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ONTARIO GEOLOGICAL SURVEY

Open File Report 5718

An Evaluation of the Industrial Mineral Potential of Parts of the Districts of Kenora and Rainy River

by

C.C. Storey

1990

Parts of this publication may be quoted if credit is given. It is recommended that reference to this publication be made in the following form:

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This project was funded equally by the governments of Canada and Ontario under the Northern Ontario Rural Development Agreement (NORDA).

Ontario Geological Survey

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V.G. Milne

V.G. Milne, Director
Ontario Geological Survey

FORWARD

This report presents the results of a one year preliminary field study, of Kenora and Rainy River in Northwestern Ontario, funded through the Federal-Provincial Northern Ontario Rural Development Agreement (NORDA), of industrial mineral deposits in parts of the districts. Industrial minerals are among the oldest commodities sought or produced in Northwestern Ontario. Interest in base and precious metals has overshadowed the presence of non-metallic commodities but the presence of and need for industrial mineral deposits was recognized prior to 1900. Limited exploration and development of industrial mineral commodities has taken place in the past, and the existing geological database is dispersed among a variety of published and unpublished sources. Growing interest in non-metallic mineral resources and economic diversification has led to a resurgence of interest in industrial minerals in all parts of Ontario.

Evaluation of twenty-three commodities leads to the conclusion that some industrial minerals deserve further evaluation by both government and the exploration industry. Graphite, marble for possible decorative stone uses, marl for agricultural purposes, rare element pegmatites, soapstone/talc, and titanium have the most exploration potential.

The descriptions and conclusions of this report will be of interest to the minerals industry and to prospectors considering diversification into industrial minerals exploration.

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Abstract

This report presents a partial inventory and assessment of the exploration and development potential for industrial mineral deposits (other than aggregate, building stone and peat) in parts of the Districts of Kenora and Rainy River. Historical production of industrial minerals in the area has consisted of building stone, brick clay, lime, marl, peat and soapstone; current production is limited to building stone, peat and potting soil. Representative examples of twenty-three commodities were examined (two from literature only) and conclusions about the exploration and development potential were reached. The commodities were grouped into four groups. Group A and B deposits have the most near term development potential, Group C require further research into the nature of known mineralization and geological environments and Group D have little or no potential at this time. Group A deposits include graphite, marble, marl, rare element pegmatites, soapstone/talc, and titanium titanium. Group B deposits include pegmatitic feldspar, pegmatitic mica, and mica schist. Group C deposits include barite, fluorspar, leucogranite, nepheline syenite,, quartzo-feldpathic sand, and specular hematite. Group D deposits include asbestos, carbonatite complexes, carbonate concretions, clay, diatomite, ochre, Paleozoic limestone boulders, kyanite-sillimanite-andalusite, and staurolite

AN EVALUATION OF THE INDUSTRIAL MINERAL POTENTIAL OF PARTS OF THE DISTRICTS OF KENORA AND RAINY RIVER

by

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1988

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This report is published with the permission of Ken Fenwick, Manager, Mineral Resources Program, Northwestern Ontario Region.

INTRODUCTION

This study was undertaken to evaluate a group of poorly known resources occurring in Northwestern Ontario which, if more fully developed, could help to diversify the economic base of the region. The project was funded through the Federal-Provincial Northern Ontario Rural Development Agreement (NORDA).

The project consisted of an examination of the various industrial mineral resources that occur in the western part of Northwestern Ontario. The purpose was to determine which resources have some potential for reasonably large deposits and marketable commodities. In addition to known resources, a few deposits of industrial minerals not previously recognized in this area were also examined. Several deposits representing good examples of each commodity type were selected for field examination on the basis of geology and accessibility. In several cases a commodity is represented by only one known deposit. There are other potential commodities that were not investigated including chromite, minerals recovered from gold and base metal tailings, expanding clay for use as light weight aggregate and absorbent, lapidary materials, rock and mineral collecting sites, etc.

The work presented here was carried out during the summer of 1984 and 1985 but incorporates some deposit examinations made during the building and ornamental stone inventory project (see OFR 5446 and 5522 and MDC 27). Background research commenced in 1982 and was done concurrently with research work for the building stone project.

LOCATION AND ACCESS

The area studied is shown in Figure 1; it corresponds to the Ministry of Natural Resources' Northwestern Region. Actual field work extended northward from the international boundary to the end of reasonable access roads north of Red Lake, and eastward from the Manitoba border to the limit of the Ministry of Natural Resources' Northwestern Region. It includes the legislative District of Kenora and part of the Districts of Kenora Patricia Portion, Rainy River and Thunder Bay. The area is crossed by Highways 11, 17, 71 (Trans-Canada Highway system), 72 and 105 plus several secondary highways and numerous township roads, forest access roads and logging roads. Both the Canadian Pacific and Canadian National Railways cross the area. In the past, major water transportation routes existed on all the large lakes and river systems. While water transport is still available, it is not currently used to a great extent.

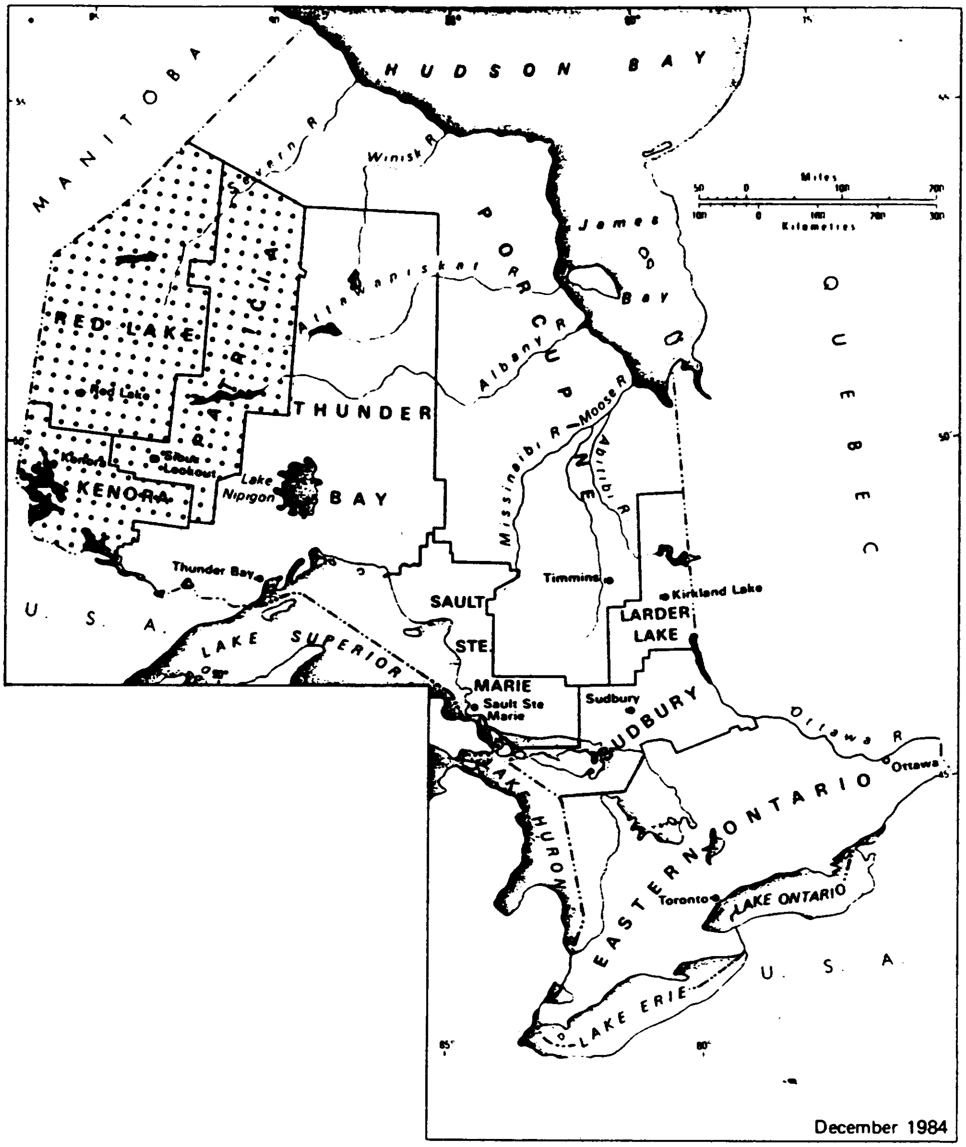


FIGURE 1. Location Map study area is shown by stipple pattern

ACKNOWLEDGMENTS

Field and office assistance was provided by R. Schienbein from June to November and S. Strachan from June to August of 1984. Discussion with Ontario Geological Survey and Regional MNDM personnel provided helpful suggestions and direction for the project. Many prospectors and property owners provided exploration ideas and information on their deposits. R. C. Beard, Mineral Development Co-ordinator (formerly Regional Mineral Resource Co-ordinator), Ministry of Northern Development and Mines, Northwestern Region, C. E. Blackburn, Kenora Resident Geologist, Ministry of Northern Development and Mines, Northwestern Region and Dr. M. A. Vos and Dr. J. Springer, Ontario Geological Survey reviewed the manuscript and provided many suggestions and recommendations.

PREVIOUS GEOLOGICAL WORK

The geology of Northwestern Ontario has been described by many authors starting in the early part of the nineteenth century with Bigsby (1852) and Owen (1852), and continuing with Bell (1873, 1886, 1887), Dawson (1875) and Lawson (1886, 1889, 1890 and 1913). Geological mapping by staff of the Geological Survey of Canada, Ontario Geological Survey (Ontario Bureau of Mines, Ontario Department of Mines), and numerous university researchers has continued to the present. Recognized industrial mineral occurrences in the areas mapped are mentioned in these reports. Reports dealing with industrial mineral commodities only include Vos et al (1982), Redden (1987), and Storey (1986). Each section of this report contains a list of literature pertaining to that commodity and each deposit description contains a complete list of literature citations pertinent to that deposit.

SOURCES OF INFORMATION

Most of the industrial mineral commodities have been described in government reports dedicated to the economic geology of that commodity. These reports describe the major deposits and commonly contain a list of recorded occurrences. Most of the industrial mineral deposits in Northwestern Ontario are classed as occurrences about which comparatively little is known. Vos et al (1982) produced a compilation of recorded industrial mineral occurrences from Assessment Files, Resident Geologist files, and various publications. Of the various industrial mineral commodities present in the area, soapstone, pegmatites and peat have been documented the most thoroughly.

The evaluation of industrial mineral resources requires information not only on the deposits themselves and their geologic environment but on uses, markets and the generally accepted specifications for the particular commodity. Often, specifications are written for material from a specific source used in an individual process. This is particularly common in the glass and ceramics industry. Many generalized specifications can be found in Knoerr (1980), Lefond (1983) and Guillet and Martin (1984) or in commodity surveys and articles published in Industrial Minerals magazine and other trade journals. Surveys of individual commodities are published from time to time by both Provincial and Federal governments.

GEOLOGICAL SETTING

Northwestern Ontario is underlain by Early Precambrian (Archean) rocks of the Superior Province and is close to the western edge of the Canadian Shield. The Superior Province has been subdivided into the English River, Quetico, Wabigoon, and Uchi Subprovinces. The Uchi and Wabigoon Subprovinces are characterized by belts of metavolcanics and metasediments intruded by gabbroic and ultramafic rocks. These belts have subsequently been deformed by tectonic events and intruded by large and small granitoid bodies of several ages. The metamorphic grade of the Uchi and Wabigoon Subprovinces varies from greenschist facies to amphibolite facies near some of the granitoid bodies. The lower grade metavolcanics and metasediments of the Wabigoon and Uchi Subprovinces frequently contain well-preserved primary textures. The Quetico Subprovince is similar in form but is primarily composed of metasediments and is of a somewhat higher metamorphic grade. The English River Subprovince is composed of highly metamorphosed metasediments and minor metavolcanics intruded by several suites of granitoid rocks particularly in the southern part. The divisions between the subprovinces are primarily stratigraphic (representing a facies change from the predominantly volcanic regimes of the Wabigoon and Uchi Subprovinces to the predominantly epiclastic regimes of the Quetico and English River Subprovinces) although they are now in part fault bounded due to tectonic overprinting (Mackasey et al 1974). Blackburn et al (1985) review the evolution of the Wabigoon Subprovince and its relationship to the adjacent subprovinces.

The youngest rocks in the area are Middle to Late Precambrian diabase dikes cross-cutting all the older rocks.

FOREST COVER AND TOPOGRAPHY

The study area forms part of two of the major forest regions of Canada - the Boreal Forest in the north and the Great Lakes - St. Lawrence Forest in the south (Rowe, 1972). The Boreal Forest is characterized by coniferous trees particularly white and black spruce, tamarack, balsam fir and jack pine plus broad leafed species (white birch, trembling aspen); the Great Lakes - St. Lawrence Region is a mixed forest characterized by white and red pine, eastern hemlock and yellow birch plus a wide variety of broad leafed species including maples, red oak, basswood and white elm. There is considerable mixing of the two forests in the transition area. The density of forest cover varies drastically depending on the soil type, drainage and recent fire and logging activity.

Large parts of the south-western English River Subprovince have 50% and greater bare rock exposure due to glaciation, fires and logging. Undergrowth includes moss and lichen covering the outcrop surface, bracken ferns and small bushes and immature trees. The surface of the bedrock has been glacially scoured; material has been eroded to various degrees depending on the resistance of the rock. The resistant rocks commonly show glacial striations on the surface. While the Canadian Shield is quite level overall the local topography can be rugged depending on rock and overburden type: local relief of 100 metres is common in the area of granitoid rocks north of Kenora. Rolling hills of bedrock separated by small lakes and muskeg-filled valleys are common. To the south and east of Kenora overburden is more prevalent and large glacio-lacustrine clay deposits (at Dryden and in the Fort Frances-Emo area) left from former glacial Lake Agassiz and abundant glacio-fluvial debris obscure much of the bedrock. Rock exposures in these areas vary from very sparse at Emo to abundant in areas south of Dryden, not inundated by the lake or washed clean by wave action. Surficial geology of Northwestern Ontario south of 51° 00' has been outlined by Zoltai (1965) and interpretations of the deposits, their extent and thickness can be found in the NOEGTS series of reports (see Gartner et al (1981)).

HISTORY OF INDUSTRIAL MINERALS

The first minerals to be exploited in Northwestern Ontario would today be called industrial minerals. The early Indian cultures used rhyolite for arrowheads and spear points, soapstone for carving, clay for pots and ochre for paints. Goods were traded among the various Indian bands along the Rainy River system and into present day Minnesota. The sites where they obtained these minerals are rarely recorded but artifacts found in Indian graves and at encampment sites indicate both use of local materials and trade to obtain materials not available locally.

The modern period of mineral investigation and exploitation dates from the mid-nineteenth century. Settlement of the area, the opening of the Lake of the Woods gold camp and construction of the Canadian Pacific Railway created a need for structural materials and refractory minerals.

Interest in non-metallic commodities in the nineteenth century was noted by Lawson (1886, 1889, 1913) who documented building stone, soapstone, mica, lime and clay deposits. In addition to dimension and crushed stone currently produced, lime for agricultural and gold milling use, pegmatite minerals, soapstone, clay for brick and tile, and peat have been produced at one time or another. Lime was produced from Paleozoic limestone boulders at Fort Frances in the 1890's and from Early Precambrian limestone at Red Lake in 1939. Both these operations were short lived. More recently (1970's) marl from Surprise Lake north of Ignace has been extracted for use in agricultural soil conditioning. Pegmatites have been investigated for mica, feldspar, beryl, lithium and tantalum since 1885. Small amounts of mica and feldspar were produced in 1923 from a pegmatite in Lake of the Woods. Many lithium pegmatites were examined near Dryden and in the Root Lake area north of Sioux Lookout in the 1950's. Pegmatites near Dryden were examined for tantalum in 1979 and 1980.

Soapstone deposits were extensively prospected and three were put into production between 1915 and 1927. The material was used for refractory purposes (gasburner tips and furnace linings) but often proved unsatisfactory. Interest in soapstone since 1927 has largely been directed at carving material for decorative and ceremonial objects. The old Wabigoon Soapstone Company was reactivated recently as Wabigoon Resources Ltd.; in the fall of 1983, the company re-evaluated the Wabigoon soapstone deposit for its talc and soapstone potential. Asbestos is formed by similar processes to soapstone and occurs in a similar geological environment. One asbestos deposit, north of Red Lake, was examined by Conwest Exploration Company Limited in 1976.

At least four brickyards have been in production, two at Kenora and one each at Dryden and Fort Frances. The most successful of these, the Brinkman Brickyard at Kenora (also known as the Western Algoma Brickyard) produced bricks during the 1890's and again during the 1920's to as late as 1929.

Peat has been produced intermittently in the Emo area since 1942. During 1985 Arctic Peat Moss Ltd. of Barwick produced a small amount of peat from a bog in Carpenter Township north of Emo and in 1984 Du-Nor Products Ltd. was preparing to produce potting soil from a peat bog near Fort Frances. Nu-Terra Ltd. of Kenora produces soil for landscaping and other horticultural uses from a peat bog near Kenora; some sand and gravel producers and excavating contractors quarry small amounts of peaty or organic rich soil for local uses from time to time as required.
Fluorite, graphite, quartz-feldspar sand and nepheline deposits have been staked and given rudimentary examination by prospectors.

COMMODITIES STUDIED

Seven commodities or commodity groups were selected for initial study; with the exception of graphite and soapstone, each of these commodity groups comprises several distinct deposit types each with its own production and marketability potential. Several other commodities about which (in most cases) little is known were grouped together as miscellaneous commodities. All groups are listed below:

Carbonate Materials	- Carbonate Concretions - Marble - Marl - Paleozoic Limestone
Ceramic Materials	- Clay - Feldspar - Granite - Sand
Graphite	
Mica	- Pegmatite - Schist
Pegmatite Minerals	- Beryl, Cesium, Feldspar, Mica, Lithium, Tantalum
Pigments	- Ochre - Specular Hematite - Titanium
Soapstone/Talc	
Miscellaneous Commodities	- Barite - Diatomite - Fluorite - Nepheline Syenite and Alkalic Complexes - Kyanite-Sillimanite - Staurolite

METHODOLOGY

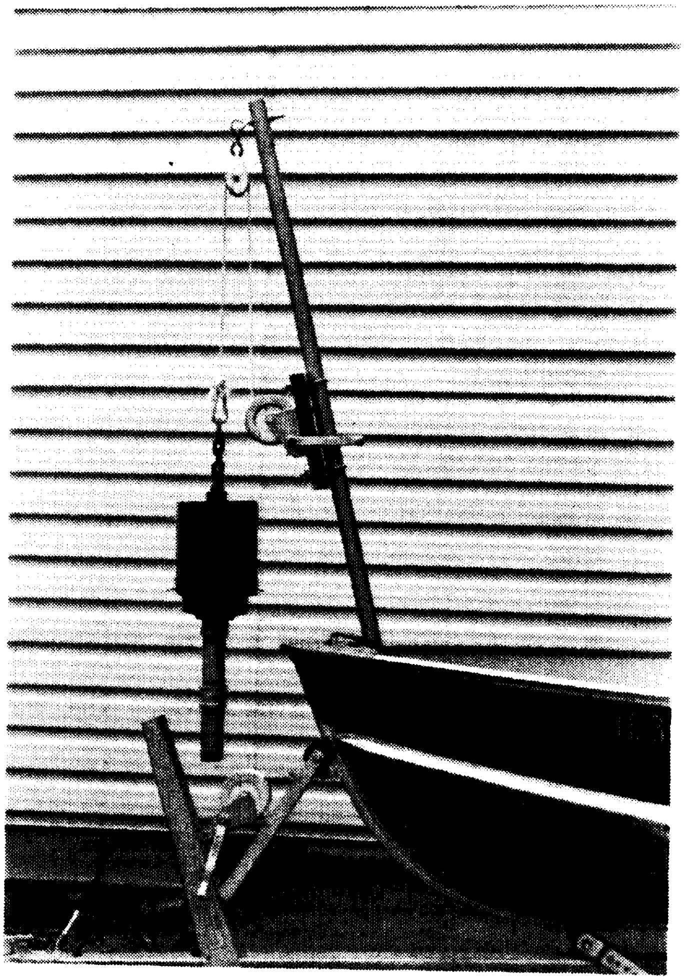
The project commenced with a review of the literature to find all references to industrial mineral deposits and any descriptions of rock types which may have industrial minerals potential. Resources that seemed to have potential were selected and representative deposits were examined in the field to determine the environment of mineralization and the potential of those deposits.

Deposits selected for examination were located in the field using aerial photographs or 1:50,000 NTS maps. The location information is included with the deposit description. Special equipment had to be obtained for some types of sampling.

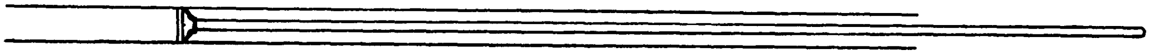
LAKE SEDIMENT SAMPLING

Lake sediments were sampled during marl deposit studies and reconnaissance work on diatom deposits. The samples were removed from the sampler and placed in glass mason jars to prevent water loss. Water contents were determined for most of the samples and some were dryed for further analytical work.

Marl and diatomite occur on lake bottoms or shallow swamps and can best be sampled with some form of remote sampling device either from a boat or through the ice in winter. Lake sediment samples were taken with a piston sampler for use in shallow water and a bomb sampler for use in water up to 12 m deep. Both recover a 5 cm core. The samplers are



Bomb sampler mounted on a small boat.



Piston sampler

FIGURE 2. Lake sediment samplers

illustrated in Fig 2. The bomb, designed after a sampling bomb used by M. Hailstone (Stff Geologist, MNDM, Kenora) during uranium exploration in the Northwest Territories, comprises two units - the sampling bomb with a detachable core barrel and a winch and boom unit mounted in a small boat. The bomb weighs 14 kg without the core barrel; the barrel used most frequently weighs 2.1 kg. With this device, core samples 15 cm long could be obtained from firm marl and some clay lake beds; soft organic sediments were penetrated to beyond the complete length of the device, a minimum of one metre.

In use, the bomb was suspended from a 6 mm nylon rope attached to a hand cranked winch mounted on a steel pipe boom. The boom was mounted in the bow of a small boat. A sample site was selected and the boat anchored with the stern into the wind (satisfactory sampling could only be done in relatively calm water) to prevent the sampler from fouling the anchor line and interferring with the outboard motor. Sufficient rope was unspooled from the winch to allow the bomb to reach the bottom; the bomb was pulled to its maximum height above the water and released to fall to the bottom. The bomb was retrieved and the core recovered. This system does not allow re-coring the same hole or determination of the depth of sediment. Water depth was determined with a lead line. The core sample obtained was relatively undisturbed in the case of firm sediment but highly disturbed in the case of soft organic sediment with a high water content. The device could sample sand and fine gravel (most material sand size and no pebbles larger than 1 cm diameter) to a depth of 2 to 5 cm.

LABORATORY WORK

Laboratory work was done by the Geoscience Laboratories, Ontario Geological Survey. This consisted of X-ray diffraction mineralogy of various rocks, most of them soapstone or talcose rocks, identification of minerals, major and trace element analyses of marbles, thirty-element spectrographic analyses and trace element including gold geochemical analyses of selected samples plus grain size determinations and brightness tests*. The results are presented with the pertinent deposit description. Major elements
SiO_2, Al_2O_3, FeO, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO, CO_2 and S were determined by X-ray fluorescence; Ba, Co, Cr, Cu, Li, Ni, Pb, Zn were determined by atomic absorption; Be, Sc, Nb, Mo, V, Sr, Y, Zr were determined by inductively coupled optical emission spectrometry; Ce, Nd, Cs, Rb, Ta were determined by X-ray fluorescence.

Grain size of samples was determined using ISO standard sieves or volumetric apparatus. Brightness was determined by the method described in Storey and Vos (1981).

Water content was determined for lake sediment samples by the method described by Lambe (1951). This gives the water content as the ratio of weight of water to weight of solid material (dry soil) in the sample and is referred to as the engineering water content. Water content is also expressed as weight per cent water in the original (wet) sample. Samples were air dried until no further weight change was noted.

* Detection limits, symbols, and elements tested for by qualitative spectrographic analysis are listed in Table 1.

TABLE 1. Trace element detection limits

Barium (Ba) - 10ppm
Cobalt (Co) - 5ppm
Chromium (Cr) - 10ppm
Copper (Cu) - 5ppm
Lithium (Li) - 3ppm
Nickel (Ni) - 5ppm
Lead (Pb) - 10ppm
Zinc (Zn) - 10ppm
Beryllium (Be) - 1ppm
Scandium (Sc) - 2ppm
Niobium (Nb) - 5ppm
Molybdenum (Mo) - 10ppm
Vanadium (V) - 5ppm
Strontium (Sr) - 5ppm
Yttrium (Y) - 5ppm
Zirconium (Zr) - 5ppm
Cerium (Ce) - 35ppm
Neodynuim (Nd) - 20ppm
Cesium (Cs) - 3ppm
Rubidium (Rb) - 5ppm
Tantalum (Ta) - 10ppm

X-ray Diffraction Mineralogy

The letters indicate an estimate of quantity present
A major, B moderate, C minor, + more, - less, - - not detected by X-ray, ? uncertainty of identification.

Qualitative spectrographic analysis (30 elements)

Element

Antimony
Arsenic
Beryllium
Bismuth
Cadmium
Cerium
Chromium
Cobalt
Copper
Germanium
Lead
Lithium
Manganese
Mercury
Molybdenum
Nickel
Niobium
Silver
Tantalum
Tellurium
Thorium
Tin
Titanium
Tungsten
Uranium
Vanadium
Yttrium
Zinc
Zirconium
Iron

Key to Symbols:

H - 10 to 100%
MH - 5 to 15%
M - 1 to 10%
LM - 0.5 to 5.0%
L - 0.1 to 1.0%
TL - 0.05 to 0.5%
T - 0.01 to 0.10%
- - None detected (or less than 0.10%)

CARBONATE MATERIALS

Four types of carbonate material are present in the area: carbonate concretions, marble (crystalline limestone and carbonate veins), marl, and Paleozoic limestone boulders. Deposits of each, except carbonate concretions, have been exploited at one time or another.

Several crystalline carbonate rocks and Paleozoic limestone occurrences have been described by Goudge (1938) and Miller (1904); Storey (1984) described marble occurrences at Red Lake and Woman Lake; other occurrences have been mentioned in various geological reports. Carbonate rocks are not widely distributed. Early Precambrian limestone is most abundant in the Uchi Subprovince. Marl is known in at least five occurrences but only one, Surprise Lake, has been previously described (Speed et al, 1985). Carbonate concretions are mentioned by Satterly (1943a). They are not known to have been used for any purpose. Paleozoic limestone is a common constituent of glacial till particularly in the southwestern Lake of the Woods and Rainy River areas.

In addition to use as building and ornamental stone, carbonate rocks are used as a source for mineral filler in rubber, paint, paper and plastic products, as raw materials for lime and cement production, when converted to lime as part of the chemical requirements for pulp making, as part of glass batch mixtures and as an agricultural soil conditioning agent. Carbonate rocks for the cement, glass and paper industries are usually obtained in large tonnages from Paleozoic limestone deposits. Suitable resources are not known to be present in the study area.

In Northwestern Ontario, carbonate rocks and unconsolidated materials have been used as a source of lime and to condition soil. Lime was produced near Fort Frances from Paleozoic limestone boulders (Lawson 1913, Goudge, 1938) and at Red Lake from Early Precambrian limestone (Horwood 1945), and soil conditioning material on a trial basis from a marl deposit north of Ignace.

CALCIUM CARBONATE EQUIVALENT (CCE)

In agriculture the CCE is the neutralizing value of limestone or other carbonate material compared to that of pure calcite. This number is used to determine which limestone would be most effective to neutralize acidic soil or water. Pure $CaCO_3$ is assigned a CCE value of 100. Pure dolomite has a CCE of 108.6 (Carr and Rooney, 1983). Carbonate minerals can contain $MgCO_3$ and in some cases $FeCO_3$ in addition to $CaCO_3$. One mole of each of the three is considered to have the same neutralizing value but $MgCO_3$ and $FeCO_3$ are much slower dissolving and would take longer to neutralize a given amount of acid. Major element chemical analyses give the composition of the rock as oxides: in the case of CaO and MgO these must be converted to carbonate to obtain the CCE ($CaCO_3 = 1.78 \times CaO$; $MgCO_3 = 2.09 \times MgO$). This assumes that all CaO and MgO in the analysis is present as carbonate minerals; any present in non-carbonate minerals cannot be distinguished from that of the carbonate minerals. In the case of marl, unmetamorphosed limestones and vein carbonates, this is a reasonable assumption but metamorphosed limestones (marble) can have a significant portion of their

CaO and MgO as insoluble calc-silicate minerals. Iron can be present as $FeCO_3$ particularly in dolomitic limestones but it is also present as part of the non-carbonate mineral fraction. Since it is present in small amounts (usually less than 1%) and probably only part of this is $FeCO_3$, iron oxide was not converted to $FeCO_3$ and was not considered in CCE determinations. $FeCO_3$ would be significant in determining the CCE of a rock containing large amounts of ferroan dolomite or ankerite.

The calculation of CCE from the analytical data is not affected by the presence of insoluble material unless that material contains a significant amount of CaO and MgO (several percent). In true or effective CCE determinations for marble the presence and composition of insoluble residue must be considered if the residue is more than a few percent. Carbonate materials used for soil conditioning are not beneficiated other than by air drying before use; i.e. any non-carbonate minerals, organic material, water, etc are spread along with the carbonate. Marl contains a large amount of water and this reduces the CCE of a given weight of the wet material to about half the value obtained from chemical analysis. The effective CCE of a unit weight of marl will increase as the water content decreases.

A formula for calculating theoretical CCE is:

$$CCE = CaCO_3 + 1.086\ MgCO_3$$

or

$$(1.78CaO) + 1.086\ (2.09MgO)$$

A formula for calculating the true or effective CCE of a given weight of material is shown below for carbonate sediment containing water or a rock with some acid insoluble material that contains CaO and/or MgO:

$$\text{True CCE} = [1.78(CaO - NCC) + 1.086(2.09(MgO - NCM))] \cdot (1-wc)$$

where: CaO is in weight%

MgO is in weight%

NCC is weight% CaO in non-carbonate minerals

NCM is weight% MgO in non-carbonate minerals

(NCC and NCM can be determined by petrographic examination to identify and quantify the minerals present)

wc is the % water content of the material at the time it is used.

In limestones other than marble NCC and NCM can be considered to be 0 and in carbonate rocks other than marl wc is 0.

Rounding of the atomic weights used in determining the conversion factors and rounding of the factors themselves introduce slight variations in the CCE values calculated by the various formulae above.

CARBONATE CONCRETIONS

Carbonate concretions are common in varved clays of Glacial Lake Agassiz in the Dryden area. Concretions are well exposed on the shores of Wabigoon, Eagle and Dinorwic Lakes but are common throughout the clay. The concretions are light gray-brown, very fine-grained masses up to several centimetres wide and 1 cm thick. They occur in layers in the clay and form lag deposits anywhere the clay is actively being eroded. Concretions form up to 5 percent (estimate) of the clay but do not seem to be uniformly distributed. Table 2 contains major and trace element analyses of some of these concretions from the Kawashegamuk Lake area. The CaO:MgO ratio of this sample is 20.3 making it a dolomitic limestone; the theoretical CCE is 71.8 (average of two determinations).

There seem to be abundant amounts of concretions available over a large part of the Dryden-Wabigoon area. Dissolution of the concretions will act to modify acid soil and groundwater. The most reasonable method of 'mining' them would be hand picking from some of the beach deposits. While there has been no reported use of these materials they may have some potential for artistic or novelty use.

Table 2. Major and trace element analyses for carbonate concretions and lime from the Hahn Lake deposit.

Major Elements (%)					Trace Elements		
	83-223	83-223D*	No. 1 (buff)	No. 2 (black)		83-223	83-223D*
SiO_2	13.60	13.50	1.27	1.53	Ba	270	280
Al_2O_3	3.62	3.64	-	-	Co	5	5
Fe_2O_3	1.30	1.30	1.20	5.53	Cr	40	39
MgO	1.86	1.87	0.61	0.58	Cu	29	29
$MgCO_3$	3.89	3.9			Li	10	10
CaO	37.90	38.00	90.50	87.04	Ni	12	11
$CaCO_3$	67.46	67.64			Pb	85	85
Na_2O	0.67	0.69			Zn	36	37
K_2O	0.64	0.64			Au	5ppb	-
TiO_2	0.09	0.08			Ag	2	2
P_2O_5	0.02	0.02					
MnO	0.01	0.01	1.13	1.40			
CO_2	36.2	36.5					
S	0	0					
LOI	36.3	36.4	4.98	2.59			
TOTAL	98.40	98.90					
CCE	71.68	71.87					

$CaCO_3$ and $MgCO_3$ are calculated values and are not part of the analysis total.

83-223 sample of carbonate concretions
No. 1 Quicklime produced from the Hahn Lake deposit
No. 2 Quicklime produced from the Hahn Lake deposit
* replicate analysis

MARBLE

Several of the marble occurrences in Northwestern Ontario have been described by Storey (1984). The commercial term marble includes carbonate rocks of various types including crystalline limestone and some Paleozoic limestones plus non-carbonate rock types such as serpentinite used as Verde Antique marble (see glossary). In this report, the term is restricted to two types of crystalline carbonate rocks: recrystallized Early Precambrian limestone and quartz-carbonate veins. For a further discussion of marble see Storey and Vos (1981) and Storey (1984).

Large units of carbonate metasediments are found in the Red Lake and Confederation Lake areas. These rocks contain variable amounts of carbonate minerals with accessory quartz, chlorite, mica, amphibole and in some cases traces of sulphide minerals. Intercalated units of siliceous material and clastic metasediments support a sedimentary origin for the carbonate units. The carbonate units at Red Lake and Confederation Lake were deposited as stromatolitic limestone (Wallace, 1980, Thurston, 1982). The origin of some of the other carbonate metasediments is undetermined. Metamorphism of carbonate sediments produces crystalline limestone by recrystallization of the carbonate minerals. With increasing degree of metamorphism the grainsize of the carbonate minerals increases and, in an impure limestone, reactions between the various components take place as described by Winkler (1979). The final product of metamorphism of an impure limestone is a calc-silicate gneiss.

Quartz-carbonate veins of hydrothermal origin are commonly associated with gold occurrences. They tend to be small and variable in composition particularly with respect to quartz content. The carbonate can be calcite, dolomite, ankerite or any mixture thereof. Carbonate veins may show several generations of vein material including both carbonate minerals and quartz. The veins frequently weather to a rusty brown colour due to decomposition of the ankerite.

The carbonate rocks, whether metasediments or vein deposits, are typically variable in colour and texture but are generally light coloured (white, grey, buff, etc.). The carbonate metasediments show the convoluted layering frequently found in commercial marbles. Only one deposit, an Early Precambrian metasediment at Hahn Lake, has been developed commercially. It was quarried briefly during the late 1930's to provide lime for the Red Lake gold mills. The known carbonate metasediments are either narrow units of restricted exposure or (as in the Uchi Subprovince) in remote locations. While satisfactory as a source of lime (in 1938) the rock probably has a greater potential as decorative stone. The analyses in Table 2 are of lime produced at Hahn Lake in 1939 (from Horwood, 1945). Analyses of crystalline limestone and carbonate veins have been published by Goudge (1938) and Storey (1984).

MARL

Marl is calcium carbonate sediment deposited through organic or chemical activity in fresh water. The material is unconsolidated and may also contain plant and animal detritus, diatoms and clastic siliceous sediment. Groundwater leaches $CaCO_3$ either from bedrock or overburden material and carries it as $Ca(HCO_3)_2$. $Ca(HCO_3)_2$ is kept in solution by an excess of CO_2; if this CO_2 is lost, $CaCO_3$ is precipitated according to the reaction $Ca(HCO_3)_2 = CO_2+CaCO_3+H_2$. When groundwater seeps into a lake, loss of CO_2 is caused by photosynthesis, the conversion of CO_2 into organic carbohydrates by plants and algae, temperature stratification, agitation and physico-chemical conditions present in the lake (pH, presence of other anions) and composition of other water inputs. Loss of CO_2 is the major cause of $CaCO_3$ precipitation. Green and particularly blue-green algae (Class Cyanophyceae, Division Schizophyta) are most important in marl deposition. The algae are frequently covered with calcium carbonate which precipitates immediately when CO_2 is removed from the water. Mollusc shell fragments are present in most marl deposits but are not a major source of $CaCO_3$.

Marl deposits in Ontario have been described by Guillet (1969) and Speed et al (1985). The uses of marl are briefly outlined by Guillet (1969), MacDonald (1984) and Schwartz (1959). From 1889 to 1919, marl was used extensively in the Portland Cement industry in Southern Ontario and was used for this purpose as recently as 1980 in one plant in Alberta (MacDonald 1984). Marl of an exceptionally white colour was used as paper filler during World War II, when imported whiting (fine ground $CaCO_3$) was not available: A few marl deposits were investigated during the 1950's and 60's as sources of lime. The major present day use of marl is treating acid agricultural land. This use has been investigated extensively in Minnesota (Schwartz 1959) and small amounts of marl are sold for liming purposes in Alberta (MacDonald 1984). Recent tests by the Ontario Ministry of Agriculture and Food and local farmers in the Dryden area of Northwestern Ontario indicate that the use of marl as a soil liming agent has a favourable effect on crop growth (E. Lick, Ministry of Agriculture and Food, Dryden, personal communication, 1984).

Marl was extracted from a shallow bay in Surprise Lake north of Ignace during the 1970's and used to condition potting soil and farmland near Dryden. Thw marl is found as two types of occurrences - lake deposits and bog deposits. The mechanism of formation is the same in either case. Lake deposits have a layer of marl on the bottom which is probably still being added to. Lake deposits are common in Southern Ontario. Bog deposits have a layer of marl covered by peat and in some cases small area of open water - these are common in Minnesota (Schwartz 1959). Bog deposits indicate increased plant growth eventually filling the lake, stopping marl deposition and allowing the formation of peat.

Marl is deposited on top of mineral soil; it may be overlain by clastic sediment or peat. Marl units can be several metres in thickness. The lake must be deep enough to prevent extensive growth of aquatic plants or large amounts of organic material will be incorporated with the marl. Marl may have organic rich layers or clastic rich layers intercalated due to fluctuations in water level or sediment input to the lake. In addition to marl, which is deposited in water only, carbonate rich water discharged onto the surface of the ground will also deposit calcium carbonate but usually in smaller amounts; this material is referred to as tufa. Prospecting guidelines for marl in Minnesota have been outlined by

Theil (1933) (reprinted in Schwartz (1959)) and are reproduced below:

> No fixed rules can be formulated to guide the prospector to the discovery of marl, but a summary of a few of the characteristic relationships between marl and its surroundings may prove useful.
>
> 1. Marl is formed either by precipitation from solution or through the activity of aquatic organisms. It is found, therefore, only in places that were once or are still covered with water. It is not necessarily confined to the immediate vicinity of present existing bodies of water, for the general water level has fallen, and many former shallow lake basins, covering thousands of acres, are now drained and dry land.
> 2. In basins where the water level was lowered rather rapidly, the marl may be exposed at the surface with very little if any muck or peat as an overburden.
> 3. In partially drained marshes and bogs the marl is found below a layer of peat that varies from 1 to 20 feet (0.3 to 6.1 m) in thickness.
> 4. Marl is most commonly found under the type of peat which develops around lakes and ponds. It is either sedge-grass peat or pond peat composed of the remains of plants such as reed grass, cat-tails, bulrushes, and grasses.
> 5. Very little marl has been found in the extensive basins covered with sphagnum moss. Most of these so-called "muskegs" or swamps represent built-up peat deposits on flat and poorly drained areas that were not covered with water sufficiently long for marl to accumulate.
> 6. Marl is found in or around hard-water lakes. It is the presence of calcium bicarbonate that gives water the property usually known as

temporary hardness. If the lake water is soft, the calcium carbonate content is so low that no marl deposits are formed.

7. Hard-water springs around the margins of a lake basin or on the floor of the basin may have marl deposited near the mouth of the spring.

8. In a chain of lakes, marl is more commonly found in the lakes toward the head of the chain. Where all the lakes in the chain are bordered by high morainic hills, this criterion is of little value.

9. In or around a large lake the most marl is usually found in abandoned embayments or indentations of the shore line. Open beaches and banks of wave-swept drift rarely have marl associated with their sediments.

10. More marl is found in the basins in regions where the glacial drift is composed of open-textured gravels and sands than where impervious clayey tills cover the surface. This is true even if the lime carbonate content of the clay is higher than that of the sands.

11. More marl has been deposited in lakes among morainic hills than in lake basins in flat areas. This is true of any type of drift. Of two glacial basins with similar drift, the one with the greater thickness of glacial drift above its water level will contain the most marl.

Most marl is deposited in clear water due to the requirement of sunlight for photosynthesis. The lakes are usually blue or blue green from the colour of the algae. Sunlight is required for biological deposition of marl but physico-chemical deposition could carry on in complete darkness.

The marl deposit at Surprise Lake is well known; it is the only one that has been evaluated. There are reports of other marl lakes and marl in peat bogs but little is known of them. Early geological work (Bell 1873 and Lawson 1889) mentioned marl in the Rainy River area but did not specify whether this is true marl or calcareous clay. Table 3 lists the recorded marl occurrences.

Uses and Exploration Potential

The main current use for marl is in agricultural soil conditioning in areas that do not have low cost limestone available. Marl has the advantage that it is already finely divided, can be handled with simple equipment and does not require any further processing once it is quarried. Other uses of marl are limited by its fine grain size, low brightness and high water content. The potential for additional marl deposits is good. The exploration guidelines published by Theil (1933) indicate that marl exploration should be directed toward areas of coarse, open textured soils and high relief (the same setting as the Surprise Lake deposit). Marl composition can vary drastically from deposit to deposit in both water content and chemistry.

Marl has been used as filler, cement raw material and as an additive to livestock feed. The high water content increases the cost of handling and transportation and decreases the available calcium carbonate in the material unless the marl is dried before use. Figure 3 is a plot of water content vs weight per unit volume after Guillet (1969). Major element analyses for samples collected in the present study are given in Table 4, and other data for the same samples in Table 5.

Table 3. Marl occurrences

MA1	Finland Bog	52C/13NW	Northland Associates Ltd. (1984)
MA2	Surprise Lake	52G/11NE	Speed et al (1985)
MA3	Yum Yum Point/ Helldiver Bay	52E/10SW	Chambers (1962)
MA4	Nu-Terra	52E/16SW	R. C. Beard (personal communication, 1984)
MA5	Shoal Lake	52E/11NE	Chambers (1962)

MA4 and MA5 were not examined in the present study.

Samples in Tables 4 and 5

103	Surprise Lake from Speed et al (1985)
104	" " " "
187	" " " "
84-0082	Yum Yum Point
84-0084	" "
84-0131	Surprise Lake
84-0133	" "
84-0136	" "
84D0082	Yum Yum Point
F-14-81	Surprise Lake from Speed et al (1985)

MAJOR ELEMENT ANALYSES

SAMPLE	SiO_2	Al_2O_3	Fe_2O_3	MgO	CAO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	CO_2	S	LOI	TOTAL
103	0.00	0.00	0.00	0.75	55.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.30	98.52
104	0.00	0.00	0.00	1.06	33.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.10	65.96
187	5.41	1.19	0.14	1.00	46.00	0.26	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84-0082	27.60	6.00	1.90	1.58	21.80	0.53	1.01	0.20	0.06	0.07	49.70	0.38	36.20	97.00
84-0084	27.00	2.64	1.29	0.64	24.70	0.17	0.42	0.13	0.15	0.05	77.30	0.54	54.50	101.70
84-0131	0.43	0.15	0.14	0.40	53.70	0.00	0.02	0.00	0.01	0.05	47.60	0.09	45.40	100.30
84-0133	1.45	0.30	0.13	0.57	53.00	0.00	0.03	0.00	0.00	0.04	46.20	0.00	44.00	99.50
84-0136	1.64	0.41	0.20	0.44	53.00	0.00	0.04	0.01	0.00	0.06	45.20	0.04	43.60	99.40
84D0082	27.30	6.08	1.83	1.66	21.90	0.53	1.02	0.20	0.06	0.06	49.60	0.41	36.10	96.70
F-14-81	2.29	0.66	0.16	0.84	52.06	0.00	0.00	0.00	0.00	0.00	0.00	0.02	43.50	99.53

TRACE ELEMENT ANALYSES

SAMPLE	Ba	Co	Cr	Cu	Li	Ni	Pb	Zn
84-0082	370	5	46	23	16	18	10	66
84-0084	0	5	22	26	0	14	13	1100
84-0131	190	5	5	11	3	5	10	20
84-0133	250	5	5	10	3	5	10	19
84-0136	210	5	9	10	3	5	10	18
84D0082	360	5	46	24	16	19	10	67

Table 4. Major and trace element analyses of Marl samples.

Table 5. Other marl information

Sample	CaO/MgO	Theoretical CCE	True CCE	Weight % Water	Engineering Water Content	Acid Insol.	Brightness
103	77.08	100.4					
104	31.89	62.56					
187	46.00	84.15					
84-0082	13.80	42.38	10.08	76.2	3.2	34.4%	
84-0084	38.59	45.35				20.6%	
84-0131	134.25	96.17	40.39	58.0	1.38	1.24%	
84-0133	92.98	96.47	46.02	52.3	1.1	2.92%	
84-0136	120.45	95.99	62.01	35.4	0.55	3.40%	48.2%
84D0082	13.19	45.2					
F-14-81	61.98	95.79					

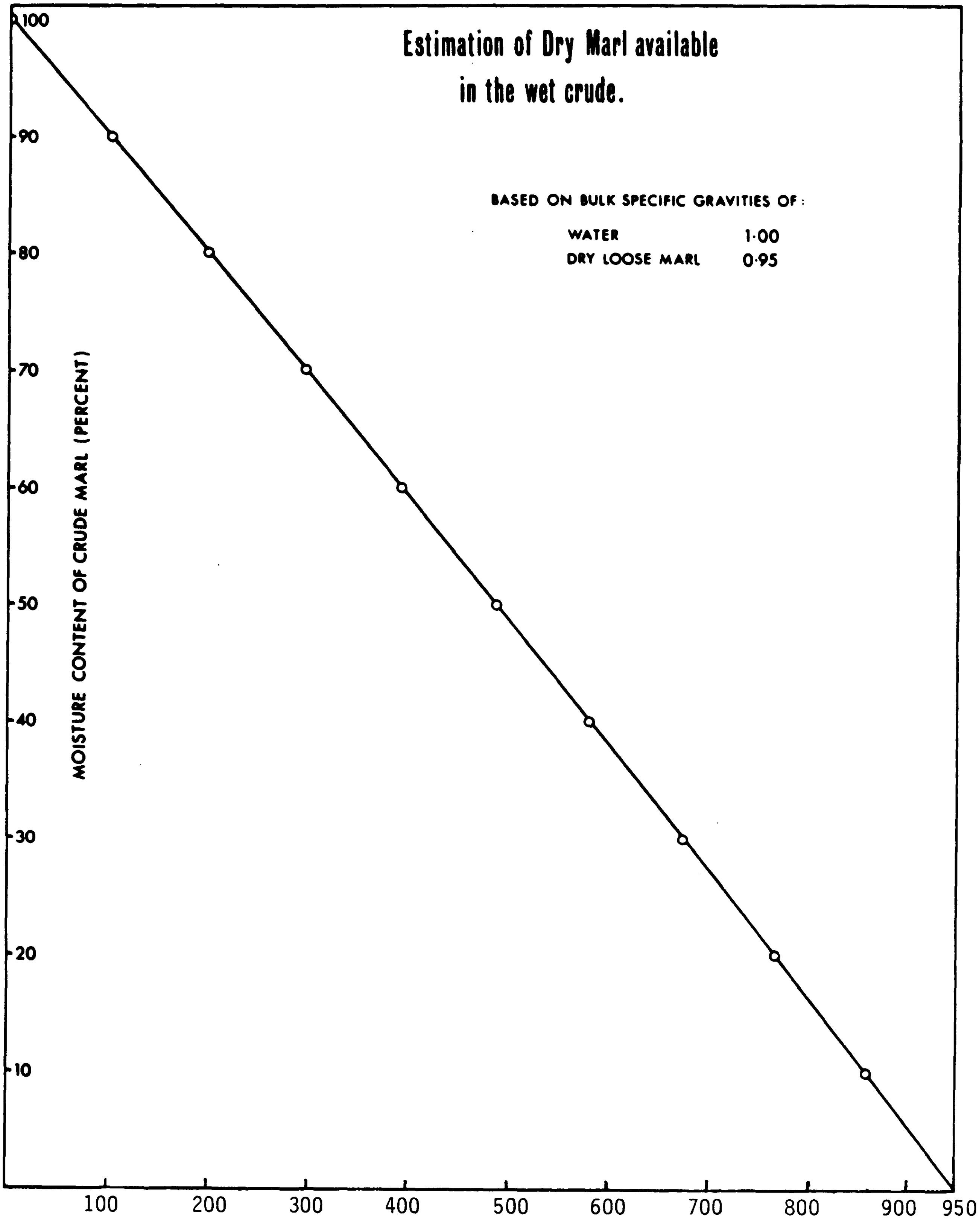


FIGURE 3. Marl content vs water content After Guillet (1969)

MR 1 FINLAND BOG

COMMODITY:	Marl
STATUS:	Occurrence
LOCATION:	NTS 52C/13 NW, Potts Township, District of Rainy River.
DESCRIPTION:	This deposit was not examined but core samples obtained during a peat inventory program contained marl below 3 metres of peat.
REFERENCES:	NTS Map 52C/13 Northland Associates Ltd. 1984: Peat and Peatland Evaluation of the Rainy River Area; Ontario Geological Survey Open File Report 5489, 9 volumes, numerous tables, figures and maps.

MR 2 Surprise Lake

COMMODITY: Marl

STATUS: Prospect/Past Producer

LOCATION: NTS 52G/11 NE, District of Kenora
49°44'34" North Latitude 91°10'53" West Longitude
UTM Grid 631000 mE, 5511450 mN Zone 15.
The quarry site (sample 84-136) was used as a location point.

ACCESS: The deposit is reached by a road that extends eastward from Highway 599 at a point 1.4 km south of the CNR crossing.

DESCRIPTION: Geological Setting: The area is underlain by granitoid rocks. The overburden in the area of the lake is a glacio-fluvial esker kame complex.

Previous Geological Work: The adjacent areas have been mapped by Trowell (1970, 1974). The overburden has been mapped by Zoltai (1965) and Mollard and Mollard (1980). The deposit has been described by Speed et al (1985).

Geology: The lake is in the centre of an esker complex. The water is dark coloured and the level has recently been raised by a beaver dam at the outlet into Crystal Lake. The southern part of the lake is underlain in part by marl (Fig. 4). Marl may also underlie other parts of the lake but this was not confirmed. The shores of the lake are steep and the lake itself is quite deep (a depth of greater than 12 m was measured in the centre of the south part). The marl is creamy white in colour and firm but thixotropic when wet. It dries to a hard white powder. Work by Speed indicates a thickness of 0.9 to 1.3 m. The marl is underlain by sand and overlain in places by gravel and/or organic sediment. Reconnaissance examination of adjacent lakes in the stream system (Crystal Lake and McLauren Lake) did not indicate marl deposits although sediment from the stream inlet to Crystal Lake did have a small carbonate content.

Chemistry: Major and trace element analyses are found in Table 4 and all other data in Table 5. The material has a limestone composition. A sample was submitted for X-ray diffraction mineralogy and found to be calcite with a trace amount of quartz - no aragonite was identified. Microscopic examination of the marl showed the sediment to be composed of subrounded grains of calcium carbonate (micrite). No identifiable fossils were seen in the samples examined. The brightness of this material is 48.2 percent due to a high content of organic material in the sample. Trace elements are at or near the analytical detection limit with the exception of barium. The grain size of the sample is very fine (silt size): 98 percent passes a 120 mesh screen. The rest of the results are in Table 6.

TABLE 6. Grain size of a sample of marl from the production site

MESH	% PASSING
10	100.0
20	100.0
40	99.8
60	99.4
120	98.0
230	94.2
0.027	79.4
0.017	74.5
0.010	67.6
0.0076	60.8
0.0055	52.9
0.0030	32.3
0.0013	12.7

ISO Standard Sieve Sizes

HISTORY: The deposit was quarried by Du-Nor Products of Sioux Lookout to obtain material to mix with potting soil and to apply to farmland in an experimental soil conditioning program.

REFERENCES: NTS Map 52G/11

Mollard, D. G. and Mollard, J. D.
1980: Press Lake Area (NTS52G/NW), District of Kenora; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 23, 26p. Accompanied by Maps 5062 and 5066, scale 1:1 000 000

Speed, A. A., Mason, J. K. and Vos, M. A.
1985: Lime Resources of the Thunder Bay Area; Ontario Geological Survey, Open File Report 5566, 173 p 25 figures, 4 tables, 1 map and 1 appendix.

Trowell N. F.
1970: Geology of the Watcomb Area; Ontario Department of Mines and Northern Affairs Geological Report 88

1974: Geology of the Bell Lake-Sturgeon Lake Area, Districts of Kenora and Thunder Bay; Ontario Div. Mines, GR114,67p. Accompanied by Maps 2268 and 2269, scale 1 inch to 1/2 mile.

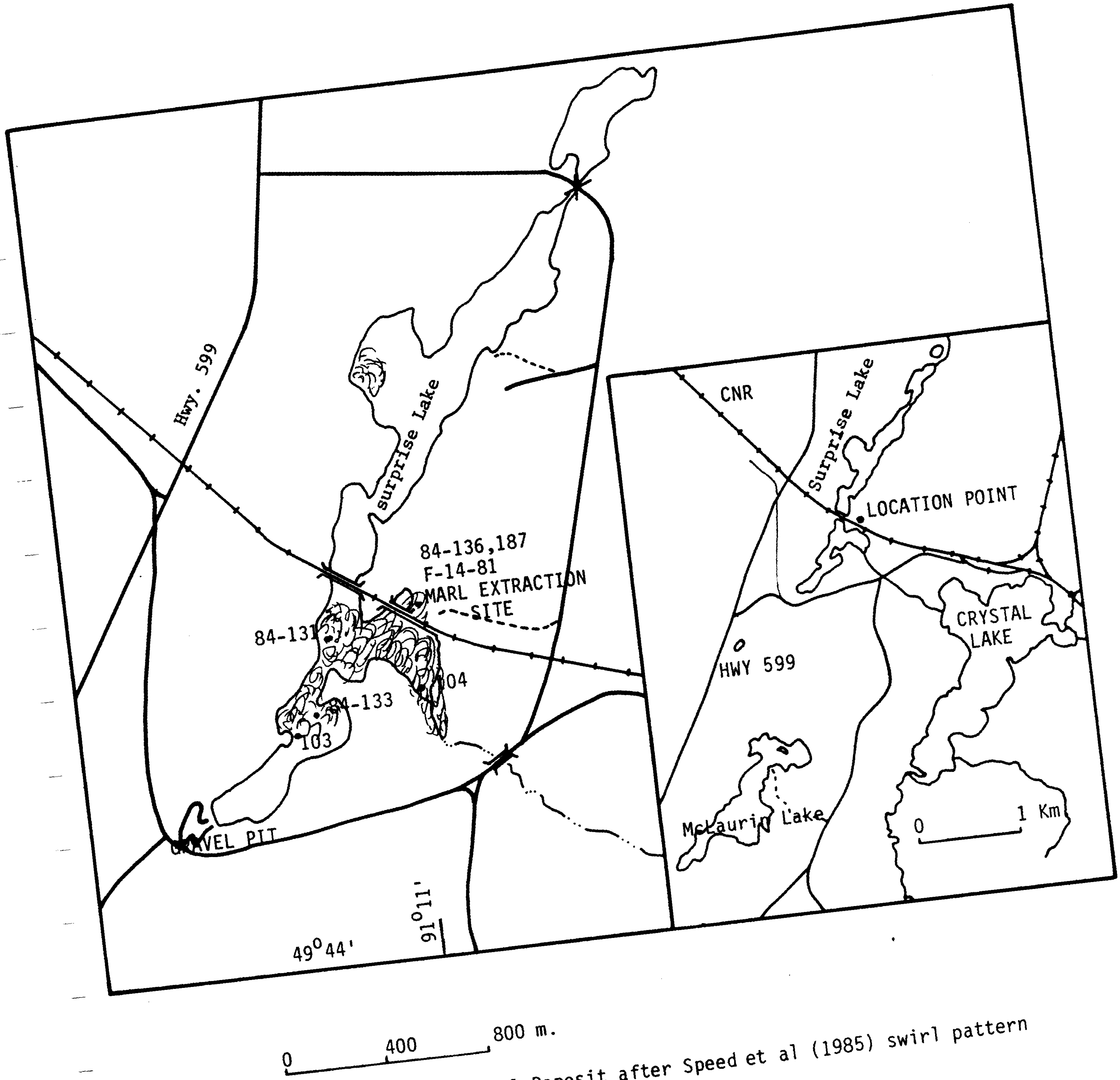


FIGURE 4. Surprise Lake Marl Deposit after Speed et al (1985) swirl pattern shows areas known to be underlain by marl.

MR 3 Yum Yum Point/Helldiver Bay

COMMODITY: Marl

STATUS: Occurrence

LOCATION: NTS 52E/10 SW, Shoal Lake, District of Kenora.
Sample 84-82 was used as a location point.
49°34'18" North Latitude 94°59'17" West Longitude
UTM Grid 356200 mE, 5492700 mN Zone 15.

ACCESS: The area can be reached by boat.

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics and metasediments.

Previous Geological Work: The area has been mapped by Davies (1982). The lake sediments were sampled by Kenora District Department of Lands and Forests staff during the 1960's as part of a lake survey program.

Geology: The lake bottom is clay overlain by organic rich sediment in the shallower more sheltered part of the bay. This material is very soft, brown in colour and contains plant and shell fragments. The water at the sample location was 2.3 m deep in 1984. The thickness and lateral extent of sediment was not determined. Similar gelatinous brown sediment with plant and shell fragments underlies part of Helldiver Bay at a depth of 1 to 3 m. When dry the sediment is a fine-grained grey mass with 2 to 3% shell fragments and minor plant material. All parts of it are found to be calcareous when tested with HCl. In comparison non-calcareous sediment from Helldiver Bay dries to a hard black cake with no reaction to HCl.

Chemistry: Two samples 84-82 from near Yum Yum Point and 84-84 from Helldiver Bay (Fig. 5) were submitted for major and trace element analyses: the results are in Tables 4 and 5. The CaO:MgO ratios are 13.8 making the material an impure (due to its high SiO_2 content) dolomitic limestone. Both samples are composed chiefly of calcite with relatively minor amounts of feldspar and quartz.

HISTORY: Marl has not been extracted in this area. The presence of marl has not been widely reported although it is known locally as a curiosity in some of the small lakes near Shoal Lake.

REFERENCES: NTS Map 52E/10

Chambers, K.
1962: The Lake of the Woods Survey - Shoal Lake, Preliminary Report; Unpublished Internal Report, Ontario

Department of Lands and Forests, Kenora.

