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PRELIMINARY REPORT ON FELIX LAKE AREA, SAGUENAY COUNTY

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PRELIMINARY REPORT

ON

FÉLIX LAKE AREA

SAGUENAY COUNTY

BY

P. J. CLARKE

QUEBEC
1962

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INTRODUCTION

The Félix Lake area was mapped in the summer of 1961. It is bounded by longitudes 66°30' and 67°00' and, on the south, by latitude 52°15'; the northern boundary of the eastern half is latitude 52°30', and that of the western half is approximately 52°35', extended to complete an unmapped portion of the Carheil Lake-Le Gentilhomme Lake area. Félix lake, for which the area is named, lies about 140 miles north of Sept-Iles and 68 miles northeast of Gagnon. The area includes all of Courchesne township and parts of Esmanville, Desjordy, Leduc, Legal and Guillimin townships plus some still unsurveyed land; in all about 405 square miles. It lies south of the Carheil Lake-Le Gentilhomme Lake area (Murphy, 1960) and east of the Gras Lake area (Clarke, 1961).

Access to the area is by float plane from Jeannine lake near Gagnon, or from Sept-Iles. There is also a one-portage canoe route from Oreway on the Quebec North-shore and Labrador Railway through Ashuanipi and Opocopa lakes into Félix lake and Moisie river. Oreway is 34 miles ENE. of Félix lake. There are few large lakes within the area, but most of it can be reached from Moisie, Carheil, Le Gentilhomme or Félix rivers.

Most of the area lies between 1,500 and 2,250 feet above sea-level. It may be divided into physiographic units: the relatively rugged uplands lying west of Moisie and Le Gentilhomme rivers, and the flat swampy lowlands east of Moisie river and north of Félix lake. Local relief in the uplands may reach 1,000 feet and 400 feet is common. Most of the hills are underlain by one or another of the following formations: relatively unaltered granulite, mica kyanite schist, hornblende garnet rock or gabbro.

GENERAL GEOLOGY

The extent to which bedrock is exposed through the cover of Pleistocene till, reworked till, and fluvioglacial deposits differs greatly throughout the area. Exposure is generally good on slopes and hill tops and especially good in the hills west of the junction of the Moisie and Le Gentilhomme rivers. Many of the small rivers flowing into the Moisie have cut their channels down to bedrock. Glacial deposits and muskeg blanket most of the area around and north of Félix lake.

All the consolidated rocks are Precambrian. The oldest, probably Archean, are granulitic rocks, with or without pyroxene. These are succeeded by quartz-feldspar-biotite-hornblende paragneisses that may include some granulitic rocks altered beyond recognition but are mainly Proterozoic. The paragneisses and the overlying marble, quartzite, ferriferous rocks, mica-kyanite schist, and hornblende-garnet rock represent metamorphosed equivalents of the Labrador Geosyncline sedimentary rocks.

Thin bodies of granite intrude the above rock types throughout the area, whereas pyroxenite and thick sills of gabbro, recrystallyzed gabbro and associated syenite and granite are abundant east of Moisie river.

TABLE OF FORMATIONS

CENOZOIC	PLEISTOCENE AND RECENT	Sorted fluvioglacial deposits Till
PROTEROZOIC	INTRUSIVE ROCKS	Granite Gabbro, altered gabbro, peridotite, diorite and syenite
	UPPER GNEISSES AND SCHISTS	Biotite and hornblende gneisses Hornblende-garnet rock Mica-kyanite schist
	METASEDIMENTARY GROUP	Wabush Lake iron-bearing rocks Wapussakatoo quartzite Duley marble
ARCHEAN AND PROTEROZOIC	LOWER GNEISSES	Less migmatized biotite or hornblende gneisses Quartz-feldspar-biotite-hornblende gneisses and migmatite Granulitic gneisses, with or without pyroxene

LOWER GNEISSES

Granulitic Gneisses

Granulitic gneisses are the oldest rocks in the area, and are believed to have formed the basement upon which the sedimentary sequence was laid. They are correlated with the Archean granulite of Duffel and Roach (1959). They occur throughout the southwest quarter of the area and are well exposed in the hills east of Carheil river. Two types occur; one with pyroxene and one without pyroxene. The latter surrounds or occurs near the former, and is the more metamorphosed of the two types.

