

DP 482

DORVAL - GUYON AREA (MISTASSINI TERRITORY)

Documents complémentaires

Additional Files



Licence



License

Cette première page a été ajoutée
au document et ne fait pas partie du
rapport tel que soumis par les auteurs.

Énergie et Ressources
naturelles

Québec





MINISTÈRE
DES RICHESSES
NATURELLES

DIRECTION GÉNÉRALE
DES MINES

DORVAL-GUYON
AREA

-MISTASSINI TERRITORY-

P.T. Moyer

Final report

GOURVERNEMENT DU QUEBEC
MINISTERE DES RICHESSES NATURELLES
EXPLORATION GEOLOGIQUE

DORVAL - GUYON AREA
-MISTASSINI TERRITORY-

BY
P.T. Moyer
1959

NOTE - Ce rapport est accompagné d'une carte
géologique à l'échelle de 1"= 1mi.

III

TABLE OF CONTENTS

INTRODUCTION

- Location
- Access
- Inhabitants
- Previous work in the region
- Mapping procedure
- Acknowledgements

NATURAL RESOURCES AND CLIMATE

- Timber
- Waterpower
- Climate

TOPOGRAPHY

- Introduction
- Relief
- Drainage

GENERAL GEOLOGY

- Introduction
- Table of Formations
- Western Complex
 - Hornblende quartz metadiorite
 - Metagranodiorite
 - Amphibolite
- Eastern Complex
 - Biotite quartz feldspar orthogneiss
 - Biotite quartz plagioclase paragneiss
 - Hornblende plagioclase gneiss
 - Hornblende quartz plagioclase gneiss
 - Quartz muscovite schist
 - Hornblende biotite plagioclase schist
 - Diabase
- Mistassini Group
 - Introduction
 - Lower Albanel Formation
 - Carbonaceous shaly dolomite
 - Black dolomitic shale
 - Interbedded argillaceous and shaly dolomite
 - Microcrystalline beige dolomite

IV

Interbedded massive and shaly dolomite
Pink dolomite
Upper Albanel Formation
Crystalline pink and grey dolomite
Interbedded dolomite and sandy dolomite
Ferruginous dolomite
Dolomitic sandstone
Microcrystalline pinkish beige dolomite

STRUCTURAL GEOLOGY

Igneous and Metamorphic Rocks
 Eastern Complex
 Schistosity and layering
 Joints
 Faults
 Western Complex
 Schistosity and layering
 Joints
 Faults
Sedimentary Rocks
 Mistassini Group
 Attitude
 Folds
 Joints
 Faults
 Mistassini Fault Zone
 Introduction
 Interpretation

ECONOMIC GEOLOGY

REFERENCES

Plates

Plate 1

- A. Southeast side of Long Island, Lake Mistassini.
 Looking southwestward..... 52
B. Cliff along southeast side of Long Island, Lake Mis-
 tassini. Lower Albanel formation,..... 52

Plate 2

- A. Interbedded argillaceous and shaly dolomite, Lower
 Albanel formation. Island northeast of Long Island,
 Lake Mistassini..... 53
B. Interbedded argillaceous and shaly dolomite, Lower
 Albanel formation. Island northeast of Long Island,
 Lake Mistassini 53

Plate 3	
A.	Interbedded dolomitic black shale and shaly dolomite, Lower Albanel formation. Long Island, Lake Mistassini. 54
B.	Shaly dolomite, Lower Albanel formation. Mistassini..... 54 cuesta, 1 mile south of north boundary of the map-area, long. 73 37 $\frac{1}{2}$ '.....
Plate 4	
A.	Beds of dolomitic black shale with concretions, Lower Albanel formation. Long Island, Lake Mistassini..... 55
B.	Intraformational conglomerate in interbedded argillaceous and shaly dolomite, Lower Albanel formation. Long Island, Lake Mistassini..... 55
Plate 5	
A.	Contorted beds of Lower Albanel formation. Island northeast of Long Island, Lake Mistassini..... 56
B.	Contorted beds of Lower Albanel formation. Island northeast of Long Island, Lake Mistassini..... 56
Plate 6	
A.	Intraformational contortions, Lower Albanel formation. Long Island, Lake Mistassini..... 57
B.	Contorted beds of the Lower Albanel formation. Island northeast of Long Island, Lake Mistassini..... 57
Plate 7	
A.	Anticlinal flexure, Lower Albanel formation. Island northeast of Long Island, Lake Mistassini..... 58
B.	Overtaken syncline, Lower Albanel formation. Looking southeastward, Gull Island, Lake Mistassini..... 58
Plate 8	
A.	Isoclinal flexure, Lower Albanel formation. Looking east-southeastward, Gull Island, Lake Mistassini..... 59
B.	Thrust fault, Lower Albanel formation. Looking west-southwestward, Gull Island, Lake Mistassini 59
Plate 9	
A.	Thrust fault, Lower Albanel formation. Looking southward, Gull Island, Lake Mistassini..... 60
B.	Thrust fault, Lower Albanel formation. Looking south-eastward, Gull Island, Lake Mistassini..... 60
Plate 10	
A.	Thrust fault, Lower Albanel formation. Looking southward, Gull Island, Lake Mistassini..... 61
B.	Interbedded shaly dolomite and dolomitic black shale; normal faulting in lower right-hand corner, Lower Albanel formation. Looking southward, Gull Island, Lake Mistassini..... 61
Plate 11	
A.	Fault(?) breccia, Lower Albanel formation. Gull Island, Lake Mistassini 62
B.	Fault breccia in vertical shear zone, Lower Albanel formation. Gull Island, Lake Mistassini..... 62

INTRODUCTION

Location

The Dorval-Guyon area, consisting of two 15-minute quadrangles, was mapped geologically during the summer of 1959. It is situated in Mistassini Territory, and bounded by latitudes $50^{\circ}30'$ and $50^{\circ}45'$ North, and by longitudes $73^{\circ}30'$ and $74^{\circ}00'$ West. The southwest corner is 45 miles north-northwest of Chibougamau, Abitibi-Est county. The east half includes Guyon township, all but the northernmost part of Dorval township, and parts of St. Simon, P  re, McOuat, and Joybert townships. The eastern part of the west half includes parts of Dorval, Guyon, and McOuat townships. Approximately one-half of the west quadrangle is occupied by the southern part of Lake Mistassini. The area covers 373.63 square miles.

The east half of the map-area straddles approximately 14 miles of the so-called Grenville front, with early Precambrian metamorphic rocks of the Grenville subprovince to the southeast and late Precambrian sedimentary rocks of the Mistassini basin to the northwest. The northwest corner of the map-area includes about 6 miles of contact between the deposits of the Mistassini basin to the southeast and the igneous-metamorphic complex of the Timiskaming-Keewatin subprovince to the northwest.

Access

The map-area can be reached by hydroplane from Chibougamau, Roberval, St. Felicien, Dore lake, and Senneterre. It is possible, however, to reach Lake Mistassini by canoe and three portages from Waconichi lake, about 20 miles by gravel road north of Chibougamau. All parts of the west quadrangle, and the northwest part of the east quadrangle, are accessible directly from Lake Mistassini. The south-central part of the east quadrangle can be reached from Lake Mistassini, by way of Chalifour river, but this passage is very difficult owing to many rapids. Rama, Vishnu, and Albanel lakes in the east half are accessible by hydroplane.

Inhabitants

The region is inhabited the year around by Indians of the Mistassini Cree tribe. During the summer months most of them live on a reservation at Mistassini Post, at the south end of Abatagauche bay, 6 miles south of the west half of the map-area. The writer was told that, in 1959, approximately 900 Indians were registered there. During the winter months practically all of the Indians travel northward, where they hunt and trap.

The Quebec Department of Game and Fisheries, and The Hudson's Bay Company, maintain operations at Mistassini Post.

There were no prospectors encountered during the 1959 field season, although a few tourist-fishermen were seen.

