

CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

Geological Survey of Canada



A GEOCHEMICAL ORIENTATION SURVEY FOR URANIUM; MacNICOL, TUSTIN,
BRIDGES AND DOCKER TOWNSHIPS (52/F/13), KENORA DISTRICT, ONTARIO

by

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TABLE OF CONTENTS

	Page
Introduction	1
Description of the Study Area	1
Location and Access	1
Physiography	1
General Geology	2
Mineralization	2
Sampling Techniques and Analytical Procedures	4
Sample Collection	4
Preparation	6
Analyses	6
Results and Discussion	9
Lake Waters and Sediments	9
Stream Waters and Sediments	20
Bedrock	20
Overburden	23
Conclusions	23
Acknowledgments	24
References	25
Appendix	
I Sample numbers and locations for surface lake waters and lake sediments, and for stream waters and sediments	26
II Surface lake waters: Field observations and analytical data	28
III Lake sediments: Field observations and analytical data	30
IV Stream waters: Field observations and analytical data	33
V Stream sediments: Field observations and analytical data	36
VI Sample numbers and locations for bedrock and overburden samples	39
VII Bedrock (composite chip samples): Field observations and analytical data	41
VIII Overburden: Field observations and analytical data	45

Tables

Table 1 Surface Lake Waters	10
2 Lake Sediments	15
3 Bedrock	21

TABLE OF CONTENTS (cont.)

	<u>Illustrations</u>	Page
Figure 1	Generalized geology	3
2	Trace metal distributions in surface lake waters	12
3	Correlation matrix and schematic representation of the significant chemical associations in the surface lake waters	14
4	Trace metal distributions in lake sediments	17
5	Correlation matrix and schematic representation of the significant chemical associations in lake sediments	19
6	Samples numbers and locations for surface lake waters and lake sediments and for stream waters and sediments	27
7	Samples numbers and locations for bedrock and overburden samples	40

Introduction

A geochemical orientation survey to determine the distribution and dispersion patterns of uranium, the base metals, and associated elements in bedrock, surficial overburden and lake and stream waters and sediments was carried out in an area covering MacNicol, Tustin, Bridges and Docker Townships, Kenora District (52/F/13), Ontario (Coker, 1975).

The survey was designed to permit testing of geochemical methods with regard to their responses to typical geological and environmental influences within the southern portion of the Superior Province of northwestern Ontario. The information obtained will be used to assess the effectiveness of geochemistry for reconnaissance surveys in these and similar nearby terrains as a basis for anticipated future regional surveys that may be carried out under the auspices of the Uranium Reconnaissance Program.

Description of the Study Area

Location and Access

The study area comprises the townships of MacNicol, Tustin, Bridges and Docker, an area of 370 square kilometres in the District of Kenora, Ontario. The area is located approximately 46 kilometres east of Kenora and 19 kilometres west of Vermilion Bay. The Trans-Canada Highway (Highway 17) runs approximately east-west through the centre of the study area. A number of secondary roads run north and south from Highway 17.

Physiography

In general, the topography is moderately rugged throughout most of this heavily forested, coniferous with subordinate deciduous treed area. Relief seldom exceeds 45 metres with maximum relief being in the order of 90 metres. Drainage is fairly well developed. Exposures of bedrock are abundant.

General Geology

The geology of the area has only recently been mapped, by A.P. Pryslak (1976), and released as Ontario Division of Mines Geoscience Report 130: "Geology of the Bruin Lake-Edison Lake Area, District of Kenora"; with accompanying Maps 2302 and 2303, at a scale of 1 inch to 1/2 mile. A generalized version of the geology of the area, after Pryslak (1976), is illustrated in Figure 1.

The bedrock comprising the east-west trending "greenstone" belt is all Early Precambrian (Archean) in age. The metavolcanic sequence varies in composition from mafic to intermediate and includes flows and pyroclastic material. Intimately associated with the metavolcanics are metasediments consisting predominantly of greywacke and minor quantities of calc-silicate gneiss, massive calc-silicate rocks of uncertain origin and iron formation. The metavolcanic-metasedimentary sequence is intruded by sills, dykes, and irregular bodies of rock that vary in composition from felsic to intermediate. The batholiths adjacent to the metavolcanic-metasedimentary belt comprise several intrusive units, and range in composition from felsic to intermediate.

Pleistocene glacial deposits, largely unsorted sand, gravel and boulders cover a large amount of the bedrock in the northern part of the area. These deposits have undergone significant erosion by glacial lake action.

Mineralization

Metallic mineralization in the area consists mainly of concentrations of sulphide and uranium minerals. The sulphides, consisting mainly of pyrrhotite and pyrite, but with minor concentrations of galena, sphalerite, chalcopyrite, molybdenite and minerals containing nickel and cobalt are associated mainly with metasediments and intermediate volcanics, and also possibly with ultramafic rocks. The sulphide occurrences in the area are described by Pryslak (1976) but to date no economic occurrences have been discovered. All uranium mineralization presently known in the area is associated with pegmatites. Mineralized pegmatites can be identified by yellow to yellow-green

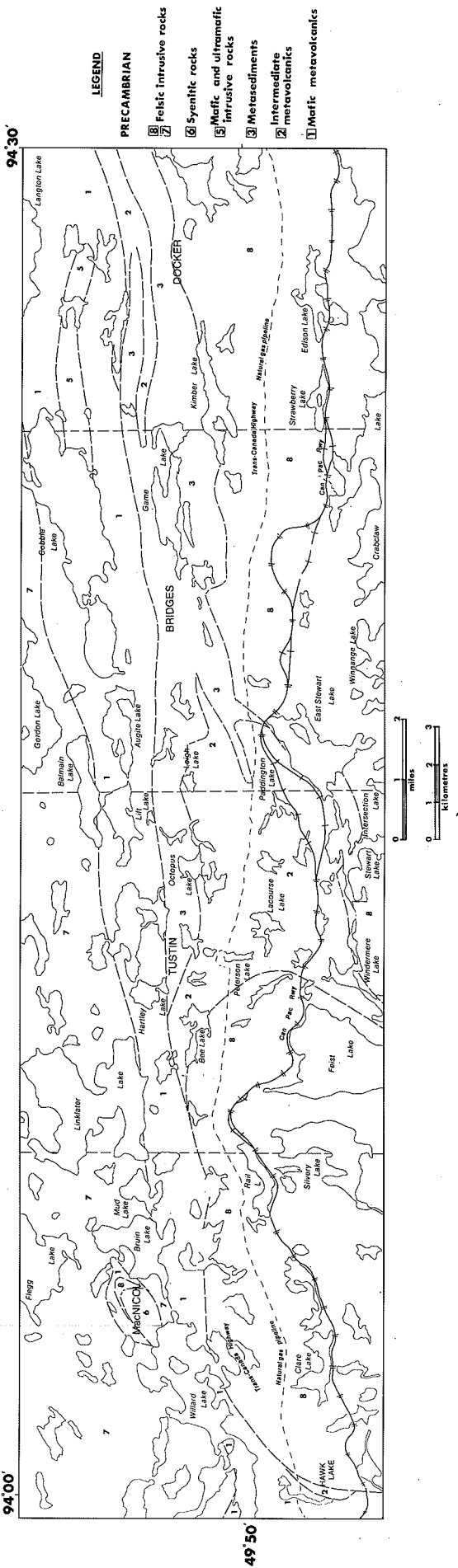


Figure 1. Generalized geology (after Pyrsiak, 1967).

secondary minerals, commonly beta-uranotite and uranophane, developed on weathered surfaces and in fractures in the pegmatite. Uraninite has been identified as the most common primary radioactive mineral although occurrences of uranothorite, allanite and tantalite have also been reported (Chisholm 1950; Satterly 1955; and Pryslak, 1976). It has also been noted that the most highly radioactive areas are invariably associated with biotite-rich zones, apatite-rich zones and/or magnetite-rich zones in the pegmatites. The distribution of uranium in the pegmatites is generally very erratic; economic concentrations are rare but an exception is the New Campbell Island Mines Ltd. property, on the northwest shore of Richard Lake, which has undergone limited underground exploration by means of two adits. This property has recently undergone reassessment (Northern Miner, February 10, 1977). Detailed descriptions of the uranium occurrences in the area are given in Chisholm (1950), Satterly (1955) and Pryslak (1976).

Non-metallic mineral occurrences of beryl and mica are also known in the region (Pryslak, 1976). The only recorded production in the area is of industrial minerals, namely building stone, and crushed rock used for ballast by the Canadian Pacific Railway Company.

In this study it is resolved to check surficial geochemical responses against known geology, primarily, with regard to the occurrence of uranium in the area.

Sampling Techniques and Analytical Procedures

Sample Collection

Lake sediment samples were obtained using a G.S.C. sampler from a Hughes 500-C turbo Helicopter. Surficial (top 5-10 cm) sediment, at the sediment-water interface was avoided (Coker and Nichol, 1975). Organic-rich sediments were collected from the central-deepest part (profundal basins) of permanent lakes and ponds. The physical nature of the sediment did not vary much from lake to lake, commonly being a brown thixotropic gel sometimes having a hydrogen sulphide odour. No difficulty was experienced in collecting such samples.

Surface lake waters, which were generally very clear in colour, were collected directly into polyethylene bottles and acidified (250 μ L of HNO₃ per 125 mL of water) on the day of collection.

Measurements of the surface and bottom water pH, dissolved oxygen content, temperature and conductivity were made using a Martek Mark V Water Quality Analyzer. Unfortunately, the physicochemical conditions of the bottom waters were measured at only the first few sample sites due to an equipment malfunction. Lake water depth was also recorded at each sample site.

A number of standard observations, as well as the Martek data, were recorded on lake water (Appendix II) and lake sediment (Appendix III) field data cards for the corresponding sample taken at each sample site (Appendix I).

The lake sediment, lake water, stream water and sediment, bedrock and surficial overburden field data cards employed in this survey have been described by Garrett (1974).

Generally clear waters and inorganic clastic sediments were collected from the central portion of active stream channels (Appendix I). Yellow to brown waters and organic-rich sediments were commonly obtained in slowly draining swampy stream channels. Stream waters were collected and treated exactly as were lake waters. A number of standard observations, including water pH, as measured using a G.S.C. model pH meter, were recorded on field cards for stream waters (Appendix IV) and stream sediments (Appendix V).

Bedrock, composite chip, samples were collected from the various lithologies present in the area (Appendix VI). Various petrographic observations, as well as the average radioactivity over the exposed extent of the sampled outcrop measured using an Exploranium GRS-101 scintillometer, were recorded on field cards (Appendix VII).

At each bedrock sample site a surficial overburden sample was also collected (Appendix VI). Most overburden in the area is characterized by podzolic soil development

except in swampy poorly-drained regions where gleysolic soil development is common. In most instances the B soil horizon was sampled. Standard observations were recorded on field cards (Appendix VIII).

Preparation

Air drying generally resulted in the organic-rich lake and stream sediments becoming extremely hard. These samples were disaggregated, using a mortar and pestle and a ceramic ball mill, to obtain a fine powder which could pass a minus 80-mesh sieve. Lake sediment sample preparation was carried out by the staff of Golder Associates, Ottawa on a contractual basis with the G.S.C. All other sample preparation was carried out at the G.S.C.

Overburden and inorganic clastic stream sediment samples were dried and sieved through an 80-mesh sieve to obtain the minus 80-mesh fraction.

Bedrock samples were crushed to approximately 1 cm in size in a jaw crusher fitted with steel plates. The crushed material was coarse sieved to remove fines in order to prevent possible contamination due to metal chips from the jaw crusher. The sample was then ground to approximately 10 mesh size in a disc mill fitted with ceramic plates. The resultant material was coned and quartered to obtain a sample of about 10 to 15 grams. This sample was ground again to about 100 mesh (98%) by mechanical agitation in a small ceramic ball mill.

Analyses

Analyses of lake sediment samples for Zn, Cu, Pb, Ni, Co, Ag, Mn, As, Mo, Fe, Hg and loss-on-ignition (L.O.I.) were carried out by Chemex Labs. Inc., Vancouver, B.C. and for U by Atomic Energy of Canada Ltd., Ottawa on a contractual basis with the Geological Survey of Canada.

A 1 g sample of minus 80- mesh lake sediment was digested in a test tube with 6 mL of a mixture of 4M HNO₃-1MHCl overnight. After digestion the test tube was immersed

in a hot water bath at room temperature and brought up to 90°C and held at this temperature for 2 hours with periodic shaking. The sample solution was cooled to room temperature and diluted to 20 mL with distilled water and mixed. The contents of Zn, Cu, Mn, Fe, Pb, Ni, Co and Ag were determined by atomic absorption spectroscopy using an air-acetylene flame. Analyses for the last four elements were carried out using simultaneous, automatic background correction.

