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Ontario Geological Survey
Report 247

Geology of the Funger Lake Area District of Thunder Bay

1986

Ministry of
Northern Development
and Mines
Ontario

Ontario Geological Survey
Report 247

Geology of the
Funger Lake Area
District of Thunder Bay

by
R.H. Sutcliffe

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Ontario
Ministry of
Northern Development
and Mines

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Deputy Minister

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Foreword

Prior to this report only reconnaissance level information was available on the geology of the Funger Lake Area. The area lies northwest of Armstrong and was presumed to be underlain by granitic rocks; however, much uncertainty existed with respect to: (1) possible extension into the area of the Caribou Lake-Pikitigushi River supracrustal rocks from the east; (2) the presence and character of anorthositic and gabbroic rocks in the area; and (3) the presence of a major mylonitic fault zone extending through the area from Pashkokogan Lake in the west. As a first step in assessing the mineral potential, it was necessary to map the area at a detailed scale to determine the presence, extent, and character of rock units which have potential base metal, lithium, chromite, and uranium mineralization associations. Sections of the waterways in the area are very picturesque with extensive exposed granitic bedrock along the shores.

V.G. Milne

Director

Ontario Geological Survey

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GEOLOGICAL MAP (BACK POCKET)

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

OTHER USEFUL CONVERSION FACTORS

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.

Geology of the Funger Lake Area

District of Thunder Bay

R.H. Sutcliffe

Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto.

Manuscript accepted for publication by the Chief Geologist, April 22, 1981. This report is published with the consent of V.G. Milne, Director, Ontario Geological Survey.

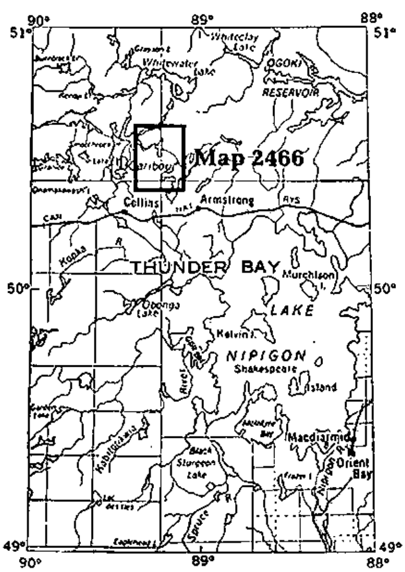
ABSTRACT

The Funger Lake Area covers approximately 386 km^2 in the District of Thunder Bay. The centre of the map area is about 30 km northwest of the town of Armstrong. The map area includes Early Precambrian (Archean) rocks of the volcanic-plutonic Wabigoon Subprovince of the Superior Province and lesser Late Precambrian (Proterozoic) rocks of the Nipigon Plate of the Southern Province.

Metavolcanic and metasedimentary rocks of the Caribou Lake-Pikitigushi River supracrustal belt bifurcate into two east-west trending limbs to the east of the map area. Within the area, metavolcanic and metasedimentary rocks have been metamorphosed to medium grade and primary features have largely been destroyed. The metavolcanic sequence consists entirely of mafic rocks and is now represented by massive to schistose amphibolite and amphibolite ± garnet ± clinopyroxene gneiss. Metasedimentary rocks intercalated with the mafic metavolcanics primarily consist of recrystallized chert, gruneritic chert, and grunerite ironstone.

Intrusive rocks account for approximately 80% of the exposed bedrock in the map area. The oldest suite of intrusive rocks consists predominantly of biotite tonalite which ranges in texture from foliated to gneissic and is intrusive into the amphibolite. The structural fabric of the tonalite suggests that it was emplaced as several domes. An extensive swarm of amphibolite, gabbro, and anorthosite gabbro dikes, trending 020° to 050°, discordantly intrudes the tonalite in the northern part of the area. The dikes represent the earliest phase of an episode of basaltic magmatism which postdated the oldest granitoid plutonism. This basaltic magmatism culminated in the intrusion of gabbroic rocks of the Outlet Bay Pluton. Hornblende gabbro constitutes the majority of the Outlet Bay Pluton but a range from anorthosite to clinopyroxenite is locally present. In the southern part of the map area, an alkaline intrusion, the Southern Caribou Lake Pluton, intrudes the biotite tonalite. This pluton varies from albite syenite to hornblende pyroxenite. Late granitoid rocks ranging in composition from granodiorite to granite intrude all other Early Precambrian (Archean) rocks. The largest body of this suite, the Smoothrock Lake Pluton, consists of garnet-muscovite-biotite granite with associated numerous sills and dikes of granite pegmatite.

On the northern boundary of the area, cataclastic textures occur in a east-west trending zone approximately 1.5 km wide. The cataclastic rocks are the eastern



SMC 15118

Figure 1. *Key map showing location of the Funger Lake Area. Scale 1:3 168 000 (1 inch to 50 miles).*

extension of the Pashkokogan Lake-Kenoji Lake Fault Zone which represents the Wabigoon-English River Subprovince boundary in this area.

Late Precambrian (Keweenawan) diabase sills, sheets, and dikes of the Nipigon Plate are common and are the youngest rocks in the map area.

Pleistocene deposits consist of thin ground moraine, esker deposits, and glaciolacustrine sand.

Mineral exploration within the map area has been minimal. Concentrations of pyrite and/or pyrrhotite without associated base metal sulphides occur within supracrustal rocks on or near Lonebreast Bay and Caribou Bay on Smoothrock Lake, and on Rove Lake. Selected grab samples indicate only traces of gold, silver, zinc, copper, and nickel at these occurrences.

Geology of the Funger Lake Area, District of Thunder Bay, by R.H. Sutcliffe, Ontario Geological Survey Report 247, 58p. Published 1986. ISBN 0-7729-1267-X.

Introduction

The Funger Lake Area covers a region bounded by Latitudes 50°23'00" to 50°37'30" North and Longitudes 89°07'30" to 89°20'00" West and comprises approximately 386 km^2. The centre of the map area is approximately 30 km northwest of the town of Armstrong (Figure 1). The map area is located at the northern margin of the Wabigoon Subprovince of the Superior Province (Douglas 1973) and includes Early Precambrian (Archean) metavolcanic and metasedimentary rocks of the Caribou Lake-Pikitigushi River greenstone belt, Early Precambrian plutonic rocks of the Sowden-Wabikimi Lakes granitoid complex, and Middle to Late Precambrian (Proterozoic) rocks of the Nipigon Plate.

The present map area is at the western extremity of the Caribou Lake Supracrustal Belt which extends for approximately 150 km to the east, north of Lake Nipigon to Marshall and O'Sullivan Lakes. The belt contains occurrences of gold, silver, copper, lead, iron, zinc, nickel, tin, beryllium, and lithium (Pye *et al.* 1965). All of these occurrences are to the east of the map area. There was no recorded mineral exploration within the map area at the time of writing.

Acknowledgments

Capable assistance in the field was provided by P.A. Fernberg, A. Bivi, G.W.L. Kavanagh, and M. Morand. P.A. Fernberg, as senior geological assistant, was responsible for approximately half of the mapping.

The author would like to thank D. Elliot of the Ontario Ministry of Natural Resources Base at Armstrong for logistical aid during the field season and W. Smith of Sportsman's Outfitting Services, Armstrong, for providing air support.

Thanks are extended to W.O. Mackasey, formerly Subsection Chief of the Central Archean Subsection, Ontario Geological Survey, for his help and supervision during all aspects of the survey.

Access

The southeastern part of the map area is accessible from Caribou Lake, which can be reached via a 10 km gravel road from Armstrong. Lonebreast Bay and Caribou Bay on Smoothrock Lake, which provide access to the northwestern part of the map area, are accessible by float equipped aircraft. Rove Lake, Cowman Lake, and several unnamed lakes in the southwestern part of the area are also accessible by air. Float equipped aircraft can be chartered in Armstrong.

A well developed system of portages connects Outlet Bay on Caribou Lake and Caribou Bay on Smoothrock Lake via the Caribou River.

Armstrong can be reached via a 280 km gravel road from Thunder Bay or via the Canadian National Railway transcontinental line. The Ministry of Transportation and Communications maintains a gravel airstrip approximately 10 km east of Armstrong, but there is no regular air service to the town.

Field Methods

Field work was carried out from late May to early September 1979. Mapping was done by pace-and-compass traverses over land and shoreline traverses along navigable lakes and streams. Outcrops were located on aerial photographs and land traverses were run from outcrop to outcrop in a zig-zag pattern. The traverses were designed to optimize time spent running perpendicular to strike. In areas of little exposure traverses were run using topographic features as controls. A spacing of approximately 400 to 500 m was maintained between adjacent compass lines where possible.

Areas of outcrop are commonly extensive, but the exposure is limited by heavy moss growth and thin ground moraine. Actual rock exposure is therefore considerably less than indicated by the areas of outcrop on the accompanying map (Map 2466, back pocket).

All parts of the shown outcrop area may not necessarily have been examined. In some cases lithological contacts shown on the accompanying map may be interpolated between observed lithological contacts.

Geological data were plotted in the field on acetate sheets attached to vertical aerial photographs at a scale of 1:15 840. The data were transferred from the acetate overlays to cronaflex base maps (1:15 840) of the Forest Resources Inventory, Ontario Ministry of Natural Resources. Base maps were supplied by the Cartography Section, Surveys and Mapping Branch, Division of Lands, Ontario Ministry of Natural Resources.

Two surveyed and cut lines are present within the area; the 7th base line and an approximately north-south line through the centre of the map area. Geology is not tied to these lines.

Previous Geological Work

Collins (1909) conducted the first systematic geological survey in the area as part of a reconnaissance of the area adjacent to the transcontinental railway line north of Lake Nipigon. More recently the map area was examined by Sage *et al.* (1974) during Operation Ignace-Armstrong. This reconnaissance survey resulted in the delineation of the major lithological and structural features within the map area. Gussow's (1942) mapping of the Caribou Lake-Pikitigushi River area included the eastern portion of the present map area.

Aeromagnetic maps covering the area were flown in 1959-60 and 1962 (ODM-GSC 1960, 1962). The map area lies within the Sioux Lookout-Armstrong geological compilation map (Davies *et al.* 1966).

Physiography

The height of land separating the natural Arctic and Atlantic watersheds passes immediately to the east of the area. Caribou Lake drains into Smoothrock Lake via the Caribou River and then into the Ogoki River System.

Elevations range from approximately 425 m, at several locations in the southern half of the map area and northeast of Rove Lake, to 350 m, the elevation of Smoothrock Lake. In general, the land slopes gently to the northwest, with the highest elevation being a result of prominent diabase ridges. Local relief is variable. The northwest quarter of the area is flat and swampy. In the remainder of the area, diabase ridges and massive outcrops of the Outlet Bay Pluton result in local relief to as much as 60 m. Small scarps and bluffs are present in the area underlain by diabase.

Outcrop density within the region is variable. The density is lowest north of Smoothrock Lake where the bedrock is covered by thick glaciolacustrine sands and esker deposits. Outcrop density is also low around Caribou Lake due to cover by thick ground moraine and esker deposits. Generally high outcrop density characterizes much of the remainder of the area with the outcrop forming elevated hills in a thin mantle of ground moraine and swamp deposits.

All streams within the map area drain into either Caribou Lake or Smoothrock Lake. Drainage is generally poorly established with swamp and muskeg being common.

General Geology

TERMINOLOGY

For clarity, a brief discussion of some terms used in this report is given below.

Precambrian Time Scale

The Precambrian time scale used is that of Ayres *et al.* (1970) for the Geological Map of Ontario. Precambrian time is subdivided into Early (Archean), and Middle and Late Precambrian (Proterozoic) eras. Time boundaries between the Early and Middle Precambrian and Middle and Late Precambrian are placed at 2500 million years and 1500 million years respectively. No radiometric ages are available for rocks within the map area. The Early Precambrian rocks have been classified on the basis of their similarity with rocks which have been dated in adjacent areas. Diabase sheets and sills are intrusive into the Late Precambrian Sibley Group metasediments (Ayres *et al.* 1971) immediately to the south of the map area and therefore diabase within the map area is classified as Late Precambrian.

Granitoid Classification

Granitoid rocks are classified according to the I.U.G.S. Subcommission on the systematics of igneous rocks (Streckeisen 1976). The plutonic rock nomenclature used in this report is explained by Streckeisen (1976).

Cataclastic Rocks

Cataclastic rocks are regarded by Bell and Etheridge (1973) as being a result of ductile deformational processes as opposed to brittle deformation. Accordingly, the term mylonite is used as defined by Bell and Etheridge (1973): a foliated rock, commonly lineated and containing megacrysts, which occurs in narrow planar zones of intense deformation. It is commonly finer grained than the surrounding rocks, into which it grades.

Foliation, Schistosity, Gneissosity

In this report, foliation, schistosity, and gneissosity are used to cover all types of megascopic penetrative planar fabrics. Several varieties of penetrative planar fabrics can be distinguished based on features such as mineralogical layering, preferred orientation of mineral grains, and primary igneous or secondary metamorphic nature. Gneissosity denotes a layering of metamorphic origin defined by layers or rocks of contrasting mineralogical composition. Schistosity denotes a structure of metamorphic origin due to well developed planar alignment of crystals within the rock. Schistosity implies a fissility to the rock. Foliation includes all penetrative planar features which are neither schistose nor gneissic. Foliation includes planar fabrics which are both metamorphic and of primary igneous origin. On the accompanying geological map, the symbol for banding is used to denote primary igneous layering in the Outlet Bay Pluton.

GEOLOGICAL SUMMARY

The Early Precambrian (Archean) rocks of the Funger Lake Area consist of:

(1) Mafic metavolcanic rocks and minor metasedimentary rocks of medium metamorphic grade,

(2) An early felsic to intermediate plutonic suite composed predominantly of biotite tonalite,

(3) A northeast trending swarm of amphibolite, gabbro and gabbroic anorthosite dikes,

(4) The gabbroic Outlet Bay Pluton which intrudes the tonalite,

(5) The mildly alkaline Southern Caribou Lake Pluton consisting of albite syenite to altered pyroxenite,

(6) Late porphyroblastic granodiorite to granite of the Caribou Bay Pluton,

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR THE FUNGER LAKE AREA

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Till, esker deposits, glaciolacustrine sand deposits; swamp, stream, lake deposits.

Unconformity

PRECAMBRIAN

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS[a]

Diabase sheets and sills, diabase dikes, granophyre related to diabase.

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)

CATACLASTIC ROCKS[b]

Mylonite, augen gneiss, protomylonite, pseudotachylite.

Fault Contact

LATE FELSIC PLUTONIC ROCKS[c,d]

Biotite granite, biotite muscovite and muscovite biotite granite, biotite granite pegmatite, muscovite granite pegmatite, garnet bearing granite and pegmatite.

Intrusive Contact

LATE FELSIC TO INTERMEDIATE PLUTONIC ROCKS[e]

Granodiorite, porphyritic granodiorite, granite, mafic granodiorite.

Intrusive Contact

ALKALINE FELSIC TO ULTRAMAFIC PLUTONIC ROCKS[f]

Albite syenite and oligoclasite, diorite and gabbro, melagabbro, hornblendite and clinopyroxenite.

Intrusive Contact

TABLE 1. Continued

MAFIC TO ULTRAMAFIC PLUTONIC ROCKS[g]

Anorthosite, anorthositic gabbro, hornblende gabbro, clinopyroxene gabbro, hornblende-clinopyroxene melagabbro, clinopyroxenite, apatite-clinopyroxene-magnetite dike rocks.

Intrusive Contact

MAFIC DIKE ROCKS

Amphibolite, gabbro, anorthositic gabbro, lamprophyre[h]

Intrusive Contact

EARLY FELSIC TO INTERMEDIATE PLUTONIC ROCKS[i]

Biotite tonalite, biotite granodiorite, biotite hornblende diorite and quartz diorite, biotite-muscovite and muscovite-biotite granite.

Intrusive Contact

METAMORPHOSED ULTRAMAFIC ROCKS

Serpentinite, metapyroxenite.

Intrusive Contact

METAVOLCANICS AND METASEDIMENTS

CHEMICAL METASEDIMENTS

Chert, grunerite chert, grunerite ironstone.

CLASTIC METASEDIMENTS

Argillite.

MAFIC METAVOLCANICS

Pillowed amphibolite, porphyritic amphibolite, massive amphibolite, foliated to schistose amphibolite[j], amphibolite $\pm$ garnet $\pm$ clinopyroxene gneiss, coarse grained amphibolite[k].

NOTES
a. Subdivision of major rock units does not indicate age relations.
b. Pashkokogan Lake-Kenoji Lake Fault Zone and Outlet Bay Fault.
c. Plutonic rock classification follows IUGS Subcommission on the Systematics of Igneous Rocks (Streckeisen 1976).
d. Late plutonic suite; Smoothrock Lake Pluton and associated rocks.
e. Caribou Bay Pluton and associated rocks.
f. Southern Caribou Lake Pluton.
g. Outlet Bay Pluton.
h. May be younger in age.
i. Early plutonic suite.
j. Schists and gneisses of probable volcanic origin.
k. May be gabbro and metagabbro in part, especially south of the Outlet Bay Pluton.

(7) A late suite of massive granite and pegmatite of the Smoothrock Lake Pluton.

Middle to Late Precambrian (Proterozoic) diabase dike sheets and sills are numerous in the area.

The Caribou Lake-Pikitigushi River supracrustal belt bifurates into two east-west trending limbs to the east of the map area. Within the area, the northern limb is named the Rove Lake Belt and is 200 to 600 m wide over a strike length of approximately 15 km. The belt is predominantly composed of mafic amphibolite sheets and mafic amphibolite ± garnet ± clinopyroxene gneisses of probable volcanic origin. Silicate facies grunerite ironstone is also locally present.

The southern limb of the Caribou-Pikitigushi belt passes through Saturday Island of Caribou Lake, north to Glen Lake and west towards Hoppins Lake. The limb is composed of massive to foliated mafic amphibolite. The southern part of the limb has been extensively fragmented by the intrusion of biotite tonalite, while in the north, adjacent to the southern side of the Outlet Bay Pluton, the amphibolite is massive and often gabbroic in texture.

Mafic metavolcanics metamorphosed to medium grade also occur centrally within the Outlet Bay Pluton. These metavolcanics locally contain relict pillow structures and appear less deformed than other metavolcanics within the area. Along the southern contact of the metavolcanics adjacent to the Outlet Bay Pluton is another zone of grunerite ironstone.

The early suite of granitoid rocks consists predominantly of biotite tonalite and minor granodiorite to granite. The tonalite displays a wide spectrum of textural variation and several ages of intrusive phases were observed. Recrystallized, foliated tonalite, often with quartz aggregates, predominates but textural variants range from gneissic to massive. Minor hornblende diorite to tonalite is present in the vicinity of mafic supracrustal remnants.

An extensive swarm of fine to medium grained massive amphibolite dikes and medium grained hornblende gabbro dikes trending 020° to 050° discordantly invades the early plutonic suite north of the Outlet Bay Pluton. Dikes of anorthositic gabbro having plagioclase phenocrysts up to 10 cm in diameter occur on Outlet Bay, Caribou Lake and northeast of Cowman Lake.

The gabbroic Outlet Bay Pluton occupies an area 8 km by 12 km and dominates the central portion of the map area. The pluton intrudes biotite tonalite and mafic metavolcanics, and is predominantly composed of medium grained hornblende gabbro with minor biotite and local relict clinopyroxene. On the southern contact of the pluton igneous layering, with rhythmic gradation from anorthosite to hornblende gabbro, is locally present. Minor sporadically distributed enclaves of altered clinopyroxenite and common fine grained amphibolite enclaves are present in the pluton.

On the southern margin of the map area a 6 km by 3.5 km alkaline pluton, the Southern Caribou Lake Pluton, intrudes the biotite tonalite. The pluton varies from albite syenite to altered pyroxenite. Albite syenite to oligoclasite predominates with the more mafic phases occurring primarily around the margin of the intrusion.

A small isolated lens of ultramafic rock occurs within the tonalite on Caribou Bay of Smoothrock Lake. The body, which is possibly an inclusion in the tonalite, varies from serpentinized dunite to metapyroxenite.

Granitoid rocks of the Caribou Bay Pluton range in composition from mafic granodiorite to granite. They intrude the Outlet Bay Pluton and mafic metavolcanics in the vicinity of the southern part of Caribou Bay of Smoothrock Lake. Granodiorite with microcline porphyroblasts to 2 cm is the characteristic rock type.

Medium grained massive garnet-muscovite-biotite granite of the Smoothrock Lake Pluton has intruded the biotite tonalite, hornblende gabbro, and amphibolite dikes in the northwestern part of the area. Numerous sills and dikes of garnet-biotite-muscovite bearing granite pegmatite invade all other Early Precambrian (Archean) rocks in the northern and western parts of the map area.

On the northern boundary of the area, cataclasis has occurred in an east-southeast trending zone approximately 1.5 km wide. These cataclastic rocks are the eastern extension of the Pashkokogan Lake-Kenoji Lake Fault Zone. Cataclasis has resulted in the development of augen gneiss, mylonite, minor pseudotachylite and strong foliation in the granitoids.

Late Precambrian (Keweenawan) diabase sills and sheets of the Nipigon Plate occur in the southwestern, southeastern and northern parts of the area. The southeastern diabase sill is underlain by grey weathering sandstone of the Sibley Group. Diabase dikes are numerous throughout the region and occur primarily as two sets trending at approximately 020° and 150°.

EARLY PRECAMBRIAN (ARCHEAN)

METAVOLCANIC AND METASEDIMENTARY ROCKS

Metavolcanic rocks, all of mafic composition, and minor metasedimentary rocks comprise approximately 10% of the map area. These supracrustal rocks form the western extension of the Caribou Lake-Pikitigushi River supracrustal belt and their areal extent is somewhat greater than previously recognized.

