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PRELIMINARY REPORT, GEOLOGY OF SILICATES LAKE AREA, SAGUENAY COUNTY

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GEOLOGICAL EXPLORATION SERVICE

H.W. MCGERRIGLE, CHIEF

Geology
of
SILICATES LAKE AREA

SAGUENAY COUNTY

PRELIMINARY REPORT

by
P.J. Clarke

Preliminary Report

on

SILICATES LAKE AREA

Saguenay County

by

P.J. Clarke

INTRODUCTION

The Silicates Lake area is about 15 miles northeast of the town of Gagnon and 10 miles east of Mt. Reed. It is bounded by longitudes $67^{\circ}45'W.$ and $68^{\circ}00'W.$ and latitudes $51^{\circ}52'30"N.$ and $52^{\circ}05'N.$, and fills the gap between the mapping by Sinclair (1961) to the north and by Kish (1965) to the south. It covers a surface area of about 155 square miles, including parts of the townships of Laussedat, Tilly, Conan, and Hesry.

The area is reached most easily by floatplane based at Gagnon, or alternatively by canoe via Petit Manicouagan lake and Petite Manicouagan river. Most of the lakes in the area are small and connected by shallow streams so that the only passable canoe routes are along Petite Manicouagan river, and the streams near Tougard (Sneak) lake and Blough lake.

The land surface lies between 1,600 and 2,400 feet above sealevel with local relief in the order of 300 feet. The surface is highest in the west and slopes down to the Petite Manicouagan River valley in the east. Maximum local relief has formed over the iron-formation and marble terrain near Blough and Silicates lakes.

The area is drained by Petite Manicouagan river and by the small river flowing through Blough lake. The dam at the outlet of Petit Manicouagan lake, a part of the electric power complex supplying Gagnon and the Lac Jeannine mine, has raised the level of Petite Manicouagan river, flooding its valley to a level of about 1,650 feet. The approximate limit of the flooding is shown on the accompanying map.

Most of the area is lightly forested with black and red spruce. Stands of birch grow on protected hillsides and jackpine covers the flat sand plains near the larger rivers. The tree cover extends to the hilltops. Underbrush is thin except in old burned areas near Tougard and Silicates lakes.

GENERAL GEOLOGY

The area lies in the Mt. Wright - Mt. Reed district of the Grenville metamorphic province, and contains most of the rock types typical of the district. These include altered Archean granulite, a thick sequence of gneisses and migmatite, and a group of Proterozoic metasedimentary rocks including marble, quartzite, and iron-formation. The latter group is probably equivalent to the chemical sedimentaries of the Labrador Trough and hence is referred to the Gagnon Group. This is overlain by generally garnetiferous quartz-feldspar-mica gneisses, some of which contain graphite, pyrite and, rarely, kyanite. The paragneisses were intruded by generally conformable masses of granitic and gabbroic rocks. The granite occurs mainly in the lower gneisses and the gabbroic gneiss in the rocks overlying the Gagnon Group. Both types of intrusions are foliated parallel to the regional gneissosity.

The regional structures strike northwesterly and dip to the northeast. In detail the structure is complex, southwesterly folds cross the dominant northwesterly trends, overturning is general, and reversals in plunge are common.

Upper gneisses underlie the northeastern corner of the area, and are separated by a thin band of Gagnon Group rocks from the lower gneissic complex which forms most of the area. Two masses of Gagnon Group rocks occur within the gneisses: one near the center of the area; the other near its southwestern corner.

DESCRIPTION OF ROCK TYPES

Altered Granulite and Speckled Gneiss

The oldest rocks of the area are pyroxene-bearing granulites and their remetamorphosed equivalents. None of the granulite is fresh but its original texture and mineralogy are preserved in some samples. The least altered granulite is a dark, rusty-weathering rock with a layered granoblastic texture. It contains about 50% feldspar, 20% quartz, and 30% combined fine secondary biotite, garnet, and hornblende as well as some remnant pyroxene. The quartz has a blue or gray cast and the feldspar is tan. The fine mafic minerals form unoriented clusters through the rock or concentrated close to the felsic layers. These rocks are correlated with the Archean granulite which underlies other parts of the Labrador Trough and has been described near Mt. Wright by Duffell and Roach (1959) and Clarke (1960).

In most places the original pyroxene and the granoblastic texture have been destroyed and the resulting rock is a fine-grained, rusty-weathering gneiss with speckles of fine mafic minerals in an otherwise disorganized matrix. Thin contorted layers of quartz and feldspar are common. These layers are coarser grained than the rest of the rock and near them the speckles are most conspicuous.

In many outcrops the mineral layering is cut by a secondary cleavage. Small folds and crenulations are formed about the cleavage, and elongation of biotite clusters and quartz grains parallel to these fold axes adds to the speckled appearance of the rock.

