.1959	0.1975	0.6077	0.2295	0.2794	0.3737	3.0000	0.1838	1.6184	4.0
4.5	BI	0.2142	0.2346	0.6179	0.3115	0.2206	0.4040	2.7692	0.1838	1.6184	4.5
5.0	BJ	0.2283	0.2346	0.6308	0.2869	0.1618	0.3232	2.6154	0.1838	1.3816	5.0
6.0	BK	0.2065	0.2963	0.7000	0.2541	0.2500	0.2626	2.4615	0.2059	1.1316	6.0
7.0	BL	0.2002	0.2716	0.6795	0.2541	0.2206	0.2828	2.4615	0.2059	1.2632	7.0
8.0	BM	0.2106	0.2901	0.6846	0.2623	0.2059	0.2828	2.1538	0.2132	1.5789	8.0
9.0	BN	0.2231	0.2716	0.7026	0.2295	0.2059	0.2626	2.3077	0.2206	1.7632	9.0
10.0	BO	0.2188	0.2778	0.6821	0.2541	0.1765	0.2929	1.9231	0.2132	1.3421	10.0
11.0	BP	0.2296	0.3148	0.7103	0.2787	0.1618	0.3030	1.6154	0.2206	1.3158	11.0
12.0	BQ	0.2142	0.2840	0.6795	0.2869	0.1765	0.2828	1.3077	0.2206	1.3816	12.0
13.0	BR	0.2217	0.2963	0.6795	0.2869	0.1912	0.3030	1.5385	0.2206	1.5395	13.0
14.0	BS	0.2152	0.3086	0.6667	0.2623	0.1912	0.3030	1.1538	0.2279	1.5000	14.0
15.0	BT	0.2198	0.2840	0.6949	0.2869	0.1765	0.2929	1.8462	0.2353	1.4211	15.0
16.0	BU	0.2084	0.2840	0.6538	0.2869	0.2059	0.2828	1.0769	0.2279	1.6184	16.0
17.0	BV	0.1940	0.2716	0.6205	0.2623	0.2353	0.2828	1.1538	0.2132	1.1579	17.0
18.0	BW	0.2171	0.3086	0.6641	0.2869	0.2353	0.3535	1.4615	0.2353	1.2500	18.0
19.0	BX	0.2087	0.2716	0.6333	0.2869	0.2206	0.2929	1.6923	0.2279	1.4868	19.0
20.0	BY	0.2396	0.2284	0.5897	0.2623	0.2059	0.1818	1.3077	0.1912	1.5526	20.0
25.0	BZA	0.2277	0.2346	0.6744	0.2541	*****	0.1515	1.0769	0.1838	1.4474	25.0
30.0	BZB	0.2163	0.2407	0.7436	0.2705	*****	0.1414	0.8462	0.2059	*****	30.0
35.0	BZC	0.1559	0.2099	0.5436	0.2459	*****	0.1717	1.1538	0.2059	1.1974	35.0
40.0	BZD	0.2403	0.2654	0.6692	0.2869	*****	0.2323	1.0769	0.2206	1.3289	40.0
45.0	BZE	0.2396	0.2716	0.6718	0.2787	*****	0.2121	0.7692	0.2206	1.0921	45.0
50.0	BZF	0.2206	0.2346	0.6410	0.2869	*****	0.2020	1.0000	0.2059	1.1447	50.0
MEAN		0.2027	0.2453	0.6261	0.2602	0.2871	0.2792	2.0223	0.2009	1.5844	
COEF VAR		15.4	20.2	13.3	11.1	75.1	21.6	54.4	13.2	34.0	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

B -13

Verification Study Including
Two Adjacent Lakes
(CB_1 Upstream Lake,
CB_2 Downstream Lake)

Lake CB_2

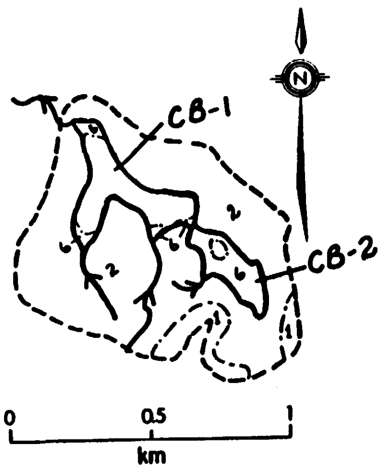
Alkalinity 0.03 Meq/L
pH 5.1

GENERAL SETTING AND DESCRIPTION

CB_2-2

CB-1 &

CB-2: These sister lakes have a relatively small watershed, with a surficial cover consisting of discontinuous till mantle. Virtually bare rock occurs on the highlands at the south end. CB-1 is dominantly organic, the basin almost completely filled in with organics. CB-2 has swampy areas around the margin.



GEOLOGICAL/GEOGRAPHICAL INFORMATION

UTM Coordinates of the sample point	16-710622/5312630
Elevation of lake above sea level	427 m (1400 ft)
Lake depth at sampling point	2.0 m
Lake area	0.05 sq km
Lake catchment area	0.29 sq km
Bedrock geology under lake basin	felsic granitic, dioritic and trondhjemitic gneisses.

DETAILS OF LAKE WATER CHEMISTRY

CB_2-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		17	9.7/100	25
1		17.6	9.4/98	25
	1.6			
2		17.5	9.4/97	28

* Specific conductivity data are temperature-corrected (25°C).

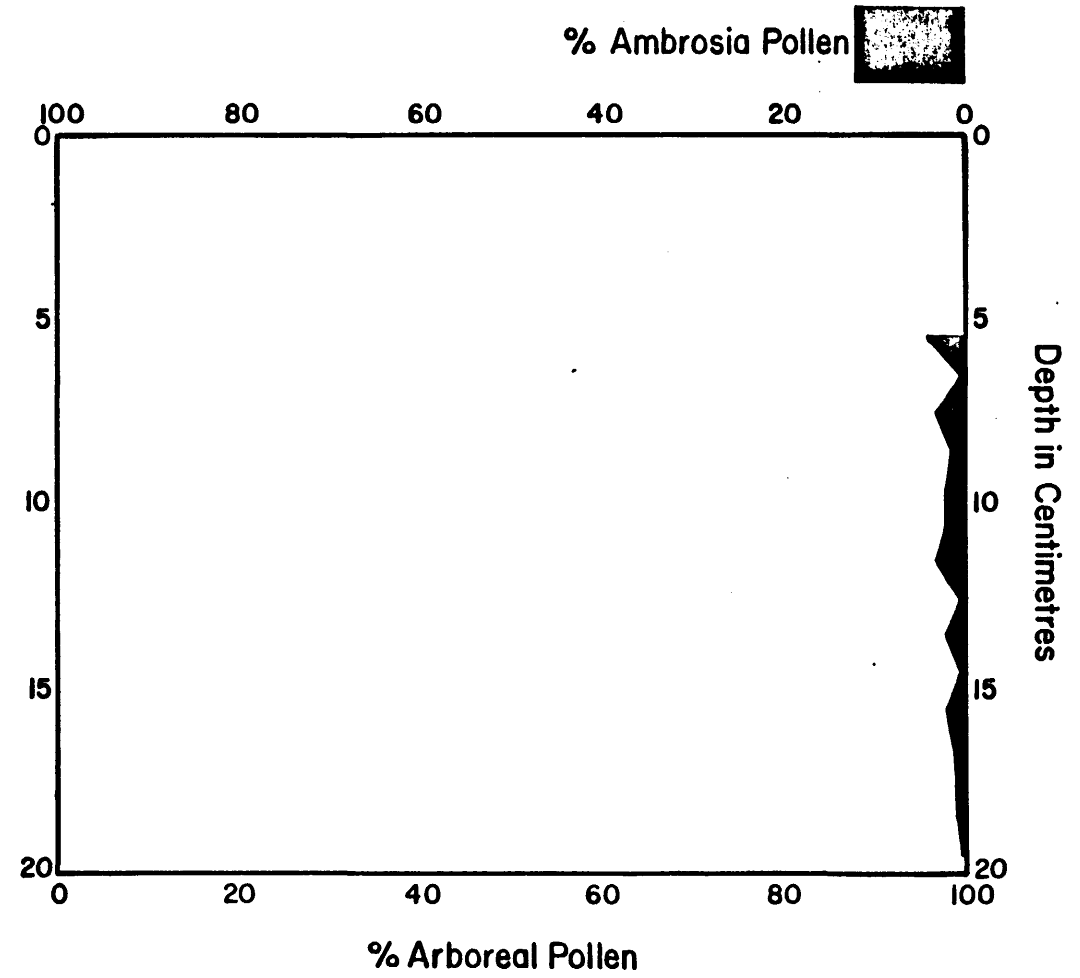
NO POLLEN DIAGRAM AVAILABLE

CB_2-5

CB_2-5

AMBROSIA RISE DIAGRAM

CB_2-6



PALYNOLOGY NOTES NOT AVAILABLE

CB_2-7

WEIGHT DATA (0-50 cm)

CB_2-8

LAKE CB_2

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CB2A	8.267	.164	98	50
CB2B	4.718	.324	93.13	50
CB2C	2.808	.188	93.27	60
CB2D	3.119	.221	92.88	60
CB2E	4.532	.308	93.2	50
CB2F	5.578	.354	93.65	50
CB2G	3.59	.255	92.87	60
CB2H	4.783	.293	93.85	50
CB2I	4.099	.242	94.09	60
CB2J	5.917	.389	93.4	60
CB2K	5.907	.394	93.31	56
CB2L	7.09	.446	93.71	52
CB2M	7.024	.393	94.4	56
CB2N	9.048	.419	95.35	60
CB2O	6.727	.302	95.49	64
CB2P	7.917	.331	95.81	64
CB2Q	7.14	.3	95.78	60
CB2R	6.519	.293	95.5	64
CB2S	6.581	.255	96.12	NO DATA
CB2T	6.866	.287	95.8	64
CB2U	6.314	.28	95.54	60
CB2V	6.807	.318	95.31	60
CB2W	6.272	.296	95.26	60
CB2X	8.867	.445	94.97	60
CB2Y	7.831	.43	94.49	60
CB2ZA	8.189	.54	93.4	52
CB2ZB	10.85	.679	93.73	52
CB2ZC	10.269	.519	94.93	52
CB2ZD	9.99	.89	91.09	36
CB2ZE	9.939	1.105	88.88	36
CB2ZF	9.25	1.189	87.14	36

CB_2-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CB_2-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CB2A	25384.	7015.	82.	5453.	5366.	2385.	5112.	1014.	0.5
1.0	CB2B	22869.	5681.	92.	5064.	4973.	2507.	4922.	892.	1.0
1.5	CB2C	25341.	6023.	83.	5181.	5368.	2307.	5586.	930.	1.5
2.0	CB2D	24342.	5586.	80.	4962.	5408.	2220.	5459.	874.	2.0
2.5	CB2E	25209.	5830.	81.	5048.	5606.	2235.	5573.	834.	2.5
3.0	CB2F	27710.	6051.	88.	5449.	6524.	2380.	6328.	808.	3.0
3.5	CB2G	27489.	5782.	86.	5515.	6564.	2320.	6370.	751.	3.5
4.0	CB2H	25625.	5547.	82.	4992.	5596.	2215.	5961.	744.	4.0
4.5	CB2I	27769.	5913.	89.	5234.	6144.	2499.	6695.	815.	4.5
5.0	CB2J	27731.	5930.	88.	5425.	6179.	2363.	6489.	795.	5.0
6.0	CB2K	27451.	5457.	87.	5888.	7493.	2308.	6289.	723.	6.0
7.0	CB2L	26973.	5186.	87.	5833.	8152.	2254.	6263.	689.	7.0
8.0	CB2M	23708.	4438.	74.	5248.	7076.	1950.	5420.	646.	8.0
9.0	CB2N	22119.	4146.	69.	4787.	6549.	1795.	5400.	668.	9.0
10.0	CB2O	19908.	3765.	64.	4387.	5725.	1640.	5080.	638.	10.0
11.0	CB2P	19337.	3638.	65.	4142.	5603.	1556.	5160.	646.	11.0
12.0	CB2Q	19339.	3742.	64.	4242.	5352.	1605.	5119.	662.	12.0
13.0	CB2R	19543.	3631.	63.	4319.	5570.	1610.	5126.	634.	13.0
14.0	CB2S	*****	*****	*****	*****	*****	*****	*****	*****	14.0
15.0	CB2T	18389.	3369.	61.	3831.	5168.	1468.	5037.	670.	15.0
16.0	CB2U	18840.	3685.	64.	4021.	5419.	1559.	5307.	634.	16.0
17.0	CB2V	20381.	3763.	68.	4306.	5987.	1665.	5617.	642.	17.0
18.0	CB2W	21752.	3954.	71.	4707.	6521.	1747.	5580.	644.	18.0
19.0	CB2X	23400.	4069.	75.	5043.	7245.	1853.	5784.	622.	19.0
20.0	CB2Y	25506.	4363.	78.	5358.	7686.	1951.	6169.	657.	20.0
25.0	CB2ZA	29843.	6105.	107.	6589.	8991.	2676.	5845.	709.	25.0
30.0	CB2ZB	30446.	6137.	107.	7029.	10218.	2703.	6106.	624.	30.0
35.0	CB2ZC	27317.	5721.	98.	6511.	8847.	2438.	5616.	635.	35.0
40.0	CB2ZD	37600.	7183.	129.	8730.	13268.	3196.	7288.	564.	40.0
45.0	CB2ZE	36624.	7981.	144.	9075.	13854.	3376.	7458.	653.	45.0
50.0	CB2ZF	35467.	7957.	142.	9109.	13733.	3337.	7249.	672.	50.0
MEAN		25447.1	5254.9	85.6	5515.9	7206.2	2203.9	5846.9	716.3	
COEF VAR		19.6	24.6	25.0	24.8	34.3	23.1	11.7	14.8	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CB2A	0.30364	0.11278	0.07736	0.29636	0.23639	0.08629	0.10970	0.90536	0.5
1.0	CB2B	0.27355	0.09133	0.08679	0.27522	0.21907	0.09070	0.10562	0.79643	1.0
1.5	CB2C	0.30312	0.09683	0.07830	0.28158	0.23648	0.08347	0.11987	0.83036	1.5
2.0	CB2D	0.29117	0.08981	0.07547	0.26967	0.23824	0.08032	0.11715	0.78036	2.0
2.5	CB2E	0.30154	0.09373	0.07642	0.27435	0.24696	0.08086	0.11959	0.74464	2.5
3.0	CB2F	0.33146	0.09728	0.08302	0.29614	0.28740	0.08611	0.13579	0.72143	3.0
3.5	CB2G	0.32882	0.09296	0.08113	0.29973	0.28916	0.08394	0.13670	0.67054	3.5
4.0	CB2H	0.30652	0.08918	0.07736	0.27130	0.24652	0.08014	0.12792	0.66429	4.0
4.5	CB2I	0.33217	0.09506	0.08396	0.28446	0.27066	0.09041	0.14367	0.72768	4.5
5.0	CB2J	0.33171	0.09534	0.08302	0.29484	0.27220	0.08549	0.13925	0.70982	5.0
6.0	CB2K	0.32836	0.08773	0.08208	0.32000	0.33009	0.08350	0.13496	0.64554	6.0
7.0	CB2L	0.32264	0.08338	0.08208	0.31701	0.35912	0.08155	0.13440	0.61518	7.0
8.0	CB2M	0.28359	0.07135	0.06981	0.28522	0.31172	0.07055	0.11631	0.57679	8.0
9.0	CB2N	0.26458	0.06666	0.06509	0.26016	0.28850	0.06494	0.11588	0.59643	9.0
10.0	CB2O	0.23813	0.06053	0.06038	0.23842	0.25220	0.05933	0.10901	0.56964	10.0
11.0	CB2P	0.23130	0.05849	0.06132	0.22511	0.24683	0.05630	0.11073	0.57679	11.0
12.0	CB2Q	0.23133	0.06016	0.06038	0.23054	0.23577	0.05807	0.10985	0.59107	12.0
13.0	CB2R	0.23377	0.05838	0.05943	0.23473	0.24537	0.05825	0.11000	0.56607	13.0
14.0	CB2S	******	******	******	******	******	******	******	******	14.0
15.0	CB2T	0.21996	0.05416	0.05755	0.20821	0.22767	0.05311	0.10809	0.59821	15.0
16.0	CB2U	0.22536	0.05924	0.06038	0.21853	0.23872	0.05640	0.11388	0.56607	16.0
17.0	CB2V	0.24379	0.06050	0.06415	0.23402	0.26374	0.06024	0.12054	0.57321	17.0
18.0	CB2W	0.26019	0.06357	0.06698	0.25582	0.28727	0.06321	0.11974	0.57500	18.0
19.0	CB2X	0.27990	0.06542	0.07075	0.27408	0.31916	0.06704	0.12412	0.55536	19.0
20.0	CB2Y	0.30510	0.07014	0.07358	0.29120	0.33859	0.07059	0.13238	0.58661	20.0
25.0	CB2ZA	0.35697	0.09815	0.10094	0.35810	0.39608	0.09682	0.12543	0.63304	25.0
30.0	CB2ZB	0.36419	0.09867	0.10094	0.38201	0.45013	0.09779	0.13103	0.55714	30.0
35.0	CB2ZC	0.32676	0.09198	0.09245	0.35386	0.38974	0.08821	0.12051	0.56696	35.0
40.0	CB2ZD	0.44976	0.11548	0.12170	0.47446	0.58449	0.11563	0.15639	0.50357	40.0
45.0	CB2ZE	0.43809	0.12831	0.13585	0.49321	0.61031	0.12214	0.16004	0.58304	45.0
50.0	CB2ZF	0.42425	0.12793	0.13396	0.49505	0.60498	0.12073	0.15556	0.60000	50.0
MEAN		0.30439	0.08448	0.08075	0.29978	0.31745	0.07974	0.12547	0.63955	
COEF VAR		19.6	24.6	25.0	24.8	34.3	23.1	11.7	14.8	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

CB_2-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CB2A	1170.0	31.0	176.0	24.0	19.0	27.0	76.0	25.0	75.0	0.5
1.0	CB2B	1218.0	32.0	161.0	22.0	18.0	28.0	66.0	20.0	63.0	1.0
1.5	CB2C	1185.0	33.0	178.0	24.0	22.0	26.0	74.0	26.0	88.0	1.5
2.0	CB2D	1100.0	28.0	173.0	22.0	19.0	22.0	55.0	24.0	89.0	2.0
2.5	CB2E	1173.0	34.0	176.0	23.0	19.0	22.0	49.0	25.0	96.0	2.5
3.0	CB2F	1180.0	32.0	194.0	25.0	19.0	20.0	49.0	25.0	112.0	3.0
3.5	CB2G	1148.0	32.0	190.0	24.0	17.0	25.0	39.0	25.0	102.0	3.5
4.0	CB2H	1139.0	29.0	174.0	22.0	17.0	23.0	28.0	25.0	98.0	4.0
4.5	CB2I	1242.0	35.0	187.0	25.0	16.0	25.0	38.0	28.0	99.0	4.5
5.0	CB2J	1205.0	32.0	187.0	24.0	19.0	12.0	24.0	29.0	84.0	5.0
6.0	CB2K	966.0	33.0	194.0	24.0	15.0	17.0	48.0	25.0	96.0	6.0
7.0	CB2L	922.0	29.0	199.0	20.0	12.0	14.0	33.0	23.0	93.0	7.0
8.0	CB2M	816.0	27.0	171.0	18.0	20.0	21.0	31.0	22.0	98.0	8.0
9.0	CB2N	760.0	24.0	167.0	20.0	15.0	13.0	27.0	21.0	90.0	9.0
10.0	CB2O	678.0	22.0	151.0	16.0	13.0	11.0	28.0	20.0	85.0	10.0
11.0	CB2P	643.0	19.0	148.0	14.0	22.0	21.0	28.0	18.0	85.0	11.0
12.0	CB2Q	637.0	20.0	149.0	14.0	13.0	9.0	25.0	19.0	92.0	12.0
13.0	CB2R	637.0	22.0	149.0	14.0	16.0	9.0	28.0	19.0	89.0	13.0
14.0	CB2S	*****	*****	*****	*****	*****	*****	*****	*****	*****	14.0
15.0	CB2T	607.0	20.0	145.0	14.0	11.0	11.0	27.0	17.0	96.0	15.0
16.0	CB2U	622.0	20.0	145.0	15.0	15.0	10.0	20.0	19.0	101.0	16.0
17.0	CB2V	669.0	24.0	156.0	15.0	12.0	10.0	17.0	20.0	97.0	17.0
18.0	CB2W	722.0	26.0	164.0	17.0	13.0	12.0	18.0	21.0	98.0	18.0
19.0	CB2X	774.0	25.0	172.0	17.0	12.0	13.0	14.0	22.0	96.0	19.0
20.0	CB2Y	826.0	27.0	191.0	18.0	15.0	12.0	18.0	24.0	90.0	20.0
25.0	CB2ZA	1346.0	39.0	251.0	28.0	14.0	20.0	4.0	30.0	71.0	25.0
30.0	CB2ZB	1207.0	35.0	259.0	25.0	13.0	14.0	8.0	30.0	59.0	30.0
35.0	CB2ZC	1195.0	35.0	243.0	24.0	13.0	16.0	7.0	29.0	55.0	35.0
40.0	CB2ZD	1420.0	49.0	316.0	29.0	17.0	21.0	5.0	30.0	76.0	40.0
45.0	CB2ZE	1685.0	51.0	327.0	33.0	18.0	21.0	5.0	34.0	56.0	45.0
50.0	CB2ZF	1671.0	54.0	325.0	36.0	17.0	19.0	5.0	37.0	56.0	50.0
MEAN		1018.8	30.6	193.9	21.5	16.0	17.5	29.8	24.4	86.2	
COEF VAR		29.8	28.3	26.5	25.8	18.7	33.4	66.1	19.6	17.6	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CB2A	0.1851	0.1914	0.4513	0.1967	0.2794	0.2727	5.8462	0.1838	0.9868	0.5
1.0	CB2B	0.1927	0.1975	0.4128	0.1803	0.2647	0.2828	5.0769	0.1471	0.8289	1.0
1.5	CB2C	0.1875	0.2037	0.4564	0.1967	0.3235	0.2626	5.6923	0.1912	1.1579	1.5
2.0	CB2D	0.1741	0.1728	0.4436	0.1803	0.2794	0.2222	4.2308	0.1765	1.1711	2.0
2.5	CB2E	0.1856	0.2099	0.4513	0.1885	0.2794	0.2222	3.7692	0.1838	1.2632	2.5
3.0	CB2F	0.1867	0.1975	0.4974	0.2049	0.2794	0.2020	3.7692	0.1838	1.4737	3.0
3.5	CB2G	0.1816	0.1975	0.4872	0.1967	0.2500	0.2525	3.0000	0.1838	1.3421	3.5
4.0	CB2H	0.1802	0.1790	0.4462	0.1803	0.2500	0.2323	2.1538	0.1838	1.2895	4.0
4.5	CB2I	0.1965	0.2160	0.4795	0.2049	0.2353	0.2525	2.9231	0.2059	1.3026	4.5
5.0	CB2J	0.1907	0.1975	0.4795	0.1967	0.2794	0.1212	1.8462	0.2132	1.1053	5.0
6.0	CB2K	0.1528	0.2037	0.4974	0.1967	0.2206	0.1717	3.6923	0.1838	1.2632	6.0
7.0	CB2L	0.1459	0.1790	0.5103	0.1639	0.1765	0.1414	2.5385	0.1691	1.2237	7.0
8.0	CB2M	0.1291	0.1667	0.4385	0.1475	0.2941	0.2121	2.3846	0.1618	1.2895	8.0
9.0	CB2N	0.1203	0.1481	0.4282	0.1639	0.2206	0.1313	2.0769	0.1544	1.1842	9.0
10.0	CB2O	0.1073	0.1358	0.3872	0.1311	0.1912	0.1111	2.1538	0.1471	1.1184	10.0
11.0	CB2P	0.1017	0.1173	0.3795	0.1148	0.3235	0.2121	2.1538	0.1324	1.1184	11.0
12.0	CB2Q	0.1008	0.1235	0.3821	0.1148	0.1912	0.0909	1.9231	0.1397	1.2105	12.0
13.0	CB2R	0.1008	0.1358	0.3821	0.1148	0.2353	0.0909	2.1538	0.1397	1.1711	13.0
14.0	CB2S	*****	*****	*****	*****	*****	*****	*****	*****	*****	14.0
15.0	CB2T	0.0960	0.1235	0.3718	0.1148	0.1618	0.1111	2.0769	0.1250	1.2632	15.0
16.0	CB2U	0.0984	0.1235	0.3718	0.1230	0.2206	0.1010	1.5385	0.1397	1.3289	16.0
17.0	CB2V	0.1059	0.1481	0.4000	0.1230	0.1765	0.1010	1.3077	0.1471	1.2763	17.0
18.0	CB2W	0.1142	0.1605	0.4205	0.1393	0.1912	0.1212	1.3846	0.1544	1.2895	18.0
19.0	CB2X	0.1225	0.1543	0.4410	0.1393	0.1765	0.1313	1.0769	0.1618	1.2632	19.0
20.0	CB2Y	0.1307	0.1667	0.4897	0.1475	0.2206	0.1212	1.3846	0.1765	1.1842	20.0
25.0	CB2ZA	0.2130	0.2407	0.6436	0.2295	0.2059	0.2020	0.3077	0.2206	0.9342	25.0
30.0	CB2ZB	0.1910	0.2160	0.6641	0.2049	0.1912	0.1414	0.6154	0.2206	0.7763	30.0
35.0	CB2ZC	0.1891	0.2160	0.6231	0.1967	0.1912	0.1616	0.5385	0.2132	0.7237	35.0
40.0	CB2ZD	0.2247	0.3025	0.8103	0.2377	0.2500	0.2121	0.3846	0.2206	1.0000	40.0
45.0	CB2ZE	0.2666	0.3148	0.8385	0.2705	0.2647	0.2121	0.3846	0.2500	0.7368	45.0
50.0	CB2ZF	0.2644	0.3333	0.8333	0.2951	0.2500	0.1919	0.3846	0.2721	0.7368	50.0
MEAN		0.1612	0.1891	0.4973	0.1765	0.2358	0.1764	2.2923	0.1794	1.1338	
COEF VAR		29.8	28.3	26.5	25.8	18.7	33.4	66.1	19.6	17.6	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

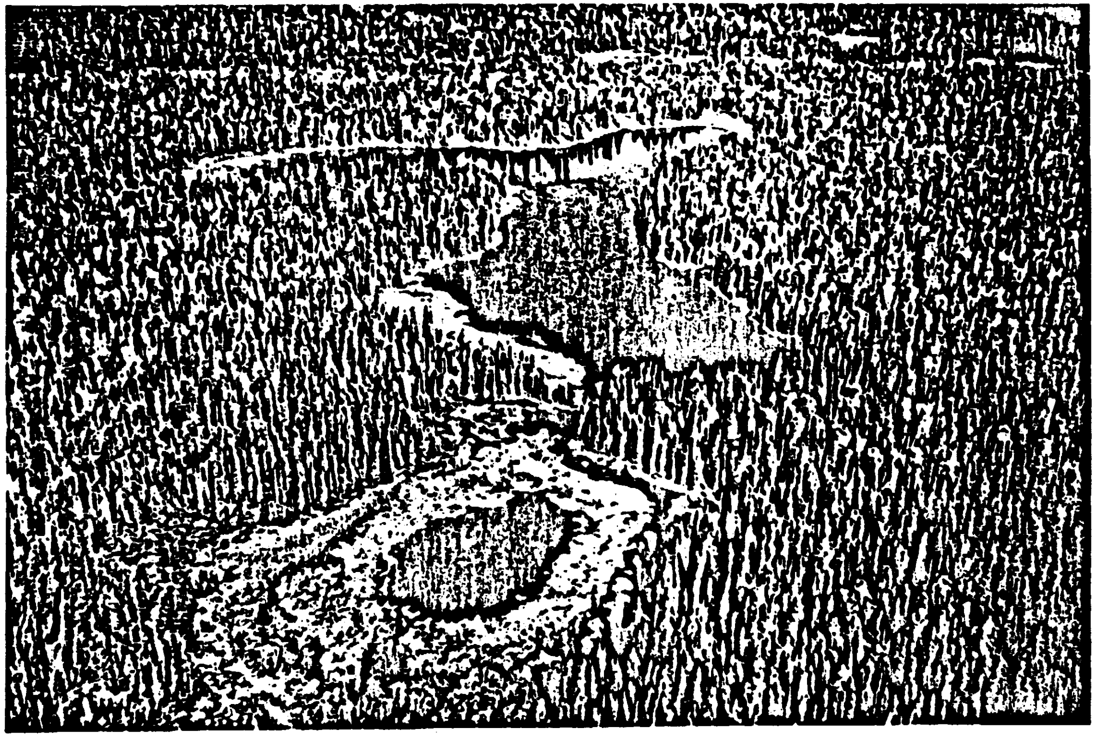
Verification Study Including Two Adjacent Lakes (CB_1 Upstream Lake, CB_2 Downstream Lake)

Lake CB_1

Alkalinity 0.05 Meq/L
pH 4.9

GENERAL SETTING AND DESCRIPTION

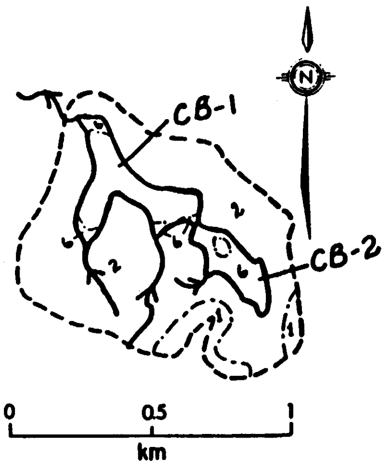
CB_1-2



CB-1 &

CB-2: These sister lakes have a relatively small watershed, with a surficial cover consisting of discontinuous till mantle. Virtually bare rock occurs on the highlands at the south end. CB-1 is dominantly organic, the basin almost completely filled in with organics. CB-2 has swampy areas around the margin.

GEOLOGICAL/GEOGRAPHICAL INFORMATION



UTM Coordinates of the sample point	16-710301/5312751
Elevation of lake above sea level	427 m (1400 ft)
Lake depth at sampling point	1.3 m
Lake area	0.1 sq km
Lake catchment area	0.47 sq km
Bedrock geology under lake basin	felsic granitic, dioritic and trondhjemitic gneisses.

DETAILS OF LAKE WATER CHEMISTRY

CB_1-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		17	9.7/100	20
1		17	7.0/72	21
	1.1			
1.3		17	6.2/64	26

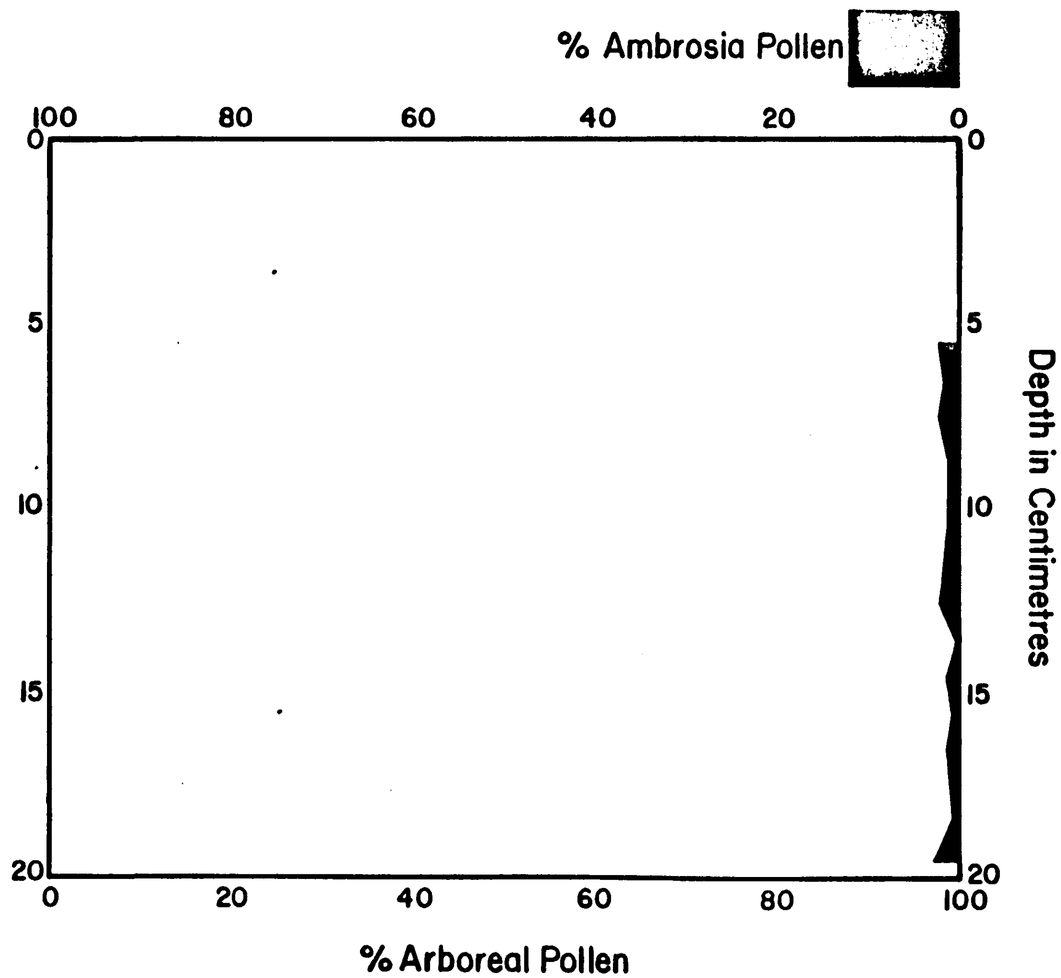
* Specific conductivity data are temperature-corrected (25°C).

NO POLLEN DIAGRAM AVAILABLE

CB_1-5 CB_1-5

AMBROSIA RISE DIAGRAM

CB_1-6



PALYNOLOGY NOTES NOT AVAILABLE

CB_1-7

WEIGHT DATA (0-50 cm)

CB_1-8

LAKE CB_1

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CB1A	9.41	.105	98.87	60
CB1B	4.167	.125	97	60
CB1C	2.203	.085	96.14	70
CB1D	2.702	.108	96	70
CB1E	3.303	.131	96.03	70
CB1F	3.843	.143	96.27	40
CB1G	2.896	.12	95.85	50
CB1H	4.149	.173	95.83	70
CB1I	3.459	.164	95.25	70
CB1J	4.242	.193	95.45	70
CB1K	7.862	.351	95.52	68
CB1L	6.124	.298	95.13	68
CB1M	5.586	.244	95.61	NO DATA
CB1N	6.274	.286	95.44	52
CB1O	7.041	.313	95.55	68
CB1P	7.386	.339	95.39	68
CB1Q	6.926	.316	95.43	72
CB1R	6.77	.304	95.49	68
CB1S	6.516	.307	95.27	68
CB1T	7.623	.339	95.54	72
CB1U	6.524	.333	94.88	68
CB1V	7.163	.345	95.18	68
CB1W	7.691	.387	94.95	64
CB1X	6.416	.326	94.91	68
CB1Y	7.497	.421	94.38	68
CB1ZA	8.469	.433	94.88	60
CB1ZB	10.599	.589	94.43	64
CB1ZC	10.94	.69	93.69	56
CB1ZD	11.579	.768	93.35	56
CB1ZE	10.089	.74	92.66	56
CB1ZF	11.1	.955	91.39	56

CB_1-9 CB_1-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CB_1-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CB1A	11371.	3565.	52.	2838.	2785.	1180.	5304.	638.	0.5
1.0	CB1B	11797.	3629.	51.	2828.	2893.	1131.	5640.	626.	1.0
1.5	CB1C	8172.	2551.	36.	1982.	1911.	793.	4045.	436.	1.5
2.0	CB1D	11617.	3256.	48.	2868.	3035.	1073.	5540.	600.	2.0
2.5	CB1E	11601.	3491.	48.	2803.	2993.	1123.	5505.	627.	2.5
3.0	CB1F	*****	*****	*****	*****	*****	*****	*****	*****	3.0
3.5	CB1F	*****	*****	*****	*****	*****	*****	*****	*****	3.5
4.0	CB1H	11178.	2919.	41.	2494.	2739.	906.	4861.	458.	4.0
4.5	CB1I	12139.	2837.	44.	2722.	2870.	1011.	5008.	427.	4.5
5.0	CB1J	12691.	3103.	49.	2913.	2914.	1095.	5440.	469.	5.0
6.0	CB1K	14278.	2860.	51.	3526.	4316.	1125.	5305.	451.	6.0
7.0	CB1L	12581.	2564.	47.	3112.	3630.	995.	4968.	411.	7.0
8.0	CB1M	*****	*****	*****	*****	*****	*****	*****	*****	8.0
9.0	CB1N	14624.	2671.	51.	3548.	4556.	1073.	5341.	392.	9.0
10.0	CB1O	13616.	2518.	47.	3275.	4564.	1004.	5311.	409.	10.0
11.0	CB1P	12492.	2374.	44.	3161.	9987.	922.	4678.	344.	11.0
12.0	CB1Q	13146.	2612.	47.	3251.	3745.	1027.	5086.	400.	12.0
13.0	CB1R	15005.	2718.	50.	3636.	4923.	1079.	5424.	390.	13.0
14.0	CB1S	14698.	2839.	51.	3528.	4504.	1099.	5598.	407.	14.0
15.0	CB1T	13396.	2458.	43.	2707.	3007.	947.	4924.	374.	15.0
16.0	CB1U	16793.	2996.	53.	3895.	5441.	1196.	5826.	410.	16.0
17.0	CB1V	14043.	2586.	46.	3286.	4496.	1009.	5422.	381.	17.0
18.0	CB1W	15135.	2801.	50.	3666.	4767.	1099.	5646.	398.	18.0
19.0	CB1X	14951.	2623.	47.	3519.	4983.	1061.	5500.	354.	19.0
20.0	CB1Y	15720.	2829.	50.	3681.	5189.	1112.	5928.	567.	20.0
25.0	CB1ZA	14512.	2991.	53.	3651.	4729.	1174.	4721.	362.	25.0
30.0	CB1ZB	16984.	3133.	57.	4153.	5558.	1273.	4977.	385.	30.0
35.0	CB1ZC	20313.	3506.	64.	4981.	6935.	1514.	5468.	356.	35.0
40.0	CB1ZD	19088.	3374.	60.	4590.	6459.	1471.	5350.	367.	40.0
45.0	CB1ZE	19715.	3558.	61.	4777.	6625.	1563.	5219.	387.	45.0
50.0	CB1ZF	20741.	3320.	57.	4527.	6362.	1549.	5133.	331.	50.0
MEAN		14371.3	2952.9	49.9	3425.6	4532.7	1128.7	5256.0	434.2	
COEF VAR		20.4	12.6	12.0	20.4	37.1	16.6	7.3	20.6	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CB1A	0.13602	0.05732	0.04906	0.15424	0.12269	0.04269	0.11382	0.56964	0.5
1.0	CB1B	0.14111	0.05834	0.04811	0.15370	0.12744	0.04092	0.12103	0.55893	1.0
1.5	CB1C	0.09775	0.04101	0.03396	0.10772	0.08419	0.02869	0.08680	0.38929	1.5
2.0	CB1D	0.13896	0.05235	0.04528	0.15587	0.13370	0.03882	0.11888	0.53571	2.0
2.5	CB1E	0.13877	0.05613	0.04528	0.15234	0.13185	0.04063	0.11813	0.55982	2.5
3.0	CB1F	******	******	******	******	******	******	******	******	3.0
3.5	CB1F	******	******	******	******	******	******	******	******	3.5
4.0	CB1H	0.13371	0.04693	0.03868	0.13554	0.12066	0.03278	0.10431	0.40893	4.0
4.5	CB1I	0.14520	0.04561	0.04151	0.14793	0.12643	0.03658	0.10747	0.38125	4.5
5.0	CB1J	0.15181	0.04989	0.04623	0.15832	0.12837	0.03962	0.11674	0.41875	5.0
6.0	CB1K	0.17079	0.04598	0.04811	0.19163	0.19013	0.04070	0.11384	0.40268	6.0
7.0	CB1L	0.15049	0.04122	0.04434	0.16913	0.15991	0.03600	0.10661	0.36696	7.0
8.0	CB1M	******	******	******	******	******	******	******	******	8.0
9.0	CB1N	0.17493	0.04294	0.04811	0.19283	0.20070	0.03882	0.11461	0.35000	9.0
10.0	CB1O	0.16287	0.04048	0.04434	0.17799	0.20106	0.03632	0.11397	0.36518	10.0
11.0	CB1P	0.14943	0.03817	0.04151	0.17179	0.43996	0.03336	0.10039	0.30714	11.0
12.0	CB1Q	0.15725	0.04199	0.04434	0.17668	0.16498	0.03716	0.10914	0.35714	12.0
13.0	CB1R	0.17949	0.04370	0.04717	0.19761	0.21687	0.03904	0.11639	0.34821	13.0
14.0	CB1S	0.17581	0.04564	0.04811	0.19174	0.19841	0.03976	0.12013	0.36339	14.0
15.0	CB1T	0.16024	0.03952	0.04057	0.14712	0.13247	0.03426	0.10567	0.33393	15.0
16.0	CB1U	0.20087	0.04817	0.05000	0.21168	0.23969	0.04327	0.12502	0.36607	16.0
17.0	CB1V	0.16798	0.04158	0.04340	0.17859	0.19806	0.03651	0.11635	0.34018	17.0
18.0	CB1W	0.18104	0.04503	0.04717	0.19924	0.21000	0.03976	0.12116	0.35536	18.0
19.0	CB1X	0.17884	0.04217	0.04434	0.19125	0.21952	0.03839	0.11803	0.31607	19.0
20.0	CB1Y	0.18804	0.04548	0.04717	0.20005	0.22859	0.04023	0.12721	0.50625	20.0
25.0	CB1ZA	0.17359	0.04809	0.05000	0.19842	0.20833	0.04247	0.10131	0.32321	25.0
30.0	CB1ZB	0.20316	0.05037	0.05377	0.22571	0.24485	0.04606	0.10680	0.34375	30.0
35.0	CB1ZC	0.24298	0.05637	0.06038	0.27071	0.30551	0.05478	0.11734	0.31786	35.0
40.0	CB1ZD	0.22833	0.05424	0.05660	0.24946	0.28454	0.05322	0.11481	0.32768	40.0
45.0	CB1ZE	0.23583	0.05720	0.05755	0.25962	0.29185	0.05655	0.11200	0.34554	45.0
50.0	CB1ZF	0.24810	0.05338	0.05377	0.24603	0.28026	0.05604	0.11015	0.29554	50.0
MEAN		0.17191	0.04747	0.04710	0.18618	0.19968	0.04084	0.11279	0.38766	
COEF VAR		20.4	12.6	12.0	20.4	37.1	16.6	7.3	20.6	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

