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MARIN-PICQUET AREA (ABITIBI-EAST ELECTORAL DISTRICT) - FINAL REPORT

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MARIN-PICQUET AREA

ABITIBI-EAST ELECTORAL DISTRICT

J.H. Remick

Final report

1977

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DEPARTMENT OF MINES
GEOLOGICAL SURVEYS BRANCH

GEOLOGICAL REPORT

MARIN-PICQUET AREA
ABITIBI-EAST ELECTORAL DISTRICT

by
J.H. Remick
1958

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MARIN-PICQUET AREA

ABITIBI-EAST ELECTORAL DISTRICT

by Jerome H. Remick

INTRODUCTION

General Statement

The Marin-Picquet area was geologically mapped by the writer during the summer of 1957 as part of the general mapping programme for the Geological Surveys Branch of the Quebec Department of Mines. A very minor amount of chalcopyrite and pyrite mineralization is present in a few of the outcrops of hornblende schist. Otherwise the rocks of the area do not contain any sulfide mineralization.

The area lies in the southern part of the Timiskaming geological subprovince of the Canadian shield and is about 50 miles north of the northern boundary of the Grenville geological subprovince. The elevation of the lakes is from 990 to 1100 feet above sea level. The land is rather flat except for a few large hills and ridges of hornblende schist, altered gabbro and granitic rocks which rise 100 to 300 feet above the local lake level (Plates I, II, III, IV, V). All of the area is northwest of the height of land.

The consolidated rocks of the map area are of Precambrian age. About four-fifths of the area is underlain by granitic rocks. Two thin belts of hornblende schist, roof pendants in the granitic rocks, cross the northern part of the area. Foliated hornblende monzonite outcrops along the southern boundary of the area. Small bodies of altered hornblende gabbro, altered anorthosite, biotite-augite monzonite and diabase occur in the northern part of the map area.

Location

The Marin-Picquet area is bounded by latitudes 49°09' and 49°30' and by longitudes 75°30' and 75°45'. It comprises an area of about 270 square miles in Abitibi-east electoral district, about 70 miles southwest of Chibougamau. It includes almost all of Marin and Picquet townships, about one-third of La Ronde township and small portions of Du Guesclin, Royal, Belmont and Urban townships.

Access

Several aviation companies located near Chibougamau provide transportation into the area, the flight distance being about 65 miles. Numerous lakes are accessible to float planes (Plate III-B). The new Chibougamau-Barraute line of the Canadian National Railway is only 8 miles north of the northwest corner of the map area. Lac Lessard, which is in the northwest corner of the map area, is

accessible by railway from Chibougamau or Barraute (17 miles west of Senneterre) to Opawica lake and then by canoe south and west for about 20 miles on Opawica lake and Lichen lake. Travel to lac Germain along rivière Germain is good and involves only a few short and well cut portages. The water level is too low to permit travel along much of boulder packed rivière Brosseau. Portages around the longer rapids on rivière Yondotega were cut during the past summer so that travel between lac Brosseau and lac Yondotega is now possible.

All surveyed township lines except the north-south line separating Marin and Picquet townships from Du Guesclin and Royal townships are in fair to good condition. This north-south township line, which was cut in 1927, is now completely overgrown and impossible to follow for more than a few tens of feet.

Field Work

The map area was completely covered by pace and compass traverses at one-half mile intervals and the geology was plotted on a base map at a scale of one-half mile to the inch. The base map was made by the Water Commission of Quebec from air photos taken by Photo Air Laurentides, Quebec.

Aerial photographs taken by the Royal Canadian Air Force at a scale of a little over 3000 feet to the inch and by Photo Air Laurentides Co, Quebec, at a scale of 1320 feet to the inch were used in planning traverses and in locating some of the larger outcrops of rock.

The mapping was carried out on a scale of one-half mile to the inch. Traverses were spaced at intervals not greater than one-half mile apart and where possible were run normal to the strike of the rocks. The shoreline of all lakes and streams was examined by canoe or on foot for rock outcrops.

The outcrop pattern as shown on the accompanying map gives a fairly accurate picture of the distribution of rock outcrops. Outcrops of hornblende schist are plentiful just south of the central part of rivière Germain and just northwest of lac Jean. Outcrops of altered gabbro are rather abundant on the large hills just south of the central part of rivière Germain. Outcrops of gneissic biotite granodiorite are quite numerous on small hills or as low outcrops between the two belts of hornblende schist. Outcrops of biotite granite occur on a hills in the southern half of the area, but in general are scarce and most of this area is devoid of outcrop.

Acknowledgments

The writer wishes to thank Fecteau Airways for their excellent transportation. Also Mr. George J. Rév of Columbia University, New York, for his outstanding workmanship on the 94 thin sections used in this report.

Richard Cavin acted as senior geological assistant and ran about half the traverses in the map area. Hubert Brosseau and Guy Dallaire ran the compass lines and performed

their duties as junior geological assistants very satisfactorily. Eugène Bossé and Paul Anctil acted as canoemen and cut the majority of the portages shown on the accompanying geological map. Gaston Gastonguay performed his duties as cook in a satisfactory manner.

Previous Work

The area was first mapped on a reconaissance scale of 1 inch to 4 miles by Retty and Norman in 1935.

The writer's preliminary observations on the Marin-Picquet area are contained in a preliminary report accompanied by a geological map at a scale of one inch to one mile. This was published by the Department of Mines, Quebec, in 1958.

The area to the south was mapped by Milner in 1939, that to the east by Deland in 1955 and that to the north by Shaw in 1937. The area to the west will be mapped by the writer during the summer of 1958.

Aeromagnetic map 5170 of the Opawica-Lewis Lake area, covering the area just north of the map area, was published by the Geological Survey of Canada in 1957 at a scale of one inch to the mile. At present there is no indication that an aeromagnetic map will be published covering the Marin-Picquet map area.

DESCRIPTION OF THE AREA

Settlement and Agriculture

The map area is uninhabited. Two employees of the

Department of Lands & Forests man the fire tower on the west shore of lac Giardini from mid-May through the end of August.

A few Indian families used to live on the western shore at the very southern end of Father lake. They successfully raised potatoes in a silty soil. Farther to the northeast on the east shore of lac Doda, the Department of Lands and Forests Post has had good success with potatoes, cabbage, lettuce, radishes, rhubarb, beans and other vegetables. The early frost seems to be the main deterent to the less hardy vegetables.

Climate

The climate is quite warm during the months of June, July, and August, but there are frequent rainy periods of from 1 to 3 days often accompanied by cooler spells of weather. Temperatures of 80° to 90° are not uncommon during the early part of the summer, but a daily average of from 55° to 65° usually prevails.

The ice is usually gone by mid-May or a few days thereafter. The lakes are warm enough for swimming from mid-June through mid-August. Freeze-up begins in November.

The leaves start to come out about the last few days in May or the first few days in June and are usually gone by mid-October.

Natural Resources

Timber

Spruce, balsam, jack pine, tamarack, cedar, birch and

poplar are the only large trees found within the area. Wild cherry, mountain ash, alder and mountain maple bushes occur in the more humid places. Abundant blueberry and occasional raspberry bushes cover some of the more open areas.

Small stands of spruce, good for pulp, are abundant throughout the area (Plates I, II-B, III, V). Only a few large spruce which would be good for lumber were observed.

Jack-pine along with some birch, poplar, and spruce cover the eskers and glacial belt south of Father lake.

Fish

Pike and pickrel are plentiful in all the larger lakes. The largest pike caught during the summer weighed 15 pounds and the largest pickrel weighed 3 pounds. Small brook trout live in some of the small, cool, spring-fed streams. Large lake trout and a few sturgeon live in Father lake but are very difficult to catch. The other large lakes in the area are neither cool enough nor deep enough to support lake trout.

Game

Moose and beaver are quite numerous while black bear are rather rare. Fresh moose tracks were seen almost daily and several dozen moose were seen at different times during the field season. Fresh beaver cuttings and dams occur along many of the smaller streams and at the heads of most of the smaller lakes. Several rabbit and a mink were also observed.

Partridge are abundant in the woods. Ducks and loons inhabit most of the lakes. Crows, owls, terns, and the blue heron were also occasionally observed.

Waterpower

A falls about 10 feet in height is situated at the northern end of lac Lessard near the northern boundary of the map area (Photo V-B). A 20 foot and 40 foot falls lies at the western end of lac Fuger.

Physiography

Relief

The lakes in the area have a general elevation of from 990 to 1100 feet. The maximum elevation of the land surface is about 1500 feet.