Previous work in the region

The region has received study, especially in recent years, because of interest in iron-bearing horizons within the Mistassini group and the possibility of finding mineral deposits along the Grenville front. Early investigations, as cited by Neilson (1953), were carried out by Richardson (1872), McOuat (1873), and Barlow (1911). Richardson reported the presence of limestones at Mistassini lake, McOuat surveyed part of the lake, and Barlow, after studying the sedimentary rocks and their algal structures, assigned the sequence to the Ordovician. Low (1886), noting the resemblance between the Mistassini sedimentary rocks and those regarded as Cambrian along the east side of James Bay, considered the Mistassini rocks Cambrian. More recently, Norman (1940) described the Mistassini group in some detail, inferring a faulted contact with the gneisses to the east-southeast and southeast.

Work within the last decade has been carried out in the region by the Quebec Department of Mines. The area to the northeast of the present area was mapped by Neilson (1953). The area south of the east quadrangle was mapped by Sater (1957), and the area south of the west quadrangle was mapped by Deland (1957).

Mapping procedure

The writer was in the field in 1959 from June 7th until September 9th. During this time two 15-minute quadrangles were mapped.

Excellent aerial photographs of the area were obtained, with a scale of 1320' per inch, from Photo Air Laurentide, Quebec, as well as a set with a scale of approximately 1 mile per inch. The base-map was prepared by Photo Air Laurentide at a scale of $\frac{1}{2}$ mile per inch.

More or less straight-line traverses were laid out at one-half mile intervals on the photographs. Transparent acetate overlays were used on which were placed notations on control points in the field. All inland traversing was done by the pace-and-compass method.

The mapping of the shoreline and islands of Lake Mistassini was carried out with the use of a 24-foot "Pointer" rented from the Hudson's Bay Company at Mistassini Post. This boat was relatively safe in rough water, making possible work on days when a freighter canoe could not be used.

Acknowledgements

The writer gratefully thanks the following people for assistance during the 1959 field season: Pierre LaSalle and Mahendra Narain, senior assistants, both of McGill University; John R. Fryer, Denis Larrivee, and Warman Castle, junior assistants, of McGill University, Laval University, and Mount Allison University, respectively. Faithful service was given

by Mr. F. X. Lapointe, cook, and Mathew Coom, canoeeman.

Mr. Glen R. Speers, manager of Hudson's Bay Company at Mistassini Post, was most helpful.

NATURAL RESOURCES AND CLIMATE

Timber

The region is wooded throughout, except in swampy areas. Types of trees represented are black spruce, Canada balsam, jack-pine, tamarack, and white birch. It is interesting to note that white birch are relatively abundant on drumlinoid land forms and, to a lesser extent, on eskers. In lower, more poorly drained places, white birch are noticeably absent.

Waterpower

There is one site in the area which has moderate to high power potential as a site for a hydro development. This is at the cascades in the Chalifour river, 3 miles north of the south boundary of the east quadrangle. Here, the waters of the Chalifour river fall between 150 and 250 feet over a distance of about $\frac{1}{2}$ mile. There are numerous rapids along waterways in the east quadrangle which might prove suitable as sites for power development, but it is believed that these would be of very minor importance.

Climate

This is a region of short, relatively rainy summers. The larger lakes are not free of ice until late May or early June, and smaller lakes freeze over by early October.

A record of daily maximum and minimum temperatures was kept during the 1959 field season. These are tabulated below.

<u>Month</u>	<u>High</u>	<u>Low</u>	<u>Av. Daily High</u>	<u>Av. Daily Low</u>
June 12-30	86	32	68	46
July 1-31	86	31	75	50
Aug. 1-31	85	36	69	50
Sept. 1-7	78	46	70	53

Thunderstorms and rainy periods are common during the summer months. Prolonged, drenching rains occurred as follows:

June 12-30:	Average once every $2\frac{1}{2}$ days			
July 1-31	"	"	"	2
Aug. 1-31	"	"	"	3
Sept. 1-7	"	"	"	2

According to Neilson (1953), temperatures during the winter frequently fall to forty degrees or more below zero, with an average close to zero.

TOPOGRAPHY

Introduction

The area may be regarded as exhibiting topography typical of the Canadian shield. The land surface slopes very gently upward away from the basin of Lake Mistassini.

Drainage channels which existed in preglacial time are now more or less filled with glacial deposits, so as to produce a low, blanketed plane. This is interrupted only here and there within the sedimentary sequence by low ridges formed by southeasterly-dipping cuestas.

Linements of glacial deposits lie roughly parallel to the strike of the sedimentary rocks, which trend northeasterly. Aerial photographs show this strong lineation, and, for the most part, it can be ascribed to the combined effect of the distribution of glacial deposits and the structure of underlying bedrock. Surface texture is not as strongly linear in regions underlain by gneissic rocks.

Relief

The Mistassini sedimentary sequence, of relatively uniform structure throughout, produces cuesta-like ridges with the dip slope in all instances to the east. These ridges are the only interruptions present in the low plane of the Mistassini basin. The height of these ridges rarely exceeds 150 feet above the general surrounding elevation. An exception to this is the Mistassini cuesta of Neilson (1953, p.4) which extends south-

westward from the Albanel area. In the present area it lies from 1,000 to 5,000 feet east of Lake Mistassini, depending on the configuration of the shoreline. It is more prominent in the north half of the area, where it produces relief of roughly 200 to 300 feet above a plane rising very gently eastward from the lake shore.

Topography of the gneisses to the southeast is more irregular and hummocky. The magnitude of local relief is similar to that of the sedimentary rocks, but appears to be the result essentially of irregular dissection rather than apparent structural control. The gneiss produces local relief of from 150 to 250 feet at the cascades in Chalifour river, 3 miles north of the south boundary of the east quadrangle. It is interesting to note that these cascades of the Chalifour lead westward to the contact with the Mistassini group. This is the only place along this contact within the map-area where there is appreciable difference in elevation between the gneiss and the younger sedimentary rocks to the west.

Drainage

The area lies northwest of the drainage divide separating drainage to the Hudson's Bay region and drainage to the Lake St. John - St. Lawrence river region. The present area drains westward indirectly into James Bay, by way of Lake Mistassini and Rupert river.

Principal courses of drainage in the east quadrangle are:
1) to the south by way of Chalifour river, 2) northward from

Vishnu lake into Albanel lake, and 3) south-southwestward through Pére township into Rama lake, and thence to Chalifour river. Other smaller streams flow directly into Lake Mistassini, Albanel lake, and Chalifour river.

GENERAL GEOLOGY

Introduction

The Dorval-Guyon area straddles the southern part of the Mistassini basin. In the southeast part it includes the contact between dolomitic rocks of the Mistassini group and the metamorphic rocks of the Grenville subprovince. Near the northwest corner it includes the contact between the Mistassini series and an igneous-metamorphic complex of the Temiskaming-Keewatin subprovince.

The metamorphic rocks of the Grenville subprovince, although restricted to a relatively small portion of the area, are represented by diverse and numerous types. Gneissosity is commonly well developed. The two most abundant rock types are biotite-quartz-feldspar orthogneiss and biotite-quartz-plagioclase paragneiss.

Rocks of the Temiskaming-Keewatin subprovince, confined to the northwest corner of the map-area, are chiefly hornblende-quartz metadiorite. This is accompanied by minor amounts of more mafic types.

The Mistassini group, assigned to the Proterozoic, overlies the metamorphic rocks. It is made up of more or less stratified, pink and grey dolomite, variously crystalline, shaly, and sandy. In most places the beds dip gently east-southeastward, with dips steepening abruptly in this direction where the beds form a sharp contact with the metamorphics of the Grenville subprovince. This is the so-called Grenville front.

Glacial deposits blanket the entire area, hence outcrops are not numerous. These deposits include drumlins, eskers, kames, and till plains.

In the following table of formations, rock types within the Western and Eastern complexes are listed from top, down, in order of relative abundance.