All of the supracrustal rocks are of medium metamorphic grade (Winkler 1976) and generally are strongly deformed. The absence of identifiable top indicators prohibits a conventional stratigraphic reconstruction. However, the distribution of the supracrustal rocks, particularly those of the southern limb, suggests that they form a steeply dipping isoclinally folded synclinal structure.

Mafic Metavolcanic Rocks

All metavolcanic rocks and schists and gneisses of probable volcanic origin within the map area are mafic in composition. All of the metavolcanic lithologies are characterized by predominantly hornblende-plagioclase metamorphic assemblages and hence subdivision in the field was made primarily on the basis of texture and to a lesser extent the presence of garnet and clinopyroxene as additional metamorphic minerals.

Th8 only primary textures observed in the field are locally preserved pillow structures and zones of amphibolite with plagioclase phenocrysts. Elongated pillows were identified at several localities on the south and west shores of the southern extension of Caribou Bay, Smoothrock Lake. The pillows, which are either too deformed or irregular for reliable top determination, are defined by the presence of mafic hornblende and garnet-rich selvages. Zones of amphibolite with relict plagioclase phenocrysts up to 2 cm in diameter are present in all three areas of metavolcanic rocks. They are particularly well exposed on the northeast tip of Saturday Island and on the smaller island immediately northeast of Saturday Island in Caribou Lake.

In hand specimen, the mafic metavolcanics have dark greenish brown to black weathered surfaces and have a dark fresh surface due to the presence of subequal proportions of hornblende and plagioclase. The metavolcanics are fine grained and vary from massive to foliated and schistose to gneissic.

A foliated to weakly schistose texture predominates in the mafic metavolcanics located centrally within the Outlet Bay Pluton and along the southern margin of the southern limb of the Caribou Lake-Pikitigushi River supracrustal belt. Massive, medium grained amphibolite is common along the southern contact of the Outlet Bay Pluton. Here the contact between the gabbro pluton and the mafic metavolcanics is difficult to define due to the presence of irregular gabbroic patches and veins developed within the massive amphibolite. The gabbroic patches appear to have developed *in situ*, possibly as hydrothermal mobilizates, and range in length from centimetres to metres.

Gneissic amphibolite of probable volcanic origin is present in the northern limb of the Caribou-Pikitigushi belt. Excellent exposures of the gneissic amphibolite are present on the south shore of Rove Lake (Photo 1). Here gneissic banding is defined by the presence of alternating hornblende and plagioclase rich bands on a

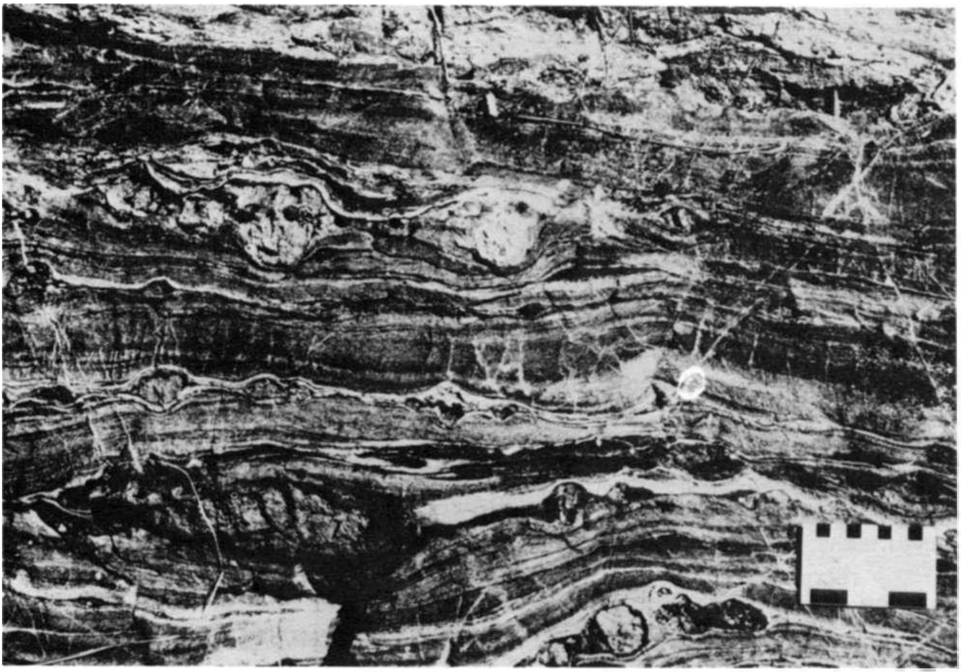


Photo 1. *Garnet-clinopyroxene amphibolite gneiss, south shore of Rove Lake. Typical appearance of gneissic amphibolite in the Rove Lake limb of the Caribou Lake-Pikitigushi River supracrustal belt. Boudinaged clinopyroxene clots are associated with hornblende and minor garnet. Boudins occur as discontinuous layers in plagioclase-hornblende gneiss.*

scale of millimetres to approximately 2 cm. Boudinaged pods of porphyroblastic clinopyroxene up to several centimetres long are often contained within the hornblende rich bands. Minor porphyroblastic garnet up to 1 cm is also present.

In thin section, the amphibolites are seen to possess a fine to medium grained recrystallized granoblastic texture with polygonal grains of plagioclase and metamorphic hornblende. Primary volcanic mineralogy is not preserved. Andesine accounts for 35 to 50% of the rock and occurs as fresh, twinned 0.2 mm to 1.0 mm grains. Most grains tend towards polygonal shapes, indicating recrystallization, although relict tabular grains are locally preserved. Green pleochroic hornblende (40-60%) is present as subhedral to euhedral prismatic grains up to 1 mm in size. Where present, garnet occurs as euhedral to anhedral poilkiloblastic grains up to 1 cm. Clinopyroxene is locally present as fine subhedral to euhedral grains in some amphibolites adjacent to the Outlet Bay Pluton and as large porphyroblastic grains in some of the gneissic amphibolites. Quartz, sphene, and magnetite occur as minor phases in most of the amphibolites. Minor biotite and chlorite are locally present as an alteration of hornblende, and epidote and sericite occur as minor alterations of plagioclase.

In the map area, mafic metavolcanic rocks can be distinguished from other rocks on the basis of:

(1) Colour index of greater than 40,

(2) Grain size is usually <1.0 mm as opposed to the coarser grain size of the gabbroic rocks,

(3) The mafic metavolcanic rocks are intruded by all of the plutonic lithologies,

(4) Presence of additional metamorphic phases such as garnet or clinopyroxene,

(5) Except immediately south of the Outlet Bay Pluton, the mafic metavolcanics are foliated, schistose or gneissic.

Metasedimentary Rocks

Clastic Metasedimentary Rocks

A unit of fine grained argillite, approximately 20 cm wide, exposed in mafic metavolcanics in the southern extension of Caribou Bay, Smoothrock Lake, is the only exposure of clastic metasedimentary rock observed in the map area. The unit contains pyrrhotite mineralization and its field relations are discussed in the section on "Economic Geology".

Chemical Metasedimentary Rocks

Chemical metasediments ranging from recrystallized chert and gruneritic chert to grunerite ironstone are found in the Rove Lake belt and near the southern contact of the mafic metavolcanic rocks within the Outlet Bay Pluton. The Rove Lake belt occurrence is restricted to an island at the eastern end of Lonebreast Bay, Smoothrock Lake. The ironstone and chert unit near the contact of the Outlet Bay Pluton and the enclosed metavolcanics was traced for approximately 5 km and appears to be approximately 50 m wide. Smaller bands of similar rock occur in the mafic metavolcanics to the north of this main unit.

The recrystallized chert to grunerite ironstone is easily recognized by the presence of interbanded quartz and grunerite. Distinction between chert, gruneritic chert, and grunerite ironstone is based on the proportion of iron bearing minerals in the rock with limits at 10 and 30% respectively. Banding is on a scale of millimetres to centimetres and individual bands of chert or grunerite are typically 1 to 2 cm thick. The recrystallized chert bands vary from very fine grained quartz to coarse granular quartz, with the appearance of veins. The grunerite is deep green in colour and varies from fine grains disseminated in the quartz to 2 to 5 mm prismatic grains in the grunerite rich bands. In thin section, the very high birefrigence, negative optical sign, and polysynthetic (100) twinning of the grunerite are characteristic (Photo 2). Minor disseminated magnetite and pyrite are commonly present in the ironstones.

METAMORPHOSED ULTRAMAFIC ROCKS OF PROBABLE INTRUSIVE ORIGIN

An isolated lens of ultramafic rock of probable intrusive origin occurs within the tonalite on Caribou Bay, Smoothrock Lake. The available exposure indicates the body has a minimum width of approximately 30 m. Its contact relations with the tonalite are not certain, although it appears to be an inclusion. An amphibolite dike of the Early Precambrian (Archean) mafic dike suite crosscuts the ultramafic body.

The ultramafic body grades from serpentinized dunite at the northwestern margin of the unit to metapyroxenite at the southeast margin. The dunite is composed of equigranular, 1 mm, rounded grains of olivine (65%), which are altered to serpentine (20%). Acicular 1 mm grains of tremolite (10%) overgrow the olivine and serpentine. Approximately 5% fine, granular opaques are associated with the alteration of olivine to serpentine. The metapyroxenite is composed of acicular tremolite up to 5 mm long, which often occurs as radiating rosettes, and minor mica.

INTRUSIVE ROCKS

Early Precambrian (Archean) intrusive rocks ranging in composition from ultramafic to felsic account for approximately 80% of the outcrop exposed in the map area.

In the field, the intrusive rocks were grouped in suites on the basis of: (a) relative age relations; (b) tectonic style or styles of emplacement, and (c) relationship with associated rocks. The suites of intrusive rocks defined in the Funger Lake Area are:

(1) An early felsic to intermediate plutonic suite of tonalite and diorite to granite,

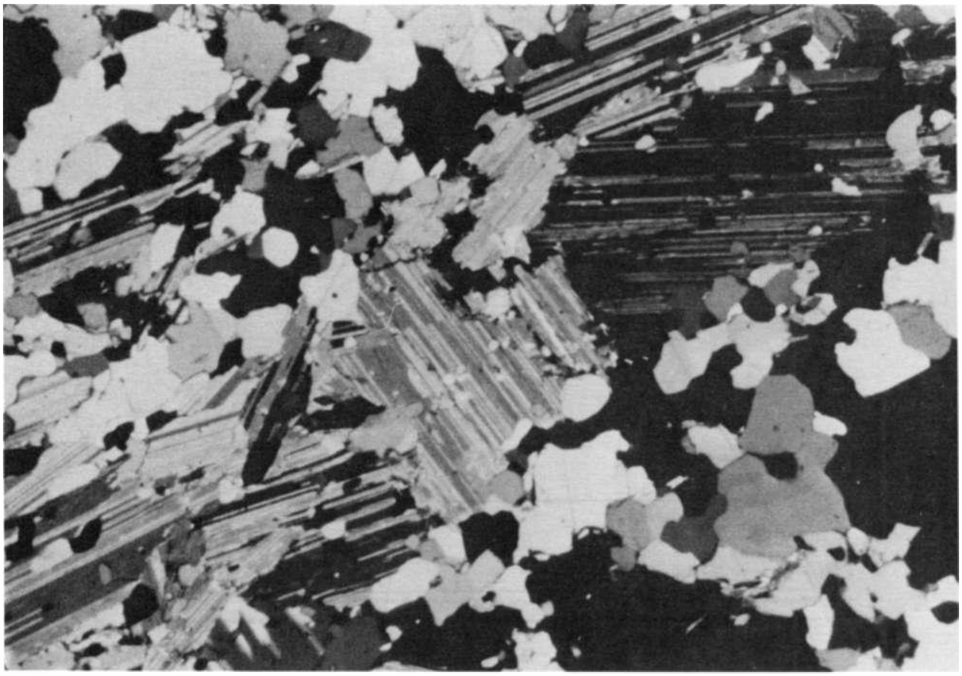


Photo 2. *Photomicrograph of grunerite ironstone from southwest of Caribou Bay, Smoothrock Lake. Ironstone is composed of alternating beds of grunerite and polygonal grains of quartz. Beds cross the photograph from lower left to upper right. Grunerite shows characteristic polysynthetic twinning. Base of photograph represents 5 mm.*

(2) A mafic dike swarm consisting of amphibolite, gabbro and gabbroic anorthosite dikes,

(3) Mafic to ultramafic plutonic rocks of the Outlet Bay Pluton,

(4) Felsic to ultramafic alkaline plutonic rocks of the Southern Caribou Lake Pluton,

(5) Late felsic to intermediate plutonic rocks of the Caribou Bay Pluton,

(6) A late felsic plutonic suite of the Smoothrock Lake Pluton.

Table 2 shows the characteristics of each the suites and the relationships between them. The lithological classification of the plutonic rocks follows Streckeisen (1976) and was accomplished in the field by staining samples for potash feldspar (Chayes 1952). Subsequently, the classification has been verified by modal counts of thin sections and stained slabs. Results of the point counting of both rock slabs and thin sections are shown in Figures 2a and 2b. The thin section modes are reported in Table 3 and slab modes in Table 4. Locations of analysed samples are shown on Figure 3 (Chart A, back pocket).

Early Felsic to Intermediate Plutonic Rocks

Early Plutonic Suite

The early plutonic suite includes a diversity of rock types ranging in composition from diorite and tonalite to granite and ranging texturally from massive to gneissic.

The unifying characteristic of the suite is that it is older than the mafic amphibolite dikes and hornblende gabbro of the Outlet Bay Pluton. This characteristic, however, is most apparent in the northern half of the area where the amphibolite dikes are abundant. Other important features of the suite are: domi-

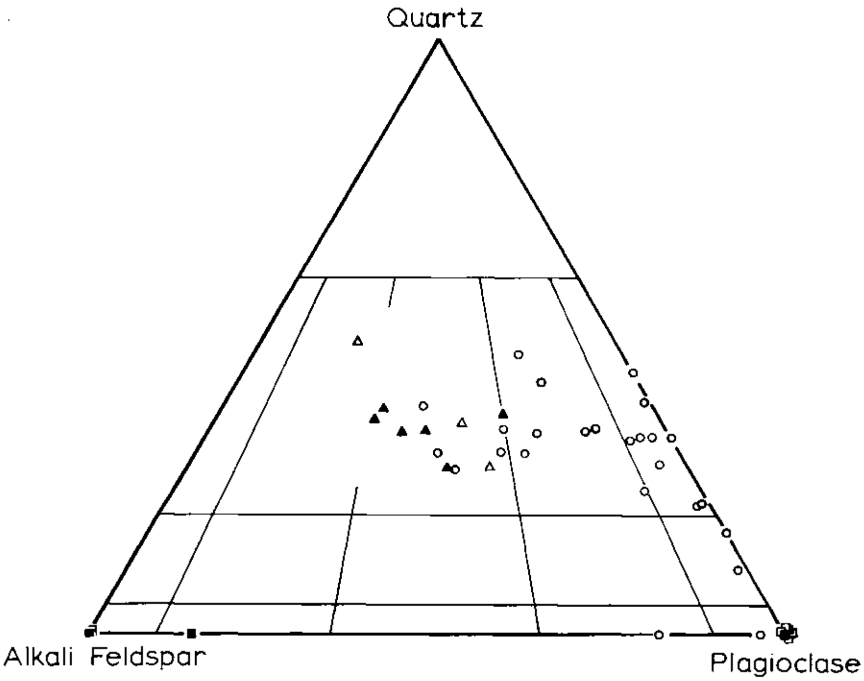


Figure 2a. *Modal alkali feldspar (microcline and plagioclase An_0 to An_5)-quartz-plagioclase (An_5 to An_{100}) for plutonic rocks of the Funger Lake Area. Field boundaries after Streckeisen (1976).*

○ *Early Felsic to Intermediate Plutonic Rocks*
□ *Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton*
■ *Felsic to Ultramafic Alkaline Plutonic Rocks - Southern Caribou Lake Pluton*
△ *Late Felsic to Intermediate Plutonic Rocks - Caribou Bay Pluton*
▲ *Late Felsic Plutonic Rocks - Smoothrock Lake Pluton and Associated Pegmatites.*

nantly tonalitic composition, predominance of biotite as the major mafic mineral, generally recrystallized texture, and presence of mafic amphibolite enclaves.

In order to facilitate description of this variable assemblage, the early plutonic suite is discussed in terms of three sub-areas. These sub-areas are natural structural subdivisions based on attitudes of foliation and gneissosity and may represent three distinct domes of tonalitic rock (*see* Figure 7, Chart A, back pocket).

Northern Sub-Area Tonalites to granodiorites of the early plutonic suite lying north of the Outlet Bay Pluton are characterized by a medium grained, recrystallized, foliated texture and often have deformed quartz aggregates. Biotite is the predominant mafic mineral, accounting for less than 15% of the total rock. Amphibolite inclusions are present but sparse in the area. Locally, adjacent to the Smoothrock Lake Pluton, microcline porphyroblasts up to 2 cm are developed.

In the vicinity of Sturgeon Arm, Caribou Lake, a variety of phases are present. The phases in sequence of intrusion are:

(1) Fine grained, gneissic to foliated, recrystallized biotite tonalite,

(2) Medium grained massive to foliated, hypidiomorphic to recrystallized, biotite tonalite with quartz aggregates,

(3) Medium grained, massive, equigranular, hypidiomorphic biotite granodiorite to muscovite-biotite and biotite-muscovite granite.

Phase 2 predominates and probably constitutes the bulk of the tonalites in the northern part of the area.

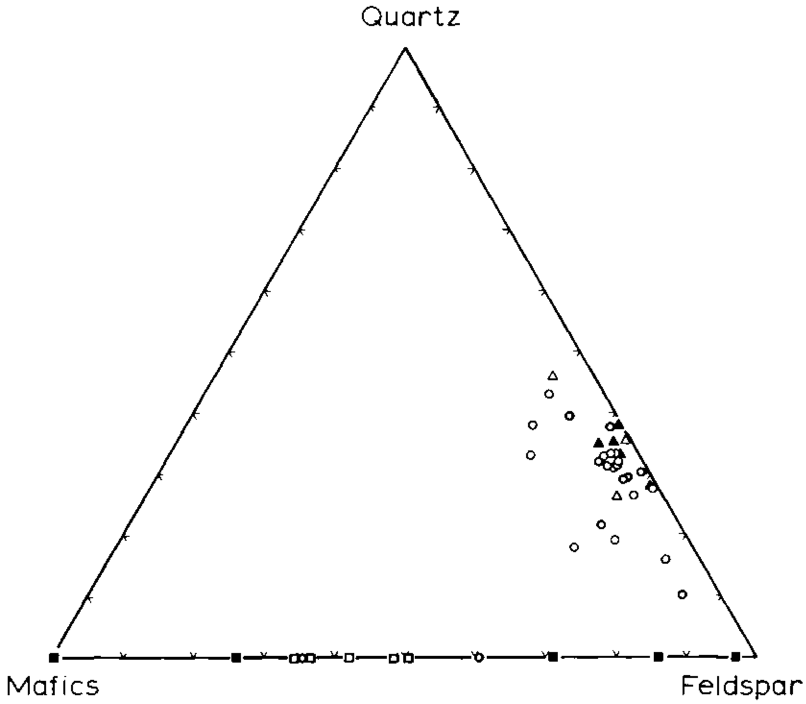


Figure 2b. *Modal Quartz-Mafics-Feldspar in plutonic rocks of the Funger Lake Area.*

○ *Early Felsic to Intermediate Plutonic Rocks*
□ *Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton*
■ *Felsic to Ultramafic Alkaline Plutonic Rocks - Southern Caribou Lake Pluton*
△ *Late Felsic to Intermediate Plutonic Rocks - Caribou Bay Pluton*
▲ *Late Felsic Plutonic Rocks - Smoothrock Lake Pluton and Associated Pegmatites.*

Phase 1 is a common phase north of Outlet Bay, between Sturgeon Arm and Cowman Lake and is also present as inclusions in Phase 2.

Phase 3 forms an irregular intrusive phase north and east of Sturgeon Arm. No intrusive contacts between Phases 2 and 3 were observed and these two phases may be compositionally gradational. Immediately north and east of the Outlet Bay Pluton, gneissic tonalite was observed to be intruded by medium grained, foliated tonalite.

Along the northern contact of the tonalitic rocks, adjacent to the metavolcanic rocks, is a local unit of garnet bearing biotite tonalite. This rock type contains poikiloblastic garnet up to 1 cm and locally has a gneissic texture.

Southeastern Sub-Area In the southeastern part of the map area, the biotite tonalite is generally fine to medium grained, recrystallized, and contains approximately 10% biotite. South of Saturday Island, Caribou Lake, and along the south shore of Alphonse Bay, Caribou Lake, through to Gibson Lake, gneissic biotite tonalite predominates. The gneissic texture has originated by two distinct processes. One type (Photo 3) is characterized by the development of granite (*sensu-stricto*) leucosomes. Poorly developed biotite melanosomes are present adjacent to the leucosomes and suggest that the differentiation has developed *in situ* and may be a result of partial melting of the tonalite. A second type of gneissic texture (Photo 4) is the product of the high degree of deformation of the suite. Original agmatitic breccias of amphibolite in tonalite have been deformed to the extent that the inclusion contacts approach parallelism and define alternating bands of tonalite and amphibolite.

