GM 37781

GEOLOGY OF THE LAKE ALBANEL IRON RANGE

GEOLOGY OF THE
LAKE ALBANEL IRON RANGE
MISTASSINI TERRITORY
QUEBEC

Townships 1530, 1531 and St-Lusson

by

Terence T. Quirke, Jr.

o-0-o

Courtesy of

ALBANEL MINERALS LIMITED

Port Arthur, Ontario

GEOLOGY OF THE LAKE ALBANEL IRON RANGE
MISTASSINI TERRITORY, QUEBEC (1)

Terence T. Quirke, Jr. (x)

ABSTRACT

The Lake Albanel iron range is located 400 miles north of Montreal, Quebec. Exploration has been conducted in the area for iron ore since 1953. Temiscamie iron-formation is overlain by the Kallio slate and is underlain by the Boulder Bay quartzite and the Upper and Lower Albanel dolomites, the sequence constituting the Mistassini group. These rocks are underlain by sediments of the Papaskwasati group which rest with angular unconformity on a basement of folded sediments and volcanics of the Sam Gunner group. The latter was earlier intruded by igneous rocks of the Takwa complex. The Papaskwasati and Mistassini sediments are relatively unmetamorphosed. They dip to the southeast and abut against high-grade metamorphic and igneous rocks of the Grenville subprovince along the Mistassini fault.

The Temiscamie iron-formation has been divided into six members and is described in some detail. On the basis of lithology, it may be correlated with the iron-formation of the Labrador trough. Results of radioactivity dating of the Temiscamie iron-formation allow some comparisons to be made to the Huronian iron-formations of the Lake Superior district and to the iron-formation of the Labrador trough.

INTRODUCTION

Recent exploration of the Temiscamie iron-formation in the region of Lake Albanel, Quebec, has afforded opportunity for the geologic studies that are the basis for the present paper. The Temiscamie is one of several iron-formations which have been investigated by various companies in recent years in the search for direct-shipping ores and others amenable to beneficiation.

(x) Assistant Professor of Geology, University of North Dakota, Grand Forks, North Dakota.

The Lake Albanel iron range is located approximately 100 miles north of Chibougamau and 400 miles north of Montreal (Fig. 1). It consists of 150-175 square miles and is included within the area of Figure 2.

Since 1952, M. J. O'Brien Limited, Ottawa, and Canadian Cliffs Limited, Port Arthur, have been investigating the iron-formation along the east shore of Lake Albanel. In 1955-1956 these companies merged their interests as Albanel Minerals Limited. During the summers of 1956, 1957 and 1959 an extensive programme of geophysical surveying and geologic mapping was completed, as well as over 60,000 feet of diamond drilling. Nine orebodies of magnetic taconite have been explored and a minimum of 200,000,000 long tons of desirable magnetic concentrates containing 66.08% iron and 7.72% silica will be available.

REGIONAL GEOLOGY

The Sam Gunner group of sediments and volcanics lies about ten miles north of the map area (Fig. 2). The rocks of this group occur within a narrow band about one mile wide, extending east-southeast from the Takwa Mountains to the Temiscamie River. Their attitude is essentially vertical with a nearly east-west strike. The rocks of sedimentary origin consist of metamorphosed pebble conglomerate, quartzite, greywacke and fine-grained arkose. The extrusive rocks are mainly dark, fine-grained andesitic lavas (Neale, 1952; Neilson, 1951). This is the oldest group of rocks in the area (Table I).

The main mass of the Takwa intrusive complex occurs in the area of the Takwa Mountains a few miles north of Lake Mistassini. The complex extends east to the Temiscamie River and for an undetermined distance to the north. Pink granite and porphyritic microcline granite are the most common rock types. A narrow band of diorite gneiss extends west of the western end

