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Report 251

Geology of the Fletcher Lake Area District of Thunder Bay

1988

Ontario

Ministry of
Northern Development
and Mines

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Ontario Geological Survey
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Geology of the Fletcher Lake Area District of Thunder Bay

by
R.H. Sutcliffe

1988

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Critical Reader: John Wood
1000-88-Aprinco

Foreword

The Fletcher Lake area lies northwest of the town of Armstrong and prior to this report only reconnaissance level information was available on the geology. The map area contains rocks of the English River and Wabigoon Subprovinces and an important aspect of the mapping was to document the subprovinces boundary relationships. A large part of the area is underlain by mafic metavolcanics. This sequence contains one of the few examples of spinifex textured ultramafic metavolcanics in the Wabigoon Subprovince. The area contains several occurrences of gold, silver and base metal mineralization and has been the location of sporadic mineral exploration since the 1940s.

V.G. Milne
Director
Ontario Geological Survey

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Map 2485 (coloured) - Fletcher Lake, Thunder Bay District
Scale 1:31 680 or 1 inch to 1/2 mile.

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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
Fletcher Lake Area
Distict of Thunder Bay

by
R.H. Sutcliffe

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

Manuscript accepted for publication by the Chief Geologist, November 19, 1983.
This report is published with the consent of V.G. Milne, Director, Ontario Geological Survey.

Abstract

The Fletcher Lake Area covers approximately 365 km^2 in the District of Thunder Bay and is about 30 km northwest of the town of Armstrong. The map area includes Early Precambrian (Archean) rocks of the Wabigoon and English River Subprovinces and lesser Late Precambrian (Proterozoic) rocks of the Nipigon Plate.

The metavolcanics and metasediments within the area form part of the Caribou Lake-Pikitigushi River metavolcanic-metasedimentary belt and consist of: ultramafic metavolcanics, mafic to intermediate metavolcanics, clastic metasediments ranging from argillite to meta-conglomerate, chert and ironstone, and subvolcanic to volcanic felsic rocks. These supracrustal rocks have been intruded by several phases of plutonic rocks which include: an early felsic to intermediate plutonic suite composed of predominantly biotite tonalite, a swarm of gabbro and amphibolite dikes, hornblende to pyroxene gabbro of the Caribou Lake Pluton, and a late felsic to intermediate plutonic suite consisting predominantly of granite.

Within the map area, the Pashkokogan Lake Fault Zone forms the English River-Wabigoon Subprovinces boundary. Rocks north of the fault zone lie within the English River Subprovince and range from migmatized metasediments to diatexitic muscovite-biotite granite.

Late Precambrian (Proterozoic) diabase sheets and dikes of the Nipigon Plate intrude the Early Precambrian (Archean) rocks. The sheets are weakly differentiated and range from olivine to quartz diabase. The Late Precambrian dike rocks include tholeiitic and alkaline suites and range in composition from mafic to felsic. Minor biotite-olivine lamprophyre dikes are also present.

No mineral production from the area has been reported; however, occurrences of gold, silver, copper, zinc, lead, and iron mineralization are present. The area is considered to be of significant potential for gold mineralization due to the association of gold with ultramafic metavolcanics.

Geology of the Fletcher Lake Area, District of Thunder Bay, by R.H. Sutcliffe, Ontario Geological Survey Report 251, 65p. Accompanied by Map 2485, scale 1:31 680 (1 inch to 1/2 mile).

Résumé

La région du lac Fletcher couvre près de 365 km^2 dans le district de Thunder Bay et se trouve à environ 30 km au nord-ouest de la ville d'Armstrong. La région illustrée sur la carte comprend des formations rocheuses de l'ère précambrienne inférieure (archéenne) des sous-provinces de la rivière aux Anglais et de Wabigoon et des formations rocheuses moins importantes de l'ère précambrienne supérieure du plateau Nipigon (protérozoique).

Les roches volcaniques métamorphisées et les roches sédimentaires métamorphisées se trouvant dans la région font partie de la ceinture de roches volcaniques métamorphisées et de roches sédimentaires métamorphisées du lac Caribou et de la rivière Pikitigushi; elles se composent de roches volcaniques métamorphisées ultramafiques, de roches volcaniques métamorphisées intermédaires à mafiques, de roches sédimentaires métamorphisées clastiques allant de l'argilite au métaconglomérat, chert et minerai de fer, et des roches sous-volcaniques aux roches volcaniques felsiques. Ces roches supracrustales ont été pénétrées par plusieurs phases de roches plutoniques comprennant: une série felsique inférieure à plutonique intermédiare composée essentiellement de biotite tonalite, une groupe de filons gabbroïques et amphiboliques, du hornblende jusqu'au gabbro pyroxène du pluton du lac Caribou, et une série felsique supérieure à plutonique intermédiaire formée essentiellement de granite.

Au sein de la région illustrée sur la carte, la zone de faille du lac Pashkokogan marque la limite entre les sous-provinces de la rivière aux Anglais et de Wabigoon. Les roches situées du nord de la zone de faille se trouvent dans la sous-province de la rivière aux Anglais et se répartissent entre les roches sédimentaires métamorphisées migmatisées et granite biotite-muscovite diatexitique.

Les couches et filons de diabase du plateau Nipigon, datant de l'ère précambrienne supérieure (protérozoique), pénètrent les roches de l'ère précambrienne inférieure (archéenne). Les couches ne se différencient que très peu et vont de la diabase à l'olivine à la diabase quartzifère. Les roches des filons de l'ère précambrienne supérieure comprennent des séries tholéiitiques et alcalines dont la composition varie de mafique à felsique. On trouve également des filons de lamprophyre d'olivine-biotite de moindre importance.

On n'a rapporté aucune production de minéraux dans la région, bien qu'il s'y trouvent des gisements d'or, d'argent, de cuivre, de zinc, de plomb et de fer minéralisé. On estime que la région offre de considérables possibilités de minéralisation d'or du fait de la présence d'or associé à des roches volcaniques métamorphisées ultramafiques.

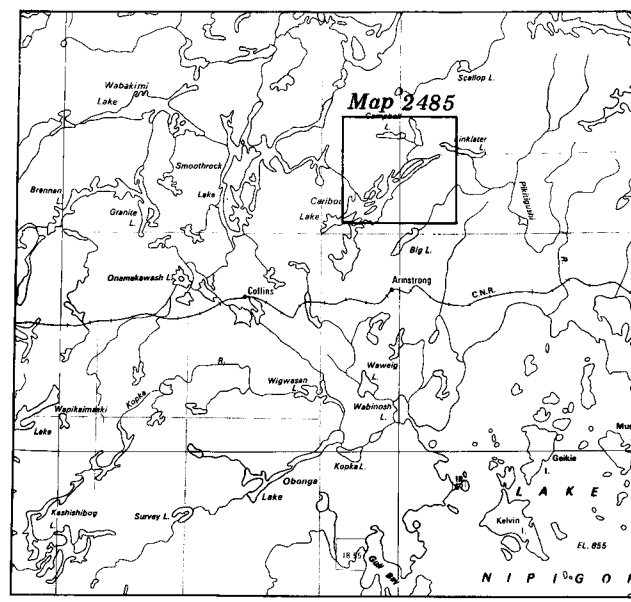

Figure 1: Index map showing the location of the Fletcher Lake Area.
(Scale: 1:1 584 000 or 1 inch to 25 miles)

Introduction

The Fletcher Lake Area covers a region bounded by Latitudes 50°26′00″ to 50°37′30″ North and Longitudes 88°53′00″ to 89°07′30″ West and comprises approximately 365 km^2. Fletcher Lake, near the center of the map area, is approximately 30 km northwest of the town of Armstrong (Figure 1).

The map area is located at the boundary of the Wabigoon and English River Subprovinces of the Superior Province (Douglas 1973). The area predominantly consists of Early Precambrian (Archean) metavolcanic and plutonic rocks of the Wabigoon Subprovince. Metasediments and plutonic rocks of the English River Subprovince are present at the northern margin of the map area. Sheets and dikes of Late Precambrian (Proterozoic) igneous rocks associated with the Nipigon Plate intrude the Early Precambrian rocks.

The present map area is at the western end of the Caribou Lake-Pikitigushi River greenstone belt (Gussow 1942) which extends east for approximately 150 km, north of Lake Nipigon to Marshall and O'Sullivan Lakes. Sporadic mineral exploration within the area has taken place since the 1940s and occurrences of gold, silver, copper, lead, zinc, and iron mineralization have been discovered. No mineral production has been reported from the area.

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Capable assistance in the field was provided by A. Bivi, M. Bunda, G. Kavanagh, J. Krol, T. Leys and S. Simigian. A. Bivi and G. Kavanagh as senior geological assistants were each responsible for approximately 1/3 of the mapping.

The author would like to thank the staff of the Ministry of Natural Resources at Armstrong, particularly D. Elliot, G. Leamy, and W. Nakamura, for providing logistical aid during the field season.

Access

Caribou Lake, which lies diagonally across the map area from southwest to northeast, provides excellent access to much of the area. Caribou Lake can be reached via a 10 km gravel road from Armstrong. Well developed portages connect Campbell Lake to Caribou Lake, via Hollingsworth, Howie and Fletcher Lakes. A system of portages also connects D'Alton Lake, Fuchsite Lake, Cumaway Lake and Caribou Lake. Most of the larger lakes in the map area are accessible by float equipped aircraft which can be chartered in Armstrong.

Armstrong is reached from Thunder Bay via Highway 527, a 280 km gravel road, or via the Canadian National Railway transcontinental line. The Ministry of Transportation and Communications maintains a gravel airstrip at Wagaming, approximately 10 km east of Armstrong but there is no regular air service.

Field Methods

Field work was carried out from early June to September, 1980. Mapping was done by pace and compass traverses over land areas, and shoreline examination of navigable lakes and streams. Outcrops were located on aerial photographs and land traverses were run from outcrop to outcrop in a zigzag pattern. Where possible, traverses were designed to optimize time spent mapping perpendicular to strike. In areas of little exposure, traverses were run using topographic features as control. A spacing of approximately 300 to 400 m was maintained between adjacent compass lines.

Within the map area, outcrop areas are commonly extensive, but exposure is limited by heavy moss cover and by thin ground moraine. Actual bedrock exposure is therefore less than indicated on the accompanying map. All parts of a shown outcrop area may not necessarily have been examined and airphoto interpretation has been used extensively to delineate the outcrop areas.

In the field, geological data were plotted on acetate sheets attached to vertical aerial photographs at a scale of 1:15 840 supplied by the Airphoto Library, Ministry of Natural Resources. The data were transferred from the acetate overlays to cronoflex base maps at a scale of 1:15 840 prepared from the Ministry of Natural

Resources Forest Resources Inventory series maps supplied by the Cartography Section, Surveys and Mapping Branch, Lands and Water Group, Ontario Ministry of Natural Resources.

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. In 1917, Hopkins examined the geology of the route from Caribou Lake to the Pikitigushi River at D'Alton Lake.

The present map area lies within the area of Gussow's (1942) map of the Caribou Lake-Pikitigushi River Area which delineates the extent of the supracrustal rocks in the immediate area. The present map area was also briefly examined by the reconnaissance surveys Operation Fort Hope (Thurston *et al.* 1969; Thurston and Carter 1970) and Operation Ignace-Armstrong (Sage *et al.* 1974). These surveys resulted in the delineation of major lithological and structural features within the region. The map area straddles the boundary between the Sioux Lookout-Armstrong geological compilation map (Davies *et al.* 1966) and the Tashota-Geraldton geological compilation map (Pye *et al.* 1965).

Aeromagnetic maps at a scale of 1:63 360 covering the area were flown in 1959-60 and 1962 (ODM-GSC 1960a, 1960b, 1962a, 1962b). Part of the map area is covered by airborne electromagnetic and magnetic maps at a scale of 1:20 000 flown in 1980 (OGS 1980) and the area immediately to the west, the Funger Lake Area, was mapped by the author (Sutcliffe 1986) in 1979.

Physiography

The height of land separating the natural Arctic and Atlantic watersheds runs through the map area to the southeast of Caribou Lake. Cumaway, Fuchsite, Michell, D'Alton, and Linklater Lakes lie within the Atlantic watershed and drain into Lake Nipigon via Big River and Pikitigushi River. Campbell, Hollingsworth, Howie, and Fletcher Lakes drain into Caribou Lake via Campbell Creek. Caribou Lake lies within the Arctic watershed and drains into Smoothrock Lake and then into the Ogoki River system.

Elevations range from approximately 345 m, the elevation of D'Alton Lake, to 440 m. Caribou Lake, the lowest lake within the Arctic watershed in the map area, has an elevation of 357 m. The highest elevations are the result of prominent diabase ridges.

Local relief is variable. In general, the area northwest of Caribou Lake is relatively flat with the exception of the diabase ridge south of Campbell and Hollingsworth Lakes. The region southeast of Caribou Lake is considerably more rugged, and massive gabbro, amphibolite and diabase outcrops result in local relief to as much as 60 m. Small scarps and cliffs are locally associated with the diabase ridges. The highest of these (80 m) occurs south of Kellar Peak on Kellar Island in Caribou Lake.

Outcrop density within the region is variable. The density is lowest in the north where the bedrock is covered by thick swamp, sand and boulder deposits and in the south where it is covered by thick moraine deposits. Generally, high outcrop density is present in the remainder of the area, with the outcrops forming elevated hills in a thin mantle of ground moraine or swamp deposits.

General Geology

GEOLOGICAL SUMMARY

The Early Precambrian (Archean) rocks of the Fletcher Lake Area south of the east-west Pashkokogan Lake Fault Zone are within the Wabigoon Subprovince. The metavolcanics and metasediments within this part of the map area form part of the Caribou Lake-Pikitigushi River metavolcanic-metasedimentary belt and consist of: (1) ultramafic to mafic metavolcanics; (2) clastic metasediments ranging from argillite to metaconglomerate; (3) chert and ironstone which are interbedded with the metavolcanics and clastic metasediments; and (4) metamorphosed subvolcanic to volcanic felsic rocks. The supracrustal rocks have been intruded by several phases of plutonic rocks which include: (1) an early felsic to intermediate plutonic suite composed predominantly of biotite tonalite; (2) a northeast trending swarm of amphibolite and gabbro dikes; (3) the gabbroic Caribou Lake Pluton; and (4) a late felsic to intermediate plutonic suite consisting predominantly of granite.

Within the map area, the Caribou Lake-Pikitigushi River metavolcanic-metasedimentary belt is subdivided into two sectors by the Caribou Lake Fault which lies along the axis of Caribou Lake. North of Caribou Lake the supracrustal rocks form a 1 to 3 km thick sequence of pillowed and massive mafic metavolcanics. Local zones of amygdaloidal, variolitic and plagioclase-phyric flows are present. Near the base of the mafic sequence adjacent to the tonalitic granitoids, 10 to 100 m thick units consisting of interbedded magnetite ironstone, amphibolitic ironstone, and chert are present.

Overlying the mafic metavolcanics and extending east-west through Campbell and Hollingsworth Lakes is a highly deformed metasedimentary sequence named the "Linklater formation" (Gussow 1942). The metasediments dominantly consist of intercalated polymictic orthoconglomerate with granitoid clasts and a polymictic volcanic-clast conglomerate. Minor paraconglomerate and wacke is present on Campbell Lake. East of Hollingsworth Lake, fine, argillaceous metasediments and ironstone occur between the metavolcanics and metaconglomerate. The interbedded magnetite ironstone, chert, and minor argillite unit attains a maximum thickness of approximately 200 m.

Mafic metavolcanics lying along the axis of Caribou Lake are generally highly deformed and altered. Carbonatization, silicification and quartz and/or carbonate veining are common from the southwest and Kellar Island to the eastern map area boundary. Minor units of talc-carbonate schist and actinolite rich ultramafic rocks are present in the zone. The alteration and deformation are related to tight folding and faulting along the Caribou Lake Fault which has not been previously recognized. This fault appears to represent a major break within the area. Fold structures and the mafic dikes swarm north of the fault are truncated by the Caribou Lake Fault.

South of Caribou Lake, the metavolcanics range from ultramafic to mafic in composition. Magnetite and sulphide ironstone and chert occur in several zones within the metavolcanics. Immediately south of Caribou Lake is a 1500 to 2000 m thick sequence of fine to medium grained gabbroic amphibolite which is largely devoid of primary volcanic structures and is probably intrusive in part.

A 500 m thick sequence of intercalated ultramafic and mafic metavolcanics is present on Cumaway Lake. The ultramafic flows range from massive serpentinite to talc-carbonate schist, but excellent spinifex textures are locally preserved. A second zone of ultramafic rocks ranging from serpentinite to talc-carbonate schist also occurs near Michell Lake.

Several faults striking at N60E and dipping south in the vicinity of Cumaway, Fuchsite, Michell and the northern end of D'Alton Lakes may have caused repetition of the supracrustal stratigraphy in this area.

On D'Alton Lake, the metavolcanics consist of a relatively uniform sequence of pillowed to massive mafic metavolcanics with minor intercalated chert and magnetite ironstone. Here the structure is dominated by a broad east plunging anticlinal fold flanked by two synclines.

TABLE 1: TABLE OF LITHOLOGIC UNITS FOR THE FLETCHER LAKE AREA

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

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

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

Diabase, pegmatitic diabase, quartz diabase, magnetite-rich diabase.

ULTRAMAFIC TO FELSIC DIKE ROCKS

Ultramafic dike rocks: biotite-olivine lamprophyre, carbonatized lamprophyre.
Mafic dike rocks: diabase, aphanitic dikes.
Felsic dike rocks: microgranophyre, trachyte, granite.

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)

CATACLASTIC ROCKS

Submylonite, mylonite.

Fault Contact

MIGMATITES[a,b,c]

Muscovite-biotite (± garnet) granite (homogenous diatexite), muscovite-biotite (± garnet) granite with metasedimentary schlieren (inhomogenous diatexite), muscovite-biotite (± garnet) pegmatite.

LATE FELSIC TO INTERMEDIATE INTRUSIVE ROCKS[d]

Biotite granite with microcline porphyroblasts, biotite granite, granite pegmatite, hornblende diorite.

Intrusive Contact

MAFIC INTRUSIVE ROCKS

MAFIC PLUTONIC ROCKS
(CARIBOU LAKE PLUTON)

Hornblende gabbro, pyroxene gabbro, layered gabbro.

TABLE 1. Continued

MAFIC DIKE ROCKS[e]

Amphibolite, hornblende gabbro.

Intrusive Contact

EARLY FELSIC TO INTERMEDIATE PLUTONIC ROCKS[f]

Biotite tonalite, biotite granodiorite, biotite (± muscovite) granite, biotite-hornblende diorite and biotite-hornblende quartz diorite, fine-grained intermediate intrusive phase.

Intrusive Contact

METAMORPHOSED SUBVOLCANIC TO VOLCANIC FELSIC ROCKS

Quartz-feldspar porphyry; fragmental porphyry, brecciated and silicified porphyry, felsite, trondhjemite, intermediate porphyritic to aphanitic dikes, sericite (muscovite) schist.

Intrusive Contact

METASEDIMENTS[g]

CLASTIC METASEDIMENTS

Volcanic-clast conglomerate, orthoconglomerate with granitoid clasts, paraconglomerate with granitoid clasts, muscovite-biotite schists of conglomeratic origin, wacke, migmatized wacke and pelite (metatexite), argillite, slate, pelitic biotite schist, garnet-bearing, sillimanite-bearing.

CHEMICAL METASEDIMENTS

Chert, recrystallized chert, magnetite-chert ironstone, amphibole-chert ironstone, magnetite-amphibole-chert ironstone, sulphide-chert ironstone, graphitic chert, carbonatized ironstone.

METAVOLCANICS[g]

MAFIC TO INTERMEDIATE METAVOLCANICS

Mafic flow, intermediate flow, pillowed flow, massive flow, coarse-grained flow (possibly gabbro)[h], amygdaloidal flow, feldspar-phyric flow, variolitic flow, flow breccia, polysutured flow, carbonatized flow, silicified flow, garnetiferous flow, highly foliated to schistose flow[i], gneissic amphibolite[j].

ULTRAMAFIC METAVOLCANICS

Serpentinized peridotite flow, metapyroxenite (actinolite-rich) flow, serpentinized peridotite and dunite[l], spinifex-bearing flow, massive flow, carbonatized flow, silicified flow, talcose flow, talc,-carbonate schist, amphibole schist.

TABLE 1: Continued

NOTES:
a) Plutonic rock classification follows the IUGS Subcommission on the Systematics of Igneous Rocks (Streckeisen 1976).
b) Terminology of migmatitic rocks follows Mehnert (1968).
c) Confined to the English River Subprovince.
d) Confined to the Wabigoon Subprovince.
e) Mafic dike rocks probably correlate with the Caribou Lake Pluton.
f) At least 2 ages of Early Felsic to Intermediate Plutonic Rocks occur.
g) Schists and gneisses of probable volcanic origin.
h) Intrusive in part, especially northeast of the Caribou Lake Pluton.
i) Rocks in these groups are subdivided lithologically. Order does not imply age relationships within or between groups.
j) Probably subvolcanic.

Quartz and/or feldspar porphyry and medium grained tonalite units are present at several locations within the mafic metavolcanics. The quartz-feldspar porphyry units on Howie Lake and Campbell Lake locally display a fragmental texture and appear to be extrusive in part.

Early Precambrian (Archean) intrusive rocks form approximately 60% of the bedrock in the map area. The rocks range in composition from gabbro to granite.

In the field the rocks were subdivided into suites of associated rock types on the basis of predominant composition, relative age relationships, style of emplacement, and relationship with adjacent rocks.

Lithological classification of these rocks follows Streckeisen (1976). Granitoid rocks were classified in the field by staining samples for potassium feldspar with sodium cobaltinitrite after etching with hydrofluoric acid. Subsequently the classifications were verified by point counting of stained slabs. Results of the point counting are illustrated in Figure 2.

Biotite tonalite is the most abundant granitoid rock in the map area. The tonalite displays considerable variation in texture, ranging from hypidiomorphic massive tonalite to recrystallized gneissic tonalite. At least two major phases of tonalitic magmatism have occurred in the area. The first phase includes the tonalitic rocks north of Caribou Lake (intruded by the gabbro dikes) and possibly the gneissic tonalite south of Caribou Lake. The second phase, which appears to be localized south of the Caribou Lake Fault, intrudes the gabbroic Caribou Lake Pluton and gneissic tonalite.

Dikes of amphibolite and hornblende gabbro, trending at N20E to N50E, discordantly intrude the tonalitic granitoids north of Caribou Lake and are a continuation of the dike swarm east of Funger Lake (Sutcliffe 1986). The dikes appear to be associated with the Caribou Lake Pluton and the Outlet Bay Pluton (Sutcliffe 1986) and may be subvolcanic.

The Caribou Lake Pluton (Sage *et al.* 1974) is an elongate intrusion of gabbro which occurs south of Caribou Lake. The pluton is composed of medium grained, massive to weakly foliated, hypidiomorphic pyroxene to hornblende gabbro. The pluton is intruded by tonalite and granite and contains inclusions of mafic metavolcanics.

West of D'Alton Lake a microcline porphyroblastic biotite granite pluton, here named the D'Alton Lake Pluton, intrudes the metavolcanics, and biotite tonalite. The hornblende gabbro which rims the northern margin of the pluton is similar to the gabbro of the Caribou Lake Pluton, and is also intruded by the granite.

The rocks north of the Pashkokogan Lake Fault Zone lie in the English River Subprovince. These rocks range from migmatized metasediments to diatexitic muscovite-biotite granite (derived from anatexis of the sediments). The metasediments are locally well bedded and consist of metawacke and metapelite compo-

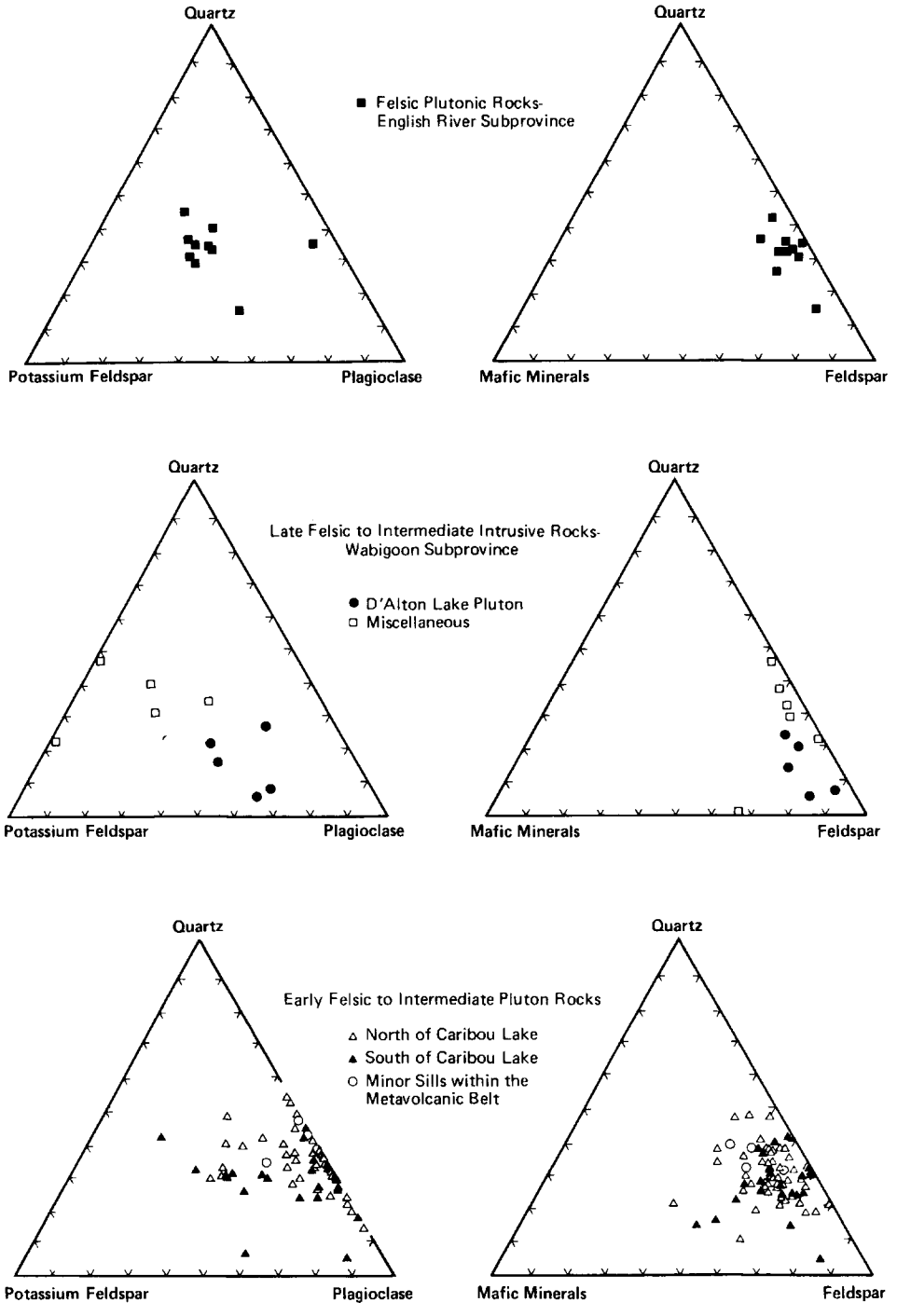


Figure 2: *Plots of modal analyses of granitoid rocks.*

nents with minor magnetite-chert ironstone. Sillimanite is locally associated with the pelitic rocks.

