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QUEYLUS AREA

ABITIBI-EAST AND ROBERVAL

ELECTORAL DISTRICTS

by

P.-E. IMBAULT

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QUEYLUS AREA

ABITIBI-EAST AND ROBERVAL ELECTORAL DISTRICTS

by
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INTRODUCTION

Location and Means of Access

The Queylus area, mapped during the summer of 1950, is part of the Chibougamau Region. It is bounded by latitudes 49°30' and 49°45' and by longitudes 74°15' and 74°30'. It comprises 193 square miles, and includes almost all of Queylus and La Dauversière townships as well as small parts of Fancamp, Haüy, Scott, and Obalski townships.

The map-area is located south of what has been considered, for almost half a century, as the "Chibougamau Mining District". It has been crossed by countless travellers on their way to Chibougamau lake and the surrounding regions.

Until 1911, the easiest way to reach the District was by way of Chamouchouane (Ashuapmuchuan) river from Lake St. Jean. This route is described in detail in chapter four of the report of the Chibougamau Mining Commission (1911). The route entered La Dauversière township through a small lake 3 miles south of the highway. Thence, a chain of lakes in La Dauversière township was reached via a shallow and tortuous stream interrupted by many rapids. From Calmor lake, in the southwestern corner of Queylus township, Inlet bay of Chibougamau lake was attained by alternately canoeing in shallow creeks and lakes, and portaging.

The completion, in 1911, of the Canadian National Railways line between Quebec and Cochrane permitted the use of a shorter and easier canoe route to the Chibougamau District. This route starts at the village of Oskelaneo, 210 miles northwest of Quebec City, and leads to Nemenjiche river in the southwest corner of the map-area.

More recently, hydroplanes have been used to penetrate into the region from water bases at such localities as Roberval, St-Félicien, Oskelaneo, Senneterre, and Amos.

Today, and since the completion of the Chibougamau road in 1949, the canoe routes are of historical interest only. The Chibougamau highway extends almost 150 miles from St-Félicien to the heart of the Chibougamau Region. It crosses the map-area in a northwesterly direction. The mileages in this report and on the accompanying map refer to distances from St-Félicien.

Travel Facilities Within the Area

Access to any locality within the map-area may be gained easily and rapidly. In the south, no point is more than 3 miles from one of the numerous lakes, or the streams and narrows that connect them. This chain of lakes may be reached from the highway by two canoe routes. The easier route starts at Perron lake, mileage 121.4, and leads into the east end of La Dauversière lake through Laurent lake. Two short portages link these three lakes. The other route starts at mileage 129.2 and leads through Calmor lake to the northeast extension of Chevrier lake. This latter route is locally called the "Mistassini Route" because it used to be followed, as mentioned above, by early explorers on their way to the Chibougamau and Mistassini regions. There are three portages on this route, one being more than 4,000 feet long. Any point in the northern part of the map-area is easily reached either from the road or from the numerous bays of Chibougamau and Merrill lakes.

If preferred, short aeroplane flights may be made to any suitable lake, either from Caché lake (mile 139 of the road), base of Mont Laurier Aviation Company, or from La Blanche lake (mile 112), base of Boreal Airways, Limited.

Travelling on foot in the bush is generally easy because undergrowth is scarce. This is in marked contrast to regions a few scores of miles to the west, as between Mattagami and Waswanipi lakes, where windfalls, alders, and secondary growths of spruce often present almost impassable barriers.

Previous Work

The first geological work within the map-area was done

by James Richardson (1872), on his traverse from Lake St. Jean to Waconichi lake. This most able geologist accurately recognized the three main rock groups and his subdivisions are still maintained today. Richardson's contribution may be summarized as follows: (1) he separated the Obatogamau granite (Dauversière stock) from the gneisses (Southeastern gneisses); (2) he described the schists north of Obatogamau lake (the present volcanic series); (3) he identified the gabbro-anorthosite complex of Lake Chibougamau.

Many other explorers and prominent geologists crossed the map-area in the first 40 years after Richardson. Most of them, however, being on their way to farther fields, did not record their observations and, therefore, added practically nothing to Richardson's work. Then came Joseph Obalski and A.P. Low.

