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Ontario Geological Survey

Report 214

**Geology of the
Miminiska Lake Area
Districts of Kenora (Patricia Portion) and
Thunder Bay**

by

Henry Wallace

1981



Ontario

**Ministry of
Natural
Resources**

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**Hon. Alan W. Pope
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Deputy Minister**

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GEOLOGICAL MAPS

(back pocket)

Map 2416 (coloured)–Miminiska Peninsula, Kenora and Thunder Bay Districts.
Scale 1 inch to ½ mile (1:31 680).

Map 2417 (coloured)–Wottam Lake, Kenora and Thunder Bay Districts.
Scale 1 inch to ½ mile (1:31 680).

CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
<i>SI Unit</i>	<i>Multiplied by</i>	<i>Gives</i>	<i>Imperial Unit</i>	<i>Multiplied by</i>	<i>Gives</i>
LENGTH					
1 mm	0.039 37	inches	1 inch	25.4	mm
1 cm	0.393 70	inches	1 inch	2.54	cm
1 m	3.280 84	feet	1 foot	0.304 8	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	1.609 344	km
AREA					
1 cm ²	0.155 0	square inches	1 square inch	6.451 6	cm ²
1 m ²	10.763 9	square feet	1 square foot	0.092 903 04	m ²
1 km ²	0.386 10	square miles	1 square mile	2.589 988	km ²
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
VOLUME					
1 cm ³	0.061 02	cubic inches	1 cubic inch	16.387 064	cm ³
1 m ³	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m ³
1 m ³	1.308 0	cubic yards	1 cubic yard	0.764 555	m ³
CAPACITY					
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	4.546 090	L
MASS					
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	31.103 476 8	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	0.453 592 37	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	907.184 74	kg
1 t	1.102 311	tons (short)	1 ton (short)	0.907 184 74	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	1016.046 908 8	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	1.016 046 908 8	t
CONCENTRATION					
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE—Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

ABSTRACT

This report and the accompanying map describe the geology of the Miminiska Lake area in the Districts of Kenora (Patricia Portion) and Thunder Bay, Ontario. The 803 km² map-area, which is centred approximately 145 km due north of Lake Nipigon, is bounded by Latitudes 51°30' N and 51°40' N and by Longitudes 88°15' W and 88°53' W.

The area, part of the Uchi Subprovince of the Canadian Shield, is underlain by a central metasedimentary sequence consisting predominantly of turbidite and iron formation units, flanked by older mafic metavolcanics to the south and by a younger mafic metavolcanic sequence to the north.

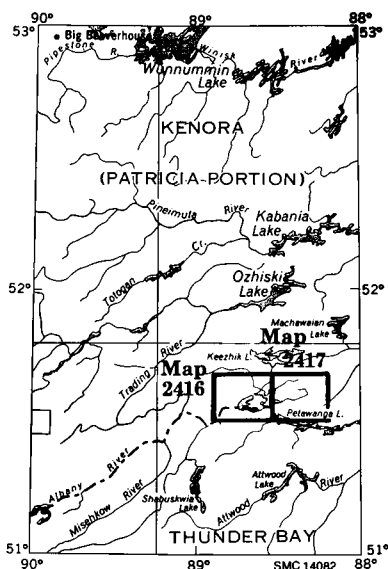


Figure 1—Key map for the Miminiska Lake area.
Scale 1:3 168 000 (1 inch to 50 miles).

A thick felsic pyroclastic wedge is conformably enclosed between the older mafic sequence and overlying metasediments in the southwestern part of the map-area. All of these supracrustal rocks, which have been intruded by a variety of mafic to felsic dikes and sills, have been metamorphosed under low grade conditions in the western and central parts of the area, and under low to medium grade conditions in the east. Major intrusions of granodioritic to quartz monzonitic composition occupy the northeastern, northwestern and southeastern corners of the area. All rocks except for a few Middle Precambrian dikes are Early Precambrian in age. Pleistocene sand and boulder deposits form extensive overburden over most of the area.

The dominant structural trend in the map-area is easterly to northeasterly. A series of tight isoclinal folds have been recognized in the eastern and central parts of the area, but west of Miminiska Peninsula the rocks appear to form a homoclinal sequence facing north. A set of major north-east-trending faults crosses the central part of the area, and east- to southeast-trending faults have been interpreted in the southwestern corner.

Occurrences of gold associated with mineralized quartz veins and shear zones, lithium in minor intrusions of pegmatite, and iron in Algoma-type iron formation are known within the area, but no mineral production has been reported.

Geology
of the
Miminiska Lake Area
Districts of Kenora (Patricia Portion) and
Thunder Bay

by
Henry Wallace¹

INTRODUCTION

Location and Access

The study area comprises a rectangle of approximately 800 km², bounded by Latitudes 51°30'N and 51°40'N and Longitudes 88°15'W and 88°53'W. Miminiska Lake, which is part of the Albany River system, is located in the centre of the map-area about 145 km north of Lake Nipigon, and 104 km east of the town of Pickle Lake. The nearest settlement of any size is Fort Hope on Indian Reserve 64 which is about 40 km east of Miminiska Lake.

Convenient access to the area is restricted to float- or ski-equipped aircraft which are available for charter from Pickle Lake, Armstrong and Nakina. The larger lakes are suitable for use by float-equipped aircraft. Ice break-up occurs in this region from mid to late May and freeze-up occurs in November. Air transportation is usually curtailed for approximately one month prior to break-up and after freeze-up. During the summer, light aircraft are usually based at Miminiska Lodge, a tourist establishment on the northeastern side of Miminiska Lake.

Within the map-area good access is provided by the Albany River system including Miminiska, Petawanga and Howells Lakes. Creeks flowing from Ferguson, Keezhik, Mezhisk and Troutfly Lakes into Miminiska Lake are usually navigable by canoe depending on water levels. Small boats, canoes and out-board motors are available for rental from Miminiska Lodge.

The southeastern and northwestern corners of the map-area are relatively inaccessible and can best be reached by helicopter.

¹Geologist, Precambrian Section, Ontario Geological Survey, Toronto. Approved for publication by Chief Geologist, December 16, 1977. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

History of Mineral Exploration

The earliest prospecting in this region was done in the late 1920s after the discovery of gold northwest of Fort Hope in 1927. Sporadic gold exploration by many companies and individuals has continued in the map-area to the present with little success. Most of this work took place in the late 1930s and early 1940s and was restricted to prospecting, trenching and shallow diamond drilling of gold-bearing quartz veins in metasediments between Frond Lake and Miminiska Island. No gold production was ever reported from the many small discoveries. The only recent gold exploration was done in 1973 and 1974 by Ymir Mining and Exploration Limited who were involved in prospecting and trenching quartz-filled and carbonatized shear zones on the north side of Keezhik Creek.

Occurrences of lithium-bearing pegmatite north of the Lilypad Lakes were discovered in 1956. Considerable trenching and diamond drilling were done at that time by Standard Lithium Corporation, and more diamond drilling was done on two showings in 1962 by R.J. Campbell.

In 1965 ground magnetometer surveys were conducted by Algoma Steel Corporation and Mattagami Mining Company Limited over concentrations of magnetitic iron formation, first outlined by an ODM-GSC aeromagnetic survey, northeast of Miminiska Peninsula and on the mainland east of Miminiska Island. Subsequently in 1966 Mattagami Mining Company Limited sponsored limited diamond drilling programs in those two areas to evaluate the occurrences as potential sources of iron ore. Results were negative at that time because of the relatively high proportion of clastic metasediments intercalated with the magnetite-chert units.

Between 1969 and 1972 Selco Exploration Company Limited, Canadian Nickel Company Limited and Conwest Exploration Company Limited were active in widely scattered parts of the map-area searching for base metal sulphide deposits. Small scale ground geophysical surveys and diamond drilling programs were done to investigate the results of company flown airborne geophysical surveys. Most of this exploration work occurred in the predominantly mafic metavolcanic sequences north and west of Miminiska Lake, on the southern part of Miminiska Peninsula, and over the predominantly felsic to intermediate metavolcanic sequence southwest of Miminiska Lake.

The reader is referred to the Economic Geology section of this report for details of histories of individual properties and known mineral occurrences and for information on mineral associations occurring within this area.

Previous Geological Work

The area around Miminiska Lake was first examined by Bell (1886) during an exploratory traverse down the Albany River from Lake St. Joseph to Fort Hope. The eastern half of the present map-area was mapped on a reconnaissance scale by Burwash (1929) after minor gold discoveries to the east near Opikeigen Lake in 1927-28.

The only previous detailed geological survey over most of the area was conducted by Prest (1939, 1942) between the summers of 1937 and 1941. From Prest's work, maps at a scale of 1 inch to 1 mile (1:63 360) were produced covering the area between Miminiska and Keezhik Lakes and the eastern end of Eabamet Lake to the east.

In 1960 Jackson (1961) mapped a vast area, including the present map-area, on a scale of 1 inch to 4 miles (1:253 440) in conjunction with the "Roads to Resources" program. In 1969, the map-area was included in Operation Fort Hope (Thurston and Carter 1969, 1970), another helicopter-supported reconnaissance survey which mapped the area between 50°30' and 52°30' North Latitude and 86° and 89° West Longitude. Maps from this program were produced at a scale of 1 inch to 2 miles (1:126 720).

Present Geological Survey

Field work for this report was done by the author and assistants during the summers of 1974 and 1975. Half the area was mapped by pace-and-compass traverses run at right angles to the regional structural trend and spaced at approximately 400 m intervals. The traverses were run between topographic features across potential outcrop areas visible on vertical aerial photographs. In areas where outcrop density, based on aerial photograph interpretation and/or direct areal reconnaissance, is very low, the traverses were spaced from 800 to 1500 m apart. All outcrops visible along lakeshores, rivers and portages were also examined. Several localities of known mineralization, such as the outcrop of iron formation east of Miminiska Lake, were examined and mapped in more detail using grid systems.

Field data were recorded on transparent acetate overlays attached to the black-and-white vertical air photographs (scale 1:15 840 or 1 inch to ¼ mile) provided by the Silviculture Section, Public Service Centre, Ministry of Natural Resources. The information was later plotted at the same scale on cronaflex base map sheets supplied by the Cartographic Section, Ontario Division of Lands, Ministry of Natural Resources. Outcrop areas were generalized to allow for reduction of the map to the publication scale of 1:31 680 (1 inch to ½ mile).

An uncoloured preliminary map of this area at a scale of 1:31 680 (1 inch to ½ mile) was issued in 1976 (Wallace 1976b). Coloured geologic maps at the same scale (Ontario Geological Survey Maps 2416 and 2417) were issued in 1978 (Wallace 1978a, 1978b); these maps accompany this report.

Physiography and Outcrop Distribution

With the exception of the morainic hills which rise up to 150 m above lake level south of Miminiska Lake, relief in the region is generally less than 15 m. East- to northeast-trending, broad, relatively flat eskerine ridges up to 25 m high occur in several parts of the area; the longest and most prominent of these extends from the Lilypad Lakes to Miminiska Lake. Outcrops are low-lying to

hummocky. Typically, narrow ridges of outcrop parallel to strike are separated by linear swampy depressions. Cliffs up to 25 m high in the central and western parts of Miminiska Peninsula are the only bold exposures in the area.

Water from all lakes and creeks in the area drains ultimately into the Albany River which flows eastward into James Bay about 550 km east of the map-area. Much of the map-area southwest and northwest of Miminiska Lake is poorly drained, but drainage provided by the many creek systems throughout the area is generally efficient. Two major falls, both held up by ridges of mafic pillow lava, occur within the map-area on the Albany River. Miminiska Falls consists of two separate, closely-spaced steps with a total drop of about 3 m and Snake Falls is an uninterrupted chute with a drop of 2.5 to 3 m.

Water levels vary considerably during the year and from year to year. The difference between levels on Miminiska Lake in the late spring of 1974 and the summer of 1975 was approximately 2.2 m.

Bedrock exposure in this region is sparse. Outcrop constitutes considerably less than 10 percent of the map-area, but its density varies markedly from place to place. The felsic intrusions in the southeast, northeast and northwest corners of the map-area are very poorly exposed. Metavolcanics are best exposed around Gumuly Lake and between Howells Lake and Troutfly Creek, where outcrop constitutes 15 to 20 percent of the total land area. The small area north of the Lilypad Lakes is unusual in this region in having an outcrop density greater than 50 percent. Metasediments are relatively well exposed between Frond and Wottam Lakes, on Miminiska Island, and across the central part of Miminiska Peninsula, but elsewhere outcrops are generally few in number and small in areal extent.

Lakeshore exposure is very dependent on water level since many of the smaller islands and low lakeshore outcrops are submerged during periods of high water.

Natural Resources

Most of the map-area is forested with stunted black spruce, balsam and larch growing in extensive sphagnum swamps, but poplar, jack pine and birch predominate in the better drained sandy areas. Large cedar and pine are common together with black spruce along the lakeshores and riverbanks.

Excellent sport fishing is carried out on many of the lakes, creeks and rivers in the area. Pickerel, pike and sturgeon are abundant in the lakes, and speckled trout inhabit many of the faster flowing creeks and rivers. Commercial fishing for pickerel and trout is carried out by residents on Petawanga Lake.

Fur-bearing animals such as beaver, otter, muskrat, fisher, marten, mink, fox and lynx are trapped in considerable numbers in the winter by residents. Large animals, such as bear and moose, now are quite scarce.

Acknowledgments

The author was ably assisted in the field by R.J. Sharpe, P. Meehan, W. Clarke and D. Reade in 1974, and by R.J. Sharpe, M. Genereux, D. Storrison and D. Nairne in 1975. Mr. Sharpe, as senior assistant, was responsible for mapping approximately half the area. Some independent mapping was also carried out by Mlle. Genereux and Messrs. Meehan and Clarke. The enthusiasm and co-operation of all these assistants, and of Mr. Sharpe in particular, are greatly appreciated.

Parts of this report are adapted from data compiled for the M.Sc. thesis of R.J. Sharpe (1979) and are acknowledged as such throughout the text. Thanks are also extended to Professor J.J. Fawcett, University of Toronto, for suggestions and interesting discussions in the field and to Mr. K. Mahoney, Chief Ranger, Ministry of Natural Resources base, Pickle Lake and his staff for information and support during the 1975 field season.

GENERAL GEOLOGY

The map-area lies within the Uchi Subprovince, a predominantly metavolcanic-metasedimentary east-trending belt in the Superior Province of the Canadian Shield. With the exception of a few wide, north-trending dikes of Middle Precambrian diabase, all the rocks in the area are Early Precambrian in age. Quaternary deposits of glacial till, and glaciolacustrine and glaciofluvial sand and gravel now cover much of the bedrock.

The central and eastern parts of the map-area are underlain by a thick metasedimentary sequence consisting predominantly of monotonously intercalated wacke and mudstone units and their metamorphic equivalents. In several places considerable thicknesses of oxide, carbonate and/or silicate facies iron formation occur intercalated with the clastic metasediments. This mixed metasedimentary sequence conformably overlies a thick metavolcanic succession, composed predominantly of mafic pillowed flows, that occupies the southern part of the map-area. To the north, there is a second predominantly mafic metavolcanic succession which appears to be younger than the metasediments. A relatively thin accumulation of conglomerate, pebbly sandstone, and arenite units quite distinct from the main sequence of metasediments to the south and east occurs in the western part of the area between the metasedimentary and younger mafic metavolcanic sequences. A wedge of felsic to intermediate pyroclastic rocks and intercalated volcanoclastic metasediments may in part directly overlie the lower mafic metavolcanics. This wedge is enclosed in the main wacke-mudstone sequence toward the east, and is overlain by the conglomerate and arenite sequence below the younger mafic metavolcanic succession.

Three major intrusions of quartz monzonitic to granodioritic composition occupy the northwestern, northeastern and southeastern corners of the map-area. The southeastern body has a relatively broad northern contact zone which grades into metasedimentary schists, while the other two intrusions appear to have relatively sharp contacts.

Minor intrusions, including dikes and sills of diabase, feldspar and quartz-feldspar porphyry and pegmatites, are very common, particularly within the metavolcanic sequences.

Low grade (Winkler 1976) metamorphic conditions prevailed in the supracrustal rocks throughout most of the area, but medium grade rocks occur in some zones east of Miminiska Lake. Structural elements are generally east-northeast-trending in the east, and northeast-trending in the western part of the area. Major folds can be outlined only in the metasediments east of Miminiska Peninsula. The major faults in the area extend northeastward from Miminiska Peninsula sub-parallel to Ferguson Creek.

Lithologies in the map-area and their relationships are summarized in Table 1.

Early Precambrian (Archean)

METAVOLCANICS

In this report metavolcanics are subdivided first into two major compositional categories on the basis of colour index (the sum of dark coloured minerals in a rock expressed in volume percent) which was assessed both in field work and in subsequent laboratory examination. Rocks classified as felsic to intermediate are characterized by colour indices less than 20 percent and include rocks of rhyolitic, rhyodacitic and dacitic composition, as well as some metavolcanics of andesitic composition. Mafic to intermediate metavolcanics have colour indices greater than 20 percent and include all basalts and most andesitic rocks.

There are two thick sequences of predominantly mafic to intermediate metavolcanics in the area, one to the south underlying, and the other to the north overlying the central metasedimentary sequence. The northern sequence consists almost exclusively of basaltic and andesitic pillowed flows and related breccias, while that to the south is composed of massive and pillowed flows in approximately equal proportions with mafic to intermediate pyroclastic rock. Felsic to intermediate rocks, which occur in the map-area mostly as pyroclastics, are uncommon within the mafic sequences except north of the Lilypad Lakes where thick accumulations of felsic pyroclastic and flow units are intercalated with pillowed mafic flows.

Felsic to intermediate pyroclastic rocks and directly derived volcanoclastic sediments form a thick wedge underlying the western arm of Miminiska Lake. This wedge probably extends southwest toward Snake Falls, but no exposure was found to support this extrapolation. A second much smaller wedge of felsic to intermediate material intercalated with and enclosed by metasediments occurs north of the mouth of Ferguson Creek. Classification of pyroclastic rocks in this report follows Fisher (1966).

TABLE 1

LITHOLOGIC UNITS OF THE MIMINISKA LAKE AREA

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Till, sand, boulders (moraine and esker deposits).

Unconformity

PRECAMBRIAN

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

Diabase, quartz diabase, olivine diabase, gabbro, quartz gabbro dikes.

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Granodiorite, quartz monzonite, pegmatite, feldspar porphyry, quartz-feldspar porphyry.

Relationships Uncertain

MAFIC INTRUSIVE ROCKS

Diabase, gabbro, metagabbro, metadiorite sills and dikes.

Intrusive Contact

METASEDIMENTS

FERRUGINOUS CHEMICAL METASEDIMENTS

Banded magnetite-quartz iron formation, banded chert; banded siderite-ankerite-quartz iron formation, banded grunerite-hornblende iron formation, banded and massive amphibole-garnet-biotite iron formation; pyritic graphitic slate.

CLASTIC METASEDIMENTS

Mudstone, phyllite, slate, subarkosic wacke, lithic subarkosic wacke, feldspathic lithwacke, lithic arkosic wacke; feldspathic litharenite, lithic arkose; polymictic pebble and cobble conglomerate, pebbly sandstone; derived metasedimentary schists.

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS AND DERIVED VOLCANICLASTIC ROCKS

Massive and flow-banded flows, autoclastic breccias; tuff, crystal tuff, laminated tuff, lapilli-tuff, lapillistone, tuff-breccia, pyroclastic breccia; quartz-feldspar porphyry; volcaniclastic metasediments.

MAFIC TO INTERMEDIATE METAVOLCANICS

Massive and pillowed flows, autoclastic breccias; massive and layered amphibolite, garnetiferous amphibolite; pyroclastic rocks; coarse amphibolite.

Mafic to Intermediate Metavolcanics

Massive Flows and Related Autoclastic Breccias

Massive basaltic to andesitic flows are common in both the mafic metavolcanic sequences but are most obvious along the south shore of Miminiska Lake where they are interlayered with pillowed units in approximately equal proportions. However, it is not possible in many cases to distinguish between coarse grained flow units and cogenetic diabase sills which are also common in that area.

The massive flows are generally featureless in outcrop except for amygdaloidal and brecciated flow tops. These could have been used to determine facing directions if numerous determinations made from well-packed pillowed flows had not been available nearby. The flows range in colour on weathered surface from light grey to black and vary considerably in grain size and texture according to the thickness of the unit, which may be anything from 2 m to 200 m.

In thin section these rocks are seen to consist of variable amounts of hornblende, chlorite, plagioclase, epidote, quartz, magnetite and sphene. Most textures observed appear to be the pseudomorphic equivalents of primary diabasic and ophitic textures, with hornblende crudely replacing pyroxene. In some thin sections plagioclase is little altered, but in others the laths are pseudomorphed by combinations of epidote, chlorite and carbonate, with granular quartz and anhedral untwinned feldspar. Other thin sections show the rocks as fine grained, even textured, felted masses of feathery hornblende with interstitial granular epidote, plagioclase and quartz. In nearly all sections a weak to moderately strong foliation is evident in the phyllosilicates and amphiboles. Grain sizes generally range from 0.05 to 0.5 mm.

In breccias associated with the massive lavas, fragments are typically very similar in composition and texture to the matrix material and are consequently quite difficult to discern in both outcrop and hand specimen. Some breccias, however, contain a high proportion of amygdaloidal fragments which are relatively easy to identify. In others there is a considerable grain size difference between the fragments and matrix, and fragment outlines are enhanced by differential erosion. Breccias commonly grade down into massive lava and vary greatly in fragment percentage and fragment size both along and across strike. Typically fragments from a few millimetres to over a metre occur together, separated by fine grained amphibolitic material which probably was originally massive aphanitic lava.

Pillowed Flows and Related Breccias

Pillowed flows and related breccias predominate in the northern mafic to intermediate metavolcanic sequence and constitute approximately half the southern sequence. The classic shape of the pillows is generally well preserved since flattening has produced axial ratios in the order of only 2:1 to 3:1, and in many places reliable top indications are obtainable (Photo 1). Pillow size and



OGS 10 25^m

Photo 1—Well-formed pillows in a basaltic flow south of Snake Falls.

packing density vary considerably. For the most part pillows are 20 to 100 cm long, with individual pillows up to 150 cm long. Packing is generally close with little interstitial material, but sparsely scattered pillows in massive lava occur in areas west of Miminiska Falls, northwest of Gumuly Lake and north of Frond Lake. These scattered pillows are typically small and lensoid bodies and are easily mistaken for pyroclastic bombs where they cannot be associated with the more closely packed pillow lavas.

In outcrop the pillows weather high relative to their selvages which are in the order of 2 to 6 cm thick between pillows. The weathered surface of the pillows varies from light grey to dark green depending upon the grain size of the constituent amphiboles (the coarser amphibolite tends to be darker) and the degree of glacial polishing (smoothly polished surfaces are darker). The selvages are invariably black or dark green. In the dark green, coarse grained amphibol-



OGS 10 297

Photo 2—Pillowed flow near Gumuly Lake showing large, central felsic domains in sharp contact with low weathering selvages.

itic flows north of Frond Lake, selvages and pillows are very difficult to discern and hence some pillows units may have been overlooked in mapping. Except in that same area, where pillow and selvage materials are notably coarse and schistose, pillow selvages and interstitial material between pillows are generally massive and very fine grained to aphanitic.

White weathering varioles of plagioclase up to 8 mm across are very common within the pillows near the north end of Howells Lake, but are much less common in the southern metavolcanics. Conversely, quartz-filled amygdules averaging 3 to 6 mm across occur in many of these flows, but appear to be more abundant in the southern metavolcanic sequence.

Most individual pillows and pillow lava exposures appear to be quite uniform in composition. However, several basaltic and andesitic flows in the Petawanga-Gumuly Lakes area and along the southern shore of Miminiska Lake consist predominantly of pillows containing felsic domains (Photo 2). These domains, which appear to be dacitic to rhyolitic in composition, weather a much lighter grey than the surrounding pillow material and on fresh surface are white and aphanitic. The domains constitute between 10 and 70 percent of the individual pillows and there is typically only one felsic domain within each pillow although two or more were observed in some pillows. Although they tend to

occur near the pillow centres and are typically ellipsoidal or similar in shape to the pillow margins, the domains may occur anywhere within the pillow and can be quite irregular in outline. In outcrop the contact between the light-weathering felsic domains and the surrounding material appears quite sharp but in a fresh hand specimen it is gradational over several centimetres. It is also notable that few amygdules and/or varioles were observed in these units. The origin of this phenomenon is not clear to the author but magmatic differentiation, possibly involving liquid immiscibility after extrusion, on the scale of individual pillows, seems likely.

Examples of pillow breccia units were recognized in several places along the southeastern shore of Miminiska Peninsula. Others were probably missed in mapping because of confusion with mafic to intermediate pyroclastic material in the area. The pillow fragments, which comprise 30 to 85 percent of these rocks, are generally quite flattened, forming ellipsoidal bodies easily mistaken for bombs. In only a few cases can segments of black selvage be seen on some fragments. Only where whole or nearly whole pillows occur within the breccia are these units easily identifiable. The matrix in most cases is now a medium grained amphibolite; none of the fine shard-like fragments typical of hyaloclastites have been preserved.

In thin section the pillow lavas vary considerably in mineralogy and texture. Hornblende is by far the most common ferromagnesian mineral but chlorite occurs to the exclusion of amphibole in some sections, particularly those of selvage material. Chlorite is also the predominant ferromagnesian mineral in the younger mafic metavolcanic sequence. Biotite is present in highly variable amounts (0 to 10 percent) but is never the major ferromagnesian mineral. Plagioclase varies in appearance from well-shaped laths, which are generally sericitized or saussuritized to some degree, to granular anhedral untwinned grains and aggregates difficult to distinguish from quartz.

Magnetite, quartz, sphene and secondary carbonate are the only other common minerals.

Many thin sections exhibit relatively well preserved intergranular and pilotaxitic textures with hornblende and/or chlorite replacing the original pyroxenes, and pseudomorphs after oligoclase laths consisting of aggregates of granular epidote and fine grained quartzofeldspathic material. Equant or rectangular masses of epidote are very common as pseudomorphs after plagioclase phenocrysts. Other pillowed flows, particularly the coarser grained units, are granoblastic in texture, containing poikiloblastic subhedral hornblende crystals, abundant granular epidote, and interstitial subhedral to anhedral grains of plagioclase. Although amphibole grains form a foliation of variable persistence in many of these thin sections, a second foliation formed by biotite and chlorite is quite common in the same rocks. In many cases these foliations are nearly parallel, but in others they are distinctly divergent.

Pyroclastic Rocks

Mafic and intermediate pyroclastic rocks are common in the southern part of Miminiska Peninsula and north of Miminiska Falls, but elsewhere in the

map-area they are rare. Most of these units are intercalated with pillowed and massive mafic to intermediate flows, but several occur stratigraphically adjacent to a major felsic pyroclastic unit and iron formation near the top of the southern metavolcanic sequence.

Most of the mafic to intermediate pyroclastic rocks can be classified as lapilli-tuff to tuff-breccia and appear andesitic in composition. These rocks are generally composed of medium to fine grained amphibolite in which the differences in colour, texture, grain size and weathering characteristics between clasts and matrix are quite obvious. The original fragmental nature of the matrix has been destroyed by metamorphism. Clasts are typically ellipsoidal, and of uniform size and composition within individual units, but size and compositional gradations were observed in several cases. Although clasts generally appear to comprise a high proportion of these rocks, this may be more apparent than real since the degree of flattening is considerable. Axial ratios are typically in the order of 5:1 to 10:1.

The matrix is commonly more mafic and darker in colour than the clasts. In many places garnets are abundant in the amphibolitic matrix but are rare in the clasts.

The mineralogy and microtextures observed in these rocks are those described in preceding sections. Textures in matrix and clasts are similar although grain size may differ by an order of magnitude. Biotite is much more abundant in many of these pyroclastic rocks, where it may exceed hornblende, than in pillowed or massive flows. Conversely epidote content is generally lower in the pyroclastic rocks. The biotite is commonly concentrated along clast boundaries and, with hornblende, imparts a strong foliation parallel to the plane of clast flattening.

Finer pyroclastic material of mafic to intermediate composition is uncommon but dark grey banded tuff sequences were noted west of Seagreen Lake and northeast of Howells Lake. Individual laminae are 2 to 10 mm thick. Slight colour differences between the laminae can be seen in thin section to be due to marked variations in the total content and type of ferromagnesian minerals present. Hornblende is predominant in most laminae but chlorite and biotite are much more abundant in some. Garnet occurs in the more mafic laminae. Scattered lapilli-sized lithic fragments of intermediate composition, containing plagioclase phenocrysts, also occur in some laminae.

Amphibolite, Garnetiferous Amphibolite and Coarse Amphibolite

Coarse to medium grained amphibolitic rocks believed to be igneous, and probably volcanic in origin, but lacking discernable primary structures such as pillows or fragments were classified only as amphibolite or garnetiferous amphibolite. Particularly coarse grained units which could well have been derived from mafic intrusions were designated separately as "coarse amphibolite". These classifications undoubtedly include rocks which originally varied in many ways, from massive flows and sheared pillow lavas to coarse and fine pyroclastic material.

Massive amphibolite and garnetiferous amphibolite vary widely in texture

from granoblastic to highly schistose and in average grain size from a millimetre to over a centimetre. Mineralogy is generally simple with only hornblende, plagioclase, quartz, biotite, magnetite, leucoxene and secondary carbonate present in most thin sections.

Layered amphibolite and garnetiferous amphibolite include gneissose rocks layered by metamorphic differentiation, originally layered tuffaceous rocks and possibly flow-banded rocks in which the banding or bedding has been blurred by metamorphism, and coarse fragmental rocks (generally pyroclastics) in which tectonic deformation has grossly flattened clasts to layer-like lenses. Of these three categories the first two are probably significant rock-types within the present area.

Gneissic amphibolites formed by metamorphic differentiation are common between north of the Lilypad Lakes and north of Wottam Lake. These rocks are generally medium to coarse grained with crude irregular layering 1 to 10 mm thick. Layering is due to marked differences in hornblende + biotite + garnet content: some layers contain less than 15 percent and others contain more than 75 percent. Quartz and plagioclase are the other major phases in these rocks.

Layered amphibolites formed from bedded pyroclastic or flow-banded rocks are generally more distinctly layered than those described above, but this distinction is not easily made in many cases. Such layered amphibolites also occur north of Frond Lake and on the southern part of Miminiska Peninsula.

"Coarse amphibolite" differs from the massive amphibolite already described only in grain size. Such rocks are most common in the metavolcanic sequences south of Miminiska Lake and around Howells Lake. Unequivocal mafic intrusive rocks have also been identified in these areas.

Felsic to Intermediate Metavolcanics

Massive and Flow-Banded Flows and Related Breccias

Felsic to intermediate rocks of this classification are restricted in the map-area to the metavolcanic sequence north of the Lilypad Lakes where they are intercalated with felsic to intermediate pyroclastic rocks and massive and pillowed mafic units. Most of the rocks are white to pale pink and are characterized by a very hard massive surface. Regular flow-banding is well developed in a few occurrences, but it is not common. All the observed flows are porphyritic with both quartz and plagioclase phenocrysts about 2 to 4 mm in diameter in an aphanitic matrix. Some flows may easily be confused with quartz-feldspar porphyry sills which are also common in that area, but in general the flows are more foliated and contain smaller phenocrysts. The large opalescent blue-grey quartz phenocrysts common in the intrusions do not occur in the flows. Individual flows are 1 to 6 m thick; the much thicker sills vary from 15 to 120 m thick. Flows can also commonly be recognized by the presence of brecciated zones at their upper and lower contacts. Nevertheless, in several places it was not obvious whether certain bodies were intrusive or extrusive in origin. Such cases are shown on the accompanying map as "quartz-feldspar porphyry" units and have

arbitrarily been included with the metavolcanics.

