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Soapstone in Ontario

By

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SOAPSTONE IN ONTARIO

Ontario Geological Survey

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SOAPSTONE IN ONTARIO

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ABSTRACT

Soapstone is a soft, massive, talc-bearing rock, generally grey in colour, formed during metamorphism and alteration of ultramafic rocks under low grade metamorphic conditions.

Soapstone is valued for its ease of workability, high heat capacity, aesthetic appeal and other characteristics.

Soapstone was extracted in Ontario in pre-historic times when it was used by indigenous people for carving ceremonial pipes and cooking utensils. Commercial production of soapstone in the province took place in the 1920's at which time it was primarily used for lining pulp mill furnaces and for metalworkers crayons and electrical insulators. Recently small amounts of soapstone have been extracted for carving.

Soapstone is becoming an increasingly popular material for architectural products, woodstoves and cookstoves, fireplaces and cookware items. Soapstone continues to be a popular medium for art sculpture.

Many of the soapstone occurrences documented in this report warrant further investigation in order to determine their economic potential.

Opportunities may exist for an Ontario soapstone producer to replace some material imported to North America for a variety of purposes and to provide raw material for sculpture.

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Soapstone In Ontario

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INTRODUCTION

This project was undertaken in recognition of an increase in interest in soapstone for a number of applications. The study was carried out by the staff of the Industrial Minerals Program, Northwestern Region.

This report documents the results of a literature survey, field visits and laboratory testing of various occurrences, as well as the results of a preliminary examination of soapstone market characteristics.

Part one of the report describes soapstone as a commodity; its properties, and uses, current production, consumption and trade of soapstone and market outlook.

Part two of the report examines soapstone in Ontario, including the history of production and geological setting, and descriptions of 46 soapstone occurrences in the province. These descriptions contain as much information as possible about each occurrence including location and access, geology and history. A number of the soapstone occurrences in northwestern Ontario were visited by the authors. The descriptions of the northeastern and southeastern Ontario occurrences are derived from the literature.

PREVIOUS WORK

Descriptions of soapstone occurrences in Ontario have been included in reports by Spence (1922, 1928 and 1940) and Wilson (1926) which examined talc, soapstone and pyrophyllite in Canada and in Hewitt's (1972) report on talc occurrences in Ontario. Storey (1986) includes descriptions of a number soapstone occurrences in a report of a building and ornamental stone inventory for part of northwestern Ontario. Redden (in press) describes several soapstone occurrences in the Ignace-Sioux Lookout area. Recent work by LeBaron and van Haaften (1989) documents talc occurrences in southeastern Ontario. Many of these occurrences include soapstone.

These references are used extensively in the descriptions of Ontario's soapstone deposits in this report.

PART ONE

SOAPSTONE-GENERAL

Terminology

Soapstone is a massive, soft, talc-bearing rock which can be easily carved, sawn or machined into various shapes. The name is derived from the greasy or soapy feel which characterizes the rock. Soapstone is generally grey to blue-grey to green in colour. The colour is determined by the mineralogy, which can be quite variable. The talc content of soapstone may vary from nearly pure talc to very minor amounts. Thus ground soapstone can be a source of commercial talc. However, some rocks which contain no talc have been called soapstone, due to their softness or greasy feel imparted by other phyllosilicate minerals. Besides talc, soapstone may also contain the minerals serpentine, chlorite, dolomite, magnesite, tremolite, actinolite, anthophyllite, diopside, mica, quartz,calcite and pyrophyllite. Magnetite and pyrite are common accessory minerals.

The mineral **talc** is a hydrous magnesium silicate with the theoretical formula $Mg_3Si_4O_{10}(OH)_2$. It is characterized by its softness ('1' on Moh's scale of hardness), greasy feel, pearly lustre and perfect basal cleavage. Talc may be white, grey or pale green in colour but is usually pure white in powdered form. Talc is valued for a number of properties including extreme whiteness and smoothness, softness, high slip and lubricity, chemical inertness, high fusion point, low thermal and electrical conductivity, high oil absorption and low shrinkage when fired. Talc has many commercial applications (see Roe and Olson 1983). It is used primarily for coating and filling paper, as a filler and surfacing material for roofing products, as a pigment extender and filler in paints, as a ceramic raw material, for filling plastics and in cosmetics.

The term **steatite** is often used synonymously with soapstone. It was originally a mineralogical name applied to pure talc but is now commonly used to refer to the massive variety of talc (block talc) suitable for the manufacture of electrical insulators (Roe and Olson 1983). Steatite is composed primarily of talc and contains less than 1.5 percent each of CaO and Fe_2O_3, and less than 4 percent Al_2O_3 in chemical composition (Harben and Bates 1984).

The term **steatitization** is used to describe the process of hydrothermal alteration of ultrabasic rocks that results in the formation of a talcose rock (Bates and Jackson 1987).

Lava is a term which has been used to refer to block talc (steatite) or products made from block talc. Spence (1940) noted that small shapes were sawn, turned, drilled and threaded from the block and then fired (calcined). Lava products include gas and oil burner tips, electrical insulators, and other items, most of which are now made from ceramic materials.

The term tailor's chalk or French chalk has been used to refer to soft, massive, talc suitable for the manufacture of crayons for marking cloth.

Other terms which have been used for steatite or soapstone include agalmatolite, figure stone, lardite, lard stone, pagodite, pot stone, and soap earth (Bates and Jackson 1987; Spence 1940).

Properties

As a result of its variable mineralogical composition soapstone does not have definite physical and chemical properties. Individual soapstones have their own properties which must be evaluated for specific applications. As previously mentioned, soapstone is generally a soft, massive rock having a greasy or soapy feel and is somewhat variable in colour. Soapstone commonly has a specific gravity in the order of 2.9. The main properties for which soapstone has been valued are softness, resistance to chemical and thermal decomposition, high heat capacity, non-absorbency and low electrical conductivity.

Hughes (1932) described the properties of soapstone. The following discussion is derived largely from this reference. The hardness of soapstone is very dependent upon its composition but its comparative softness, massive uniformity, and ease of work-ability have made it the most easily fabricated natural stone. Soapstone can commonly be worked with ordinary woodworking tools. Soapstone containing no carbonate is comparatively inert. Even at high temperatures it is resistant to the action of strong acids and alkalis. This relative chemical inertness contributes to the durability of the stone; it exhibits little or no deterioration when exposed to weathering agents for long periods. Soapstone takes up heat slowly but once hot it holds the absorbed heat much longer than other stones. Soapstone is non-absorbent, commonly having an absorption by weight of less than 0.1 percent. Soap-stone exhibits low electrical conductivity. It has fairly high transverse and compressive strength.

The physical and chemical properties of a soapstone currently being commercially produced in Finland are delineated in Appendix A. The appendix comprises product information from Suomen Vuolukivi Oy for their soapstone which is marketed under the name TuliKivi (meaning Firestone). Other important properties which are described are resistance to thermal shock and frost, sound absorption and the aesthetic appeal of natural soapstone.

Soapstone finds a variety of uses and applications as a result of these properties. These are described in the following section.

Uses and Specifications

Historical Uses

The early use of soapstone was described by Hughes (1932):

> "Probably the earliest known uses of soapstone were dependent upon the ease with which it could be cut. Early Egyptian scarabs and amulets were carved steatite coated with a blue vitreous glaze. The Assyrians used it for signets, and numerous carved steatite ornaments were found among ruins in Rhodesia. For centuries the Chinese and Japanese have carved weird figures out of steatite or agalmatolite; the handiwork of the present generation may be purchased in any Oriental curio shop.
>
> The cathedral of Trondhjem, Norway, was built about 1200 A. D. of soapstone from Gudbransdal. The structure recently was rebuilt to repair damage due to vandalism and fire, but otherwise the stone is in good condition. It has hardened considerably since the building was first erected. Steatite found in association with serpentine near Cornwall, England, was used in the manufacture of old Worcester porcelain."

Prehistoric natives of North America recognized the ease with which soapstone was shaped and its heat retaining properties, and carved a variety of items from the material including; ornaments, pipes, cookware, pots, lamps, bowls and other utensils (Clifton 1985; Prud'homme 1987).

Early European settlers in North America used heated, cut soapstone blocks for warming stones in carriages, sleighs and beds. In the late 19th century, tubs, sinks, hearthstones, mantels, fireless cookers, griddles, firebrick and various utensils were manufactured from soapstone (Clifton 1985). Spence (1940) outlined the uses of soapstone which were common in the early part of this century. As an architectural stone, soapstone was used in building construction, for stairs, and for interior and exterior decorative stone work. It was also used for manufacturing monuments, urns, birdbaths and similar articles. Due to its high heat retention, soapstone was also used to line ovens and for bake-oven hearths. As a refractory material, soapstone was used as furnace stone for lining and in the construction of furnaces for metallurgical work. Due to its resistance to chemical attack, cut soapstone blocks and brick were used to line alkali recovery furnaces in kraft pulp mills using sodium sulphate. In laboratories and chemical plants, soapstone was used for bench and table tops, fume cupboard hoods, sinks and tanks. Soapstone was used for lavatories and laundry tubs due to its low moisture absorption. Soapstone was used for switchboard panels due to its low electrical conductivity. Table 1 (from Wilson 1926) summarizes the uses of soapstone in the 1920's.

Table 1: Uses of Soapstone @ 1920's (from Wilson 1926)

SOAPSTONE

WHITE OR PALE GREY (derived from dolomite)		GREY OR GREEN (derived from serpentinized ultrabasic igneous rocks)
Lava Blanks For electrical insulation. For gas burner tips etc.	**For Marking** Sawn into crayons and pencils. Tailors or French chalk.	**Electrical Industry** Switch boards and base plates.
	Carvings Used chiefly by Chinese and other Orientals	**Metallurgical Industries** As moulds for casting iron, brass, copper etc.
		Kraft Paper As brick for lining smelting furnaces.
		Polishing of Wooden Handles By tumbling in cylinder with small blocks of talc
		Glass Moulds for bottles, etc
		Laboratory Tables
		Laundry Tubs and Sinks
		Nails In polishing nails by tumbling with blocks of talc

Modern Uses

Soapstone presently finds a number of applications which are also dependent on its unique properties. These are summarized in Table 2.

Table 2: Modern Uses of Soapstone

Application	Properties
artistic medium (sculpture blocks) 'carving stone'	workability/softness aesthetic appeal
architectural/building stone (interior and exterior) (including wall and floor tile, countertops, sinks)	durability aesthetic appeal compressive and flexural strength frost resistance sound absorption
refractory bricks (linings)	high fusion point
heating, cooking and sauna stoves, fireplaces	high heat capacity aesthetic appeal fire resistance
cooking utensils (cookstones, griddles)	high heat capacity aesthetic appeal
sauna stone	high heat capacity withstands temperature changes
metalworkers crayons	softness heat resistance
laboratory tables, benches sinks etc.	resistance to chemical attack
electrical insulators	low electrical conductivity

Soapstone has always been a popular medium for native sculptors and other artists. Carving is a very important sector of the Canadian Eastern Arctic economy (see discussion of the carving industry under 'Production' in this report).

The growing interest in soapstone for architectural products, fireplaces, stoves etc. is related to the general growing popularity of using natural materials. While soapstone has been popular for these uses in Europe for some time, and has been produced on a small scale in the United States, it has recently been brought to the attention of the North American market on a larger scale by the Finnish company Suomen Vuolukivi Oy. The company imported material from their Finnish quarries initially and in 1986 acquired and subsequently reactivated past-producing quarries in Schuyler, Virginia. The company produces tile and heating and cooking stoves made of soapstone blocks. These stoves are considered safer and more efficient, as well as less polluting, than conventional wood burning units. The wood is burned quickly and at high temperature, thus eliminating the creosote problem. The stoves are designed such that the soapstone is heated while the wood burns and then heat is radiated for an extended period of time afterward.

Soapstone still finds use for such applications as laboratory furniture, electrical insulators, and metalworkers crayons but has largely been replaced by other materials.

Specifications

Dimensional Stone: Deposits of soapstone suitable for the production of cut stone products, such as wall and floor tile, stoves, fireplaces, furniture and refractory brick, should be capable of producing large, unfractured blocks which can be sawn into required slabs and blocks by modern methods. Blocks should ideally be a minimum of 1 m^3. Blocks produced from existing soapstone quarries are commonly 1.5 to 3 m^3. Currently, however, slabs are sawn from smaller soapstone blocks produced as a by-product of talc mining.

The soapstone should not contain irregularities such as veins which would destroy the structural integrity of the sawn products.

For architectural stone, stoves and fireplaces, the stone should be fairly homogeneous in colour throughout the deposit and have an attractive texture. For exterior applications in particular the soapstone should be free of deleterious minerals such as sulphides which would affect its appearance or integrity upon weathering. There are no standard specifications by the American Society for Testing and Materials (ASTM) for soapstone building stone. It would appear, however, that soapstone should have properties similar to that specified for marble. For floor tile,

harder varieties of soapstone are sufficiently abrasion resistant to stand up to foot traffic.

For refractory brick, soapstone should be free of minerals which would result in decomposition at high temperatures.

For laboratory tables and benches the soapstone should be free of minerals such as carbonates which would react with strong chemicals.

Artistic Medium: The suitability of stone for carving is largely dependent upon the preferences of the individual artist. Soapstone of varying colours is used. Many sculptors use very soft talcose rock. Gibbins (1987) reports that the Inuit prefer stone that is soft enough to be worked but hard enough that it can be handled without scratching. The Inuit commonly carve serpentinites which have a distinctive yellowish-green colour, a greasy feel, a waxy lustre, a hardness ranging from 2 1/2 to 5 and take a good to excellent polish; as well as laminated argillite (Gibbins 1987). While some artists prefer stone with a homogeneous colour and texture, Gibbins reports that variations such as layering or alteration zones are used by skilled carvers to enhance the beauty and uniqueness of a carving. In general, soapstone for carving should be massive as foliated varieties tend to spall or undercut during working.

Stone Studio Siku Inc. of Parry Sound, Ontario produce a number of products using a technique called relief carving. A variety of finishes including polished, honed, sandblasted and hand engraving are applied to slabs of soapstone to create the art work. The artists require fairly soft soapstone having a homogeneous colour and texture.

Metalworkers crayons: Soapstone should be massive and compact enough to be cut into small, hand-held pieces which are soft enough to mark metal.

It should be reiterated that individual soapstones must be tested for specific applications.

CURRENT PRODUCTION, CONSUMPTION AND TRADE

North American Soapstone Production

There are currently two commercial producers of soapstone in Canada; Bakertalc Inc. and Luzcan Inc., both in Quebec. Soapstone is produced as a by-product of talc mining operations by the two companies. Soapstone and similar materials are also extracted on a non-commercial basis from various sites in the Northwest Territories and northern Quebec for carving. These materials form the basis of a substantial industry in the Canadian Eastern Arctic. Three companies produce soapstone in the United States; The New Alberene Stone Company, Inc., Steatite of Southern Oregon Inc., and Vermont Soapstone Company Ltd. Total North American production of soapstone from the five commercial sources is approximately 2300-2350 tonnes.

Bakertalc Inc.

Bakertalc Inc. produces talc and soapstone from the Van Reet Mine at South Bolton, Quebec, 95 km southeast of Montreal. The underground mining operation produces 10,000 tonnes of talc per year. On average, 5 tonnes of soapstone for sculpture purposes are produced annually. The material which is considered suitable for sculpture is only found in certain areas of the mine, in veins which pinch and swell. The soapstone is drilled and blasted, and conveyed by trolley and truck to the surface. Some of the smaller sized pieces of soapstone are roughly sorted into 45 kg (100 lb) bags. The largest sculpture blocks produced are 11 kg (25 lb) blocks, roughly 15 cm by 30 cm by 20 cm (6 inches by 12 inches by 8 inches). Sculptors can purchase their own blocks at the mine site. While the soapstone is generally supplied to individuals, it is also distributed by Gwartzman's Canvas and Art Supplies of Toronto. In the past, shipments of soapstone have been made to carvers in the Arctic. The soapstone sells for $1.10/kg ($0.50/lb) on average. (I. Miller, Bakertalc Inc, personal communication, 1990)

Luzcan Inc.

Luzcan Inc. produces talc and soapstone from open pit mining operations in St. Pierre de Broughton, Quebec. The present production site is a former asbestos mine, located adjacent to quarries formerly operated by the Broughton Soapstone and Quarry Company Ltd. Luzcan produces 50,000 tonnes of talc per year and 300 tonnes of soapstone. Approximately 1000 tonnes of soapstone is removed to produce 300 tonnes of finished material.

Soapstone is marketed through Luzcan's subsidiary Benmic Inc. and is sold as sculpture block and in slab form. Sculpture block is produced primarily in rough blocks 8 cm (3 inches) cubed. Approximately 10 larger blocks, 30 cm (12 inches) cubed, are produced per year. The company has sold carving stone to Cape Dorset, N.W.T carvers in the past. Benmic Inc. cannot meet the demand for soapstone for carving as only a limited amount of soapstone can be extracted in block form (ie., unfractured) from the mine.

Slabs for refractory use, 2 cm (3/4 inch) thick, are sawn in two grades; soft material for exterior use in 9 cm (3 1/2 inch) by 55 cm (21 inch) slabs and harder material for interior use in 33 cm (13 inch) by 40 cm (16 inch) slabs. The slabs are used for facing and lining stoves, and in producing griddles and other cooking utensils. The company formerly produced soapstone crayons but now import this product from China for North American distribution. Luzcan does, however, produce crayons made from reconstituted talc.

The price of the soapstone varies with the size of the product; the larger pieces extracting a higher price. The smaller, rough pieces sell for $0.99/kg ($0.45/lb) and slabs for $3.86/kg ($1.75/lb) (C. Renaud, Luzcan Inc., personal communication, 1990)

Carvingstone - Eastern Arctic

The contemporary carving industry in the Arctic has developed in the last 40 years. Carving stone is extracted on a non-commercial basis by the artists and others using primitive mining methods employing chisels, wedges, crowbars and sledgehammers, as well as gasoline-powered drills and non-explosive demolition agents (S-mite).

Gibbins (1987) reports that:

> "Eskimo carvings are a multi-million-dollar sector of the national and northern economy, with estimated annual payments of $5-10 million to as many as 2000 Inuit carvers. Mark-ups from transportation and other marketing costs, as well as retailers' profits add an equal or greater amount to the final value."

The combined income of a leading carver and his immediate family can amount to $100,000 per year. Single carvings may sell in the $30,000 range (Brundege and Fisher 1990).

Carvings are produced of varying sizes. Modern carvings tend to be larger than traditional carvings. Tools used in carving include power saws and drills, geological picks, hammers and chisels, hand saws, and files.

The New Alberene Stone Company, Inc.

The New Alberene Stone Company, Inc. quarries and fabricates soapstone at Schuyler, Virginia. The company is a subsidiary of Suomen Vuolukivi Oy of Finland who acquired the Virginia operations in 1986. The quarry and plant formerly operated as the Alberene Stone Division of Georgia Marble Corporation and under a variety of other names previously. Annual quarry production is estimated at 400 to 500 m^3 (roughly 1200 to 1500 tons). The quarry produces blocks which are 1.8 m by 1.2 m by 1.2 m (6 feet by 4 feet by 4 feet) on average. The company has a fully modernized plant including block saw, multiblade gang saws and smaller trim saws, and a full automated grinding and polishing line. Installation of the new equipment was completed in December, 1989. The plant has a capacity of 57,000 m^2 (2 million square feet) per year but is not expected to operate at this level for some time. Production in 1989 was 5,500 - 6,500 m^2 (60,000 - 70,000 square feet). The company sells soapstone slab stock. The main finished products of the plant are floor tile and laboratory and residential countertops and wall systems. Stoves and fireplaces, and cookware are also produced. The soapstone has a hardness of around 3 on Moh's scale. Soapstone slab products, 3 cm (1 1/4 inches) thick, sell for US$130.00/$m^2$ (US$12.00 per square foot) and tile, 10 mm thick, sells for US$43.00/$m^2$ (US $4.00 per square foot) (J. Smith, The New Alberene Stone Company, Inc., personal communication, 1990)

Steatite of Southern Oregon Inc.

Steatite of Southern Oregon Inc. produces 320 to 450 tonnes (350 to 500 tons) of soapstone/steatite annually. Soapstone and chlorite are quarried at several locations in southern Oregon. The stone is extracted by drilling and the use of non-explosive demolition agents (S-mite). Blocks are removed making use of natural fracturing. Quarried blocks range in size from 45 kg (100 pounds) to 3.6 tonnes (4 tons) and average about 1.4 to 1.8 tonnes (1.5 to 2 tons) (roughly equivalent to 0.5 to 0.6 m^3). The soapstone produced by Steatite of Southern Oregon Inc. is massive and varies in colour from light green to dark green, brown, orange and red. The stone is processed at the company's plant in Grants Pass, Oregon. Processing includes sawing, grinding and other surface finishing. Approximately 90 percent of the soapstone produced is sold for sculpture purposes, in blocks of 0.45 kg to 270 kg (1 pound to 600 pounds) each. Most is sold in the United States (primarily Alaska). Shipments have also been made to Germany, Finland, Sweden, Denmark, New Zealand, Kenya and Nairobi. In addition to the raw material, the company also deals in art

sculpture. The remaining production is sawn into tiles and blocks for constructing and facing woodstoves. Trimmed soapstone blocks sell for US$1.10/kg (US$0.50/lb). Cut soapstone slab sells for US$1.55/kg (US$0.70/lb) and higher. (S. Pugh, Steatite of Southern Oregon Inc., personal communication, 1990)

Vermont Soapstone Company Ltd.

This company quarries soapstone at Chester, Vermont. Production is estimated at 45 to 55 tonnes (50 to 60 tons) per year in the form of approximately 20 blocks in the order of 1 m^3 (30 cubic feet) each. The blocks, measuring 0.8 m by 0.8 m by 1.5 m (30 inches by 30 inches by 60 inches) on average, are extracted from a hillside quarry which has been in use since the 1860's. The blocks are selectively removed from lenses of soapstone by removal of the surrounding harder country rock, and by drilling and channelling. The soapstone is 65 to 75 percent talc and has a hardness of 2 to 2.5.

Soapstone is sawn and finished at Vermont Soapstone Co. Ltd.'s processing plant in Perkinsville, Vermont. The company primarily produces sinks, countertops, fireplace linings and pizza-oven linings. They also make some smaller items such as griddles, bed warmers and boot dryers. Eighty percent of the raw material processed at this plant is purchased from quarries in Virginia, Brazil and China. Approximately 450-550 m^2 (5000-6000 square feet) of soapstone finished products are fabricated. Most of the products are 3 cm (1 1/4 inches) thick and sell for US$348.20/$m^2$ (US$32.35/ square foot). Products are cut to size and ready to install. The company is the only sink manufacturer in the United States and sells 60-70 sinks per year for domestic applications (G. Bowman, Vermont Soapstone Co. Ltd., personal communication, 1990).

North American Soapstone Consumption

Energy, Mines and Resources Canada (EM&R) and the United States Bureau of Mines (USBM) compile consumption information such that data on soapstone destined to be transformed into value-added objects is included with a variety of "minor" talc end-uses. Their "Other" categories are described as follows:

EM&R	**USBM**
fertilizers	art sculpture
adhesives	asphalt filler and coating
cleaners	crayons
bearings and brake linings	floor tile
refractories	foundry facings
miscellaneous uses	rice polishing
	stucco

In the United States, reported consumption in the above category totalled 122,000 tons and 110,000 tons in 1987 and 1988 respectively (Virta in press). The most recent data publicly available for Canada is for the 1985 and 1986 periods where 6,824 tonnes and 7,120 tonnes respectively were reported consumed by end-uses in the "Other" category (Shaw and Boucher 1988). It is estimated that of the total North American indicated consumption of some 120,000 to 130,000 tonnes per year, demand for "soapstone" does not probably exceed approximately 20,000 tonnes annually.

North American Trade in Soapstone

In Canada and the United States, soapstone is imported and exported under the following two tariff categories:

Item	Description
2526.10.00	Natural steatite, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape - not crushed, not powdered. (Crude Soapstone)
6815.99.20	Talc, steatite and soapstone, cut or sawed, or in blanks, crayons, cubes, disks or other forms. (Note: Statistics Canada (Statscan) only reports data for the broader category 6815.99 which also includes models and casts of a kind used in the manufacture of dental prostheses; foundry facings; stone signs; cast articles of basalt; and cast articles of clay or cement). (Value-Added Soapstone)

Note: These tariff categories relate to commercial or industrial soapstone materials and do not contain data relating to works of art (ie. sculpture).

(i) **Canada**

Statscan import data (tonnes, Cdn$) for 1988 and the first three quarters of 1989 are given in Tables 3, 4 and 5.

Table 3: Imported Crude Soapstone (2526.10.00) - Canada

	1988		Jan-Aug 1989	
	Ontario	B.C.	Ontario	Manitoba
Country of Origin				
United States	238t($99,000)	42t($13,000)	66t($41,000)	3t($2,000)
China	26t($3,000)	-	-	-
Brazil	7t($2,000)	16t($6,000)	16t($2,000)	-
Sweden	-	-	18t($25,000)	-
Total	**271t($105,000)**	**58t($19,000)**	**100t($68,000)**	**3t($2,000)**

Table 4: Imported Value-Added Soapstone (6815.99) - Canada

	1988		Jan-Aug 1989	
	Ontario	B.C.	Ontario	Manitoba
Country of Origin				
United States	$3,671,000	$12,000	$1,778,000	$1,000

Table 5: Crude Soapstone Imports-Average Cdn$/tonne

	1988		Jan-Aug 1989	
	Ontario	B.C.	Ontario	Manitoba
Country of Origin				
United States	$416	$310	$621	$667
China	$115	-	-	-
Brazil	$286	$375	$63	-
Sweden	-	-	$1389	-

Statscan also reports that Canadian exports of crude and value-added soapstone were almost exclusively to destinations in the United States in 1988 and during the first eight months of 1989. Shipments were made from both Ontario and Quebec. USBM data (Virta in press) indicates that 402 tons of crude soapstone valued at US$36,000 were imported from Canada in 1988 and none in 1987. In addition, 149 tons (US$40,000) and 108 tons (US$128,000) of value-added Canadian material was imported in 1988 and 1987 respectively.

Under the terms of the free-trade agreement the tariff rates which apply between Canada and the United States are shown in Table 6.

Table 6: Tariff rates on soapstone between Canada and the United States - 1989-1998.

	Imports into Canada		**Imports into United States**	
	Crude	Value-Added	Crude	Value-Added
Jan 1/89	7.36%	9.18%	$32/tonne	free
Jan 1/90	5.52%	8.16%	$24/tonne	"
Jan 1/91	3.68%	7.14	$16/tonne	"
Jan 1/92	1.84%	6.12%	$ 8/tonne	"
Jan 1/93	free	5.10%	free	"
Jan 1/94	"	4.08%	"	"
Jan 1/95	"	3.06%	"	"
Jan 1/96	"	2.04%	"	"
Jan 1/97	"	1.02%	"	"
Jan 1/98	"	free	"	"

With respect to Canadian imports of crude material, all of it finds end-use application as soapstone "objects". However, some of the Canadian crude material exported to the United States may be processed by grinding for other uses.

(ii) **United States**

USBM import data (tons, US$) for 1987 and 1988 are given in Tables 7, 8 and 9. (Virta in press):

Table 7: Imported Crude Soapstone (2526.10.00) - United States

	1987	1988
Country of Origin		
Australia	1,450t($87,000)	20,122t($1,468,000)
Canada	-	402t($36,000)
China	-	9,126t($599,000)
Japan	-	694t($95,000)
Italy	216t($24,000)	-
Other	8,438t($805,000)	4,917t($419,000)
Total	**10,104t($916,000)**	**35,261t($2,617,000)**

Table 8: Imported Value-Added Soapstone (6815.99.20) - United States

	1987	1988
Country of Origin		
Brazil	398t($151,000)	204t($59,000)
Canada	108t($128,000)	149t($40,000)
China	386t($288,000)	768t($435,000)
Italy	1,123t($1,090,000)	-
Japan	-	19t($24,000)
Korea	34t($19,000)	19t($13,000)
Other	288t($341,000)	183t($200,000)
Total	**2,337t($2,017,000)**	**1,303t($880,000)**

Table 9: Soapstone Imports-Average US$/ton

	1987		1988	
	Crude	Value-Added	Crude	Value-Added
Country of Origin				
Australia	60	-	73	-
Brazil	-	379	-	289
Canada	-	1185	90	1355
China	-	746	66	566
Italy	111	971	-	-
Japan	-	-	137	1263
Korea	-	559	-	684
Other	95	1184	85	1093

USBM data on export of soapstone is not reported in Virta (in press).

MARKET OUTLOOK

Market Opportunities for an Ontario Producer

Examination of soapstone import data indicates that market opportunities for an Ontario producer could exist in replacing crude soapstone being imported into North America, particularly the United States, from off-shore sources. This market is estimated to be in the order of several thousand tonnes annually. Similarly, a potential Ontario soapstone producer and fabricator could capture a portion of the value-added soapstone market in North America presently being serviced by off-shore sources. This market is also estimated to be no more than several thousand tonnes per year but the material carries a higher unit-value than the imported crude. Statscan and USBM data suggest that fabricated soapstone products command at least twice the price per tonne of crude material.

However, the impact of recent developments in domestic production of soapstone in the United States on the volume and value of soapstone imported from off shore may be significant. Suomen Vuolukivi Oy of Finland reactivated soapstone quarrying in Schuyler, Virginia in 1987 and operates under the name The New Alberene Stone Company, Inc. The company has subsequently expanded and modernized their fabricating facility in Schuyler. The plant has not begun to operate anywhere near the potential capacity of 57 000 m^2 per year at this time.

Presently off-shore sources of soapstone appear to be lower in cost than domestic sources. Soapstone slab (3 cm thick) from Brazil sells for US$8.50 per square foot, F.O.B. U.S. east coast. Virginia slab of the same thickness is currently US$12.00 per square foot, F.O.B. Schuyler.

The rate of growth in demand for soapstone products in North America is not known. The greatest potential for growth appears to be in architectural and domestic products. The general trend toward increasing use of natural stone in architecture also includes soapstone. Recognition of this growth in demand is demonstrated by the activities of The New Alberene Stone Company, Inc. Besides architectural tile the company produces kitchen countertops, stoves, fireplaces and a variety of stoneware items. These products have been successfully manufactured and marketed in Europe for years and their relatively recent introduction to North America should assist in generating a greater public awareness of soapstone's potential in what might be generally considered, in North America, as non-traditional soapstone applications.

An opportunity would also appear to exist in supplying soapstone sculpture block. There appears to be a shortage of sculpture block available from Canadian producers at the present time. In particular sculptors expressed difficulty in obtaining larger blocks in the order of 30 cm by 30 cm by 30 cm.

PART TWO

SOAPSTONE IN ONTARIO

History of Production

Early extraction of soapstone in Ontario was carried out, on a small scale, by indigenous people. The stone was carved into ceremonial pipes and cooking utensils. Soapstone is reported to have been used from a number of sites including: southwest of French Portage on Lake of the Woods (Lawson 1886) (occurrence **NW2**), the upper end of Pipestone Lake (Coleman 1895) (**NW6**), at Rocky Islet Bay, Rainy Lake (Coleman 1895) (**NW15**) and at Pipestone Bay, Red Lake (Dowling 1912) (**NW1**).

The earliest recorded investigation of soapstone for commercial purposes in Ontario is in the late 1910's and early 1920's. A number of locations in northwestern Ontario were investigated for their soapstone potential. These include Pipestone Peninsula, Lake of the Woods (**NW7**), Eagle Lake (**NW3**), Wabigoon (**NW10**), Mile Lake (**NW4**), Trap Lake (**NW9**), Shebandowan Lake (**NW18**), and Little Turtle Lake (**NW13**). Most of the activity was for the purpose of securing material for lining furnaces in pulp mills. Actual production of soapstone for this purpose is only recorded from two locations. In 1915 and around 1918 - 1919 shipments of soapstone from Pipestone Peninsula, Lake of the Woods were made to the pulp mill in Dryden. At the later date four railcar loads of stone are reported to have been shipped. Soapstone was quarried at Eagle Lake from 1924 to 1927 (see Photos 1 and 2). Approximately 310 tons of soapstone valued at $12,600 were produced at this time. A saw plant was located at the quarry site. The stone was cut into furnace lining blocks and sold to pulp mills in Dryden and Winnipeg. Soapstone was also produced from 1923 to 1926 by the H.H. Wood Talc Company from the Little Turtle Lake deposit. Approximately 50 tons of soapstone was produced for the manufacture of steelworkers crayons and lava products.

No further production of soapstone in Ontario is recorded until recently. Recent activity has involved the extraction of a small amount of soapstone from Coste Island, Lake of the Woods (**NW2**) in 1975 by F. Thorgrimson for carving ornamental objects and ceremonial pipes. Since 1983, Thorgrimson has annually removed small amounts of soapstone from the waste dump of the past-producing quarry at Eagle Lake (**NW3**) (See Photos 3 and 4). In 1984, some soapstone was extracted from a quarry in Kaladar Twp., southeastern Ontario (**SE23**) and shipped to Vermont for use as decorative facing for woodstoves. Wabigoon Resources Ltd. is currently (1989-90) investigating the possibility of extracting soapstone from the occurrence on Wabigoon Lake (**NW10**). A number of occurrences described in this report have undergone investigation as potential sources of talc.

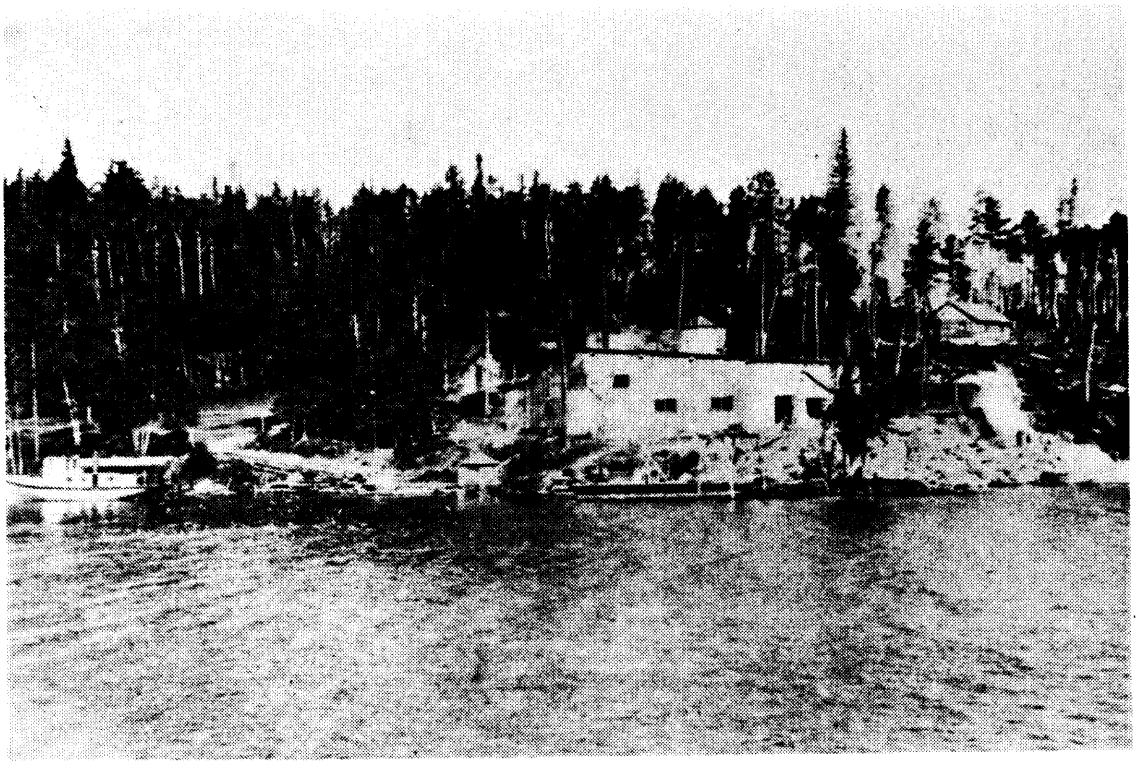


Photo 1: General view of soapstone quarry of Grace Mining Company, on Eagle Lake, Ontario. Sawing-shed is shown at left of pit. (from Spence 1928)

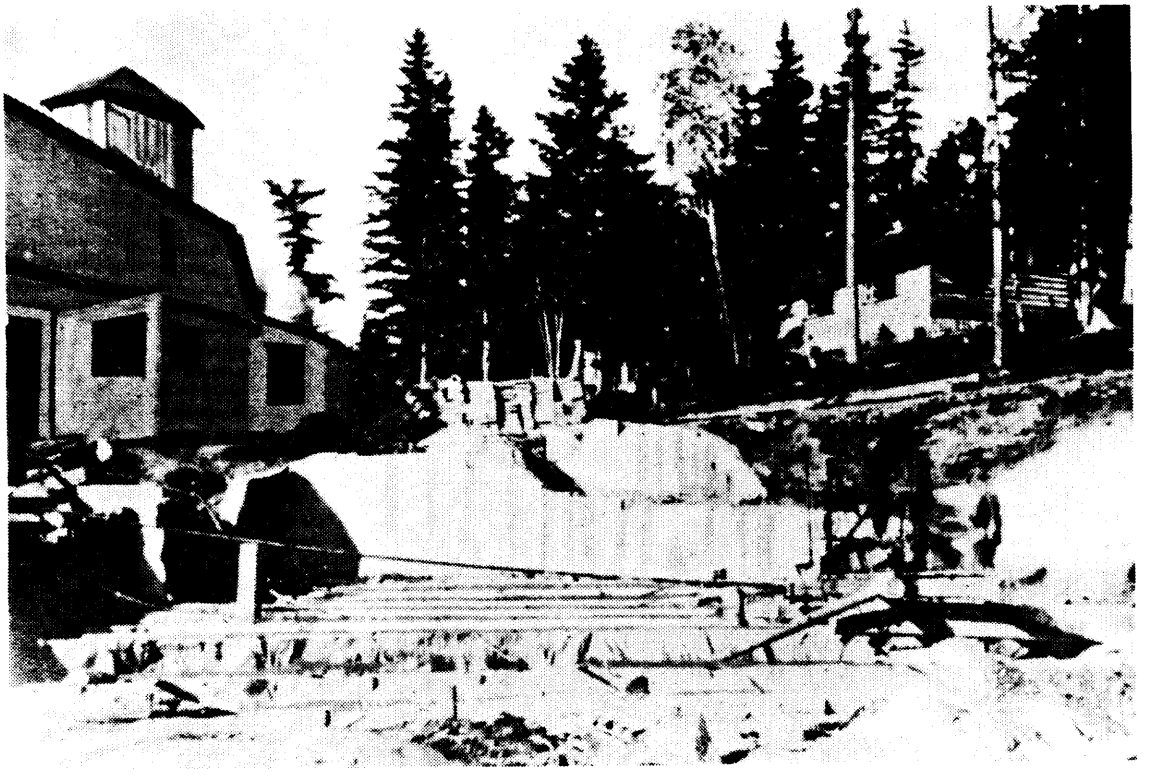


Photo 2: Soapstone quarry of Grace Mining Company, Eagle Lake, Ontario, showing bench method of working. (from Spence 1928)

Photo 3: Carvings by F. Thorgrimson - Eagle Lake Soapstone

Photo 4: Carving by F. Thorgrimson - Eagle Lake Soapstone

Geological Setting

General

The formation of soapstone is dependent on the formation of the mineral talc. Talc is a secondary mineral formed by the alteration of other magnesium-silicates such as serpentine, pyroxene and siliceous dolomite. The geological settings in which talc occurs are diverse but in general talc is associated with two main rock types; dolomite, and ultramafic and mafic igneous rocks. Talc forms as a secondary mineral, either directly from pre-existing rocks or through introduction of new material. Most talc forms under low-grade metamorphic conditions. Most talc deposits are found in Precambrian rocks (Roe and Olson 1983). Other favourable sites for talc formation include igneous-sedimentary contacts, faults and shear zones (Harben and Bates 1984).

While most commercial talc deposits are associated with dolomitic rocks, soapstone is most commonly associated with ultramafic and mafic igneous rocks.

In ultramafic rocks which have undergone serpentinization, talc-bearing rocks may replace entire lenses or other bodies of serpentinite or form a shell around them. Winkler (1979) describes the metamorphism of ultramafic rocks. The presence of water and/or carbon dioxide is required. The introduction of H_2O converts ultramafic rocks to serpentinites, composed primarily of antigorite or lizardite/chrysotile, minor talc or quartz, or brucite and some magnesite. The introduction of H_2O and CO_2 results in the conversion of serpentites to assemblages consisting of talc and magnesite and sometimes dolomite. In the case where a small amount of CO_2 is present with water, rims of talc and magnesite are commonly formed enclosing serpentinite, which was formed previously by the introduction of H_2O alone.

Harben and Bates (1984) note that steatitization (the formation of talc-rich rock) occurs by two processes. The first, the metasomatic reaction between serpentinite and introduced CO_2, results in talc-carbonate assemblages. The following reaction is from Winkler (1979).

$$2 \text{ serpentine} + 3\ CO_2 = 1 \text{ talc} + 3 \text{ magnesite} + 3\ H_2O$$

The second process involves the reaction between serpentinite and siliceous country rock and results in talc-rich rocks. Winkler (1979) records the following reaction:

$$1 \text{ serpentine} + 2 \text{ quartz} = 1 \text{ talc} + H_2O$$

In carbonate rocks, talc is the first mineral to form during progressive metamorphism of siliceous dolomitic limestones by the following reaction (Winkler 1979):

$$3 \text{ dolomite} + 4 \text{ quartz} + 1 \ H_2O = 1 \text{ talc} + 3 \text{ calcite} + 3 \ CO_2$$

Tremolite is formed with increasing temperature by the following reactions (Winkler 1979):

$$5 \text{ talc} + 6 \text{ calcite} + 4 \text{ quartz} = 3 \text{ tremolite} + 6 \ CO_2 + 2 \ H_2O$$

$$2 \text{ talc} + 6 \text{ calcite} = 1 \text{ tremolite} + 1 \text{ dolomite} + 1 \ CO_2 + 1 \ H_2O$$

$$2 \text{ dolomite} + 1 \text{ talc} + 4 \text{ quartz} = 1 \text{ tremolite} + 4 \ CO_2$$

Dolomitic rocks, tremolitized by granitic rocks emplaced nearby, may be altered to talc schist during retrograde metamorphism (Harben and Bates 1984).

Harben and Bates (1984) also note that small talc deposits have formed by the introduction of pegmatites into serpentinite and by massive steatitization of mafic rock.

Geological Setting of Ontario Soapstone Occurrences

Soapstone in Ontario occurs within a variety of geological settings within Precambrian rocks of the Canadian Shield. The occurrences in northwestern and northeastern Ontario predominantly occur within metavolcanic-plutonic belts of the early Precambrian Superior Province. They are associated with altered mafic and ultramafic volcanic and intrusive rocks. The southeastern Ontario occurrences occur within the Middle to Late Precambrian Central Metasedimentary Belt of the Grenville Province. Most are derived from the alteration of ultramafic rocks and occur along the western margins of the Elzevir and Weslemkoon batholiths within a belt of Tudor Formation mafic metavolcanics (LeBaron and van Haaften 1989). The geology of the area is described in detail in LeBaron and van Haaften (1989).

Two of the southeastern Ontario occurrences are associated with dolomitic rocks. One occurrence in northeastern Ontario is associated with mafic intrusive rocks of the Southern Province. A number of the soapstone occurrences are related to shear zones or faults. The geological setting of the soapstone occurrences is summarized in Table 10.

Table 10: Summary of Soapstone Occurrences in Ontario

Note: An occurrence which has had any exploratory work done on it is referred to as a prospect.

* visited during study of talc in southwestern Ontario by LeBaron and van Haaften (1989)

Occurrence	Status	Field Visit	Geological Province/Belt	Rock Association	Comments
NW1 Ball Township (Pipestone Bay, Red Lake)	Occurrence	No	Superior/Uchi	ultramafic intrusive	-three minor occurrences -size unknown
NW2 Coste Island (French Portage Occurrence) (Pipestone Point)	Prospect	Yes	Superior/Wabigoon	ultramafic/ metavolcanic	-carvingstone was extracted from a small pit -soapstone unit is 2 to 3 m wide
NW3 Eagle Lake (Grace Mine) (Grace Soapstone Quarry)	Past producer (1924-1927)	Yes	Superior/Wabigoon	mafic intrusive/ metavolcanic	-lens of soapstone possibly 30 m by 180 m -poorly exposed -may continue along strike
NW4 Mile Lake	Prospect	Yes	Superior/Wabigoon	ultramafic intrusive	-two small soapstone occurrences (poorly exposed) -NW occurrence - 2 m wide -shear zone -SE occurrence - 15 m by 15 m exposed
NW5 Phillips Township	Occurrence	Yes	Superior/Wabigoon	ultramafic intrusive	-25 m wide talcose unit -length unknown -shear zone
NW6 Pipestone Lake, Northwest Arm (Pipestone Lake North)	Occurrence	No	Superior/Wabigoon	ultramafic intrusive	-size unknown -possibly shear zone related

Occurrence	Status	Field Visit	Geological Province/Belt	Rock Association	Comments
MW7 Pipestone Peninsula (Pipestone Portage) (Andrew Bay Deposit)	Past producer (1915, 1918-1919)	Yes	Superior/Wabigoon	ultramafic intrusive	-30 m by 40 m exposed -lensoidal talc bearing unit
MW8 Sucan Lake	Occurrence	No	Superior/Wabigoon	mafic-ultramafic intrusive	-size unknown
MW9 Trap Lake	Prospect	Yes	Superior/Wabigoon	ultramafic intrusive	-soapstone unit 250 m by 400 m
MW10 Wabigoon (Wabigoon Soapstone Company, Limited) (Pidgeon Deposit)	Prospect	Yes	Superior/Wabigoon	mafic-ultramafic intrusive	-two bands of soapstone 15 m and 25 m wide -exposed length 160 m
MW11 Zealand Twp.	Occurrence	No	Superior/Wabigoon	mafic-ultramafic intrusive	-five minor soapstone occurrences
MW12 Claxton Twp.	Occurrence	Yes	Superior/Wabigoon	ultramafic intrusive	-3 m wide talcose unit exposed for 70 m -in small lenses
MW13 Little Turtle Lake (H.H. Wood Talc Company)	Past producer (1922-1926)	Yes	Superior/Wabigoon	mafic intrusive/ metavolcanic	-possible size of soapstone unit 4 m by 30 m
MW14 Milk Lake (Buttermilk Lake) (Seine River)	Occurrence	No	Superior/Wabigoon	mafic metavolcanic	-several lenses of soapstone -the largest is 7 m by 30 m
MW15 Rocky Islet Bay	Occurrence	Yes	Superior/Wabigoon	mafic metavolcanic	-two small talcose units -6 m by 15 m -1.8 by 3 m and 3.6 by 3 m
MW16 Ross Island (Pipestone Lake South)	Occurrence	No	Superior/Wabigoon	ultramafic intrusive	-talcose unit 3 m wide, length unknown -other occurrences along strike
MW17 Puddy Lake	Occurrence	No	Superior/Wabigoon	ultramafic intrusive	-soapstone unit 15 m by 60 m -shear zone related

Occurrence	Status	Field Visit	Geological Province/Belt	Rock Association	Comments
NW18 Upper Shebandowan Lake	Occurrence	Yes	Superior/Shebandowan	mafic metavolcanic	-minor talcose occurrence
NE1 Carr-Taylor-Wilkie Townships	Occurrence	No	Superior/Abitibi	mafic metavolcanic	-shear zone/fault related -noted in drill holes -soapstone up to 91 m wide
NE2 Four Corners Property (Reeves Township Joint Venture)	Occurrence	No	Superior/Abitibi	mafic metavolcanic	-shear zone related -81 m wide
NE3 Penhorwood Mine (Manville Property)	Talc producer	No	Superior/Abitibi	ultramafic intrusive	-talc mine -soapstone potential unknown
NE4 Panache Lake	Occurrence	No	Southern/Huronian	mafic intrusive	-0.7 to 1 m wide vein-like talcose body
NE5 Adams Mine (Jalore)	Iron-ore producer	No	Superior/Abitibi	mafic metavolcanic	-soapstone in mine waste dump
SE1 Pennick Lake (Oso Twp., Conc. II, Lot 25 or 26)	Occurrence	No *	Grenville/Central Metasedimentary	mafic metavolcanic	-size unknown -shear zone related
SE2 Pittsburgh Twp., Conc. III, Lot 35, south half	Talc prospect	No	Grenville/Central Metasedimentary	mafic intrusive	-size unknown
SE3 Potter Creek (Cashel Twp., Conc. II, Lot 16)	Occurrence	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-talc-rich unit 6 m by 45 m
SE4 Dubblestein (Cashel Twp., Conc. VII, Lot 2)	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-talc-rich unit 15 m by 40 m

Occurrence	Status	Field Visit	Geological Province/Belt	Rock Association	Comments
SE5 McMurray (Cashel Twp., Conc. VIII, Lot 7)	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-series of talcose units 2 m to 10 m wide
SE6 Madoc Talc and Mining Company (Cashel Twp., Conc. XII, Lot 17)	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-talc-rich rocks in zones from 10 cm to 30 m in width
SE7 Elzevir Twp., Conc. I, Lot 27	Occurrence	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-northeast extension of SE19
SE8 Elzevir Twp., Conc. I, II, Lots 14-18	Occurrence	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-talc units 2-15 m in width and up to 60 m in length
SE9 Elzevir Twp., Conc. II, Lot 15	Occurrence	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-area 500 m by 500 m is 60 percent talcose rock
SE10 Queensborough Road (Elzevir Twp., Conc. II, Lots 10, 11, Conc. III, Lots 8, 9, 10, 11, Conc IV, Lots 6, 7, 8, 9)	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-two talcose zones 100 to 200 m wide -length 3.5 km
SE11 Elzevir Twp., Conc. VI, Lot 5 Conc. VII, Lots 4, 5	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-several zones of soapstone, the largest is 250 m by 500 m
SE12 Pipe Lake (Faraday Twp., Conc. X, Lot II)	Talc prospect	No *	Grenville/Central Metasedimentary	dolomite	-two narrow talcose tremolitic units

Occurrence	Status	Field Visit	Geological Province/Belt	Rock Association	Comments
SE13 Grimsthorpe Twp., Conc. IV, Lot 13, south half	Talc prospect	No	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-1 m wide talcose shear zone on surface -18 m of talcose rock intersected in drilling
SE14 Grimsthorpe Twp., Conc. V, Lots 8,9,10	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-talcose zone 10 m by 200 m
SE15 Canada Talc Industries Mine (Henderson Mine) (Conley Mine)	Talc producer	No *	Grenville/Central Metasedimentary	dolomite	-talc mine -compact steatite unit is soapstone
SE16 Madoc Twp., Conc. X, XI, Lots 18-21	Occurrence	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-lenses of talcose rock 2 to 15 m wide and up to 60 m in length -northward extension of SE8
SE17 Madoc Twp., Conc XI, Lot 15	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-similar to SE16
SE18 Madoc Twp., Conc. XI, Lot 17 west half	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-2.5 m wide vein of talcose rock -length unknown -possibly shear zone related
SE19 Cooper (Madoc Twp., Conc. XI, Lots 22,23,24 and Elzevir Twp., Conc. I, Lot 24)	Occurrence	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-lenses of talcose rock up to 60 m wide and 300 m in length
SE20 Madoc Twp., Conc. XI, Lot 28	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic-mafic metavolcanic	-talcose zone 10 m wide and 300 m in length
SE21 Cedar Hill (Pakenham Twp., Conc. VI, Lot 6)	Talc prospect	No *	Grenville/Central Metasedimentary	ultramafic intrusive	-talc unit 29 m by up to 100 m

Occurrence	Status	Field Visit	Geological Province/Belt	Rock Association	Comments
SE22 Grindstone Island (South Burgess Twp., Conc. I)	Talc past producer	No	Grenville/Central Metasedimentary	ultramafic intrusive	-serpentinite
SE23 Hearthstone (Kaladar Twp., Conc. II, Lot 13)	Past producer (1984)	No *	Grenville/Central Metasedimentary	ultramafic intrusive/metavolcanic	-20 m wide band of talc-anthophylite schist

DESCRIPTIONS OF ONTARIO SOAPSTONE OCCURRENCES

Descriptions of forty six Ontario soapstone occurrences follow. These descriptions are based on literature search, geological field work, and laboratory and other testing.

The distribution of the occurrences is shown on Figure 1. The occurrence descriptions are organized into three areas; northwestern Ontario, northeastern Ontario, and southeastern Ontario. Figures 2, 3 and 4 show the location of the occurrences within these areas.

Tables 11 and 12 list a number of minor talc/soapstone occurrences in northwestern and northeastern Ontario. All known talc occurrences in southeastern Ontario are documented in LeBaron and van Haaften (1989).

