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NORTH HALF OF OBALSKI TOWNSHIP, ELECTORAL DISTRICT OF ABITIBI-EAST

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BERTRAND-T. DENIS, Chief

GEOLOGICAL REPORT 71

NORTH HALF
of
OBALSKI TOWNSHIP

ELECTORAL DISTRICT

of

ABITIBI-EAST

by

R. BRUCE GRAHAM



QUÉBEC

REDEMPTI PARADIS

PRINTER TO HER MAJESTY THE QUEEN

1956

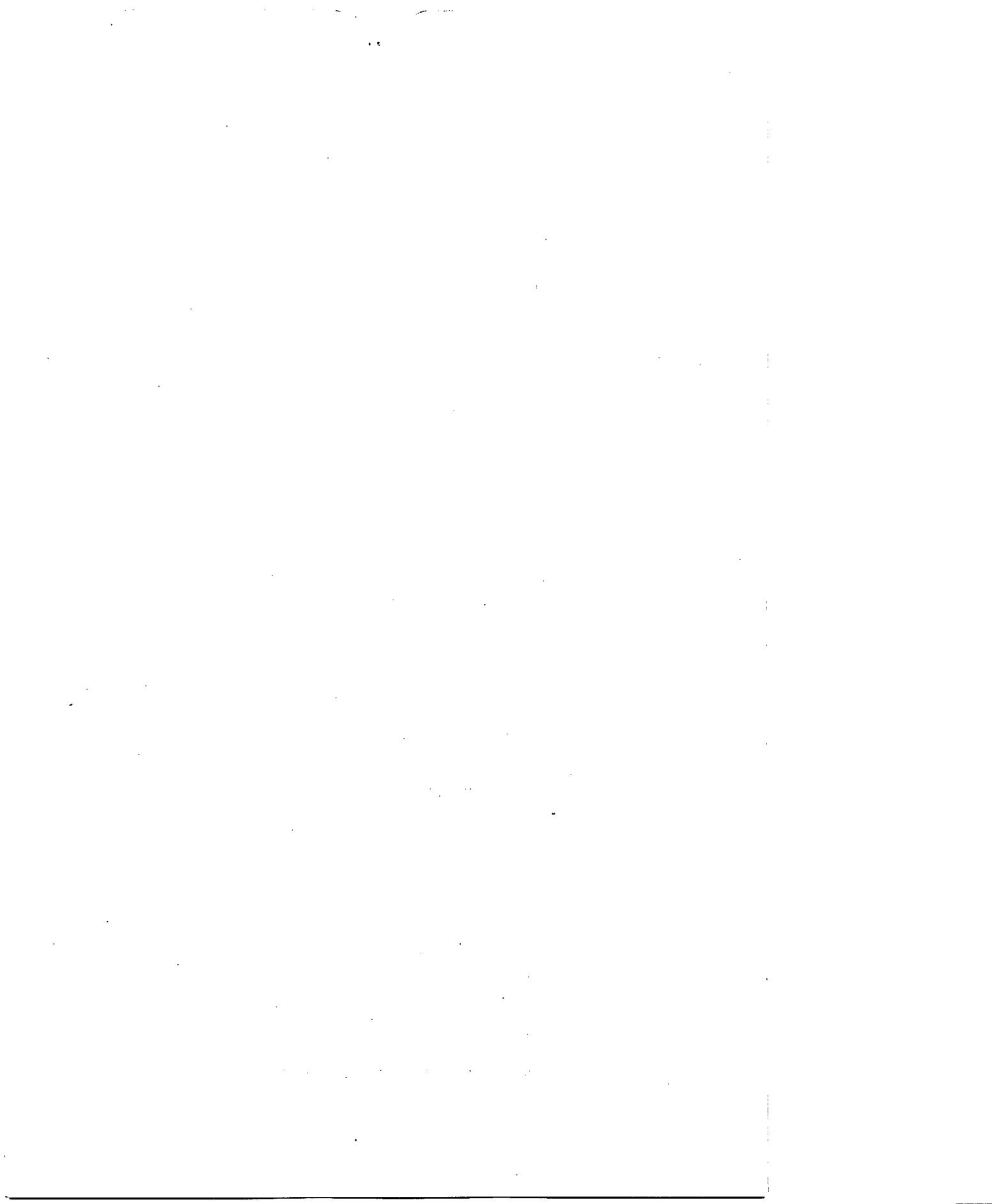


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MAPS

North Half of Obalski Township

- Map No. 1091 - West Part (In pocket)
 Map No. 1092 - East Part (In pocket)

NORTH HALF OF OBALSKI TOWNSHIP

Abitibi-East County

by

R. Bruce Graham

INTRODUCTION

General Statement

Obalski township lies in the northeast corner of Abitibi-East county, 300 miles north of Montreal. The northwest corner of the township is at latitude $49^{\circ}53'N.$ and longitude $74^{\circ}28'W.$ The area mapped is situated just north of the height of land between the St. Lawrence river and James bay. It lies in the drainage basin of Chibougamau and Doré lakes. There is little relief, except for a few isolated hills and ridges, the highest of which attains a height of about 450 feet above Doré lake and separates Caché lake from Cachée bay in Doré lake. Other hills are found at the north end of Merrill island, and on Gouin peninsula just south of Merrill island. The rocky ridges in the northwest corner of the map-area mark the beginning of the more rugged topography north of Doré lake.

The low lying regions are covered with muskeg out of which project small ridges oriented in the direction of the ice movement and ovoid in outline. These consist of poorly sorted to unsorted clay, sand, gravel and boulders.

Both the hills and valleys are covered by a thick forest growth of spruce, jack pine, balsam, cedar, tamarack, birch and poplar.

The lake bottoms are covered with sand and gravel and the lake waters are clear. Doré and Chibougamau lakes contain numerous shoals and reefs consisting of bed rock or submerged ovoid gravel ridges. In places, however, they reach depths of 80 to 90 feet. The maximum recorded depth in Chibougamau lake is 192 feet.

Chibougamau and Caché lakes drain into Doré lake. Doré lake drains to the southwest by way of Chibougamau river, its water eventually reaching James bay.

The area is easily reached from St. Félicien by the Chibougamau highway, which traverses the western part of the map-area. The eastern part is accessible by canoe from Doré and Chibougamau lakes.

In 1903 Peter McKenzie discovered asbestos on Asbestos island, to the northeast of the present area, and gold, copper and iron in the surrounding region. The Merrill Island deposit was discovered in 1920, Campbell Chibougamau in 1922, Obalski in 1928, and Kayrand and Quebec Chibougamau Goldfields in 1950. The Chibougamau highway, built by the Quebec Department of Mines, was completed in 1949.

Field Work

The base map was prepared from aerial photographs at a scale of 1 inch equals 1,000 feet. The geology was mapped by pace and compass traverses or by traverses along picket lines where these were present. The traverse interval was varied to suit the complexity of the geology and the amount of rock exposure.

A preliminary map of the northwest quarter of Obalski township (Map No. 878) was published on a scale of 1 inch equals 1,000 feet (1)*. The maps which accompany the present report (Maps Nos. 1091, 1092) are also on a scale of 1 inch equals 1,000 feet.

Acknowledgments

The writer gratefully acknowledges the courtesy and cooperation of those in charge of mining exploration and development within the area. R.P. Mills and J.H. Morgan of Quebec Smelting and Refining Ltd., Royran Gold Fields Ltd. and Kayrand Mining and Development Company Ltd., L. Oughtred and R. Dallaire of Merrill Island Mining Corporation Ltd., S.A. Malouf and D. Giauque of Campbell Chibougamau Mines Ltd., P.M. Malouf and R. Bellemarre of Quebec Chibougamau Goldfields Ltd., H.E. Corbett and C. Goddard of Jaculet Mines Ltd. and Taché Lake Mines Ltd., J. Harris of Wright Hargreaves Mines Ltd., and J. Kyle of O'Leary-Malartic Mines Ltd., aided the writer whenever possible and were free with information regarding their respective properties.

R. Smith in 1950 and S. Jenness in 1951 ably performed their duties of senior assistants. F. McGowan and M. Couture in 1950, and G. Fortin, P. Bate and E. Legendre in 1951, performed the duties of student assistants in a capable and satisfactory manner. All of the samples taken by the writer were assayed in the laboratories of the Quebec Department of Mines.

*References are at the end of the report.

Previous Work

The first published report of the geology in the region was that of Richardson in 1872 (2). This work was followed by examinations by Obalski in 1904 (3) and 1905 (4), Low in 1905 (5) and Dulieux in 1908 (6). The work of the Chibougamau Commission followed in 1910 (7). Mawdsley in 1927 (8) and Retty in 1929 (9) carried out geological investigations to the north, west and south of the present map-area. In 1934 Mawdsley and Norman (10) mapped the geology of the Chibougamau sheet and in 1935 and 1936 Norman extended the mapping to the west (11, 12).

GENERAL GEOLOGY

The consolidated rocks in the area are all of Precambrian age. They are predominantly intrusives, of compositions ranging from acid to basic. A subordinate amount of volcanics and related intrusives underlie the northwest part of the area. Dykes of diabase are believed to be the youngest intrusive rocks in the area.

Table of Formations

Pleistocene		Boulders, gravel, sand, clay	
Major Unconformity			
Precambrian	Faulting		
		Diabase	
	Intrusive Contact Faulting		
		Diorite and gabbro dykes Grey feldspar porphyry dykes and grey fine-grained quartz diorite dykes	
	Intrusive Contact Faulting		
	David Lake Group	Pegmatite Quartz porphyry Granite Granodiorite Quartz diorite Younger diorite	Quartz gabbro
	Intrusive Contact		
	Doré Lake Group	Anorthosite Fine-grained gabbro Older diorite Porphyritic gabbro Gabbro, pyroxenite, amphibolite, magnetite formation	Gabbro- anorthosi- te transi- tion zone
	Intrusive Contact		
	Volcanic Rocks	Andesite, basalt, tuff, flow breccia	

Volcanic Rocks

The volcanic rocks are confined to the northwestern part of the area. At the northwest corner, they outcrop across a width of 1 mile and are part of a volcanic sequence which extends to the north beyond the map-area. These formations have a regional strike of a few degrees north of east. The volcanics consist of fine-grained dark green to medium green flows, some of which are separated by flow breccia, tuff and agglomerate. Also present are dykes and sills of related rock believed to be contemporaneous with the igneous activity which accompanied the formation of the volcanic complex.

The colour is controlled by the proportions of fine albite, carbonate and chlorite present. Near shear zones, the carbonate content increases and lenticular aggregates of quartz grains are present. These are in part parallel to the schistosity. Flow structures and amygdules in the lavas are locally present. Pillow structures were noted just east of the Chibougamau road. Flow breccia was observed in the northwest corner of the area and in the exposures on the road to the Obalski mine, a half mile east of the Chibougamau highway. The fragments are sub-angular to rounded, and range between 2 and 6 inches in diameter. They are of basaltic composition and are enclosed in a fine-grained basaltic matrix. The fragments generally weather a lighter colour than the matrix.