Arsenic in the lake sediment was determined colorimetrically using silver diethyldithiocarbamate. Decomposition was accomplished by heating a 1 g sample with 20 mL of 6M HCL at 90°C for 1.5 hours. Colorimetric measurements were made at 520 nm.

A 500 mg sample of minus 80-mesh lake sediment was decomposed in 1.5 mL conc. HNO₃ at 90°C for 30 minutes. At this point 0.5 mL conc HCl was added and the digestion was continued at 90°C for an additional 90 minutes. After cooling, 8 mL of a 1250 ppm Al solution were added and the solution was made up to 10 mL with distilled water. Mo was estimated by direct aspiration of the sample solution into the nitrous oxide-acetylene flame of an atomic absorption spectrophotometer.

Mercury contents of the lake sediment samples were determined by the Hatch and Ott procedure, with some modifications, as described by Jonasson et al. (1973).

Loss-on-ignition (L.O.I.) was determined on a 500 mg sample of lake sediment by ashing during a three hour time-temperature controlled rise to 500°C. The organic carbon content of a lake sediment sample is proportional to the percent weight loss-on-ignition (Coker and Nichol, 1975).

The delayed neutron activation method of analysis, by which the lake sediment samples were analyzed for the total U, was developed by Atomic Energy of Canada Ltd., Commercial Products Division, and is described in some detail by Boulanger et al. (1975).

All other analytical work was carried out in the laboratories of the Geochemistry Section, Resource Geophysics and Geochemistry Division, Geological Survey of Canada, Ottawa.

A 50 mL aliquot of acidified water sample (lake and stream water) was extracted in 6 mL of MIBK with 3 mL of 1% APDC. The contents of Zn, Cu, Pb, Ni and Co in the concentrate were estimated by atomic absorption spectrophotometry. The contents of Mn and Fe in the water samples were determined by direct atomic absorption spectrophotometry.

The fluorometric method of analysis of the lake and stream water samples, and of the stream sediment, surficial overburden and bedrock samples, for acid extractable uranium, was based on that described by Smith and Lynch (1969).

The Zn, Cu, Mn, Fe, Pb, Ni and Co contents of the stream sediment and surficial overburden samples were estimated employing identical digestion, leach and atomic absorption spectrophotometric techniques, including background correction for Pb, Ni and Co, as used by Chemex Labs. for lake sediments.

A 1 g sample of prepared bedrock sample material (≈ 100 mesh) was digested in a platinum dish with 7 mL of 50% HF. This was taken to dryness and a mixture of 5 mL conc. HNO_3 -2 mL conc HClO_4 added and evaporated until fumes of HClO_4 were produced. The resultant material was then taken up in 20 mL of 1M HCl. The contents of Zn, Cu, Fe, Mn, Pb, Ni and Co were estimated by atomic absorption spectrophotometry using an air-acetylene flame. Analyses of the last three elements were carried out using simultaneous, automatic background correction.

Analyses of the Mo content of the stream sediment, surficial overburden and bedrock samples were carried out in an identical manner to that employed by Chemex Labs for lake sediments.

The D.C. arc emission spectrographic method used to analyze the lake sediment, surficial overburden and bedrock samples for Sr, Ba, Mn, Ti, Al, Ca, Mg, Fe, K, Pb, Zn, V, Mo, Cr, Cu, Co, Ni, Be, La and Y is described by Timperley (1974).

Detection limits for the analytical methods used are given with the analytical data in the appendices. The actual number used for reporting values below the lower detection limit, usually approximately one-half the lower detection limit, and upper detection limit, usually equal to upper detection limit, are also given. Analytical data for surface lake waters, lake sediments, stream waters, stream sediments, bedrock and overburden are listed in Appendices II, III, IV, V, VII, and VIII respectively.

Evaluation of quality of the analytical data was based on a blind duplicate and reference control sample system. Each of these samples were present on a random 5 per cent frequency basis. In each block of 20 samples there were 17 routine field samples, one field duplicate sample, one blind duplicate, and one reference control sample. The field duplicate sample was collected at one of the 17 routine field sites, the blind duplicate is a split of one of the 18 field samples and the reference control sample is a split from one of several reference bulk samples available. Rejection or acceptance of data for each block of 20 samples was determined by statistical criteria involving the blind duplicate and reference control sample data. Rejected data were replaced by new data after repeat analyses.

Results and Discussion

Lake Waters and Sediments

A summary of the analytical data for the surface lake water samples (Appendix II) is presented in Table 1. Both physical and chemical measurements are given. As the surface lake water sample population is small (total sample population equals 41) no attempt has been made to transform the data before statistical analyses. Rather, by examination of the histograms and statistics of the total data population highly anomalous values for any

Table 1
Surface Lake Waters

	n	\bar{x}	σ	min	max ¹	max ²
Temp. (°C)	41	22	0.5	21	23	2.8 (1)
pH	41	7.1	0.3	5.9	7.5	
Cond (umhos/cm)	41	28	16	9	74	
O ₂ (ppm)	41	7.6	0.7	6.5	9.9	

Zn (ppb)	41	2.6	1.5	0.2*	5.0	
Cu (ppb)	40	0.9	0.8	0.2*	3.8	2.8 (1)
Pb (ppb)	41	4.5	3.8	2.0*	13.5	
Co (ppb)	41	6.7	2.0	3.0	10.4	
Ni (ppb)	40	1.7	1.1	1.0*	5.7	4.3 (1)
Fe (ppb)	40	74	90	10*	742	469 (1)
Mn (ppb)	40	10	10	5*	61	49 (1)
U (ppb)	40	0.17	0.13	0.02*	0.64	0.48(1)

n = number of samples. (In some cases highly anomalous samples removed before final statistical parameters determined ie: Cu, Ni, Fe, Mn and U)

\bar{x} = arithmetic mean

σ = standard deviation

min = minimum value (* indicates values equal to one half the lower detection limit)

max¹ = maximum value

max² = maximum value after highly anomalous samples removed (i.e. Fe: max¹ = 742, max² = 469(1); the (1) indicates one value greater than 469 (i.e. 742) removed to normalize the data population before calculation of \bar{x} and σ values.

individual parameter can be identified. These highly anomalous values (i.e. 3.8 for Cu, 5.7 for Ni, 742 for Fe, 61 for Mn and 0.64 for U) were removed to help normalize the data population for each individual parameter in order to prevent the final statistical computations (i.e. \bar{x} and σ) from being dominated by a few highly anomalous values.

The pH of the surface lake waters was found to be close to neutral (7.0) and vary little from lake to lake ($\bar{x} = 7.1, \sigma = 0.3$) in the area. Conductivity measurements of surface lake waters in the area are relatively low ($\bar{x} = 28 \text{ umhos/cm}, \sigma = 16 \text{ umho/cm}$). The lowest conductivity values tend to occur in lakes within granitic terrane and the highest values are concentrated within an area underlain by mafic metavolcanics, between Bee Lake in the east and just east of Willard Lake in the west. Surface lake waters are all relatively warm ($\bar{x} = 22^\circ\text{C}$) and oxygenated ($\bar{x} = 7.6 \text{ ppm dissolved oxygen}$).

The regional distributions of Zn, Cu, Pb, Co, Ni, Fe, Mn and U in surface lake waters are illustrated in Figure 2. When at least two or more adjacent samples have trace element concentrations in excess of the $\bar{x} + 1\sigma$ level for a given element these samples have been grouped together (eg. -- U --, --- Fe, Mn --, - Pb-, etc). These $\bar{x} + 1\sigma$ groupings, derived using an empirical form of cluster analysis, are indicative of regional trends in the trace element concentrations of the surface lake waters in the area. Within these trends, or as isolated occurrences, samples having trace element concentrations in excess of the $\bar{x} + 2\sigma$ level for any element are indicated by: **P, U, Ni**, etc.

A series of regional trends have been outlined by this simplistic cluster analysis. Two of the major zones are: U encompassing, and Ni peripheral to the numerous uranium occurrences, with minor sulphides in the Bee Lake – Bruin Lake region and; Zn, Ni and lesser Co and Pb in the Feist Lake – Lacourse Lake – East Stewart Lake region, an area underlain by intermediate metavolcanics containing minor sulphide occurrences. Several other far less extensive trends of Mn, Zn and Co, Cu, Co, Pb, U, and Fe and Mn are also present in the area.

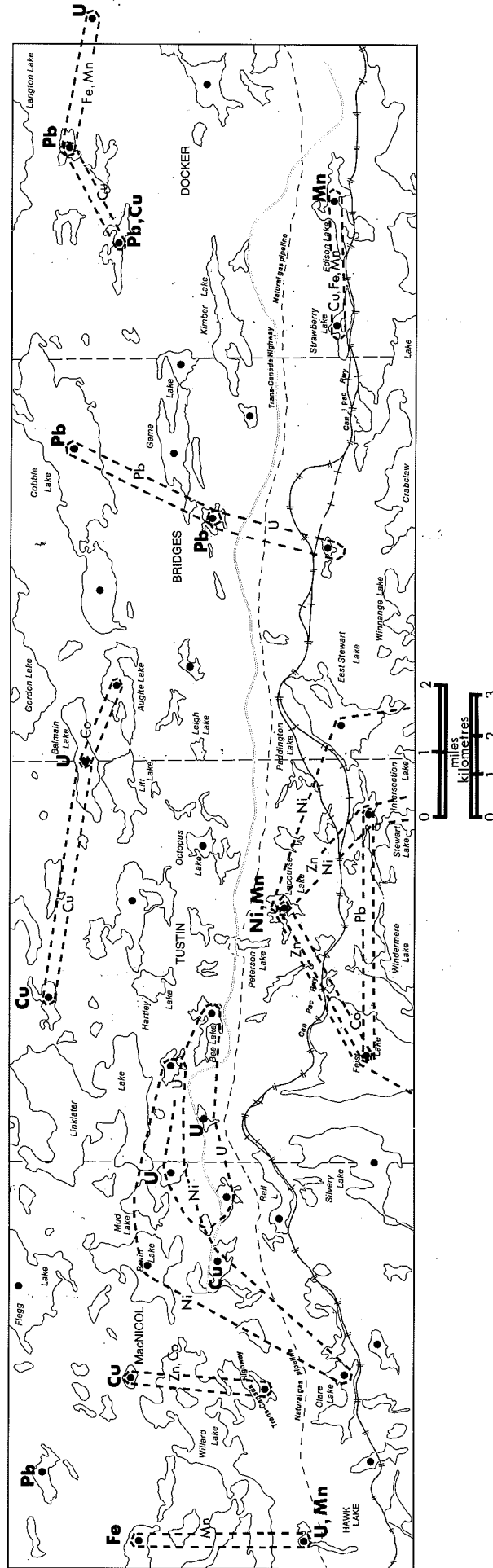


Figure 2. Trace metal distributions in surface lake waters.

By examining the correlations existing between the twelve measured surface lake water parameters (Figure 3) it is possible to explain some of the variation in the trace element contents of the surface lake waters. The association of Mn with Fe, and of Fe with \bar{O}_2 (low amounts of dissolved oxygen) indicates the tendency of Fe, and to a lesser extent Mn, to remain in solution to relatively higher concentrations in waters with low amounts of dissolved oxygen. If the waters are enriched in oxygen, Fe and then Mn will tend to interact with oxygen, forming hydroxide and/or oxide precipitates, and be taken out of solution. Another association of interest is that of Cond (conductivity) with U, Cu and Zn. At higher conductivities, usually indicative of increased carbonate content, as bicarbonate, at the pH levels recorded (i.e. > 7.0), U and Zn can stay in solution as hydrated carbonate complexes.

Although interesting in their own right, data from water samples are best viewed with complimentary sediment data (Table 2). Because of the small sample population ($n = 41$) the sediment data (Appendix III) have had highly anomalous values removed (see Table 2) to help normalize the data population for each individual parameter. This is to prevent the final statistical computations (i.e. \bar{x} and σ) from being dominated by a few highly anomalous values.

Because of a malfunction in the Martek Mark V Water Quality Analyzer the physiochemical conditions of the bottom waters could be measured in only the first nine lakes sampled. In general terms the lake bottom waters were found to be acid (pH = 4.1 to 6.0) and oxidizing (2.60 to 7.12 ppm dissolved oxygen), generally indicative of oligotrophic lakes. However, three of the lakes examined had very low levels of dissolved oxygen (0.14, 0.24 and 0.27 ppm dissolved oxygen) and were likely trending towards eutrophic or dystrophic conditions. Bottom water conductivities ranged from 4 to 50 umhos/cm and although one lake had relatively warm (22°C) bottom waters most were cold (4 to 12°C).

The regional distributions of Zn, Cu, Pb, Ni, Co, Mn, As, Mo, Fe, Hg and U in lake sediments are illustrated in Figure 4. The sediment data have been treated

A.