Hills of hornblende schist and altered hornblende gabbro, elongated parallel to the strike of their schistosity, rise 10 to about 200 feet above the lake level just south of the central portion of riviere Germain and northeast of lac Turcotte (Plate II). Hills of granite 50 to 200 feet high parallel the western shore of Father lake (Plate IV). Several glacially covered granitic hills, 100 to about 300 feet high, occur near lac Yondotega. A fire tower is located on the highest hill(Plate V-A).

Drainage

The area is drained northward to lac Germain and then

westward via riviere Germain, lac Lessard and Lichen lake, eventually emptying into the Waswanipi-Nottaway system and so to James Bay.

Ground Covering

The land surface is covered by a mantle of glacial debris varying in thickness from a few feet to a few hundred feet. Pleistocene glaciation has removed much of the loose rock and covered much of the area with a blanket of glacial debris. Only a few of the higher rock hills and outcrops rise appreciably above the glacial covering. Some of the glacial hills have a rock core and the outcrops can often bee seen on their steep sides. A sand plane with at least one esker covers the southeast cornor of the map area. An esker , which is flanked by a small sand plane, trends southwesterly from the southwest end of lac Brosseau.

REGIONAL GEOLOGY

The Marin-Picquet area is in the southern part of the Timiskaming geological subprovince of the Canadian shield about 50 miles north of the boundary of the Grenville subprovince. It is about 50 miles southwest of Chibougamau and about 20 miles east of Bachelor lake. All the consolidated rocks are believed to be of Precambrian age.

Early Precambrian volcanic and sedimentary rocks together with small generally concordant bodies of basic intrusive rock have been isoclinally folded along an

east-west axis and now appear as thick bands or lense-like roof pendants in a sea of granite. Three such bands of rock have been recognized in the Chibougamau-Bachelor Lake region. The present report concerns the area between the central and southern belt of metamorphosed volcanic, sedimentary and basic igneous rocks and includes the very southern part of the central belt. Northeasterly trending diabase dykes, some of which are traceable for many miles, and the youngest rocks in the area.

Northeasterly trending cross-cutting faults, strike faults and southeasterly fractures and shear zones are the dominant structural features in the area. According to Claveau (1948) the cross faults are younger than the strike faults or shear zone faults. He also believes that dip slip movement was prevalent along the strike faults and that there was a relative northward shift of the east block in the northeasterly cross faults.

Some of the granitic bodies of the region were intruded along the antiolinal axes of the earlier isoclinally folded Precambrian sedimentary, volcanic and basic igneous rocks.

Copper, gold, silver, zinc, lead, nickel, and molybdenum occur in ore deposits in the district near the major faults and fractures in southeasterly trending shears and fractures.

GEOLOGY OF THE AREA

All the consolidated rocks of the area are believed to be of Precambrian age. About four-fifths of the area is

underlain by acidic intrusive rocks, mainly gneissic biotite granodiorite and biotite granite. Two thin belts of hornblende schist, believed to be recrystallized volcanic rocks and so the oldest rocks in the map area, cross the northern part of the area. Small bodies of altered anorthosite, hornblende schist, altered hornblende gabbro, and biotite-augite monzonite underlie the northern-most part of the map area. Foliated hornblende monzonite outcrops along the southern boundary of the area. Diabase cuts the granitic rocks in the northwest corner of the map area and those south of lac Germain.

The rocks in the map area are assumed to be Precambrian in age and will be classified as such. To assign an age more specific than just Precambrian to the rocks of the map area would be unsound until the radioactive age of the various rock types have been determined. Terms such as Keewatin, and Keweenawan have therefore been omitted from this report and a purely descriptive terminology has been used in their place.

TABLE OF FORMATIONS

Pleistocene and Recent	Unconsolidated Sediments	Boulders, gravel, sand, silt
	Great Unconformity	
	Unaltered Basic Intrusive Rocks	Diabase
	Intrusive Contact	
	Acidic Intrusive Rocks	Biotite-augite monzonite
		Pegmatite
		Biotite granite
		Gneissic biotite granodiorite
		Gneissic biotite-hornblende granodiorite
		Gneissic hornblende granodiorite
	Intrusive Contact	
Precambrian	Altered Intermediate and Basic Intrusive Rocks	Foliated hornblende monzonite
		Altered hornblende gabbro
	Intrusive Contact	
	Altered Basic Intrusive Rocks	Altered anorthosite
	Intrusive Contact	
	Recrystallized Volcanic Rocks	Hornblende schist

RECRYSTALLIZED VOLCANIC ROCKS

Distribution

Hornblende schist (amphibolite) outcrops in two narrow east-west trending belts in the northern part of the map area and in two small areas in the northeast part of the map area. Most of the outcrops occur in hills elongated parallel to their schistosity, 10 to over 200 feet high, in contrast to the relatively flat low-lying nature of the surrounding granite. A little metagabbro occurs with the hornblende schist in the northeast corner of the map area and on the large hill just east of lac Fayolle. These latter outcrops are too scattered to show separately on the accompanying map.

Small hills and ridges of hornblende schist (amphibolite) are plentiful just south of the central part of rivière Germain or just north of the northwest part of lac Jean. The large hill of hornblende schist just east of lac Fayolle (Plate II) is heavily covered with trees and glacial debris and so outcrops are scarce. An excellent cross-section of the entire belt, including its contact with the granite, commences about 1/2 mile north of the northwest end of the large island in lac Jean.

Lithology

A hand specimen of the rock consists of small hornblende needles and sugary feldspar grains, the former predominating.

The sub-parallel alignment of the c-axis or long direction of the hornblende crystals gives rise to the good schistosity of this rock. The lineation of these needles in the plane of schistosity is within 20° in many samples. The fresh and weathered surfaces of the rock are dark blue. The weathered surface usually shows lenticular banding and has a grey tinge if much feldspar is present. The majority of the rock is fine grained.

The writer prefers the name hornblende schist to amphibolite for this rock for it denotes its field characteristics, namely a fine-grained schistose rock consisting predominantly of small hornblende needles in subparallel to parallel alignment with some fine white feldspar grains which the microscope shows to be untwinned plagioclase. Many competent geologists might be inclined to classify this rock as an amphibolite. However, since the term amphibolite is also used for medium-to coarse-grained rocks consisting almost wholly of equant hornblende grains and does not adequately describe the appearance of this rock in the field, the writer prefers to use the term hornblende schist and reserve the term amphibolite for rocks consisting almost wholly of equant hornblende grains.

A limited amount of metamorphic differentation of hornblende, feldspar and possibly epidote into various layers during recrystallization, followed by injection of

quartz, epidote, sulfide minerals and granite parallel to the schistosity and accented by differential weathering give the weathered surface a lenticularly banded appearance. The lenticular bands are paper thin to about 3/4 of an inch wide and an inch to several feet in length. Lenticular bands rich in granite, epidote or veins of quartz are more resistant than bands rich in hornblende, feldspar or sulfide minerals. The majority of banding is due to a difference in the proportion of hornblende, feldspar and epidote. Except for the fact that some of the bands containing various proportions of feldspar, epidote, and hornblende are more resistant than others containing different proportions of these minerals, much of the lenticular banding would go unnoticed as the difference in mineral content and color between the majority of bands is usually not pronounced.

The fresh surface shows a mixture of foliated hornblende needles and sugary feldspar grains and sometimes poorly defined white paper thin folia of feldspar, green folia of epidote and folia rich in bluish black hornblende needles. Separation of hornblende and feldspar into separate bands is not pronounced enough to warrent calling this rock a gneiss.

Bluish bands or folia are rich in hornblende; white bands or folia are rich in feldspar, granite or vein quartz; light green bands or lenses are rich in epidote

often accompanied by sulfide minerals and quartz; and rusty brown bands contain some sulfide minerals.

The foliation is bent around the light green lenticular bands or lenses containing intermixed grains of epidote, some quartz, a little included hornblende schist and often sulfides. These epidote rich bands usually consist of several wider lenticular portions connected by much narrower portions. Disseminated pyrite and in places a little chalcopyrite occur in many of the outcrops in close proximity to veins of quartz or lenses rich in quartz and epidote.

Except for a few remenant pillow structures on the north shore of lac Germain no other relict structures typical of volcanic rocks were noted in the hornblende schist in the map area. Small drag folds, and cheveron folds are present in the hornblende schist just north of the north shore of lac Germain. The rocks in this area are finer grained than those in the two belts to the south and have a slightly greener tint. Injected quartz veins and feldspar veins follow the folds and do not cut across them.