Only one exposure of tuff was observed. It is a fine-grained, carbonatized, schistose rock. The outcrop is located 1 mile east of the northwest corner of the map-area.

Intrusive Rocks

Intrusive rocks underlie the major part of the area. They have been divided into two groups: an older quartz-poor group and a younger more acid quartz-rich group. The older group is termed the Doré Lake group and the younger the David Lake group.

Doré Lake Group

The Doré Lake group consists of gabbro (containing local concentrations of disseminated titaniferous magnetite and segregations of pyroxenite and amphibolite), porphyritic gabbro, older diorite, fine-grained gabbro, and anorthosite.

Gabbro

An outcrop of gabbro 1 1/2 miles wide extends from Cachée

bay through Caché lake to the south boundary of the map-area. Other exposures are found north of Caché lake and near the north boundary of the map-area. Gabbro of similar appearance was also observed just southwest of Half Moon lake. An altered phase of the gabbro is shown on the map as a separate unit and is described under the heading of Quartz Gabbro in the David Lake group (p.12).

The gabbro is coarse grained and weathers brown to dark green. It consists essentially of plagioclase, amphibole and pyroxene. The relative amounts of these constituents vary considerably from place to place. Consequently, there are local segregations of amphibolite and pyroxenite. Amphibolite is found on the large hill just east of the north end of Caché lake, whereas pyroxenite is most common along the west side of the gabbro intrusive mass west of Caché lake. The amount of feldspar present in the gabbro is variable, but rarely exceeds 30 per cent. Segregational banding is common. The banding consists of alternating feldspar-rich and ferromagnesian-rich layers up to 2 feet wide. It is best developed along the east side of the gabbro mass.

Examined under the microscope, the plagioclase was found to be considerably altered, the composition ranging from albite to andesine. The least altered plagioclase is albite. Its association with highly clouded more basic plagioclase suggests that it has recrystallized from the more basic plagioclase. The hornblende is pleochroic from yellowish green to bluish green and is altered to chlorite and in a few places to biotite. Titaniferous magnetite makes up 5 to 10 per cent of the rock and occurs as euhedral grains surrounded by hornblende, or by carbonate, epidote and zoisite, as lamellae along cleavage planes in hornblende, and as fine dust-like inclusions in hornblende and altered plagioclase. A few grains of augite were noted, occurring interstitially between a group of magnetite anhedral. Locally, quartz and apatite have been introduced and the hornblende has been redistributed as veinlets cutting aggregates of plagioclase and hornblende. All specimens examined show some evidence of introduction of quartz and apatite minerals or redistribution of existing minerals.

A band of magnetite-rich gabbro lies between Caché and Doré lakes adjacent to the contact between gabbro and anorthosite. This formation will be described in the section on economic geology.

Porphyritic Gabbro

Porphyritic gabbro occurs adjacent to the south margin of the volcanic rocks in the northwest corner of the area, as dykes in the volcanic formations at the north boundary of the area 1,100 feet east of the Chibougamau road and as apophysis-like bodies in gabbro in the

southwestern part of the area. Its relationship with other members of the Doré Lake group is not clear, as no contacts were found. The body in the southwestern part of the area is cut by diorite and granite of the David Lake group and by a diabase dyke.

The porphyritic gabbro is fine to coarse grained and grey black in colour. The fine-grained variety has well defined phenocrysts of feldspar up to 1/2 inch in length. In the coarse-grained variety the phenocrysts are larger - up to 1 inch in size - but rounded and irregular in outline. The latter variety occurs adjacent to the south margin of the volcanic rocks in the northwest corner of the area and may represent a distinct rock type.

In thin section, the feldspar phenocrysts are seen to consist of a matted aggregate of opaque saussurite. The groundmass is an aggregate of hornblende, chlorite, epidote, clinozoisite and a little carbonate, euhedral apatite and magnetite. Some clear andesine is also present in the groundmass.

The gabbro in the northwestern part of the map-area also contains phenocrysts of what appears to be highly altered hornblende. These phenocrysts contain rods of magnetite. Similar phenocrysts were not observed in the porphyritic gabbro elsewhere, which supports the possibility of this being a type distinct from the fine-grained porphyritic gabbro.

Older Diorite

Older diorite is so named to distinguish it from the diorite of the David Lake group. The largest body of older diorite occurs as a boss intruding the gabbro just west of Caché lake and elongated in the same direction as the gabbro. It has been traced for a length of 8,000 feet and a width of 3,000 feet. Apophyses and dykes occur on the peninsula in Caché lake and some were found east of the lake. The contacts are gradational, suggesting that the two rock types are closely related genetically. The relationships are best seen on the rocky hill between Caché and Gladstone lakes. Dykes of diorite branch out from the main mass and transect the segregational bands in the gabbro. The dykes have sharp contacts and are notably finer grained along their borders than in the central part. One of these dykes was observed to grade into a granodioritic phase. This apparently represents an extreme phase of differentiation within the older diorite-gabbro complex.

The older diorite weathers brownish grey to green. On the fresh surface it is greenish grey to green. It is massive, medium-coarse grained and has a granitic texture. It consists essentially of

grey feldspar and hornblende. The feldspar makes up 30 to 50 per cent of the rock. It is highly saussuritized and has the approximate composition of andesine. Magnetite is a characteristic accessory mineral. A few grains of quartz are locally present.

Fine-Grained Gabbro

Fine-grained gabbro outcrops along the northwest side of the main mass. It is massive, heavy and compact. The fresh surface is greenish black and the weathered surface is grey. The rock consists of up to 35 per cent feldspar which occurs as tiny flecks and needles. In thin section, some of the feldspar was found to be too highly saussuritized to be identified; but fresh grains of albite were also present. Surrounding the feldspar is a dense mat of hornblende, chlorite, epidote and clinozoisite. Titanite is also present and magnetite is a consistent secondary mineral. Some introduced quartz is locally present, especially in specimens from the vicinity of the Obalski shaft.

Uniformity of grain size and of texture is a characteristic of this rock and it is easily confused with the more massive phases of the basic lava. Where the fine-grained gabbro and the lava lie in proximity, as they do in the northern part of the area just east of the Chibougamau road, it is not always possible to distinguish between the two.

The contacts between the fine-grained gabbro and the main gabbro mass are sharp; also, dykes of fine-grained gabbro cut the coarse-grained gabbro. These relationships are best seen just east of the north end of Caché lake, but have also been observed in several other localities. They indicate that the coarse-grained gabbro had crystallized before the introduction of the fine-grained gabbro.

No contacts were found between fine-grained gabbro and older diorite. However, since the older diorite is considered to be contemporaneous with the coarse-grained gabbro (p. 6), it is therefore inferred to be older than the fine-grained gabbro.

Despite the evidence of differences in age, the close similarity in mineralogy of the gabbro, the porphyritic gabbro, the older diorite and the fine-grained gabbro, and the appearance of magnetite in all of them, suggest that nevertheless these rocks are closely related genetically.

Anorthosite

The anorthosite within the area is part of the north limb of a large horseshoe-shaped mass which curves around the northeast end of

Chibougamau lake (13, 14 Map No. 882). On the fresh surface the anorthosite varies from light grey to white. The weathered surface is grey, buff or reddish brown. The grains vary from medium to coarse. A distinct brecciated structure is present in much of the anorthosite within the map-area. The fragments consist of aggregates of altered plagioclase in a chloritic matrix. Isolated altered subhedral plagioclase crystals also occur in the matrix and locally impart a porphyritic appearance to the rock. In the areas of freshest anorthosite, which are mainly in the northeast corner of the map-area, the rock is greyish blue and coarse grained. The feldspar displays plagioclase twinning. Some white phases, in which the feldspar also displays plagioclase twinning, are present in these areas.

The freshest specimen examined under the microscope was a coarse-grained granitic aggregate consisting of about 85 per cent clear subhedral twinned andesine containing scattered shreds of white mica. Some of the laths of andesine are fractured and brecciated. A later untwinned variety of andesine occurs as veins in the twinned variety and as finer-grained interstitial subhedral grains. The remainder of the rock consists of flakes of chlorite occurring in the interstices and in the andesine, a few grains of quartz in the andesine, and scattered grains of epidote and leucoxene. No plagioclase more basic than andesine was observed in any of the anorthosite specimens examined in thin section, but Mawdsley and Norman (10, p. 28) identified labradorite locally veined with andesine. Generally, the plagioclase has been altered to zoisite, clinzoisite, white mica or saussurite, and oligoclase. Pseudomorphic albite twinning is present in some of the zoisite. The altered plagioclase occurs as aggregations and as isolated anhedral.

The groundmass consists of white mica, chlorite, untwinned oligoclase, epidote, clinzoisite and a little quartz and carbonate. Magnetite, titanite and leucoxene are characteristic but sparse accessories. A few aggregates of anthophyllite were noted in some sections. The proportions of the different minerals in the groundmass vary from place to place. In some sections the groundmass consists of a mat of white mica or chlorite. The chlorite is a colourless variety with a characteristic olive yellow interference colour. The groundmass generally comprises 5 to 25 per cent of the rock, but may in the extreme comprise 50 per cent. In general, when the groundmass exceeds 10 per cent, the rock has the brecciated appearance previously described.

The plagioclase aggregates have been fractured and broken and the fractures are filled with groundmass material. Chlorite and white mica occur as veinlets in which the minerals are bladed and have a sub-parallel to parallel orientation. This contrasts markedly with

the usual mat-like texture of the groundmass and suggests redistribution of the original chlorite contained in the anorthosite.

A few segregations of pyroxenite and gabbro, some of which contain noteworthy amounts of magnetite, occur in the anorthosite. Most of them are less than 20 feet in diameter.

The contact between the gabbro and the anorthosite which lies to the east of it is well exposed north of the creek joining Caché lake with Doré lake. The only contact exposed south of the creek is near the southern limit of the area. Between these exposures the contact has been located approximately by means of 3 dip needle traverses spaced 1,500 feet apart. This contact is in general conformable to the elongation of the gabbro and to the strike of the segregational banding in the gabbro. The contact between the older diorite and the anorthosite, which lies just east of Gladstone lake, is everywhere obscured by drift. Such evidence as was found indicated that it too is conformable.

Gabbro-Anorthosite Transition Zone

A transition zone, which varies in width from a few feet up to 700 feet, separates the gabbro from the anorthosite. The anorthosite of the transition zone contains grey aggregates of plagioclase which have been altered to epidote and clinozoisite. These aggregates, which are irregular in outline, in places attain a length of 6 inches. They comprise approximately 90 per cent of the rock. The groundmass is fine grained and greenish-grey in colour. It consists predominantly of chlorite containing a considerable amount of epidote and clinozoisite. This variety of anorthosite contains schlieren-like areas of gabbroic material. The transition from anorthosite to gabbro takes effect through a progressive decrease of epidote-zoisite and an increase in the amount of chlorite and the presence of hornblende and of titaniferous magnetite in the groundmass of the anorthosite. In the more gabbroic parts of the transition zone the hornblende which, in the normal gabbro, occurs as well defined anhedral and subhedral, has the form of shredded and ragged relicts of plates and prisms. Much of the hornblende has been altered to a felted mass of fine-grained chlorite. The titaniferous magnetite for the most part is grouped into rod-like skeletal aggregates, some of which form a hexagonal outline. The interstices between the rods are filled with a semi-opaque aggregate of epidote, leucoxene and chlorite. A few residual grains of hornblende occur in these magnetite aggregates. A little titanite is also present. The irregularly shaped aggregates of epidote and clinozoisite contain abundant shreds of chlorite, especially around their margins. Similarly, epidote and clinozoisite occur in the chloritized hornblende. Veinlets of carbonate and chlorite containing some apatite also occur.