The English River-Wabigoon Subprovinces boundary is marked by the strongly deformed to locally mylonitized fault zone between diatexitic granitoids (English River) and conglomeratic metasediments (Wabigoon). Rocks in this zone indicate that the conglomerates were the proximal facies equivalent of the sandstones and pelites of the English River Subprovince. This sequence is similar to that in the Elwood, Neverfreeze and Savant Lakes Area to the west (Trowell *et al.* 1977) which also lies at the subprovince boundary.

Shallow dipping Late Precambrian (Proterozoic) diabase sheets and mafic to felsic dikes intrude the Early Precambrian (Archean) rocks. Diabase sheets in the area achieve thicknesses in excess of 500 m. The sheets are weakly differentiated and range from fine grained olivine diabase at the base, to medium and locally coarse grained quartz diabase toward the top.

Late Precambrian dike rocks in the area display a variety of textural and compositional variations. Tholeiitic and alkaline suites are present, and the dikes range from mafic to felsic. Minor biotite olivine lamprophyre and carbonate-rich lamprophyre dikes are also present, particularly in the vicinity of Kellar Island.

EARLY PRECAMBRIAN (ARCHEAN)

METAVOLCANICS

Metavolcanics, ranging in composition from ultramafic to mafic with minor intermediate rocks, form approximately 90% of the metavolcanic-metasedimentary sequence. The metavolcanics within the map area are predominantly of medium metamorphic grade (amphibolite facies) with lesser areas of low metamorphic grade (upper greenschist facies). The metavolcanics are generally moderately deformed with primary volcanic textures being obscured or destroyed but sufficient areas of low deformation are present to enable the primary characteristics of the volcanics to be ascertained.

In the field, subdivision of the metavolcanics into ultramafic and mafic metavolcanics was based primarily on colour index with the mafic metavolcanics containing less than 90% and more than 35% mafic minerals. Additional characteristics which distinguish the ultramafic from mafic metavolcanics include:

(1) Presence of serpentine and talc in the ultramafic metavolcanics,

(2) Ultramafic rocks lack pillow structures but locally display spinifex textures.

Ultramafic Metavolcanics

Within the map area, ultramafic rocks occur at three main localities: the northern end of Cumaway Lake; the western end of Michell Lake; and east of Kellar Island. In addition, minor ultramafic rocks were identified at the southwest end of Kellar Island and on an island approximately 2 km southwest of Fred's Point, Caribou Lake. At these localities evidence for a volcanic origin of the ultramafics was only observed at Cumaway Lake where excellent spinifex textures are present.

On Cumaway Lake the ultramafic rocks occur as thin (2 to 10 m) units intercalated with the mafic metavolcanics. One exposure on a point on the east side of the lake is typical of their occurrence (Photo 1). Here, four individual ultramafic lava flows varying in width from 1.5 to 3 m are alternately interlayered with four massive mafic flows 3 to 4 m wide. At this location, the ultramafic flows are predominantly massive but one flow contains well developed spinifex texture near its southern contact, indicating that the sequence faces south (compare Pyke *et al.* 1973). This conclusion is supported by the presence of polysuturing at the south side of some of the mafic flows.

On Michell Lake the ultramafics occur as thin 2 to 4 m wide units intercalated with the mafic metavolcanics and as a wider, 100 m zone of massive serpentinite which may be a subvolcanic intrusion. The thin units are sheared and carbonatized and primary textures, if originally present, were not recognized. The wider unit is

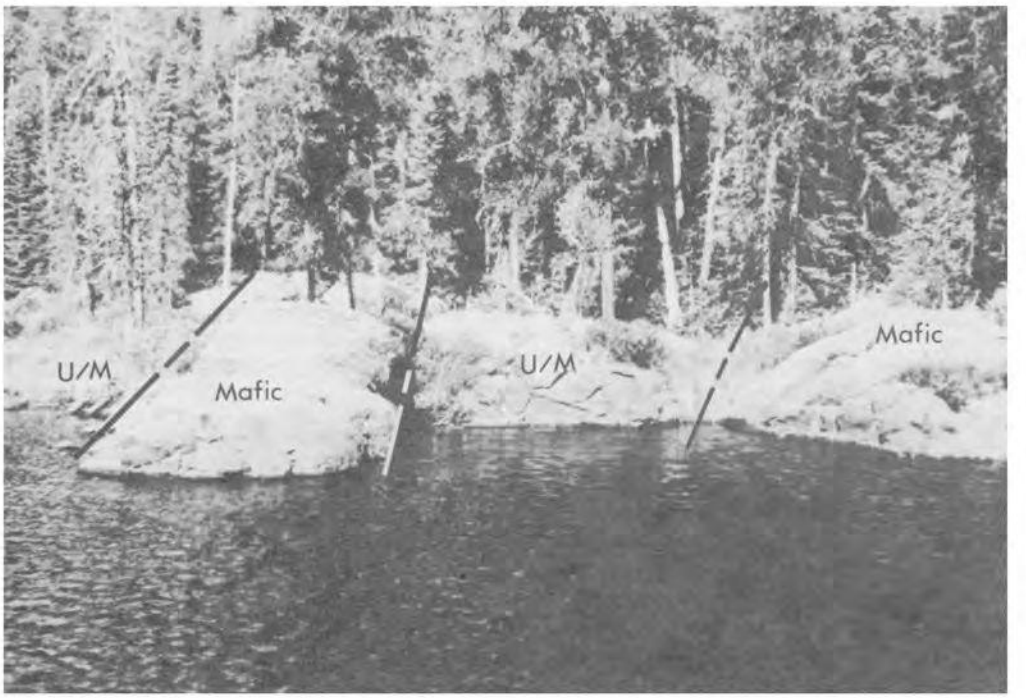


Photo 1: *Intercalated mafic and ultramafic (U/M) metavolcanic flows on the eastern shore of Cumaway Lake. Flows dip at approximately 70° to the south, spinifex textures indicate tops to the south at this location.*

Photo 2: *Pseudomorphed olivine spinifex in ultramafic metavolcanic flows, eastern shore of Cumaway Lake.*

massive and contains a zone, with 90% large (1 cm) serpentinized olivine phenocrysts, which possibly represents a cumulate phase.

North and east of Kellar Island the ultramafic rocks occur as thin units of talc-carbonate + amphibole schist intercalated with the mafic metavolcanics and as a zone of massive to sheared ultramafics containing predominantly amphibole and talc.

Compositionally the ultramafic rocks range from metaperidotite to metapyroxenite. Peridotite lava flows are more common and contain predominantly serpentine and talc assemblages. Pyroxenitic rocks contain approximately 50% amphibole with lesser talc and serpentine.

The peridotitic lava flows exhibit both spinifex and massive textures. Where present, spinifex is readily identified on the weathered surface and consists of sheaves of platy relict olivine grains, 2 to 10 cm long, pseudomorphed by talc (Photo 2). More commonly the flows are massive and display a polygonal "elephant hide" fracture pattern.

In hand specimen, the peridotitic lava flows exhibit a range in colour of the weathered surface from very light green to dark green and shades of buff. The fresh surface, however, is more diagnostic and is usually distinctly dark green due to the presence of serpentine. This colour is particularly evident on thin translucent flakes of rock which are bright emerald green. The sheared ultramafic rocks which contain more talc than serpentine are not as distinctly green but are easily recognized due to the soft, greasy texture.

In thin section, the massive peridotitic lava flows are seen to contain approximately 80% platy, 0.1 to 0.2 mm grains of serpentine which forms a matted matrix. Talc (0-10%) overgrows the serpentine, and variable amounts of carbonate occur as a granular replacement or as rhombic grains. Minor opaques and chlorite are mixed with the serpentine. No relict textures or minerals were observed in thin sections of the massive parts of the flows.

The spinifex texture in thin section appears as fine matted grains of talc (60%) which pseudomorph long blades of olivine several centimetres long and approximately 1 mm wide. Interstitial to the blades is a mixture of serpentine (15%) and chlorite (15%) with minor opaques and carbonate.

Pyroxenitic flows vary in texture from massive to sheared and no primary volcanic textures were observed within them. They are classified as metavolcanic largely on the basis of their association with other volcanic rock types. In hand specimen, they vary from light grey to dark green on both the weathered and fresh surface, but medium grained, acicular to prismatic amphibole can readily be identified as the major mineral component. In thin section they are seen to contain approximately 60% tremolite which forms clusters and rosettes of acicular grains 1 to 2 mm long. Talc (20%) and chlorite (20%) with minor quartz and opaque minerals form the remainder of the rock.

The ultramafic rocks exhibit varying degrees of alteration and both carbonatization and silicification of the rocks have occurred. Carbonate is commonly present as small (1 to 2 mm), orange-weathering, rhombohedral crystals which account for up to 20% of the rock or as a granular replacement. More extensive alteration to carbonate is observed associated with the talc-carbonate schists and on a small island at the northeast end of Kellar Bay where the rock is locally composed of over 80% orange-weathering carbonate. Quartz veining and silicification of pyroxenitic ultramafic rocks has occurred on the islands east of the northern end of Kellar Island. Here quartz veins are injected into the pyroxenite and patches of granular quartz replace the pyroxenite and account for up to 60% of the rock. Minor fuchsite is associated with this alteration.

Mafic to Intermediate Metavolcanics

Mafic metavolcanics constitute approximately 35% of the map area and are by far the most abundant supracrustal rocks within the area. Associated with the mafic metavolcanics are rare intermediate metavolcanic rocks.

North of Caribou Lake the mafic metavolcanics form a 1 to 3 km thick sequence of pillowed and massive flows. Local zones of amygdaloidal, variolitic and plagioclase-phyric flows are present but uncommon. Interflow metasedimentary material is rare except near the base of the sequence adjacent to the tonalitic granitoids where interbedded magnetite and amphibole ironstone and chert are commonly present. In the sequence north of Caribou Lake, primary textures are best preserved north of Kellar Island where the deformation is least intense and the metamorphic grade is low. Here the flows are composed of alternating pillowed and massive units. Pillows are regularly formed, 45 to 75 cm in diameter, with thin (1 to 2 cm) selvages, and are bun-shaped. Local hyaloclastite breccia is preserved in the interstices of pillows. West of Howie Lake and north toward the metasediments, the sequence becomes more deformed and of higher metamorphic grade. In these regions, primary textures become less common and the metavolcanics range from massive to schistose and locally gneissic. Immediately south of the metavolcanic-metasedimentary contact, through Campbell and Hollingsworth Lakes, the metavolcanics are highly garnetiferous, locally containing up to 30% garnet.

Metavolcanic rocks lying along the axis of Caribou Lake are generally highly deformed and altered. Carbonatization, silicification and quartz and/or carbonate veining are common from the southwest end of Kellar Island to the eastern map boundary. In this zone, primary textures are poorly preserved and the rocks are predominantly highly foliated to sheared. South and west of Kellar Island there is a general increase in metamorphic grade and the rocks become highly schistose. Adjacent to the tonalitic granitoids the metavolcanics are gneissic due to the metamorphic segregation of feldspathic bands. Relict pillow structures, however, were observed as far south as the islands southwest of Fred's Point. Alteration and deformation of the metavolcanics along Caribou Lake are related to tight folding and faulting along the Caribou Lake Fault.

Immediately south of Caribou Lake is a 1.5 to 2 km thick sequence of fine to medium grained gabbroic amphibolite which is largely devoid of primary volcanic structures. This sequence is probably intrusive in part since local crosscutting relationships are observed within the massive amphibolite.

In the vicinity of Cumaway Lake, massive mafic flows are intercalated with the ultramafic flows. These mafic flows are fine grained and are generally devoid of pillow structures. Several flows, however, have polysutured textures which can locally be shown to occur near the top of the flows (Photo 3). The occurrence of polysuturing in these flows is unusual since the texture is more commonly associated with ultramafic flows (Pyke *et al.* 1973).

On D'Alton Lake the metavolcanics consist of a uniform sequence of pillowed to massive flows. These flows are similar to those developed north of Caribou Lake. The pillows are bun-shaped, 45 to 75 cm in diameter, and regularly formed with thin selvages. Porphyritic and amygdaloidal textures are rare.

The mafic metavolcanics weather green to grey and locally black. Fresh surfaces are similarly coloured but darker. Very dark green to black weathered surfaces are due to the development of hornblende. Orange-brown coloured weathered surfaces indicate carbonatization. Silicified flows are very pale green to whitish on the weathered and fresh surfaces. Silicified mafic flows are distinguished from silicified ultramafic flows and unaltered intermediate to felsic rocks by: (1) the presence of textures or structures (eg. pillows) normally attributed to mafic flows; and (2) observing the gradation from unaltered to altered rock.

In thin section, the mafic metavolcanics are seen to vary considerably in mineralogy and texture. However, while the mineralogy is secondary and usually metamorphic, primary volcanic textures are abundant, particularly in areas of low deformation. Pillow basalts commonly display microporphyritic, pilotaxitic textures. The microphenocrysts are plagioclase laths, 0.1 to 0.3 mm long which often display a "swallow-tail" habit in longitudinal section. Massive portions of flows exhibit isogranular to subophitic textures and are fine to medium grained. The plagioclase in these rocks is coarser and has a tabular habit. In areas of higher metamorphic grade and penetrative deformation, primary textures are destroyed and the rocks contain foliated, prismatic amphibole and equant polygonal plagioclase.

Photo 3: *Polysutured texture of mafic metavolcanic flows, eastern shore of Cumaway Lake.*

Mineralogy of the mafic metavolcanics is largely dependent on metamorphic grade. Areas of low grade metamorphism commonly contain plagioclase (20 to 40%) and actinolite (55 to 75%), with minor epidote group minerals, opaques, chlorite, carbonate, and quartz. The plagioclase compositions are rarely albite and more commonly range from oligoclase to andesine. In areas of medium grade metamorphism the mafic metavolcanics contain plagioclase (30 to 40%), and hornblende (55 to 65%) with minor opaques, epidote, sphene, biotite, and quartz. Plagioclase compositions range from oligoclase to andesine. A thin section of garnetiferous amphibole from Hollingsworth Lake indicates that this rock is composed of poikiloblastic garnet (30%), brown to green pleochroic hornblende (30%), andesine (25%), grunerite which overgrows hornblende (5%), and minor biotite, quartz and magnetite. The anomalous mineralogy of the rock indicates an enrichment of iron in this zone.

Metavolcanic rocks, which are probably intermediate in composition, occur in an isolated outcrop approximately 3 km northwest of the south end of Howie Lake and on an island in the north end of D'Alton Lake. These metavolcanics are considerably lighter in colour than the mafic metavolcanics and have a light grey weathered and fresh surface. The colour index appears to be less than 30% but the rocks were not studied in thin section.

METASEDIMENTS

Chemical Metasediments

Chemical metasediments ranging from chert to ironstone are intercalated with the metavolcanics and clastic metasediments at numerous locations within the map area. The term ironstone is defined as a chemical sedimentary rock that contains 33% or more of the common iron minerals by volume. This definition excludes any other chemically precipitated sediments such as chert, and clastic sedimentary material, that are commonly interlayered with ironstone. Oxide, sulphide and silicate ironstones are present. All of the ironstones in the map area are interbedded with chert on a scale of millimetres to centimetres.

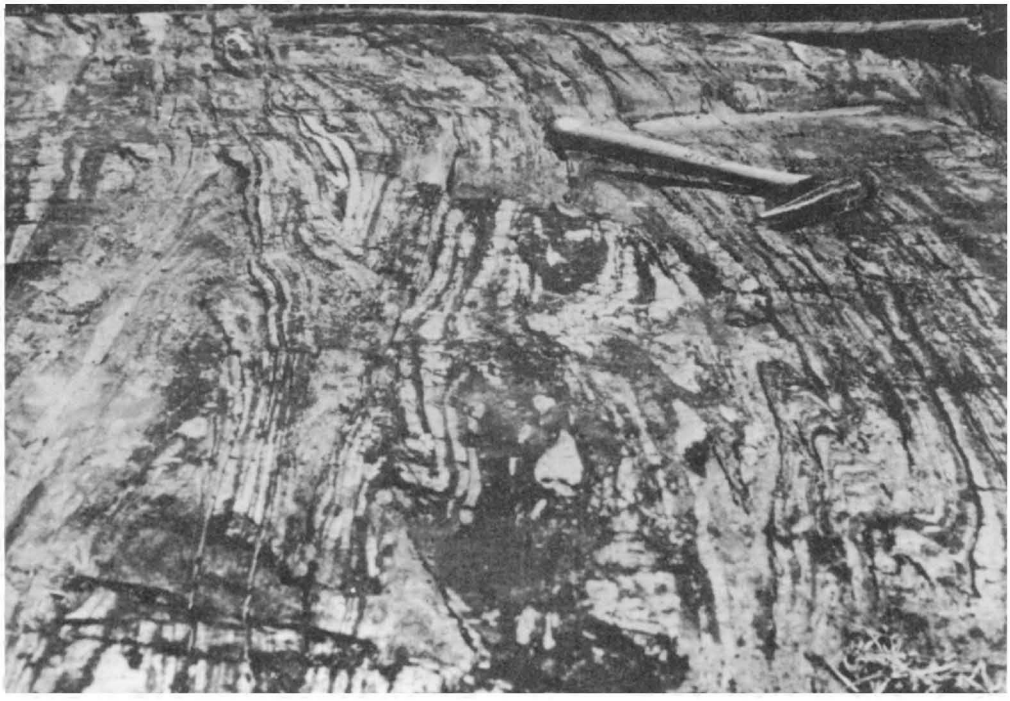


Photo 4: *Folded magnetite-chert ironstone interbedded with argillite, east of Hollingsworth Lake.*

The 50 to 200 m wide ironstone unit east of Hollingsworth Lake occurs along the interface between fine argillaceous metasediments and conglomeratic metasediments. This unit consists of intercalated magnetite ironstone and chert beds which average approximately 1 cm in thickness, interbedded with lesser argillaceous metasedimentary layers, which also are on the order of a centimetre in thickness (Photo 4). The central portion of the ironstone unit contains the least clastic material (less than 25%) but the ratio of chert beds to magnetite ironstone beds appears to remain approximately constant throughout at about 2 to 1. Minor greenish amphibole is locally associated with the chert and ironstone beds but this may be clastic in origin. A thin section of the Hollingsworth Lake magnetite ironstone and chert unit shows that the principal constituents are quartz (60%), magnetite (40%) and hornblende with minor biotite, microcline, apatite, and sphene. Polygonal to sutured 0.1 to 0.5 mm grains of quartz occur as relatively pure beds (recrystallized chert) associated with the magnetite rich ironstone beds. The magnetite occurs as blocky 0.2 to 0.5 mm grains. Minor apatite is associated with the chert and magnetite layers. The argillaceous beds contain hornblende (30%), chloritized biotite (10%), quartz (60%) and traces of sphene and microcline.

At the west end of Campbell Lake a unit of interbedded amphibolitic ironstone and chert is intercalated within the metavolcanics on both the northern and southern shores of the lake. This ironstone is similar to those reported in the Funger Lake Area (Sutcliffe 1986) and although not studied in thin section is probably composed of grunerite and quartz. The rock consists of alternating 1 to 2 cm beds of green amphibole (ironstone) and medium to coarse granular quartz (chert). The outcrops are commonly rusty weathered due to the presence of minor disseminated iron sulphides.

Overlying the quartz-feldspar porphyry in the vicinity of the Fayolle Occurrence, south of Campbell Lake, is a 20 m wide unit of granular quartz which is believed to be recrystallized chert. The unit consists of predominantly 1 to 2 mm grains of quartz and has a crumbly, friable texture. Weathered surfaces of the rock

are commonly very rusty due to the local presence of massive iron sulphide lenses.

The chemical metasedimentary unit east of Fletcher Lake ranges in composition from chert to magnetite-amphibole ironstone and chert, and locally amphibole ironstone and chert. The upper part of the unit (southeastern side) is predominantly chert which locally shows a weak bedding due to streaks of iron minerals. The chert weathers off-white and has a grey fresh surface. The lower part of the unit is more iron-rich. It typically contains interbanded magnetite ironstone, amphibole ironstone, and chert layers on a scale of millimetres to approximately 1 cm. Red-brown carbonate occurs as discontinuous layers and fills crosscutting fractures in the rock. A thin section of interbedded amphibole ironstone chert from the unit contained interbanded 1 cm thick recrystallized chert layers (50%) and amphibole layers. Quartz as 0.05 to 0.5 mm polygonal grains occurs within the recrystallized chert layers. The amphibole layers are composed of very fine matted aggregates of actinolite and poikiloblastic 0.5 mm hornblende grains which overgrow actinolite. Actinolite also occurs as acicular, radiating clusters within the chert layers. Garnet occurs as a layer near one of the interfaces between amphibole and quartz. The garnet is highly altered to chlorite. Magnetite is only present as a trace component.

Ironstone and chert are extensively developed along the islands in Caribou Lakes, southwest of Kellar Island, where several units up to 20 m wide are intercalated with the metavolcanics. These chemical metasediments range from magnetite ironstone chert to magnetite-amphibole ironstone and chert. They are typically very regularly interbanded, with recrystallized chert, magnetite and amphibole ironstone beds averaging approximately 0.5 cm in thickness. A thin section of the unit indicates an average content of quartz (55%), actinolite (30%) and magnetite (15%). The unit probably correlates with the chemical metasediments west of Fletcher Lake.

In the vicinity of Kellar Island, Caribou Lake, several zones of sulphide ironstone are associated with recrystallized chert units. The sulphide zones are usually narrow (0.5 m wide) and consist of pyrite.

Numerous small zones of chemical metasedimentary rocks were mapped in the vicinity of the northern end of D'Alton Lake. These rocks range from chert to sulphide ironstone. A 100 m wide unit of recrystallized chert occurs on the western shore of the northern end of D'Alton Lake. This rock is similar to the recrystallized chert at the Fayolle Occurrence and contains lenses and pods of pyrite ironstone. On the north side of the unit, an exploration trench exposes a graphitic chert breccia. This breccia appears to be intraformational and consists of broken up 1 cm thick beds of chert in a darker graphitic chert matrix. On the eastern shore, and on the islands at the northern end of D'Alton Lake, sulphide ironstone in which the sulphide is predominantly pyrrhotite is exposed. One exploration trench exposes ironstone consisting of 2 cm thick alternating recrystallized chert bands and pyrrhotite-amphibole ironstone bands. The pyrrhotite also occurs in fractures and veins which crosscut the recrystallized chert.

An ironstone unit consisting of highly folded recrystallized interbedded magnetite ironstone and chert occurs near the southern end of D'Alton Lake near the base of the metavolcanic sequence. This unit might correlate with the ironstone unit exposed southwest of Kellar Island since it is similar in character.

Within the English River Subprovince, interbedded magnetite ironstone and chert outcrops at several locations. This ironstone unit is intercalated with wacke and also occurs as enclaves within diatexitic granitoid. The relatively long strike length of the unit (7 km) is largely inferred from an airborne magnetic anomaly and numerous magnetic anomalies encountered on the ground.

Clastic Metasediments

Clastic metasediments are found in the northern part of the map area within the Wabigoon and English River Subprovinces as high grade migmatized metasedimentary rafts within diatexitic granite.

Photo 5: *Highly deformed volcanic clast orthoconglomerate, southern shore of Hollingsworth Lake. View locking parallel to subhorizontal lineation on vertical rock face.*

The most extensive unit of clastic metasediments lies within the Wabigoon Subprovince. This 1.5 to 2 km wide zone of argillite to metaconglomerate, south of the Pashkokogan Lake Fault Zone, apparently overlies the mafic metavolcanics. This sequence was named the Linklater formation by Gussow (1942) and was considered to consist predominantly of quartzite. The present mapping indicates that the unit is predominantly composed of highly deformed volcanic-clast orthoconglomerate and orthoconglomerate with granitoid clasts.

The volcanic-clast orthoconglomerate is composed of felsite, quartz porphyry and lesser quartz clasts. Primary textural characteristics of the rock are largely destroyed by the high degree of deformation which has resulted in length to width ratios of clasts on the order of 20 to 1 on subhorizontal surfaces. The best preserved primary textures are visible on vertical surfaces which are perpendicular to the steeply dipping foliation and subhorizontal lineation in the rock (Photo 5). The volcanic conglomerate contains pebble to cobble sized clasts and is clast supported. The matrix appears to be more micaceous than the clasts. The unit may possibly be a deformed intermediate to felsic breccia; however, deformed quartz clasts which may be recrystallized chert are common within the unit. This suggests that the unit is more likely to be of sedimentary origin and derived from weathering of an intermediate to felsic volcanic terrain.

