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Geology of the
MAPLE MOUNTAIN AREA

Districts of Timiskaming, Nipissing, and Sudbury

By

K. D. Card, W. H. McIlwaine, and H. D. Meyn

Geological Report 106

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ABSTRACT

The Maple Mountain area comprises approximately 1,800 square miles and is bounded by Longitudes 80°00′W and 81°00′W and Latitudes 47°03′45″N and 47°35′45″N.

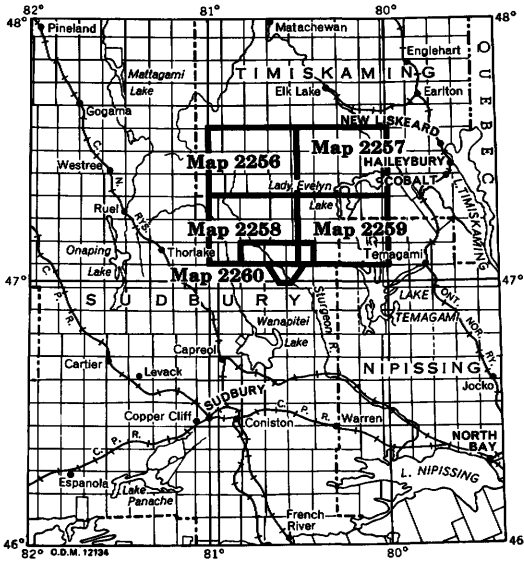

Figure 1—Key map showing location of the Maple Mountain area. Scale 1 inch to 50 miles.

Precambrian rocks of Archean and Proterozoic age underlie the map-area and are overlain by unconsolidated Cenozoic glacial and glaciofluvial deposits. Archean rocks include mafic and felsic metavolcanics, metasediments, and iron formation that are intruded by composite granitic batholiths. Several types of migmatites are present near the contacts of the granites with the older metavolcanics and metasediments. Mafic intrusions of gabbroic composition intrude the granitic and older rocks but apparently do not intrude the Proterozoic sequence.

Proterozoic metasedimentary rocks of the Huronian Supergroup unconformably overlie the Archean rocks. Huronian clastic metasediments, with a maximum total thickness of about 20,000 feet, can be divided into eight lithostratigraphic formations corresponding to the Mississagi, Bruce, Espanola, Serpent, Gowganda, Lorrain, Gordon Lake, and Bar River Formations. Nipissing-type gabbroic rocks and late diabase dikes intrude the Archean and Proterozoic sequences.

The Maple Mountain area is part of the Southern Structural Province of the Canadian Shield. Archean rocks were deformed about axes trending east-west to northwest presumably during both Archean and Proterozoic deformational events. The Proterozoic rocks were faulted and gently folded prior to intrusion of the Nipissing Diabase and were again mildly deformed and regionally metamorphosed under lower greenschist facies conditions after intrusion of the Nipissing Diabase.

Mineral exploration has revealed the presence of silver, iron formation, copper, zinc, and uranium mineralization. There has been limited production of silver from vein deposits of native silver and iron-nickel arsenides associated with Nipissing Diabase intrusions. Most of the copper-zinc mineralization is also associated with the Nipissing intrusions.

Siliceous oxide iron formations occur in Archean metavolcanic-metasedimentary sequences at several localities, and low-grade uranium mineralization occurs near the base of the Mississagi Formation where it is exposed in the south-central part of the area.

Geology
of the
Maple Mountain Area
Districts of Timiskaming, Nipissing, and Sudbury

By

K. D. Card[1], W. H. McIlwaine[2], and H. D. Meyn[3]

INTRODUCTION

The centre of the Maple Mountain area is approximately 60 miles northeast of Sudbury and 25 miles south of Gowganda, Ontario. The map-area is bounded by Longitudes 80°00′W and 81°00′W, and approximately by Latitudes 47°03′45″N and 47°35′45″N. All or parts of 41 townships, an area of about 1,800 square miles, were mapped during the 1969 field season by the writers and assistants. McIlwaine carried out mapping in Ray, Donovan, Whitson, van Nostrand, Speight, and Auld Townships; Meyn mapped Marconi, Turner, Seagram, and parts of Cotton, DeMorest, and Clary Townships; Card was responsible for mapping the remainder of the area. Information on townships previously mapped was added from the following sources: Onaping area (Collins 1917), Leonard Township (Langford 1927), Leith, Charters, and Corkill Townships (McIlwaine 1971), Delhi Township (Lawton 1954), LeRoche and Cynthia Townships (Simony 1964), Cynthia Township (Moorhouse 1942), and Dane, Cole, and Aston Townships (Todd 1926).

Access to the northern tier of townships is provided by several gravel bush roads leading south from Highway 560, between Elk Lake and Gowanda, and south from the village of Elk Lake. Turner Township and vicinity can be reached by bush roads of the Goulard Lumber (1962) Limited, Sturgeon Falls. Areas around the northern end of Lake Temagami can be reached on an excellent gravel road of Canadian Johns-Manville Company Limited that extends west from Highway 11 north of Temagami Village. Bush roads of the Portelance Lumber Limited provide access to areas in the southwest.

The Montreal River system provides some access to the northern part of the area, as do the Wanapitei, Sturgeon, and Obabika Rivers in the south. The Florence Lake-Lady Evelyn River system can be navigated, although portages are numerous. The Lake Temagami-Lady Evelyn Lake system provides good water access to the eastern part of the area, and is much used by canoeists. Float-equipped aircraft offer the only convenient method of travel in most of the area.

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Manuscript accepted for publication by the Chief Geologist 20 July 1970.

The map-area is located in the classical Huronian region extending northwards from Sudbury to Cobalt. Reconnaissance mapping was carried out in the early 1900s by Collins (1917), but until the mid-1900s the region received relatively little attention from geologists and prospectors. During the 1950s, mining companies, searching for uranium, discovered low-grade uranium mineralization in basal Huronian rocks in Turner Township and further investigation by company and government geologists (Jas. E. Thomson 1960; Roscoe 1969) indicated the presence of Lower Huronian formations that had previously been assigned to the Gowganda and Lorrain Formations. With this in mind, it was thought that similar rocks existed elsewhere in the map-area at the base of the Huronian Supergroup and mapping was undertaken to test this possibility as well as to outline the sequence in the Turner Township area. In addition, there are numerous silver occurrences of the Cobalt-type associated with Nipissing Diabase in the northern part of the area. Mapping of the Nipissing Diabase bodies was carried out to ascertain their form, petrography, and field relationships, to assess the known mineral deposits, and to outline areas of possible economic interest. Rock, soil, vegetation, and water samples were collected for geochemical studies. General studies of the stratigraphy, sedimentology, structure, and metamorphism were carried out to elucidate the geological history of the area as a part of the Southern Province of the Canadian Shield.

Mapping was by pace and compass traversing overland, and by canoeing along the shorelines of the major lakes and streams. Data gathered were plotted on perfatrace overlays on 1 inch to ¼ mile air photographs. This information was transferred to 1 inch to ¼ mile base maps for part of the area, and to 1 inch to 1 mile photographs and base maps for the entire area. Maps of the Forest Resources Inventory series were used by the Cartography Section of the Ontario Division of Lands, Ministry of Natural Resources in compiling base maps. Float-equipped aircraft supplied by Sudbury Aviation Limited and the Ontario Ministry of Natural Resources, Field Service Division, were used to transport men and equipment to various lakes in the district where fly-camps were set up and traverses run. Much of the central part of the area was mapped during the month of August with a helicopter supplied by Pegasus Airlifts Limited. The helicopter was used to drop and pick up traverse teams and to trace contacts.

The writers were ably assisted in the field by the following persons: L. B. Chorlton, Henry Wallace, P. A. Maynes, R. J. Larson, J. C. French, J. R. Bowlby, C. J. Findlay, D. G. Scarr, M. A. Woodley, D. R. Jaques, P. L. Reeves, Emile Mailloux, B. J. Miller, C. J. Mailloux, P. R. Robertson, G. A. Shepard, D. H. Mills, Yves (J. C.) Deslauriers, B. P. Meyer, and R. G. Keeler.

In addition to working in the field, Miss Chorlton did much of the preparatory work for the project during the preceding winter while she was employed as a geological assistant in the Sudbury Resident Geologist's office. Maynes, Larson, French, Chorlton, Mailloux, and Wallace were responsible for part of the mapping. The writers thank the following companies and individuals for assistance and information: J. McMahon and C. Armstrong, Sudbury Aviation Limited; W. Nash and W. Gray, Pegasus Airlifts Limited; Cecil Fielding, Carman Fielding, D. Stickles, Portelance Lumber Limited; Goulard Lumber (1962) Limited; Denison Mines Limited; Noranda Exploration Company; Canadian Johns-Manville Company Limited; Ministry of Natural Resources, Field Services Division, Elk Lake; and Henry King, Matachewan.

NATURAL RESOURCES

The main industries of the area are lumbering, tourism, and trapping. The forest resources of the area have been extensively utilized in the past, so that now very little remains of the large stands of pine and spruce that once were present. The scattered remnants of this forest are now being harvested by lumber companies in the southwestern, north-central, and eastern parts of the area. Portelance Lumber Limited operates a mill at Hamlow Lake, Ellis Township where about 20 men are employed and Canadian Johns-Manville Company Limited operates lumber camps around Lake Temagami. Only immediately adjacent to the shorelines of some of the larger lakes can the original forest be seen. Removal of these forests, along with the fires that commonly followed, has resulted in erosion of the thin soil cover from many of the hills and consequently these areas now support no, or very sparse, vegetation. Tree species common to the area include spruce, balsam, poplar, white birch, jack pine, white pine, red pine, yellow birch, maple, and ash. There are no large tracts of land in the area suitable for agriculture.

Fish, including pickerel, bass, pike, and trout, are relatively abundant in some of the lakes and streams. Game and fur-bearing animals present include moose, bear, grouse, duck, beaver, otter, and mink.

The area is very scenic, with high rolling hills, clear lakes, and streams with numerous rapids and waterfalls. Some of the water courses can be navigated by canoe, and consequently numerous canoe groups use the area. There are private cottages and several commercial camps on Temagami and Lady Evelyn Lakes, but relatively few in the interior.

TOPOGRAPHY AND DRAINAGE

The Maple Mountain area is located on the Precambrian Shield of northeastern Ontario just south of the height of land. The Shield here is a broken, low plateau elevated approximately 1,500 feet above sea level. Local topographic relief averages only about 300 feet but the country is nevertheless very rugged and hilly. Rocky hills, many with steep sides, alternate with valleys partly filled with glacial drift, swamps, and lakes. Locally there are large flat or hummocky areas of glaciofluvial deposits and moraine.

The highest elevation in the area is Maple Mountain, which stands 2,000 feet above sea level and 950 feet above nearby Anvil Lake. Mount Ferguson has an elevation of 1,909 feet and is 965 feet above Lake Temagami. Hills around Bluesucker and Florence Lakes are about 1,700 feet above sea level and 600 feet above local lake levels. Topography is strongly controlled by bedrock lithology and structure. The Lorrain sandstones are resistant to erosion and consequently form high, steep-sided hills. Nipissing Diabase is also resistant to erosion and forms lower hills, commonly in a line along the trend of the body. Olivine diabase dikes weather rapidly and are expressed topographically as long, narrow valleys. The Gowganda and older Huronian Formations generally stand at lower elevations although low ridges and small scarps produced by resistant beds are common. Archean granites and metavolcanics generally form low, hummocky topography with abundant swamps and lakes. Structures such as faults are expressed as narrow, steep-walled valleys, many of which are occupied by lakes and streams such as the Sturgeon and Montreal Rivers. Smoothwater and McGiffin Lakes lie in basins formed by synclinal folds in the Huronian formations.

Glaciation subdued the topography by rounding the hills and partly filling the valleys with glacial debris. More extensive areas of moraine, glaciolacustrine, and valley train deposits form broad, flat-bottomed valleys.

Numerous streams, including the Sturgeon, Obabika, and the east branch of the Montreal River, have their sources within the Maple Mountain area. The map-area is located just south of the continental drainage divide and there are also several interior local drainage divides. Consequently the streams are small and swift, with numerous rapids and falls, and lakes are numerous. The northern part of the area drains north into the Montreal River system, which then flows southeast into Lake Timiskaming. The southern part of the area is drained southwards, eventually into Lake Huron, by the Wanapitei, Sturgeon, and Obabika Rivers. The central part of the area drains eastwards via Lady Evelyn River and Lady Evelyn Lake to the Montreal River. Waterfalls are common along the Sturgeon and Lady Evelyn Rivers. Kettle Falls on the Sturgeon River has a total drop of 75 feet; Helen Falls on the Lady Evelyn River drops 81 feet.

EXPLORATION AND MINING HISTORY

In 1880, W. A. Austin surveyed a line up the Sturgeon River in connection with location of a route for the transcontinental line of the Canadian Pacific Railway. Proudfoot, in 1888, and Niven, in 1896, surveyed the Algoma-Nipissing boundary immediately west of the map-area (Collins 1917). In 1875, Robert Bell (1876) ascended the Sturgeon River-Stull Lake-Scarecrow Lake system to Smoothwater Lake and the Montreal River. Burwash (1896) accompanied Niven's survey party and mapped the geology along the boundary line. Barlow (1897) mapped in the eastern part of the area, and Parsons (1901, p.102) traversed parts of the area via Lakes Temagami and Obabika to Sturgeon River and northward to the Montreal River. Geological exploration in the southern part of the area was carried out by Miller (1901), Coleman (1901), and Moorhouse (1942). Exploration in the north was conducted by Knight (1907), Burrows (1910), Collins (1913), Todd (1926), and Langford (1927). In 1908, Collins (1917) started work in the Onaping map-area, which includes the western part of the Maple Mountain area. Lawton (1954) mapped Delhi Township, and Simony (1964) mapped Cynthia Township and part of LeRoche Township. Jas. E. Thomson (1960) described the rocks and associated uranium occurrences in Turner Township, and Roscoe (1969) reviewed the stratigraphy and correlation of the rocks northeast of Sudbury.

The results of aeromagnetic surveys of the map-area are shown on Aeromagnetic Maps 1514G (Smoothwater Lake Sheet, GSC 1965d), 1513G (Pilgrim Creek Sheet, GSC 1965c), 1504G (Lady Evelyn Lake Sheet, GSC 1965b), 1503G (Obabika Lake Sheet, GSC 1965a), and 284G (Gowganda Sheet, GSC 1956) issued by the Geological Survey of Canada, at a scale of 1 inch to 1 mile.

Uncoloured preliminary geological maps of the Maple Mountain area published by the Ontario Department of Mines are listed in the reference section at the end of this report (Donovan 1965; McIlwaine and Card 1969; McIlwaine 1969a,b,c,d,e, and f; 1970a and b; Meyn 1969a,b, and c; Card *et al.* 1970a and b).

Following the discovery of silver at Cobalt in 1903, prospectors expanded their search for silver in outlying areas. Silver was discovered at Elk Lake in 1906, in the Gowganda area in 1907, and in Leith Township at the Hudson Bay Silver Mine (now Rustex Mining Corporation) by Dan O'Gorman in 1908. The following year, Hugh Kell discovered silver at the Kell Mine in Corkill Township. Production from the Hudson Bay Mine amounted to 80,186 ounces of silver and 565 pounds of cobalt, and 1,620 ounces of silver were produced from the Kell Mine (McIlwaine 1971). According to Knight (1907), small shipments of silver ore were made from occurrences in Whitson Township, notably the White Reserve Mine, in the early 1900s. Knight also noted the discovery of silver at several localities in Auld, Charters, and Donovan Townships, and of copper, and zinc mineralization on the Lady Evelyn River between Lady Evelyn Lake and the Montreal River.

The Coppersand Lake mineralization was discovered by Father Paradis of Porcupine early in the century (Simony 1964, p. 22). It was staked in the 1950s by D. Desrosier of North Bay and optioned to Mayer Mining Company Limited. The New Delhi Mines Limited deposit in Delhi Township was staked by L. J. Lahay in the early 1930s. Sulphide mineralization near Perkins Lake, Turner Township, has been investigated a number of times in the past, the last time, to the field party's knowledge, in 1956 (Assessment Work Files, Ontario Division of Mines, Sudbury).

Iron formation in Leonard and Cotton Townships was investigated by MacKenzie and Mann Limited in the early 1900s. The Cotton Township occurrences were later investigated in detail by M. A. Hanna Company in the 1950s, and in the 1960s by Ironco Mining and Smelting Company Limited that currently own the deposit. Kokoko Lake iron formation in Cynthia and Chambers Townships was investigated by Dominion Gulf Company in the 1950s and in 1968 was owned by Jalore Mining Company Limited.

Uranium was discovered in Turner Township in 1954 and the occurrences found have been tested by several companies, notably Harrison Minerals Limited, Noranda Mines Limited, and Denison Mines Limited.

During the 1969 field season, exploration was being carried out in the Lady Evelyn Lake area for base metals, and in Whitson and van Nostrand Townships for silver. A water-radon geochemical survey for uranium was carried out by private interests in the southwestern part of the map-area.

GENERAL GEOLOGY

The bedrock, which is of Precambrian age, is divisible into six major units on the basis of relative age:

Late diabase dikes
Nipissing-type mafic intrusions
Huronian Supergroup metasediments
Matachewan-type mafic intrusions
Archean granitic rocks
Archean metavolcanics and metasediments and iron formation.

Table 1 TABLE OF LITHOLOGIC UNITS FOR THE MAPLE MOUNTAIN AREA

CENOZOIC
QUATERNARY
RECENT
Swamp, lake, and stream deposits
PLEISTOCENE
Glacial, glaciofluvial, and glaciolacustrine deposits

Unconformity

PRECAMBRIAN
PROTEROZOIC
MAFIC INTRUSIONS
LATE DIABASE INTRUSIONS
Diabase, olivine diabase

Intrusive Contact

NIPISSING DIABASE
Gabbro, granophyre, metagabbro, amphibolite

Intrusive Contact

HURONIAN SUPERGROUP
COBALT GROUP
BAR RIVER FORMATION
Sandstone
GORDON LAKE FORMATION
Sandstone, argillite, chert, chert breccia
LORRAIN FORMATION
Sandstone, conglomerate, greywacke, siltstone
GOWANDA FORMATION
Conglomerate, greywacke, argillite, siltstone, sandstone

Unconformity

QUIRKE LAKE GROUP
SERPENT FORMATION
Sandstone, argillite, siltstone
ESPANOLA FORMATION
Limestone, siltstone
BRUCE FORMATION
Conglomerate, sandstone
HOUGH LAKE GROUP
MISSISSAGI FORMATION
Sandstone, conglomerate, argillite, siltstone

Unconformity

ARCHEAN
MAFIC INTRUSIONS
EARLY MAFIC INTRUSIONS
Diabase, gabbro, metagabbro (Matachewan-type)

Intrusive Contact

FELSIC INTRUSIVE AND METAMORPHIC ROCKS
GRANITIC ROCKS
Quartz monzonite, granodiorite, quartz diorite
MIGMATITIC ROCKS
Gneiss, agmatite, migmatite

Intrusive Contact

METAVOLCANICS AND METASEDIMENTS
FELSIC METAVOLCANICS AND METASEDIMENTS
Rhyolite, intermediate metavolcanics, trachyte, pyroclastics, schist, iron formation, slate, sandstone, conglomerate
MAFIC METAVOLCANICS
Basalt, andesite, amphibolite, amphibolite schist, diabase

The map-area is underlain mainly by metasediments of the Huronian Supergroup that occur extensively along the North Shore of Lake Huron and northwards into the Cobalt-Kirkland Lake area. The Huronian sequence within the map-area has been deformed and metamorphosed, albeit mildly, probably by the same orogenic events which affected Huronian rocks along the North Shore of Lake Huron. Consequently, the Maple Mountain area can be included in the Southern Structural Province of the Canadian Shield.

Archean metavolcanics and associated metasediments are the oldest rocks in the area. They are mainly Keewatin-type mafic to felsic metavolcanics, iron formation, greywacke, and argillite, although a small area of metasediments and felsic metavolcanics in the northwest may be stratigraphically equivalent to the Timiskaming sequence of the Timmins-Kirkland Lake area.

Granitic batholiths, probably emplaced during the Kenoran orogeny some 2,500 million years ago (Lowdon *et al.* 1963), intruded and metamorphosed the volcanic rocks. A variety of migmatitic rocks were formed by interaction of granitic magma and the older metavolcanics. Matachewan-type mafic dikes intrude the granites and older rocks but are apparently older than the Huronian metasediments.

Metasediments of the Proterozoic Huronian Supergroup were deposited on an irregular topographic surface developed by faulting, uplift, and erosion of the older rocks. The Huronian is divisible into three groups and eight lithostratigraphic formations that can be correlated with the regional sequence outlined by the Federal-Provincial Committee on Huronian Stratigraphy (Robertson, Frarey, Card 1969; Robertson, Card, Frarey 1969).

Huronian rocks were folded, faulted, and metamorphosed, probably during several Proterozoic orogenic events. Proterozoic diabase and gabbro intrusions were emplaced during and after these orogenic events.

Pleistocene glaciation scoured and gouged the bedrock and left behind a thin, discontinuous mantle of ground moraine. Retreat of the continental glaciers resulted in the formation of end moraine, glaciofluvial, and glaciolacustrine deposits.

ARCHEAN

METAVOLCANICS AND METASEDIMENTS

MAFIC METAVOLCANICS

Keewatin-type mafic metavolcanics are exposed in the northwestern and southeastern corners of the map-area and, in addition, underlie smaller areas exposed in Leith and Turner Townships, and occur as remnants in the granitic rocks in the southwest. They are mainly metamorphosed mafic flows and intrusions with minor intercalated pyroclastic rocks and metasediments, including iron formation. Contacts with the granitic rocks are irregular and there is abundant evidence for metamorphism, metasomatism, and assimilation of the volcanic rocks by granitic magma. Granitic dikes intrude the older rocks, and metavolcanic fragments are locally abundant within the granite. Interaction between the granitic magma and the metavolcanics has produced a variety of intermediate rocks including mafic migmatite, gneiss, and agmatite.

Mafic metavolcanics in the northwest are part of a large 'greenstone' belt that extends northwards to the Timmins area. Dark green to black, fine- to coarse-grained basalt and andesite, as flows and intrusions, are dominant rock-types. They are composed of saussuritized plagioclase, amphibole, and quartz, with variable amounts of potassic feldspar, chlorite, biotite, carbonate, epidote, and sphene. Pyrite, chalcopyrite, and iron oxide minerals are commonly present in minor amounts. Chemical and modal analyses are given in Table 2.

Mafic metavolcanics in the southeastern part of the area are part of a 'greenstone' belt that extends eastwards toward Temagami Village. According to descriptions by Moorhouse (1942), these rocks are similar to those in the northwest.

Table 2 CHEMICAL AND MODAL ANALYSES OF METAVOLCANICS AND IRON FORMATION FROM THE MAPLE MOUNTAIN AREA; CHEMICAL ANALYSES BY MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

CHEMICAL ANALYSES
MAJOR COMPONENTS IN PERCENT

	1	2	3	4
SiO_2	49.5	54.1	57.0	24.8
Al_2O_3	17.2	15.3	2.22	3.88
Fe_2O_3	4.92	4.21	12.6	56.0
FeO	4.93	7.92	11.2	9.32
MgO	3.76	3.88	1.66	trace
CaO	11.8	2.32	2.82	3.32
Na_2O	2.35	4.37	0.08	0.10
K_2O	0.08	0.30	0.01	0.10
H_2O+	2.02	3.53	0.75	0.05
H_2O-	0.30	0.20	0.32	0.12
CO_2	0.15	1.12	9.32	2.52
TiO_2	0.94	1.34	0.01	0.02
P_2O_5	0.19	0.33	0.10	0.17
S	0.02	0.44	0.93	0.02
MnO	0.15	0.11	0.12	0.03
Total	98.3	99.5	99.1	100.3
Specific Gravity	2.96	2.68	2.91	3.39

TRACE ELEMENTS IN PPM

As	...	...	5
Ag	1	...	1
Co	30	25	10
Cr	150	100	10
Cu	20	10	100
Ga	30	30	5
Li	...	20	...
Ni	100	70	20
Pb	100	40	50
Sb	...	...	32
Sc	60	30	20
Sr	250	50	10
V	250	100	...
Y	30	30	20
Zn	80	120	50
Zr	150	200	100

MODAL ANALYSES
IN PERCENT

Mineral	A	B	C
Plagioclase	44.8	40	47
Amphibole	26.2	36	...
Quartz	16.2	4	13
Biotite	12.0	1	29
Chlorite	trace	2	3.5
Muscovite	trace	...	...
Epidote	trace	13	7.5
Carbonate	trace	...	...
Ilmenite	...	4	...
Iron oxide minerals	trace	...	...
Iron sulphide minerals	trace	...	...

1 — Basalt, Leith Township (McIlwaine 1971, p. 7)
2 — Andesite, Leith Township (McIlwaine, 1971, p. 7)
3 — Jasper-rich iron formation (McIlwaine 1971, p. 8)
4 — Magnetite-rich iron formation (McIlwaine 1971, p. 8)
A — Quartz basalt, Dufferin Township
B — Diabase in metavolcanics, Turner Township
C — Felsic schist, Turner Township
... not detected

Highly metamorphosed mafic volcanic rocks occur in Turner Township where they are associated with felsic metavolcanics, iron formation, and schistose metasediments. Fine- to medium-grained amphibolite and diabase composed of uralitic amphibole and saussuritized feldspar, probably representing thick flows and hypabyssal intrusions, are the common rock types.

Mafic metavolcanic inclusions in the granitic rocks range in size from a few inches to several hundred feet. They are medium- to coarse-grained black amphibolite composed mainly of blue-green hornblende, intermediate plagioclase, and quartz. Locally, metavolcanic fragments are so abundant that the resulting mixed volcanic-granitic rock is best termed agmatite; for example in Dufferin Township.

Primary features observed include flow contacts, amygdules, pillows, glomeroporphyritic and variolitic textures, and intercalations of agglomerate and breccia. Secondary foliations are locally well-developed and are generally east-west except near granite contacts where they tend to parallel the contacts.

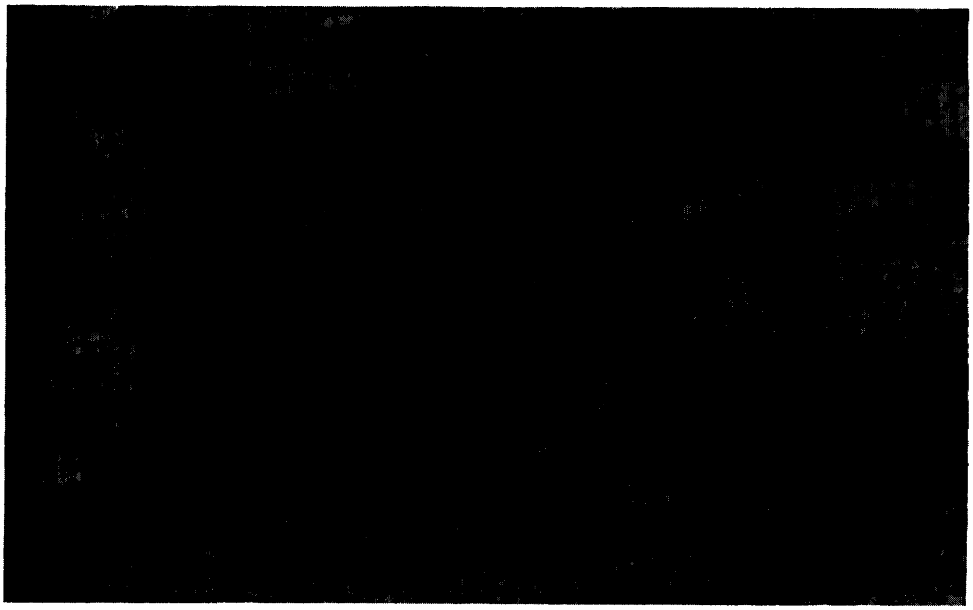
FELSIC METAVOLCANICS AND METASEDIMENTS

Archean felsic metavolcanics and associated metasediments occur in Leonard, Cynthia, Chambers, and Turner Townships.

Felsic volcanic flows, felsic pyroclastic rocks, and metasediments in Leonard Township uncomformably overlie Keewatin-type mafic metavolcanics and are in turn overlain unconformably by rocks of the Huronian Gowganda Formation. These relationships led Graham (1932) to correlate the sequence with the Timiskaming of the Kirkland Lake area. However, as Collins (1917, p.51) previously pointed out, there is no real basis for such a correlation. The sequence in Leonard Township and townships immediately north consists of a basal volcanic breccia and tuff member, followed by thick felsic flows, breccia, and tuff that grade up into sandstone, slate, and conglomerate (Graham 1932). The rhyolite is a massive grey, fine-grained to porphyritic rock composed of albite and quartz phenocrysts in a quartz-feldspar-chlorite groundmass. Flow banding and amygdules are present. Pale red, commonly porphyritic trachyte also is present and consists of potassic feldspar, oligoclase, and hornblende phenocrysts in a fine-grained groundmass of similar composition. Tuff and breccia consist of rhyolite and trachyte fragments up to 6 inches long in a fine-grained, locally well-bedded matrix (Photo 1). The pyroclastic rocks grade upwards into arkosic sandstone that is composed of quartz, feldspar, rhyolite, and jasper fragments in a chloritic matrix. Well-bedded argillite is present near the top of the section, as is conglomerate consisting of rounded volcanic, granitic, and jasper fragments, up to 8 inches in diameter, in an arkosic matrix.

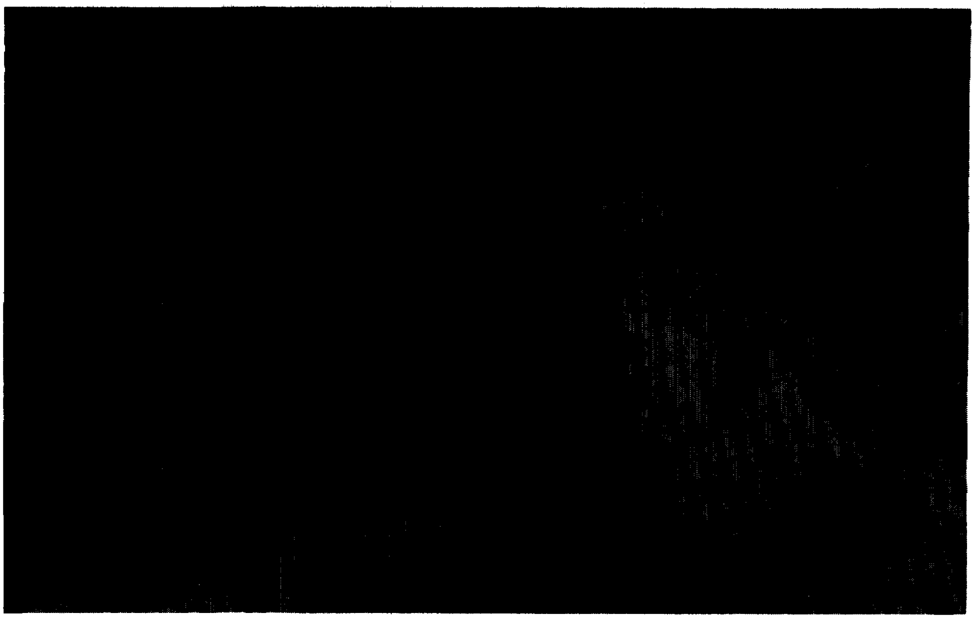
Felsic metavolcanics in the southeast, in Cynthia and Chambers Townships, are apparently conformable with and interbedded with mafic metavolcanics. They consist mainly of rhyolitic and trachytic flows, agglomerate, and tuff with minor porphyritic flows and quartz porphyry dikes. The rocks are light green, schistose, and are composed mainly of quartz and sericite with variable amounts of epidote, chlorite, and carbonate. Feldspar and quartz phenocrysts, and calcite and quartz amygdules, are present locally as are ellipsoidal and spherulitic structures.

In northwestern Turner Township, schistose felsic metavolcanics and metasediments are intercalated with mafic schists and diabasic rocks, either as flows or hypabyssal intrusions. In the centre of the township, fragmental felsic metavolcanics



ODM8726

Photo 1—Rhyolite breccia; north of the iron formation; Turner Township.



ODM8727

Photo 2—Folded banded iron formation intruded by granitic rocks; east of Burwash Lake, Cotton Township.

predominate, whereas in the southeast felsic pyroclastic rocks are associated with iron formation. The pyroclastic rocks include rhyolitic tuff and tuff-breccia composed of felsic volcanic fragments averaging 2 inches in length in a fine-grained rhyolitic matrix.

IRON FORMATION

Deposits of Archean iron formation of the Algoma-type (Gross 1965; Shklanka 1968) occur in Leonard, Leith, Cotton, Turner, Cynthia, and Chambers Townships.

Iron formation in Leonard Township has a composition characteristic of the oxide facies, consisting of thin, alternating magnetite-rich and quartz-rich interbeds. In addition, hematitic and sideritic sections are present as well as zones of chlorite and sericite schist. The iron formation occurs as several parallel layers associated with mafic metavolcanic and pyroclastic rocks in a northwest-trending zone up to 350 feet wide and 1¼ miles long. Analyses of up to 52 percent Fe have been obtained, but the average grade is lower (Shklanka 1968, p.70).

Iron formation in Leith Township is also associated with mafic metavolcanics and is less than 30 feet wide and approximately ½ mile long. It consists essentially of thin magnetite-rich and quartz-rich laminae or beds. Jasper, carbonate, and minor pyrite are locally present. Chemical analyses by McIlwaine (1971) of magnetite-rich and jasper-rich varieties are given in Table 2.

Kokoko Lake iron formation in Cynthia and Chambers Townships is of the oxide facies consisting primarily of magnetite, quartz, and jasper. Iron formation occurs as two parallel zones up to 500 feet wide and 3½ miles long associated with chloritic and tremolitic tuff, and ferruginous sandstone (this iron formation is mainly outside the map-area). Individual layers range in thickness from microscopic to several feet, and have been much deformed by small-scale folding and faulting. Granite has intruded the iron formation on the east (out of the map-area). Reported average grades are approximately 25 to 40 percent Fe over widths up to 500 feet (Shklanka 1968, p.266).

Iron formation (Photo 2) in Cotton Township, currently owned by Ironco Mining and Smelting Limited, is of the oxide facies, consisting primarily of magnetite and quartz with minor amphibole, chlorite, and sulphide minerals. It has been metamorphosed under almandine-amphibolite facies conditions of regional metamorphism. The iron formation occurs as isolated blocks in migmatitic granitic rocks that presumably represent granitized metavolcanics and metasediments (Collins 1917). Numerous granitic and gabbroic dikes (too small to show at map scale) intrude the iron formation. Blocks of iron formation, which are up to 500 feet in outcrop width, outline an S-shaped fold with a strike length of about 7½ miles (not all in the map-area). The iron formation is a dark grey to black laminated rock with discontinuous magnetite- and quartz-rich layers and interbeds of greenish, chloritic, massive to well-bedded metavolcanics and pyroclastic rocks; grades in the richer sections range from 20 to 50 percent and average 30 percent iron (Assessment Work Files, Ontario Division of Mines, Resident Geologist's Office, Sudbury).

Iron formation in Turner Township is associated with felsic fragmental metavolcanics and occurs as a steeply-dipping, northeast-trending zone 200 to 600 feet in outcrop width and 1½ miles long. It consists of thinly bedded chert, magnetite-chert, greywacke, and pyrite-pyrrhotite. Original textures and structures have been largely obliterated by brecciation, folding, and metamorphism. Sulphide-facies iron formation is dominant in the south, whereaas oxide facies iron formation is dominant in the north.

CONDITIONS OF FORMATION OF METAVOLCANIC AND ASSOCIATED ROCKS

If the unconformity between the Keewatin-type mafic metavolcanics and felsic metavolcanics and associated metasediments in Leonard Township is of local significance only, all the volcanic-sedimentary accumulations in the map-area follow a stratigraphic sequence that is common to many 'greenstone' belts of the Canadian Shield. According to Goodwin (1968), the typical Archean 'greenstone' sequence consists of basal basalt and andesite flows and related intrusions, middle flows, fragmentals, and pyroclastic rocks of mafic to felsic composition, and upper volcanogenic sediments with subordinate volcanic components. This assemblage is the result of a three-stage series of events:

1. Construction of a thick broad platform of extrusive mafic volcanic rocks.
2. Increasingly explosive eruptions of intermediate to felsic calc-alkaline pyroclastic rocks leading to erection of high-rising piles upon the mafic platform.
3. Erosion of the volcanic piles and deposition of volcanogenic sedimentary rocks.

There is evidence in the Maple Mountain area, in the form of sorted, bedded material, that the rocks were deposited in water. Goodwin (1968) postulated that such sequences formed under thin-crustal conditions around unstable protocontinents and represent a mechanism of crustal growth.

FELSIC PLUTONIC AND MIGMATITIC ROCKS

MIGMATITIC ROCKS

Migmatitic gneiss and agmatite occur mainly in Dufferin Township, near the contacts between granitic rocks and older, mafic metavolcanics. In addition, there are areas within the granitic rocks in the southwest and southeast where amphibolite inclusions are sufficiently abundant to term the rock agmatite. At the scale of mapping these zones could not be outlined in detail, but they probably represent screens around the margins of individual granitic plutons that form the larger composite batholiths.

The migmatitic rocks are highly variable in composition and structure, but, generally, two varieties are distinguishable. Agmatite, consisting of blocks of amphibolite and amphibolite gneiss in a granitic groundmass is the most common. The blocks range in size from a few inches to several hundred feet and typically constitute 30 to 50 percent of the rock mass. In some localities, the inclusions are angular, showing little evidence of assimilation; in other localities, inclusions have been extensively assimilated by granitic magma and are irregular mafic patches with vague, gradational contacts with the enclosing mafic granitic rocks. Dark coloured migmatitic gneiss occurs locally near granite-metavolcanic contacts. The migmatitic gneiss is layered, individual layers ranging in thickness from about 1 inch to several feet, and has well-developed gneissosity and lineation. Granitic and pegmatitic dikes and segregations are generally abundant. The gneiss is composed of plagioclase, hornblende, and quartz, with variable amounts of potassic feldspar, biotite, chlorite, iron oxide, and sulphide minerals. Garnet is present in some layers.

The migmatitic rocks are the products of interaction between granitic magma and older, mainly mafic, volcanic rocks. In general, near granite-metavolcanic contacts, passive block-stoping of the metavolcanics by the magma has resulted in agmatite showing little evidence of assimilation. Away from such contacts, assimilative processes were effective to varying degrees in redistributing the mafic components throughout the magma, resulting in more or less obliteration of the inclusions and concomitant increase in mafic mineral content of the granitic rocks. Migmatitic gneiss was probably formed by similar processes of assimilation and granitization, with the addition of active deformation while these processes operated.

GRANITIC ROCKS

Archean granitic rocks occur extensively in the southwestern and southeastern parts of the Maple Mountain area, and as a small inlier in northern Corkill Township. The Corkill inlier is part of a larger granitic body that extends to the north. The southwestern granites are the northern part of an approximately circular batholith some 250 square miles in extent, which is surrounded by younger Huronian rocks, whereas the southeastern granites represent the western margins of a granite-'greenstone' complex also exposed through the Huronian cover rocks over an area of about 250 square miles (Ginn *et al.* 1964).

The granitic batholiths apparently consist of a number of discreet plutons each 4 to 8 miles in diameter. Pluton margins are marked by migmatitic zones or areas of recognizable metavolcanic rocks and iron formation. The composition and texture of the rocks within each pluton and from pluton to pluton are relatively constant, most rocks being medium- to coarse-grained quartz monzonite and granodiorite. However, around pluton margins, the rocks are compositionally and texturally variable, from granite to quartz diorite, and commonly migmatitic.

Pink and grey quartz monzonite and granodiorite are the dominant granitic rock types throughout the area. They are medium- to coarse-grained, equigranular or porphyritic, and are composed essentially of quartz, sodic plagioclase, and perthitic potassic feldspar. Mafic minerals (hornblende, biotite, and chlorite) are generally present in amounts less than 5 percent, although locally, around mafic inclusions and near contacts with metavolcanics or migmatites, these minerals are abundant. Other local variations noted include brick-red coloration (presumably due to hematitization of feldspar), decrease in quartz content to form a syenite or quartz syenite variant, and local, coarsely porphyritic or pegmatititc patches and dikes. Some pegmatite and aplite dikes are also present.

Chemical and modal analyses of typical granitic rocks are given in Table 3.

Table 3 | CHEMICAL AND MODAL ANALYSES OF GRANITIC ROCKS FROM THE MAPLE MOUNTAIN AREA; CHEMICAL ANALYSES BY MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

CHEMICAL ANALYSES
MAJOR COMPONENTS IN PERCENT

	1	2	3
SiO_2	70.2	72.7	69.22
Al_2O_3	16.8	15.3	15.06
Fe_2O_3	1.10	0.47	1.64
FeO	1.26	1.06	2.55
MgO	1.37	1.09	0.98
CaO	3.49	1.00	3.19
Na_2O	4.43	5.07	4.07
K_2O	1.77	1.94	1.00
H_2O+	0.70	1.00	1.39
H_2O-	0.07	0.10	...
CO_2	0.10	0.11	0.33
TiO_2	0.34	0.28	0.53
P_2O_5	0.10	0.50	...
S	0.01	0.01	...
MnO	0.04	0.04	...
Total	101.8	100.7	98.96
Specific Gravity	2.66	2.64	

TRACE ELEMENTS IN PPM

	1	2
As	...	5
Ba	400	300
Co	10	5
Cu	7	3
Ga	20	20
Ni	20	15
Pb	15	10
Sr	300	300
V	40	10
Zn	50	60
Zr	150	50

MODAL ANALYSES
MAJOR COMPONENTS IN PERCENT

	A	B	C	D	E	F	G
Quartz	18.0	23.6	35.2	20.2	25	26	29
Plagioclase	59.2	44.6	40.5	52.2	25	42	51
Potassic feldspar	21.3	26.4	23.0	15.9	41	27	16
Chlorite Muscovite	1.5*	2.0*	1.0*	trace*	4**	5**	trace
Biotite	...	...	...	6.5	...	...	4
Hornblende	...	3.0	...	5.0	...	...	...
Epidote	...	trace	trace	trace	...	...	...
Zircon	...	trace	...	...	...	...	...
Sphene	...	trace	...	trace	...	...	...
Iron oxides	trace	trace	...	trace	5	...	...
Carbonate	...	...	...	...	trace	...	...
Apatite	...	...	...	...	...	...	trace
Plagioclase composition	Albite	Oligoclase-albite	Albite	Albite	...	$An_{35}\pm5$	$An_{37}\pm5$

1 — Grey granodiorite, Corkill Township (McIlwaine 1971, p. 10)
2 — Pink granodiorite, Corkill Township (McIlwaine 1971, p. 10)
3 — Porphyry dike (Todd 1926)

A — Albite granodiorite, Valin Township
B — Quartz monzonite, Selkirk Township
C — Albite quartz monzonite, Aston Township
D — Mafic-rich granodiorite, Howey Township
E — Granite, Turner Township
F — Quartz monzonite, Marconi Township
G — Quartz diorite, Marconi Township

* Combined value for chlorite and muscovite.
** Combined value for chlorite, muscovite, and biotite.
... not detected

Secondary foliations (gneissosity) are generally weakly and sporadically developed except near pluton margins where they tend to be parallel to the contacts. Within the plutons, foliations trend east-west and north-south, and were possibly formed during the same deformational events that affected the Huronian rocks. Metamorphic effects are similarly weakly developed, and consist mainly of saussuritization of feldspar and chloritization of mafic minerals. These phenomena too are probably ascribable to Proterozoic events.

The granitic rocks were probably emplaced as a series of discreet plutons during the Kenoran orogeny approximately 2,500 million years ago.

The general compositional homogeneity of the bodies indicates a common mode of origin, probably magmatic for the most part. Evidence for magmatic origin includes the compositional homogeneity, mode of occurrence as discreet plutons separated by screens of country rock, generally sharp contacts with the country rocks, abundant evidence for block-stoping, and the presence of rotated inclusions. However, assimilation and granitization were operative, at least locally. Evidence for these processes includes partial to complete assimilation of mafic inclusions and local development of migmatitic contact phases. Collins (1917, p.58) cited evidence for large-scale metasomatism in Cotton Township. Here granitic rocks, containing abundant amphibolite xenoliths in varying degrees of assimilation, include numerous blocks of iron formation. Collins estimated that over an area of approximately 50 square miles the metavolcanics, which originally enclosed the iron formation, were assimilated, leaving the more resistant iron formation.

In conclusion, metasomatic processes were undoubtedly operative to a varying degree around the margins of the plutons, but the plutons themselves are probably primarily of magmatic origin. The ultimate origin of the magma, whether by subcrustal magmatic derivation, or by granitization processes operating within the crust below our present level of observation, is unknown.

MAFIC INTRUSIONS

Early Mafic Intrusions

Matachewan-type mafic dikes and small plutons intrude the Archean granitic and older rocks but apparently do not intrude the rocks of the Huronian Supergroup. Consequently they are considered to be late Archean in age, and similar rocks outside the Maple Mountain area have yielded a potassium:argon radiometric age of 2,485 million years (Fahrig and Wanless 1963). Most of the intrusions are too small to be shown at map scale, and in addition there are probably numerous Matachewan-type dikes that were not distinguished from the enclosing metavolcanics.

Matachewan-type intrusions are mainly north-trending, steeply dipping, rusty weathering dikes or dike swarms. Simple dikes range in width from a few feet to about 100 feet, and in the Maple Mountain area, seldom can be traced for more than a few thousand feet along strike. Petrographically there are several varieties present including gabbro, metagabbro, and porphyritic diabase. The fresh gabbro is composed of plagioclase (labradorite), augite, and accessory magnetite, quartz, and micropegmatite. These rocks are chemically similar to Nipissing Diabase, except for higher total iron and Fe_2O_3:FeO ratios (Table 4).

Saussuritization of the primary plagioclase and chloritization of the pyroxene has resulted in widespread alteration to metagabbro. Large rounded phenocrysts or clumps of phenocrysts in some dikes produce a striking porphyritic or glomeroporphyritic texture.

Table 4 CHEMICAL ANALYSIS OF NON-PORPHYRITIC MATACHEWAN-TYPE DIABASE, CORKILL TOWNSHIP, MAPLE MOUNTAIN AREA (McILWAINE 1971, p.22). CHEMICAL ANALYSES BY MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

MAJOR COMPONENTS IN PERCENT		TRACE ELEMENTS IN PPM	
SiO_2	48.4	Ag	...
Al_2O_3	13.3	As	...
F_2O_3	16.4	Ba	200
FeO	1.09	Co	40
MgO	6.30	Cr	100
CaO	6.12	Cu	110
Na_2O	2.62	Ga	20
K_2O	0.82	Li	50
H_2O+	3.13	Ni	60
H_2O-	0.36	Pb	10
CO_2	0.24	Sb	12
TiO_2	1.31	Sc	50
P_2O_5	0.15	Sr	100
S	0.11	V	200
MnO	0.23	Y	30
Total	100.6	Zn	140
Specific Gravity	2.94	Zr	150

PROTEROZOIC

HURONIAN SUPERGROUP

Collins (1917) mapped all the Proterozoic rocks of the Onaping area, which included the western part of the Maple Mountain area, as Gowganda and Lorrain Formations. He described the Gordon Lake and Bar River Formations, which he termed 'banded cherty quartzite' and 'white quartzite', but did not distinguish these on his map.

Exploration for uranium in the Turner Township area in the 1950s revealed the presence of rocks that are correlative with lower Huronian formations. Thomson (1960) correlated these with the Mississagi Formation, whereas Roscoe (1969) suggested that they belong to the Serpent Formation. The present mapping demonstrates that these rocks can be correlated with the Mississagi, Bruce, Espanola, and Serpent Formations of the Huronian Supergroup.

HOUGH LAKE GROUP

MISSISSAGI FORMATION

Rocks of the Mississagi Formation are exposed in central and southeastern Turner Township, in southwestern Seagram Township, northeastern DeMorest Township, and northwestern Clary Township. The thickness of the formation in southeastern Turner Township is approximately 2,000 feet. The contact with the underlying Archean rocks is unconformable.

All rocks between the Archean basement and the overlying Bruce Formation have been assigned to the Mississagi Formation, as it was not possible to map sub-


ODM8728

Photo 3—Polymictic conglomerate of the Mississagi Formation; Turner Township.

divisions equivalent to the other formations of the Hough Lake and Elliot Lake Groups.

The Mississagi Formation of the Maple Mountain area can be subdivided into several lithostratigraphic members. The basal part of the formation consists of about 400 feet of sandstone, argillite, and conglomerate, with a local basal polymictic conglomerate. The middle member, about 1,500 thick, consists of medium- to coarse-grained cream to brown weathering sandstone. Bedding ranges in thickness from about 1 inch to 10 feet and crossbedding is common. Thin argillite interbeds are present. The upper member, about 100 feet thick, represents the gradational contact zone with the overlying Bruce Formation. The rocks of this zone consist of rusty weathering, pyritic sandstone, interbedded sandstone and conglomerate, and an upper rusty weathering greenish grey argillaceous schist with scattered pebbles.

The northernmost outcrop of Mississagi Formation occurs on the side of a hill in central Turner Township where laminated argillite similar to that of the Gowganda Formation is overlain by conglomerate and sandstone. The polymictic conglomerate consists of 70 to 80 percent fragments varying in diameter from ¼ inch to 10 inches, and averaging 2½ inches, in a dark grey-green argillaceous sandstone matrix. The fragments are lithologically diverse but vein quartz pebbles constitute about 10 percent of the rock. The massive sandstone beds are composed of medium-grained quartz and feldspar grains with much pyrite.

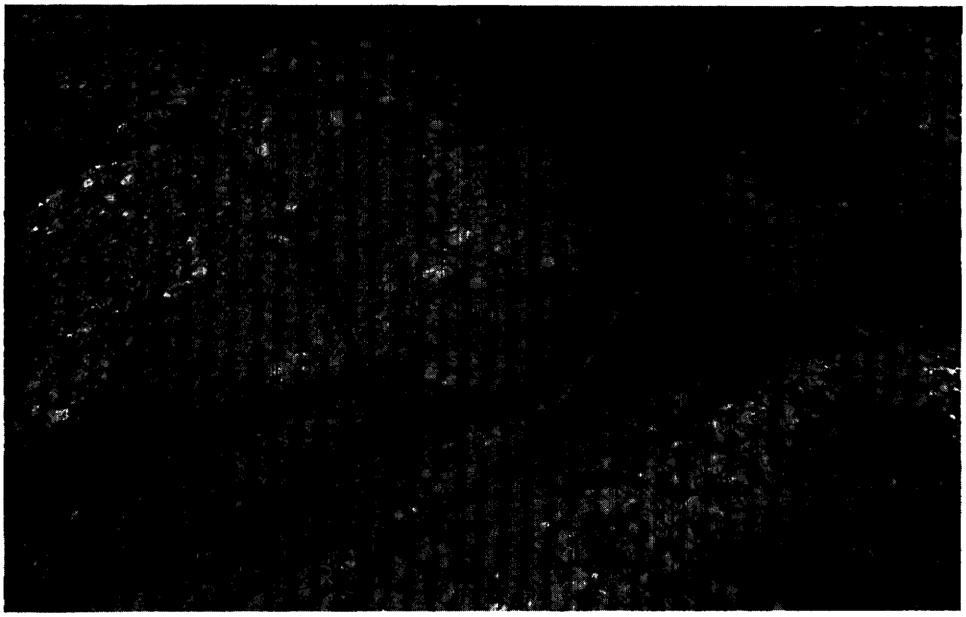
Conglomerate of the Mississagi Formation is exposed in pits beside the road 1,800 feet northwest of the pond with the two islands in central Turner Township (see Yorston Lake, Map 2260, back pocket). The polymictic conglomerate is about 30 feet thick and is composed of about 60 percent fragments in a black quartzitic matrix. The fragments range in diameter from ⅛ inch to 3 inches (the average is 2 inches) and consist of vein quartz, quartzite, siltstone, black chert, and rhyolitic tuff. The upper part of this conglomerate contains smaller fragments (maximum 1 inch and average ⅝ inch) and the radioactivity here is twice background. The matrix of the conglomerate is typical Mississagi sandstone with rounded to subangular grains of quartz in a sericitic groundmass with about 3 percent pyrite. Interbedded with the conglomerate are reddish grey, massive, coarse-grained sandstone and fine-grained sandstone that contains pyrite and carbonate.