The alteration of the ferromagnesian constituents of the gabbroic material in the transition zone, and the mutual occurrence of inclusions of chlorite in the epidote-clinozoisite aggregates and of epidote-clinozoisite aggregates in the chloritized hornblende, suggests alteration within a transition zone already formed rather than a contact metamorphic effect produced when one rock intrudes another. From the evidence observed, therefore, it would appear that this zone represents a true transition phase between gabbro and anorthosite derived from the same magnetite-bearing basaltic magma.

An apophysis of transition rock occurs in gabbro 2,000 feet north of the south boundary of the area and 700 feet west of the gabbro - anorthosite contact. An apophysis of anorthosite occurs in quartz gabbro just north of the west end of Cachée bay. A dyke-like body of anorthosite cuts transition rock 1,000 feet north of the central part of Cachée bay. Two dykes of anorthosite cut the older diorite just east of Gladstone lake. These relationships may be accounted for in part by the level of erosion with respect to the upper contour of the anorthosite - gabbro contact and in part by the injection of anorthosite into the surrounding rock during later movements in the anorthosite.

David Lake Group

Included in the David Lake group is the granite north and east of David lake, the granite that underlies the southern part of Doré lake and most of Chibougamau lake, and related younger diorite, quartz diorite, granodiorite, quartz porphyry and pegmatite marginal to these granites. Quartz gabbro is also included in this group.

The relative ages of these rock types are, from oldest to youngest, younger diorite, quartz diorite, granodiorite, granite and pegmatite. The quartz porphyry was not found in contact with the other rocks of this group, but it is probably intermediate in age between the granite and the pegmatite.

Younger Diorite

The younger diorite, with which is associated quartz diorite, occupies a wedge-shaped zone between the anorthosite and the granite in Chibougamau lake and on Gouin peninsula. It apparently represents a border phase between the granite and the anorthosite. The zone is broadest at the east boundary of the map-area, where it is 8,000 feet wide. It narrows towards the west, pinching out between Gouin peninsula and Lefebvre island in Doré lake. A second body of diorite underlies the western part of Gouin peninsula in the south central part of the map-area. It too separates granite from anorthosite.

The diorite weathers grey, brownish grey and greenish grey. It is medium to coarse grained with a granitic texture. It may be distinguished from the older diorite by its consistently lighter colour, due to the smaller proportion of ferromagnesian constituents. The plagioclase is altered for the most part to saussurite. The least altered plagioclase is sodic andesine. Epidote, as subhedral grains and veinlets, biotite, and chlorite altering from biotite, along with the andesine, are the major constituents of the rock. Apatite, magnetite, titanite, leucoxene and pyrite are characteristic accessory minerals. The pyrite is locally altered to hematite around its margins.

Dykes of granite and fine-grained diorite cut the younger diorite. Along the contact of the diorite and anorthosite, inclusions of anorthosite occur in the diorite and dykes of diorite cut the anorthosite.

Quartz Diorite

Quartz diorite lies along the north side of the granite which outcrops to the south and west of Half Moon lake. A smaller body outcrops just to the north of Cachée bay and another in the gabbro mass 1,000 feet east of the north end of Caché lake. Quartz diorite also occurs as dykes and apophyses in the younger diorite zone associated with the granite in Chibougamau lake and on Gouin peninsula. These bodies of quartz diorite are cut by dykes of fine-grained diorite, granodiorite and granite.

The quartz diorite weathers light grey to brownish grey. On the fresh surface it is light grey to dark greenish grey. The texture is coarse grained and granitic. This rock consists of quartz, feldspar and ferromagnesian minerals. The quartz content varies between 10 and 20 per cent and the feldspar content, between 20 and 50 per cent. The feldspar is grey, but in places it has a pinkish tint. It varies in composition from albite to sodic andesine. Chlorite is the ferromagnesian constituent. Carbonate, pyrite, titanite, leucoxene, sericite, apatite and zircon are minor constituents.

Granodiorite

Granodiorite occurs as small apophyses in the quartz diorite which lies north of Cachée bay and adjacent to the granite in the vicinity of Half Moon lake. It weathers light grey, is coarse grained and has a granitic texture. The feldspar is pinkish grey. Together with the quartz, it comprises 50 to 70 per cent of the rock. The remaining constituents are ferromagnesian minerals.

Granite, Quartz Porphyry, Pegmatite

The southeast part of the map-area and a smaller area south and west of Half Moon lake are underlain by granite. Granite also occurs as dykes and small apophyses in gabbro and older diorite around Caché lake and as dykes in anorthosite adjacent to the west shore of Doré lake in the southern part of the map-area. A granite boss is exposed along the shore for 400 feet at the north side of Merrill island. A few pegmatite stringers were found cutting the granite. Some dykes of fine-grained quartz porphyry cut the volcanic rocks on the shore of the small lake on the north boundary of the area 1,200 feet east of the Chibougamau highway.

The granite in the southeast part of the area is part of a large northeasterly-trending body which divides the anorthosite into two limbs, extending across Doré lake and Chibougamau lake into Roy and McCorkill townships.

The granites of the David lake group are characterized by a high quartz content, varying between 25 and 40 per cent, and a low ferromagnesian content, varying between 5 and 15 per cent. A grey granite with a high quartz and low ferromagnesian content predominates. Subordinate varieties are a pink and a medium-grained light grey variety. The feldspar is oligoclase and albite oligoclase. Orthoclase was identified in one section. Chlorite is the dominant ferromagnesian constituent; in the least altered specimens it was observed to be an alteration of biotite. Muscovite is present in small amounts. Apatite is a universally present accessory. Clinzoisite, epidote, zircon, allanite, titanite, leucoxene, magnetite and pyrite are minor constituents. In almost every specimen examined in thin section some of the quartz has been introduced.

Quartz Gabbro

Quartz gabbro outcrops as a northerly-trending elongated irregular mass west and north of Caché lake. Another body of quartz gabbro lies along the north side of the granite which outcrops in the vicinity of Half Moon lake. East of Half Moon lake the bedrock is obscured by drift. It is possible that the quartz gabbro east of the Chibougamau highway and that near Half Moon lake are one continuous sill-like body.

The quartz gabbro is similar in appearance to the gabbro of the Doré Lake group (p. 4), except for the presence of abundant quartz, which comprises up to 20 per cent of the rock in grains from 1/16 inch to 1/8 inch in size.

The specimens examined in thin section contain 25 to 35 per cent quartz; andesine and chlorite account for the remaining 65 to 75 per cent. The andesine is in places largely altered to saussurite and in others cut and replaced by quartz. A few myrmekitic intergrowths of quartz and andesine were noted. In general, the quartz cuts the andesine and locally replaces it. The original amphibole of the gabbro has been completely altered to chlorite. The chlorite occurs interstitially between the quartz and plagioclase, as ribbons between quartz and plagioclase, filling fractures in the quartz and replacing the plagioclase. Apatite is an accessory mineral and leucoxene, sericite, titanite and carbonate are minor constituents.

Quartz cuts and replaces andesine, indicating that it has been introduced. The chlorite occurs in fractures in the quartz as well as in the andesine, indicating that, although the chlorite may not have been introduced, at least it has been redistributed. This redistribution probably took place during the introduction of quartz into the gabbro.

A contact between fine-grained gabbro of the Doré Lake group and quartz gabbro is exposed 2,000 feet north of the west end of Cachée bay. Here quartz occurs in the fine-grained gabbro, gradually fading out away from the quartz gabbro. No conclusions have been drawn from this relationship.

Contacts between quartz gabbro and fine-grained gabbro are sharply defined by the difference in grain size between the two rocks. However, quartz grains extend beyond the contact into the fine-grained gabbro, gradually fading out with distance from the contact. A similar relationship holds between quartz diorite of the David Lake group and gabbro of the Doré Lake group. In this case there is a zone of quartz gabbro between the quartz diorite and the gabbro. A contact of this type was observed 3,000 feet south of Cachée bay. Here, as elsewhere, the position of the contact is established by the presence or absence of quartz.

The relationships noted above indicate that the quartz was introduced along zones in the Doré Lake gabbro and to a lesser extent into adjacent formations. This introduction of quartz is substantiated by thin section examination. If this is the case, the quartz gabbro is of metasomatic origin, probably having been formed during the period of intrusion of the David Lake group, and can be regarded as having originally been part of the gabbro of the Doré Lake group. The source of the quartz was probably the granitic magma of the David Lake group. Several bosses and apophyses of quartz diorite and granodiorite which outcrop around Cachée bay indicate that granitic rocks underlie this area at no great depth. The quartz gabbro is well developed here as well as adjacent to the granite and quartz diorite south of Half Moon lake.

Later Dykes

Dykes of grey feldspar porphyry and grey fine-grained quartz diorite as well as diorite and gabbro cut the David Lake and Doré Lake groups. The grey feldspar porphyry and grey fine-grained quartz diorite dykes are similar in composition to the granite in the vicinity of Doré and Chibougamau lakes. Subsequent to the intrusion of the Doré Lake group, there was a period of faulting which was followed by the intrusion of the above dykes. They thus represent a distinct period of intrusion, although they are possibly genetically related to the granite. The gabbro and diorite dykes are younger than the grey feldspar porphyry and the grey fine-grained quartz diorite dykes.

Grey Feldspar Porphyry Dykes and

Grey Fine-Grained Quartz Diorite Dykes

The above dykes are widespread in the anorthosite, especially in the vicinity of Doré lake. They have a regional northwest trend and commonly lie along shear zones. These dykes dip vertical to steeply northeast or southwest and are up to 50 feet wide.

The dykes of grey feldspar porphyry are fine grained and light grey in colour. They contain lath-like feldspar phenocrysts, up to 1/2 inch in length, having subhedral outlines. The phenocrysts of the grey feldspar porphyry are for the most part too altered for identification. In only two specimens were the feldspar phenocrysts identified and they were found to be oligoclase. For the most part, they are altered to saussurite or an aggregate containing varying amounts of white mica, carbonate, quartz, epidote and clinozoisite. The groundmass consists of an aggregate of fine-grained plagioclase, quartz and chlorite. The composition of the plagioclase varies between albite and oligoclase. Other minerals present in varying amounts are white mica, epidote, clinozoisite, carbonate, leucoxene, apatite and titanite. In one specimen, a few subhedra of anthophyllite were identified. Quartz, oligoclase and carbonate have been introduced into some of these dykes. In such cases, the dykes have undergone some deformation and recrystallization.