	U	Mn	Fe	Ni	Co	Pb	Cu	Zn	O ₂	Cond	pH	Temp.
Temp	.23	-.01	.13	.02	-.01	-.31	-.02	.45	-.39	.29	.38	
pH	.03	-.06	-.05	.20	.10	-.02	.12	.48	-.22	.45		
Cond	.32	-.01	-.06	.09	.27	-.25	.40	.39	-.13			
O ₂	-.03	.07	-.32	-.24	-.04	.15	-.08	-.25				
Zn	-.08	-.14	-.10	.16	.28	-.09	.01					
Cu	-.00	-.07	-.16	-.07	.22	-.11						
Pb	-.22	-.13	-.11	.10	.13							
Co	.23	.18	-.07	.14								
Ni	.15	.05	.09									
Fe	.41	.56										
Mn	.21											
U												

n = 41
(- indicates a negative correlation)

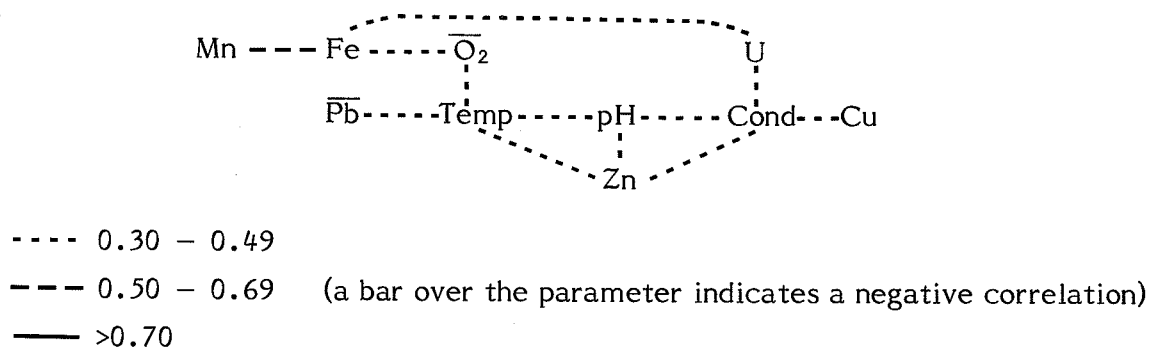
B.

Figure 3. Correlation matrix and schematic representation of the significant chemical associations in surface lake waters.

Table 2
Lake Sediments

	n	\bar{x}	σ	min	max ¹	max ²	
Zn (ppm)	37	86	21	46	392	144	(4)
Cu (ppm)	40	41	16	18	98	72	(1)
Pb (ppm)	39	11	4	1*	32	18	(2)
Ni (ppm)	40	25	10	12	57	53	(1)
Co (ppm)	39	13	5	4	45	28	(2)
Mn (ppm)	38	478	266	190	34,500	1120	(3)
As (ppm)	39	5.1	1.6	2.0	8.0		
Mo (ppm)	41	2	1	1*	6		
Fe (%)	40	2.19	1.27	0.80	8.00	6.00	(1)
Hg (ppb)	38	112	43	35	290	210	(1)
U (ppm)	39	17.7	10.2	2.3	74.5	41.6	(2)
Loss-on-ignition (%)	41	32.5	13.1	3.6	57.4		

- n = number of samples. (In some cases highly anomalous samples removed before final statistical parameters determined i.e.: Zn, Cu, Pb, Ni, Co, Mn, Fe, Hg and U)
- \bar{x} = arithmetic mean
- σ = standard deviation
- min = minimum value (* indicates values equal to one half the lower detection limit)
- max¹ = maximum value
- max² = maximum value after highly anomalous samples removed (i.e. Mn: Max¹ = 34,500, max² = 1120(3); the (3) indicates three values greater than 1120 (i.e. 34,500, 1680, and 1680) were removed to normalize the data population before calculation of \bar{x} and σ values)

exactly as the water data (see page 11 and Figure 2). When two or more adjacent samples exceed the $\bar{x} + 1\sigma$ level for a given element these samples are grouped together (eg.-U-, -Ni, Co-, etc.) to illustrate regional trends in the data. Samples having trace element concentrations in excess of the $\bar{x} + 2\sigma$ level for any element are indicated by: **Cu, U, Pb**, etc.

Exact correspondence of sediment and water data is missing although taken together the respective data reinforce each other and do direct attention to the most significant concentration of uranium occurrences in the area, between Bee and Willard Lakes. In general the sediment data seem to be more indicative of the geology and mineralization, as known, in the area. This is undoubtedly due to factors such as: very low or undetectable levels of trace metals in the waters of the area and the inherent analytical problems in determining such low levels; varied physiochemical conditions in the lakes of the area; and the effects of organics on trace metal distributions.

Three major areas of interest are highlighted by the sediment data. The first, in the east part of the area between Octopus and Willard Lakes is characterized by lake sediments with elevated levels of U, in the west, and of Cu, in the east. The centre of the area between Bee and Mud Lakes, has lake sediments with elevated levels of both Cu and U, as well as Zn, As, Co, Mn and Fe. This trend is a reflection of the known uraniferous pegmatite occurrences between Bee and Willard Lakes. The second area centres on Game Lake and is primarily characterized by lake sediments with elevated levels of Zn, Cu, Pb, Hg, and As with lesser Mo, Co and Mn. These patterns are indicative of the numerous occurrences of sulphides in the metasediments in this area. The numerous small very low grade (see Pryslak, 1976) occurrences of uranium in pegmatites around Kimber Lake are not indicated by the lake sediments. Tied into Game Lake, to the north, is the third major area of interest extending from Cobble Lake in the east westward to Balmain Lake. This area is characterized by lake sediments enriched in U, Ni and Cu with lesser Co, Mn and Mo and is possibly coincident with the ultramafic intrusions present in the Cobble Lake - Lift Lake area.

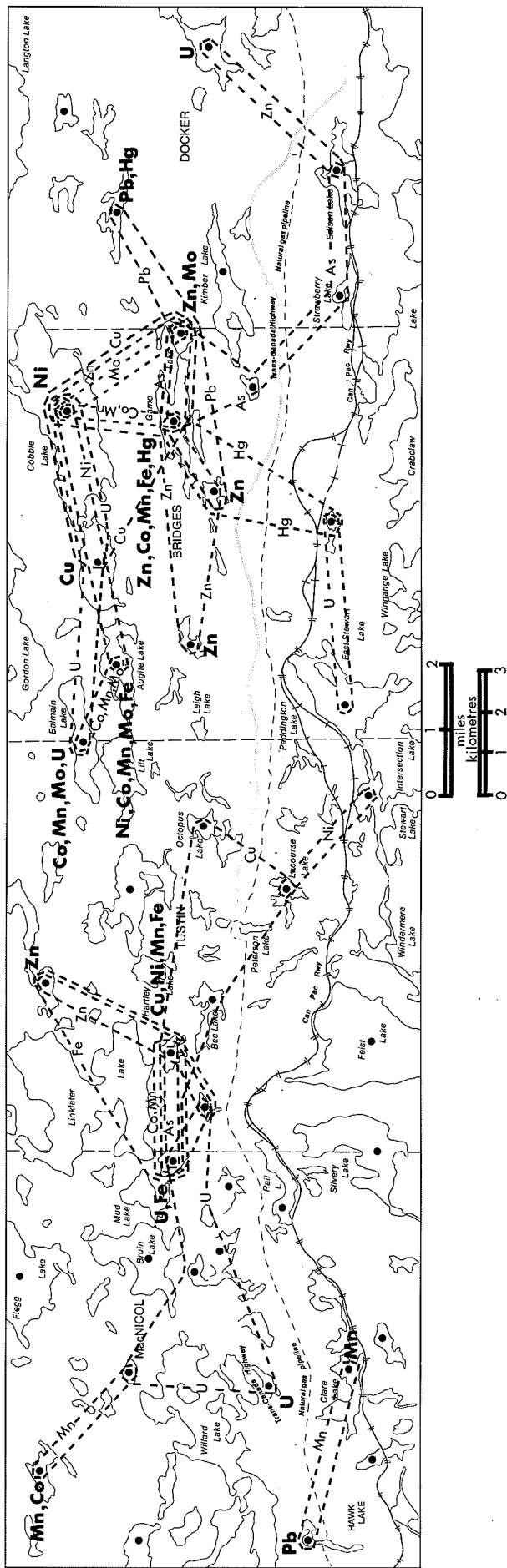


Figure 4. Trace metal distributions in lake sediments.

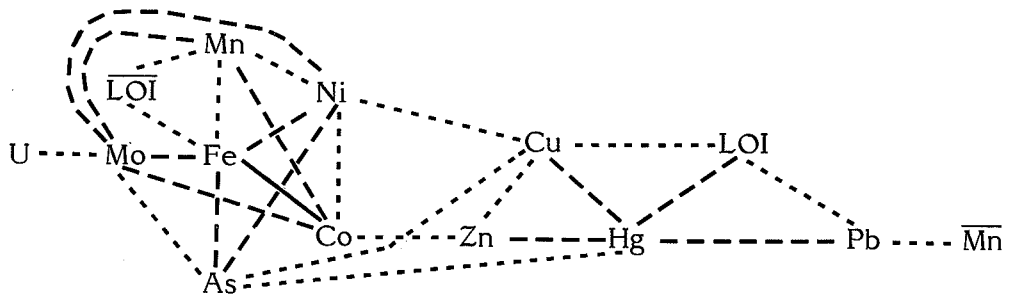
Correlations existing between the measured lake sediment parameters (Figure 5) can possibly explain some of the variation apparent in the trace element contents of the lake sediments. The associations of Cu and Hg, and to a lesser extent, Pb with L.O.I. (loss-on-ignition) illustrates the affinity of these elements to form complexes with, and be concentrated by, organic matter. The level of concentration is a function of trace element availability (i.e. overburden, bedrock and/or mineralization) and the amount and type of organic matter present in the lacustrine and surrounding environments. The association of Zn, Cu, Hg and to a degree As is most likely due to the presence of sulphide mineralization such as occurs in the area between Game and Leigh Lakes. The associations of Ni with Cu and of Ni with Co reflect the chemical influence on lake sediment composition of the ultramafic intrusive rocks present in the area between Cobble and Lift Lakes. Trace metal scavenging by Fe and Mn oxide and hydroxide complexes is indicated by the association of Fe, Mn, Co, Ni, Mo and As. In cases where Fe and Mn compounds constitute a large part of the bottom sediment, the relative amount of organic material decreases as indicated by the association of Fe and Mn with negative L.O.I.

Examination of the D.C. arc emission spectrographic data for lake sediments (Appendix III) reveals that the distributions of other elements may also reflect bedrock lithology or mineralization in the area. Elevated levels of Cr in the sediments from lakes in the Lift Lake – Cobble Lake and the Silvery Lake – East Stewart Lake – Bee Lake areas are probably due to the presence of ultramafic intrusive and intermediate volcanic rocks respectively. Several of the lakes with notably high levels of Fe and Mn in their sediments also have relatively elevated levels of Ba, Sr, Al and sometimes Ca. Several of the lakes having sediments with anomalous U concentrations, such as in Balmain Lake and between Bee and Mud Lakes, also have elevated levels of V, La and Y which may be due to the combined influence of pegmatitic uranium mineralization and the intermediate and mafic metavolcanics in these areas.

A.

	Zn	Cu	Pb	Ni	Co	Mn	As	Mo	Fe	Hg	LOI	U
U	-.13	.17	.07	-.04	.04	-.12	.17	.30	-.30	-.08	.18	
LOI	.13	.41	.37	-.19	-.26	-.33	.01	-.21	-.37	.54		
Hg	.57	.53	.55	.02	.20	-.23	.32	-.06	.04			
Fe	.13	.18	-.17	.50	.76	.63	.49	.55				
Me	.03	.13	-.02	.50	.57	.62	.40					
As	.24	.33	.21	.31	.46	.13						
Mn	-.05	-.21	-.32	.47	.60							
Co	.34	.12	-.09	.40								
Ni	.11	.47	-.19									
Pb	.21	.25										
Cu	.32											
Zn												

B.



----- 0.30 - 0.49
 - - - - - 0.50 - 0.70
 ————— >0.70

(a bar over the parameter indicates a negative correlation).

Figure 5. Correlation matrix and schematic representation of the significant chemical associations in lake sediments.

Stream Waters and Sediments

Interpretation presented here for stream water data (Appendix IV) and sediment data (Appendix V) from this area should be regarded as tentative. While lake basins are generally fairly well developed, interconnecting streams are not. Streams in the area are of two types: (1) those that flow at a slow to moderate rate, have generally clear water and inorganic clastic sediment; (2) those that flow very slowly, have clear to brownish water, organic-rich sediment, and are generally associated with a swampy regime and impeded drainage. There is a definite relationship between elevated metal levels, in both waters and sediments, and the presence of organic-rich sediments in streams (see Appendices IV and V). The basic drawback to utilizing stream waters and sediments in mineral exploration in an area such as this is that it is impossible to obtain a consistent sample type (i.e. either all organic or all inorganic) at each sample site. Analytical data derived from mixed organic and inorganic sediments is generally impossible to interpret. The data must be separated into two classes and each group interpreted as a discrete sample medium. At the start of this study the idea was to collect both organic and inorganic sediments at each site to see which sediment type was a better indicator of mineralization, bedrock lithology, etc. but this did not prove practicable as the two sediment types were seldom both available at any given sample site.

