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Petrography of the Harvest Lake Area, Quebec, Canada

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Senior Thesis

PETROGRAPHY OF THE HARVEY LAKE AREA, QUEBEC, CANADA

by

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ABSTRACT

It was found, by determining the types of minerals found in the Harvey Lake area, that the sedimentary rocks of sandstone, dolostone, limestone, and shales were regionally metamorphosed to a degree of metamorphism corresponding with that of the "Staurolite-Almandine Subfacies" of the "Almandine-Amphibolite Facies." These minerals were determined by hand-sample inspection, by thin-section observations, and by observing powdered samples immersed in refractive oils.

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INTRODUCTION

General Statement:

The rock specimens were first labeled to facilitate recording identification data. Hand-size specimens were then examined and tentatively identified, if possible. Next, thin-sections were made and examined under a petrographic microscope, as also done with powdered samples immersed in refractive oil. The mineral assemblage was then used to determine the metamorphic facies.

Location of Specimen Area:

The rock specimens were taken from the Harvey Lake area which is approximately bounded by latitudes 52° 30' and 52° 33' and by longitudes 67° 39' and 67° 43'. This area is in the northeast corner of Menneval County in the Province of Quebec, Canada.

Acknowledgments:

I am indebted to Mr. Gillett for advice, rock specimens, references, and maps, and to Dr. Quirke for references and maps. The help and assistance received from Mr. Kohanowski and Mr. Morris McCollum in giving advice and supplies is also greatly appreciated.

Previous Work:

Previous work done in the specific area from which the rock specimens were collected was done by Mr. Phillips for Quebec Department of Mines in 1958 and by Mr. Gillett for the M. V. Boylen Engineering Offices. 1958 There is a great deal of material written about the general area, which because of its confidential nature, is unavailable to the public.

REGIONAL GEOLOGY

The structure of the rocks of this area is characterized by a general northwesterly trends with most of the observable lineations, as shown by gneissic structure and axis of minor folds, plunge in this direction at angles up to 50°. This area as a whole is characterized by very tight isoclinal folds and by overturned beds so that dips on bedding and schistosity are rarely a guide to a regional stratigraphic sequence. In general the rocks have been deformed by flowage rather than by fracture, so that many of the mappable units disappear by attenuation rather than by faulting. Tectonic thickening of rock units, small-scale isoclinal folds, chevron folds, drag folds, and boudinage are all common. (Phillips, 1958, p. 7).

The complex folding of the iron formations suggest that two periods of folding have occurred. The second folding, with axis trending northeast is believed to be imposed upon the general northwest trending structures. The few faults that were mapped in the northern part of Faber County, Quebec are of high angle and small displacement, and are probably somewhat later than the main folding. (Phillips, 1958, p. 7).

The specimen area is situated just beyond the southwestern end of what is termed the Labrador Trough in the "Grenville Province," which is an area that has been subjected to high temperature metamorphism. The degree of metamorphism decreases northward to Ungava Bay. The iron formation, near Harvey Lake, contains high grade metamorphic minerals and has been folded plastically. (Gillett, 1957, p. 3).

The absolute age of the last metamorphism of these rocks, as determined from Potassium-Argon dating, is 1.2 billion years to 0.9 billion years. (Quirke, 1960, p. 323).

DESCRIPTION OF SPECIMEN AREA

The specific area from which the rock specimens were collected is known as Turtleback Hill, which is located just southwest of Harvey Lake. This hill is thought to be underlain by a semi-recumbent anticline, with its axis trending northeast. (Phillips, 1958, p. 7). Within the specimen area these are thought to be at least two distinct bands of iron formation which structural evidence indicates are not the same band repeated by folding or faulting. (Gillett, 1957, p. 4).

DESCRIPTION OF ROCK SPECIMENS

Specimen #1 is a dark grey, magnetic, friable rock which has a red streak, specularite luster, and many colorless grains.

(a) The colorless crystals have a conchoidal fracture, a weak birefringence, and refractive indices of 1.540 and 1.550. This mineral is believed to be quartz.

(b) The opaque, black magnetic grains with a red streak are believed to be magnetite and hematite.

The mineral proportions are approximately:

quartz	60 %
magnetite and hematite	40 %

Specimen #2 is a dark, specularitic, slightly magnetic, veined rock which has a red streak.

(a) The veins of colorless grains have low birefringence, conchoidal fracture, and refractive indices of about 1.540 and 1.550. This mineral is believed to be quartz.

(b) The opaque, black grains, of which some, but not all, are magnetic, are believed to be magnetite and specularite hematite.

The mineral proportions are approximately:

quartz	50 %
magnetite and hematite	50 %

Specimens #3 and #11 are hard, white rocks which effervesce slightly in cold dilute HCl. These rocks in hand specimen, in thin-section, and in powdered sample appear to be identical.

