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PART OF GABOURY AND BLONDEAU TOWNSHIPS

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DEPARTMENT
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MINERAL DEPOSITS SERVICE

PART OF

GABOURY AND BLONDEAU TOWNSHIPS

Témiscamingue County

GEOLOGICAL REPORT-145

L. KISH

1971

G.R.-145

TABLE OF CONTENTS

TABLES

ILLUSTRATIONS

Maps

Plates

PLACE NAMES

The particles affecting some French place names are left out in this report.

lac des Bois = Bois lake
lac en Coeur = Coeur lake
lac aux Pins = Pins lake

INTRODUCTION

The mapped area includes the east half of ranges III to VIII of Gaboury township and a section of about 25 sq. miles of the adjacent Blondeau township, comprising much of ranges III to VI. Detailed mapping of the area was induced by the discovery and development of a zone of copper-nickel mineralization (Lorraine mine) near the eastern border of range III in Gaboury township.

Location and access

Gaboury and Blondeau townships are in Témiscamingue county about 25 miles east of Lake Témiscamingue. Highway 62 connecting Ville-Marie to Belleterre, lies about 2 miles north of the map area.

The central part of Gaboury township may be reached by a motor road that branches from the highway at the village of Latulipe and leads to des Bois lake. Another motor road enters Gaboury township at its northeast corner and connects the mine site of Lorraine Mining Co to Highway 62. The south-central part of Blondeau township is accessible by canoe from a landing point, situated at the intersection of Highway 62 with Gauvin lake, about 5 miles west of Belleterre. The canoe route leads south through Girard lake to Allard and Grassy lakes. An approach to the southwest portion of the township is provided by a tractor road which branches from the highway at Lett lake and extends to the south, through Conrego Nickel Mines (Regcourt) camp to Kelly lake.

Previous work

The first geological work in the area was done by Retty (1931) who mapped Blondeau and Gaboury townships at a scale of one inch to one mile. Henderson (1936) studied the broad belt that extends from

Lake Témiscamingue eastward to Soufflot lake and includes Gaboury, Blondeau and Guillet townships. The Belleterre area (most of Guillet township and the eastern margin of Blondeau township) was mapped by Auger (1952) who studied, in detail, the structural relations of the gold deposits near Belleterre.

A federal-provincial aeromagnetic survey map that covers the area is available (Belleterre sheet 1472-G).

Exploration work by mining companies is summarized in the section on Economic Geology.

Field work

The eastern half of Gaboury township was mapped in 1964 (L. Kish, 1966). Mapping of part of Blondeau township started in the second half of the summer of 1966 and was completed in 1967. Most of the area was covered by systematic traverses 500 feet apart. Mineralized zones and surface showings were studied in more detail.

In general, outcrops are abundant, especially west and southwest of Bois lake, around the Lorraine mine, and south of Girard lake. However, between Bois lake and Coeur lake most of the bedrock is covered by glacial overburden.

Acknowledgements

In 1964 the writer was assisted by Jean Descarreaux, as senior assistant, and M. Farnsworth and P. Imbault as student assistants. In 1966, P. Blümel was the senior assistant, and the students were M. L'Heureux, J.G. Chabot and F. Cloutier. In 1967, Iqbal Leghari, R. Dionne and L. Goulet assisted the writer. Their help is gratefully acknowledged. The writer also expresses his gratitude to the management of Lorraine Mining Co., for permitting access to their diamond drilling results. Mr. Popov, the mine geologist, supplied some specimens from the underground workings for chemical and microscopic study.

Physiographic description

The area in general has a moderate relief; the altitude ranges between 975 and 1275 feet above sea-level. The most hilly areas occur south of Girard lake; in ranges IV and V along the shores of Allard lake; and southwest of Bois lake. The northern, flat part of Gaboury township is part of the Témiscamingue clay belt, which extends over a large area east of Lake Témiscamingue. Most of the map-area is covered by woods. Spruce, birch and poplar are the common types of trees.

Lakes and seasonal streams are abundant in Gaboury and Blondeau townships, but rivers are scarce.

In the southern part of Gaboury township, and in the eastern section of Blondeau township, the lakes are elongated and their shape is controlled by structural features in the bedrock. Allard lake, which is known locally also as Nine mile or Neuf milles lake, is a representative example. In the central, flat part of the map-area, where glacial overburden is abundant, the lakes are shallow and irregular in shape.

Numerous ponds and small flooded areas are caused by beaver dams. Larger swamps are found next to the inlet of Allard lake, and southwest of the outlet of Bois lake.

There are two drainage patterns in the area. The waters of Gaboury township are collected in Bois and McKenzie lakes and drained north to des Quinze lake through Bois and McKenzie rivers, and Fraser river.

In the eastern part of the map-area the waters flow from north to south. Girard lake and Kelly lake drain to Allard and eventually to Kipawa lake.

Glacial features

The effect of glaciation is evident from striae on the rock surfaces and from locally abundant, glacial deposits. Striae suggest that the last ice-sheet moved south to southwest. The glacial deposits, which are especially abundant between in Bois lake and Coeur lake, are mainly sand. In the northernmost part of Gaboury township, abundant clay marks the southern margin of the very extensive Abitibi-Témiscamingue clay belt.

GENERAL GEOLOGY

Gaboury and Blondeau townships are in the Superior geological province. The contact between the Superior and Grenville provinces, which lies south of the map-area, appears to be a zone of gradual increase in the grade of regional metamorphism. The effect of the high-grade Grenville metamorphism on the mineral assemblages of the rocks is obvious in the southern part of the map-area.

The bedrock in the map-area is of Precambrian age. On the basis of genetic and stratigraphic relations, the rocks may be divided into three major groups.

1. Central Belt - A belt of altered volcanic rocks, with associated intrusive rocks, extends easterly in the central part of the map-area. It is about 3 miles wide at the western border of the area and less

than 3,000 feet in the eastern half of Blondeau township. The same rock types are found in the northeastern corner of the map-area. As they are separated here from the central belt, by a one-mile band of granitic rocks, they are referred in this report to the Girard group. Their western limit is marked by faults and they extend east into the Belleterre mining area.

The volcanic rocks range in composition from basic to silica-rich. Tuffaceous sedimentary rocks occur locally with the lavas. Pillow structures and flow lines are common features in the dark lavas. Some units of andesite grade from a fine-grained to a dioritic texture. The pale lavas are mostly massive and some contain abundant quartz phenocrysts. The fine-grained, pyroclastic rocks, and the matrix of most of the fragmental rocks, are rich in silica. Locally, layers of sedimentary rocks, including thin layers of magnetic, cherty, iron formation, are recognized within the volcanic rocks.

Some intrusions are restricted to the volcanic belt. Gabbro and diorite are widespread, and at several places copper-nickel mineralization is associated with them. The leucocratic intrusive rocks include porphyritic syenite, a pink, porphyritic granite, and quartz-porphyry. Narrow aplite dikes cut the lavas in Gaboury township. Lamprophyre is found as dike rock, as is serpentinite, which occurs near McKenzie and Girard lakes.

2. South Belt - Metamorphosed sedimentary rocks, mainly biotite paraschists, underlie the south part of the area. Layers of conglomerate occur near the base of the sedimentary formations. Farther south the paraschists are complexly and abundantly injected by a pink granite. Some of the meta-sedimentary rocks contain garnet and staurolite.