Bedrock

The analytical data for bedrock samples (Appendix VII) are summarized in Table 3. Although bedrock sample populations are small, sometimes only one sample of a given rock type to a maximum of eight samples, some variation in metal concentrations between different bedrock lithologies is evident.

Relative to granitic rocks, intermediate metavolcanics, mafic metavolcanics, metasediments and gabbro are enriched in Zn, Co, Ni (the one gabbro sample notably so), Fe, and Mn. Both lake waters (Figure 2), in the intermediate metavolcanics in the Feist Lake – Lacourse Lake – East Stewart Lake area, and lake sediments (Figure 4), in

Table 3
Bedrock

Rock type	n	Zn ppm	Cu ppm	Pb ppm	Co ppm	Ni ppm	Fe %	Mn ppm	U ppm	Mo ppm
Granitic gneiss	3	39 24-57	10 9-13	25 21-30	8 4-14	18 6-33	1.55 1.00-2.60	300 145-588	1.0 0.6-1.3	2.7 2.3-3.1
	5	13 10-17	3 2-7	45 27-56	1 1-2	3 1-3	0.37 0.26-0.53	181 52-619	56.8 1.2-150.0	2.2 1.8-2.7
Granite	8	29 13-38	5 2-11	28 3-54	3 1-5	4 2-8	0.85 0.44-1.16	141 67-194	8.7 1.7-44.5	2.4 1.9-3.3
	3	38 37-41	5 3-6	24 20-26	3 2-4	4 2-5	1.02 0.95-1.16	202 184-233	1.7 1.5-2.0	2.9 2.6-3.3
Intermediate metavolcanics	8	80 70-109	32 13-58	12 7-14	31 24-47	94 34-191	4.92 2.96-7.86	925 421-2212	0.5 0.2-0.9	3.7 3.1-4.7
	8	90 69-126	54 24-90	9 4-12	38 23-51	78 20-128	6.78 3.96-12.85	1240 677-2269	0.5 0.1-1.8	4.1 3.1-6.2
Metasediments	1	90 -	45 -	14 -	24 -	127 -	3.18 -	550 -	0.7 -	3.2 -
	1	71 -	67 -	4 -	66 -	305 -	7.36 -	1280 -	0.3 -	2.1 -

n = number of samples;

14 = arithmetic mean

8 - 50 = range (minimum - maximum)

metasediments centred around Game Lake and in the region of ultramafic intrusions in the Cobble Lake – Lift Lake area, yield trace metal patterns indicative of the enrichment of Zn, Co, Ni, Fe and Mn in the associated bedrock lithologies (see discussion of lake water and sediment data pages 9 and 15 respectively). Granitic rocks in the area are relatively enriched in U and Pb, granite pegmatites particularly so. However, there is a large variation in the U contents and somewhat lesser variation in the Pb contents of barren (U = 1.2, 1.3 and 1.8 ppm; Pb = 27, 34 and 54 ppm) and enriched (U = 129.5 and 150.0 ppm; Pb = 52 and 56 ppm) pegmatites. The mineralized pegmatites in the Bee Lake – Willard Lake area are clearly indicated by U in both lake waters and sediments (Figures 2 and 4, pages 11 and 16 respectively).

Examination of the D.C arc emission spectrographic data for bedrock (Appendix VII) shows that in addition to the metals already examined intermediate and mafic volcanic, and metasedimentary rocks are relatively enriched in Ti, Co, Mg, V and Cr, the latter two types possibly in La and Y as well. Gabbros are enriched in Co, Mg, and Cr; granites in Ba and possibly La; and granite pegmatites in Be and perhaps in La and Y. Some of these chemical characteristics are reflected in the associated lake sediments (see page 18).

The degree to which the metal contents of the lake water and sediment reflect those in the bedrock lithologies with which they are associated depends on many factors. The nature of the bedrock itself, its mineralogy and grain size, the degree of exposure and susceptibility to weathering and erosion comprise one factor. Superimposed on and sometimes overshadowing the chemical characteristics of the bedrock is the presence or absence of mineralization, its texture – disseminated, vein or massive, its nature – sulphide, oxide, carbonate, etc., its exposure and susceptibility to weathering and erosion, and its effect on the chemical environment (Eh and pH). In addition one must consider the nature of the overburden and of the lacustrine environment (as previously discussed). In total the relationship between the chemistry of the bedrock and that of the associated lake sediments is extremely complex requiring an awareness of the various

physical and chemical processes operative in the various environments in order to properly interpret the lake sediment data and focus on areas of possible economic mineral potential.

Overburden

In general the analyses of overburden from the area provided little useful interpretive information. The overburden, being largely eroded and reworked by glacial lake action, is composed mainly of sandy ground moraine containing gravel and boulders. Chemically the overburden is relatively homogeneous and has generally low trace metal levels throughout the area (see Appendix VIII). The underlying bedrock is not reflected by the overburden with perhaps the exception of elevated levels of U in soils adjacent to some of the uraniferous pegmatites in the area.

Conclusions

The application of geochemical methods and their responses to typical geological and environmental influences within the southern portion of the Superior geologic province of northwestern Ontario has been demonstrated.

At the sampling scale employed both lake water and sediment analytical data provide information indicative of pegmatitic U mineralization, disseminated sulphide mineralization, bedrock lithologies and the physicochemical nature of the lacustrine environment. Although the data are complex and at times difficult to interpret a definite value is found in interpreting hydrogeochemical dispersion patterns in terms of elemental associations which are based on a knowledge of trace and minor element assemblages related to known mineralization, bedrock lithologies and lacustrine physicochemistry in the study area.

Both waters and sediments provide meaningful data although each sample type has its own advantages. Whereas lake waters can be collected anywhere, lake sediments can yield further useful data on many additional elements, undetectable in waters, which may prove to be accessories in economic mineral assemblages or favourable host rocks. The

areal extent of the lake sediment trace element distribution patterns indicates that reconnaissance scale sampling, every 13 km², using lakes would be successful in locating most zones containing pegmatitic uranium mineralization in the area. However, sampling every 2 to 5 km² in the search for sulphide mineralization is preferable in this geologic environment.

The use of stream waters and sediments for mineral exploration in this area did not prove worthwhile nor was the chemistry of the overburden present particularly indicative of that of the underlying bedrock lithologies. Clay deposits present in the surrounding region are a definite restriction in the application of any type of regional or detailed geochemical methods.

Acknowledgments

Assistance in the field during 1975 was provided by S. Earle. Preparation of base maps and the computer listings in the appendices was carried out by C. Crosby. D. Ellwood provided guidance with computer programming. Sample preparation at the G.S.C. was carried out by P. Lavergne and S. Earle. Analyses carried out within the G.S.C. were performed by A. Jones, R. Horton, G. Gauthier and E. Moore.

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Appendix I

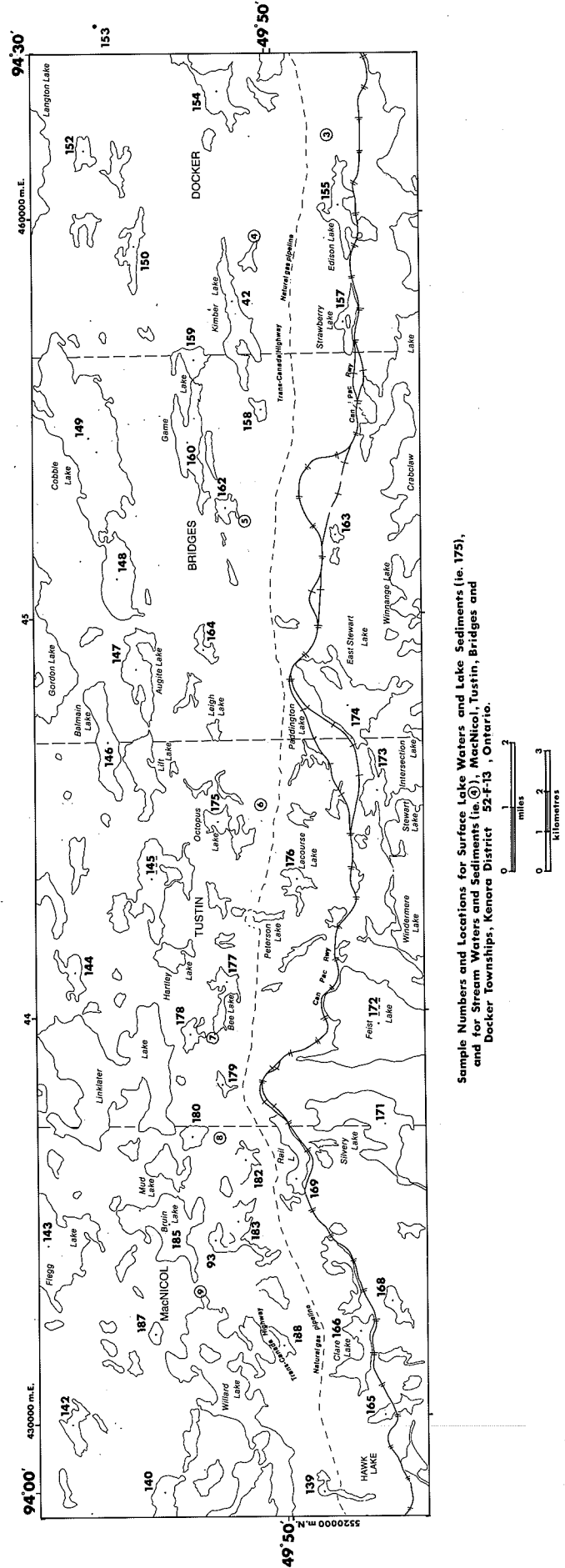
Sample Numbers and Locations for Surface Lake Waters and Lake Sediments,
and for Stream Waters and Sediments,
MacNicol, Tustin, Bridges and Docker Townships, Kenora District
(52/F/13), Ontario

At each lake sample site a surface lake water (52F13755XXX) and lake sediment (52F13756XXX) sample were collected. Only the last three significant digits of each sample number are plotted at each site. The surface lake water and lake sediment samples have, therefore, the same last three digits at each site. Sample numbers underlined (eg. 9, 76, 163 etc.) indicate that while a water sample was obtained at the sample site no sediment was collected.

The field observations and analytical data for the lake water samples (identified by a 5 in digit eight of the eleven digit sample number - 52F13755XXX) and the lake sediment sample (identified by a 6 in digit eight of the eleven digit sample number - 52F13756XXX) are listed in Appendices II and III respectively.

At each stream sample site a stream water (52F13753XXX) and stream sediment (52F13754XXX) sample were collected. Only the last three significant digits of each sample number are plotted at each site. The stream water and sediment samples have, therefore, the same last three digits at each site.

The field observations and analytical data for the stream water samples (identified by a 3 in digit eight of the eleven digit sample number - 52F13753XXX) and the stream sediment sample (identified by a 4 in digit eight of the eleven digit sample number - 52F13754XXX) are listed in Appendices IV and V respectively.



Sample Numbers and Locations for Surface Lake Waters and Lake Sediments (ie. 175), and for Stream Waters and Sediments (ie. ④), MacNicol, Tustin, Bridges and Docker Townships, Kenora District 52-F-13, Ontario.

Figure 6. Appendix I; Sample numbers and locations for surface lake waters and lake sediments and for stream waters and lake sediments.

Appendix IISurface Lake WatersField Observations and Analytical Data

Key: Catchment basin rock type: (lake entirely within bedrock unit and drainage into lake also predominately from within same bedrock unit).