Table of Formations

Cenozoic	Pleistocene and Recent	Kame and drumlinoid deposits; glacio-fluvial deposits; till plains; beach deposits.
		Unconformity
Late Precambrian	Mistassini Group	Upper Albanel formation Crystalline pink and grey dolomite Interbedded dolomite and sandy dolomite Ferruginous dolomite Dolomitic sandstone Microcrystalline pinkish beige dolomite
		Lower Albanel formation Carbonaceous shaly dolomite Black dolomitic shale Interbedded argillaceous and shaly dolomite Microcrystalline beige dolomite Interbedded massive and shaly dolomite Pink dolomite
		Unconformity
Early Precambrian	Eastern Complex	Biotite-quartz-feldspar orthogneiss Biotite-quartz-plagioclase paragneiss Hornblende-plagioclase gneiss Hornblende-quartz-plagioclase gneiss Quartz-muscovite schist Hornblende-biotite-plagioclase schist Diabase
		Unconformity
	Western Complex	Hornblende-quartz metadiorite Metagranodiorite Amphibolite

Western Complex

Inland about 1 mile from the west shore of Lake Mistassini, and roughly parallel to the shore, the Mistassini group forms a non-conformable contact with an igneous-metamorphic complex of older rocks. The northwest corner of the map-area includes approximately 6 square miles of this complex. Shaly dolomite and dolomitic shale lie in a belt between the contact and Lake Mistassini.

The area of the igneous-metamorphic complex coincides with a slight but noticeable topographic rise and relatively hummocky terrain. Even though outcrops are rather scarce in the region of the contact, differences in topographic character can be used in determining the approximate location of the contact.

At least 85 percent of the Western complex is occupied by hornblende-quartz metadiorite. The metadiorite is essentially uniform throughout, forming here and there low, discontinuous ledges and more extensive exposures on the slopes of hills. Outcrops are generally sparse. The metadiorite is accompanied in places by fine-grained metagranodiorite and amphibolite.

Hornblende quartz metadiorite

The metadiorite has a rather coarsely crystalline, spotty appearance. Pale greenish beige to pinkish beige feldspar and disseminated as well as somewhat aggregated dark greyish green hornblende occur throughout. Grains are subhedral to anhedral, ranging from about 0.5 mm. to 4.0 mm., with most between 2.0 mm. and 3.5 mm. Hence the texture is essentially equigranular. Sodic andesine (Ab_{6.8}-An_{3.2}), which is largely

untwinned, makes up approximately 65 per cent, green to olive brown hornblende makes up from 15 to 20 per cent, and quartz composes 10 to 15 per cent. Accessory epidote makes up to about 2 per cent, and it is characteristic of all the specimens. Minor accessories are, in order of relative abundance, chlorite, sericite, biotite, sphene, and apatite. There are traces of ilmenite-leucoxene, actinolite (possibly after pyroxene), hematite, magnetite, and pyrite.

In nearly all outcrops examined, faint to distinct internal lineation occurs, representing more or less incipient gneissosity. However, many outcrops show little conspicuous evidence of deformation.

Metagranodiorite

Here and there, situated sparsely throughout the metagranodiorite, there are isolated outcrops of largely fine-grained light grey to pinkish grey metagranodiorite. Several outcrops occur together about $\frac{1}{2}$ mile southeast of the northwest corner of the map-area. Outcrops seen were never more than a few yards square in area.

Grains are subhedral to anhedral, ranging from 0.5 mm. to 2.0 mm., with an average of roughly 1.0 mm. Approximately 20 per cent potash feldspar, apparently largely microcline, and 40 per cent sodic andesine (Ab_{6.4}-An_{3.6}) make up the feldspar. Much of the plagioclase is untwinned. There is about 35 per cent quartz. Accessory greyish brown to pale olive brown biotite, which is generally somewhat chloritized, makes up from 1 to 3 per cent. Hornblende is absent. Minor accessories are, in order of relative abundance, chlorite, muscovite, sphene, epidote, apatite, and sericite, with traces of magnetite, hematite,

ilmenite-leucoxene, and pyrite.

Gneissic structure is barely visible in most exposures.

A boulder of about 10 cu. ft. was seen in which the metagranodiorite forms a sharp contact with the metadiorite discussed above. However, the two were not seen together in the same exposure. Relative age relationships are unknown.

Amphibolite

Several outcrops of amphibolite occur within a one-half square mile area, 2 miles east-southeast of the northwest corner of the map-area. Similar rocks were not found elsewhere in the Western complex, and it was seen nowhere in direct association with the metadiorite or metagranodiorite. Because of its relatively high degree of metamorphism, ^{the amphibolite} is regarded here as possibly an earlier rock type into which are intruded the dioritic and granodioritic rocks.

The amphibolite is dark greenish grey to black. Grains are largely anhedral, ranging from 0.25 mm. to 2.5 mm., with most between 1.0 mm. and 2.0 mm. It is made up of from 40 to 50 per cent green to olive brown hornblende, 35 to 45 per cent sodic andesine (Ab6.2-An3.8), 10 per cent quartz, and 2 per cent biotite. Minor accessories are, in order of relative abundance, apatite, sericite, epidote, sphene, and carbonate, with traces of chlorite, leucoxene, hematite, zircon, and pyrite.

Although there is indicated here a quantitative range in mineral composition, the amphibolite does not have visible compositional layering. Compositional differences appear to be distributed irregularly.

Eastern Complex

The metamorphic rocks which occupy that portion of the Grenville subprovince which occurs in the southeastern part of the map-area are designated here as the Eastern complex. This complex lies in sharp contact with mildly deformed dolomitic beds of the Mistassini group to the west-northwest and northwest. This contact is the so-called Grenville front, and marks what is apparently a fault of regional extent.

Outcrops of the Eastern complex of pre-Mistassini rocks are generally sparsely scattered, and rock types vary widely. For these reasons, structural and petrologic relationships among the various rock types are impossible to ascertain. Some rock types are widespread, whereas others may occur in only a few exposures within an area of a few hundred square yards. The types recognized are, in order of relative abundance, biotite-quartz-feldspar orthogneiss, biotite-quartz-plagioclase paragneiss, hornblende-plagioclase gneiss, hornblende-quartz-plagioclase gneiss, quartz-muscovite schist, hornblende-biotite-plagioclase schist, and diabase.

Biotite-quartz-feldspar orthogneiss

Outside of the regions occupied by biotite-quartz-plagioclase paragneiss, the biotite-quartz-feldspar orthogneiss is apparently the most abundant and widespread rock type of the Eastern complex. This is not definite because of scarcity of exposures.

It weathers whitish grey, pinkish grey, and greyish pink. Grains are generally subhedral to anhedral, ranging in size from less than 1.0 mm. up to about 5.0 mm. The average grain size lies between approximately 1.0 mm. and 2.5 mm. The rock type is characterized throughout by 25-40 per cent quartz, 40-55 per cent sodic andesine, 5-20 per cent pale green to olive brown biotite, 2-8 per cent orthoclase, 1-10 per cent epidote, with minor proportions here and there of bluish green to pale brownish green hornblende, chlorite, apatite, muscovite, sericite, and magnetite.

This rock type should be regarded as one having relatively broad limits in the relative proportions of the minerals listed above. From place to place the appearance of the rock may differ rather strikingly, but the mineral suite given here does seem to be characteristic of the rock type, as a whole. For example, in one place it may be relatively rich in biotite, whereas, in another, biotite may play a minor role, thus partly determining differences in the color of the rock. Moreover, where mafic minerals are relatively abundant, distinct gneissosity is more likely to be found.

Biotite-quartz-feldspar orthogneiss generally lacks compositional layering. Gneissosity is commonly more or less

clearly visible, and in many places it is intensely developed. Migmatite, or "mixed gneiss", is very rare.

Biotite-quartz-feldspar orthogneiss was not seen in direct contact with other rock types. Therefore, it was not seen to be intrusive. However, in view of relatively uniform mineral composition, lack of migmatite, and widespread occurrence, it is regarded here as essentially meta-igneous.

Biotite-quartz-plagioclase paragneiss

This unit lies adjacent to the contact between the Mistassini group and the Grenville subprovince, apparently throughout almost the entire extent of the Grenville in the map-area. The zone of biotite-quartz-plagioclase paragneiss attains a width of approximately 2 miles at the cascades in Chalifour river. The zone becomes narrower north and south of this latitude.

The unit differs from the biotite-quartz-feldspar gneiss, discussed above, in color, texture, and mode of occurrence. The biotite-quartz-plagioclase paragneiss is characterized by orange-pink feldspar, widely varying concentration of dark greenish grey chloritized biotite, and definite sedimentary structures.