The volcanic clast orthoconglomerate has a creamy buff to grey weathered surface and a grey fresh surface. It is commonly highly fissile due to the well developed foliation. Thin section study shows the rock contains quartz (50-60%), plagioclase (oligoclase, 15 to 20%), microcline (15 to 20%), muscovite (8 to 10%), biotite (trace to 2%), and minor opaques. The texture is highly foliated and recrystallized, with fine polygonal grains of quartz and feldspar. Pods of coarser quartz and to a lesser extent feldspar, which may be relict clasts, result in a flaser texture.

Orthoconglomerate with granitoid clasts is similar to the volcanic-clast orthoconglomerate, but this rock contains granitic clasts in addition to the volcanic

clasts. The granitic clasts vary from pebble to cobble sized and are generally less deformed than the other clasts (Photo 6). Locally they retain a well rounded shape. The clasts have a pinkish weathered surface and a well foliated, recrystallized, medium grained texture. A thin section of a granitoid clast contains quartz (30%), microcline (30%), plagioclase (oligoclase 30%), muscovite (6%), and biotite (4%). The granitoid clasts are not readily comparable with any of the granitoid plutons in the map area.

On Campbell Lake, highly deformed paraconglomerate with matrix supported granitoid clasts is exposed locally. A good example is located on the southern shore of the large island in the center of the lake. This conglomerate has a wacke matrix which has been metamorphosed to biotite schist. The paraconglomerate is believed to represent a transitional facies between the conglomerate of the Wabigoon Subprovince and wacke of the English River Subprovince.

Underlying the conglomeratic metasediments, in the vicinity of Hollingsworth Lake, is an approximately 400 m wide unit of fine argillaceous metasediments. This argillite also underlies and is in part intercalated with the ironstone east of Hollingsworth Lake. The unit is generally finely bedded to laminated. In places the bedding is destroyed by recrystallization and deformation, and the rock is a biotite schist. Locally, poikiloblastic garnets up to 1 cm in diameter are present in the unit. In hand specimen, the argillite has a rusty brown weathered surface, a grey fresh surface, and a fine grained well foliated texture. Thin section study shows the rock to contain quartz (20-30%), plagioclase (oligoclase, 10-20%), microcline (0-20%), biotite and chloritized biotite (20-40%), garnet (0-15%), and traces of opaques, tourmaline and apatite. The texture is foliated and generally recrystallized although in some specimens the clastic texture of quartz grains is preserved.

The clastic metasediments of the English River Subprovince within the map area consist of wacke, pelitic biotite schist, and migmatized equivalents. The metasediments occur as rafts within the diatexitic granitoids and range in size from

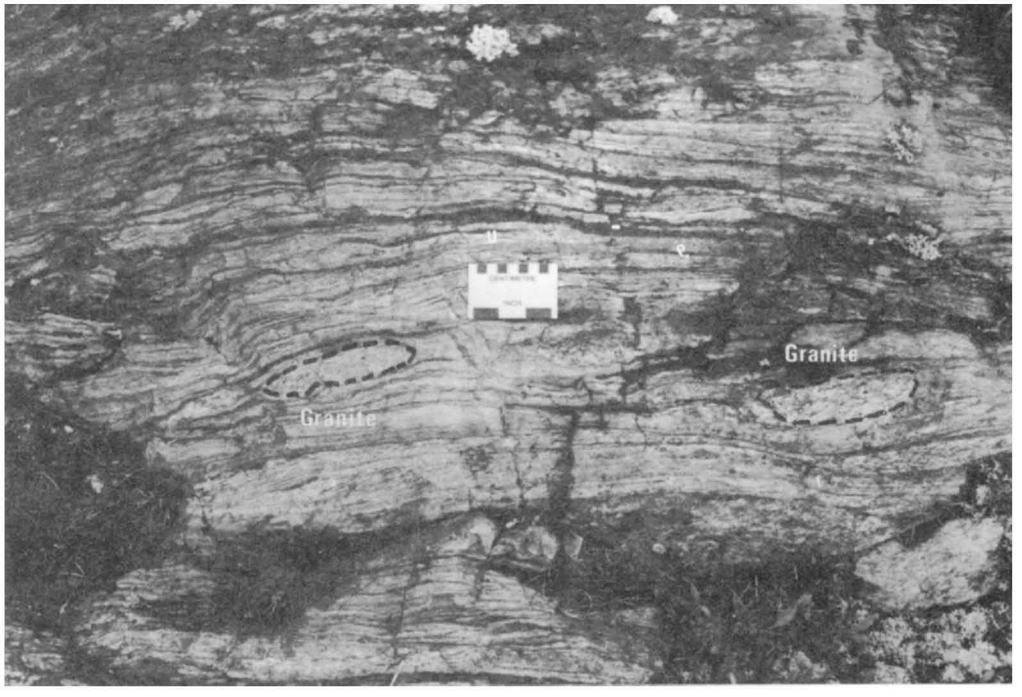


Photo 6: *Highly deformed orthoconglomerate with granitoid clasts, east of Hollingsworth Lake. Granitoid clasts (outlined) are less deformed than fine grained felsic clasts which are only recognizable as bands in the photograph.*

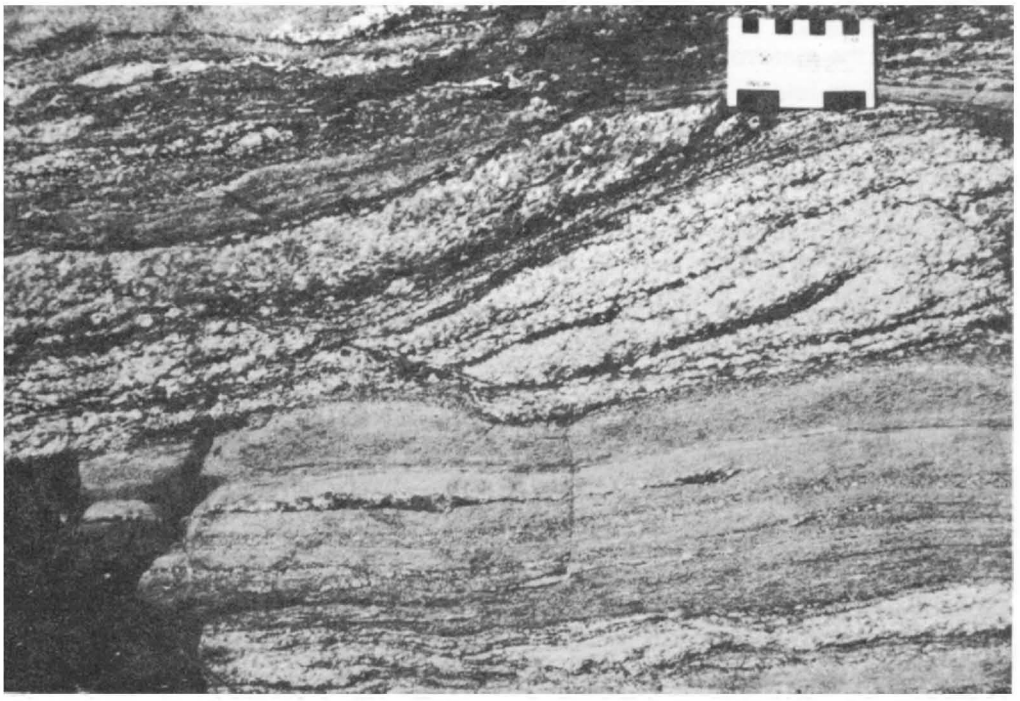


Photo 7: *Metatexitic metasedimentary migmatite on Hollingsworth Lake. Granitoid leucosome (coarser grained) is restricted to pelitic component in the upper half of the photograph.*

several metres to kilometres in length. Locally, bedding is preserved within these metasediments and indicates that the pelites and wackes are interbedded.

Wacke is the predominant metasedimentary rock type within this part of the area. The wacke has a rusty, brown grey weathered surface and a medium grey fresh surface. The rock has an equigranular, medium grained, well foliated texture. In thin section, the rock is seen to contain quartz (15 to 45%), plagioclase (andesine, 40 to 60%), biotite (15 to 25%), with minor opaques, apatites, zircon, and tourmaline. Biotite exhibits a pale straw to deep red brown pleochroism. Minor garnet was observed associated with the wacke in the field, but not in thin section. The rock has a recrystallized, granoblastic, foliated texture with polygonal 0.5 to 1.0 mm grains of quartz and feldspar.

The pelitic units are medium to coarse grained, schistose, and contain more mafic minerals than the wackes. In thin section, the pelitic metasediments are seen to contain biotite (20 to 45%), muscovite (5 to 10%), quartz (15 to 20%), plagioclase (oligoclase 20 to 50%), sillimanite (0 to 5%), and minor zircon, opaques, and apatite.

Metasediments within the English River Subprovince are migmatized and commonly display stromatitic structures (Mehnert 1971) as a result of the *in situ* development of muscovite-biotite granite leucosome (Photo 7). This type of migmatite is referred to as metatexite by Breaks *et al.* (1978) within the English River Subprovince. The granite leucosome is usually situated within the pelitic portion of the metasediments. Most of the pelitic rocks are migmatized. Locally the leucosome contains cordierite.

METAMORPHOSED SUBVOLCANIC TO VOLCANIC FELSIC ROCKS

Subvolcanic felsic rocks within the map area consist predominantly of quartz-feldspar porphyry with minor felsite and trondhjemite. These rocks vary in form from small 1 to 2 m wide dikes to quasi-conformable sills several kilometres long. Most of the subvolcanic felsic rocks appear to have been metamorphosed as

indicated by recrystallized textures, and foliation trends which parallel those in the supracrustal rocks. In addition, the Howie Lake porphyry appears to have been folded with the metavolcanics.

The quartz-feldspar porphyry extending from the southern end of Howie Lake northwest towards Campbell Lake is the largest subvolcanic body within the map area. The porphyry may be a lava dome structure rather than intrusive since it: (1) locally exhibits fragmental texture, (2) is conformable to the mafic metavolcanics, and (3) appears to be capped locally by a chert unit containing sulphide mineralization. Fragments within the body are developed in the vicinity of Howie Lake. Here they occur as vague angular brecciated porphyry fragments (2 to 10 cm long) in a matrix of similar composition which is more foliated than the host. In addition, 2 to 3 cm diameter rounded structures composed of alternating, concentric 1 mm thick layers of quartz and aphanitic felsic material occur; these may or may not be fragments. The origin of these structures is not known but the concentric arrangement of phases is similar to that in some orbicular textures. The Howie Lake porphyry body has been locally brecciated and injected by quartz veins. Granular patches of fine quartz also replace the porphyry in these zones.

The interpretation of the above textures as being primary volcanic textures must be treated with caution since the intrusion has been metamorphosed to medium grade and has undergone considerable deformation.

The quartz-feldspar porphyry body on Campbell Lake is similar to the body on Howie Lake except that the former is more highly deformed. Local fragmental textures are also observed in this body but whether the structures are primary or related to deformation is not known. Locally, the Campbell Lake body is observed to contain mafic inclusions. The body approaches an equigranular rather than porphyritic texture on a local scale, and these rocks are classified as trondhjemite. Most of the Campbell Lake porphyry is highly sheared to mylonitic and consists of muscovite or sericite schist.

Throughout the map area, small dikes and sills of quartz-feldspar porphyry, felsite and trondhjemite intrude the supracrustal rocks. The felsite is a felsic, aphanitic rock and the trondhjemite is a felsic, equigranular, fine to medium grained rock. Feldspar porphyry dikes and sills which are intermediate in composition intrude the mafic metavolcanics south of Hollingsworth Lake. Intermediate dikes are also present in the metavolcanic rocks on Cumaway Lake.

The quartz-feldspar porphyries and associated rock types have pale coloured weathered surfaces that are commonly cream coloured but vary to pink and light grey. Fresh surfaces are usually light grey to pinkish. The rocks are aphanitic with quartz and plagioclase phenocrysts up to 3 mm. The phenocrysts range from euhedral to augen shaped, depending on the amount of deformation. One thin section of the Howie Lake porphyry indicates that the quartz phenocrysts (10%) are rounded and resorbed. Plagioclase phenocrysts (5%) are subhedral and tabular but are heavily altered to sericite and appear to be oligoclase in composition. The matrix consists of fine (0.1 mm) grains of quartz and feldspar with patches of larger (0.5 mm) poikiloblastic muscovite. Staining of the hand specimen with sodium cobaltinitrate after etching with hydrofluoric acid indicates that potassium and plagioclase feldspars are present in the matrix. Minor tourmaline, sphene and opaques are present in the rock, but the tourmaline may be secondary since it is associated with silicification in the thin section.

Thin section study of the Campbell Lake porphyry indicates a highly deformed and recrystallized, flaser to granoblastic texture. Relict phenocrysts occur as lenticular quartz and plagioclase (oligoclase) aggregates to 4 mm long. The matrix is composed of quartz (25%), oligoclase (25%), and microcline (15%) which occur as 0.1 mm polygonal grains. Muscovite (15%) and biotite (5%) occur as 0.1 to 1.0 mm grains scattered throughout.

EARLY FELSIC TO INTERMEDIATE PLUTONIC ROCKS

Plutonic rocks consisting of predominantly tonalite are abundant within the map area and form part of a large batholithic complex named the Sowden-Wabikimi granitoid complex (Sage *et al.* 1974) which extends for approximately 100 km west of the map area.

The early plutonic suite in the Fletcher Lake Area includes a diversity of granitoid rock types which are similar in characteristics to those described in the Funger Lake Area (Sutcliffe 1986) to the west. The suite includes rocks ranging in composition from hornblende diorite to muscovite-biotite granite with biotite tonalite predominating. The rocks range in texture from recrystallized and gneissic to hypidiomorphic and massive.

In the Funger Lake Area (Sutcliffe 1986), several ages of tonalite emplacement were recognized, but it was thought that the entire suite was older than the mafic dikes and the gabbroic Outlet Bay Pluton. In the present map area, evidence indicates that two distinct episodes of tonalitic magmatism have occurred: one predates the mafic plutonism, and the other postdates it. The first episode includes the granitoid rocks north of Caribou Lake since these rocks are clearly older than the mafic dike swarm which intrudes them. Also possibly included within the first phase is the gneissic tonalite south of Caribou Lake. The second episode, which is present south of the Caribou Lake Fault, intrudes the gabbroic Caribou Lake Pluton and the gneissic tonalite.

The conclusion that two ages of tonalite are present is largely based on the interpretation that the mafic dike swarm and the gabbroic Caribou Lake Pluton are contemporaneous. This correlation is suggested by the interpretation that the Outlet Bay Pluton to the west is contemporaneous with the dike swarm (Sutcliffe 1986) and the close mineralogical and chemical similarities between the dike swarm, Outlet Bay Pluton and Caribou Lake Pluton. Additional evidence for two significantly different ages of tonalite comes from the occurrence of massive to foliated tonalite crosscutting gneissic tonalite south of the Caribou Lake Fault.

It should be noted that on the accompanying map the tonalites are considered as one unit. This is done because it is not possible in all cases to assign a particular exposure of tonalite to a particular episode.

Important features of the early plutonic suite are: (1) the dominantly tonalitic composition, (2) predominance of biotite as the major mafic mineral, and (3) generally fine to medium grained, equigranular, recrystallized, foliated texture. The suite is intrusive into the mafic metavolcanic rocks and commonly contains mafic amphibolite enclaves.

Tonalites of the early plutonic suite situated north of Caribou Lake and west of Fletcher Lake are generally characterized by a medium-grained, recrystallized, foliated texture. Along the northern part of this body, foliated to massive biotite tonalite with quartz aggregates, which are presumably recrystallized quartz phenocrysts, is the common rock type. In the vicinity of Brockway Lake and west to the boundary of the map area, several phases were recognized. These phases, which are similar to those observed in the Sturgeon Arm area of Caribou Lake (Sutcliffe 1986), are:

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

(2) Medium grained, massive to foliated, hypidiomorphic to weakly recrystallized biotite tonalite,

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

Although phase (3) has been distinguished as a distinct unit on the map, no contacts between phases (2) and (3) were identified in the field and the phases may be compositionally gradational. Along the southern contact of the tonalitic rocks with the mafic metavolcanics, the tonalite is highly foliated to gneissic and has a moderately well developed linear fabric.

A fine grained phase which is intermediate in composition and commonly highly foliated to sheared is present as inclusions within the tonalite north of

Caribou Lake. The inclusions are present throughout this body but are particularly abundant along the northern and southern contact zones. This phase is also present as small dikes and sills within the metavolcanic rocks in the vicinity of Fred's Point and adjacent islands on Caribou Lake. The unit appears to be the oldest phase associated with the early plutonic suite.

Rocks of the early plutonic suite south of the Caribou Lake Fault are less well exposed than those in the north, except on the shore and adjacent islands of Caribou Lake. In this area, gneissic biotite tonalite predominates. The gneissic texture has originated by several processes:

(1) Development of *in situ* granite (*sensu stricto*) leucosomes and feldspathic segregations,

(2) Interlayering and deformation of leucocratic tonalite within the biotite tonalite,

(3) Deformation of amphibolite enclaves within the tonalite.

The textures are similar to those described in the area to the west (Sutcliffe 1986).

In the zone of gneissic tonalite, the presence of numerous amphibolite enclaves is characteristic. The enclaves are highly strained and migmatized and exhibit varying degrees of reaction with the tonalite. In these areas. muscovite-hornblende diorite to quartz diorite is present both as an intrusive phase into the biotite tonalite and as a phase which is gradational with the tonalite.

South of the Caribou Lake Fault, fine to medium grained, foliated, biotite tonalite occurs in the vicinity of Beaver Island and as a phase which discordantly intrudes the gneissic biotite tonalite and gabbro of the Caribou Lake Pluton. These tonalitic rocks represent the second episode of tonalitic magmatism within the area.

The sills and dikes of biotite tonalite which occur within the metavolcanic rocks are generally medium grained, foliated and recrystallized. Northeast of Fred's Point, Caribou Lake the tonalite sill within the metavolcanics contains deformed quartz and feldspar phenocrysts up to 5 mm long.

Despite a wide range in textures and lithological relationships within the early plutonic suite, the rocks are relatively uniform compositionally. Figure 2 shows that rocks of the early plutonic suite from north of Caribou Lake, south of Caribou Lake and minor sills within the metavolcanic rocks all have overlapping compositional fields. The majority of the rocks are classified as tonalite, but gradations to quartz diorite, granodiorite and granite are present. Most rocks within the suite contain less than 20% mafic minerals, predominantly biotite.

The tonalitic rocks of the Fletcher Lake Area are characterized by a light grey weathered surface and a lighter grey fresh surface. Plagioclase, which generally accounts for 50 to 80% of the rock, occurs as 1 to 2 mm grains. The grains vary from a well twinned, subhedral, tabular habit to a poorly twinned equant, polygonal habit with increasing deformation. The plagioclase in most rocks shows some evidence of recrystallization, is of oligoclase composition, and is relatively fresh. Quartz, 20 to 40%, occurs as aggregates of grains up to 10 mm long and as interstitial to lobate grains 0.5 to 3 mm long. Microcline is absent to minor in the tonalitic rocks, but where present it occurs as fresh, well twinned, interstitial grains. Biotite is the predominant mafic mineral (5 to 20%) and occurs as 0.5 to 1 mm tabular to irregular grains which are pleochroic from green-brown to light brown. The biotite commonly forms clotty aggregates and contains numerous inclusions of accessory minerals. Characteristic accessories of the tonalitic rocks are allanite, sphene, apatite and magnetite. Minor epidote and sericite occur as alterations of the plagioclase.

The 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. Staining for potassium feldspar is the only reliable method to distinguish the granodiorites and granites from the tonalites in the field. The low mafic mineral content (less than

10%), local presence of muscovite, and generally less recrystallized texture serve as helpful diagnostic features to identify the granodiorite and granite.

In thin section, these rocks are seen to be equigranular with subequal plagioclase, microcline, and quartz. Plagioclase of oligoclase composition occurs as tabular 1 to 2 mm grains. Microcline is fresh and occurs as anhedral interstitial grains. Myrmekite extending from the plagioclase grains overgrows the microcline. Biotite and lesser muscovite occur as ragged 0.2 to 0.5 mm grains in clotty aggregates.

MAFIC INTRUSIVE ROCKS

Mafic Dike Rocks

North of Caribou Lake, an extensive swarm of mafic amphibolite and hornblende gabbro dikes invade the early felsic to intermediate plutonic rocks and mafic metavolanics. The dikes trend at N20E to N50E and are discordant to their host lithologies. They are a continuation of the mafic dike swarm in the Funger Lake Area (Sutcliffe 1986) and therefore the swarm should have a minimum width of approximately 20 km. The dikes range in width from a few centimetres to approximately 200 m. In regions with the greatest density of dikes, they account for up to 30% of the exposed bedrock.

Along Caribou Lake, the dikes invade the southwest trending limb of mafic metavolcanics. They appear to be truncated by the Caribou Lake Fault since no mafic dikes clearly associated with the swarm were identified south of the fault. Along the northern tonalite-supracrustal contact, south of Campbell Lake, the relationship between the dike swarm and metavolcanic belt is obscured by a diabase sill and poor exposure. No mafic dikes were identified within the supracrustal rocks in that area.

Evidence was presented on the Funger Lake Area (Sutcliffe 1986) that the mafic dikes are related to the gabbroic Outlet Bay Pluton. This relationship is also valid within the Fletcher Lake map area where the gabbroic Caribou Lake Pluton is also interpreted to be genetically related to late mafic dikes. Whereas the mafic dikes and Outlet Bay Pluton have been emplaced into an early phase of tonalitic rocks, the Caribou Lake Pluton was emplaced into metavolcanic rocks and intruded by a later phase of tonalites.

In the field, the dikes are distinguished from mafic enclaves on the basis of: (1) discordant nature with respect to the host rocks, and (2) generally massive texture. The dikes truncate foliation trends in the tonalite and metavolcanic hosts and locally contain enclaves of the host. No chilled margins were observed in the dikes. The dikes range from fine grained amphibolite with a relict diabasic texture to medium grained hornblende gabbro. Fine grained amphibolite is the dominant type. This rock type weathers black to dark green and has a dark fresh surface. Plagioclase varies in composition from calcic andesine to labradorite, accounts for 20 to 45% of the rock and generally occurs as fresh, subhedral, tabular, well twinned, 0.2 to 1 mm grains. Anhedral, rounded plagioclase phenocrysts up to 1 cm long, accounting for up to 10% of the rock, were locally observed but rare. The amphibole varies from pale green pleochroic hornblende to colourless uralitic actinolite (40 to 75%). The amphibole occurs as scaly aggregates (0.1 to 0.5 mm) to subhedral grains (1 mm) which appear to replace pyroxene that originally had a subophitic texture. Quartz is present in some rocks as interstitial grains or intergrown with hornblende. Minor biotite locally replaces hornblende. Magnetite, and 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 (Sutcliffe 1986) and the Caribou Lake Pluton. Plagioclase, varying from calcic andesine to labradorite in composition, accounts for 35 to 45% of the rock. The plagioclase occurs as subhedral, tabular grains, with well developed albite, Carlsbad, and pericline twins and is generally fresh. Hornblende to actinolite (45 to 60%) has a similar habit to the amphibole in the finer grained dikes.

Mafic Plutonic Rocks

The elongate Caribou Lake Pluton (named by Sage *et al.* 1974) intrudes mafic metavolcanic rocks south of the Caribou Lake Fault. The pluton, which has a maximum length of approximately 10 km, consists predominantly of hornblende gabbro with minor clinopyroxene gabbro.

Contacts between the Caribou Lake Pluton and the adjacent rocks are variable. On the northwestern side of the pluton, several phases of granitoids, ranging in composition from tonalite to granite, invade the gabbro. Granitoid dikes are abundant in the gabbro and blocks of gabbro are commonly included within the granitoids. These relationships are chronologically dissimilar to those observed for the Outlet Bay Pluton (Sutcliffe 1986) where a similar gabbro pluton postdates the tonalitic rocks. On the basis of the correlation of these gabbroic plutons, it is suggested that this is evidence for two phases of tonalitic rocks.

The southern contact of the pluton is not well exposed but the relationships seem to be similar to the northwestern contact, with the gabbro being intruded by several granitoid phases.

To the east, the Caribou Lake Pluton is in contact with the mafic metavolcanics and here the relationship appears to vary from gradational to discordant. The zone of massive, commonly gabbroic amphibolite south of Caribou Lake is difficult to distinguish from the medium grained gabbro except on a basis of grain size. It is possible that the gabbroic amphibolite is a finer grained phase of the hornblende gabbro.

The Caribou Lake Pluton contains sparse mafic metavolcanic enclaves which appear to have been metamorphosed to high grade assemblages. Several phases of tonalitic to dioritic to granitic dikes are present within the pluton.

Medium grained, clinopyroxene to hornblende gabbros with 35 to 65% mafics are the predominant rock types within the pluton. The rocks are distinguished by: (1) colour index; (2) hypidiomorphic, subophitic texture with fresh, tabular feldspar grains; (3) medium grain size; and (4) massive to weakly foliated fabric. Hornblende gabbros are dark grey with steely blue feldspars and black hornblende; pyroxene gabbros have earthy brown coloured feldspars and the pyroxene is distinctly green.