A slightly coarser grain size and in places "lit-par-lit" layers of granitic material characterizes the hornblende schist in the southern belt. The hornblende schist in the northern belt is finer grained and lacks the "lit-par-lit" layers. The termination of the western end of the northern belt may be on the islands and adjacent shoreline of lac Lessard.

A highly migmatized hornblende schist occurs on

one of the islands in lac Lessard (Plate VII). and in places on the eastern shoreline of lac Lessard. The migmatized hornblende schist shown in Plate VII is a medium grey rock containing some pink feldspar grains and a grey schistose background. It and the adjacent granite are both cut by pink feldspar and epidote veinlets.

Plate VIII shows remenants or xenoliths of hornblende schist in granite near the termination of the northern belt of hornblende schist on the east shore of lac Lessard. The rock is of similar appearance to that found in the two belts of hornblende schist. These photos show the sharp contact between the granite and the intruded xenoliths of hornblende schist and also that the granite generally intrudes the hornblende schist along its planes of schistosity. The hornblende schist may have been in a semi-plastic state when it was intruded by the granite for its outer margins have been bent and pushed apart and there is no indication that the pieces will fit back together again. The relationship in the photo probably shows on a small scale the relationship between the granite and the two thin belts of hornblende schist in the map area.

migmatite

R-213
R-215
R-257

hornblende

R-3
R-4
R-8
R-20
R-28
R-55
R-75
R-76
R-96
R-102
R-112
R-113
R-115
R-220
R-224
R-225
R-232
R-253
R-254
R-256

Petrography

In thin section the hornblende schist consists predominantly of hornblende and plagioclase with some epidote, zoisite and/or clinozoisite and accessory sericite magnetite, sphene, pyrite, chalcopyrite and pyrrhotite(?).

The average grain size of the hornblende is 1/2 to 3/4 mm and that of the plagioclase 1/8 to 1/2 mm. A few sections contain lenticular layers rich in hornblende or epidote. The layers are generally 1 to 4 mm thick.

A fine-grained crystalloblastic texture is prevalent. Hornblende and plagioclase show a poikioblastic texture as they contain small inclusions of each other. Good foliation and fairly good linneation are shown by the long prismatic grains of hornblende.

Hornblende is present as deeply pleochroic (γ-bright green, β-green, α-very pale yellowish green) long prismatic crystals showing fairly good prismatic cleavage and having ragged terminations. Many of the grains show a sieve texture as they contain rounded inclusions of untwinned plagioclase. Generally about 65 to 70 per cent hornblende is present.

Plagioclase, which makes up about 20 per cent of each section, is present as small, equidemensional, untwinned, anhedral grains. Many of the grains contain a few small inclusions of hornblende. A few grains show fairly wide polysynthetic twinning striations and in these few cases there are usually only several twins per grain. The index of refraction of the plagioclase in every section is greater than that of Canada Balsam. A good measurement of the extinction angles of the albite twin lamallae in several sections indicates that the plagioclase has the composition of about mid-andesine.

Epidote is present as single subhedral colorless grains in many of the sections and makes up a large proportion of the light green lenticular layers and lenses in the rock. The layers are from 1 to 4 mm in thickness and consist of about 40 to 90 per cent epidote and small amounts of plagioclase and hornblende. Epidote contained in the small lenses is coarser grained than that disseminated in the rock and often accompanied by quartz. Subhedral grains of zoisite and/or clinozoisite are present in each section.

Some of the plagioclase, especially that in the lower belt, is altered to sericite. Quartz occurs in small lenses or veinlets generally parallel to the foliation of the other minerals. Magnetite is disseminated in many of the rocks. Pyrite, chalcopyrite, and pyrrhotite(?) are present in the small epidote rich lenses or as small lenses parallel to the foliation of the other minerals.

Origin

The hornblende schist in the map area is most likely the recrystallized equivalent of Keewatin-type volcanic rocks formed under medium intensity regional metamorphism by the heat from the adjacent granite as it cooled. The rock belongs to the amphibolite facies. Except for the bands, lenses or veins of granite, quartz, feldspar, sulfide minerals, and possibly some of the epidote, there

has probably been little change in the overall chemical composition of the hornblende schist during metamorphism. Some of the rocks in these two belts showing thin layering may have been derived from the recrystallization of sedimentary rocks or volcanic tuffs. Detailed field and petrographic work on many samples would be necessary to determine this. However, on the basis of the absence of quartz, potash feldspar, biotite and structural features characteristic of sedimentary rocks, the hornblende schist in the map area is considered to be recrystallized volcanic rocks with included minor recrystallized gabbroic phases. The gradation of Keewatin-type volcanic rocks identified by Deland (1955) about 1 mile east of the northeast corner of the map area into hornblende schists of the map area and the pillow structures and greenish color of the rocks on the north shore of lac Germain support this belief.

ALTERED BASIC AND INTERMEDIATE INTRUSIVE ROCKS

Altered Anorthosite

Distribution

Altered anorthosite outcrops in rounded hills which underlie some of the northeast corner of the map area and continues northward into the Lewis Lake area.

The few outcrops of altered anorthosite in the map area, if taken by themselves probably should be referred to as coarse-grained gabbro as they are similar

in composition to a gabbro. However they are referred to as altered anorthosite because they are similar to the rocks outcropping in the large bodies of altered anorthosite in the map area to the north (Shaw, 1940) and to the northeast (Resnick, 1957).

Lithology

The rock is massive, coarse-grained, and has a very rough weathered surface. It consists of varying proportions of hornblende and plagioclase. Hornblende is green, shows good cleavage and aggregates are up to 1½ inches long. It is more resistant than plagioclase and stands out on the weathered surface about 1/8 inch giving the weathered surface its typical roughness. Generally about 15 to 20 per cent hornblende is present but there are small patches consisting predominantly of hornblende. Plagioclase is present as rectangular to somewhat rounded grains 1/4 to 3/4 inch in length. The fresh plagioclase is very light grey and shows both polysynthetic twinning striations and good cleavage. Many of the plagioclase grains are partially or completely surrounded by hornblende giving the rock a net-like texture.

The rock is massive except for a few small southwest striking schistose zones. Several small dykes of gneissic biotite granodiorite cut the altered anorthosite and small inclusions of hornblende schist occur in the

altered anorthosite. It is therefore younger than the hornblende schist and older than the granite.

Petrography

R-6
R-7
R-72
C-14
C-15

Five thin sections of the altered anorthosite were examined. They consisted predominantly of plagioclase and green hornblende with some chlorite, sericite, epidote, zoisite and/or clinozoisite. Accessory sphene, leucoxene, and magnetite are present. Quartz, calcite and pyrite occur in a few of the slides as late veins.

The plagioclase is coarse grained, subhedral and relatively fresh. In one section the plagioclase was heavily sericitized and in several it was brecciated and fractured. Its albite twin lamallae are rather wide and their extinction angle as measured on the universal stage indicates they have the composition of intermediate labradorite. Small grains of epidote , zoisite and/or clinozoisite occur in the plagioclase in each section. The epidote group minerals often occur as thin borders between hornblende and plagioclase. Generally about 10 per cent of the plagioclase has been altered to the epidote group minerals.

Green pleochroic hornblende occurs both in aggregates of subhedral grains averaging 1 mm in size and as single large grains. Remnants of a colorless clino-pyroxene occur in two of the sections and so the hornblende is uralitic. It commonly occurs around the edges of the large plagioclase grains.

Chlorite occurs in one of the sections in large sheets with included disseminated leucoxene. Hornblende borders some of the chlorite.

Disseminated grains of magnetite and/or ilmenite occur only in the pyroxene, hornblende or chlorite, and they are lacking in some sections. Disseminated grains of sphene occur in chlorite and in some of the large uralitic grains of hornblende.

Altered Hornblende Gabbro

Distribution

Altered hornblende gabbro outcrops at the eastern end of rivière Germain, just south of the central part of rivière Germain and in the northwest part of the map area.

The exposures just south of rivière Germain occur in large rocky hills elongated parallel to the strike of the schistosity of the hornblende schist. Outcrops of the northern body are poor as most of the outcrops are on the sides and crests of glacially covered hills.

Lithology

The rock is medium grained, massive to lightly schistose and consists of plagioclase and hornblende. The hornblende content averages between 25 and 35 per cent in the northern body and 45 and 60 per cent in the outcrops just south of the central part of rivière Germain. Small portions of the northern body of gabbro contain up to 70 per cent hornblende. Hornblende weathers more slowly than plagioclase giving the weathered

surface its typical roughness. Hornblende occurs as clusters of grains and is variable in amount from outcrop to outcrop.