TABLE 2: SUMMARY OF FIELD RELATIONS AND CHARACTERISTICS OF EARLY PRECAMBRIAN INTRUSIVE ROCK SUITES OF THE FUNGER LAKE AREA

Suite[1]	Lithologies Present[2,3]	Texture[2]	Structure[2]	Intrudes or Contains Enclaves of	Intruded by	Possible Range in Age Relations
Early Felsic to Intermediate Plutonic Suite	*Biotite tonalite* to granodiorite, minor hornblende diorite and quartz diorite, minor muscovite bearing granite.	*Recrystallized, equigranular, medium grained,* locally contains microcline porphyroblasts, late granodiorite to granitic phases are medium grained, hypidiomorphic.	*Gneissic* to *foliated* to massive	Mafic metavolcanics, locally grunerite ironstone.	Mafic dike swarm, Outlet Bay Pluton, Southern Caribou Lake Pluton, Caribou Bay Pluton, Late Plutonic Suite.	Early Plutonic Suite(1) ↕ 1
Mafic Dike Swarm	*Amphibolite, hornblende gabbro,* anorthositic gabbro.	*Fine grained, weakly diabasic,* locally porphyritic (amphibolite); *medium grained, hypidiomorphic* (gabbro) anorthositic gabbro has plagioclase phenocrysts.	*Massive,* dike margins locally foliated.	Discordantly intrudes all phases of Early Plutonic Suite.	Outlet Bay Pluton, Late Plutonic Suite.	Mafic Dike Swarm(2) ↑ 2 ↑ 4

TABLE 2 Continued

Suite[1]	Lithologies Present[2,3]	Texture[2]	Structure[2]	Intrudes or Contains Enclaves of	Intruded by	Possible Range in Age Relations
Mafic to Ultramafic Plutonic Suite (Outlet Bay Pluton)	*Hornblende gabbro;* locally clinopyroxene bearing, locally ranges to mela-gabbro and gabbroic anorthosite, anorthosite associated with igneous layering, clinopyroxenite present as enclaves, minor crosscutting apatite-pyroxene-magnetite dikes.	*Medium grained, hypidiomorphic;* locally contains plagioclase phenocrysts.	*Massive,* locally a weak primary plagioclase alignment; local primary igneous layering.	Amphibolite enclaves, local biotite tonalite enclaves; truncates mafic dikes.	Caribou Bay Pluton, Late Plutonic Suite.	2 Outlet Bay Pluton(3) 3 4 5
Felsic to Ultramafic Alkaline Plutonic Suite (Southern Caribou Lake Pluton)	*Albite syenite;* diorite to gabbro mela-gabbro, hornblendite, clinopyroxenite, mafic phases generally around the perimeter of the intrusion.	*Medium grained; hypidiomorphic.*	*Massive* to *foliated;* well developed primary feldspar alignment.	Biotite tonalite of Early Plutonic Suite	Pegmatite of Late Plutonic Suite.	Southern Caribou Lake Pluton(4)

TABLE 2 Continued

Suite[1]	Lithologies Present[2,3]	Texture[2]	Structure[2]	Intrudes or Contains Enclaves of	Intruded by	Possible Range in Age Relations
Late Felsic to Intermediate Plutonic Suite (Caribou Bay Pluton)	*Biotite granodiorite* and mafic granodiorite with microcline megacrysts; minor biotite granite.	*Medium grained; microcline megacrysts* to 2 cm; minor equigranular granite.	*Massive* to *foliated*	Biotite tonalite of Early Plutonic Suite, Outlet Bay Pluton, mafic metavolcanics.	Pegmatite of Late Plutonic Suite	Caribou Bay Pluton(5) 4 5
Late Felsic Plutonic Suite (Smoothrock Lake Pluton and associated pegmatites)	Biotite-muscovite and muscovite-biotite *granite* and *pegmatite*; often garnet bearing.	*Medium-grained; hypidiomorphic; equigranular;* to inequigranular *pegmatitic;* pegmatites have graphic intergrowth.	*Massive;* weakly foliated near contacts of Smoothrock Lake Pluton.	Biotite tonalite; mafic dike swarm; Outlet Bay Pluton; Southern Caribou Lake Pluton; Caribou Bay Pluton.		Late Plutonic Suite(6) 6

[1]Suites are arranged from top to bottom in order of inferred decreasing age.
[2]Predominant characteristics italicized.
[3]Granitoid classification after Streckeisen (1976)

TABLE 3: MODAL ANALYSES OF REPRESENTATIVE THIN SECTIONS

	Mafic Metavolcanics			Early Plutonic Suite						Mafic Dike Swarm			Outlet Bay Pluton
Sample No.	**14**	**90**	**215**	**3**	**87**	**157**	**229**	**326**	**89**	**60**	**88**	**S1**	**217**
Quartz	5	3	-	31	16	33	38	18	43	-	3	-	TR
Microcline	-	-	-	-	-	1	-	1	14	-	-	-	-
Plagioclase	24	26	65	64	79	51	49	64	35	31	19	-	42
Clinopyroxene	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphibole	68	67	33	-	-	-	-	-	-	67	76	-	50
Olivine	-	-	-	-	-	-	-	-	-	-	-	-	-
Biotite	-	-	TR	4	4	15	11	11	-	-	-	-	1
Muscovite	-	-	-	TR	-	-	-	-	8	-	-	-	-
Chlorite	-	-	-	TR	TR	-	-	-	-	-	-	-	-
Apatite	-	-	-	TR	TR	TR	TR	TR	-	TR	-	-	3
Sphene	2	2	2	1	-	-	1	TR	-	1	1	-	-
Zircon	-	-	-	-	-	TR	TR	-	-	-	-	-	TR
Epidote	-	-	-	-	-	1	TR	5	-	-	-	-	-
Clinozoisite	-	-	-	1	TR	-	-	-	-	TR	-	-	-
Allanite	-	-	-	-	-	TR	TR	TR	-	-	-	-	-
Sillimanite	-	-	-	-	-	-	-	-	TR	-	-	-	-
Rutile	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbonate	-	-	-	-	-	-	-	1	-	-	-	-	-
Opaques	2	2	TR	-	-	TR	TR	TR	TR	1	1	-	4
Serpentine	-	-	-	-	-	-	-	-	-	-	-	-	-
Prehnite	-	-	-	-	-	-	-	-	-	-	-	-	-
Plagioclase Composition	An_{50}	An_{36}	An_{59}	An_{27}	-	An_{30}	-	-	An	An_{65}	An_{48}	-	An_{37}
Total Points Counted	635	542	585	602	630	464	500	529	700	638	600		634

Note: TR indicates <1%

TABLE 3: Continued

	Southern Caribou Lake Pluton						Caribou Bay Pluton	Late Plutonic Suite		Diabase			
Sample	**131**	**154**	**156**	**130**	**101**	**102**	**204**	**246**	**231**	**105**	**160**	**164**	**350**
Quartz	-	-	-	-	-	-	46	35	32	-	-	-	-
Microcline	-	86	-	-	22	-	35	21	35	-	-	-	-
Plagioclase	97	TR	78	-	4	TR	13	39	26	63	58	61	60
Clinopyroxene	-	7	-	-	19	71	-	-	-	29	38	32	27
Amphibolite	-	1	6	38	29	-	-	-	1	TR	TR	2	
Olivine	-	-	-	-	-	-	-	-	-	1	-	1	-
Biotite	2	4	13	-	7	-	6	3	4	2	TR	3	1
Muscovite	-	-	-	-	-	-	TR	2	3	-	-	-	-
Chlorite	-	-	-	-	TR	-	TR	-	TR	-	-	-	-
Apatite	TR	1	1	-	1	TR	TR	-	-	-	TR	TR	-
Sphene	-	1	1	-	1	TR	TR	-	-	-	-	-	-
Zircon	-	-	-	-	-	-	TR	TR	TR	-	-	-	-
Epidote	-	-	TR	-	6	-	TR	-	-	-	-	-	-
Clinozoisite	-	-	1	-	-	-	-	-	-	-	-	-	-
Allanite	-	-	-	-	-	-	-	-	-	-	-	-	-
Sillimanite	-	-	-	-	-	-	-	-	-	-	-	-	-
Rutile	-	-	-	-	-	-	-	TR	-	-	-	-	-
Carbonate	-	-	-	-	2	TR	-	TR	-	-	-	-	-
Opaques	1	1	TR	-	-	-	TR	TR	TR	4	5	3	7
Serpentine	-	-	-	-	-	-	-	-	-	-	-	TR	-
Prehnite	-	-	-	-	-	-	-	TR	TR	-	-	-	-
Plagioclase Composition	-	-	An_{30}	-	-	-	-	-	-	An_{64}	An_{64}	-	An_{67}
Total Points Counted	348	609	470		736	511	505	608	507	611	561	500	620

TABLE 3: Continued

SAMPLE DESCRIPTIONS

14	Amphibolite schist, Caribou Lake
90	Porphyritic amphibolite schist, Caribou Lake
215	Amphibolite schist, Caribou Bay, Smoothrock Lake
3	Biotite tonalite, Outlet Bay, Caribou Lake
87	Biotite tonalite, Sturgeon Arm, Caribou Lake
157	Gneissic biotite tonalite, Caribou Lake
229	Foliated biotite tonalite, Johnson Lake
326	Biotite tonalite, Lake "A"
89	Muscovite granite, Sturgeon Arm, Caribou Lake
60	Amphibolite dike, Outlet Bay, Caribou Lake
88	Amphibolite dike, Sturgeon Arm, Caribou Lake
S1	Anorthosite gabbro, Outlet Bay, Caribou Lake (Stone 1974)
217	Hornblende gabbro, Caribou Bay, Smoothrock Lake
131	Albite syenite, west of Caribou Lake
154	Albite syenite, west of Caribou Lake
156	Diorite, west of Caribou Lake
130	Gabbro, west of Caribou Lake
101	Melagabbro, Caribou Lake
102	Pyroxenite, Caribou Lake
204	Porphyritic granite, Caribou Bay, Smoothrock Lake
246	Granite, Caribou Bay, Smoothrock Lake
231	Granite, Kelly Lake
105	Diabase, near base of sill, Caribou Lake
160	Diabase, toward top of sill, Gibson Lake
164	Diabase, near base of sill, Gibson Lake
350	Diabase dike, north of Outlet Bay, Caribou Lake

In the zone of gneissic amphibolite, the presence of numerous amphibolite enclaves is characteristic. The enclaves are often highly strained, as noted above, and are migmatized with varying degrees of reaction with the tonalite host. In the zones containing amphibolite, biotite hornblende diorite to quartz diorite are present both as intrusive phases into biotite tonalite and as phases which are gradational with the tonalite. In the latter case, the hornblende diorite to quartz diorite appears to be a result of hybridization of the biotite tonalite by assimilation of amphibolite.

Southwestern Sub-Area Biotite tonalitic rocks in the southwestern portion of the map area are dominantly medium grained and weakly foliated to massive. Biotite, again the predominant mafic mineral, accounts for less than 15% of the rock. Sparse amphibolite inclusions are locally present but less deformed than in the southeastern area. Foliations within the tonalite define the eastern part of a domical structure centred on Reaching Lake and there is a general progression from massive tonalite in the centre of the dome to foliated tonalite at the perimeter. Locally, adjacent to the metavolcanic rocks at the margin of the dome, gneissic amphibolite is present. A minor unit of biotite granodiorite defined by the development of late, euhedral microcline porphyroblasts up to 2 cm in diameter, is present near the eastern margin of the dome.

In general, tonalitic rocks of the Funger Lake Area are characterized by a grey weathered and a lighter grey fresh surface. Plagioclase, of oligoclase composition, occurs as 1 to 2 mm grains and accounts for 50 to 80% of the rock. In thin section, the plagioclase displays an equant, polygonal habit with only a few grains showing a relict igneous subhedral texture. Albite, Carlsbad and pericline twinning is usually poorly developed. These textural features suggest deformational recrystallization of the suite. Quartz, 20 to 40%, occurs as strained lobate grains and aggregates of grains varying in size from 3 to 10 mm. In the tonalites, microline is absent to minor and where present occurs as fresh, well twinned, interstitial grains. Local

TABLE 4. MODAL ANALYSES OF PLUTONIC ROCKS FROM THE FUNGER LAKE AREA

	Early Felsic to Intermediate Plutonic Rocks																	
Sample #	**58**	**63**	**64**	**65**	**66**	**68**	**69**	**71**	**72**	**85**	**145**	**167**	**314**	**316**	**317**	**320**	**342**	**352**
Volume Percent																		
Quartz	38	32	29	29	30	31	31	28	27	32	19	10	33	2	33	-	40	-
Plagioclase	28	60	45	34	43	59	61	38	65	51	67	83	53	60	45	29	40	58
K-Feldspar	32	5	21	33	25	6	5	33	4	11	3	1	9	7	17	6	13	2
Others	2	3	5	4	2	4	3	1	4	6	11	6	5	11	5	65	7	40
Total Points:	556	640	500	500	500	570	499	585	513	509	500	509	504	499	500	575	400	513

	Mafic Plutonic Rocks Outlet Bay Pluton				Late Felsic Plutonic Rocks Caribou Bay Pluton		Late Felsic Plutonic Rocks Smoothrock Lake Pluton			
Sample #	**73**	**211**	**227**	**237**	**232**	**234**	**91**	**96**	**311**	**1**
Volume Percent										
Quartz	-	-	-	-	26	35	33	28	35	38
Plagioclase	50	34	37	49	41	36	31	37	22	23
K-Feldspar	-	-	-	-	26	28	33	34	40	39
Others	50	66	63	51	7	1	3	1	3	-
Total Points:	510	504	509	512	601	521	493	502	602	552

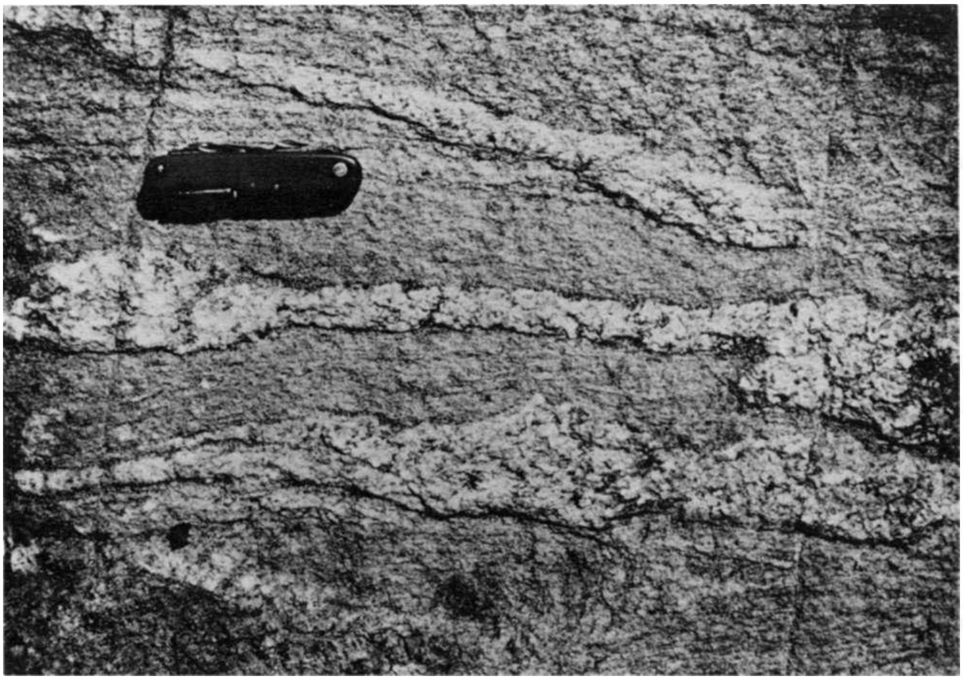


***Photo 3.** Gneissic banding in biotite tonalite, southwest of Cove Island, Caribou Lake. Banding due to development of coarser grained granite (sensu stricto) leucosomes in foliated biotite tonalite. Note narrow biotite melansomes along the margins of granite leucosomes.*

granodioritic phases display euhedral well twinned microline porphyroblasts up to 2 cm long. These grains include, embay, and locally replace other phases indicating that microcline crystallized after the other phases. Biotite, the predominant mafic mineral (2 to 11%), occurs as 0.5 to 1 mm tabular grains. Characteristic accessories of the tonalitic rocks are allanite, which is usually rimmed by epidote, apatite, sphene and magnetite. Epidote and sericite alteration of plagioclase are present but minor.

The massive granodioritic to granitic phases of the early plutonic suite are characterized by an equigranular medium grained, hypidiomorphic texture. The colour varies from pink to light grey on both fresh and weathered surfaces and may be a misleading field characteristic. The absence of recrystallization, low mafic mineral content, local presence of muscovite, and higher proportion of microcline serve as diagnostic features. In thin section, the rocks are equigranular with subequal plagioclase of oligoclase composition, microcline, and quartz. Plagioclase is subhedral and tabular while quartz and microcline are interstitial. Biotite and lesser muscovite form tabular grains up to 5 mm in size.

Mafic Dike Rocks

An extensive swarm of mafic amphibolite, hornblende gabbro and local anorthositic gabbro dikes, trending at 020° to 050°, discordantly invades the early plutonic suites north of the Outlet Bay Pluton. The dikes range from a few centimetres to approximately 50 m wide and can be traced for distances in excess of 1 km in areas of good exposure. The parallelism of the dikes suggests that they were emplaced in one intrusive event although local crosscutting relationships are observed. On Outlet Bay of Caribou Lake, massive amphibolite dikes crosscut the anorthositic gabbro dike.

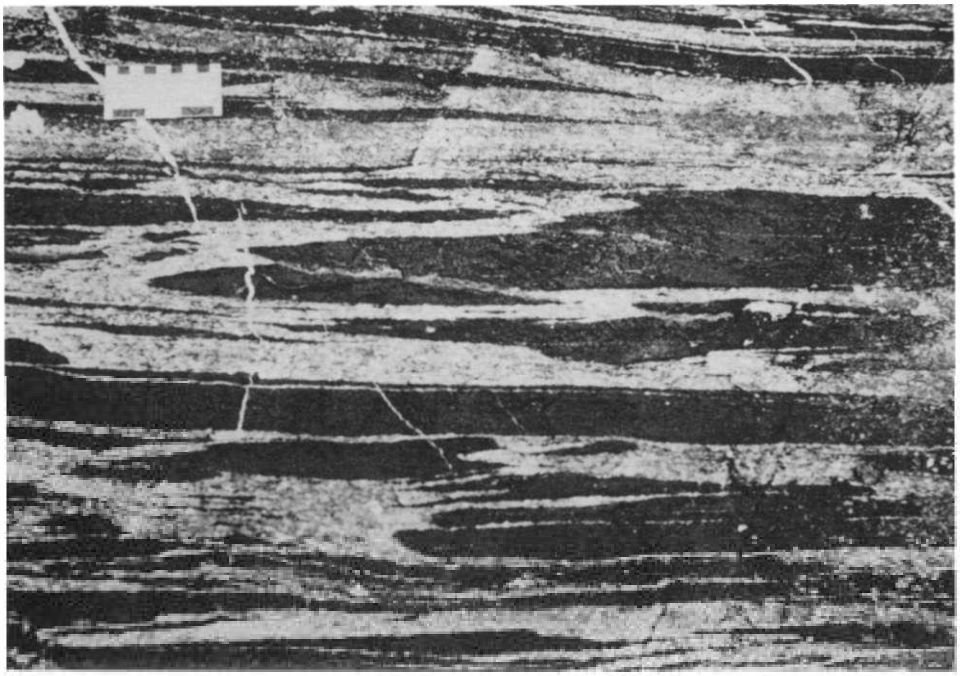


Photo 4. *Gneissic banding in biotite tonalite, Outlet Bay, Caribou Lake. Banding is a result of deformation of agmatitic breccia composed of amphibolite in biotite tonalite.*

The dikes are present in most areas of tonalitic rocks in the northern portion of the map area. The densest distribution of dikes occurs in the vicinity of Sturgeon Arm, Caribou Lake and in the area of the unnamed lakes northwest of Cowman Lake. In this region, dikes account for up to 30% of the exposed bedrock. Near the northern contact of the tonalitic rocks with the amphibolites, the exposure is poor, but the dikes appear to diminish in frequency. South of the Outlet Bay Pluton, dikes are not absent, but very sparsely distributed. Representation of the dikes on the accompanying geological map is partially schematic since one dike symbol may be used to indicate a zone with several small dikes.

In the field, the dikes are easily recognized based on: (1) colour index greater than 50, (2) discordant nature with respect to the tonalitic rocks, and (3) generally massive texture. The dikes resemble the amphibolite enclaves in colour index and mineralogy, however, the massive texture and discordant nature serve to distinguish them. Contacts of the dikes and the tonalite (Photo 5) show apophyses of amphibolite in tonalite, inclusions of tonalite in amphibolite, and truncation of the fabric of the tonalite. No chilled margins were observed in the amphibolite dikes.