In thin section, plagioclase is present as subhedral tabular grains, 2 to 5 mm long, which range from calcic andesine to labradorite in composition. The grains are very fresh with well developed albite, Carlsbad, and pericline twins, and only minor alteration to epidote minerals. Weakly developed normal zoning of plagioclase is present in some rocks. Where present, clinopyroxene occurs as relict grains 1 to 2 mm long, interstitial to the plagioclase, and surrounded by amphibole. Commonly the pyroxene cores grade out to colourless uralitic amphibole, to pleochroic green hornblende at the margins. All stages of alteration of clinopyroxene to amphibole are preserved within the rocks of the pluton, but most rocks contain clusters of subhedral 0.5 to 1 mm amphibole grains which are pleochroic blue-green, to dark green, to light brown. Biotite is present in trace amounts as grains up to 1 mm long which replace amphibole. Magnetite accounts for up to 5% of the rock and occurs as irregular grains interstitial to original clinopyroxene or included within hornblende. Sphene, where present, rims the magnetite. Minor quartz is present as polygonal grains intergrown with the amphibole and appears to be a product of the breakdown of clinopyroxene. Epidote and chlorite are present as alterations of the mafic minerals.

The gabbro pluton which rims the northern margin of the granitic D'Alton Lake Pluton is very similar to the Caribou Lake Pluton in character. The two gabbro intrusions are probably consanguineous. Some outcrops of the gabbro near D'Alton Lake exhibit well developed fluidal alignment of feldspars and locally a weak igneous layering is present. Igneous layering is reported to be present in the Caribou Lake Pluton (Sage *et al.* 1974) but was not observed during the present survey.

LATE FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

The late felsic to intermediate plutonic rocks lying within the map area consist of: (1) biotite granite with microcline porphyroblasts which is here named the D'Alton Lake Pluton, (2) minor biotite granite dikes, (3) granite pegmatite dikes, and (4) minor hornblende diorite dikes. The late plutonic rocks are generally massive and discordantly intrude all other Early Precambrian (Archean) rocks within the Wabigoon Subprovince.

The D'Alton Lake Pluton, which is the largest single body of the late plutonic suite within the map area, is an elliptical intrusion with a maximum width of approximately 6 km. The intrusion is relatively homogeneous but compositionally overlaps the granite, granodiorite, quartz monzonite and quartz monzodiorite fields (Figure 2). Rocks of the pluton intrude metavolcanics, biotite tonalite and hornblende gabbro. Scattered relict amphibolite enclaves are present throughout the intrusion and hornblende gabbro enclaves occur where the pluton intrudes the gabbro.

Rocks of the D'Alton Lake Pluton are massive and have a medium grained, hypidiomorphic texture. They contain 10 to 30% subhedral, tabular microcline megacrysts which average approximately 1 cm in length. On both the fresh and weathered surfaces the rock is pink.

In thin section, the granitoids are seen to contain subequal amounts of plagioclase, microcline and quartz. The plagioclase, which is of oligoclase composition, occurs as 1 to 4 mm tabular grains and is moderately altered to sericite, particularly in the cores of the grains. This alteration appears to indicate a relict zoning. Microcline occurs as megacrysts up to 6 mm long which include quartz and plagioclase. The grains also locally replace plagioclase. They appear to have crystallized late and therefore are considered to be porphyroblasts as opposed to phenocrysts. Some microcline is also present as finer anhedral interstitial grains. Quartz occurs as 0.5 to 2 mm strained grains which are interstitial to the plagioclase. Biotite, the predominant mafic mineral of the pluton, generally accounts for approximately 5 to 10% of the rock. It occurs as anhedral, corroded grains up to 2 mm long which are locally chloritized and oxidized. Minor muscovite is associated with the biotite but is probably secondary. Traces of opaques occur as discrete subhedral grains or as fine granules with biotite. Sphene is associated with the chloritization of biotite. Minor accessory apatite is usually included in biotite.

Numerous dikes of granite pegmatite are present within the granitoid terrains north and south of Caribou Lake. The pegmatite dikes intrude rocks of the early plutonic suite and the Caribou Lake Pluton. They vary in width from a scale of centimetres to tens of metres and tend to be quasi-conformable with pre-existing rock fabrics.

The pegmatites range in composition from granite to alkali feldspar granite and contain biotite and/or muscovite as mafic minerals. Garnet is locally present as an accessory phase. The dikes are white to pink and inequigranular with grains ranging in size from millimetres to over 10 cm. Graphic intergrowth of quartz in feldspar is common.

MIGMATITES

Plutonic rocks of the English River Subprovince occur north of the Pashkokogan Lake Fault Zone. These rocks consist predominantly of muscovite-biotite granite (*sensu stricto*) and appear to be derived from anatexis of metasediments. This rock type is commonly referred to as "diatexite" in the English River Subprovince (Breaks *et al.* 1978). Two subdivisions of diatexite, based on the volume of remnant sedimentary material, can be made in the field (Breaks *et al.* 1978). These are: (1) inhomogenous diatexite, which contains greater than 10% metasedimentary inclusions, and (2) homogenous diatexite which contains less than 10% relict sedimentary material.

Field characteristics which distinguish the diatexitic granitoids from other plutonic rocks include: (1) white weathered surfaces, (2) inequigranular, medium to coarse grained texture, (3) presence of accessory garnet and local cordierite.

The inhomogeneous diatexite contains numerous metasedimentary inclusions which exhibit varying degrees of fusion and incorporation into the granitic matrix. These inclusions include: (1) wispy schlieren and clots of paleosome (restite) material, which consist predominantly of biotite; (2) metatexite rafts which exhibit a banded (stromatitic) structure and; (3) fine grained metawacke rafts which do not contain a mobilizate phase. Commonly the inhomogeneous diatexite retains a weakly banded structure defined by alignment of the enclaves. This however may be a secondary effect resulting from deformation along the Pashkokogan Lake Fault Zone and not a relict from layering in the metasediments.

The diatexitic granitoids are predominantly granite (*sensu stricto*) in composition but locally range to granodiorite-tonalite (Figure 2). In thin section, the rocks contain subequant plagioclase (oligoclase), microcline and quartz. The plagioclase is subhedral, tabular, and ranges from 1 mm to 1 cm in length. The grains contain moderately well developed albite twinning, are mildly sericitized and have weak normal zoning. Bulbous myrmekite locally projects from plagioclase and overgrows microcline where microcline and plagioclase are in contact. The microcline is anhedral and interstitial to the plagioclase. The grains range from 1 mm to 1 cm in size and are fresh with well developed gridiron twinning. Microcline contains plagioclase inclusions and locally replaces plagioclase. Quartz forms anhedral aggregates up to 1 cm which are also interstitial to the plagioclase. Biotite (5%) and muscovite (2%) are the predominant mafic minerals. Both occur as 1 mm to 2 mm grains which form mafic mineral clots. Biotite tends to be ragged and anhedral, and exhibits deep reddish brown to straw coloured pleochroism. Muscovite is tabular in habit. Euhedral zircons are locally abundant as an accessory phase and are included within biotite. Euhedral apatite and minor opaques are also associated with the mafic minerals. Alterations include minor chloritization of the biotite and sericitization of plagioclase. Garnet was not observed in thin section, but is commonly present in minor amounts within the diatexitic granitoids. It occurs as 1 to 2 mm euhedral grains. Minor cordierite was also locally observed within the diatexite. It occurs as pale blue grains up to 5 mm in diameter which weather recessively with respect to feldspar and quartz.

Biotite-muscovite pegmatite, which is mineralogically similar to diatexitic granites but with coarser grain size, is common within the metasedimentary rocks south of the Pashkokogan Lake Fault Zone. The pegmatite occurs as sills up to 60 m wide which parallel the foliation within the metasediments. The pegmatites locally contain accessory garnet.

CATACLASTIC ROCKS

Cataclastic rocks within the Fletcher Lake Area are primarily associated with the Caribou Lake Fault and with the Pashkokogan Lake Fault Zone. In both of these faults, cataclasis has affected all of the Early Precambrian (Archean) rocks in the area traversed by the faults, but Late Precambrian (Proterozoic) intrusive rocks are apparently not affected. Minor cataclastic rocks are also associated with the faults in the vicinity of Cumaway Lake.

Cataclastic rock types associated with the Pashkokogan Lake Fault Zone and the Caribou Lake Fault include submylonite and mylonite. Cataclastic textures are best exhibited by granitoid rocks which have been affected by faulting, but metaconglomerate south of the Pashkokogan Lake Fault Zone also displays these characteristics. Rocks which show development of a strong cataclastic foliation and have developed flaser to augen textures, but have not become finely comminuted, are classified as submylonite. In submylonite, the original lithology, prior to cataclasis is usually identifiable.

Submylonite is characterized by a strong planar fabric. Quartz, often fractured, develops a flaser texture with elongated, lenticular, ribbon-like grains with length to width ratios in excess of 20:1, and lens shaped aggregates or augen. The

phyllosilicates, particularly micas, are present as streaky aggregates often resulting in a parting surface within the rock. Variations in grain size and compositional banding locally result in gneissic textures in the submylonite. Particularly good examples of submylonite associated with the Caribou Lake Fault are exposed on the northern shore of Beaver Island, Caribou Lake. Good examples of the submylonite in the Pashkokogan Lake Fault Zone are present on the western shore of Hollingsworth Lake.

With more intensive deformation, the grains become very finely comminuted and the resulting rock type is mylonite. The mylonite is a hard, fine to very fine grained, grey to brown weathering rock. Due to the fine grain size mylonite may appear to be massive, with a splintery fracture. Commonly the mylonite is developed as zones a few centimetres wide in less deformed rock into which it grades. Mylonite is relatively rare within the map area but occurs at a few poorly exposed localities along the southern shore of Caribou Lake, particularly at the narrows between Kellar Island and the mainland.

In thin section, the cataclastic rocks display progressive stages of deformation and recrystallization. With increasing deformation grain size is reduced, primary textures are progressively destroyed, and the fabric of quartz and feldspar approaches an interlocking mosaic of polygonal grains. The finest grain sizes are approximately 0.1 mm. Phyllosilicates are recrystallized into wispy aggregates parallel to foliation and then to fine individual grains. Intensely deformed rocks contain fine microfractures, oriented at high angles to the foliation, which are filled with carbonate and quartz.

On Cumaway Lake, the faults occur primarily in mafic metavolcanics and a different type of cataclastic effect is present. Here the faults are defined by breccias and shear zones. The breccias typically consist of angular (1 to 4 cm) fragments of country rock cemented by reddish to white carbonate and minor silica. Locally the breccias consist predominantly of carbonate with isolated metavolcanic fragments. The breccia zones range from less than a metre up to several metres in width. A particularly good example of the fault breccia is exposed on the eastern shore of Cumaway Lake at the Lett Occurrence.

LATE PRECAMBRIAN (PROTEROZOIC)

Late Precambrian (Proterozoic) diabase sheets and ultramafic to felsic dike rocks associated with the Nipigon Plate intrude the Early Precambrian (Archean) rocks in the area. Age relations between these Late Precambrian rocks are poorly understood and at present the only observed intrusive relationship is that the felsic granophyre dikes discordantly intrude the mafic diabase sheet on D'Alton Lake. On the southern part of Caribou Lake, outside the present map area, a diabase sheet intrudes sediments of the Sibley Group which are assigned to the Late Precambrian (Ayres *et al.* 1970) and have been dated at 1339±33 Ma by Franklin *et al.* (1980). The dike rocks and the diabase sheets are therefore assigned to the Late Precambrian Keweenawan igneous event. South of Lake Nipigon K-Ar determinations on the chill zones of diabase sills indicate a minimum age of 1060 Ma for these igneous rocks (Franklin 1970).

ULTRAMAFIC TO FELSIC DIKE ROCKS

Late Precambrian (Proterozoic) dike rocks in the area display a variety of textural and compositional variations. The variety of dikes may be related to the position of the map area near the northern end of Lake Nipigon which is believed to be a graben structure (Card *et al.* 1972).

Minor ultramafic dikes occur as biotite-olivine lamprophyres and carbonate-rich lamprophyres along the shores of Caribou Lake. These dikes are generally small (less than 0.5 m in width) and also occur as the matrix of narrow breccia zones. The lamprophyres weather from bright red to orange brown and have dark to pale grey fresh surfaces. The dikes weather down with respect to the metavolcanic host rocks and commonly have a pitted weathered surface. In thin section, these dikes are seen to contain 30 to 50%, 0.5 mm to 1 cm, pseudomorphed rounded olivine

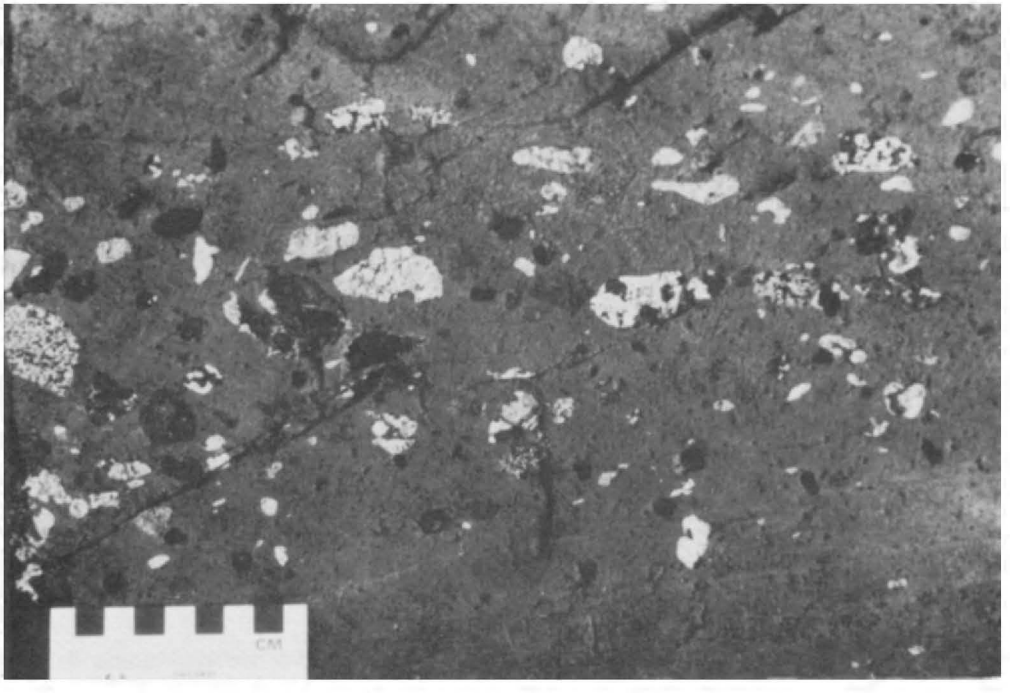


Photo 8: *Alkaline mafic dike, Fuchsite Lake. The dike contains numerous phenocrysts of plagioclase, clinopyroxene and iron-titanium oxides and rounded inclusions of clinopyroxene gabbro. Miarolitic cavities are present in the dike but not visible in the photograph.*

phenocrysts and angular olivine fragments. The olivine has been replaced by serpentine and carbonate. Pale brown, pleochroic, fresh biotite phenocrysts range from 0.5 to 3 mm and account for up to 25% of the rock. Locally the phenocrysts have been bent and fractured. A fine grained matrix of biotite, opaques and carbonate forms 40 to 50% of the rock. Apatite is locally present as an accessory phase.

Mafic dikes are common throughout the map area and range in width from a few centimetres to approximately 30 m. Both alkaline and tholeiitic mafic suites are present, but this distinction between the suites was not recognizable in the field, and therefore not indicated on the map. However, the alkaline mafic dike rocks appear to be characterized by the presence of miarolitic cavities, generally porphyritic texture, locally ocellar texture and locally abundant xenoliths (Photo 8). Tholeiitic dike rocks, on the other hand, lack these textures, except for local dikes with plagioclase phenocrysts.

The alkaline dikes range in grain size from aphanitic to medium grained and usually weather a reddish brown colour. The dikes contain phenocrysts of hornblende, which is pleochroic pale brown to very deep red brown, plagioclase (andesine), and augite. Apatite and relict olivine phenocrysts are present in one specimen. The hornblende and augite phenocrysts are resorbed and have oxidized margins. Plagioclase phenocrysts are also resorbed and have potassium feldspar alteration around the margins in some specimens. Sub-spherical miarolitic cavities within the dikes account for up to 10% of the rock and average approximately 0.5 mm in size. The cavities commonly contain a carbonate core which is rimmed by chlorite. Epidote, agate, and possibly zeolite are also present in some rocks. The matrix of the alkaline dikes consists predominantly of plagioclase (40-50%) which occurs as fresh, tabular .2 to .3 mm grains and is andesine in composition. Clinopyroxene (10-20%) is interstitial to the plagioclase. Granular carbonate (5-15%), chlorite and biotite (10%) and minor opaques are present in most rocks.

The alkaline dikes generally show evidence of considerable late magmatic or deuteric alteration.

The tholeiitic diabase dikes are very similar in mineralogy and texture to the diabase sheets which are described in the next section. These dikes contain tabular labradorite (45 to 60%) and subophitic clinopyroxene (30 to 45%) with minor olivine, magnetite, biotite and hornblende. Euhedral tabular plagioclase phenocrysts up to 2.5 cm in length are locally present such as in the dike west of Fletcher Lake.

Intermediate to felsic granophyre dikes are present throughout the map area as dikes averaging 1 to 2 m in width. A granophyre dike crosscuts a diabase sheet 600 m west of D'Alton Lake. The granophyre is readily recognized due to the fine grain size, buff coloured to brick red weathered surface, splintery fracture, and discordant relationships. Most granophyre dikes are porphyritic with sparse quartz and feldspar phenocrysts, generally less than 3 mm in diameter. Locally, miarolitic cavities up to 1 cm in diameter are filled with carbonate and vuggy quartz. In thin section, phenocrysts are seen to consist of highly resorbed and embayed 2-3 mm grains of quartz, and subhedral highly altered grains of plagioclase and potassium feldspar. The matrix of the granophyre usually consists of very fine graphically intergrown quartz and feldspar, with minor chlorite. Most samples are highly oxidized with patches and granules of hematite throughout the matrix. Some dikes contain up to 10% carbonate in the matrix.

Several trachyte dikes are present within the area and are included with the granophyres on the accompanying geological map. These dikes contain approximately 90%, 0.5 mm laths of orthoclase which displays a well defined trachytic texture. Minor sericite, hematite and chlorite are also present. A particularly good example of a trachyte dike is exposed on the small island at the entrance to the bay approximately 3 km west of the southern end of Kellar Island.

On the southeast arm of D'Alton Lake, a medium grained hornblende granite dike believed to be related to the granophyres intrudes the diabase sheet.

Certain dikes exhibit a very well developed ocelli texture. A good example of this type of dike occurs on the eastern shore of Cumaway lake. The dike, which is aphanitic and dark grey in colour, contains 1 to 2 mm light grey aphanitic spherical structures which comprise approximately 60% of the rock. These ocelli display a steeply plunging linear alignment which is presumably due to magma flow during intrusion. Staining of the sample indicates that the ocelli are highly enriched in potassium feldspar relative to the matrix. It is suggested that the ocelli may have formed from a process of immiscibility in the magma which has resulted in the separation of a potassic phase.

MAFIC INTRUSIVE ROCKS

Diabase sheets of the Nipigon Plate are exposed over approximately 10% of the map area. Within the map area, the sheets are discordant and intrude the Early Precambrian (Archean) rocks.

In outcrop, the diabase typically weathers a rusty brown colour and has a dark grey fresh surface. The diabase outcrops have a blocky appearance due to three near perpendicular joint sets, one of which is subhorizontal. No penetrative fabrics were observed in the diabase sheets.

Both upper and lower contacts of diabase sheets were observed at several locations within the map area. The lower contacts are characterized by a chill zone of aphanitic, microporphyritic diabase with polygonal fractures which is approximately 2 to 5 cm thick. This grades upward into a zone of very fine grained diabase approximately 1 m thick which grades into medium grained diabase with ophitic to intersertal textures. Hornblende hornfels contact metamorphism accompanied by the development of 1 cm hornblende porphyroblasts was observed adjacent to the diabase sheet south of Caribou Lake. The upper contacts appear to be more irregular than the lower contacts but are also characterized by a zone of chilled diabase.

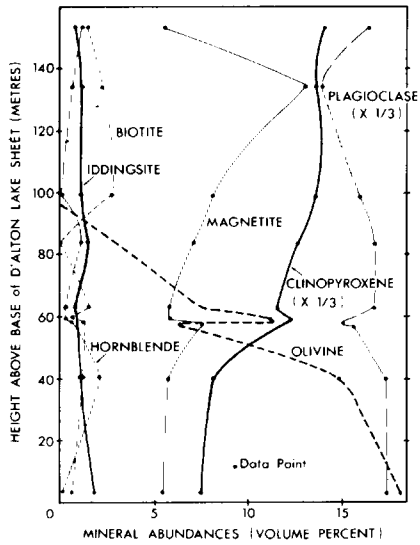


Figure 3: *Variation of modal mineral abundances with height in the D'Alton Lake sheet.*

In thin section, the texture of the diabase varies within individual sheets and also between sheets. Chill zones are characterized by a microporphyritic texture with 0.1 to 0.2 mm plagioclase and olivine phenocrysts in a matrix of very fine grained plagioclase, mafics and opaques. The bulk of the sheets are medium grained with textures that range from ophitic to intersertal. The sheet on Kellar Island is characterized by ophitic textures while the D'Alton Lake sheet has subophitic to intersertal textures. Near the top of the sheets the diabase becomes coarser grained with abundant microgranophyric quartz-feldspar intergrowths and pegmatitic patches with grain sizes in excess of 1 cm. Mineralogy within the sheets is relatively uniform and consists of tabular labradorite, ophitic to anhedral interstitial clinopyroxene, rounded grains of olivine, with minor magnetite, biotite, hornblende, quartz, and apatite.

Kavanagh (1981) has studied in detail the mineralogical variations within a section of the D'Alton Lake sheet. Modal variations observed within the sheet, which is approximately 190 m thick at the studied section, are summarized in Figure 3. Kavanagh's study shows that the sheet is composite and contains an internal chilled contact 36 m above the base. Marked vertical mineralogical changes which occur within the sheet include depletion of forsteritic olivine and enrichment of magnetite, and alkali-feldspar-quartz intergrowths toward the top. The sheet also contains an olivine rich zone 25 m above the internal chilled contact. Kavanagh concluded that the lack of contact metamorphism indicates that the sheet cooled quickly and was rapidly differentiated. Differentiation occurred by fractional crystallization and gravitational settling. The D'Alton Lake sheet is similar in composition, mineralogical variation, and differentiation processes to the Triassic Palisades sill in New Jersey (Walker 1970).

CENOZOIC

QUATERNARY

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

Pleistocene

Following the most recent glaciation, the Wisconsinan stage, ice sheets retreated from the area between 9000 and 9500 years ago (Prest 1970). The ice sheets and subsequent glacial lakes modified the existing surface by erosion of the bedrock and deposition of surficial material. Glacial striae, chatter marks and roches moutonneés indicate that direction of ice movement was approximately south. Pleistocene deposits in the area include glacial, glaciofluvial and glaciolacustrine deposits.

Ground moraine consisting of sandy till is the most widely distributed surficial deposit in the map area. The till forms a thin discontinuous mantle on the bedrock. Thicker till deposits of the Nipigon moraine (Zoltai 1965a) are found in the southernmost part of the map area.

Two eskers were mapped in the area. One extends through the western end of Campbell Lake and was traced for approximately 10 km. The other extends through Beaver and Cove Islands of Caribou Lake and is approximately 6 km long within the map area. The eskers are composed of cobbley to bouldery sand and stand approximately 10 to 15 m above the surrounding land.

The map area lies near the former shoreline of glacial Lake Agassiz as mapped by Zoltai (1965a). Sand deposited by the lake is present in the northern part of the area.

The northern part of the area also contains numerous open areas without vegetation which are underlain by subangular boulders. These boulder fields are often several hundred metres long and are generally linear. Boulder lithologies generally reflect the bedrock in the area. The boulder fields may be beach deposits or alternatively spillway deposits.

Recent

Recent deposits include clay, silt, and sand which are being deposited by creeks and lakes. Organic muds are being deposited in swamps and muskegs.

Geochemistry

Twenty-six samples from the Early Precambrian (Archean) rocks and six samples from the Late Precambrian (Proterozoic) rocks were selected for major and trace element analyses. Analytical results are reported in Tables 2a and 2b.

The majority of the samples (23) were taken from the mafic to ultramafic metavolcanic rocks and this suite of samples defines an approximate north-south cross-section across the supracrustal belt. Additional samples of Early Precambrian rocks include one sample each from the quartz-feldspar porphyry intrusion on Howie Lake, a volcanic conglomerate from Hollingsworth Lake and a hornblende gabbro from the Caribou Lake Pluton. Four samples of the Late Precambrian diabase sill on D'Alton Lake were analyzed for major elements since the petrography of this sill was studied in detail by Kavanagh (1981). One Late Precambrian mafic alkaline dike and one felsic granophyre dike were also analyzed for major elements. Locations of samples selected for chemical analysis are given in Figure 4.

The chemical analyses show that the mafic metavolcanics range in composition from iron-rich tholeiitic basalts to magnesium-rich tholeiitic basalts to komatiitic basalt according to the classification of Jensen (1976) (Figure 5a). No correlation of chemical evolution of the basalts with stratigraphy was discerned from the available data. The data, however, indicate that the basalts from south of Caribou Lake are more magnesium-rich than those north of Caribou Lake, although fields for the two groups of analyses overlap. These data are consistent with the occurrence of peridotitic komatiites south of Caribou Lake associated with magnesium-rich tholeittic and komatiitic basalts. The data further support the interpretation that the volcanic sequences north and south of Caribou Lake are distinct (*see* "Caribou Lake Fault").

Sample 398, a massive basalt from south of Caribou Lake which may possibly be intrusive, has an anomalously high Fe/(Fe+Mg) ratio when compared to other basaltic rocks from the map area. This sample is typical of the massive gabbroic amphibolite found south of Caribou Lake, and of the chemistry of the gabbroic Outlet Bay Pluton and associated mafic dike swarm to the northwest (Sutcliffe 1986). This possibly indicates a genetic relationship between these groups of rocks.

Samples 1111 and 1115 are classified as peridotitic komatiites and are characterized by MgO in excess of 30%, low TiO_2, and low alkalis.