The gradation from a well foliated gneiss to a definite granulitic rock may take place within 50 feet. The granulitic gneisses and the overlying quartz-feldspar-biotite gneiss are roughly parallel in attitude and apparently conformable.

a) With pyroxene.— The pyroxene-bearing type is compact, medium grained and brown. Most specimens have about 15% granitic material as $\frac{1}{2}$-inch bands cutting the host rock at 2- to 3-inch intervals. Typical specimens contain about 20% quartz, 50% feldspar, 0-30% of which may be microcline, 0-15% pyroxene (hypersthene and augite), about 5% hornblende, 5 - 15% biotite and 10% garnet. The feldspar is brown or blue grey, with warped cleavage visible on the large grains. Quartz has a blue cast. The biotite is oriented at random and so the rock lacks fissility.

Retrograde metamorphism has converted much of the pyroxene to a fine-grained mixture of biotite, quartz and garnet, which remains as mafic clots scattered through the rock. Some of the clots have cores of pyroxene.

b) Without pyroxene. — A more intense alteration of the pyroxenic rock results in a medium-grained, rusty weathering type with a characteristic mottled texture. In this rock biotite forms $\frac{1}{4}$- to $\frac{1}{2}$-inch clots in a rusty weathering, quartz-feldspar matrix. A typical specimen contains about 20% quartz, 35-50% feldspar up to 30% of which may be microcline, 10-25% biotite, 5-10% garnet, and 0-15% hornblende.

These rocks are distinguished from the overlying gneisses of the same composition by being mottled rather than banded and by the generally rusty weathered surface.

Other Gneisses

The most widespread rock types of the area are the quartz-feldspar-biotite-hornblende paragneisses that occur below, and to a lesser extent above, the metasedimentary group. These gneisses are divided on the bases of texture and predominant mafic mineral into three main groups: segregated hornblende gneiss, segregated biotite gneiss, and poorly segregated hornblende-biotite gneiss.

Segregated gneisses

The segregated gneisses are found only below the metasedimentary group. They occur in the western part of the area and east of Moisie river. A typical segregated biotite gneiss is composed of 20-25% quartz, 45-60% feldspar, 5% hornblende, 10-20% biotite, and 0-5% garnet. White felsic bands $\frac{1}{2}$ inch to 3 inches thick make up about one-third of the rock, the remainder being bands of mixed felsic

and mafic minerals, with some relatively pure biotite bands and rare pods of dark green amphibole.

The segregated hornblende gneisses contain the same essential minerals but are richer in mafics, generally containing 10-15% biotite and 10-20% hornblende. The hornblende tends to be segregated into elongate patches as well as bands, and all gradations exist between the segregated hornblende gneiss and a slightly gneissic rock of granodiorite composition.

East of Moisie river the mafic minerals form 1 x 3mm. lenses in a matrix of quartz and feldspar, and $\frac{1}{4}$- to $\frac{3}{4}$-inch felsic bands may comprise up to 25% of the rock. The gneisses here are microcline-rich and weather pink. They lack the foliation fissility of the gneisses to the west, breaking instead on joints.

Poorly segregated biotite and hornblende gneisses

These gneisses occur most abundantly with the Proterozoic sedimentaries in the north-central part of the area. They lie both above and below rocks of the metasedimentary group, and grade into well segregated gneiss. The gradation, which was observed in several places across a width of about 100 feet, involves the migration of the felsic minerals and is probably metamorphic rather than stratigraphic. The gneiss does not show mineral banding but generally has good foliation fissility due to the parallel orientation of its biotite flakes. It tends to be finer grained and to weather more readily than the well segregated gneiss. Its mineral composition approximates that of the well segregated gneiss, with garnet being more widespread and muscovite present in some places. Some rusty weathering units and graphitic units occur.