In a pit on the eastern side of the same pond a slightly different section is exposed. The sedimentary rocks near the contact (contact not seen) with the basement felsic metavolcanics are contorted and the nature of the contact is not clear. No paleosol was observed. The lowermost beds are silty and grade through pinkish sandstone into very coarse sandstone (3 mm) with graded beds, crossbeds, graded crossbeds, argillaceous lenses, some chlorite and magnetite on bedding plane surfaces, and pyrite cubes scattered throughout. Bedding ranges from ½ inch to 3 feet thick. Lenses of polymictic and oligomictic quartz-pebble conglomerate, 2 to 3 feet thick, are interbedded. The pebbles range in diameter from ⅛ inch to 6 inches and the matrix is composed of about 50 percent fine-grained sericite and 50 percent larger subangular to rounded clastic grains of quartz. Chlorite and carbonate are present throughout the matrix. Pyrite grains averaging 0.15 mm in diameter constitute up to 15 percent of the rock. Pyrite content apparently cannot be correlated with any other feature of the rock. Radioactivity was measured at 4-times background over an argillaceous sandstone bed composed of about 24 percent clastic quartz grains in a fine-grained matrix (62 percent) of sericite and chlorite with accessory sphene (9 percent), pyrite (5 percent), and zircon. The abundance of sphene is unusual and it suggests a nearby source for these sedimentary rocks.

On the eastern shore of Discovery Pond (local name), east-central Turner Township, near Bull Lake Fault, dull grey to black, medium-grained sandstone with silty interbeds and conglomeratic lenses are exposed. The conglomerate pebbles are small, ranging in diameter up to ½ inch and averaging ⅓ inch. Radioactivity was 12-times background and radioactive minerals are concentrated in pyritiferous silty bedding plane partings, not in the conglomerate. Farther north along the shore of this pond the count dropped to 4-times background in siltstone with conglomeratic interbeds.

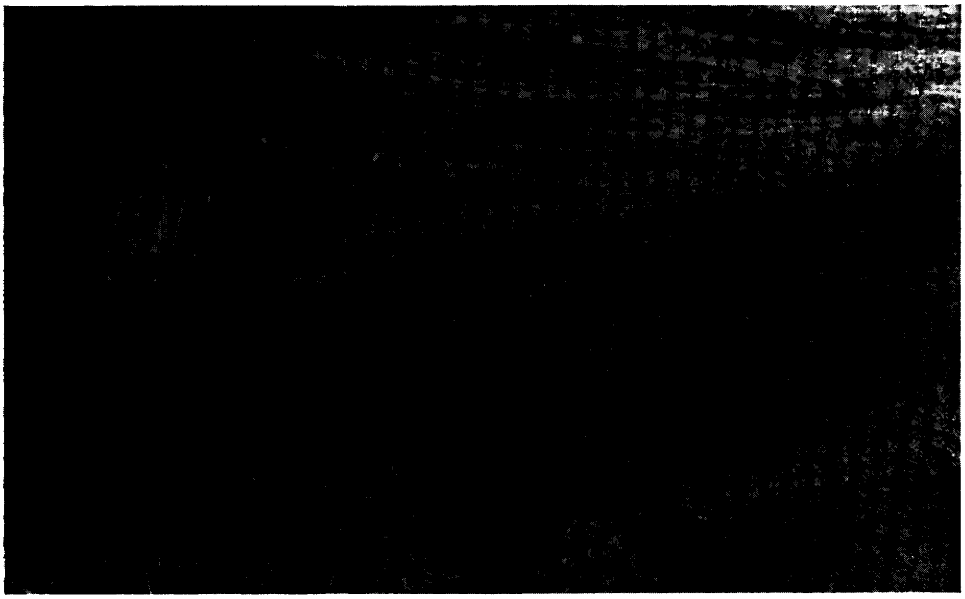
The Mississagi Formation on the western shore of Yorston Lake, Seagram Township, consists of grey weathering, medium-grained sandstone and dark green argillite. Bedding is 6 to 24 inches thick, less in the argillaceous beds, and crossbeds are common. Individual crossbedded units average 1 foot to 2 feet thick and individual crossbed laminae are from ⅒ to ¼ inch thick. Rusty stain and rusty pits are common, indicating the presence of disseminated pyrite.

Petrographic studies of typical Mississagi sandstone show that it is composed of subangular to subrounded grains of quartz and plagioclase in a finer grained matrix of quartz and muscovite. Potassic feldspar is absent and the plagioclase has



ODM8729

Photo 4—Quartz-pebble conglomerate lenses in sandstone, Mississagi Formation; Turner Township.



ODM8730

Photo 5—Crossbedded Mississagi sandstone; Turner Township.

been extensively altered to mica, carbonate, and chlorite. Pyrite, sphene, and zircon are generally present as accessory minerals.

The 'rusty schist' from the top of the formation is composed of quartz grains averaging 0.5mm in diameter (3-16 percent) in an abundant (78-87 percent) fine-grained matrix of sericite, chlorite, biotite, pyrite, and sphene. Laminated bedding and slump structures were observed locally.

Modal analyses of typical rocks are given in Table 5. Paleocurrent determinations based on orientation of crossbedding indicates that the depositional currents flowed generally south (Figure 3).

The rocks of the Mississagi Formation were probably deposited in a fluvial environment.

Table 5 MODAL ANALYSES OF ROCKS OF THE MISSISSAGI, BRUCE, AND SERPENT FORMATIONS IN THE MAPLE MOUNTAIN AREA

	A	B	C	D	E	F	G	H	I	J
Quartz	24	69	72	40			34	41	43	57
					3*	16*	4*			
Potassic feldspar	...	...	...	...				...	8	20
Plagioclase	...	8	1	2			...	10	42	23
Matrix	62	20	26	53	87	78	57	47	7	x
Muscovite	...	...	...	...	...	...	...	...	...	...
Biotite	x	...	...	...	...	x		2	x	x
							3**			
Chlorite	...	...	...	...	1	x		...	x	...
Carbonate	...	2	1	5	...	...	...	...	...	x
Magnetite	5	...	...	...	...	...	...	...	...	...
Pyrite	...	1	...	x	6	5	2	x	x	x
Sphene	9	...	...	...			...		...	...
					4***	x***		x***		
Leucoxene	...	...	...	...			...		...	...
Zircon	x	...	...	...	...	...	...	x	x	...

A — Basal Mississagi fine-grained sandstone, Turner Township.
B — Lower Mississagi sandstone, Turner Township.
C — Middle Mississagi sandstone, Turner Township.
D — Upper Mississagi sandstone, Turner Township.
E — Mississagi rusty schist, Seagram Township.
F — Mississagi rusty schist, Seagram Township.
G — Bruce conglomerate matrix, DeMorest Township.
H — Bruce conglomerate matrix, Clary Township.
I — Lower Serpent Formation siltstone, DeMorest Township.
J — Serpent sandstone, DeMorest Township.

... not detected
x trace
* Combined value for quartz and feldspar
** Combined value for chlorite and biotite
*** Combined value for sphene and leucoxene

QUIRKE LAKE GROUP

BRUCE FORMATION

Rocks of the Bruce Formation are exposed in southeastern Turner Township, southwestern Seagram Township, northeastern DeMorest Township, and northwestern Clary Township. No single continuous stratigraphic section is available to determine the thickness of the formation but it is estimated to be about 1,000 feet thick in the north and possibly 2,000 feet thick in the south. The Bruce Formation appears to be in conformable and gradational contact with both the underlying Mississagi Formation and the overlying Espanola Formation.

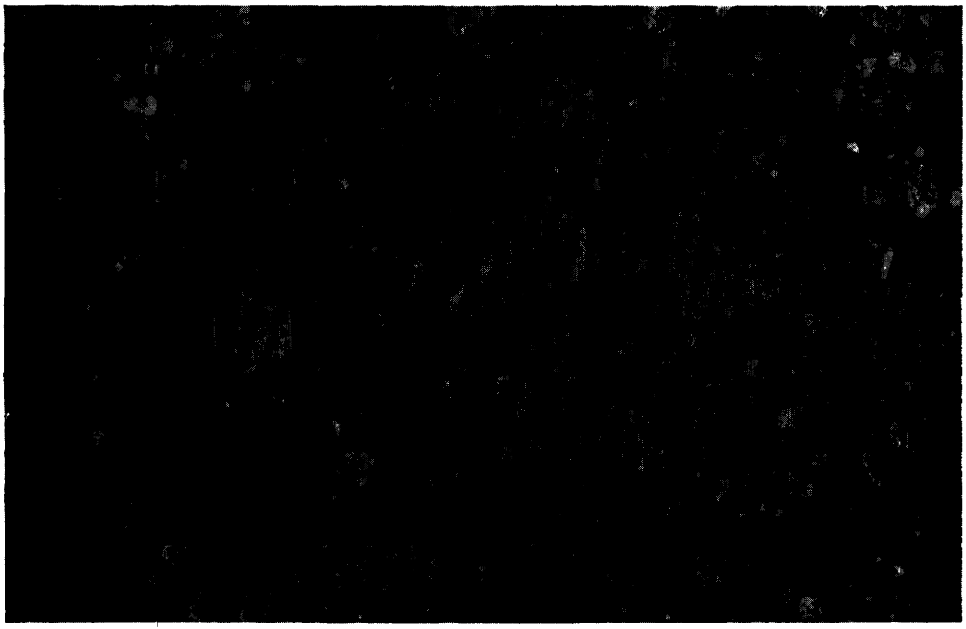


Photo 6—Bruce conglomerate; Turner Township. ODM8731

Polymictic paraconglomerate with about 3-15 percent rock fragments in a dark grey greywacke matrix is the typical rock type of the Bruce Formation but lenses containing up to 80 percent rock fragments were observed. The fragments generally range in diameter from ¼ inch to 3 inches, but locally boulders up to 4 feet in diameter are present. Rock fragments are subrounded to subangular, and consist of white granite, pale pink granite, light grey chert, vein quartz, siltstone, argillite, mafic igneous rocks, and felsic metavolcanics. In some outcrops the size distribution of the pebbles appears to be unimodal, in others distinctly bimodal. Pyrite cubes up to ¼ inch in diameter are common.

In thin section the matrix of the Bruce conglomerate is composed of subangular to subrounded grains of quartz in a fine-grained sericitic groundmass. The average size of the grains is 0.3mm. No potassic feldspar is present and some of the plagioclase grains are partly altered to sericite. Biotite, chlorite, pyrite, sphene, and zircon are also present. Modal analyses are given in Table 5.

Minor amounts of sandstone similar to Mississagi sandstone are present in the Bruce Formation. A sandstone bed about 20 feet thick is exposed in the southwestern corner of Seagram Township and southeast of Yorston Lake. Thin argillaceous partings and interbeds are also present locally within the Bruce.

The contact with the overlying Espanola Formation is conformable and gradational over a stratigraphic interval of about 10 feet. Near the top of the Bruce Formation, the proportion of pebbles in the Bruce conglomerate decreases from 15 percent to zero, the matrix becomes dark coloured and silty, and bedding appears. Laminated and massive siltstone is interbedded with conglomeratic siltstone, and then with silty limestone of the Espanola Formation.

The unstratified, poorly sorted character of the conglomerate, the diversity of lithologies represented by the fragments, and the wide areal extent, suggest that the Bruce Formation is of glacial or glaciofluvial origin.

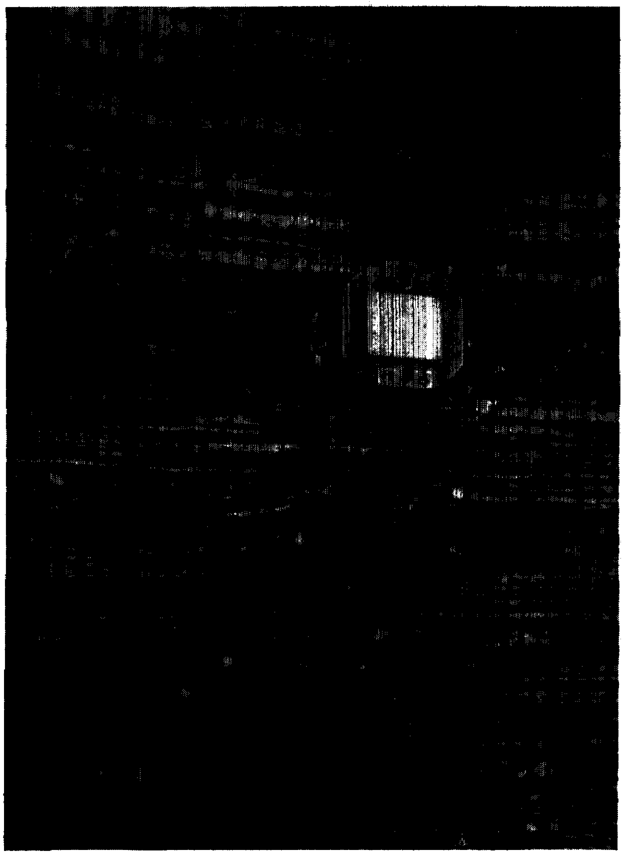


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Photo 7—Espanola limestone and siltstone; DeMorest Township.

ESPANOLA FORMATION

The Espanola Formation, as mapped in northern DeMorest and Clary Townships, consists of a sequence of limestone and siltstone with an average thickness of about 250 feet (Photo 7). There are considerable variations in outcrop width of the formation, some due to original thickness variations, some to folding.

Interbedded brown to black siltstone and white to grey limestone constitute most of the formation whereas calcareous silty greywacke is dominant near the top. Bedding in the siltstone-limestone sequence varies in thickness from approximately $\frac{1}{10}$ inch to 1 inch. Limestone is composed mainly of interlocking calcite grains with variable proportions of quartz grains whereas the siltstone is composed of quartz, feldspar, calcite, mica, chlorite, sphene, and pyrite.

Secondary foliations and minor folds are common in the Espanola Formation, indicating its relative incompetence to deformational stresses.

The thin rhythmically interbedded siltstones and limestones of the Espanola Formation were probably deposited under tranquil conditions with periodic influxes of fine detrital sediments alternating with periods of carbonate deposition.

SERPENT FORMATION

Rocks of the Serpent Formation are exposed in northern DeMorest and Clary Townships where the formation is estimated to be 2,000 feet thick. The contact with the underlying Espanola Formation is apparently conformable and gradational, although it was not seen in outcrop.

The lower part of the Serpent Formation consists of sandstone and calcareous siltstone similar to that of the upper part of the Espanola Formation. The remainder of the Serpent Formation consists mainly of massive, white, grey, or pink weathering, medium- to coarse-grained sandstone. Small pebbles of quartz and feldspar are locally abundant, and argillaceous interbeds and partings are common. Pyrite is locally abundant in the sandstone.

In thin section, the calcareous siltstone is seen to consist of quartz grains in a relatively fine-grained matrix of sericite and calcite with accessory pyrite, sphene, and zircon. The sandstone is composed of interlocking quartz and feldspar grains averaging 1mm in diameter with minor interstitial sericite, chlorite, biotite, and carbonate. Pyrite is abundant. Modal analyses are given in Table 5.

Sediments of the Serpent Formation were probably deposited in a fluvial or fluvial-deltaic environment.

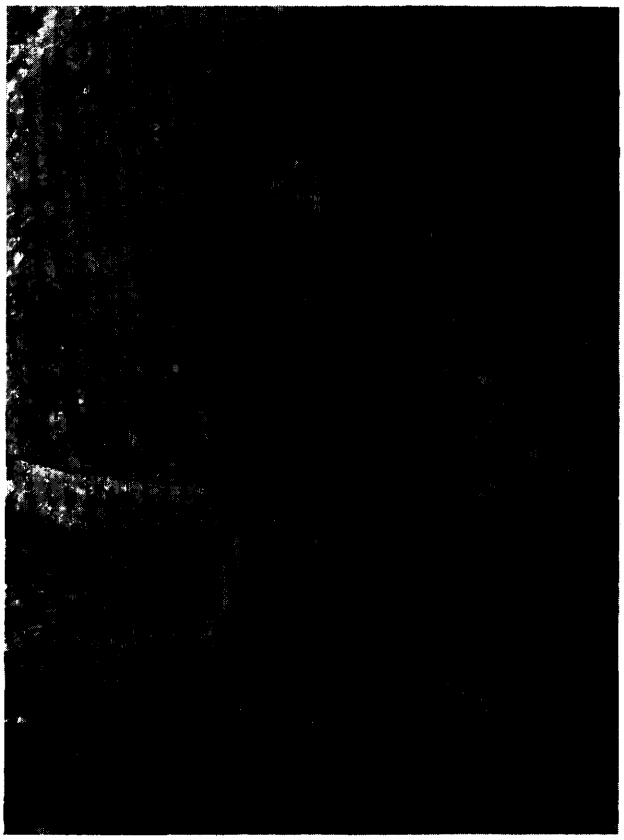
COBALT GROUP

GOWGANDA FORMATION

Rocks of the Gowganda Formation occur in the southern, eastern, and northwestern parts of the map-area where they unconformably overlie Archean granitic and volcanic rocks, and older Huronian sedimentary rocks. The Gowganda ranges in thickness from 0 to 5,000 feet, and where present, averages about 3,000 feet. There are rapid variations in thickness, especially of the lower part, from place to place. For example, in the southeast, the formation is estimated, on the basis of field mapping, to be 3,000 to 4,000 feet thick, in the south-central area, 1,500 to 2,000 feet thick, and in the southwest, 0 to 200 feet thick.

The Gowganda Formation was deposited on an erosion surface of some relief. Simony (1964) stated that variations in thickness of the Gowganda Formation, confirmed by diamond drilling, suggest a local basement relief of at least 1,000 feet. McIlwaine (1971) cited inliers of Archean rocks that represent basement topographic highs as evidence for a rugged basement terrain. Collins (1917) calculated a basement topographic relief in excess of 3,000 feet, as did Schenk (1965) in the Lake Temagami area.

The contact between the Gowganda Formation and the Archean is sharp, the unconformity is generally smooth and undulating, or locally jagged, and the Archean rocks immediately below the contact appear fresh and unweathered. Grant (1964) and Schenk (1965) have described a striated, grooved basement surface below the Gowganda in the Lake Temagami area that they ascribe to Proterozoic glaciation. The Gowganda-Archean contact is exposed immediately west of Solace Lake, Selkirk Township, where Gowganda conglomerate and argillite lie on a smooth undulating surface of granitic rocks (Photo 8). The basal conglomerate includes large un-

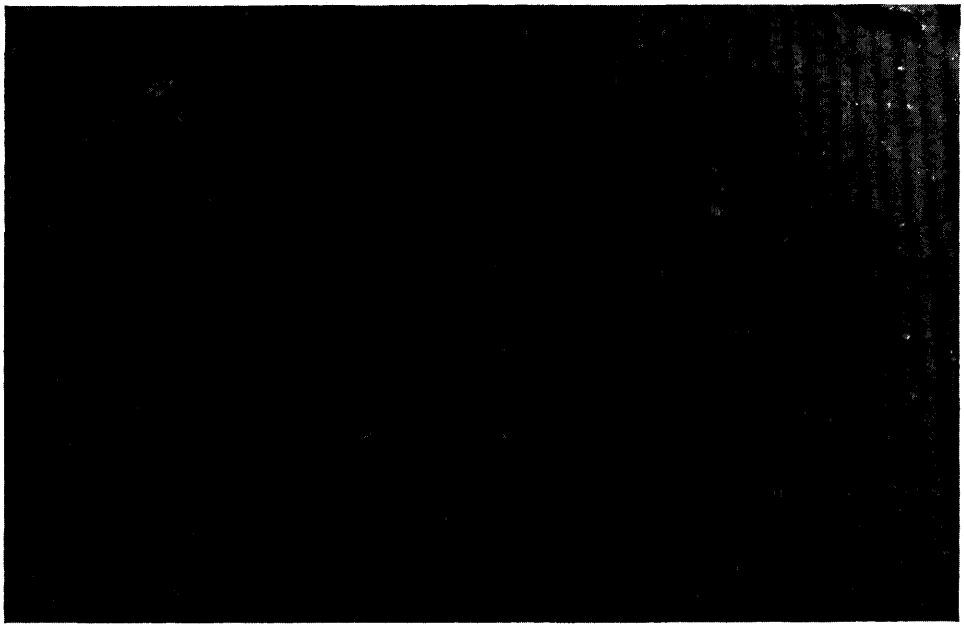


ODM8733

Photo 8—Unconformity between Gowganda conglomerate (above) and Archean granitic rocks (below); Selkirk Township. The hammerhead rests on the unconformity.

weathered granite boulders similar to the unweathered underlying Archean granite immediately below the unconformity. On the southern shore of Neault Lake, Valin Township, basal conglomeratic rubble is 'plastered' onto steep cliffs of granite. The basal conglomerate is composed of coarse angular fragments derived mainly from the underlying bedrock, and probably represents rubble deposited along fault scarps. West of McKee Lake, Dufferin Township, the contact between the Gowganda Formation and Archean metavolcanics is again smooth and undulating, and the basal conglomerate here is composed largely of metavolcanic fragments.

In the Turner Township area, the Gowganda Formation overlies rocks of the Hough Lake and Quirke Lake Groups as well as older Archean metavolcanics and granites. The contact between the Gowganda and the older Huronian rocks is apparently an angular unconformity as evidenced by onlap of the Gowganda over successively older formations, local strike and dip discordance as noted in outcrops, and angular dip discordance as shown by diamond drilling. Evidence for an unconformable relationship between the Gowganda and Serpent Formations exists in the form of angular strike and dip discordance in some localities, but in others, the two formations appear to be conformable. No fragments of the older Huronian rocks



ODM8734

Photo 9—Polymictic paraconglomerate of the Gowganda Formation; north of Seagram Lake, Seagram Township.

were noted in the Gowganda Formation. The upper part of the Serpent Formation consists of thin-bedded, locally crossbedded grey to pink, medium-grained sandstone. Overlying this, in apparent conformity, is a paraconglomerate composed of granitic pebbles in a quartz greywacke matrix, and a unit of laminated argillite and siltstone with rafted pebbles up to 18 inches in diameter. This is succeeded by argillite with conglomeratic lenses, a fault breccia, and pebbly mudstone typical of the Gowganda Formation.

The Gowganda Formation is divisible into a generally conglomeratic lower half, and an argillaceous upper half. In the southwest, the lower conglomeratic member, where present, ranges in thickness from 100 to 1,000 feet, whereas the upper member is approximately 1,500 to about 2,000 feet thick. In the southeast, the succession consists of a lower conglomeratic member (1,000 feet), a lower argillite (200 feet), and upper conglomerate (500 feet), and an upper argillite (1,000 feet). The stratigraphic succession in the northwest is similar, although the section is probably thicker (Figure 2).

The lower, conglomeratic part of the formation consists of basal polymictic paraconglomerate (Photo 9), orthoconglomerate, pebbly mudstone, greywacke, argillite, siltstone, and sandstone. There are rapid facies changes and variations in thickness. The upper argillaceous part consists of laminated argillite, siltstone, and sandstone. Conglomeratic members in the upper half of the formation are heterogeneous assemblages of interbedded pebbly mudstone, polymictic paraconglomerate, sandstone, siltstone, and argillite. Near the top of the formation, sandstone interbeds increase in abundance as the gradational contact with the overlying Lorrain Formation is approached.

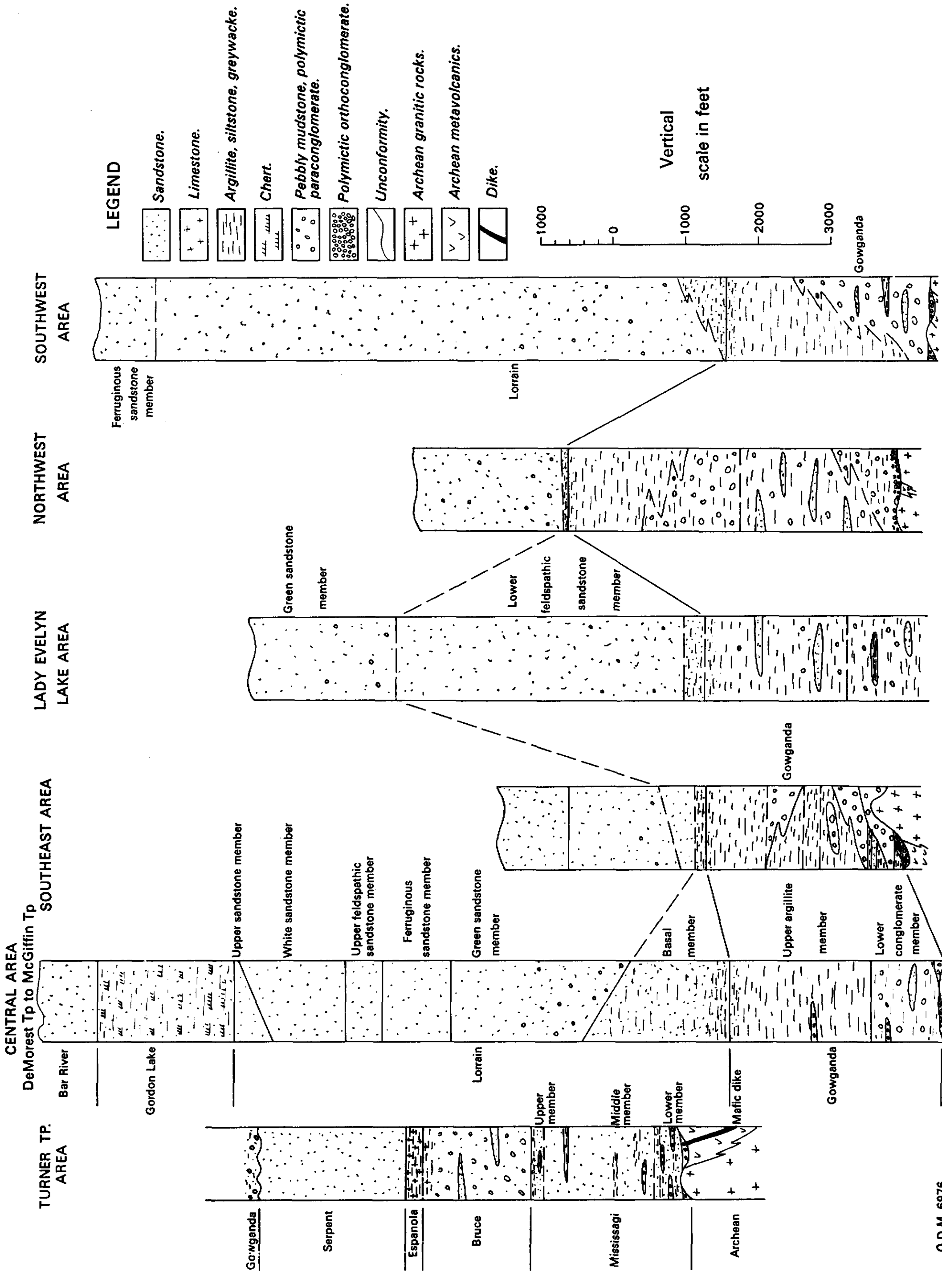


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Figure 2—Generalized stratigraphic column for the Huronian Supergroup in the Maple Mountain area.

Table 6

CHEMICAL AND MODAL ANALYSES OF ROCKS OF THE GOWGANDA FORMATION IN THE MAPLE MOUNTAIN AREA; CHEMICAL ANALYSES 3, 4, AND 5 BY MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

CHEMICAL ANALYSES
MAJOR COMPONENTS IN PERCENT

	1	2	3	4	5
SiO_2	62.43	57.76	65.6	60.4	51.2
Al_2O_3	15.27	17.82	17.0	19.4	21.9
Fe_2O_3	2.38	2.87	1.20	3.42	2.40
FeO	3.83	4.96	3.06	4.94	5.76
MgO	3.82	4.16	2.93	2.70	5.92
CaO	2.15	1.22	0.34	0.65	0.40
Na_2O	4.07	3.15	6.47	2.33	5.14
K_2O	1.77	3.36	0.28	3.01	2.63
H_2O+	3.02	3.19	2.01	3.47	3.93
H_2O-	...	...	0.20	0.18	0.23
P_2O_5	0.18	0.23	0.14	0.14	0.14
MnO	0.08	0.00	0.03	0.11	0.07
TiO_2	0.65	0.75	0.75	0.73	0.95
CO_2	...	...	0.08	0.20	0.06
S	...	...	0.01	0.01	0.01
Total	...	...	100.1	101.7	100.7
Specific Gravity	...	...	2.65	2.79	2.73

TRACE ELEMENTS IN PPM

	1	2	3	4	5
Ba	...	...	...	600	300
Co	...	...	20	12	20
Cr	...	...	100	300	350
Cu	...	...	10	20	4
Ga	...	...	20	30	40
Li	...	...	30	40	30
Mn	...	...	...	...	...
Ni	...	...	60	70	90
Pb	...	...	10	10	...
Sb	...	...	...	8	8
Sc	...	...	20	30	60
Sr	...	...	15	100	30
Ti	...	...	70	...	...
V	...	...	20	150	200
Y	...	...	40	20	...
Zn	...	...	150	40	20
Zr	...	...	—	200	150

MODAL ANALYSES
MAJOR COMPONENTS IN PERCENT

	A	B	C	D	E	F	G
Quartz	21.0	36.2	72.8	26.0	15.8	13.4	53.7
Plagioclase	7.1	9.6	10.7	32.0	14.5	10.4	21.5
Potassic feldspar	1.9	2.5	9.6	3.0	4.5	1.4	8.5
Rock fragments	8.3	3.8	0.4	12.0	47.4	2.6	2.3
Matrix	...	...	...	27.0	17.5	72.2	14.0
Chlorite	42.5	35.4	1.8	trace	trace	trace	trace
Biotite	...	...	...	...	trace	...	...
Hornblende	...	...	...	trace	trace	...	...
Muscovite	16.6	9.9	2.0	trace	trace	trace	trace
Epidote	1.9	1.3	1.7	trace	trace	trace	trace
Iron oxide minerals	0.4	0.8	0.8	...	trace	trace	trace
Iron sulphide minerals	trace	trace	trace	trace	...	trace	trace
Accessory minerals	0.3	0.5	0.2	trace	...	trace	trace

1 — Average of 9 "tillite" matrices, Cobalt-Gowganda area (Young 1969)
2 — Average of 9 laminated argillites (Young 1969)
3 — Feldspathic siltstone, Leith Township (McIlwaine 1971, p. 12)
4 — Well-laminated ("varved") argillite, Medina Township
5 — Irregularly laminated argillite, Selkirk Township

A — Average of five conglomerate matrices (Simony 1964)
B — Average of five greywackes (Simony 1964)
C — Average of two quartzites (Simony 1964)
D — Polymictic paraconglomerate matrix, Selkirk Township
E — Basal polymictic orthoconglomerate overlying Archean metavolcanic rocks, Dufferin Township
F — Pebbly mudstone, Dufferin Township
G — Feldspathic sandstone, North Williams Township

... not detected

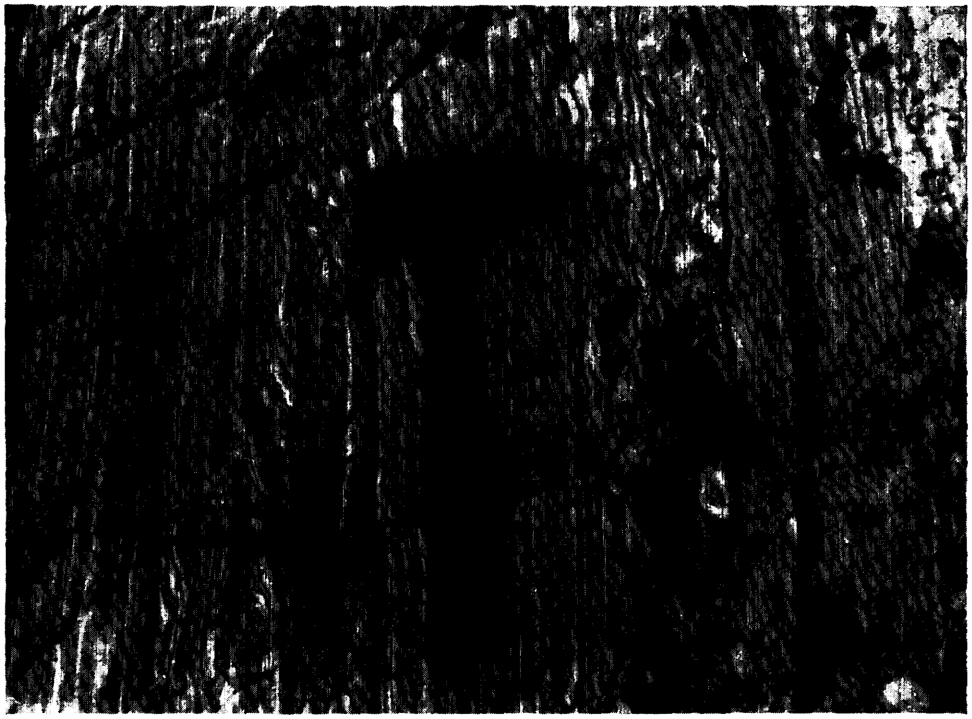

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Photo 10—Interbedded argillite and siltstone just above the graditional contact with the Serpent Formation; northeast DeMorest Township.

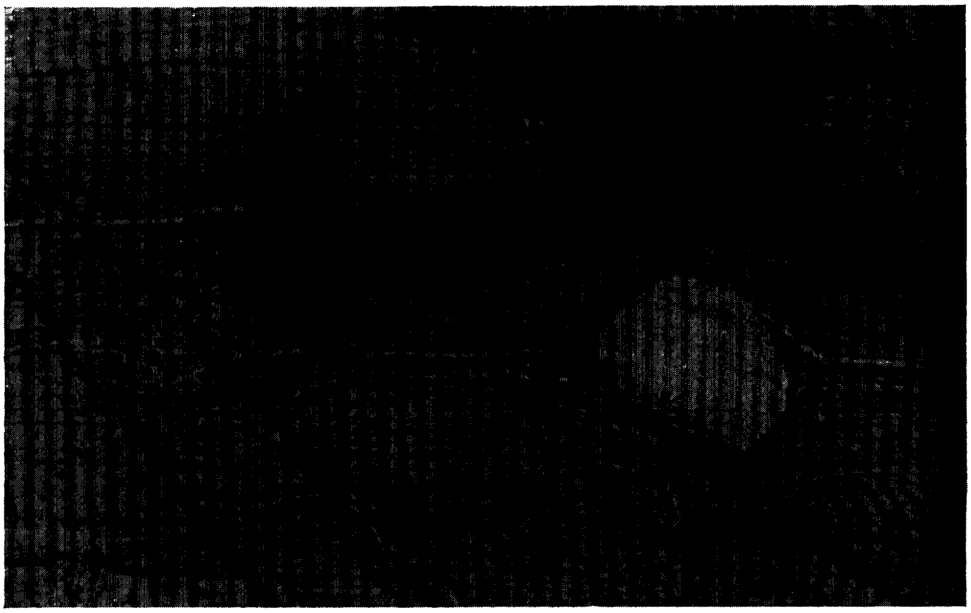
The basal conglomerate is composed of angular to rounded boulders, cobbles, and pebbles in a massive to faintly stratified greywacke or siltstone matrix. Rock fragments range in size from microscopic to several feet, and constitute approximately 20 to 80 percent of the rock. The composition of the fragments varies with the underlying bedrock; in areas underlain by granitic rocks, most of the rock fragments are granitic, whereas in areas of metavolcanic basement, most are metavolcanic. Conglomerates higher up in the lower member are mainly tillite-type pebbly mudstone and polymictic paraconglomerate consisting of 5 to 20 percent rock fragments in a massive to bedded greywacke, siltstone, or laminated argillite matrix composed of quartz, feldspars, rock fragments, micas, chlorite, epidote, iron oxides, and sulphide minerals. Rock fragments are angular to rounded, range in diameter from less than 1 inch to about 4 feet, and are mainly granitic and metavolcanic with subordinate quartz, schist, diabase, and slate. Where the matrix is bedded, the stratification is commonly deformed about the rock fragments. Conglomeratic rocks in the upper part of the formation include pebbly mudstone, commonly with a laminated argillite matrix, and polymictic paraconglomerate and orthoconglomerate with rounded pebbles of relatively uniform size averaging about 1 inch in diameter. Locally the matrix is of subgreywacke or protoquartzite composition. Modal and chemical analyses of tillite-type conglomerate matrices given in Table 6 demonstrate the abundance of matrix and plagioclase, and the high Na_2O:K_2O, MgO:CaO, and FeO:Fe_2O_3 ratios of these rocks.

Argillite occurs throughout the formation but is most common in the upper half where it constitutes over half of the sequence (Photo 10). Two types of laminae are present: irregular and varve-like. Irregularly laminated argillite, the dominant type in the southern and western part of the map-area, consists of irregular, lenticular, alternating thin (⅛ inch to 3 inches) beds of silt, clay, and sand. Beds are commonly graded and small-scale crossbedding is present in the sandy beds. Alternate beds are generally light to dark grey in colour, although shades of pink and green are also present. 'Varved' argillite is the dominant type in the eastern and northern part of the area. Individual laminae are regular, have great lateral continuity relative to their thickness, and are mainly graded couplets of silt- and clay-sized material. Thicknesses of individual laminae are generally uniform, and range from about ¹⁄₁₆ to ½ inch. Alternating laminae are coloured in various shades of grey, black, pink, brown, and green.

Petrographic study shows that the irregularly laminated argillite consists mainly of angular quartz and feldspar grains ranging from less than 0.01mm to 0.1mm in diameter in a finer grained matrix of chlorite, epidote, mica, and opaque minerals. Larger grains up to 0.2mm in diameter are common, as are 'rafted' pebbles up to several inches in maximum dimension. The 'varved' argillites are similar mineralogically, but are finer grained (0.001mm to 0.01mm) and contain more chlorite and mica. Chemical analyses of Gowganda argillites given in Table 6 demonstrate the high Al_2O_3, Na_2O, MgO, and iron, and the low CaO content of these rocks. Analyses of 'varved' and irregularly laminated argillites given in Table 6 show that the irregularly laminated argillites contain significantly greater amounts of MgO and Na_2O than do the 'varved' argillites.

Siltstone and fine-grained greywacke are most abundant in the lower part of the formation where they are interbedded with pebbly mudstone and paraconglomerate. They are dark grey rocks with bedding averaging 1 foot to 2 feet in thickness. Graded bedding and poorly developed laminations are present, as are rafted pebbles. In thin section, they are seen to consist of angular quartz, feldspar, and rock fragments ranging in diameter from about 0.01 mm to 1 mm set in a finer grained matrix rich in chlorite, mica, epidote, and opaque minerals.

Thin beds of protoquartzite and subgreywacke are present throughout the formation but are most common in the middle and upper parts. Pink and grey feldspathic sandstones are interbedded with siltstone, greywacke, argillite, and conglomerate east of McKee Lake, Dufferin Township. Bedding here averages about 1 inch to 2 feet thick and soft-sediment deformation structures are abundant. A thick unit of crossbedded feldspathic sandstone with interbedded conglomerate, argillite, and protoquartzite is exposed near Linger Lake in Seagram Township. Sandstone 'lumps' ranging from a few inches to several feet in maximum dimensions are common in conglomeratic rocks throughout the area, probably indicating the presence of sandstone beds that were broken up and incorporated in the conglomerate. Thin-bedded sandstone-siltstone sequences occur in the upper part of the formation and in the transition zone between the Gowganda and Lorrain Formations. Petrographically the sandstones are feldspathic protoquartzites and subgreywackes consisting of quartz, feldspar, and rock fragments in a sparse, fine-grained micaceous matrix (Table 6).



ODM8736

Photo 11—Rafted pebbles in fine-grained sandstone of the Gowganda Formation; from the same outcrop as Photo 10, northeast DeMorest Township.

SEDIMENTARY STRUCTURES

Sedimentary structures observed in the conglomeratic rocks include irregular bedding, channelling, rapid facies changes, laminated bedding, and rafted pebbles that have deformed the laminations (Photo 11). Pebbles commonly have a preferred orientation, probably indicative of the direction of flow of the depositional medium. Evidence that the pebble orientation is primary rather than secondary includes the lack of deformational features in the pebbles or surrounding matrix such as stretching, fracturing, or striations on pebble surfaces. Laminated bedding is the characteristic feature of the argillites, but graded bedding, ripples, and small-scale crossbedding are also common. Poorly developed graded bedding is present in the siltstone-greywacke sequences as is crossbedding and graded bedding in the cleaner sandstones. Features such as ball-and-pillow structure, flame structure, sandstone 'lumps', convolute laminations, and sedimentary breccia are common throughout the formation indicating the prevalence of slumping and other soft-sediment deformation processes.

Phenomena attributable to secondary tectonic and metamorphic processes include poorly-developed foliations and lineations, biotite and chlorite porphyroblasts, and quartz, carbonate, chlorite, and epidote veins.

ORIGIN OF THE GOWGANDA FORMATION

Paleocurrent determinations by Lindsey (1969), and the writers, based on orientations of long axes of pebbles, ripple marks, and crossbedding indicate that the rocks of the Gowganda Formation were deposited by south-flowing currents. Lindsey (1969) calculated a grand-vector mean for paleocurrents in the Cobalt region, including the northern and eastern margins of the Maple Mountain area, of approximately S10W. Scattered observations within the map-area support this general paleocurrent trend.

Paleocurrent and petrographic data indicate that the logical source for the Gowganda sedimentary rocks is the Archean granitic 'greenstone' terrain to the north. Abundance of plagioclase, the unweathered nature of rock and mineral grains, and the generally high Na_2O:K_2O ratios of the Gowganda rocks indicate little weathering in the source area. The disappearance of the older Huronian rocks indicates a topographically positive area existed north of Turner Township in pre-Gowganda time.

Collins (1917), among others, postulated that the Gowganda Formation is of glacial origin. Lindsey (1969) concurred, and cited evidence for a glacial origin as well as examining other possible depositional environments and agencies such as alluvial fans, submarine slumping, and turbidity flows. Roscoe (1969), on the other hand, points out that the Gowganda Formation, as well as the Ramsay Lake and Bruce Formations, are parts of cyclical sequences that reflect a recurrent tectonic pattern rather than being related to 'extraneous' processes such as glaciation.

The present study shows that the Gowganda Formation includes a great variety of sedimentary rocks, probably deposited by a variety of processes including glaciation, turbidity flows, slumping, and fault-scarp erosion. Evidence for glaciation includes the similarity of Gowganda sedimentary rocks to Pleistocene tills and varved clays, the great areal extent of till-like conglomerate with a homogeneous pebble fabric, rafted pebbles, and striated pavement. Evidence for turbidity currents and slumping includes graded bedding and soft-sediment deformational structures.

Lindsey (1969) postulated that the Gowganda Formation is divisible into a southern marine glacial facies and a northern continental glacial facies. Irregularly laminated argillite, bedded conglomerate, and the presence of limestone, are believed by him to indicate marine glacial conditions, whereas 'varved' argillite, general lack of bedding in conglomerate, and absence of calcareous rocks, are indicative of continental glacial conditions. If Lindsey's hypothesis is correct, the transition from marine to continental glacial conditions occurred southwest of Lady Evelyn Lake (Figure 3).

In summary, rocks of the Gowganda Formation were derived under rigorous climatic conditions from older Archean rocks and deposited by south-flowing depositional media in a basin formed initially by faulting. Glaciation was the main process of transportation and deposition, whereas turbidity currents, slumping, and erosion along fault scarps were of lesser, though widespread, importance. There was possibly a transition from continental to marine conditions in the area southwest of Lady Evelyn Lake during the time of deposition of the Gowganda Formation. It is possible that glaciation was not of continental extent, but rather the Gowganda Formation was deposited primarily by widespread valley glaciers related to tectonic uplift in the source area.

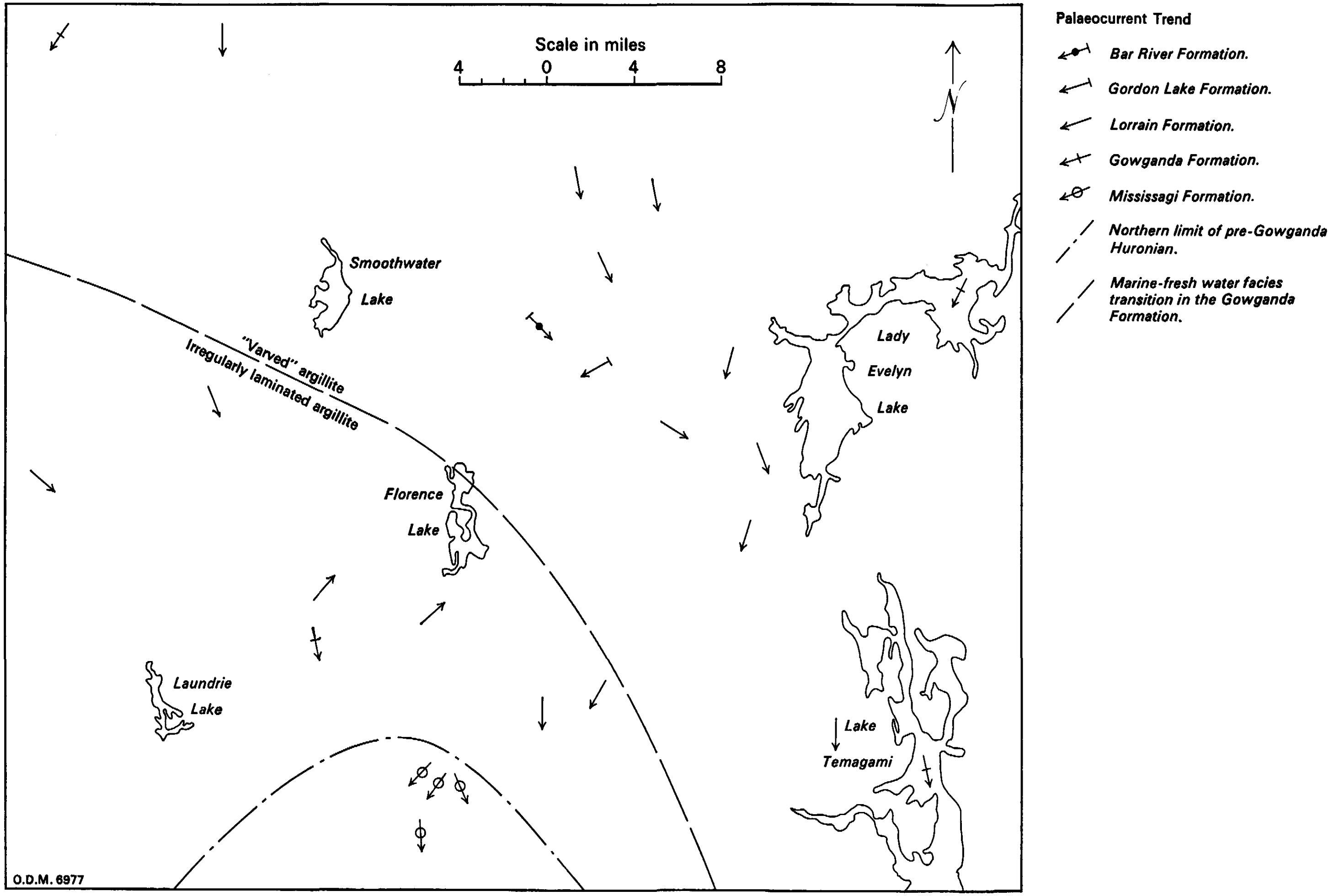


Figure 3—Huronian paleocurrents and paleogeography in the Maple Mountain area.

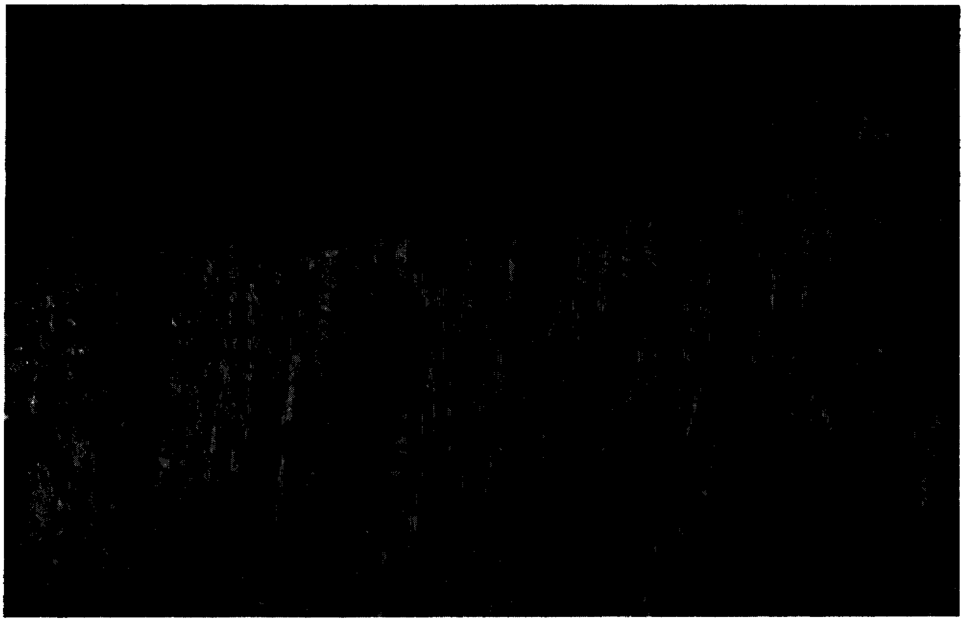


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Photo 12—Flat-lying Lorrain sandstone exposed in a typical cliff section; Parker Township.

LORRAIN FORMATION

Sandstones (Photo 12) of the Lorrain Formation underlie most of the map-area and attain a maximum total thickness of approximately 7,500 feet and an average thickness of about 5,000 feet. Greywacke, feldspathic sandstone, micaceous sandstone, hematitic sandstone, and orthoquartzite form an interfingering, interbedded sequence that is generally divisible into seven lithostratigraphic members:

a. Basal member, 0 to possibly 2,000 feet of interbedded sandstone and siltstone, that represent the transition zone between the Gowganda and Lorrain Formations grading up into pink and grey feldspathic sandstones in the Lady Evelyn Lake area.
b. Lower feldspathic sandstone member, up to several thousand feet of coarse-grained, impure feldspathic sandstone.
c. Green sandstone member, 1,500 to 3,000 feet of medium- to coarse-grained, pebbly green sandstone with interbeds and units of pink feldspathic sandstone, ferruginous sandstone, white micaceous sandstone, and green argillite.
d. Ferruginous sandstone member, a few hundred to approximately 1,000 feet of hematite-bearing sandstone with some white, feldspathic, and green sandstone units.
e. Upper feldspathic sandstone member, several hundred feet of feldspathic sandstone with interbedded hematitic and white micaceous sandstone.