Most of the Early Precambrian rocks which were analyzed show some alteration of primary chemistry to varying degrees. Chemical alteration is particularly evident in sample 603, a metabasalt, which has been spilitized by addition of sodium and depletion of calcium. This was the only metavolcanic rock in which the plagioclase was identified as albite in thin section. Sample 609 is classified chemically as a peridotitic komatiite; however, the high SiO_2 in relation to the MgO content of the rock suggests that it has been silicified.

Four samples (1116, 1117, 1118, 1119) analyzed for major elements from the Late Precambrian diabase sill on D'Alton Lake indicate that the sill has a tholeiitic chemistry. Kavanagh (1981) concluded that the chemistry of the chill zone of the D'Alton Lake sill differed from the original magma of other well documented tholeiitic sills, particularly the Triassic Palisades sill, in lower SiO_2, lower MgO, and higher FeO contents. The D'Alton Lake sill displays upward enrichment of iron and depletion of magnesium (Figure 5b) and varies from olivine normative at the base to quartz normative at the top. Simple upward variation of composition is complicated by the presence of two magma phases, separated by an internal chilled contact within the sill. Kavanagh (1981) considers that the chemical variation is due to fractional crystallization and gravitational settling of early formed crystals. The sample of granophyre (342) is thought to be a final differentiation product of the mafic magma, possibly through liquid immisciblility (Kavanagh 1981).

One sample of a mafic dike from Fuchsite Lake containing augite, hornblende, andesine and altered olivine phenocrysts in an augite and feldspar matrix is alkaline. The rock is nepheline and olivine normative, metaluminus (molecular Al_2O_3/Na_2O+K_2O = 1.7) and has a K_2O/Na_2O ratio of 1.3.

TABLE 2a - ANALYSES OF EARLY PRECAMBRIAN ROCKS - FLETCHER LAKE AREA

WT%	390	398	580	581	582	583	584	586	587	588	589	603	604
SiO_2	48.4	46.8	46.9	47.0	48.4	47.0	48.5	47.3	47.9	49.5	50.2	42.8	50.2
TiO_2	0.94	2.67	0.92	0.63	0.61	0.70	0.62	0.65	0.94	1.02	1.11	2.32	1.44
Al_2O_3	15.4	12.0	16.2	15.7	17.5	17.0	17.3	17.9	16.1	14.5	12.8	18.5	13.2
Fe_2O_3	12.1	22.1	11.8	10.3	9.53	9.46	9.98	9.57	11.2	13.2	11.5	16.0	15.6
MnO	0.17	0.32	0.19	0.15	0.14	0.14	0.19	0.15	0.18	0.27	0.17	0.11	0.23
MgO	8.79	3.95	8.09	8.72	8.53	9.73	8.55	9.13	8.01	7.14	10.3	7.26	6.68
CaO	9.53	8.32	11.0	13.2	11.9	11.3	11.5	10.6	10.4	9.87	8.70	1.61	9.00
Na_2O	2.81	2.23	1.56	1.69	2.11	1.48	2.00	2.34	2.03	2.38	2.62	5.04	1.87
K_2O	0.09	0.69	0.50	0.12	0.11	0.34	0.01	0.09	0.19	0.14	0.51	0.00	0.10
P_2O_5	0.06	0.13	0.07	0.05	0.05	0.05	0.05	0.05	0.07	0.07	0.16	0.16	0.10
CO_2	0.16	0.19	0.23	1.30	0.26	0.15	0.20	0.38	0.27	0.60	0.25	1.38	0.10
S	0.01	0.27	0.04	0.03	0.04	0.05	0.02	0.02	0.06	0.19	0.05	0.48	0.03
LoI	1.6	0.2	1.3	2.3	1.3	2.1	1.2	2.2	1.7	1.5	2.1	5.7	0.9
Total	99.9	99.4	98.5	99.9	100.2	99.3	99.9	99.9	98.7	99.6	100.1	99.5	99.3
Au (ppb)	9	-	2	70	4	40	ND	2	ND	9	2	16	ND
Ba (ppm)	70	-	140	110	100	120	100	90	100	90	240	30	70
Co (ppm)	77	-	47	42	43	44	44	44	42	41	48	62	49
Cr (ppm)	357	-	383	353	400	420	400	400	380	164	480	230	88
Cu (ppm)	6	-	78	50	91	56	27	76	75	94	50	160	135
Li (ppm)	12	-	15	6	6	9	4	10	8	9	11	25	14
Ni (ppm)	148	-	146	165	170	205	173	167	130	82	310	118	50
Zn (ppm)	135	-	120	106	66	78	77	72	89	140	140	170	135

TABLE 2a Continued

WT%	605	606	607	608	610	1113	1114	609	1111	1115	350	1	14
SiO_2	50.7	48.7	51.5	49.5	46.7	49.0	48.6	50.7	37.7	38.6	52.3	76.5	77.2
TiO_2	1.11	0.75	0.83	1.05	0.88	1.01	0.83	0.54	0.24	0.16	1.09	0.21	0.33
Al_2O_3	14.8	14.8	14.7	15.5	15.1	14.6	15.5	5.46	2.81	2.60	1.62	15.6	14.1
Fe_2O_3	12.1	12.6	11.5	12.1	11.8	12.8	11.9	12.1	10.01	7.49	12.5	0.59	1.08
MnO	0.24	0.22	0.21	0.26	0.18	0.23	0.19	0.15	0.07	0.06	0.18	0.01	0.23
MgO	7.11	7.21	8.38	6.15	7.26	6.97	8.57	23.0	33.6	35.0	5.05	0.23	0.00
CaO	8.88	11.8	9.13	9.84	12.8	10.9	11.0	2.82	2.62	2.06	8.85	0.10	0.22
Na_2O	3.39	2.33	3.22	3.39	1.01	2.27	2.17	0.29	0.00	0.00	3.06	3.17	2.08
K_2O	0.07	0.08	0.16	0.11	0.65	0.21	0.31	0.00	0.00	0.00	0.85	3.47	3.00
P_2O_5	0.08	0.05	0.06	0.08	0.06	0.07	0.06	0.04	0.01	0.01	0.07	0.02	0.03
CO_2	0.15	0.43	0.08	0.46	0.12	0.19	0.08	0.11	3.86	3.64	0.11	0.14	0.41
S	0.13	0.05	0.02	0.08	0.02	0.07	0.05	0.21	0.04	0.04	0.03	0.01	0.02
LoI	1.1	1.1	1.1	1.1	1.4	1.1	0.9	4.5	13.0	12.9	0.3	0.6	0.9
Total	99.6	99.6	100.5	99.1	98.4	99.2	100.0	99.6	100.1	98.9	100.4	100.5	99.2
Au (ppb)	7	2	3	2	2	ND	22	ND	2	4	-	-	-
Ba (ppm)	70	120	140	80	240	100	100	20	30	20	-	-	-
Co (ppm)	49	49	48	51	55	47	46	93	80	90	-	-	-
Cr (ppm)	120	297	317	352	350	192	367	2090	2900	2100	-	-	-
Cu (ppm)	38	149	86	106	45	100	200	67	8	12	-	-	-
Li (ppm)	8	5	6	8	18	6	7	22	ND	ND	-	-	-
Ni (ppm)	85	108	105	131	141	92	140	1410	1380	2180	-	-	-
Zn (ppm)	170	97	120	120	71	110	93	170	64	43	-	-	-

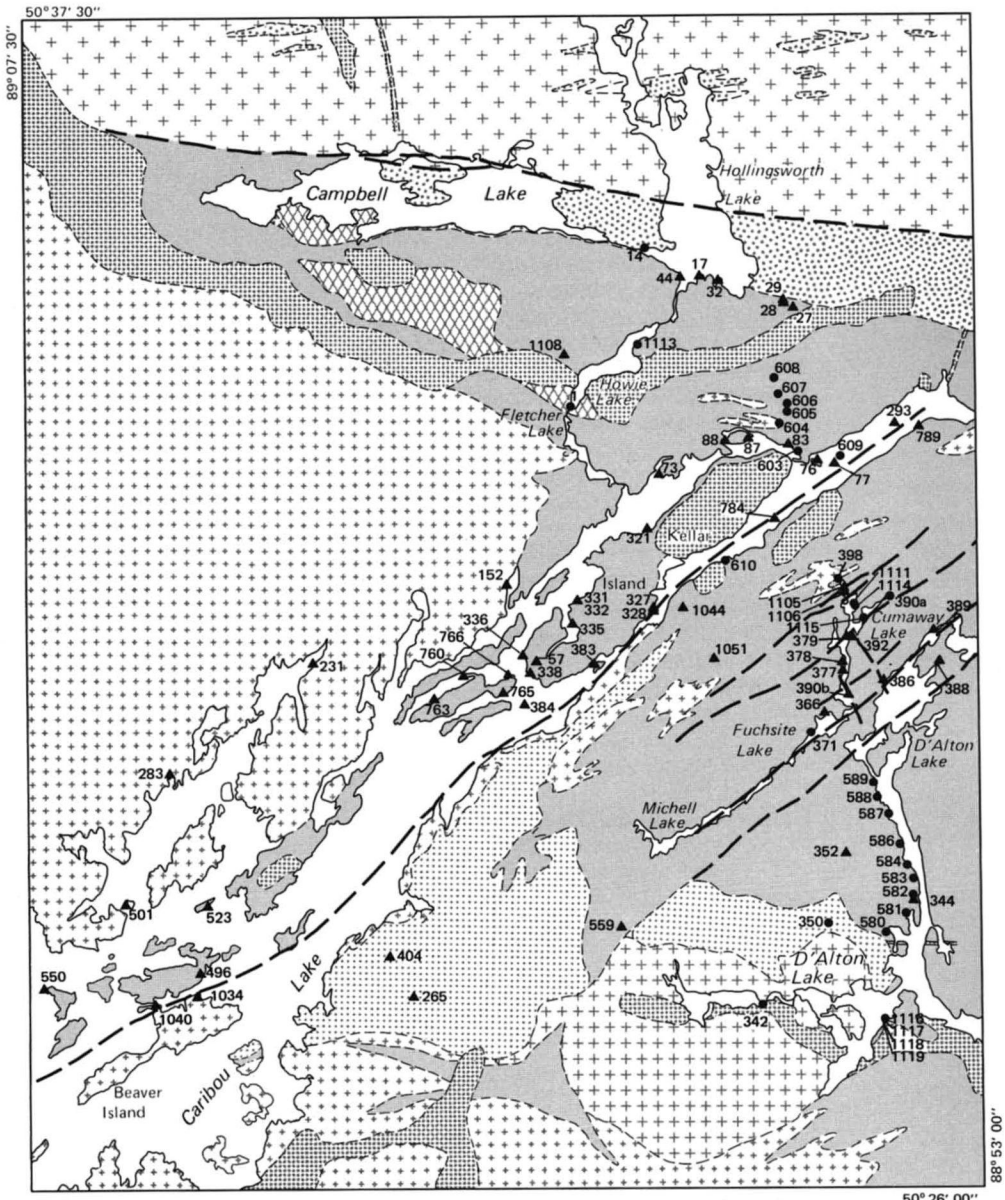
TABLE 2a: Continued	ROCK NAME
390	Massive mafic metavolcanic (Mg-tholeiitic basalt)
398	Massive mafic metavolcanic, possibly intrusive (Fe-tholeiitic basalt)
580	Massive mafic metavolcanic (Mg-tholeiitic basalt)
581	Fine-grained mafic metavolcanic (Mg-tholeiitic basalt)
582	Pillowed mafic metavolcanic (Mg-tholeiitic basalt)
583	Massive mafic metavolcanic (Mg-tholeiitic basalt)
584	Pillowed mafic metavolcanic (Mg-tholeiitic basalt)
586	Massive mafic metavolcanic (Mg-tholeiitic basalt)
587	Pillowed mafic metavolcanic (Mg-tholeiitic basalt)
588	Foliated mafic metavolcanic (Fe-tholeiitic basalt)
589	Fine-grained mafic metavolcanic (komatiitic basalt)
603	Foliated mafic metavolcanic (Fe-tholeiitic basalt)
604	Pillowed mafic metavolcanic (Fe-tholeiitic basalt)
605	Pillowed mafic metavolcanic (Mg-tholeiitic basalt)
606	Pillowed mafic metavolcanic (Mg-tholeiitic basalt)
607	Massive mafic metavolcanic (Mg-tholeiitic basalt)
608	Pillowed mafic metavolcanic (Fe-tholeiitic basalt)
610	Fine-grained, mafic metavolcanic (Mg-tholeiitic basalt)
1113	Pillowed mafic metavolcanic (Mg-tholeiitic basalt)
1114	Massive mafic metavolcanic (Mg-tholeiitic basalt)
609	Foliated metapyroxenite flow (peridotitic komatiite)
1111	Serpentinized periodotite flow (peridotitic komatiite)
1115	Serpentinized periodotite flow (peridotitic komatiite)
350	Hornblende gabbro (calc-alkaline basalt), Caribou Lake Pluton
1	Quartz-feldspar porphyry, (calc-alkaline rhyolite), Howie Lake
14	Volcanic conglomerate, (calc-alkaline rhyolite), Hollingsworth Lake

Jensen (1976) classification in parenthesis

TABLE 2b - ANALYSES OF LATE PRECAMBRIAN ROCKS - FLETCHER LAKE AREA

	1116	1117	1118	1119	342	371
SiO_2	48.5	48.8	47.9	47.9	67.9	46.5
TiO_2	1.50	1.46	1.32	1.79	0.44	1.63
Al_2O_3	15.5	14.8	15.9	15.5	16.4	14.7
FeO	12.07	13.78	12.97	14.32	3.45	9.37
MnO	0.15	0.22	0.20	0.22	0.04	0.13
MgO	5.61	6.42	6.91	5.97	0.80	6.77
CaO	10.8	10.0	9.87	9.77	1.33	7.31
Na_2O	3.30	2.37	2.27	2.26	3.44	2.77
K_2O	0.22	0.10	0.32	0.40	4.19	3.70
P_2O_5	0.14	0.15	0.14	0.15	0.06	0.59
CO_2	0.23	0.08	0.11	0.10	0.17	1.38
S	0.02	0.02	0.01	0.01	0.01	0.06
Lol	0.7	0.0	0.0	0.0	1.0	4.4
Total	98.7	98.2	97.9	98.4	99.2	99.3

1116 Basal chilled diabase, D'Alton Lake Sheet (Sample H of Kavanagh 1981).
1117 Diabase, D'Alton Lake Sheet (Sample J of Kavanagh 1981), top of lower phase of sill.
1118 Diabase, D'Alton Lake Sheet (Sample N of Kavanagh 1981), base of upper phase of sill.
1119 Magnetite rich diabase, D'Alton Lake Sheet (Sample S of Kavanagh 1981), top of upper phase of sill.
342 Granophyre intrusive into diabase, D'Alton Lake Sheet (Sample B of Kavanagh 1981).
371 Alkaline mafic dike, Fuchsite Lake.



PRECAMBRIAN

Late Precambrian (Proterozoic)

- Mafic Intrusive Rocks

Early Precambrian (Archean)

- Migmatites - English River Subprovince
- Late Felsic to Intermediate Intrusive Rocks - Wabigoon Subprovince
- Mafic Plutonic Rocks
- Early Felsic to Intermediate Plutonic Rocks
- Metamorphosed Subvolcanic to Volcanic Felsic Rocks
- Metasediments
- Metavolcanics
- Geological contact
- Fault
- 17▲ Assay location with number
- 350● Chemical analysis location with number

Figure 4: *Location of chemical analyses and assay samples from the Fletcher Lake Area.*

Figure 5a

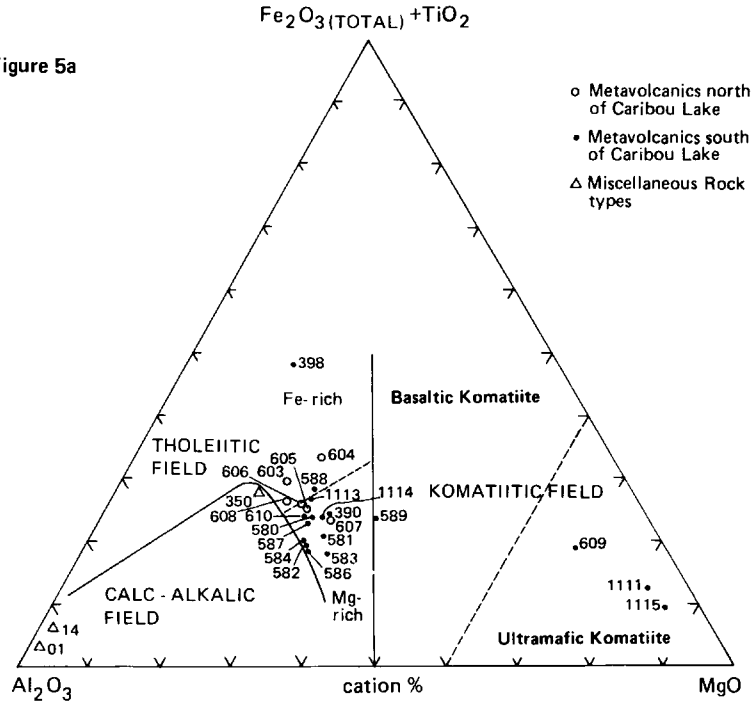


Figure 5b

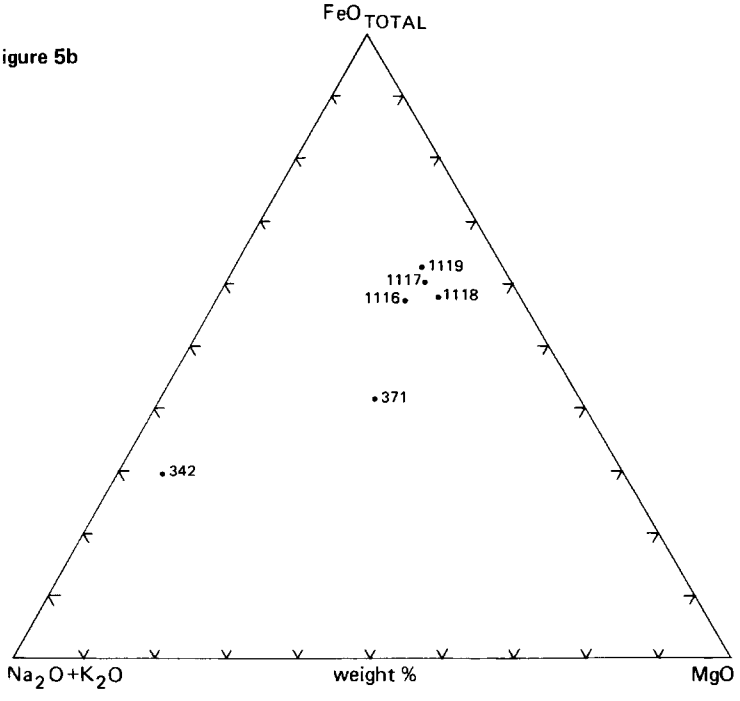


Figure 5a: *Al_2O_3-$Fe_2O_3+TiO_2$-MgO plot (Jensen 1976) for Early Precambrian (Archean) rocks.*

Figure 5b: *Na_2O+K_2O-FeO-MgO plot for Late Precambrian (Proterozoic) rocks of the Fletcher Lake Area.*

Metamorphism

Supracrustal rocks within the map area have undergone regional metamorphism. Local zones of superimposed contact metamorphism can also be locally recognized, however, these two metamorphic types are probably interrelated. Rocks within the map area have mineral assemblages indicative of low, medium and high metamorphic grades (Figure 6) as defined by Winkler (1976, p.234-251).

Mafic metavolcanics exhibit low grade (greenschist) metamorphic assemblages in the vicinity of D'Alton Lake and north of Kellar Island. Assemblages developed in this zone only rarely contain albite and the zone is defined primarily by the occurrence of actinolite. The plagioclase compositions appear to be andesine and may be relict. Rare occurrences of albite + chlorite + epidote assemblages appear to be restricted to altered metavolcanics.

The appearance of hornblende as the dominant amphibole within mafic metavolcanics is considered by Winkler (1976) to occur near the transition from low to medium grade, and therefore has been used to define the medium grade metamorphic zone in the area. Ultramafic rocks within the medium grade zone, however, commonly contain predominantly serpentine + talc + chlorite assemblages which are considered by (Winkler 1976) to be essentially low grade.

High grade metamorphism has affected metasedimentary rafts within the diatexitic granitoids north of the Pashkokogan Lake Fault Zone. High grade metamorphism is inferred by the interpretation of anatexis within these metasediments. The assemblage sillimanite + biotite + quartz + oligoclase + muscovite is present within pelitic rocks in the zone. The presence of muscovite appears to be anomalous and it may be secondary since the disappearance of muscovite in this assemblage should coincide with the beginning of partial melting.

A zone of pyroxene-hornfels contact metamorphism as defined by Turner (1968) occurs adjacent to the Caribou Lake Pluton. Metavolcanic rocks in this zone are commonly fine grained and massive and have a distinct dark greenish colour. The mineral assemblage orthopyroxene + clinopyroxene + andesine was identified in thin sections from these rocks.

In general, metamorphic grade within the area increases towards major plutonic bodies. Metamorphic grade also appears to increase toward the English River Subprovince.

Minor Late Precambrian (Proterozoic) contact metamorphic effects were observed to be associated with the diabase sheets. The mafic metavolcanics lying within a few centimetres of the base of the sheet south of Kellar Island contain 1 cm hornblende porphyroblasts in a matrix of very fine massive amphibolite. This is considered to indicate hornblende hornfels contact metamorphism.

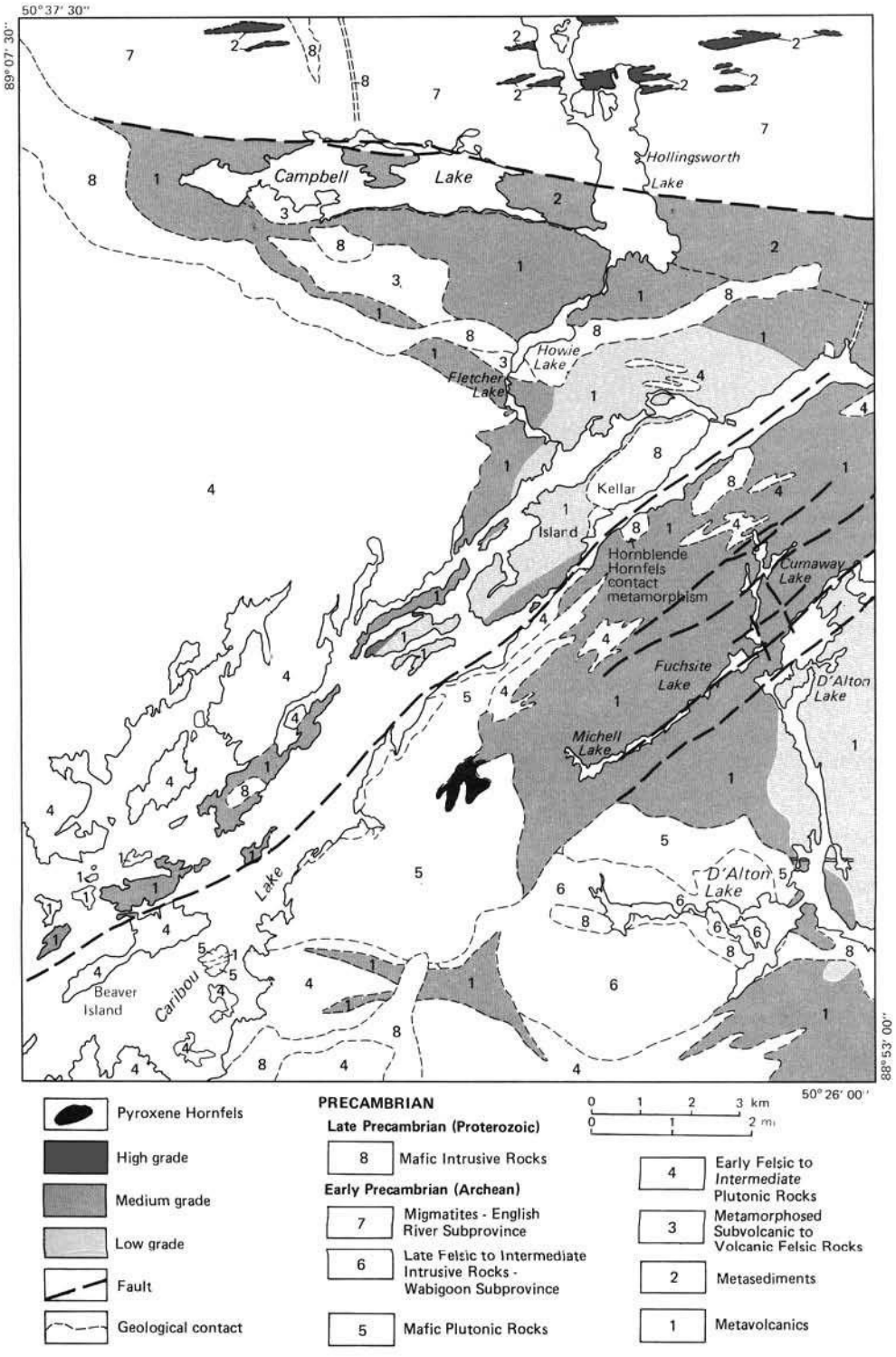


Figure 6: *Distribution of metamorphic zones in the Fletcher Lake Area.*

Structural Geology

MAJOR FOLDS AND FACING DIRECTIONS

North of Caribou Lake the Fletcher Lake Anticline (Figure 7) dominates the structure of the metavolcanic rocks. The anticline extends from the eastern contact of the tonalite through to Kellar Island. North of the anticline several determinations of flow tops from pillows indicate a north facing sequence, while limited data indicate that the metavolcanics between Fletcher and Caribou Lakes are south facing. Extrapolation of the axial trace of the anticline east to Kellar Island is largely based on the attitudes of the schistosity, with which the axial trace of the fold is assumed to be subparallel. Attitudes of bedding within the ironstone unit east of Fletcher Lake indicate that the fold plunges steeply east. Lineations within the metavolcanics in Kellar Bay apparently contradict the easterly plunge; however, these lineations may be associated with the Caribou Lake Fault.