In two outcrops north of the westernmost of the Lilypad Lakes bun-shaped pillows about 70 cm long were found scattered in otherwise massive flow material which appeared to be dacitic in composition.

In thin section the flow rocks invariably exhibit granoblastic texture, but sericite, chlorite and biotite which constitute 5 to 20 percent of the rocks form a distinct foliation in most samples. Anhedral quartz phenocrysts have commonly been reduced to coarse granular aggregates and subhedral albite phenocrysts are typically highly sericitized and/or saussuritized. The matrix is invariably a very fine grained, even textured, interlocking mosaic of quartz, feldspars and phyllosilicates. Variations in grain size and in the proportions of sericite and ferromagnesian minerals between laminae produce the colour contrasts in flow-banded rocks. Small euhedral garnets were observed in several thin sections of felsic flows.

Pyroclastic Rocks

Most of the felsic to intermediate metavolcanic rocks in map-area appear to be pyroclastic in origin, ranging from fine lithic tuff and crystal tuff to pyroclastic breccia. These rocks predominate in all of the exposed felsic metavolcanic areas outlined on the accompanying map.

Lapilli-tuff and lapillistone are the most common clast-size categories present but fine tuff and tuff-breccia units are also common in most areas. Coarse pyroclastic breccia appears to be restricted to a few occurrences along the western shore of Miminiska Lake and adjacent islands. These rock-types grade into one another both along and across strike. Most of the rocks appear to be dacitic to rhyodacitic in composition, but some are definitely rhyolitic (see Petrochemistry).

In the finer pyroclastic rocks, the ratio of lithic clast content to crystal and crystal fragment content varies widely. These rocks are light grey or white on the weathered surface and light grey on the fresh surface. In nearly all cases bedding from a few millimetres to over a metre thick can be discerned, but some outcrops of crystal tuff such as that at the mouth of Ferguson Creek are completely massive. White-weathering lapilli-sized clasts are sparsely scattered in most of the fine pyroclastic units, but are far less common in predominantly crystal bearing tuffs.

The lithic clasts are not always easily discernible in thin section. In many cases, however, the clasts can be distinguished from the surrounding matrix because of differences in ferromagnesian content, grain size, texture, and abundance and type of phenocrysts. Phyllosilicates are typically concentrated around the clast boundaries, thus defining their general shapes. Lithic clasts of all sizes from ash to bombs are in nearly all cases highly flattened with axial ratios between 5:1 and 20:1.

Quartz and albite constitute over 75 percent of most of the pyroclastic rocks, the remainder being made up of sericite, biotite, chlorite, hornblende, epidote and secondary carbonate, with minor magnetite, apatite, tourmaline, sphene, graphite, zircon and microcline perthite. The lithic clasts in any one

sample are generally of the same composition and texture, but those from different units may exhibit very different characteristics. The clast textures vary from markedly porphyritic to equigranular or seriate, but nearly all are microcrystalline with average matrix grain size less than 0.01 mm. Although some clasts show well preserved igneous textures with prominent lath-shaped feldspars, most consist of granular quartzofeldspathic material with anhedral untwinned feldspar. In either case the material is generally massive or only very weakly foliated. Euhedral plagioclase phenocrysts are abundant in the clasts but quartz phenocrysts are rare.

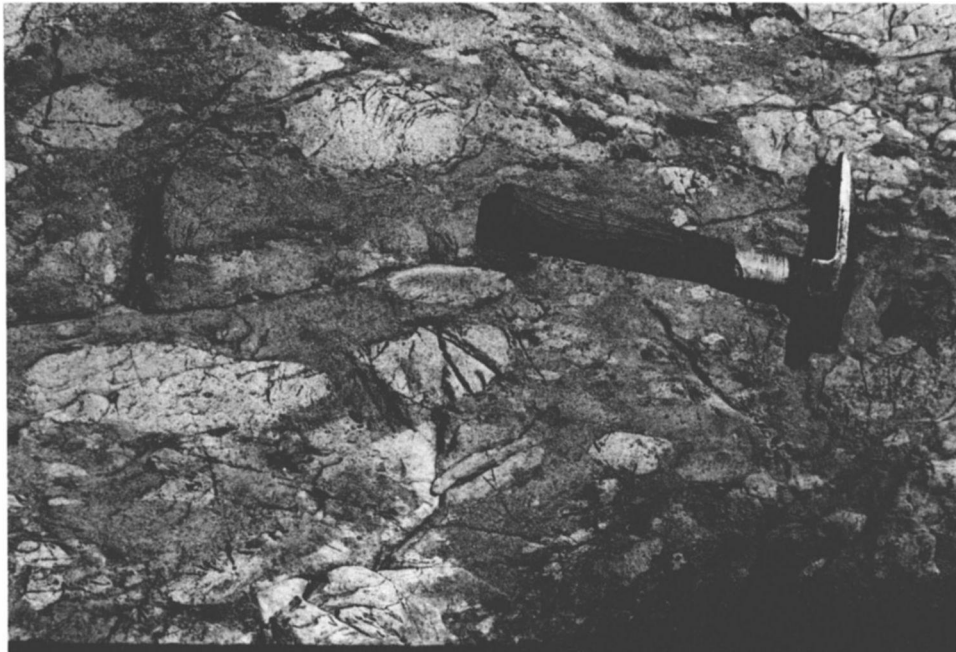
The matrix which surrounds the recognizable lithic clasts is a very fine grained (0.05 to 0.2 mm) chaotic mass of granular quartz and feldspar containing considerable amounts of alteration products and other secondary materials such as epidote, chlorite, hematite, leucoxene, sericite, biotite and carbonate. The biotite, chlorite and sericite form a strong foliation deflecting sharply around lithic clasts and crystals alike. Originally this interstitial matrix material must have consisted of small vitric fragments and/or chemical cement but no vestiges of these were observed. Biotite in some rocks forms a foliation at a high angle to the plane of clast flattening and the generally more prominent sericitic foliation.

The sand-sized crystal fraction in the tuffs constitutes from less than 5 to greater than 60 percent of the rocks. Plagioclase and quartz are the only common crystal phases. In general, plagioclase crystals are more abundant but quartz grains are larger. The plagioclase crystals, which weather a chalky white, are commonly 2 to 5 mm but range up to 2 cm and are typically euhedral to subhedral and equant. Twinning and, in some cases, complex zoning are fairly well preserved despite moderately high to high saussuritization or sericitization. In some sections broken and bent crystals were observed but these are not common.

Quartz grains weather dull grey and are black and vitreous on fresh surface. Most are approximately 5 mm in diameter and are typically subrounded or ovoid. Many, however, have very irregular corroded shapes with large wormy embayments. In some rocks most of the quartz crystals have been reduced to tightly interlocking aggregates of polygonal grains but most grains have retained their original form.

These fine pyroclastic materials occur alone and also form the matrix of the coarser pyroclastic rock types. Lapilli-tuff, lapillistone and tuff-breccia are the major components of the felsic to intermediate pile on the western side of Miminiska Lake and are common in most of the minor sequences. In a few places these rocks coarsen into pyroclastic breccia. In general, the clasts in an individual unit are predominantly of one rock-type and are typically more felsic in appearance than their matrix. Invariably the clasts are porphyritic with quartz and feldspar phenocrysts present in a massive aphanitic groundmass. Although matrix-clast boundaries are sharp in weathered outcrops, they are very difficult to see on a fresh surface.

Some of the coarsest pyroclastic rocks exposed are on small islands just north of the westernmost point of Miminiska Peninsula (Photo 3). This tuff breccia is unusual in that the clasts, which are up to 45 cm across, are more equant and angular relative to those in most of the pyroclastic rocks, and in that at least three distinct clast lithologies were noted. The total clast content



CGS 10 298

Photo 3—Rhyolitic tuff-breccia on the small islands off the western tip of Miminiska Peninsula.

in this exposure, compared with other pyroclastic rocks in the area, is uncommonly low (20 to 35 percent by volume). Some clasts closely resemble the light grey aphanitic rhyodacitic crystal tuff matrix. A second clast type is markedly more porphyritic, containing large (0.4 to 0.8 cm) quartz and feldspar phenocrysts, and the third type is an aphanitic porcellaneous rhyolite. In contrast, only a few hundred metres away on the peninsula itself, the pyroclastic sequence consists of dacitic to andesitic lapilli-tuff and tuff-breccia units with much higher proportions of flattened lapilli and bomb-sized clasts.

On the western side of the western arm of Miminiska Lake lapilli-tuff, lapillistone and tuff-breccia units of dacitic to rhyodacitic composition are very well exposed on a series of islands. These rocks are intercalated with minor units of metasedimentary, volcanoclastic and fine pyroclastic material. At least one of the lapilli-tuff to lapillistone units changes considerably in composition and in dominant clast size from a dacitic lapillistone unit near the bottom to a fine grained andesitic lapilli-tuff and lithic tuff near its top. Clast size gradation across strike is evident in several places in this area. All determinations indicate a decrease in clast size toward the northwest, and hence stratigraphic tops in that direction. This inference is reinforced by scour and depositional structures in the metasedimentary intercalations.

The pyroclastic rocks north of the Lilypad Lakes are notable for their fissility and high degree of clast flattening. Many of these rocks appear to be rhyodacitic or rhyolitic in composition and most are lapilli-tuff to tuff-breccia. These units commonly occur intercalated with finely laminated tuff, thin carbonaceous mudstone units, felsic flows and more felsic pyroclastic units.

Pyroclastic rocks in the minor felsic sequences north of the mouth of Ferguson Creek and north of Curry Bay for the most part comprise dacitic tuff, crystal tuff and lapilli-tuff units, commonly intercalated with minor metasedimentary beds.

Quartz-Feldspar Porphyry

Small, conformable, rhyolitic and rhyodacitic quartz-feldspar porphyry units of uncertain origin (i.e. either intrusive or extrusive) are arbitrarily included in this description of metavolcanics even though some of these rocks are almost certainly subvolcanic. For the most part these units consist of massive, hard, featureless, white-weathering, commonly well-jointed rock. They are also similar in that they contain a high proportion of quartz, sodic plagioclase and microcline phenocrysts, but the size, numerical ratios and point densities of the phenocrysts vary considerably. Crystal contents as high as 60 percent were observed in some cases, but more commonly the phenocrysts comprise less than 30 percent of the rocks. Typically quartz phenocrysts, ovoid to amoeboid in shape, are larger than the subhedral to euhedral feldspars which are generally more numerous and show complex twinning and distinct zoning. In some cases, the oligoclase and microcline grains form a seriate texture consisting of equant phenocrysts from 5 mm long to matrix sized crystals. The matrix, which is invariably aphanitic, is a quartzofeldspathic mosaic containing abundant uniformly distributed sericite and variable amounts of chlorite, biotite and epidote which generally form small ragged lenticular clusters. As in most rocks in the area, the phyllosilicates define a distinct foliation which is usually visible only in thin section.

Volcaniclastic Metasediments

These rocks occur intercalated with the felsic to intermediate pyroclastic rocks along the western arm of Miminiska Lake and consist predominantly of lithic and crystal fragments derived from the pyroclastics nearby. They would be properly termed lithic arkose, feldspathic litharenite, pebbly sandstone and pebble conglomerate as sedimentary rocks. They are gradational into the adjacent pyroclastic rocks both along and across strike.

The volcaniclastic metasediments weather white to light brown and have a distinctly gritty appearance due to their high content of coarse sand and granule-sized fragments. The distinction between the lapilli-tuff and the coarser volcaniclastic metasediments, conglomerate and pebbly sandstone is commonly quite obvious in the field since the metasediments contain fragments of mudstone, wacke-type rocks and mafic metavolcanic material as well as the

predominant felsic to intermediate metavolcanic fragments which are identical to clasts in the pyroclastic rocks. The conglomeratic and pebbly sandstone units are generally less than 2 m thick with well-defined upper and lower contacts. The conglomerates are matrix-supported with framework fragments comprising less than 25 percent of their volume. Poor fragment size gradation, increasing from top to bottom, is common in many units. The degree of deformation of all types of fragments is highly variable. Some mudstone fragments are equant and angular, yet in adjacent units similar fragments are flattened with axial ratios of 4:1 or 5:1.

Although the conglomeratic units do occur in sequence, they more commonly are separated by beds or sequences of massive pebbly or granular sandstone and/or arenite units exhibiting few indications of bedding. Small scale scour channels were found in the tops of several beds, particularly in those overlain by conglomeratic units.

In beds of finer volcanoclastic metasediment the percentage of recognizable material not of felsic pyroclastic origin (i.e. mudstone, wackes, mafic metavolcanic amphibolite, etc.) is much lower (1.0 percent). However, these metasediments differ noticeably from pyroclastic rocks in that their content of sand-sized material is markedly higher than that of the pyroclastics. The ratio of sand-sized quartz to feldspar is also much higher in the reworked (metasedimentary) material. Commonly sand-sized quartz grains constitute 30 to 40 percent and plagioclase constitutes 20 to 25 percent of the volcanoclastic metasediments, whereas in pyroclastic rocks these amounts are reversed. The proportion of lithic fragments in the metasediments is generally considerably lower than that in the pyroclastics. Some metasedimentary units contain up to 75 percent crystals and crystal fragments and were certainly derived from a nearby source of crystal tuff. Sand-sized plagioclase grains in such metasediments are angular and equant but broken corners and crystal fragments are very common. In general they are not very different in size and shape from phenocrysts in the primary pyroclastic rocks which indicates very short transport distances to sites of final deposition.

Lithic fragments in individual thin sections of the volcanoclastic metasediments vary considerably in texture and composition, in contrast to thin sections of primary tuffaceous material in which clasts are typically quite uniform. In most of the thin sections examined, fragments of all types, both lithic and crystal, are equant in shape and sharp in outline, unlike the wispy lensoid clasts in pyroclastic material. The typical overall texture of these volcanoclastic rocks is chaotic and massive except for weak foliations produced by alignment of sericite and other phyllosilicate grains and small carbonate lenses.

METASEDIMENTS

Clastic Metasediments

Epiclastic metasediments in the map-area include a variety of rock-types because of primary genetic differences and the spectrum of metamorphic ranks represented. At least two major sedimentary facies were recognized within the

map-area. Spatially the most important is represented by a thick sequence of rhythmically bedded wacke and mudstone units which underlies much of the central and eastern parts of the area. These rocks have many of the characteristics of a distal turbidite sequence (Walker 1967). The second sedimentary facies is represented by a sequence of conglomerate, pebbly sandstone and arenaceous units with minor mudstone intercalations and occurs in the western part of the area between the wacke sequence and the northern metavolcanics. These metasediments appear to have the characteristics of proximal turbidites (Walker 1967). Interpretation of the relationships between these two clastic metasedimentary sequences is reserved for a later section (see Stratigraphy).

Metamorphic grade generally increases from west to east in this area. West of the eastern shore of Miminiska Lake, the rocks are recognizably epiclastic both in outcrop and thin section, with relatively minor departures from original textures and mineralogy. To the east, however, it is increasingly difficult to recognize original features, as progressive metamorphism has produced phyllitic, schistose and migmatitic rocks. Because of poor exposure in many places, it is not possible to trace individual beds or groups of beds between areas of relatively high and low metamorphic rank but there is little doubt that the rocks are equivalent.

Metamorphic effects on a regional scale are discussed in a separate section of this report (see Metamorphism). In general, the rocks are described below in order of increasing metamorphic rank, beginning with those rocks exhibiting well-preserved epiclastic features. For continuity the rocks are grouped as they occur in the field.

The sandstone classification scheme used in this report is that of Young (1967).

METASEDIMENTS OF LOW TO VERY LOW METAMORPHIC RANK

Wacke-Mudstone Association

Interbedded units of wacke-type sandstone and mudstone and their more highly metamorphosed equivalents form a thick, continuous sequence which underlies about half of the map-area. The low grade, recognizably epiclastic, portion of this sequence is relatively well exposed in the central part of Miminiska Peninsula, on the southern part of Miminiska Island and on the smaller islands to the south and east. Particularly good exposures occur along the eastern shore of Miminiska Peninsula where bare, wave-washed outcrops commonly permit recognition of fine sedimentary structures and textures that are not visible in most places.

Bedding is discernible in most outcrops. Beds are typically perfectly regular on the outcrop scale with distinct parallel contacts (Photo 4). The lower contact of the wacke unit is very sharp: light grey or buff-weathering sandstone is in stark contrast with the underlying black claystone or siltstone. The wacke becomes progressively darker in colour as average grain size decreases upward within the bed and commonly grades into the mudstone above.



OGS 10 299

Photo 4—Laminated to thinly bedded wacke-mudstone sequence on the island east of Miminiska Lodge.

Bed thickness varies from less than a centimetre to over a metre but few units observed were over 30 cm. Beds in a single outcrop are commonly approximately equal in thickness but in some places, such as on the outcrops east of Miminiska Lodge, units of considerable thickness comprised of sequences of thin beds (0.5 to 2 cm thick) are interleaved with units comprised of thicker (10 to 25 cm) beds. The abrupt change from thick to thin bedded sequences possibly reflects a change in provenance and/or the path of the depositing current. The average bed thickness seems to decrease from the eastern to the western side of Miminiska Lake where few beds exceed 5 cm in thickness. This may represent a depositional trend but the poor exposure of the metasediments on the western side of Miminiska Lake makes conclusive interpretation impossible.

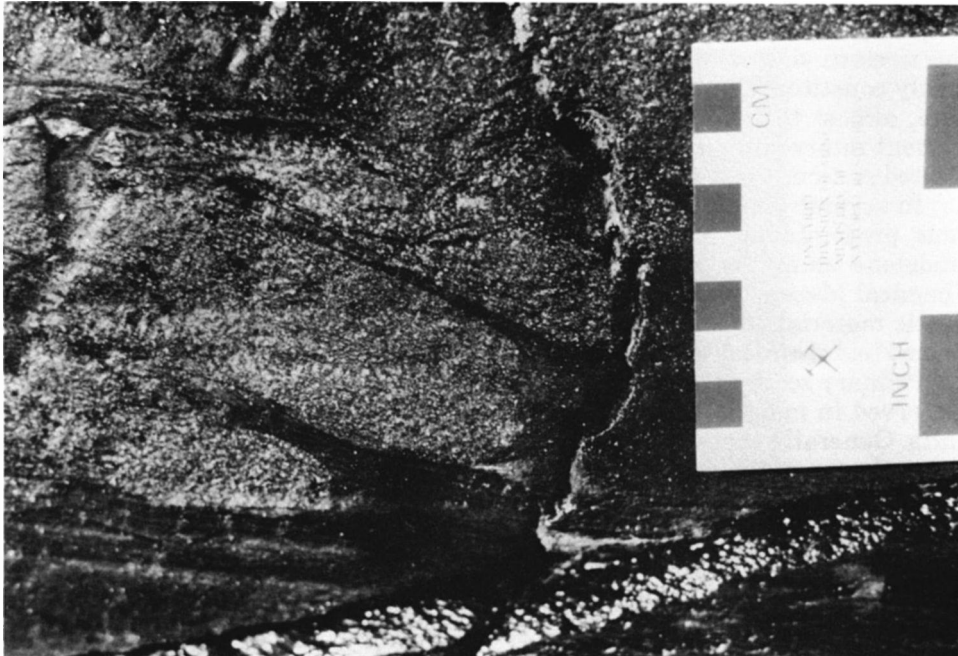
The proportions of sandstone and mudstone vary widely. Typically the ratio is in the range of 4:1 to 2:1. In outcrops where beds are thin, particularly on the western side of Miminiska Lake, pelagic or hemipelagic mudstone commonly constitutes over half the section. Elsewhere the wacke units predominate, almost to the exclusion of mudstone beds. Amalgamated wacke beds without intervening mudstone units are common and are predominant across limited sections.

In several places within this metasedimentary sequence, beds of ferruginous, predominantly chemically-formed material take the place of the typical mudstone units. These ferruginous rocks take many forms (see Ferruginous Chemical Metasediments) but generally contain considerable amounts of fine clastic material. These are constituents of mudstone which would have been formed had chemical sedimentation not proceeded more rapidly.

Primary sedimentary and soft-sediment deformational structures are well preserved in many areas. Graded bedding is very common within the wacke units. Generally there is a continuous gradation from the base of a sandstone bed to the top of the overlying mudstone but in other examples grading occurs over only a fraction of the bed thickness and the remainder is essentially massive. Cross bedding was rarely observed but, where found, occurs in the interior portion of thin beds. Fine internal laminations were rarely discernible except in the upper parts of some thick wacke units and in very thin beds in which the entire sandy or silty portion of the rock is finely laminated. By far the most common bed-type is the simple massive unit with no grading except near the top of the wacke fraction where the contact between sandstone and overlying mudstone is blurred.

Dark mudstone chips up to several centimetres long, presumably scoured from underlying mudstone units, were observed at the base of many wacke units, but the most commonly observed features on bedding surfaces are load casts and flame structures, particularly at the base of coarse grained wacke beds (Photo 5). These features generally constitute unequivocal stratigraphic top indicators, particularly when observed in conjunction with graded beds, but "pseudo-load casts" (Ojakangas 1972), produced by minor faulting and/or shearing at oblique angles to the bedding planes, are also quite common and can give erroneous top indications. Some load casts, which can be up to several centimetres deep, extend through underlying mudstone units, completely disrupting those beds. Detached load casts and ball-and-pillow structures were also found in some places. Load cast-like features were rarely found without concomittant flame structures. Such sole features may represent scour casts of some type but no definite interpretations can be made since bedding planes are not exposed. A single example of clastic intrusion was found on the eastern side of Miminiska Peninsula where a massive wacke dike about 5 cm wide pierces several thin overlying mudstone and fine sandstone units.

The framework constituents in the wacke units vary in grain size from silt to coarse sand and even very coarse sand at the base of some units in the upper part of the sequence. Most beds grade upward from medium sand but in many of the thin units the coarsest basal material is only very fine sand or even silt. The mudstone units consist of fine silt and coarse clay-sized material. Over the entire map-area there is a trend toward coarsening of clastic material upward in the sequence.

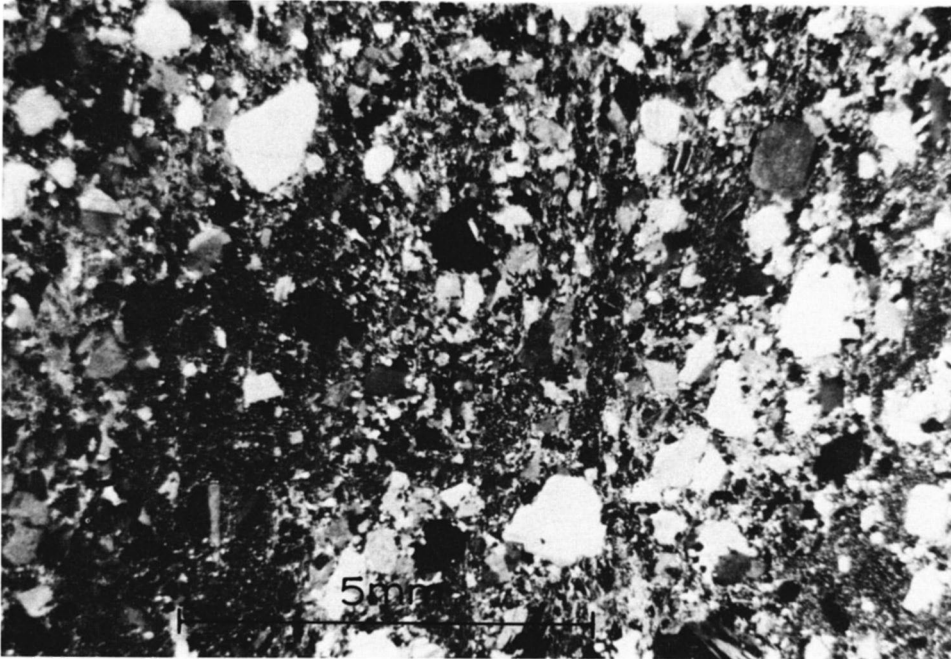


OGS 10300

Photo 5—Load casts in the base of a graded coarse wacke surrounded by the underlying dark grey mudstone. The shape of the load casts is accentuated by deformation.

In thin section the sandstones exhibit obvious bimodal grain size distribution typical of wacke-type sediments. The framework grains, which are predominantly quartz and feldspar, are generally subrounded to subangular except where recrystallization has transformed them into irregular lensoidal patches. Quartz is the dominant framework mineral in most thin sections, forming between 60 and 95 percent of the sand-sized crystal fragments. Slightly sericitized albitic plagioclase comprises most of the balance of the sand-sized grains. Sparsely distributed microcline and microcline perthite occur in a few samples.

Sand-sized lithic fragments are very difficult to recognize with certainty. The most easily discernible lithic fragments are mafic metavolcanic schists rich in chlorite, mudstone chips rich in phyllosilicates, and chert. At the other extreme, felsic to intermediate metavolcanic and most metasedimentary fragments are very difficult to distinguish from matrix material after the effects of diagenesis, deformation and low grade metamorphism. Recrystallization has tended to equalize the grain sizes and textures of the lithic fragments with the surrounding matrix. At the same time these fragments are contorted into very nebulous shapes. They are wrapped around the more competent crystal grains and blend into developing foliation patterns. The result is that it becomes im-

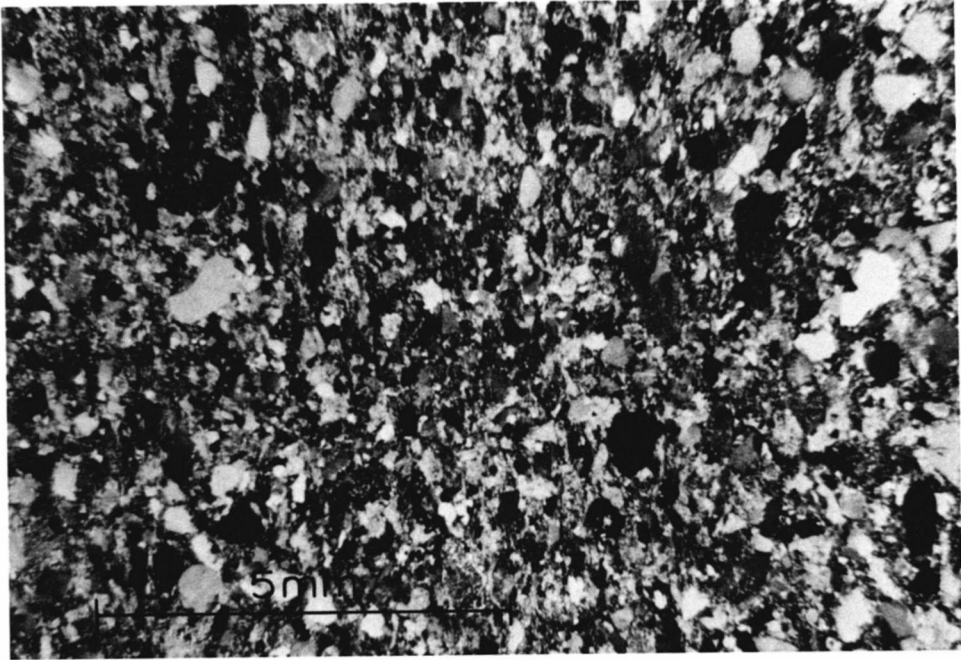


OGS 10 301

Photo 6—Photomicrograph (crossed polarizers) of a lithic subarkosic wacke from northeast of Howells Lake.

possible to recognize most types of fine grained quartzofeldspathic lithic fragments. Such rocks typically appear to be subarkosic wackes with high percentages of matrix (from 30 to 60 percent), when in fact they were probably originally lithic subarkosic wackes (Photo 6) or even feldspathic lithwackes (Photo 7). This problem was not resolved in most of the cases examined and the rocks can only be termed wackes. As the effects of recrystallization increase, matrix (i.e. original matrix + former quartzofeldspathic lithic fragments) grains progressively increase in size until the rock is essentially equigranular. This necessitates the use of metamorphic terminology in their classification even though these rocks quite commonly display well-preserved macroscopic sedimentary features.

In very low grade rocks, the matrix consists predominantly of rounded fine silt and clay-sized quartz and feldspar grains averaging 0.02 to 0.03 mm in diameter. In matrix material which has undergone partial recrystallization the grains are polygonal and generally exceed the 0.03 mm maximum usually applied in the classification of matrix material (Okada 1971). Grain sizes from 0.05 to 0.08 mm are most common. Other major matrix minerals, occurring in highly variable proportions, include phyllosilicates (mostly chlorite and sericite but biotite occurs in some thin sections), epidote and secondary carbonate.



OGS 10 302

Photo 7—Photomicrograph (crossed polarizers) of a feldspathic lithwacke from the northwestern part of Miminiska Peninsula.

Minor phases are magnetite, hematite, graphite, sphene, zircon and secondary tourmaline. In nearly all thin sections phyllosilicates form a foliation which deflects around framework grains.

Examination of mudstones in thin section is rather unrewarding because of their grain size which is generally finer than the matrix present in wacke beds. With the exception of spotted slate samples, the mudstones are very even textured, containing no sand-sized and few coarse silt-sized crystal fragments. No lithic fragments were discernible. Quartz, plagioclase, potassic feldspar, chlorite and muscovite were identified in these rocks by X-ray diffraction techniques. In some samples the phyllosilicates are cryptocrystalline, but in most thin sections examined they are considerably coarser grained than the quartzofeldspathic material (up to 0.1 mm in length), and form distinct undulating foliations which can be at high angles to bedding. These foliations, which are commonly pronounced, may be strongly crenulated, producing secondary foliations and slaty cleavages. The abundance, habit and size of chlorite and sericite flakes vary markedly from lamination to lamination over a few millimetres in some sections.

Many slaty mudstone units from all parts of the metasedimentary sequence around Miminiska Lake contain black chlorite-rich clots which form 5 to 10 percent of the rocks, giving them a spotted appearance. These ovoid clots,

which are between 0.5 and 2.0 mm in cross-section, consist of coarse ragged chlorite flakes and coarse grained polygonal quartz. They probably represent retrograded cordierite porphyroblasts but no fresh cordierite is known within the area. White clots consisting of sericite, graphite and coarse grained quartz up to 2 mm long also occur in some slaty mudstone units. These generally have subhedral lath-shaped outlines and are interpreted as pseudomorphs after andalusite porphyroblasts.

This sequence of repeatedly interbedded wacke and mudstone units has most of the characteristics attributed to turbidite facies rocks. The important features include: (a) beds are laterally continuous and parallel sided on outcrop scale, (b) graded bedding is very common in the wacke units, (c) the sandstones are immature, being rich in labile constituents and being very poorly sorted, (d) points (b) and (c) indicate rapid deposition of the sandstones from a high energy current, yet these rocks are intercalated with quiet water, very fine grained clastic metasediments and ferruginous chemical sediments, (e) the A and E divisions of the classical Bouma turbidite model are very common and the B and/or C divisions were recognized in some wacke units.

