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LAC GEORGET AREA (SAGUENAY COUNTY) - RAPPORT FINAL

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MINISTÈRE
DES RICHESSES
NATURELLES

DIRECTION GÉNÉRALE
DES MINES

LAC GEORGET AREA

-SAGUENAY COUNTY-

A.J. Sinclair

Rapport final

MINISTERE DES RICHESSES NATURELLES
EXPLORATION GEOLOGIQUE

LAC GEORGET AREA

-SAGUENAY COUNTY-

Rapport final

par

A.J. Sinclair

1960

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MAP: See map 1316 of PR 414 (1" = 1 mi.)

INTRODUCTION

General Statement

Field mapping in the Lac Georget area was carried out during the summer of 1959 as part of a large-scale mapping project by the Quebec Department of Mines in the Mount Reed-Mount Wright district, Saguenay county. The district is important for its vast resources of low grade, concentrating-type, metamorphosed, sedimentary iron ore.

The Lac Georget area, which lies within the Grenville province, is underlain by high grade regionally metamorphosed rocks, including semipelitic gneiss, feldspathic granulite, microcline gneiss, and meta-gabbro. Isolated outcrops of quartzite, calc-silicate rock, and grunerite-quartz-carbonate rock are present, and resemble the basal members of the iron formation sequence common to neighbouring areas (e.g. Phillips, 1958). Iron formation of economic interest was not found.

Location

The Lac Georget area is about 160 miles north-northwest of Sept Isles. The map-area comprises 185 square miles and is bounded by north latitudes $52^{\circ} 15'$ and $52^{\circ} 30'$, and west longitudes $68^{\circ} 00'$ and $68^{\circ} 15'$. Most of Boucault township, and parts of Claudel, Surveyor, Roz, Gomez, and Sevestre townships are included in the area.

Access

Direct access to the area is by float plane from Sept Isles. Numerous lakes are suitable for landing of small float aircraft, and the large lakes, Le Cocq, Split, and Georget, can accommodate Canso aircraft.

No navigable water routes extend into the area. In the past trappers have reached the area from the Moisie river, 18 miles east of Lac Georget, but numerous long portages are necessary.

The southern boundary of the area lies about 25 miles north of the northern limit of the Shelter Bay-Jeannine Lake access road. This is an improved gravel road owned by Quebec Cartier Mining Company, and a permit from this company is required before the road may be used for travel.

Within the area a thin cover of trees affords easy travel by foot. Canoe travel is restricted to lakes and the southern part of the Themines river. Most of the streams are shallow and rocky.

Field Work

Field data were plotted on a one-half mile to the inch basemap supplied by the cartographic branch of the Quebec Department of Mines. In the field, extensive use was made of R. C. A. F. aerial photographs and an "advance edition" topographic map prepared by the Dept. of Mines and Technical Surveys, Ottawa.

The area was covered systematically by pace-and-compass traverses run at one-quarter to one-half mile intervals. Shoreline geology of many of the lakes was carried out.

Acknowledgments

Field assistants were Pierre Gillain, senior assistant; Michael Easdon, Howard Wiggett, Jean Vezina, and Michael Feeney, junior assistants; Charles Ouellet, cook; and Adelard Jordain, canoeman. These people carried out their work in a satisfactory manner.

Previous Work

Exploration companies have been active in the Mount Reed-Mount Wright district for the past decade but no geological information has been recorded from the Lac Georget area. A large adjoining region, to the east, has been mapped by Duffell and Roach (1959) on a scale of 4 miles to 1 inch. Within this large region, one-half mile to the inch mapping has been carried out by Phillips (1958, 1959), Murphy (1959a, 1959b), and Clarke (1959).

Mackean (1959) has mapped the Mount Reed area which is south of, and adjoins, the Lac Georget area.

DESCRIPTION OF THE AREA

Settlement and Resources

The area is uninhabited, although in the past it has served as winter trapping grounds for Indians from the Maliotanem Reserve, near Sept Isles. Organic soil is scarce, thus the agricultural potential of the area is negligible. The climate is subarctic and the prevailing wind is westerly.

Except for a small burn west of Lac Georget, the area is sparsely forested with black spruce 4-7 inches at the butts, and minor amounts of larch, balsam, alder and birch. In the southern third of the area the cover of trees is particularly thin, although larch and balsam become more abundant than to the north. Near the northern boundary of the map-area are two small "stands" of tall, straight spruce, with up to 18 inch butts. These stands are located 3 miles north of the northern tip of Pack lake, and 1 1/2 miles west of the southern end of North lake. Both stands cover an area of less than 1/2 square mile.

