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ONTARIO
GEOLOGICAL SURVEY
Open File Report 5236
Silica in Ontario
Supplement
by
M.A. Vos

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Abstract

In 1963 the Ontario Department of Mines published Industrial Mineral Report No 9, Silica in Ontario, by D.F. Hewitt. A supplement to this report has now been completed. New developments recorded in this supplement include the opening of a silica (quartzite) quarry on Badgeley Island, Georgian Bay by Indusmin Limited. Potential new deposits of glass sand have been discovered in Cargill Township, District of Cochrane, as a result of drilling for phosphates by International Minerals and Chemical Corporation.

In 1975 Cretaceous silica sands in the Moose River Basin, James Bay Lowland have been intersected in several drill holes in a program of geological and geophysical studies in this area sponsored by the Ontario Division of Mines. Analytical results of these drill samples, and analyses of surface samples of precambrian quartzites along the north shore of Lake Huron have been recorded here.

Expansion of the glass manufacturing industry in Ontario raises the demand for raw materials and increasingly favours development of local resources.

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SILICA IN ONTARIO*

SUPPLEMENT

by

M.A. Vos**

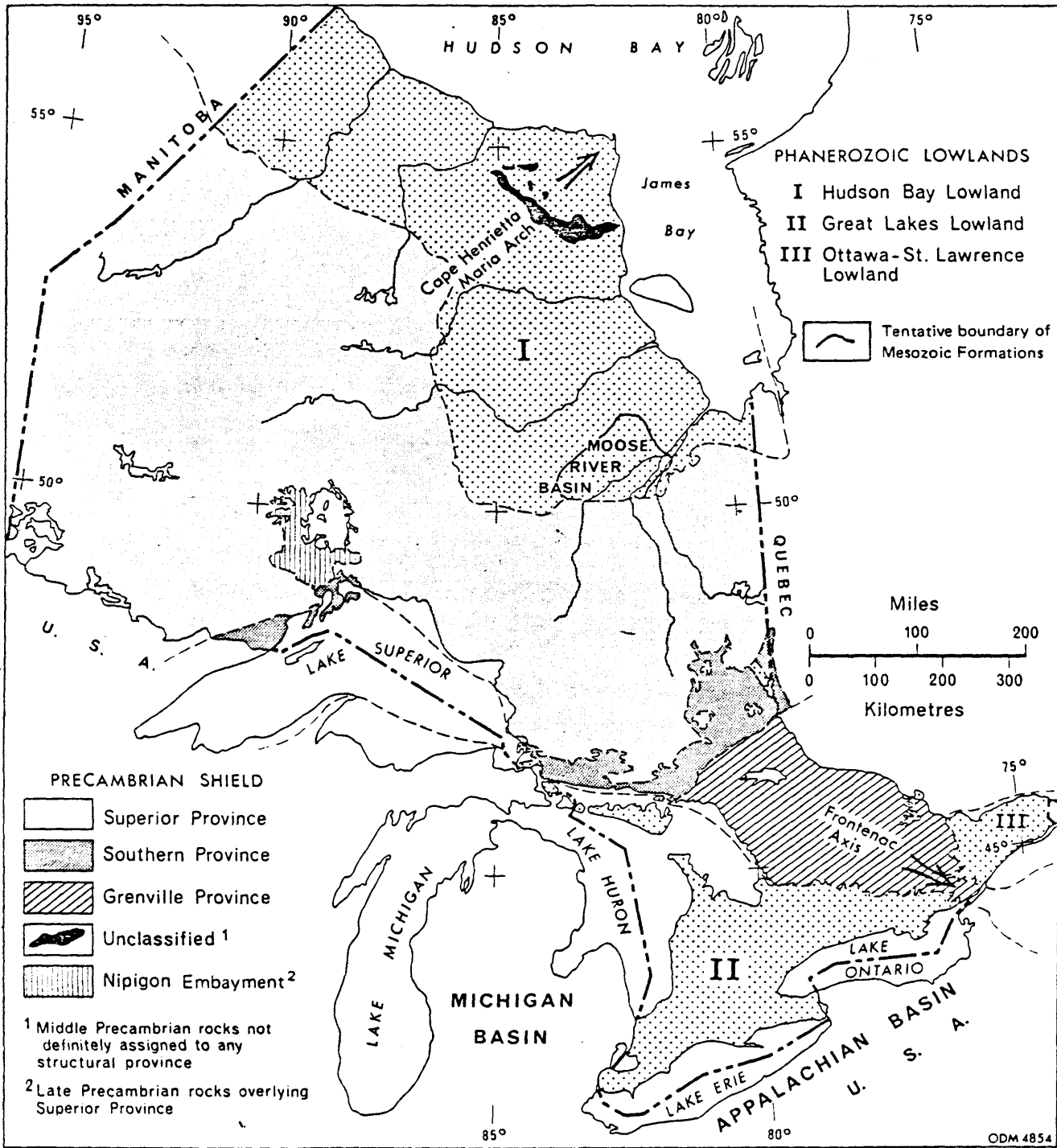
INTRODUCTION

New developments in the silica industry in Ontario including the Ontario Silica Operation of Indusmin Limited and new information on silica resources make it desirable to publish a supplement to Industrial Mineral Report No. 9: "Silica in Ontario" (Hewitt, 1963).

In the years from 1970 to 1975 annual Ontario production of silica amounted to approximately 1,200,000 tons. The producing companies in 1975 were Bolenders Limited, Falconbridge Nickel Mines Limited, Indusmin Limited and International Nickel Company of Canada Limited. Ontario silica is used as smelter flux in nickel production, as raw material in the production of ferro silicon and silicon carbide, as glass sand, as raw material in the production of silica brick and as aggregate for concrete facing. Fines developed as a by-product of glass sand manufacture are further reduced in size to silica flour. Silica flour is used as enamel frit or pottery flint in the ceramics industry and, combined with portland cement in a ratio of 45 to 100, in autoclave-cured concrete products (Pearse, 1974). It also serves as filler in rubber and asbestos cement products, as extender in paint and as an abrasive agent in soap and scouring pads. In Ontario silica is produced from the following sources:

* approved for publication by Chief, Mineral Deposits Section, Geological Branch, Ontario Division of Mines, January 11, 1978.

** Geologist, Mineral Deposits Section, Geological Branch, Ontario Division of Mines



MAP A

GEOLOGICAL REGIONS of ONTARIO and LOCATION of MOOSE RIVER BASIN (after HEWITT and FREEMAN 1972, Figure 5).

- 1) Grenville* quartzite: Bolenders Limited of Eagle Lake produces silica for manufacture of brick from property on lots 24,25, Concession IV, Guilford Township, Haliburton County
- 2) Silica sand (up to 58 percent quartz): Deltaic sands of Quaternary age in Garson Township, Sudbury District, are produced for use as smelter flux by Falconbridge Nickel Mines Limited and International Nickel Company of Canada Limited (Burwasser, 1976).
- 3) Huronian Quartzite (Lorrain Formation): Smelter flux is produced in Lawson Quarry, lot 13, Curtin Township (see Map B) Sudbury District, by International Nickel Company of Canada Limited.
- 4) Huronian quartzite (Bar River Formation): Silica is produced by Indusmin Limited from a property on (see Map B) Badgeley Island, Georgian Bay (West of Killarney) for use in ferro-alloy industries, glass manufacture, abrasive products and special concrete.

New information includes a reconnaissance survey of (see Map B) Precambrian quartzites in the Georgian Bay and Sudbury areas, (see Map C) and analytical results of drill core from the James Bay Lowland. Results of drilling in Cargill Township, 28 km (17½ mi) southwest of Kapuskasing are taken from Sandvik and Erdosh (1976) (see Map C).

Precambrian quartzites were sampled in order to document more fully the character of different orthoquartzite formations recently distinguished by Robertson et al, (1969) and mapped by

* Grenville Geological Province, see Map A.

K.D. Card (1967). Knowledge of the distribution of deposits with economic potential is necessary in view of long range land use plans for this area. Drilling in the James Bay Lowland has taken place on several occasions from 1965 to 1975 and has significantly increased knowledge of the distribution of Cretaceous silica sands. Remoteness of these deposits as well as depth of overburden mitigate against their early development. Nevertheless, because of their inherent value and magnitude, the deposits increasingly attract the attention of potential developers. Essential data on regional distribution were obtained in a program of drilling and geophysical examination along an 80-km (50-mi) section NW of Smoky Falls, Kipling Township, sponsored by the Ontario Division of Mines (Rogers et al., 1975). Chemical and mineralogical analyses of the drill samples by staff of the Mineral Research Branch, Division of Mines have now become available.

In 1975 and 1976, extensive drilling of a potential phosphate ore body/
in Cargill Township
by International Minerals and Chemical Corporation has revealed the presence of up to 130 m (424 ft) of quartz sand interbedded with gravel, silt and clay. The quartz content exceeds 95 percent in many sections (Sandvik and Erdosh, 1976). The pre-glacial sand-clay unit overlies an apatite rich residuum of deeply weathered carbonatite. In the event of phosphate production by open pit method, much of this material will have to be removed in the process.

imported material is actually glass sand but the difference between glass sand produced and consumed in Canada was 263,483 tons in 1966 and 285,637 tons in 1974. Equating the amounts with imported glass sand it becomes obvious that the large increase in consumption of glass sand from 421,840 tons in 1966 to 800,386 tons in 1974 (these figures include raw material for fibre glass production) is largely provided for from Canadian sources. The average value quoted for Canadian glass sand in / ^{Statistics Canada} has increased from \$6. per ton in 1966 to \$9. per ton in 1974.

A measure of Ontario's share in the increased production of glass may be obtained from figures for cost of materials and supplies. These costs amount to 68% of the total for Canada in 1966 and 77% in 1973. Translated in use of silica sand this would mean that in 1974 approximately 75% of 800,386 tons or 600,289 tons were consumed in glass manufacture in Ontario. A large amount of this glass sand had to be imported from other parts of Canada or the United States of America. Further expansion of the glass manufacturing industry in Ontario will raise the demand for mineral raw materials and put increased pressure on development of local resources.

GEOLOGY

Silica, the double oxide of silicon (SiO_2) is a component part of most common rock forming minerals.

In pure form it occurs as the mineral quartz. Natural

MARKET

Silica products in Ontario include silica flux, silica brick, glass and abrasives (ferrosilicon and silicon carbide). Fines developed as a by-product of glass sand manufacture are used in the production of ceramics and special concretes. Crushed quartz for concrete facing is produced on demand. Statistics * in the Ontario Mineral Review (Ministry of Natural Resources) show that production of silica in Ontario since 1966 has fluctuated between a low of 865,384 tons in 1969 and a high of 1,748,092 tons in 1970 when the first shipments of ore from the Indusmin operation on Badgeley Island were received. Since then annual production has steadied between 1.18 million tons and 1.24 million tons (1,208,394 tons in 1975). A total of four producers is recorded. Indusmin Limited with a shipment of 434,000 tons from the Badgeley Island quarry in 1975, is the only producer supplying to manufacturers of glass and abrasives.

Figures for production of glass and abrasives are available from the Dominion Bureau of Statistics (Statistics Canada). The use of glass sand by large establishments has approximately doubled from 1966 to 1973. Production of abrasives on the other hand has remained stable. The quantity of silica sand used for this purpose is approximately 150,000 tons annually.

Imports of silica sand to Canada ranged from about 1 million tons at \$4.00 per ton in 1966 to 1.15 million tons at \$8.00 per ton in 1975. There is no indication how much of this

* Production of silica sand used in portland cement is not included in statistics.

concentrations of quartz form the ore of silicon and the raw material for glass production. Used in bulk preferably without beneficiation the quartz concentrations have to be very pure to qualify as ore. In Ontario, the following resources are quoted and discussed by Hewitt (1963):

Precambrian Quartzites:

Lorrain Quartzite*
Grenville Quartzite

Paleozoic Sandstones:

Potsdam or Nepean Sandstone
Medina Sandstone
Oriskany Sandstone
Sylvania Sandstone

Unconsolidated Sands:

Sault Ste. Marie Area
Southern Ontario

Pegmatitic and Vein Quartz

To this list of resources have been added the unconsolidated Cretaceous sands of the Mattagami Formation, Moose River Basin, James Bay Lowland and the sands overlying phosphate deposits in Cargill Township.

The type of deposit chosen as a source of raw material is largely determined by the nature of manufactured products. Production of ferro silicon and silicon carbide requires lump silica which is preferentially produced from quartzites or sandstones. Production of glass relies on sand sized silica favouring unconsolidated sand as a raw material. White opaque and clear translucent varieties of quartz used for facing

*It is now recognized that this term was used indiscriminately for two different orthoquartzites. They have recently been assigned respectively to the Lorrain and Bar River Formation (Robertson et al., 1969) separated by argillites and quartzites of the Gordon Lake Formation.

precast concrete slabs are obtained from pegmatite and vein quartz.

Unconsolidated sands of the Moose River Basin, James Bay Lowland, associated with kaolin, fireclay and lignite, form part of a deltaic sedimentary sequence fringing the Hudson Bay depression of the Canadian Shield (see Fig. 11). The sands and clays, initially ascribed to a single stratigraphic unit, the Mattagami Formation (Dyer, 1928), have recently been shown to consist of Middle Jurassic clastic beds overlain by Lower Cretaceous sands and clays; the unconformity corresponds to a hiatus in deposition of some 60 million to 70 million years (Telford et al., 1975). Lower Cretaceous silica sands have been found up to a distance of 30 km (18½ mi) north of the east-trending Precambrian Escarpment. In east-west direction the sands occur over a distance of 80 km or more. Vertically the Mattagami Formation extends to a depth of 188 m (617 ft) in Hambly Township. Geophysical surveys indicate that this depth increases towards the Escarpment (Utard, 1975).

The deposits in the deltaic sequence described above are of variable composition and have been subject to pre-Pleistocene erosion. A buried river valley is indicated, for instance, by a single drill hole at Campbell Lake, Sanborn Township. Here Pleistocene deposits are in contact with Paleozoic beds at a depth of 213 m (700 ft) (Hogg et al., 1953, p.117).

The Mesozoic Formations are overlain by glacial and marine deposits of Quaternary age imparting a topographically unevent-

ful, flat lying and extremely ill-drained surface made up of swamps, bogs and muskeg. Irregularity in the thickness of overlying deposits is common although, as a rule, a substantial amount of overburden of 20 m (65 ft) or more is present at all times. Consequently surface outcrops of the Mattagami Formation are confined to the deeply incised riverbeds.

In Cargill Township drilling has revealed the presence of up to 130 m (424 ft) of silica sand overlying deeply weathered phosphate deposits. The sands occur in preglacial troughs and have been derived from local sources. Their association with kaolinite suggests that the sands have been subject, at least partially, to the same intense weathering which has affected the underlying carbonatite.

DEPOSITS

New information on silica pertains to deposits of Precambrian quartzites, Paleozoic sandstones, Cretaceous sandstones of the James Bay Lowland and sands in Cargill Township. The information will be discussed in this order in the following section of the report.

PRECAMBRIAN QUARTZITES

Badgeley Island Quarry, Indusmin Limited

Location.

Badgeley Island, $6\frac{1}{2}$ km (4 mi) long and $\frac{1}{2}$ km ($\frac{1}{4}$ mi) wide lies near the north shore of Georgian Bay, approximately 5 km (3 mi) west of the village of Killarney (see Map B). Killarney can be reached via Highway 637, which connects with Highway 69 some 40 km (25 mi) south of Sudbury.

The quarry is located in high ground in the northeast half of the north east trending island, in a band of Bar River quartzite which rises up to 110 m (360 ft) above lake level. The quarry is reached by company motor launch from Killarney in a traveltime of approximately 30 minutes. The boat carries employees to and from work each day.

Geology.

Quartzite of the Badgeley Island Quarry belongs to the Bar River Formation, a unit at the top of the Huronian Supergroup. The Bar River Formation, previously distinguished by Collins (1925) as the "Upper White Quartzite", was formally named by Frarey (1967). It can be divided into 5 intergradational units (Card, 1975, p.164-168) of a total thickness of at least 900 m (3000 ft). The orthoquartzites in these units are up to 180 m (600 ft) thick and consist mainly of: "..... rounded, well

sorted, fine to medium (0.1 to 0.3 mm) grains of quartz (95%) with recrystallized silica cement and minor amounts of muscovite and accessory hematite, zircon, tourmaline, and monazite." (Card, 1975, p.166).

On Badgeley Island the ore body is formed by Bar River orthoquartzite described by A.R. Watt (1974) as a near vertical to south dipping band, striking north 70° east, bounded by granite and diabase to the northeast and southwest, by granite to the southeast and grading rapidly into argillaceous siltstones to the northwest. The outcrop is mantled by dolomitic limestone of Ordovician age at lower level to the northwest, west and southwest. The geologic map (Card, 1976) shows both diabase and amphibolite intrusions in the ore body and a geologic contact of Bar River orthoquartzite with underlying Gordon Lake sediments to the northwest.

Watt (1974) gives the following details:

"The deposit consists of massive, dense, very fine grained white buff white and yellow-brown-white quartzite. Generally the deposit is well fractured with several steep fault escarpments. Cutting the deposit are several diabase dikes of varying widths. Waste areas within the deposit are related to these dykes, fault zones and outer contacts with surrounding rock types. Typical ore analysis is:

Silica	SiO ₂	98.5%
Alumina	Al ₂ O ₃	0.8
Iron	Fe ₂ O ₃	0.04
Lime, Magnesia	CaO+MgO	0.03
Potash	K ₂ O	0.14
Soda	Na ₂ O	0.01
Phosphorus	P ₂	0.004
Titania	TiO ₂	0.02
L.O.I.		0.16

This ore is suitable for ferro-silicon manufacture.

After size reduction to glass sand the iron is reduced in the sand to 0.03% and the alumina to 0.6%. The sand is suitable for the flint glass industry."

Mining.

Development:

Discovery of the deposit and exploratory drilling took place in 1967. Nineteen diamond drill holes totalling 2,639 m (8,659 ft) indicated a 20,000,000 ton ore body on part of the company held claims covering Badgeley Island. In 1968 Indusmin Limited purchased the Killarney Quarry on Badgeley Point on the north shore of Lake Huron opposite Badgeley Island (Card 1976,p.53). Some exploratory drilling adjacent to this quarry was carried out, including in 1968 two holes totalling 231 m (759 ft) and in 1971 two holes totalling 135.5 m (451 ft), respectively.