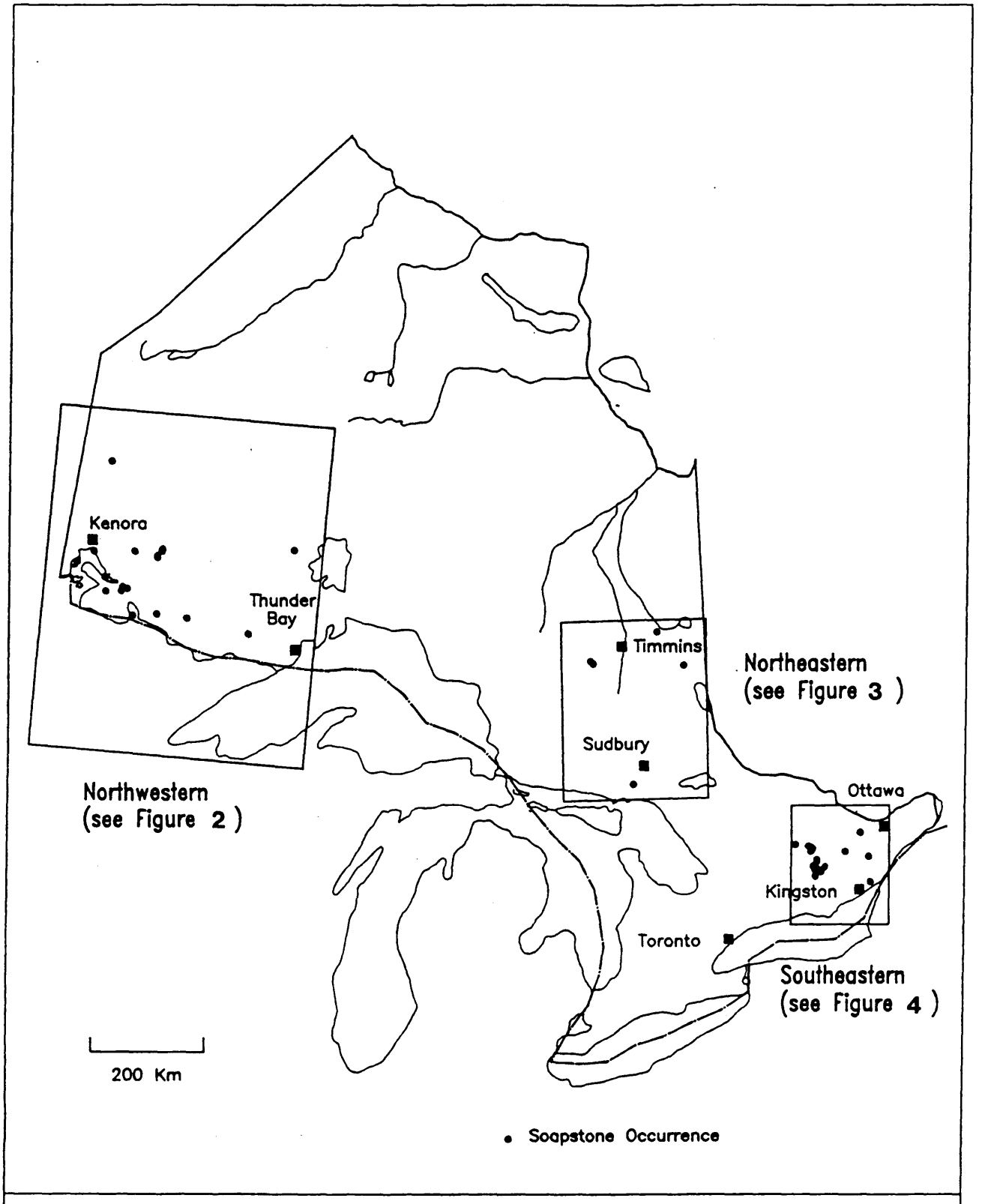


Figure 1 : Soapstone Occurrences in Ontario

LEGEND

Figure 2: Soapstone Occurrences - Northwestern Ontario

Kenora District

- **NW1** Ball Township
- **NW2** Coste Island
- **NW3** Eagle Lake
- **NW4** Mile Lake
- **NW5** Phillips Township
- **NW6** Pipestone Lake, Northwest Arm
- **NW7** Pipestone Peninsula
- **NW8** Sucan Lake
- **NW9** Trap Lake
- **NW10** Wabigoon
- **NW11** Zealand Township

Rainy River District

- **NW12** Claxton Township
- **NW13** Little Turtle Lake
- **NW14** Milk Lake
- **NW15** Rocky Islet Bay
- **NW16** Ross Island

Thunder Bay District

- **NW17** Puddy Lake
- **NW18** Upper Shebandowan Lake

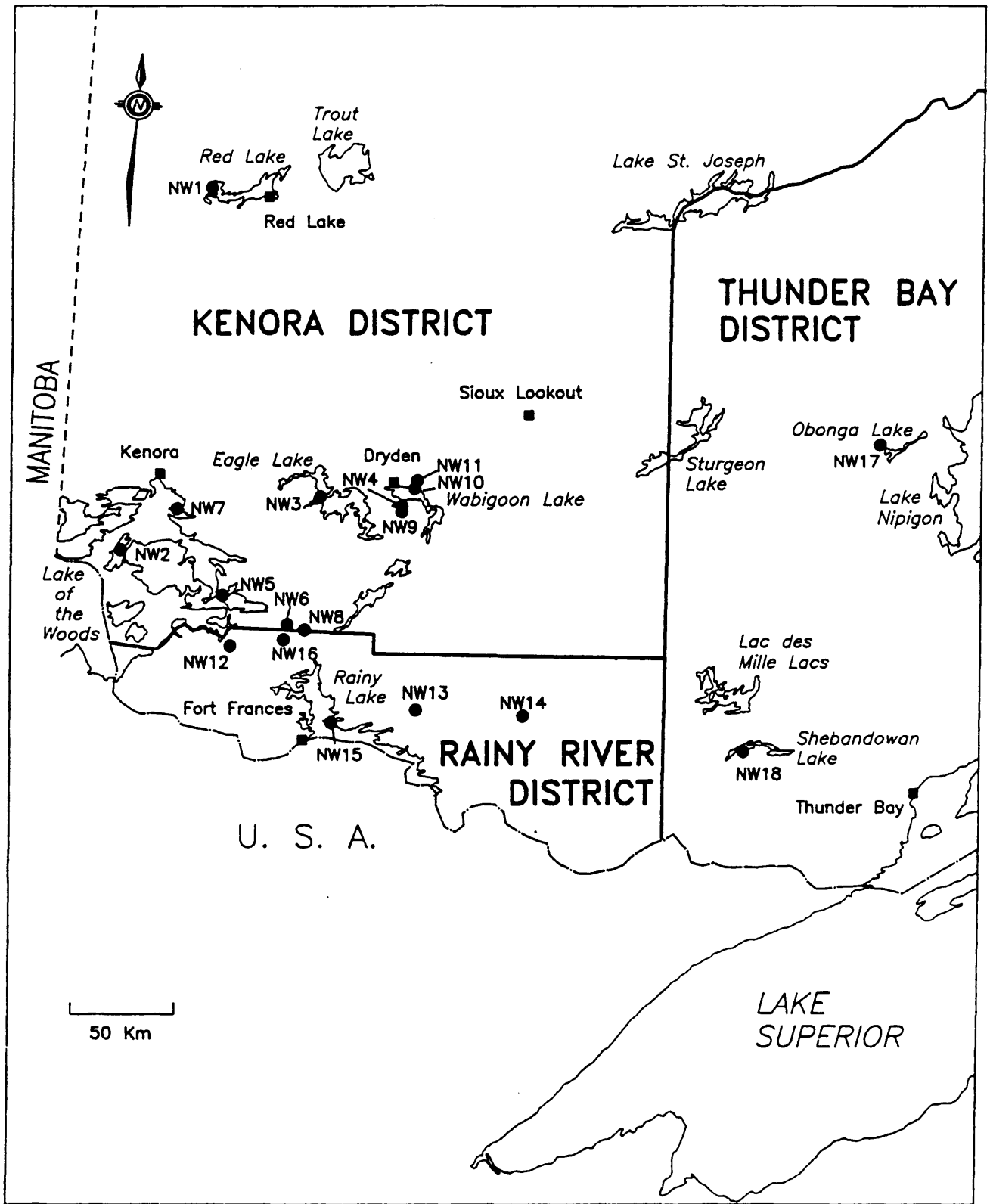


Figure 2 : Soapstone Occurrences – Northwestern Ontario

LEGEND

Figure 3: Soapstone Occurrences - Northeastern Ontario

Cochrane District
- **NE1** Carr-Taylor-Wilkie Townships
- **NE2** Four Corners Property
- **NE3** Penhorwood Mine

Sudbury District
- **NE4** Panache Lake

Timiskaming District
- **NE5** Adams Mine

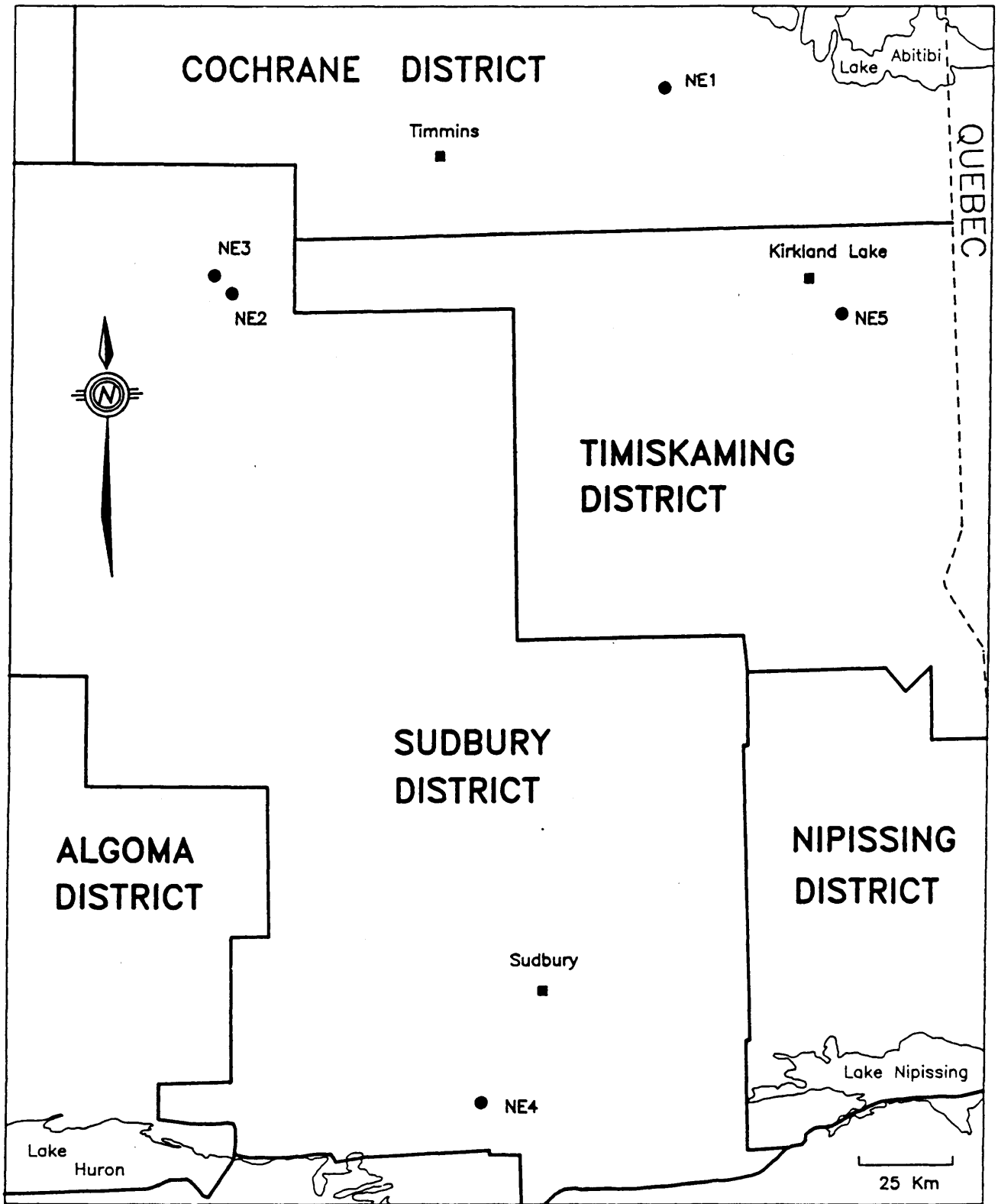


Figure 3 : Soapstone Occurrences – Northeastern Ontario

LEGEND

Figure 4: Soapstone Occurrences - Southeastern Ontario

Frontenac County
- **SE1** Pennick Lake
- **SE2** Pittsburgh Twp. ,Con. III, Lot 35 South half

Hastings County
- **SE3** Potter Creek
- **SE4** Dubblestein
- **SE5** McMurray
- **SE6** Madoc Talc and Mining Company
- **SE7** Elzevir Twp., Con. I, Lot 27
- **SE8** Elzevir Twp., Con. I,II, Lots 14-18
- **SE9** Elzevir Twp., Con. II, Lot 15
- **SE10** Queensborough
- **SE11** Elzevir Twp., Con. VI, Lot 5
  Con. VII, Lots 4,5
- **SE12** Pipe Lake
- **SE13** Grimsthorpe Twp., Con. IV, Lot 13 South half
- **SE14** Grimsthorpe Twp., Con. V, Lots 8,9,10
- **SE15** Canada Talc Industries Limited
- **SE16** Madoc Twp., Con. X,XI,Lots 18-21
- **SE17** Madoc Twp., Con. XI, Lot 15
- **SE18** Madoc Twp, Con. XI, Lot 17 West half
- **SE19** Cooper
- **SE20** Madoc Twp., Con. XI, Lot 28

Lanark County
- **SE21** Cedar Hill

Leeds County
- **SE22** Grindstone Island

Lennox and Addington County
- **SE23** Hearthstone

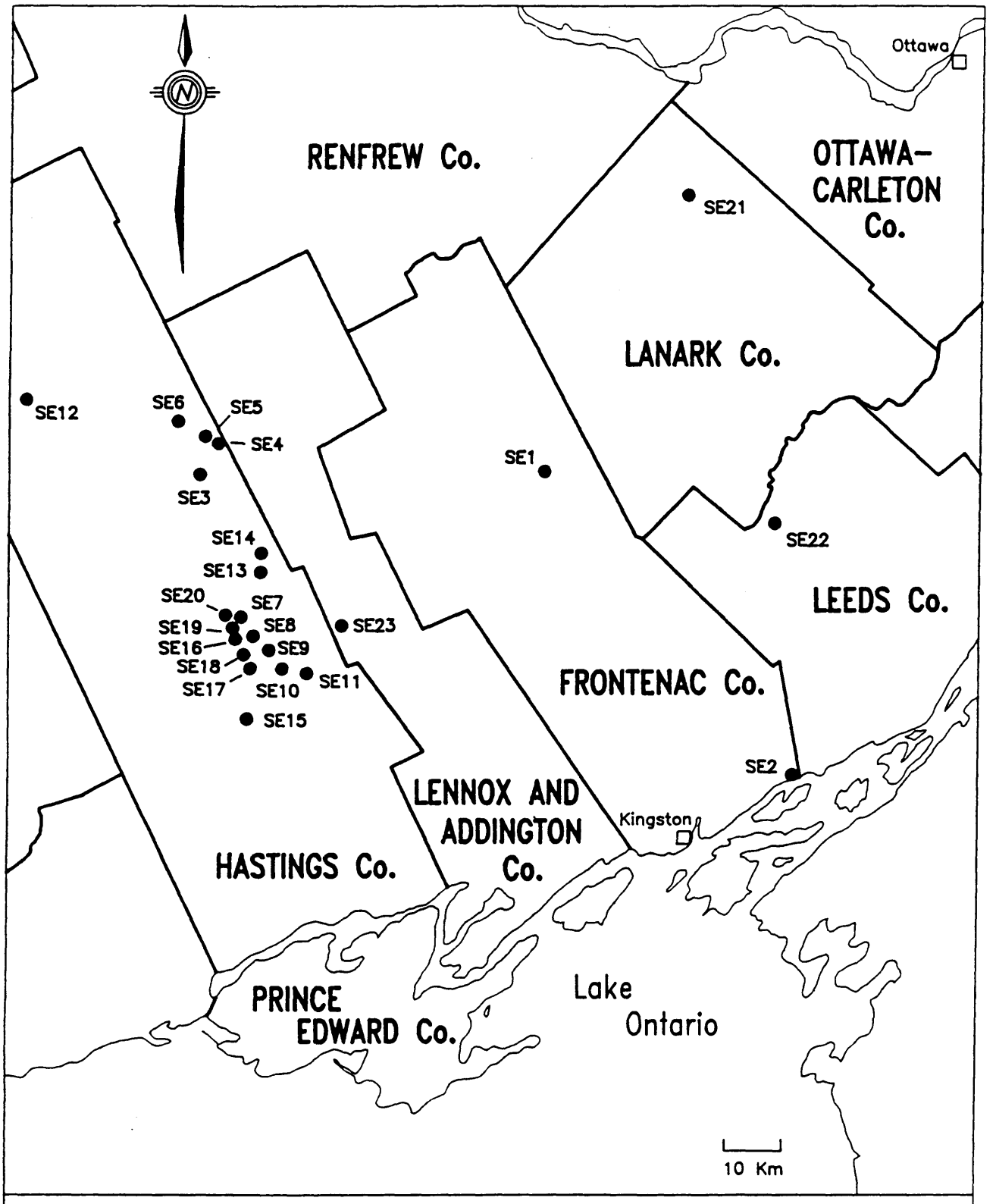
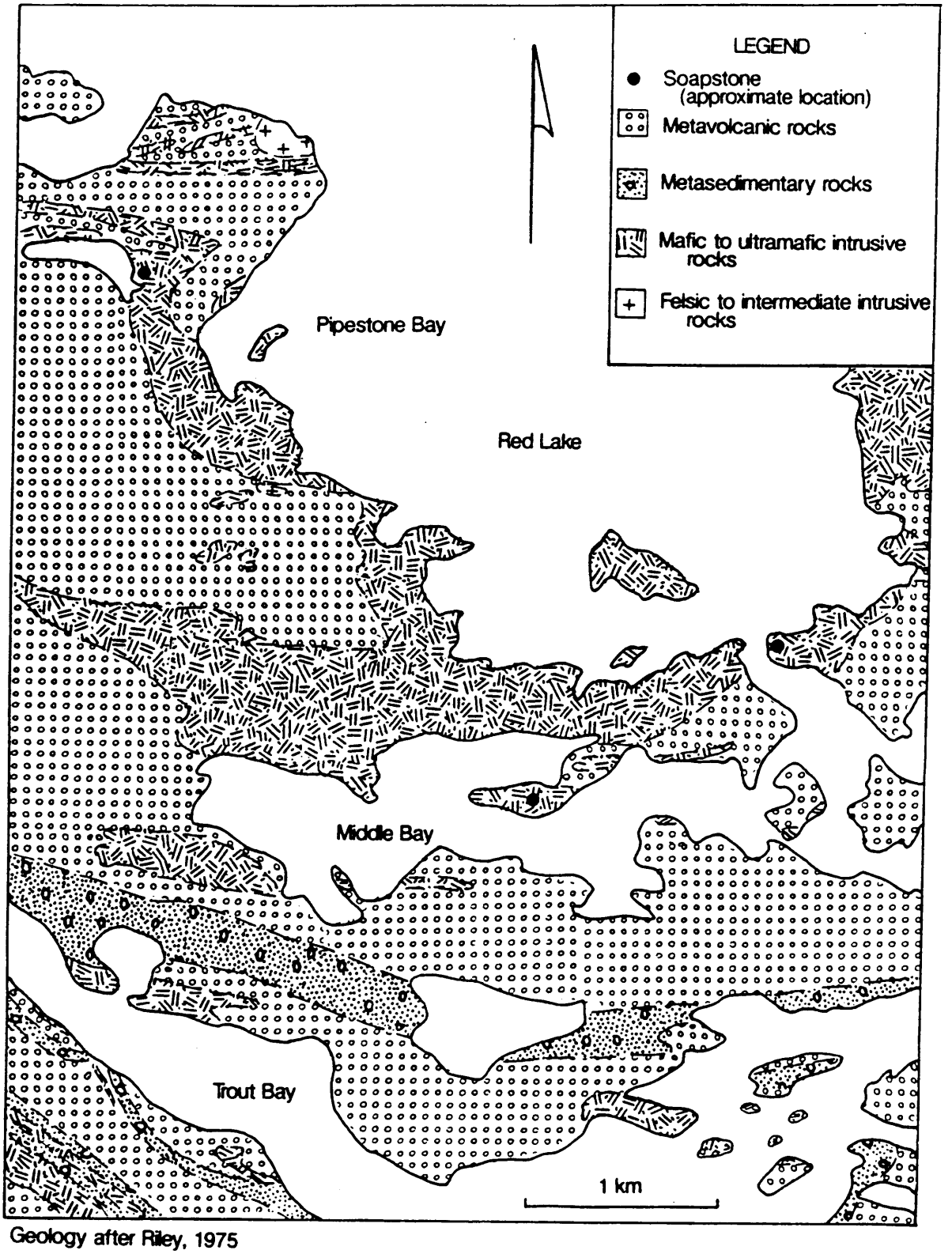


Figure 4: Soapstone Occurrences – Southeastern Ontario



Geology after Riley, 1975

Figure 5: Geology in the Vicinity of the Ball Township Soapstone Occurrences (NW1)

NW1: Ball Township
(Pipestone Bay, Red Lake)

COMMODITY: Soapstone

STATUS: Occurrence

LOCATION: Three occurrences were noted by Horwood (1945) within the vicinity of Pipestone Bay, Red Lake; in Ball Township, 30 km west northwest of the town of Red Lake. Locations are approximate as occurrences were not located on maps by previous workers (see Figure 5).

Claim Map: G-3740, Ball Township;
Red Lake Mining Division

NTS: 52M/1SE

I. West of Pipestone Bay on the shore of a small lake on the former Cole Property.

UTM: Zone 15 412800E 5657750N

Latitude: 51° 03' 50" Longitude: 94° 14' 30"

II. In Phillips Channel at the outlet of Pipestone Bay.

UTM: Zone 15 416200E 5655750N

Latitude: 51° 03' 00" Longitude: 94° 11' 37"

III. On Middle Bay of Red Lake.

UTM: Zone 15 415000E 5654850N

Latitude: 51° 02' 38" Longitude: 94° 12' 39"

ACCESS: The occurrences are accessible by water from the town of Red Lake, on Red Lake.

HISTORY OF DEVELOPMENT: The stone is reported to have been extracted by the natives for making pipes (Dowling 1912).

GEOLOGY: The area was mapped by Horwood (1945) and Riley (1975). Riley shows the area to be predominantly underlain by felsic to mafic metavolcanics and metamorphosed mafic to ultramafic intrusive rocks.

Horwood (1945) described the three occurrences as follows:

I. "The talcose rock on the Cole property is a soft, medium-grained, rusty-grey-weathering material, which in places shows gradations to a less altered rock, which has some of the characteristics of a basic greenstone. On fresh surfaces the rock is light-grey in colour. It is much too impure to be of any commercial value. Small cracks in the rock contain stringers of pure talc with a maximum width of about an inch."

II. "The talc rock at the outlet of Pipestone bay was used by the Indians for making pipes and is locally known as "pipestone." the rock is lighter-coloured than that at the Cole property and appears to have been more completely altered. In thin section it is found to be composed of carbonate grains, surrounded by a fine-grained matrix of talc, and a little magnetite and pyrite. Other less pure specimens contain serpentine and a little quartz as well as carbonate and talc. Microscope work indicates that the basic greenstones have been altered first to serpentine-bearing rocks, then by the replacement action of hydrothermal solutions to serpentine-carbonate rocks, and in places to almost pure magnesium carbonates."

III. "The talc rocks on the Middle Bay claims are light-green to grey-green talc schists and are associated with basic greenstones. They are not as talcose as the rocks at the outlet of Pipestone bay."

Horwood interpreted the talcose rocks to be altered greenstones. Riley, however, mapped the rock in the vicinity of the occurrences as carbonatized serpentinite, serpentinized pyroxenite, and peridotite; indicating that the talcose rocks are altered ultramafics.

REFERENCES: Dowling (1912, p. 24)
Horwood (1945, p. 27-28)
Riley (1975)

NW2: Coste Island Occurrence
(French Portage Occurrence)

COMMODITY: Soapstone

STATUS: Prospect

OWNERSHIP: Crown land

LOCATION: The occurrence is located 41.5 km south-southwest of the town of Kenora on the southeastern shore of a small island in Lake of the Woods. The island is located just north of Falcon Island between the southeastern part of Coste Island and the western part of the Aulneau Peninsula.

Claim Map: G-2602, Astron Bay, Lake of the Woods; Kenora Mining Division

NTS: 52E/7NE

UTM: Zone 15 376467E 5475322N

Latitude: 49° 25' 12" Longitude: 94° 42' 12"

ACCESS: The island is accessible by boat. The recommended route from Kenora (from Canadian Hydrographic Service Maps 6218, 6212, 6216) is to follow the Main Track until the Southern Track branches off at Whisky Island. The Southern Track leads to French Portage and Coste Island.

HISTORY OF DEVELOPMENT:

early - Lawson (1886) noted that natives had used this stone to make ceremonial pipes for many years.

1975 - Frank Thorgrimson of Keewatin, held a quarry permit on the ground. He extracted a small amount of stone for carving ornamental pieces.

DESCRIPTION OF SITE: On the southeast shore of the island there is a small pit, approximately 1 m wide, where material has been removed.

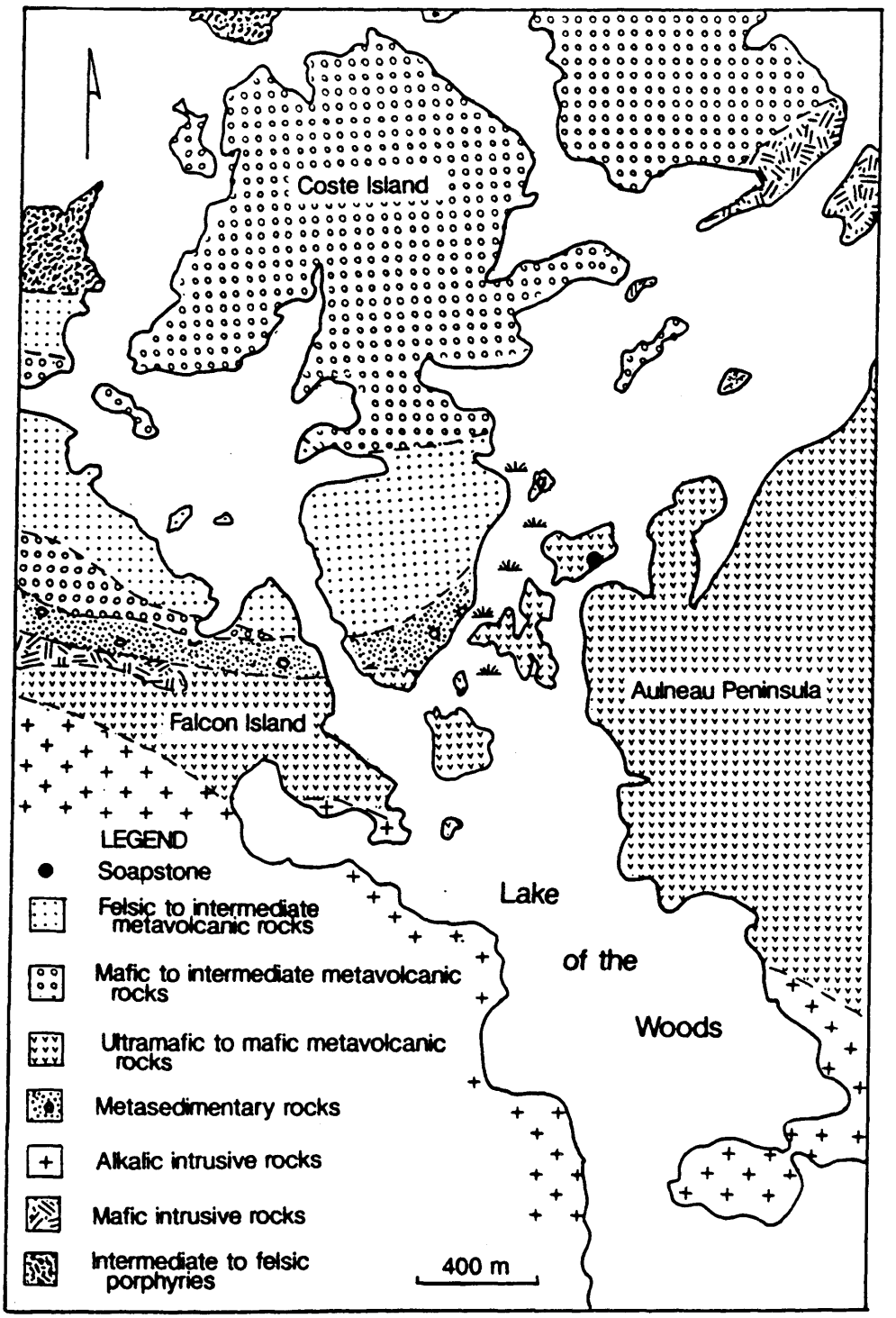
GEOLOGY: The area was mapped by Lawson (1886), Thomson (1937), and Ayer et al (1989). The geology of the area, shown on Figure 6, comprises ultramafic to intermediate metavolcanics and syenitic intrusive rocks. The soapstone occurs within fine-grained, dark green, ultramafic metavolcanics; now talc-chlorite-amphibole schist. Pillows are evident within the metavolcanics at the north end of the small island. At the south end of the island, mica is evident along fracture surfaces within the metavolcanics.

Previous workers have described the soapstone unit as approximately 60 m in width (Storey 1986; Resident Geologist's files, MNDM, Kenora). The authors noted only a 2 m to 3 m wide unit of material soft enough to be called soapstone. The unit trends parallel to the shore of the island (060°) and dips very steeply.

STONE DESCRIPTION: The stone is fine grained, dark grey in colour, soft and highly suited to carving.

X-ray diffraction mineral analysis reported by Storey (1986) indicated the rock is variable in composition. One sample was predominantly talc and chlorite with amphibole and dolomite; a second sample contained primarily chlorite and amphibole with lesser talc. The second sample is presumably a less altered rock than the first.

REFERENCES:
Ayer et al (1989)
Lawson (1886, p. 148-149, p. 49cc)
Storey (1986, p. 82)
Thomson (1937)



Geology after Ayer et al, 1989

Figure 6: Geology in the Vicinity of the Coste Island Soapstone Occurrence (NW2)

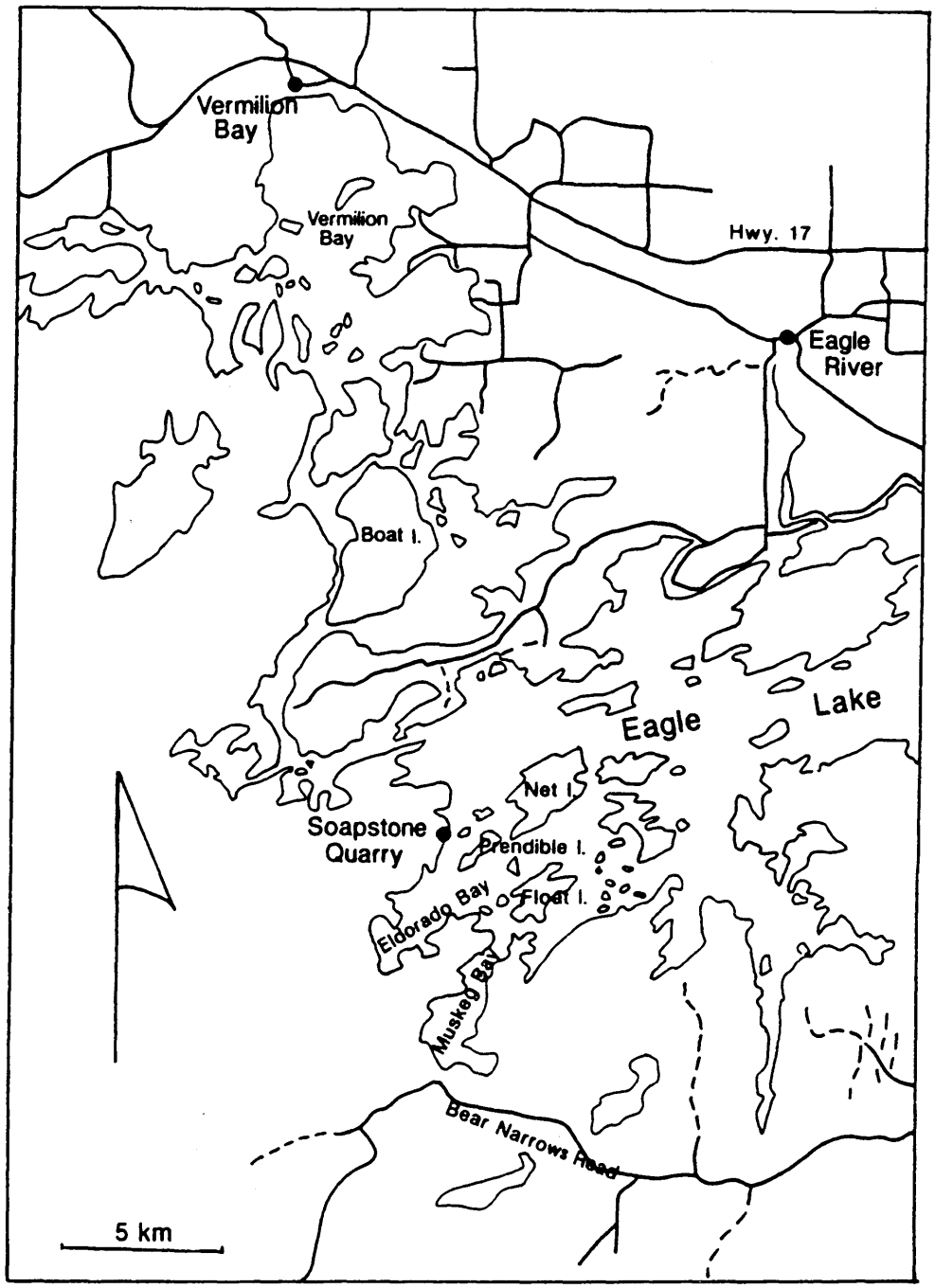


Figure 7: Location of the Eagle Lake Soapstone Quarry (NW3)

NW3: Eagle Lake
(Eagle Lake Soapstone Quarry)
(Eagle Lake Soapstone Mines Ltd.)
(Grace Soapstone Quarry)
(Grace Mining Company)
(Grace Mine)

COMMODITY: Soapstone

STATUS: Past producer

OWNERSHIP: Quarry permit issued to F. Thorgrimson of Keewatin. Claim K590013 held by Camreco lnc. (searched January, 1990) excludes quarry permit-soapstone.

LOCATION: The quarry is located 16.5 km southwest of the village of Eagle River. It is on the southwest shore of Eagle Lake, west of Prendible Island on claim K590013 (see Figure 7).

Claim Map: M-1729, Garnet Bay, Eagle Lake;
Kenora Mining Division

NTS: 52F/11NW

UTM: Zone 15 476900E 5501650N

Latitude: 49° 40' 08" Longitude: 93° 19' 14"

ACCESS: The site is accessible by water. A boat can be launched from any number of sites on the north shore of Eagle Lake which can be reached via good roads leading south from the Trans-Canada highway.

HISTORY OF DEVELOPMENT:

Note: The quarry is situated adjacent to the former Grace Gold Mine which was operated by the Grace Mining Company prior to 1911 and between 1920 and 1922. In the early 1920's, the Grace Mine manager, W.J. Richards of Kenora, discovered the soapstone unit on the mine property while prospecting in the area. When the gold mine failed, the company developed the soapstone quarry. All the original shareholders in the gold mine are reported to have retained their interests in the development of the soapstone quarry. (The Daily Times-Journal, July 7, 1925; Moorhouse 1941). The company became known as Eagle Lake Soapstone Mines Ltd. See Photos 1 and 2 from Spence (1928) showing the quarry when it was operating.

1924 - 95 tons of soapstone were reported to have been prepared for market (Rogers and Young 1926a). One shipment of 40 blocks, each 12 by 12 by 18 inches (30 by 30 by 45 cm), for Kraft mill furnace linings was reported. Another shipment was lost when a scow sunk. (Sutherland et al 1926a) The quarry employed 7 to 9 men during the summer months under the supervision of manager W.J. Richards. At this time the plant installed at the quarry site consisted of two boilers, a two drill Ingersol-Rand air compressor, a derrick and hoist, a Sullivan channelling machine and a gang saw (Sutherland et al 1926a).

1925 - 64 tons (3 carloads) of soapstone were sawn and sold to the Dryden paper mill (Rogers and Young 1926b; Sutherland et al 1926b). Additional equipment installed at the quarry included two more Pollard gangsaws which had been used in cutting the marble for the parliament buildings in Winnipeg. A 75 foot steamer (tug) and 50 foot barge were also acquired for the operation. (The Daily Times-Journal, July 7, 1925). Buildings on the property included a bunk-house, cook-house, office, managers house, and mill building. (Sutherland et al 1926b)

1926 - 110 tons of soapstone were sawn and sold to Ontario pulp mills (Rogers and Young 1928). The quarry and plant operated during the summer months (Sutherland et al 1928).

1927 - 135 tons of soapstone were sawn and sold to pulp and paper mills at Dryden and Winnipeg (Rogers and Young 1929). Operations had ceased by July (Sutherland et al 1928). No further production by the Grace Mining Company is reported.

Summary of Production: 1924-1927
(from Resident Geologist's Files, MNDM, Kenora)

	Days in operation	Mined tons	Milled tons	Sales Milled tons	$
1924	150	95	40	-	-
1925	240	75	-	64	2,525
1926	-	500	240*	110*	4,400
1927	-	200	-	135	5,670

* The Grace Mining Company channelled their soapstone and sawed 240 tons of which 110 tons were sold to pulp mills in Ontario.

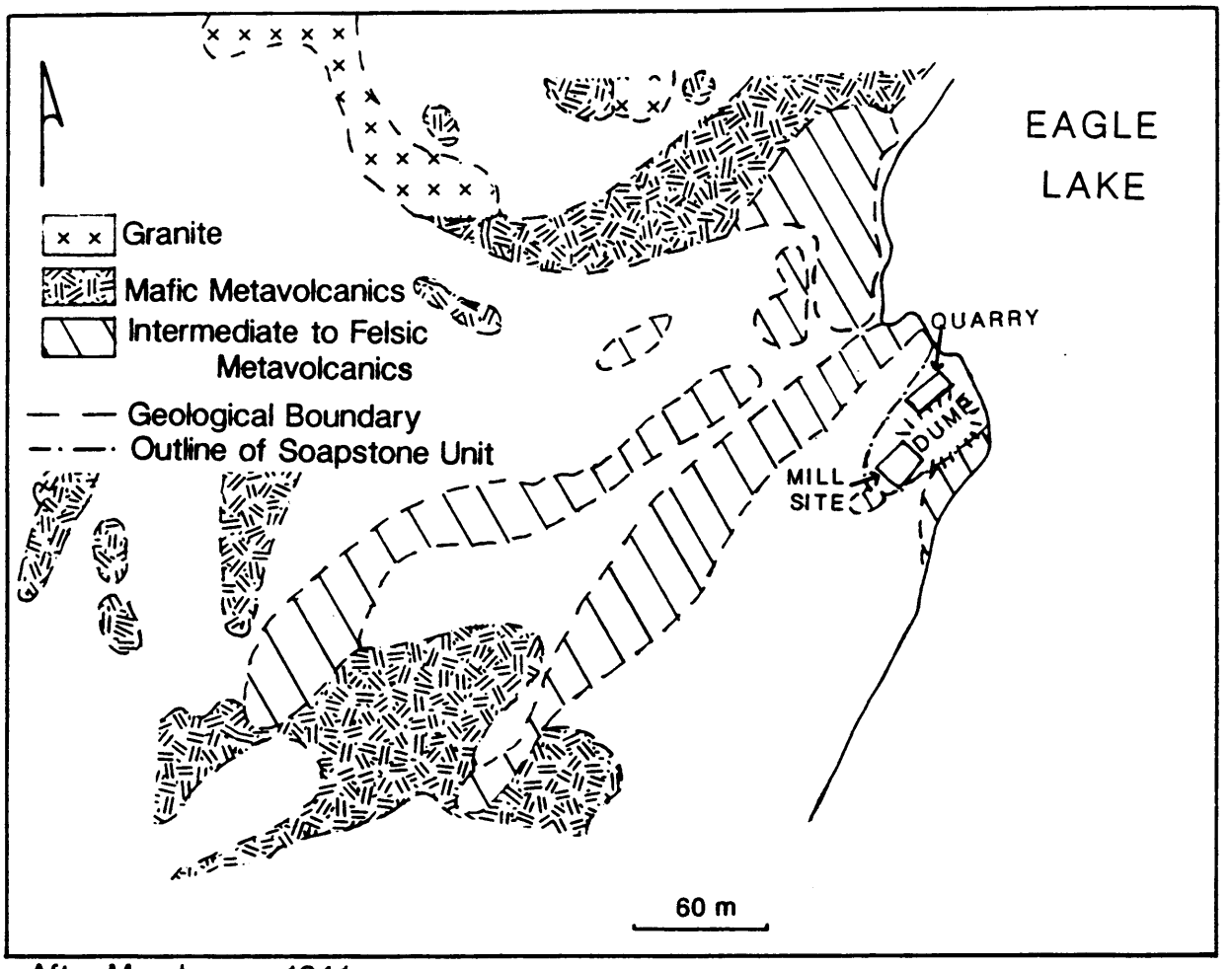
1981 - Frank Thorgrimson was issued a quarry permit encompassing the old quarry and waste dumpsite. Small amounts of stone have been extracted annually from the waste material at the site for carving purposes.

DESCRIPTION OF SITE: The former site of the quarry can be seen from the lake; a large waste pile of small soapstone pieces and cuttings extends to the waters edge adjacent to a low, gently sloping outcrop which is 13 m wide (see Photo 5). Many names and comments are carved in the soft stone. The quarry is located approximately 10 m from the shore. It is flooded and the sides are mostly overgrown with vegetation. The quarry is 10 m by 19.5 m, elongate in a northeasterly direction, and at least 4 m deep (depth was hard to determine due to water level). The quarry appears to be deepest at the southwest end. In this area three ledges of the quarry are exposed; the ledge nearest the top of the quarry is 1 m high, the next 1.5 m high and, the lowest ledge is 2 m high. It appears that the stone was channelled at 1 m intervals along each ledge. Blocks are stacked along the southeast side of the quarry (see Photo 6). Within this pile, the blocks have been sawn to the approximate dimensions of 0.3 m by 0.7 m by 1.3 to 1.4 m. The largest block is 1.4 m by 1.35 m by 0.73 m. Overburden is 0.5 m to 1 m thick at the quarry and appears to get thicker away from the quarry. The foundations of the mill and other buildings can be seen south of the quarry.

GEOLOGY: The geology of the area was mapped by Moorhouse (1941) and is shown on Figure 8. The soapstone deposit has been described by Spence (1928, 1940), Moorhouse (1941), Storey (1986), Redden (in press), and Kennedy and Sherlock (1989). The soapstone unit occurs within felsic to intermediate metavolcanics and is enclosed in a talc-chlorite schist. The metavolcanics are layered and appear to be fragmental. The schistosity is 060° dipping steeply to the south or vertical. The soapstone unit also strikes 060° to 065°. It seems to be limited to a small area and is poorly exposed. The soapstone could not be traced along strike inland (southwest) further than 40 m, similar units (talc-chlorite schist) were found on the islands that occur approximately 600 m along strike to the northeast. Storey (1986) described the unit as 30 m wide by up to 180 m in length and possibly lensoidal in character.

Photo 5: Waste Dump at Eagle Lake Soapstone Quarry

Photo 6: Sawn Soapstone Blocks at Site of Eagle Lake Quarry



After Moorhouse, 1941

Figure 8: Geology in the Vicinity of the Eagle Lake Soapstone Occurrence (NW3)

STONE DESCRIPTION: The soapstone is dark grey to grey-green in colour and soft. It is fine grained. Narrow, brown, iron-carbonate veins cut the soapstone. In some cases, coarse-grained pale-green talc is developed within the veins. Slickensided surfaces within the soapstone are covered with a dark green mineral, apparently chlorite and/or serpentine.

Only occasional joints or fractures were observed within the quarry. The outcrop at the shore line is very fractured with a fracture spacing of 15 cm common. The size of the sawn blocks at the site would indicate that the fracturing or jointing within the deposit is widely spaced. The mineralogy of the soapstone as determined by X-ray diffraction analysis is shown below:

Talc	50%
Chlorite	30%
Serpentine	<5%
Dolomite	10%
Magnesite	-
Magnetite	<5%
Epidote	<5%

(Geoscience Laboratories, Ontario Geological Survey, MNDM)

This agrees with analyses reported in Storey (1986) and from thin section observations made by Moorhouse (1941).

TEST RESULTS:

Specific Gravity: 2.88

Chemical Analysis:

	1	2	3	4
SiO_2	43.20	40.30	38.40	37.50
TiO_2	-	0.38	0.32	0.36
Al_2O_3	6.74	5.94	7.14	5.15
Fe_2O_3	3.51	4.15	5.10	13.10
FeO	7.95	8.15	7.65	-
MnO	-	0.07	0.11	0.14
MgO	27.64	27.20	26.70	26.70
CaO	1.30	2.71	2.884	4.32
Na_2O	-	0.0	0.02	0.0
K_2O	-	0.01	0.01	0.0
P_2O_5	-	0.07	0.04	0.06
CO_2	1.95	4.19	4.17	6.30
S	-	0.06	0.06	0.07
H_2O^+	7.80	6.19	7.10	-
H_2O^-	-	0.0	0.10	-
Total	**100.09**	**99.40**	**99.80**	**93.70**
LOI	-	10.00	10.90	12.30

1. Spence (1940)
2. Redden (in press)
3. Geoscience Laboratories, Ontario Geological Survey, MNDM - 1988
4. Geoscience Laboratories, Ontario Geological Survey, MNDM - 1989

Note: Total Fe expressed as Fe_2O_3; Fe, H_2O^+, H_2O^- not determined.

Thermal Tests: (from Redden in press) (tests performed by Geoscience Laboratories, Ontario Geological Survey, MNDM)

A - 500°C % weight loss - 0.11 (Note 1,2,4,6)
B - 1050°C % weight loss - 10.97 (Note 1,3,5,6)

Notes:
1. block size approx. 2.5 x 5 x 5 cm
2. blocks heated at 500 degrees C for 3 hours
3. blocks heated to 800 degrees C then raised to 1050 degrees over 2 hours, maintained at 1050 degrees for 2 hours then left for 13 hours at 800 degrees
4. colour changed from initial dull green to dull grey
5. colour changed from initial dull green to a combination of light brown and dull orange/red
6. hairline shrinkage cracks with random orientations appeared in most samples. no spalling or disintegration. no visible changes in dimensions

Redden also tested small (3-8 cm) pieces of the soapstone in place of lava rock in a propane barbecue and larger pieces as sauna rocks and found the stone suitable for both applications. Redden reports that 2.5 cm thick slabs of the soapstone placed on a wood stove, operated intermittently for four months, showed no visible changes other than slight discolouration of one sample.

Carving Tests:

1. The soapstone from Eagle Lake was determined to be somewhat hard for the carving techniques employed by Stone Studio Siku Inc. of Parry Sound, Ontario (B. Krummrei, Stone Studio Siku Inc., personal communication, 1989).

2. Results of test carving by Brian Clark of Edmonton are reported in Redden (in press). They are as follows:

" 1. The soapstone is harder than any other soapstone carved thus far. It takes much more time during the carving stage. Over 15 hours were taken in the initial carving and polishing. An additional 4 hours were used for oiling and finishing.

2. The rock is too hard for normal soapstone tools, i.e. rasp, files. Carbide shaping tools with an electric drill were found to be most effective.

3. The texture is similar to typical soapstone materials. The soapstone holds together well, the texture is fairly massive and therefore the stone does not exhibit a significant metamorphic foliation. This ... lack of schistosity is very important for sculptors. The dust is dark compared to the commonly white-grey dust of soapstone.

4. The rock has a fairly uniform physical quality; it has a few very local hard spots. No pyrite or other metallic minerals were noted.

5. The soapstone is a dense rock and doesn't undercut (spall) upon working, which is typical of most other soapstones. From this aspect the soapstone is of superior quality.

6. The soapstone polishes quickly; wet 240 and 400 sandpaper was used.

7. Overall the soapstone is nice and satisfying

to work with allowing a fair amount of detail to be incorporated into a carving. From several points of view, the soapstone appears to be superior to many other soapstones presently available to sculptors. It has an attractive dark appearance (similar to Brazilian soapstone) when finished with oil and wax."

3. F. Thorgrimson of Keewatin carves a variety of items from the Eagle Lake soapstone including ceremonial pipes, amulets and birds and animals (see Photos 3 and 4). He also uses electrical tools to aid with initial shaping of the carvings as the stone is quite hard. He notes that detail and finishing are very time consuming.

REFERENCES: Kennedy and Sherlock (1989, p. 173)
Moorhouse (1941, p. 25)
Redden (in press)
Rogers and Young (1926a, p. 35)
Rogers and Young (1926b, p. 41)
Rogers and Young (1928, p. 41)
Rogers and Young (1929, p. 39)
Spence (1928, p. 21)
Spence (1940, p. 66)
Storey (1986, p. 93-95)
Sutherland et al (1926a, p. 77)
Sutherland et al (1926b, p. 167)
Sutherland et al (1928, p. 177)

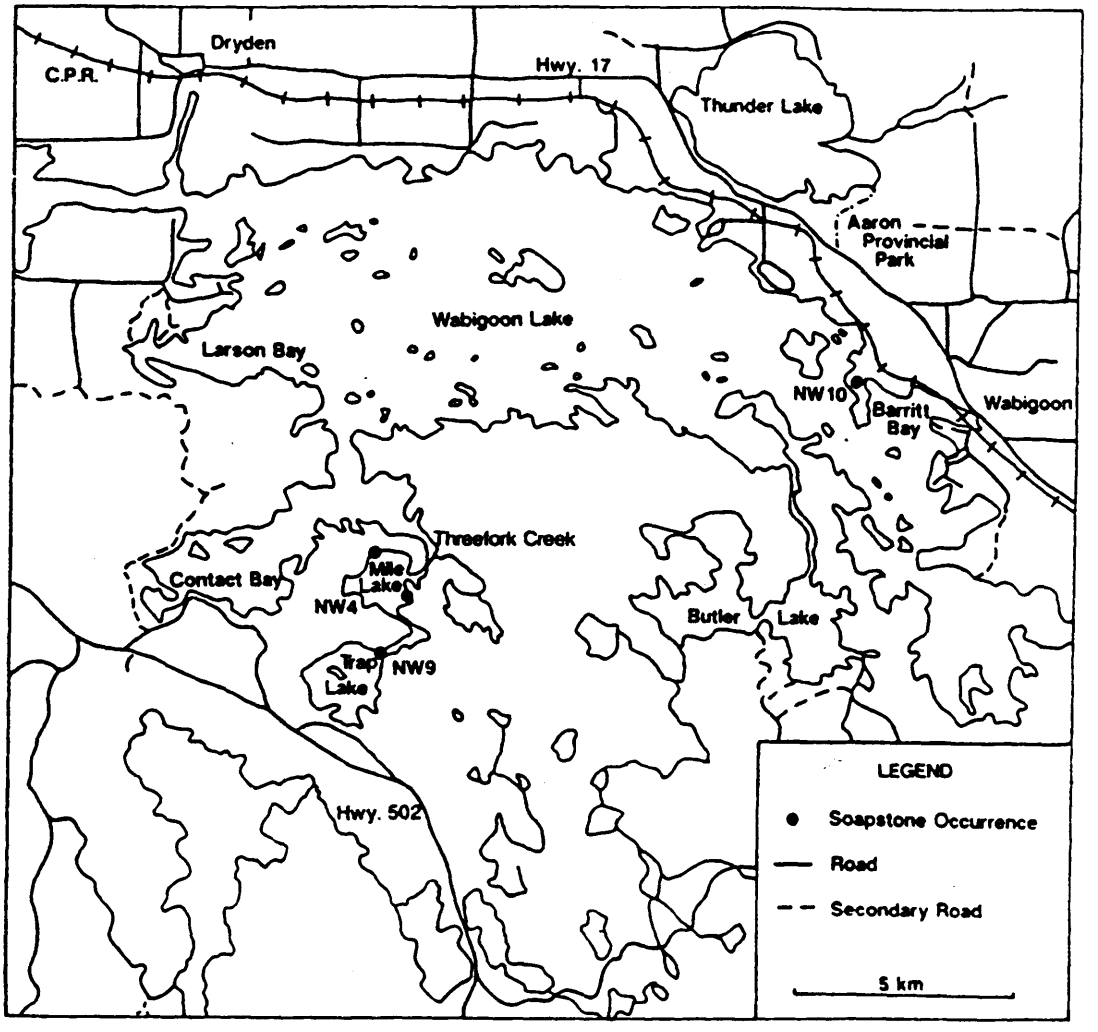


Figure 9: Location of the Wabigoon (NW 10), Mile Lake (NW 4) and Trap Lake (NW 9) Soapstone Occurrences

NW4: Mile Lake

COMMODITY: Soapstone

STATUS: Prospect

OWNERSHIP: Southeast occurrence - Staked claim held by Eagle Lake Explorations Ltd.
Northwest occurrence - Staked claim held by Ken Bernier

(searched January 31, 1990)

LOCATION: Two occurrences are located approximately 12 km south-southeast of the town of Dryden on the northwest and southeast shores of Mile Lake (see Figure 9).