3. North Belt - A large mass of granodiorite and gray granite occupies the north part of the map-area and extends beyond its limits.

Near the contact with the central volcanic belt the granodiorite and the gray granite are deformed and contain inclusions of rocks of the central belt. A pink, two-feldspar granite is mixed with the granodiorite in the eastern half of Blondeau township.

Diabase dikes cut the lava and the granodiorite.

Table of formations

Pleistocene		Clay, sand, gravel, boulders	
Late Precambrian	Intrusive rocks	Diabase dikes	
Early Precambrian	Intrusive rocks	North Belt	Pink Granite Granodiorite and albite granite
	Metasedimentary rocks and associated intrusive rocks	South Belt	Granite Injected paraschist Biotite paraschist, some conglomerate
	Intrusive rocks	Central Belt	Serpentinite Lamprophyre Aplite Pegmatite Porphyritic granite Quartz porphyry Porphyritic syenite Diorite, quartz diorite Gabbro, some pyroxenite
	Metavolcanic and associated sedimentary rocks	Central Belt	Iron formation Tuff and intervolcanic sedimentary rock Agglomerate and volcanic breccia Dacite, rhyolite Dioritic andesite – microgabbro Basalt, andesite, some trachyandesite

GEOLOGICAL EVOLUTION AND STRUCTURAL GEOLOGY

The major geological events, as deduced from the structural and stratigraphic relations, may be summarized as follows:

The volcanic rocks, which are host to various intrusive bodies, are the oldest rocks in the area. Well developed pillow structures allow for top determinations and indicate that, in the steeply dipping, monoclinal sequence, the flows face south.

Two areas of abundant, acidic, volcanic rocks, with associated pyroclastic and intervolcanic sedimentary rocks, occur within the central belt. The acidic rock units around Lett lake will be subsequently referred to as the Lett group; those between Ménard and Dupuis lakes will be known as the Ménard group. The Lett and Ménard groups represent periods of extrusion of siliceous volcanic rocks and of the deposition of tuffs, and some waterlaid sediments. The Lett group, which is lower in the sequence, contains abundant dacite and rhyolite, whereas, in the Ménard group, dacitic and trachyandesitic flows are overlain by tuffaceous sediments.

The renewal of volcanic activity, after a period of inter-volcanic sedimentation, was marked by the extrusion of dark lavas.

Gabbro and diorite intruded the volcanic and pyroclastic rocks before the main period of regional metamorphism. These intrusive rocks are found only within the volcanic belt. A genetic relation between the magmas of the extrusive and intrusive rocks, of similar chemical composition, is possible.

A long period of marine sedimentation followed the volcanism. The sedimentary formations extend to the south beyond the limits of the map-area and into the Grenville Province. Conglomerate occurs near the base of the sedimentary sequence and graded bedding is clearly visible.

During a long period of regional metamorphism, almost all the dark minerals in the extrusive and intrusive rocks of the central belt were recrystallized, and the feldspars altered to some degree. The sedimentary rocks of the south belt were recrystallized to paraschists.

The intrusion of the granitic rocks in the north belt, and the injection of the metasedimentary rocks, occurred after this main period of regional metamorphism. The granitic rocks in the north part of the area form a batholith. A coarse, albite granite and a gray granodiorite are the main rock types. A pink, two-feldspar granite cuts the gray granitic rocks in the eastern part of Blondeau township.

The emplacement of the granitic rocks had a marked effect on the tectonic evolution of the area. The older formations were folded into a huge anticline, the south limb of which, in part, is represented by the south-facing sequence of volcanic and sedimentary rocks of the map-area. A substantial part of the older rocks have been eroded and the core-forming granitic rocks are exposed over a broad area. Near the contact, inclusions of volcanic rocks, gabbro and diorite, in the grey granitic rocks, are plentiful and, in places, huge. The mineralogical changes in the rocks along the contact zone are described in another part of this report.

Henderson (1936) interpreted the volcanic-sedimentary sequence of Gaboury and Blondeau townships as a monocline, which, "represents the southern limb of a major fold that has been cut off on the north by the granite" (p. 14). Auger (1952) concluded that the rocks of the Belleterre map-area also, "belong to the southern limb of a large anticlinal fold surrounding the granitic batholith" (p. 26). Both conclusions are in agreement with the author's interpretation. Volcanic rocks, about 15 miles northwest of the present map-area, may represent the northern limb of the above-mentioned anticline.

Each of the three major, rock groups of the map-area has distinct structural features: 1) in the central belt, a deformation of the pillows was accompanied by the development of a primary schistosity before the folding, 2) in the sedimentary rocks to the south, the plane of schistosity formed during the regional metamorphism has influenced the pattern of injection into the paraschists, 3) a foliation, marked by quartz, has developed in the granitic rocks of the north belt, especially along the edge of the batholith.

The primary schistosity in a dark lavas is parallel to the elongation of the pillows. In range IV of Gaboury township, the primary schistosity has an easterly or southeasterly strike, and the formations dip very steeply to the south or are vertical.

A deviation from the east-west trend occurs, west and southwest of Bois lake, where the elongation of pillows and the strike of schistosity is to the northeast.

The elongation of the pillows in the western half of Blondeau township ranges from 90^{o} to 120^{o}. Most commonly it is about 110^{o}, and the plane of schistosity dips steeply to the south. In this near-vertical sequence of lavas the tops of pillows face to the south.

The dacite and rhyolite are found intimately associated with tufaceous layers, fragmental rocks and intervolcanic sedimentary rocks. The primary layers of sediments, and the elongation of particles in the fragmental rocks, were used to establish their structural relations. An analysis of these structural features reveals that the rocks of the Lett group were folded before a second regional schistosity had developed in the area. The broad, open folds, north and east of Lett lake, have roughly northeast trending axes with steep plunges to southwest.

The above-mentioned irregularity of the tuffaceous layers, west and southwest of Bois lake, is probably also caused by folds, but there is not sufficient information to fully support this contention.

In the Ménard group and in the formations south of it, evidence of folds is scarce. In the Ménard group, the layering is parallel to the southern contact of the volcanic belt.

In the metasedimentary rocks, the primary bedding is parallel to the schistosity, which strikes roughly east-west, and the dips are nearly vertical.

A northeast-trending, and relatively late, regional fracturing has affected all the rocks of the area. Joints, shears and faults have developed parallel to the direction of fracturing.

Shear zones produced chlorite and epidote schists between McKenzie and Bois lake and at several places south of these two lakes. The schists are composed mainly of chlorite and/or epidote, and feldspars, and occur within deformed lavas or, as south of Bois lake, within porphyritic rocks. In some instances their origin is uncertain and they may have been derived from diorite or gabbro.

A porphyritic granite body, which extends across the western area of Bois lake, is elongated parallel to the general fracturing of this part of the area.

In the central part of Blondeau township, the rocks are intensively fractured along a near-vertical plane that strikes N45°-55°E. Some of these fractures represent faults and narrow lakes lie along them. The displacement occurred after the main period of metamorphism and folding; thus the faults cut through the major rock types. A left-handed horizontal separation was observed at several places.

A north-northwest fracturing is less common and is probably complementary to the northeast trending set. The diabase dikes are parallel to the northwest fractures.