The most common bed type in this sequence is the (A-E) type, which according to Walker (1967) is formed under low flow regime conditions probably in the distal or medial portion of a submarine fan.

Conglomeratic Metasediments

Conglomeratic metasediments are rare within the wacke-mudstone sequence. They occur only near the base of the sequence on Miminiska Peninsula, on the western side of Miminiska Peninsula and northeast of Curry Bay near the fringes of volcanic centres within the metasediments. The conglomerate, which is poorly exposed north of the metavolcanic-metasediment contact on the eastern shore of Miminiska Peninsula, appears to be highly silicified. It contains a high proportion of porphyritic felsic and intermediate metavolcanic material in a buff-coloured wacke matrix. Many fragments are hard to distinguish from the matrix because of the pervasive alteration and the total fragment content is difficult to estimate, but the rock is probably matrix-supported and essentially oligomictic.

Conglomeratic units on the northwestern side of Miminiska Peninsula are intercalated with wacke-mudstone beds, and appear to be thin (<1.0 m) and of limited areal extent. These rocks are polymictic, matrix-supported pebble and cobble conglomerates and pebbly sandstones which grade into coarse wacke beds along strike. Most of the pebbles and cobbles, which are fairly well rounded, are intermediate metavolcanic rocks and varieties of wacke and mudstone with relatively few quartz and granitoid fragments.

Northeast of Curry Bay, conglomerates exposed west of the small felsic to intermediate metavolcanic wedge contain a high proportion of intermediate metavolcanic fragments. The conglomeratic units are quite thin (most less than 30 cm) and are intercalated with lenses of coarse arkosic sandstone. Adjacent conglomerate beds vary very greatly in fragment size and type and in the proportion of fragments to matrix, but most units are framework-supported po-

lymictic cobble and pebble conglomerates. Granitoid and felsic to intermediate metavolcanic fragments are approximately equal in abundance in many units. The granitoid fragments tend to be larger and much more rounded than all other types. Aphanitic and porphyritic felsic metavolcanic fragments, which tend to be angular and equant, predominate in some beds. Coarse quartz fragments tend to be subangular or even irregular in shape as do fragments of chert and jasper, which are relatively uncommon. Mafic to intermediate metavolcanic fragments and metasedimentary fragments are considerably flattened between the more competent components which tends to obscure their true abundance. The smaller mafic and intermediate metavolcanic fragments are often difficult to distinguish from matrix material, which is medium to coarse grained, light green-weathering wacke.

Graphitic Mudstone Association

Between wedges of felsic to intermediate pyroclastic material west of the mouth of Ferguson Creek, there is a relatively thin metasedimentary sequence consisting of graded units of coarse lithic arkosic wacke rich in metavolcanic fragments and soft sericitic and graphitic mudstone. In places the mudstone and wacke units are intercalated but in other parts of the stratigraphic section thinly laminated to thinly bedded mudstones occur alone over thicknesses of several tens of metres. The sericitic units weather light grey and are very soft and fissile, whereas the graphitic material is black and relatively massive. Laminations in the graphitic units in the order of 0.01 mm thick can be discerned in thin section. The graphite itself is cryptocrystalline and the bulk of the rock consists of fine silt and clay-sized quartzofeldspathic material and sericite. Contacts between graphite-rich and sericite-rich layers are very sharp, but some relatively coarse grained graphite occurs within sericitic units. Sericite forms a strong foliation which is generally crenulated to form the slaty cleavage responsible for the marked fissility of these rocks.

Graphite is not commonly a major mineral in the main wacke-mudstone sequence described previously and the sericite content of these rocks appears much higher than that of mudstones in the main sequence. These relatively unusual compositions probably reflect volcanic activity, as attested by the presence nearby of felsic to intermediate volcanic rocks, not commonly found within the wacke-mudstone sequence.

Conglomerate-Arenite Association

Rocks of this association conformably overlie and are probably in part intercalated with the wacke-mudstone sequence previously described. In contrast to the thick monotonous wacke-mudstone succession, the conglomerate-arenite sequence is quite thin (in the order of 600 m), and contains considerable lithologic variety. This upper sequence can be traced along the contact with the northern metavolcanics between the southwestern corner of the map-area and Keezhik Creek. It appears to become thinner, and individual units within it ap-



OGS 10 303

Photo 8—Conglomerate from east of the Albany River, southwest of Howells Lake. Note the high proportion of intermediate metavolcanic fragments.

pear to become finer toward the northeast. It was not recognized in the eastern part of the area.

This association consists predominantly of conglomerates and sandstones, with relatively minor mudstone intercalations scattered throughout the section. In marked contrast to the matrix-rich wackes found in the wacke-mudstone sequence, these sandstones are arenites and wackes with low matrix content. Also in contrast is the presence of easily recognizable lithic fragments which are abundant both in hand specimens and in thin sections of these rocks. The degree of deformation and the grade of metamorphism are relatively low in rocks of this upper sequence.

At its thickest point northeast of Howells Lake, the lower part of this sequence consists mostly of feldspathic litharenite and lithic arkose units inter-

bedded with pebbly units of similar composition and minor mudstone beds. Similar sections occur west of Curry Bay and around Keezhik Creek. Above the arenite-pebbly sandstone succession in the Howells Lake and Albany River sections the metasediments become coarser, developing into a sequence of cobble and pebble conglomerates (Photo 8) interbedded with pebbly sandstone and feldspathic litharenite units. Topping the sequence, immediately underlying the metavolcanics, is a thin succession of laminated argillaceous units similar to the mudstone beds found sparsely distributed throughout the whole sequence.

The feldspathic litharenite units, which are 10 to 50 cm thick, are generally massive, without grading or other internal structure. The rocks weather a light buff colour and the preponderance of coarse and medium sand-sized crystal and rock fragments gives them a distinctly gritty appearance. Lithic fragments, predominantly aphanitic felsic to intermediate metavolcanic materials, are lenticular to ovoid and weather chalky white. The crystal fragments, predominantly quartz, are generally subangular to irregular in shape. The ease with which lithic fragments and matrix can be distinguished in thin section depends on the fragment size (from coarse sand-sized to fine silt-sized fragments), fragment type and degree of deformation but, where the distinction can be made, matrix appears to constitute only 10 to 20 percent by volume. Up to 90 percent of the sand-sized and silt-sized lithic fragments are fine to very fine grained felsic to intermediate metavolcanics; many contain microphenocrysts of plagioclase and, less commonly, quartz. Other lithic fragment types such as chert, chloritic mafic metavolcanics and metasediments are far less common. Sericite, chlorite, epidote, hematite, carbonate and fine silt-sized quartz and feldspar grains make up the matrix.

The pebbly sandstone units are generally well stratified and exhibit well developed fragment size gradation in some cases. Aphanitic felsic to intermediate metavolcanic pebbles are again the predominant fragment type but several other lithologies can be recognized. White, high-weathering, massive granitoid pebbles are common, as are massive quartz, felsic quartz-feldspar porphyry, jasper, magnetite-chert iron formation, chert, mudstone and chloritic metavolcanic fragments. The granitoid and quartz pebbles are typically the largest present and are quite well rounded while the other fragment types are highly variable in shape. In some outcrops the metavolcanic and mudstone fragments are markedly flattened and molded around more competent fragments but elsewhere all fragment types retain their original shape and are only slightly deformed.

In some occurrences the pebbly sandstones grade into pebble conglomerates but generally the pebble content does not exceed 10 to 15 percent. The matrix of the pebbly units varies from buff feldspathic litharenite to dull greenish grey feldspathic lithwacke or lithic subarkosic wacke. The latter is difficult to distinguish in outcrop from some intermediate to mafic metavolcanic pebbles and some types of clastic metasedimentary fragments. In thin section the wacke-type rocks differ from the arenites only in their higher proportion of silt-size crystal fragments and phyllosilicate content. Strictly speaking these are not true wackes since the fine material has a mean grain size in the order of 0.08 mm, well above the 0.03 mm usually taken as the distinction between "matrix" and "framework" grains. However, many of these rocks have such ob-

vious bimodal grain size distributions in the sand and/or silt-sized material that the term wacke is here applied to rocks containing more than 15 percent clastic material smaller than 0.10 mm.

Pebble and cobble conglomerate units are commonly graded but other sedimentary structures such as cross-bedding, imbrication, etc., are normally lacking. Conglomerate beds range in thickness from 30 cm to over 5 m and typically have sharp, parallel contacts. In most cases these units occur in sequence but interbeds of finer pebbly and granular sandstone and arenite also occur. The ratio of pebbles and cobbles to finer clastic material varies greatly. The larger fragments form between 20 and 80 percent of the rocks but essentially fragment-supported (orthoconglomerate) units containing 40 to 70 percent pebble- and cobble-sized fragments are most common. The coarsest conglomeratic units found are east of the Albany River in the southwestern corner of the area, where some granitoid cobbles at the base of some beds are 15 to 20 cm in diameter. Northeast of that section fragments larger than 10 cm in diameter are uncommon.

The relative proportions of fragment lithologies in the conglomerate units differ considerably from those in the finer metasediments. Although felsic to intermediate cobbles and pebbles predominate in most of the conglomerates, mafic to intermediate metavolcanic and granitoid types are more abundant in some beds and generally make up a much higher percentage of all units.

The matrix of the conglomerates is the greenish grey bimodal arenite or "wacke" previously described. In thin section it is seen to contain abundant chlorite, sericite and carbonate, along with a very high proportion of sand-sized lithic fragments.

Mudstone units form only a very small fraction of the section in the Howells Lake and Albany River areas where rare black laminated mudstone sequences are 1 to 6 cm thick. These generally occur between sandstone and pebbly sandstone units but were also observed in close proximity to conglomerate beds. In the section west of Curry Bay, however, similar mudstone units are more abundant, forming 5 to 10 percent of the total sequence. In the Howells Lake and Curry Bay sections the predominantly conglomerate-arenite sequence is overlain by about 15 to 30 m of interbedded mudstone and fine wacke units similar to rocks common in the western part of the wacke-mudstone association.

The conglomerate-arenite sequence has several characteristics typical of the coarse clastic rocks associated with the feeder channel in suprafan lobe segments of the submarine fan deposit model proposed by Walker (1976). The most important general observations leading to this conclusion are: a) the conglomeratic beds are relatively thin and commonly are graded, but are never cross-stratified or imbricated, which implies deposition from high energy but short duration currents, b) the coarse sedimentary material is interbedded with thin mudstone successions, which indicates that deposition took place in normally quiet, relatively deep water, and c) a lateral transition occurs from graded conglomerate to graded pebbly arenite and massive arenite.

The conglomerate-arenite sequence coarsens upward in the stratigraphic section and to the southwest, indicating progradation from southwest to northeast. The thin sequence of laminated mudstone and fine wacke units immediately overlying the conglomeratic units suggests that the source area for detri-

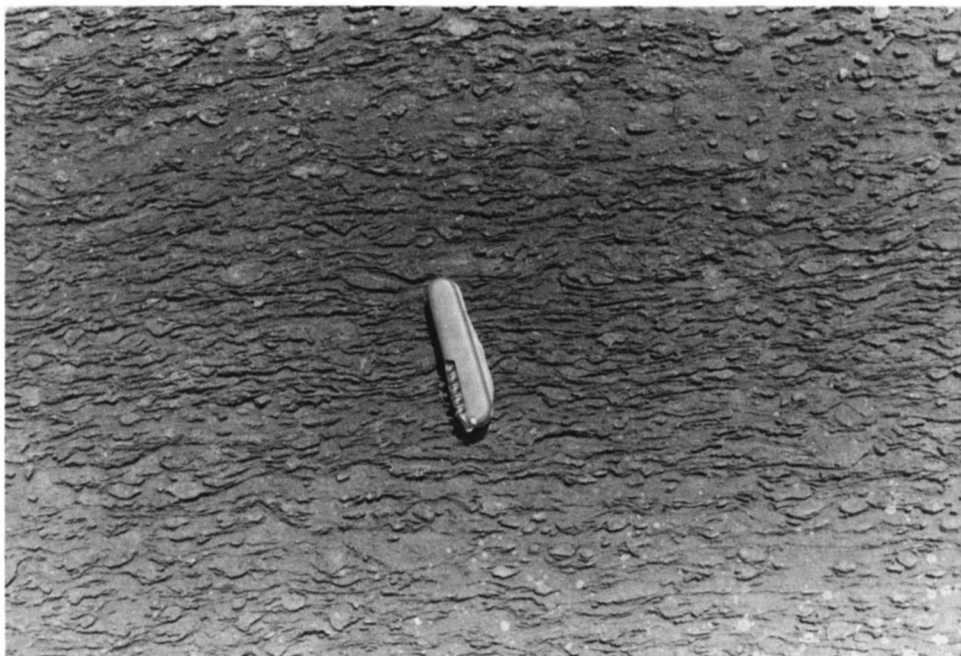
tus had been depleted by erosion or lowered by tectonic events, or that materials being eroded were diverted to new channels. This is further discussed in a following section (see Stratigraphy).

METASEDIMENTS OF INTERMEDIATE METAMORPHIC RANK

In the eastern part of the map-area the clastic metasediments have been metamorphosed to a variety of phyllitic and schistose rocks, and in the southeastern corner anatexis has resulted in an extensive aureole of paragneiss and migmatite around the Kawitos Lake intrusion. West of Wottam Lake most of the clastic metasediments differ little in outcrop appearance from the low metamorphic rank metasediments in the vicinity of Miminiska Lake. Sedimentary structures are generally well preserved and megascopically rocks have retained their epiclastic aspects despite considerable recrystallization and the development of moderately strong micaceous phyllosilicate foliations visible on a microscopic scale. Such rocks also occur along a zone of low metamorphic rank extending from Wottam Lake to Goss Lake and narrowing from about 2.5 km at Wottam Lake to less than 1 km at Goss Lake. In the margins of this zone mudstone and fine wacke units become progressively more phyllitic and slaty cleavage is enhanced, but coarser sandstone units are little changed.

North and south of the Wottam-Goss Lake zone the metasediments are more schistose but the outline of individual beds is well preserved. Because of original differences in bulk composition between units, the types, relative abundance, and size of metamorphic minerals vary markedly, making individual beds easily traceable. A crudely defined progression in index minerals was noted northward and southward from the low grade Wottam-Goss Lake zone, following the familiar first occurrence Barrovian pattern of biotite, almandine garnet and staurolite. Biotite is common in small amounts, subordinate to chlorite, in metasediments as far west as the east side of Miminiska Peninsula but between Miminiska Lake and Wottam Lake biotite-rich quartz-feldspar-biotite (\pm amphibole) schist is the predominant rock type. In beds of suitable composition north and south of the Wottam-Goss Lake zone garnet and staurolite, and in some cases andalusite and sillimanite, porphyroblasts have developed. Commonly almandine garnet and staurolite porphyroblasts occur together within the same units with a quartz-feldspar-biotite (\pm amphibole) matrix but adjacent beds containing only one of these porphyroblast minerals also occur. Large andalusite porphyroblasts occur in schist containing both staurolite and almandine north of Frond Lake (Photo 9).

The highest grade metamorphic rocks occur in the southeastern corner of the map-area. A large area south of Mezhisk Lake is underlain by predominantly medium grained to pegmatitic quartz monzonitic rocks which contain sparse vestiges of garnet, staurolite, sillimanite and biotite-bearing schists and iron formation.



OGS 10 304

Photo 9—Staurolite-, andalusite- and garnet-bearing schist from north of Frond Lake. A layering is suggested by variations in the size and distribution of the porphyroblasts.

Phyllite, Slate, Quartz-Feldspar-Chlorite-Sericite (\pm Biotite \pm Amphibole) Schist

Phyllitic rocks derived from mudstone and fine wacke are very fine grained, light grey with a moderately developed cleavage commonly at high angles to the bedding. In thin section the clastic components of the phyllitic rocks are seen to be only slightly coarser than those in mudstone units in the western part of the area, but alignment of very fine sericite and chlorite flakes forms strong foliations. It is crenulation of this foliation at more or less regular intervals (1-3 mm) that produces the phyllitic character of the rock. Mineralogy, so far as can be determined in such fine grained rocks, is simple with quartz, feldspar, sericite, chlorite and magnetite as major phases and tourmaline and leucoxene as ubiquitous accessories.

North and south of the phyllitic zone the fine grained metasediments are represented by dull, dark grey slate or fine grained black chlorite and/or biotite schists. The slate has a strong fissility subparallel to bedding. It is similar in composition to the phyllite but the phyllosilicates are more abundant, more uniformly distributed, and form perfect foliations. As in some incipient slates found near Miminiska Lake itself, many slate units here contain small clots

and relatively large (1-2 mm) porphyroblasts of chlorite. These may represent pseudomorphs after a previous phase such as cordierite.

The quartz-feldspar-chlorite-sericite (\pm biotite \pm amphibole) schists are considerably coarser grained than the slate or original mudstone from which they were derived. Foliation due to phyllosilicates and streaks of quartzofeldspathic material is relatively ragged compared to slate and phyllite. Biotite is much more common in the schistose rocks and is the most abundant phyllosilicate in many units. Small poikiloblastic hornblende and garnet porphyroblasts, altered to chlorite and carbonate in some thin sections, occur in some units of these schists.

In most of the schists just described tourmaline and graphite are ubiquitous accessories, generally forming 1 to 2 percent of the rock. Some units south of Goss and Wottam Lakes, however, contain up to 10 to 15 percent tourmaline and 4 to 5 percent graphite. The tourmaline and graphite are typically concentrated in individual units or a few adjacent units interlayered with units of much lower concentration suggesting that the distribution of these minerals is related to a syndepositional feature.

Quartz-Feldspar-Biotite (\pm Sericite \pm Chlorite \pm Amphibole) Schist

These rocks, derived from the wacke portion of the metasedimentary sequence, vary considerably in texture and mineralogy; some are poorly foliated, even granoblastic, whereas others are highly schistose. Quartzofeldspathic material may be equigranular, or have a bimodal grain size distribution similar to the original sedimentary rocks. Some of these schist units are homogeneous but others are layered on a microscopic and/or mesoscopic scale with adjacent layers differing in the proportion of phyllosilicates and quartzofeldspathic material present.

Biotite is the predominant phyllosilicate in most of these schists but chlorite is present in significant amounts in most thin sections. Together, these two minerals commonly form 20 to 40 percent of the rocks by volume. In many thin sections biotite and chlorite are intergrown suggesting replacement of the biotite by retrograde chlorite. Biotite occurs in small (0.1 to 0.3 mm long) subhedral flakes which, along with fine sericite (0.05 to 0.1 mm) and chlorite, form the foliation in these rocks, and in large (1 to 3 mm) ragged poikiloblastic grains and clots, randomly distributed and oriented, around which the foliation is deflected.

Sericite in some cases is the most abundant phyllosilicate present. This is probably due to lower iron and magnesium contents in such rocks relative to biotite + chlorite-rich units. Sericite is typically the finest grained of the phyllosilicate components and is the most consistently parallel to foliation.

Amphibole occurs as both groundmass grains forming part of the foliation and as porphyroblasts up to 5 mm across, but for the most part it is a minor constituent. However, some rocks, intercalated with predominantly biotite-bearing metasediments and presumed to be clastic metasediments themselves, contain 15 to 30 percent hornblende. Such rocks appear to be particularly common between Gumuly and Fogerty Lakes.

Quartz is a major mineral in all these rocks. It varies considerably in habit depending upon the degree of recrystallization but in most rocks it is polygonized to some extent. Feldspars are ubiquitous, but their apparent abundance is quite variable and difficult to estimate accurately in thin section without chemical staining techniques. Twinned plagioclase and microcline grains are uncommon but in most thin sections feldspar may be distinguished from nearby quartz by its dusty appearance due to the presence of very fine alteration products. The feldspar grains are generally angular to irregular in shape, comparable in size to the quartz, and commonly occur interstitially between quartz grains.

Tourmaline, magnetite and sphene are the common accessory minerals.

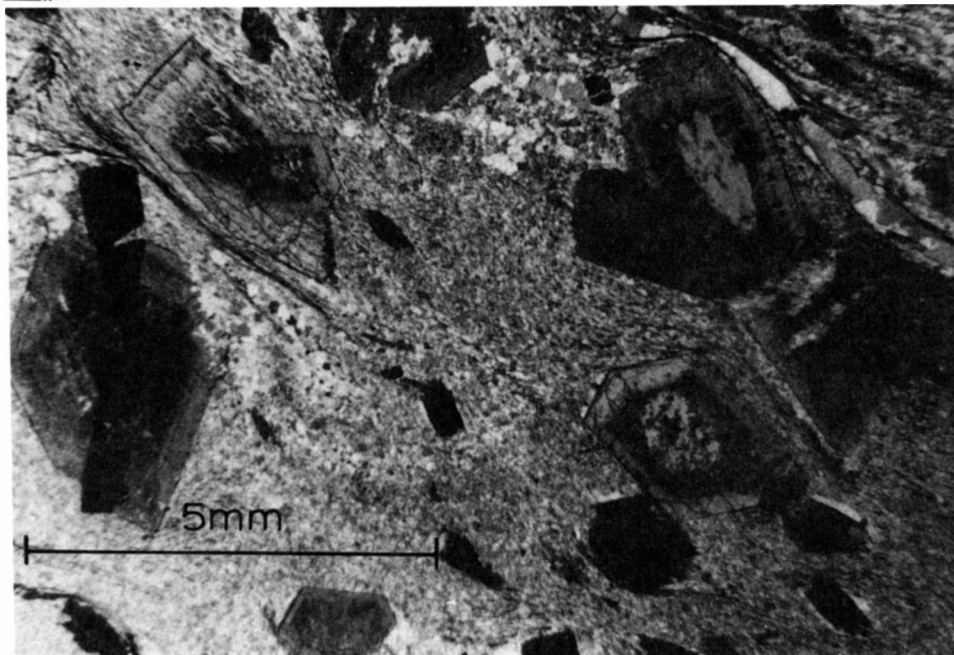
Almandine-Quartz-Feldspar-Biotite (\pm Sericite \pm Chlorite \pm Amphibole) Schist

Schists which contain pale pink or red almandine porphyroblasts but which in other ways are similar to those rocks just described are very common in the eastern part of the area. The garnets constitute from 1 to 25 percent of these rocks and range in size from microcrystalline up to 1.5 cm in diameter. In form they are generally subhedral but vary from perfect inclusion-free euhedra, which are typically small, to irregular, subround or even tabular crystals which may be riddled with inclusions of varying size. The vast majority of inclusions are quartz or plagioclase but tourmaline and magnetite are also very common. Arrangement of the inclusions in planar zones with intervening inclusion-poor zones is typical, with the included grains elongated parallel to these zone boundaries. This alignment initially paralleled the foliation within the rock when the garnet porphyroblast formed but in many cases rotation of the garnet crystals has produced large angular discrepancies between the inclusion trains and the external foliation. 'Snowball' garnets, in which the inclusions occur in a spiral pattern indicating continued growth while the garnet crystal rotated, are not common but were observed in some thin sections. External foliations formed by phyllosilicates are deflected around garnet grains and enclose lensoid pressure shadows filled with relatively coarse grained quartz and large phyllosilicate flakes.

Sericite is conspicuous by its absence from most of these rocks but is a major phase in others. This variation is presumably a function of bulk chemistry. Biotite and chlorite occur both together and exclusive of each other in different units.

Staurolite-Quartz-Feldspar-Biotite (\pm Almandine \pm Sericite \pm Chlorite \pm Andalusite or Sillimanite \pm Amphibole) Schist

Staurolite-bearing schists are very common north of Goss, Frond and Fogerty Lakes. Generally these schists are interlayered with staurolite-free biotite or almandine \pm biotite schists but in some outcrops staurolite occurs in several adjacent beds making individual units difficult to distinguish.



OGS 10 305

Photo 10—Photomicrograph (plane light) of well-formed, inclusion-free, twinned and zoned staurolite porphyroblasts in a staurolite-biotite-quartz-plagioclase schist from north of Fogerty Lake.

The staurolite porphyroblasts are dark brown on outcrop surface and are exceptionally resistant to weathering. On the fresh surface they are a dull, light brown and are rather difficult to discern in many hand specimens. Like garnet, staurolite varies widely in size and form throughout the area. Typically, the porphyroblasts are large, up to 4 cm in length, with crystals 2 cm long being very common. In most areas staurolites are poikiloblastic, consisting of rather nebulous anhedral nets of the mineral enclosing numerous much smaller inclusions which may constitute over 60 percent of the total volume. In some examples, however, notably from the outcrops north of Fogerty Lake, the staurolite crystals are very well formed and inclusion-free except for very fine opaque materials (Photo 10) which occur in well-defined zones. Garnet, quartz, feldspars, tourmaline, chlorite, biotite and iron-titanium oxides commonly occur as inclusions within staurolite grains. As in the large garnet porphyroblasts, inclusions within the staurolite grains are aligned in zones and are parallel to the long dimension of the host crystal which is generally still parallel to the external foliation.

Although staurolite is unaltered in many thin sections, many others contain staurolite that is partially or completely altered to clots of fine grained, felted sericite, chlorite and quartz. Only small cores of staurolite may remain to distinguish these clots from similar but typically more ragged clots of sericite

and quartz which occur as replacement of andalusite. Where the two minerals occur together, as they commonly do, the andalusite is more equant but less well formed and lighter in colour than the staurolite. In some outcrops north of Frond Lake ovoid andalusite knots are up to 5 cm across and constitute up to 25 percent of the rock. The occurrence of andalusite is strongly composition-dependent and it is not common in other parts of the area.

Sillimanite was not observed in any thin sections from rocks of this area. However, it was found in rocks from north of Rich Lake about 10 km east of Mezhisk Lake, where it occurs in staurolite-bearing schists very close to the Kawitos Lake batholith contact zone to the south (Wallace 1976a). Small amounts of fibrolite, altering to muscovite, occur with phyllosilicates in envelopes enclosing pressure shadows around staurolite porphyroblasts.

Ferruginous Chemical Metasediments and Related Rocks

Ferruginous rocks of chemical origin are an important part of the metasedimentary sequence in the map-area. Some iron formation units also occur near the contacts between the metasedimentary sequence and the upper and lower metavolcanic sequences but very few ferruginous rocks were found deep within the metavolcanic terrain where they commonly occur further to the east (Wallace 1974, 1976a).

The iron formations (defined as rocks of sedimentary origin containing more than 15 percent iron by weight) take several forms within this area. Typical oxide facies Algoma-type (Gross 1965) iron formation, consisting of monotonously interlaminated magnetite-rich and quartz-rich (meta-chert) laminae, is by far the most abundant type throughout the area. Carbonate facies iron formation (Gross 1965), consisting of interlayered siderite-rich and quartz-rich laminae, was found in only one location within the map-area but its metamorphosed equivalent, a garnet-amphibole-biotite rock, is common in several places east of Miminiska Peninsula. Metamorphosed silicate facies iron formation, composed of grunerite-rich, hornblende-rich and quartz-rich layers, is also common in the eastern part of the area, particularly between Frond and Wotam Lakes. Pyrrhotitic, graphitic mudstone, believed to be sulphide facies iron formation (Gross 1965), occurs in outcrop near the top of the southern metavolcanic sequence on the eastern side of Miminiska Peninsula. It should be noted that although these rock types are described separately in this section, with the exception of the sulphide facies rocks, they are commonly closely spatially associated and are in many places intercalated on a fine scale.

Magnetite-Quartz (Oxide Facies) Iron Formation

Although the amount of banded magnetite-chert iron formation exposed is relatively small, aeromagnetic data (ODM-GSC 1960a, b) clearly indicate that this rock type is a major component within the wacke-mudstone metasedimentary sequence in the central and eastern parts of the area. Where the iron formation is exposed, it is seen in most places to occur as numerous relatively thin



OGS 10 306

Photo 11—Interbedded magnetite-quartz iron formation and wacke-mudstone from Miminiska Island. The dark grey laminated iron formation weathers high and the contacts with the metasediments weather very low.

units (typically 5 to 50 cm thick) interbedded with beds of fine wacke, or mudstone or their metamorphosed equivalents, in roughly equal proportions (Photo 11). Commonly these clastic intercalations also contain anomalously high amounts of magnetite (up to 15 percent in some thin sections) presumably due to simultaneous clastic sedimentation and chemical precipitation. Intercalations of coarse sandstone between iron formation units are rare.

Each iron formation unit consists of thin (0.2 to 2.0 mm thick) interlaminated magnetite-rich and quartz-rich layers which are continuous and regular in thickness on an outcrop scale. In most outcrops the magnetite-rich laminae are black and the silica-rich bands are dark to light grey. The iron formation weathers high relative to the intervening clastic material and the sharp contacts between the lithologies typically weather very low. Both the iron- and silica-rich laminae are microcrystalline in most cases.

In thin section this type of chemical metasediment is seen to consist of magnetite and quartz with variable amounts of biotite, chlorite, stilpnomelane, epidote, tourmaline, Na-Fe amphiboles, grunerite, hematite and calcite. The grain size of the magnetite euhedra is quite uniform in the specimens examined, ranging from 0.02 to 0.2 mm and averaging 0.05 mm. However, in the highly metamorphosed iron formation units which can still be clearly recog-

nized in the contact zone of the Kawitos Lake batholith south of Mezhisk Lake the magnetite grains average 0.15 mm and range up to 0.5 mm in size. Quartz forms an interlocking granular mosaic and is considerably coarser than the magnetite in all rocks.

The concentration of magnetite in the magnetite-rich laminae is highly variable, from 30 to 90 percent. In most cases the concentration drops quite sharply at the contacts with the quartz-rich laminae, which are generally 2 to 3 times thicker than the magnetite-rich laminae. South of Mezhisk Lake in the Kawitos Lake batholith contact zone, however, the magnetite content is relatively uniform in all laminae, presumably because of metamorphism. In more typical examples, the central parts of quartz-rich laminae contain little magnetite (0 to 5 percent) but in others they contain up to 30 percent magnetite. The iron silicate minerals stilpnomelane and grunerite, which constitute 20 to 30 percent of some rocks, generally occur as small crystals within and close to the magnetite-rich laminae, probably forming as reaction products after original silicate and carbonate minerals which were unstable under medium-grade metamorphic conditions. Chlorite, where present, is also concentrated in the magnetite-rich laminae. The shoreline outcrop of finely interbedded oxide iron formation and fine clastic metasediment about 1.5 km west of the mouth of Ferguson Creek is unusual in this area in that the silica-rich laminae contain a high proportion of very fine grained epidote (up to 90 percent) which gives those laminae a distinct light green colour. The locality is also unusual in that the rock contains abundant black acicular crystals of crossite (an Na-Fe amphibole) up to 1 cm long. The crossite occurs in both the magnetite- and the quartz-rich laminae and is also abundant in the fine wacke interbeds, forming up to 10 percent of some. Thin lenses of jasper which also occur in this outcrop are rare in most other parts of the area.

About 1200 m south of Wottam Lake there is a unit of banded chert over 7 m thick with no clastic metasedimentary intercalations. This unit occurs in close proximity to amphibole-biotite-garnet rocks believed to be metamorphosed silicate and/or carbonate iron formation (described in a later section). The porcellaneous white laminated chert contains relatively small amounts of magnetite, chlorite and other iron silicates, and is believed to be genetically related to banded magnetite-quartz iron formation. Other, much thinner examples of this type of chemical metasediment occur north of Goss Lake and on Miminiska Peninsula.