Davies, J. C.
1982: Bag Bay, District of Kenora; Ontario Geological Survey Map 2422 scale 1:31 680

Ptarmigan Bay and Shoal Lake; Canadian Hydrographic Service Navigational Chart 6217.

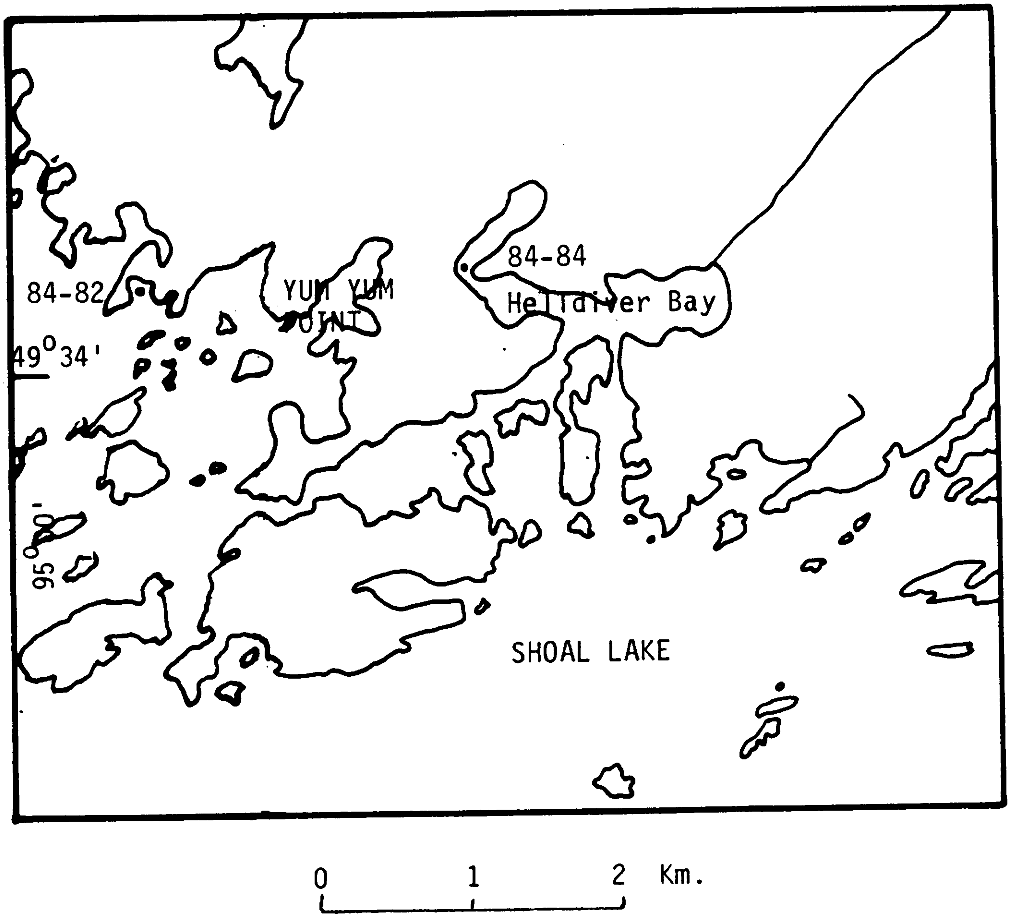


FIGURE 5. Yum Yum Point/Helldiver Bay Marl Sample Sites

PALEOZOIC LIMESTONE

There are no confirmed exposures of Paleozoic bedrock in the area. One reported occurrence (Lawson 1913) could not be located during systematic mapping by Davies (1973). Limestone as boulders and smaller pieces is a common constituent of glacial materials (till sheets and outwash deposits) and are a likely source of carbonate to form marl and concretionary deposits. Instances of large Paleozoic boulders are rare but Lawson (1889) and Goudge (1938) state that they do exist and would be suitable for use as a source of agricultural lime. The analyses below (Table 7) are of dolomitic limestone boulders found east of the town of Rainy River (from Goudge, 1938).

Table 7. Analyses of Paleozoic Limestone Boulders

	1	2	3
SiO_2	2.28	1.28	2.19
Fe_2O_3	0.64	0.37	0.41
Al_2O_3	0.56	0.17	0.42
$CaPO_4$	0.07	0.02	0.04
$CaCO_3$	53.12	54.37	89.14
$MgCO_3$	46.63	44.34	7.95
Total	100.30	100.55	100.15
CaO	29.75	30.45	49.92
MgO	21.92	20.84	3.74
CaO:MgO	1.36	1.46	13.35
Theoretical CCE	103.76	102.52	97.77

1 Dark brown dolomite
2 Light brown dolomite
3 Buff calcium limestone

PL 1 CROZIER TOWNSHIP LIME PIT

COMMODITY: Limestone

STATUS: Past Producer (?)

LOCATION: NTS 52C/12 SE, Section 17 Crozier Township, District of Rainy River.

DESCRIPTION: This deposit was not examined but has been mentioned by Davies (1973), Goudge (1938) and Lawson (1913). Lawson describes it as follows:

> In section 17 of the township of Crozier, about 6 miles west of Fort Frances, there is a small outcrop of cream-coloured fossiliferous limestone, emerging from beneath the glacial drift which mantles the region. A shallow pit has been sunk on the outcrop and in this the dip of the limestone beds is seen to be about 10° in a southerly direction, which could not be exactly determined owing to the smallness of the exposures and the uneven character of the stratification.

Davies (1973) did not find this outcrop (or large glacial erratic) during mapping and postulates that it may have been removed for lime and any quarry openings completely overgrown. Lawson (1889) and Goudge (1938) mention the burning of limestone boulders for agricultural lime. There is no direct reference to this location as a source of limestone to supply a kiln but it is possible.

REFERENCES: NTS Map 52C/12
Davies J. C.
1973: Geology of the Fort Frances Area, District of Rainy River; Ontario Division of Mines Geological Report 107

Goudge, M. F.
1938: Limestones of Canada, part IV, Ontario; Canada Department of Mines and Resources, Mines and Geology Branch Publication 781.

Lawson, A. C.
1889: Report on the Geology of the Rainy Lake Region; Geol. Nat. Hist., Surv. Canada, Ann. Report, Vol.3, Pt.1, Rept.F, 183p. Accompanied by map scale 1 in to 2 miles.

1913 The Archean Geology of Rainy Lake Re-studied; Geol. Surv. Canada, Mem.40, 115p. Accompanied by Map 98A, scale 1 inch to 1 mile

CERAMIC AND GLASS MATERIALS

A wide variety of mineral commodities are used in the ceramic and glass industries.

Ceramics include structural clay products (brick, tile, etc.), artistic clay products, porcelain, whiteware, chinaware and porcelain enamel. Ceramics are made from clay or shale to form the body of the ware with added silica (quartz or silica sand) to bond the particles together plus fluxes (feldspar, nepheline syenite, spodumene), colouring agents (usually metal oxides), special property producers or modifiers and processing aids. Many ceramic objects are glazed with a mixture of feldspathic minerals and colouring agents.

Glass is made from a mixture of silica sand, feldspathic minerals, lime and colouring agents. A wide variety of mineral additives are used to produce the many special types of glass used today.

SPECIFICATIONS

Ceramic raw materials include clay, feldspar and silica plus other minerals found in natural clay or shale deposits. Some of these other minerals are beneficial, some are not. Additional minerals are added to the mix to modify the forming or firing properties of ceramic ware, brick and tile. Table 8 contains mineralogical and chemical compositions of clays from Southern Ontario and the United States used in brick and tile manufacture and the Cretaceous fire clay from Kipling Township in the James Bay Lowlands. Mineralogical composition of a clay deposit is more important than its chemical composition

TABLE 8 Composition of Some Ontario Clay Deposits

		SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	CO_2	H_2O+	H_2O-	SO_3
1.	Dochart Brick & Tile Co.	56.46	16.1	7.48	3.31	3.72	2.53	3.6	0.87	0.14	2.20	3.18	0.54
	Toronto Brick Co.	60.35	12.4	4.31	6.20	2.31	2.00	2.62	0.60	4.26	1.88	1.27	0.56
2.	Kipling Township Fire Clay	51.8	33.05	0.84	0.03	0.09			0.70				

		Quartz	Calcite	Dolomite	Soda Fsp	K-Fsp	Amphibole	Gypsum	Clay Total				
1.	Dochart Brick & Tile Co.	21	6	3	6	2	0.5-5	tr	56				
	" " " "	18	-	-	13	3	1.0-10	tr	56				
	" " " "	22	-	-	11	2	0.5-5	tr	60				
	Toronto Brick Co.	34	4	2	8	1	0.5-5	tr	46				
	" " "	24	4	6	6	2	0.5-5	tr	53				
	" " "	30	4	4	9	4	0.5-5	tr	44				
	" " "	41	2	<0.5	9	1	0.5-5	tr	41.5				
3.	Brown Clay	49			4				40	5sericite	1Rutile	1Limonite	
	Black Clay	39				10			41	" "	1		4 Carbon
	Soft Grey Clay	45				8			40	4	1	0.5py	1.5
	Blue Clay	48	2		1			0.5	40	5chlor.	1	0.5py	1
	White Clay	40				10			40	10 musc.			
	Fire Clay	49				2			45		1	1.0py	2

REFERENCES
1. Guillet (1967a)
2. Guillet (1967b)
3. Brownell (1976)

provided it meets certain minimum standards with respect to alumina, lime and alkali content.

The glass industry uses a much wider variety of minerals than the clay products industry. These include: silica sand, soda ash, limestone, dolomite, feldspar, aplite, nepheline syenite, blast furnace slag, borax, salt cake, gypsum, barite, fluorspar, arsenic, iron chromite, iron pyrite, nitre, spodumene, selenium and carbon. Of these materials, silica sand, soda ash, limestone or dolomite, and feldspathic minerals make up the bulk of the glass batch. The remaining materials, and many more, are used in small amounts to modify the batch to give the final product special properties. The primary batch materials must meet stringent chemical and physical specifications. Table 9 lists chemical analyses of mineral commodities used in glass manufacture. A low iron content in these materials is critical. To produce a satisfactory raw material, the iron content must be amenable to reduction by beneficiation methods.

CLAY

Clay deposits in Northwestern Ontario have been described by Guillet (1977), and Keele (1924), and were noted as early as 1885 by Lawson (1886). Varved clays deposited by Glacial Lake Agassiz during late and post glacial times are widely distributed over Northwestern Ontario (Zoltai 1965, Teller et al 1983). Extensive areas of clay are found along the Rainy River and in the Dryden - Wabigoon area. Some of the clays have been used to produce brick for local construction (Lawson 1886), (Keele 1924). Brick and tile plants that used clay have been described by Baker (1906), Montgomery (1930), and Guillet (1967a);

TABLE 9. Composition of Some Natural Silicate Materials used in Glassmaking

	SiO_2	Al_2O_3	Fe_2O_3	Cr_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Li_2O
1. White sand	99.7	0.08	0.025	0.0002	0.02	0.01	0.01	0.004	0.005	
Yellow sand	99.1	0.25	0.150	0.0020	0.05	0.01	0.01	0.015	0.050	
Feldspar	68.0	19.4	0.075	0.0003	0.01	1.4	0.02	6.9	4.0	
Aplite	60.5	23.0	0.41	0.0003	0.20	5.6	0.05	6.1	2.9	
Nepheline Syenite	59.5	23.9	0.085	0.0003		0.2		10.5	5.0	
2. Indusmin Neph. Syentie										
330	59.9	23.5	0.08			0.6	0.1	10.2	5.0	
333	60.0	23.4	0.35			0.7	0.1	9.9	4.8	
IMC Neph Syenite										
Summit	60.2	23.5	0.07			0.3	tr	10.6	5.1	
Ridge	60.1	23.4	0.5			0.3	tr	10.5	4.9	
Norsk Nefelin	55.9	24.2	0.1			1.3	tr	7.9	9.0	
3. Soda Flotation Fsp	67.54	19.25	0.06			1.94	tr	6.96	4.05	
Potash Flotation Fsp	67.04	18.02	0.04			0.38	tr	2.12	12.10	
Dry Ground Fsp	71.84	16.06	0.09			0.48	tr	3.72	7.60	
Feldspathic sand	79.2	12.1	0.06			0.52	tr	4.8	2.62	0.35
Low Iron Aplite	63.71	21.89	0.09		0.43	5.70	tr	5.60	2.37	
Canadian Nepheline Syenite	61.4	22.74	0.06			0.70	tr	9.54	4.95	

1. Mills (1983) p. 341
2. Minnes et al (1983) p933
3. Rogers et al (1983) p721

Table 10 summarizes the recorded brick yards. A major difficulty with glacial clays is their high carbonate content, particularly in the Dryden-Wabigoon area, and their relatively low content of clay minerals. Carbonate minerals are present in finely ground rock fragments in the clay and as pebbles and concretions; coarse carbonate fragments are much more damaging to the brick causing "lime pops" at the surface upon weathering.

The term clay is used to denote both a group of related hydrous aluminum silicate minerals (kaolinite group, illite group, montmorillonite group) referred to as clay minerals, and fine rock or mineral fragments having a diameter of 1/256 mm (4 microns) or less. Clay minerals are formed by weathering or hydrothermal alteration of feldspathic rock-forming minerals, according to reactions such as:

Orthoclase feldspar + water ---> Kaolinite clay + Silica + potassium

$K_2O.Al_2O_3.6SiO_2+2H_2O$ ---->$Al_2O_3.2SiO_2.2H_2O+ K_2O$.

The other feldspars weather to clay minerals in a similar manner. Clay-size rock fragments are formed by particle comminution during weathering and sediment transport. The primary component of the glacial lake clays is finely ground rock flour from weathered or slightly weathered glacial materials and bedrock outcrops. As such, the clay mineral content of samples of this material analysed during this study is quite low.

The Cretaceous fire clay deposits of the Moose River Basin were formed by extensive weathering of feldspathic sand, but none of the glacial materials in Northwestern Ontario have been exposed to weathering processes intense enough or long enough to produce the high quality aluminous clay used in fine ceramics. Brick produced from some of the clays was satisfactory however, the evidence being ninety year old buildings constructed from this brick that are still standing. High quality china clay or fire clay from preglacial weathering periods is not likely to have been preserved in this environment. Tests of clay from the Claim 286 deposit (see Table 10 and Figures 6c, e, f) compare favourably with those of Brady and Dean (1968) deemed "suitable for brick and tile."

Figures 6a to h shows details of clay sample sites from various places. Figures 7a and b show the locations of these sites. A limited amount of laboratory work was performed on some of these samples. Results are in Table 11. Chemical analyses of these samples compare favourably with clays used by the Dochart Brick and Tile Company and the Toronto Brick Company (Table 8): however, the mineralogical composition is less favourable. Two of the samples do not contain significant amounts of clay minerals. The samples that do contain smectite are from a site that was indicated to be satisfactory brick and tile material by Brady and Dean (1968). The Brinkman Brickyard at Kenora used clay similar to the latter deposits.

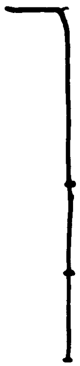
Table 10. Recorded brickyards and clay occurrences (other than Guillet (1977) samples)

NAME	LOCATION	PERIOD OF OPERATION	COMMENTS	REFERENCES
Brinkman Brickyard (Western Algoma Brick Company)	Kenora	1890 to circa 1898 ? to 1927	Produced orange-red coloured brick used in some buildings in Kenora	Keele (1924) Mead (1981)
Dryden Timber and Power Company	Dryden	circa 1912	Brick was used in the construction of the paper mill at Dryden, the brick proved unsatisfactory	Keele (1924)
Fitzgerald's Brickyard	Kenora	1884	Produced 50 000 brick in 1884	Lawson (1886) Lawson et al (1897)
Fort Frances Brickyard	Fort Frances		Brick proved unsatisfactory	Johnston (1915) Keele (1924)
Jaffray Township	Pat. Claim 286 Con II Jaffray Tp	--	A test of one sample by Brady and Dean (1968) indicated it "should be suitable for brick and tile"	Brady and Dean (1968) p31
Vernon Clay Occurrence	Kenora	--	Clay sample from a site in the vicinity of the Fitzgerald Brickyard was tested by the Canada Department of Mines , Mines Branch and found to be unsuitable for clay products.	Assessment File 52E/10NE J - 1

This list does not necessarily include all clay sites tested. It is believed that a brickyard was operated near Hudson to produce brick for the buildings at the Northern Pyrite Mine in Drayton Township circa 1907.

DRYDEN AREA Barclay Township
NTS 52F/15SE
UTM 524800 mE 5516000 mN Zone 15

Top of Bank



0 Alternating grey and brown layers

92 Transition from red layers to brown layers
Alternating red and grey-brown layers
Red makes up about 60% of clay Sample 84-190

137 Greenish-brown slightly silty clay

184 End of section in fine sand

Total section is 184 cm. Top unit is similar to the second unit but is drier. All clay is varved, layers are 5 to 10 mm. The red layers are distinctive in this clay, they show up well when wet.

DRYDEN AREA Webb Township
NTS 52F/16NW
UTM 536400 mE 5529400 mN Zone 15

Light grey-brown varved clay exposed for 1 metre in bank. Minor cream coloured calcareous layers.

FIGURE 6a. Dryden area clay samples

ENA AREA
NTS 52E/16 NW
UTM 393800 mE 5534300 mN Zone 15

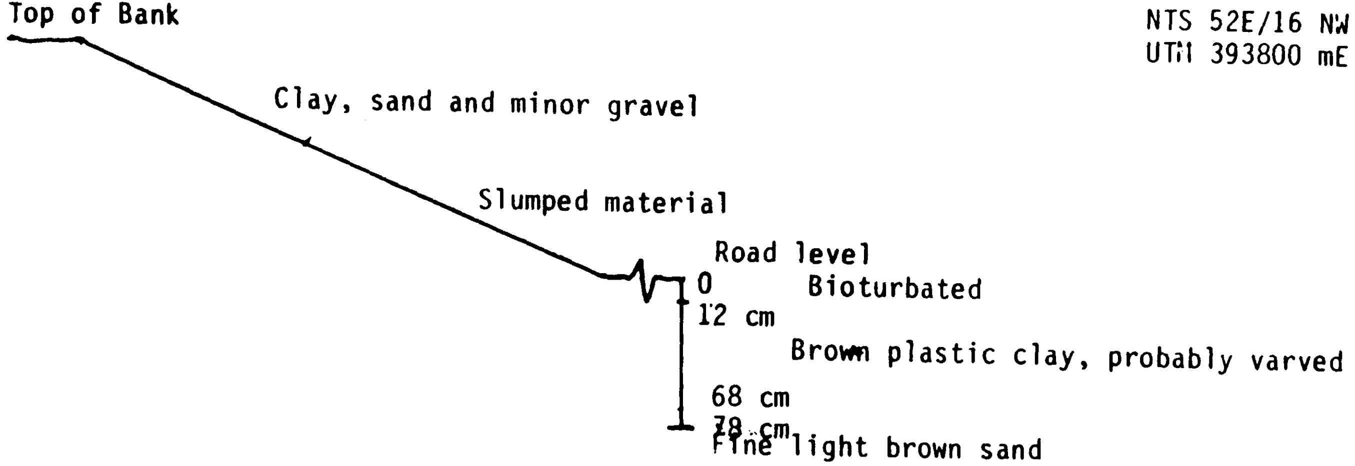


FIGURE 6b. Ena clay section

HOMESTAKE ROAD
NTS 52E/16 SW
UTM 397000mE 5514600 mN

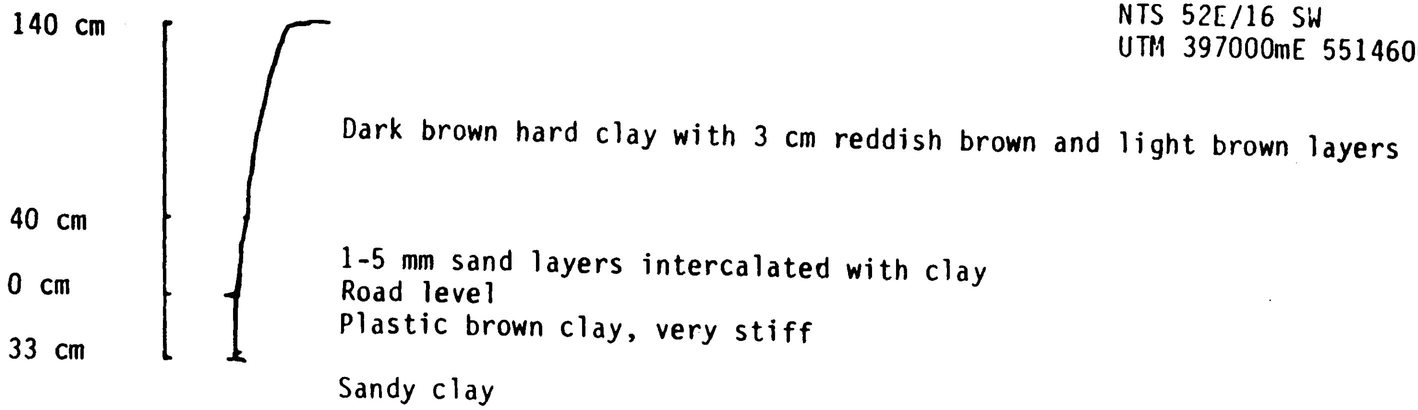
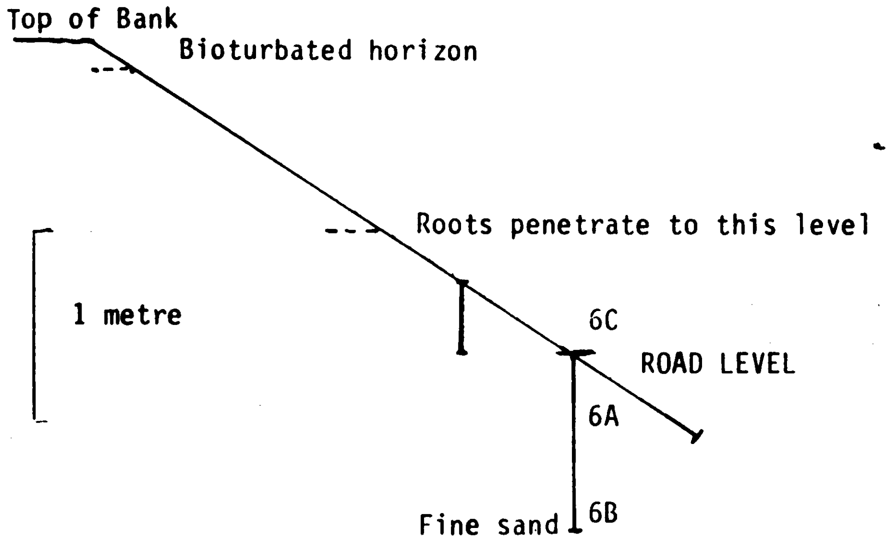


FIGURE 6c. Homestake road clay section

MURIEL LAKE AREA
NTS 52F/15SE
UTM 379300 mE 5517100 mN Zone 15



6A 0 to 71 cm sticky, brown with dark grey streaks, occasional 1-2 mm silt layers. At 52 cm buff streaks appear and the overall colour becomes lighter. At 71 cm rusty brown streaks appear and fine silty layers are present.
6B 71-89 cm varved, colour is lighter brown than 6A layers 1 cm and less, becomes darker with depth. End at 89 cm in a thin (1-2 cm) water saturated sand layer over bed rock
6C 35 cm of clay similar to 6A

FIGURE 6d. Muriel Lake clay section

TRANSMITTER ROAD SITE 3
NTS 52F/16 SW
UTM 397700mE 5513800mN Zone 15

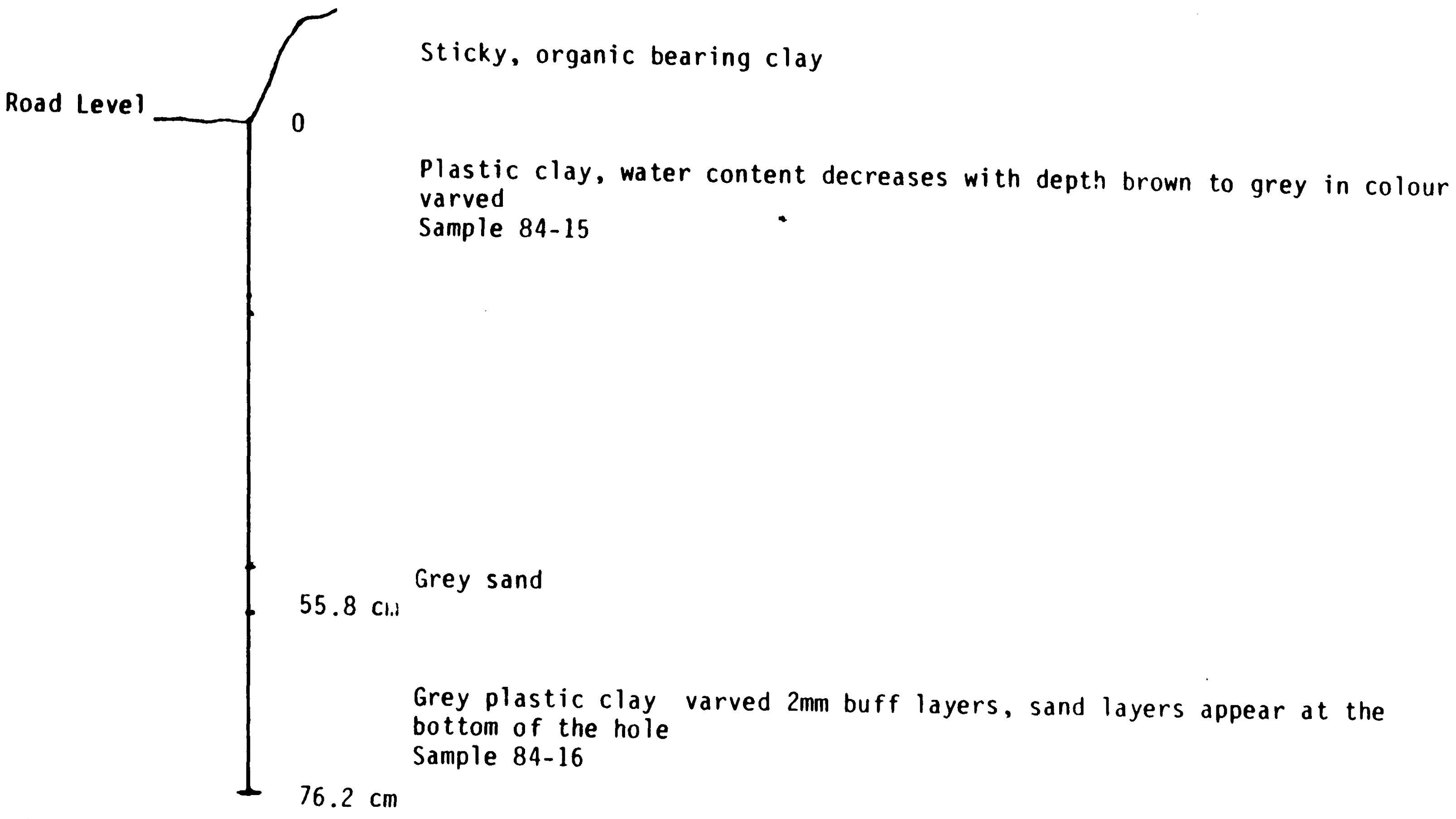
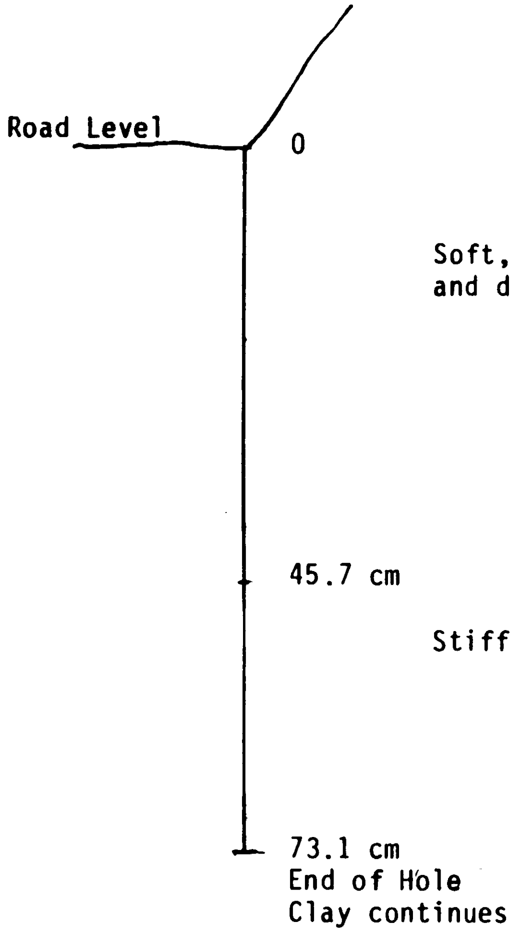


FIGURE 6e Transmitter Road (Patented Claim 286) clay section Site 3

TRANSMITTER ROAD SITE 4
NTS 52F/16 SW
UTM 397200mE 5513900mN Zone 15

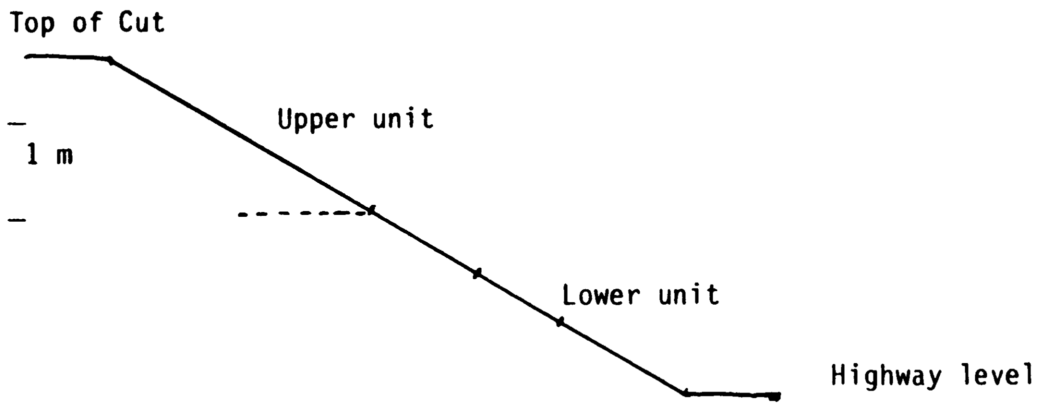


Soft, plastic , brown clay- no evidence of layering, material gets harder and drier with depth. Sample 84-18

Stiff brown clay no sand layers, probably varved. Sample 84-19

FIGURE 6f. Transmitter Road (Patented Claim 286) clay section Site 4

HIGHWAY 105 84-158
NTS 52K/11 NW
UTM 479200 mE 5614400 mN Zone 15



3.5 m total thickness
Bedded plastic, brown clay
Upper unit is 1.6 m thick slightly gritty feeling clay with
occaisional pebbles beds are 2-5 cm
Lower unit has no obvious pebbles
Both units contain light brown calcareous layers that make up 5-10%
of the total unit, they are 1 mm or less in thickness

HIGHWAY 105 84-157
NTS 52K/11NW
UTM 476800 mE 5616200 mN Zone 15
0.5 m exposure of massive plastic brown clay no sand layers

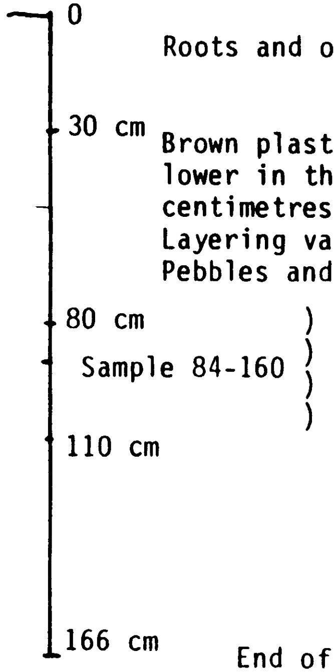
FIGURE 6g. Highway 105 clay section

FIGURE 6h. Wenasaga Road clay sample sites.

WENASAGA ROAD #1
NTS 52K/15 SE
UTM 523000 mE 5635000 mN (approx.)
Calcareous clay of undetermined thickness overlain by 2 m of fine sand, clay contains numerous boulders

WENASAGA ROAD #2
NTS 52K/15 SE
UTM 525000 mE 5632000 mN (approx.)
Intercalated clay and fine sand 60-70% clay. Bedding 5-15 mm, clay is massive, brown; sand is light grey to brown laminated and calcareous.

WENASAGA RIVER CLAY SECTION #3
NTS 52K/11 NE
UTM Grid 487600mE 5613100mN Zone 15



Roots and other organic material in clay

Brown plastic clay with light grey calcareous layers, layering is less distinct lower in the section, calcareous layers are concentrated in a zone from 80 to 110 centimetres below the ground level.
Layering varies from 0.5 to 5 cm, the thickness changes over short distances.
Pebbles and boulders are rare.

Calcareous zone

End of section Clay continues below 166 cm.

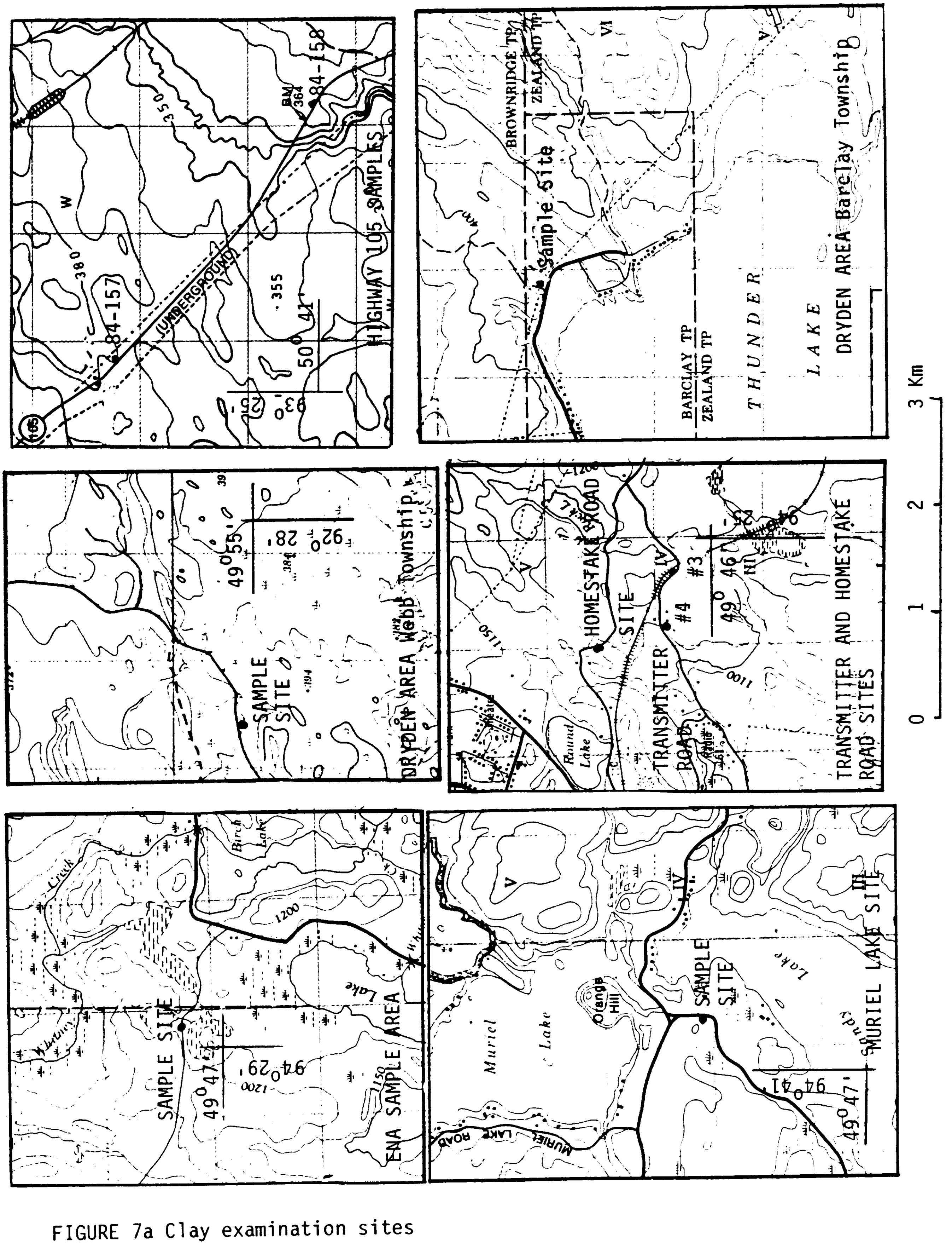


FIGURE 7a Clay examination sites

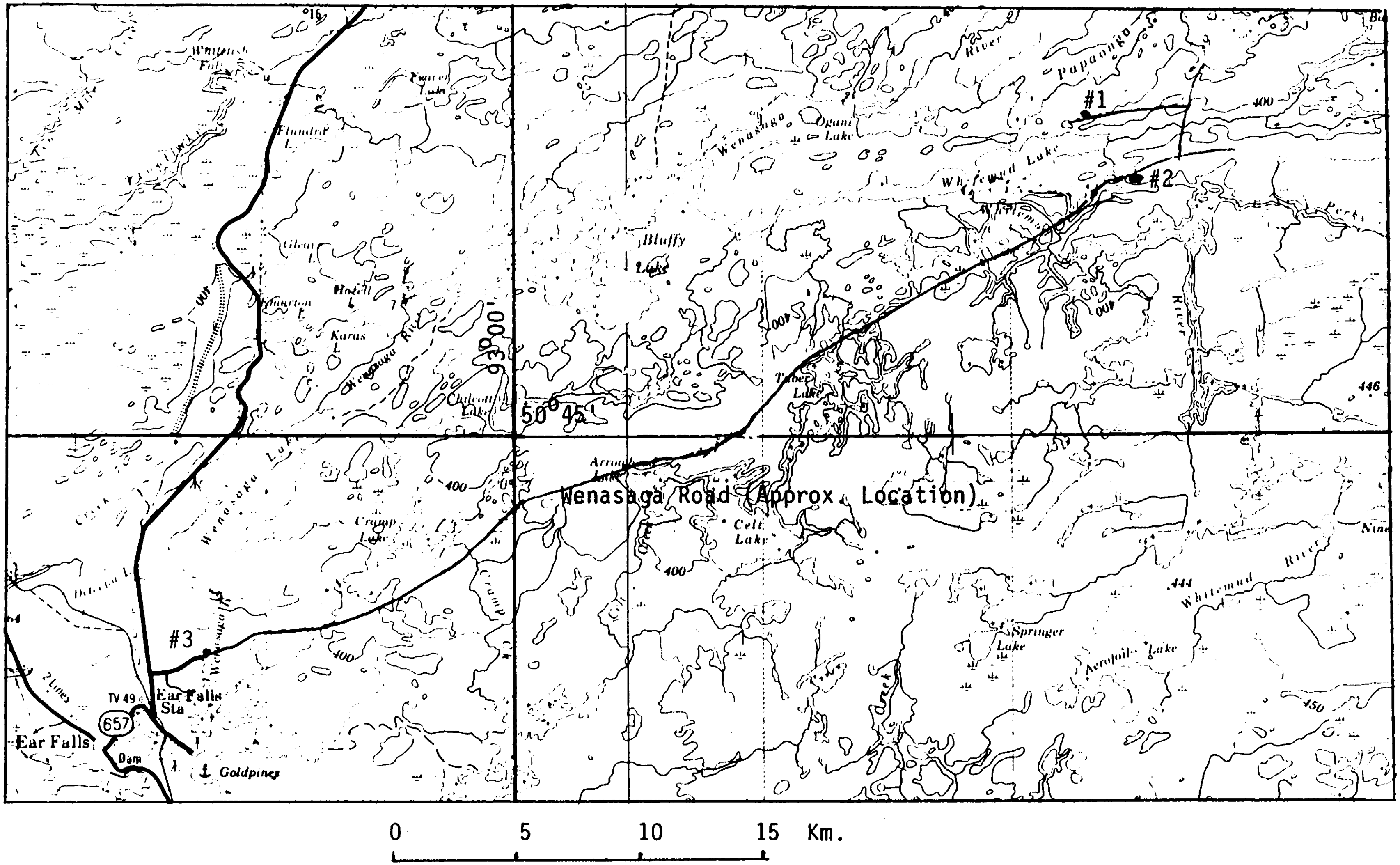


FIGURE 7b. Wenasaga Road Clay Samples

MAJOR ELEMENT ANALYSES

SAMPLE	SiO2	Al2O3	Fe2O3	MgO	CAO	Na2O	K2O	TiO2	P2O5	MnO	CO2	S	LOI	TOTAL
84-0018	64.90	15.10	4.75	1.86	2.40	2.61	2.57	0.60	0.11	0.08	0.37	0.01	4.60	99.60
84-0019	61.90	15.50	5.53	2.24	2.17	2.05	2.55	0.67	0.11	0.07	0.64	0.00	6.10	98.90
84-0160	57.70	11.90	3.31	3.05	8.43	2.84	2.08	0.51	0.34	0.06	6.60	0.01	8.60	98.80
84-0189	61.70	15.30	5.59	2.44	2.64	2.47	2.59	0.73	0.06	0.09	1.42	0.01	5.90	99.50
84-0190	54.90	14.50	6.50	4.50	4.35	2.01	2.65	0.74	0.07	0.11	2.28	0.01	8.80	99.10
84-0192	57.50	16.40	6.25	2.65	1.69	1.57	2.62	0.73	0.05	0.06	0.86	0.00	9.70	99.20

X-Ray Diffraction Results

Sample	**Amphibole**	**Chlorite**	**Quartz**	**Plogioclase**	**K-Feldspar**	**Smectite**
0018	**C**	**C**	**A**	**B**	**C**	B(?)
19	**C**	**C**	**A**	**B**	**C**	B(?)

Samples 0018 and 19 appear to contain smectite but positive identification was not possible.

Sample	**Plagioclase**	**K-Feldspar**	**Quartz**	**Amphibole**	**Calcite**	**Dolomite**	**Chlorite**	**Mica**
189	**AB**	**C**	**A**	**C**	**-**	**-**	**C**	**C**
190	**AB**	**C**	**A**	**C**	**C**	**C**	**C**	**C**

Notes: For clays these are very low in clay minerals. There may be minor montmorillonite present but it was not confirmed.

TABLE 11. Clay analytical results. All sample numbers are preceeded by 84-

FELDSPAR (PEGMATITIC)

Pegmatitic feldspar deposits have been mentioned by Hewitt (1952, 1967), Lawson (1886), de Schmid (1916) and Spence (1932). There is only one deposit in Northwestern Ontario that actually produced feldspar and that was only for a brief period (Falcon Island deposit).

Feldspars are divided into two commercial groups, soda spar (sodium feldspars) and potash spar (potassium feldspar). The former is used in the glass industry, the latter in the porcelain enamel, electrical porcelain and ceramic industries. In glass mixes, feldspar is used as a source of both alumina and alkalis while in enamel, ceramic and electrical porcelain mixes, potash spar is used to supply potassium to give the resulting product specific properties. Pegmatitic feldspar from southern Ontario was used extensively in the glass, ceramic and porcelain enamel industries until the early 1950's. In Canada and the northeastern United States the use of pegmatitic feldspar in glass has been supplanted by nepheline syenite but there is still a small market for potassium feldspar in dental spar and high voltage electrical insulators. Boyd (1982) in reference to Canadian production states that "feldspar production was limited to a few small mines for potassium-rich dental spar exported to the United States, and production of high quality feldspar by Thunderbrick Limited for their own use in tiles." Thunderbrick Limited was a specialty brick and tile company active at Thunder Bay, Ontario in 1982.

Several samples of pegmatitic feldspar were analysed; results are in Table 12. Feldspars as found in rocks are combinations of alkali feldspars (albite and orthoclase) $(Na,K)[AlSi_3O_8]$and plagioclase

($Na[AlSi_3O_8]$-$Ca[Al_2Si_2O_8]$). Feldspar minerals rarely correspond to their ideal chemical composition. The alkali feldspars form a partial solid solution series between potassium rich and sodium rich end members. Microcline, the common form of potassium feldspar found in pegmatites, usually contains a small amount of sodium feldspar in solid solution and exsolved sodium feldspar as perthitic intergrowth. Potassium feldspars are also albitized by the pegmatite fluid phase as it becomes more fractionated during pegmatite formation.

The limited analytical results in Table 12 indicate that both types of pegmatitic feldspar would be satisfactory ceramic material; the main difficulty with these deposits is their small size. Deposits are numerous and small amounts of by-product or co-product feldspar could be produced along with some other minerals. Complete descriptions of the deposits can be found in the section on pegmatites. There is small demand (4 000 tonnes per year in 1983-84) for potassium feldspar for high voltage electrical insulators and artificial teeth (Boucher, 1985).

SPODUMENE

Spodumene, a source of lithium, is added to certain types of glass (Searls, 1980) to increase thermal shock resistance, thermal conductivity and resistance to abrasion and acid attack. Glass ceramic cooking ware, glass range tops and sealed beam automotive lamps are a few of the applications of lithium-containing glass.

Table 12 contains two analyses of spodumene, from the Mavis Lake and Kozowy - Leduchowski pegmatites. Lithium contents of these samples are 2.98% (Mavis Lake) and 2.90% (Kozowy - Leduchowski) which correspond to 6.42% and 6.24% Li_2O respectively (using a conversion factor of 2.153 to convert from Li to Li_2O. Pure spodumene can contain 8% Li_2O but it is readily altered to albite and the lithia content rarely exceeds 7.5% (Hewitt 1967). The samples obtained from the Mavis Lake pegmatite have a high iron content which makes them unsatisfactory as a glass batch additive, the low iron content of the Kozowy - Leduchowski samples has not been confirmed by additional analyses.

MAJOR ELEMENT ANALYSES

SAMPLE	SiO2	Al2O3	Fe2O3	MgO	CAO	Na2O	K2O	TiO2	P2O5	MnO	CO2	S	LOI	TOTAL
82-0123	64.40	19.00	0.00	0.00	0.07	1.61	13.30	0.00	0.28	0.00	0.08	0.00	0.40	99.10
82-0190	65.10	19.10	0.00	0.00	0.02	3.17	11.50	0.00	0.00	0.00	0.06	0.00	0.10	99.00
84-0002	65.40	18.80	0.00	0.00	0.05	3.59	11.00	0.00	0.01	0.00	0.04	0.00	0.20	99.10
84-0034	65.80	18.50	0.00	0.00	0.03	2.04	12.80	0.04	0.02	0.00	0.07	0.00	0.20	99.40
84-0074	66.10	18.70	0.00	0.00	0.02	3.23	11.00	0.03	0.03	0.00	0.08	0.00	0.20	99.30
84-0144	70.50	18.00	0.11	0.00	1.05	9.32	0.16	0.08	0.64	0.07	0.07	0.01	0.30	*0.20
84-0162	64.80	20.00	0.00	0.00	0.15	2.64	11.70	0.06	0.38	0.00	0.04	0.01	0.40	*0.10
84-0171	64.40	20.00	0.00	0.00	0.10	1.98	12.30	0.03	0.38	0.00	0.07	0.00	0.30	99.50
84-0172	64.40	30.60	0.86	0.00	0.12	0.04	0.02	0.03	0.01	0.07	0.14	0.01	0.30	96.60
84-0177	64.50	19.90	0.00	0.00	0.07	2.00	12.10	0.05	0.54	0.01	0.09	0.00	0.40	99.50
84-0181	64.80	19.90	0.00	0.00	0.13	2.49	11.10	0.00	0.38	0.05	0.12	0.00	0.30	99.10
84-0182	63.60	29.00	0.04	0.00	0.06	0.00	0.08	0.11	0.24	0.14	0.11	0.01	0.90	94.20
84A0175	64.50	20.00	0.00	0.00	0.08	2.07	12.20	0.04	0.45	0.01	0.06	0.00	0.30	99.60
84B0175	65.00	20.20	0.00	0.00	0.11	1.63	12.20	0.05	0.62	0.00	0.07	0.00	0.50	*0.30
84D0002	66.00	18.80	0.00	0.00	0.04	3.51	10.90	0.05	0.01	0.00	0.04	0.00	0.20	99.50
84D0074	66.20	18.60	0.00	0.00	0.02	3.34	11.00	0.02	0.04	0.00	0.07	0.00	0.20	99.40
84D0144	70.10	18.00	0.11	0.00	1.06	9.28	0.17	0.09	0.66	0.07	0.08	0.01	0.50	*0.00
84D0182	63.90	28.80	0.04	0.00	0.06	0.00	0.08	0.11	0.24	0.14	0.11	0.01	0.70	94.10

TABLE 12. Major element analyses of feldspar and spodumene samples.

82-0123 Potassium feldspar, Mavis Lake deposit Area # 1

82-0190 Potassium feldspar, Harrison Mica deposit

84-0002 Potassium feldspar, Medicine Lake deposit

84-0034 Potassium feldspar, McCallum deposit

84-0074 Potassium feldspar, English River Beryl deposit

84-0144 Sodium feldspar, Sandy Creek Beryl deposit

84-0162 Potassium feldspar, Cramp Lake Pegmatite

84-0171 Potassium feldspar, Mavis Lake Deposit Area # 1

84-0172 Spodumene, Mavis Lake Deposit Area # 1

84-0177 Potassium feldspar, Mavis Lake Deposit Area # 2

84-0181 Potassium feldspar, Kozowy-Leduchowski deposit

84-0182 Spodumene, Kozowy-Leduchowski deposit

84A0175 Potassium feldspar, Mavis Lake Deposit Area # 4

84B0175 Potassium feldspar, Mavis Lake Deposit Area # 4

84D0002)

84D0074) Replicate analyses

84D0144)

84D0182)

* indicates analysis total of 100%

LEUCOGRANITE

Ceramic raw materials are required in large tonnages of uniform material. Pegmatite sources have always been at a disadvantage in that pegmatites tend to be small and have significant compositional differences from deposit to deposit. Feldspar sources in the United States include large pegmatites, alaskite granitoid bodies, feldspathic sand and granite. Granitoid bodies have an advantage over pegmatites in uniform composition over large areas. There has been no recorded production of feldspar from granitoid bodies in Northwestern Ontario but several quarries, some quite large, have been operated for many years to produce dimension and crushed stone. Samples of waste from some of these quarries and samples from some other granitoid bodies were analysed for major elements; results are in Table 13a,b &c; Barth's mesonorm was calculated for all but 84-197. Granitoid rocks were classified by the Streckeisen (1976) system (Figures 8a and 8b) based on both stained slabs of the rock and normative minerals. Figure 9 shows sample locations other than stone quarries.

Iron occurs in granitoid rocks in four forms: ferromagnesian minerals (biotite, hornblende), free iron oxides (hematite and magnetite), iron sulphides (pyrite, etc.), and limited substitution for aluminum in the feldspar crystal lattice; the first two types account for the largest amount of the iron. Iron oxide is the main colouring agent in granitoid rocks, particularly deep pink and red granites (see Storey, 1984). The granitoid bodies selected for sampling were white to grey in colour (except the Vermilion Bay Granite) to minimize free iron oxide content and all were low in ferro-magnesian minerals. The samples in Table 13a with the highest iron content (84-138, 139, 140) also have the highest biotite content (both normative and modal). The samples were passed through a Franz magnetic separator prior to analysis to attempt to remove iron bearing minerals (biotite, hornblende, magnetite). Only small amounts of magnetic minerals were removed by this method but more intense methods could be more effective.

The results indicate a mixture of potash and soda feldspar but a relatively high iron content in the material analysed. There is considerable variation in rock composition in samples from different parts of the same granitoid body. In all, the normative soda spar content exceeded the normative potash spar (modal analysis does not support this for the Vermilion Bay and Butler samples but the differences are not great and do not affect the classification). The white granitoid bodies (all samples except 84-70) with the exception of 84-163 have normative soda spar to normative potash spar ratios of 3.2 or more. The analyses in Table 13a all show iron contents higher than those of feldspathic materials in current commercial use but these are essentially raw samples whereas published analyses of commercial samples are beneficiated material as shipped to glass manufacturers. The high normative soda spar to normative potash spar ratio indicates rocks that would be poor candidates for potassium feldspar production, but that could be beneficiated to produce soda feldspar or a quartz - feldspar mixture. Rocks with a low normative soda spar to normative potash spar ratio (Vermilion Bay Granite, Butler Quarry granite) would be suitable for production of potassium feldspar by flotation or a potash feldspar rich quartz - feldspar mixture.

To produce a high potash spar concentrate by flotation the feed rock should possess a high initial potassium feldspar content (i.e. low normative spar ratio); these are rocks that would plot toward the lower left corner of the Streckeisen diagram (Figure 8). Actual proportions of the feldspars and quartz and how they compare to the normative values would have to be determined by petrological examination and flotation bench tests. Some of the known granitoid bodies of Northwestern Ontario have been subdivided into suites (Breaks et al, 1978); of these the potassic suite would probably be the one that should be investigated for feldspar production. The type of granitoid body that could have potential as a feldspar source would be rich in potasium feldspar, have a low ferro-magnesian and iron oxide mineral content, be of uniform composition and a size that would allow long term production. Many of the small, late stage granitoid bodies warrant examination for feldspar potential.

MAJOR ELEMENT ANALYSES

SAMPLE	SiO2	Al2O3	Fe2O3	MgO	CAO	Na2O	K2O	TiO2	P2O5	MnO	CO2	S	LOI	TOTAL
84-0051	71.80	15.50	1.44	0.22	2.12	4.55	2.32	0.25	0.00	0.03	0.11	0.01	0.70	98.90
84-0052	73.40	15.00	1.50	0.27	1.97	4.07	2.48	0.17	0.00	0.05	0.16	0.01	0.80	99.70
84-0070	73.00	14.90	0.73	0.11	1.36	3.38	5.17	0.17	0.00	0.02	0.11	0.01	0.40	99.20
84-0138	69.70	18.00	2.55	0.74	4.68	4.75	1.65	0.31	0.03	0.03	0.07	0.01	0.80	98.60
84-0139	66.60	16.40	3.17	1.05	4.29	4.16	1.58	0.45	0.05	0.04	0.06	0.01	0.80	98.60
84-0140	73.20	15.00	1.63	0.33	2.72	4.08	1.88	0.24	0.01	0.03	0.12	0.01	0.80	99.90
84-0163	73.00	15.00	0.94	0.13	1.33	3.44	4.84	0.27	0.00	0.03	0.13	0.01	0.40	99.40
84-0164	74.40	14.70	0.82	0.22	1.99	4.31	2.54	0.18	0.00	0.03	0.13	0.01	0.50	99.70
84-0197	73.70	15.10	0.71	0.21	1.17	4.62	3.33	0.07	0.03	0.03	0.23	0.01	0.90	99.90
84D0164	74.10	14.70	0.83	0.22	2.00	4.28	2.54	0.27	0.00	0.03	0.12	0.01	0.40	99.40

TABLE 13a. Granitoid rock major element analyses.

Table 13b. Barth's Mesonorm

PHASE	84-51	84-52	84-70	84-138	84-139	84-140	84-163	84-164	84-164D
MAJOR MINERALS									
Q	30.6	34.5	29.3	20.9	26.5	34.8	30.3	33.6	33.6
ORTH	13.4	14.2	30.8	8.1	7.1	10.5	28.7	14.6	14.7
ALB	41.6	37.2	30.9	43.2	38.4	37.2	31.4	39.1	39.0
ANOR	9.1	8.2	5.5	21.7	19.5	12.0	4.8	8.4	8.3
ACCESSORY MINERALS									
APTT	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
SPH	0.5	0.4	0.4	0.7	1.0	0.5	0.6	0.4	0.6
HMTT	1.0	1.1	0.5	1.8	2.3	1.2	0.7	0.6	0.6
CALC	0.3	0.5	0.3	0.2	0.2	0.3	0.4	0.4	0.3
CRND	2.5	3.0	2.0	0.6	1.0	2.2	2.6	2.0	2.1
BTT	0.9	1.1	0.5	2.8	4.1	1.3	0.5	0.9	0.9

The mineral phases calculated are:

Q	Quartz
ORTH	Orthoclase
ALB	Albite
ANOR	Anorthite
APTT	Apatite
SPH	Sphene
HMTT	Hematite
CALC	Calcite
CRND	Corundum
BTT	Biotite

These are standard hypothetical minerals calculated from the major element chemical analysis. Some of the accessory minerals calculated (CRND, CALC, SPH, APTT) may not be present as actual minerals in the rock and were not considered in classifying the granite. The component elements may occur rather as impurities, ion substitution or alteration products in the major minerals. In particular corundum is not likely to be present in granite since "...even the hottest magmas of granitic composition are not likely to contain much alumina in excess of that required for the feldspars and hence that they are restricted in potential corundum." (Deer, Howie and Zussman, 1962)

Table 13c. Granitoid rock samples

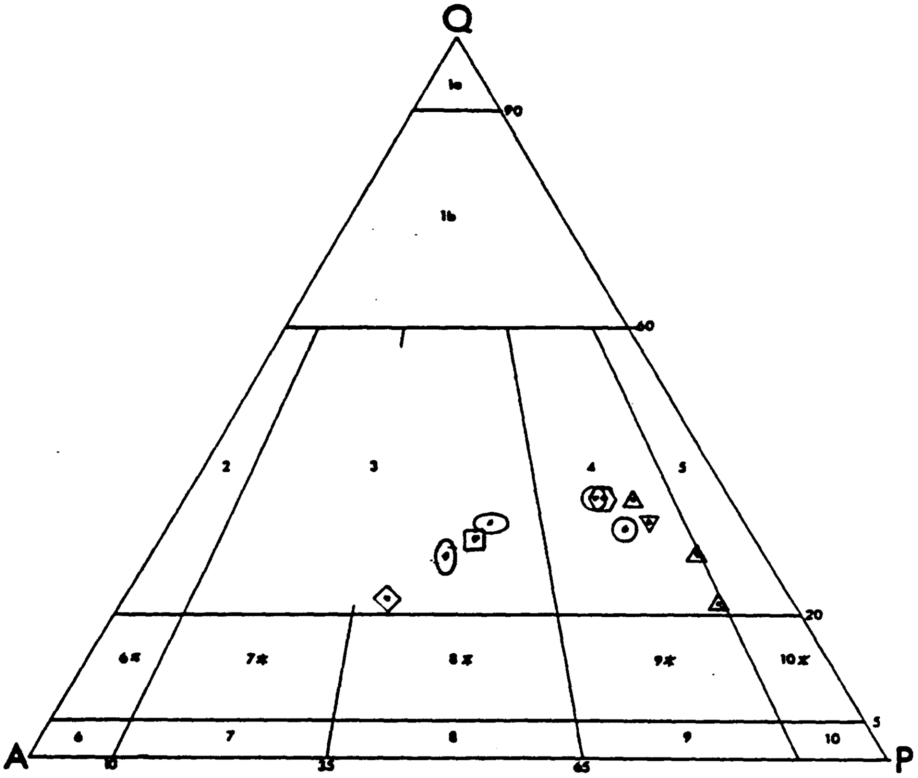
SAMPLE	LITHOLOGY	NORMATIVE SPAR RATIO
84-0051 Dore Lake Granite	Granodiorite *	3.8
84-0052 Dore Lake Granite	Granodiorite *	3.2
84-0070 Vermilion Bay Granite from Nelson Granite Ltd. Quarry	Granite * +	1.2
84-0138 Revell Batholith	Tonalite *	8.0
84-0139 " "	Tonalite *	8.2
84-0140 " "	Granodiorite * +	4.2
84-0163 Waste from Butler Quarry	Granite * +	1.3
84-0164 Fines from CPR Hawk Lake Quarry	Granodiorite *	3.3
84-0197 Bear Pass Stock		
84D0164 Duplicate sample	Granodiorite *	3.2

* from normative mineral calculation

\+ from modal analysis

Normative Spar Ratio = (ANOR + ALB)/ORTH

Both 84-0138 and 0139 plot on the field boundary



Q quartz, besides tridymite and cristobalite in volcanic rocks.
A alkali feldspars (orthoclase, microcline, perthite, anorthoclase, albite An 00—05, besides sanidine in volcanic rocks).
P plagioclase An 05—100, scapolite.