Following the discovery in 1903 of what were believed to be valuable deposits of asbestos, copper, and gold, Obalski (1904), then Inspector of Mines for the Province of Quebec, explored the Lake Chibougamau region. The map accompanying his report shows his interpretation of the rocks around and north of Obatogamau lake. These rocks were subdivided into two groups, the contact between them trending southwestward from near the northeast corner of the present map-area. Southeast of the contact, the rocks were "Laurentian granites and gneisses" whereas, to the northwest, there was a "massive diorite (so-called Huronian) which varies in colour from dark to light-green and sometimes presents a schistose appearance". From all the evidence, this diorite formation is the same as the volcanic group of the present report.

In the following year, Low (1906) travelled for the second time from Lake St. Jean to Chibougamau, passing through the map-area. The relevant portion of his map shows three rock groups: (1) biotite granite around Obatogamau lake (probably younger than (2); this is the Dauversière stock; (2) hornblende granite and gneiss around the southern half of Lake Chibougamau; (3) Lower Huronian - diabase and diabase schist (this includes the lavas between Obatogamau and Chibougamau lakes), and the bedded conglomerate, quartzite, and arkose found about Waconichi lake.

In 1910, the Chibougamau Mining Commission (1911), appointed to determine the advisability of building a railroad to Chibougamau, examined an area of 1,110 square miles, the southern limit of which was just south of Chibougamau lake. The northern two

miles of the present map-area was included in this examination. The rocks found there are described as Laurentian granite and diorite gneiss. Following the rejection of the railway project, interest in the Chibougamau region died down, and geological exploration was at a standstill for many years.

Parts of the volcanic belt and of the Dauversière stock are shown on the Nottaway map-sheet, a compilation of an extensive area in northwestern Quebec prepared in 1927 by H.C. Cooke.

In 1929, Tolman (1930), for the Geological Survey of Canada, carried on geological mapping in the Obatogamau River area. His examinations were mostly confined to the waterways, so that, although the rock types were accurately recognized, their extensions and contacts were not defined.

It was not until 1938, following the work of Mawdsley in 1927 and 1930, and of Norman in 1935, that a map (the Chibougamau sheet, East Half) was published which showed with fair completeness and accuracy the main rock groups of the district (Mawdsley and Norman, 1938). The Queylus area is located in the northeast quadrant of the Chibougamau Sheet, East Half. It is the first area of the sheet to be mapped since 1938 at the scale of one-half mile to one inch.

Acknowledgments

The base maps used during the field work were prepared by the Department of Lands and Forests, Quebec. Vertical aerial photographs of different sources and value were used constantly in the field. Those covering Queylus township were taken by Photographic Surveys Limited, in 1947, and are excellent both as to clarity of detail and uniformity of scale. The ones covering La Dauversière township were taken by the Royal Canadian Air Force in 1929, and proved very useful particularly for shoreline mapping.

The field party included Stanley W. Holmes of Cornell University, senior assistant; André Deland of McGill University, junior assistant: Gerard Brassard and Mauril Perron, canoemen; Aurelien St. Gelais, driver; and Henri Blanchette, cook. All discharged their duties in a satisfactory manner.

Sincere thanks are due to the local officials of H.J. O'Connell Limited, particularly Messrs. W.C. Smyth, P. Cleary, and E. Thomas, for numerous courtesies and services.

PHYSICAL FEATURES

Topography

The map-area lies close to the eastern border of a long plateau that slopes gently westward for 150 miles. With a few exceptions, the local relief is only a few scores of feet above the level of the lakes. In Queylus township most of the surface forms are of glacial origin, whereas in La Dauversière township the characteristic appearance of the granitic terrain that is so common throughout the Shield is maintained.

Evidence of glacial action is widespread in Queylus township. Perhaps the most conspicuous features are ridges of sand and gravel that trend northeast. Individual ridges are up to 4,000 feet long by 800 feet wide. They are generally pointed at both ends, although some of the ends are quite blunt. They may represent either drumlins or moraines. Other hills of less definite shape and orientation, like the one on the northwest side of the bridge across Queylus bay, also may represent moraines.