Some of these biotite or hornblende gneisses in the southwestern part of the area may have been derived from granulite.

High in this sequence of gneisses are one or more beds characterized by $\frac{1}{4}$- to $\frac{1}{2}$-inch felsic bands in an unsegregated matrix of quartz, feldspar and biotite. Garnet and hornblende or muscovite may also occur in the matrix. In places the rock has felsic porphyroblasts rather than bands, but whatever their form the felsic segregations are rimmed by biotite selvages. This banded gneiss marks a horizon close to, and generally below, the metasedimentary group.

METASEDIMENTARY GROUP

A sequence made up of marble, quartzite and ferriferous rocks occurs in this and adjoining areas. It appears to be conformable with the underlying biotite and hornblende gneisses. Unit thicknesses are variable and pinchouts are common. Where they occur together the marble generally underlies the iron-bearing rocks.

Duley Marble

Marble is the most abundant formation in the metasedimentary group. It is best exposed near Carheil river north of 52°30' and west of the junction of the Moisie and Le Gentilhomme. Layers 6 feet thick of gneiss and marble are interbanded along Le Gentilhomme river. The marble is a coarse-grained, equigranular dolomite with less than 10% calcite, 10-40% white diopside, and minor quartz tremolite and phlogopite. Green diopside and actinolite are present in some iron-rich facies. The silicates form bands 1 inch to 2 inches thick on original bedding

surfaces. The long axes of diopside crystals lie parallel to the local fold axes.

Wapussakatoo Quartzite

A quartzite layer up to 30 feet thick underlies the iron-bearing rocks at several places along Le Gentilhomme—Moisie River valley, and one outcrop of quartzite breccia occurs about 2 miles north of the outlet of Félix lake.

The quartzite is grey, medium to coarse grained and massive. It differs from quartzites seen in areas farther north and west in generally containing 5% graphite and some pyrite.

Wabush Lake "Iron Formation"

Silicate Carbonate Facies: Almost all the ferriferous rocks are of the silicate carbonate facies. They occur near the northern end of Carheil river, Midway lake, and in the hills east of Le Gentilhomme - Moisie River valley. Recorded thicknesses of the formation range from 10 to 40 feet.

The rock is made up of alternating layers ½ inch to 8 inches thick of quartz and a mixture of quartz, green (diopside-hedenbergite) pyroxene and brown (hypersthene) pyroxene. Pods 3-12 inches across of buff-coloured ferrodolomite are present here and there. Magnetite and some graphite are present in both quartz and silicate layers, and some of the pods contain olivine. Cummingtonite-grunerite appears in some specimens as an alteration of the hypersthene. Mineral composition is generally variable between the limits quartz 20-70%, hypersthene 10-35%, hedenbergite 5-35%, carbonate 5-25%, magnetite 5-25%, graphite 5%, grunerite 0-10%. Near Midway lake and Pegma lake the formation grades from silicate-rich at the base to quartz-rich at the top.

Oxide facies. At two places in the northwest corner of the area (on the shore of Carheil river, and near Midway lake), the formation contains about 35% magnetite and only minor silicates. Full thicknesses of the bands could not be measured but about 6 feet was exposed in each place.

Several boulders of quartz-specularite rock as well as of marble and of silicate rocks were found in the glacial deposits in the valley of Le Gentilhomme river. As these boulders are usually found within a mile or two of their source it is possible that the oxide facies of the formation occurs beneath glacial deposits here.

The banded gneiss, which usually occurs near the metasedimentary group outcrops in Le Gentilhomme valley.