CB_1-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CB1A	533.0	15.0	137.0	13.0	13.0	21.0	41.0	13.0	82.0	0.5
1.0	CB1B	541.0	15.0	142.0	13.0	12.0	23.0	34.0	13.0	50.0	1.0
1.5	CB1C	380.0	12.0	100.0	10.0	10.0	13.0	22.0	10.0	35.0	1.5
2.0	CB1D	505.0	15.0	139.0	12.0	11.0	23.0	32.0	13.0	45.0	2.0
2.5	CB1E	493.0	15.0	141.0	13.0	10.0	20.0	31.0	13.0	41.0	2.5
3.0	CB1F	*****	*****	*****	*****	*****	*****	*****	*****	*****	3.0
3.5	CB1F	*****	*****	*****	*****	*****	*****	*****	*****	*****	3.5
4.0	CB1H	410.0	10.0	125.0	10.0	17.0	14.0	34.0	10.0	49.0	4.0
4.5	CB1I	452.0	11.0	131.0	11.0	11.0	20.0	38.0	12.0	55.0	4.5
5.0	CB1J	527.0	11.0	137.0	11.0	11.0	21.0	33.0	13.0	49.0	5.0
6.0	CB1K	481.0	13.0	158.0	10.0	10.0	14.0	31.0	13.0	57.0	6.0
7.0	CB1L	427.0	15.0	141.0	8.0	10.0	13.0	27.0	13.0	51.0	7.0
8.0	CB1M	*****	*****	*****	*****	*****	*****	*****	*****	*****	8.0
9.0	CB1N	497.0	19.0	153.0	10.0	12.0	16.0	27.0	13.0	40.0	9.0
10.0	CB1O	434.0	16.0	146.0	8.0	11.0	14.0	21.0	13.0	37.0	10.0
11.0	CB1P	407.0	15.0	131.0	8.0	9.0	15.0	21.0	12.0	41.0	11.0
12.0	CB1Q	484.0	11.0	143.0	10.0	10.0	14.0	26.0	14.0	43.0	12.0
13.0	CB1R	502.0	17.0	154.0	10.0	12.0	18.0	21.0	14.0	41.0	13.0
14.0	CB1S	517.0	19.0	155.0	11.0	12.0	15.0	26.0	14.0	43.0	14.0
15.0	CB1T	444.0	9.0	128.0	11.0	10.0	7.0	26.0	12.0	43.0	15.0
16.0	CB1U	556.0	17.0	163.0	14.0	10.0	8.0	22.0	14.0	39.0	16.0
17.0	CB1V	437.0	16.0	175.0	11.0	12.0	7.0	27.0	12.0	41.0	17.0
18.0	CB1W	475.0	17.0	152.0	12.0	13.0	9.0	32.0	13.0	58.0	18.0
19.0	CB1X	479.0	15.0	149.0	12.0	12.0	10.0	19.0	13.0	44.0	19.0
20.0	CB1Y	486.0	15.0	159.0	13.0	11.0	10.0	26.0	14.0	44.0	20.0
25.0	CB1ZA	600.0	19.0	172.0	12.0	30.0	7.0	19.0	15.0	29.0	25.0
30.0	CB1ZB	707.0	23.0	187.0	18.0	23.0	7.0	17.0	16.0	*****	30.0
35.0	CB1ZC	825.0	25.0	208.0	18.0	36.0	15.0	9.0	17.0	20.0	35.0
40.0	CB1ZD	800.0	25.0	199.0	17.0	10.0	13.0	10.0	17.0	19.0	40.0
45.0	CB1ZE	853.0	25.0	197.0	18.0	18.0	16.0	8.0	18.0	23.0	45.0
50.0	CB1ZF	768.0	24.0	192.0	17.0	20.0	*****	10.0	18.0	23.0	50.0
MEAN		536.4	16.4	154.1	12.2	13.8	14.2	24.6	13.6	42.3	
COEF VAR		24.1	27.6	16.1	24.1	45.6	34.6	34.6	14.6	30.5	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CB1A	0.0843	0.0926	0.3513	0.1066	0.1912	0.2121	3.1538	0.0956	1.0789	0.5
1.0	CB1B	0.0856	0.0926	0.3641	0.1066	0.1765	0.2323	2.6154	0.0956	0.6579	1.0
1.5	CB1C	0.0601	0.0741	0.2564	0.0820	0.1471	0.1313	1.6923	0.0735	0.4605	1.5
2.0	CB1D	0.0799	0.0926	0.3564	0.0984	0.1618	0.2323	2.4615	0.0956	0.5921	2.0
2.5	CB1E	0.0780	0.0926	0.3615	0.1066	0.1471	0.2020	2.3846	0.0956	0.5395	2.5
3.0	CB1F	*****	*****	*****	*****	*****	*****	*****	*****	*****	3.0
3.5	CB1F	*****	*****	*****	*****	*****	*****	*****	*****	*****	3.5
4.0	CB1H	0.0649	0.0617	0.3205	0.0820	0.2500	0.1414	2.6154	0.0735	0.6447	4.0
4.5	CB1I	0.0715	0.0679	0.3359	0.0902	0.1618	0.2020	2.9231	0.0882	0.7237	4.5
5.0	CB1J	0.0834	0.0679	0.3513	0.0902	0.1618	0.2121	2.5385	0.0956	0.6447	5.0
6.0	CB1K	0.0761	0.0802	0.4051	0.0820	0.1471	0.1414	2.3846	0.0956	0.7500	6.0
7.0	CB1L	0.0676	0.0926	0.3615	0.0656	0.1471	0.1313	2.0769	0.0956	0.6711	7.0
8.0	CB1M	*****	*****	*****	*****	*****	*****	*****	*****	*****	8.0
9.0	CB1N	0.0786	0.1173	0.3923	0.0820	0.1765	0.1616	2.0769	0.0956	0.5263	9.0
10.0	CB1O	0.0687	0.0988	0.3744	0.0656	0.1618	0.1414	1.6154	0.0956	0.4868	10.0
11.0	CB1P	0.0644	0.0926	0.3359	0.0656	0.1324	0.1515	1.6154	0.0882	0.5395	11.0
12.0	CB1Q	0.0766	0.0679	0.3667	0.0820	0.1471	0.1414	2.0000	0.1029	0.5658	12.0
13.0	CB1R	0.0794	0.1049	0.3949	0.0820	0.1765	0.1818	1.6154	0.1029	0.5395	13.0
14.0	CB1S	0.0818	0.1173	0.3974	0.0902	0.1765	0.1515	2.0000	0.1029	0.5658	14.0
15.0	CB1T	0.0703	0.0556	0.3282	0.0902	0.1471	0.0707	2.0000	0.0882	0.5658	15.0
16.0	CB1U	0.0880	0.1049	0.4179	0.1148	0.1471	0.0808	1.6923	0.1029	0.5132	16.0
17.0	CB1V	0.0691	0.0988	0.4487	0.0902	0.1765	0.0707	2.0769	0.0882	0.5395	17.0
18.0	CB1W	0.0752	0.1049	0.3897	0.0984	0.1912	0.0909	2.4615	0.0956	0.7632	18.0
19.0	CB1X	0.0758	0.0926	0.3821	0.0984	0.1765	0.1010	1.4615	0.0956	0.5789	19.0
20.0	CB1Y	0.0769	0.0926	0.4077	0.1066	0.1618	0.1010	2.0000	0.1029	0.5789	20.0
25.0	CB1ZA	0.0949	0.1173	0.4410	0.0984	0.4412	0.0707	1.4615	0.1103	0.3816	25.0
30.0	CB1ZB	0.1119	0.1420	0.4795	0.1475	0.3382	0.0707	1.3077	0.1176	*****	30.0
35.0	CB1ZC	0.1305	0.1543	0.5333	0.1475	0.5294	0.1515	0.6923	0.1250	0.2632	35.0
40.0	CB1ZD	0.1266	0.1543	0.5103	0.1393	0.1471	0.1313	0.7692	0.1250	0.2500	40.0
45.0	CB1ZE	0.1350	0.1543	0.5051	0.1475	0.2647	0.1616	0.6154	0.1324	0.3026	45.0
50.0	CB1ZF	0.1215	0.1481	0.4923	0.1393	0.2941	*****	0.7692	0.1324	0.3026	50.0
MEAN		0.0849	0.1012	0.3951	0.0998	0.2027	0.1433	1.8956	0.1003	0.5565	
COEF VAR		24.1	27.6	16.1	24.1	45.6	34.6	34.6	14.6	30.5	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

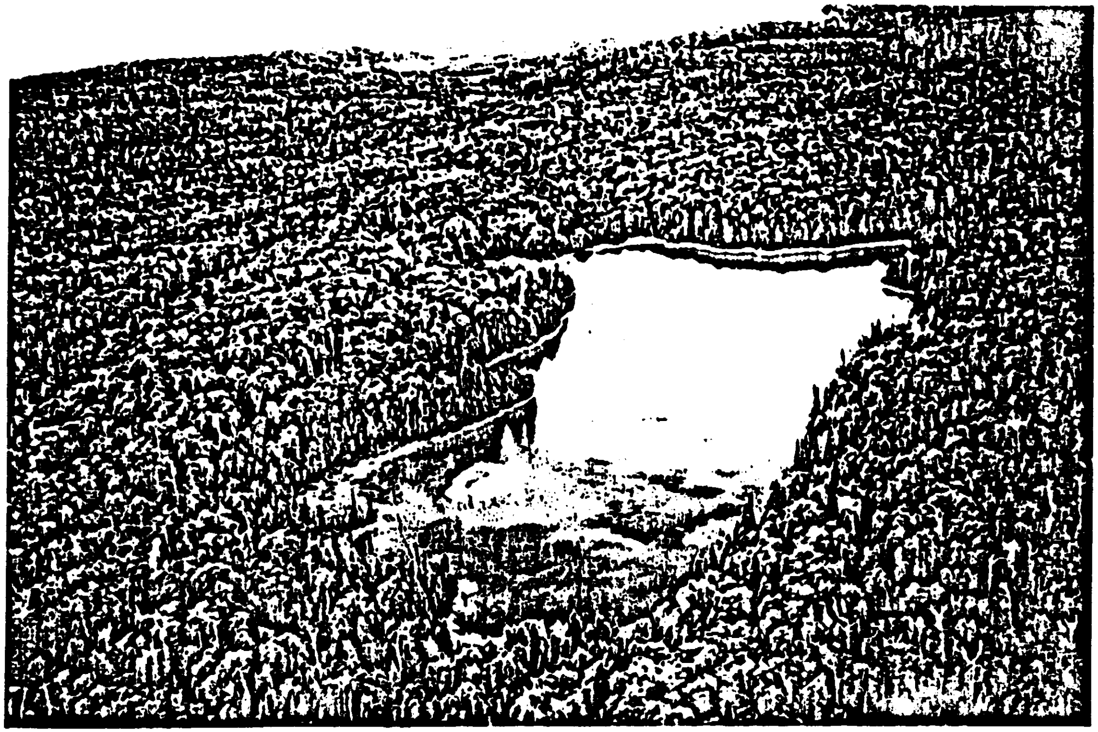
CB1-13

Alkalinity 0.12 Meq/L
pH 6.6

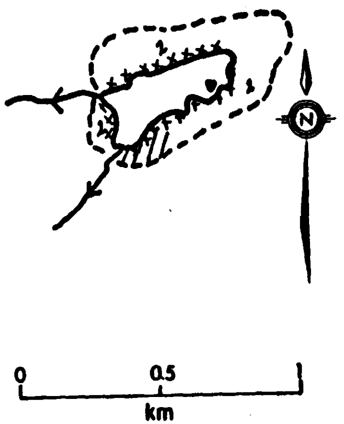
Lake CS

GENERAL SETTING AND DESCRIPTION

CS-2



CS: This lake has a very small watershed, covered by a discontinuous till deposit. Reworking of the glacial sediments provides the source of the sand and gravel deposits found at the mouths of the incoming streams. There is some very recent and localized logging along the southern shore.



GEOLOGICAL/GEOGRAPHICAL INFORMATION

UTM Coordinates of the sample point	16-657631/5327030
Elevation of lake above sea level	427 m (1400 ft)
Lake depth at sampling point	11.0 m
Lake area	0.09 sq km
Lake catchment area	0.30 sq km
Bedrock geology under lake basin	felsic metavolcanics, sericitic quartzo-feldspathic schists and gneisses.

DETAILS OF LAKE WATER CHEMISTRY

CS-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		16	9.9/100	46
1		17	9.9/92	46
2		17	8.5/87	46
3		17	8.4/86	46
4		12.9	8.2/77	46
	4.2			
5		9.2	8.9/76	47
6		7.7	8.7/73	50
7		7.1	8.4/69	50
8		6.0	8.5/68	51
9		5.5	8.2/65	52
10		5.2	8.1/64	52
11		5.0	7.9/62	79

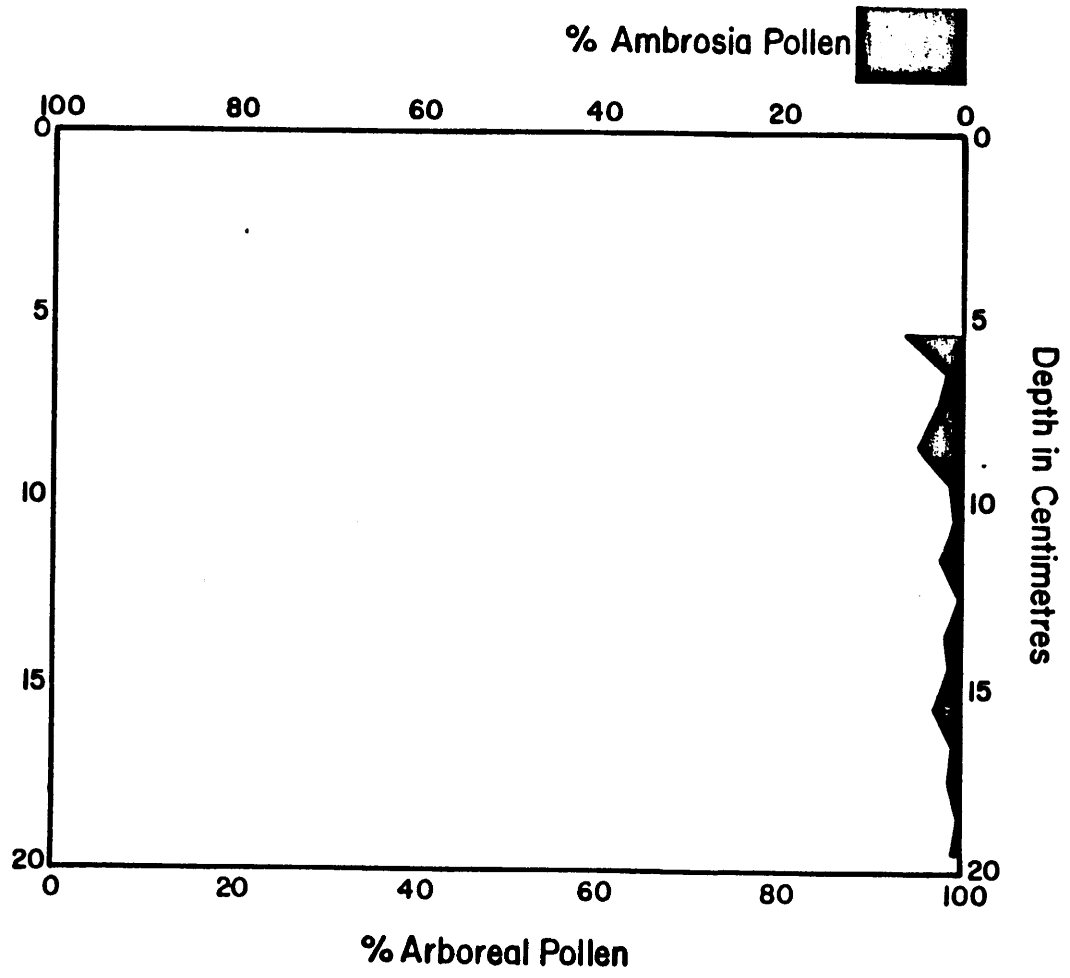
* Specific conductivity data are temperature-corrected (25°C).

NO POLLEN DIAGRAM AVAILABLE

CS-5

AMBROSIA RISE DIAGRAM

CS-6



PALYNOLOGY NOTES NOT AVAILABLE

CS-7

WEIGHT DATA (0-50 cm)

CS-8

LAKE CS

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CSA	1.91	.149	92.14	40
CSB	3.237	.273	91.56	40
CSC	2.785	.209	92.49	40
CSD	2.907	.232	92.02	50
CSE	2.965	.204	93.08	40
CSF	2.379	.164	93.1	NO DATA
CSG	3.15	.217	93.07	40
CSH	2.67	.175	93.44	40
CSI	2.73	.179	93.44	40
CSJ	3.53	.222	93.68	50
CSK	4.367	.266	93.9	48
CSL	5.21	.313	93.97	52
CSM	4.917	.302	93.85	48
CSN	5.6	.362	93.53	48
CSO	6.376	.415	93.47	44
CSP	5.973	.435	92.71	44
CSQ	6.471	.463	92.83	44
CSR	5.93	.411	93.05	48
CSS	7.89	.518	93.43	48
CST	5.822	.421	92.75	48
CSU	4.945	.35	92.9	44
CSV	6.764	.549	91.86	44
CSW	6.211	.486	92.17	44
CSX	6.211	.486	92.17	44
CSY	6.583	.516	92.14	44
CSZA	9.219	.778	91.56	44
CSZB	9.67	.865	91.05	48
CSZC	10.65	1.008	90.52	44
CSZD	9.559	.779	91.84	44
CSZE	10.33	1.14	88.96	48
CSZF	9.979	1.173	88.23	48

CS-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CS-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CSA	28830.	16370.	336.	4027.	2271.	2193.	6688.	1017.	0.5
1.0	CSB	29380.	16926.	304.	4347.	2386.	2201.	6504.	924.	1.0
1.5	CSC	32351.	18748.	336.	4876.	2673.	2404.	6599.	957.	1.5
2.0	CSD	30639.	16428.	300.	4482.	2547.	2234.	6500.	889.	2.0
2.5	CSE	32029.	16262.	305.	4478.	2470.	2247.	6894.	908.	2.5
3.0	CSF	53179.	25077.	508.	7068.	3939.	3491.	11356.	1518.	3.0
3.5	CSG	31034.	14481.	307.	3842.	1958.	1997.	6803.	930.	3.5
4.0	CSH	33872.	14874.	346.	4083.	2033.	2101.	7466.	1012.	4.0
4.5	CSI	32717.	13349.	354.	3556.	1870.	1943.	7805.	1015.	4.5
5.0	CSJ	33931.	13099.	368.	3450.	1839.	1978.	8288.	1072.	5.0
6.0	CSK	33175.	11698.	373.	3221.	1861.	1995.	8322.	995.	6.0
7.0	CSL	34232.	11379.	381.	3431.	2207.	2143.	8376.	979.	7.0
8.0	CSM	34903.	11495.	371.	3717.	2464.	2248.	8361.	970.	8.0
9.0	CSN	34282.	11340.	349.	3831.	2548.	2298.	8221.	954.	9.0
10.0	CSO	33468.	11017.	356.	3896.	2592.	2362.	8017.	907.	10.0
11.0	CSP	35054.	11245.	351.	4335.	3042.	2551.	8149.	917.	11.0
12.0	CSQ	35032.	11358.	338.	4184.	2784.	2470.	8088.	912.	12.0
13.0	CSR	34834.	11210.	331.	4184.	2692.	2483.	8017.	821.	13.0
14.0	CSS	34022.	11124.	324.	3725.	2369.	2271.	8067.	936.	14.0
15.0	CST	34986.	10858.	321.	3774.	2401.	2254.	8132.	948.	15.0
16.0	CSU	36244.	11378.	325.	4040.	2424.	2381.	8379.	955.	16.0
17.0	CSV	35507.	11238.	313.	3982.	2577.	2357.	8416.	951.	17.0
18.0	CSW	35613.	10947.	308.	4041.	2740.	2428.	8579.	951.	18.0
19.0	CSX	35537.	11078.	306.	4114.	2736.	2522.	8508.	943.	19.0
20.0	CSY	35846.	11239.	303.	4214.	2738.	2577.	8703.	988.	20.0
25.0	CSZA	34745.	10930.	340.	4099.	3100.	2447.	7073.	1105.	25.0
30.0	CSZB	34334.	10017.	273.	3640.	2888.	2323.	7237.	1193.	30.0
35.0	CSZC	33837.	9776.	260.	3851.	3022.	2365.	7363.	1168.	35.0
40.0	CSZD	34754.	10651.	247.	4107.	3066.	2472.	7549.	1183.	40.0
45.0	CSZE	33177.	10138.	254.	4080.	3155.	2402.	7344.	1142.	45.0
50.0	CSZF	33027.	9895.	251.	4070.	3151.	2413.	7245.	1165.	50.0
MEAN		34341.0	12762.1	327.1	4088.5	2598.2	2340.4	7840.3	1010.5	
COEF VAR		11.3	25.4	14.9	15.6	17.3	11.5	11.8	13.0	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CSA	0.34486	0.26318	0.31698	0.21886	0.10004	0.07934	0.14352	0.90804	0.5
1.0	CSB	0.35144	0.27212	0.28679	0.23625	0.10511	0.07963	0.13957	0.82500	1.0
1.5	CSC	0.38697	0.30141	0.31698	0.26500	0.11775	0.08698	0.14161	0.85446	1.5
2.0	CSD	0.36650	0.26412	0.28302	0.24359	0.11220	0.0808<	0.13948	0.79375	2.0
2.5	CSE	0.38312	0.26145	0.2874	0.24337	0.10881	0.08130	0.14794	0.81071	2.5
3.0	CSF	0.63611	0.40317	0.47925	0.38413	0.17352	0.12630	0.24369	1.35536	3.0
3.5	CSG	0.37122	0.23281	0.28962	0.20880	0.08626	0.07225	0.14599	0.83036	3.5
4.0	CSH	0.40517	0.23913	0.32642	0.22190	0.08956	0.07601	0.16021	0.90357	4.0
4.5	CSI	0.39135	0.21461	0.33396	0.19326	0.08238	0.07030	0.16749	0.90625	4.5
5.0	CSJ	0.40587	0.21059	0.34717	0.18750	0.08101	0.07156	0.17785	0.95714	5.0
6.0	CSK	0.39683	0.18807	0.35189	0.17505	0.08198	0.07218	0.17858	0.88839	6.0
7.0	CSL	0.40947	0.18294	0.35943	0.18647	0.09722	0.07753	0.17974	0.87411	7.0
8.0	CSM	0.41750	0.18481	0.35000	0.20201	0.10855	0.08133	0.17942	0.86607	8.0
9.0	CSN	0.41007	0.18232	0.32925	0.20821	0.11225	0.08314	0.17642	0.85179	9.0
10.0	CSO	0.40033	0.17712	0.33585	0.21174	0.11418	0.08546	0.17204	0.80982	10.0
11.0	CSP	0.41931	0.18079	0.33113	0.23560	0.13401	0.09229	0.17487	0.81875	11.0
12.0	CSQ	0.41904	0.18260	0.31887	0.22739	0.12264	0.08936	0.17356	0.81429	12.0
13.0	CSR	0.41667	0.18023	0.31226	0.22739	0.11859	0.08983	0.17204	0.73304	13.0
14.0	CSS	0.40696	0.17884	0.30566	0.20245	0.10436	0.08216	0.17311	0.83571	14.0
15.0	CST	0.41849	0.17457	0.30283	0.20511	0.10577	0.08155	0.17451	0.84643	15.0
16.0	CSU	0.43354	0.18293	0.30660	0.21957	0.10678	0.08614	0.17981	0.85268	16.0
17.0	CSV	0.42472	0.18068	0.29528	0.21641	0.11352	0.08527	0.18060	0.84911	17.0
18.0	CSW	0.42599	0.17600	0.29057	0.21962	0.12070	0.08784	0.18410	0.84911	18.0
19.0	CSX	0.42508	0.17810	0.28868	0.22359	0.12053	0.09124	0.18258	0.84196	19.0
20.0	CSY	0.42878	0.18069	0.28585	0.22902	0.12062	0.09323	0.18676	0.88214	20.0
25.0	CSZA	0.41561	0.17572	0.32075	0.22277	0.13656	0.08853	0.15178	0.98661	25.0
30.0	CSZB	0.41069	0.16105	0.25755	0.19783	0.12722	0.08404	0.15530	1.06518	30.0
35.0	CSZC	0.40475	0.15717	0.24528	0.20929	0.13313	0.08556	0.15800	1.04286	35.0
40.0	CSZD	0.41572	0.17124	0.23302	0.22321	0.13507	0.08944	0.16200	1.05625	40.0
45.0	CSZE	0.39685	0.16299	0.23962	0.22174	0.13899	0.08690	0.15760	1.01964	45.0
50.0	CSZF	0.39506	0.15908	0.23679	0.22120	0.13881	0.08730	0.15547	1.04018	50.0
MEAN		0.41078	0.20518	0.30855	0.22220	0.11446	0.08467	0.16825	0.90222	
COEF VAR		11.3	25.4	14.9	15.6	17.3	11.5	11.8	13.0	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

CS-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CSA	696.0	22.0	166.0	25.0	30.0	34.0	267.0	29.0	422.0	0.5
1.0	CSB	735.0	23.0	172.0	25.0	28.0	31.0	267.0	32.0	441.0	1.0
1.5	CSC	746.0	23.0	195.0	26.0	32.0	21.0	216.0	33.0	419.0	1.5
2.0	CSD	742.0	22.0	181.0	24.0	28.0	24.0	182.0	31.0	385.0	2.0
2.5	CSE	749.0	21.0	187.0	25.0	28.0	24.0	178.0	32.0	377.0	2.5
3.0	CSF	1131.0	31.0	297.0	39.0	44.0	33.0	223.0	53.0	502.0	3.0
3.5	CSG	692.0	21.0	169.0	23.0	27.0	23.0	124.0	31.0	290.0	3.5
4.0	CSH	729.0	22.0	184.0	26.0	32.0	22.0	113.0	34.0	307.0	4.0
4.5	CSI	644.0	18.0	163.0	24.0	30.0	22.0	82.0	32.0	222.0	4.5
5.0	CSJ	699.0	20.0	165.0	27.0	29.0	21.0	65.0	34.0	180.0	5.0
6.0	CSK	525.0	16.0	157.0	26.0	27.0	20.0	46.0	32.0	119.0	6.0
7.0	CSL	547.0	18.0	162.0	27.0	25.0	20.0	24.0	32.0	101.0	7.0
8.0	CSM	571.0	18.0	168.0	28.0	25.0	22.0	33.0	33.0	107.0	8.0
9.0	CSN	573.0	18.0	169.0	27.0	22.0	19.0	38.0	33.0	113.0	9.0
10.0	CSO	580.0	19.0	168.0	28.0	24.0	21.0	26.0	33.0	116.0	10.0
11.0	CSP	618.0	21.0	178.0	29.0	25.0	29.0	29.0	33.0	111.0	11.0
12.0	CSQ	617.0	21.0	174.0	28.0	24.0	21.0	31.0	34.0	120.0	12.0
13.0	CSR	605.0	20.0	174.0	28.0	25.0	19.0	29.0	33.0	122.0	13.0
14.0	CSS	561.0	19.0	163.0	27.0	27.0	22.0	30.0	32.0	90.0	14.0
15.0	CST	576.0	19.0	166.0	27.0	25.0	31.0	17.0	33.0	103.0	15.0
16.0	CSU	613.0	21.0	175.0	28.0	27.0	23.0	19.0	34.0	108.0	16.0
17.0	CSV	583.0	20.0	172.0	27.0	25.0	23.0	19.0	32.0	115.0	17.0
18.0	CSW	586.0	19.0	169.0	27.0	26.0	24.0	11.0	32.0	123.0	18.0
19.0	CSX	600.0	21.0	169.0	28.0	26.0	22.0	21.0	33.0	117.0	19.0
20.0	CSY	612.0	22.0	172.0	28.0	24.0	21.0	18.0	34.0	115.0	20.0
25.0	CSZA	820.0	23.0	195.0	30.0	25.0	19.0	10.0	37.0	93.0	25.0
30.0	CSZB	771.0	21.0	184.0	29.0	32.0	20.0	10.0	35.0	92.0	30.0
35.0	CSZC	737.0	22.0	182.0	30.0	31.0	19.0	11.0	35.0	89.0	35.0
40.0	CSZD	779.0	25.0	187.0	32.0	34.0	20.0	11.0	36.0	93.0	40.0
45.0	CSZE	783.0	25.0	182.0	30.0	32.0	12.0	13.0	34.0	95.0	45.0
50.0	CSZF	743.0	23.0	179.0	27.0	31.0	20.0	8.0	34.0	94.0	50.0
MEAN		676.2	21.1	178.2	27.6	28.1	22.6	70.0	33.7	186.5	
COEF VAR		17.3	13.0	13.3	10.3	14.9	20.1	115.5	11.4	69.0	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CSA	0.1101	0.1358	0.4256	0.2049	0.4412	0.3434	*****	0.2132	5.5526	0.5
1.0	CSB	0.1163	0.1420	0.4410	0.2049	0.4118	0.3131	*****	0.2353	5.8026	1.0
1.5	CSC	0.1180	0.1420	0.5000	0.2131	0.4706	0.2121	*****	0.2426	5.5132	1.5
2.0	CSD	0.1174	0.1358	0.4641	0.1967	0.4118	0.2424	*****	0.2279	5.0658	2.0
2.5	CSE	0.1185	0.1296	0.4795	0.2049	0.4118	0.2424	*****	0.2353	4.9605	2.5
3.0	CSF	0.1790	0.1914	0.7615	0.3197	0.6471	0.3333	*****	0.3897	6.6053	3.0
3.5	CSG	0.1095	0.1296	0.4333	0.1885	0.3971	0.2323	9.5385	0.2279	3.8158	3.5
4.0	CSH	0.1153	0.1358	0.4718	0.2131	0.4706	0.2222	8.6923	0.2500	4.0395	4.0
4.5	CSI	0.1019	0.1111	0.4179	0.1967	0.4412	0.2222	6.3077	0.2353	2.9211	4.5
5.0	CSJ	0.1106	0.1235	0.4231	0.2213	0.4265	0.2121	5.0000	0.2500	2.3684	5.0
6.0	CSK	0.0831	0.0988	0.4026	0.2131	0.3971	0.2020	3.5385	0.2353	1.5658	6.0
7.0	CSL	0.0866	0.1111	0.4154	0.2213	0.3676	0.2020	1.8462	0.2353	1.3289	7.0
8.0	CSM	0.0903	0.1111	0.4308	0.2295	0.3676	0.2222	2.5385	0.2426	1.4079	8.0
9.0	CSN	0.0907	0.1111	0.4333	0.2213	0.3235	0.1919	2.9231	0.2426	1.4868	9.0
10.0	CSO	0.0918	0.1173	0.4308	0.2295	0.3529	0.2121	2.0000	0.2426	1.5263	10.0
11.0	CSP	0.0978	0.1296	0.4564	0.2377	0.3676	0.2929	2.2308	0.2426	1.4605	11.0
12.0	CSQ	0.0976	0.1296	0.4462	0.2295	0.3529	0.2121	2.3846	0.2500	1.5789	12.0
13.0	CSR	0.0957	0.1235	0.4462	0.2295	0.3676	0.1919	2.2308	0.2426	1.6053	13.0
14.0	CSS	0.0888	0.1173	0.4179	0.2213	0.3971	0.2222	2.3077	0.2353	1.1842	14.0
15.0	CST	0.0911	0.1173	0.4256	0.2213	0.3676	0.3131	1.3077	0.2426	1.3553	15.0
16.0	CSU	0.0970	0.1296	0.4487	0.2295	0.3971	0.2323	1.4615	0.2500	1.4211	16.0
17.0	CSV	0.0922	0.1235	0.4410	0.2213	0.3676	0.2323	1.4615	0.2353	1.5132	17.0
18.0	CSW	0.0927	0.1173	0.4333	0.2213	0.3824	0.2424	0.8462	0.2353	1.6184	18.0
19.0	CSX	0.0949	0.1296	0.4333	0.2295	0.3824	0.2222	1.6154	0.2426	1.5395	19.0
20.0	CSY	0.0968	0.1358	0.4410	0.2295	0.3529	0.2121	1.3846	0.2500	1.5132	20.0
25.0	CSZA	0.1297	0.1420	0.5000	0.2459	0.3676	0.1919	0.7692	0.2721	1.2237	25.0
30.0	CSZB	0.1220	0.1296	0.4718	0.2377	0.4706	0.2020	0.7692	0.2574	1.2105	30.0
35.0	CSZC	0.1166	0.1358	0.4667	0.2459	0.4559	0.1919	0.8462	0.2574	1.1711	35.0
40.0	CSZD	0.1233	0.1543	0.4795	0.2623	0.5000	0.2020	0.8462	0.2647	1.2237	40.0
45.0	CSZE	0.1239	0.1543	0.4667	0.2459	0.4706	0.1212	1.0000	0.2500	1.2500	45.0
50.0	CSZF	0.1176	0.1420	0.4590	0.2213	0.4559	0.2020	0.6154	0.2500	1.2368	50.0
MEAN		0.1070	0.1302	0.4569	0.2261	0.4127	0.2287	5.3871	0.2479	2.4537	
COEF VAR		17.3	13.0	13.3	10.3	14.9	20.1	115.5	11.4	69.0	

 LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

GENERAL SETTING AND DESCRIPTION

CB_3-2

Duplicate core from Lake CB_1

Refer to page CB_1-2 of this Section

GEOLOGICAL/GEOGRAPHICAL INFORMATION

Refer to page CB_1-3 of this Section

DETAILS OF LAKE WATER CHEMISTRY

Refer to page CB_1-4 of this Section

NO POLLEN DIAGRAM AVAILABLE

CB3-5

CB3-5

AMBROSIA RISE DIAGRAM

Refer to page CB_1-6 of this Section

PALYNOLOGY NOTES NOT AVAILABLE

CB3-7

WEIGHT DATA (0–50 cm)

CB_3-8

LAKE CB_3

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CB3A	4.44	.212	95.22	50
CB3B	5.697	.419	92.64	50
CB3C	3.473	.376	89.14	40
CB3D	6.702	.591	91.18	50
CB3E	5.359	.418	92.2	50
CB3F	6.246	.465	92.54	50
CB3G	6.105	.466	92.35	50
CB3H	6.993	.506	92.76	50
CB3I	6.512	.464	92.87	60
CB3J	5.917	.438	92.59	50
CB3K	10.888	.625	94.26	52
CB3L	10.468	.468	95.52	64
CB3M	9.062	.346	96.18	64
CB3N	9.935	.427	95.69	64
CB3O	10.289	.37	96.4	68
CB3P	6.87	.264	96.15	68
CB3Q	NO DATA	-	-	-
CB3R	8.863	.401	95.46	64
CB3S	6.815	.339	95.01	64
CB3T	8.26	.026	99.67	60
CB3U	9.064	.418	95.37	60
CB3V	8.55	.427	94.99	48
CB3W	11.137	.516	95.36	52
CB3X	10.359	.559	94.6	52
CB3Y	12.474	.658	94.71	52
CB3ZA	9.87	.64	93.51	52
CB3ZB	9.199	.629	93.15	52
CB3ZC	11.24	.62	94.48	64
CB3ZD	10.429	.55	94.72	64
CB3ZE	9.599	.709	92.6	48
CB3ZF	8.89	1.079	87.85	36

CB3-9 CB3-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CB_3-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CB3A	26241.	6185.	77.	5568.	5935.	2204.	5250.	899.	0.5
1.0	CB3B	26292.	5857.	76.	5377.	6381.	2170.	5380.	869.	1.0
1.5	CB3C	30447.	6021.	85.	6314.	7876.	2407.	6557.	856.	1.5
2.0	CB3D	28913.	5639.	83.	5804.	7213.	2326.	6250.	800.	2.0
2.5	CB3E	27524.	5458.	79.	5607.	6803.	2208.	5920.	721.	2.5
3.0	CB3F	27919.	5452.	79.	5538.	6800.	2236.	6102.	722.	3.0
3.5	CB3G	28734.	5663.	84.	5764.	6729.	2349.	6275.	762.	3.5
4.0	CB3H	30197.	5781.	88.	6165.	7259.	2411.	6697.	759.	4.0
4.5	CB3I	28077.	5516.	84.	5765.	6649.	2291.	6310.	758.	4.5
5.0	CB3J	27475.	5387.	83.	5436.	6445.	2258.	6339.	742.	5.0
6.0	CB3K	25672.	4997.	81.	5284.	6404.	2158.	6258.	623.	6.0
7.0	CB3L	16830.	3810.	64.	3798.	4347.	1623.	5216.	617.	7.0
8.0	CB3M	17562.	3576.	61.	3472.	4032.	1552.	5207.	632.	8.0
9.0	CB3N	16614.	3352.	59.	3354.	3892.	1474.	5194.	627.	9.0
10.0	CB3O	15951.	3124.	56.	3284.	3878.	1384.	5214.	621.	10.0
11.0	CB3P	15787.	3147.	56.	3294.	3880.	1350.	5296.	606.	11.0
12.0	CB3Q	16734.	3268.	60.	3415.	4083.	1418.	5495.	596.	12.0
13.0	CB3R	18679.	3627.	67.	3866.	4763.	1600.	5801.	576.	13.0
14.0	CB3S	19360.	3700.	69.	4007.	4910.	1646.	5847.	560.	14.0
15.0	CB3T	20028.	3778.	68.	4133.	5085.	1705.	5945.	572.	15.0
16.0	CB3U	20858.	4031.	72.	4434.	5479.	1841.	6065.	577.	16.0
17.0	CB3V	22861.	4536.	80.	4886.	6366.	2029.	6335.	595.	17.0
18.0	CB3W	22556.	4334.	76.	4726.	6010.	1960.	6150.	621.	18.0
19.0	CB3X	23529.	4456.	79.	4862.	6297.	2022.	6289.	578.	19.0
20.0	CB3Y	25490.	4726.	84.	5199.	6691.	2183.	6602.	588.	20.0
25.0	CB3ZA	31881.	6045.	110.	6873.	9438.	2767.	6017.	703.	25.0
30.0	CB3ZB	32466.	6152.	112.	6186.	9442.	2799.	6132.	722.	30.0
35.0	CB3ZC	24335.	4777.	86.	5077.	6179.	2163.	6176.	709.	35.0
40.0	CB3ZD	22377.	4410.	61.	4806.	5953.	1986.	4905.	649.	40.0
45.0	CB3ZE	35166.	6827.	129.	7820.	10839.	3176.	6675.	658.	45.0
50.0	CB3ZF	38110.	7530.	131.	9096.	11608.	3227.	9096.	789.	50.0
MEAN		24666.6	4876.2	80.0	5135.8	6376.3	2094.3	6032.1	680.9	
COEF VAR		23.7	23.5	23.2	25.6	29.8	22.6	12.4	13.9	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CB3A	0.31389	0.09944	0.07264	0.30261	0.26145	0.07974	0.11266	0.80268	0.5
1.0	CB3B	0.31450	0.09416	0.07170	0.29223	0.28110	0.07851	0.11545	0.77589	1.0
1.5	CB3C	0.36420	0.09680	0.08019	0.34315	0.34696	0.08708	0.14071	0.76429	1.5
2.0	CB3D	0.34585	0.09066	0.07830	0.31543	0.31775	0.08415	0.13412	0.71429	2.0
2.5	CB3E	0.32923	0.08775	0.07453	0.30473	0.29969	0.07988	0.12704	0.64375	2.5
3.0	CB3F	0.33396	0.08765	0.07453	0.30098	0.29956	0.08090	0.13094	0.64464	3.0
3.5	CB3G	0.34371	0.09104	0.07925	0.31326	0.29643	0.08499	0.13466	0.68036	3.5
4.0	CB3H	0.36121	0.09294	0.08302	0.33505	0.31978	0.08723	0.14371	0.67768	4.0
4.5	CB3I	0.33585	0.08868	0.07925	0.31332	0.29291	0.08289	0.13541	0.67679	4.5
5.0	CB3J	0.32865	0.08661	0.07830	0.29543	0.28392	0.08169	0.13603	0.66250	5.0
6.0	CB3K	0.30708	0.08034	0.07642	0.28717	0.28211	0.07808	0.13429	0.55625	6.0
7.0	CB3L	0.20132	0.06125	0.06038	0.20641	0.19150	0.05872	0.11193	0.55089	7.0
8.0	CB3M	0.21007	0.05749	0.05755	0.18870	0.17762	0.05615	0.11174	0.56429	8.0
9.0	CB3N	0.19873	0.05389	0.05566	0.18228	0.17145	0.05333	0.11146	0.55982	9.0
10.0	CB3O	0.19080	0.05023	0.05283	0.17848	0.17084	0.05007	0.11189	0.55446	10.0
11.0	CB3P	0.18884	0.05059	0.05283	0.17902	0.17093	0.04884	0.11365	0.54107	11.0
12.0	CB3Q	0.20017	0.05254	0.05660	0.18560	0.17987	0.05130	0.11792	0.53214	12.0
13.0	CB3R	0.22343	0.05831	0.06321	0.21011	0.20982	0.05789	0.12448	0.51429	13.0
14.0	CB3S	0.23158	0.05949	0.06509	0.21777	0.21630	0.05955	0.12547	0.50000	14.0
15.0	CB3T	0.23957	0.06074	0.06415	0.22462	0.22401	0.06169	0.12758	0.51071	15.0
16.0	CB3U	0.24950	0.06481	0.06792	0.24098	0.24137	0.06661	0.13015	0.51518	16.0
17.0	CB3V	0.27346	0.07293	0.07547	0.26554	0.28044	0.07341	0.13594	0.53125	17.0
18.0	CB3W	0.26981	0.06968	0.07170	0.25685	0.26476	0.07091	0.13197	0.55446	18.0
19.0	CB3X	0.28145	0.07164	0.07453	0.26424	0.27740	0.07315	0.13496	0.51607	19.0
20.0	CB3Y	0.30490	0.07598	0.07925	0.28255	0.29476	0.07898	0.14167	0.52500	20.0
25.0	CB3ZA	0.38135	0.09719	0.10377	0.37353	0.41577	0.10011	0.12912	0.62768	25.0
30.0	CB3ZB	0.38835	0.09891	0.10566	0.33620	0.41595	0.10127	0.13159	0.64464	30.0
35.0	CB3ZC	0.29109	0.07680	0.08113	0.27592	0.27220	0.07826	0.13253	0.63304	35.0
40.0	CB3ZD	0.26767	0.07090	0.05755	0.26120	0.26225	0.07185	0.10526	0.57946	40.0
45.0	CB3ZE	0.42065	0.10976	0.12170	0.42500	0.47749	0.11491	0.14324	0.58750	45.0
50.0	CB3ZF	0.45586	0.12106	0.12358	0.49435	0.51137	0.11675	0.19519	0.70446	50.0
MEAN		0.29505	0.07840	0.07544	0.27912	0.28089	0.07577	0.12944	0.60792	
COEF VAR		23.7	23.5	23.2	25.6	29.8	22.6	12.4	13.9	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