LITHOLOGY

METAVOLCANIC AND ASSOCIATED SEDIMENTARY ROCKS

Basic and intermediate extrusive rocks

Andesite and basalt

Dark lavas are abundant in most parts of the central belt and are especially well exposed southwest of Bois lake, in Gaboury township, and west of Allard lake, in range IV of Blondeau township. Andesite and basalt form thick flows in which many of the primary (extrusive), macroscopic characteristics, such as pillow structures and flow lines, are well preserved. Regional metamorphism transformed andesite and basalt into rocks of identical appearance. The fresh surface of the dark metavolcanic rocks is commonly bluish grey (variety with abundant secondary amphibole), or greenish (chlorite variety). The color expresses a different grade of regional metamorphism, not the difference in primary composition, which is shown only by chemical analysis.

Porphyritic and amygdaloidal varieties are locally abundant. The amygdules are from 2 to 8 mm. in diameter and appear as pale dots in the dark matrix. In the pillowed lavas they are concentrated along the chilled margin of the pillows (Plate IA).

In the porphyritic flows the phenocrysts of feldspar are angular and vary in size between 2 and 4 mm. In some sheared lavas the phenocrysts are elongated and may be mistaken for deformed amygdules.

Because of an intensive metamorphic recrystallization, the data from a microscopic study of the lavas are less informative than those gained from hand specimens and from outcrops. A recrystallized, granuloblastic texture is seen in thin-section. Plagioclase and amphibole are the main constituents. The plagioclase forms a fine-grained mosaic and is commonly untwinned. The amphibolite is a pale, bluish-green variety and occurs as needles and prisms, some of which are sub-parallel. Locally the amphibole forms dens clusters which appear in hand specimens as dark spots (spotted lavas).

Chlorite is found in specimens north of Bois lake, where the amphibole is less abundant. Epidote and calcite are minor constituents, and biotite is seen in places. Quartz may be present but the rocks are deficient in potash-feldspar. Pyrite is the common, opaque, accessory mineral.

The total SiO_2 and alkali contents of some dark lavas are summarized in Table 1. Comparing the results of the analyses to the field names given, it is concluded that the lavas were estimated to be more siliceous than they actually are. For comparison, Table 1 gives the silica and alkali contents of average calc-alkali andesite and basalt (Nockolds, 1954). In general the tenor of K_2O is very low in the dark lavas of the central belt. The high potassium content in one specimen (8) may be due to local metasomatism. It is obvious from Table 1 that, in general, the regional metamorphism was not accompanied by metasomatic changes.

Table 1

Total Silica and Alkali Content of the Dark Lavas

No.	SiO_2	Na_2O	K_2O	Field Names	Name by Chemical Comp.
1	48.22	0.92	0.40	Andesite or basalt	
2	49.48	1.96	0.92	Average andesite	
3	51.82	2.91	1.36	Sheared andesite	
4	54.84	3.70	1.02	Andesite	
5	46.81	2.89	0.49	Dark basaltic lava	
6	48.94	1.85	0.30	Dark volcanic rock	
7	47.86	1.33	0.20	Basalt	
8	52.24	3.20	2.23	Andesite or basalt	
9	-	2.78	1.23	Andesite adjacent to sediment. rock	
10	52.94	-	-	Andesite	
11	50.23	2.61	0.42	Trachyte	Andesite
12	49.98	2.85	0.53	Trachyte	Andesite
13	51.29	2.54	0.68	Trachyte	Andesite
Nockolds (1954)	54.20	3.67	1.11		Average calc-alkaline andesite
Nockolds (1954)	51.33	2.76	0.82		Average "central" basalt

Trachyandesite

The most widespread occurrence of trachyandesite is north of Ménard lake, where it is overlain by siliceous flows and tuffaceous sediments of the Ménard group. The trachyandesites have the same flow features as the andesites and basalts, but contain more plagioclase and are paler in color. However, chemical analysis could safely distinguish the trachyandesite from some other pillowed lavas. On the map it is grouped with andesite and basalt.

Dioritic andesite – microgabbro

This rock unit occurs as small patches in the volcanic rocks of both Gaboury and Blondeau townships. The rock is transitional between a fine-grained, dark lava and a diorite or gabbro. Its contact with the extrusive rocks may be sharp, or may form a transitional zone in which a gradual increase in grain size may be observed. Examples of a gradational contact are well exhibited between the Conrego camp and Kelly lake.

The dioritic andesite or microgabbro is massive, dark, and lacks flow features. In the 2 to 3 mm. weathered margin, the white plagioclase is readily distinguishable from the mafic constituents. The mineral composition as seen under the microscope is that of a fine-grained amphibolite. Most of the plagioclase of the rock is recrystallized and forms a clear mosaic of untwinned crystals. The pale green, amphibole blades are up to 1 mm. long. Quartz and epidote are minor constituents. Table 2 shows a partial analysis of two specimens. The silica and alkali contents of the dioritic andesite or microgabbro are close to those of the dark lavas in Table 1.

Table 2

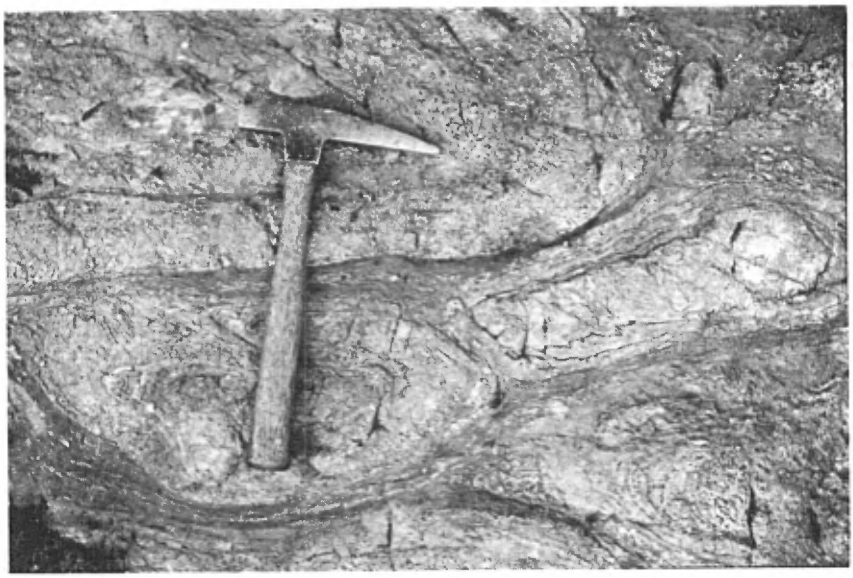
Dioritic Andesite

No.	SiO_2	Na_2O	K_2O
14	48.79	2.40	1.40
15	49.92	1.94	0.27

Siliceous lavas, pyroclastic rocks and intervolcanic sedimentary rocks

These rocks occur in close association and are commonly interlayered. Wherever one or the other type predominates, it is marked on the map as being of effusive (Rd), pyroclastic (Tf, A.), or sedimentary (Sed) origin.

PLATE I



A - Pillow structure in the basic lava. Note vesicular margin; Range IV, near east border of Gaboury township.

B - Bombs in the agglomerate. Range IV, Gaboury township.

Dacite and rhyolite

In the field an attempt was made to separate these two rock types. Chemical analyses indicate that most of the rocks originally mapped as rhyolites are actually porphyritic dacites.

Siliceous volcanic rocks are common southwest of Bois lake in Gaboury township and make up a substantial portion of the Lett and Ménard groups in Blondeau township.