In 1969 crushing equipment was transferred from Badgeley Point to the island where construction of docking facilities and a crushing and screening plant were started. In the same year construction of a mill to process the Badgeley Island fines was undertaken in Midland, Ontario. Both plants went

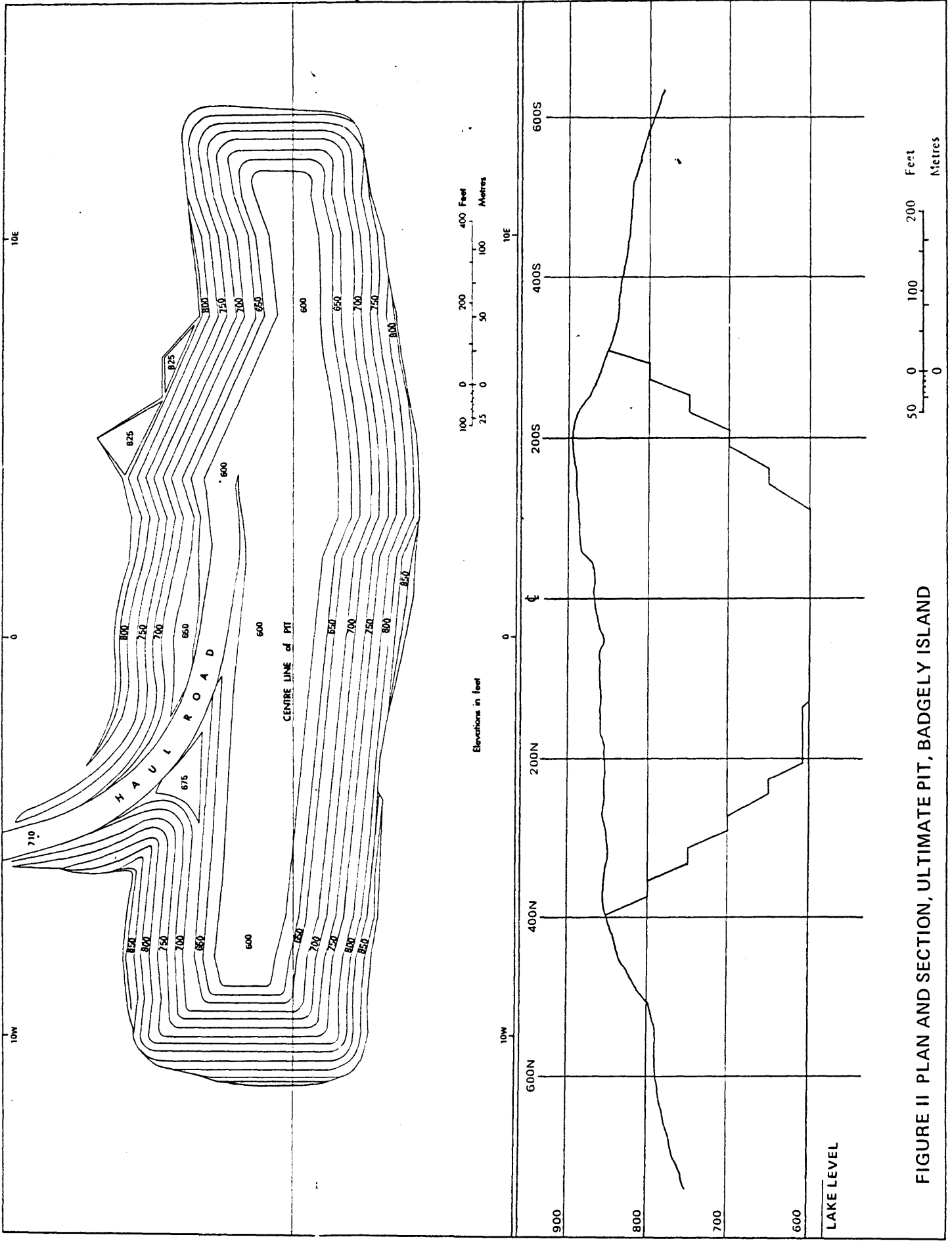


FIGURE II PLAN AND SECTION, ULTIMATE PIT, BADGELY ISLAND

The drill pattern is 10' x 10' on a regular 25 foot bench . Explosive factor is 0.55 lb per ton of ore using AN-FO, slurries and aluminized slurries depending on water conditions. Excellent fragmentation is a prerequisite to loading, crusher capacity and reduced wear, consequently the high explosive factor. Very little secondary breakage is required" (Watt,1974,p.75).

Loading and Haulage:

For loading and haulage a 3-cubic yard hydraulic shovel (Poclain HC300), a 5-cubic yard front end loader (Michigan 275) and 4 Euclid trucks are available. Most hauling is done with the two economic, off highway duty, 35-ton capacity dump truck units.

Crushing and Screening:

"The trucks dump into the feed hopper from which the ore is fed at the rate of 280 t.p.h. to a 40" x 42" jaw crusher. The crushed ore is then conveyed to a separate secondary crusher building where it is screened at 3.5 inches. The screened oversize goes to a 24" x 36" jaw crusher with the crushed material returning to the primary screen. The screen undersize then passes over a secondary double deck screen where it is screened at 2 3/4 and 1/8 inches. The 3 1/2 x 2 3/4-inch product is stockpiled using a radial stacking conveyor and the minus 2 3/4-inch product is stockpiled separately on another identical stockpiling system. Both screens are washed using high pressure sprays. Wash water passes

into operation in 1970.

Operation:

In 1974 the following details concerning the mining operation were published by Watt:

"The mine plan calls for the removal of approximately 15,000,000 tons of ore by open pit methods with an additional 3,000,000 tons of waste. The pit will be 2,400 feet long and final depth of 330 feet. The pit is designed for 25 to 30 foot benches leaving a safety berm every 50 to 60 feet.

Ramp access and final pit configuration have yet to be finalized pending additional geological information. Mining of the down ramp will not start for 5 years. A general outline of the pit is shown in figure 2 [Figure 1]" (Watt, 1974,p.4.)

Mining and crushing is carried out with a crew of 40 men working two shifts per day, 5 days per week, from May till December.

Drilling and Blasting:

"Pit development and bench mining have been done with two Gardner Denver Air Track drills using 4½ inch bore drills and 600 C.F.M. of compressed air each. Hole diameter is 3½ inches and normal bench drilling requires a hole length of 28 to 30 feet. The drilling rate in quartzite approximates 45 feet per hour. Bit wear rate is very high with an average life of 120 feet, using tungsten carbide bits. Bits must be resharpened every 10 feet to obtain maximum life.

through an Atkins spiral classifier with the collected sands re-introduced to the fines and the water pumped to a settling area.

The simplicity of operation is offset by exceptional maintenance considerations.

The extreme wear requires the changing of jaw plates every 50,000 tons crushed. For the 1974 season, a 5½ foot standard cone crusher will supplement the secondary jaw crusher providing increased plant capacity and improved size control". (Watt, 1974,p.6,7).

A 48-inch conveyor belt in a steel tunnel underneath each stockpile transfers ore to the ship loader system at the dock. The depth of water (36.5 m (120 ft)) allows for loading of lake vessels of any size. Lump ore (-3½ inch + 2 3/4 inch) is shipped directly to the customer while quartzite fines are taken to the plant at Midland, a distance of approximately 190 km (118 mi) taking 12 to 13 hours by boat.

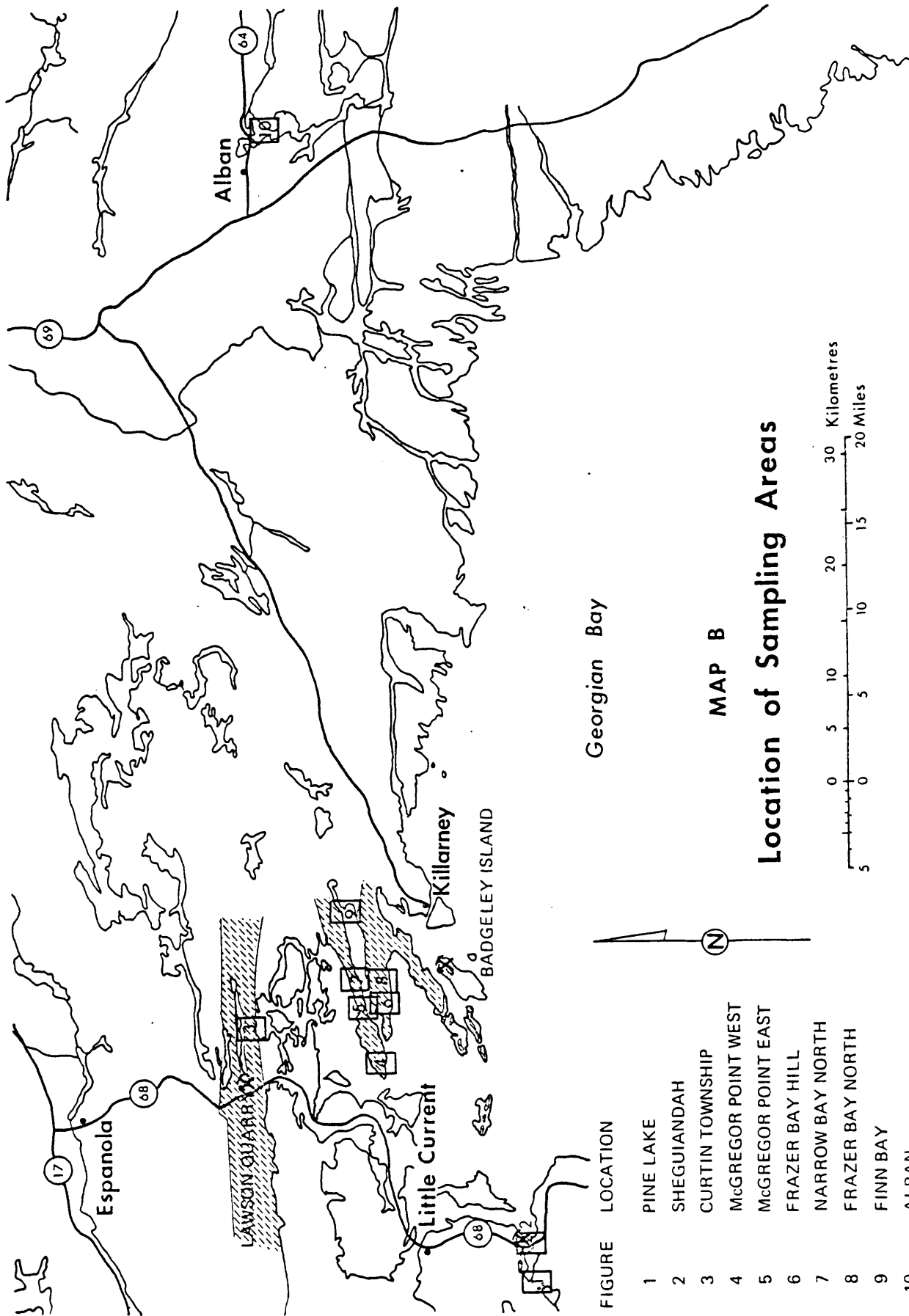
Midland Operation:

At Midland ore is stockpiled for year round operation. The mill operates 24 hours per day at a nominal rate of 1200 tons per day. A work force of 35 men is employed (Watt 1974,p.8).

From the stockpile ore is loaded onto a conveyor belt and passed via dryer to a crusher. Here it is reduced to minus ½-inch size in closed circuit with a screening plant. Further reduction to glass sand size is described by Watt (1974,p.9,10):

"The most important parameter to the milling operation is to produce as much sand size material as possible in the range of 30 to 200 mesh. To minimize the fines generation the primary grinding mill was installed initially as a rod mill. The mill is 14 feet long, 11 feet in diameter with an end peripheral discharge. It is in closed circuit with ten Tyler 4' x 10' double deck screens. The rod mill could not effectively reduce to near size material at desired capacity and the mill was converted to balls. The conversion to balls is somewhat unusual in that 4-inch balls have to be used in order to break the larger pieces and, to minimize the generation of fines, the balls are rejected at 2.5 inches through designed openings in the discharge grate. Rejected balls are removed from the system using a self cleaning belt magnet. Converting the mill from rod to balls increased mill capacity from 39 t.p.h. to 46 t.p.h. A 20% increase in speed provided a further increase to 51 t.p.h. A further increase in the mill capacity is expected from the finer feed resulting from the new closed circuit crusher operation. Paradoxically a reduction in fines generated is also expected as present large pieces do not break down but wear down."

After closed circuit screening and grinding of sand and extraction of extreme fines by air classification a further stage of grinding of the extreme fines in either a steel ball



Georgian Bay

MAP B

Location of Sampling Areas

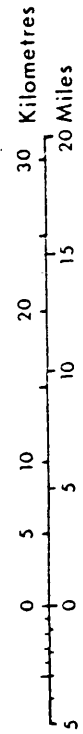


FIGURE LOCATION

- 1 PINE LAKE
- 2 SHEGUIANDAH
- 3 CURTIN TOWNSHIP
- 4 MCGREGOR POINT WEST
- 5 MCGREGOR POINT EAST
- 6 FRAZER BAY HILL
- 7 NARROW BAY NORTH
- 8 FRAZER BAY NORTH
- 9 FINN BAY
- 10 ALBAN

HURONIAN ORTHOQUARTZITE



mill or pebble mill reduces these to flour which is then air classified. The different products are used in ceramics, cleanser and concrete products industries. Environmental control, particularly dust control, is essential in mining, milling and handling of silica products. Methods of dust control include wetting, collecting of dust in air bags by vacuum suction, enclosure of equipment, sealing of screens with special rubber, pressurising of operator control booths with filtered air and restriction of access to whole areas placed under vacuum pickup; here controls are maintained regardless of isolation. Dust masks are worn by personnel in designated areas. Other controls include noise and water control. Measures taken to achieve controls are discussed in more detail by Watt (1974, p.12-18).

RECONNAISSANCE SURVEY OF PRECAMBRIAN QUARTZITES

Precambrian orthoquartzites in Ontario are a source of raw material for production of silica flux, ferro silicon, glass sand and silica flour. Study of the geology and stratigraphy of Huronian sedimentary rocks in recent years has led to a revised stratigraphic nomenclature first recommended by Robertson, Card and Frarey (1969).

Precambrian orthoquartzite in Ontario is prevalent in the Southern and Grenville Geological Provinces

Deposits in the Southern Province belong to the Huronian Supergroup of sediments (Robertson, Card and Frarey

1969, p. 12), occurring along the north shore of Lake Huron (see Map B). Previously referred to as Lorrain Quartzite (Hewitt 1963) these orthoquartzites locally were found in recent mapping (Card 1976) to belong to two distinct geologic formations, the Lorrain and Bar River, separated by impure quartzites and micaceous rocks of the Gordon Lake Formation. The Huronian Supergroup of rocks represents a sequence of immature clastic sediments derived from a dominantly felsic plutonic terrain to the north. In a recent publication (Card et al. 1977) the sediments are described as forming a southeastward thickening wedge on the southern flank of the Superior Province craton. Thickening is particularly abrupt across zones now marked by major faults of the Murray Fault system, according to the authors. A total cumulative thickness in excess of 10,000 m is measured in the Sudbury-Espanola area (Card et al. 1977, p.2).

Orthoquartzites represent the most mature sediments in the sequence. Occurring near the top of the Huronian they are interpreted (Card et al. 1976, p.24) as deriving from sedimentary rock reworked under influence of the winnowing action of waves and currents in a turbulent nearshore shelf environment. The presence of kyanite derived from kaolin, seen as an indication of a change to tropical climate (Card et al. 1977, p.8), suggests that the rocks were exposed to weathering above water level.

Grenville orthoquartzites are found, amongst others, along the French River near Alban and in Wyse Township (see p.47). Although the Grenville metasedimentary sequence in this area is found to be equivalent to at least the lower part of the Huronian Supergroup, the possibility of detailed correlation of orthoquartzites in both sequences must be ruled out, according to Lumbers (1975, p.49).

The present survey, based on partial analyses of orthoquartzites and adjacent rocks, adds information on the character and distribution of orthoquartzites and may be useful as a guide to exploration for potential silica ore deposits. It is also intended to serve as a mineral evaluation guide for purposes of land use planning and park development.

Rock samples have been collected at wide but regularly spaced intervals along sections of favourable geology. The orthoquartzite ridges provide almost continuous outcrop in the sample areas. A total of 62 new analyses in 10 sections in the Manitoulin, Sudbury, McGregor Bay and French River areas are given. The sections are: 1) Pine Lake; 2) Sheguiandah; 3) Curtin Township; 4) McGregor Point West; 5) McGregor Point East. 6) Frazer Bay Hill; 7) Narrow Bay North; 8) Frazer Bay North; 9) Finn Bay and 10) Alban (see Map B; Location of Sampling Areas).

In sample descriptions the limits pertaining to grain size are those given on p. 36. The thickness of stratigraphic beds is expressed as follows:

thin bedded	:	thickness	5-10 cm	(2- 4 inches)
medium bedded	:	thickness	10-30 cm	(4-12 inches)
thick bedded	:	thickness	30-90 cm	(12-36 inches)
massive bedded	:	thickness	over 90 cm	(over 36 inches)

Partial analyses were carried out by staff of the Mineral Research Branch, Division of Mines, Ministry of Natural Resources. Accuracy of the analyses is considered to be within $\pm 2\%$ although results as a rule are well within these limits. None of the analyses show a total less than 98% which indicates that very little impurities exist besides those oxides analysed. For practical purposes it is justifiable to recalculate the results to a total of 100 which adds 1 or 2 percentage points to most silica analyses.