The dikes range from fine grained amphibolite with a relict diabasic texture, to medium grained hornblende gabbro, to anorthositic gabbro having plagioclase phenocrysts up to 10 cm in diameter. Fine grained amphibolite is the dominant rock type, weathers black, and has a dark fresh surface. Plagioclase, varying from calcic andesine to labradorite in composition accounts for 20 to 45% of the rock and occurs as fresh, well twinned, tabular 0.2 to 1.0 mm grains. Fresh, subhedral tabular to anhedral, rounded plagioclase phenocrysts up to 1 cm long are locally present and account for up to approximately 10% of the rock. Pale green pleochroic hornblende to colourless uralitic amphibole (40 to 75%) occurs as scaly aggregates and masses of fine grains (0.1 to 0.5 mm) which appear to replace pyroxene that originally had a subophitic texture. A trace of interstitial quartz is present in some rocks. Minor biotite locally replaces hornblende. Magnetite and

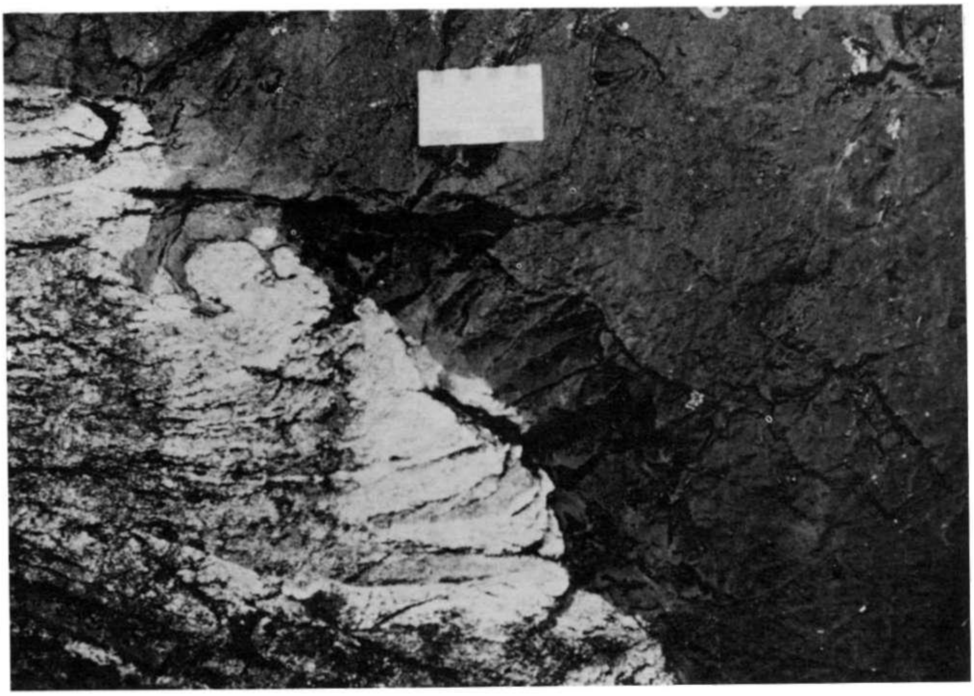


***Photo 5.** Massive amphibolite dike in gneissic biotite tonalite, Outlet Bay, Caribou Lake. Note apophysis of amphibolite in tonalite, truncation of gneissic banding, and small inclusions of tonalite along the contact with the amphibolite. The contact shown here is somewhat atypical in that the tonalite-dike contacts are usually planar.*

sphene which mantles the magnetite, are common accessories. Minor epidote and saussurite alteration of plagioclase is present in some rocks.

Dikes of medium grained hornblende gabbro are lithologically similar to the gabbro of the Outlet Bay Pluton. Plagioclase varying from calcic andesine to labradorite in composition, accounts for 35 to 45% of the rock. The plagioclase occurs as 1 to 2 mm subhedral, tabular grains, with well developed albite, Carlsbad, and pericline twins and is generally fresh with only minor alteration to saussurite. Pale green amphibole (45 to 60%) has a similar habit to the amphibole in the finer grained dikes. Grains of biotite (up to 5%) replace the amphibole.

Dikes of anorthositic gabbro occur on Outlet Bay, Caribou Lake (Photo 6) and northwest of Cowman Lake. At both localities, the rocks are characterized by approximately 80% large (3-10 cm) plagioclase megacrysts in a matrix of hornblende gabbro which is similar to the medium grained gabbro dikes previously described. The large plagioclase crystals are fresh, with albite and Carlsbad twins easily visible in hand specimen. Microprobe analyses by Stone (1974) indicate that the megacrysts are bytownite in composition. Epidote and clinozoisite occur as single grains and clusters replacing the plagioclase phenocrysts but account for less than 5% of the rock. The phenocrysts also contain very fine inclusions of hornblende.

<u>Lamprophyre Dikes</u>

An isolated dike of massive, coarse grained, ultramafic lamprophyre intrudes tonalite and amphibolite on the northeast arm of Reaching Lake. The dike has been included within the mafic dike suite on the geological map (Map 2466, back pocket) but may be considerably younger in age. The dike is composed of large

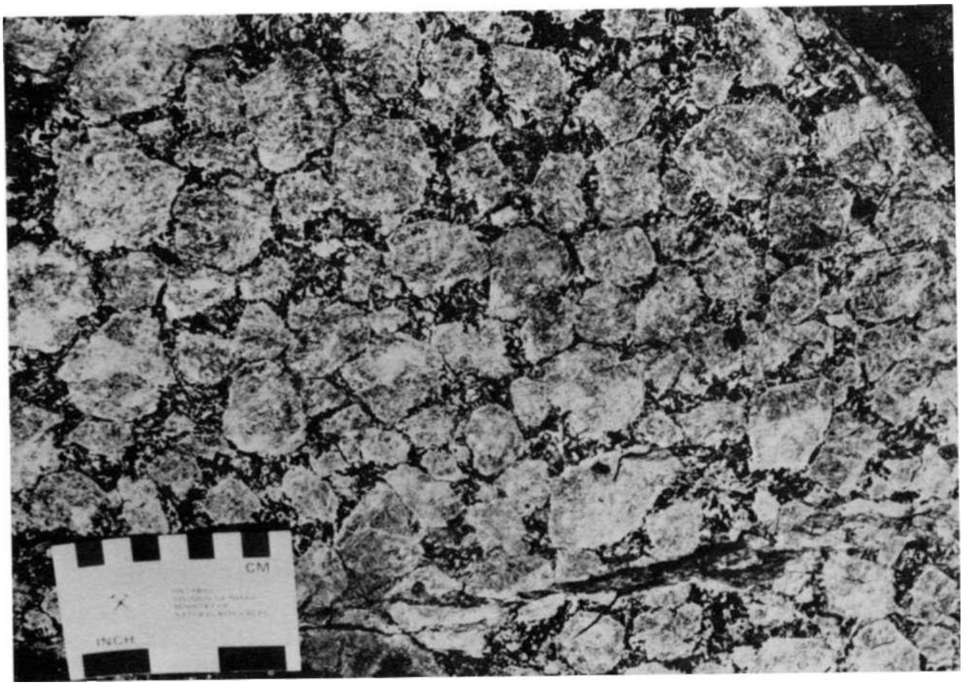


Photo 6. *Anorthosite gabbro dike, Outlet Bay, Caribou Lake. Large plagioclase phenocrysts in hornblende gabbro matrix. Dike is intrusive into biotite tonalite.*

grains of pale green amphibole (60%) which replaces pyroxene, large irregular grains of phlogopite (25%), subhedral, 1 to 4 mm olivine grains (10%), and minor magnetite.

Mafic to Ultramafic Plutonic Rocks

Outlet Bay Pluton

The crescent shaped gabbroic Outlet Bay Pluton (Sage *et al.* 1974) occupies an area of approximately 12 km by 8 km and dominates the central portion of the map area. The pluton is intrusive into biotite tonalite on its northern and eastern margins and into mafic metavolcanics and biotite tonalite on the southern margin. Contacts between the gabbro pluton and country rock are generally concordant although local enclaves of biotite tonalite and numerous enclaves of mafic metavolcanics demonstrate that the gabbro pluton postdates these rock types. Fine grained amphibolite dikes of the mafic dike swarm are truncated by the Outlet Bay Pluton; however, two hornblende gabbro apophyses up to 4 km long extend north from the pluton and parallel to the dike swarm.

Medium grained, hornblende gabbro with 35 to 65% mafics is the predominant rock type of the pluton. Local irregular variation of mafics above and below this range results in the designation metagabbro and gabbroic anorthosite respectively. Minor anorthosite is present as a felsic component in rhythmic igneous layering on the southern contact of the pluton. Altered clinopyroxenite occurs as enclaves near the eastern and southern contacts of the pluton. Discordant dikes of an apatite-altered clinopyroxene-magnetite rock are also locally present.

Hornblende Gabbro, Anorthosite Gabbro, Metagabbro Gabbroic rocks of the Outlet Bay Pluton are recognized in the field by: (1) colour index of 30 to 70%, (2) hypidiomorphic and subophitic texture, and (3) massive to weakly foliated fabric. The rocks have dark grey to rusty weathered surfaces and a speckled dark and light grey fresh surface. Rarely the gabbroic rocks contain plagioclase phenocrysts up to 1 cm long, and at one locality on the southeast part of Caribou Bay a rounded plagioclase megacryst 15 cm in diameter was observed.

In thin section, 2 to 5 mm, subhedral tabular grains of plagioclase (calcic andesine to labradorite) show well developed albite, Carlsbad and pericline twins. Weakly developed normal and oscillatory zonings of plagioclase are present in some rocks. Minor alteration of plagioclase to saussurite and epidote is evident, but most of the plagioclase is remarkably fresh. Pale green pleochroic amphibole (30 to 45%) is present as scaly aggregates of fine grains which appear to replace clinopyroxene and show a subophitic texture. Clinopyroxene is preserved in some samples, where it occurs in 1 to 2 mm subhedral grains interstitial to plagioclase. All stages of alteration of clinopyroxene from colourless, fibrous uralite to scaly actinolite, to hornblende are preserved within rocks of the pluton. Biotite occurs in amounts from a trace to 8%. It occurs as ragged grains up to 2 mm long which replace hornblende. Some rocks contain up to 8% magnetite as irregular grains interstitial to the mafic minerals. In rocks with a high proportion of magnetite, stubby, euhedral apatite is included within the magnetite. In rocks with minor magnetite, apatite is included within hornblende. Minor interstitial quartz is present as a trace component. Sphene, where present, rims the grains of magnetite.

Hand specimen and thin section observations of the gabbroic rocks of the Outlet Bay Pluton show them to be remarkably similar to the hornblende gabbro dikes of the mafic dike swarm.

Altered Pyroxenite Inclusions of medium grained, massive, altered pyroxenite varying in size from a few centimetres (Photo 7) up to outcrop scale are locally present in the southern and eastern parts of the Outlet Bay Pluton. The inclusions are recognized by their ultramafic character (greater than 90% mafics) and dark green colour.

The inclusions are composed of 85 to 99% of equant, interlocking grains (1 to 3 mm) of clinopyroxene pseudomorphed by uralitic amphibole. The uralite retains the clinopyroxene diallage texture (001 parting) which is indicated by aligned opaque inclusions. Irregular, green pleochroic hornblende replaces the uralite. Apatite (0 to 5%), magnetite (0 to 5%) and traces of sphene are present as accessory phases.

Anorthosite and Rhythmic Layering Minor hornblende anorthosite, with less than 10% mafics, is associated with the development of rhythmic igneous layering in several localities on the southern margin of the pluton (Photo 7). Individual layers range in thickness from 2 m to approximately 4 cm. The layers grade compositionally from hornblende gabbro with approximately 60% mafics to anorthosite with less than 10% mafics. The anorthosite at the top of the layer is overlain by gabbro at the base of the next layer. Clotty clinopyroxenite enclaves are locally present at the base of the layers.

Apatite-Altered Pyroxene-Magnetite Dike Rocks Minor dikes composed of subequal altered clinopyroxene and magnetite with lesser apatite intrude the hornblende gabbro, east of Caribou Bay, Smoothrock Lake. The dikes, which are several metres wide, have sharp contacts against the gabbro and locally contain gabbro enclaves. In thin section the dikes are seen to contain approximately 45% magnetite which forms an irregular net, enclosing altered clinopyroxene (Photo 8). The clinopyroxene (45%) now highly altered to uralitic amphibole, forms rounded grains to 1 mm which are generally totally enclosed by magnetite. Traces of relict clinopyroxene are still present. Apatite (10%) forms squat euhedral prisms up to 0.3 mm long which are included in the magnetite.

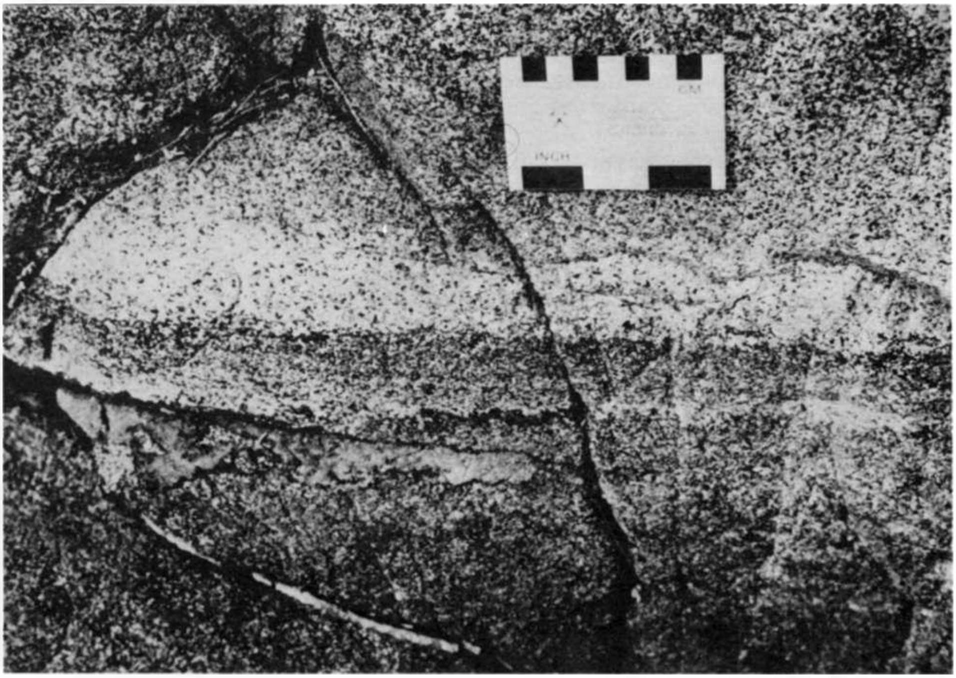


Photo 7. *Igneous layering in hornblende gabbro near the southern contact of the Outlet Bay Pluton. Tops are toward bottom of the photograph. Parts of these layers shown are: (1) anorthositic gabbro to anorthosite of 1 layer (top of photo); (2) a poorly developed gabbro to anorthositic gabbro layer (centre of photo approximately 4 cm wide); and (3) gabbro at the bottom of the third layer associated with an elongate clinopyroxenite inclusion (bottom of photo).*

On the basis of a series of experiments on the magnetite-fluorapatite system, Philpotts (1967) has suggested that a liquid with the composition of approximately 2/3 magnetite and 1/3 apatite is immiscible with a dioritic silicate liquid. Accordingly, the apatite-altered pyroxene-magnetite dike rocks are believed to have formed by accumulation of an immiscible iron rich phase and its subsequent intrusion into the gabbro from which it separated. This interpretation is consistent with the presence of irregular interstitial magnetite-apatite aggregates in the hornblende gabbro.

Alkaline Felsic to Ultramafic Plutonic Rocks

Southern Caribou Lake Pluton

The Southern Caribou Lake Pluton occupies an area of approximately 6 km by 3.5 km on the southern margin of the map area and is intrusive into biotite tonalites of the early plutonic suite. The pluton is highly variable in composition and ranges from albite syenite to hornblende pyroxenite. Outcrop exposure over the eastern portion of the body is poor and therefore relationships between the phases are poorly understood. However, the mafic phases occur primarily around the western margin of the intrusion and are locally present as inclusions within the felsic rocks.

Albite Syenite and Oligoclasite Medium grained, hypidiomorphic albite syenite to oligoclasite with less than 20% mafics is the predominant rock type. The low colour index and distinctive steel grey weathering plagioclase serve to distinguish this rock type. In much of the syenite to oligoclasite there is a well developed foliation due to alignment of subhedral, tabular plagioclase. In thin section (Photo

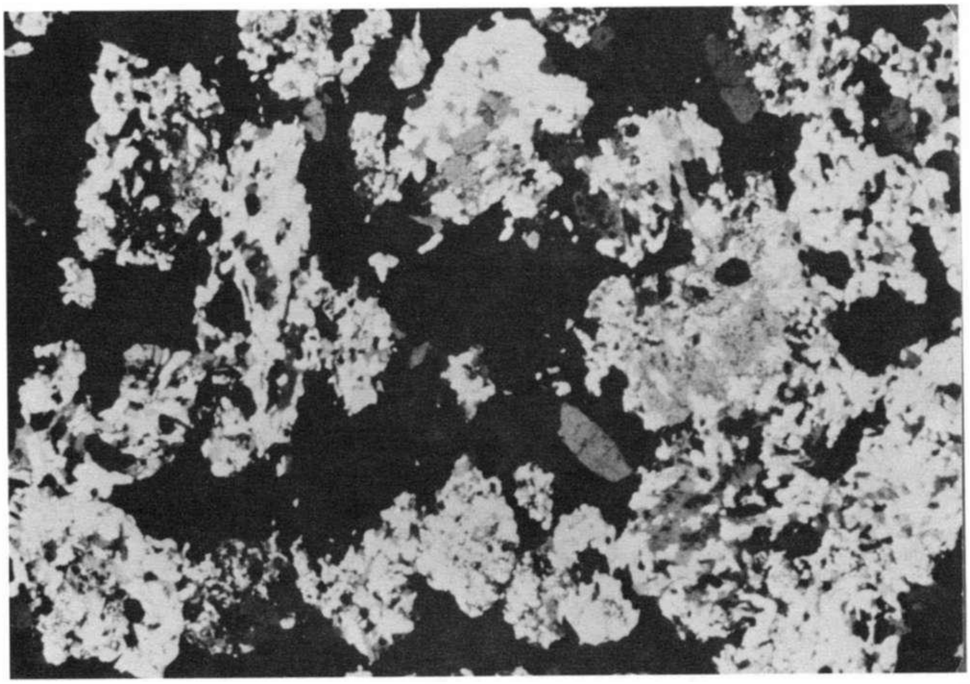


Photo 8. *Photomicrograph of apatite-altered pyroxene-magnetite dike rock intruding hornblende gabbro of the Outlet Bay Pluton, southeast of Caribou Bay, Smoothrock Lake. Magnetite forms a net surrounding rounded grains of uralitized clinopyroxene. Apatite occurs as subhedral crystals within magnetite. Base of photograph represents 5 mm.*

9), the rock is seen to contain over 80% of 2 to 4 mm tabular grains of fresh plagioclase. The grains are untwinned and characterized by a very fine antiperthitic texture. The plagioclase grains are granulated and recrystallized along the boundaries, and some larger grains are fractured. This weakly cataclastic texture combined with the strong plagioclase foliation is believed to have developed during intrusion of the pluton. Biotite, hornblende and green pleochroic clinopyroxene are developed in variable proportions, but in total, account for less than 15% of the rock. The biotite and hornblende generally form coronal textures rimming pyroxene. Minor sphene, opaques and apatite are accessory phases in the rock.

<u>Diorite and Gabbro</u> Hornblende and hornblende-pyroxene diorite to gabbro are minor phases of the pluton. The relationships of these phases with more felsic and more mafic end members have not been established. They are medium grained, hypidiomorphic, massive to weakly foliated and distinguished by a higher colour index (20-65% mafics) than the syenite and oligoclasite.

The one thin section of gabbro studied contained approximately 50% subhedral, tabular, 1 to 2 mm grains of andesine. The plagioclase is very fresh and has well developed albite and Carlsbad twins. Pigeonite (40%) is the predominant mafic mineral, and occurs as 1 to 2 mm subhedral grains, interstitial to plagioclase, and rimmed by hornblende and fine stubby grains of biotite. The pigeonite which is unusual in a plutonic rock, was identified by its 2V angle of approximately 15° and its positive optical sign. Magnetite (3%) occurs as irregular grains interstitial to pyroxene and contains squat prisms of apatite (2%).

Photo 9. *Photomicrograph of clinopyroxene-albite syenite, Southern Caribou Lake Pluton. Untwinned albite is finely antiperthitic and has granulated grain edges. Clinopyroxene grains (at left centre and a smaller grain at right centre) are rimmed by fine hornblende. Base of photograph represents 5 mm.*

Melagabbro, Clinopyroxenite, Hornblendite Mafic to ultramafic phases of the pluton include melagabbro, hornblende clinopyroxenite, and clinopyroxene hornblendite. The melagabbro contains greater than 65% mafic minerals, is medium to coarse grained, hypidiomorphic, and massive. Clinopyroxene accounts for approximately 50% of the rock and occurs as 1 to 4 mm subhedral grains which are highly altered to hornblende. Hornblende (20 to 30%) is pale green pleochroic and occurs both as a patchy alteration of the clinopyroxene and as larger grains poikilitically enclosing clinopyroxene. Minor biotite locally replaces the hornblende. Anhedral plagioclase is interstitial to the mafics and epidote, and carbonate and chlorite occur as alterations.

Medium grained massive hornblendite to clinopyroxenite contains in excess of 85% mafic minerals and is dark green to black coloured. Variable proportions of clinopyroxene and hornblende reflect progressive alteration of the pyroxene to amphibole. The clinopyroxene occurs as equigranular, subhedral, 2 to 3 mm grains. Pale green pleochroic hornblende occurs as a pervasive alteration of pyroxene, initially present as patchy alterations and eventually poikilitically enclosing relict pyroxene. Minor plagioclase is interstitial and very heavily altered to epidote and carbonate. Euhedral apatite varies from fine, squat grains in amphibole to 1 cm, acicular grains interstitial to mafics. Sphene occurs as euhedral grains up to 1 mm long and as a granular phase included in hornblende. Minor pyrite and magnetite are also present.

Late Felsic to Intermediate Plutonic Rocks

Caribou Bay Pluton

The Caribou Bay Pluton is a small irregular granite to granodiorite pluton which intrudes the contact between the Outlet Bay Pluton and mafic metavolcanics on

Caribou Bay, Smoothrock Lake. Thin sills of granodiorite similar to that of the Caribou Bay Pluton also intrude the gabbro-metavolcanics contact to the west of the main body.

The Caribou Bay Pluton varies from equigranular, biotite granite to biotite granodiorite. The characteristic rock type of the pluton however is porphyritic granodiorite to granite with microcline megacrysts up to 3 cm in diameter. The megacrysts contain numerous inclusions of plagioclase, quartz and mafic minerals, indicating they were late phases to crystallize. Mafic granodiorite with 20 to 30% mafic minerals locally occurs as a hybrid phase of the pluton adjacent to the metavolcanics. Enclaves of mafic amphibolite and hornblende gabbro are present within rocks of the pluton.