The grey fine-grained quartz diorite dykes are similar in appearance to the grey feldspar porphyry dykes, but the phenocrysts are lacking. Quartz has been introduced into some of the dykes and some of the leucoxene occurs in vein-like forms, suggesting that it too has in part been introduced, probably originally as titanite. Such dykes have undergone some brecciation and recrystallization.

The grey fine-grained quartz diorite dykes cut some grey feldspar porphyry dykes and are in turn cut by other grey feldspar

porphyry dykes. Further, the phenocrysts in some of the grey feldspar porphyry dykes fade out in some parts of the dykes. In such cases they are similar in appearance to the grey fine-grained quartz diorite dykes.

The dykes of this group are similar in mineralogy to the granite underlying parts of Doré and Chibougamau lakes. It is the writer's opinion that they represent a differentiate of the granite, but are distinctly later in age, as a period of widespread faulting occurred between the intrusion of the granite and the intrusion of the dykes.

Diorite and Gabbro Dykes

Dark green ferromagnesian-rich dykes containing up to 20 per cent grey to greenish grey altered feldspar occur similarly to the grey feldspar porphyry and the grey fine-grained quartz diorite dykes. The dykes richer in feldspar were classified as diorite and those poorer in feldspar as gabbro. The altered feldspar content of various dykes in this group varies from 5 to 20 per cent and hence a clear-cut distinction between the two varieties cannot always be made.

Examination of thin sections showed these dykes to be much altered. The original plagioclase now consists of clinozoisite and epidote or an aggregate of saussurite. Hornblende and augite are present but are largely altered to chlorite. In some specimens epidote and clinozoisite aggregates comprise most of the specimen. Some white mica and introduced quartz is generally present. Carbonate, apatite, titanite, ilmenite, magnetite and pyrite are minor constituents. Quartz has been introduced into several of the specimens examined.

Dykes of diorite and gabbro cut the grey feldspar porphyry and grey fine-grained quartz diorite dykes and hence are younger. Fine-grained gabbro dykes were also observed in the granite northeast of David lake and in the granite in the southeastern part of the map-area.

Diabase Dykes

A northeasterly-trending diabase dyke passes through Chibougamau lake in the eastern part of the map-area. This dyke is about 60 feet wide. Small sub-parallel branches occur adjacent to this dyke. The diabase is coarse grained in the central parts of the larger dykes. The margins are aphanitic, indicating chilling. On the fresh surface the rock is greenish to greyish black. It contains approximately 50 per cent feldspar in the form of greenish grey laths which impart a diabasic texture, 5 per cent biotite, and pyroxene.

In thin section the rock displays typical diabasic texture.

It consists of labradorite, hypersthene, augite and biotite, with apatite and magnetite as minor constituents.

Apart from the diabase being younger than the granite, its age is not known. Dykes of diabase commonly occur late in the sequence of Precambrian intrusives. Until more information regarding the age of this diabase is available, it is tentatively regarded as the youngest rock in the map-area.

Pleistocene

The western and southwestern part of the area is extensively covered by sand and gravel under a cover, generally only a foot or so deep, of moss which supports a thick growth of Labrador tea. Low drumlin-like ridges of sand and gravel are a characteristic part of the topography. Many reefs and islands in Doré and Chibougamau lakes are also drumlin-like in outline and consist of sand, gravel and boulders. These deposits and the courses of the creeks and small streams within the area, as well as the trend of Gouin peninsula, are all parallel to the direction of the glacial striae found on rock exposures. The direction of the ice movement, indicated by these glacial striae, was S.50°W. to S.60°W. over most of the area and S.35°W. to S.40°W. in the southern part of the area.

Gouin peninsula is a low ridge-like barrier of land separating Doré lake from Chibougamau lake. It consists of boulders, sand and gravel with intercalations of clay. Very little rock is exposed except at the north end and in the central part of the peninsula. The unsorted nature of this deposit suggests that it is of glacial origin, possibly a medial moraine formed by accumulation in a split in the ice sheet along the low rock ridge which separated the basins of Doré and Chibougamau lakes during a late stage of glaciation.

STRUCTURAL GEOLOGY

General Statement

The formations within the map-area are believed to lie on the south flank of a syncline, the axis of which passes in an easterly direction from Antoinette lake to McKenzie bay (10, p. 19), about 5 miles north of the map-area. The volcanic formations dip steeply, with local variations from the vertical both to the north and the south. The top of the formations, as determined from pillow structures and grain grading, appears to be to the north. However, two top determinations

of somewhat doubtful nature, east of Chibougamau road, were to the south.

The anorthosite which outcrops to the east of Caché lake dips under the gabbro to the west at 30° to 50° , although steeper and gentler dips were observed. Segregational banding in the gabbro near its contact with the eastern anorthosite mass strikes in a general northerly direction and is conformable with the gabbro - anorthosite contact. Segregational banding in the gabbro just east of Gladstone lake strikes slightly south of east and dips 35° to 70° northeast.

The intrusives of the David Lake group in the northwest part of the area appear to have a plunge to the east.

There are 2 main sets of joints and faults in the area, namely northeast and east to southeast. Fracturing is widespread, the anorthosite particularly being highly fractured and transected by myriad joints and shear zones both on a large and a small scale. The feldspar fragments in the anorthosite breccia in many places contain minute fractures which impart a shattered appearance to the rock.

Northeast Faults

Many northeast faults are present in the region. They vary from small joint-like fractures with displacements measured in fractions of an inch to strongly brecciated and sheared zones with apparent horizontal displacements of many hundreds of feet. These are members of a northeast fault system which converge on the Waconichi-Gwillim lake fault (15, p. 78).

The most prominent northeast fault within the area is the McKenzie Narrows fault. It is described by Mawdsley and Norman (10, pp. 51-55). Its trace lies along the southeast side of Caché lake and passes through Doré lake just west of Merrill island. The shear zone is exposed in the bed of the creek which flows from Caché lake to Doré lake 2,700 feet from the outlet of Caché lake. The rock in the creek bed is brecciated over a width of 20 feet and for 50 feet to the northwest the rock formations are fractured, schistose, carbonatized and mineralized with pyrite. Diamond drilling in Doré lake on the Royran Gold Fields property, 2,000 feet east and 2,500 feet north of the point where the north-south centre line of Obalski township intersects the southeast shore of the lake, indicates that the main zone of the fault is 55 feet wide and consists of talc-sericite schist which dips 40° northwest. A further 2,000 feet northeast, on Campbell Chibougamau property, drilling in the lake bed indicates that the strike of the

fault swings from N.40°E. to N.60°E., and the dip steepens to vertical. The width of the zone here is 50 feet. A geophysical survey indicates that the strike of the fault is N.45°E. at a point 1,500 feet north of the Quebec Chibougamau Goldfields camp on the north tip of Merrill island.

In the vicinity of the creek which flows from Caché lake to Doré lake, the anorthosite-gabbro contact on the northwest side of the fault appears to be displaced 3,700 feet horizontally toward the northeast. Criteria from which the total displacement and the direction of movement can be determined were not found. Mawdsley and Norman (10, p. 52) state that "the rocks on the east side of the fault have been moved upwards relative to those on the west side and, therefore, belong to a much deeper horizon than those west of the fault".

Many other northeast faults are present, but only a few were located along which a displacement could be determined. Three of these are on the northwest side of the McKenzie Narrows fault between Caché and Doré lakes. They cut the anorthosite-gabbro contact into a series of segments with apparent horizontal displacements up to 400 feet, northwest side towards the southwest. Another fault lies along the channel between Merrill and Lefebvre islands. A diorite dyke has been offset by this fault. The apparent horizontal displacement is 250 feet, the block on the northwest side having been displaced towards the southwest. A grey fine-grained quartz diorite dyke has been truncated by still another fault striking N.50°E. at the north tip of Merrill island. The extension of this dyke could not be found.

East to Southeast Faults

East to southeast faults are present everywhere in the area. None were recognized approaching the length of the McKenzie Narrows fault, although the carbonate zone in the northwestern part of the area may represent a fault of considerable length. These faults are characterized by zones of carbonatization, shearing and brecciation up to and exceeding 1,000 feet in width. Within the anorthosite mass they pinch and swell and their strikes and dips change over short distances. They also branch and form horsetails. Some southeast shear zones are linked by easterly-trending shears. Two zones of carbonatized chlorite schist in the northwest corner of the map-area represent the most prominent shearing belonging to this system of faulting. These zones strike slightly north of east. The foliation dips vertically to 75° northwest.

Other zones of shearing belonging to the east to southeast set are widespread. They are notably present on the Obalski property,

where they are gold-bearing structures, and on the Kayrand, Merrill Island, Campbell Chibougamau and Quebec Chibougamau Goldfields properties on and adjacent to Merrill island. In these cases, the zones are sulphide-bearing structures containing copper, zinc, gold and silver. There are two other zones on the east shore of Caché lake, respectively 3,000 and 6,000 feet south of the north end of the lake. They are 100 to 200 feet wide and are carbonatized and strongly schistose. Other faults are widespread and are shown on the accompanying map.

The relative age of the northeast faults with respect to the east to southeast faults has not been definitely established. Inferential evidence indicates that the final movements along the northeast faults were later than the major movements along the east to southeast faults. Both sets of faulting transect granite and its associated pegmatite.

Dykes of grey fine-grained quartz diorite, grey feldspar porphyry, diorite and gabbro in many places lie along southeast shears. Some of these dykes are massive, some have sheared contacts, and some are schistose throughout. It is probable that these dykes intruded the east to southeast shear zones after the major period of deformation, but were affected by subsequent local movements.

Information obtained from diamond drilling indicates that the southeasterly-trending shear zone which contains the Quebec Chibougamau Goldfields sulphide deposits and a parallel diorite dyke is offset by the northeast fault in the channel between Merrill and Lefebvre islands.

No intrusives are reported to cut the Chibougamau sediments but intrusives do cut the southeast shear zones. The northeast faults cut the Chibougamau sediments. These relationships suggest that the latest movements, at least along the northeast faults, are later than the major movements along the southeast faults. No evidence has been found to indicate that the northeast faults were formed after the formation of the east and southeast faults or that movements along these latter faults ceased before the formation of the northeast faults. In connection with this, Mawdsley and Norman (10, p.47) point out evidence of movement along the McKenzie Narrows fault before the deposition of the Chibougamau sediments.

The sulphide mineralization is later than the major movements along the east and southeast zones and the dykes which intrude them. Slickensides on the sulphide minerals and on re-sheared hydrothermally replaced parts of the shear zones were probably formed during later subsidiary movements. The Quebec Chibougamau Goldfields sulphide

zone is apparently truncated by northeast faulting. Mawdsley and Norman (10, p.57) are of opinion that the northeasterly system of faulting is younger than part at least of the sulphide mineralization.

ECONOMIC GEOLOGY

Concentrations of iron, copper, lead, zinc, gold and some silver have been found within the area. These concentrations may be divided into 3 groups: segregational-, vein- and replacement-type deposits.