The siliceous volcanic rocks are very fine grained and pale colored. Because of the high content of silica they are hard, and show conchoidal fracturing. Quartz phenocrysts are commonly observed in hand specimens; phenocrysts of feldspar are rare.

The siliceous volcanic rocks have been regionally metamorphosed but, because of the small quantity of dark minerals, the metamorphic character of these rocks is less obvious than that of the dark lavas.

A microscopic study shows that the matrix of the siliceous lavas is a very fine-grained mixture of quartz and feldspar, with chlorite and biotite as minor constituents. A partial resorption of the quartz phenocrysts is seen under the microscope. The euhedral shape of the quartz crystals is preserved, even in those grains which are recrystallized to an optically discontinuous mosaic. In some thin-sections, garnet and muscovite with sieve texture were noticed. Some specimens contain secondary calcite.

A study of the sodium/potassium ratios shows that the tenor of K_2O is near or below one per cent, and that Na_2O predominates markedly (3:1) over K_2O. The chemical characteristics of the siliceous rocks in Gaboury and Blondeau townships indicate that most of the acidic volcanic rocks,including those with quartz phenocrysts, would be properly called dacites, instead of the locally accepted usage of rhyolite. As was the case with the dark lavas, there is a tendency to class the rocks, on the basis of hand specimen properties, as more siliceous than they really are.

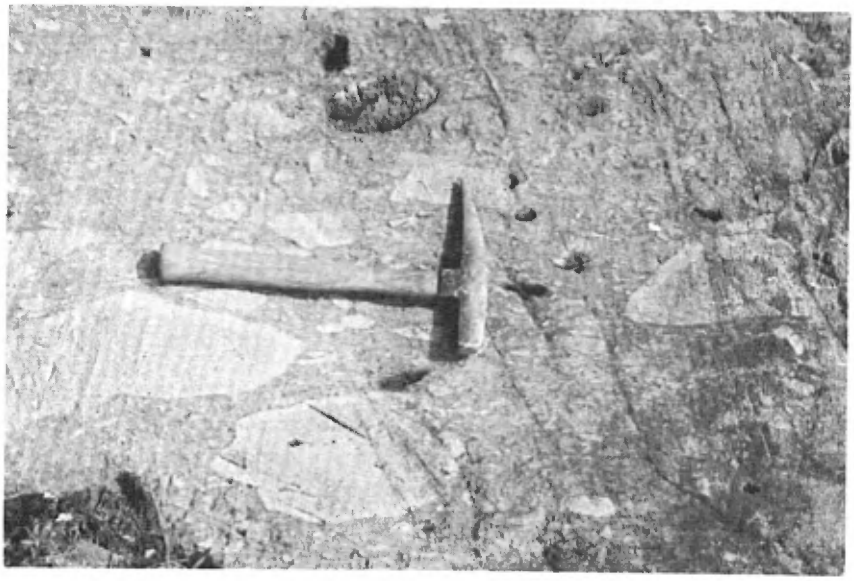
Agglomerate and volcanic breccia

The pyroclastic rocks, containing bombs and blocks, form layers in both dark and pale lavas, and in this respect they differ from the tuffs, most of which are silica-rich.

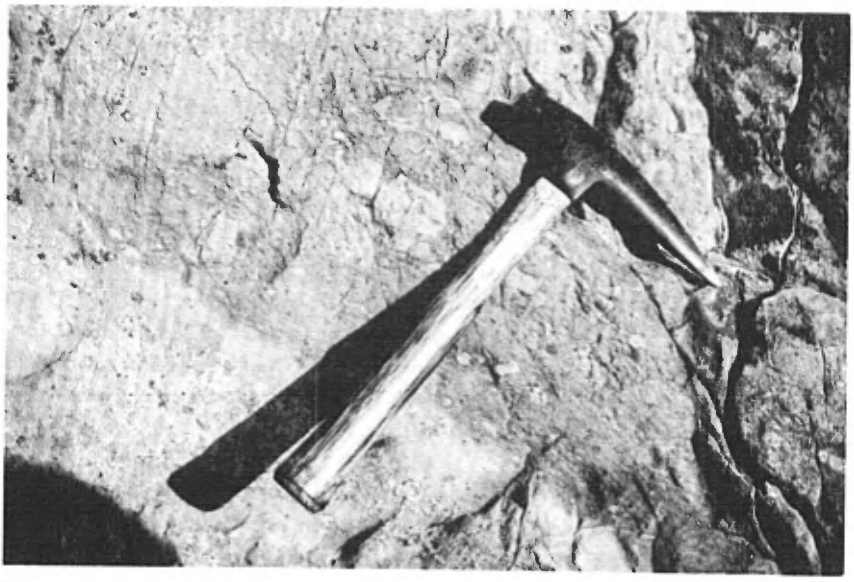
Agglomerates are common near Bois lake. Here the bombs are up to 1/2 foot in diameter and are more siliceous than the groundmass (Plate 1B).

In the southwest part of Kelly lake the agglomerates are made up of basic particles in a pale, tuffaceous matrix. In the breccias

PLATE II



A - Brecciated tuffaceous layers. Southwest end of Kelly lake, Blondeau township.



B - Flow-breccia, McKenzie lake.

on the island of the southwest part of Kelly lake, both the blocks and the matrix are siliceous in composition. The angular shape of the particles suggests that they derive from tuff layers, which were broken up in a semi-consolidated stage (Plate IIA). East of the township line that separates Gaboury and Blondeau townships, and north of the Lorraine mine base line, a tectonic breccia is exposed in which both the matrix and fragments are broken and recemented into a second-generation matrix of pegmatitic quartz.

The flow breccia of the area differs from the above-described pyroclastic rocks; it originates from a partly consolidated lava, broken up into fragments which were incorporated in a flow of the same composition. This relation is well illustrated by the breccia found at McKenzie lake (Plate IIB). The only difference between the groundmass and the fragments is that the latter are loaded with amygdules.

Tuff and intervolcanic sedimentary rocks

Most of the pyroclastic material in the area is siliceous tuff. Pale tuff either forms independant outcrops or is interlayered with siliceous flows and intervolcanic sediments. There are no sharp contacts between these rock types and the siliceous tuff grade through tuffaceous sediments into silica-rich, and occasionally alumina-rich, sedimentary rocks, which were deposited in a marine environment.

The significance of the formation of the Lett and Ménard groups was discussed earlier. The siliceous rocks of both groups represent the final stages of a volcanic period which ended with the deposition of the intervolcanic marine sediments. Tuff layers also occur in the area as layers in dark flows (marked TFL on the map). Most of the tuff layers contain pyrite and constitute targets for prospecting.

The freshly stripped, glaciated surface of the tuff is grey or pinkish and the broken surface is uniformly grey. The small, tuffaceous particles are better seen on the weathered surface, as they stand out by differential erosion.

The intervolcanic sedimentary rocks are well layered, and graded bedding is suggested in some layers (Plate IIIA). In narrow zones, the layers are broken into angular pieces and form an intraformational conglomerate. The rock is fine grained and in hand specimens some highly siliceous varieties show a sugary texture and resemble dirty quartzite. Another variety with oriented mica flakes looks like mica schist.

A study of thin-sections shows that the tuff and associated sedimentary rocks are recrystallized. Very faint fragment outlines may be noted in some tuff but, in general, the microscopic study is not informative as to the origin of the rocks. In the sedimentary rocks the fine-grained, quartz-feldspar mixture is dotted with minute flakes of biotite. In places, porphyroblastic garnet and muscovite may be seen. Andalusite was found in two thin-sections.