Late Felsic Plutonic Rocks

A late suite of granite and granite pegmatite intrudes all of the major Early Precambrian (Archean) lithologic units in the area. This suite is particularly well developed in the northern and western parts of the map area where the Smoothrock Lake Pluton intrudes the early plutonic suite and numerous sills and dikes of pegmatite invade the Outlet Bay Pluton and early plutonic suite. Pegmatite dikes also intrude the Caribou Bay Pluton on an island in the southern part of Caribou Bay. Minor dikes of biotite granite and pegmatite are present in the southern part of the area and may be contemporaneous with the Smoothrock Lake Pluton.

Smoothrock Lake Pluton

The Smoothrock Lake Pluton was originally defined by Sage *et al.* (1974) and only the eastern portion of the body is included in the present map area. Within the area, the pluton is composed of medium grained, equigranular, muscovite-biotite and locally garnet bearing granite. The pluton is massive, except near its contacts where a weak biotite foliation is present. The colour of the granite varies from grey to pink and is not a useful field criterion for its recognition.

The contacts of the Smoothrock Lake Pluton and the early plutonic suite are poorly preserved; however, some relationships are evident, particularly along the north shore of Caribou Bay, Smoothrock Lake. Near this contact, there are extensive sills and dikes of granite and pegmatite injected approximately parallel to the foliation in the tonalite to granodiorite of the early plutonic suite. Near the contact, but within the tonalite-granodiorite, euhedral microcline metablasts to 1.5 cm are commonly developed and account for up to 20% of the rock.

In thin section, the granite of the Smoothrock Lake Pluton is seen to contain subequal concentrations of plagioclase, quartz and microcline. Plagioclase (oligoclase) occurs as subhedral, 1 to 2 mm long grains, which show well developed albite and Carlsbad twinning. The grains are heavily sericitized and embayed and partially replaced by microcline. The fresh, anhedral microcline is interstitial and weakly perthitic. Quartz occurs as weakly strained, anhedral, interstitial grain aggregates ranging in size from 2 to 4 mm. Dark red-brown pleochroic biotite (3 to 4%) occurs as ragged 1 to 2 mm grains and clots of grains. The biotite is oxidized, chloritized and contains pods of prehnite parallel to the cleavage. Muscovite (2 to 3%) occurs as 1 to 3 mm grains which are commonly associated with biotite but are unaltered. Zircon and minor opaques are common accessories and are generally associated with the mafic minerals. Minor rutile is associated with chloritization of the biotite.

Pegmatites

Numerous apophyses of pegmatite associated with the Smoothrock Lake Pluton are present in the northern portion of the map area. The pegmatite occurs as sills and dikes which trend at approximately 060°, dip subvertically, and are quasi-conformable with foliation trends in the early plutonic suite. The dikes are white to pink, inequigranular, massive, and have grain sizes ranging from a few millimetres to over 10 cm.

Slabbed samples of pegmatite stained for potassium feldspar indicate that the pegmatites contain potassium feldspar, plagioclase and quartz. Commonly the proportion of plagioclase exceeds potassium feldspar. Several thin sections indicate that the plagioclase is fresh and of oligoclase composition. Graphic intergrowths of quartz in feldspar are a characteristic texture of the pegmatite. Muscovite is the predominant mafic mineral except in the southern part of the area where biotite is more abundant. The muscovite occurs as large euhedral crystals up to 6 cm long and locally forms dendritic aggregates and clusters. Red, euhedral garnet up to 1 cm in diameter is a common accessory.

Cataclastic Rocks

Cataclastic rocks within the Funger Lake Area occur primarily within the Pashkokogan Lake-Kenoji Lake Fault Zone (Sage *et al.* 1974) on the northern boundary of the area. In this zone cataclasis has affected all of the Early Precambrian (Archean) rocks but the Middle to Lake Precambrian (Proterozoic) diabase is unaffected. In the map area the fault zone marks the Wabigoon-English River Subprovinces boundary (Breaks *et al.* 1978); however, to the west the fault trends northwest across the English River Subprovince. A minor zone of cataclasis is also associated with faulting along Outlet Bay of Caribou Lake. On Map 2466 (back pocket) this cataclasis along Outlet Bay is indicated by schistosity symbols.

Cataclastic rock types of the Pashkokogan Lake-Kenoji Lake Fault Zone are poorly exposed and include mylonite, augen gneiss, and minor pseudotachylite. Granitoid rocks which show development of a strong cataclastic foliation but have not become finely comminuted are common within the zone and have been classified as protomylonite. Commonly, outcrops within the zone show variable magnitudes of cataclasis, resulting in a range from protomylonite to mylonite and rarely pseudotachylite in single exposures. The original lithologies within the zone appear to be primarily tonalitic rocks of the early plutonic suite and granite and pegmatite of the late granitic suite. Particularly good exposures of the cataclastic rocks are present on the north shore of Rove Lake (Photo 10).

In protomylonite, a strong planar to linear fabric is developed in the original granitoid lithology. In this fabric, quartz and feldspar are present as elongated, lenticular to ribbon-like grains, and micas are present as streaky aggregates. Further deformation results in the development of augen of less deformed granitoid pods and crystals in a foliated to schistose matrix. The augen range in size from millimetres to a few centimetres. In both augen gneiss and protomylonite the original lithology is identifiable.

With more extensive comminution of the grains, a fine to very fine grained, grey to brown weathering mylonite is developed. Commonly the mylonite is developed as zones a few centimetres wide in less deformed rock and often contains augen shaped pods and crystals of less deformed material. Minor pseudotachylite occurs within the mylonite on the northern shore of Rove Lake. The pseudotachylite weathers reddish brown and occurs as wispy injections parallel to the foliation in the mylonite.

In thin section the cataclastic rocks show variable degrees of deformation and recrystallization. The fabrics approach an interlocking mosaic of fine polygonal grains of quartz and feldspar. Micas are recrystallized into wispy aggregates parallel to foliation. With increasing deformation the grain size is reduced and the quartz and feldspar grains tend toward polygonal shapes.

The textures within the Pashkokogan Lake-Kenoji Lake Fault Zone are comparable with observations on other fault zones which indicate that recrystallization and deformation under strain is the dominant process in producing the cataclastic textures (Bell and Etheridge 1973). Evidence of brittle deformation, granulation, and fault gouge effects are not present.

Subhorizontal slickensides and local penetrative subhorizontal quartz lineation suggest subhorizontal movement along the Pashkokogan Lake-Kenoji Lake Fault Zone. No consistent sense of fault displacement was obtained from minor folds or other asymmetrical structures within the zone.

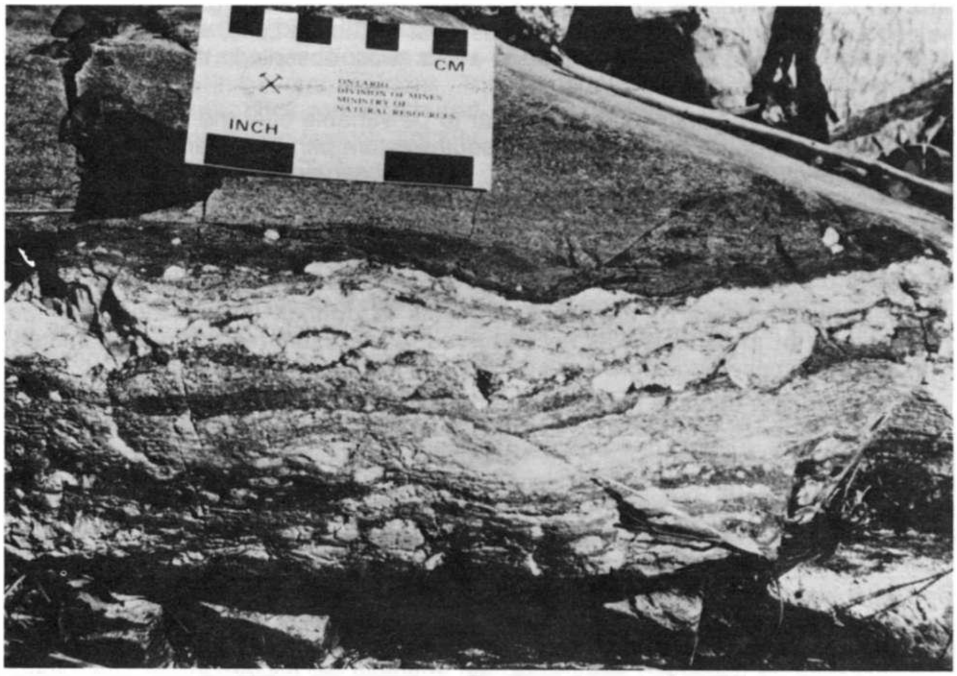


***Photo 10.** Mylonite to augen gneiss, Pashkokogan Lake-Kenoji Lake Fault Zone, north shore of Rove Lake. The mylonite is composed of finely comminuted granite and weathers brown to grey. The augen gneiss contains porphyroclasts of feldspar and granite in a mylonite matrix.*

Fault movement along the Outlet Bay Fault appears to have been active over at least two stages. Minor mylonitization of the biotite tonalite is visible at a few locations on the south shore of Outlet Bay of Caribou Lake. The mylonitized tonalites are banded on a scale of centimetres, fine grained, and show a recrystallized, polygonal texture in thin section. Early Precambrian (Archean) amphibolite dikes crosscut the mylonitized tonalite and are undeformed, indicating mylonitization preceeds dike emplacement. Dextral strike slip displacements of up to 150 m in the Late Precambrian (Proterozoic) diabase dikes indicate that some fault movement occurred after diabase dike emplacement. Minor hydrothermal alteration, epidotization, and hematization of the tonalite and amphibolite enclaves is present along Outlet Bay and may have occurred during this late stage movement.

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

LATE PRECAMBRIAN

Mafic Intrusive Rocks

Diabase Sheets and Sills

Discordant diabase sheets and concordant diabase sills of the Nipigon Plate are exposed over approximately 10% of the map area. The sills and sheets are outliers, left as erosional remnants of tabular bodies with an originally greater areal extent. The diabase occurs as shallow dipping discordant sheets intrusive into Early Precambrian (Archean) rocks. Outside of the map area concordant sills of diabase are intruded into Late Precambrian (Proterozoic) Sibley Group sediments near the Early Precambrian-Late Precambrian unconformity.

The diabase forms prominent flat topped hills which rise above the peneplained Early Precambrian rocks. The hills generally have one steep face, on which cliffs up to approximately 25 m high are developed, and slope gradually away on the opposite side. In certain areas, such as west of Gibson Lake, where the contact of the diabase and Early Precambrian rocks was observed, the slope of the diabase hill parallels the dip of the sheet.

The dips of the diabase sheets appear to be variable over the area and reflect gentle basin and dome structures. In the southwestern part of the area, the diabase forms a semi-circular outcrop pattern and, where observed, the contacts dip toward the centre of the structure suggesting a shallow basin-like configuration. In the northern part of the area the slope of the diabase ridge suggests the sheet dips north and northeast, while in the southeastern part of the area, the diabase appears to dip to the east.

The total thickness of the diabase sheets is difficult to estimate since the upper contact of the sheets was not observed. A maximum relief of approximately 60 m on the diabase ridges provides a minimum thickness for the sills.

In outcrop, the diabase typically weathers a rusty brown colour and has a dark grey fresh surface. Weathered surfaces show that the fine to medium grained tabular plagioclase is enclosed by subophitic to ophitic pyroxene. Outcrops of diabase generally have a blocky appearance due to the presence of three near perpendicular joint sets, one of which is subhorizontal. The two other sets dip subvertically but no preferred strike was observed. No penetrative fabric was observed within the diabase.

The contact of the diabase sheet with Early Precambrian tonalite was observed at a few locations in the southwestern part of the area. The lower contact is particularly well exposed on a steep outcrop approximately 50 m west of the northwest bay of Gibson Lake. Here the diabase is discordant to the biotite tonalite. At the contact, a chill zone of aphanitic diabase is approximately 0.3 m thick and is polygonally fractured. Overlying the aphanitic chill is approximately 1 m of fine grained diabase which grades upward to medium grained diabase with a subophitic to ophitic texture characteristic of the bulk of the sheet.

In thin section, the diabase is seen to be composed of tabular labradorite (45 to 60%), ophitic to subophitic clinopyroxene or pigeonite (30 to 45%), rounded grains of olivine, sometimes altered to serpentine or iddingsite (0 to 5%) with minor magnetite, biotite, hornblende, and apatite. Mineralogical variations attributable to magmatic differentiation were observed in thin sections from the bottom toward the top of the sheets and sills and include:

(1) Decrease in anorthite content from An_{67} to An_{54} was observed in the plagioclase of the diabase south of Glen Lake,

(2) Decrease in proportion of modal olivine from 3% to absent in the diabase west of Gibson Lake,

(3) Presence of micrographic quartz-feldspar intergrowths toward the top of the diabase south of Glen Lake.

All of these features were not observed in any single diabase.

Diabase Dikes

Diabase dikes striking at approximately 020° and 150° and dipping near vertically are abundant throughout the map area. The dikes vary considerably in width. Those striking at approximately 020° are generally 20 to 50 m wide, while those at a strike of 150° are usually less than 2 m. The wider dikes were traced discontinuously for up to 15 km.

In outcrop, hand specimen, and thin section the dikes are very similar to the diabase sills and sheets. The topographic expression of the dikes as positive linear features as opposed to flat topped hills is sufficient to distinguish them. Furthermore, the dikes lack the prominent subhorizontal joints typical of the sheets and sills. Smaller dikes, less than 1 m in width, and the chill zones of wide dikes are aphanitic with a conchoidal fracture and contain plagioclase microlites.

Granophyre Dikes Related to Diabase

Narrow (0.5 to 10 m) discontinuous dikes of granophyre were observed associated with the diabase in several locations. The granophyre is easily recognized by its fine grained matrix, brick red weathered surface, splintery to conchoidal fracture, and generally porphyritic texture. Locally, miarolitic cavities to 1 cm are filled with vuggy quartz.

In thin section, the granophyre is fine grained and porphyritic to glomeroporphyritic. Phenocrysts include fresh to oxidized clinopyroxene, resorbed and oxidized hornblende, chloritized and oxidized biotite, hematized and sericitized plagioclase (oligoclase), resorbed and corroded sanidine, resorbed quartz, and euhedral apatite. The phenocrysts range in size from 2 mm to 1 cm and account for 10 to 50% of the rock. The matrix is holocrystalline, very fine grained, highly oxidized and composed of intergrown quartz and feldspar with chlorite and magnetite.

There is a particularly good exposure of a narrow granophyre dike (not shown on the map as a separate unit) on the southern shore of Outlet Bay, Caribou Lake, approximately 600 m east of Sturgeon Arm. The exposure shows a glomeroporphyritic texture with plagioclase, sanidine, biotite, hornblende, and pyroxene.

CENOZOIC

The surficial geology of the region including the present map area has been documented by Zoltai (1965b) after his mapping of the surficial geology of the Thunder Bay region (Zoltai 1965a). The following description of the surficial geology of the Funger Lake Area is largely based on Zoltai's (1965a, 1965b) interpretations, augmented by field observations made in the present survey.

PLEISTOCENE

The map area was glaciated during the Pleistocene Epoch. The Wisconsin ice sheets, which produced the most recent glaciation, retreated from the map area between 9000 and 9500 years ago (Prest 1970). The ice sheets and subsequent glacial lakes modified the existing surface relief by erosion of the bedrock and deposition of surficial material.

Glacial striae, chattermarks and roches moutonnées indicate that the latest direction of ice movement was approximately due south. Pleistocene deposits within the Funger Lake Area consist of glacial, glaciofluvial, glaciolacustrine, and aeolian deposits.

Glacial Deposits

Ground moraine consisting of sandy till is the most widely distributed surficial deposit in the map area. Throughout most of the area the till is thin and forms a discontinuous mantle on the bedrock. Rounded cobbles to boulders constitute approximately 25% of the till and match the bedrock lithology in the vicinity. Boulder fields are sporadically distributed throughout the area and are believed to have been derived by erosion of the sandy component from the till leaving behind the coarse boulders.

Glaciofluvial Deposits

An esker extends from the northern to the southern boundary of the map area, approximately through the centre of the area. The esker has a broadly sinuous pattern, and is breached or interrupted at approximately 1 to 2 km intervals. Two smaller tributary eskers join the major esker along its course. One is present west of Rove Lake and the other south of Alphonse Bay, Caribou Lake. The eskers vary in height with their crests ranging up to 20 m above the surrounding country. The eskers are composed of cobbly to bouldery sand. In the southern part of the area south of Caribou Lake the major esker appears to have been modified by wave action since it is breached, terraced, and surrounded by a broad sandy apron.

Glaciolacustrine and Aeolian Deposits

The map area lies within the region occupied by former glacial Lake Agassiz (Zoltai 1965a). Extensive sand deposited by the lake is present in the northwestern part of the area between Caribou and Lonebreast Bays, Smoothrock Lake. The sand and fine sand are generally stone free and form a thick mantle burying most of the bedrock.

Between Lonebreast Bay and Caribou Bay, Smoothrock Lake, the sand has been wind drifted into dunes. The dunes are of a transverse type (Zoltai 1965a) and form elongate, arcuate hills 10 to 15 m above the sand plain. The dunes are now stabilized by vegetation.

RECENT

Recent deposits include lacustrine and fluvial clay, silt, and sand which are being deposited by creeks and lakes. Organic muds are presently being deposited in swamps and muskeg. The most extensive area of swamp is between Caribou and Lonebreast Bays, Smoothrock Lake. Here the swamp overlies glaciolacustrine and aeolian sand.

Geochemistry

Nineteen samples from the major suites of Precambrian rocks from the area were selected for major element analyses. Analytical results are reported in Table 5. Three analyses of the anorthositic gabbro dike on Outlet Bay were taken from Stone (1974). One typical analysis of the anorthositic dike is reported in Table 5. Additional unpublished data from rock types in the area was supplied by F.W. Breaks (Geologist, Ontario Geological Survey) (Table 6). This data was obtained from rocks collected during Operation Ignace-Armstrong (Sage *et al.* 1974). All analyses are by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

Results for all the Early Precambrian (Archean) samples are plotted on an AFM diagram (Figure 4) and on a Na_2O-K_2O-CaO diagram (Figure 5). The AFM diagram shows that rocks of the Funger Lake Area represent two distinct trends. A tholeiitic trend is indicated by rocks of the mafic dike suite, including anorthositic gabbros, and the Outlet Bay Pluton. Three samples of mafic metavolcanics also plot as tholeiitic. The wide chemical variation of the Southern Caribou Lake Pluton indicates a calc alkaline trend. Limited analyses of the early plutonic suite and a granite from the late plutonic suite also plot as calc alkaline. It should be stressed however that different rock types falling within similar trends in the AFM diagram do not necessarily represent progressive chemical change of a common differentiating magma source. For instance, rocks of the early plutonic suite, late plutonic suite and Southern Caribou Lake Pluton all plot as calc alkaline, however, distinct differences between these suites are evident on the Na_2O-K_2O-CaO diagram

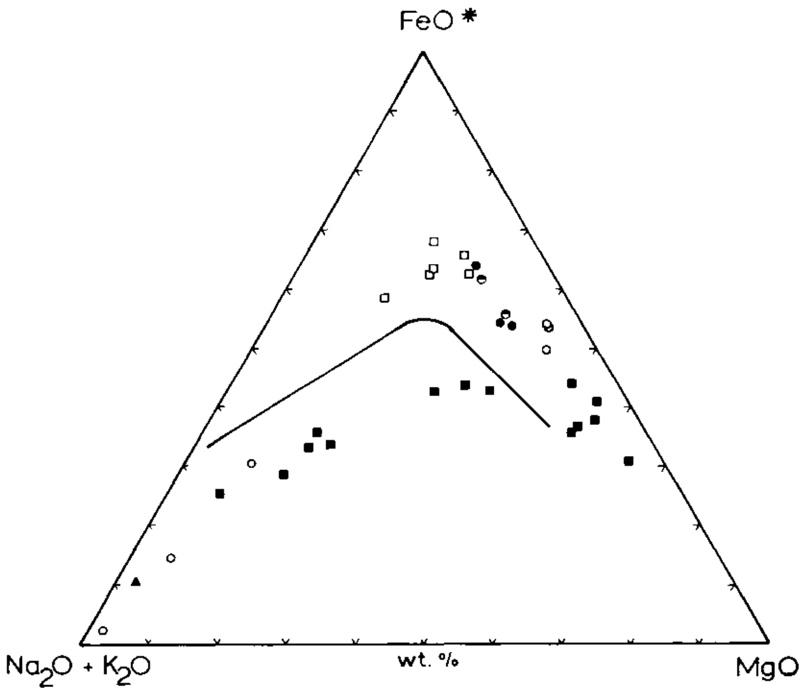


Figure 4. *Weight percent ($Na_2O + K_2O$)–FeO*–MgO for rocks of the Funger Lake Area. Curve separates tholeiitic and calc alkaline suites for reference (after Irvine and Baragar 1971). *Total iron as FeO.*

● *Mafic Metavolcanic Rocks*

○ *Early Felsic to Intermediate Plutonic Rocks*

Mafic Dike Rocks:

◓ *Amphibolite Dikes*

○ *Anorthositic Gabbro Dike*

□ *Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton*

■ *Felsic to Ultramafic Alkaline Plutonic Rocks - Southern Caribou Lake Pluton*

▲ *Late Felsic Plutonic Rocks - Smoothrock Lake Pluton*

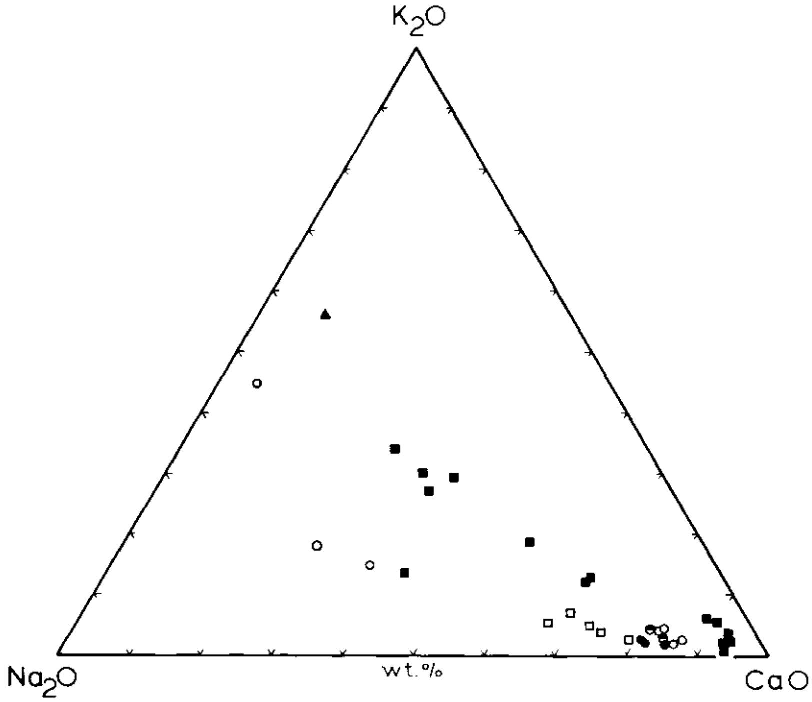


Figure 5. Weight percent Na_2O-K_2O-CaO for rocks of the Funger Lake Area.
● Mafic Metavolcanic Rocks
○ Early Felsic to Intermediate Plutonic Rocks
Mafic Dike Rocks:
◓ Amphibolite Dikes
○ Anorthositic Gabbro Dike
□ Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton
■ Felsic to Ultramafic Alkaline Plutonic Rocks - Southern Caribou Lake Pluton
▲ Late Felsic Plutonic Rocks - Smoothrock Lake Pluton

(Figure 5). $Na_2O/(Na_2O + K_2O)$ within these rocks ranges from 0.38 to 0.75 with the early plutonic suite having the highest ratios, the Southern Caribou Lake Pluton intermediate ratios, and one sample of the late plutonic suite has the lowest ratio.