(a) The colorless rhombic crystals have high birefringence, extinction symmetrical with cleavage outlines, and refractive indices of 1.490 and 1.650. This mineral is believed to be a calcic-dolomite.

(b) The colorless grains with conchoidal fracture, weak birefringence, and refractive indices of 1.540 and 1.550 is believed to be quartz.

The mineral proportions are approximately:

quartz 70 %

calcic-dolomite 30 %

Specimen #4 is a dark, strongly magnetic rock with narrow, white layers.

(a) The black, opaque, magnetic grains are believed to be magnetite.

(b) The colorless grains with conchoidal fracture, weak birefringence, and refractive indices of about 1.540 and 1.550 are believed to be quartz.

The mineral proportions are approximately:

magnetite 60 %

quartz 40 %

Specimen #5 is a dark, magnetic rock with a micaceous, greenish weathered surface and some of the small white veins effervesce in cold, dilute HCl.

(a) Small rhombic crystals which have a high birefringence and refractive indices of 1.490 and 1.650 are believed to be calcic-dolomite.

(b) Colorless grains which have conchoidal fracture, low birefringence, and refractive indices of 1.540 and 1.550 are believed to be quartz.

(c) Black, opaque, magnetic grains are believed to be magnetite.

(d) Thin, light green flakes which have weak birefringence, optically positive, and refractive indices of about 1.580 are believed to be chlorite.

The mineral proportions are approximately:

calcic dolomite	30 %
quartz	30 %
magnetite	25 %
chlorite	5 %

Specimen #6 is a gray, friable rock with black specks.

(a) Black, opaque, magnetic grains are believed to be magnetite.

(b) The colorless grains with conchoidal fracture, low birefringence, and refractive indices of 1.540 and 1.550 are believed to be quartz.

(c) The small green crystals showing a 124° and 56° cleavage, 15° extinction angle, optically negative, and refractive indices of 1.600 and 1.655 are believed to be actinolite.

The mineral proportions are approximately:

magnetite	20 %
quartz	70 %
actinolite	5 %

Specimen #7 is a greenish dark, magnetic rock.

(a) Black, opaque, magnetic grains are believed to be magnetite.

(b) Colorless grains with conchoidal fracture, low birefringence, and refractive indices of about 1.540 and 1.550 are believed to be quartz.

(c) Light green, pleochroic grains with high refractive indices, optically negative, parallel extinction, rather strong birefringence are believed to be epidote.

The mineral proportions are approximately:

magnetite 25 %

quartz 65 %

epidote 15 %

Specimen #8 is a greenish, granular rock which effervesces slightly in cold, dilute HCl.

(a) Light green, pleochroic grains with high birefringence, optically negative, parallel extinction, high refractive indices are believed to be epidote.

(b) Colorless grains with conchoidal fracture, low birefringence, and refractive indices of about 1.540 and 1.550 are believed to be quartz.

(c) Colorless crystals with high birefringence, and refractive indices of about 1.490 to 1.550 are believed to calcite.

The mineral proportions are approximately:

quartz 55 %

epidote 15 %

calcite 30 %

Specimen #9 is a light brown micaceous rock with a band of reddish crystals.

(a) Colorless grains with conchoidal fracture, low birefringence, and refractive indices of 1.540 and 1.550 are believed to be quartz.

(b) The reddish crystals with very high refractive indices and remain dark under crossed nicols are believed to be garnet.

(c) The micaceous flakes are colorless, optically negative, 35° 2 V angle, and refractive indices of about 1.560 and 1.600. This mineral is believed to be muscovite.

The mineral proportions are approximately:

quartz 70 %

muscovite 20 %

garnet 10 %

Specimen #10 is a rock with a greasy luster, conchoidal fracture, corase grained, white to colorless, hardness of 7 and is believed to be quartz.

Specimen #11 is included with speciman #3.

Specimen #12 is a red and black rock, is strongly magnetic and has developed large red crystals.

(a) The black, opaque, magnetic grains are believed to be magnetite.

(b) The reddish grains have very high refractive indices and remain dark under crossed nicols. This mineral is believed to be garnet.

The mineral proportions are approximately:

garnet 30 %

magnetite 70 %

Specimen #13 is a very dark, fine-grained, magnetic rock.

(a) The green grains in columnar crystal aggregates or in isolated grains is optically negative, shows twinning and parallel extinction, moderate birefringence, and indices of refraction higher than 1.736. This mineral is believed to be epidote.

(b) Black, opaque, magnetic grains are believed to be magnetite.

(c) Colorless grains which have low birefringence, optically negative, conchoidal fracture, and refractive indices of 1.540 and 1.550 are believed to be quartz.