A chemical study of the alkali content shows that the sodium to potassium ratio of the siliceous tuff is very variable, even within a single outcrop, and that the tenor of Na_2O is generally higher than in the acid flows. These variable chemical characteristics of the tuffs, compared to the fairly constant Na_2O/K_2O ratios of the siliceous flows, may be of some help in distinguishing between these two apparently similar rock types.

Iron formation

Layers of magnetic iron formation, 2 to 12 feet thick, occur in the southern part of the central belt. In Gaboury township the iron formation is a horizon marker. Despite some disruptions, it can be traced from McKenzie lake through the eastern part of Bois lake to range IV of Blondeau township.

The rock is very fine grained, and is made up of thin layers of glassy quartz and magnetite. Locally it contains specks of pyrite.

Intrusive Rocks of the Central Belt

Gabbro

Gabbro forms irregular bodies in the central belt of Gaboury and Blondeau townships. It cuts the volcanic and pyroclastic rocks, but is older than the sedimentary rocks south of the central belt. It is regionally metamorphosed and some textural and mineralogical differences can be observed locally. The least altered variety of gabbro is near McNab lake in Gaboury township. Here the rock is massive and medium grained. Ophitic texture is seen on the fresh surface. The minerals are twinned sodic labradorite and partly amphibolitized pyroxene. Clinopyroxene can be recognized under the microscope. The secondary minerals are amphibole and biotite and the accessory opaque mineral is magnetite.

The metagabbro west of Bois lake, and on range III of Gaboury township, is intensely altered and the original ophitic texture is difficult to recognize. In some cases the alteration is so intense that, in hand specimens, the gabbro cannot be distinguished from an altered diorite. The contacts between these two types of rocks are only approximations and it is possible that some highly altered gabbro is mapped with the diorites.

The borders between the plagioclase and mafic minerals are blurred by the fine-grained recrystallization of the primary minerals. The plagioclase is sericitized and in part replaced by epidote. Pale green amphibole is the abundant secondary mineral, but some chlorite and epidote also occur. Quartz may be present in minor quantities. The grains of some opaque accessory minerals are surrounded by sphene. On the basis

of the present mineralogy the metagabbro near des Bois lake may be called amphibolite. Some coarse facies are composed entirely of amphibole crystals and the rock is probably an altered pyroxenite. In this hornblende rock, plagioclase may occur in places as inclusions in the amphibole plates. A specimen of the hornblende rock from the west shore of Bois lake contains 45.40% SiO_2, 1.05% Na_2O, and 0.94% K_2O.

The metagabbro near the Lorraine mine is similar to that west of Bois lake, but is slightly less altered. Most of the secondary amphibole is in blades, but some form pseudomorphs after pyroxene. Rarely in large plates, relics of pyroxene survived the regional metamorphism. Most of the magnetite is altered to leucoxene.

The copper-nickel mineralization of the Lorraine mine is at the contact of the altered gabbro with dark volcanic rocks. Mafic facies similar to the above-mentioned altered pyroxenite are found in the mine, and some brecciated hornblende rock is incorporated in the ore. A specimen from the mine contains 45.71% SiO_2, 2.30% Na_2O and 0.27% K_2O.

Around the Regcourt (Conrego Nickel Mines) zone of copper-nickel mineralization, the gabbro is medium to coarse in grain and near its northern contact, where the deposit lies, it contains some bluish quartz.

South of Girard lake the gabbro is coarse grained and completely amphibolitized. Locally, specks of sulphide minerals occur in the metagabbro that intrudes the Girard group.

Diorite and quartz diorite

Dioritic rocks form sills, lenses and small irregular bodies in the central belt of the map-area and are especially abundant along the northern margin of this belt in Gaboury township.

In Blondeau township, along range line V/VI, blocks of gabbro, incorporated in the diorite, show the age relations between the two types of intrusive rocks.

There are some mineralogical and textural changes in the diorite at different localities. An average diorite is grey and massive, and the medium sized grains form a salt-and-pepper texture.

Regional metamorphism caused a partial recrystallization of the diorite. Plagioclase and secondary amphibole are the main constituents. The plagioclase is cloudy and partly replaced by epidote. Relic twins and zoning are recognizable in some thin-sections. Specimens from Gaboury township may contain up to 30% epidote. The amphibole is in blades or needles. Relics of primary hornblende also occur. Locally

biotite may be present and accessory calcite, sphene, apatite, and opaque grains were noted. An average specimen of the diorite north of Bois lake contains 50.46% SiO_2, 3.54% Na_2O and 0.96% K_2O. The diorite near Lett lake contains some quartz.

In Gaboury township and along the northern margin of the central belt altered dioritic rocks form a front, about 4 miles long, against the granitic rocks to the north. Originally they may have been diorites and gabbros but the changes in texture and mineralogy, which were brought about by the contact metamorphism of the adjacent granitic intrusive rocks and by regional metamorphism, obliterated the primary features. In the field these rocks were named "contact metadiorite". An attempt has been made to separate on the map a chloritized (ID_k) and a quartz-bearing, granitized variety (ID_g).

Secondary amphibole is present in amounts up to 40%, and the tenor of chlorite may be as high as 20%. Epidote rarely exceeds 5%. In the granitized variety of the contact metadiorite, bluish quartz is uniformly distributed and constitutes up to 20% of the rock. The mafic minerals replace part of the plagioclase and the minerals form a fine-grained, complex mixture.

Porphyritic syenite

Syenitic dikes and veins are especially abundant between McKenzie and Bois lake. An irregular body of syenite cuts the volcanic rocks south of McKenzie lake.

The syenitic rocks are pale in color and in general have a porphyritic texture. Most of the porphyritic syenite is deformed and resembles augen gneiss. The feldspar phenocrysts are up to 5 mm. long. They are whitish in hand specimen and an intense sericitic alteration is seen in thin-sections. Zoning and twinning of the plagioclase are barely noticeable. The fine-grained groundmass is made up of feldspar, muscovite, biotite, epidote; a minor quantity of quartz and calcite may be present.

Quartz porphyry

An elongated, dike-like body of quartz porphyry is found north of Bois lake and extends roughly parallel to a pink, porphyritic granite dike. Several isolated groups of outcrops of the same rock are found along the north-south township-line that separates Gaboury and Blondeau townships.

The quartz porphyry is a pale grey rock, which is commonly sheared. The rounded quartz eyes and the plagioclase phenocrysts, some of which are zoned, are surrounded by a fine-grained groundmass of feldspar, quartz, epidote and chlorite. Amphibole in minute needles may be present.

PLATE III

A - Intervolcanic sedimentary rocks (centre) interlayered with tuff and volcanic breccia.

B - Lamprophyre dike with inclusions, McKenzie lake, Gaboury township.

Porphyritic granite

A dike of porphyritic granite extends northeasterly across the western area of des Bois lake. It contains inclusions of altered gabbro and dark, volcanic rocks. No contact relations were found between this granite and the other granitic rocks of the area. The rock is fresh and unaltered and, in spite of the fact that it is described with the rocks of the central belt, it may be younger than some of the granites outside the central belt.

The rock is massive, and pink on the fresh surface. Randomly oriented phenocrysts, up to one inch long, stand out on the uneven weathered surface. The fine-grained, quartzofeldspathic groundmass is dotted with biotite, hornblende and epidote.