Animal life is not abundant in the region. Caribou, ducks, and several varieties of small birds

were observed during the 1959 field season. Old beaver houses and dams are plentiful, but the only fresh beaver cuttings found were southeast of Portage lake. Pike, sucker, and speckled trout are scarce in the lakes and streams.

Physiography

Topography

The main topographic feature in the Lac Georget area is the remarkably even surface which is broken intermittently by hills of bedrock that rise gently to a height of 200-300 feet above the general level. Maximum relief is 650 feet, with elevations above mean sea level ranging from 2000 feet near Lac Le Cocq, to 2650 feet on a hill one mile west of North lake. Hills are most abundant around the north end of Split lake, and to the east of Pack lake. The area represents an uplifted peneplain with a southerly slope, whose features have been modified by Pleistocene glaciation of Wisconsin age. Small ridges of till and glaciofluvial deposit add to the undulating character of the surface. Hills and ridges generally have a pronounced elongation in a north-northwest direction.

Outcrops are scarce, and are confined mainly to hillsides and a few stream beds.

Drainage

Most of the area is drained by the south-flowing Themines river, which forms part of the headwaters of the Manicouagan river. East and southeast of Lac Georget the streams flow southeast into the Hart Jaune river, and north of Pack lake, drainage is

into an unnamed lake which impinges slightly onto the northeast corner of the area. Streams are consequent on Pleistocene deposits. The drainage pattern is mostly deranged although the Themines river has a pinnate pattern where it crosses the central part of the area.

Many of the small streams and elongate lakes are aligned sub-parallel to the direction of movement of the Wisconsin ice sheet; that is, a north by north-northwest direction.

GENERAL GEOLOGY

Outline of Regional Geology

Duffell and Roach (1959) have mapped an area of 3200 square miles, east of and adjoining the Lac Georget area. Their map-area (Mount Wright) lies within the Grenville province close to the Grenville "front". The generalized Precambrian stratigraphic sequence proposed by Duffell and Roach is given in table 1.

Table 1: Precambrian Stratigraphic Sequence in the Mount Wright Map-area (Duffell and Roach, 1959).

	Gabbro, minor intermediate and ultrabasic rocks, commonly metamorphosed to amphibolite.
PROTEROZOIC	Hornblende-garnet gneiss and migmatized equivalents, graphitic gneiss, granitic gneiss.
	Iron Formation Sequence: marble, quartzite, recrystallized chert, metamorphosed iron formation.
ARCHEAN (?) AND	Biotite-feldspar gneiss, hornblende-biotite-feldspar gneiss, with migmatitic equivalents, biotite-muscovite gneiss, granitic gneiss, minor muscovite and kyanite gneiss.
PROTEROZOIC	Charnockite Suite: sub-horizontally layered granitic and dioritic hypersthene-biotite gneiss, minor amounts of pyroxene-bearing basic lenses and inclusions.

The Mount Wright area is divided into 3, nearly east-trending zones. The charnockite suite constitutes the northern zone; iron formation occurs mainly as infolded synclines in the biotite-feldspar gneiss of a large central zone; and hornblende-garnet gneiss makes up a southern zone. Small basic and ultrabasic

intrusions occur here and there.

The central and southern zones are interpreted respectively as an "anticlinorium" and a "synclinorium". The Lac Georget area is on the westward extension of parts of the central and southern zones.

Mapping on a scale of 1/2 mile to the inch in the Mount Wright region by the Quebec Department of Mines has shown that at least 2 periods of folding have affected certain areas (Mackean, 1959; Phillips, 1958; and Murphy, 1959). Also, detailed stratigraphy of the iron formation sequence in various localities has been worked out, and is presented in table 2. Murphy (1959) states that marble and quartzite, the basal members of the iron formation sequence, are, in part, comparable time-rock units. He also suggests that the silicate facies and oxide facies of the iron formation are equivalent in age, and represent respectively, original deep and shallow water depositional environments. Knowles and Gastil (1959) have further emphasized the importance of the sedimentary facies concept, in their discussion of the metamorphosed iron formation sequence at Wabush lake, 24 miles northeast of Mount Wright.

General Geology of the Lac Georget Area

The rocks of the Lac Georget area are Precambrian gneisses, granulite, and minor amounts of quartzite, calc-silicate rock, grunerite-carbonate-quartz rock, peridotite, and metagabbro. The map-area is divided into north, central, and southern zones of nearly equal size.

The northern zone is underlain by the North Lake gneisses of unknown stratigraphic position, and includes oligoclase-quartz gneiss, microcline gneiss, and minor amounts of oligoclase-hornblende gneiss, and coarse grained biotite-garnet-oligoclase schist.