Petrography

N. Alt
R-241
R-245
R-247
Altered
R-50
R-233

Thin sections examined from the three bodies of altered hornblende gabbro are fairly similar, differing slightly in the percentage of hornblende present. They consist predominantly of plagioclase, hornblende, chlorite, sericite and epidote group minerals. Accessory amounts of biotite, leucoxene, rutile, magnetite, ilmenite, pyrite, calcite, and quartz are present in some of the sections.

Plagioclase is in subhedral rectangular grains and has the composition of acidic labradorite. It is generally altered quite heavily to sericite and epidote group minerals.

Hornblende is in anhedral to subhedral grains and shows light green pleochroism. Some of the larger grains contain an oriented network of fine opaque needles. Remenants of a colorless pyroxene were noted in one section from the gabbro in the northwest part of the map area. It is probable that most of the hornblende is uralitic.

Foliated Hornblende Monzonite

Distribution

Foliated hornblende monzonite outcrops near the

the southern boundary of the map area. The majority of outcrops are on the sides or crests of glacially covered hills.

Lithology

The rock is equigranular, homogeneous, foliated, medium grained and jointed. It consists of 25 to 30 per cent hornblende and plagioclase. Accessory minerals include biotite, chlorite, epidote and magnetite.

Hornblende occurs as long prismatic grains averaging 1/4 inch in length. No lenticular masses or aggregates of hornblende grains were noted. Good alignment of prismatic grains of hornblende give the rock its good foliation. Linneation of hornblende is only fair.

Some of the plagioclase is in rectangular grains and shows good cleavage and polysynthetic twinning striations. However most of the original plagioclase grains are white to chalky white and in places show a light pink tinge.

A few flakes of biotite are present in some of the outcrops. The biotite is separated from the hornblende in places and so it is probably primary. Chlorite is present in varying amounts as an alteration product of hornblende. Epidote-filled fractures occur in many outcrops. Small disseminated grains of magnetite occur in most outcrops.

The fresh surface has a mottled black and white

appearance. The weathered surface is often dark and somewhat rough due to the greater resistance of hornblende during weathering. Some of the weathered surfaces are dark rusty brown.

Petrography

A-125
R-177
R-181
B-79

Four thin sections of the foliated hornblende monzonite were studied. Plagioclase, orthoclase and hornblende are the main constituents. Biotite is present in two of the sections. Sericite, chlorite, leucoxene and the epidote group minerals are the principal secondary minerals. Magnetite, sphene, apatite, zircon, and quartz are present in accessory amounts.

Plagioclase is present in subhedral rectangular grains, some of which show carlsbad twinning. Slight sericitization and some epidotization has taken place. Its composition is acidic andesine. Thin section study shows the rock to contain 10 to 15 per cent orthoclase and so it is herein referred to as monzonite rather diorite.

Hornblende occurs in subhedral prismatic grains 1 to 4 mm long containing some poikilitic inclusions of magnetite, zircon, and plagioclase. It shows good green pleochroism (gamma-bright rich green, beta--medium green, alpha--light yellow-green) and some grains show twinning on the front pinachoid. Generally about 20 to 30 percent hornblende is present.

Biotite is present in two of the sections as large separate grains or as intergrowths with hornblende.

It shows olive green pleochroism.

Chlorite is secondary after biotite and hornblende and contains long inclusions of leucoxene parallel to its cleavage.

Hornblende Gabbro

Distribution

A few outcrops of hornblende rich gabbro occur with the foliated hornblende monzonite southwest of lac Podeur on the southern boundary of the map area and on the peninsula forming the northwest shore of lac Germain.

Lithology

The rock is massive, medium-grained and consists of about 85 per cent hornblende and 15 per cent plagioclase. It is almost an amphibolite. The weathered surface is rough and black and the fresh surface shows white rectangular grains of feldspar embedded in a mass of black hornblende grains.

ACIDIC INTRUSIVE ROCKS

General

Acidic intrusive rocks cover about four fifths of the map area. Gneissic biotite granodiorite and minor amounts of gneissic biotite-hornblende granodiorite and gneissic hornblende granodiorite with inclusions of hornblende schist underlie much of the northern half of the map area. A rather massive biotite granite,

which is free from inclusions of hornblende schist, underlies the southern half of the map area. A small mass of biotite-augite monzonite outcrops northwest of lac Germain. Differences in mineral content, structure, and grain size are the main factors used in the field to distinguish between the various types of acidic intrusive rocks.

The rocks are divided into the following three groupings: gneissic granodiorite containing biotite, biotite and hornblende, and hornblende ; biotite granite and biotite-augite monzonite. No definite field criteria were noted which would indicate the age relationship between the three groups of acidic rocks. The order in which they are discussed is purely an intuative suggestion by the writer on the age relationship.

Gneissic Biotite Granodiorite

Distribution and lithology

Gneissic biotite granodiorite with inclusions of hornblende schist and minor amounts of gneissic biotite-hornblende granodiorite and gneissic hornblende granodiorite underlies much of the northern part of the map area.

The gneissic biotite granodiorite is uniform in composition and texture and is similar to the gneissic

biotite "granite" found to the northeast of the map area (Remick, 1957). The rock is grey, medium-grained, and consists of 20 to 30 per cent quartz, 10 to 15 per cent biotite and white feldspar most of which is plagioclase. Epidote and occassional grains of sphene are the chief megascopically visible accessory minerals.

Biotite shows good foliation either as single grains or paper thin lenticular folia. Biotite-rich bands were noted in a few places. Booklets of biotite rather than thin folia occur in the granodiorite along the shore of lac Germain, lac Lessard and rivière Germain. The booklets are between 1/8 and 1/4 of an inch in diameter and weather easily leaving slit-shaped voids on the weathered surface. This rock is more properly referred to as foliated biotite granodiorite.

The gneissic granodiorite south of lac Germain is cut by barren milky quartz veins and contains a few disseminated pyrite cubes. It is somewhat schistose in places. A finer grained biotite granite cuts some of the outcrops and probably is a later phase of the biotite granodiorite.

R-44
R-57
R-85
R-86
R-101
R-235

Petrography

Thin sections consist of about 40 per cent plagioclase, 15 per cent orthoclase, 30 per cent quartz,

10 per cent biotite, 3 to 5 per cent epidote group minerals and accessory amounts of magnetite, zircon, sphene, apatite, pyrite, chlorite, sericite, muscovite and leucoxene. Less than 1 per cent each microcline and hornblende were noted in one section only.

Plagioclase occurs in large subhedral rectangular grains and has the composition of acidic andesine. It is lightly altered to sericite and epidote group minerals. Orthoclase occurs in smaller grains.

Biotite is present in thin groups of long flakes with epidote and occurs between grains of plagioclase or quartz. Its gamma index shows dark olive green pleochroism.

Magnetite occurs in a few sections as large grains with and in biotite. Pyrite occurs as cubes in several slides.

The texture is medium grained and equigranular and the minerals, especially the biotite, show good foliation. Biotite occurs with epidote, magnetite and sphene in small lenticular masses and not as individual flakes. The term gneissic, rather than foliated, is therefore used for this rock type. The foliation of all the minerals is believed to be primary and to have been formed before the rock had solidified.

Under the microscope there are several mineralogical, textural and structural features which are characteristic of the gneissic biotite granodiorite and which are

lacking in the biotite granite. They are:

(1) The absence of microcline and disseminated euhedral crystals of sphene and magnetite.

(2) The ratio of potash feldspar to plagioclase is about 1 to 3.

(3) Biotite occurs in groups of large cleavage flakes forming thin lenticular layers with epidote, sphene and sometimes magnetite.

(4) Foliation of biotite is very good and that of the other minerals is fairly good.

(5) The epidote and biotite content are noticeably higher.

(6) Plagioclase is sodic andesine rather than sodic oligioclase.

(7) Pyrite occurs in some sections.

Gneissic Biotite-Hornblende Granodiorite and Gneissic Hornblende Granodiorite

Distribution and Lithology

These rock types usually occur together interlayered with gneissic biotite granodiorite between the two belts of hornblende schist. Some hornblende granodiorite occurs southwest of lac Brosseau and also northeast of lac Brosseau as "lit-par-lit" layers in the southern belt of hornblende schist. Layers of gneissic granodiorite rich in hornblende are limited in extent and are usually only a few feet or a few tens of feet in thickness. These granites may have up to 20 per cent

hornblende. The hornblende content for these rocks may have been derived from former blocks of hornblende schist as this rock type often occurs nearby.