Claim Map: G-2579, Contact Bay, Wabigoon Lake; Kenora Mining Division

NTS: 52F/10NW

Southeast Occurrence

UTM: Zone 15 516450E 5502450N

Latitude: 49° 40' 36" Longitude: 92° 46' 18"

Claim: 1019768

Northwest Occurrence

UTM: Zone 15 515700E 5503700N

Latitude: 49° 41' 27" Longitude: 92° 46' 54"

Claim: 1119527

ACCESS: The deposit may be reached by boat from Wabigoon Lake through Contact Bay via Threefork Creek. Boat launches are located in numerous places on Wabigoon Lake. Highway 502, which goes south from Dryden, passes just south of Contact Bay and Trap Lake which is south of Mile Lake. Roads lead to both bodies of water from the highway (see Figure 9).

HISTORY OF DEVELOPMENT:

~1924 - The two occurrences were discovered and test blocks were extracted from the southeast occurrence, presumably by the Wabigoon Soapstone Company, Ltd. (Wright in Wilson 1926; Satterly 1943).

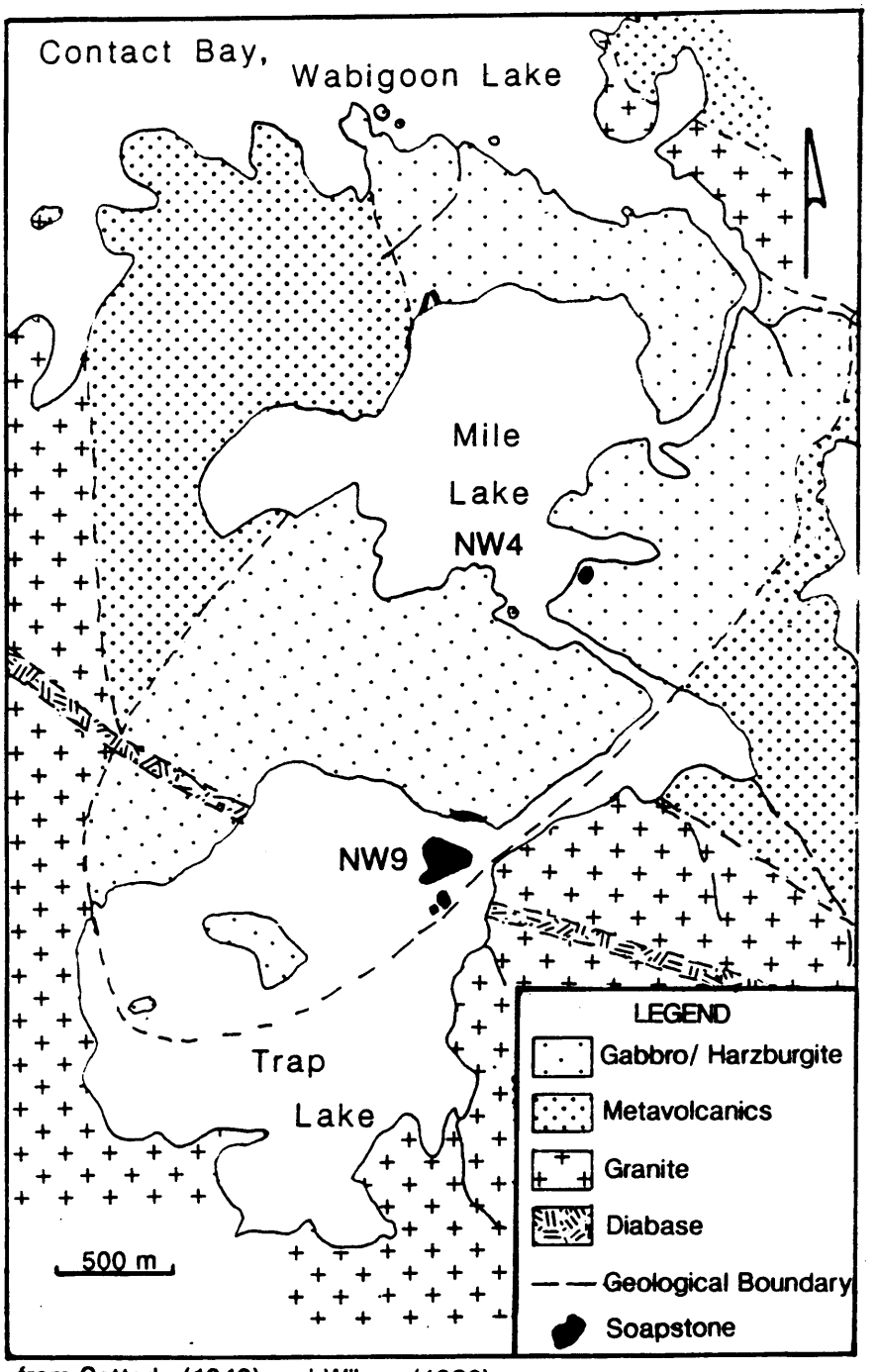
1970 - Test pits were sunk on the northwest occurrence during copper/nickel exploration (Storey 1986).

DESCRIPTION OF SITE:

Northwest occurrence - A small outcrop of soapstone is located on the shore of the lake. At the shore the outcrop has a width of 0.5 m to 2 m. The clay overburden prevents determination of the extent of the occurrence (Redden in press).

Southeast occurrence - The occurrence is exposed in one outcrop approximately 20 m from the shore of the lake. The outcrop is roughly 15 m by 15 m. Evidence of past work consists of one small pit from which material has been removed. Some remnant pieces of the soapstone lie about the site; some of them have sawn surfaces. Several caved-in and overgrown trenches in the clay overburden were observed between the shore and the outcrop.

GEOLOGY: The area was mapped by Satterly (1943). The Mile Lake-Trap Lake area is underlain by a northeast-trending mafic to ultramafic body (4.2 km by 1.8 km in size) which intrudes metavolcanic rocks to the north and granitic rocks to the south. The granitic and mafic to ultramafic rocks are cut by a 100 m wide northwest-trending diabase dike. The geology is shown on Figure 10. Satterly notes that the mafic to ultramafic rocks are gabbro and harzburgite. The soapstone occurrences appear to be altered ultramafic components of the intrusive body. The Mile Lake occurrences are described by Satterly (1943), Storey (1986), and Kennedy and Sherlock (1989). The northwest occurrence is described by Redden (in press). Satterly (1943) suggested that the southeast occurrence was probably a highly altered, ultrabasic lens in the gabbro. The northwest occurrence, located near the contact of the gabbro and metavolcanics contained biotite, probably metamorphic in origin. In the area of the northwest occurrence the talc-bearing rocks appear to be associated with a shear zone in the gabbroic rocks (Storey 1986). The exposure of both occurrences is limited.



from Satterly (1943) and Wilson (1926)

Figure 10: Geology in the Vicinity of the Mile Lake (NW4) and Trap Lake (NW9) Soapstone Occurrences

STONE DESCRIPTION:

Northwest occurrence - Satterly (1943) described the soapstone as greenish in colour and coarse grained with aggregates of biotite. Redden (in press) described the stone as mottled grey and black with disseminated carbonate and a few carbonate stringers. X-ray diffraction mineral analysis reported by Storey (1986) notes one sample composed predominantly of talc and chlorite with minor dolomite and very minor amphibole. Three other samples contained talc and serpentine as the major constituents of the rock, with minor amphibole and very minor quartz and mica.

Southeast occurrence - The soapstone is medium-grained and mottled greenish-grey and black. Storey (1986) noted joints 115°/80° S and 355°/90° spaced 0.6 m and more apart.

TEST RESULTS:

Specific Gravity: 2.85 (Southeast occurrence)

Chemical Analysis:

	1	2
SiO_2	38.80	37.60
TiO_2	0.35	0.11
Al_2O_3	5.78	6.25
Fe_2O_3	3.90	11.10
FeO	9.61	-
MnO	0.10	0.09
MgO	25.00	26.90
CaO	4.80	4.62
Na_2O	0.0	0.0
K_2O	0.0	0.0
P205	0.06	0.01
CO_2	4.49	6.26
S	0.15	0.01
H_2O^+	6.25	-
H_2O^-	0.06	-
TOTAL	**98.30**	**92.95**
LOI	9.30	12.90

1. Northwest occurrence (Redden in press)
2. Southeast occurrence (Geoscience Laboratories, Ontario Geological Survey, MNDM)

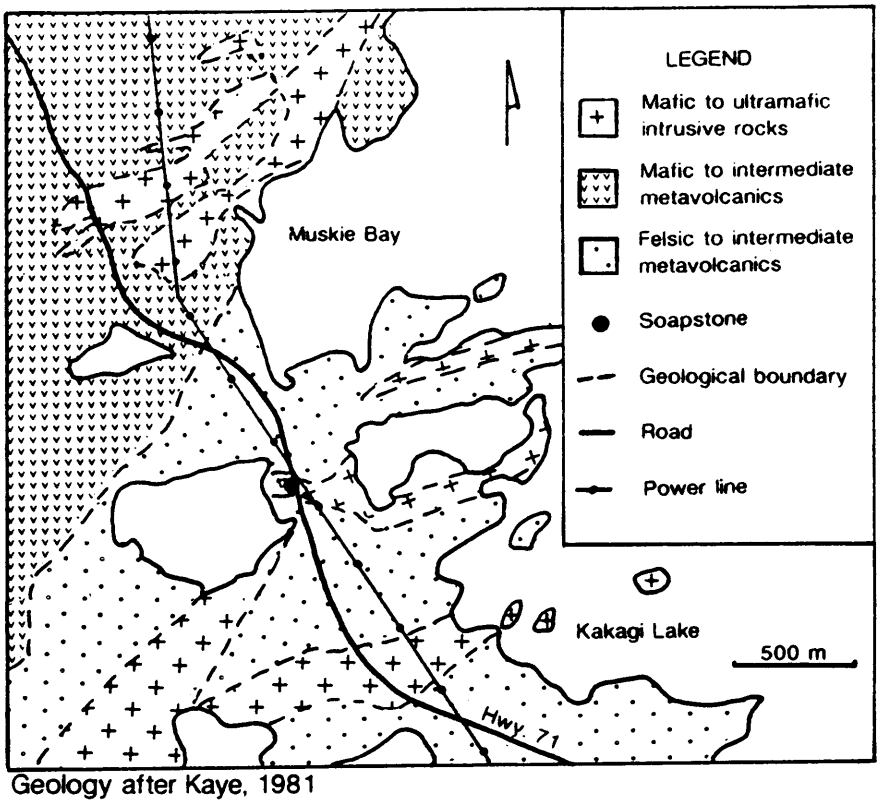
Note: Total Fe expressed as Fe_2O_3; FeO, H_2O^+, H_2O^- not determined

Carving Tests: A sample from the southeast occurrence was submitted to Stone Studio Siku Inc. of Parry Sound, Ontario It was determined to be the most suitable carving material of the northwestern Ontario soapstone samples tested, although still somewhat hard for the carving techniques employed by the artist (B. Krummrei, Stone Studio Siku, Inc., personal communication, 1988). A relief carving produced from the material is the frontispiece of this report. The stone has an attractive mottled appearance and adapts well to the various finishes applied including polished, honed, sandblasted and hand engraved.

Redden (in press) reports that carver B. Clark of Edmonton found the material from the northwest occurrence suitable for carving.

REFERENCES:

Kennedy and Sherlock (1989, p. 174-175)
Redden (in press)
Satterly (1943, p. 54)
Storey (1986, p. 99-100)
Wright (in Wilson, 1926, p. 58)



Geology after Kaye, 1981

Figure 11: Geology in the Vicinity of the Phillips Township Soapstone Occurrence (NW5)

NW5: Phillips Township

COMMODITY: Soapstone, Talc

STATUS: Occurrence

OWNERSHIP: Staked claim held by Canadian Nickel Company Limited (searched January 22, 1990)

LOCATION: The occurrence is located 70 km southeast of the town of Kenora, in Phillips Township. It is on the west side of Kakagi Lake, just south of Muskie Bay (see Figure 11). The occurrence is on claim K.777690.

Claim Map: M-2102, Phillips Twp;
Kenora Mining Division

NTS: 52F/4NW

UTM: Zone 15 427950E 5452400N

Latitude: 49° 13' 20" Longitude: 93° 59' 22"

ACCESS: The occurrence lies on the east side of Highway 71, 13 km north of Nestor Falls, in an outcrop between the road and a powerline opposite a sign (facing north) which reads "Muskie Bay Road 500 m".

HISTORY OF DEVELOPMENT: There is no record of exploration or development work for soapstone having been carried out on this occurrence.

GEOLOGY: The area was mapped by Burwash (1934) and Kaye (1981). The occurrence was previously described by Storey (1986). The area is underlain by intermediate to felsic metavolcanics and ultramafic intrusive rocks, predominantly clinopyroxenite. The occurrence lies within a narrow ultramafic band (see Figure 11).

Just north of the occurrence, within the felsic metavolcanics, are zones up to 1 m wide that are talc and carbonate rich. These areas are strongly foliated. The foliation is oriented 160 and near vertical in dip. There are also small areas of massive talc present in the metavolcanics.

The occurrence comprises a talc-chlorite schist that is 25 m wide and of undetermined length. The schistosity trends 150° to 160° and dips steeply north. The intensity of the schistosity is variable; while some of the material is weakly foliated, a number of more intensely schistose zones, possibly shear zones, up to 1 m wide were observed. The rock contains approximately 30 percent iron carbonate which is randomly distributed, as well as thin carbonate and talcose veins.

STONE DESCRIPTION: The stone is fine grained, soft, and foliated. It is dark green on fresh surfaces; the weathered surface is a rusty colour.

X-ray diffraction mineral analysis reported by Storey (1986) indicates that the soapstone is composed primarily of talc and chlorite, with dolomite and minor amphibole.

REFERENCES: Burwash (1934)
Kaye (1981)
Storey (1986, p. 107-108)

NW6: Pipestone Lake, Northwest Arm (Pipestone Lake North)

COMMODITY: Soapstone

STATUS: Occurrence

OWNERSHIP: Staked claims held by Noranda Exploration Co. Ltd. (searched February, 1990)

LOCATION: The occurrence is located 60 km north northwest of the town of Fort Frances in the southern part of a bay on the southwestern shore of the Northwest Arm of Pipestone Lake. It is on staked claims K.980811 and K.980822.

Claim Map: G-2670, Brooks Lake;
Kenora Mining Division

NTS: 52F/04NE

UTM: Zone 15 459800E 5442900N

Latitude: 49° 08' 23" Longitude: 93° 33' 03"

ACCESS: Pipestone Lake is accessible by boat via Burditt Lake, from the north end of Highway 615, 45 km northwest of Fort Frances.

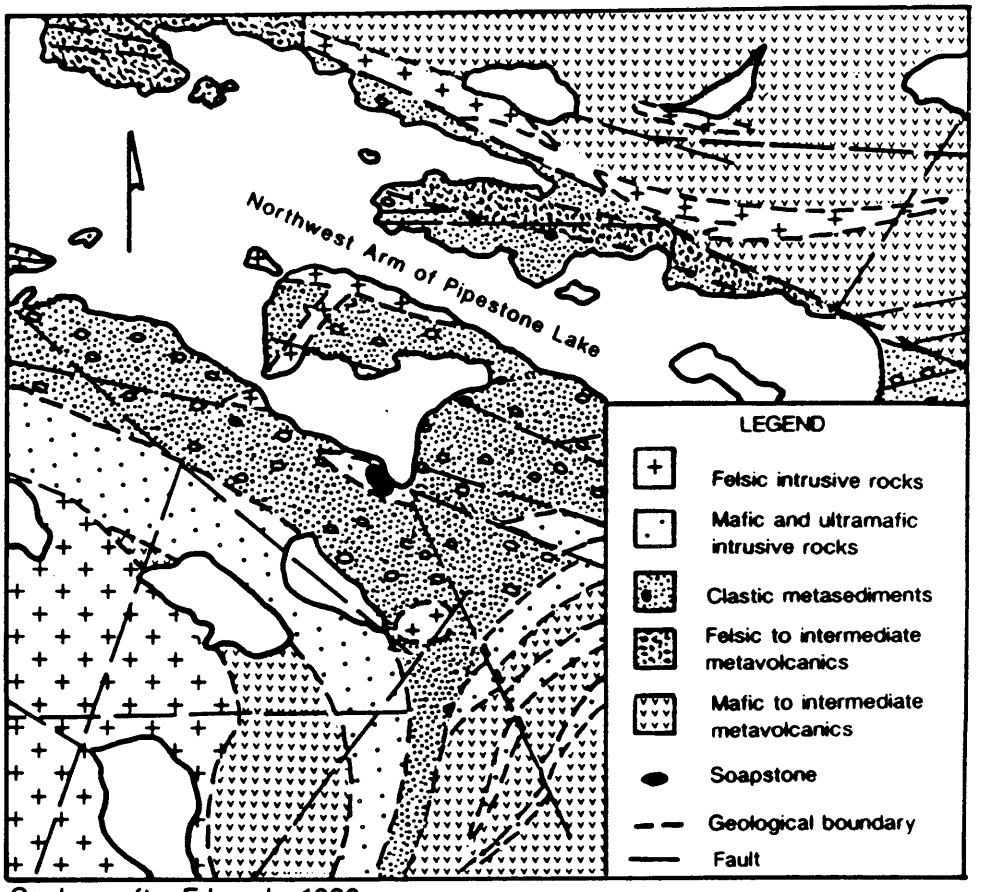
HISTORY OF DEVELOPMENT: Coleman (1895) noted that the material had been used by the natives for making ornamental ceremonial pipes.

GEOLOGY: The area was mapped by Thomson (1936) and Edwards (1980). The area is underlain by metasediments and metavolcanics intruded by mafic and ultramafic and felsic intrusive rocks. The occurrence lies within a small northwest-trending lens-shaped peridotite body that is fault bounded on its northeast side. Storey (in press) notes that the talc-rich rock occurs adjacent to this fault (see Figure 12).

STONE DESCRIPTION: Storey (in press) described the occurrence. The stone is fine-grained, soft, magnetic, and dark green to blue-grey in colour. The weathered surface of the rock is rusty. X-ray diffraction mineral analysis indicated that talc is the primary mineral in the rock with dolomite and minor chlorite and magnetite.

REFERENCES:

Coleman (1895, p. 76)
Edwards (1980)
Storey (in press)
Thomson (1936)



Geology after Edwards, 1980

Figure 12: Geology in the Vicinity of the Pipestone Lake, Northwest Arm Soapstone Occurrence (NW6)

NW7: Pipestone Peninsula
(Pipestone Portage)
(Andrew Bay Deposit)

COMMODITY: Soapstone

STATUS: Past Producer

OWNERSHIP: At time of writing (January, 1990) the area is withdrawn from staking as a candidate provincial park but is in the process of being re-opened for staking (S.Rivett, Mining Recorder, MNDM, Kenora, personal communication, 1990).

LOCATION: The occurrence is located 20 km southeast of the town of Kenora, in Manross Township, on a narrow strip of land 75 m wide, which is part of Pipestone Peninsula. It is the site of an old portage joining Moore Bay and Andrew Bay of Lake of the Woods (see Figure 13).

Claim Map: M-2338, Whitefish Bay and Manross Township; Kenora Mining Division

NTS: 52E/9NW

UTM: Zone 15 403400E 5497500N

Latitude: 49° 37' 27" Longitude: 94° 20' 08"

ACCESS: The occurrence is accessible by boat from the town of Kenora on Lake of the Woods. The following route is from Canadian Hydrographic Services Maps 6218 and 6212: Follow the main track from Kenora. After going through the Devil's Gap, follow the East Track. Just south of Middle Island and Hay Island, turn eastward to enter Moore Bay. The portage and quarry site are located south of a small bay along the north shore of the peninsula.

HISTORY OF DEVELOPMENT:

1915 - Messrs. Mather and Beveridge shipped soapstone from this site to the Dryden Timber and Power Company, Dryden for lining soda-smelting furnaces. The stone was used in blocks 45 cm (18 inches) by 30 cm (12 inches by 20 cm (8 inches) (Sutherland et al 1916).

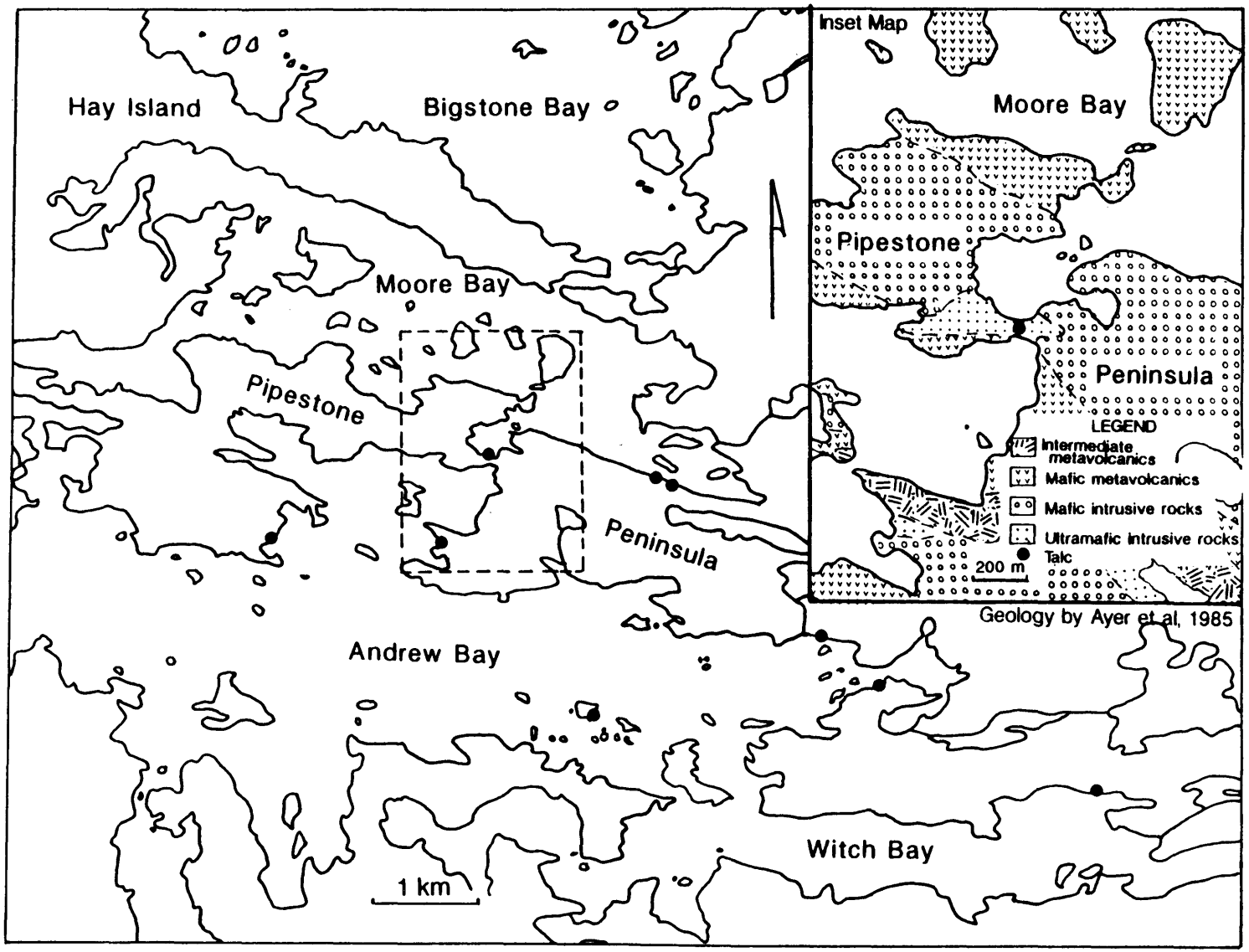


Figure 13: Location and Geology of the Pipestone Peninsula Occurrence (NW7)

~1918-19 - The Dryden Pulp and Paper Company shipped four railcar loads of stone to their Dryden mill. The stone was shipped by scow to the railway at Kenora. The stone was sawn into blocks and tested as furnace lining material but was apparently too seamy and did not stand up under heat. (Spence 1922)

No further work is reported at this site.

DESCRIPTION OF SITE: The old workings are located just east of the portage/trail. They consist of a working face 5 m to 6 m high which was developed in the side of a bluff, facing the Moore Bay side of the peninsula, as well as a trench and a number of small pits, approximately 30 m uphill and inland (south) of the quarry face. The working face is approximately 30 m in length. Some slabs of the soapstone and waste pieces lie in piles in front of the face. Sawn surfaces and drill marks were observed on the face and waste blocks. A couple of old pits in overburden were observed on the Andrew Bay side of the peninsula where the past workers may have tried to locate the soapstone unit.

GEOLOGY: The area was mapped by Lawson (1886), Suffel (1931) and Ayer et al (1985). Ayer et al noted a number of talc occurrences in the Pipestone Peninsula area, including this occurrence, which are hosted within narrow units of metamorphosed ultramafic intrusive rocks associated with mafic and intermediate metavolcanics and mafic intrusive rocks. These occurrences are shown on Figure 13.

The soapstone occurrence has been described by Spence (1922, 1940), Wilson (1926) and Storey (1986). The soapstone unit is only exposed in the vicinity of the old workings; for approximately 30 m along strike and intermittently across a width of 30 to 40 m in old pits. Schistosity is somewhat variable, from westerly striking to west-southwesterly striking and dips very steeply to vertical. Storey (1986) describes the soapstone as developed in narrow (1 m) lenses in altered mafic rocks. The unit appears to become less talcose along strike in either direction. Much of the soapstone is cut by narrow iron-carbonate veins and carbonate veins. Non-talcose metavolcanics were noted on the Andrew Bay side of the peninsula.

Spence (1922) describes the occurrence as follows:

> "The stone cannot be classed as a soapstone, and possesses more the character of a soft, chloritic slate. It is brownish-green in colour, somewhat harsh to the touch, and yields a dirty grey powder having little or no slip. It occurs as a band about 75 feet wide, enclosed

in harder, grey slate, and striking almost due east. The dip is steep. The rock has a slaty structure, exhibits considerable jointing, and breaks out in large blocks; it stands up well under the hammer. The band is drift-covered east of the outcrop on Moore bay, and its extent was not determined."

STONE DESCRIPTION: The soapstone is dark grey in colour and foliated. It is quite fractured on the whole and parts readily along the foliation. It commonly contains narrow (<1 cm) dolomitic veins.

Storey (1986) reports the mineralogy, as determined by X-ray diffraction analysis, to consist primarily of talc, chlorite and dolomite. The talc content appears to be quite variable, as the softness of the stone varies within the unit.

TEST RESULTS:

Chemical Analysis: (from Spence 1922)

SiO2	39.14
FeO	8.79
Fe_2O_3	3.48
Al_2O_3	7.32
CaO	5.92
MgO	21.31
CO2	7.31
H2O (above 105°C)	6.68
Total	**99.95**

REFERENCES:

Ayer et al (1985)
Lawson (1886)
Spence (1922, p. 34-35)
Spence (1940, p. 63-64)
Storey (1986, p. 102-103)
Suffel (1931)
Sutherland et al (1916, p. 67)
Wilson (1926, p. 56)

NW8: Sucan Lake

COMMODITY: Soapstone

STATUS: Occurrence

OWNERSHIP: Crown land (searched February, 1990)

LOCATION: The occurrence lies along the western shore of the southern bay of Sucan Lake, 55 km north of the town of Fort Frances.

Claim Map: G-2679, Kaiarskons Lake;
Kenora Mining Division

NTS: 52F/3SW, NW

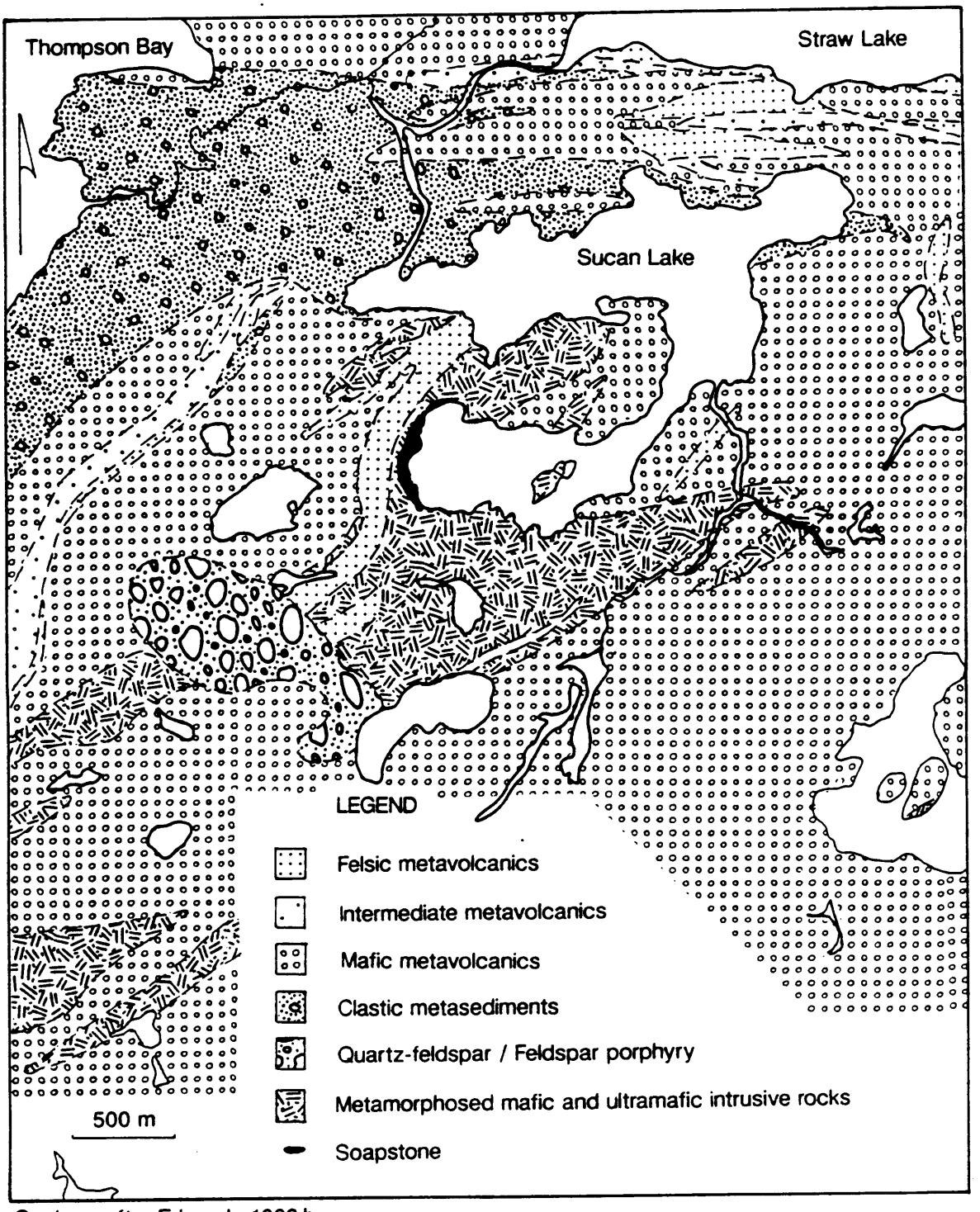
UTM: Zone 15 468400E 5439750N

Latitude: 49° 06' 41" Longitude: 93° 25' 57"

ACCESS: The occurrence is accessible from Sucan Lake. Sucan Lake may be reached from Straw Lake, which is reached by portage from Thompson Bay of Pipestone Lake. Pipestone Lake is accessible by boat via Burditt Lake from the north end of Highway 615, 45 km northwest of Fort Frances. (Edwards 1983b)

HISTORY OF DEVELOPMENT: There is no record of exploratory work for soapstone at this location. Diamond drilling was carried out in the vicinity of the occurrence in 1969 by the Canadian Nickel Company Limited during copper exploration.(Resident Geologist's Files, MNDM, Kenora)

GEOLOGY: The area was mapped by Thomson (1934) and Edwards (1983b). The occurrence was described by Storey (in press). Edwards notes that the area south of Sucan Lake is underlain by a roughly crescent-shaped stock-like composite mafic to ultramafic body which intrudes mafic flows and felsic tuff and lapilli tuff (see Figure 14). The occurrence consists of altered (talcose, serpentinized) peridotite within this body.



Geology after Edwards 1983 b

Figure 14: Geology in the Vicinity of the Sucan Lake Soapstone Occurrence (NW8)

STONE DESCRIPTION: Storey (in press) notes that the talcose rock is blue-grey in colour, soft and fine grained with no obvious foliation. The rock varies in hardness. It contains ankerite which results in a rusty weathered surface. X-ray diffraction mineral analysis, reported by Storey, indicates that the rock consists primarily of talc with chlorite and dolomite and minor magnetite and amphibole.

REFERENCES:

Edwards (1983b, p. 32,56)
Storey (in press)
Thomson (1934)

Photo 7: Soapstone Outcrop on Island RK246, Trap Lake

Photo 8: Soapstone Outcrop on Island RK246, Trap Lake

NW9: Trap Lake

COMMODITY: Soapstone

STATUS: Prospect

OWNERSHIP: E.G.G. Pidgeon

LOCATION: The deposit is located 13 km south-southeast of the town of Dryden. It is on two islands, RK 246 and RK 249, and a reef located near the northeast shore of Trap Lake at the outlet of the lake, called Threefork Creek (see Figure 9). The islands are included in patent claim K 3829.

Claim Map: G-2579, Contact Bay, Wabigoon Lake; Kenora Mining Division

NTS: 52F/10NW

UTM: Zone 15 515850E 5501350N

Latitude: 49° 40' 01" Longitude: 92° 46' 45"

ACCESS: The deposit may be reached by boat from Wabigoon Lake through Contact Bay and Mile Lake via Threefork Creek. Boat launches are located in numerous places on Wabigoon Lake. Highway 502, which goes south from Dryden, passes just south of Contact Bay and Trap Lake. Roads lead to both bodies of water from the highway.(see Figure 9)

HISTORY OF DEVELOPMENT:

1923 - Mr. L. Pidgeon of Wabigoon discovered the occurrence. He staked 2 claims covering the Trap Lake soapstone outcrops. Thermo-Stone Quarries, Ltd. was incorporated to quarry and market the material. Some stripping was carried out and several cubic feet of soapstone were removed for testing (Wright in Wilson 1926).

1924 - Thermo-Stone Quarries, Ltd. and Wabigoon Soapstone Company, Ltd. were amalgamated. No further work is reported in regard to the soapstone at Trap Lake (Wright in Wilson 1926; Spence 1928).

DESCRIPTION OF SITE: The occurrence comprises the two islands and a small reef at the outlet of Trap Lake. The islands are covered by thick overburden and outcrop is limited to the shoreline. The larger island (No. 246) is roughly 250 m by 250 m. It has fairly continuous outcrop on the west side (see Photo 7 and 8).

The smaller island (No. 249) is about 70 m by 40 m and has good outcrop on the east side. Some evidence of the old trenching in the overburden was present but it was not apparent where the test blocks had been extracted from the islands.

The overburden is clay rich containing carbonate concretions. The concretions make up much of the beach on the southwest side of the island. As well, a horizon of red clay was found in place on the land bridge joining the point on the south side of the island to the main part of the island.

GEOLOGY: The area was mapped by Satterly (1943). The Mile Lake-Trap Lake area is underlain by a northeast-trending mafic to ultramafic body (4.2 km by 1.8 km in size) which intrudes metavolcanic rocks to the north and granitic rocks to the south. These rocks are all cut by a 100 m wide northwest-trending diabase dike. The geology is shown on Figure 10. Satterly notes that the rocks are gabbro and harzburgite. The soapstone occurrences appear to be altered ultramafic components of the intrusive body.

Soapstone makes up the bulk of the two islands and was reported by Wright (in Wilson 1926) to occur on the shore of Trap Lake north of the islands. The deposit has been described by Wright (1924 and in Wilson 1926), Spence (1940), Storey (1986) and Kennedy and Sherlock (1989). Satterly describes the occurrence as follows: On the northwest point of Island No. 246

> ...."the soapstone is fairly massive but has widely spaced fractures, is medium-grained and grey and green in colour, the two colours representing pseudomorphs after two minerals. In thin section under the microscope the aggregate consists of talc, carbonate, and antigorite, with a minor amount of penninite and iron ores. The original two minerals were probably olivine and a pyroxene. The olivine is represented by an aggregate of talc; carbonate, with grains of iron ore; and some antigorite. The pyroxene pseudomorph shows strips of antigorite at right angles to each other, presumably paralleling two sets of cleavages, with a talc aggregate between these strips. The original rock was, therefore, a variety of peridotite; as harzburgite occurs on a nearby island, the rock was most likely that species."

STONE DESCRIPTION: Both islands are composed of similar material. The soapstone is dark grey in colour and medium grained (2 mm to 4 mm). It is cut by talc and carbonate veins, 0.5 cm to 2 cm wide, which trend 190° on average.

Jointing commonly trends 190° and tends to be quite widely spaced (0.5 m to 2 m) on both islands. A vertical outcrop face on the northwest part of Island No. 246 shows sheeting to be 0.5 m to 1.5 m in thickness, dipping shallowly to the west.

The soapstone is composed primarily of talc and chlorite with dolomite and minor magnetite, serpentine and amphibole (Wright in Wilson 1926; Satterly 1943; Storey 1986).

TEST RESULTS:

Specific Gravity: 2.9

Chemical Analysis:

SiO_2	45.30
TiO_2	0.13
Al_2O_3	5.76
Fe_2O_3	11.90
MnO	0.17
MgO	22.90
CaO	4.89
Na_2O	0.02
K_2O	0.18
P_2O_5	0.03
CO_2	3.11
S	0.01
Total	**94.40**
LOI	7.40

Geoscience Laboratories, Ontario Geological Survey, MNDM
Note: Total Fe expressed as Fe_2O_3; FeO, H_2O^+, H_2O^- · > not determined.

REFERENCES:

Kennedy and Sherlock (1989, p. 175)
Satterly (1943, p. 54-55)
Spence (1928, p. 21)
Spence (1940, p. 64-66)
Storey (1986, p. 103-104)
Wright (1924, p. 871-872)
Wright in Wilson (1926, p. 63-66)
Wilson (1926, p. 22)

Photo 9: Stripped Area, Wabigoon Soapstone Prospect

NW10: Wabigoon
(Wabigoon Soapstone Company, Limited)
(Pidgeon Deposit)

COMMODITY: Soapstone, Talc

STATUS: Prospect

OWNERSHIP: Wabigoon Soapstone Company Limited

LOCATION: The deposit is located approximately 2 km west of the village of Wabigoon, in Zealand Township, on the peninsula forming the western boundary of Barritt Bay, Wabigoon Lake. (see Figure 9). It is within patent claim H.W. 133 W.PT.

Claim Map: M-2061, Zealand Township;
Kenora Mining Division

NTS: 52F/10NE

UTM: Zone 15 526150E 5507750N

Latitude: 49° 43' 24" Longitude: 92° 38' 00"

ACCESS: The deposit can be reached by a good trail of about 500 m that leads southwest from the Canadian Pacific Railway. The trail can be reached by walking 0.7 km northwest on the tracks from the CPR crossing at Polar Star Road. Polar Star Road leads south of Highway 17 on the west side of the village of Wabigoon. Water access from Wabigoon Lake is also possible.

HISTORY OF DEVELOPMENT:

1919 - John D. Aaron of Wabigoon discovered the soapstone deposit (The Daily Times-Journal, April 7, 1924).

1921 - E.G. Pidgeon bought the property and carried outstripping and quarried several cubic feet of soapstone for test purposes (Wright in Wilson 1926).

1922 - Pidgeon sold one half interest in the property to H.H. Sutherland of Toronto. Together they organized the Wabigoon Soapstone Company, Limited to develop the deposit. Work on the property consisted of stripping, sampling, clearing timber and road building (Rogers 1925; Sutherland et al 1923).

1924 - The Wabigoon Soapstone Company was amalgamated with Thermo-Stone Quarries, Limited. No further work was carried out (Wright in Wilson 1926).

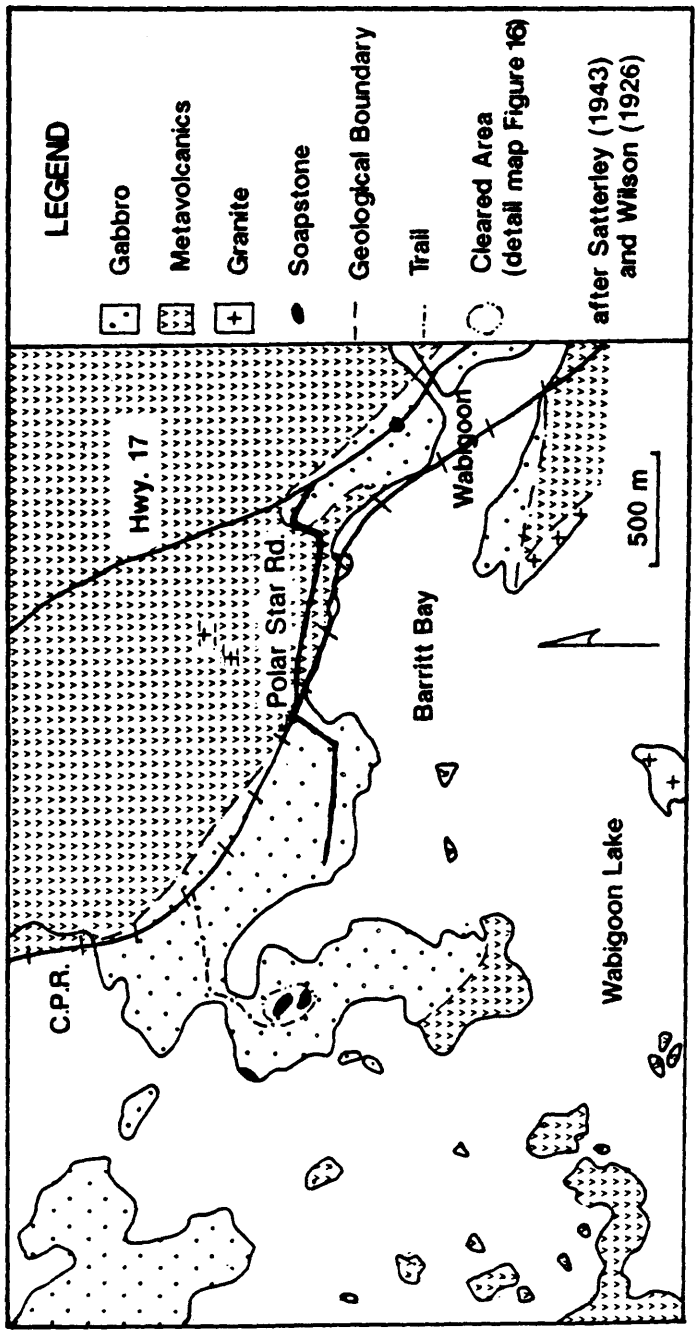


Figure 15: Geology in the Vicinity of the Wabigoon Soapstone Deposit (NW10)

1925-1926 - It is reported that no sales occurred, but that developmental work was done on the property (Rogers and Young 1926b, 1928).

No further work is reported until:

1983 - Wabigoon Resources Limited of Toronto carried out stripping, trenching and surface sampling, as well as a rotary drilling program to obtain samples for talc flotation tests. No results are available.(Redden in press)

DESCRIPTION OF SITE: The area stripped by Wabigoon Resources Ltd, is roughly 160 m by 90 m as shown in Figure 16 (see Photo 9). Four test pits were noted at the site, also shown on Figure 16. The work site comprises a low northwest trending ridge bordered by swamp to the northeast and sloping gently to the southwest.

GEOLOGY: The geology of the area was mapped and described by Wright (in Wilson 1926) and (Satterly 1943). The area is underlain by an elongate, northwest trending gabbroic intrusive within mafic to intermediate metavolcanics as shown on Figure 15.

The deposit has been described by Spence (1922, 1940), Wright (1924 and in Wilson 1926), Satterly (1943), Storey (1986), Kennedy and Sherlock (1989) and Redden (in press). The area stripped by Wabigoon Resources was mapped by Kennedy and Sherlock (1989) and is shown on Figure 16. The soapstone occurs in two northwest-trending, steeply dipping units separated by 40 m of gabbro. Both are bounded by shear zones on each side. The northern band of soapstone ranges from 10 m to 15 m in width and is exposed over a length of 150 m to 160 m. Within this band three different types of soapstone were recognized (see Figure 16). The first is grey in colour, up to 5 m in width, and variable in nature. The second type is greenish-grey in colour and contains up to 20 to 30 percent iron-carbonate rhombs. It is 8 to 10 m wide, highly fractured, and riddled with narrow rusty veins. Narrow veins (3 cm) of pure, white, coarse-grained talc were observed in one test pit. The third type is fine-grained green soapstone that occurs in a narrow (0.5 m) band. The southern band of soapstone is approximately 25 m wide and generally consistent throughout,resembling the second type of soapstone in the northern band; the unit containing the iron-carbonate rhombs.

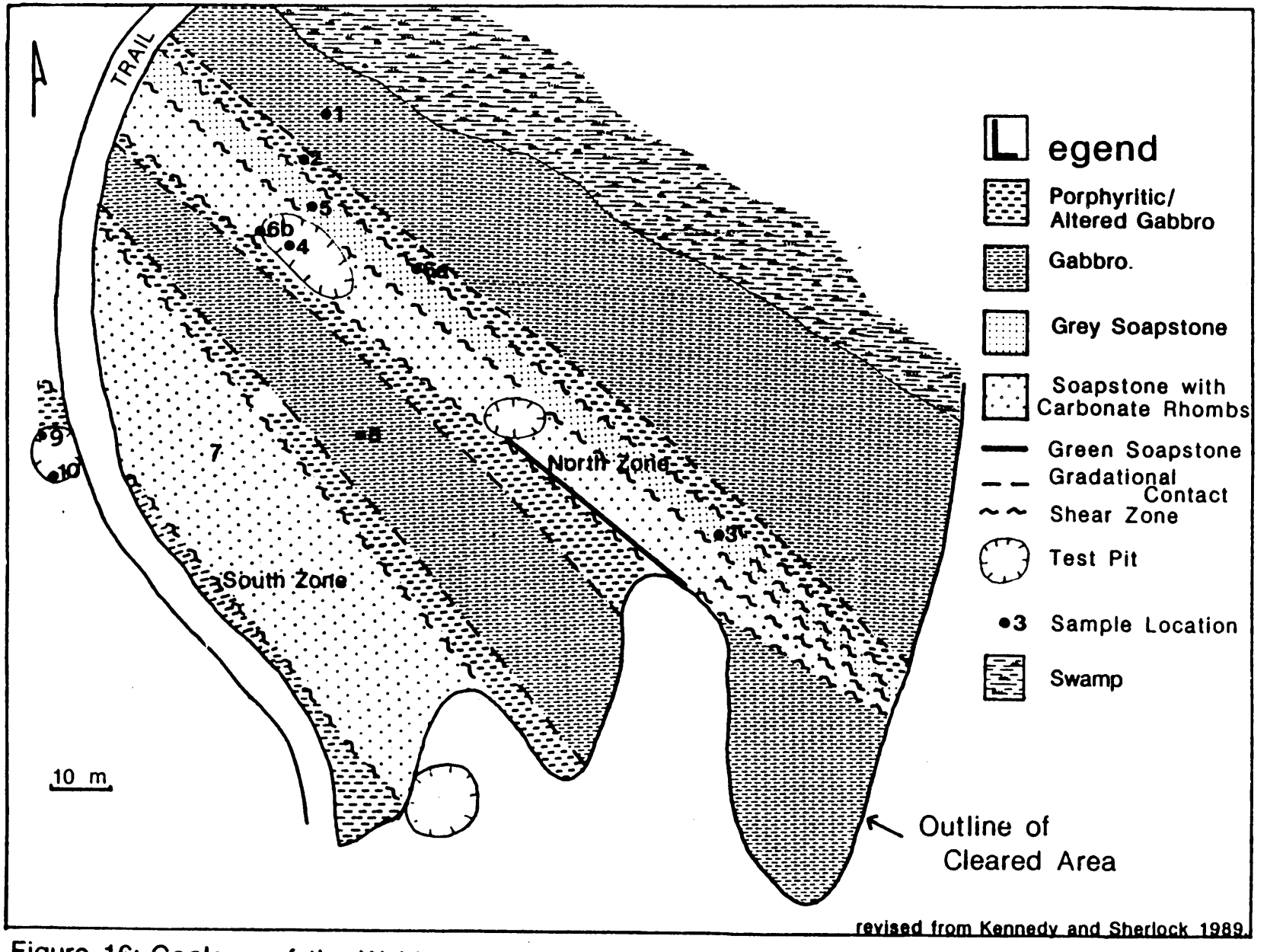


Figure 16: Geology of the Wabigoon Soapstone Deposit (NW 10)

The porphyritic gabbroic rock which borders the soapstone units appears to be an altered version of the surrounding gabbro. Wright (1924) and Satterly (1943) noted from thin section observations that the gabbro was highly altered adjacent to the soapstone; pyroxene having altered to amphibole. In places the contact between the soapstone and the gabbro appears to be transitional. Previous authors have suggested that the soapstone is altered gabbro or an altered related ultramafic intrusive rock.

STONE DESCRIPTION: Overall the soapstone is very fractured. It is fine to medium grained. The grey soapstone unit retains the texture of the adjacent gabbroic rocks. The northern band contains three units that vary in colour. They are grey, green, and greenish-grey with brown iron-carbonate rhombs. The southern unit is greenish-grey with brown iron-carbonate rhombs. The carbonate rhombs occur individually as 1 mm to 5 mm grains and in clumps or aggregates of 1 cm to 3 cm diameter. The carbonate rhomb unit is cut by numerous, thin (3 mm to 4 mm) rusty veins of varying directions. This unit also contains magnetite in sufficient quantity to be detected with a hand magnet. The finer-grained grey and green soapstone units are non-magnetic.

The mineralogical composition of the soapstone is quite variable. Spence (1922) described the soapstone as composed largely of talc, with some chlorite and dolomite. Satterly (1943) noted:

> "A thin section of grey soapstone with brown carbonate rhombs shows, under the microscope, an aggregate of antigorite with bands of magnetite, talc, chlorite, and an iron-carbonate."

Wright (1924) noted:

> "Thin sections of soapstone examined under the microscope consist of a felty aggregate of talc, with small amounts of dolomite, chlorite, and magnetite. The thin sections of poor quality soapstone contain besides talc, considerable dolomite in large bunches or nests, calcite, abundant magnetite, chlorite, and in most cases a little serpentine. In the thin sections of hard soapstone the talc is in aggregates and the chlorite and other minerals act as a cementing material between the lumps of talc."

Wright (in Wilson 1926) noted:

> "It is estimated, from a detailed microscopic study of six thin sections of Wabigoon soapstone, that talc forms from 50 to 75 per cent of the rock, chlorite from 10 to 30 per cent, dolomite from 2 to 20 per cent, serpentine from 0 to 12 per cent, and magnetite from 2 to 3 per cent."

X-ray diffraction analysis of three samples reported by Storey (1986) indicates variable mineralogical content. One sample was talc and magnesite rich with minor chlorite and dolomite. The other two were chlorite rich; one with talc, dolomite and magnesite as important constituents, the other with major amounts of quartz and feldspar, and minor mica, calcite and amphibole. The location of the samples were not given; the last was apparently not from the soapstone unit.

Redden (in press) reports the presence of magnesite in soapstone samples from both the north and south units.

TEST RESULTS:

Physical Properties: (from Spence 1922) - Spence notes that the tests were done on surface samples.