Q + A + P = 100
1a, quartzolite (silexite); 1b, quartz-rich granitoids; 2, alkali-feldspar granite; 3, granite; 4, granodiorite; 5, tonalite, 6*, quartz alkali-feldspar syenite; 7*, quartz syenite; 8*, quartz monzonite; 9*, quartz monzodiorite/quartz monzogabbro; 10*, quartz diorite/quartz gabbro/quartz anorthosite; 6, alkali-feldspar syenite; 7, syenite; 8, monzonite; 9, monzodiorite/monzogabbro; 10, diorite/gabbro/anorthosite

FIGURE 8a. Streckeisen granitoid rock classification system as used by Storey (1983, 1984,1986). Data points were generated by computer for the samples listed in Table 13c.

	NORMATIVE	MODAL
DORE LAKE GRANITE	⊙	
VERMILION BAY GRANITE	⊡	◈
REVELL BATHOLITH	△	▽
BUTLER QUARRY	⬭	⬯
CPR HAWK LAKE QUARRY	⬡	

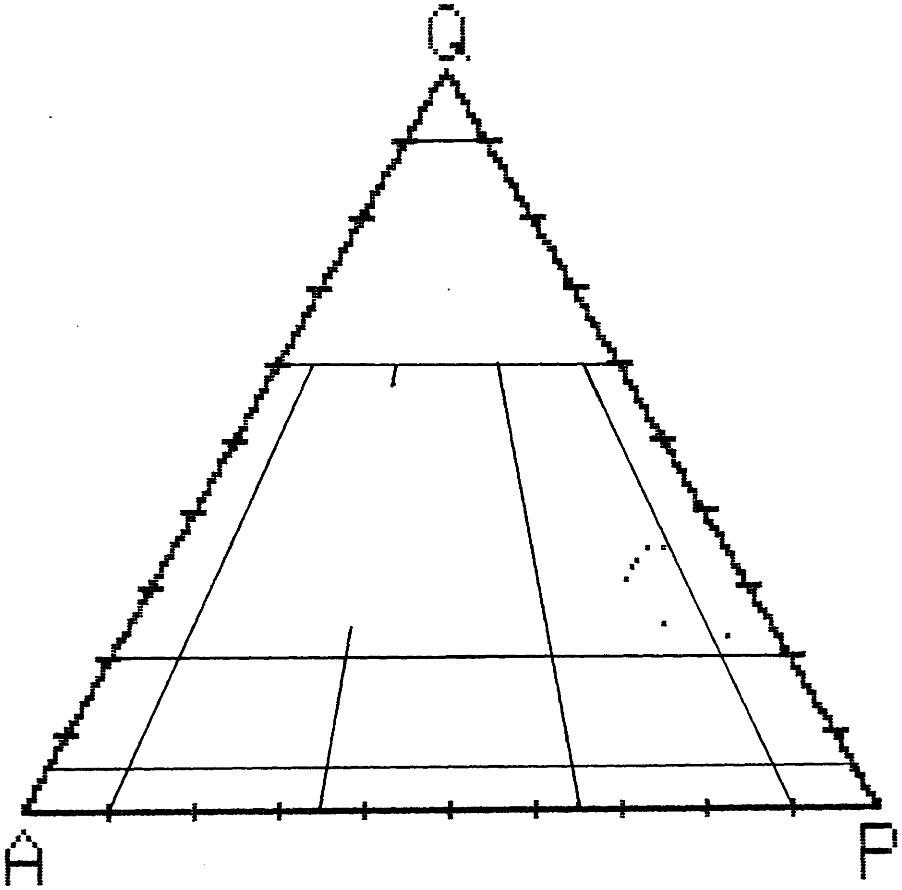


FIGURE 8b. Computer generated QAP diagram for seven modal analyses of samples from the Revell Batholith published by Storey (1986). Field divisions were drawn after plotting, to conform to Figure 8a.

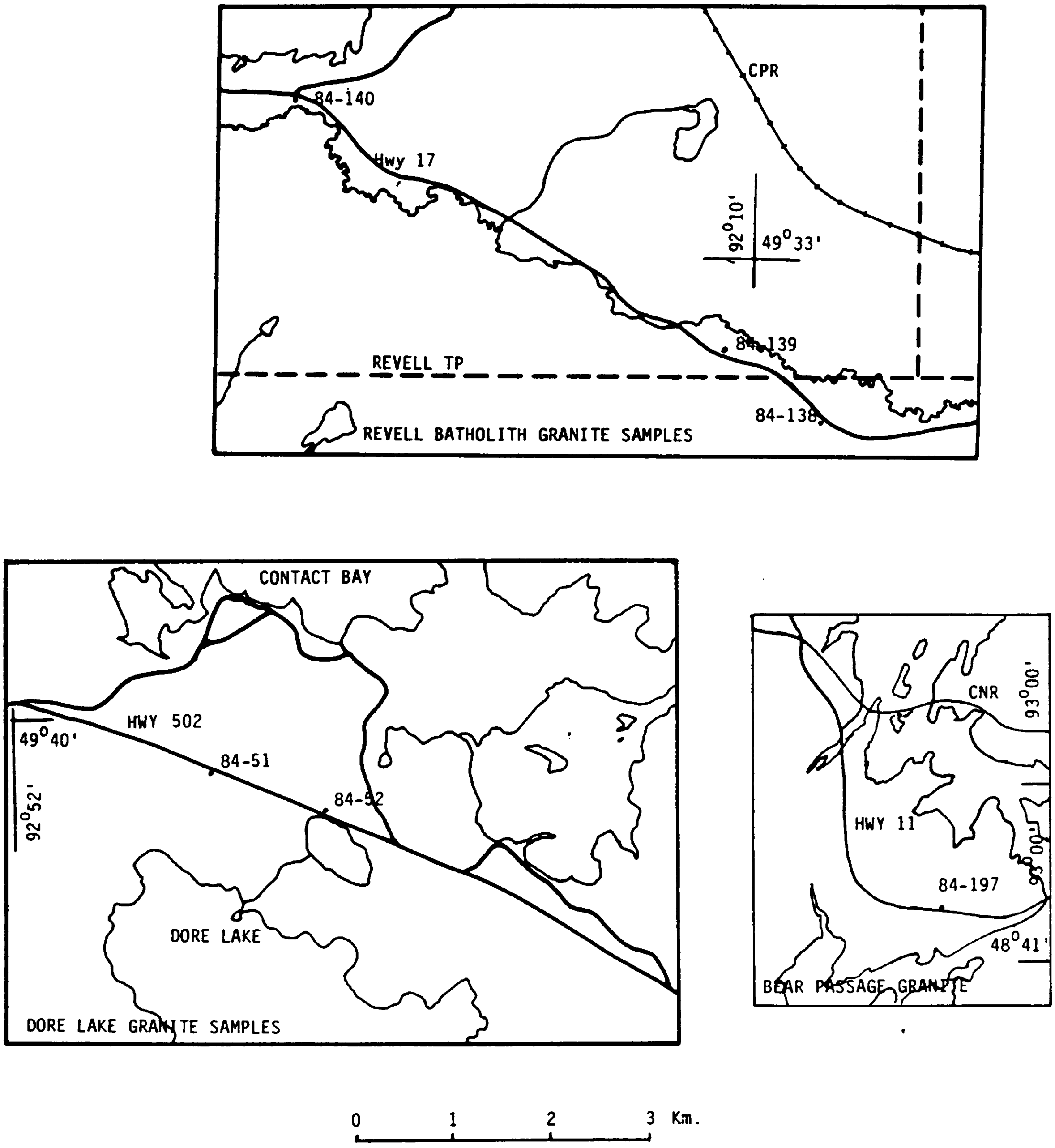


FIGURE 9. Granite sample locations other than quarry sites.

QUARTZO-FELDSPATHIC SAND

Large amounts of fine quartzo-feldspathic sand are found in glacial outwash deposits. One occurrence of this material has been noted (Redditt Sand deposit in Redditt Township) and mistakenly reported as silica sand (Resident Geologist Files, Kenora, File 52E/16 NW A-1). Similar sands have been used as a feldspar source in the United States and investigated in other parts of Ontario (Guillet, 1983). This type of sand occurs in many places in Northwestern Ontario although often only as a thin layer. Adequate supplies and a potential market would justify further investigation of these sands.

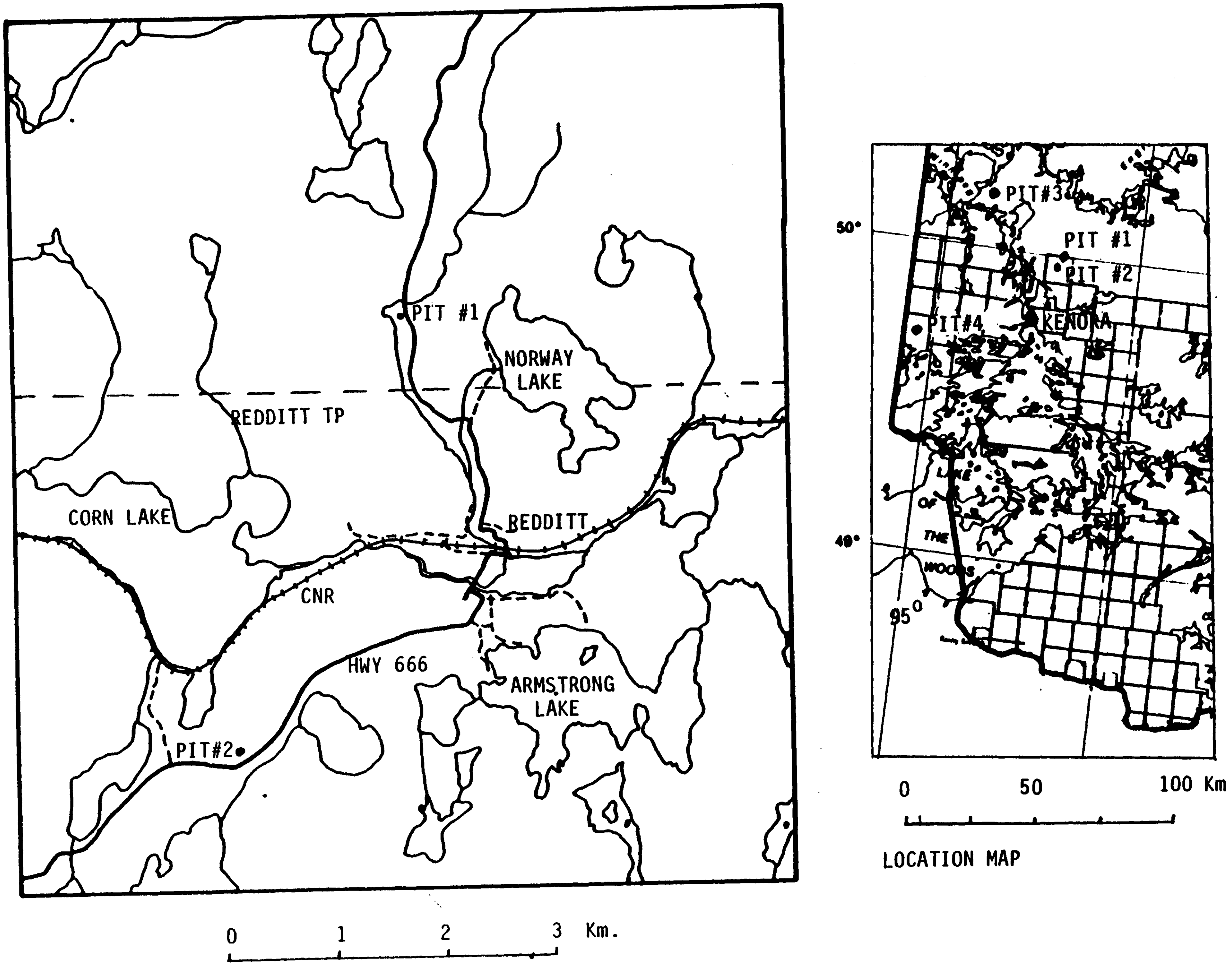
O 1 REDDITT SAND

COMMODITY:	Quartzo-feldspathic sand
STATUS:	Occurrence
LOCATION:	NTS 52E/16 NW Redditt Township, District of Kenora. 49°59'47" North Latitude, 94°24'02" West Longitude UTM Grid 399600mE, 5539000mN Zone 15. A gravel pit 2 km north of Redditt was taken as a location point, 600m north of the north boundary of Redditt Township. Only Pits #1 and #2 are the Redditt Sand deposit, Pits #3 and #4 are similar deposits included for comparison purposes (Fig. 10).
ACCESS:	The deposit is crossed by the English River Road and is exposed in pits 2 km north of Redditt.
DESCRIPTION:	Geological Setting: The area is underlain by glacio-fluvial materials.

Previous Geological Work: The surficial geology has been mapped by Zoltai (1965) and Hallett and Roed (1980).

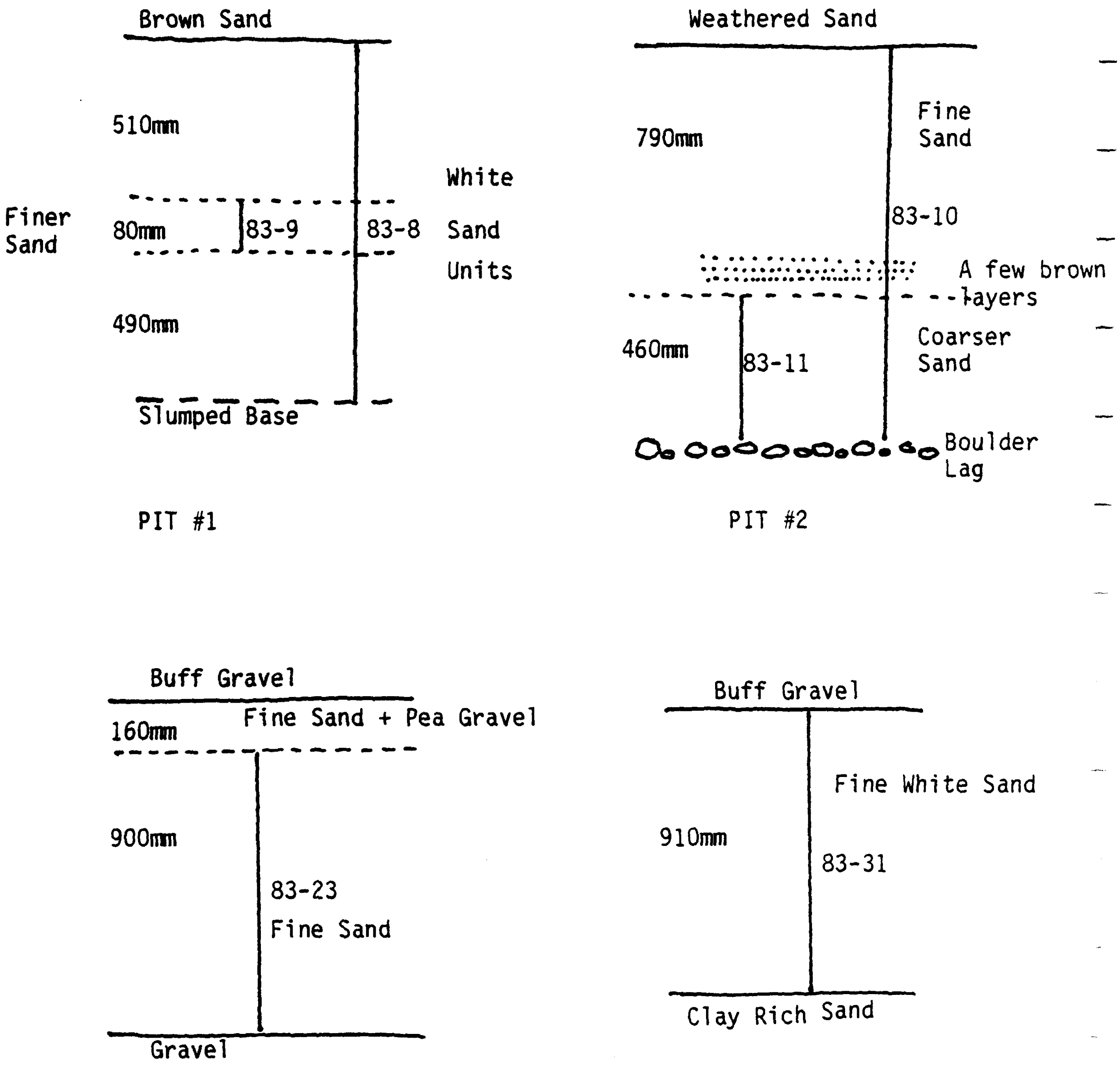
Geology: The deposit comprises intercalated beds of fine sand and minor gravel. Layers of pebble to boulder size rocks can be found intercalated with the sand unit and in the beds immediately below the sand unit. The overlying and underlying material is rusty brown gravel with a high proportion of sand. The unit identified as silica sand is very light buff in colour and stands out against the darker units. The light coloured sand unit is exposed in gravel pits north of Redditt and in pits adjacent to Highway 658 2.5 km southwest of Redditt. Similar sand units are exposed in gravel pits on the Sand Lake Road north of Minaki (Pit #3) and the Shoal Lake Road, Ewart Township (Pit #4). These exposures are quite thin in comparison to the Redditt exposure. The sand unit at Redditt was exposed for two m at the time of initial examination and was sampled for 1.03 m; the base of the unit is obscured by extensive slumping of the pit faces.

The sand in Pit #1 shows parallel laminations 2 mm in thickness. Approximately 10 to 15% of the unit consisted of slightly coarser sand layers and occasional gravel layers. There is a larger scale layering of the deposit based on grain size as shown in Figure 10b. All layering dips to the southwest.



LOCATION MAP

FIGURE 10a. Redditt Sand Deposit



PIT #1

PIT #2

PIT #3

PIT #4

FIGURE 10b. Sand Pit Sections.

Pit #2 exposes 1.25 m of fine sand. Ripple drift cross lamination indicating current flow to the southwest appears in the upper part of the unit, and there are a few rusty brown layers in the central part. A boulder lag layer was taken as a lower limit to the deposit.

Pit #3 on the Sand Lake Road exposes slightly over 1 m of fine sand between brown sand and gravel units. The sand can be subdivided into two units, the upper containing approximately 5% pebbles, the lower only occasional pebbles. Ripple drift cross lamination indicates current flow towards the east. This unit has a higher pebble content than the others and the adjacent units have a darker rusty colouring.

Pit #4 on the Shoal Lake Road exposes 91 cm of sand underlain by a very fine clay rich unit. The sand unit is similar to that found in Pit #2.

Petrology and Chemistry: Samples from all four pits were submitted for grain size, major element analysis and X-ray diffraction mineralogy. Heavy mineral separations were performed on two samples. All grain sizes are expressed in ISO standard sieve sizes. Major element analyses and X-ray diffraction mineralogy indicate the samples are of very similar composition with the exception of a high iron content in 83-23. Results are in Tables 14, 15, 16 and 17. There is no indication that Pits 3 and 4 are in the same deposit as the Redditt Pits.

Samples: 83-8 1.08 m channel sample Pit # 1
83-9 8 cm fine grained layer in the centre of channel sample 83-8
83-10 1.25 m channel sample Pit # 2
83-11 46 cm channel sample slightly coarser grained lower part of sample 83-10
83-23 90 cm channel sample Pit # 3
83-31 91 cm channel sample Pit # 4

Table 14 Grain Size Analysis

			SAMPLES			
Mesh Size	83-8	83-9	83-10	83-11	83-23	83-31
14	94.1	99.3	99.6	99.9	98.6	98.6
18	91.4	99.1	99.5	99.8	98.4	97.0
25	87.1	98.8	99.3	99.5	98.3	93.4
35	77.9	97.7	98.3	96,6	98.1	82.5
45	64.2	94.0	94.0	83.6	97.7	56.0
60	45.3	82.7	84.8	59.2	96.3	22.6
80	27.1	60.6	71.4	36.2	90.3	7.7
120	18.0	40.6	58.4	22.4	80.4	4.3
170	6.2	16.1	34.7	9.6	47.1	1.1
230	3.4	9.1	23.3	5.6	31.9	0.3
.034			13.7		12.7	
.022			8.8		5.9	
.013			4.9		2.0	

TABLE 15 X-Ray Diffractometry Mineralogy Minus 14 Mesh Fraction

	83-8	83-9	83-10	83-11	83-23	83-31
Plagioclase	A	A	A	A	A	A
Quartz	A	A	A	A	A	A
K Feldspar	C	C	CD	D	D	CD
Mica	CD	D	D	D	D	D
Amphibole	CD	C	C	CD	C	D
Chlorite-kaolin	CD	CD	D	D	D	CD

A-Abundant
B-Moderate
C-Minor
D-Very Minor

Note: Chlorite and kaolin have similar diffraction patterns; at these levels not distinguished

Table 16 Heavy Mineral Separation

SAMPLE	Mesh -60 +120 Wt. Used	Heavy Mineral Weight	%	Non-Magnetic Weight	Magnetics %*
83-8	26.91	0.797	2.96	0.737	7.53
83-10	26.12	0.605	2.32	0.559	7.60

Heavy Mineral Concentrate

83-8 Minerals observed are listed below in decreasing quantities:
black hornblende
light-green epidote
garnet, red, pink and brown (refractive indices greater than 1.78)
pale-green diopside
biotite (weathered), apatite, zircon.

83-10 The sample is much the same as 83-8 except that this contains more biotite that is fresh and unweathered.

* The % magnetics refers to % of the heavy mineral concentrate.

HISTORY: The sand has been quarried along with the associated units for use in local road construction.

REFERENCES: NTS Map 52E/16

Hallet, D. R. and Roed, M. A.
1980: Rat Portage Bay Area (NTS 52E/NE and part of 52E/NW), District of Kenora; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 20, 13p. Accompanied by Maps 5055 and 5057, scale 1:100,000.

Zoltai, S. C.
1965: Surficial Geology, Kenora-Rainy River; Ontario Department of Lands and Forests, Map S165, scale 1:506 880.

Assessment Files, Resident Geologist Office, Kenora, File 52E/16 NW A-1.

MAJOR ELEMENT ANALYSES

SAMPLE	SiO2	Al2O3	Fe2O3	MgO	CAO	Na2O	K2O	TiO2	P2O5	MnO	CO2	S	LOI	TOTAL
83-0008	76.70	12.80	0.85	0.37	2.10	3.38	2.46	0.16	0.02	0.02	0.07	0.00	0.70	99.20
83-0009	76.60	12.60	0.95	0.35	2.26	3.33	2.27	0.31	0.03	0.02	0.08	0.01	0.60	99.10
83-0010	76.50	13.00	0.77	0.44	2.38	3.23	2.19	0.28	0.04	0.03	0.22	0.01	0.50	99.90
83-0011	76.90	12.70	0.90	0.42	2.28	3.27	2.10	0.17	0.02	0.02	0.17	0.00	0.90	99.00
83-0023	75.50	12.80	1.75	0.68	2.51	3.00	2.22	0.29	0.05	0.05	0.23	0.00	0.30	99.40
83-0031	76.60	13.00	0.69	0.33	2.14	3.41	2.21	0.09	0.01	0.02	0.13	0.01	0.40	99.00

TABLE 17: Redditt Sand Major Element Analyses

GRAPHITE

Two types of graphite deposits occur in Northwestern Ontario: flake graphite disseminated in medium to high grade metasediments, and fine grained 'amorphous' graphite disseminated in low grade, fine grained argillaceous metasediments intercalated with metavolcanics. The graphite in both these types of deposit is crystalline but the particle size of 'amorphous' graphite is much smaller than that of flake graphite. A better term for this would be powder graphite since amorphous implies a lack of crystal structure which is not the case.

The uses of graphite have been described by Graffin (1983) and Taylor (1980). The major use of natural flake graphite is in crucibles, foundry facings and similar refractory items in the iron and steel industry. Lubricants, bearings, brake linings, packings, pencils and refractories use various amounts of natural graphite. Artificial graphite has taken over many of the uses of natural graphite in the electrical industries. However, uses that require a flake rather than a powdered product will continue to require natural graphite. Major world producers of graphite are the Republic of Korea, Sri Lanka (Ceylon), Malagasy Republic (Madagascar), URRS, Austria, Mexico, India, Czechoslovakia, and Norway.

Graphite production in Ontario ended in 1954 with the closure of the Black Donald Mine near Calabogie. Recent exploration activity in Southeastern Ontario has been directed at disseminated flake graphite in metasediments (Villard and Garland 1985, Kingston and Papertzian 1985, Garland 1987). The deposits investigated contain 2 to 4 weight per cent graphite and occur in metasediments of the Grenville Province of the Canadian Shield. In Table 18 several graphite deposits in other parts of the world, some of which are currently producing, are listed for comparison with those in Northwestern Ontario.

Of 10 recorded graphite occurrences, (Table 19) four are flake, five are powder, and the form of one is not determined. Four deposits were examined, two flake and two powder.

Graphitic metasediment units are commonly noted as EM conductors. The units usually contain sulphide minerals and a small amount of very fine grained graphite (powder graphite) in an argillaceous matrix. These are common in the Wabigoon Subprovince. The two powder graphite occurrences examined are in the same geological environment but contain more graphite and have small spherical cavities (called vesicles by Thomson (1937)), many of which are filled with loose graphite.

Flake graphite disseminated in metasediments is restricted to medium to high grade metamorphic terranes in the English River Subprovince. The rocks have been metamorphosed to inhomogeneous diatexite. They contain graphite flakes in amounts from less than 1% to 20%. The widths of the graphitic horizons vary from a few centimetres to several metres and they appear to be stratigraphically controlled. Similar deposits in Saskatchewan, southern Ontario, and Quebec have received recent attention from the graphite industry. Gneiss hosted graphite deposits and in Butt Township near Huntsville, Ontario are being evaluated for possible production (George Cross News Letter, December 5, 1984).

The origin of both deposit types seems to be metamorphism of organic material deposited with the sediment, similar to deposits described by Storey and Vos (1981) and Springer (1982) from metasediments of the Grenville Supergroup in Southern Ontario. Sedimentary rocks commonly frequently contain small amounts of organic material which can be pyrolized (decomposed by heat) during metamorphism. Literature cited by Springer (1982) states that amounts of graphite up to 20% are "within the expected range for normal sedimentary rocks." Flake graphite is only found in medium to high grade metamorphic rocks: the higher the grade, the larger the flakes.

Of the deposits examined only the flake graphite seeems to be present in quantities approaching economic grade. The Treelined Lake deposit has a width of 3 metres or more and an undetermined strike length; it occurs in metasediments that extends along the central part of the English River Subprovince from the Manitoba Border to the west end of Lac Seul. There is a good probability of more occurrences of this type in metasediments of the English River Subprovince. Other occurrences could occur in metasediments of similar metamorphic grade in other parts of the area.

Graphite is difficult to analyse for. The analyses presented in this report were done by analysing for total carbon, reported as CO_2, and carbonate carbon also reported as CO_2; the difference was taken as non-carbonate carbon and was converted to graphite. A more satisfactory method is to separate the graphite by flotation and express the graphite content as weight per cent of the original rock and analyse the graphite concentrate for its carbon content and non-graphite minerals.

Table 18 Graphite Deposits Similar to Those in Northwestern Ontario.

Country	Ore Type	Grade	Age	Reference
Austria	Metasediments	40-45%	?	(1)
Czechoslovakia		?	Precambrian	(2)
Canada				
(Quebec)	Metasediments		Late Precambrian	(3)
(Saskatchewan)*	"	5-10%	Precambrian	(3)
Malagasy Republic	Metasediments (deeply weathered sediment & grains)	3-10%	?	(1)
Norway	Metasediments	20-30%	Precambrian	(2)
USA (Texas)*	Metasediments (weathered schist)	5%	Precambrian	(4)
West Germany	Metasediments	20-25%	Carboniferous	(1)

References:
1. Graffin (1983)
2. Harben and Bates (1984)
3. Guliov (1984)
4. Taylor (1980)

* Deposits no longer in production (1985)

Table 19 Graphite Deposits

* G1	Corkscrew Island	powder
* G2	Pope Lake	flake
* G3	Sucan Lake Graphite	powder
* G4	Treelined Lake	flake
G5	Falcon Island	powder
G6	Manitou Stretch	powder
G7	Meehan	flake
G8	Olson	?
G9	Lount Lake	flake (?)
G10	Wilkinson	powder

Only deposits with an asterisk were examined.

G 1 CORKSCREW ISLAND

COMMODITY: Graphite

STATUS: Occurrence

LOCATION: NTS 52E/10 NE, District of Kenora.
49°40'46" North Latitude, 94°43'02" West Longitude
UTM Grid 376100 mE, 5504200 mN Zone 15.

ACCESS: The deposit can be reached from Lake of the Woods.

DESCRIPTION: Geological Setting: The area is underlain by intercalated metavolcanics and metasediments.

Previous Geological Work: The area has been mapped by Lawson (1886), and Thomson (1937). The deposit has been described by Thomson (1937), Parsons (1913), Lawson (1886) and Greenland (1913). Thomson describes the material as follows:

> The Corkscrew Island exposures are worthy of more detailed discussion. Here, a band of sediments has been preserved at various places along the shore and outcrops at intervals for a distance of almost half a mile along the strike. The maximum width of the band is about 25 feet. At this point a detailed section from south to north shows slaty chlorite schist on the south wall, then a series of six interbanded vesicular and non-vesicular chert zones. The vesicular chert ranges in width from 8 feet to less than 1 foot in width. Then comes a zone of black chert 10 feet wide. It is in sharp contact with sericite schist on the north boundary. Samples of typical vesicular chert and the non-vesicular variety were taken from this location for rock analyses, and their composition is recorded below. Contrary to the observations of Lawson, the vesicular chert contains little or no pyrite in the form of round balls filling the spherical holes, although occasionally a few pyrite cubes are found in or near narrow silicified and pyritized zones in the adjoining chert.
>
> Freshly broken samples of the vesicular chert show a dense, black, slate-like groundmass. The spherical cavities generally occur at irregularly located zones in the rock, but some samples are full of these small holes and resemble pumice in texture. The cavities range from half an inch in diameter to microscopic dimensions. The greater number of these are empty, but some are partly enclosed by a narrow rim of quartz. At a few exposures the vesicles are filled with pyrite or marcasite, but this condition is rare.

Thin sections of the black chert show the rock to be composed of tiny quartz grains with delicate wisps of carbonaceous material interlaminated between bands of quartz. There are also traces of sericite. The vesicular graphitic chert consists of the same mineral assemblage, but the graphite particles are often so numerous that they make parts of the section almost opaque. The primary quartz and graphite of the groundmass appear to have been deposited simultaneously. Secondary quartz occurs as small veinlets, which run in all directions through the groundmass, and also as small columnar crystals arranged in a radial fashion around the rim of a vesicle. Traces of sericite are sometimes found with the secondary quartz.

Geology: The deposit is composed of lens shaped masses of vesicular graphitic metasediment in fine grained black slaty metasediments intercalated between fine grained grey-green schistose metasediments. At the point examined (Figure 11) the black slaty unit is 3 metres wide. Foliation in the slate and adjacent rocks trends 095°/90° to steep north. The highly graphitic parts make up only a small proportion of the black unit. The graphitic material is very similar to that of Sucan Lake deposit.

A sample of graphitic material was submitted for major and trace element analysis. Results are given in Table 20, below:

TABLE 20 Analytical results

SiO_2	76.4%	Au	80ppb
Al_2O_3	10.0%	Co	<5ppm
Fe_2O_3	3.78%	Cr	<82ppm
MgO	0.08%	Cu	50ppm
CaO	0.09%	Li	10ppm
Na_2	1.06%	Ni	<5ppm
K_2O	0.91%	Pb	114ppm
TiO_2	0.60%	Zn	38ppm
P_2O_5	0.0%		
MnO	0.01%		
CO_2	16.3%		
S	0.13%		
LOI	7.5%		
TOTAL	100.4%		

In the analysis all carbon is expressed as CO_2 this corresponds to total CO_2 of 0.65% and non-carbonate carbon (graphite) of 4.4%.

HISTORY: There has been no recorded extraction of this material.

REFERENCES: NTS Map 52E/10

Greenland, C. W.
1913: On the Origin and structure of the Carbonaceous schists of the Lake of the Woods; Transaction Canadian Mining Institute Vol. 16, p. 584-597.

Lawson, A. C.
1886: Report on the Geology of the Lake of the Woods Region; Geological Survey of Canada Vol. 1, Part cc new series.

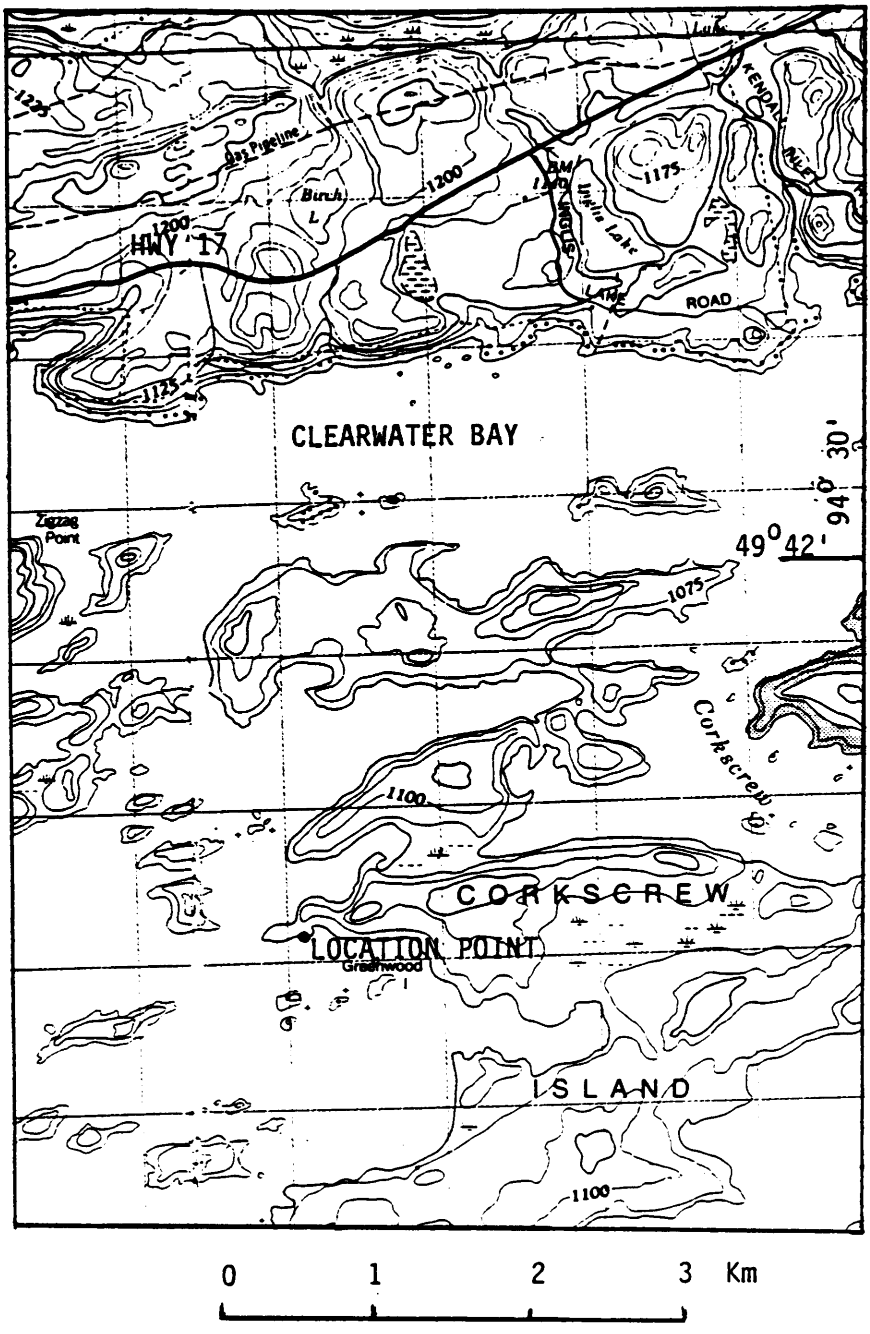


FIGURE 11. Location map Corkscrew Island Graphite Deposit

Parsons, A. L.
1913: The Lake of the Woods and other Areas, Kenora District; Ontario Bureau of Mines Annual Report, Volume 22, Part 1, p. 210-232, for 1913.

Thomson, J. E.
1937: Geology of the North Central Part of the Lake of the Woods; Ontario Department of Mines Annual Report, Vol. 45, Part 3, for 1936.

G 2 POPE LAKE

COMMODITY: Graphite

STATUS: Occurrence

LOCATION: NTS 52F/14 NE Mutrie Township, District of Kenora.
49°52'34" North Latitude, 93°13'03" West Longitude
UTM Grid 484400 mE, 5524750 mN Zone 15.

ACCESS: The deposit is at the southwest corner of Pope Lake and can be reached by traversing through the bush from an old disused logging road that leaves a township road (Figure 12).

DESCRIPTION: Geological Setting: The area is underlain by metasediments (metagreywacke).

Previous Geological Work: The surrounding area has been mapped by Breaks et al (1976).

Geology: The rocks are exposed only sporadically along the lakeshore. The graphitic rock is fine grained rusty weathering metasediment containing a small amount of disseminated pyrite and pyrrhotite. The rock is foliated 110°/75° to 80° N. Fine disseminated graphite flakes make up less than 1% of the rock. Samples of fresh and weathered graphitic rock were analysed for major and trace elements, results are tabulated below.

84-178 red, friable partly weathered rock from ridge immediately above a campfire site.
84-179 rusty weathered graphite bearing metasediment, contains disseminated pyrite and pyrrhotite.

Trace element analysis of the freshest rock present indicates a high copper content and a very high zinc content. In spite of a deep red colour, the weathered material contained only a small amount of iron oxide.

Table 21. Analytical results.

Major Element Analysis 84-178

SiO_2	68.4
Al_2O_3	15.0
Fe_2O_3	2.27
FeO	0.51
MgO	0.85
CaO	3.97
Na_2O	1.89
K_2O	4.53
TiO_2	0.34
P_2O_5	0.02
MnO	0.04
CO_2	1.32
S	0.09
H_2O+	0.26
H_2O-	0.16
LOI	1.2
TOTAL	99.6

	84-179	84-179D
Au	6	4
Co	19	20
Cr	54	54
Cu	180	179
Li	6	6
Ni	41	41
Pb	30	30
Zn	930	925
F	80	90

HISTORY: The deposit was originally staked during uranium exploration in the 1970's but there is no information on record.

REFERENCES: NTS Map 52F/14

Breaks, F. W. Bond, W.D., Westerman, C. J. and Harris, N. 1976: Operation Kenora-Ear Falls, Dryden-Vermilion Bay Sheet, District of Kenora; Ontario Div. Mines, Prelim. Map P.1203, Geol. Ser., scale 1:63,360 or 1 inch to 1 mile, Geology 1975.

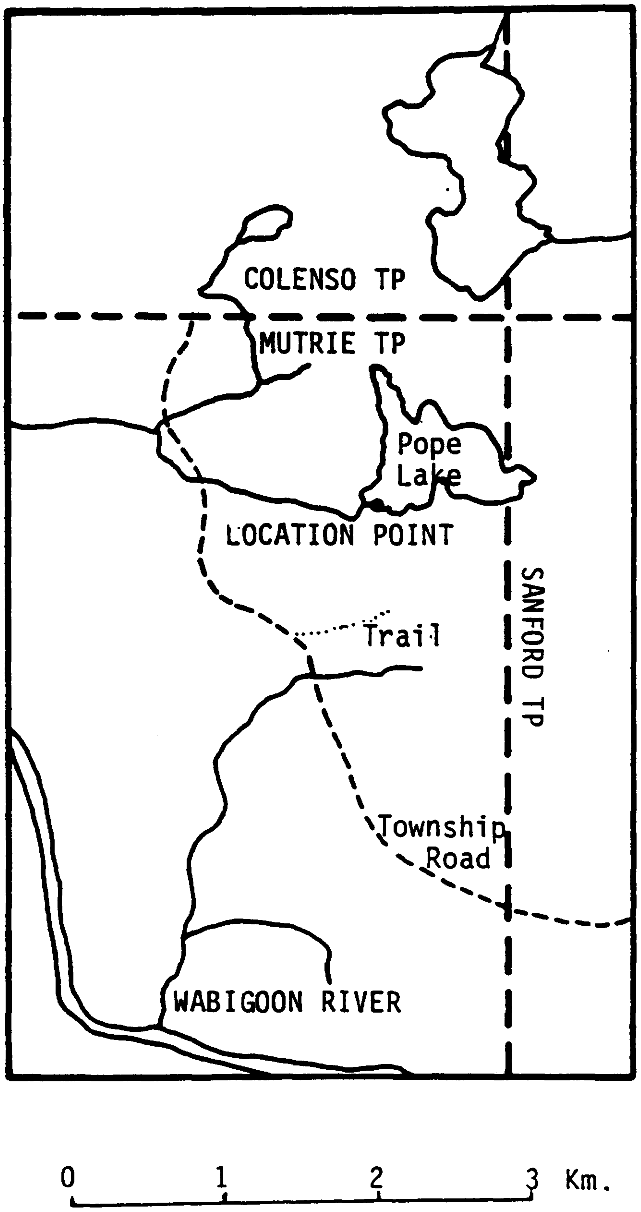


FIGURE 12. Pope Lake Graphite deposit location map

G 3 SUCAN LAKE GRAPHITE

COMMODITY: Graphite

STATUS: Occurrence

LOCATION: NTS 52F/3 SE, District of Kenora.
49°07'04" North Latitude, 93°25'57" West Longitude
UTM Grid 468400 mE, 5440400 mN Zone 15.
See Figure 34 for location map.

ACCESS: The deposit can be reached from Sucan or Straw Lakes (Figure 34).

DESCRIPTION: Geological Setting: The area is underlain by metasediments and metavolcanics of the Wabigoon Subprovince.

Previous Geological Work: The area has been mapped by Edwards and Sutcliffe (1984), and Thomson (1935). The description below is from Thomson:

> Freshly broken rock specimens show a dense, black, slatelike groundmass. At irregularly located zones in the rock spherical cavities occur. Some have very minute dimensions and others are half an inch in diameter. The greater number of these are empty, but some are filled with a framework of delicate graphite flakes. In the Sucan Lake material an occasional vesicle is filled with pyrite or marcasite. The spherical cavities are often enclosed by a narrow rim of quartz.
>
> Thin sections show the rock to be composed entirely of quartz, graphite, and a few tiny flakes of sericite. The groundmass consists of small quartz grains, which in some sections are surrounded by a rim of graphite. Some pieces of graphite are interstitial between quartz grains. Sometimes alternate bands of quartz and graphite may be observed. It is very probable that the quartz and graphite in the groundmass were deposited simultaneously. Around the periphery of the vesicles small columnar quartz crystals are radially arranged. These form a part of the quartz veinlets that run throughout the groundmass in an irregular fashion. All of this later generation of quartz was introduced after the consolidation of the rock. Sometimes graphite is seen in a vesicle within the enclosing rim of quartz crystals

Geology: There is little bedrock exposure in the area. The graphitic unit described by Thomson is found as float along the lakeshore but not in outcrop. Powdery graphite occurs in 2 to 5 mm vesicles in a fine grained black ground mass. The vesicles are commonly rimmed with white quartz. Graphite powder spills out of any opened vesicle when samples of the rock are handled.

The overburden along the shore is dark gray and sooty in appearance.

Chemistry: X-ray diffraction mineralogy indicated the following minerals present: quartz, feldspar, mica, chlorite, graphite. CO_2 does not appear in the total because it is determined by a seperate procedure. Major element analysis of this rock indicates the following composition:

Table 22 Major element analyses by different methods

	XRF	Chemical
SIO_2	60.0	58.4
Al_2O_3	12.0	8.7
Fe_2O_3	0.0	0.1
MgO	0.22	0.1
CaO	0.15	0.1
Na_2O	2.54	2.35
K_2O	1.76	1.64
TIO_2	0.48	0.13
P_2O_5	0.02	0.02
MnO	0.00	0.00
S	0.48	0.48
LOI	21.0	21.0
Total	98.2	92.5

Total carbon as CO_2 - 63.7%

Laboratory comments
Note: The sample contains considerable graphite making the analysis difficult. We performed both chemical and spectrographic analysis on the sample; the two methods show good agreement, the minor variations are almost certainly due to the difficult matrix. The analysis that totals closest to 100% is probably the better one. Total carbon is reported as CO_2 at 63.7%. This is equivalent to 17.4% C. Carbonate carbon was also determined; the value found was 0.52% CO_2. Thus the net amount of graphitic carbon is 17.2% (by difference).

HISTORY: There has been no recorded production of material from this deposit

REFERENCES: NTS Map 52F/3

Edwards, G. R. and Sutcliffe, R. H.
1984: Straw Lake; Ontario Geological Survey Map 2463, Precambrian Geology Series, Scale 1 inch to 1/2 mile Geology 1976.

Thomson, J. E.
1934: Geology of the Straw-Manitou Lakes Area; Ontario Department of Mines Annual Report, Volume 43, Part 4, for 1934.

G 4 TREELINED LAKE

COMMODITY: Flake Graphite

STATUS: Occurrence

LOCATION: NTS 52L/8 SW District of Kenora.
50°17'54" North Latitude, 94°27'28" West Longitude
UTM Grid 396200 mE, 5572600 mN Zone 15.

ACCESS: The deposit is 59 km north of Kenora. The English River Road passes about 2 km south of the deposit.

DESCRIPTION: Geological Setting: The area is underlain by diatexitic metasediments of the English River Subprovince.

Previous Geological Work: The area has been mapped by Breaks et al (1975). The occurrence was described by Redden (1987) subsequent to this study and there is a confidential property visit report on file in the Kenora Resident Geologist Office.

Geology: The deposit occurs in highly metamorphosed metasediments that contain a large proportion of pegmatitic remobilized material. The metasediments trend east-northeast but this is locally variable (050° to 110° layering) and dip to the north at variable angles. Graphitic zones vary widely in graphite content from less than 1% to 15% (visual estimate) and in width from 0.5 m to greater than 5 m. The occurrence can be divided into two parts: the north section with abundant (50%) leucocratic mobilizate intruding fine to medium grained biotite metasediment (restite) and the south part containing the main graphite showing consisting of highly graphitic biotite metasediment and a smaller proportion of mobilizate. In both parts the restite material is similar. Layering in the metasediments is 2 to 5 cm in thickness. Graphite flakes range in size from very small (less than 0.1 mm) to 2 mm and larger; most are in the 1 mm size range. The layers with the highest graphite content have the largest flakes. Graphite occurs in both the mobilizate (pegmatite) and the restite (metasediment). Dissemminated pyrite and pyrrhotite are present in the restite in places forming lensoid concentrations. Examination of the various pits and trenches on the deposit indicated the highest graphite content in the south part of the deposit. A pit in this unit indicated a graphite zone at least 3 m wide with graphite rich layers .3 to .6 m. Point counts of thin sections of the graphite rich material indicate 17% to 20% total opaque minerals (graphite plus sulphide) of which most is graphite. The grain size of the metasediment is 0.1 to 0.5 mm with occasional mafic mineral grains. The results of X-ray diffraction mineralogy performed on four samples of graphitic rock are in Table 23. The dominant mineral is quartz. A sample of the graphitic rock from the south pit was analysed for gold and contained 40 ppb Au.

Table 23. X-ray difraction mineralogy

Sample	Quartz	K-feld.	Plag. Feld	Mica
84-86	A	B	-	D
84-89	A	B	-	D
84-93	A	-	A	D
84-95	A	B	B	C

HISTORY: The deposit was discovered in 1968 as a uranium occurrence. It was restaked in 1976 by John Harrison and George Perkins again as a uranium occurrence. The south graphite pit was sunk at this time. There had been no evaluation of its graphite potential prior to this study, and its uranium potential appears to be limited.

REFERENCES: NTS Map 52L/8

Breaks, F. W., Bond, W. D., McWilliams, G. H., Gower, C. F., Findlay, D., and Stone, Denver
1975: Operation Kenora-Sydney Lake, Umfreville-Separation Lakes Sheet, District of Kenora; Ontario Div,. of Mines, Prelim. Map P.1028 Geol. Ser., scale 1 inch to 1 mile or 1:63,360. Geology 1974.

Redden, J. W.
1987: Industrial Minerals Project; in Sioux Lookout Resident Geologist's Area, Northwestern Region: p. 46-71 in Report of Activities 1986, Regional and Resident Geologists, edited by C. R. Kustra. Ontario Geological Survey, Miscellaneous Paper 134, 322p.

Resident Geologist Files, Kenora

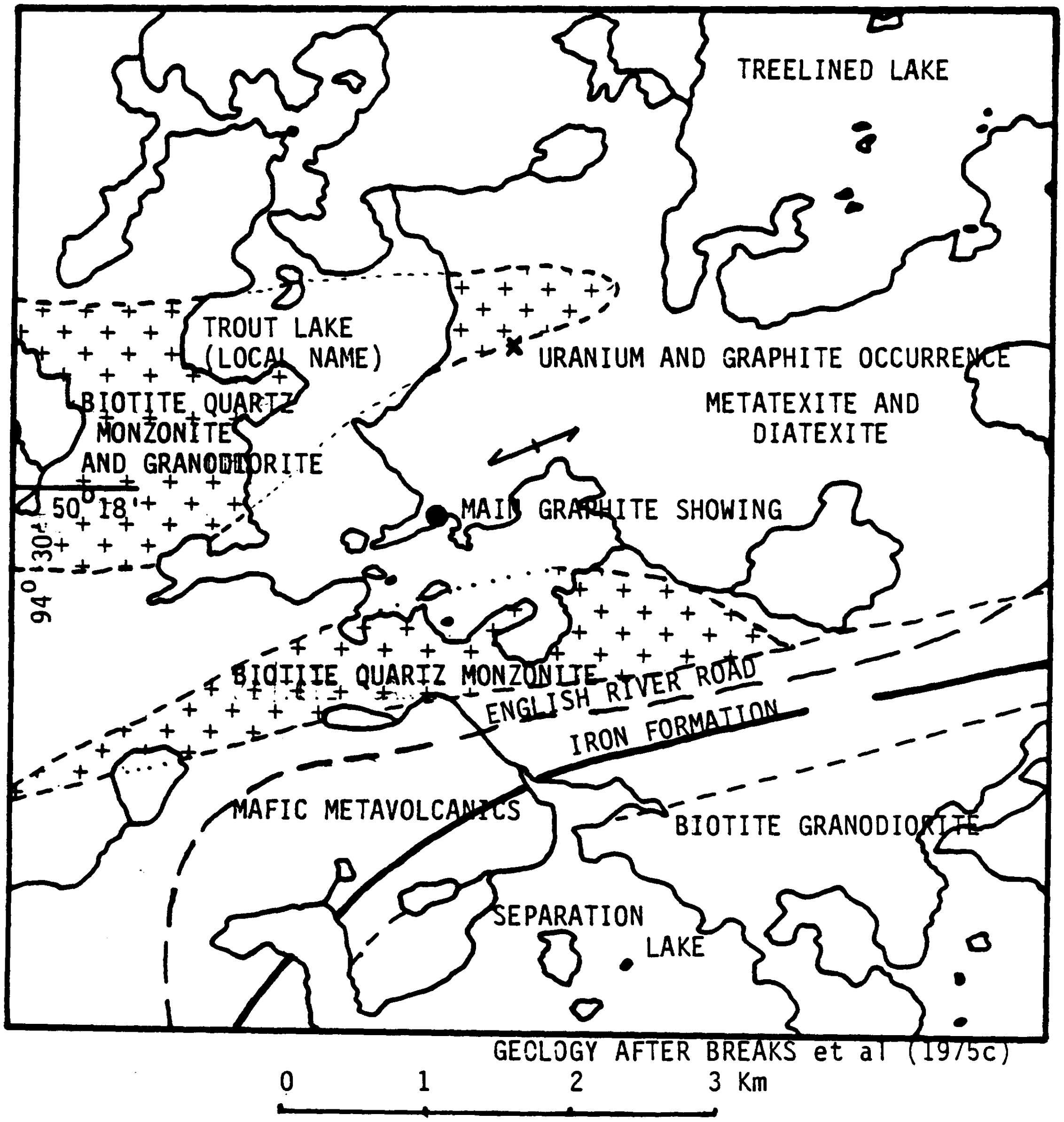


FIGURE 13. TREELINED LAKE GRAPHITE DEPOSIT

MICA

Micaceous minerals (muscovite, phlogopite, and biotite) are common in igneous and metamorphic rocks. Granitoid rocks contain 3% to 10% mica, usually biotite. Pegmatites contain biotite and/or muscovite as a major constituent and have been the prime source of sheet muscovite for electrical, electronic and other uses for many years. The use of sheet mica is declining due to technological changes and the demand for deposits with large sheets is likewise declining. The trend in mica consumption is to use fine-ground, delaminated mica flakes as reinforcing filler in plastics and an extender and filler in paint and building materials. Guillet and Kriens (1984) discuss the uses and sources of modern mica products.

Mica produced for filler use is either muscovite or phlogopite, however muscovite is preferred because of its light colour. Mica is produced as a by-product of feldspar or spodumene mining and in some cases is produced from residual deposits mined primarily for kaolin. Mica is also mined from schistose rocks in Quebec and Scotland (Guillet and Kriens (1984). The Suzorite deposit of Suzor Township, Quebec contains 85 to 90% phlogopite with minor feldspar and pyroxene in a high grade metamorphic terrane. In Southern Ontario, a muscovite-quartz schist deposit in Kaladar Township containing about 60% muscovite has been examined recently as a possible source of flake muscovite (Kingston and Papertzian, 1984) and a similar deposit in Clarendon Township, Frontenac County is also reported. This type of deposit can also produce quartz, garnet, or other minerals as co-products.

In addition to muscovite and phlogopite, a small amount of biotite is produced (in combination with muscovite) in the United States for oil well drilling fluid (Guillet and Kriens, 1984). Biotite is not as useful as a filler because of its black colour, thick brittle flakes and low dielectric strength. Chlorite could be of some value as a filler. Vermiculite is mica (phlogophite or biotite) that has been affected by natural surficial or hydrothermal alteration (addition of interlayer water) so that it expands greatly when flash fired.

In Northwestern Ontario only small amounts of pegmatitic mica have been produced (Falcon Island and Harrison Mica deposits). A deposit of quartz-muscovite schist west of Sioux Lookout, known as the Rainbow Quarry, contains up to 37.5% muscovite in layers of fine flakes. Other micaceous rocks may be present. Vermiculite is reported in the Carb Lake and Schryburt Lake carbonatite complexes (Sage 1976, 1983b,c, Vos et al 1982). Biotite is common in granitoid rocks and chlorite in metavolcanic rocks and soapstone deposits (Storey 1984). Phlogopite deposits have not been reported in Northwestern Ontario. There is a small possibility of producing by-product muscovite from the lithium and rare element pegmatites near Dryden if these pegmatites were ever brought to production. Mica schist deposits are the most promising for future development provided large deposits can be found. Metasediments of the English River Subprovince and parts of the Wabigoon Subprovince could contain mica schist deposits similar to that at the Rainbow Quarry.

Examination of some of these metasediments was not encouraging, many of the English River metasediments are very hard diatexite and have only a low mica content.

Muscovite forms early in metamorphism of pelitic sedimentary rocks and felsic volcanic rocks and persists into high-grade metamorphism. Although high grade metamorphism is not required to form muscovite schist, the Southern Ontario and Quebec deposits noted above are found in moderate to high grade terranes. Numerous examples of sericite schist (sericite is a muscovite-like mica produced by alteration) in fault zones in the Wabigoon and Uchi Subprovinces contain only a small amount of mica in tiny flakes that are distinguishable only by petrographic or X-ray methods. Many of the flagstone deposits examined by Storey (1983, 1984) are of this type. The correct primary rock composition is necessary to form the large amounts of mica found in minable deposits. Metasediment units of the correct mineralogy to form abundant muscovite are not common in the study area. The Rainbow deposit, although small, indicates that muscovite schists containing a large proportion of mica can occur in Northwestern Ontario.

MICA 1 RAINBOW QUARRY

COMMODITY: Mica

STATUS: Occurrence

LOCATION: NTS 52K/1 SW
The deposit is located 0.8 km west of the west boundary of Vermilion Additional Township, District of Kenora.
50°14'53" North Latitude 92°17'35" West Longitude
UTM Grid 550500mE 5547700mN Zone 15.

ACCESS: The workings are reached by gravel road from Hudson as shown in Figure 14.

DESCRIPTION: Geological Setting: The area is underlain by mafic to intermediate metavolcanics with intercalated metasediments.

Previous Geological Work: The area has been mapped by Hurst (1933), and Johnston (1972). The deposit has been described as a decorative stone quarry by Storey (1983). A description of the deposit is found in the Sioux Lookout Resident Geologist's Files.

Geology: The deposit comprises two quartzite units with fuchsite-mariposite and muscovite developed in thin layers parallel to the strike of the units. Workings consist of a 46.5 m long trench 3 m wide at the east end and 1 m wide at the west end oriented parallel to the strike of the unit. The rocks exposed on the property are mafic metavolcanics, some units showing highly deformed pillows with intercalated micaceous quartzite and wacke units. A well developed foliation trends 090° to 095° and dips 75° to 80°south. Green fuchsite-mariposite is developed in 1 to 2 mm layers parallel to the foliation separated by 2 to 10 mm of white sugary quartz. The green mica is also present in much smaller amounts throughout much of the quartzite giving most of it a light green colour. A white muscovite-quartz unit is exposed in the south side of the trench. This part of the deposit is folded into many en echelon dragfolds plunging 83° in direction 050°. The unit is approximately one metre wide but is thickened by drag folding. The rock breaks readily along the foliation particularly the white muscovite unit. The quartzite is exposed on the north limb of a north eastward plunging fold and similar units without the fuchsite/mariposite can be found on the south limb at the same stratigraphic level (R. Huggins, Resource Geologist Sioux Lookout, personal communication, 1982). Two samples of material were submitted for X-ray diffraction mineralogy. The results are shown in Table 24, below:

TABLE 24. X-ray Diffraction Mineralogy

	Quartz	Plagioclase	Muscovite
82-196	A	-	B
82-224	A+	?C	C

Other minerals (amphibole, chlorite, talc, serpentine, dolomite, calcite, magnesite) were not detected in these samples.
82-196 is the white muscovite-quartz material
82-224 is the green mariposite material
Both these samples are predominantly quartz. Both muscovite and mariposite/fuchsite appear as muscovite in the X-ray pattern. The ? indicates some uncertainty in the identification of plagioclase.