Table 2: A Compilation of the Detailed Stratigraphy of the Iron Formation Sequence at Various Localities Within the Mount Reed-Mount Wright District, Quebec.

Mount Reed (Mackean, 1959)	Mount Wright (Murphy, 1959)	Peppler Lake-east half (Phillips 1959)	Tuttle Lake Phillips (1958)
	Muscovite-quartz schist	Garnet-mica schist kyanite	Garnet-muscovite- biotite schist
		Garnet-hornblende gneiss	Garnet-hornblende gneiss
		Chlorite-silicate- magnetite schist	Grunerite-chlorite- magnetite schist
Quartz-iron oxide formation	Oxide iron formation	Magnetite and/or specularite quartzite	Magnetite and/or specularite quartzite
	Conglomerate		
Iron silicate formation	Silicate iron formation	Silicate-carbonate quartzite, and sil- icate gneiss	Grunerite-carbonate- magnetite quartz- ite
Quartzite	Quartzite	White quartzite	White quartzite
Dolomite	Marble	Marble	Marble

Oligoclase-quartz-biotite gneiss and small amounts of graphitic schist, biotite schist, and oligoclase-quartz-microcline gneiss are the characteristic rock types of the Lac Georget gneisses in the central zone. All outcrops of the iron formation sequence including quartzite, dolomitic marble, calc-silicate rock, and grunerite-carbonate-quartz rock found in the area, occur within the central zone.

The southern zone is underlain by feldspathic granulite and a few outcrops of metagabbro and peridotite.

Pleistocene and Recent deposits cover 98% of the area and consist mostly of till, glaciofluvial deposits, and peat.

A table of formations is given in table 3.

SOUTH ZONE

Feldspathic Granulite

The southern zone is underlain mainly by medium grained granular rocks of variable macroscopic appearance due to presence or absence of gneissic structure and augen of feldspar, and variation in mafic mineral content. The mineralogy of these "granulites"¹ is the same, but for purposes of discussion they can be divided into two groups: feldspathic granulite in which feldspar constitutes over 75% of the rock, and mafic granulite in which mafic minerals comprise more than 30% of the rock. All gradations of composition exist between these two extremes.

¹The term granulite is used to define a granular metamorphic rock.

Table 3: TABLE OF FORMATIONS

CENOZOIC	Recent beach sands and peat deposits Pleistocene glacial and glaciofluvial deposits.
PRECAMBRIAN	Peridotite
	Pegmatite
	Metagabbro
	Iron formation sequence: (a) quartzite, (b) calc-silicate rock, (c) grunerite-carbonate-quartz rock, (d) dolomitic marble.
	Lac Georget gneisses: (a) oligoclase-quartz-biotite gneiss, (b) graphite schist, (c) biotite schist (d) granite gneiss.
	Rocks of Unknown Stratigraphic Position. North Lake Gneisses: (a) oligoclase-quartz gneiss, (b) microcline gneiss, (c) plagioclase-hornblende gneiss, (d) biotite-garnet-oligoclase schist. Feldspathic Granulite: possibly includes migmatized equivalents of the Lac Georget gneisses.

Feldspathic granulite is pale to medium grey on the weathered surface, and blue-grey porphyroblasts of potash feldspar up to 1 inch long stand out slightly in relief. On the fresh surface the rock is pink to pale yellow-grey and has a mottled appearance due to potash feldspar porphyroblasts. The texture is granoblastic with an average grain size of 0.3 mm. In a few places gneissic structure is present but is normally weakly developed. Ordinarily the rock is structureless. In some cases, such as east of Portage lake, the granulite appears to be a mass of coalesced feldspar augen.

An average composition is: oligoclase-An₂₄ to An₂₈ (70%), potash feldspar (8%), quartz (6%), biotite (5%), hornblende (4%), diopside (3%), garnet (3%), and minor apatite, sphene, zircon and magnetite. An outcrop 1 1/2 miles west of the south end of Lac Georget contains 6% chlorite.

Quartz and plagioclase occur as anhedral crystals with plagioclase rarely idioblastic against quartz. The plagioclase is rarely antiperthitic. Potash feldspar porphyroblasts are perthitic and are normally fractured. Hornblende, biotite and diopside occur as small irregular clots encircled by small euhedral garnet crystals. The pleochroism of hornblende is dark green to pale yellow-green, and of biotite is dark brown to pale yellow-brown.