Table 7 CHEMICAL AND MODAL ANALYSES OF ROCKS OF THE LORRAIN FORMATION IN THE MAPLE MOUNTAIN AREA; CHEMICAL ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES

	CHEMICAL ANALYSES MAJOR COMPONENTS IN PERCENT				TRACE ELEMENTS IN PPM		
	1	2	3		1	2	3
SiO_2	68.6	81.6	84.6	Ba	150	200	200
Al_2O_3	19.0	11.4	10.0	Co	7	3	3
Fe_2O_3	4.00	2.01	0.15	Cr	50	30	30
FeO	0.60	0.27	0.27	Cu	3	3	3
MgO	0.10	0.10	0.10	Ga	20	15	10
CaO	0.10	0.10	0.11	Li	...	...	...
Na_2O	0.15	0.05	2.04	Mn	30	10	10
K_2O	3.62	2.93	1.71	Ni	30	20	10
H_2O+	2.49	1.02	0.55	Pb	...	10	...
H_2O-	0.22	0.04	0.04	Sc	...	20	...
CO_2	0.10	0.10	0.12	Sr	10	15	10
TiO_2	0.42	0.22	0.08	Ti	...	...	...
P_2O_5	0.03	0.03	0.01	V	30	20	10
S	0.01	0.01	0.01	Y	...	...	...
MnO	0.01	0.01	0.01	Zn	8	4	4
Total	99.3	99.7	99.7	Zr	100	100	50
Specific Gravity	2.73	2.66	2.57				

	MODAL ANALYSES MAJOR COMPONENTS IN PERCENT														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Quartz	29.0	49.9	69.8	54.7	41.5	59.0	61.8	55.5	42	41	73.8	74.2	70	88.0	97.8
Plagioclase	10.0	12.7	12.6	10.3	12.3	3.5	...	...	43*	46*	6.5*	3.1*	10*	...	0.2
Potassic feldspar	3.7	16.7	10.5	16.3	16.2	6.0	1.0	...						...	...
Rock fragments	4.2	2.0	0.3	...	6.3	15.5	1.0	2.9	14	5	3.5	6.2	3	1.3	0.3
Matrix	53.1	18.7	...	...	23.7	16.0	36.2	41.6	1	8	16.2	15.2	17	10.7	...
Biotite	...	trace	...	...	trace	...	...	...	...	...	...	...	...	...	...
Muscovite	trace	trace	2.9	14.6	trace	trace	trace	trace	...	...	trace	1.2	...	trace	1.7
Kaolinite	...	...	...	...	trace	...	trace	trace	...	...	...	...	...	trace	...
Chlorite	trace	...	2.7	3.8	...	...	...	...	...	...	...	...	...	...	...
Epidote	trace	...	0.2	...	...	...	...	trace	...	...	...	...	...	...	...
Iron oxide minerals	trace	trace	0.5	0.2	trace	...	...	trace	...	...	...	...	...	...	trace
Sulphide minerals	...	trace	...	...	...	...	...	...	...	...	...	...	...	...	...
Accessory minerals	trace	...	0.5	0.1	...	...	trace	trace	...	...	...	...	...	...	trace

1 — Micaceous sandstone, Charters Township (McIlwaine 1971, p. 12)
2 — Micaceous sandstone, Charters Township (McIlwaine 1971, p. 12)
3 — Feldspathic sandstone, Charters Township (McIlwaine 1971, p. 12)
A — Feldspathic greywacke, lower member, Medina Township
B — Medium-grained feldspathic greywacke, lower member, Dundee Township
C — Average of three feldspathic sandstones, lower arkose member (Simony 1964)
D — Average of three arkoses, lower arkose member (Simony 1964)
E — Coarse-grained feldspathic greywacke, lower arkose member, Sladen Township
F — Coarse-grained lithic greywacke, green sandstone member, Valin Township
G — Green micaceous greywacke, green sandstone member, Corley Township
H — Hematitic greywacke, ferruginous member, Parker Township
I — Feldspathic sandstone, van Nostrand Township
J — Feldspathic sandstone, Auld Township
K — Micaceous sandstone, Donovan Township
L — Micaceous sandstone, van Nostrand Township
M — Micaceous sandstone, Auld Township
N — White orthoquartzite, white sandstone member, Selby Township
O — Fine-grained orthoquartzite, upper member, McGiffin Township
* Combined value for plagioclase and potassic feldspar
... not detected

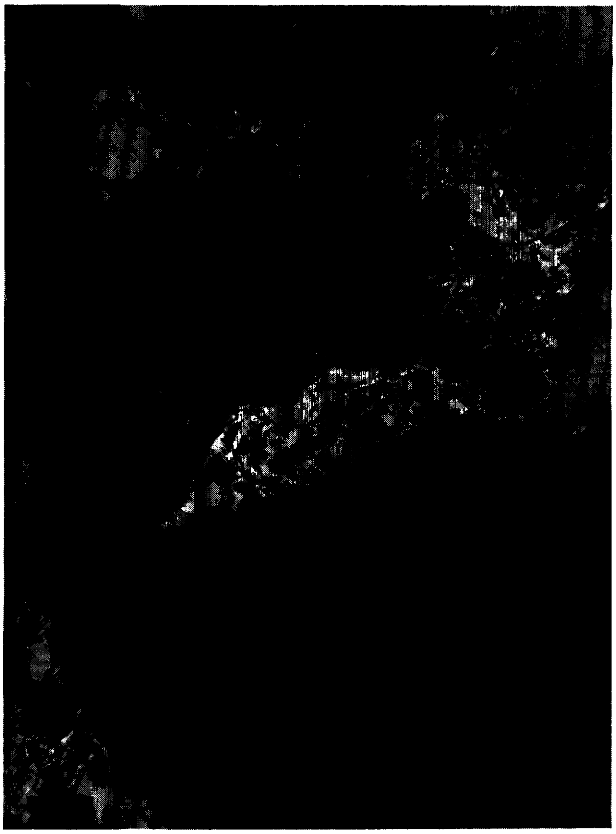

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Photo 13—Photomicrograph of pyrophyllite grown interstitially between quartz grains in micaceous Lorrain Formation sandstone. Width of photo represents 2 mm. Crossed nicols.

f. White sandstone member, approximately 1,000 to 1,500 feet of white micaceous sandstone.
g. Upper sandstone member, 100 to 200 feet of fine-grained hematitic and white sandstone.

The contact between the Lorrain and underlying Gowganda Formation is gradational, generally over a stratigraphic interval of about 50 to 100 feet. Gowganda laminated argillite is succeeded by thin-bedded siltstone and fine-grained sandstone, commonly containing slump structures. In the Lady Evelyn Lake area, the transition rocks are overlain by a thick sequence of pink and grey feldspathic sandstone with argillite interbeds and units. In the southwest, a thin sequence of pink and grey feldspathic sandstone is overlain abruptly by green micaceous sandstone.

The basal sandstones are thin- to medium-bedded grey or pink weathering rocks composed of fine- to medium-grained subangular grains of quartz, feldspar, and rock fragments in an abundant matrix of muscovite, chlorite, biotite, epidote, quartz, and feldspar. Pyrite, sphene, and iron-titanium oxide minerals are commonly present. Sorting is poor to moderate and the rocks are mainly feldspathic greywacke and subgreywacke (Table 7).

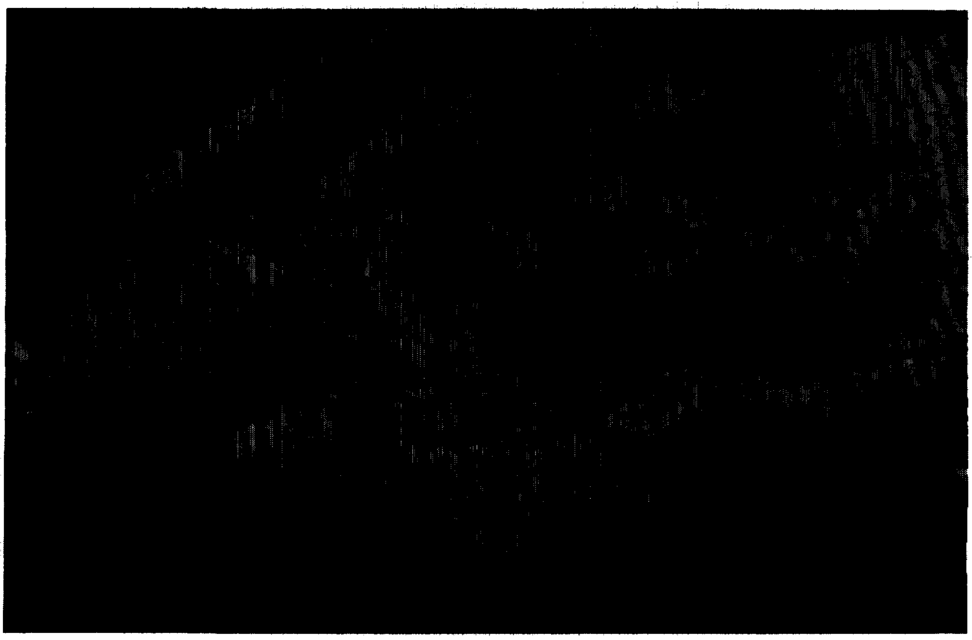

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Photo 14—Photomicrograph of pyrophyllite. Same section as Photo 13. Width of photo represents 0.5 mm. Crossed nicols.

The lower feldspathic sandstones are medium- to thick-bedded, medium- to coarse-grained rocks composed of subangular to subrounded grains of quartz, feldspar, and granitic rock fragments in a matrix of muscovite, biotite, and fine quartz and feldspar. Hematite is commonly present as grain coatings. The sorting is poor to moderate, and the rocks are feldspathic greywacke and arkose.

Green sandstones are medium- to thick-bedded, medium- to coarse-grained rocks composed of quartz, feldspar, and rock fragments in an abundant to sparse matrix of mica, quartz, and feldspar. The mica, which gives the rock its characteristic green colour, is a ferri-muscovite. Sorting is generally poor and most of the rocks are greywackes and subgreywackes. Pebbles of quartz, chert, and jasper averaging about ½ inch in diameter occur as thin lenses, irregular patches, and scattered pebbles.

Ferruginous sandstones are medium- to thick-bedded, medium-grained buff-weathering rocks composed of subangular to subrounded quartz and chert grains in a matrix of muscovite with some pyrophyllite and kaolinite (Photos 13 and 14). Hematite coats other minerals and occurs as small round spots, irregular streaks, or evenly distributed throughout the rock. Quartz overgrowths on detrital quartz grains are abundant. The rocks are poorly to moderately sorted and include greywacke, subgreywacke, and protoquartzite.

The rocks of the upper feldspathic sandstone member are medium-grained, medium- to thick-bedded feldspathic quartzite and arkose.

White sandstones are medium grained, medium bedded, and consist of rounded quartz grains with quartz overgrowths in a sparse matrix of mica, with minor iron oxide minerals. Sorting is moderate to good, and most of the rocks are orthoquartzites. X-ray analysis of the micaceous minerals demonstrates that they consist mainly of muscovite with some pyrophyllite, kaolinite, and diaspore.

White and pink, fine-grained sandstone of the upper member consists of rounded quartz grains with quartz overgrowths and chert fragments in a very sparse muscovite matrix. Hematite is commonly present as grain coatings. The rocks are thin to medium bedded, and are generally laminated with alternating pink and white, fine- and medium-grained laminae ranging in thickness from about ⅛ inch to 1 inch.

SEDIMENTARY FEATURES

Primary sedimentary structures present include bedding, laminated bedding, and graded bedding. Crossbedding, mainly of trough or festoon type, is present throughout the formation. Slump structures and channelling are common in the lower part of the formation and ripple marks are abundant in the upper part.

Measurement of the attitudes of crossbedding and ripple marks at several localities within the area indicates depositional paleocurrents flowed generally from north to south. There is meagre evidence in the southwest for paleocurrents from the southwest (Figure 3).

The textural and mineralogical maturity of the sandstones increases from bottom to top of the formation, probably indicating increased reworking in the depositional environment. The change from rocks with abundant feldspar to rocks with kaolinite and hematite probably indicates a change in climate from cold-rigorous to warm-tropical conditions. Consequently the sedimentary rocks of the lower part of the formation were deposited rapidly under rigorous conditions, were little reworked, and are possibly of fluvial origin. The sediments of the upper part of the Lorrain Formation probably were deposited in shallow epicontinental seas covering metastable cratonic blocks of the Superior Province where they were intensively reworked and sorted by waves and currents.

GORDON LAKE FORMATION

Rocks correlated with the Gordon Lake Formation of the Bruce Mines area (Frarey 1967) occur around the shores of Smoothwater Lake in the centre of a north-trending basin structure, in McGiffin Township in a northwest-trending basin, and in McGiffin and Selby Townships in a block partly bounded by faults. The formation is approximately 2,500 feet thick and is in abrupt but apparently conformable contact with the underlying Lorrain Formation.

The Gordon Lake Formation consists of a sequence of thinly-bedded, interbedded sandstone, argillite, chert, and chert breccia, which are coloured in various shades of white, grey, brown, green, and black. Impure sandstone, composed of fine-grained, angular quartz and feldspar in a silty matrix of chlorite, muscovite, kaolinite, and quartz, comprises about 60 percent of the formation. It is a poorly sorted rock and is classified as a fine-grained greywacke or subgreywacke. Green argillite interbeds constitute approximately 20 percent of the formation. Chert beds averaging less than 1 inch in thickness, and chert breccia consisting of angular to rounded chips of chert in a sandstone or argillite matrix, constitute the remaining

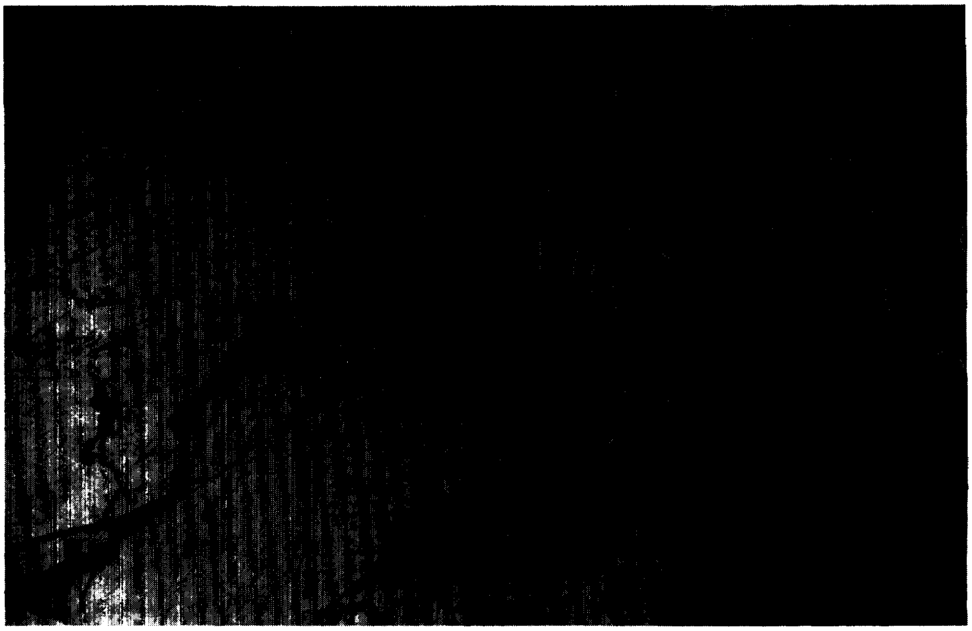

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Photo 15—Ripple marks in the Gordon Lake Formation; Donovan Township.

20 percent of the formation. The chert is probably not a true chert, that is chemically precipitated microcrystalline quartz and chalcedony, but rather is composed of very fine-grained detrital quartz, mica, and chlorite. Much argillaceous material is commonly present, as are silt- and sand-sized quartz and feldspar grains.

Sedimentary structures noted include small-scale crossbedding, laminated bedding, and ripple marks (Photo 15). The chert breccias were probably formed by breaking up of consolidated chert beds prior to consolidation of the sandy and argillaceous materials.

Rocks of the Gordon Lake Formation were deposited in water, possibly under deeper water conditions than existed during deposition of the underlying Lorrain Formation. This is indicated by their fine-grained nature and delicately laminated bedding.

BAR RIVER FORMATION

Sandstone correlated with the Bar River Formation of the Bruce Mines area (Frarey 1967) occurs in the centre of the McGiffin Basin where it conformably overlies Gordon Lake Formation rocks. This formation, which is uppermost in the Huronian Supergroup of Ontario, is at least 1,500 to 2,000 feet thick.

Medium- to thick-bedded, fine- to medium-grained pink and white orthoquartzite is the only rock type observed in this formation in the Maple Mountain area. Petrographic study shows that it is composed of more than 90 percent rounded, well-sorted quartz grains, with minor chert fragments, in a sparse matrix of muscovite and fine quartz. Minor amounts of hematite coating on quartz grains give the pink colour.

Ripple marks, mainly asymmetric current ripple marks, are abundant and have great diversity of orientation. However, most indicate south- or southeast-flowing paleocurrents.

The sediments of the Bar River Formation, like those of the Lorrain Formation, were probably deposited in a shallow-water, near-shore environment where they were rigorously winnowed and sorted by waves and currents.

MAFIC INTRUSIONS

NIPISSING DIABASE

Gabbroic intrusions, commonly referred to as 'Nipissing Diabase', occur throughout the Maple Mountain area. They are members of a suite of tholeiitic gabbros that intrude the Huronian in the Cobalt-Sault Ste. Marie area. They were apparently all emplaced at about the same time and have been dated at 2,160±30 million years (Fairbairn *et al.* 1969; Van Schmus 1965; Lowden *et al.* 1963), and are remarkably similar in form, mineralogy, and geochemistry throughout the region. There are some differences from place to place, but for the most part, these are ascribable to post-emplacement events.

FORM AND MECHANISM OF INTRUSION

There are more than one dozen separate gabbroic intrusions exposed in the Maple Mountain area, which range from dikes a few feet thick to sill-like bodies possibly 1,000 feet thick. Several have an elliptical ring-like outcrop pattern, similar to the 'diabase basins' of the Cobalt area (Thomson 1966). The largest of these, the 'Smoothwater Lake diabase basin', is approximately 12 miles wide and 20 miles long. There are several others such as the one in Dundee and Acadia Townships that are 3 miles wide and 6 to 9 miles long. The outer and inner contacts of these bodies generally dip inward at angles of 30 to 50, and consequently they are probably cone-sheet intrusions. Other Nipissing Diabase bodies in the area have the form of incomplete rings, thick tabular dike-like and sill-like bodies, and thin dikes.

Most Nipissing Diabase bodies have their long dimensions oriented approximately north-south, indicating that their emplacement was controlled to some extent by pre-existing faults and folds. In detail, the contacts are transgressive across bedding and fold structures in the country rocks. The gabbros are generally massive and unsheared, although locally near contacts a weakly-developed secondary foliation is present. Field evidence indicates that the Nipissing intrusions were emplaced after the early north-south folding and during the weak east-west folding event. There have been post-Nipissing movements on many of the major faults, but otherwise the amount of post-Nipissing deformation is minor.

Regional uniformity in composition and time of emplacement of the Nipissing-type 'diabases' implies a common, widespread source such as the mantle or lower crust. Possibly large regional faults of the Onaping and Lake Timiskaming Systems tapped the mantle providing passageways for upwelling gabbroic magma. Gretener

(1969) has pointed out that tabular intrusive bodies tend to orient themselves perpendicular to the least compressive principal stress axis (using 3 axes x, y, and z, where x and y are the horizontal axes and z is the vertical axis). Consequently, in sedimentary strata, magma will rise in the form of a dike until a level is reached where the two horizontal principal stresses exceed the vertical stress and will then spread laterally to form a sill. Certain strata will act as stress barriers blocking the upward movement of the magma, but with local changes in the state of stress brought on by flexuring or other mechanisms, the sill will break through this stress barrier and rise to the next barrier in the section. Repetitions of this process could produce the cone-sheet intrusions.

Table 8 MODAL ANALYSES OF NIPISSING DIABASE INTRUSIONS* IN THE MAPLE MOUNTAIN AREA

	PYROXENE GABBRO							
	LMM-111	CMM-123	CMM-89	CMM-70	CMM-11	76-01	21-02	77-03A
Plagioclase	40.9	56.8	49.5	47.2	48.8	49.6	54.1	58.8
Orthopyroxene	29.6	22.6	17.1	12.0	18.2			
Clinopyroxene	29.4	19.6	32.0	33.3	31.7	29.6**	29.2**	31.0**
Amphibole	x	x	x	x	...	1.0	x	...
Chlorite	x	...	...	x	x	3.5	1.8	9.1
Biotite	x	x	x	...	x	...	...	...
Muscovite	...	x	x	x	x	...	...	...
Quartz granophyre	...	1.0	1.1	6.2	1.2	4.2	11.5	...
Ilmenite-magnetite	0.1	x	0.3	1.3	0.1	7.0	3.2	1.0
Epidote	x	x	x	x	...	...	...	...
Talc, serpentine	x	...	x	x	x	...	...	...
Apatite	...	...	...	...	...	5.0	...	x
Plagioclase composition	$An_{76\pm5}$- $An_{55\pm5}$	$An_{65\pm5}$- $An_{56\pm5}$	$An_{68\pm5}$- $An_{50\pm5}$	$An_{76\pm5}$- $An_{44\pm5}$	$An_{78\pm5}$- $An_{55\pm5}$	...	$An_{70\pm5}$	Lab.
Pyroxene: plagioclase	60/40	57/47	50/50	45/47	50/49	...	...	...
Orthopyroxene: clinopyroxene	50/50	23/20	17/32	12/33	18/32	...	...	...

	METAGABBRO, GRANOPHYRIC GABBRO, GRANOPHYRE									
	LMM-86	MMM-148	MMM-103	CMM-134	CMM-1	LMM-39	CMM-107	CMM-119	MMM-167	CMM-109	26-01A
Plagioclase	43.0	61.6	47.8	38.4	52.6	55.8	42.0	53.5	31.4	58.0	66.2
Amphibole	33.7	27.6	44.3	55.5	39.4	17.7	34.8	20.7	20.2	...	11.0
Uralitized pyroxene	...	...	...	x	...	...	...	...	...	...	...
Quartz granophyre	20.5	0.7	2.6	3.8	4.2	15.6	17.2	25.0	31.6	39.8	21.2
Muscovite	x	...	x	x	...	...	x	x	x	...	...
Biotite	...	x	...	...	1.8***	...	...	x	...	...	...
Chlorite	x	8.1	x	x	...	8.7	x	x	8.2	1.6	...
Epidote	x	x	x	x	...	x	x	...	x	x	...
Sphene	...	...	...	...	...	x	...	...	...	0.6	...
Leucoxene	2.8	2.0	5.3	2.3	2.0	2.2****	6.0****	0.8****	8.6****	...	1.6****
Magnetite	...	...	...	...	...					...	
Sulphide minerals	...	...	x	...	...	x	x	...	x	...	...
Plagioclase composition	Albite	Albite	Albite	$An_{60\pm5}$ plus Albite	$An_{73\pm5}$ plus Albite	Albite	Albite	$An_{38\pm5}$	$An_{8\pm3}$	$An_{35\pm5}$	$An_{65\pm3}$

* See Table 9 for sample locations and descriptions
** Combined value for orthopyroxene and clinopyroxene
*** Combined value for biotite and chlorite
**** Combined value for leucoxene and magnetite
x trace
... not detected

PETROGRAPHY

Nipissing Diabase intrusions are differentiated and partly altered or metamorphosed. Consequently variations in composition and mineralogy produced by these processes permit the distinction of several varieties including gabbro, norite, granophyric gabbro, granophyre or aplite, metagabbro, and granophyric metagabbro.

The unaltered gabbro is a dark grey to black, brown weathering medium-grained rock composed essentially of zoned plagioclase (labradorite-bytownite), clinopyroxene (augite), and orthopyroxene (bronzite, inverted pigeonite). Minor amounts of primary ilmenite-magnetite, quartz, and granophyre, and secondary amphibole, mica, chlorite, talc, and epidote are commonly also present. Modal analyses show that the total pyroxene to plagioclase ratio is generally about 1:1 and that the orthopyroxene to clinopyroxene ratio ranges from 1:3 to 1:1 (Table 8). Consequently the rocks can be classified as augite gabbro and norite. The texture is medium-grained doleritic with subhedral to euhedral plagioclase crystals approximately 1 mm in length and euhedral orthopyroxene crystals up to several cm long with anhedral interstitial clinopyroxene, quartz, and granophyre. Exsolution lamellae of clinopyroxene are present in the orthopyroxene crystals, some of which are of the 'Stillwater-type' (Hess 1960). This type of exsolution indicates that some of the orthopyroxene represents inverted pigeonite. Exsolution blebs of orthopyroxene are also present in the clinopyroxene. The iron-titanium oxide minerals consist of lamellar intergrowths of ilmenite and magnetite.

Granophyric gabbro consists of variable proportions of plagioclase, pyroxene, quartz, granophyre, iron-titanium oxides, and their alteration products. The rock is texturally variable and consists of irregular masses of very coarse-grained granophyric gabbro in a medium-grained granophyric gabbro groundmass. Quartz and granophyre are relatively abundant, and occur interstitially, as irregular masses, and as small dike-like bodies. The granophyric gabbros are generally more or less completely altered with the original plagioclase (labradorite) saussuritized and the pyroxenes uralitized.

Minor amounts of aplite or granophyre occur as small irregular masses and dikes, and as larger masses in the upper parts of some thick sills. The granophyre is a pink, fine- to medium-grained rock consisting of plagioclase (albite-andesine), quartz, and granophyre with variable amounts of amphibole, chlorite, biotite, epidote, sphene, carbonate, apatite, zircon, and iron-titanium oxide minerals. There is every gradation present from gabbro with minor interstitial granophyre through granophyric gabbro, to leucocratic granophyre (Table 8).

Alteration or metamorphism of the Nipissing intrusions occurs throughout, but is most prevalent in the southern part of the map-area. Metamorphism begins along contacts and fractures such as joints and spreads outward from these. Pyroxene is altered first to talc and chlorite, transitory mineral phases that commonly have reacted to form uralitic amphibole, actinolite, and blue-green hornblende. Plagioclase is altered to epidote and albite. The ilmenite laths of the primary ilmenite-magnetite intergrowths are altered to leucoxene and sphene. The resulting metagabbro is a medium-grained, dark green to black rock composed of variable proportions of saussuritized plagioclase, amphibole, quartz, granophyre, and magnetite with accessory mica, chlorite, sphene, leucoxene, and sulphide minerals (Table 8).

Table 9 CHEMICAL ANALYSES OF NIPISSING DIABASE INTRUSIONS IN THE MAPLE MOU

CHEMICAL ANALYSES — MAJOR COMPONENTS IN PERCENT

	LMM-111	CMM-123	CMM-89	CMM-70	CMM-11	LMM-86	MMM-148	MMM-103	CMM-134	CMM-1	LMM-39	CMM-107	CMM-119	MMM-167
SiO_2	51.0	50.2	52.3	50.8	50.8	55.4	48.8	50.9	50.5	50.7	51.6	52.8	66.7	50.4
Al_2O_3	13.6	15.5	12.3	15.6	13.8	13.1	17.6	12.6	14.0	14.4	14.0	12.6	13.8	11.6
Fe_2O_3	1.05	1.15	1.38	1.46	1.67	3.75	1.80	4.90	3.02	1.95	5.40	4.59	2.42	5.50
FeO	6.87	6.16	7.75	7.14	6.41	8.59	5.12	11.7	6.99	7.50	9.80	11.8	5.76	13.2
MgO	11.0	9.17	11.0	7.31	10.1	5.11	7.23	5.64	9.21	6.93	4.85	3.28	1.28	3.76
CaO	12.6	13.3	11.0	12.4	13.0	8.09	10.3	8.20	10.7	11.4	3.54	6.68	1.08	7.03
Na_2O	1.12	1.29	1.29	1.51	1.34	3.26	2.64	1.37	1.47	2.08	5.41	2.98	5.63	2.94
K_2O	0.24	0.29	0.36	0.65	0.24	0.87	1.69	0.36	0.73	0.63	0.70	1.13	0.38	0.88
H_2O+	0.98	0.63	0.74	1.34	0.72	2.01	3.32	2.74	2.89	1.90	2.48	2.04	1.70	2.07
H_2O-	0.18	0.12	0.18	0.26	0.14	0.30	0.41	0.26	0.33	0.22	0.22	0.27	0.32	0.21
CO_2	0.05	0.09	0.12	0.10	0.10	0.09	0.12	0.10	0.14	0.12	0.1	0.12	0.19	0.09
TiO_2	0.36	0.42	0.46	0.48	0.41	0.94	0.48	1.32	0.59	0.57	1.26	1.60	0.63	1.79
MnO	0.17	0.16	0.19	0.17	0.17	0.20	0.15	0.28	0.17	0.20	0.26	0.29	0.14	0.24
P_2O_5	0.03	0.02	0.17	0.05	0.15	0.07	0.02	0.07	0.04	0.05	0.05	0.10	0.20	0.09
S	0.04	0.03	0.03	0.07	0.04	0.11	0.05	0.05	0.05	0.08	0.01	0.12	0.02	0.08
Total	99.3	98.5	99.3	99.3	99.1	101.9	99.7	100.5	100.8	98.7	99.7	100.4	100.2	99.9
Specific Gravity	3.07	...	3.05	2.99	3.03	2.98	2.91	3.01	2.99	2.95	2.86	3.01	2.71	3.03

TRACE ELEMENTS IN PPM

	LMM-111	CMM-123	CMM-89	CMM-70	CMM-11	LMM-86	MMM-148	MMM-103	CMM-134	CMM-1	LMM-39	CMM-107	CMM-119	MMM-167
Ag	...	...	...	...	...	...	...	...	...	...	...	...	...	...
As	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ba	...	...	...	...	...	...	300	150	150	150	200	400	...	200
Be	...	...	...	...	...	...	...	...	...	...	...	...	5	...
Co	40	30	40	40	40	40	40	50	50	40	40	50	13	50
Cr	600	700	600	300	700	20	400	15	200	150	10	40	20	...
Cu	60	60	60	100	60	90	80	140	80	150	40	140	150	60
Ga	10	15	15	15	15	30	20	20	20	20	20	20	30	30
Li	...	...	...	...	...	20	30	...	...	30	...	...	...	...
Mn	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mo	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ni	250	150	190	120	170	60	170	60	240	120	70	50	20	40
Pb	40	10	10	10	10	10	100	10	10	60	10	40	10	10
Sb	4	4	4	4	4	8	8	8	4	4	14	12	4	12
Sc	60	50	50	50	60	60	40	50	50	60	60	40	40	60
Sn	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sr	100	150	150	200	200	100	200	250	150	250	100	300	150	150
Ti	...	...	...	...	...	...	...	...	...	...	...	...	...	...
V	150	250	250	250	250	300	200	500	250	300	500	250	30	500
Y	...	...	...	...	20	30	...	30	...	20	30	30	60	30
Zn	60	50	70	60	60	90	100	120	60	90	120	250	40	100
Zr	...	...	...	...	...	50	...	100	...	...	40	100	300	50

LMM-111 — Pyroxene gabbro, Acadia Township
CMM-123 — Pyroxene gabbro, Medina Township
CMM-89 — Pyroxene gabbro, Medina Township
CMM-70 — Pyroxene gabbro, minor alteration, Medina Township
CMM-11 — Pyroxene gabbro, minor alteration, Dundee Township
76-01** — Porphyritic pyroxene gabbro, minor alteration, Speight Township
21-02** — Pyroxene gabbro, minor alteration, Donovan Township
77-03A** — Pyroxene gabbro, minor alteration, Speight Township
LMM-86 — Metagabbro, (partly altered pyroxene gabbro), Brewster Township
MMM-148 — Metagabbro, Corley Township
MMM-103 — Metagabbro, Cynthia Township
CMM-134 — Metagabbro, Dundee Township
CMM-1 — Metagabbro, Dundee Township
LMM-39 — Granophyric metagabbro, Dane Township
CMM-107 — Granophyric metagabbro, Klock Township
CMM-119 — Mafic granophyre, Dane Township
MMM-167 — Granophyric metagabbro, Ellis Township
CMM-109 — Leucocratic granophyre, Dane Township
LMM-84 — Metagabbro, Brewster Township

; ANALYSES* BY MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

CMM-109	LMM-84	LMM-78	3	2	4	5	MT-9	MT-19	MT-16	MT-17	MT-75	ST-2	ET-24	CT-28
74.1	53.0	53.7	51.8	51.6	59.4	67.2	52.0	69.2	52.0	52.0	52.8	58.8	52.4	51.3
12.6	14.3	13.4	14.5	13.4	12.2	12.1	15.5	13.7	14.0	15.0	15.4	13.0	13.6	14.5
0.25	4.83	2.82	4.19	2.87	5.36	4.28	1.20	0.99	1.53	1.98	0.66	4.32	1.30	1.07
1.44	6.09	8.07	8.12	8.85	6.52	3.80	8.00	5.00	9.77	9.01	8.94	8.26	9.63	9.03
0.48	7.35	5.50	5.50	5.35	2.85	1.00	5.80	0.91	5.35	5.40	6.82	1.17	6.42	6.42
0.45	5.72	8.06	8.84	8.61	3.16	1.84	10.4	0.90	9.40	10.0	10.3	4.66	9.52	10.5
3.77	4.49	2.66	2.82	2.70	4.58	5.55	1.92	4.17	2.14	2.09	1.86	2.81	2.40	1.92
4.34	1.16	1.19	1.36	1.52	0.63	0.24	0.93	3.18	0.53	0.48	0.58	1.98	0.63	0.40
0.57	2.16	2.08	2.05	2.26	1.59	0.98	1.71	1.41	1.93	1.90	1.79	2.03	2.07	1.92
0.12	0.26	0.40	0.13	0.22	0.17	0.04	0.22	0.22	0.24	0.22	0.26	0.21	0.23	0.22
0.10	0.39	0.21	0.11	0.18	0.22	1.27	0.12	0.15	0.14	0.26	0.20	0.57	0.14	0.18
0.23	0.88	1.30	0.89	1.04	1.14	0.70	0.71	0.51	0.98	0.86	0.69	0.96	0.72	0.69
0.03	0.11	0.20	0.23	0.20	0.11	0.07	0.18	0.11	0.21	0.20	0.20	0.20	0.21	0.19
0.12	0.05	0.07	0.09	0.12	0.18	0.14	0.04	0.12	0.05	0.04	0.03	0.24	0.04	0.04
0.01	0.01	0.10	0.11	0.10	0.14	0.01	0.10	0.04	0.08	0.13	0.05	0.01	0.02	0.03
98.6	100.8	99.8	100.7	99.0	98.3	99.2	98.8	100.6	98.4	99.6	100.6	99.2	99.3	98.4
2.62	2.88	2.99	2.96	2.90	2.70	2.64	2.96	2.63	2.94	2.97	2.91	2.85	2.93	2.89
...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	5	5	5	5	5	5	5	5	5
500	...	200	200	...	...	...	250	500	200	200	200	400	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	40	40	40	40	30	8	44	13	56	49	44	24	50	43
10	100	100	30	150	...	...	150	20	30	50	80	20	40	250
4	12	130	140	100	80	45	134	6	144	143	126	16	112	143
20	20	20	20	20	30	30	20	20	20	20	15	30	30	20
...	20	20	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8	110	90	80	90	40	10	111	17	78	85	108	25	100	112
10	10	10	20	15	200	10	10	10	10	10	15	10	15	15
4	10	10	8	8	12	12	4	10	8	6	4	10	4	8
20	50	50	50	50	50	20	50	30	50	50	50	30	60	60
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	100	200	200	200	50	30	250	200	250	250	250	250	250	250
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
500	300	300	300	300	300	...	300	10	300	250	300	30	300	300
40	20	20	20	20	30	80	20	20	20	20	20	40	20	20
2	100	130	150	120	30	60	63	30	78	82	84	74	76	72
150	50	60	60	80	200	300	20	60	20	20	20	30	20	20

LMM-78 — Partly altered gabbro, Trethewey Township
3 — Metagabbro, Leith Township
2 — Metagabbro, Charters Township
4 — Metagabbro, Corkill Township
5 — Granophyre, Corkill Township
26-01A** — Metagabbro, Donovan Township
MT-9 — Partly altered gabbro, Turner Township
MT-13 — Granophyric metagabbro, Turner Township
MT-16 — Metagabbro, Turner Township
MT-17 — Metagabbro, Turner Township
MT-75 — Metagabbro, Turner Township
ST-2 — Metagabbro, Turner Township
ET-24 — Metagabbro, Turner Township
CT-28 — Metagabbro, Turner Township

* These analyses did not include a check for the presence of Au.

** In Tables 8 and 11 only.

... Not detected.

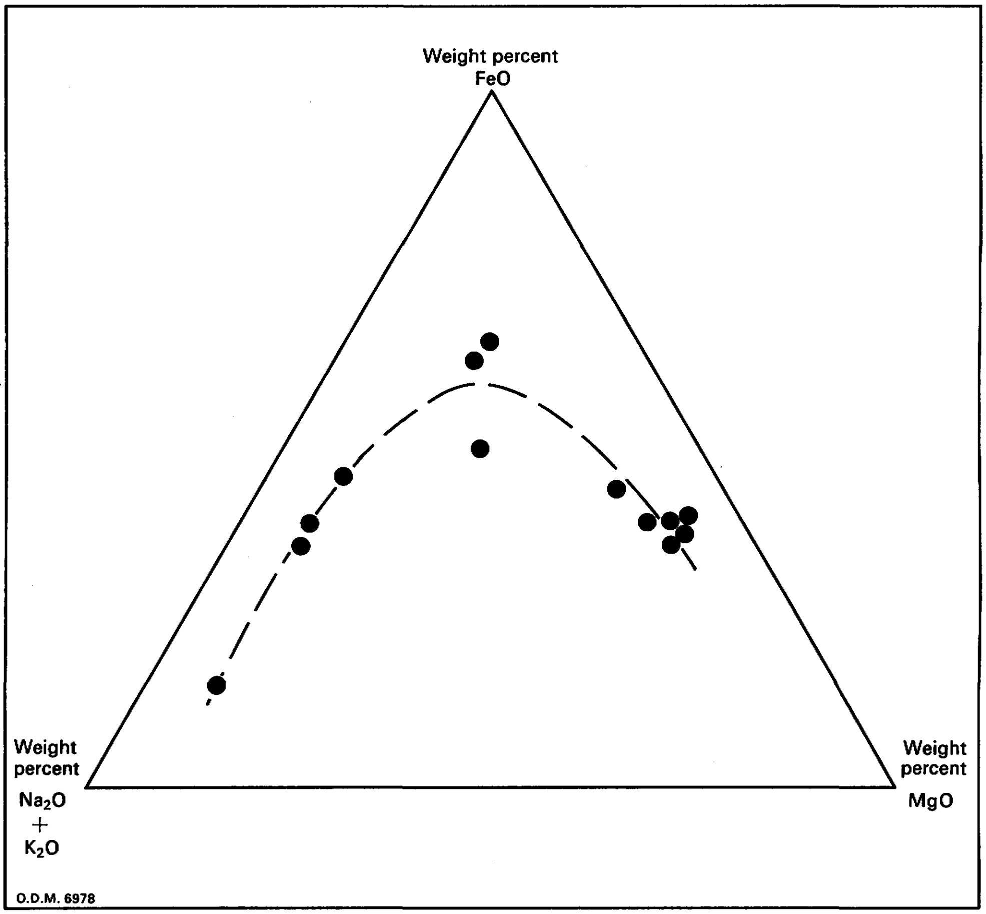


Figure 4—Differentiation diagram for Nipissing intrusions in the Maple Mountain area.

There is evidence for magmatic differentiation, in the form of gravity settling of early-formed orthopyroxene crystals, and local igneous layering. Consequently the Nipissing intrusions were probably emplaced as a liquid but solidified relatively quickly. Exsolution phenomena in the pyroxene crystals show that the magma temperature was close to the pyroxene inversion temperature of approximately 1,100°C (Hess 1960).

The parent magma was of tholeiitic composition as is indicated by the presence of normative silica, and, commonly, modal quartz. Gravity settling of early-formed pyroxene crystals, especially orthopyroxene, led to depletion of the residual magma in MgO and CaO, and relative enrichment in iron, Na_2O, and K_2O. Consequently, MgO and CaO decrease progressively from pyroxene gabbro to granophyre, iron increases from gabbro to granophyric gabbro, then decreases in granophyre, and Na_2O and K_2O increase progressively from gabbro to granophyre, Na_2O showing the greatest increase. The differentiation trend with respect to MgO, FeO, and alkalis (Figure 4) is similar to that of other thick sills (Hess 1960). The chemical and mineralogical composition and differentiation trends show that granophyre or aplite is a normal product of differentiation of the gabbroic magma and is not the result of assimilation of aluminous country rocks.

The change from gabbro to metagabbro apparently involves essentially no change in bulk composition other than the addition of water and possibly of sulphur (Table 9). There is an approximately two-fold increase in these constituents during metamorphism (compare, for example, analyses LMM-111, CMM-123, CMM-89, and CMM-11 with LMM-86, MMM-148, MMM-103, and CMM-1). The change from gabbro to metagabbro was probably produced by the lower greenschist facies regional metamorphism that also affected the Huronian rocks.

BEHAVIOUR OF MINOR ELEMENTS DURING CRYSTALLIZATION AND METAMORPHISM

Nickel and chromium are concentrated in the more pyroxene-rich gabbros, probably in the orthopyroxene, and decrease rapidly in the granophyric gabbros and granophyres (Figure 5). Cobalt is present in relatively constant amounts in the gabbros and granophyric gabbros and decreases rapidly in the granophyres. Manganese, copper, titanium, and zinc, increase in the granophyric gabbros and decrease markedly in the granophyres (Figure 5).

There is apparently no constant relationship between the amount of sulphur and the degree of differentiation or between the amount of sulphur present and the concentration of metals such as nickel and copper (Table 9). Consequently elements such as nickel and copper in the unaltered gabbros are probably in solid solution in the silicates. There is an increase in sulphur content from gabbro to metagabbro (Table 9), and in the metamorphosed rocks, elements such as nickel, copper, and zinc, are probably mainly present in the form of sulphide minerals.

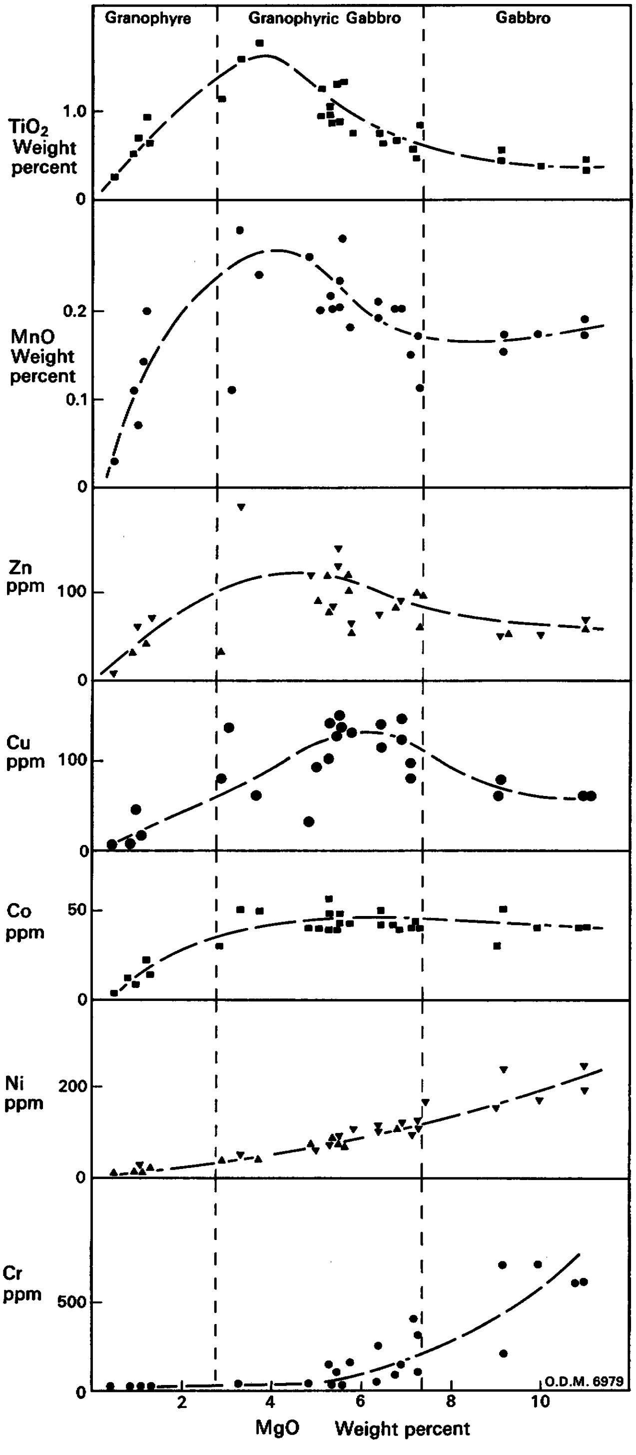


Figure 5—Element variation diagram for Nipissing intrusions in the Maple Mountain area.

REGIONAL VARIATIONS IN ASSOCIATED MINERAL DEPOSITS

In the Cobalt-Gowganda area, mineralization associated with the generally unaltered Nipissing Diabase consists almost exclusively of quartz-carbonate vein deposits of silver, cobalt, and nickel. The ore minerals are native metals, arsenides, and sulpharsenides; sulphides are practically absent.

In the southern Maple Mountain area and southward, and along and close to the North Shore of Lake Huron, mineralization associated with the generally altered Nipissing Diabase consists mainly of copper, nickel, and zinc sulphide minerals with some gold and silver. These minerals occur as disseminations and massive pods in the highly altered gabbro, and in associated quartz-carbonate veins. In addition, there are quartz-carbonate veins containing arsenopyrite, pyrite, and gold.

The regional change from silver-cobalt-arsenide vein deposits in the north to copper-nickel-zinc sulphide deposits in the south occurs within the Maple Mountain area. The approximate line of separation between the two types of mineralization runs east from Leckie Township to van Nostrand Township and northeast through Auld Township. This change was noted by Collins (1917) who ascribed it to a regional change from quartz diabase in the north to quartz norite in the south. However, recent studies (Card 1968; 1969) have shown that both quartz diabase and quartz norite are present in the southern Maple Mountain and Sudbury-North Shore of Lake Huron intrusions with quartz diabase probably being the most abundant phase. Also, Hriskevich (1968) has demonstrated that quartz norite (hypersthene diabase) forms a major part of the Cobalt sill. Consequently, the change in associated mineralization cannot be attributed to regional mineralogical variations in the diabase.

In terms of bulk chemical composition, degree of differentiation, and differentiation trend, there are no appreciable differences between the Nipissing intrusions in the Maple Mountain, Cobalt-Gowganda, and Sudbury-North Shore of Lake Huron areas. In Table 9, analyses LLM-84, LLM-78, 3, 2, 4, and 5 are from gabbros with associated silver-cobalt arsenide mineralization whereas the remainder of the rocks analyzed are from gabbro intrusions with associated copper-nickel-zinc sulphide mineralization. Comparison of the major and minor element compositions of gabbros with similar differentiation indices shows no appreciable differences in trace element content between the two groups.

The only significant regional variation noted is the generally greater degree of metamorphism of the southern gabbros with respect to those in the north.

As noted previously, the alteration of the gabbro results in several-fold increases in water and sulphur. Consequently, metamorphism may have provided a mechanism for the formation of nickel, copper, and zinc sulphide minerals by a sulphurization process whereby these metals, originally present in trace amounts in silicates, are released during alteration to combine with sulphur brought into the system by hydrous fluids. The sulphide minerals formed would either remain disseminated throughout the altered rock, or be locally concentrated in 'wet zones' as indicated by the presence of granophyre, quartz veins, carbonate, and epidote.

LATE DIABASE INTRUSIONS

Late diabase intrusions belonging to two dike swarms of regional extent, a northwest-trending 'Sudbury Swarm' and a northeast-trending (late diabase) swarm, occur in the Maple Mountain area. Dikes within each swarm have relatively constant compositions, orientations, and radiometric ages. Both dike swarms are post-tectonic and post-metamorphic with respect to Penokean-Hudsonian (Proterozoic-orogenic) events, but there has been post-diabase fault movement and local alteration.

Dikes of the Sudbury Swarm consist of calcic plagioclase (labradorite-bytownite), titaniferous augite, olivine, apatite, and magnetite-ilmenite (Table 10). Minor chloritization of olivine is prevalent. The Sudbury dikes are approximately 1,280 million years old (Van Schmus 1965).

Table 10 CHEMICAL AND MODAL ANALYSES OF LATE DIABASE INTRUSIONS FROM THE MAPLE MOUNTAIN AND SURROUNDING AREAS; CHEMICAL ANALYSIS BY MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

	MODAL ANALYSES IN PERCENT		
	1	2	3
Olivine	20.6	13.2	14.2
Augite	15.3	10.4	13.0
Plagioclase	60.5	66.0	66.8
Chlorite	0.5	1.7*	1.0*
Biotite	...		
Ilmenite-magnetite	2.6	7.1	5.0
Accessory minerals (mainly apatite)	0.5	1.5	x
Plagioclase composition	Labradorite	An_{72}	$An_{70\pm5}$

(1) Average of 4 olivine diabases (Sudbury Swarm) from the Lake Temagami area (Simony 1964, recalculated to total 100 percent)

(2) Average of 5 olivine diabases (Sudbury Swarm), Hyman and Drury Townships (Card 1965)

(3) Average of 4 olivine diabases (Sudbury Swarm), Maple Mountain area

(A) Chemical analysis of olivine diabase, Lake Temagami

* Combined value for chlorite and biotite

... not detected

CHEMICAL ANALYSES	
MAJOR COMPONENTS IN PERCENT	A
SiO_2	48.2
Al_2O_3	16.5
Fe_2O_3	1.93
FeO	11.3
MgO	5.50
CaO	8.75
Na_2O	3.28
K_2O	0.98
H_2O+	0.81
H_2O-	0.10
CO_2	0.10
TiO_2	1.94
MnO	0.20
P_2O_5	0.36
S	0.11
TRACE ELEMENTS IN PPM	
Ba	600
Co	40
Cr	150
Cu	50
Ga	20
Ni	100
Pb	10
Sb	14
Sc	40
Sr	500
V	250
Y	30
Zn	100
Zr	100

The late northeast-trending diabase dikes are composed of calcic plagioclase, pyroxene, quartz, granophyre, and iron-titanium oxides. These later dikes were emplaced approximately 1,230 million years ago (Fahrig and Wanless 1963).

Fahrig and Jones (1969) pointed out that dikes of the Sudbury Swarm are similar in trend, radiometric age, and paleomagnetic characteristics to dikes of the Mackenzie Swarm in the northeastern Canadian Shield. They postulate that formation of dike swarms of this magnitude is in response to incipient continental rifting caused by weak or short-lived convection currents in the mantle.

CENOZOIC

Pleistocene glacial processes have scoured and eroded the bedrock and deposited a thin, discontinuous mantle of till. Locally, moraine, glaciofluvial, and glaciolacustrine deposits were formed during retreat of the continental ice sheet.

There is evidence, in the form of glacial striae, for ice movement in two directions (Figure 6). In the north and west, glacial striae are oriented south to S20E, whereas in the southeast, striae strike mainly S20W. Locally, in the south-central part of the area, the two sets of striae occur together, with the southwest set apparently older than the north-south set. The age relationships are not clear, and it is possible that the two orientations reflect two separate ice lobes of similar age that coalesced in this area (Boissonneau 1968). There is also evidence, in the form of glacial reworking of previously formed glaciofluvial deposits, for local readvance of the ice sheet.

According to Prest (1969), the Wisconsin ice sheet withdrew from this area about 10,000 years ago. It was during this time that most of the moraine, glaciofluvial, and glaciolacustrine deposits were formed. Glacial Lake Ogilvie occupied a small part of the area in the northwest, and the southern margin of glacial Lake Barlow-Ojibway extended into the northern part of the area (Boissonneau 1968). Major spillways extended south from these lakes through the map-area.

Unconsolidated surficial sediments associated with Pleistocene glaciation can be subdivided into glacial, glaciofluvial, and glaciolacustrine deposits. Glacial deposits include ground moraine, end moraine, and washboard or De Geer moraine (Prest 1968). The ground moraine is till composed of sand and boulders that reflect the composition of the underlying bedrock. End moraines, consisting of sand and gravel, form east-west-trending belts that indicate successive ice front positions. Boissonneau (1968) has designated a belt in the north, the Fawcett Moraine, and another belt immediately south of the map-area, the Obabika Moraine. In addition, there are several minor moraines that possibly indicate other ice-front positions. Washboard or De Geer moraines were developed on glaciolacustrine and glaciofluvial deposits, probably by local readvance of the ice mass.

Glaciofluvial deposits include eskers, outwash, and valley-train deposits. Single eskers and esker complexes are oriented south, generally parallel to the glacial striae. They are composed of sand and gravel. The largest eskers and esker complexes are associated with valley-train and outwash deposits consisting of silt, sand, and gravel that extend southwards from glacial Lakes Ogilvie and Barlow-Ojibway, and from the Fawcett and Lake Temagami Moraines (Figure 6). Lake Ogilvie emptied southwards down the valley now occupied by the Sturgeon River. Lake Barlow-Ojibway apparently had several outlets through the area, one extending

Maple Mountain Area

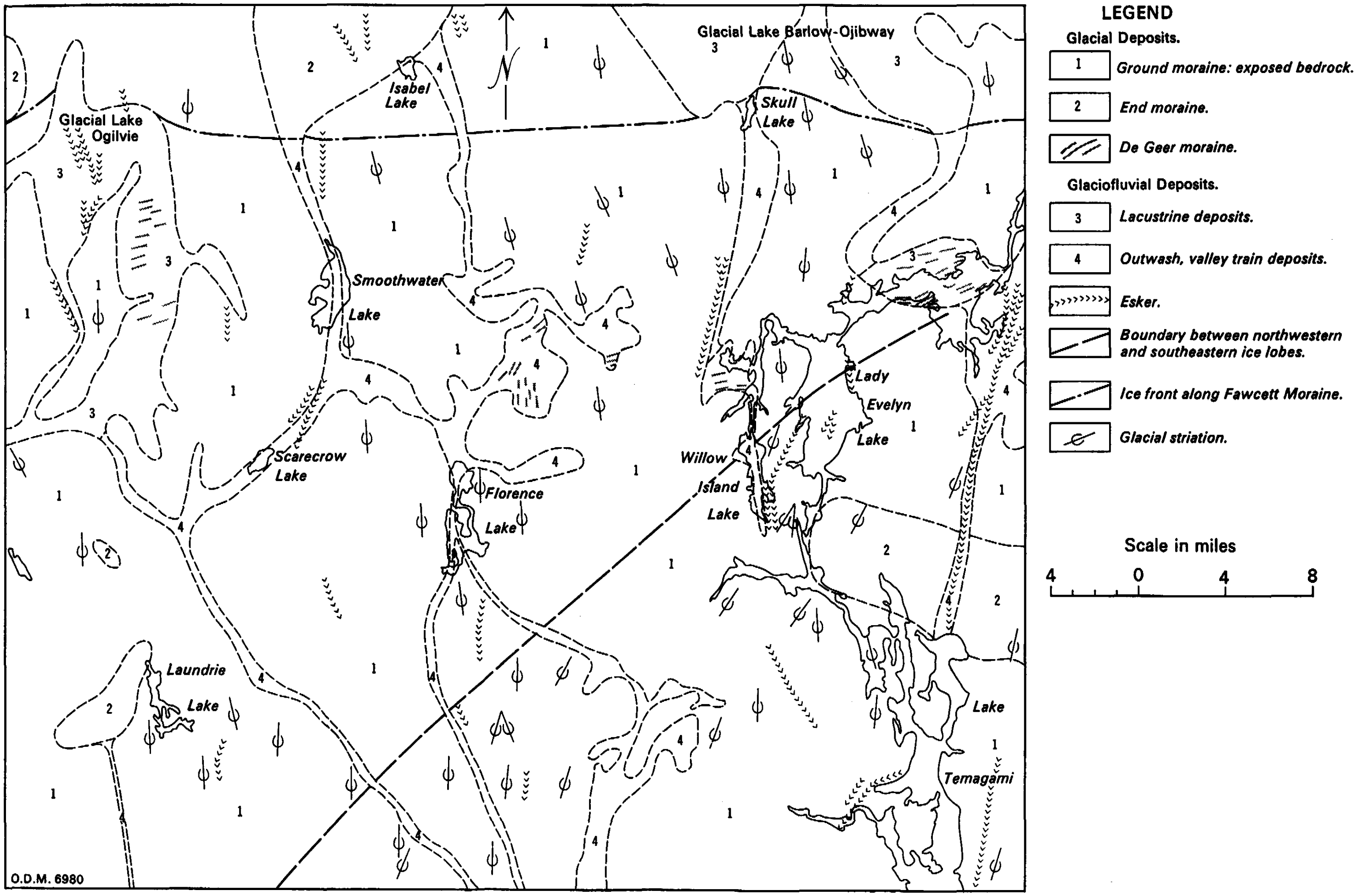


Figure 6—Surficial geology of the Maple Mountain area.

south through Skull Lake and Willow Island Lake, and other through what is now the Lady Evelyn Lake-Lake Temagami system. Drainage from the Fawcett Moraine extended south through Smoothwater and Scarecrow Lakes to the Sturgeon River valley, and through the Isabel Lake-Florence Lake-Obabika River system. The Wanapitei River valley was apparently also a major drainage system during this time.