The rock is white to very pale green and is sugary in appearance with bright reflective muscovite layers. A thin section of the white mica schist cut perpendicular to the foliation was found to consist of 37.5% mica and 62.5% quartz. Most mica occurs in layers 0.1 to 0.5 mm thick separated by 0.2 to 1 mm quartz layers. Mica flakes in the layers are up to 1 mm long and often appear continuous, and a small amount of quartz appears in the mica layers. In the quartz layers grains 0.2 to 1.5 mm long are elongate parallel to the layering; isolated small (0.1 mm) mica flakes occur throughout the layers. Approximately 15% (visual estimate) of the mica occurs as isolated flakes. The quartz does not appear strained although the sample shows small folds.

HISTORY: The deposit was stripped and trenched circa 1972 by Rainbow Quarries Ltd. A small amount of material was removed for ornamental purposes and was marketed under the name Hudson Jade prior to 1984. The deposit was under quarry permit to Rino Moretti of Sioux Lookout, Ontario but this permit was cancelled in 1985. The white micaceous material has not been quarried.

REFERENCES: NTS Map 52K/1

Hurst, M. E.
1933: Geology of the Sioux Lookout Area; Ontario Department of Mines Annual Report, Vol, 41, Pt. 6, for 1932 p1-33.

Johnston, F. J.
1972: Geology of the Vermilion-Abram Lakes Area, District of Kenora; Ontario Division of Mines Geological Report 101.

Storey, C. C.
1983: Preliminary Report of the Building and Ornamental Stone Inventory, Kenora and Rainy River Districts; Ontario Geological Survey Open File Report 5446, 143p, 20 tables, 37 figures.

Resident Geologist Files, Sioux Lookout.

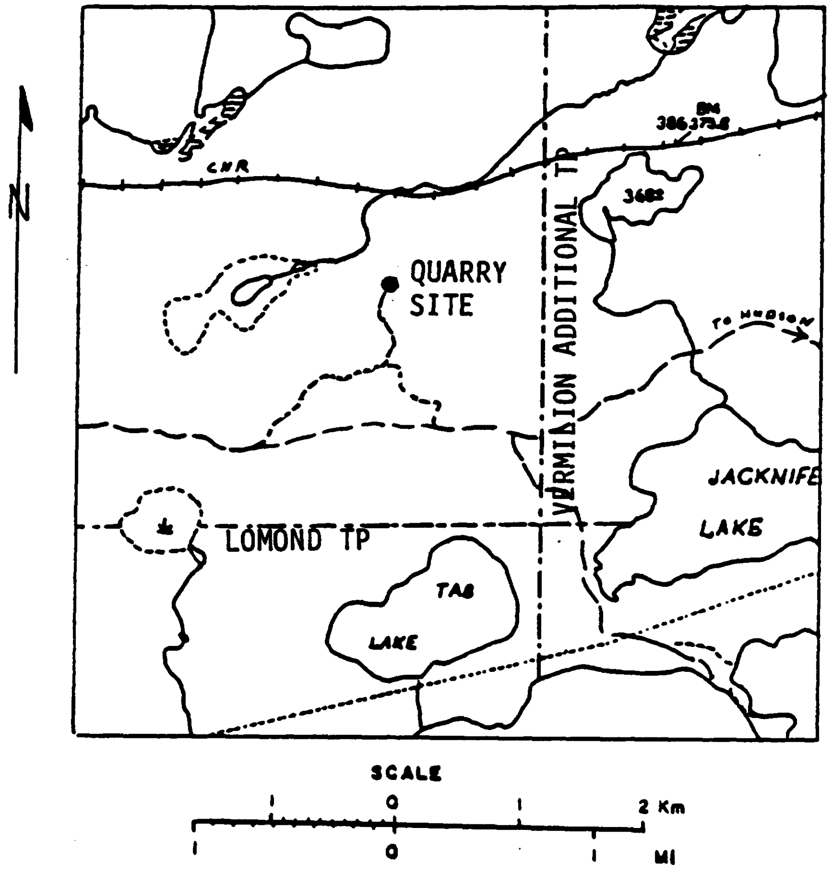


FIGURE 14. Rainbow Quarry location map

PEGMATITE

Pegmatite deposits contain a wide variety of potentially valuable minerals. The most common of these are feldspar, mica and quartz. While these minerals comprise the bulk of all pegmatites, only three deposits in the area have been investigated solely for them. Most of the recorded pegmatite deposits were initially examined for uranium, lithium, or beryllium mineralization and several were examined for tantalum during 1979 and 1980. Production of pegmatite minerals has been limited to feldspar (Falcon Island deposit by the Falcon Island Mining Company) and mica (Harrison Mica deposit at Cobble Lake, Falcon Island deposit, and a small pegmatite near Oxdrift Station). These were small short lived ventures more in the line of bulk sampling than mining. What little is known of the history of the Harrison Mica and Falcon Island deposits is described in the appropriate property descriptions.

The literature on pegmatites is extensive and includes: the origins of pegmatites (Jahns 1953; Jahns and Burnham 1969; Mulligan 1960); exploration for pegmatite commodities (Norton and Page 1956; Beus 1962, Beus et al 1968, Ovchinnikov 1976, Rose 1976, and Trueman and Cerny 1982); and compilations of deposit information (Hewitt 1952, 1967). Hewitt (1967) describes the major pegmatite commodities and lists the recorded deposits of each in Ontario. Cameron et al (1949) described the internal structures of pegmatites based on extensive work by the United States Geological Survey during World War II. Cerny (ed.) (1982a) gives an up-to-date overview of research on pegmatites. Breaks (1979, 1980, 1983) examined many of the pegmatites in the Dryden, Sandy Creek, and Roadhouse River areas.

Pegmatites are formed by crystallization from volatile-rich melts derived from either partial melting of supracrustal rocks (diatexis) or the late stage volatile rich phases of granitoid igneous intrusions. Such volatile rich melts tend to contain all the elements whose ions do not fit into the crystal lattices of common rock forming minerals resulting in a concentration of these ions in the last liquid phases as the melt cools and crystallizes. When the last liquid phase finally crystallizes the resulting rock has the exotic mineralogy so characteristic of pegmatites.

Pegmatites are found in medium to high grade metamorphic terrains intruded by granitoid rocks. In Northwestern Ontario, the English River Subprovince consists of diatexitic metasediments and metavolcanics and numerous igneous bodies. Large areas of diatexite (migmatitic rocks characterized by a pegmatoid phase or mobilizate injected into a foliated metasediment host rock or restite) are found toward the north of the subprovince (Northern Supracrustal Domain of Breaks et al, 1978). In this terrain, rare element mineralization is found in some pegmatites formed from highly fractionated residual diatexitic magmas (Breaks et al 1978). Numerous pegmatoid bodies, some of which bear exotic minerals but most of which consist only of quartz, feldspar, and micas, occur in the diatexite. Most of the rare element pegmatites are white to very light pink in colour and show replacement and alteration zones. Known rare element pegmatites occur along the margins of the English River Subprovince where it interfaces with metavolcanics of the Wabigoon and Uchi Subprovinces, and associated with metavolcanic belts within the English River Subprovince. Large pegmatite fields in the Dryden area containing rare elements are associated with late stage granitoid bodies possibly formed in part by diatexis. Other pegmatite fields are not as large but are of a similar origin. Several pegmatites, some with beryl, occur in areas of the Wabigoon Subprovince (Graphic Lake, Falcon Island) away from the recognized English River granitoid bodies.

Pegmatites were injected into their host rock as indicated by frequent xenoliths in the pegmatite and apophyses of pegmatite into the host rock. Pegmatites occur in groups (swarms) of similar mineralogy that are related to a particular granitoid batholithic complex.

PEGMATITE COMMODITIES

Pegmatoid rocks are the source of three groups of mineral commodities: non-metallic minerals (feldspar, mica, quartz) for use in the glass, ceramics and other industries; rare element minerals (beryllium, cesium, tantalum, lithium, rare earths, etc.) used in a wide variety of metallurgical, and high technology industries and as additives in some ceramic and glass mixtures (Edwards and Copley, 1977); and uranium. The first group has been discussed by Hewitt (1952, 1967), and Storey and Vos (1981). Non-metallic mineral pegmatites containing only feldspar, mica, and quartz (barren pegmatites, ie no exotic minerals) can be found associated with most granitoid complexes. Rare element pegmatites have been discussed by many authors including Hewitt (1967) and Mulligan (1965, 1968). In Northwestern Ontario they are found primarily along the margins of the English River Subprovince. While there has been much exploration of pegmatites for rare elements and uranium, the only production has been of non-metallic minerals which can be produced from both barren and rare element pegmatites. Co-production of rare elements and non-metallic commodities is done in North Carolina (Searls, 1980). Major pegmatite deposits in Manitoba described by Crouse and Cerny (1972), and Cerny (1982b), occur in a similar geological environment to the Northwestern Ontario pegmatites. Table 26 lists the known pegmatite deposits and the recorded commodities, if any, that they contain or have produced. Pegmatites do not often lend themselves to bulk mining techniques. The high cost of selective mining and mineral sorting limits pegmatite deposits to high-value minerals and a few special commodities (such as high potasium feldspar for high voltage electrical insulators) that can justify the costs involved.

MINERALOGY

Granitic pegmatites have the same major minerals as granitoid rocks, ie quartz, potassium feldspar, sodium feldspar, biotite, and muscovite. The accessory minerals include apatite, beryl, columbite, garnet, spodumene, tourmaline, pollucite, columbite, tantalite, molybdenite, uranium, and rare earth minerals. The major minerals are usually present in proportions that give the rock a classification of granite to quartz monzonite and occasionally granodiorite. The most prevalent mineral is microcline, usually perthite which is white to pink in colour. Soda feldspar (albite and oligoclase) occurs as a primary mineral and as a replacement of primary potassic feldspar (albitization). Peristerite is present in some of the pegmatites. The colour of feldspar can be used to divide pegmatites into two groups: pink and white. Pink colouration is commonly due to fine disseminated hematite (similar to granitoids) although colour is also affected by ion substitution and crystal lattice disruption. Both potassic and sodic feldspars can be coloured but usually the potassic feldspars are pink, the sodic feldspars are white. Euhedral (blocky in the Russian literature) feldspars are common. Quartz is the next most common pegmatite mineral. Most of it is white to light grey in colour. It occurs as monomineralic segregations (quartz core), as various sized grains intermixed with feldspar grains, and as graphic intergrowth with feldspar (graphic granite). Smoky quartz is present in uraniferous pegmatites but is rare or not present at all in the non-uraniferous pegmatites.

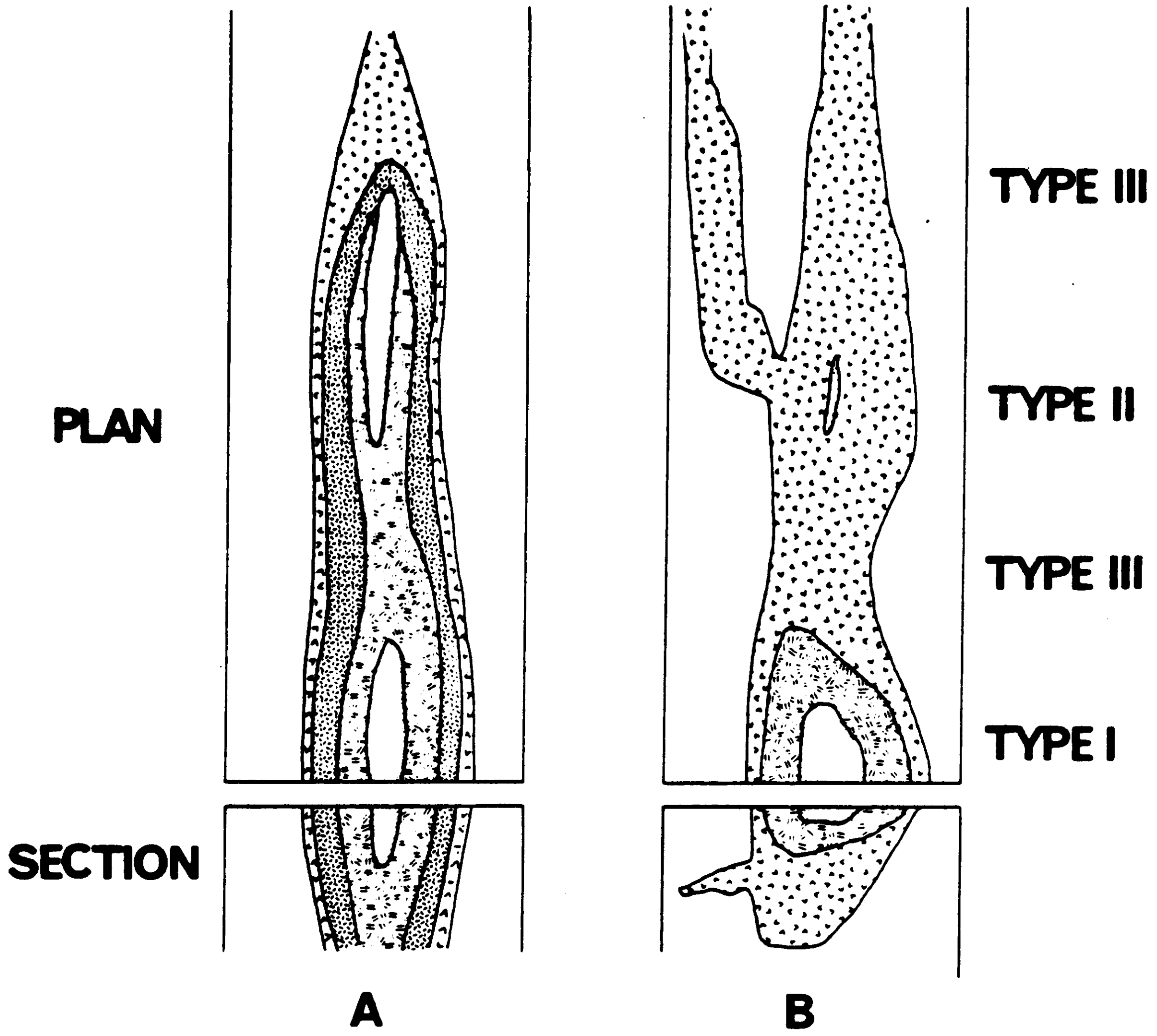
Both biotite and muscovite may be present. Some pegmatites have both micas, some only one. Micas occur in 'books' ranging in size from a few millimetres to several tens of centimetres (these are relatively rare, reported only in the Falcon Island, Harrison and Oxdrift deposits). Muscovite is colourless to pale green, the latter commonly associated with the lithium pegmatites of the Dryden pegmatite field. Biotite is the most common mica in pegmatoid rocks (just as it is the most common mica in granitoid rocks). Where both micas are present muscovite is usually subordinate to biotite.

While a wide range of accessory minerals can be present, the economically important accessory minerals (beryl, columbite, tantalite, spodumene, pollucite, etc.) are present in only a few pegmatites and then only in very small amounts. Spodumene is a notable exception in that when it does occur it makes up a significant proportion of the pegmatite. Accessory minerals are commonly restricted to only one or more zones of a pegmatite.

ZONING

There are two types of zoning in pegmatites, internal mineralogical zoning, and zoning of the pegmatite field as a whole. One of the most characteristic features of pegmatites is mineralogical zoning. The following excerpt from Cameron et al (1949), quoted Storey and Vos (1981), describes zoning in its idealized form:

> 1. Border zone - thin, fine-grained material adjacent to the contact with the host rock
> 2. Wall zone - next zone after border zone, thicker and much coarser than border zone (name comes from long established usage in the United States pegmatite industry; Jahns 1949)
> 3. One or more intermediate zones - which may or may not be continuous shells
> 4. Core - innermost zone, usually a series of pods in the central area of the pegmatite.
>
> In addition to these zones, pegmatites may also contain fracture fillings and replacement bodies (formed by replacing pre-existing pegmatite). The contacts between zones may be sharp or gradational. The intermediate zones are not necessarily continuous shells. The core is usually not continuous, rather being found as a series of lens-shaped pods in the central part of the pegmatite. The presence of



A. SHOWS CHANGES IN ZONING IN A TYPE I PEGMATITE.

B. SHOWS CHANGES FROM TYPE I TO TYPE II TO TYPE III ALONG STRIKE.

TYPE I. FULLY ZONED

TYPE II. RUDIMENTARY ZONED—SMALL QUARTZ CORE NOT NECESSARILY IN CENTRE, POSSIBLY A SMALL DISCONTINUOUS ZONE OF ACCESSORY MINERALS.

TYPE III. HOMOGENEOUS MIXTURE OF QUARTZ AND FELDSPAR SIMILAR TO TYPE I BORDER PHASE.

FIGURE 15 Mineralogical Zoning in pegmatites, from Storey and Vos (1981)

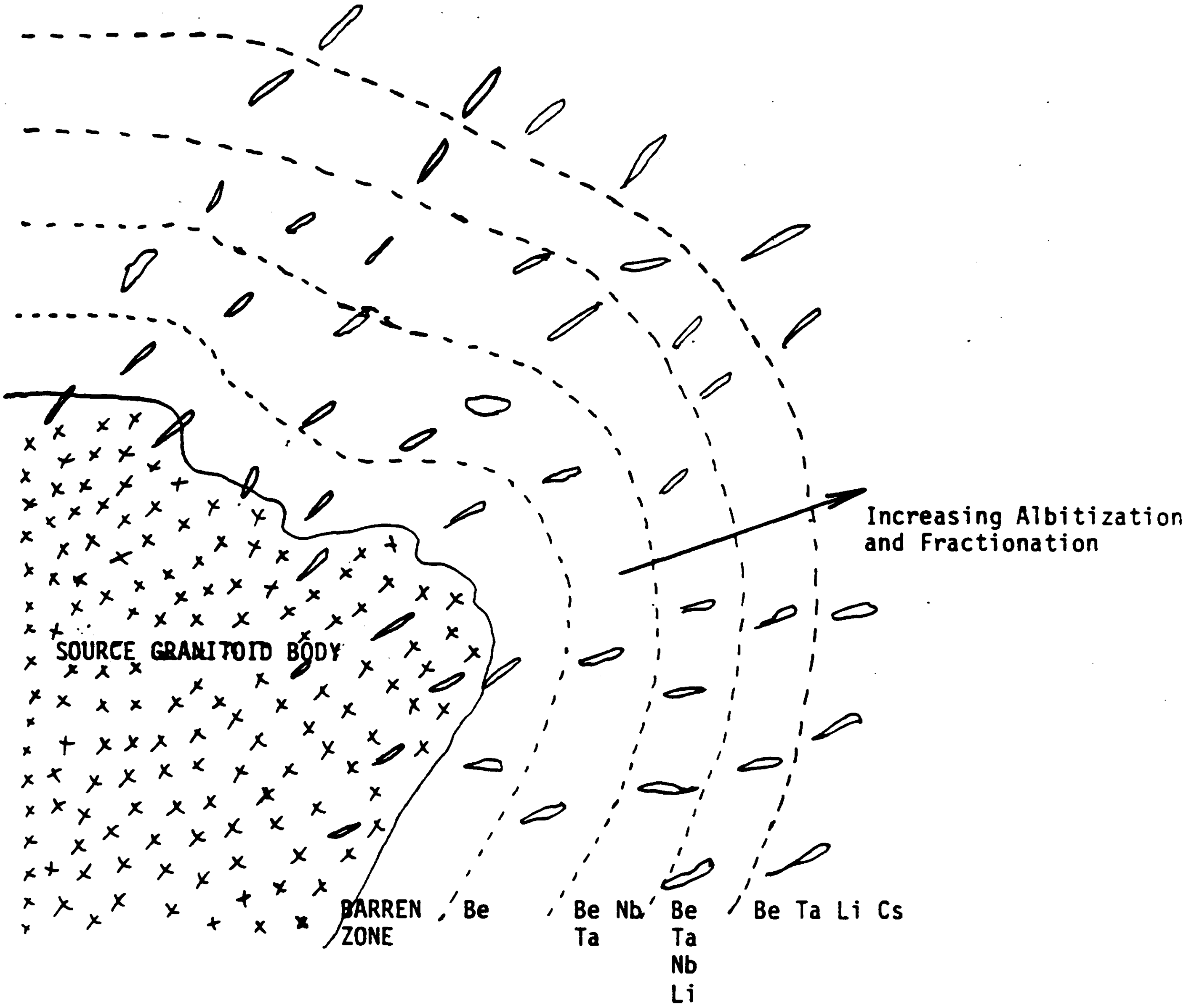


FIGURE 16 Pegmatite field zoning, after Truman and Cerny (1982)

zones does not appear to be dependent on the width of the body but it is a common occurrence for the wide parts of a body to be zoned and the narrow intervening parts to be more or less homogeneous.

Figure 15 illustrates these features. Completely zoned (Type 1, Fig. 15) pegmatites are rare in Northwestern Ontario; most are homogeneous or show only rudimentary zoning. Pegmatites in the Mavis Lake and Gullwing-Tot Lake fields contain extensive internal zoning. Replacement zones (sometimes affecting the entire body) are common. A few others (Harrison Mica and Graphic Lake) also show zoning.

Pegmatite field zoning follows an idealized pattern shown in Figure 16. The pegmatites become increasingly complex and enriched in rare elements away from the granitoid source. The pegmatites close to or within the source granitoid body contain only quartz, feldspar, and mica while those further away contain a wide variety of minerals including the rare element minerals that did not crystallize earlier in the pegmatite fractionation process. This gives rise to mappable zones of pegmatites each with a distinct mineral assemblage representing a certain stage of fractionation.

PEGMATITE RECONNAISSANCE

Known rare element pegmatites occur in several places in Northwestern Ontario. The intent of the reconnaissance work was to expand the known pegmatite fields and investigate pegmatite areas that have not been systematically examined in the past. Geochemical exploration for pegmatites has received a great deal of interest in the USSR; Trueman and

Cerny (1982a) review some of this literature. The emphasis of lithogeochemical surveys is to find alteration halos in the host rock caused by dispersion of highly mobile alkali elements from the pegmatite fluid phases, possible source granitoid bodies, and the actual mineralized pegmatites themselves. Work by Ovchinnikov (1976) and Pryslak and Hutton (1980) indicates that lithium is the most useful pathfinder element in pegmatite exploration.

Three types of material were sampled: pegmatite and pegmatoid granitic rocks, known pegmatite host rocks, and mica books from pegmatites. The results are in Table 27 with sample descriptions and locations. UTM grid locations are provided for each sample to allow the reader to plot the locations accurately on 1:50 000 National Topographic Series maps. Anomaly levels were set as the mean plus two standard deviations; these were calculated after the clearly anomalous high values were deleted from the data set (this was taken as any value higher than 400 ppm). Since the majority of the samples were from pegmatites or pegmatoid granitic rocks only those samples were used in the calculation.

Anomaly levels (in ppm) are listed in Table 25, below:

Table 25. Anomaly levels in pegmatite reconnaissance samples.

Ba	529	Be*	18
Co*	23	Mo*	16
Cr*	44	Nb	95
Cu*	33	Sc	31
Li	208 (240)**	Sr	278
Ni*	23	V	55
Pb	99	Y	43
Zn	110	Zr	102

* indicates elements with too few values above the analytical detection limit to give a reliable standard deviation.

** results from Pryslak and Hutton (1980).

A data set from Pryslak and Hutton (1980) (lithium analyses only) gave an anomaly level of 240 ppm for the metavolcanic host rocks of the Mavis Lake pegmatite deposits. Figure 17 shows histograms of the lithium distribution for both data sets and the combined data set. The histograms are similar for both the pegmatoid rocks and the metavolcanic host rocks, however the distribution for the pegmatoid rocks has a significant break at a lower value (180 ppm) than that for the metavolcanics (300 ppm). This is due to sampling the metavolcanics in a lithium pegmatite field where lithium enrichment is widespread. The lithium anomaly levels from both data sets are similar. In examining the data, any lithium value in excess of 100ppm but not over the anomaly level was considered to be high for this data set and is indicated in the Table 27 sample descriptions.

There is a preponderance of values in the interval from detection limit to 80 ppm, particularly in the data for the reconnaissance samples (Top graph Fig. 17). This supports considering any Li value greater than an arbitrary 100 ppm to be of interest. The 95th percentile (96th percentile for the reconnaissance data) for the data sets less than 400 ppm are indicated on Figure 17; the value (240 ppm) compares favourably with the anomaly level calculated. This value is also indicated as a percentile of the entire data set on each histogram. The reconnaissance samples have a large proportion of highly anomalous values far in excess of 400 ppm due to the bias of sampling near known rare element pegmatites. The Mavis Lake data set also has a large number of highly anomalous values but also has values in the 200 to 400 ppm range

Anomalous samples are indicated in Table 27. Known lithium and beryllium pegmatites gave clear lithium anomalies in both the pegmatite and host rock. Anomalies in the host rock or pegmatite samples are more significant than anomalies in mica-only samples. Sampling of micas indicates that lithium was present in the fluid phase of some pegmatites although not enough was present to form an anomaly in the rest of the rock. The presence of lithium anomalies indicates favourable areas for follow-up lithogeochemical sampling to define anomaly size, fractionation state of the pegmatites, and possible rare element mineralization. Sampling in the Graphic Lake area indicated lithium anomalies in an area where no lithium mineralization has yet been reported, but pegmatites simillar in appearence to known rare element pegmatites are present. Samples taken east of the Root Lake pegmatite field (84-2063, 2064, 2065) indicate a lithium anomaly east of the recorded spodumene pegmatites. The

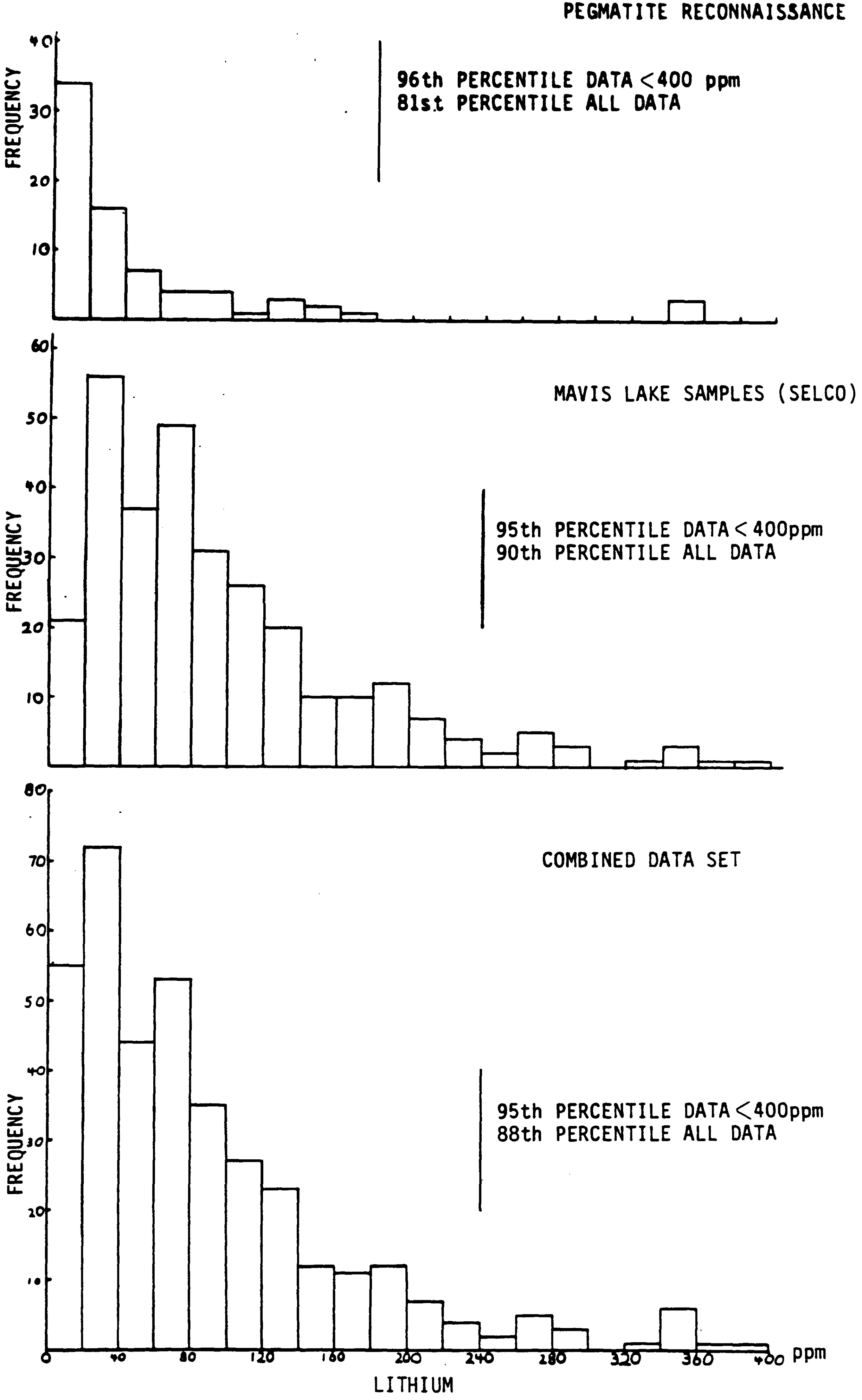


FIGURE 17 Lithium distribution in pegmatite samples

pegmatites that contain rare element mineralization are usually white to pale pink sodic pegmatites often showing albitization of potassium feldspars (Dryden pegmatite field and Gullwing-Tot Lake pegmatite field). The pink potassic pegmatites commonly associated with late stage potassic suite granitoid rocks (Southern English River Subprovince, Dryberry Batholith, etc.) are not known to contain significant rare metal mineralization.

RECOMMENDATIONS FOR EXPLORATION

The known rare element pegmatites of the Dryden Pegmatite Field are associated with the Ghost Lake Batholith and granitoid rocks in the vicinity of Gullwing Lake. Exploration by lithogeochemical surveys for lithophile elements, particularly lithium, in the vicinity of these pegmatites and their parent granitoid bodies could further expand the known fields and possibly delineate additional fields. The vicinity of several pegmatite occurrences listed in Table 26 but not examined during this study would be attractive areas to begin further exploration. Moorhouse (1941) mentions beryl in pegmatites around Eagle Lake, Miller (1900) mentions a beryl occurrence in Seine Bay of Rainy Lake. Finally, beryl is found in the Mica Point Pegmatite indicating that these areas may be of interest. Limited sampling along the contact of the Dryberry Batholith near Gibi Lake gave favourable lithium values indicating an attractive area for further exploration (Trowell et al 1980, tentatively identified beryl in pegmatites near Gibi Lake, see Graphic Lake pegmatite deposit, this report).

On a regional scale all the known lithium bearing pegmatites occur along or near subprovince boundaries (eg. Maligne River: Quetico - Wawa interface; Georgia Lake: Wabigoon - Quetico interface) a fact also noted by Riley et al (1971). The interface between the north part of the English River Subprovince and the Uchi Subprovince is known to contain several beryl and lithium occurrences making the entire interface an attractive area which, together with the interface between the Wabigoon and Quetico Subprovinces, warrants further exploration.

Table 26. Pegmatite Deposits
Commodity indicates the commodity reported, produced or sought if this is known; no commodity is assigned to the Cramp Lake deposit because it was found during the progress of this study.

DEPOSITS DESCRIBED IN TEXT

NAME	DISTRICT	TOWNSHIP/NTS	COMMODITY
Cramp Lake	Kenora	52K/11 NE	
English River Beryl	Kenora	52L/7 SE	Beryl
Falcon Island	Kenora	52E/7 SE	Muscovite Feldspar Beryl
Graphic Lake	Kenora	Work	Lithium
Harrison Mica	Kenora	Bridges	Muscovite Tantalum
Hollinger East	Kenora	MacNicol	Uranium Molybdenum
Kozowy-Leduchowski	Kenora	Webb	Cesium Lithium Beryl
Mavis Lake	Kenora	Brownridge	Lithium Tantalum Beryl
McCallum	Kenora	Tustin	Uranium
Medicine Lake	Kenora	Tustin	Beryl
Sandy Creek	Kenora	52K/11 NW	Beryl

DEPOSITS NOT DESCRIBED IN TEXT

NAME	DISTRICT	TOWNSHIP/NTS	COMMODITY	REFERENCE
Capital Lithium Mines - McCombe	Kenora/ Patricia	52J/13 NE	Lithium	Assessment Files, Sioux Lookout Hewitt (1967) p 48
Capital Lithium Mines - Root Lake	Kenora/ Patricia	52J/13 NE	Lithium	" "
Coates	Kenora	Webb	Beryl Tantalum	Breaks et al (1985)
Coates South	Kenora	Webb	Beryl	" "
Dryden Airport	Kenora	Zealand	Beryl	" "
Gullwing Lake	Kenora	Webb	Lithium	" "
Massberyl	Kenora	52K/15 SW	?	Assessment Files, Red Lake
Mica Point (Gullwing Lake)	Kenora	Webb	Tantalum	Breaks et al (1985)
Milestone	Kenora	Brownridge	Lithium Tantalum	Assessment Files, Kenora
Oneman Lake	Kenora	52L/7 NW	Beryl	Stockwell (1932) p 127
Oxdrift	Kenora	52F/15 SW	Muscovite	Moorhouse (1941) p24
Pashkokogan	Thunder Bay	52J/16 NE	Beryl Tantalum	Assessment Files, Sioux Lookout
Petrunka Tungsten	Kenora	Zealand	Tungsten Beryl	Breaks et al (1985)
Pulford	Kenora	52L/6 NE	?	Assesment Files Kenora
Seine Bay	Rainy River	52C/10 NE	Beryl	Miller (1900) p 195
Setting Net Lake	Kenora/ Patricia	53C/12 NE	Beryl	Ayres (1970)
Taylor	Kenora	Zealand	Beryl	Satterly (1943a) p 55

TABLE 27a. Pegmatite reconnaissance

TRACE ELEMENT ANALYSES

SAMPLE	Ba	Co	Cr	Cu	Li	Ni	Pb	Zn	Be	Mo	Nb	Sc	Sr	V	Y	Zr
84-0048	730	5	8	5	16	6	53	42	1	10	8	3	260	8	7	75
84-0049	1170	5	5	5	3	5	82	12	1	10	4	1	265	3	2	15
84-0050	700	5	5	8	6	5	76	30	1	10	6	1	215	9	25	65
84-0142	70	7	36	8	1120	3	10	104	21	25	130	5	40	24	2	3
84-0143	100	5	16	14	1100	5	21	74	35	10	23	2	80	8	19	14
84-0145	520	28	675	14	1530	158	10	134	25	10	13	18	245	115	9	125
84-0147	70	5	11	30	345	5	10	64	165	10	30	2	90	8	17	23
84-0170	190	5	5	5	14	5	42	16	1	10	5	4	135	2	10	50
84-0174	20	5	11	5	730	5	10	285	23	25	145	3	145	45	2	10
84-0187	0	0	0	0	0	0	0	0	8	10	1	1	60	2	1	1
84-2001	20	5	5	5	14	5	15	20	3	10	25	2	14	1	20	40
84-2002	20	5	5	5	34	5	10	22	6	10	50	3	13	1	21	30
84-2003	850	10	138	13	158	20	42	64	2	10	14	10	450	80	10	135
84-2004	70	5	5	5	20	5	73	25	1	10	55	5	16	1	17	45
84-2005	70	5	5	5	3	5	53	14	3	10	30	2	23	1	17	30
84-2006	440	5	5	5	20	5	30	41	2	10	5	1	505	16	2	70
84-2007	30	5	21	5	26	5	25	17	1	10	20	3	18	1	2	18
84-2008	20	5	5	5	40	5	545	24	2	10	35	8	11	1	45	35
84-2009	30	5	5	5	52	5	10	36	4	10	45	21	12	3	10	30
84-2010	20	5	5	6	820	5	107	135	8	10	625	17	12	4	1	20
84-2011	40	5	5	5	66	5	61	70	1	10	22	2	16	1	8	18
84-2012	40	5	5	5	43	5	106	30	1	10	23	8	15	1	35	30
84-2013	50	5	5	5	72	5	32	38	1	10	24	1	13	1	10	30
84-2014	30	5	5	5	90	5	62	48	2	10	25	1	12	1	45	25
84-2015	80	45	298	37	41	130	110	116	1	10	30	55	150	95	25	25
84-2016	40	5	5	5	72	5	65	33	1	10	17	1	16	1	2	16
84-2017	30	5	5	5	22	5	46	34	1	10	25	7	14	1	35	75
84-2018	40	5	5	5	350	5	40	140	4	10	160	16	13	1	20	30
84-2019	50	5	5	5	40	5	35	42	1	10	90	3	11	1	30	90
84-2020	70	42	351	108	36	105	62	100	1	10	25	50	135	240	17	20
84-2021	10	5	5	5	595	5	10	86	9	10	615	55	17	2	2	21
84-2022	20	5	5	5	40	5	27	36	2	10	55	4	14	1	15	30
84-2023	30	5	5	5	170	5	10	50	2	10	105	25	11	1	10	18
84-2024	40	5	5	5	43	5	19	30	3	10	35	12	13	1	8	24
84-2025	1330	5	5	5	36	5	82	50	2	10	7	1	800	15	4	140
84-2026	1060	5	5	6	26	5	23	32	1	10	7	1	645	9	4	65

TRACE ELEMENT ANALYSES

SAMPLE	Ba	Co	Cr	Cu	Li	Ni	Pb	Zn	Be	Mo	Nb	Sc	Sr	V	Y	Zr
84-2027	190	47	16	8	26	22	67	116	4	10	45	19	977	355	30	35
84-2028	370	5	5	2	4	5	41	21	1	10	3	1	815	5	1	21
84-2029	720	5	5	17	4	5	34	18	1	10	4	1	1030	5	2	18
84-2030	430	5	5	35	6	5	10	18	1	10	4	1	670	5	1	20
84-2031	710	16	71	34	44	31	40	71	2	10	7	14	310	85	11	135
84-2032	530	5	7	12	6	5	56	20	1	10	1	1	160	1	3	35
84-2033	280	5	5	6	11	5	36	20	1	10	2	1	175	1	3	70
84-2034	30	15	24	18	2000	7	105	1380	2	10	235	70	18	30	10	20
84-2035	40	5	5	5	16	5	72	47	2	10	11	1	23	1	25	30
84-2036	60	5	7	5	17	5	62	38	2	10	5	1	30	1	12	55
84-2037	20	5	5	5	26	5	63	50	2	10	5	1	40	1	9	100
84-2038	1320	5	5	5	3	6	56	28	1	10	1	1	390	2	3	40
84-2039	1060	10	58	8	11	27	36	50	1	10	4	13	410	40	11	60
84-2040	240	5	5	5	4	5	54	24	2	10	4	1	70	1	2	30
84-2041	640	5	5	7	4	7	92	28	1	10	2	1	175	1	3	35
84-2042	500	5	5	5	6	5	51	30	3	10	1	1	175	1	3	40
84-2043	1160	5	5	5	4	5	90	31	1	10	1	1	235	2	9	55
84-2044	600	6	12	6	22	9	31	50	1	10	2	1	175	6	17	70
84-2045	780	5	5	5	3	5	41	20	1	10	1	1	170	1	8	70
84-2046	250	7	53	6	30	17	25	64	2	10	6	7	200	30	6	55
84-2047	200	5	5	5	16	5	16	24	3	10	10	8	100	6	6	21
84-2048	630	5	189	5	3	25	53	22	1	10	1	1	190	1	2	14
84-2049	400	5	5	5	19	5	47	38	1	10	1	1	190	1	2	14
84-2050	60	5	5	5	52	5	28	29	4	10	20	6	35	4	16	45
84-2051	50	5	5	5	106	5	11	36	6	10	50	9	17	2	23	6
84-2052	20	5	5	5	62	5	13	20	17	10	45	5	11	1	17	23
84-2053	20	5	5	5	348	5	11	44	4	10	35	5	60	5	11	12
84-2054	20	5	6	6	134	5	12	32	4	10	100	9	30	4	65	45
84-2055	140	5	10	1900	128	5	48	250	675	10	22	2	165	8	25	70
84-2056	210	5	15	12	159	18	25	23	14	10	8	2	105	11	5	3
84-2057	280	5	5	5	24	5	18	20	3	10	7	1	135	8	2	30
84-2058	600	5	5	5	12	5	28	17	2	10	4	1	265	5	2	55
84-2059	360	12	53	16	87	10	50	100	2	10	16	13	375	60	95	170
84-2060	820	5	5	5	16	5	36	28	1	10	5	2	255	5	4	30

TRACE ELEMENT ANALYSES

SAMPLE	Ba	Co	Cr	Cu	Li	Ni	Pb	Zn	Be	Mo	Nb	Sc	Sr	V	Y	Zr
84-2061	790	5	10	7	6	6	38	14	1	10	4	1	235	6	5	21
84-2062	400	5	5	5	30	5	19	13	4	10	3	3	200	2	2	2
84-2063	20	5	8	6	610	5	10	270	25	30	135	2	200	18	2	8
84-2064	230	5	5	5	6	5	43	10	1	10	5	7	95	7	10	17
84-2065	750	5	5	6	3	5	40	10	1	10	4	1	235	10	3	7
84-2066	520	5	5	5	4	5	167	12	1	10	5	3	200	7	11	35
84-2067	40	5	5	5	3520	5	10	66	175	10	75	1	45	4	2	21
84-2068	180	32	390	26	1560	148	10	98	4	10	14	22	180	155	11	90
84-2069	90	46	605	14	640	245	10	84	2	10	17	23	355	225	14	55
84-2070	70	33	75	113	94	43	111	170	2	10	21	30	305	230	25	115
84-2071	60	5	5	5	1220	5	11	52	6	10	17	1	135	5	5	7
84-2072	700	34	800	380	6950	80	29	160	5	10	13	45	110	200	16	7
84-2073	210	40	520	144	86	77	10	80	1	10	14	35	150	240	12	10
84-2074	40	5	5	5	7	5	10	22	4	10	7	6	35	3	30	25
84-2075	20	5	5	6	126	5	10	30	6	10	65	6	21	2	45	25
84-2076	20	5	5	5	16	5	11	14	3	10	35	1	19	2	12	23
84-2077	830	25	182	5	860	72	17	190	12	10	30	20	290	115	9	110
84-2078	20	5	5	5	46	5	10	32	4	10	40	6	30	2	6	10
84-2079	20	5	5	5	10	5	10	26	3	10	35	2	14	2	8	14
84D0048	710	5	8	5	16	6	53	42	1	10	8	2	250	7	7	70
84D0049	1140	5	5	5	3	5	82	12	1	10	4	1	265	3	2	15
84D0143	100	5	17	14	1060	5	20	74	35	10	22	2	80	8	17	13
84D2001	20	5	5	5	14	5	15	20	3	10	25	2	14	1	22	40
84D2022	20	5	5	5	40	5	28	35	2	10	50	5	13	2	16	30
84D2030	450	5	5	36	6	5	10	18	1	10	6	1	660	5	1	21
84D2053	20	5	5	5	345	5	11	46	4	10	35	3	50	5	8	10
84D2074	40	5	5	5	7	5	10	22	4	10	7	5	35	2	30	25

TABLE 27b. Pegmatite reconnaissance sample descriptions.

SAMPLE	UTM	NTS	DISTRICT/ TOWNSHIP	DESCRIPTION	ANOMALY
48	500800mE 5521100mN	52F/15SW	Kenora/ Eton	White homogeneous pegmatite mobilizate	Ba
49	500900mE 5521000mN	"	"	White homogeneous pegmatite mobilizate	Ba
50	504600mE 5519000mN	"	Kenora Wainwright	White pegmatite mobilizate containing minor apatite	Ba
142	477950mE 5615450mN	52K/11NW	Kenora	Sandy Creek-Beryl deposit muscovite only sample	High Zn Li,Be
143	477950mE 5615450mN	"	"	Sandy Creek Beryl apatite rich pegmatite	Li,Be
145	477950mE 56154500mN	"	"	Sandy Creek Beryl deposit host rock	Zr,Y, Be,Zn Cr,Li, Ni
147	477950mE 5615450mN	"	"	Sandy Creek beryl deposit replacement zone	Li,Be
170	523900mE 5517700mN	52F/15SE	Kenora/ Brownridge	Mavis Lake pegmatite muscovite from outcrop area #1	
174	524250mE 5517700	"	"	Mavis Lake pegmatite muscovite from outcrop area #4	Li,Zn Be,Nb
2001	422200mE 5494850mN	52E/9SE	Kenora Work	Graphic Lake Pegmatite, white muscovite-quartz-feldspar pegmatite	
2002	422200mE 5494800mN	"	"	"	
2003	542200me 5494850mN	"	"	Graphic Lake Pegmatite metasediment host rock adjacent to 2001	Ba,Sr,Zr High Li
2004	423200mE 5495000mN	"	"	Graphic Lake Pegmatite biotite-muscovite quartz-feldspar graphic granite pegmatite	
2005	423500mE 5494800mN	"	"	Graphic Lake Pegmatite pink biotite-quartz-feldspar pegmatite cutting granitoid rocks 600m south of main pegmatite	
2006	423500mE 5494800mN	"	"	Graphic Lake pegmatite granitoid host rock for 2005	Sr,High Ba

SAMPLE	UTM	NTS	DISTRICT/ TOWNSHIP	DESCRIPTION	ANOMALY
2007	423200mE 5495800mN	52E/9SE	Kenora Work	Graphic Lake Pegmatite pink homgeneous pegmatite with minor muscovite and tourmaline cutting granitoid rocks	Ba
2008	423500mE 5495400mN	"	"	Graphic Lake Pegmatite main pegmatite body	
2009	423700mE 5495400mN	"	"	" " " " " "	
2010	444550mE 5523500mN	52F/13SW	Kenora/ Tustin	Medicine Lake Pegmatite muscovite only sample	Li,Rb Zn,Nb
2011	444550mE 5523500mN	"	"	Medicine Lake Pegmatite grab sample of typical pegmatite from trench	
2012	444550mE 5523500mN	"	"	" " " " " " " " " "	Pb
2013	444550mE 5523500mN	"	"	Medicine Lake Pegmatite grab samples from a replacement zone	
2014	444550mE 5523500mN	"	"	Medicine Lake Pegmatite grab sample from a replacement zone	
2015	444500mE 5523600mN	"	"	Medicine Lake pegmatite host rock north contact	Nb,Cr,Ni Pb,Zn
2016	444600mE 5523300mN	"	"	Medicine Lake pegmatite biotite rich pegmatite 200m south of pits	
2017	444600mE 5523350mN	"	"	Medicine Lake pegmatite garnet-biotite-muscovite quartz-feldspar pegmatite 200m south of pits	
2018	444300mE 5522800mN	"	"	Medicine Lake pegmatite replacement zone near south contact	Li,Zn Nb
2019	444300mE 5522800mN	"	"	Medicine Lake pegmatite older pegmatite adjacent to 2018	
2020	44300mE 5522800mN	"	"	Medicine Lake Pegmatite host rock of south contact	Sc,V
2021	444300mE 5522800mN	"	"	Medicine Lake Pegmatite muscovite only from 2018 site	Li,Nb Sc
2022	423700mE 5495400mN	52E/9SE	Kenora/ Work	Graphic Lake Pegmatite chip sample 89 cm across a replacement zone	

SAMPLE	UTM	NTS	DISTRICT/ TOWNSHIP	DESCRIPTION	ANOMALY
2023	423700mE 5495400mN	52E/9SE	Kenora/ Work	Graphic Lake Pegmatite muscovite only sample replacement zone	Nb High Li
2024	423700mE 5495400mN	"	"	Graphic Lake Pegmatite grab sample from replacement zone	
2025	420800mE 5492600mN	52E/9SE	Kenora/ Code	White pegmatite cutting granitoid rocks Dryberry Batholith near west contact zone	Ba,Sr Zr
2026	420900mE 5492700mN	"	"	Fine grained grey granitoid dike cutting metavolcanics	Ba,Sr
2027	420900mE 5492700mN	"	"	Metavolcanic host to 2026	Zn,Sr,V
2028	423250mE 5489900mN	"	"	White pegmatite cutting grey granitoid rocks of the Dryberry Batholith	Sr
2029	423300mE 5489900mN	"	"	" " " " " " " " " "	Ba,Sr
2030	423300mE 5489900mN	"	"	" " " " " " " " " "	Sr
2031	428350mE 5518400mN	52F/13SW	Kenora/ MacNicol	Hollinger East deposit chip sample 1.3m across metavolcanic host rock	
2032	428350mE 5518400mN	"	"	Hollinger East deposit chip sample 6m across pegmatite trench A	Ba
2033	428350mE 5518600mN	"	"	Hollinger East deposit chip sample 3m across pegmatite Trench B	
2034	442150mE 5520700mN	"	Kenora/ Tustin	Biotite only sample from McCallum pegmatite deposit	Li,Rb Zn,Mo
2035	442150mE 5520700mN	"	"	Pink homogeneous pegmatite from McCallum deposit	
2036	442100mE 5520500mN	"	"	White biotite-quartz-albite-microcline graphic granite pegmatite with smoky quartz - McCallum deposit	
2037	442000mE 5520500mN	"	"	Pegmatite replacement zone material with accessory garnet - McCallum deposit	
2038	473200mE 5620950mN	52K/11NW	Kenora	White muscovite-biotite quartz-feldspar pegmatite mobilzate	Ba,Sr

SAMPLE	UTM	NTS	DISTRICT/ TOWNSHIP	DESCRIPTION	ANOMALY
2039	475100mE 5604500mN	52K/11SW	Kenora	White biotite pegmatite mobilizate with accessory garnet	Ba.Sr
2040	483200mE 5605300mN	"	"	15 cm wide white pegmatoid mobilizate with apatite	
2041	476600mE 5616400mN	52K/11NW	Kenora	White pegmatoid mobilizate with smoky quartz muscovite-biotite-quartz-feldspar pegmatite hosted in biotite gneiss	Ba
2042	476700mE 56164500mN	"	"	Similar material to 2041	Ba
2043	475200mE 5618100mN	"	"	Muscovite-biotite-quartz-feldspar pegmatite mobilizate reported to contain spodumene (Assessment Files MNR Red Lake)	Ba
2044	475200mE 5618100mN	"	"	North edge of same pegmatite as 2043	Ba
2045	476000mE 5617200mN	"	"	White muscovite-biotite-quartz-feldspar pegmatite mobilizate with traces of apatite	
2046	490500 5623900mN	52K/14SE	"	White homogeneous biotite quartz-feldspar pegmatite mobilizate with thin (5mm) biotite seams	
2047	489200mE 5624200mN	"	"	White muscovite-quartz-feldspar pegmatite mobilizate with smoky quartz	
2048	487150mE 5517850mN	52F/14SE	Kenora/ Sanford	White muscovite-biotite-quartz-feldspar homogeneous pegmatite	Ba.Sr
2049	487150mE 5517850mN	"	"	Same pegmatite as 2048 but contains apatite	
2050	395000mE 5567300mN	52L/8SW	Kenora	Homogeneous pale pink muscovite-biotite-quartz-feldspar pegmatite, containing graphic granite and much smoky quartz, 3 metres wide, trends 075°/90° cuts metavolcanics, minor uranophane on weathered surface	
2051	394300mE 5569700mN	"	"	Pale pink muscovite-quartz-feldspar pegmatite, muscovite books up to 1-2 cm, has a small quartz core	High Li
2052	394400mE 5570400mN	"	"	White muscovite-biotite-quartz-feldspar pegmatite dike trends 080° approximately 15m wide	High Be
2053	392400mE 5569000mN	52L/7SE	Kenora	English River Beryl pinkish white pegmatite	Li

SAMPLE	UTM	NTS	DISTRICT/ TOWNSHIP	DESCRIPTION	ANOMALY
2054	392400mE 5569000mN	52L/7SE	Kenora	English River Beryl pinkish white pegmatite	Nb High Li
2055	391200mE 5569000mN	"	"	English River Beryl pinkish white pegmatite	Cu,Zn Be High Li
2056	499600mE 5618800mN	52K/11SW	Kenora	White pegmatite from Cramp Lake deposit	High Li
2057	488800mE 5622000mN	52K/14SE	Kenora	White pegmatitoid mobilizate from diatexite metasediments	
2058	488800mE 5622000mN	"	"	" " " " " "	Ba, high Sr
2059	488700mE 5621900mN	"	"	" " " " " "	Sr,V, Y,Zr
2060	487600mE 5618850mN	52K/11NW	Kenora	Pink pegmatoid mobilizate with biotite,muscovite and traces of apatite	Ba
2061	488400mE 5619900mN	"	"	Pink pegmatoid mobilizate from diatexite	Ba
2062	493600mE 5615100	52K/11NW	"	White pegmatoid mobilizate with minor garnet and biotite	
2063	611000mE 563100mN	52J/14SW	Kenora	White muscovite-biotite-garnet-quartz-feldspar pegmatoid mobilizate in biotite rich restite	Li,Zn Be,Nb
2064	611500mE 5627000mN	"	"	White muscovite-garnet-quartz-feldspar pegmatite mobilizate	
2065	611000mE 5623000mN	"	"	White muscovite-apatite-quartz-feldspar pegmatoid mobilizate	Be
2066	611000mE 5623000mN	52J/14SW	Kenora	Same pegmatite mobilizate as 2065 with tourmaline	Pb
2067	523900mE 5517700mN	52F/15SW	Kenora/ Brownridge	Mavis Lake pegmatite, pegmatite from trenches in outcrop area #1	Li,Be
2068	523900mE 5517700mN	""	"	Mavis Lake Pegmatite host rock from north contact outcrop area #1	Li,V

SAMPLE	UTM	NTS	DISTRICT/ TOWNSHIP	DESCRIPTION	ANOMALY
2069	524250mE 5517700mN	52F/15SW	Kenora/ Brownridge	Mavis Lake pegmatite host rock at north contact outcrop area #4	Li,Sr V
2070	524250mE 5517700mN	"	"	Mavis Lake Pegmatite host rock 23m north of north contact outcrop area #4	Sr,V Zn,Zr
2071	538950mE 5536700mN	52F/16SW	Kenora/ Webb	Kozowy-Leduchowski deposit pegmatite wall zone south end of pegmatite	Li
2072	538950mN 5536700mN	"	"	Kozowy-Leduchowski deposit host amphibolite at south contact of dike	
2073	538950mE 5530700mN	"	"	Kozowy-Leduchowski deposit host rock 10 m south of dike	
2074	527200mE 5522800mN	52F/15NE	Kenora/ Brownridge	White tourmaline-muscovite-quartz-feldspar pegmatite, trends 075°/75°S, host rock is grey metasediment. Pegmatite contains minor smoky quartz.	
2075	422200mE 5494859mN	52E/9SE	Kenora/ Work	Graphic Lake pegmatite-white muscovite-quartz-feldspar pegmatite with small quartz core	
2076	421650mE 5494300mN	"	"	Graphic Lake pegmatite homogeneous muscovite-quartz-feldspar pegmatite	
2077	421650mE 5494300mN	"	"	Amphibolite host rock to 2076	High Be Zr,Ba Li,Zn Sr
2078	421200mE 5493800mN	"	"	Graphic Lake pegmatite homogeneous white pegmatite	
2079	421000mE 5493850mN	52E/9SE	Kenora/ Work	Graphic Lake Pegmatite muscovite-quartz-feldspar pegmatite similar to 2078 contains pale green muscovite	

All sample numbers are preceeded by the suffix 84-

PG 1 CRAMP LAKE

COMMODITY: Feldspar

GROUP: Non-metallic

STATUS: Occurrence

LOCATION: NTS 52K/11 NE, District of Kenora.
50°43'25" North Latitude, 93°00'22" West Longitude
UTM Grid 499600 mE 5618800 mN Zone 15.

ACCESS: The pegmatite is beside the Wenasaga Forest Access Road (Figure 18).

DESCRIPTION: Geological Setting: The area is underlain by metasediments that have been partially melted (diatexite).

Previous Geological Work: The area has been mapped at a reconnaissance scale by Breaks et al (1976).

Geology: The rock examined is a white homogeneous muscovite-biotite-quartz microcline pegmatite. Muscovite is only a minor constituent. The host rock is fine grained dark grey-brown biotite rich diatexite with pink garnetiferous layers. Layering trends 105°. The pegmatite is roughly parallel to the layering but is irregular in width. Microcline crystals up to 15 cm wide are common. There are several dikes from 1 to 4 m in width in addition to large (30 metre) dike sampled.

Petrology and Chemistry: Samples of the pegmatite and feldspar were analysed, results are in Tables 27 and 12 respectively. The pegmatite is high in lithium although not anomalous.

HISTORY: There is no record of exploration directed at these pegmatites.

REFERENCES: NTS Map 52K/11

Breaks, F. W., Bond, W. D., Desnoyers, D. W., Stone, Denver, and Harris, N.
1976: Operation Kenora-Ear Falls, Bruce-Bluffy Lakes Sheet, District of Kenora; Ontario Div. Mines, Prelim. Map P.1199, Geol. Ser., scale 1:63,360 or 1 inch to 1 mile, Geology 1975.