The three samples of mafic metavolcanic amphibolites are tholeiitic in composition on the AFM plot (Figure 4) and straddle the high magnesian tholeiite-high iron tholeiite field boundary of Jensen (1976). The samples have a limited range in composition with SiO_2 in the range 49-50 weight percent.

Samples of tonalite from the early felsic to intermediate plutonic suite (Table 5) are characterized by high SiO_2 (69 to 71 wt %), high Al_2O_3 (17.1 to 17.5 wt %), high Na_2O (4.25 to 5.08 wt %) and low K_2O (1.28 to 1.66 wt %). The tonalites are peraluminous with molecular $Al_2O_3/(CaO + Na_2O + K_2O)$ ranging from 1.21 to 1.19. These major element characteristics indicate that the Funger Lake Area tonalites are compositionally similar to tonalitic rocks which form the early plutonic phase in several other shield areas. They are comparable to the "ancient tonalites" of the Barberton area, South Africa (Glickson 1976) and the Saganaga Tonalite of the Minnesota-Ontario region (Arth and Hanson 1975).

The geochemistry of the mafic dike suite (Table 5) and Outlet Bay Pluton (Tables 5 and 6) is particularly interesting since these rocks represent a major episode of basaltic magmatism which postdates the initial phase of granitoid plutonism. In order to test whether the major element analyses of the mafic dike suite and Outlet Bay Pluton are comparable to typical basaltic rocks, the analyses were plotted against several discriminating ratios of Irvine and Baragar (1971). According to Irvine and Baragar's (1971) classification, the dike rocks and gabbros are chemically identical to subalkaline, high iron tholeiitic basalts (Figures 6a to 6c). However, TiO_2 (average 2.44 wt %) and P_2O_5 (1.30 wt %) are generally high in the Outlet Bay Pluton. The basaltic chemistry of the gabbro and dikes raises the possibility that they may represent a magma chamber and feeder system for high iron basalts in the greenstone belt occupying a stratigraphically higher position than the metavolcanic rocks exposed within the present map area.

The Southern Caribou Lake Pluton (Tables 5 and 6) shows a wide range in chemistry and varies from ultramafic to felsic. The pluton is alkali-calcic (Peacock alkali-lime index) and is olivine and/or nepheline normative. Weight percent Na_2O/K_2O is approximately equal to 1 and molecular $Al_2O_3/(CaO + Na_2O + K_2O)$ is <1 (metaluminous). Oligoclasites and syenites of the pluton have high Sr (300 to 1000 ppm) and Ba (240 to 880 ppm) (Breaks, unpublished data). These chemical features indicate a similarity between the Southern Caribou Lake Pluton and alkaline rocks such as the Icarus Syenite in northeastern Minnesota (Arth and Hanson 1975). In Minnesota, the syenites are associated with more abundant "synodiorites" (monzodiorites) (Arth and Hanson 1975).

Several samples of Late Precambrian (Proterozoic) diabase were analyzed to test for possible differentiation within the rocks. The samples (Table 5) included one dike, one pair of samples from the top and bottom of a vertical exposure of a diabase sill (west of Gibson Lake) and an additional sample from near the base of a sill (Caribou Lake). All samples are tholeiitic and show a very limited range in composition with no systematic variation in major elements.

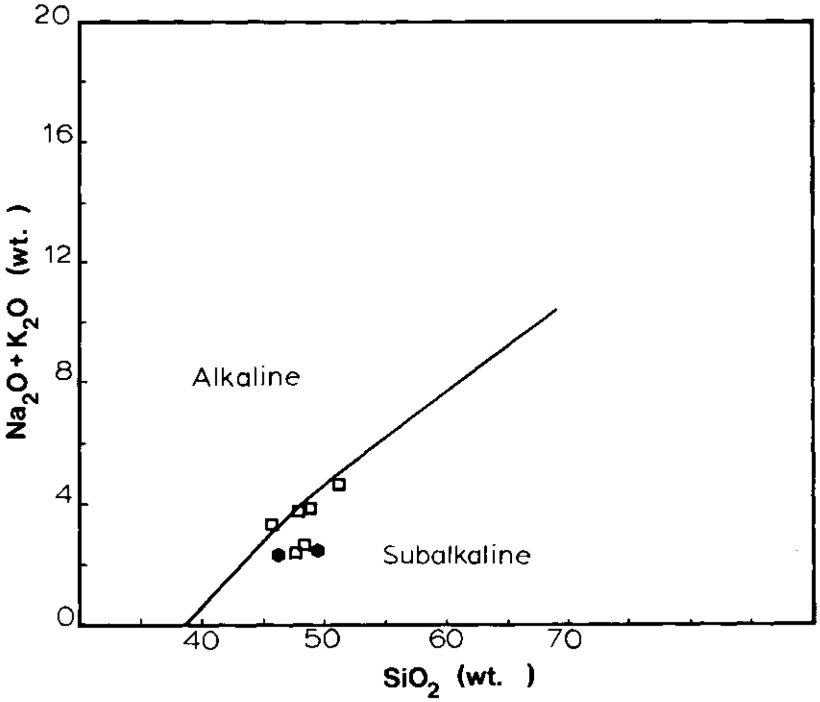


Figure 6a: Weight percent Na_2O+K_2O versus weight percent SiO_2 separating alkaline and subalkaline fields (after Irvine and Baragar 1971).
□ Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton
● Mafic Dike Rocks - Amphibolite Dikes

TABLE 5: CHEMICAL ANALYSES OF REPRESENTATIVE ROCK TYPES

	Mafic Metavolcanics			Early Plutonic Suite						Mafic Dike Swarm			Outlet Bay Pluton
Sample No.	14	90	215	3	87	157	229	326	89	60	88	51	217
SiO_2	49.20	49.20	50.10	-	70.90	69.70	-	-	71.80	46.40	49.20	47.50	45.80
TiO_2	0.88	1.33	0.84	-	0.18	0.41	-	-	0.17	1.41	1.26	0.27	3.71
Al_2O_3	14.10	14.00	14.90	-	17.50	17.10	-	-	17.30	14.40	14.10	27.40	13.90
FeO*	11.40	14.40	11.05	-	1.21	2.79	-	-	0.19	11.95	13.92	4.41	15.45
MnO	0.20	0.23	0.25	-	0.03	0.04	-	-	0.02	0.21	0.23	0.09	0.24
MgO	7.17	5.78	7.46	-	0.49	0.90	-	-	0.21	7.46	6.39	3.43	4.04
CaO	10.70	10.30	11.80	-	2.52	3.18	-	-	0.47	11.30	10.20	13.20	9.53
Na_2O	2.19	2.08	1.91	-	5.08	4.25	-	-	4.51	1.81	1.83	1.65	2.80
K_2O	0.32	0.28	0.22	-	1.66	1.28	-	-	4.11	0.45	0.57	0.39	0.50
P_2O_5	0.09	0.12	0.09	-	0.07	0.11	-	-	0.06	0.12	0.11	0.03	1.71
CO_2	0.07	0.12	0.05	-	0.11	0.10	-	-	0.22	0.18	0.14	0.10	0.04
S	0.07	0.07	0.01	-	0.01	0.02	-	-	0.01	0.18	0.17	0.03	0.05
LOI	0.60	0.50	0.30	-	0.70	0.30	-	-	0.60	1.40	0.60	1.07	0.50
Total	96.99	98.41	98.98	-	100.46	100.18	-	-	99.67	97.27	98.72	99.57	98.27

*FeO = Fe_2O_3(total)/1.1134

TABLE 5: Continued

Sample No.	131	154	156	130	101	102	204	246	231	106	160	164	350
	Southern Caribou Lake Pluton						Caribou Bay Pluton	Late Plutonic Suite		Diabase			
SiO_2	-	-	53.60	51.40	48.50	48.30	-	73.70	-	48.30	48.60	48.90	47.90
TiO_2	-	-	0.73	1.04	0.91	0.89	-	0.22	-	1.28	1.55	1.51	1.86
Al_2O_3	-	-	22.30	13.10	9.09	6.28	-	15.50	-	15.90	15.30	14.20	17.80
FeO*	-	-	5.29	9.97	7.48	8.37	-	1.01	-	13.47	13.92	13.92	11.68
MnO	-	-	0.06	0.17	0.12	0.15	-	0.01	-	0.19	0.19	0.21	0.17
MgO	-	-	2.67	7.03	11.30	12.50	-	0.30	-	5.73	5.09	6.39	5.91
CaO	-	-	5.84	8.39	17.40	18.60	-	0.91	-	9.79	10.60	10.00	8.68
Na_2O	-	-	6.23	3.57	1.14	0.78	-	3.29	-	2.36	2.39	2.53	2.96
K_2O	-	-	1.84	2.76	1.21	0.67	-	5.35	-	0.73	0.37	0.40	0.79
P_2O_5	-	-	0.41	0.37	0.14	0.26	-	0.11	-	0.18	0.16	0.17	0.21
CO_2	-	-	0.08	0.21	1.18	1.06	-	0.13	-	0.15	0.12	0.07	0.13
S	-	-	0.01	0.03	0.01	0.03	-	0.00	-	0.05	0.02	0.04	0.14
LOI	-	-	0.70	0.80	2.00	1.80	-	0.00	-	0.00	0.20	0.20	0.10
Total	-	-	99.76	98.84	100.48	99.69	-	100.13	-	98.13	98.51	98.54	98.33

*FeO=FE_2O_3(total)/1.1134
For sample descriptions refer to Table 3.

TABLE 6. CHEMICAL ANALYSES FROM THE OUTLET BAY AND SOUTHERN CARIBOU LAKE PLUTONS

Sample No.	Southern Caribou Lake Pluton										Outlet Bay Pluton				
	HH19-5	H19-15B[1]	H19-20[2]	H19-30[3]	H19-31	H19-32[4]	H19-5	H19-10[5]	H20-83	H19-59[6]	G17-3	G17-4	G18-57[2]	G20-105[4]	G20-107
SiO_2	49.80	47.90	46.50	48.30	49.00	49.30	56.40	55.40	54.20	56.20	47.50	48.10	50.80	48.60	47.70
TiO_2	0.50	0.80	0.80	0.91	0.95	0.72	0.67	0.67	1.16	0.68	2.74	1.20	2.36	2.24	2.36
Al_2O_3	5.00	6.50	6.90	7.81	15.70	13.80	20.40	19.30	18.00	20.90	16.40	15.60	20.10	17.00	17.30
Fe_2O_3	3.51	4.52	3.68	3.38	3.55	3.82	1.85	3.50	1.42	2.80	4.39	3.84	3.06	4.64	4.46
FeO	4.50	6.83	6.60	4.88	6.26	6.55	3.03	3.28	4.95	2.33	9.01	10.50	7.32	9.50	10.20
MnO	0.07	0.08	0.08	0.13	0.17	0.19	0.08	0.09	0.13	0.05	0.19	0.28	0.14	0.18	0.17
MgO	16.20	14.70	11.20	11.80	7.40	8.96	2.53	2.98	3.71	1.52	4.58	5.76	2.58	4.35	4.40
CaO	17.60	15.60	19.80	18.40	10.50	9.88	5.29	5.32	6.19	4.33	10.50	10.30	8.98	8.71	9.80
Na_2O	0.81	0.97	1.08	0.93	3.03	2.68	4.93	4.72	4.53	8.09	1.70	2.40	3.83	3.07	3.05
CO	0.41	0.19	0.43	1.13	1.85	1.83	4.41	3.81	4.41	4.83	0.51	0.34	0.75	0.89	0.65
P_2O_5	0.05	0.07	0.09	0.09	0.25	0.07	0.34	0.27	0.76	0.64	0.23	0.05	0.63	0.05	0.05
CO_2	1.04	0.58	0.81	1.10	0.25	0.68	0.14	0.14	0.15	0.11	0.10	0.13	0.15	0.16	0.13
S	0.01	0.01	0.04	0.01	0.13	0.03	0.01	0.01	0.01	0.01	0.07	0.05	0.03	0.13	0.06
H_2O^+	0.60	1.08	0.69	0.39	0.54	1.29	0.93	0.91	0.45	0.48	0.82	0.90	0.65	1.00	1.04
H_2O^-	0.27	0.33	0.26	0.23	0.25	0.24	0.23	0.23	0.42	0.24	0.28	2.20	0.21	0.22	0.20
Total:	100.1	100.2	99.0	99.5	99.8	100.0	100.7	100.4	100.5	100.2	99.0	99.6	101.6	100.7	101.5

Notes:
Unpublished data by the Geoscience Laboratories, Ontario Geological Survey, Toronto. Samples collected by F.W. Breaks, 1973.
[1]Metagabbro [2]Hornblende [3]Clinopyroxenite [4]Gabbro [5]Diorite [6]Syenite

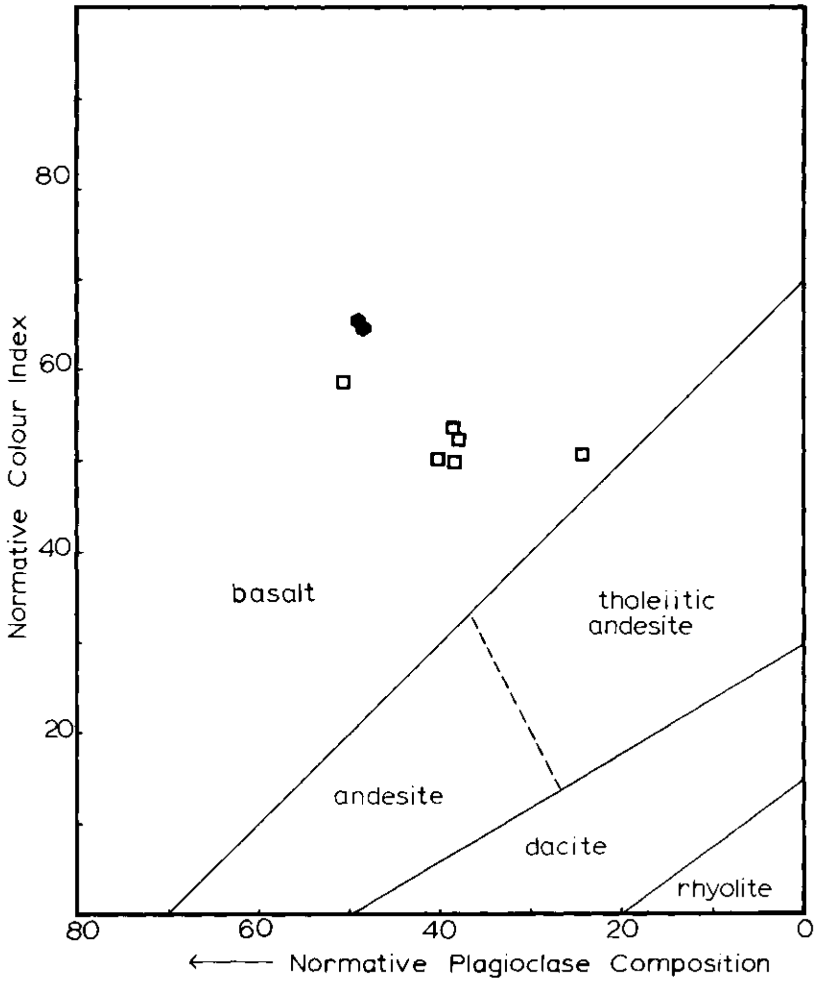


Figure 6b. *Weight percent C.I.P.W. normative colour index versus C.I.P.W. normative plagioclase composition for subalkaline rocks (after Irvine and Baragar 1971).*

□ *Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton*

● *Mafic Dike Rocks - Amphibolite Dikes*

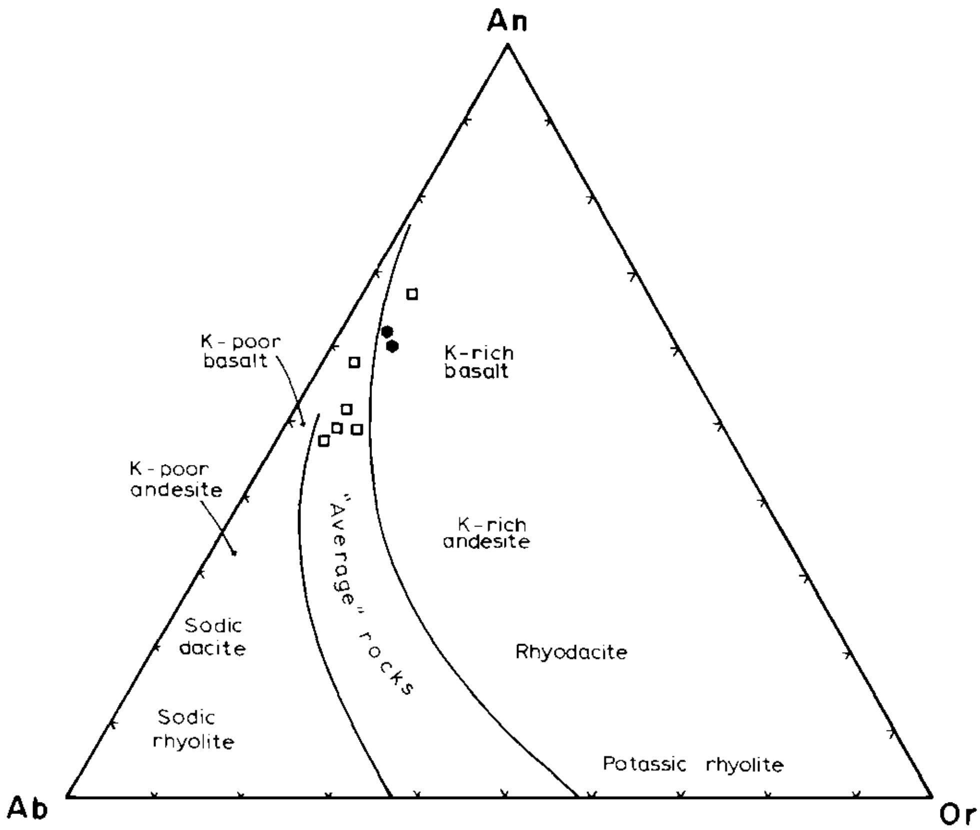


Figure 6c. *Weight percent C.I.P.W. normative albite-anorthite-orthoclase plot for subalkaline rock suites (after Irvine and Baragar 1971).*

□ *Mafic to Ultramafic Plutonic Rocks - Outlet Bay Pluton*

● *Mafic Dike Rocks - Amphibolite Dikes*

Structural Geology

FOLIATED, SCHISTOSE, GNEISSIC, AND LINEAR FABRICS

Most of the metavolcanic rocks and rocks of the early plutonic suite have a well developed planar fabric produced by either subparallel alignment of micas, amphiboles, and feldspars; or segregation of mineral phases into layers. Planar fabrics are weakly developed in rocks of the Outlet Bay Pluton and late plutonic suite and absent in the Late Precambrian (Proterozoic) diabase.

Mafic metavolcanic rocks have a predominantly foliated fabric due to alignment of hornblende crystals. This foliation is generally subparallel to the metavolcanic-plutonic contacts and is metamorphic in origin. Along the northern margin of the Rove Lake belt, gneissic banding is present within the metavolcanic rocks. The banding is due to segregation of hornblende and plagioclase into distinct layers.

Foliation in the rocks of the early plutonic suite is primarily due to the alignment of biotite although locally a quartz fabric contributes to the foliation. The foliation in the tonalitic rocks may have originated during emplacement of the plutons and therefore may be primary in origin, or a secondary foliation developed during a metamorphic event. Distinction between the two possibilities is not easy in many cases. The accompanying structural geology map (Figure 7, Chart A, back pocket) shows that foliations in the tonalite in the southern part of the map area are developed subparallel to the plutonic-metavolcanic interface and define parts of two dome structures. One dome is centred on Reaching Lake and the other on Alphonse Bay, Caribou Lake. This configuration suggests that the foliation may have developed during emplacement of the tonalite. In the northern part of the area, the structure of the tonalite is complicated by the intrusion of the Outlet Bay Pluton and Smoothrock Lake Pluton. The origin of the fabric within this part of the tonalitic rocks is uncertain.