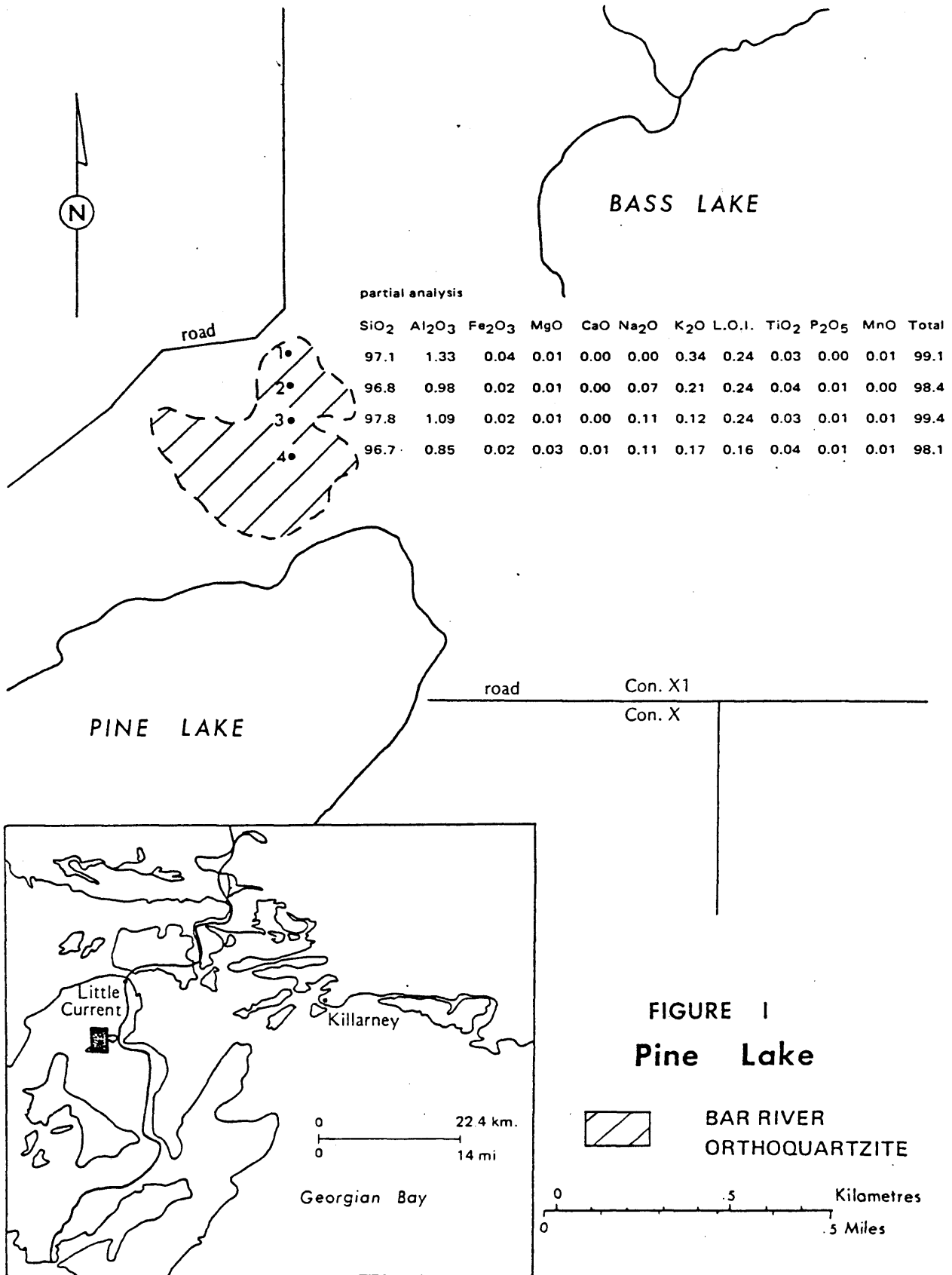


FIGURE I
Pine Lake

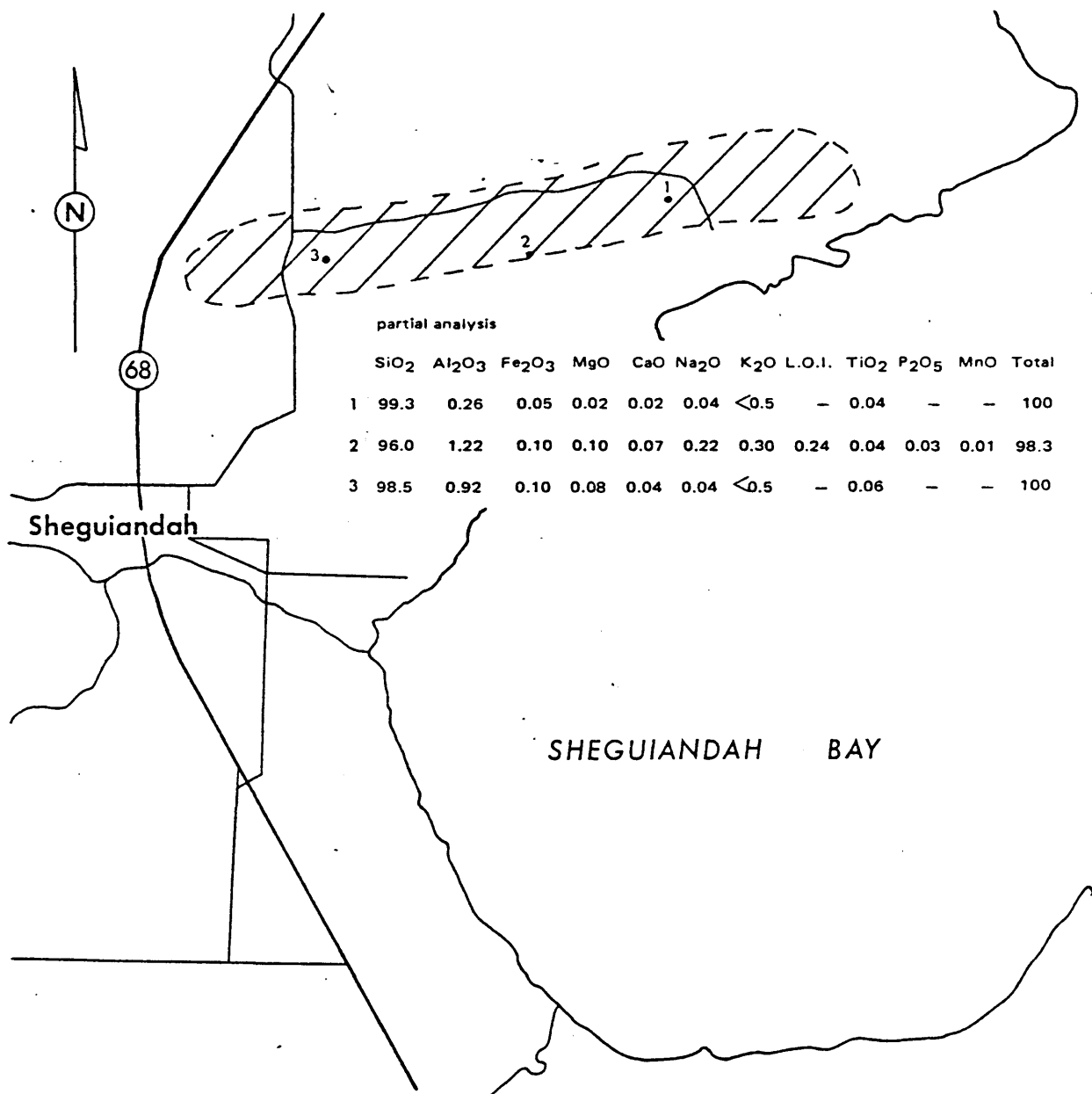
(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

1. Pine Lake

Section occurs in small outcrop of Bar River orthoquartzite surrounded by Ordovician limestone in Lot 4 and 5, Concession XI, Bidwell Township, Manitoulin Island, 4½ km (2 3/4 mi) west of Sheguiandah. Four samples were analysed. Results compare favourably with a single new analysis of a sample taken in the Sheguiandah quarry (Sheguiandah -2).

Description of Samples:

1. Pink and white quartzite
2. Fine grained, white quartzite
3. Pink and white, fine grained quartzite
4. Milky white quartzite



partial analysis

	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	L.O.I.	TiO ₂	P ₂ O ₅	MnO	Total
1	99.3	0.26	0.05	0.02	0.02	0.04	<0.5	-	0.04	-	-	100
2	96.0	1.22	0.10	0.10	0.07	0.22	0.30	0.24	0.04	0.03	0.01	98.3
3	98.5	0.92	0.10	0.08	0.04	0.04	<0.5	-	0.06	-	-	100

SHEGUIANDAH BAY

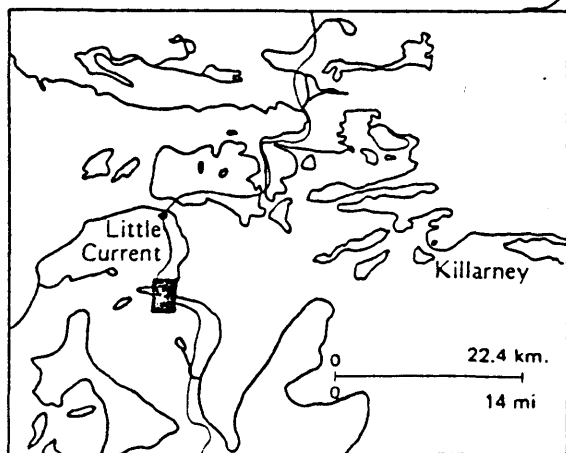
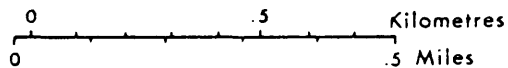


FIGURE 2
Sheguiandah

 BAR RIVER ORTHOQUARTZITE



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

2. Sheguiandah:

In Figure 2 a single new analysis of rock from the Sheguiandah quarry shown for comparison with 2 analyses given by Hewitt (1963,p.14).

Description of Samples

1. Composite chip sample across a 125-foot width in a north-south direction at the east end of the present quarry operation (Hewitt, 1963,p.14, sample 61-3).
2. Quartzite from south side of existing quarry face in central part of quarried area.
3. Composite chip sample taken across a 70-foot width in a north-south direction at the west end of the present quarry (Hewitt, 1963,p.14, sample 61-2).

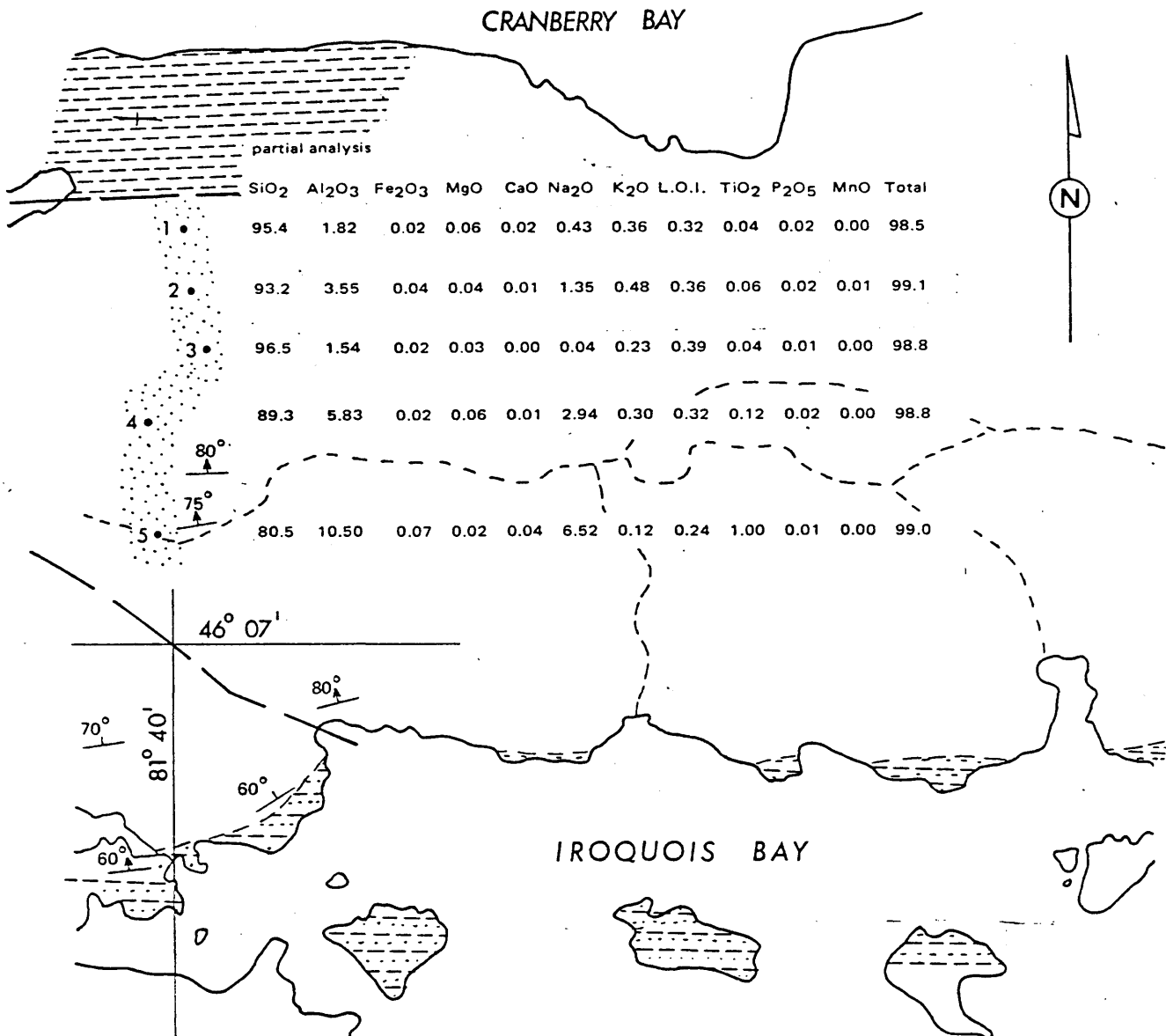
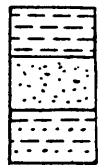
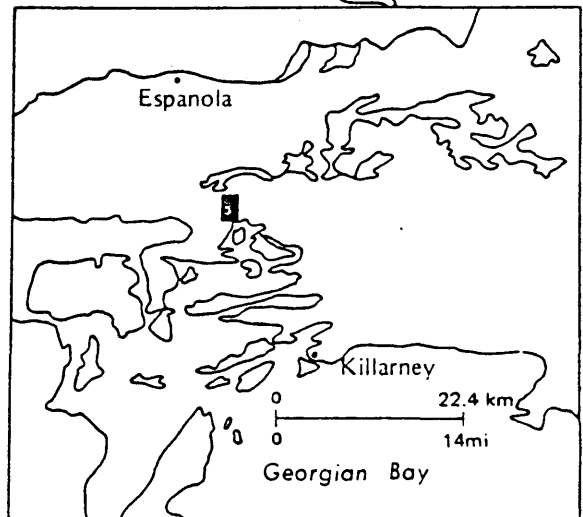
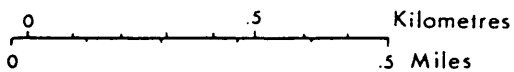


FIGURE 3

Curtin Township



GORDON LAKE FORMATION
 LORRAIN ORTHOQUARTZITE
 GOWGANDA FORMATION



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

3. Curtin Township

Section across east trending ridge of Lorrain quartzite, 5 km (3.2 mi) east of Whitefish Falls. The strike of this formation is east and the dip near-vertical. The analyses indicate a feldspar content in parts of this formation which detracts from the value as a potential silica ore.

Description of Samples

1. White, fine grained quartzite
2. White, fine grained quartzite
3. White, fine grained quartzite; pink quartzite occurs in adjacent outcrop
4. Pink and white quartzite; green quartzite occurs in adjacent outcrop
5. Pink, feldspathic quartzite

Card et al (1977, p. 74) give the following analysis of a fine grained orthoquartzite, Upper Lorrain Formation, Curtin Township:

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	Na ₂ O	K ₂ O	H ₂ O	TiO ₂	P ₂ O ₅	Total	SG
95.96	2.73	0.35	0.26	0.21	0.11	0.03	0.01	99.66	2.72

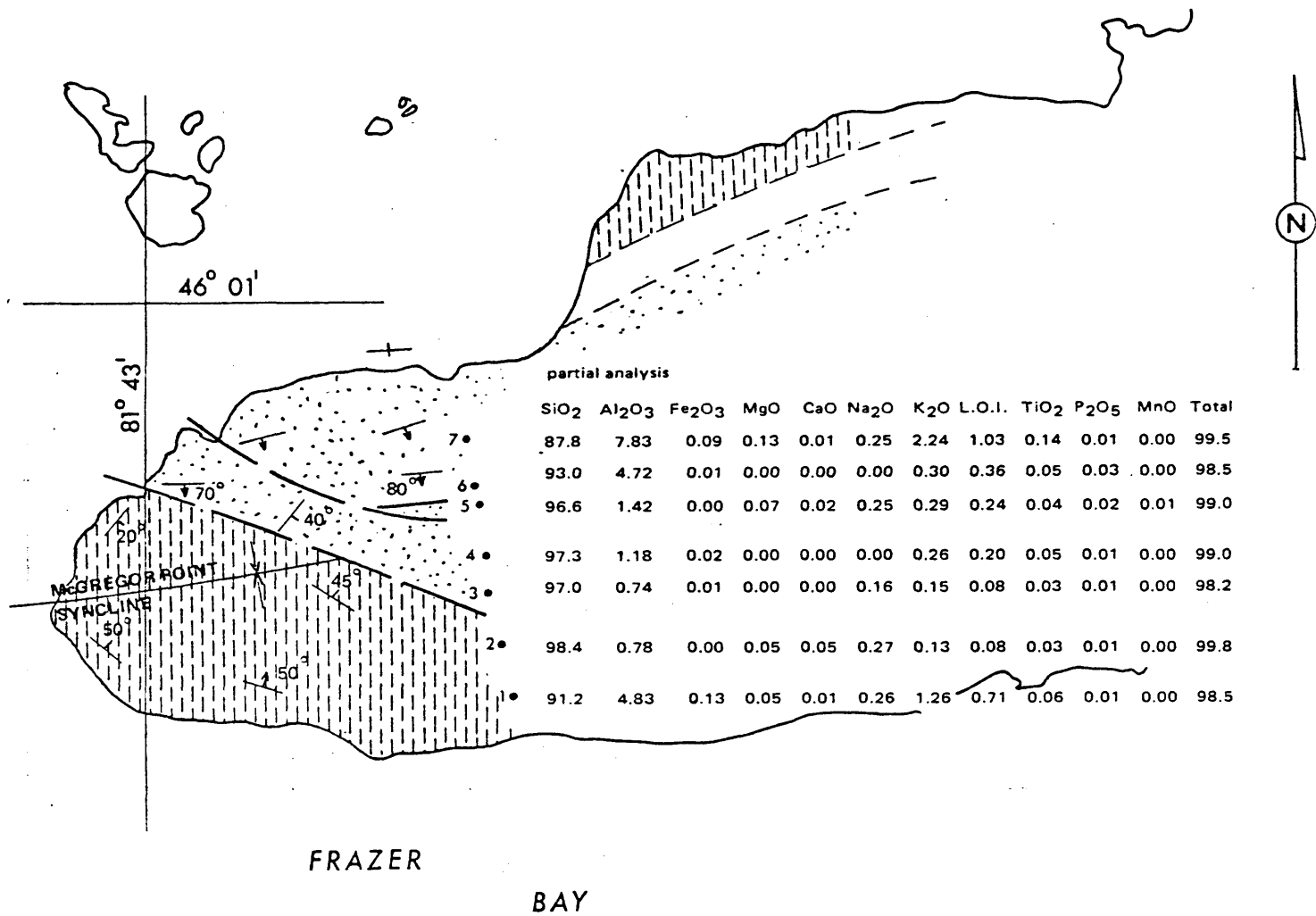
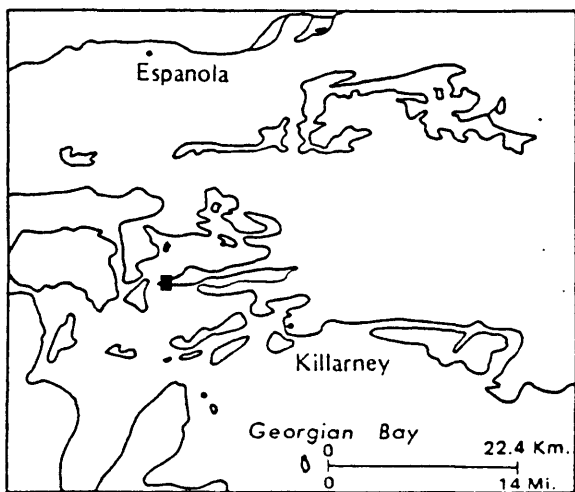


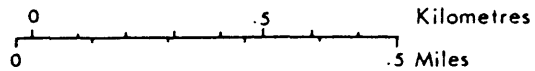


FIGURE 4

Mc Gregor Point West



-  LORRAIN FELDSPATHIC QUARTZITE
-  LORRAIN ORTHOQUARTZITE



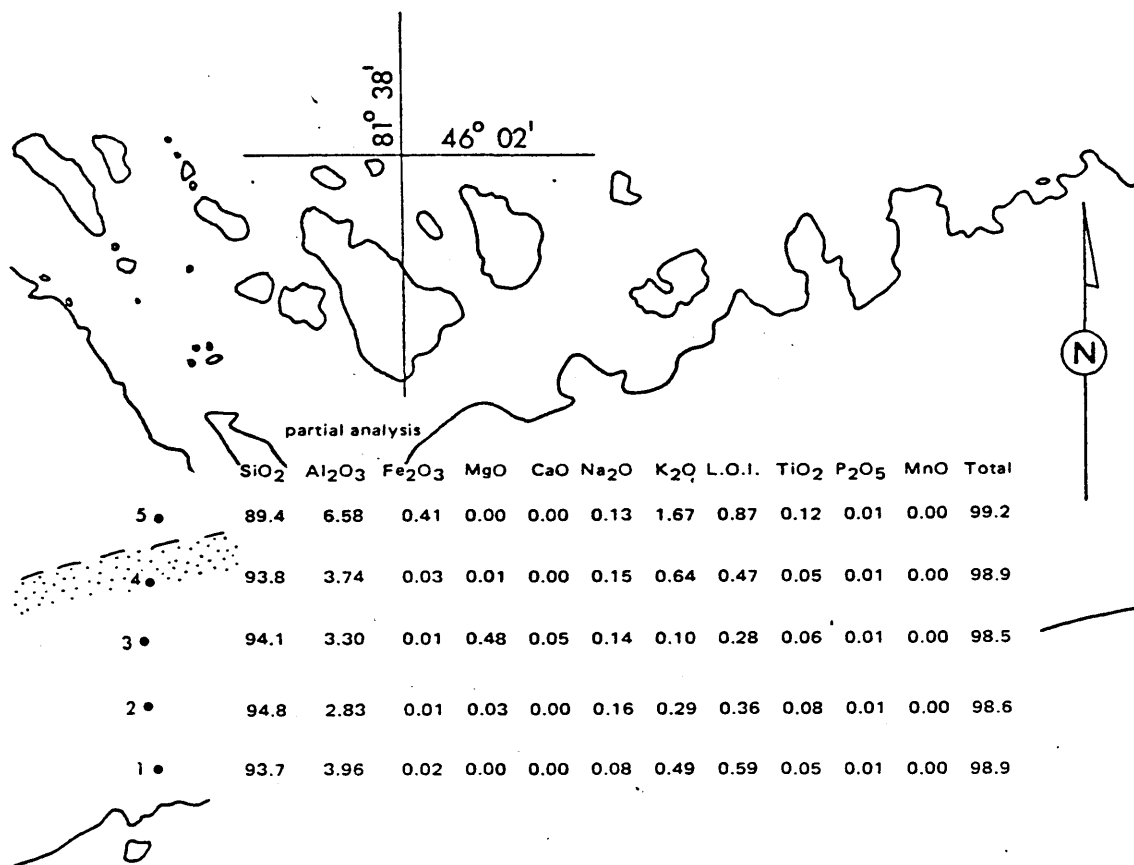
(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

4. McGregor Point West

Section across west part of McGregor Point, 1 km (3/4 mi) east of tip of land. A synclinal structure in the predominantly vertical and east striking Lorrain quartzites is indicated by Card (1976). The rocks belong to the upper part of the Lorrain Formation, the potentially ore forming medium grained to fine grained and cherty orthoquartzites with lenses of quartz and jasper pebble conglomerate. Kyanite is occasionally present (Card, 1976, p.18, Map 2317).