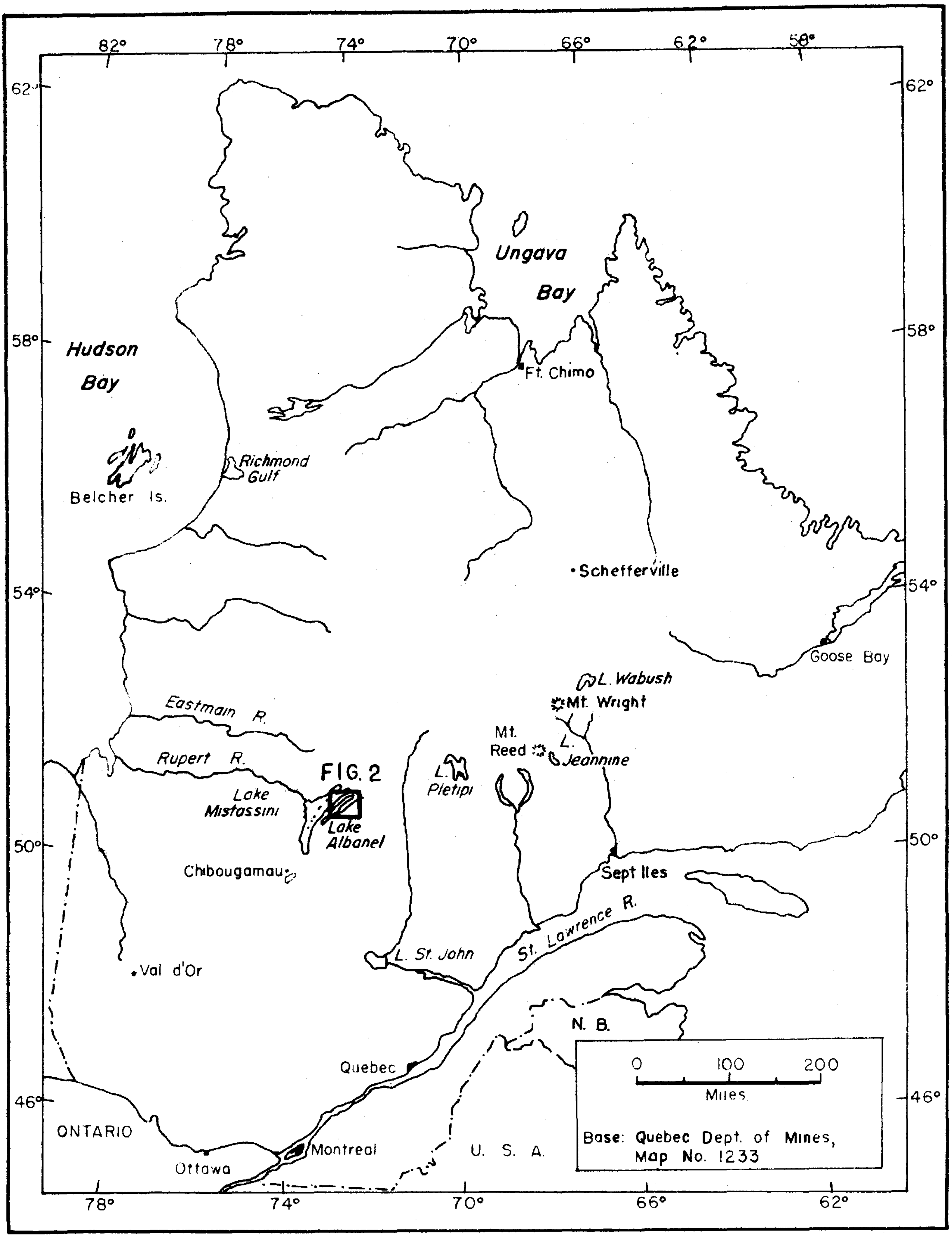
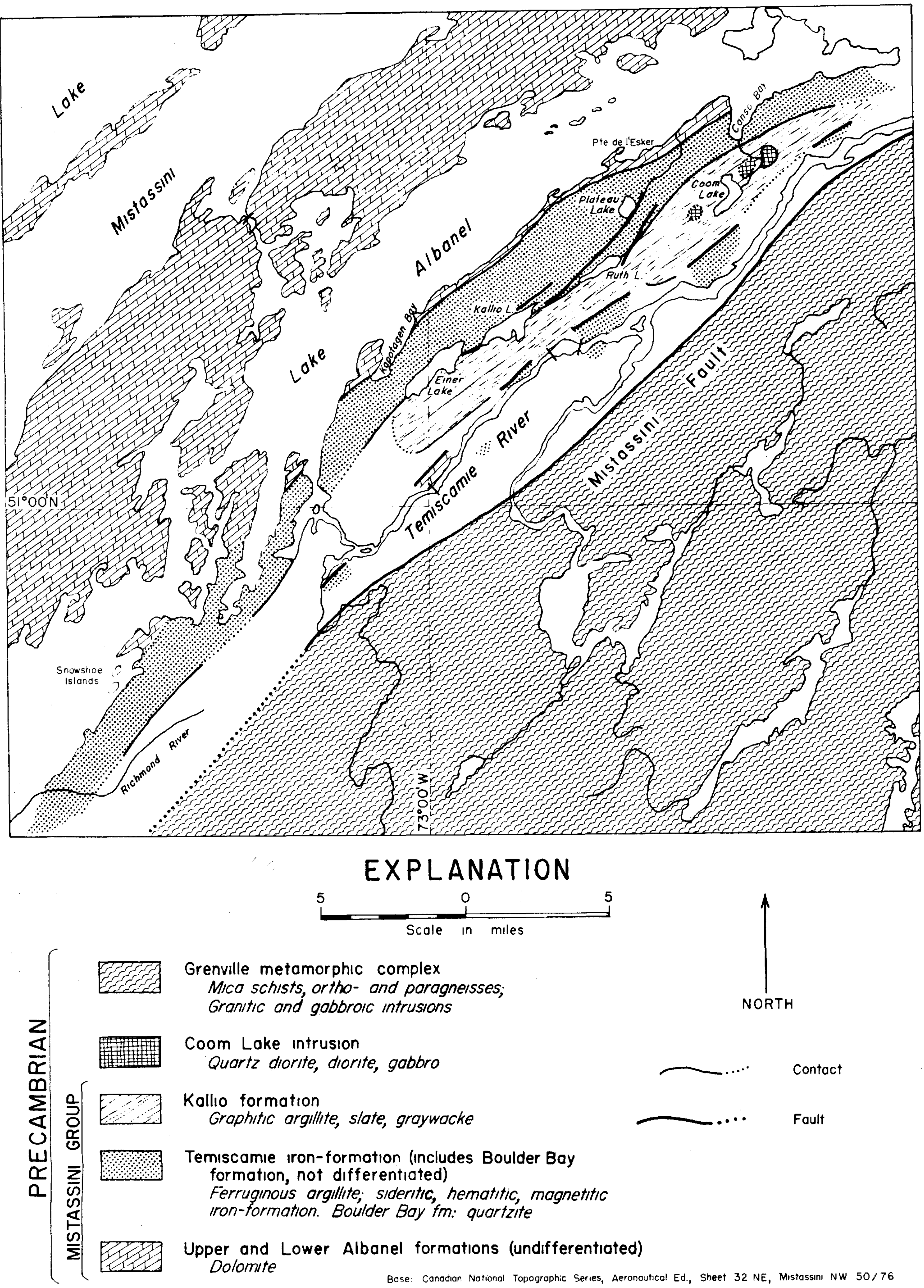