Segregational-type Deposits

Magnetite Formation

A zone of magnetite-bearing gabbro, termed magnetite formation, which lies between Caché lake and Doré lake, has been traced for a length of 2 miles in a north-south direction. It is 100 to 500 feet wide and averages 300 feet. Due to the relief of the terrain, a section of the formation 200 feet thick is exposed. The magnetite formation lies along the contact between gabbro and transition rock which separates the gabbro from the anorthosite. It dips to the west under the gabbro at angles of 20° to 50°. The magnetite formation is in sharp contact with the transition rock but it grades upward into the gabbro. Dip-needle traverses indicate that the gabbro is rich in magnetite, in places over widths of 1,600 feet, adjacent to the contact of gabbro and transition rock, but only the richest, lower part of this magnetite zone is shown as magnetite formation on the map. The magnetite formation consists of sheets of nearly massive magnetite in magnetite-rich gabbro conformable to the segregational banding in the gabbro and to the strike of the contact between the gabbro and the transition zone. The alternating sheets of magnetite and magnetite-rich gabbro range in width up to 1 foot. On surface exposures the magnetite stands out as black ridges in the gabbro.

In polished section, it was found that anhedral magnetite and ilmenite were present. The ilmenite also occurs as lamellar intergrowths along octahedral planes in the magnetite. The grains are 0.7 to 1 mm. in size. The lamellar intergrowths are generally between 0.007 and 0.01 mm. wide.

In thin section, the rock is seen to have the composition of a gabbro with a granitoid texture. It consists essentially of calcic andesine, hornblende, chlorite and magnetite. The andesine has a marked orientation parallel to the (010) face. The ferromagnesian constituents occur in part as anhedral grains and in part in aggregates of smaller grains. Magnetite occurs both interstitially and molded on the hornblende grains. Apatite, a characteristic accessory of the gabbro body as a whole, was not observed.

Ten chip samples, over widths up to 200 feet, were taken from the outcrops of the iron formation. The metallic iron content varied from 25.93 to 57.32 per cent, and the metallic titanium from 1.77 to 10.78 per cent. The weighted average of the 10 samples is given in Table 1 (Sample No. 2) on page 22.

The essentially disseminated, rather than vein-like, nature of the magnetite, its concentration at the base of the gabbro and the gradually decreasing magnetite content away from the base of the gabbro suggest that the magnetite formation is a product of differentiation in situ within the gabbro.

Magnetite dykelets, up to 4 inches wide, fill fractures in the quartz diorite and granodiorite immediately north of Cachée bay. Other smaller concentrations of magnetite within the area occur in gabbro and pyroxenite along the west shore of the central part of Caché lake, 300 feet west of a point on the Chibougamau road 9,500 feet north of the southwest tip of Caché lake.

Outside of the map-area deposits of magnetite and titaniferous magnetite are known to occur in the neighboring townships of Le-moine, McCorkill, Roy and Scott. A tabulation of analyses of samples from the more important of the known deposits in the Chibougamau region is given on the following page.

From an examination of the analyses, it may be seen that titanium is not present in sufficient quantity to be regarded as having commercial possibilities under present conditions. It will be noted that there is a wide variation in the titanium content of samples from different localities. Work done up to the present has been insufficient to determine the reason for this variation. Under the microscope, specimens high in titanium were observed to be a relatively fresh gabbro with the magnetite disseminated throughout, occurring interstitially and moulded around amphibole crystals. In the case of the low titanium type, the matrix is a more basic and more altered serpentinous gabbro. The magnetite occurs as veinlets and as disseminated grains up to 4 mm. in size, some of which are skeleton-like and are filled with inclusions of gangue minerals. The vein-like distribution of the magnetite suggests that it has undergone a certain amount of redistribution. This could have taken place contemporaneously with the serpentinization of this variety of gabbro. The difference in the petrographic compositions of the two types of gabbro indicates an initial difference in the composition of respective phases in the basic differentiate of the original basaltic magma and could explain why the one contains magnetite deposits high in titanium and the other contains deposits low in titanium.

Table 1.- Sampling of Chibougamau Magnetite Formation

Township	Sample No.	Fe	Ti	SiO ₂	Insol. Residue	P	S	Mn
McCorkill	1	53.12	7.57	N.D.		N.D.	N.D.	N.D.
Obalski	2	32.5	5.3	29.9		0.00	0.12	0.73
"	3	25.52	3.02 ^x	32.80	44.80	0.00	0.26	N.D.
"	4	24.55	3.84 ^x	32.20	49.26	0.00	0.44	N.D.
Roy	5	31.89	0.98	19.74		0.02	0.02	0.06
"	6	68.03	0.07	1.83		0.03	0.01	0.03
"	7	35.7	0.86	N.D.	23.3	0.017	0.25	N.D.
"	8	23.8	0.69	N.D.	33.54	0.022	0.18	N.D.
"	9	32.2	0.96	24.5		0.04	0.04	0.08
Scott	10	24.80	3.13	34.46		0.21	0.18	0.32

^xCalculated from TiO₂ reported by analyst.

- 1.- Titaniferous magnetite disseminated in gabbro. Sampled by W.W. Longley (14, p.6).
- 2.- Magnetite disseminated in gabbro, between Caché lake and Doré lake. Average of 10 chip samples, over widths up to 200 feet. Sampled by R.B. Graham.
- 3.- Magnetite disseminated in gabbro. 75 lb. sample from surface exposures submitted to Department of Mines, Ottawa, by Grand Chibougamau Mines Ltd. (16, p.7).
- 4.- Magnetite disseminated in gabbro. 56 lb. sample of diamond drill cores submitted to Department of Mines, Ottawa, by Grand Chibougamau Mines Ltd. (16, p.7).
- 5.- Magnetite disseminated in gabbro, 1/2 mile north of Nepton bay. Sampled by R.B. Graham.
- 6.- Massive magnetite (veinlet), 1/2 mile north of Nepton bay. Sampled by R.B. Graham.
- 7.- Magnetite disseminated in gabbro. Sorcerer mountain deposit, 1/4 mile north of Magnetite bay. Width 80 feet. Sampled by the Chibougamau Mining Commission (7, p.215).
- 8.- Magnetite disseminated in gabbro. Sorcerer mountain deposit, 1/4 mile north of Magnetite bay. Width 500 feet. Sampled by the Chibougamau Mining Commission (7, p.215).
- 9.- Magnetite disseminated in gabbro. 45-foot intersection from a diamond drill hole drilled by L.M. Wilson on south side of Gouin peninsula, 700 feet west of McKenzie - Roy township line. Sampled by R.B. Graham.
- 10.- Disseminated magnetite in gabbro from near the anorthosite in the eastern part of Scott township. Sample submitted to Quebec Department of Mines by J. Sharp.

Vein-type Deposits

Quartz veins are common in the area. Some of the larger ones are shown on the accompanying map. They strike in various directions but most commonly between east and southeast, following the trace of shear zones. They are mineralized to varying degrees with pyrite and chalcopyrite associated with subordinate amounts of pyrrhotite and sphalerite. Some of the veins are gold-bearing. The vein quartz was fractured before introduction of the sulphide minerals and gold. Pyrite was the first of the metallic minerals to be deposited. Following the deposition of the pyrite a further period of fracturing and brecciation took place. Pyrrhotite, chalcopyrite, sphalerite, galena and gold were then deposited. The order of deposition of these minerals is not clear. Such evidence as could be obtained from examination of polished sections indicates that the chalcopyrite was deposited in part contemporaneously with and in part later than the pyrrhotite. The sphalerite was deposited after the pyrrhotite and chalcopyrite, and galena followed the sphalerite.

Replacement-type Deposits

Replacement deposits are the most widespread type of metallic sulphide concentration in the district. They generally occur in or adjacent to shear zones. Within the map-area the important deposits of this type all occur in anorthosite which has a marked brecciated structure.

The typical minerals, in order of abundance, are pyrrhotite, pyrite, chalcopyrite, sphalerite and galena. Gold is also present, but its distribution is erratic. The sulphides occur as disseminations, stringers and lenses in sheared and hydrothermally altered anorthosite breccia, and replacing the matrix between the altered feldspar fragments. The grains of the pyrite, pyrrhotite and chalcopyrite are very fine to medium fine. Both types exist side by side. The texture depends on the constituents of the rock and the degree to which the sulphides have replaced them.

Examinations of polished specimens from the replacement deposits indicate that pyrite is the oldest of the sulphides. It was preceded and accompanied by the introduction of quartz. Following the deposition of the pyrite, there was a period of fracturing and introduction of more quartz. Pyrrhotite and chalcopyrite were then introduced, probably contemporaneously. Some minor veining effects indicate that part of the chalcopyrite was deposited after the pyrrhotite. Sphalerite, followed by galena, was then deposited and finally there was a further period of fracturing and introduction of quartz. There is some evidence

that a later generation of pyrrhotite and chalcopyrite followed the deposition of the sphalerite and galena, but further work will be necessary to verify this. Other gangue minerals which accompanied the quartz are referred to in the paragraph on blue-grey alteration (p.25). In the deposits where sphalerite and galena are subordinate to the chalcopyrite, they occur in fractures filled with white carbonate or quartz, or both, along the outer fringes of the sulphide zones as well as within them, particularly where the interior part is silicified. No gold was observed in any of the specimens examined and its relationship with the sulphide mineralization is not known. Magnetite is commonly associated with the sulphides. It is apparently older than the pyrite.

The anorthosite breccia along the sulphide-bearing zones is sheared and hydrothermally altered. As the shear zone is approached the fragments, which consist ordinarily of andesine partially altered to clinozoisite and saussurite, with subordinate epidote, become an aggregate of oligoclase, clinozoisite and white mica with subordinate epidote, quartz and chlorite. Within the zones of more intense hydrothermal alteration, zoisite takes the place of clinozoisite in the alteration of the plagioclase fragments. With successively more intense alteration the fragments are replaced by white mica or talc containing minor amounts of chlorite, quartz, oligoclase and clinozoisite. In the extreme, the fragments are completely replaced by white mica or talc and are thus indistinguishable from the matrix, which is made up predominantly of the same minerals. This results in a soft structureless rock which displays little evidence of the original shearing.

The matrix of the least altered varieties of anorthosite breccia consists of oligoclase, white mica and chlorite, in varying proportions, and minor amounts of clinozoisite, zoisite and epidote. Within the shear zones, this matrix has been altered by dynamic metamorphism to an aggregate of chlorite and white mica or talc. These minerals are replaced to varying degrees by quartz, albite, oligoclase, carbonate, chlorite, apatite, rutile, titanite, green mica, clinozoisite, epidote, muscovite, white mica, talc, leucoxene and sulphides which have been deposited in varying proportions by hydrothermal solutions. The minerals thus deposited occur as aggregates, lenses, veinlets and complete replacements. The sulphides are consistently associated with quartz and albite which are in many places accompanied by chlorite and carbonate. The hydrothermal alteration extends some distance into the country rock from the sulphide zones.

The colour of the altered rock is governed by the proportions of the various minerals which have replaced the original constituents.