The mineral proportions are approximately:

quartz 50 %

magnetite 30 %

epidote 20 %

Specimen #14 is a brown, micaceous rock with black specks.

(a) Grains with conchoidal fracture, low birefringence, optically positive, and refractive indices of 1.540 to 1.550 are believed to be quartz.

(b) Colorless micaceous flakes with 35° 2 V angle, optically

negative, and refractive indices about 1.560 and 1.600 are believed to be muscovite.

(c) Reddish brown, micaceous, pleochroic flakes with strong birefringence, optically negative, very low 2 V angle, and refractive indices of about 1.540 to 1.635 are believed to be biotite.

The mineral proportions are approximately:

quartz 75 %

muscovite 20 %

biotite 5 %

Specimen #15 is a cream to white colored rock with many dark green, long prismatic crystals showing 124° and 56° cleavage.

(a) The green crystals are lathlike in powder sample and thin-section, show 17° extinction angle with some longitudinal sections showing parallel extinction, strong birefringence, and has refractive indices of 1.600 and 1.650. This mineral is believed to be actinolite.

(b) The cream to white colored mineral effervesces with cold, dilute HCl, shows rhombic cleavage, and has a refractive indices of 1.520 and 1.690. This mineral is believed to be a calcic-dolomite.

The mineral proportions are approximately:

calcic-dolomite 70 %

actinolite 30 %

Specimen #16 is a light green rock of radiating, fibrous crystals.

This mineral shows an 18° extinction angle, lathlike crystals, is optically negative with refractive indices of about 1.610 and 1.650. This mineral is believed to be tremolite-actinolite.

Specimen #17 is a coarse grained, cream colored rock.

The large, tabular crystals have a 17° extinction angle, narrow lamellae, and refractive indices of 1.655 and 1.700. This mineral is

believed to be grunerite.

The coarse grained, cream colored crystals effervesce with cold, dilute HCl, show rhombic cleavage, and has refractive indices of 1.520 and 1.690. This mineral is believed to be calcic dolomite.

The mineral proportions are approximately:

grunerite	50 %
calcic-dolomite	50 %

Specimen #18 is a light gray to white colored, coarse grained rock which effervesces slightly with cold, dilute HCl and has large green, long prismatic crystals (3 x 7 and up to 25 mm long).

(a) The whitish-tan crystals show rhombic cleavage, some twinning, high birefringence, and has refractive indices of 1.510 and 1.680. This mineral is believed to be calcic-dolomite.

(b) The large green crystals show a 124° by 56° cleavage, 18° extinction angle, optically negative, and refractive indices of 1.600 and 1.655. This mineral is believed to be actinolite.

The mineral proportions are approximately:

calcic-dolomite	70 %
actinolite	30 %

Specimen #19 is a green rock composed of prismatic crystals showing cleavage at 124° and 56°, extinction angle of 15°, very faint pleochroism, refractive indices about 1.600 and 1.655, optically negative. This mineral is thought to be actinolite.

PETROGRAPHIC INTERPRETATION

The metamorphic grade, as indicated by the mineral assemblage of the rock specimens, corresponds with that of the "Staurolite-Almandine Subfacies" of the "Almandine-Amphibolite Facies." This subfacies is characterized by almandine, biotite, muscovite, quartz, epidote, grunerite,

tremolite, and actinolite. (Turner and Verhoogan, 1960, p. 545-546).

The original minerals before metamorphism were sandstones, limestones, dolostones, and probably some shales from which alumina was extracted to form some of the amphiboles.

The type of metamorphism of this area is believed to be regional due to the type of mineral assemblage and the large area which has been metamorphosed.

SUMMARY AND CONCLUSION

The rocks of the "Grenville Province" in the southwestern end of what is known as the Labrador Trough in Quebec, Canada have been metamorphosed from the sedimentary rocks, sandstones, dolostones, limestones, and shales, to a degree of metamorphism corresponding with that of the "Staurolite-Almandine Subfacies" of the "Almandine-Amphibolite Facies." The degree of metamorphism increased southward from Ungava Bay toward the Harvey Lake area. The age of the last metamorphosed rock is about one billion years as determined from Potassium-Argon dating.

Age of metamorphism.