The biotite-quartz-plagioclase paragneiss appears to be made^{up}/of at least three facies. The most common is a dark greenish grey rock with flecks here and there of orange-pink plagioclase feldspar. This dark facies can be seen to grade in places into a distinctive feldspathic rock which, here and there, is rather uniformly orange-pink, bearing only traces of biotite. The third facies is a boulder conglomerate. These three principal types are described below.

The dark facies of the biotite-quartz-plagioclase paragneiss occurs throughout the unit, and it is the most abundant type, making up possibly as much as 75 per cent of the unit. It is best seen in the exposures at the falls and rapids in Chalifour river. It is somewhat irregularly dark greenish grey, with

isolated as well as aggregated flecks of orange-pink color. Grains range from 0.1 mm. to 5.0 mm., with most between 0.5 mm. and 2.0 mm. Subangular to well-rounded grains are typical. Chloritized biotite is characteristic, making up as much as 25 per cent of the rock. An increase in quartz apparently accompanies the increased mica content. Some of the more highly micaceous specimens contain up to roughly 20 per cent quartz. The rest of the rock is made up of plagioclase feldspar, at least some of which is twinned andesine (Ab_{6.4}-An_{3.6}). All untwinned feldspar studied is biaxial positive, with $n >$ Canada balsam. The feldspar is moderately sericitized. Some specimens contain up to about 3 per cent epidote. Minor accessories are carbonate, chlorite, sericite, muscovite, hornblende, sphene, hematite, magnetite, limonite, and zircon.

There appears to be complete gradation from the dark facies into an orange-pink feldspathic facies, with only minor proportions of primary and secondary mafic minerals. It might be regarded as "cleaner" than the chloritized biotite facies. Studies thus far suggest that this rock is essentially a metamorphosed arkose or arkosic sandstone. The texture is similar to that of the dark facies. The orange-pink facies contains from 50 per cent to 80 per cent plagioclase feldspar. As in the darker facies, the feldspar is largely untwinned. However, none was studied which was not biaxial positive, with Canadian balsam. The most calcic appears to be andesine. The feldspar is sparingly to moderately sericitized. It is generally rather difficult to distinguish between quartz and untwinned andesine in making an estimation of relative percentages of the two. It appears, however, that this facies is, for the most part, relatively low in quartz. Much of it ap-

pears to contain less than 30 per cent quartz, and only a few specimens show as much as 50 per cent. Much of the coloring is due apparently to the presence of limonite which is readily visible throughout the thin-sections. Minor accessories are carbonate, limonite, chlorite, magnetite, hematite, muscovite, and zircon.

On the east side of the Chalifour river, $3/4$ miles southwest of the westernmost rapids, the orange-pink facies occurs in a cobble conglomerate. The cobbles are subspherical and very well-rounded, with maximum axial lengths of approximately 8 inches. Most are between 1 inch and 4 inches. Cobbles and enclosing matrix are orange-pink, being composed of quartz and feldspar of moderately coarse texture.

On the east side of the Chalifour river, along the northernmost rapids at the right-angle bend in the river, the orange-pink facies of the biotite-quartz-plagioclase paragneiss occurs in tabular layers from $\frac{1}{2}$ inch to 3 inches thick, separated by planes of discontinuity. Elsewhere the lithology shows, in places, crude compositional layering, especially where the dark facies is gradational with the orange-pink facies. Schistosity is distinct in thin-sections of the micaceous facies, but otherwise schistosity is not readily visible.

Hornblende-plagioclase gneiss

Rocks of this type are restricted to the west shore of the south half of Rama lake and to an area of unknown extent $\frac{1}{2}$ mile east-northeast of the north end of Rama lake. Rocks of similar character were not seen elsewhere.

The hornblende-plagioclase gneiss of the south half of Rama lake is finer-grained and contains a greater proportion of hornblende than essentially the same rock type $\frac{1}{2}$ mile east-northeast of Rama lake. The latter can be regarded as an orthogneiss, whereas the former is of unknown origin.

The hornblende-plagioclase gneiss of the south half of Rama lake occurs in several irregular layers in exposures of biotite quartz feldspar gneiss. Because of limited exposures the exact structural relationship between the two rock types is imprecisely known. At one place the hornblende-rich rock cuts obliquely through the gneissic structure of the surrounding rock at an angle of roughly 20 degrees. Layers are at least $1\frac{1}{2}$ feet thick, with a maximum thickness of at least 10 feet. Maximum thickness could not be determined because of limited exposure. The hornblende-plagioclase gneiss of the south half of Rama lake is dark grey, with grains ranging from 0.2 mm to about 3 mm. It is made up of from 40 to 55 per cent green to olive brown hornblende, 30 to 45 per cent plagioclase, and 10 per cent to 15 per cent quartz. Plagioclase is rarely twinned, but all grains of feldspar examined are biaxial positive, with $n >$ Canada balsam. The most calcic appears to be calcic andesine. Minor accessories are biotite, magnetite, sphene, sericite, epidote, and apatite, with traces

of chlorite, carbonate, zircon^{and}/ garnet. Schistosity is barely visible to virtually absent.

The hornblende-plagioclase gneiss east-northeast of Ramallake occurs in several exposures, as shown on the accompanying map. It is not in association with other rock types in these exposures. The rock is rather coarsely crystalline, weathering with a spotty black and beige appearance. Grains range from 0.2 mm. to about 4.5 mm. with most between 2.0 mm. and 4.0 mm. The content is similar to that of the hornblende plagioclase gneiss of the south half of Rama lake, except that there is less hornblende and quartz, and more plagioclase. Hornblende makes up from 30 to 35 per cent, and there is generally about 5 to 8 per cent quartz. The plagioclase is calcic andesine. Although here called a gneiss, gneissic structure is generally not visible. Composition and relative coarseness suggest an igneous origin.

Hornblende-quartz-plagioclase gneiss

Two places can be seen on the map between the north end of Rama lake and the east boundary of the area, where there are exposures of a medium- to coarse-grained hornblende-quartz-plagioclase gneiss. This rock type differs from the hornblende-plagioclase gneiss described above in the proportions of essential minerals present and grain size. Grains range up to 6.0 mm. with most between 1.0 mm. and 3.0 mm. The present rock type contains about 15 per cent pale dark green to olive brown hornblende, roughly 40 to 45 per cent quartz, with approximately 35 to 40 per cent plagioclase. All feld-

spars examined are biaxial positive, with $n >$ Canada balsam. The most calcic twinned plagioclase is andesine. Minor accessories are biotite, sericite, chlorite, epidote, and magnetite. The exposures of hornblende quartz plagioclase gneiss are isolated in a region of predominantly biotite quartz feldspar gneiss. Megascopically, the only difference between the two is in mafic mineral content and slightly coarser texture of the hornblende-bearing gneiss. Gneissic structure is not strongly developed, although it is generally visible.

Quartz-muscovite schist

Quartz-muscovite schist is restricted to a one-half mile stretch along the east shore of the upper part of the Chalifour river, $1\frac{1}{2}$ miles east-southeast of the intersection of longitude $73^{\circ}35'$ and latitude $50^{\circ}35'$. Weathered surfaces are pale greenish grey and are characterized by sparsely disseminated red flecks of hematite. Grains range generally from 0.2 mm. to 0.8 mm. It is made up of quartz and muscovite, in approximately equal proportions, with only traces of bluish grey tourmaline, apatite, hematite, and magnetite. Schistosity is intensely developed, dipping uniformly east-southeastward 50 degrees. Compositional layering is lacking.

Hornblende-biotite-plagioclase schist

Hornblende-biotite-plagioclase schist was found in two exposures. One is along the east side of the upper part of Chalifour river, immediately south of the quartz-muscovite schist. The other exposure is 2-3/4 miles west-northwest of the southeast corner of the map-area. Where it is associated with quartz-muscovite schist, the schistosity of the two rock types is concordant. Hornblende-biotite-plagioclase schist is made up of about 60 per cent plagioclase feldspar, twinned grains of which are calcic andesine (Ab6.6-An3.4), 35 per cent pale green to olive brown hornblende and biotite in approximately equal proportions, and less than 5 per cent quartz. Minor accessories are sphene, chlorite, and apatite.