North of Lac Le Cocq and northeast of Split lake are small zones of feldspathic granulite containing numerous dark inclusions of variable size, shape and degree of angularity. In outward appearance the inclusions are composed of medium grained, granular mafic minerals with minor red garnet and feldspar. A thin section examination showed the composition to be oligoclase-An₂₅ (50%), hornblende (20%), biotite (20%), diopside (5%), garnet (3%), and rare apatite, magnetite and sphene. Note the similar mineral assemblages of

the inclusions and the feldspathic granulite.

There are two possible origins for the dark inclusions in the feldspathic granulite--remnants of metasomatic processes, or inclusions in an igneous intrusion. Considering the angularity of many of the inclusions it is difficult to picture them as being remnants of replacement. Probably they represent xenoliths in an igneous body emplaced prior to regional metamorphism.

Mafic granulite is similar mineralogically and texturally to the feldspathic granulite. The important differences between the two rocks are presence or absence of structures and different mafic-felsic ratios. The mafic rocks contain about 30% combined hornblende, biotite and diopside, and normally have gneissic structure, feldspar augen up to 1 inch long, or lit-par-lit pegmatite layers. The feldspathic granulite rarely shows well developed gneissic structure, contains no feldspar augen, and hornblende, biotite and diopside rarely total more than 10% of the rock. It should be emphasized that rocks are found with properties intermediate between the mafic and feldspathic granulites and that a distinction between the two extreme types is arbitrary.

Because of the wide range of mafic to felsic ratios, the similarity of mineralogy, and the preponderance of feldspathic granulite over the mafic-rich variety, the two rock types are grouped together on the accompanying map.

The origin of the granulitic rocks is obscured because metamorphic convergence has resulted in the formation of similar mineralogies of what were different rock types prior to regional metamorphism.

The mineral assemblage is unstable compared with the theoretical assemblages given by Turner and

Verhoogen (1951), and Fyfe, Turner, and Verhoogen (1958). The rock is in the almandine amphibolite facies. The association garnet-microcline, and the lack of muscovite and epidote suggest the rock is in the sillimanite almandine subfacies,

NORTH ZONE

The North Lake Gneisses

Oligoclase-Quartz Gneiss:

Oligoclase-quartz gneiss, the most abundant rock type in the North Lake gneisses, is best exposed on a hilltop one mile west of the south end of North lake. The rock has a medium to coarse, granular texture, and a gneissic structure with layers varying up to one inch in thickness. The colour is pale-grey on the weathered surface and pink, white, or pale-grey on the fresh surface. The range in composition, obtained by examination of thin sections, is: oligoclase (50-80%), quartz (10-40%), biotite (3-10%), epidote (2-6%), and the accessory minerals, microcline, sphene, muscovite, chlorite, apatite, and iron ores (trace to 3%).

A hand-specimen distinction between the Lac Georget gneisses of the central zone, and mafic-rich North Lake gneisses of the northern zone, is made by the presence of epidote and the lack of garnet in the North lake gneisses. Conversely the Lac Georget gneisses contain garnet and lack epidote. Also the Lac Georget gneisses normally contain more than 10% mafic minerals.

Oligoclase porphyroblasts, containing numerous small inclusions of epidote, constitute 5% of the oligoclase-quartz gneiss. Epidote, as subhedral to euhedral crystals, is commonly associated with biotite-

rich layers. The biotite flakes are aligned parallel to the gneissic structure, are slightly chloritized and have a pleochroic formula Y=Z = greenish brown, X=pale yellow-brown. Chloritized biotite indicates slight retrogressive metamorphism of the staurolite-quartz subfacies stable assemblage oligoclase-biotite-epidote-muscovite-microcline.

Microcline Gneiss:

All microcline-rich rocks of the northern zone, which include migmatite, white microcline-oligoclase-quartz rock, and gneissic microcline granite, are grouped in the microcline gneiss unit. Because of their variation in macroscopic appearance, the rock types are discussed individually below.

A large outcrop of migmatite 1/4 mile south of Snail lake, forms a series of rapids in the Themines river. The migmatite consists of alternating layers of coarse-grained, pink, microcline-quartz pegmatite, and pinkish-grey, medium-grained, granular, dark layers, both up to several inches thick. The dark layers form 75% of the rock and have a thin gneissic structure consisting of discontinuous dark and light coloured laminae less than 2 mm. thick. The mineral composition of the dark layers is: microcline (40%), oligoclase-An₂₇ (30%), quartz (25%), and minor amounts of biotite, muscovite, apatite, and chlorite. The texture is granoblastic with an average grain size of 1 mm. Muscovite and feldspar are commonly symplektitic. Biotite has a pleochroic formula Y=Z=dark greenish-brown, X=pale yellow-brown,

and is partly chloritized. Micas are arranged sub-parallel to the gneissic structure. The rock is in the staurolite-quartz subfacies of the almandine-amphibolite facies.