CB3-11

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CB3A	1092.0	33.0	176.0	23.0	20.0	27.0	38.0	26.0	107.0	0.5
1.0	CB3B	1083.0	33.0	176.0	22.0	18.0	22.0	35.0	23.0	95.0	1.0
1.5	CB3C	1128.0	30.0	206.0	35.0	19.0	25.0	43.0	26.0	97.0	1.5
2.0	CB3D	1103.0	34.0	191.0	28.0	18.0	23.0	42.0	25.0	106.0	2.0
2.5	CB3E	1063.0	33.0	186.0	21.0	18.0	15.0	21.0	24.0	91.0	2.5
3.0	CB3F	1054.0	34.0	188.0	22.0	27.0	14.0	26.0	25.0	97.0	3.0
3.5	CB3G	1161.0	32.0	192.0	25.0	20.0	16.0	28.0	27.0	98.0	3.5
4.0	CB3H	1172.0	36.0	205.0	25.0	17.0	16.0	21.0	28.0	105.0	4.0
4.5	CB3I	1164.0	33.0	196.0	23.0	15.0	16.0	24.0	27.0	96.0	4.5
5.0	CB3J	1126.0	32.0	185.0	23.0	17.0	15.0	20.0	27.0	107.0	5.0
6.0	CB3K	786.0	27.0	182.0	22.0	16.0	17.0	38.0	24.0	107.0	6.0
7.0	CB3L	805.0	18.0	138.0	24.0	14.0	235.0	39.0	19.0	109.0	7.0
8.0	CB3M	597.0	19.0	131.0	16.0	12.0	16.0	28.0	18.0	98.0	8.0
9.0	CB3N	554.0	18.0	126.0	17.0	15.0	14.0	27.0	19.0	87.0	9.0
10.0	CB3O	516.0	16.0	124.0	15.0	13.0	12.0	23.0	18.0	72.0	10.0
11.0	CB3P	488.0	16.0	127.0	14.0	11.0	14.0	23.0	17.0	71.0	11.0
12.0	CB3Q	538.0	17.0	135.0	15.0	13.0	16.0	13.0	17.0	78.0	12.0
13.0	CB3R	600.0	20.0	146.0	16.0	13.0	15.0	20.0	17.0	83.0	13.0
14.0	CB3S	623.0	22.0	150.0	16.0	23.0	19.0	12.0	20.0	83.0	14.0
15.0	CB3T	623.0	23.0	151.0	17.0	13.0	16.0	18.0	20.0	79.0	15.0
16.0	CB3U	674.0	22.0	156.0	18.0	13.0	13.0	19.0	20.0	77.0	16.0
17.0	CB3V	773.0	28.0	172.0	20.0	12.0	17.0	14.0	22.0	69.0	17.0
18.0	CB3W	732.0	21.0	167.0	18.0	12.0	14.0	19.0	22.0	72.0	18.0
19.0	CB3X	752.0	22.0	170.0	20.0	14.0	14.0	14.0	22.0	68.0	19.0
20.0	CB3Y	625.0	28.0	181.0	21.0	17.0	17.0	15.0	22.0	67.0	20.0
25.0	CB3ZA	1379.0	43.0	257.0	28.0	23.0	14.0	13.0	31.0	68.0	25.0
30.0	CB3ZB	1403.0	44.0	256.0	30.0	24.0	7.0	10.0	33.0	89.0	30.0
35.0	CB3ZC	1053.0	30.0	197.0	23.0	12.0	8.0	13.0	29.0	92.0	35.0
40.0	CB3ZD	993.0	30.0	187.0	21.0	20.0	9.0	9.0	27.0	113.0	40.0
45.0	CB3ZE	1532.0	49.0	286.0	31.0	16.0	16.0	12.0	34.0	118.0	45.0
50.0	CB3ZF	1504.0	43.0	256.0	29.0	17.0	18.0	14.0	31.0	*****	50.0
MEAN		925.7	28.6	180.5	21.9	16.5	22.9	22.3	23.9	90.0	
COEF VAR		32.8	30.5	22.2	23.6	24.1	170.1	43.9	19.9	16.7	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CB3A	0.1728	0.2037	0.4513	0.1885	0.2941	0.2727	2.9231	0.1912	1.4079	0.5
1.0	CB3B	0.1714	0.2037	0.4513	0.1803	0.2647	0.2222	2.6923	0.1691	1.2500	1.0
1.5	CB3C	0.1785	0.1852	0.5282	0.2869	0.2794	0.2525	3.3077	0.1912	1.2763	1.5
2.0	CB3D	0.1745	0.2099	0.4897	0.2295	0.2647	0.2323	3.2308	0.1838	1.3947	2.0
2.5	CB3E	0.1682	0.2037	0.4769	0.1721	0.2647	0.1515	1.6154	0.1765	1.1974	2.5
3.0	CB3F	0.1668	0.2099	0.4821	0.1803	0.3971	0.1414	2.0000	0.1838	1.2763	3.0
3.5	CB3G	0.1837	0.1975	0.4923	0.2049	0.2941	0.1616	2.1538	0.1985	1.2895	3.5
4.0	CB3H	0.1854	0.2222	0.5256	0.2049	0.2500	0.1616	1.6154	0.2059	1.3816	4.0
4.5	CB3I	0.1842	0.2037	0.5026	0.1885	0.2206	0.1616	1.8462	0.1985	1.2632	4.5
5.0	CB3J	0.1782	0.1975	0.4744	0.1885	0.2500	0.1515	1.5385	0.1985	1.4079	5.0
6.0	CB3K	0.1244	0.1667	0.4667	0.1803	0.2353	0.1717	2.9231	0.1765	1.4079	6.0
7.0	CB3L	0.1274	0.1111	0.3538	0.1967	0.2059	2.3737	3.0000	0.1397	1.4342	7.0
8.0	CB3M	0.0945	0.1173	0.3359	0.1311	0.1765	0.1616	2.1538	0.1324	1.2895	8.0
9.0	CB3N	0.0877	0.1111	0.3231	0.1393	0.2206	0.1414	2.0769	0.1397	1.1447	9.0
10.0	CB3O	0.0816	0.0988	0.3179	0.1230	0.1912	0.1212	1.7692	0.1324	0.9474	10.0
11.0	CB3P	0.0772	0.0988	0.3256	0.1148	0.1618	0.1414	1.7692	0.1250	0.9342	11.0
12.0	CB3Q	0.0851	0.1049	0.3462	0.1230	0.1912	0.1616	1.0000	0.1250	1.0263	12.0
13.0	CB3R	0.0949	0.1235	0.3744	0.1311	0.1912	0.1515	1.5385	0.1250	1.0921	13.0
14.0	CB3S	0.0986	0.1358	0.3846	0.1311	0.3382	0.1919	0.9231	0.1471	1.0921	14.0
15.0	CB3T	0.0986	0.1420	0.3872	0.1393	0.1912	0.1616	1.3846	0.1471	1.0395	15.0
16.0	CB3U	0.1066	0.1358	0.4000	0.1475	0.1912	0.1313	1.4615	0.1471	1.0132	16.0
17.0	CB3V	0.1223	0.1728	0.4410	0.1639	0.1765	0.1717	1.0769	0.1618	0.9079	17.0
18.0	CB3W	0.1158	0.1296	0.4282	0.1475	0.1765	0.1414	1.4615	0.1618	0.9474	18.0
19.0	CB3X	0.1190	0.1358	0.4359	0.1639	0.2059	0.1414	1.0769	0.1618	0.8947	19.0
20.0	CB3Y	0.0989	0.1728	0.4641	0.1721	0.2500	0.1717	1.1538	0.1618	0.8816	20.0
25.0	CB3ZA	0.2182	0.2654	0.6590	0.2295	0.3382	0.1414	1.0000	0.2279	0.8947	25.0
30.0	CB3ZB	0.2220	0.2716	0.6564	0.2459	0.3529	0.0707	0.7692	0.2426	1.1711	30.0
35.0	CB3ZC	0.1666	0.1852	0.5051	0.1885	0.1765	0.0808	1.0000	0.2132	1.2105	35.0
40.0	CB3ZD	0.1571	0.1852	0.4795	0.1721	0.2941	0.0909	0.6923	0.1985	1.4868	40.0
45.0	CB3ZE	0.2424	0.3025	0.7333	0.2541	0.2353	0.1616	0.9231	0.2500	1.5526	45.0
50.0	CB3ZF	0.2380	0.2654	0.6564	0.2377	0.2500	0.1818	1.0769	0.2279	*****	50.0
MEAN		0.1465	0.1764	0.4629	0.1793	0.2429	0.2313	1.7146	0.1755	1.1838	
COEF VAR		32.8	30.5	22.2	23.6	24.1	170.1	43.9	19.9	16.7	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

GENERAL SETTING AND DESCRIPTION

CB_4-2

Duplicate core from Lake CB_2

Refer to page CB_2-2 of this Section

Refer to page CB_2-3 of this Section

DETAILS OF LAKE WATER CHEMISTRY

CB_4-4

Refer to page CB_2-4 of this Section

NO POLLEN DIAGRAM AVAILABLE

CB4-5

CB4-5

AMBROSIA RISE DIAGRAM

CB_4-6

Refer to page CB_2-6 of this Section

PALYNOLOGY NOTES NOT AVAILABLE

CB4-7

CB4-7.

WEIGHT DATA (0-50 cm)

CB4-8

LAKE CB_4

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CB4A	7.203	.445	93.82	50
CB4B	5.122	.334	93.46	60
CB4C	8.917	.622	93.02	5
CB4D	8.054	.567	92.94	60
CB4E	5.484	.425	92.25	50
CB4F	6.723	.443	93.41	40
CB4G	7.186	.519	92.76	50
CB4H	6.168	.434	92.96	40
CB4I	6.751	.524	92.22	50
CB4J	9.548	.736	92.29	40
CB4K	8.277	.48	94.2	40
CB4L	8.883	.83	90.65	36
CB4M	12.734	1.019	91.99	32
CB4N	7.284	.524	92.8	48
CB4O	8.988	.951	89.4	44
CB4P	9.37	.797	91.49	32
CB4Q	12.844	1.024	92.02	40
CB4R	7.124	.623	91.25	48
CB4S	NO DATA	-	-	-
CB4T	9.414	.856	90.89	44
CB4U	8.356	.861	89.68	36
CB4V	8.04	.975	87.86	32
CB4W	10.782	1.44	86.64	32
CB4X	13.039	1.951	85.02	28
CB4Y	11.734	2.056	82.47	24
CB4ZA	8.88	1.75	80.29	28
CB4ZB	8.48	1.71	79.83	28
CB4ZC	9.82	2.56	73.93	28
CB4ZD	8.089	2.059	74.53	24
CB4ZE	NO DATA	-	-	-
CB4ZF	NO DATA	-	-	-

CB4-9 CB4-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CB4A	27344.	6640.	83.	5176.	6263.	2391.	5475.	1024.	0.5
1.0	CB4B	26262.	5898.	79.	5161.	5775.	2243.	6237.	949.	1.0
1.5	CB4C	27043.	6037.	81.	5432.	6039.	2307.	6459.	985.	1.5
2.0	CB4D	26435.	5759.	80.	5348.	5819.	2296.	6355.	971.	2.0
2.5	CB4E	28740.	5784.	86.	5676.	7004.	2339.	6859.	775.	2.5
3.0	CB4F	28929.	5770.	86.	5687.	7147.	2336.	7017.	739.	3.0
3.5	CB4G	28330.	5739.	84.	5508.	6678.	2317.	6593.	756.	3.5
4.0	CB4H	29003.	5801.	87.	5739.	7022.	2378.	6876.	752.	4.0
4.5	CB4I	32219.	6058.	95.	6352.	8726.	2532.	7760.	706.	4.5
5.0	CB4J	33825.	6207.	101.	6934.	9888.	2621.	8237.	664.	5.0
6.0	CB4K	33914.	8510.	115.	7734.	11553.	2885.	8901.	529.	6.0
7.0	CB4L	35295.	6388.	115.	7990.	12236.	2883.	9156.	528.	7.0
8.0	CB4M	30933.	5964.	107.	7237.	10800.	2593.	8084.	567.	8.0
9.0	CB4N	30764.	5740.	99.	6623.	9246.	2536.	7633.	681.	9.0
10.0	CB4O	37961.	6654.	121.	7966.	12920.	3029.	9481.	592.	10.0
11.0	CB4P	28634.	5884.	104.	6645.	6828.	2523.	7489.	643.	11.0
12.0	CB4Q	30275.	5788.	96.	6387.	8337.	2543.	7230.	687.	12.0
13.0	CB4R	30362.	5771.	97.	6580.	8920.	2539.	7395.	649.	13.0
14.0	CB4S	31044.	6108.	102.	6610.	9178.	2663.	7727.	633.	14.0
15.0	CB4T	30370.	6203.	101.	6649.	9224.	2604.	8111.	655.	15.0
16.0	CB4U	34419.	6516.	117.	7793.	11020.	2929.	8688.	594.	16.0
17.0	CB4V	34817.	6740.	124.	8336.	13062.	2988.	9339.	528.	17.0
18.0	CB4W	35634.	6679.	123.	8552.	13398.	2982.	9391.	497.	18.0
19.0	CB4X	37162.	7221.	134.	8961.	13786.	3205.	9752.	506.	19.0
20.0	CB4Y	39681.	7028.	132.	9548.	14951.	3188.	10023.	432.	20.0
25.0	CB4ZA	44778.	8228.	155.	9645.	13578.	3838.	7861.	800.	25.0
30.0	CB4ZB	49727.	8735.	169.	10880.	18025.	4080.	9004.	491.	30.0
35.0	CB4ZC	47589.	7920.	161.	10874.	17735.	3779.	8687.	381.	35.0
40.0	CB4ZD	48832.	8536.	170.	10949.	18504.	3987.	9126.	445.	40.0
45.0	CB4ZE	*****	*****	*****	*****	*****	*****	*****	*****	45.0
50.0	CB4ZF	*****	*****	*****	*****	*****	*****	*****	*****	50.0
MEAN		33804.2	6562.3	110.5	7343.9	10471.1	2811.5	7963.7	660.7	
COEF VAR		19.4	14.2	23.8	23.7	35.5	18.5	14.8	25.2	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CB4A	0.32708	0.10675	0.07830	0.28130	0.27590	0.08651	0.11749	0.91429	0.5
1.0	CB4B	0.31414	0.09482	0.07453	0.28049	0.25441	0.08115	0.13384	0.84732	1.0
1.5	CB4C	0.32348	0.09706	0.07642	0.29522	0.26604	0.08347	0.13861	0.87946	1.5
2.0	CB4D	0.31621	0.09259	0.07547	0.29065	0.25634	0.08307	0.13637	0.86696	2.0
2.5	CB4E	0.34378	0.09299	0.08113	0.30848	0.30855	0.08462	0.14719	0.69196	2.5
3.0	CB4F	0.34604	0.09277	0.08113	0.30908	0.31485	0.08452	0.15058	0.65982	3.0
3.5	CB4G	0.33888	0.09227	0.07925	0.29935	0.29418	0.08383	0.14148	0.67500	3.5
4.0	CB4H	0.34693	0.09326	0.08208	0.31190	0.30934	0.08603	0.14755	0.67143	4.0
4.5	CB4I	0.38539	0.09740	0.08962	0.34522	0.38441	0.09161	0.16652	0.63036	4.5
5.0	CB4J	0.40461	0.09979	0.09528	0.37685	0.43559	0.09483	0.17676	0.59286	5.0
6.0	CB4K	0.40567	0.13682	0.10849	0.42033	0.50894	0.10438	0.19101	0.47232	6.0
7.0	CB4L	0.42219	0.10270	0.10849	0.43424	0.53903	0.10431	0.19648	0.47143	7.0
8.0	CB4M	0.37001	0.09588	0.10094	0.39332	0.47577	0.09381	0.17348	0.50625	8.0
9.0	CB4N	0.36799	0.09228	0.09340	0.35995	0.40731	0.09175	0.16380	0.60804	9.0
10.0	CB4O	0.45408	0.10698	0.11415	0.43293	0.56916	0.10959	0.20345	0.52857	10.0
11.0	CB4P	0.34251	0.09460	0.09811	0.36114	0.30079	0.09128	0.16071	0.57411	11.0
12.0	CB4Q	0.36214	0.09305	0.09057	0.34712	0.36727	0.09200	0.15515	0.61339	12.0
13.0	CB4R	0.36318	0.09278	0.09151	0.35761	0.39295	0.09186	0.15869	0.57946	13.0
14.0	CB4S	0.37134	0.09820	0.09623	0.35924	0.40432	0.09635	0.16582	0.56518	14.0
15.0	CB4T	0.36328	0.09973	0.09528	0.36136	0.40634	0.09421	0.17406	0.58482	15.0
16.0	CB4U	0.41171	0.10476	0.11038	0.42353	0.48546	0.10597	0.18644	0.53036	16.0
17.0	CB4V	0.41647	0.10836	0.11698	0.45304	0.57542	0.10810	0.20041	0.47143	17.0
18.0	CB4W	0.42624	0.10738	0.11604	0.46478	0.59022	0.10789	0.20152	0.44375	18.0
19.0	CB4X	0.44452	0.11609	0.12642	0.48701	0.60731	0.11596	0.20927	0.45179	19.0
20.0	CB4Y	0.47465	0.11299	0.12453	0.51891	0.65863	0.11534	0.21509	0.38571	20.0
25.0	CB4ZA	0.53562	0.13228	0.14623	0.52418	0.59815	0.13886	0.16869	0.71429	25.0
30.0	CB4ZB	0.59482	0.14043	0.15943	0.59130	0.79405	0.14761	0.19322	0.43839	30.0
35.0	CB4ZC	0.56925	0.12733	0.15189	0.59098	0.78128	0.13672	0.18642	0.34018	35.0
40.0	CB4ZD	0.58411	0.13723	0.16038	0.59505	0.81515	0.14425	0.19584	0.39732	40.0
45.0	CB4ZE	******	******	******	******	******	******	******	******	45.0
50.0	CB4ZF	******	******	******	******	******	******	******	******	50.0
MEAN		0.40436	0.10550	0.10423	0.39912	0.46128	0.10172	0.17089	0.58987	
COEF VAR		19.4	14.2	23.8	23.7	35.5	18.5	14.8	25.2	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

CB4-11

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CB4A	1147.0	32.0	194.0	26.0	23.0	11.0	36.0	29.0	102.0	0.5
1.0	CB4B	1059.0	28.0	187.0	22.0	14.0	12.0	42.0	24.0	99.0	1.0
1.5	CB4C	1142.0	29.0	192.0	24.0	16.0	14.0	41.0	26.0	89.0	1.5
2.0	CB4D	1111.0	26.0	188.0	22.0	21.0	13.0	48.0	26.0	97.0	2.0
2.5	CB4E	1121.0	33.0	198.0	23.0	16.0	17.0	30.0	26.0	107.0	2.5
3.0	CB4F	1103.0	31.0	199.0	30.0	23.0	17.0	37.0	27.0	106.0	3.0
3.5	CB4G	1155.0	31.0	194.0	23.0	16.0	18.0	28.0	26.0	108.0	3.5
4.0	CB4H	1158.0	32.0	196.0	24.0	17.0	13.0	23.0	28.0	102.0	4.0
4.5	CB4I	1166.0	28.0	219.0	23.0	18.0	16.0	26.0	26.0	87.0	4.5
5.0	CB4J	1209.0	41.0	233.0	25.0	13.0	13.0	15.0	26.0	75.0	5.0
6.0	CB4K	959.0	37.0	254.0	25.0	14.0	23.0	25.0	24.0	72.0	6.0
7.0	CB4L	947.0	36.0	266.0	24.0	12.0	18.0	25.0	25.0	59.0	7.0
8.0	CB4M	940.0	37.0	239.0	23.0	12.0	19.0	28.0	24.0	68.0	8.0
9.0	CB4N	877.0	31.0	224.0	23.0	12.0	16.0	31.0	24.0	73.0	9.0
10.0	CB4O	999.0	45.0	285.0	25.0	12.0	19.0	28.0	25.0	55.0	10.0
11.0	CB4P	943.0	35.0	221.0	24.0	14.0	17.0	34.0	26.0	77.0	11.0
12.0	CB4Q	910.0	31.0	213.0	23.0	12.0	18.0	38.0	25.0	77.0	12.0
13.0	CB4R	891.0	31.0	219.0	22.0	15.0	18.0	33.0	24.0	82.0	13.0
14.0	CB4S	916.0	35.0	223.0	24.0	14.0	19.0	45.0	25.0	93.0	14.0
15.0	CB4T	911.0	34.0	224.0	23.0	18.0	21.0	37.0	24.0	90.0	15.0
16.0	CB4U	1022.0	41.0	259.0	26.0	16.0	19.0	26.0	26.0	60.0	16.0
17.0	CB4V	997.0	38.0	270.0	25.0	12.0	21.0	18.0	25.0	65.0	17.0
18.0	CB4W	1032.0	39.0	276.0	25.0	12.0	22.0	17.0	25.0	49.0	18.0
19.0	CB4X	1111.0	51.0	286.0	28.0	12.0	24.0	13.0	27.0	47.0	19.0
20.0	CB4Y	1062.0	47.0	307.0	26.0	10.0	23.0	11.0	25.0	47.0	20.0
25.0	CB4ZA	1804.0	55.0	373.0	36.0	14.0	20.0	9.0	40.0	75.0	25.0
30.0	CB4ZB	1666.0	61.0	389.0	33.0	8.0	17.0	7.0	33.0	40.0	30.0
35.0	CB4ZC	1456.0	62.0	379.0	30.0	6.0	18.0	5.0	29.0	36.0	35.0
40.0	CB4ZD	1594.0	63.0	398.0	32.0	33.0	20.0	3.0	31.0	48.0	40.0
45.0	CB4ZE	*****	*****	*****	*****	*****	*****	*****	*****	*****	45.0
50.0	CB4ZF	*****	*****	*****	*****	*****	*****	*****	*****	*****	50.0
MEAN		1117.5	38.6	251.9	25.5	15.0	17.8	26.2	26.6	75.3	
COEF VAR		20.6	26.9	24.7	13.6	33.9	18.6	46.4	12.4	28.4	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CB4A	0.1815	0.1975	0.4974	0.2131	0.3382	0.1111	2.7692	0.2132	1.3421	0.5
1.0	CB4B	0.1676	0.1728	0.4795	0.1803	0.2059	0.1212	3.2308	0.1765	1.3026	1.0
1.5	CB4C	0.1807	0.1790	0.4923	0.1967	0.2353	0.1414	3.1538	0.1912	1.1711	1.5
2.0	CB4D	0.1758	0.1605	0.4821	0.1803	0.3088	0.1313	3.6923	0.1912	1.2763	2.0
2.5	CB4E	0.1774	0.2037	0.5077	0.1885	0.2353	0.1717	2.3077	0.1912	1.4079	2.5
3.0	CB4F	0.1745	0.1914	0.5103	0.2459	0.3382	0.1717	2.8462	0.1985	1.3947	3.0
3.5	CB4G	0.1828	0.1914	0.4974	0.1885	0.2353	0.1818	2.1538	0.1912	1.4211	3.5
4.0	CB4H	0.1832	0.1975	0.5026	0.1967	0.2500	0.1313	1.7692	0.2059	1.3421	4.0
4.5	CB4I	0.1845	0.1728	0.5615	0.1885	0.2647	0.1616	2.0000	0.1912	1.1447	4.5
5.0	CB4J	0.1913	0.2531	0.5974	0.2049	0.1912	0.1313	1.1538	0.1912	0.9868	5.0
6.0	CB4K	0.1517	0.2284	0.6513	0.2049	0.2059	0.2323	1.9231	0.1765	0.9474	6.0
7.0	CB4L	0.1498	0.2222	0.6821	0.1967	0.1765	0.1818	1.9231	0.1838	0.7763	7.0
8.0	CB4M	0.1487	0.2284	0.6128	0.1885	0.1765	0.1919	2.1538	0.1765	0.8947	8.0
9.0	CB4N	0.1388	0.1914	0.5744	0.1885	0.1765	0.1616	2.3846	0.1765	0.9605	9.0
10.0	CB4O	0.1581	0.2778	0.7308	0.2049	0.1765	0.1919	2.1538	0.1838	0.7237	10.0
11.0	CB4P	0.1492	0.2160	0.5667	0.1967	0.2059	0.1717	2.6154	0.1912	1.0132	11.0
12.0	CB4Q	0.1440	0.1914	0.5462	0.1885	0.1765	0.1818	2.9231	0.1838	1.0132	12.0
13.0	CB4R	0.1410	0.1914	0.5615	0.1803	0.2206	0.1818	2.5385	0.1765	1.0789	13.0
14.0	CB4S	0.1449	0.2160	0.5718	0.1967	0.2059	0.1919	3.4615	0.1838	1.2237	14.0
15.0	CB4T	0.1441	0.2099	0.5744	0.1885	0.2647	0.2121	2.8462	0.1765	1.1842	15.0
16.0	CB4U	0.1617	0.2531	0.6641	0.2131	0.2353	0.1919	2.0000	0.1912	0.7895	16.0
17.0	CB4V	0.1578	0.2346	0.6923	0.2049	0.1765	0.2121	1.3846	0.1838	0.8553	17.0
18.0	CB4W	0.1633	0.2407	0.7077	0.2049	0.1765	0.2222	1.3077	0.1838	0.6447	18.0
19.0	CB4X	0.1758	0.3148	0.7333	0.2295	0.1765	0.2424	1.0000	0.1985	0.6184	19.0
20.0	CB4Y	0.1680	0.2901	0.7872	0.2131	0.1471	0.2323	0.8462	0.1838	0.6184	20.0
25.0	CB4ZA	0.2854	0.3395	0.9564	0.2951	0.2059	0.2020	0.6923	0.2941	0.9868	25.0
30.0	CB4ZB	0.2636	0.3765	0.9974	0.2705	0.1176	0.1717	0.5385	0.2426	0.5263	30.0
35.0	CB4ZC	0.2304	0.3827	0.9718	0.2459	0.0882	0.1818	0.3846	0.2132	0.4737	35.0
40.0	CB4ZD	0.2522	0.3889	1.0205	0.2623	0.4853	0.2020	0.2308	0.2279	0.6316	40.0
45.0	CB4ZE	*****	*****	*****	*****	*****	*****	*****	*****	*****	45.0
50.0	CB4ZF	*****	*****	*****	*****	*****	*****	*****	*****	*****	50.0
MEAN		0.1768	0.2384	0.6459	0.2089	0.2206	0.1797	2.0133	0.1955	0.9914	
COEF VAR		20.6	26.9	24.7	13.6	33.9	18.6	46.4	12.4	28.4	

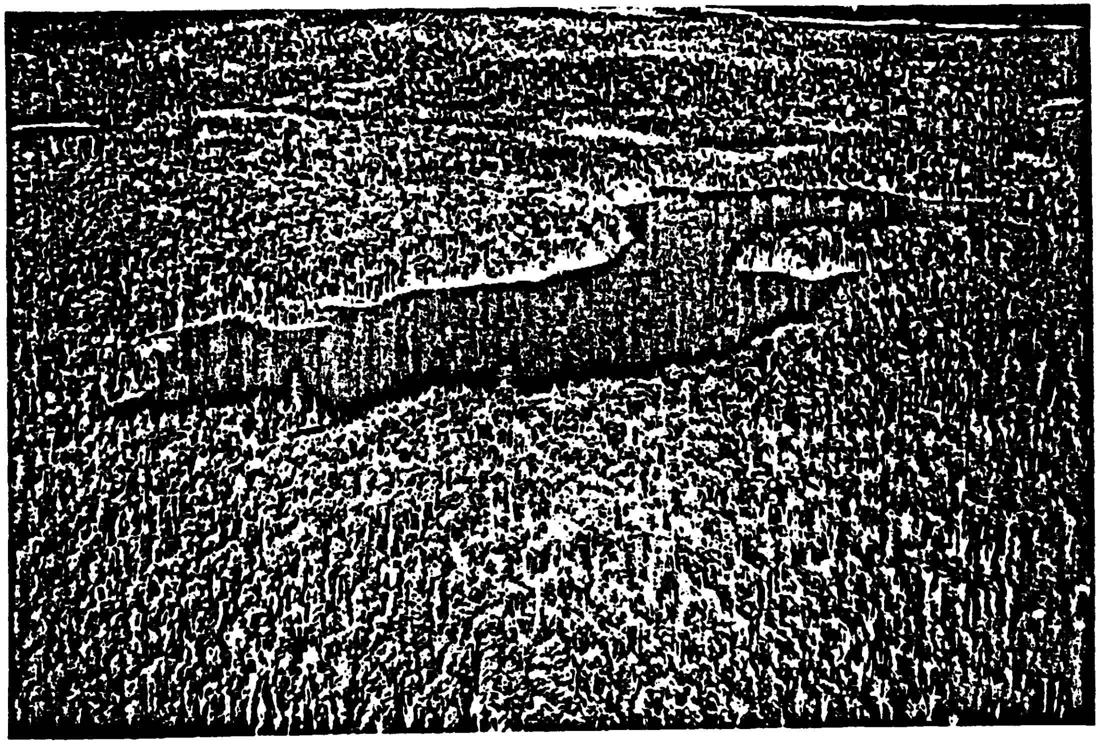
CB4-13 LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK CB4-13

Alkalinity 0.12 Meq/L
pH 6.4

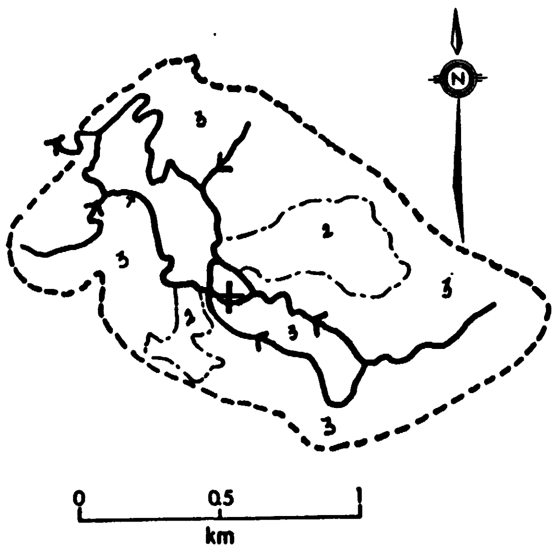
Lake CJ

GENERAL SETTING AND DESCRIPTION

CJ-2



CJ: This lake basin is dominated by glacial sediments. A relatively thick and continuous till deposit covers most of the watershed, with the till being thinner and patchy in localized areas. The relief in the basin is low to moderate. There has been substantial reworking of the glacial sediments providing the source of the sand and gravel deposits occuring along the lake margin.



GEOLOGICAL/GEOGRAPHICAL INFORMATION

UTM Coordinates of the sample point	16-697434/5336100
Elevation of lake above sea level	442 m (1450 ft)
Lake depth at sampling point	1.7 m
Lake area	0.13 sq km
Lake catchment area	0.49 sq km
Bedrock geology under lake basin	massive granitic rocks and mafic metavolcanics.

DETAILS OF LAKE WATER CHEMISTRY

CJ-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		17.5	9.5/100	44
1		17.0	6.0/72	45
	1.3			
1.7		17.0	4.5/47	55

* Specific conductivity data are temperature-corrected (25°C).

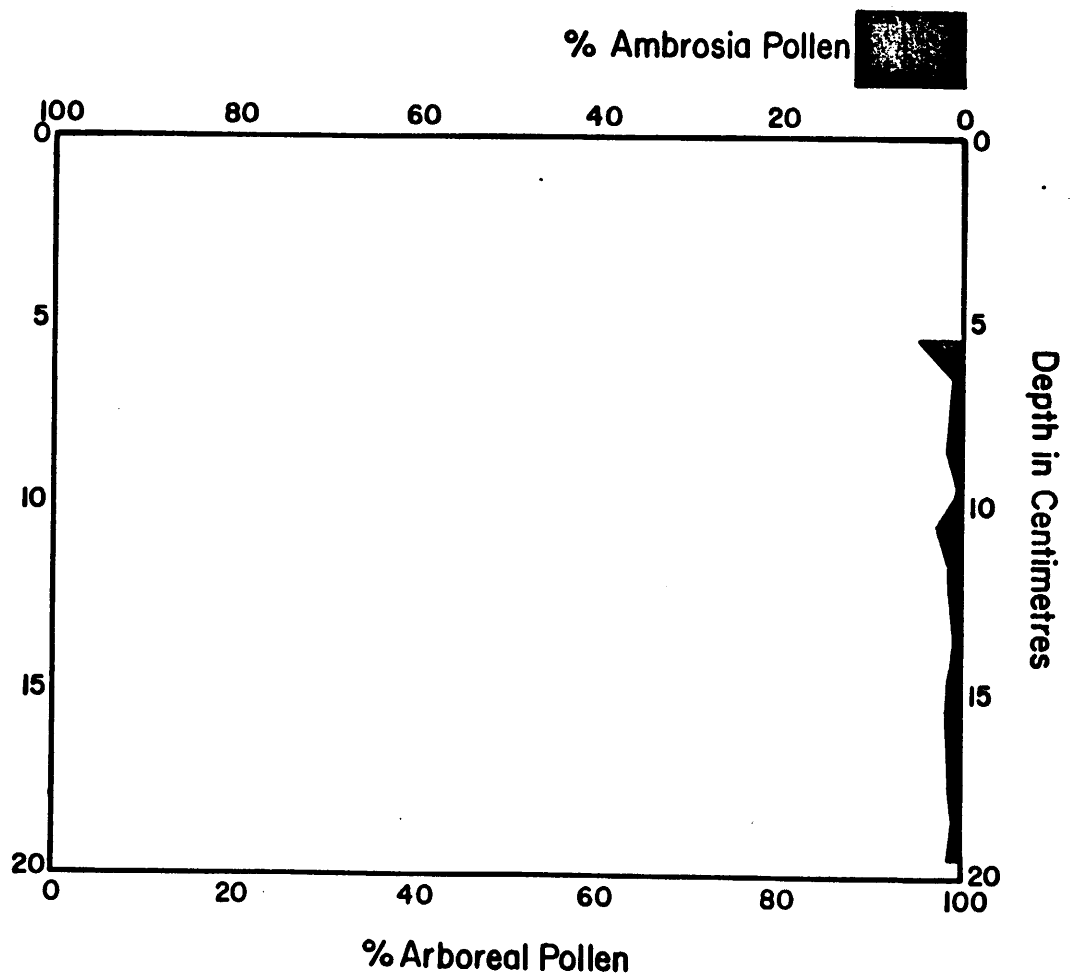
NO POLLEN DIAGRAM AVAILABLE

CJ-5

CJ-5

AMBROSIA RISE DIAGRAM

CJ-6



PALYNOLOGY NOTES NOT AVAILABLE

CJ-7

WEIGHT DATA (0-50 cm)

CJ-8

LAKE CJ

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CJA	2.796	.114	95.88	40
CJB	2.822	.182	93.51	30
CJC	3.483	.247	92.91	30
CJD	3.539	.243	93.1	30
CJE	3.57	.26	92.68	30
CJF	4.15	.331	92.02	40
CJG	4.671	.348	92.54	40
CJH	4.429	.383	91.35	30
CJI	3.399	.299	91.17	30
CJJ	4.756	.395	91.67	30
CJK	5.296	.493	90.69	36
CJL	6.375	.605	90.5	36
CJM	7.298	.682	90.65	36
CJN	9.38	.967	89.68	36
CJO	7.249	.709	90.21	36
CJP	7.543	.848	88.74	36
CJQ	8.81	1.012	88.5	36
CJR	6.236	.711	88.58	36
CJS	7.46	.845	88.67	36
CJT	6.464	.735	88.61	40
CJU	6.994	.781	88.83	36
CJV	6.5	.91	85.98	32
CJW	6.275	.787	87.45	32
CJX	7.108	.896	87.38	36
CJY	8.366	1.081	87.06	36
CJZA	NO DATA	-	-	-
CJZB	10.349	1.39	86.57	32
CJZC	9.64	1.299	86.52	32
CJZD	10.499	1.78	83.04	32
CJZE	9.56	1.503	84.27	32
CJZF	9.42	1.489	84.18	32

CJ-9

CJ-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CJ-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CJA	19085.	6813.	220.	2156.	1662.	1724.	6190.	600.	0.5
1.0	CJB	17003.	7437.	304.	1900.	1531.	1540.	5769.	602.	1.0
1.5	CJC	18118.	6331.	147.	1949.	1541.	1582.	6100.	563.	1.5
2.0	CJD	19624.	6433.	129.	2159.	1734.	1642.	6189.	580.	2.0
2.5	CJE	20418.	5980.	115.	2518.	2405.	1752.	6398.	536.	2.5
3.0	CJF	19455.	5955.	113.	2163.	1893.	1685.	6022.	525.	3.0
3.5	CJG	19149.	5793.	107.	2107.	1855.	1538.	5840.	476.	3.5
4.0	CJH	20694.	6004.	100.	2440.	2461.	1639.	6091.	449.	4.0
4.5	CJI	20982.	5899.	98.	2408.	2602.	1700.	5945.	441.	4.5
5.0	CJJ	20946.	5355.	89.	2425.	2526.	1891.	5568.	415.	5.0
6.0	CJK	22483.	5695.	108.	2971.	3367.	1791.	5910.	420.	6.0
7.0	CJL	22817.	5679.	108.	2976.	3207.	1790.	6079.	439.	7.0
8.0	CJM	21554.	5655.	101.	2594.	2451.	1649.	5682.	398.	8.0
9.0	CJN	22494.	5867.	100.	2862.	2974.	1751.	5768.	392.	9.0
10.0	CJO	21618.	5630.	105.	2680.	2987.	1673.	5813.	395.	10.0
11.0	CJP	21620.	5434.	97.	2829.	3544.	1719.	5893.	377.	11.0
12.0	CJQ	23028.	5748.	96.	3076.	4086.	1833.	6301.	363.	12.0
13.0	CJR	20870.	5740.	98.	2782.	2998.	1913.	6568.	368.	13.0
14.0	CJS	21187.	6261.	102.	2796.	3030.	2084.	7020.	392.	14.0
15.0	CJT	19892.	5478.	94.	2519.	2654.	1762.	6445.	383.	15.0
16.0	CJU	20637.	5695.	97.	2697.	2858.	1880.	6598.	381.	16.0
17.0	CJV	22428.	6307.	101.	3159.	3910.	2356.	7073.	367.	17.0
18.0	CJW	22564.	6104.	99.	3233.	3971.	2078.	7086.	370.	18.0
19.0	CJX	21025.	6712.	94.	2800.	3358.	1903.	7366.	353.	19.0
20.0	CJY	21913.	6244.	104.	3017.	3398.	2104.	7110.	365.	20.0
25.0	CJZA	23088.	6685.	101.	3445.	4204.	2244.	5737.	380.	25.0
30.0	CJZB	23186.	7248.	114.	3587.	4299.	2369.	5873.	392.	30.0
35.0	CJZC	22784.	6674.	106.	3526.	4077.	2275.	5932.	413.	35.0
40.0	CJZD	23856.	7630.	109.	3920.	4465.	2546.	6095.	363.	40.0
45.0	CJZE	23080.	6684.	107.	3697.	4330.	2326.	6055.	385.	45.0
50.0	CJZF	22743.	6882.	107.	3532.	3927.	2356.	6462.	392.	50.0
MEAN		21301.3	6195.2	115.2	2804.0	3042.1	1906.3	6225.1	428.2	
COEF VAR		7.6	9.5	36.0	18.7	29.2	14.8	7.6	17.4	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CJA	0.22829	0.10953	0.20755	0.11717	0.07322	0.06237	0.13283	0.53571	0.5
1.0	CJB	0.20339	0.11957	0.28679	0.10326	0.06744	0.05572	0.12380	0.53750	1.0
1.5	CJC	0.21672	0.10178	0.13868	0.10592	0.06789	0.05724	0.13090	0.50268	1.5
2.0	CJD	0.23474	0.10342	0.12170	0.11734	0.07639	0.05941	0.13281	0.51786	2.0
2.5	CJE	0.24423	0.09614	0.10849	0.13685	0.10595	0.06339	0.13730	0.47857	2.5
3.0	CJF	0.23272	0.09574	0.10660	0.11755	0.08339	0.06096	0.12923	0.46875	3.0
3.5	CJG	0.22905	0.09313	0.10094	0.11451	0.08172	0.05564	0.12532	0.42500	3.5
4.0	CJH	0.24754	0.09653	0.09434	0.13261	0.10841	0.05930	0.13071	0.40089	4.0
4.5	CJI	0.25098	0.09484	0.09245	0.13087	0.11463	0.06151	0.12758	0.39375	4.5
5.0	CJJ	0.25055	0.08609	0.08396	0.13179	0.11128	0.06842	0.11948	0.37054	5.0
6.0	CJK	0.26894	0.09156	0.10189	0.16147	0.14833	0.06480	0.12682	0.37500	6.0
7.0	CJL	0.27293	0.09130	0.10189	0.16174	0.14128	0.06476	0.13045	0.39196	7.0
8.0	CJM	0.25782	0.09092	0.09528	0.14098	0.10797	0.05966	0.12193	0.35536	8.0
9.0	CJN	0.26907	0.09432	0.09434	0.15554	0.13101	0.06335	0.12378	0.35000	9.0
10.0	CJO	0.25859	0.09051	0.09906	0.14565	0.13159	0.06053	0.12474	0.35268	10.0
11.0	CJP	0.25861	0.08736	0.09151	0.15375	0.15612	0.06219	0.12646	0.33661	11.0
12.0	CJQ	0.27545	0.09241	0.09057	0.16717	0.18000	0.06632	0.13521	0.32411	12.0
13.0	CJR	0.24964	0.09228	0.09245	0.15120	0.13207	0.06921	0.14094	0.32857	13.0
14.0	CJS	0.25343	0.10066	0.09623	0.15196	0.13348	0.07540	0.15064	0.35000	14.0
15.0	CJT	0.23794	0.08807	0.08868	0.13690	0.11692	0.06375	0.13830	0.34196	15.0
16.0	CJU	0.24685	0.09156	0.09151	0.14658	0.12590	0.06802	0.14159	0.34018	16.0
17.0	CJV	0.26828	0.10140	0.09528	0.17168	0.17225	0.08524	0.15178	0.32768	17.0
18.0	CJW	0.26990	0.09813	0.09340	0.17571	0.17493	0.07518	0.15206	0.33036	18.0
19.0	CJX	0.25150	0.10791	0.08868	0.15217	0.14793	0.06885	0.15807	0.31518	19.0
20.0	CJY	0.26212	0.10039	0.09811	0.16397	0.14969	0.07612	0.15258	0.32589	20.0
25.0	CJZA	0.27617	0.10748	0.09528	0.18723	0.18520	0.08119	0.12311	0.33929	25.0
30.0	CJZB	0.27734	0.11653	0.10755	0.19495	0.18938	0.08571	0.12603	0.35000	30.0
35.0	CJZC	0.27254	0.10730	0.10000	0.19163	0.17960	0.08231	0.12730	0.36875	35.0
40.0	CJZD	0.28536	0.12267	0.10283	0.21304	0.19670	0.09211	0.13079	0.32411	40.0
45.0	CJZE	0.27608	0.10746	0.10094	0.20092	0.19075	0.08415	0.12994	0.34375	45.0
50.0	CJZF	0.27205	0.11064	0.10094	0.19196	0.17300	0.08524	0.13867	0.35000	50.0
MEAN		0.25480	0.09960	0.10864	0.15239	0.13401	0.06897	0.13359	0.38234	
COEF VAR		7.6	9.5	36.0	18.7	29.2	14.8	7.6	17.4	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CJA	526.0	31.0	197.0	22.0	28.0	40.0	31.0	17.0	117.0	0.5
1.0	CJB	474.0	16.0	186.0	19.0	23.0	41.0	25.0	15.0	90.0	1.0
1.5	CJC	483.0	23.0	197.0	22.0	23.0	34.0	22.0	17.0	96.0	1.5
2.0	CJD	527.0	25.0	213.0	22.0	23.0	36.0	26.0	20.0	114.0	2.0
2.5	CJE	543.0	24.0	211.0	22.0	28.0	35.0	24.0	17.0	116.0	2.5
3.0	CJF	520.0	22.0	202.0	24.0	26.0	33.0	26.0	16.0	106.0	3.0
3.5	CJG	479.0	26.0	201.0	21.0	27.0	38.0	19.0	15.0	92.0	3.5
4.0	CJH	502.0	25.0	221.0	22.0	25.0	37.0	23.0	17.0	90.0	4.0
4.5	CJI	503.0	25.0	198.0	22.0	23.0	41.0	18.0	16.0	84.0	4.5
5.0	CJJ	475.0	24.0	206.0	22.0	25.0	31.0	17.0	14.0	81.0	5.0
6.0	CJK	403.0	27.0	215.0	21.0	27.0	37.0	19.0	19.0	87.0	6.0
7.0	CJL	423.0	26.0	212.0	23.0	29.0	35.0	18.0	20.0	80.0	7.0
8.0	CJM	369.0	26.0	210.0	21.0	33.0	36.0	18.0	18.0	79.0	8.0
9.0	CJN	390.0	27.0	216.0	22.0	32.0	36.0	17.0	19.0	76.0	9.0
10.0	CJO	400.0	26.0	209.0	21.0	31.0	37.0	22.0	19.0	71.0	10.0
11.0	CJP	407.0	26.0	199.0	20.0	28.0	36.0	12.0	19.0	65.0	11.0
12.0	CJQ	408.0	27.0	203.0	21.0	31.0	137.0	9.0	19.0	63.0	12.0
13.0	CJR	398.0	27.0	178.0	24.0	32.0	37.0	7.0	19.0	57.0	13.0
14.0	CJS	403.0	26.0	182.0	25.0	34.0	41.0	6.0	21.0	58.0	14.0
15.0	CJT	387.0	25.0	171.0	24.0	33.0	36.0	5.0	18.0	57.0	15.0
16.0	CJU	414.0	25.0	176.0	24.0	30.0	37.0	14.0	20.0	57.0	16.0
17.0	CJV	480.0	25.0	192.0	25.0	31.0	41.0	11.0	21.0	55.0	17.0
18.0	CJW	441.0	27.0	191.0	24.0	36.0	38.0	5.0	20.0	55.0	18.0
19.0	CJX	407.0	25.0	184.0	23.0	35.0	37.0	7.0	20.0	54.0	19.0
20.0	CJY	461.0	27.0	184.0	25.0	33.0	38.0	8.0	22.0	55.0	20.0
25.0	CJZA	602.0	27.0	231.0	28.0	38.0	35.0	15.0	25.0	48.0	25.0
30.0	CJZB	629.0	28.0	231.0	29.0	37.0	38.0	15.0	26.0	48.0	30.0
35.0	CJZC	621.0	31.0	221.0	28.0	33.0	33.0	18.0	26.0	50.0	35.0
40.0	CJZD	685.0	30.0	227.0	30.0	47.0	34.0	16.0	28.0	49.0	40.0
45.0	CJZE	647.0	28.0	225.0	29.0	33.0	40.0	20.0	26.0	48.0	45.0
50.0	CJZF	628.0	29.0	221.0	30.0	35.0	41.0	22.0	27.0	53.0	50.0
MEAN		485.0	26.0	203.5	23.7	30.6	40.2	16.6	19.9	72.6	
COEF VAR		18.1	10.5	8.1	12.5	17.0	44.4	40.9	18.5	29.6	