Glaciolacustrine sediments, including varved clay, silt, and sand were deposited mainly in glacial Lake Ogilvie in the northwest.

The sequence of events during the Cenozoic can be summarized as follows:

1. The ice front advanced southwards over the area in the form of two lobes, one moving south, the other southwest. There is some evidence that the southwest-moving lobe was the older of the two.
2. The ice front retreated across the area about 10,000 years ago. Periodic halts of the ice front are marked by moraines.
3. Lakes Ogilvie and Barlow-Ojibway were formed in front of the ice mass, and lacustrine and outwash deposits were formed.
4. Local readvance of the ice front and overriding of previously formed lacustrine and outwash deposits formed washboard moraines.
5. The ice retreated again, the glacial lake withdrew northwards following the retreating ice, and the sediments deposited have been reworked to a limited extent up to the present day (by rain, shifting streams, and local lakes).

STRUCTURAL GEOLOGY

According to Stockwell (1964) and Map 1251A, Tectonic Map of Canada (Stockwell 1969), the Maple Mountain area lies in the 'Cobalt Plain', a region of undeformed Aphebian (Proterozoic) cover rocks on Kenoran (Archean) orogenic rocks; 'Cobalt Plain' is classified as part of the Superior Province of the Canadian Shield.

In structural setting, style of deformation, and grade of metamorphism, the Maple Mountain area is similar to the Elliot Lake-Flack Lake area (from personal observation). The Huronian rocks of both areas were probably affected by the same deformational and metamorphic events that affected Huronian rocks in the Southern Province along the North Shore of Lake Huron. The relatively low intensity of deformation and metamorphism in the Maple Mountain and Elliot Lake-Flack Lake areas is probably due to their structural setting. The Huronian of both areas can be considered as epicontinental sequences deposited in local basins formed on relatively stable cratonic blocks. The Huronian of the North Shore area, on the other hand, probably represents deposition in a relatively unstable miogeosynclinal area. Therefore, in the opinion of the writers, the Maple Mountain area is part of the Southern Province of the Canadian Shield, and was affected by Proterozoic orogenic events.

STRUCTURE OF THE ARCHEAN ROCKS

Archean rocks are exposed in the northwestern, southern, and eastern parts of the map-area. In the northwest, Keewatin-type metavolcanics are part of a broad synclinorium that extends to the north (Map 2046, Ginn *et al.* 1964). These rocks are steeply folded about axes trending about N25W. Timiskaming-type metasediments and metavolcanics are preserved in a synclinal basin within the larger Keewatin synclinorium (which lies mainly outside the map-area). Direction of folding of the Timiskaming-type rocks is generally coincident with that of the Keewatin, but there is a marked angular unconformity between the two sequences in this area.

The southern Archean area consists mainly of granitic rocks with significant amounts of metavolcanics in Turner Township only. Here steeply dipping flows, pyroclastic rocks, and iron formation generally trend northeast and possibly represent the limb of a north-trending fold structure. Iron formation in Cotton Township was apparently folded about east-trending axes. Foliations (gneissosity) in the granitic rocks are weakly developed, strike mainly east-west, and dip steeply. Both north-south and east-west foliations are present in the metavolcanics.

The eastern Archean terrain consists of granitic rocks in the north, and metavolcanics and iron formation in the south. Structural-stratigraphic trends in the metavolcanics are east-west to southwest, and these rocks are part of a large synclinal 'greenstone' belt that extends northeastwards out of the map-area (Bennett 1969). The metavolcanics are intruded by granitic batholiths that have caused local structural deflections. Faults striking about N60E, tension fractures striking N70W, and foliations striking east-west to north-northwest occur in these rocks.

STRUCTURE OF THE HURONIAN ROCKS

STRUCTURAL ZONES

The main basin of Huronian rocks can be subdivided into six structural zones on the basis of structural trends. In each zone there is relatively constant orientation of major and minor structures, commonly one or two structural elements are dominant, and there are differences in orientation or dominance of structural elements from one zone to another. The interpretation of structural zones and orientation of structural elements within each zone are portrayed in Figure 7.

In the Turner Township area, a topographic high in the basement is almost surrounded by rocks of the Mississagi, Bruce, Espanola, and Serpent Formations. These rocks, as well as the Archean rocks, are unconformably overlain by the Gowganda Formation. The Mississagi-Serpent sequence was apparently folded into an open, north-trending fan-like synform prior to deposition of the Gowganda rocks. The fan-like pattern may reflect a paleovalley in the basement rocks.

The major folds in the Smoothwater Lake, Maple Mountain, and Lake Temagami zones trend north-south, whereas in the Montreal River zone they strike generally northeast, and in the McGiffin zone, northwest (see Figure 7). In the first three zones, there are minor or intermediate folds trending east-west, and in the last two, folds trending generally north-south.

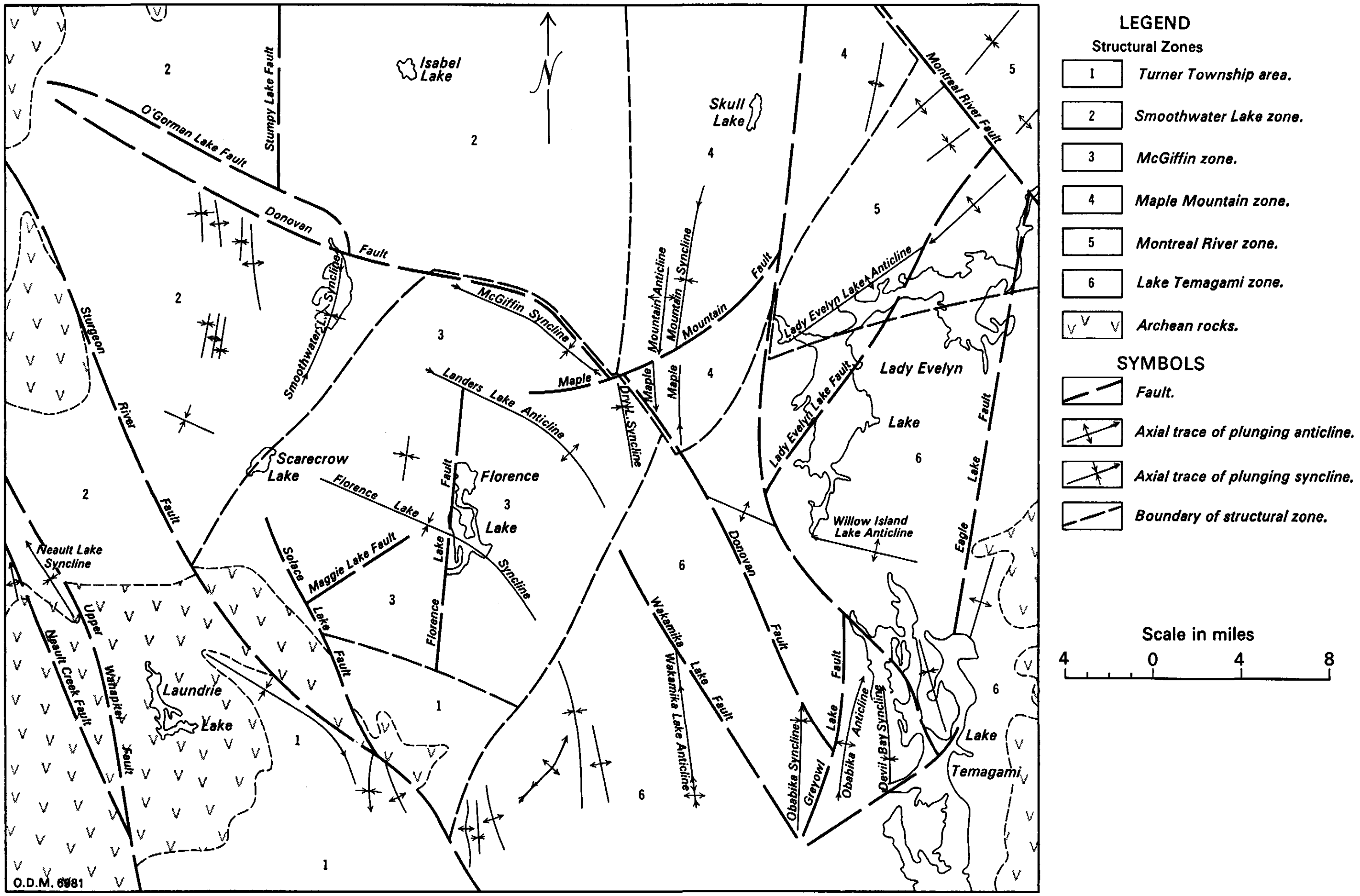


Figure 7—Structural zones and structural trends of the Maple Mountain area.

FOLDS

Three major fold sets that trend north, northwest, and northeast, are present.

North-trending folds such as the Maple Mountain Syncline and the Obabika Lake Syncline have curved axes that strike north-northeast to north-northwest; fold axes are horizontal or plunge gently north and south. Most are broad, open, basin-and-dome structures with approximately upright axial planes. Dips on limbs are generally less than 25 degrees, except near exposed basement rocks and in the Smoothwater Lake Syncline where dips up to 80 degrees are encountered.

Northwest folds such as the McGiffin Syncline, the Landers Lake Anticline, and the Florence Lake Syncline have axes that strike N40W to N70W; fold axes are horizontal or plunge gently east and west. Some, like the Florence Lake Syncline, are apparently bent until they are approximately parallel to north-northwest fold axes in adjacent zones. The northwest folds are also broad, open, approximately upright basin-and-dome structures with gently dipping limbs except near exposed basement rocks and in the McGiffin Syncline near the centre of the basin where dips up to 65 degrees occur.

The axis of the main northeast-trending fold, the Lady Evelyn Lake Anticline, strikes approximately N45E to N55E and plunges southwest at a low angle. Dips on the limbs average about 10 degrees and this structure too is a broad, open fold with an upright axial plane.

FAULTS

Faults in the Maple Mountain area can be divided into four groups on the basis of orientation; north-northwest, northwest, north to north-northeast, and northeast. All are apparently steeply dipping and have both dip-slip and strike-slip components of movement.

North-northwest faults such as the Neault Creek, Upper Wanapitei, Sturgeon River, and Wakimika Lake Faults occur mainly in the western two-thirds of the area. They strike approximately N25W and apparently dip steeply. Movement has resulted in right-hand and left-hand apparent horizontal offsets of Gowganda-Archean and Gowganda-Lorrain contacts of up to 3 miles. Apparent horizontal offsets of gabbro bodies are smaller, generally less than ½ mile. Late diabase dikes are displaced several hundred feet across some of the faults. The north-northwest faults are part of a regional fault system, the Onaping System (Wilson 1949) that extends over a large region in this part of the Shield. Vertical movements produced a series of horsts and grabens that strongly controlled deposition of the Huronian sequence. Consequently, they were formed prior to deposition of the Huronian sedimentary rocks but post-Huronian, post-Nipissing Diabase, and post-late diabase movements have occurred as well.

Northwest faults such as the O'Gorman Lake, Donovan, and Montreal River Faults strike approximately N45W and apparently dip steeply. Vertical and horizontal movements have resulted in left-hand and right-hand apparent horizontal displacements of up to several miles. The northwest faults are also part of a regional fault system, the Timiskaming System (Wilson 1949). They were possibly formed prior to deposition of the Huronian sedimentary rocks although evidence for their control of Huronian sedimentation is poor or lacking. They have been reactivated periodically in post-Huronian and even post-Paleozoic time.

Faults such as the Stumpy Lake, Florence Lake, Greyowl Lake, and Eagle Lake structures strike approximately north to N40E. Right- and left-hand apparent horizontal displacements of a few hundred to a few thousand feet have occurred, probably as a result of dominantly vertical movements.

Maple Mountain, Lady Evelyn Lake, and Maggie Lake Faults strike approximately N50E to N80E. Right- and left-hand horizontal displacements of contacts and fold axes of a few hundred to a few thousand feet have occurred.

The relationship between the Onaping and Timiskaming Fault Systems is confused by the repetitive nature of the movement on them. In the Cobalt area and northward, the two systems are superimposed but no clear-cut evidence of their relative original ages can be established (H. L. Lovell, Resident Geologist, Kirkland Lake, 1970, personal communication). The Onaping System faults definitely formed prior to Huronian sedimentation, but evidence for controls on Huronian sedimentation by the Timiskaming System faults is poor. Consequently the Onaping System may be the older, or the two systems may have originated at approximately the same time. The northeast faults appear to be relatively younger as they displace fold axes, and, possibly, northwest-trending faults.

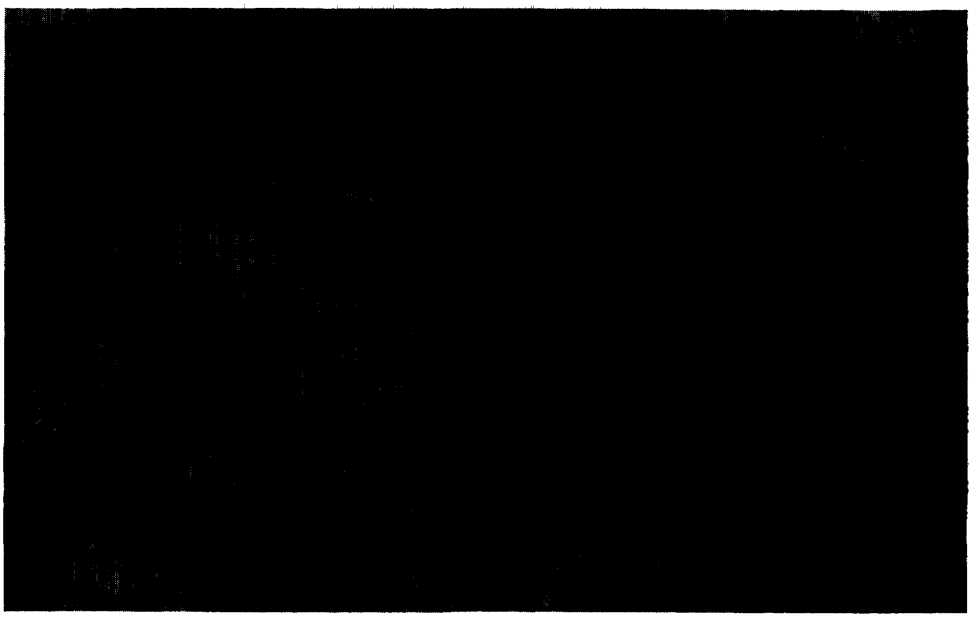
MINOR STRUCTURES

Foliations, lineations, and minor folds are poorly developed in Maple Mountain area, probably because of low intensity of deformation and lithologic character of the rocks, that is, mainly coarse-grained sandstones. Axial plane foliations and lineations parallel to fold axes are found in fine-grained pelitic rocks of the Gowganda Formation, whereas lineations on bedding surfaces, presumably the result of interbed slip during flexural folding, occur sparingly in Lorrain sandstones.

Two sets of foliations are present, one trending generally north-south, the other, east-west. Foliations of the first set strike approximately N45W to N45E and dip both east and west at angles ranging from 35 to 90 degrees. Many of the north-trending foliations strike approximately north to N25W, parallel to major fold axial planes. Foliations of the east-west set strike N60E to S70E (N70W) and dip both north and south at angles of 60 to 90 degrees.

Lineations, slickensides on foliation and bedding planes, can also be divided into two sets on the basis of orientation. Lineations of a north-trending set strike aproximately north to N25W and plunge north at angles of 25 to 50 degrees. Lineations of the east-west set strike N75E to S80E (N80W) and plunge east and west at low angles.

Minor folds of one set have axes striking generally northeast to northwest and plunging gently north, whereas folds of a second set strike generally east-west and plunge gently east and west.



ODM8741

Photo 16—Brecciated rocks of the Gowganda Formation; Turner Township.

BRECCIA

Breccia formed by slumping of semi-consolidated sediment is common in the Gowganda, Lorrain, and Gordon Lake Formations. Sequences of interbedded greywacke and argillite in the lower part of the Gowganda Formation have been extensively disrupted to form breccia consisting of angular to rounded rock fragments in a generally sparse silty matrix (Photo 16). Fragments range in size from about 1 inch to several feet and are commonly deformed and fractured. The matrix is massive, or locally exhibits flow lines around fragments. Breccia in the lower part of the Lorrain Formation, probably formed by soft-sediment slumping, consists of rounded fragments of sandstone in a siltstone or argillaceous sandstone matrix. Breccia in the Gordon Lake Formation consists of small, angular to rounded chert chips in a sandy or argillaceous matrix. Evidence that these breccias probably originated by slumping of poorly consolidated sediments includes their occurrence in certain lithologic sequences at certain stratigraphic horizons, and the deformational features in fragments indicative of relatively poor consolidation at the time of disruption.

Lawton (1954) has described several extensive areas of breccia in Delhi Township that are similar to the 'Sudbury breccia'. These are unrelated to discernible structural features, such as faults or folds, and to stratigraphy or lithology. They occur in both the Lorrain and Gowganda Formations as transgressive linear belts and consist of angular to rounded fragments of country rocks and possibly Nipissing Diabase in a dark, fine-grained, flinty matrix. Rock fragments range in maximum dimension from less than 1 inch to about 15 feet and commonly show evidence of milling. The matrix shows evidence of fluid behaviour in the form of flow lines and penetration into thin cracks in fragments and adjacent country rocks. The matrix is composed of comminuted rock materials and its composition varies sympathetically with the country rock in which it is found. For example, breccia matrix in Gowganda argillite is rich in chlorite and epidote, whereas in Lorrain sandstone, it is mainly quartz and sericite. Breccia zones are transgressive across structural-stratigraphic trends in the country rocks, contacts are sharp or gradational over a few feet, and contact attitudes are highly variable. The Sudbury-type breccias are younger than the Huronian, and probably younger than the Nipissing Diabase. The origin of these breccias is unknown.

TECTONIC SYNTHESIS

Archean metavolcanics and metasediments were deformed about northwest-, east-west-, and northeast-trending axes, probably during Kenoran and earlier orogenic events. They were undoubtedly affected by more than one event as there are angular unconformities in the sequence, deflection of earlier-formed structures by granitic intrusions, and imposition of later gneissic foliations on the granites.

After the end of the Kenoran orogeny, a major system of northwest-striking faults formed. Resulting graben structures provided basins for deposition of the sediments that constitute the Huronian Supergroup.

There is evidence, in the form of an angular unconformity below the Gowganda Formation, cross-folds, and cleavage relationships, that the Huronian rocks were affected by several mild deformational events.

Folds of the Maple Mountain area are non-cylindrical, doubly plunging, open structures formed by flexural slip on bedding planes during several superimposed deformational events. Major horizontal compressive stresses oriented approximately east-west formed the early north-south folds whereas the later, approximately east-west folds were formed by horizontal compression acting in a generally north-south plane.

The main fault sets are oriented northwest, north, and northeast. If these are interpreted as normal (gravity) faults, then the principal stress active during their formation was vertical. If they are interpreted as strike-slip faults, then the major stresses would be oriented approximately north-south at one time, and east-west at another. There is evidence for both strike-slip and dip-slip movement on most of the faults, and consequently the following sequence of events is postulated:

1. Early normal (gravity) faulting and the formation of a graben system into which sediments were deposited.
2. Folding of the sedimentary sequence about north-south axes accompanied by strike-slip movement on reactivated faults.
3. Folding of the rocks about east-west-trending axes, again accompanied by strike-slip movement on reactivated faults, and possibly by intrusion of Nipissing Diabase bodies.

CORRELATION OF AEROMAGNETIC DATA WITH GEOLOGY

On examination of Aeromagnetic Maps 284G (Gowganda Sheet, GSC 1956), 1514G (Smoothwater Lake Sheet, GSC 1965d), 1513G (Pilgrim Creek Sheet, GSC 1965c), 1503G (Obabika Lake Sheet, GSC 1965a), and 1504G (Lady Evelyn Lake Sheet, GSC 1965b), it is apparent that most of the aeromagnetic features in the Maple Mountain area can be related to bedrock geology.

Archean mafic metavolcanics are moderately responsive magnetically with levels of 2,200 to 2,400 gammas. Felsic metavolcanics and metasediments are somewhat lower, whereas Archean iron formations produce anomalies of up to 9,500 gammas. The size and intensity of iron formation anomalies are related to dimensions and grade of the iron formation. For example, the Kokoko Lake deposit, which is up to 500 feet wide, 3.5 miles long, and averages about 30 percent Fe produces an anomaly of 9,500 gammas whereas the iron formation in Leith Township that is about 30 feet wide, 0.5 miles long, and averages about 15 percent Fe produces a magnetic response of only 1,300 gammas.

Archean granitic rocks produce low (1,700 to 2,200 gammas), variable magnetic responses. Areas of leucocratic rocks are low and relatively regular, whereas more migmatitic areas are generally higher (up to 2,400 gammas) and irregular.

Rocks of the Gowanda Formation are variably responsive magnetically in the range 2,000 to 2,500 gammas. There are apparently one or more magnetically responsive units in the lower part of the formation. The Lorrain, Gordon Lake, and Bar River Formations produce low, relatively uniform magnetic responses in the 1,800 to 2,200 gammas range.

Nipissing Diabase bodies are moderately responsive and they produce a striking pattern of alternating magnetic highs and lows along their outcrop traces. Magnetic highs of about 2,400 gammas alternate with magnetic lows of about 2,200 gammas. Petrographic examination shows that unaltered gabbros contain minor to moderate amounts of ilmenite-magnetite. Metamorphism resulted in alteration of the ilmenite of the original ilmenite-magnetite intergrowths to leucoxene and sphene, leaving the magnetite lamellae unaltered. In addition, uralitization of the pyroxene resulted in the formation of magnetite that appears as a fine dust in the uralitic amphibole. Consequently, metamorphism produced an overall increase in magnetite content, and a change in the oxide mineralogy from ilmenite-magnetite to magnetite. In Table 11 oxide mineralogy and content is compared with magnetic response as deduced from the Aeromagnetic Maps. It is evident that the altered magnetite-bearing metagabbros are more responsive magnetically than are the ilmenite-magnetite-bearing fresh gabbros and that the alternating pattern of magnetic highs and lows can probably be related to metamorphism.

Late olivine diabase dikes produce narrow, linear anomalies that assist in tracing these dikes. Magnetic intensity varies from about 2,100 to 2,400 gammas, some dikes are more responsive than others, and magnetic intensity commonly varies along the trace of a single dike. Presumably the magnetic variations are due to variations in magnetite content of the dike rocks.

There are several magnetic anomalies in the area that cannot be correlated directly with bedrock geology. In the north, a broad, southeast-trending anomaly approximately 1,000 gammas above the 'background' of about 2,300 gammas occurs

Table 11 | COMPARISON OF MAGNETIC RESPONSE OF NIPISSING DIABASES (OF THE MAPLE MOUNTAIN AREA) WITH OXIDE MINERAL COMPOSITION AND CONTENT

SAMPLE* NO.	ROCK TYPE	OXIDE MINERAL COMPOSITION	OXIDE CONTENT** IN PERCENT	RELATIVE MAGNETIC RESPONSE***
LMM-111	Pyroxene gabbro	Ilmenite-magnetite	0.1	Low
CMM-89	Pyroxene gabbro	Ilmenite-magnetite	0.3	Intermediate
CMM-70	Pyroxene gabbro	Ilmenite-magnetite	1.3	Intermediate
76-01	Granophyric pyroxene gabbro	Ilmenite-magnetite	7.0	Low
LMM-86	Metagabbro	Magnetite	2.0	High
MMM-148	Metagabbro	Magnetite	1.5	High
MMM-103	Metagabbro	Magnetite	5	High
CMM-1	Metagabbro	Magnetite	1.0	High

* See Table 9 for location of samples.
** Oxide content determined by point count modal analysis.
*** Relative magnetic response determined from Aeromagnetic Maps (GSC 1956; 1965a, b, c, d).

over areas underlain by Huronian sedimentary rocks and Nipissing Diabase. McIlwaine (1971) pointed out that the anomaly has the same trend as exposed basement rocks, including iron formation, in the northern part of the area, and attributes the anomaly to a basement topographic 'high' under a thin cover of Huronian rocks. This may be true in the north, but in the south, the anomaly persists over areas underlain by the upper part of the Huronian sequence where the basement must be at great depth. It is possible that this anomaly is due to highly magnetic basement rocks such as iron formation, or to a large sill-like mafic body at depth.

At the northern end of Lady Evelyn Lake there is a broad east-west anomaly over areas underlain by Gowganda Formation and Nipissing Diabase. The anomaly has a pattern and intensity similar to that of nearby Nipissing Diabase bodies and could consequently indicate a large, subsurface gabbro sill.

ECONOMIC GEOLOGY

Exploration has been carried out sporadically in the Maple Mountain area for the past 70 years for silver, gold, base metals, uranium, and iron. To date, there has been only limited production of silver and cobalt.

Small, but commonly rich, vein deposits containing native silver and associated iron-nickel arsenides occur in Nipissing Diabase intrusions in the northern two tiers of townships. These deposits are similar in mineralogy and mode of occurrence to those at Cobalt and Gowganda.

Sulphide minerals containing copper and zinc, with minor lead and nickel, and commonly with appreciable gold and silver, are found in the southern part of the map-area. Mineralization occurs as disseminations and massive pods in highly altered Nipissing Diabase, and in quartz-carbonate veins in and around the gabbro intrusions. Sulphide mineralization also occurs in the Archean metavolcanics and with iron formation. In addition, minor amounts of sulphide minerals, mainly pyrite with some chalcopyrite, occur in several of the Huronian formations, notably the Mississagi, Bruce, Gowganda, and Lorrain. Sulphide mineralization has recently been discovered immediately outside the map-area in Stull Township but its mode of occurrence is not known.

Iron formations of the Algoma-type (oxide facies) occur in the Archean 'greenstone' belts exposed in the map-area (Gross 1965). There has been no production from these, but similar deposits outside the map-area to the north and southwest have been utilized. Several deposits within the Maple Mountain area, notably the Burwash Lake and Kokoko Lake iron formations are probably of sufficient size and grade to warrant future production.

Uranium mineralization similar to that of the Elliot Lake area occurs in quartz-pebble conglomerate and grit at or near the base of the Mississagi Formation in the Turner Township area. Exploration has demonstrated the existence of extensive, but low grade uranium deposits here.

HEAVY METAL CONTENT AND CONDUCTIVITY OF SURFACE WATERS IN THE MAPLE MOUNTAIN AREA

Thirty-three one-quart samples of surface water were collected from thirty lakes and streams in the map-area. These were analyzed in the geochemistry laboratories, McMaster University, by Titania Mayer under the supervision of Dr. J. R. Kramer.

Since trace metals are generally present in natural water in concentrations below the sensitivity limits of the atomic absorption spectrophotometer, an extraction technique using ammonium pyriolidine dithiocarbamate as a chelating agent and methyl isobutyl ketone to extract these chelates was used. The technique enhanced sensitivity and improved the detection limit to less than 0.5 parts per billion. Conductivity was measured in a bridge-type instrument using a cell having a constant of 0.1.

The amount and kind of material in solution in the waters of any given lake depends on a number of factors, including the nature of the bedrock and surficial deposits in the lake basin, characteristics of the lake water itself such as pH, and contributions from outside the system in the form of rain and snow. In most natural lake waters cadmium is generally present in concentrations of less than 1 part per billion, nickel is rarely meausrable above 2 parts per billion, and zinc and copper above 5 and 10 parts per billion respectively (J. R. Kramer 1970, personal communication).

In Table 12, the heavy metal contents and conductivities of various lake waters are correlated with bedrock and surficial geology of their basins. Many lakes in the Maple Mountain area have above-average heavy metal contents, especially of nickel and zinc. In general, lakes whose basins (basin being defined as the area extending outward from the shore for approximately 1 mile plus the area covered by water) are underlain mainly (more than 30 percent) by gabbro have relatively high chromium and zinc, and low cadmium and copper contents. Lakes underlain by the Gowganda Formation have relatively high copper and nickel, and low chromium and zinc contents. Lakes underlain by Lorrain Formation have moderate to high copper, nickel, and zinc contents. Lakes with drift filled or swampy basins tend to have higher heavy metal contents than those with rocky basins.

One water sample was taken from the Lady Evelyn River about 1 mile north (downstream) of a number of copper-zinc sulphide occurrences that are found along the channel at the water's edge in Barr Township. Comparison of the heavy metal content of this sample with others taken south (upstream) of the mineral occurrences shows that it is appreciably higher in nickel (23 parts per billion versus 2.5 to 8 parts per billion) but not in copper (2.2 ppb versus 1 to 2 ppb) and is lower in zinc (2.2 ppb versus 4.5 to 7.5 ppb). This would indicate that heavy metals such as zinc and copper do not remain long in solution in anomalously high concentrations.

However, zinc can be present in lake water in concentrations of more than 10 times 'local background' as is indicated by the results from Stewart Lake, Haentschel Township. Here zinc is present in the water in concentrations of 123 parts per billion. The source of this zinc is probably local and is especially interesting in view of the fact that Stewart Lake is located about 8 miles from known base metal occurrences in Stull Township.

SILVER AND COBALT

Native silver in association with Co-Fe-Ni arsenides is found at several localities in the map-area; these deposits occur in narrow carbonate and quartz-carbonate veins in Nipissing Diabase intrusions. Other associated minerals found include chalcopyrite, pyrite, sphalerite, galena, bismuth, annabergite, and erythrite.

Veins up to several inches thick occur singly in narrow fractures or as multiple vein systems in shear zones. Aplite dikes, as the Rustex Mine (property 49) in Leith Township and the White Reserve Mine (property 6) in Whitson Township, are found parallel to some veins and the two appear to be genetically related.

The host rock in all these examples is Nipissing Diabase. Throughout the region there appears to be an association of mineralized veins with the footwall contact of the gabbro. The deposits at the White Reserve Mine (property 6), The Triangle Silver Mine (property 58), and the Rustex Mine (property 49) are examples. A few are associated with the hanging-wall contact; the Wilder occurrence (property 59) in Donovan Township is an example. Strike of the veins or vein systems is either normal to or parallel to the gabbro contacts.

The ore shoots found to date have been small but are commonly rich. Only the Rustex and White Reserve Mines have records of (limited) production.

DESCRIPTION OF PROPERTIES

This section describes the properties and mineral deposits that have been explored for silver and cobalt in the Kirkland Lake and Sudbury Resident Geologists' regions. Table 13 indicates information that is on file in the Resident Geologists' offices in Kirkland Lake and Sudbury. Numbers in brackets following each heading refer to property numbers on the maps (Maps 2256, 2257, 2258, 2259, and 2260, back pocket). Property ownerships are as of September 15, 1969.

Table 12

CORRELATION OF HEAVY METAL CONTENT OF LAKE WATER WITH GEOLOGY IN THE MAPLE MOUNTAIN AREA; ANALYSES BY TITANIA MAYER AND J. R. KRAMER, McMASTER UNIVERSITY; CORRELATION BY AUTHORS

LAKE, TOWNSHIP	SURROUNDING BEDROCK IN PERCENT				BASIN	SURFICIAL DEPOSITS	PPB					SPECIFIC CONDUCTIVITY MHOS PER cm AT 25° C
	GRANITE & VOLCANIC ROCKS	GOW-GANDA	LORRAIN	GABBRO			Cd	Cr	Cu	Ni	Zn	
Benner, Dundee		15	15	70	Rock	Thin moraine	1.6	5	3.5	8	11.5	39
Bob, Canton			100		Rock-30% Drift-70%	Moderate moraine	1.4	5	3	8	9.5	42
Muskego River, Dane		100			Swampy	Glaciofluvial	0.5	—	1	15	4.5	42
North Lady Eveyln River (North of sulphide occurence), Barr		50		50	Rock	Thin moraine	—	—	2.2	23	2.2	39
Maggie, Selkirk		20	50	30	Swamp	Moderate moraine	0.2	—	1	1.5	10.5	40
McKee, Dufferin	20	80			Rock-30% Swamp-70%	Glaciolacustrine	0.2	—	2	19	1.5	71
Pilgrim, Dundee		20	60	20	Rock	Thin moraine	—	—	2	19	12.5	40
Wakimika, Shelburne		30	60	10	Rock-70% Drift-30%		—	—	3	4	1	43
Bluesucker, Dundee			80	20	Rock-50% Drift-50%	Thin moraine	—	3	4	6	8.5	46
Sucker Gut, Leo			70	30	Rock	Thin moraine	—	—	0.5	6	2	40
Tupper, Rorke			80	20	Rock-10% Drift-90%	Moderate moraine	—	4	0.5	3.5	2.5	38
Willow Island, Medina			95	5	Rock-50% Drift-50%	Moraine, glaciofluvial	—	3	3	9	3	39
Stewart, Haentschel	10	40	30	20	Swampy	Glaciofluvial, moraine	—	10	—	4	123	55
Solace, Selkirk	15	40	30	15	Rocky	Thin moraine	—	3	0.5	15	4.3	44
Eagle, Cole		10	10	80	Drift	Moraine, glaciofluvial	1.5	4	3.5	—	0.7	47
Whitefish Bay, Lake Temagami, Aston					Drift-80% Rock-20%	Thick moraine	0.5	—	8.5	—	0.5	52

Sharp Rock Inlet, Lake Temagami, Canton		90		10	Rock-70% Drift-30%	Thin moraine	1	—	8.5	—	0.5	39
Red Squirrel, Aston	10	80		10	Drift-70% Rock-30%	Moderate moraine	0.8	—	3	—	0.7	not determined
Trethewey, Trethewey			70	30	Drift-90% Rock-10%	Moderate moraine	—	10	3.5	5	2.5	40
Ferguson Bay, Lake Temagami, Cynthia		80		20	Drift-50% Rock-50%	Moderate moraine	1	3	3	1	1.5	49
Aston, Aston		100			Drift	Thick moraine	0.8	6	2	8	2.8	44
Schmoo, Gamble			100		Drift	Thick glaciofluvial	3.5	3	2	8	11	42
Barter, Cole		20	10	70	Rock-90% Drift-10%	Thin moraine	2	—	3	5	2.3	38
Buff, Rorke			100		Drift	Moraine, glaciofluvial	—	2	1	3	9.7	42
Small Island, Klock		50		50	Swampy	Moraine, glaciofluvial	0.3	2	0.5	—	2.5	49
Diamond, Shelburne		10	90		Rock-70% Drift-30%	Thin moraine	0.3	—	2	2.5	4.7	39
Old Bill, Rorke			90	10	Drift-80% Rock-20%	Moderate moraine	—	1	0.4	3	1	35
Paul (Sturgeon River), Selkirk	90	10			Rock	Thin moraine	0.3	1	3	5	2.5	52
Sirdevan, Medina		60		40	Drift	Thick moraine	0.5	2	1	2.5	5.5	46
Hobart, Rorke			80	20	Drift-80% Rock-20%	Moraine, glaciofluvial	—	6	3	5	4.7	37
Mocassin, Klock			60	40	Swampy	Moderate moraine	—	3	3	—	5.5	560
Lady Evelyn, Leo		30	60	10	Rocky	Thin moraine	0.3	4	2	5	4.7	39
Katherine (Lady Evelyn River), Sladen			100		Rocky	Thin moraine	0.3	1	1	2.5	7.5	39

Maple Mountain Area

Table 13 ASSESSMENT DATA, FOR THE MAPLE MOUNTAIN AREA, ON FILE WITH ONTARIO DIVISION OF MINES AS OF 31 DECEMBER 1969

FILE NAME	TOWNSHIP	TYPE OF INFORMATION	S-SUDBURY FILES KL-KIRKLAND LAKE FILES*	NUMBER OF DRILL HOLES AND FOOTAGE	DATE OF WORK OR FILE
Ames, Ezra	Corkill	DD	KL	1-483′	1964
Argentium Silver Mines Ltd.	Banks	AMAG	KL		1969
Argentium Silver Mines Ltd.	Speight	AMAG	KL		1969
Argentium Silver Mines Ltd.	van Nostrand	GL; EM; GC; rTr	KL		1968
Argentium Silver Mines Ltd.	Whitson	GL; DD; EM; GC; rTr; sTr	KL	5-3032′	1968
Armstrong, J. (Bergeron)	van Nostrand	Correspondence	KL		1951
Barbana Mining Corp. Ltd.	Klock	GL	KL		1943
Button	van Nostrand	Correspondence	KL		1948
Byles, George	Ray	GL	KL		1960
Canadian Johns-Manville Co. Ltd.	Turner, Dundee, Seagram	GP	S		1968
Canadian Johns-Manville Co. Ltd.	Turner	DD and sections	S	3-3043′	1968
Charron	Auld	GL	KL		*circa* 1912
Consolidated Red Poplar Mines Ltd.	Donovan	GL; DD; clippings; Tr.	KL	6-1023′	1963
Darby Mines Ltd.	Whitson	GL; Thin section; Hand Sample	KL		1948
D'Eldona Gold Mines Ltd.	Turner	DD; SA; Plans; Property report	S	19-3179′	1956
Delhi Temagami Gold Mines Ltd.	Delhi	GL; DD; SA	S	1-200.3′	1947
Denison Mines Ltd.	Seagram	DD	S	1-2159′	1968
Denison Mines Ltd.	Seagram	DD and section	S	2-3011′	1969
Derosier, D.	Aston	GL	KL		1957
Derosier, D.	Cynthia	GL; DD; SA; and sample	KL	15-1034′	1957-1963
Dominion Gulf Co., Group 1	Cynthia	GL; DD; MAG; rTr	KL	4-2831′	1952, 1954
Dominion Ores Ltd.	Whitson	GL	KL		*circa* 1913
Duggan, H.	Donovan	Reference	KL		1926
Exploration Syndicate of Ontario	North Williams	GL; SA; Clipping	KL		1925
Garvey	Charters	GL	KL		1962
Goldie Lake Mining and Development Co. Ltd.	van Nostrand	SA; Clipping	KL		1928
Gowganda-Duggan Silver Mines Ltd.	Donovan	GL	KL		1961
Haines	Donovan	Reference	KL		1926
Hardie, Arnold A.	Cynthia	rTr	KL	**	1969
Hardiman Bay Mines Ltd.	Brewster	GL; DD; MAG; EM	KL	1-507′	1965-1966
Harrison-Hibbert Mines Ltd.	Turner	DD	S	9-1468.5′	1954
Harrison-Hibbert Mines Ltd.	Turner	GL	S		1956
Hitchcock	Auld	GL	KL		1912-1958
Hudson Bay	Leith	GL; Hand Sample	KL		1910-1966
Ironco Mining and Smelting Co. Ltd.	Cotton	GL; GP; Pros.	S		1962
Ironco Mining and Smelting Co. Ltd.	Cotton	DD; Pros.	S	11-5029.5′	1964
Ironco Mining and Smelting Co. Ltd.	Cotton	DD; report and sections	S		1965
Keevil Mining Group Ltd.	Aston	MAG; EM	KL		1965
Keevil Mining Group Ltd.	Cynthia	MAG; EM	KL		1965
Kell, Hugh	Corkill	GL	KL		1917
Kennedy Syndicate	Donovan	GL	KL		*circa* 1911
Kordol Exploration Ltd.	Auld	GL; DD; UG; SA	KL	14-3089′	1961, 1962
Lahay, L. J.	Delhi	DD	S	11-702′	1952
Last, Henry (The Macrae Mining Co. Ltd.)	DeMorest	GP	S		1969
Leroy, Sam	Speight	GL	KL		1963
Lucky Six	Donovan	Claims sketch	KL		. . .
McCready, W.	Cynthia	Dip Needle; Hand Sample	KL		1949
MacLeod, Duncan, and Kearney, Don	Ray	Clipping	KL		1925
McWatters Gold Mines Ltd.	Donovan	DD; Clipping	KL	17-1274′	1951
Martin	Brewster	GL	KL		pre 1920
Mattagami Explorers Corp.	Auld	GL; Clipping	KL		1963
Mattawapika Claims (H. A. Mark)	Klock	GL	KL		1969
Mayer Mining Co. Ltd.	Aston	Clipping	KL		1960
Mayer Mining Co. Ltd.	Cynthia	Clipping	KL		1960
National Steel Corp. of Canada Ltd.	Cotton	GP; SA	S		1954
National Steel Corp. of Canada Ltd.	Cotton	DD and sections	S	37-10, 136.5′	1955
New Delhi Mines Ltd.	Delhi	GP	S		1952
New Delhi Mines Ltd.	Delhi	DD	S	6-1270′	1952
New Delhi Mines Ltd.	Delhi	DD and sections and plans	S	5-1290′	1956
New Norzone Mines Ltd.	Delhi	GL; GP	S		1952
Ni-Ag-Co Mines Ltd.	Whitson	GL; DD; UG	KL	2-559′	1950
Noranda Mines Ltd.	Clary	DD; SA	S	1-1001′	1967
Noranda Mines Ltd.	DeMorest	DD; SA	S	1-777′	1967
Noranda Mines Ltd.	Turner	DD; SA	S	4-2989′	1967
Normingo Mines Ltd.	Turner	GL	S		1954
Ourgold Mining Co. Ltd.	Corkill	Clipping	KL		1965
Pearson, George	Corkill	GL	KL		1949-1957
Pollock, Bruce	Ray	GL	KL		1964
Quinlan, A. J.	Speight	GL	KL		1950
Rusty Lake Mining Corp.	Leith	GL; DD; SA; UG; Clipping, Thin section; Reference; Hand Sample	KL	9-2461′	1935-1964
Shannon, H. S.	Delhi	GL	S		1950

Table 13, continued

FILE NAME	TOWNSHIP	TYPE OF INFORMATION	S-SUDBURY FILES KL-KIRKLAND LAKE FILES*	NUMBER OF DRILL HOLES AND FOOTAGE	DATE OF WORK OR FILE
Siconor Mines Ltd.	Donovan	GL; MAG; Clipping; GP; Tr	KL		1960
Silver Chest Mines Ltd.	Corkill	GL; Correspondence	KL		1947
Silver Chief Mines Ltd.	Turner	GL; SA	S		1949
Silver Valley Mines Ltd.	Leith	GL; Clipping	KL		1933-1959
Solid Silver Mines Ltd.	Auld	GL; GC; DD; Clipping	KL		1958-1964
Spencer	Speight	GL; Tr	KL		*circa* 1912
Stanwick, Steve	Speight	rTr	KL		1970
Taylor, E. O.	Speight	Gl; rTr	KL		1912, 1950
Thompson-Lundmark Gold Mines Ltd.	Donovan	GL; DD	KL	10-713′	1949-1956
Triangle Silver Mines Ltd.	Auld	GL; UG; Hand Sample	KL		1920-1958
Truss, T. C.	Auld	GL; Thin section; Hand Sample	KL		1953
Walton-Quinlan	Auld	GL; DD; Hand Sample	KL	2-69′	1951-1953, 1956, 1957
Welsh, Beatrice M.	Auld	GL; DD	KL	6-1800′	1959
Welsh, Beatrice M.	Charters	GL; DD	KL	5-961′	1961
Welsh, Beatrice M.	Donovan	GL	KL		1961
White Reserve Mines Ltd.	Whitson	GL; DD; UG; Thin section; Hand Sample	KL	3-2107′	1918, 1948-1951
Wilder, F.	Donovan	GL	KL		1920, 1945
Wilkinson	Leith	GL	KL		1956

* Entries from Kirkland Lake files mainly from Lovell 1970.
** Gunnex Ltd. completed 21 holes, 2,500′ on this property in 1970.

Abbreviations:

A	Airborne
DD (2-2000′)	Diamond drilling, two holes, 2000 feet total
EM	Electromagnetic
GC	Geochemical
GL	Geological (may include maps and reports; company prospectuses and financial statements)
GP	Geophysical
MAG	Magnetic, magnetometer
Pros	Prospectus
SA	Sampling, assaying beneficiation studies
Tr	Trenching (rTr — rock trenching; sTr — soil trenching or stripping)
UG	Underground geology (also includes level plans with no geology)

ARGENTIUM SILVER MINES LIMITED (1)

BERGERON LAKE DEPOSIT

The Bergeron Lake deposit area is in van Nostrand Township and its approximate location is shown on the Makobe Lake Map (Map 2257, back pocket). The location of the pits shown on the map is taken from George (1968). They were not observed during field work and the following description is from Knight (1907, p.126):

> Bergeron's claim at south end of Bergeron lake, township of Van Nostrand. About 250 feet southeast of the portage a shaft has been sunk 25 feet. There is a vein here which shows about an inch of smaltite. Between here and the end of the portage mentioned another shaft has been sunk at the junction of two cracks. Cobalt bloom was noted on the surface at some points. The veins are in diabase.

ARGENTIUM SILVER MINES LIMITED (2)

DARBY SILVER MINE

In 1969, the company held a large block of claims about 1 mile wide along the eastern boundary of Whitson Township. Most of the claims are unsurveyed, but a few, including MR12840, MR17898, MR30303, MR30304, MR30306, MR30307, MR30308, MR30309, MR31310, MR31311, and MR38837 are surveyed. The main areas of interest on the property are two old mines, The Darby (2) and the White Reserve (6) Mines; see the Makobe Lake Map (Map 2257, back pocket) for the approximate location of these properties.

The main occurrence here is on surveyed claim MR12839, which represents an approximate restaking of HF23 (see Knight 1907, Map).

The claim was first worked around 1908 and 1909 but since that time there appears to have been little or no serious exploration attempted; the claim was mapped by Union Miniere Explorations and Mining Corporation Limited in 1968.

Robert Thomson (1948) described the property in some notes he made following a visit to the property; the following two paragraphs are condensed from these notes:

There are two short adits and a shallow shaft (the shaft was not found by the field party). The two adits have been driven into the gabbro ridge along the western shore of Darby Lake. The South Adit, which is about halfway along the lake, is about 120 feet long and trends N60W; there is a 20-foot deep winze about 80 feet from the portal. The North Adit is about 50 feet long trending S85W.

A short distance north of Darby Lake on top of the gabbro ridge is a shaft reported to be about 100 feet deep.

GENERAL GEOLOGY

The claim is underlain entirely by a westerly dipping Nipissing-type intrusion. Much of the intrusive rock on the property is red pegmatitic granophyre; this is especially so close to and at the adit portals. Robert Thomson (1948) found that veins are common near the contact of the granophyre with the more normal quartz gabbro. About 250 feet north of the South Adit this contact can be seen.

Veins

Knight (1907) mentioned the occurrence of six small veins from 1¼ inches or less in thickness and according to Robert Thomson (1948) five of these are on the western shore of Darby Lake. The vein structure in the South Adit in coarse-grained granophyric gabbro varies from a breccia zone up to 9 inches wide down to a mere fracture. It strikes N60W and dips 81S at the end of the adit. Robert Thomson (1948) observed erythrite and annabergite in the breccia zone.

Along the vein structure in the North Adit fractures and slips occur across a width of 9 feet; the main one is along the south wall and this dips 82S. Thomson

(1948) observed minor carbonate vein material with erythrite; also observed were native bismuth and cobalt arsenides. The bismuth occurs in narrow veinlets less than 1 mm thick.

A vein with erythrite strikes N50W through the shaft collar and dips out of the south side of the shaft at a depth of about 20 feet. Another vein at a depth of 80 feet is reported to contain cobalt. There is very little carbonate vein material in the vein structure (Thomson 1948).

ARGENTIUM SILVER MINES LIMITED (3)

GOLDIE LAKE DEPOSIT

At the northeast end of Goldie Lake, in van Nostrand Township, is a shaft that is 131 feet deep with 35 feet of crosscutting (OBM 1915, p. 128). An old blueprint of the area adjacent to the shaft is on file in the Ontario Division of Mines, Kirkland Lake Resident Geologist's Office. It indicates that the vein on which the shaft was sunk (No. 2) has been explored on the surface for a length of 60 feet from the shaft at a bearing of N80E. It also reports an assay of 65 ounces of silver per ton over 12 inches. There are numerous other sub-parallel veins in the general vicinity of the shaft. For the general location of this deposit see the Makobe Lake Map (Map 2257, back pocket).

ARGENTIUM SILVER MINES LIMITED (4)

NICCOLITE LAKE DEPOSIT

Three shallow pits (each about 8 feet by 8 feet) were found on the eastern shore of Niccolite Lake in van Nostrand Township. These pits were put down to test a 4-inch aplite dike that strikes N20W and dips to 70E. The only mineralization observed was some erythrite in a fracture in the aplite.

Peter George (1968) mentioned numerous pits along the north-pointing peninsula of gabbro in Niccolite Lake.

See the Makobe Lake Map (Map 2257, back pocket) for the approximate location of this deposit.

ARGENTIUM SILVER MINES LIMITED (5)

SKULL LAKE PROPERTY

Sergiades (1968, p.366) reported several veins, about 1 inch wide, in Nipissing Diabase on the eastern shore of Skull Lake in Speight Township; these veins showed some silver and smaltite. For the approximate location of this property see the Makobe Lake Map (Map 2257, back pocket).

ARGENTIUM SILVER MINES LIMITED (6)

WHITE RESERVE MINE

The main workings of this mine are on surveyed claims MR30307 and MR30308, in the eastern part of Whiston Township (see the Makobe Lake Map, Map 2257, back pocket, for the approximate location of the mine); these claims represent the former claims RSC55 and RSC56.

HISTORY AND DEVELOPMENT

According to Sergiades (1968, p.364) silver was first discovered here by the White brothers in 1907. In 1908, trenching and pitting were carried out by Canadian Ores Limited and the main shaft was put down 125 feet (Sergiades 1968).

In 1909 and 1910 the property was operated by White Reserve Mines Limited. This company deepened the main shaft to 140 feet and lateral development was done on the 70-foot and 140-foot levels. A 200-foot adit was also driven into the gabbro along Vein No. 21, which was the most productive vein on the property.

In 1914, the property was held by The White Reserve Mining Company Limited. Development by this company to the end of 1918 included the following: the main shaft was sunk a further 10 feet to a depth of 150 feet with a total 215 feet of lateral work on the 70-foot level and 822 feet on the 140-foot level. Three other shafts were also put down: No. 21 shaft was 90 feet deep with 110 feet of drifting on the 30-foot level; No. 10 shaft was 50 feet deep and No. 14 shaft 30 feet deep (Sergiades 1968).

There appears to have been little or no further underground work done since that time although various interests have carried out surface work and diamond drilling.

The White Reserve Mining Company Limited, in 1920, optioned the property to a group of individuals headed by J. B. Tyrrell (ODM 1921, p.125).

In 1945, Niki Silver-Cobalt Mines Limited dewatered and examined the workings (ODM 1946, p.95).

Ni-Ag-Co Mines Limited was formed in 1946 and their five-claim property included the White Reserve Mine. In 1950, this company dewatered the underground workings. The surface work included 200 feet of trenching and three diamond drill holes totalling 2,107 feet; underground exploration included five diamond drill holes totalling 618 feet.

The property was taken over by Argentium Silver Mines Limited in 1968 (Sergiades 1968). An option was taken on the property that same year by Union Miniere Explorations and Mining Corporation Limited. Work done by Union Miniere included geophysical, geochemical, and geological surveys and five diamond drill holes totalling 3,022 feet.

Some surface blasting has also been done by Argentium Silver Mines.