Pegmatite

Pink, granitic pegmatite dikes, 1 foot to 3 feet thick, were noted with the rocks of the central belt of Gaboury township. The pegmatite may be genetically related to the pink granite that injected the sedimentary formations south of the central belt.

Aplite

Pink, or greyish pink, aplitic dikes cut the volcanic rocks west of the Lorraine mine in Gaboury township. The dikes are narrow and only some of them are shown on the map. The dike material is very fine grained and is composed of a mixture of quartz and feldspars.

Lamprophyre

Dikes of mica lamprophyre, up to 3 feet thick, are found with the rocks of the central belt. They are fairly abundant in Gaboury but rare in Blondeau township. Some of the dikes are shown on the map. The lamprophyre dikes cut the extrusive, dark intrusive, and syenitic rocks of the central belt; thus, they are among the youngest rocks of the central belt.

The rock is massive and medium-grained. Shiny mica flakes are conspicuous on the dark grey weathered surface.

Thin-sections reveal an intense alteration of the minerals. Pale green hornblende and seal-brown biotite are the dark constituents.

Rounded inclusions stand out on the weathered surface of some lamprophyre dikes near McKenzie lake. The inclusions are from 1/2 inch to 2 inches in diameter (Plate IIIB). Similar pebble-like inclusions were noted by Auger (1952) in lamprophyres of the Belleterre area, northeast of the map-area.

Serpentinite

Two serpentinite dikes are known in the area. The smaller is about 250 feet wide and is found at the western limit of the map-area (McKenzie lake); the other is about 500 feet wide and is situated on the eastern border of the map-area (Girard lake).

Irregular shrinkage cracks are seen on the weathered surface, which is whitish, gray, or rusty brown in color. Fibrous asbestos is found in veinlets in the serpentinite near the eastern end of McKenzie lake.

The rock is very fine grained and is dark bluish grey on the fresh surface. A microscopic study shows that the primary minerals are completely transformed to serpentine, which is dotted with granules of magnetite. Secondary carbonate is a common accessory mineral.

The dike cuts the diorite and gabbro but its age relative to other intrusions is unknown.

Metasedimentary Rocks

The south part of the area is underlain by metamorphosed sedimentary rocks, which have been injected with granitic material. The contact between the metasedimentary rocks and the rocks of the central belt is characterized by a transitional zone, which was formed during the waning stages of the volcanic activity and at the outset of the marine sedimentation. This relationship is well illustrated by the rocks on the eastern shore of McNab lake, in Gaboury township, where the sequence from north to south is as follows: conglomerate, biotite paraschist, basic lava-flow, tuff, biotite paraschist.

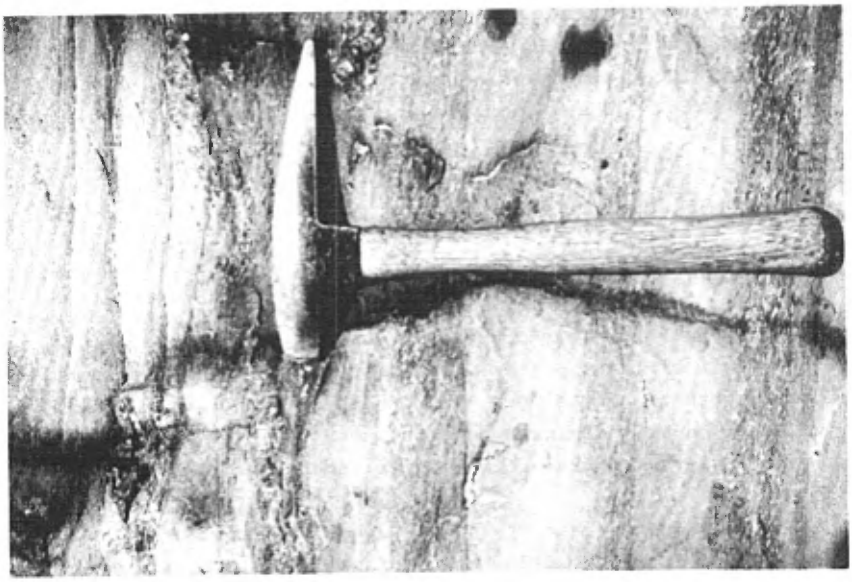
Most of the metamorphosed sedimentary rocks have been derived from graywackes. Graded bedding is the primary feature that can be observed locally. It is well displayed on the south shore of the pond that lies on the western border of the map-area and at the contact between the sedimentary and volcanic rocks (Plate IVA).

Biotite paraschist

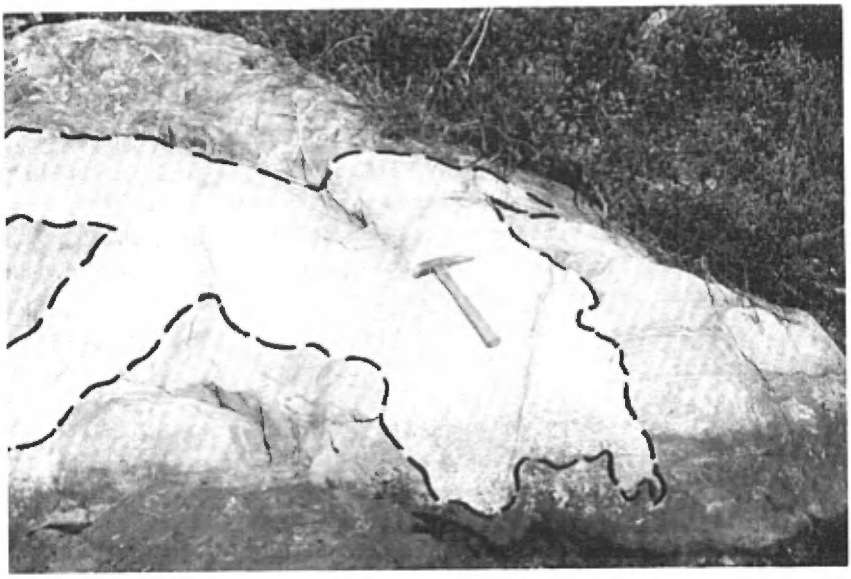
In most of the map-area the primary features, except the layering, are obscured by metamorphism and injection. A medium- to fine-grained, grey, biotite paraschist is the product of the regional metamorphism.

Slight compositional changes in the paraschist can be observed locally and are expressed by the various ratios of the dark minerals to the quartz-feldspar aggregate. Biotite is the predominant dark mineral, the subparallel flakes of which are oriented parallel to the primary layers of the sediments.

PLATE IV



A - Graded bedding in the paraschist, west border of the area.



B - Gray granite cuts the pillowed lava, Kelly lake, Blondeau township.

Varieties include a paraschist in which muscovite forms porphyroblastic plates. In some aluminous paraschists, fibrolite needles are mixed with muscovite. Garnet is fairly common and staurolite is present in places.

Garnetiferous biotite schist is found near Castor lake and occurs abundantly in the southwest corner of the map-area. The garnet forms 1 to 2 mm. large euhedra and is pink in hand specimen. It may form up to 8% of the rock. The garnet is pyralmandine and has physical properties as follows:

Index of refr.	N = 1.80
Density	D = 4.15
Unit cell edge	$\underline{a}$ = 11.5 Å

Staurolite may constitute up to 15% of the paraschist on the western limit of the map-area. This mineral is hardly noticeable on the weathered surface of the rock, but can be easily recognized on the fresh surface. Under the microscope, the staurolite has a goldish pleochroism, and a sieve texture with abundant inclusions of quartz.