Crushing Strength (Compressive Strength)	Sample	(lbs/sq.in.)
	1	12,140
	2	10,269
	3	10,755

Transverse Strength (Modulus of Rupture)	Sample	(lbs/sq.in.)
	1	1,827
	2	1,920

Fusion Temperature: 1400°C (two samples)
(compares to 1350° for Alberene soapstone)(Spence 1922)

Corrosion Test:

Samples immersed in concentrated HCl and boiled for 48 hours - weight loss = 9.47%
Same test done to Alberene soapstone - weight loss = 17.95% (Spence 1922)

Absorption: 0.12%
(Samples dried for 24 hours and immersed in water for 72 hours) (Spence 1922)

Thermal Tests: (from Redden in press)

	500°C % weight loss (notes 1,2,4,6)	1050°C % weight loss (notes 1,3,5,6)
1 shoreline outcrop	0.49	11.43
2 shoreline outcrop	0.57	12.36
3 north zone	0.20	5.13
4 north zone	0.64	8.63
5 south zone	4.59	15.39
6 south zone	2.77	15.31
7 south zone	0.34	4.91

Notes:
1. block size approximately 2.5 cm by 5 cm x 5 cm
2. blocks heated at 500°C for 3 hours
3. blocks heated to 800°C then raised to 1050°C over 2 hours, maintained at 1050 degrees for 2 hours then left for 13 hours at 800 degrees
4. colour changed from initial dull green to dull grey
5. colour changed from initial dull green to a combination of light brown and dull orange/red
6. hairline shrinkage cracks with random orientations appeared in most samples, no spalling or disintegration no visible changes in dimensions

Chemical Analysis:(sources listed below)

	1	2	3	4	5	6
SiO_2	41.94	51.44	48.60	40.40	31.90	48.20
TiO_2	-	-	0.22	0.13	0.27	0.17
Al_2O_3	7.57	4.79	5.18	4.82	6.74	5.43
Fe_2O_3	2.05	3.68	10.30	3.58	3.43	1.52
FeO	7.71	7.24	-	7.31	7.63	8.26
MnO	-	-	0.18	0.15	0.21	0.18
MgO	25.39	26.43	23.10	26.10	28.40	24.00
CaO	3.42	0.0	7.20	4.02	3.32	6.77
Na_2O	-	-	0.0	0.0	0.10	0.0
K_2O	-	-	0.0	0.0	0.0	0.0
P_2O_5	-	-	0.01	0.0	0.02	0.02
CO_2	5.09	0.11	0.08	5.68	10.30	0.20
S	-	-	0.01	0.01	0.01	0.01
H_2O^+	6.71	6.56	-	6.89	6.89	5.31
H_2O^-	-	-	-	0.05	0.07	0.14
Total	**99.88**	**100.22**	**94.88**	**99.20**	**99.30**	**100.20**
LOI			4.90	11.70	16.60	5.00

	7	8	9	10	11
SiO_2	49.10	43.60	34.40	35.20	45.80
TiO_2	0.27	0.16	0.13	0.15	0.13
Al_2O_3	4.97	6.38	3.72	3.97	1.18
Fe_2O_3	1.76	1.80	5.83	5.47	2.00
FeO	8.50	9.61	6.99	7.23	9.85
MnO	0.12	0.14	0.17	0.16	0.09
MgO	24.80	25.70	29.30	28.70	25.30
CaO	4.46	2.23	1.27	1.70	1.51
Na_2O	0.0	0.0	0.08	0.03	0.0
K_2O	0.0	0.0	0.0	0.0	0.0
P_2O_5	0.03	0.01	0.01	0.01	0.01
CO_2	0.07	2.95	11.70	10.90	0.14
S	0.01	0.01	0.01	0.01	0.01
H_2O^+	5.39	7.12	5.30	5.21	7.39
H_2O^-	0.06	0.10	0.04	0.04	0.13
Total	**99.5**	**99.8**	**99.2**	**98.8**	**99.6**
LOI	4.8	9.10	16.40	15.60	

1. Spence (1922)
   Wabigoon stone, representative of material of northern band
2. Spence (1922)
   Wabigoon stone, 18-inch band of soapstone bordering northern band
3. North zone, grey soapstone unit
   (Geoscience Laboratories,Ontario Geological Survey, MNDM)
   (Total Fe expressed as Fe_2O_3 - FeO, H_2O^+, H_2O^- - not determined)

4, 5. Redden (in press) - shoreline outcrop

6, 7, 8. Redden (in press) - north zone

9, 10, 11. Redden (in press) - south zone

REFERENCES: Kennedy and Sherlock (1989, p. 174-175)
Redden (in press)
Rogers (1925, p. 29)
Rogers and Young (1926b, p. 41)
Rogers and Young (1928, p. 41)
Satterly (1943, p. 53-54)
Spence (1922, p. 35-38)
Spence (1940, p. 64-66)
Storey (1986, p. 105-106)
Sutherland et al (1923, p. 23-25)
Wright (1924, p. 871-872)
Wright (in Wilson 1926, p. 57-63)

NW11: Zealand Township

COMMODITY: Soapstone

STATUS: Occurrence

LOCATION: Five minor occurrences are located in Zealand Township and Brownridge Township, east of the town of Dryden (see Figure 17). They are:

1 - Zealand Twp., north half of lot 6, Concession III
2 - Zealand Twp., north half of lot 4, Concession III
3 - Zealand Twp., south half of lot 4, Concession III
4 - Zealand Twp., lot 17, Concessions VII and VIII
5 - Brownridge Twp., 1.6 km north of lots 7 and 8, Con. VI, Zealand Twp. (Satterly 1943)

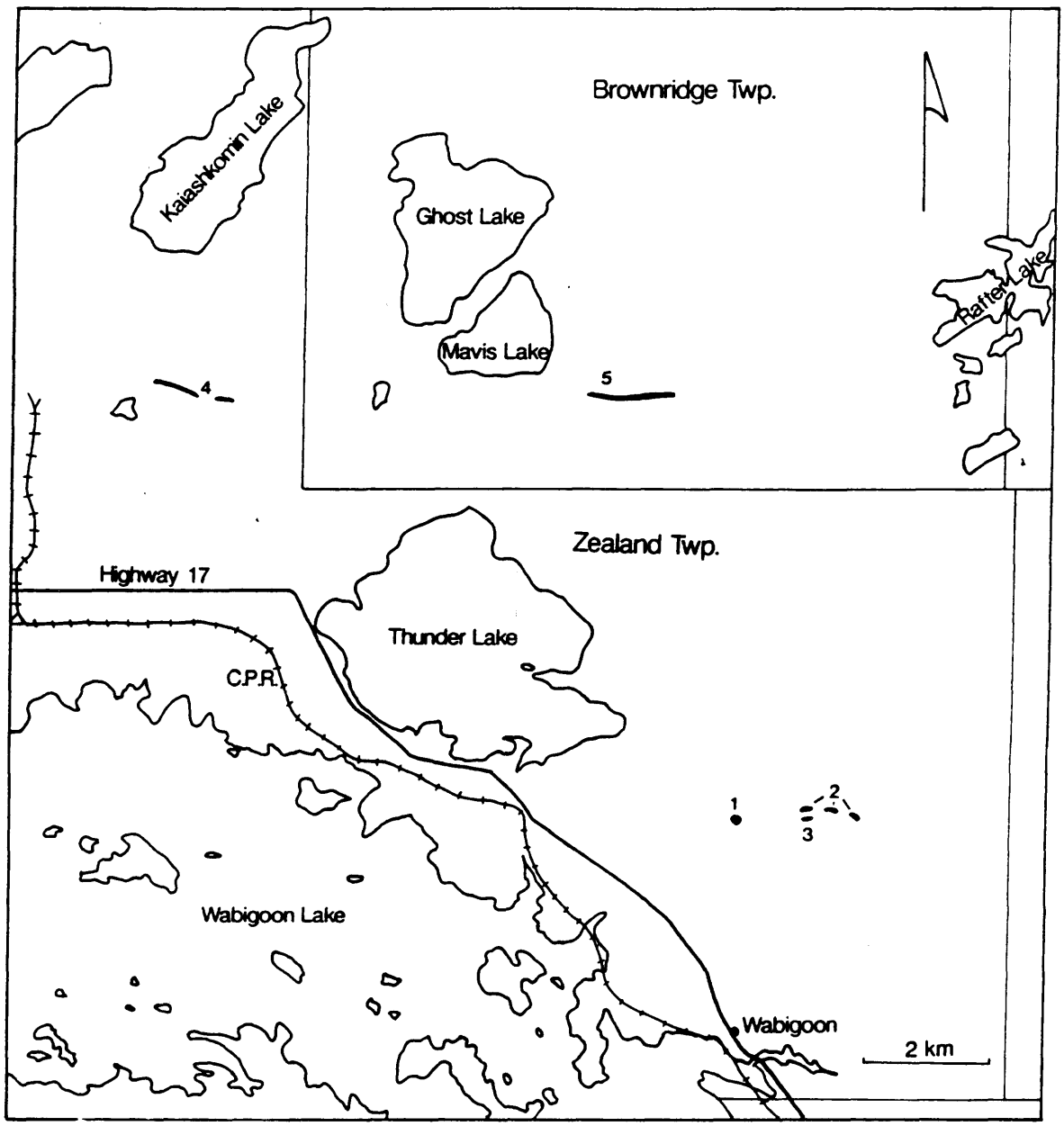
Claim Map: M-2061, Zealand Twp., M-1954, Brownridge Twp.; Kenora Mining Division

NTS: 52F/15SE

GEOLOGY: The area was mapped by Satterly (1943). The soapstone occurrences were described by Pettijohn (1939) and Satterly (1943) as small altered mafic to ultramafic intrusions and sills within metavolcanics . Satterly notes that the sills.....

> "stand out in contrast to the surrounding dark-green to black colour of the volcanics. A thin section of a specimen from lot 17, concession VIII, Zealand Township, shows an aggregate of fractured and altered olivine, amphibole, chlorite, and accessory iron ores and rare feldspar grains. The rock is an altered peridotite. These sills range from 30 to 100 feet in thickness. Tourmalinization of the adjacent volcanics on the margin of the sill has resulted in the formation in several localities of a tourmaline amphibolite. Associated with this rock in places are quartz-tourmaline veins. It would, therefore, seem highly probable that the development of the soapstone in these sills is due to hydrothermal action accompanying the injection of these quartz veins."

REFERENCES:
Pettijohn (1939, p. 768)
Satterly (1943, p. 55)



after Satterly, 1943
Figure 17: Location of the Zealand Township Occurrences (NW 11)

NW12: Claxton Township

COMMODITY: Soapstone

STATUS: Occurrence

OWNERSHIP: Crown land

LOCATION: The occurrence is located in Claxton Township, 60 km northwest of the town of Fort Frances. It is located on the east side of Highway 71, approximately 4 km south of Caliper Lake Provincial Park (see Figure 18).

Claim Map: G-2635, Pinus Lake;
Kenora Mining Division

NTS: 52F/4SW

UTM: Zone 15 434050E 5432200N

Latitude: 49° 02' 30" Longitude: 93° 54' 07"

ACCESS: The occurrence is exposed on the side of Highway 71.

HISTORY OF DEVELOPMENT: There is no recorded development of the occurrence, but it has probably been examined by carvers and prospectors (Storey 1986).

GEOLOGY: The geology of the area is shown on Map 2443 (Blackburn 1981). The occurrence has been described by Edwards (1982) and Storey (1986). The soapstone occurs within a small, elongate, ultramafic body, 5 km by 2 km, within the Sabaskong Batholith (Blackburn 1981). The soapstone unit is exposed for 70 m along the highway and has a width of approximately 3 m. Storey (1986) noted that:

> "The talcose rock is found in rounded blobs 0.3 to 0.6 m long, often surrounded by a rim of chlorite-rich material 1 to 2 cm thick. The talc-bearing rocks show a wavy foliation trending northward and roughly vertical. The talc/soapstone is developed in amphibolitized peridotite (Edwards 1982).....The surrounding rocks include agmatitic dikes of granitoid and more mafic intrusive rocks."

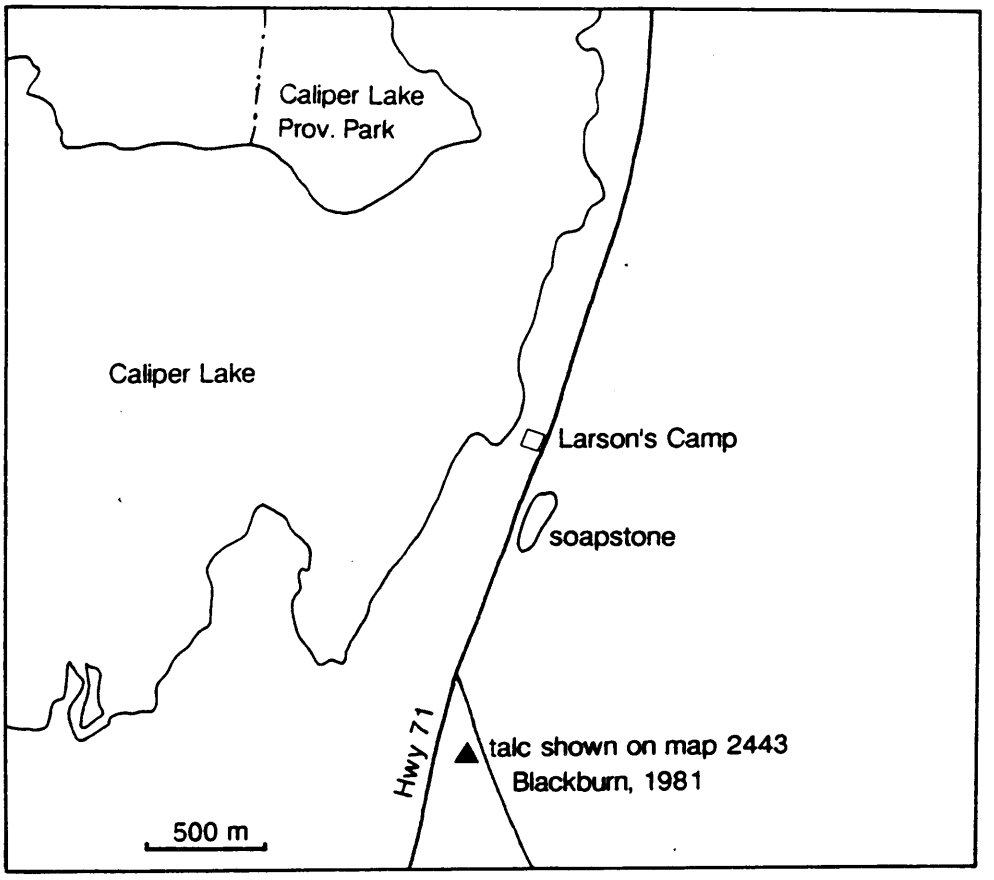
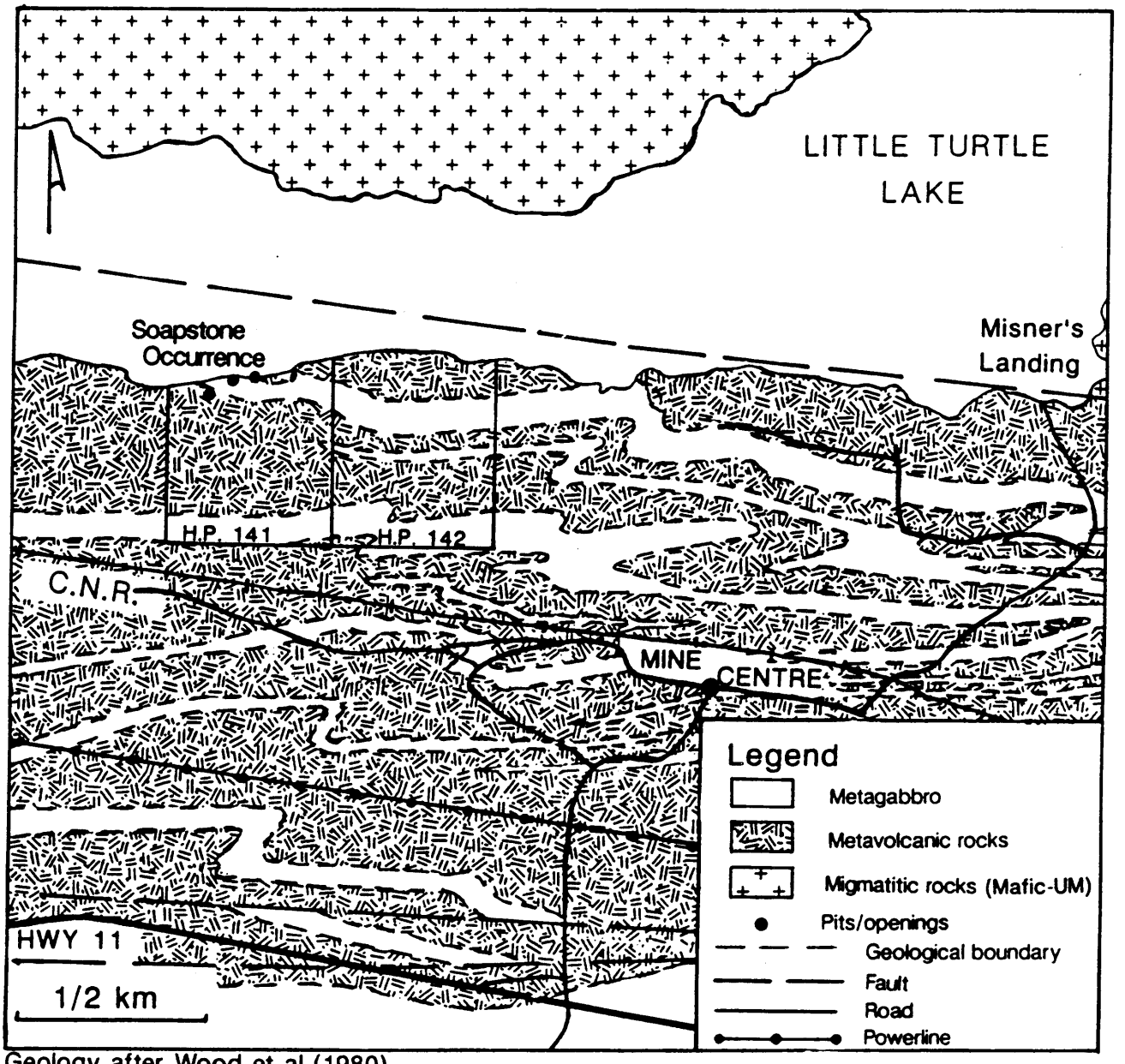


Figure 18: Location of the Claxton Township Soapstone Occurrence (NW12)

STONE DESCRIPTION: The stone is fine grained, soft and light grey-green in colour; darker green in the more chlorite-rich areas. The presence of iron-carbonate is indicated by brown weathered surfaces. Samples submitted for X-ray diffraction analysis, reported by Storey (1986), indicate the rock is variable in composition. Talc, chlorite, and mica are the predominant minerals with lesser amphibole, calcite, quartz, feldspar and mica.

REFERENCES: Storey (1986, p. 91)
Blackburn (1981)
Edwards (1982)



Geology after Wood et al (1980)

Figure 19: Geology in the Vicinity of the Little Turtle Lake Soapstone Occurrence (NW13)

NW13: Little Turtle Lake
(H.H. Wood Talc Company)

COMMODITY: Soapstone, Steatite, Talc

STATUS: Past producer

OWNERSHIP: William and Alice Conway

LOCATION: The occurrence is located on the south shore of Little Turtle Lake on patent claim HP 141. It is approximately 1 km northwest of the village of Mine Centre, 58 km west-northwest of the town of Fort Frances.

Claim Map: G-2682, Little Turtle Lake; Kenora Mining Division

NTS: 52C/15SE

UTM: Zone 15 527000E 5402200N

Latitude: 48° 46' 28" Longitude: 92° 38' 02"

ACCESS: The occurrence can be reached by boat from Little Turtle Lake. A boat can be launched at Misner's Landing 2 km east of the site. The boat launch is 2 km northeast of the junction of the Mine Centre road and Highway 11 (see Figure 19). Alternatively the site can be reached by walking through the bush along the shore of Little Turtle Lake from cottages located west of the landing.

HISTORY OF DEVELOPMENT:

1922 - Sutherland et al (1923) reported:

> "In June, 1922, the company began to work a soapstone deposit on H.P. 141. When inspected in August, a pit, 5 feet by 6 feet, had been sunk near the shore of the lake and was 12 feet deep. In addition to the soapstone obtained during the sinking of the pit, between two and three cubic yards had been channelled with a plugger drill from the deposit nearby. The portion of the soapstone deposit being worked was a band, two feet six inches wide, with a strike of 105 degrees magnetic.

> The soapstone is sawed at the property into steel-worker's crayons, 1/2-inch to 3/8-inch by 4 and 5 inches. Power for the plugger drill and the saw is supplied by a 15-horse-power Clayton air compressor, driven by gasoline. Four men were employed under the supervision of H.H. Wood..."

Eardley-Wilmot (1924) reported:

> "About a car lot of talc was mined by H.H. Wood at Mine Centre in the Rainy River district, Ontario. Crayons for metal workers and heat resisting and electrical insulators were manufactured by means of a sawing, lathing and baking process."

1923 - Further development at the quarry involved stripping of the talc vein for about 30 m. The soapstone was quarried in ledges or steps, and blocks of 0.6 m by 0.6 m by 0.6 m (0.2 m_3) were extracted and sawn into slabs. Wood carried out further exploration along strike of the vein. He removed a considerable amount of overburden in one place and uncovered the vein for a width of 3.7 m. He contacted the Geological Survey of America in Washington to find possible buyers of the soapstone with encouraging results. (The Daily Times-Journal, September 15 1923)

Some shipments were made of soapstone/talc, in various forms, primarily for testing purposes. The largest shipment of 17 tons was used in the manufacture of lava products (eg. gas burner tips). Shipments of metal workers crayons were also made from the quarry. (Sutherland et al 1925)

1924 - No sales are reported. H.H. Wood and foreman,Andrew Jackson, worked at the quarry to prepare blocks for sale. (Daily Times-Journal, May 8 1924; Rogers and Young 1926a)

1925 - No work was performed at the property during the year (Sutherland et al 1926b).

1926 - In May, three men were employed preparing a 30 ton shipment for the Lava Corporation of America, Chattanooga, Tennessee. Work was halted soon after due to the drowning death of H.H. Wood. (Sutherland et al 1926b).

DESCRIPTION OF SITE: At the time this property was visited, the water level of Little Turtle Lake was very high. For this reason only two of the three pits reported by Storey (1986) were found. The pits are located close to the shoreline, and are overgrown and filled with water. Therefore little can be seen of the geology. The third pit was apparently under water. Its approximate location was determined by the presence of drilled blocks on the shore (see Photo 10). Within the patent area three trenches were found which are also overgrown.

GEOLOGY: The area has been mapped by Lawson (1913), Tanton (1936) and Wood et al (1980). The geology is shown on Figure 19. The area is underlain by intermediate metavolcanics intruded by narrow gabbroic sills which are related to a gabbro-anorthosite intrusive body located south of the area (Wood et al 1980). The metavolcanics are chlorite-rich and dark green in colour, well foliated and split readily along the foliation. The metagabbro is dark grey and fine to medium-grained. (Storey 1986). The occurrence is poorly exposed except in the pits near the lakeshore. It has been described by Storey (1986) and Kennedy and Sherlock (1989). Storey described the occurrence in the three pits, numbered 1 through 3, west to east, as follows:

> "Openings 1 and 2 were sunk in metavolcanics. No. 1 is completely overgrown and little can be seen of the rock. Opening 2 is a pit 3 by 3 by 1 m deep on the lakeshore. The rock is layered with softer material forming thin layers parallel to the foliation. There is a trace of disseminated pyrite in the rock and minor seams of pyrite parallel to the foliation. The foliation in the metavolcanics trends 070°/85°N. Opening 3 is in gabbroic rock. The foliation is much weaker than in the metavolcanics and soft lensoid masses of talcose material are present. The weathered overgrown state of the workings obscures the details of these lenses. Narrow quartz veins are associated with the talcose rock in all of the workings. Often the softest material is intimately associated with the veins."

The soapstone has apparently formed by the alteration of metavolcanics and metagabbro.

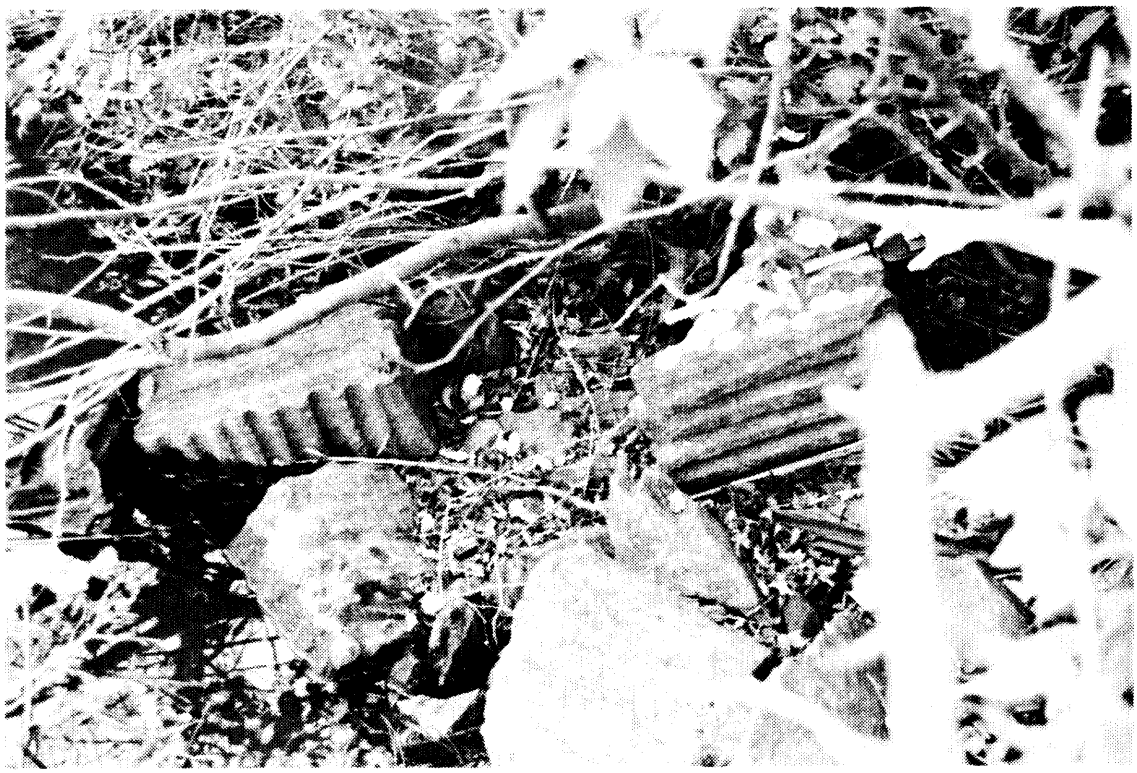


Photo 10: Waste Blocks of Soapstone at Little Turtle Lake Occurrence

STONE DESCRIPTION: The soapstone is grey in colour, fine grained, and soft enough to be scratched with a fingernail. However, Storey (1986) reports, from X-ray diffraction mineral analysis, that the rock contains primarily chlorite and amphibole with quartz and plagioclase and minor talc.

TEST RESULTS:

Specific Gravity: 2.86

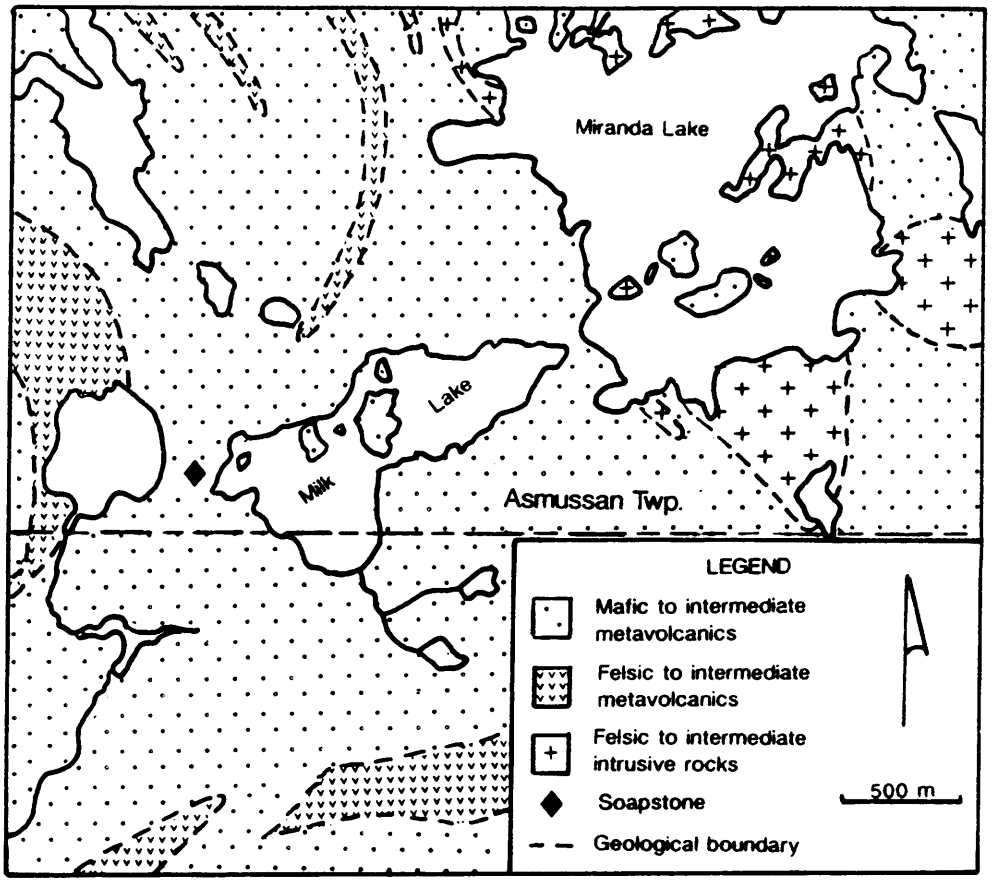
Chemical Analysis:

SiO_2	39.80
TiO_2	0.28
Al_2O_3	5.92
Fe_2O_3	-
FeO	12.90
MnO	0.16
MgO	27.60
CaO	2.78
Na_2O	0.0
K_2O	0.0
P_2O_5	0.08
CO_2	4.23
S	0.05
H_2O^+	-
H_2O^-	-
Total	93.81
LOI	10.60

(Geoscience Laboratories, Ontario GeologicalSurvey, MNDM)
Note: Total Fe expressed as Fe_2O_3; FeO, H_2O^+, and H_2O^-, not determined

REFERENCES:

Eardley - Wilmot (1924, p. 40)
Lawson (1913)
Rogers and Young (1926a, p. 35)
Storey (1986, p. 97-98)
Sutherland et al (1923, p. 25)
Sutherland et al (1925, p. 20)
Sutherland et al (1926b, p. 167)
Tanton (1936)
Wood et al (1980)



Geology after Fumerton and Kresz, 1981

Figure 20: Geology in the Vicinity of the Milk Lake Soapstone Occurrence (NW14)

NW14: Milk Lake
(Buttermilk Lake)
(Seine River)

COMMODITY: Soapstone

STATUS: Occurrence

OWNERSHIP: Crown land (searched February, 1990)

LOCATION: The occurrence is located 22 km west of the town of Atikokan, on the south boundary of Asmussen Township, on the western shore of Milk Lake.

Claim Map: G-568, Asmussen Township;
Thunder Bay Mining Division

NTS: 52B/13SW

UTM: Zone 15 578750E 5401200N

Latitude: 48° 45' 30" Longitude: 91° 55' 45"

ACCESS: The occurrence is quite inaccessible. The CNR passes 3 km to the south and Highway 11, 4 km south of the occurrence. There is no road or water access to the occurrence from these routes.

HISTORY OF DEVELOPMENT: There is no recorded development of this occurrence.

GEOLOGY: The area was mapped by Moore (1940) and Fumerton (1986). The area in the vicinity of the occurrence is underlain by mafic to intermediate and intermediate to felsic meta-volcanics. Dioritic to tonalitic and granitic plutonic rocks lie to the northeast and metasediments to the south (Fumerton 1986) (see Figure 20). The occurrence was described by Tanton (1927), Moore (1940) and Spence (1940). Tanton (1927) notes:

> "...a rectangular area, measuring about 400 feet on each side, underlain by a contorted, dark green, chlorite schist believed to be a highly altered, basic, pyroclastic rock. The schist is traversed by a few irregularly disposed aplite seams and lenses with an average width of 6 inches, which follow the bends in the schistosity for distances of a few feet and, in one case, scores of feet. The rock along the margins and beyond the terminations of these seams has been

altered to grey soapstone and consists of talc with a small percentage of serpentine. The soapstone merges with both the aplite and the chlorite schist. The largest observed soapstone mass is 25 feet wide. It strikes northwesterly from the lake shore and may be safely assumed to have a length of at least 100 feet. Four other irregular, lenticular masses are partly exposed, with maximum known widths of 4 feet and lengths of 12 feet; and there are other small masses....The rock outcrops in this vicinity are sufficiently numerous to show that the dark green, soapstone-bearing schist is of restricted extent. Beyond where the soapstone occurs the schist is visible for only a few hundred feet south and in that direction no soapstone outcrops. Massive pillow lavas and pyroclastics of intermediate composition cut by pegmatite and aplite dykes outcrop around the area underlain by the dark green schist."

REFERENCES:

Fumerton (1986 p. 37)
Moore (1940, p. 34)
Spence (1940, p. 67)
Tanton (1927, p. 10c-11c)

NW15: Rocky Islet Bay

COMMODITY: Soapstone

STATUS: Occurrence

OWNERSHIP: Patent (surface rights only)

LOCATION: The occurrence is located 14.5 km northeast of the town of Fort Frances, in Watten Township. The occurrence is exposed in two locations near Rocky Islet Bay of Rainy Lake. One exposure (A) is on the southeastern side of a peninsula in the bay, 850 m north of the Rocky Islet Bay bridge on Highway 11. A second exposure (B) is located 1.2 km west of the bridge, in a roadside outcrop on Highway 11.

Claim Map: M-2128, Watten Township;
Kenora Mining Division

NTS: 52C/11NE

A. UTM: Zone 15 485750E 5393400N

Latitude: 48° 41' 47" Longitude: 93° 11' 30"

B. UTM: Zone 15 484700E 5392700N

Latitude: 48° 41' 25" Longitude: 93° 12' 27"

ACCESS: Exposure A is accessible by water from Rainy Lake. A small pit in the side of a hill is located approximately 15 m from the shore. Exposure B is a roadside outcrop on Highway 11.

HISTORY OF DEVELOPMENT: Coleman (1895) notes that material from this site was used by the natives as pipestone.

GEOLOGY: The area was mapped by Harris (1974). The area is underlain by mafic to intermediate metavolcanic rocks. Felsic and intermediate intrusive rocks lie north of the occurrence (see Figure 21).

At exposure A, Harris (1974) reports a lens-shaped zone of tremolite-talc schist, 6 m by 15 m, surrounded by hornblende schist. The centre of the zone contains the most talc; the tremolite content increasing towards the outside of the zone.

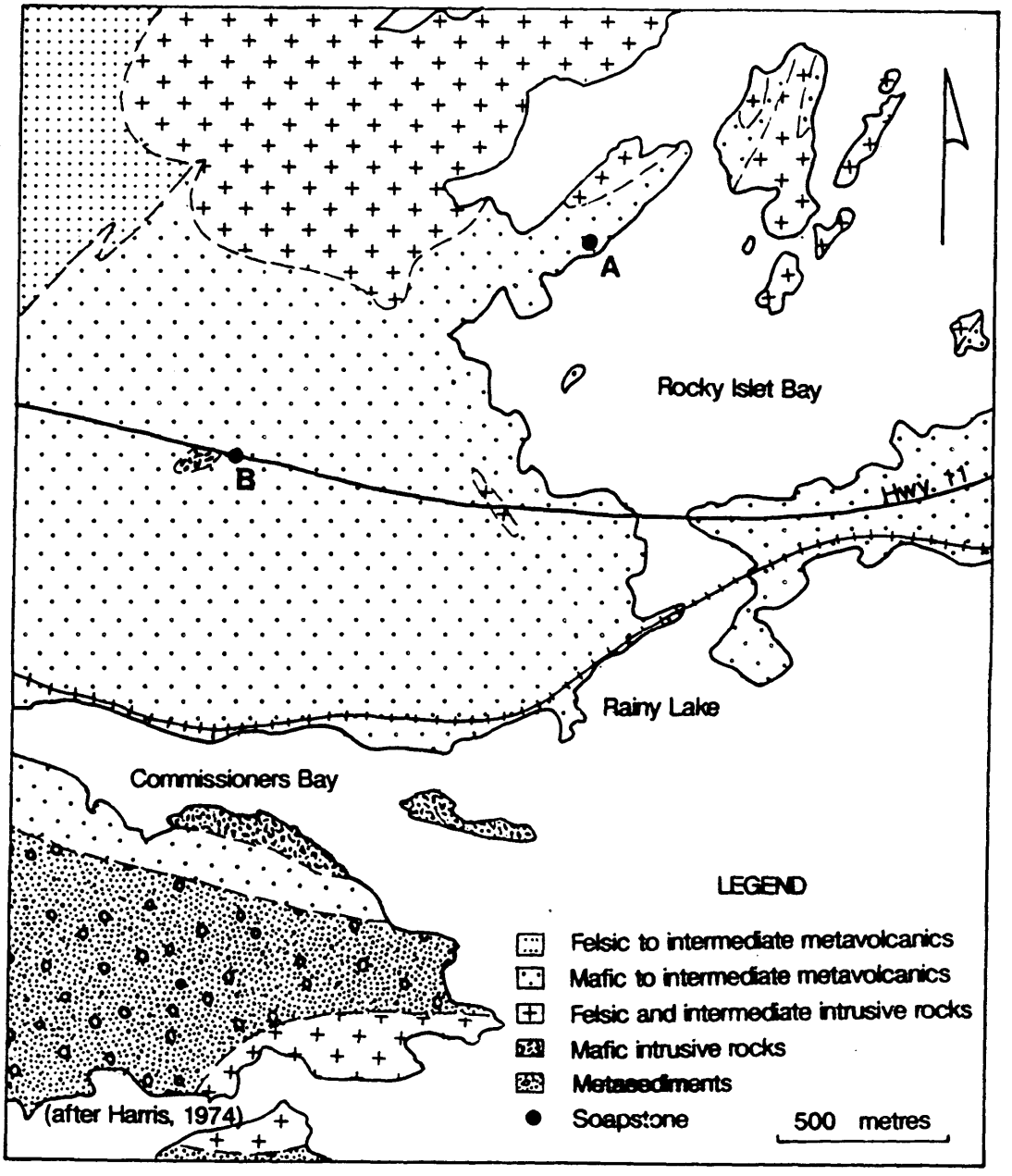


Figure 21: Geology in the Vicinity of the Rocky Islet Bay Soapstone Occurrence (NW15)

2 Exposure B, on the highway, is approximately on strike with exposure A (Harris 1974). Layers/lenses of soft, light green, chloritic schist striking 240° to 260° occur within dark green metavolcanics. On the north side of the highway, two lenses of talc-tremolite schist, 1.8 by 3 m, and 3.6 by 3 m, are exposed. Talc also occurs as a thin veneer on some surfaces.

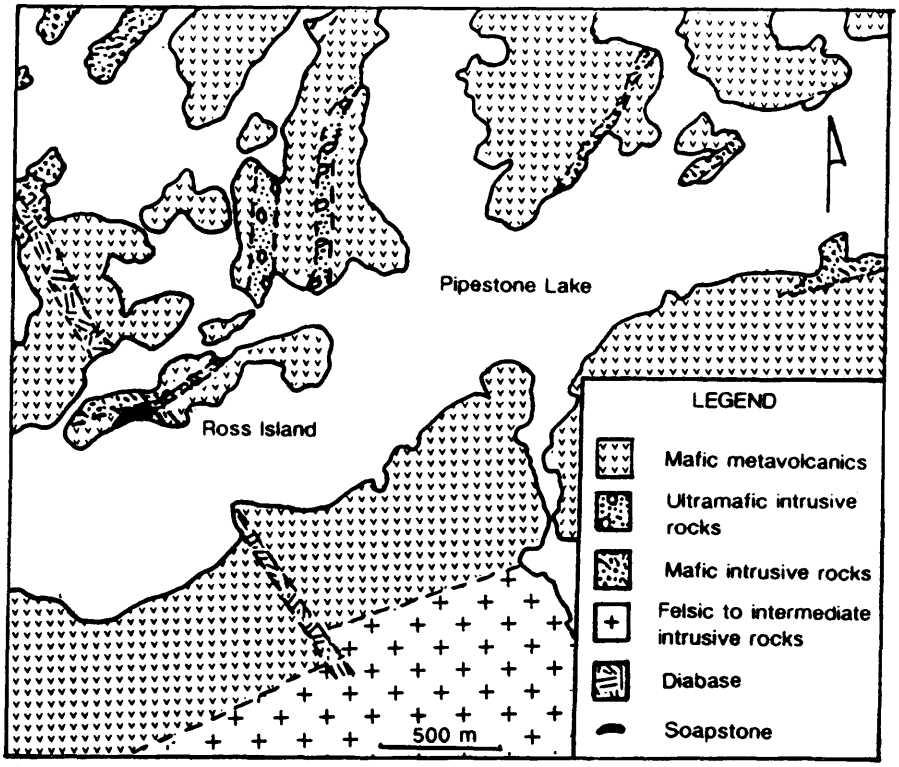
STONE DESCRIPTION:

A. The stone is a greenish-grey talc-tremolite schist.

B. The stone is pale green (talc rich) to bright green(tremolite rich).

Coleman (1895) reports the rock consists mainly of talc with magnetite and minor chlorite.

REFERENCES: Coleman (1895, p. 85)
Harris (1974, p. 16)



Geology after Edwards, 1983a

Figure 22: Geology in the Vicinity of the Ross Island Soapstone Occurrence (NW16)

NW16: Ross Island
(Pipestone Lake South)

COMMODITY: Soapstone

STATUS: Occurrence

OWNERSHIP: Crown land

LOCATION: The occurrence is located 52 km north northwest of the town of Fort Frances on the south shore of Ross Island in Pipestone Lake.

Claim Map: G-2671, Dash Lake;
Kenora Mining Division

NTS: 52F/04SE

UTM: Zone 15 459275E 5434610N

Latitude: 49° 03' 54" Longitude: 93° 33' 27"

ACCESS: Pipestone Lake is accessible by boat via Burditt Lake, from the north end of Highway 615, 45 km northwest of Fort Frances.

HISTORY OF DEVELOPMENT: There is no recorded development at this site.

GEOLOGY: The area was mapped by Thomson (1936) and Edwards (1983a). The geology is shown on Figure 22. The area is underlain by mafic metavolcanics, and mafic and ultramafic intrusive rocks. These units are cross-cut by a diabase dike. The soapstone was formed by alteration of a peridotite sill (Storey 1986). Storey notes that:

> "The rock called soapstone is a fine-grained rusty weathering zone about 3 m wide; the strike length is unknown due to overburden and water cover. The rock is foliated 080°/85°S. The original rock is a dark green to black, fine-grained peridotite. The contact with the soapstone is gradational over 1 m. Foliation in the peridotite is the same as that of the soapstone."

The talcose unit was mapped by Edwards as also occurring 5.5 to 8 km southwest of this location and for 1.5 km northeast. Edwards (1983a) noted:

"A poorly exposed, narrow (less than 30 cm) vein of talcose, slip-fibre asbestos was formed in metaperidotite (now talc, carbonate, and serpentine), 240 m from the west end of the south shore of Ross Island...."

STONE DESCRIPTION: Storey (1986) reported X-ray diffraction mineral analysis of a sample indicated chlorite as the major constituent of the rock and talc as a minor constituent.

REFERENCES:
Edwards (1983a, p. 24-25, 47)
Storey (1986, p. 101)
Thomson (1936)

NW17: Puddy Lake

COMMODITY: Talc, Soapstone

STATUS: Occurrence

OWNERSHIP: K. Kuhner (searched February, 1990)

LOCATION: Puddy Lake is located 175 km northwest of Thunder Bay and 50 km west of Lake Nipigon. A talc schist outcrop occurs south of the lake, at the eastern end on claim TB786341.

Claim Map: G-118, Puddy Lake;
Thunder Bay Mining Division

NTS: 52H/13NE

UTM: Zone 16 319300E 5537750N

Latitude: 49° 58' 00" Longitude: 89° 31' 18"

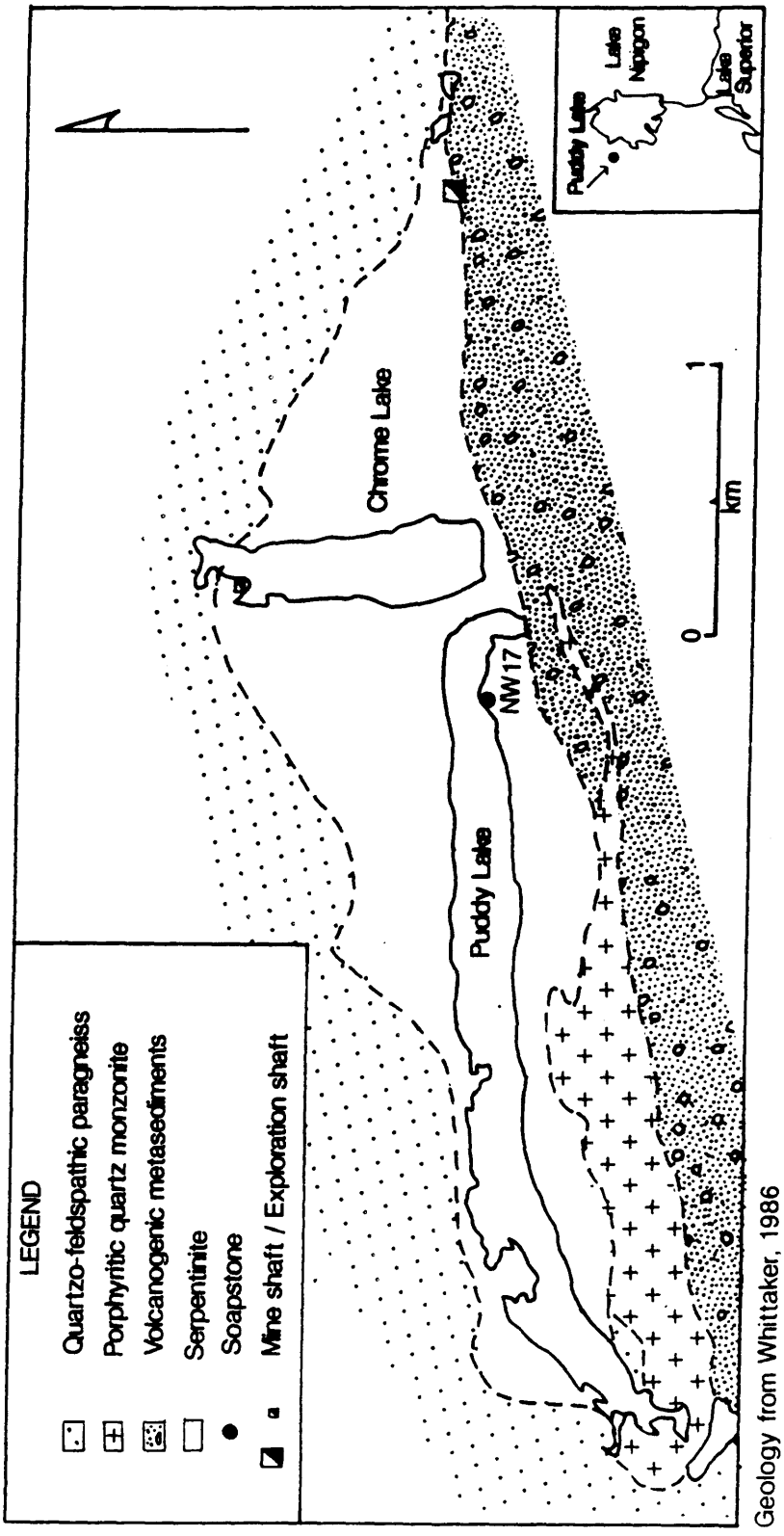
ACCESS: The property is accessible by float-plane.

HISTORY OF DEVELOPMENT: Mining exploration and development in the area has been concentrated on the chromite occurrences hosted by the same ultramafic intrusion that hosts the talc. An exploration shaft was sunk by Chromium Mining and Smelting Corporation Limited in the early 1930's.

GEOLOGY: The area was mapped by Graham (1931), Hurst (1932), Kidd (1934) and Kustra (1967). Mineralogical work was done by Simpson and Chamberlain (1967).

The Puddy Lake area is underlain by a large serpentinized ultramafic intrusion, exposed for approximately 7 km by 1 km as shown on Figure 23 (Whittaker 1986). The intrusion is located at the contact between quartzo-feldspathic paragneiss to the north and volcanogenic metasediments to the south. Porphyritic quartz monzonite occurs along a portion of the southern contact of the ultramafic unit.

The ultramafic intrusion has been pervasively serpentinized (Whittaker 1986). The unit was identified by textural and mineral evidence as being originally dunite and peridotite (Karvinen 1968).



Geology from Whittaker, 1986

Figure 23: Geology in the Vicinity of the Puddy Lake Soapstone Occurrence (NW17)

Talc occurs throughout the unit but is concentrated along shear zones and adjacent to the contacts. Rocks along the southern boundary contain the most talc (Watkinson and Mainwaring 1980).

The occurrence has an exposed length of 60 m and a width of 15 m (K. Kuhner, Prospector personal communication, 1990).

STONE DESCRIPTION: The stone is medium to coarse grained. The hardness is variable throughout the unit. It is moderately magnetic. On weathered surfaces, it has a greyish colour, however on fresh surfaces, the stone has a mottled appearance with a pinkish-red colour.

TEST RESULTS:

1. **Mineralogy**

	Percent
Talc	75
Chlorite	0
Serpentine	<5
Dolomite	20
Magnesite	0
Magnetite	0
Epidote	0

Geoscience Laboratories, Ontario Geological Survey, MNDM

2. **Chemical Analysis**

SiO_2	42.1
Al_2O_3	0.39
Fe_{2O3}	1.22
FeO	1.26
MgO	27.4
CaO	9.17
Na_2O	0.05
K_2O	0.00
TiO_2	0.00
P_2O_5	0.01
MnO	0.03
CO_2	14.4
S	0.01
H_2O^+	3.01
H_2O^-	0.09
Total	**99.14**
LOI	17.8

Geoscience Laboratories, Ontario Geological Survey, MNDM

REFERENCES:

Graham (1931, p. 51-60)
Hurst (1932, p. 111-119)
Karvinen (1968)
Kidd (1934, p. 16-37)
Kustra (1967)
Simpson and Chamberlain (1967)
Watkinson and Mainwaring (1980, p. 220-234)
Whittaker (1986)

NW18: Upper Shebandowan Lake

COMMODITY: Soapstone, Talc

STATUS: Occurrence

OWNERSHIP: Staked claim held by Minnova Inc. (searched August 1989)

LOCATION: The occurrence is located on the south shore of Upper Shebandowan Lake, 92 km west northwest of the city of Thunder Bay.

Claim Map: G-2714, Kashabowie Lake;
Thunder Bay Mining Division

NTS: 52B/9NW

UTM: Zone 15 689500E 5389520N

Latitude: 48° 37' 55" Longitude: 90° 25' 40"

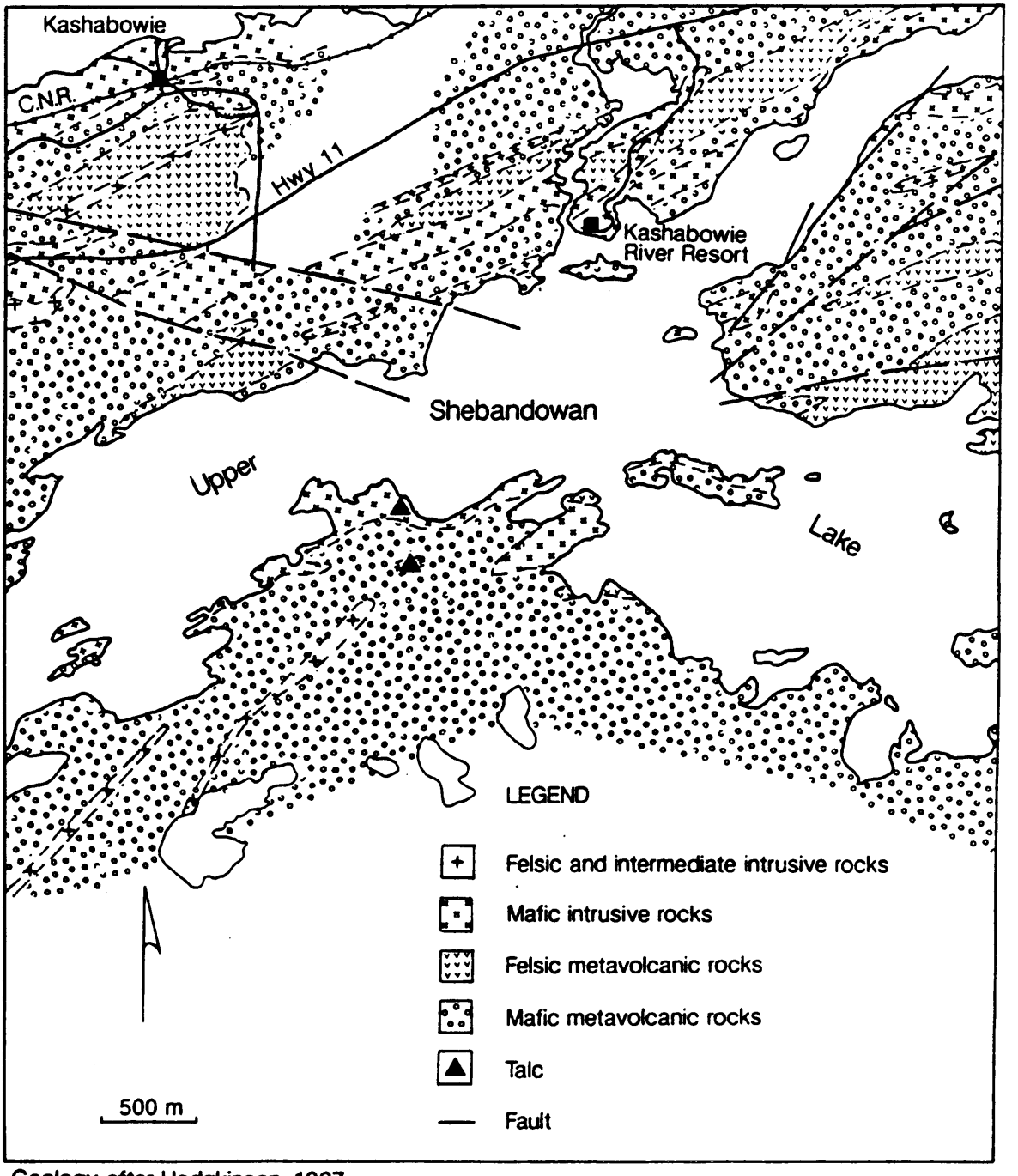
ACCESS: The occurrence can be reached by boat launched on the north shore of Upper Shebandowan Lake. The nearest boat launch, at the Kashabowie River Resort, is approximately 1.6 km north northwest of the occurrence. The launch is accessible from Highway 11 which passes north of Upper Shebandowan Lake.(see Figure 24)

HISTORY OF DEVELOPMENT:

1930 - This occurrence is probably that which was reported to be under investigation as a potential supply of soapstone by Mr. E. Cowperthwaite of Interprovincial Industries (Canada) Limited (Canadian Mining Journal Mar. 7, 1930; The Fort William Daily Times Journal Sept. 5, 1930; Sept. 16, 1930).