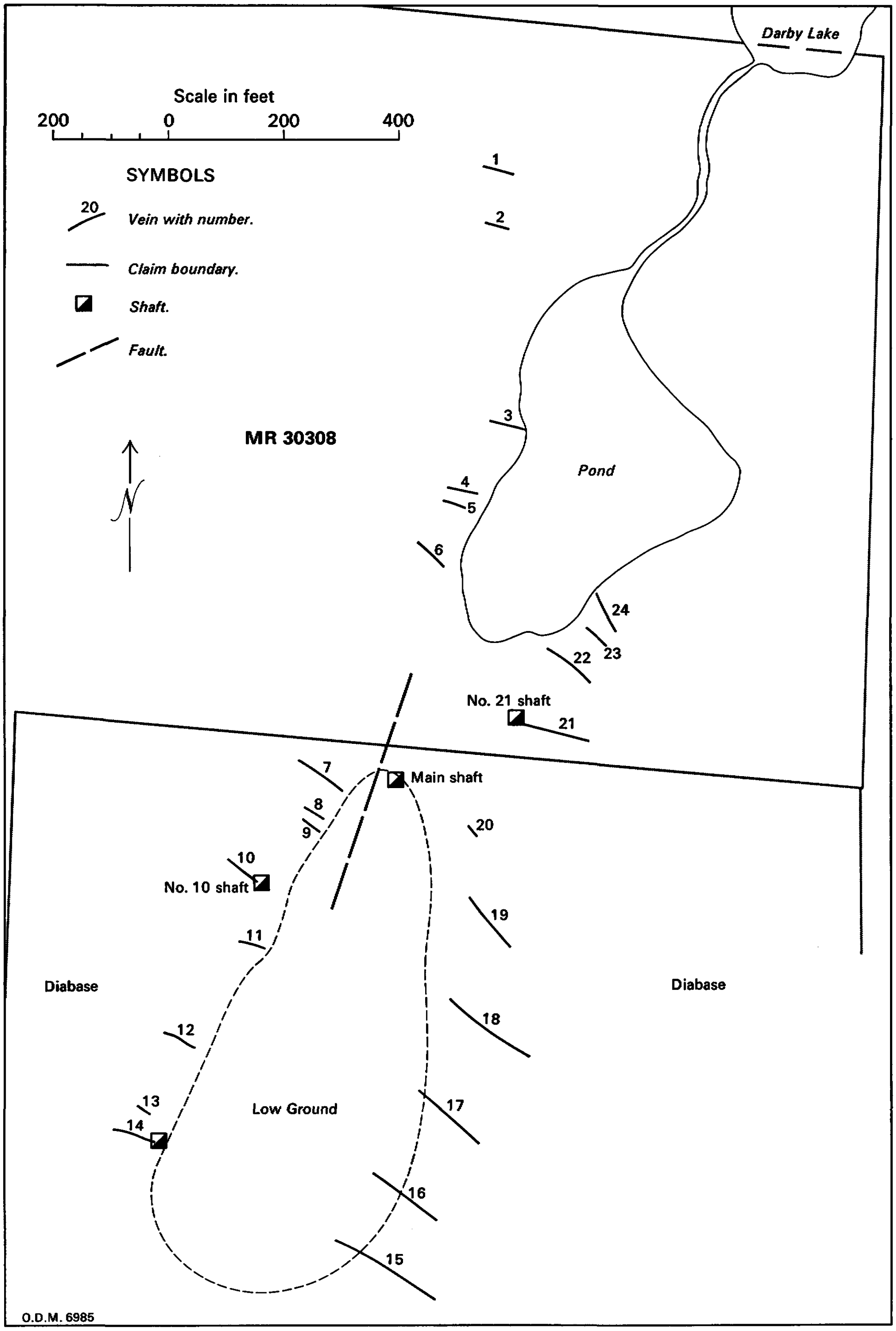


Figure 8—White Reserve Mine, Maple Mountain area, location of veins in vicinity of mine; from a company plan on file with ODM (claim lines do not correspond with recent staking).

GENERAL GEOLOGY

Feldspathic and micaceous sandstones have been intruded by a sill of Nipissing Diabase. Both the sedimentary rocks and the sill dip gently to the west; Peter George (1968) estimated a dip of 15 to 20 degrees for the sill and Collins (1913, p.56) gave a dip of 25 degrees at Darby Lake.

There are two north-south-trending ridges of gabbro separated by a depression through Darby Lake and extending to the south. Robert Thomson (1951) stated that in some old reports it has been suggested that this depression represents a major fault that is readily observable in the underground workings. However, in an examination of the workings Thomson (1951) did not find any evidence to suggest a major fault.

There are, however, two distinct types of gabbro on either side of the depression. The gabbro is fine-grained to the east of the depression and more coarse-grained and granophyric to the west.

ECONOMIC GEOLOGY

A total of 24 veins have been found on the surface and several of these have been explored underground. Figure 8 shows the location of these veins.

All the veins are entirely in Nipissing Diabase and they are usually associated with aplite dikes (Robert Thomson 1951). George (1968) stated that the veins are in narrow fractures that are commonly sub-horizontally slickensided. Wall-rock alteration includes carbonatization and to a lesser degree epidote alteration.

The following paragraphs describing the veins have been summarized from Robert Thomson (1951).

The veins have been found on both sides of the Darby Lake depression but none has been traced across the depression. The veins are sub-parallel and form a set striking northwesterly and have a vertical dip. Two north-striking veins were found on the 140-foot level.

The veins occur near the contact of a transition zone between coarse-grained gabbro overlying fine-grained gabbro; none has been traced to either the upper or lower contact of the sill. It is difficult, however, to trace the veins over any great distance as the vein structures are narrow fractures. Although the ore shoots, which have been found, were rich, they were very small.

Robert Thomson (1951) observed the following minerals: native silver, which occurs in the veins and as leaf silver in the wall-rock; niccolite; bismuth; gold, reported from No. 10 vein; cobalt, reported from No. 10 vein in amounts up to 10 percent over 7 inches; chalcopyrite (minor); and ullmannite (NiSbS), one of the cobaltite group, in the gabbro. Pink, white, and dark grey calcite also occurs. The dark grey to black calcite contains magnetite. The texture of the calcite in some of the veins indicates that it may occur as a replacement of the gabbro.

No. 21 Vein

This vein was the most productive and most extensively developed. Thomson

(1951) examined the vein and the following two paragraphs are summarized from his report:

The vein is up to 1½ inches wide and silver has been found in the wall-rock up to 1 inch from the vein. The vein strikes N77W and is nearly vertical. It has been traced for 200 feet east of the shaft by pits and trenches and at the extreme east the vein is just a narrow fracture.

Specimens examined from the dump of the No. 21 shaft are of pink calcite, although other parts of the vein are dark grey, containing argentite and some native silver. In part, the vein is a breccia in which gabbro inclusions are completely altered to dark green scaly chlorite. Vugs, up to ½ inch in diameter, contain clear calcite crystals. Chalcopyrite is minor in both the vein and the wall-rock. Cobalt arsenides are present and some appear to be safflorite $(Co,Fe)As_2$.

Production

According to Sergiades (1968, p.364), a probable 18,002 ounces of silver were produced in 1909 and between 1920 and 1940 there was a total of 6,773 ounces of silver and 452 pounds of cobalt and 267 pounds of nickel produced.

Underground Workings

Four shafts were put down by early workers and these were known as the Main Shaft, No. 10 Shaft, No. 14 Shaft, and No. 21 Shaft. The shafts were numbered according to the vein number on which they were put down. Underground workings are shown on Figure 9 (most of the information in this section is from company plans).

The Main Shaft is vertical and is just north of No. 7 vein (not labelled on Figure 9) and is reported to be 150 feet deep. Levels have been developed at 70 feet and 140 feet.

No. 10 Shaft is 50 feet deep; from the shaft there is also an adit bearing N78W into the gabbro hill. A vein structure up to 3 inches wide with erythrite is found in the adit (vein not shown on Figure 9).

Sergiades (1968) reported a depth of 30 feet for No. 14 Shaft; Thomson (1951) reported two fractures about 5 feet apart containing erythrite.

No. 21 Shaft is 90 feet deep with a level developed at 20 feet; these workings do not connect with the Main Shaft. The level has been stoped to the surface in places.

Diamond Drilling

Diamond drilling programs were undertaken by Ni-Ag-Co Mines Limited and Union Miniere Explorations and Mining Corporation Limited.

Assays reported in the Ni-Ag-Co Mines drill logs on file with the Ontario Division of Mines (Resident Geologist's Office, Kirkland Lake) indicate only trace

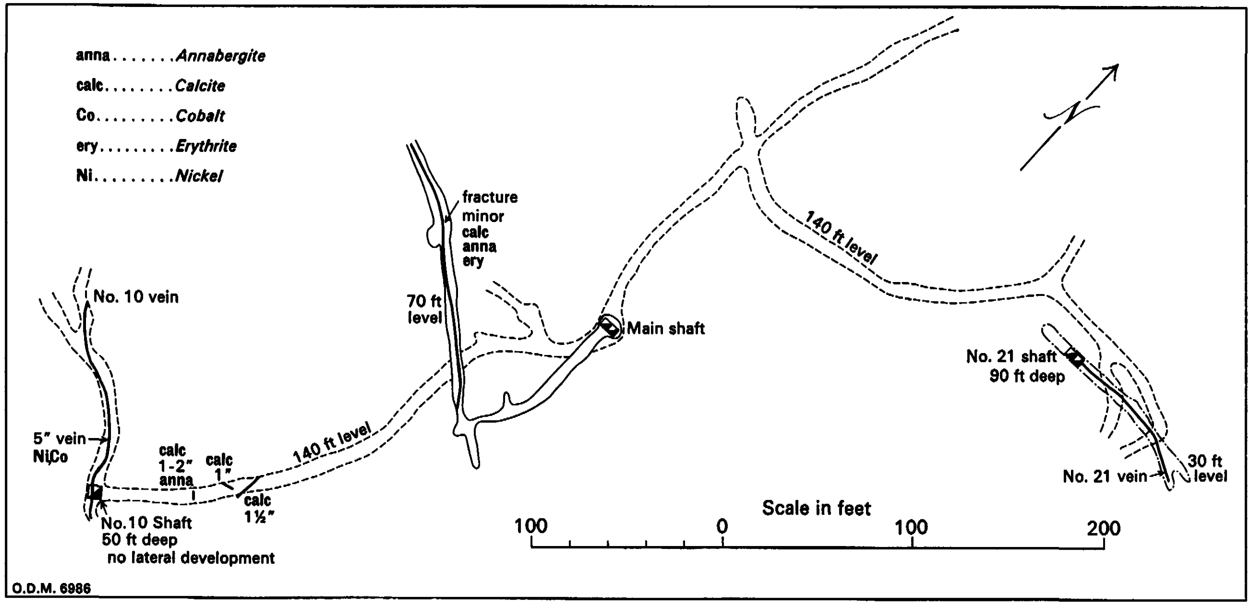


Figure 9—White Reserve Mine, Maple Mountain area, underground plans of Main Shaft and No. 21 Shaft workings; after Ni-Ag-Co Mines Limited company plans, *circa* 1946.

amounts of silver in hole No. 3. Underground drilling by Ni-Ag-Co Mines is indicated only by underground plans of this company on file with the Ontario Division of Mines; no logs are on file.

Union Miniere Explorations and Mining Corporation Limited drilled five holes in the vicinity of the mine workings; all were put down to explore the downward extension of known veins.

The No. 1 hole was under 21 and 22 veins, No. 2 under 7, 8, 9, and 10 veins, No. 3 beneath 12, 13, and 14 veins and No. 4 beneath 3, 4, and 5 veins; hole No. 5 was put down under two mineralized zones on the western shore of Darby Lake.

Assay results indicated a 4-foot wide zone from 478.5 feet to 482.5 feet in hole 3 that averaged 1.60 ounces of silver per ton. All other assays were less than 0.30 ounce per ton (Assessment work files, Ontario Division of Mines, Resident Geologist's Office, Kirkland Lake).

Geophysical Surveys

Union Miniere Explorations and Mining Corporation Limited conducted ground and air magnetic surveys, and ground electromagnetic surveys, of the property.

The air magnetic surveys outlined the gabbro. The ground magnetic survey also showed numerous anomalies; one of these within the gabbro was attributed to thickening of the gabbro due to faulting.

Four conductors were outlined by the electromagnetic survey; none, however, were of economic significance.

Geochemical Survey

Union Miniere Explorations and Mining Corporation Limited also undertook a bedrock geochemical survey to obtain data on the distribution of Ag, Co, Ni, and Bi in the gabbro.

Several anomalous areas were found but none was considered significant.

W. S. ARMSTRONG, ESTATE (7)

In 1969, this property between Philbrick and McKenzie Lakes in Speight Township consisted of 5 surveyed claims: HR726, MR5128, MR5129, MR5130, and MR5268. The claim group straddles the northwestern rim of the Philbrick Lake gabbro basin; see the Makobe Lake Map (Map 2257, back pocket) for the approximate location of this property.

During the field work in 1969, a pit was found on MR5129 and a series of 3 pits were found on HR726.

The pit on MR5129 is approximately 6 feet by 4 feet and 4 feet deep. It has been put down on a vertical fracture zone striking N15E. Epidotized slickensides were observed in the dump material.

On HR726 a series of 3 pits were observed on the northwestern side of the gabbro ridge (top pit is 5 by 5 by 3 feet deep, middle pit is 6 by 6 by 5 feet deep, and bottom pit is 4 by 4 by 4 feet deep). They are each 20 feet apart and have been put down on a narrow fracture zone trending N50W; some calcite with minor pyrite was observed in the dump material.

W. A. BEATTY (8)

This Charters Township property is described in McIlwaine (1971) and its approximate location is shown on the Smoothwater Lake Map (Map 2256, back pocket).

ANDREW BYBERG (9,10,11)

In 1969, the owner held two properties in Donovan Township and one in Charters Township; the approximate locations of these properties are shown on the Smoothwater Lake Map (Map 2256, back pocket).

CHARTERS TOWNSHIP (9)

This Charters Township property is described in McIlwaine (1971).

GOWGANDA-DUGGAN MINE (10)

The claim is underlain by fine- to medium-grained Nipissing Diabase and is near the footwall contact of the west-dipping northeast rim of the Smoothwater Lake gabbro basin.

Mineralization was evidently discovered here in 1909 and some development work was done at that time in the form of trenching (Burrows 1921). Burrows described a vein on HR720 (MR30245 is an approximate re-staking of HR720) as follows:

> . . . On claim H.R. 720 there is a calcite vein three inches in width with strike N.71 degs.W., that has been traced for about 400 feet on the claim and on adjacent claim to the northwest for 200 feet. A little native silver, smaltite and niccolite were found in places in the calcite. A pit 10 feet deep was sunk on the vein 150 feet east of No. 4 post. Just west of the pit is another vein, three inches in width, showing calcite with a little smaltite, crossing the longer vein. Two veins of calcite carrying bloom and copper pyrite occur in Northwest part of claim T.C.418.

Two shallow shafts were put down in 1923 by the Gowganda Duggan Silver Syndicate (ODM 1924, p.87). Shaft sinking continued during the following year and by the end of 1924 there were three shallow shafts; one of these was down to 50 feet and 40 feet of drifting was done from the bottom (ODM 1925, p.156). In 1926, the main shaft was continued from 50 feet to a depth of 165 feet (ODM 1926, p.147). This work was performed by Gowganda-Duggan Silver Mines Limited. In 1927, the main shaft was put down to 312 feet and levels established at 150 feet and 300 feet. Drifting on the 150-foot level went for 65 feet east and 60 feet west from a 20-foot crosscut. There was 235 feet of crosscutting and 208 feet of drifting on the 300-foot level (ODM 1927, p.159). Only some of the shafts were found by the field party.

By the end of 1928 greater than 900 feet of lateral work was completed with over 800 feet of this on the 300-foot level (ODM 1928, p.169).

Batchelor Duggan Mines Limited acquired the property in 1936 but no work was recorded.

In 1963, the property was optioned by Consolidated Red Poplar Minerals Limited from the present owner and work was carried on over the summer months. This work included cleaning out and deepening some of the old trenches.

Numerous samples were collected but assay results indicated low 'silver values' (Sullivan 1963). The logs of six diamond drill holes were submitted for assessment credit; these holes totalled 1,097 feet and were all drilled from north to south. Four were drilled to the west of the shaft to investigate the downward extension of the main vein but met with limited success. The others were drilled to the east of the shaft to investigate the reason for underground development southeast of the shaft (Sullivan 1963). Assay results were all very low with 0.22 ounce of silver per ton over a core length of 2 feet, the highest result obtained.

A sample from the 10-foot depth in a shallow shaft gave 311.9 ounces of silver per ton on assay (Sullivan 1963).

THOMPSON MINE (11)

This property was held, in 1969, by Andrew Byberg by virtue of his staking the four claims MR50297, MR50484 to MR50486; the mine is just north of Collins Lake, Donovan Township.

The Thompson deposit was found prior to 1920 and early development consisted of the sinking of a shallow shaft, to about 30 feet, and some trenching. In 1920, the property was optioned to Thompson-Lundmark Gold Mines Limited. Subsequently short options were held by Moneta Porcupine Mines Limited (date not known), McWatters Gold Mines Limited (1951), Hasaga Gold Mines Limited (1956). Logs of 17 short diamond drill holes totalling 1,273.6 feet were submitted for assessment credit by McWatters Gold Mines, also 10 holes by Hasaga Gold Mines, totalling 660 feet. Figure 10 shows the work by Hasaga and also previous workings on the property. No assays were submitted by McWatters.

In 1960, Siconor Mines Limited held the property as part of a large block of claims. Work carried out by Siconor included electrical resistivity and magnetic geophysical surveys (Szetu 1960) and geological mapping (MacVeigh 1960).

GENERAL GEOLOGY

Except for the small area of Archean metavolcanics at the northwestern corner of Collins Lake, all of the rocks on the property are medium- to coarse-grained

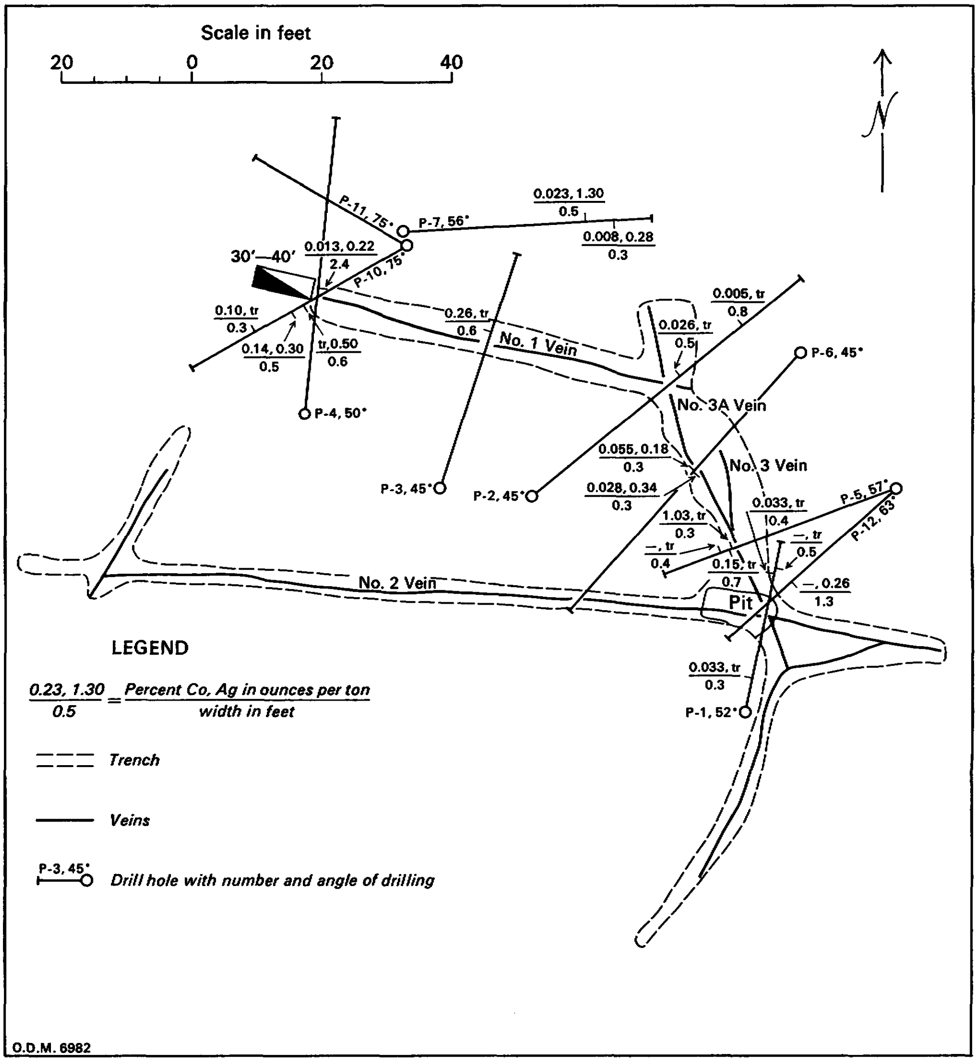


Figure 10—Thomson-Lundmark occurrence, in the Maple Mountain area, showing diamond drill holes by Hasaga Gold Mines Limited, 1956.

Nipissing Diabase. The metavolcanics have been exposed due to the fault going through Collins Lake. The gabbro dips gently to the west; this area of gabbro is part of the northeast rim of the Smoothwater Lake basin.

ECONOMIC GEOLOGY

The following two paragraphs are summarized from MacVeigh (1960):

There are three main veins at this occurrence: veins No. 1 and No. 2 strike east and vein No. 3 strikes north and intersects No. 2; vein No. 3A is a branch of No. 3, which intersects vein No. 1 (Figure 10). Fifty pounds of silver were recovered from the junction of No. 2 and No. 3 veins by Thompson-Lundmark Gold Mines Limited. The most persistent vein appears to be No. 2; it is vertical and has been traced for 380 feet to the east across the valley of the fault through Collins Lake. Assays of 10 ounces of silver per ton over 3 inches and 7 ounces of silver per ton over 5 inches were obtained by MacVeigh (1960).

No. 1 vein is exposed over a 1-inch width in the southeast corner of the shaft; there is some visible silver.

Sergiades (1968, p.415) reported assays of up to 2,000 ounces of silver per ton and 5 percent cobalt. Assays from logs of Hasaga Gold Mines Limited reported up to 1.30 ounces of silver per ton over 0.5 foot (see Figure 10 for assay values).

ELEANOR LAKE DEPOSIT (18)

A short note by Robert Thomson in the Kirkland Lake files stated that G. Byles reported to him, in 1960, that 'there is a silver or cobalt vein' in Nipissing Diabase on the northeastern side of Eleanor Lake in Ray Township. This was not found during the field work, but the approximate location of this deposit is shown on the Smoothwater Lake Map (Map 2256, back pocket).

WILLIAM GARVEY, ESTATE (20)

This Charters Township property is described in McIlwaine (1971) and its approximate location is shown on the Smoothwater Lake Map (Map 2256, back pocket).

G. J. GEREGHTY (21)

In 1969, G. J. Gereghty held four unsurveyed claims, L21508 to L21511 inclusive, on and around the northern end of Barr Lake in Brewster Township; see the Smoothwater Lake Map (Map 2256, back pocket) for the approximate location of these claims.

The following three paragraphs are summarized from correspondence with Gereghty (1970, written communication):

There is a mineral occurrence on a small hill of outcrop just west and above the river flowing from Barr to Kaa Lakes (this outcrop was not found during reconnaissance mapping by the field party).

A pit measuring 8 feet by 8 feet by 25 feet deep has been put down on a narrow north-striking fracture zone with narrow veins of nickel-cobalt arsenides; the nickel is in the form of niccolite. Some shallow trenching was done north of the pit for about 50 feet.

Mr. Gereghty also found evidence of diamond drilling by former owners of the claim.

According to the Smoothwater Lake Map (Map 2256, back pocket) this occurrence is in the Lorrain Formation but it is possible it is associated with a gabbro dike.

Haines Deposit (22)

This deposit is on the former Haines claim (GG2606) in Donovan Township and its approximate location is shown on the Smoothwater Lake Map (Map 2256, back pocket). It was not staked in 1969, but lies adjacent on the east to claim GG2882. The deposit was not observed during the field work but has been described by Burrows (1921, p.42-43) as follows:

> . . . a shallow shaft has been sunk on a calcite vein from an inch to two and a half inches in width with a strike N62 degs.E. The vein carries disseminated smaltite [(Co,Ni) As_{3-x}], niccolite [NiAs], chloanthite [(Ni, (Co) As_{3-x}] and some native silver. The rock is a coarse-grained diabase showing some reddish granophyric interstices of quartz and feldspar.

Hardiman Bay Mines Limited [1966] (24)

During the winter of 1965-1966 Hardiman Bay Mines Limited held a group of 18 unsurveyed claims on and around Gooseneck Lake in Brewster Township; see the Smoothwater Lake Map (Map 2256, back pocket) for the approximate location of these claims.

The property is underlain by Lorrain Formation intruded by Nipissing Diabase, which dips south to southwest.

Hardiman Bay Mines conducted geophysical surveys, including magnetometer and electromagnetic surveys, and geological mapping. The electromagnetic survey indicated a conductor about 1,200 feet long trending northwest along the southern part of Gooseneck Lake. Subsequent diamond drilling on this conductor indicated nothing of economic value.

The results of the above work were submitted for assessment work credit and are on file with the Ontario Division of Mines (Resident Geologist's Office, Kirkland Lake).

JAMES HILLCOAT (25)

In 1969, James Hillcoat held two unsurveyed claims (L225184 and L225185) east of Steele Lake in northern Donovan Township. The approximate location of these claims is shown on the Smoothwater Lake Map (Map 2256, back pocket).

The claims are near the hanging-wall contact of the westerly dipping northeast rim of the Smoothwater Lake gabbro basin.

About 700 feet east of Steele Lake is a shaft of unknown depth. There are several trenches adjacent to the shaft. Carbonate and quartz-carbonate vein material was observed in the dump material; chalcopyrite was observed. Two grab samples taken during the field season and analyzed by the Mineral Research Branch of the Ontario Division of Mines gave the following results:

a – 0.42 percent copper and traces of cobalt, nickel, and silver.
b – 0.15 ounce of silver per ton and traces of cobalt, copper, and nickel.

HENRY KING (29,30)

In 1969 Mr. King held two blocks of claims in Speight Township: the Boundary claims (29), and the Munroe Lake deposit (30). The approximate location of both of these blocks of claims is shown on the Makobe Lake Map (Map 2257, back pocket).

BOUNDARY CLAIMS (29)

Mr. King, in 1969, held two unsurveyed claims (MR50554 and MR50555) just south of the north boundary and in the central part of Speight Township. He reported (1970, written communication) that some stripping, drilling, and blasting had been done and also reported the occurrence of silver, gold, cobalt, and bismuth. The claims are underlain by gabbro.

MUNROE LAKE DEPOSIT (30)

In 1969, the Munroe Lake property consisted of three unpatented claims (L212496, L212497, and L212498) just south of Munroe Lake in Speight Township. The claims straddle the northeast-trending rim of the Philbrick Lake gabbro basin.

The deposit is about 600 feet south of Munroe Lake; a calcite vein strikes N35E and dips 75NW and is 2 to 4 inches wide. Chalcopyrite and pyrite are visible in the vein, which is hosted by coarse-grained light green gabbro.

Two grab samples were taken by the field party and analyzed by the Mineral

Research Branch, Ontario Division of Mines. The analytical work gave the following results:

a – 130.5 ounces of silver per ton, 0.07 percent copper, and traces of nickel and cobalt.
b – 349.6 ounces of silver per ton, 0.20 percent cobalt, 0.19 percent copper, and a trace of nickel.

A pit 5 feet by 5 feet and about 7 feet deep was observed near the vein but the vein was not seen in the pit. There is also a trench about 2 to 4 feet wide and about 30 feet long in which the vein has been exposed.

As there was no visible silver in the analyzed samples it would indicate that the silver is very finely divided and that this occurrence merits more work.

Henry King (1970, written communication) reported drilling had also been done; he also reported the presence of gold.

LYNCH DEPOSIT (35)

A shaft was put down on this deposit in Speight Township, in the early days and is thought to be about 50 feet deep (H. Lynch, prospector, 1969, personal communication).

The shaft was put down on a carbonate vein up to 4 inches wide; the vein strikes N50W and is vertical. The vein has been further explored about 50 feet to the southeast by a pit that has exposed minor silver in a fracture zone in granophyric gabbro with minor carbonate. Chalcopyrite, pyrite, and erythrite were also observed. This latter work was done by H. Lynch and his associates in the summer of 1969. See the Makobe Lake Map (Map 2257, back pocket) for the approximate location of this property.

WILLIAM MOORE (43)

In 1969, William Moore held three unsurveyed claims (MR47780, MR47781, and MR47783) on and around the northern end of McKenzie Lake in Speight Township; see the Makobe Lake Map (Map 2257, back pocket) for the approximate location of these claims.

The claims straddle the northeast-trending north rim of the Philbrick Lake gabbro basin.

Workings on this property include a trench that is 3 to 5 feet deep and about 100 feet long; some stripping has also been done around this trench.

The trench has exposed a calcite vein, 4 to 12 inches wide; the vein strikes N45E and dips 70NE.

A grab sample taken by the field party contained visible pyrite; upon analysis by the Mineral Research Branch of the Ontario Division of Mines the following results were obtained: 4.30 ounces of silver per ton and traces of copper, cobalt, and nickel.

OURGOLD MINING COMPANY LIMITED (47)

The Corkill Township property of Ourgold Mining Company Limited is described in McIlwaine (1971). Its approximate location is shown on the Smoothwater Lake Map (Map 2256, back pocket).

REEKIE LAKE OCCURRENCE (48)

North of Reekie Lake in Leckie Township, several old pits have been opened in mineralized Nipissing Diabase and small quartz-carbonate veinlets. Sulphide minerals, which are present in amounts less than 5 percent, include pyrrhotite, chalcopyrite, and galena. For the approximate location of this property see the Smoothwater Lake Map (Map 2256, back pocket).

RUSTEX MINING CORPORATION (49)

For a description of this Leith Township property the reader is referred to Masters (1971). The approximate location of the property is shown on the Smoothwater Lake Map (Map 2256, back pocket).

TAYLOR DEPOSIT (52)

Former claim HS574, locally known as the Taylor claim, was not held in 1969; it is about 500 feet from the centre of the southeastern shore of McKenzie Lake in Speight Township; see the Makobe Lake Map (Map 2257, back pocket) for the approximate location of this claim.

The main feature of the deposit is a predominantly carbonate vein, which, for the most part, varies between 5 and 15 inches wide, and is in a fracture zone up to 4 feet wide. The vein parallels the contact of the northwest rim of the Philbrick Lake gabbro basin and dips steeply southeast. Previous workers, between 1915 and 1917, exposed the vein for a distance of about 600 feet by trenching and pitting. A shaft, 155 feet deep with some 25 feet of lateral work at the 150-foot level, was also put down near the northeast end of the trenching.

Robert Thomson (1953a) examined the surface workings and reported that erythrite was common in numerous places along the vein; he also reported the presence of chalcopyrite and cobalt arsenides and, in one place, galena. No silver was observed but William Moore (1970, written communication) reported that some native silver was found in the early days.

TREMBLE LAKE DEPOSIT (53)

Two pits were observed in Nipissing Diabase about ¼ mile east of Tremble Lake in Ray Township. One of these pits expose a north-striking ½-inch quartz-carbonate vein; no mineralization was observed. The approximate location of this property is shown on the Smoothwater Lake Map (Map 2256, back pocket).

TRUSS DEPOSIT (54)

Robert Thomson (1953b) described pits and trenches (not found by the field party) about 300 feet north of the Montreal River, opposite the mouth of Mocassin Creek, in Auld Township; see the Makobe Lake Map (Map 2257, back pocket) for the approximate location of this deposit. These workings are in gabbro and were blasted to investigate some radioactivity that had been detected. Chlorite was found along east-west fractures that were thought to contain the radioactivity; pyrite and chalcopyrite were also observed.

H. G. WALTON (55)

BRADLEY-DONALDSON MINE

In 1969, H. G. Walton held four claims, L213456, L213457, L213458, and MR19274, along the western shore of Lepha Lake in Auld Township and occupying the east half of lot 5, concesssion IV. See the Makobe Lake Map (Map 2257, back pocket) for the approximate location of these claims.

This occurrence known as the Bradley-Donaldson was evidently discovered prior to 1910 as it was mentioned by Miller (1910, p.163). Burrows and Hopkins (1922, p.15) stated that "no work has been done for several years" but that an adit had been driven westward into a high ridge of 'diabase'. According to Robert Thomson (1953c) several small pits north of the adit were put down by the present owner. Logs for two short diamond drill holes, totalling 68.5 feet, were submitted in 1957 for assessment work credit (Assessment Work Files, ODM, Kirkland Lake).

GENERAL GEOLOGY

The occurrence is located near the footwall contact of an easterly dipping gabbro intrusion. The overlying rock is feldspathic sandstone of the Lorrain Formation.

The main vein has been exposed for about 50 feet by an adit that has been driven from the lakeshore at S80W into the gabbro cliff. The bottom of the adit has been excavated to a depth of 35 feet (Robert Thomson 1953c) but was flooded in 1969.

The following paragraph is paraphrased from Robert Thomson (1953c):

There are about 15 fractures over a width of 6 to 7 feet in the adit; there are at least 3 calcite veins up to 3 inches wide in the fractures. Minerals observed include quartz, carbonate, chalcopyrite, bornite, and erythrite.

B. M. WELSH (57)

This Charters Township property is described in McIlwaine (1971) and its approximate location is shown on the Smoothwater Lake Map (Map 2256, back pocket).

B. M. WELSH (56,58)

In 1969, the owner held 13 unsurveyed claims in the northeastern corner of Auld Township; the claims occupied the southern three-quarters of the west half of lot 2, concession VI, all of lot 3, concession VI, and the northern three quarters of the east half of lot 4, concession VI; see the Makobe Lake Map (Map 2257, back pocket) for the approximate locations of these two properties. Historically there are two known occurrences: the Triangle Silver Mine (58) is in the southwest quarter of the south half of lot 2, concession VI and the southeast quarter of the south half of lot 3, concession VI; a smaller occurrence is located just southwest of the lake in the west half of lot 3, concession VI and is locally known as the Charron silver mine (56).

CHARRON SILVER MINE (51)

A 30-foot shaft was put down on this silver find *circa* 1913 (Cunningham 1962) and was known as the Charron silver mine. Very little exploration was done from that time until 1959 when the present owner put down three diamond drill holes; some trenching was done in 1960 (Ogden 1962).

This mine formed part of the ground optioned by Kordol Exploration Limited, and as part of their diamond drilling program one long drill hole was put down at this site.

GENERAL GEOLOGY

The occurrence is close to the east-dipping footwall contact of the Nipissing

Diabase where it intrudes feldspathic and micaceous sandstones of the Lorrain Formation. The gabbro is fine to medium grained.

ECONOMIC GEOLOGY

The following two paragraphs are summarized from Ogden (1962):

A number of easterly striking calcite stringers with copper and silver mineralization have been found. Two veins can be seen in the shaft and one is exposed 25 feet to the east where minor silver can be seen.

Diamond drill holes Nos. 1 and 2, put down in 1959, encountered veins about halfway down the hole; this would put them north of the veins exposed in the shaft. Another vein, 150 feet south of the shaft, was encountered in the No. 3, 1959 drill hole; the vein assayed 24 to 97 ounces of silver per ton over 8 inches.

TRIANGLE SILVER MINE (58)

HISTORY AND DEVELOPMENT

Silver was apparently first discovered in lot 3, concession VI in 1912 and in lot 2 the following year; at that time it was known as the Hitchcock Location. Kenabeek Silver Mines Limited was formed in 1916 to develop the property; in 1917 the company was reorganized to form Kenabeek Consolidated Silver Mines Limited. These companies started shaft sinking and were down 150 feet by the end of 1917. They also did some crosscutting and drifting on the 132-foot level. After going into liquidation in 1918 Kenabeek Consolidated was reorganized in 1919 as Triangle Silver Mines Limited; this new company deepened the shaft to 188 feet and did about 100 feet of lateral development on the 182-foot level. An adit was also driven 125 feet into the hill 290 feet west of the shaft along the Tunnel Vein. Work was terminated early in 1920 and Triangle Silver Mines went into liquidation in 1922 (Burrows 1921, p.50-51; Burrows and Hopkins 1922, p.14-15).

Silver Sill Mining Company Limited was incorporated in 1923; further development by this company in 1924 included deepening the shaft to 250 feet with 376 feet of lateral development at this level. Figure 11 shows the underground plans of the mine. Information on this property comes from a variety of sources and the sources do not all agree as to the depths of the intermediate levels established in the mine.

The claims then became open for staking and were subsequently acquired by the present owner. In 1959, two diamond drill holes, totalling 833.2 feet, were put down in the vicinity of the shaft (Figure 11).

The property was optioned in 1961 to Kordol Exploration Limited. Work by this company included geological mapping by Ogden (1962) and 14 diamond drill holes, totalling 2,597 feet. The option was dropped.

Another option was taken, in 1963, by Mattagami Explorers Corporation.

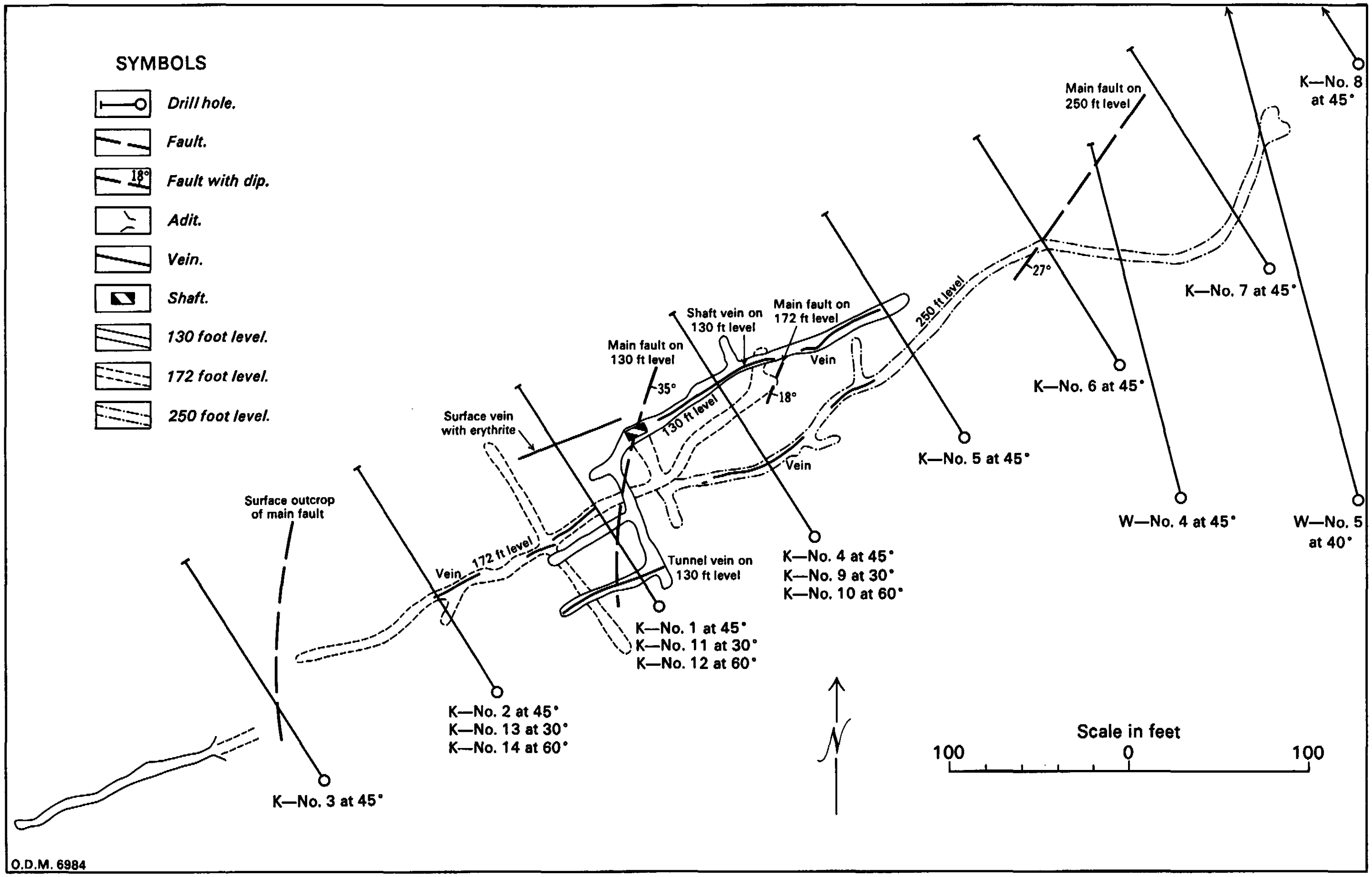


Figure 11—Triangle Silver Mine underground plan; after plans by Kordol Exploration Limited, drill holes by B. M. Welsh, 1959, are shown by W, and by Kordol Exploration Limited, 1962, are shown by K.

GENERAL GEOLOGY

Feldspathic sandstone of the Lorrain Formation is intruded by the easterly dipping western rim of the Henwood gabbro basin (Robert Thomson 1966). Ogden (1962) reported a dip of about 45E for the gabbro in the vicinity of the mine. The gabbro is fine to medium grained in texture and is dark to light grey with local pink granophyric areas.

One northerly striking fault has been recognized in the underground workings (Ogden 1962). The fault dips 35E and has caused a sinistral displacement of rock units of about 60 feet (Ogden 1962). Ogden also recognized two similar faults in the same area from aerial photographs.

ECONOMIC GEOLOGY

The silver-cobalt-bearing carbonate veins in the mine all occur in association with the footwall contact and are all normal to the contact (Cunningham 1962). The two main veins on the property are described by Cunningham (1962) as the Shaft Vein and the Tunnel Vein; the following descriptions are mainly summarized from his report.

Shaft Vein

The Shaft Vein was exposed at the surface about 8 feet north of the shaft; it has been explored by an open cut about 30 feet long beginning about 25 feet west of the shaft. The vein strikes N70E and is almost vertical. Burrows and Hopkins (1922, p.15) reported the vein striking N66E and dipping 80S on the 132-foot level.

At the surface the Shaft Vein is a mineralized fracture zone, 4 feet wide, with individual veinlets or stringers, up to 4 inches wide. Drilling has indicated that this zone system is at least 1,700 feet long; in depth the vein has been traced down to the bottom of the mine workings.

Mineralization observed in the vein includes silver, cobalt arsenides, erythrite, chalcopyrite, galena, and sphalerite.

Tunnel Vein

The Tunnel Vein is sub-parallel to and about 70 feet south of the Shaft Vein. The strike is not constant; in the adit the vein strikes about N72E and to the northeast of the adit it strikes N53E. The vein dips about 80S. The vein structure is a fracture zone varying from 1 inch to 3 inches wide. There is very little carbonate material or metallic mineralization. The vein has been trenched for 150 feet above the adit on top of the hill.

Cunningham (1962) considered that south crosscuts on the 127-foot and 172-foot levels cut the Tunnel Vein and that the vein was followed for about 60 feet on the 127-foot level.

One sample from the Tunnel Vein assayed 2,030 ounces of silver per ton in the vein and the adjoining wall-rock assayed 40 to 104 ounces per ton (Cunningham 1962).

Diamond Drilling

Two drill holes (Figure 11) put down by the present owner, in 1959, were all in gabbro but no assay results were recorded on the logs submitted for assessment work credit.

Fourteen holes (Figure 11) were put down by Kordol Exploration Limited in 1962; all rock encountered was gabbro. Assay results (in ODM Assessment Work Files, Resident Geologist's Office, Kirkland Lake) from this work were not encouraging; from 216 sludge assays 150 gave nil or trace silver and 64 of them were less than 1 ounce per ton and only two were greater than 1 ounce. The highest was 2.91 ounces of silver per ton. A total of 39 core assays were made and 15 of these gave nil or trace. Of the rest, 16 were less than 1 ounce and 8 greater than 1 ounce with the best result obtained being 14.69 ounces of silver per ton.

Underground Workings

In plans from Kordol in 1962, (the underground workings are shown in Figure 11) the shaft is 250 feet deep with levels developed at 130 feet, 172 feet, and 250 feet; the adit is 140 feet long. As mentioned previously there appears to be a variety of depths published by different sources.

Production

The only reference to production found was the statement by Sergiades (1968, p.362) that some silver ore was raised *circa* 1918.

FRANK WILDER (59)

LOCATION AND HISTORY

In 1969, the Wilder property consisted of four surveyed claims (GG3541, GG3542, GG4117, and GG4118) located just west of Kenneth Lake in Donovan Township; see the Smoothwater Lake Map (Map 2256, back pocket) for the approximate location of this property. The mineral occurrences on the property were found by Frank Wilder in 1912. Burrows (1921, p.44) reported that Wilder

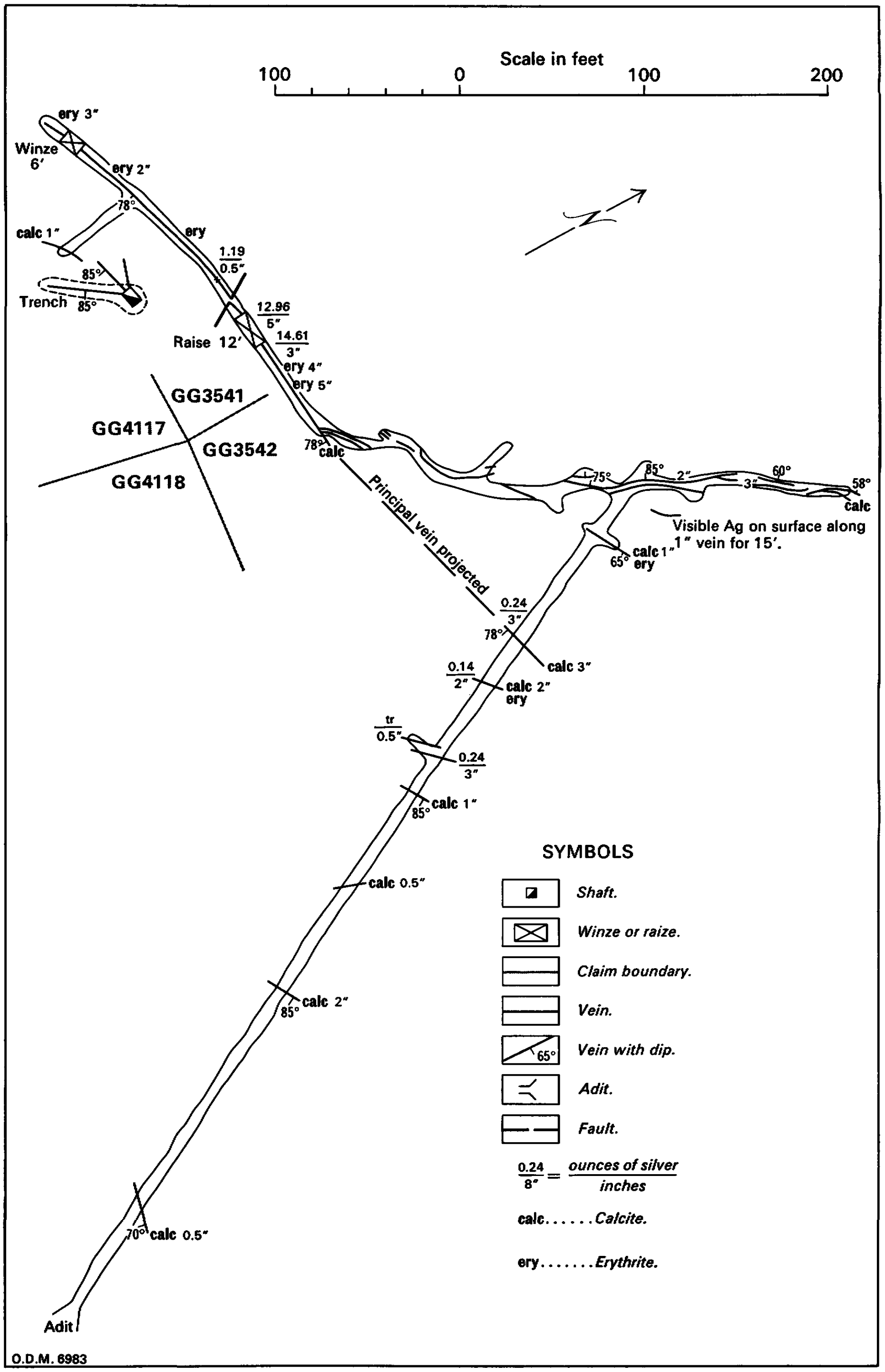


Figure 12—Plan of Wilder adit workings in Maple Mountain area (after a plan by E. L. MacVeigh 1960).

did surface exploration in 1920; a 28-foot open cut about 5 feet deep was made along a calcite vein ½ inch to 2 inches wide, striking N65E to N45E.

In 1929, the property was optioned to Miller Lake O'Brien Mines Limited; work done by this company included 1,000 feet of lateral work from an adit and sinking a 50-foot shaft.

In 1960, the property was optioned to Siconor Mines Limited as part of a large block of claims held by the company. Work done by this company included electrical resistivity and magnetic geophysical surveys (Szetu 1960), along with surface and underground geological mapping (MacVeigh 1960); some sampling was done along the veins exposed in the adit.

UNDERGROUND WORKINGS

The underground workings on the property were all developed by Miller Lake O'Brien Mines Limited in 1930. There is a vertical shaft, 50 feet deep, with no lateral development. The adit was driven N27W for 560 feet; from the northern end further drifting was done for 120 feet to the east and 380 feet to the west (Figure 12).

GENERAL GEOLOGY

The entire claim group is underlain by Nipissing Diabase and is on the northeastern rim of the Smoothwater Lake basin near the hanging-wall contact. The gabbro on the Wilder property is generally fine-grained.

MacVeigh's (1960) map shows several faults trending a few degrees east of north across the property (too numerous and close to show on Map 2256, back pocket). Numerous east-west cross faults also occur.

ECONOMIC GEOLOGY

The following two paragraphs are condensed from MacVeigh (1960):

Silver has been found on the Wilder property in at least three localities. A number of veins striking N32E and dipping steeply northwest were found in the eastern part of the adit workings (Figure 12). To the southwest of the adit drift a persistent calcite vein was discovered; the vein has a strike of N75E and dips 78S. The vein has been traced for 230 feet with numerous occurrences of erythrite. The vein has also been identified in the crosscut 440 feet from the adit portal (Figure 12). A 12-foot raise has been driven in the vein 220 feet southwest of the main adit drift. Two moiled samples taken by MacVeigh assayed 12.96 ounces of silver per ton over 5 inches and 14.61 ounces per ton over 3 inches. A grab sample also from the raise (also taken by MacVeigh) assayed 29.10 ounces of silver per ton. A small amount of visible silver and some cobalt arsenides were observed at the western end of the raise.

This raise is about 60 feet from the bottom of the shaft and there is a cross fracture between the raise and the shaft.

BASE METALS, GOLD, AND SILVER

Sulphide minerals containing copper, zinc, gold, silver, lead, and nickel occur in the map-area where they are associated mainly with Archean metavolcanics and iron formation, and Nipissing Diabase. In addition, minor amounts of sulphide, mainly pyrite, were noted in the Mississagi, Bruce, Serpent, Gowganda, and Lorrain Formations of the Huronian Supergroup.

DESCRIPTION OF PROPERTIES

COLE DEPOSIT (16)

Minor amounts of disseminated sulphide minerals, mainly pyrrhotite and minor chalcopyrite, occur in a Nipissing Diabase body near its contact with Lorrain sandstones in the central part of Cole Township. See the Diamond Lake Sheet (Map 2259, back pocket) for the approximate location of this deposit.

ARNOLD HARDIE (23)

COPPERSAND LAKE DEPOSIT

The Coppersand Lake property consists of three unsurveyed claims in a north-south line from the north boundary of Cynthia Township; from north to south the claims are L225444, T61491, and L225443. The main mineral occurrence is on T61491. See the Diamond Lake Sheet (Map 2259, back pocket) for the approximate location of this deposit.