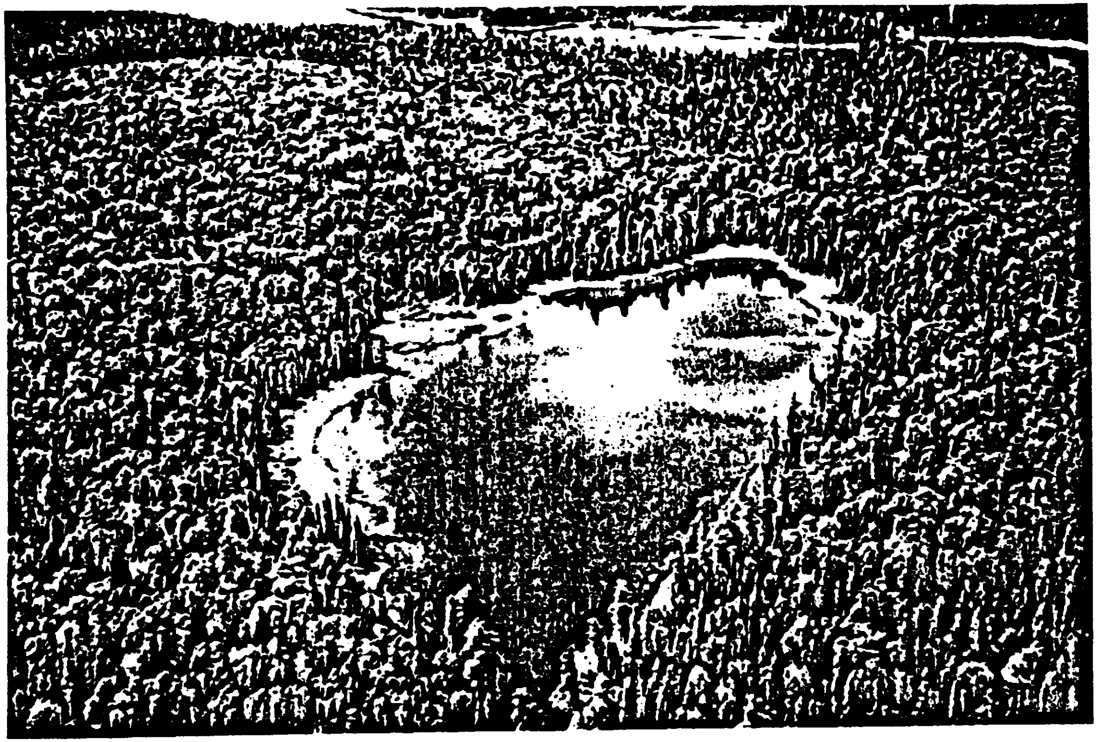
DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CJA	0.0832	0.1914	0.5051	0.1803	0.4118	0.4040	2.3846	0.1250	1.5395	0.5
1.0	CJB	0.0750	0.0988	0.4769	0.1557	0.3382	0.4141	1.9231	0.1103	1.1842	1.0
1.5	CJC	0.0764	0.1420	0.5051	0.1803	0.3382	0.3434	1.6923	0.1250	1.2632	1.5
2.0	CJD	0.0834	0.1543	0.5462	0.1803	0.3382	0.3636	2.0000	0.1471	1.5000	2.0
2.5	CJE	0.0859	0.1481	0.5410	0.1803	0.4118	0.3535	1.8462	0.1250	1.5263	2.5
3.0	CJF	0.0823	0.1358	0.5179	0.1967	0.3824	0.3333	2.0000	0.1176	1.3947	3.0
3.5	CJG	0.0758	0.1605	0.5154	0.1721	0.3971	0.3838	1.4615	0.1103	1.2105	3.5
4.0	CJH	0.0794	0.1543	0.5667	0.1803	0.3676	0.3737	1.7692	0.1250	1.1842	4.0
4.5	CJI	0.0796	0.1543	0.5077	0.1803	0.3382	0.4141	1.3846	0.1176	1.1053	4.5
5.0	CJJ	0.0752	0.1481	0.5282	0.1803	0.3676	0.3131	1.3077	0.1029	1.0658	5.0
6.0	CJK	0.0638	0.1667	0.5513	0.1721	0.3971	0.3737	1.4615	0.1397	1.1447	6.0
7.0	CJL	0.0669	0.1605	0.5436	0.1885	0.4265	0.3535	1.3846	0.1471	1.0526	7.0
8.0	CJM	0.0584	0.1605	0.5385	0.1721	0.4853	0.3636	1.3846	0.1324	1.0395	8.0
9.0	CJN	0.0617	0.1667	0.5538	0.1803	0.4706	0.3636	1.3077	0.1397	1.0000	9.0
10.0	CJO	0.0633	0.1605	0.5359	0.1721	0.4559	0.3737	1.6923	0.1397	0.9342	10.0
11.0	CJP	0.0644	0.1605	0.5103	0.1639	0.4118	0.3636	0.9231	0.1397	0.8553	11.0
12.0	CJQ	0.0646	0.1667	0.5205	0.1721	0.4559	1.3838	0.6923	0.1397	0.8289	12.0
13.0	CJR	0.0630	0.1667	0.4564	0.1967	0.4706	0.3737	0.5385	0.1397	0.7500	13.0
14.0	CJS	0.0638	0.1605	0.4667	0.2049	0.5000	0.4141	0.4615	0.1544	0.7632	14.0
15.0	CJT	0.0612	0.1543	0.4385	0.1967	0.4853	0.3636	0.3846	0.1324	0.7500	15.0
16.0	CJU	0.0655	0.1543	0.4513	0.1967	0.4412	0.3737	1.0769	0.1471	0.7500	16.0
17.0	CJV	0.0759	0.1543	0.4923	0.2049	0.4559	0.4141	0.8462	0.1544	0.7237	17.0
18.0	CJW	0.0698	0.1667	0.4897	0.1967	0.5294	0.3838	0.3846	0.1471	0.7237	18.0
19.0	CJX	0.0644	0.1543	0.4718	0.1885	0.5147	0.3737	0.5385	0.1471	0.7105	19.0
20.0	CJY	0.0729	0.1667	0.4718	0.2049	0.4853	0.3838	0.6154	0.1618	0.7237	20.0
25.0	CJZA	0.0953	0.1667	0.5923	0.2295	0.5588	0.3535	1.1538	0.1838	0.6316	25.0
30.0	CJZB	0.0995	0.1728	0.5923	0.2377	0.5441	0.3838	1.1538	0.1912	0.6316	30.0
35.0	CJZC	0.0983	0.1914	0.5667	0.2295	0.4853	0.3333	1.3846	0.1912	0.6579	35.0
40.0	CJZD	0.1084	0.1852	0.5821	0.2459	0.6912	0.3434	1.2308	0.2059	0.6447	40.0
45.0	CJZE	0.1024	0.1728	0.5769	0.2377	0.4853	0.4040	1.5385	0.1912	0.6316	45.0
50.0	CJZF	0.0994	0.1790	0.5667	0.2459	0.5147	0.4141	1.6923	0.1985	0.6974	50.0
MEAN		0.0767	0.1605	0.5219	0.1943	0.4502	0.4060	1.2779	0.1461	0.9554	
COEF VAR		18.1	10.5	8.1	12.5	17.0	44.4	40.9	18.5	29.6	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

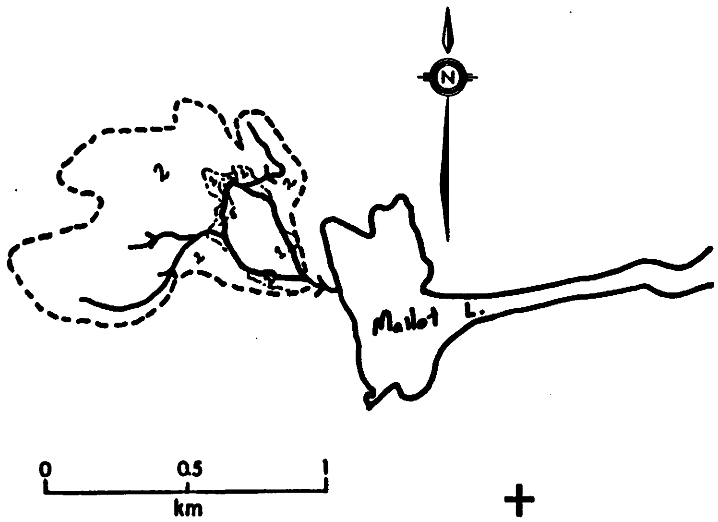
Lake CF pH 5.3

GENERAL SETTING AND DESCRIPTION

CF-2



CF: This drainage basin is relatively small and closed. The basin is dominated by a discontinuous till cover with a couple small pockets of sand at the northern margin of the lake. The rest of the shoreline is primarily rock.



GEOLOGICAL/GEOGRAPHICAL INFORMATION

UTM Coordinates of the sample point	16-707410/5243272
Elevation of lake above sea level	422 m (1450 ft)
Lake depth at sampling point	7.2 m
Lake area	0.08 sq km
Lake catchment area	0.46 sq km
Bedrock geology under lake basin	Early Precambrain felsic intrusive quartz monzonite and clastic metasediments plus quartz-plagioclase-, biotite-hornblende garnet, biotite and staurolite schist and gneiss.

DETAILS OF LAKE WATER CHEMISTRY

CF-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		22	8.8/100	24
1		18.5	6.8/72	26
2		18.4	4.6/49	26
3		17.7	3.7/38	26
4		16.0	3.1/31	30
	4.8			
5		12.0	3.0/28	35
6		9.6	2.7/20	38
7		7.9	2.3/19	42
7.2		7.0	2.1/17	48

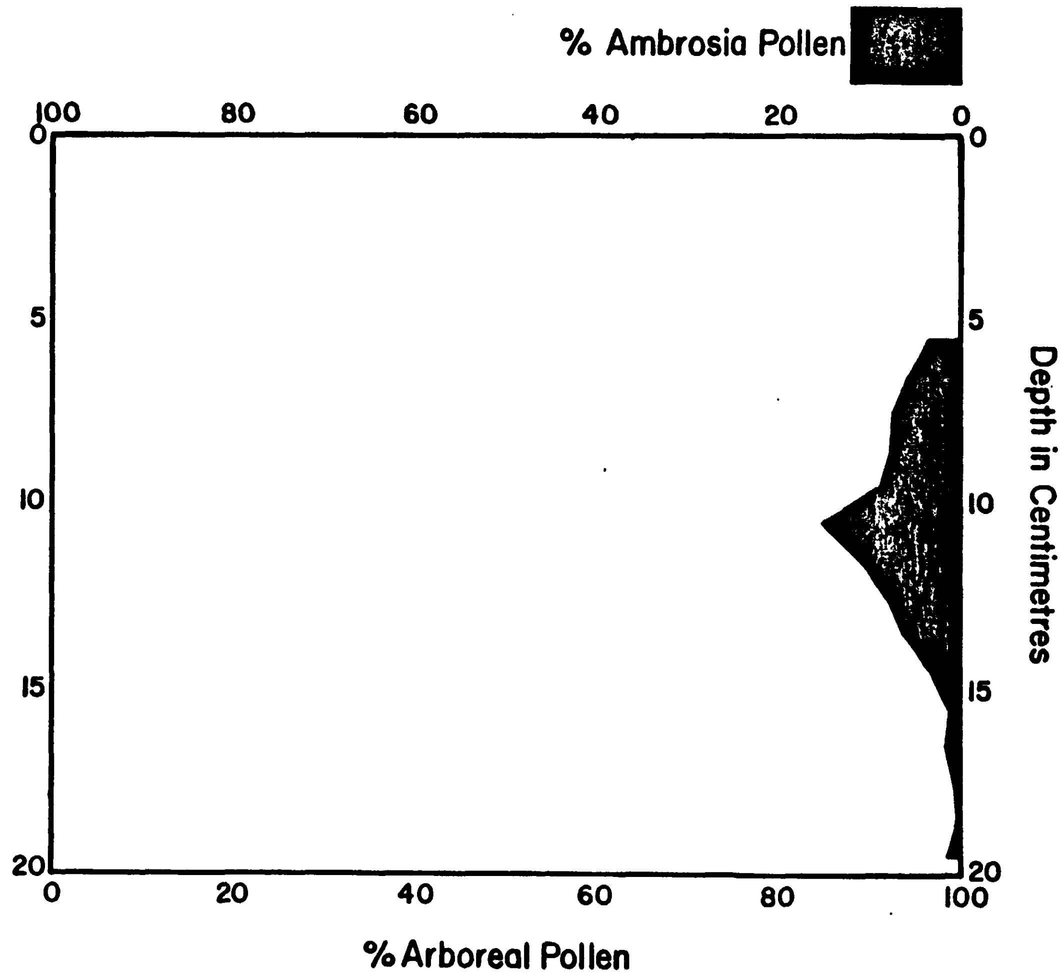
* Specific conductivity data are temperature-corrected (25°C).

NO POLLEN DIAGRAM AVAILABLE

CF-5

Ambrosia RISE DIAGRAM

CF-6



PALYNOLOGY NOTES NOT AVAILABLE

CF-7

WEIGHT DATA (0-50 cm)

CF-8

LAKE CF

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CFA	3.544	7E-03	99.77	NO DATA
CFB	1.429	.03	97.9	NO DATA
CFC	4.526	.078	98.27	NO DATA
CFD	3.546	.098	97.2	40
CFE	3.48	.095	97.24	NO DATA
CFF	2.102	.059	97.14	NO DATA
CFG	3	.151	94.96	30
CFH	3.367	.185	94.5	40
CFI	3.853	.223	94.21	50
CFJ	4.023	.26	93.51	40
CFK	5.254	.305	94.17	48
CFL	6.276	.358	94.29	40
CFM	6.37	.394	93.8	44
CFN	5.161	.426	91.72	40
CFO	5.529	.421	92.38	48
CFP	6.254	.443	92.9	44
CFQ	5.283	.297	94.37	52
CFR	6.758	.357	94.71	56
CFS	5.822	.303	94.77	60
CFT	5.435	.305	94.37	60
CFU	6.054	.301	95.01	64
CFV	5.799	.223	96.15	NO DATA
CFW	5.777	.24	95.84	NO DATA
CFX	5.366	.225	95.78	NO DATA
CFY	6.442	.274	95.74	56
CFZA	10.139	.786	92.23	60
CFZB	10.21	.583	94.28	56
CFZC	10.08	1.017	89.91	44
CFZD	10.139	.786	92.23	60
CFZE	10.939	.849	92.23	48
CFZF	9.16	.855	90.66	44

CF-9

CF-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CF-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CFA	*****	*****	*****	*****	*****	*****	*****	*****	0.5
1.0	CFB	29334.	12688.	75.	2648.	1188.	1572.	3425.	1905.	1.0
1.5	CFC	*****	*****	*****	*****	*****	*****	*****	*****	1.5
2.0	CFD	37058.	9568.	72.	2184.	1113.	1511.	3456.	1609.	2.0
2.5	CFE	36239.	9344.	64.	2123.	894.	1427.	3092.	1447.	2.5
3.0	CFF	*****	*****	*****	*****	*****	*****	*****	*****	3.0
3.5	CFG	33493.	7930.	58.	2269.	1262.	1471.	2632.	1147.	3.5
4.0	CFH	36336.	9212.	67.	2591.	1627.	1505.	3277.	1386.	4.0
4.5	CFI	34791.	10411.	77.	2842.	1690.	1542.	3561.	1594.	4.5
5.0	CFJ	33842.	10103.	75.	2780.	1401.	1499.	3261.	1542.	5.0
6.0	CFK	38853.	11596.	79.	3126.	1614.	1567.	3427.	1472.	6.0
7.0	CFL	42141.	9970.	88.	4072.	2291.	1946.	3634.	1371.	7.0
8.0	CFM	39006.	9002.	82.	3480.	1937.	1616.	3465.	1408.	8.0
9.0	CFN	39137.	13211.	82.	4812.	2323.	2120.	3230.	1244.	9.0
10.0	CFO	31241.	10183.	70.	2826.	1492.	1351.	3149.	1459.	10.0
11.0	CFP	33925.	16175.	70.	2881.	1590.	1335.	3260.	1550.	11.0
12.0	CFQ	36393.	13418.	70.	2307.	1236.	1173.	3572.	1660.	12.0
13.0	CFR	40850.	13974.	76.	2407.	1247.	1204.	3897.	1911.	13.0
14.0	CFS	40838.	8340.	79.	1763.	1054.	996.	4496.	2109.	14.0
15.0	CFT	34170.	7663.	70.	1428.	644.	877.	3935.	1984.	15.0
16.0	CFU	38497.	8489.	81.	1557.	1099.	988.	4453.	2115.	16.0
17.0	CFV	*****	*****	*****	*****	*****	*****	*****	*****	17.0
18.0	CFW	*****	*****	*****	*****	*****	*****	*****	*****	18.0
19.0	CFX	*****	*****	*****	*****	*****	*****	*****	*****	19.0
20.0	CFY	44364.	8374.	82.	1716.	1015.	1025.	3899.	2078.	20.0
25.0	CFZA	35896.	8754.	87.	1498.	716.	1036.	3795.	1995.	25.0
30.0	CFZB	38044.	9735.	94.	1880.	1802.	1249.	4111.	2045.	30.0
35.0	CFZC	37287.	8139.	84.	2370.	1502.	1555.	3376.	1642.	35.0
40.0	CFZD	35037.	8919.	99.	2033.	919.	1289.	4129.	2150.	40.0
45.0	CFZE	38161.	9335.	93.	2230.	1198.	1326.	4109.	2082.	45.0
50.0	CFZF	39531.	9332.	106.	2154.	1276.	1480.	4519.	2064.	50.0
MEAN		36978.6	10154.6	79.2	2479.1	1365.2	1386.4	3646.4	1718.8	
COEF VAR		9.0	20.9	13.8	31.2	30.9	20.5	12.8	18.0	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CFA	******	******	******	******	******	******	******	******	0.5
1.0	CFB	0.35089	0.20399	0.07075	0.14391	0.05233	0.05687	0.07350	1.70089	1.0
1.5	CFC	******	******	******	******	******	******	******	******	1.5
2.0	CFD	0.44328	0.15383	0.06792	0.11870	0.04903	0.05467	0.07416	1.43661	2.0
2.5	CFE	0.43348	0.15023	0.06038	0.11538	0.03938	0.05163	0.06635	1.29196	2.5
3.0	CFF	******	******	******	******	******	******	******	******	3.0
3.5	CFG	0.40063	0.12749	0.05472	0.12332	0.05559	0.05322	0.05648	1.02411	3.5
4.0	CFH	0.43464	0.14810	0.06321	0.14082	0.07167	0.05445	0.07032	1.23750	4.0
4.5	CFI	0.41616	0.16738	0.07264	0.15446	0.07445	0.05579	0.07642	1.42321	4.5
5.0	CFJ	0.40481	0.16243	0.07075	0.15109	0.06172	0.05423	0.06998	1.37679	5.0
6.0	CFK	0.46475	0.18643	0.07453	0.16989	0.07110	0.05669	0.07354	1.31429	6.0
7.0	CFL	0.50408	0.16029	0.08302	0.22130	0.10093	0.07041	0.07798	1.22411	7.0
8.0	CFM	0.46658	0.14473	0.07736	0.18913	0.08533	0.05847	0.07436	1.25714	8.0
9.0	CFN	0.46815	0.21240	0.07736	0.26152	0.10233	0.07670	0.06931	1.11071	9.0
10.0	CFO	0.37370	0.16371	0.06604	0.15359	0.06573	0.04888	0.06758	1.30268	10.0
11.0	CFP	0.40580	0.26005	0.06604	0.15658	0.07004	0.04830	0.06996	1.38393	11.0
12.0	CFQ	0.43532	0.21572	0.06604	0.12538	0.05445	0.04244	0.07665	1.48214	12.0
13.0	CFR	0.48864	0.22466	0.07170	0.13082	0.05493	0.04356	0.08363	1.70625	13.0
14.0	CFS	0.48849	0.13408	0.07453	0.09582	0.04643	0.03603	0.09648	1.88304	14.0
15.0	CFT	0.40873	0.12320	0.06604	0.07761	0.02837	0.03173	0.08444	1.77143	15.0
16.0	CFU	0.46049	0.13648	0.07642	0.08462	0.04841	0.03575	0.09556	1.88839	16.0
17.0	CFV	******	******	******	******	******	******	******	******	17.0
18.0	CFW	******	******	******	******	******	******	******	******	18.0
19.0	CFX	******	******	******	******	******	******	******	******	19.0
20.0	CFY	0.53067	0.13463	0.07736	0.09326	0.04471	0.03708	0.08367	1.85536	20.0
25.0	CFZA	0.42938	0.14074	0.08208	0.08141	0.03154	0.03748	0.08144	1.78125	25.0
30.0	CFZB	0.45507	0.15651	0.08868	0.10217	0.07938	0.04519	0.08822	1.82589	30.0
35.0	CFZC	0.44602	0.13085	0.07925	0.12880	0.06617	0.05626	0.07245	1.46607	35.0
40.0	CFZD	0.41910	0.14339	0.09340	0.11049	0.04048	0.04664	0.08861	1.91964	40.0
45.0	CFZE	0.45647	0.15008	0.08774	0.12120	0.05278	0.04797	0.08818	1.85893	45.0
50.0	CFZF	0.47286	0.15003	0.10000	0.11707	0.05621	0.05355	0.09697	1.84286	50.0
MEAN		0.44233	0.16326	0.07472	0.13473	0.06014	0.05016	0.07825	1.53460	
COEF VAR		9.0	20.9	13.8	31.2	30.9	20.5	12.8	18.0	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

CF-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CFA	*****	*****	*****	*****	*****	*****	*****	*****	*****	0.5
1.0	CFB	498.0	15.0	514.0	23.0	34.0	32.0	67.0	27.0	146.0	1.0
1.5	CFC	*****	*****	*****	*****	*****	*****	*****	*****	*****	1.5
2.0	CFD	601.0	17.0	207.0	31.0	35.0	40.0	84.0	33.0	183.0	2.0
2.5	CFE	598.0	17.0	156.0	28.0	37.0	41.0	63.0	33.0	156.0	2.5
3.0	CFF	*****	*****	*****	*****	*****	*****	*****	*****	*****	3.0
3.5	CFG	633.0	19.0	136.0	26.0	26.0	28.0	83.0	27.0	166.0	3.5
4.0	CFH	645.0	20.0	138.0	28.0	33.0	29.0	106.0	32.0	203.0	4.0
4.5	CFI	656.0	20.0	140.0	28.0	37.0	36.0	122.0	38.0	292.0	4.5
5.0	CFJ	626.0	20.0	138.0	27.0	39.0	38.0	125.0	37.0	276.0	5.0
6.0	CFK	518.0	17.0	142.0	27.0	38.0	22.0	111.0	36.0	187.0	6.0
7.0	CFL	642.0	22.0	166.0	29.0	39.0	29.0	117.0	37.0	192.0	7.0
8.0	CFM	604.0	19.0	143.0	27.0	34.0	21.0	85.0	35.0	177.0	8.0
9.0	CFN	660.0	21.0	169.0	24.0	30.0	20.0	65.0	37.0	145.0	9.0
10.0	CFO	472.0	15.0	115.0	20.0	37.0	19.0	63.0	34.0	170.0	10.0
11.0	CFP	459.0	16.0	132.0	21.0	34.0	19.0	67.0	35.0	134.0	11.0
12.0	CFQ	412.0	14.0	112.0	20.0	35.0	21.0	61.0	32.0	122.0	12.0
13.0	CFR	436.0	14.0	121.0	22.0	34.0	20.0	69.0	36.0	110.0	13.0
14.0	CFS	375.0	11.0	106.0	22.0	140.0	17.0	42.0	36.0	98.0	14.0
15.0	CFT	363.0	10.0	92.0	20.0	36.0	15.0	29.0	37.0	103.0	15.0
16.0	CFU	369.0	10.0	105.0	21.0	36.0	18.0	28.0	39.0	92.0	16.0
17.0	CFV	*****	*****	*****	*****	*****	*****	*****	*****	*****	17.0
18.0	CFW	*****	*****	*****	*****	*****	*****	*****	*****	*****	18.0
19.0	CFX	*****	*****	*****	*****	*****	*****	*****	*****	*****	19.0
20.0	CFY	348.0	10.0	108.0	24.0	33.0	17.0	12.0	34.0	73.0	20.0
25.0	CFZA	499.0	12.0	111.0	31.0	35.0	23.0	6.0	41.0	78.0	25.0
30.0	CFZB	575.0	14.0	125.0	28.0	38.0	21.0	5.0	43.0	81.0	30.0
35.0	CFZC	738.0	20.0	134.0	31.0	35.0	18.0	8.0	46.0	80.0	35.0
40.0	CFZD	618.0	15.0	116.0	27.0	41.0	17.0	8.0	51.0	91.0	40.0
45.0	CFZE	575.0	17.0	120.0	28.0	47.0	17.0	11.0	45.0	93.0	45.0
50.0	CFZF	771.0	23.0	104.0	32.0	38.0	19.0	12.0	49.0	88.0	50.0
MEAN		547.6	16.3	146.0	25.8	40.0	23.9	58.0	37.2	141.4	
COEF VAR		21.4	23.2	54.1	14.5	51.8	32.5	67.8	15.7	41.2	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CFA	*****	*****	*****	*****	*****	*****	*****	*****	*****	0.5
1.0	CFB	0.0788	0.0926	1.3179	0.1885	0.5000	0.3232	5.1538	0.1985	1.9211	1.0
1.5	CFC	*****	*****	*****	*****	*****	*****	*****	*****	*****	1.5
2.0	CFD	0.0951	0.1049	0.5308	0.2541	0.5147	0.4040	6.4615	0.2426	2.4079	2.0
2.5	CFE	0.0946	0.1049	0.4000	0.2295	0.5441	0.4141	4.8462	0.2426	2.0526	2.5
3.0	CFF	*****	*****	*****	*****	*****	*****	*****	*****	*****	3.0
3.5	CFG	0.1002	0.1173	0.3487	0.2131	0.3824	0.2828	6.3846	0.1985	2.1842	3.5
4.0	CFH	0.1021	0.1235	0.3538	0.2295	0.4853	0.2929	8.1538	0.2353	2.6711	4.0
4.5	CFI	0.1038	0.1235	0.3590	0.2295	0.5441	0.3636	9.3846	0.2794	3.8421	4.5
5.0	CFJ	0.0991	0.1235	0.3538	0.2213	0.5735	0.3838	9.6154	0.2721	3.6316	5.0
6.0	CFK	0.0820	0.1049	0.3641	0.2213	0.5588	0.2222	8.5385	0.2647	2.4605	6.0
7.0	CFL	0.1016	0.1358	0.4256	0.2377	0.5735	0.2929	9.0000	0.2721	2.5263	7.0
8.0	CFM	0.0956	0.1173	0.3667	0.2213	0.5000	0.2121	6.5385	0.2574	2.3289	8.0
9.0	CFN	0.1044	0.1296	0.4333	0.1967	0.4412	0.2020	5.0000	0.2721	1.9079	9.0
10.0	CFO	0.0747	0.0926	0.2949	0.1639	0.5441	0.1919	4.8462	0.2500	2.2368	10.0
11.0	CFP	0.0726	0.0988	0.3385	0.1721	0.5000	0.1919	5.1538	0.2574	1.7632	11.0
12.0	CFQ	0.0652	0.0864	0.2872	0.1639	0.5147	0.2121	4.6923	0.2353	1.6053	12.0
13.0	CFR	0.0690	0.0864	0.3103	0.1803	0.5000	0.2020	5.3077	0.2647	1.4474	13.0
14.0	CFS	0.0593	0.0679	0.2718	0.1803	2.0588	0.1717	3.2308	0.2647	1.2895	14.0
15.0	CFT	0.0574	0.0617	0.2359	0.1639	0.5294	0.1515	2.2308	0.2721	1.3553	15.0
16.0	CFU	0.0584	0.0617	0.2692	0.1721	0.5294	0.1818	2.1538	0.2868	1.2105	16.0
17.0	CFV	*****	*****	*****	*****	*****	*****	*****	*****	*****	17.0
18.0	CFW	*****	*****	*****	*****	*****	*****	*****	*****	*****	18.0
19.0	CFX	*****	*****	*****	*****	*****	*****	*****	*****	*****	19.0
20.0	CFY	0.0551	0.0617	0.2769	0.1967	0.4853	0.1717	0.9231	0.2500	0.9605	20.0
25.0	CFZA	0.0790	0.0741	0.2846	0.2541	0.5147	0.2323	0.4615	0.3015	1.0263	25.0
30.0	CFZB	0.0910	0.0864	0.3205	0.2295	0.5588	0.2121	0.3846	0.3162	1.0658	30.0
35.0	CFZC	0.1168	0.1235	0.3436	0.2541	0.5147	0.1818	0.6154	0.3382	1.0526	35.0
40.0	CFZD	0.0978	0.0926	0.2974	0.2213	0.6029	0.1717	0.6154	0.3750	1.1974	40.0
45.0	CFZE	0.0910	0.1049	0.3077	0.2295	0.6912	0.1717	0.8462	0.3309	1.2237	45.0
50.0	CFZF	0.1220	0.1420	0.2667	0.2623	0.5588	0.1919	0.9231	0.3603	1.1579	50.0
MEAN		0.0867	0.1007	0.3744	0.2115	0.5888	0.2412	4.4585	0.2735	1.8610	
COEF VAR		21.4	23.2	54.1	14.5	51.8	32.5	67.8	15.7	41.2	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

Verification Study
Previously Sampled in 1981

Lake X_1

Alkalinity 0.04 Meq/L
pH 5.6

GENERAL SETTING AND DESCRIPTION

X_1-2

Refer to 1981 Descriptive and Geochemical Data
(Part II - Section 1, pgs. X-2 and X-3)

Refer to 1981 Descriptive and Geochemical Data
(Part II - Section 1, pgs. X-1 and X-3)

DETAILS OF LAKE WATER CHEMISTRY

X_1-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0.0		21	8.9/100	28
1.0		21.7	8.1/92	30
1.1	visible on lake bottom	21.7	8.1/89	31

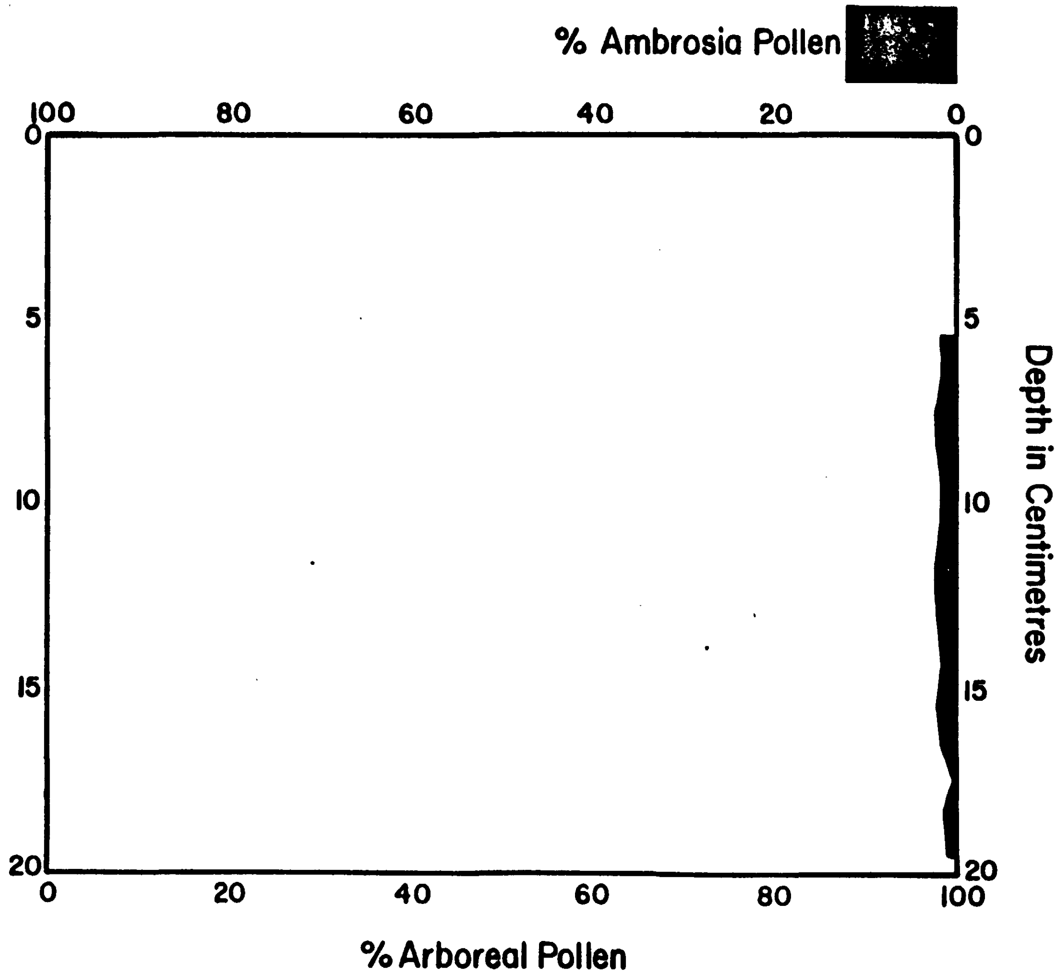
* Specific conductivity data are temperature-corrected (25°C).

NO POLLEN DIAGRAM AVAILABLE

X_1-5 X_1-5

<u>AMBROSIA</u> RISE DIAGRAM

X_1-6



PALYNOLOGY NOTES NOT AVAILABLE

 X_1-7

WEIGHT DATA (0-50 cm)

LAKE X_1

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
X1A	2.909	.098	96.63	40
X1B	3.603	.214	94.03	30
X1C	2.637	.195	92.57	40
X1D	3.328	.265	92.03	30
X1E	2.772	.252	90.91	40
X1F	3.245	.309	90.48	40
X1G	2.231	.225	89.87	40
X1H	2.731	.269	90.11	30
X1I	2.801	.291	89.61	30
X1J	3.254	.289	91.11	40
X1K	6.005	.588	90.19	36
X1L	6.95	.649	90.66	36
X1M	6.698	.65	90.29	36
X1N	6.757	.642	90.5	36
X1O	6.923	.64	90.74	40
X1P	7.297	.638	91.24	36
X1Q	6.907	.605	91.24	36
X1R	6.241	.631	89.89	32
X1S	6.266	.62	90.1	32
X1T	6.513	.663	89.8	36
X1U	6.866	.671	90.21	36
X1V	6.402	.647	89.87	32
X1W	6.347	.651	89.74	32
X1X	7.193	.439	93.89	32
X1Y	7.28	.71	90.24	36
X1ZA	11.58	1.121	90.31	48
X1ZB	10.68	1.145	89.26	32
X1ZC	8.33	.899	89.19	32
X1ZD	9.929	1.23	87.61	36
X1ZE	9.879	1.046	89.4	28
X1ZF	7.91	1.039	86.85	28

X1-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

X_1-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	X1A	23640.	8220.	68.	3009.	1990.	1494.	3299.	880.	0.5
1.0	X1B	23282.	6906.	63.	2744.	1872.	1408.	3189.	802.	1.0
1.5	X1C	24436.	7891.	69.	2851.	1942.	1475.	3175.	811.	1.5
2.0	X1D	24375.	5723.	61.	2849.	2007.	1471.	3278.	754.	2.0
2.5	X1E	23667.	5959.	69.	2831.	1983.	1465.	3183.	723.	2.5
3.0	X1F	22518.	5889.	68.	2968.	2164.	1530.	3415.	730.	3.0
3.5	X1G	25471.	5724.	71.	2815.	2253.	1479.	3479.	684.	3.5
4.0	X1H	25110.	5862.	63.	2841.	2443.	1503.	3585.	647.	4.0
4.5	X1I	26717.	5162.	66.	2853.	2552.	1575.	3852.	685.	4.5
5.0	X1J	25761.	5148.	68.	2804.	2485.	1533.	3759.	661.	5.0
6.0	X1K	29807.	4733.	66.	3481.	3379.	1536.	3600.	582.	6.0
7.0	X1L	29293.	4688.	62.	3414.	3315.	1503.	3607.	584.	7.0
8.0	X1M	29056.	4766.	65.	3379.	3411.	1498.	3601.	565.	8.0
9.0	X1N	29121.	4604.	61.	3336.	3306.	1498.	3664.	590.	9.0
10.0	X1O	28422.	4420.	60.	3137.	3146.	1457.	3692.	589.	10.0
11.0	X1P	28229.	4528.	62.	3166.	3167.	1458.	3732.	589.	11.0
12.0	X1Q	28843.	4525.	63.	3252.	3253.	1504.	3837.	662.	12.0
13.0	X1R	28458.	4343.	56.	3240.	3301.	1486.	3779.	621.	13.0
14.0	X1S	27513.	4206.	55.	3355.	3306.	1480.	3680.	575.	14.0
15.0	X1T	28473.	4447.	58.	3292.	3230.	1523.	3754.	597.	15.0
16.0	X1U	25826.	4082.	54.	3074.	2883.	1403.	3543.	552.	16.0
17.0	X1V	30281.	4867.	67.	3629.	4082.	1665.	4139.	616.	17.0
18.0	X1W	29827.	4612.	61.	3479.	3522.	1600.	4063.	620.	18.0
19.0	X1X	26794.	4185.	56.	3183.	3132.	1451.	3769.	586.	19.0
20.0	X1Y	28481.	4436.	58.	3209.	3183.	1527.	4017.	620.	20.0
25.0	X1ZA	20121.	3804.	50.	2400.	2669.	1643.	2673.	449.	25.0
30.0	X1ZB	27436.	4962.	65.	3362.	3275.	1823.	3573.	577.	30.0
35.0	X1ZC	27635.	5082.	68.	3216.	3334.	1874.	3807.	596.	35.0
40.0	X1ZD	30024.	5345.	72.	3627.	4005.	1984.	4067.	658.	40.0
45.0	X1ZE	30398.	5451.	74.	3777.	3976.	2103.	4328.	656.	45.0
50.0	X1ZF	30147.	5267.	72.	3742.	3925.	2054.	4180.	605.	50.0
MEAN		27069.7	5156.0	63.6	3171.5	2983.6	1580.7	3655.5	640.8	
COEF VAR		9.6	19.6	9.1	10.1	21.7	11.6	9.3	13.4	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	X1A	0.28278	0.13215	0.06415	0.16353	0.08767	0.05405	0.07079	0.78571	0.5
1.0	X1B	0.27849	0.11103	0.05943	0.14913	0.08247	0.05094	0.06843	0.71607	1.0
1.5	X1C	0.29230	0.12686	0.06509	0.15495	0.08555	0.05336	0.06813	0.72411	1.5
2.0	X1D	0.29157	0.09201	0.05755	0.15484	0.08841	0.05322	0.07034	0.67321	2.0
2.5	X1E	0.28310	0.09580	0.06509	0.15386	0.08736	0.05300	0.06830	0.64554	2.5
3.0	X1F	0.26935	0.09468	0.06415	0.16130	0.09533	0.05535	0.07328	0.65179	3.0
3.5	X1G	0.30468	0.09203	0.06698	0.15299	0.09925	0.05351	0.07466	0.61071	3.5
4.0	X1H	0.30036	0.09424	0.05943	0.15440	0.10762	0.05438	0.07693	0.57768	4.0
4.5	X1I	0.31958	0.08299	0.06226	0.15505	0.11242	0.05698	0.08266	0.61161	4.5
5.0	X1J	0.30815	0.08277	0.06415	0.15239	0.10947	0.05546	0.08067	0.59018	5.0
6.0	X1K	0.35654	0.07609	0.06226	0.18918	0.14885	0.05557	0.07725	0.51964	6.0
7.0	X1L	0.35039	0.07537	0.05849	0.18554	0.14604	0.05438	0.07740	0.52143	7.0
8.0	X1M	0.34756	0.07662	0.06132	0.18364	0.15026	0.05420	0.07727	0.50446	8.0
9.0	X1N	0.34834	0.07402	0.05755	0.18130	0.14564	0.05420	0.07863	0.52679	9.0
10.0	X1O	0.33998	0.07106	0.05660	0.17049	0.13859	0.05271	0.07923	0.52589	10.0
11.0	X1P	0.33767	0.07280	0.05849	0.17207	0.13952	0.05275	0.08009	0.52589	11.0
12.0	X1Q	0.34501	0.07275	0.05943	0.17674	0.14330	0.05441	0.08234	0.59107	12.0
13.0	X1R	0.34041	0.06982	0.05283	0.17609	0.14542	0.05376	0.08109	0.55446	13.0
14.0	X1S	0.32910	0.06762	0.05189	0.18234	0.14564	0.05355	0.07897	0.51339	14.0
15.0	X1T	0.34059	0.07150	0.05472	0.17891	0.14229	0.05510	0.08056	0.53304	15.0
16.0	X1U	0.30892	0.06563	0.05094	0.16707	0.12700	0.05076	0.07603	0.49286	16.0
17.0	X1V	0.36221	0.07825	0.06321	0.19723	0.17982	0.06024	0.08882	0.55000	17.0
18.0	X1W	0.35678	0.07415	0.05755	0.18908	0.15515	0.05789	0.08719	0.55357	18.0
19.0	X1X	0.32050	0.06728	0.05283	0.17299	0.13797	0.05250	0.08088	0.52321	19.0
20.0	X1Y	0.34068	0.07132	0.05472	0.17440	0.14022	0.05525	0.08620	0.55357	20.0
25.0	X1ZA	0.24068	0.06116	0.04717	0.13043	0.11758	0.05944	0.05736	0.40089	25.0
30.0	X1ZB	0.32818	0.07977	0.06132	0.18272	0.14427	0.06596	0.07667	0.51518	30.0
35.0	X1ZC	0.33056	0.08170	0.06415	0.17478	0.14687	0.06780	0.08170	0.53214	35.0
40.0	X1ZD	0.35914	0.08593	0.06792	0.19712	0.17643	0.07178	0.08727	0.58750	40.0
45.0	X1ZE	0.36361	0.08764	0.06981	0.20527	0.17515	0.07609	0.09288	0.58571	45.0
50.0	X1ZF	0.36061	0.08468	0.06792	0.20337	0.17291	0.07431	0.08970	0.54018	50.0
MEAN		0.32380	0.08289	0.05998	0.17236	0.13143	0.05719	0.07844	0.57218	
COEF VAR		9.6	19.6	9.1	10.1	21.7	11.6	9.3	13.4	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