GRNS - granitic gneiss
GRNT - granite
IMVC - intermediate metavolcanics
MMVC - mafic metavolcanics
MSDM - metasediments

Colour:
0 - clear
1 - brown transparent
2 - white cloudy
3 - brown cloudy

ACIDIFIED (250 MICROLITRES OF NITRIC ACID PER 125 MILLILITRES OF WATER) ON DAY OF COLLECTION

MAP SHEET	SAMPLE NUMBER	UTM ZONE	UTM COORDINATES		CATCH BASIN ROCK TYPE	COL	TEMP DEG C	PH	COND		DIS OXY PPM	ZN PPB	CU PPB	PB PPB	CO PPB	NI PPB	FE PPB	MN PPB	U PPB
			EAST	NORTH					MHO	CM									
52F13	755042				MVVC	0	22	6.6	32	9.34	0.2	0.2	2.0	8.3	1.0	79	49	0.48	
52F13	755068	15	428200	5519400	GRNS	0	22	6.5	12	6.80	1.1	0.2	2.0	5.6	1.0	469	21	0.16	
52F13	755139	15	428200	5523200	GRNS	0	21	5.9	9	7.65	0.2	0.2	13.5	6.0	3.5	43	5	0.12	
52F13	755142	15	430000	5525500	GRNS	0	21	6.5	13	8.00	0.2	0.2	2.0	3.0	1.0	16	5	0.02	
52F13	755143	15	434300	5526000	GRNS	0	21	6.7	16	7.70	0.2	2.1	6.0	7.4	2.0	26	5	0.06	
52F13	755144	15	441200	5525200	GRNS	0	21	7.1	21	8.20	0.2	1.0	6.0	3.0	1.0	10	5	0.02	
52F13	755145	15	443500	5523200	GRNT	0	21	6.6	17	7.80	0.2	2.8	2.0	9.0	1.0	35	5	0.44	
52F13	755146	15	447200	5524300	GRNT	0	21	6.8	21	9.94	2.8	1.1	2.0	9.0	1.0	28	5	0.24	
52F13	755147	15	448800	5523500	GRNT	0	21	7.0	20	7.30	0.2	0.2	6.0	7.4	1.0	22	5	0.08	
52F13	755148	15	451000	5523900	GRNT	0	21	7.4	30	7.93	1.1	0.6	12.5	5.6	2.0	34	5	0.08	
52F13	755149	15	454200	5524400	GRNT	0	21	7.3	24	7.90	2.0	2.0	9.5	5.6	1.0	134	15	0.08	
52F13	755150	15	459200	5523300	GRNT	0	21	7.2	30	8.80	3.0	2.0	12.5	6.4	1.0	211	26	0.24	
52F13	755152	15	461600	5524400	MVVC	0	22	7.1	29	6.50	2.5	0.2	2.0	5.6	3.5	742	31	0.64	
52F13	755153	15	465600	5523800	MVVC	0	22	7.1	11	8.00	0.2	0.2	2.0	4.5	2.0	10	5	0.24	
52F13	755154	15	468000	5518100	GRNT	0	22	7.1	40	7.25	1.1	2.0	2.0	4.5	1.0	184	34	0.16	
52F13	755155	15	468000	5518100	GRNT	0	22	7.3	24	6.70	1.1	2.0	2.0	7.4	1.0	225	25	0.08	
52F13	755157	15	457200	5518100	GRNT	0	22	7.1	18	7.30	1.1	1.1	6.0	9.0	1.0	118	19	0.08	
52F13	755158	15	455100	5520100	GRNT	0	22	6.9	21	7.50	3.0	1.1	2.0	3.5	1.0	94	5	0.12	
52F13	755159	15	456600	5521800	MVVC	0	22	7.1	25	7.50	3.0	1.7	2.0	3.5	1.0	54	5	0.10	
52F13	755160	15	454200	5522000	MVVC	0	22	7.2	27	7.32	3.2	0.2	13.4	7.4	1.0	60	5	0.28	
52F13	755162	15	452700	5521100	MVVC	0	22	7.0	9	7.35	3.0	0.2	2.0	5.8	1.0	152	5	0.04	
52F13	755163	15	452000	5518300	GRNT	0	22	7.4	20	7.70	4.0	0.5	2.0	8.2	1.0	36	5	0.20	
52F13	755164	15	449200	5521700	GRNT	0	23	7.4	29	7.00	4.0	0.2	2.0	7.3	3.5	103	5	0.22	
52F13	755165	15	430000	5517800	GRNT	0	22	6.8	26	6.96	3.0	0.2	6.0	7.3	1.0	103	15	0.16	
52F13	755166	15	432000	5518200	GRNT	0	22	6.9	10	6.98	4.0	0.2	2.0	9.0	1.0	25	10	0.18	
52F13	755168	15	432600	5517400	GRNT	0	22	7.1	26	6.98	4.0	0.2	2.0	7.3	1.0	10	5	0.02	
52F13	755169	15	436600	5519900	GRNT	0	22	7.1	10	7.85	4.0	0.2	2.0	9.5	1.0	10	5	0.02	
52F13	755171	15	437200	5517500	GRNT	0	21	7.1	17	7.71	5.0	0.8	9.5	9.0	1.0	10	5	0.02	
52F13	755172	15	439800	5517400	GRNT	0	22	7.4	23	7.35	3.0	0.5	6.0	5.8	3.5	51	5	0.22	
52F13	755173	15	445600	5517700	GRNT	0	22	7.2	22	7.80	3.0	0.5	6.0	7.3	3.5	20	5	0.12	
52F13	755174	15	447700	5518200	GRNT	0	22	7.2	31	7.50	5.0	0.6	2.0	5.8	2.3	10	5	0.02	
52F13	755175	15	445000	5521500	IMVC	0	21	7.2	29	7.51	4.0	0.2	2.0	10.3	4.3	238	61	0.12	
52F13	755176	15	443400	5519600	IMVC	0	21	7.1	57	7.51	3.0	1.0	2.0	6.5	1.0	32	5	0.34	
52F13	755177	15	440800	5521400	IMVC	0	22	7.2	30	7.35	3.0	1.1	10.0	3.0	3.5	69	5	0.04	
52F13	755178	15	439600	5522300	MVVC	0	22	7.3	63	7.62	3.0	1.8	2.0	7.4	2.0	133	5	0.46	
52F13	755179	15	438300	5521500	GRNT	0	22	7.3	57	7.62	4.0	1.1	2.0	7.4	3.5	41	5	0.44	
52F13	755180	15	436800	5521000	GRNT	0	22	7.5	61	7.42	3.0	0.2	2.0	8.0	2.0	10	5	0.30	
52F13	755181	15	434900	5521200	GRNT	0	22	7.4	36	6.83	3.0	2.7	2.0	10.4	5.7	30	5	0.20	
52F13	755185	15	434800	5523000	GRNT	0	22	7.3	22	7.64	3.2	0.2	7.5	5.7	3.5	10	5	0.16	
52F13	755187	15	432200	5522400	GRNT	0	22	7.1	74	6.83	5.0	3.8	2.0	8.9	1.0	53	5	0.12	
52F13	755188	15	431900	5520100	GRNT	0	22	7.1	57	7.67	5.0	0.8	2.0	8.9	1.0	10	5	0.08	

Lower detection limits

Value recorded for the lower detection limit is equal to approximately one-half the actual detection limit

Appendix IIILake SedimentsField Observations and Analytical Data

Key: Catchment basin rock type: (see explanation Lake Waters)

Composition: The four columns are used to describe the bulk mechanical composition of the collected sediment on scales of 0 to 3 and 0 or 1.

The total of the first three columns must add to 3 or 4:-

blank or	0	Absent	
	1	Minor	<33%
	2	Medium	33-67%
	3	Major	>67%

The three size fractions are divided as follows

column	1	>0.125 mm	Sand
	2	<0.125 mm	Fines, Silt and Clay
	3		Organics

The fourth column is used to record the presence of an organic gel or gyttja:-

blank or	0	Absent
	1	Present

Colour: Up to two of the colours may be checked (1 in appropriate column.)

column	1	Tan
	2	Yellow
	3	Green
	4	Grey
	5	Brown
	6	Black

GEOCHEMICAL ORIENTATION SURVEY FOR URANIUM, MACNICOL, TUSTIN, BRIDGES AND DOCKER TOWNSHIPS, KENORA DISTRICT (52/F/13), ONTARIO, 1975
 ORGANIC LAKE CENTRE SEDIMENTS
 THE DATA LISTED BELOW (SR TO Y) WERE ESTIMATED BY EMISSION SPECTROMETRY

ANALYTICAL DATA CONTINUED FROM PREVIOUS PAGE

MAP SHEET	SAMPLE NUMBER	SR PPM	BA PPM	MN PPM	TI PPM	AL %	CA %	MG %	FE %	K %	PB PPM	ZN PPM	V PPM	MO PPM	CR PPM	CU PPM	CO PPM	NI PPM	BE PPM	LA PPM	Y PPM	
52F13	756042	58	478	734	1172	3.0	0.4	0.1	2.6	0.4	23	94	48	2.5	28	57	10	20	1.0	98	26	
52F13	756093	72	292	127	1652	4.6	0.4	0.1	2.9	0.4	12	129	45	2.2	34	31	16	43	1.0	134	35	
52F13	756139	277	578+1800	2098	6.1	1.2	0.5	3.8	3.8	1.3	19	111	51	2.5	41	19	30	22	3.0	93	29	
52F13	756140	183	501	839	2376	5.5	0.9	0.4	3.6	1.2	17	97	63	2.1	41	35	14	21	2.3	112	32	
52F13	756143	202	477	376	234	5.0	1.1	0.3	4.2	1.3	15	136	50	2.5	45	36	14	25	1.0	108	37	
52F13	756144	207	540	1121	2494	5.9	1.1	0.4	4.2	1.3	22	132	81	3.4	61	51	36	39	2.1	246	76	
52F13	756146	477+2100	1800	2241	6.3	2.8	0.6+15.0	3.1	3.1	3.1	31	139	23	7.0	57	31	50	58	3.2	33	15	
52F13	756147	114	386	273	2093	5.2	0.9	0.6	2.9	1.0	14	102	51	2.0	118	66	13	55	1.0	72	33	
52F13	756149																					
52F13	756150																					
52F13	756152	58	268	188	1536	3.9	0.6	0.3	2.0	0.6	11	114	38	1.0	45	54	14	34	1.0	52	19	
52F13	756153	177	498	602	2692	6.0	1.1	0.6	3.5	1.3	24	117	63	2.1	54	25	18	30	2.2	50	21	
52F13	756154	78	403	511	1641	4.4	0.5	0.2	2.3	0.6	18	161	50	2.3	38	45	17	26	2.7	89	33	
52F13	756155	186	629	785	3552	6.5	1.1	1.0	4.6	2.0	23	130	92	2.8	80	37	24	46	2.2	75	29	
52F13	756157	163	509	657	3198	5.9	1.0	0.8	3.4	1.4	23	114	68	2.8	66	36	21	40	2.5	68	26	
52F13	756158	97	352	228	1690	3.8	0.7	0.2	2.2	0.6	13	126	42	2.0	34	38	17	25	1.0	65	21	
52F13	756159	124	473	1319	2212	4.9	0.8	0.3	6.0	0.9	17	320	72	3.9	47	62	56	42	1.0	131	49	
52F13	756160	75	342	419	1709	3.9	0.7	0.2	2.8	0.5	20	221	57	2.1	53	83	15	32	1.0	77	28	
52F13	756162	93	344	122	1788	4.1	0.6	0.2	1.9	0.5	12	107	41	2.0	77	45	15	45	1.0	92	34	
52F13	756163	113	383	219	2007	4.6	0.8	0.3	2.2	0.8	22	374	41	1.0	47	56	15	36	2.2	67	27	
52F13	756164	59	232	311	1166	3.3	0.6	0.1	1.5	0.3	12	334	32	2.1	42	58	16	34	1.0	93	31	
52F13	756165	130	420	510	1948	4.7	0.7	0.2	2.1	0.7	15	120	47	2.3	38	36	11	20	2.2	87	31	
52F13	756166	236	568	1183	2155	5.8	1.2	0.3	4.1	1.3	18	99	60	2.4	47	25	22	20	1.0	85	33	
52F13	756168	134	390	465	1835	4.7	0.8	0.3	2.3	0.7	17	103	54	2.0	38	30	13	20	2.1	74	31	
52F13	756169	125	362	265	1797	4.6	0.6	0.2	2.1	0.7	15	108	34	2.0	41	34	11	21	2.1	96	34	
52F13	756171	337	863	522	3176	6.8	1.5	0.8	3.3	2.2	18	102	84	2.3	67	30	16	55	1.0	46	19	
52F13	756173	90	332	201	1750	4.3	0.5	0.3	1.7	0.5	13	153	31	2.2	64	46	13	38	2.1	87	33	
52F13	756174	285	577	947	2684	6.2	1.4	0.7	3.3	1.7	20	114	60	2.6	65	25	21	35	2.6	52	24	
52F13	756175	88	343	161	1583	3.7	0.6	0.1	2.0	0.6	14	102	38	1.0	48	68	13	39	1.0	83	29	
52F13	756176	66	231	50	1214	3.1	0.6	0.1	1.5	0.1	10	115	30	2.1	31	61	24	39	1.0	113	44	
52F13	756177	310	861	752	6397	6.7	2.1	1.1	5.8	2.0	21	185	126	3.1	63	133	22	23	1.0	64	62	
52F13	756178	51	240+1800	1709	3.8	0.5	0.3	6.3	0.4	0.4	17	182	54	3.6	63	95	24	23	1.0	64	62	
52F13	756179	75	401	730	1348	3.2	0.9	0.1	3.1	0.2	13	148	60	2.2	35	52	27	27	1.0	108	54	
52F13	756180	46	304	770	1214	3.6	0.3	0.1	6.2	0.3	18	102	74	3.6	58	66	23	31	1.0	177	57	
52F13	756182	99	272	235	1485	3.6	0.6	0.2	1.6	0.5	10	110	40	1.0	38	53	11	19	1.0	112	33	
52F13	756183	108	277	300	1635	3.7	0.5	0.2	1.5	0.5	20	117	36	1.0	35	48	10	19	1.0	108	33	
52F13	756185	161	338	307	2184	4.5	0.8	0.4	2.4	0.7	14	126	42	2.1	50	38	10	27	1.0	107	38	
52F13	756187	76	303	858	1482	3.9	0.5	0.1	2.6	0.5	16	111	65	2.2	37	52	21	23	2.0	181	46	
52F13	756188	64	256	216	1376	3.2	0.4	0.1	1.3	0.4	14	97	32	1.0	27	26	9	19	1.0	67	25	
Lower detection limits		30	50	100	100	0.5	0.2	0.2	0.2	0.2	2	25	10	2.0	10	4	2	4	2.0	10	10	
		15	25	50	50	0.2	0.1	0.1	0.1	0.1	1	13	5	1.0	5	2	1	2	1.0	5	5	
Upper detection limits		1300	2100	1800	6500	10.0	4.0	8.0	15.0	9.0	100	1200	250	20.0	200	250	150	150	25.0	350	300	

(Value recorded for the lower detection limit is equal to approximately one-half the actual lower detection limit)

Appendix IVStream WatersField Observations and Analytical Data

Key: Rock-type: The major rock-type of the catchment area or hydrological system is recorded:-

GRNT - granite
IMVC - intermediate metavolcanics
MMVC - mafic metavolcanics

Stream width: The width of the stream at the sample site is recorded to the nearest metre.