The occurrence was described by Simony (1964, p.22-23) as follows:

> There are several old pits and trenches exposing irregular quartz-carbonate veins along the eastern base of Mount Ferguson. These pits are said to have been put down more than 45 years ago and to be the work of Father Paradis of Porcupine. D. Derosier of North Bay, who staked the claims, had carried out some trenching and had drilled one short, vertical hole when the property was examined by D. Burk in May 1957. In 1960 three claims, around Coppersand Lake, were optioned to Mayer Mining Company Limited. When the property was examined by the author [Simony] in July 1960, six short, vertical holes had been drilled on a flat-lying quartz vein, ¼ mile south of Coppersand Lake.
>
> The showings lie in a small valley that runs in a northeasterly direction to join a larger northwest-trending valley in which the Coppersand Lake is situated. This larger valley lies along the eastern and lower contact of the diabase [gabbro] mass forming Mount Ferguson. In this area, the . . . [gabbro] mass is coarse-grained, granophyric, and has the structure of a sill. It is underlain by argillite, greywacke, and conglomerate of the Gowganda Formation. Near the lower contact of the sill, quartz-carbonate veins are found both in the . . . [gabbro] and the adjacent varved argillite.
>
> There are three main showings, all in a small area about ¼ mile south of Coppersand Lake. Beginning in the south, there is a flat-lying quartz-carbonate vein containing pyrite, chalcopyrite, pyrrhotite, and galena in stringers and patches. This vein lies in the . . . [gabbro] near its lower contact, and has inclusions of sheared . . . [gabbro] and argillite. Core from six short holes drilled through the vein shows that it ranges in thickness between 10 and 30 feet

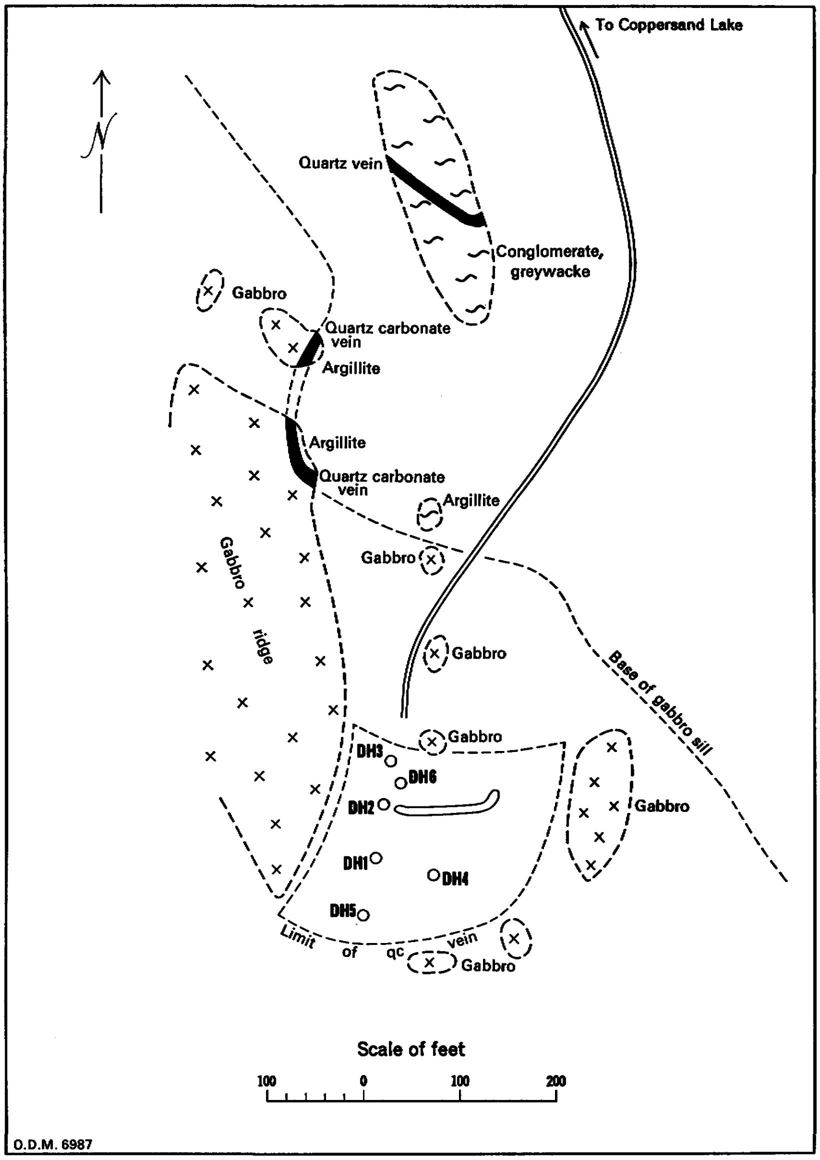


Figure 13—Sketch map of Coppersand Lake showings, Cynthia Township, Maple Mountain area; modified after Simony (1964, p.22).

> and that the mineralization is spottily distributed. Grab samples taken by Derosier gave the following results upon assay: copper, 1.36-10 percent; silver, up to 5.32 ounces per ton; lead, up to 3.59 percent. A chip sample collected by the author [Simony] along a shallow trench 100 feet long was assayed by the Provincial Assayer and was found to contain: 0.02 ounces per ton of gold, 1.42 percent copper, and traces of cobalt, nickel, and silver.
>
> To the north, at the . . . [gabbro]-argillite contact, there is a conformable vein of quartz and carbonate. It has a rolling strike and dips 20 degrees to the west and southwest. It ranges in thickness from 6 inches to 6 feet and is strongly mineralized at the base with chalcopyrite. Samples taken by Derosier contained: 9.22 percent copper, 0.13 percent nickel, 0.09 percent cobalt, and 8.56 . . . [ounces] silver [per ton].
>
> About 200 feet to the north, on the west slope of the valley in which Coppersand Lake is situated, and about 100 feet below the lower contact of the . . . [gabbro] sill, an 8-foot-thick quartz vein cuts interbedded conglomerate and greywacke. This vein strikes N.30°W. and has a dip of 10°-40°NE. The vein is exposed in a northeast-trending cliff, and near the base of the cliff chalcopyrite is concentrated in patches.

Logs of another six diamond drill holes were submitted in 1964 for assessment credit. These holes further indicated a thick quartz-carbonate vein containing chalcopyrite and pyrite.

Work by the present owner, during the summer of 1969, included deepening and extending old trenches and blasting a number of new pits (A. Hardie 1970, written communication). Analytical results of samples taken by Hardie gave the following ranges: gold, trace to 0.20 ounce per ton; silver 0.7 ounce to 6.25 ounces per ton; 0.32 to 22.5 percent copper; 0.11 to 0.57 percent nickel; and 0.06 to 0.13 percent cobalt. Hardie does not record the type of sampling used.

KEEVIL MINING GROUP LIMITED [1966] (28)

During the winter of 1965-1966 Keevil Mining Group Limited optioned, from D. Derosier, two adjacent claims just east of Coppersand Lake in Cynthia Township. These two claims straddled the Cynthia-Aston township boundary. See the Diamond Lake Map (Map 2259, back pocket) for the approximate location of these claims.

The claims were explored by electromagnetic and magnetometer geophysical surveys. The only anomaly detected probably indicates a gabbro dike (Woolham 1966).

LADY EVELYN LAKE DEPOSIT (31)

Very minor amounts (less than 1 percent) of disseminated pyrite and chalcopyrite occur over a wide area in sandstones at the base of the Lorrain Formation between Sucker Gut and Lady Evelyn Lakes. These have no commercial importance, but are of interest as possible indicators of large, low-grade sedimentary deposits. For the approximate location of this deposit see the Makobe Lake Map (Map 2257, back pocket).

R. E. McIntosh (41)

Mining Location WR90

In the Assessment Work Files in the Ontario Division of Mines, Sudbury Resident Geologist's Office a number of private reports are available on this Turner Township property. Most of the following information is based on one of these private reports by Jas. E. Thomson written in 1949 after he had visited the property.

HISTORY AND DEVELOPMENT

The showing on WR90 was first briefly described by Parsons (1901) who wrote as follows:

> Ten chains above the portage I examined what is known as the *Leroy Location.* It is a quartz vein in country rock of greenstone [gabbro]. The vein is 5 feet wide, strikes east and west and dips south 60 degrees. It contains iron and copper pyrites and galena. A sample taken across the mineralized portion of the vein gave the following results on assay: .02 oz. per ton gold, 23.28 oz. per ton silver, 5.64 percent copper, 25.74 percent lead. A little work has been done on this location consisting of several test pits, and stripping of the vein for a short distance.

Additional surface development work was done in 1929 by the O'Connor Syndicate. In 1949, the property was optioned by The Coniagas Mines Limited from Silver Chief Mines Limited and nine drill holes, totalling 1,021 feet, were put down in May and June of that year. The work in 1929 and 1949 was done under the direction of E. W. Todd and much information is taken from his reports (private reports in ODM Assessment Work Files, Resident Geologist's Office, Sudbury). In 1956, 19 diamond drill holes, totalling 3,179 feet, were drilled by D'Eldona Gold Mines Limited.

GEOLOGY

The general geology of the property is shown on the Solace Lake Map (Map 2258, back pocket) and the Yorston Lake Map (Map 2260, back pocket). The rocks in the vicinity of the showing consist of Gowganda argillite, laminated argillite, and siltstone, which are intruded by Nipissing Diabase. The exposed part of the quartz vein lies along the contact between the sedimentary rocks and the gabbro. The vein strikes approximately east-west and dips 50-60S. Drill hole information indicates that the vein actually follows a shear zone in the sedimentary rocks at and near the gabbro-Gowganda contact.

Surface trenching across the vein at 100-foot intervals was carried out where possible. Many of the trenches were 10 to 15 feet deep and in 1956 (when Thomson visited the property), and also in 1969, when the author (Meyn) visited the property, much material had slumped and probably refilled the trenches thus making a surface examination unsatisfactory. The exposed length of the vein is 1,100 feet but it may be longer because the western end is covered with overburden. At the eastern end, the vein appears to finger out along several fractures. Its surface width varies from 10 to 60 feet but the true width is less because of the southerly dip. The vein is mineralized with galena, chalcopyrite, and minor amounts of sphalerite. The best mineralized section, indicated by E. W. Todd's original sampling, is a mineralized sheet 320 feet long and 14.7 feet wide (probably apparent and not true width) with an average grade of 0.22 ounce of gold per ton, 6.6 ounces of silver per ton, 1.1 percent copper, 4.2 percent lead, and 0.24 percent zinc (E. W. Todd 1929, private report in ODM Assessment Work Files, Sudbury Resident

Table 14 ASSAYS AND ANALYSES FROM WR90, TURNER TOWNSHIP, MAPLE MOUNTAIN AREA

TRENCH OR DRILL HOLE	WIDTH SAMPLED IN FEET	GOLD IN OZ/TON	SILVER IN OZ/TON	Cu PERCENT	Pb PERCENT	Zn PERCENT	SAMPLER
1	7.3	0.02	4.86	0.39	4.49	0.28	E. W. Todd*1929
3	25.6	0.015	9.48	1.36	5.08	0.13	E. W. Todd
4	8.0	0.01	4.18	0.64	3.95	0.30	E. W. Todd
...	9.4	0.032	4.57	2.24	4.56	0.55	E. W. Todd
5	18.1	0.043	4.50	1.40	3.40	0.35	E. W. Todd
10	37.6	0.02	Tr.	1.7	0.40	0.11	E. W. Todd
11	5.4	0.005	0.63	3.00	0.16	0.20	E. W. Todd
	10.0	0.0005	0.09	1.8	0.07	Nil	E. W. Todd
6	6.0	0.04	5.62	3.03	7.01	...	Jas. E. Thomson** 1949
DDH4	12.0	Tr.	1.27	0.73	1.88	...	Jas. E. Thomson
DDH4	8.0	Tr.	Tr.	...	...	...	Jas. E. Thomson
1		0.01	1.80	0.09	2.73	...	D'Eldona Gold Mines Ltd.*** 1956
1		Nil	0.13	0.06	0.19	...	D'Eldona
5		0.01	4.82	0.22	4.27	...	D'Eldona
5		Nil	0.07	0.04	0.04	...	D'Eldona
6		0.04	0.62	0.47	0.55	...	D'Eldona
10		0.01	0.49	0.55	0.48	...	D'Eldona
10		0.010	0.08	0.20	0.02	...	D'Eldona
11		0.005	0.09	0.26	0.01	...	D'Eldona
11		0.005	Tr.	0.32	0.02	...	D'Eldona
4		0.01	Tr.	0.32	0.01	...	D'Eldona
4		0.02	4.55	1.35	4.13	...	D'Eldona
3		0.01	5.27	1.55	4.48	...	D'Eldona
3		0.01	1.63	1.17	1.83	...	D'Eldona
3		Nil	0.06	0.06	0.07	...	D'Eldona

* E. W. Todd 1929, private report in ODM Assessment Work Files, Sudbury Resident Geologist's Office.
** Jas. E. Thomson 1949, private report in ODM Assessment Work Files, Sudbury Resident Geologist's Office.
*** ODM Assessment Work Files, Sudbury Resident Geologist's Office.
... not detected

Geologist's Office). Drilling in 1949 and 1956 failed to find additional mineralization as good as that found at the surface. Assay results available have been compiled in Table 14.

HOWARD MARK (36,37,38,39,40)

In 1969, Howard Mark and his partners (L. Brennan and F. Strickland) held a block of 70 claims in the southeastern corner of Klock Township and other claims in adjacent Barr, Dane, and Kittson Townships. The main area of interest is a zone along the Lady Evelyn River, which runs approximately along the north-south boundary between the townships. The approximate locations of all five properties held by Mark are shown on the Makobe Lake Map (Map 2257, back pocket).

Numerous minor sulphide deposits occur along the north Lady Evelyn River between Lady Evelyn Lake and the Montreal River, a distance of about 4½ miles. Barlow (1907) described these deposits, and reported the presence of galena, cerussite ($PbCO_3$), sphalerite, chalcopyrite, pyrite, and hematite, and quoted an assay of 8.75 ounces of silver per ton. Todd (1926) noted cobalt bloom on the small island at the northern end of Lady Evelyn Lake.

GENERAL GEOLOGY

A highly altered Nipissing Diabase body intrudes Gowganda laminated argillite in this area. The river follows the contact of the main metagabbro mass for some distance. In addition to the main body, which apparently dips westward, there are several dike-like offshoots, one of which strikes east-west, the other north-northwest. The north-northwest dike averages about 100 feet in width and is extensively mineralized.

The main Nipissing intrusion consists of medium-grained gabbro, granophyric gabbro, and granophyre. These rocks are extensively altered to hornblende metagabbro, and tremolite-actinolite, epidote, and quartz-carbonate veins are relatively abundant. The offshoot dikes are highly altered, fine- to medium-grained green or black metagabbro, and also contain numerous quartz-carbonate and epidote veins.

The metagabbro body is apparently located at the intersection of two major fault systems. The Mocassin Lake Fault strikes northwest and is probably a part of the 'Lake Timiskaming Rift System' as defined by Lovell and Caine (1970). The Eagle Lake Fault strikes approximately north-south. These faults were formed prior to intrusion of the Nipissing Diabase, but there has been minor post-Nipissing Diabase movement as evidenced by offsetting of dike contacts and shearing of the gabbro.

CHARACTER OF MINERALIZATION

Sulphide minerals, including pyrrhotite, pyrite, chalcopyrite, galena, and sphalerite, in that order of abundance, occur as disseminations and pods in quartz-carbonate veins and in metagabbro. There is a positive correlation relationship between abundance of sulphide minerals, abundance of quartz-carbonate veins, amount of granophyric material as disseminations and dikelets in the gabbro, and degree of alteration of the gabbro.

FIRST BAY DEPOSITS (36)

On the northeastern bank of the Lady Evelyn River, in Barr Township, metagabbro is in abrupt contact with Gowganda argillite. The argillite has been metamorphosed to hornfels for about 2 feet away from the contact, and the gabbro is highly sheared and altered. There are numerous quartz-carbonate veins present, ranging in thickness from about 1 inch to 3 feet. They strike N48E, dip 70NW, and are arranged in an *en echelon* pattern. They apparently occupy dilatant fracture zones or kink folds in the gabbro. Many of the veins carry minor (less than 5 percent) amounts of erratically distributed chalcopyrite, pyrite, and galena. Minor amounts (1 percent) of pyrrhotite and chalcopyrite occur in the metagabbro as well.

On the western bank of the Lady Evelyn River, there are numerous small gossan zones in the metagabbro, produced by weathering of minor (1 percent) amounts of disseminated pyrrhotite and chalcopyrite. There are also several quartz-carbonate veins that contain some sulphide minerals, as well as chlorite and epidote. The gabbro here is granophyric, highly altered, and contains epidote and tremolite-actinolite veins, and disseminated sulphide minerals. Several pits on the north shore of the wider part of the river, have opened up a quartz-carbonate-epidote vein, about 2 feet wide, that contains about 10 percent sulphide minerals, mainly pyrite, chalcopyrite, galena, and sphalerite over areas of a few square feet. An analysis by the Mineral Research Branch of the Ontario Division of Mines, of a 'high-grade' sample, taken by Card, from this pit gave the following: Copper, 0.38 percent; Nickel, trace; Lead, 0.25 percent; Zinc, trace.

INLAND DEPOSITS (37)

Minor amounts of sulphide minerals have recently been discovered about 1 mile west of the Lady Evelyn River, in Klock Township, in granophyric metagabbro. These consist of minor amounts of pyrrhotite, chalcopyrite, galena, and sphalerite in metagabbro and in quartz-carbonate stringers.

ISLAND DEPOSITS (38)

Minor amounts of disseminated pyrrhotite, chalcopyrite, galena, and sphalerite occur in granophyric metagabbro on a small island at the eastern end of Lady Evelyn Lake, in Dane and Kittson Townships. Sulphide minerals are generally present in amounts less than 2 percent, but constitute up to 20 percent over areas of a few square feet. A pit measuring about 8 feet by 15 feet by 10 feet deep is present. An analysis by the Mineral Research Branch of the Ontario Division of Mines, of mineralized dump material collected from this location by Card is as follows: Copper, 0.07 percent; Nickel, trace; Lead, 0.13 percent, Zinc, 0.09 percent; Cobalt, trace.

KLOCK DEPOSITS (39)

Sulphide minerals occur in the metagabbro dike on a cliff above the western bank of the Lady Evelyn River and on a small point immediately to the south, also on the western bank of the river. Numerous short quartz-carbonate veins, ranging in thickness from ¼ inch to 2 feet, occur in the metagabbro. Veinlets, patches, and disseminations of pyrrhotite, chalcopyrite, and minor galena and sphalerite, occur in the veins and in the wall-rocks close to the veins. These occurrences have been tested by several pits, the largest of which is about 15 feet long, 3 feet wide, and 3 feet deep. An analysis by the Mineral Research Branch, Ontario Division of Mines, of a 'high-grade' grab sample taken by Card from the pit on top of the cliff gave the following results: Copper, 7.95 percent; Nickel, trace; Zinc, 0.04 percent; Lead, 4.50 percent.

SECOND BAY OCCURRENCE (40)

Minor amounts of disseminated pyrrhotite, pyrite, and chalcopyrite occur in the north-northeast dike on the western bank of the Lady Evelyn River. Sulphide minerals generally constitute less than 5 percent over areas of a few square feet. They have been explored recently by a small pit.

METRON EXPLORATIONS LIMITED (42)

In 1969, Metron Explorations Limited held a group of 161 mining claims in Stull Township. Some of that property extends into the area covered by Operation Maple Mountain. The only information available is reported under the heading 'Two copper finds in Shining Tree area' in the Northern Miner (1970). An induced polarization survey was reportedly underway on the property at that time.

In the western part of Stull Township, out of the map-area, the ground that is referred to in the Northern Miner as belonging to Chimo Gold Mines Limited appears to be the same ground as is registered in the name of Harold Barry. E. J. Rivers and Theodore Brown also hold ground in the western half of the township.

NEW DELHI MINES LIMITED (44)

New Delhi Mines Limited, successor to Delhi Temagami Gold Mines Limited, holds a lead-silver-gold property. In 1969, this company owned 15 surveyed claims in the northern part of Delhi Township on the southwestern side of Wakimika Lake; for the approximate location of this property see the Diamond Lake Map (Map 2259, back pocket). The original company, Delhi Temagami Gold Mines Limited, was incorporated in September 1934 with L. J. Lahay as president. A description of the property is given in K. D. Lawton (1954), and the following is a condensed version of the information given there.

The New Delhi group of claims encloses the northern end of a Nipissing Diabase sill and adjacent country rock composed of thin-bedded Gowganda greywacke. The gabbro is part of the main sill that trends northerly across the western part of the township from the southwest corner. A dike of olivine diabase about 250 feet wide is projected across the property with a general strike of about N75W.

The deposit consists of a system of somewhat vuggy, quartz-carbonate veins filling fractures in the Nipissing Diabase. The veins contain inclusions of the wallrock, mostly quartz gabbro. The veins are mineralized with argentiferous galena and a little pyrite and chalcopyrite; native gold is erratically distributed throughout the veins. Some of the veins are also known to occur in the adjoining thinly bedded greywacke. The veins are irregular in width, strike, dip, and distribution of galena mineralization.

The property was developed prior to 1949 by trenching and test-pitting, diamond drilling, and by underground work. Two adits, of about 200 feet and 50 feet in length, were driven and a small shaft (not shown on the map) about 30 feet deep was also sunk (Lawton 1954, p.16).

The surface plan (Lawton 1954, surface plan, back pocket) of the geology, along the main showing of New Delhi Mines Limited, shows most of the exposed veins, test pits, and trenches opened up in this part of the property. Some estimates of dimensions, tonnage, and grade figures, and some analyses are also given by Lawton (1954, p.16-18) as follows:

DIMENSIONS AND GRADE OF DEPOSIT

Some 21,692 pounds of vein material were taken from the Lahay vein during the period March 14-April 7, 1950, as part of a bulk-sampling program recommended for the property. The material was taken from seven cuts across the surface of the vein spaced at 10-foot intervals, to cover a total length of 80 feet of vein. The section of the Lahay vein represented by the bulk sample lies immediately east of the main adit entrance on the side of the hill. The 21,692 pounds of vein material, analyzed by the Temiskaming Testing Laboratory, Cobalt, gave the following assay:

Lead	percent 7.13
Silver	ounces per ton 5.58
Gold	ounces per ton 0.25

In November, 1950, underground exploration of the vein system was begun from an adit level. In all, 880 feet of drifting was done on 5 veins encountered at this horizon. Four holes were also drilled below the adit level, and these indicated persistence of the veins at least 200 feet below this horizon. Four ore shoots with a combined length of 381 feet were found, and three development faces were in ore when underground work ceased.

In a report dated June 29, 1951, L. R. Simard, consulting geologist for the company, estimated that there were 54,000 tons of ore, from surface to 200 feet below the adit level. The recoverable net value of this ore at the property was estimated to be $20.25 per ton. The dimensions and grade of the ore shoots developed on the adit level are summarized by Mr. Simard as follows:

VEIN	LENGTH FEET	AVERAGE WIDTH FEET	GOLD OUNCES PER TON	SILVER OUNCES PER TON	LEAD PERCENT
Lahay	102	2.87	0.084	3.65	7.29
No. 1, south, A	74	4.20	0.040	2.08	6.35
No. 1, south, B	21	3.92	0.007	1.65	12.17
No. 4, south	184	4.52	0.262	2.76	8.69
Total	381				

Solace Lake Lead-Silver Deposit (50)

Mineralized quartz veins in rocks of the Gowganda Formation on the eastern shore of Solace Lake, in Selkirk Township, have been explored in the past by pits and trenches. No records of this work are available. For the approximate location of this area see the Solace Lake Map (Map 2258, back pocket).

Quartz and quartz-carbonate veins occur in Gowganda argillite approximately 250 feet south of a Nipissing Diabase intrusion. The veins strike north-south and dip vertically. The main vein, which is about 4 feet in maximum width, is exposed for about 100 feet back from the shore where it disappears under drift. The second vein, approximately 2 feet wide, can be traced northwards only a few feet. Several other short veins a few inches wide are present.

The vein material consists mainly of white quartz (90 percent), pods and crystals of calcite (9 percent), and chlorite (1 percent).

Sulphide minerals, mainly galena (95 percent) with minor pyrite (3 percent), and chalcopyrite (2 percent), are erratically distributed through the veins as pods and disseminations. Sulphide minerals constitute approximately 5 percent of the exposed vein material.

Analyses of a galena-rich grab sample taken by Card and of a chip sample taken by Carman Fielding (a local businessman) in 1968 gave the following results:

A *Grab Sample*	B *Chip Sample*
Lead — 10.2 percent	. . .
Copper — trace	. . .
Silver — 4.08 ounces per ton	Silver — 3.71 ounces per ton
. . .	Gold — 0.06 ounce per ton

A. Analysis by Mineral Research Branch, Ontario Division of Mines.

B. Assay by Sudbury Assay Office, May 27, 1968.

SUCKER GUT LAKE DEPOSIT (51)

Minor amounts of pyrrhotite and chalcopyrite occur in granophyric Nipissing Diabase on the western shore of Sucker Gut Lake in Leo Township; for the approximate location of this deposit see the Makobe Lake Map (Map 2257, back pocket). An analysis by the Mineral Research Branch of the Ontario Division of Mines, of a mineralized gabbro grab sample, taken by Card is as follows:

Copper — 0.05 percent
Nickel — trace
Cobalt — trace
Zinc — none detected
Lead — none detected

IRON

There are seven known occurrences of Algoma-type, oxide facies iron formation of Archean age within the map-area (Shklanka 1968). Two of these, the Burwash Lake deposit in Cotton Township and the Kokoko Lake deposit in Cynthia Township are listed by Shklanka as major occurrences. Other occurrences of oxide facies and minor sulphide and carbonate facies iron formation are found in Turner, Leonard, Howey, and Leith Townships.

DESCRIPTION OF PROPERTIES

FOURNIER LAKE DEPOSIT (19)

This deposit of iron formation is described by Shklanka (1968, p.469-470) as Algoma-type, oxide facies. In 1910, systematic trenching was done at 40-foot intervals by MacKenzie and Mann Limited. This systematic sampling outlined a zone 10 to 50 feet wide and 4,000 feet long containing 40.6 percent iron, 15.4 percent silica, and 2.7 percent sulphur. Selected samples analyzed as high as 52 percent iron. See the Smoothwater Lake Map (Map 2256, back pocket) for the approximate location of this deposit.

The iron formation was described by Collins (1913, p.36) as follows:

> On the east side of Fournier lake, near the centre of Leonard township, a ridge of iron formation can be traced north and south for 1¼ miles. The average width is 350 feet. At the south it dies out in a swamp; northward the country is sandy, and Huronian formation overlies the Keewatin. The ridge is composed of [a] succession of elongated patches of iron formation mingled with green schists which have resisted erosion somewhat better than the greenstones and green schists on either side of it. Both schist and iron formation dip 85° west, the strike coinciding with the axis of the ridge. A little iron formation occurs also on the west side of Fournier lake, and at a few other points short distances away from the main ridge.
>
> The patches of iron formation are not sharply defined from the enclosing schists, and usually contain much interbanded chloritic and rusty or cream coloured sericitic schists. The iron

formation is cherty looking, indistinctly banded and dull grey of different shades. Across the strike grey bands alternate with a number of darker ones from 1 to 5 feet wide which contain enough magnetite and hematite to form a lean iron ore. The dark bands taper and disappear along the strike, and are usually weathered and encrusted with limonite at the surface.

IRONCO MINING AND SMELTING COMPANY LIMITED (26)

Ironco Mining and Smelting Company Limited held, in 1969, a group of 52 contiguous mining claims in the southeastern part of Cotton Township near the southern end of Burwash Lake (the lake is just west of the map-area). The property can be reached by air to Burwash Lake or by a logging road owned by the Portelance Lumber Limited that extends north from Highway 545, north of Capreol. See the Solace Lake Map (Map 2258, back pocket) for the approximate location of this property.

HISTORY

Extensive work has been done on this property. Two private reports for Ironco Mining and Smelting Company Limited, one by J. M. Montgomery (1965) and the other by A. T. Griffis (1963) are available in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury. The descriptions and information for this property, except for the quotation from Collins (1917), are taken mainly from these sources.

The Burwash Lake deposits were examined in the early 1900s by MacKenzie and Mann Limited (Collins 1917, p.126). In the early 1950s, an airborne magnetometer survey covering about 450-square miles was made by the M. A. Hanna Company. The Burwash Lake deposits were staked by Lowphos Ore Limited, a Hanna subsidiary, and explored by detailed geological and geophysical surveys, trenching, and diamond drilling. In 1958, the claims came open and were restaked by E. Blanchard and held for a time by Messrs. Watts, Blanchard *et al.* The property is currently held (1969) by Ironco Mining and Smelting Company Limited, who in the 1960s carried out extensive geological, geophysical, and diamond drilling programs.

The total amount of exploration work carried out on the deposits by the various owners is not known, but includes airborne and ground magnetometer surveys, detailed geological surveys, much trenching, and over 15,000 feet of diamond drilling. This work has outlined 15 possible pit areas containing indicated or inferred reserves of 450,000 tons per vertical foot averaging 20.7 percent iron. Potential tonnage is estimated to be in excess of 100 million tons. Preliminary tests indicate a concentrate, grading 68.2 percent iron and 5.0 percent silica, can be made with a recovery of 93 percent.

GEOLOGY

The following description of the geology of the area is taken from Collins (1917, p.125,126):

> The iron formation east and southeast of Burwash lake comprises a large number of distinct masses, all of small size, embedded in granite-gneiss. The granite-gneiss also contains a multitude of angular fragments and ribbons of glistening black hornblende gneiss such as characterize its contacts with pre-Huronian schist areas. It is quite evident, in fact, that in this neighbourhood the granite-gneiss batholith invaded a roof of pre-Huronian schists and that the patches of iron formation and hornblende gneiss that now occur in the granite-gneiss are the only remaining vestiges of that roof. Apparently iron formation resisted assimilation by the granitic magma better than the remainder of the schist-complex since its original characteristics have not been obliterated by metamorphism and it occurs in relatively large amounts.
>
> In consequence, however, of the intense effect of the granite-gneiss the iron formation differs considerably from that at Shiningtree. The banded character is retained; but in addition to silica and magnetite a bright green, fibrous amphibole (grunerite) has been developed in large amount. Limonite and hematite fail completely. It is quite obvious that a rock so highly anamorphosed would afford little opportunity for the concentration of its iron content, especially since it occurs in small scattered bodies. Unless the iron ore had been concentrated before batholithic invasion there is little likelihood of finding an ore-body; and no evidence of such early concentration has been found. The best ore seen would not yield more than 30 percent of iron, and the probability of the Burwash Lake range ever producing iron ore in paying quantities is very remote. . . .

The following Table of Formations was established by A. T. Griffis (1963) for the area of the property:

Table of Formations
(Burwash Lake area)

Cenozoic
Pleistocene
Sand, gravel, and surface till

Great Unconformity

Precambrian

Major Folding and Faulting

Proterozoic
Upper Huronian
Lorrain quartzite
Gowganda conglomerate

Great Unconformity—Foldings

Archeozoic
Matachewan(?)
Diabase dikes (intrusive)
Algoman
Pegmatite (intrusive)
Granite (intrusive)
Haileyburian(?)
Diorite and gabbro (intrusive)
Keewatin
Iron formation and associated quartzite, interbedded with dioritic lavas and tuffs.

The following description of the geology is summarized from the two reports by Montgomery and Griffis (their surveys were more detailed than the reconnaissance mapping carried out by the Ontario Division of Mines field party). The rocks will be described from the oldest to the youngest.

Lavas and Tuffs

These are greenish, fine-grained, chloritic completely altered lavas and faintly banded to distinctly bedded tuffs of the same general composition as the lavas. They are now gneisses, schists, and hornfelses. They are closely associated with the iron formation and appear to occur above and below the iron formation and in fact may be to some extent interbedded with it but the iron formation does not have the variety of metamorphic types common to the metavolcanics.

Iron Formation

The iron formation is a blue to blue-black layered rock with discontinuous layers of magnetite and quartz-amphibole up to 1 inch wide. Content of magnetite varies from 0 to 100 percent as does the content of quartz and amphibole in the respective bands. In one instance a 12-foot diamond drill hole intersection of iron formation had 55 percent soluble iron. One lengthy drill hole intersection of quartz-rich iron formation had less than 10 percent soluble iron. The amphibole is usually light coloured so it is probably cummingtonite or actinolite.

The metamorphosed iron formation (amphibolite facies) has been very resistant to later agents of metamorphism although there is some retrograde metamorphism indicated by the presence of chlorite and sulphide minerals along fractures and near the granite where hydrothermal activity is evident. There are some minor occurrences of magnetite associated with sphalerite and chalcopyrite showing crosscutting relationships against the other magnetite.

Some of the lean iron formation with a high quartz-carbonate content has also 2 to 10 percent iron sulphides, which weather to limonite when those rocks are exposed. Many veins and dikes of aplite, pegmatite, and quartz form *lit-par-lit* and crosscutting bodies within the iron formation.

Diorite and Gabbro

There are at least four intrusive rocks that cut the iron formation; one of these is the diorite and gabbro. Included in this category are rocks with a variable character. Some rocks are gneissic amphibolite; others have a high feldspar content with, in one sample, an ophitic texture. The most common texture is an equigranular one. Many narrow dikes of diorite have no chilled contact where they cut iron formation. This is in contrast to the granite-pegmatite group that shows border alteration effects and contains altered xenoliths.

Granite and Pegmatite

Dikes and irregular bodies of granite and pegmatite intrude the older rocks. These rocks have the relatively simple mineralogy of feldspar and quartz with up to 25 percent accessory mica and amphibole. Grain size is variable from fine aplite to coarse pegmatite. Many xenoliths of earlier rock types occur in outcrops and seem likely as explanations of some drill core variations. These intrusions cut all rocks except diabase.

Diabase

The diabase is a typical dark green ophitic textured rock with disseminated sulphide minerals and chilled borders. It occurs as tabular, nearly vertical, bifurcating dikes with chilled borders. Many narrow branching dikes occur; but excepting some bright red iron oxide on joint planes, in and near the dikes, no alteration effects were observed.

Gowganda and Lorrain Formations

Conglomerate and sandstone of the Huronian Supergroup outcrop along Burwash Lake (out of the map-area), Burwash Creek, and Sandspit Lake just north of the Ironco holdings. The sedimentary rocks are younger than the previously described rocks.

Metamorphism

Except for alteration along fractures and near granite pegmatite bodies that indicate hydrothermal activity, the iron formation is remarkably uniform in character. Preservation of bedding makes it possible to describe folding and faulting. Regional metamorphism of the iron formation has produced a quartz-magnetite-amphibole assemblage that has been persistent despite later intrusive activity. The metavolcanics and diorite-gabbro rock types show a range of metamorphic effects including the development of small bodies of gneiss, chlorite schist, and hornfels.

The iron formation displays a gneissic foliation that is locally contorted by minor folds and faults.

The net result of the metamorphism has been to produce some large isolated bodies of magnetite-rich iron formation that have favourable characteristics for recovery of a high-grade product.

The rocks were so intensely metamorphosed that detailed stratigraphic sequences cannot be determined. However, the metavolcanics and iron formation are cut by all the intrusive rock types and so must be the oldest. The fact that the iron formation now has a spatial configuration that is interpreted as folding presupposes a tabular form before folding occurred. The drag folding and faulting of layered iron formation before dike intrusion indicate that the layering is primarily a stratigraphic rather than a metamorphic banding although metamorphism has modified the mineralogy. It is on this premise that an interpretation of the folding is based.

STRUCTURAL GEOLOGY

The iron formation occurs in a layer up to 500 feet thick across most of the property. It is so intruded by diabase, diorite, and granite pegmatite bodies, and so folded and faulted, that it appears as isolated bodies of iron formation sursounded by the later intrusions. Where small isolated blocks of iron formation are caught up in intrusive bodies their structures are commonly the same as in large bodies of iron formation and seem to be unrelated to structures in the intrusion. It seems probable, therefore, that folding and faulting of iron formation bands predates the smaller intrusive bodies. Felsic intrusive rocks do occupy the crests of anticlines and troughs of synclines but age relationships were not determined.

The iron formation and the lavas are tightly folded and steeply dipping. The fold structure is in the form of an irregular 'S', about 7½ miles in length.

West of Tillie Creek the iron formation has a sharp west-pointing 'V' form, which may express a west-plunging antiformal structure. At Tillie Creek the synformal fold with low northwest plunge is cut along the axis by granite. The west limb of the antiform is stretched or faulted and the iron formation to the east of Burwash Lake is the steeply dipping east limb of the fold. This continues to the east of the Twin Lakes (Figure 14) where a second synformal structure with a low northwest plunge is again cut by irregular intrusion of granite and pegmatite.

Beyond this fold the iron formation continues to the northwest on the southern side of an anticlinal structure to Gourlay Lake. Here the iron formation swings around to the east with flat dips at the nose of the fold indicating a low northwest plunge. The iron formation extends east to Sandspit Lake (Figure 14) with a fairly uniform thickness and with a steep north dip. At Sandspit Lake the mapping indicates a tight double synclinal structure with the iron formation on the north limb of the fold extending into the lake where it may be covered by Cenozoic sediments.

There are minor faults, generally with displacements of less than 1 foot, in the formation; whether or not this reflects the presence of faults along which larger displacements have occurred is not proven because the stratigraphy is fragmentary. A study of Hanna drill logs indicates that the pegmatites at Burwash Lake have low dips similar to the iron formation, usually striking northeast with 20 to 30 degree dips to the north or northwest. Figure 14 shows the outline of the iron formation on the property.

ECONOMIC GEOLOGY

Montgomery (1965) stated:

> The drilling, surface mapping and geophysical surveys indicate 135,000 tons per vertical foot of quartz magnetite iron formation where the soluble iron content in samples is greater than 20%.

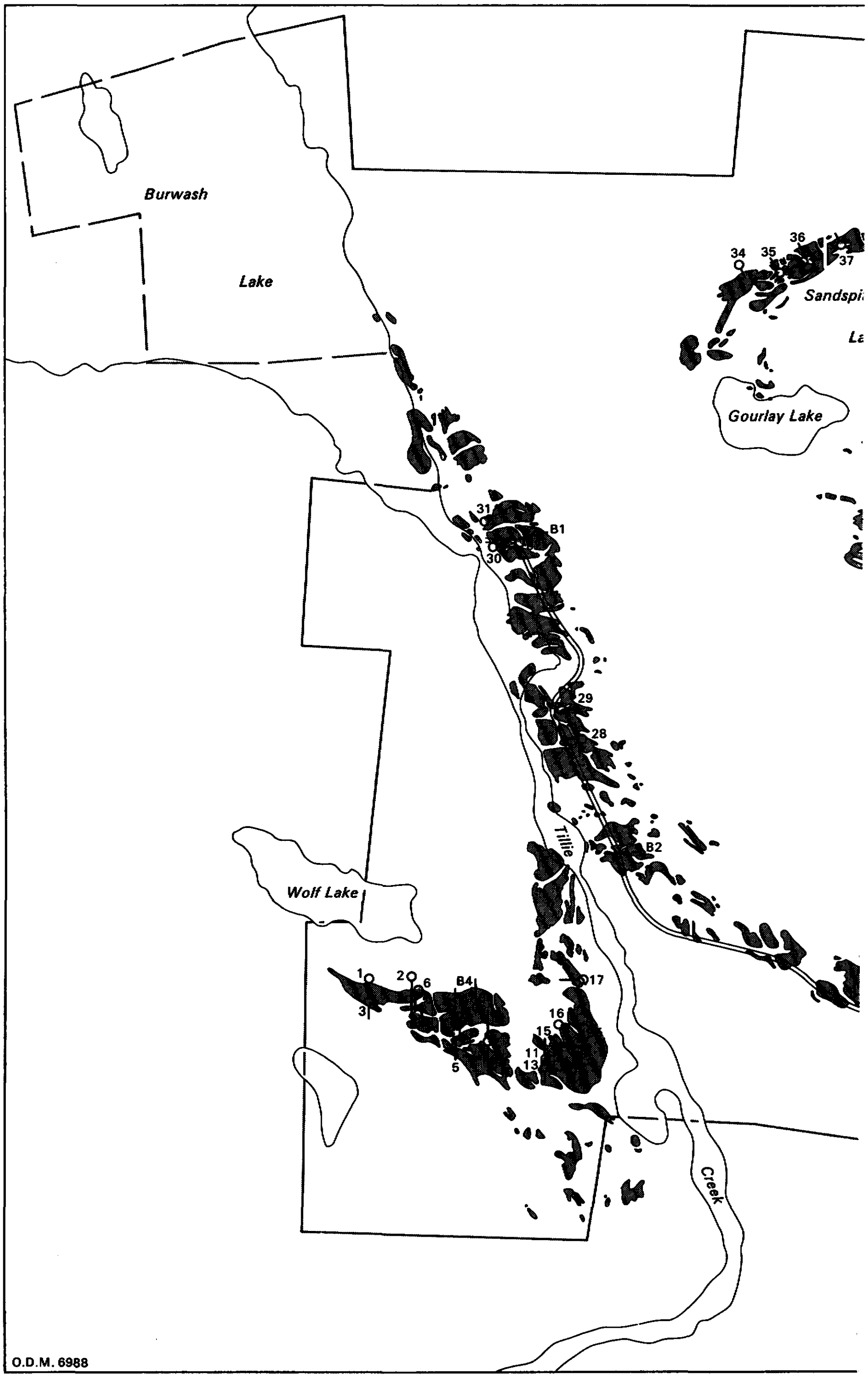
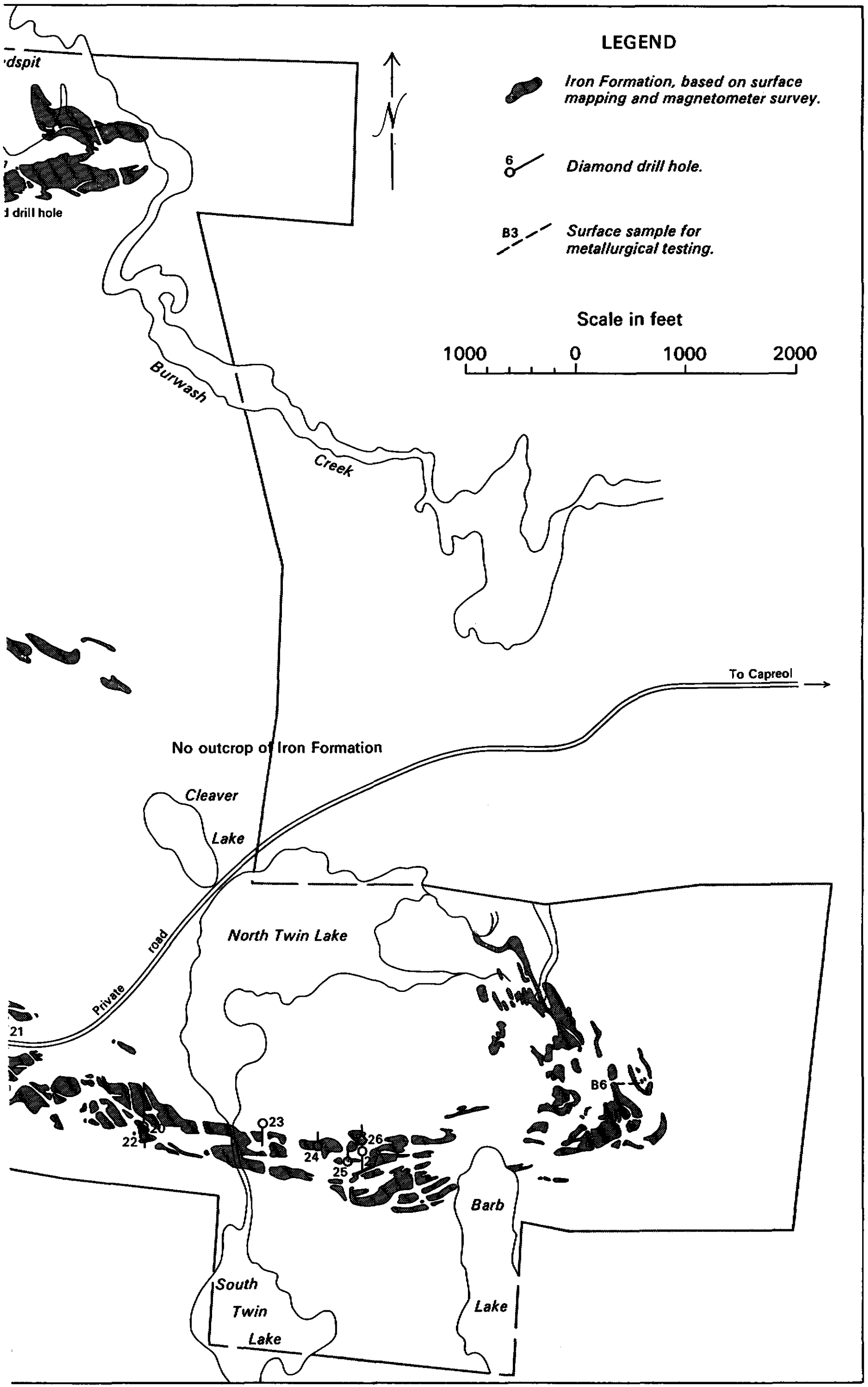


Figure 14—Generalized outline of iron formation on Ironco Mining and Sr



ny Limited Burwash Lake claim group; after company plans, 1965.

The sub-surface distribution, similar to that found by surface geological mapping, shows isolated bodies of various size surrounded by swarms of small intrusive bodies.

Possible pit areas, as suggested by Dr. Griffis [private report in Ontario Division of Mines Assessment Work Files, Resident Geologist's Office, Sudbury], in his earlier report, are here retained for purposes of description and for continuity with previous work.

The drilling in holes I-3 to I-8 and Lowphos 28 to 32 examines an area called No. 1 Central. 80,000 tons per vertical foot of 20.5% soluble iron is indicated by this drilling. Tests carried out on the drill core samples by Lakefield Research of Canada Limited show that 29% of this material, that is 23,000 tons per vertical foot, can be recovered as a magnetic concentrate grading 65.19% soluble iron.

Dips indicated on drill sections are steep (70° to 90°), in this area so that any open pit should be able to operate to good depths.

The area called No. 1 South [these areas are not labelled on Figure 14] was examined by the drilling of hole I-2. This hole recovered some good grade iron formation but the iron formation intersections were separated by lengths of pegmatite and granite so that no sizeable tonnage could be established. The surface geology shows areas of good grade iron formation and the magnetic survey also shows high readings so it is possible that the drill hole followed a major dimension of a tabular intrusive body. The granite pegmatite bodies have attitudes which lend support to such an interpretation.

The area called No. 2 North was examined by hole I-1 and confirmed the presence of a volume of material having a calculated average grade of 16.39% over 165 feet of intersection. The iron formation assayed an average grade of 22.08% and this may reflect the type of grade recoverable by magnetic cobbing. 26,000 tons per vertical foot is indicated by surface mapping and magnetometer surveys. A reduction of this tonnage to allow for the shorter intersection in the ore hole still indicates 20,000 tons per vertical foot grading 16.39%. Metallurgical testing indicates 20.87% of this material, that is, 4,000 tons per vertical foot, of 66.40% Soluble Fe can be recovered by magnetic concentration.

Table 15 RESULTS OF ANALYSES AND METALLURGICAL TESTING, BURWASH LAKE IRON FORMATION IN THE MAPLE MOUNTAIN AREA (AFTER MONTGOMERY 1965)

HOLE NO.	LENGTH IRON FORMATION ONLY	SOL. FE PERCENT	LENGTH IF AND INCLUDED WASTE	SOL. FE PERCENT IF AND INCLUDED WASTE (CALCULATED)	DAVIS TUBE TESTING—IF		
					SOL. FE IN MAGNETIC CONCENTRATES PERCENT	WT. PERCENT OF CONCENTRATE RECOVERED	RECOVERY OF SOL. FE PERCENT
I-1	122.5	22.08	165.0	16.39	66.40	20.87	90.35
I-3	137.0	20.29	146.0	19.04	64.21	25.43	82.83
I-4	306.0	19.80	356.0	16.00	65.04	25.88	87.80
Lph 28	130.0	29.88	130.0	29.88			
Lph 29	110.0	26.22	110.0	26.22			
I-5	138.0	19.87	161.0	17.03	62.62	27.07	89.1
I-6	127.0	25.32	184.5	17.43	65.48	32.04	90.17
I-7	169.5	23.96	222.0	18.29	65.86	31.56	86.6
I-8	276.0	22.93	305.5	20.71	66.86	30.81	92.0
Lph 30	110.0	19.19	110.0	19.18			
Lph 32	160.0	23.08	160.0	23.08			
Lph 31	390.0	23.43	390.0	23.43			
I-9	204.0	18.78	225.0	17.02	63.07	23.80	85.26
I-10	194.5	19.85	230.0	16.97	66.17	25.45	87.5
I-11	225.0	16.02	248.0	14.54	65.69	19.37	82.41
No. 1 central	2053.5	22.69	2275.0	20.47	65.19	28.9	88.48
No. 5	623.5	18.11	703.0	16.06	64.98	22.5	84.98
TOTAL	2677.0	—	2978.9	—	—	—	—
Average		21.64		19.28	65.09	23.3	87.52

The area called No. 5 was partially investigated by probes I-9 to I-11 which established the presence of iron formation over a length of 623.5 feet in these holes. The core samples averaged 18.11% Soluble Iron. Metallurgical testing showed that 22% by weight of this material could be magnetically recovered to yield a concentrate grading 64.98% Soluble Fe. The drill sections show good continuity with surface outcrops. Sizeable volumes of higher grade material which would average above 20% Fe . . . were indicated.

Surface mapping and magnetic surveys indicate 56,000 tons per vertical foot for the whole of area No. 5. The 1964 drilling indicates 35,000 tons per vertical foot for the iron formation . . . [where] it was drilled. Tonnages of higher grade material would be smaller than the 35,000 tons per vertical foot estimated and more drilling is needed to outline the higher grade bodies. The metallurgical tests show that 7,700 tons of concentrate per vertical foot could be recovered.

A total, therefore, of 35,000 tons per vertical foot of concentrate averaging 65.09% Soluble Iron could be recovered from volumes of material indicated by surface mapping, magnetometer surveys, and by the 1964 drill programme.

JALORE MINING COMPANY LIMITED (27)

KOKOKO LAKE IRON FORMATION

Archean iron formation of the Algoma-type, oxide facies occurs in Cynthia and Chambers Townships in the Kokoko Lake area; see the Diamond Lake Map (Map 2259, back pocket) for the approximate location of this property. It has been investigated several times since the turn of the century and is currently (1969) owned by Jalore Mining Company Limited. It was described by Moorhouse (1942) and was tested in 1951-1952 by Dominion Gulf Company. Dominion Gulf carried out an extensive program of trenching, diamond drilling, and geophysical surveying, and outlined four zones measuring 130 feet by 1,100 feet, 360 feet by 1,500 feet, 416 feet by 3,000 feet, and 170 feet by 1,400 feet, with a potential grade of more than 25 percent magnetite (Shklanka 1968, p.266).

The iron formation occurs in a ridge trending approximately east-west and ranges in thickness from 300 to 1,000 feet. It consists of alternating layers of magnetite, silica, and jasper. Some martite (hematite pseudomorphous after magnetite) is associated with the magnetite. There are lenses in which magnetite is interbedded with jasper alone, and others in which magnetite is interbedded only with silica in the form of fine-grained quartz or chert. The magnetite-jasper lenses are said to have a higher grade and to be fairly common. The layering ranges in thickness from very fine to 2 inches and averages about ¼ to ½ inch. Locally the iron formation is brecciated, the fragments being cemented by silica. Drag folding is common, and in some outcrops it can be observed that the chert and jasper bands have broken and magnetite was injected into the cracks. Two prominent directions of faulting have been recognized: one striking N35E, and the other N50E. Both left-hand and right-hand movement has taken place.

Magnetite forms 10 to 50 percent of the rock by volume, and the magnetite grains have a diameter averaging about 0.18 mm (Moorhouse 1942). Preliminary sampling indicates a grade of 25 to 40 percent iron over a width of 500 feet (Shklanka 1968, p.266).

URANIUM

In Ontario, the basal Huronian rocks are the host of the world's largest known reserves of uranium and consequently form a very favourable geological unit for uranium exploration. In the Elliot Lake area, the Huronian succession below the Bruce Formation can be divided into five lithostratigraphic formations, the Mississagi, Pecors, Ramsay Lake, McKim, and Matinenda (Robertson, Frarey, and Card 1969; Robertson, Card, and Frarey 1969). Northeast of Sudbury this subdivision is apparently not possible and only one formation has been mapped below the Bruce Formation. This unit is probably the lithostratigraphic equivalent of the Mississagi Formation.

Most of the known uranium mineralization* occurs in the Matinenda Formation but there are also occurrences of uranium-bearing conglomerate, grit, and argillite in the basal Mississagi Formation north and east of Sudbury and other localities. In the Maple Mountain area, the Mississagi Formation is exposed in Turner, Seagram, Clary, and DeMorest Townships and accompanying uranium mineralization has been explored by a number of companies by geological and geophysical surveys and diamond drilling. No uranium deposits of commercial grade have been discovered to date. Uranium mineralization is widespread but grades are generally low to very low. This is demonstrated by the results of company exploration and by analysis of selected samples taken during the present survey and analyzed by the Mineral Research Branch of the Ontario Division of Mines (Table 16).

Table 16 URANIUM ANALYSES OF ROCKS OF THE MISSISSAGI FORMATION, TURNER, SEAGRAM, AND DEMOREST TOWNSHIPS, MAPLE MOUNTAIN AREA; ANALYSES BY THE MINERAL RESEARCH BRANCH OF THE ONTARIO DIVISION OF MINES

SAMPLE NO.	TOWNSHIP	RADIOACTIVITY (BETA RAY ACTIVITY) URANIUM OXIDE (U_3O_8) EQUIVALENT
ET-69-63	Turner	0.002 percent
ET-69-64	Turner	0.003
MO-69-6	DeMorest	0.003
MS-69-12	Seagram	0.003
MT-69-29	Turner	0.004
MT-69-30	Turner	0.003
MT-69-31	Turner	0.003
MT-69-34	Turner	0.004
MT-69-35	Turner	0.005
MT-69-36	Turner	0.004
MT-69-38	Turner	0.004
MT-69-39	Turner	0.003
MT-69-44	Turner	0.002
MT-69-48	Turner	None detected
MT-69-52	Turner	None detected
MT-69-53	Turner	0.001
MT-69-55	Turner	0.005
MT-69-71	Turner	0.002
MT-69-74	Turner	0.002
MT-69-84	Turner	0.003
MT-69-85	Turner	None detected

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*Most of the information in this section is from company reports and the presence or absence of thorium is not discussed in these reports.