In another variety of paraschist, chlorite, epidote, and amphibole are present instead of the aluminous minerals. Potassic feldspar is generally absent. Apatite and opaque minerals are accessory constituents.

The biotite paraschist east of Castor lake contains finely distributed magnetite, sufficient to cause magnetic anomalies.

Conglomerate

Conglomerate layers occur at several places near the base of the sedimentary formations. Two prominent localities, both east of McNab lake, are indicated on the map. The pebbles, up to 2 inches in diameter, are apparent on the weathered surface of the outcrops. They are elongated parallel to the schistosity of the adjoining paraschist and are slightly different in composition from the groundmass, which is composed of the same material as the paraschist.

Injected paraschist

The paraschist is complexly injected by pink granite. Most of the injection occurred along the plane of schistosity, in a lit-par-lit manner, but irregular mixing also occurs. The contacts between the metasedimentary rocks and the granite are sharp. Units where the injected material is from 25 to 75% are differentiated on the map, as injected paraschist, from those which are mainly granite or non-injected paraschist.

The injected pink granite is pegmatitic in places. It is leucocratic and contains some muscovite, and less commonly biotite.

Intrusive Rocks of the North Belt

Granodiorite and grey albite granite

There are three types of granitic rock in the north part of the area. A granodiorite and a grey, albite granite are genetically related, have similar hand-specimen characteristics and, therefore, were mapped as one unit. The third type is a pink, two-feldspar granite which is younger than the grey, granitic rocks, and is abundant only in Blondeau township, especially in range VI near the eastern border of the map-area.

The grey, granitic rocks contain abundant and, in places, large inclusions of rocks of the central belt, such as volcanic rocks and dark intrusive rocks. The contacts between the granitic and volcanic host rocks are usually sharp, but the contacts between the dark intrusive rocks and grey granite are often confused (see the section above on contact metadiorites p.16). Tongues and veins of granitic material have penetrated into the rocks of the central belt along the contact zone. Plate IVB, illustrates the relation between pillow lavas and grey granite.

The grey, granitic rock is coarse in grain. A gneissic texture is shown by the sub-parallel trails of bluish quartz which, being more resistant to the erosion than the feldspar, stands out on the weathered surface. Granulation can be seen in thin-sections, around the feldspar crystals. Some specimens resemble augen gneisses.

The major rock constituents are quartz and feldspar; the mafic minerals are biotite (6 to 15%); epidote (3 to 7%); chlorite (4 to 8%), and in some specimens, hornblende.

A considerable alteration of the minerals is seen in thin-sections. The plagioclase is sericitized, and relic polysynthetic twinning is recognizable. In the granodiorites the composition of the plagioclase is An_{28-32}, and is albite in the grey granite.

The younger, pink granite contains plagioclase and microcline and the tenor of K_2O is considerably higher than in the grey granites. The pink granite is also coarse in grain, and northeast of Allard lake a deformed variety with augen gneissic texture was found.

Late Precambrian Intrusions

Diabase

Dikes of diabase are found in the eastern part of range III in Gaboury township and in ranges IV, V and VI of Blondeau township. The dikes cut the rocks of the central belt and the grey, granitic rocks, and their unaltered nature suggests that they are relatively late Precambrian intrusions. All dikes strike northwest. On the outcrop surface the diabase is reddish brown and an ophitic texture is apparent in hand specimen.

The minerals of the diabase appear fresh in thin-sections. The plagioclase is well twinned labradorite. The main mafic mineral is a subcalcic augite with a moderately small (+) 2V. Magnesian olivine is a minor constituent. Biotite and magnetite are accessory minerals.

ECONOMIC GEOLOGY

A copper-nickel mine produced in the area from 1964 to 1968. Another sizeable copper-nickel deposit is known on the property of Conrego Nickel Mines Ltd. (formerly Cons. Regcourt), a subsidiary of Kelly Lake Nickel Mines Ltd. A variety of other minerals have been discovered. Their mode of occurrence is described below.

Asbestos

Fibrous asbestos is associated with the serpentinite body at McKenzie lake, near the east end of the lake. The serpentinite body is magnetically anomalous and, thus, may be outlined by a magnetite survey in areas covered by overburden. The interpretation of the magnetic anomaly east and south of McKenzie lake is difficult, owing to the presence of a band of magnetic iron formation at the southeast end of the lake.

The asbestos fibres were developed in the serpentinite as irregular veinlets (cross fibres), and along shear surfaces (slip fibres).

Iron

The extent of the magnetic iron formation in the area was described above. In the very fine-grained, layered rock the magnetite is completely mixed with cherty silica. Many of the magnetite anomalies of the area are caused by the magnetite iron formation and some of them have been drilled.

Tungsten

Scheelite occurs in range IV, lot 29 of Gaboury township. Here the outcrop of metavolcanic rock is cut by pegmatitic granite, in which the scheelite is found.

Copper and nickel

Sulfides of copper and nickel are associated with basic intrusive rocks at several places in the area. The mineralization is found at, or near, the contact between the metagabbro (or diorite), and the older, volcanic rocks. The sulfide mineralization and the associated intrusive rocks are massive, whereas the country rock is sheared, in most cases. The major occurrences of sulfide mineralization are described below.

Mining and Exploration

Lorraine Mining Co.

This company is a subsidiary of McIntyre Porcupine Mines Ltd. The company's property consists of 58 mining claims having an area of 3177 acres covering lots 44 to 52, range III, and the north halves of lots 44 to 52, range IV of Gaboury township, and extending onto range VI and parts of ranges V and VII of Blondeau township.

A surface showing of massive, sulfide mineralization, on lot 51, range IV, Gaboury township, was discovered by O'Brien Rivard in 1961. The above-mentioned property was optioned by the present owner from Mespi Mines Ltd. Geophysical surveys and diamond drilling were performed in 1963 and a shaft with six levels was completed during the summer of 1964. Production started in December 1964, with a mill capacity of 400 tons/day, and lasted until August 1968.

The orebody occurred at the contact of the altered metagabbro with sheared, dark, metavolcanic rocks. It was elongated parallel to the contact, striking N65^{o}E and dipping 70^{o} south. The massive sulfide lens had a length of 250 feet at the surface. A detailed account of the geology of the mine is given by Descarreaux (1967).

Chalcopyrite and pyrrhotite were the predominant minerals in the ore; the other opaque minerals noted in polished sections were pentlandite, violarite, marcasite, pyrite and magnetite. Traces of gold and silver were found with veins of quartz at the lowest level of the mine.

In the pre-production period an estimate indicated 550,000 tons averaging 1.57% Cu and 0.62% Ni. A total of 661,480 tons of ore were milled, yielding 11,956,819 lbs copper and 5,202,883 lbs nickel, as well as some silver and gold.

Exploration of the mining property east of the mine and underground continued during the years of production. Several small mineralized zones were discovered in the basic intrusive rocks east of the mine, in Blondeau township.

McIntyre Porcupine Mines Ltd.

Concurrently with the evaluation of the Lorraine Mining property, in 1963, McIntyre Porcupine Mines explored some ground around the Blondeau nickel showing south of Lett lake. Nine holes were drilled; most of them penetrated dark lavas. Some disseminated pyrite was found.