The content of hornblende and biotite can be approximated from the weathered surface where the biotite has been partially dissolved by weathering, leaving slight linear depressions whereas the hornblende remains relatively unchanged. The weathered surface is generally rough as differential weathering has dissolved many of the minerals often leaving quartz sticking out above the other minerals.

Petrography

R-83
R-221
R-222
R-223
C-33

Thin sections of this rock are very similar mineralogically, texturally and structurally to the gneissic biotite granodiorite but differ from this rock in having some hornblende.

R-50
R-109

The rock consists of from 30 to 45 per cent plagioclase, 10 to 20 per cent orthoclase, 20 to 30 per cent quartz, 1 to 12 per cent biotite, 2 to 15 per cent hornblende, and 3 to 5 per cent epidote group minerals. Accessory pyrite, apatite, magnetite, zircon and sphene are also present. Chlorite, leucoxene and sericite occur as alteration products.

Hornblende occurs as large prismatic grains in lenticular groupings with biotite, epidote, magnetite and sphene. It is strongly pleochroic (gamma--bright rich green, beta--medium but deeper green, alpha--light yellow-green). Some grains are twinned on the front

pinacoid.

Magnetite occurs in lenticular folia with hornblende and biotite and is gnerallly more abundant than in the gneissic biotite granodiorite.

Some of the biotite is altered to chlorite with long grains of leucoxene parallel to the cleavage.

All minerals show a good primary foliation and are somewhat elongated in that direction. In addition biotite, magnetite, epidote, sphene, and hornblende occur in small thin lenticular folia or groupings giving the rock its gneissic appearance. The folia are generally not more than a centimeter in length.

Biotite Granite

Distribution and Lithology

The southern half of the map area is underlain by a fine-to medium-grained, fresh, generally massive, grey biotite granite of rather uniform composition and appearance. It consists of 1 to 8 per cent biotite, 20 to 20 per cent quartz, potash feldspar and plagioclase. Accessory amounts of magnetite are characteristically present in almost every specimen. Sphene and epidote are often present. Porphyritic grains of potash feldspar, ranging in size from 1/8 to over 2 inches in length, occur in varying proportions in some of the outcrops.

In the field the biotite granite may be differentiated from the gneissic biotite granodiorite which occurs to

the north by:

(1) The general massive nature of the rock, its granitic texture and lack of foliation of the biotite.

(2) The homogeneous distribution of minerals in the rock.

(3) A smaller content and smaller grain size of biotite.

(4) The presence of disseminated octahedra of magnetite.

(5) The presence of porphyritic or smaller sized grains of potash feldspar with poikilitic inclusions of the other rock forming minerals.

(6) The almost universal association with small veins and masses of pegmatite.

(7) The absence of other rock types, especially hornblende schist.

Most of the outcrops are massive and show a typical granitic texture. The minerals, especially biotite, are somewhat foliated near the outer margins of the biotite granite body.

The grain size varies from fine to medium. The fine-grained granite often has only 1 per cent and usually not more than 3 per cent biotite in very fine flakes, an equigranular texture, and a smooth weathered surface. The medium grained granite contains 4 to 8 per cent biotite, generally shows a porphyritic texture due to large potash feldspar grains and has a rough weathered surface. The magnetite content is often higher in the fine grained granite and sphene is more common in the medium grained granite.

Biotite occurs in both tiny flakes and in 1/8 inch flakes in the medium grained granite and only in tiny flakes in the finer grained granite. In both types of granite the tiny flakes of biotite are smaller than the other minerals present. The biotite content is between 4 and 8 per cent in the medium grained granite while it is usually under 3 per cent in the fine-grained granite.

Plagioclase occurs as rectangular grains showing good cleavage and polysynthetic twinning striations.

Quartz tends to fill the spaces between the feldspar grains. It commonly occurs as grains about 1/8 inch in size in the medium grained rocks.

Potash feldspar occurs as grains averaging 1/8 inch in most outcrops. The grains are 1/2 to 2 inches in length west of lac Yondotega, around lac Pierrefond and at the northern boundary of the rock body. They occur with the medium grained granite and are accompanied by a higher content of biotite. The finer grained granite usually has some potash feldspar grains not over 1/8 inch in length. The potash feldspar phenocrysts are roughly rectangular, show good cleavage and carlsbad twin halves, and contain poikilitic inclusions of all the rock minerals. They stick out noticeably on the weathered surface and give the rock a porphyritic appearance. The content of large potash feldspar grains

in the medium grained granite is about 10 to 15 per cent but there is some variation in amount in each outcrop.

No definite regional elongation of the potash feldspar phenocrysts was noted, but in places the elongation was parallel to a faint foliation and inter-layering of the fine and medium-grained granite.

Magnetite is a characteristic accessory mineral which occurs as small well formed octahedra in amounts ranging from a few grains to 0.5 per cent. The magnetite content of the fine-grained granite is often greater than that in the medium grained granite.

Sphene is usually present in the medium grained granite as perfectly formed light brown crystals. It often shows a wedge-shaped or acute rhombic outline. The prismatic form is dominant in the well formed crystals. It is not commonly found in the finer grained rocks.

Epidote occurs in small amounts in the medium-grained granite near biotite.

Small veins or masses of quartz-potash feldspar pegmatite characteristically cut almost every outcrop. Quartz veins, except on Father lake, are rare. Pyrite is extremely rare.

Alteration accompanied by quartz, pink feldspar and epidote veinlets has in places imparted a light pink tinge to a strong salmon pink color to the rock. It usually starts along fractures and joints. This is

especially noticeable in the outcrops along the shoreline of Father lake. A small granite island in Father lake on the east boundary of the map area in which the rocks are well fractured shows the extreme in this type of alteration. Here the feldspar grains are colored a deep salmon pink by a fine hematite dust. Specular hematite filled fractures and a few grains of purple fluorite occur with the rocks showing the strongest alteration. Where present this type of alteration has affected both the fine-and medium-grained granite.

Inclusions of hornblende schist, hornblende and other rock types seem to be absent from this rock body.

The finer grained granite cuts the medium-grained granite in the southeast corner of Father lake and at the forest rangers' cabin on the west shore of lac Giardini. The fine and medium grained granite appear interlayered at the forest rangers cabin. The layers strike between N. 50° E. and N. 60° E. and dip 30° to the northwest. A one inch wide pegmatite vein also strikes parallel to the layering. The finer grained granite is more resistant and so sticks out above the porphyritic medium-grained granite. The long direction of many of the potash feldspar phenocrysts (which occur only in the medium-grained granite) is roughly parallel to the layering. A large angular boulder at the firest rangers' cabin shows excellent layering of the medium-grained porphyritic granite with

the fine-grained equigranular granite. The bands are several inches wide and the long direction of the potash feldspar phenocrysts is roughly parallel to the strike of the bands.

R-137
R-138
R-139
R-142
C-92

Fine
R-128
R-145
R-150
R-178

Medium
R-88
R-89
R-105
R-111
R-123
R-133
R-135
R-146
R-165
R-1357
R-171
R-182
R-184
C-57
C-93
C-101
D-3

Gneiss
R-87
R-108
R-175
R-244
C-49

Petrography

An examination of 32 thin sections of biotite granite showed it to be quite uniform mineralogically. There is however some variation in the grain size, texture, and percentage of each mineral present.

The sections are fine to medium grained and equigranular to porphyritic. The finer grained sections are equigranular and the coarser grained sections are apt to be porphyritic. The minerals are homogeneously distributed throughout each section.

Plagioclase, microcline, orthoclase, quartz, and biotite are the main primary constituents. Sphene, magnetite, zircon and apatite are present in accessory amounts of 1 per cent or less. Muscovite, sericite, chlorite, leucoxene, epidote, zoisite and/or clinozoisite are characteristic alteration products which occur in almost every slide. Hematite, fluorite, and calcite occur in a few slides.

Plagioclase occurs as lightly sericitized subhedral rectangular grains and has the composition of acidic oligioclase. Much of the plagioclase is zoned and some grains show carlsbad twinning in addition to the usual

albite twinning. The plagioclase is somewhat altered to sericite, muscovite, epidote, zoisite and/or clinozoisite and calcite. Sericite and muscovite are the main alteration products. Sericitic alteration may be randomly distributed throughout the plagioclase grain or it may be structurally controlled andm may occur along alternate twin lamallae, the inner zone of a zoned plagioclase grain, or between some of the inner zones outlining the former euhedral shape of the grain. Muscovite occurs as large flakes having ragged terminations and sometimes irregular inclusions of plagioclase or later muscovite of a different orientation which has replaced the irregular plagioclase inclusions.