In the southern part of the map area, a gneissic fabric is locally developed in the tonalitic rocks. The gneissic fabric is due to the presence of granite leucosomes within the biotite tonalite (Photo 3). The leucosomes are rimmed by zones enriched in biotite and therefore appear to have developed *in situ*. The granite leucosomes are concordant to weakly discordant to the biotite foliation in the host tonalite and appear to have developed during emplacement of the plutons. Local development of a gneissic fabric is also present in zones containing abundant mafic enclaves. Here, gneissosity is due to deformation of *lit-par-lit* injection migmatite and agmatitic breccias resulting in alternating planar bands of amphibolite and tonalite (Photo 4).

Foliation in the Southern Caribou Lake Pluton and Outlet Bay Pluton is due to alignment of tabular plagioclase crystals and is believed to be primary in origin. A particularly well developed fluidal texture is present in some areas of the Southern Caribou Lake Pluton.

Penetrative linear fabrics are only locally developed within the map area. The most prominent development is in the Pashkokogan Lake-Kenoji Lake Fault Zone and in an east-west trending zone within the biotite tonalite in Alphonse Bay, Caribou Lake. Lineation in the biotite tonalite is defined by linear aggregates of quartz and is subhorizontal.

FOLD STRUCTURES

The absence of suitable stratigraphic top indicators prohibits the recognition of folds within the supracrustal rocks. Consequently, no fold axes are shown on the accompanying map. Minor drag folds are developed in banded grunerite ironstone southeast of Caribou Bay, Smoothrock Lake and in mylonitic rocks along Outlet Bay, Caribou Lake.

The tri-lobed form of the mafic metavolcanic rocks south of the Outlet Bay Pluton is suggestive of a triply plunging synformal structure. There is no stratigraphic evidence to support this interpretation; however, the structure would be compatible with the adjacent domes of tonalite to the south and west of the metavolcanics.

JOINTS

Jointing is a pervasive secondary structure affecting most rock types in the area. No systematic record of joints was made during mapping and the following comments are based on field observation as opposed to statistical analyses.

In the Early Precambrian (Archean) rocks of the map area subvertical joint sets at approximately 020° and 150° are prominent. A statistical study of joint orientations was not attempted but the joints appear to parallel diabase dikes, minor late block faults, and prominent lineaments within the area.

Diabase sills and sheets generally have three sets of joints developed approximately at right angles to each other. One set of the joints is generally subhorizontal and together the three sets give the diabase outcrops a characteristic blocky appearance.

FAULTS

Two distinct styles and ages of faulting are recognized within the map area. One type is associated with extensive cataclasis and recrystallization under strain. Cataclastic rocks associated with this type of faulting are characterized by the Pashkokogan Lake-Kenoji Lake Fault Zone and discussed in the section on "General Geology". The second type of faulting is minor late block faulting which appears to be related to the predominant northeast and southeast trending joint sets.

The late block faults are primarily recognized by the displacement of diabase dikes although locally they have offset the contact of the Outlet Bay Pluton. Strike slip displacements associated with this style of faulting are usually less than 500 m. Topographic lineaments are developed along the late faults. Other lineaments in the area may be the locus of fault movement which has not been recognized due to small strike displacement or absence of suitable lithological contacts to indicate offsets.

Hydrothermal alteration is commonly visible in granitoid rocks adjacent to the block faults. Effects of this activity include:

(1) General alteration of nearby rocks including hematization, epidotization, and chloritization of mafic minerals and alteration of feldspars to clay minerals,

(2) Presence of epidote and quartz veinlets in the nearby wall rocks.

STRUCTURAL RELATIONS BETWEEN EARLY PRECAMBRIAN (ARCHEAN) INTRUSIVE SUITES

This section provides a brief summary of the tectonic style which characterizes each of the major intrusive suites within the map area. The structural data for the Funger Lake Area is summarized in Figure 7 (Chart A, back pocket).

The fabric of the early plutonic suite is semiconformable with the relict supracrustal belts. In the southern part of the area, where the relationship is most evident, the fabric defines two domical structures within the early plutonic suite. One dome is centred on Reaching Lake and the other on Alphonse Bay, Caribou Lake. This domical structure defined by the fabric does not appear to reflect deformation of the early plutonic suite by younger plutonic rocks. Instead, the fabric appears to have developed during the emplacement of the tonalites into their present position. This interpretation is consistent with the structural analyses of the similar early tonalitic rocks in the western Wabigoon Subprovince which indicates that the fabric of the tonalites is due to diapirism (Schwerdtner *et al.* 1979).

Amphibole, gabbro, and gabbroic anorthosite dikes are concentrated north of the Outlet Bay Pluton and have a dominant trend of 020° to 050°. The mafic dike swarm appears to be related to the Outlet Bay Pluton. Evidence for this includes: (1) similarities in mineralogy and chemistry; and (2) parallelism of the two large gabbro apophyses and the dike swarm.

The linear nature and parallelism of the swarm is similar to the tectonic style of the Middle to Late Precambrian (Proterozoic) diabase dikes although considerably more localized in areal extent. Such dike swarms occupy brittle fracture systems generated normal to a minimum compressive stress direction (Hills 1972).

The dikes may have been emplaced along a fracture system generated by the rise of the Outlet Bay Pluton. As such the dikes are believed to represent the first phase of a period of basaltic magmatism which began after the tonalites had cooled sufficiently to fracture in a brittle manner.

The gabbro of the Outlet Bay Pluton has semiconformable relationships with the mafic metavolcanic rocks and biotite tonalite. Local inclusions of both metavolcanic rocks and tonalite, however, demonstrate that the gabbro postdates both. The internal structure of the pluton is predominantly massive although a local foliation is present in the limbs and axial region of the crescent shaped body. The location and form of the gabbro pluton appears to have been controlled in part by the geometry of the interface between the metavolcanic rocks and the tonalites of the early plutonic suite. Effects of the emplacement of the Outlet Bay Pluton on the tonalitic rocks have not been established in this study.

The Southern Caribou Lake Pluton displays discordant to quasi-conformable relations with the early plutonic suite, and locally truncates the fabric trend of the tonalitic rocks. Enclaves of the tonalite are present in the pluton. Poor exposure along most of the contact limits further interpretation of the mode of emplacement of this body.

The small Caribou Bay Pluton has been intruded along the contact of the Outlet Bay Pluton and mafic metavolcanics. Smaller sill like bodies of rock similar to the Caribou Bay Pluton also occur along the contact of the Outlet Bay Pluton and early plutonic suite. Enclaves of both amphibolite and gabbro are present within the Caribou Bay Pluton and smaller sills.

Late granite and pegmatite of the Smoothrock Lake Pluton and associated dikes discordantly intrude the metavolcanics, early plutonic suite, amphibolite dikes, Outlet Bay Pluton, Southern Caribou Lake Pluton, and the Caribou Bay Pluton. The granite is massive except for a weak biotite foliation near the contacts of the Smoothrock Lake Pluton. Sills and dikes of pegmatite across the northern portion of the area are broadly concordant with the trend of biotite foliations in the tonalite but in detail show crosscutting relationships.

Aeromagnetic Data

The map area is covered by airborne magnetometer surveys flown in 1959-1960 and 1962 for the Ontario Geological Survey and the Geological Survey of Canada. The resulting aeromagnetic maps (ODM-GSC 1960; 1962) have been used for correlation of geology with magnetic data.

A correlation is present between the total field magnetic intensity and pattern and some of the lithological units. Areas underlain by granitoid rocks are characterized by intermediate magnetic intensity (60 000 to 61 000 gammas) and generally widely spaced contour lines. The gabbroic Outlet Bay Pluton and alkaline Southern Caribou Bay Pluton are characterized by a broadly intermediate magnetic intensity (60 000 to 61 000 gammas) with patchy zones of high magnetic intensity (61 000 to 61 500 gammas) and highly variable magnetic gradients. The zones of high magnetic intensity appear to correlate with concentrations of magnetite in the plutons. Areas underlain by diabase sills and sheets in the southwestern part of the map area have a weak relative magnetic intensity (60 000 to 60 500 gammas) and correlate with magnetic depressions. A pronounced linear magnetic depression north of the Outlet Bay Pluton correlates with the edge of the pluton and the Outlet Bay Fault Zone.

The mafic metavolcanics, amphibolite dikes, and diabase dikes all appear to be too small in areal extent relative to their magnetic character to have a distinct expression on the aeromagnetic maps.

Economic Geology

EXPLORATION ACTIVITY

Mineral exploration within the map area has been minimal. At the time of writing, no work had been recorded for the area at the Assessment Files Research Office, Ontario Geological Survey, Toronto, or at the Resident Geologist Office, Ontario Ministry of Northern Development and Mines, Thunder Bay. No claims were held within the map area as of October 1, 1979.

Evidence of minor trenching of pyrite occurrences in mafic metavolcanic rocks was observed west of Caribou Bay, Smoothrock Lake, during field mapping. Precious metal and base metal exploration in the Caribou Lake-Pikitigushi River metavolcanic-metasedimentary belt to the east of the map area has been intermittent since 1954.

PYRITE AND PYRRHOTITE MINERALIZATION

Concentrations of pyrite and/or pyrrhotite without associated base metal sulphides were found at several localities within the map area (Map 2466, back pocket), predominantly associated with supracrustal rocks. The mineralized areas are described individually in the following section. Analytical results are summarized in Table 7.

Lonebreast Bay, Smoothrock Lake

The island of grunerite ironstone exposed near the eastern end of Lonebreast Bay, Smoothrock Lake (Map 2466, back pocket) contains minor pyrite mineralization. The ironstone strikes east-west, dips vertically and appears to be contained within the mafic amphibolites which form the western extension of the Caribou Lake-Pikitigushi River belt. The length and width of this unit is unknown as it is only exposed on the island. Extensive gossan is present in the ironstone on the west end of the island and the entire outcrop has rusty weathering.

The ironstone is composed of interbedded fine recrystallized chert (1-4 cm wide bands) and medium grained grunerite (0.5-2 cm wide bands). Fine grains of grunerite are disseminated throughout the ironstone, and pyrite is also present as pods up to 1 cm long within the grunerite. The pyrite mineralization is less than 10%. No sulphide mineralization was found in the heavily weathered gossan at the western end of the outcrop.

A selected grab sample with pyrite mineralization from the central part of the outcrop yielded only traces of gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

A minor (0.3 m wide) sulphide gossan zone with pyrite mineralization is exposed in mafic garnet amphibolite gneiss on the north shore of Lonebreast Bay, immediately west and along strike from the described island.

Rove Lake

Two occurrences of massive to disseminated pyrite are exposed on the south shore of Rove Lake in the northeastern corner of the map area. The occurrences are exposed within the east-west trending zone of gneissic to foliated mafic amphibolites. The amphibolite has been extensively epidotized, silicified and fractured, probably as a result of faulting along the Pashkokogan-Kenoji Lakes Fault Zone immediately to the north.

At the western occurrence up to 30% fine disseminated pyrite is present in a zone of silicified amphibolite approximately 2.5 m wide. The east-west trending mineralized zone is contained within the silicified amphibolite. The zone is approximately 0.5 m wide, dips steeply to the south and is exposed over a 2.0 m strike length. A selected grab sample collected by the field party yielded only a trace of gold and a trace of copper (0.06% Cu; Geoscience Laboratories, Ontario Geological Survey, Toronto). Numerous boulders mineralized with pyrite are present on the shore of Rove Lake in the immediate area of the occurrence.

TABLE 7. ASSAYS OF SELECTED GRAB SAMPLES

Sample	Location	Rock Type	Mineralization	Cu	Ni	Zn	Au	Ag
79-19-242	1	Grunerite Ironstone	Py	-	-	-	tr	-
79-19-49	2a	Silicified Amphibolite	Py	0.06	-	0.05	tr	-
79-19-50	2b	Amphibolite (?)	Py	-	-	-	tr	-
79-19-100	3a	Amphibolite	Po,Py	-	-	-	tr	-
79-19-201	3a	Argillite	Pc,Py	-	-	-	tr	-
79-19-208	3b	Qtz-Carb Vein	Po,Py	-	-	-	tr	-
79-19-209	3b	Silicified Amphibolite	Po,Py	-	-	-	tr	-
79-19-212	3c	Silicified Amphibolite	Po	-	0.03	0.13	tr	-
79-19-210	3d	Amphibolite	Po,Py	-	-	-	tr	-
79-19-237	4a	Grunerite Ironstone	Py	-	-	-	tr	-
79-19-235	4b	Grunerite Ironstone	Py	-	-	-	tr	tr

Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.
Cu, Ni, Zn in wt %. Highest assay or values over 0.05 wt % reported. Pb was analyzed for, but all values were below 0.003 wt %.
All samples analyzed for Cu, Ni, Pb, Zn, Au, Ag.
Cu, Ni, Zn, Pb by atomic absorption.
Au, Ag by fire assay.

The eastern occurrence consists of a pyrite mineralized inclusion in a biotite-muscovite granite pegmatite. The inclusion is exposed at the base of an outcrop on the Rove Lake shoreline and is approximately 0.5 m by 1.0 m in size. The mineralization consists of massive to 50% disseminated pyrite in a rock composed of green amphibole with 5 mm quartz eyes. The rock may be either an altered mafic metavolcanic rock or grunerite ironstone, similar to that exposed on Lonebreast Bay to the west. A selected grab sample indicated only traces of gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

Caribou Bay, Smoothrock Lake

Several occurrences of pyrite and pyrrhotite mineralization are present within the mafic metavolcanic rocks exposed in the centre of the Outlet Bay Pluton. The mineralization occurs as sulphide veins and disseminations and is associated with quartz and/or carbonate veins.

The occurrences exposed on the point on the western shore of the south part of Caribou Bay consist of pyrrhotite and pyrite mineralizaton in a bedded argillaceous interflow sediment and associated amphibolite facies mafic metavolcanics. The interflow sediment is approximately 20 cm wide, strikes at 060°, dips vertically, and contains approximately 30% fine disseminated pyrrhotite. The associated mafic metavolcanics contain approximately 5% pyrite and pyrrhotite mineralization in the form of 1 mm sulphide veinlets and disseminations. A narrow zone of regolith of unknown age consisting of angular argillite and garnet amphibolite fragments in a limonite matrix, separates the argillaceous sediments and the metavolcanics. The zone of mineralization is approximately 1 m wide and the strike length is unknown, as the occurrence is poorly exposed in a bouldery bank at the lakeshore. Numerous mineralized boulders are present on the shoreline. Selected grab samples of the mineralized argillite and amphibolite were collected by the field party from this location, but both samples analyzed contained only traces of gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

Sulphide mineralization is exposed along the western shore of the narrow channel connecting the southern part of Caribou Bay with the main part of the bay, and in the adjacent islands. The pyrrhotite and minor pyrite mineralization occurs as 1 mm wide sulphide veinlets and sparse disseminations (reaching 10% sulphides) in amphibolite and silicified amphibolite. The amphibolite is fractured and locally contains quartz and/or carbonate veins which also contain minor sulphide mineralization. The zone of mineralization, alteration, and sulphide gossan extends for over 100 m on the western shore of the channel. Selected grab samples collected by the field party yielded only traces of gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

The north tip of an island in the previously mentioned channel contains a zone of up to 20% pyrrhotite in silicified amphibolite intruded by granodiorite dikes. The zone trends approximately 020°, dips steeply, and is approximately 10 m wide. A selected grab sample collected by the field party gave a positive test for nickel with dimethylglyoxime. An assay performed on the sample yielded only a trace of nickel (0.03% Ni) and traces of zinc (0.13% Zn) and gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

Sulphide mineralization is present on the western shore of the Caribou Bay channel, near the northern contact of the mafic metavolcanics, adjacent to the Outlet Bay Pluton. The pyrrhotite and pyrite mineralization occurs as sulphide veinlets and disseminations accounting for less than 10% of the amphibolite. A selected grab sample of the mineralized amphibolite indicated only a trace of gold (Geoscience Laboratories, Ontario Geological Survey, Toronto). The entire exposure (approximately 100 m^2) has rusty weathering.

Ironstone, Southwest of Caribou Bay

The grunerite ironstone occurring near the contact of the Outlet Bay Pluton and mafic metavolcanics south of Caribou Bay commonly contain disseminated pyrite mineralization. The ironstone consists of interbanded medium grained recrystallized chert and grunerite with minor very fine magnetite. Finely disseminated pyrite is predominantly associated with the grunerite bands.

At the eastern exposure the ironstone occurs on the northern edge of a large outcrop. The bedding in the ironstone is highly contorted but the unit trends east-west and is approximately 10 m wide. Up to 15% disseminated pyrite is present in the grunerite bands. The outcrop has local rusty weathering and a pungent smell indicative of arsenopyrite; but no such mineralization was found. A selected grab sample collected by the field party yielded only a trace of gold (Geoscience Laboratories, Ontario Geological Survey, Toronto).

The western exposure is very similar to the first. Up to 20% pyrite mineralization is associated with the grunerite bands. The mineralization is present on the south edge of the outcrop over a zone approximately 10 m wide. A selected grab sample yielded only traces of gold and silver (Geoscience Laboratories, Ontario Geological Survey, Toronto).

Mafic Metavolcanics, Southwest of Caribou Bay

The field party located two exploration trenches in schistose amphibolite facies mafic metavolcanic rocks southwest of Caribou Bay. The northeastern trench exposes pyrite mineralization associated with a minor unit of grunerite ironstone in mafic metavolcanics at the contact of a foliated granodiorite dike trending at 110°, and dipping steeply to the south. The southwestern trench contains minor sulphide gossan in schistose amphibolite. A selected grab sample of pyrite mineralized ironstone from the northeastern location yielded no significant metal content.

SAND AND GRAVEL

An area of fine well sorted lacustrine sand forms a plain covering approximately 12 km^2 in the northwestern part of the map area. The lacustrine sand has been modified to form dunes, with a relief of approximately 10 m above the sand plain. The sand deposits however, are largely surrounded by wet muskeg.

No gravel deposits were identified in the map area. The sinuous esker which runs from north to south through the map area is composed of sand and boulders at the surface and may have a gravel component.

RECOMMENDATIONS FOR MINERAL EXPLORATION

Supracrustal rocks in the northern limb of the Caribou Lake-Pikitigushi River belt from Rove Lake to Lonebreast Bay, Smoothrock Lake, and in the central core of the Outlet Bay Pluton have the most potential for base metal and precious metal mineralization in the area. In the Rove Lake belt, the observed pyrite mineralization is stratabound and lies within the thin unit of gneissic to schistose amphibolite facies mafic metavolcanics and associated ironstone. Pyrrhotite and pyrite mineralization in mafic metavolcanic rocks in the core of the Outlet Bay Pluton is associated with fracturing, veining, and alteration, possibly as a result of intrusion of the gabbro. The original source of the mineralization however may be syngenetic as suggested by the mineralized interflow sediment near the south end of Caribou Bay.

Grunerite ironstone exposed in Lonebreast Bay and southwest of Caribou Bay is consistently mineralized with pyrite and analyzed grab samples yielded traces of gold.

The presence of igneous layering and local clinopyroxenite along the southern contact of the gabbroic Outlet Bay Pluton indicate that this zone may have a potential for metals associated with early cumulate phases in the gabbro. The relatively iron-rich nature of the gabbro—$FeO^{Total}/(MgO + FeO^{Total}) \cong 0.8$ (Geoscience Laboratories, Ontario Geological Survey, Toronto) —indicates that the magma may have been too highly evolved to crystallize chromite and that ilmenite or magnetite would be more likely to crystallize. While disseminated magnetite is common in the rock, no seams or large accumulations were identified. Observed magnetic anomalies in the pluton are caused by: (1) apatite-altered clinopyroxene-magnetite dike rocks east of Caribou Bay, and (2) local disseminated magnetite in amphibolite and gabbro in several other locations.

No mineralization of economic interest was observed in the tonalite granodiorite of the early plutonic suite. Pegmatites associated with the late felsic plutonic suite have a simple mineralogy. No indication of lithophile element mineralization (Li, Ce, Be, Ta, Sn) was observed, during the field season.

The Early Precambrian-Middle Precambrian (Archean-Proterozoic) unconformity may have potential for uranium mineralization. Outcrop of the Sibley Group sandstone is restricted to a very small area immediately south of the southeastern corner of the map area. No radiometric anomalies were identified by the field party using a 3-channel radiation spectrometer (McPhar TV-LA) in the area in which the Sibley Group outcrops.

No mineralization was observed associated with the Keweenawan diabase sills. In the Thunder Bay area, metals, particularly silver, associated with the Keweenawan sills are believed to have had their source in the underlying Rove shale (Franklin 1970). The absence of favourable source rocks in the present map area suggests the sills have limited economic potential.

REFERENCES

Arth, J.G., and Hanson, G.N.
1975: Geochemistry and Origin of the Early Precambrian Crust of Northeastern Minnesota, Geochimica et Cosmochimica Acta, Volume 30, p.325-362.

Ayres, L.D., Lumbers, S.B., Milne, V.G., and Robeson, D.W.
1970: West Central Sheet, Ontario Geological Map, Ontario Department of Mines, Map 2199, scale 1 inch to 16 miles.

Bell, T.H., and Etheridge, M.A.
1973: Microstructure of Mylonites and Their Descriptive Terminology, Lithos, Volume 6, p.337-348.

Breaks, F.W., Bond, W.D., and Denver Stone
1978: Preliminary Geological Synthesis of the English River Subprovince, Northwestern Ontario and Its Bearing Upon Mineral Exploration, Ontario Geological Survey, Miscellaneous Paper 72, 55p.

Chayes, F.
1952: Notes on the Staining of Potash Feldspar by Sodium Cobaltinitrite in Thin Sections, American Mineralogist, Volume 37, p.337-340.

Collins, W.H.
1909: A Geological Reconaissance of the Region Traversed by the National Transcontinental Railway Between Lake Nipigon and Clay Lake, Ontario Geological Survey of Canada, Publication Number 1059.