Quartz-feldspar-biotite Gneisses

About half of the area is underlain by foliated quartz-feldspar-biotite gneisses with varying degrees of compositional layering and migmatitic injection. In contrast to the speckled gneiss, these rocks have a strong foliation fissility which is followed by the felsic layers of the more segregated varieties. A higher degree of segregation is generally accompanied by a coarser grain and more contorted texture. Thin felsic layers or lenses comprise up to a third of the gneiss. Selvages of shiny black biotite generally separate the felsic layers from a mixed groundmass. The degree of mineral segregation is not simply related to stratigraphic position; both homogeneous and well-segregated gneisses occur close to, and were apparently derived from, the

Table of Formations

Pleistocene and Recent	Glacial and fluvioglacial deposits						
PROTEROZOIC	Igneous Rocks	<table border="1" style="width: 100%;"> <tr> <td style="width: 30%;">Gabbroic suite</td> <td>granophyre hornblende-plagioclase-garnet gneiss gabbro</td> </tr> <tr> <td colspan="2">Gneissic granite and pegmatite</td> </tr> </table>	Gabbroic suite	granophyre hornblende-plagioclase-garnet gneiss gabbro	Gneissic granite and pegmatite		
	Gabbroic suite	granophyre hornblende-plagioclase-garnet gneiss gabbro					
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Upper Schists	Quartz-feldspar-mica-garnet gneiss † graphite, pyrite, kyanite Hornblende-garnet-pyroxene rock Quartz-mica-garnet schist						
Gagnon Group	<table border="1" style="width: 100%;"> <tr> <td style="width: 30%;">Wabush Lake Formation</td> <td>quartz-specularite facies quartz-magnetite-silicate facies silicate-carbonate facies</td> </tr> <tr> <td colspan="2">Wapussakato Quartzite</td> </tr> <tr> <td colspan="2">Duley Marble</td> </tr> </table>	Wabush Lake Formation	quartz-specularite facies quartz-magnetite-silicate facies silicate-carbonate facies	Wapussakato Quartzite		Duley Marble	
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ARCHEAN ?	Lower Gneisses	Quartz-feldspar-biotite gneisses and migmatite (minor hornblende) Altered granulite and speckled gneiss					

speckled gneiss, and both have been found in conformable contact with rocks of the Gagnon Group. Thus, it seems probable that the lower gneisses were derived from both Archean and Proterozoic material.

The approximate composition of these gneisses is 25% quartz, 45% white oligoclase and 30% biotite. Hornblende-bearing gneisses occur throughout the area but are especially common underlying the Gagnon Group near Aubertin (Margaret) and Tougard lakes. Pink feldspar (microcline) and chlorite are common in the gneisses near the granite bodies in the western part of the area.

Gagnon Group

The Gagnon Group includes the Duley Marble, Wapuskatoo Quartzite and Wabush Lake Formation. The iron-formation (Wabush Lake) is subdivided into quartz-specularite, quartz-magnetite-silicate, and silicate-carbonate facies. The quartz-specularite and quartz-magnetite-silicate facies contain more than 20% iron oxide; the silicate-carbonate facies contains less and is not considered economic at present.

The type of iron-formation and sedimentaries accompanying it change across the area. The thickness of the group is also variable. West of Aubertin lake quartz-specularite iron-formation is underlain by marble and quartzite. At Silicates lake marble underlies quartz-magnetite iron-formation; near Blough lake marble occurs both above and below silicate-carbonate iron-formation; and east of Aubertin lake and Tougard lake silicate-carbonate iron-formation rests directly on gneiss. Thin layers of gneiss are intercalated through the Gagnon Group in many parts of the area.

Duley Marble

The marble is a coarse-grained (3-8 mm.) carbonate rock, containing 10-40% quartz and calcsilicate minerals, and rare phlogopite. Where the marble is thick, as near Blough lake, it forms steep, blocky outcrops. Thinner beds are covered in many places by swampy meadows.

The quartz and calcsilicate minerals (white tremolite and diopside) follow bedding planes or, less commonly, fractures and, weathering in relief, give the rock a rough banded

surface. The carbonate is mostly black weathering dolomite, with subsidiary calcite interstitial to the dolomite and associated with the silicate layers. Near iron-formation the marble becomes light tan, weathers brown, and contains green actinolite instead of tremolite.

Wapussakatoo Quartzite

Quartzite is confined to the area west of Aubertin lake where it appears to overlie and grade laterally into the Duley Marble. It is a coarse-grained, grayish white rock, which in places resembles bull quartz. Bedding shows as faint color bands or a strong joint set. Minor minerals, such as specularite, muscovite, dolomite, actinolite and garnet amount to less than 5% of the rock.

The quartzite grades into quartz-muscovite schist by increase in mica content, and into iron-formation by increase in specularite.