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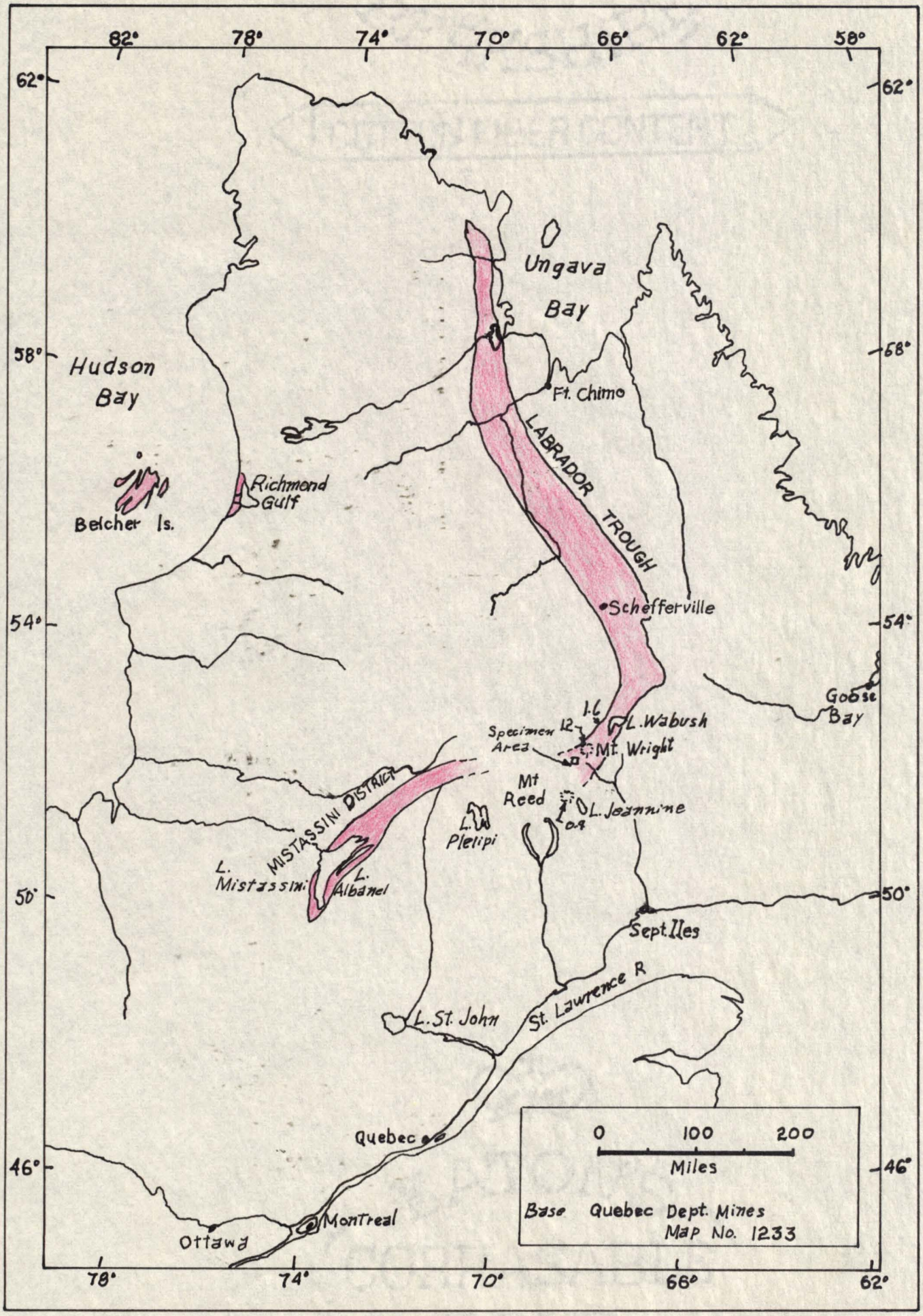
82°
78°
74°
70°
66°
62°
58°
62°
58°
54°
50°
46°
Ungava Bay
Hudson Bay
Ft. Chimo
LABRADOR TROUGH
Richmond Gulf
Belcher Is.
Schefferville
Goose Bay
L.6
L. Wabush
12
Specimen Area
Mt. Wright
Mt Reed
L. Jeannine
L. Pletipi
MISTASSINI DISTRICT
L. Mistassini
L. Albanel
Sept Iles
L. St. John
St. Lawrence R
Quebec
Montreal
Ottawa
0 100 200
Miles
Base Quebec Dept. Mines
Map No. 1233

67° 41′

52° 32′

28.5°

HARVEY LAKE

52° 32′

67° 41′

LEGEND

- Iron Formation
- Orthoquartzite
- Dolomite
- Paragneiss & Migmatite

Rock Types

Increase in Age

- Gneiss
- Dolomite
- Iron Formation
- Orthoquartzite
- Dolomite
- Gneiss
- Dolomite
- Iron Formation
- Dolomite

OUTCROP

LINEATION

FOLIATION

BEDDING

GEOLOGICAL CONTACT

GLACIAL STRIAE

GEOLOGICAL MAP

HARVEY LAKE AREA

QUEBEC, CANADA

SCALE: 1000 FEET = 1 INCH

1000 0 1000 2000

FEET