Description of Samples:

1. Light grey, coarse grained, micaceous quartzite; beds medium thick to massive, with red stained joints; predominantly vertical
 2. White, fine grained orthoquartzite; beds medium thick near vertical; sample is representative in section of 76 m (250 ft) of orthoquartzite of unusual whiteness
 3. White, fine grained orthoquartzite; medium bedded; continuous outcrop
 4. White, fine grained orthoquartzite; medium bedded; continuous outcrop; occasionally pink weathering
 5. White fine grained orthoquartzite; medium bedded; continuous outcrop
 6. White, translucent, medium to coarse grained orthoquartzite; massive appearance
 7. White, medium grained quartzite, thin bedded
-



NARROW BAY

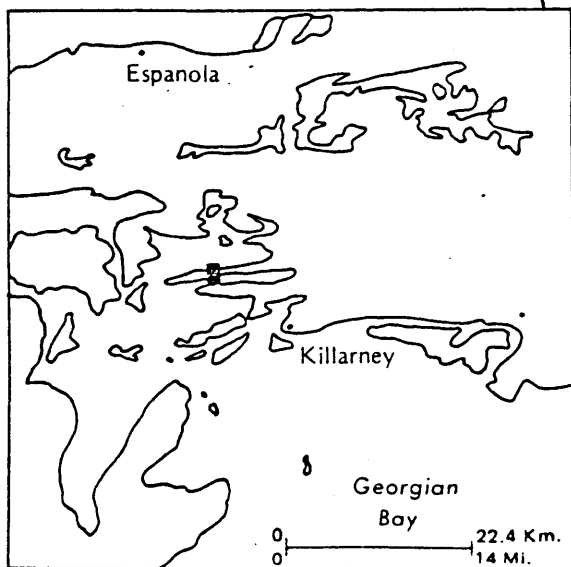
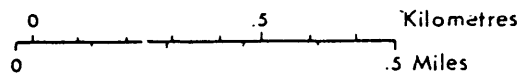


FIGURE 5
McGregor Point East



LORRAIN
ORTHOQUARTZITE



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

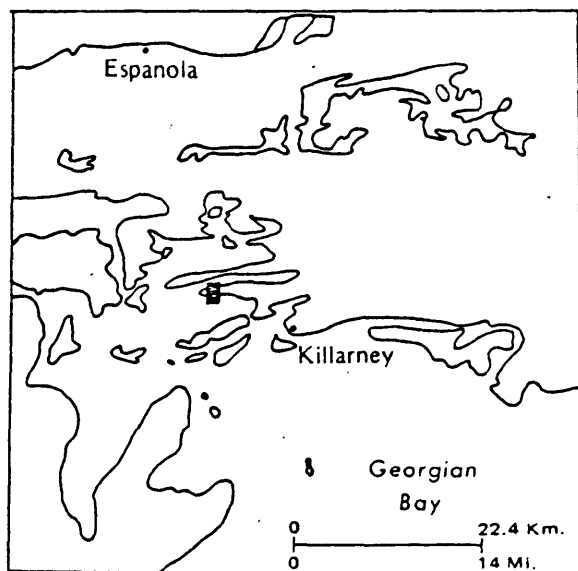
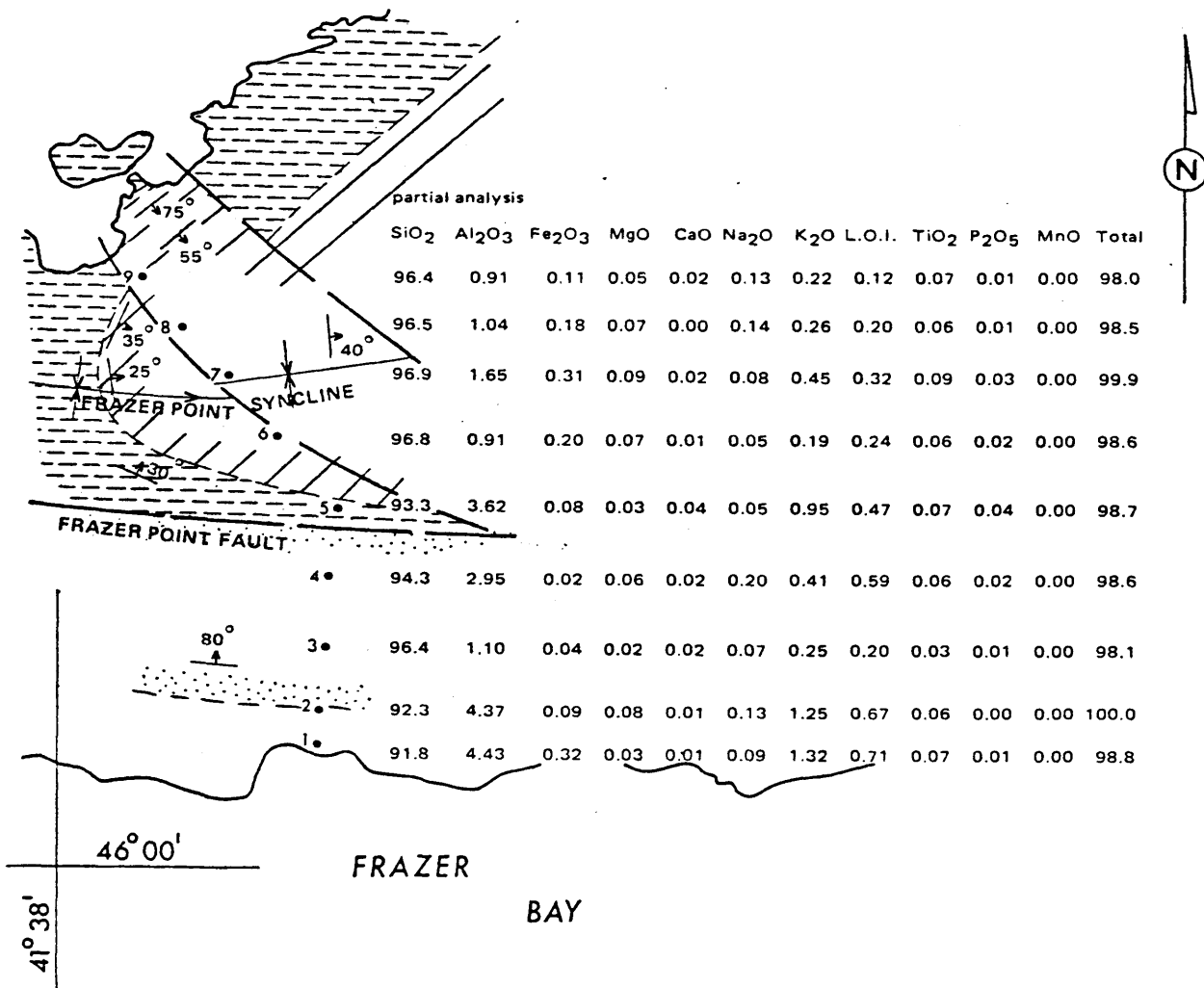
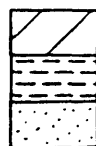
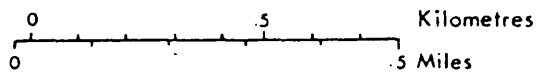


FIGURE 6
Frazer Bay Hill



BAR RIVER ORTHOQUARTZITE
GORDON LAKE FORMATION
LORRAIN ORTHOQUARTZITE



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

5. McGregor Point East

Section across the McGregor Point orthoquartzite ridge, 6¼ km (4 mi) east north east of tip of land. The rocks in this section are predominantly medium grained orthoquartzites occurring below the top of the Lorrain Formation. They are more aluminous than the overlying fine grained orthoquartzites. Dashed line indicates contact with impure Middle Lorrain quartzites.

Description of Samples:

1. White, medium grained orthoquartzite; occasionally pink weathering
2. White and pink, medium to coarse grained orthoquartzite; continuous outcrop
3. Pink, medium grained orthoquartzite; continuous outcrop of white and pink quartzite
4. White, medium grained orthoquartzite
5. Light grey, medium to coarse grained quartzite; occasionally conglomeratic, cross bedded

6. Frazer Bay Hill

Section across Frazer Point, 3.6 km (2¼ mi) east of western tip of land. Sampled rocks include medium to fine grained Upper Lorrain orthoquartzite (analyses 2,3,4) and fine grained Bar River orthoquartzites forming respectively the south limb and center of the McGregor Point syncline in this area. The Bar River orthoquartzite is locally richer in iron and less aluminous than the Lorrain orthoquartzite.

Description of Samples:

- 1 White and pink, coarse grained, translucent quartzite
2. White and minor pink, medium grained quartzite; between 1 and 2 occasional 1/3- to 2/3-m (1-2 foot) bed of argillite
3. White and pink, fine grained quartzite; fractured and jointed; infrequent outcrops
4. White, medium to fine grained quartzite; sparse outcrops
5. White, fine grained quartzite; adjacent to (north of) fault dipping 60°-70° North
6. White and pink, fine grained quartzite; infrequent outcrops
7. White and pink, fine grained quartzite; sparse outcrops
8. White and pink, fine grained quartzite
9. White, fine grained quartzite

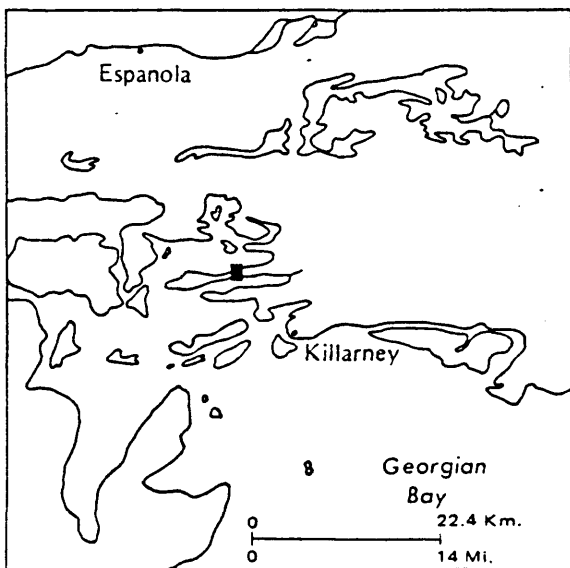
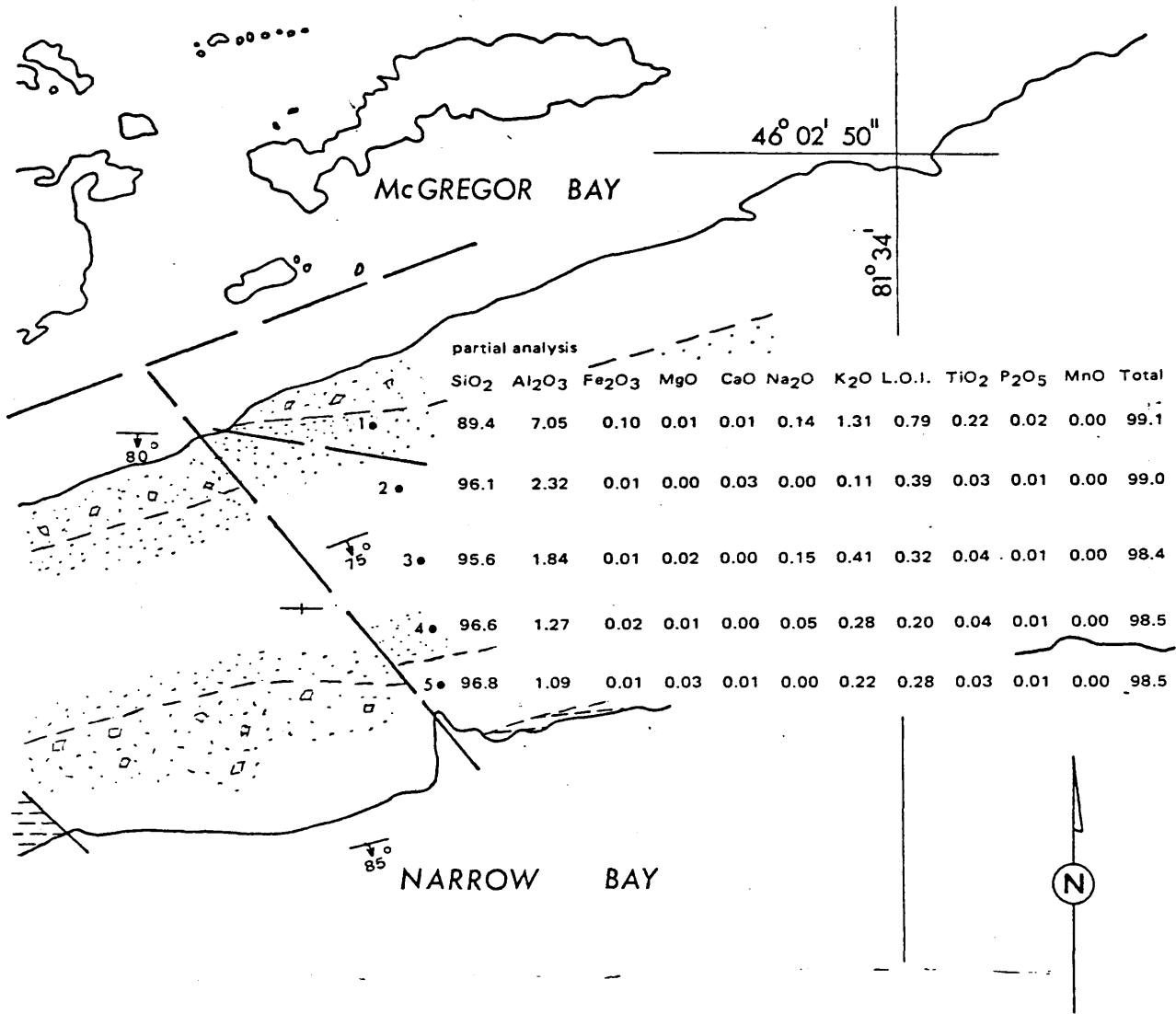


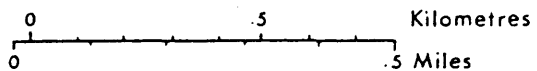


FIGURE 7

Narrow Bay North

-  GORDON LAKE SILTSTONE
-  LORRAIN ORTHOQUARTZITE
- CHERTY QUARTZITE



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

7. Narrow Bay North

Section across the McGregor Point orthoquartzite ridge, 10.8 km (6 3/4 mi) east north east of tip of land, north of Narrow Bay. The ridge is a continuation of the medium to coarse grained orthoquartzites occurring below the top of the Lorrain Formation that were intersected in the McGregor Point West and McGregor Point East sections. They are part of the north limb of the McGregor Point Syncline. The analyses show a lateral variation with diminishing alumina content going eastward.

Description of Samples:

1. White, coarse grained, semi-translucent quartzite;
medium bedded to massive
2. White, medium grained, translucent quartzite
3. White and pink, medium to coarse grained quartzite;
medium bedded to massive
4. White and minor pink, medium grained quartzite;
medium bedded to massive
5. White and pink, fine grained quartzite; medium
bedded to massive

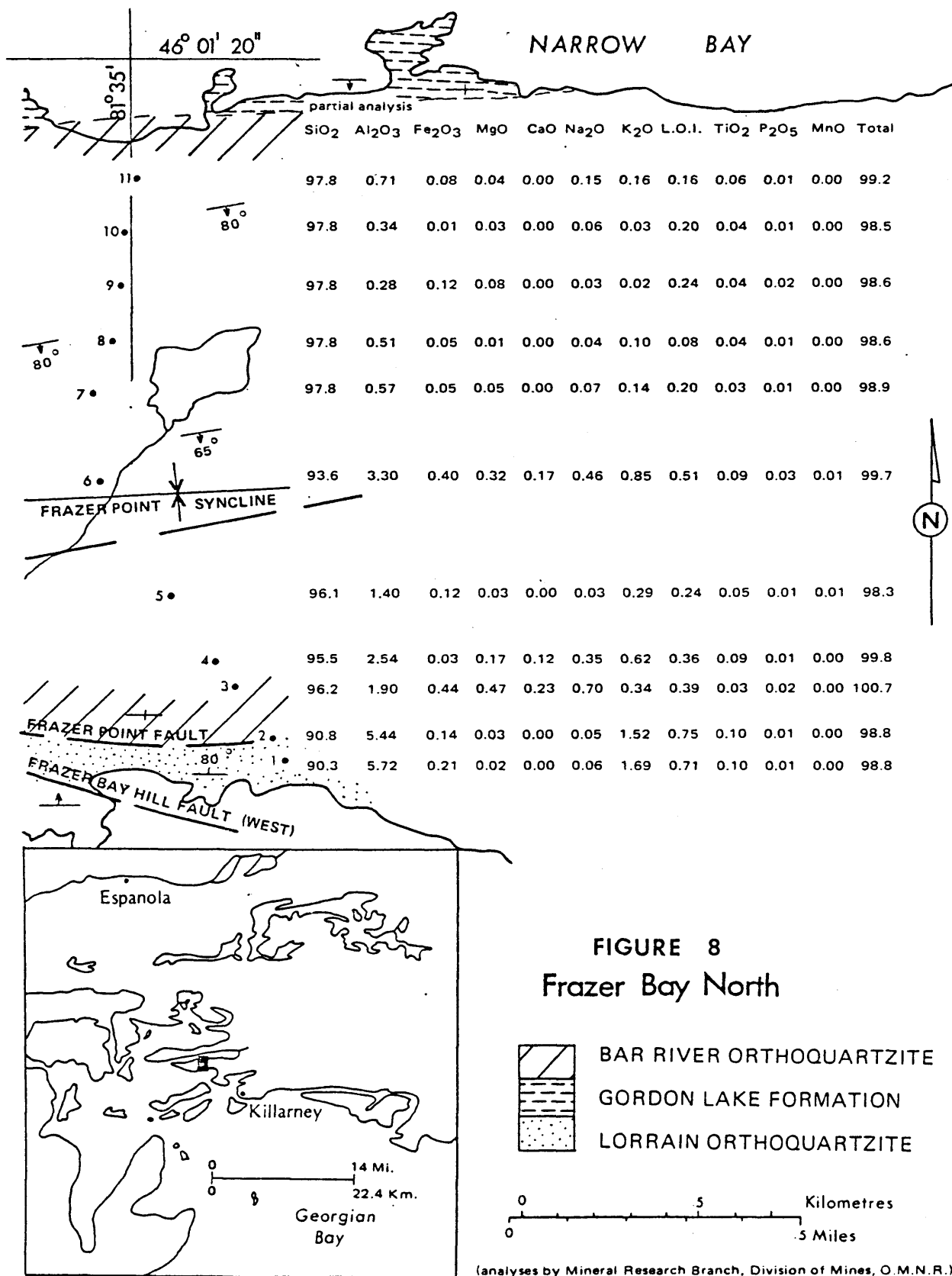


FIGURE 8
Frazer Bay North

BAR RIVER ORTHOQUARTZITE
 GORDON LAKE FORMATION
 LORRAIN ORTHOQUARTZITE

(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

8. Frazer Bay North

Section across quartzite ridge 6.9 km (4.3m) east of tip of Frazer point. The Frazer Point Fault brings Lorrain quartzite (samples 1 and 2) in contact with Bar River orthoquartzite. Samples 3 to 11 represent Bar River orthoquartzite of both the south limb (3 to 5) and the north limb (6-11) of the Frazer Point Syncline. In this section there is a higher frequency of argillaceous material interbedded with the orthoquartzites than in the lower part of the Bar River Formation in the Fraser Bay Hill section (see Figure 6). The iron content of orthoquartzites is lower in the Frazer Bay North section.