Banded magnetite-chert and banded chert units occur in only a few localities, for the most part north of Goss Lake, within the metavolcanic sequences in this area. There, in nearly all cases, these units are close to or at the contact between the northern mafic metavolcanic sequence and the metasediments to the south. The magnetite-rich and quartz-rich laminae are very similar in all aspects to the material already described as intercalations with fine clastic metasediments. In the metavolcanic sequence the banded iron formation units are interlayered with amphibolitic rocks. Many of these amphibolite units are layered and may represent metamorphosed tuffaceous rocks but other massive units are probably thin flows. In some places the material intercalated with the iron formation units is a combination of clastic metasediments and metavolcanic amphibolite.

Siderite-Quartz (Carbonate Facies) Iron Formation

The only example of iron carbonate-bearing iron formation in the map-area occurs on the western shore of Miminiska Lake east of the north end of Howells Lake. A unit of banded, siderite chert material about 25 cm in apparent thickness occurs in a small outcrop of predominantly magnetite-quartz iron formation at this locality. This dull brown unit weathers preferentially and can easily be overlooked.

On fresh surface the rock is seen to consist of semi-continuous alternating bands from 2 to 4 mm thick of light grey, white, and light brown microcrystalline material. Petrographic examination shows that the light brown bands consist almost exclusively of very fine, even grained, granular masses of siderite with a few large scattered magnetite euhedra. Minor ankeritic dolomite was also identified in some of these bands along with quartz and micas. The light grey bands contain abundant granular quartz and large irregular patches composed of anhedral calcite crystals, sericite and small sparsely scattered siderite rhombs. Some of these bands contain very high proportions of sericite. The white bands are relatively coarse grained granular quartz, again with sparsely scattered siderite rhombs and rare patches of calcite. Relatively large detrital quartz and plagioclase grains were found scattered throughout the unit in each type of band.

Arsenopyrite wedges up to several millimetres long seem to occur within the iron carbonate-bearing unit and not within the surrounding oxide facies rocks.

Amphibole-Garnet-Biotite (Metamorphosed Carbonate and/or Silicate Facies) Iron Formation

According to Klein (1973) the metamorphism of carbonate facies iron formation under medium to high grade conditions and relatively low P_{CO_2} will result in the reaction of original carbonates and silicates with quartz from adjacent cherty laminae to produce grunerite and other amphiboles and iron-rich silicates. Under the same conditions silicate facies rocks which originally consist of complex mixtures of greenalite, minnesotaite, stilpnomelane, iron carbonates, quartz and iron oxides react to form assemblages typically containing grunerite, hornblende and garnet. Commonly the metamorphic mineral assemblages derived from the two facies are indistinguishable. (It should be noted here that the preservation of iron carbonate-chert assemblages with no apparent reaction is not necessarily indicative of low grade metamorphic conditions since such assemblages are stable at considerable temperatures where P_{CO_2} has remained high, *ibid*).

Within the map-area rocks composed largely of iron-rich silicates (see Petrochemistry, Table 5) are very common. Clearly these metamorphic rocks, which vary widely in appearance and in many aspects of their bulk chemistry, were derived from sediments which contained a high proportion of carbonate and/or silicate facies iron formation. These rocks are categorized in the map legend and described below in two groups. The first includes banded rocks, roughly analogous to banded oxide and carbonate facies rocks, which are char-

acterized by high grunerite contents. The second group of rocks are predominantly massive (i.e. non-banded) and consist of hornblende, almandine, biotite and chlorite in highly variable proportions.

Banded, grunerite-rich rocks of the first group were found in several places near Goss Lake and on the east-central part of Miminiska Peninsula and the small island to the east. In nearly all exposures these rocks occur intercalated with other types of ferruginous chemical metasediment. This is to be expected since the stability fields of the original iron silicates (greenalite, minnesotaite and stilpnomelane) overlap both the iron oxide and iron carbonate fields on Eh versus pH plots (Stanton 1972).

Near Goss Lake banded grunerite-hornblende rocks are interlayered with laminae of magnetite-quartz iron formation and with amphibole-garnet-biotite schist layers which are described later in this section. All three rock types commonly occur within a single hand specimen. On the weathered surface, the rock is dull rusty brown and no banding is visible. However, on fresh surface alternating bands of grunerite and hornblende are striking in appearance. The grunerite-rich bands, generally 2 to 10 mm thick, are honey-brown. Individual acicular crystals up to 1 mm long, aligned parallel to banding, are readily visible. The hornblende-rich bands, which are 1 to 3 mm thick, are black and generally finer grained. Irregularly spaced throughout the rock are thin magnetite-rich laminae generally less than 1 mm thick. Quartz-rich (meta-chert) laminae are rare.

The banding is also distinct in thin section. In most bands grunerite and hornblende are mutually exclusive but they occur in approximately equal proportions in a few bands and in some cases they are intimately intergrown. Quartz is a ubiquitous but sparse phase except in rare meta-chert laminae. Small magnetite euhedra are scattered throughout the grunerite- and hornblende-rich bands as well as predominating in the magnetite-rich laminae which also contain abundant chlorite and grunerite. Chlorite and stilpnomelane are relatively minor constituents and occur as fine flakes scattered throughout most thin sections.

Grunerite crystals, which occur in felted masses, are typically acicular, subhedral and very well twinned. Commonly they include small quartz and magnetite grains. The texture of the hornblende-rich bands is quite different in that the amphibole grains are ragged and commonly occur in stellate bundles or in very irregular mosaic patches. Chemically the grunerite- and hornblende-rich bands are very different (see Table 5, Analyses 67 and 68), undoubtedly reflecting original differences in bed composition.

Grunerite-rich rocks on the eastern point of Miminiska Peninsula and on the island immediately to the east also occur in close proximity to other ferruginous chemical metasediments such as hornblende-garnet iron formation and graphitic and pyritic slate. However, these rocks all occur within the mafic metavolcanic sequence near its upper contact with the overlying metasedimentary sequence. They also differ from the Goss Lake rocks in that banding is much thicker, meta-chert layers are abundant, and hornblende-rich units are uncommon. Typically the rocks on Miminiska Peninsula consist of light brown grunerite-rich layers up to several centimetres thick interlayered with creamy meta-chert units from 0.5 to 10 cm thick. In some places the rock forms a breccia with the brittle meta-chert present as large angular and tabular fragments

up to a metre long surrounded by the iron silicate-rich material. Commonly the fragments are only misaligned by a few degrees and separated by a few centimetres.

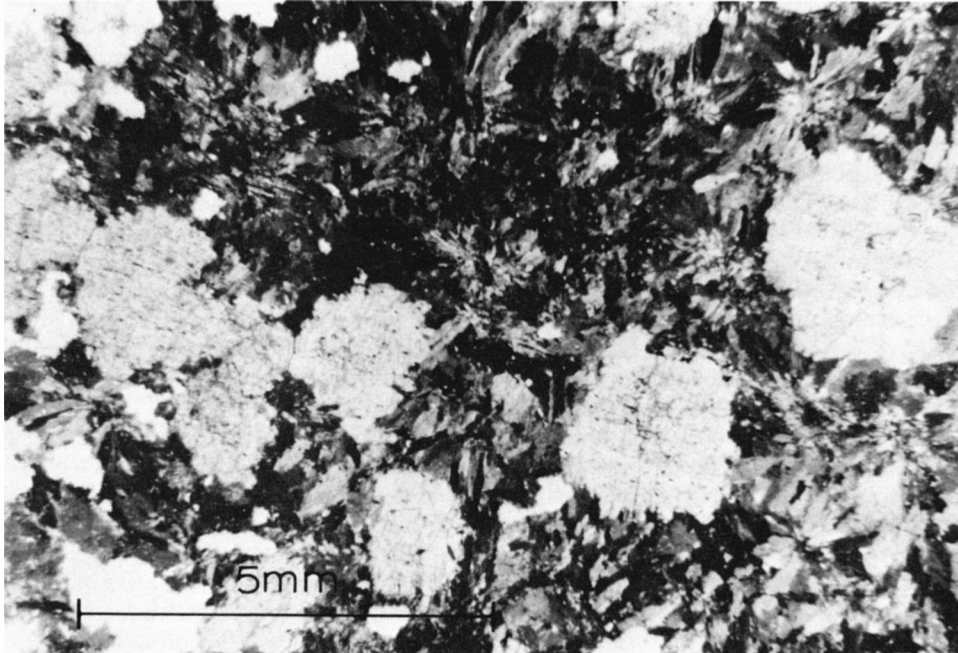
Thin section examination of the brown material, which is commonly quite soft and friable, shows that it consists of grunerite, calcite, almandine and magnetite with minor chlorite and stilpnomelane. The very fine grained grunerite forms felted masses of anhedral crystals. Euhedral garnet grains, which are up to 15 percent of some these rocks, are up to 2 mm across and are highly altered to epidote. Magnetite grains vary greatly in size and shape; some are large, anhedral and poikiloblastic, while smaller grains tend to be subhedral. Magnetite constitutes 2 to 5 percent of these rocks. Calcite, which comprises about 10 percent of some sections, occurs as large irregular patches elongate parallel to the bedding. Its presence in these rocks probably indicates an original carbonate component.

Intercalations of grunerite-cumingtonite-rich material in the magnetite-quartz iron formation units occur on islands in the eastern part of Miminiska Lake, but these are generally only several millimetres to a few centimetres thick and appear to be quite rare.

The second type of iron silicate-bearing iron formation common in the map-area is grunerite-poor, hornblende- and/or garnet-rich and generally massive. These rocks vary greatly in appearance depending mostly upon the proportions of their major phases (hornblende, almandine, quartz and biotite). In some occurrences these rocks differ little in mineralogy from amphibolite and garnet amphibolite derived from mafic metavolcanics, but in many such cases identification of the rock-type can be made from association or textural characteristics. Most, but not all, of these rocks occur within the metasedimentary sequence and in close association with readily identifiable oxide facies rocks. Commonly there are indications of relict bedding. There are small but observable differences in grain size and/or relative abundances of the major constituents between beds in some exposures. There may also be textural differences between adjacent beds, e.g. hornblende in one bed may form stellate clusters while in others feathery hornblende grains may be randomly oriented. Typically these rocks have inhomogeneous textures in contrast to metavolcanic amphibolites which generally vary little in grain size or texture within a single unit.

In several places in the Frond Lake-Wottam Lake area iron-rich rocks containing 30 to 50 percent almandine garnet form prominent domical outcrops. The garnets, which are up to 1.5 cm in diameter, are most resistant to weathering and stand out to form a very rough knobby surface. Hornblende, biotite and chlorite, which are all abundant and much finer grained than the garnets, form a crude foliation. A rather indistinct layering is commonly produced on outcrop scale by variations in the abundance of garnet in each layer. In thin section garnets and hornblende are poikiloblastic with numerous small quartz inclusions. Helicitic textures are common within the garnets which are generally subhedral but in some cases are markedly elongated.

A well-exposed outcrop of hornblende, hornblende-garnet and hornblende-biotite rocks occurs south of Wottam Lake in close proximity to a thick banded chert unit previously described under oxide facies iron formation. Several layers of ferruginous silicate rock, each about 30 cm to 2 m thick and differing in texture, mineralogy and grain size, occur over a distance of some 10 m across



OGS 10 307

Photo 12—Photomicrograph (plane light) of a garnet-amphibole rock (meta-iron formation) from the Mezisk Lake area.

strike. These layers probably represent individual beds or groups of beds but their contacts are rather indistinct and irregular.

The mineralogy of these rocks is relatively simple with amphibole (hornblende and/or actinolite), garnet (almandine), biotite and/or chlorite, quartz and magnetite as major phases occurring in very different proportions from layer to layer. In some layers acicular or feathery amphibole crystals form coarse stellate patterns. In others, large (up to 3 mm) biotite porphyroblasts are scattered throughout a schistose hornblende-quartz matrix and in a few layers hornblende- and quartz-rich streaks form a gneissic structure in the rock. Although nearly all of these rocks are black to dark green in colour with very high ferromagnesian mineral contents, one layer about 1.5 m thick is quite siliceous in appearance, containing only about 20 to 30 percent fine hornblende + biotite, the rest being coarse quartz. This probably represents a unit of original chert which because of its thickness was not transformed by reaction with original iron carbonate and/or iron silicate units in the same manner as much thinner intercalated chert units probably were.

In addition to the variation in silicate mineralogy between layers, there are obvious differences in their sulphide mineral contents. Some layers contain high proportions of arsenopyrite (up to 20 percent), while others contain predominantly pyrrhotite. The sulphide minerals are commonly concentrated in concordant semi-continuous streaks and lenses within individual layers. This

may indicate that bedding was originally finer than the present layering. The common occurrence of high proportions of arsenopyrite in these rocks and in other similar massive ferruginous silicate rocks throughout the area may point to their correlation with the arsenopyrite-bearing primary carbonate facies iron formation previously described from the western side of Miminiska Lake.

In contrast to the crudely layered rocks described above, many of the ferruginous silicate rocks are truly massive and featureless over thicknesses of several metres. The best exposed example of this is south of the metasedimentary-metavolcanic contact on the eastern side of Miminiska Peninsula and on the small island to the east. This rock consists of intergrowths of coarse hornblende and large anhedral to euhedral garnets with randomly distributed minor irregular patches of quartz-rich material. This rock type can easily be mistaken for a metavolcanic amphibolite but its coarse grain size (1 to 1.5 cm), completely massive character, and above all its chemical composition (see Table 5, Analyses 63 and 64) are indicative of its chemical sedimentary origin.

A third notable occurrence of massive ferruginous silicate metasediments was found on the large island south of Miminiska Island. At the island's eastern tip very thin units of magnetite-chert and grunerite-cummingtonite iron formation are surrounded by a sequence of massive chloritic mudstones and hornblende-biotite and hornblende-garnet rocks, all of which have high iron contents (see Table 5, Analyses 55 and 56). The hornblende and hornblende-garnet rocks exhibit the stellate amphibole texture found in other such chemical metasediments and commonly have a rusty surface. The chloritic mudstones, which are fine to very fine grained except for randomly scattered hornblende porphyroblasts up to 1 cm long, are dark green and featureless in hand specimen. In thin section these are seen to consist of little but chlorite and quartz which form a uniform mosaic texture without foliation. This rock-type appears to be the product of fine clastic sedimentation simultaneous with precipitation of iron-rich silicate and/or carbonate material which formed a cement between the quartz grains and later was metamorphosed to chlorite.

Sulphide Facies Iron Formation

A unit of sulphide facies iron formation occurs near the top of the lower metavolcanic sequence on the eastern side of Miminiska Peninsula. The unit appears to be interbedded with mafic to intermediate pyroclastic rocks and is just below the thick felsic pyroclastic unit shown on the accompanying map. The extent of the sulphide facies rock is not known but it cannot be more than 2 m thick. It consists of black, graphitic and chloritic, very fine grained slate containing narrow streaks and small ellipsoidal pods of very fine pyrrhotite and pyrite constituting no more than 5 percent of the rock. The unit is very poorly exposed and where seen was covered by a thin gossanous layer under thick moss. Pyrrhotite was also found in thin stringers in the surrounding metavolcanic rocks.

METAMORPHISM

Detailed petrographic work has confirmed the field observation that there is a distinct pattern in the changes in the metamorphic mineral assemblages in the rocks of the eastern and central parts of the area (Sharpe 1979). This pattern can be expressed in terms of zones of progressively higher metamorphic grade bounded by isograds (not necessarily isoreaction-grads; Winkler 1976) which delineate the first appearance of index minerals characteristic of each zone. These zones are outlined in Figure 2 and the mineral assemblages commonly identified in pelitic rocks from the different zones are summarized in Table 2.

The pattern of increasing metamorphic grade to the north and south of an east-trending axis of the chlorite zone could have originated in a number of ways. Perhaps the simplest explanation is that the metavolcanic-metasedimentary sequence was downwarped into the crust along an axis parallel to the chlorite zone, thus establishing similar lateral pressure-temperature gradients north and south of that axis. A second possible interpretation of the observed metamorphic pattern is that regional metamorphism predated deformation in this area (Sharpe 1979). When large scale folding occurred metamorphic zones already imprinted upon the supracrustal rocks were maintained in the sub-concordant arrangement now observed. A third possibility (Sharpe 1979) is that the metamorphic changes to the north and south of the chlorite zone are the products of two distinct metamorphic events. Sharpe proposed that a regional event could have been responsible for the northward progression of metamorphic grade north of the chlorite zone, while the southward progression may be the result of contact metamorphism around the Kawitos Lake batholith.

STRATIGRAPHY

Stratigraphic relationships between the major lithologic sequences appear to be relatively simple in the map-area. However, this simplicity may be more apparent than real when the lack of exposure, marker horizons and reliable top indicators are taken into account. Assuming that the regional structural interpretation (see Structural Geology) is correct, the following model for the stratigraphic development of the map-area in the Early Precambrian has been developed (also see Figure 3).

The first rocks deposited were the mafic metavolcanics which now occur in the southern part of Miminiska Lake and near Petawanga Lake (lower mafic volcanic sequence, Fig. 3). The lower contact of this sequence is not exposed but it has a minimum stratigraphic thickness, assuming no unknown structural complications, of 7000 to 10 000 m. For the most part this sequence is made up of basaltic pillowed flows and massive flows relatively low in vesicularity that have been intruded by numerous mafic sills. These rocks were apparently extruded during a prolonged period of quiet but continuous volcanism in relatively deep water. Near the top of this sequence, mafic, intermediate and felsic pyroclastic rocks and varieties of iron formation become volumetrically impor-

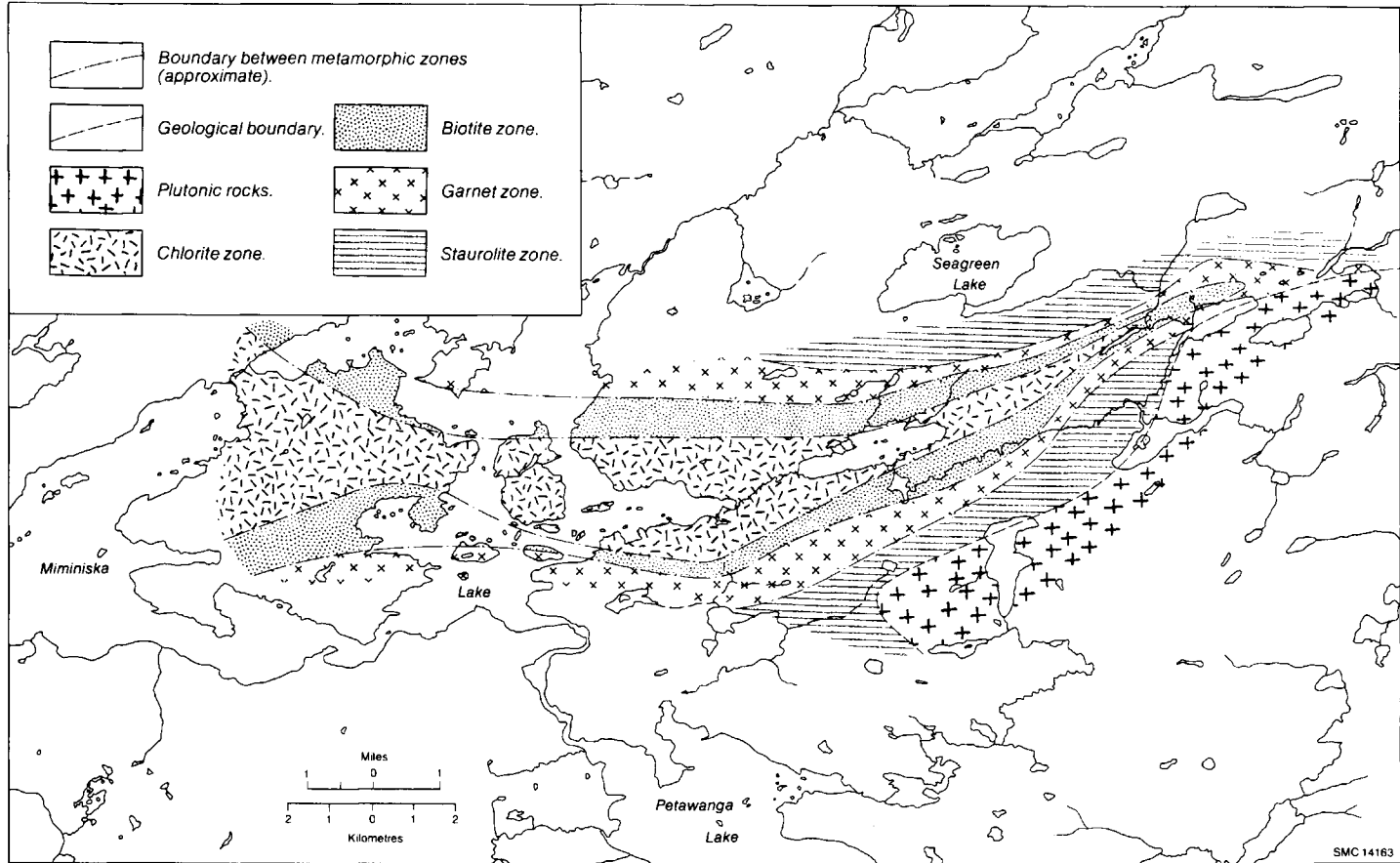


Figure 2—Map of metamorphic zones of the east-central section of the Miminiska Lake area. Modified after Sharpe (1979).

TABLE 2 | COMMON MINERAL ASSEMBLAGES IN THE METAMORPHIC ZONES OF THE MIMINISKA LAKE AREA. (MODIFIED AFTER SHARPE (1979)).

INDEX MINERAL (ZONE)	METAMORPHIC MINERAL ASSEMBLAGES IN METAPELITES IN THE MIMINISKA LAKE AREA ¹	COMPARABLE METAMORPHIC GRADE (WINKLER 1976)
<i>chlorite</i>	<i>ser + plag + chl</i>	<i>low</i>
<i>biotite</i>	<i>bio + ser + plag ± chl</i> <i>bio + chl + plag</i> <i>bio + plag ± ser</i>	<i>low</i>
<i>garnet</i>	<i>bio + ser + plag ± gt</i> <i>bio + chl + plag ± gt</i> <i>bio + plag</i> <i>chl + ser + plag ± bio ± gt²</i>	<i>(almandine) - low</i>
<i>staurolite</i>	<i>staur + bio + ser + plag ± gt ± chl</i> <i>staur + bio + plag ± ser ± gt ± chl</i> <i>staur + bio + plag ± and ± gt ± ser</i> <i>bio + plag ± gt ± chl</i> <i>bio + ser + plag + chl²</i>	<i>(almandine + andalusite) -medium</i>

Notes:

1. Quartz is present in all assemblages.
2. Chlorite in the presence of sericite at conditions above biotite grade is believed to have formed by retrograde processes.

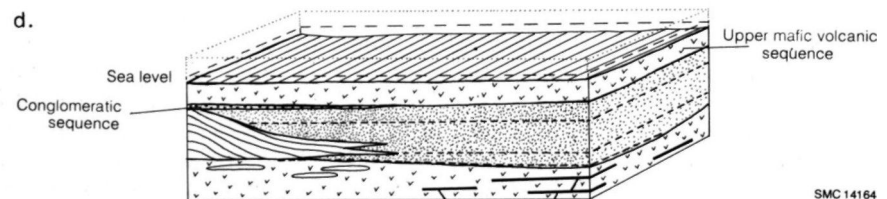
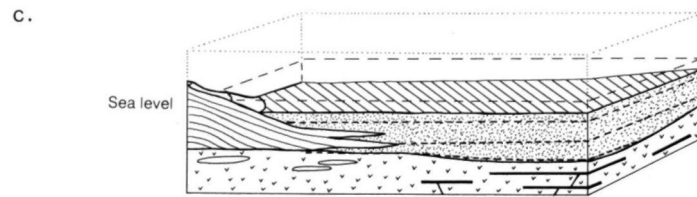
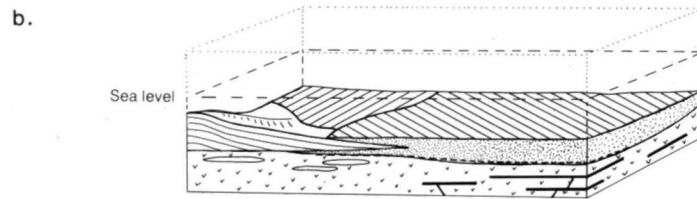
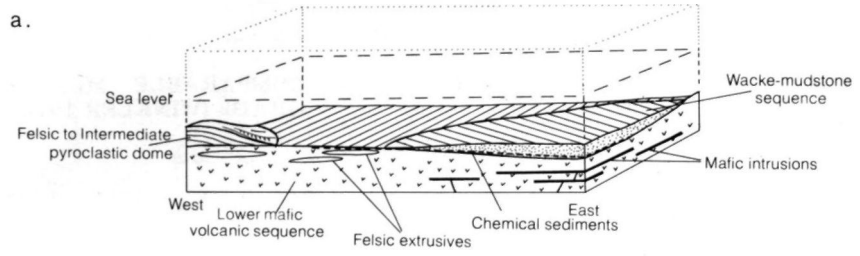
Abbreviations:

and = andalusite	gt = almandine	staur = staurolite
bio = biotite	plag = plagioclase	
chl = chlorite	ser = sericite	

tant and predominant in the west, probably indicating waning volcanic activity characterized by more sporadic, more localized, but more violent eruptive events.

Topographically this predominantly mafic platform may have been relatively high in the west and low in the east. This is suggested by the iron formation within the volcanic sequence on Miminiska Peninsula which transgresses onto the sedimentary sequence north of Miminiska Falls. Thus the clastic sediments which were conformably deposited on the volcanic pile may have overlapped the volcanics to the west. These sediments have the characteristics of medial to distal turbidites (Walker 1976), indicating deposition in quiet, relatively deep water at a considerable distance from their source. On the average, bed thickness and clast size appear to increase in this sedimentary se-

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quence from east to west, but little can be determined with certainty about the direction of sediment transport. Units of chemical sediments intercalated with the clastic rocks also indicate a quiet water depositional environment.

Explosive volcanic activity began in the west while the sediments were being deposited on the mafic volcanic sequence in the east. Felsic to intermediate pyroclastics accumulated in a local centre resting on the lower mafic metavolcanic sequence, or possibly upon a thin sedimentary veneer overlying the mafic rocks. The centre attained an estimated maximum thickness in the order of 2000 to 2500 m. Most, if not all, of this material can be assumed to have been deposited subaqueously because numerous thin mudstone intercalations, identical to the turbidite units seen elsewhere in the western part of the area, occur between pyroclastic units. Although no obvious pyroclastic rock units were recognized in the turbidite sequence in the central and eastern parts of the area, the iron formations which occur at several stratigraphic positions within that predominantly clastic sequence were probably directly derived from the volcanic centre.

Deposition of the turbidite units continued as the volcanic activity in the west waned, or more probably moved laterally, and sediments in time covered most of the pyroclastic centre. The total thickness of this distal to medial turbidite sequence as estimated from a continuous, essentially monoclinical section along the east side of Miminiska Peninsula between the lower mafic metavolcanic contact and the axial trace of the iron formation-defined fold north of Miminiska Island is approximately 4500 m.

The felsic to intermediate, predominantly pyroclastic centre in the west eventually became, at least in part, significantly subaerial and rapid erosion produced abundant volcanic detritus on its flanks. This material was probably soon redeposited by subaqueous slumping and/or turbidity currents to form a prograding submarine fan sequence (Walker 1976) consisting of conglomeratic and arenaceous rocks very rich in lithic volcanic fragments. At its thickest point, near Howells Lake, this sequence of coarse sediments consists of 350 m of massive lithic arenite units overlain by about 150 m of conglomerate, pebbly sandstone and massive lithic arenite and lithic wacke units with a few mudstone intercalations. Toward the northeast, away from the thickest part of the

Figure 3—Hypothetical development of the stratigraphy of the Miminiska Lake area.

- (a) The lower mafic volcanic sequence, which includes numerous mafic sills and several felsic units and iron formations in its upper part, is overlain by turbiditic sediments from the east and is capped by a dome of felsic to intermediate pyroclastics in the west.
- (b) The distal to medial turbidite sequence thickens and covers most of the area, interdigitating with pyroclastic rocks from the rising volcanic centre in the west.
- (c) The volcanic centre becomes subaerial and rapid erosion of the felsic to intermediate pyroclastic material occurs. The rest of the area is covered by a thick turbidite sequence interbedded in several positions with chemical sediments which are probably related to the volcanic activity in the west.
- (d) A sequence of coarse sediments derived from the eroded pyroclastic centre is deposited from high energy turbidity current action in the west while deposition of distal turbidites continues in the east. A second major mafic volcanic cycle covers the entire area with pillowed basaltic flows.

volcanic centre, this sedimentary sequence thins and grades into a sequence of granular sandstone and sandstone units, mostly lithic wackes, where mudstone intercalations are far more common. A thin succession of mudstone beds found in the Albany River section, measuring only a few metres thick, conformably overlies the conglomeratic sequence there and marks the final stage of large scale sedimentation in the area.

A second major cycle of quiet, continuous volcanic activity then began. Like the lower mafic volcanic sequence these younger volcanics consist predominantly of mafic pillowed flows. These flows, which are the youngest supracrustal rocks in this area, accumulated to a minimum thickness of 3000 m.

PETROCHEMISTRY

The study and comparison of chemical characteristics of rocks from the map-area have aided in solving several problems of rock identification and stratigraphic correlation which were evident in the field. Most samples selected for chemical analysis were single specimens believed to be representative of the units from which they were collected. In the case of fragmental rocks (e.g. pyroclastic rocks, flow breccia material, etc.) samples, where possible, were sufficiently large as to contain representative proportions of matrix and fragments which were analyzed together as a single sample. In the case of banded chemical metasediments, most analyzed samples consisted of numerous rock chips collected over a continuous strike width of 2 to 3 m. Rocks were analyzed using a variety of XRF, atomic absorption and wet chemical techniques by the Geoscience Laboratories, Ontario Geological Survey, Toronto. The results of these analyses are compiled in Tables 3, 4 and 5, and the locations from which the analyzed specimens were collected are shown in Figure 4.

Metavolcanics

Analyses of metavolcanic samples are plotted on AFM and "Jensen" plots in Figure 5. These plots both show that there is a distinct chemical difference between rocks of the upper and lower metavolcanic sequences. This reinforces the structural-stratigraphic interpretation (see Stratigraphy) that the two sequences are of different age and magmatic origin.

In both the AFM and "Jensen" plots analyses of samples from the lower volcanic sequence show a continuous calc-alkaline trend. The rocks range in composition from tholeiitic and calc-alkaline basalts to calc-alkaline andesites, dacites and rhyolites. On the other hand, the analyses of rocks from the upper volcanic sequence, northwest of Miminiska Lake, plot in a relatively restricted field in both figures. These rocks are predominantly tholeiitic basalts; no felsic or intermediate volcanic differentiates were analyzed from this sequence.

Rocks from the felsic to intermediate pyroclastic wedge around the western arm of Miminiska Lake are calc-alkaline rhyolites and those north of the mouth of Ferguson Creek range from tholeiitic to calc-alkaline rhyolite.