FIGURE 1

Index map of Quebec showing the location of the Lake Albanel iron range and Figure 2



Base: Canadian National Topographic Series, Aeronautical Ed., Sheet 32 NE, Mistassini NW 50/76

FIGURE 2

Geologic map of the Lake Albanel iron range. White areas are those of little or no outcrop. Geology compiled from sources given in text.

TABLE I

TABLE OF FORMATIONS

Pleistocene and Recent			
UNCONFORMITY			
PRECAMBRIAN	Grenville metamorphic complex		Granites and associated intrusives Orthogneiss Paragneiss
			Coom Lake intrusions
	Mistassini group	Kallio formation	Slate, arkose, graywacke
		Temiscamie iron-formation	Upper sideritic chert member Magnetitic iron-silicate member Upper argillite member Magnetitic chert member Lower sideritic chert member Lower argillite member
		Boulder Bay formation	Quartzite
		Local (?) Unconformity	
		Upper Albanel formation	Dolomite
		Lower Albanel formation	Dolomite
	Papaskwasati group		Quartz sandstone, pebble conglomerate
	UNCONFORMITY		
	Takwa intrusive complex		Granite and related intrusions Gneiss
	INTRUSIVE CONTACT		
	Sam Gunner group		Interbedded sedimentary and volcanic rocks