Orthoclase occurs in smaller grains often showing carlsbad twins. It is somewhat altered to sericite.

Microcline occurs as rather large unaltered anhedral grains having poikilitic inclusions of all the rock forming minerals. It is perthitic and often shows carlsbad twins. The grains vary in size from 1 mm. to over 5 cm in length and so the larger grains form phenocrysts. Inclusions of plagioclase and orthoclase are usually heavily sericitized. They are also rounded and often contain a light border free from sericitization. In addition some of the plagioclase and orthoclase bordering the microcline shows radially distributed worm-like intergrowths or rounded grains of quartz (?). Carlos

texture involving arms of microcline replacing plagioclase were noted in several sections. It is believed that these replacement features together with the unaltered nature and the lack of definite crystallographic boundaries for the microcline indicate that the phenocrysts were formed by replacement after the rock was in place and probably before it had fully cooled.

Biotite shows olive green pleochroism and occurs in separate and disseminated flakes which are generally smaller than the other minerals present. Inclusions of zircon with pleochroic haloes and occassionally sphene were observed. Some of the sheets of biotite are altered to chlorite with long thin grains of leucoxene paralleling the cleavage.

Generally about 1 per cent sphene is present as disseminated euhedral wedge shpaed crystals occurring in biotite, in other minerals, or between the grain boundaries. It is sometimes twinned. About 1 per cent or less magnetite is present as disseminated euhedra.

Zircon occurs as small euhedra in biotite having the usual pleochroic halo, occassionally in larger anhedral grains in the other minerals and between their grain boundaries. Several grains were zoned. Long prismatic crystals with bipyramidal terminations or crosssections of them occur in the biotite.

Apatite often shows the hexagonal crosssection.

Subhedral grains of epidote occur in and near biotite. They usually show a light yellow pleochroism which is most intense (bright yellow) at its contact with biotite.

Hematite occurs along fractures and around the boundaries of some minerals. It is usually near a crystal of magnetite and undoubtedly is an alteration product of magnetite.

Microscopically this rock differs from the gneissic biotite granodorite by:

(1) The presence of perthitic microcline which often contains poikilitic inclusions of the rock forming minerals.

(2) The ratio of potash feldspar to plagioclase is about 1 to 1.

(3) Biotite occurs as small separate disseminated flakes.

(4) Foliation is generally lacking and there is no lenticular grouping or layering of the dark minerals.

(5) The percentage of biotite and epidote is noticeably smaller.

(6) Plagioclase is sodic oligioclase.

(7) The presence of 0.5 to 1 per cent each of disseminated euhedra of magnetite and sphene.

Pegmatite

Distribution and Lithology

Small veins and masses of quartz-potash feldspar pegmatites are almost always found associated with the

biotite granite. They are not very common with the gneissic biotite granodorite. The pegmatite veinlets are 1 to 4 inches wide, several feet long and show fairly straight contacts with the granite. They show no zoning.

Several larger pegmatite masses occur on both sides of the falls at the northern end of lac Lessard.

Biotite-Augite Monzonite

Distribution and Lithology

Biotite-augite monzonite outcrops on relatively high hills in much of the map area directly northwest of lac Germain.

The outcrops grouped under this heading show some variation in grain size, mineral composition, color, structure, and character of the weathered surface. The characteristics are constant in any single hill of rock, but vary from one hill to another. In addition outcrops of biotite granite occur in this area.

The rock is fine- to medium-grained. It consists of from 20 to 25 per cent biotite and black augite in varying proportions, pink and white feldspar, a little quartz, and accessory pyrite and octahedra of magnetite. Hornblende occurs in some of the western outcrops.

Thin lenticular folia of biotite impart a gneissic character to some of the rock. Much of the rock is massive.

The weathered surface is often smooth. The fresh surface is usually pink. The weathered and fresh surface of some of the outcrops are a dirty yellow brown.

Petrography

R-10
R-11
R-14
R-60
R-65

Thin sections of samples taken from the eastern and central portion of the body consist of plagioclase, pyroxene, biotite, microcline and orthoclase. Accessory magnetite, apatite and zircon are present. Sericite, muscovite, uralitic hornblende, calcite and chlorite are the secondary minerals. In the western portion of the body the amounts of microcline, orthoclase and hornblende increase at the expense of plagioclase and pyroxene. Accessory amounts of sphene and quartz are also present in the western portion. The content of dark minerals ranges from 25 to 40 per cent in the eastern and central part of the body to 20 per cent in the western portion of the body.

Plagioclase is characteristically present as long and rather narrow rectangular grains showing carlsbad twinning in addition to albite twinning. Its composition is about mid-andesine. It is slightly sericitized. Orthoclase replaces some of the plagioclase and retains the carlsbad twinning. Worm-like remnants of plagioclase occur in some of the orthoclase. Microcline replaces plagioclase and orthoclase and increases in amount

toward the western portion of the rock body. The microcline is fresh, perthitic and shows carlsbad twinning. In a few places pseudomorphous microcline retains the long and rectangular outline of the replaced plagioclase grain. Except in one slide containing 50 per cent microcline, the ratio of potash feldspar to plagioclase feldspar is 1 to 2 .

It is believed that the pyroxene is colorless to very light green augite. Some grains show twinning on the front pinacoid. Uralitization has taken place periphially and along cracks. The amount of uralitization increases from east to west. A few remenants of pyroxene occur in the sections taken from the western portion of the body. The uralitic amphibole is green hornblende.

Biotite occurs as long flakes, some of which are slightly bent and show undulatory extinction. Of the five sections examined, biotite shows olive green pleochroism in four and chocolate brown pleochroism in the other. It is usually fresh and is present in smaller amounts than amphibole or pyroxene.

About 2 per cent magnetite occurs in the rock . It is in subhedral to euhedral grains and occurs within or bordering the dark colored minerals. The magnetite content of this rock type is high enough so that it will probably give a higher than normal magnetic anomaly.

About 0.5 to 1 per cent apatite is present as hexagonal crosssections of long hexagonal prisms with bipyramidal terminations. Some of the biotite contains euhedra of apatite.

UNALTERED BASIC INTRUSIVE ROCKS

Fine-Grained Diabase

Distribution and Lithology

Two small outcrops of fine- to almost medium-grained diabase were noted cutting the granite about 1 mile south of lac Germain. The outcrops are small and their direction could not be determined. The weathered surface is rusty brown and feels like a fine sand paper. The rock is fine to almost medium grained, dark grey, massive and contains accessory pyrite.

A small dyke of black aphanitic rock with a conchoidal fracture in which only a few small feldspar laths were visible was noted cutting the granite in the same vicinity. It is probably just a chilled facies of the larger outcrops of diabase.

Petrography

C-43 Under the microscope the rock is fine- to medium-grained and shows a good diabasic texture. It consists of 60 per cent plagioclase, 30 per cent pyroxene, and 2 per cent magnetite. A little late quartz and micrographic is also present as well as a few cubes of pyrite. The plagioclase is somewhat sericitized and has a minimum composition of calcic andesine.

Medium-Grained Diabase

Distribution and Lithology

Two outcrops of medium to almost coarse grained diabase cut the granite in the very northwest cornor of the map area. Their exact strike could not be ascertained , but it is believed to be northeast. The rock is fresh, massive and consists of about 30 per cent black pyroxene and plagioclase laths. Accessory amounts of epidote, pyrite, and magnetite-ilmenite are also present.

The rock shows a good diabasic texture with clusters of pyroxene partially enclosing plagioclase laths. The plagioclase shows good cleavage and polysynthetic twinning striations and the augite shows good cleavage. Some of the plagioclase has a light pink tinge. The weathered surface is rusty brown. Exfoliation has rounded the outcrops. This rock is similar to the diabase found to the northeast (Remick, 1957).

Petrography

R-188 A thin section of the medium-grained diabase consists of 55 per cent plagioclase, 25 per cent pyroxene and 5 per cent magnetite. Secondary minerals include chlorite, sericite, epidote, serpentine, amphibole, and hematite. A little pyrite is also present. The plagioclase is in long laths and is quite heavily sericitized. The pyroxene is in subhedral grains and is lightly altered to light brown amphibole and chlorite.