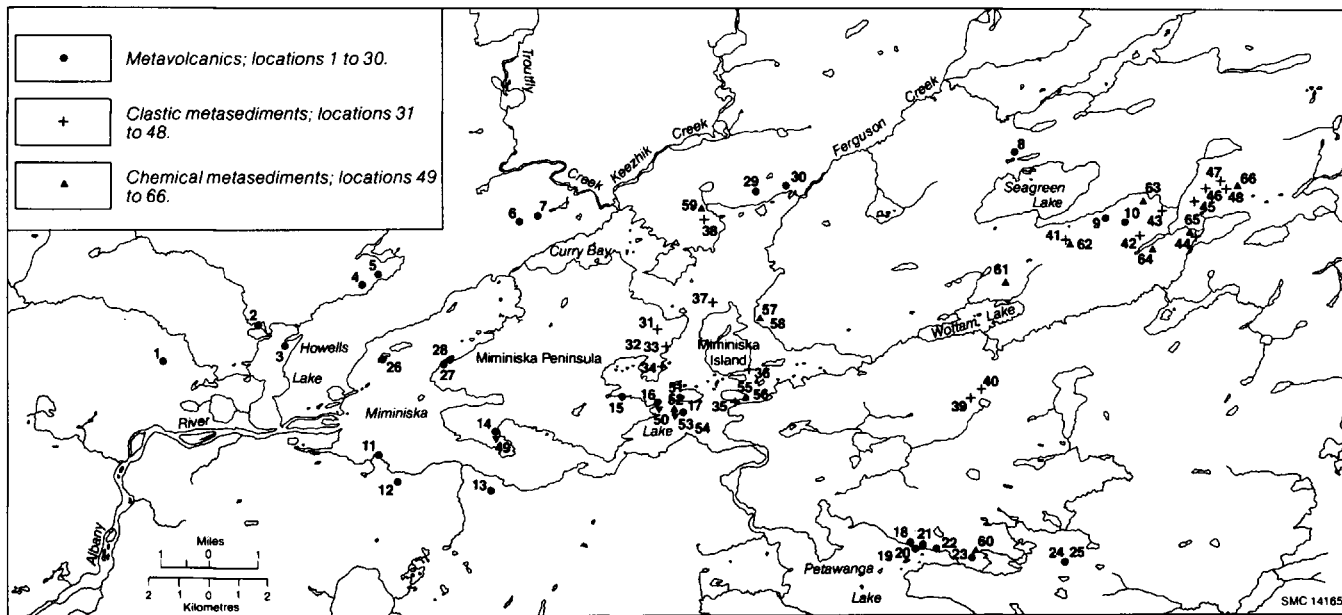


Figure 4—Sketch map of the Miminiska Lake area, showing the locations of samples collected for chemical analysis (Tables 3 to 6).

TABLE 3 | PARTIAL CHEMICAL ANALYSES OF SAMPLES OF THE METAVOLCANIC LABORATORIES, ONTARIO GEOLOGICAL SURVEY, TORONTO.

Sample ¹	1	2	3	4	5	6	7
SiO ₂	48.4 ²	54.8	45.6	48.1	46.6	55.5	53.3
Al ₂ O ₃	14.4	15.7	15.3	14.8	15.3	14.0	14.7
Fe ₂ O ₃	12.9	12.3	13.2	12.4	13.6	7.56	8.92
MgO	7.31	5.27	5.84	7.08	8.04	5.36	5.73
CaO	11.5	5.88	13.5	8.43	10.5	10.6	10.4
Na ₂ O	2.06	3.61	0.92	1.21	1.24	2.19	2.05
K ₂ O	0.07	0.24	0.04	0.00	0.01	0.27	0.29
L.O.I.	2.15	2.44	2.24	6.87	3.35	n.d. ³	n.d.
TiO ₂	0.96	0.84	0.96	1.07	1.13	0.98	0.58
P ₂ O ₅	0.07	0.09	0.63	0.08	0.08	n.d.	n.d.
MnO	0.02	0.23	0.18	0.19	0.19	0.15	0.18
Total	99.8	101.4	98.4	100.2	100.0	96.6	96.2
Sample	16	17	18	19	20	21	22
SiO ₂	63.8	59.9	77.6	62.1	76.7	54.6	68.1
Al ₂ O ₃	17.4	16.1	13.2	15.4	12.0	15.8	15.0
Fe ₂ O ₃ (total)	3.11	8.09	0.68	5.15	1.13	9.50	5.32
MgO	1.44	3.06	0.13	1.28	0.30	4.17	0.64
CaO	4.77	5.52	1.49	11.7	1.86	8.73	2.90
Na ₂ O	4.45	3.61	3.34	0.57	1.40	2.78	3.45
K ₂ O	1.28	1.30	2.94	0.07	4.63	1.16	2.75
L.O.I.	n.d.	0.55	n.d.	n.d.	n.d.	n.d.	n.d.
TiO ₂	0.87	0.80	0.22	1.72	0.22	1.62	0.88
P ₂ O ₅	n.d.	0.14	n.d.	n.d.	n.d.	n.d.	n.d.
MnO	0.06	0.13	0.04	0.09	0.04	0.14	0.09
Total	97.2	99.2	99.6	98.1	98.3	98.5	99.1

Notes:

1. Sample locations are shown on Figure 4.
2. Analyses are given in oxide weight percent.
3. n.d. = not determined.

Rock types:

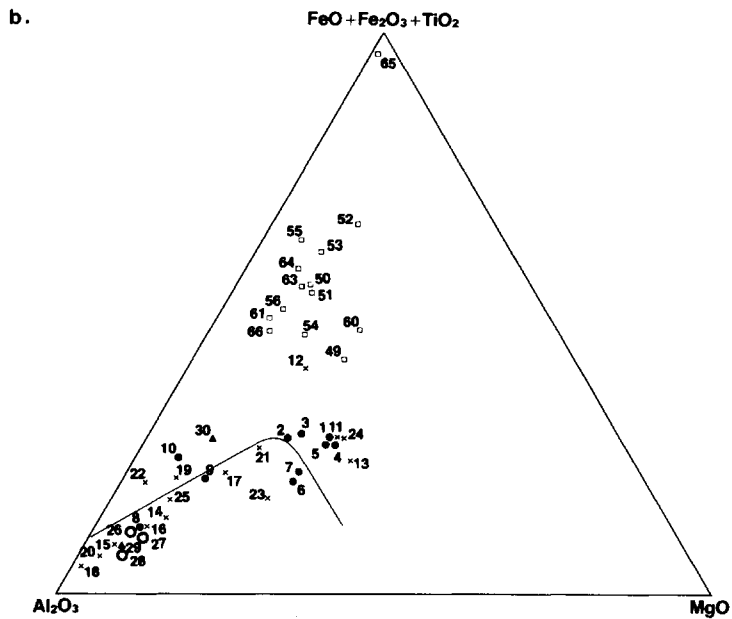
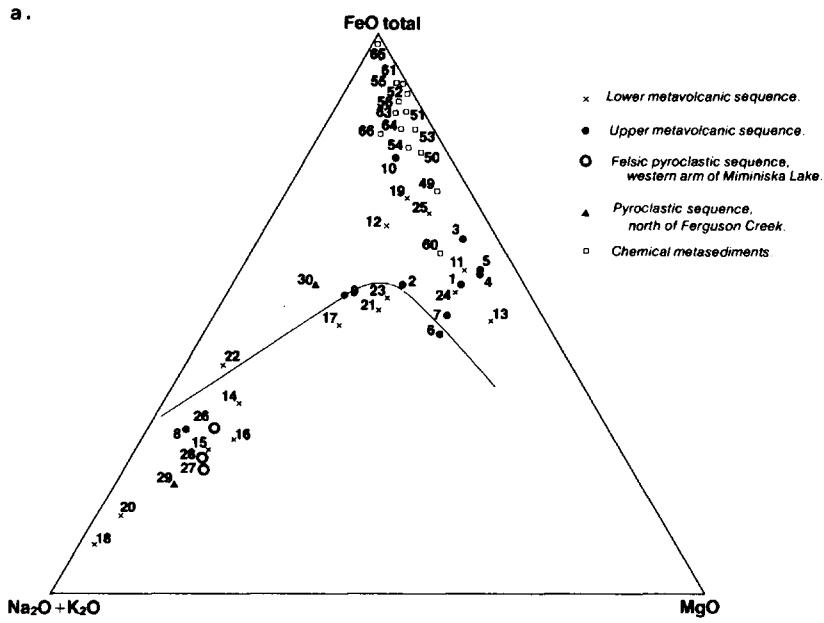
- | | |
|------------------------|-------------------------|
| 1. Mafic pillowed flow | 8. Felsic lapilli-tuff |
| 2. Mafic tuff | 9. Layered amphibolite |
| 3. Mafic pillowed flow | 10. Chert |
| 4. Mafic pillowed flow | 11. Mafic pillowed flow |
| 5. Mafic massive flow | 12. Mafic amphibolite |
| 6. Mafic pillowed flow | 13. Mafic pillowed flow |
| 7. Mafic pillowed flow | 14. Intermediate tuff |

ROCKS OF THE MIMINISKA LAKE AREA, ANALYSES DONE BY THE GEOSCIENCE

8	9	10	11	12	13	14	15
69.4	55.6	83.9	47.2	51.3	48.3	67.9	67.2
15.0	18.5	5.21	14.5	12.9	15.0	15.8	17.8
2.93	8.33	2.14	14.0	17.5	12.0	3.91	2.32
0.70	2.72	0.36	7.83	4.41	9.24	1.68	0.75
4.27	8.38	4.68	11.6	8.46	12.8	3.84	3.88
4.15	2.83	0.19	1.63	3.45	1.62	3.63	3.88
1.21	0.70	0.07	0.08	0.21	0.09	1.65	1.16
2.23	n.d.	n.d.	1.87	0.32	0.51	1.43	n.d.
0.43	1.54	0.34	0.82	1.39	0.63	0.48	0.66
0.13	n.d.	n.d.	0.06	0.08	0.07	0.14	n.d.
0.06	0.18	0.15	0.21	0.27	0.22	0.08	0.03
100.5	98.8	97.0	99.8	100.3	100.5	100.5	97.7
23	24	25	26	27	28	29	30
57.4	47.7	63.1	66.3	69.7	63.9	70.7	69.4
15.9	14.6	15.5	15.3	14.6	21.6	15.1	11.9
8.84	13.5	4.96	2.79	2.45	2.55	1.86	6.84
3.66	8.10	1.53	0.88	1.05	1.13	0.75	1.48
7.89	11.2	12.2	4.69	3.01	2.04	2.45	1.70
2.34	2.22	0.40	4.22	4.28	4.02	3.48	2.54
1.00	0.22	0.13	0.89	1.40	2.53	2.34	1.01
0.95	0.55	1.43	4.55	3.15	2.63	n.d.	n.d.
1.08	0.71	0.59	0.32	0.36	0.45	0.25	1.26
0.20	0.07	0.08	0.06	0.09	0.19	n.d.	n.d.
0.15	0.21	0.08	0.08	0.05	0.02	0.05	0.06
99.4	99.1	100.0	100.1	100.1	101.1	97.0	96.2

- 15. Intermediate lapilli-tuff
- 16. Intermediate tuff
- 17. Intermediate lapillistone
- 18. Felsic tuff
- 19. Intermediate pillowed flow
- 20. "Felsic domain" in matrix of 19
- 21. Mafic tuff
- 22. Felsic tuff

- 23. Mafic pillowed flow
- 24. Mafic pillowed flow
- 25. "Felsic domain" in matrix of 24
- 26. Felsic crystal tuff
- 27. Felsic lapilli tuff
- 28. Intermediate lapilli-tuff
- 29. Felsic tuff
- 30. Felsic crystal tuff



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Figure 5—AFM and "Jensen Cation" plots of the analysed samples of metavolcanic and metasedimentary rocks of the Miminiska Lake area.
 (a) AFM plot (oxide weight percent).
 (b) "Jensen Cation" plot (cation percent).

Pillowed flows containing pillows with felsic domains tend to be andesitic in composition; the cores vary from dacitic to rhyolitic. All other pillowed flows analyzed are basaltic.

Clastic Metasediments

A variety of clastic metasediments, from low to medium metamorphic grade, were analyzed to assist in the interpretation of the variation in metamorphic paragenesis in rocks from the map-area. Analyses of these rocks are listed in Table 4.

Chemical Metasediments

Most of the chemical metasediments analyzed were essentially silicate rocks consisting of hornblende + quartz + almandine + biotite. As has been discussed in previous sections, these rocks in many cases are difficult to distinguish from garnetiferous amphibolites of mafic volcanic origin but the chemical characteristics of these rocks are very different. The analyses listed in Table 5 show that the metasediments vary widely in their chemical composition, but in all cases the iron content is considerably higher than that of a mafic volcanic rock. This marked discrepancy in chemistry can be seen clearly in Figure 5 where the chemical metasediments plot in fields quite distinct from the meta-volcanic suites. The wide variation in the bulk chemistry of the chemical metasediments is a reflection of the highly variable proportions of original iron carbonate-rich or iron silicate laminae, chert laminae, and clastic sedimentary units which reacted to produce relatively homogeneous rocks. Similarly the three analyses of banded magnetite-quartz iron formation (Table 5, Analyses 57, 58 and 59) show considerable variation because of different proportions of magnetite-rich laminae, chert laminae and intercalated mudstone units in each sample. The banded grunerite-hornblende rock (Table 5, Analysis 65) is particularly rich in iron; in fact, the analysis is comparable to analyses of pure grunerite (Table 5, Analysis 67).

Table 6 gives the results of magnetic concentration of three magnetite-quartz iron formation samples using the Davis Tube method. The tests were done to determine the concentratability of these potential iron ores with decrease in particle size (i.e. increase in grinding time). The results indicate that the grade of concentrate increases markedly in all cases with decrease in particle size because more complete separation of fine grained magnetite and silicate material is possible. Finer grinding would probably further increase the grade of concentrate obtained with a slight additional loss in the percentage of iron recovered. From Table 5, Analyses 57, 58 and 59, it is apparent that phosphorus and sulphur contents of these rocks are low. The titanium contents of samples 57 and 59 are low and decrease with magnetic concentration. However, in sample 58 titanium actually increases with magnetic concentration indicating that it is intimately associated with magnetite in that rock.

TABLE 4 | CHEMICAL ANALYSES OF SAMPLES OF THE CLASTIC
DONE BY THE GEOSCIENCE LABORATORIES, ONTARIO

Sample ¹	31	32	33	34	35	36	37	38
SiO ₂	68.7 ²	66.1	53.8	64.5	59.8	66.5	52.4	59.2
Al ₂ O ₃	17.1	17.4	24.1	16.8	22.6	17.4	25.4	18.0
Fe ₂ O ₃	0.73	1.74	2.57	0.55	1.51	0.67	2.89	3.59
FeO	3.38	3.86	5.54	3.94	3.24	4.93	4.66	6.13
MgO	1.37	2.24	3.22	1.85	1.27	1.68	3.07	2.00
CaO	0.25	1.46	1.57	3.59	1.20	1.42	1.17	0.10
Na ₂ O	3.13	3.24	2.67	2.86	1.67	1.89	1.89	5.26
K ₂ O	1.74	1.28	2.94	1.45	3.60	1.93	3.81	1.86
H ₂ O ⁺	2.05	1.57	3.16	1.87	2.67	2.61	3.37	1.69
H ₂ O ⁻	0.52	0.63	0.52	0.24	0.35	0.56	0.68	0.44
CO ₂	0.15	0.14	0.14	1.75	0.24	0.12	0.16	0.11
TiO ₂	0.80	0.67	0.89	1.11	1.19	0.71	0.87	1.16
P ₂ O ₅	0.17	0.11	0.11	0.14	0.14	0.05	0.11	0.14
S	0.00	0.04	0.10	0.13	0.02	0.10	0.07	0.02
MnO	0.06	0.06	0.09	0.10	0.05	0.07	0.08	0.05
Total	100.2	100.5	101.4	100.9	99.6	100.6	100.6	99.8

Notes:

1. Sample locations are shown on Figure 4.
2. Analyses are given in oxide weight percent.

Rock types:

- | | |
|------------------|------------------|
| 31. Lithic wacke | 35. Slate |
| 32. Lithic wacke | 36. Slate |
| 33. Slate | 37. Slate |
| 34. Lithic wacke | 38. Lithic wacke |
| | 39. Lithic wacke |

EARLY MAFIC INTRUSIVE ROCKS

Mafic intrusive bodies, mostly sills, are very common within the metavolcanic sequences particularly north and east of Petawanga Lake and south of Miminiska Lake. They appear to be penecontemporaneous with the flows they intrude and commonly cannot be distinguished from thick, massive coarse grained flows in outcrop or thin section. Except along the shore of Petawanga Lake, intrusive contacts are rarely exposed. Inland it is very difficult to locate and trace contacts between concordant metagabbroic intrusions and surrounding mafic metavolcanics, and it is probable that many smaller sills were missed during mapping.

METASEDIMENTARY ROCKS OF THE MIMINISKA LAKE AREA. ANALYSES
GEOLOGICAL SURVEY, TORONTO.

39	40	41	42	43	44	45	46	47	48
65.6	61.5	63.4	58.9	63.4	56.0	56.9	61.5	55.8	59.0
18.1	22.0	15.0	17.7	18.8	18.0	16.5	19.2	22.2	17.9
2.41	1.90	3.21	0.91	2.33	1.33	5.71	3.77	2.67	2.78
3.06	2.25	5.42	8.45	4.50	9.15	12.5	5.17	5.17	7.58
1.29	1.11	1.63	2.00	1.79	2.20	2.63	2.56	3.01	2.51
2.41	3.91	1.70	2.30	1.43	3.17	2.03	1.65	0.82	1.94
4.26	2.02	3.02	1.64	2.08	1.32	1.54	2.13	1.70	3.80
1.47	1.71	2.22	3.64	2.18	4.63	1.78	2.27	3.23	2.72
0.39	1.45	1.14	1.54	0.85	1.49	0.84	0.98	3.28	0.93
0.71	0.49	0.42	0.37	0.29	0.47	0.42	0.58	0.48	0.28
0.17	0.11	0.09	0.10	0.13	0.12	0.19	0.20	0.14	0.11
0.62	1.37	1.21	1.02	1.32	0.92	0.53	0.68	0.82	0.57
0.09	0.14	0.10	0.14	0.17	0.19	0.17	0.11	0.09	0.14
0.09	0.05	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02
0.11	0.07	0.04	0.07	0.07	0.10	0.05	0.05	0.07	0.02
100.8	100.1	98.6	98.8	99.4	99.1	101.8	100.9	99.5	100.3

- | | |
|--|--|
| <p>40. Staurolite-biotite schist
 41. Staurolite-biotite-garnet schist
 42. Biotite schist
 43. Staurolite-biotite schist
 44. Garnet-biotite schist</p> | <p>45. Garnet-biotite-chlorite schist
 46. Staurolite-garnet schist
 47. Biotite-chlorite schist
 48. Garnet-biotite-chlorite schist</p> |
|--|--|

The mafic sills are up to 300 m thick and examples over 80 m thick are common near Gumuly and Petawanga Lakes. Smaller sills are abundant south of Miminiska Lake, and in the northern metavolcanic sequence between Howells Lake and Keezhik Creek. The rocks typically weather dark green and generally appear massive and even textured. Jointing is not well developed in most cases.

In hand specimen the mafic intrusive rocks range in texture from well preserved metadiabasic, with hornblende replacing original augite, to highly schistose; most recognizable examples of sills are more similar to the former. Grain size varies up to one centimetre for hornblende crystals in the sills near Petawanga Lake and within the large sill which crosses Curry Bay. An increase in grain size inward from both contacts is noticeable within most of the thicker sills.

TABLE 5 | CHEMICAL ANALYSES OF SAMPLES OF THE CHEMICAL DONE BY THE GEOSCIENCE LABORATORIES, ONTARIO

Sample ¹	49	50	51	52	53
SiO ₂	43.7 ²	50.3	42.3	37.6	43.5
Al ₂ O ₃	13.0	12.3	12.4	8.6	12.5
Fe ₂ O ₃ (total)	23.3	20.9	29.7	41.1	28.1
Fe (total)	16.3	14.6	20.8	28.8	19.7
MgO	6.8	4.00	3.37	4.30	4.40
CaO	7.48	8.30	8.30	5.90	7.40
Na ₂ O	1.00	0.63	0.79	0.12	0.81
K ₂ O	0.53	0.33	0.23	0.02	0.24
H ₂ O ⁺	n.d. ³	n.d.	n.d.	n.d.	n.d.
H ₂ O ⁻	n.d.	n.d.	n.d.	n.d.	n.d.
CO ₂	n.d.	0.55	n.d.	n.d.	0.21
L.O.I.	1.79	n.d.	n.d.	2.99	n.d.
TiO ₂	0.73	0.60	0.64	0.35	0.50
P ₂ O ₅	0.12	n.d.	0.13	n.d.	n.d.
S	n.d.	n.d.	n.d.	n.d.	n.d.
MnO	0.70	n.d.	0.45	1.56	n.d.
Total	99.2	97.9	98.3	102.5	97.7
Sample	59	60	61	62	63
SiO ₂	40.0	35.9	55.7	59.1	45.7
Al ₂ O ₃	4.1	20.4	13.5	13.8	14.4
Fe ₂ O ₃ (total)	50.3	18.5	23.2	17.5	23.7
Fe (total)	35.2	12.9	16.2	12.2	16.6
MgO	1.10	7.92	1.89	2.00	3.90
CaO	0.70	8.29	1.30	1.78	10.6
Na ₂ O	n.d.	1.15	0.11	2.21	0.90
K ₂ O	n.d.	1.59	0.05	1.93	0.33
H ₂ O ⁺	n.d.	n.d.	4.08	0.82	n.d.
H ₂ O ⁻	n.d.	n.d.	0.40	0.47	n.d.
CO ₂	n.d.	n.d.	0.18	0.11	0.20
L.O.I.	0.80	3.67	n.d.	n.d.	n.d.
TiO ₂	0.15	2.19	0.91	1.10	0.70
P ₂ O ₅	0.15	0.10	0.25	0.11	n.d.
S	0.05	n.d.	0.02	0.01	n.d.
MnO	0.04	0.21	0.23	0.10	n.d.
Total	97.4	99.9	101.8	101.0	100.4

Notes:

1. Sample locations are shown on Figure 4. Samples 67 and 68 are representative analyses from Deer et al. (1963, p.239 and 277)
2. Analyses are given in oxide weight percent.
3. n.d. = not determined.

Rock types:

- | | |
|---|--|
| 49. Garnet-amphibole meta-iron formation | 54. Garnet-amphibole meta-iron formation |
| 50. Garnet-amphibole meta-iron formation | 55. Amphibole-biotite meta-iron formation |
| 51. Garnet-amphibole-chlorite meta-iron formation | 56. Chlorite-amphibole meta-iron formation |
| 52. Garnet-amphibole-biotite meta-iron formation | 57. Magnetite-quartz meta-iron formation |
| 53. Garnet-amphibole meta-iron formation | 58. Magnetite-quartz meta-iron formation |

**METASEDIMENTARY ROCKS OF THE MININISKA LAKE AREA. ANALYSES
GEOLOGICAL SURVEY, TORONTO.**

54	55	56	57	58
50.2	59.0	58.8	53.3	53.0
12.1	10.3	11.4	11.1	12.0
21.3	22.5	21.8	27.7	26.5
14.9	15.8	15.3	19.4	18.5
3.68	1.90	2.08	1.90	2.30
8.84	0.80	1.60	1.00	2.20
1.03	0.10	0.45	n.d.	n.d.
0.31	0.08	0.07	n.d.	n.d.
n.d.	n.d.	n.d.	n.d.	n.d.
n.d.	n.d.	n.d.	n.d.	n.d.
n.d.	0.13	n.d.	n.d.	n.d.
0.47	n.d.	2.99	2.71	1.81
0.53	0.45	0.48	0.45	0.45
0.14	n.d.	0.19	0.15	0.17
n.d.	n.d.	n.d.	0.04	0.08
0.30	n.d.	0.10	0.04	0.07
98.9	95.3	100.0	98.4	98.6
64	65	66	67	68
36.3	44.6	39.4	47.54	50.08
17.0	1.30	18.8	0.20	9.42
30.6	46.0	29.4	0.71	1.14
21.4	32.9	20.6	47.25	6.89
4.00	0.20	2.88	0.04	16.00
5.60	4.90	4.29	0.00	12.53
0.36	0.10	0.19	0.29	1.09
1.21	0.08	2.55	0.11	0.21
n.d.	n.d.	1.27	1.55	1.49
n.d.	n.d.	0.29	n.d.	n.d.
0.22	0.15	0.28	n.d.	n.d.
n.d.	n.d.	n.d.	n.d.	n.d.
0.50	0.10	1.32	n.d.	0.36
n.d.	n.d.	0.57	n.d.	n.d.
n.d.	n.d.	0.02	n.d.	n.d.
n.d.	n.d.	0.16	2.14	0.33
95.8	97.4	101.4	99.84	99.54

- 59. Magnetite-quartz meta-iron formation
- 60. Garnet-amphibole meta-iron formation
- 61. Garnet-biotite-chlorite meta-iron formation
- 62. Garnet-biotite meta-iron formation
- 63. Garnet-amphibole meta-iron formation

- 64. Garnet-amphibole meta-iron formation
- 65. Grunerite-hornblende meta-iron formation
- 66. Garnet-biotite meta-iron formation
- 67. Grunerite
- 68. Hornblende

TABLE 6 | DAVIS TUBE TEST RESULTS FOR THREE SAMPLES OF MAGNETITE-QUARTZ IRON FORMATION OF THE MIMINISKA LAKE AREA. ANALYSES DONE BY THE GEOSCIENCE LABORATORIES, ONTARIO GEOLOGICAL SURVEY, TORONTO.

Sample ¹	Concentrate Recovered (percent of initial sample)	Soluble Iron Units in Initial Sample	Soluble Iron Units in Concentrate	Total Recovery of Iron by Davis Tube (percent of initial sample)	Grade of Concentrate	Titanium Content (weight percent)
57						
-100 mesh	25.7	18.9	14.6	77.2	56.8	0.11
-200 mesh	23.2	18.9	14.1	74.2	60.6	0.10
58						
-100 mesh	29.1	14.6	10.1	69.2	34.8	0.93
-200 mesh	22.7	14.6	9.9	67.8	43.6	1.10
59						
-100 mesh	68.2	33.2	33.0	99.4	48.4	<0.05
-200 mesh	50.2	33.2	32.0	96.4	63.8	<0.05

Notes:

1. Sample locations are shown on Figure 4 and chemical analyses of the samples are given in Table 5.

Invariably primary pyroxenes have been completely altered to hornblende, actinolite and/or chlorite. Plagioclase in thin sections from the sills north of Petawanga Lake and those south of Miminiska Lake is andesine-labradorite and is not appreciably altered. However, in the intrusions in the northern metavolcanic sequence and in the Curry Bay sill, plagioclase is extensively saussuritized albite. Magnetite and leucoxene aggregates have replaced original titaniferous magnetite grains in most thin sections. Tourmaline and apatite are common accessory minerals, and secondary quartz and carbonate minerals are ubiquitous.

Textures in some thin sections appear to have been directly derived from the original diabasic or ophitic pyroxene-plagioclase intergrowths. Hornblende is crudely pseudomorphous after pyroxene, and altered plagioclase grains or granular aggregates of plagioclase and quartz have retained the subhedral lath shapes of original feldspars. In many cases, however, the hornblende forms a felted mass of large and small acicular crystals which dominate the rock with interstitial granular or irregular shaped plagioclase and quartz grains.

These mafic intrusive rocks almost certainly represent a number of different ages. Prest (1939) related the Curry Bay sill to mafic rocks north of the eastern arm of Keezhik Lake, inferring that these were post-tectonically emplaced and probably considerably younger than the synvolcanic mafic intrusions mentioned above. This indeed may be the case, since some faults which offset metavolcanic-metasedimentary contacts in the Curry Bay area do not appear to affect the metagabbro body. The same relationship may be true of the metagabbro dike which cuts the felsic to intermediate metavolcanic sequence near the northwestern shore of Miminiska Peninsula.

Metadiorite dikes and sills consisting of subhedral hornblende grains and pink-weathering, highly sericitized plagioclase laths occur north of Goss Lake intruding the mafic metavolcanics, but they appear to be relatively rare.

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Portions of three major felsic to intermediate intrusions underlie the northwestern, northeastern and southeastern corners of the map-area. These intrusions and minor dikes and sills of quartz-feldspar porphyry, feldspar porphyry and pegmatite are described separately below. Classification of rock-types in this part of the report follows Ayres (1972).

Troutfly Lake Batholith

Only one small outcrop of this body was found within the northwest corner of the map-area, but the contact can be outlined fairly accurately by its aeromagnetic signature (ODM-GSC 1960a). Aeromagnetic relief over the batholith is very low in contrast to marked relief patterns over surrounding metavolcanics.

The one outcrop examined consists of massive pink biotite quartz monzon-

ite to granodiorite. Thin section analysis showed that the rock contains only 3 to 5 percent biotite and epidote, and exhibits a well preserved, non-foliated igneous texture. This may not be representative of the whole intrusion, however, since this exposure is probably within 150 m of the metavolcanic contact. Somewhat better exposure exists northwest of the map-area near Troutfly Lake, where the rocks have been mapped as massive biotite granite (Thurston and Carter 1970).

Cluff Lake Stock

This intrusion in the northeast corner of the map-area is also very poorly exposed but, like the Troutfly Lake batholith, its contacts are clearly outlined by sharp discontinuities between the aeromagnetic patterns over the body and those over the surrounding rocks (ODM-GSC 1960b). Most of this sub-circular stock lies northeast of the map-area where it has been mapped as massive porphyritic biotite and hornblende-biotite quartz monzonite and granodiorite (Wallace 1976a).

Approximately 5 km northeast of the Lilypad Lakes where the contact of the intrusion with the mafic metavolcanics is exposed (Wallace 1976a), a hybrid zone about 20 m thick was found consisting of porphyritic quartz dioritic and trondhjemitic phases.

The massive character of the intrusive phases, the shape of the stock, and its strongly discordant position in the highly folded country rocks suggest that this body was emplaced post-tectonically.

Kawitos Lake Batholith

This batholith occupies the southeastern corner of the map-area, but its size and shape are poorly defined because of its broad, gradational contact with the metasediments to the north. Most of the body within the map-area forms part of this contact zone, which consists of quartz monzonites interleaved with and/or including metasedimentary rocks. The proportion of metasediments to granitoid rocks varies with proximity to the contact. Toward the intrusion, fewer metasedimentary schist bands are recognizable and toward the supracrustal sequence, the pegmatitic and granitic layers are thinner and less numerous. Individual layers of refractory metasedimentary material, notably iron formation, were found in the pluton up to 3 km south of the gradational contact with the metasediments. Migmatitic and lit-par-lit paragneiss with intimate intermixing of paleosome and neosome on a small scale are generally restricted to the area within two hundred metres of the contact.