An outcrop of oligoclase-quartz gneiss, 1-3/4 miles northwest of Pack lake, contains a 10 foot thick layer of a coarsely crystalline white rock, similar in composition to the dark layers of the migmatite. A rock with the same composition and appearance as the white layer is exposed 3 miles southwest of the northeast corner of the map-area.

Pink, coarse-grained, gneissic granite outcrops 3 miles west of the south end, and 1-1/2 miles east of the north end, of Snail lake. Seventy-five percent of the rock is composed of microcline, and the remainder consists of quartz, altered plagioclase, and some muscovite, biotite, chlorite, and apatite. On the weathered surface the rock is pale pinkish-grey, and joint faces are brick-red. Gneissic structure is weakly developed.

Hornblende-Plagioclase Gneiss:

Four small outcrops of hornblende-plagioclase gneiss were found 1 mile south of the northeast corner of the map-area on the east boundary, at the south end of Snail lake, 1/4 mile west of the south end of North lake, and 3 miles west of Long lake. The weathered outcrop surface is dark grey in colour and limonite stain is present here and there. Gneissic structure, consisting of 5% discontinuous felsic layers up to 5 mm. thick, can be seen on the fresh

surface. The compositions of specimens from the Snail Lake outcrop and the east boundary outcrop are given in table 4.

Table 4: Composition of Hornblende-Oligoclase Gneisses.

Mineral	Snail Lake outcrop	East Boundary outcrop.
Oligoclase	45%	54%
Hornblende	20	38
Biotite	20	1.5
Quartz	5	2
Epidote	8	Trace
Sphene	1	Trace
Apatite	Trace	1
Opaque Minerals	Trace	1.5
Garnet	-	2

The plagioclase has a granoblastic texture and an average grain size of 0.8 mm. Elongate feldspar in the East Boundary outcrop, hornblende, and biotite are aligned parallel to the compositional layering.

Hornblende occurs as anhedral, elongate grains with a pleochroic formula X=pale yellow-green, Y=green, and Z=deep grass-green, and an absorption scheme $X < Y < Z$. Biotite forms euhedral grains with a pleochroic formula Y=Z=brownish green, X=pale yellow-brown; and an absorption scheme $Y=Z > X$. Quartz occurs as lenticular masses up to 1 inch in length in the east boundary outcrop, and as evenly distributed anhedral grains in the other outcrops. Epidote is present as subhedral to euhedral crystals, some of which show a faint pleochroism from yellowish to colourless.

The mineral assemblage oligoclase-hornblende-biotite-epidote-garnet, places the rocks in the staur-olite quartz subfacies of the almandine amphibolite facies. Absence of garnet from the Snail Lake outcrop is explained by the inconstant occurrence of garnet in plagioclase-

hornblende gneisses (Harker, 1939, p. 284).

Originally the rocks may have been calcareous chloritic shales or intermediate to basic volcanics. The lack of preserved primary structures does not permit a precise designation of the parent rock.

Biotite-Garnet-Oligoclase Schist:

An outcrop of coarsly crystalline biotite-garnet-oligoclase schist is situated on the northeast corner of a small lake 3 miles north of Pack lake. The rock weathers to a light grey colour, and garnet stands out in relief over biotite and felsic minerals. A fresh surface has a mottled appearance due to numerous red, euhedral garnet porphyroblasts up to 1 cm. in diameter, set in a dark grey matrix of biotite, oligoclase, and quartz. The wavy schistosity is due to the growth of large garnet crystals.

Mineral components of the rock are biotite (35%), garnet (30%), oligoclase (26%), quartz (5%), and accessory sphene, apatite, potash feldspar, magnetite, and chlorite, (4%). Felsic minerals are anhedral, have a granular texture, and have an average grain size of 1 mm. Garnet is poikiloblastic and contains numerous inclusions of quartz. Euhedral biotite has a strong parallel alignment, is curved around garnet crystals, and has a pleochroic formula $Y = Z = \text{red-brown}$, $X = \text{pale yellow-brown}$, and has an absorption scheme $Y = Z > X$.

The mineral assemblage biotite-garnet-oligoclase-quartz places the rock in the almandine amphibolite facies.

The rock was originally a pelitic sediment.

CENTRAL ZONE

The Lac Georget Gneisses

The Lac Georget Gneisses, including oligoclase-quartz-biotite gneiss, and minor graphite schist, biotite schist, and granite gneiss, underlie the central zone, and are best exposed along the Themines river and east of Pack lake.