X1-11

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

X_1-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	X1A	610.0	17.0	184.0	26.0	21.0	35.0	50.0	21.0	88.0	0.5
1.0	X1B	590.0	17.0	172.0	16.0	22.0	24.0	37.0	20.0	88.0	1.0
1.5	X1C	618.0	17.0	180.0	18.0	17.0	24.0	38.0	22.0	98.0	1.5
2.0	X1D	594.0	17.0	170.0	16.0	17.0	28.0	39.0	19.0	134.0	2.0
2.5	X1E	628.0	18.0	166.0	17.0	19.0	29.0	44.0	20.0	126.0	2.5
3.0	X1F	671.0	21.0	171.0	19.0	19.0	33.0	41.0	21.0	145.0	3.0
3.5	X1G	652.0	20.0	172.0	26.0	17.0	32.0	34.0	20.0	149.0	3.5
4.0	X1H	637.0	19.0	170.0	24.0	18.0	32.0	22.0	19.0	112.0	4.0
4.5	X1I	695.0	20.0	179.0	25.0	22.0	29.0	9.0	18.0	97.0	4.5
5.0	X1J	650.0	19.0	171.0	23.0	18.0	20.0	17.0	18.0	77.0	5.0
6.0	X1K	577.0	19.0	196.0	16.0	15.0	19.0	16.0	18.0	84.0	6.0
7.0	X1L	570.0	19.0	193.0	15.0	16.0	20.0	14.0	18.0	82.0	7.0
8.0	X1M	543.0	19.0	187.0	15.0	14.0	19.0	19.0	18.0	70.0	8.0
9.0	X1N	530.0	19.0	187.0	14.0	15.0	18.0	12.0	17.0	67.0	9.0
10.0	X1O	518.0	17.0	190.0	15.0	15.0	21.0	18.0	18.0	67.0	10.0
11.0	X1P	539.0	18.0	186.0	13.0	15.0	21.0	18.0	18.0	78.0	11.0
12.0	X1Q	536.0	18.0	187.0	14.0	16.0	19.0	15.0	17.0	73.0	12.0
13.0	X1R	379.0	17.0	181.0	13.0	16.0	26.0	18.0	16.0	65.0	13.0
14.0	X1S	418.0	15.0	171.0	12.0	16.0	25.0	17.0	16.0	61.0	14.0
15.0	X1T	492.0	11.0	177.0	11.0	15.0	24.0	19.0	17.0	86.0	15.0
16.0	X1U	479.0	13.0	167.0	17.0	15.0	24.0	12.0	16.0	59.0	16.0
17.0	X1V	562.0	16.0	192.0	12.0	16.0	24.0	16.0	18.0	58.0	17.0
18.0	X1W	576.0	19.0	185.0	14.0	17.0	25.0	15.0	18.0	63.0	18.0
19.0	X1X	511.0	18.0	188.0	13.0	17.0	24.0	16.0	17.0	67.0	19.0
20.0	X1Y	548.0	19.0	182.0	13.0	17.0	25.0	15.0	18.0	60.0	20.0
25.0	X1ZA	680.0	19.0	148.0	13.0	19.0	16.0	9.0	14.0	42.0	25.0
30.0	X1ZB	717.0	22.0	201.0	17.0	21.0	26.0	8.0	18.0	54.0	30.0
35.0	X1ZC	740.0	20.0	205.0	17.0	17.0	22.0	4.0	19.0	55.0	35.0
40.0	X1ZD	781.0	23.0	207.0	19.0	18.0	26.0	5.0	19.0	63.0	40.0
45.0	X1ZE	822.0	24.0	210.0	21.0	21.0	20.0	7.0	21.0	58.0	45.0
50.0	X1ZF	800.0	24.0	209.0	19.0	29.0	21.0	4.0	19.0	65.0	50.0
MEAN		602.0	18.5	183.4	16.9	17.7	24.2	19.6	18.3	80.4	
COEF VAR		17.1	14.6	7.7	24.9	16.9	19.1	62.8	9.2	33.5	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	X1A	0.0965	0.1049	0.4718	0.2131	0.3088	0.3535	3.8462	0.1544	1.1579	0.5
1.0	X1B	0.0934	0.1049	0.4410	0.1311	0.3235	0.2424	2.8462	0.1471	1.1579	1.0
1.5	X1C	0.0978	0.1049	0.4615	0.1475	0.2500	0.2424	2.9231	0.1618	1.2895	1.5
2.0	X1D	0.0940	0.1049	0.4359	0.1311	0.2500	0.2828	3.0000	0.1397	1.7632	2.0
2.5	X1E	0.0994	0.1111	0.4256	0.1393	0.2794	0.2929	3.3846	0.1471	1.6579	2.5
3.0	X1F	0.1062	0.1296	0.4385	0.1557	0.2794	0.3333	3.1538	0.1544	1.9079	3.0
3.5	X1G	0.1032	0.1235	0.4410	0.2131	0.2500	0.3232	2.6154	0.1471	1.9605	3.5
4.0	X1H	0.1008	0.1173	0.4359	0.1967	0.2647	0.3232	1.6923	0.1397	1.4737	4.0
4.5	X1I	0.1100	0.1235	0.4590	0.2049	0.3235	0.2929	0.6923	0.1324	1.2763	4.5
5.0	X1J	0.1028	0.1173	0.4385	0.1885	0.2647	0.2020	1.3077	0.1324	1.0132	5.0
6.0	X1K	0.0913	0.1173	0.5026	0.1311	0.2206	0.1919	1.2308	0.1324	1.1053	6.0
7.0	X1L	0.0902	0.1173	0.4949	0.1230	0.2353	0.2020	1.0769	0.1324	1.0789	7.0
8.0	X1M	0.0859	0.1173	0.4795	0.1230	0.2059	0.1919	1.4615	0.1324	0.9211	8.0
9.0	X1N	0.0839	0.1173	0.4795	0.1148	0.2206	0.1818	0.9231	0.1250	0.8816	9.0
10.0	X1O	0.0820	0.1049	0.4872	0.1230	0.2206	0.2121	1.3846	0.1324	0.8816	10.0
11.0	X1P	0.0853	0.1111	0.4769	0.1066	0.2206	0.2121	1.3846	0.1324	1.0263	11.0
12.0	X1Q	0.0848	0.1111	0.4795	0.1148	0.2353	0.1919	1.1538	0.1250	0.9605	12.0
13.0	X1R	0.0600	0.1049	0.4641	0.1066	0.2353	0.2626	1.3846	0.1176	0.8553	13.0
14.0	X1S	0.0661	0.0926	0.4385	0.0984	0.2353	0.2525	1.3077	0.1176	0.8026	14.0
15.0	X1T	0.0778	0.0679	0.4538	0.0902	0.2206	0.2424	1.4615	0.1250	1.1316	15.0
16.0	X1U	0.0758	0.0802	0.4282	0.1393	0.2206	0.2424	0.9231	0.1176	0.7763	16.0
17.0	X1V	0.0889	0.0988	0.4923	0.0984	0.2353	0.2424	1.2308	0.1324	0.7632	17.0
18.0	X1W	0.0911	0.1173	0.4744	0.1148	0.2500	0.2525	1.1538	0.1324	0.8289	18.0
19.0	X1X	0.0809	0.1111	0.4821	0.1066	0.2500	0.2424	1.2308	0.1250	0.8816	19.0
20.0	X1Y	0.0867	0.1173	0.4667	0.1066	0.2500	0.2525	1.1538	0.1324	0.7895	20.0
25.0	X1ZA	0.1076	0.1173	0.3795	0.1066	0.2794	0.1616	0.6923	0.1029	0.5526	25.0
30.0	X1ZB	0.1134	0.1358	0.5154	0.1393	0.3088	0.2626	0.6154	0.1324	0.7105	30.0
35.0	X1ZC	0.1171	0.1235	0.5256	0.1393	0.2500	0.2222	0.3077	0.1397	0.7237	35.0
40.0	X1ZD	0.1236	0.1420	0.5308	0.1557	0.2647	0.2626	0.3846	0.1397	0.8289	40.0
45.0	X1ZE	0.1301	0.1481	0.5385	0.1721	0.3088	0.2020	0.5385	0.1544	0.7632	45.0
50.0	X1ZF	0.1266	0.1481	0.5359	0.1557	0.4265	0.2121	0.3077	0.1397	0.8553	50.0
MEAN		0.0953	0.1143	0.4701	0.1383	0.2609	0.2447	1.5087	0.1347	1.0573	
COEF VAR		17.1	14.6	7.7	24.9	16.9	19.1	62.8	9.2	33.5	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

X1-13

Michipocoten Island

Lake CU

Alkalinity 0.04 Meq/L

pH 6.1

GENERAL SETTING AND DESCRIPTION

CU-2

Data not available

Data not available

DETAILS OF LAKE WATER CHEMISTRY

CU-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		19	9.4/100	19
1		17.5	9.0/93	20
2		17.2	8.5/87	23
3		17.1	8.5/87	24
4		17.0	8.0/82	25
	4.1			
5		15.0	8.0/79	25
6		12.8	7.6/72	25
7		12.1	6.7/62	27

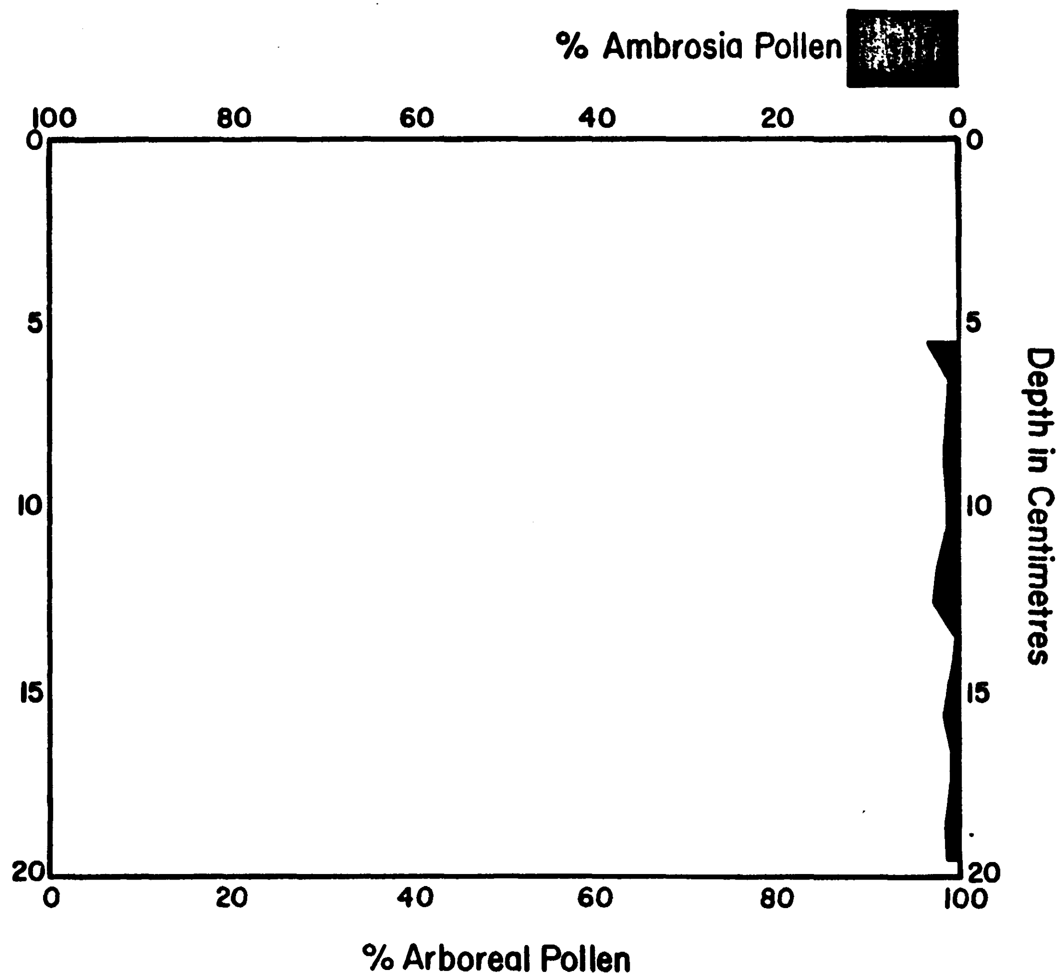
* Specific conductivity data are temperature-corrected (25°C).

NO POLLEN DIAGRAM AVAILABLE

CU-5

AMBROSIA RISE DIAGRAM

CU-6



PALYNOLOGY NOTES NOT AVAILABLE

CU-7

CU-7

WEIGHT DATA (0-50 cm)

CU-8

LAKE CU

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CUA	1.421	.062	95.56	80
CUB	3.893	.166	95.73	60
CUC	5.395	.246	95.44	50
CUD	4.643	.217	95.3	60
CUE	6.337	.305	95.17	50
CUF	3.608	.179	95.01	50
CUG	5.837	.322	94.46	40
CUH	3.358	.186	94.43	50
CUI	4.89	.262	94.64	50
CUJ	4.279	.211	95.04	50
CUK	5.484	.321	94.14	48
CUL	4.921	.225	95.4	NO DATA
CUM	5.594	.245	95.6	52
CUN	6.148	.239	96.11	52
CUO	5.481	.23	95.78	NO DATA
CUP	5.289	.264	95	52
CUQ	7.139	.319	95.53	52
CUR	4.232	.196	95.36	48
CUS	5.885	.252	95.7	NO DATA
CUT	5.586	.26	95.32	48
CUU	6.646	.333	94.99	48
CUV	4.648	.255	94.51	48
CUW	6.961	.363	94.78	48
CUX	6.111	.324	94.68	48
CUY	7.699	.433	94.37	52
CUZA	9.189	.596	93.5	48
CUZB	10.969	.728	93.36	52
CUZC	10.149	.714	92.96	48
CUZD	10.109	.669	93.37	48
CUZE	9.53	.64	93.28	44
CUZF	8.26	.62	92.49	44

CU-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

CU-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CUA	12600.	13376.	336.	1875.	554.	815.	1840.	1017.	0.5
1.0	CUB	16476.	15000.	304.	2477.	727.	1062.	2471.	924.	1.0
1.5	CUC	25306.	19850.	336.	3687.	1410.	1587.	3805.	957.	1.5
2.0	CUD	24030.	15113.	300.	3596.	1361.	1526.	3608.	889.	2.0
2.5	CUE	26389.	15136.	305.	3655.	1414.	1620.	3958.	908.	2.5
3.0	CUF	26118.	15237.	508.	3750.	1409.	1614.	3915.	1518.	3.0
3.5	CUG	29895.	15695.	307.	4024.	1545.	1790.	5117.	930.	3.5
4.0	CUH	28132.	15702.	346.	3773.	1419.	1669.	3996.	1012.	4.0
4.5	CUI	27675.	15028.	354.	3699.	1382.	1627.	4048.	1015.	4.5
5.0	CUJ	28841.	15627.	368.	3781.	1418.	1662.	4314.	1072.	5.0
6.0	CUK	26924.	15642.	277.	3022.	1135.	1477.	3926.	934.	6.0
7.0	CUL	*****	*****	*****	*****	*****	*****	*****	*****	7.0
8.0	CUM	27552.	13154.	269.	1915.	822.	1095.	4617.	880.	8.0
9.0	CUN	27020.	12279.	279.	1825.	764.	1052.	4739.	854.	9.0
10.0	CUO	*****	*****	*****	*****	*****	*****	*****	*****	10.0
11.0	CUP	26399.	11020.	265.	1895.	837.	1073.	4698.	798.	11.0
12.0	CUQ	27913.	10429.	270.	2093.	980.	1151.	4787.	838.	12.0
13.0	CUR	*****	*****	*****	*****	*****	*****	*****	*****	13.0
14.0	CUS	28878.	11062.	280.	2140.	1037.	1205.	4924.	896.	14.0
15.0	CUT	29152.	10487.	279.	2268.	1123.	1254.	5031.	917.	15.0
16.0	CUU	29057.	10634.	280.	2363.	1120.	1310.	5212.	913.	16.0
17.0	CUV	28457.	10511.	275.	2533.	1186.	1359.	5261.	897.	17.0
18.0	CUW	28145.	10160.	277.	2680.	1253.	1440.	5390.	911.	18.0
19.0	CUX	28148.	10151.	287.	2736.	1242.	1471.	5375.	921.	19.0
20.0	CUY	27952.	9747.	281.	2849.	1251.	1544.	5488.	905.	20.0
25.0	CUZA	32073.	9536.	230.	2749.	1269.	1531.	4692.	881.	25.0
30.0	CUZB	30615.	10097.	309.	2957.	*****	1645.	4664.	1001.	30.0
35.0	CUZC	32804.	10342.	295.	3474.	1601.	1796.	4925.	1027.	35.0
40.0	CUZD	32693.	10140.	293.	3016.	1447.	1599.	5443.	1192.	40.0
45.0	CUZE	33197.	10686.	269.	2721.	1205.	1475.	5339.	1266.	45.0
50.0	CUZF	33309.	10644.	258.	2955.	1669.	1547.	5393.	1192.	50.0
MEAN		27705.4	12588.7	301.3	2875.3	1206.7	1428.4	4534.9	980.9	
COEF VAR		15.8	21.2	16.6	23.5	22.9	17.3	19.2	15.2	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CUA	0.15072	0.21505	0.31698	0.10190	0.02441	0.02949	0.03948	0.90804	0.5
1.0	CUB	0.19708	0.24116	0.28679	0.13462	0.03203	0.03842	0.05303	0.82500	1.0
1.5	CUC	0.30270	0.31913	0.31698	0.20038	0.06211	0.05742	0.08165	0.85446	1.5
2.0	CUD	0.28744	0.24297	0.28302	0.19543	0.05996	0.05521	0.07742	0.79375	2.0
2.5	CUE	0.31566	0.24334	0.28774	0.19864	0.06229	0.05861	0.08494	0.81071	2.5
3.0	CUF	0.31242	0.24497	0.47925	0.20380	0.06207	0.05839	0.08401	1.35536	3.0
3.5	CUG	0.35760	0.25233	0.28962	0.21870	0.06806	0.06476	0.10981	0.83036	3.5
4.0	CUH	0.33651	0.25244	0.32642	0.20505	0.06251	0.06038	0.08575	0.90357	4.0
4.5	CUI	0.33104	0.24161	0.33396	0.20103	0.06088	0.05886	0.08687	0.90625	4.5
5.0	CUJ	0.34499	0.25124	0.34717	0.20549	0.06247	0.06013	0.09258	0.95714	5.0
6.0	CUK	0.32206	0.25148	0.26132	0.16424	0.05000	0.05344	0.08425	0.83393	6.0
7.0	CUL	******	******	******	******	******	******	******	******	7.0
8.0	CUM	0.32957	0.21148	0.25377	0.10408	0.03621	0.03962	0.09908	0.78571	8.0
9.0	CUN	0.32321	0.19741	0.26321	0.09918	0.03366	0.03806	0.10170	0.76250	9.0
10.0	CUO	******	******	******	******	******	******	******	******	10.0
11.0	CUP	0.31578	0.17717	0.25000	0.10299	0.03687	0.03882	0.10082	0.71250	11.0
12.0	CUQ	0.33389	0.16767	0.25472	0.11375	0.04317	0.04164	0.10273	0.74821	12.0
13.0	CUR	******	******	******	******	******	******	******	******	13.0
14.0	CUS	0.34543	0.17785	0.26415	0.11630	0.04568	0.04360	0.10567	0.80000	14.0
15.0	CUT	0.34871	0.16860	0.26321	0.12326	0.04947	0.04537	0.10796	0.81875	15.0
16.0	CUU	0.34757	0.17096	0.26415	0.12842	0.04934	0.04740	0.11185	0.81518	16.0
17.0	CUV	0.34039	0.16899	0.25943	0.13766	0.05225	0.04917	0.11290	0.80089	17.0
18.0	CUW	0.33666	0.16334	0.26132	0.14565	0.05520	0.05210	0.11567	0.81339	18.0
19.0	CUX	0.33670	0.16320	0.27075	0.14870	0.05471	0.05322	0.11534	0.82232	19.0
20.0	CUY	0.33435	0.15670	0.26509	0.15484	0.05511	0.05586	0.11777	0.80804	20.0
25.0	CUZA	0.38365	0.15331	0.21698	0.14940	0.05590	0.05539	0.10069	0.78661	25.0
30.0	CUZB	0.36621	0.16233	0.29151	0.16071	******	0.05952	0.10009	0.89375	30.0
35.0	CUZC	0.39239	0.16627	0.27830	0.18880	0.07053	0.06498	0.10569	0.91696	35.0
40.0	CUZD	0.39106	0.16302	0.27642	0.16391	0.06374	0.05785	0.11680	1.06429	40.0
45.0	CUZE	0.39709	0.17180	0.25377	0.14788	0.05308	0.05336	0.11457	1.13036	45.0
50.0	CUZF	0.39843	0.17113	0.24340	0.16060	0.07352	0.05597	0.11573	1.06429	50.0
MEAN		0.33140	0.20239	0.28427	0.15627	0.05316	0.05168	0.09731	0.87580	
COEF VAR		15.8	21.2	16.6	23.5	22.9	17.3	19.2	15.2	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

CU-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CUA	337.0	13.0	166.0	8.0	20.0	14.0	80.0	16.0	120.0	0.5
1.0	CUB	424.0	16.0	172.0	16.0	30.0	18.0	226.0	21.0	168.0	1.0
1.5	CUC	661.0	24.0	195.0	16.0	32.0	22.0	199.0	32.0	316.0	1.5
2.0	CUD	629.0	24.0	181.0	16.0	34.0	24.0	191.0	30.0	351.0	2.0
2.5	CUE	691.0	25.0	187.0	17.0	32.0	23.0	185.0	32.0	403.0	2.5
3.0	CUF	688.0	27.0	297.0	18.0	32.0	24.0	184.0	33.0	382.0	3.0
3.5	CUG	750.0	28.0	169.0	19.0	35.0	25.0	188.0	35.0	412.0	3.5
4.0	CUH	706.0	26.0	184.0	17.0	35.0	20.0	165.0	33.0	353.0	4.0
4.5	CUI	677.0	25.0	163.0	17.0	31.0	17.0	153.0	33.0	336.0	4.5
5.0	CUJ	696.0	26.0	165.0	17.0	33.0	21.0	149.0	33.0	317.0	5.0
6.0	CUK	451.0	20.0	156.0	15.0	33.0	21.0	124.0	28.0	224.0	6.0
7.0	CUL	*****	*****	*****	*****	*****	*****	*****	*****	*****	7.0
8.0	CUM	338.0	16.0	131.0	13.0	34.0	22.0	51.0	21.0	139.0	8.0
9.0	CUN	344.0	17.0	126.0	13.0	34.0	18.0	48.0	21.0	120.0	9.0
10.0	CUO	*****	*****	*****	*****	*****	*****	*****	*****	*****	10.0
11.0	CUP	347.0	17.0	121.0	13.0	32.0	19.0	27.0	22.0	97.0	11.0
12.0	CUQ	387.0	17.0	124.0	13.0	45.0	19.0	24.0	22.0	84.0	12.0
13.0	CUR	*****	*****	*****	*****	*****	*****	*****	*****	*****	13.0
14.0	CUS	416.0	18.0	126.0	13.0	33.0	19.0	30.0	24.0	94.0	14.0
15.0	CUT	446.0	18.0	127.0	14.0	37.0	18.0	15.0	25.0	85.0	15.0
16.0	CUU	489.0	20.0	127.0	15.0	40.0	22.0	21.0	26.0	90.0	16.0
17.0	CUV	475.0	20.0	134.0	14.0	33.0	20.0	23.0	25.0	105.0	17.0
18.0	CUW	532.0	22.0	138.0	16.0	33.0	14.0	23.0	26.0	102.0	18.0
19.0	CUX	525.0	21.0	139.0	16.0	31.0	19.0	21.0	26.0	100.0	19.0
20.0	CUY	547.0	21.0	138.0	15.0	65.0	71.0	27.0	27.0	98.0	20.0
25.0	CUZA	633.0	22.0	156.0	15.0	44.0	17.0	19.0	26.0	100.0	25.0
30.0	CUZB	665.0	25.0	172.0	16.0	27.0	16.0	10.0	29.0	93.0	30.0
35.0	CUZC	799.0	29.0	174.0	17.0	49.0	13.0	11.0	31.0	98.0	35.0
40.0	CUZD	681.0	26.0	168.0	17.0	44.0	15.0	12.0	30.0	95.0	40.0
45.0	CUZE	695.0	29.0	157.0	17.0	47.0	15.0	10.0	31.0	105.0	45.0
50.0	CUZF	731.0	31.0	159.0	18.0	48.0	14.0	10.0	31.0	121.0	50.0
MEAN		562.9	22.3	159.0	15.4	36.5	20.7	79.5	27.5	182.4	
COEF VAR		25.4	20.7	21.5	14.2	23.4	49.3	94.8	17.2	63.7	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CUA	0.0533	0.0802	0.4256	0.0656	0.2941	0.1414	6.1538	0.1176	1.5789	0.5
1.0	CUB	0.0671	0.0988	0.4410	0.1311	0.4412	0.1818	*****	0.1544	2.2105	1.0
1.5	CUC	0.1046	0.1481	0.5000	0.1311	0.4706	0.2222	*****	0.2353	4.1579	1.5
2.0	CUD	0.0995	0.1481	0.4641	0.1311	0.5000	0.2424	*****	0.2206	4.6184	2.0
2.5	CUE	0.1093	0.1543	0.4795	0.1393	0.4706	0.2323	*****	0.2353	5.3026	2.5
3.0	CUF	0.1089	0.1667	0.7615	0.1475	0.4706	0.2424	*****	0.2426	5.0263	3.0
3.5	CUG	0.1187	0.1728	0.4333	0.1557	0.5147	0.2525	*****	0.2574	5.4211	3.5
4.0	CUH	0.1117	0.1605	0.4718	0.1393	0.5147	0.2020	*****	0.2426	4.6447	4.0
4.5	CUI	0.1071	0.1543	0.4179	0.1393	0.4559	0.1717	*****	0.2426	4.4211	4.5
5.0	CUJ	0.1101	0.1605	0.4231	0.1393	0.4853	0.2121	*****	0.2426	4.1711	5.0
6.0	CUK	0.0714	0.1235	0.4000	0.1230	0.4853	0.2121	9.5385	0.2059	2.9474	6.0
7.0	CUL	*****	*****	*****	*****	*****	*****	*****	*****	*****	7.0
8.0	CUM	0.0535	0.0988	0.3359	0.1066	0.5000	0.2222	3.9231	0.1544	1.8289	8.0
9.0	CUN	0.0544	0.1049	0.3231	0.1066	0.5000	0.1818	3.6923	0.1544	1.5789	9.0
10.0	CUO	*****	*****	*****	*****	*****	*****	*****	*****	*****	10.0
11.0	CUP	0.0549	0.1049	0.3103	0.1066	0.4706	0.1919	2.0769	0.1618	1.2763	11.0
12.0	CUQ	0.0612	0.1049	0.3179	0.1066	0.6618	0.1919	1.8462	0.1618	1.1053	12.0
13.0	CUR	*****	*****	*****	*****	*****	*****	*****	*****	*****	13.0
14.0	CUS	0.0658	0.1111	0.3231	0.1066	0.4853	0.1919	2.3077	0.1765	1.2368	14.0
15.0	CUT	0.0706	0.1111	0.3256	0.1148	0.5441	0.1818	1.1538	0.1838	1.1184	15.0
16.0	CUU	0.0774	0.1235	0.3256	0.1230	0.5882	0.2222	1.6154	0.1912	1.1842	16.0
17.0	CUV	0.0752	0.1235	0.3436	0.1148	0.4853	0.2020	1.7692	0.1838	1.3816	17.0
18.0	CUW	0.0842	0.1358	0.3538	0.1311	0.4853	0.1414	1.7692	0.1912	1.3421	18.0
19.0	CUX	0.0831	0.1296	0.3564	0.1311	0.4559	0.1919	1.6154	0.1912	1.3158	19.0
20.0	CUY	0.0866	0.1296	0.3538	0.1230	0.9559	0.7172	2.0769	0.1985	1.2895	20.0
25.0	CUZA	0.1002	0.1358	0.4000	0.1230	0.6471	0.1717	1.4615	0.1912	1.3158	25.0
30.0	CUZB	0.1052	0.1543	0.4410	0.1311	0.3971	0.1616	0.7692	0.2132	1.2237	30.0
35.0	CUZC	0.1264	0.1790	0.4462	0.1393	0.7206	0.1313	0.8462	0.2279	1.2895	35.0
40.0	CUZD	0.1078	0.1605	0.4308	0.1393	0.6471	0.1515	0.9231	0.2206	1.2500	40.0
45.0	CUZE	0.1100	0.1790	0.4026	0.1393	0.6912	0.1515	0.7692	0.2279	1.3816	45.0
50.0	CUZF	0.1157	0.1914	0.4077	0.1475	0.7059	0.1414	0.7692	0.2279	1.5921	50.0
MEAN		0.0891	0.1373	0.4077	0.1262	0.5373	0.2092	6.1154	0.2019	2.4004	
COEF VAR		25.4	20.7	21.5	14.2	23.4	49.3	94.8	17.2	63.7	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

Verification Study
Previously Sampled in 1981

Lake W_1

Alkalinity 0.33 Meq/L
pH 6.7

GENERAL SETTING AND DESCRIPTION

W_1-2

Refer to 1981 Descriptive and Geochemical Data
(Part II - Section 1, pgs. W-2 and W-3)

Refer to 1981 Descriptive and Geochemical Data
(Part II - Section 1, pgs. W-1 and W-3)

DETAILS OF LAKE WATER CHEMISTRY

W_1-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		16.2	9.6/100	163
1		17.0	8.7/89	163
2	2	17.0	7.3/75	215

* Specific conductivity data are temperature-corrected (25°C).

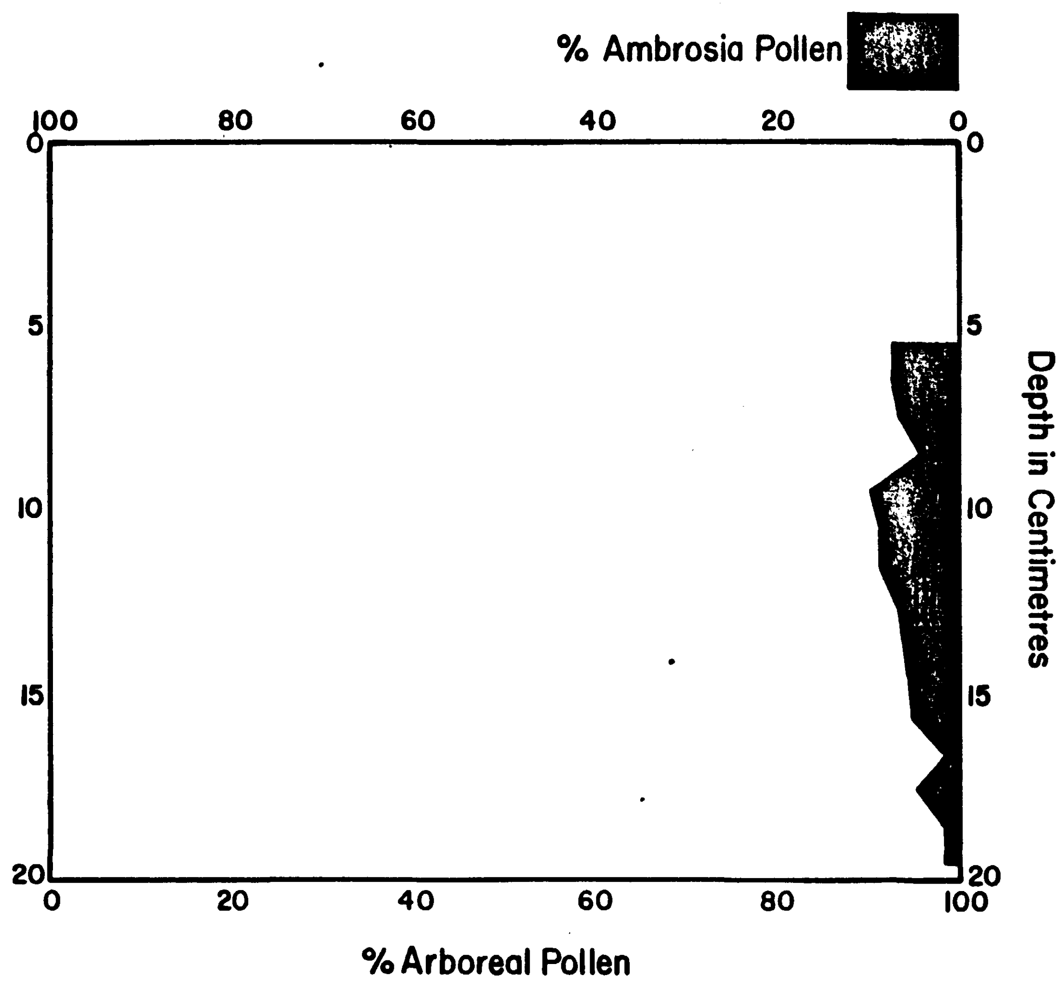
NO POLLEN DIAGRAM AVAILABLE

W_1-5

W_1-5

AMBROSIA RISE DIAGRAM

W_1-6



PALYNOLOGY NOTES NOT AVAILABLE

W_1-7 W_1-7

WEIGHT DATA (0-50 cm)

LAKE W_1

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
W1A	8.999	.192	97.85	60
W1B	5.57	.297	94.66	60
W1C	4.582	.288	93.69	60
W1D	5.201	.313	93.98	50
W1E	5.139	.337	93.44	50
W1F	4.234	.289	93.17	60
W1G	5.166	.327	93.65	70
W1H	3.682	.225	93.88	60
W1I	4.225	.254	93.98	50
W1J	3.693	.234	93.63	60
W1K	5.881	.313	94.66	68
W1L	6.075	.28	95.37	72
W1M	5.971	.303	94.9	60
W1N	6.388	.28	95.61	56
W1O	2.57	.261	89.8	56
W1P	5.424	.196	96.36	NO DATA
W1Q	5.861	.204	96.5	NO DATA
W1K	5.586	.192	96.54	NO DATA
W1S	5.877	.213	96.37	NO DATA
W1T	7.647	.275	96.4	52
W1U	6.643	.253	96.17	NO DATA
W1V	9.53	.368	96.12	60
W1W	6.348	.259	95.9	56
W1X	6.449	.256	96.01	60
W1Y	6.14	.256	95.81	56
W1ZA	11.27	.699	93.79	56
W1ZB	10.109	.532	94.72	32
W1ZC	9.77	.538	94.49	60
W1ZD	9.429	.544	94.22	56
W1ZE	11.859	.703	94.06	60
W1ZF	8.549	.504	94.09	60

W1-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

W_1-10

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	W1A	11970.	54940.	1951.	2667.	1758.	3672.	11993.	869.	0.5
1.0	W1B	11667.	53199.	1907.	2534.	1722.	3464.	14525.	787.	1.0
1.5	W1C	12205.	56083.	1905.	2651.	1792.	3307.	16675.	810.	1.5
2.0	W1D	12051.	56110.	1822.	2571.	1799.	3346.	16285.	816.	2.0
2.5	W1E	11007.	52236.	1012.	2164.	1574.	2418.	13145.	678.	2.5
3.0	W1F	11454.	49346.	950.	2169.	1584.	2385.	15099.	614.	3.0
3.5	W1G	10888.	47999.	774.	2024.	1402.	2103.	13575.	535.	3.5
4.0	W1H	10764.	48583.	779.	2095.	1363.	2144.	14498.	518.	4.0
4.5	W1I	11114.	46353.	830.	2146.	1399.	2268.	14375.	521.	4.5
5.0	W1J	11002.	40599.	734.	2133.	1331.	2105.	14285.	462.	5.0
6.0	W1K	7882.	22675.	382.	1940.	788.	1453.	9309.	370.	6.0
7.0	W1L	7255.	18356.	326.	1796.	602.	1308.	8443.	326.	7.0
8.0	W1M	12676.	24979.	458.	2887.	1361.	2080.	15575.	581.	8.0
9.0	W1N	12485.	18412.	402.	2897.	1407.	1974.	15737.	554.	9.0
10.0	W1O	11734.	10834.	349.	2641.	1298.	1813.	18478.	560.	10.0
11.0	W1P	*****	*****	*****	*****	*****	*****	*****	*****	11.0
12.0	W1Q	*****	*****	*****	*****	*****	*****	*****	*****	12.0
13.0	W1R	*****	*****	*****	*****	*****	*****	*****	*****	13.0
14.0	W1S	*****	*****	*****	*****	*****	*****	*****	*****	14.0
15.0	W1T	7470.	6642.	249.	1541.	749.	1255.	13697.	462.	15.0
16.0	W1U	*****	*****	*****	*****	*****	*****	*****	*****	16.0
17.0	W1V	6596.	5147.	205.	1238.	534.	1092.	12571.	441.	17.0
18.0	W1W	6518.	5845.	235.	1135.	530.	1140.	13440.	452.	18.0
19.0	W1X	7079.	6581.	240.	1271.	705.	1136.	12106.	432.	19.0
20.0	W1Y	7416.	4833.	204.	1388.	1013.	1051.	11518.	364.	20.0
25.0	W1ZA	7964.	5427.	190.	216.	1267.	1274.	10049.	355.	25.0
30.0	W1ZB	8814.	5444.	187.	1445.	1428.	1356.	10586.	336.	30.0
35.0	W1ZC	10110.	4831.	171.	2129.	1343.	1535.	11820.	325.	35.0
40.0	W1ZD	10363.	4881.	99.	2386.	1354.	1523.	10485.	323.	40.0
45.0	W1ZE	11200.	4845.	73.	2819.	1366.	1621.	11074.	322.	45.0
50.0	W1ZF	13745.	4784.	72.	4274.	1969.	1762.	11434.	354.	50.0
MEAN		10131.9	25383.2	634.8	2121.4	1286.1	1945.6	13106.8	506.4	
COEF VAR		20.9	82.0	94.7	36.0	31.3	39.0	18.2	32.7	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	W1A	0.14318	0.88328	1.84057	0.14495	0.07744	0.13285	0.25736	0.77589	0.5
1.0	W1B	0.13956	0.85529	1.79906	0.13772	0.07586	0.12533	0.31170	0.70268	1.0
1.5	W1C	0.14599	0.90166	1.79717	0.14408	0.07894	0.11965	0.35783	0.72321	1.5
2.0	W1D	0.14415	0.90209	1.71887	0.13973	0.07925	0.12106	0.34946	0.72857	2.0
2.5	W1E	0.13166	0.83981	0.95472	0.11761	0.06934	0.08748	0.28208	0.60536	2.5
3.0	W1F	0.13701	0.79334	0.89623	0.11788	0.06978	0.08629	0.32401	0.54821	3.0
3.5	W1G	0.13024	0.77169	0.73019	0.11000	0.06176	0.07609	0.29131	0.47768	3.5
4.0	W1H	0.12876	0.78108	0.73491	0.11386	0.06004	0.07757	0.31112	0.46250	4.0
4.5	W1I	0.13294	0.74523	0.78302	0.11663	0.06163	0.08205	0.30848	0.46518	4.5
5.0	W1J	0.13160	0.65272	0.69245	0.11592	0.05863	0.07616	0.30655	0.41250	5.0
6.0	W1K	0.09428	0.36455	0.36038	0.10543	0.03471	0.05257	0.19976	0.33036	6.0
7.0	W1L	0.08678	0.29511	0.30755	0.09761	0.02652	0.04732	0.18118	0.29107	7.0
8.0	W1M	0.15163	0.40159	0.43208	0.15690	0.05996	0.07525	0.33423	0.51875	8.0
9.0	W1N	0.14934	0.29601	0.37925	0.15745	0.06198	0.07142	0.33770	0.49464	9.0
10.0	W1O	0.14036	0.17418	0.32925	0.14353	0.05718	0.06559	0.39652	0.50000	10.0
11.0	W1P	******	******	******	******	******	******	******	******	11.0
12.0	W1Q	******	******	******	******	******	******	******	******	12.0
13.0	W1R	******	******	******	******	******	******	******	******	13.0
14.0	W1S	******	******	******	******	******	******	******	******	14.0
15.0	W1T	0.08935	0.10678	0.23491	0.08375	0.03300	0.04541	0.29393	0.41250	15.0
16.0	W1U	******	******	******	******	******	******	******	******	16.0
17.0	W1V	0.07890	0.08275	0.19340	0.06728	0.02352	0.03951	0.26976	0.39375	17.0
18.0	W1W	0.07797	0.09397	0.22170	0.06168	0.02335	0.04124	0.28841	0.40357	18.0
19.0	W1X	0.08468	0.10580	0.22642	0.06908	0.03106	0.04110	0.25979	0.38571	19.0
20.0	W1Y	0.08871	0.07770	0.19245	0.07543	0.04463	0.03802	0.24717	0.32500	20.0
25.0	W1ZA	0.09526	0.08725	0.17925	0.01174	0.05581	0.04609	0.21564	0.31696	25.0
30.0	W1ZB	0.10543	0.08752	0.17642	0.07853	0.06291	0.04906	0.22717	0.30000	30.0
35.0	W1ZC	0.12093	0.07767	0.16132	0.11571	0.05916	0.05554	0.25365	0.29018	35.0
40.0	W1ZD	0.12396	0.07847	0.09340	0.12967	0.05965	0.05510	0.22500	0.28839	40.0
45.0	W1ZE	0.13397	0.07789	0.06887	0.15321	0.06018	0.05865	0.23764	0.28750	45.0
50.0	W1ZF	0.16441	0.07691	0.06792	0.23228	0.08674	0.06375	0.24536	0.31607	50.0
MEAN		0.12119	0.40809	0.59891	0.11529	0.05666	0.07039	0.28126	0.45216	
COEF VAR		20.9	82.0	94.7	36.0	31.3	39.0	18.2	32.7	

 LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK W1-11

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

W_1-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	W1A	416.0	15.0	114.0	9.0	38.0	26.0	100.0	17.0	135.0	0.5
1.0	W1B	406.0	14.0	103.0	9.0	36.0	25.0	96.0	17.0	138.0	1.0
1.5	W1C	428.0	16.0	108.0	9.0	37.0	28.0	98.0	18.0	141.0	1.5
2.0	W1D	411.0	15.0	104.0	8.0	50.0	27.0	106.0	17.0	150.0	2.0
2.5	W1E	405.0	14.0	87.0	8.0	38.0	25.0	103.0	14.0	143.0	2.5
3.0	W1F	401.0	15.0	90.0	10.0	42.0	24.0	101.0	16.0	167.0	3.0
3.5	W1G	372.0	13.0	79.0	8.0	42.0	29.0	97.0	15.0	176.0	3.5
4.0	W1H	379.0	13.0	84.0	9.0	56.0	26.0	99.0	15.0	161.0	4.0
4.5	W1I	367.0	13.0	87.0	11.0	49.0	34.0	99.0	15.0	164.0	4.5
5.0	W1J	367.0	13.0	81.0	10.0	49.0	29.0	98.0	15.0	166.0	5.0
6.0	W1K	270.0	16.0	60.0	9.0	41.0	15.0	56.0	13.0	96.0	6.0
7.0	W1L	234.0	11.0	60.0	8.0	34.0	13.0	46.0	12.0	84.0	7.0
8.0	W1M	419.0	17.0	97.0	11.0	69.0	22.0	56.0	17.0	154.0	8.0
9.0	W1N	405.0	17.0	103.0	11.0	76.0	23.0	65.0	17.0	177.0	9.0
10.0	W1O	376.0	17.0	97.0	11.0	100.0	52.0	55.0	15.0	128.0	10.0
11.0	W1P	*****	*****	*****	*****	*****	*****	*****	*****	*****	11.0
12.0	W1Q	*****	*****	*****	*****	*****	*****	*****	*****	*****	12.0
13.0	W1R	*****	*****	*****	*****	*****	*****	*****	*****	*****	13.0
14.0	W1S	*****	*****	*****	*****	*****	*****	*****	*****	*****	14.0
15.0	W1T	250.0	11.0	66.0	7.0	56.0	18.0	41.0	10.0	79.0	15.0
16.0	W1U	*****	*****	*****	*****	*****	*****	*****	*****	*****	16.0
17.0	W1V	189.0	9.0	59.0	6.0	67.0	20.0	24.0	8.0	57.0	17.0
18.0	W1W	196.0	9.0	58.0	6.0	63.0	19.0	24.0	9.0	60.0	18.0
19.0	W1X	181.0	9.0	55.0	7.0	66.0	12.0	30.0	8.0	66.0	19.0
20.0	W1Y	175.0	8.0	59.0	6.0	66.0	17.0	19.0	8.0	62.0	20.0
25.0	W1ZA	273.0	11.0	67.0	14.0	*****	10.0	16.0	12.0	53.0	25.0
30.0	W1ZB	315.0	12.0	64.0	14.0	*****	16.0	11.0	12.0	47.0	30.0
35.0	W1ZC	353.0	13.0	91.0	16.0	*****	18.0	11.0	13.0	55.0	35.0
40.0	W1ZD	365.0	14.0	92.0	14.0	*****	18.0	10.0	14.0	55.0	40.0
45.0	W1ZE	417.0	15.0	102.0	17.0	*****	14.0	13.0	16.0	62.0	45.0
50.0	W1ZF	492.0	16.0	116.0	17.0	*****	15.0	10.0	17.0	67.0	50.0
MEAN		340.8	13.3	84.0	10.2	53.8	22.1	57.1	13.8	109.3	
COEF VAR		25.8	19.6	22.7	31.7	30.6	38.3	64.6	22.2	42.8	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	W1A	0.0658	0.0926	0.2923	0.0738	0.5588	0.2626	7.6923	0.1250	1.7763	0.5
1.0	W1B	0.0642	0.0864	0.2641	0.0738	0.5294	0.2525	7.3846	0.1250	1.8158	1.0
1.5	W1C	0.0677	0.0988	0.2769	0.0738	0.5441	0.2828	7.5385	0.1324	1.8553	1.5
2.0	W1D	0.0650	0.0926	0.2667	0.0656	0.7353	0.2727	8.1538	0.1250	1.9737	2.0
2.5	W1E	0.0641	0.0864	0.2231	0.0656	0.5588	0.2525	7.9231	0.1029	1.8816	2.5
3.0	W1F	0.0634	0.0926	0.2308	0.0820	0.6176	0.2424	7.7692	0.1176	2.1974	3.0
3.5	W1G	0.0589	0.0802	0.2026	0.0656	0.6176	0.2929	7.4615	0.1103	2.3158	3.5
4.0	W1H	0.0600	0.0802	0.2154	0.0738	0.8235	0.2626	7.6154	0.1103	2.1184	4.0
4.5	W1I	0.0581	0.0802	0.2231	0.0902	0.7206	0.3434	7.6154	0.1103	2.1579	4.5
5.0	W1J	0.0581	0.0802	0.2077	0.0820	0.7206	0.2929	7.5385	0.1103	2.1842	5.0
6.0	W1K	0.0427	0.0988	0.1538	0.0738	0.6029	0.1515	4.3077	0.0956	1.2632	6.0
7.0	W1L	0.0370	0.0679	0.1538	0.0656	0.5000	0.1313	3.5385	0.0882	1.1053	7.0
8.0	W1M	0.0663	0.1049	0.2487	0.0902	1.0147	0.2222	4.3077	0.1250	2.0263	8.0
9.0	W1N	0.0641	0.1049	0.2641	0.0902	1.1176	0.2323	5.0000	0.1250	2.3289	9.0
10.0	W1O	0.0595	0.1049	0.2487	0.0902	1.4706	0.5253	4.2308	0.1103	1.6842	10.0
11.0	W1P	*****	*****	*****	*****	*****	*****	*****	*****	*****	11.0
12.0	W1Q	*****	*****	*****	*****	*****	*****	*****	*****	*****	12.0
13.0	W1R	*****	*****	*****	*****	*****	*****	*****	*****	*****	13.0
14.0	W1S	*****	*****	*****	*****	*****	*****	*****	*****	*****	14.0
15.0	W1T	0.0396	0.0679	0.1692	0.0574	0.8235	0.1818	3.1538	0.0735	1.0395	15.0
16.0	W1U	*****	*****	*****	*****	*****	*****	*****	*****	*****	16.0
17.0	W1V	0.0299	0.0556	0.1513	0.0492	0.9853	0.2020	1.8462	0.0588	0.7500	17.0
18.0	W1W	0.0310	0.0556	0.1487	0.0492	0.9265	0.1919	1.8462	0.0662	0.7895	18.0
19.0	W1X	0.0286	0.0556	0.1410	0.0574	0.9706	0.1212	2.3077	0.0588	0.8684	19.0
20.0	W1Y	0.0277	0.0494	0.1513	0.0492	0.9706	0.1717	1.4615	0.0588	0.8158	20.0
25.0	W1ZA	0.0432	0.0679	0.1718	0.1148	*****	0.1010	1.2308	0.0882	0.6974	25.0
30.0	W1ZB	0.0498	0.0741	0.1641	0.1148	*****	0.1616	0.8462	0.0882	0.6184	30.0
35.0	W1ZC	0.0559	0.0802	0.2333	0.1311	*****	0.1818	0.8462	0.0956	0.7237	35.0
40.0	W1ZD	0.0578	0.0864	0.2359	0.1148	*****	0.1818	0.7692	0.1029	0.7237	40.0
45.0	W1ZE	0.0660	0.0926	0.2615	0.1393	*****	0.1414	1.0000	0.1176	0.8158	45.0
50.0	W1ZF	0.0778	0.0988	0.2974	0.1393	*****	0.1515	0.7692	0.1250	0.8816	50.0
MEAN		0.0539	0.0821	0.2153	0.0835	0.7904	0.2234	4.3905	0.1018	1.4388	
COEF VAR		25.8	19.6	22.7	31.7	30.6	38.3	64.6	22.2	42.8	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

Verification Study
Previously Sampled in 1981

Lake W_4

Alkalinity 0.47 Meq/L
pH 7.7

GENERAL SETTING AND DESCRIPTION

W4-2

Refer to 1981 Descriptive and Geochemical Data (Part II - Section 1, pgs. W-2 and W-3)

Refer to 1981 Descriptive and Geochemical Data
(Part II - Section 1, pgs. W-1 and W-3)

DETAILS OF LAKE WATER CHEMISTRY

W_4-4

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		15.9	9.5/100	159
1		15.8	9.2/92	161
2		15.5	7.7/70	161
2.2	visible on lake bottom	15.5	6.8/64	170

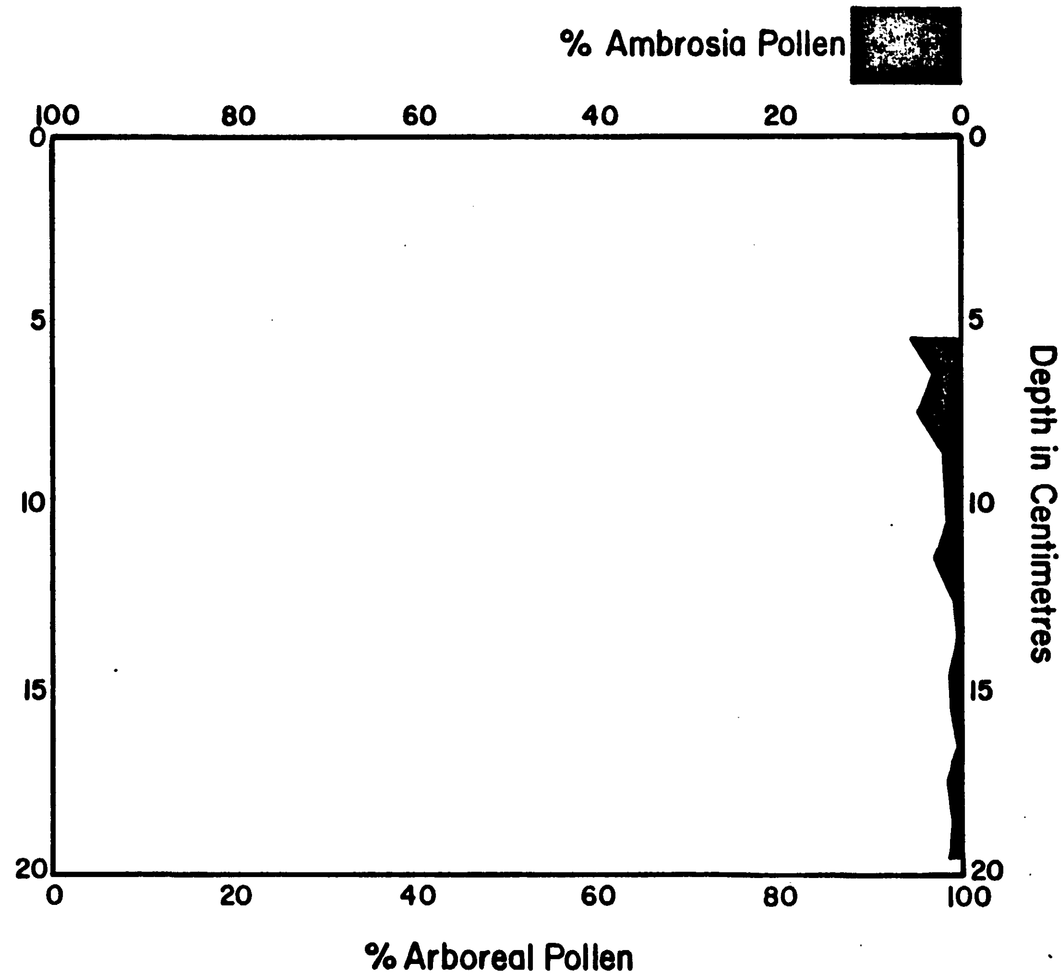
* Specific conductivity data are temperature-corrected (25°C).

NO POLLEN DIAGRAM AVAILABLE

W4-5 W4-5

AMBROSIA RISE DIAGRAM

W4-6



PALYNOLOGY NOTES NOT AVAILABLE

W4-7

WEIGHT DATA (0-50 cm)

W_4-8

LAKE W_4

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
W4A	.518	.053	89.59	20
W4B	3.216	.319	90.05	20
W4C	5.765	.602	89.54	20
W4D	3.679	.377	89.72	10
W4E	4.445	.486	89.04	10
W4F	4.112	.471	88.52	20
W4G	3.261	.402	87.67	20
W4H	3.508	.447	87.23	20
W4I	3.122	.382	87.76	30
W4J	4.893	.538	89	30
W4K	4.21	.378	90.99	36
W4L	5.41	.484	91.03	36
W4M	4.725	.396	91.59	32
W4N	4.6	.33	92.82	28
W4O	5.248	.362	93.1	32
W4P	5.537	.346	93.73	36
W4Q	4.145	.323	92.2	32
W4R	5.499	.367	93.3	32
W4S	5.55	.379	93.17	28
W4T	5.041	.355	92.93	32
W4U	5.958	.408	93.13	32
W4V	4.441	.311	92.99	36
W4W	3.702	.271	92.65	28
W4X	4.555	.346	92.38	32
W4Y	4.883	.379	92.21	28
W4ZA	8.859	.73	91.74	28
W4ZB	12.17	.916	92.46	36
W4ZC	10.6	.67	93.67	44
W4ZD	12.28	.705	94.25	40
W4ZE	9.17	.539	94.11	48
W4ZF	9.67	.49	94.93	56

W4-9

W4-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	W4A	27254.	45953.	2758.	6202.	6999.	5000.	9667.	369.	0.5
1.0	W4B	27977.	47028.	2296.	6334.	7184.	5126.	9684.	388.	1.0
1.5	W4C	28327.	39252.	1580.	6428.	7323.	5144.	9369.	378.	1.5
2.0	W4D	28539.	37039.	1399.	6519.	6927.	4956.	9390.	385.	2.0
2.5	W4E	30163.	34475.	1239.	6867.	7577.	4888.	9831.	397.	2.5
3.0	W4F	30042.	33835.	1071.	6848.	7523.	4653.	9527.	358.	3.0
3.5	W4G	28044.	36460.	1031.	6362.	6963.	4367.	9386.	337.	3.5
4.0	W4H	29429.	35942.	902.	6608.	7565.	4321.	10003.	353.	4.0
4.5	W4I	30685.	36616.	862.	6797.	7556.	4395.	9834.	352.	4.5
5.0	W4J	26736.	33465.	680.	5891.	6534.	3878.	9352.	342.	5.0
6.0	W4K	25161.	27426.	494.	5807.	7131.	3375.	8806.	258.	6.0
7.0	W4L	24221.	25860.	471.	4339.	5050.	3318.	8399.	269.	7.0
8.0	W4M	25959.	22463.	466.	5758.	7493.	3567.	9038.	261.	8.0
9.0	W4N	22148.	20291.	337.	4820.	5667.	3150.	7923.	237.	9.0
10.0	W4O	20235.	16982.	372.	4478.	4972.	2900.	8511.	234.	10.0
11.0	W4P	17743.	13229.	267.	3734.	4381.	2533.	7823.	205.	11.0
12.0	W4Q	19150.	12906.	317.	4161.	4623.	2718.	8330.	224.	12.0
13.0	W4R	17561.	10508.	275.	3683.	4109.	2505.	7767.	197.	13.0
14.0	W4S	17343.	8706.	264.	3728.	3924.	2471.	7789.	211.	14.0
15.0	W4T	16758.	7938.	215.	3557.	3660.	2356.	7695.	196.	15.0
16.0	W4U	17168.	7310.	192.	3638.	3631.	2362.	7999.	197.	16.0
17.0	W4V	18094.	7551.	201.	3803.	4054.	2469.	8597.	215.	17.0
18.0	W4W	17301.	8585.	178.	3822.	3838.	2348.	8118.	183.	18.0
19.0	W4X	16530.	6585.	160.	3478.	3877.	2208.	7387.	183.	19.0
20.0	W4Y	17548.	6133.	166.	3708.	4025.	2340.	7500.	169.	20.0
25.0	W4ZA	19028.	13519.	429.	4538.	4257.	3031.	7146.	120.	25.0
30.0	W4ZB	22662.	13729.	200.	5132.	4179.	3203.	9280.	11.	30.0
35.0	W4ZC	20630.	12206.	164.	4552.	3122.	2883.	9661.	*****	35.0
40.0	W4ZD	17992.	6765.	97.	3902.	3092.	2513.	8911.	455.	40.0
45.0	W4ZE	19705.	11041.	97.	4439.	3393.	2711.	10613.	*****	45.0
50.0	W4ZF	20303.	11582.	79.	4455.	3147.	2701.	13176.	659.	50.0
MEAN		22594.7	21012.3	621.3	4980.3	5283.1	3367.4	8919.7	280.8	
COEF VAR		21.5	62.0	103.7	23.8	31.1	29.1	13.2	43.1	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	W4A	0.32600	0.73879	2.60189	0.33707	0.30833	0.18090	0.20745	0.32946	0.5
1.0	W4B	0.33465	0.75608	2.16604	0.34424	0.31648	0.18546	0.20781	0.34643	1.0
1.5	W4C	0.33884	0.63106	1.49057	0.34935	0.32260	0.18611	0.20105	0.33750	1.5
2.0	W4D	0.34138	0.59548	1.31981	0.35429	0.30515	0.17931	0.20150	0.34375	2.0
2.5	W4E	0.36080	0.55426	1.16887	0.37321	0.33379	0.17685	0.21097	0.35446	2.5
3.0	W4F	0.35935	0.54397	1.01038	0.37217	0.33141	0.16834	0.20444	0.31964	3.0
3.5	W4G	0.33545	0.58617	0.97264	0.34576	0.30674	0.15800	0.20142	0.30089	3.5
4.0	W4H	0.35202	0.57785	0.85094	0.35913	0.33326	0.15633	0.21466	0.31518	4.0
4.5	W4I	0.36705	0.58868	0.81321	0.36940	0.33286	0.15901	0.21103	0.31429	4.5
5.0	W4J	0.31981	0.53802	0.64151	0.32016	0.28784	0.14030	0.20069	0.30536	5.0
6.0	W4K	0.30097	0.44093	0.46604	0.31560	0.31414	0.12211	0.18897	0.23036	6.0
7.0	W4L	0.28972	0.41576	0.44434	0.23582	0.22247	0.12004	0.18024	0.24018	7.0
8.0	W4M	0.31051	0.36114	0.43962	0.31293	0.33009	0.12905	0.19395	0.23304	8.0
9.0	W4N	0.26493	0.32622	0.31792	0.26196	0.24965	0.11397	0.17002	0.21161	9.0
10.0	W4O	0.24205	0.27302	0.35094	0.24337	0.21903	0.10492	0.18264	0.20893	10.0
11.0	W4P	0.21224	0.21268	0.25189	0.20293	0.19300	0.09164	0.16788	0.18304	11.0
12.0	W4Q	0.22907	0.20749	0.29906	0.22614	0.20366	0.09834	0.17876	0.20000	12.0
13.0	W4R	0.21006	0.16894	0.25943	0.20016	0.18101	0.09063	0.16667	0.17589	13.0
14.0	W4S	0.20745	0.13997	0.24906	0.20261	0.17286	0.08940	0.16715	0.18839	14.0
15.0	W4T	0.20045	0.12762	0.20283	0.19332	0.16123	0.08524	0.16513	0.17500	15.0
16.0	W4U	0.20536	0.11752	0.18113	0.19772	0.15996	0.08546	0.17165	0.17589	16.0
17.0	W4V	0.21644	0.12140	0.18962	0.20668	0.17859	0.08933	0.18448	0.19196	17.0
18.0	W4W	0.20695	0.13802	0.16792	0.20772	0.16907	0.08495	0.17421	0.16339	18.0
19.0	W4X	0.19773	0.10587	0.15094	0.18902	0.17079	0.07988	0.15852	0.16339	19.0
20.0	W4Y	0.20990	0.09860	0.15660	0.20152	0.17731	0.08466	0.16094	0.15089	20.0
25.0	W4ZA	0.22761	0.21735	0.40472	0.24663	0.18753	0.10966	0.15335	0.10714	25.0
30.0	W4ZB	0.27108	0.22072	0.18868	0.27891	0.18410	0.11588	0.19914	0.00982	30.0
35.0	W4ZC	0.24677	0.19624	0.15472	0.24739	0.13753	0.10431	0.20732	******	35.0
40.0	W4ZD	0.21522	0.10876	0.09151	0.21207	0.13621	0.09092	0.19122	0.40625	40.0
45.0	W4ZE	0.23571	0.17751	0.09151	0.24125	0.14947	0.09808	0.22775	******	45.0
50.0	W4ZF	0.24286	0.18621	0.07453	0.24212	0.13863	0.09772	0.28275	0.58839	50.0
MEAN		0.27027	0.33782	0.58609	0.27067	0.23274	0.12183	0.19141	0.25071	
COEF VAR		21.5	62.0	103.7	23.8	31.1	29.1	13.2	43.1	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

W4-11

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

W4-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	W4A	1343.0	35.0	229.0	26.0	51.0	50.0	46.0	36.0	107.0	0.5
1.0	W4B	1389.0	37.0	224.0	26.0	55.0	64.0	52.0	37.0	98.0	1.0
1.5	W4C	1435.0	36.0	216.0	27.0	52.0	34.0	40.0	36.0	90.0	1.5
2.0	W4D	1449.0	36.0	222.0	27.0	60.0	32.0	40.0	38.0	95.0	2.0
2.5	W4E	1570.0	42.0	234.0	36.0	60.0	30.0	43.0	41.0	98.0	2.5
3.0	W4F	1560.0	36.0	236.0	39.0	56.0	34.0	38.0	39.0	94.0	3.0
3.5	W4G	1435.0	34.0	215.0	31.0	81.0	34.0	36.0	38.0	92.0	3.5
4.0	W4H	1462.0	39.0	226.0	27.0	56.0	36.0	41.0	39.0	110.0	4.0
4.5	W4I	1464.0	39.0	227.0	27.0	68.0	48.0	46.0	41.0	94.0	4.5
5.0	W4J	1348.0	39.0	200.0	30.0	66.0	35.0	37.0	36.0	90.0	5.0
6.0	W4K	923.0	29.0	188.0	20.0	75.0	30.0	51.0	31.0	101.0	6.0
7.0	W4L	973.0	28.0	180.0	21.0	78.0	24.0	47.0	29.0	104.0	7.0
8.0	W4M	859.0	32.0	188.0	23.0	86.0	33.0	47.0	29.0	108.0	8.0
9.0	W4N	681.0	24.0	165.0	22.0	90.0	37.0	45.0	24.0	91.0	9.0
10.0	W4O	618.0	23.0	146.0	20.0	97.0	29.0	30.0	22.0	79.0	10.0
11.0	W4P	508.0	19.0	129.0	18.0	121.0	30.0	29.0	19.0	71.0	11.0
12.0	W4Q	579.0	21.0	139.0	24.0	125.0	32.0	18.0	21.0	73.0	12.0
13.0	W4R	516.0	19.0	128.0	21.0	120.0	35.0	14.0	19.0	65.0	13.0
14.0	W4S	515.0	20.0	126.0	21.0	116.0	27.0	18.0	19.0	64.0	14.0
15.0	W4T	472.0	18.0	125.0	20.0	117.0	31.0	8.0	18.0	61.0	15.0
16.0	W4U	481.0	19.0	128.0	21.0	120.0	26.0	13.0	18.0	62.0	16.0
17.0	W4V	512.0	20.0	136.0	22.0	127.0	30.0	9.0	20.0	67.0	17.0
18.0	W4W	474.0	18.0	127.0	20.0	120.0	76.0	10.0	18.0	58.0	18.0
19.0	W4X	428.0	15.0	122.0	18.0	107.0	39.0	9.0	16.0	54.0	19.0
20.0	W4Y	505.0	21.0	130.0	20.0	121.0	25.0	9.0	17.0	57.0	20.0
25.0	W4ZA	802.0	26.0	172.0	26.0	*****	26.0	19.0	26.0	59.0	25.0
30.0	W4ZB	807.0	33.0	201.0	36.0	*****	44.0	11.0	28.0	75.0	30.0
35.0	W4ZC	667.0	29.0	196.0	34.0	*****	48.0	10.0	26.0	85.0	35.0
40.0	W4ZD	646.0	35.0	162.0	32.0	*****	43.0	12.0	23.0	91.0	40.0
45.0	W4ZE	721.0	31.0	178.0	35.0	*****	54.0	10.0	26.0	81.0	45.0
50.0	W4ZF	744.0	33.0	181.0	39.0	*****	61.0	6.0	28.0	*****	50.0
MEAN		899.5	28.6	176.6	26.1	89.0	38.0	27.2	27.7	82.5	
COEF VAR		44.6	27.5	22.3	24.0	30.8	32.2	58.5	29.5	20.7	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	W4A	0.2125	0.2160	0.5872	0.2131	0.7500	0.5051	3.5385	0.2647	1.4079	0.5
1.0	W4B	0.2198	0.2284	0.5744	0.2131	0.8088	0.6465	4.0000	0.2721	1.2895	1.0
1.5	W4C	0.2271	0.2222	0.5538	0.2213	0.7647	0.3434	3.0769	0.2647	1.1842	1.5
2.0	W4D	0.2293	0.2222	0.5692	0.2213	0.8824	0.3232	3.0769	0.2794	1.2500	2.0
2.5	W4E	0.2484	0.2593	0.6000	0.2951	0.8824	0.3030	3.3077	0.3015	1.2895	2.5
3.0	W4F	0.2468	0.2222	0.6051	0.3197	0.8235	0.3434	2.9231	0.2868	1.2368	3.0
3.5	W4G	0.2271	0.2099	0.5513	0.2541	1.1912	0.3434	2.7692	0.2794	1.2105	3.5
4.0	W4H	0.2313	0.2407	0.5795	0.2213	0.8235	0.3636	3.1538	0.2868	1.4474	4.0
4.5	W4I	0.2316	0.2407	0.5821	0.2213	1.0000	0.4848	3.5385	0.3015	1.2368	4.5
5.0	W4J	0.2133	0.2407	0.5128	0.2459	0.9706	0.3535	2.8462	0.2647	1.1842	5.0
6.0	W4K	0.1460	0.1790	0.4821	0.1639	1.1029	0.3030	3.9231	0.2279	1.3289	6.0
7.0	W4L	0.1540	0.1728	0.4615	0.1721	1.1471	0.2424	3.6154	0.2132	1.3684	7.0
8.0	W4M	0.1359	0.1975	0.4821	0.1885	1.2647	0.3333	3.6154	0.2132	1.4211	8.0
9.0	W4N	0.1078	0.1481	0.4231	0.1803	1.3235	0.3737	3.4615	0.1765	1.1974	9.0
10.0	W4O	0.0978	0.1420	0.3744	0.1639	1.4265	0.2929	2.3077	0.1618	1.0395	10.0
11.0	W4P	0.0804	0.1173	0.3308	0.1475	1.7794	0.3030	2.2308	0.1397	0.9342	11.0
12.0	W4Q	0.0916	0.1296	0.3564	0.1967	1.8382	0.3232	1.3846	0.1544	0.9605	12.0
13.0	W4R	0.0816	0.1173	0.3282	0.1721	1.7647	0.3535	1.0769	0.1397	0.8553	13.0
14.0	W4S	0.0815	0.1235	0.3231	0.1721	1.7059	0.2727	1.3846	0.1397	0.8421	14.0
15.0	W4T	0.0747	0.1111	0.3205	0.1639	1.7206	0.3131	0.6154	0.1324	0.8026	15.0
16.0	W4U	0.0761	0.1173	0.3282	0.1721	1.7647	0.2626	1.0000	0.1324	0.8158	16.0
17.0	W4V	0.0810	0.1235	0.3487	0.1803	1.8676	0.3030	0.6923	0.1471	0.8816	17.0
18.0	W4W	0.0750	0.1111	0.3256	0.1639	1.7647	0.7677	0.7692	0.1324	0.7632	18.0
19.0	W4X	0.0677	0.0926	0.3128	0.1475	1.5735	0.3939	0.6923	0.1176	0.7105	19.0
20.0	W4Y	0.0799	0.1296	0.3333	0.1639	1.7794	0.2525	0.6923	0.1250	0.7500	20.0
25.0	W4ZA	0.1269	0.1605	0.4410	0.2131	*****	0.2626	1.4615	0.1912	0.7763	25.0
30.0	W4ZB	0.1277	0.2037	0.5154	0.2951	*****	0.4444	0.8462	0.2059	0.9868	30.0
35.0	W4ZC	0.1055	0.1790	0.5026	0.2787	*****	0.4848	0.7692	0.1912	1.1184	35.0
40.0	W4ZD	0.1022	0.2160	0.4154	0.2623	*****	0.4343	0.9231	0.1691	1.1974	40.0
45.0	W4ZE	0.1141	0.1914	0.4564	0.2869	*****	0.5455	0.7692	0.1912	1.0658	45.0
50.0	W4ZF	0.1177	0.2037	0.4641	0.3197	*****	0.6162	0.4615	0.2059	*****	50.0
MEAN		0.1423	0.1764	0.4529	0.2139	1.3088	0.3835	2.0943	0.2035	1.0851	
COEF VAR		44.6	27.5	22.3	24.0	30.8	32.2	58.5	29.5	20.7	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

W4-13

Mine Tailings Pond

Lake CH

pH 3.3

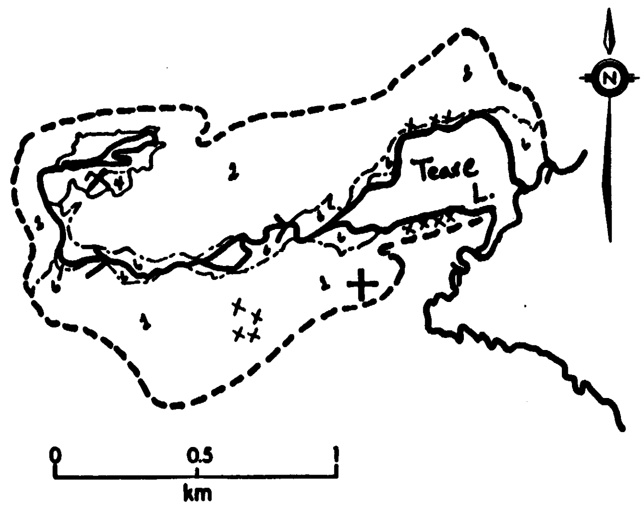
GENERAL SETTING AND DESCRIPTION

CH-2

CH: Teare Lake is the main depositional basin from an open pit mine. A thin discontinuous till cover lies over the northern half of the basin, while the south half is essentially bare rock. There appears to be a small deposit of outwash sediments near the mine site. Swamp deposits are developed along the stream which leads from the mine to the lake. In terms of lake sediments, the surficial deposits play a minor role compared to the sediments from the mine.

GEOLOGICAL/GEOGRAPHICAL INFORMATION

UTM Coordinates of the sample point	16-688771/5349340
Elevation of lake above sea level	396 m (1300 ft)
Lake depth at sampling point	1.1 m
Lake area	0.21 sq km
Lake catchment area	1.40 sq km
Bedrock geology under lake basin	felsic metavolcanics, diorite.



DETAILS OF LAKE WATER CHEMISTRY

Lake Depth (M)	Secchi Depth (M)	Temperature (°C)	Dissolved Oxygen (PPM % Saturation)	Specific Conductivity * (Micromhos/cm)
0		16.5	9.6/100	576
1	visible on lake bottom	17.5	8.0/83	667

* Specific conductivity data are temperature-corrected (25°C).

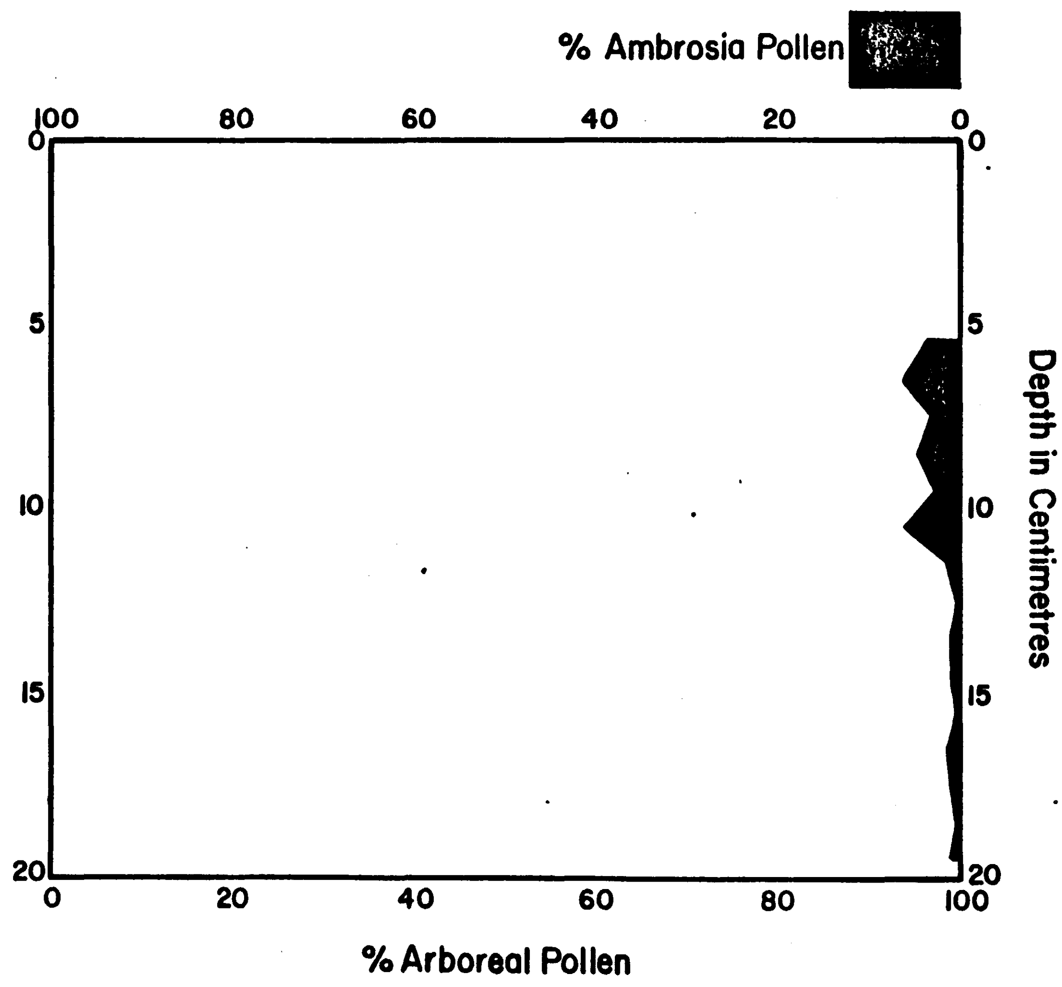
NO POLLEN DIAGRAM AVAILABLE

CH-5

CH-5

AMBROSIA RISE DIAGRAM

CH-6



PALYNOLOGY NOTES NOT AVAILABLE

CH-7

WEIGHT DATA (0-50 cm)

CH-8

LAKE CH

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CHA	7.19	.488	93.21	30
CHB	2.73	.464	82.96	30
CHC	3.042	.489	83.89	30
CHD	3.752	.416	88.88	40
CHE	3.912	.249	93.63	50
CHF	2.283	.153	93.29	60
CHG	2.545	.152	94.02	50
CHH	2.294	.172	92.5	50
CHI	2.769	.176	93.6	50
CHJ	2.235	.199	91.05	50
CHK	3.779	.289	92.35	56
CHL	4.846	.331	93.17	52
CHM	6.638	.443	93.32	56
CHN	5.959	.381	93.6	56
CHO	6.559	.429	93.45	52
CHP	7.202	.409	94.3	56
CHQ	6.835	.361	94.71	60
CHR	6.707	.346	94.84	60
CHS	7.064	.364	94.84	56
CHT	6.491	.35	94.59	56
CHU	5.894	.275	95.31	56
CHV	5.892	.317	94.6	56
CHW	6.221	.337	94.58	56
CHX	5.972	.409	93.13	48
CHY	6.194	.544	91.21	48
CHZA	10.56	1.113	89.46	44
CHZB	NO DATA	-	-	-
CHZC	NO DATA	-	-	-
CHZD	NO DATA	-	-	-
CHZE	NO DATA	-	-	-
CHZF	NO DATA	-	-	-

CH-9 CH-9

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-PPM

DEPTH (CM)	SAMPLE CODE	AL PPM	FE PPM	MN PPM	K PPM	NA PPM	MG PPM	CA PPM	P PPM	DEPTH (CM)
0.5	CHA	2117.	*****	163.	524.	91.	319.	585.	241.	0.5
1.0	CHB	2945.	*****	162.	454.	71.	283.	622.	226.	1.0
1.5	CHC	3204.	*****	249.	450.	75.	285.	735.	277.	1.5
2.0	CHD	6674.	*****	348.	746.	209.	420.	1318.	475.	2.0
2.5	CHE	11400.	40138.	404.	1933.	1014.	1047.	2725.	626.	2.5
3.0	CHF	11854.	19526.	356.	2095.	1282.	1090.	2807.	518.	3.0
3.5	CHG	10553.	32691.	312.	1770.	1132.	1010.	2479.	441.	3.5
4.0	CHH	9722.	28503.	298.	1613.	773.	920.	2147.	404.	4.0
4.5	CHI	10134.	28724.	323.	1656.	772.	961.	2201.	438.	4.5
5.0	CHJ	11289.	30636.	347.	1825.	1076.	1081.	2347.	465.	5.0
6.0	CHK	13228.	38888.	378.	2149.	1391.	1080.	2262.	486.	6.0
7.0	CHL	15281.	26989.	407.	2227.	1475.	1183.	2472.	542.	7.0
8.0	CHM	17626.	23413.	376.	2349.	1616.	1256.	2608.	621.	8.0
9.0	CHN	18722.	23311.	376.	2222.	1553.	1265.	2651.	624.	9.0
10.0	CHO	20593.	21932.	368.	2251.	1514.	1275.	2685.	643.	10.0
11.0	CHP	13801.	16613.	346.	1680.	1382.	1173.	2926.	417.	11.0
12.0	CHQ	10769.	15008.	359.	1510.	1367.	1149.	3267.	317.	12.0
13.0	CHR	10662.	12472.	350.	1323.	1239.	1136.	3248.	305.	13.0
14.0	CHS	11389.	11543.	283.	1627.	1508.	1173.	3119.	267.	14.0
15.0	CHT	13140.	16121.	345.	1709.	1621.	1285.	3341.	251.	15.0
16.0	CHU	15377.	13659.	375.	1752.	2029.	1392.	3665.	268.	16.0
17.0	CHV	14514.	16933.	344.	1572.	1429.	1232.	3284.	288.	17.0
18.0	CHW	14158.	13842.	345.	1732.	1463.	1328.	3336.	264.	18.0
19.0	CHX	14876.	13886.	300.	2240.	2052.	1471.	3245.	241.	19.0
20.0	CHY	15669.	14250.	288.	2417.	2398.	1562.	3423.	235.	20.0
25.0	CHZA	14183.	17460.	421.	2511.	2055.	1942.	3466.	234.	25.0
30.0		*****	*****	*****	*****	*****	*****	*****	*****	30.0
35.0		*****	*****	*****	*****	*****	*****	*****	*****	35.0
40.0		*****	*****	*****	*****	*****	*****	*****	*****	40.0
45.0		*****	*****	*****	*****	*****	*****	*****	*****	45.0
50.0		*****	*****	*****	*****	*****	*****	*****	*****	50.0
MEAN		12072.3	61521.3	331.7	1705.3	1253.3	1089.2	2575.5	389.0	
COEF VAR		36.9	152.9	18.9	34.1	48.6	35.2	33.6	36.2	

DEPTH (CM)	SAMPLE CODE	AL KK	FE KK	MN KK	K KK	NA KK	MG KK	CA KK	P KK	DEPTH (CM)
0.5	CHA	0.02532	4.70997	0.15377	0.02848	0.00401	0.01154	0.01255	0.21518	0.5
1.0	CHB	0.03523	4.59833	0.15283	0.02467	0.00313	0.01024	0.01335	0.20179	1.0
1.5	CHC	0.03833	4.72465	0.23491	0.02446	0.00330	0.01031	0.01577	0.24732	1.5
2.0	CHD	0.07983	4.02199	0.32830	0.04054	0.00921	0.01520	0.02828	0.42411	2.0
2.5	CHE	0.13636	0.64531	0.38113	0.10505	0.04467	0.03788	0.05848	0.55893	2.5
3.0	CHF	0.14179	0.31392	0.33585	0.11386	0.05648	0.03944	0.06024	0.46250	3.0
3.5	CHG	0.12623	0.52558	0.29434	0.09620	0.04987	0.03654	0.05320	0.39375	3.5
4.0	CHH	0.11629	0.45825	0.28113	0.08766	0.03405	0.03329	0.04607	0.36071	4.0
4.5	CHI	0.12122	0.46180	0.30472	0.09000	0.03401	0.03477	0.04723	0.39107	4.5
5.0	CHJ	0.13504	0.49254	0.32736	0.09918	0.04740	0.03911	0.05036	0.41518	5.0
6.0	CHK	0.15823	0.62521	0.35660	0.11679	0.06128	0.03907	0.04854	0.43393	6.0
7.0	CHL	0.18279	0.43391	0.38396	0.12103	0.06498	0.04280	0.05305	0.48393	7.0
8.0	CHM	0.21084	0.37641	0.35472	0.12766	0.07119	0.04544	0.05597	0.55446	8.0
9.0	CHN	0.22395	0.37477	0.35472	0.12076	0.06841	0.04577	0.05689	0.55714	9.0
10.0	CHO	0.24633	0.35260	0.34717	0.12234	0.06670	0.04613	0.05762	0.57411	10.0
11.0	CHP	0.16508	0.26709	0.32642	0.09130	0.06088	0.04244	0.06279	0.37232	11.0
12.0	CHQ	0.12882	0.24129	0.33868	0.08207	0.06022	0.04157	0.07011	0.28304	12.0
13.0	CHR	0.12754	0.20051	0.33019	0.07190	0.05458	0.04110	0.06970	0.27232	13.0
14.0	CHS	0.13623	0.18558	0.26698	0.08842	0.06643	0.04244	0.06693	0.23839	14.0
15.0	CHT	0.15718	0.25918	0.32547	0.09288	0.07141	0.04649	0.07170	0.22411	15.0
16.0	CHU	0.18394	0.21960	0.35377	0.09522	0.08938	0.05036	0.07865	0.23929	16.0
17.0	CHV	0.17361	0.27223	0.32453	0.08543	0.06295	0.04457	0.07047	0.25714	17.0
18.0	CHW	0.16935	0.22254	0.32547	0.09413	0.06445	0.04805	0.07159	0.23571	18.0
19.0	CHX	0.17794	0.22325	0.28302	0.12174	0.09040	0.05322	0.06964	0.21518	19.0
20.0	CHY	0.18743	0.22910	0.27170	0.13136	0.10564	0.05651	0.07345	0.20982	20.0
25.0	CHZA	0.16965	0.28071	0.39717	0.13647	0.09053	0.07026	0.07438	0.20893	25.0
30.0		******	******	******	******	******	******	******	******	30.0
35.0		******	******	******	******	******	******	******	******	35.0
40.0		******	******	******	******	******	******	******	******	40.0
45.0		******	******	******	******	******	******	******	******	45.0
50.0		******	******	******	******	******	******	******	******	50.0
MEAN		0.14441	0.98908	0.31288	0.09268	0.05521	0.03940	0.05527	0.34732	
COEF VAR		36.9	152.9	18.9	34.1	48.6	35.2	33.6	36.2	

LAKE SEDIMENT GEOCHEMICAL DATA : MAJOR ELEMENTS-KK

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-PPM

CH-12

DEPTH (CM)	SAMPLE CODE	TI PPM	ZR PPM	BA PPM	CR PPB	CU PPM	NI PPM	PB PPM	V PPM	ZN PPM	DEPTH (CM)
0.5	CHA	8.0	7.0	6.0	4.0	31.0	33.0	28.0	16.0	41.0	0.5
1.0	CHB	11.0	7.0	8.0	9.0	35.0	29.0	26.0	17.0	41.0	1.0
1.5	CHC	19.0	8.0	5.0	13.0	43.0	30.0	28.0	21.0	48.0	1.5
2.0	CHD	85.0	10.0	15.0	28.0	61.0	35.0	33.0	22.0	49.0	2.0
2.5	CHE	298.0	15.0	74.0	38.0	99.0	22.0	31.0	15.0	28.0	2.5
3.0	CHF	332.0	14.0	81.0	30.0	52.0	24.0	25.0	16.0	32.0	3.0
3.5	CHG	299.0	12.0	67.0	19.0	47.0	33.0	35.0	12.0	33.0	3.5
4.0	CHH	283.0	11.0	61.0	17.0	48.0	38.0	33.0	10.0	94.0	4.0
4.5	CHI	283.0	10.0	71.0	15.0	44.0	40.0	34.0	10.0	61.0	4.5
5.0	CHJ	289.0	11.0	80.0	15.0	37.0	41.0	35.0	11.0	193.0	5.0
6.0	CHK	222.0	11.0	96.0	13.0	33.0	43.0	45.0	12.0	214.0	6.0
7.0	CHL	238.0	12.0	114.0	10.0	25.0	43.0	40.0	12.0	283.0	7.0
8.0	CHM	264.0	13.0	115.0	9.0	21.0	44.0	36.0	13.0	385.0	8.0
9.0	CHN	244.0	12.0	118.0	8.0	20.0	40.0	35.0	11.0	326.0	9.0
10.0	CHO	257.0	12.0	148.0	8.0	21.0	37.0	39.0	12.0	294.0	10.0
11.0	CHP	221.0	14.0	87.0	6.0	18.0	30.0	20.0	9.0	149.0	11.0
12.0	CHQ	171.0	10.0	46.0	5.0	17.0	24.0	11.0	9.0	102.0	12.0
13.0	CHR	173.0	11.0	51.0	5.0	18.0	23.0	8.0	8.0	78.0	13.0
14.0	CHS	210.0	11.0	76.0	6.0	18.0	19.0	9.0	8.0	66.0	14.0
15.0	CHT	196.0	11.0	119.0	5.0	19.0	24.0	16.0	8.0	91.0	15.0
16.0	CHU	222.0	10.0	192.0	6.0	19.0	23.0	3.0	9.0	93.0	16.0
17.0	CHV	209.0	12.0	146.0	5.0	19.0	24.0	6.0	10.0	90.0	17.0
18.0	CHW	216.0	12.0	71.0	6.0	19.0	22.0	6.0	10.0	85.0	18.0
19.0	CHX	270.0	14.0	85.0	8.0	18.0	20.0	13.0	11.0	75.0	19.0
20.0	CHY	280.0	14.0	77.0	9.0	18.0	23.0	13.0	12.0	64.0	20.0
25.0	CHZA	419.0	17.0	93.0	11.0	37.0	20.0	13.0	15.0	68.0	25.0
30.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	30.0
35.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	35.0
40.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	40.0
45.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	45.0
50.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	50.0
MEAN		220.0	11.6	80.8	11.8	32.2	30.2	23.9	12.3	118.6	
COEF VAR		43.7	19.6	54.6	70.9	57.3	27.2	51.7	29.9	83.0	