Blue-grey alteration consists mainly of talc and white mica with quartz, albite, carbonate, apatite and occasionally some epidote. It is commonly associated with the sulphide mineralization. It occurs as a replacement of shear zones and fragments in the anorthosite breccia, as stringer-like forms in anorthosite breccia, and as nuclear growths in the various types of matrix found in the anorthosite breccia. Greater proportions of albite, oligoclase, quartz and carbonate impart a smoky grey, dark grey, grey or light grey colour. Locally there is complete white siliceous replacement. This is the type of alteration most intimately associated with the more massive sulphide replacement. However, all of the above types of alteration may be regarded as favourable indicators of sulphide mineralization.

A buff or yellowish brown colour is imparted in some instances by carbonate, which replaces the original matrix of the anorthosite breccia.

Bright green mica in a few localities comprises most of the matrix of the breccia but is not a common variety.

A dark green matrix is a regional characteristic of the anorthosite and is due to the presence of predominant chlorite.

Yellow and yellowish green varieties of matrix are due to a predominant sericitic alteration. This type commonly occurs along and adjacent to shear zones and is a dynamic, rather than hydrothermal, variety of alteration.

The assemblage of albite, oligoclase, quartz and chlorite that is so closely associated with the sulphide mineralization is basically the same as that which comprises the granite, grey fine-grained quartz diorite dykes and grey feldspar porphyry dykes. This strongly suggests that they all have a common origin which can most conveniently be referred to the granite underlying the southern part of Doré lake and most of Chibougamau lake.

The deposits in the vicinity of Doré lake all occur on either side of and within a mile of the McKenzie Narrows fault. These include the Kayrand, Merrill Island, Quebec Chibougamau Goldfields and Campbell Chibougamau properties on or adjacent to Merrill Island, which are described in this report, as well as the Kokko Creek property of Merrill Island Mining Corporation Ltd. (17, p.11), the property of Jaculet Mines Ltd. (18, p.32) and the Cedar Bay property of Campbell Chibougamau Mines Ltd. (19, pp.135-138), (18, p.41) on the northeast shore of Doré lake in McKenzie township. With the exception of the Cedar Bay property, which has a complex structural setting, the sulphide-bearing zones are related to southeasterly-trending

shear zones. These relationships suggest that the McKenzie Narrows fault acted as the major structural control, while the southeast shear zones acted, where conditions were favourable, as traps for the localizing of mineralizing solutions.

Slickensiding of the sulphide minerals and shearing and fracturing of the replaced parts of the shear zones indicate movements in these zones subsequent to the mineralization.

There is some evidence, in the vicinity of Merrill island, that warping of the McKenzie Narrows fault plane is one of the favourable conditions requisite for the localizing of mineralizing solutions along the northeast shear zones. Warping of the shear zones which strike southeast also imposes an important control on sulphide deposition. An example of this is the east zone of Merrill Island Mining Corporation Ltd. This zone is arcuate in outline and is richer in copper than the main Merrill Island zone, which is straight. Another example is the Quebec Chibougamau Goldfields deposit, the richest and widest part of which lies in the arcuate part of the ore structure.

A further controlling factor in the localization of the mineralizing solutions is the presence of the grey fine-grained quartz diorite and grey feldspar porphyry dykes. The replacement sulphide deposits are found along zones which contain swarms of these dykes. Although the sulphides generally lie within the sheared and altered anorthosite breccia, they are also found in the dykes, extending across their contacts with anorthosite breccia and also in the schistose parts of the dykes. The distribution of these dykes with respect to the shear zones and sulphide deposits suggests that they had a supporting or ribbing effect on the anorthosite breccia during post-dyke but pre-ore movements, providing low pressure zones favourable for sulphide deposition. A further supplementary control by these dykes is suggested in the Campbell Chibougamau sulphide body. In this section, a grey fine-grained quartz diorite dyke, or dykes, in many places forms the hanging wall of the sulphide zone, suggesting that these dykes had a damming effect on the mineralizing solutions.

DESCRIPTION OF PROPERTIES

Cachée Bay (Chibougamau) Mines Ltd.

This property consists of 15 claims numbered C.4482-84, claims 1 to 5, which lie in the north central part of the area. Rocks outcrop only in the northern part of the property. They consist of basic volcanic formations bounded on the south and west by gabbro, quartz gabbro and fine-grained gabbro. These rocks are succeeded

to the south by anorthosite. A northeasterly-trending shear zone 200 to 300 feet wide in the northern part of the property apparently offsets the anorthosite - quartz gabbro contact 500 feet to the right. This displacement and the location of the north contact of the anorthosite were determined by examination of the few rock exposures found, supplemented by geophysical observations.

Trenching has been carried out on some exposures of schistose gabbro which lie along the southwest side of the shear zone. Lenses and stringers of milky quartz are locally present. Sparse chalcopyrite occurs in fractures in the quartz. Some veinlets of crystalline carbonate were also observed. Trenching in fine-grained gabbro 6,000 feet west of the north-south centre line of the township and 1,200 feet south of its north boundary has exposed 3 easterly-trending shear zones, one of which is quartz-bearing. Considerable trenching has also been done in quartz gabbro a short distance to the southeast.

Just west of the Obalski camp on Doré lake a quartz vein in anorthosite breccia near the lake shore has been explored by 3 cross trenches for a length of 130 feet. It strikes N.20°W. and is sparingly mineralized with chalcopyrite. In the early fall of 1950, 3 diamond drill holes were drilled in chlorite gabbro in the northern part of the property. In the fall of 1951, Eastmac Mines Ltd., under an option agreement, did some drilling on the vein just west of the camp. Some sulphide mineralization containing low but encouraging tenors in copper were encountered.

Campbell Chibougamau Mines Ltd. (Merrill Island deposit)

Ref.: Que. Bur. Mines, Ann. Rept. 1929, Pt. D, pp.62, 63
Geol. Surv. Can., Mem. 185, pp. 74-76
Que. Bur. Mines, Ann. Rept. 1936, Pt. A, pp. 96, 97
Que. Dept. Mines, P.R. No. 283, pp. 41-43
Que. Dept. Mines, P.R. No. 287, p. 13

This property comprises claims Q.2452, Q.2455, Q.2469, Q.2471 and Q.13901, which cover the extension into Doré lake of the main sulphide zone of Merrill Island Mining Corporation Ltd. This part of the sulphide zone was drilled first in 1929 when 20 diamond drill holes were drilled by Chibougamau Prospectors Ltd. and again in 1935 when Consolidated Chibougamau Goldfields Ltd. drilled 12 more holes. The present company carried out a drilling campaign in the winter of 1950-51 and shaft sinking is now in progress on Merrill island.

The extension of the main zone of Merrill Island Mining Corporation has been traced for 330 feet into the lake. It is estimated by the company to contain about 1,000,000 tons averaging 3.56 per cent copper and 0.15 ounce of gold per ton. The mineralization and structure of this deposit are similar to the Merrill Island Mining Corporation part of the zone which is described on pages 31 to 33.

A second, but only partially explored sulphide lens, has been found 200 feet northwest along the strike of the main zone. The copper and gold tenors are about the same as in the main zone.

It is believed that a dip extension of the Kayrand ore zone enters the property adjacent to Kayrand ground at a vertical depth of about 800 feet. Three diamond drill intersections gave core lengths of 5 to 18 feet containing 1.67 to 3.00 per cent copper, 0.80 to 3.42 per cent zinc and some silver.

Central Mining Corporation

This company holds a group of 15 claims numbered C.8978, claims 1 to 5; C.8982, claims 1 to 5; and C.8984, claims 1 to 5. The eastern part of the property is underlain by anorthosite and quartz gabbro which cuts across the west end of Cachée bay. A narrow tongue of gabbro separates these rocks from the fine-grained gabbro which lies to the west. The north end of the magnetite formation (p. 20) passes through the eastern part of the property.

Grand Chibougamau Mines Ltd.

Grand Chibougamau Mines Ltd. holds 13 claims situated between Cachée bay and the north end of Cachée lake. The claims are numbered C.8389, claims 1 to 5; C.12504, claims 3 to 5; and C.12507, claims 1 to 5. Some diamond drilling was done on the property in 1946 and several quartz veins were examined.

Three of the quartz veins on the property are shown on the accompanying map. The vein filling is milky quartz, for the most part barren. A few coarse pyrite crystals are found along the margins of the veins and in the country rock adjacent to them. One vein in the central part of C.8389, claim 2, has been traced for a length of 1,200 feet. It varies in width from a few inches to 3 feet. It strikes northeast to east and dips 60° to 80° northwest. The country rock is gabbro.

A quartz vein which is mineralized a little more than the others lies in the south central part of C.8389, claim 3. This vein is 1 to 3 feet wide, strikes northwest, dips vertically and has been

traced for 100 feet. The country rock is anorthosite breccia. The vein consists of milky and black glassy quartz. The two types of quartz appear to merge one into the other. The vein is mineralized with pyrite and chalcopyrite. The black variety of quartz appears to carry most of the mineralization. This was the most favourable appearing vein observed on the property. A sample taken by the writer assayed 0.001 ounce of gold per ton and 0.25 per cent copper.

The magnetite formation (p.20) crosses the eastern part of this property from north to south. In 1952, 7 diamond drill holes having a total footage of 3,110.6 feet were drilled along a length of 1,800 feet of the magnetite formation. The drilling indicated the tenor of this body to be approximately 20 per cent iron and 3 to 4 per cent titanium over widths of 70 to 200 feet, although considerable magnetite is present over widths up to 400 feet.

Kayrand Mining and Development Company Ltd.

Ref.: Que. Dept. Mines, P.R. No. 283, p.43

Kayrand holds a group of 20 claims which are numbered C.30192, claims 4, 5; C.30224, claims 1 to 5; C.36959, claims 1 to 3; C.43690, claims 1 to 5; and C.43697, claims 1 to 5.

The northern part of the property is underlain by anorthosite, and anorthosite breccia. The southern part is underlain by granite. A body of gabbro intrudes the anorthosite breccia 250 feet north of the northwest end of the structural zone which contains the Kayrand deposit. The gabbro crosses the zone and terminates 1,500 feet to the southeast. The gabbro body is tabular but irregular in shape. Its dip varies from horizontal to 50° northeast and it has a general strike of N.35°W. with many local deviations. Its horizontal width on surface varies from 100 to 400 feet; the true width, indicated by diamond drilling, is 30 to 90 feet. Offshoots from the main gabbro body intrude the anorthosite breccia.

The copper-bearing zone was discovered in the spring of 1950 by diamond drilling in an area of anomalies outlined by magnetic and electrical surveys. The zone lies along a shear in anorthosite breccia. It has been traced southeast from the north boundary of the property for a length of 1,900 feet. It dissipates itself at the southeast end as a series of joints and shatter zones in the anorthosite breccia.

A grey fine-grained quartz diorite dyke, which has been traced for a length of 1,500 feet, intrudes the shear zone. It is sheared and silicified and has several branches.

The copper-bearing shear zone, the gabbro and the grey fine-grained quartz diorite dyke have been cut into 2 nearly equal segments by a fault striking N.70°E. The apparent horizontal displacement along the fault plane is 150 to 200 feet left. The northwest segment strikes N.75°W., whereas the southeast segment strikes N.45°W.