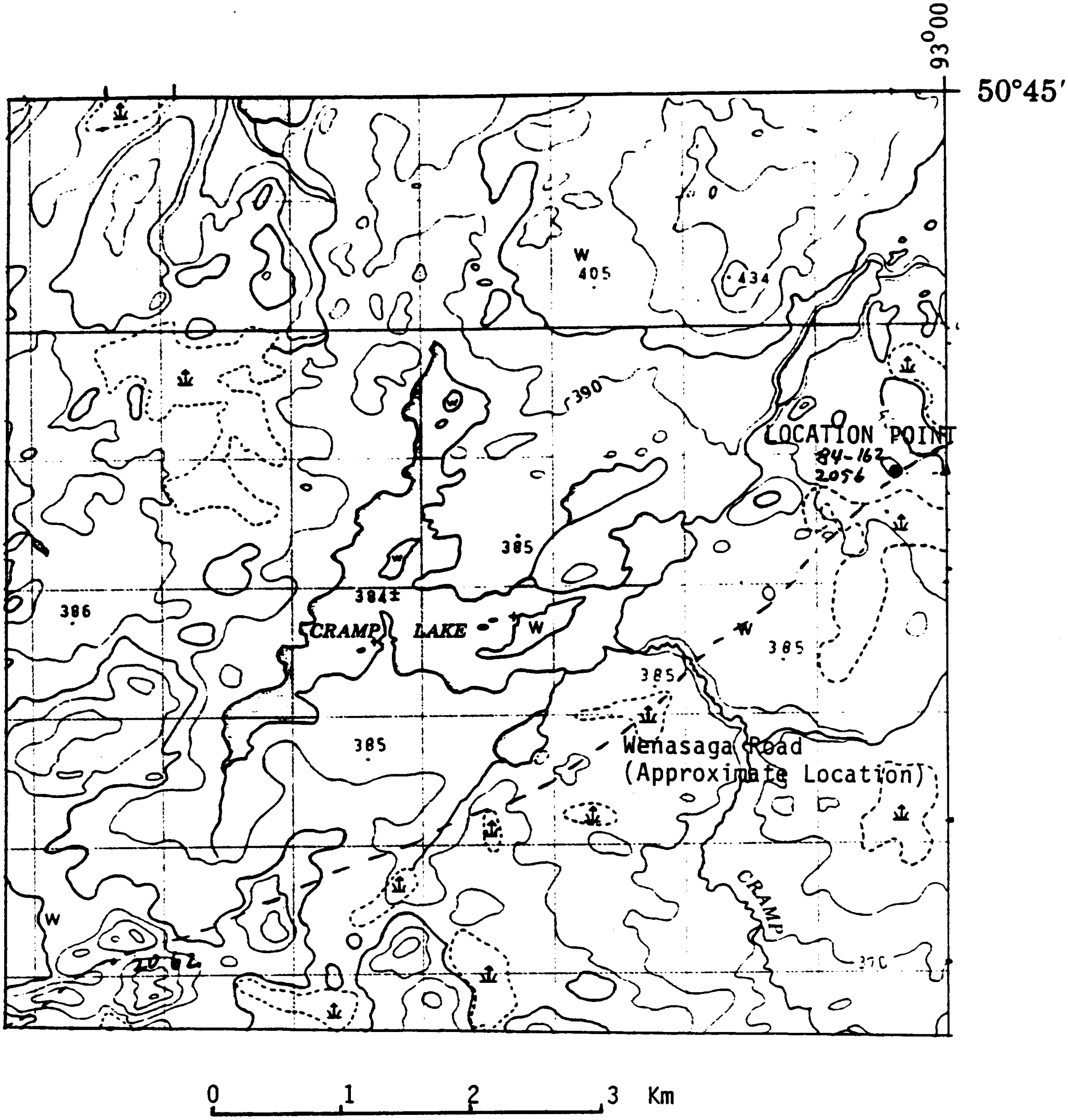


FIGURE 18. Cramp Lake Deposit Location Map

PG 2 ENGLISH RIVER BERYL

COMMODITY: Beryl, rare elements

GROUP: Rare element

STATUS: Occurrence

LOCATION: NTS 52L/7 SE District of Kenora.
50°15'55" North Latitude, 94°31'30" West Longitude
UTM Grid 391400mE, 5569000mN Zone 15.

ACCESS: The pegmatite is on the north shore of English River 3.8 km west of the Separation Rapids bridge on the English River Road.

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics and metasediments of the English River Subprovince.

Previous Geological Work: The area has been mapped at a reconnaissance scale by Breaks et al (1975). The beryl occurrence has been mentioned by Hewitt (1967), Trail (1970) Stockwell (1932) and Vos et al (1982). There is no published description of the deposit.

Geology: The rocks of this area are pillowed and massive mafic metavolcanics with intercalated iron rich metasediments. The rocks trend east-west and have been intruded by numerous pegmatite dikes. One dike, reported to contain small beryl crystals, is apparently much larger than the others. This dike is a homogenous biotite-muscovite-quartz-microcline-graphic granite pegmatite trending 155°. It is about 20 m wide and was traced for 200 m along strike. The contacts are not exposed. Accessory minerals noted are red garnet and green apatite. The colour of the pegmatite is white to pale pink. The other pegmatites of the area are exposed in islands in the English River and road cuts along the English River Road. Some of these show zoning, usually a quartz core with blocky microcline; a replacement/fracture filling zone was noted in one.

Chemistry: A sample of feldspar from the pegmatite was analysed for major elements 84-0074 (Table 12). Samples taken along the English River Road 84-2053, 2054, 2055 (Table 27) show high but not anomulous lithium and a slightly higher than background beryllium.

HISTORY: The beryl was first noted in 1931. There is no evidence of exploration work on this pegmatite.

REFERENCES: NTS Map 52L/7

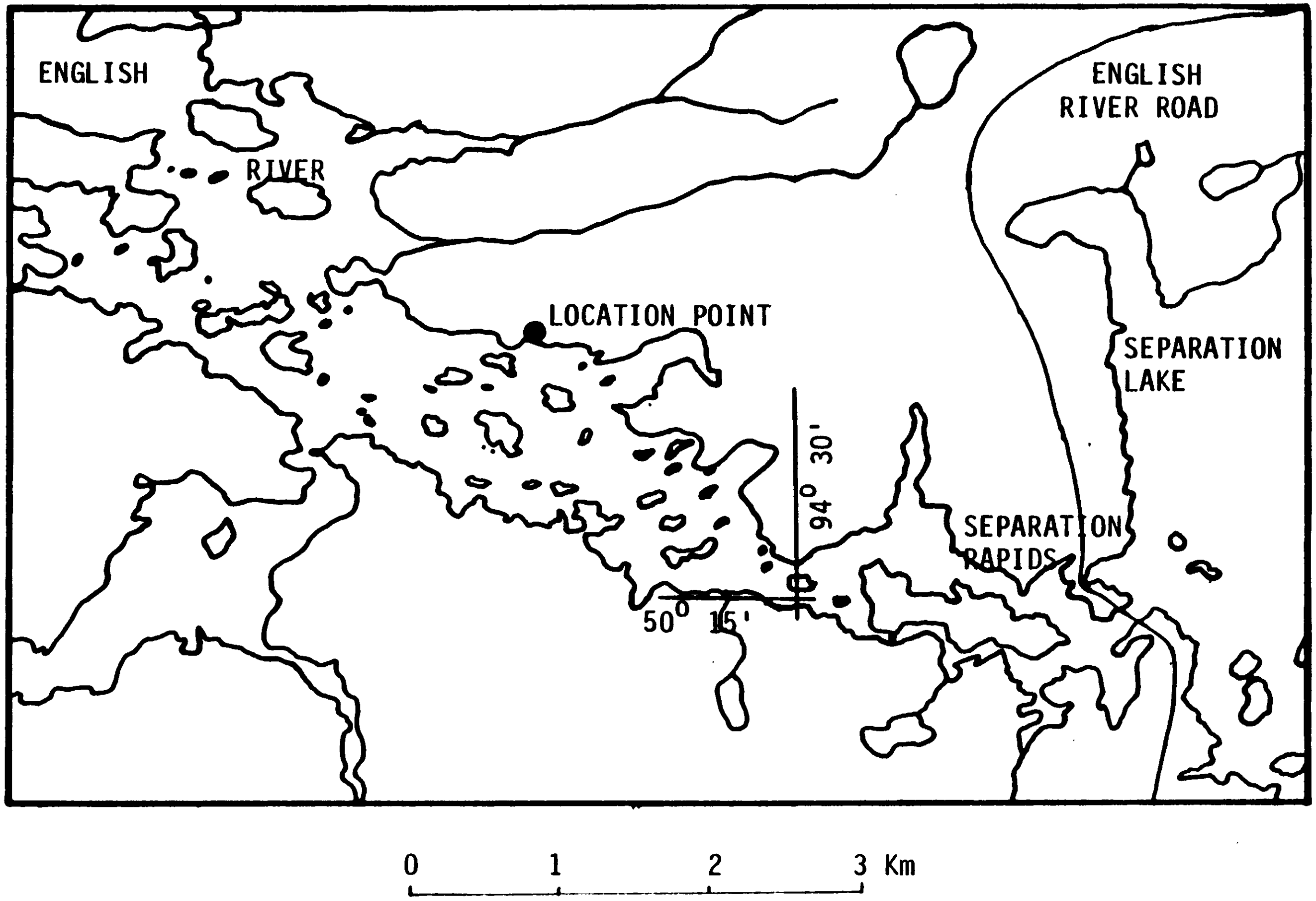


FIGURE 19. ENGLISH RIVER BERYL DEPOSIT

Breaks, F. W., Bond, W.D., McWilliams, G. H., Gower, C. F., Findlay, D., and Stone, Denver
1975: Operation Kenora-Sydney Lake, Umfreville-Separation Lakes Sheet, District of Kenora; Ontario Div. of Mines, Prelim. Map P.1028 Geol. Ser., scale 1 inch to 1 mile or 1:63,360. Geology 1974.

Hewitt, D. F.
1967: Pegmatite Mineral Resources of Ontario: Ontario Department of Mines Industrial Mineral Report 21.

Stockwell, C. H.
1932: Lithium Deposits; p108-128 in Geology and mineral deposits of a part of southeastern Manitoba by J. F. Wright; Geological Survey of Canada Memoir 169.

Trail, R. J.
1970: A Catalogue of Canadian Minerals; Geological Survey of Canada Paper 69-45.

Vos, M. A., Abolins, T., and Smith, V.
1982: Industrial Minerals of Northern Ontario-Supplement 1, Ontario Geological Survey Open File Report 5388, 344p., 3 figures and 1 table.

PG 3 FALCON ISLAND

COMMODITY: Mica, Feldspar, Beryl

GROUP: Non-metallic and rare element

STATUS: Past Producer/Prospect

LOCATION: NTS 52E/7 SE District of Kenora.

ACCESS: The deposit is 55 km southwest of Kenora on Falcon Island, Lake of the Woods (Figure 20).

DESCRIPTION: The deposit was not examined. It has been described by Carlson (1955) and Vos et al (1982) is mentioned by Hewitt (1952, 1967), Lawson (1886) Spence (1932) and de Schmid (1916). The description below is compiled from reports on file in the Kenora Resident Geologist Office. The host rock is mafic metavolcanics trending east-west and dipping to the north. The pegmatite trends northwest and dips southwest. It is coarse grained with white to pale pink microcline and large muscovite books. The dike is about 3 m wide and has been traced for up to 800 m along strike. Samples of the muscovite and feldspar proved to be satisfactory for commercial use (see Table 28).

HISTORY: The deposit was discovered and first mined for mica in 1885 by unrecorded persons. In 1926 and 1927 it was quarried for feldspar by the Winnipeg Roofing Company - a few hundred tons were produced. It was re-examined in 1943 for mica and feldspar by the Falcon Island Mining Company but no information is available on their operations. Circa 1955 it was staked for its beryl content by E. H. Arnold of Minneapolis. This is the first report of beryl in the pegmatite. Large (10 cm) crystals are present. There has been no further work recorded. A large beryl crystal from this deposit is in the mineral collection at the Kenora Resident Geologist Office.

REFERENCES: NTS Map 52E/7

Carlson, H. D.
1955: Brief Report on a Beryl shown on Falcon Island, Lake of the Woods, Kenora Resident Geologist Office, File 52E/7 SE & SE B-1.

de Schmid, A. E.
1916: Feldspar in Canada; Canada Department of Mines Mines Branch Report 401.

Hewitt, D. F.
1952: Feldspar in Ontario; Ontario Department of Mines Industrial Mineral Circular No. 3.

1967: Pegmatite Mineral Resources of Ontario; Ontario Department of Mines, Industrial Mineral Report 21.

Lawson, A. C.
1886: Report on the Geology of the Lake of the Woods Region; Geological Survey of Canada Annual Report, Volume 1, New Series, Part CC.

Vos, M. A., Abolins, T., and Smith, V.
1982: Industrial Minerals of Northern Ontario-Supplement 1, Ontario Geological Survey Open File Report 5388, 344 p., 3 figures and 1 table.

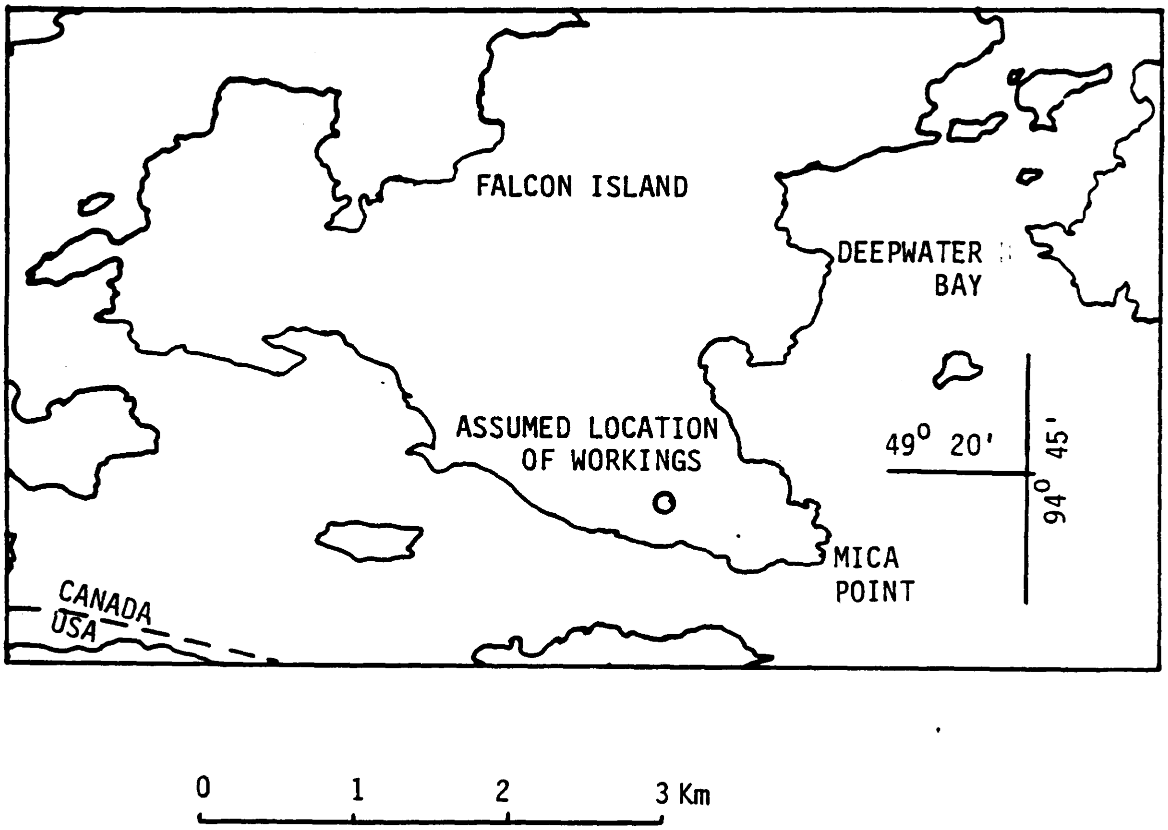
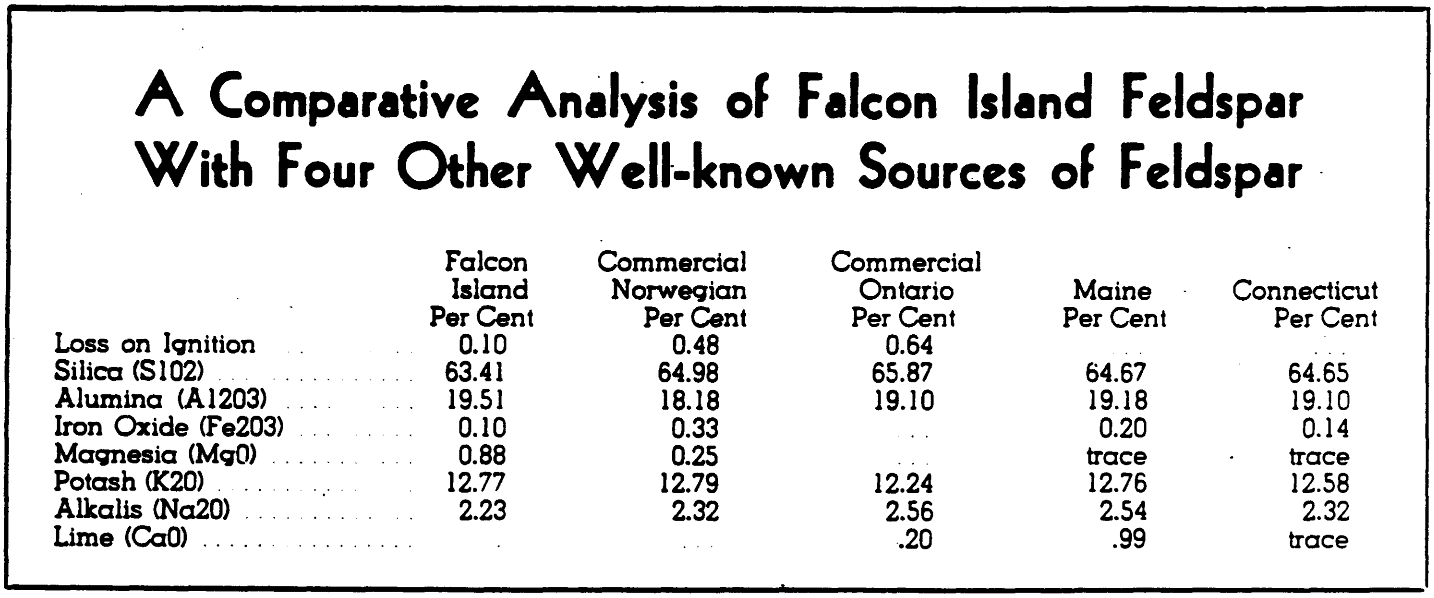


FIGURE 20. Location map Falcon Island pegmatite



A Comparative Analysis of Falcon Island Feldspar With Four Other Well-known Sources of Feldspar

	Falcon Island Per Cent	Commercial Norwegian Per Cent	Commercial Ontario Per Cent	Maine Per Cent	Connecticut Per Cent
Loss on Ignition	0.10	0.48	0.64	...	...
Silica (S102)	63.41	64.98	65.87	64.67	64.65
Alumina (A1203)	19.51	18.18	19.10	19.18	19.10
Iron Oxide (Fe203)	0.10	0.33	...	0.20	0.14
Magnesia (Mg0)	0.88	0.25	...	trace	trace
Potash (K20)	12.77	12.79	12.24	12.76	12.58
Alkalis (Na20)	2.23	2.32	2.56	2.54	2.32
Lime (Ca0)		...	.20	.99	trace

TABLE 28. Analysis of Falcon Island feldspar from Falcon Island Mining Company prospectus, on file Resident Geologist Office, Kenora.

PG 4 GRAPHIC LAKE

COMMODITY: Rare elements

GROUP: Rare element

STATUS: Occurrence

LOCATION: NTS 52E/9 SE Work Township, District of Kenora.
49°36'30" North Latitude, 94°03'24" West Longitude
UTM Grid 423650mE, 5495450mN Zone 15.
The largest pegmatite in the east part of the group was used as a location point.

ACCESS: The pegmatites are crossed by Highway 71; further access is provided by Graphic Lake and old logging roads (Figure 21).

DESCRIPTION: Geological Setting: The area is underlain by metasediments intruded by pink and white pegmatites.

Previous Geological Work: The area has been mapped by Trowell (1979, 1980) and in part by Suffel (1931).

Geology: A large number of white to pale pink pegmatites intrude the metasediments and metavolcanics in this area. They are roughly parallel to the foliation of the host rocks (040° to 050°). Rudimentary zoning is evident in one pegmatite observed near the south end of Graphic Lake, where small quartz segregations were observed. The remainder of the pegmatites are homogeneous but some of the large ones have minor replacement or fracture filling zones. The major minerals present are pale green muscovite, biotite, quartz, white to pale pink microcline and microcline graphic granite. Trowell (1979) tentatively identified beryl from some of these pegmatites. Xenoliths of the host rocks are common.

Chemistry: Samples of these pegmatites are included with the pegmatite reconnaissance work sample numbers 84-2001 to 2009, 84-2022 to 2030, 84-2075 to 2079 (Table 27). Samples of the metavolcanic host rock show elevated lithium values. One sample near the main dike contains 158 ppm and one at the south end of Graphic Lake contains 860 ppm.

HISTORY: The area was aparently staked and explored circa 1980 (old claim posts) but no information on this work is available.

REFERENCES: NTS Map 52E/9

Suffel, G. G.
1931: Geology of the Bigstone Bay Area, Lake of the Woods,

District of Kenora Ontario Deparment of Mines Annual Report Vol. 39, p. 3 for 1930.

Trowell, N. F.
1979: Gibi Lake Area, District of Kenora; p.31-34 in Summary of Field Work, 1979 by the Ontario Geological Survey, edited by V. G. Milne, O.L. White, R. B. Barlow, and C. R. Kustra, Ontario Geological Survey, Miscellaneous Paper 90, 245p.

Trowell, N. F. Logothetis V., Caldwell, G. F.
1980: Gibi Lake Area, District of Kenora; p. 17-20 in Summary of Field Work, 1980, by the Ontario Geological Survey, edited by V. G. Milne, O.L. White, R. B. Barlow, J. A. Robertson and A. C. Colvine, Ontario Geological Survey, Miscellaneous Paper 96, 201p.

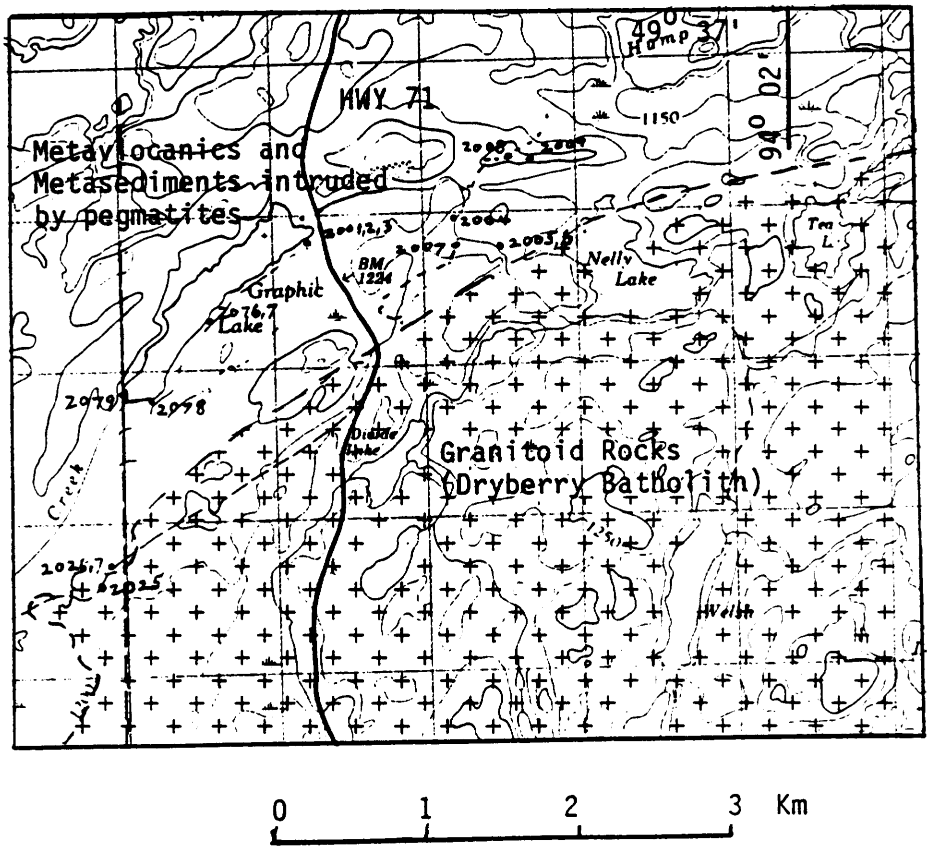


FIGURE 21. Graphic Lake Area

PG 5 HARRISON MICA

COMMODITY:	Muscovite (also Ta and Cb)
GROUP:	Non-metallic
STATUS:	Occurrence
LOCATION:	NTS 52F/13 SE Bridges Township, District of Kenora. 49°51'54" North Latitude, 93°39'17" West Longitude UTM Grid 452950mE, 5523600mN Zone 15.
ACCESS:	The workings can be reached from Cobble Lake (Figure 22).

DESCRIPTION: Geological Setting: The area is underlain by mafic metavolcanics and mafic intrusive rocks intruded by late stage granitoid pegmatites.

Previous Geological Work: The area has been mapped by Pryslak (1976). The deposit has been described by Pryslak (1976), and Vos et al (1982). Excerpts from Pryslak (1976) follow:

> The muscovite-bearing pegmatite trends easterly through the centre of the claim, dips subvertically, and has a maximum width of 150 feet (46 m). Microcline, perthitic microcline, and quartz are the major mineral constituents, and biotite, muscovite and tourmaline occur in lesser amounts. Minor blue-green garnet and rare tantalite-columbite have also been identified by D. P. Parrott (personal communication).
>
> Black tourmaline locally forms up to 10 percent of the pegmatite mass and can be readily observed in the dike, between 100 and 300 feet (30 and 90 m) west of the adit. Individual crystals range up to 10 inches (25 cm) in length and 2 1/2 inches (5.3 cm) in diameter. Biotite books, up to 5 inches (13 cm) in diameter, and 2 inches (5 cm) thick, form about 5 percent of the pegmatite mass. Muscovite is segregated in small lenses in the pegmatite. The largest muscovite zone occurs near the entrance of the adit, strikes easterly, and dips vertically. The zone has a maximum thickness of 2 feet (0.6 m) and can be traced on the surface for a distance of 30 feet (9 m). The east end of the zone is under water. A 50-foot (15 m) horizontal diamond drill hole, located about 200 feet (60 m) west of the adit, intersected a muscovite-bearing zone about 20 feet (6 m) wide. The muscovite has a light greenish brown colour and forms books up to 18 inches (46 cm) in diameter, and up to 5 inches (13 cm) thick. Most of the larger books contain structural imperfections known as 'A' reeves and wedge structure (see glossary).

Geology: Mapping by Pryslak (1976) indicates the pegmatite

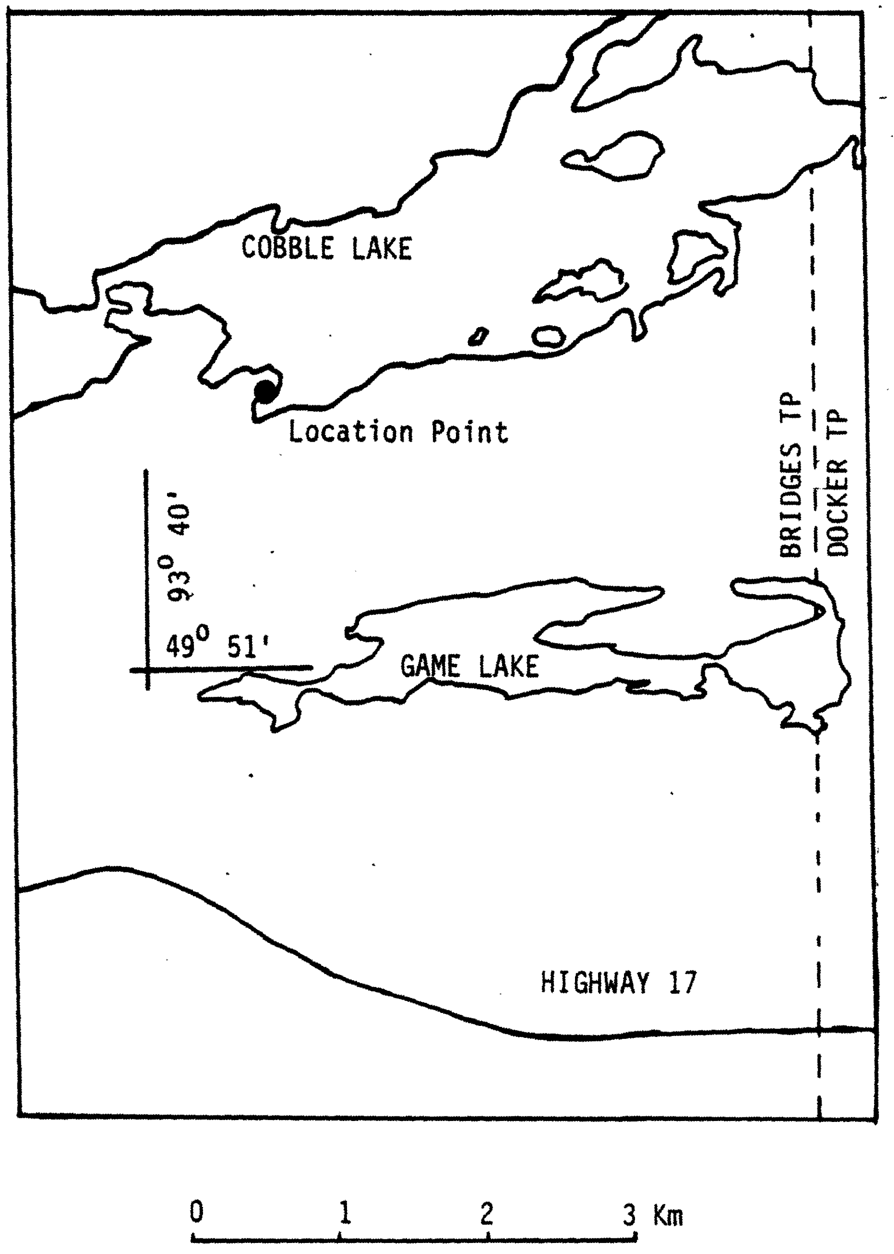


FIGURE 22. Harrison Mica Deposit location map.

is part of a larger pegmatitic granitoid body that extends 2.4 km to the west. The body is described as a dike but seems sill-like in the vicinity of the workings. A horizontal adit and several diamond drill holes intersect muscovite zones. The rock is muscovite-quartz-microcline pegmatite with accessory tourmaline, biotite, and tantalite. This body is zoned but the extent of the zoning is not evident in the exposures.

Chemistry: A sample of the feldspar (82-190) was analysed. Results are in Table 12. Assays of grab samples from near the adit indicate up to 1.85% Cb_2O_5 and 0.17% Ta_2O_5 although other assays of presumably similar material did not duplicate these values.

HISTORY: The deposit was discovered by H. R. Harrison in 1952 at which time an adit was driven into the pegmatite. In 1953 and 1954 six diamond drill holes were drilled. A test sample of mica was shipped to General Electric Co. probably in 1954. In 1955 it was evaluated for tantalum and columbite. There has been no further work recorded.

REFERENCES:

NTS Map 52F/13
Pryslak, A. P.
1976: Geology of the Bruin Lake-Edison Lake Area, District of Kenora: Ontario Div. Mines, GR130,61p. Accompanied by Maps 2302 and 2303, scale 1 inch to 1/2 mile (1.31 680) and chart.

Vos, M.A., Abolins, T., and Smith, V.
1982: Industrial Minerals of Northern Ontario-Supplement 1, Ontario Geological Survey Open File Report 5388, 344 p., 3 figures and 1 table.

Assessment Files, Resident Geologist Office, Kenora, File D-1

PG 6 HOLLINGER EAST

COMMODITY: Uranium, Molybdenum

GROUP: Uranium

STATUS: Occurrence

LOCATION: NTS 52F/13 SW MacNicol Township, District of Kenora.
49°48'56" North Latitude, 93°59'43" West Longitude
UTM Grid 428350mE, 5518400mN Zone 15.

ACCESS: The deposit can be reached by traversing through the bush from Highway 17 (Figyre 23).

DESCRIPTION: Geological Setting: The area is underlain by mafic metavolcanics intruded by granitoid rocks of the Dryberry Batholith.

Previous Geological Work: The area was mapped by Pryslak (1976). A compilation by Blackburn et al (1981) shows uranium and copper mineral occurrences in this area.

Geology: The pegmatite is a homogeneous body 6 m wide and of undetermined length. The host rock is black amphibolite with granitoid stringers. The pegmatite is conformable with the foliation of the host rock 020°/90°. An inclusion of host rock is found at the south end of the exposure. The pegmatite is exposed for 67 m along strike by trenches and stripping. The major working is Trench B. The body is white to slightly pinkish biotite-quartz-feldspar -graphic granite pegmatite with minor molybdenite. The host rock weathers rusty from sulphide mineralization along the south side of Trench B.

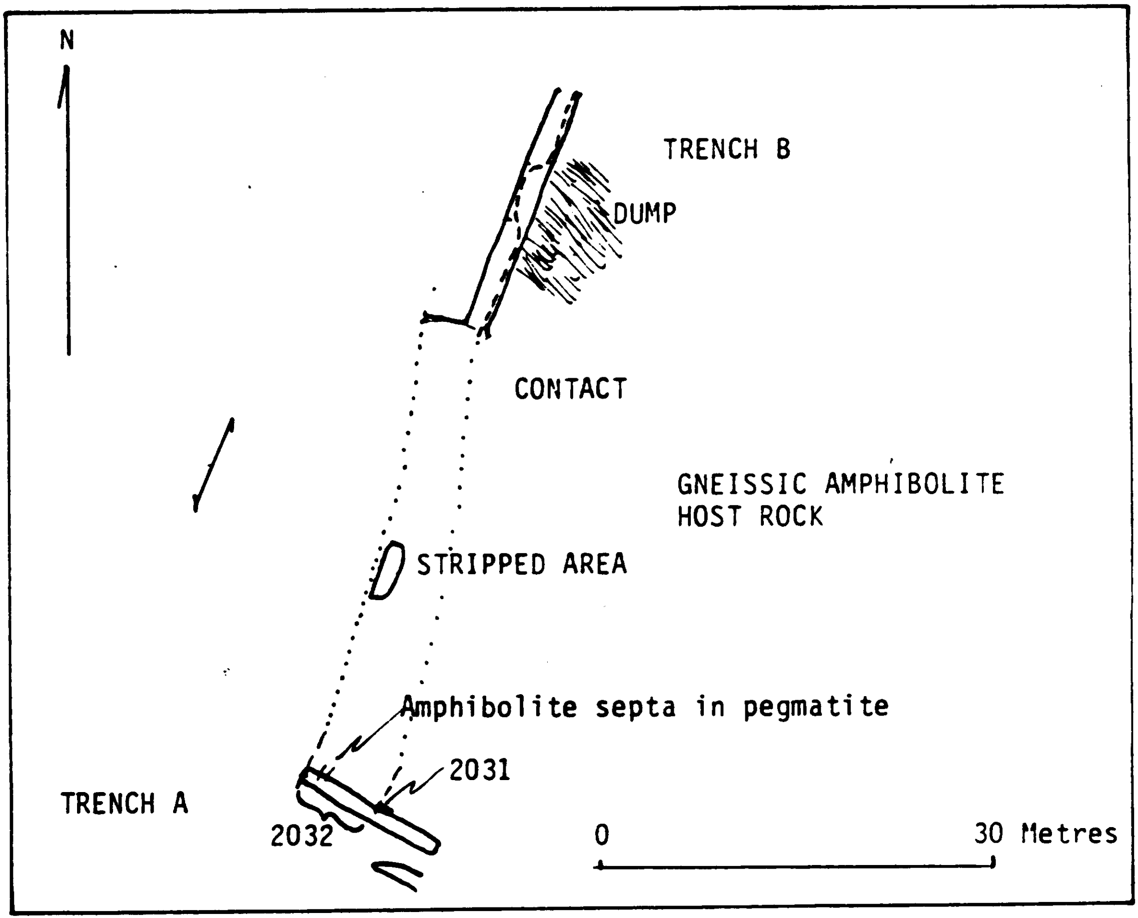
Chemistry: Samples of the pegmatite and host rock were included in the pegmatite reconnaissance (Table 27 samples 84-2031, 2032, 2033).

HISTORY: There is no record of the trenching on this occurrence. Presumably it was done during uranium exploration in the 1950's. In 1975 Kerr-Addison Mines Ltd. carried out diamond drilling near the old workings and found rocks similar to those exposed in the pits.

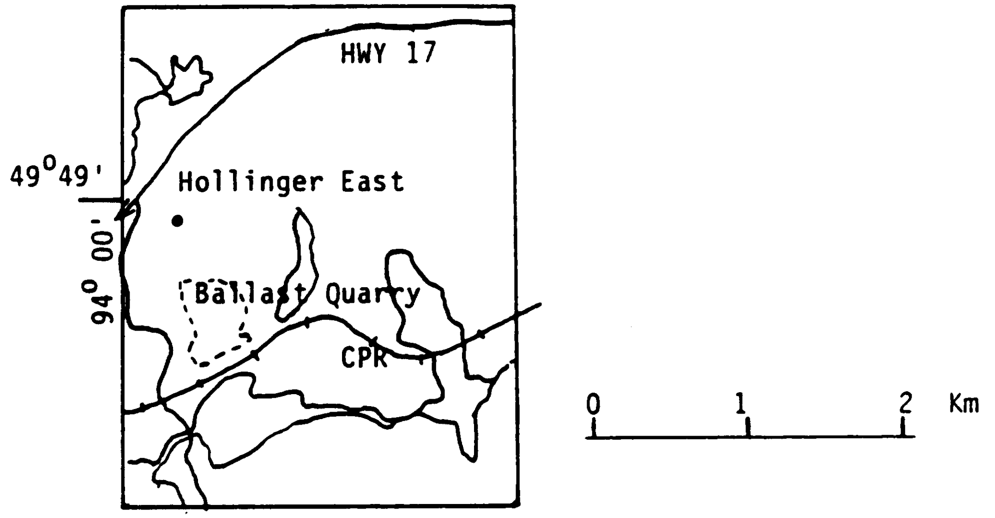
REFERENCES: NTS Map 52F/13

Blackburn, C. E., Beard, R. C., and Rivett, S.
1981: Kenora - Fort Frances Geological Compilation Series; Ontario Geological Survey Map 2443 scale 1:253 440.

Pryslak, A. P.
1976: Geology of the Bruin Lake - Edison Lake Area,



TRENCHES AND GEOLOGY



LOCATION MAP

FIGURE 23. HOLLINGER EAST DEPOSIT

District of Kenora; Ontario Division of Mines Geoscience Report 130.

Assessment Files, Resident Geologist Office, Kenora, File P - 2.

PG 7 KOZOWY - LEDUCHOWSKI

COMMODITY: Cs, Li, Ta

GROUP: Rare element

STATUS: Occurrence

LOCATION: NTS 52F/16 NW Webb Township, District of Kenora.
49°55'46" North Latitude, 91°27'30" West Longitude
UTM Grid 538900mE, 5530700mN Zone 15.

ACCESS: The deposit can be reached by an old trail that extends east from the North Ghost Lake access road (Figure 24).

DESCRIPTION: Geological Setting: The area is underlain by metavolcanic and metasediments intruded by granitoid rocks.

Previous Geological Work: The area has been mapped by Page (1984) and Harding (1951). The deposit has been described by Breaks (1980), Page (1984) Vos et al (1982) and mentioned by Hewitt (1967).

Geology: The pegmatite is a zoned body exposed for 48 m along strike. It is a maximum of 6 m in width. The body trends 140° and dips steeply to the northeast Diamond drilling indicates it is lens shaped. Zoning comprises a 15 to 30 cm border zone, a muscovite-spodumene-quartz-feldspar wall zone with minor tantalite which makes up the bulk of the body, an incomplete intermediate zone of similar pegmatite containing pollucite and a small discontinuous quartz core. Both plagioclase and potassium feldspars are present. Replacement zones cut the wall zone along fractures subparallel to the strike. Garnet, apatite, tourmaline and tantalite are accessory minerals in both the wall and border zones. These zones show albitization of K-feldspar and replacement of spodumene by lepidolite, green mica and cookeite (Breaks, 1980). The pollucite zone is restricted to the south end of the body. Muscovite is pale green in colour, and the remainder of the pegmatite is white with a slight pinkish tint from hematite stain. The pollucite zone has a slight purple tint (possibly due to lepidolite).

The host rock is a dark gray to almost black coloured amphibolite. It has a weak foliation 070° and is schistose adjacent to the contact with the pegmatite. The schistosity is parallel to the contact. The contact is sharp and inclusions of host rock appear in the pegmatite.

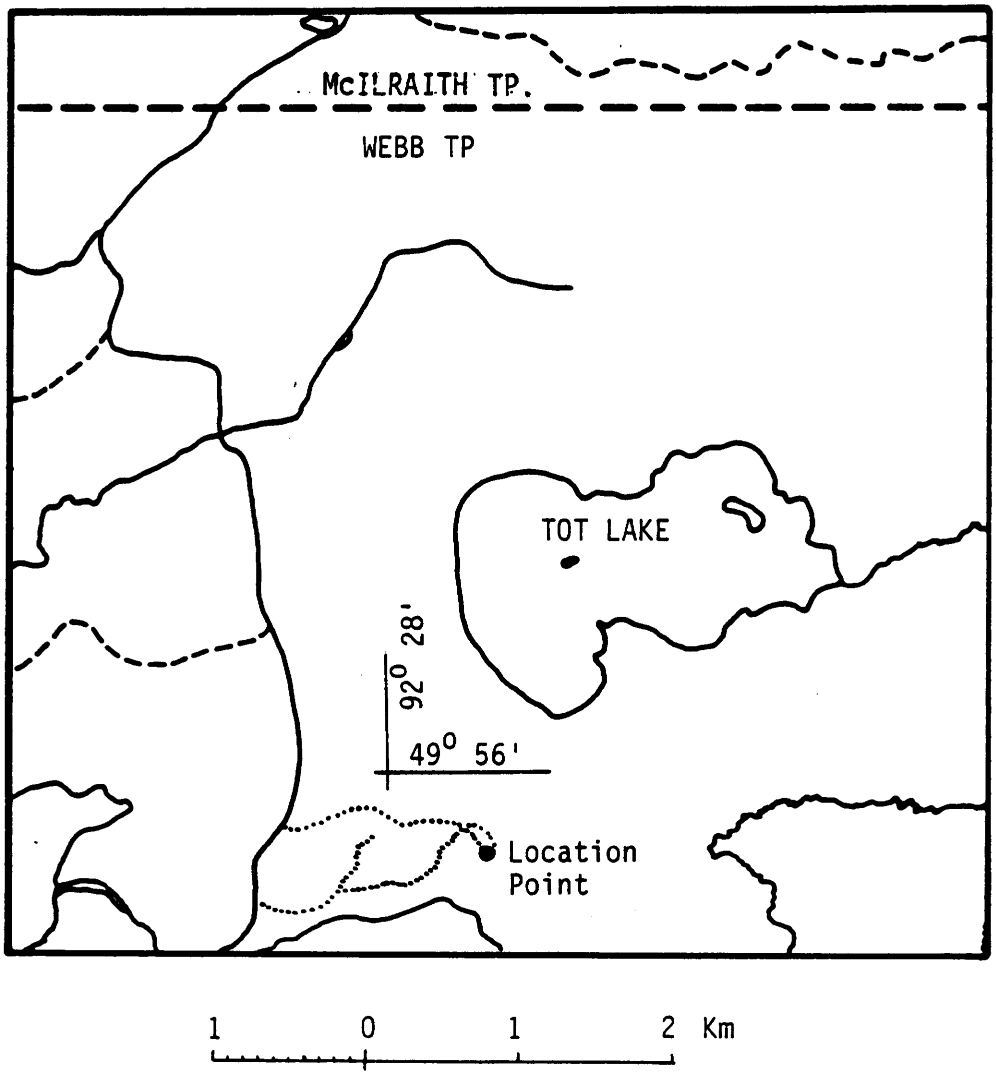


FIGURE 24. Kozowy-Leduchowski Deposit Location Map

Chemistry: Samples of the major minerals were analysed (84-0181 and 0182). The results are in Table 12. A chip sample for 1 m across the pollucite zone contained 2.9% cesium, 0.71% rubidium and 40ppm tantalum.

HISTORY: The deposit was originally staked by A. Kozowy and A. Leduchowski in 1964. It was optioned to Canal Metal Mines in 1964 who carried out trenching and diamond drilling. In 1978 and 1979 Tantalum Mining Corporation of Canada Ltd. drilled three holes to determine the extent of the pegmatite.

REFERENCES: NTS Map 52F/16

Harding, W. D.
1951: Geology of the Gullwing Lake-Sunstrum Area: Ontario Department of Mines Annual Report Vol. 59, Part 4, for 1950.

Hewitt, D. F.
1967: Pegmatite Mineral Resources of Ontario: Ontario Department of Mines Industrial Mineral Report 21.

Page, R. O.
1984: Geology of the Lateral Lake Area, District of Kenora, Ontario Geological Survey Open File Report 5518, 175p., 8 tables, 12 photos, 13 figures and 4 maps in back pocket.

Vos, M. A.,w Abolins, T., and Smith, V.
1982: Industrial Minerals of Northern Ontario-Supplement 1, Ontario Geological Survey Open File Report 5388, 344 p., 3 figures and 1 table.

Assessment File, Resident Geologist, Sioux Lookout.

PG 8 McCALLUM

COMMODITY: Pegmatite

GROUP: Non-metallic and rare element

STATUS: Occurrence

LOCATION: NTS 52F/13 SW Tustin Township, District of Kenora
49°50'11" North Latitude, 93°48'24" West Longitude
UTM Grid 442000mE, 5520500mN Zone 15.

ACCESS: The pegmatites are exposed along the Trans Canada natural gas pipeline (Figure 25).

DESCRIPTION: Geological Setting: The area is underlain by mafic metavolcanics intruded by granitoid rocks.

Previous Geological Work: The area has been mapped by Pryslak (1976). There is a brief description of the occurrence in the Kenora Resident Geologist files.

Geology: There are numerous homogeneous pegmatitic dikes hosted by mafic metavolcanics. The composition of them is biotite-quartz-albite-microcline-graphic granite pegmatite. All but one of the pegmatites examined were pink due to hematitic staining and pink microcline. Smoky quartz is present in small amounts. Some of the albite present is the variety peristerite. The pegmatites have been intruded roughly parallel to the strike of the host rock (north to northwest). One of the dikes is a white pegmatite with small apparent replacement zones similar in appearance to the Medicine Lake pegmatite.

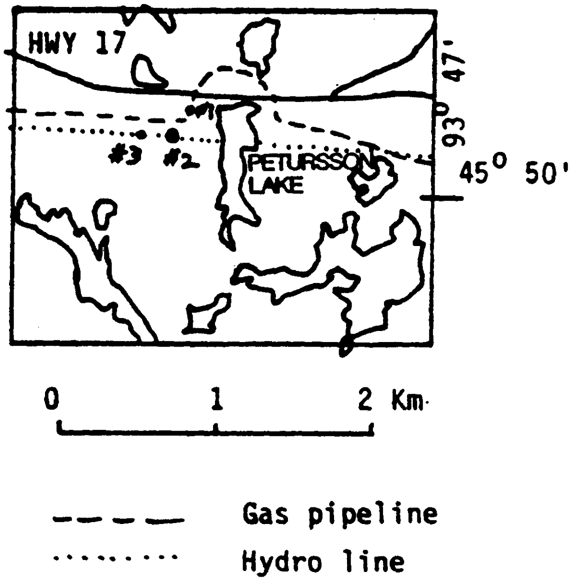
Chemistry: Several samples from these pegmatites were analysed as part of the pegmatite reconnaissance (samples 84-2034 to 2037 Table 27). One sample of biotite (84-2034) has a high lithium content. A sample of microcline was also analysed Table 12, sample 84-34.

HISTORY: The area has been examined for uranium, base metals and molybdenum mineralization although no pits were observed in the pegmatites. Tin is reported from a small pegmatite in this immediate area although this was not confirmed (Resident Geologist Files). A small sulphide deposit was discovered south of the pegmatite area (Pryslak 1976)

REFERENCES: NTS Map 52F/13

Pryslak, A. P.
1976: Geology of the Bruin Lake - Edison Lake Area, District of Kenora; Ontario Division of Mines Geoscience Report 130.

Resident Geologist Files, Kenora.



#1 Pegmatite samples 2034, 2035
#2 Pegmatite location point for deposit
and sample 2036
#3 Pegmatite samples 2037 and 84-34

FIGURE 25 McCallum Pegmatite

PG 9 MAVIS LAKE

COMMODITY:	Rare elements (Li, Ta, Be)
GROUP:	Rare element
STATUS:	Prospect
LOCATION:	NTS 52F/15 SE Brownridge Township, District of Kenora 49°48'46" North Latitude, 92°40'04" West Longitude UTM Grid 523900 mE, 5517650 mN Zone 15. #1 pegmatite was taken as a location point.
ACCESS:	The pegmatites are accessible by a trail from the Ghost Lake Road (Figure 26a).

DESCRIPTION: Geological Setting: The area is underlain by metasediments and metavolcanics intruded by numerous pegmatite dikes.

Previous Geological Work: The area has been mapped by Satterly (1943); Breaks et al (1976), (1978), and Breaks and Kuehner (1984). The deposit has been described by Breaks (1982, 1983), Mulligan (1965), Vos et al (1982), and Pryslak and Hutton (1980) and is mentioned by Hewit (1967), Mulligan (1957) and Trail (1970).

Geology: The deposit comprises a group of en echelon homogeneous to rudimentarily zoned white granitoid pegmatites. Mapping by Breaks (1984) and Pryslak and Hutton (1980) indicates at least 8 pegmatite dikes 3 to 10 m in width in a zone 600 m wide and 900 m long which is part of the much larger Dryden Pegmatite Field (Figure 27) The dikes trend east-west to slightly south of east, contacts are sharp but irregular. Most of them dip moderately to steeply to the north except one dike that dips moderately to the south. Zoning is most evident in dike #1 and is present as a narrow border phase, with a tourmaline - spodumene - quartz - microcline wall zone, and a microcline - quartz core with blocky microcline. Accessory minerals include beryl, apatite, tantalite, tourmaline, and garnet. The other dikes are homogeneous. There is albitization of spodumene and potassium feldspar particularly in the pegmatite at station 4 (Figure 26b).

Petrology and Chemistry: The dikes have been extensively sampled for lithium; the results are summarized in Table 29. Geochemical exploration by TANCO in 1980 indicated lithium anomalies in the host metavolcanics near the known spodumene pegmatite dikes and in several places where unexposed dikes are suspected (Pryslak and Hutton 1980). Alteration of the host rock is evident in the vicinity of station 2 for several metres away from the contact. The effect was not observed 20 m from the contact. Samples of the pegmatite and host rock were analysed as part of the pegmatite reconnaissance. Results are in Table 27 (samples 84-170, 174 and 84-2067 to 2070). Three samples of feldspar and one of spodumene were analysed for major elements, results are in Table 12 (samples 82-0123, 84-0171, 0172 and 0177).

Table 29. Mavis Lake diamond drilling results

Lun-Echo Gold Mines Ltd.

Hole	Angle	From	To	True Width	% LiO_2
E-11	45	9.0	26.5	16.0	1.46
E-11A	75	4.0	25.5	21.0	1.08
E-14	45	40.9	61.8	21.0	0.654
E-9	45	28.2	33.2	5.0	0.83
E-7	45	14.0	19.0	5.0	0.72
B-10	75	212.9	216.9	4.0	Nil
E-10	45	8.7	18.8	9.5	0.79
E-10A	75	9.0	16.5	7.0	0.81
B-9	75	306.6	307.5	0.9	Nil
E-8	40	154.5	175.5	21.0	0.909
E-8A	80	163.5	170.5	6.5	Nil
E-5	45	1.8	12.8	9.5	2.76
E-4	45	2.0	25.0	23.0	1.50
E-4	45	0.3	15.0	10.0	1.27
E-2	45	5.0	14.3	9.3	1.00
E-1	45	5.0	40.0	35.0	1.20
B-5	45	136.4	140.5	4.1	Nil
E-21	45	21.4	35.0	13.6	0.96

All intersections are in feet

Selco Mining Corporation

Hole	Intersection	Ta_2O_5	Nb_2O_5	SnO_2	LiO_2	P_2O_5	Tot. Fe
M-3	5	Tr	0.01	0.013	0.78		
	5	Tr	0.01	0.008	1.46		
	5	0.01	0.01	0.006	2.33	0.45	0.10
	5	0.01	0.02	0.004	1.32	0.38	0.03
	5	0.01	0.02	0.006	1.45	0.40	0.08
	5	Tr	0.01	0.005	0.84	0.47	0.09
	6.9	Tr	0.01	0.015	2.09		
M-4	5	Tr	0.01	0.009	1.62		
		Tr	0.01	0.022	1.15		

All intersections are in feet and are the length of core assayed rather than true width.

For locations, see Figure 26b.
All data compiled from assessment work on file Resident Geologist Office, Kenora.

HISTORY: The deposits were originally noted by Satterly (1943) but there was no mention of spodumene. The pegmatites were staked circa 1955 and diamond drilled by Lun-Echo Gold Mines Ltd. in 1956 for a total of 6647 feet (2020 m). By 1961 500,000 tons of ore grading 1% Li_2O was outlined. The deposit was re-investigated for its tantalum potential by Tantalum Mining Corporation of Canada and Selco Mining Co. Ltd. in 1979 and 1980.

REFERENCES: NTS Map 52F/15

Breaks, F. W.
1982: Metamorphism and rare-metal Pegmatites of the Dryden Area; p4-12 in Stratigraphy and Structure of the Western Wabigoon Subprovince and its Margins, Northwestern Ontario, by C. E. Blackburn et al, Geological Association of Canada - Mineralogical Association of Canada Joint Annual Meeting, Winnipeg Manitoba, Field Trip 3.

Breaks, F. W.
1983: Lithophile Mineralization in the Dryden Pegmatite Field; p 15-20 in Summary of Field Work 1983 by the Ontario Geological Survey edited by John Wood, Owen L. White, R. B. Barlow and A. C. Colvine, Ontario Geological Survey, Miscellaneous Paper 116, 313p.

Breaks, F. W., Bond, W.D., Westerman, C.J. and Harris, N.
1976: Operation Kenora-Ear Falls, Dryden-Vermilion Bay Sheet, District of Kenora; Ontario Div. Mines, Prelim. Map P.1203, Geol. Ser., scale 1:63,360 or 1 inch to 1 mile. Geology 1975.

Breaks, F. W., Bond, W. D., Westerman, C. J. Gower, C. F., Stone; Denver, Desnoyers, D. W., McWilliams, G. H., Harris, N., and Findlay, D.
1978: Western English River Subprovince and Parts of Uchi and Wabigoon Subprovinces, General Geology and Lithophile Type Mineralization; Districts of Kenora and Kenora (Patricia Portion); Ontario Geological Survey Prelim. Map P. 1971, Geological Ser., Scale 1:253 440 or 1 inch to 4 miles. Geology 1974, 1975. Compilation 1976.

Breaks, F. W. and Kuehner, S.
1984: Precambrian Geology of the Eagle River-Ghost Lake Area, Kenora District; Ontario Geological Survey, Map P. 2623, Geological Series - Preliminary Map, scale 1:31 680 or 1 inch to 1/2 mile. Geology 1980, 1983.

Hewitt, D. F.
1967: Pegmatite Mineral Resources of Ontario; Ontario Department of Mines Industrial Mineral Report 21.

Mulligan, R.
1957: Lithium deposits of Manitoba, Ontario and Quebec, 1956; Geological Survey of Canada Paper 57-3.

1965: Geology of Canadian Lithium Deposits; Geological Survey of Canada Economic Geology Report No. 21

Pryslak, A.P. and Hutton, D. A.
1980: Fairservice Option Exploration for the Tantalum Potential of the Mavis Lake Pegmatites Lithium Lithogeochemical Survey March 1980; Resident Geologist Office, Kenora, Assessment File 52F/15 SE M-9.

Trail R. J.
1970: A Catalogue of Canadian Minerals; Geological Survey of Canada Paper 69-45.

Vos, M.A., Abolins, T., and Smith, V.
1982: Industrial Minerals of Northern Ontario-Supplement 1, Ontario Geological Survey Open File Report 5388, 344 p., 3 figures and 1 table.

Satterly, J.
1943: Geology of the Dryden-Wabigoon Area; Ontario Department of Mines Annual Report Vol. 50, Pt. 2 for 1941.

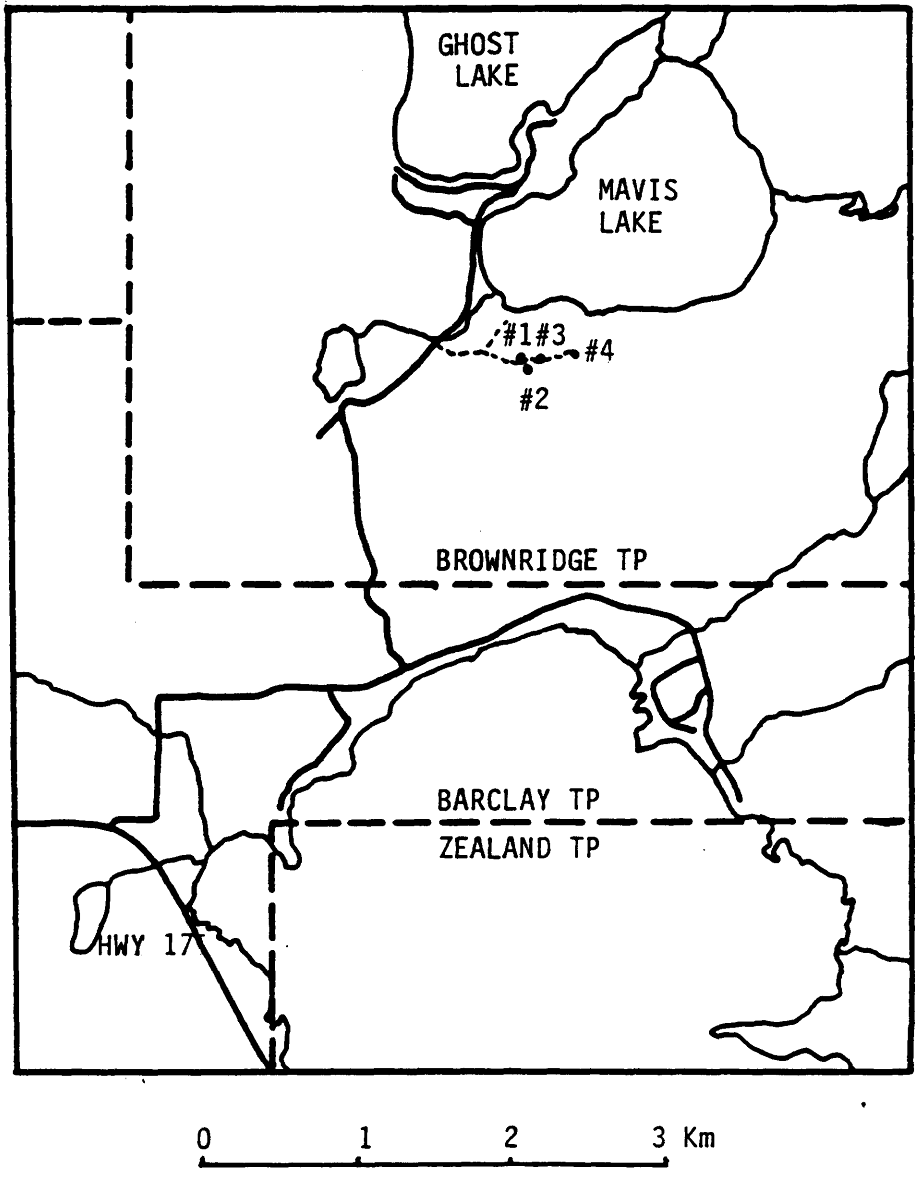


FIGURE 26a Mavis Lake Pegmatite location map

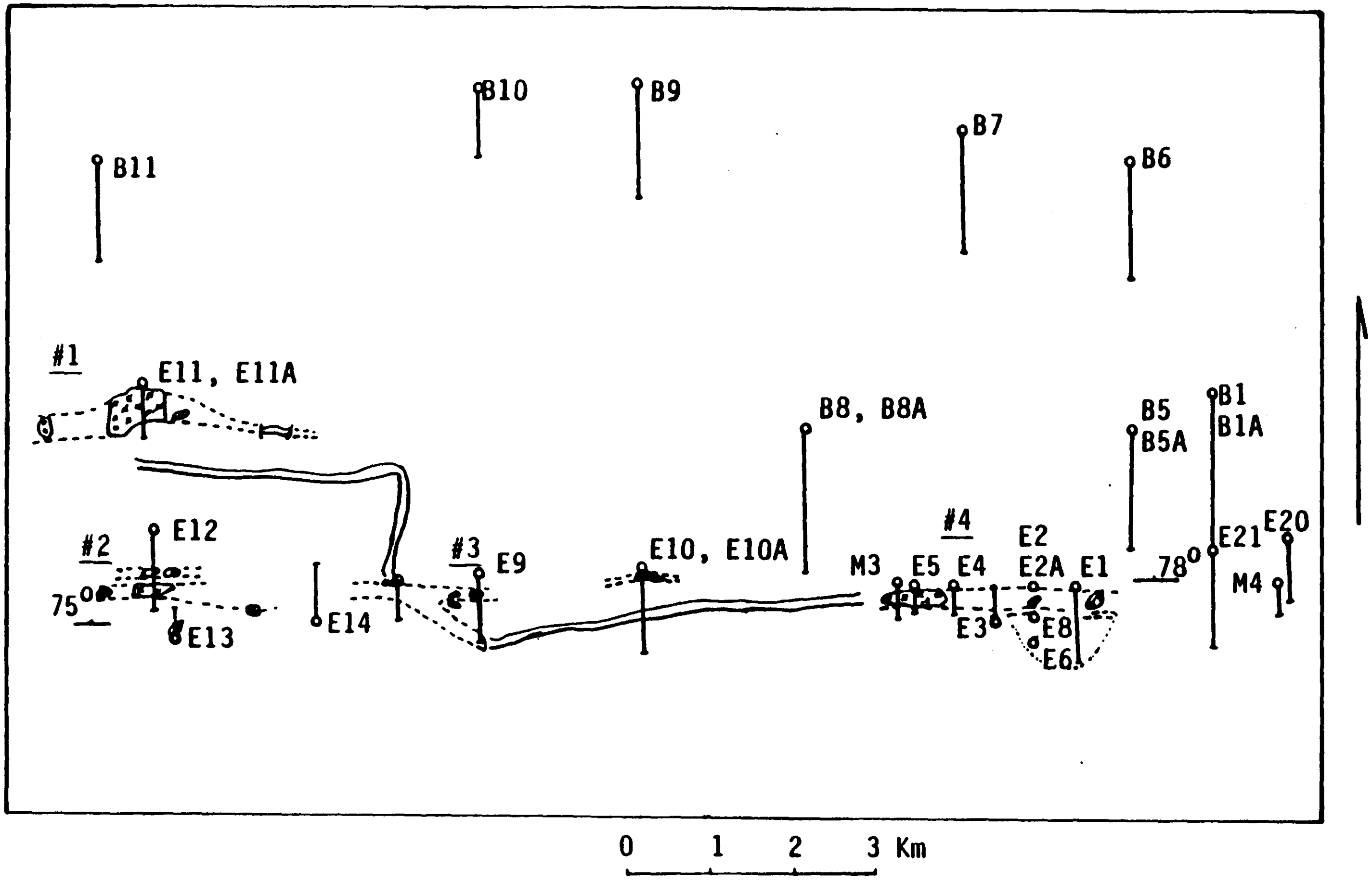


FIGURE 26b. Mavis Lake Pegmatite drill hole locations and pegmatite outcrops compiled from assessment file data MNDM Resident Geologist Office Kenora.