CANADIAN JOHNS-MANVILLE COMPANY LIMITED (12)

In 1967, the Canadian Johns-Manville Company Limited held a large group of claims covering major parts of Grigg, Stobie, Marconi, and Turner Townships, 25 claims in the southeast corner of Dundee Township, and 56 claims in the western part of Seagram Township. These claims were tested by airborne magnetometer, electromagnetic, and radiometric surveys and in part by geological mapping. The information covering 244 claims in Turner Township and claims in Dundee and Seagram Townships is available in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury, and in the Parliament Buildings, Toronto (File 63-2275). Some of these claims were still held in 1969. See the Solace Lake and Yorston Lake Maps (Maps 2258, and 2260, back pocket) for the approximate location of these claims.

In 1967, the company drilled three holes, totalling 2,919 feet, in Turner Township. The geological information obtained in these holes is shown in a schematic cross-section (Figure 16). The location of these holes is shown on the Yorston Lake Map (Map 2260, back pocket), and they are labelled CJM-1, CJM-2, and CJM-3. Hole CJM-3 appears to have been drilled on ground still held by the Canadian Johns-Manville Company Limited in 1969. That ground is further described under the section on property 13.

CANADIAN JOHNS-MANVILLE COMPANY LIMITED (13)

HARRISON MINERALS LIMITED, T. SAVILLE CLAIMS

The Canadian Johns-Manville Company Limited on December 31, 1969 held a group of 11 unpatented claims around a small pond, locally referred to as Discovery Pond, about ½ mile southwest of Bull Lake, in Turner Township. Considerable work had been done on these claims before they were acquired by Canadian Johns-Manville. See the Solace Lake Map (Map 2258, back pocket) or the Yorston Lake Map (Map 2260, back pocket) for the approximate location of these claims.

The following report is based on private reports by T. de Geoffroy (1954) for Normingo Mines Limited, by K. J. Benner (1954) on the Seville-Friday group of claims, and by Mid-North Engineering Services Limited (1956). These reports are available in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury. Jas. E. Thomson (1960, p.78,79) provides additional information. It should be noted that claims held by Normingo Mines Limited and those to the north held by Harrison-Hibbert Mines Limited were consolidated, and Harrison Minerals Limited succeeded Harrison-Hibbert Mines Limited in 1955.

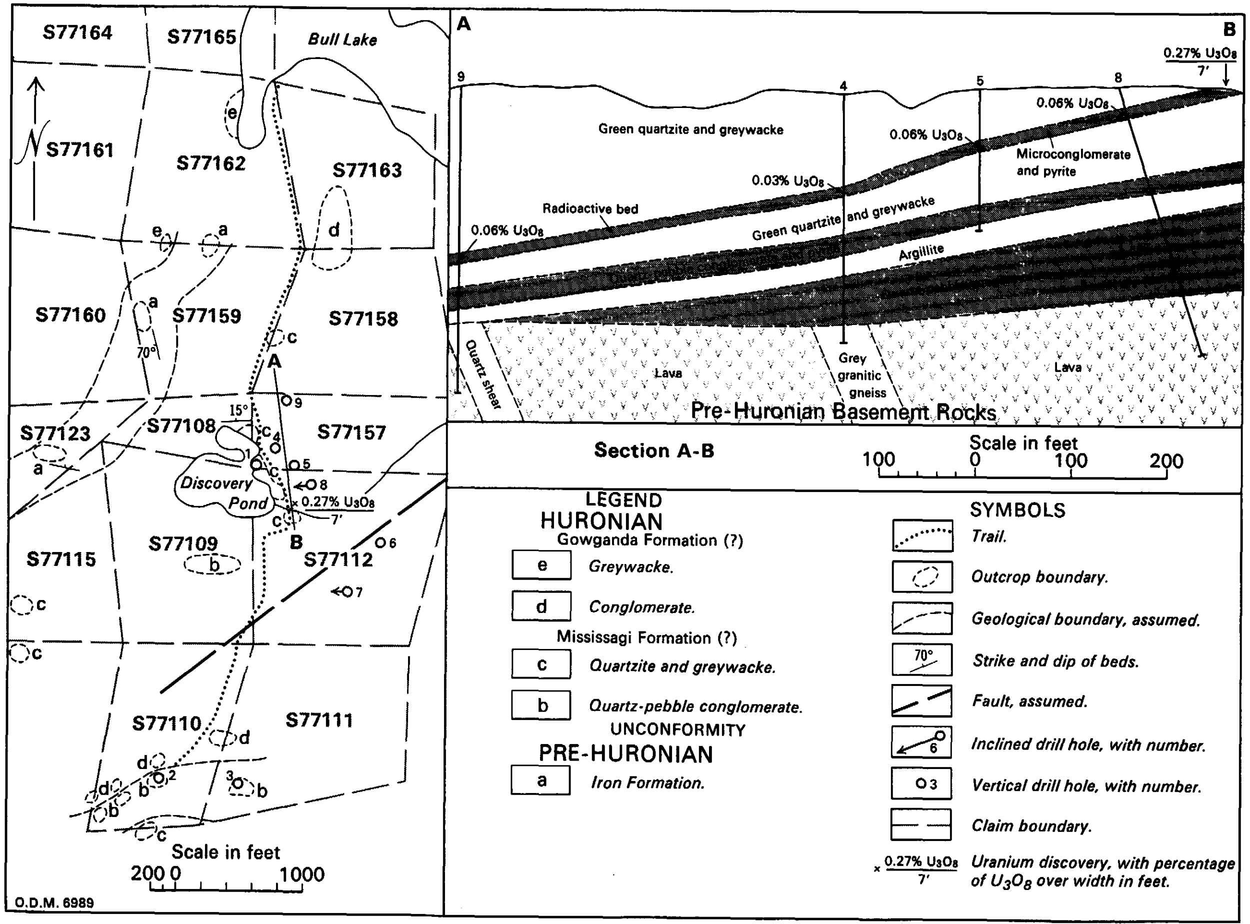


Figure 15—Harrison Minerals Limited property: geological sketch map and section showing uranium occurrence, Turner Township, Maple Mountain area; after Thomson 1960, Chart D.

HISTORY

In 1954, Normingo Mines Limited reported eight significant radiometric anomalies and drilled three short holes, totalling 51 feet, and did some surface clearing. Harrison Minerals Limited reported 1,579 feet of diamond drilling in 1956. The claims were allowed to lapse and some of them are now part of the Canadian Johns-Manville group of claims.

GENERAL GEOLOGY

The general geology of the area is shown on the Solace Lake Map (Map 2258, back pocket) and the Yorston Lake Map (Map 2260, back pocket) and a detailed map of the original property is shown on Figure 15 from Jas. E. Thomson (1960, Chart D). The basement rocks consist of deformed lavas, pyroclastic rocks, and iron formation that are overlain unconformably by relatively undeformed sedimentary rocks of the Huronian Supergroup. Basic intrusions cut the pre-Huronian and the Huronian rocks.

A cross-section based on drilling information shows the succession near Discovery Pond (local name, see Figure 15). Quartz-pebble conglomerate lies chiefly on basement rocks and is overlain by argillite, quartz-pebbles (with pyrite) conglomerate, green quartzite, and greywacke, the radioactive bed pyritic 'microconglomerate' approximately 30 feet thick, and at the top more green quartzite and greywacke. The Huronian rocks are folded and dips range from 25 to 70 degrees north, east, and south. To the south of the property the dip is to the east and to the northwest the dip is to the northeast.

ECONOMIC GEOLOGY

The radiometric survey indicated eight distinct radioactive anomalies but investigation proved all to be caused by low grade uranium mineralization. The highest uranium content indicated by analyses was 0.27 percent U_3O_8, across 7 feet in a surface pit located in the microconglomerate. Subsequent drilling encountered only very low uranium values in the microconglomerate. The best sample, obtained from the drill holes, was found to contain 0.06 percent U_3O_8. Chemical analyses show that minor amounts of thorium and relatively large amounts (2 percent) of zirconium are present (Ontario Division of Mines Assessment Work Files, Resident Geologist's Office, Sudbury).

CANADIAN JOHNS-MANVILLE COMPANY LIMITED [1968] (14)

In 1968, the Canadian Johns-Manville Company Limited carried out geological mapping and an airborne magnetic, electromagnetic, and radiometric survey of 97 claims held by the company in central Marconi Township. The information on the survey is available in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury, and in the Parliament Buildings, Toronto (File 63-2277). For the approximate location of these claims see the Solace Lake Map (Map 2258, back pocket) or the Yorston Lake Map (Map 2260, back pocket).

CAN-FER MINES LIMITED [1967] (15)

In 1967, Can-Fer Mines Limited had staked a group of 21 claims in Marconi Township. Surface sampling was carried out on radioactive pegmatite dikes carrying up to 0.8 pounds U_3O_8 per ton; this was reported in the Northern Miner (1967). For the approximate location of these claims see the Solace Lake Map (Map 2258, back pocket) or the Yorston Lake Map (Map 2260, back pocket).

DENISON MINES LIMITED (17)

On 31 December 1969, Denison Mines Limited held a group of unsurveyed, contiguous mining claims; of these, 43 claims were located in Seagram Township, 18 in Clary Township, 3 in DeMorest Township, and 11 in Turner Township. Three diamond drill holes, totalling 5,170 feet, were drilled in Seagram Township. The general geology and the location of the drill holes is shown on the Yorston Lake Map (Map 2260, back pocket).

Hole No. SM68-1 was drilled on claim S144818. This claim is shown inside Turner Township on the Ontario Division of Mines claim maps but the company shows that it actually straddles the boundary between Turner and Seagram Townships. Hole No. SM68-1 was collared in Seagram Township on claim S144818 and drilled to a depth of 2,159 feet. It was started in the transition zone between the Bruce and Mississagi Formations. In the last 200 feet some radioactive rock units were encountered but analyses were not reported. The hole ended in gabbro.

Hole No. SM69-1 was drilled close to the north boundary of claim S144758. The hole was started in Gowganda Formation, cut a 6-foot minette dike at 180 feet, and entered the Mississagi Formation at 331 feet. It continued in quartzite, greywacke, argillite, conglomeratic quartzite, and quartz-pebble conglomerate of the Mississagi Formation to a depth of 1,361 feet. Radioactive zones were encountered in the last 200 feet. The hole was continued in brecciated andesitic volcanic rocks to 1,445 feet.

Hole No. SM69-2 was drilled in the northwest quarter of claim S144743. In it 1,566 feet of Gowganda Formation were encountered above a volcanic basement.

HENRY LAST (32)

On December 31, 1969, Henry Last and associates held a group of 70 contiguous, unsurveyed mining claims in the northwest quadrant of Clary Township. This group of claims is part of a larger group of claims centred on DeMorest Township. The claims were tested by an airborne magnetometer survey in 1969. The results of the survey are available in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury, and in the Parliament Buildings, Toronto (File 63-2542).

HENRY LAST (33)

On 31 December 1969, Henry Last and associates held a large group of unsurveyed mining claims covering most of the northern half of DeMorest Township and extending into Stobie, Turner, and Clary Townships. These claims were covered by an airborne magnetometer survey in 1969. The information on the survey is available in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury, and the Parliament Buildings, Toronto (File 63-2542).

HENRY LAST (34)

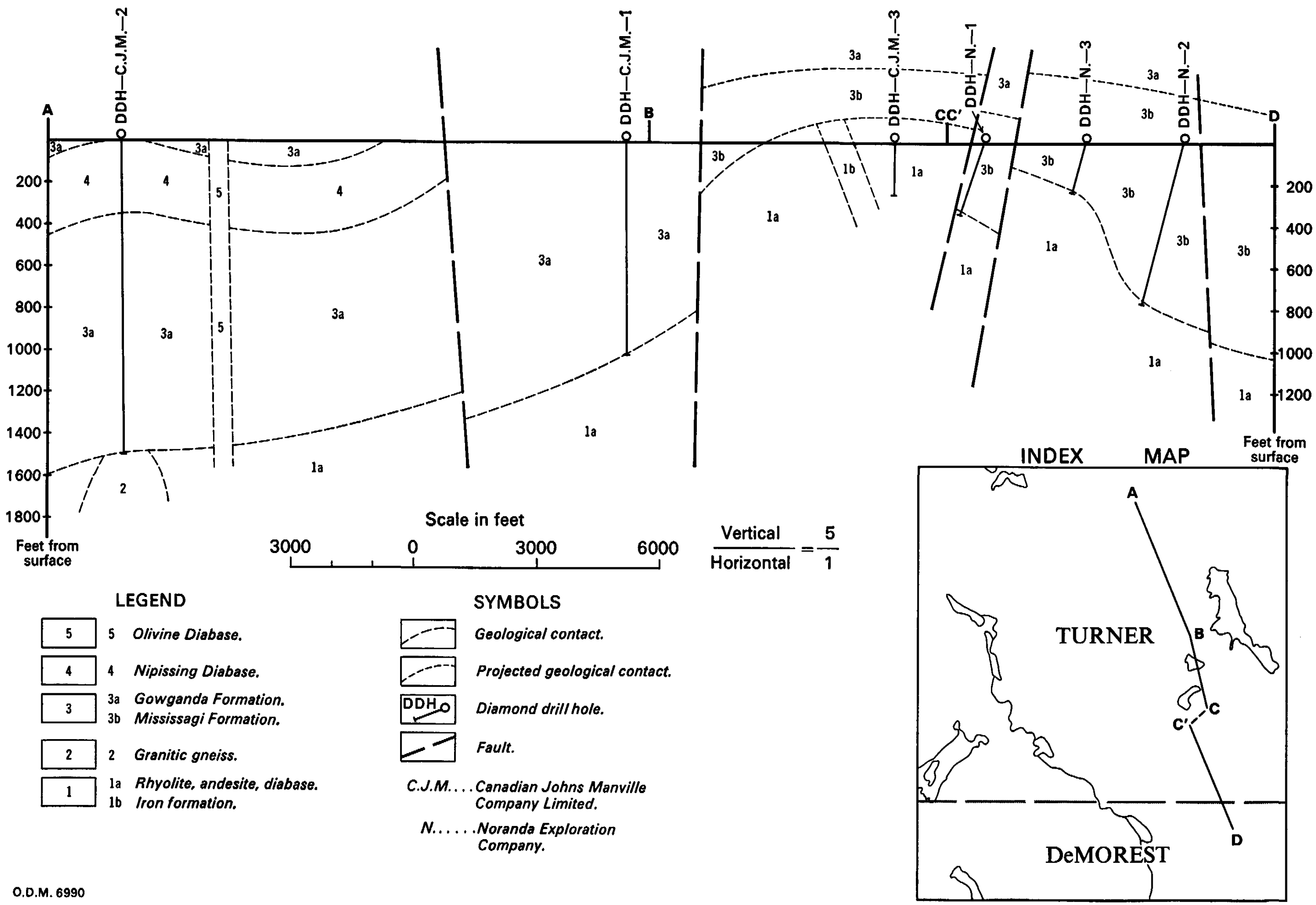
An airborne magnetometer survey centred on DeMorest Township was carried out by Canadian Aero Service Limited in 1969 for Henry Last and associates. This survey also covered 14 claims on the southern boundary of Turner Township. The information is in the Ontario Division of Mines Assessment Work Files in the Resident Geologist's Office, Sudbury, and in the Parliament Buildings, Toronto (File 63-2542) as part of the DeMorest survey.

NORANDA EXPLORATION COMPANY (45)

On 3 December 1969, Noranda Exploration Company held a group of 16 contiguous unsurveyed mining claims in north-central Clary Township. In March 1967, a diamond drill hole, totalling 1,001 feet, was drilled in the southeast quadrant of claim S140175. The hole intersected rocks of the Gowganda Formation to a depth of 907 feet where it entered Nipissing Diabase and was then discontinued. No further work is reported in this area.

NORANDA EXPLORATION COMPANY (46)

Noranda Exploration Company, on 31 December 1969, held a group of 37 contiguous mining claims near the southeastern boundary of Turner Township. In 1967, the company drilled four diamond holes, totalling 2,989 feet on this property. The general geology of this property is shown on the Yorston Lake Map (Map 2260, back pocket). Hole N-1, drilled in the southwestern quarter of claim S140200, was collared in rocks of the Mississagi Formation. Interbedded quartzite and quartz-pebble conglomerate were intersected to a depth of 364 feet. From 364 feet to the end of hole at 389 feet the rock was fine-grained, dark green, and chloritic, and contained quartz pebbles; it is described in the log as a 'Keewatin Volcanic Rego-



O.D.M. 6990

Figure 16—Schematic cross-section based on diamond drilling in Turner and DeMorest Townships, Maple Mountain area; from ODM Assessment Work data.

lith'. The maximum U_3O_8 reported in the log is 0.008 percent at a depth of 285 feet (Ontario Division of Mines Assessment Work Files, Resident Geologist's Office, Sudbury).

Hole N-3, drilled in the northeast quarter of claim S140225, was also collared in rocks of the Mississagi Formation. The hole intersected Mississagi quartzite and siltstone to 223 feet where it entered a 'Keewatin Volcanic Regolith' to 400 feet. The hole continued to its end, at 619 feet, in andesite. No exceptionally high radioactivity is marked on the log (Ontario Division of Mines Assessment Work Files, Resident Geologist's Office, Sudbury) and the following note is given at the end of this log: "the andesite is definitely *not* diabase but the Keewatin volcanic basement; hence the hole has intersected a rise on the bank of the paleochannel." Holes N-1, and N-3 from Turner Township and hole N-2 from DeMorest Township are shown in schematic cross-section AD, Figure 16. Here the interpretation shown is one of a fault between holes N-1 and N-3 rather than a paleovalley.

Hole N-4 drilled in the northwestern quarter of claim S140226, was collared in rocks of the Mississagi Formation. The hole intersected Mississagi quartzite, grit, and quartz-pebble conglomerate to a depth of 721 feet. From 721 to 784 feet, the end of hole, the drilling intersected Keewatin rhyolitic tuff and sedimentary rocks. No exceptionally high radioactivity is reported in the log.

Hole N-5 drilled in claim S140086 in Turner Township, was collared in rocks of the Gowganda Formation. The hole continued in Gowganda greywacke, siltstone, argillite, and pebbly argillite, to a depth of 1,064 feet. From 1,064 to 1,197, the end of the hole, Nipissing Diabase was encountered. No report is made on radioactivity in the hole.

A noteworthy fact is that all the logs report the presence of abundant (up to 50 percent) sulphide minerals in rocks of the Mississagi Formation, especially near the basement. The sulphide minerals present are mainly pyrite with some pyrrhotite and minor chalcopyrite.

SUGGESTIONS FOR MINERAL EXPLORATION

No definite indications of ore deposits of economic importance, other than those already known, were discovered during the course of mapping. However, several general concepts that could be applicable to mineral exploration in the general region were evolved.

Sulphide minerals are relatively common in several of the Huronian formations, notably the Mississagi, Gowganda, and lower Lorrain. The possible existence of large, low grade copper and zinc sulphide deposits of the stratiform type in these rocks warrants investigation. Sulphide mineralization of this type will commonly be very fine-grained, and simple geochemical sampling techniques to indicate its presence would be useful.

Most of the known silver, gold, and base metal deposits in the district are associated with the Nipissing Diabase. The silver-bearing veins of the Cobalt-type are generally small but rich, and limited production from some of these may be warranted in the future. Based on the present work, trace element geochemical studies on the gabbros themselves do not appear likely to indicate the presence or absence of deposits of economic importance. However, it was found that there appears to be a direct correlation between degree of differentiation and alteration, and the occurrence of base metal sulphides. Exploration for large tonnage, low-grade copper, zinc, nickel, gold, and silver deposits in metamorphosed Nipissing intrusions throughout the North Shore region could be rewarding. To date, most of the exploration of the Nipissing Diabase has been oriented toward finding smaller, higher grade deposits and these appear to be few in number.

The Burwash Lake and Kokoko Lake iron deposits appear to be of sufficient size and grade to warrant future development as market and transportation conditions dictate.

Exploration for uranium in the basal Huronian sedimentary rocks outside of the main Elliot Lake camp, with the exception of the Agnew Lake area, has not met with notable success. There are numerous known uranium deposits in the Sault Ste. Marie-Lake Temagami region, but with the above noted exceptions, all have proven to be of insufficient size or grade to be economic. However, the existence of such widespread mineralization indicates that the possibility of discovering additional uranium deposits is good but will probably require a great deal of work, such as, detailed stratigraphic, structural, sedimentological, and paleocurrent studies. General studies throughout much of the Huronian belt have now been completed and these will provide a basis for future, more detailed investigations.

Work in the Maple Mountain area has produced several concepts that possibly have some application to exploration for uranium. Paleocurrent studies here and elsewhere in the Huronian belt show that the dominant Huronian paleocurrents were from the north or northwest. Consequently the Huronian sedimentary rocks, and presumably their associated uranium mineralization, were derived from the Archean basement rocks of the Superior Province. There is evidence that Huronian sedimentation was controlled by valleys produced by faults of the Timiskaming and Onaping Systems. There is also evidence that the northern paleolimit of the 'Bruce Group' probably extended through the centre of Maple Mountain area. Consequently the zone of intersection of these old faults with the Huronian paleolimit line may be favourable areas for Lower Huronian sedimentation and uranium deposition. Examination of geological or topographic maps of the North Shore region demonstrates the presence of numerous northwest-trending lineaments of the Timiskaming and Onaping types in the Archean basement rocks. Interestingly enough, some of these extend southwards towards the Huronian sequence in the Elliot Lake, Agnew Lake, and Turner Township areas. Possibly the favourable environment for uranium deposition lies farther down the paleoslope, in the 'delta front' or 'offshore' areas.

Heavy metal content of surface water is possibly a useful prospecting tool, but the method has not been sufficiently tested to evaluate its usefulness. The present study shows that anomalous concentrations of these elements in surface waters may indicate local concentrations of base metals in the nearby rocks. It is also apparent that the heavy metals tested probably stay in solution in relatively great concentrations for only short distances. Consequently, anomalously high concentrations of heavy metals in surface waters probably closely define areas of exploration interest. The high concentration of zinc in the waters of Stewart Lake, Haentschel Township, is a case in point, especially since the lake is located just southeast of Stull Township where base metal mineralization is known to exist.

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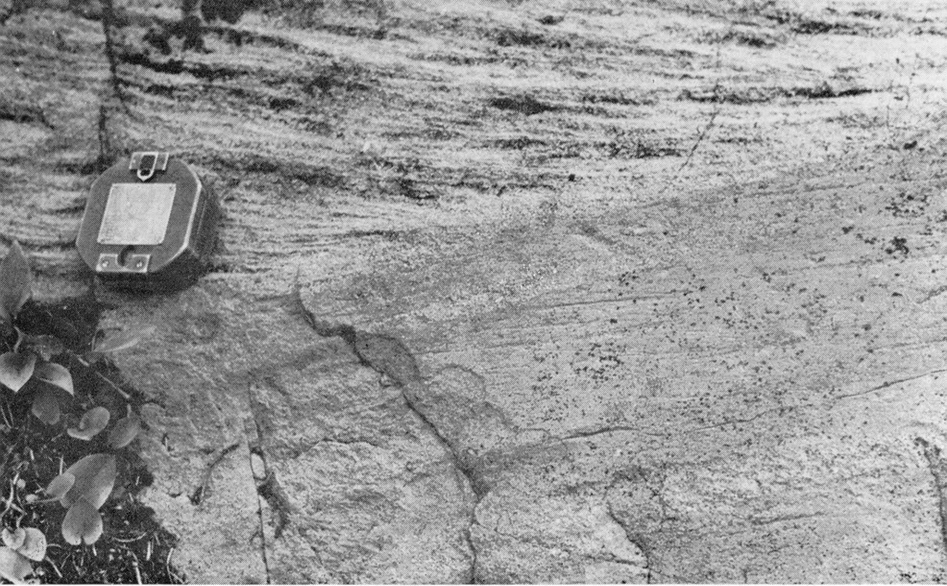

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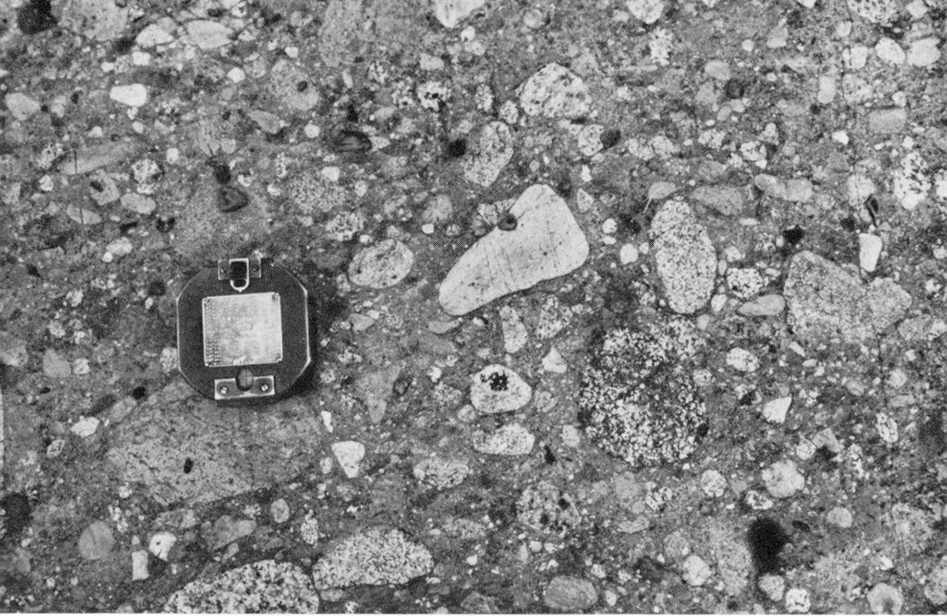

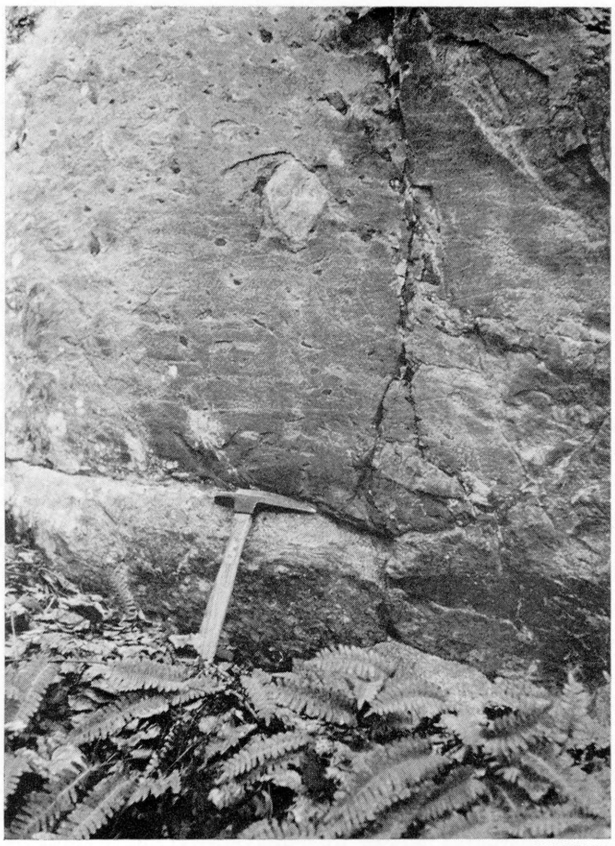

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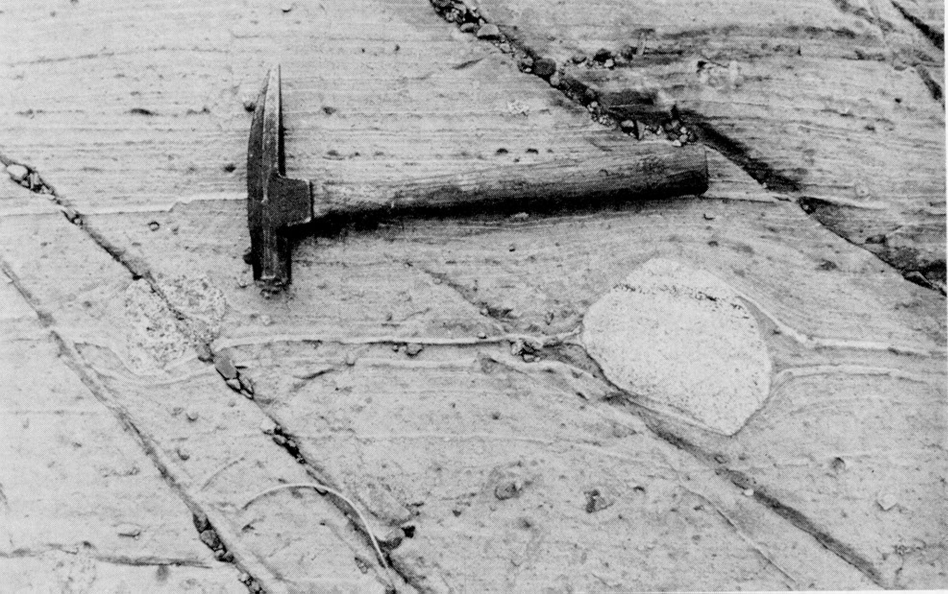
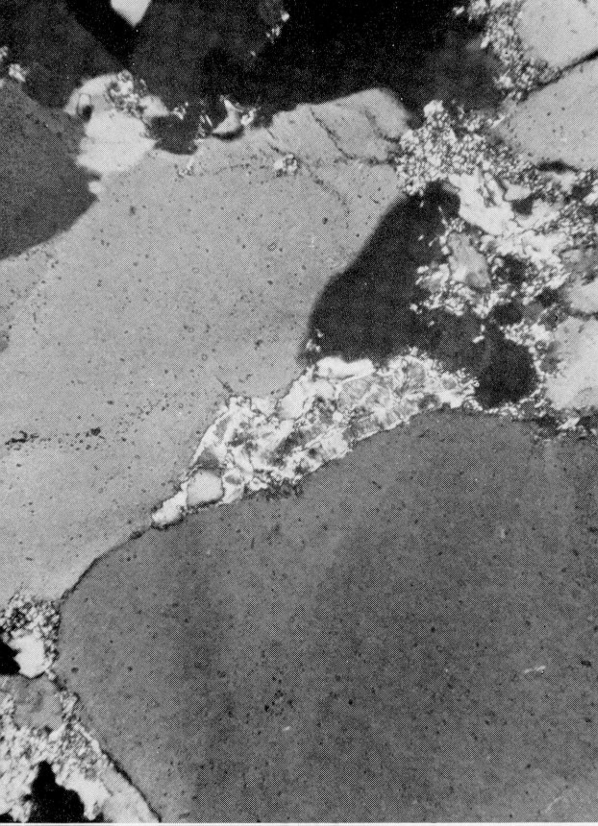
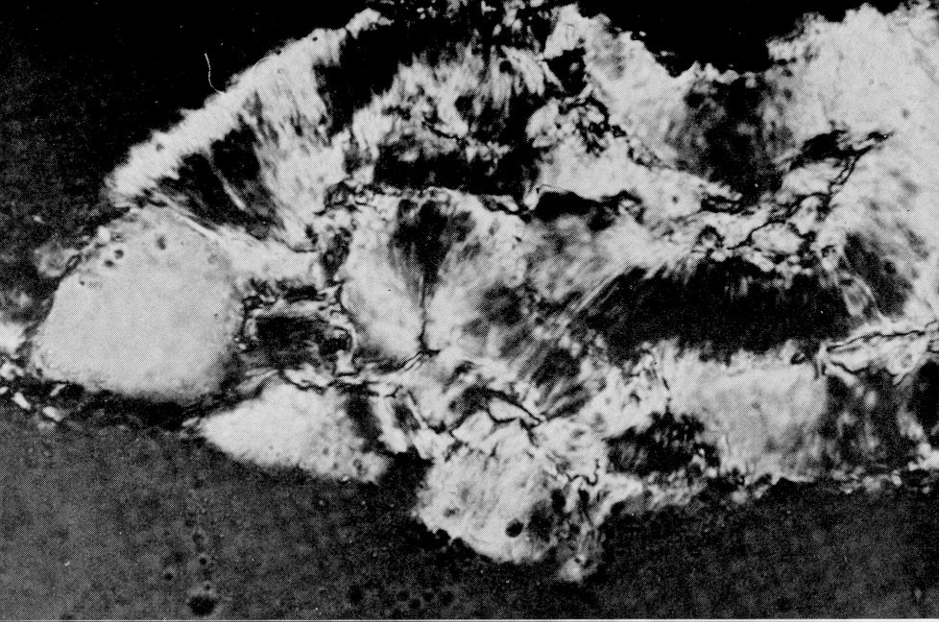
Photo 8—Unconformity between Gowganda conglomerate (above) and Archean granitic rocks (below); Selkirk Township. The hammerhead rests on the unconformity.

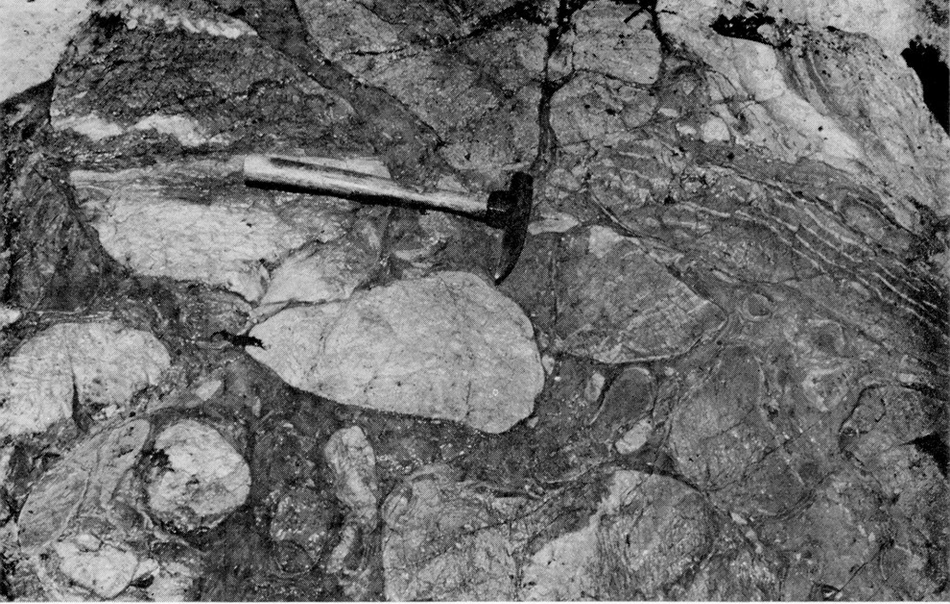
weathered granite boulders similar to the unweathered underlying Archean granite immediately below the unconformity. On the southern shore of Neault Lake, Valin Township, basal conglomeratic rubble is 'plastered' onto steep cliffs of granite. The basal conglomerate is composed of coarse angular fragments derived mainly from the underlying bedrock, and probably represents rubble deposited along fault scarps. West of McKee Lake, Dufferin Township, the contact between the Gowganda Formation and Archean metavolcanics is again smooth and undulating, and the basal conglomerate here is composed largely of metavolcanic fragments.

In the Turner Township area, the Gowganda Formation overlies rocks of the Hough Lake and Quirke Lake Groups as well as older Archean metavolcanics and granites. The contact between the Gowganda and the older Huronian rocks is apparently an angular unconformity as evidenced by onlap of the Gowganda over successively older formations, local strike and dip discordance as noted in outcrops, and angular dip discordance as shown by diamond drilling. Evidence for an unconformable relationship between the Gowganda and Serpent Formations exists in the form of angular strike and dip discordance in some localities, but in others, the two formations appear to be conformable. No fragments of the older Huronian rocks









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Map 2256
Smoothwater Lake

SYMBOLS

- *Glacial striae.*
- *Esker.*
- × *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- + *Bedding, horizontal.*
- *Bedding, top unknown; (inclined, vertical).*
- *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- *Schistosity; (horizontal, inclined, vertical).*
- *Gneissosity, (horizontal, inclined, vertical).*
- *Foliation; (horizontal, inclined, vertical).*
- *Lineation with plunge.*
- *Geological boundary, observed.*
- *Geological boundary, position interpreted.*
- *Geological boundary, deduced from geophysics.*
- *Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.*
- *Lineament.*
- *Drag folds with plunge.*
- *Anticline, syncline, with plunge.*
- *Vein.*
- *Shaft.*
- MA *Magnetic attraction.*
- RA *Radioactivity.*
- *Motor road.*
- *Other road.*
- .... *Trail, portage, winter road.*
- ▪ *Building.*
- *District boundary, approximate position only.*
- *Township boundary, base line or meridian, approximate position only.*
- *Township boundary, unsurveyed.*
- *Surveyed line, approximate position only.*
- ㉑ *Location of mining property. See list of properties.*

SOURCES OF INFORMATION

Geology of Ray and Donovan Townships by W. H. McIlwaine, 1969. Geology of the remaining townships by K. D. Card, 1969. Geology is not tied to surveyed lines.

Maps and plans of mining companies.

Map 179A, Onaping, by W. H. Collins, Geological Survey of Canada, Mem. 95, 1917.

Map 36c, Shiningtree Silver Area, Ontario Department of Mines, 1927.

Aeromagnetic maps 284G and 1514G, Geological Survey of Canada.

Preliminary maps:
- *P. 301, Maple Mountain Sheet, scale 1 inch to 2 miles, issued 1965.*
- *P. 502, Leith Township; P. 503, Charters Township; P. 504, Corkill Township; P. 558, Donovan Township; P. 559, Ray Township, scale 1 inch to ¼ mile, issued 1968.*
- *P. 584, Smoothwater Lake Area, scale 1 inch to 1 mile, issued 1970.*

Cartography by C. Karpetas and assistants, Ministry of Natural Resources, 1972.

Base map derived from maps of the Forest Resources Inventory, Ministry of Natural Resources, with additional information by K. D. Card.

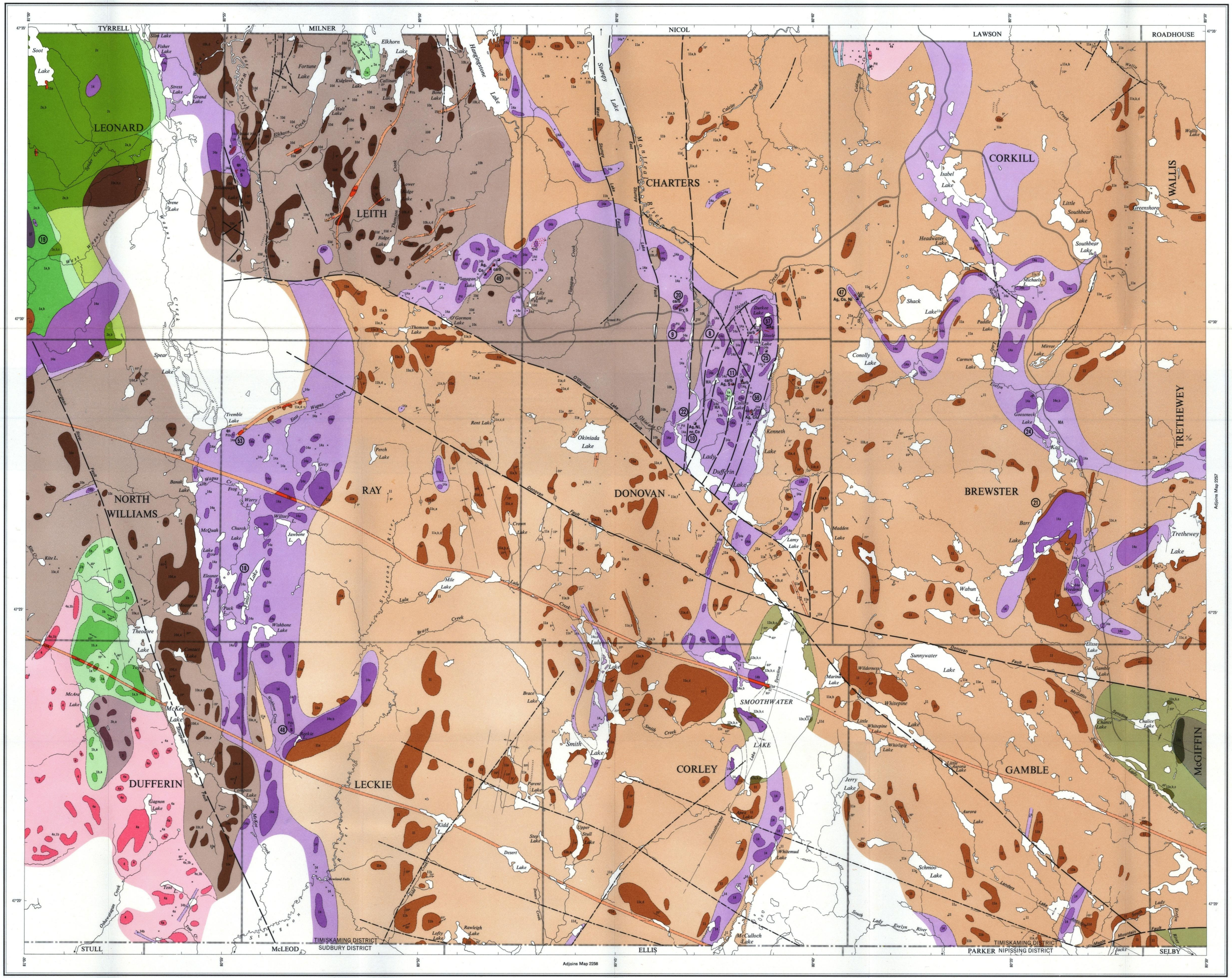
Magnetic declination in the area was approximately 9°30′ W, 1969.

LIST OF PROPERTIES

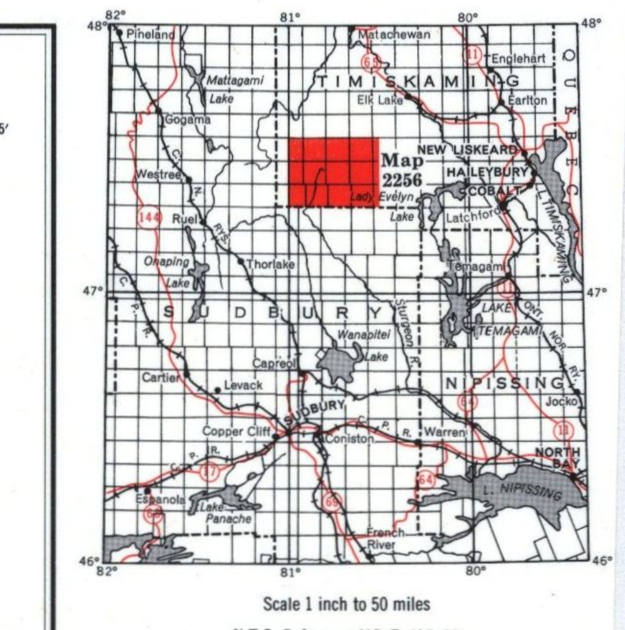
Argentium Silver Mines Ltd.
1. *Bergeron Lake deposit, van Nostrand Township.†*
2. *Darby Silver Mine, Whitson Township.†*
3. *Goldie Lake deposit, van Nostrand Township.†*
4. *Niccolite Lake deposit, van Nostrand Township.†*
5. *Skull Lake property, Speight Township.†*
6. *White Reserve Mine, Whitson Township.†*
7. *Armstrong, W. S., Estate, Speight Township.†*
8. *Beatty, W. A., Charters Township.*
Byberg, Andrew.
9. *Charters Township.*
10. *Gowganda-Duggan Mine, Donovan Township.*
11. *Thompson Mine, Donovan Township.*
Canadian Johns-Manville Co. Ltd.
12. *Dundee, Grigg, Marconi, Seagram, Stobie, and Turner Townships.†*
13. *(Harrison Minerals Ltd., T. Saville claims), Turner Township.†*
14. *Marconi Township [1968].†*
15. *Can-Fer Mines Ltd. [1967], Marconi Township.†*
16. *Cole deposit, Cole Township.†*
17. *Denison Mines Ltd., Clary, DeMorest, Seagram, and Turner Townships.†*
18. *Eleanor Lake deposit, Ray Township.*
19. *Fournier Lake prospect, Leonard Township.*
20. *Garvey, William, Estate, Charters Township.*
21. *Gereghty, G. J., Brewster Township.*
22. *Haines claim, Donovan Township.*
23. *Hardie, Arnold, Coppersand Lake deposit, Cynthia Township.†*
24. *Hardiman Bay Mines Ltd. [1966], Brewster Township.*
25. *Hillcoat, James, Donovan Township.*
26. *Ironco Mining and Smelting Co. Ltd., Cotton Township.†*
27. *Jalore Mining Co. Ltd., Kokoko Lake, Cynthia and Chambers Townships.†*
28. *Keevil Mining Group Ltd., [1966], Cynthia and Aston Townships.†*
King, Henry.
29. *Boundary claims, Speight Township.†*
30. *Munroe Lake deposit, Speight Township.†*
31. *Lady Evelyn Lake deposit, Leo Township.†*
Last, Henry.
32. *Clary Township.†*
33. *DeMorest Township.†*
34. *Turner Township.†*
35. *Lynch deposit, Speight Township.†*
Mark, Howard.
36. *First Bay deposit, Barr Township.†*
37. *Inland deposit, Klock Township.†*
38. *Island deposit, Dane and Kittson Townships.†*
39. *Klock deposits, Barr Township.†*
40. *Second Bay deposit, Barr Township.†*
41. *McIntosh, R. E., Turner Township.†*
42. *Metron Explorations Ltd., Stull Township.†*
43. *Moore, William, Speight Township.†*
44. *New Delhi Mines Ltd., Delhi Township.†*
Noranda Exploration Co.
45. *Clary Township.†*
46. *Turner and DeMorest Townships.†*
47. *Ourgold Mining Company Ltd., Corkill Township.*
48. *Reekie Lake occurrence, Leckie Township.*
49. *Rustex Mining Corp., Leith Township.*
50. *Solace Lake lead-silver deposit, Selkirk Township.†*
51. *Sucker Gut Lake deposit, Leo Township.†*
52. *Taylor deposit, Speight Township.†*
53. *Tremble Lake deposit, Ray Township.*
54. *Truss deposit, Auld Township.†*
55. *Walton, H. G., Bradley-Donaldson Mine, Auld Township.†*
Welsh, B. M.
56. *Charron Silver Mine, Auld Township.†*
57. *Charters Township.*
58. *Triangle Silver Mine, Auld Township.†*
59. *Wilder, Frank, Donovan Township.*

Ownership of properties as of December 31, 1969. Date in square brackets [1968] indicates year of last major work on property. For further information, see report.

†Appears on accompanying maps of Geological Report 106.



Published 1973



Scale 1 inch to 50 miles
N.T.S. Reference 41P/7, 41P/10

LEGEND

CENOZOIC[a]
QUATERNARY
RECENT
Stream, lake, and swamp deposits.

PLEISTOCENE
Glacial, glaciofluvial, and glaciolacustrine deposits.

UNCONFORMITY

PRECAMBRIAN[b]
PROTEROZOIC
MAFIC INTRUSIONS
LATE DIABASE INTRUSIONS

15 *Diabase.†*
15a *Olivine diabase.*

INTRUSIVE CONTACT

NIPISSING DIABASE INTRUSIONS[c]

14 *Unsubdivided.*[d]
14a *Pyroxene gabbro.*[d]
14b *Hornblende gabbro, metagabbro.*[d]
14c *Epidote amphibolite.*
14d *Granophyre.*[d]

INTRUSIVE CONTACT

HURONIAN SUPERGROUP
COBALT GROUP
BAR RIVER FORMATION

13 *Unsubdivided.†*
13a *Sandstone.*

GORDON LAKE FORMATION[c]

12 *Unsubdivided.*
12a *Sandstone.*
12b *Argillite.*
12c *Chert, chert breccia.*

LORRAIN FORMATION[c]

11 *Unsubdivided.*
11a *Green and grey micaceous pebbly sandstone.*
11b *Feldspathic sandstone.*
11c *White sandstone.*
11d *Ferruginous sandstone.*
11e *Argillaceous sandstone, greywacke, siltstone.*
11f *Conglomerate.*

GOWGANDA FORMATION[c]

10 *Unsubdivided.*
10a *Pebbly mudstone-polymictic paraconglomerate, greywacke, siltstone, or laminated argillite matrix.*
10b *Polymictic orthoconglomerate, greywacke or siltstone matrix.*
10c *Sandstone, feldspathic sandstone, greywacke.*
10d *Argillite, siltstone.*
10e *Laminated argillite.*

QUIRKE LAKE GROUP
SERPENT FORMATION[c]†

9a *Sandstone.*
9b *Argillite, siltstone.*

ESPANOLA FORMATION†

8 *Limestone, siltstone.*

BRUCE FORMATION[c]†

7a *Polymictic conglomerate.*
7b *Sandstone.*

HOUGH LAKE GROUP
MISSISSAGI FORMATION[c]†

6 *Unsubdivided.*
6a *Sandstone.*
6b *Argillite, siltstone, argillaceous schist.*
6c *Polymictic conglomerate.*

UNCONFORMITY

ARCHEAN
MAFIC INTRUSIONS
EARLY MAFIC INTRUSIONS

5 *Gabbro, metagabbro, diabase.*

INTRUSIVE CONTACT

FELSIC INTRUSIVE AND METAMORPHIC ROCKS
GRANITIC ROCKS[c]

4 *Unsubdivided.*
4a *Quartz monzonite, granodiorite.*
4b *Porphyritic quartz monzonite, granodiorite, quartz diorite.†*

GNEISS AND MIGMATITES[c]

3 *Unsubdivided.*
3a *Quartz-feldspar gneiss, migmatite.*
3b *Mafic migmatite, agmatite.*

METAVOLCANICS AND METASEDIMENTS
FELSIC METAVOLCANICS AND METASEDIMENTS[c]

2 *Unsubdivided.†*
2a *Rhyolite, trachyte, intermediate metavolcanics.*
2b *Felsic tuff, breccia, agglomerate.*
2c *Sandstone, argillite, conglomerate.*[e]
2d *Felsic schist.†*

MAFIC METAVOLCANICS[c]

1 *Unsubdivided.†*
1a *Basalt, andesite.*
1c *Diabase.†*
1b *Amphibolite, amphibolite schist.*

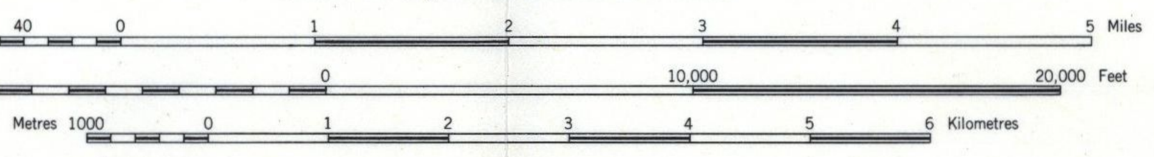
IF *Iron formation.*

△ △ △ *Breccia.*

Ag	*Silver.*	**Ni**	*Nickel.*
Au	*Gold.†*	**Pb**	*Lead.†*
carb	*Carbonate.*	**q**	*Quartz.*
Co	*Cobalt.*	**qc**	*Quartz-carbonate.*
Cu	*Copper.†*	**S**	*Sulphide mineralization.*
ery	*Erythrite.*	**U**	*Uranium.†*
Fe	*Iron.†*	**Zn**	*Zinc.†*
nc	*Niccolite.*		

Map 2256
SMOOTHWATER LAKE
TIMISKAMING DISTRICT

Scale 1 : 63,360 or 1 Inch to 1 Mile



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[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured and uncoloured parts on the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown, respectively, in deep and light tones of the same colour. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

[c] *The rocks of these units are subdivided lithologically and the order does not imply age relationship within the groups.*

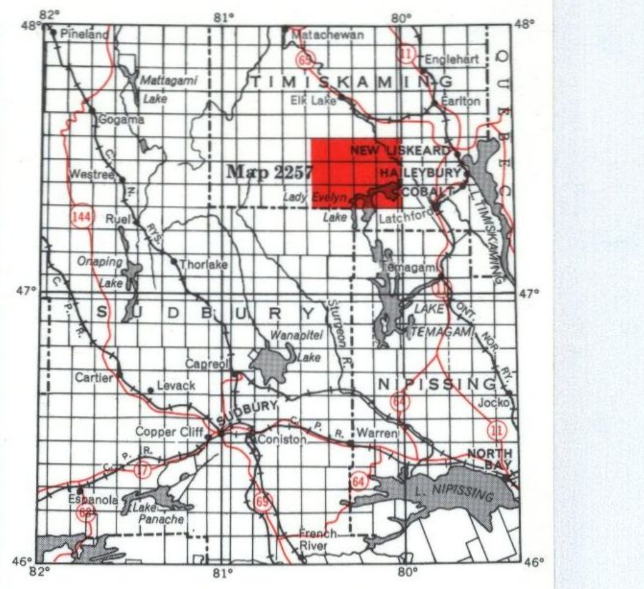
[d] *Nipissing-type.*

[e] *Timiskaming-type.*

†Appears on accompanying maps of Geological Report 106.