Description of Samples

1. Translucent, coarse grained, buff weathering quartzite
2. White, semi-translucent, medium grained quartzite; medium bedded; sericitic on bedding planes
3. White, bluish white and pink, fine grained quartzite
4. White, semi-translucent, fine to medium grained quartzite, massive
5. Pink, fine grained quartzite
6. White quartzite; pink, purple and blue quartzites and argillite are common between locations 5 and 6
7. White, fine grained quartzite; thick bedded to massive
8. White, fine grained quartzite; thick bedded to massive; minor pink and blue quartzite in adjacent outcrops
9. White, fine grained quartzite; thick bedded to massive
10. White, fine grained quartzite; thick bedded to massive; occasional pink quartzite in adjacent outcrops
11. White, fine grained quartzite; argillite in adjacent outcrops

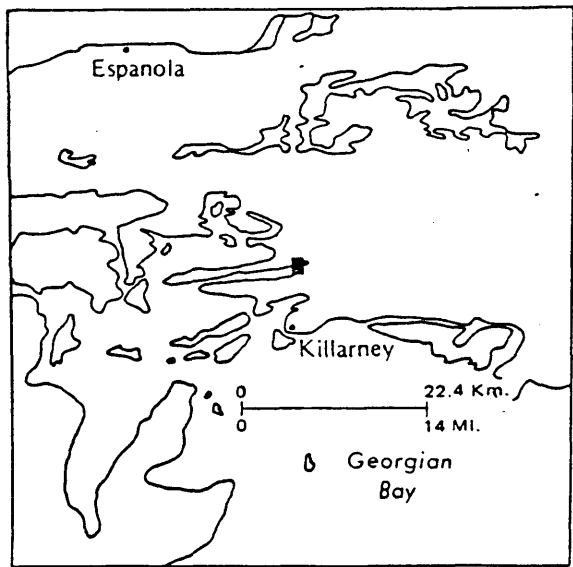
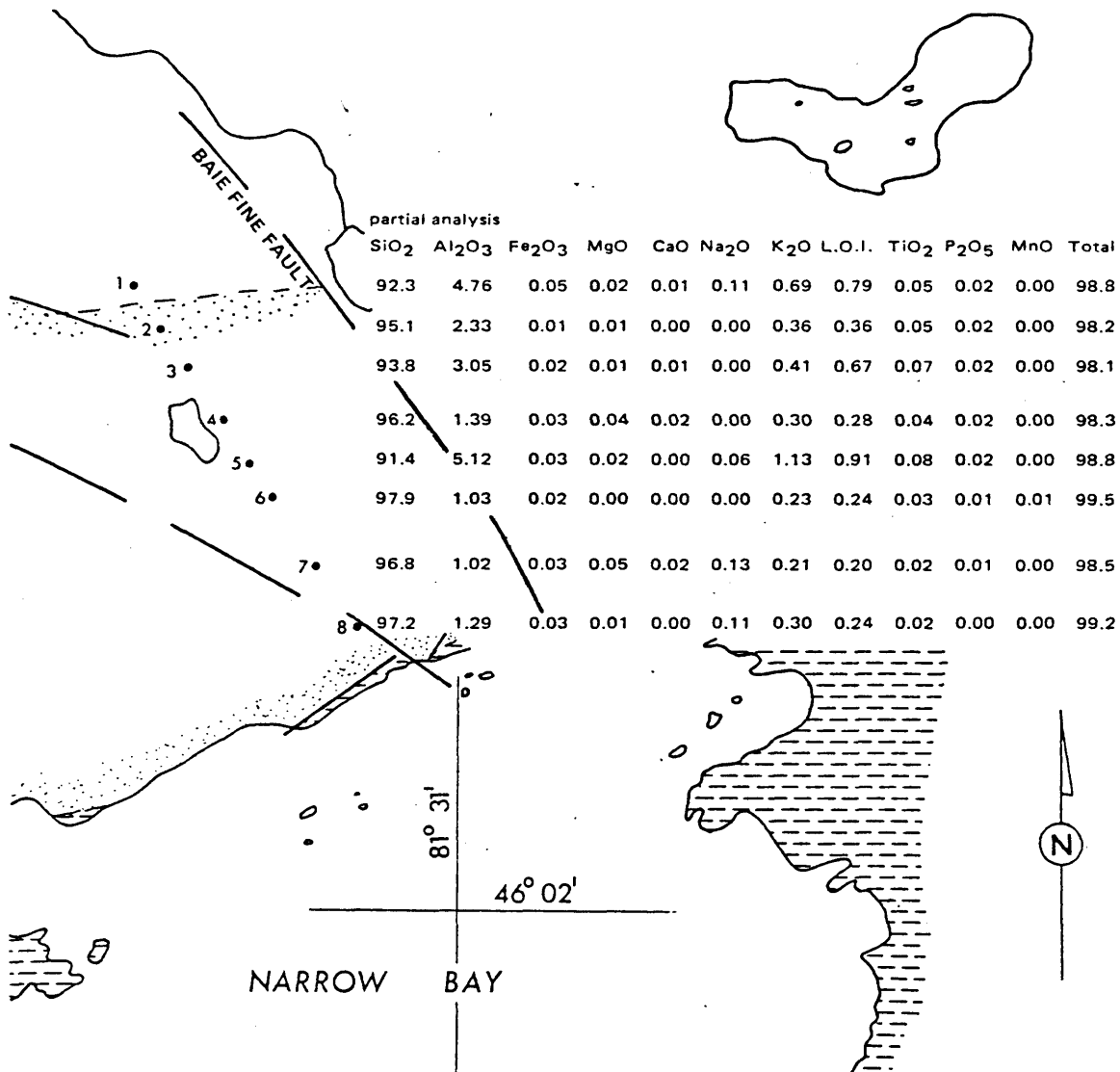
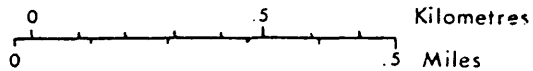
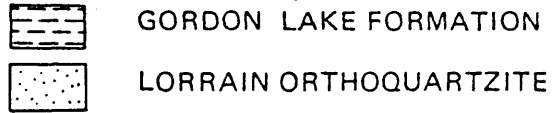


FIGURE 9

Finn Bay



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

9. Finn Bay

Section across ridge of Lorrain orthoquartzite north of Narrow Bay, 0.4 km ($\frac{1}{4}$ mi) west of Baie Fine fault, near entrance of Finn Bay. Analyses indicate that the medium grained orthoquartzites here have a variable alumina content consistent with a trend of diminishing alumina content in eastward direction as noted in section 7 (Narrow Bay) in the upper part only. Kyanite is common in this area.

Description of Samples:

1. Light grey, medium to coarse grained quartzite; irregularly jointed
2. Light grey, medium grained quartzite; pink quartzite in adjacent outcrop
3. Light grey, medium to coarse grained quartzite, semi-translucent
4. Light grey, medium grained quartzite; yellowish grey weathering
5. Light greyish-white, fine grained quartzite; pink quartzite in adjacent outcrop
6. White, medium grained quartzite; pink and occasionally green quartzite in adjacent outcrops
7. White, occasionally pink, medium grained quartzite occasionally sericitic
8. White, occasionally pink quartzite; sparse outcrops

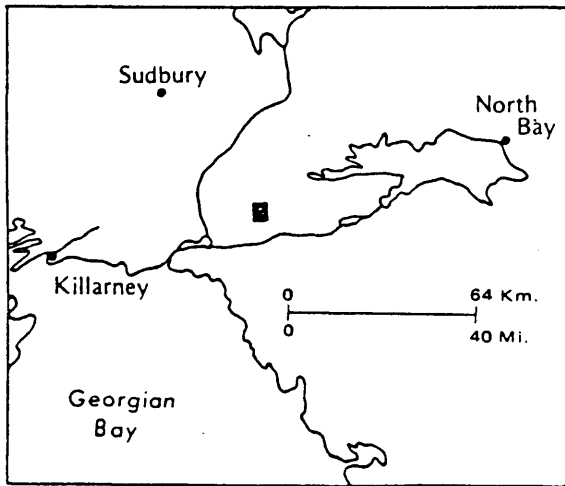
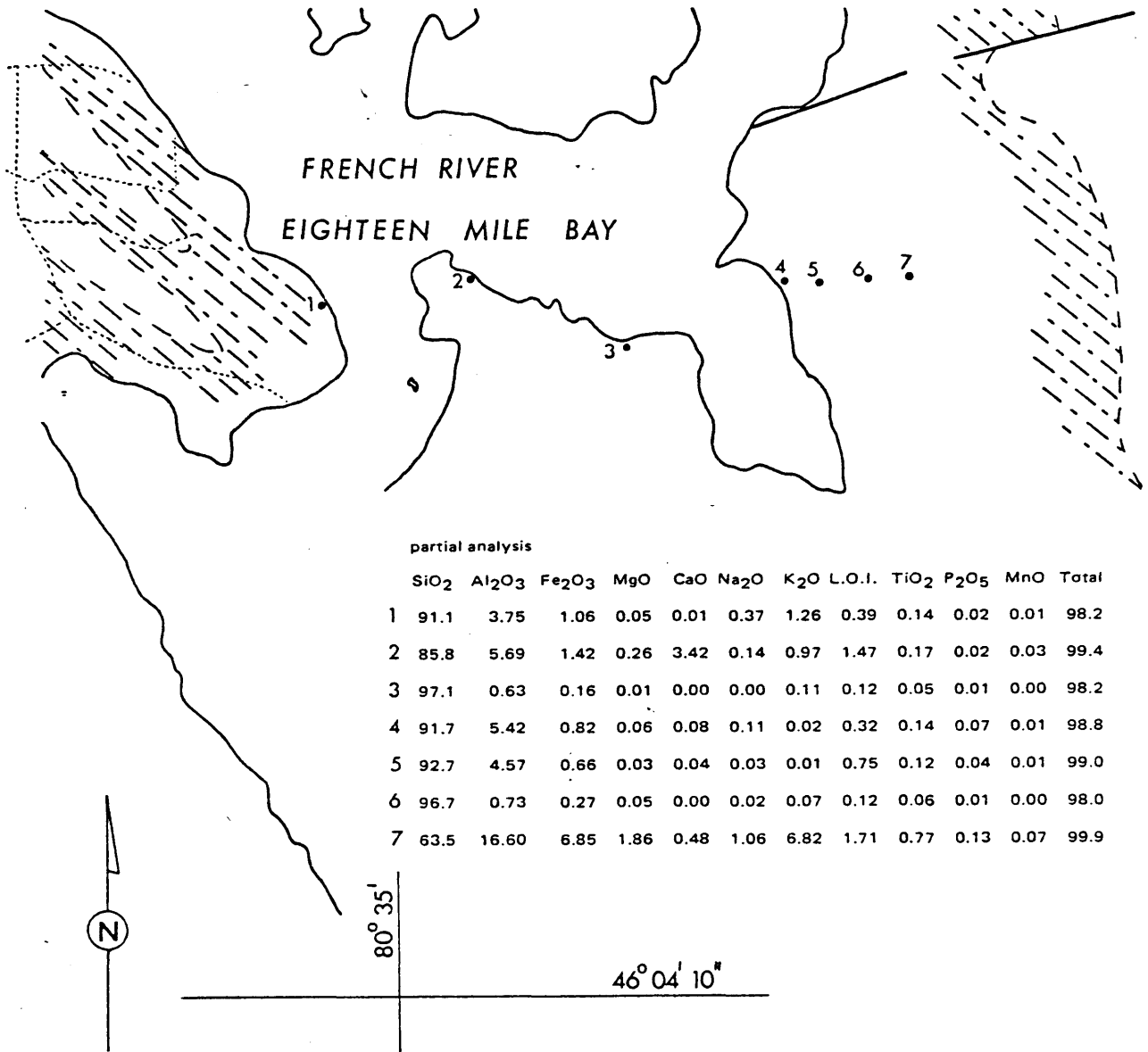
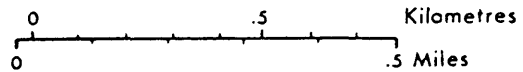


FIGURE 10

Alban



GRENVILLE
ORTHOQUARTZITE



(analyses by Mineral Research Branch, Division of Mines, O.M.N.R.)

10. Alban

Section of shoreline samples across Eighteen Mile Bay, on boundary of Bigwood and Mason Townships, 4 km (2½ mi) south east of Alban. The quartzites in this section are part of the quartzite formation exposed in Cosby and Delamere Townships correlated with "Lorrain" (Lorrain or Bar River) quartzite (Hewitt, 1963,p.14). They are generally less pure and only two analyses (3 and 6) are comparable with those given by Hewitt (op. cit.). There is no recorded production of quartzite from this area although test shipments have been made (Hewitt, op. cit.)..

Description of Samples:

1. Pink, medium grained quartzite
2. Grey, fine-grained and pink, coarse grained muscovite-quartzite beds alternating in outcrop
3. Very light grey, coarse grained, translucent quartzite; some muscovite and light brown biotite
4. Pinkish grey, medium grained quartzite
5. Pink, coarse grained micaceous quartzite
6. White and pink, coarse grained translucent quartzite; minor white mica
7. Medium grey quartzite

Paleozoic Sandstones

Pittsburgh Township Quarry, Canada Cement Lafarge Limited.

In conjunction with construction of a cement plant at Bath, 22 km (14 mi) west of Kingston, Ontario, Canada Cement Lafarge Limited in 1973 opened and temporarily operated a silica quarry ^{in Potsdam Sandstone} on a property 20 km (12.5 mi) east of Kingston ^{and} north of Highway 2. The property includes lots 30, 31 and part of ^{Lot} 32, Concession III, Pittsburgh Township, Frontenac County. Stone was trucked to the cement plant via Highway 401. Recently this source of silica has been abandoned in favour of an unconsolidated sand produced from a pit 5 km (3 m) north of Verona on Highway 38. The property in Pittsburgh Township is underlain by Potsdam Sandstone previously quarried locally by Kingston Silica Corporation (Hewitt, 1963, p.18). The east face of the new quarry, on Lot 31, Concession III, is shown in figure 12 and described in (12):

(12) Quarry Section, Canada Cement Lafarge Quarry,
Pittsburgh Township

- 2.6 m - sandstone, grey, medium to fine grained, thick to medium bedded; buff and rusty weathering beds alternating; colour of rusty weathering beds ranges from grey to purple
- 2.1 m - sandstone, grey, fine grained, medium bedded, buff grey weathering, carbon rich zones at 73 cm from bottom (6 cm) and at top (15 cm); pebbles at 1.1 m from bottom (red and white sandstone pebbles up to 2 cm in diameter; quartz pebbles and angular quartz grains $< \frac{1}{2}$ cm in diameter);
- 1.5 m - sandstone, bluish grey, fine grained, thick bedded; rare pebbles up to $\frac{1}{2}$ cm in diameter in upper $\frac{1}{2}$ m;
- 1.5 m - rubble; floor of quarry