The metasedimentary schists weather dull grey and generally occur in sharp contact with the surrounding granitoid rocks, suggesting an intrusive rather than a metasomatic origin for the granitoids. Where the metasedimentary inclusions comprise greater than 10 percent of the rock, they are shown separately on the accompanying map. In many cases these schist units are con-

tinuous for several tens to hundreds of metres along strike with only minor disruptions, injections of granitoid material, or variation in thickness. Known iron formation beds or groups of beds can be traced on aeromagnetic maps for several kilometres and aeromagnetic patterns over these units can be used to infer structural detail within the batholith. These metasedimentary inclusions have textures and mineralogy similar to those of the schists described previously. Most units are coarse grained quartz-feldspar-biotite (\pm sericite \pm amphibole) schists. Almandine garnet is common in many of the schists but staurolite is relatively rare. Foliation is strong in many examples but units exhibiting granoblastic texture are also common.

Granitoid and pegmatoid rocks in this batholith are generally gradational into one another. Sharp contacts around pegmatoid pods and dikes of all sizes are rare. The rocks are massive, leucocratic, non-foliated to weakly foliated and generally have well developed igneous textures. The finer grained rock has an average grain size of 2 to 4 mm and in thin section can be seen to be a mosaic of anhedral quartz (20 to 30 percent), oligoclase (25 to 35 percent) and microcline (20 to 30 percent) and 5 to 10 percent ferromagnesian minerals, mostly biotite and chlorite with minor muscovite. This mosaic is surrounded by a fine grained quartzofeldspathic mortar. Fine myrmekitic intergrowths of quartz and feldspar are also common. Alteration of feldspars appears slight in most samples.

Some pegmatite zones in the batholith contain little other than subhedral to anhedral quartz, microcline and sodic plagioclase, but others contain 10 to 20 percent of coarse, randomly oriented, white mica and biotite. Small red almandine garnet euhedra form up to 1 percent of the rock in some localities. Black prismatic tourmaline crystals up to 20 cm long are common, forming up to 30 percent in small pockets while other nearby pegmatoid bodies are tourmaline-free. The relative proportions of medium grained and pegmatitic material vary widely. Both appear to intrude the metasedimentary schist units and typically the pegmatitic phases appear to be intrusive into the finer granitoid rocks.

Quartz-Feldspar Porphyry and Feldspar Porphyry

Dikelets of these rock-types are common throughout the area, but intrusions of mappable dimensions are uncommon except in the areas north of the Lilypad Lakes and east of the Albany River north of Snake Falls. In many cases it is not possible to distinguish between extrusive and intrusive units of these rocks. Some bodies mapped as felsic flows may be intrusions and vice versa.

At least three similar quartz-feldspar porphyry sills between 60 and 120 m thick occur north of the Lilypad Lakes. The rocks weather pink to light grey but on the fresh surface they are medium grey. The sills can be distinguished from nearby felsic metavolcanics by their massive character and by their large blue opalescent quartz phenocrysts. Pink and white plagioclase phenocrysts are typically smaller than the quartz eyes, but are far more numerous, forming 10 to 20 percent of the rock. Microcline phenocrysts are small and relatively rare. The quartzofeldspathic matrix is very fine grained with muscovite defining a weak foliation. These rocks are probably equivalent in composition to rhyodacite or dacite. Biotite flakes are randomly oriented and quartz pheno-

crysts are subrounded in the eastern part of the sills but toward the west, biotite is distinctly aligned and quartz eyes are lensoid. Scattered pyrite is also common in the western parts of the sills.

The largest intrusive quartz-feldspar porphyry body in the western part of the map-area occurs about one kilometre south of the bend in the Albany River west of Howells Lake. No contacts are exposed but the massive, uniform character of the body suggests an intrusive origin. In outcrop and in thin section the rock is quite similar to the Lilypad Lakes porphyries. Ovoid aggregates of granular quartz are up to 5 mm in diameter. Subhedral plagioclase (oligoclase) and microcline form a seriate texture with grains from phenocrysts up to 4 mm long down to microlites in the quartzofeldspathic matrix. Scattered fine grained chlorite and epidote clusters form about 15 percent of the groundmass.

Plagioclase phenocrysts in the small quartz-feldspar porphyry sills near the Albany River north of Snake Falls are commonly altered to epidote or chlorite-carbonate aggregates. The textures of these smaller intrusions are very similar to those in the large sill and they are rhyodacitic to dacitic in composition (Thurston and Carter 1970, p.12, analysis 5).

On the peninsula in the northeastern corner of Howells Lake there is a white-weathering rhyodacitic quartz-feldspar porphyry sill approximately 12 m thick. The rock consists of large subangular quartz phenocrysts constituting about 10 percent by volume and much more numerous plagioclase (oligoclase) crystals occurring as individual phenocrysts and glomeroporphyritic clusters totalling 40 to 50 percent. As in many of these rocks the fine quartzofeldspathic matrix has a weak sericitic foliation. Sphene and magnetite are the only common accessory minerals.

A number of small sills and dikes of felsic to intermediate composition occur in the mafic metavolcanics between Howells Lake and Troutfly Creek. Many of these contain a few quartz phenocrysts. They consist of 20 to 30 percent sericitized or saussuritized subhedral to euhedral plagioclase and microcline perthite phenocrysts scattered in a very fine grained, even-textured quartzofeldspathic matrix which contains variable amounts of biotite and/or chlorite and epidote. The composition of these rocks seems similar to that of quartz latite.

Pegmatite

Intrusions of simple pegmatite consisting of quartz, albite, microcline and variable amounts of muscovite and tourmaline form a significant portion of the contact zone north of the Kawitos Lake batholith. The proportion and average size of pegmatite injections in the metasedimentary sequence decrease northward away from the batholith. A few small dikes, generally less than 1 m wide and varying widely in orientation, occur as far north as the metavolcanic-metasedimentary contact between Seagreen Lake and the Lilypad Lakes.

By far the most notable pegmatite bodies are lithium-bearing dikes which intrude mafic metavolcanics north of the Lilypad Lakes. Several of these exotic pegmatite dikes, which are up to 12 m wide, have been found in two localities. One is north of the westernmost of the Lilypad Lakes, and the other is just out-

side the map-area (Wallace 1976a). As well as quartz, albite, microcline and white mica, these pegmatites contain variable amounts of spodumene, lepidolite, pink and purple tourmaline, amblygonite, scheelite, pollucite and beryl. The pale green spodumene, which forms crystals up to 45 cm long and 15 cm wide, is commonly intergrown with microcline, and in some dikes constitutes as much as 40 percent of the rock. Single spodumene crystals span the entire width of small intrusions.

Pink and lavender lepidolite occur as masses of fine flakes typically in association with spodumene or tourmaline. The tourmaline, which in thin section can be seen to be partially altered to lepidolite and white mica, was found in several dikes in only small quantities, but one spectacular occurrence is located about 1200 m north of the easternmost of the Lilypad Lakes immediately outside the map-area. In a dike about 7 m wide the tourmaline, along with small amounts of lepidolite and fluorite, constitutes about 20 percent of the rock, locally forming crystals up to 20 cm long. The chemical composition and mineralogy of these pegmatites are further described in the Economic Geology section of this report.

Middle Precambrian

LATE MAFIC INTRUSIVE ROCKS

Two diabase dikes, one striking northeastward through Miminiska Island and the other striking northward through Gumuly and Wottam Lakes, are believed to be Middle Precambrian in age. The dike which crosses Miminiska Island has been dated by a whole-rock K-Ar method at $1,960 \pm 130$ m.y. (Wanless *et al.* 1966, p.74). A few much narrower dikes assumed to be of the same age occur near the larger examples and strike subparallel to them. The two major dikes are 120 to 160 m wide and dip vertically. Their outcrops are characterized by a massive even textured appearance and moderately well developed joint sets parallel and normal to their contacts. The contacts, where exposed, are very sharp. The dikes have black, aphanitic chilled margins which are only one to two centimetres wide. Grain size increases gradually inward and in places was observed as large as 5 mm. The surrounding rocks are generally undisturbed at the contacts, commonly meeting the dike at approximately right angles. In the argillaceous metasediments, contact effects include a noticeable bleaching and hardening of the rocks and the production of a strong fissility parallel to the contact up to 5 m from the dikes.

The diabase weathers a light brown to pink colour but appears dark to light grey on fresh surface depending on grain size. In nearly all hand samples well preserved igneous textures are visible on both fresh and weathered surfaces. In thin section these rocks vary considerably in appearance. Some exhibit perfectly preserved ophitic, sub-ophitic and diabasic textures formed by virtually unaltered augite, labradorite, olivine and Fe-Ti oxides. Other examples have only poorly preserved original textures and mineralogy is extensively altered. In these, hornblende and chlorite form crude pseudomorphs after the primary

pyroxene, which may persist in relict cores. Labradorite laths retain good twinning but are commonly sericitized. Olivine grains are pseudomorphed by serpentine and iddingsite, and titaniferous magnetite has broken down to form magnetite, hematite, and leucoxene. Large (up to 5 mm), highly irregular grains of quartz, believed to be primary, occur interstitial to the major components in some sections.

The dike which passes through Miminiska Island is an olivine diabase; the other major dike is predominantly a quartz diabase.

Cenozoic

QUATERNARY

Pleistocene and Recent

All of the region was covered by glacial ice of Late Wisconsinan age, and later, at one time or another, by glacial lake waters of Lake Agassiz (Elson 1967). Over 90 percent of the map-area is now covered by extensive glacial, glaciolacustrine and glaciofluvial deposits of varying thickness.

Much of the area is mantled by flat to gently undulating ground moraine, typically less than 10 m thick, consisting of bouldery silt-sand. Commonly the surface layers have been winnowed of fine material leaving residual gravel deposits. Within the map-area itself, there seems to be little glaciolacustrine silt and clay on top of the primary glacial material. The effects of wave action in eroding and/or sorting material in the moraines south of Miminiska Lake appear to have been slight.

The most prominent glacial feature in the region is the range of high morainic hills along the southern side of Miminiska Lake, which are considered to be an eastern extension of the Agutua End Moraine (Prest 1963). The maximum elevation above lake level is approximately 170 m, and much of the terrain is 30 to 60 m above Miminiska Lake. The moraine is composed of material ranging from bouldery and slightly clayey, sand-silt till to bouldery, clean silty sand till (Prest 1963).

The location of masses of stagnant melting ice in this area has given rise to a number of striking features in and around the moraine. South of Howells Lake, there is a large area of outwash material, mostly gravel, which is pitted by dozens of small kettle lakes 20 to 30 m deep (Prest 1963). To the northwest of Bolster Lake, which has the appearance of a very large kettle, there is a series of very sharply defined ridges and troughs, over 50 m from crest to bottom, aligned parallel to the lake shore. These ridges may represent large scale crevasse fillings formed as ice and other material collapsed around the forming kettle (Burwasser, personal communication). A long linear trench, some 200 m wide and as much as 50 m deep, extends through the moraine southwestward from the southeast shore of Miminiska Lake. Its trend is defined by a succession of elongate kettles and kettle lakes. This trench is subparallel to nearby

faults and to a Middle Precambrian diabase dike, which suggests that its position was determined by a zone of crustal weakness. Whatever its origin, the trench appears to have served as a meltwater channel since eskers, which were probably formed marginal to the melting ice sheet, meet the trench at its southern end just inside the map-area.

Small thick lobes of morainic material, mostly bouldery sand-silt, also occur west and northwest of Howells Lake and between Howells and Miminiska Lakes. Some of these are highly pitted and appear to be derived from small blocks of stagnant ice detached from the main retreating ice sheet.

Eskers in this area, with the exception of those marginal to the Agutua Moraine, trend east-northeast, parallel to the direction of ice movement. The most extensive esker complex in the area extends semi-continuously from the Lily-pad Lakes to Miminiska Lake. Much smaller examples occur just south of Runions Lake and northwest of Gumuly Lake. Typically these complexes consist of a medial, steep-sided sinuous ridge up to 30 m high, representing the original subglacial river channel, flanked in most places by broad, relatively flat aprons which slope quite gently down from the central ridge to the level of the surrounding terrain. These aprons represent supra-glacial material which accumulated in the wide surface valley above the subglacial stream and was later deposited on top of the esker as the intervening ice dissipated. Lines of elongate kettles typically occur along each side of a medial ridge where ice was trapped below the super-glacial material and later melted to form surface depressions. The eskerine deposits, where examined by the field party, consist of rather poorly sorted gravelly sand till.

The direction of ice movement, as indicated by glacial furrows and striae and glacial fluting, is consistently toward 257°. Well developed striae are fairly common in well polished outcrops of mafic metavolcanics and fine grained siliceous metasediments. Long glacial furrows up to 70 cm deep occur north of the Lily-pad Lakes. Glacial fluting, consisting of strongly aligned, low ice-molded ridges and intervening creek-filled depressions, imparts a marked grain to the north-central and southeastern parts of the area, but much better examples of this occur northwest of the map-area near Cluff Lake. True drumlin ridges were not observed.

No earlier ice movement direction indicators have been preserved.

STRUCTURAL GEOLOGY

Regional Setting

The rocks in the map-area form part of the Uchi Subprovince, a sublinear east-trending belt of predominantly supracrustal rocks within the Superior Province of the Canadian Shield. In the vicinity of the map-area this belt is relatively broad, having a continuous width of about 35 km. Beyond the map-area the Uchi Subprovince is bounded to the south by highly metamorphosed sedimentary and plutonic rocks of the English River Gneiss Belt and to the north by similar rocks of the Gods Lake Belt. In this region the boundaries between

these major lithologic and structural subdivisions are in general ill-defined and poorly understood. A generalized outline of these and other major subdivisions of the Canadian Shield in Ontario is given in Diagram A of the Geological Map of Ontario (Ayres *et al.* 1971).

The Miminiska Lake area appears to lie on the southern flank of a relatively open regional syncline. The east-west axis of this structure passes just south of Keezhik Lake and extends toward Troutfly Lake in the west and Opikeigen Lake in the east (see Figure 6). Prest (1939) suggested that this is an east-plunging syncline. Three major felsic to intermediate intrusions, the Cluff Lake stock, the South Bay stock and the Troutfly Lake batholith (Thurston and Carter 1970), are aligned along the fold axis, presumably exploiting a zone of structural weakness associated with the fold trough.

In the western part of the map-area the strata appear to form a homoclinal sequence facing northward toward the regional synclinal axis. However, in the eastern and central parts of the area the juxtaposition of top indicators, the abundance of minor folds and other minor structural features, and lithologic and aeromagnetic patterns strongly suggest that repeated isoclinal folding occurs within the metasedimentary sequence. A number of subparallel east-trending folds have been recognized, but many additional fold structures are suspected. This folding may have been caused by the intrusion of the Kawitos Lake batholith which might have been sufficiently energetic to produce intense crumpling in the relatively incompetent metasediments.

Minor Structural Elements

FOLIATION, SCHISTOSITY AND GNEISSOSITY

These planar structural elements are for the most part parallel or subparallel to primary features such as bedding and flow contacts.

Nearly all of the rocks in the map-area possess a mineral foliation. In the western half of the area such foliation is rarely distinct in hand specimen, but weakly to moderately well-defined phyllosilicate foliations can be seen in most thin sections of these rocks. East of Miminiska Lake most of the metasedimentary rocks are schistose with relatively high biotite and/or chlorite content. Foliation due to the parallelism of tectonically flattened clasts, pillows, porphyroblasts, etc., is also common in many areas.

In some places foliations are crenulated, giving rise to secondary foliations or crenulation cleavages which are commonly better developed than the first. The crenulation cleavages were observed in several instances to occur in conjugate sets symmetrically arranged about the axial planes of minor folds.

Slaty cleavage, which is common in the fine grained metasediments in the central part of the area, commonly occurs at moderately high angles to bedding. Marked refraction of the cleavage occurs at the boundaries between beds of different competency such as mudstone and magnetite-quartz iron formation.

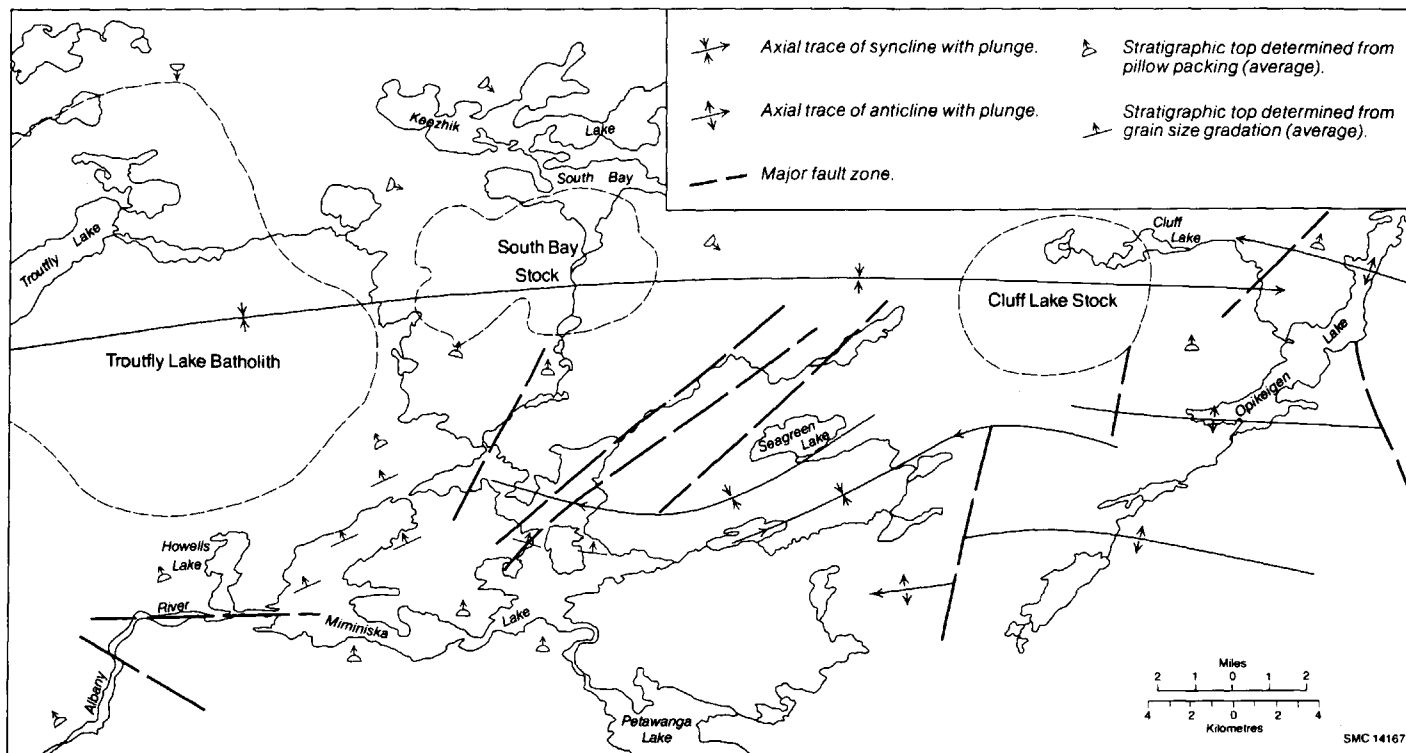


Figure 6—Sketch map of the major structural features of the Miminiska Lake and surrounding areas.

Mafic metavolcanics and amphibole-garnet-biotite iron formation units north of Frond Lake and some mafic metavolcanics around the southern part of Miminiska Lake are gneissose. Commonly these rocks are completely gradational into rocks which are schistose but lack gneissosity both along and across strike. The felsic to intermediate intrusive rocks generally exhibit weak to moderately strong mineral foliations, but gneissosity was not observed in those rocks. The obvious metasedimentary inclusions within the Kawitos Lake batholith are invariably schistose.

LINEATIONS

Lineations formed by elongated clasts in conglomerates and pyroclastic rocks, and by pillows, varioles and/or amygdules in metavolcanics are common in the western part of the area. Locally they are consistent in their orientation, but the degree of deformation of these features varies remarkably over very short distances.

In the eastern and central parts of the area most lineations are associated with minor folds and crenulations. These are particularly common in the areas north of Goss and Frond Lakes and on the northwestern side of Miminiska Peninsula. In general they are also consistent in trend and plunge in their respective areas and are probably indicative of the orientation of major fold structures. Mineral lineations are not prominent, but they were observed in association with some minor folds parallel to the fold axes.

JOINTING

Joints are common in most rock-types throughout the area and are particularly prominent in metavolcanic rocks and mafic intrusives where they appear to be cooling-related phenomena. The best developed joints are in the Middle Precambrian dikes where they occur in three sets normal to one another, with two sets parallel to the dike contact. Notable examples of well-developed joint sets which appear to have been produced tectonically occur in the felsic metavolcanics on the north shore of the Lilypad Lakes and in the iron formation on the northern tip of Miminiska Island. With few exceptions joint data have not been recorded on the accompanying map because of inconsistent joint orientations between closely spaced stations.

MINOR FOLDS

Minor folds varying from less than a metre to outcrop scale in amplitude are common in the metasedimentary sequence. As already noted, these folds are abundant north of Frond and Goss Lakes, where most have shallow to moderate westerly plunges (Photo 13), and on the northwestern side of Miminiska Peninsula, where most plunge moderately southwestward. However, the minor



OGS 10 308

Photo 13—Minor folds in a wacke-mudstone association from north of Frond Lake. Axial plunges are 30° to 45° westward.

foldings are most numerous in association with the major fold defined by the magnetite-quartz iron formation sequence in the northeastern part of Miminiska Lake. The iron formation itself is commonly highly contorted, with most fold axes approximately parallel to the trend of the major fold. Even thin iron formation units intercalated with relatively undeformed clastic metasediments are commonly intricately folded. Only a few of the lineations representing fold axes appear on the accompanying map to avoid confusion in some areas.

The closure of relatively small folds is not always apparent in outcrop. In the area around the northeastern arm of Miminiska Lake, several folds larger than individual outcrops are indicated by changes in bedding strike and facing directions over small areas. Folds of intermediate scale, with wavelengths in the order of a few hundred metres, are suggested by aeromagnetic patterns over the iron formation east of Miminiska Lake but these occur in areas of very poor exposure and their orientation cannot be determined in the field.

Most minor folds appear to parallel the regional lithologic and structural trends but a small proportion, particularly in the central part of the area, are approximately perpendicular to these trends. The tectonic significance of these folds is not clear, but they may be related to a deformation event which produced cross-folding in this region (Thurston and Carter 1970).

MINOR FAULTS

Offsets with displacements of a few centimetres are abundant in some parts of the metasedimentary sequence, particularly in mudstone units around Miminiska Lake where regular bedding makes the disruptions obvious. Nearly all of these features are approximately perpendicular to bedding with sub-vertical slip planes. The offsets take several forms: many are simple planar discontinuities along which minor movement has occurred, others are kink bands which are typically 1 to 2 cm wide and still others are sigmoidal tension gashes arranged en echelon along the displacement zone. In several cases these sigmoidal tension gashes, which are commonly quartz-filled, occur in combination with the kink bands.

The sense of movement along these offsets is consistently dextral in the rocks around the northwestern arm of Miminiska Lake but elsewhere they do not appear to follow a consistent pattern. Because of their very small scale, these features are not shown on the accompanying map.

Major Structural Elements

MAJOR FOLDS

The positions of major folds within the map-area are difficult to define because of generally poor exposure and lack of facing criteria in many critical areas. Nevertheless the existence of a number of east-trending isoclinal folds can be interpreted within the metasediments in the eastern and central parts of the area. The evidence for these structures comes from aeromagnetic patterns over iron formation units, from lithologic patterns where discernible, and from minor structures including top indicators such as graded bedding. The approximate locations of axial traces of major folds are indicated on Figure 6 along with estimates of axial plunges from related parasitic folds.

The axial trace of one major fold, which is outlined by the distribution of geophysically interpreted iron formation (ODM-GSC 1960a, b), extends from the mouth of Curry Bay to Seagreen Lake, passing north of Miminiska Island. Closure of the iron formation marker horizon occurs on the eastern side of Curry Bay. Top determinations from only the southern limb indicate that the fold is a syncline. Minor folds within the iron formation and clastic metasediments suggest that the major fold axis plunges steeply west.

A second major fold, inferred from lithologic symmetry north and south of Goss Lake, has a closure north of Frond Lake. This fold is probably an anticline but facing criteria are generally lacking. The position of the axial trace west of Goss Lake is difficult to estimate because of inconsistent aeromagnetic expression over marker horizons of iron formation. Near the nose of this fold in the Frond Lake-Goss Lake area, most minor folds plunge westward at 15 to 25°, while in the Wottam Lake area most minor folds plunge more steeply eastward. This apparent undulation in fold axes suggests cross-folding of the major structure.

The nose of a third major east-trending fold, which lies entirely within the Kawitos Lake batholith south of Mezhisk Lake, is indicated by aeromagnetic patterns over remnant iron formation units. Minor structures within iron formation units in that area suggest that the fold is an anticline plunging to the west.

MAJOR FAULTS AND LINEAMENTS

As with the large scale folds, most of the major faults in the map-area cannot be well documented in outcrop and have been inferred on the basis of offsets in aeromagnetic patterns and/or the obvious juxtaposition of different stratigraphic units in conjunction with linear or sub-linear topographic features visible on aerial photographs. Other distinct linear features which cannot be directly attributed to the presence of underlying faults are shown on the accompanying map as lineaments. Many such lineaments are probably faults, particularly those which parallel known faults.

The most prominent fault system in the map-area consists of a number of major subparallel northeast-trending breaks and associated lineaments which parallel Ferguson Creek and extend from Miminiska Peninsula to Ferguson Lake. The faults are associated with strong topographic linear features and obvious aeromagnetic and lithologic offsets. Although their net displacements are not known, their strike slip components appear to be 1 to 3 km.

The fault indicated on the geological map along the Albany River immediately west of Miminiska Lake is inferred mainly from the 2 km offset of the metasedimentary-metavolcanic contact in that area. However, the northwest-trending fault shown south of this fault is based on little evidence other than the presence of a strong lineament. The displacements of contacts on the map are only one set of possible solutions to the problem of extrapolating the stratigraphy in an area of very poor exposure.

The Miminiska Fault, which was initially proposed by Prest (1939) as a thrust fault separating the southern metavolcanic sequence from the metasediments to the north, is not indicated by field evidence. North of Miminiska Falls the contact between metavolcanics and metasediments is definitely conformable but further west across Miminiska Peninsula the contact is not exposed.

North- to north-northeast-trending lineaments are common throughout the area. Only the most prominent are shown on the accompanying map.

Economic Geology

Parts of the Miminiska Lake area were extensively prospected for gold in the late 1920s and the 1930s. Exploration for gold, lithium, iron, and base metal sulphides has continued sporadically since then (see History of Mineral Exploration), but to date no economically viable deposits have been found. The most recent activity has been directed toward the identification of base metal sulphide deposits within the metavolcanics in the western part of the area.

Conventional prospecting has been restricted in the region by the relatively remote location and poor exposure. Few modern geological or geophysical surveys and diamond drill programs have been carried out. The type of exploration work done in the map-area and the records submitted for assessment credit to the Ministry of Natural Resources are listed in Table 7.

Although some staking and prospecting were reported within the map-area during the winters of 1974 and 1975, no exploration activity was encountered during the present mapping. The general locations of claim blocks held during the period of the mapping until December 31, 1975 are indicated on the accompanying map, but only surveyed claims are shown individually. The sites of exploration work on ground no longer held and the locations of known mineral occurrences not covered by current claims are also indicated on the map.

Mineral deposits found thus far within the map-area fall into four categories:

- 1) Gold-bearing quartz-carbonate veins and shear zones in (a) clastic metasediments and (b) metamorphosed iron formation where the gold appears to be associated with arsenopyrite and other sulphide minerals.
- 2) Magnetite-quartz and carbonate-quartz iron formation associated with the wacke-mudstone (distal turbidite) sequence.
- 3) Lithium-bearing pegmatite dikes.
- 4) Base metal sulphide deposits associated with (a) sulphide iron formation and (b) felsic to intermediate metavolcanics. The characteristics of each type of deposit are summarized below; descriptions of individual properties and occurrences are listed in a later section of this report.

GOLD-BEARING QUARTZ-CARBONATE VEINS AND SHEAR ZONES

Most known gold occurrences in the map-area are found in quartz- and/or carbonate-filled veins or shear zones which cut clastic metasediments and metamorphosed iron formations. Gold showings have also been investigated in quartz veins cutting mafic to intermediate metavolcanics and felsic to intermediate porphyry sills in the western part of the area.

In the past, exploration work has been concentrated in a relatively narrow zone about 2 km wide extending from Frond Lake to Miminiska Island. Several small occurrences have been reported from this zone. The gold generally occurs in relatively narrow, semi-continuous, east-trending quartz-carbonate veins and shear zones cutting, or in close proximity to, ferruginous amphibole-garnet-biotite rocks believed to be metamorphosed iron formation. In and adjacent to many of these veins arsenopyrite, pyrite, pyrrhotite, chalcopyrite, malachite and tourmaline occur in highly variable amounts. Arsenopyrite and pyrrhotite are by far the most abundant of these minerals, occurring both within the veins, disseminated throughout or in massive lenses within the amphibole-garnet-biotite rocks. Higher gold contents have been reported to be associated with arsenopyrite (Prest 1939), but very few precise assay values are available from the many old workings in the area. Descriptions of many of these workings and

the types of mineralization encountered are given by Prest (1939).

No visible gold was found by the field party although several showings and much waste rock were examined. Over thirty composite samples of quartz vein and sulphide-bearing material were analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto, and of these only one contained more than trace amounts of silver and gold.

Since the 1920s gold has also been known to occur in quartz- and carbonate-filled shear zones cutting clastic metasediments in the Keezhik Creek area. Visible gold, and channel sample assays of 0.1 to 0.4 ounce of gold/ton, have recently been reported from one such occurrence north of the creek (Bayne 1974). The main shear zone parallels the creek and is up to 3 m wide. The shear zones are separated by relatively undeformed metasediments but these too are highly silicified and carbonatized. Minor amounts of sulphides, mostly pyrite, arsenopyrite and pyrrhotite, are finely disseminated throughout the sheared material. The sulphides also occur in small pods and lenses where veinlets narrow or bifurcate. Additional information on this occurrence is given under Ymir Mining and Exploration Limited.

MAGNETITE-QUARTZ AND SIDERITE-QUARTZ IRON FORMATION

Concentrations of magnetite-quartz, Algoma-type iron formation have been recognized in this area since Burwash (1929) made the first geological reconnaissance. However, the iron formation is generally poorly exposed and the full areal extent of the iron deposits there was not realized until aeromagnetic data became available (ODM-GSC 1960a, b). At that time very high positive magnetic anomalies ($>13,000$ gammas relief) over the large area, outlined on the accompanying map as G4a, indicated the potential economic significance of the deposits.

The magnetite-quartz iron formations in most parts of the map-area occur interbedded with mudstone and fine wacke units of the turbidite sequence. The proportion of chemical to clastic metasediments varies widely (from 1:1 to 1:8 but 1:2 to 1:4 is most common) on all scales, as do their relative bed thicknesses (from fine laminations 0.3 cm (Photo 14) to beds over a metre thick). In many outcrops the assessment of the relative abundance of chemical and clastic units is complicated by intricate folding and faulting on outcrop scale (Photo 15). This deformation, which has resulted in multiple repetitions and reversals in stratigraphy, is responsible for the concentration of magnetite-quartz iron formation in the northeastern part of Miminiska Lake. Where the iron formation is not appreciably deformed the corresponding aeromagnetic relief is generally much lower (from a few hundred to 5,000 gammas), indicating a much lower overall magnetite content in the mixed chemical-clastic sequence.