Oligoclase-Quartz-Biotite Gneiss:

Oligoclase-quartz-biotite gneiss has a dark grey to black weathered surface with numerous, irregular rust-coloured streaks. Quartz lenticules, up to 1 foot in length, and irregular, discontinuous, pegmatite layers varying up to 1 inch in thickness, rarely constitute 5% of the rock. A weak to well-developed gneissic structure is present, with discontinuous layers about 2 mm. thick. A few of the biotite-rich outcrops are schistose.

On the fresh surface the rock has a pale grey to dark grey colour, and a granoblastic texture with a grain size ranging from 0.5 to 1 mm. Mica flakes are aligned parallel to the gneissic structure and small lineations (corrugations) are present in the plane of foliation.

The range of compositions is: oligoclase (20-60%), quartz (20-50%), biotite (5-20%), muscovite (0-15%), and accessory minerals, including garnet, apatite, zircon, graphite, antiperthite, magnetite, tourmaline, limonite, sphene, epidote, chlorite and sericite (about 5%). The minerals are fresh in appearance with rare examples of alteration being--sericitization of plagioclase and chloritization of biotite.

Quartz is generally less abundant than oligoclase, and both minerals occur as anhedral grains with a granoblastic texture. Oligoclase ($An_{24}-An_{30}$) is commonly gradationally zoned (rims slightly more calcic than cores), and is rarely idioblastic against quartz. Biotite has a pleochroic formula $Y=Z$ =red brown, X =pale yellow-brown, and generally contains small inclusions of zircon surrounded by pleochroic haloes. Garnet is the commonest accessory mineral, and occurs as subhedral to euhedral crystals 2 mm. or more, in diameter.

The assemblage oligoclase-quartz-biotite-muscovite-garnet places the rock in either the stauroilite-quartz, or the kyanite-muscovite-quartz subfacies of the almandine amphibolite facies.

The rock was originally a semipelitic sediment.

Biotite Schist:

Biotite schist outcrops 1-1/4 miles north of Pack lake. The rock is dark brown (limonite) on the weathered surface, and lustrous black on the fresh surface. Abundant large biotite flakes with parallel alignment give the rock its shistose structure. Mineral components are: biotite (60%), plagioclase (26%), calcite (6%), quartz (5%), and minor amounts of sphene, apatite, magnetite, pyrite, chlorite, garnet, sericite, and hematite.

Plagioclase, quartz and carbonate are anhedral with an average grain size of 0.8 mm. A small amount of carbonate also occurs as a replacement of plagioclase. Biotite flakes are commonly 2 mm. in maximum dimension, have a fair parallel alignment, and have a pleochroic formula $Y=Z$ =red brown, X =pale yellow brown. Most biotite

is euhedral, but some crystals have ragged edges and are partly chloritized. Calcite has been introduced after regional metamorphism.

The rock was originally a pelitic sediment.

Graphite Schist:

A large outcrop of graphite schist is situated on the east bank of the Themines River, 2-3/4 miles north of the junction of the Themines river and the outlet from Lac Georget. The rock is a dark, dull grey to rust colour on the weathered surface. Fresh cleavage faces are silver-grey in colour and have a metallic lustre. A thin section study revealed the composition: graphite (30%), biotite (6%), muscovite (3%), limonite (1%), the remainder being quartz and plagioclase. The grain size of the anhedral quartz and plagioclase ranges from 0.1-0.2 mm. Micas and graphite commonly have a maximum dimension of 0.3 mm. Graphite, and to a lesser degree micas, have a pronounced preferred orientation, giving the rock its schistose character.

Granite Gneiss:

Several outcrops of granite gneiss are exposed 1-1/2 miles south of the graphite schist outcrop, to the west of the Themines river. In macroscopic appearance the rock is similar to the gneissic microcline granite of the northern zone. Thin section study of the rock was not made.

Iron Formation Sequence

Iron formation, as defined by Gross (1959), was not found in the Lac Georget area. However, rocks

similar to basal members of iron formation sequences in neighbouring areas (e.g. Murphy, 1959; and Phillips, 1959), including calc-silicate rock, quartzite, grunerite-quartz-carbonate rock, and dolomitic marble, are exposed here and there in the central zone.

Calc-silicate Rock:

The only exposures of calc-silicate rock known in the area are located on a peninsula on the south shore of Chaleur lake, where the gently dipping sequence of conformable layers is that given in table 5.

Table 5: Sequence of Layers Exposed on the South Shore of Chaleur Lake.