Small radial fibrous aggregates of serpentine having a bright green pleochroism fill in some of the spaces between the plagioclase laths. Epidote contains patches showing a rather bright yellow pleochroism. The high magnetite content of the rock would cause a high magnetic anomaly.

UNCONSOLIDATED SEDIMENTS

Unconsolidated glacial sediments of Pleistocene age consisting mostly of sand with some boulders, gravel and silt cover much of the area. Eskers, drumlins, esker troughs, sand plains, and ground moraine are the main depositional glacial features. Glacial striae, glacial groves and polished rock surfaces are the main erosional glacial features.

A heavy blanket of ground moraine covers much of the map area, expecially the southern fifth. A sand plain, deeply cut by small streams, covers the southeast corner of the map area. The sediments in this area are sorted but unstratified and consist of sand with a few round boulders and layers of clayey silt. Much of rivière Father has cut down through the sand and now flows on a floor of grey clayey-silt. A discontinuous southwest trending esker flanked by water-filled esker troughs on its southern side continues from Deland's area to the east into the southeast corner of the map area and trends southwest, leaving the area at the southern end of lac Podeur. Several braided eskers

border lac Fodsur.

A wide esker-like ridge runs southwest from a little north of lac Brosseau to the south end of lac Lorene. It is flanked by a flat sand plain on both sides.

Southwesterly trending drumlin-like hills are present in the northwest part of the map area. Some have a rock core.

Glacial striae and glacial grooves in the altered hornblende gabbro at the falls on lac Lessard give readings between N. 37° E. and N. 35° E. The glacial striae and glacial grooves in the granite on the east shore of lac Germain strike at N. 40° E.

Most of the large angular boulders noted during the course of the field season were generally within a few hundred or perhaps a few thousand feet of similar rock type. This is especially true of boulders of hornblende schist and gabbro.

STRUCTURAL GEOLOGY

Schistosity and Foliation

The schistosity and lenticular banding in the hornblende schist strikes east to slightly south of east paralleling the trend of the belts shown on the accompanying map. The dip of the schistosity in the western end of the southern belt of hornblende schist is about 75° to the north. The dip of the hornblende

schist in the central part of the northern belt is about 75° south and that in the western end of the northern belt about 75° north. The dips of the other portions of the hornblende schist are vertical or within a few degrees of vertical.

Foliation in the gneissic biotite granodiorite and that in the northern part of the biotite granite strikes slightly south of east in the western part of the map area, east-west in the central part of the map area, and slightly north of east in the eastern part of the map area.

Foliation in the hornblende monzonite is slightly north of east, paralleling the drawn geological contact with the biotite granite.

Drag Folds

Small drag folds are common in the small patch of hornblende schist which underlies the northeast side of the map area. The strike of their axial plane varies from N. 20° E. to N. 35° E. which is about normal to the schistosity in these rocks. Veins of quartz and feldspar injected parallel to the schistosity of the hornblende schist follow the drag folds.

Faulting

It is quite possible that the contact between the small patch of hornblende schist which outcrops at the

northeast side of the map area and the acidic rocks to the west is a fault contact. The abrupt end of the schistosity of the hornblende schist nearly normal to its contact with the acidic rocks to the west supports this belief.

Jointing

Three sets of joints, one nearly horizontal and two nearly vertical, striking about nort-south and about east-west, characteristically occur in the biotite granite (Plate VI-B). Jointing parallels the rocky shoreline of Father lake. Two nearly vertical sets of joints, striking about north-south and about east-west, are present in a few of the outcrops of gneissic biotite granodorite.

ECONOMIC GEOLOGY

Mineralization in the Hornblende Schist

Disseminated pyrite occurs in the hornblende schist in individual cubes and as small lenses associated with small amounts of injected quartz. A little chalcopyrite was noted in a few of the granular quartz-epidote lenses in the western part of the southern belt of hornblende schist. Rusty weathered surfaces occur in places in the hornblende schist.

Mineralization in the Gneissic Biotite Granodiorite

The granite on the east shore of lac Germain and that to the southeast of lac Germain is cut by barren quartz veins. A few cubes of pyrite and small schistose

zones occur in this area.

Mineralization in the Biotite Granite

Alteration of some of the biotite granite on the shores of Father lake has given this rock a light to deep salmon pink color. This color is deepest and the alteration strongest on a small island at the eastern boundary of the map area. Several fractures filled with specular hematite and a few grains of purple fluorite were noted in this outcrop along with a good deal of close fracturing.

A little molybdenite was noted in a large angular boulder of coarse-grained amphibolite found on the high hill of biotite granite separating lac Yondotega and lac Giardini. The molybdenite was associated with granite filled fractures which cut the rock.

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Plate I

3411-57-H

A--Looking east-southeast from the fire tower on the west shore of lac Giardini. The northern two-thirds of lac Yondotega is shown in the background.

3412-57-H

B--Looking southeast from the fire tower on the west shore of lac Giardini. This photo adjoins the right side of Photo A above.

Plate II

Photo manquante 3404-57-H

A--The east shore of the southern part of lac Germain. The hill of hornblende schist shown in the photo below stands out in the background a little to the right of center.

3405-57-H

B--A heavily wooded hill of hornblende schist just east of lac Fayolle.

Plate III

3402-57-H

A--Looking north from the top of the hill shown in Photo B of Plate II. The terrain is gently rolling.

3406-57-H

B--The south shore of lac Brosseau. Note the low relief of the marshy terrain.

Plate IV

3416-57-H

A--Looking at the northeast shore of lac Bonnemain. Heavily wooded hills of biotite granite can be seen in the background.

3418-H-57

B--Looking northwest along the west shore of the southern part of Father lake. Steep granite hills form the western shoreline.

Plate V

3407-57-H

A--A heavily wooded and glacial covered hill of biotite granite on the west shore of lac Giardini. A forest tower (not shown in the photo) is ontop of the hill.

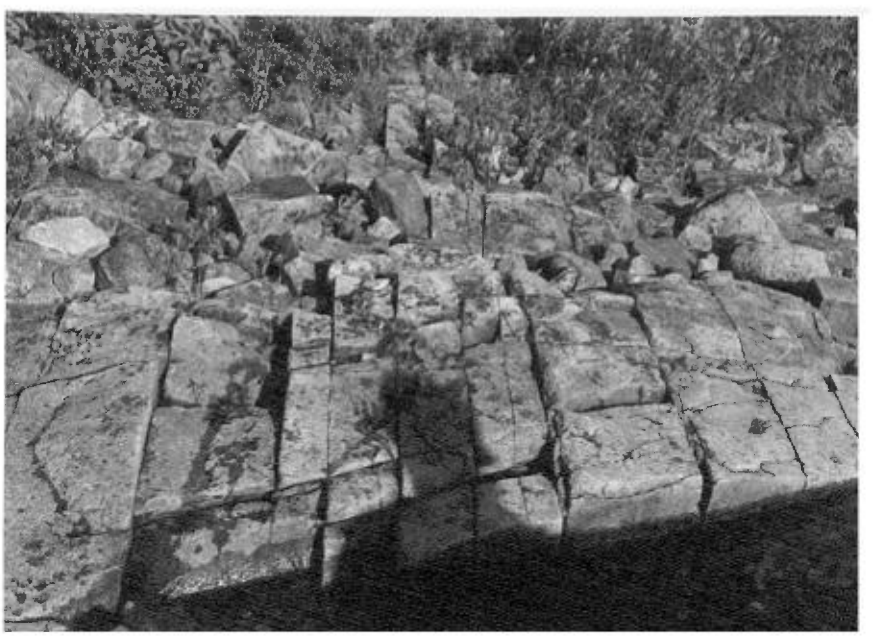
3424-57-H

B--Looking north at the falls at the northern end of the southern half of lac Lessard.