Two south facing flow tops in an otherwise north facing sequence west of Howie Lake indicate a minor syncline and anticline in this region. These minor folds do not appear to persist east of Howie Lake where a consistently north facing sequence is indicated by flow tops.

Along the center of Caribou Lake in the vicinity of the southern end of Kellar Island, the metavolcanics have been folded isoclinally. The syncline and anticline are indicated by the morphology of the islands, minor folds and foliation, and lineation patterns. No facing directions were determined in the zone to support this interpretation. However, unpublished aeromagnetic data (New Jersey Zinc Exploration Company (Canada) Limited) indicates that the sulphide ironstone outcrops at the southwest end of Kellar Island are part of a continuous unit folded into an "S" shaped structure. The noses of the structure are coincident with the inferred syncline and anticline. The schistosity within the area appears to be axial planar and indicates that the folds are overturned with axial planes that dip at approximately 50° to the southeast.

The northeast trending Caribou Lake Fault appears to truncate structures developed north of the fault from those south of the fault.

South of Caribou Lake the metavolcanics strike at approximately N60E. Within the zone from Caribou Lake to D'Alton Lake no top directions could be obtained from the mafic metavolcanics. However, spinifex and polysuturing indicate that the ultramafic metavolcanics on Cumaway Lake face south. South facing pillow tops were also found on the northern part of D'Alton Lake.

In the vicinity of D'Alton Lake, facing directions indicate a broad anticline flanked by two synclines. The anticline plunges east away from the pluton. Although pillows are relatively well preserved in the vicinity of D'Alton Lake, difficulty was encountered in determining reliable facing directions. This may possibly be due to relatively flat lying strata in this area, a hypothesis supported by the shallow dipping chert-ironstone unit encountered between the pluton and the lake. The two flanking synclines, through the northern and southern ends of D'Alton Lake, appear to coincide with the tongues of metavolcanic rocks which extend into the plutonic terrain.

FAULTS

Pashkokogan Lake Fault Zone

On a regional scale, the most prominent fault within the map area is the east trending fault zone which extends through Campbell and Hollingsworth Lakes. This fault, named the Pashkokogan Lake Fault Zone, coincides with the Wabigoon-English River Subprovinces boundary within the map area. To the west, however, the fault crosses the English River Subprovince and in the vicinity of Pashkokogan Lake is coincident with the English River-Uchi Subprovinces boundary. The fault was initially named the Pashkokogan Lake-Kenoji Lake Fault Zone (Sage *et al.* 1974) but subsequently has been referred to as the Pashkokogan Lake Fault Zone (Breaks *et al.* 1977).

The fault follows a relatively narrow, well defined zone through Campbell Lake to Hollingsworth Lake, but from Hollingsworth Lake to the eastern boundary of the

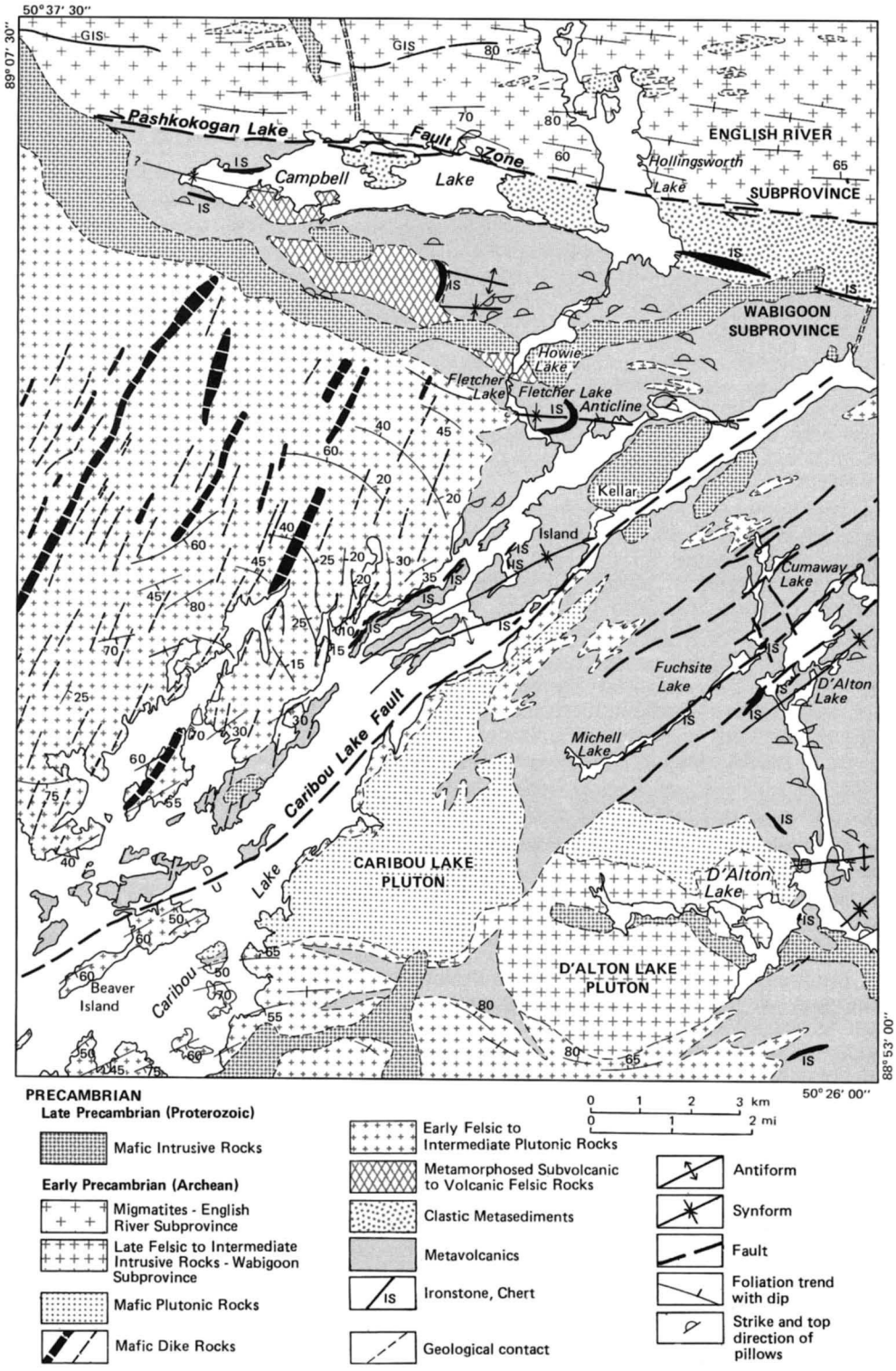


Figure 7: *Generalized geology and structure of the Fletcher Lake Area.*

map area it becomes less definite. Possibly, in this zone the cataclastic effects of the fault zone are dissipated by shearing of the metasediments.

A predominance of "Z" minor folds indicates a dextral movement along the zone. Where present, mineral lineations in the zone are subhorizontal suggesting that the fault has predominantly strike-slip displacement.

Caribou Lake Fault

The Caribou Lake Fault extends diagonally across the map area through Caribou Lake trending at approximately N60E. No trace of the fault was recognized to the west (Sutcliffe 1986) or at the eastern boundary of the present map area.

The fault has been recognized on the basis of: the prominent lineament along Caribou Lake; alteration and fracturing of metavolcanic rocks; and mylonitization of granitoid rocks along the zone. Minor folds associated with the fault are particularly well developed in the vicinity of Beaver Island. Here the folds predominantly plunge 30° to 45° southwest and suggest that the fault is a southeast dipping reverse fault with a dextral strike-slip component. Similar structures developed elsewhere along the zone generally support this interpretation. The indication that the southern block has moved up is consistent with a higher metamorphic grade in the south.

The Caribou Lake Fault is believed to represent a fundamental structural discontinuity within the map area. In the northern block, folds and the mafic dike swarm are truncated by the fault, however, in the southern block the structure parallels the fault. A tentative hypothesis is that the southern block is in part younger than the northern block and that the massive mafic volcanics south of Caribou Lake may be coeval with the mafic dike swarm in the north.

The reverse fault geometry of the Caribou Lake Fault suggests an association with thrusting. The 45° to 50° dip of the Caribou Lake Fault is intermediate between high angle reverse faults and thrusts (low angle reverse faults).

Faults in the Vicinity of Cumaway and Fuchsite Lakes

In the area of Cumaway and Fuchsite Lakes, two sets of intersecting faults were mapped. The most prominent set of faults trends at N60E parallel to the strike of the metavolcanics. The other trends at N20W.

The fault set at N60E has been recognized primarily on a basis of prominent lineaments along which shearing of the metavolcanics has occurred. Fault breccia associated with the faults occurs at several locations on Cumaway Lake and along the southern shore of Fuchsite Lake.

Shearing along these strike faults indicates that they dip at approximately 45° southeast. At the Lett Occurrence numerous well developed slickensides developed on quartz covered surfaces of sheared tonalite indicate that the fault here has a predominantly dip-slip movement, although the relative displacement could not be determined. The strike, dip and dip slip of these faults appears to be the same as the Caribou Lake Fault which is possibly a reverse fault. Therefore, a similar movement may be implied for the N60E trending faults on Cumaway Lake.

It is possible that these faults may have caused repetition of the ironstone and ultramafic metavolcanic units in the vicinity of Cumaway, Michell and Fuchsite Lakes.

The set of faults trending at approximately N20W is less well developed. This set is recognized on a basis of airphoto lineaments along which fracturing of the mafic metavolcanics has occurred. The fractures which are spaced several centimetres apart dip approximately 45° W and do not impart a penetrative fabric in the host rocks. On the southeastern shore of Cumaway Lake the fractures have resulted in a dextral offset of quartz veins in mafic metavolcanics. Diabase and granophyre dikes on Cumaway Lake trend parallel to the N20W fractures and suggest that these faults may have been active in the Late Precambrian (Proterozoic).

Silicification, carbonatization, and epidote alteration of mafic metavolcanics is particularly well developed on Cumaway Lake and appear to be related to both sets of faults.

STRUCTURE OF THE EARLY PRECAMBRIAN (ARCHEAN) INTRUSIVE ROCKS OF THE WABIGOON SUBPROVINCE

Rocks of the early plutonic suite have fabrics which range from massive to gneissic. Foliated rocks with recrystallized textures predominate. The fabric of the suite is generally conformable with the supracrustal rocks. North of Caribou Lake, the fabric of the suite appears to relate to deformation during emplacement. South of Caribou Lake, the origin of gneissic textures is not certain. At least two phases of tonalitic magmatism appear to have occurred. The first phase is intruded by amphibolite and gabbro dikes north of Caribou Lake, while the second phase intrudes the gabbro south of Caribou Lake. The conclusion that two ages of tonalite magmatism have occurred is largely based on the correlation of the mafic dike swarm with the Caribou Lake Pluton. This correlation appears probable since the Caribou Lake Pluton is very similar to both the mafic dike rocks and the Outlet Bay Pluton. Additional evidence for two significantly different ages of tonalite comes from the occurrence of massive to foliated tonalite crosscutting gneissic tonalite south of the Caribou Lake Fault.

The extensive swarm of amphibolite and gabbro dikes which discordantly invade the Archean tonalitic and metavolcanic rocks north of the Caribou Lake Fault is a unique feature within the Wabigoon Subprovince. Similar swarms however, have been reported in the Slave Province by Baragar and McGlynn (1976) who relate the dikes to Archean mafic volcanic rocks unconformably overlying a granitoid basement. No simple relationship can be demonstrated in the present area however, since the dikes also crosscut the mafic metavolcanics along Caribou Lake and the tonalite is apparently intrusive into these metavolcanics. It is possible the dikes were subvolcanic feeders for high-iron tholeiitic volcanics at a higher level in the stratigraphy. The massive volcanics south of the Caribou Lake Fault are possible candidates for being extrusive equivalents of the dikes.

The linear nature and parallelism of the dike swarm indicates that the dikes have been emplaced into a stabilized crust. This suggests that the tonalitic rocks north of Caribou Lake represent relatively old crustal material.

Gabbroic rocks of the Caribou Lake Pluton are generally massive except near the southwestern end of the pluton where the rocks are foliated and recrystallized. The pluton appears to have been passively emplaced into the mafic metavolcanics. Very little deformation has occurred along the gabbro-mafic metavolcanic contact which locally appears to be gradational.

RELATIONSHIP BETWEEN THE WABIGOON AND ENGLISH RIVER SUBPROVINCES

In the map area the subprovince boundary is marked by a strongly deformed to locally mylonitized zone of faulting. The fault separates highly deformed metaconglomerates of the Wabigoon Subprovince from diatexitic granitoids and migmatized metasediments of the English River Subprovince. The fault zone is therefore coincident with an abrupt lithological and metamorphic transition.

The relationship of the rock types in the zone, however, suggests a stratigraphic linkage between the two subprovinces. The metaconglomerate of the Wabigoon Subprovince appears to be a proximal equivalent of the wacke and pelite turbidite-type sequence observed in the English River. A link between the two rock types possibly occurs on Campbell Lake where paraconglomerate, consisting of granitoid clasts in a wacke matrix, and local gradations from pebble conglomerate to wacke occur.

This sequence, although highly deformed in the present area, appears to be comparable to a well preserved conglomerate to wacke facies change observed in the Elwood, Neverfreeze and Savant Lakes area to the west (Trowell *et al.* 1977) which also lies at the subprovince boundary.

In the Fletcher Lake Area, north facing pillows within a kilometre of the contact suggest that the metasedimentary sequence overlies the metavolcanic sequence. However, clasts in the metaconglomerate cannot be related to the underlying sequence and therefore the relationship between the metasediments and volcanic-plutonic terrain to the south remains uncertain.

STRUCTURE OF THE LATE PRECAMBRIAN (PROTEROZOIC) INTRUSIVE ROCKS

The diabase sheets in the map area do not occur simply as outliers of a once larger continuous sheet. Most of the intrusions in the area are discordant to the Early Precambrian (Archean) rocks and both upper and lower contacts are exposed. The intrusions vary in form and their shapes include (Figure 8):

(1) Tabular sheets with parallel strikes and moderately steep dips (Howie Lake Sheet).

(2) Shallow basin-like sheets which have had the upper contact removed by erosion (Kellar Island Sheet).

(3) Lopsided funnel shaped structures with steep dips on one side and shallow dips on the other (D'Alton Lake Sheet).

Factors controlling the emplacement of these sheets and the development of these forms have not been determined.

Late Precambrian (Proterozoic) dikes in the area do not exhibit a strong preferred orientation (Figure 8). This fact is somewhat puzzling since in the adjacent Funger Lake Area (Sutcliffe 1986) the large diabase dikes all strike at approximately N20E and several smaller dikes strike at approximately N30W. Furthermore, it has been proposed that the Nipigon plate is a graben or half graben (Card *et al.* 1972). A fracture system reflecting this structure might be expected to produce an approximately north-south alignment to the dikes in the Fletcher Lake Area.

Although the structure of the Late Precambrian rocks is not readily related to the development of a graben structure and continental rift system, the evolution of the rocks appears to be more consistent with this hypothesis. Biotite-olivine lamprophyres and alkaline mafic rocks are commonly associated with regions of rifting (Hyndman 1972, p.197). The tholeiitic dikes and sheets may represent a later stage of magmatism associated with this environment. The granophyres are probably the last stage of magmatism and derived from the diabase sheets by differentiation.

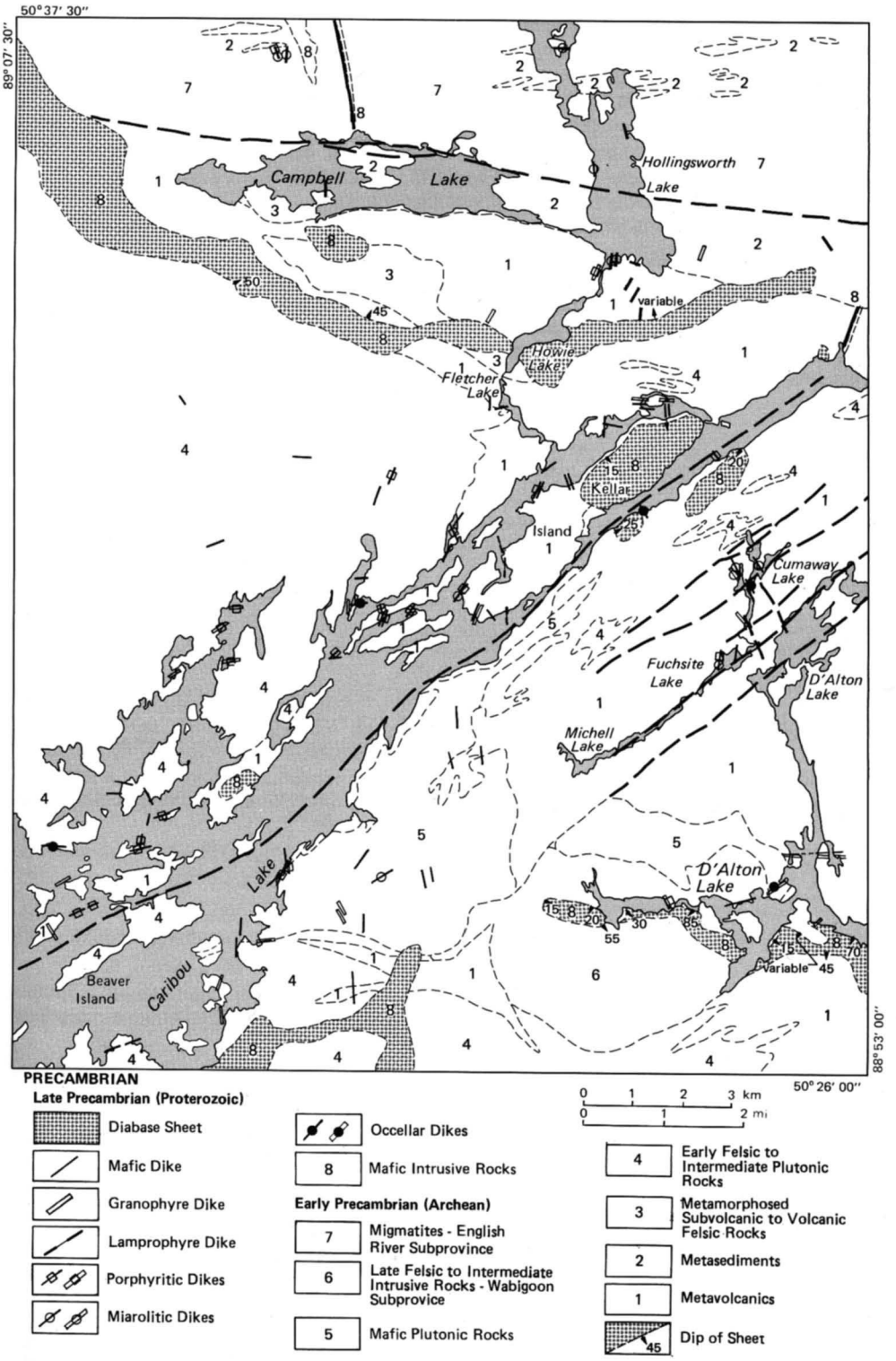


Figure 8: *Structure and distribution of Late Precambrian (Proterozoic) rocks in the Fletcher Lake Area.*

Correlation of Geology to Geophysical Data

The map area is covered by airborne magnetometer surveys flown in 1956-1960 and 1962 for the former Ontario Department of Mines, and the Geological Survey of Canada. The aeromagnetic maps (ODM-GSC 1960a; 1960b; 1962a; 1962b) provide a basis for the correlation of geology with magnetic data over the map area. In addition, the supracrustal rocks within the map area are covered by airborne magnetic and electromagnetic surveys flown in 1980. The resulting maps (OGS 1980) enable more detailed interpretations to be made, especially within the supracrustal rocks.

Correlations are discernable between the magnetic total field intensity and pattern and some of the lithologic units. Areas underlain by granitoid rocks are characterized by intermediate magnetic intensity (60 500 to 61 000 gammas) and generally widely spaced contour lines. The gabbroic Caribou Lake Pluton is characterized by generally high magnetic intensity (61 000 to 62 000 gammas) with steep magnetic gradients. Areas underlain by diabase sills have weak relative magnetic intensities (60 000 to 60 500 gammas) and correlate with magnetic depressions. Mafic metavolcanic rocks are characterized by intermediate magnetic intensities (60 500 to 61 000 gammas) but have highly variable magnetic gradients. Magnetite ironstone-chert formations appear as linear zones of high magnetic intensity (greater than 61 500 gammas).

On the detailed aeromagnetic maps, regions underlain by ultramafic rocks in the vicinity of Cumaway and Michell Lakes are characterized by higher magnetic intensities (60 600 to 61 000 gammas) than the surrounding mafic metavolcanics. The Pashkokogan Lake Fault Zone, Caribou Lake Fault and some faults near Cumaway and Fuchsite Lakes appear as magnetic discontinuities. Fold structures on D'Alton Lake also seem to be supported by the magnetic data.

The airborne electromagnetic data indicates numerous strong anomalies in the following areas:

(1) Along the metavolcanic-metasedimentary contact near Hollingsworth Lake, coincident with sulphide mineralization in the zone,

(2) Along the tonalite-metavolcanic contact west of Fletcher Lake in the vicinity of the Fletcher Lake Occurrence,

(3) At the west end of Campbell Lake,

(4) In the vicinity of the northern end of D'Alton Lake where anomalies are coincident with faulting and zones of sulphide ironstone.

Smaller clusters of anomalies are also associated with zones of sulphide mineralization such as at the Fayolle Occurrence; the Pollard Occurrence; sulphide ironstones near Kellar Island; and the Glenora Occurrence.

Economic Geology

Sporadic prospecting for gold prior to 1939 is reported to have taken place in the Caribou Lake area (Gussow 1942). Most of this work was done in the vicinity of the southwestern end of Kellar Island, Caribou Lake, where gold and copper mineralization was reported (Gussow 1942). The mineralization is associated with quartz and quartz-carbonate veins in sheared and carbonatized mafic metavolcanics. During the field season, numerous pits and trenches, which presumably date back to this period, were observed in the vicinity of Kellar Island.

From the early 1950s to 1971, the primary interest in the area had been base metals. Copper, lead, and zinc mineralization occur at several localities within the area. In addition, numerous zones of massive pyrrhotite and pyrite mineralization occurring within the metavolcanic sequence have been explored. Oxide facies ironstone in the northeastern part of the area has also been a focus of prospecting activity. Most of the available assessment data for the area pertains to this period of exploration.

During 1979 and 1980, there was renewed interest in the area, and this has lead to regional geological exploration programs for both gold and base metals. At the end of 1980, approximately 350 claims were held within the map area, but at the time of writing no work had been reported for assessment credits from the related activity.

Assessment data discussed in this report is available at the Assessment Files Research Office, Ontario Geological Survey, Toronto, or at the Resident Geologist Office, Ministry of Northern Development and Mines, Thunder Bay.

During the field season, 59 samples were collected for assays. Most of these samples were taken from zones of sulphide mineralization or quartz veins for which no data were previously available. Most samples with visible sulphide mineralization were analyzed for Au, Ag, Cu, Pb, Zn. Quartz veins were generally analyzed for Au and also for As to test possible correlations between the abundances of As and Au. Sulphide ironstones were also analyzed for Co. Sample locations are shown in Figure 4 and the assay results summarized in Table 3. In addition, most rocks analyzed for major elements were also analyzed for Au (Table 2).

Assay data that relate to specific occurrences are discussed in the following sections. The data indicate:

(1) Arsenic does not appear to correlate with gold in the quartz veins.

(2) Quartz veins with the highest concentrations of gold are generally found in the Kellar Island and Cumaway Lake areas.

(3) Sulphides with highest base metal concentrations, apart from known showings, occur south of Hollingsworth Lake near the metavolcanic-metasedimentary contact.

DESCRIPTION OF PROPERTIES AND EXPLORATION

(1) ESSO MINERALS CANADA LIMITED (KELLAR ISLAND PROSPECT)

The Kellar Island Prospect is located at the southwest end of Kellar Island, Caribou Lake and is centered on gold and chalcopyrite mineralization in quartz-carbonate veins in altered mafic metavolcanics.

The property was held by Central Manitoba Mines Limited in 1956 and during that year the company conducted ground magnetic and EM surveys and trenching. The geophysical surveys delineated several zones of ironstone in the area. During 1956 and 1957 Central Manitoba Mines Limited drilled 14 diamond drill holes (1287 m total). Four holes were drilled in the main gold-copper showing and additional holes tested quartz-carbonate veins and zones of ironstone in the adjacent area. Chalcopyrite mineralization is reported in the drill logs at the main showing. No further work was reported. In 1980 the property was held by Esso Minerals Canada Limited.