Diabase

One exposure of diabase was found. It is $\frac{1}{2}$ mile south of latitude $50^{\circ}40'$, about $\frac{1}{2}$ mile west of the east boundary of the map-area. It is dark grey, with laths of plagioclase up to 3.0 mm. long. It is made up of approximately 60 per cent labradorite and 38 per cent augite, with the remainder composed of chlorite, sericite, magnetite, ilmenite-leucoxene, and traces of pyrite. This is the only diabase found, and it is not associated directly with other rock types.

MISTASSINI GROUP *

Introduction

Within the map-area the Mistassini group is made up entirely of dolomites and various types of dolomitic rocks. They form an arcuate lineament trending generally northeasterly throughout the map-area. The group has been traced northeastward, beyond Lake Mistassini into the region of the Otish Mtns., and on toward Mt. Reed and Mt. Wright. It has not been adequately demonstrated that the strata of the Labrador trough are correlatives of those of the Mistassini basin. On the other hand, reasonable objection to the suggestion of such a correlation has not been forthcoming. The Mistassini group extends southwestward beyond the area mapped by Deland (1953), which lies immediately south of the west half of the present area.

Neilson (1950), working at the north end of Lake Mistassini, estimates that the thickness of the Lower and Upper Albanel dolomites is 6,500 to 8,400 feet. The total thickness of these formations within the present map-area is considered by the writer to be somewhat less than Neilson's estimate.

The belt occupied by the Mistassini group within the map-area is approximately 18 miles wide. The northwest contact lies inland about 1 mile from the west shore of Lake Mistassini. The width of the belt extends southeastward to the Chalifour river and, at the northeast corner of the map-area, roughly 2 miles southeast of Albanel lake.

* Usage of the term "group" here follows Quirke, et al (1960, p.315).

The strata are evenly bedded, unmetamorphosed, and show no angular unconformities. Abrupt changes here and there in lithology, although slight, probably signify disconformable relationships. It can be stated that the upper half of the sequence was deposited probably in a shallower sea, with shoreline conditions closer to the present region. The upper half lacks shaly beds and contains appreciable proportions of quartz sand.

The Mistassini group, within the map-area, can be subdivided readily into two formations. These are taken to correspond to the Lower and Upper Albanel formations elsewhere, names first applied apparently by Wahl (1953). In addition, the Mistassini group to the northeast includes, above the Albanel dolomites, the Temiscamie iron-formation (Neilson, 1950, 1953; Wahl, 1953). In the present map-area, and in those of Deland (1953) and Sater (1953) immediately to the south, the iron-formation was not found.

Lower Albanel Formation

Carbonaceous shaly dolomite. This lithology is characterized by dark grey, sooty weathering and the platy structure of shale. It outcrops here and there on a few of the islands west of

Long Island, in Lake Mistassini. It is best seen in two exposures along the west shore of Lake Mistassini, where they represent apparently the lowest beds exposed in the Lower Albanel formation.

Both occurrences are more or less bedding plane exposures, hence detailed information about bedding characteristics is lacking. However, it can be seen on the outcrop that the dolomite breaks into relatively massive plates, or flagstones, up to about inches thick. The rock is very fine-grained, and contains in places more or less rectangular sections of intraformational breccia up to 2 inches wide and 6 inches long. The fragments weather to a lighter color and are less carbonaceous than the enclosing dark, carbonaceous rock.

Black dolomitic shale. A few beds of black dolomitic shale can be seen in the excellent exposures of Long Island and Gull Island. These beds range from 2 inches to 2 feet thick, and they are interbedded with more massive, argillaceous dolomite. The black shale breaks up into plates between 1/8 inch to 1 inch thick, and it is less resistant to weathering than the associated argillaceous dolomite.

The black shale of Long Island occurs largely in two beds each of which is about 2 feet thick, separated by about 3 feet of argillaceous dolomite. They occur near the south end of the island; the lower bed lies roughly 1 foot above the water line. The lower bed contains concretions 1 to 2 feet across. Limonitic stains are common, and there are found here and there nodules of granular pyrite up to 1 inch in diameter.

Black dolomitic shale occurs in 3 or 4 beds on the north side of Gull Island. Here, they are 8 inches to 2 feet thick, underlying a thrust fault described below under structural geology. Thrusting has dragged these beds, as can be seen in one of the photos in this report.

Interbedded argillaceous and shaly dolomite. This sequence occupies Gull Island and the regions along the strike of Long Island and the peninsula west of Abatagouché bay. Some of the beds along the east shore of Lake Mistassini resemble this lithology, and demarcation of these rocks from those sedimentary rocks to the east is somewhat arbitrary.

The argillaceous dolomite is fine-grained, and it is generally medium dark grey on the fresh surface. The rock weathers characteristically to a pale buff grey, slightly chalky, residual coating. The rock is well bedded, with layers ranging from 2 inches to 1 foot thick. The argillaceous component produces in places laminar layers which are visible only on the weathered surfaces.

The argillaceous dolomite is interbedded here and there with relatively thin beds which have a shaly appearance. The beds of these shaly portions are from approximately 1/8 inch to 2 inches thick. Color is the same as that of the thicker beds, but the shaly layers form slight recesses upon weathering.

The region of the interbedded argillaceous and shaly dolomite is particularly well jointed. Two sets are developed at approximately right angles, from about 4 inches to 1 foot apart. This commonly gives sections of the rock a blocky appearance, an effect which can be seen in some of the accompanying photo-

graphs. Vug fillings can be seen here and there of relatively soft, black carbonaceous material.

Microcrystalline beige dolomite. There are several localities within the Lower Albanel dolomite where there occurs a very fine-grained, relatively homogenous rock which resembles lithographic carbonate. Several outcrops occur along the east shore of an embayment of Lake Mistassini, $2\frac{1}{2}$ miles south of the north boundary of the map-area and 1 mile west of long. $73^{\circ}40'$. The same type of rock occurs approximately 8 miles along strike to the southwest, and it is possible that the rock type is continuous throughout the area. These latter exposures lie $1\frac{1}{2}$ miles east of the channel at the north end of Abatagouche bay.

The dolomite is microcrystalline, breaks with a conchoidal fracture, and is generally laminated with respect to color. It is pale greyish beige to pinkish beige, and weathers pale yellowish brown. Beds are up to 6 inches thick. Partings of visibly crystalline dolomite may be present.

Interbedded massive and shaly dolomite. This lithology makes up much of the sequence between the east shores of Lake Mistassini and Abatagouche bay and the contact between the Lower and Upper Albanel formations. It is particularly well exposed in the cuesta which trends northeasterly through the northern part of the area, roughly 1 mile east of Lake Mistassini. The rock differs from the lower beds of the Upper Albanel formation in bedding characteristics, grain-size, composition, and coloring.

The more massive beds are several inches to several feet thick. They are medium dark grey to dark grey, except for a very few pinkish beds, and weather to a slightly darker grey than the lower beds of the Upper Albanel. The present beds tend to lack the pale brownish residue of weathering which occurs on the argillaceous dolomites to the west. The rock is fine-grained, and, in places, is barely visibly crystalline. Here and there it is weakly laminated. Sand is characteristically absent.

Shaly beds are characteristic of this lithology. They are interbedded with the more massive dolomite, and are generally less than 2 inches thick. The shaly dolomite and massive dolomite differ essentially only in thickness of beds.

Pink dolomite. Pink dolomite is rare in the Lower Albanel formation. It is found only here and there within $\frac{1}{8}$ mile of the contact with the Upper Albanel formation. As a rule, the pink dolomite of the Upper Albanel is more or less massively crystalline. The present pink dolomite is fine-grained, in beds 1 inch to 1 foot thick, and commonly interbedded with shaly grey dolomite. Sand is not found.

Upper Albanel Formation

Crystalline pink and grey dolomite. This lithology, with here and there a component of quartz sand, makes up the great bulk of the Upper Albanel formation. Pink and grey beds appear to occur in about equal proportions, although in places there may be more of one than the other. The texture is fine- to medium-grained and visibly crystalline. Beds are 6 inches to 10 feet thick, with most over 2 feet thick. Intraformational conglomerate is common, color laminations are less common, and cross-bedding is rare. Neither colored rock is relatively more resistant to weathering.