POTSDAM SANDSTONE

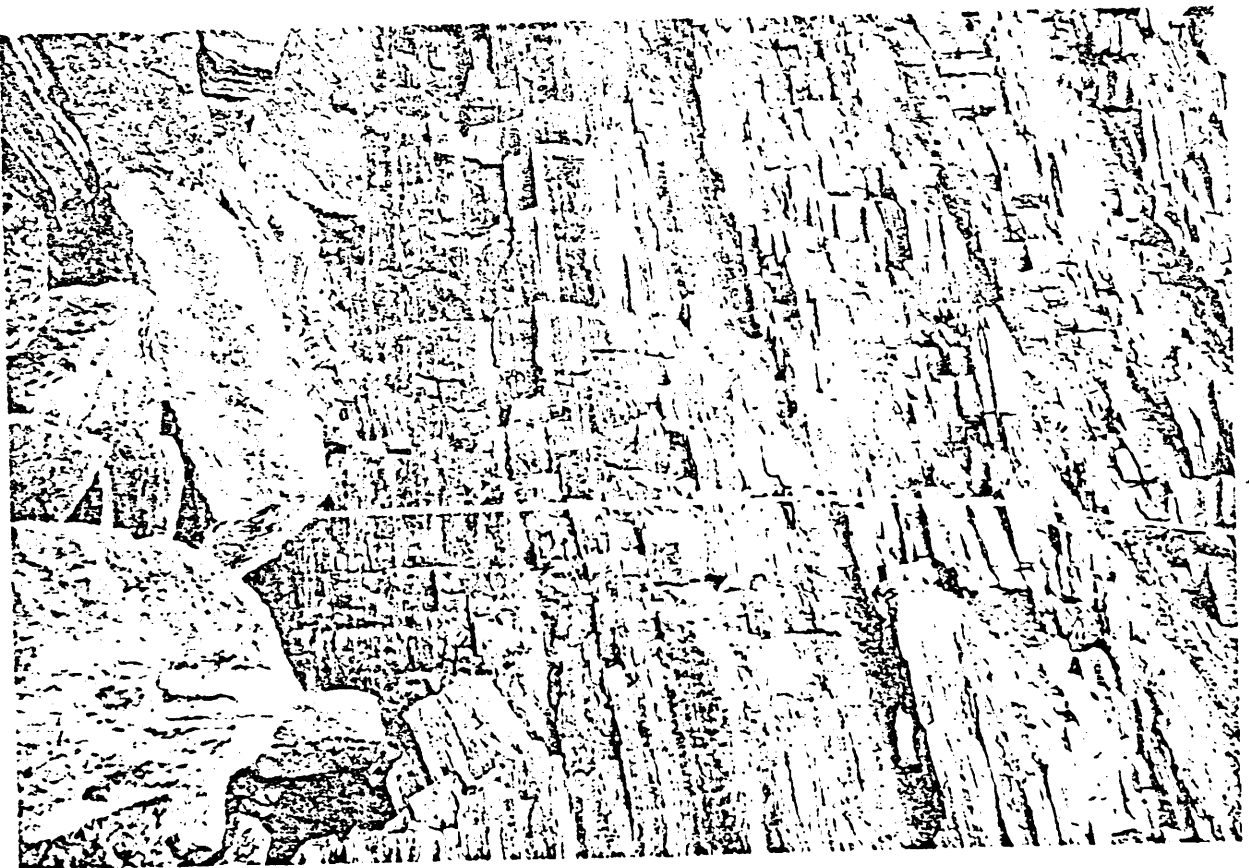
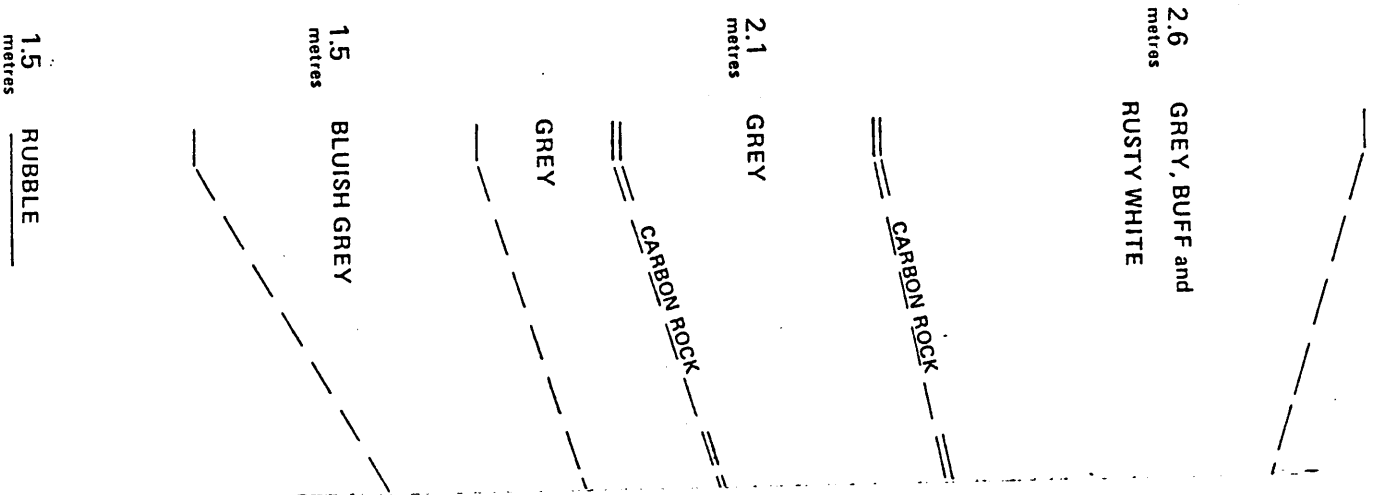
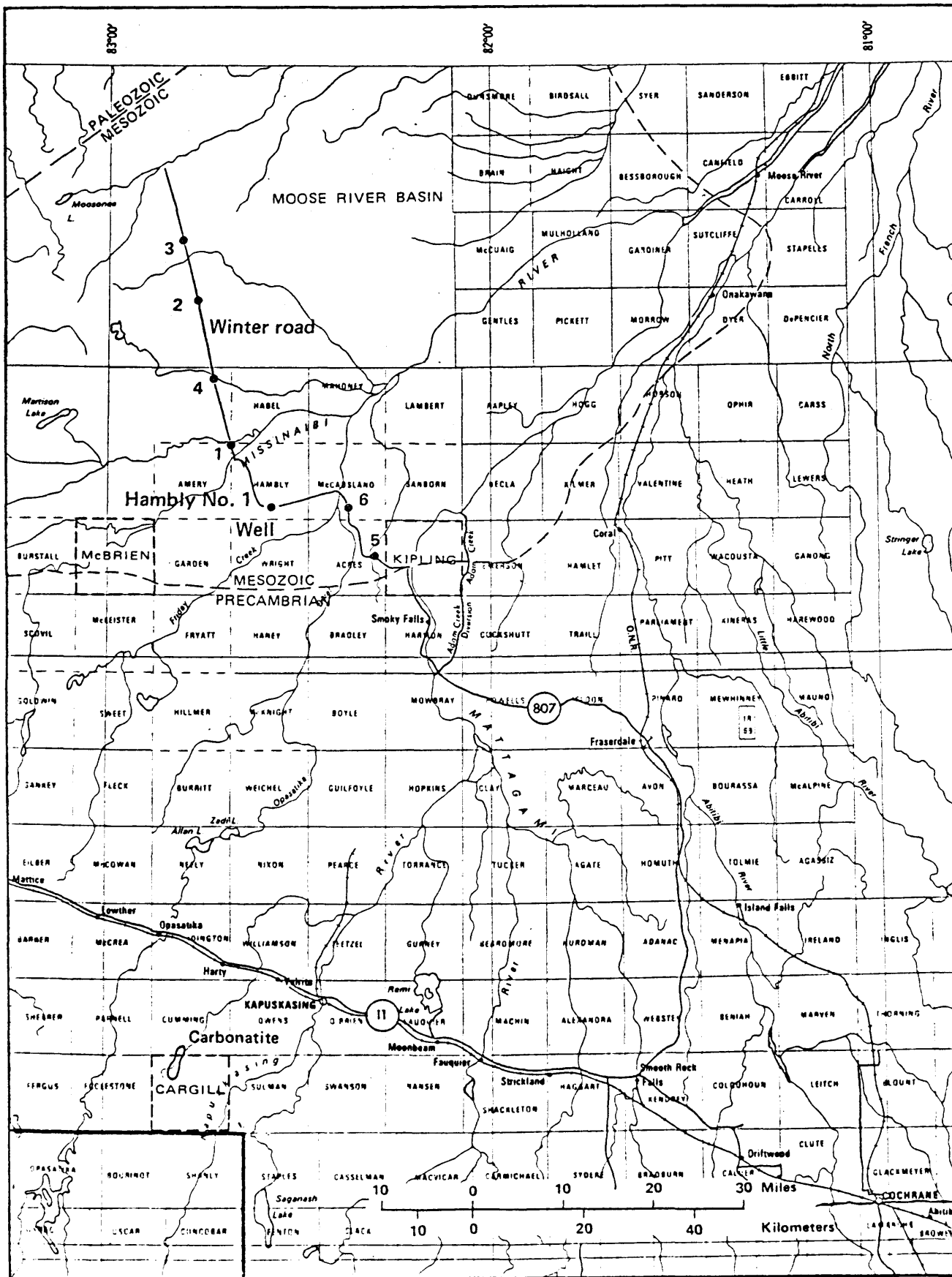


FIGURE 12

SECTION

CANADA CEMENT LAFARGE QUARRY, PITTSBURGH TOWNSHIP



MAP C SILICA SAND DEPOSIT AND DRILL LOCATIONS, NORTHERN ONTARIO

Cretaceous Sands, James Bay Lowland

McBrien Township* Deposit, Algocen Mines Limited

Algocen Mines Limited, Sault Ste. Marie

Mining Lease No. 102884

Area: 6,395.25 acres (2,590.25 ha)

Location: Northeast part of McBrien Township (see
Figure 13

Minerals: Silica sand-kaolin, fireclay

The property was acquired by Algoma Central and Hudson Bay Railway in 1965 as part of the area covered under Exploratory Licence of Occupation No. 13,788. Licence rights were taken over in 1967 by Algocen Mines Limited, a subsidiary company. The latter company obtained mining rights to approximately 1/10th of the explored area, or 6,395.25 acres (2,590 ha) in June, 1972.

Drilling and Sampling

Drilling and sampling of deposits on the property was completed by Algocen Mines Limited in 1970. A total of 78 auger holes to an average depth of 35 m (115 ft) has been drilled on No 1. deposit and another 4 holes to an average depth 32 1/3 m (106 ft) on No. 2 deposit. A total of 21 trenches and test pits plus surface samples provided approximately 350 tons of material for testing.

* Location see Map C

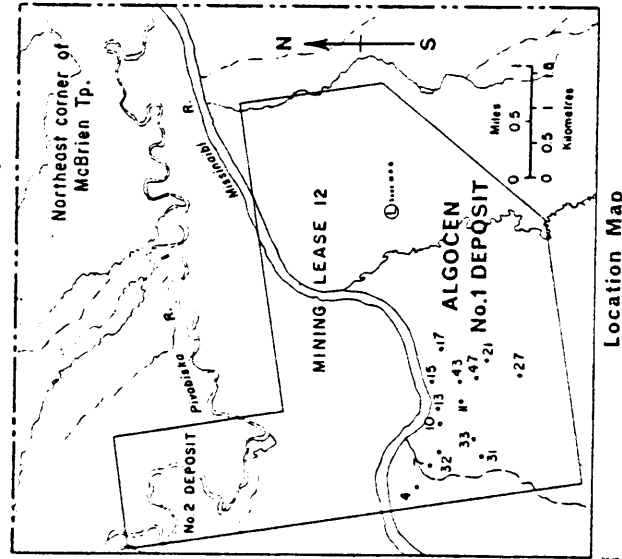
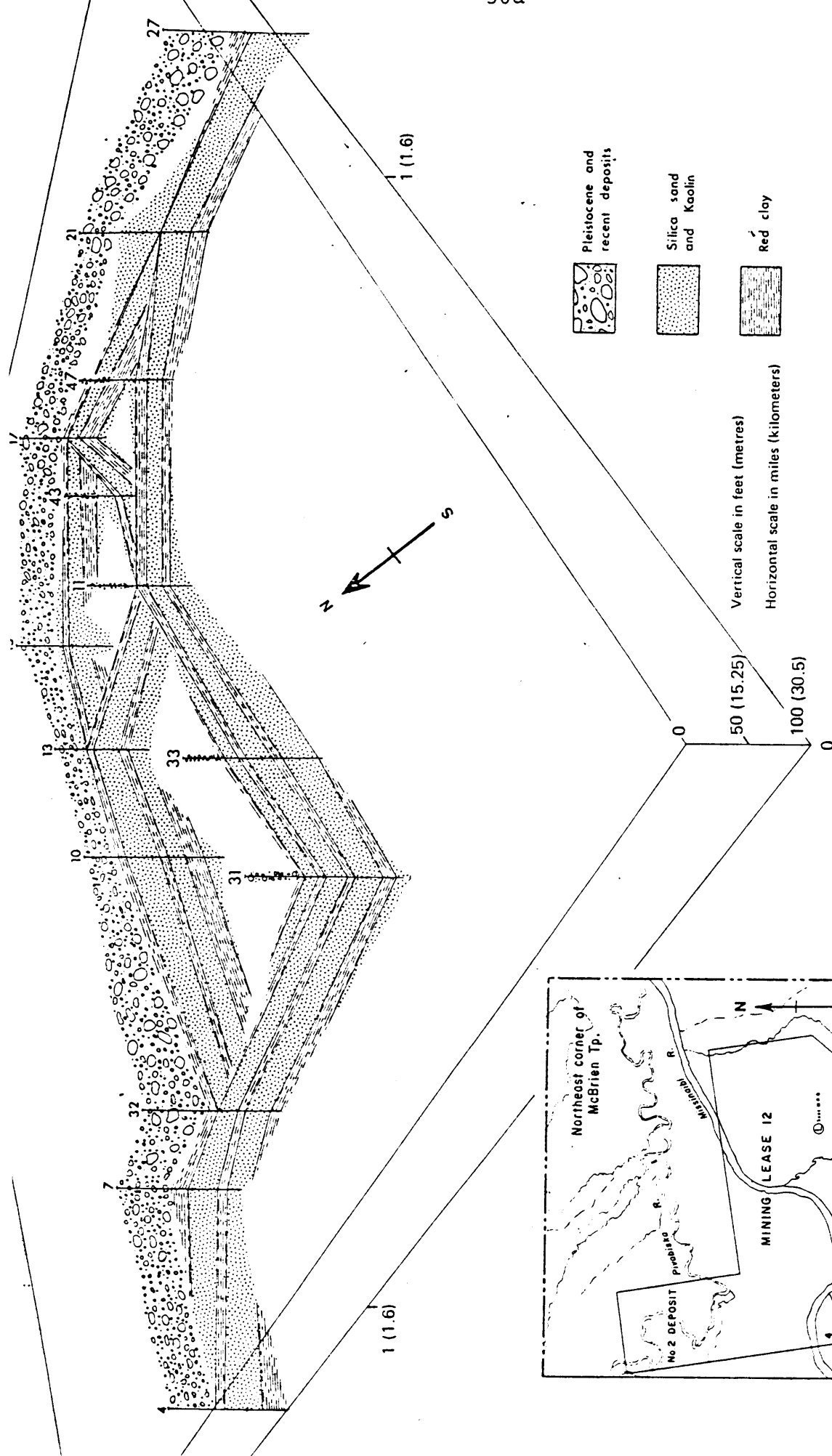


Figure 13
 Alгоцен No.1 Deposit
 McBrien Township James Bay Lowland

Geology

Results of testing have indicated the presence of glass sand and filler grade kaolin clay (paper, plastics, rubber). The material occurs in two deposits. No. 1 deposit lies adjacent to and south of the Missinaibi River. No. 2 deposit is located approximately 2 miles (3 km) northwest of the No. 1 deposit, adjacent to the Pivabiska River. The deposits in all likelihood are connected at depth. The horizontal attitude of silica sand and kaolin clay beds in No. 1 deposit is shown in the accompanying fence diagram (Figure 13). None of the holes drilled reached Paleozoic bedrock.

Analysis of some samples of silica sand-kaolin from McBrien Township, James Bay Lowlands were published by Smith and Murthy (1970, p.807). Out of 21 samples 56.2 percent of the material is in the size range (-20+140 mesh) of commercial glass sand. In this range sizes are distributed as follows:

<u>Size</u>	<u>Percentage</u>
+20 mesh	0.8
-20 + 35	3.4
-35 + 45	5.9
-45 + 60	27.5
-60 + 80	41.2
-80 +100	13.2
-100+120	5.5
-120+140	1.2
-140	1.3

With magnetic beneficiation it was possible to reduce the iron content to a range of 0.01 - 0.015 percent and an analysis of beneficiated sand (Smith and Murthy 1970,p.808)

is represented below:

SiO ₂	99.73%
Al ₂ O ₃	0.10
CaO ₂	0.03
MgO	0.009
TiO ₂	0.013
ZrO ₂	<u>0.009</u>
Total	99.89%

Reserves

Estimated tonnage	:	200 million
Reserves of glass sand:		2/3 x 200 million=134 million tons
Reserves of kaolin clay:		1/6 x 200 million= 33 million tons
Tailings (waste rock)	:	1/6 x 200 million= <u>33 million tons</u>
		Total 200 million tons

Kipling Township*drilling, Indusmin Limited

In 1970 an area in Kipling Township 3 km north of the Precambrian Escarpment and 1.5 km west of the Mattagami River was drilled by Indusmin Limited. Information in the Assessment Files**shows that the area is approximately 1.5 km² and is centred on the location of a previous borehole showing silica sand-kaolin deposits within 18.3 m (60 ft) from the surface. Ten vertical holes (total depth 516 m) were drilled, nine in the described area and one 0.8 km (½ mi) to the south. Silica sand, kaolin and fireclay were encountered from a depth of 18 m (60 ft) in one hole to the bottom of the deepest hole at 61 m (202 ft). The average intersection contains:

overburden	27.6 m (90.5 ft)
fireclay	3.2 m (10.5 ft)
silica sand-kaolin	<u>20.8 m (68.2 ft)</u>
average depth of holes:	51.6 m (169.2ft)

None of these holes reached the base of the deposits which, on the basis of seismic refraction work (OFR5148, Pt.II), is postulated to occur at a depth of approximately 183 m (600 ft) at a point 6 km west of here. The drill program was undertaken to investigate the potential for kaolin production. The company has since relinquished its claims on the property.

* Location see Map C.

** File 83.1-77, Assessment Files, Ministry of Natural Resources

Moose River Basin Studies

The Moose River Basin is a sedimentary basin in the Hudson Bay area of the Precambrian Shield (see Map A). Lying to the south of the larger Hudson Bay Basin and southwest of James Bay, it is truncated to the south by the east trending Precambrian Escarpment.

Mesozoic deposits in this basin are confined between latitudes $50^{\circ}07'$ to $51^{\circ}20'$ and between longitudes $81^{\circ}15'$ to $83^{\circ}45'$, underlying an area of approximately 5,000 square miles ($13,000 \text{ km}^2$) within these boundaries.

Lignite bearing Mesozoic sediments have been known to exist in the Moose River Basin for over 50 years. Keele (1920) designated them as the Mattagami series followed by Dyer (1928) who referred to these unindurated Mesozoic beds as the Mattagami Formation. A description of macro-plant remains suggesting a Cretaceous or possibly Late Jurassic age for the unit was published by Bell (1928). Using palynological data, Norris et al. (1976) established a late Middle or Late Albian (Lower Cretaceous) age for the upper part of the Mattagami Formation in Kipling Township.

In 1975 a program of drilling and geophysical studies of the basin was commissioned by the Ontario Division

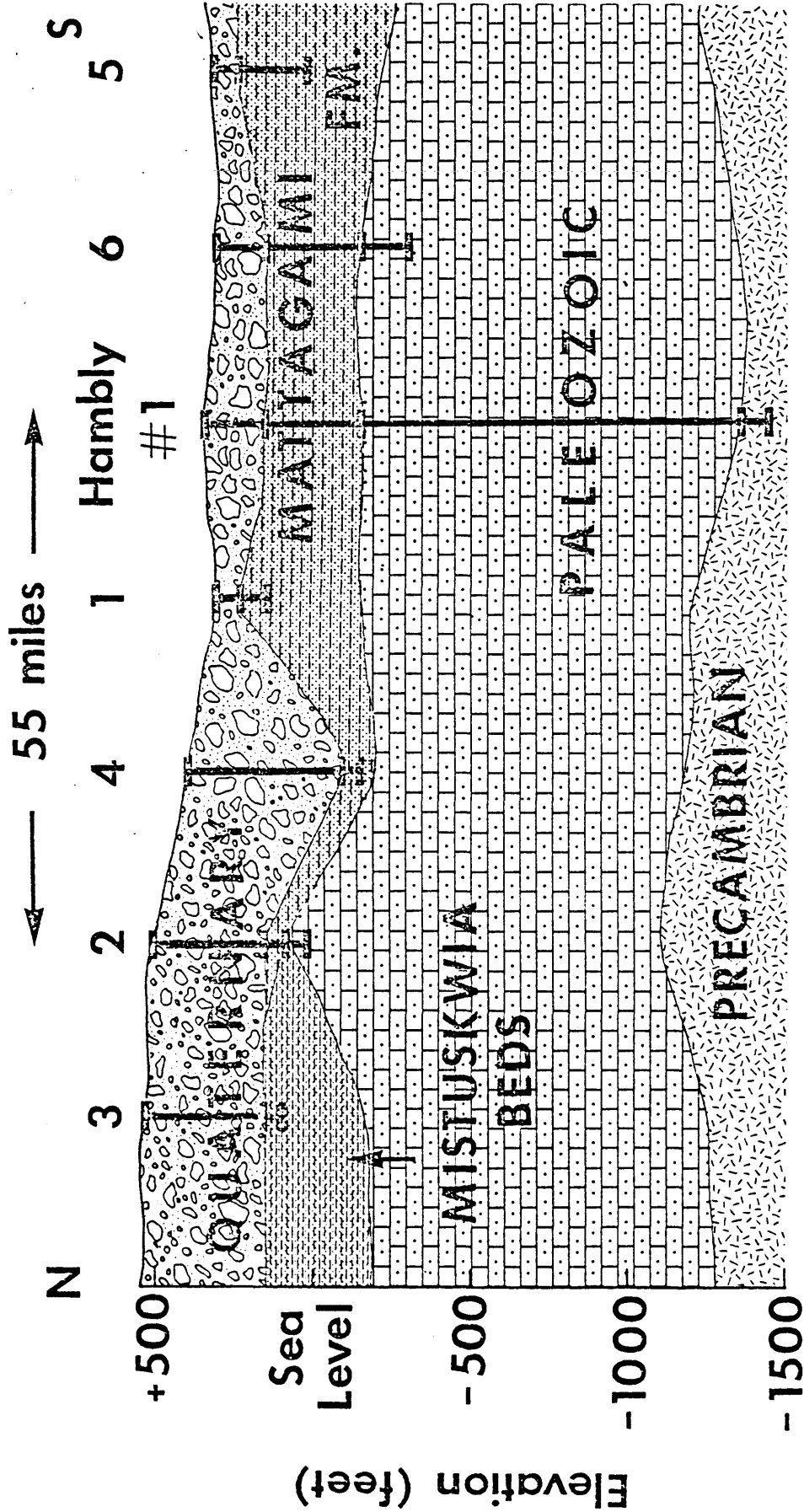


Figure 14. Seismic and Palynological Correlation,

Moose River Basin, Ontario

(after Telford and Norris, 1975)

of Mines. A refraction seismic and resistivity survey and reversed circulation chip drilling (6 holes) were conducted along 110 km of winter road NNW of Smoky Falls (see Map C). The results are expressed in a profile of geologic formations along this road shown in Figure 14. The Mistuskwia beds are older than the Mattagami Formation and probably of Middle Jurassic age (OFR 5158, p.19).