There is no recorded developmental work on the occurrence. Most of the activity in the area has been exploration for base metals (Resident Geologist Files, MNDM, Thunder Bay).

DESCRIPTION OF SITE: Outcrop is limited in the vicinity of the occurrence. Talcose rocks occur near the shore and approximately 200 m south of the shore. There is no evidence of work on the soapstone at the site.



Geology after Hodgkinson, 1967

Figure 24: Geology in the Vicinity of the Upper Shebandowan Lake Occurrence (NW18)

GEOLOGY: The area was mapped by Tanton (1938) and Hodgkinson (1968) who both noted the talc occurrence. The area is underlain by mafic metavolcanics intruded by gabbroic rocks. Talc-bearing chlorite schist was noted near the shoreline of the lake and about 200 m inland (see Figure 24). Talc-carbonate schist, interpreted to be metaperidotite, is noted in drill logs by Falconbridge Nickel Mines Ltd. from exploratory drilling carried out in 1974 in the vicinity of the occurrence (Resident Geologists Files, MNDM, Thunder Bay).

REFERENCES: Hodgkinson (1968)
Tanton (1938)

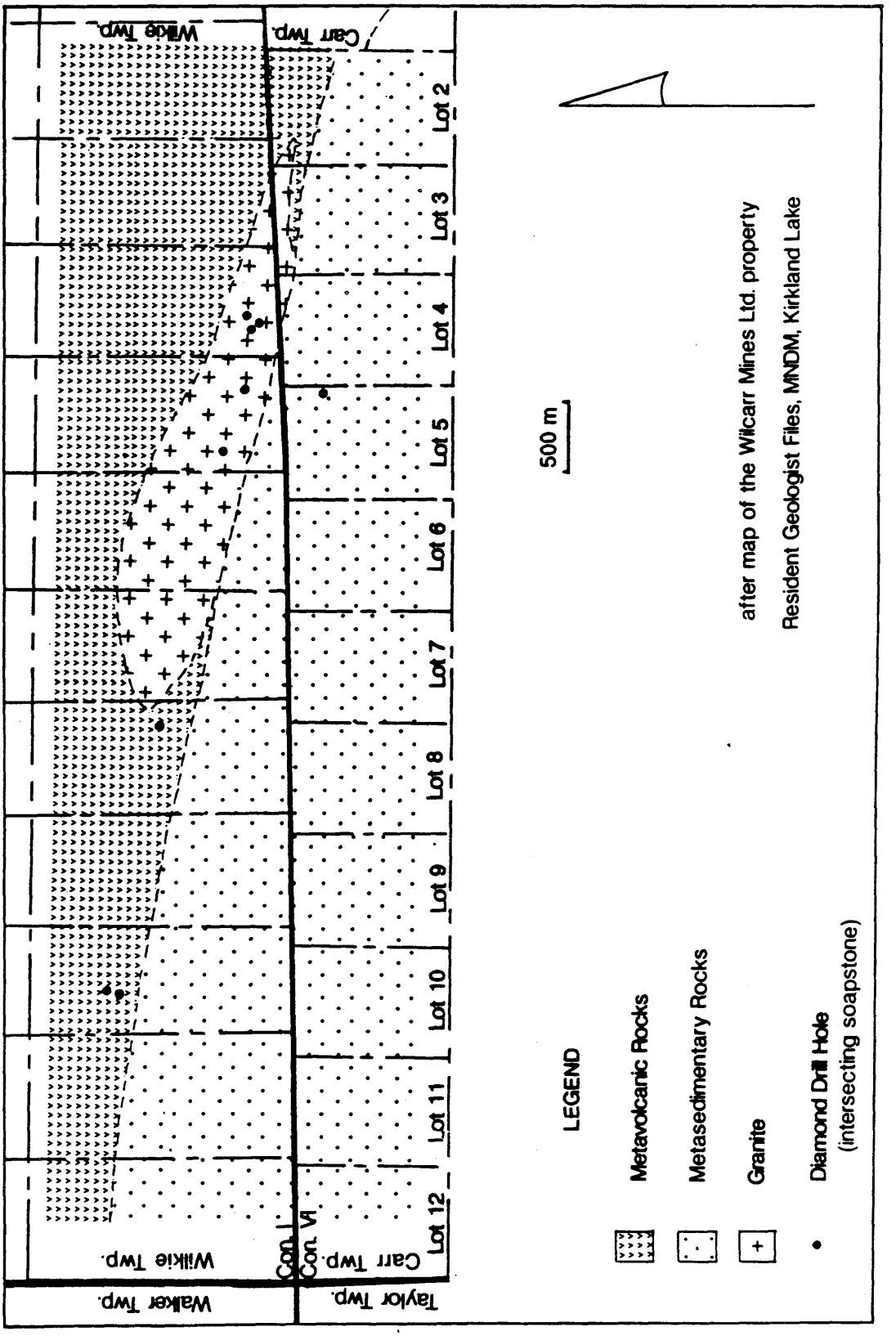


Figure 25: Geology in the Vicinity of the Carr - Taylor - Wilkie Townships Soapstone Occurrence (NE1)

NE1: Carr, Taylor and Wilkie Townships

COMMODITY: Soapstone

STATUS: Occurrence

LOCATION: Soapstone occurs along both the Destor-Porcupine and the Pipestone faults in Carr, Taylor and Wilkie Townships, approximately 65 km east of Timmins. Occurrences noted by Prest (1952) in Carr Township include Concession III, Lot 11, Concession II near the Taylor-Carr boundary and Concession VI, Lot 2. Within Wilkie Twp., Concession I, Lot 8 and Lot 10 were mentioned. Diamond drill logs of Wilcarr Mines Ltd. show soapstone in Carr Township in Concession VI, Lot 5. In Wilkie Township, soapstone was noted in Concession I, Lots 4, 5, 8 and 10. (see Figure 25) (Resident Geologist's Files, MNDM, Kirkland Lake)

NTS: 42A/9SW

UTM: Zone 17 540350E 5385660N

Latitude: 48° 37' 30" Longitude: 80° 27' 09"

ACCESS: The area is accessible by Highways No. 101 and No. 11 which cross Carr Township.

HISTORY OF DEVELOPMENT:

1945 - Diamond drilling on the Wilcarr property, carried out by Anglo-Huronian Limited, intersected the soapstone (Prest 1952).

GEOLOGY: The area was mapped by Prest (1952). A zone of talc-chlorite schists and serpentine schists referred to as soapstone occurs along both the Destor-Porcupine and the Pipestone faults. The faults are located along a large part of the volcanic-sedimentary contact, with the metavolcanics lying to the north and the metasediments to the south of the faults. A large body of albite granite is located within the metavolcanic rocks adjacent to the contact. The width of the soapstone varies but is up to 91 m. Soapstone was only noted in drill core. Surface exposure in the area is poor (Prest 1952).

STONE DESCRIPTION: The soapstone is described as a soft greenish rock with a greasy or slippery feel, composed predominantly of talc and serpentine, associated minerals include chlorite, sericite, titanite and carbonate (Prest 1952).

REFERENCES: Prest (1952, p. 1-18)

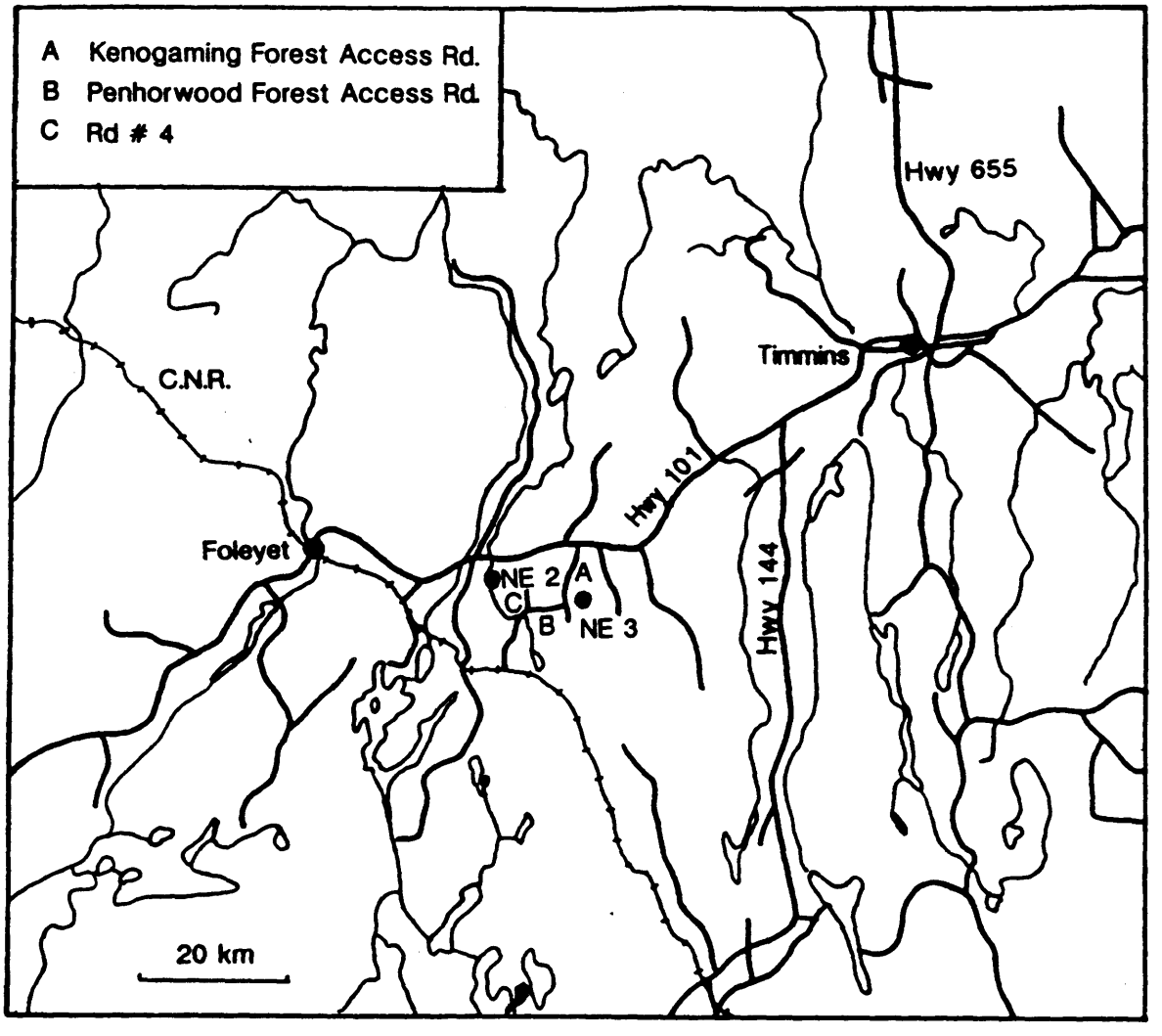


Figure 26: Location of the Four Corners Property (NE2) and the Penhorwood Mine (NE3)

NE2: Four Corners Property
(Reeves Township Joint Venture)

COMMODITY: Gold, Soapstone

STATUS: Occurrence

OWNERSHIP: American Barrick Resources Corp. (searched Dec. 1989)

LOCATION: The property is located in northeastern Penhorwood Township, Swayze area on claim P-947253. It is approximately 65 km southwest of Timmins (see Figure 26).

Claim Map: G-3244, Penhorwood Township; Porcupine Mining Division

NTS: 42B/1NE

Latitude: 48° 10' 09" Longitude: 82° 01' 35"

ACCESS: Access to the property is by Highway 101, west from Timmins for 60 km to the Kenogaming Forest Access Road. Travel south for 7 km to the Penhorwood Forest Access Road, west for 6.5 km to logging road No. 4, then north for 600 m to reach the trench.

HISTORY OF DEVELOPMENT:

1987 - A trench was dug across a regional shear zone known as the "Fuchsite Zone" as part of an exploration program for gold.

GEOLOGY: Trenching on the property has exposed, across a width of 81.4 m, variably foliated to intensely sheared talc-carbonate and talc-chlorite-carbonate schists, locally with more massive zones (see Figure 27). These rocks are hosted within mafic to intermediate metavolcanics.

STONE DESCRIPTION: The soapstone is a pale grey colour on fresh surface, highly talcose, and carbonatized. The rock is schistose and appears mylonitized.

REFERENCES: Resident Geologist's Files, Ministry of Northern Development and Mines, Timmins.

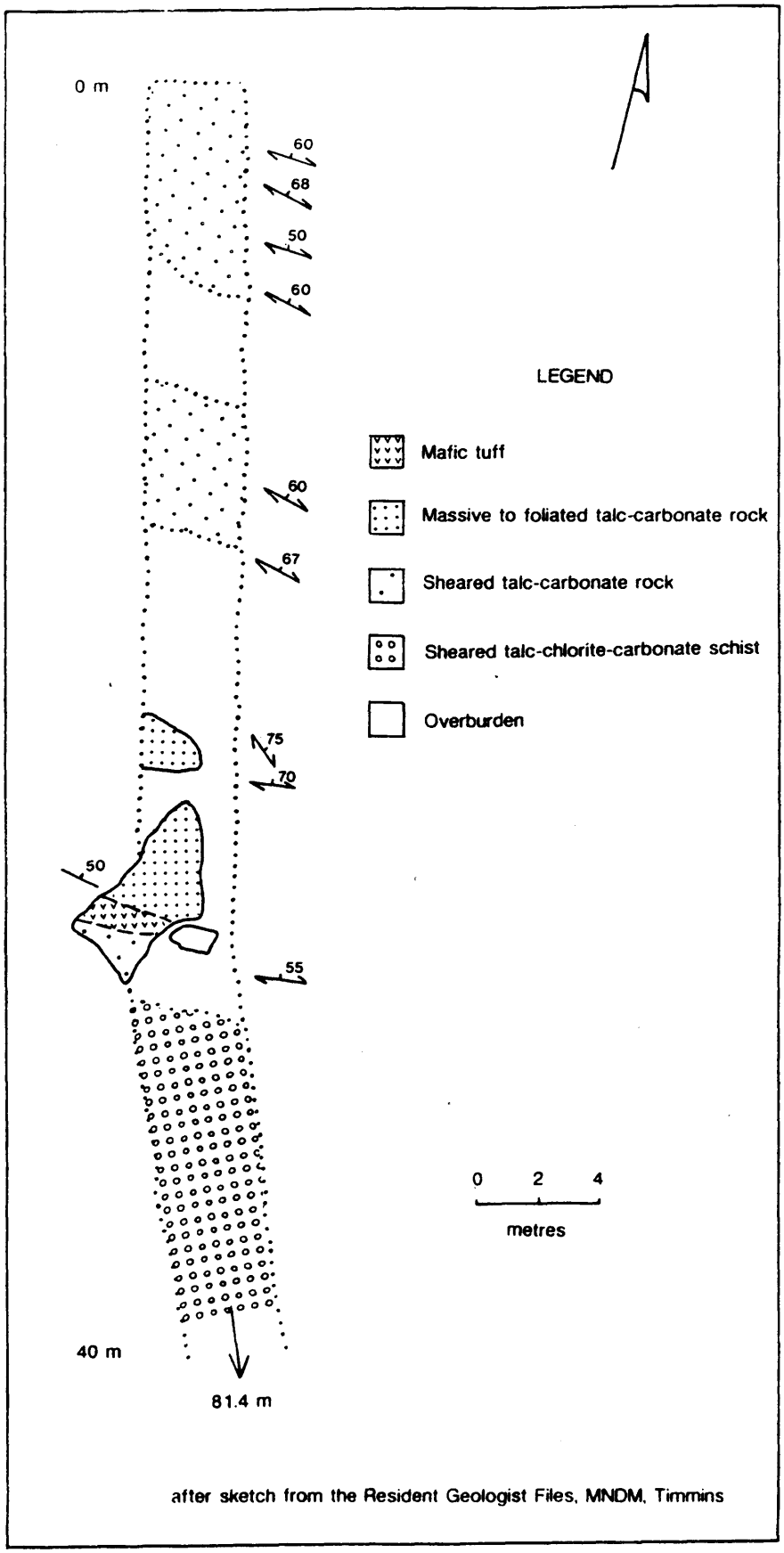


Figure 27: Map of trench on the Four Corners Property (NE2)

NE3: Penhorwood Mine
(Manville Property)

COMMODITY: Talc, Soapstone

STATUS: Talc producer

OWNERSHIP: Talcs de Luzenac SA

LOCATION: The mine is located in north-central Penhorwood Township, Swayze area on patent claim S. 82791. It is approximately 65 km southwest of Timmins (see Figure 26).

Claim Map: G-3244, Penhorwood Township; Porcupine Mining Division

NTS: 42B/1NE

Latitude: 48° 11' 24" Longitude: 82° 06' 07"

ACCESS: The property is accessible by following Highway 101 west from Timmins for 70 km to the Reeves Mine/Luzenac turnoff. Travel south for 3 km to the Luzenac Mill. A pass from Luzenac is required for access.

HISTORY OF DEVELOPMENT:

1974 - The property was developed by the Canadian Johns-Manville Company Limited (Karvinen and Hunt 1975).

July-Dec. 1976 - Canadian Johns-Manville Corporation operated the mine (Harben 1986).

July 1978 - Steetley Talc acquired the property from Canadian Johns-Manville Company Limited and began production (Coope 1982).

Aug. 1988 - Borax Holdings Ltd. and Talcs de Luzenac SA acquired Steetley Talc (Griffiths 1988).

Production Figures
(tons of talc)

1979	3000	
1989	8200	
1981	15000	
1982	N/A	
1983	23100	
1984	35000	
1986	35000	
1987	40000	
1988	50000	(estimate)
1989	60000	(estimate)

N/A - not available
(Resident Geologist's Files, MNDM, Timmins)

DESCRIPTION OF SITE: The Penhorwood Mine is an open pit mine.

GEOLOGY: The property is underlain by metavolcanic rocks which have been intruded by diorite, peridotite and gabbro. Talc-magnesite ore occurs in contact with highly altered ultramafic sills and plugs. Alteration is in the form of serpentine and carbonate (Vos et al 1987).

STONE DESCRIPTION: The soapstone is pale grey to olive green in colour and has a mottled appearance. It is locally fractured with magnesite occurring within the fractures (Resident Geologist's Files Ministry of Northern Development and Mines, Timmins).

Note: The owners have not evaluated the soapstone potential of the mine property (C. Renaud, Luzcan Inc, personal communication, 1990).

REFERENCES:
Coope (1982, p. 10)
Griffiths (1988, p. 119)
Harben (1986, p. 36-38)
Karvinen and Hunt (1975, p. 103)
Vos et al (1987 p. 101)

NE4: Panache Lake

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: The occurrence is located along the northeast shore of Lake Panache, approximately 40 km east of Espanola.

Claim Map: G-4018, Caen Township;
Sudbury Mining Division

NTS: 41I/3NE

UTM: Zone 17 483268E 5119739N

Latitude: 46° 13' 59" Longitude: 81° 13' 01"

HISTORY OF DEVELOPMENT: Wilson (1926) reported that the stone was used locally for making pencils for marking on stone, etc.

GEOLOGY: Lake Panache is predominantly underlain by Huronian metasedimentary rocks which have been intruded by Nipissing diabase. Felsic plutonic rocks and metamorphosed gneiss occur to the north (see Figure 28) (Card 1978).

Soapstone is reported by Wilson (1926) as "a vein - like body of soapstone 2 or 3 feet wide" occurring within Huronian quartzite. The occurrence is near the contact between the metasedimentary rocks and the diabase (Ontario Geological Survey, 1984; Card 1978). The soapstone would appear to represent an altered inclusion of diabase. Talc is mentioned by Vos et al (1987) within the mylonitized zone of the Lake Panache Fault at the western end of the lake.

STONE DESCRIPTION: The stone is soft and grey-green in colour (Wilson 1926).

REFERENCES:
Card (1978)
Ontario Geological Survey (1984)
Vos et al (1987, p. 31)
Wilson (1926, p. 67)

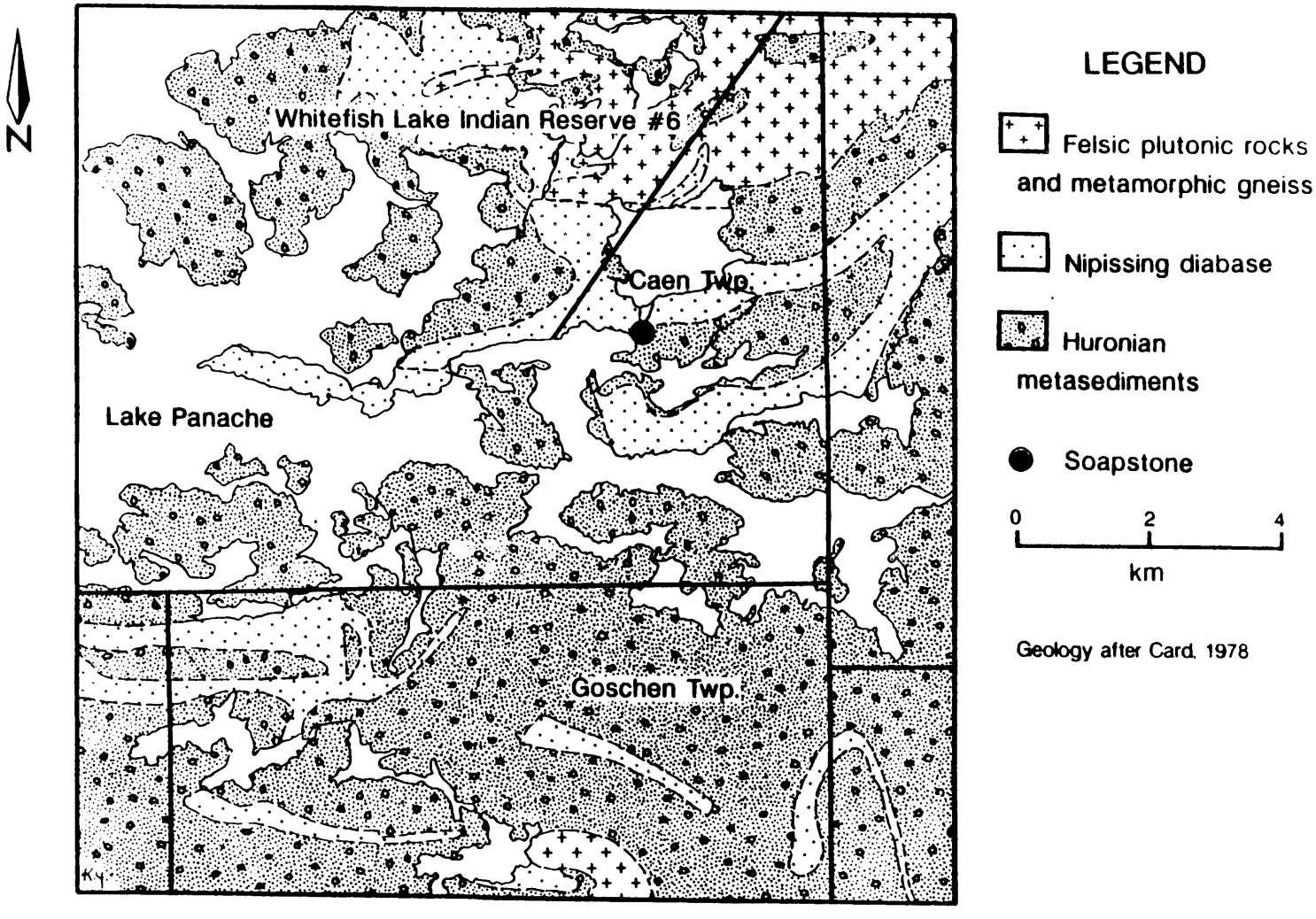


Figure 28 Geology in the Vicinity of the Panache Lake Soapstone Occurrence (NE4)

NE5: Adams Mine
(Jalore)

COMMODITY: Iron, Minor Soapstone

STATUS: Iron-ore producer

OWNERSHIP: Dominion Foundries and Steel Company Limited (Dofasco)

LOCATION: The Adams Mine is located in Boston Township, 12 km southeast of the town of Kirkland Lake (see Figure 29) on claim 55824.

Claim Map: G-3209, Boston Township;
Larder Lake Mining Division

UTM: Zone 17

Latitude: 48° 04' 09" Longitude: 79° 56' 05"

ACCESS: Access to the mine is via Highway 66, west of Kirkland Lake, south along Highway 112 and then east along road No. 650.

HISTORY OF DEVELOPMENT:
(from the Daily Press, Tuesday Nov 21, 1989)

1902 - Iron was first discovered on the property.

1954 - J. and L. Steel Corporation acquired the claims.

1962 - J. and L. Steel Corporation started construction of the plants.

1964 - Initial shipment of ore.

1971 - Dofasco Inc. bought the mine.

1986 - First mine to produce flux pellets.

1990 - Planned closure of the mine on March 31.

GEOLOGY: The Boston Township iron range is approximately 9.6 km in length and 915 to 1220 m in width occurring along the southeastern boundary of the Lebel syenite stock. The iron range consists of horizons of chert-magnetite iron formation, cherty quartzite and metavolcanic rocks (Dubuc 1966).

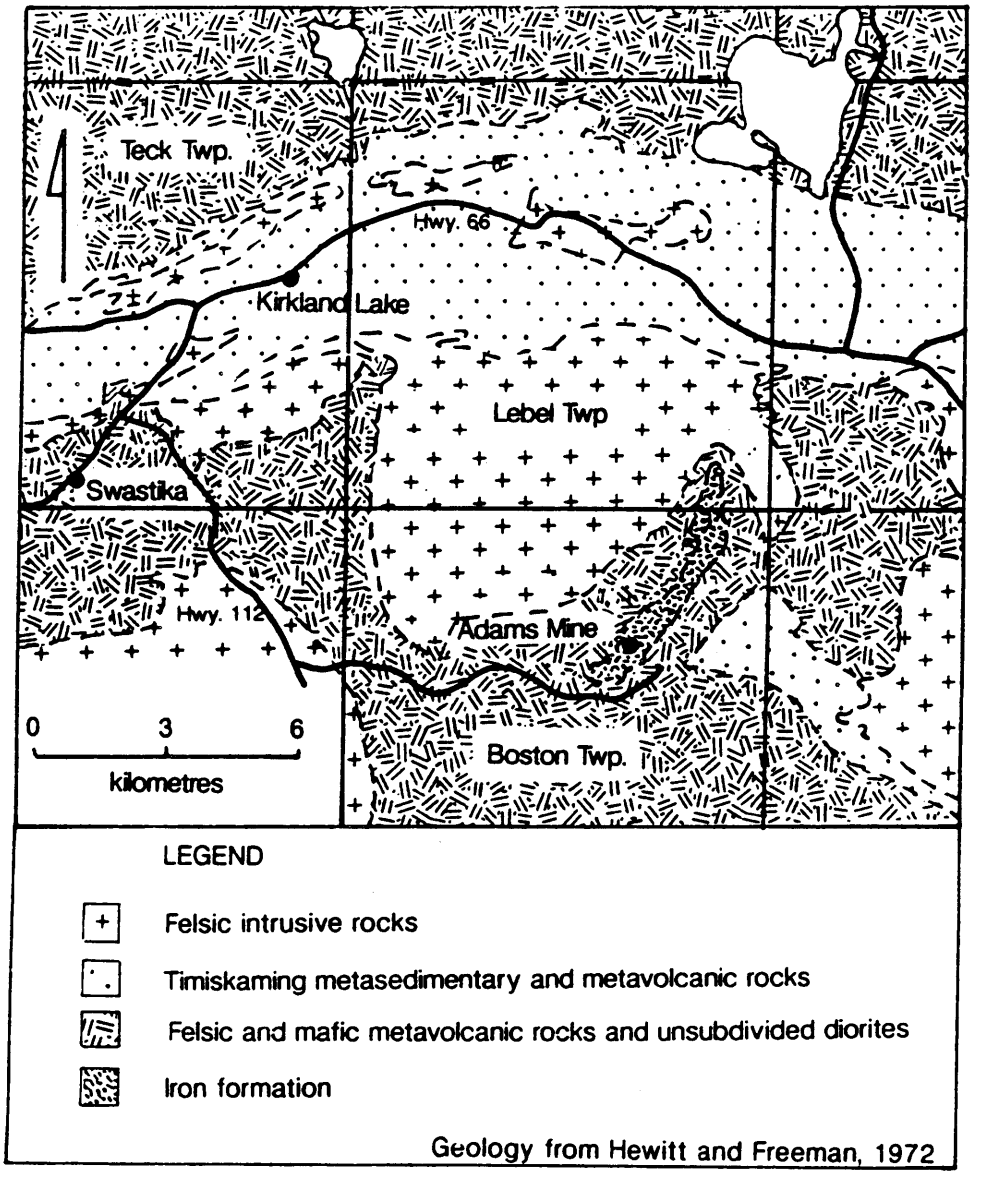


Figure 29: Geology in the Vicinity of the Adams Mine Soapstone Occurrence (NE5)

STONE DESCRIPTION: The soapstone is described as a massive talc-chlorite schist. Approximately 5 percent of the material in the mine waste dump is reported to be soapstone (H. Lovell, Regional Minerals Specialist, MNDM, Kirkland Lake, personal communication, 1989).

REFERENCES: Dubuc (1966, p. 176-181)

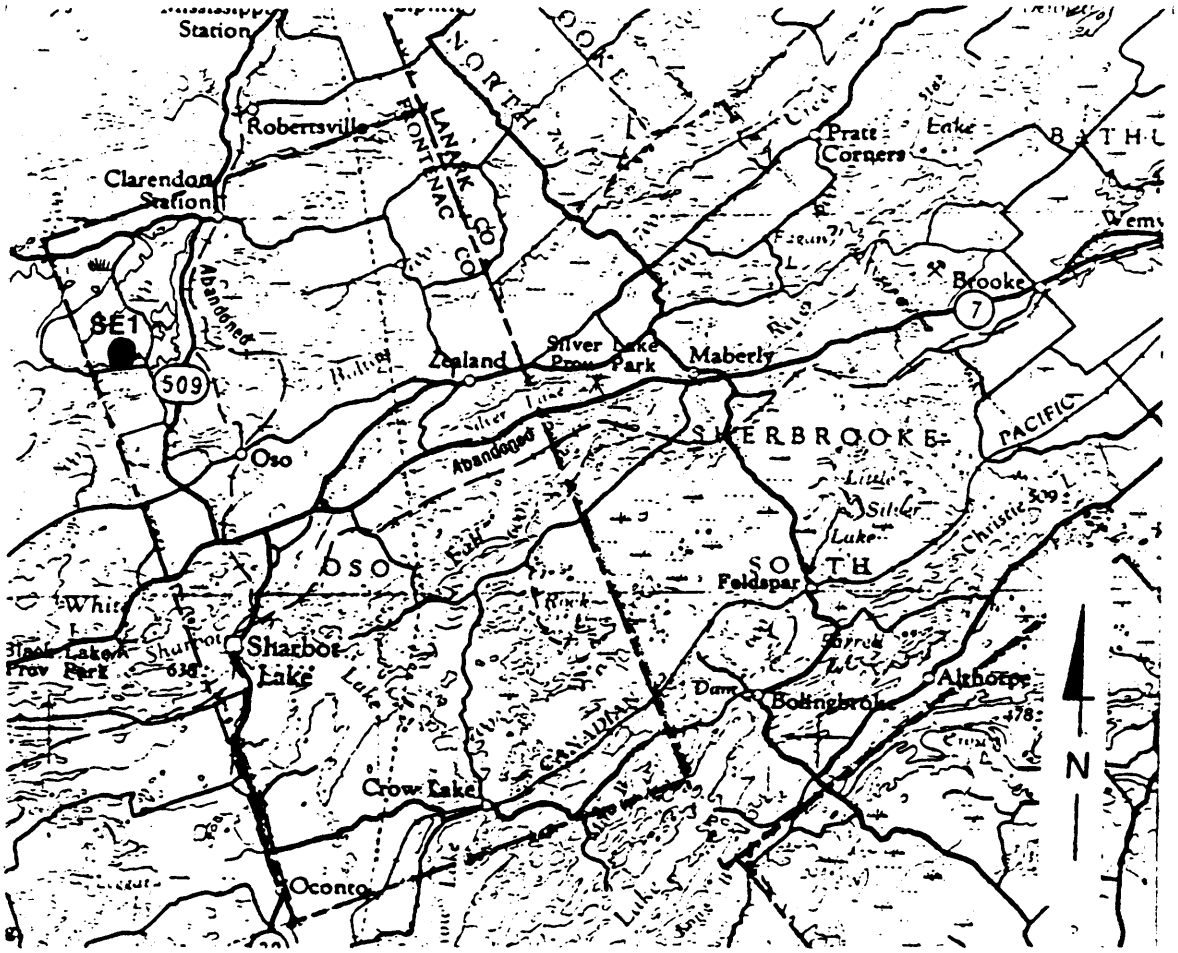


Figure 30: Location of the Pennick Lake Soapstone Occurrence (SE1), Oso Township, Frontenac County

SE1: Pennick Lake
(Oso Township, Concession II, Lot 25 or 26)

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: The occurrence is located in the northwest corner of Oso Township, Frontenac County. It is approximately 5 km northwest of the village of Oso (see Figure 30).

Claim Map: M-138, Oso Township;
Southern Ontario Mining Division

NTS: 31C/15SE

UTM: Zone 18 363350E 4966250N

Latitude: 44° 50' 00" Longitude: 76° 43' 35"

ACCESS: A trail leads west from the Pennick Lake Road approximately 500 m to the occurrence (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT: There is no record of development.

GEOLOGY: The area is underlain by mafic metavolcanic rocks. Talcose rocks occur within the metavolcanics adjacent to a shear zone trending roughly northeast, west of Pennick Lake. Minor amounts of carbonate metasediments are present as well. The outcrop consists of a low-lying north-trending ridge approximately 100 m wide, traceable along strike for 500 m (Wolff 1985).

STONE DESCRIPTION: The unit consists of a talc-tremolite-serpentine-calcite schist (Wolff 1985). Thin section examination of a talc-rich phase of the schist by Wolff (1985), showed the mineralogy to consist of 70 percent talc, 18 percent plagioclase, 5 percent tremolite, 5 percent iron oxides, and 2 percent opaques and pyrite.

REFERENCES: LeBaron and van Haaften (1989, p. 60)
Wolff (1985, p. 61)

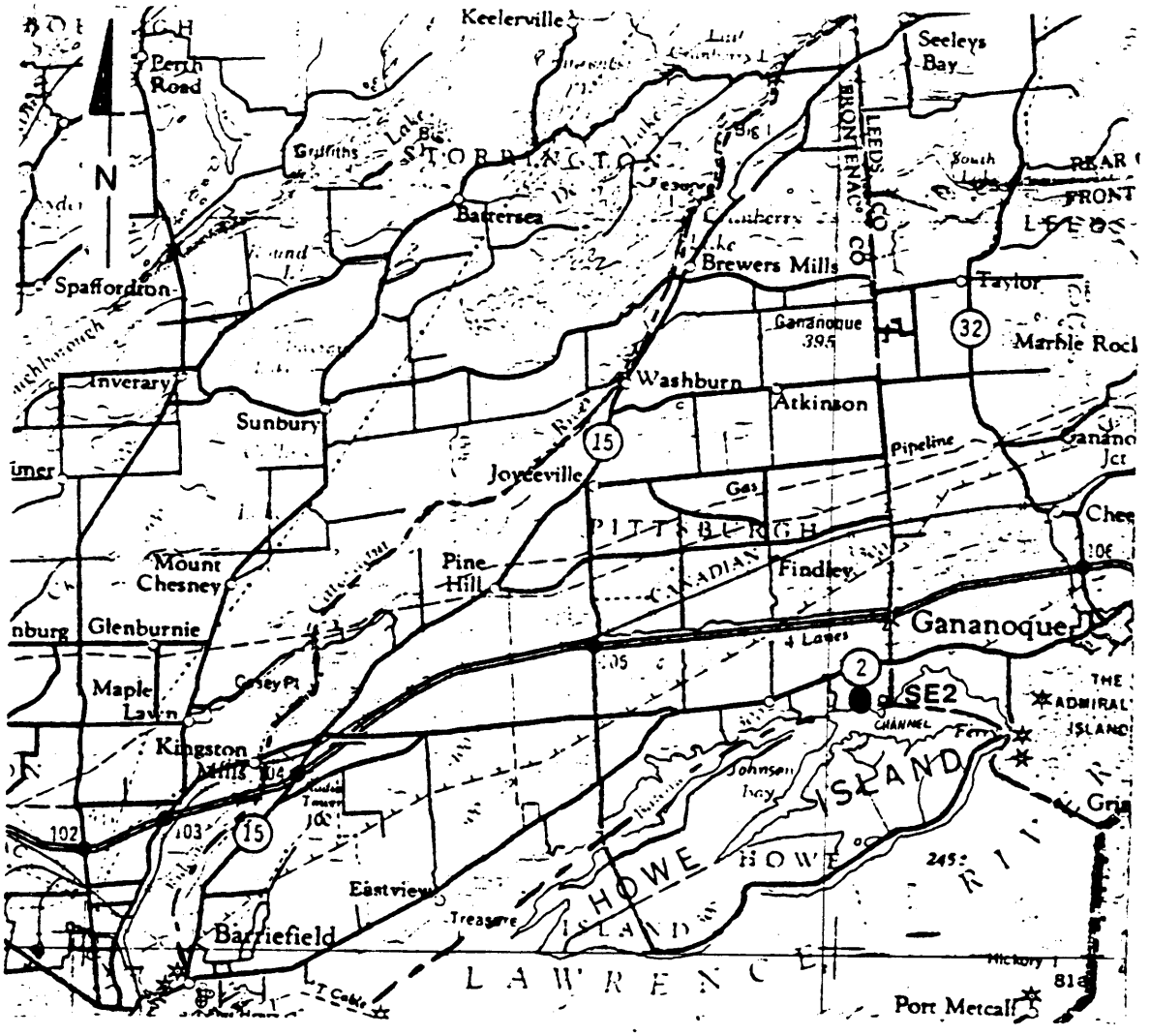


Figure 31: Location of the Pittsburgh Township, Frontenac County Soapstone Occurrence (SE2)

Scale

5km

SE2: Pittsburgh Township, Concession III, Lot 35 south half

COMMODITY: Soapstone, Talc

STATUS: Talc Prospect

LOCATION: The prospect lies between the St. Lawrence River and Highway No. 2, 8 km west of Gananoque. It is approximately 0.4 km south of Highway No. 2 (see Figure 31).

Claim Map: M-1334, Pittsburgh Township; Southern Ontario Mining Division

NTS: 31C/8SE

UTM: Zone 18 401000E 4907000N

Latitude: 44° 18' 30" Longitude: 76° 14' 23"

HISTORY OF DEVELOPMENT:

~1900 - Sparham Roofing Company of Montreal used the material in the manufacture of fireproof roofing. Production was reported to be a few hundred tons (Spence 1922).

DESCRIPTION OF SITE: A few small scattered pits occur on the property (Spence 1922).

GEOLOGY: The area was mapped by Wynne-Edwards (1962) as paragneiss and pegmatite cut by a diabase dyke. Cambro-Ordovician sandstone is also found in the area. LeBaron and van Haaften (1989) suggest that the diabase has been altered to form the talcose rock. Spence (1922) however, refers to the soapstone as altered pyroxenite.

STONE DESCRIPTION: Spence (1922, 1940) described the rock as soft and dark, apparently a pyroxenite, partly altered to talc.

TEST RESULTS:

Chemical Analysis: (from Spence 1922)

SiO_2	50.64
FeO	0.79
Fe_2O_3	0.55
Al_2O_3	1.06
CaO	4.84
MgO	30.49
CO_2	5.21
H_2O (above 105°C)	6.26
Total	**99.84**

REFERENCES: LeBaron and van Haaften (1989, p. 65-66)
Spence (1922, p. 24-25)
Spence (1940, p. 77-78)
Wynne-Edwards (1962)

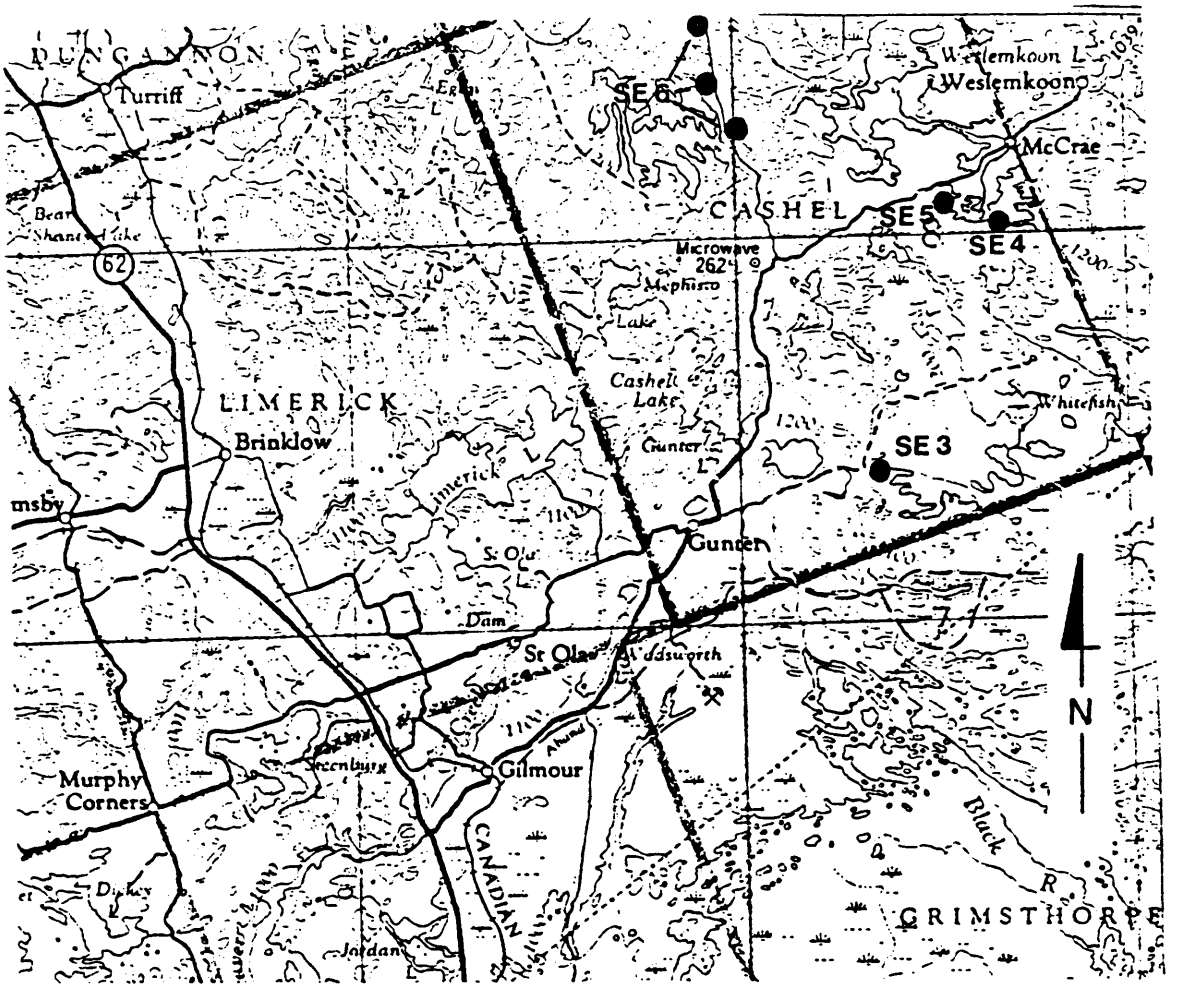
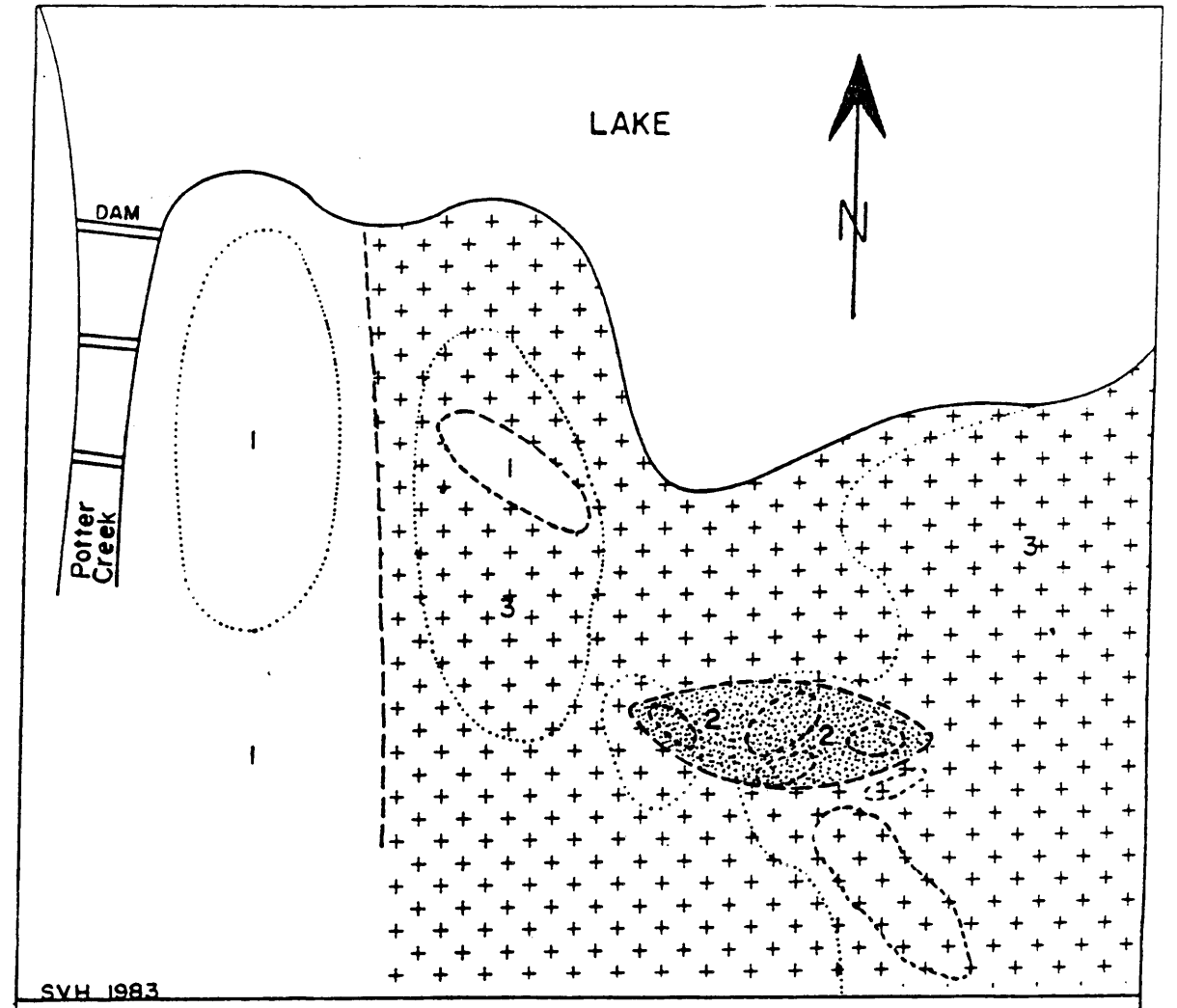


Figure 32: Location of the Cashel Township, Hastings County Soapstone Occurrences

Scale

5km



LEGEND

+3+	GRANODIORITE
2	TALCOSE ROCK
1	METAMORPHOSED MAFIC VOLCANIC ROCK
— — —	INTERPRETED GEOLOGIC CONTACT
---------	OUTCROP
.....	HIGH RELIEF AREA: MAINLY OUTCROP

APPROXIMATE SCALE

0 15 30 45 60 75m

Figure 33: Geology of the Potter Creek (SE3) Soapstone Occurrence, Cashel Township
(from LeBaron and van Haaften, 1989)

SE3: Potter Creek
(Cashel Township, Concession II, Lot 16)

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: This occurrence is located 5 km east of the village of Gunter. It is south of an unnamed lake on Potter Creek in south central Cashel Township, Hastings County (see Figure 32).

Claim Map: M-71, Cashel Township;
Southern Ontario Mining Division

NTS: 31C/14NW

UTM: Zone 18 303534E 4973747N

Latitude: 44° 53' 31" Longitude: 77° 29' 17"

ACCESS: The occurrence is easily accessible by foot from a dirt track whick leads eastward from Gunter for 5 km to the unnamed lake.

HISTORY OF DEVELOPMENT: There is no record of development.

GEOLOGY: Talc-rich rocks occur within a mafic metavolcanic inclusion in the Weslemkoon batholith (see Figure 33). The contact between the metavolcanics and the batholith is approximately 100 m to the west of the talc unit, which is exposed over a length of 45 m, with a width of up to 6 m (Lumbers 1968).

STONE DESCRIPTION: The unit is generally fine-grained and compact. Thin section analysis of 3 samples by LeBaron and van Haaften (1989) showed the unit has variable composition. Two samples consisted mainly of serpentine and carbonate. The third contained 38 percent talc. Lumbers (1968) reports minor tremolite, chlorite, anthophyllite and iron-titanium oxide minerals.

REFERENCES: LeBaron and van Haaften (1989, p. 73)
Lumbers (1968, p. 44)

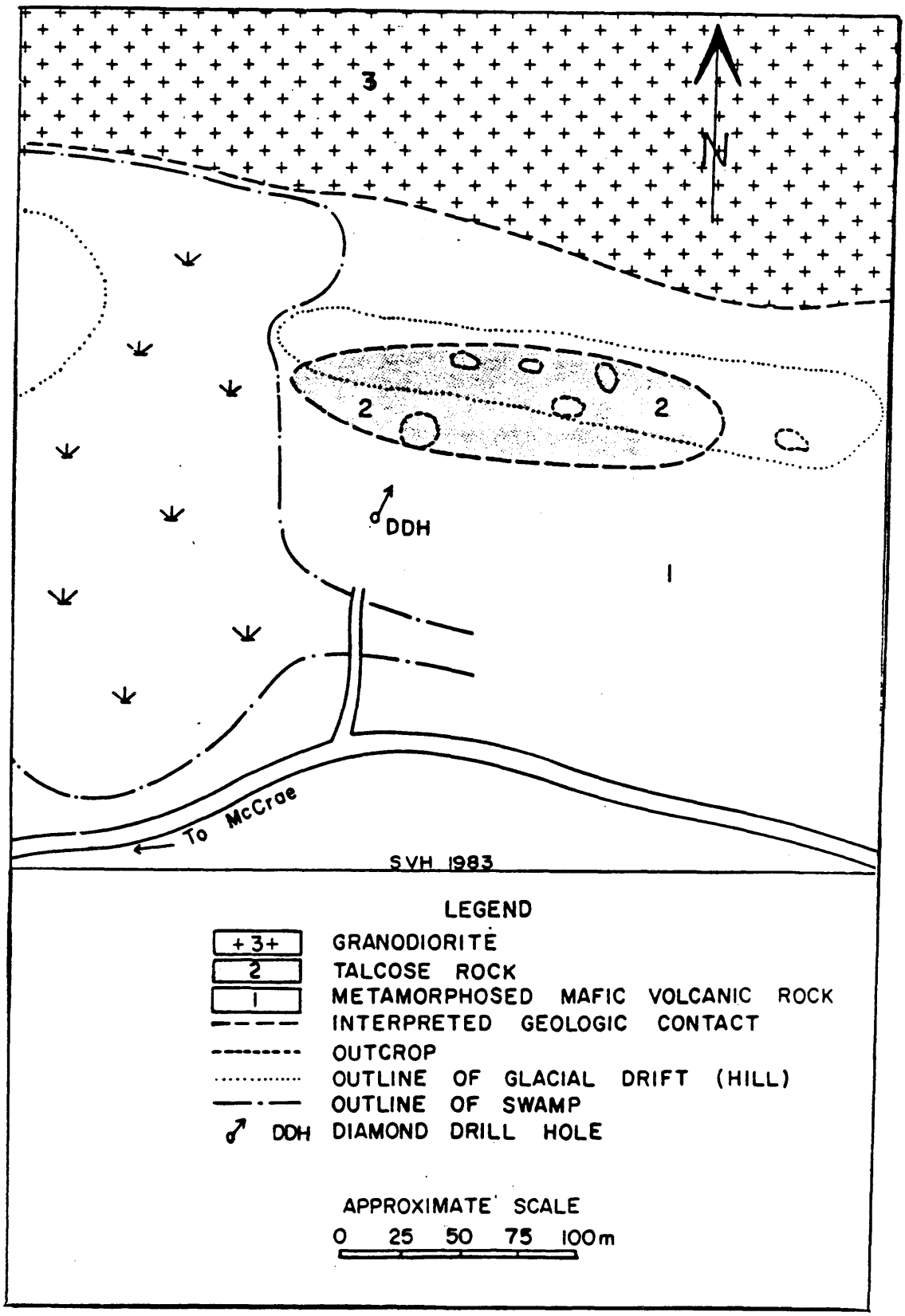


Figure 34: Geology of the Dubblestein (SE4) Soapstone Occurrence, Cashel Township

(from LeBaron and van Haaften, 1989)

SE4: Dubblestein
(Cashel Township, Concession VII, Lot 2)

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The prospect is located in east-central Cashel Township, Hastings County, 10.5 km northeast of the village of Gunter (see Figure 32).