During 1980, the main showing was mapped by the field party at a scale of 1:600 (1 inch to 50 feet) (Figure 9). The host rocks are mafic metavolcanics which

TABLE 3: ASSAYS OF GRAB SAMPLES - FLETCHER LAKE AREA

Sample	Type	Material	Au	Ag	As	Cu	Pb	Zn	Co
17	Selected Grab	Massive sulphide	tr oz/ton	tr oz/ton	--	790 ppm	10 ppm	2680 ppm	--
27	Grab	Amphibolite, sulphides	tr oz/ton	tr oz/ton	--	410 ppm	n.d.	200 ppm	--
28	Selected Grab	Sulphide gossan	tr oz/ton	tr oz/ton	--	180 ppm	n.d.	52 ppm	
29	Selected Grab	Massive sulphide	tr oz/ton	tr oz/ton	--	140 pppm	n.d.	41 ppm	--
32	Selected Grab	Massive sulphide	tr oz/ton	tr oz/ton	--	860 ppm	10 ppm	1180 ppm	--
49	Selected Grab	Massive sulphide	tr oz/ton	tr oz/ton	--	790 ppm	10 ppm	2680 ppm	--
57	Selected Grab	Quartz vein, sulphides	0.41 oz.ton	--	1 ppm	1.52%	--	--	--
73	Grab	Quartz vein	5 ppb	--	5 ppm	--	--	--	--
76	Selected Grab	Massive sulphide	0.01 oz/ton	tr oz/ton	--	745 ppm	n.d.	34 ppm	--
77	Grab	Quartz vein	13 ppb	--	6 ppm	--	--	--	--
83	Grab	Quartz-carb. vein	n.d.	--	1 ppm	--	--	--	--
87	Grab	Quartz-carb. vein	n.d.	--	2 ppm	--	--	--	--
88	Grab	Metavolcanic, sulphides	tr oz/ton	tr oz/ton	--	57 ppm	n.d.	242 ppm	--
152*	Grab	Diabase, sulphides	--	--	--	21 ppm	--	--	--
231	Grab	Quartz vein	5 ppb	--	n.d.	--	--	--	--
265	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
283	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
293	Grab	Quartz vein	5 ppb	--	13 ppm	--	--	--	--
321	Grab	Quartz vein	7 ppb	--	4 ppm	--	--	--	--
327	Grab	Quartz vein	10 ppb	--	2 ppm	52 ppm	--	--	--
328	Grab	Altered metavolcanic	22 ppb	--	1 ppm	--	--	--	--
331	Grab	Quartz vein	2 ppb	--	3 ppm	--	--	--	--
332	Selected Grab	Massive sulphide	0.04 oz/ton	--	--	--	--	--	--
335	Selected Grab	Massive sulphide	--	--	--	54 ppm	n.d.	17 ppm	88 ppm
336	Grab	Quartz vein	2 ppb	--	n.d.	--	--	--	--
338	Grab	Quartz vein, sulphides	50 ppb	--	n.d.	314 ppm	--	--	--
344	Grab	Quartz vein	n.d.	--	1 ppm	--	--	--	--
352	Grab	Quartz vein	6 ppb	--	1 ppm	--	--	--	--
366	Grab	Quartz vein	8 ppb	--	1 ppm	--	--	--	--
377	Grab	Quartz vein	12 ppb	--	2 ppm	--	--	--	--

TABLE 3: Continued

Sample	Type	Material	Au	Ag	As	Cu	Pb	Zn	Co
378	Grab	Quartz vein	34 ppb	--	1 ppm	--	--	--	--
379	Grab	Altered metavolcanic	3 ppb	--	3 ppm	--	--	--	--
383	Selected Grab	Massive sulphide	tr oz/ton	--	--	61 ppm	10 ppm	20 ppm	62 ppm
384	Grab	Quartz vein	<2 ppb	--	2 ppm	--	--	--	--
386	Grab	Chert, sulphides	21 ppb	--	9 ppm	--	--	--	--
388	Selected grab	Massive sulphide	tr oz/ton	--	--	340 ppm	n.d.	15 ppm	160 ppm
389	Grab	Quartz veins	14 ppb	--	8 ppm	--	--	--	--
390	Grab	Quartz vein	33 ppb	--	7 ppm	--	--	--	--
392	Grab	Quartz vein	14 ppb	--	1 ppm	--	--	--	--
404	Grab	Quartz vein	2 ppb	--	2 ppm	--	--	--	--
501	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
523	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
550	Grab	Quartz vein	36 ppb	--	1 ppm	--	--	--	--
559	Selected grab	Amphibolite, sulphides	tr oz/ton	tr oz/ton	--	42 ppm	n.d.	207 ppm	--
760	Grab	Quartz vein	8 ppb	--	1 ppm	--	--	--	--
763	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
765	Grab	Quartz vein	2 ppb	--	n.d.	--	--	--	--
766	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
784	Grab	Quartz vein	2 ppb	--	3 ppm	--	--	--	--
789	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
1034	Grab	Quartz vein	n.d.	--	n.d.	--	--	--	--
1040	Grab	Ironstone, sulphides	0.01 oz/ton	tr oz/ton	--	790 ppm	12 ppm	153 ppm	--
1044	Selected grab	Amphibolite, sulphides	0.01 oz/ton	0.13 oz/ton	--	430 ppm	n.d.	46 ppm	--
1051	Grab	Quartz vein	15 ppb	--	1 ppm	--	--	--	--
1105	Selected Grab	Sulphide breccia	0.05 oz/ton	12.03 oz/ton	--	2.00%	2.10%	11.05%	--
1106	Grab	Quartz vein	0.04 oz/ton	0.46 oz/ton	--	7300 ppm	250 ppm	1500 ppm	--
1108	Selected Grab	Massive sulphide	tr oz/ton	0.24 oz/ton	--	54 ppm	14 ppm	119 ppm	--

nd - not detected tr - Au <.01 oz/ton
-- - not determined - Ag <.10 oz/ton

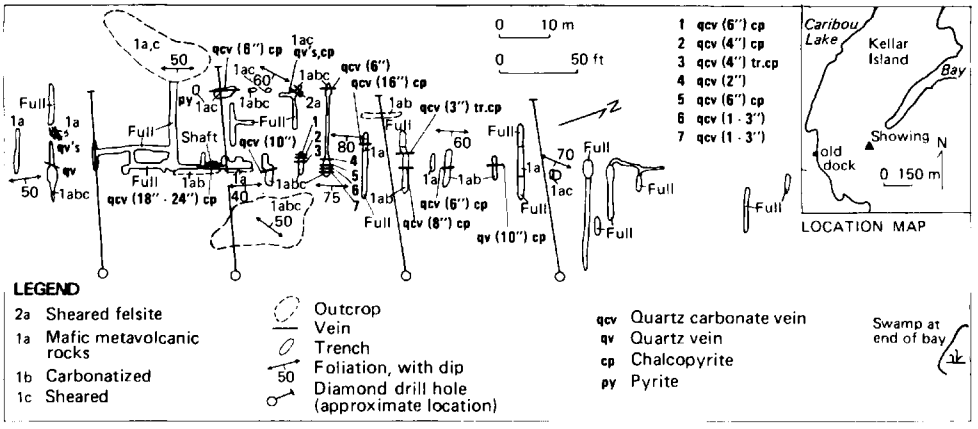


Figure 9: Plan of the Kellar Island Prospect (1). Location and outline of trenches from an unpublished map by R.A. Riley (1969).

are transitional from amphibolite to greenschist facies metamorphic rank. The rocks have a foliated to schistose fabric which generally trends at N15E to N25E and dips steeply east. Carbonate alteration is widespread, particularly in the sheared rocks. Minor units of talc carbonate schist were observed along strike from the showing on the southwest shore of Kellar Island.

Chalcopyrite mineralization is restricted to quartz-carbonate veins which range in thickness from less than 2 cm to approximately 0.7 m and trend parallel to the foliation. The veins contain from 0 to 50% coarse grained carbonate which weathers red and has a buff fresh surface. The chalcopyrite is present in most of the veins and varies from a trace to 20%. It occurs as disseminated grains to irregular patches up to 2 cm in diameter. No other sulphide minerals were detected by the author with the exception of minor pyrite in the metavolcanic rocks.

The main zone of mineralization is about 3 m wide and can be traced for approximately 50 m parallel to strike. Individual veins appear to be discontinuous. The veins and mineralization appear to be hydrothermal in origin and structurally controlled along the axis of a synclinal fold.

A selected grab sample (sample 57) of the main quartz vein with approximately 15% chalcopyrite yielded 0.41 oz/ton Au, 1 ppm As, and 1.52% Cu (Geoscience Laboratories, Ontario Geological Survey, Toronto).

(2) FORBES, J.H. (LETT OCCURRENCE)

The Lett Occurrence consists of base and precious metal mineralization associated with a fault breccia near the north end of Cumaway Lake. Noranda Mines Limited optioned the property from S.M. Lett in 1956 and conducted ground EM-magnetic surveys and reconnaissance geological mapping over the area. No further signifi-

cant mineralization was discovered. In 1966 and 1967, the Algoma Steel Corporation Limited drilled five diamond drill holes (99 m) in the zone and intersected chalcopyrite, sphalerite and galena mineralization. The property was briefly re-examined by Triton Explorations Limited in 1970 when detailed geological mapping and ground magnetic and EM surveys were conducted in an area to the south (*see* "Triton Occurrence (12)"). In 1980, the property was held by J.H. Forbes (4 claims) but no further development was reported.

During the present survey, the property was mapped in detail (Figure 10). The mineralization occurs along a fault breccia which trends at approximately N70E and dips steeply south. On the east shore of Cumaway Lake, the fault separates altered trondhjemite to the north and massive mafic metavolcanics to the south.

The fault breccia, which is about 25 m wide at the western end of the property, consists of angular country rock fragments cemented by calcite and quartz. Mineralization consists of disseminated chalcopyrite and sphalerite in the silicified breccia to massive sphalerite, chalcopyrite and galena in the matrix of the breccia. Some mineralization is also associated with quartz veins. Malachite and azurite are well developed in fractures, particularly in the trench at the eastern end of the property. Argentite is reported by Triton Explorations Limited but was not confirmed by the author. The mineralization zone trends at N65E, dips steeply southeast, and appears to be approximately 80 m long and approximately 10 m wide.

Two grab samples collected during the present survey (samples 1105 and 1106) yielded respectively: Au = 0.05 oz/ton, Ag = 12.03 oz/ton, Cu = 2.00%, Zn = 11.05%, Pb = 2.10% and Au = 0.04 oz/ton, Ag = 0.46 oz/ton, Cu = 0.73%, Zn = 0.15%, Pb = 0.02% (Geoscience Laboratories, Ontario Geological Survey, Toronto).

(3) LINDHOLM, R. (BOVIN-GILBERT OCCURRENCE)

The Bovin-Gilbert Occurrence is located about 1/2 mile east of the southern end of Fletcher Lake, near the northwestern shore of Caribou Lake. The mineralization consists of argentiferous galena and sphalerite associated with magnetite-amphibole ironstone and chert.

The discovery was made by J.N. Bovin and A. Gilbert during the 1940s. Conwest Exploration Company Limited and Central Patricia Gold Mines Limited diamond drilled six holes (357 m) on the property in 1949 but did not intersect any significant mineralization. Kennco Explorations (Canada) Limited examined the area in 1957 but interest was centered on the Fletcher Lake Area to the west (*see* "New Jersey Zinc Exploration Company (Canada) Limited (Fletcher Lake Occurrence (8)"). In 1959, Cominco Limited (then The Consolidated Mining and Smelting Company of Canada Limited) did ground EM and geological surveys over the

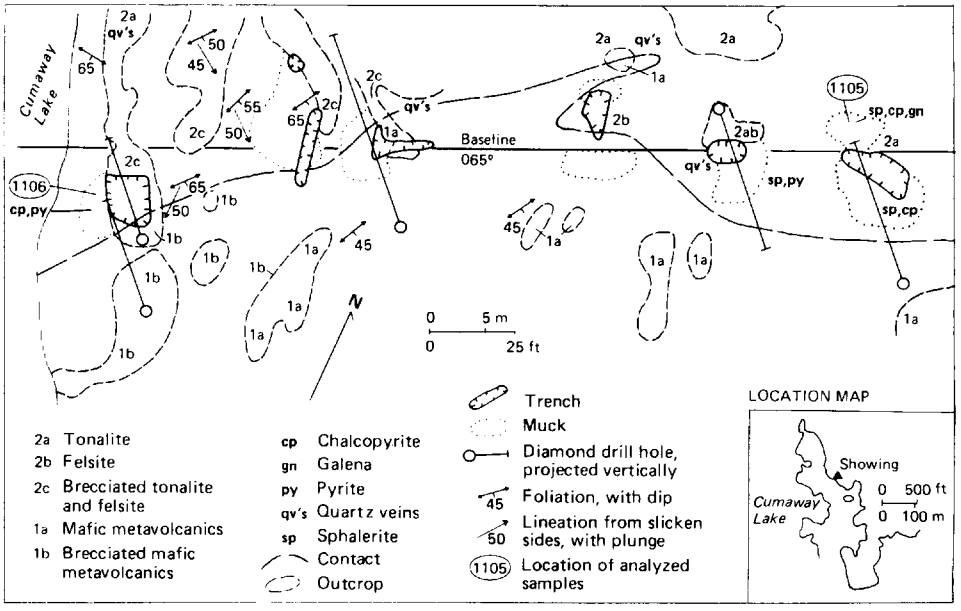


Figure 10: Plan of the Lett Occurrence (2).

ironstone. In 1961, the area was optioned by Centurion Mines Limited and magnetic, EM and geological surveys followed by diamond drilling (5 holes for 199 m) were carried out in 1962 and 1963. This drilling intersected additional galena mineralization northeast of the occurrence. In 1980, R. Lindholm held one claim covering the main galena occurrence. No further development has been reported.

The property was mapped in detail during the present survey (Figure 11). The host rock of the mineralization is a unit of chert, ferruginous chert and magnetite-amphibole ironstone approximately 50 m wide which lies within mafic metavolcanics. The ironstone is well bedded on a centimetre scale and strikes N15E to N30E, dipping 50° to 80° southeast. The ironstone and chert is locally folded and fractured. The fractures dip subvertically and cross the bedding at high angles. Minor quartz veins and carbonate alteration are present along some of the fractures and locally this alteration extends laterally from the fractures and trends parallel to the bedding.

The mineralization is not extensive, but high in grade. Galena with minor sphalerite was identified at three locations. The major occurrence is an irregular vein 5 cm to 20 cm wide exposed over a length of approximately 2 m. The vein is composed of 80% coarse grained galena with 15% reddish carbonate and 5% pyrite. Minor disseminated sphalerite is present within the chert host. The other occurrences are small and consist of galena and sphalerite mineralization which occupies crosscutting fractures, or small pods parallel to the bedding. The mineralization is associated with quartz, carbonate and minor pyrite.

The association of the mineralization with fractures and alteration indicate that the occurrence is structurally controlled. The fracturing may be related to brittle failure of the more competent chert-ironstone at the nose of the Fletcher Lake Anticline.

An analysis of the high grade galena vein yielded 47.3% Pb and 98.44 oz/ton Ag (Thurston and Carter 1970).

(4) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED

During 1980, New Jersey Zinc Exploration Company (Canada) Limited staked approximately 200 claims within the map area. The claims include eight former properties which are discussed under separate headings and several new areas of

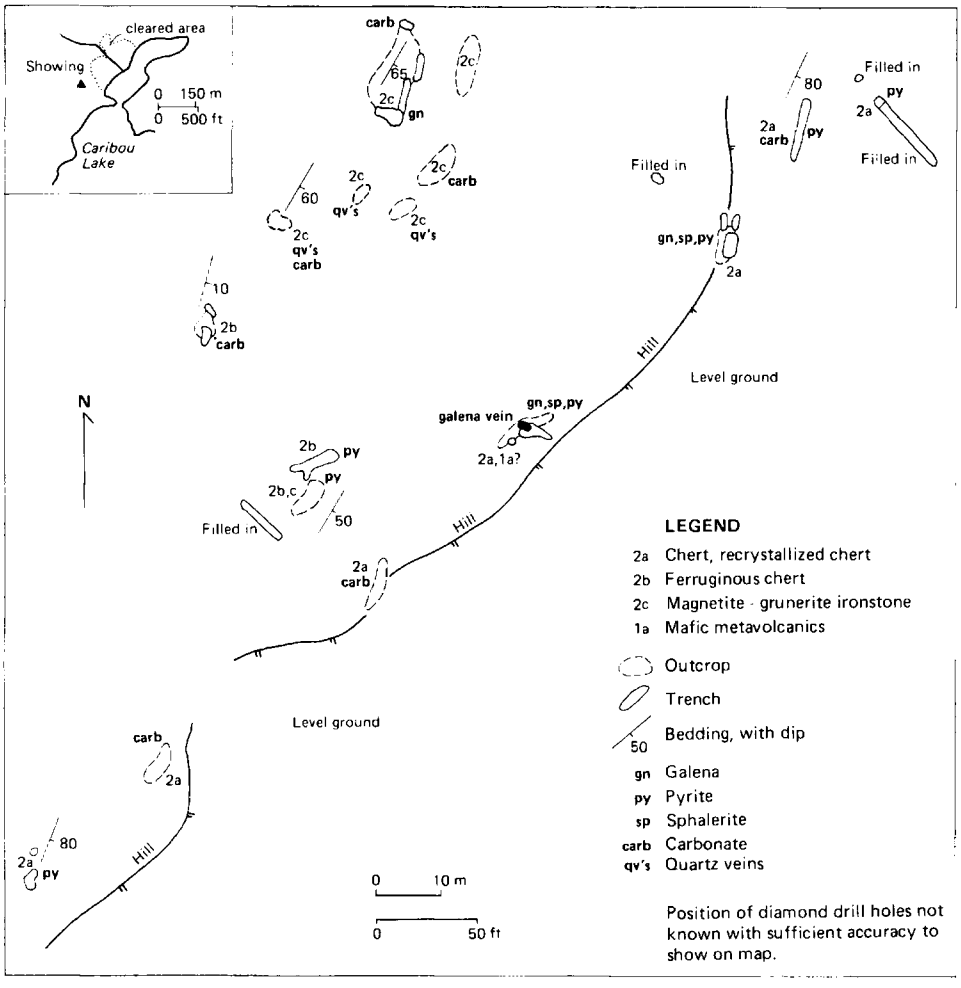


Figure 11: *Plan of the Bovin-Gilbert Occurrence (3).*

exploration (properties labelled (4) on Map 2485, back pocket). The new areas of exploration are situated within metavolcanics and metasediments north and south of Caribou Lake. No work by New Jersey Zinc Exploration Company was filed for assessment credit as of December 1980.

(5) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (CAMP OCCURRENCE)

Kennco Explorations (Canada) Limited examined a group of four claims east of Howie Lake in 1957. Mineralization predominantly consists of pyrite associated with mafic metavolcanics and tonalitic to dioritic intrusive rocks. Exploration consisted of geological, geochemical and ground EM-magnetic surveys followed by trenching and diamond drilling (5 holes, 202 feet). Pyrite and pyrrhotite mineralization was encountered but no significant base metal or precious metal mineralization was discovered.

Field mapping during the present survey indicated that the host rocks are amphibolite facies mafic metavolcanics which are commonly pillowed.

The amphibolite is intruded by fine grained biotite tonalite. At the main group of trenches, pyrite mineralization occurs as stringers and massive lenses which contain fragments of brecciated tonalite. Pyrrhotite mineralization is predominantly

disseminated and occurs primarily within the mafic metavolcanics. Minor chalcopyrite is reported to be present but was not observed by the author. The zone of mineralization is reported to be 200 feet wide and extend 800 feet northwest from Howie Lake.

A selected grab sample of massive pyrite collected by the field party (sample 1108) yielded: Ag = 0.24 oz/ton, Au = trace, Cu = 54 ppm, Zr = 119 ppm, and Pb = 14 ppm (Geoscience Laboratories, Ontario Geological Survey, Toronto).

(6) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (CANPAC-TOMBILL-GUNNEX OCCURRENCE)

During 1971, Gunnex Limited-Tombill Mines Limited-CanPac Minerals Limited carried out a joint exploration venture on a group of 15 claims south of Caribou Lake. Geological, soil geochemical, magnetometer, horizontal coil EM and VLF-EM surveys, and trenching were completed. The mineralization is reported to consist of disseminated pyrrhotite, pyrite and scattered chalcopyrite in mafic metavolcanics and massive pyrrhotite and pyrite associated with interflow metasediments (Assessment Files Research Office, Toronto). No significant base metal mineralization is indicated by the report. The property was not examined in detail by the present field party and no exploration trenches were observed.

(7) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (CENTURION OCCURRENCE)

During 1962 and 1963, Centurion Mines Limited conducted ground EM, magnetic and geological surveys over a group of 43 claims which included the Bovin-Gilbert Occurrence. The company investigated the strike extension of the mineralized chert and ironstone unit which hosts argentiferous galena and sphalerite mineralization. In late 1963, the company diamond drilled five holes (199 m) and encountered further galena, sphalerite and minor chalcopyrite mineralization associated with ironstone. No assays were reported.

(8) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (FLETCHER LAKE OCCURRENCE)

Kennco Explorations (Canada) Limited examined ten claims centered on Fletcher Lake in 1957. Interest was centered on a zone of massive to disseminated pyrrhotite, pyrite and magnetite mineralization approximately 1/2 mile west of the northern end of Fletcher Lake. During 1957, the company conducted ground EM, magnetic, geochemical and geological surveys, and exploration trenching but no significant base or precious metal mineralization was found.

The mineralized zone is 60 m wide and extends for over 600 m parallel to the strike of the metavolcanic rocks (approximately N80W) and the tonalite-metavolcanics contact. The host rock of the mineralization is amphibolite which varies from massive to schistose and contains up to 30% garnet. The mineralization occurs as lenses and varies from massive to disseminated pyrrhotite and pyrite. Minor chalcopyrite is reported in the assessment files but was not observed by the field party.

(9) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (GINN OCCURRENCE)

In 1957, A.P. Ginn diamond drilled five holes (135 m) and did minor trenching on two claims on the southeastern side of Kellar Island and on the mainland south of Kellar Island. The author was not able to locate the property and information in the assessment files does not indicate the location clearly. Diamond-drill logs indicate that the mineralization consists of massive to disseminated pyrrhotite and pyrite with minor chalcopyrite, within mafic metavolcanics. The diamond drill holes have not been located on the accompanying map. No assays are reported.

(10) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (GLENORA GOLD MINES OCCURRENCES)

During 1954 and 1955, Glenora Gold Mines Limited did 988 m of diamond drilling (8 holes) in a zone of massive pyrite-pyrrhotite mineralization on the mainland north of Kellar Island. Minor chalcopyrite is reported in some of the drill logs. No geological or geophysical work is reported, and the occurrence was not examined in detail by the author. The dimensions of the mineralized zone are not known. No assays are reported.

(11) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (LUN-ECHO OCCURRENCE)

In 1957, Lun-Echo Gold Mines Limited trenched and diamond drilled (1 hole, 18 m) sulphide zones on one claim on the southeastern shore of Caribou Lake opposite Kellar Island. The largest trench is blasted on the side of the steep southern shore of the lake and is clearly visible from the lake and from the air.

The mineralization consists of massive to disseminated pyrrhotite and pyrite associated with mafic metavolcanic rocks. Minor chalcopyrite is reported in a diamond drill log submitted for assessment but was not verified by the author.

A grab sample of sulphide mineralized amphibolite collected by the author 150 m southeast of the main trench (sample 1044) yielded: Au = 0.01 oz/ton, Ag = 0.13 oz/ton, Cu = 430 ppm, and Zn = 46 ppm (Geoscience Laboratories, Ontario Geological Survey, Toronto).

(12) NEW JERSEY ZINC EXPLORATION COMPANY (CANADA) LIMITED (TRITON OCCURRENCES)

Triton Explorations Limited examined a group of 90 claims extending from Cumaway Lake to the northern end of D'Alton Lake in 1971. The company performed trenching and geological, ground magnetometer and EM surveys. Several zones of pyrite-pyrrhotite mineralization were delineated within the metavolcanics. The company also re-examined the Lett Occurrence (2). The sulphide mineralization at the northern end of D'Alton Lake consists of massive to disseminated pyrite and pyrrhotite associated with chemical metasediments.

Selected grab samples of mineralized ironstone collected by the author yielded the following results: Sample 386: Au = 21 ppb; and Sample 388: Au = trace, Cu = 340 ppm, Zn = 15 ppm, Co = 160 ppm (Geoscience Laboratories, Ontario Geological Survey, Toronto).

(13) RIO TINTO CANADIAN EXPLORATION LIMITED

At the end of 1980, Rio Tinto Canadian Exploration Limited held approximately 140 claims within the map area. The claims include three former properties which are discussed separately and several new areas of exploration in the northern part of the area (shown as 13 on Map 2485, back pocket). No work has been filed for assessment credit by Rio Tinto Canadian Exploration Limited as of December 1980.

(14) RIO TINTO CANADIAN EXPLORATION LIMITED (FAYOLLE OCCURRENCE)

In 1954, A. Fayolle discovered a zone of massive pyrrhotite-pyrite mineralization south of Campbell Lake. In that year, Fayolle carried out trenching and diamond drilling (14 holes, 154 feet). Thirteen holes were drilled at the main showing and one hole was drilled to the north. In 1956, Kennco Exploration (Canada) Limited conducted geological, geochemical, and ground EM and magnetic surveys over a group of four claims, but did not delineate any significant base metal mineralization.