DEPTH (CM)	SAMPLE CODE	TI KK	ZR KK	BA KK	CR KK	CU KK	NI KK	PB KK	V KK	ZN KK	DEPTH (CM)
0.5	CHA	0.0013	0.0432	0.0154	0.0328	0.4559	0.3333	2.1538	0.1176	0.5395	0.5
1.0	CHB	0.0017	0.0432	0.0205	0.0738	0.5147	0.2929	2.0000	0.1250	0.5395	1.0
1.5	CHC	0.0030	0.0494	0.0128	0.1066	0.6324	0.3030	2.1538	0.1544	0.6316	1.5
2.0	CHD	0.0134	0.0617	0.0385	0.2295	0.8971	0.3535	2.5385	0.1618	0.6447	2.0
2.5	CHE	0.0472	0.0926	0.1897	0.3115	1.4559	0.2222	2.3846	0.1103	0.3684	2.5
3.0	CHF	0.0525	0.0864	0.2077	0.2459	0.7647	0.2424	1.9231	0.1176	0.4211	3.0
3.5	CHG	0.0473	0.0741	0.1718	0.1557	0.6912	0.3333	2.6923	0.0882	0.4342	3.5
4.0	CHH	0.0448	0.0679	0.1564	0.1393	0.7059	0.3838	2.5385	0.0735	1.2368	4.0
4.5	CHI	0.0448	0.0617	0.1821	0.1230	0.6471	0.4040	2.6154	0.0735	0.8026	4.5
5.0	CHJ	0.0457	0.0679	0.2051	0.1230	0.5441	0.4141	2.6923	0.0809	2.5395	5.0
6.0	CHK	0.0351	0.0679	0.2462	0.1066	0.4853	0.4343	3.4615	0.0882	2.8158	6.0
7.0	CHL	0.0377	0.0741	0.2923	0.0820	0.3676	0.4343	3.0769	0.0882	3.7237	7.0
8.0	CHM	0.0418	0.0802	0.2949	0.0738	0.3088	0.4444	2.7692	0.0956	5.0658	8.0
9.0	CHN	0.0386	0.0741	0.3026	0.0656	0.2941	0.4040	2.6923	0.0809	4.2895	9.0
10.0	CHO	0.0407	0.0741	0.3795	0.0656	0.3088	0.3737	3.0000	0.0882	3.8684	10.0
11.0	CHP	0.0350	0.0864	0.2231	0.0492	0.2647	0.3030	1.5385	0.0662	1.9605	11.0
12.0	CHQ	0.0271	0.0617	0.1179	0.0410	0.2500	0.2424	0.8462	0.0662	1.3421	12.0
13.0	CHR	0.0274	0.0679	0.1308	0.0410	0.2647	0.2323	0.6154	0.0588	1.0263	13.0
14.0	CHS	0.0332	0.0679	0.1949	0.0492	0.2647	0.1919	0.6923	0.0588	0.8684	14.0
15.0	CHT	0.0310	0.0679	0.3051	0.0410	0.2794	0.2424	1.2308	0.0588	1.1974	15.0
16.0	CHU	0.0351	0.0617	0.4923	0.0492	0.2794	0.2323	0.2308	0.0662	1.2237	16.0
17.0	CHV	0.0331	0.0741	0.3744	0.0410	0.2794	0.2424	0.4615	0.0735	1.1842	17.0
18.0	CHW	0.0342	0.0741	0.1821	0.0492	0.2794	0.2222	0.4615	0.0735	1.1184	18.0
19.0	CHX	0.0427	0.0864	0.2179	0.0656	0.2647	0.2020	1.0000	0.0809	0.9868	19.0
20.0	CHY	0.0443	0.0864	0.1974	0.0738	0.2647	0.2323	1.0000	0.0882	0.8421	20.0
25.0	CHZA	0.0663	0.1049	0.2385	0.0902	0.5441	0.2020	1.0000	0.1103	0.8947	25.0
30.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	30.0
35.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	35.0
40.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	40.0
45.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	45.0
50.0		*****	*****	*****	*****	*****	*****	*****	*****	*****	50.0
MEAN		0.0348	0.0715	0.2073	0.0971	0.4734	0.3046	1.8373	0.0902	1.5602	
COEF VAR		43.7	19.6	54.6	70.9	57.3	27.2	51.7	29.9	83.0	

LAKE SEDIMENT GEOCHEMICAL DATA : MINOR ELEMENTS-KK

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WEIGHT DATA (0-20 cm)

LAKE W_1

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
W-1-1	NO DATA	-	-	-
W-1-2	NO DATA	-	-	-
W-1-3	NO DATA	-	-	-
W-1-4	NO DATA	-	-	-
W-1-5	NO DATA	-	-	-
W-1-6	NO DATA	-	-	-
W-1-7	NO DATA	-	-	-
W-1-8	NO DATA	-	-	-
W-1-9	NO DATA	-	-	-
W-1-10	NO DATA	-	-	-
W-1-11	NO DATA	-	-	-
W-1-12	NO DATA	-	-	-
W-1-13	NO DATA	-	-	-
W-1-14	NO DATA	-	-	-
W-1-15	NO DATA	-	-	-
W-1-16	NO DATA	-	-	-
W-1-17	NO DATA	-	-	-
W-1-18	NO DATA	-	-	-
W-1-19	NO DATA	-	-	-
W-1-20	NO DATA	-	-	-

WEIGHT DATA (0-20 cm)

LAKE W_2

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
W-2-1	NO DATA	-	-	-
W-2-2	5.267	.321	93.88	36
W-2-3	7.87	.65	91.72	32
W-2-4	6.719	.517	92.3	32
W-2-5	8.336	.764	90.83	36
W-2-6	6.12	.535	91.25	36
W-2-7	5.55	.512	90.75	36
W-2-8	5.877	.527	91.01	40
W-2-9	4.824	.394	91.81	NO DATA
W-2-10	6.408	.649	89.85	40
W-2-11	3.897	.582	85.04	44
W-2-12	9.634	.815	91.53	44
W-2-13	5.921	.461	92.19	44
W-2-14	7.718	.56	92.73	32
W-2-15	6.932	.509	92.64	40
W-2-16	8.448	.683	91.91	36
W-2-17	6.074	.483	92.03	36
W-2-18	6.38	.55	91.36	36
W-2-19	4.798	.416	91.32	40
W-2-20	7.093	.644	90.9	32

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WEIGHT DATA (0-20 cm)

LAKE W_3

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
W-3-1	.247	.112	54.43	NO DATA
W-3-2	3.421	.33	90.35	32
W-3-3	1.33	.221	83.3	32
W-3-4	2.078	.302	85.42	36
W-3-5	.754	.141	81.16	32
W-3-6	.671	.12	81.96	36
W-3-7	2.058	.27	86.83	40
W-3-8	1.641	.145	91.1	36
W-3-9	2.402	.232	90.3	48
W-3-10	4.081	.243	94.02	36
W-3-11	1.638	.176	89.25	36
W-3-12	4.216	.263	93.76	24
W-3-13	1.412	.117	91.64	NO DATA
W-3-14	5.26	.265	94.96	44
W-3-15	4.8	.246	94.85	NO DATA
W-3-16	3.377	.204	93.95	NO DATA
W-3-17	4.358	.186	95.73	NO DATA
W-3-18	2.364	.189	91.96	NO DATA
W-3-19	1.393	.087	93.68	NO DATA
W-3-20	4.301	.205	95.23	NO DATA

WEIGHT DATA (0-20 cm)

LAKE W_4

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
W-4-1	1.592	.251	84.18	NO DATA
W-4-2	5.394	.611	88.67	48
W-4-3	5.83	.682	88.3	28
W-4-4	4.427	.507	88.55	40
W-4-5	4.905	.509	89.6	36
W-4-6	3.747	.502	86.57	40
W-4-7	7.081	.744	89.48	28
W-4-8	6.447	.657	89.79	28
W-4-9	5.732	.508	91.13	32
W-4-10	7.571	.701	90.72	36
W-4-11	6.247	.527	91.56	44
W-4-12	5.605	.497	91.13	NO DATA
W-4-13	6.063	.603	90.03	36
W-4-14	5.287	.586	88.91	28
W-4-15	6.418	.732	88.58	60
W-4-16	7.213	.932	87.07	68
W-4-17	6.076	.926	84.74	64
W-4-18	6.708	1.006	84.99	64
W-4-19	6.579	.704	89.28	68
W-4-20	7.201	.855	88.12	44

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WEIGHT DATA (0-20 cm)

LAKE Z_1

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
Z-1-1	NO DATA	-	-	-
Z-1-2	NO DATA	-	-	-
Z-1-3	NO DATA	-	-	-
Z-1-4	NO DATA	-	-	-
Z-1-5	NO DATA	-	-	-
Z-1-6	NO DATA	-	-	-
Z-1-7	NO DATA	-	-	-
Z-1-8	NO DATA	-	-	-
Z-1-9	NO DATA	-	-	-
Z-1-10	NO DATA	-	-	-
Z-1-11	NO DATA	-	-	-
Z-1-12	NO DATA	-	-	-
Z-1-13	NO DATA	-	-	-
Z-1-14	NO DATA	-	-	-
Z-1-15	NO DATA	-	-	-
Z-1-16	NO DATA	-	-	-
Z-1-17	NO DATA	-	-	-
Z-1-18	NO DATA	-	-	-
Z-1-19	NO DATA	-	-	-
Z-1-20	NO DATA	-	-	-

WEIGHT DATA (0-20 cm)

LAKE Z_2

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
Z-2-1	5.119	.46	91.01	NO DATA
Z-2-2	8.27	.809	90.2	NO DATA
Z-2-3	5.027	.54	89.25	NO DATA
Z-2-4	8.298	.91	89.02	NO DATA
Z-2-5	5.178	.525	89.86	NO DATA
Z-2-6	8.187	.797	90.26	NO DATA
Z-2-7	6.307	.85	86.5	NO DATA
Z-2-8	4.719	.899	80.95	NO DATA
Z-2-9	2.654	.623	76.49	NO DATA
Z-2-10	5.929	.733	87.62	NO DATA
Z-2-11	3.283	.4	87.81	NO DATA
Z-2-12	6.571	.884	86.53	NO DATA
Z-2-13	4.002	.743	81.41	NO DATA
Z-2-14	5.958	.589	90.09	NO DATA
Z-2-15	4.692	.489	89.57	NO DATA
Z-2-16	6.477	.673	89.6	NO DATA
Z-2-17	3.782	.58	84.66	NO DATA
Z-2-18	7.511	.853	88.64	NO DATA
Z-2-19	6.492	.787	87.86	NO DATA
Z-2-20	5.754	.668	88.37	NO DATA

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WEIGHT DATA (0-20 cm)

LAKE Z_3

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
Z-3-1	NO DATA	-	-	-
Z-3-2	3.784	.361	90.43	NO DATA
Z-3-3	3.877	.456	88.24	48
Z-3-4	3.817	.346	90.91	48
Z-3-5	3.468	.334	90.36	32
Z-3-6	4.374	.274	93.73	48
Z-3-7	3.146	.304	90.3	52
Z-3-8	NO DATA	-	-	-
Z-3-9	1.615	.225	86.07	NO DATA
Z-3-10	7.167	.554	92.27	48
Z-3-11	2.792	.34	87.79	NO DATA
Z-3-12	5.585	.607	89.13	36
Z-3-13	3.914	.41	89.52	44
Z-3-14	7.362	.602	91.81	44
Z-3-15	3.414	.412	87.93	44
Z-3-16	4.732	.426	90.97	44
Z-3-17	4	.465	88.37	44
Z-3-18	7.004	.685	90.2	48
Z-3-19	2.768	.403	85.4	44
Z-3-20	4.461	.504	88.7	40

WEIGHT DATA (0-20 cm)

LAKE Z_4

SAMPLE NUMBER	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
Z-4-1	.743	.141	81.02	36
Z-4-2	3.502	.444	87.32	40
Z-4-3	4.496	.63	85.96	36
Z-4-4	4.798	.763	84.09	28
Z-4-5	4.768	.828	82.61	32
Z-4-6	4.69	.883	81.15	32
Z-4-7	2.587	.558	78.4	36
Z-4-8	7.316	1.126	84.59	36
Z-4-9	2.246	.565	74.81	32
Z-4-10	6.377	1.162	81.77	36
Z-4-11	3.714	.964	74.02	32
Z-4-12	4.124	.957	76.79	32
Z-4-13	3.801	.987	74.01	24
Z-4-14	3.526	.853	75.81	28
Z-4-15	3.216	.871	72.89	28
Z-4-16	4.38	.988	77.44	28
Z-4-17	3.238	.829	74.36	28
Z-4-18	5.197	1.157	77.71	28
Z-4-19	3.349	.988	70.47	24
Z-4-20	8.22	4.675	43.12	8

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WEIGHT DATA (0-50 cm)

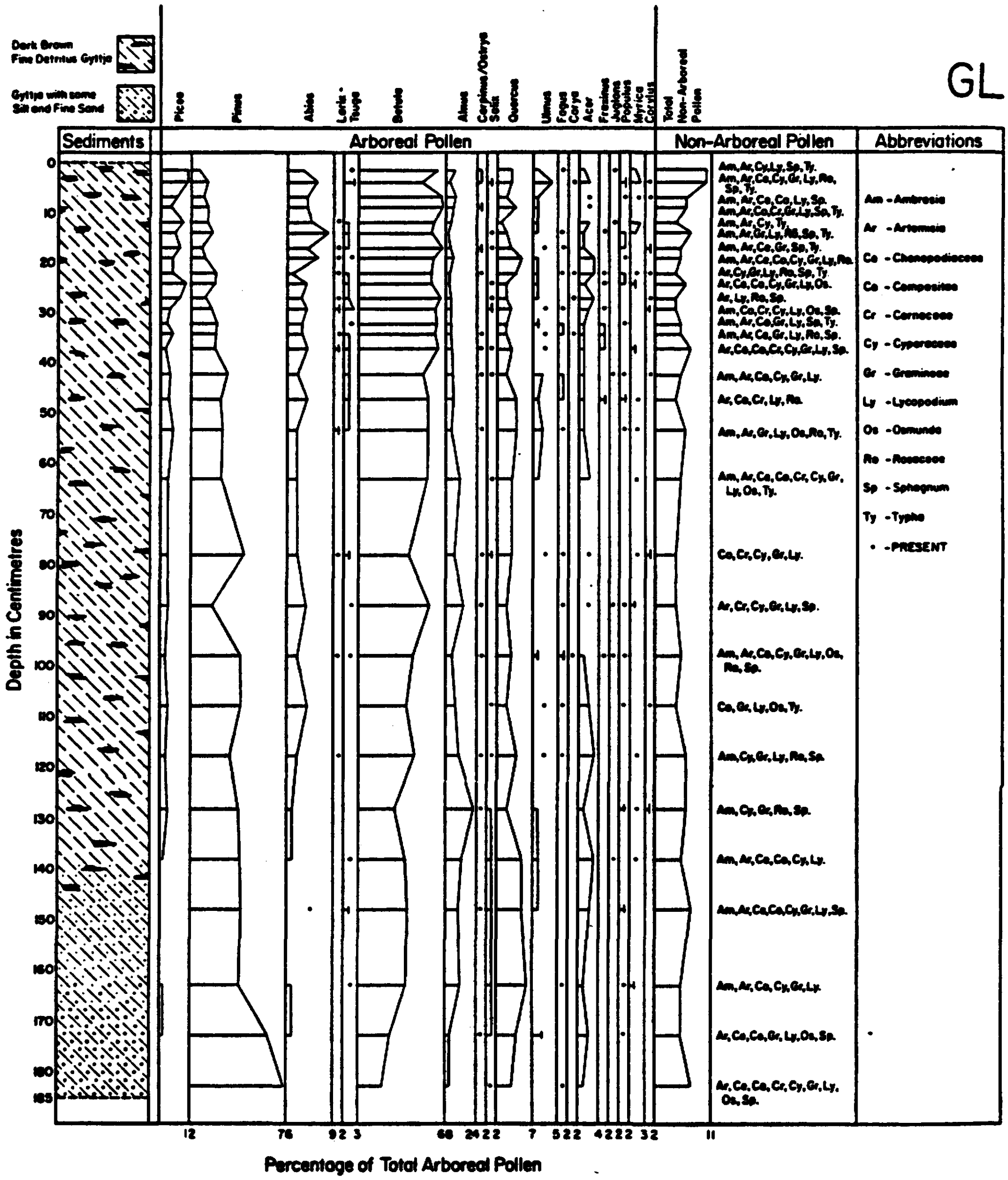
LAKE CEZ

SAMPLE CODE	WET WEIGHT GRAMS	DRY WEIGHT GRAMS	MOISTURE LOSS (PERCENT)	LOI (PERCENT)
CEZA	9.7	.44	95.46	60
CEZB	10.6	.23	97.83	NO DATA
CEZC	11.94	.649	94.55	56
CEZD	12.169	1.14	90.63	56
CEZE	13.17	1.12	91.49	56
CEZF	12.09	.48	96.02	60
CEZG	12.419	.169	98.63	NO DATA
CEZH	9.03	.5	94.46	60
CEZI	8.83	.51	94.22	68
CEZJ	8.889	.549	93.81	60
CEZK	9.39	.62	93.39	64
CEZL	9.29	.649	93	60
CEZM	9.279	.759	91.81	64

SECTION 4

Long Core Data

SECTION 4 - CONTENTS



Pollen diagram for Doc Greg Lake. Extends into the pine zone at about 6,000 yrs. B.P.

4-2

SAMPLE CODE	CORE	SAMPLE DEPTH	WET WT.	DRY WT.	LOI	Si	Al	Fe	Mn	K	Na	Mg	Ca	P	Ti	Zr	As	Cr	Cu	Hg	Ni	Pb	U	V	Zn	SAMPLE CODE
01		0	21.45	4.56	21.1	178000	54250	18699	281	9610	17156	7527	15299	1038	2365	85	7.4	234.9	33.7	120	51.8	97	0.1	69	288	01
02		2.5	32.90	5.57	22.9	192100	62099	21173	342	9910	18532	7849	15831	1086	2347	73	5.8	93.1	34.6	80	40.5	80	0.1	56	252	02
03		5.0	31.88	5.20	23.9	203000	58050	18959	292	10560	17142	7552	14690	1076	2281	82	3.4	113.6	29.7	80	58.1	98	0.1	64	288	03
04		7.5	24.62	4.08	24.0	193000	60950	17930	284	10010	17520	7585	14850	1155	2276	81	3.0	244.5	31.9	80	64.4	36	0.2	96	196	04
05		10.0	27.90	4.78	23.4	187300	60900	16944	269	9060	17538	7174	16070	1136	3215	79	1.9	134.1	32.6	80	262.6	28	0.1	80	208	05
06		12.5	32.05	5.41	23.5	197400	61800	18672	292	10610	11036	8047	15130	1136	2908	75	0.9	98.2	30.6	80	41.2	27	0.1	88	229	06
07		15.0	23.36	3.79	20.5	200800	62549	17978	284	9550	17644	7660	13990	1175	2425	77	1.6	261.4	31.7	60	18.9	25	0.1	64	196	07
08		17.5	30.83	5.76	21.6	201300	58150	18442	295	10710	17336	7960	19798	1084	2520	80	2.0	307.4	29.2	60	62.5	36	0.1	140	224	08
09		20.0	28.09	4.95	20.8	204800	55700	18292	296	10270	17028	7867	14204	1039	2492	84	0.05	84.1	25.6	80	[illegible]	28	0.1	152	200	09
10		22.5	32.64	6.69	20.5	117200	67150	19248	315	10090	21023	8318	16735	1214	2593	87	0.8	130.7	31.3	80	64.8	33	0.1	56	204	10
11		25.0	26.66	6.31	20.1	209700	65800	19065	342	10420	21067	9263	16235	1190	2667	96	0.05	223.6	31.0	50	146.3	36	0.1	40	196	11
12	I	27.5	30.40	6.36	19.8	208300	66000	17903	296	9920	21920	7702	16759	1165	2336	78	2.3	104.0	33.7	80	138.8	32	0.1	64	156	12
13		30.0	31.57	6.41	20.2	213500	67700	18252	304	10540	21859	8082	16587	1193	2604	93	1.2	167.0	35.8	80	199.8	40	0.2	84	196	13
14		32.5	34.82	7.11	19.9	225800	66250	18200	300	11320	21428	8080	16911	1125	2590	91	1.2	117.9	32.5	80	42.8	43	0.1	84	164	14
15		35.0	28.06	5.36	18.6	223300	62750	18069	306	10640	20196	8091	6820	1037	2465	83	1.0	49.8	9.9	70	46.7	31	0.1	108	180	15
16		37.5	33.42	7.10	17.9	234300	68199	18612	308	10840	21868	8282	16318	1135	2509	85	2.3	202.0	32.3	70	[illegible]	38	0.1	104	196	16
17		40.0	26.43	5.87	17.3	236500	67150	19024	319	12860	19289	8589	17586	1111	2669	105	0.90	189.2	32.4	5	150.8	31	0.1	132	152	17
18		42.5	33.69	7.97	16.1	213400	68550	18919	310	11590	22580	8307	15517	1079	2677	95	0.90	113.2	29.2	5	263.9	27	0.1	156	164	18
19		45.0	33.76	7.19	15.6	210000	62950	19494	317	11890	20310	8510	13947	978	2769	102	0.90	137.2	27.7	40	362.4	24	0.1	156	168	19
20		47.5	36.66	9.78	14.6	255900	69950	20459	333	13380	22922	8933	15028	1013	3085	106	0.05	172.1	28.8	240	415.9	29	0.1	156	160	20
21		55	33.35	9.33	14.8	205900	59728	23513	398	6700	18247	10213	15070	747	3277	125	1.0	58	26	5	34	16	0.1	60	67	21
22		65	44.89	13.99	14.8	202500	61210	21725	363	8760	18466	9731	17670	702	3096	146	2.0	88	30	5	67	17	05	69	73	22
24		75	51.31	14.08	12.8	207100	56580	16251	262	8090	16332	6840	13550	720	2037	76	2.0	70	22	5	73	25	04	62	74	24
25		85	49.47	13.02	14.4	192200	63396	15556	247	8300	19472	6771	13640	771	1909	95	3.0	58	23	5	150	17	2.0	64	74	25
26		95	49.50	13.12	15.1	181900	61865	15909	251	9250	19011	6990	13970	686	1970	90	2.0	35	18	5	33	17	1.8	67	77	26
	II																									
27		105	51.12	14.81	16.1	204300	56699	14509	235	6410	17126	6295	12920	676	1740	76	3.0	68	20	5	227	17	0.4	59	80	27

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28		115	52.55	16.66	14.0	199600	61923	14980	240	7700	19540	6572	13540	674	1809	99	2.0	52	21	5	42	18	2.2	64	71	28
29		125	33.91	7.09	24.2	171200	53558	14213	229	8430	15752	6155	12970	478	1688	80	3.2	56	28	5	75	17	2.3	63	75	29
30		135	33.11	6.30	26.4	163900	53973	14288	232	7960	16977	6500	13440	373	1665	82	3.4	83	40	5	143	17	2.9	59	91	30
32		145	44.61	7.85	23.3	162700	53687	13952	212	8520	16293	5947	12050	453	1521	72	1.5	34	37	5	43	19	2.0	63	93	32
33	III	155	46.64	17.49	12.2	206300	62006	16141	250	7600	19137	7520	13750	617	1857	82	4.0	44	28	5	66	19	1.8	67	79	33
34		165	44.81	19.03	12.5	189400	63717	16663	260	7660	20785	7251	14200	581	1800	74	3.8	37	23	5	68	19	2.5	66	69	34
35		175	34.35	12.79	14.2	184600	64589	16019	258	7620	21677	7141	14750	475	1807	78	3.5	33	28	5	63	18	2.9	68	63	35

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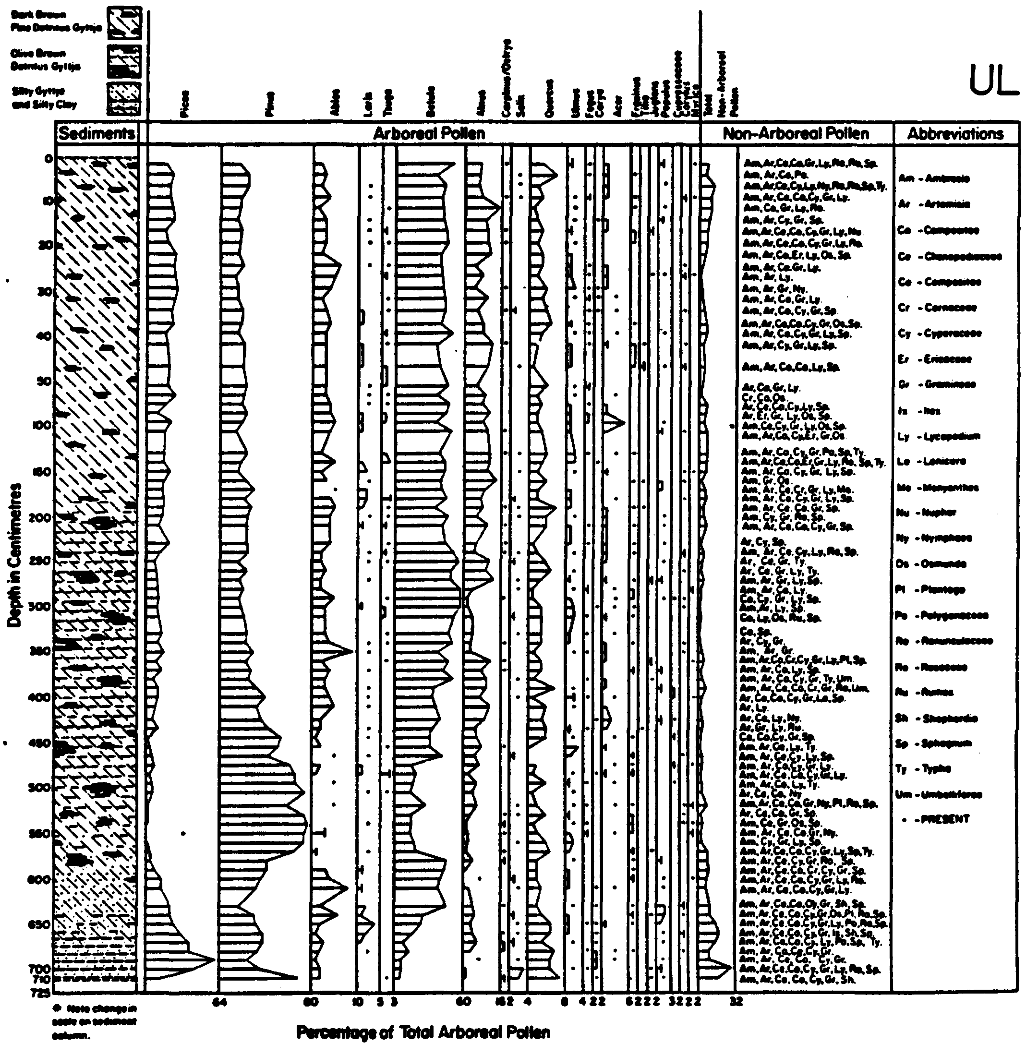

Pollen diagram for core UL from Furnival Lake.

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SAMPLE CODE	CORE	SAMPLE DEPTH	WET WT.	DRY WT.	L.O.I	Si	Al	Fe	Mn	K	Na	Mg	Ca	P	Ti	Zr	As	Cr	Cu	Hg	Ni	Pb	U	V	Zn	SAMPLE CODE
01		0	24.03	0.69			21625	9363	244.6	3560	4855	3818	4720	1127	6281		10.1	260.4	40.1		3797	80	0.1	40	260	01
02		2.5	26.29	1.63		148600	27611	2167	40.0	4200	5710	8505	2668	1462	152		7.2	43.5	10.0	260	70.1	107	0.1	96	240	02
03		5.0	24.22	1.56		160200	30610	7068	113.0	4160	6693	2863	7676	1541	49.3		9.8	24.7	29.8		218.5	186	0.1	28	264	03
04		7.5	25.90	1.56	49.2	166500	33965	24794	449.7	4580	8232	9486	23818	1453	1988		8.9	560	115.6	320	2246	123	0.1	44	268	04
05		10.0	26.09	1.83	48.8	146400	36160	24064	420.4	5020	11606	8218	22083	1315	1752		10.4	472.8	46.3	130	1373	98	0.1	22	256	05
06		12.5	26.70	1.98	48.1	150400	30364	21635	314.6	4230	7839	8507	20071	1076	1944		11.0	552.8	101.5	100	1565	67	0.1	24	244	06
07		15.0	26.71	1.62	48.1	152200	31270	21135	395.3	4160	8500	9016	20907	1012	1617		8.9	309.6	150.4	160	728	58	0.1	20	228	07
08		17.5	29.28	2.38	48.7	151200	33990	24594	475.5	4780	9081	11610	25873	1008	1929		6.9	417.0	132.2	170	1044	48	0.1	12	216	08
09		20.0	26.00	1.51	48.1	154600	31656	24284	461.7	5080	9900	12390	25532	1040	1925		4.8	448.0	143.3	340	1241	41	0.6	93	196	09
10		22.5	24.31	1.62	48.5	154500	41610	19313	335.6	6780	9805	10728	20142	971	2684		5.4	356.0	105.0	160	829.9	39	0.1	56	200	10
11		25.0	30.12	1.65	49.1	154000	36095	17504	312.1	4730	8590	9372	19295	939	1390		4.0	240.0	96.0	130	88.8	26	0.1	32	200	11
12		27.5	25.14	1.43	49.3	158000	36045	18064	312.7	4260	9090	9188	19569	939	1276		2.0	361.0	102.3	80	1059	29	0.5	96	200	12
13		30.0	25.04	1.54	49.1	156700	34635	19283	333.3	4820	9187	9027	20964	969	1327		1.5	262.4	109.3	200	6779	21	0.1	84	208	13
14		32.5	26.71	1.71	47.6	169900	31500	17679	298.4	4340	8773	8585	18434	868	1473		1.8	608.9	98.9	180	6171	23	0.1	88	204	14
15		35.0	30.19	1.86	48.3	140100	29489	16444	278.2	2820	4923	8275	17725	825	1243		2.8	271.1	143.0	100	1058	21	0.1	48	224	15
16		37.5	28.02	1.58	48.1	131900	31455	17953	315.4	5330	5688	9340	20177	852	1474		1.7	151.9	149.2	400	218	35	0.1	80	212	16
17		40.0	27.56	1.46	48.1	131900	31695	16544	286.6	5590	6196	8646	18325	836	1351		0.9	202.0	111.6	90	512	33	0.1	44	212	17
18		42.5	24.95	1.34	47.7	139400	30760	15884	270.0	5270	5755	8408	17463	796	1319		1.5	129.9	103.3	130	247.9	35	0.1	56	216	18
19		45.0	21.83	1.29	46.6	144600	33650	16044	235.1	5720	7963	8519	17326	830	1353		1.6	146.0	105.8	50	262	32	0.1	44	200	19
20		47.5	29.45	1.68	47.2	147500	33289	16163	280.4	5720	6257	8913	17451	806	1401		0.9	42.8	110.0	100	82.1	31	0.1	108	192	20
	I																									
21		55	29.93	2.50	45.2	150900	32025	16946	277	4010	6430	8924	16720	839	1313	42	1.6	50	82	5	122	12	4.2	45	109	21
22		65	22.34	1.55	44.1	122200	30914	18558	321	3980	6194	9619	17950	954	1274	39	2.5	105	76	5	140	22	3.2	40	104	22
23		75	32.01	3.45	46.9	133200	29395	15316	258	3470	5626	8169	15810	847	1126	40	1.5	101	82	5	174	22	3.2	34	103	23
24		85	23.78	1.97	46.9	141000	32253	14728	259	4030	6194	8433	16060	921	1175	39	1.0	55	79	5	72	24	3.3	38	110	24
25		95	35.09	2.34	46.1	133000	30876	14736	251	3360	5388	7987	15810	953	1100	34	2.5	64	85	5	76	24	4.0	30	105	25
26		105	29.87	1.60	45.7	129700	27829	13063	220	3480	4911	7195	14030	863	1035	36	2.0	75	82	47	206	28	2.9	27	126	26

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29		115	47.53	2.87	47.2	155600	29400	14011	240	3640	5112	6786	14280	997	995	32	4.1	46	60	5	90	30	3.6	25	109	29
30		125	42.06	2.63	47.7	136500	30815	13761	240	3580	5602	7022	14730	970	1013	38	3.6	62	65	5	69	20	33	24	106	30
31		135	40.16	2.58	45.9	157800	32639	16110	278	4450	5896	8849	16970	907	1282	40	2.8	98	78	5	79	16	2.7	35	106	31
32	II	145	46.04	3.22	46.4	149200	32591	16264	278	3570	5945	8889	17110	980	1300	37	2.2	53	81	20	97	13	3.3	36	107	32
33		155	42.33	3.28	46.5	163900	30722	14197	243	2990	5299	7613	15850	1107	1136	38	1.5	61	80	10	119	12	1.5	22	94	33
34		165	37.91	2.85	45.7	155000	31345	13780	239	3610	5050	7677	15620	1192	1097	33	1.6	51	92	5	73	11	1.0	28	104	34
35		175	37.93	2.77	46.2	150000	28144	12973	230	2840	4309	7017	15430	1188	1016	29	2.0	88	101	5	59	7	0.1	38	98	35
36		185	40.44	3.00	46.7	143700	27782	12905	229	2550	4203	6786	15590	1262	978	24	3.0	85	108	5	69	10	0.2	40	89	36
37		195	38.71	2.99	47.3	199900	28524	11387	205	2640	4471	6148	13780	1319	862	25	25	80	90	5	68	10	0.3	36	88	37

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40		205	41.91	2.65	47.6	169000	25706	10203	186	2660	3647	5436	13020	1229	783	25	35	67	105	10	62	9	0.1	35	90	40
41		215	41.18	2.99	46.7	160000	27458	10869	195	2740	3931	5797	13560	1180	859	28	3.0	75	92	5	64	11	0.1	35	88	41
42		225	39.99	2.99	47.6	154900	26330	10611	199	3050	3915	5698	13870	1237	772	22	1.5	76	102	5	70	10	0.1	36	89	42
43		235	39.34	3.15	45.8	183000	27569	11637	213	2930	4239	6248	14720	1221	856	24	2.5	82	110	5	92	10	0.4	37	91	43
44	III	245	45.12	3.74	44.4	187900	25642	11379	207	3040	4214	6222	13780	1056	840	23	30	75	90	5	71	10	0.5	43	89	44
45		255	42.48	3.71	45.6	152200	26549	10710	201	2980	4207	5982	13810	1182	847	26	2.0	68	88	15	68	12	1.3	37	85	45
46		265	46.29	4.45	44.0	205500	26620	10514	205	2890	4092	5765	13890	1381	792	23	2.0	105	168	13	180	10	0.5	35	108	46
47		275	45.37	3.96	44.0	197200	27084	10949	209	3220	4182	6079	14630	1304	876	27	1.0	69	97	5	63	13	0.5	37	85	47
48		285	42.32	3.82	43.3	163100	25728	10381	200	3160	3905	5642	14290	1340	830	25	3.2	66	100	5	74	12	0.3	44	88	48
51		295	45.73	3.59	42.0	154900	25877	11244	216	2960	4247	6299	14450	1059	1002	36	2.0	72	106	5	73	11	1.1	34	84	51
52		305	39.62	4.27	41.2	131600	28079	11978	228	3570	4453	6559	15150	1133	1062	37	1.0	93	122	5	168	12	0.1	39	91	52

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53		315	42.79	4.44	41.1	130400	26964	11901	250	3630	4152	6320	15270	1180	970	29	1.4	190	132	5	104	12	0.4	38	94	53
54		325	42.72	4.57	39.2	167400	24347	10152	199	2870	3470	5549	13350	1132	900	29	3.0	97	98	5	56	13	0.7	29	89	54
55	IV	335	45.19	4.50	36.7	168900	21507	7950	157	2390	2651	3865	9458	1286	595	25	3.0	193	73	5	59	5	0.4	36	68	55
56		345	47.41	5.60	38.3	269000	18669	6862	135	1990	2373	3427	9756	1289	536	22	2.0	93	83	5	92	5	0.1	30	64	56
57		355	41.65	3.58	39.8	162600	18453	8824	175	2150	2254	4321	13320	1226	685	19	2.2	87	116	5	46	7	0.7	30	63	57
58		365	43.15	5.06	40.9	142100	15600	7951	157	1750	1937	3955	12200	940	580	18	3.4	85	124	5	57	6	0.4	23	60	58
59		375	42.06	4.76	40.2	242200	16640	9063	168	2070	2253	4407	12640	871	690	22	4.1	107	131	5	56	5	0.7	31	69	59
61		385	49.50	5.22	37.0	169600	12064	5869	116	1420	1248	2536	10920	739	418	13	2.0	79	140	14	75	5	0.4	17	68	61
62		395	45.67	4.86	38.4	196100	11574	5427	114	1320	1301	2555	10770	751	400	16	3.5	71	138	18	53	4	0.4	17	72	62
63		405	44.99	4.62	38.7	184800	10517	4737	90	1220	1130	1902	8645	736	292	15	3.8	61	141	10	51	5	0.5	20	70	63
64		415	45.42	4.32	39.3	219100	9066	6226	80	1120	1153	1775	8005	531	273	14	4.0	76	118	15	142	4	0.4	15	66	64
65		425	38.20	3.79	45.0	154600	11249	5583	100	1290	1553	2415	9398	589	352	17	4.5	59	129	10	68	4	0.3	21	72	65

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66	V	435	44.51	4.37	40.0	166700	11321	6947	91	1280	1466	2223	8508	590	339	18	4.2	54	147	10	40	4	1.1	15	62	66
67		445	43.89	4.59	36.1	137900	12980	6849	91	1710	1406	2173	8275	621	391	19	4.0	71	168	10	93	4	0.3	15	66	67
68		455	43.14	4.44	36.0	176100	14971	7935	87	2480	1376	2357	7517	532	420	20	4.2	74	158	16	61	6	0.1	18	65	68
69		465	43.98	4.15	44.2	138800	9281	6259	91	1150	1338	2079	9012	535	306	15	3.8	83	158	5	73	4	0.5	20	74	69
70		475	50.25	4.78	44.0	160300	10948	6482	93	1350	1411	2152	9278	682	342	18	4.2	52	191	5	46	4	1.8	14	98	70
72		485	46.23	4.00	49.7	166100	10130	11279	103	1380	1393	2344	9830	785	346	20	3.8	57	303	5	67	5	1.9	19	73	72
73		495	47.97	4.06	50.8	133500	10934	9829	107	1320	1465	2776	10190	677	427	26	4.0	94	238	5	76	6	1.6	23	75	73
74		505	48.44	4.00	52.9	125700	12872	8522	103	1800	1772	3024	10010	676	503	24	4.0	44	220	5	62	7	2.3	24	62	74
75		515	46.79	3.93	56.3	116500	12752	11319	125	1730	2345	3521	11400	748	472	25	4.0	85	273	19	74	6	2.5	27	62	75
76	VI	525	39.06	3.44	57.7	111700	19396	14264	168	2480	4011	5040	13890	890	717	37	4.2	77	305	5	99	8	2.7	34	71	76
77		535	36.32	3.31	54.2	116700	16788	14541	149	2340	3169	4310	12800	834	614	32	4.4	155	344	5	369	9	3.7	32	68	77
78		545	40.51	4.58	43.0	144600	37010	21448	278	6360	10897	8972	18240	995	1327	59	2.0	125	369	5	286	13	3.6	53	80	78

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79		555	31.71	5.05	35.5	212000	37333	21076	276	6220	10763	9339	17700	861	1416	66	4.0	123	352	5	136	13	0.5	51	72	79
80		565	34.87	4.72	36.6	158200	39166	23265	286	7400	11184	9605	18310	944	1473	61	4.2	73	347	5	129	13	1.6	57	69	80
83		575	38.88	11.49	16.2	242000	53995	23141	364	10380	16774	18056	33520	725	1905	89	2.5	105	163	5	148	21	2.0	69	60	83
84		585	49.56	20.10	14.1	224700	51716	21247	371	10230	15960	22076	50350	664	1859	67	2.0	79	102	5	179	24	0.4	62	53	84
85		595	61.30	31.96	13.3	217000	52520	20620	411	11350	16532	23696	66620	576	2013	78	0.1	96	78	5	100	26	0.2	68	48	85
	VII																									
86		605	42.62	23.45	13.6	229400	50919	20294	423	10350	16266	24736	73840	553	2026	82	1.0	72	75	5	60	26	0.3	58	46	86
87		615	41.19	22.34	15.6	214100	49205	18396	349	11510	16802	22517	80270	503	1575	64	2.0	69	78	5	78	25	0.4	68	45	87
88		625	41.58	25.05	13.5	225400	50969	17604	350	10650	16363	23667	60550	614	1737	71	1.0	58	92	5	79	24	0.3	62	43	88
89		635	60.58	35.16	12.2	223300	52027	15737	317	11030	17545	24327	53390	535	1733	95	1.0	44	74	5	54	23	0.1	60	41	89
90		645	51.22	31.26	12.3	227100	49977	14291	296	16320	18467	23177	66570	493	1585	86	1.8	41	55	5	54	23	1.6	53	34	90

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END CORE

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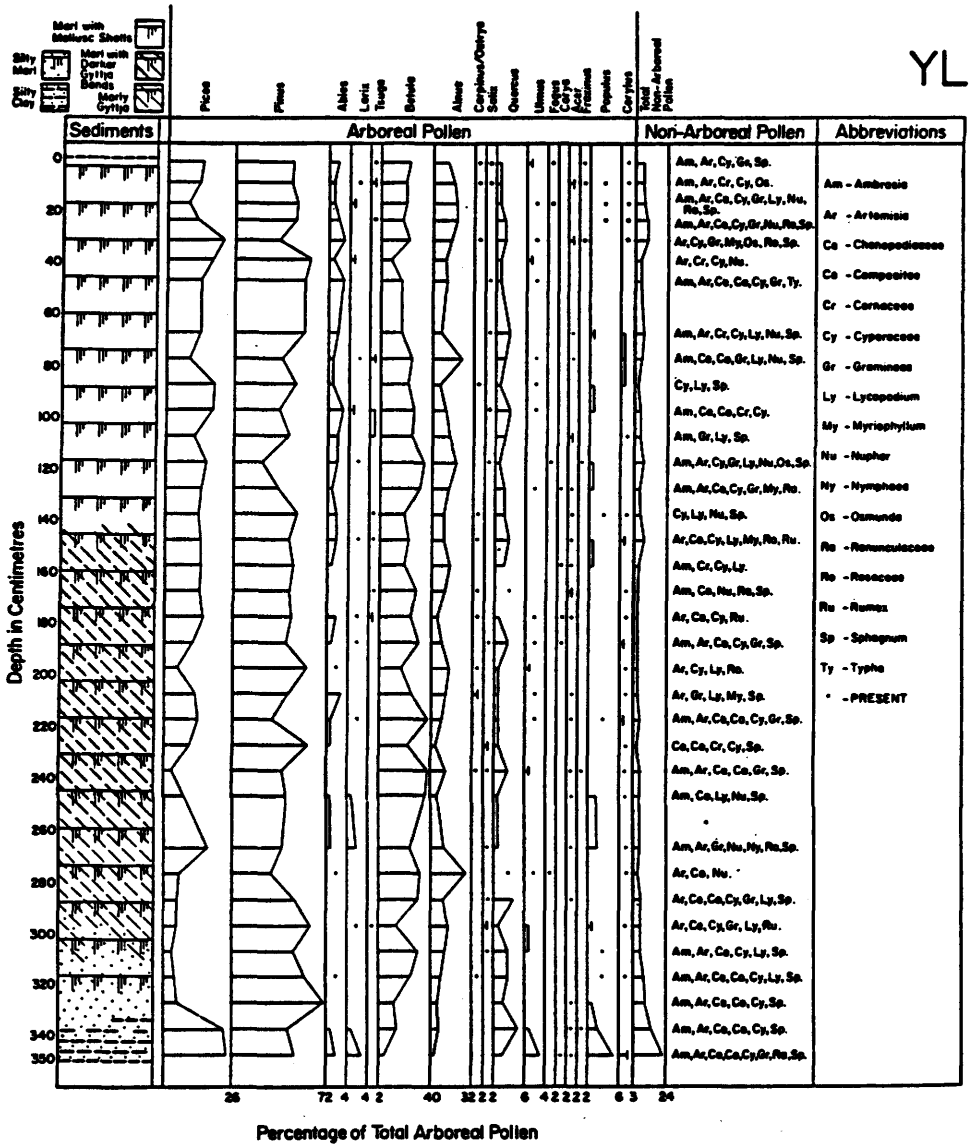

Pollen diagram for lake YL. Extends down to the pine zone about 6,500 yrs. B.P.