DRYDEN PEGMATITE FIELD

The Dryden Pegmatite Field is a group of sodic pegmatites along the north boundary of the Wabigoon Subprovince that is noted for a variety of rare element minerals, some approaching economic concentrations. The field is divided into the Mavis Lake sub-field shown on Figure 27b and the Gullwing - Tot Lake sub-field shown in Figure 27c, their relative positions are indicated in Figure 27a. Geological mapping and research in this area has been carried on by Moorhouse (1941), Satterly (1943), Breaks et al (1976, 1978), Pryslak and Hutton (1980), Ucakuwun (1981), Breaks and Kuehner (1984), and Page (1984).

Pegmatites were first noted in this area by Burwash (1939), Moorhouse (1941) and Satterly (1943), but there is evidence of interest in pegmatites and their economic minerals earlier than this (the Oxdrift muscovite occurrence, see Table 26). Lithophile mineralization, in particular the presence of beryl, was noted by these authors. The extent of lithophile mineralization was not recognized until the lithium exploration rush of 1956 and 1957. Work by Breaks and Kuehner (1984) and Ucakuwun (1981) has related the Mavis Lake pegmatites to the Ghost Lake Batholith. The latter is a peraluminous (molecular proportion of Al_2O_3 is greater than that of K_2O and Na_2O combined) two mica granitoid body that extends from the village of Eagle River to Ghost Lake. The pegmatites are east-west trending and are all hosted within mafic metavolcanics. A parent granitoid body for the Gullwing - Tot Lake pegmatites has not yet been determined (Breaks, 1985). These are more varied in orientation but all but one of the known dikes are hosted in mafic metavolcanics. Research into the Gullwing - Tot subfield has not been as extensive as that into the Mavis Lake subfield. A large number of apparently barren pegmatites along the south side of Gullwing Lake have been mapped by Page (1984). There is good potential for further discoveries of rare element pegmatites in both fields and in particular the Gullwing - Tot subfield.

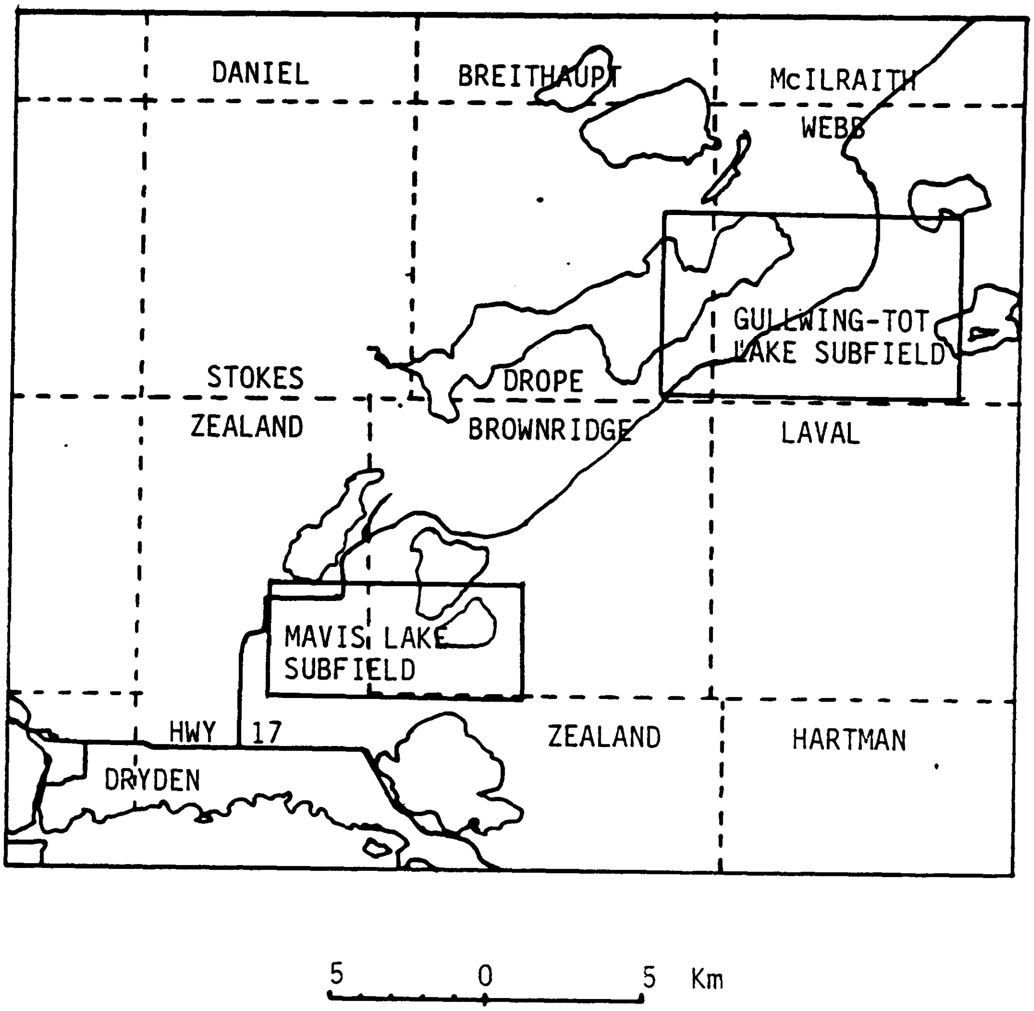


FIGURE 27a. Locations of the two Dryden Pegmatite Fields.

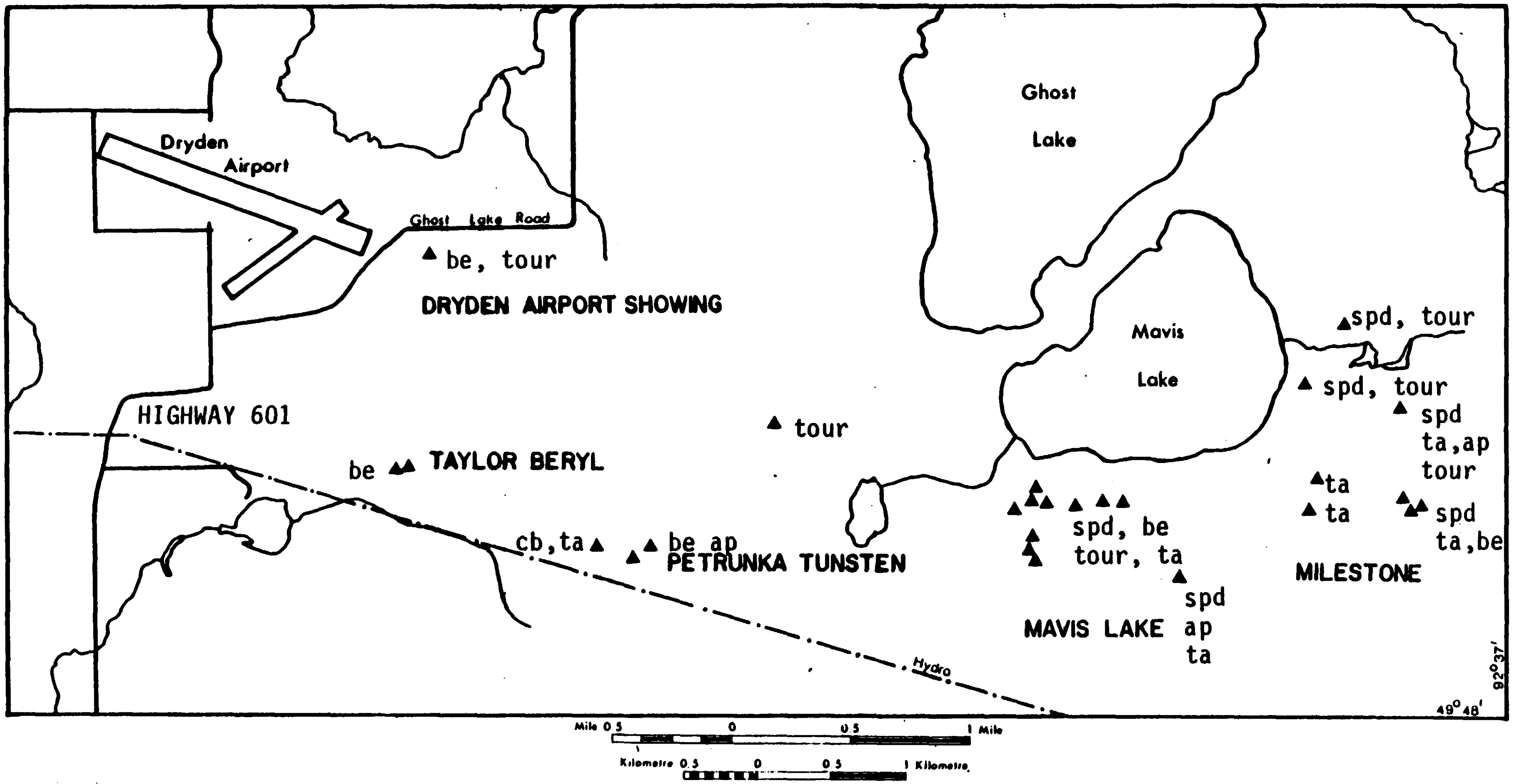


FIGURE 27b. DRYDEN PEGMATITE FIELD - Mavis Lake Subfield, deposit names refer to Table 26. Mineral abreviations: ap - apatite, be - beryl, cb - columbite, spd - spodumene, ta - tantalite, tour - tourmaline.

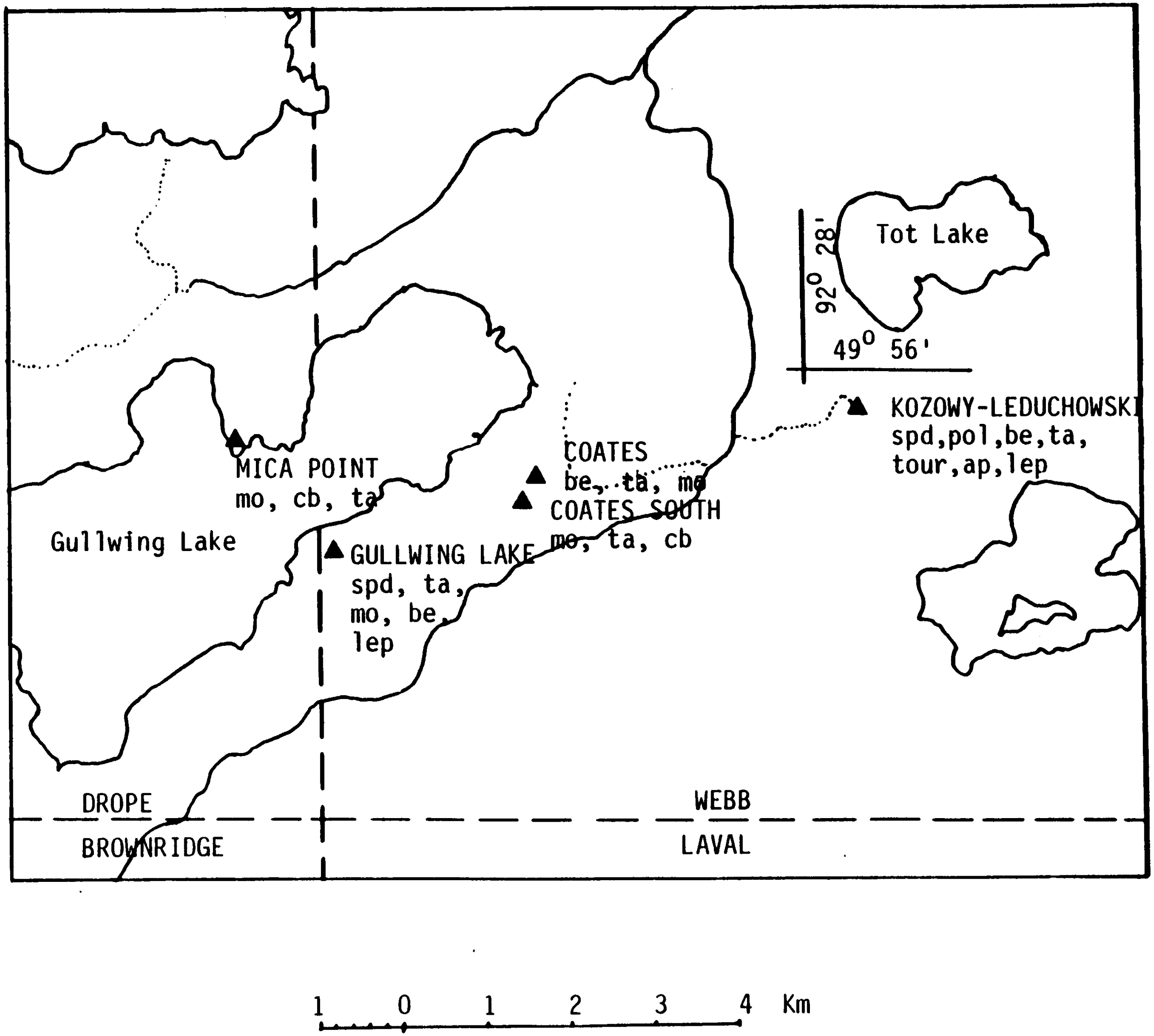


FIGURE 27c. DRYDEN PEGMATITE FIELD - Gullwing-Tot Lake Subfield, deposit names refer to Table 26. Mineral abreviations: ap - apatite, be - beryl, cb - coloumbite lep - lepidolite, pol - polucite, RE - rare earth element minerals, spd - spodumene ta - tantalite, tour - tourmaline

PG 10 MEDICINE LAKE

COMMODITY: Beryl, Tantalum

GROUP: Rare element

STATUS: Occurrence

LOCATION: NTS 52F/13 SW Tustin Township, District of Kenora.
49°51'50" North Latitude, 93°46'21" West Longitude
UTM Grid 444500 mE, 5523500 mN Zone 15.

ACCESS: The deposit is crossed by the Gordon Lake Road, extending from Highway 17 (Figure 28).

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics and metasediments intruded by large pegmatite bodies.

Previous Geological Work: The area has been mapped by Pryslak (1976). The deposit has been described by Pryslak (1976), Chisholm (1949), Vos et al (1982), and Trail 1970.

Geology: The deposit is a zoned white to light pink pegmatite. The dominant minerals are quartz and microcline with accessory hornblende, biotite, muscovite and garnet; beryl and tantalite are also present. Most of the rock is homogeneous fine grained pegmatite with coarse replacement/fracture filling zones. The vicinity of the beryl occurrence has zones of dark grey quartz with blocky microcline (frequently graphic granite) 30 cm and larger; green muscovite and red garnet are common accessories in these zones and some contain beryl (clear to pale yellow in colour). Beryl crystals have been reported from this deposit but none were actually seen in the pits. The pegmatite has been explored by stripping and trenching for 250 m along its north contact. The stripped area trends 035°. The known beryl is restricted to this area. The entire pegmatite body is exposed for 1000 m along strike and has a width of 500 m based on mapping by Pryslak (1976). The contacts of the pegmatite are sharp; numerous narrow dikes and stringers intrude the host rock (amphibolite, metagabbro, metasediments.) The coarse pegmatite zones are distributed throughout the body but are much more prevalent near the north contact.

Petrology and Chemistry: Analyses of the pegmatite and some of its major minerals are found in Tables 27 (samples 84-2010 to 2021) and 12 (sample 84-0002). Lithium is high in mica samples from replacement zones and is anomalous in one pegmatite sample from near the south contact of the body. In spite of this pegmatite being recorded as a beryl occurrence, only very low Be was indicated in the samples analysed.

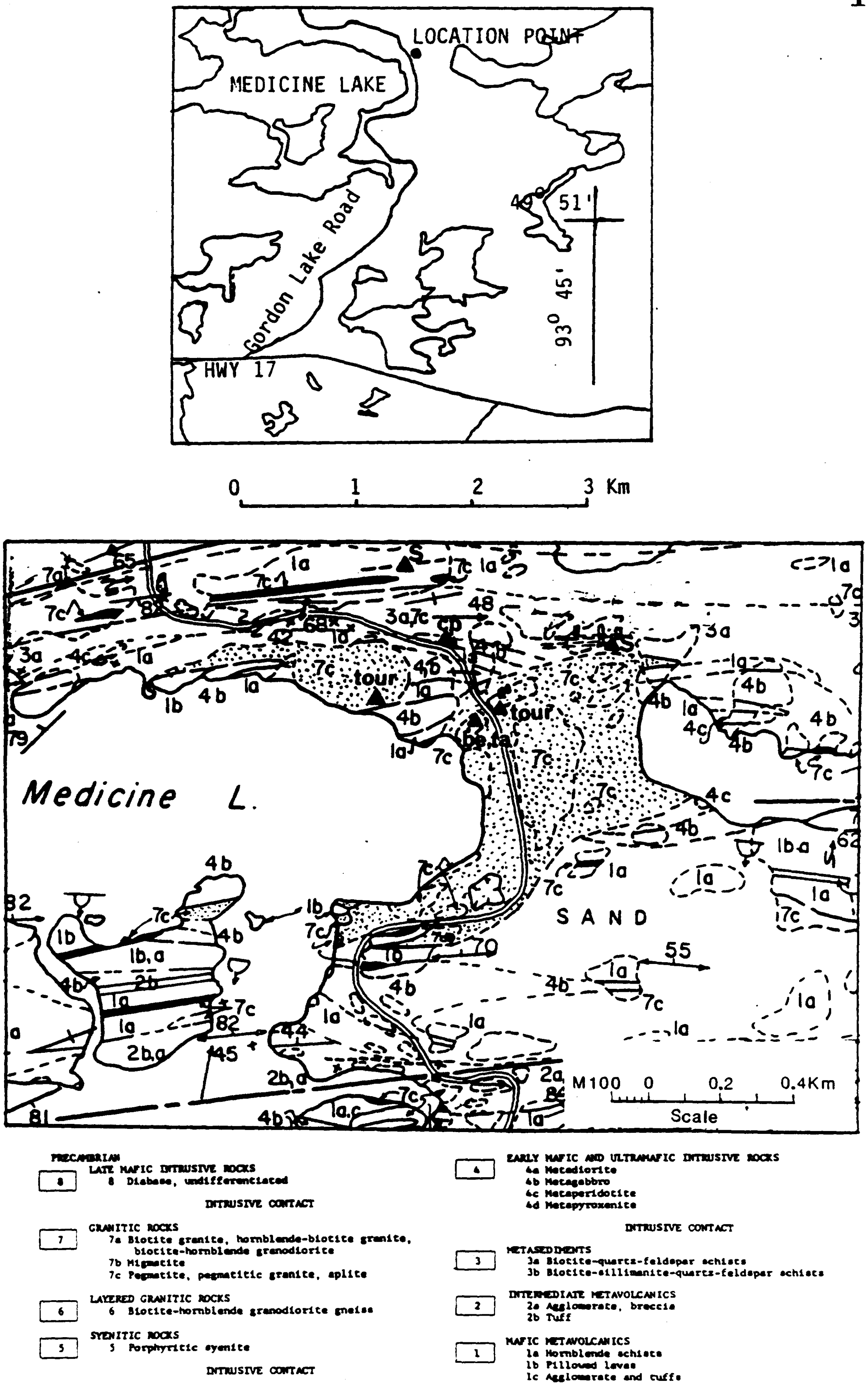


FIGURE 28. MEDICINE LAKE PEGMATITE Stipple pattern shows pegmatite. be, ta, tour symbols indicate the recorded mineralized parts of the pegmatite. Geology from Pryslak (1968).

HISTORY: The deposit was discovered in 1949 by E. Sobiski. The pegmatite was stripped and trenched at this time. The area was held by Falconbridge Nickel Mines Ltd. in 1969 and the adjacent metagabbro was investigated for its nickel-copper mineralization. There has been no recorded work on the pegmatite since 1949 but it is currently (1985) being examined for its beryl potential.

REFERENCES: NTS Map 52F/13

Chisholm, E.O.
1949: A brief report on a Beryl Occurrence on Medicine Lake, Township 40, Kenora Mining Division, District of Kenora Ontario; Resident Geologist Office, Kenora Assessment File T-1

Pryslak, A.P.
1968: Tustin Township; Ontario Department of Mines Preliminary Map P472, scale 1:15,840. Geology 1967.

1976: Geology of the Bruin Lake-Edison Lake Area. District of Kenora; Ontario Div. Mines GR 130,61p. Accompanied by Maps 2302 and 2303, scale 1 inch to 1/2 mile (1:31,680) and chart.

Trail, R. J.
1970: A catalogue of Canadian Minerals, Geological Survey of Canada Paper 69-45

Vos, M.A., Abolins, T., and Smith, V.
1982: Industrial Minerals of Northern Ontario-Supplement 1, Ontario Geological Survey Open File Report 5388, 344 p., 3 figures and 1 table.

PG 11 SANDY CREEK (Eylofson-Gulbis Beryl Showing)

COMMODITY: Beryl

GROUP: Rare element

STATUS: Occurrence

LOCATION: NTS 52K/11 NW District of Kenora.
50°41'34" North Latitude, 93°18'40" West Longitude
UTM Grid 477950mE, 5615450mN Zone 15.

ACCESS: The deposit is reached by a 280 m trail that extends east from Highway 105, 1.2 km north of bridge over Sandy Creek, 9.5 km north of Ear Falls (Figure 29).

DESCRIPTION: Geological Setting: The area is underlain by diatexitic metasediments.

Previous Geological Work: The area has been mapped at a reconnaissance scale by Bruce (1924) and Breaks et al (1976). The deposit is mentioned by Breaks (1979), Hewitt (1967) and described by Vos et al (1982).

Geology: The deposit is a lensoid pegmatite up to 5 m wide. Foliation in the host rock trends 080° and the pegmatite is roughly parallel to this. The dip is not exposed but previous work (Assessment Files, Red Lake) indicate it to be about 60° north. The dike was stripped for a length of 54 m from its western end to a place along its length where overburden thickness became too great to strip at the time of exploration. The host rock is dark gray biotite diatexite. Contacts between the pegmatite and the host are sharp and tongues of pegmatite intrude the host along the north contact. The dike shows zoning and most of it (80%) is composed of aplitic quartz and white feldspar; replacement zones of coarse apatite-muscovite-quartz-albite pegmatite are present at the east end of the exposure. Beryl is found in these zones, frequently associated with dark green apatite. The beryl is difficult to identify but berylometer (see glossary) studies done during exploration of the pegmatite indicate significant beryl anomalies (Assessment Files, Red Lake).

Chemistry: Samples from the pegmatite were analysed for trace elements (samples 84-142 to 147, Table 27). High lithium values were obtained in the host rock near the contact, in muscovite from a replacement zone, in apatite pegmatite, and in typical replacement zone pegmatite. A high beryllium content was found in the replacement zone pegmatite. A sample of coarse feldspar from a replacement zone was analysed for major elements; results are in Table 12 (sample 84-0144).

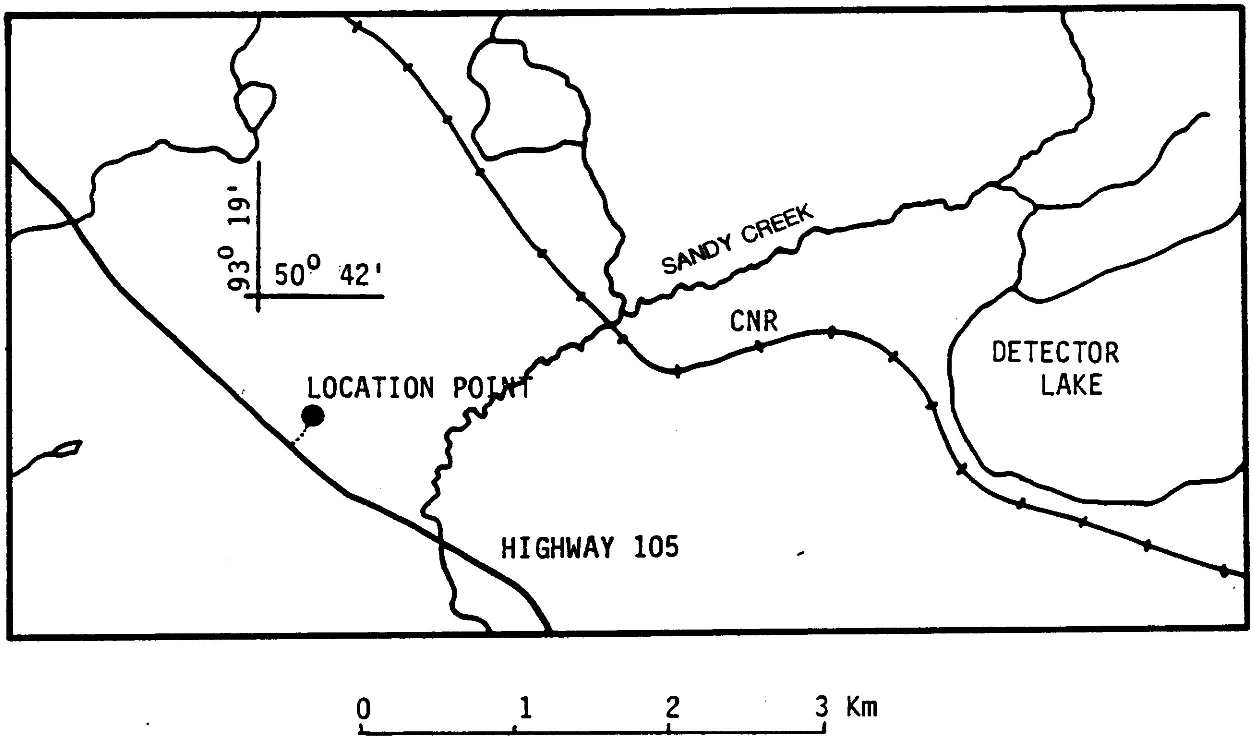


FIGURE 29. SANDY CREEK BERYL DEPOSIT

HISTORY: The occurrence was discovered by Wm. Gulbis in 1962. Stripping, trenching and a berylometer survey took place in 1962 and 1963 under option to Madsen Red Lake Gold Mines Ltd. The deposit is currently (1985) being examined for its beryl potential.

REFERENCES: NTS Map 52K/11

Breaks, F. W.
1979: Lithophile Mineralization in Northwestern Ontario, Rare Element Granitoid Pegmatites; p5-7 in Summary of Field Work, 1979, by the Ontario Geological Survey, edited by V. G. Milne, O. L. White, R. B. Barlow and C. R. Kustra, Ontario Geological Survey Miscellaneous Paper 90, 245p.

Breaks, F. W., Bond, W. D., Desnoyers, D. W. Stone, Denver, and Harris, N.
1976: Operation Kenora-Ear Falls, Bruce-Bluffy Lakes Sheet, District of Kenora; Ontario Div. Mines, Prelim. Map P.1199, Geol. Ser., scale 1:63,360 or 1 inch to 1 mile. Geology 1975.

Bruce, E. L.
1924: Geology of the Upper Part of the English River Valley; Ontario Department of Mines Annual Report Volume 33 part 4 for 1924 p 1-11.

Hewitt, D. F.
1967: Pegmatite Mineral Resources of Ontario; Ontario Department of Mines Industrial Mineral Report 21.

PIGMENTS

Pigments are divided into two groups: natural pigments and synthetic pigments. A natural pigment is a mineral that can be used as a colouring agent after fine grinding and little or no further treatment other than calcination. Most pigments used today are synthetic or manufactured compounds including metallic oxides or other compounds and organic dyes from vegetable, petroleum or coal tar sources. Many natural pigments are iron oxides and hydrated iron oxides in shades of yellow (goethite, lepidocrocite, ochre, sienna, limonite), red (hematite, calcined siderite, calcined pyrite), brown (umber, calcined limonite, calcined siderite and goethite) and black (magnetite, slate). Calcium carbonate, kaolin, talc, mica, asbestos, barite, nepheline syenite and other filler minerals frequently act as extenders to white pigments (particularly TiO_2) in paints and paper, rubber, plastics etc. The fillers act to increase the strength of the material, improve surface properties, extend the primary pigments, control viscosity and stability, enhance application and processing properties and lower overall costs of the finished product. Extender minerals, sometimes referred to as functional mineral pigments, have been discussed by Kollonitsch et al (1970), and Guillet and Kriens (1984).

The use of natural iron oxide as a pigment is far older than the production of metallic iron. Early man used natural pigments for rock paintings, body paint and other colouring purposes. The properties of a mineral that make it a good pigment are permanent colour, consistent reproducable colour, non-toxic nature, oil absorbtion (how much liquid is required to wet a given amount of pigment) particle size and shape, and optical properties. Natural iron oxide pigments have been discussed by Jolly and Collins (1980), Jones (1978), Watson (1979), and Hancock (1983). Titanium dioxide pigments have been discussed by Rose (1969), and Lynd and Lefond (1983)

IRON OXIDE PIGMENTS

Both natural and synthetic iron oxide are used as pigments. Many artist's oil colours are natural iron oxides from various sources in Spain, Italy, France, Cypress, the Persian Gulf area, and the United States. The use of natural iron oxide is declining in favour of synthetic iron oxide from steel mill wastes. These have the advantage of more uniform composition and physical properties, and a lower heavy metal and other toxic trace element content. Pigments are often custom designed for a particular purpose. Hematite and magnetite for pigment use can be obtained from some iron deposits worked for metallic iron.

Micaceous iron oxide (specular hematite) is used in rust inhibiting coatings for the protection of steel. This is the only natural iron oxide that has not been successfully supplanted by a synthetic product. Specular hematite has a platy structure that forms a protective layer over the steel surface. The hematite must form thin uniform flakes that bond well to the other paint ingredients and each other. The major world source of specular hematite is in Austria.

Two types of iron oxide minerals are used for pigment: hematite and magnetite (Fe_2O_3 and Fe_3O_4 respectively) and the hydrated iron oxides (goethite, limonite, siderite) collectively referred to as ochres. No ochres or specular hematite have been produced in Northwestern Ontario but the Mather mine in Michigan produced iron oxide for both metal and pigment as recently as 1979 (Jolly and Collins 1980).

The major producing and past producing ochre deposits in the United States are in residual material located south of the limit of glaciation. Jolly and Collins (1980) indicate limonite deposits in Northern Minnesota close to the Rainy River (Canada-USA border). Abundant small residual ochre deposits in weathered metavolcanic rocks and the overlying soils provided a source of pigment for the indigenous people. Ochre deposits, while common in Northwestern Ontario, are small and were formed by weathering of sulphide deposits or iron carbonate rich metavolcanics. Glaciation destroyed any pre-existing large deposits like those in the southern United States.

The ochre deposits are not an attractive exploration target because of their small size, low iron oxide content, widely varying mineralogy, and the low demand for natural iron oxide pigment. Some Early Precambrian iron deposits contain significant amounts of red iron oxide and 'ochre' but these have not been exploited for other than metallic iron production (Steeprock Iron Mine, east of the current study area). Specular hematite is the only natural pigment material that warrants exploration. Reported occurences in Northwestern Ontario are small and little is known about the geology or mineralogy of deposits other than the Griffith Mine (see description this report). There may be undiscovered deposits since Jolly and Collins (1980) state that "specular hematite is a fairly common mineral in mines of the Lake Superior region, as well as other areas...", although the Lake Superior region they refer to is underlain by rocks of Middle Precambrian age.

TITANIUM DIOXIDE PIGMENTS

Titanium dioxide produces a brilliant white pigment used in paint, paper, rubber, plastics and other materials. Titanium minerals are mined from sand deposits (heavy mineral sands) in Australia and from rock deposits (titaniferous magnetite, illmenite-hematite and illmenite-rutile in mafic intrusive rocks) in Quebec. The only significant deposits that have been found in Northwestern Ontario are titaniferous magnetite, although ilmenite, rutile and sphene occur as accessory minerals in several base metal deposits in the Mine Centre - Fort Frances area (Poulson, 1984). No production has occurred but a group of deposits in the Bad Vermilion Lake Sill, east of Fort Frances, have been investigated intermittently since 1911 as a source of iron and titanium. Titanium deposits can produce either pigment or metal or both. Trowell et al (1980) mention an additional titaniferous magnetite deposit in mafic to ultramafic intrusive rocks near Gibi Lake southeast of Kenora, and a few other occurrences have been mentioned in diamond drill results from copper and nickle exploration in mafic intrusive complexes (Resident Geologist Files, Sioux Lookout and Red Lake). Titaniferous magnetite segregations in layered gabbro complexes are attractive exploration targets provided sufficient titanium is present in the deposits.

Table 30. Pigment deposits

DEPOSIT		LOCATION	DETAILS
P 1	Bad Vermilion Lake Sill	52C/10 NE&NW	Titaniferous magnetite segregations in a layered mafic sill complex
P 2	English River Iron Formation	52L/8 SW	Apparent specular hematite forms a small proportion of a metamorphosed iron stone deposit
P 3	Gibi Lake Occurence	52E/9 NE	Titaniferous magnetite segregations in mafic sills
P 4	Griffith Mine	52K/14 SW	Apparent specular hematite in iron stone deposit
P 5	Kekekwa Lake	52F/7 NW	"Narrow stringers and veins of specular hematite occur in brecciated granitic rock" Blackburn (1974)
P 6	Minaki Pyrite Mine	52L/2 SE	Red gossan zone over a pyrrhotite-pyrite body

P 1 BAD VERMILION LAKE SILL

COMMODITY: Titanium (titaniferous magnetite)

STATUS: Prospect

LOCATION: NTS 52C/10 NW, NE, Farrington Township (in part),
District of Rainy River.
48°43'02" North Latitude, 92°44'01" West Longitude
UTM Grid 519600mE, 5395800mN Zone 15.
The drill site on the shore of Bad Vermilion Lake is used as a location point.

ACCESS: The deposit is located between Bad Vermilion Lake and Highway 11. Access is from the lake at the east end and the highway at the west end (Figure 30).

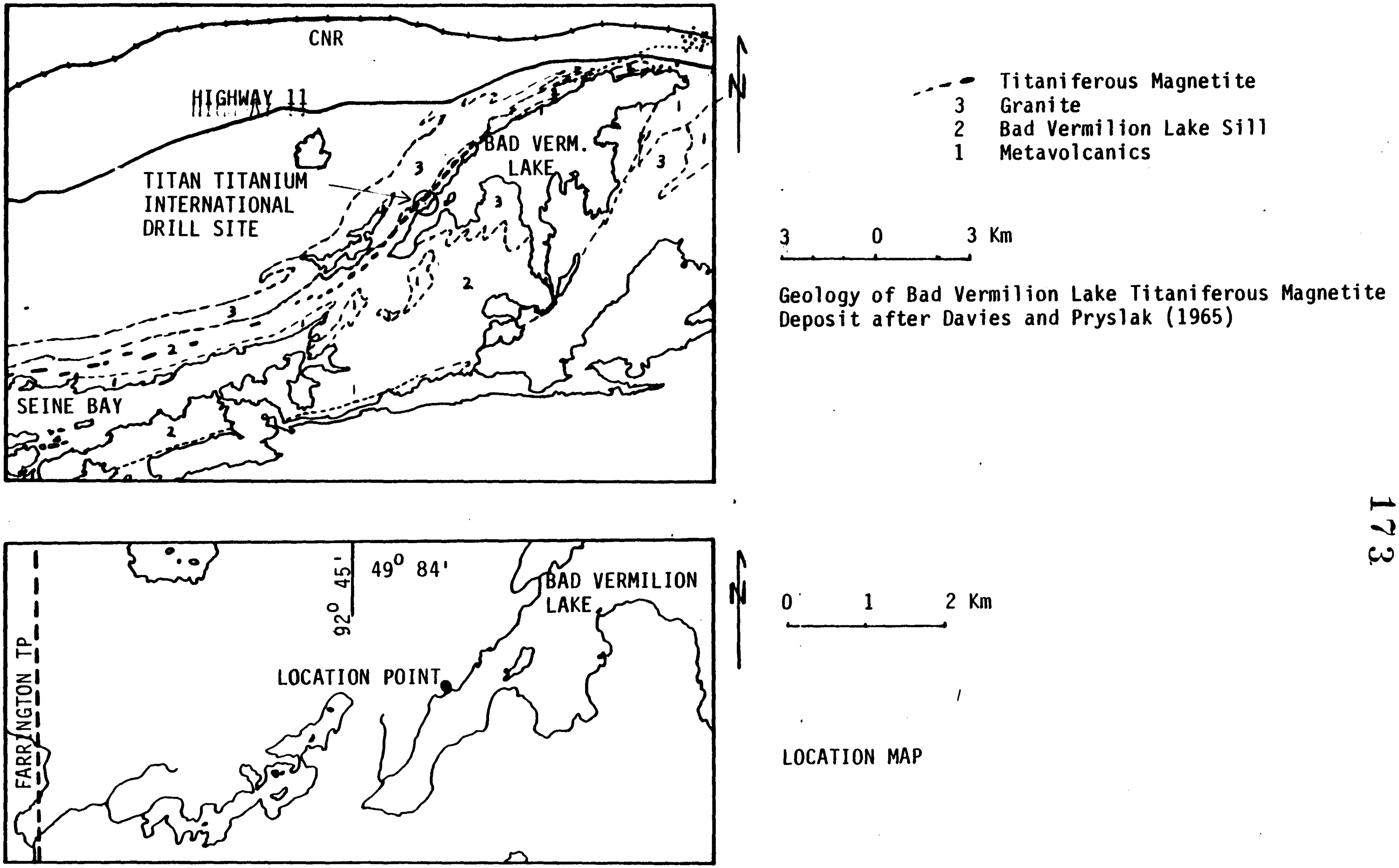
DESCRIPTION: Geological Setting: The area is underlain by metavolcanics intruded by a layered gabbroic sill.

Previous Geological Work: The area has been mapped by Lawson (1899, 1913), Harris (1974), Tanton (1936), and Wood et al (1980). The deposit has been described by Poulson (1984), Rose (1969), and Robinson (1922).

Geology: As shown in Figure 30 the titaniferous magnetite forms a series of lens shaped bodies extending the length of the east-northeast trending Bad Vermilion Lake Sill from Mine Centre to Seine Bay, a distance of 18 km. The sill faces north (Poulson, 1984); accumulations of titaniferous magnetite occur in the central and upper parts of the intrusion. The titaniferous magnetite content of the bodies is highly variable, both massive and disseminated mineralization are present. Massive mineralization consists of closely packed grains of titaniferous magnetite with interstitial silicates. Massive zones are enveloped by disseminated titaniferous magnetite which grades into non-mineralized gabbro. Minor amounts of apatite, chlorite, talc and cross-fibre 'asbestos' are present. The deposits have formed by magmatic segregation.

Chemistry: Analyses by Robinson (1922), Rose (1969), and Stratmat Ltd (Assessment Files) indicate a wide variation in titanium content. Table 31 lists analyses from several sources.

HISTORY: The deposit was first examined in 1911 by a Mr. Hunter of Duluth, Minnesota. The deposit was extensively mapped , drilled and sampled by Stratmat Ltd. from 1956 to 1958. In 1984 and 1985 it was being evaluated by Titan Titanium International of Toronto.



Geology of Bad Vermilion Lake Titaniferous Magnetite Deposit after Davies and Pryslak (1965)

LOCATION MAP

FIGURE 30. Bad Vermilion Lake Titaniferous Magnetite deposit

REFERENCES: NTS Map 52C/10

Harris, F. R.
1974: Geology of the Rainy Lake Area, District of Rainy River; Ontario Division of Mines Geological Report 115, 94p Accompanied by maps 2278 and 2279.

Lawson, A. C.
1888: Report on the Geology of the Rainy Lake Region; Geological Survey of Canada Annual Report New Series, Vol.3, Pt.F, p1-182.

1913 The Archean Geology of Rainy Lake Re-studied; Geological Survey of Canada Memoir 40.

Poulson, K. H.
1984: The Geological Setting of Mineralization in the Mine Centre - Fort Frances Area, District of Rainy River; Ontario Geological Survey Open File Report 5512.

Robinson, A. H. A.
1922: Titanium; Canada Department of Mines, Mines Branch Pub.579.

Rose, E. R.
1969: Geology of Titanium and Titaniferous Deposits of Canada; Geological Survey of Canada Economic Geology Report No. 25.

Tanton T. L.
1936: Mine Centre Area; Geological Survey of Canada Map 334A.

Wood, J., Dekker, J, Jansen, J. G., Keay, J. P. and Panagapko, D.
1980: Mine Centre Area (Western Half), District of Rainy River; Ontario Geological Survey Preliminary Map P. 2201, Geological Series scale 1:15840
Geology 1976, 1977.

Table 31. Titanium analyses Bad Vermilion Lake

TiO_2	FeO	Fe_2O_3	SiO_2	P	Reference
5.89	22.9	13.23			1
26.03	48.45	*	7.35	0.05	2a
17.21	44.04		6.76	0.004	2b
20.50	46.70		6.50	0.02	2c
27.54	46.60		2.47	0.29	2d
20.74	42.63				3
19.67	43.62				4
20.06	42.0				5
15.56	34.17				6
3.43	25.00				7
10.7	50.06				8
13.7	32.9				9
17.88					10

1. Rose (1969)
2a. Robinson (1922), average of 1 ton sample
2b. Robinson (1922), sample across 20 feet of outcrop
2c. " " bulk sample
2d. " " 32 feet of outcrop
3. Assessment Files Kenora, average of 27 samples for Titan Iron Mines Ltd. 1947
4. " " " average of 16 samples for S. J. Bird, 1947
5. " " " average of 10 samples by National Lead Company, 1948
6. " " " average of 18 samples for Titan Iron Mine, 1948
7. One sample of gabbro from shaft dump at west end of magnetite horizon, this study
8. One grab sample from old test pit at Titan Titanium drill site, this study
9. Assessment Files Kenora, Titan Titanium 1984 Diamond Drilling, average of 20 samples over 205.4 feet of core, minimum 7.99% TiO_2, maximum 22.58% TiO_2
10. Assessment Files Kenora, Titan Titanium 1984 Diamond Drilling, average of 15 samples over 156.5 feet of core, minimum 5.62%, maximum 25.58% TiO_2

* blanks mean not analysed for.

P 2 English River Iron Formation (Separation Lake Prospect)

COMMODITY:	Specular Hematite
STATUS:	Occurence
LOCATION:	NTS 52L/8 SW, District of Kenora. 50°15'55" North Latitude, 94°28'47" West Longitude UTM Grid 394500mE, 5568900mN Zone 15. The exposure in a road cut on the English River Road was taken as a location point.
ACCESS:	The deposit is exposed in road cuts along the English River Forest Access Road , 2 km north of Separation Rapids (Figure 31).

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics and metasediments of the northern part of the English River Subprovince.

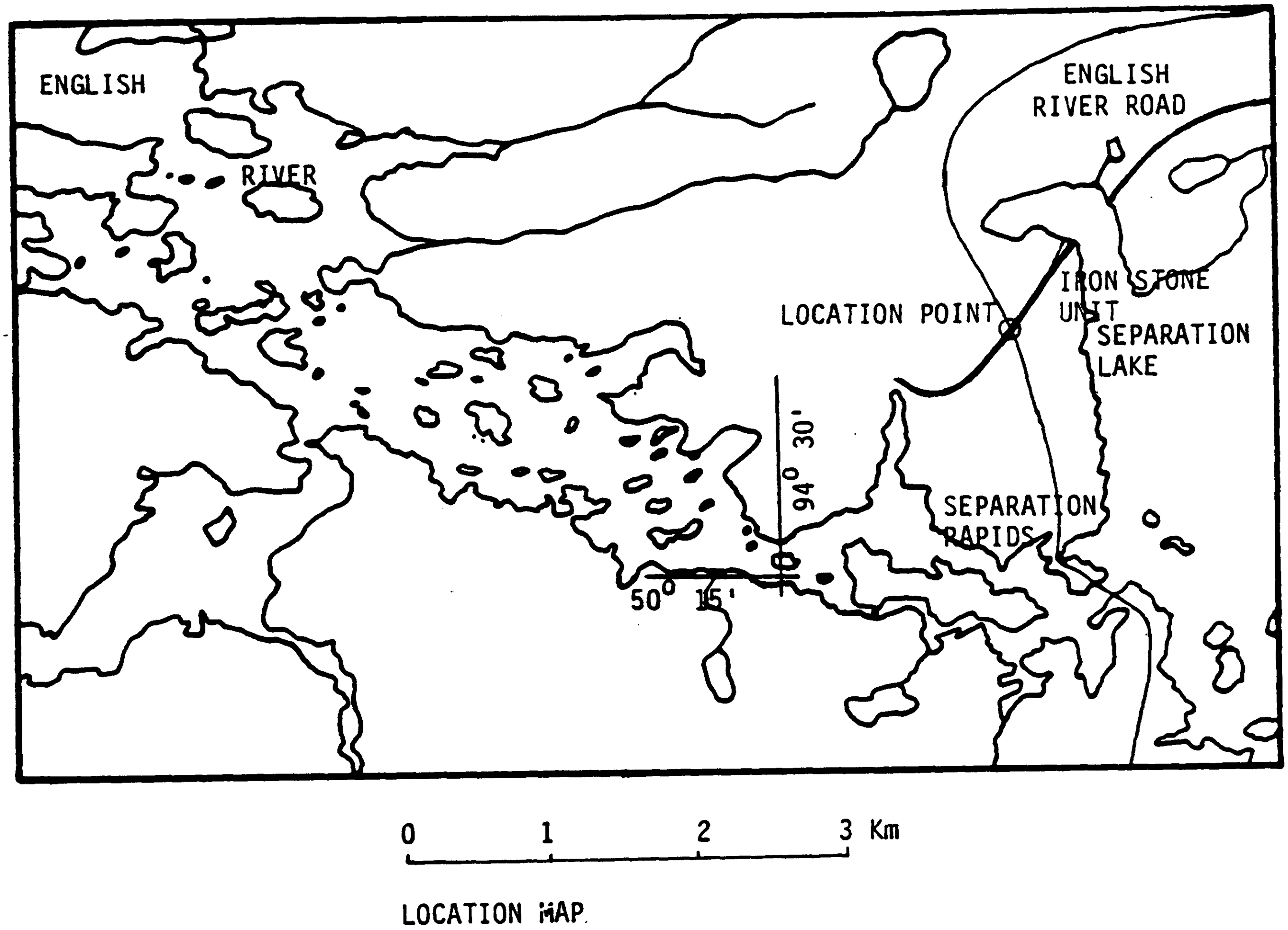
Previous Geological Work: The area has been mapped at a reconnaissance scale by Breaks et al (1975). A brief description of the deposit is published in Shklanka (1968).

Geology: The rocks of this area are predominantly metasediments with intercalated mafic metavolcanics; they have been metamorphosed to amphibolite grade. The ironstone unit forms a horizon that extends eastward from Separation Rapids around the west end of Separation Lake to Helder Lake. The rock is well layered with magnetite rich layers and biotite, hornblende and quartz rich layers. Minor pyrite and pyrrhotite rich layers are also present. At the place examined, layering trends 060° and dips steeply to the north. A small amount of ironstone near the north contact of the unit appears to contain specular hematite.

Petrology and Chemistry: Analyses of the iron formation published by Shklanka (1968) indicate up to 37.76% iron. A sample of sulphide rich material (5 to 10% sulphide in 1mm layers) gave the following analytical results:

Au	7ppb
Co	39ppm
Cr	10ppm
Cu	580ppm
Li	3ppm
Ni	46ppm
Zn	68ppm
F	70ppm

The mineralogy of the apparent specular hematite unit was found to be magnetite, quartz, and amphibole by X-ray diffraction. The apparent specular nature is due to the



SCHEMATIC SECTION THROUGH IRON STONE UNITS

NORTH

Black fine grained amphibolite unit
18.2 metres thick

3 metre iron stone unit

27.4 metres amphibolite

Samples taken here
9 metres intercalated iron stone and fine grey metasediment
9 metres amphibolite

6 metres iron stone

Amphibolite

SOUTH

FIGURE 31. ENGLISH RIVER IRON FORMATION

well developed foliation rather than the presence of specular hematite.

HISTORY: The deposit was discovered in 1934. Magnetometer surveys and diamond drilling were carried out in 1957 by Tombill Gold Mines Ltd., and further diamond drilling in 1959 by Centurion Mines Ltd. There has been no further recorded exploration activity. The deposit was evaluated as a source of metallic iron rather than pigment.

REFERENCES: NTS Map 52L/8

Breaks, F. W., Bond, W. D., McWilliams, G. H., Gower, C. F., Findlay, D., and Stone, Denver
1975: Operation Kenora-Sydney Lake, Umphreville-Separation Lakes Sheet, District of Kenora; Ontario Division of Mines, Prelim Map P 1028, scale 1:63 360.

Shklanka, R.
1968: Iron Deposits of Ontario; Ontario Department of Mines Mineral Resources Circular No. 11.

Assessment Files, Kenora.

P 4 GRIFFITH MINE

COMMODITY:	Specular hematite
STATUS:	Occurrence
LOCATION:	NTS 52K/14 SW, District of Kenora. 50°49'16" North Latitude, 93°21'54" West Longitude UTM Grid 474200mE, 5629800mN Zone 15.
ACCESS:	The mine is on the west shore of Bruce Lake 25 km north of Ear Falls and can be reached by Highway 105.

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics and metasediments of the Uchi Subprovince.

Previous Geological Work: The area has been mapped by Shklanka (1970). The deposit has been described by Shklanka (1968, 1970)

Geology: The ore body is a complexly folded sequence of ferruginous metasediments. Distinct units can be identified and mapped. The rock consists of alternating magnetite rich and siliceous layers. Specular hematite has been reported from one part of the orebody referred to by mine staff as the Outer Massive unit. The rock is layered with thin, highly reflective layers of flakey minerals separated by layers of magnetite and grey to red siliceous material. Samples of this material were submitted to the Geoscience Laboritories, OGS, Toronto for mineralogical examination with the following results:

> Sample Description: The sample is a piece of iron ore containing quartz and magnetite with lesser amounts of hematite. In places, the rock has developed a schistosity in association with which there appears to be specular hematite.
>
> Procedure: A portion of the sample was finely pulverized and x-rayed. Another sample was removed and coarsely ground. Both samples were examined using the petrographic microscope.
>
> Results: Considerable quartz, magnetite and mica were identified, accompanied by hematite. Under the microscope, flat relatively thick plates of hematite were observed. On further grinding, the hematite did not cleave into thinner flakes; it simply broke down into finer granules.

Conclusion: The hematite in the ore is brittle and fails to form thin cleavage fragments when broken. The spectacular reflections of light on the schistose surfaces are due in part to mica; at the same time the iron oxides have recrystallized against the mica surfaces, enhancing the obeserved reflections.

For these reasons, the hematite probably has little or no potential as an industrial pigment.

HISTORY: The deposit has produced iron ore for the Steel Company of Canada Ltd. from 1968 to 1986 and material from the Outer Massive unit was used to face a house in Ear Falls.

REFERENCES: NTS Map 52K/14
Shklanka, R
1968: Iron Deposits of Ontario; Ontario Department of Mines Mineral Resources Circular 11.

1970: Geology of the Bruce Lake Area; Ontario Department of Mines Geological Report 82.

P 6 MINAKI PYRITE MINE

COMMODITY: Iron oxide pigment (Ochre)

STATUS: Occurrence

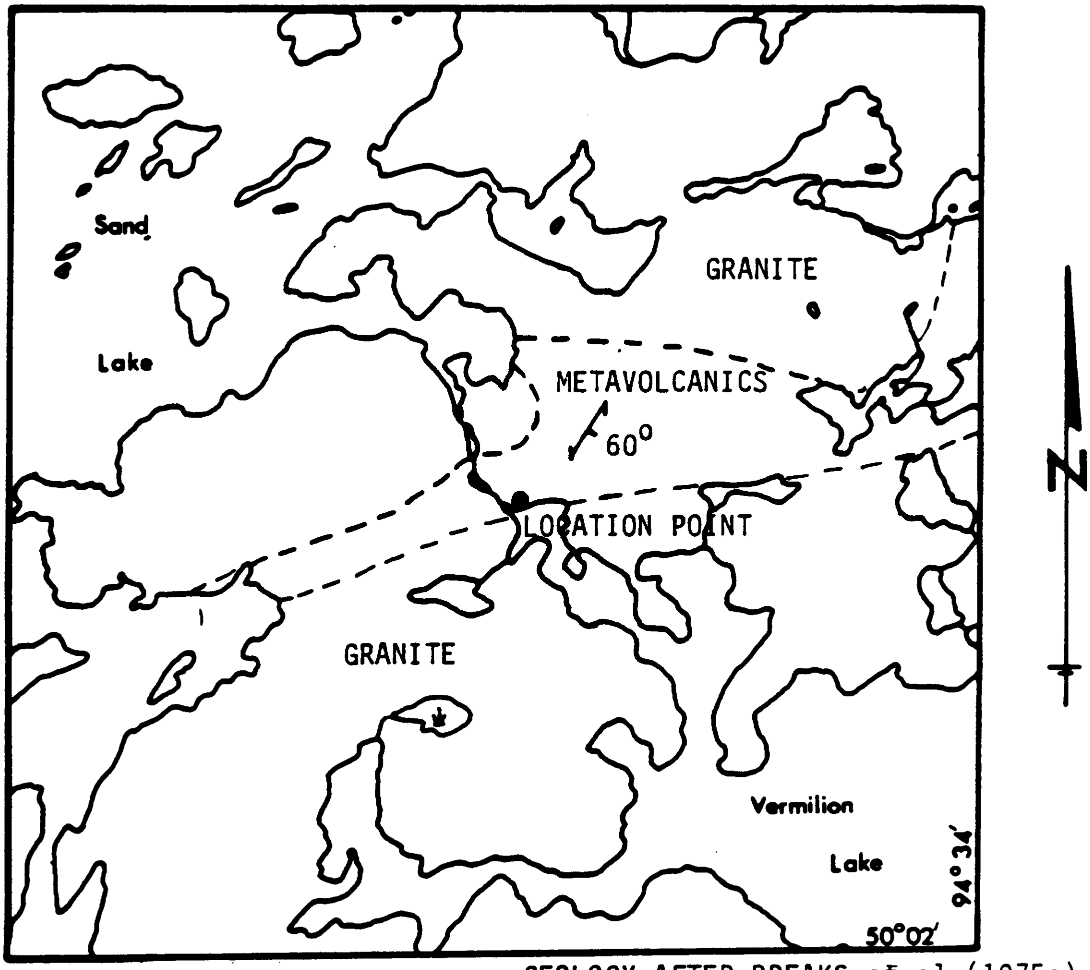
LOCATION: NTS 52L/2 SE, District of Kenora.
50°04'05" North Latitude 94°36'06" West Longitude
UTM Grid 385450 mE, 5546950 mN Zone 15.

ACCESS: The deposit is 10 km northeast of Minaki and can be reached from Sand Lake or Vermilion Lake (Figure 32).

DESCRIPTION: Geological Setting: The area is underlain by a narrow arcuate metavolcanic belt extending east-northeastwards from Sand Lake to Perch Lake.

Previous Geological Work: The area has been mapped at a reconnaissance scale by Breaks et al (1975), and is included in a compilation by Thurston and Bartlett (1981). The deposit has been described by Wright and Stockwell (1934) and Sinclair et al (1938).