Wabush Lake Formation

The most widespread type of iron-formation belongs to the silicate-carbonate facies. These rocks are composed of varying proportions of quartz, clinopyroxene, orthopyroxene, carbonate, magnetite, cummingtonite, graphite and garnet, in approximately that order of abundance. Quartz-rich types are generally layered and pyroxene-rich types have more massive textures. The carbonate may be either dolomite or calcite. Magnetite generally makes up less than 10% of the rock.

Rocks containing more than 20% magnetite are mapped as quartz-magnetite iron-formation. The distinction is mainly economic; both facies contain essentially the same minerals but the quartz-magnetite facies is richer in magnetite and quartz and lacks appreciable carbonate. It is generally finer grained and more evenly layered than the silicate-carbonate iron-formation. Magnetite tenor is about 30%. The largest body of this type of iron-formation lies east of Silicates lake.

The iron-formation in the Aubertin Lake structure belongs to the quartz-specularite facies. It is a medium-grained (1-3 mm.) rock containing about 30% specularite as thin (1/8"-1/2") layers or lenses in gray glassy quartz. Accessories are magnetite

(less than 10%), muscovite, actinote, and calcite. The formation is 10 to 100 feet thick, normally measuring about 30 feet.

Contacts with the enclosing formations are conformable, abrupt in the case of gneiss and marble, and gradational in the case of quartzite and quartz-mica schist. Slight deformation and pegmatite injection have occurred along some contacts.

Upper Schists and Gneisses

The rocks overlying the Gagnon Group are generally garnetiferous, and have a more homogeneous or schistose texture than the lower gneisses. The upper schists are exposed in the northeast corner of the area, near Blough lake, and in the tight synclines of the Aubertin Lake structure. They vary in composition across the area so that facies differences in the Gagnon Group continue into the overlying schists.

The iron-formation near Aubertin lake is accompanied, and generally overlain, by a coarse-grained schist composed of glassy quartz, coarse greenish muscovite, garnet, and accessory amounts of feldspar, biotite, specularite and carbonate. An associated schist contains quartz, plagioclase, two micas, epidote and garnet.

Near Blough lake certain layers of the upper schist contain graphite, pyrite, and rarely kyanite in addition to the usual quartz, plagioclase, mica and garnet. One especially pyritic layer, immediately south of Blough lake, crops out as a crumbly gossan zone almost a mile long.

A thin bed of flaggy, quartzose gneiss, and a thin stratiform body of dark, massive, hornblende-garnet-pyroxene rock are interlayered with the Gagnon Group near Silicates and Blough lakes. These beds are too small to be shown on the accompanying map.

Igneous Rocks

Two groups of igneous rocks, differing in composition and occurrence, have injected the metasedimentary succession. Pink granite and pegmatite intrude the lower gneisses and Gagnon Group rocks. The granite occurs throughout the area but is most abundant in its northwestern part.

The upper gneiss in the northeastern corner was injected by a large mass of gabbroic rock, now altered to hornblende-plagioclase-garnet orthogneiss. The basic orthogneiss is accompanied by pink, sugary "granophyre".

Granite and Pegmatite

The granite is a medium-grained, pink, faintly gneissic rock containing about 30% quartz, 60% pink feldspar (both plagioclase and microcline) and 10% biotite. It forms generally conformable bodies ranging in thickness from inches to thousands of feet. Gneissic remnants and wispy biotite inclusions make up to a third of most outcrops, and the granite grades through migmatite into the surrounding gneiss.

Pegmatite occurs in smaller discordant bodies which intrude to higher levels than the granite. It contains stubby books of muscovite in addition to biotite. Near iron-formation the pegmatite contains dark red feldspar, garnet, and interstitial magnetite. Euhedral laths of black allanite occur in pegmatite in the southwestern corner of the area.

Hornblende-garnet-plagioclase Orthogneiss

The basic orthogneiss is confined to the northeastern corner of the area, where it is best exposed on a hill overlooking Petite Manicouagan river. It is a lenticular-textured gneiss composed of 60-75% tan plagioclase and elongate clusters or streaks of approximately equal parts biotite, hornblende, and garnet. Some samples contain 5-10 mm. augen of blue-gray plagioclase enclosed in a finer, sugary groundmass. Where foliation is not strongly developed, coronas of garnet surround the mafic clusters. The rock, which probably formed by deformation of a gabbro or diorite, is correlated with Sinclair's (1961) hornblende-garnet-feldspathic gneiss.

A small body of salmon-pink "granophyre" is associated with the basic orthogneiss. The "granophyre" is a fine-grained, poorly foliated, flaggy rock composed of sugary pink feldspar and minor quartz and biotite.