Claim Map: M-71, Cashel Township;
Southern Mining Division

NTS: 31C/14NW

UTM: Zone 18 306450E 4980450N

Latitude: 45° 15' 00" Longitude: 77° 27' 25"

ACCESS: The property may be reached by a dirt trail leading south from the road to Weslemkoon Lake, approximately 1.6 km west of McCrae (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1982 - The property consists of four claims which were held by A. Dubblestein and M. Dubblestein. Canada Talc Industries Limited cored two diamond drill holes totalling 116 m, one of which cut the soapstone zone (LeBaron and van Haaften 1989).

GEOLOGY: Talc-rich rocks occur within mafic metavolcanics of the Tudor Formation adjacent to the Weslemkoon batholith (see Figure 34). At this site, the talcose rock can be traced along strike for approximately 40 m with an exposed width of 15 m. The unit grades from an anthophyllite-tremolite-chlorite unit into the contact metamorphosed amphibolite of the Tudor metavolcanics (Lumbers 1968).

STONE DESCRIPTION: The stone contains 30 to 60 percent talc (fine- to medium-grained flakes), abundant tremolite, minor anthophyllite and dolomite as well as 10 percent iron-titanium oxide minerals (Lumbers 1968). Dillon and Barron (1982) describe the stone as medium-grained, medium to buff, grey-green rocks which are massive to poorly foliated. They contain 10 to 30 percent talc with anthophyllite, chlorite, tremolite and dolomite as accessory minerals.

REFERENCES:
Dillon and Barron (1982, p. 230)
LeBaron and van Haaften (1989, p. 75-77)
Lumbers (1968, p. 41-44)

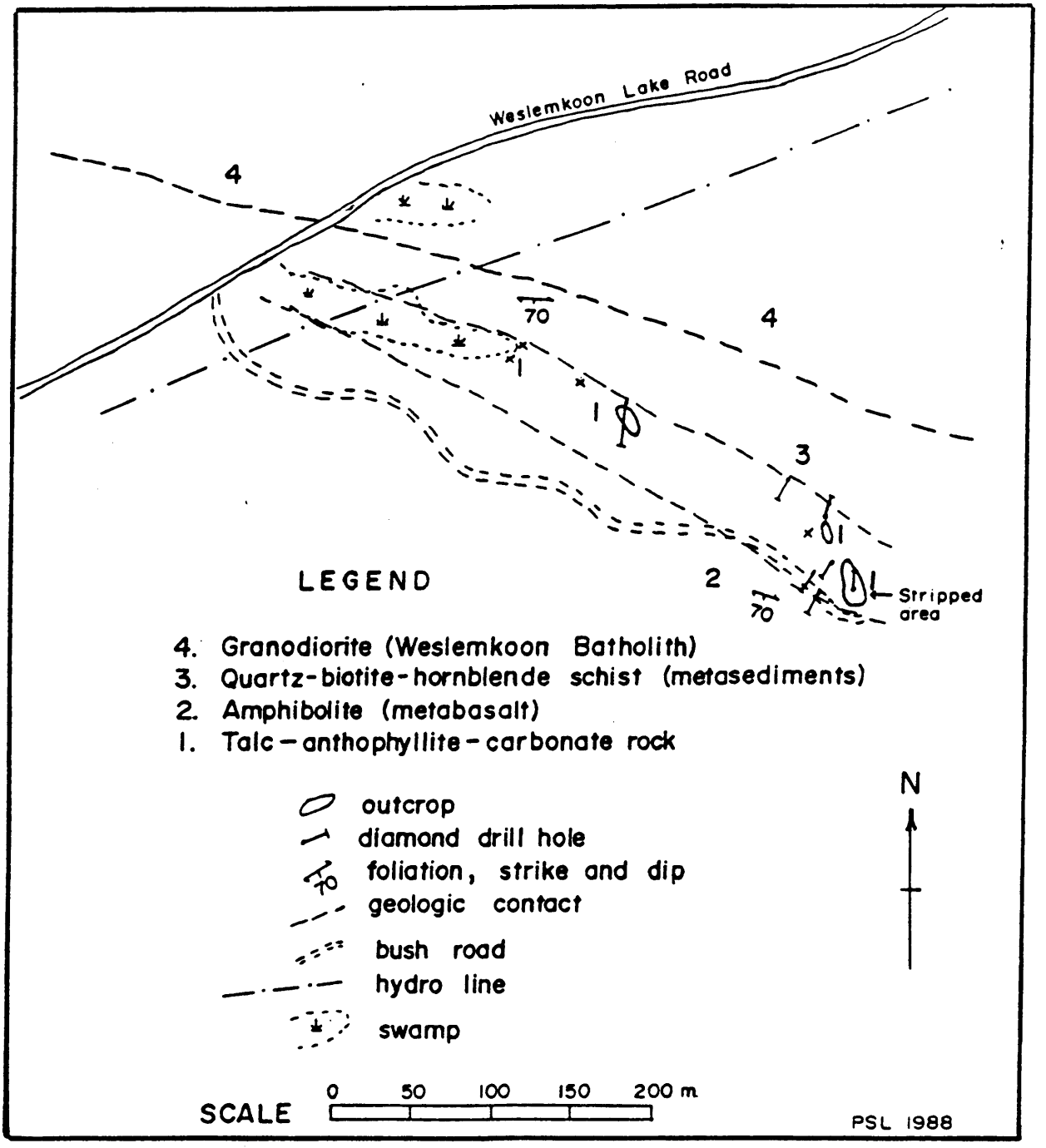


Figure 35: Geology of the McMurray (SE5) Soapstone Occurrence, Cashel Township (from LeBaron and van Haaften, 1989)

SE5: McMurray
(Cashel Township, Concession VIII, Lot 7)

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The prospect occurs in east-central Cashel Township, Hastings County, 10 km northeast of the village of Gunter (see Figure 32).

Claim Map: M-71, Cashel Township;
Southern Ontario Mining Division

NTS: 31C/14NW

UTM: Zone 18 304800E 498100N

Latitude: 45° 12' 30" Longitude: 77° 28' 30"

ACCESS: The property is accessible from the village of Gunter by travelling 12 km northeast along the Weslemkoon Lake Road, and south along a bush road for approximately 500 m (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1982 - Stripping and diamond drilling (304 m in 17 drill holes) by David McMurray; drill core is stored at the Ministry of Northern Development and Mines Drill Core Library, Bancroft (LeBaron and van Haaften 1989).

GEOLOGY: The zone of talc-carbonate-serpentine altered ultramafic rock occurs approximately 50 m southwest of the margin of the Weslemkoon batholith as shown on Figure 35. It strikes northwesterly with a steep dip to the southwest. To the north of the zone is banded, quartz-biotite-hornblende schist, and to the south, amphibolitic metabasalt (LeBaron and van Haaften 1989). Cashel Township was mapped by Lumbers (1968). The talc unit is comprised of a series of talc-carbonate-anthophyllite altered ultramafic units,2 m to 10 m wide, separated by narrow bands of chlorite schist, biotite schist and quartz biotite schist which are 20 cm to 40 cm wide (LeBaron and van Haaften 1989).

TEST RESULTS:

Beneficiation tests consisting of froth flotation and magnetic separation were completed by LeBaron (1988) on a composite sample from two diamond drill holes, 150 m apart along the zone:

1. Mineralogy of samples in volume percent (determined by thin section point counts and X-ray diffraction).

	1	2	3
Talc	30	40	42
Dolomite	24	10	5
Calcite	24	20	1
Serpentine	16	11	33
Chlorite	3	13	1
Anthophyllite	0	1	3
Magnetite	3	5	15

2. Mineralogy of the talc products after beneficiation.

	Percent
Talc	86
Dolomite	4
Serpentine/Chlorite	10
Anthophyllite	0

REFERENCES: LeBaron and van Haaften (1989, p. 78-80)
LeBaron (1988)
Lumbers (1968)

**SE6: Madoc Talc and Mining Company
(Cashel Township, Concession XII, Lot 17)**

COMMODITY: Talc, Soapstone

STATUS: Talc prospect

LOCATION: The property is located in Hastings County, Cashel Township, Concession XII, Lots 16 and 17, Concession XIII, Lot 16 and Concession XIV, Lots 15 and 16 (see Figure 32). The shaft is situated on Concession XII, Lot 17. It is approximately 10 km north of Gunter.

Claim Map: M-71, Cashel Township;
Southern Ontario Mining Division

NTS: 31C/13NE

UTM: Zone 18 300021E 4982750N

Latitude: 44° 58' 19" Longitude: 77° 32' 09"

ACCESS: The property is located adjacent to the forest access road in north-central Cashel Township, Hastings County (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

The property has been examined for its talc potential.

1937 - The area was staked by L.S. Reeves (Spence 1940).

1938 - The Madoc Talc and Mining Company of Trenton started exploration of the property. A 27 m shaft was sunk with a 15 m cross cut at the 26 m level and 38 m of drifting. Only small trial lots of talc were shipped (Spence 1940).

1981-1982 - Canada Talc Industries Limited of Madoc and Roger Young of Havelock held mining claims over the area. Five diamond drill holes totalling 360 m were drilled by Canada Talc Limited on both properties (LeBaron and van Haaften 1989).

DESCRIPTION OF SITE: The shaft which is located in Concession XII, Lot 17, has been filled in.

GEOLOGY: Talcose rocks in the area are hosted within mafic metavolcanics or at the contact between mafic and felsic metavolcanics. The talc zones, which range in width from 10 cm to 30 m, occur within 180 m of the Weslemkoon batholith (Lumbers 1968)(see Figure 36).

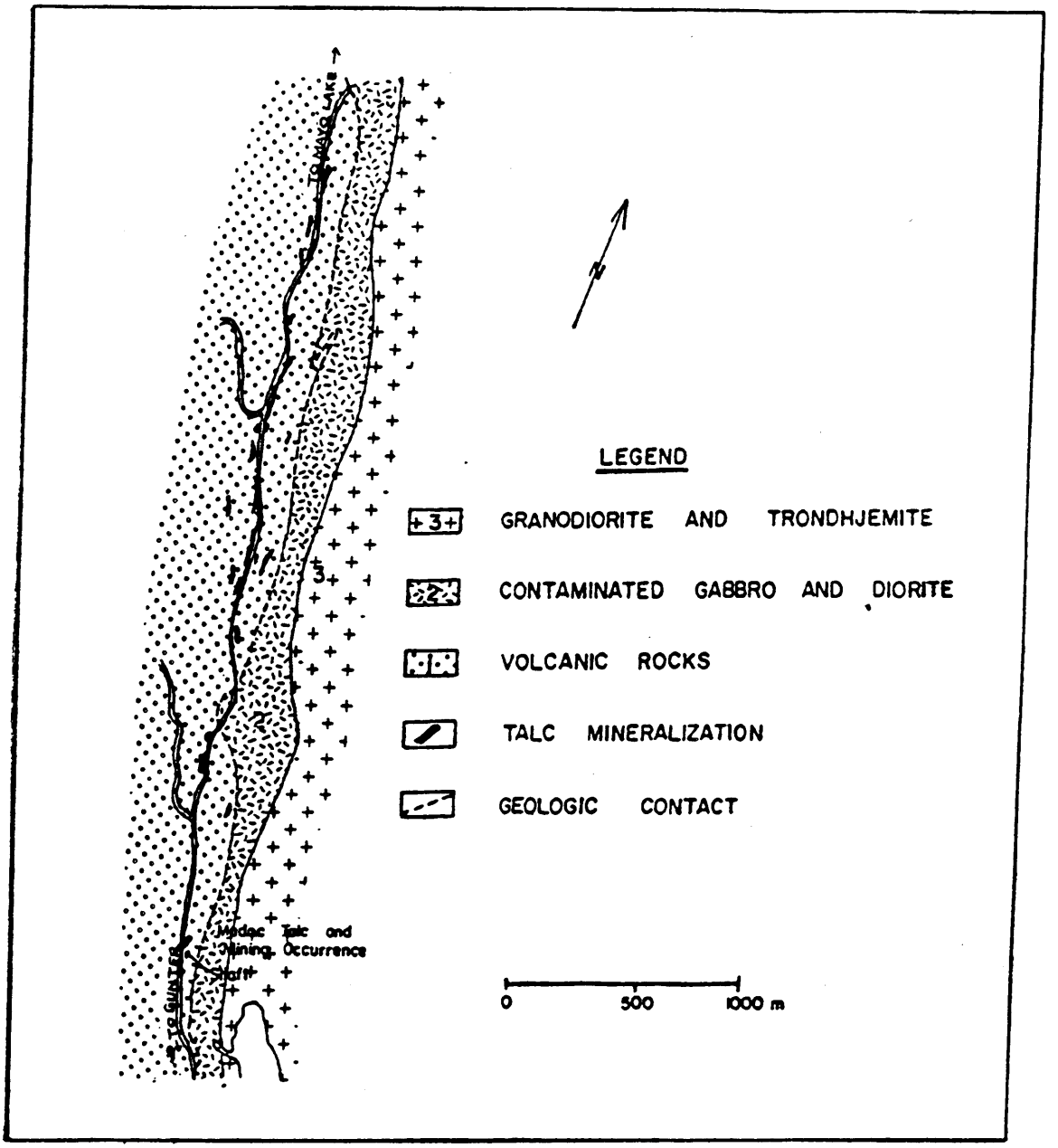


Figure 36: Geology of the Madoc Talc and Mining Company (SE6) Soapstone Occurrence, Cashel Township

(from LeBaron and van Haaften, 1989)

At the shaft in Concession XII, Lot 17, the talc-rich zone is approximately 20 m wide. The zone grades eastward into tremolite-dolomite schist which is adjacent to gabbro of the batholith. To the west, the zone is in sharp contact with para-amphibolite (LeBaron and van Haaften 1989).

STONE DESCRIPTION: The stone is described as a greenish, fine-grained, chlorite talc schist locally containing abundant dolomite. Semi-chloritized hornblende is also reported in some bands. In part however, the rock is more massive than foliated and is referred to by Spence (1940) as soapstone, who suggests it might be used for "sawing into blocks".

TEST RESULTS:

Chemical Analysis:

	1	2	3
SiO_2	40.08	55.86	41.49
FeO	3.70	0.0	0.0
Fe_2O_3	1.87	5.82	6.05
Al_2O_3	1.75	2.23	2.38
CaO	4.85	2.43	4.20
MgO	9.81	26.74	28.36
CO_2	16.45	0.0	0.0
H20 (above 105°C)	4.12	0.0	0.0
Loss on ignition	0.0	5.71	16.00

1. Spence (1940)
2, 3. Lumbers (1968)

Standard reflectance and oil absorption tests (in percent) were performed by Lumbers (1968).

	1	2
Reflectance	60.5	72.5
Oil Absorption	29.7	24.97

Beneficiation tests consisting of froth flotation and magnetic separation were completed by LeBaron (1988) on a composite sample:

1. Mineralogy of samples in volume percent (determined by thin section point counts and X-ray diffraction).

	1	2
Talc	18	28
Dolomite	49	38
Calcite	0	0
Serpentine	11	9
Chlorite	0	1
Anthophyllite	21	23
Magnetite	1	1

2. Mineralogy of the talc products after beneficiation

	Percent
Talc	93
Dolomite	2
Serpentine/chlorite	2
Anthophyllite	3

REFERENCES: LeBaron (1988)
LeBaron and van Haaften (1989, p. 81-85)
Lumbers (1968, p. 41-44)
Spence (1940, p. 75-76)

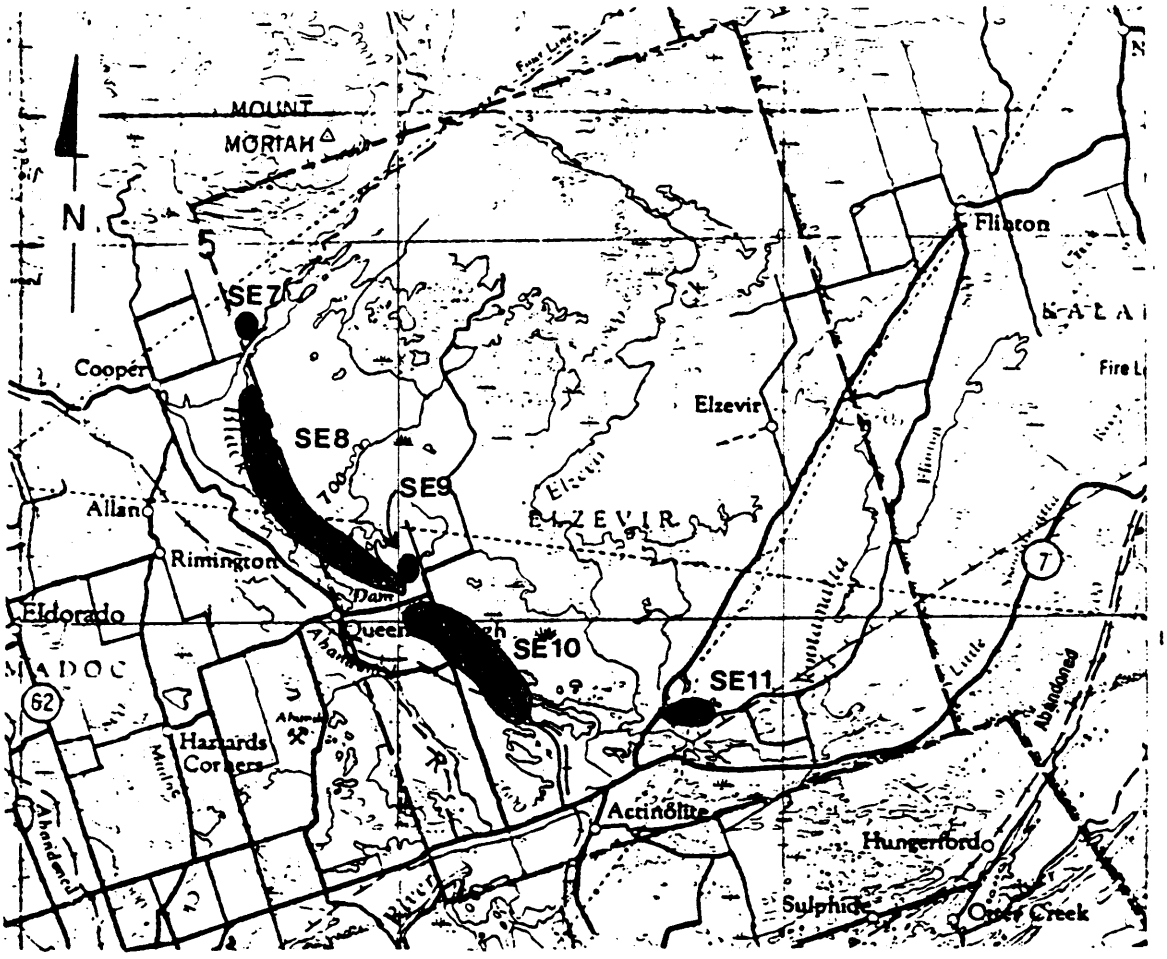


Figure 37: Location of the Elzevir Township, Hastings County Soapstone Occurrences

Scale

| 5km |

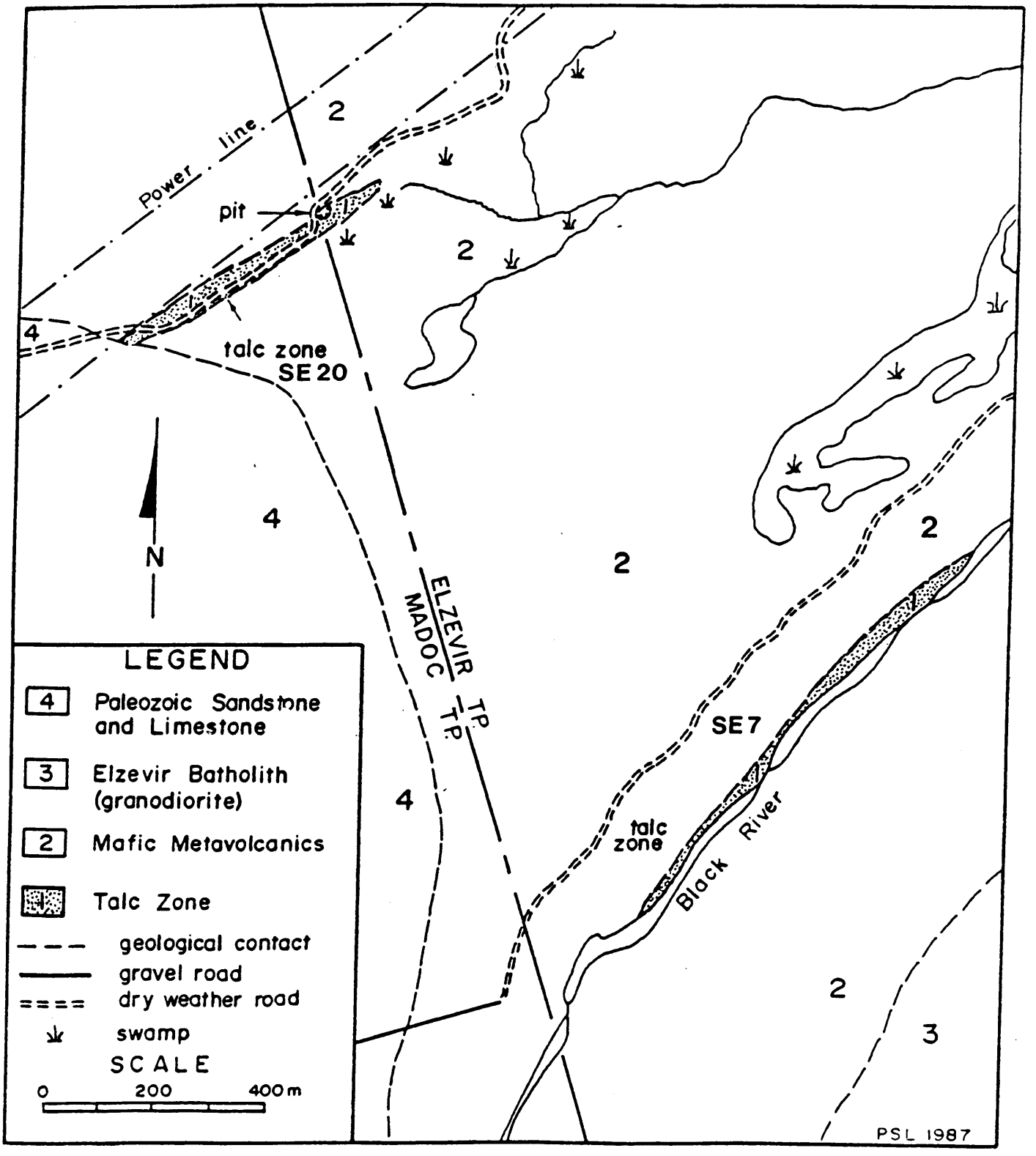


Figure 38: Geology in the Vicinity of Soapstone Occurrences SE7, Elzevir Township and SE20, Madoc Township

(from LeBaron and van Haaften, 1989)

SE7: Elzevir Township, Concession I, Lot 27

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: The property is located along the Black River east of the village of Cooper in northwestern Elzevir Township, Hastings County (see Figure 37).

Claim Map: G-1261, Elzevir Township;
Southern Ontario Mining Division

NTS: 31C/11NW

UTM: Zone 18 305950E 4947400N

Latitude: 44° 39' 15" Longitude: 77° 27' 10"

ACCESS: This occurrence may be reached by travelling east along the road from Cooper for approximately 2.5 km.

HISTORY OF DEVELOPMENT: There is no record of development.

GEOLOGY: Talcose rocks are found within mafic metavolcanic rocks of the Tudor Formation, adjacent to the Elzevir trondhjemite batholith (see Figure 38). This occurrence is the northeast extension of occurrence SE19 (LeBaron and van Haaften 1989).

STONE DESCRIPTION: The unit is mainly composed of talc, serpentine and dolomite with lesser amounts of tremolite, chlorite, anthophyllite and magnetite (LeBaron and van Haaften 1989).

REFERENCES: LeBaron and van Haaften (1989 p. 86-87)
Wilson (1926 p. 91)

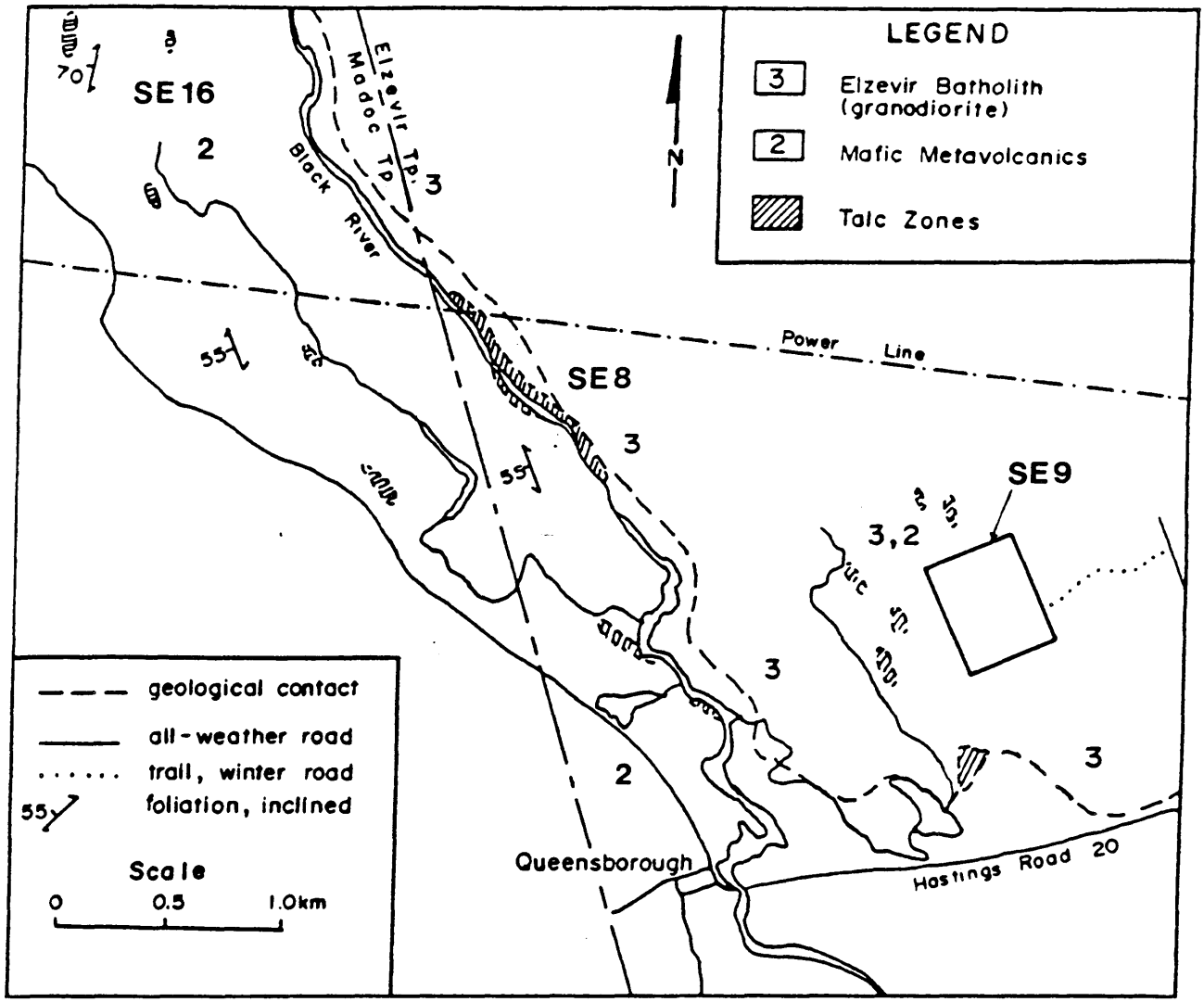


Figure 39: Geology in the Vicinity of Soapstone Occurrences SE8 and SE9, Elzevir Township and SE16, Madoc Township

(from LeBaron and van Haaften, 1989)

SE8: Elzevir Township, Concession I, II, Lots 14-18

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: Several occurrences are located along the west boundary of Elzevir Township, Hastings County approximately 1.5 km north-northeast of the village of Queensborough (see Figure 37).

Claim Map: G-1261, Elzevir Township;
Southern Ontario Mining Division

NTS: 31C/11SW

UTM: Zone 18 309000E 4941550N

Latitude: 44° 36' 08" Longitude: 77° 24' 05"

ACCESS: The occurrences can be reached by foot from Hastings County Road No. 20 (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT: There is no record of work on the occurrences.

GEOLOGY: The area was mapped by Dillon and Barron (1985) as mafic to ultramafic metavolcanic rocks in contact with the Elzevir granodiorite batholith which lies to the east. Talcose rock occurs within the metavolcanics adjacent to the batholith and as lenses within the batholith. In this location the width of the talc units ranges from 2 to 15 m. They are up to 60 m in length (see Figure 39).

STONE DESCRIPTION: The talcose rocks are described as soft, massive to poorly foliated, with a light greenish grey to pinkish grey colour on weathered surfaces. Fine carbonate veinlets occur throughout the unit, commonly associated with chlorite and magnetite (Dillon and Barron 1985).

Thin section examination by Dillon and Barron (1985) indicates the talc content of the rock varies from 20 to 80 percent and carbonate up to 30 percent. Chlorite, serpentine and magnetite occur in varying amounts.

REFERENCES: Dillon and Barron (1985 p. 32-33)
LeBaron and van Haaften (1989, p. 94-96)

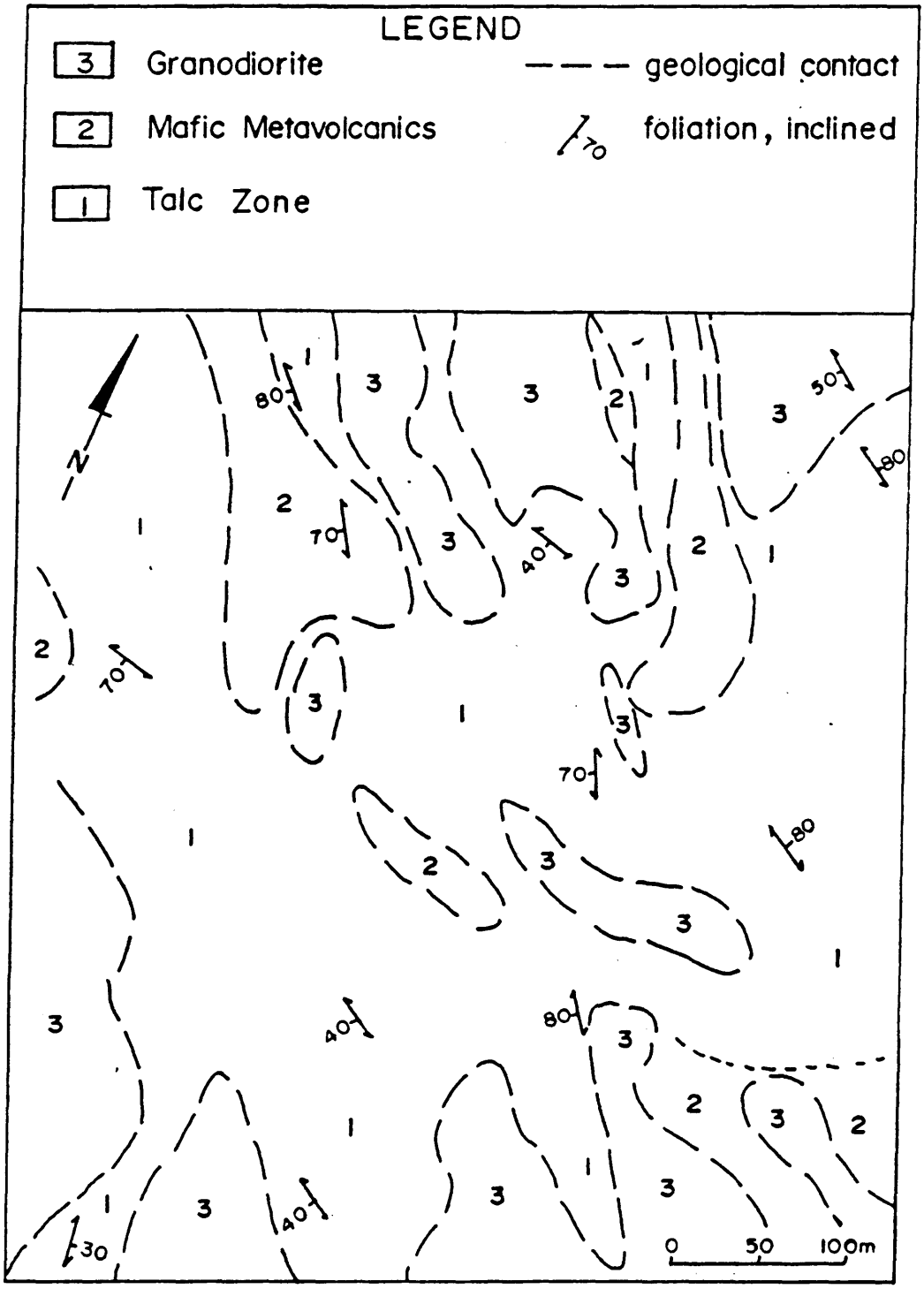


Figure 40: Geology of the Soapstone Occurrence SE9, Elzevir Township (from LeBaron and van Haaften, 1989)

SE9: Elzevir Township, Concession II, Lot 15

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: The occurrence is located in west central Elzevir Township, Hastings County, 2 km northeast of the village of Queensborough (see Figure 37).

Claim Map: G-1261, Elzevir Township;
Southern Ontario Mining Division

NTS: 31C/11SW

UTM: Zone 18 310450E 3941350N

Latitude: 44° 36' 00" Longitude: 77° 23' 00"

ACCESS: The occurrence is accessible by a trail leading west from a concession road, which is located 2.5 km east of Queensborough, north of Hastings County Road No. 20 (see Figure 39) (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT: There is no record of development on the property.

GEOLOGY: Talc-rich rock occurs in mafic to ultramafic metavolcanic rocks which lie in an embayment within the Elzevir granodiorite batholith. Dillon and Barron (1985) who mapped an area (500 m by 500 m)in detail estimated that 60 percent of the area was talcose material, mainly a soft talc-chlorite-carbonate-magnetite schist. The remainder consists of small plugs of intrusive material and lenses of altered mafic metavolcanic rocks, shown in Figure 40.

STONE DESCRIPTION: The stone is fine to medium grained, soft and massive to poorly foliated. The weathered surface has an irregular, pitted appearance, medium greenish grey colour with a slight pinkish tone due to the weathering of magnetite.

The composition of the unit varies from talc-chlorite to chlorite-serpentine-talc to talc-carbonate. Thin sections show the average talc content to be 50 percent, although it may range from 30 to 80 percent. Chlorite makes up 20 to 50 percent, dolomite 5 to 15 percent and magnetite 2 to 5 percent (Dillon and Barron 1985).

REFERENCES: Dillon and Barron (1985, p. 41-47)
LeBaron and van Haaften (1989, p. 97-99)

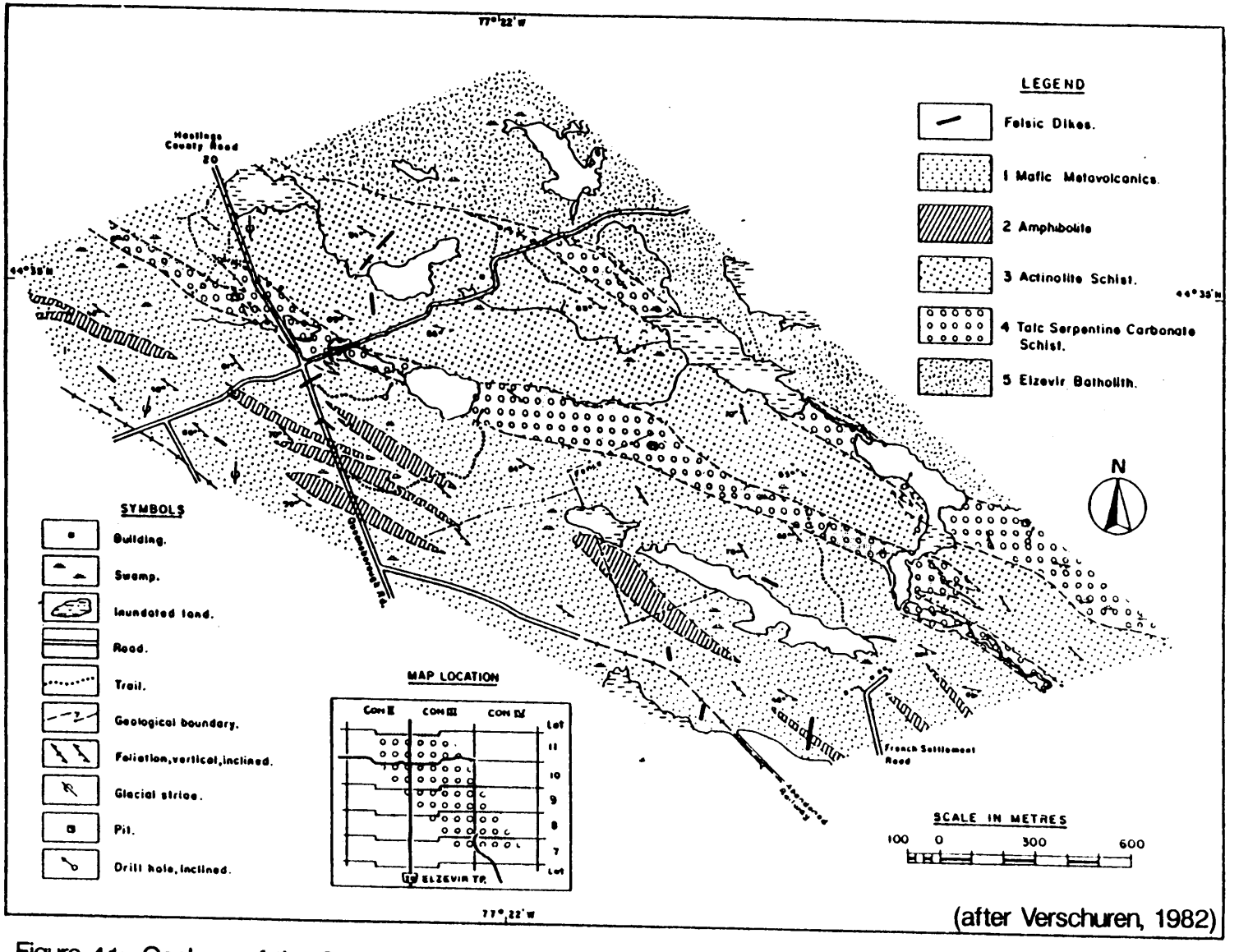


Figure 41: Geology of the Queensborough Road (SE10) Soapstone Occurrence, Elzevir Township (from LeBaron and van Haaften, 1989)

SE10: Queensborough Road
(Elzevir Township, Concession II, Lots 10,11
Concession III, Lots 8,9,10,11
Concession IV, Lots 6,7,8,9)

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The property is located in southwestern Elzevir Township, Hastings County, approximately 5 km northwest of the village of Actinolite (see Figure 37).

Claim Map: G-1261, Elzevir Township;
Southern Ontario Mining Division

NTS: 31C/11SW

UTM: Zone 18 312700E 4938510N

Latitude: 44° 34' 14" Longitude: 77° 21' 50"

ACCESS: The area is accessed by Hastings County Road No. 20. Road No. 20 goes north to Queensborough from Highway 7.

HISTORY OF DEVELOPMENT:

late 1800's-1926 - The area was prospected for talc and actinolite. An exploration pit 1.5 m square and 0.6 m deep was dug on Concession III, Lot 11 (Wilson 1926).

1930's - Diamond drilling was carried out on Concession IV, Lot 8. As well, several pits, are located on this lot. The main pit is a 3 m by 2.5 m face in the side of a hill. A second pit has a diameter of 4.6 m and a depth of 3 m (Hewitt 1972).

1940's - A trench 20 m long, 2.5 m wide and 1.2 m deep was put down on Concession III, Lot 9 (Hewitt 1972).

1982 - Steep Rock Iron Mines Limited and Canada Talc Industries Limited mapped, sampled and drilled the area. Limited bench-scale testing was carried out (Verschuren 1982).

GEOLOGY: The area is underlain by mafic metavolcanics to the west and the Elzevir batholith to the east. Detailed mapping of the area by Verschuren (1982) shows two north-west trending zones of talc-serpentine-carbonate schist, approximately 100 to 200 m wide, occurring between the metavolcanics and the batholith (see Figure 41). Separating

the two zones is actinolite schist, which is thought to represent the unaltered equivalent of the talc-serpentine-carbonate schist. The zones are composed of talc, serpentine, dolomite and magnetite in varying proportions. (Verschuren 1982).

STONE DESCRIPTION: Wilson (1926) notes a lenticular body of soapstone on Concession III, Lot 10, 48 m by 36 m in size. The rock had a pitted appearance on weathered surface.

On Concession III, Lot 11, Wilson (1926) describes a zone of "irregularly foliated talcose dolomite" approximately 45 m in length with a width of 4.5 to 6 m.

Hewitt (1972) describes the material in Concession IV, Lot 8 as veins of talc in serpentinized green metavolcanics. Dump material from one pit includes blocks of "mauve-grey foliated talc".

REFERENCES:
Hewitt (1972, p. 28-29)
LeBaron and van Haaften (1989, p. 88-90)
Verschuren (1982, p. 92-96)
Wilson (1926, p. 91-92)

SE11: Elzevir Township, Concession VI, Lot 5
Concession VII, Lots 4,5

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The property is located in the southern part of Elzevir Township, Hastings County, 4 km northeast of the village of Actinolite (see Figure 37).

Claim Map: G-1261, Elzevir Township;
Southern Ontario Mining Division

NTS: 31C/11SW

UTM: Zone 18 317650E 4937550N

Latitude: 44° 34' 05" Longitude: 77° 18' 28"

ACCESS: The prospect is accessible by following Highway 7 east for 1 km from the junction with Highway 37 and then north along the road to Flinton for approximately 2 km. There, a side road leads east. The talcose rocks are located at the "Hayloft" campgrounds in the vicinity of the hydro line along this road.

HISTORY OF DEVELOPMENT:

1883-1908 - Several quarry openings were made and stone extracted for manufacturing roofing material by J. James of Actinolite (Spence 1940).

1908-1929 - The Actinolite Mining Company, Limited of Bloomfield, New Jersey acquired the properties and erected a grinding plant at Actinolite. A small tonnage of ground roofing material was produced annually (Spence 1940).

Wilson (1926) describes seven pits located on the property. Three pits are located in Con. VI, Lot 5, three in Con. VII, Lot 4 and one in Con. VII, Lot 5. The pits range in length up to 36.5 m, in width from 1.5 to 15 m and from 1.5 to 6 m in depth.

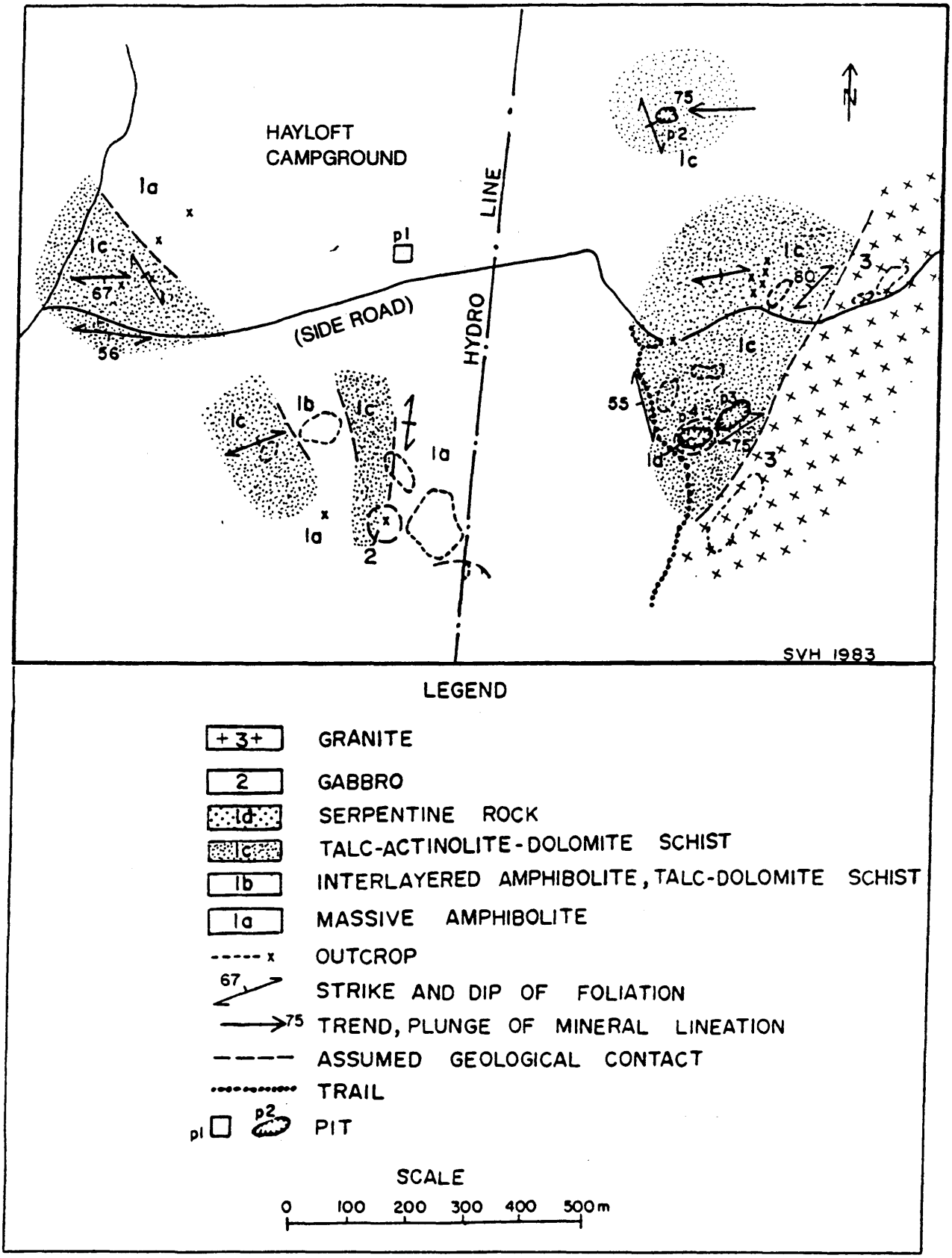


Figure 42: Geology of the Soapstone Occurrence SE11, Elzevir Township (from LeBaron and van Haaften, 1989)

GEOLOGY: The area was mapped by Thompson (1972) and LeBaron et al(1987) as mafic to ultramafic volcanic rocks. Granodiorite of the Elzevir batholith occurs to the north, east and southeast. The most altered portions of the ultramafic volcanic unit occur as talc-actinolite-dolomite schists, classified as soapstone, interlayered with amphibolite and serpentinized units (see Figure 42) (LeBaron and van Haaften 1989).

STONE DESCRIPTION: Thin section examination by Wilson (1926) of the schist showed talc, carbonate, serpentine and magnetite. A thin section from a sample collected in a pit contains 40 percent talc (LeBaron and van Haaften 1989).

REFERENCES:
LeBaron et al (1987, p. 301-306)
LeBaron and van Haaften (1989, p. 91-93)
Spence (1940, p. 74-75)
Thompson (1972)
Wilson (1926, p. 92-93)

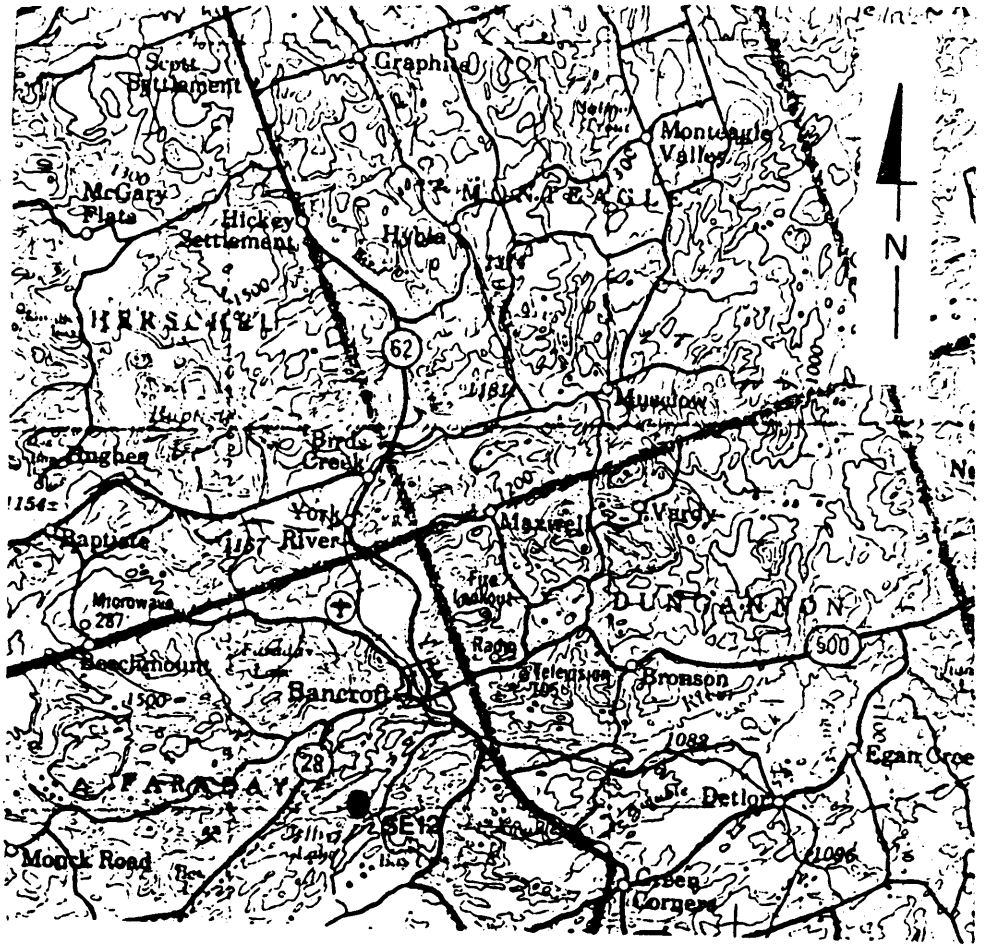


Figure 43: Location of the Pipe Lake (SE12) Soapstone Occurrence, Faraday Township, Hastings County

Scale

5km

SE12: Pipe Lake
(Faraday Township, Concession X, Lot 11)

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The occurrence is located near the shore on Pipe Lake, in the northeastern part of Faraday Township, Hastings County (see Figure 43).

Claim Map: G-3147, Faraday Township;
Southern Ontario Mining Division

NTS: 31F/4SW

UTM: Zone 18 272100E 4988000N

Latitude: 45° 00' 39" Longitude: 77° 53' 29"

ACCESS: The prospect is accessible by a dirt road which leads west from Highway 62, approximately 1 km south of the centre of Bancroft (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1942 - A pit was sunk on the southeast shore of Pipe Lake by persons unknown (Storey and Vos 1981).

Hewitt (1972) reported that blasting had occurred in a small area on the northern side of the lake.

GEOLOGY: The area is underlain by a northeast trending belt of interlayered dolomitic and calcitic marbles and paragneiss (Storey and Vos 1981).

LeBaron and van Haaften (1989) report two slightly talcose rock units. One occurs north of the lake in tremolitic rock and the other in tremolitic zones in marble, south of the lake (see Figure 44).

STONE DESCRIPTION: Thomson (1943) reports talc and soapstone on this property. The soapstone is composed of massive amphibolite with talc along the slip planes. Storey and Vos (1981) who examined the tremolitic marble report that it is predominantly pale green tremolite with minor phlogopite and dolomite.