The sulphide mineralization occurs in and adjacent to the dyke, and extends a short distance laterally beyond the shear zone into the anorthosite breccia, preferentially replacing the matrix of the breccia. In the surface exposure the sulphides are on the hanging wall side of the grey fine-grained quartz diorite dyke, but with depth the sulphides lie within and underneath the dyke. An envelope of alteration of the type previously described as being a favourable indicator of sulphide mineralization (p. 25) surrounds the sulphide zone. It is variable in width, and is locally absent. The alteration extends laterally beyond the sulphides and has a maximum width of 50 feet, as determined from a few type sections. Some shear zones branching away from the main zone have a similar type of alteration, but no sulphide mineralization was intersected in them by diamond drilling. However, they merit further investigation. As the shear zone dies out to the southeast, the sulphides decrease, occurring in quartz veins or lenses from a fraction of an inch up to 5 inches wide which lie along joint planes.

The sulphide mineralization consists of chalcopyrite, pyrrhotite, pyrite and a little sphalerite. Small amounts of gold and silver are associated with the sulphides.

In polished section, the pyrite was found to be the earliest and the most strongly fractured of the sulphides. The pyrrhotite and chalcopyrite were the next sulphides to be deposited. They lie along fractures in quartz, which comprises most of the gangue. The sphalerite is later and cuts the chalcopyrite.

The sulphide mineralization has been traced for a length of 1,600 feet. It lies in and conformable with both of the faulted segments of the shear zone previously described. The zone dips 70° northeast.

Within the zone is a lens of sulphide mineral reported by the company to contain 250,000 tons of an average tenor of 2 per cent copper, with small amounts of gold, silver and zinc. This lens has a plunge of 30° to 50° to the northwest. It is 600 feet long, and, normal to the axis of plunge, it measures 150 feet from top to bottom. Prospects for the discovery of other lenses at depth are regarded as

favourable, as intersections of average tenor have been reported from diamond drill holes extending down to depths of 800 feet.

Kenzie Gold Mines Ltd.

This company holds a group of 5 claims situated on the west side of Caché lake. The claims are numbered C.30269, claims 1 to 5. The property is underlain by gabbro and diorite of the Doré Lake group. Much trenching has been done on the property but to date little of note has been reported. A sample taken from an area of sulphide mineralization in the No. 6 zone, which has been traced into Caché lake, is reported to have assayed 0.04 ounce of gold per ton.

Merrill Island Mining Corporation Ltd.

Ref.: Geol. Surv. Can., Sum. Rept. 1927, Pt. C, pp. 18,19
Que. Bur. Mines, Ann. Rept. 1929, Pt. D, pp. 63-65
Geol. Surv. Can., Mem. 185, pp. 74-76
Que. Bur. Mines, Ann. Rept. 1936, Pt. A, pp. 96, 97
Que. Dept. Mines, P.R. No. 283, pp. 44, 45
Que. Dept. Mines, P.R. No. 287, pp. 14, 15

The Merrill Island property of this company comprises block C and C.30216, claims 1 to 5, which occupy the northeast part of Merrill island. A copper deposit was discovered on this property in 1920. During the winter of 1935-36, Consolidated Mining and Smelting Company of Canada, Ltd., under an option agreement with Blake Chibougamau Mining Corporation, drilled 26 diamond drill holes on the island. From late August 1950 to the end of August 1951 the present company had completed 36,063 feet of diamond drilling on their own account and an additional 3,575 feet jointly with Quebec Chibougamau Goldfields Ltd. Drilling was continuing when the writer left the field.

The property is underlain by anorthosite and anorthosite breccia. A granite boss is exposed along the shore for 400 feet at the north side of the island 800 feet northeast of the sulphide zone. The southwest part of the property extends south of Merrill island into the lake and this part of the property contains a nose of granite projecting northwest for 1,200 feet from the main anorthosite - granite contact. This nose plunges to the northwest under the anorthosite, extending under the large bay on the northwest side of the island and along the southwest side of the sulphide zone.

The sulphide zone lies along a complex shear zone in anorthosite breccia. The shear zone consists of a number of interlocking shears with a general strike of N.60°W. and dips ranging from vertical to steeply southwest or steeply northeast. These shears are linked by

subordinate east-west shear zones. The anorthosite breccia between the shear zones has been silicified and sericitized to varying degrees. The overall width of the zone is approximately 600 feet. It has been traced from the lake shore on the northwest side of the island southeast for 3,000 feet, where it is truncated by a northeasterly-trending fault extending along the southeast side of Merrill island and through the channel between Merrill and Lefebvre islands. Several other northeast faults displace the sulphide-bearing structure. Apparent horizontal displacements are, for the most part, less than 100 feet. Southeasterly-striking dykes of grey fine-grained quartz diorite, grey feldspar porphyry, gabbro and diorite lie along the zone.

The sulphide mineralization occurs as disseminations and nearly massive lenses replacing the sheared anorthosite or, in the east zone, replacing the anorthosite breccia which has been subject to tensional stresses due to the local arcuate shape of zones of shearing along which movement has occurred. The amount of sulphides and their relative proportions vary considerably from place to place both in the surface exposures and in diamond drill intersections. The contacts with the country rock are gradational. The sulphide minerals are chalcopyrite, pyrrhotite, pyrite and minor sphalerite. Some gold and silver is associated with the sulphides.

Polished sections of typical specimens of the sulphide were examined under the microscope. The pyrite is well fractured and tends to be disseminated throughout the gangue, whereas the other sulphides occur along the fractures. Chalcopyrite and pyrrhotite are intimately associated, the chalcopyrite having a marked tendency to enclose the pyrrhotite. A period of fracturing, succeeded by deposition of quartz, preceded their emplacement. The sphalerite cuts chalcopyrite and also contains inclusions of chalcopyrite. A few small rounded blebs of galena were observed in the sphalerite. After the deposition of sphalerite and galena, there was a further period of fracturing and introduction of quartz. Some magnetite is present, cut by chalcopyrite. Its relations with the other sulphide minerals were not observed, but it is probably the oldest of the metallic minerals. Talcose alteration and subsequent silicification and mineralization with albite, oligoclase and chlorite are characteristic of this sulphide deposit.

Exploration to date has been concentrated mainly along two zones of sulphide replacement, referred to as the main zone and the east zone, connected by an easterly-trending sulphide zone which dips 55° north.

The main zone, which strikes approximately N.50°W. and dips steeply to the southwest, contains persistent sulphide mineraliz-

ation over widths up to 110 feet. This zone may be divided into two bodies in which copper mineralization is concentrated to the greatest degree. The first extends from the lake shore southeast for 500 feet and has a width of 29 feet; the second extends from 900 to 1,900 feet southeast of the lake shore and has a width of 21 feet. Except at the extreme northwest end, the first body is not as well mineralized on surface as it is below the 150-foot horizon.

The east zone lies about 300 feet northeast of the southeast end of the main zone. It has a general trend of N.30°W. but is more sinuous than the main zone. It has been drilled for a length of 1,000 feet. Its width is ordinarily between 50 and 60 feet but sulphide mineralization extends in some sections over widths up to 220 feet. Below the 350-foot horizon the copper content decreases appreciably. There is evidence of a fault intersecting the east zone at about the 350-foot horizon.

According to a progress report to the shareholders of the company dated February, 1952, these two zones contain 908,700 tons of indicated ore grading 2.17 per cent copper, 0.009 ounce of gold and 0.51 ounce of silver per ton between the surface and the 350-foot horizon. Deep drilling has established continuity below the 1,000-foot horizon.

Obalski (1945) Ltd.

Ref.: Que. Bur. Mines, Ann. Rept. 1929, Pt. D, pp. 60-62
Geol. Surv. Can. Mem. 185, pp. 70-74
Que. Bur. Mines, P.R. No. 111, p. 16
Que. Bur. Mines, Ann. Rept. 1936, Pt. A, pp. 95, 96
Que. Bur. Mines, P.R. No. 120, pp. 37, 38
Que. Dept. Mines, P.R. No. 227, pp. 113, 114

This property comprises 25 claims numbered Q.881-85; Q.1152-53; Q.1211-17; Q.3258-62; Q.3283-84; Q.3287-89 and Q.3291. Claim Q.1215 is in McKenzie township. The remaining claims of the group are in the north central part of Obalski township. A shaft 277 feet deep is located in claim Q.1213, 8,400 feet west of the north-south centre line of the township and 2,500 feet south of its north boundary. A motor road to the shaft area branches from the Chibougamau highway at a point 1,300 feet south of mile post 143.

Work was done on this property by Obalski-Chibougamau Mining Company Ltd. in 1928 and 1929, Obalski Mining Corporation in 1936, 1937 and 1939, Obalski (1945) Ltd. in 1946 and Campbell Chibougamau Mines Ltd. in 1951. The work done includes stripping, trenching, diamond drilling, geophysical surveys, construction of tractor

roads and buildings, shaft sinking, and 1,176 feet of underground development work. Levels have been established at the 150- and 250-foot horizons.

The northern part of the property is underlain by basic volcanic rocks. Elsewhere the rocks are gabbroic intrusives of the Doré Lake group, cut by apophyses of quartz diorite and granodiorite of the David Lake group.

The most promising gold discoveries have been made in the vicinity of the shaft. Most of the work has been carried out on 3 quartz veins known as A, C and D veins. These veins vary in strike from east to southeast and lie along narrow, somewhat discontinuous shear zones. The shear zones have a horsetail arrangement branching away from a sharp bend in a fault where its strike changes from east to southeast. This flexure is located approximately 9,500 feet west of the north-south centre line of the township and 2,300 feet south of its north boundary. The quartz veins lie for the most part in fine-grained gabbro. The parts of the veins which lie in quartz diorite or quartz gabbro contain considerably less gold.

D Vein

The D vein strikes approximately east and dips 75° south to vertical. It has been traced for 1,200 feet and is 6 inches to 1 foot wide. It lies along a shear in fine-grained gabbro. The shear joins the fault described above 400 feet west of the vein.

The D vein consists of milky quartz well mineralized with chalcopyrite and pyrite. In polished section some pyrrhotite and a little sphalerite were found associated with the chalcopyrite. Locally there are vugs in the vein. As the shear zone becomes weaker at the east and west ends of the exposed parts of the vein, the vein becomes narrower and more lens-like. This vein has been explored to a depth of 600 feet by diamond drilling.

According to company assay plans, the part of the D vein exposed at the surface is 528 feet long and contains 1.09 ounces of gold per ton over a width of 15.9 inches or 0.50 ounce over a width of 38.4 inches. A part of this is a high-grade shoot which has an average tenor of 1.78 ounces per ton over a length of 110 feet and a width of 20 inches. Eleven diamond drill holes, drilled over a length of 1,200 feet to intersect the vein at depths and ranging from 110 to 608 feet, showed gold tenors up to 0.04 ounce per ton for core lengths of 0.6 to 3.2 feet.

A Vein

The A vein lies about 300 feet southeast of the D vein, along a discontinuous shear zone which has been traced for a length of 1,600 feet.