A few eskers have been noted. They show up very plainly on aerial photographs, but are generally difficult to identify on the ground because of vegetation. The esker 2 1/2 miles southeast of Line bay, in the northwest section of the map-area, is about 15 feet high and 50 feet wide, and is rounded in cross-section. Other eskers are less conspicuous in the field, but, from their appearance on photographs, they seem to have similar dimensions.

The northeast trend in Queylus township is also shown by a general alignment of lakes, streams, and swamps (Plate I-A). The streams are all post-glacial, and a northeast-southwest direction has been imposed on them by the shape and orientation of the glacial deposits. The drainage is poorly developed in this township, as indicated by the presence of countless swamps and muskegs.

The topography in La Dauversière township does not show any definite trends, and so is in marked contrast to that in Queylus. This is due to the fact that La Dauversière township is underlain by granitic rocks for the most part. The surface is generally hummocky and the hillocks seldom attain an elevation of more than 30 feet above the level of the adjacent lakes.

Two prominent hills stand out above the plateau. One is immediately north of Perron lake, in the eastern part of La Dauversière township, and the other is near the northeast corner of the area, south of Chibougamau lake. They are about 150 feet above the general level, and are underlain by lava and gabbro, respectively. Their gently rolling tops, indented here and there by deep gullies, undoubtedly represent a pre-glacial erosion surface.

The highest relief of the map-area is found in the southeastern section. The hills there belong to the northeast-trending height-of-land that separates the Hudson Bay and St. Lawrence drainage systems. A surveyed line approximately follows the crests of the hills and marks the boundary between Abitibi-East and Roberval counties. Seen in longitudinal section, the height-of-land consists of a succession of cuesta-like hills with slopes steep to the north but long and gentle to the south (Plate I-B). The summits of the hills are the remnants of an old peneplain that now stands a little over 1,500 feet above sea level (Chibougamau-Roberval topographic map, Department of Mines and Resources, Ottawa, 1942).

Drainage

The greater part of the map-area lies on the northwest side of the height-of-land, and hence drains to Hudson Bay. A few square miles in the southeastern section drains into Lake St. Jean through the Nicabau-Chamouchouane (Ashuapmuchuan) river system. Two basins collect the main runoff of the area: Chibougamau lake in the north, and a chain of lakes in the south.

Until 1950, the system of lakes that covers the southern half of the map-area and extends to the west had been known as the "Obatogamau" or "Oba-tuk-oman", meaning literally "Wooded Narrows Lake". Actually this system includes five lakes, separated by narrows, each of which has a very complex outline consisting of long points and deep intricate bays. To avoid confusion and to facilitate description, the Quebec Geographic Commission subdivided "Obatogamau" into five distant lakes with the following names, from east to west: La Dauversière, Le Royer, Chevrier, Verneuil, and Fancamp. The first three lakes are within the boundaries of the map-area and the last two mostly in Fancamp township to the west.

Generally, the streams are shallow and, even at high water, they are interrupted by many rapids. At low water, navigation in the creeks and even in many of the lakes is dangerous.

Timber, Fish, and Game

Black spruce constitutes the main timber stand of the map-area. It is found everywhere except on the summits of the gravel hills. The trees are generally slender and are devoid of branches near their base (Plate II-A). The diameter of the butt is usually less than one foot although some are found that measure up to two feet or more. White spruce, tamarack, and Banksian pine are rare. Birch and poplar are found on many of the gravel ridges. They form a pleasant contrast with dark spruce which rapidly supersede them on the flanks of the hills (Plate II-B). Jack pines are not numerous but are widely distributed, particularly in the granitic areas of La Dauversière township. In places, they grow on bare rock (Plate III-A) where their subsistence depends upon small quantities of humus found in joints.

Two moose and a few muskrat were seen by different members of the party. Moose seem to be rather abundant in the southern part of La Dauversière township. A few bear tracks and sign of foxes were also noted.