Examination of outcrops in Adam Creek, east of the Mattagami River in Kipling Township, established the extension of silica sand-kaolin and fireclay deposits eastward over a distance of at least 6 miles (10 km) (OFR 5158, p.23.).

Drill samples have been analysed by staff of the Mineral Research Branch, Ontario Division of Mines. Composite samples of silica sand representing drill sections shown in Figure 15 were described and tested for size distribution, mineralogy, chemical composition and clay content (-325 mesh). The information is reproduced in condensed form in figures 16-19 and fully in Tables I - III.

The presence of kaolin in silica sand was qualitatively established in samples of water flushing the drill chips to surface in reversed circulation drilling. Otherwise the -325 mesh fraction in all but one composite ^{sample of} sand was found to be fine quartz silt. The exception is sand 4 in which an appreciable amount of chlorite, illite and expanding clay occurs.

LOCATION OF SAND SAMPLES

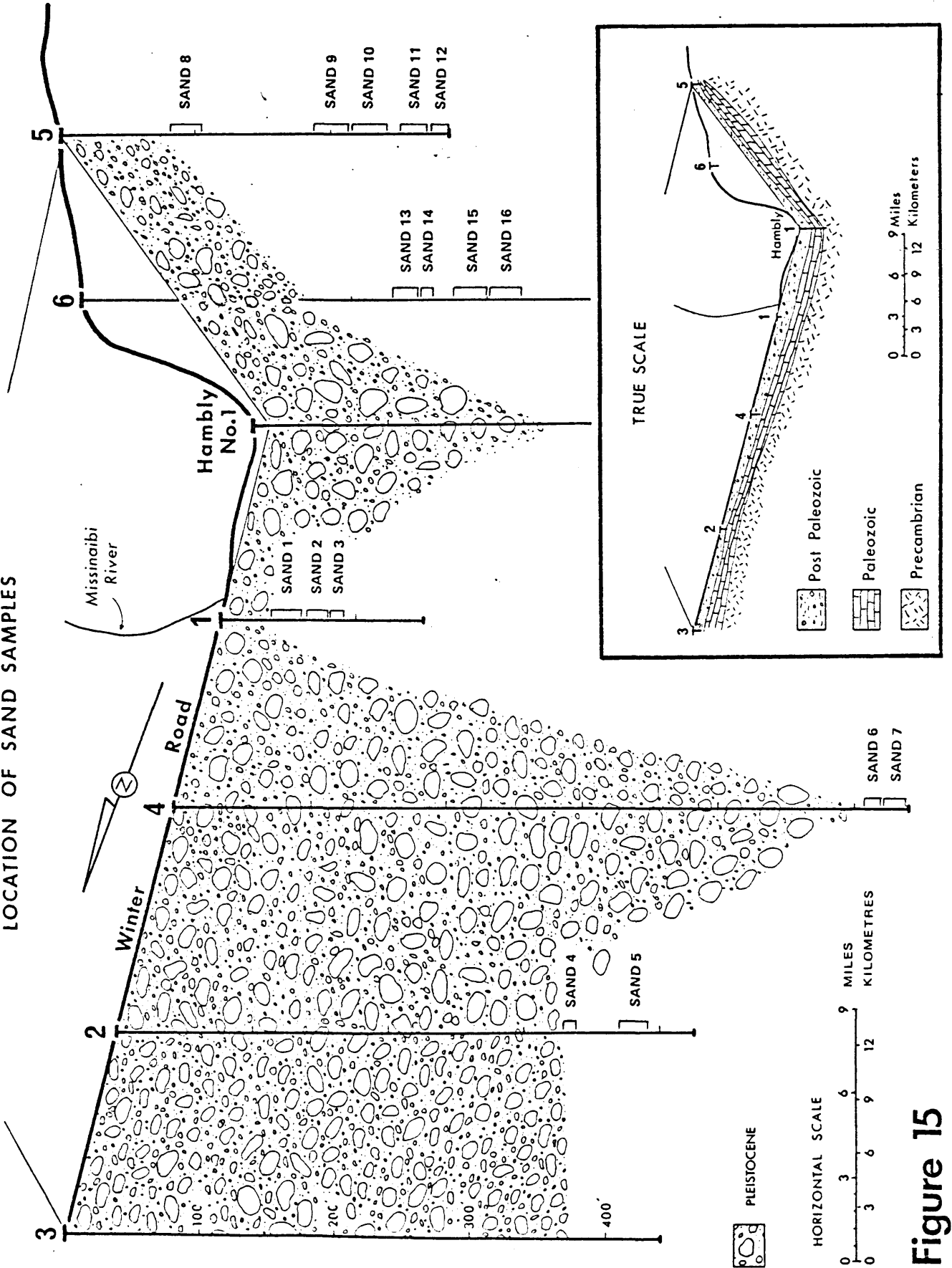
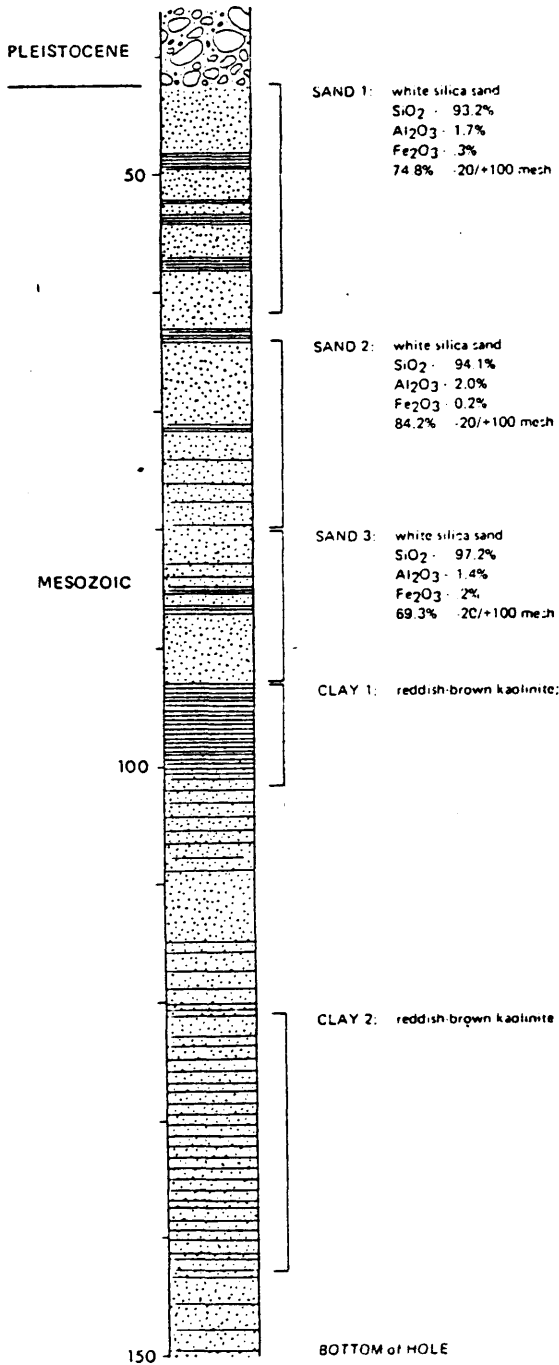


Figure 15

Drill Hole

75-11-01

elev. of collar 305.8 ft.



Drill Hole

75-11-02

elev. of collar 491.1 ft.

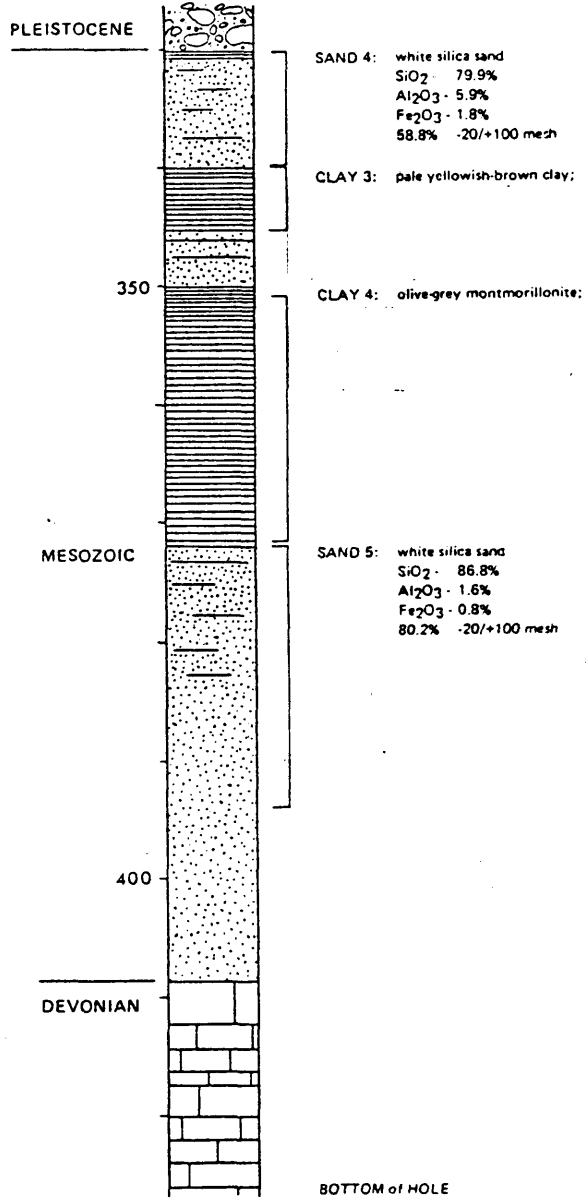


Figure 16

JAMES BAY LOWLANDS

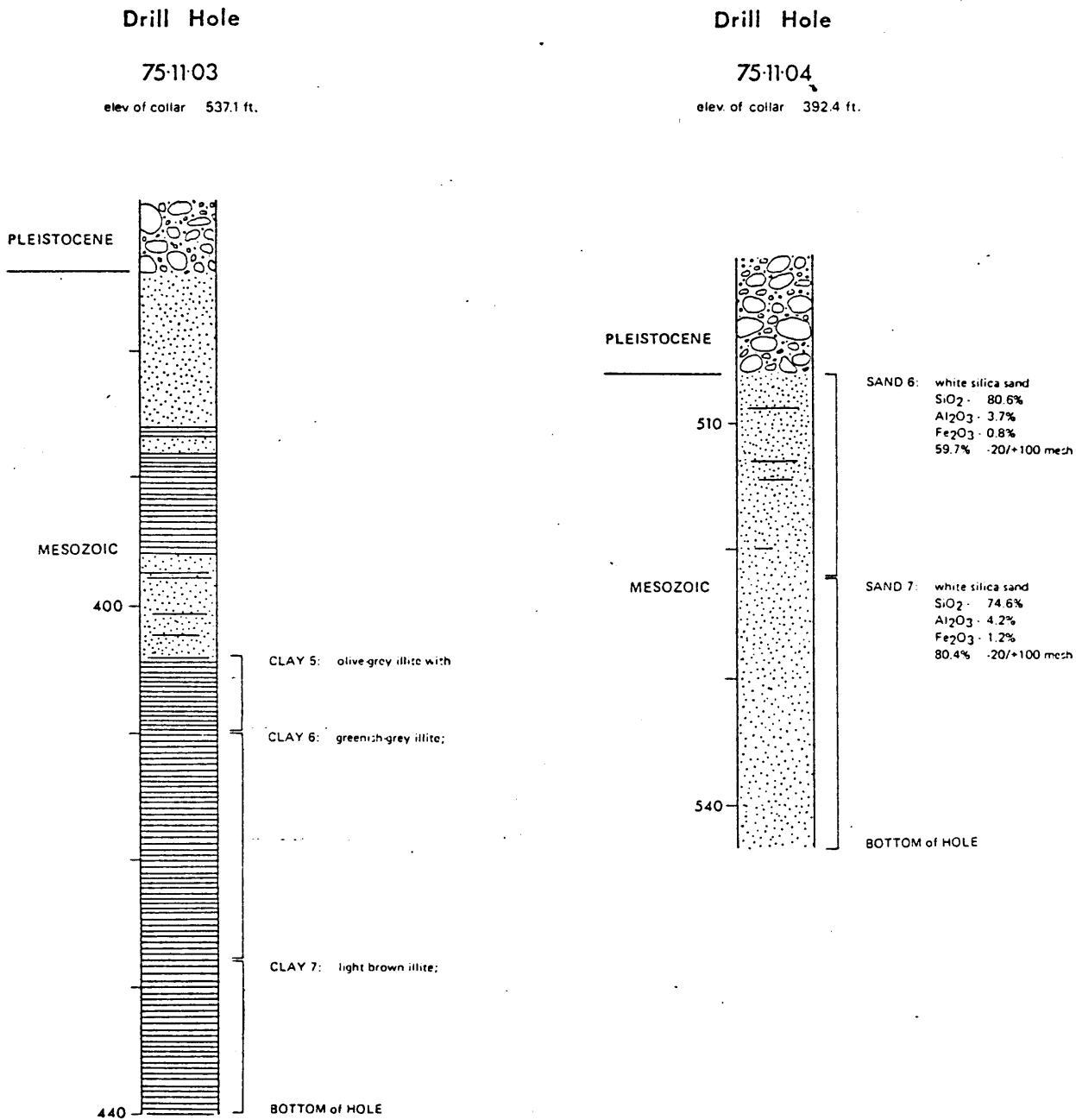


Figure 17

JAMES BAY LOWLANDS

Drill Hole
75-11-05

elev. of collar 331.1 ft.

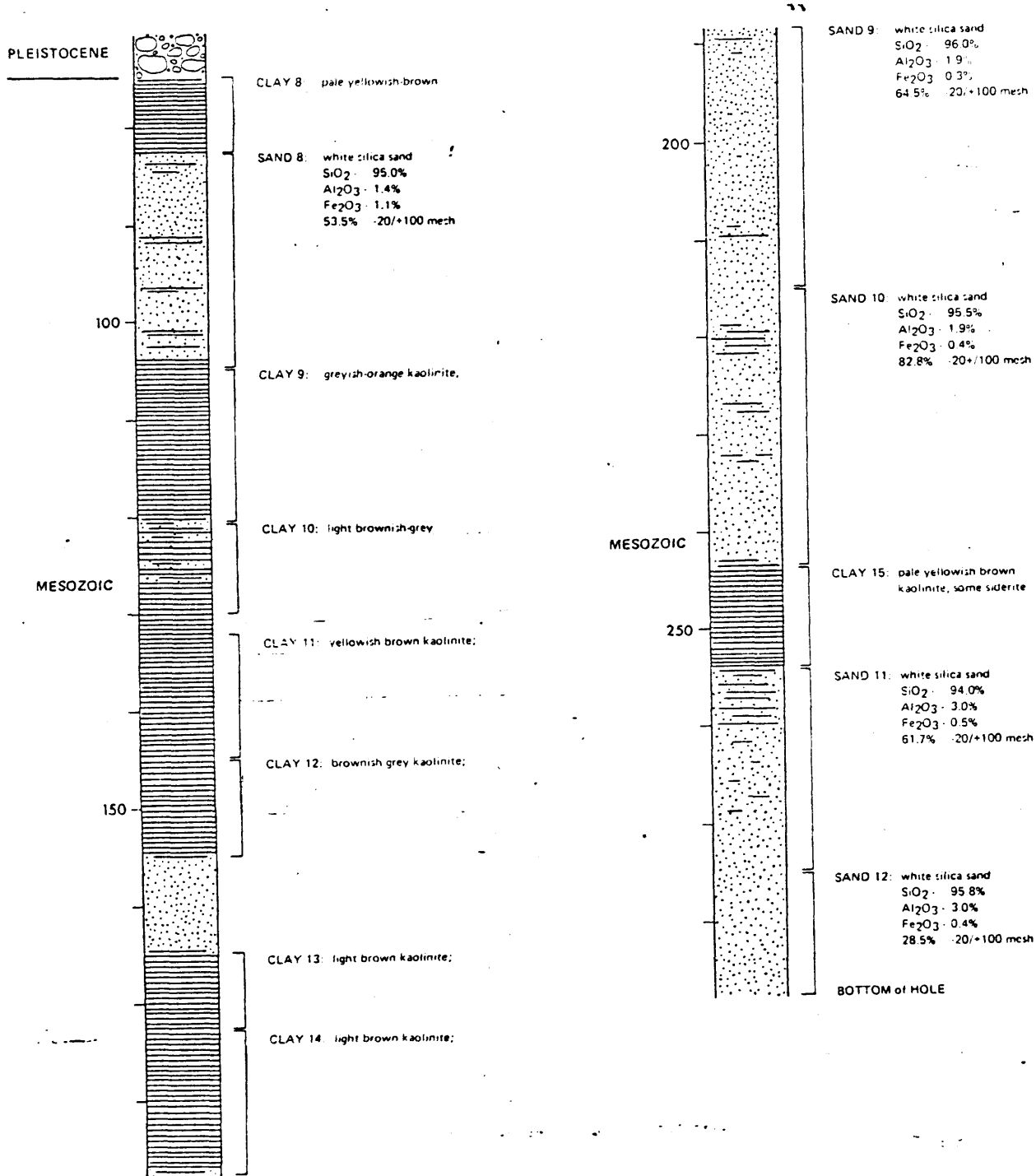


Figure 18

JAMES BAY LOWLANDS

-35e-

Drill Hole
75:1106

elev. of collar 307.2 ft.

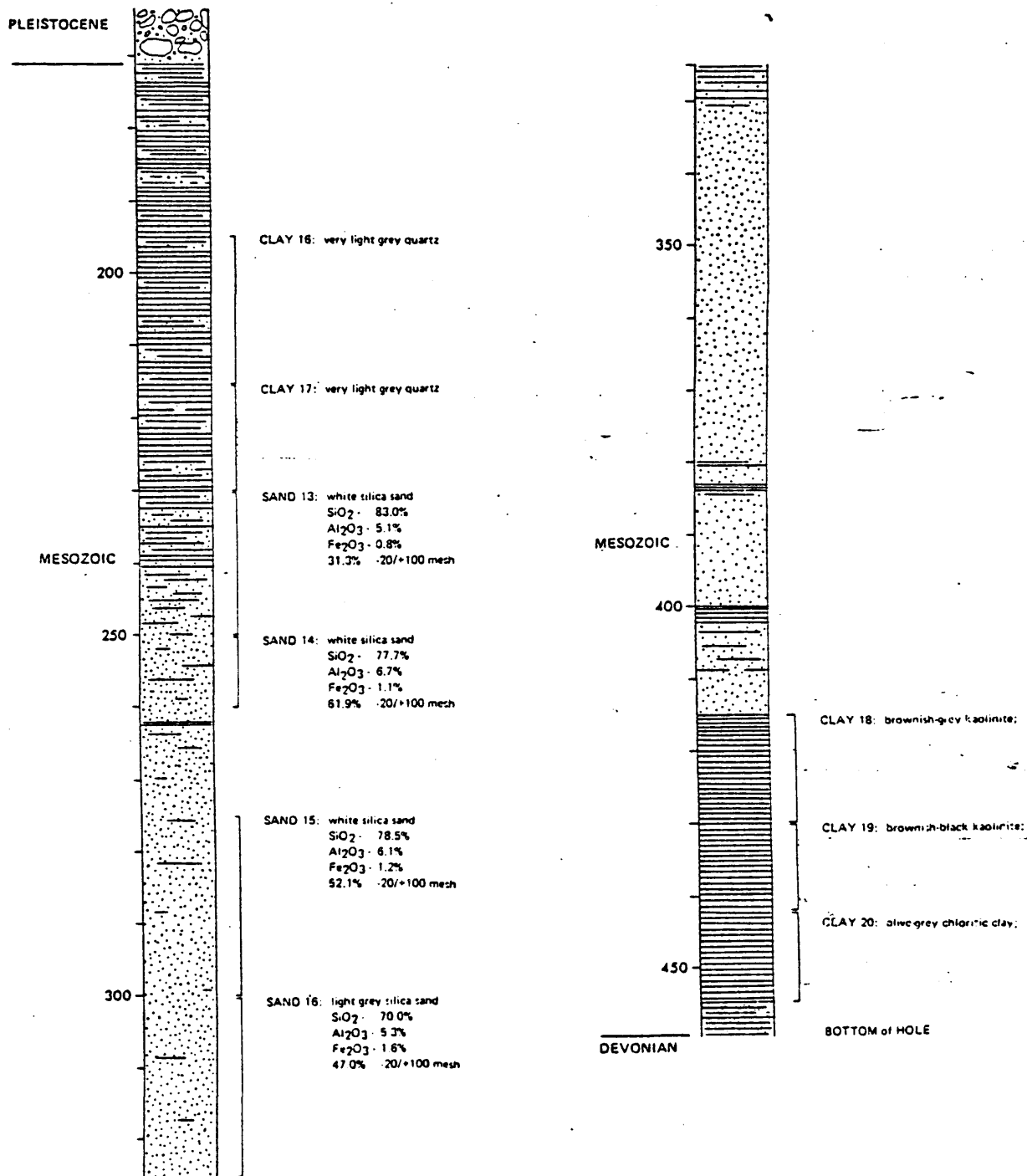


Figure 19

JAMES BAY LOWLANDS

HAMBLY No.1 DRILL HOLE

elev. of collar 377.5 ft.