Water depth: The water depth is recorded to the nearest centimetre.

Bank type: The general nature of the bank material is described here:

- 1 - Alluvial
- 2 - Colluvial (bare rock, residual or mountain soils)
- 3 - Glacial till
- 4 - Glacial outwash sediments

Colour: The general colour and suspended load of the water is noted:

- 1 - Clear
- 2 - Brown transparent
- 3 - Brown cloudy

Water Flow Rate: -

- 0 - Stagnant
- 1 - Slow
- 2 - Moderate
- 3 - Fast
- 4 - Torrent

Precipitate or Stain: The presence of any coatings on pebbles, boulders or stream bottoms is recorded:-

- 0 - None
- 1 - Red, brown or black
- 2 - White or buff

pH: The pH of the stream water.

GEOCHEMICAL ORIENTATIONAL SURVEY FOR URANIUM, MACNICOLL, TUSTIN, BRIDGES AND DOCKER TOWNSHIPS, KENORA DISTRICT (52/F/13), ONTARIO, 1975

ACIDIFIED (250 MICROLITRES OF NITRIC ACID PER 125 MILLILITRES OF WATER) ON DAY OF COLLECTION

MAP SHEET	SAMPLE NUMBER	UTM ZONE	EAST	NORTH	ROCK TYPE	STR WATER WIDTH M	DEPTH CM	BANK TYPE	COL	FLOW RATE	PPT	PH	ZN PPB	CU PPB	PB PPB	CO PPB	NI PPB	FE PPB	MN PPB	U PPB				
52F13	753003	15	461900	5518200	GRNT	2	5	4	1	1	0	6.8	2.0	1.0	5.2	1.0	3.4	831	34	0.12				
52F13	753004	15	459400	5520100	GRNT	1	2	4	1	1	0	6.9	2.4	0.5	2.0	1.0	2.6	277	47	0.56				
52F13	753005	15	452400	5520500	GRNT	2	5	3	1	2	0	6.4	4.2	1.4	2.0	5.5	1.0	198	17	0.22				
52F13	753006	15	445700	5520200	IMVC	1	4	3	1	1	0	6.5	2.5	2.2	2.0	1.0	21.0	289	127	0.18				
52F13	753007	15	439500	5521700	IMVC	1	2	3	1	1	0	7.1	7.3	2.2	2.0	5.0	3.4	62	6	0.36				
52F13	753008	15	437000	5521500	MMVC	1	2	3	1	2	0	6.9	0.2	1.2	2.0	1.0	1.0	173	14	0.48				
52F13	753009	15	433000	5522200	GRNT	5	4	3	0	2	0	6.8	1.5	0.2	2.0	1.0	1.0	10	5	0.12				
													0.5	0.5	5.0	2.0	2.0	10	0.04					
													0.2	0.2	2.0	1.0	1.0	5	0.02					

Lower detection limits

Value recorded for the lower detection limit is equal to approximately one-half the actual detection limit

Appendix V

Stream Sediments

Field Observations and Analytical Data

Key: Rock-type: (see explanation Stream Waters)

Stream width: The width of the stream at the sample site is recorded to the nearest metre.

Stream depth: The water depth is recorded to the nearest centimetre.

Bank type: The general nature of the bank material is described here:-

- 1 - Alluvial
- 2 - Colluvial (bare rock, residual or mountain soils)
- 3 - Glacial till
- 4 - Glacial outwash sediments

Colour: The general colour and suspended load of the water is noted:-

- 0 - Clear
- 1 - Brown transparent
- 2 - White cloudy
- 3 - Brown cloudy

Water flow rate: -

- 0 - Stagnant
- 1 - Slow
- 2 - Moderate
- 3 - Fast
- 4 - Torrent

Precipitate or Stain: The presence of any coatings on pebbles, boulders or stream bottoms is recorded:-

- 0 - None
- 1 - Red, brown or black
- 2 - White or buff

Sediment Composition: The three columns are used to describe the bulk mechanical composition of the collected sample on scales of 0 to 3, the total of the columns must add to 3 or 4:-

- 0 - Absent
- 1 - Minor, <33%
- 2 - Medium, 33-67%
- 3 - Major, >67%

The size fractions are divided as follows:-

46	>0.125 mm	Sand
47	<0.125 mm	Fines, silt and clay
48		Organics

- Examples: - 013 No sand, <33% Fines, >67% Organics
 121 <33% Sand, 33-67% Fines, <33% Organics
 220 33-67% Sand, 33-67% Fines, No Organics
 030 No sand, >67% Fines, No Organics

The first might represent a muskeg sediment; the second a sample from a swampy stream section; and the third and fourth clear washed stream sediments.

pH: The pH of the stream water:

GEOCHEMICAL ORIENTATION SURVEY FOR URANIUM , MACNICOL, TUSTIN, BRIDGES AND DOCKER TOWNSHIPS , KENORA DISTRICT (52/F/13) , ONTARIO , 1975
 U BY FLUORIMETRY ; MO, ZN, CU, PB, NI, CO, MN AND FE BY ATOMIC ABSORPTION TECHNIQUES

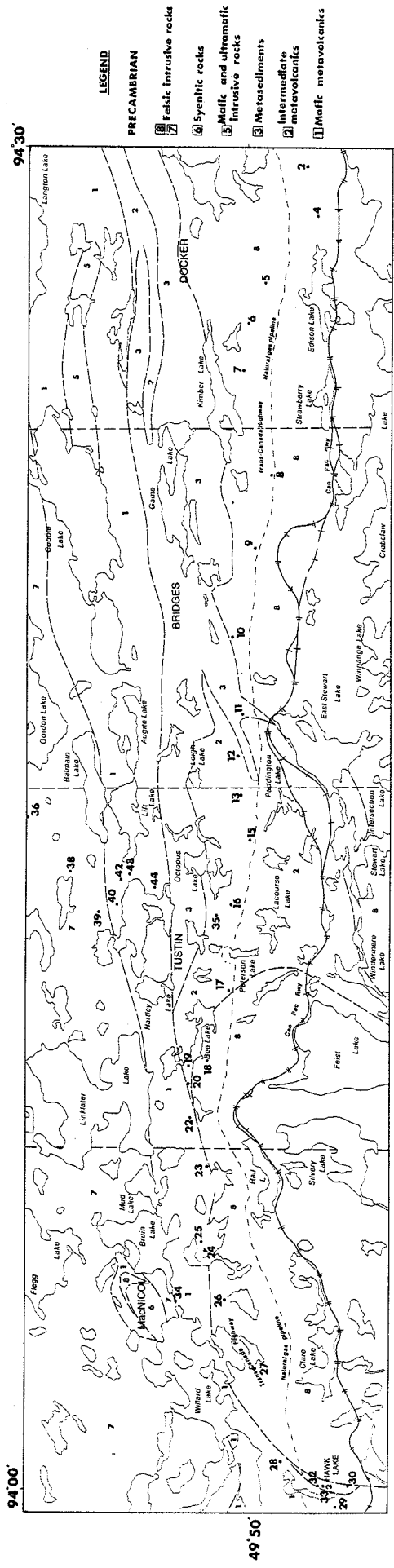
MAP SHEET NUMBER	UTM ZONE	EAST COORDINATES	NORTH COORDINATES	ROCK TYPE	WATER DEPTH CM	BANK TYPE	COL RATE	FLOW RATE	PPT	WATER		MO PPM	ZN PPM	CU PPM	PB PPM	NI PPM	CO PPM	MN PPM	FE %	U PPM	LOI %
										STR	STR										
52F13 754003	15	461900	5518200	GRNT	2	5	4	1	0	121	6.8	0.3	16	4	6	8	5	60	0.48	1.7	2.8
52F13 754004	15	459400	5520100	GRNT	1	2	4	1	0	3	6.9	1.1	34	8	11	13	9	184	0.69	29.6	46.2
52F13 754005	15	452400	5520500	GRNT	2	5	3	1	0	21	6.4	0.5	110	10	7	13	13	315	1.31	4.1	8.2
52F13 754006	15	445700	5520200	IMVC	4	4	3	1	0	13	6.5	1.4	42	23	11	74	17	251	0.77	10.9	45.1
52F13 754007	15	439500	5521700	IMVC	1	2	3	1	0	31	7.1	0.5	38	8	7	12	5	174	0.82	3.7	2.3
52F13 754008	15	437000	5521500	MHVC	1	2	3	1	0	31	6.9	0.8	22	9	6	12	5	120	0.75	5.2	1.4
52F13 754009	15	433000	5522200	GRNT	5	4	3	0	0	31	6.8	0.5	16	6	6	13	5	74	0.52	1.3	1.7

Lower detection limits
 Value recorded for the lower detection limit is equal to
 approximately one-half the actual lower detection limit

Appendix VISample Numbers and Locations for Bedrock and
Overburden Samples, MacNicol, Tustin, Bridges
and Docker Townships, Kenora District (52/F/13),
Ontario

At each site a bedrock, composite chip sample, (52F13752XXX) and overburden (52F13751XXX) sample were collected. Only the last three significant digits of each sample number are plotted at each site. The bedrock and overburden samples have, therefore, the same last three digits at each site.

The field observations and analytical data for the bedrock samples (identified by a 2 in digit eight of the eleven digit sample number - 52F13752XXX) and the overburden samples (identified by a 1 in digit eight of the eleven digit sample number - 52F13751XXX) are listed in Appendices VII and VIII respectively.



Sample Numbers and Locations for Bedrock and Overburden Samples, McNicol, Tustin, Bridges, Docker Townships, Kenora District 52 P-13, Ontario.

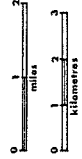


Figure 7. Appendix VI; Sample numbers and locations for bedrock and overburden samples.

Appendix VIIBedrock (Composite Chip Samples)Field Observations and Analytical Data

Key:	<u>Bedrock type:</u>	GBBR	gabbro
		GRDR	granodiorite
		GRNS	granitic gneiss
		GRNT	granite
		GRPG	granite pegmatite
		IMVC	intermediate metavolcanics
		MMVC	mafic metavolcanics
		MSDM	metasediments

Age: 01 Precambrian undivided

Colour:

0	White	<20% dark minerals
1	White and black	20-40%
2	White equals black	40-60%
3	Black and white	60-80%
4	Black	>80%
5	Grey	
6	Green	
7	Buff	
8	Orange or yellow	
9	Red or purple	

Grain size:

0	<0.004 mm	Clay	glassy
1	0.004- 0.025 mm	Silt	aphanitic
2	0.025- 0.125 mm	very fine Sand	aphanitic
3	0.125- 0.250 mm	fine Sand	very fine grained
4	0.250- 0.50 mm	medium coarse Sand	very fine grained
5	0.50 - 1.00 mm	coarse Sand	fine grained
6	1.00 - 2.00 mm	very coarse Sand	medium grained
7	2.00 - 5.00 mm	Granules	medium grained
8	5.00 - 20.0 mm	Pebbles	coarse grained
9	> 20.0 mm	Cobbles, etc.	very coarse grained

<u>Texture:</u>	0	Uniform grain size
	1	Variable grain size
	2	Megacrystic
	3	Pegmatitic
	4	Miarolitic
	5	Pyroclastic
	6	Cataclastic
	7	Bioclastic
	8	Oolitic
	9	Other

<u>Banding or Bedding:</u>	0	Massive
	1	Bedded
	2	Crossbedded
	3	Slump structured
	4	Schistose or foliated
	5	Gneissic banding
	6	Migmatitic
	7	Oriented megacrysts
	8	Trachytic groundmass
	9	Other

<u>Alteration:</u>	0	Fresh
	1	Weathered
	2	Weathered, gossanous
	3	Hydrothermal bleached white
	4	Hydrothermal stained red or rusty

Radioactivity (counts per second): Average cps obtained over the length of the outcrop sampled. Measurements were made with an Exploranium GRS-101 scintillometer.