ONTARIO
DIVISION OF MINES
HONOURABLE LEO BERNIER, *Minister of Natural Resources*
W. Q. MACNEE, *Deputy Minister of Natural Resources*
G. A. Jewett, *Executive Director, Division of Mines* E. G. Pye, *Director, Geological Branch*

Map 2257
Makobe Lake



Scale 1 inch to 50 miles
N.T.S. references 41P/8, 41P/9

SYMBOLS

- Glacial striae.
- Esker.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, horizontal.
- Bedding, top unknown; (inclined, vertical).
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
- Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
- Schistosity; (horizontal, inclined, vertical).
- Gneissosity, (horizontal, inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Lineation with plunge.
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Geological boundary, deduced from geophysics.
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Drag folds with plunge.
- Anticline, syncline, with plunge.
- Vein.
- Shaft.
- MA Magnetic attraction.
- RA Radioactivity.
- Motor road.
- Other road.
- Trail, portage, winter road.
- Building.
- District boundary, approximate position only.
- Township boundary, base line or meridian, approximate position only.
- Township boundary, unsurveyed.
- Surveyed line, approximate position only.
- ㊲ Location of mining property. See list of properties.

SOURCES OF INFORMATION

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Maps and plans of mining companies.

Map 179A, Onaping, by W. H. Collins, Geological Survey of Canada, Mem. 95, 1917.

Map 35c, Anima-Nipissing Lake Area, Ontario Department of Mines, 1926.

Aeromagnetic maps 1504G and 1505G, Geological Survey of Canada.

Preliminary maps:
P. 301, Maple Mountain Sheet, scale 1 inch to 2 miles, issued 1965.
P. 566, Van Nostrand Township; P. 573, Speight Township; P. 579, Auld Township; P. 580, Whitson Township, scale 1 inch to ¼ mile, issued 1969.
P. 585, Lady Evelyn Lake Sheet, scale 1 inch to 1 mile, issued, 1970.

Cartography by C. Karpetas and assistants, Ministry of Natural Resources, 1972.

Base map derived from maps of the Forest Resources Inventory, Ministry of Natural Resources, with additional information by K. D. Card.

Magnetic declination in the area was approximately 9°30′ W, 1969.

LIST OF PROPERTIES

Argentium Silver Mines Ltd.
1. Bergeron Lake deposit, van Nostrand Township.
2. Darby Silver Mine, Whitson Township.
3. Goldie Lake deposit, van Nostrand Township.
4. Niccolite Lake deposit, van Nostrand Township.
5. Skull Lake property, Speight Township.
6. White Reserve Mine, Whitson Township.
7. Armstrong, W. S., Estate, Speight Township.
8. Beatty, W. A., Charters Township.†
Byberg, Andrew.
9. Charters Township.†
10. Gowganda-Duggan Mine, Donovan Township.†
11. Thompson Mine, Donovan Township.†
Canadian Johns-Manville Co. Ltd.
12. Dundee, Grigg, Marconi, Seagram, Stobie, and Turner Townships.†
13. (Harrison Minerals Ltd., T. Saville claims), Turner Township.†
14. Marconi Township [1968].†
15. Can-Fer Mines Ltd. [1967], Marconi Township.†
16. Cole deposit, Cole Township.†
17. Denison Mines Ltd., Clary, DeMorest, Seagram, and Turner Townships.†
18. Eleanor Lake deposit, Ray Township.†
19. Fournier Lake prospect, Leonard Township.†
20. Garvey, William, Estate, Charters Township.†
21. Gereghty, G. J., Brewster Township.†
22. Haines claim, Donovan Township.†
23. Hardie, Arnold, Coppersand Lake deposit, Cynthia Township.†
24. Hardiman Bay Mines Ltd. [1966], Brewster Township.†
25. Hillcoat, James, Donovan Township.†
26. Ironco Mining and Smelting Co. Ltd., Cotton Township.†
27. Jalore Mining Co. Ltd., Kokoko Lake, Cynthia and Chambers Townships.†
28. Keevil Mining Group Ltd., [1966], Cynthia and Aston Townships.†
King, Henry
29. Boundary claims, Speight Township.
30. Munroe Lake deposit, Speight Township.
31. Lady Evelyn Lake deposit, Leo Township.
Last, Henry.
32. Clary Township.†
33. DeMorest Township.†
34. Turner Township.†
35. Lynch deposit, Speight Township.
Mark, Howard.
36. First Bay deposit, Barr Township.
37. Inland deposit, Klock Township.
38. Island deposit, Dane and Kittson Townships.
39. Klock deposits, Barr Township.
40. Second Bay deposit, Barr Township.
41. McIntosh, R. E., Turner Township.†
42. Metron Explorations Ltd., Stull Township.†
43. Moore, William, Speight Township.
44. New Delhi Mines Ltd., Delhi Township.†
Noranda Exploration Co.
45. Clary Township.†
46. Turner and DeMorest Townships.†
47. Ourgold Mining Company Ltd., Corkill Township.†
48. Reekie Lake occurrence, Leckie Township.†
49. Rustex Mining Corp., Leith Township.†
50. Solace Lake lead-silver deposit, Selkirk Township.†
51. Sucker Gut Lake deposit, Leo Township.
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54. Truss deposit, Auld Township.
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Welsh, B. M.
56. Charron Silver Mine, Auld Township.
57. Charters Township.†
58. Triangle Silver Mine, Auld Township.
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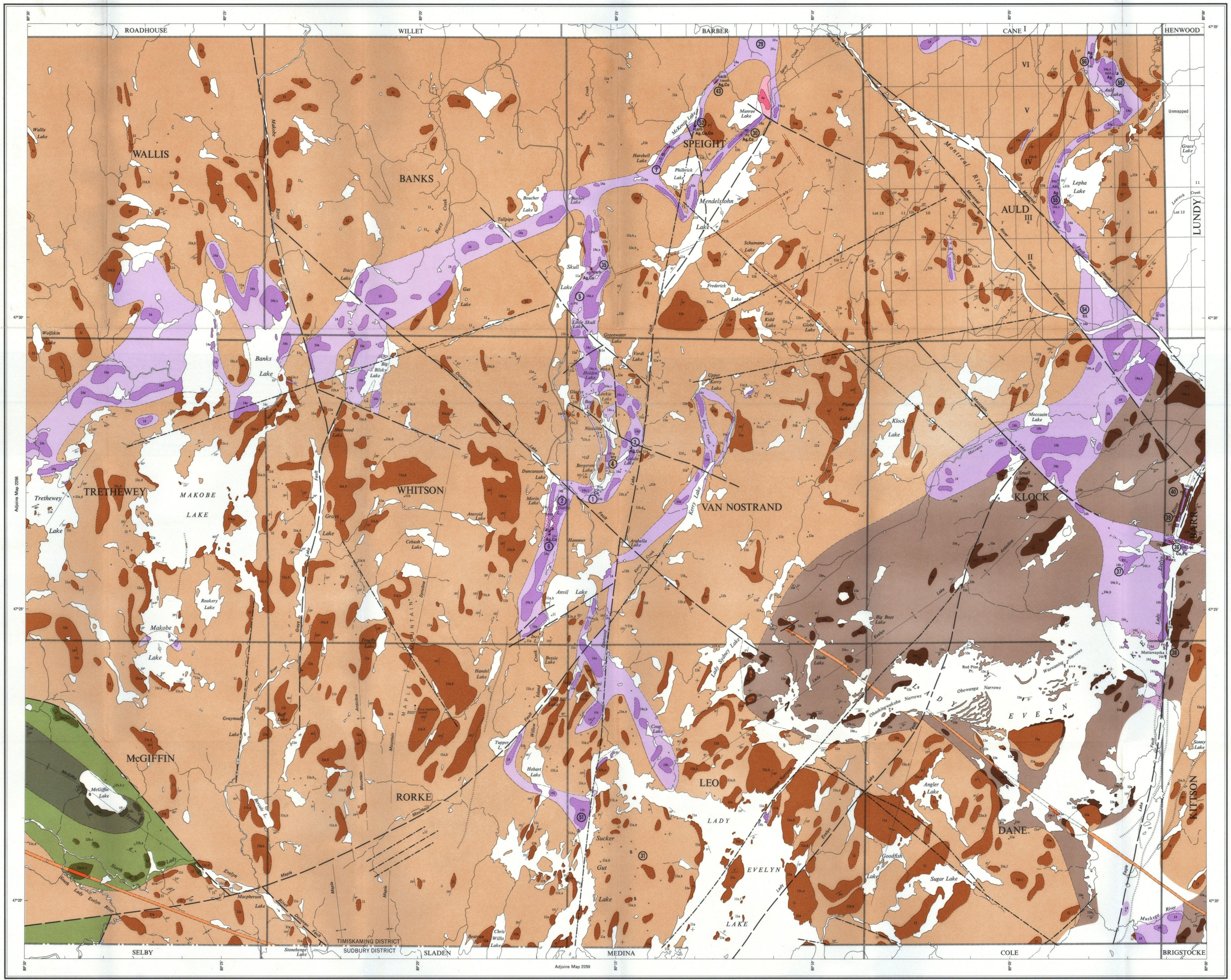
Ownership of properties as of December 31, 1969. Date in square brackets [1968] indicates year of last major work on property. For further information, see report.

†Appears on accompanying maps of Geological Report 106.



Published 1973

Map 2257

MAKOBE LAKE

TIMISKAMING DISTRICT

Scale 1 : 63,360 or 1 Inch to 1 Mile

Chains 80 40 0 1 2 3 4 5 Miles
Feet 10,000 0 10,000 20,000 Feet
Metres 1000 0 1 2 3 4 5 6 Kilometres

LEGEND

CENOZOIC[a]
QUATERNARY
RECENT
Stream, lake, and swamp deposits.

PLEISTOCENE
Glacial, glaciofluvial, and glaciolacustrine deposits.

UNCONFORMITY

PRECAMBRIAN[b]
PROTEROZOIC
MAFIC INTRUSIONS
LATE DIABASE INTRUSIONS

15
15 Diabase.
15a Olivine diabase.

INTRUSIVE CONTACT

NIPISSING DIABASE INTRUSIONS[c]

14
14 Unsubdivided.[d]
14a Pyroxene gabbro.[d]
14b Hornblende gabbro, metagabbro.[d]
14c Epidote amphibolite.

14d
14d Granophyre.[d]†

INTRUSIVE CONTACT

HURONIAN SUPERGROUP
COBALT GROUP
BAR RIVER FORMATION

13
13 Unsubdivided.†
13a Sandstone.

GORDON LAKE FORMATION[c]

12
12 Unsubdivided.
12a Sandstone.
12b Argillite.
12c Chert, chert breccia.

LORRAIN FORMATION[c]

11
11 Unsubdivided.
11a Green and grey micaceous pebbly sandstone.
11b Feldspathic sandstone.
11c White sandstone.
11d Ferruginous sandstone.
11e Argillaceous sandstone, greywacke, siltstone.
11f Conglomerate.

GOWGANDA FORMATION[c]

10
10 Unsubdivided.†
10a Pebbly mudstone-polymictic paraconglomerate, greywacke, siltstone, or laminated argillite matrix.
10b Polymictic orthoconglomerate, greywacke or siltstone matrix.
10c Sandstone, feldspathic sandstone, greywacke.
10d Argillite, siltstone.
10e Laminated argillite.

QUIRKE LAKE GROUP
SERPENT FORMATION[c]†

9
9a Sandstone.
9b Argillite, siltstone.

ESPANOLA FORMATION†

8
8 Limestone, siltstone.

BRUCE FORMATION[c]†

7
7a Polymictic conglomerate.
7b Sandstone.

HOUGH LAKE GROUP
MISSISSAGI FORMATION[e]†

6
6 Unsubdivided.
6a Sandstone.
6b Argillite, siltstone, argillaceous schist.
6c Polymictic conglomerate.

UNCONFORMITY

ARCHEAN
MAFIC INTRUSIONS
EARLY MAFIC INTRUSIONS†

5
5 Gabbro, metagabbro, diabase.

INTRUSIVE CONTACT

FELSIC INTRUSIVE AND METAMORPHIC ROCKS
GRANITIC ROCKS[c]

4
4 Unsubdivided.†
4a Quartz monzonite, granodiorite.
4b Porphyritic quartz monzonite, granodiorite, quartz diorite.†

GNEISS AND MIGMATITES[c]†

3
3 Unsubdivided.
3a Quartz-feldspar gneiss, migmatite.
3b Mafic migmatite, agmatite.

METAVOLCANICS AND METASEDIMENTS
FELSIC METAVOLCANICS AND METASEDIMENTS[c]†

2
2 Unsubdivided.
2a Rhyolite, trachyte, intermediate metavolcanics.
2b Felsic tuff, breccia, agglomerate.
2c Sandstone, argillite, conglomerate.[e]
2d Felsic schist.

MAFIC METAVOLCANICS[c]†

1
1 Unsubdivided.
1a Basalt, andesite.,
1b Amphibolite, amphibolite schist.
1c Diabase.

IF
IF Iron formation.†

△ △ △ △ *Breccia.†*

Ag	*Silver.*	**Ni**	*Nickel.†*
Au	*Gold.†*	**Pb**	*Lead.*
carb	*Carbonate.*	**q**	*Quartz.†*
Co	*Cobalt.*	**qc**	*Quartz-carbonate.*
Cu	*Copper.*	**S**	*Sulphide mineralization.*
ery	*Erythrite.*	**U**	*Uranium.†*
Fe	*Iron.†*	**Zn**	*Zinc.†*
nc	*Niccolite.†*		

---

[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured and uncoloured parts on the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown, respectively, in deep and light tones of the same colour. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

[c] *The rocks of these units are subdivided lithologically and the order does not imply age relationship within the groups.*

[d] *Nipissing-type.*

[e] *Timiskaming-type.*

†Appears on accompanying maps of Geological Report 106.

ONTARIO
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W. Q. MACNEE, Deputy Minister of Natural Resources
G. A. Jewett, Executive Director, Division of Mines E. G. Pye, Director, Geological Branch

Map 2258
Solace Lake

SYMBOLS

Glacial striae.
Esker.
Small bedrock outcrop.
Area of bedrock outcrop.
Bedding, horizontal.
Bedding, top unknown; (inclined, vertical).
Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
Schistosity; (horizontal, inclined, vertical).
Gneissosity, (horizontal, inclined, vertical).
Foliation; (horizontal, inclined, vertical).
Lineation with plunge.
Geological boundary, observed.
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Anticline, syncline, with plunge.
Vein.
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RA Radioactivity.
Motor road.
Other road.
Trail, portage, winter road.
Building.
District boundary, approximate position only.
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Township boundary, unsurveyed.
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㊷ Location of mining property. See list of properties.

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Byberg, Andrew.
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28. Keevil Mining Group Ltd., [1966], Cynthia and Aston Townships.†
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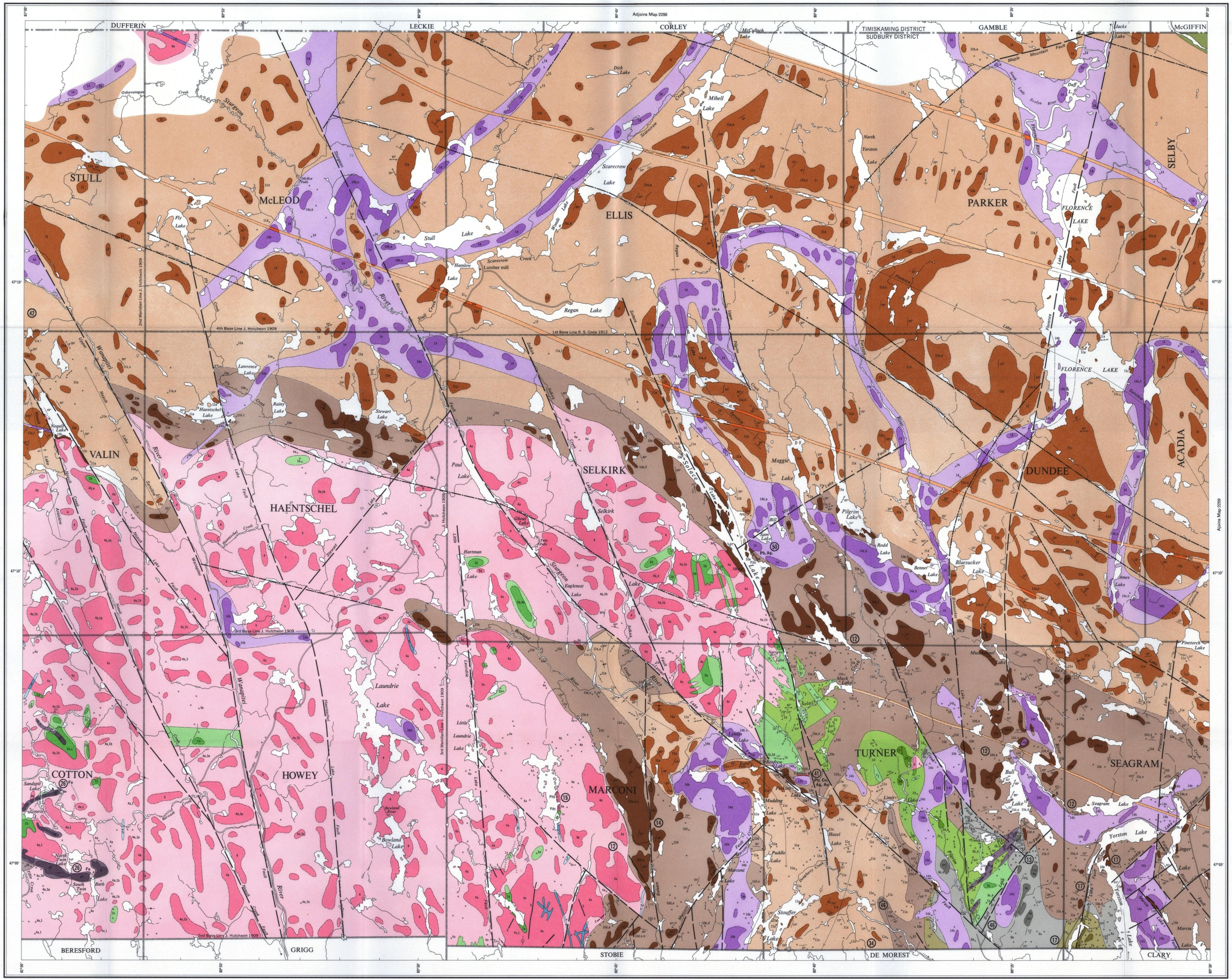
29. Boundary claims, Speight Township.†
30. Munroe Lake deposit, Speight Township.†
31. Lady Evelyn Lake deposit, Leo Township.†
Last, Henry.
32. Clary Township.†
33. DeMorest Township.†
34. Turner Township.
35. Lynch deposit, Speight Township.†
Mark, Howard.
36. First Bay deposit, Barr Township.†
37. Inland deposit, Klock Township.†
38. Island deposit, Dane and Kittson Townships.†
39. Klock deposits, Barr Township.†
40. Second Bay deposit, Barr Township.†
41. McIntosh, R. E., Turner Township.
42. Metron Explorations Ltd., Stull Township.
43. Moore, William, Speight Township.†
44. New Delhi Mines Ltd., Delhi Township.†
Noranda Exploration Co.
45. Clary Township.†
46. Turner and DeMorest Townships.
47. Ourgold Mining Company Ltd., Corkill Township.†
48. Reekie Lake occurrence, Leckie Township.†
49. Rustex Mining Corp., Leith Township.†
50. Solace Lake lead-silver deposit, Selkirk Township.
51. Sucker Gut Lake deposit, Leo Township.†
52. Taylor deposit, Speight Township.†
53. Tremble Lake deposit, Ray Township.†
54. Truss deposit, Auld Township.†
55. Walton, H. G., Bradley-Donaldson Mine, Auld Township.†
Welsh, B. M.
56. Charron Silver Mine, Auld Township.†
57. Charters Township.†
58. Triangle Silver Mine, Auld Township.†
59. Wilder, Frank, Donovan Township.†

Ownership of properties as of December 31, 1969. Date in square brackets [1968] indicates year of last major work on property. For further information, see report.

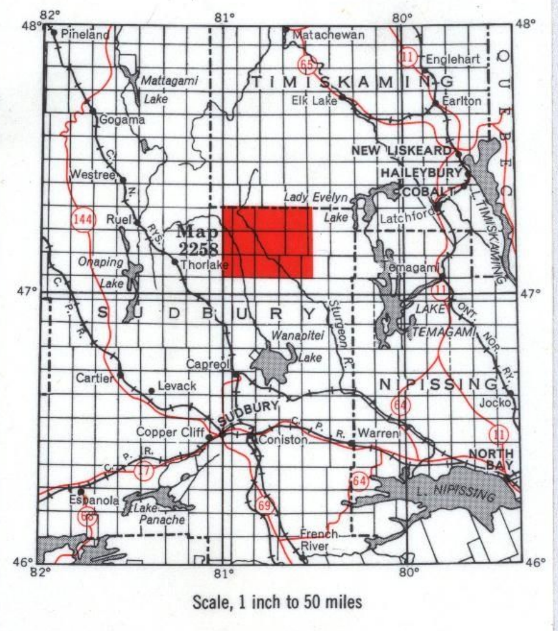
†Appears on accompanying maps of Geological Report 106.



Published 1973

Map 2258
SOLACE LAKE
SUDBURY DISTRICT

Scale 1 : 63,360 or 1 Inch to 1 Mile



Scale, 1 inch to 50 miles

N.T.S. Reference 41P/2, 41P/7

LEGEND

CENOZOIC[a]
QUATERNARY
RECENT
Stream, lake, and swamp deposits.

PLEISTOCENE
Glacial, glaciofluvial, and glaciolacustrine deposits.

UNCONFORMITY

PRECAMBRIAN[b]
PROTEROZOIC
MAFIC INTRUSIONS
LATE DIABASE INTRUSIONS

15 Diabase.
15a Olivine diabase.

INTRUSIVE CONTACT

NIPISSING DIABASE INTRUSIONS[c]

14 Unsubdivided.[d]
14a Pyroxene gabbro.[d]
14b Hornblende gabbro, metagabbro.[d]
14c Epidote amphibolite.
14d Granophyre.[d]

INTRUSIVE CONTACT

HURONIAN SUPERGROUP
COBALT GROUP
BAR RIVER FORMATION†

13 Unsubdivided.
13a Sandstone.

GORDON LAKE FORMATION[c]

12 Unsubdivided.†
12a Sandstone.†
12b Argillite.†
12c Chert, chert breccia.†

LORRAIN FORMATION[c]

11 Unsubdivided.
11a Green and grey micaceous pebbly sandstone.
11b Feldspathic sandstone.
11c White sandstone.
11d Ferruginous sandstone.
11e Argillaceous sandstone, greywacke, siltstone.
11f Conglomerate.

GOWGANDA FORMATION[c]

10 Unsubdivided.
10a Pebbly mudstone-polymictic paraconglomerate, greywacke, siltstone, or laminated argillite matrix.
10b Polymictic orthoconglomerate, greywacke or siltstone matrix.
10c Sandstone, feldspathic sandstone, greywacke.
10d Argillite, siltstone.
10e Laminated argillite.

QUIRKE LAKE GROUP
SERPENT FORMATION[c]†

9a Sandstone.
9b Argillite, siltstone.

ESPANOLA FORMATION†

8 Limestone, siltstone.

BRUCE FORMATION[c]

7a Polymictic conglomerate.
7b Sandstone.

HOUGH LAKE GROUP
MISSISSAGI FORMATION[e]

6 Unsubdivided.
6a Sandstone.
6b Argillite, siltstone, argillaceous schist.
6c Polymictic conglomerate.

UNCONFORMITY

ARCHEAN
MAFIC INTRUSIONS
EARLY MAFIC INTRUSIONS

5 Gabbro, metagabbro, diabase.

INTRUSIVE CONTACT

FELSIC INTRUSIVE AND METAMORPHIC ROCKS
GRANITIC ROCKS[c]

4 Unsubdivided.
4a Quartz monzonite, granodiorite.
4b Porphyritic quartz monzonite, granodiorite, quartz diorite.

GNEISS AND MIGMATITES[c]

3 Unsubdivided.†
3a Quartz-feldspar gneiss, migmatite.†
3b Mafic migmatite, agmatite.

METAVOLCANICS AND METASEDIMENTS
FELSIC METAVOLCANICS AND METASEDIMENTS[c]

2 Unsubdivided.
2a Rhyolite, trachyte, intermediate metavolcanics.
2b Felsic tuff, breccia, agglomerate.
2c Sandstone, argillite, conglomerate.[e]†
2d Felsic schist.

MAFIC METAVOLCANICS[c]

1 Unsubdivided.
1a Basalt, andesite.
1b Amphibolite, amphibolite schist.
1c Diabase.

IF Iron formation.

△ Breccia.

Ag	*Silver.*	**Ni**	*Nickel.†*
Au	*Gold.*	**Pb**	*Lead.*
carb	*Carbonate.†*	**q**	*Quartz.*
Co	*Cobalt.†*	**qc**	*Quartz-carbonate.*
Cu	*Copper.*	**S**	*Sulphide mineralization.*
ery	*Erythrite.†*	**U**	*Uranium.*
Fe	*Iron.*	**Zn**	*Zinc.†*
nc	*Niccolite.†*		

---

[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured and uncoloured parts on the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown, respectively, in deep and light tones of the same colour. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

[c] *The rocks of these units are subdivided lithologically and the order does not imply age relationship within the groups.*

[d] *Nipissing-type.*

[e] *Timiskaming-type.*

†Appears on accompanying maps of Geological Report 106.

ONTARIO
DIVISION OF MINES
HONOURABLE LEO BERNIER, *Minister of Natural Resources*
W. Q. MACNEE, *Deputy Minister of Natural Resources*
G. A. Jewett, *Executive Director, Division of Mines* E. G. Pye, *Director, Geological Branch*

Map 2259
Diamond Lake

SYMBOLS

- *Glacial striae.*
- *Esker.*
- *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- *Bedding, horizontal.*
- 35° *Bedding, top unknown; (inclined, vertical).*
- 50° 65° *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*
- 85° 65° *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- 55° *Schistosity; (horizontal, inclined, vertical).*
- 80° *Gneissosity, (horizontal, inclined, vertical).*
- 30° *Foliation; (horizontal, inclined, vertical).*
- 15° *Lineation with plunge.*
- *Geological boundary, observed.*
- *Geological boundary, position interpreted.*
- *Geological boundary, deduced from geophysics.*
- *Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.*
- *Lineament.*
- 60° 60° *Drag folds with plunge.*
- 70° 70° *Anticline, syncline, with plunge.*
- *Vein.*
- *Shaft.*
- MA *Magnetic attraction.*
- RA *Radioactivity.*
- *Motor road.*
- *Other road.*
- *Trail, portage, winter road.*
- *Building.*
- *District boundary, approximate position only.*
- *Township boundary, base line or meridian, approximate position only.*
- *Township boundary, unsurveyed.*
- *Surveyed line, approximate position only.*
- ⑯ *Location of mining property. See list of properties.*

SOURCES OF INFORMATION

Geology of Seagram Township by H. D. Meyn, 1969. Geology of the remaining townships by K. D. Card, 1969. Geology is not tied to surveyed lines.

Maps and plans of mining companies.

Map 179A, Onaping, by W. H. Collins, Geological Survey of Canada, Mem. 95, 1917.

Maps 1954-1, Township of Delhi, published 1954 and 2057, Northwestern Timagami Area, published 1964, Ontario Department of Mines.

Aeromagnetic maps 1503G and 1504G, Geological Survey of Canada.

Preliminary maps:
P. 301, Maple Mountain Sheet, scale 1 inch to 2 miles, issued 1965.
P. 570, Seagram, and part of Clary Townships, scale 1 inch to ¼ mile, issued 1969.
P. 585, Lady Evelyn Lake Sheet, scale 1 inch to 1 mile, issued 1970.

Cartography by C. Karpetas and assistants, Ministry of Natural Resources, 1972.

Base map derived from maps of the Forest Resources Inventory, Ministry of Natural Resources, with additional information by K. D. Card.

Magnetic declination in the area was approximately 9°30′ W, 1969.

LIST OF PROPERTIES

Argentium Silver Mines Ltd.
1. *Bergeron Lake deposit, van Nostrand Township.†*
2. *Darby Silver Mine, Whitson Township.†*
3. *Goldie Lake deposit, van Nostrand Township.†*
4. *Niccolite Lake deposit, van Nostrand Township.†*
5. *Skull Lake property, Speight Township.†*
6. *White Reserve Mine, Whitson Township.†*
7. *Armstrong, W. S., Estate, Speight Township.†*
8. *Beatty, W. A., Charters Township.†*

Byberg, Andrew.
9. *Charters Township.†*
10. *Gowganda-Duggan Mine, Donovan Township.†*
11. *Thompson Mine, Donovan Township.†*

Canadian Johns-Manville Co. Ltd.
12. *Dundee, Grigg, Marconi, Seagram, Stobie, and Turner Townships.†*
13. *(Harrison Minerals Ltd., T. Saville claims), Turner Township.†*
14. *Marconi Township [1968].†*
15. *Can-Fer Mines Ltd. [1967], Marconi Township.†*
16. *Cole deposit, Cole Township.*
17. *Denison Mines Ltd., Clary, DeMorest, Seagram, and Turner Townships.†*
18. *Eleanor Lake deposit, Ray Township.†*
19. *Fournier Lake prospect, Leonard Township.†*
20. *Garvey, William, Estate, Charters Township.†*
21. *Gereghty, G. J., Brewster Township.†*
22. *Haines claim, Donovan Township.†*
23. *Hardie, Arnold, Coppersand Lake deposit, Cynthia Township.*
24. *Hardiman Bay Mines Ltd. [1966], Brewster Township.†*
25. *Hillcoat, James, Donovan Township.†*
26. *Ironco Mining and Smelting Co. Ltd., Cotton Township.†*
27. *Jalore Mining Co. Ltd., Kokoko Lake, Cynthia and Chambers Townships.*
28. *Keevil Mining Group Ltd., [1966], Cynthia and Aston Townships.*

King, Henry
29. *Boundary claims, Speight Township.†*
30. *Munroe Lake deposit, Speight Township.†*
31. *Lady Evelyn Lake deposit, Leo Township.†*

Last, Henry.
32. *Clary Township.†*
33. *DeMorest Township.†*
34. *Turner Township.†*
35. *Lynch deposit, Speight Township.†*

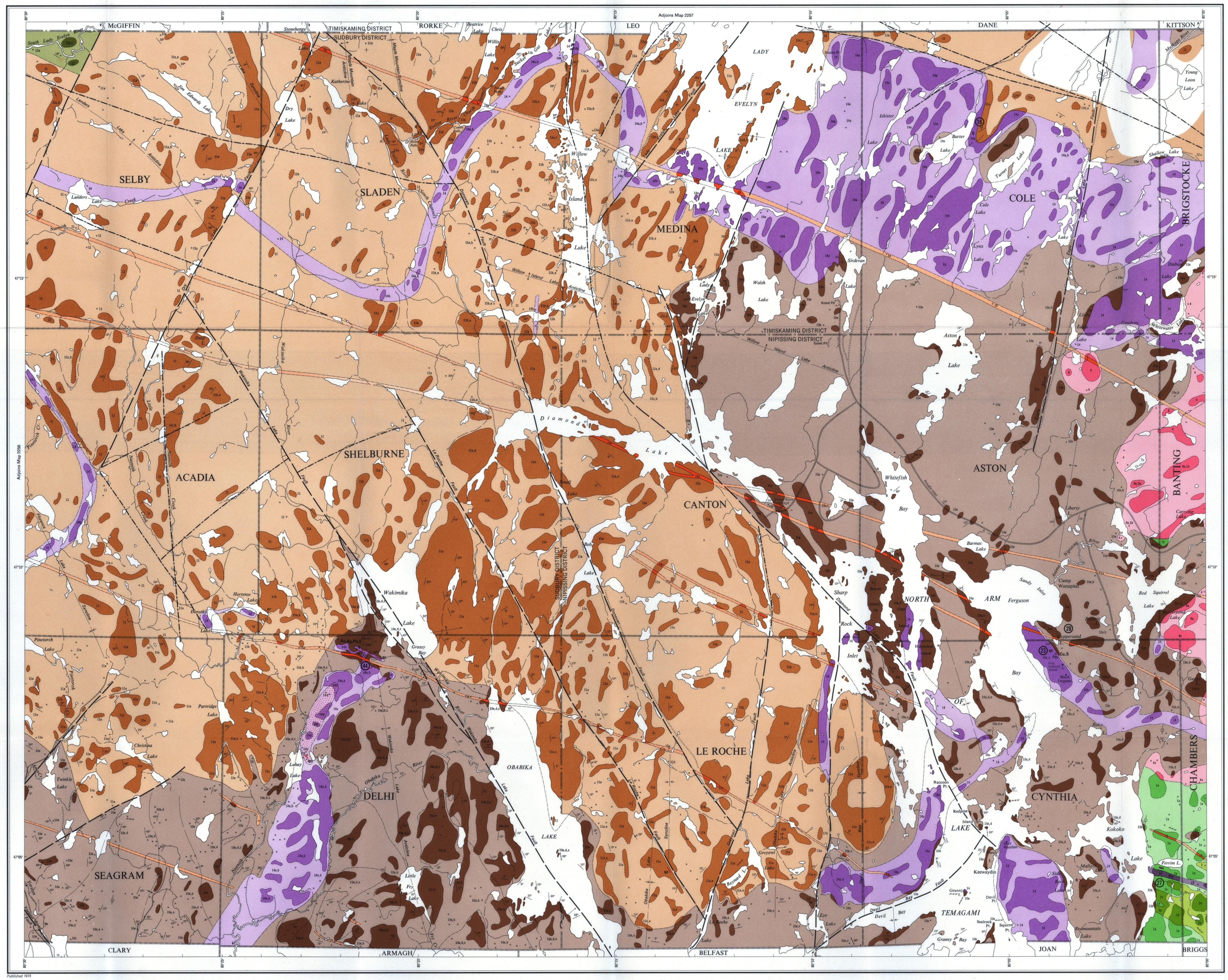
Mark, Howard.
36. *First Bay deposit, Barr Township.†*
37. *Inland deposit, Klock Township.†*
38. *Island deposit, Dane and Kittson Townships.†*
39. *Klock deposits, Barr Township.†*
40. *Second Bay deposit, Barr Township.†*
41. *McIntosh, R. E., Turner Township.†*
42. *Metron Explorations Ltd., Stull Township.†*
43. *Moore, William, Speight Township.†*
44. *New Delhi Mines Ltd., Delhi Township.*

Noranda Exploration Co.
45. *Clary Township.†*
46. *Turner and DeMorest Townships.†*
47. *Ourgold Mining Company Ltd., Corkill Township.†*
48. *Reekie Lake occurrence, Leckie Township.†*
49. *Rustex Mining Corp., Leith Township.†*
50. *Solace Lake lead-silver deposit, Selkirk Township.†*
51. *Sucker Gut Lake deposit, Leo Township.†*
52. *Taylor deposit, Speight Township.†*
53. *Tremble Lake deposit, Ray Township.†*
54. *Truss deposit, Auld Township.†*
55. *Walton, H. G., Bradley-Donaldson Mine, Auld Township.†*

Welsh, B. M.
56. *Charron Silver Mine, Auld Township.†*
57. *Charters Township.†*
58. *Triangle Silver Mine, Auld Township.†*
59. *Wilder, Frank, Donovan Township.†*

Ownership of properties as of December 31, 1969. Date in square brackets [1968] indicates year of last major work on property. For further information, see report.

†Appears on accompanying maps of Geological Report 106.



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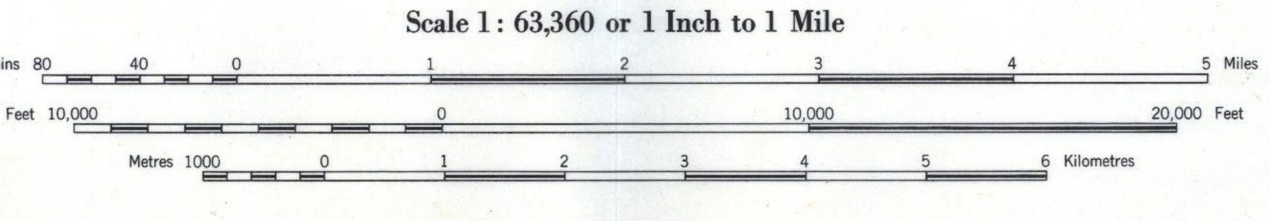
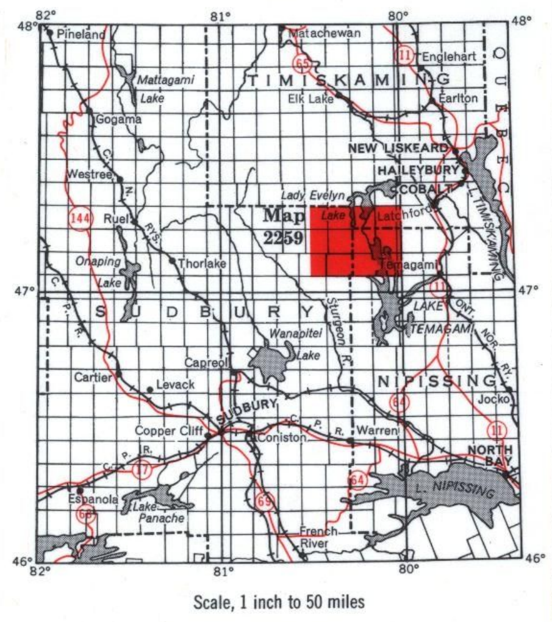
Map 2259

DIAMOND LAKE

NIPISSING, SUDBURY and TIMISKAMING DISTRICTS

Scale 1 : 63,360 or 1 Inch to 1 Mile





Scale, 1 inch to 50 miles

N.T.S. Reference 41 P/1, 41 P/8

LEGEND

CENOZOIC[a]
QUATERNARY
RECENT
Stream, lake, and swamp deposits.

PLEISTOCENE
Glacial, glaciofluvial, and glaciolacustrine deposits.

UNCONFORMITY

PRECAMBRIAN[b]
PROTEROZOIC
MAFIC INTRUSIONS
LATE DIABASE INTRUSIONS

15	*15 Diabase.* *15a Olivine diabase.*

INTRUSIVE CONTACT

NIPISSING DIABASE INTRUSIONS[c]

14	*14 Unsubdivided.*[d] *14a Pyroxene gabbro.*[d] *14b Hornblende gabbro, metagabbro.*[d] *14c Epidote amphibolite.*
14d	*14d Granophyre.*[d]†

INTRUSIVE CONTACT

HURONIAN SUPERGROUP
COBALT GROUP
BAR RIVER FORMATION†

13	*13 Unsubdivided.* *13a Sandstone.*

GORDON LAKE FORMATION[c]

12	*12 Unsubdivided.* *12a Sandstone.* *12b Argillite.†* *12c Chert, chert breccia.*

LORRAIN FORMATION[c]

11	*11 Unsubdivided.* *11a Green and grey micaceous pebbly sandstone.* *11b Feldspathic sandstone.* *11c White sandstone.* *11d Ferruginous sandstone.* *11e Argillaceous sandstone, greywacke, siltstone.* *11f Conglomerate.*

GOWGANDA FORMATION[c]

10	*10 Unsubdivided.* *10a Pebbly mudstone-polymictic paraconglomerate, greywacke, siltstone, or laminated argillite matrix.* *10b Polymictic orthoconglomerate, greywacke or siltstone matrix.* *10c Sandstone, feldspathic sandstone, greywacke.* *10d Argillite, siltstone.* *10e Laminated argillite.*

QUIRKE LAKE GROUP
SERPENT FORMATION[c]†

9	*9a Sandstone.* *9b Argillite, siltstone.*

ESPANOLA FORMATION†

8	*8 Limestone, siltstone.*

BRUCE FORMATION[c]†

7	*7a Polymictic conglomerate.* *7b Sandstone.*

HOUGH LAKE GROUP
MISSISSAGI FORMATION[c]†

6	*6 Unsubdivided.* *6a Sandstone.* *6b Argillite, siltstone, argillaceous schist.* *6c Polymictic conglomerate.*

UNCONFORMITY

ARCHEAN
MAFIC INTRUSIONS
EARLY MAFIC INTRUSIONS†

5	*5 Gabbro, metagabbro, diabase.*

INTRUSIVE CONTACT

FELSIC INTRUSIVE AND METAMORPHIC ROCKS
GRANITIC ROCKS[c]

4	*4 Unsubdivided.* *4a Quartz monzonite, granodiorite.* *4b Porphyritic quartz monzonite, granodiorite, quartz diorite.†*

GNEISS AND MIGMATITES[c]†

3	*3 Unsubdivided.* *3a Quartz-feldspar gneiss, migmatite.* *3b Mafic migmatite, agmatite.*

METAVOLCANICS AND METASEDIMENTS
FELSIC METAVOLCANICS AND METASEDIMENTS[c]

2	*2 Unsubdivided.* *2a Rhyolite, trachyte, intermediate metavolcanics.* *2b Felsic tuff, breccia, agglomerate.* *2c Sandstone, argillite, conglomerate.*[e]† *2d Felsic schist.†*

MAFIC METAVOLCANICS[c]

1	*1 Unsubdivided.†* *1a Basalt, andesite.* *1b Amphibolite, amphibolite schist.* *1c Diabase.†*
IF	*IF Iron formation.*

△ △ △	*Breccia.*

Ag	*Silver.*	**Ni**	*Nickel.†*
Au	*Gold.*	**Pb**	*Lead.*
carb	*Carbonate.†*	**q**	*Quartz.*
Co	*Cobalt.†*	**qc**	*Quartz-carbonate.*
Cu	*Copper.*	**S**	*Sulphide mineralization.*
ery	*Erythrite.†*	**U**	*Uranium.†*
Fe	*Iron.*	**Zn**	*Zinc.†*
nc	*Niccolite.†*		

---

[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured and uncoloured parts on the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown, respectively, in deep and light tones of the same colour. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

[c] *The rocks of these units are subdivided lithologically and the order does not imply age relationship within the groups.*

[d] *Nipissing-type.*

[e] *Timiskaming-type.*

†Appears on accompanying maps of Geological Report 106.

SYMBOLS

- Glacial striae.
- Esker.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, horizontal.
- Bedding, top unknown; (inclined, vertical).
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
- Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
- Schistosity; (horizontal, inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Jointing; (horizontal, inclined, vertical).
- Anticline, syncline, with plunge.
- DH Drill hole; (vertical, inclined).
- Drill hole; (projected vertically).
- Vein.
- RA Radioactivity.
- Swamp.
- Building.
- Other road.
- Trail, portage, winter road.
- Township boundary, or meridian line, with mileposts, approximate position only.
- Property boundary, approximate position only.
- Surveyed line, with mileposts, approximate position only.
- 41 Location of mining property, surveyed. See list of properties.
- ⑬ Location of mining property, unsurveyed. See list of properties.

SOURCES OF INFORMATION

Geology by H. D. Meyn and assistants, 1969. Geology is not tied to surveyed lines.

Maps supplied by mining companies.

Map 179A, Onaping, by W. H. Collins, Geological Survey of Canada, Mem. 95, 1917.

Aeromagnetic maps 1503G and 1513G, Geological Survey of Canada.

Preliminary maps, P. 568 Marconi Township, P. 569 Turner Township and northeast part of DeMorest Township and P. 570 Seagram Township and northwest part of Clary Township, scale 1 inch to ¼ mile, issued 1969.

Cartography by M. G. Sefton and assistants, Ministry of Natural Resources, 1972.

Base maps derived from maps of the Forest Resources Inventory, Ministry of Natural Resources, with additional information by H. D. Meyn.

Magnetic declination in the area was approximately 9°30′ W, 1969.

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3. Goldie Lake deposit, van Nostrand Township.†
4. Niccolite Lake deposit, van Nostrand Township.†
5. Skull Lake property, Speight Township.†
6. White Reserve Mine, Whitson Township.†
7. Armstrong, W. S., Estate, Speight Township.†
8. Beatty, W. A., Charters Township.†

Byberg, Andrew.
9. Charters Township.†
10. Gowganda-Duggan Mine, Donovan Township.†
11. Thompson Mine, Donovan Township.†

Canadian Johns-Manville Co. Ltd.
12. Dundee, Grigg, Marconi, Seagram, Stobie, and Turner Townships.
13. Harrison Minerals Ltd., T. Saville claims, Turner Township.
14. Marconi Township [1968].
15. Can-Fer Mines Ltd. [1967], Marconi Township.
16. Cole deposit, Cole Township.†
17. Denison Mines Ltd., Clary, DeMorest, Seagram, and Turner Townships.
18. Eleanor Lake deposit, Ray Township.†
19. Fournier Lake prospect, Leonard Township.†
20. Garvey, William, Estate, Charters Township.†
21. Gereghty, G. J., Brewster Township.†
22. Haines claim, Donovan Township.†
23. Hardie, Arnold, Coppersand Lake deposit, Cynthia Township.†
24. Hardiman Bay Mines Ltd. [1966], Brewster Township.†
25. Hillcoat, James, Donovan Township.†
26. Ironco Mining and Smelting Co. Ltd., Cotton Township.†
27. Jalore Mining Co. Ltd., Kokoko Lake, Cynthia and Chambers Townships.†
28. Keevil Mining Group Ltd., [1966], Cynthia and Aston Townships.†

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29. Boundary claims, Speight Township.†
30. Munroe Lake deposit, Speight Township.†
31. Lady Evelyn Lake deposit, Leo Township.†

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32. Clary Township.
33. DeMorest Township.
34. Turner Township.
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36. First Bay deposit, Barr Township.†
37. Inland deposit, Klock Township.†
38. Island deposit, Dane and Kittson Townships.†
39. Klock deposits, Barr Township.†
40. Second Bay deposit, Barr Township.†
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42. Metron Explorations Ltd., Stull Township.†
43. Moore, William, Speight Township.†
44. New Delhi Mines Ltd., Delhi Township.†

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45. Clary Township.
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49. Rustex Mining Corp., Leith Township.†
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52. Taylor deposit, Speight Township.†
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54. Truss deposit, Auld Township.†
55. Walton, H. G., Bradley-Donaldson Mine, Auld Township.†

Welsh, B. M.
56. Charron Silver Mine, Auld Township.†
57. Charters Township.†
58. Triangle Silver Mine, Auld Township.†
59. Wilder, Frank, Donovan Township.†

Ownership of properties as of December 31, 1969. Date in square brackets [1968] indicates year of last major work on property. For further information, see report.

†Appears on accompanying maps of Geological Report 106.

ONTARIO
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W. Q. MACNEE, *Deputy Minister of Natural Resources*
G. A. Jewett, *Executive Director, Division of Mines* E. G. Pye, *Director, Geological Branch*

Map 2260

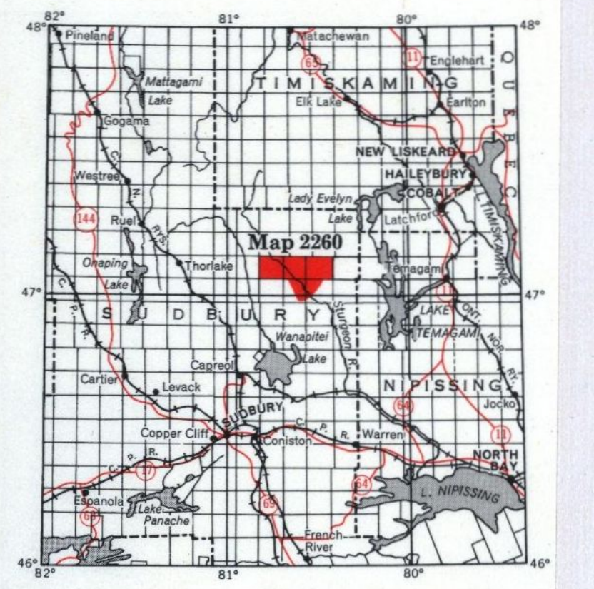
YORSTON LAKE

SUDBURY DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles
Metres 1000 0 1 2 3 Kilometres
Feet 1000 0 5,000 10,000 Feet

Map 2260
Yorston Lake



Scale 1 inch to 50 miles

N.T.S. reference 41P/1, 41P/2

LEGEND

CENOZOIC[a]

QUATERNARY

RECENT

Stream, lake, and swamp deposits.

PLEISTOCENE

Glacial, glaciofluvial, and glaciolacustrine deposits.

UNCONFORMITY

PRECAMBRIAN[b]

PROTEROZOIC

MAFIC INTRUSIONS

LATE DIABASE INTRUSIONS

15
- 15 Diabase.
- 15a Olivine diabase.†

INTRUSIVE CONTACT

NIPISSING DIABASE INTRUSIONS[c]

14
- 14 Unsubdivided.[d]
- 14a Pyroxene gabbro.[d]†
- 14b Hornblende gabbro, metagabbro.[d]
- 14c Epidote amphibolite.†

14d
- 14d Granophyre.[d]

INTRUSIVE CONTACT

HURONIAN SUPERGROUP

COBALT GROUP

BAR RIVER FORMATION†

13
- 13 Unsubdivided.
- 13a Sandstone.

GORDON LAKE FORMATION[c]†

12
- 12 Unsubdivided.
- 12a Sandstone.
- 12b Argillite.
- 12c Chert, chert breccia.

LORRAIN FORMATION[c]

11
- 11 Unsubdivided.†
- 11a Green and grey micaceous pebbly sandstone.
- 11b Feldspathic sandstone.
- 11c White sandstone.†
- 11d Ferruginous sandstone.†
- 11e Argillaceous sandstone, greywacke, siltstone.
- 11f Conglomerate.†

GOWGANDA FORMATION[c]

10
- 10 Unsubdivided.
- 10a Pebbly mudstone-polymictic paraconglomerate, greywacke, siltstone, or laminated argillite matrix.
- 10b Polymictic orthoconglomerate, greywacke or siltstone matrix.†
- 10c Sandstone, feldspathic sandstone, greywacke.
- 10d Argillite, siltstone.
- 10e Laminated argillite.

QUIRKE LAKE GROUP

SERPENT FORMATION[c]

9
- 9a Sandstone.
- 9b Argillite, siltstone.

ESPANOLA FORMATION

8
- 8 Limestone, siltstone.

BRUCE FORMATION[c]

7
- 7a Polymictic conglomerate.
- 7b Sandstone.

HOUGH LAKE GROUP

MISSISSAGI FORMATION[c]

6
- 6 Unsubdivided.
- 6a Sandstone.
- 6b Argillite, siltstone, argillaceous schist.
- 6c Polymictic conglomerate.

UNCONFORMITY

ARCHEAN

MAFIC INTRUSIONS

EARLY MAFIC INTRUSIONS

5
- 5 Gabbro, metagabbro, diabase.

INTRUSIVE CONTACT

FELSIC INTRUSIVE AND METAMORPHIC ROCKS

GRANITIC ROCKS[c]

4
- 4 Unsubdivided.
- 4a Quartz monzonite, granodiorite.
- 4b Porphyritic quartz monzonite, granodiorite, quartz diorite.†

GNEISS AND MIGMATITES[c]†

3
- 3 Unsubdivided.
- 3a Quartz-feldspar gneiss, migmatite.
- 3b Mafic migmatite, agmatite.

METAVOLCANICS AND METASEDIMENTS

FELSIC METAVOLCANICS AND METASEDIMENTS[c]

2
- 2 Unsubdivided.
- 2a Rhyolite, trachyte, intermediate metavolcanics.
- 2b Felsic tuff, breccia, agglomerate.
- 2c Sandstone, argillite, conglomerate.[e]†
- 2d Felsic schist.

MAFIC METAVOLCANICS[c]

1
- 1 Unsubdivided.
- 1a Basalt, andesite.
- 1b Amphibolite, amphibolite schist.
- 1c Diabase.

IF
- IF Iron formation.

- △ Breccia.

Ag	Silver.	**Ni**	Niçkel.†
Au	Gold.	**Pb**	Lead.
carb	Carbonate.†	**q**	Quartz.
Co	Cobalt.†	**qc**	Quartz-carbonate.†
Cu	Copper.	**S**	Sulphide mineralization.
ery	Erythrite.†	**U**	Uranium.
Fe	Iron.†	**Zn**	Zinc.
nc	Niccolite.†		

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[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured and uncoloured parts on the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown, respectively, in deep and light tones of the same colour. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

[c] *The rocks of these units are subdivided lithologically and the order does not imply age relationship within the groups.*

[d] *Nipissing-type.*

[e] *Timiskaming-type.*

†Appears on accompanying maps of Geological Report 106.