The grey dolomite is medium grey to dark grey, with lighter beds here and there. Weathering is commonly to rather light bluish grey. The pink dolomite is pink, greyish pink, pale purplish pink, pale pinkish beige, and mottled pink and beige or grey.

Interbedded dolomite and sandy dolomite. Between one-third and one-half of the crystalline pink and grey dolomite contains noticeable quartz sand. In general, the sandy portions appear to be distributed irregularly throughout the formation, as continuous sandy horizons can not be discerned. Contacts are found rarely between sandy and non-sandy dolomite. The rock at any one outcrop is with or without sand. The quartz sand ranges up to approximately 1.0 mm. in diameter and is well rounded. Sandy beds contain roughly 5 to 15 per cent sand,

with some having as much as 30 per cent.

There are a few areas where sand occurs throughout the dolomite exposed. The shore traverse across the south end of Vishnu lake shows, across strike, a continuous sequence of sandy dolomite through a distance of approximately 3 miles. It appears as though this is exceptional, however, and that sandy beds elsewhere are more generally interlayered with non-sandy beds.

The thickness and texture of beds containing sand are essentially the same as these aspects of the more common crystalline pink and grey dolomite, described above.

Ferruginous dolomite. There are two places within the Upper Albanel formation where hematite-rich dolomite beds are found. Both zones are restricted to stratigraphic intervals each of apparently less than 100 feet. These zones are found (1) $\frac{1}{2}$ mile east of long. $73^{\circ}45'$, $2\frac{3}{4}$ miles north of the south boundary of the map-area, and (2) $1\frac{1}{4}$ miles west of long. $73^{\circ}40'$, $1\frac{1}{4}$ miles south of the north boundary.

The rock is dark reddish grey, with a slight purplish tint here and there. Weathered surfaces are slightly lighter than fresh ones, and weathered surfaces are completely free of limonitic stains. Texture is fine- to medium-grained, with crystalline dolomite readily visible. Tiny aggregates and disseminated, finely-divided hematite are present. The iron content here is appreciable, for hand specimens have a relatively high specific gravity. The rock is somewhat tougher

and more resistant to erosion than the essentially non-ferruginous dolomite.

In the two localities described here, the beds are from about 1 foot to 5 feet thick, having a massive appearance. The rock is slightly laminated throughout, and this gives weathered surfaces a weakly ribbed or corrugated appearance, with bands $1/8$ to $1/2$ inch wide.

It can be noted that these ferruginous beds do not occur at the top of the Upper Albanel dolomite, but lie well down in the formation. It is considered that these beds do not represent any part of the Temiscamie iron-formation, found in areas to the northeast.

Dolomitic sandstone. Here and there in the Upper Albanel formation, especially in the upper half, sand is relatively abundant. One place was noted where the dolomite is actually quite siliceous and relatively resistant to erosion. This is $\frac{1}{4}$ mile north of lat. $50^{\circ}40'$, 1 mile west of the east boundary of the map-area. The outcrop is about 50 feet wide across strike, with beds ranging from 6 inches to 3 feet thick. The rock is slightly ferruginous, with brownish pink fresh and weathered surfaces. Closely packed sand grains weather to relief, and make up from 40 to 60 per cent. The beds underlie a low ridge which passes through this locality. Traverses across strike to the north and south do not reveal the unit.

Microcrystalline pinkish beige dolomite. A distinctive dolomite is found here and there which is recognized by its microcrystalline texture and pale color. It is found along the southeast

shore of Vishnu lake, in a few outcrops at the south end of Albanel lake, and in a few scattered exposures southeast of Albanel lake. The massive beds are commonly slightly laminated, with color bands ranging from pinkish beige to greyish white. Some beds reveal scattered, well-rounded quartz sand grains, but in these beds the sand makes up less than 10 per cent. Weathered surfaces are present here and there, in relief, with concordant parting of argillaceous and silty material.

STRUCTURAL GEOLOGY

Igneous and Metamorphic Rocks

Eastern Complex

Schistosity and layering

Schistosity is distinctly developed in the micaceous lithologies of the Eastern complex, except in the mica-poor facies of the biotite-quartz-plagioclase paragneiss. Where mica is lacking and hornblende is conspicuous, such as in the hornblende-quartz-plagioclase gneiss and hornblende-plagioclase gneiss, very poorly developed schistosity and/or internal lineation result. The trend of schistosity appears to be consistently parallel to the Mistassini fault zone throughout the Eastern complex. Magnitude of dip varies considerably, but wherever observed it is southeasterly.

Layers separated by planes of discontinuity are present in the biotite-quartz-plagioclase paragneiss at the cascades in Chalifour river. These layers are from $\frac{1}{2}$ inch to 3 inches thick. The trend is parallel to the Mistassini fault zone, and the dip where seen is at low angles southeasterly. Compositional layering, as contrasted with structural layering, is not particularly noticeable in the Eastern complex.

Outcrops are generally scarce in the Eastern complex, and thus little is known about the overall structure here. The schistosity impressed upon the rocks dips everywhere in a southeasterly direction. However, the structural relationships

among the masses of different lithology are probably very complex, for different rock types appear here and there in what appears to be a more or less irregular distribution.

Joints

There are three rather conspicuous sets of joints developed in the gneissic rocks of the Eastern complex. All are essentially vertical, the system reflecting close similarity in attitude to the joint pattern to the west and northwest, in the Mistasini group. The strongest set is developed in a north-south to N30E-S30W orientation. There is a set in an east-west direction, and one trending N45W-S45E. The latter two sets are not present everywhere, whereas the strongest set can be found more or less well-developed in nearly all exposures.

Faults

Nowhere within the Eastern complex was there found field evidence, direct or indirect, of faulting at the megascopic level. However, it is difficult to conceive of this metamorphic complex, possibly of Grenville affinities, as being free of appreciable megascopic shearing. A study of the small scale aerial photographs reveals the presence of strong lineaments which cannot be ignored, and these are interpreted here as possible shear zones. Only the major ones are shown on the accompanying map, and these are given a special symbol, for field evidence for their presence is lacking.

Western Complex

Schistosity and layering.

In general, both schistosity and layering are less distinctly developed in the rocks of the Western complex than in those of the Eastern complex. This is due probably to the character of the lithologies involved, for the presence of amphibolite here indicates medium to high rank metamorphism. Schistosity is lacking in the hornblende quartz metadiorite, but it is distinctly developed in the amphibolite. Schistosity in these exposures trends about N20W-S20E and dips 10 to 35 degrees east-northeasterly. This trend is discordant to the contact with the Mistassini group to the southeast, which strikes north-northeasterly. This is especially interesting because a discordant relationship was not found between the schistosity of the Eastern complex and the trend of the Mistassini fault zone.

Discontinuous, moderately distinct compositional layers, lenses, and stringers appear here and there in the metadiorite. These are formed by the segregation and more or less irregular distribution of hornblende and biotite. In some places, a gneissose appearance results from such segregations. In addition, some cataclastic deformation has occurred in the metadiorite, producing a crude internal lineation. This is formed by elongated feldspar and quartz grains which lie parallel to compositional layers.

Joints

Nowhere in the restricted number of exposures seen within the Western complex were joints found. Exposures are small, and it is probable that a pattern of joints will be found in areas to the west, where exposures are more numerous and extensive. It is interesting to note that a system of joints is prominent in the two exposures of dolomite mapped along the west shore of Lake Mistassini, about a mile southeast of the Western complex. Here, three sets are developed. In order of decreasing prominence, they are: 1) east-west, 2) north-south to northeast-southwest, and 3) northwest-southeast. Major crustal adjustments which affected the Mistassini group must have had some effect on the basement rocks. Hence, it might be expected that a similar system of joints occurs somewhere within the igneous-metamorphic complex northwest of the Mistassini group.

Faults

As in the Eastern complex, evidence of faulting, or shearing, was not found. Aerial photographs of this region reveal several strong lineaments which transect the contact between the dolomitic rocks and the underlying complex. These are shown on the accompanying map, although field evidence does not suggest their presence.