Table 5 (Analyses 57, 58, and 59) and Table 6 show the results of chemical analyses done by the Geoscience Laboratories, Ontario Geological Survey, Toronto on portions of bulk samples of magnetite-quartz iron formation from three localities. Each sample of 20 to 40 kg consisted of chips collected over a distance of approximately 3 m across strike, and included representative proportions of chemical and clastic metasediments. Table 6 also shows the grade of

Geology of Miminiska Lake Area

TABLE 7 | SUMMARY OF EXPLORATION WORK IN THE MIMINISKA LAKE ASSESSMENT FILES RESEARCH OFFICE, ONTARIO DIVISION OF OF NATURAL RESOURCES, THUNDER BAY.

File Name	Area	Property Reference Number
Algoma Steel Corporation Limited	Miminiska Lake	8
Boyles Engineering Offices	Nesting Lake	12
Campbell, R. J.	Ferguson Lake	1
Canadian Nickel Company Limited	Miminiska Lake Snowdrift Lake	2
Central Patricia Gold Mines Limited	Miminiska Lake	3
Connell Mining and Exploration Company Limited	Fronde Lake	5
Conwest Exploration Company Limited	Snowdrift Lake	4
Fronde Lake Mining Company Limited	Fronde Lake	5
International Mining Corporation (Canada) Limited	Fronde Lake	6
Leta Explorations Limited	Miminiska Lake	8
Mattagami Mining Company Limited	Miminiska Lake	8
Selco Exploration Company Limited	Nesting Lake Miminiska Lake Nesting Lake Snowdrift Lake Miminiska Lake	9
Standard Lithium Corporation	Ferguson Lake	1
Thompson, R.	Miminiska Lake	10
Ymir Mining and Exploration Limited	Nesting Lake	12

AREA TO DECEMBER 31, 1979. INFORMATION GATHERED FROM FILES IN THE
MINES, TORONTO AND/OR IN THE REGIONAL GEOLOGIST'S OFFICE, MINISTRY

Assessment File Research Office Number	Type of Work	Date
<i>R.G.O.</i>	<i>G.M.</i>	<i>1965</i>
<i>63.1078</i>	<i>G.M., G.E.M.</i>	<i>1960</i>
<i>11</i>	<i>D.D.H. (3)</i>	<i>1962</i>
<i>15, 16</i>	<i>D.D.H. (2)</i>	<i>1972</i>
<i>13</i>	<i>D.D.H. (3)</i>	<i>1972</i>
<i>R.G.O.</i>	<i>D.D.H. (9)</i>	<i>1951</i>
<i>R.G.O.</i>	<i>G, D</i>	<i>1945</i>
<i>10</i>	<i>D.D.H. (2)</i>	<i>1971</i>
<i>2.1150</i>	<i>G.M., G.E.M.</i>	<i>1972</i>
<i>63.35</i>	<i>G., G.M.</i>	<i>1946</i>
<i>63.25</i>	<i>G.M.</i>	<i>1945</i>
<i>63.1672</i>	<i>G.M.</i>	<i>1965</i>
<i>11, 12</i>	<i>D.D.H. (4)</i>	<i>1966</i>
<i>2.404</i>	<i>G.M.</i>	<i>1970</i>
<i>2.645</i>	<i>G.M.</i>	<i>1971</i>
<i>2.645</i>	<i>G.M.</i>	<i>1971</i>
<i>2.645</i>	<i>G.M.</i>	<i>1971</i>
<i>13, 14</i>	<i>D.D.H. (2)</i>	<i>1972</i>
<i>10</i>	<i>D.D.H. (8)</i>	<i>1955-1956</i>
<i>10</i>	<i>D.D.H. (6)</i>	<i>1951</i>
<i>2.1715</i>	<i>G.</i>	<i>1974</i>

Abbreviations: R.G.O. = available only at the Regional Geologist's Office;
D = dip needle survey and map;
D.D.H. = diamond-drill hole (number of holes in brackets);
G. = geological map and/or report;
G.M. = ground magnetometer survey and map;
G.E.M. = ground electromagnetic survey and map.



OGS 10 309

Photo 14—Interlaminated mudstone and magnetite-quartz iron formation on the mainland east of Miminiska Island. Iron formation and clastic metasedimentary units typically are 5 to 50 cm thick; finely laminated occurrences are unusual.

magnetic concentration which can be expected after crushing to the indicated particle size. Finer crushing would probably further increase the grade of concentrate with some loss in the percentage recovery of Fe. In analyses of samples taken from diamond drill cores from the major iron formation occurrences in the area, crushing to -325 mesh commonly gave concentrates containing 65 to 70 percent Fe compared with original Fe values of 13 to 30 percent. The percentages of such deleterious components as phosphorus and sulphur appear to be moderately low in the samples analysed. Additional information on the geol-



OGS 10310

Photo 15—Folded magnetite-quartz iron formation from a small island in the eastern arm of Miminiska Lake. Similar folds on a variety of scales occur throughout the metasedimentary sequence east of Miminiska Peninsula.

ogy of the Miminiska Lake iron deposits is given under their current claim holder, Mattagami Mining Company Limited.

Siderite-quartz iron formation was first found in the map-area during the present survey. The very small amount of this material exposed is intercalated with magnetite-quartz iron formation along the northwestern side of Miminiska Lake. However, the siderite-quartz material, which is mined for iron ore in many areas of the world including the Michipicoten Iron Ranges, may be much more abundant in this area than is apparent in outcrop. As previously described in the General Geology section under Ferruginous Chemical Metasediments, iron-rich amphibole-garnet-biotite rocks in the eastern part of the map-area are believed to be metamorphosed carbonate iron formation. These rocks are also intimately associated with magnetite-quartz iron formation but in many outcrops in the east the amphibole-garnet-biotite rocks predominate and commonly attain considerable total thicknesses (tens of metres). Since neither the iron-rich silicate rocks nor the primary iron carbonate-rich rocks are significantly magnetic their relative abundance with respect to magnetite-quartz iron formation is impossible to estimate.

LITHIUM-BEARING PEGMATITE DIKES

Pegmatite dikes cutting mafic metavolcanics north of the Lilypad Lakes contain the lithium-bearing minerals spodumene, lepidolite and amblygonite as well as tourmaline, pollucite, fluorite, beryl, scheelite, cassiterite and minor gold in a matrix of quartz, albite, microcline and white mica. Spodumene constitutes up to 40 percent of the dike in some occurrences and averages more than 20 percent overall in some dikes. One sample from such a dike contained 2.05 percent Li_2O (Geoscience Laboratories, Ontario Geological Survey, Toronto) but values as high as 4.45 percent Li_2O have been reported for other samples (Assessment Files Research Office, Ontario Division of Mines, Toronto).

Other dikes containing only minor spodumene are richer in lepidolite, pink tourmaline (elbaite), amblygonite and pollucite. A sample of this material was analyzed and found to contain 1.20 percent Li_2O , 2.54 percent Cs_2O , and 0.02 percent Sn (Geoscience Laboratories, Ontario Geological Survey, Toronto).

More information on the major lithium occurrence in this area is given in the following section under the title R.J. Campbell.

BASE METAL SULPHIDE DEPOSITS

No significant base metal sulphide deposits have as yet been found in the map-area but potentially favourable environments for such mineralization have been recognized. One such environment is in sulphide facies iron formation known to exist in the southeastern corner of Miminiska Peninsula. There a thin (<2 m) unit of black graphitic slate containing up to 20 percent pyrite and pyrrhotite with traces of chalcopyrite occurs in close stratigraphic proximity to felsic and intermediate pyroclastic rocks and metamorphosed carbonate and/or silicate iron formations. A diamond-drill hole through this sequence (to check a conductor found by airborne electromagnetic surveys (see Canadian Nickel Company Limited in the following section)) intersected what was termed a meta-tuff unit estimated to contain 8 percent disseminated total sulphides, but only pyrite and pyrrhotite were reported (Assessment Files Research Office, Ontario Division of Mines, Toronto). Up to 17 percent total sulphides, occurring as disseminated mineralization and massive bands, were also reported in adjacent pyroclastic units (Assessment Files Research Office, Ontario Division of Mines, Toronto). Although the copper, zinc and lead contents of the sulphide iron formation and the surrounding rocks appear to be quite low in this locality, the composition of such rocks, including their metal content, may vary considerably along strike.

A second potentially favourable environment for base metal sulphide mineralization occurs in the mafic to intermediate metavolcanics, both flows and pyroclastic rocks, in many parts of the area. Disseminated pyrite and pyrrhotite are very common in these rocks and copper mineralization in the form of chalcopyrite and minor malachite was noted by the field party in several localities in intermediate pillowed flows north of Petawanga Lake and in intermediate pyroclastic units northeast and southwest of Howells Lake and in the southern part of Miminiska Peninsula.

The third and possibly most significant geological environment for the occurrence of base metal sulphide mineralization is in a felsic to intermediate metavolcanic accumulation, mostly pyroclastic rocks, such as that south of the western side of Miminiska Lake and less prominent examples north of the Lily-pad Lakes and north of the mouth of Ferguson Creek. Minor amounts of pyrite and pyrrhotite were found in many of these rocks, generally in the more felsic units, but no other sulphide minerals were observed during the present survey. Chemical analyses of samples of felsic metavolcanic material from the north-western shore of Miminiska Lake and from the western side of Miminiska Peninsula gave copper values ranging from 15 to 20 ppm; lead, from >10 to 15 ppm and zinc, from 45 to 80 ppm. In all cases sulphur was less than 0.01 percent.

A zone of brecciated siliceous rock about 3 m thick containing more than 75 percent massive pyrrhotite and pyrite has been reported from a diamond-drill hole located about 1500 m west of the southwestern corner of Miminiska Peninsula (File No. DDH, Rept. No. 14, Miminiska Lake Area, Assessment Files Research Office, Ontario Division of Mines, Toronto). No other sulphides were reported. The breccia zone, in which the fragments appear to be strongly chloritized, is in conformable contact with magnetite-quartz iron formation which is also brecciated and considerably altered. In this iron formation iron sulphides constitute about 30 percent of the rock and occur surrounding chloritized rock fragments and in numerous small veins and fracture fillings. This sulphide-rich breccia zone is along strike from the previously described sulphide facies iron formation that is exposed on the eastern side of Miminiska Peninsula but exact correlation is impossible.

DESCRIPTION OF PROPERTIES

Properties, mineral deposits and areas of past exploration activity are described in this section, listed alphabetically under the following headings: (a) for properties in good standing as of December 31, 1975, by the full name of the company or individual under whose name the claims are registered; (b) for known mineral deposits on ground no longer held as of December 31, 1975, by a local geographic name or abbreviated company name; (c) in the case of an area of notable exploration activity where no mineralization was found, by the name of the last company or individual to have done major work followed by the date of that work in square brackets. Historical details contained in these descriptions are for the most part taken from company reports on file with the Assessment Files Research Office, Ontario Division of Mines, Toronto, from reports and records of the Ontario Division of Mines, and from information made available by the companies and individuals concerned.

Campbell, R.J. (1)

Three patented claims Pa27167, Pa27168 and Pa27169 north of the westernmost of the Lily-pad Lakes were held by R.J. Campbell in 1974-1975.

HISTORY

Lithium-bearing pegmatite dikes north of the Lilypad Lakes were known at the time of Prest's field work in 1942. The first recorded work on these occurrences was done in 1956 after staking by Standard Lithium Corporation Limited. That year, 7 diamond drill holes totalling 760 m were drilled on claims Pa27167 and Pa27168. Several trenches were blasted across spodumene- and lepidolite-bearing dikes, and channel samples were taken for analysis.

The same area was restaked in 1963 by R.J. Campbell who drilled an additional 3 diamond drill holes on claim Pa27168. No further work has been reported on the property.

GEOLOGY AND MINERALIZATION

The property is predominantly underlain by mafic metavolcanics with felsic pyroclastic rocks to the north and metasediments to the south. Several coarse to medium grained pegmatite intrusions, mostly intruding the mafic metavolcanics, have been explored. Most of the intrusions are east-west-trending and dip steeply northward. Some appear to be concordant and others are clearly cross-cutting. At least one major dike strikes north-south. Nearly all of the intrusions contain some spodumene but visible lepidolite and tourmaline are far less common in this area. Spodumene, which forms crystals up to 50 cm long, occurs in the pegmatites in concentrations up to 40 percent. The other major constituents of the pegmatites in this area are quartz, white albite, pink to white microcline (which commonly forms crystals as large as spodumene) and white mica. Visible fluorite, scheelite and beryl are rare but do occur in some intrusions; in fact, scheelite contents as high as 10 to 15 percent over 1.3 m were reported in drill logs (Assessment Files Research Office, Ontario Division of Mines, Toronto). Amblygonite (a lithium-bearing feldspar) and pollucite (a cesium-bearing zeolite) are not readily distinguished from white albite in the field, but have subsequently been identified by X-ray and quantitative chemical analyses of whole rock and mineral samples. Allanite, apatite, cassiterite and zircon were also identified in thin sections of this material.

The best drill hole intersection reported in this claim group averaged 1.07 percent Li_2O over 10.4 m of mineralized pegmatite. Several grab samples from the main dike, which has been traced in trenches and drill holes for a length of 240 m and over a width of 1.5 to 7.5 m, ranged in grade from 0.53 to 4.07 percent Li_2O (Regional Geologist's Files, Ontario Division of Mines, Thunder Bay).

Canadian Nickel Company Limited [1972] (2)

In 1972 this company put down a total of four diamond drill holes in three separate localities within the map-area as part of a regional exploration program resulting from geophysical surveys. One hole, 56 m long, located on the eastern tip of the southern part of Miminiska Peninsula, intersected felsic to

intermediate pyroclastic rocks and a 2 m thick unit of graphitic slate containing considerable disseminated pyrrhotite and pyrite. No other sulphide minerals were reported (Assessment Files Research Office, Ontario Division of Mines, Toronto).

A second drill hole 55 m long was put down in the southwestern corner of Miminiska Peninsula. This hole intersected mostly felsic to intermediate meta-volcanics containing minor disseminated pyrrhotite and pyrite, and a 1 m thick breccia zone containing 25 percent pyrrhotite (Assessment Research Files Office, Ontario Division of Mines, Toronto).

The other two holes are located at the extreme western edge of the map-area south of the Troutfly Lake batholith. These holes reportedly intersected intermediate pyroclastic rocks including a thin graphitic tuffaceous unit containing minor sulphide mineralization (Assessment Files Research Office, Ontario Division of Mines, Toronto).

Central Patricia Gold Mines Limited (3)

In 1974-1975 this company held a block of 28 patented claims, Pa5936 to Pa5959 inclusive and Pa6034 to Pa6037 inclusive, located east of Miminiska Island and south of claims held by Mattagami Mining Company Limited (8).

Prior to 1946 this claim block, along with the other ground between Miminiska Island and Frond Lake, was prospected for gold. "Considerable" trenching and diamond drilling was reported in the central part of this property where gold was found in small amounts in sheared metasediments. These workings were not found by the field party and their exact location is not known. No other exploration work has been reported on the property.

Conwest Exploration Company Limited [1946] (4)

In the 1940s this company drilled a number of diamond drill holes and carried out surface exploration on Miminiska Island while exploring for gold. This site was not located during the survey.

Fron Lake Mining Company Limited (5)

In 1975 this company held a block of 27 patented claims consisting of Pa5138 to Pa5156 inclusive, Pa5159 to Pa5161 inclusive, Pa5164, Pa5165 and Pa6079 to Pa6081 inclusive. In 1974 the same company also held a block of mining claims contiguous with those listed north of Frond Lake, but these were allowed to lapse in that year.

Much of this ground was first explored by Connell Mining and Exploration Company Limited in the early 1940s. The following description is taken from

Prest (1942, p.23-24):

The main showing occurs in and near the iron formation on the south side of Goss Lake. A considerable amount of diamond-drilling and trenching has been completed and interesting mineralization encountered. The values are always closely associated with arsenopyrite, but this mineral, which is the most abundant sulphide, does not always carry gold. Pyrrhotite is a common sulphide; where it is most abundant values are poor. Pyrite and traces of chalcopyrite are also present. Sulphides are always localized where the garnet amphibolites, mentioned previously, occur in the sediments.

Two breaks, known as the north and south, have been explored on this property. Both are cross-fractures with smaller connections along the strike. The east end of the south break occurs in the drag-folded section of the iron formation where it is crossed by the trail to Frond Lake. This is the best showing so far discovered on the property. The west end is in banded sediments near the iron formation south of the west end of Goss Lake, and is in general a low-grade section.

The northern break has been uncovered paralleling Goss Lake from a point 5 chains south of the west end to the central part, where a swampy section covers it, and is reported to have been picked up by the drills where the trail from Frond Lake reaches Goss Lake. The break thus lies north of the iron formation but roughly parallel to it. Like the southern break it is best developed in the drag folded region, and there may be a break parallel to the axial planes of these drag folds. The northern break is in a banded slaty greywacke between softer argillaceous-looking beds. It is weakly magnetic, but this is in part due to the amount of pyrrhotite in the replaced rock adjacent to the quartz veins. The iron formation proper lies to the south of this horizon. The break is best developed in the east outcrop of the two lying north of the iron formation south of Goss Lake.

Quartz veins with a maximum width of 3½ feet, but usually about 2 feet wide and very irregular, cut across the resistant banded greywacke and have led to differential replacement and mineralization along the bedding planes. The workable mineralized zone has a maximum width of about 15 feet. In this zone the main cross-fracture veins occur every 15 to 20 feet, and the mineralization is practically continuous from one to the other. The quartz veins dip to the east at 50 to 60 degrees, and the bedding dips north at 70 degrees. Most of the veins are sharply terminated at the north edge of the banded greywacke where it is in contact with the sheared, grey-weathering schist. Not all the veins cross the full width of the brittle greywacke.

No further work was reported in this area until 1972 when a large part of the claim group, including all of the lapsed claims, was covered by a combined ground magnetic and electromagnetic survey in an attempt to locate base metal sulphide occurrences. A number of moderately strong northeast- to east-trending anomalies were indicated but most of these were interpreted to result from iron formations and no follow-up work has been reported.

Two of the main gold showings on the property were located during the present survey. One showing, which probably corresponds to Prest's "northern break" south of the west end of Goss Lake, consists of several shallow north-south trenches along an east-trending base line exposing pyrrhotite and some arsenopyrite in fine grained amphibole-rich schist and much coarser garnet-amphibole rocks. Banded grunerite-hornblende iron formation was also found nearby. No gold was visible in the narrow quartz veins in these trenches, and selected sulphide-bearing grab samples collected by the field party and analysed by the Geoscience Laboratories, Ontario Geological Survey, Toronto were found to contain only trace amounts of gold and silver.

The second showing visited is located about 300 m west of the mouth of the creek from Goss Lake into Frond Lake. This too is tightly folded metamorphosed iron formation consisting of amphibole-garnet and amphibole-biotite rocks and interbedded magnetite-quartz and grunerite-hornblende rocks. Many old shallow trenches and exposures of stripped rock were found over a large area but little sulphide mineralization (mostly pyrrhotite) was seen.

Grab samples of rusty weathering quartz vein material intruding the iron formation were analysed but found to contain only traces of gold and silver.

International Mining Corporation (Canada) Limited [1945] (6)

A number of small sulphide showings originally worked for gold by International Mining Corporation (Canada) Limited in 1945 were found by the field party north of Wottam Lake. Baker (1946) reported that during 1945 considerable trenching was carried out, a ground magnetometer survey was conducted and seven diamond drill holes totalling 213 m were drilled in three locations north of the central part of Wottam Lake. One drill hole intersected a quartz vein reportedly containing 0.21 ounce of gold per ton over 13 cm but generally the results were described as inconclusive and disappointing. There has been no record of additional exploration work in this area.

Kidd, R. (7)

In 1975 R. Kidd held a block of 20 mining claims located over the northeastern part of Howells Lake. The block consisted of claims TB416555 to TB416564 inclusive and TB431661 to TB431670 inclusive. There has been no report of exploration work done on the property since 1971 when Conwest Exploration Company Limited drilled two diamond drill holes totalling only 49 m, collared on a small island in the northeastern corner of Howells Lake. The holes intersected intermediate metavolcanics cut by numerous veins and stringers of quartz and calcite but very little mineralization of any kind was reported. Prest (1939, p.17) reported that in the same area: "A number of porphyry bodies heavily mineralized with pyrite occur on a small island in Howells Lake. There was also much massive stibnite occurring here as float, but only minor amounts were found in place. Neither the porphyry bodies nor the quartz stringers within them carry a gold content."

Mattagami Mining Company Limited (8)

This company held two groups of leased claims in the map-area during 1974-1975. One group, on the peninsula east of Curry Bay, consists of claims Pa33658, Pa33659, Pa33662 to Pa33665 inclusive and Pa33671 to Pa33674 inclusive. The second group is located on the mainland east of Miminiska Peninsula and north of the claim block held by Central Patricia Gold Mines Limited. This claim block includes claims Pa33627, Pa33628, Pa33630 to Pa33634 inclusive, Pa33636, Pa33637, Pa33640 and Pa33655. As can be seen on the accompanying map, these claim blocks closely follow the magnetitic iron formation, outlined by its pronounced aeromagnetic expression.

HISTORY

Burwash (1929) was the first to recognize the iron ore potential of the Miminiska Lake iron formation but the occurrence was largely ignored because of its remote location. Prospecting was carried out in both of these claim blocks in the 1940s but this was directed toward gold, which was believed to be associated with folded iron formation in this area. In 1946 Leta Explorations Limited performed a dip needle survey over the northwestern claim group to assess the structure which is largely hidden by thick overburden, but little was found (Assessment Files Research Office, Ontario Division of Mines, Toronto).

The first reported exploration activity related to iron was a ground magnetometer survey done by Algoma Steel Corporation Limited in 1965 over the southeastern claim block. The survey was performed to examine the large positive aeromagnetic anomaly apparent on published government maps (ODM-GSC 1960a, b), to estimate iron formation thicknesses, and to locate specific targets for further investigation. The following year, after control of the property was assumed by Mattagami Mining Company Limited, a more detailed ground magnetic survey was conducted over both claim groups prior to diamond drilling operations. That summer four diamond drill holes (two holes on each claim block) with a total length of 897 m were put down to intersect the iron formation across what was interpreted to be its maximum thickness.

GEOLOGY

The iron formation in this area has been described in detail in a previous section (see Ferruginous Chemical Metasediments). Since these properties are poorly exposed, most of the information regarding unit thickness, structure, etc. has been inferred from the magnetic surveys. The following information is taken from a report by Gray (1965):

Anomaly No. 1 constitutes a long magnetic trend which lies along the north shore of Miminiska Island and extends a distance of about four miles on to the mainland to the east.

The airborne magnetics show an off-scale reading of 73,000 gammas over the general area of the anomaly. The ground magnetometer shows the iron formation to be composed of numerous zones of medium to high intensity magnetic anomalies stretched en echelon and merging into and out of several main parallel bands over the length of the iron formation.

Anomaly No. 2 - The second anomaly lies on the peninsula of ground on the north shore of Miminiska Lake. The airborne magnetic anomaly shows an off-scale reading of 73,000 gammas over the area. The ground magnetometer work revealed three main magnetic zones. The southern zone was surveyed for a distance of 5,200 feet. It lies south of base line 50°00N and crosses base line 40°00N. The magnetics continue off the end of the grid to the east and west. The zone is thought to be comparatively weak, the higher magnetics being represented by the 40,000 gamma contour line.

The Middle zone was surveyed for a distance of 6,200 feet and it also continues off the grid to the east and west. The highest reading recorded on this was 132,000 gammas. The magnetics are stronger on this zone, with 40,000 gamma line carrying through the complete zone. There are several magnetic highs on this zone which are well over 60,000 gammas and are from 100 to 150 feet wide and 1500 to 2000 feet long.

The northern zone was not fully surveyed, but was picked up at three different intervals on the northern edge of the grid. The magnetics were traced for a distance of 13,000 feet. The zone appears weaker than the Middle zone except to the east where several higher intensity anomalies are locat-

ed. These lie in the area of base line 90°00N and between 40°00E and 72°00E. The zones are from 1,000 to 2,000 feet long and 100 to 150 feet wide. The northern part of the grid did not fully cover the most northern magnetic high and its width cannot be presently ascertained.

A later report by Effinger (1966) reached the following conclusions:

The magnetometer survey has indicated that the iron formation has been tightly folded, thereby increasing the overall thickness considerably in some areas. However, between these areas the iron formation is generally narrow and uncontorted.

Because of the interlayered waste rock and the fine grained nature of the magnetite, complex beneficiation techniques will be necessary to make an acceptable product from the ore.

From detailed mapping of the large iron formation outcrops on the northern part of Miminiska Island and the adjacent mainland, it is readily apparent that the iron formation is folded on a highly variable scale with steeply plunging northwest- and southeast-trending axes. Some parts of these outcrops are intricately contorted, with fold wavelengths commonly 2 to 3 m or less, while in other parts of the outcrop bedding appears to be planar and regular over 10s of metres. The proportion of chemical metasediment to clastic metasediment varies considerably over these outcrops. In some parts the ratio is roughly 1:1 over a thickness of several metres but generally it is in the range of 1:2 to 1:4.

The following results were obtained from the diamond drilling done by Mattagami Mining Company Limited. In the northwestern claim group, one of the two diamond-drill holes intersected 155 m of iron formation with intercalated clastic metasedimentary units. Assay results reported from this hole vary between 18.2 and 32.6 percent elemental iron. Magnetic concentrates derived after crushing to -325 mesh varied from 59.6 to 66.1 percent elemental iron. In the southeastern claim block one drill hole intersected 165 m of mixed chemical and clastic metasediments. The reported analyses ranged from 13.0 to 30.0 percent elemental iron but after crushing to -325 mesh and magnetic separation, concentrates were found to contain between 64.6 and 70.4 percent elemental iron (Assessment Files Research Office, Ontario Division of Mines, Toronto).

Selco Exploration Company Limited [1972] (9)

In 1970 and 1971 this company carried out a number of small scale ground magnetometer surveys in several widely separated localities in the western part of the map-area to test the results of privately-flown airborne geophysical surveys. In 1972, two diamond drill holes 113 m and 94 m long were drilled into coincident magnetic and electromagnetic anomalies located under Miminiska Lake east and northeast of the point where the Albany River enters the lake. Only minor pyrrhotite-bearing chloritic schist units were reported from the northern hole, but in the southern hole a sulphide breccia zone some 3 m thick was found in felsic metavolcanics. The zone contained approximately 75 percent massive barren sulphides, pyrrhotite and pyrite. No other sulphide minerals were reported (Assessment Files Research Office, Ontario Division of Mines, Toronto).

Thompson, R. [1951] (10)

In 1951, R. Thompson drilled nine shallow diamond drill holes totaling 257 m to intersect quartz veins cutting metavolcanics northeast of Howells Lake. Reported analyses of whole and split core samples indicate generally low gold values except in rare quartz veins containing considerable finely disseminated pyrite, where gold contents up to 0.18 ounce per ton were obtained (Assessment Files Research Office, Ontario Division of Mines, Toronto).

A number of small trenches were found in this vicinity by the field party, but little mineralization was found in the vein material. Grab samples were analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto but only traces of gold and silver were found. The reported drill sites were not found by the field party.

Wottam Lake Occurrence (11)

Approximately 1000 m south of Wottam Lake, the field party located an old gold showing worked in the early 1940s by Coin Lake Gold Mines Limited (Prest 1942). The workings included nine closely spaced trenches up to 6 m long and 1.5 m deep and several diamond drill holes along a zone of amphibole-biotite-garnet iron formation and banded chert. Over a width of about 5 m these rocks contain 1 to 5 percent disseminated arsenopyrite. In the centre of the zone massive pods and blebs of arsenopyrite and pyrite and/or pyrrhotite occur within the amphibole-biotite-garnet rock and adjacent lenses of quartz up to 0.5 m wide. The quartz lenses are parallel to the northeasterly structural trend of the outcrop.

Grab samples of mineralized quartz vein material and adjacent wall rock were collected by the field party and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto. Only one sample of mineralized wall rock contained more than trace amounts, and that contained 0.04 ounce of gold per ton and 0.14 ounce of silver per ton. Prest (1939) also reported only low gold values from this occurrence.

Ymir Mining and Exploration Limited (12)

In 1975 this company held a block of 15 mining claims, TB369957 to TB369971 inclusive, along the southern part of Keezhik Creek. This group of claims had been reduced from a larger block of 26 claims held by the company the previous year when considerable exploration work was done on the property.

HISTORY

The property has been worked from time to time since the late 1920s. In 1937 Prest (1939) reported prospecting along a "gold-quartz vein" striking approximately N50°E along Keezhik Creek. He described visible gold in these veins but stated that values were reported as being low. He also stated that, "At the mouth of Keezhik Creek, bodies of pyrite occur near the sedimentary-volcanic contact; pyrite and quartz with traces of gold have also been reported", but added that "drilling here did not warrant further exploration". No details on this drilling are available.

In 1959-1960 the northeastern part of this property was included in geological, ground magnetic and electromagnetic surveys done by M.J. Boylen Engineering Offices subsequent to their airborne geophysical surveys in the region in 1959. The company was apparently searching for base metal sulphide bodies but no significant conductors or magnetic anomalies were located (Assessment Files Research Office, Ontario Division of Mines, Toronto).

In 1961, Mr. J.C. Baker located the old gold showings but little work was undertaken until 1973 when the present claims were restaked and reconnaissance prospecting was done over the entire block. Most of the activity in 1974 was centred around one trench located about 100 m north of Keezhik Creek. This trench was sampled extensively and bulk samples were taken from the rock dump nearby.

GEOLOGY

This area is poorly exposed except for a few scattered outcrops along Keezhik Creek. With the exception of a narrow north-trending diabase dike all these outcrops appear to consist of clastic metasediments. For the most part these rocks are coarse grained lithic arenites and/or wackes in which rock and mineral fragments up to 5 mm are common. Finer grained wacke units and slaty units were also found in some outcrops. East- to northeast-trending shear zones were found in most outcrops.

MINERALIZATION

The gold reported on the property occurs in silicified sheared metasediments in which quartz and carbonate stringers are abundant. In the main trench area, a N50°E striking shear zone approximately 3 m wide consisting of several narrow anastomosing shears has been stripped over a length of approximately 15 m. Pyrite, pyrrhotite and arsenopyrite are sparsely disseminated within the quartz-carbonate material. Very fine but visible free gold has been reported (Bayne 1974) in a number of grab samples.

The following results were reported by Bayne (1974) for channel samples

Geology of Miminiska Lake Area

taken from the main trench and for bulk samples from the adjacent waste rock dump:

An 11-foot width averaged 0.502 oz. gold per ton uncut and 0.479 oz/ton cut. The observed visible gold (V.G.) was rejected from these samples before assay and the resulting rejects from five of the six continuous samples over the 11-foot width were submitted as a composite which assayed 1.88 oz/ton. Including the V.G. in the average calculation gave a weighted average gold assay of 0.753 oz/ton uncut and 0.574 oz/ton cut.