Geology: The northwest end of Vermilion Lake is noted for its bright orange-red soil. This led to investigation of the area and the discovery of a large massive pyrrhotite-pyrite body. The body is hosted in schistose, apparently silicified, metavolcanics with disseminated pyrrhotite and pyrite plus stringers of pyrrhotite and pyrite. Pyrrhotite is the dominant sulphide. The sulphide body trends northeast and dips steeply to the northwest (Assessment Files). It is deeply weathered and does not outcrop but has been exposed by pits and diamond drilling. The soils on the south and east side of the hill are stained red from FeO. Iron oxide forms a thin coating on all soil particles, rocks, and outcrop surfaces in the trenches. The stream flowing out of Vermilion Lake has iron stain in its bed. The host rocks for the sulphide body have been mapped as mafic metavolcanics. Granitoid rocks mapped as quartz monzonite to granite can be found on either side of the metavolcanics and are in close proximity to the sulphide body on the south side. Decomposition of the pyrrhotite created strongly acid groundwater that attacked the other rocks, leaching them and creating the red iron staining and a material referred to as hydrous silica by Wright and Stockwell (1934). The soils are thin on top of the hill but are up to 5.5 m (18 ft) thick (Assessment Files) in the area of the pits. The soil in the top 0.5 metre is bright orange red, then abrubtly becomes yellow due to changes in the oxidation state of iron minerals. The yellow continues to the maximum depth of the exposures and presumably to the bedrock surface.



GEOLOGY AFTER BREAKS et al (1975e)

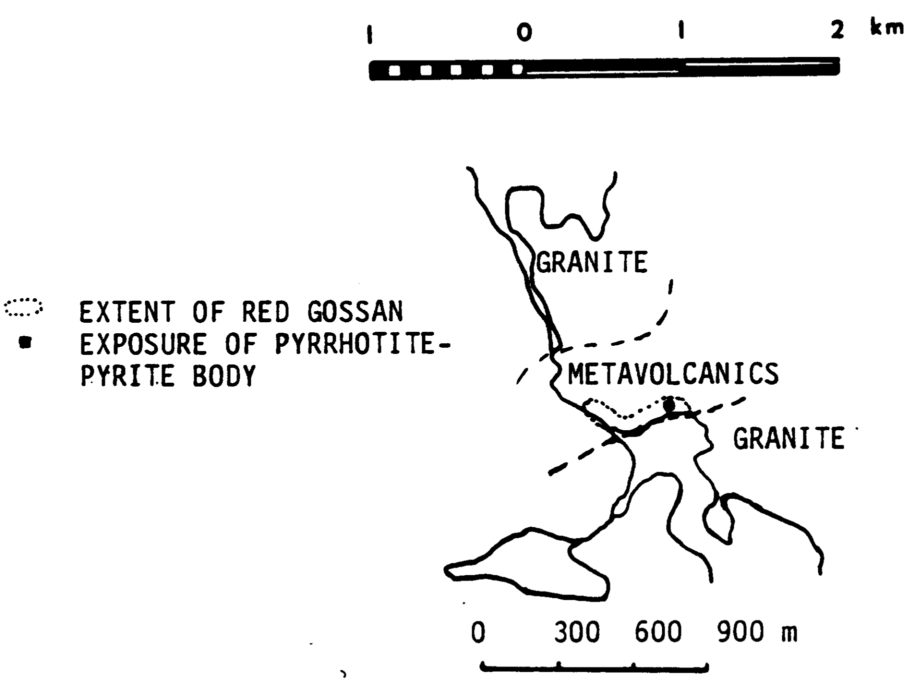


FIGURE 32. MINAKI PYRITE MINE

Chemistry: Major element analyses of both the red and yellow soil are shown in Table 32. Jarosite is the iron mineral responsible for the yellow colour of sample 84-38. Further oxidation to hematite and goethite has resulted in the red colour near the surface. The rest of the soil is predominantly quartz. The so-called hydrous silica of Wright and Stockwell has formed from the decomposition of granitoid rocks.

Table 32. Major Element Analyses

	84-38	84-41
SiO_2	67.10	44.80
Al_2O_3	0.47	6.69
Fe_2O_3	14.60	34.00
MgO	0.0	0.0
CaO	0.05	0.12
Na_2O	0.36	0.23
K_2O	1.12	0.79
TiO_2	0.09	1.03
P_2O_5	0.01	0.06
MnO	0.14	0.12
CO_2	0.13	1.33
S	3.69	1.64
LOI	14.4	11.8
TOTAL	98.3	99.6

HISTORY: There has been no reported quarrying of the red soil. The deposit was discovered in 1918 by F. McCallum. There was no systematic examination until 1937 when the Minaki Mining and Development Company was incorporated to develop the deposit as a source of pyrite (for sulphur, sulphuric acid, etc.). This company carried out trenching and diamond drilling in 1937 only. The deposit was still held by F. McCallum in 1949 and 1950 and at that time he was trying to interest other mining companies in it. There is no further record of their work on this property and the charter of the Minaki Mining and Development Company was cancelled in 1957 after several years of inactivity. More recently the area was staked for gold exploration.

REFERENCES: NTS Map 52L/2

Breaks, F. W., Bond, W. D., McWilliams, G. H., Gower, C. F., and Stone, Denver
1975: Operation Kenora-Sydney Lake, Kenora-Minaki Sheet, District of Kenora; Ontario Div. Mines Prelim. Map P.1030 Geol. Ser., scale 1 inch to 1 mile or 1:63,360. Geology 1974.

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1938: Mines of Ontario in 1937; Ontario Department of Mines Annual Report Vol. 47, Pt. 1 for 1937 p. 80 to 249.

Thurston, P. C. and Bartlett, J. R.
1981: Lower English River Sheet, Kenora District; Ontario Geological Survey Preliminary Map P.2394, Compilation Series, Scale 1:126720 or 1 inch to 2 miles. Compilation 1978.

Wright, J. F. and Stockwell C. H.
1934: Hydrous Silica Deposit North of Minaki Ontario; Canada Department of Mines Geological Survey Summary Report 1933 Part D.

Assessment Files, Resident Geologist Office, Kenora File 52L/2 SE File C-1.

SOAPSTONE/TALC/ASBESTOS

There is a resurgence of interest in soapstone as a refractory material in woodstoves and other residential heating systems and as an artist's medium. Soapstone deposits, their environment and the literature on soapstone have been described by Storey (1983, 1984, 1986). Fifteen deposits have been described (Table 33) including all the known past producers, prospects and major occurrences. Two additional soapstone deposits were examined during the present study and further sampling was carried out on some of the other deposits. Conclusions about, and exploration potential of soapstone are found in Storey (1984).

Soapstone is resistant to chemical and thermal decomposition, and has a high heat capacity. In the past this made it an attractive material for furnace linings in pulp mills, boiler settings and other refractory uses. The thermal properties of soapstone rather than its artistic potential led to exploration of the several deposits in the past. They were investigated as a source of refractory material during the 1920's. Many of the deposits proved unsatisfactory because the material cracked or crumbled due to variations in refractory properties. Soapstone was produced from the Eagle Lake deposit (S 3) from 1925 to 1927 and from the H. H. Wood deposit in 1922 and 1923. The Trap Lake, Mile Lake and Pipestone Peninsula deposits were investigated during the 1920's but did not produce. There has been no recent known systematic examination of soapstone deposits until the fall of 1983 when Wabigoon Resources Ltd. began a program to re-evaluate the Wabigoon Deposit (S 12) as a source of soapstone blocks and possibly talc for various industrial uses. Soapstone has traditionally been removed on a small scale from many deposits for carving pipes and ceremonial items by the Indian peoples. Currently, local carvers obtain material from several of the deposits.

The definition of soapstone is imprecise but implies that talc is a major constituent of the rock. Talc development in a rock as it is altered or metamorphosed is described by Winkler (1979). Narrow shear zones in mafic to ultramafic rocks often contain talc. Most of the soapstone deposits examined show a foliation which could have developed because the talc allowed easy deformation or the deformation gave rise to the development of talc.

The highest quality soapstones are almost entirely composed of talc. The colour is blue grey to grey-green and most are fine grained. The presence of large amounts of carbonate or chlorite is deleterious. Carbonates are not resistant to heat; and since they are present in varying amounts throughout the rock the hardness of the rock is variable making carving with simple tools more difficult. Chlorite tends to give the soapstone a foliation making carving difficult. In addition to true soapstone the native people have reportedly carved any rock soft enough to be worked with the tools available at the time. These include altered metavolcanics (chloritic or sericitic schist) and soft metasediments.

Talcose alteration of ultramafic rocks is commonly associated with gold mineralization. Massive talc is found in a few of the deposits as at the Madsen Mine near Red Lake but a mixture of talc, chlorite and carbonates is more common. The association of soapstone with gold mineralization led to the development, in 1922, of the H. H. Wood Talc Company deposit at Little Turtle Lake near Mine Centre, District of Rainy River. This deposit produced a small amount of soapstone for metal worker's crayons, gas burner tips and ornamental goods.

Altered mafic to ultramafic intrusive rocks that host soapstone deposits can also host asbestos mineralization. The major talc/soapstone deposits in the Eastern Townships of Quebec (near Broughton and South Bolton) are found in the same type of ultramafic rock complexes as the asbestos deposits of Thetford Mines. Altered ultramafic intrusive rock bodies are found in all parts of the Wabigoon and Uchi Subprovinces. Small amounts of serpentine minerals (usually picrolite) with an acicular to asbestiform habit occur in a few of these rocks. One occurrence of asbestos, at Ponask Lake north of Red Lake, has been examined by industry. While minor asbestos-like mineral occurrences are present, no large deposits have been reported. The two forms of acicular to fibrous minerals that occur in altered ultramafic rocks are cross fibre and slip fibre. Cross fibre occurs as veins and fracture fillings; as the name implies the mineral 'fibres' are oriented across the width of the veins. Slip fibre occurs as a lineation on the foliation surface of the rock. All asbestos deposits are of the cross fibre type: slip fibre does not form economic deposits.

No deposits have been opened for talc alone and no production of talc has been reported even as a byproduct of soapstone. The deposits examined have a relatively low talc content with the exception of some parts of the Wabigoon, Eagle Lake, Pipestone Peninsula and Madsen deposits. Talc could possibly be produced from these or some of the other deposits but further exploration and beneficiation studies are required to determine their talc potential. Given the current state of the asbestos industry none of the asbestos deposits present in the area warrant further exploration work. Soapstone, however, is a worthwhile target; mafic to ultramafic intrusive bodies particularly near known gold occurrences are promising areas.

Table 33. Soapstone/Talc/Asbestos deposits

Soapstone			
	S 1	Claxton Township - occurrence	see Storey (1984, 1986)
	S 2	Coste Island - prospect	
	S 3	Eagle Lake Soapstone Quarry - past producer	
	S 4	Labyrinth Bay - occurrence	
	S 5	Little Turtle Lake (H. H. Wood Talc Co.) - past producer	
*	S 6	Madsen - occurrence	
	S 7	Mile Lake #1 - prospect	
	S 8	Mile Lake #2 - occurrence	
	S 9	Pipestone Lake - occurrence	
	S 10	Pipestone Peninsula - past producer	
	S 11	Trap Lake - prospect	
	S 12	Wabigoon - prospect	
	S 13	Mica Point - occurrence	
	S 14	Phillips Township - occurrence	
*	S 15	Pipestone Bay (Red Lake) - occurrence	
	S 16	Pipestone Lake North - occurrence	
	S 17	Sucan Lake - occurrence	
Asbestos			
	S 18	Anderson Asbestos Occurence	
*	S 19	Ponask Lake	

* these deposits were not examined, text descriptions were compiled from literature sources.

S 16 PIPESTONE LAKE NORTH

COMMODITY: Soapstone

STATUS: Occurrence

LOCATION: NTS 52F/4 NE, District of Kenora.
49°08'23" North Latitude, 93°33'03" West Longitude
UTM Grid 459800 mE, 5442900 mN Zone 15.

ACCESS: The deposit is on the south west shore of the Northwest Arm of Pipestone Lake (Figure 33) and is reached by air from Kenora.

DESCRIPTION: Geological Setting: The area is underlain by metasediments and metavolcanics intruded by small mafic to ultramafic intrusive bodies.

Previous Geological Work: The area has been mapped by Edwards (1980), and Thomson (1936).

Geology: The talcose rocks are exposed in outcrops along the lakeshore. The rock is mapped as peridotite by Edwards (1980) and forms part of a small lensoid mafic to ultramafic body bounded by a fault on its east side. The main talcose occurrence is adjacent to this fault zone. The extent is shown on Figure 33. The rock is soft, dark green in colour and magnetic. The most talcose rock is very soft, fine grained blue-grey in colour. None of the rocks are foliated. The talcose rocks weather rusty and have a dark brown weathered rind. X-ray diffraction results are given in Table 34 below:

Table 34. X-ray Difraction Results

	84-44	84-46
Talc	A	A
Chlorite	C	C
Dolomite	B	B
Magnesite	-	-
Amphibole	-	-
Calcite	-	-
Quartz	-	-
Plagioclase	-	-
Magnetite	C	C

Ankerite rhombs (iron rich dolomite) are visible in some of the material but not in the most talcose part of the unit.

HISTORY: There has been no recorded extraction of this rock.

REFERENCES: NTS Map 52F/4

Edwards, G. R.
1980: Geology of the Schistose Lake Area, District of Kenora; Ontario Geological Survey Report 194, 67p. Accompanied by Map 2421, scale 1:31680 or 1 inch to 1/2 mile.

Thomson, J. E.
1936: Geology of the Rowan-Straw Lakes Area; Ontario Department of Mines Annual Report, Vol. 44, part 4 for 1935 p. 1-28.

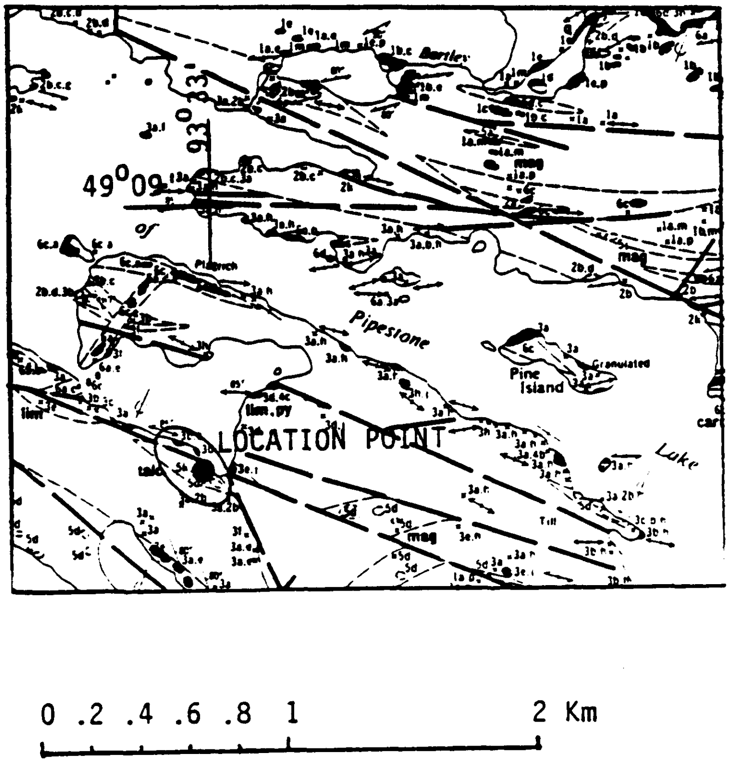

FIGURE 33. Pipestone Lake North Deposit, Geology from Edwards (1980)

LEGEND
6 Metamorphosed felsic intrusive rocks
5 Metamorphosed mafic to ultramafic intrusive rocks
4 Chemical metasediments
3 Clastic metasediments
2 Felsic to intermediate metavolcanics
1 Mafic to intermediate metavolcanics

S 17 SUCAN LAKE SOAPSTONE

COMMODITY: Soapstone

STATUS: Occurrence

LOCATION: NTS 52F/3, District of Kenora.
49°06'41" North Latitude 93°25'57" West Longitude
UTM Grid 468400 mE, 5439750 mN Zone 15.

ACCESS: The deposit can be reached from Sucan Lake (Figure 34). Sucan Lake can be accessed by air or by boat from Straw Lake.

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics and metasediments intruded by mafic to ultramafic rocks.

Previous Geological Work: The area has been mapped by Edwards and Sutcliffe (1984) and Thomson (1934).

Geology: The talcose unit is part of a larger gabbroic body that underlies the southwest part of Sucan Lake. The western most part of the gabbro is a north northeast trending serpentinized peridotite body possibly intrusive into the gabbro. The talcose rock is soft, fine grained, blue-grey in colour. It contains ankerite and weathers with a 1 to 3 mm rusty rind. The rock varies in hardness over short distances. The rock has no obvious foliation. X-ray diffraction studies on samples of the talcose rock gave the following results (Table 35):

Table 35. X-ray Diffraction Mineralogy

Sample	Talc	Chlorite	Dolomite	Magnetite	Amphibole
84-198	A+	B	C	D	-
84-199	A	B	B	D	-
84-200	C	A	C	D	D

84-198 Typical talcose rock
84-199 Softest material present
84-200 Serpentinite from north of the talcose zone

The most talcose rocks are found in the area shown on Figure 34. A shear zone 150 m south of the talcose rocks trends 110°/90° and contains quartz-carbonate vein material with minor pyrite. A sample of the vein material was submitted for trace element analyses, results are 10ppb gold and less than 2ppm silver.

HISTORY: There is no record of soapstone extraction in this area although the body was diamond drilled by Canadian Nickel Company in 1969 during copper exploration.

LEGEND

7 Subvolcanic dike rocks
6 6a *Peridotite (dunite in part)*
- 6b *Pyroxenite*
- 6c *Gabbro*
- 6d *Quartz-amphibole gabbro*
- 6e *Leucocratic gabbro, gabbroic anorthosite*
- 6f *Ophitic, knobby gabbro*
- 6g *Porphyritic (plagioclase) gabbro*
- 6h *Serpentinized*
- 6j *Carbonatized*
- 6k *Schistose*
- 6m *Amphibolite*
- 6n *Magnetite-bearing*
- 6p *Talcose*

4 Clastic metasediments
3 Felsic metavolcanics
2 Intermediate metavolcanics
1 Mafic metavolcanics

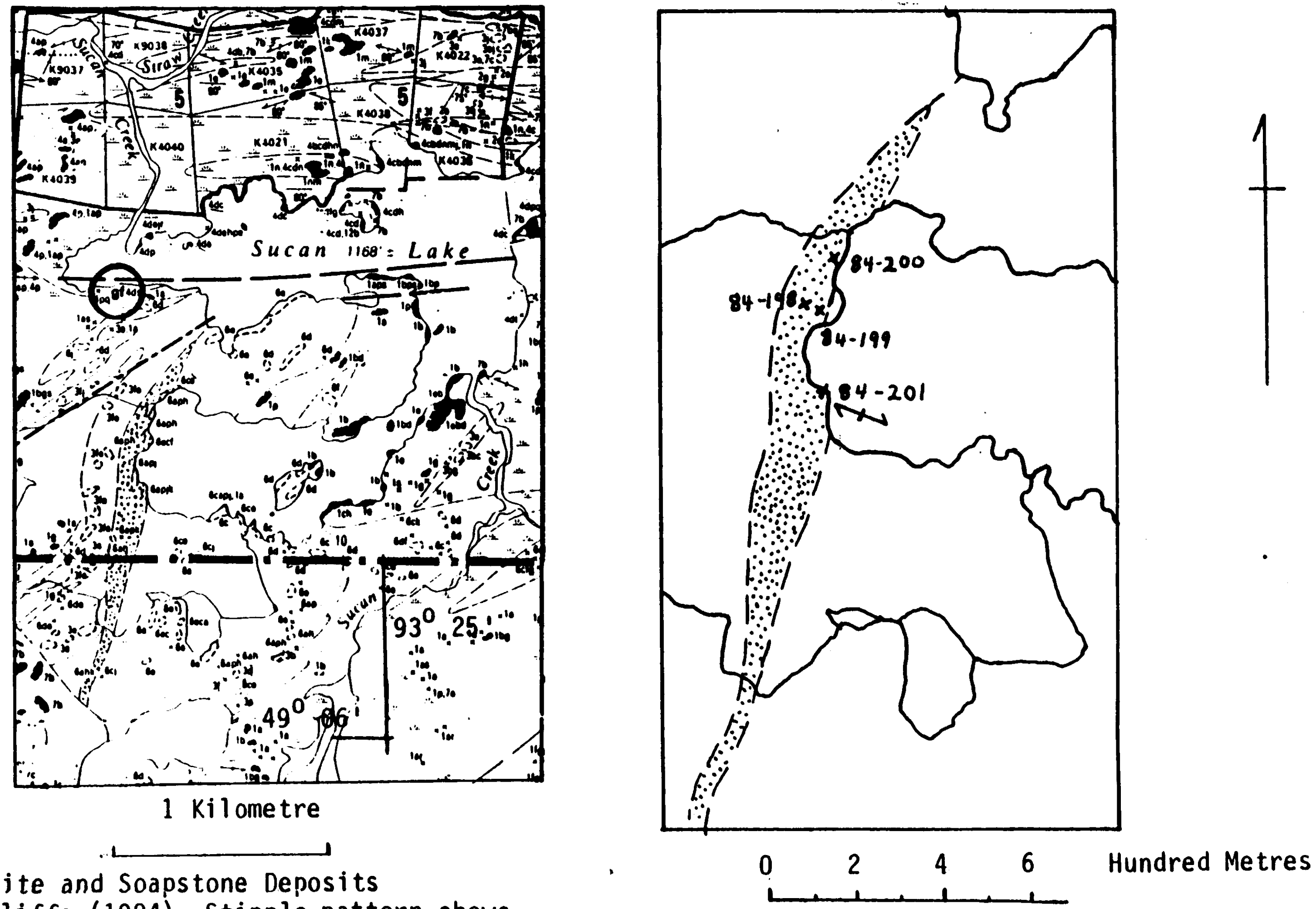

FIGURE 34. Sucan Lake Graphite and Soapstone Deposits
Geology from Edwards and Sutcliffe (1984). Stipple pattern shows talcose unit. Symbol gf is the location of the graphite occurrence.

REFERENCES: NTS Map 52F/3

Edwards, G. R. and Sutcliffe, R. H.
1984: Straw Lake: Ontario Geological Survey Map 2463, Precambrian Geology Series, scale 1 inch to 1/2 mile. Geology 1976.

Thomson, J. E.
1934: Geology of the Straw-Manitou Lake Area, Ontario Department of Mines Annual Report, Volume 43, part 4 for 1934.

Assessment Files, Resident Geologist Office, Kenora, File 52F/3 SW A-3

S 18 ANDERSON 'ASBESTOS' OCCURRENCE

COMMODITY: Asbestos

STATUS: Occurrence

LOCATION: NTS 52E/10 SE, District of Kenora.
49°32'33" North Latitude, 94°41'37" West Longitude
UTM Grid 377700 mE, 5489000 mN Zone 15.

ACCESS: The deposit is reached from Lake of the Woods.

DESCRIPTION: Geological Setting: The area is underlain by metasediments and metavolcanics intruded by ultramafic rocks.

Previous Geological Work: The area has been mapped by Lawson (1886) and Davies (1978, 1983).

Geology: The 'asbestos' minerals are formed in fractures in peridotite. Two types of fibrous appearing minerals are present: those forming slip fibres in joints and fractures and those forming cross fibres in veins. The cross fibre veins are up to 1 cm wide. The peridotite is a dark green, fine grained rock described by Davies (1978) as follows: " Round olivine grains up to 2 mm across were the principal constituents of the peridotite which occurs from one to two miles (1.5 to 3.5 km) west of Oak Point. Interstitial material is mainly talc and magnetite which may have been derived from original amphibole or pyroxene. The olivine has been completely serpentinized." Cross fibre veins make up only a small proportion of the rock and are erratically distributed through the entire mass of peridotite. A sample of cross fibre material was submitted to the Geoscience Laboritories, OGS and identified as serpentine (picrolite). A small amount of chrysotile has been identified in veins from this location (Resident Geologist files, Kenora).

HISTORY: The occurrence was originally reported by Lawson (1886) and has been prospected occasionally since then (Resident Geologist files, Kenora). There are no pits or other workings in the deposit.

REFERENCES: NTS Map 52E/10

Davies, J. C.
1978: Geology of the Shoal Lake-Western Peninsula Area, District of Kenora; Ontario Geological Survey OFR 5242, 131 p., 1 table, 7 figures, 20 photographs, and 4 maps, scale 1:15,840 or 1 inch to 1/4 mile.

1983: Western Peninsula, Kenora District; Ontario Geological Survey Map 2423.

Lawson, A. C.
1886: Geology of the Lake of the Woods Region; Geological Survey of Canada Annual Report, New Series, Volume 1, Part cc.

Resident Geologist Files, Kenora.

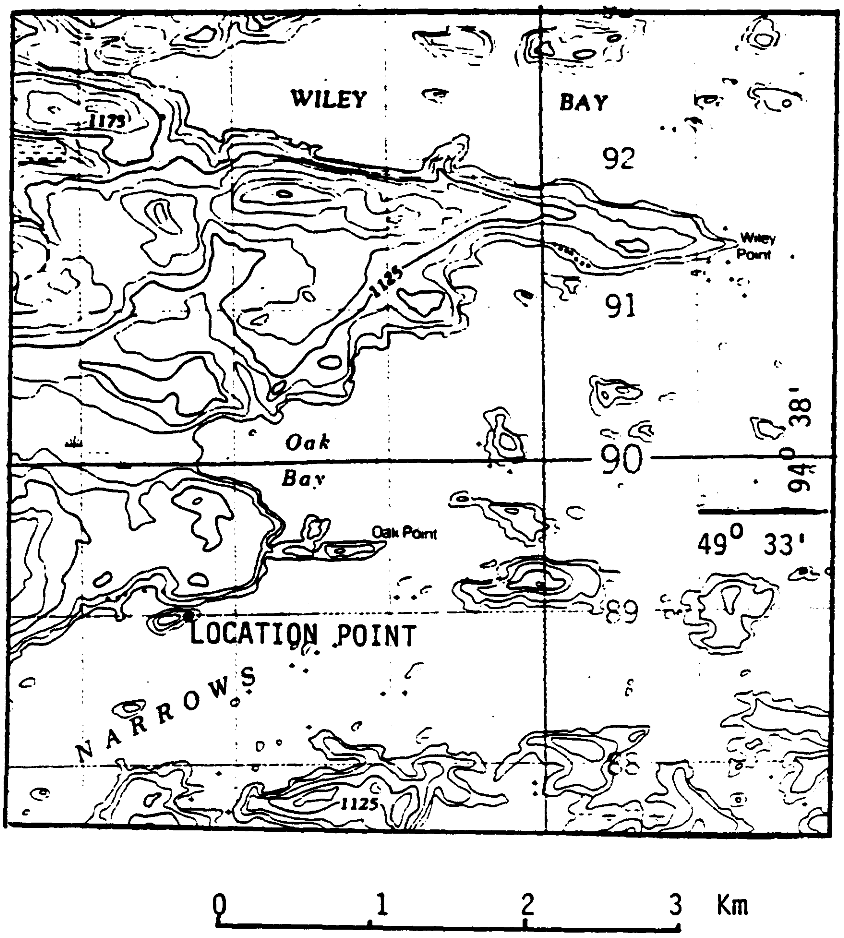

FIGURE 35. Location map Anderson Asbestos Occurrence

S 19 PONASK LAKE

COMMODITY: Asbestos

STATUS: Prospect

LOCATION: NTS 52K/2 SE, District of Kenora.

ACCESS: The deposit is on the north side of Ponask Lake 346 km north of Red Lake.

DESCRIPTION: The deposit was not examined. The description below is summarized from assessment work on file at the MNDM Resident Geologist Office in Red Lake. The deposit is described as follows:

> The outcropping ultrabasics are black to dark green, fine to medium-grained massive to hightly sheared, serpentine-carbonate-talc-magnetite rocks. Occasionally, areas containing relict olivine pseudomorphs are preserved and indicate that the serpentinite was originally a dunite.
>
> The main asbestos occurrence outcrops at only one place, on the northern shoreline of the large peninsula on claim no. KRL 433016. Fibre bearing serpentinite is exposed over an area of about 65 feet x 20 feet. Light green chrysotile cross fibre veinlets form 7 to 10% of the rock on average, the proportion reaching 25% of densely ribboned fibre locally. There is a modest (2%) proportion of 1/4" fibre, the bulk of the fibre measuring 1/16". The great majority of the fibre veinlets strike northeasterly with vertical to very steep northwesterly dips. Magnetite occurs as trains along the fibre margins and also disseminated throughout the intervening serpentinite and occasionally within the fibre veinlets themselves.

Asbestos was discovered here in 1973 by Inco during copper-nickel exploration. The deposit was restaked in 1975 and mapped and diamond drilled by Conwest Exploration Company Ltd. in 1975 and 1976. There has been no further exploration work on this deposit due to its remote location and low grade.

REFERENCES: NTS Map 52K/2
Assessment Files, Resident Geologist Office, Red Lake.

MISCELLANEOUS COMMODITIES

There are many possible industrial minerals in both the Precambrian bedrock and surficial deposits although they have received very little attention from individuals, industry, or government. Several industrial minerals were selected for investigation: viz. barite, diatomite, fluorspar, kyanite-sillimanite-andalusite, nepheline syenite and alkalic complexes, and staurolite.

BARITE

Barite mineralization has been reported in the Thunder Bay area of Northwestern Ontario. These deposits are of two types: Middle to Late Precambrian veins, and Early Precambrian bedded deposits in the Hemlo area. Many of the vein deposits have been described by Guillet (1963). Patterson (1984) describes the bedded deposits at Hemlo and compares them to deposits in the United States, Australia and Africa. The Hemlo barite occurrences are found in a sequence of metasediments between mafic metavolcanics and fragmental felsic metavolcanics. The barite unit is one to two metres thick and has been traced for up to eight kilometres. In their research on this deposit Thomson and Glidden (1985) support a syngenetic origin for the barite.

In Newfoundland barite has been produced from tailings at the Asarco-Price massive sulphide deposit at Buchans (Dean, 1984).

There are no reported occurrences of barite veins or bedded barite deposits in the study area. Geological environments similar to those at Hemlo and Buchans be may present. Deep water, oxygen starved, sedimentary basins, particularly those associated with syngenetic sulphide deposits, warrant research to determine their barite potential. Barite will not be an attractive exploration target in Northwestern Ontario until more is known about possible syngenetic Early Precambrian barite deposits.

DIATOMITE

Diatoms are single celled aquatic algae of the order Bacillariophyceae. They are found in small amounts in all bodies of fresh or salt water. The siliceous frustules or cell walls of these algae form part of the sediment found on lake and stream bottoms. There are two groups of diatoms, those with radial symmetry (centric diatoms) and those with bilateral symmetry (pennate diatoms) Diatoms live in most bodies of water but only rarely form a significant deposit. A deposit comprising predominantly diatom frustules and small amounts of clastic sediment is called diatomite. Diatomite is used in a wide variety of products and industrial processes. Filter media in the food and beverage industry, water filtration plants and chemical industry; functional filler in paint, insecticides, and chemical products; reinforcing material in rubber goods; and mild abrasive in cleaning materials, are a few of the uses of diatomite. Diatomite is unique among mineral products in that it can absorb up to 2 1/2 times its weight of water. This enables it to be used as a carrier for many potentially hazardous chemical products (acids, nitroglycerine). The structure of the diatom frustule gives it a low density and thermal conductivity making it a good insulating material. Diatoms are heat resistant and non-reactive in most chemical processes making them good catalyst carriers. The filtering ability is related to the shape, size and form of the frustules. Each species (there are 12000 to 16000; Kadey 1983) has a unique shape structure and size range.

Diatomite deposits have not previously been reported in Northwestern Ontario. One deposit (in a shallow lake environment similar to many small lakes in Northwestern Ontario) is described by Laird (1935) in Claw Lake, Cabot Township, District of Sudbury. Diatomite deposits in the Muskoka - Parry Sound area are described by Eardly-Wilmot (1928), and Satterly (1943b,c). Diatomite was produced from some of these deposits during the 1930's and from one deposit in 1953 (Arnoldi 1955). The environment of all these deposits is similar: small, shallow, swampy lakes or marshes with abundant algae and plant life. Active diatom deposition has ceased in many of these deposits due to infilling of the lake by vegetation and sediment.

Diatoms assimilate large amounts of silica and have a major effect on the balance of silica dissolved in lake water. Intensive diatom reproduction and resulting sedimentation of their frustules can deplete the dissolved silica more rapidly than it is replaced by inputs from surface and ground water. The amount of silica in solution acts as a control on the amount and species of diatoms present. Major diatom growth occurs during late winter and spring in most lakes. Wetzel (1983) discusses the role of diatoms in fresh water ecosystems. Kadey (1983) lists the following environmental requirements for abundant diatom growth:

large shallow basins
abundant supply of soluble silica
abundant supply of nutrients
absence of toxic or growth inhibiting constituents in the water
minimum supply of clastic sediment

Diatoms can reproduce rapidly and accumulate rapidly as they die (up to 4 mm per year, Kadey 1983). Known diatom rich deposits in Ontario have developed since the end of the last period of glaciation and there are some currently being deposited.

Two environments were investigated - clear lakes in predominately granitoid terrain and shallow organic rich lakes. The former environment showed only small amounts of organic sediment, the latter had large thicknesses of organic sediment or gyttja and is the same environment as that hosting the deposits formerly in production near Parry Sound, Ontario. Three deposits of this type were examined: Bunny Lake; Old Woman Lake; and Tabor Lake. A complete description of the Old Woman Lake deposit follows; samples from the other two are described in Table 36.

Samples were obtained as described under Lake sediment sampling. They were examined under a microscope to see that they contained diatoms. They were then dried and three from Old Woman Lake split and submitted for major element analysis. The remaining material was burned to remove organic matter and the resulting light brown material was examined under a microscope to determine the diatom content of the non-organic fraction of the sediment.

DIATOM RECONNAISSANCE

The bottoms of several small and large lakes were sampled (Table 36). UTM grid locations are given for each sample to enable the reader to accurately locate them on 1:50,000 National Topographic Series maps. The

Table 36. Lake Sediment Samples Other Than Marl

	UTM	NTS	WATER DEPTH	WET COLOUR	DRY COLOUR	WATER CONTENT	DESCRIPTION
83	356250mE 5492600mN	52E/10SE	4.5m	Grey	--	--	Firm clay.
85A	358700mE 5493200mN	52E/10SE	1m	light brown	Black		Very soft highly organic gelatinous sediment with abundant fresh plant fragments.
85B	"	"	"	"	Dark brown		" "
97	436300mE 5502200mN	52F/12NW	2.4m	Beige	Beige		Fine sand with minor organic detritus.
98	434700mE 5502200mN	52F/12NW	3.6m	Light grey	Light grey		Fine silty clay, no carbonate.
99	434700mE 5502050mN	52F/12NW	2.4m	Brown	Grey		Very soft organic rich sediment, 30% fine sand particles in dry sediment.
100	432700mE 5498050mN	52F/12NW	2.1m	Light brown	Light grey		Fine sand, organic fraction forms a hard matrix.
101	432800mE 5498100mN	52F/12NW	3.9m	Light brown	Light brown to grey		Sand with organic material, dry sediment has a grey matrix of organic material and fine silt.
102	433100mE 5497900mN	52F/12NW	6.1	Dark grey	Grey		Soft gellatinous mixture of silt and organic sediment. dry sediment is approximately 50% sand, becmes buff coloured when calcined, diatoms are visible in both the raw and calcined material.
103	438250mN 5503600mN	52F/12NW	3.3m	Light brown	Light brown		Fine sand with thin (3mm) organic layer on top.
104	438400mE 5503200mN	52F/12NW	2.7m	Light brown	Light brown		Fine sand with thin (3mm) organic layer on top.
105A	438800mN 5503250mN	52F/12NW	3.6m	Orange	Orange		Fine silty sediment overlying light brown sand.
105B	"	"	3.6m	Orange	Orange		Sand and gravel with minor silt, rusty orange colour when dry. sand particles are covered with fine rusty-orange iron oxide material.
106	438800mE 5505300mN	52F/12NW	2m	Brown	Grey		Very soft, deep organic sediment with minor roots and plant parts 10% fine sand material is buff when calcined.
107A	433050mE 5503800mN	52F/12NW	0.3m	Black	Brown		Organic rich sediment from shore of a small lake. contains abundant (75%) fibrous plant material.
110	530100mE 5489450mN	52F/10SE	2.1m	Brown	Brown		Organic rich sediment in marsh.

111	542800mE 5486100mN	52F/9SW	2.1m	Light grey	Light grey		Soft clay.
112	542800mE 5486400mN	52F/9SW	7.1m	Brown	Grey		Very soft gelatinous, organic rich sediment, small sand content (10% visual estimate), occaisional diatoms evident.
113	542500mE 5486500mN	52F/9SW	5.1m	Brown	Grey-brown		Very soft gelatinous organic rich sediment, diatoms appear on surface of dry sediment.
114	425550mE 5480350mN	52E/8NE	1m	Brown	Grey-brown		Very fine grained organic rich sediment with roots and other plant parts.
115	425550mE 5480450mN	52E/8NE	1-1.5m	Dark brown	Brown		Organic rich sediment, becomes light buff coloured on calcination.
116	425500mE 5480500mN	52E/8NE	1m	Dark brown	Brown		Soft gelatinous organic rich sediment.
117	423400ME 5481950mN	52E/8NE	2m	Dark brown	Grey		Very soft organic rich sediment with roots and plant parts.
118	423950mE 5482100mN	52E/8NE	1.2m	Grey	Grey		Sandy silt with abundant organic material overlying it.
119	424500mE 5481200mN	52E/8NE	2m	Brown	Dark grey		Very soft deep organic sediment with a trace of fine sand.
120	423800mE 5481750mN	52E/8NE	2.1m	Brown	Grey-		Very soft deep organic sediment, a few large diatoms show on dry surface of sample, contains a small amount of fine sand.
121	424100mE 5482250mN	52E/8NE	2m	Brown	Grey-		Very soft deep organic sediment, diatoms show up on surface of dry sample when examined under a microscope.
135	632700mE 5510500mN	52G/11NE	1m	Brown	Light brown	40.3%	Crystal lake, soft mud with very minor carbonate content.
137	629950mE 5509500mN	52G/11NE	1.6m	Dark brown	Dark brown	93.5%	McLauren Lake slimy organic sediment.
193	425550mE 5480350mN	52E/8NE	1m	Dark brown	Brown	71.9%	45 cm core of organic sediment from same location as 84-114.
194	425400mE 5480500mN	52E/8NE		Dark brown	Brown		30 cm core from north end of lake near edge of floating vegetation mat.
195	425750mE 5480350mN	52E/8NE	0.5m	Brown	Brown	60.5%	20cm core from south end of lake soft organic rich sediment with roots.

All sample numbers are preceeded by the prefix 84-

Sample Locations:

84-83, 85A, 85B	Shoal Lake, Yum Yum Point-Helldiver Bay area
84-97 to 102	Hillock Lake
84-103 to 106	Veronica Lake
84-107A	Small lake near Hillock Lake
84-110	Kaminnassin Bay, Dinorwic Lake
84-111 to 113	Tabor Lake
84-114 to 116	Old Woman Lake
84-117 to 121	Bunny Lake
84-135	Crystal Lake
84-137	McLauren Lake
84-193 to 195	Old Woman Lake

lakes were chosen because they are close to roads and accessible with the available equipment. There is little known or recorded about lake sediments in Northwestern Ontario and no way of selecting the available lakes for maximum diatom content. The bottoms were found to be bedrock, sand, clay, or gyttja. Only samples from the organic rich (gyttja) bottoms were found to contain diatoms. Organic sediment contained large quantities of water, in some up to 95%, partly decomposed plant material and large quantities of amorphous black organic matter; the remainder is fine sand, clay, plant spicules and diatoms. When the sediment is dried, the organic fraction shrinks and the inorganic fraction becomes more visible making up 50% or more by volume of the dry sediment having been less than 5% by volume of the moist sediment. The dry sediment is very hard and resists disagregation, and the siliceous material is cemented by the organic fraction. Diatoms appear in samples from Tabor Lake, Bunny Lake and one sample from a sheltered bay of Hillock Lake, in addition to samples from Old Woman Lake. All of the gyttja samples burned to a buff coloured powder when calcined over a gas stove, the calcined sediment still containing a large proportion of unburned organic matter. Diatom contents of the Tabor Lake and Bunny lake samples were estimated at 2 to 5% of the dry sediment. They do not appear to have the variety of species present that were found in Old Woman Lake. The Hillock Lake diatom sample contained only a few diatoms. The other Hillock Lake samples were fine sand accompanied by organic matter but did not appear to contain diatoms.

CONCLUSIONS

The diatomite deposits currently in production in the United States are marine deposits of late Miocene to early Pliocene age in California and late Tertiary or Pleistocene freshwater deposits in Nevada. These are fossil deposits that are above water and contain very little material other than diatoms due to decomposition of organic matter. The known Ontario deposits contain large amounts of organic matter and water. The cost and difficulty of drying, removing organic matter, and separating the diatoms from other siliceous sediment make them less attractive as a source of diatoms than fossil deposits.

Diatoms are present in most lake environments and can be present in relatively large amounts given the right environmental conditions. The results of limited sampling indicate that diatom rich deposits similar to the Claw Lake deposit have been formed. The lakes selected for study may not be completely representative of those in the shield areas but the similarity of deposits from several parts of the province indicate that the possibility of finding a minable deposit of diatomite is low. Organic rich sediment removed from some lakes during construction projects has been used in a similar manner to peat for local garden soil improvement.

OLD WOMAN LAKE

COMMODITY: Diatomite

STATUS: Occurrence

LOCATION: NTS 52E/8 NE, Devonshire Township, District of Kenora.
49°28'27" North Latitude 94°01'40" West Longitude
UTM Grid 425500 mE, 5480400 mN Zone 15.
The approximate centre of the lake was used as a location point.

ACCESS: The lake is immediately north of Highwy 71, 8 km northeast of Sioux Narrows.

DESCRIPTION: Geological Setting: The area is underlain by thin silty to sandy till, clayey till and glacial lake clay overlying Early Precambrian metasediments and metavolcanics.

Previous Geological Work: The surficial deposits have been mapped as ground morain by Zoltai (1965) and Hallett and Roed (1980).

Geology: The lake is shallow (1 to 1.5 m of water) with extensive marsh around the shore. Abundant water lillies and aquatic plants grow in the entire lake. Bottom sediment is very soft and deep. The sampling bomb penetrated at least two metres of material. The upper part of the sediment contains roots and plant fragments. The total depth of sediment was not determined. The amount of plant debris increases at the edge of the marshy area.

Petrology and Chemistry: Samples of the sediment were collected and examined under a microscope to identify their contents and analysed for major and trace elements. All sediment samples were dark brown to black gelatinous material that dried to a hard black crust. Occasional fine sand grains are evident in the dry material. Raw sediment contains diatoms, fine clastic sediment, large amounts of organic material and unidentified siliceous objects, possibly plant spicules. The material resembles that in a photo micrograph of diatomite in Laird (1935). Selected samples were calcined and treated with sodium hypochlorite to remove organic material and point counted to get the proportion of the various components. Calcination

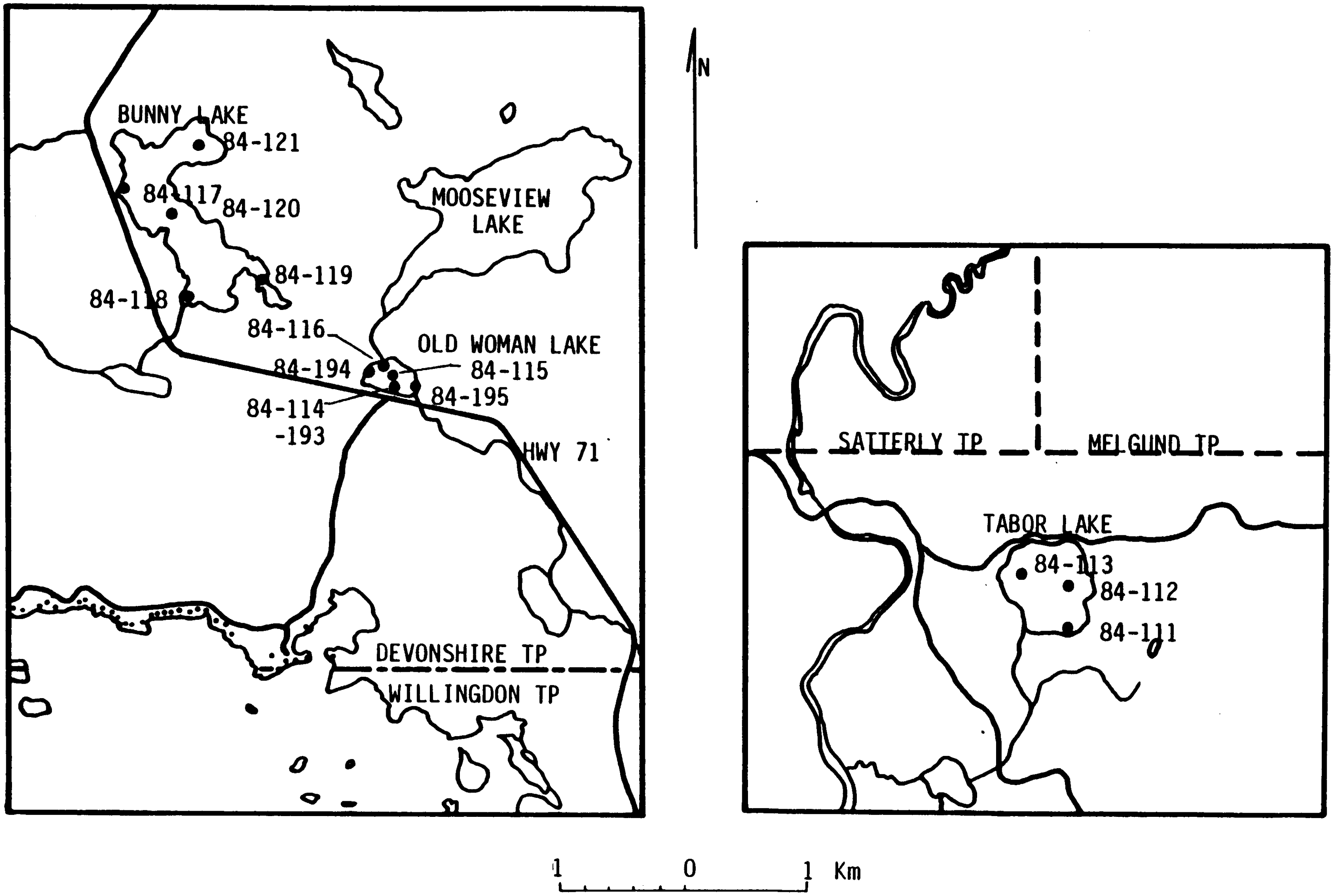

FIGURE 36. Sample locations for the Old Woman Lake, Bunny Lake and Tabor Lake diatom deposits.

resulted in hard light brown lumps that could be disaggregated when mixed with water. When heated sufficiently part of the material fused to form a frothy, light green glass.

Major element analyses are in Table 37. The high CO_2 values were converted to non-carbonate carbon as follows. Carbonate carbon was determined to be <0.04% non-carbonate carbon content was determined as (total CO_2 x 0.273) and is listed below:

84-193	24.1%
84-194	26.0%
84-195	16.7%
84-193D	24.2%

The following laboratory report gives the results of x-ray diffraction and minerological examination:

MINERALOGY

The following bulk Mineralogy was interpreted from the bulk major analysis and XRD results for the three specimens.

Estimated weight percent of minerals

Sample	Plagio-clase	Quartz + Diatoms	K-Feldspar + Mica	K-Feldspar	Mica	Rest	L.O.I.	Total
0193	9	32	4	-	-	5	48.3	98.3
0194	11	26	6	-	-	4	93.3	99.3
0195	19	32	-	4	6	4	33.6	98.6

The XRD traces, of all three samples, show a large broad hump centred approximately at 4.10Å . When the samples were heated and the XRD repeated the hump subsided. It was also observed that the volume of material was greatly reduced. When viewed under the microscope these samples contained a large mass of brown earthy isotropic material with minor (by volume) quartz, diatom fragments and feldspar. Heating reduced the volume of isotropic material and proportionately increased the volume of crystalline silicate material when viewed under the microscope.

This large amount of X-ray amorphous and microscope isotropic material must be a hydrocarbon (This is corraborated by the large L.O.I. and carbon content).

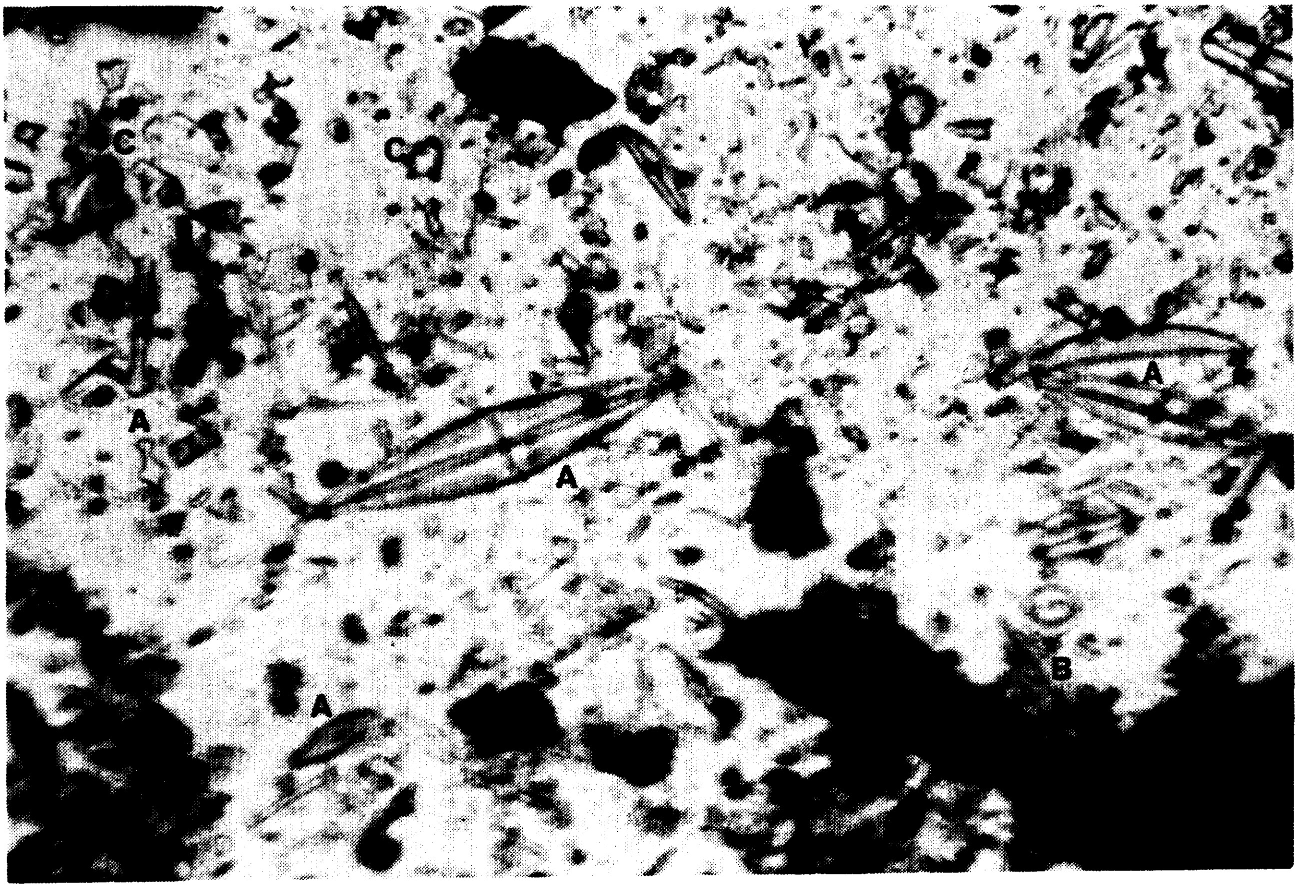

FIGURE 37. Photomicrograph of diatomaceous lake sediment. Field of view is 1.5 mm wide. Black blobs are organic mater, A - diatom, B - spicule, C - clastic siliceous sediment grain. Sample was taken from the Old Woman Lake Diatom Deposit.

MAJOR ELEMENT ANALYSES

SAMPLE	SiO2	Al2O3	Fe2O3	MgO	CAO	Na2O	K2O	TiO2	P2O5	MnO	CO2	S	LOI	TOTAL
84-0193	39.20	5.87	1.88	0.56	1.20	0.35	0.75	0.22	0.15	0.03	88.20	0.32	48.30	98.50
84-0194	37.40	6.20	1.51	0.48	1.52	0.69	0.94	0.21	0.13	0.03	95.10	0.45	49.30	98.40
84-0195	48.50	8.99	1.90	0.66	1.63	1.29	1.43	0.30	0.07	0.03	61.10	0.32	33.60	98.40
84D0193	39.00	5.75	1.88	0.56	1.21	0.28	0.75	0.22	0.13	0.03	88.60	0.32	48.30	98.10

TABLE 37. Major element analyses of Old Woman Lake sediment.

Microscopic examination of calcined sediment indicates it to be fine sand, diatoms, other siliceous spicules and residual organic material. There are at least six distinct species of pennate diatoms but only rare centric diatoms; most are intact. They range in size from less than 0.01 mm to 0.2 mm; sand fragments are 0.01 mm. Point counting indicated a composition of 16% diatoms (all species), 23.8% sand, 51.7% organic mater and 8.5% other siliceous spicules. Observed diatom and mineral content corresponds to that obtained by X-ray diffraction and major element analysis.

HISTORY: There has been no production of diatoms or sediment from this lake.

REFERENCES: NTS Map 52 E/8

Hallett, D. R. and Roed, M. A.
1980: Northwest Angle Area (NTS 52E/SE and part of 52E/SW), Districts of Kenora and Rainy River, Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 36, 12p. Accompanied by Map 5056, scale 1:100 000.

Zoltai, S. C.
1965: Kenora-Rainy River Surficial Geology; Ontario Department of Lands and Forests Map S165 scale 1: 506 880

Laird, H. C.
1935: Geology of the Makwa-Churchill area; Ontario Department of Mines Annual Report Volume 43 part 3 for 1934 p 37-80

FLUORSPAR

Fluorite or fluorspar (CaF_2) is used as a flux in iron and steel making, as a source of fluoride chemicals, in particular hydrofluoric acid, and in ceramics and glass. Fluorspar is produced in three grades: Acid Grade, minimum 97% CaF_2, less than 1.5% silica; Ceramic Grade No. 1, 95-96% CaF_2; Ceramic Grade No. 2, 80% to over 90% CaF_2, and other minerals as specified for the use intended; and Metallurgical Grade, 80% to 90% CaF_2, maximum 15% SiO_2.

Fluorspar deposits in Ontario have been described by Guillet (1964). Fluorspar has been produced from Late Precambrian pegmatite and associated vein deposits in several places in Haliburton and Renfrew Counties and from fracture filling vein deposits cutting both Paleozoic and Precambrian rocks near Madoc in Southeastern Ontario. Production has not been reported from Northwestern Ontario. Most Canadian production was from Paleozoic vein deposits cutting granite at St. Lawrence on the Burin Penninsula in Newfoundland. Major world production is from Mexico, followed by Mongolia and the USSR.

Fluorite occurs in a variety of geological environments (Harben and Bates, 1984), two of which are known to occur in Northwestern Ontario: auriferous quartz veins, and alkalic complexes. Five deposits have been recorded (Table 38) and additional auriferous quartz vein occurrences are reported in diamond drill logs on file at the Resident Geologist offices in Red Lake and Sioux Lookout. The most promising of these recorded deposits, the Thrasher, was examined. Surface mineralization indicated a relatively small amount of fluorite irregularly distributed in the vein system but diamond drill logs (Assessment Files, Kenora) indicate a higher fluorite content. The Thrasher deposit may contain significant amounts of fluorite along with gold mineralization. Co-production with gold might be possible from this deposit if sufficient fluorite and gold are present. Ten to twenty per cent fluorite in lead-zinc veins is economically recoverable in some deposits in the United States (Fulton and Montgomery 1983). Fluorite is present in the Sturgeon Narrows Alkalic Complex (Trowell, 1976, 1983a,b) but "...no concentrated zones having economic potential have been detected" (Trowell, 1983a).

Fluorite occurrences such as the Thrasher indicate that deposits could exist with sufficient fluorite to warrant extraction as a by-product of gold recovery. The low number of recorded occurrences of either deposit type indicates a low potential for mineable deposits. Commercial fluorite deposits are of considerably higher grade (usually at least 15% fluorite) than the known occurrences and are of much greater size.

Table 38 FLUORSPAR OCCURRENCES

DEPOSIT	DESCRIPTION	REFERENCE
Oldberg Lake	Fluorite with molybdenite in quartz veins	Kresz et al (1982)
Sturgeon Narrows Alkalic Complex East Bay Occurrence	Up to 2% fluorite disseminated in alkalic syenite	Trowell (1976, 1983b)
Sturgeon Narrows Alkalic Complex Narrows Island Occurrence	" " "	" "
Thrasher	Fluorite in quartz-carbonate veins	Assessment Files, MNDM Kenora
Vista Lake Complex	Fluorite as an accessory mineral in alkalic to subalkalic syenite	Trowell (1983a)

FL 4 THRASHER FLUORITE

COMMODITY:	Fluospar
STATUS:	Occurrence
LOCATION:	NTS 52F/5 NW, District of Kenora. 49°25'54" North Latitude, 93°55'02" West Longitude UTM Grid 433500mE, 5475600mN Zone 15.
ACCESS:	The deposit can be reached by water from Sioux Narrows via Lobstick Bay of Lake of the Woods, or from Highway 17 on the Maybrun Road (Figure 38).

DESCRIPTION: Geological Setting: The area is underlain by metavolcanics with intercalated metasediments.

Previous Geological Work: The area has been mapped by Johns et al (1983, 1984). The deposit has been described by Thomson (1945).

Geology: The fluorite is part of a quartz vein system 1.3 m in width at the surface. The immediate area around the vein has been stripped and channel sampled during recent gold exploration, but there is little other exposure of the vein or possible other fluorite bearing veins nearby. The vein system is exposed in shallow trenches in a stream bed. The host rock of the vein is felsic tuff and lapilli-tuff that appears highly silicified and contains 1% disseminated pyrite (visual estimate). They weather with a thin rusty rind. Foliations trend east-west and are intense enough in places to make the rock a sericite schist. Fluorite is deep purple and forms narrow fine grained sugary veinlets; it is obvious over 0.3 m in one part of the vein system. Visual estimates indicate up to 15 % fluorite over short distances, but the percentage is quite variable. Thomson (1945) indicates sparse fluorite over 1.3 m. Diamond drilling on behalf of C. Karas in 1964 (Resident Geologist Files, Kenora) indicated 10 % to 30 % fluorite, the best intersection being 11.5 feet (3.5 m). Thomson (1945) indicates a second fluorite showing 1 to 2 miles (1.6 to 3.2 km) further east.

Chemistry: Two grab samples of vein material from the surface exposure were analysed with the results in Table 39. Pure fluorite contains 48.9% fluorine and 51.1% calcium thus the fluorine values in Table 39 correspond to 2.96% fluorite in 84-60 and 5.93% fluorite in 84-62. The samples analysed appeared to have similar fluorite contents to the visual estimates mentioned above but the results indicate considerable variation. Visual estimates of fluorite content are much higher than the analytical results indicated.