Sedimentary Rocks
Mistassini Group

Attitude

In general, strata of the Mistassini group trend north-northeastward to northeastward. The north-northeasterly trends occur in the southern half of the map-area. There are some divergencies to northerly and northwesterly trends, but these are uncommon and only of local interest.

Dips practically everywhere are easterly to southeasterly. Dips the reverse of this are very rare, and associated only with minor folding, which is discussed below. Beds are inclined generally less than 20 degrees, with many dips commonly between 5 and 10 degrees. Other beds are nearly horizontal, and here and there dips are moderately steep, that is, about 25 to 35 degrees. Within a mile of the contact with the Eastern complex, beds of the Upper Albanel formation are inclined up to about 80 degrees east-southeastward. The regional structure of the Mistassini group can be regarded apparently as homoclinal.

Folds

Broad, regional folds are absent in the Mistassini group. However, there are to be found rather commonly folds of only local importance, both aerially and stratigraphically. In almost every case these folds show only a few feet of closure, and tend to be overturned, thus resembling drag folds.

Three sets of these folds have been mapped throughout most portions of the Mistassini group. By far the most widely distributed and abundant is a set trending east-west to

N65W-S65E. In all cases the fold axes are either horizontal or plunge southeastward, and in most cases the folds are more or less overturned toward the southwest. The height of the folds is generally less than 5 feet, and commonly they are between $\frac{1}{2}$ foot and 3 feet high. This set is especially prominent along the northeast shore of Vishnu lake and along the shore of Long Island, in Lake Mistassini. The occurrence of the folds does not appear to be restricted stratigraphically with regard to the entire sequence of the Mistassini group.

A second and third set of folds is found along the shore of the south half of Long Island, in Lake Mistassini. These sets are restricted to this locality, where they accompany the nearly east-west set described above. The second and third sets trend N10E-S10W to N25E-S25W, and N15W-S15E, respectively. Both are less tightly folded and more symmetrical than the first set described above. Axes of the folds of the second and third sets are horizontal or show no preferred plunge direction.

Where exposure permits, it can be seen that the effect of folding tends to be restricted stratigraphically. That is, there may be relatively undisturbed beds above and below an interval containing rather tightly folded, overturned "drag" folds. This can be seen in a few of the photographs in this report. The writer tends to regard many of these folds as essentially intraformational contortions, slump phenomena, or "storm rollers."

Joints

There are two sets of joints of almost equal prominence, and a third set which occurs sparsely only here and there. The first set of joints trends parallel to the most prominent set of folds, east-west to N65W-S65E, and these joints are present almost everywhere, even where folds are absent. A second set of joints commonly accompanies the first set, and trends north-south to N25E-S25W. A third set occurs here and there, with a northwesterly-southeasterly trend, and may occur in place of the north-south to north-northeasterly set.

The most prominent joints are from about 3 inches to several feet apart. Those less well-developed may be 6 to 8 feet apart, but nevertheless rather evenly spaced. Where more than one set of joints is well developed, weathered surfaces commonly show a blocky appearance where disintegration of the rock has taken place along joint planes. This can be seen in some of the photographs.

There is remarkable concordancy between the trends of folds and joints. Moreover, the most prominent set of joints lies parallel to the most common trend of folding, east-west to N65W-S65E.

Faults

Evidence of faulting in the Mistassini group is rare. Exposed faults were found only along the shore of Gull Island, in Lake Mistassini. An apparent fault breccia occurs near the base of the Upper Albanel formation, $\frac{1}{2}$ mile east of long. 73°45'

3 1/4 miles north of the south boundary of the map-area.

In addition, there are certain lineaments which are prominent on the aerial photographs. The most prominent of these are shown on the accompanying map, and are indicated as having been inferred from the photographs. Field evidence for these "faults" is lacking. The possibility of faulting along the contact between the Mistassini group and the Eastern complex, the so-called Mistassini fault zone, is discussed below under a separate heading.

Considering the lack of exposed faults elsewhere, Gull Island is unique. The island is 1 mile long and $\frac{1}{2}$ mile wide. Cliff exposures of the Lower Albanel dolomite are nearly continuous along the north and northeast sides of Gull Island. It is in these exposures that thrusting and normal faulting can be seen. Along a short stretch of the central part of the north side of the island, there occurs a slightly warped, nearly horizontal fault plane. This fault lies about half-way up the cliff, which here is about 50 feet high. A photograph of this structure accompanies the report. The nearly horizontal fault surface is overlain concordantly by massive beds of grey dolomite. Below the fault surface there are alternating beds of argillaceous dolomite, dolomitic shale, and a few beds of dark, sooty, carbonaceous shale. On the east side of this exposure the beds below the fault dip from 20 to 30 degrees westward, and within about 40 feet to the west these same beds are more or less horizontal. The folding of the beds below the fault surface is regarded here as a drag effect produced by overthrusting in a generally north-

westerly direction. The succession of lithologies here suggests, however, that younger beds still overlies older ones.

The northeast side of the island reveals a thrust fault with somewhat different relationships regarding inclination of beds above and below the fault plane. In the thrust seen on the north side of the island the beds below the fault are dragged, hence indicate relative direction of thrust movement. In the thrust on the northeast side, the beds above the fault form an anticline overturned slightly toward the north, with the north flank truncated by the fault. The beds below the fault here are horizontal to gently dipping in a southerly direction. These folds indicate that the hanging wall moved northward or northwestward relative to the foot wall. In addition, in the exposure on the northeast side of the island, the southerly flank of the anticline in the hanging wall is cut by a high angle normal fault dipping southward.

The writer is unable to state definitely that the faults seen on the north side and on the northeast side of Gull Island are the same fault. Exposures are not continuous throughout, but the writer considers it likely that the faults seen at these two places are continuous with each other. At both places the faults occur at roughly the same elevation, have a more or less horizontal attitude, and indicate similar relative direction of thrust movement.

An exposure of breccia occurs about 1000 feet east of the contact placed between the Lower and Upper Albanel formations. The outcrop is situated $\frac{1}{2}$ mile east of long. $73^{\circ}45'$, $3 \frac{1}{4}$ miles north of the south boundary of the map-area. The exposure

is part of a cuesta-like land form dipping eastward, which rises about 25 feet above the plain to the west. The outcrop is several hundred square feet in area. The breccia contains a disjointed mosaic of angular blocks of massive grey, crystalline dolomite from less than 1 inch up to $2\frac{1}{2}$ to 3 feet across. Most of the blocks are more than 6 inches across. The matrix is slightly finer-grained, and weathers to a noticeably lighter and more brownish color than do the enclosed blocks. There is no indication of bedding or folding. The regional trend of this brecciation could not be traced in the field or inferred from the aerial photographs.

Mistassini Fault Zone

Introduction

The contact within the map-area between the Mistassini group and the Eastern complex of the Grenville subprovince is part of the so-called Grenville front or, synonymously, the Mistassini fault zone. This lineament extends northeastward from George Bay on Lake Huron, past Sudbury and Lake Timiskaming, to Lake Mistassini, and southeast of Mt. Reed and Mt. Wright in the Ungava Peninsula. The contact zone has been studied elsewhere in Mistassini Territory by Norman (1940), Wahl (1953), and Neilson (1953).

Although none of these workers has seen a major fault at this contact, all infer its presence from indirect evidence. Norman postulates a regional high-angle thrust fault with overthrusting in a northwesterly direction. Both Wahl and Neilson accept this postulate, and Neilson states that, in addition, "...there remains the possibility that the two groups were brought into their present relationship by down-faulting of the sedimentary rocks." Apparently Neilson does not exclude the possibility of regional normal faulting.

There are two places within the map-area where sedimentary and metamorphic rocks occur within several hundreds of feet of each other on opposite sides of the contact zone. These places are at the south end of Krishna lake and west of the cascades in Chalifour river, 3 miles north of the south boundary of the map-area.

Interpretation

The following discussion presents a brief description of pertinent aspects of the contact zone, along with the writer's interpretation of their structural significance. The information is given in numbered paragraphs, each dealing with one particular aspect, and each intended to support a theory of faulting along the contact.