of the Sam Gunner group, but this may be an altered phase of the older sedimentary sequence. Along the northern edge of the Sam Gunner group, a gray to pink biotite granite gneiss has been injected, at least in part, lit-par-lit. This gneiss is considerably contaminated and contains partly digested inclusions of biotite-and-hornblends-rich rocks as well as recognizable inclusions of rocks of the Sam Gunner group (Neal, 1952; Neilson, 1951). Thus, the Takwa intrusive complex is definitely younger than the Sam Gunner group and biotite from it has been dated by the A^{40}/K^{40} method as about 1.6 b y (Quirke, et al., 1960).

The Papaskwasati group consists of relatively unmetamorphosed pebble conglomerate, sandstone, quartzite and greywacke. This group crops out to the west of the Takwa Mountains and north of Lake Mistassini. The rocks dip gently and lie unconformably on the Takwa complex. They are considered to be conformable with the overlying dolomite of the Mistassini group (Neilson, 1951).

The Mistassini group is comprised of dolomite, quartzite, iron-formation and slate. The rocks dip gently to the southeast and lie within the basin partially occupied by Lake Mistassini and Lake Albanel. Excellent exposures may be seen on the islands and shores of both lakes in low-lying cuestas and between the east shore of Lake Albanel and the Temiscamie River.

The southeastern part of the map area (Fig. 2) is underlain by igneous and metamorphic rocks of diverse types and probably of different ages. These rocks are not a lithic unit nor is it likely that they were formed within a limited time, but what they do appear to have in common is that they were more or less metamorphosed at approximately one billion years ago. For this reason they are referred to here as the Grenville metamorphic complex, in the sense that the metamorphism was impressed upon all of them at about the same time (Quirke, et al., 1960). Rocks of this complex strike northeast-southwest and are separated from the sediments of the Papaskwasati and Mistassini groups by the Mistassini fault (Huron-Mistassini or Grenville fault). The most common rock type is paragneiss, and it is generally accepted that these gneisses are highly metamorphosed and granitized sediments.

TEMISCAMIE IRON-FORMATION

Stratigraphy

The lower and upper Albanel formations are the oldest rocks of the Mistassini group. In general they consist of dolomite and have an estimated thickness of between 6,500 and 8,400 feet (Neilson, 1950, p. 50-51). The Boulder Bay quartzite overlies the dolomite. It ranges in thickness from 30 to 50 feet.

Detailed mapping along with information from diamond drill holes and laboratory studies has warranted the division of the Temiscamie iron-formation into six members (Quirke, 1958). Unfortunately, it is impossible to show the member boundaries on the accompanying geologic map (Fig. 2) because of its small scale.

The lower argillite member is found everywhere at the bottom of the Temiscamie iron-formation. In outcrop it is a dense black, and bedding, including cross-bedding, can be seen. Secondary cleavage is absent but bedding parting, along which graphite is concentrated, is conspicuous. Fine-grained muscovite, minnesotaite and other layered silicates such as biotite comprise as much as 90 percent of the rock. Small angular grains of quartz are scattered throughout, but do not exceed five percent. Plagioclase grains occur less frequently. Chemical and mineralogical analyses indicate that this member is an argillitic phase of James' (1954) silicate facies of iron-formation. It ranges in thickness from 9 to 40 feet.

In outcrop the overlying lower sideritic chert member appears well bedded. The more resistant cherty beds may be up to one foot thick, the less resistant beds between being less than one inch thick. The colour of the exposed surfaces is light brown to buff. In drill core the thicker beds are white to light brown, depending on the amount of siderite and ankerite present. Beds containing more than 50 percent minnesoatite are light greenish grey. The less resistant thin beds are brown to dark grey and contain a high percentage of iron carbonate frequently with visible stilpnomelane. The member ranges in thickness from 20 to 40 feet.