UPPER GNEISSES AND SCHISTS

Mica-kyanite schist

Coarse-grained, mica-kyanite schist is a widespread marker formation in the group of younger rocks in the hills west of Le Gentilhomme and Moisie rivers. It is a tough rock which forms rounded outcrops and caps the highest hills in the area. Common mineral compositions range as follows: quartz 20-35%, feldspar 20-35%, biotite 0-20%, muscovite 10-20%, kyanite 5-20%, garnet 5%, graphite 0-5%. The micas and kyanite are oriented to give the rock a rough foliation. Thin felsic layers

and porphyroblasts with biotite selvages form on foliation surfaces. The kyanite forms deep blue laths up to an inch long which stand in relief on weathered surfaces. It is concentrated with layers and pods of clear quartz.

Hornblende-garnet Rock

Hornblende-garnet rock is well exposed in the two basin structures west of Le Gentilhomme river. It is massive, black and composed essentially of garnet and hornblende in 2-4mm. crystals. The garnet, which is evenly distributed throughout the hornblende, commonly has a ¼mm. crust of white feldspar. Feldspar may be concentrated in thin lenses and bands, giving the rock a weak foliation. The rock stands up as hills but crumbles into a coarse red sand where exposed to weathering. A common range of composition is hornblende 45-55%, garnet 25-40%, feldspar 15-30% and minor amounts of biotite and graphite.

Where exposed just east of Le Gentilhomme river the rock is composed of fine-grained green hornblende and pyroxene with about 25% coarse red garnet and resembles a basic lava.

A band of basic gneiss occurs in the layered gneisses near the eastern edge of the area. It is composed of 30-40% feldspar, 10-20% garnet, 25-55% hornblende and 20-35% diopsidic pyroxene. Most samples are rich in pyroxene or amphibole, but not both. In some places egg-sized clots of pyroxenes are separated by ½- to 1-inch veinlets of pink feldspar and quartz. It is not known whether this rock and the hornblende-garnet rock that occurs above the Wabush Lake formation are related.

INTRUSIVE ROCKS

Basic Intrusive Rocks

Coarse-grained coronitic gabbros with some associated diorite and syenite occur throughout the eastern part of the area but are best exposed in the southeast quarter where they stand as hills above the surrounding gneisses.

In its least altered form the gabbro consists of 20% black augite, 10% biotite, 5% magnetite surrounded by 10-20% alteration halos of uralitic amphibole, biotite and garnet, and with 50% ophitic intergrowths of more or less altered plagioclase. Alteration to clinozoisite gives some of the plagioclase a green tint. The ophitic-textured, green, feldspar gabbro is best exposed where it intrudes the younger paragneiss about one mile south of the outlet of Le Gentilhomme lake. It also occurs as remnants in the more altered gabbro near Hook lake and the outlet of Félix lake.

Most of the gabbro has been completely recrystallized to a brown granoblastic rock containing 35-60% brown feldspar, 10-35% pyroxene, 15% garnet and 10-30% mixed biotite and hornblende. In places this rock is well foliated and may contain thin felsic bands. In other places it may be very coarse grained with one-inch porphyroblasts of black hypersthene surrounded by red garnet alteration in a matrix of feldspar; here, also, magnetite is associated with pyroxene, and some of the pyroxene may be altered to biotite. A common composition for the very coarse-grained phase is 55% feldspar, 20-35% biotite, 10% garnet, and 5% magnetite. Felsic portions of this rock contain some quartz and microcline feldspar.

Any type of gabbro may grade abruptly into any other type.

Ultrabasics

Sills of medium-grained, black peridotite inject the gneisses at several places along a zone roughly parallel to Moisie river in the southern half of the area. They are composed of black pyroxene with about 30% olivine and minor biotite and hornblende. Outcrops weather deeply to a coarse pyroxene sand. Sulphides are associated with the ultrabasics near Pegma lake and 1¼ miles north of the southern border in the western part of the area. The Pegma Lake ultrabasic underlies a gabbro body from which it probably differentiated.

Granite

Small gneissic granite bodies occur throughout the area but are most abundant in the segregated gneisses. They are medium grained, grey to pink, and usually composed of 25-35% quartz, 55-65% feldspar and 5-10% biotite. West of the Moisie the granites contain two-thirds plagioclase and one-third microcline feldspar, whereas east of the Moisie microcline amounts to more than two-thirds of the feldspar content. East of the Moisie the granites weather pink and are marked by red stains 2mm. in diameter resulting from alteration of a black non-metallic mineral (allanite?).