Gabbro

An isolated outcrop of massive black gabbro (plagioclase 50%, biotite 15%, hornblende 15%, pyroxene 15%) occurs in the speckled gneiss in the southeastern part of the area. A similar gabbro was found in the lower gneiss near the area's southwestern corner. In contrast to the large body of basic orthogneiss, the small gabbro bodies have retained their primary texture and mineralogy.

Pleistocene and Recent

The Precambrian bedrock is overlain by a cover of unconsolidated deposits which are thickest in the northeastern part of the area.

In the west, where the land surface is highest, the ground moraine is unpatterned. East of a line marked by the Aubertin Lake - Tougard Lake drainage the land becomes flatter and the glacial deposits are molded into south-southeast-trending ridges. A train of Gagnon Group float is spread southeastward from its origin near Aubertin lake to the southern border of the area.

In the valley of Petite Manicouagan river eskers and thick layered sand deposits occur. Less extensive sand deposits were formed north of Tougard lake and near Blough lake.

STRUCTURAL GEOLOGY

The regional structure is characterized by strong northwesterly folds crossed by subsidiary northeasterly folds. Both fold systems affect the Proterozoic rocks but their relative ages have not been determined. Similar trends occur in the speckled gneiss, but here the subsidiary northeasterly foliations are more apparent. In places, they strike into the prevailing northwesterly trend of the surrounding rocks, possibly localizing the Archean-Proterozoic unconformity.

Cleavage, striking mainly east or northeast, cuts the speckled gneiss to produce small shear folds, contortions, and mineral streaks on the foliation. The cross cleavage is best

developed in the speckled gneiss, but was also seen in the surrounding gneiss.

The foliated gneiss and Gagnon Group rocks strike mainly northwest and dip to the northeast. Lineations in the form of small fold axes, mineral streaks and elongation, and wrinkles on foliation planes plunge to the north or northwest. Reversals of plunge are common in the southern part of the area. The axial planes of small folds are nearly horizontal in the northwest corner of the area, and elsewhere dip northeast. Many of the small folds plunge down the dip of their axial planes.

Structural detail shows best in local areas underlain by Gagnon Group rocks. These areas have the good exposure, the marker beds to show their structure, and the economic interest to encourage detailed mapping. Near Aubertin lake the iron-formation forms the limbs of a tight synclinal structure, bent around and dipping off the flanks of two central domes. The structure is approximately symmetrical about the central domes. As dips are low the outcrop pattern is strongly affected by topography.

The Blough Lake - Silicates Lake local area is a complex down fold composed of two parallel synclines trending west-northwestward and overturned to the southwest. Northeasterly cross-folds cause a widening in the Blough Lake fold and bending of the axes near the noses of both folds.

No large-scale faults were observed in the area. The only breaks noted were small strike shears in the Gagnon Group and upper schists.

Economic Geology

Iron

The area, a part of the Mt. Reed - Mt. Wright district, has been thoroughly prospected for iron. Hundreds of claims have been staked over its iron deposits. Two large claim groups, covering the Aubertin Lake and the Silicates Lake - Blough Lake deposits, and a smaller group over iron-formation near the northern border, are held by the Quebec Cartier Mining Company. All other claims on iron-formation have been allowed to lapse.

In the Aubertin Lake deposit quartz-specularite († magnetite) iron-formation averaging slightly less than 30% Fe crops out on the limbs of tight synclines, bent around and dipping off the flanks of two central domes. The structure is about three miles long but the iron bed is too thin (20'-100') and too spread out to be mined in a single operation.

The complex synclinal mass of Gagnon Group rocks ending near Blough and Silicates lake contains several deposits of quartz-magnetite iron-formation. The area's largest deposit was formed east of Silicates lake where the cross-folded nose brings together (and thickens?) iron-formation beds into a large deposit. Limited exploration drilling has indicated an average grade of about 30% Fe.

Similar quartz-magnetite iron-formation strikes westward from the west end of Silicates lake. Preliminary drilling in this zone indicates the formation is about 100 feet thick.

Sulfides

Two occurrences of pyrite were found in the area: one, in a zone of coarsely recrystallized skarn in the upper schist and marble directly southeast of Delahaise(Sybill) lake; the other, a pyrite- and graphite-rich band of upper schist directly south of Blough lake. The latter occurrence has been staked by Prosper Exploration Limited. Single grab samples from the two showings, analysed by the Department of Natural Resources, contain traces of copper, lead, zinc, gold, and silver.

A reconnaissance sampling of stream sediments was carried out over most of the area. The muddy fraction of the samples was analysed for copper, zinc, lead, and molybdenum.

There is no simple correlation between high metal content and underlying rock type or sample location. The highest total metal concentration was found north of the Aubertin Lake structure, and three high-molybdenum muds occur along the border south of Blough lake.

Sand and Gravel

Sand and gravel from the eskers and sorted fluvial deposits along the main river courses would supply construction material for the development of the area.

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