Economically, the magnetitic chert member is the most important member of the Temiscamie iron-formation. In outcrop it is pinkish-white with scattered or bedded black to blue-black hematite and magnetite grains. The rock has a similar aspect in drill core. Although gross features such as bedding or other types of segregation cannot be as easily discerned in drill core, oolite and granule textures are more easily recognized. Quartz (recrystallized chert) is the most common mineral of the matrix in which the magnetite and hematite occur. Magnetite occurs as masses of euhedral grains, as concentrations of euhedral grains in layers, as scattered crystals as the periphery or interior of oolites and as outlining or filling granules. The blades are seldom longer than 0.15 mm or wider than 0.03 mm and the octahedra have a diameter less than 0.05 mm. Magnetite rarely makes up more than 50 percent of the rock except in individual beds less than six inches thick. Hematite is ubiquitous but far exceeded in amount by magnetite. Dust-size hematite is scattered throughout the member; relic textures of oolites, granules and syneresis cracks are excellently delineated by it. Ankerite and siderite occur throughout the member and may make up almost 100 percent of an individual layer. Stilpnomelane and minnesotaite do not exceed five percent of the rock. The average thickness of the magnetitic chert is about 140 feet.

The upper argillite member immediately overlies the magnetic chert member but seldom crops out because of its lack of resistance to weathering. The rock is dark green to greenish-black in colour, well jointed and massive. The lower 10 to 20 feet may be magnetic. The upper part of the member becomes thinly bedded with excellent bedding parting. Oolites, granules and other textures are absent. The most abundant minerals are fine-grained ankerite and siderite which form the matrix for the other minerals. Stilpnomelane occurs as a mat of lath-shaped crystals in carbonate layers and may comprise as much as 90 percent of a layer, giving a greenish hue to the rock. Detrital quartz grains occur in thin layers or scattered sporadically. The thickness of this member ranges from four to 46 feet. Although the field name "argillite" was given to this member, on the basis of mineralogic and chemical analysis it has been shown to belong to the silicate facies of iron-formation.

The areal distribution of the magnetitic iron-silicate member has not been fully delineated because outcrops are sparse and a limited amount of diamond drilling has been done in these areas. In outcrop the rock consists of alternating black and white, thin (less than 2 cm.) layers. The black layers consist of magnetite and stand out in relief. The mineralogy of this member is similar to the upper argillite except that magnetite and minnesotaite make up as much as 90 percent of some layers. The thickness is estimated to be less than 100 feet.

The upper sideritic chert member is the uppermost member of the Temiscamie iron-formation. Its aspect in outcrop and its mineralogy are similar to the lower sideritic chert member. However, in drill core the bedding is less well defined. Furthermore, granules, oolites and syneresis cracks are common in contract to their virtual absence in the lower sideritic chert member. No drill hole goes through the entire thickness of the upper sideritic chert member, but from structural evidence it is believed to be at least 100 feet thick.

Within the Temiscamie iron-formation the contacts between the members are gradational or marked by interbedding. The contact with the underlying Boulder Bay quartzite is gradational, but the contact with the overlying Kallio slate is haarp. The base of the Kallio formation is identified by finely bedded black chert without siderite in contract to the thicker bedded chert and siderite of the upper member of the Temiscamie iron-formation.

Structure

Along the Albanel lake front the Temiscamie iron-formation dips gently (less than 15°) to the southeast. These gentle dips are terminated on the southeast by a series of sub-parallel faults in the Kallio Lake-Ruth Lake-Plateau Lake area. South-eastward, rocks of the Kallio formation are sheared and exhibit excellent slaty cleavage. Between the sheared Kallio slates and the main Mistassini fault zone along the Temiscamie River, rocks of the Mistassini group including the Temiscamie iron-formation are block faulted and in places overturned. The general strike of the faults, the rock cleavage and the fold axes trends northeast paralleling the Mistassini fault zone and the intensity of their deformation increases southeastward towards the Mistassini fault zone. These structures are considered to be part of, or at least attributable to, movements along this fault zone between rocks of the Mistassini group and those of the Grenville metamorphic complex.

Age and Correlation

The composite chemical analysis of the Temiscamie iron-formation is similar to those of several iron-formations in the Lake Superior region (Quirke, et al., 1960). Chemical analyses of the iron-formation of the Labrador trough are not available for comparison. Wahl (1953), Bergeron (1957) and others have correlated the rocks of the Mistassini basin with those of the Labrador trough on the basis similar stratigraphy and lithology. There are also similarities in the stratigraphic succession of the Mistassini and Lake Superior districts.