Rock type	Thickness
Calc-silicate rock	top
Quartzite	10'
Oligoclase-quartz-mica gneiss	8'
Calc-silicate rock	4'
Oligoclase-quartz-mica gneiss	bottom

The calc-silicate rock is dark to pale green on the weathered surface, depending on whether actinolite or diopside, respectively, is most abundant. Fresh surfaces are lighter in colour than are weathered faces. Coarse crystals of diopside and actinolite, varying up to 2 inches in maximum dimension, and having random orientation, are the only major constituents of the rock. Discontinuous layers of calcite about 3 inches thick, are present, and are ordinarily separated by 1 foot layers of calc-silicates. Accessory clinzoisite is present.

The rock was originally an argillaceous dolomite, and is now in a state of medium grade metamorphism in the staurolite-quartz subfacies of the almandine amphibolite facies.

Quartzite:

Grey quartzite is exposed on the south shore of Chaleur lake (see table 5) and $\frac{3}{4}$ mile northwest of Pack lake. The Chaleur lake outcrop has alternate dark and pale grey layers about 1/4 inch thick which probably represent original bedding. Colour differences between layers is due to variable hematite (specularite) content. The composition of the Chaleur lake outcrop is quartz (96%), specular hematite (3%), and minor biotite, muscovite, apatite, and garnet. The rock has a mosaic texture with grains ranging from 1-2 mm. in diameter.

Quartzite northwest of Pack lake has a uniform dark grey colour, and a mosaic texture with grains averaging 0.8 mm. in diameter. The composition is quartz (95%), biotite (3%), and rare magnetite, apatite, muscovite, garnet and chlorite.

In both outcrops the flaky minerals have a parallel alignment.

Grunerite-Quartz-Carbonate Rock:

Grunerite-quartz-carbonate rock is exposed in two outcrops 1/2 mile east of Pack lake. The weathered surface of the rock is dull, dark brown, and patches of limonite are common. The fresh surface is brown to greenish-brown, and shows the thin laminated nature of the rock. Layers are irregular and vary up to 1/2 inch thick. Grunerite crystals have a subparallel alignment.

In thin section the composition is seen to be grunerite (40%), quartz (32%), carbonate (27%), and accessory pyrite, pyrrhotite, magnetite, and hematite. Alternate layers are grunerite-carbonate rich, and quartz rich. Opaque minerals are most abundant in the quartz layers.

Dolomitic Marble:

A 10 foot layer of dolomitic marble, interbedded with oligoclase-quartz₂-biotite gneiss is located on the east bank of the Themines river, 3 miles north of the junction of the Themines river and the outlet from Lac Georget (i.e. 150 feet north of the graphite schist outcrop). The marble is pale grey on the weathered surface and slightly lighter in colour on the fresh surface. It consists of coarse dolomite and calcite crystals up to 2 mm. in length. Staining with copper nitrate solution showed the ratio of dolomite to calcite to be 2:1. Small dark layers 1-2 mm. thick are interbedded with relatively pure marble layers about 10 mm. thick. The rock was not studied in thin section.

INTRUSIVE ROCKS

Metagabbro:

Metagabbro is exposed on the north central part of the west shore of Split lake, and on a hill 1 mile west of the south end of Split lake. The fresh and weathered surfaces have dark patches of green hornblende and black biotite evenly distributed in a pale pink granulitic matrix of plagioclase and garnet. Average grain diameter is 0.5 mm. The composition is plagioclase-An₄₅ (59%), garnet (15%), biotite (8%), hornblende (7%), diopside (3%), quartz (3%), hypersthene (2%), and apatite, sphene and iron ores.

Plagioclase occurs as fresh anhedral to subhedral grains with albite twinning. Garnet is most abundant as rims of euhedral crystals surrounding mafic patches. Biotite has a red-brown to pale yellow pleochroism, and flakes have a pronounced parallel alignment. Hornblende is present both as euhedral crystals and as irregular patches which have altered from hypersthene.

Hypersthene contains oriented plates of clinopyroxene, and occurs as feather-edged, relict crystals within masses of hornblende. Biotite is present in abnormally high amounts. This can be attributed to potash metasomatism (Moorhouse, 1959) due to remobilization of material from the surrounding potash-rich rocks.

The rock was originally a norite or a hypersthene gabbro.

Pegmatites:

Pegmatites are rare. The largest one found forms the core of a small anticline on the eastern boundary, east of Lac Georget. The pegmatite is exposed for a length of 30 feet and has a maximum width of 10 feet. It consists of large irregular masses of quartz and of feldspar, with an overall quartz-feldspar ratio of 1:1.