Davies, J.C., Pryslak, A.P., and Pye, E.G.
1966: Sioux Lookout-Armstrong Sheet, Geological Compilation Series, Ontario Department of Mines, Map 2169, scale 1 inch to 4 miles.

Douglas, R.J.W.
1973: Geological Provinces, Map 27-28, *in* The Natural Atlas of Canada, Department of Energy, Mines and Resources, Ottawa.

Franklin, J.M.
1970: Metallogeny of the Proterozoic Rocks of the Thunder Bay District, Ontario, Ph.D. Thesis, University of Western Ontario, 317p.

Glickson, A.Y.
1976: Trace Element Geochemistry and the Origin of Early Precambrian Acid Igneous Series, Barberton Mountain Land, Transvaal, Geochimica et Cosmochimica Acta, Volume 40, p.1261-1280.

Gussow, W.C.
1942: Geology of the Caribou-Pikitigushi Area, Ontario Department of Mines, Volume 49, Part 6, 1940, p.1-12. Accompanied by Map No. 49q, scale 1 inch to 1 mile.

Irvine, T.N., and Baragar, W.R.A.
1971: A Guide to the Chemical Classification of Common Volcanic Rocks, Canadian Journal of Earth Sciences, Volume 8, p.523-548.

Jensen, L.S.
1976: A New Cation Plot for Classifying Subalkalic Voclanic Rocks, Ontario Division of Mines, Miscellaneous Paper 66, 22p.

ODM-GSC
1960: Goldsborough Lake, Thunder Bay District, Ontario, Ontario Department of Mines and Geological Survey of Canada, Aeromagnetic Series Map 940G, scale 1 inch to 1 mile. Survey flown May, 1959 to March 1960.
1962: Armstrong, Thunder Bay District, Ontario; Ontario Department of Mines and Geological Survey of Canada, Aeromagnetic Series Map 2114G. Scale 1 inch to 1 mile, Survey flown April to October, 1962.

Philpotts, A.R.
1967: Origin of Certain Iron-Titanium Oxide and Apatite Rocks, Economic Geology, Volume 62, p.303-330.

Prest, V.K.
1970: Quaternary Geology of Canada, Geological Survey of Canada, Economic Geology Report 1 (5th Edition), p.616-764.

Pye, E.G., Harris, F.R., Fenwick, K.G., and Vaille, J.
1965: Tashota-Geraldton Sheet, Geological Compilation Series, Ontario Department of Mines, Map 2102, scale 1 inch to 4 miles.

Sage, R.P., Breaks, F.W., Stott, G., and McWilliams, G., and Bowen, R.P.
1974: Operation Ignace-Armstrong, Pashkokogan-Caribou Lakes Sheet, District of Thunder Bay, Ontario Division of Mines, Preliminary Map P.962, Geological Series, scale 1 inch to 2 miles. Geology 1973.

Schwerdtner, W.M., Stone, D., Osadetz, K., Morgan, J., and Stott, G.M.
1979: Granitoid Complexes and the Archean Tectonic Record in the Southern Part of Northwestern Ontario; Canadian Journal of Earth Sciences, Volume 16, p.1965-1977.

Stone, Denver
1974: Ovoid Anorthositic Gabbro at Caribou Lake, Ontario, B.Sc. Thesis, Queens University, Kingston, Ontario, 59p.

Streckeisen, A.
1976: To Each Plutonic Rock Its Proper Name, Earth Science Reviews, Volume 12, p.1-33.

Winkler, H.G.F.
1976: Petrogenesis of Metamorphic Rocks, 4th Edition, Springer-Verlag Publishers, New York, 334p.

Zoltai, S.C.
1965a: Thunder Bay, Surficial Geology, Ontario Department of Lands and Forests, Map S265, scale 1 inch to 8 miles. Geology 1958 to 1960.
1965b: Glacial Features of the Quetico-Nipigon Area, Ontario; Canadian Journal of Earth Sciences, Volume 2, p.247-269.

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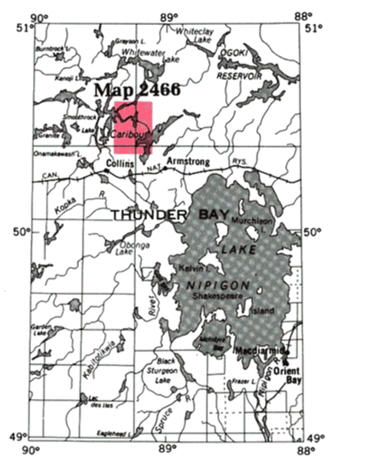
Ontario



Scale 1 inch to 50 miles
NTS Reference 52I/6, 52I/11

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Till, esker deposits, glaciolacustrine sand deposits, swamp stream and lake deposits.

UNCONFORMITY

PRECAMBRIAN[b]

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

- 12 *Unsubdivided.*
- 12a *Diabase dikes.*
- 12b *Diabase sheets, diabase sills.*
- 12c *Granophyre, porphyritic granophyre dikes related to diabase.*

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)[c]

CATACLASTIC ROCKS[d]

- 11 *Unsubdivided.*
- 11a *Mylonite.*
- 11b *Augen gneiss.*
- 11c *Protomylonite.*
- 11d *Pseudotachylite.*

FAULT CONTACT

LATE FELSIC PLUTONIC ROCKS[e]

- 10 *Unsubdivided.*
- 10a *Biotite granite.*
- 10b *Biotite muscovite granite, muscovite biotite granite.*
- 10c *Biotite granite pegmatite.*
- 10d *Muscovite granite pegmatite.*
- 10e *Garnet bearing.*

INTRUSIVE CONTACT

LATE FELSIC TO INTERMEDIATE PLUTONIC ROCKS[f]

- 9a *Porphyritic granodiorite, granodiorite.*
- 9b *Granite, equigranular.*
- 9c *Mafic granodiorite.*

INTRUSIVE CONTACT[g]

ALKALINE FELSIC TO ULTRAMAFIC PLUTONIC ROCKS[h]

- 8a *Biotite±hornblende±clinopyroxene albite syenite, oligoclasite, mafics less than 20%.*
- 8b *Biotite±hornblende±clinopyroxene diorite, gabbro, mafics 20% to 65%.*
- 8c *Hornblende-clinopyroxene melagabbro, mafics 65% to 90%.*
- 8d *Hornblende-clinopyroxene, clinopyroxene-hornblendite.*

INTRUSIVE CONTACT[i]

MAFIC TO ULTRAMAFIC PLUTONIC ROCKS[j,k]

- 7a *Anorthosite.*
- 7b *Hornblende anorthositic gabbro.*
- 7c *Hornblende gabbro.*
- 7d *Clinopyroxene gabbro.*
- 7e *Hornblende-clinopyroxene melagabbro.*
- 7f *Hornblende clinopyroxenite, clinopyroxenite.*
- 7g *Apatite-clinopyroxene-magnetite dike rocks.*
- 7h *Clinopyroxene bearing.*
- 7j *Quartz bearing.*
- 7k *Magnetite bearing.*
- 7m *Plagioclase phenocryst bearing.*
- 7n *Rhythmically layered.*

INTRUSIVE CONTACT

MAFIC DIKE ROCKS

- 6 *Unsubdivided.*
- 6a *Amphibolite.*
- 6b *Hornblende gabbro.*
- 6c *Gabbroic anorthosite, anorthositic gabbro.*
- 6d *Plagioclase phenocryst bearing.*
- 6e *Mafic lamprophyre.*[l]

INTRUSIVE CONTACT

EARLY FELSIC TO INTERMEDIATE PLUTONIC ROCKS

- 5 *Unsubdivided.*
- 5a *Biotite tonalite.*
- 5b *Biotite granodiorite.*
- 5c *Biotite-hornblende diorite, quartz diorite.*
- 5d *Biotite-muscovite granite, muscovite-biotite granite.*
- 5e *Massive.*
- 5f *Foliated.*
- 5g *Gneissic with granite leucosome.*
- 5h *Quartz phenocryst bearing, quartz aggregate bearing.*
- 5j *Microcline metablast bearing.*
- 5k *Garnet bearing.*

INTRUSIVE CONTACT

METAMORPHOSED ULTRAMAFIC ROCKS

- 4a *Serpentinized dunite.*
- 4b *Metapyroxenite.*

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS

CHEMICAL METASEDIMENTS

- 3a *Chert.*
- 3b *Gruneritic chert.*
- 3c *Gruneritic ironstone.*

CLASTIC METASEDIMENTS

- 2a *Argillite.*

MAFIC METAVOLCANICS

- 1 *Amphibolite, unsubdivided.*
- 1a *Pillowed amphibolite.*
- 1b *Porphyritic amphibolite.*
- 1c *Massive amphibolite.*
- 1d *Foliated to schistose amphibolite.*[m]
- 1e *Amphibolite gneiss±clinopyroxene±garnet.*[m]
- 1g *Coarse-grained amphibolite.*[n]
- 1h *Magnetite bearing amphibolite.*
- 1j *Garnet bearing amphibolite.*

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po *Pyrrhotite.*
py *Pyrite.*

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[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts of the map.*
[b] *Bedrock geology. Outcrops and inferred extensions of each rock unit are shown respectively in deep and light tones of the same colour. Where in places a formation is too narrow to show in colour and must be represented in black, a short black bar appears in the appropriate block.*
[c] *Plutonic rock classifications follows the IUGS Subcommission on the systematics of igneous rocks (Streckeisen, 1976).*
[d] *Pashkokagan Kenoji Lake Fault Zone.*
[e] *Smoothrock Lake Pluton and associated pegmatites.*
[f] *Caribou Bay Pluton.*
[g] *Age relation with respect to unit 8 indeterminate.*
[h] *Southern Caribou Bay Pluton.*
[i] *Age relations with respect to units 7 and 9 indeterminate.*
[j] *Outlet Bay Pluton.*
[k] *Rocks designated as containing clinopyroxene may contain uralitized clinopyroxene.*
[l] *Age relations with respect to units 6 to 10 indeterminate.*
[m] *Schists and gneisses are of probable volcanic origin.*
[n] *May be gabbro and metagabbro in part, particularly south of Outlet Bay Pluton.*

SYMBOLS

- *Glacial striae. Glacial fluting or drumlin.*
- *Esker.*
- *Bedrock; (small outcrop, area of outcrop).*
- *Bedding, horizontal.*
- *Bedding, top unknown; (inclined, vertical).*
- *Bedding, top indicated by arrow; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from relationship of cleavage and bedding; (inclined, overturned).*
- *Lava flow; top (arrow) from pillows shape and packing. Lava flow; top in direction of arrow.*
- *Direction of paleocurrent.*
- *Schistosity; (horizontal, inclined, vertical).*
- *Gneissosity; (horizontal, inclined, vertical).*
- *Foliation; (horizontal, inclined, vertical).*
- *Banding; (horizontal, inclined, vertical).*
- *Lineation with plunge.*
- *Geological boundary; (observed, position interpreted, deduced from geophysics).*
- *Magnetic contour value in gammas. Magnetic attraction.*
- *Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.*
- *Lineament.*
- *Jointing; (horizontal, inclined, vertical).*
- *Drag folds with plunge.*
- *Anticline, syncline, with plunge.*
- *Drill hole; (vertical, inclined, projected vertically, projected up dip). Overburden shown.*
- *Location of sample.*
- *Vein, vein network. Width in inches or feet.*
- RA *Radioactivity.*
- *Swamp.*
- *Motor road. Provincial highway number encircled where applicable.*
- *Other road. Trail, portage, winter road.*
- *International or Provincial boundary.*
- *County, District, Regional or District Municipal Boundary, with mile post.*
- *Municipal Boundary, (City, Town, Improvement District, Incorporated Township), with milepost.*
- *Township, Indian Reserve, Meridian, Base Line, Provincial Park, with milepost, (surveyed, unsurveyed).*
- *Mining property, surveyed. Mineral deposit or mining property, unsurveyed.*
- *Surveyed line. Unsurveyed line.*

All boundary and survey lines are approximate position only.

Some symbols may not occur on this map.

Published 1983

PROPERTIES, MINERAL DEPOSITS

No current or defunct properties for which geological or related information is available are present within the map area as of October 1, 1979.

No claims were held in the map-area as of October 1, 1979.

Ontario Geological Survey

Map 2466

FUNGER LAKE

THUNDER BAY DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

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

SOURCES OF INFORMATION

Geology by R.H. Sutcliffe and P.A. Fernberg and assistants, Ontario Geological Survey, 1979.

Geology is not tied to surveyed lines.

ODM-GSC Aeromagnetic Maps 940G and 2114G.

Preliminary map (OGS), P 962, Operation Ignace Armstrong, Pashkokogan-Caribou Lakes sheet, issued 1974. Names of some major plutons and structure features were taken from this map.

Cartography by D.G. James and assistants, Surveys and Mapping Branch, 1982.

Basemap derived from Forest Resources Inventory maps 504891, 504892, 505891, 505892 with minor revisions by R.H. Sutcliffe, Ontario Geological Survey.

Magnetic declination in the area was approximately 2° East in 1980.

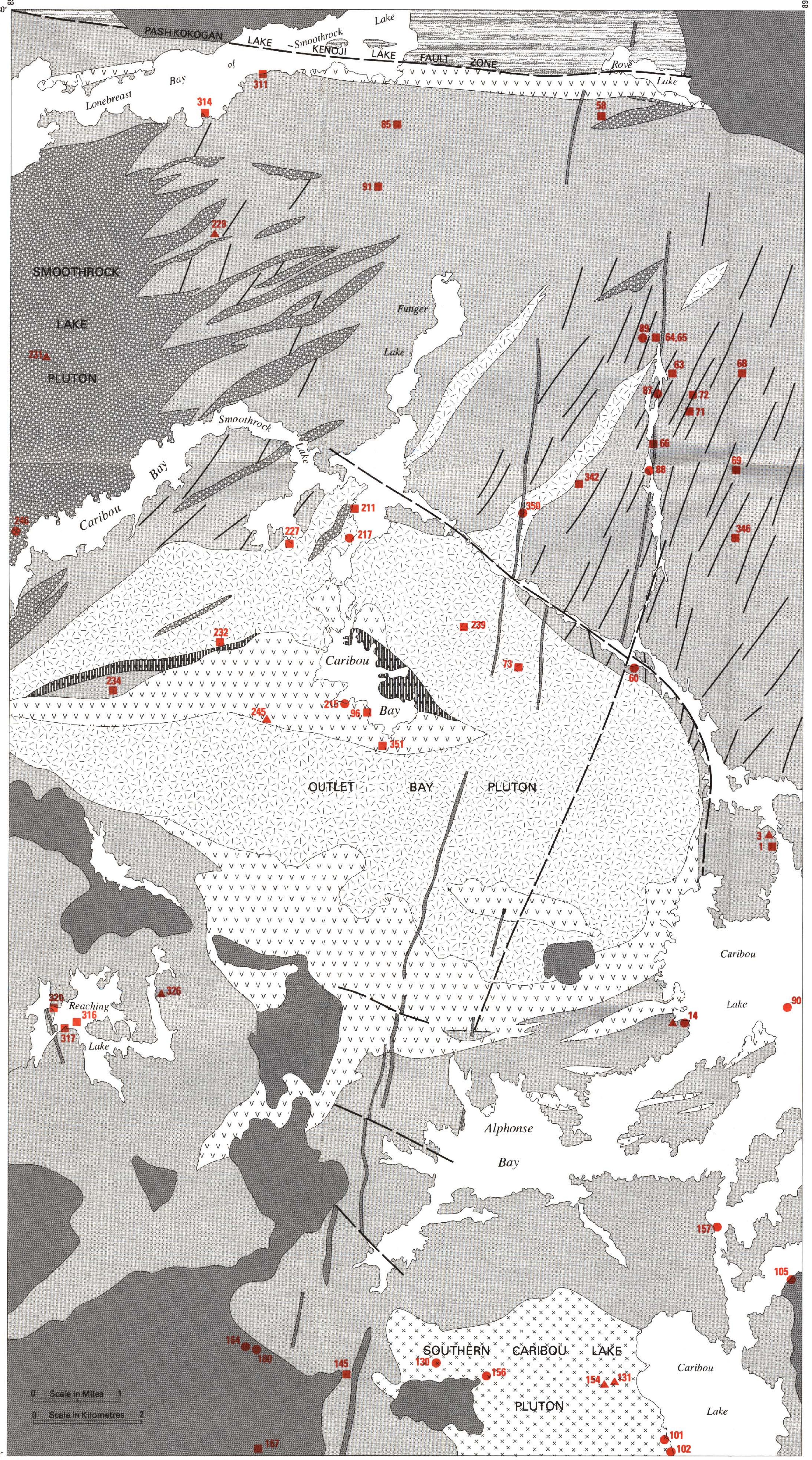

Figure 3: Location of chemical and modal analyses

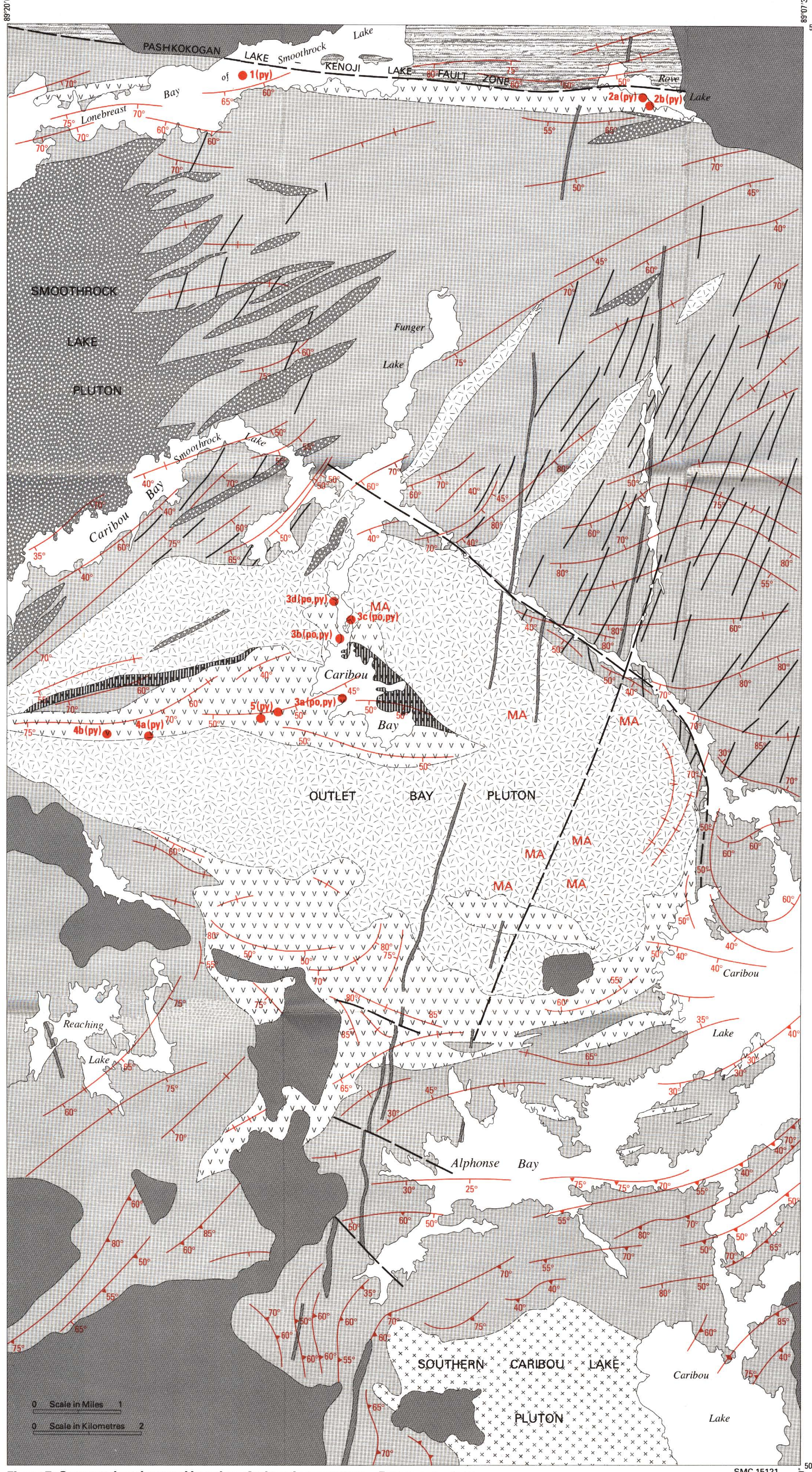

Figure 7: Structural geology and location of mineral occurrences—Funger Lake Area

SMC 15121

LEGEND

PRECAMBRIAN

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

Diabase.

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)

Cataclastic Rocks

FAULT CONTACT

Late Felsic Plutonic Rocks Smoothrock Lake Pluton

INTRUSIVE CONTACT

Late Felsic to Intermediate Plutonic Rocks, Caribou Bay Pluton

INTRUSIVE CONTACT

Felsic to Ultramafic Alkaline Plutonic Rocks, Southern Caribou Lake Pluton

INTRUSIVE CONTACT

Mafic to Ultramafic Plutonic Rocks, Outlet Bay Pluton

INTRUSIVE CONTACT

Mafic Dike Rocks

INTRUSIVE CONTACT

Felsic to Intermediate Plutonic Rocks, Early Plutonic Suite

INTRUSIVE CONTACT

Mafic Metavolcanic Rocks and minor Metasediments

SYMBOLS

Fault.

Geological contact.

55° *Strike and dip of foliation; schistosity.*

65° *Strike and dip of gneissosity.*

Thinsection mode and chemical analysis.

Thinsection mode.

Modal analysis on stained slab.

Numbers refer to sample numbers.

METAL AND MINERAL REFERENCE

po *Pyrrhotite.*

py *Pyrite.*

MA *Magnetic attraction.*

Numbers refer to sulphide occurrences described in text.