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SAMPLE CODE	CORE	SAMPLE DEPTH	WET WT.	DRY WT.	LOI	Si	Al	Fe	Mn	K	Na	Mg	Ca	P	Ti	Zr	As	Cr	Cu	Hg	Ni	Pb	U	V	Zn	SAMPLE CODE
01		0	33.87	4.83	51.6	19900	6910	1126	110	1320	4293	3575	358403	231	113	5	0.5	97.0	22.8	80	141.5	64	0.5	56	140	01
02		2.5	24.25	4.85	50.4	19500	6055	1190	99	1420	3370	3182	365104	194	108	5	1.0	34.9	11.2	50	[illegible]	54	0.1	76	84	02
03		5.0	35.15	8.32	49.8	20000	6600	1214	104	1140	3834	3361	400304	115	129	5	1.0	59.7	20.6	30	[illegible]	56	0.3	36	136	03
04		7.5	33.66	8.23	50.0	23400	7170	1020	92	1530	3995	3408	360003	188	124	6	1.0	92.6	12.9	70	[illegible]	59	0.1	48	62	04
05		10.0	33.50	9.32	50.6	26800	7200	880	89	1360	3396	3418	368702	179	130	5	0.05	13.1	19.3	50	[illegible]	63	0.1	58	[illegible]	05
06		12.5	31.05	7.96	50.4	40800	7025	843	86	1640	4882	3483	350003	167	105	5	1.2	59.3	15.5	50	[illegible]	59	0.1	60	80	06
07		15.0	37.35	10.46	50.0	22300	6129	853	85	1010	3784	3340	313990	159	103	5	0.9	61.2	17.8	40	152.3	47	0.1	90	99	07
08		17.5	39.90	11.02	50.2	16100	7025	911	87	1900	6022	3974	358403	165	119	5	2.6	75.6	17.6	10	[illegible]	54	0.3	34	112	08
09		20.0	32.40	9.07	49.0	14000	4846	936	88	1240	4001	3556	236802	109	130	5	1.0	36.9	13.5	10	[illegible]	49	0.1	72	60	09
10		22.5	40.60	13.79	49.2	19500	5604	679	79	1050	3610	3232	401700	126	81	4	0.3	38.3	16.4	10	[illegible]	63	0.1	44	68	10
11	I	25.0	36.50	13.15	49.0	19400	5400	558	74	710	3610	3186	366600	118	59	3	1.0	34.3	15.0	40	[illegible]	55	0.1	80	120	11
12		27.5	37.53	12.27	48.4	11900	5265	840	85	710	3872	3671	363700	100	61	3	0.3	61.6	17.0	10	78.6	52	0.1	40	162	12
13		30.0	39.15	14.67	48.8	15800	5360	759	83	860	3722	3618	408101	102	81	3	1.1	85.5	15.0	20	131.0	48	0.1	88	96	13
14		32.5	41.43	15.62	48.8	18800	5074	530	211	560	3879	3576	[illegible]	93	44	3	0.8	61.9	13.3	20	[illegible]	52	0.1	76	120	14
15		35.0	36.06	14.17	49.2	16500	5120	449	81	830	3985	3199	364199	106	33	3	0.5	77.3	11.4	10	[illegible]	51	0.1	80	92	15
16		37.5	44.37	18.42	41.6	18000	4949	427	71	740	3778	2535	408299	36	29	2	1.9	74.0	14.4	10	[illegible]	60	0.1	100	136	16
17		40.0	36.23	15.41	48.3	[illegible]	4986	495	74	910	3429	3997	392099	81	26	3	1.9	96.0	11.4	10	399.0	51	0.1	76	84	17
18		42.5	37.10	15.86	48.3	14100	4650	506	75	560	3708	3584	440900	85	28	2	3.2	172.7	14.4	10	[illegible]	54	0.1	4	56	18
19		45.0	35.38	15.01	48.1	13500	4350	522	77	620	3043	3743	449900	83	29	2	1.2	34.0	13.5	40	[illegible]	70	0.1	4	7	19
20		47.5	41.65	18.64	47.6	12900	4510	611	66	490	2665	3458	455099	82	21	2	0.9	66.1	19.3	40	301.0	52	0.1	4	[illegible]	20
24		55	59.01	19.32	48.8	2000	2938	401	62	660	301	3283	399008	102	40	2	0.1	1	12	5	1	32	1.3	17	27	24
25		65	54.30	21.55	49.2	1600	1994	155	28	390	44	1750	202602	75	6	1	1.2	2	<1	5	80	31	1.2	24	20	25
26		75	47.35	14.97	51.9	1800	2596	422	49	540	199	2361	293106	118	22	2	1.0	2	3	5	10	39	1.5	66	26	26
27		85	56.97	20.38	47.8	1300	1938	277	57	910	117	3085	358203	72	2	1	0.1	<1	2	5	3	31	1.3	50	24	27
28	II	95	58.41	20.97	48.8	1100	1919	224	45	270	90	2588	295602	68	6	1	0.8	1	1	5	1	39	1.6	64	19	28

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29		105	53.00	16.04	51.8	200	2169	256	46	410	247	2619	308209	90	14	2	0.8	4	<1	5	13	30	1.4	35	27	29
30		115	58.16	18.56	50.3	200	2266	210	73	370	335	2589	292600	94	230	4	5.8	29	25	5	12	27	1.9	23	28	30
31		125	45.78	13.43	50.1	1900	2603	376	53	440	359	2646	326106	120	31	2	0.6	1	13	10	11	30	1.7	28	41	31
32		135	49.33	10.23	57.6	800	5176	2912	83	920	926	2956	286105	214	95	4	0.8	4	<1	5	13	30	1.4	35	27	32
34		145	53.72	13.04	50.2	800	4035	433	72	1440	1149	2366	278500	195	143	7	0.2	33	18	5	10	24	1.8	19	39	34
35		155	52.54	12.99	53.4	800	4068	469	47	1020	1196	2311	276300	131	93	7	3.8	7	15	15	3	26	1.8	34	42	35
36		165	48.06	12.62	51.8	700	2388	272	48	390	335	2321	311000	112	40	5	1.1	4	16	11	5	27	2.1	23	30	36
37		175	56.11	15.38	49.8	800	3871	533	56	950	987	2388	319900	110	65	6	1.0	3	21	5	4	28	2.1	33	31	37
38	III	185	53.48	15.56	49.4	700	3243	454	57	810	409	2753	332800	94	45	<1	1.6	4	18	5	20	28	3.2	37	25	38
39		195	48.01	13.37	50.3	100	2227	350	69	360	285	2455	317300	97	28	3	1.6	5	14	5	20	30	2.6	22	27	39
40		205	50.56	14.65	49.0	700	34025	1264	99	1550	72200	2799	320200	136	158	552	32	5	12	5	1	84	2.5	36	30	40

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41		215	50.59	14.83	49.9	600	3263	57	74	790	973	2792	359400	111	46	6	1.0	4	15	5	11	29	2.1	27	26	41
42		225	43.98	4.78	50.9	300	2536	394	91	430	410	2454	334400	136	28	7	4.8	7	18	10	21	27	2.8	28	30	42
45		235	43.17	4.87	49.6	200	2646	366	91	500	393	2852	219200	94	292	2	3.7	32	31	10	30	31	1.8	29	26	45
46		245	50.25	13.55	48.7	700	2744	391	60	450	221	2398	258700	110	69	2	3.5	15	16	15	64	29	2.2	28	28	46
47		255	46.48	10.25	55.5	800	4298	1420	44	790	426	2100	225300	218	119	7	3.8	11	28	11	51	24	2.3	30	37	47
48		265	46.56	9.38	55.9	3400	8737	2567	43	1690	1114	2259	205000	247	243	10	4.7	8	39	5	40	24	4.0	39	42	48
49	IV	275	47.64	12.49	51.8	800	4343	1231	62	930	649	2960	284400	167	107	5	1.0	5	23	5	9	32	3.5	27	33	49
50		285	44.83	11.81	52.7	2000	7258	2170	61	1800	841	2977	258100	175	213	9	1.0	6	32	5	1	25	4.7	44	35	50
51		295	51.77	11.54	49.8	11000	5900	1991	84	1410	947	4010	299000	141	156	8	1.1	7	32	10	15	29	2.5	38	33	51
52		305	51.57	21.83	45.4	16000	8608	2661	92	1260	1677	4994	300500	140	248	10	2.8	5	37	5	7	31	4.0	35	32	52
53		315	51.56	28.96	28.3	186000	29980	6778	141	8380	9721	17211	190900	246	834	55	1.0	9	17	5	1	19	4.2	31	15	53

END OF CORE

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SECTION 5

OTHER INFORMATION

A. LIST OF DIATOM SPECIES

B. BATHYMETRIC MAPS (1981)

SECTION 5 - CONTENTS

DIATOMS FROM LAKE SEDIMENT CORES, ALGOMA DISTRICT, NORTH OF LAKE SUPERIOR

Achnanthes affinis Grun	alp*
Achnanthes biasolettiana (Kutz) Grun	-
Achnanthes conspicua A. Mayer	-
Achnanthes deflexa Reim	alp
Achnanthes delicatula (Kutz) Grun	alp
Achnanthes detha Hohn and Hellerm	-
Achnanthes exigua Grun	alp
Achnanthes exigua, var. heterovalva krasske	alp
Achnanthes flexella (Kutz) Brun	ind
Achnanthes lacunarum Hustedt	-
Achnanthes lanceolata (Breb) Grun	alp
Achnanthes lanceolata var. omissa Reim	-
Achnanthes linearis (W.Sm) Grun	alp
Achnanthes linearis f. curta H.L. Sm	-
Achnanthes marginulata Grun	-
Achnanthes microcephala (Kutz) Grun	ind*
Achnanthes minutissima Kutz	ind
Achnanthes minutissima var. robusta Hust	ind
Achnanthes peragalli Brun and Herib	ind
Achnanthes pinnata Hust	alp
Achnanthes sp.	-
Actinella punctata Lewis	acb*
Amphipleura pellucida Kutz	alp
Amphora cf. acutiuscula Kutz	-
Amphora ovalis Kutz	alp
Amphora ovalis var. pediculus (Kutz) V.H. ex DeT	alp
Anomoeoneis follis (Ehr) Cl	ind
Anomoeoneis intermedia Ostr	-
Anomoeoneis serians var. brachysira (Breb ex Kutz) Hust	acb
Anomoeoneis serians (Breb ex Kutz) Cl	acb
Anomoeoneis vitrea (Grun) Ross	alp
Anomoeoneis zellensis (Grun) Cl	-
Asterionella formosa Hass	alp

*ALP= ALKALIPHILOUS ALB= ALKALIBIONTIC ACP= ACIDOPHILOUS ACB= ACIDOBIONTIC IND= INDIFFERENT AND "-" pH INDICATOR STATUS UNKNOWN

C

Caloneis alpestris (Grun) Cl	
Caloneis bacillaris (Greg) Cl	
Caloneis cf. bacillum (Grun) Cl	alp*
Caloneis ventricosa (Ehr) Meist	alp
Cocconeis placentula Ehr	alp
Cyclotella antiqua W. Sm	acp
Cyclotella bodanica Eulenst.	alp
Cyclotella comta (Ehr) Kutz	ind*
Cyclotella meneghiniana Kutz	alp
Cyclotella stelligera Cl. and Grun	ind
Cymatopleura solea (Breb) W. Sm	alp
Cymbella amphicephala Naeg ex Kutz	ind
Cymbella angustata (W. Sm) Cl	alb*
Cymbella cesatii (Rabh) Grun ex A.S.	ind
Cymbella cistula (Ehr) Kirchn	ind
Cymbella cistula var. gibbosa Brun	ind
Cymbella cuspidata Kutz	alp
Cymbella cymbiformis Ag	alp
Cymbella cymbiformis var. nonpunctata Font	alp
Cymbella delicatula Kutz	alb
Cymbella hauckii V. Heurck	alp
Cymbella hebridica Grun ex Cl	-
Cymbella helvetica Kutz	alp
Cymbella hustedtii Krasske	-
Cymbella hybrida Grun ex Cl	-
Cymbella inaequalis (Ehr) Rabh	-
Cymbella lunata W. Sm	-
Cymbella microcephala var. crassa Reim	alp
Cymbella microcephala Grun	ind
Cymbella minuta Hilse ex Rabh	ind
Cymbella minuta f. latens (Krasske) Reim	ind
Cymbella minuta var. silesiaca (Bleisch ex Rabh) Reim	ind
Cymbella muelleri Hust	alp
Cymbella naviculiformis Auersw. ex Heib	ind

Cymbella norvegica Grun	-
Cymbella prostrata (Berk) Cl	alp*
Cymbella pusilla Grun	acp*
Cymbella rupicola Grun	-
Cymbella turgida Greg	-
Cymbella sp.	-
D	
Denticula elegans f. valida Pedic	alp
Diatoma elongatum Hust	alp
Diatoma tenue var. elongatum Lyng	-
Diploneis elliptica (Kutz) Cl	ind*
Diploneis finnica (Ehr) Cl	-
Diploneis marginestriata Hust	-
Diploneis oblongella (Naeg ex Kutz) Ross	alp
Diploneis oculata (Breb) Cl	alp
Diploneis puella (Schum) Cl	-
E	
Epithemia adnata (Kutz) Breb	alb*
Epithemia argus var. alpestris Grun	alp
Epithemia argus (Ehr) Kutz	alp
Epithemia smithii Carruthers	-
Epithemia sp.	-
Eunotia arcus Ehr	acp
Eunotia arcus var. bidens Grun	ind
Eunotia arcus var. uncinata (Ehr) Grun	-
Eunotia bactriana Ehr	acb*
Eunotia bidentula W. Sm	-
Eunotia bigibba Kutz	-
Eunotia carolina Patr	-
Eunotia curvata (Kutz) Lager	acp
Eunotia elegans Ostr	acp
Eunotia exigua (Breb ex Kutz) Rabh	acp
Eunotia fallax Cl	acp

Eunotia flexuosa var. eurycephala Grun	-
Eunotia flexuosa Breb ex Kutz	acp*
Eunotia gibbosa Grun	-
Eunotia glacialis Meist	-
Eunotia incisa W. Sm ex Greg	-
Eunotia meisteri Hust	acp
Eunotia monodon Ehr	acp
Eunotia naegelli Migula	acp
Eunotia parallela Ehr	-
Eunotia pectinalis var. curta V.H.	-
Eunotia pectinalis var. minor (Kutz) Rabh	acp
Eunotia pectinalis (O. Mull) Rabh	acp
Eunotia pectinalis var. ventricosa Grun	acp
Eunotia pectinoides Carter	-
Eunotia perpusilla Grun	acp
Eunotia polyglyphis f. pentaglyphis Grun	-
Eunotia praerupta var. bidens (Ehr) Grun	-
Eunotia praerupta Ehr	acp
Eunotia quaternaria Ehr	-
Eunotia repens var. deflexa A. Cl	-
Eunotia robusta var. diadema (Ehr) Ralfs	-
Eunotia rostellata Hust ex Patr	-
Eunotia cf. septentrionalis Ostr.	acp
Eunotia serra Ehr	alp*
Eunotia suecica A. Cl	-
Eunotia tautoniensis Hust ex Patr	acp
Eunotia tridon Ehr	-
Eunotia trinacria var. undulata Hust	-
Eunotia vanheurckii Patr	acp
F	
Fragilaria bicapitata A. Mayer	-
Fragilaria brevistriata Grun	-
Fragilaria constricta Ehr	acp

Fragilaria construens var. binodis (Ehr) Grun	ind*
Fragilaria construens (Ehr) Grun	alp*
Fragilaria construens var. venter (Ehr) Grun	alp
Fragilaria crotonensis Kitton	-
Fragilaria lapponica Grun	-
Fragilaria leptostauron var. dubia (Grun) Hust	alp
Fragilaria leptostauron (Ehr) Hust	alp
Fragilaria pinnata var. intercedens (Grun) Hust	alp
Fragilaria pinnata Ehr	alp
Fragilaria pinnata var. trigona (Brun and Herib) Hust	alp
Fragilaria cf. vaucheriae (Kutz) Peter	-
Fragilaria virescens Ralfs	ind
Frustulia rhomboides var. amphipleuroides (Grun) Cl	-
Frustulia rhomboides var. capitata (A. Mayer) Patr	acp*
Frustulia rhomboides (Ehr) DeT	acp
Frustulia rhomboides var. saxonica (Rabh) DeT	acp
G	
Gomphonema acuminatum Ehr	alp
Gomphonema affine Kutz	-
Gomphonema dichotomum Kutz	-
Gomphonema gracile Ehr emend V.H.	ind
Gomphonema grunowii Patr	-
Gomphonema intricatum Kutz	alp
Gomphonema intricatum var. vibrio (Ehr) Cl	alp
Gomphonema novacula Hohn and Hellerm	ind
Gomphonema parvulum Kutz	ind
Gomphonema subtile var. sagitta (Schum) Cl	-
Gomphonema subtile Ehr	ind
Gomphonema truncatum Ehr	-
Gyrosigma attenuatum (Kutz) Rabh	-
H	
Hantzschia amphioxys (Ehr) Grun	alp

M	
Mastagloia grevillei W. Sm	-
Mastagloia cf. muradii Voigt	-
Melosira arenaria Moorse	alp*
Melosira distans (Ehr) Kutz	acp*
Melosira distans f. clinostriata Cl	acp
Melosira distans var. lirata CO Mull) Bethge	acp
Melosira granulata (Ehr) Ralfs	-
Melosira islandica O. Mull	alp
Melosira italica (Ehr) Ralfs	-
Melosira italica subsp. subarctica O. Mull	alp
Melosira undulata (Ehr) Kutz	-
Melosira sp.	-
Meridion circulare (Grev) Ag	-
N	
Navicula amphibola Cl	ind*
Navicula aurora Sov	alp
Navicula bacillum Ehr	ind*
Navicula bicephala Hust	-
Navicula bipennata Cl	-
Navicula capitata Ehr	alp
Navicula cryptocephala Kutz	alp
Navicula cuspidata (Kutz) Kutz	alp
Navicula cuspidata var. major Neist	alp
Navicula dicephala Ehr	alp
Navicula elginensis (Greg) Ralfs	-
Navicula elginenesis var. rostrata (A. Mayer) Patr	-
Navicula explanata Hust	alp
Navicula gottlandica Grun	-
Navicula hustedtii Krasske	-
Navicula insignita Hust	-
Navicula jaernefeltii Hust	acp
Navicula laevissima Kutz	-

Navicula lanceolata (Ag) Kutz	alp*
Navicula ludloviana A.S.	-
Navicula minima Grun	alp
Navicula mournei Patr	-
Navicula notha Wallace	-
Navicula cf. peregrina (Ehr) Kutz	-
Navicula peticolasii M. Perag	-
Navicula pseudoscutiformis Hust	-
Navicula pupula var. capitata Skv and Meyer	ind*
Navicula pupula var. mutata (Krasske) Hust	-
Navicula pupula Kutz	ind
Navicula pupula var. rectangularis (Greg) Grun	ind
Navicula pusilla W. Sm	acp*
Navicula radiosa var. iparvo Wallace	-
Navicula radiosa Kutz	ind
Navicula radiosa var. tenella (Breb ex Kutz) Grun	ind
Navicula cf. rhynchocephala var. amphiceros (Kutz) Grun	-
Navicula scandinavica (Lagst.) Cl. Nach A. Schmidt	-
Navicula cf. siofokensis (Pant)	alp
Navicula subtilissima Cl	acp
Navicula tenelloides Hust	-
Navicula tripunctata var. schizoneomoides (V.H.) Patr	alb*
Navicula tuscula Ehr	alb
Navicula variostriata Krasske	-
Navicula sp.	-
Neidium affine (Ehr) Pfitz	ind
Neidium affine var. amphirhynchus (Ehr) Cl	alp
Neidium affine var. longiceps (Greg) Cl	acp
Neidium bisulcatum (Lager) Cl	ind
Neidium dibium (Ehr) Cl	ind
Neidium hitchcockii (Ehr) Cl	-
Neidium iridis var. amphigomphus (Ehr) A. Mayer	ind
Neidium iridis var. ampliatum (Ehr) Cl	ind
Neidium iridis (Ehr) Cl	ind

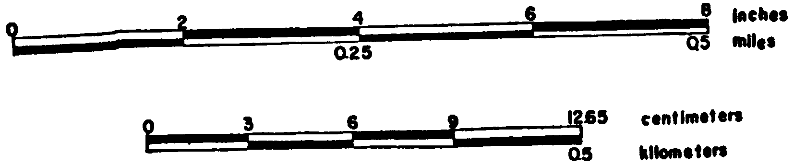
Neidium iridis var. subundulatum (Cl-Eul) Reim	ind*
Neidium sacoense Reim	-
Neidium temperei Reim	alp*
Neidium tumescens (Grun) Cl	-
Nitzschia accommodata Damas	-
Nitzschia acicularis W. Sm	alp
Nitzschia amphibia Grun	alp
Nitzschia denticula Grun	alp
Nitzschia denticula var. curta Grun	alp
Nitzschia fonticola Grun	alp
Nitzschia hantzschiana Rabh	-
Nitzschia intermedia Hantzsch	-
Nitzschia kutzingiana Hilse	alp
Nitzschia lunata Hantzsch	-
Nitzschia oregana Sovereign	ind
Nitzschia palea (Kutz) W. Sm	ind
Nitzschia sigma (Kutz) W. Sm	-
Nitzschia sinuata (W. Sm) Grun	-
P	
Pinnularia abaujensis (Pant) Ross	ind
Pinnularia abaujensis var. linearis (Hust) Patr	-
Pinnularia abaujensis var. rostrata (Patr) Patr	acp*
Pinnularia abaujensis var. subundulata (A. Mayer ex Hust) Patr	ind
Pinnularia acrosphaeria var. turgidula Grun ex Cl	-
Pinnularia acuminata var. bielowskii (Herib and Perag) Patr	alp
Pinnularia amblys Hohn and Hellerm	-
Pinnularia biceps Greg	acp
Pinnularia biceps var. minor (Boye Pet) A. Cl	-
Pinnularia braunii (Grun) Cl	-
Pinnularia brebissonii (Kutz) Rabh	-
Pinnularia brebissonii var. diminuta (Grun) Cl	-
Pinnularia brevicostata Cl	-

Pinnularia dactylus Ehr	-
Pinnularia divergens W. Sm	acp*
Pinnularia divergentissima (Grun) Cl	-
Pinnularia flexuosa Cl	acp
Pinnularia formica (Ehr) Patr	-
Pinnularia gibba Ehr	-
Pinnularia hilseana Jan	-
Pinnularia lata (Breb) Rabh	acp
Pinnularia latevittata Cl	-
Pinnularia laticeps A. Cl	-
Pinnularia maior (Kutz) Rabh	acp
Pinnularia maior var. transversa (A.S.) Cl	acp
Pinnularia mesolepta (Ehr) W. Sm	acp
Pinnularia microstauron (Ehr) Cl	ind*
Pinnularia mormonorum (Grun) Patr	-
Pinnularia nodosa (Ehr) W. Sm	acp
Pinnularia rupestris Hantz	-
Pinnularia singularis (A.S.) Cl	-
Pinnularia subcapitata Greg	-
Pinnularia substomatophora Hust	-
Pinnularia trigonocephala Cl	-
Pinnularia viridis var. commutata (Grun) Cl	ind
Pinnularia viridis (Nitz) Ehr	-
R	
Rhopalodia gibba (Ehr) O. Mull	alp*
Rhopalodia parallela (Grun) O. Mull	alb
S	
Semiorbis hemicyclus (Ehr) Patr	acb*
Stauroneis acuta W. Sm	alp
Stauroneis anceps Ehr	ind
Stauroneis anceps f. gracilis Rabh	ind
Stauroneis anceps f. linearis (Ehr) Hust	ind
Stauroneis livingstonii Reim	-

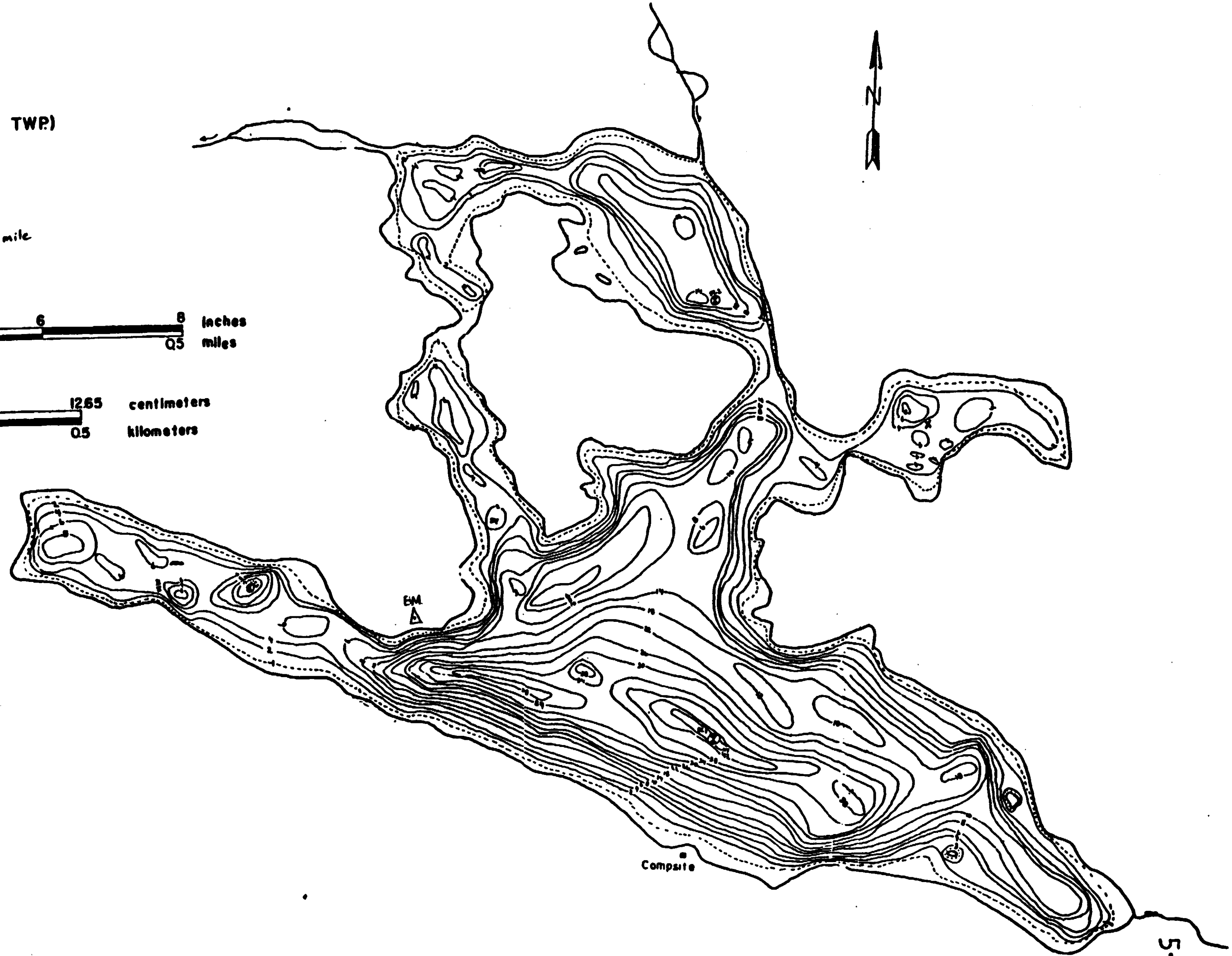
Stauroneis phoenicenteron (Nitz) Ehr	ind*
Stauroneis phoenicenteron f. gracilis (Ehr) Hust	ind
Stauroneis smithii Grun	ind
Stenopterobia intermedia Lewis	acp*
Stephanodiscus astrea var. minutula (Kutz) Grun	alb*
Surirella angustata Kutz	alp*
Surirella biseriata Breb	alp
Surirella biseriata f. minor V.H.	-
Surirella biseriata var. constricta Grun	ind
Surirella elegans var. minor Ehr	-
Surirella linearis var. constricta (Ehr) Grun	ind
Surirella linearis W. Sm	ind
Surirella cf. ovata Kutz	ind
Surirella robusta var. astridae (Hust) A. Cl	-
Surirella robusta var. constricta Font	-
Surirella robusta var. splendida (Ehr) V. Heurck	-
Surirella sigma Quelle	-
Synedra acus Kutz	alp
Synedra cf. closteroides Grun v. Jarnefelti Molder	-
Synedra delicatissima W. Sm	-
Synedra longissima W. Sm	-
Synedra parasitica (W. Sm) Hust	alp
Synedra radians Kutz	-
Synedra rumpens Kutz	ind
Synedra rumpens var. fragilarioides Grun	-
Synedra socio Wallace	ind
Synedra ulna (Nitz) Ehr	alp
Synedra sp.	-
T	
Tabellaria binalis (Ehr) Grun	acb*
Tabellaria fenestrata (Lyng) Kutz	acp
Tabellaria flocculosa (Roth) Kutz	acp

BARBARA LAKE

WAWA DISTRICT
TWP. 26 RANGE 15 (RAAFLAUB TWP.)
LAT. 47°16' LONG. 84° 20'
AREA = 58.40 HECTARES
A.C.F. = 0.965
SCALE — 16" = 1 mile   1" = 1/16 mile
25.3 cm = 1 km

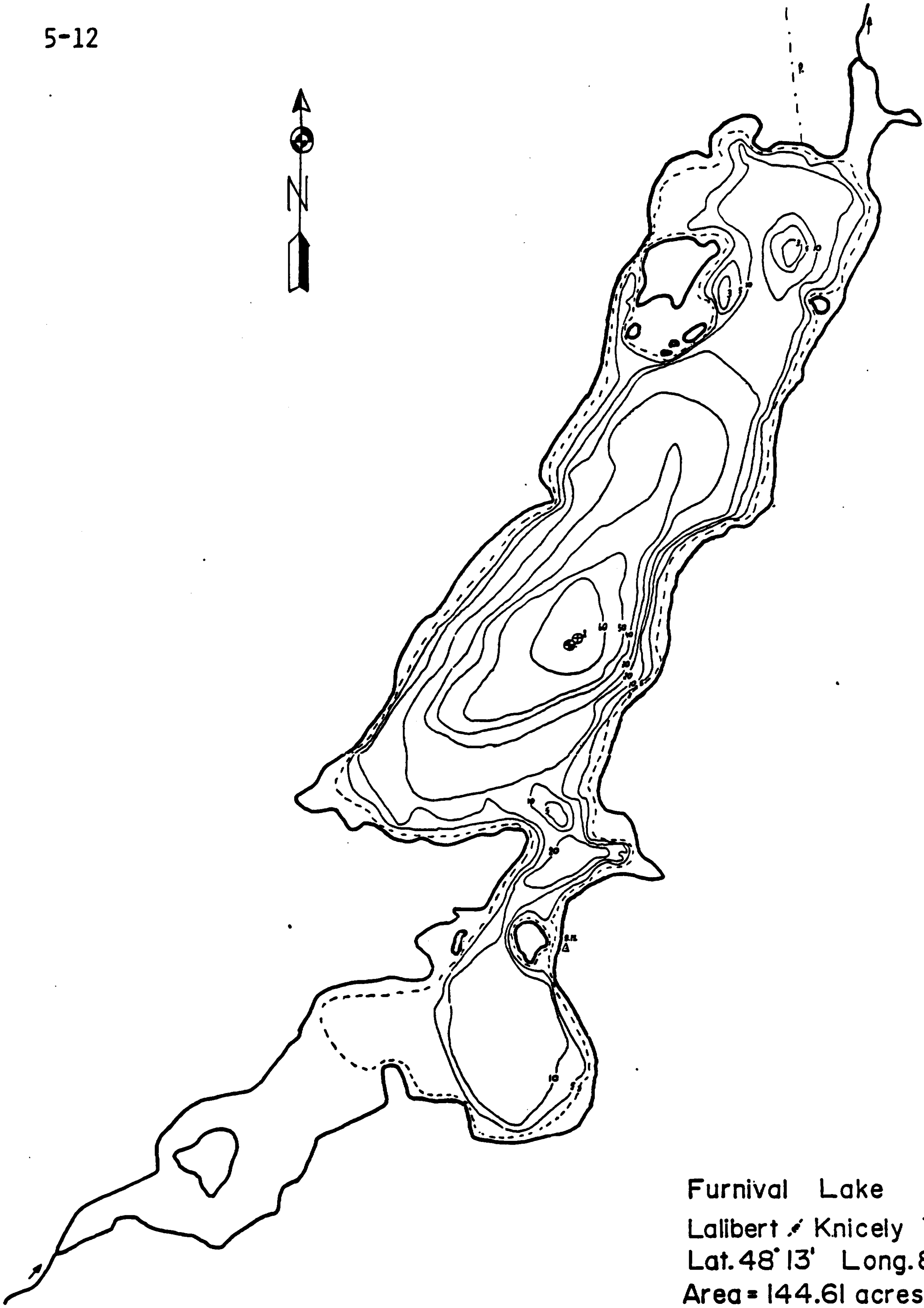


LAKE X_4



1978 S. KERR & D. PERRON

5-12



Furnival Lake

Lalibert / Knicely Twps.

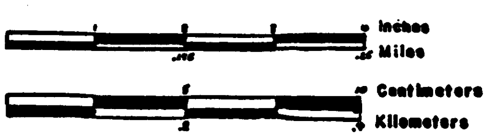
Lat. 48° 13' Long. 84° 56'

Area = 144.61 acres

A.C.F. = 1.094

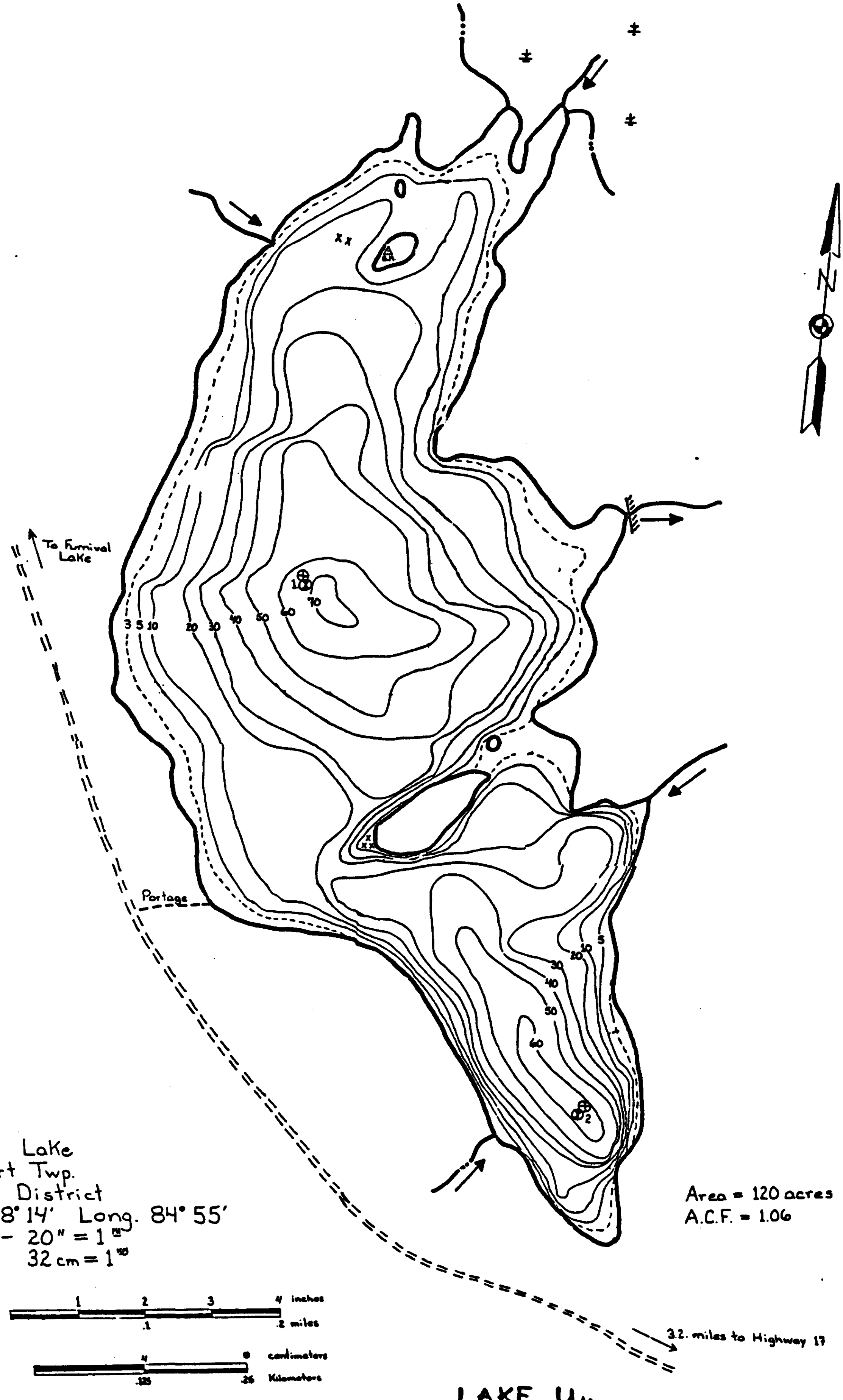
Scale - 16" = 1 MILE

25cm. = 1 KM



LAKE U_3

H. VALENSKY '77

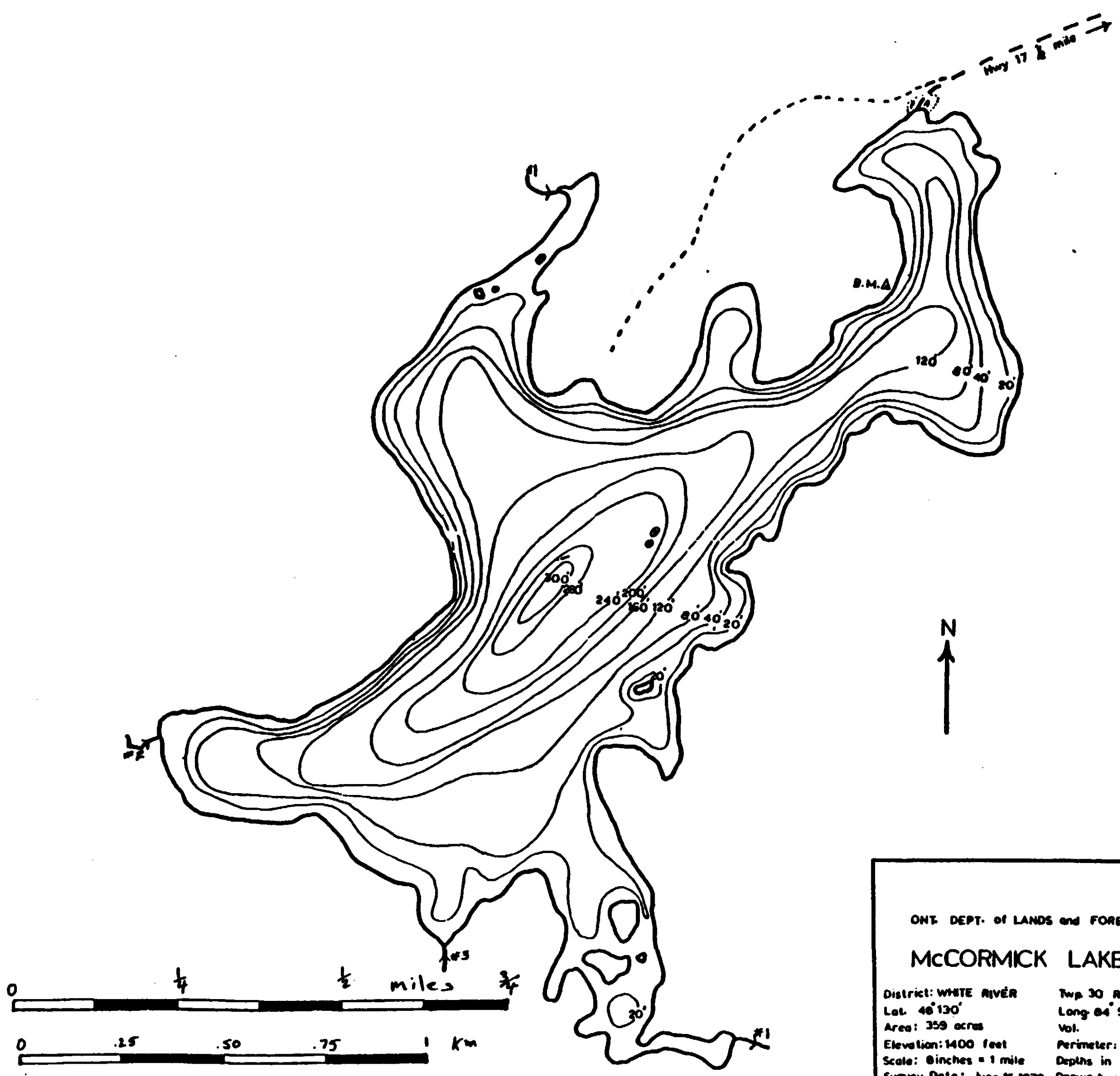


Cruise Lake
Lalibert Twp.
Wawa District
Lat. 48° 14' Long. 84° 55'
Scale - 20" = 1 mi
32 cm = 1 km

Area = 120 acres
A.C.F. = 1.06

LAKE U4

LAKE U_5



ONT. DEPT. of LANDS and FORESTS

McCORMICK LAKE

District: WHITE RIVER	Twp. 30 Range 26
Lat. 48°130′	Long. 84°530′
Area: 359 acres	Vol.
Elevation: 1400 feet	Perimeter: 74 miles
Scale: 8 inches = 1 mile	Depths in feet
Survey Date: June 15, 1970	Drawn by: B. Ruggles