GEOCHEMICAL ORIENTATIONAL SURVEY FOR URANIUM, MANGANESE, BRIDGES AND DOCKER TOWNSHIPS, KENORA DISTRICT (52/F/13), ONTARIO, 1975
 BEDROCK (COMPOSITE CHIP SAMPLES)
 U BY FLUORIMETRY; ZN, CU, PB, CO, NI, FE, MN, AND MO BY ATOMIC ABSORPTION TECHNIQUES

MAP SHEET	SAMPLE NUMBER	UTM ZONE	EAST	NORTH	ROCK TYPE	C AGE	O L	GR SIZE	T E X	BND A OR L BED T	RAD O/C ACT LTH CFS M	ZN PPM	CU PPM	PB PPM	CO PPM	NI PPM	FE PPM	MN PPM	U PPM	MO PPM
52F13	752002	15	463600	5518300	GRNS	01 0	0	7	1	5	0	36	9	30	4	16	10634	145	1.30	2.6
52F13	752004	15	462200	5517900	GRPG	01 0	0	8	1	5	0	11	2	27	1	3	3039	52	1.20	2.3
52F13	752005	15	460500	5519300	GRDR	01 0	0	6	0	0	0	37	6	20	3	4	11636	233	1.50	2.9
52F13	752006	15	459400	5520000	GRNT	01 0	0	6	0	0	1	25	2	3	3	3	7200	110	2.30	2.3
52F13	752007	15	458200	5520000	GRNT	01 0	0	6	0	0	0	35	4	29	2	2	10182	125	1.70	3.3
52F13	752008	15	455000	5519400	GRDR	01 0	0	7	1	0	0	41	3	25	4	2	9455	188	1.50	3.3
52F13	752009	15	453100	5520100	GRNT	01 0	0	6	0	1	6	35	4	16	5	8	11636	194	2.10	2.1
52F13	752010	15	451200	5520400	GRPG	01 9	9	9	3	0	0	17	2	52	1	3	5280	78	129.50	1.8
52F13	752011	15	448800	5520200	GRPG	01 0	0	9	3	0	0	150	25	34	1	3	2645	87	1.80	2.1
52F13	752012	15	447900	5520300	IMVC	01 3	6	1	4	1	4	34	8	26	65	65	42368	621	.20	3.5
52F13	752013	15	446800	5520300	IMVC	01 5	2	2	0	4	0	70	13	13	26	94	41579	589	.50	3.9
52F13	752015	15	445400	5520300	IMVC	01 5	2	1	4	0	0	29	14	14	24	92	29600	421	.58	3.3
52F13	752016	15	443800	5520700	IMVC	01 5	2	2	1	4	0	77	18	13	24	34	43947	813	.29	3.3
52F13	752017	15	441700	5520700	IMVC	01 5	2	0	4	0	0	72	47	13	35	77	61316	1100	.50	4.0
52F13	752018	15	439700	5521000	GRDR	01 0	0	7	1	0	0	37	6	26	2	5	9509	184	2.80	2.6
52F13	752019	15	439200	5521900	IMVC	01 5	2	0	4	0	0	95	24	13	32	100	48112	912	.88	3.1
52F13	752020	15	439200	5521900	GRPG	01 0	0	7	1	0	0	10	7	56	1	3	3200	69	1.30	2.1
52F13	752022	15	438200	5521600	IMVC	01 5	3	1	4	0	0	73	58	14	33	100	48392	735	.68	3.6
52F13	752023	15	436800	5521300	MMVC	01 4	3	1	0	0	0	83	61	11	48	126	73566	1338	.12	4.0
52F13	752024	15	434600	5521500	GRNT	01 9	8	3	2	0	0	16	4	47	1	2	4444	67	11.50	2.1
52F13	752025	15	434500	5521500	MMVC	01 5	3	1	4	0	0	75	90	12	31	59	47832	715	1.80	6.2
52F13	752026	15	433300	5520900	GRNT	01 1	4	4	1	0	0	38	11	19	4	6	10264	181	1.70	2.3
52F13	752027	15	431500	5520400	MMVC	01 9	4	4	1	0	0	35	7	23	3	4	8755	165	3.20	3.1
52F13	752028	15	428900	5519300	MMVC	01 5	3	1	4	0	0	69	25	11	23	37	39600	704	.69	3.1
52F13	752029	15	433200	5522100	MMVC	01 4	2	1	4	0	0	85	77	7	47	92	72448	1700	.05	3.4
52F13	752030	15	428300	5517700	MMVC	01 3	2	1	4	0	0	72	54	11	23	44	41399	677	.67	3.9
52F13	752032	15	428300	5518500	GRNT	01 9	8	2	0	0	0	13	3	54	2	2	5689	127	44.50	1.9
52F13	752033	15	428300	5518600	MMVC	01 4	2	1	4	0	0	107	24	9	35	128	47832	1110	.29	3.5
52F13	752034	15	433200	5522100	MMVC	01 3	4	1	4	0	0	126	49	4	51	20	128485	2269	.05	4.2
52F13	752035	15	443600	5521000	IMVC	01 3	4	1	4	0	0	109	40	7	47	191	78601	2212	.26	4.7
52F13	752036	15	446300	5526000	GRNS	01 8	6	1	5	0	0	24	10	21	6	6	9962	168	.57	3.1
52F13	752038	15	444700	5524900	GRNS	01 8	6	1	5	0	0	57	13	23	14	33	26000	588	1.20	2.3
52F13	752039	15	443800	5524100	GRNT	01 1	4	1	4	0	0	32	5	32	2	4	9660	159	2.30	2.4
52F13	752040	15	443800	5523600	MSDM	01 3	4	1	4	0	0	90	45	14	24	127	31800	550	.73	3.2
52F13	752042	15	444300	5523600	MMVC	01 4	3	1	4	0	0	99	51	4	46	116	91250	1445	.05	4.1
52F13	752043	15	444500	5523500	GRPG	01 0	9	3	0	0	0	14	3	56	2	1	4444	619	150.00	2.7
52F13	752044	15	444200	5522700	GBBR	01 4	3	1	0	0	0	71	67	4	66	305	73566	1280	.29	2.1

Lower detection limits
 Value recorded for the lower detection limit is equal to
 one-half the actual lower detection limit

GEOCHEMICAL ORIENTATION SURVEY FOR URANIUM, MAGNOLIA, JUSTIN, BRIDGES AND DOCKER TOWNSHIPS, KENORA DISTRICT (52/F/13), ONTARIO, 1975
 BEDROCK (COMPOSITE CHIP SAMPLES)
 THE DATA LISTED BELOW (SR TO Y) WERE ESTIMATED BY EMISSION SPECTROMETRY

ANALYTICAL DATA CONTINUED FROM PREVIOUS PAGE

MAP SHEET	SAMPLE NUMBER	SR PPM	BA PPM	MN PPM	TI PPM	AL %	CA %	MG %	FE %	K %	PB PPM	ZN PPM	AG PPM	V PPM	MO PPM	CR PPM	CU PPM	CO PPM	NI PPM	BE PPM	LA PPM	Y PPM
52F13	752002	382	827	131	1125	7.6	1.6	0.3	1.7	3.9	17	38	0.2	36	1.6	42	14	4	17	1.3	36	5
52F13	752004	332	839	50	338	7.5	1.2	0.1	0.4	3.6	8	12	0.2	23	0.5	6	5	1	6	0.5	50	5
52F13	752005	505	715	172	1387	7.5	1.9	0.2	1.7	2.4	7	60	0.2	39	1.4	9	17	1	5	0.5	38	5
52F13	752006	382	700	50	932	6.9	1.5	0.1	1.4	4.1	20	66	0.2	18	1.3	15	71	1	18	0.5	63	5
52F13	752007	262	1319	50	944	6.2	0.9	0.1	1.4	4.1	1	41	0.2	48	0.5	14	3	1	3	0.5	194	5
52F13	752008	398	959	50	1355	8.0	1.5	0.1	2.0	3.8	8	39	0.2	41	0.5	11	10	1	5	0.5	68	5
52F13	752009	417	1046	50	1414	6.0	2.0	0.2	2.0	2.9	5	70	0.2	55	1.0	23	11	2	10	0.5	95	5
52F13	752010	161	501	50	440	7.1	0.6	0.1	0.7	5.1	76	55	0.2	5	1.5	3	18	1	4	2.4	43	5
52F13	752011	27	39	50	363	5.6	0.6	0.1	0.3	2.4	37	34	0.2	5	0.5	3	6	1	2	2.7	27	16
52F13	752012	343	386	651	3932	6.9	3.7	2.0	5.1	2.2	12	48	0.2	178	3.1	141	36	26	54	1.1	21	15
52F13	752013	477	888	702	3908	6.1	3.8	2.1	5.4	1.9	18	61	0.2	186	3.9	150	25	32	125	1.1	71	17
52F13	752015	440	676	391	2701	6.5	3.6	1.4	4.4	2.8	16	52	0.2	136	1.9	150	42	30	125	1.6	37	14
52F13	752016	643	1010	1011	4384	7.7	4.3	1.7	5.7	2.7	10	46	0.2	177	3.0	50	18	28	32	1.6	46	19
52F13	752017	632	544	582	4296	6.3	5.8	1.2	7.2	1.8	6	31	0.2	301	3.1	150	45	35	63	0.5	5	30
52F13	752018	562	840	100	1107	6.3	1.8	0.1	1.3	2.5	16	39	0.2	31	1.2	8	4	1	5	2.1	36	5
52F13	752019	297	342	975	3866	6.0	3.4	3.0	5.3	1.5	22	119	0.2	166	4.1	150	27	35	125	1.7	38	16
52F13	752020	95	174	50	207	6.6	0.9	0.1	0.3	2.9	60	46	0.2	5	1.5	3	10	1	3	2.9	17	5
52F13	752022	481	550	1186	4484	7.2	3.8	1.8	5.8	1.3	15	75	0.2	159	4.2	150	68	32	125	1.2	40	15
52F13	752023	129	81	1538	5194	7.0	5.1	3.2	7.6	0.8	11	103	0.2	229	5.6	150	64	50	125	0.5	15	23
52F13	752024	89	56	50	237	6.7	0.6	0.1	0.6	3.2	57	51	0.2	11	1.7	3	4	1	3	3.6	18	5
52F13	752025	1300	820	649	4475	6.2	4.0	2.0	5.7	1.9	14	58	0.2	179	4.0	92	91	31	125	1.8	112	21
52F13	752026	663	1023	111	1249	5.9	1.6	0.2	1.3	1.8	14	72	0.2	28	1.4	6	12	2	6	2.1	30	5
52F13	752027	574	1046	50	1234	6.0	1.5	0.1	1.0	1.8	16	78	0.2	22	1.1	6	6	1	3	1.5	40	5
52F13	752028	553	631	620	3797	6.8	4.2	1.7	5.2	2.0	11	47	0.2	164	3.2	91	20	22	34	1.5	49	17
52F13	752029	144	158	1621	4583	6.5	5.6	3.5	8.8	0.6	12	65	0.2	279	5.5	150	83	58	125	0.5	5	19
52F13	752030	379	577	781	4837	6.9	3.3	1.8	5.1	1.6	10	74	0.2	174	3.7	113	48	20	36	0.7	37	21
52F13	752032	119	47	50	338	7.0	1.1	0.1	0.8	1.7	52	52	0.2	11	0.5	4	2	1	2	1.6	16	5
52F13	752033	362	551	1150	4806	6.9	4.3	3.3	5.7	1.4	13	83	0.2	205	3.7	150	24	41	125	1.3	43	18
52F13	752034	117	94	1800	6500	6.0	4.2	2.0	14.0	0.5	7	94	0.2	400	6.3	6	48	66	26	0.5	20	50
52F13	752035	399	244	1800	4593	7.9	5.5	3.0	7.8	0.8	9	136	0.2	215	5.4	150	30	44	125	0.5	41	27
52F13	752036	383	1500	50	1151	6.4	1.3	0.1	1.2	3.2	13	51	0.2	43	0.5	9	8	1	5	1.4	26	5
52F13	752038	284	604	798	2752	6.6	2.7	1.1	3.6	2.2	23	67	0.2	101	2.9	57	12	14	29	1.8	28	19
52F13	752039	490	1556	127	1159	6.9	1.3	0.1	1.2	3.1	25	68	0.2	19	1.6	8	8	1	6	1.5	40	12
52F13	752040	505	511	733	4159	7.1	3.2	2.0	4.1	1.6	13	124	0.2	127	3.6	150	43	28	125	0.5	37	13
52F13	752042	178	47	1800	5328	8.4	5.2	4.7	8.4	0.4	7	113	0.2	245	6.8	150	49	44	86	1.4	12	21
52F13	752043	11	7	650	100	6.0	0.3	0.1	0.5	3.3	43	46	0.2	5	0.5	3	3	1	2	2.1	24	34
52F13	752044	116	49	1101	2878	6.1	5.3	5.5	8.1	0.2	13	55	0.2	193	4.7	150	70	79	125	0.5	11	12
Lower detection limits		2	2	100	200	0.5	0.2	0.2	0.2	0.2	2	25	0.5	10	1.0	2	2	2	2	1.0	10	10
		1	1	50	100	0.2	0.1	0.1	0.1	0.1	1	13	0.2	5	0.5	1	1	1	1	0.5	5	5

(Value recorded for the lower detection limit is equal to approximately one-half the actual lower detection limit)

Upper detection limits	1300	2100	1800	6500	10.0	8.0	8.0	15.0	9.0	100	1000	10.0	20.0	150	200	150	300	450
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Appendix VIIIOverburdenField Observations and Analytical Data

Key: Underlying Bedrock Type: (see explanation Bedrock)

Slope: The slope of the ground at the sample site is recorded in two parts.