Other discontinuous quartz veins are found along this zone for a further 800 feet to the southeast; their gold tenor is low. The A vein strikes N.70°W. and dips close to vertical down to the 200-foot horizon. Below this it dips 70° southwest. Diamond drilling has established the continuity of the vein to a vertical depth of 360 feet. The southeast part of the vein lies in quartz gabbro and quartz diorite. According to assay plans of the trenching, the gold tenor is lower in this part of the vein.

The A vein consists of milky quartz which in places contains vugs. The largest vug noted is 3 feet by 3 feet by 2 feet. It is lined with quartz crystals which are cut by fractures filled with massive chalcopyrite. The vein has a maximum width of 7 feet, but is ordinarily between 1 and 3 feet wide. Narrow stringers from this vein branch off into the wall rock. The vein is mineralized with pyrite and chalcopyrite as lenses and stringers up to 3 inches wide. According to company assay plans, the average tenor of this vein at the surface is 0.28 ounce of gold per ton and 2.76 per cent copper for a length of 256 feet and a width of 50 inches. This vein was explored by 9 diamond drill holes over a length of 600 feet. Intersections at vertical depths of 82 to 360 feet were encouraging, the best three being 22.4 feet at 0.09 ounce of gold per ton and 2.00 per cent copper, 17.9 feet at 0.07 ounce of gold per ton and 3.17 per cent copper and 6.8 feet at 0.226 ounce of gold per ton and 6.16 per cent copper. Further drilling on this vein was carried out in 1951 by Campbell Chibougamau Mines Ltd. No important mineralization was reported.

C Vein

The C vein lies along a moderate shear about 5 feet wide which strikes N.65°W. and dips 60° southwest to vertical. West of the vein the shear curves towards the west and merges with the shear containing the A vein. The C vein has been traced for a length of 885 feet on the surface and explored to a depth of 340 feet by diamond drilling. It has a maximum width of 3 feet.

The C vein consists of well fractured milky quartz. It is somewhat lens-like; also small veinlets of quartz branch into the country rock. Pyrite occurs abundantly along fractures in the quartz. Only a little chalcopyrite occurs in this vein.

The C vein has been trenched and sampled for a length of 540 feet. Four high-grade shoots are reported to have the following gold content at the surface:

No. 1 shoot (at east end) - 0.78 ounce of gold per ton for a length of 75 feet and a width of 40.1 inches.

No. 2 shoot (55 feet west of No. 1) - 0.49 ounce of gold per ton for a length of 40 feet and a width of 18.7 inches.

No. 3 shoot (205 feet west of No. 2) - 0.78 ounce of gold per ton for a length of 45 feet and a width of 12.3 inches.

No. 4 shoot (70 feet west of No. 3) - 0.51 ounce of gold per ton for a length of 25 feet and a width of 21.2 inches.

The above tenors are for the vein only. The wall rock is mineralized but the gold content is low. No. 3 and No. 4 shoots are separated by drift and there is a possibility that they are two parts of a single continuous shoot.

The vein has been explored to a depth of 340 feet by 4 diamond drill holes spaced over a length of 600 feet. The best intersection reported is 1.80 ounces of gold per ton for a core length of 4.0 feet.

The company reports 150,000 tons with an average tenor of 0.404 ounce of gold per ton and 1.18 per cent copper for the A, C and D veins. Several other veins occur on the property, but their gold tenor is reported to be low.

A vein 1 to 3 feet wide, striking a few degrees west of north, was discovered on the east edge of a hill 6,000 feet west of the north-south centre line and 2,900 feet south of the north boundary of the township. It is mineralized with pyrite and chalcopyrite. A sample taken by the writer was found to contain 0.017 ounce of gold per ton and 1.04 per cent copper.

In the fine-grained gabbro 2,300 feet south and 400 feet west of the Obalski shaft a sulphide zone of the replacement type has been explored by trenching. Its site is indicated by an anomaly on the electrical survey that was carried out on the property. The sulphides consist of chalcopyrite, pyrrhotite and pyrite as veinlets up to 1/4 inch wide and as disseminations in the gabbro. Quartz veinlets are also present in this zone and magnetite is common in the gabbro. A sample taken from this zone by the writer contained 0.002 ounce of gold per ton, 1.84 per cent copper and a trace of nickel.

A narrow, sparsely mineralized quartz vein outcrops on the southwest shore of Cachée bay. It strikes N.35°W. and dips 80° northeast. A sample taken by the writer assayed 0.028 ounce of gold per ton.

Quebec Chibougamau Goldfields Ltd.

Ref.: Que. Dept. Mines, P.R. No. 283, pp. 45-47

This company holds a group of 19 claims in McKenzie and Obalski townships. The claims in Obalski township are numbered C.30220, claims 1 to 5; C.30298, claim 4; C. 39202, claims 1, 2; C.41286, claims 1, 2; and C.G.2325, claim 3.

A copper-bearing zone on this property, under the northeast tip of Merrill island, has been traced for 400 feet by diamond drilling. It strikes N.38°W. and dips steeply to the northeast. The structure which controls the mineralization consists of 3 nearly parallel southeasterly-trending shear zones which dip steeply southwest and are linked by a set of parallel shear zones which dip steeply to the northeast. The northeasterly-dipping shears have characteristics which indicate both tensional and shear stresses. It is along the tension shears that the sulphide mineralization occurs. Since the northeasterly-dipping link-shears, which are mineralized, join with the southwesterly-dipping shears before they reach surface, the sulphide mineralization itself does not reach surface but is capped by 80 to 100 feet of schistose anorthosite. The vertical range of the mineralization is controlled by the dip length of the northeasterly-dipping shears which link the southwesterly-dipping shears. It is about 1,000 feet in the most strongly mineralized parts outlined by diamond drilling near the southeast end of the deposit. Towards the northwest the shears become narrow and the mineralization dies out. Towards the southeast, the structure is truncated by a series of 3 northeasterly-trending faults which lie along the channel between Merrill and Lefebvre islands and converge just south of the property to form a single fault along the southeast side of Merrill island (p. 32). The extension of the mineralized zone to the east of the fault has not been found.

Many grey dykes, both massive and porphyritic, lie along this zone and a diorite dyke 30 feet wide lies parallel to the sulphide zone 160 feet to the north on the hanging wall side. The dykes dip steeply to the southwest whereas the ore dips steeply to the northeast. The diorite dyke has been intersected by diamond drilling to the east of the fault which offsets the mineralized zone. There is an apparent horizontal displacement of 250 feet along this dyke west side southward.

The sulphide mineralization consists of pyrrhotite and pyrite with coarse chalcopyrite and locally sphalerite and a little galena. Small amounts of gold and silver are reported to be associated with the sulphides. The sulphides occur as stringers, massive lenses and disseminations replacing schistose anorthosite and the matrix of only weakly schistose but strongly brecciated anorthosite. The mineralization is, for the most part, similar to that of the other sulphide deposits on Merrill island. There is some evidence of chalcopyrite cutting sphalerite, suggesting an overlapping in periods of deposition of these two minerals.

Between June 1950 and April 1951, 28,435 feet of diamond drilling was done on the property. According to company reports, some of the diamond drill intersections of the main sulphide zone gave the following results:

Hole No.	Vertical Depth Feet	True Width Feet	Au Oz. per ton	Ag Oz. per ton	Cu Per Cent	Zn Per Cent
Thirty feet from southeast end of sulphide zone						
S-19	135	20	0.014	1.07	1.9	1.5
S-20	215	12	0.007	0.99	3.1	1.4
S-29	405	12	---	--	4.0	0.5
Sixty feet from southeast end of sulphide zone						
S-13	170	20	0.005	0.88	3.3	2.0
S-21	275	17	0.009	0.56	2.2	1.0
S-27	335	10	---	0.45	2.4	3.2
One hundred and sixty-five feet from southeast end of sulphide zone						
S-10	155	9	0.02	0.72	1.7	0.3
One hundred and eighty feet from southeast end of sulphide zone						
S-22	325	8	0.003	0.55	3.0	1.8

The company estimates that the sulphide zone contains 500,000 tons of mineral with an average of 2.2 per cent copper and 1.2 per cent zinc.

Two other structural zones of interest which occur on the property merit further investigation. One of these lies just north of the Quebec Chibougamau sulphide zone and is in reality the continuation of the sulphide-bearing structure. At least 3 parallel, south-westerly-dipping shear zones from 40 to 120 feet apart are present and are cut by dykes of grey fine-grained quartz diorite and grey feldspar porphyry. This appears to be a duplication of the structure containing the sulphide deposit. The other is a sinuous southeasterly-striking shear zone crossing the base of the promontory containing the Quebec Chibougamau Goldfields sulphide deposit, about 1,000 feet south of its

most northerly tip. Where exposed on surface it is 15 to 20 feet wide and dips 60° southwest. The fault apparently continues under the lake, northwest towards the McKenzie Narrows fault, its course being indicated by a resistivity survey. The rock on the shore of Merrill island, 150 to 200 feet south of the fault, is well jointed and contains many narrow discontinuous shears. These shears are mineralized with disseminated pyrite and in a few places lenses of chalcopyrite and pyrite up to 4 feet long and 6 inches wide. A sample of this mineral taken by the writer assayed 0.01 ounce of gold per ton, 0.27 ounce of silver per ton, 3.14 per cent copper and no zinc. The mineralization appears to be stronger nearer the fault.

Royran Gold Fields Ltd.

Ref.: Que. Dept. Mines, P.R. No. 283, p. 47

This group consists of 10 claims, C.6063, claims 1 to 5, and C.9339, claims 1 to 5. The extreme northern part of the property is underlain by diorite, quartz gabbro and gabbro; the remainder is underlain by anorthosite. The McKenzie Narrows fault passes through the southern part of the property. Diamond drilling along this fault indicates that it dips 35° northwest. The shear zone consists of talc schist and has a width of 300 feet.

Following a resistivity survey which was made in the winter of 1949-50, 4 diamond drill holes were drilled on the hanging wall side of the McKenzie Narrows fault to test a rather widespread anomaly. This anomaly was found to be caused by stringers and disseminations of pyrite in altered anorthosite. In addition, 11 exploration holes were drilled, of which 4 were directed to intersect the McKenzie Narrows fault and 2, the extension of the Kayrand sulphide zone into the Royran Gold Fields property. In all, 8,400 feet of diamond drilling was done on this group. It is understood that no important mineralization was encountered.

Titanic Mine Holdings Ltd.

This group of 15 claims, in the northwest corner of the township, comprises C.8952, claims 4, 5; C.30235, claims 4, 5; C.37024, claims 1, 2; C.43775, claims 1, 2; C.46119, claim 3; C.46146, claim 2; and C.G.2780, claims 1 to 5. Numerous stringers of milky quartz containing some carbonate are present on this property. There are vugs in some of the stringers of quartz. On the picket line which crosses over an east-facing cliff 5,700 feet east of and 5,300 feet south of the northwest corner of the township, there are some quartz veins and irregular small masses of chalcopyrite and pyrite. A similar occurrence along a shear zone 3 feet wide which strikes N.38°E. is exposed in a trench 40 feet north of the picket line.

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