Kelly Lake Nickel Mines Ltd. (Conrego Nickel Mines Ltd)

This company took over Consolidated Regcourt Mines Ltd. by an exchange of shares. It holds the Regcourt copper-nickel deposit through a subsidiary, Conrego Nickel Mines Ltd. The deposit is located in Range V, Blondeau township, west of Kelly lake. Folded dark lavas, siliceous volcanic rocks and layered tuffaceous sedimentary rocks are complexly intruded by gabbro and diorite. The main zone of copper-nickel mineralization is exposed by trenches in gabbro, near the contact with siliceous volcanic rock.

The first work reported was done by Jellicoe Mining (1939) Ltd. A geophysical survey and drilling program were carried out in 1953. Work by Sapphire Petroleums Ltd is reported in 1955, and the property was transferred to Conrego Nickel Mines Ltd in 1956. Aeromagnetic, ground-magnetic and electromagnetic surveys, and 55,000 feet of diamond drilling were performed in 1956 and 1957. The exploration work was resumed in 1964, when further geophysical work and diamond drilling were carried out. The mineralized zone has an east-west elongation. It is about 35 feet wide and extends to a depth of 1,000 feet. The average grade of the mineralized material is estimated by the company to be 1.24% combined copper and nickel. The metallic minerals are chalcopyrite, pyrrhotite, pyrite, pentlandite and violarite. The tonnage indicated by the drilling has been estimated by Conrego Mines to be 1,250,000 tons.

New Blondeau Nickel Mines Ltd (Formerly Blondeau Nickel Mines Ltd)

Exploration by this company covered the area around Lett lake in Gaboury township. A group of 58 claims were explored by geophysical survey and diamond drilling. A copper-nickel showing south of Lett lake was tested by 24 drill holes in 1957. The sulfide mineralization is in the dark, intrusive rock, near the contact with lavas. Part of the company's property was transferred to McIntyre Porcupine Mines Ltd in 1963.

Sapphire Petroleum Ltd (Cabol Enterprises Ltd since 1962)

The company owned 68 claims east of Lett lake (parts of Blondeau Nickel and Conrego properties). A geophysical survey covered the area and several anomalies were tested by diamond drilling. The Jellicoe (later Conrego) showing and the Roy showing were tested in detail by drilling and trenching in 1955-56.

Temiscamingue Metals Ltd

In 1952, this company conducted a geophysical survey and drilled 5 holes on a property of 30 claims, located around Bois lake and including some of the water area of the lake. Two holes were drilled on lot 45, south of range line IV/V, where massive pyrite contains traces of Cu. The third hole is south of the southern arm of Bois lake. Here the paraschist is sheared and contains secondary quartz. No mineralization of economic importance was found. Parts of the property were transferred to Consolidated Tungsten Mining Corporation, Delhi Pacific Mining Co. and Silvermaque Mining Co.

Consolidated Tungsten Mining Corporation
(Mount Wright Iron Mines Co. Ltd since 1958)

In 1957, the company continued the exploration of part of the area that was acquired from Temiscamingue Metals Ltd. A geophysical survey was conducted and five holes were drilled into geophysical anomalies. Most of the drilling intersected magnetic iron formation.

Silvermaque Mining Ltd

The area south of Bois lake, on both shores of the southern arm of the lake, was covered by magnetic and electromagnetic surveys in 1962. Two holes were drilled into an anomalous zone and encountered a band of magnetic iron formation.

Delhi Pacific Mines Ltd

In 1963, the company conducted a geophysical survey east of Bois lake. Two magnetic anomalies were tested by diamond drilling in 1964. The drill holes intersected magnetic iron formation.

SOQUEM

SOQUEM explored 3 groups of claims in the area in 1966-67. One group is located northeast of Ménard lake, where dark lavas contain bands of magnetic iron formation. A second group, straddling the boundary between Gaboury and Blondeau townships, is south of Pins lake. Here some pyroclastic material is interlayered with dark lavas. The third group of claims, in Blondeau township beyond the southern limit of the map-area, is underlain by injected paraschist. Some magnetic electromagnetic anomalies were checked by pack-sack drilling.

The claim area northeast of Ménard lake was previously investigated by McIntyre Porcupine Mines Ltd. Some sulfide mineralization, mainly pyrite and pyrrhotite, was found. Assay results indicated low copper-nickel values.

Terrex Mining Co. Ltd

In ranges IV and V, lots 36 to 43 of Gaboury township were covered by a geophysical survey in the spring of 1968. The claims, with the exception of lot 43, range V, were still in good standing in 1969.

Acme Gas and Oil Co. Ltd

This company explored an area of 55 lots and 4 half-lots in ranges III and IV of Gaboury township. A geophysical survey was done during the winter of 1965-66. Two diamond drill holes intersected a zone of minor pyrite-pyrrhotite mineralization.

Quewest Mining Corp.

Part of the serpentinite body at the east end of McKenzie lake (Gaboury township) was explored in 1963. A magnetite survey outlined the asbestos-bearing ultramafic body. A diamond drill hole, drilled to a depth of 163 feet, cut several veins containing chrysolite.

Belleterre Quebec Mines Ltd

The company owned 20 claims north of Coeur lake, part of which now belongs to Lorraine Mining Co. The work on the property included geological mapping, geophysical survey, trenching and one diamond drill hole. Spotty sulfide mineralization, with minor chalcopyrite in vein quartz, was intersected.

Nealon Mines Ltd

In 1957, the company conducted exploration over an area located west and south of Ménard lake. Six holes were drilled, but no significant mineralization was found. Parts of the property were acquired by Blondeau Nickel Mines Ltd and by Soquem.

Consolidated Golden Arrow Mines Ltd

A group of 14 claims straddling the Gaboury and Blondeau township line was explored by geophysical survey. In 1963, two holes were drilled across an electromagnetic anomaly.

McWatters Gold Mines Ltd

The company held 39 claims near the centre of Blondeau township, adjoining Lorraine Mining property. Most part of the claim area is underlain by grey granitic rocks. A geophysical survey in 1963 did not reveal any anomaly.

Lamaque Gold Mines Ltd

The company conducted a geophysical survey on claims south of Girard lake in 1954. No further work has been reported.

Feindel and Brookbank claims

In 1952, two holes were drilled on claims located between Kelly and Allard lakes. The holes penetrated metagabbro.

Lavallee claims

Near range line I/II, on lots 39, 40, 41 of Gaboury township, the bedrock is sheared. Quartz has been introduced into a sheared zone, which is up to 15 feet wide. Pyrite and some copper stain are visible in the vein quartz. Random samples contained up to 0.11% Cu and 0.05 ounce of gold per ton.

Petosa claims

On range IV of Gaboury township an occurrence of sheelite has been known for many years. This mineral is associated with coarse granitic pegmatite which cuts sheared dark volcanic rocks. The outcrops around the occurrence have been explored by stripping and blasting. The central part of lot 29 was intensively prospected in 1954.

Phillane Exploration and Development Ltd (Defunct company)

In 1957, a group of 45 claims were explored by the company. A magnetic survey covered the ground around the outlet of Allard lake to Grassy lake.

GEOCHEMICAL SAMPLING

Samples from stream sediments were collected during the traverses and were analyzed for trace elements. Because of the scarcity of streams and the abundance of clay in the glacial deposits, stream sediment sampling is not a very effective method of exploration in the area. Results are shown on the map.

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