Direction of slope, towards the direction, i.e.

N slopes away to north

SW slopes away to the southwest

Magnitude of slope, to the nearest 5 degrees, i.e.

05	5°
25	25°

<u>Relief</u> :	0	Flat		
	1	Low,	0 - 50	feet
	2	Gentle,	50 - 200	feet
	3	Moderate,	200 - 1000	feet
	4	High,	>1000	feet

<u>Dominant Vegetation</u> :	0	No trees
	1	Conifers
	2	Deciduous
	3	Mixed conifers and deciduous
	M	Moss
	G	Grass
	L	Labrador tea
	S	Spruce
	N	Pine
	C	Cedar
	T	Tamarak
	P	Poplar
	H	Hemlok
	M	Maple
	B	Birch
	O	Oak
	A	Alder
	W	Willow

<u>Vegetation Intensity:</u>	0	Open
	1	Sparse
	2	Moderate, Parkland
	3	Well-wooded, Forest

<u>Soil Type:</u>	10	Chernozem	-	undifferentiated
	11			brown
	12			dark brown
	13			black
	14			dark grey
	20	Solonetyic	-	undifferentiated
	21			solonety
	22			Solod
	30	Podzolic	-	undifferentiated
	31			grey brown
	32			dark grey wooded
	33			grey wooded
	34			humic Podzol
	35			Podzol
	40	Bremisolic	-	undifferentiated
	41			brown forest
	42			brown wooded
	43			acid brown wooded
	44			acid brown forest
	45			concretionary brown
	46			alpine brown
	50	Regosolic	-	undifferentiated
	51			Regosol
	52			Podzo-Regosol
	60	Gleysolic	-	undifferentiated
	61			humic Gleysol
	62			Gleysol
	63			eluviated Gleysol
	70	Organic	-	undifferentiated
	71			Fibrisol
	72			Mesisol
	73			Humisol
	80	Glacial	-	undifferentiated
	81			local till
	82			transported till
	83			glacial-lacustrine sediment
	84			esker sediment

Depth: Depth to the top of the sample in centimetres.

Thickness: Sample thickness in centimetres.

<u>Soil Horizon:</u>	<u>United States</u>	<u>Canada</u>
0	A ₀₀	L or L-H
1	A ₀	F
2	A ₁	H or A _h
3	A ₂	A _e
4	A ₃	AB
5	B ₁	BA
6	B ₂	B _f or B _t
7	B ₃	BC
8	C	C

<u>Colour:</u>	
0	White
1	Buff
2	Yellow
3	Orange
4	Pink
5	Red
6	Brown
7	Dark Brown
8	Black
9	Grey

<u>Texture:</u>			
0	<0.004 mm	fine Silt and Clay	clayey Soil
1	0.004-0.125 mm	Silt	clayey Loam
2	0.125-0.5 mm	fine Sand	Loam
3	0.5 -1.0 mm	medium Sand	sandy Loam
4	1.0 -2.0 mm	coarse Sand	sandy Soil
5	>2.0 mm	Granules etc.	

Consistence: The consistence of the sample is used to describe the aggregate nature of the sample and is dependent on the moisture content of the sample. See Moisture.

When sample is wet, Moisture = 1

11	Non sticky - non plastic
12	slightly plastic
13	plastic
14	very plastic

This is extended to slightly sticky, sticky and very sticky material.

	<u>non plastic</u>	<u>slightly plastic</u>
non sticky	11	12
slightly sticky	21	22
sticky	31	32
very sticky	41	42

	<u>plastic</u>	<u>very plastic</u>
non sticky	13	14
slightly sticky	23	24
sticky	33	34
very sticky	43	44

When sample is moist, Moisture = 2

51	non coherent
52	very friable
53	friable
54	firm
55	very firm

When sample is dry, Moisture = 3

61	loose
62	soft
63	slightly hard
64	hard
65	very hard
66	extremely hard
71	weakly cemented
72	strongly cemented
73	indurated

<u>Moisture:</u>	1	wet
	2	moist
	3	dry

<u>Drainage:</u>	1	Rapidly drained
	2	Well drained
	3	Moderately well drained

GEOCHEMICAL ORIENTATION SURVEY FOR URANIUM, MAGNOL, TUSTIN, BRIDGES AND DOCKER TOWNSHIPS, KENORA DISTRICT (52/F/13), ONTARIO, 1975

U BY FLUORIMETRY; ZN, CU, PB, CO, NI, FE, MN, AND MO BY ATOMIC ABSORPTION TECHNIQUES

MAP SHEET	SAMPLE NUMBER	UTM ZONE	UTM COORDINATES		UNDER LYING ROCK TYPE	SLOPE	R	E DOM L	VEG INT	SOIL TYPE	DEP CM	THK CM	H C T			O O E			CU PPM	PB PPM	CO PPM	NI PPM	FE PPM	MN PPM	U PPM	MO PPM	
			EAST	NORTH									S	T	R	N	S	R									S
52F13	751002	15	463600	5518300	GRNS	S10	1	1S	3	51	5	5	6	6	1	61	3	2	24	28	5	14	34000	266	1.0	4.6	
52F13	751004	15	462200	5517900	GRPG	S05	1	1S	3	62	15	5	6	6	0	33	1	2	32	17	15	46	36000	528	1.0	0.8	
52F13	751005	15	460500	5519300	GRDR	SE15	1	3A	2	51	10	5	6	6	3	61	3	2	10	10	8	15	16762	334	0.8	0.1	
52F13	751006	15	459400	5520000	GRNT	N10	1	1S	3	34	20	5	6	6	2	53	2	2	19	17	9	21	35600	334	0.9	1.2	
52F13	751007	15	458200	5520000	GRNT	S10	1	1S	3	35	15	5	6	5	2	53	2	2	12	17	11	33	27429	334	1.9	0.6	
52F13	751008	15	455000	5519400	GRDR	N05	1	1S	3	35	10	5	6	5	2	53	2	2	15	24	12	30	30857	331	0.9	1.0	
52F13	751009	15	453100	5520100	GRNT	S20	1	1S	3	35	5	5	6	5	4	52	2	2	34	21	13	28	32000	545	1.6	2.3	
52F13	751010	15	451200	5520400	GRPG	SE10	1	3S	3	35	10	177	5	6	5	4	52	2	2	34	21	18	40	43200	572	1.2	0.4
52F13	751011	15	448800	5520200	GRPG	S05	1	3S	3	35	15	5	6	5	2	53	2	2	16	18	10	21	27429	269	15.0	1.3	
52F13	751012	15	447900	5520300	IMVC	S20	1	1N	3	35	10	5	6	6	2	53	2	2	14	18	13	47	24331	366	1.0	1.5	
52F13	751013	15	446800	5520200	IMVC	S10	1	1N	3	35	15	5	6	6	2	53	2	2	6	14	9	32	23619	331	0.7	0.4	
52F13	751015	15	445400	5520300	IMVC	NE15	1	3A	3	35	10	5	6	5	2	53	2	2	11	21	16	44	27429	359	0.6	0.9	
52F13	751016	15	443800	5520700	IMVC	S10	1	2B	3	35	15	5	6	5	2	53	2	2	18	17	12	32	28571	391	0.4	0.1	
52F13	751017	15	441700	5520700	IMVC	E10	1	3A	3	35	15	5	6	5	2	53	2	2	45	15	22	46	46800	617	0.9	1.7	
52F13	751018	15	439700	5521900	GRDR	N05	1	3A	3	35	10	5	6	6	2	53	2	2	9	15	10	27	22476	344	0.6	0.4	
52F13	751019	15	439200	5521900	IMVC	N05	1	3N	3	35	5	5	6	5	2	53	2	2	24	24	13	38	27810	431	13.0	1.1	
52F13	751020	15	439200	5521900	GRPG	N05	1	3N	3	35	10	5	6	6	2	53	2	2	48	17	18	47	40000	528	8.8	1.9	
52F13	751022	15	438200	5521600	IMVC	S05	1	2B	2	35	20	10	6	6	1	61	3	2	14	15	15	42	42800	451	0.5	0.6	
52F13	751023	15	436800	5521300	MMVC	S05	0	1	2B	2	5	5	6	6	1	61	3	2	28	17	18	50	37600	469	0.8	0.1	
52F13	751024	15	434600	5521500	GRNT	S05	1	2B	2	35	5	10	6	5	1	61	3	2	24	15	13	38	31238	448	16.8	1.2	
52F13	751025	15	433500	5520900	MMVC	S05	1	2B	2	35	10	10	6	6	2	61	3	2	19	21	17	40	26190	479	22.0	0.1	
52F13	751026	15	431500	5520900	GRNT	S05	1	3B	2	35	15	5	6	5	1	61	3	2	11	18	11	25	27810	366	1.1	1.0	
52F13	751027	15	431500	5520100	GRNT	S05	0	1	1S	2	15	5	6	5	1	61	3	2	7	17	11	29	23619	322	0.8	0.7	
52F13	751028	15	428900	5519300	MMVC	S05	0	1	2B	2	10	5	6	5	1	61	3	2	37	28	12	25	35600	414	6.0	3.4	
52F13	751029	15	433200	5522100	MMVC	N05	1	1S	2	35	15	5	6	5	1	61	3	2	81	19	17	41	45600	445	1.2	4.5	
52F13	751030	15	428300	5517700	MMVC	S05	1	1N	2	51	10	5	6	7	1	61	3	2	41	21	22	53	57778	1074	0.5	2.5	
52F13	751032	15	428300	5518500	GRNT	S05	0	1	1N	3	10	5	6	6	1	61	3	2	57	10	19	40	59111	490	5.2	8.7	
52F13	751033	15	428300	5518600	MMVC	S05	0	1	1N	2	51	5	6	6	2	61	3	2	33	17	27	77	44800	818	10.8	1.5	
52F13	751034	15	433200	5521000	MMVC	N05	1	3B	3	51	15	5	6	6	2	61	3	2	35	36	41	71	33600	4191	1.3	1.6	
52F13	751035	15	443600	5521000	IMVC	N05	1	1N	2	35	15	5	6	5	1	61	3	2	28	8	32	115	59556	1029	0.2	2.9	
52F13	751036	15	446300	5526000	GRNS	N05	1	3B	2	35	15	5	6	6	1	61	3	2	24	21	14	19	40800	431	0.9	1.6	
52F13	751038	15	444700	5524900	GRNS	S05	0	1	2A	2	20	5	6	5	1	61	3	2	13	21	10	19	38000	366	3.0	2.8	
52F13	751039	15	443800	5524100	GRNT	S05	1	2B	3	35	15	5	6	6	1	61	3	2	11	19	12	23	36000	466	1.6	1.0	
52F13	751040	15	443800	5523600	MSOM	S05	0	1	3B	2	35	10	5	6	6	1	61	3	2	18	10	13	38	44800	579	0.5	1.1
52F13	751042	15	444300	5523600	MMVC	S05	0	1	2B	2	35	15	5	6	6	1	61	3	2	16	15	13	34	32800	424	0.9	0.7
52F13	751043	15	444500	5523500	GRPG	S05	1	2B	3	35	20	10	6	6	1	61	3	2	17	13	13	25	27429	306	84.0	0.6	
52F13	751044	15	444200	5522700	GBBR	S05	0	1	3S	3	15	5	6	5	1	61	3	2	12	13	12	39	30857	397	1.2	0.3	

Lower detection limits

Value recorded for the lower detection limit is equal to one-half the actual lower detection limit