The property was mapped in detail during the 1980 field season (Figure 12). The mineralization occurs near the nose of an easterly plunging open syncline. The host of the mineralization is primarily a fine grained equigranular quartzite unit 10 to 30 m wide. The quartzite shows no primary textural features and is probably recrystallized chert. It is entirely composed of quartz, but is characteristically rusty

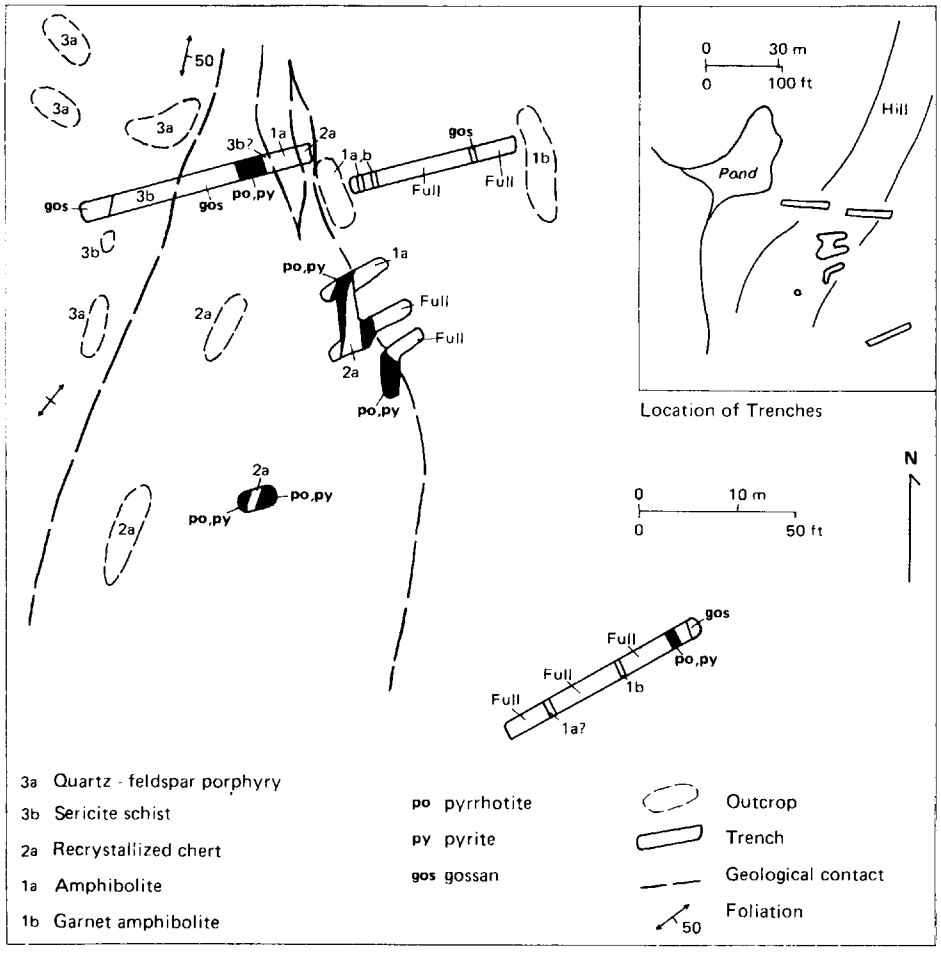


Figure 12: *Plan of the Fayolle Occurrence (14).*

coloured due to limonite staining. Foliated to massive garnetiferous amphibolite is interpreted to overlie the quartzite and is also locally mineralized. Sheared quartz-feldspar porphyry underlies the quartzite unit.

Mineralization occurs as lenses of massive pyrrhotite up to 3 m wide. Up to 10% coarse pyrite is present as large euhedral crystals or blebs in the pyrrhotite. One octahedral pyrite crystal 5 cm long was collected by the author. Minor possible malachite staining was observed on the massive pyrrhotite but no chalcopyrite was identified. Several lenses of massive mineralization are present and they appear to occur principally within the quartzite, although one lens is present within the mafic metavolcanics.

On the basis of association of the mineralization with the quartzite, the occurrence is considered to be volcanogenic.

No assay samples were collected by the field party from the occurrence. Assays of samples collected by Thurston and Carter (1970) and by Kennco Exploration (Canada) Limited did not reveal any economic values.

(15) RIO TINTO CANADIAN EXPLORATION LIMITED (HOLLINGSWORTH IRON MINES LIMITED PROSPECT)

In the 1950s, C.W. Menifee staked the oxide facies ironstone east of Hollingsworth Lake (Figure 13). In 1965, the property, which consisted of 65 claims, was optioned by Cliffs of Canada Limited and the company carried out magnetic surveys, geological mapping, and concentration tests. In 1971, Hollingsworth Iron Mines

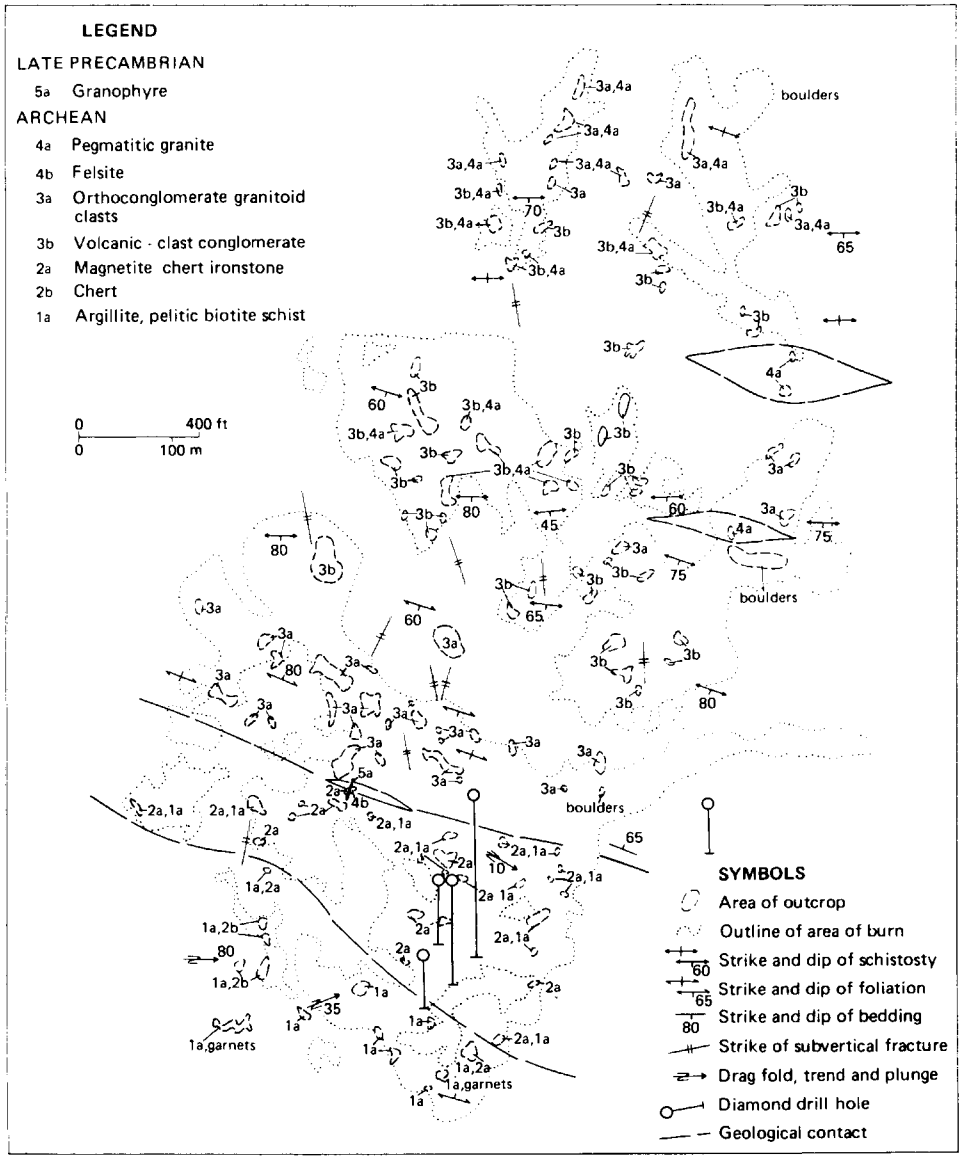


Figure 13: *Plan of the Hollingsworth Iron Mines Limited Prospect (15).*

Limited was incorporated to develop the property, and diamond drilling and beneficiation tests were carried out. The Northern Miner (August 19, 1971, p.16, 22) reports a tonnage estimate of 217 000 long tons per vertical foot (86.8 million long tons to 400 feet). Subsequently the property was re-staked by Rio Tinto Canadian Exploration Limited, but no further development was submitted for assessment credits.

The best exposures and greatest width of the ironstone are found near the western end of the property. Here the ironstone unit reaches widths of up to 215 m. Cliffs of Canada Limited cut 21 assay samples for a combined length of 107 m from this zone. The arithmetic mean of the assay results on the samples was 21.59% soluble iron. The high value was 28.20% and the low was 16.74% soluble iron. Davis tube tests on drill core samples were made in 1971. The results

indicated that iron concentrates containing less than 2% SiO_2 could be produced by magnetic separation after grinding 80% to -26 μm and that this concentrate contained about 70% soluble iron.

(16) RIO TINTO CANADIAN EXPLORATION LIMITED (POLLARD OCCURRENCE)

During 1955, J.G. Pollard drilled 12 short diamond drill holes in mafic metavolcanics south of Campbell Lake. Drill logs were filed for 4 holes (216 m) and indicate unspecified sulphide mineralization associated with mafic metavolcanics. The property was not examined in detail by the author.

OTHER MINERAL OCCURRENCES

Molybdenite

During the current survey, minor molybdenite was observed as disseminated grains in biotite tonalite on the northern end of the large island in Caribou Lake, approximately 3 km southwest of the portage into Brockway Lake. Quartz vein float with approximately 15% molybdenite was observed at the western end of the portage from Fuchsite to Michell Lakes. The author considers that the float was probably not far removed from its source.

Talc

Talc veins up to 2 cm wide were observed crosscutting serpentinized peridotite on Cumaway Lake. The veins contain platy talc crystals oriented perpendicular to the vein and minor carbonate.

Fluorite

Fluorite is associated with some fine grained granophyre dikes. It occurs as a fine grained, bright purple phase, filling fractures and locally filling vuggy cavities within a granophyre dike on the southeastern shore of Caribou Lake; opposite Kellar Island.

Graphite

Two occurrences of graphite were noted within the map area. On the southern shore of Hollingsworth Lake, graphite occurs as rounded clasts and as angular fragments in massive sulphide lenses in mafic metavolcanic rocks. On the northern shore of D'Alton Lake, graphite is exposed in a trench where it is present in the matrix of a graphite-chert breccia.

RECOMMENDATIONS FOR EXPLORATION

Gold

Relatively minor emphasis has been placed on gold exploration within the area since the 1950s. Several factors, however, indicate that the area is a favourable environment for gold and that more exploration is warranted. Previously unreported ultramafic metavolanics on Cumaway Lake and ultramafic rocks of possible metavolcanic origin on Michell and Caribou Lakes are specific targets for further investigation. The ultramafic rocks are associated with zones of deformation and alteration, particularly related to faulting. The rocks are generally carbonatized, and locally associated with silicification and quartz and/or quartz-carbonate veining. These features, specifically the alteration, deformation and veining, have been shown to be important factors in Archean gold deposits (Pyke 1975).

In the vicinity of the southwestern end of Kellar Island the mafic metavolcanics are highly deformed and carbonatized and have been injected by quartz and quartz-carbonate. The deformation appears to be related to tight folding subparallel to the axis of Caribou Lake. This zone warrants further investigation since it contains proven gold values of economic significance. The zone also contains minor occurrences of talc-carbonate schist. Metamorphism may also have a control

on the localization of the quartz veining since the most abundant veining appears to occur near the amphibolite-greenschist facies boundary.

Copper-Zinc-Lead

Chalcopyrite, sphalerite, and galena mineralization at the northern end of Cumaway Lake is associated with a northeast trending fault breccia zone. Several similar fault zones are present in the vicinity and further mineralization may be present. This association, however, may be more favourable for gold particularly since the faults are associated with ultramafic rocks.

Chalcopyrite mineralization, at the southwest end of Kellar Island, is associated with quartz-carbonate veins in altered mafic metavolcanics. This association is also considered to be more significant for gold mineralization.

Argentiferous galena and sphalerite mineralization east of Fletcher Lake appears to be fracture controlled and restricted to the competent ironstone-chert. The interpreted hinge zone of the anticlinal axis north of the showing may have potential for further mineralization.

The numerous pyrrhotite-pyrite occurrences within the map area are generally associated with the mafic metavolcanics. Minor chalcopyrite mineralization and locally graphite are present within the pyrrhotite and pyrite. Several of these occurrences are associated with chemical metasediments and may be synvolcanic (Fayolle Occurrence, D'Alton Lake Occurrences, and Hollingsworth Lake Occurrences). The association of garnet amphibolite with sulphide mineralization within the map area is noteworthy.

Along the northern boundary of the metavolcanic rocks an extensive zone of sulphide mineralization is largely untested and warrants further investigation. This zone, which occurs within 100 m of the metavolcanic-metasedimentary contact, is consistently mineralized over a strike length of approximately 10 km and contains significant copper and zinc values. Metavolcanics within the zone are garnetiferous, locally containing up to 50% garnet, possibly due to alteration processes associated with mineralization.

Copper-Nickel

The ultramafic flows, particularly on Cumaway and Michell Lakes, may warrant investigation for copper and nickel. On the southern shore of Michell Lake, an exposure of serpentinite contains in excess of 80% pseudomorphed olivine crystals to 1 cm diameter and probably represents a cumulate zone.

Lithophile Elements

Beryl and cassiterite mineralization at Linklater Lake, 8 km to the east of the map area, is associated with pegmatitic muscovite granite which is possibly a residual diatexitic magma. Similar pegmatites are present within the map area in the vicinity of the English River-Wabigoon Subprovinces boundary, but no lithophile element mineralization of this type has been observed within the map area to date.

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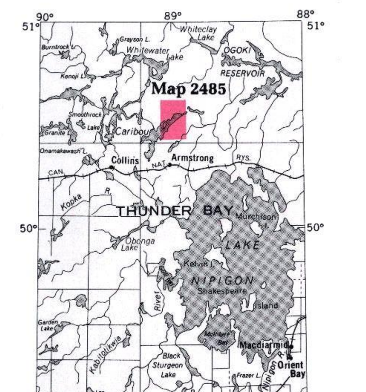
Ontario Geological Survey
Map 2485
Fletcher Lake

Ministry of Northern Development and Mines
Ontario



Scale 1 inch to 50 miles
N.T.S. Reference 52I/6, 52I/7, 52I/10, 52I/11

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, feet or metres.
- 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.

PROPERTIES, MINERAL DEPOSITS

1. Esso Minerals Canada Ltd. (Kellar Island prospect).
2. Forbes, J.H. (Lett occurrence).
3. Lindholm, P. (Bovin-Gilbert occurrence).
4. New Jersey Zinc Exploration Co. (Canada) Ltd.
5. Camp occurrence.
6. Canpac-Tombill-Gunnex occurrence.
7. Centurion occurrence.
8. Fletcher Lake occurrence.
9. Ginn occurrence.
10. Glenora occurrence.
11. Lun-Echo occurrence.
12. Triton occurrences.
13. Rio Tinto Canadian Exploration Ltd.
14. Fayolle occurrence.
15. Hollingsworth prospect.
16. Pollard occurrence.

Information current to December 31, 1980.

Former properties on ground now open for staking are only shown if exploration data is available. For further information see report.

SOURCES OF INFORMATION

Geology by R.H. Sutcliffe and assistants, Ontario Geological Survey, 1980. Geology is not tied to survey lines.

Aeromagnetic maps (OGS-GSC) 940G, 950G, 2114G, 2123G.

Preliminary maps (OGS), P2409 and P2410, Fletcher Lake (east and west sheets), scale 1:15,840, issued 1981.

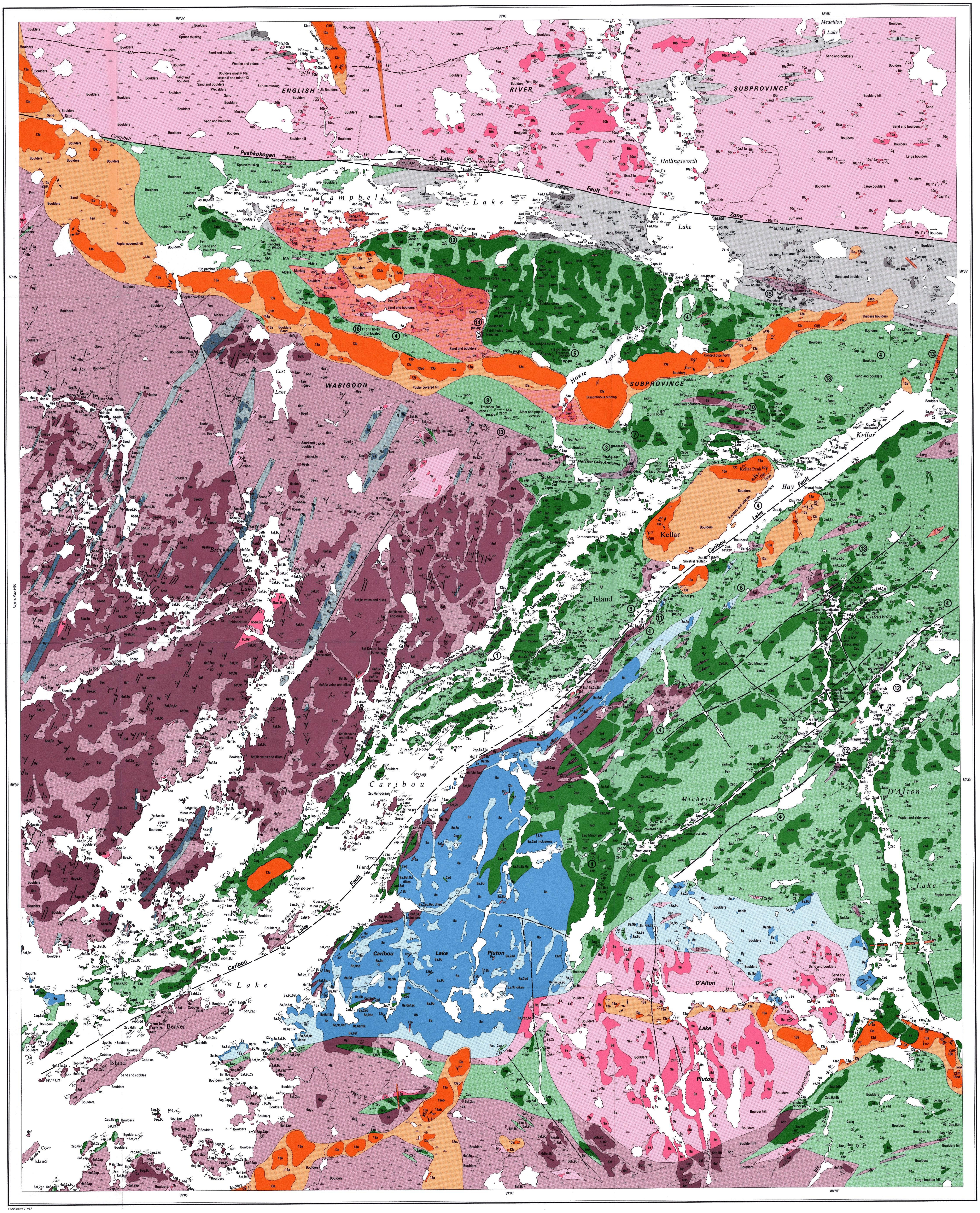
Cartography by M.G. Sefton and assistants, Surveys and Mapping Branch, Ministry of Natural Resources, 1984, revised by P.A. Wisbey, 1986.

Basemaps derived from maps of the Forest Resources Inventory, Ministry of Natural Resources, with additional information by R.H. Sutcliffe.

Magnetic declination in the area was approximately 0° 02′ West in 1980.

Parts of this publication may be quoted if credit is given. It is recommended that reference be made in the following form.

Sutcliffe, R.H.
1987: Fletcher Lake; Ontario Geological Survey Map 2485, Precambrian Geological Series, scale 1 inch to ½ mile, geology 1980.



Published 1987

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Till, esker deposits, glacio lacustrine sand deposits, swamp, stream and lake deposits.

UNCONFORMITY

PRECAMBRIAN[b,c]

LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

- 13 Unsubdivided.
- 13a Diabase, medium-grained.
- 13b Pegmatitic diabase.
- 13c Quartz diabase.
- 13d Magnetite-rich diabase.

ULTRAMAFIC TO FELSIC DIKE ROCKS

- 12 Unsubdivided.
- 12a Diabase, fine to medium-grained.
- 12b Aphanitic mafic dike.
- 12c Felsic microgranophyre, trachyte.
- 12d Granite.
- 12e Biotite-olivine lamprophyre, carbonatized lamprophyre.
- 12f Miarolitic.
- 12g Porphyritic.
- 12h Ocellar structure.

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)

CATACLASTIC ROCKS

- 11a Submylonite.
- 11b Mylonite.

FAULT CONTACT

MIGMATITES[d]

- 10 Unsubdivided.
- 10a Muscovite-biotite (± garnet) granite (homogeneous diatexite)[e]
- 10b Muscovite-biotite (± garnet) granite with metasedimentary schlieren (inhomogenous diatexite).
- 10c Biotite granite.
- 10d Muscovite-biotite (± garnet) pegmatite.

LATE FELSIC TO INTERMEDIATE INTRUSIVE ROCKS[f]

- 9 Unsubdivided.
- 9a Microcline porphyroblastic biotite granite.
- 9b Biotite granite.
- 9c Granite pegmatite.
- 9d Hornblende diorite.

INTRUSIVE CONTACT

MAFIC INTRUSIVE ROCKS

MAFIC PLUTONIC ROCKS (CARIBOU LAKE PLUTON)

- 8 Unsubdivided.
- 8a Hornblende gabbro.
- 8b Pyroxene gabbro.
- 8c Layered gabbro.

INTRUSIVE CONTACT

MAFIC DIKE ROCKS[g]

- 7 Unsubdivided.
- 7a Amphibolite.
- 7b Hornblende gabbro.

INTRUSIVE CONTACT

EARLY FELSIC TO INTERMEDIATE PLUTONIC ROCKS[h]

- 6 Unsubdivided.
- 6a Biotite tonalite.
- 6b Biotite granodiorite, biotite (± muscovite) granite.
- 6c Biotite-hornblende diorite, biotite-hornblende quartz diorite.
- 6d Fine-grained intermediate phase.
- 6e Massive.
- 6f Foliated.
- 6g Gneissic.
- 6h Sheared.
- 6j Plagioclase phenocrysts.
- 6k Quartz phenocrysts.

INTRUSIVE CONTACT

METAMORPHOSED SUBVOLCANIC TO VOLCANIC FELSIC ROCKS[i]

- 5 Unsubdivided.
- 5a Quartz-feldspar porphyry.
- 5b Felsite.
- 5c Trondhjemite.
- 5d Intermediate, porphyritic to aphanitic dikes.
- 5e Fragmental porphyry.[j]
- 5f Brecciated and silicified porphyry.
- 5g Sericite (muscovite) schist.

INTRUSIVE CONTACT

METASEDIMENTS

CLASTIC METASEDIMENTS[i]

- 4 Unsubdivided.
- 4a Volcanic-clast conglomerate.
- 4b Orthoconglomerate, granitoid clasts.
- 4c Paraconglomerate, granitoid clasts.
- 4d Muscovite-biotite schist.[k]
- 4e Wacke.
- 4f Migmatized wacke, pelite (metatexite).[e]
- 4g Argillite, slate.
- 4h Pelitic biotite schist.
- 4j Garnet-bearing.
- 4k Sillimanite-bearing.

CHEMICAL METASEDIMENTS[i]

- 3 Unsubdivided.
- 3a Chert, recrystallized chert.
- 3b Magnetite-chert ironstone.
- 3c Amphibole-chert ironstone.
- 3d Magnetite-amphibole-chert ironstone.
- 3e Sulphide ironstone.
- 3f Graphitic chert.
- 3g Carbonatized ironstone.

METAVOLCANICS

MAFIC TO INTERMEDIATE METAVOLCANICS[i]

- 2 Unsubdivided.
- 2a Mafic flow.
- 2b Intermediate flow.
- 2c Pillowed flow.
- 2d Massive flow.[m]
- 2e Coarse-grained flow.[m]
- 2f Amygdaloidal flow.
- 2g Feldspar-phyric flow.
- 2h Variolitic flow.
- 2j Flow breccia.
- 2k Polysutured flow.
- 2m Carbonatized flow.
- 2n Silicified flow.
- 2o Garnetiferous flow.
- 2p Highly foliated to schistose flow.[n]
- 2q Gneissic amphibolite.

ULTRAMAFIC METAVOLCANICS[i]

- 1 Unsubdivided.
- 1a Serpentinized peridotite flow.
- 1b Metapyroxenite (actionolite-rich) flow.
- 1c Serpentinized peridotite, dunite.[p]
- 1d Spinifex flow.
- 1e Massive flow.
- 1f Carbonatized flow.
- 1g Silicified flow.
- 1h Talcose flow.
- 1j Talc-carbonate schist.
- 1k Amphibole schist.

Ag	Silver.
Au	Gold.
cp	Chalcopyrite.
Cu	Copper.
Fe	Iron.
fl	Flourite.
fu	Fuchsite.
gf	Graphite.
gn	Galena.
mo	Molybdenite.
Pb	Lead.
po	Pyrrhotite.
py	Pyrite.
q	Quartz
qc	Quartz-carbonate.
sp	Sphalerite.
talc	Talc
tour	Tourmaline.
Zn	Zinc.

[a] Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts of the map.

[b] Bedrock geology. Outcrop 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 colour and must be represented in black, a short black bar appears in the appropriate block.

[c] Plutonic rock classification follows the IUGS Subcommission on the Systematics of Igneous Rocks (Streckeisen, 1976).

[d] Predominently in English River Subprovince

[e] Terminology of migmatitic rocks follows Mehnert (1968).

[f] Confined to the Wabigoon Subprovince.

[g] Mafic dike rocks are probably correlative with the Caribou Lake Pluton (unit 8).

[h] At least two ages of Early Felsic to Intermediate Plutonic Rocks may be present, one phase is earlier than units 7 and 8, and one phase is possibly older than unit 8.

[i] Rocks in units 1, 2, 3, 4, and 5 are subdivided lithologically. Order does not imply age relationships within or between groups.

[j] Possibly extrusive breccia.

[k] Of probable conglomeratic origin.

[m] May be intrusive in part, especially northeast of the Caribou Lake Pluton.

[n] Schists and gneisses of probable volcanic origin.

[p] Probably intrusive.

The letter "G" preceding a rock unit number, for example "G3" indicates interpretation from geophysical data in drift covered area

Ontario Geological Survey

Map 2485

FLETCHER 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