Veins of pink feldspar, quartz, biotite, and pegmatite are associated with the gabbro bodies of the area.

GLACIAL GEOLOGY

Much of the area is covered by a layer of till and fluvioglacial deposits. Over most of the area the till lacks any clear trend, but where drumloid ridges do occur they trend south-southeast.

Glacial streams have left deposits of sorted sand and gravel in channels followed by the present Carheil, Moisie and Félix rivers. A chain of eskers lies in the upper Moisie and Félix River valleys. The small river joining the Moisie just south of the area has scoured its channel free of sediment over a width of about 100 feet and a length of about 8 miles.

STRUCTURAL GEOLOGY

The main structural feature is the long synclinal fold extending from the outlet of Carheil lake, west of Moisie river, to the southern edge of the area. From Pegma lake northward a subordinate anticline lies in the centre of the main synclinal structure. Interpretation of the nose near Pegma lake as a simple anticline runs counter to the obvious interpretation of the dips in the marble outlining the nose. An anticline, however, is indicated by the local lineations, the stratigraphic succession and the occurrences of thin marble and ferriferous units to the west of the twin basins of hornblende-garnet rock and mica-kyanite schist. A fan-shaped anticline is suggested by the dips in the marble.

A subordinate east-west fold produced the domes and basins on the west side of the synclinorium and in the westward swing of the metasedimentary groups at the southern edge of the area.

Lineations formed by drag fold axes, streaking of quartz grains on foliation planes, and orientation of diopside crystals in marble, tend to parallel

the "b" axis of the local folds. Most of the lineations plunge southeast or south-southeast but northwesterly plunges occur in the north-central and south-central parts of the area.

The major folds in the north are overturned towards the northeast. Folds are upright in the central part of the area, and overturned towards the west in the western, southern, and eastern parts.

The Moisie river coincides with an abrupt change in rock type, from metasedimentary units and younger paragneiss on the west to layered and migmatized gneiss, granite, and basic intrusives on the east. There has been local shearing, much drag folding and feldspathization of the gneisses east of the river, and injection of ultrabasic sills in a zone straddling the river. Such features suggest that the Moisie lies along a major fault, the east side of which probably moved up relative to the west. Movement directions shown on small faults and drag folds near the Moisie river are ambiguous.

ECONOMIC GEOLOGY

Iron

An oxide facies of iron-bearing rock was found in only two places, namely, near Midway lake, and near the outlet of Carheil lake. The exposed thickness in both places was about 6 feet.

Erratic boulders of quartz-specularite rocks along Le Gentilhomme valley near latitudes 52°26' and 52°30' may be of local origin.

Sulphides

Sulphide showings, some containing copper, nickel, and zinc, are associated with basic intrusive rocks near Pegma lake and on the Moisie river near the southern border.

Bellechasse Mining Corporation mapped and drilled the Pegma Lake deposits (Gleeson, 1956). The largest of the showings (c) is a zone 400 feet long and 30-50 feet wide in which sulphides are disseminated through peridotite at the base of a gabbro sill. Gleeson reports 1-1.5% combined copper and nickel, 0.3% cobalt, and a trace to 0.1 oz./ton silver in this deposit.

The marble directly west of Pegma lake contains a quartz vein with sulphide-bearing pods (showing "b") in places containing 10-20% sphalerite, 2-5% pyrrhotite, and minor marcasite, magnetite and chalcopyrite.

Assays made by the Quebec Department of Natural Resources on sulphides from showings "d" and "e" indicate only traces of copper and nickel and negligible gold and silver.

Kyanite

Mica schist directly south of Le Gentilhomme Lake outlet contains 25% kyanite in a zone 100 feet thick.

Sand and Gravel

Fluvioglacial deposits suitable for construction purposes occur in old stream channels followed by Carheil, Moisie, and Félix rivers.

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