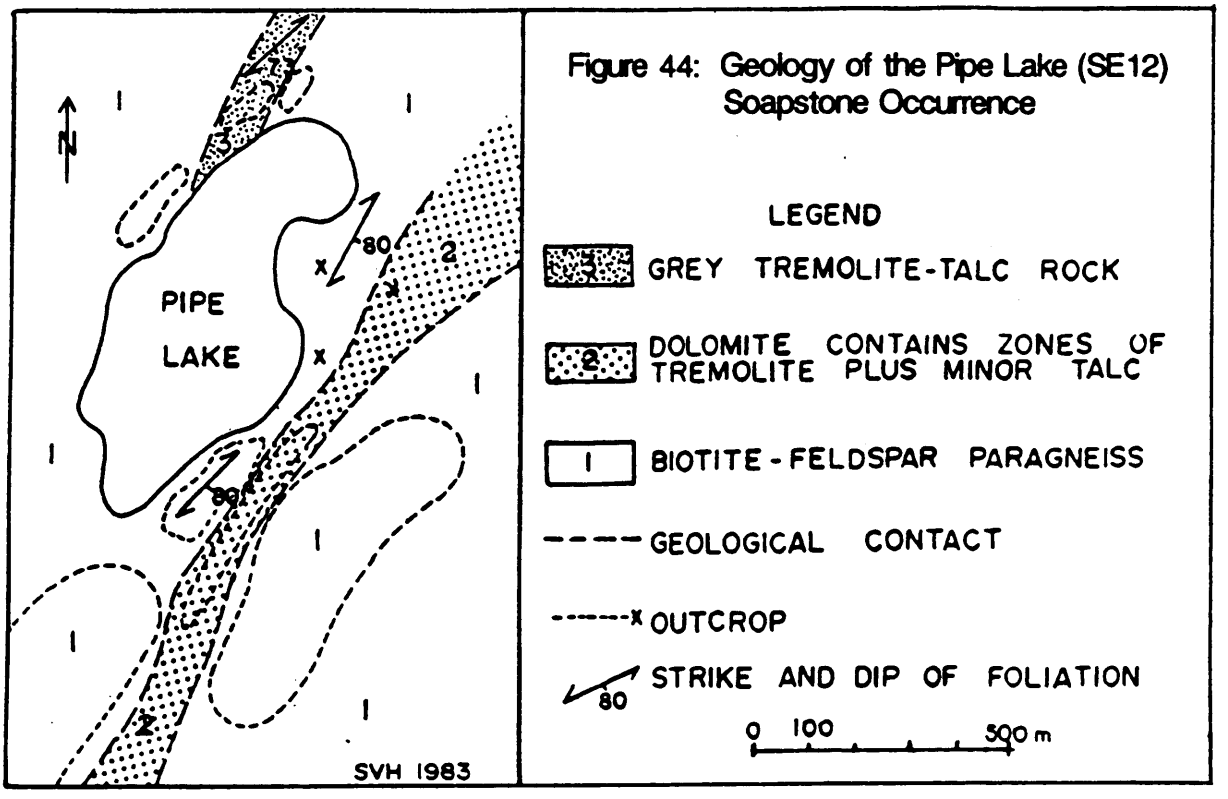


Figure 44: Geology of the Pipe Lake (SE12) Soapstone Occurrence

(from LeBaron and van Haaften, 1989)

TEST RESULTS:

Chemical Analysis: from Thomson (1943)

	Percent
SiO_2	59.00
Fe_2O_3	1.95
Al_2O_3	1.37
CaO	3.12
MgO	29.28
loss on ignition	4.60
SO_3	0.67
H_2O (above 105°C)	2.63
Total	**102.62**

REFERENCES:

Hewitt (1972, p. 30)
LeBaron and van Haaften (1989 p. 100-101)
Storey and Vos (1981, p. 192)
Thomson (1943, p. 71)

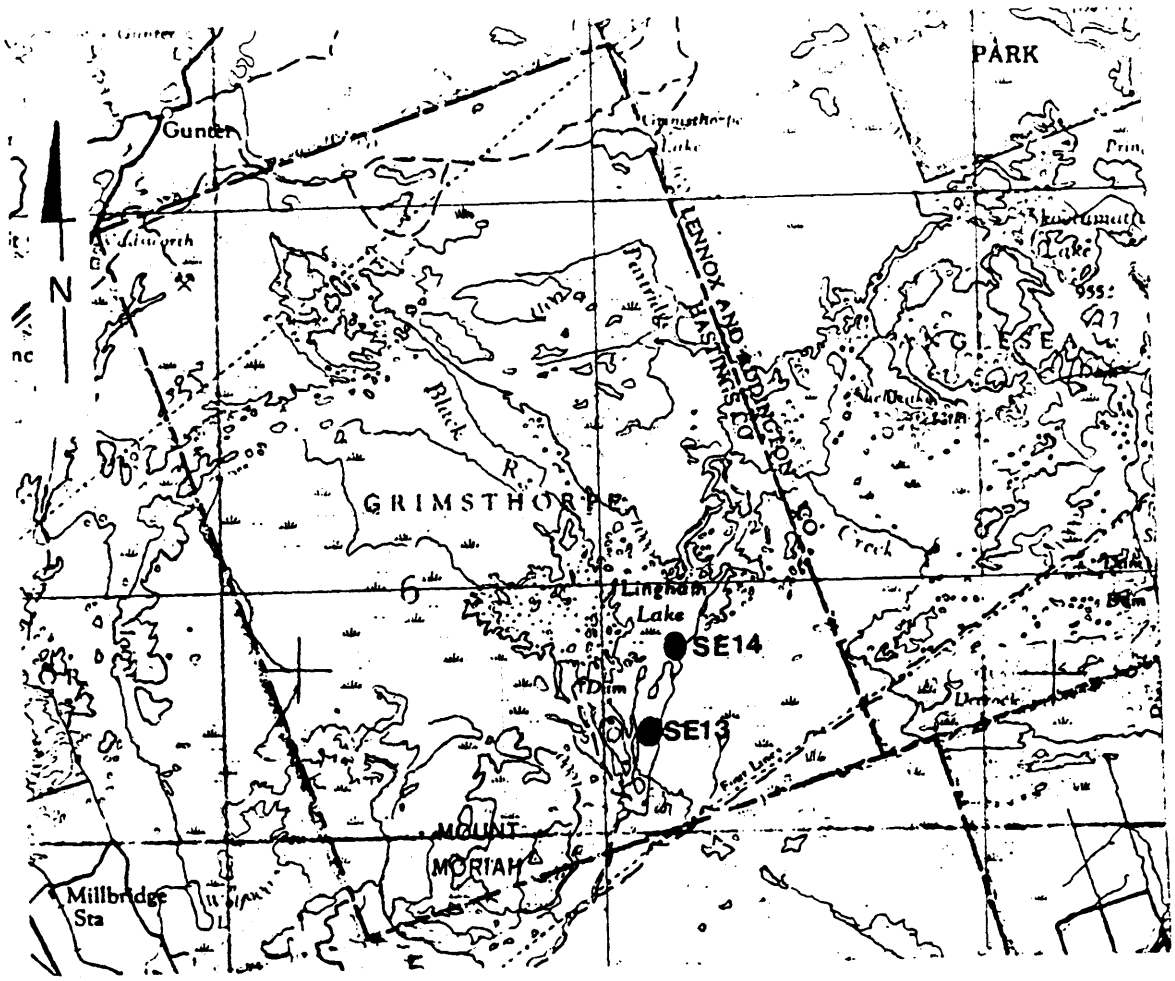


Figure 45: Location of the Grimsthorpe Township, Hastings County Soapstone Occurrences

Scale

5km

SE13: Grimsthorpe Township, Concession IV, Lot 13, south half

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The property is located in the southern part of Grimsthorpe Township, Hastings County (see Figure 45).

Claim Map: M-97, Grimsthorpe Township; Southern Ontario Mining Division

NTS: 31C/11NW

UTM: Zone 18 311300E 49563000N

Latitude: 44° 44' 00" Longitude: 77° 23' 00"

ACCESS: The area is accessible by a road following the power line in northern Elzevir Township. Three km northeast of Lingham Lodge on the power line, a trail along the east shore of Canniff Creek leads to the Black River. At the Black River, a trail heads north to the prospect (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1948 - Active Exploration Syndicate cored five diamond drill holes on the showing (Hewitt 1972).

DESCRIPTION OF SITE: LeBaron and van Haaften (1989) found no evidence of diamond drilling during a field visit.

GEOLOGY: The area is underlain by metavolcanic rocks. Hewitt (1972) described the showing as a talcose zone hosted by serpentinized greenstone. Drill hole five was reported to have a 18 m section of talc and talcose rock. LeBaron and van Haaften (1989) located a 1 m wide shear zone containing 5 to 10 percent talc within serpentinized mafic metavolcanics near the centre of Lot 13, Conc.IV.

REFERENCES: Hewitt (1972, p. 31)
LeBaron and van Haaften (1989, p. 104-105)

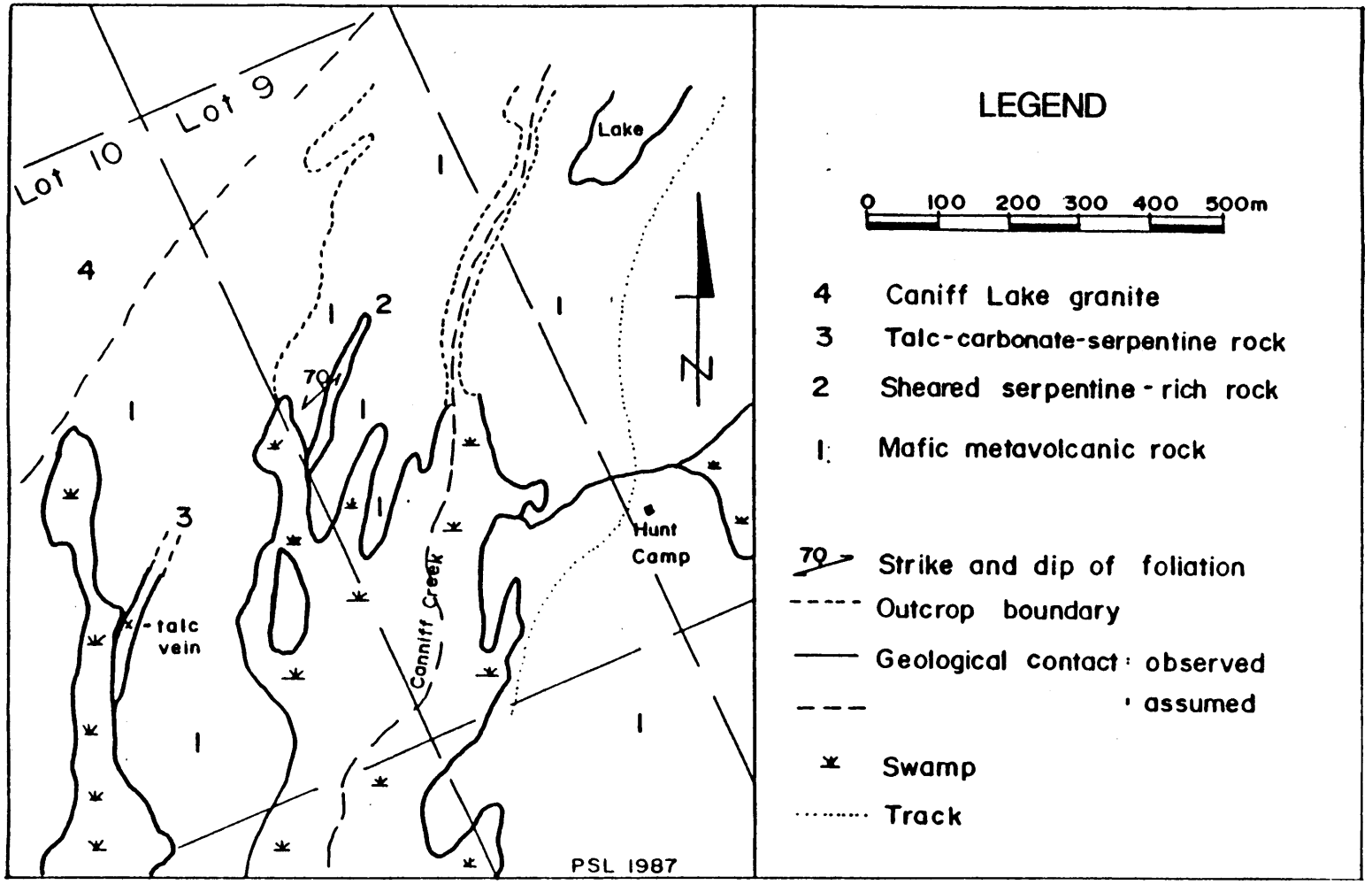


Figure 46: Geology of the Soapstone Occurrence SE14, Grimsthorpe Township (from LeBaron and van Haaften, 1989)

SE14: Grimsthorpe Township, Concession V, Lots, 8,9,10

COMMODITY: Talc, Soapstone

STATUS: Talc prospect

LOCATION: The prospect is located east of Lingham Lake, along Canniff Creek in southeastern Grimsthorpe Township, Hastings County (see Figure 45).

Wilson (1926) and Spence (1940) locate the occurrence in Lot 9. Spence (1922) reports talc mineralization on Lots 8, 9, 10. LeBaron and van Haaften (1989) during field examination located an occurrence in Lot 10 shown on Figure 46.

Claim Map: M-97, Grimsthorpe Township;
Southern Ontario Mining Division

NTS: 31C/14SW

UTM: Zone 18 312000E 4958350N

Latitude: 44° 45' 25" Longitude: 77° 22' 30"

ACCESS: The property is accessible by road from northern Elzevir Township following the power line. Three km northeast of Lingham Lodge on the power line, a track follows the east shore of Canniff Creek to the prospect (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT: Wilson (1926) reports an opening 0.3 m to 1.2 m wide and 0.9 m deep, excavated adjacent to a southeastward facing cliff 3.6 m high. A second pit, 0.6 m to 1.2 m wide and 0.3 m to 0.9 m deep is located 90 m northeast of the first pit.

GEOLOGY: Talc occurs within serpentinized and talc-carbonate altered rocks in mafic metavolcanics in a unit approximately 10 m wide and 200 m in length. The Canniff Lake granite lies to the north of the occurrence (LeBaron and van Haaften 1989).

STONE DESCRIPTION: Spence (1940) describes the stone as a pale apple-green foliated talc.

TEST RESULTS:

Chemical Analysis: from Wilson (1926)

	Percent
SiO_2	60.45
Al_2O_3	0.27
Fe_2O_3	0.78
FeO	2.04
NiO	0.50
CaO	0.16
MgO	29.84
H_2O at 100°C	0.32
H_2O above 100°C	5.42
Total	**99.78**

REFERENCES: Hewitt (1972, p. 31-32)
LeBaron and van Haaften (1989, p. 106-108)
Spence (1922, p. 25; 1940, p. 75)
Wilson (1926, p. 90-91)

SE15: Canada Talc Industries Mine
(Henderson Mine)
(Conley Mine)

COMMODITY: Talc, Soapstone, Talcose Dolomite, Dolomite

STATUS: Talc producer

OWNERSHIP: W.R. Barnes Company Limited

LOCATION: Huntingdon Township, Concession XIV, Lots 14 E 1/2, 15 NW 1/4. The mine is located on the southeast edge of the town of Madoc (see Figure 47).

Claim Map: G-1269, Huntingdon Township; Southern Ontario Mining Division

NTS: 31C/11SW

UTM: Zone 15 305050E 4930450N

Henderson Mine

Latitude: 44° 30' 05" Longitude: 77° 27' 15"

Conley Mine

Latitude: 44° 30' 15" Longitude: 77° 27' 10"

ACCESS: The property is accessible by road from Madoc (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT: (from LeBaron and van Haaften 1989)

1880's - Talc was discovered at Madoc.

1896 - The Henderson Mine was opened.

1911 - The Conley Mine was discovered.

1914 or 1915 - Production began at the Conley Mine.

1937 - The Henderson and Conley properties were merged.

1951-1983 - The Mine was operated by Canada Talc Industries Limited.

1983 - The Company was reorganized as Canada Talc Limited.

DESCRIPTION OF SITE: An open pit is located on the Henderson ore body. The Henderson Mine had three shafts. Two, located in the talc orebody, were abandoned due to caving. The third,

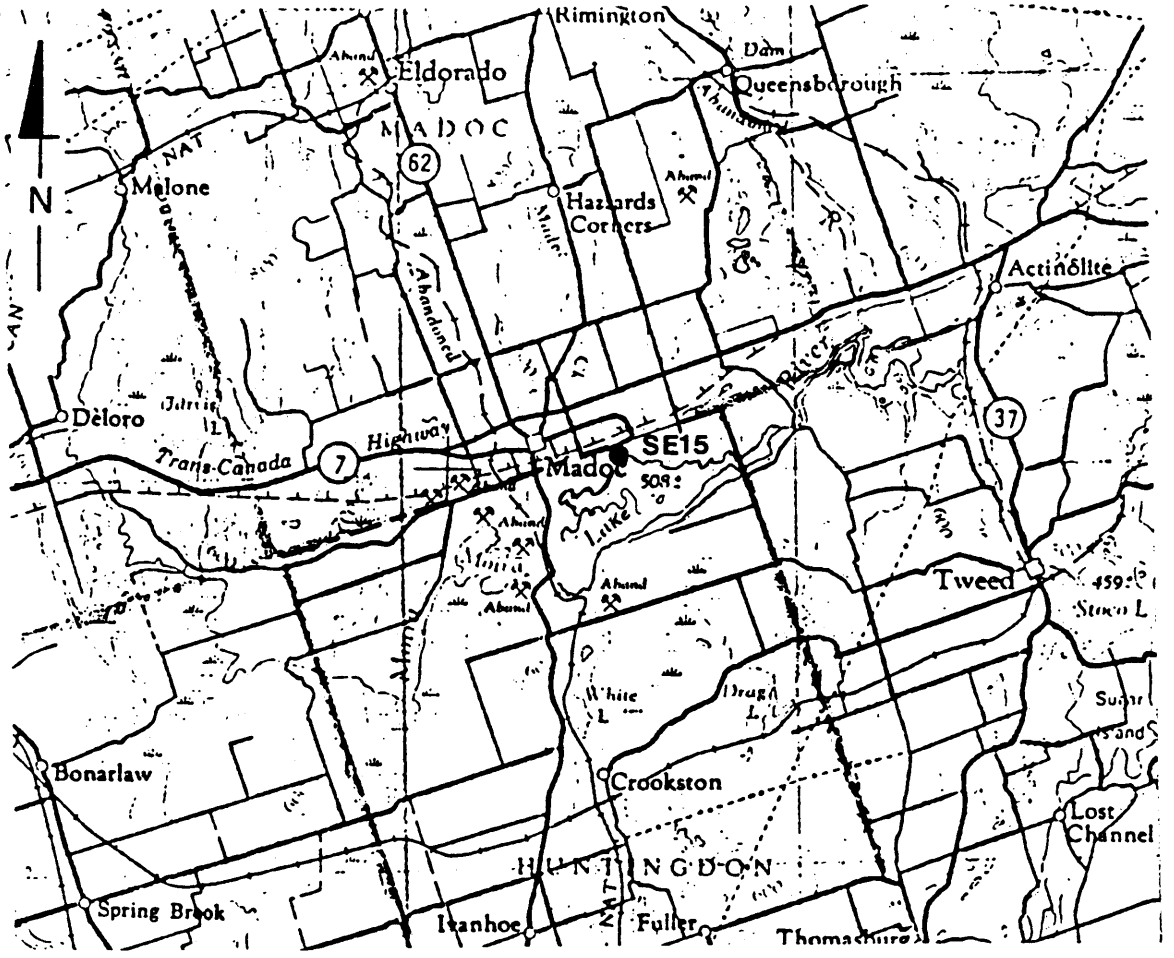


Figure 47: Location of the Canada Talc Industries Mine (SE15) Soapstone Occurrence, Huntingdon Township, Hastings County

located north of the orebody is still used today for pumping, ventilation and as an escape way and is shown on Figure 48. The old Conley Mine had two shafts, both of which are sealed off. The present production shaft was sunk in 1935 near a newly discovered ore body.(LeBaron and van Haaften 1989).

GEOLOGY: The talc orebodies are hosted by dolomitic marble which is tremolitic in part. Interlayered with the marble are quartzite, amphibolite and phyllite. Dark coloured dykes called "madocite" by Wilson (1926) cut the metasediments. A pink albitic granitic stock, the Moira Granite, outcrops approximately 800 m southeast of the mine site. The general strike of rocks in the area is northeast with a subvertical dip. Paleozoic sediments, sandstone, conglomerate and limestone overlie the Precambrian rocks in some areas of the property. The geology is described in more detail in LeBaron and van Haaften (1989).

STONE DESCRIPTION: The Henderson orebody contains large masses of compact steatite which varies in colour from green to white (LeBaron and van Haaften 1989). Simandl and Ogden (1982) noted that near the contact between the micaceous dolomite and the talc body, the dolomite is partially steatitized.

The company supplies small sculpture blocks to artists from time to time. At present the steatitized unit is not accessible underground. The unit is reported to be massive and unfractured but large blocks cannot be brought to surface. The soapstone is apple green, 60 to 70 percent talc and has a hardness of 2 to 2 1/2 on Moh's scale. (Dirk Demont, Canada Talc Ltd., personal communication 1990).

REFERENCES:
Hewitt (1968, p. 30-37)
Hewitt (1972, p. 9-23)
LeBaron and van Haaften (1989, p. 110-121)
Simandl and Ogden (1982)
Wilson (1926, p. 78-80)

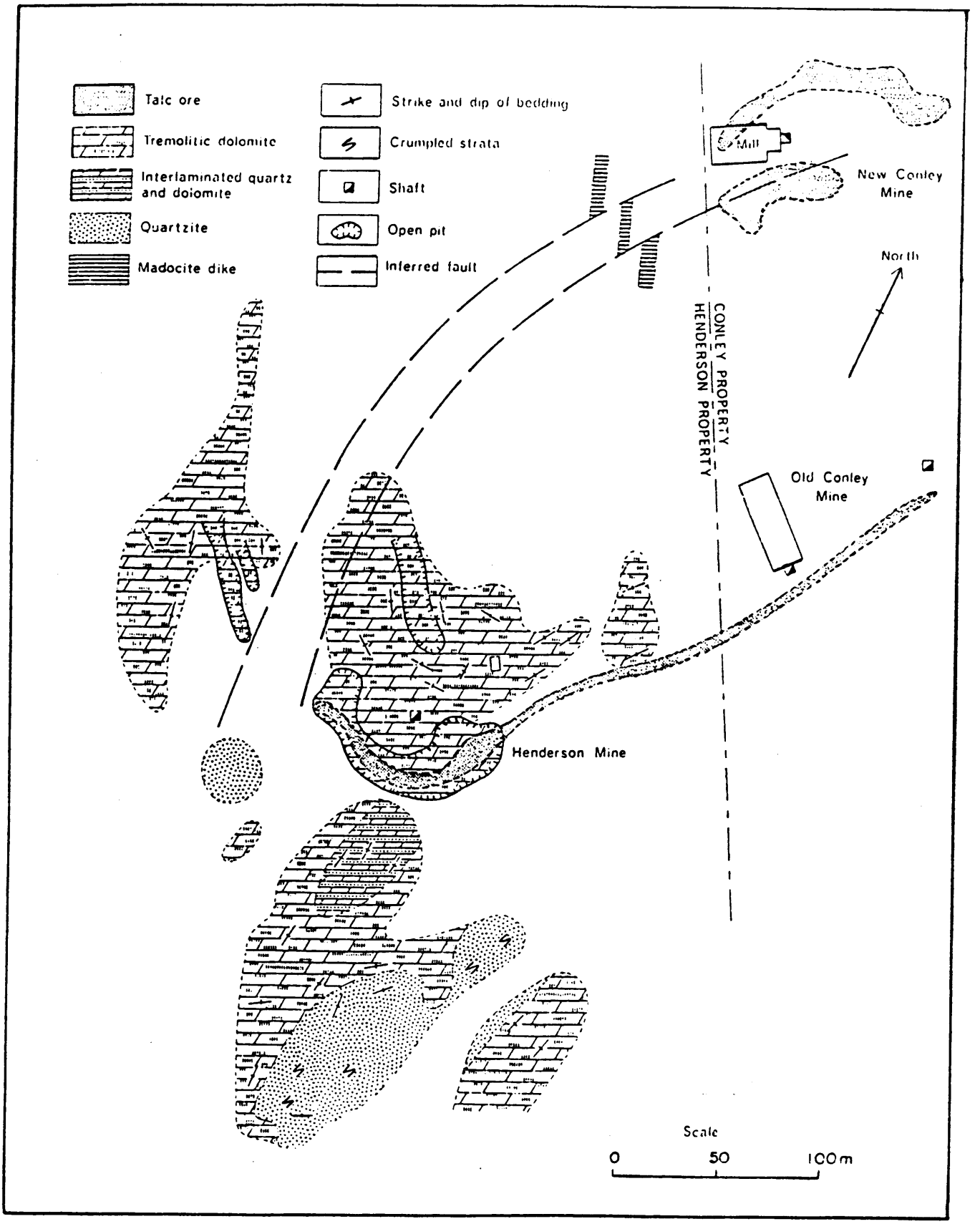


Figure 48: Geology of the Canada Talc Industries Mine (SE15), Huntingdon Township (from LeBaron and van Haaften, 1989)

SE16: Madoc Township, Concession X, XI, Lots 18-21

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: Several occurrences are located along the eastern boundary of Madoc Township, Hastings County, approximately 3 km east southeast of the village of Cooper (see Figure 49).

Claim Map: G-1269, Madoc Township
Southern Ontario Mining Division

NTS: 31C/12NW

UTM: Zone 18 306100E 4945050N

Latitude: 44° 38' 00" Longitude: 77° 27' 00"

ACCESS: The area is accessible by Hastings County Road No. 20 and then on foot to each occurrence (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT: There is no record of development

GEOLOGY: The area is underlain by mafic to ultramafic metavolcanic rocks. The Elzevir granodiorite batholith lies to the east (LeBaron and van Haaften 1989). Lenses of talcose rock 2 to 15 m in width and up to 60 m in length occur within the metavolcanic rocks adjacent to the batholith. The occurrence is the northward extension of occurrence SE8 into Madoc Township, mapped by Dillon and Barron (1985) (see Figure 39).

STONE DESCRIPTION: Dillon and Barron (1985) describe the talc zones as soft, massive to poorly foliated and light greenish-grey to pinkish-grey in colour with an irregular weathered surface. Small fractures filled with carbonate and associated chlorite and magnetite occur throughout the unit.

REFERENCES: Dillon and Barron (1985, p. 94-96)
LeBaron and van Haaften (1989, p. 149)

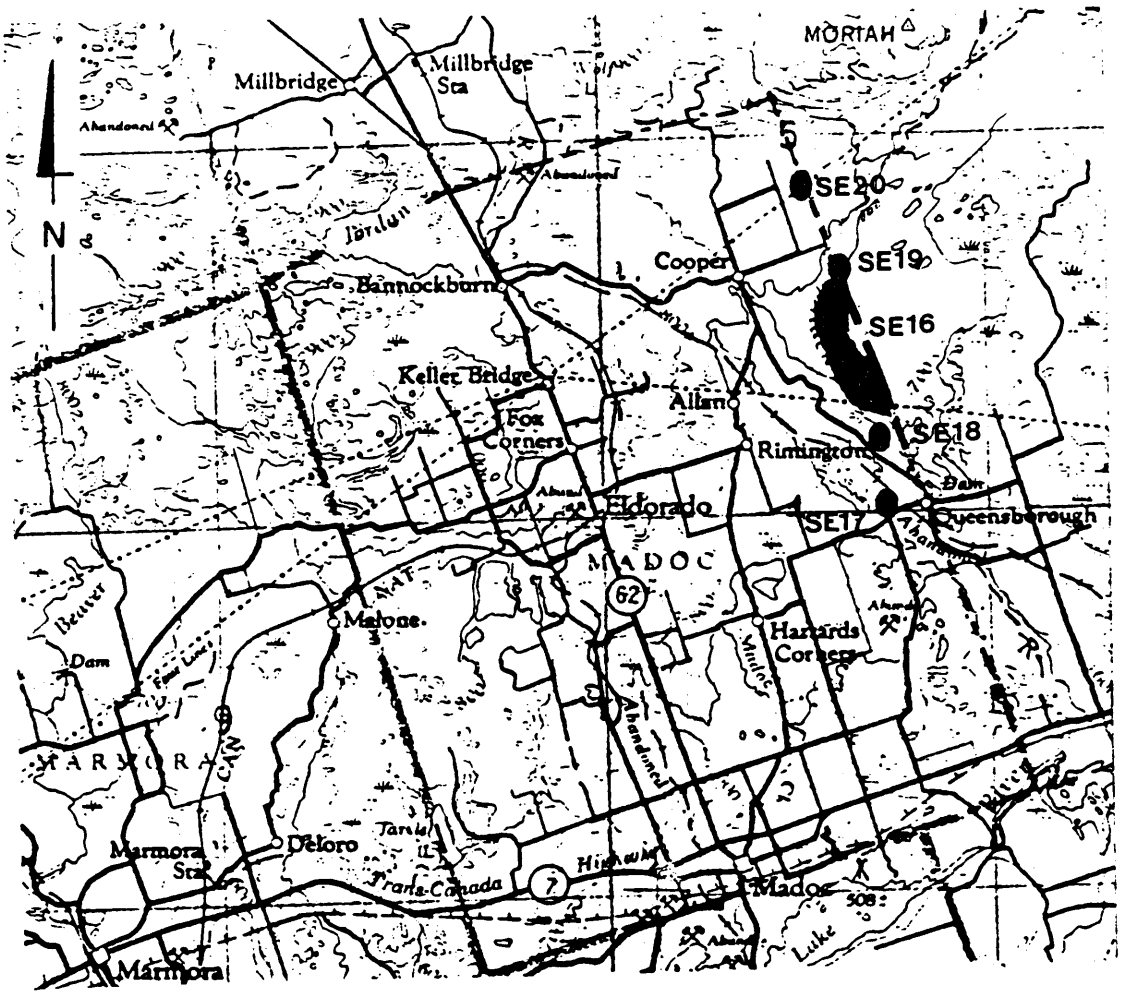


Figure 49: Location of the Madoc Township, Hastings County Soapstone Occurrences

Scale

5km

SE17: Madoc Township, Concession XI, Lot 15

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The property is located in east-central Madoc Township, Hastings County. It is approximately 750 m west of the village of Queensborough (see Figure 49).

Claim Map: G-1269, Madoc Township;
Southern Ontario Mining Division

NTS: 31C/11SW

UTM: Zone 18 307650E 4940200N

Latitude: 44° 35' 25" Longitude: 77° 25' 15"

ACCESS: The prospect may be reached by travelling west along the road from Queensborough for approximately 1 km and then north along a side road.

HISTORY OF DEVELOPMENT:

Wilson (1926) reported that a 3 m square pit, 1.5 m deep was sunk into talc-dolomite schist.

GEOLOGY: The talc-dolomite schist is an alteration zone within the metavolcanic rocks (Wilson 1926). The geology is similar to that described in occurrence SE16.

REFERENCES: LeBaron and van Haaften (1989, p. 143)
Wilson (1926, p. 77)

SE18: Madoc Township, Concession XI, Lot 17 West half

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

OWNERSHIP: K. Barry (LeBaron and van Haaften 1989)

LOCATION: The prospect is located in east-central Madoc Township, Hastings County. It is approximately 2.5 km northwest of the village of Queensborough (see Figure 49).

Claim Map: G-1269, Madoc Township;
Southern Ontario Mining Division

NTS 31C/11SW

UTM: Zone 18 307000E 4942000N

Latitude: 44° 36' 20" Longitude: 77° 25' 40"

ACCESS: The property is accessible by paved road, travelling north from Queensborough for approximately 2.5 km. It is approximately 175 m east of the road on land that belongs to Kevin Barry.

HISTORY OF DEVELOPMENT: A pit was dug to expose the dolomite-talc rock (LeBaron and van Haaften 1989).

DESCRIPTION OF SITE: The pit lies on the northeast side of a northwest-trending valley (LeBaron and van Haaften 1989).

GEOLOGY: The property is underlain mainly by amphibolite (metabasalt) which strikes northwest with a steep dip to the southwest. A 2.5 m wide vein of dolomite-talc rock occurs along foliation. The amphibolite adjacent to this unit is sheared (LeBaron and van Haaften 1989).

STONE DESCRIPTION: The talc-dolomite rock is composed of up to 80 percent talc, 20 percent dolomite or magnesite with minor magnetite (LeBaron and van Haaften 1989).

REFERENCES: LeBaron and van Haaften (1989 p. 144)

SE19: Cooper
(Madoc Township, Concession XI, Lots 22,23,24 and Elzevir Township, Concession I, Lot 24)

COMMODITY: Soapstone, Talc

STATUS: Occurrence

LOCATION: The property is located in the northeast corner of Madoc Township, Hastings County. It is 2.25 km east of the village of Cooper (see Figure 49).

Claim Map: G-1269, Madoc Township;
Southern Ontario Mining Division

NTS: 31C/11NW

UTM: Zone 18 306000E 4946650N

Latitude: 44° 38'07" Longitude: 77° 27' 05"

ACCESS: The area is accessible by following a concession road east of the village of Cooper to the Black River and then south along the river for 3 km towards Queensborough (Dillon and Barron 1985).

HISTORY OF DEVELOPMENT: There is no record of development on the property.

GEOLOGY: The talc occurrences lie within the mafic metavolcanics of the Tudor Formation within 500 m to the west of the Elzevir trondhjemite batholith (see Figure 50). Lenses of the talcose rocks up to 60 m in width and 300 m in length occur discontinuously in the metavolcanic belt, which is approximately 3 km in width (Dillon and Barron 1985).

STONE DESCRIPTION: The talc-chlorite-dolomite schist is fine to medium grained with a well developed foliation. Talc content varies from 30 to 80 percent. Minor amounts of serpentine and magnetite are present (Dillon and Barron 1985).

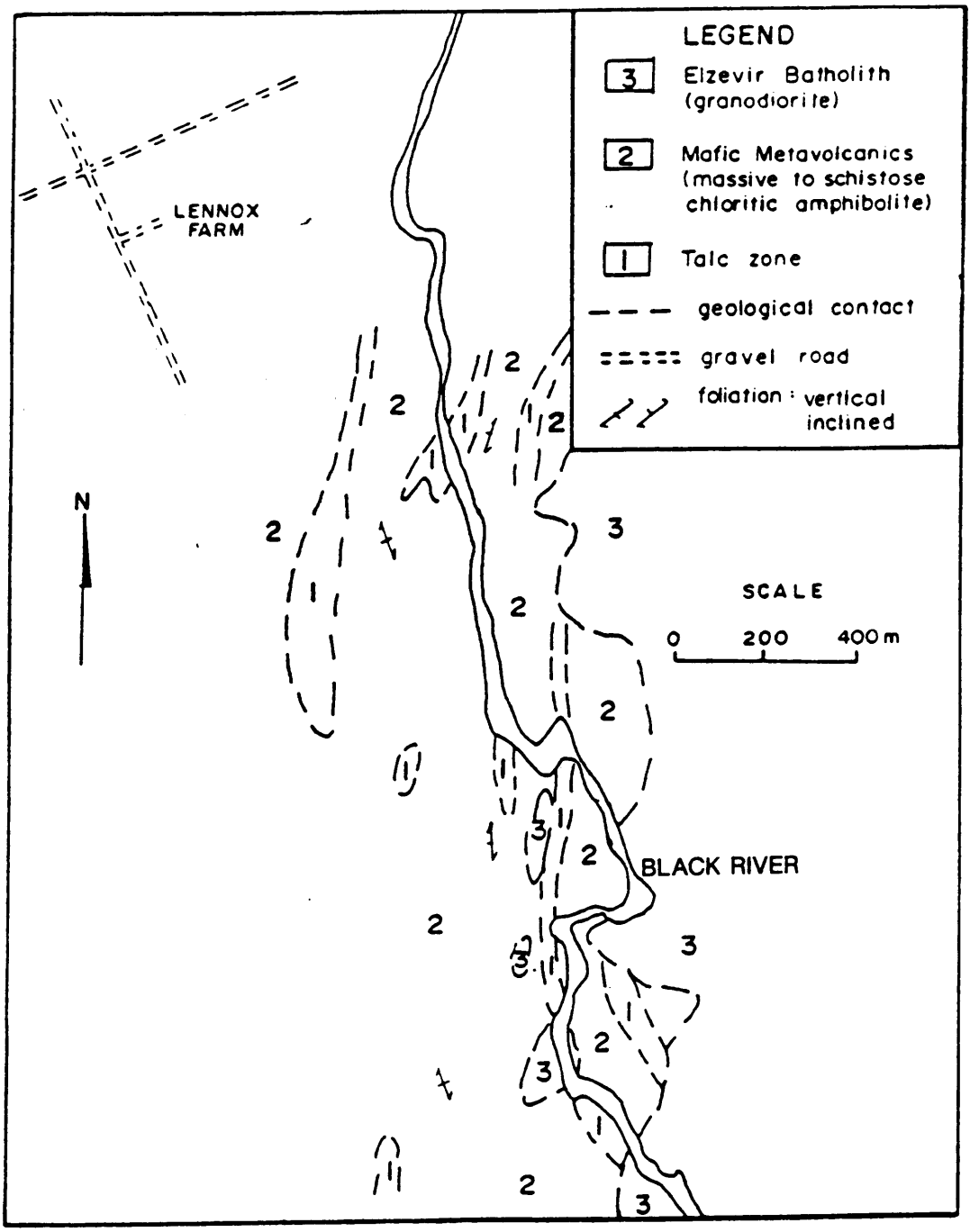


Figure 50: Geology of the Cooper Soapstone Occurrence (SE19), Madoc and Elzevir Townships (from LeBaron and van Haaften, 1989)

TEST RESULTS:

Beneficiation Tests consisting of froth flotation and magnetic separation were completed by LeBaron (1988):

1. Mineralogy of samples in volume percent (determined by thin section point counts and X-ray diffraction).

	1	2
Talc	37	46
Dolomite	41	18
Calcite	0	0
Serpentine	19	29
Chlorite	1	5
Anthophyllite	0	0
Magnetite	2	2

2. Mineralogy of the talc products after beneficiation (LeBaron 1988).

	Percent
Talc	88
Dolomite	3
Serpentine/Chlorite	9
Anthophyllite	0

REFERENCES: Dillon and Barron (1985, p. 30-31)
LeBaron and van Haaften (1989, p. 145-148)
LeBaron (1988)

SE20: Madoc Township, Concession XI, Lot 28

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The prospect is located in northeastern Madoc Township, Hasting county, along the hydro line road near the Madoc-Elzevir township line approximately 2.5 km northeast of the village of Cooper(see Figure 49).

Claim Map: G-1269, Madoc Township;
Southern Ontario Mining Division

NTS: 31C/11NW

UTM: Zone 18 305450E 4948500N

Latitude: 44° 39' 50" Longitude: 77° 26' 50"

ACCESS: The property is accessible by road from Cooper, by travelling 1.5 km east to a concession road and then north for 1.25 km to the powerline. A dirt road follows the power line to the occurrence; a distance of approximately 750 m.

HISTORY OF DEVELOPMENT: A small pit lies on the south side of the hydro line road at the Madoc-Elzevir township line. (LeBaron and van Haaften 1989)

GEOLOGY: LeBaron (1987) mapped the area as massive to strongly foliated metabasalts of the Tudor formation containing a zone of talc-chlorite-serpentine-carbonate altered ultramafic rocks. The zone is approximately 10 m wide, 300 m long and trends 70/60N. The Elzevir granodiorite batholith is 1.7 km to the southeast (see Figure 38).

STONE DESCRIPTION: The talc-chlorite-serpentine-carbonate schist is generally a pale green colour. The talc content varies from 20 to 30 percent. Within the pit the rock is friable, highly oxidized (red in colour) and is composed of approximately 50 percent talc, 40 percent carbonate and 10 percent magnetite and hematite. (LeBaron and van Haaften 1989)

REFERENCES: LeBaron et al (1987, p. 301-306)
LeBaron and van Haaften (1989, p. 150-152)

SE21: Cedar Hill
(Pakenham Township, Concession VI, Lot 6)

COMMODITY: Soapstone, Talc

STATUS: Talc prospect

LOCATION: The occurrence is located in the southern part of Pakenham Township, Lanark County, 1 km southwest of the village of Cedar Hill (see Figure 51).

Claim Map: T-2411 Pakenham Township; Southern Ontario Mining Division

NTS: 31F/8SW

UTM: Zone 18 395850E 5013300N

Latitude: 45° 16' 00" Longitude: 76° 19' 25"

ACCESS: The occurrence is located at the end of a dirt road on the farm on Lot 6 (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1937 - The occurrence was discovered by J. Bell of Almonte, who opened several small pits.

GEOLOGY: The area was mapped by Hill (1974) as predominantly marble. Talc occurs as a thick layer within quartzite which lies within the marble (see Figure 52). The talc body has been exposed over a width of 29 m and may extend under overburden up to 100 m (LeBaron and van Haaften 1989).

STONE DESCRIPTION: The occurrence was described by Spence (1940) as soft, yellowish to pale brown renesselaerite-steatite derived from altered pyroxenite. The dolomite which hosts the pyroxenite is in part serpentinized. The rock has a coarse, irregular grain, as the original form of the pyroxene crystals was preserved.

The talc unit was examined in thin section by LeBaron and van Haaften (1989) and found to be pyroxene crystals replaced by 80 percent talc and 10 percent carbonate.

In the quartz-free zones, the rock was reported by Spence (1940) to cut easily. The majority of material however contains a mixture of quartz, dolomite and serpentine.

LeBaron and van Haaften (1989) reported that the material would be good carving stone.

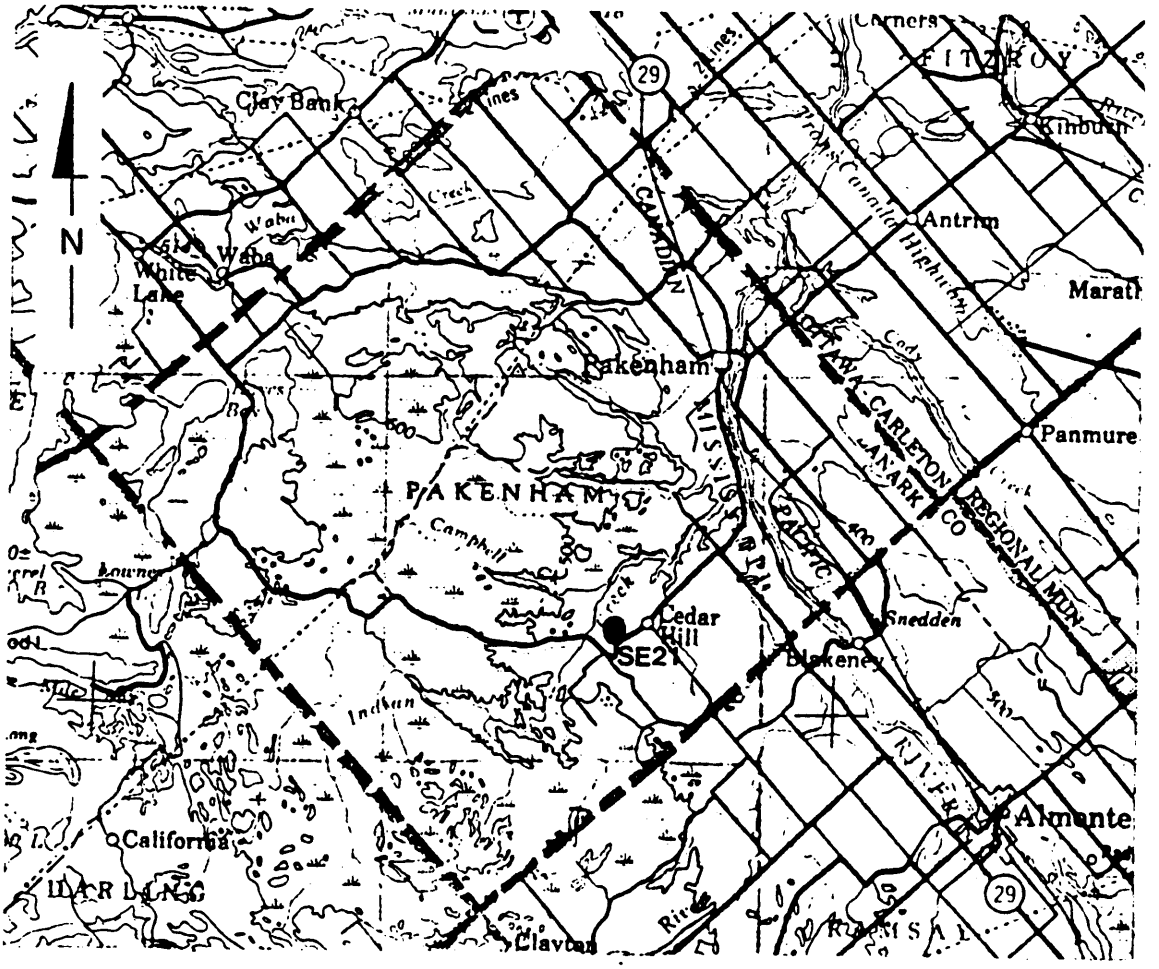


Figure 51: Location of the Cedar Hill Soapstone Occurrence (SE21), Pakenham Township, Lanark County

Scale

5km

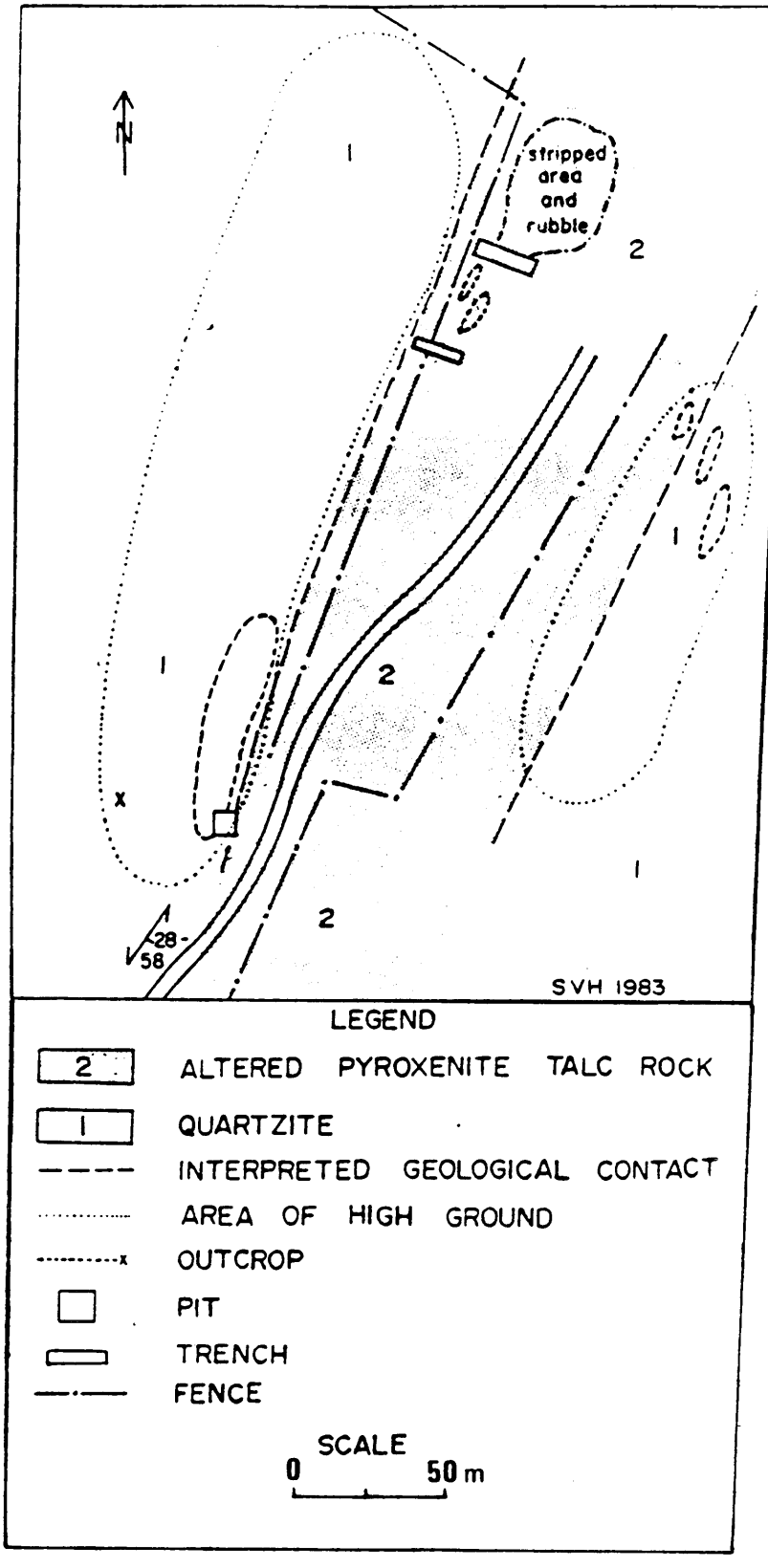


Figure 52: Geology of the Cedar Hill Soapstone Occurrence (SE21), Pakenham Township (from LeBaron and van Haaften, 1989)

TEST RESULTS:

Chemical Analysis: (from Spence 1940)

	1	2	3
SiO_2	59.10	60.92	57.27
FeO	0.35	0.39	0.51
Fe_2O_3	0.17	0.23	0.72
Al_2O_3	0.52	0.38	0.74
CaO	2.10	0.68	3.20
MgO	30.50	30.62	29.34
CO_2	1.26	0.72	7.94
H_2O above 105°C	5.78	5.78	0.28
Total	**99.78**	**99.72**	**100.00**

REFERENCES:
Hill (1974)
LeBaron and van Haaften (1989, p. 175-177)
Storey and Vos (1981, p. 195-196)
Spence (1940, p. 79)

SE22: Grindstone Island
(South Burgess Township, Concession I)

COMMODITY: Soapstone, Talc

STATUS: Talc past producer

LOCATION: The property is located on Grindstone Island in Big Rideau Lake, Leeds County. It is approximately 5 km west-northwest of the village of Portland (see Figure 53).

Claim Map: M-0061, South Burgess Township; Southern Ontario Mining Division

NTS: 31C/16

Latitude: 44° 46' 00" Longitude: 76° 13' 00"

ACCESS: The island is reached by boat (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1893-1899 - Rock was quarried and shipped to Montreal by the Sparham Roofing Company to be used to manufacture roofing. The material was removed from a circular pit with a diameter of 23 m and a depth of 8 m (Spence 1922).

STONE DESCRIPTION: Spence (1922) described the stone as a soft, brown to grey green, medium-to coarse-grained, altered pyroxenite. The degree of alteration varies throughout the quarry, with some areas relatively unaltered.

Wilson (1926) referred to the material as fine-grained, massive green serpentinite.

REFERENCES: LeBaron and van Haaften (1989, p. 182-183)
Spence (1922, p. 33,34 ; 1940, p. 80)
Wilson (1926, p. 25)

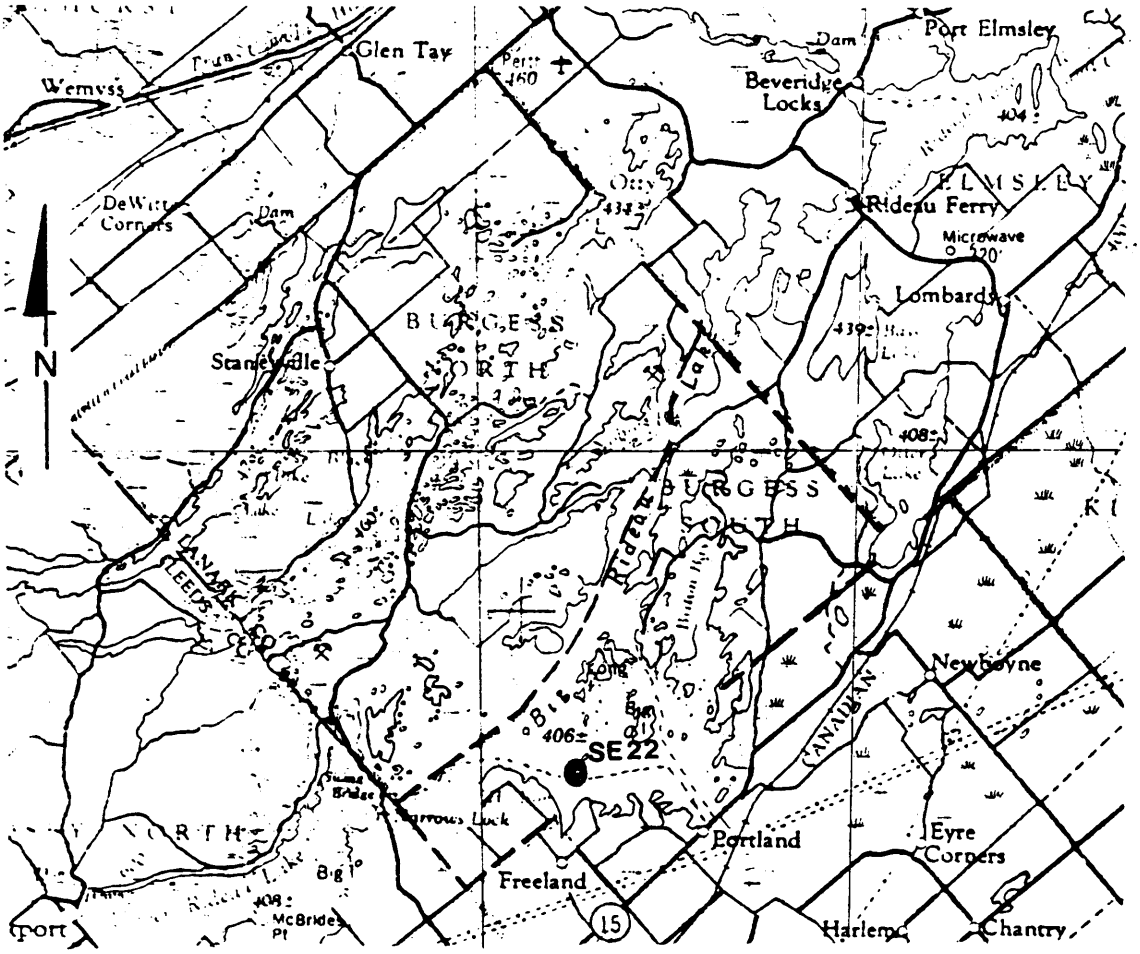


Figure 53: Location of the Grindstone Island Soapstone Occurrence (SE22), South Burgess Township, Leeds County

Scale

5km

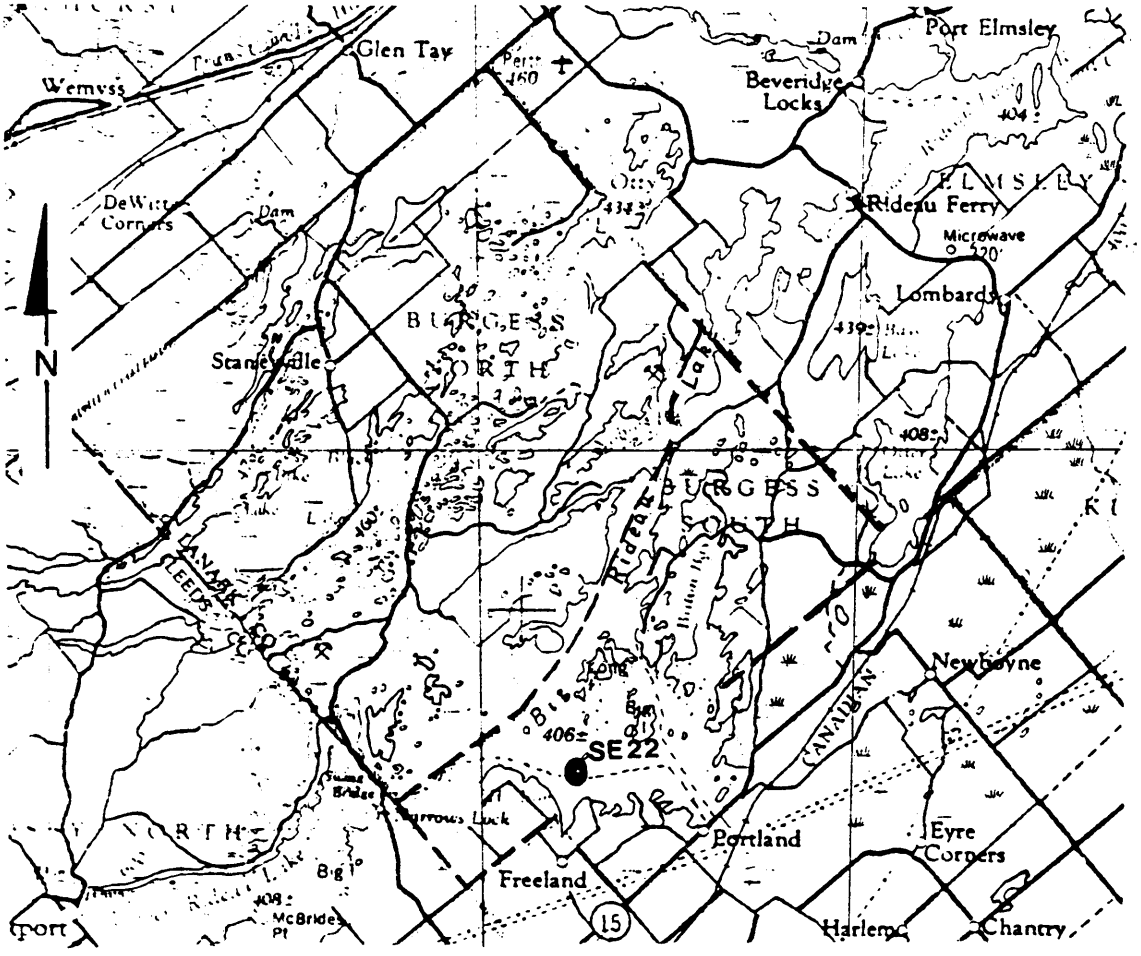


Figure 53: Location of the Grindstone Island Soapstone Occurrence (SE22), South Burgess Township, Leeds County

Scale

5km

SE23: Hearthstone
(Kaladar Township, Concession II, Lot 13)

COMMODITY: Soapstone, Talc

STATUS: Past producer

LOCATION: The quarry is located along Flinton Creek, approximately 6.5 km south of Flinton (see Figure 54).