Wall samples contiguous to both sides of the foregoing 11-foot width, before and after blasting and scaling to an effective straight width of 13.5 feet, assayed 0.02 oz/ton and 0.093 oz/ton on respective south and north walls. The weighted average gold assay over this expanded width, then, was:

I) Omitting observed V.G. composite 1.88 oz/ton-

0.391 oz/ton uncut,

0.374 oz/ton cut

II) Including observed V.G. composite 1.88 oz/ton-

0.604 oz/ton uncut,

0.463 oz/ton cut

A 53.9 pound bulk sample, collected at random from the old dump along both sides of the old trench extending 45 feet S-W of the N-E face sampled in situ, was handled by the same procedure as to observed visible gold.

The weighted average assays for four separate laboratory "mixing and splitting cuts" following crushing were:-

I) Omitting observed V.G. composite 1.43 oz/ton-0.296 oz/ton

II) Including observed V.G. composite 1.43 oz/ton-0.390 oz/ton uncut

0.355 oz/ton cut.

Suggestions for Future Mineral Exploration

With the strong prospect of improved bulk transportation facilities in this region, occurrences of iron or base metals may become economically viable in the future. If proven ore deposits near Lake St. Joseph to the southwest of the map-area are brought into production with rail or slurry pipeline connections to the south, the Miminiska Lake deposits and other potential ore bodies in this region will bear re-examination. Although the areal extent of the magnetitic iron formations are quite well known from aeromagnetic data, the possibility that considerably more iron is present in the form of non-magnetic siderite-rich iron formation in the central and western part of the area cannot be overlooked. Since gold has been found associated with rocks now recognized as metamorphosed carbonate iron formation, the sideritic iron formation should also be prospected for gold.

Known base metal sulphide deposits are few in this area but this may reflect poor exposure, particularly in the felsic metavolcanic areas. A number of areas within the metavolcanic sequences should be examined on the ground. These include:

1) the upper part of the lower metavolcanic sequence which includes felsic to intermediate pyroclastic units, mafic pyroclastic units, chemical metasediments and several small sulphide showings; 2) the thick felsic to intermediate pyroclastic sequence underlying the western arm of Miminiska Lake and its probable extension southwestward toward Snake Falls. The extent and composition of this pile is largely unknown but accumulations of coarse felsic pyroclastic

material found along the western side of Miminiska Peninsula suggest that further investigation is warranted. Magnetic-electromagnetic surveys and diamond drilling will certainly be required in assessing this area's potential; 3) the area north of the Lilypad Lakes where mafic and felsic metavolcanics, including pyroclastic rocks, are interlayered with thick felsic porphyry sills; 4) the northern part of Petawanga Lake where several small sulphide showings were found in an area which showed no signs of previous prospecting activity; 5) the small lens of felsic to intermediate pyroclastic rocks north of the mouth of Ferguson Creek which also appears to be unexplored.

Minor amounts of chalcopyrite were found at the contact of the Cluff Lake intrusion east of the map-area (Wallace 1976a). These contacts and the intrusion itself should be prospected for copper, gold and molybdenum.

Most prospecting for gold in this area has been concentrated in the metasediments, particularly in and around units of deformed and/or metamorphosed iron formation where they are cut by east-trending shear zones. Results have generally been discouraging. The known association of gold with felsic quartz-feldspar porphyry bodies cutting mafic metavolcanics east of the map-area near the Fort Hope Mine (Wallace 1976a) should be further investigated in the areas north of the Lilypad Lakes and in the upper metavolcanic sequence around Howells Lake.

The Kawitos Lake batholith contact zone in the southeastern corner of this area should be explored for lithium-bearing pegmatite bodies related to those which occur north of the Lilypad Lakes. The exotic pegmatite bodies there are believed to be related to the Kawitos Lake batholith itself. The cesium, tin, uranium, beryllium and tungsten contents of such exotic pegmatites should also be investigated.

REFERENCES

- Ayres, L.D.
1972: Guide to granitic rock nomenclature in reports of the Ontario Division of Mines; Ontario Division of Mines, Miscellaneous Paper 52, 14p.
- Ayres, L.D., Lumbers, S.B., Milne, V.G., and Robeson, D.W.
1971: Ontario Geological Map; Ontario Department of Mines and Northern Affairs, Map 2196, scale 1 inch to 16 miles. Compilation 1970.
- Baker, J.M.
1946: Unpublished report on a Geomagnetic Survey north of Wottam Lake, Miminiska Lake Area, Ontario, 4p; prepared for International Mining Corporation (Canada) Limited; Assessment Files Research Office, Ontario Division of Mines, Toronto.
- Bayne, A.S.
1974: Unpublished report on Exploration Activity in the Keezhik Creek Area, Ontario, 19p; prepared for Ymir Mining and Exploration Limited; Assessment Files Research Office, Ontario Division of Mines, Toronto.
- Bell, R.
1886: Report on an Exploration of Portions of the At-Ta-Wa-Pish-Kat and Albany Rivers, Lonely Lake to James Bay; Geological Survey of Canada, Annual Report, Vol.2, Report G, p.1G-38G.
- Burwash, E.M.
1929: Geology of the Fort Hope gold area, District of Kenora (Patricia Portion); Ontario Department of Mines, Vol.38, pt.2, p.1-48, (published 1930).
- Deer, W.A., Howie, R.A., and Zussman, J.
1963: Rock Forming Minerals, Vol.2, Chain Silicates; John Wiley & Sons, New York, N.Y., 374p.
- Effinger, F.D.
1966: Unpublished report on a Magnetometer Survey of the Miminiska Lake Area, Ontario, 3p; prepared for Mattagami Mining Company Limited; Assessment Files Research Office, Ontario Division of Mines, Toronto.
- Elson, J.A.
1967: Geology of Glacial Lake Agassiz; In Life, Land, and Water, edited by W.J. Mayer-Oakes, Proceedings of the 1966 Conference on Environment Studies of the Glacial Lake Agassiz Region, University of Manitoba Press, Winnipeg, p.37-95.
- Fisher, R.V.
1966: Rocks composed of volcanic fragments and their classification; Earth-Science Reviews, Vol.1, p.287-298.
- Gray, J.E.
1965: Unpublished report on a Magnetometer Survey on the Miminiska Lake Area, Ontario, 2p; prepared for Algoma Steel Corporation, Limited; Assessment Files Research Office, Ontario Division of Mines, Toronto.
- Gross, G.A.
1965: Geology of Iron Deposits in Canada, Vol.1, General Geology and evolution of iron deposits; Geological Survey of Canada, Economic Geology Report 22, 181p.
- Jackson, G.D.
1961: Miminiska (NTS 52P), Ontario; Geological Survey of Canada, Map 8-1961, scale 1 inch to 4 miles. Geology 1960.

Geology of Miminiska Lake Area

Jensen, L.S.

1976: A new cation plot for classifying subalkalic volcanic rocks; Ontario Division of Mines, Miscellaneous Paper 66, 22p.

Klein, Cornelis Jr.

1973: Changes in Mineral Assemblages with Metamorphism of Some Banded Precambrian Iron-Formations; *Economic Geology*, Vol.68, p.1075-1088.

ODM-GSC

1960a: Miminiska Lake Sheet, Kenora and Thunder Bay Districts, Ontario; Ontario Department of Mines - Geological Survey of Canada, Aeromagnetic Map 954G, 1 inch to 1 mile. Survey Map 1959 to March 1960.

1960b: Opikeigen Lake Sheet, Kenora and Thunder Bay Districts; Ontario Department of Mines - Geological Survey of Canada, Aeromagnetic Map 964G, scale 1 inch to 1 mile. Survey Map 1959 to March 1960.

Ojakangas, R.W.

1972: Archean Volcanogenic Graywackes of the Vermilion District, Northeastern Minnesota; *Geological Society of America Bulletin*, Vol.83, No.2, p.429-441.

Okada, Hakuyu

1971: Classification of Sandstone: Analysis and Proposal; *Journal of Geology*, Vol.79, p.509-525.

Prest, V.K.

1939: Geology of the Keezhik-Miminiska Lakes Area; Ontario Department of Mines, Vol.48, pt.6, p.1-21. Accompanied by Map No.48e, scale 1 inch to 1 mile.

1942: Geology of the Fort Hope Area; Ontario Department of Mines, Vol.51, pt.3, p.1-28 (published 1944). Accompanied by Map No.51b, scale 1 inch to 1 mile.

1963: Red Lake-Lansdowne House area, northwestern Ontario Surficial Geology; *Geological Survey of Canada Paper* 63-6. Accompanied by Maps 4-1963 (bedrock-drift), 5-1963 (surficial geology).

Sharpe, R.J.

1979: A Petrological Study of Some Archean Metamorphic Rocks from the Miminiska Lake Area, northwestern Ontario; unpublished M.Sc. thesis, University of Toronto, 282p.

Stanton, R.L.

1972: *Ore Petrology*; McGraw-Hill Book Company, New York, 713p.

Thurston, P.C. and Carter, M.W.

1969: Operation Fort Hope, Lansdowne House-Fort Hope Sheet; Ontario Department of Mines, Preliminary Geological Map P.562, scale 1 inch to 2 miles. *Geology* 1969.

1970: Operation Fort Hope; Ontario Department of Mines and Northern Affairs, Miscellaneous Paper 42, 64p.

Walker, R.G.

1967: Turbidite Sedimentary Structures and Their Relationship to Proximal and Distal Depositional Environments; *Journal of Sedimentary Petrology*, Vol.37, p.25-43.

1976: Facies Models; 2 Turbidites and Associated Coarse Clastic Deposits; *Geoscience Canada*, Vol.3, No.1, p.25-30.

Wallace, Henry

1974: Opikeigen Lake Area, District of Kenora (Patricia Portion); Ontario Division of Mines, Preliminary Map P.926, Geological Series, scale 1 inch to ½ mile. *Geology* 1973.

1976a: Geology of Opikeigen Lake Area, District of Kenora (Patricia Portion); Ontario Division of Mines, Open File Report 5163, 102p.

1976b: Miminiska Lake Area, District of Kenora (Patricia Portion); Ontario Division of Mines, Preliminary Map P.992, Geological Series, scale 1:31 680 or 1 inch to ½ mile. *Geology* 1973, 1974, 1975.

1978a: Miminiska Peninsula, Kenora and Thunder Bay Districts; Ontario Geological Survey, Map 2416; scale 1:31 680 or 1 inch to ½ mile. Geology 1974, 1975.

1978b: Wottam Lake, Kenora and Thunder Bay Districts; Ontario Geological Survey, Map 2417, scale 1:31 680 or 1 inch to ½ mile. Geology 1974, 1975.

Wanless, R.K., Stevens, R.D., Lachance, G.R., and Rimsaite, J.Y.H.

1966: Age Determinations and Geological Studies, K-Ar Isotopic Ages; Report 6, Geological Survey of Canada, Paper 65-17.

Winkler, H.G.F.

1976: Petrogenesis of Metamorphic Rocks, Revised Fourth Edition; Springer-Verlag New York Inc., 334p.

Young, G.M.

1967: Sedimentology of Lower Visean? Rocks in the Western Part of the Ballina and Donegal Synclines, Northwestern Ireland; unpublished Ph.D. Thesis, University of Glasgow, 204p.

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Scale: 1 inch to 50 miles
N.T.S. Reference: 527/10

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT
Glacial till, sand and gravel deposits, glaciofluvial sand deposits, glaciofluvial sand and gravel deposits, lake, stream and swamp deposits

UNCONFORMITY

PRECAMBRIAN²⁰

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

7 Diabase, gabbro, quartz gabbro, (quartz diabase, olivine diabase) dikes

INTRUSIVE CONTACT

EARLY PRECAMBRIAN

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

6 Unsubdivided
6a Granodiorite, quartz monzonite,
6b Pegmatite
6c Felsite, porphyry, quartz-feldspar porphyry

RELATIONSHIP UNCERTAIN

MAFIC INTRUSIVE ROCKS

5 Unsubdivided
5a Diabase, gabbro, meltegarro (sills and dikes)
5b Meltegarro (sills and dikes)

INTRUSIVE CONTACT

METASEDIMENTS

FERRUGINOUS CHEMICAL METASEDIMENTS

4 Unsubdivided
4a Banded magnetite-quartz iron formation, banded chert
4b Banded siderite-silica-quartz iron formation
4c Banded greenite-hornblende iron formation
4d Massive to banded amphibole-garnet-biotite iron formation
4e Pyritic, ferruginous granitic siltstone

CLASTIC METASEDIMENTS*

3 Unsubdivided
3a Mudstone, siltstone, slate, quartz-sericite schist
3b Siltstone, shale, silty subarkose waste, felspathic siltstone, lithic arkose
3c Lithic arkose, felspathic siltstone
3d Polymictic pebbles and cobble conglomerate, pebbly sandstone
3e Quartz-feldspar-biotite schist
3f Garnetiferous quartz-feldspar-biotite schist
3g Staurolite quartz-feldspar-biotite schist

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS

2 Unsubdivided
2a Massive and flow-banded flows, auto-clastic breccias
2b Tuff, crystal tuff, laminated tuff
2c Tuff breccia, pyroclastic breccia
2d Quartz-feldspar porphyry
2e Volcaniclastic metasediments

MAFIC TO INTERMEDIATE METAVOLCANICS

1 Unsubdivided
1a Massive flows and related auto-clastic breccias
1b Amphibolites
1c Garnetiferous amphibolite
1d Pyroclastic rocks
1e Coarse amphibolite

MINERAL DEPOSITS

Ag Silver
As Arsenopyrite
Au Gold
Cp Chalcopyrite
Fe Iron
Li Lithium
Mn Manganese
Pb Pyrite
S Sulfide mineralization

*Unconsolidated deposits. Cenozoic deposits are represented by the lighter colored and uncoloured parts of the map.

*Bedrock geology. Outcrops and inferred extensions of each rock unit are shown respectively in deep and light tones of the same color. Where a place a formation is too narrow to show in color and must appear in black, a short black bar appears in the appropriate block.

*Subdivision of major rock units does not indicate age relationship.

*May be in part extrusive.

*Age relationship between these units uncertain.

*May be in part intrusive.

*Consistent detrital material derived almost exclusively from units 2b, c, and d found nearby.

*Occurs only on companion sheet.

SOURCES OF INFORMATION

Geology by Henry Wallace and assistants, Geological Branch, 1974-5.

Geology is not tied to surveyed lines.

Aeromagnetic maps 954G and 964G, ODM-GSC.

Ontario Division of Mines; Map 46, Volume 48, 1939; Map 51b, Volume 51, 1942.

Preliminary maps (ODM) P58, Lansdowne House; Fort Hope Sheet, scale 1 inch to 2 miles, issued 1910, and P58, Miminiska Lake, scale 1 inch to 1/2 mile, issued 1916.

Cartography by P. A. Wosbey and assistants, Surveys and Mapping Branch, 1978.

Base maps derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by Henry Wallace.

Magnetic declination in the area was approximately 1° 40' West in 1974.

SYMBOLS

Glacial strat.

Glacial fluting.

Esker or moraine.

Small bedrock outcrop.

Area of bedrock outcrop.

Bedding, top unknown; (inclined, vertical).

Bedding, top indicated by arrow; (inclined, vertical, overturned).

Lava flow; top (arrow) from pillow shape and packing.

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.

Joining; (horizontal, inclined, vertical).

Drill hole; (vertical, inclined).

Swamp.

Trail, portage, winter road.

District boundary.

Mining property, surveyed, approximate position only.

Mineral deposit; mining property, unsurveyed.

Surveyed line, approximate position only.

PROPERTIES, MINERAL DEPOSITS

1. Campbell, R. J.†

2. Canadian Nickel Co. Ltd. (1972).

3. Central Nickel Gold Mines Ltd.†

4. Corwest Exploration Co. Ltd. (1945)†

5. Froid Lake Mining Co. Ltd.†

6. International Mining Corporation (Canada) Ltd. (1945)†

7. Kidd, R.

8. Matlagani Lake Mines Ltd.

9. Seko Mining Corp. Ltd. (1972).

10. Thompson, R. (1951).

11. Wotlam Lake occurrence.†

12. Ymir Mining and Exploration Ltd.

Information current to December 31st, 1975.

†Only former properties on ground now open for staking are shown where exploration information is available.

†In square brackets indicates last year of exploration activity. For further information see report.

†Occurs only on companion sheet.

NOTES

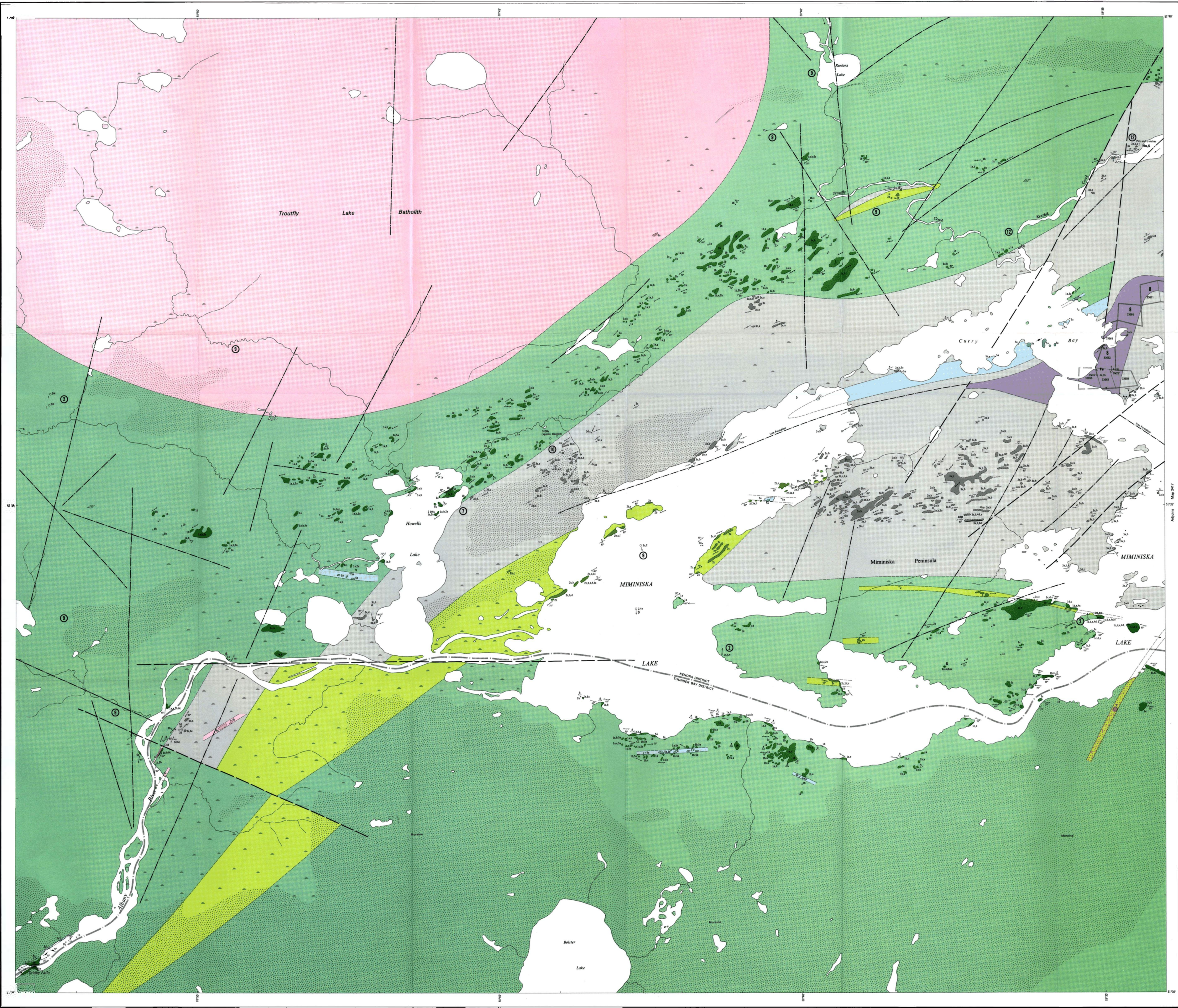
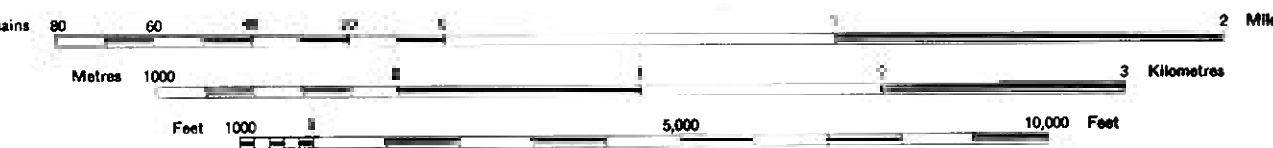
The designating letters 'PA' have been omitted on this map from the numbers marking the mining claims recorded at the office of the Thunder Bay Mining Division.

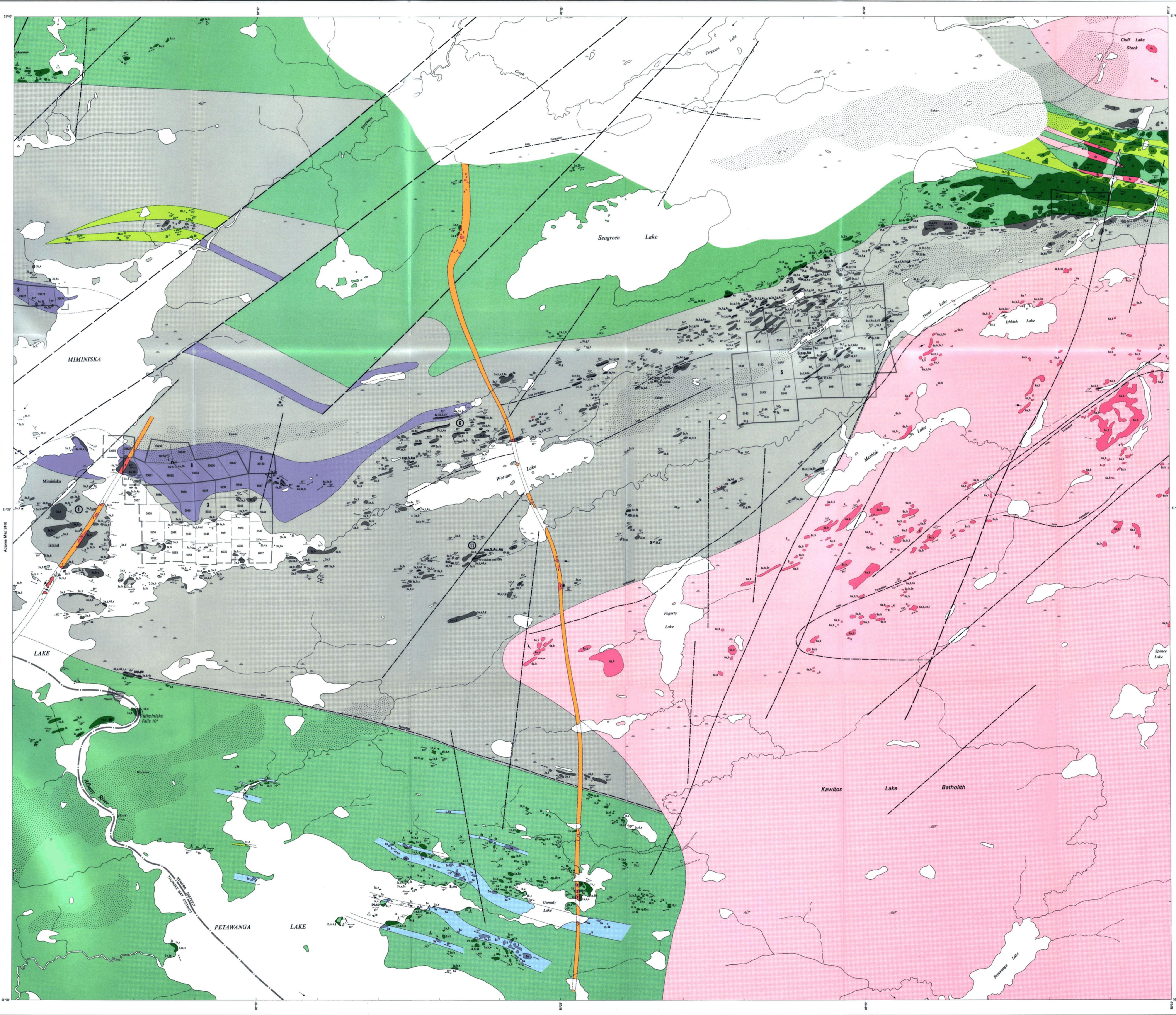
Ontario
Ministry of Natural Resources
Hon. James A. C. Auld
Minister
Dr. J. K. Reynolds
Deputy Minister

Ontario Geological Survey
Map 2416

MIMINISKA PENINSULA
KENORA and THUNDER BAY DISTRICTS

Scale 1:31,680 or 1 inch to 1/2 Mile





LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Glacial till, sand and gravel deposits, glauconitic and deposits, glaciofluvial sand and gravel deposits, lake, stream and silt deposits

UNCONFORMITY

PRECAMBRIAN

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

7 Diabase, gabbro, quartz gabbro, quartz diorite, diorite, diabase dikes

INTRUSIVE CONTACT

EARLY PRECAMBRIAN

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

6 Unsubdivided
6a Granodiorite, quartz monzonite
6b Pegmatite
6c Feldspar porphyry, quartz-feldspar porphyry

RELATIONSHIP UNCERTAIN

MAFIC INTRUSIVE ROCKS

5 Unsubdivided
5a Diabase, gabbro, metagabbro (sills and dikes)
5b Metatortrite (sills and dikes)

INTRUSIVE CONTACT

METASEDIMENTS

FERRUGINOUS CHEMICAL METASEDIMENTS*

4 Unsubdivided
4a Banded magnetite-quartz iron formation, laminated
4b Banded siderite-ankerite-quartz iron formation
4c Banded grunerite-hornblende iron formation
4d Massive to foliated amphibole-pyrite-ankerite iron formation
4e Pyritic, pyritic-graphitic slate,†

CLASTIC METASEDIMENTS*

3 Unsubdivided
3a Mudstone, siltstone, slate, quartz-sericite schist
3b Siltstone, shale, lithic siltstone, lithic argillite
3c Lithic arkose, feldspathic arkose
3d Polymictic pebble and cobble conglomerate, pebbly sandstone,†
3e Quartz-feldspar gneiss
3f Garnetiferous quartz-feldspar-biotite schist
3g Stratiolitic quartz-feldspar-biotite schist

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS*

2 Unsubdivided
2a Massive and flow-banded flows, andesitic breccias
2b Tuff, tuffaceous tuff, laminated tuff
2c Lignite, lignite
2d Tuffaceous, pyroclastic breccia
2e Quartz-feldspar porphyry,†
2f Volcanoclastic metasediments,†

MAFIC TO INTERMEDIATE METAVOLCANICS*

1 Unsubdivided
1a Massive flows and related andesitic breccias
1b Flowed flows and related breccias
1c Amphibolite
1d Garnetiferous amphibolite
1e Pyroclastic rocks
1f Coarse amphibolite

MINERAL DEPOSITS

Ag Silver
As Arsenopyrite
Au Gold
Cp Chalcopyrite
Fe Iron
Li Lithium
Mn Malachite
Pb Pyrite
Py Pyrite
S Sulphide mineralization

UNCONSOLIDATED DEPOSITS

Cenozoic deposits are represented by the lighter colored and uncolored parts of the map.

BEDROCK GEOLOGY

Outcrops and inferred extensions of each rock unit are shown respectively in deep and light lines of the same color. Where in places a formation is too narrow to show in color and must appear in black, a short black bar appears in the appropriate block.

*Subdivision of major rock units does not indicate age relationship.

†May be in part extrusive.

‡Age relationship between these units uncertain.

§May be in part intrusive.

¶Consistent detrital material derived almost exclusively from units 2a, c and d found nearby.

‡Occurs only on companion sheet.

SOURCES OF INFORMATION

Geology by Henry Wallace and assistants, Geological Branch, 1974-5.

Geology is not tied to surveyed lines.

Aeromagnetic maps 954G and 964G, ODM-GSC.

Ontario Division of Mines, Geological Branch, 1962.

Map 48a, Volume 49, 1959.

Map 51a, Volume 51, 1962.

Preliminary maps (ODM) P569, Landslide House-Fort Hope Sheet, scale 1 inch to 2 miles, issued 1970, and P592, Miminiska Lake, scale 1 inch to 2 1/2 miles, issued 1976.

Cartography by P. A. Wisbey and assistants, Surveys and Mapping Branch, 1978.

Base maps derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by Henry Wallace.

Magnetic declination in the area was approximately 1° 40' West in 1974.

PROPERTIES, MINERAL DEPOSITS

1. Campbell, R. J.

2. Canadian Nickel Co. Ltd. (1972)†

3. Central Patricia Gold Mines Ltd.

4. Cornwell Exploration Co. Ltd. (1948)

5. Fond Lake Mining Co. Ltd.

6. International Mining Corporation (Canada) Ltd. (1948)

7. Kidd, R. J.

8. Mattagami Lake Mines Ltd.

9. Sals Mining Corp. Ltd. (1972)†

10. Thompson, R. (1951)†

11. Wottam Lake occurrence.

12. Zinc Mining and Exploration Ltd.†

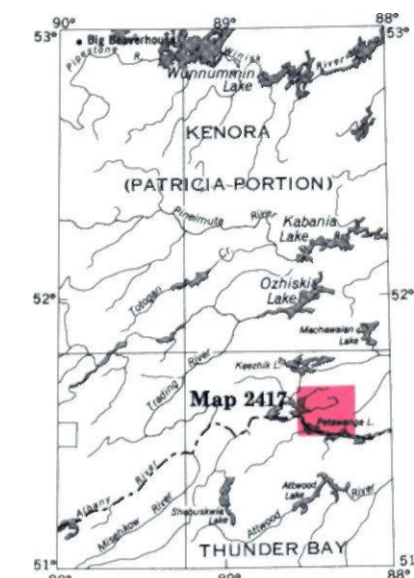
Information current to December 31st, 1975.

Only former properties on ground now open for staking are shown where exploration information is available.

†Occurs only on companion sheet.

NOTES

The designating letters 'PA' have been omitted on this map from the numbers marking the mining claims recorded at the office of the Thunder Bay Mining Division.



Scale: 1 inch to 50 miles
N.T.S. Reference: SP/9, SP/10

SYMBOLS

- Glacial striae
- Glacial fluting
- Esker or moraine
- Small bedrock outcrop
- Area of bedrock outcrop
- Bedding, top unknown, (inclined, vertical)
- Bedding, top indicated by arrow, (inclined, vertical, overturned)
- Lava flow, top (arrow) from pillows (shape and packing)
- Foliation (horizontal, inclined, vertical)
- Lineation with plunges
- Geological boundary, position interpreted
- Geological boundary, deduced from geophysics
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament
- Joining (horizontal, inclined, vertical)
- Drill hole; (vertical, inclined)
- Swamp
- Trail, portage, winter road
- District boundary
- Mineral deposit, mining property, approximate position only.
- Mineral deposit; mining property, surveyed, approximate position only.
- Surveyed line, approximate position only.

Ontario Geological Survey
Map 2417
WOTTAM LAKE
KENORA AND THUNDER BAY DISTRICTS

Scale 1:31,680 or 1 Inch to 1/2 Mile

Ministry of Natural Resources
Ontario

Hon. James A. C. Auld
Minister
Dr. J. K. Reynolds
Deputy Minister

Chain 80 60 40 20 0 20 40 60 80 Miles
Feet 1000 500 0 500 1000 Feet