- 1) The sedimentary rocks dip southeastward into the gneisses along the contact zone. Moreover, this southeasterly dip steepens as the contact is approached, and open folds are found here and there. Evidence for overturning in the contact zone is lacking. If the dolomites are younger than the neighboring gneisses, then a conformable relationship would require that the beds dip in the opposite direction, that is, to the northwest.
- 2) The northwesterly thrust postulated by Norman (1940) is suggested in the present area by the arcuate configuration of the contact. This contact is convex in a northwesterly direction, a condition one would expect where thrusting is in this direction (C. M. Nevin, personal communication). Northwesterly movement is apparent in the thrusting which has occurred at Gull Island, Lake Mistassini. It seems likely that this faulting is somehow related to major thrusting which may have occurred along the contact zone.

In view of an interpretation of thrusting to the northwest, it is not at all clear as to how the beds came to dip toward the southeast along the supposed fault. One might well expect

the beds to be dragged in such a way as to produce northwesterly dips.

3) The Temiscamie iron-formation, which overlies the Upper Albanel formation in areas to the northeast, is not present in the Dorval-Guyon area. This may be explained in one or more of three ways: 1) non-deposition of the iron-formation in the present area, 2) greater relative downward movement of the Mistassini group in areas to the northeast, thus preserving the iron-formation there, and 3) a northwesterly-acting thrust fault may have passed northwest of the iron-formation in the present area, thus "faulting it out." The last two possibilities cannot be discounted, and both require faulting along the contact zone.

ECONOMIC GEOLOGY

The Dorval-Guyon area, although comprising two 15-minute quadrangles, is apparently devoid of mineral deposits of economic interest. Except for very sparsely disseminated magnetite and pyrite here and there in the Eastern complex, and traces of disseminated pyrite in the dolomites, mineralization was not found. The contact zone between the Mistassini group and the Eastern complex is no exception to this statement.

The Temiscamie iron-formation occurs along strike to the northeast (Neilson, 1953). This is the youngest formation of the Mistassini group, and hence overlies the Upper Albanel formation. Neilson describes it as being made up of taconites with magnetite-rich beds. Magnetite is disseminated and in lenticular bands, and constitutes up to 50 per cent of the rock. Fine-grained silica is contained in the formation, with chert common in sideritic beds. The iron-formation was not found in the present map-area, where it would be expected to lie immediately west of the Mistassini fault zone.

Both Deland (1957) and Sater (1957) report lead-zinc mineralization in the areas immediately south of the present map-area. These are relatively minor replacement deposits of galena and sphalerite along northeasterly shear zones in the dolomite. The writer visited one such deposit 1 mile north of Mistassini Post, in Deland's area. He describes this occurrence as a few crystal aggregates of galena, sphalerite, and

pyrite in a shear zone about 200 feet wide. Galena and sphalerite form aggregates disseminated here and there in the mildly schistose dolomite, and are concentrated mostly in a zone 15 feet wide. Such occurrences were watched for in the Dorval-Guyon area, but none were found.

The deposits of glacial till which blanket the area would provide sand and gravel for construction purposes. Eskers are especially promising in this respect, and the prominent ones are shown on the accompanying map.

REFERENCES

- Barlow, A.E. et al (1911) Geology and Mineral Resources of the Chibougamau Region, Quebec; Dept. Colonization, Mines, and Fisheries, Que., Mines Branch, 1911, pp. 131-133.
- Deland, A.N. (1957) Preliminary Report on Duquet Area, Mistassini Territory: Quebec Dept. of Mines, P.R. No. 331.
- Low, A.P. (1886) Report on the Mistassini Expedition, 1884-85; Geol. Surv. Can., Ann. Rept., Vol. I, Pt. D, 1886, pp. 1-55.
- McOuat, W. (1873) Report of Explorations of Country Between Lake St. John and Lake Mistassini; Geol. Surv. Can., Rept. of Progress 1871-72, 1873, pp. 115-119.
- Neilson, J.M. (1950) Geology of the Mistassini Region, Northern Quebec: Ph.D. thesis (unpubl.), Univ. Minn., 156 p.
- _____ (1953) Albanel Area, Mistassini Territory: Quebec Dept. of Mines, G.R. No. 53.
- Norman, G.W.H. (1940) Thrust Faulting of Grenville Gneisses Northwestward Against the Mistassini Series of Mistassini Lake, Quebec; Jour. Geol., Vol. 48, No. 5, July-August, 1940, pp. 512-525.
- Quirke, T.T., Jr. et al (1960) Composition and Age of The Temiskamie Iron-Formation, Mistassini Territory, Quebec, CAN.; Econ. Geol., Vol. 55, No. 2, March-April, 1960, pp. 311-26.
- Richardson, J. (1872) Report on the Country North of Lake St. John, Quebec; Geol. Surv. Can., Rept. of Progress 1870-71, 1872, pp. 283-308.
- Sater, G.S. (1957) Preliminary Report on McOuat-Gauvin Area, Mistassini Territory and Roberval Electoral District; Quebec Dept. of Mines, P. R.No. 356.
- Wahl, W.G. (1953) Temiscamie River Area, Mistassini Territory; Quebec Dept. of Mines, G.R. No. 54, 1953



A. Southeast side of Long Island, Lake Mistassini.
Looking southwestward.



B. Cliff along southeast side of Long Island, Lake Mistassini.
Lower Albanel formation.



A. Interbedded argillaceous and shaly dolomite, Lower Albabel formation. Island northeast of Long Island, Lake Mistassini.



B. Interbedded argillaceous and shaly dolomite, Lower Albabel formation. Island northeast of Long Island, Lake Mistassini.



- A. Interbedded dolomitic black shale and shaly dolomite, Lower Albanel formation. Long Island, Lake Mistassini.



- B. Shaly dolomite, Lower Albanel formation. Mistassini cuesta, 1 mile south of north boundary of the map-area, long. $73^{\circ}37\frac{1}{2}'$.



A. Beds of dolomitic black shale with concretions, Lower Albanel formation. Long Island, Lake Mistassini.



B. Intraformational conglomerate in interbedded argillaceous and shaly dolomite, Lower Albanel formation. Long Island, Lake Mistassini.



A. Contorted beds of Lower Albanel formation. Island northeast of Long Island, Lake Mistassini.



B. Contorted beds of Lower Albanel formation. Island northeast of Long Island, Lake Mistassini.



A. Intraformational contortions, Lower Albanel formation. Long Island, Lake Mistassini.



B. Contorted beds of the Lower Albanel formation. Island northeast of Long Island, Lake Mistassini.



A. Anticlinal flexure, Lower Albanel formation. Island northeast of Long Island, Lake Mistassini.



B. Overturned syncline, Lower Albanel formation. Looking southeastward, Gull Island, Lake Mistassini.



A. Isoclinal flexure, Lower Albanel formation. Looking east-southeastward, Gull Island, Lake Mistassini.



B. Thrust fault, Lower Albanel formation. Looking west-southwestward, Gull Island, Lake Mistassini.



A. Thrust fault, Lower Albanel formation. Looking southward,
Gull Island, Lake Mistassini.



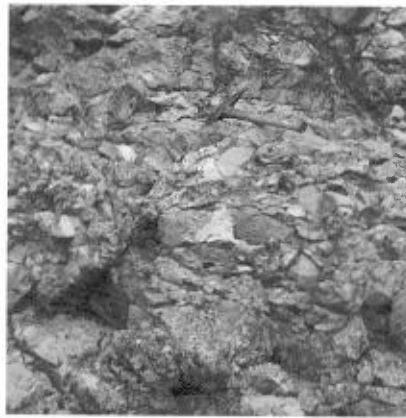
B. Thrust fault, Lower Albanel formation. Looking southeastward,
Gull Island, Lake Mistassini.



A. Thrust fault, Lower Albanel formation. Looking southward, Gull Island, Lake Mistassini.



B. Interbedded shaly dolomite and dolomitic black shale; normal faulting in lower right-hand corner, Lower Albanel formation. Looking southward, Gull Island, Lake Mistassini.



A. Fault(?) breccia, Lower Albanel formation. Gull Island, Lake Mistassini.



B. Fault breccia in vertical shear zone, Lower Albanel formation. Gull Island, Lake Mistassini.