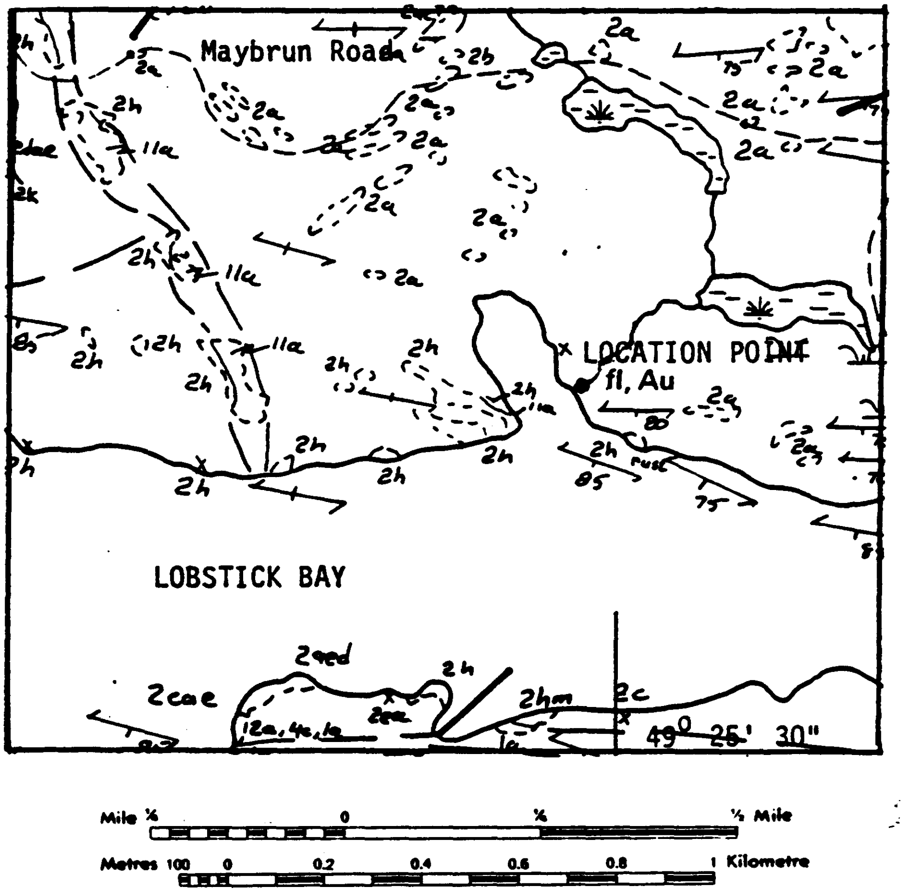

FIGURE 38. Thrasher Fluorite Deposit Geology and Location Map
Geology from Johns and Davison (1983)

LEGEND

11	Diabase
4	Clastic Metasediments
2	Intermediate to Felsic Metavolcanics
1	Mafic to Intermediate Metavolcanics

Table 39. Analytical results Thrasher Fluorite Occurrence.

	84-60	84-62
Au	1460ppb	2040ppb
Co	6	7
Cr	10	11
Cu	40	62
Li	30	30
Ni	7	11
Pb	50	47
Zn	72	74
Be	1	1
F	1.45%	2.90%

all values in ppm unless indicated otherwise
84-60 grab sample of fluorite rich vein material
84-62 sample of fluorite vein from shallow trench

HISTORY: The deposit was reportedly discovered in the 1930's by T. L. Tanton of the Geological Survey of Canada. It was staked in 1944 by J. Thrasher. Six holes were diamond drilled in 1964 for a total of 687 feet (209.4 m), for C. Karas. The deposit is currently (1985) being evaluated for its gold potential.

REFERENCES: NTS Map 52F/5

Johns, G. W. and Davison, J. G.
1983: Precambrian geology of the Long Bay-Lobstick Bay Area, Eastern Part, Kenora District; Ontario Geological Survey Map P 2595, Geological Series-Preliminary Map scale 1:15 840, Geology 1982.

Johns, G. W., Good, D. J. and Davison, J. G.
1984: Precambrian Geology of the Long Bay-Lobstick Bay Area, Kenora District; Ontario Geological Survey Map P 2595 (Rev.) Geological Series-Preliminary Map scale 1:15 840, Geology 1982, 1983.

Thompson, R.
1945: Note on claim K 10282 Lobstick Bay, District of Kenora, unpublished report, Resident Geologist Office, Kenora, Assessment File H-1.

Assessment Files, Resident Geologist Office, Kenora File 52F/5 H-1.

KYANITE-SILLIMANITE-ANDALUSITE

The alumino-silicate minerals (kyanite, sillimanite, and andalusite) are common constituents of medium to high grade metamorphic rocks. All three minerals have the same composition $Al_2O_3.SiO_2$ but have different crystal structures. These three polymorphs are indicative of increasing temperature and pressure of metamorphism in the following order: andalusite, low temperature, low pressure; sillimanite, high temperature, moderate pressure; kyanite, high pressure. Deposits consist of disseminated minerals in schists and gneisses; residual deposits developed over metasediments; heavy mineral sands (mined in Georgia, USA and South Africa); kyanite quartzite (mined in the Piedmont Region of the Appalachian Mountains) and massive kyanite and sillimanite mined in India and South Africa. Most deposits contain 10% to 25% alumino silicate minerals disseminated as large porphyroblasts. These are separated from the rock by crushing to 35 mesh (ISO sieve size) and flotation treatment. The concentrate is further processed by crushing to finer sizes for use in refractory mixtures and calcination to produce mullite ($3Al_2O_3.SiO_2$) and quartz.

Mapping by Breaks and Kuehner (1984) and Breaks et al (1975abcdef, 1976abcdef) indicated kyanite and sillimanite bearing metasediments in the English River Subprovince. Investigation of some of these rocks indicated only small amounts of alumino-silicate minerals in a very hard matrix. The schist deposits in the United States and other parts of the world that produce sillimanite contain porphyroblastic crystals rather than the felty aggregate of acicular sillimanite, quartz, mica and other minerals (fibrolite) that is the common form of occurrence in metamorphic rocks. Fibrolite cannot be beneficiated to produce a saleable product (Bennett and Castle 1983).

Thin section examination of sillimanite nodules from the southern English River Subprovince, near the village of Eagle River, indicates felty sillimanite (fibrolite) containing about 25% sillimanite with a mixture of quartz, biotite, and feldspar. Nodules make up 5% to 10% of the complete rock. Sillimanite is present in the rest of the rock but not plentiful other than in the nodules. While kyanite and sillimanite are common, no deposits of porphyroblastic crystals have been reported. The potential for large deposits of these minerals in a mineable form does not appear to be great. Andalusite is present although not reported as often as kyanite and sillimanite. Andalusite as both fibrolite and porphyroblasts is present in the host rocks of the Red Lake gold deposits (Ferguson 1966). Many of these porphyroblasts are only partially formed. The presence of partial porphyroblasts in some occurrences of andalusite, the low temperature and pressure polymorph, and fibrolite nodules in most, implies that the rocks have not remained at the required metamorphic grade long enough to form porphyroblast deposits.

NEPHELINE SYENITE AND ALKALIC COMPLEXES

Canada is the world's foremost producer of nepheline syenite, all from deposits in Methuen Township, Southern Ontario. Nepheline syenite is used as a source of alumina and alkalies in glass batch mixes and ceramics and as an extender pigment and filler in paint, rubber and plastics. Large amounts are consumed annually in the glass and ceramics industry in Canada and the northeastern United States.

Alkalic igneous rocks contain more sodium and/or potassium than are required to form feldspar with the available silica. The mineralogy of these rocks is varied but feldspars, biotite, and hornblende are common just as in granitic rocks; their textures, mode of occurrence, and appearence are similar to the more common granitoid rocks. However many are deficient in silica making them syenites and foid bearing syenites in the Streckeisen classification (foid is a collective term for feldspathoid minerals). Nepheline is the most common and economically important feldspathoid mineral, and is a major constituent of nepheline syenites mined for glass and ceramic material. In addition to nepheline syenite, alkalic rock complexes can contain a wide variety of minerals some of which have economic significance. Not all alkalic complexes contain nepheline syenite. Alkalic complexes can also contain carbonatite deposits. These are carbonate rocks of apparent magmatic origin. They are of economic importance as host rocks of phosphate, vermiculite, niobium, fluorite, and rare earths, and in some cases calcium carbonate can also be recovered. The three known carbonatite deposits are here grouped with the alkalic rocks although in some instances their age and origin is different from that of the alkalic syenite complexes.

A compilation map by Ayres et al (1971) indicates ten occurrences, in Northwestern Ontario, of alkalic rocks under the general map classification: "Carbonatite, nepheline and alkalic syenites, fenite and associated mafic and ultramafic rocks". Table 40 summarizes the details of these and one other deposit (N 5 Squaw Lake was not indicated by Ayres et al, 1971). Recent mapping has indicated that some of these are not true alkalic rocks (eg. Viola Lake Stock, Johns and Richey 1982). Carbonatite complexes have been described by Sage (1976, 1983a,b,c). The three that are known, Big Beaverhouse, Carb Lake and Shryburt Lake, are in remote locations and have little economic potential at the present due to their locations although they have been examined by industry. To be of economic interest in Northwestern Ontario the deposits would have to be close to transportation routes and amenable to low cost processing.

Nepheline syenite is reported in the Sturgeon Narrows and Squaw Lake alkalic complexes both of which have been mapped by Trowell (1976, 1983a,b). These are polyphase complexes of syenitic rocks composed of varying amounts of plagioclase, microcline, microcline perthite, orthoclase, nepheline, augite, amphibole, and biotite; accessory minerals include zeolites, calcite, sphene, pyrite, garnet, scapolite, cancrinite, apatite, fluorite, and magnetite. Mafic minerals make up 10% to 25% of the complexes. Nepheline is commonly altered to zeolites and sodalite in the Sturgeon Narrows complex (Trowell 1983a). Tables 41 and 42 contain analyses of various rocks from these complexes. They have not been evaluated as ceramic raw material. Early work by Miller (1903 p 104) indicates the possibility of other alkalic rock bodies in the area north and east of Sturgeon Lake.

Table 40. Reported Alkalic Complexes and Carbonatite Bodies
The first six deposits are known alkalic complexes or carbonatite bodies, the remainder have been reported as or grouped with alkalic complexes at some time. Their true nature, if known, is indicated.

N 1	Bell Lake	52G/14SE and 52G/15SW 49°49'00" 90°58'00"	Early Precambrian polyphase alkalic syenite intrusive complex	Trowell (1983a)
N 2	Big Beaverhouse	53A/13NW 52°54'05" 89°53'00"	Carbonatite, Middle to Late Precambrian, explored in 1961, 1962, 1972 by Many Lakes Exploration Co. for Niobium	Ayres et al (1971) Sage (1983a) Vos et al (1982)
N 3	Carb Lake	52J/13SW and 53K/16SE 54°46'45" 92°00'00"	Carbonatite, Middle to Late Precambrian, diamond drilled in 1968 by Big Nama Creek Mines Ltd. for its niobium and rare earth potential. Contains rare earths, niobium and fluorite	Ayres et al (1971) Sage (1983b) Bennett & Riley (1969) Vos et al (1982)
N 4	Schryburt Lake	53A/12SE 52°36'59" 89°36'59"	Carbonatite, Middle to Late Precambrian, examined in 1961 by Many Lakes Exploration Company for niobium and in 1975 by International Minerals and Chemicals Corp. for apatite	Ayres et al (1971) Sage (1983c) Vos et al (1982)
N 5	Squaw Lake	52J/2SE 50°05'00" 90°33'00"	Early Precambrian polyphase nepheline and alkalic syenite complex	Trowell (1983a)
N 6	Sturgeon Narrows	52G/15NW 52J/2SE 50°00'00" 90°45'00"	Early Precambrian polyphase nepheline and alkalic syenite complex	Ayres et al (1971) Trowell (1976, 1983a)
N 7	Falcon Island Stock	52E/7NE,NW 49°24'00" 94°45'00"	Reported as alkalic but probably not	Ayres et al (1971) Lawson et al (1897)
N 8	Unnamed body	53J/13SE 54°47'00" 91°30'00"	Calc-alkalic hornblende syenite, hornblende monzonite and granite age and potential unknown.	Ayres et al (1971) Bennett and Riley (1969) page 39
N 9	Unnamed body	53J/2NW 54°14'00" 90°30'00"	Unknown	Ayres et al (1971) Bennett and Riley (1969)
N 10	Unnamed body at Summach Lake	52K/12SW 93°59'00" 50°05'00"	Gabbroic and ultramafic rocks; not alkalic	Ayres et al (1971) Breaks et al (1975b)
N 11	Viola Lake Stock	52E/9SE,SW 49°03'00" 94°15'00"	Early Precambrian granitoid rock; not an alkalic body	Ayres et al (1971) Johns & Richey (1982)

Major Elements	1	2	3	4	5	6	7	8	9	10	11
SiO_2	52.80	56.30	56.50	56.80	57.10	60.00	62.10	63.10	63.20	65.30	65.80
Al_2O_3	18.20	21.90	15.40	18.70	18.50	18.50	18.20	20.40	18.90	19.00	18.00
Fe_2O_3	2.24	1.02	3.08	1.49	5.00	1.33	2.00	0.33	2.07	0.72	1.15
FeO	3.16	1.78	2.11	1.54	3.00	1.30	1.54	1.05	1.22	0.24	0.32
MgO	1.13	0.18	1.34	0.20	0.46	0.30	0.79	0.44	0.18	0.10	0.12
CaO	4.68	1.04	6.47	3.80	0.14	2.18	2.59	1.90	0.18	0.89	1.03
Na_2O	5.51	8.42	5.65	7.77	4.21	6.25	7.07	6.80	6.85	6.36	6.80
K_2O	6.41	6.56	5.12	4.73	8.01	6.28	3.26	5.14	5.74	7.34	6.17
H_2O^+	1.24	0.93	1.26	0.75	0.56	1.23	0.41	0.18	0.18	0.11	0.00
H_2O^-	0.01	0.26	0.08	0.19	0.27	0.42	0.32	0.32	0.02	0.11	0.00
CO_2	2.72	0.60	1.05	2.55	0.15	0.56	0.13	0.60	0.15	0.15	0.17
TiO_2	0.53	0.38	0.46	0.46	0.77	0.45	0.54	0.18	0.24	0.44	0.18
P_2O_5	0.50	0.03	0.72	0.14	0.02	0.06	0.19	0.20	0.02	0.23	0.39
S	0.16	0.21	0.14	0.23	0.03	0.04	0.02	0.05	0.02	0.04	0.04
MnO	0.12	0.04	0.12	0.05	0.05	0.03	0.05	0.05	0.04	0.03	0.03
Total	99.4	99.6	99.5	99.4	98.3	98.9	99.2	100.7	100.0	100.9	100.2
Specific Gravity	2.66	2.53	2.75	2.60	2.58	2.59	2.66	2.56	2.65	2.57	2.58

Trace Elements	1	2	3	4	5	6	7	8	9	10	11
Ag	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ba	1650	600	2300	460	1500	780	650	710	180	550	540
Be	<1	<1	<1	<1	<1	<1	<3	<1	<1	<1	<1
Co	8	<5	10	<5	6	<5	8	8	<5	<5	<5
Cr	6	<5	<5	<5	<5	<5	15	50	<5	<5	<5
Cu	6	<5	10	6	8	8	9	15	15	<5	7
Ga	10	10	10	10	10	10	20	10	20	10	10
Li	20	25	10	9	15	15	10	15	15	6	10
Mo	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ni	5	<5	<5	<5	<5	<5	15	25	<5	<5	<5
Pb	65	<10	<10	<10	<10	<10	30	<10	30	<10	<10
Sc	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10
Sn	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sr	2000	400	1000	1000	200	600	500	500	100	300	400
V	60	40	70	50	70	40	40	50	30	30	30
Y	20	<10	10	10	<10	<10	20	<10	<10	<10	<10
Zn	90	80	90	60	150	55	100	50	95	25	35
Zr	<10	100	100	<10	10	100	500	100	200	<10	90
Rb	80	120	60	60	150	110	40	60	146	100	110

Normative Minerals	1	2	3	4	5	6	7	8	9	10	11
Apatite	1.073	0.061	1.529	0.294	—	0.126	0.395	0.407	0.041	0.081	0.082
Pyrrhotite	0.569	0.708	0.493	0.801	0.107	0.140	0.069	0.169	0.069	0.101	0.101
Ilmenite	0.757	0.514	0.650	0.643	1.102	0.631	0.746	0.244	0.330	0.275	0.397
Orthoclase	38.846	37.674	30.706	28.055	48.676	37.373	19.131	29.530	33.506	42.087	35.532
Albite	21.523	28.312	41.298	44.057	38.836	46.807	62.981	58.716	60.697	52.988	59.444
Anorthite	6.130	2.499	1.548	2.176	0.714	3.887	8.230	7.886	0.752	1.551	0.346
Corundum	—	—	—	—	—	—	—	0.712	1.222	—	—
Magnetite	2.400	1.035	3.265	1.542	5.371	1.399	2.075	0.335	2.136	—	—
Wollastonite	0.244	—	6.553	5.772	—	1.437	—	—	—	0.991	1.428
Enstatite	—	—	—	—	1.305	—	0.983	—	0.490	—	—
Ferrosilite	—	—	—	—	0.066	—	0.112	—	0.105	—	—
Quartz	—	—	—	—	0.860	—	2.647	—	0.651	—	1.179
Diopside	6.393	—	7.502	1.107	—	1.667	2.361	—	—	—	0.645
Forsterite	—	—	—	—	—	—	—	0.885	—	—	—
Fayalite	—	—	—	—	—	—	—	0.765	—	—	—
Nepheline	17.499	27.055	6.084	15.540	—	5.792	—	0.352	—	1.422	—
Hedenbergite	4.567	1.172	0.372	—	—	0.741	0.269	—	—	—	—
Rutile	—	—	—	—	—	—	—	—	—	0.018	0.066
Hematite	—	—	—	—	—	—	—	—	—	0.487	0.780

NOTES

Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto. Major elements in weight percent, trace elements in parts per million, normative compositions in molecular weight percent.
Ce, La, and Nd were tested for but not detected.

SAMPLES

Sample No.	Latitude	Longitude
1. T275-1	50.05833	90.55667
2. T425-2	50.08333	90.54167
3. T293-3	50.07500	90.54167
4. T2337-1	50.08333	90.54167
5. T2432-1	50.08333	90.56667
6. T2435-1	50.07500	90.57500
7. T2436-1	50.05832	90.57500
8. T266-1	50.06667	90.58333
9. T2430-1	50.07500	90.57500
10. T265-3	50.06667	90.55833
11. T2406-1	50.06667	90.56667

TABLE 41: MAJOR AND TRACE ELEMENT ANALYSES AND NORMATIVE MINERALOGY OF SAMPLES FROM THE SQUAW LAKE ALKALIC COMPLEX. FROM TROWELL (1983b)

Major Elements	1	2	3	4	5	6	7	8
SiO_2	60.30	57.80	56.80	66.60	54.80	59.40	60.90	53.70
Al_2O_3	22.30	15.90	19.00	16.10	19.00	16.40	18.10	16.50
Fe_2O_3	2.27	5.32	3.19	2.13	3.41	3.05	2.82	2.27
FeO	0.28	0.63	0.77	1.32	1.95	1.39	2.09	4.72
MgO	0.42	0.08	0.40	0.85	1.52	1.12	2.29	4.90
CaO	1.16	6.63	1.86	2.01	3.09	3.24	2.19	7.51
Na_2O	4.07	6.80	8.25	5.26	8.64	6.62	6.07	5.50
K_2O	8.28	5.09	7.41	4.53	5.75	4.50	5.19	2.30
H_2O^+	.80	0.62	1.63	0.63	1.39	0.54	0.53	0.86
H_2O^-	0.04	0.13	0.11	0.12	0.11	0.11	0.02	0.10
CO_2	0.70	0.28	0.96	1.25	0.72	3.52	0.16	0.81
TiO_2	0.30	0.75	0.38	0.38	0.41	0.57	0.52	0.75
P_2O_5	0.02	0.10	0.04	0.09	0.07	0.29	0.22	0.46
S	0.05	0.30	0.15	0.01	0.30	0.46	0.02	0.02
MnO	0.07	0.10	0.11	0.07	0.16	0.11	0.08	0.14
Total	101.06	100.53	100.06	101.35	101.32	101.32	100.30	100.54
Specific Gravity	2.66	2.68	2.56	2.69	2.61	2.55	2.65	2.86

Trace Elements	1	2	3	4	5	6	7	8
Ba	500	800	600	1000	1500	1500	1000	1000
Co	4	4	7	4	9	10	10	25
Cr	15	nd	nd	20	300	70	20	150
Cu	20	7	9	9	10	30	20	35
Ga	15	5	15	15	20	10	20	15
Li	nd	nd	nd	nd	100	nd	nd	50
Ni	20	10	15	20	30	50	20	100
Pb	10	15	20	10	30	15	15	nd
Sb	nd	nd	nd	nd	nd	nd	nd	1
Sc	nd	nd	nd	nd	20	nd	nd	20
Sr	250	1000	1000	300	400	350	1000	1200
V	50	200	30	40	50	40	150	140
Y	nd	150	nd	nd	nd	20	20	25
Zn	50	40	90	60	150	110	100	100
Zr	150	200	150	150	250	250	300	0
Be	5	3	3	3	5	nd	5	3
Rb	200	90	140	80	200	90	90	40

Normative Minerals	1	2	3	4	5	6	7	8
Quartz	1.692	—	—	12.757	—	—	—	—
Corundum	4.934	—	—	—	—	—	—	—
Orthoclase	48.394	29.745	42.637	26.753	32.747	26.721	29.873	13.488
Albite	36.110	39.099	24.817	47.155	18.059	54.461	53.086	38.365
Anorthite	5.559	—	—	6.922	—	1.742	6.621	13.427
Nepheline	—	10.145	24.817	—	29.436	2.022	—	6.357
Acmite	—	3.450	8.652	—	6.060	—	—	—
Diopside	—	0.436	2.149	1.861	8.081	6.209	1.855	12.101
Hedenbergite	—	—	—	0.098	2.651	—	0.187	4.328
Enstatite	1.146	—	1.120	1.413	—	—	0.145	—
Ferrosilite	—	—	—	0.074	—	—	0.015	—
Forsterite	—	—	—	—	—	—	3.810	5.522
Fayalite	—	—	—	—	—	—	0.385	1.975
Wollastonite	—	12.525	1.855	—	0.363	1.893	—	—
Magnetite	0.058	—	—	2.224	1.160	1.104	2.869	2.353
Ilmenite	0.413	0.605	0.515	0.529	0.550	0.797	0.705	1.036
Pyrite	0.129	0.772	0.380	0.026	0.752	1.203	0.051	—
Hematite	1.525	2.801	—	—	—	1.398	—	—
Apatite	0.041	0.207	0.081	0.188	0.141	0.610	0.448	0.955
Sodium Silicate	—	—	0.895	—	—	—	—	—
Rutile	—	0.214	—	—	—	—	—	—
Chromite	—	—	—	—	—	—	—	0.024
Plagioclase Composition	^{An}13.340	^{An}0	^{An}0	^{An}12.801	^{An}0	^{An}3.001	^{An}11.098	^{An}25.925

NOTES

Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto Major elements in weight percent, trace elements in parts per million, normative composition in molecular weight percent.

Ce, La, Nd, and Nb were tested for but were not detected.

nd = not detected.

SAMPLES (Samples 1-7 are from the Quest Lake map-area, Trowell 1976)

	Sample No.	Latitude	Longitude
1	1-20-7	49 93900	91 86500
2	3-38-4	49 99400	90 71200
3	PL-1A	49 96100	90 81500
4	1-24-18	49 96400	90 81500
5	2-35-13	49 80100	90 75700
6	1-22-2	49 94400	90 85800
7	1-25-1	49 94000	90 85100
8	1-32-2C-3	50 00910	90 66720

TABLE 42: MAJOR AND TRACE ELEMENT ANALYSES AND NORMATIVE COMPOSITION OF SAMPLES FROM THE STURGEON NARROWS ALKALIC COMPLEX. FROM TROWELL (1983b)

STAUROLITE

Staurolite is used as a sandblasting abrasive, foundry sand and in some cases as a source of alumina in cement (Fulton, 1983). It is produced from mineral sands in Florida. Small amounts of staurolite are present in upper greenschist facies metasediments. Little is known about the potential, if any, of these deposits. Examples of staurolite bearing rocks are described by Trowell (1983a,b). Many of the comments made about kyanite, sillimanite and andalusite occurrences apply equally well to the known staurolite occurrences. Staurolite makes up only a small proportion of the rock and cannot be economically separated from it. The potential for large deposits in a minable form does not appear to be great. Euhedral staurolite may be of some interest as mineralogical specimens.

SUMMARY AND CONCLUSIONS

The industrial mineral commodities other than building stone, aggregate, and peat have been the subject of varying amounts of study and economic examination since the beginning of mineral exploration in Northwestern Ontario. Table 43 summarizes the commodities studied and the reported number of deposits of each. Only a very small number of these have been evaluated by industry at any more than a preliminary level and actual mineral production has been minor.

Table 43 Deposit summary

COMMODITY	DEPOSITS REPORTED IN THE LITERATURE	DEPOSITS EXAMINED FOR THIS REPORT
Asbestos	2	2 (one from literature only)
Barite	0	0
Carbonatite	3	0
Carbonate concretions	1	1
Clay	4 brickyards 10 sample sites (Guillet, 1977) 2 other sites	9
Diatomite	0	3
Feldspar (pegmatitic)	1	11
Fluorspar	3	1
Graphite	10	4
Kyanite, Sillimanite Andalusite and Staurolite	0	Reconnaissance work in several areas
Leucogranite	3	6

Marl	5	2
Marble	3	1
Mica (schist)	0	1
Mica (pegmatitic)	2	1
Nepheline Syenite	2	0
Ochre	1	1
Paleozoic Limestone Boulders	1	0
Pegmatite (includes feldspar, lithium, mica and rare element pegmatites)	27 (other than uranium occ-urences)	10
Quartzo-feldspathic sand	1	1
Soapstone/Talc	15	2 in addition to those in Storey (1983, 1984)
Specular Hematite	3	2
Titanium	2	1

Based upon the preceeding evaluation the various commodities have been placed in one of four groups:

A - recommended for exploration by the mineral industry and for further market oriented research and inventory work.

B - commodities that warrant exploration work to meet specific requirements but require further investigation and study to fully determine exploration and development potential.

C - commodities of largely unknown nature that require further basic research and study to determine whether they have exploration potential.

D - commodities that deserve no further attention unless there is a radical change in markets and technology or unless hitherto unknown deposits or deposit types are discovered.

Group A and B deposits have the most near term development potential, group C require further research into the nature of known mineralization and geological environments and Group D have little or no potential at this time. Two of the Group D deposits, clay and ochre may have potential for small scale local uses. In particular ochre is still used by native groups for traditional paint.

GROUP A DEPOSITS

GRAPHITE

Graphite occurs in two deposit types: flake graphite accompanied by extensive sulphide mineralization and fine powder (amorphous) graphite in black graphitic schists. The flake deposits are similar to deposits in Southern Ontario that have received recent industry attention. The major flake graphite deposit examined has attractive grades of large flakes over a 6 metre width for an undetermined strike length. This deposit is hosted in diatexitic metasediments of the English River Subprovince. The geological setting is promising for additional significant deposits particularly in the vicinity of the Treelined Lake deposit.

MARBLE (Early Precambrian limestone and carbonate veins)

Although one deposit of Early Precambrian limestone provided lime on a trial basis for the Red Lake area gold mills, most contain too much material other than $CaCO_3$ for use as filler. Reported Early Precambrian limestones of reasonable size are all in presently remote locations and those that are more accessible are narrow units with only a low carbonate content. Carbonate veins are more accessible but still contain large amounts of non-carbonate material. Some of the material examined polishes well and might have development potential, on a small scale, for decorative purposes.

MARL

Marl of a quality suitable for soil conditioning was extracted from one deposit in the region on a trial basis in the 1970's and other deposits are known. There is current local interest for this type of agricultural product. Given the availability of a local market it may be possible to develop some of these deposits. Since the market is rather limited, such operations would be small and employ only a limited number of people.

RARE ELEMENT PEGMATITES (beryllium, cesium, lithium, tantalum)

Pegmatite deposits contain a variety of minerals of economic interest. Several have been investigated for different commodities at different times. These are the best known and most studied of the industrial mineral occurrences in the area. Extensive exploration for lithium, tantalum and uranium has located many significant deposits particularly along the boundaries between the English River and the Wabigoon and Uchi Subprovinces and the Wabigoon and Quetico Sub-Provinces. Despite the large amount of exploration work already carried out there is good potential for additional discoveries of pegmatites containing rare elements with the possibility of byproduct feldspar and mica. The timing of further exploration will be dependant upon market demand.

SOAPSTONE/TALC

Talcose rocks are common in many of the mafic and ultramafic intrusive bodies in the area, particularly those associated with many of the major gold deposits. Several soapstone deposits in the area have been exploited in the past as refractory material and some are currently quarried on a very limited scale for carving and decorative material. There is some potential for expanded production of soapstone carving material for the native communities specializing in soapstone carvings and for the broader hobby market. The market potential for soapstone as a refractory material is less well known. Most of these talcose rocks are dark in colour and have a varied mineralogy making them unsuitable for talc production. There is a good probability of additional significant deposits being discovered.

TITANIUM

Titaniferous magnetite deposits similar to those mined in Quebec are found near Mine Centre; one is currently (1985) being evaluated by Titan Titanium International Ltd. The known deposits form an extensive horizon in the Bad Vermilion Lake Sill, a layered mafic complex. Trowell et al (1980) indicate a similar type of mineralization in the Gibi Lake area 30 km southeast of Kenora. Although the likelihood of finding additional large deposits seems to be limited, there is good potential in the Bad Vermilion Lake Sill deposits for both TiO_2 pigment and titanium metal. However major technological advances seem necessary to permit separation of the titanium.

GROUP B DEPOSITS

FELDSPAR (Pegmatitic)

Numerous pegmatites have potential as sources of small tonnages of good quality potassium feldspar. Large areas of the English River Subprovince are composed of diatexite which consists largely of pegmatoid material in a gneissic hostrock. Further work is required to assess the potential for finding and outlining significant tonnages of feldspar and to determine the marketability of this material.

MICA (Pegmatitic)

Muscovite occurs in significant quantities in two pegmatite deposits (Falcon Island and Harrison Mica), and test shipments were made from these in the past. Due to technology changes, the demand for mica of this type has declined greatly. High North American labour costs give sheet mica from these deposits relatively little market potential. Byproduct mica might be produced as a ground mineral from feldspar or rare element pegmatite mines.

MICA (SCHIST)

Although most of the major shear zones in the region contain highly schistose rocks that appear to be favourable for mica schist deposits, most of those examined were found to contain only small amounts of mica. The one example of schist that contains reasonable amounts of muscovite is the Rainbow Quarry deposit near Hudson. Further study might target high potential zones within the major shear zones. Rocks containing as low as 20 to 30% mica could be of some interest (J. Springer OGS, personal communication). Small amounts of mica are present in many other rock types and could possibly be produced as a byproduct of other mineral production. Significant amounts of chlorite are present in the talcose schists or soapstones.

GROUP C DEPOSITS

BARITE

There are no recorded vein or bedded barite deposits. The recent discovery of bedded barite at Hemlo indicates that this kind of mineralization can occur. Further research may indicate that this is a reasonable exploration target in this area.

FLUORSPAR

Fluorite has been reported in nepheline syenite complexes and a few gold bearing quartz veins. The potential of the combined gold - fluorite deposits is largely unknown but that of the nepheline syenite fluorite deposits is small. Further research is required to determine the feasibility of any co-production with gold. Commercial fluorite deposits in other parts of the world are of considerably higher grade than the known occurrences.

LEUCOGRANITE

Since numerous light coloured granitoid rocks have been reported it was expected that some could be amenable to bulk mining as a source of feldspathic minerals for ceramic uses. The granitoid rocks sampled tended to have a higher iron content than those currently accepted for ceramic use. Further work including mapping, sampling, and flotation bench tests should be directed at potassic suite granitoid rocks and leucogranite - alaskite type rocks to find potential sources of potassium feldspar.

NEPHELINE SYENITE

Alkalic rocks in the Sturgeon Narrows and Squaw Lake alkalic complexes contain nepheline syenite. The deposits have been geologically mapped but not specifically examined for their industrial mineral potential. They do not appear to have much potential for ceramic and glass material due to their remote locations and high iron content. Beneficiation studies would be necessary to determine if a usable product could be made.

QUARTZO-FELDSPATHIC SAND

A deposit of light coloured sand near Redditt was originaly described as silica sand: this proved to be quartzo-feldspathic sand with a low iron content, similar to sands examined by Guillet (1983). The material is very uniform in composition over considerable distances. There is abundant sand of this type in the region and it might be possible to beneficiate it for ceramic use or for use as masonry sand.

SPECULAR HEMATITE

Small amounts of specular hematite are reported in several iron deposits of the area including the Griffith Mine near Ear Falls and near Kekekwa Lake south of Dryden. Several deposits sampled and tested in this project as possible sources of pigments turned out to be unsatisfactory. Better material may be present in other deposits but further examination would be necessary to determine this. A laminated stone from the specular hematite unit at the Griffith Mine has good potential for decorative facing stone.

GROUP D DEPOSITS

ASBESTOS

The known deposits are relatively low grade and are found mostly in remote locations (eg. Ponask Lake). Given the poor outlook for the asbestos industry there appears to be little potential for any of the known deposits and little likelihood for the discovery of better deposits.

CARBONATITE COMPLEXES

Known carbonatite complexes have been examined by both industry and government. They are in very remote locations and appear to have low potential at this time.

CARBONATE CONCRETIONS

Although common in the Dryden - Wabigoon area, carbonate concretions have not been used for any known commercial purpose. They appear to have little potential at present although they could possibly be useful on a small scale as novelty items or as a soil conditioning agent.

CLAY

Despite one successful brickyard and several other attempts at brick making, clay products have not been produced to any great extent. Sampling indicates clay deposits are variable and often contain only a small amount of clay minerals and a low Al_2O_3 content. Many of the clays are calcareous making them unsuitable for brick or tile although ceramic tests by Guillet (1977) indicated some clays with satisfactory firing qualities. Products made outside the area have completely captured the brick and tile market.

DIATOMITE

Organic rich material up to several metres in depth occurs in many small lakes and restricted bays of large lakes. Samples of this material from a few lakes contain varying amounts of diatoms. The present commercial outlook for these deposits is poor due to low diatom content, difficulties in producing a marketable product, and competition from high quality deposits elsewhere.

OCHRE

The Minaki Pyrite Mine is noted for its extensive development of orange-red soil over the deposit. It has not been reported as a pigment source but it is likely that the native peoples used similar materials as pigments. The FeO content of this soil is low and the deposit is probably too small for most commercial uses. Rusty gossan and weathered rock surfaces are a common accompaniment to sulphide mineral occurrences but most of this material has little or no potential for pigment production.

PALEOZOIC LIMESTONE BOULDERS

Limestone boulders near Fort Frances were used to produce small amounts of agricultural lime in the 19th century. Large boulders are not common but small boulders could be collected from some gravel pits and stone piles and used locally to condition agricultural land or prepare fish spawning beds.

KYANITE-SILLIMANITE-ANDALUSITE AND STAUROLITE

Several reported occurrences in the Dryden and Ear Falls areas were examined but were found to contain only small amounts of these minerals and those not in a form usable by the industry. The metamorphic grade of the area examined was sufficient to form the minerals but the original lithologies apparently did not have the correct composition to form large amounts of them.

APPENDIX

GLOSSARY OF TERMS

The definitions below were compiled from the American Geological Institute Glossary of Geology (1) or from A Dictionary of Mining, Mineral and Related Terms by the United States Bureau of Mines (2) and a few were taken from sources listed at the end. Those with no reference were defined by the writer as used in this report.

Alaskite (1): Granitoid rock in which quartz constitutes 20-60%, alkali feldspar to total feldspar is greater than 90% and the rock has only a few % dark minerals.

(a): light-coloured alkali feldspar granite, little or no dark component.

Anatexis (1): Melting of preexisting rock.

Aplite (1): Light coloured hypabyssal igneous rock characterized by fine-grained granular texture. Composition ranges from gabbroic to granitic but the term aplite with no modifier is understood to mean granitic aplite.

Berylometer (1): A portable instrument used to detect naturally occuring beryllium. A gamma ray source in the instrument transforms Be_9 to Be_8 plus a neutron. Measurement of the neutron production rate allows for a quantitative evaluation of beryllium.

Brightness (b): A measure of the whiteness of ground marble or other material. A ground sample is compressed to a flat pellet and placed in a spectrophotometer with reflectance attachment the light reflected from the sample is compared to that from a $MgCO_3$ standard. The standard is set at 100% and the measured value from the sample is expressed as a percentage of this.

Calcine (2): To expel volatile matter by heat as carbon dioxide, water, sulphur, etc. with or without oxidation; to roast; to burn (said of limestone in making lime).

Coal tar (2): Tar obtained by the destructive distillation of bituminous coal usually in coke ovens or retorts and consisting of numerous constituents (benzene, xylenes, pyridine, quinoline, phenol, cresols etc.) used for making many organic chemicals.

Commodity: Any product of mining that is deemed to have some monetary value.

Concretion (1): A hard compact rounded mass or aggregate of mineral matter generally formed by the orderly and logical precipitation from aqueous solution in the pores of soil, sedimentary or volcanic rock. The cementing agent is usually calcite, dolomite, iron oxide, pyrite or gypsum.

Diatexis (1): High grade (ie nearly but not complete) anatexis involving rock components with high melting points.

Diatexite (1): Rock formed by diatexis.

EM Conductor: A rock unit, shear zone or other electrically conducting body that gives anomalous readings when crossed by an electromagnetic survey. The survey may be airborne or on the ground and can be any of several geophysical methods.

Euhedral (1): Said of an individual mineral crystal that is completely bounded by its own regularly developed crystal faces and whose growth was not restrained or interfered with by adjacent crystals.

Feldspathoid (1): A group of comparatively rare rock-forming minerals consisting of aluminosilicates of sodium, potassium or calcium and having too little silica to form feldspar. Feldpathoids are chemically related to the feldspars but differ from them in crystal form and physical properties; they take the place of feldspars in igneous rocks that are undersaturated with respect to silica or that contain more alkalies and aluminium than can be accommodated in the feldspars. Feldspathoids may be found in the same rock with feldspars but never with quartz or in the presence of free magmatic silica.

Flux (ceramic) (2): Any substance or mixture which lowers the normal vitrifying temperature of a ceramic body or composition (eg. fluorspar, nepheline syenite, calcium oxide, etc.).

Fractionation (1): Separation of a cooling magma into parts by the successive crystallization of different minerals at progressively lower temperatures.

Glacio-fluvial (1): Pertaining to the meltwater streams flowing from wasting glacier ice and especially to the deposits and landforms produced by such streams as kame terraces, and outwash plains.

Granitoid (1): A term applied to any light-coloured, coarse-grained igneous rock containing quartz as an essential component along with feldspar and mafic minerals.

Graphic (1): The texture of an igneous rock that results from the regular intergrowth of quartz and feldspar crystals. The quartz commonly occupies triangular areas producing the effect of cunieform writing on a background of feldspar.

Graphic granite (1): A pegmatite characterized by graphic intergrowth of quartz and alkali feldspar.

Greenschist facies (1): A term for schistose rocks containing an abundance of green minerals eg chlorite, epidote or actinolite which are produced by regional metamorphism at a low to moderate temperature and low to moderate pressure.

G. S. C.: Geological Survey of Canada

Gyttja (1): A dark, pulpy freshwater mud characterized by abundant organic matter that is more or less determinable and deposited or precipitated in a lake whose waters are rich in nutrients and oxygen or in a marsh. It is an anaerobic sediment laid down under conditions varying from aerobic to anaerobic and is capable of supporting aerobic life.

Lag (1): Coarse grained material that is rolled or dragged along the bottom of a stream at a slower rate than the finer material or that is left behind after currents have winnowed or washed away the finer material.

Leucocratic (1): Light coloured; applied to a light coloured igneous rock relatively poor in mafic minerals.

Micrite (1): Chemically precipitated carbonate (calcite) mud.

Migmatite (1): A composite rock composed of igneous or igneous looking and/or metamorphic materials which are generally distinguishable megascopically. Its formation may involve solid-state reconstitution in the presence of fluids. Injection of magma or in situ melting or both may take place.

MNDM: Ministry of Northern Development and Mines.

Mobilizate (1): The mobile phase of any consistancy that existed during migmatisation.

Modal analysis: Determining the actual mineral composition of a rock sample by physical examination; usually expressed in weight or volume per cent.

NOEGTS: Northern Ontario Engineering Geology Terrain Study; a series of reports and maps describing surficial materials particularly those of interest in road and similar construction projects. Information is derived from air photo interpretation and field surveys.

Norm (1): The theoretical mineral composition of a rock expressed in terms of standard mineral modules that have been determined by specific chemical analysis for the purpose of classification and comparison. The theoretical mineral composition that might be expected had all chemical components crystallized under equilibrium conditions according to certain rules.

Normative mineral (1): Standard minerals.

Normative spar ratio: Ratio of potassium feldspar to sodium and calcium feldspar calculated from the norm derived from major element chemical analysis.

Ochre (1): An earthy, usually impure, pulverulent, and red, yellow, or brown iron oxide extensively used as pigment.

Pegmatite (1): An exceptionally coarse-grained (most grains one centimetre or more in diameter) igneous rock with interlocking crystals usually found as irregular dikes, lenses or veins especially at the margin of batholiths. Their composition is generally that of granite although other compositions are known.

Pegmatoid (1): An igneous rock that has the coarse-grained texture of a pegmatite but that lacks graphic intergrowth and/or typically granitoid composition.

Peraluminous (1): An igneous rock in which the molecular proportion of aluminium oxide is greater than that of sodium oxide and potassium oxide combined.

Percentile: If a set of data is arranged in order of magnitude the values dividing the set into 100 equal parts are called percentiles, eg. 95th percentile means 95% of the values in the data set are less than this value.

Peristerite (1): A gem variety of albite with blue or bluish-white luster characterized by sharp internal reflections of blue, green and yellow; an inhomogeneous unmixed sodic plagioclase with a composition ranging between An_2 and An_{24}. It resembles moonstone.

Porphyritic (1): An igneous rock in which larger crystals (phenocrysts) are set in a finer groundmass which may be crystalline or glassy or both.

Porphyroblast (1): A pseudoporphyritic crystal in a rock produced by thermodynamic metamorphism.

Quartz core: Quartz forming a monomineral1ic mass usually near the centre of a zoned granitic pegmatite.

Quartzo-feldspathic: Sand consisting predominantly of quartz and feldspar.

Resource (c): A concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust in such form that economic extraction of a commodity is currently or potentially feasible.

Residual deposit (1): a. The residue formed by weathering in place.
b. An ore deposit formed in clay by the conversion of metallic compounds (as of manganese, iron, lead or zinc) into oxidized form by weathering at or near the Earth's surface.

Restite (1): An essentially nongenetic designation for all immobile or less mobile parts of migmatites during migmatization.

Reeves (d): Reeves are lines, striations, corrugations or folds arising from innumerable partings across the basal cleavage of muscovite. "A" reeves appear as two sets of rulings or striations intersecting at a 60 degree angle.

Sericite (1): A white fine-grained potassium mica occuring in small scales and flakes as an alteration product of various alumino silicate minerals having a silky luster and found in various metamorphic rocks (especially in schists and phyllites) or in the wall rocks, fault gouge and vein fillings of many ore deposits. It is usually muscovite or very close to muscovite in composition and may also include much illite.

Spicule (1): One of the numerous, often very minute, calcareous or siliceous bodies occurring in and serving to stiffen and support the tissues of various invertebrates and frequently found in sediment samples.

Stromatolite (1): A term generally applied to a variously shaped, often domal laminated calcareous sedimentary structure formed in a shallow water environment under the influence of a mat or assemblage of sediment binding blue-green algae that trap fine detritus and secrete calcium carbonate.

Syenite (1): A group of plutonic rocks containing alkali feldspar, a small amount of plagioclase, one or more mafic minerals and quartz if present only as an accessory. With increasing quartz content syenite grades into granite.

Verde Antique: Dark green serpentinite with numerous carbonate veins. The rock takes a high polish and is a commercial form of marble although the rock is not a metamorphosed carbonate rock.

Volatile (1): A material such as water or carbon dioxide in a magma whose vapour pressures are sufficiently high for them to be concentrated in any gasseous phase.

Wedge (d): Wedge mica is caused by the interlayering of laminae of unequal size. On spliting the mica sheets are thicker on one side than the other.

(a) Streckeisen (1976)
(b) Storey and Vos (1981)
(c) Robertson (1975)
(d) Thomson (1955)

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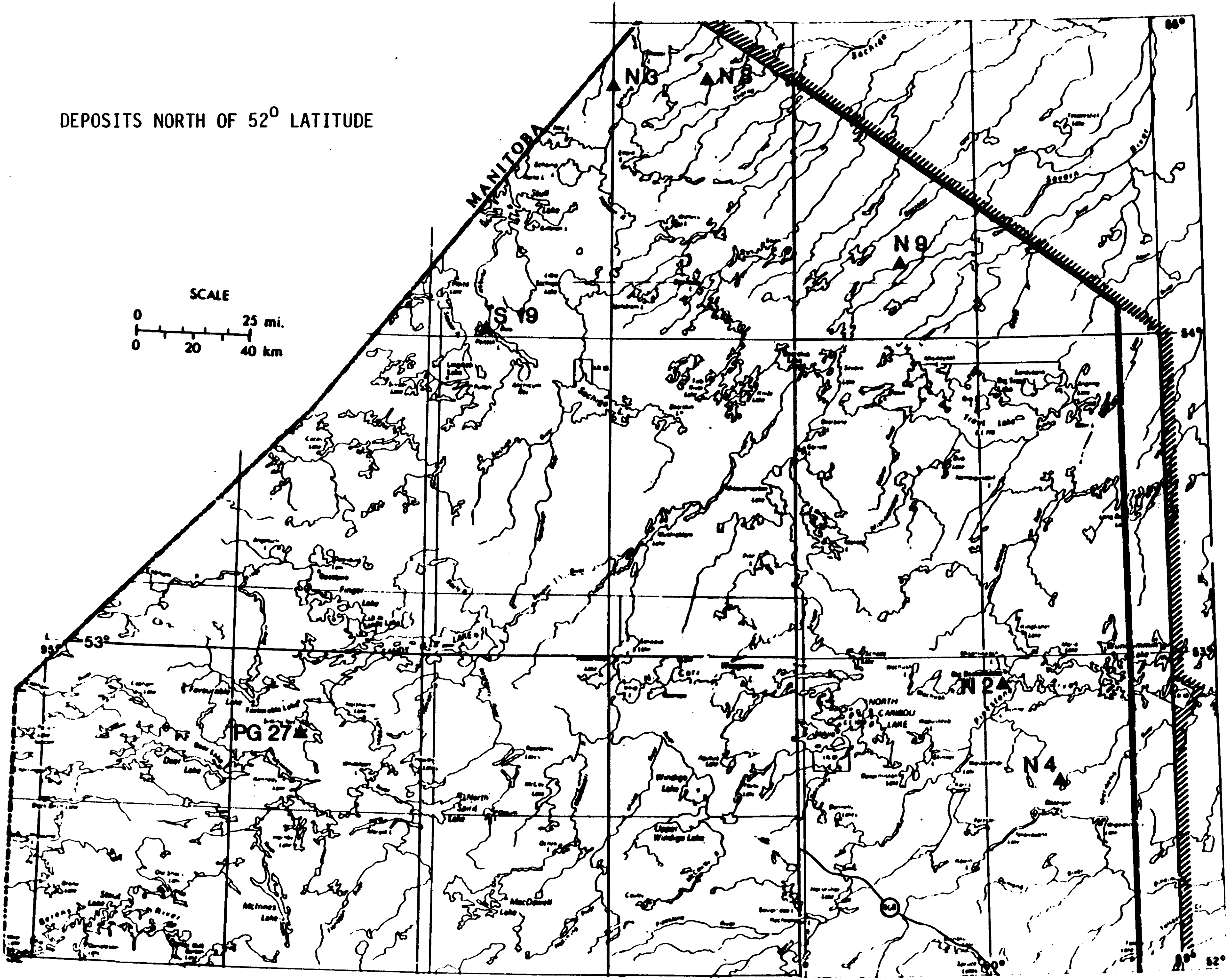
DEPOSITS NORTH OF 52° LATITUDE



DEPOSIT LOCATION MAP

All the deposits described or mentioned in the text are plotted on the map. Deposit numbers and names are the same as those used in the text and Storey (1986) with the exception of the leucogranite deposits, the Rainbow Quarry mica deposit and the Woman Lake Narrows marble deposit.

CARBONATE MATERIALS

CARBONATE CONCRETIONS

CC 1	Dinorwic Lake
CC 2	Kawashegamuk Lake

MARBLE

M 1	Gaherty Island
M 2	Hahn Lake (Patricia Lime Co.)
M 3	Kawashegamuk Lake
M 4	Woman Lake Narrows

MARL OCCURRENCES

MR 1	Finland Bog
MR 2	Suprise Lake
MR 3	Yum Yum Point/Helldiver Bay
MR 4	Nu-Terra
MR 5	Shoal Lake

PALEOZOIC LIMESTONE

PL 1	Crozier Township Lime Pit

CERAMIC AND GLASS MATERIALS

RECORDED BRICKYARDS AND CLAY OCCURRENCES

BR 1	Brinkman Brickyard (Western Algoma Brick Company)
BR 2	Dryden Timber and Power Company
BR 3	Fitzgerald's Brickyard
BR 4	Fort Frances Brickyard
BR 5	Jaffray Township
BR 6	Vernon Clay Occurrence

LEUCOGRANITE

LG 1	Bear Pass Stock
LG 2	Butler Quarry
LG 3	CPR Hawk Lake Ballast Quarry Fines
LG 4	Dore Lake Granite
LG 5	Revell Batholith
LG 6	Vermilion Bay Granite from Nelson Granite Ltd. Quarry

QUARTZO-FELDSPATHIC SAND

Q 1	Redditt Sand

GRAPHITE DEPOSITS

G 1	Corkscrew Island
G 2	Pope Lake
G 3	Sucan Lake Graphite
G 4	Treelined Lake
G 5	Falcon Island Graphite
G 6	Manitou Stretch
G 7	Meehan
G 8	Olson
G 9	Lount Lake
G 10	Wilkinson

MICA (OTHER THAN PEGMATITIC)

MICA 1	Rainbow Quarry

PEGMATITE DEPOSITS

DEPOSITS DESCRIBED IN TEXT

PG 1	Cramp Lake
PG 2	English River Beryl
PG 3	Falcon Island
PG 4	Graphic Lake
PG 5	Harrison Mica
PG 6	Hollinger East
PG 7	Kozowy-Leduchowski
PG 8	Mavis Lake
PG 9	McCallum
PG 10	Medicine Lake
PG 11	Sandy Creek

DEPOSITS NOT DESCRIBED IN TEXT

PG 12	Capital Lithium Mines – McCombe
PG 13	Capital Lithium Mines – Root Lake
PG 14	Coates
PG 15	Coates South
PG 16	Dryden Airport
PG 17	Gullwing Lake
PG 18	Massberyl
PG 19	Mica Point (Gullwing Lake)
PG 20	Milestone
PG 21	Oneman Lake
PG 22	Oxdrift
PG 23	Pashkokogan
PG 24	Petrunka Tungsten
PG 25	Pulford
PG 26	Seine Bay
PG 27*	Setting Net Lake
PG 28	Taylor

PIGMENT DEPOSITS

P 1	Bad Vermilion Lake Sill
P 2	English River Iron Formation
P 3	Gibi Lake Occurrence
P 4	Grifith Mine
P 5	Kekekwa Lake
P 6	Minaki Pyrite Mine

SOAPSTONE/TALC/ASBESTOS DEPOSITS

SOAPSTONE

S 1	Claxton Township
S 2	Coste Island
S 3	Eagle Lake Soapstone Quarry
S 4	Labyrinth Bay
S 5	Little Turtle Lake (H.H. Wood Talc Co.)
S 6	Madsen
S 7	Mile Lake #1
S 8	Mile Lake #2
S 9	Pipestone Lake
S 10	Pipestone Peninsula
S 11	Trap Lake
S 12	Wabigoon
S 13	Mica Point
S 14	Phillips Township
S 15	Pipestone Bay (Red Lake)
S 16	Pipestone Lake North
S 17	Sucan Lake

ASBESTOS

S 18	Anderson Asbestos Occurrence
S 19*	Ponask Lake

MISCELLANEOUS COMMODITIES

DIATOMS

D 1	Bunny Lake
D 2	Hillock Lake
D 3	Old Woman Lake
D 4	Tabor Lake

FLUORSPAR OCCURRENCES

FL 1	Oldberg Lake
FL 2	Sturgeon Narrows Alkalic Complex East Bay Occurrence
FL 3	Sturgeon Narrows Alkalic Complex Narrows Island Occurrence
FL 4	Thrasher
FL 5	Vista Lake Complex

KYANITE

K 1	Eagle River

REPORTED ALKALIC COMPLEXES AND CARBONATITE BODIES

N 1	Bell Lake
N 2*	Big Beaverhouse
N 3*	Carb Lake
N 4*	Schryburt Lake
N 5	Squaw Lake
N 6	Sturgeon Narrows
N 7	Falcon Island Stock
N 8*	Unnamed body
N 9*	Unnamed body
N 10	Unnamed body at Summach Lake
N 11	Viola Lake Stock

*These deposits are north of 52°00′.

Ontario
Ministry of Natural Resources
Hon. James A. C. Auld
Minister
Dr. J. K. Reynolds
Deputy Minister
Robert G. Code
Surveyor General

MAP 24-6
Districts of
RAINY RIVER, KENORA
and part of
KENORA PATRICIA PORTION
1978

Scale: 1:600 000

Miles 10 0 10 20 30 40 Miles
Kilometres 10 0 10 20 30 40 50 60 Kilometres

Though care has been exercised to ensure that all geographical names appearing on this map are authentic, reliable information concerning corrections or additions to those shown is welcomed by the Ministry of Natural Resources and should be addressed to:

Surveyor General,
Ministry of Natural Resources,
Parliament Buildings,
Toronto, Ontario.

Cartography by the Surveys and Mapping Branch. Ministry of Natural Resources

County, District, Regional or District Municipality	KENORA
Township, Incorporated	IGNACE
Improvement District	BALMERTOWN ID
Township, Geographic	SMELLIE
City, Town or Village limits	
City or Town Centre	■
Population more than 50,000	SUDBURY
10,000 to 50,000	KENORA
5,000 to 10,000	Dryden
1,000 to 5,000	Red Lake ●
500 to 1,000	Hudson ●
50 to 500	Ignace ●
Less than 50	Gunne ●
Dispersed rural community	Dance
Name still in use but part of a city, town, borough, or area municipality	Duluth Jct ■
International Boundary	
Interprovincial Boundary	

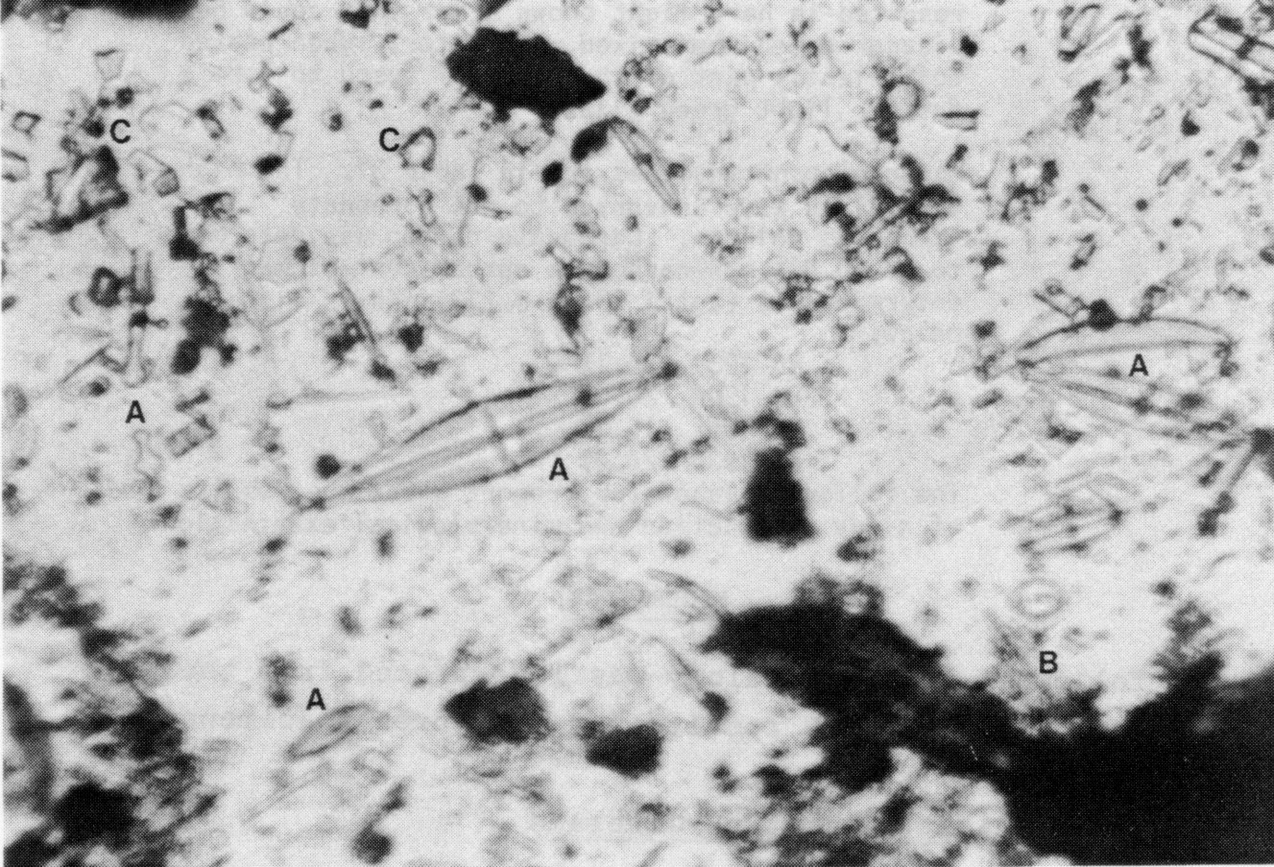
County, District, Regional or District Municipal Boundary	
Township Boundary, surveyed	
Township Boundary, unsurveyed	
Provincial or National Park	
Indian Reserve	
Elevation, land	407 m
Elevation, water	338 m
Hydro Electric Generating Station	
Hydro Electric Transmission Line	
Natural Gas Pipeline	
Railway line and station	
Hospital or Red Cross outpost	
Dam	D
King's Highway	
Secondary Highway	
All Weather Road	
Road (unimproved)	

Lambert Conformal Projection, Stan
and 53°30′

DEPOSIT LOCATION MAP

OCCURRENCE	▲
PROSPECT	●
PRODUCER/PAST PRODUCER	■


20E3


C
C
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