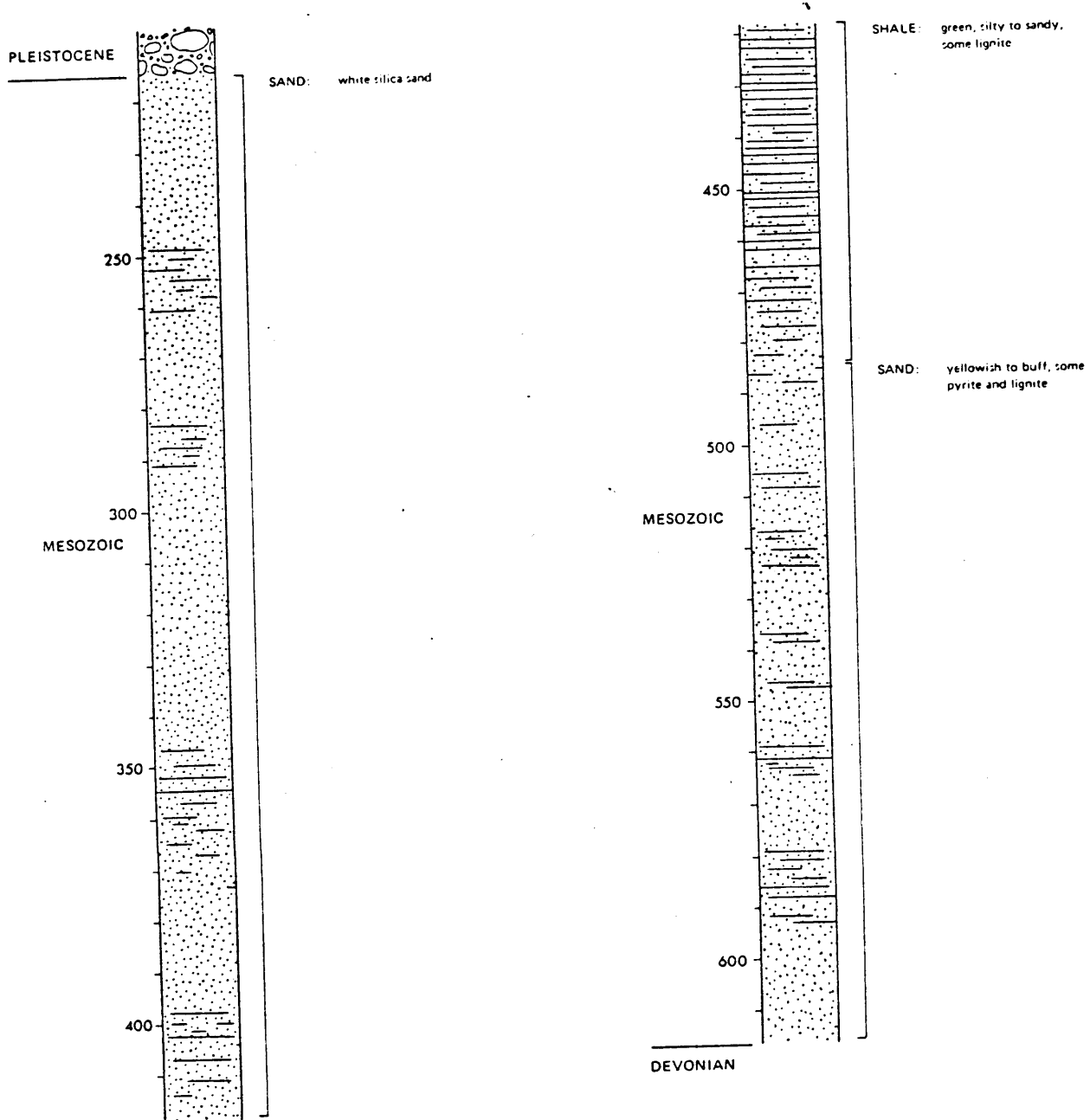


Figure 20

DESCRIPTION OF SAMPLES

Sample description was carried out as part of the laboratory analysis. The following discussion is pertinent to an understanding of Table I (Moddle, 1976):

"In the columns titled clarity, angularity, and shape, the following classification was used if several characteristics were found. For example if in the shape column "high + low sphericity" is written, then the grains are nearly equally of both types, but with high sphericity predominating slightly. If written "low + high sphericity", then low predominates slightly. In a case where it is written "low with minor high sphericity" then grains with high sphericity make up less than 20% of the sample. The same convention follows in the columns - clarity and angularity.

Clarity

All of the samples were either transparent or translucent. The fine to coarse sizes tending to be transparent and the larger ones more translucent, slightly frosted and pitted. Nearly every sample contains less than 1% opaque quartz and is only noted where prevalent.

Grain Size

Most samples have a wide range of grain sizes, from very fine to pebble.

Limits Used (grain diameter in mm)

	2 mm	pebble
1.0	2.0 mm	very coarse sand
0.5 -	1.0 mm	coarse sand
0.25 -	0.5 mm	medium sand
0.1 -	0.25 mm	fine sand
< 0.1 mm.		very fine sand

Angularity

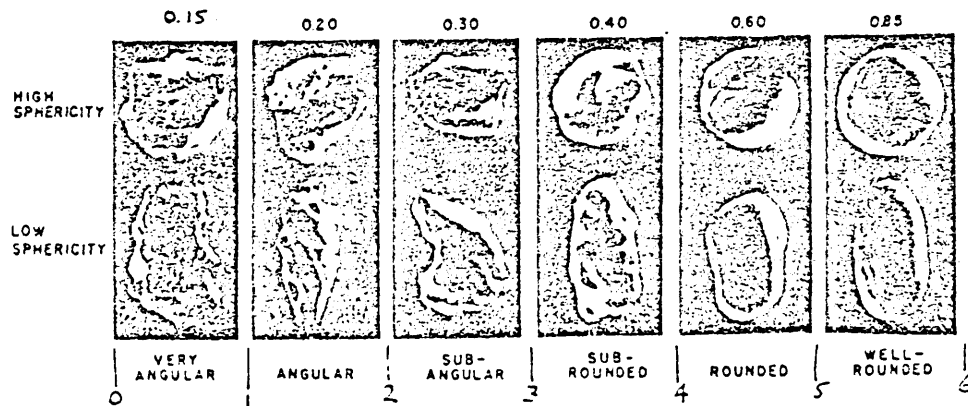
Powers'* guide to angularity is used. The very fine to coarse grains tended to be angular to subangular while the larger very coarse + pebbles were subrounded.

(Exceptions were present).

shape (Sphericity)

The Roundness Scale * shows the differences in the two types (high + low sphericity). The larger grain sizes tended towards the high sphericity and the lower sphericity was found in the smaller grain sizes.

* Roundness Scale of Maurice Powers (1953).



Impurities

In most samples impurities make up 1-2% of the total. Notable impurities include: Amphibole - common, usually occurring as hornblende in bladed crystals; chlorite-occurs primarily in quartz-chlorite aggregates; carbonate occurs either as rock fragments (often with fine quartz grains) or as fine carbonate silt. The silt is often found coating quartz grains. Crinoid ossicles were found in 2 samples.

Garnet is generally common but in small amounts. The pink/red variety is prevalent while purple ones are very rare. The garnets are usually very angular and vitreous.

Muscovite (abbreviated Ms.) occurs as a common accessory mineral in a weathered form - probably sericite. It is opaque, inflexible, and irregular in form. It is concentrated in drill Hole 75-11-05 and in sand 2. Super panning and franz separation can be used to beneficiate the sand.

Biotite is found in dark brown and rarer green shades. It is found mainly in drill hole 75-1106 and samples containing amphibolite rock fragments.

Rock fragments encountered include amphibolite, greenstone gneiss, limestone, sandstone and quartzite. An unusual sandstone found in drill hole 75-11-02 is a coarse grained pyrite cemented variety. Rock fragments are generally subrounded to rounded.

Clinopyroxenes are mainly dark green laths, good euhedral forms are rare. Orthopyroxene is very rare. It is a distinctive light bluish grey in orthorhombic crystals.

Ilmenite, pyrite, and magnetite are found in most samples. Euhedral forms are rare. Pyrite often has a red lacquer or

irridescent coating.

Zircon occurs in two forms: 1) A fluorescent anhedral variety and 2) a rarer euhedral type. The euhedral type is a tetragonal crystal often doubly terminated with pyramids. It is non-fluorescing and seems to be of a different origin. The fluorescent variety is very angular and glassy and is only distinguishable from quartz by its density, x-ray identification and characteristic yellow-orange fluorescence. The fluorescence is only seen under ultraviolet radiation.

Lignite as dull black fibrous material occurs in small amounts. Often organic remains are recognizable.

Siderite (FeCO_3) occurs most commonly as pastel coloured translucent grains, often subrounded. A more localized variety is an oolitic siderite. They are spheres of concentric bands of dark brown siderite. An x-ray powder pattern confirmed the identification. Their origin is probably due to inorganic precipitation but an organic origin is a possibility. They seem to be concentrated in a few stratigraphic sections and could form an horizon.

Other minerals found include pistachio green anhedral epidote, trigonal black and colourless tourmaline crystals, and colourless and bladed tabular kyanite grains."

DISCUSSION

A discrepancy exists between visual estimates of quartz content of sand samples and chemical determination of silica content: with the exception of one sample (sand 4), laboratory values/are lower than expected. This is mainly due to the presence of fine grained carbonates, which in visual examinations are included with quartz. The analyses are accurate to within $\pm 2\%$ but the accuracy will generally fall well within this range.

Hole No. 1

Location: North bank of Soveska River, near northwest corner of Hanbly Township

Depth : 46 m (150 feet)

Log : Overburden 0-13 m (0-43 ft)

Mesozoic Formations 13-46 m (43-150 ft)

Depth of geophysical marker horizon (contact Paleozoic - 152 m (495 ft)

The upper 15 m of Mesozoic sediments in Hole No. 1 is predominantly white quartz sand with transparent, subangular grains of medium to coarse grain size. Minor amounts of clay are interbedded. Samples 1-3 represent all but $\frac{1}{2}$ m (2 feet) of this 15 m intersection.

The sand is rather coarse for purposes of glass manufacture. In view of the content of clay and fine carbonates it may be expected that washing and sieving will raise the silica content considerably. Other impurities consist of amphibole, chlorite, pyroxene, garnet, zircon and siderite. Muscovite is present in sample 2 and some fragments of greenstone occur in the upper part of the section. (sample 1)

Beneficiation e.g. heavy mineral separation and/or magnetic separation will be required to a) further raise the silica content, and b) reduce the content of iron, titanium and chromium.

In glass sand the maximum permissible content of chromium is 6 p.p.m. and of cobalt 2 p.p.m. The measured quantities are equal to or only slightly in excess of these specifications.

Sands intersected in Hole No. 1 are comparable to material found in Algocen No. 1 Deposit, McBrien Township, 28 km (18 m) southwest of this location.

Hole No. 2

Location: 26 km (16 m) NNW of Hole No.1.

Depth : 130 m (427 feet)

Log : Overburden 0 - 100.5 m

Mesozoic Formations 100.5 - 124.5 m

Paleozoic Formations 124.5 - 130 m

Two samples of sand taken respectively from 100.5 - 103.5 m (sand 4) and 113-120 m (sand 5) show that the material has little potential for glass production. Sand 4, a medium brown sand with transparent, fine to medium sized, subrounded quartz grains has an insufficient percentage of required grain sizes, a high iron content and 32 parts per million chrome. Sand 5, a white sand with transparent to frosted, round grains, has a much better grain size distribution. Carbonate fines and high iron content detract from its value however.

Deep burial (> 100 m), limited thickness (24 m) and absence of kaolinite or fireclay are a major economic disadvantage of Mesozoic Formations at this location. The nature of clays (illite, montmorillonite) suggests that the sediments in hole No. 2 belong to the less thoroughly weathered Middle Jurassic Mistuskwia beds rather than the Cretaceous Mattagami Formation.

Hole No. 3

Location: 39 km (24 m) NNW of Hole No. 1

Depth : 134.5 m (441 feet)

Log : Overburden 0-114 m

Mesozoic Formations 114-134.5

Depth geophysical marker horizon (contact Paleozoic)
220 m (720 feet)

Sands in hole No. 3 (114-123 m) have not been analysed for economic potential. Depth of overburden (114 m), impurities (lignite, pyrite), content of clay (illite) and remoteness of location all detract from a potential value making economic analyses redundant at the present time.

Hole No. 4

Location: 13 km (8 m) NNW of Hole No. 1

Depth : 165 m (542.5 feet)

Log : Overburden 0 - 154 m

Mesozoic Formations: 154-165 m

Depth of geophysical marker horizon (contact Paleozoic) 173.5 m (570 ft.) Two samples (sand 6 and 7) represent the total intersection of Mesozoic Formations in Hole No. 4. The white silica sands

consist of angular, transparent quartz grains. The composite samples have a wide spread of grain sizes including an appreciable amount of carbonate fines. The content of iron (Fe_2O_3 : 0.80-1.20%) and Chromium (10-18 p.p.m.) is high. The sands will require a great deal of beneficiation to classify as glass sand.

Hole No. 5.

Location: Acres Township, east half, 4 km (2.5 m) north of Precambrian Escarpment and 2.5 km (1.5 m) west of Kipling Township boundary.

Depth: 88 m (288 feet)

Log : Overburden 21.75 m
Mesozoic Formations 66.25 m

Depth: Geophysical marker horizon (contact Paleozoic)
- 167.50 m (550 feet)

Five samples of sand represent respectively depths of 26-32 m (sand 8), 57-65.5 m (sand 9), 65.5-74.5 m (sand 10), 77.7-83.8 m (sand 11) and 83.8-88 m (sand 12), or a total of 34 m in a 66.25 m interval of the Mattagami Formation. The sands are white with transparent to translucent, subangular to subrounded quartz grains.

Clay samples in this intersection show an abundance of kaolinite which also occurs in association with the sands. Other and impurities are: some red garnet, muscovite, biotite and minor siderite, magnetite, ilmenite, pyrite and lignite. Very little carbonate or feldspar is indicated by the chemical analyses leaving clay, primarily kaolinite, as the major impurity. Separation of

clay by washing should raise the silica content sufficiently for use as glass sand. Further beneficiation will be necessary to reduce the iron content and possibly that of chrome in some instances. A favourable grain size distribution is found in sands 9, 10 and 11, while the coarser sands 8 and 12 lend themselves to uses in silica brick and ^{possibly} as foundry sand.

The depth to which these potentially favourable sands extend and their proximity to transportation facilities near Smoky Falls, Harmon Township makes deposits directly north of the PreCambrian Escarpment in this area particularly attractive.

Hole No. 6

Location: McCausland Township, Central Part; on high ground east of Opatatika River, near river crossing

Depth: 175 m (573.5 feet)

Log: Overburden 52 m (170 feet)
Mesozoic Formations 88 m (289 feet)
Paleozoic Formations 35 m (114.5 feet)

Due to the frequently silty nature and high content of impurities of sands in Hole No. 6 only sands in the upper part of the bore hole have been analysed for economic potential. Samples include 70-76 m (sand 13), 76-79 m (sand 14), 84-91.5 m (sand 15) and 91.5-99 m (sand 16).

The geologic history of deposits intersected in Hole No. 6 has not been determined unequivocally. Although the white quartz sand with transparent, angular to subrounded grains of a wide range of sizes is typical of sands of the Mattagami Formation, the possibility exists that this material has been contaminated

with clays and organic debris, possibly as a result of reworking in what is now a buried river valley. Clay samples lack kaolinite which is not found until below a depth of 126.5 m.

The analysed sands have an unfavourable grain size distribution with too high a percentage of either fines and clay (sands 13, 14, and 15) or of coarse material (sand 16) to be useful as a source of glass sand. The impurities listed include hornblende, chlorite, biotite, magnetite, ilmenite, pyrite, siderite, zircon and garnet. Red feldspar, white carbonate pebbles and fragments of sandstone occur in sand 16. The presence of carbonates and feldspar, although not detected visually, is also expressed in the chemical analyses of sands 13, 14 and 15. Consequently the sands are also too low in silica content to be of interest as a source of glass sand.

SILICA SAND IN CARGILL TOWNSHIP

Sands overlying a phosphate deposit in Cargill Township, 30 km southwest of Kapuskasing (See Map C) are described by Sandvik and Erdosh (1976). The sands are referred to as the preglacial overburden overlying an apatite crystal residue resulting from chemical weathering of carbonatite. The preglacial overburden is described as follows (Sandvik and Erdosh, 1976, p.8):

"A heterogeneous, irregular unit which is pre-glacial and mostly locally derived, is made up of quartz sand commonly containing wood chips, organic clay, and kaolinite with minor interbedded gravel and silt. The quartz sand is light to grey to white, with grain size ranging from very fine to coarse, with quartz content exceeding 95% in many sections. The quartz grains are irregular

in shape and apparently unweathered.

The organic clay interbedded with the quartz sand is dark brown to jet black and very soft and commonly up to a few meters in thickness. Narrow interbedded gravel and silt are ubiquitous. In one place, at the southwest end of the south sub-complex pure kaolinite at least 22 metres thick underlies the quartz sand.

The sand-clay unit is variable in thickness. It is generally confined to pre-glacial troughs, where it is 130 metres thick, and is absent or thin over preglacial ridges."

This unit has not been dated with certainty but indications are that it is of Upper Cretaceous age (Telford, personal communication). Mining of the phosphate deposit would make quartz sand available as a by-product of the operation at little or no extra cost.

EXPLORATION

In the Annual Report of the Regional and Resident Geologists 1976 (Ontario Geological Survey, MP 71, p.111,) Indusmin Limited is reported by Giblin* to have completed a geological survey and trenching for quartz. The property comprises 8 claims in lots 6 and 7, Concessions I and II, Hawley Township, District of Sudbury. The deposit is characterized as vein quartz mixed with feldspar in the Assessment Report.

A vein quartz deposit in Murchison Township, Nipissing District is held by Comet Quartz Limited, Carnarvon, Ontario, KOM 1JO. The property is located in Lots 14 and 15, Concession IV. Some samples of very clear, transparent quartz from this

* P.E. Giblin, Regional Geologist, Northeastern Region, Ontario Ministry of Natural Resources

property were submitted by Mr. Steckley.

Many prospective silica deposits in Eastern Ontario underlie patented land claims. Information on exploration of this land does not become readily available for publication by this office.

A quartzite prospect in Wyse Township, Nipissing District is being investigated at the time of writing this report (oral communication, Mr. Heberer, St. Catharines). Information on the deposit has not been made available till now.

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