However, the correlation of Precambrian rocks in widely separated regions on the basis of composition and stratigraphic succession is not always dependable; environmental conditions may have been duplicated, and as a result similar rocks may have been deposited at different times.

For this reason a series of samples was collected, and three of these have been utilized for A^{40}/K^{40} age determinations (Quirke, et al., 1960). As mentioned above, a sample from the Takwa complex gave an age of 1.6 b y. From a sample of the lower argillite member of the Temiscamie iron-formation an age of 1.3 b y was obtained. A sample of biotite gneiss from the Grenville complex gave an age of about 1.0 b y, agreeing well with other ages determined from other places within the Grenville subprovince.

If the 1.6 b y age is accepted at the time of orogeny that developed the east-west structural trend of the Takwa complex, then the time of deposition of the overlying sediments of the Papaskwasati and Mistassini groups is limited to between 1.6 and 1.0 billion years. The Temiscamie iron-formation, then, cannot be correlated with the iron-formations of the Lake Superior region, because the latter were involved in an orogeny dated at approximately 1.7 b y (Goldich, et al., 1957). The 1.3 b y age of the lower argillite member tends to support this interpretation. However, it must be pointed out that the later Grenville orogeny may have caused the loss of some of the argon so that the dates reported are only minimum ages. Further complications are appearant when the absolute ages from the Labrador trough are considered in connection with the structural history of the area of Mt. Reed and Mt. Wright.

o-O-o

REFERENCES

(x) denotes those references cited in text)

(x) Bergeron, Robert, 1957, Late Precambrian rocks of the north shore of the St. Lawrence River and of the Mistassini and Otish Mountains areas, Quebec, in The Proterozoic of Canada: Roy. Soc. Canada, Spec. Pub. 2, p. 124-131.

Gill, J. E., et al., 1957, The Proterozoic in Canada: Roy. Soc. Canada, Spec. Pub. 2, 191 p.

(x) Goldich, S. S., Baadsgaard, H., and Nier, A. O., 1957, Investigations in A^{40}/K^{40}dating: Am. Geophys. Union Trans., v. 38, p. 550.

Hogberg, R. K., 1957, Mineralogy and petrography of iron-formation at Lake Albanel, Quebec, Canada: M. S. thesis (unpublished), Michigan State University, 46 p.

(x) James, H. L., 1954, Sedimentary facies of iron-formation: Econ. Geology, v. 49, no. 3, p. 235-293.

Neal, J. T., 1958, Stratigraphy and structure of a portion of the iron-formation at Lake Albanel, Quebec: M. S. thesis (unpublished), Michigan State University, 74 p.

(x) Neale, E. R. W., 1952, Preliminary report on Bethoulat Lake area, Mistassini Territory, Quebec: Que. Dept. Mines, Prelim. Rept. no. 264, 13 p.

(x) Neilson, J. M., 1950, Geology of the Mistassini region, northern Quebec: Ph.D. thesis (unpublished), University of Minnesota, 156 p.

__________ 1950, Preliminary report on Temiscamie Mountains map area, Mistassini Territory, Quebec: Que. Dept. Mines, Prelim. Rept. no.238, 8 p.

(x) __________ 1951, Preliminary report on Takwa River area, Mistassini Territory, Quebec: Que. Dept. Mines, Prelim. Rept. no. 254, 9 p.

__________ 1953, Albanel area, Mistassini Territory, Quebec: Que. Dept. Mines, Geol. Rept. no. 53, 35 p.

(x) Quirke, T. T., Jr., 1958, Mineralogy and stratigraphy of the Temiscamie iron-formation, Lake Albanel Iron Range, Mistassini Territory, Quebec: Ph.D. thesis (unpublished), University of Minnesota, 115 p.

(x) Quirke, T. T., Jr., Goldich, S. S., Krueger, H. W., 1960, Composition and age of the Temiscamie iron-formation, Mistassini Territory, Quebec, Canada: Econ. Geology, v. 55, no. 2, p.

Thomson, J. E., et al., 1956, The Grenville Problem: Roy. Soc. Canada, Spec. Pub. 1, 119 p.

(x) Wahl, W. G., 1953, Temiscamie River area, Mistassini Territory, Quebec: Que. Dept. Mines, Geol. Rept. no. 54, 32 p.

o-O-o