Claim Map: G-1266, Kaladar Township; Southern Ontario Mining Division

NTS: 31C/11NE

UTM: Zone 18 325650E 4949200N

Latitude: 44° 40' 45" Longitude: 77° 12' 15"

ACCESS: The property is accessible by travelling south for 6.5 km along the upper Flinton Road (east of the Skootamatta River) and then east along a bush road for 1 km (LeBaron and van Haaften 1989).

HISTORY OF DEVELOPMENT:

1981 - C.R. Young drilled one diamond drill hole to test the zone.

1984 - The quarry was operated to produce decorative stone for wood stoves. (LeBaron and van Haaften 1989).

GEOLOGY: The quarry occurs within a band of altered ultramafic rock approximately 20 m wide with a northeast strike and near vertical dip. Calc-silicate metasediments lie to the west with siliceous metasediments and pegmatite to the east (see Figure 55) (LeBaron and van Haaften 1989).

STONE DESCRIPTION: The altered ultramafic unit is composed of talc-anthophyllite schist. The stone is a grey-green colour on fresh surface weathering to a dark green to reddish orange colour. Thin section examination by Verschuren et al (1986) showed a composition of 60 percent talc, 30 percent anthophyllite and 10 percent dolomite with minor amounts of magnetite, hematite, tremolite and carbonate. The anthophyllite occurs as rosettes up to 1.5 cm in diameter.

REFERENCES: LeBaron and van Haaften (1989, p. 191-193)
Verschuren et al (1986, p. 115 -119)

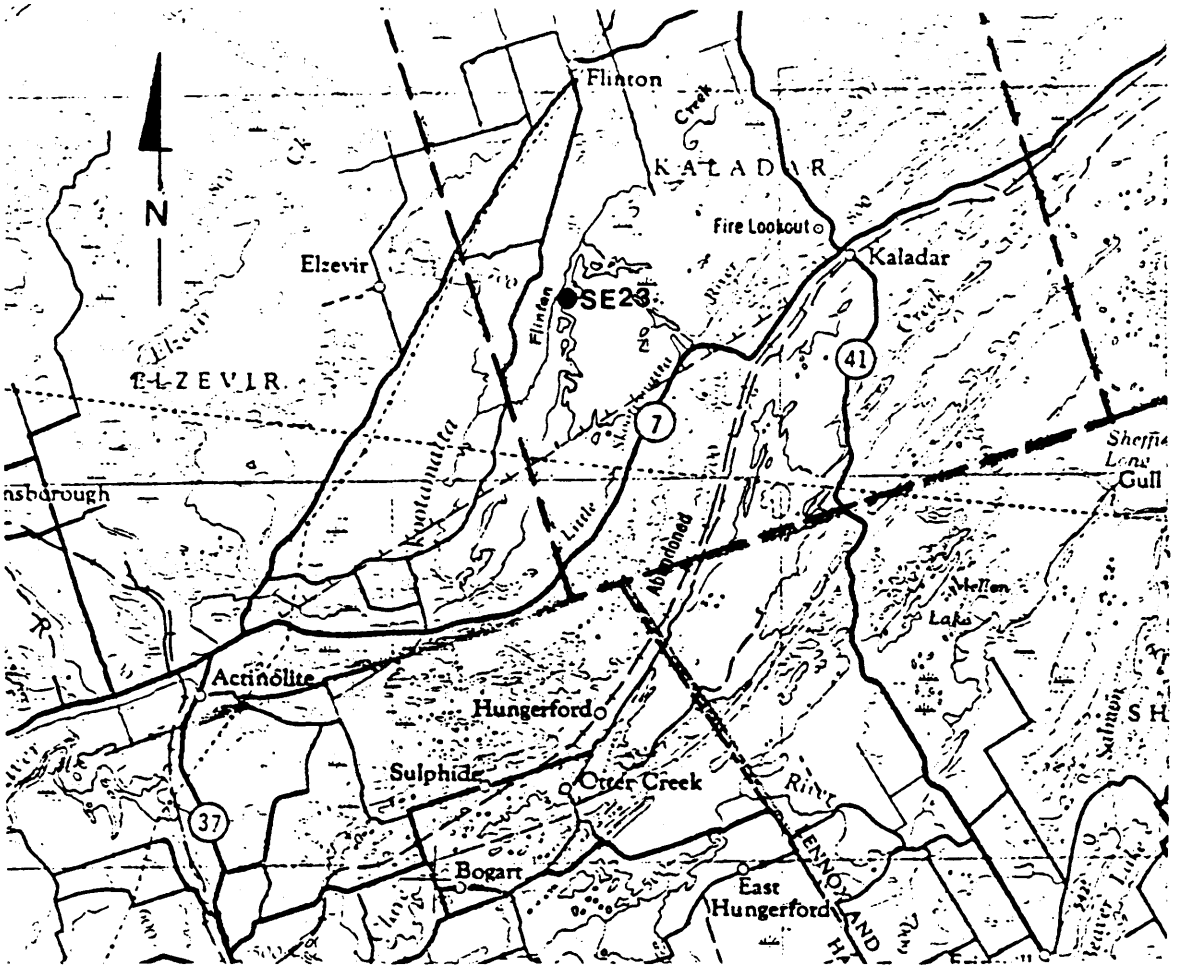


Figure 54: Location of the Hearthstone Soapstone Occurrence (SE23), Kaladar Township, Lennox and Addington County

Scale

5km

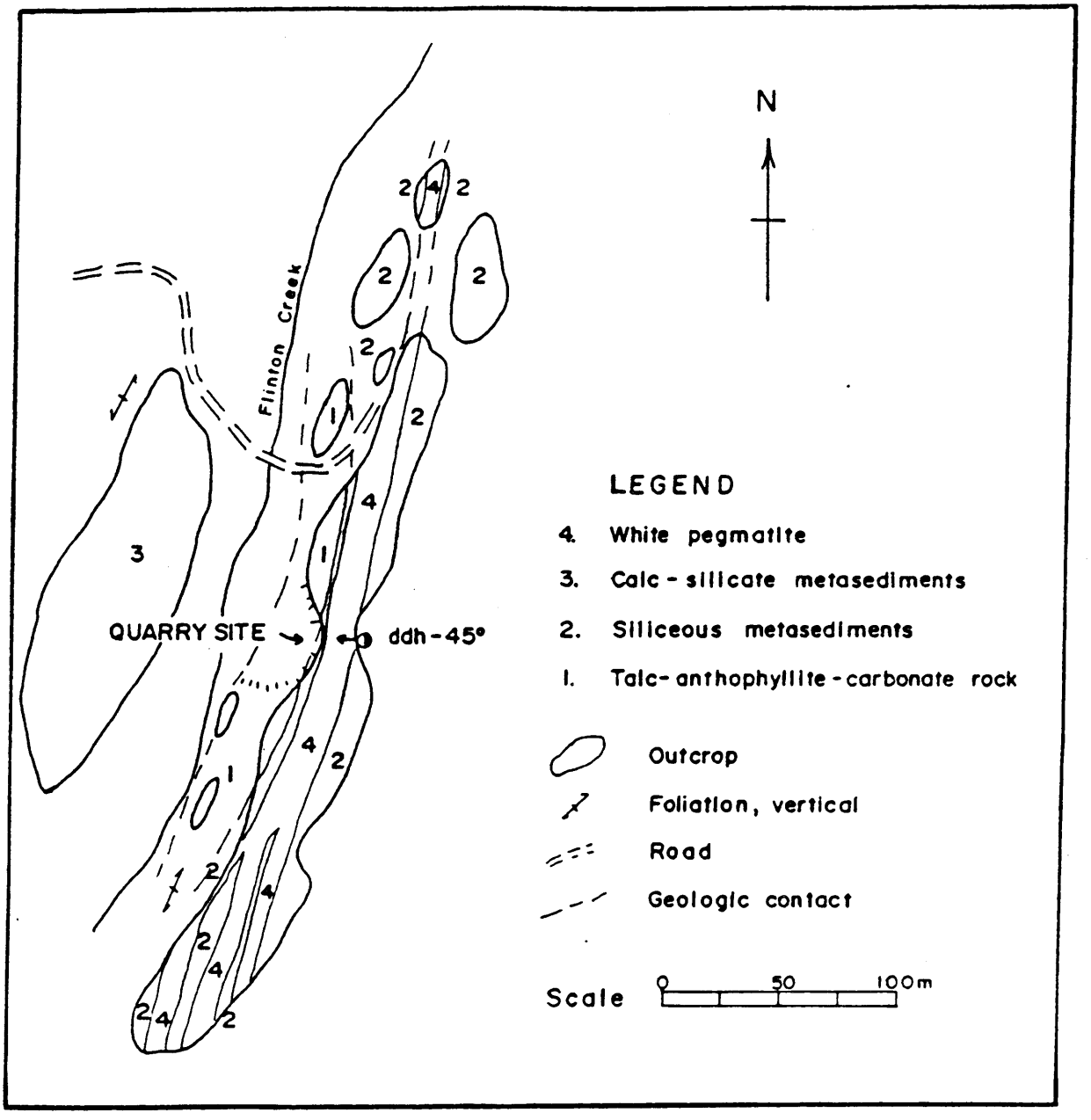


Figure 55: Geology of the Hearthstone Soapstone Occurrence (SE23), Kaladar Township (from LeBaron and van Haaften, 1989)

Table 11: Minor Occurrences - Northeastern Ontario

Property name (alternate name)	Commodity	Location	Geology	Comments
Clucas Booker	Gold, soapstone	Cochrane District Deloro Township 42A/6NW 48° 25' 58" 81° 16' 42"	Soapstone was noted in diamond drill core at the Destor Porcupine Fault (Resident Geologist Files, MNDM, Timmins).	Exploration in the area was concentrated on gold occurrences.
Fitzpatrick Creek	Talc	Algoma District Acton Township East-southeast of Dibben Lake on Fitzpatrick Creek 42C/9SE 48° 31' 45" 84° 05' 55"	Talc occurs within a 6 m wide sill of serpentinite, over a length of 6 m (Vos et al 1987).	
Hislop Township	Gold, talc	Cochrane District Hislop Township Lot 1, Con. III 42A/8NW 48° 29' 32" 80° 16' 58"	Talc-chlorite schist occurs within Early Precambrian mafic flows and pyroclastic rocks (Prest 1957).	
Ladouceur	Gold, talc	Cochrane District Hislop Township N1/2 Lot 4, Con. IV 42A/9SW 48° 30' 21" 80° 18' 38"	Talc schist occurs southwest of a hornblende syenite (Prest 1957).	Diamond drilling for gold on the property occurred in 1949 (Prest 1957).
Lee Valley (May Twp.)	Talc	Sudbury District May Township southeast corner 41I/4NW 46° 11' 33" 81° 56' 26"	Talc occurs in a vein widening from 0.8 m at surface to 3.3 m at 12 m depth (Wilson 1926).	A 12 m shaft was sunk on the property in 1896 and deepened to 15 m in 1910. A small amount of talc was produced for foundry use (Hewitt 1972).

Property name (alternate name)	Commodity	Location	Geology	Comments
Parting Lake	Talc, asbestos	Sudbury District Semple Township Surrounding the small lake in the south-central part of the township. 41P/14NW (1)47° 57' 10" 81° 16' 20" (2)47° 56' 30" 81° 16' 10" (3)47° 57' 05" 81° 15' 45"	The occurrences are within a crescent-shaped ultramafic to mafic intrusive sill (Bright 1978).	Exploration activity in the area was concentrated on asbestos prospects (Bright 1978).
Shallow River	Serpentine, talc	Cochrane District Beatty Township 2.4 km southeast of Painkiller Lake, north of Shallow River. 42A/10SW 48° 36' 28" 80° 19' 10"	Serpentinized peridotite occurs along the margin of a mafic to ultramafic sill (Satterly 1952).	

Table 12: Minor Occurrences - Northwestern Ontario

Property name (alternate name)	Commodity	Location	Geology	Comments
Arnold Lake	Soapstone, talc	Rainy River District 425 m west of the north end of the bay at the outlet of Arnold Lake 52B/13SW 48° 46' 00" 91° 50' 00"	Dark green chlorite schist altered to grey soapstone and talc. Outcrop is 1.2 m in diameter (Tanton 1927)	Similar to the Milk Lake Occurrence (NW14) (Tanton 1927).
Goodchild Lake	Talc	Thunder Bay District 3 km west of Cirrus Lake, 0.8 km northeast of Goodchild Lake. 42D/16NE 48° 53' 20" 86° 11' 25"	Talc occurs within a U-shaped serpentinite body, associated with carbonitization (Milne 1967).	
Greenwater Lake	Talc	Thunder Bay District 400 m inland from the northwest shore of Greenwater Lake. 52B/9SW 48° 36' 05" 90° 28' 50"	Peridotite is strongly altered to serpentine, talc, carbonate, chlorite, and magnetite. The stone is a massive, fine to medium grained, dark grey to dark green rock (Resident Geologist Files, MNDM, Thunder Bay).	
Kakagi Lake	Asbestos, talc	Kenora District In the vicinity of Kakagi Lake. 52F/4NW 49° 08' 50" 92° 53' 00"	Talc occurs within "some of the green schists" in the area (Vos et al 1982).	
Madsen Mine	Soapstone	Kenora District Baird Township 52K/13NW 50° 58' 04" 93° 55' 02"	Talc occurs within an altered peridotite called the South Austin "footwall talc". It ranges from 9 to 60 m in width (Ferguson 1965).	Gold was produced from 1938 to 1976. Talcose rocks are mainly found underground (Storey 1986).
Mica Point (Falcon Island)	Soapstone	Kenora District The central part of Mica Point, Falcon Island, Lake of the Woods. 52E/7SW 49° 20' 00" 94° 47' 00"	Talc may occur within soft, dark green to dark grey, massive metavolcanics. Zones vary in width from 3 to 12 m. (Storey 1986)	

Property name (alternate name)	Commodity	Location	Geology	Comments
Playter Harbour, Pulpwood Harbour	Talc, serpentine, asbestos	Thunder Bay District In the North part of Pukaskwa National Park. 42D/9SE, SW 48° 35' 10" 86° 17' 23"	Talc was noted in carbonatized rocks in the Playter and Pulpwood Harbours area and in ultramafic sills northwest of the Pic River estuary (Muir 1977, 1982).	A band of talc, serpentine and asbestos was noted between Playter and Pulpwood Harbours and Mussy Lake (Industrial Minerals Files, Thunder Bay).
North Spirit Lake	Talc	Kenora District North and south of the North Spirit Lake Fault. 53C/10SW 52° 30' 00" 92° 50' 00"	Ultramafic rocks consist of talc-tremolite serpentinite, talc-carbonate-chlorite serpentinite and talc schist (Wood 1977).	
Northern Light Lake	Talc	Thunder Bay District Eastern shore of Northern Light Lake in Southeast Bay. 52B/7SE 48° 15' 15' 90° 35' 00"	Dark coloured talcose schist occurs within a shear zone in metavolcanics. A small (1 by 1.5 m) occurrence.	
Preachers Lake (Spring Lake)	Talc	Rainy River District Senn Township Located along the shore at the southeast corner of Preachers Lake. 52C/13 NW 48° 55' 16" 93° 49' 17"	Talc schist occurs within felsic metavolcanics. It is soft, dark grey and very fractured. The occurrence is approximately 3 m wide and 6 m long (Blackburn 1976).	
Quest Lake	Talc	Thunder Bay District Approximately 1.6 km north of Barge Lake. 52G/14NW 49° 55' 10" 90° 46' 00"	Talc occurs within a serpentinized peridotite body as veinlets and fracture filling (Trowell 1976).	
Sackville Township	Soapstone, talc,	Thunder Bay District Sackville Township 52A/5NW 48° 26' 52" 89° 54' 50"	Talcose serpentinized ultramafic intrusive rocks. A small occurrence.	

Property name (alternate name)	Commodity	Location	Geology	Comments
Shoal Lake	Soapstone, serpentine	Kenora District North shore of a small island in the northwest part of Labyrinth Bay, Shoal Lake. 52E/10SW 49° 36' 29" 94° 49' 52"	Metasediments and mafic metavolcanics intruded by metamorphosed mafic and ultramafic rocks. The sill of ultramafic rock is exposed for 75 m (Storey 1986).	
Toronto Lake (Cross Lake)	Asbestos, talc	Thunder Bay District Southwest shore of Toronto Lake 42L/5SW 50° 20' 25" 87° 52' 00"	Several occurrences are associated with the serpentinite of the Toronto Lake Complex (Vos et al 1987).	Talcose rocks were noted in drill core in 1959 (Resident Geologist Files, MNDM, Thunder Bay).
Witch Bay	Talc	Kenora District Manross Township Northshore of Witch Bay, Lake of the Woods. 52E/9SW 49° 35' 49" 94° 15' 29"	The occurrence is thought to be a soft, decomposed hornblende schist (Vos et al 1987).	Shown on Figure 13.

RECOMMENDATIONS AND CONCLUSIONS

A number of the soapstone occurrences described in this report would appear to have the potential to produce some volume of soapstone and warrant further investigation of their dimensional stone and carvingstone potential. The Eagle Lake **(NW3)**, Mile Lake **(NW4)**, Trap Lake **(NW9)**, Wabigoon **(NW10)** and Puddy Lake **(NW17)** occurrences in northwestern Ontario and the Four Corners Property **(NE2)** in northeastern Ontario should be further evaluated in order to determine their extent, capacity to produce soapstone blocks, and physical characteristics. Most of the occurrences in southeastern Ontario appear to be of significant size and should also be examined for their soapstone potential. Many of these have been examined for their talc potential but not as soapstone prospects. It is recommended that talc producers and developers evaluate the possibility of producing carvingstone as a by-product of their operations.

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PROPERTIES OF TULIKIVI

Mineral composition:
The talc content of the Nunnanlahti soapstone makes it easily workable, and the exceptionally high magnesium content gives it good strength and heat resistance properties, which are not shared by other stones classified as soapstone.

Thermal properties of TuliKivi:
Melting point 1630...1640 °C
Softening under pressure ta = 1420 °C
te > 1510 °C
Specific heat capacity 0.98 kJ/kg °C
Thermal conductivity 6.4 W/mK

Thermal expansion:
Thermal expansion is linear up to ca 500 °C, i.e. 0.0017 %/°C.

Resistance to temperature changes:
Resistance to temperature changes and frost is excellent, which is why TuliKivi is a popular material in sauna stoves as well as on the outside surfaces of buildings.

Strength properties:
TuliKivi has a compression strength of 25 MN/m², which is doubled when the temperature increases.

Flexural strength:
The flexural strength is along the cleavage 16.8 MN/m² and vertically against the cleavage 15.7 MN/m².

Hardness:
Hardness on the Mohs scale is 2...3.

Chemical resistance:
TuliKivi can easily withstand even strong acids and bases. TuliKivi also meets the requirements for non-toxicity for use with foodstuffs (Paragraph 16 of the Finnish Foodstuffs Statute).

Electrical conductivity:
At a relative humidity of 45 % TuliKivi is classified as a good insulator.
The specific resistance is then $2 \cdot 10^{7}...2 \cdot 10^{9}$ Ωm.

The thermal and strength data are based on research carried out by the Technical Research Centre of Finland, Research Report No. 174/80/BET.

Manufacturer:

TULIKIVI

Suomen Vuolukivi Oy
SF-83940 Nunnanlahti
Tel. 976-78150, Telex 4731 tulik sf

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tiling materials
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FireStone
Suomen Vuolukivi Oy

General information

The quarries of Suomen Vuolukivi Oy are located at Nunnanlahti on Pielinen, a lake in eastern Finland. The soapstone (steatite) products of the company are known under the trade name FireStone. Both quantitatively and qualitatively, the Nunnanlahti deposit is considered one of the best in the world. Its industrial exploitation dates back to the 19th century.

The soapstone was formed some two thousand million years ago. As the primordial Karelian rocks folded, olivine was altered through talcification into steatite. The metamorphism lasted about 200 million years.

This process took place under high pressure and temperature. The hydrothermal pressure was caused by a rock mass that rose to a height of about 11 kilometres, and the temperature varied between 300 and 800 °C.

Vammala 1982 Vammalan Kirjapaino Oy Offset

Properties of FireStone

Composition

In a technical sense, the term soapstone refers to a rock type consisting of soft minerals that can easily be sawed or carved with an ordinary knife or chisel. Soapstone occurs as veins and lenses, especially in association with serpentinites. Talc and magnesite are tightly interwoven in soapstone. Talc flakes have grown into the magnesite to form a homogeneous, uniformly grey stone.

Chemical composition

SiO_2	30 to 33 %
MgO	27 to 32 %
CO_2	20 to 21 %
H_2O (as water of crystallization)	2 to 3 %
FeO, Fe_2O_3	8 to 10 %
CaO	1 to 2 %
Al_2O_3	1 to 2 %

Mineral composition

Talc	$Mg_3Si_4O_{10}(OH)_2$	40 to 50 %
Magnesite	$MgCO_3$	40 to 50 %
Penninite	$Mg_5Al_2Si_3O_{10}(OH)_8$	5 to 8 %

The talc content makes the Nunnanlahti soapstone easy to work, and the exceptionally high magnesite content gives it its outstanding strength which is unparalleled by other rocks classified as soapstones.

Structure

Soapstone has a clearly banded structure (Figure 2). Depending on the purpose for which they are to be used, pieces can be cut either along or across the banding. Cross-banding material is used for fireplaces and furnaces where the stone is directly exposed to fire and high temperatures. Slabs cut along the banding can be used for all other purposes (see Applications).
The stone has only one weak splitting direction, and so chipping is unusual. Even so, the splitting plane must be considered in high temperature applications.

Colour

The soapstone comes in several shades of grey. The structure is more clearly visible in the lighter shades (see cover photo), but the colour is more uniform in the darker shades. The colour and structure can be enhanced by suitable finishing agents.

Thermal characteristics of FireStone

Melting point	1630 to 1640 °C
Softening under pressure	t_e = 1420 °C
	t_e > 1510 °C
Specific heat capacity	0.98 kJ/kg °C
Thermal conductivity	6.4 W/mK

Resistance to thermal shock

The resistance to thermal shock was determined according to DIN 51068 Part 1 and applying BS 1902 Part 1A. The temperatures are 200 °C, 500 °C and 950 °C. The spalling numbers according to DIN 51068 Part 1 are 30 at 200 °C, 30 at 500 °C and 6.5 at 950 °C. The strength level is undiminished at 200 °C, and it is only reduced by about 20 % at 500 °C.
The spalling number to BS 1902 Part 1A is 30 at each of the test temperatures (200 °C, 500 °C and 950 °C). The strength level was not reduced at all in this determination. The scale is 0–30, where 30 represents the best possible resistance to thermal shock.

Frost resistance

The frost resistance test showed no signs of weathering after 25 cycles of freezing and immersion in water. The strength was also unaffected, and thus met the highest requirements.

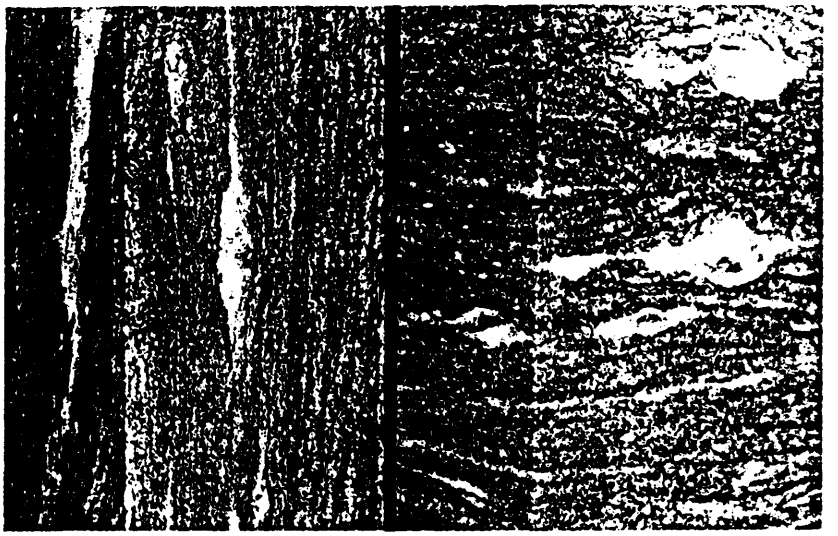

Figure 2.
Slabs cut along and across the banding
Cross-banding material is used for fireplaces because it withstands high temperatures without deterioration.

Thermal expansion

Thermal expansion is linear, at 0.0017 %/°C, up to about 500 °C. Greater changes take place at the first firing at higher temperatures between 600 °C and 1100 °C, and these should be taken into account in application designs (Figure 3).

Density

The density is 2980 kg/m³. A weight loss of about 20 per cent takes place when soapstone is heated to a temperature range between 570 °C and 700 °C. This is due to the decomposition of magnesite under release of carbon dioxide. A further weight loss of about 2 per cent between 900 °C and 1000 °C is due to the loss of water chemically bound to the talc.

Strength properties

Compression strength

FireStone has a compression strength of 25 MN/m². This value is more than doubled, reaching 54 MN/m², when the temperature is raised to 1000 °C. Thus the compression strength is very good (Figure 4).

Flexural strength

The flexural strength is 16.8 MN/m² along the banding and 15.7 MN/m² across it.

Hardness

The hardness on the Mohs scale is 2–3. Owing to the low hardness, the stone is easy to work with all ordinary tools. The hardness can be increased to a value of 4 on the Mohs scale by a suitable finish.

Chemical resistance

FireStone has very good chemical resistance properties. It even withstands strong acids and is only attacked by the very strongest bases. FireStone also meets the Finnish requirements for non-toxicity for use with foodstuffs (Paragraph 16 of the Finnish Foodstuffs Statute).

Electrical conductivity

At a relative humidity of 45 %, FireStone is classified as a good insulator, the resistivity being $2 \times 10^7 - 2 \times 10^8\ \Omega$m. At a relative humidity of 95 %, the resistivity is still $2 \times 10^4\ \Omega$m.

The thermal and strength data are based on studies by the Technical Research Centre of Finland, Report No. 174/80/BET.

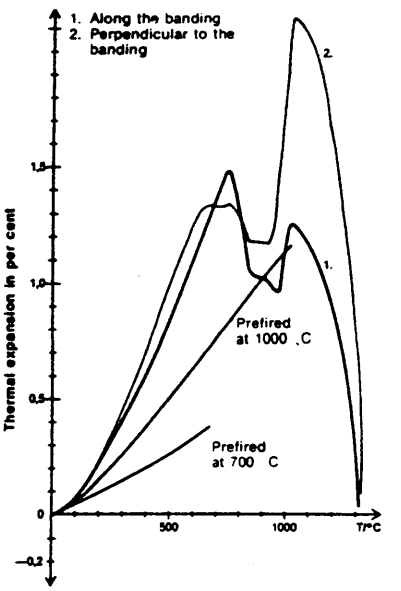

Figure 3.
The thermal expansion of FireStone is linear up to about 500 °C (about 0.0017 %/°C). When heated for the first time to above 600 °C, the stone undergoes considerable dimensional changes. The carbonate contained in the soapstone decomposes at around 650 °C to 750 °C, which is manifested as a knee in the thermal expansion graph (the blue and black curves). Further changes take place between 750 °C and 1050 °C, and these must be taken into account when designing soapstone applications. Pieces that have been heated once (prefired) exhibit a considerably smaller and practically linear thermal expansion (red curves). The temperatures occurring in domestic fireplaces or baking ovens are considerably lower, about 100 °C to 350 °C.

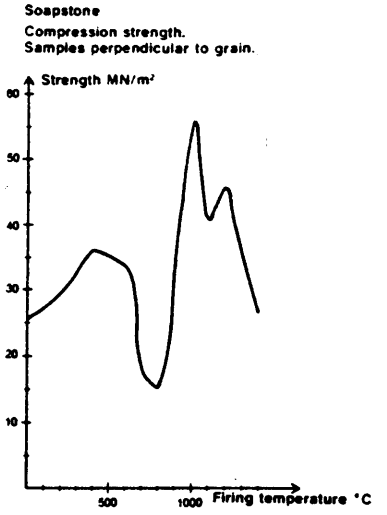

Figure 4.
Compression strength of FireStone as a function of temperature. The compression strength acquired by firing is maintained after cooling. This property, which is due to the bonding of free magnesium with talc to form stronger compounds than before, makes it possible to harden, by prefiring, pieces that will be exposed to exceptionally high mechanical, chemical or thermal stresses.

Working

Quarrying

Because of its toughness, the stone is quarried by drilling and chiselling or sawing. The blocks, which are obtained from an opencast quarry, vary in size from 1.5 to 3 m³.

Sawing

The stone is sawed in three stages with diamond-blade circular saws.
First, the raw block comes to the blanking saw. The blade has a diameter of 2000 mm and a maximum depth of cut of 750 mm. The sawing orientation is chosen at this stage according to the intended use of the stone (Figure 5).
The next stage is the multiple-blade circular saw with ten parallel blades. The thickness of the resulting deals is determined by selecting the correct blade spacers. The blade diameter is 800 mm and the maximum depth of cut 300 mm (Figure 6). The next stage is calibration of the deal width by milling and grooving of the edges.
The final step is cross-cutting to the desired length (Figure 7).

Other machining

Minor sawing is possible with circular saws with carbide-tipped blades. FireStone can also be sawed with hacksaws or even wood saws, but the cutting speed is obviously much lower than with diamond blades.
Any holes required can be drilled with ordinary high-speed steel drills. Carbide-tip drills can also be used, but they are by no means essential. It is important to ensure that the stone dust resulting from drilling is efficiently removed from the hole.
Soapstone can easily be turned on a lathe with the aid of carbide-tipped tools. A cutting speed of about 4 to 6 m/min can be used for roughing; for finishing and shaping the speed can be higher, about 6 to 10 m/min. A positive cutting angle of about 2 degrees is recommended.
Soapstone can also be milled, sculptured by chiselling, rasped, filed and sandpapered for finishing. Either wood grinding abrasives or carborundum wheels can be used for grinding.

Finish and colours

As a standard product FireStone is shipped with a sawed surface. Stoves are ground on the external surfaces. Because of its softness, soapstone cannot be polished in the same way as hard rock materials. Grinding is easy to accomplish, even on site after installation, by dry grinding with woodworking tools or abrasive paper or, for larger areas, by a hand-held grinder. Small holes are easy to patch with a mixture of grinding dust and water-glass solution.
The colour of FireStone varies from light to dark grey, and its texture varies correspondingly from that of coarse-grained marble to that of a denser and more fine-grained rock.
If desired, the surface pattern and greenish tint of the stone can be enhanced by varnishing. The manufacturer supplies a heat-resistant varnish designed for stove surfaces; it makes the surface easy to clean and brings out the natural beauty of the stone.

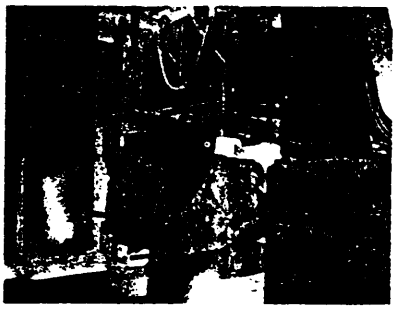

Figure 5.
The raw blocks are cut into 300-mm-thick cants with a blanking saw.

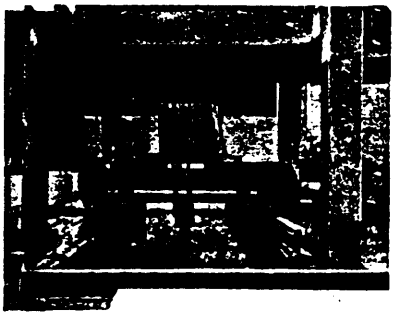

Figure 6.
The cants are slit into deals of the desired thickness with a multiple-blade saw.

Applications

In comparison with other stone materials and synthetic products, FireStone has many exceptional properties that indicate its natural applications:
- refractory at high temperatures and pressures
- chemical resistance
- bending and compression strength
- excellent heat capacity
- good thermal conductivity
- electrical insulation
- easy machining
- a natural product

Stoves and fireplaces

FireStone is traditionally known as an excellent material for fireplaces and stoves (Figure 8).
The stoves are assembled from FireStone pieces with thicknesses of 40, 60, 100 and 120 mm, a width of 298 mm and lengths of 190 to 820 mm.
The stoves can be assembled from calibrated stone pieces with »zero-thickness« joints by making use of grooves milled into the sides.
The pieces are cemented together with a mixture of soapstone powder, water glass and water, which comes close to the properties of the stone when it hardens.
For good thermal efficiency, all stoves in the product range work on the counter-current principle.
The product range currently comprises baking ovens, a combined baking oven and kitchen stove, and fireplaces (Figure 10). Separate brochures are available on the different types.

Refractory linings and sauna stoves

- grates and fire boxes
- industrial refractory linings
- filling stones for sauna stoves
- sauna stoves

Floor and wall tiling

FireStone can also be used for flooring or wall tiling. The tile size is 150 × 150, 150 × 300 or 300 × 300, and the thickness is 10 mm. The usual mounting methods used for ceramic tiles can also be used for FireStone.
Owing to the high thermal capacity of FireStone, floor heating is well suited to stone floors.
The surface can be finished to a Mohs hardness of 4, which is satisfactory for a stone floor.
The recommended thicknesses for floor tiles are 25, 30 and 40 mm, width 298 mm and length 200 – 800 mm.
On inside walls, tiles with thicknesses of 10, 25, 30, 40 or 60 mm and a width of 298 mm are recommended.

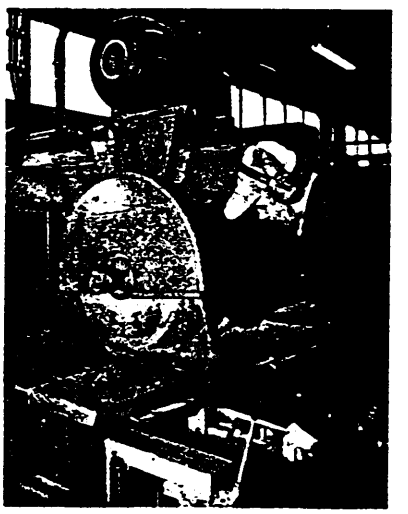

Figure 7.
The deals are cut down to the desired sizes with a cross-cut saw.

Sculpture, bric-a-brac, etc.

FireStone is a natural stone that is easy to carve, which makes it an excellent material for decorative objects and sculpture (Figure 8).

Figure 9.
At the beginning of this century, soapstone was a very popular material in public buildings. Good examples are the facades of the Finnish National Museum and the National Theatre. The photo above shows part of the facade of the old headquarters of the Pohjola insurance company, which is entirely clad with soapstone from Nunnanlahti.

Standard products

Stone deals

Thickness:	stock sizes	40, 60, 100 mm
	on request	25, 30 mm
Width:	stock sizes	298 mm
	on request	below 300 mm
Length:	deal	1000 to 2000 mm
	cut to measure	on request

Grooves can be milled into two sides on request. Standard products have a sawed surface. Dimension tolerance: ± 1.5 mm.

Flat sheets

Dimensions to order
maximum (width × length) 750 × 2000 mm

Fireplaces and stoves

Standard types according to separate brochures.

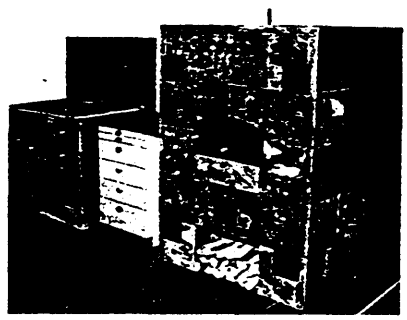

Figure 10.
The stoves and ovens in current production are assembled from accurately cut modular pieces, which are numbered and packed with all accessories and assembly instructions.

Figure 8.
A decorative fireplace. a typical product of Suomen Vuolukivi Oy from 1902.

Production

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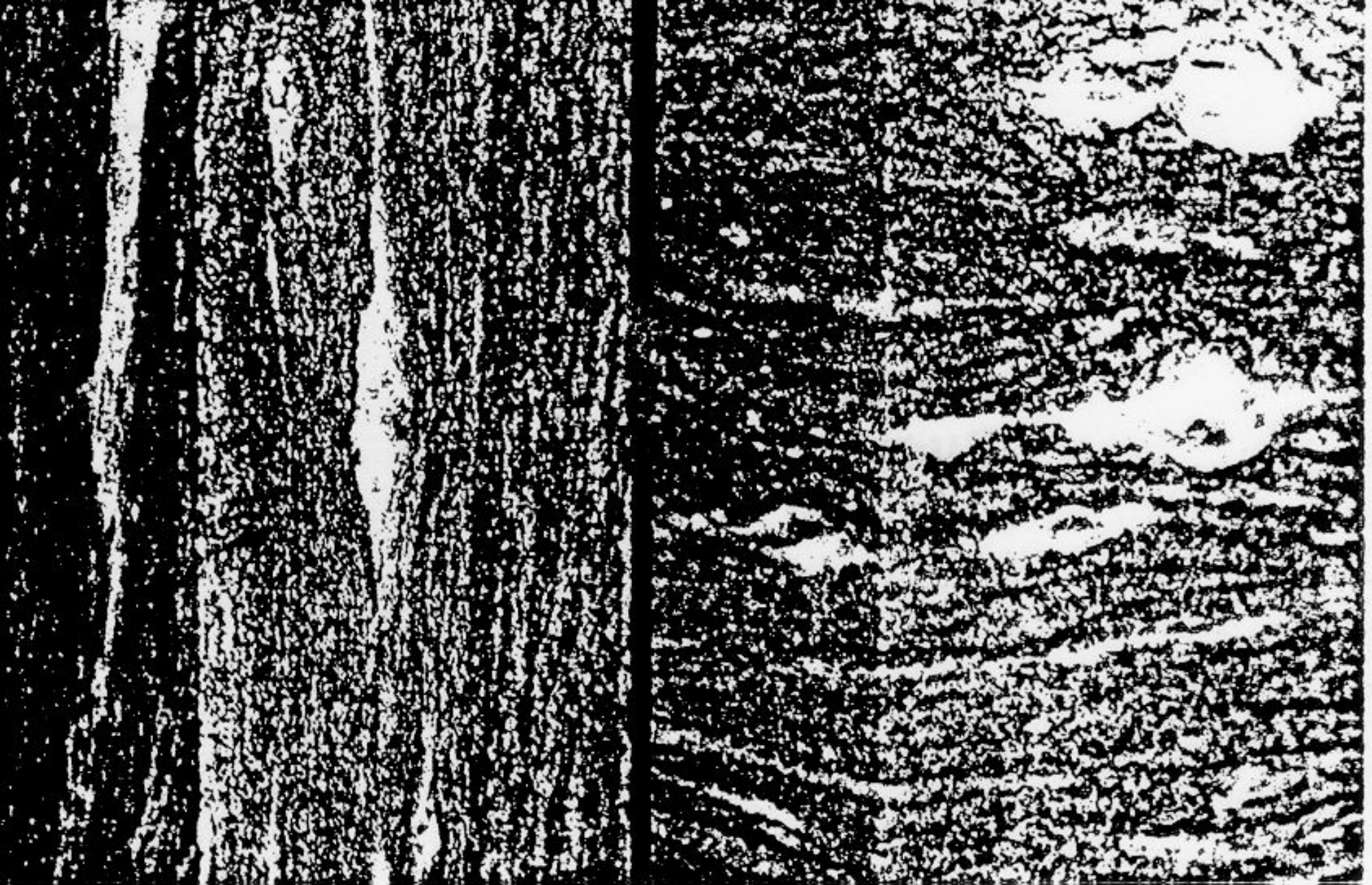
CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

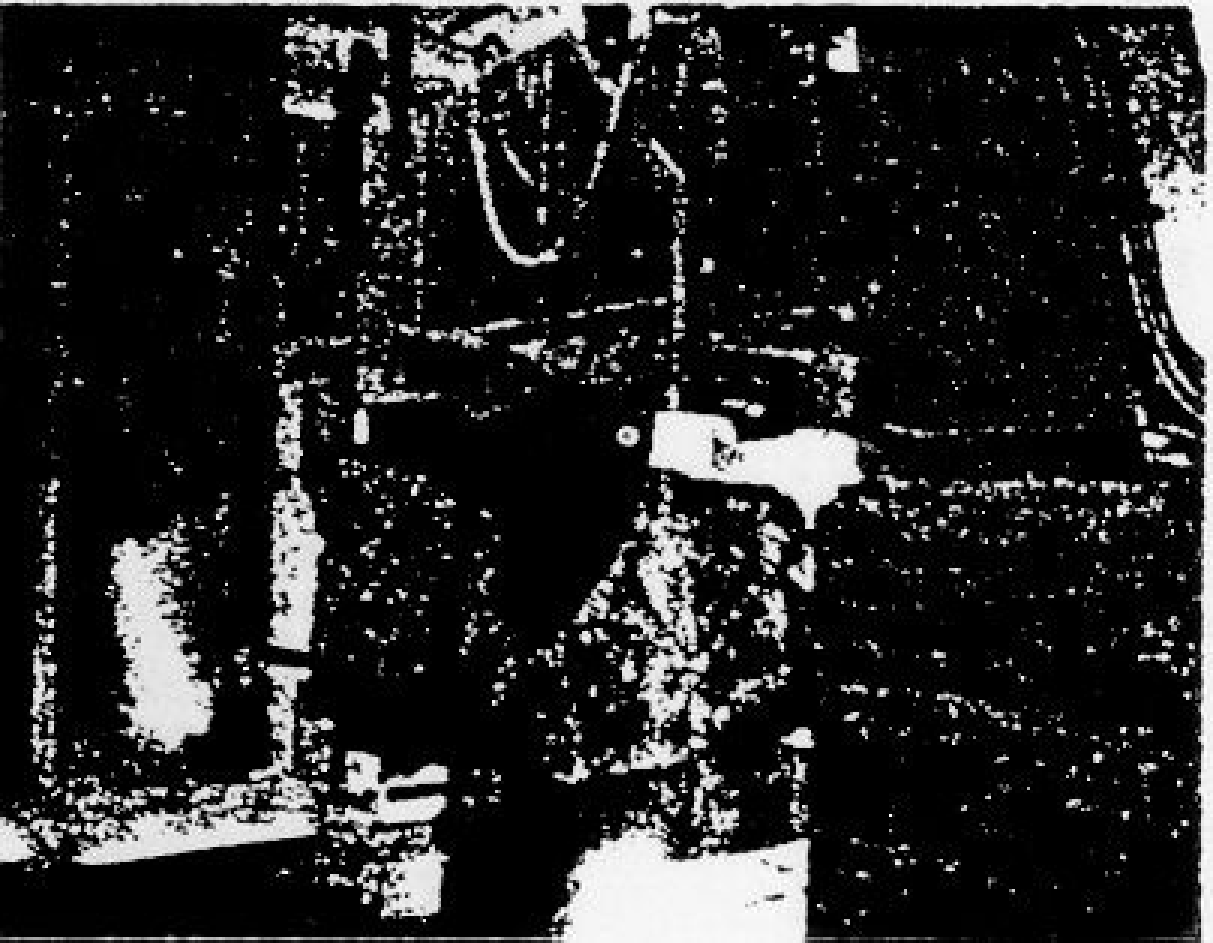
Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

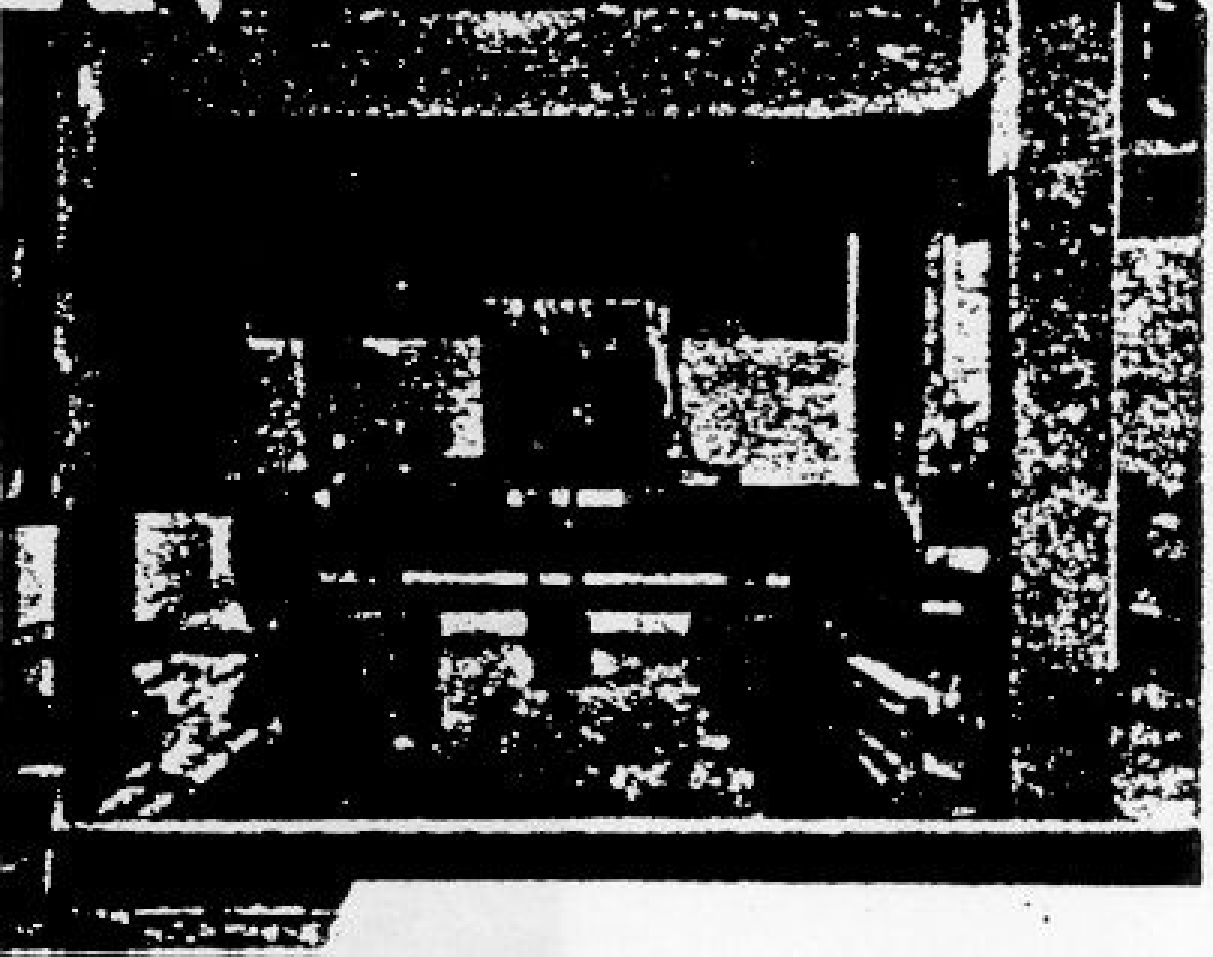
OTHER USEFUL CONVERSION FACTORS

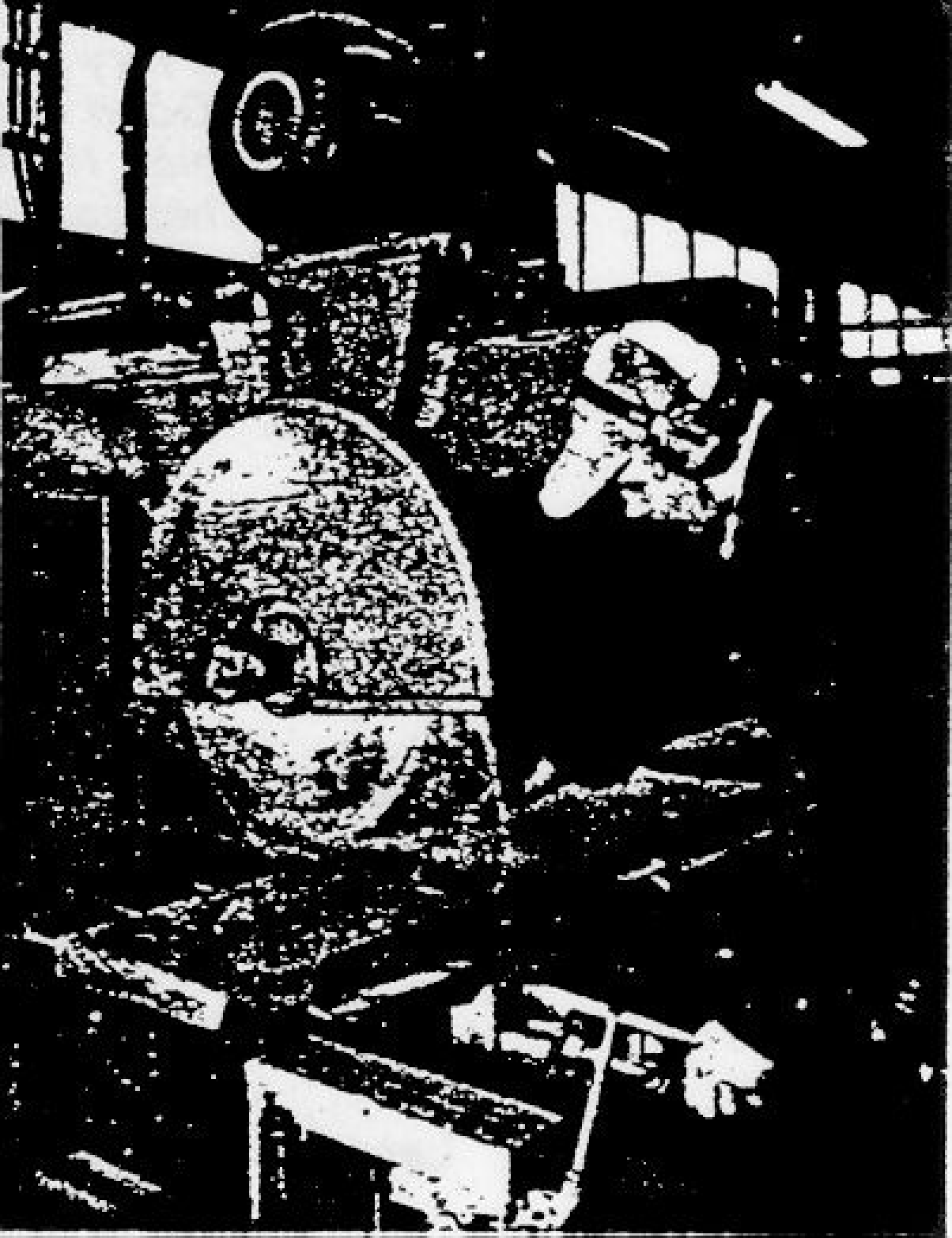
	Multiplied by	
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.










POHJOLA