Other pegmatites occur as 1-4 inch diklets cross-cutting the foliation, and as regular or irregular layers and pods up to 3 inches thick, paralleling the foliation.

Within the southern zone, small pegmatite diklets and layers contain about equal amounts of quartz, pink plagioclase and blue potash feldspar.

White quartz-feldspar pegmatites occur in the central zone, normally with accessory muscovite. All pegmatites found in the northern zone are rich in microcline, and occur as layers several inches thick, paralleling the foliation.

Aplites:

Two small diklets of pink aplite, 2 inches thick, were found in the southern zone, and consist of oligoclase, microcline and quartz.

Peridotite:

Two ultrabasic masses are exposed in the southern zone. One is a gently dipping, slightly discordant sill 25-50 feet thick, with chilled edges about 2 inches thick. The sill crops out between Split lake and the north end of West Split lake. The weathered surface is an earthy pale brown, and on the fresh surface are dark green crystals set in a pale green matrix. The dark crystals are up to 2 mm. long and comprise 90% of the rock. In thin section the composition is seen to be clinopyroxene (45%), amphibole (10%), hypersthene (5%), microcrystalline matrix, and accessory garnet, olivine, biotite, plagioclase, carbonate, magnetite, and serpentine.

A second ultrabasic mass of unknown form crops out on a peninsula on the east shore of Pinnacle lake. The weathered surface of the rock is dark green to a pale rust brown, and the fresh surface is dark green. A thin section examination showed a variable composition. Major constituents are olivine, amphibole and hypersthene. Accessory minerals are garnet, phlogopite, clinopyroxene, carbonate, serpentine, spinel (pleonaste), chalcopyrite, pyrrhotite, magnetite, sphene, and iddingsite.

Both ultrabasic bodies are massive and are characterized by coronas of fibrous hypersthene surrounding oval-shaped grains of olivine. The hypersthene is in turn surrounded by minute amphibole crystals. Amphibole also occurs as large poikilitic crystals, which in some case can be seen to have altered from hypersthene.

GLACIAL GEOLOGY

Most of the map-area has a cover of till and large erratics deposited by the Wisconsin ice sheet. The southern part of the Themines river valley is underlain by bedded sand and gravel deposits and remnants of a south-trending esker; and the two main branches of the northern part of the river are

paralleled by two south-trending eskers. The Themines river was probably the site of a glacial meltwater channel.

Southeast of Portage lake are a number of fine sand ridges, possibly kames, with varying directions of elongation.

The direction of movement of the Wisconsin ice sheet is evident from the southerly trends of the eskers, and the pronounced elongation of till ridges in a south by south-southeast direction. Crag and tail structures on some of the hills of bedrock indicate a southerly sense to the ice movement.

Evidence for only one period of glaciation was found.

STRUCTURAL GEOLOGY

The lack of a marker bed and the scarcity of outcrops make a structural interpretation of the area difficult.

Folds:

No well defined large-scale folds were recognized. On the eastern boundary, east of the south end of Chaleur lake, a small open fold with a curved axial plane and a pegmatite core, was found. North of the bend in the axial plane the fold plunges 5° along an azimuth of 210° ; south of the bend, the fold plunges 20° along an azimuth of 190° and the axial plane strikes $N14^{\circ}E$ and dips $80^{\circ}E$. A drag fold on the east limb was formed by relative movement opposite to that which would have resulted if it were related to a fold formed by lateral compression.

A second small open fold is located 1 mile east of the north end of Pack lake. The fold has a plunge of 28° in a 276° direction, and a lineation on the south limb has a plunge of 100° in a 259° direction.

It is unlikely that the lineation is related to the folding.

Joints:

Joints are abundant throughout the map-area. Although they appear to have random orientation, a contoured stereonet plot of poles to joint faces has two pronounced maxima, corresponding to vertical joint sets striking $N42^{\circ}E$ and $N54^{\circ}W$. All joints observed are dilation features.

ECONOMIC GEOLOGY

The Mount Reed-Mount Wright district is noted for its numerous metamorphosed sedimentary iron ore deposits. Iron formation of economic interest was not found by the writer, but a thin layer of quartz-hematite rock has been reported to crop out on the west boundary, 4 miles south of the northwest corner of the map-area (Firth, 1959). Several magnetic anomalies were located in the vicinity of Pack lake (see accompanying map).

Sulphides are rare in the area. Accessory pyrrhotite and chalcopyrite occur in the Pinnacle lake ultrabasic body.

Sand and gravel deposits are abundant in the southern half of the Themines river valley. Two prominent eskers near the northern portion of the Themines river consist of poorly sorted gravel. Ridges of fine sand are located southeast of Portage lake.

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