Plate VI

3397-57-H

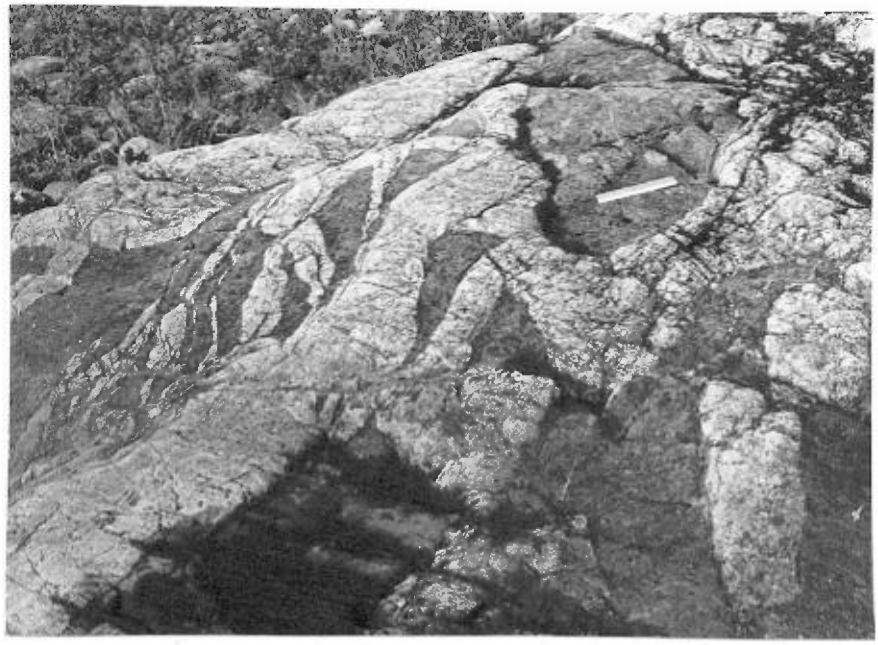
A--A small hill of jointed biotite granite on the east shore of the southern part of lac Germain. This photo is of the central part of the shoreline shown in Photo A of Plate II.



3417-57-H

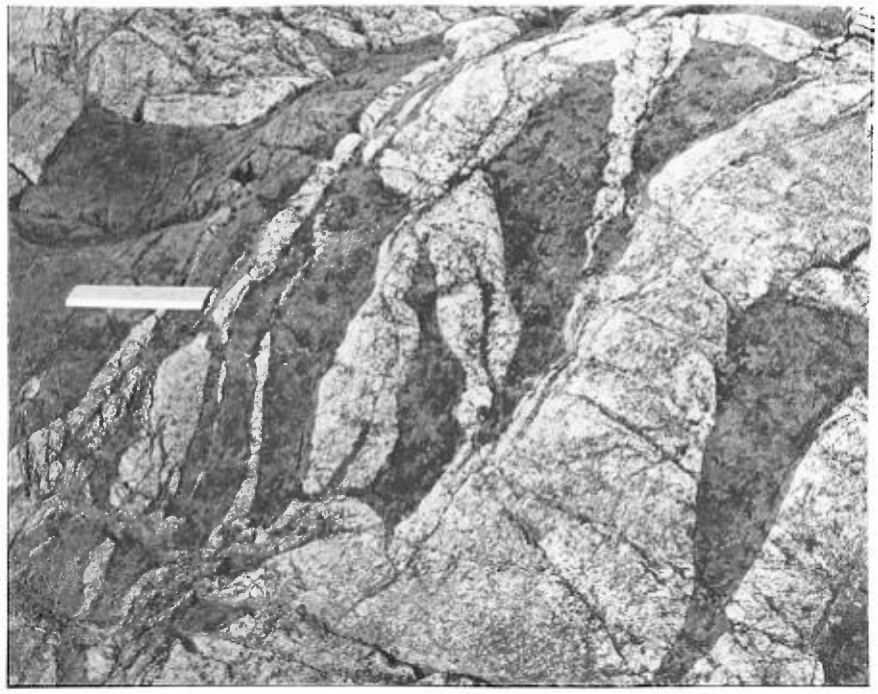
B--Well jointed biotite granite on the east shore of Father lake showing two vertical and one nearly horizontal set of joints.

Plate VII



3421-57-H

A--Intrusive breccia of migmatized hornblende schist in biotite granite on an island in lac Lessard. The scale is shown by a six inch ruler.



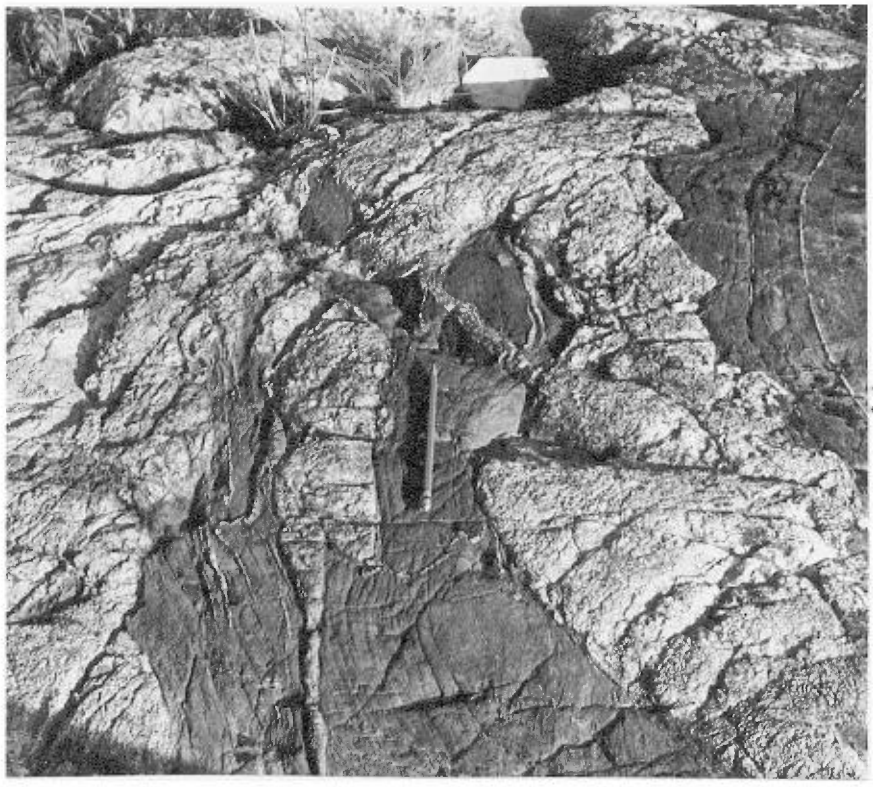
3422-57-H

B--A detail view of the left hand portion of the above photo. The granite intrudes the migmatized hornblende schist nearly parallel to its schistosity. The scale is shown by a six inch ruler.

Plate VIII

3427-57-H

A--Biotite granite intruding hornblende schist along its schistosity on the east shore of lac Lessard at the termination of the northern belt of hornblende schist. A pencil in the central part of the photo shows the scale.



3426-57-H

B--Detail of the above photo. Note that much of the granite intrudes the hornblende schist parallel to its schistosity. A pencil in the central part of the photo shows the scale.

157 Ridge Road
Grosse Pointe Farms, 36
Michigan
17 March 1958
St. Patrick's Day

Dear Dr. McGerrigle:

Under separate cover I am sending you my final report and map for my 1957 work. A copy of this letter is enclosed with each report.

THE REPORT: I understand that this report will be published with my final report for my 1958 field work. Would you take one copy of my 1957 final report and read it over, noting places where I have given too much detail and places where I have not given enough detail. Also if there are poor phrases or grammar, would you correct it. Another item you might correct is the information given under the various headings (especially the introductory material) and my organization. We will assume that my petrology and petrography are correct. If you would look over my report with these changes in mind it would save a great deal of time and produce a better final report for 1958. I will take the corrected copy in the field. I regret having made the same errors of grammar in this final report as I made in the preliminary report, but I never received an edited copy of my 1957 preliminary report.

Since the writing of my final report, several things bother me a bit so I want to set them down. The most important is the use of the word monzonite in place of the field term diorite. The content of alkali feldspar is not great in these rocks and they could conceively be termed diorites. I would be glad to follow departmental and current usage on the subject. It might only stretch the term diorite a small bit.

THE MAP: Since the map I am sending you and the map I shall do this summer will be published as a unit, I did not wish to mark my linen with various rock subdivisions, especially in the granodorite field. You will therefore find these subdivisions indicated on ink on the ozilid map which bears the original copy of the legend and symbols. All copies of the map show the same contacts.

The contacts are not put on the linen map as they are subject to change in regard to Deland's 1955 area and my 1958 area. There is much glacial covering and so few outcrops and so contacts can be shifted somewhat. I shall draw the final contacts after my 1958 field season.

I have tried to follow the procedure that you and Mac advised in putting together the final report. The photos are glued with rubber cement and may be easily removed and the cement rubbed off. The thin sections are in the margins of the appropriate places. The photograph numbers are on the back of each photo and on the corresponding page.

Sincerely, Jerome H. Remick