Pike and pickerel are abundant in all the large lakes. White fish and lake trout may be caught in Chibougamau lake. Speckled trout were sought, particularly in the small lakes and creeks, but without success.

GENERAL GEOLOGY

General Statement

All the consolidated rocks of the map-area are of Precambrian age. They constitute two main groups of about equal extent. The older group is largely volcanic and possibly Keewatin in age. It is a complex of lavas (basaltic and andesitic) with minor quantities of pyroclastics, sedimentary rocks, and sills of diorite and gabbro. The younger group consists of several types of rock which are intrusive into the first group.

It should be noted that, on the accompanying Table of Formations and on the map, the gneisses and the dark schists cropping out in the southeastern corner of the area have been shown separately from the two main groups. This separation has been made because, in the past, these rocks have been assigned to the Grenville sub-province. In this report the dark schists are assigned to the Keewatin-type rock, and the gneisses, to the later intrusive group.

The areas underlain by the main rock types are estimated as follows:

Volcanic group	95	square	miles
Dauversière stock	60	"	"
Northern granite	20	"	"
Gabbro-anorthosite	10	"	"
Verneuil stock	2	"	"
Southeastern Gneisses and schists	6	"	"
	193	"	"

Table of Formations

CENOZOIC	Gravel, sand, clayey sand	
	Unconformity	
PRECAMBRIAN	Diabase dykes (Keweenawan?)	
	Intrusive contact	
	Verneuil stock: massive biotite granite Dauversière stock: biotite granite Northern (Chlorite) granite Gabbro-anorthosite	Southeastern gneisses: biotite granite orthogneiss
	Intrusive contact	Intrusive contact
	Volcanic group (Keewatin type): - Sills of diorite and gabbro - Sedimentary rocks: biotite and hornblende schists - Pyroclastic rocks: tuff and volcanic conglomerate - Lavas: recrystallized and altered basalts and andesites	Dark hornblende-garnet schist

Keewatin-type Rocks

Keewatin-type rocks underlie the central and southern parts of the map-area, with the exception of the extreme southeast corner and a large circular mass of granite in the central part of La Dauversière township. North of the granite body, the volcanic belt is 5 to 8 miles wide. Due to the scarcity of exposures, its contact with the intrusives to the north is somewhat indefinite. The contact seems to trend southeast from the northwest corner of the area to the vicinity of Inlet bay. In this distance chloritic granite lies to the north of the volcanic rocks. Farther east, the granite gives place to gabbro-anorthosite, and the contact runs eastward for about 3 miles before turning sharply northeast. The boundary between the Keewatin-type rocks and the southeastern gneisses crosses the southern border of the map-area 3 miles west of the eastern margin and trends northeasterly. East and west of the Dauversière stock, the volcanic and associated rocks are squeezed into narrow belts by the granitic mass.

The Keewatin-type rocks are an essentially igneous complex with minor amounts of sedimentaries. The igneous members include lavas (basalt with some andesite), pyroclastics, and sills of gabbro and diorite. The exact proportion of each rock type is difficult to estimate for several reasons: the restricted area of individual exposures; the general dirtiness of exposed surfaces; the relatively great distances separating exposures; the similarity in composition and appearance of different formations, particularly the lavas; and the great complexities in the detailed structure of the belt. In this area, the belt of Keewatin-type rocks is believed to consist predominantly of lavas of intermediate composition with interlayers of the other rock types.

Lavas

The lavas are grey to black and generally fine-grained. Deformed pillows and amygdules are common, but flow structures are scarce. The amygdules, usually small and lenticular, consist of one or more of the following minerals: quartz, epidote, calcite, feldspar, chlorite, and hornblende. In many instances, thin veinlets mark the narrow channels through which the mineral solutions travelled to the vesicles.

The degree of schistosity varies from absent in some places to well-developed in others. Such variation is thought to be the result of differences in competence between the cores and the margins of the flows because, where the rock is coarser, it is generally more massive.

The lavas are of intermediate composition, being mainly basalt with some andesite. However, many facies have developed throughout the belt as a result of variable metamorphism. As far as could be ascertained through microscopic studies of thin sections, few of the minerals are of primary origin.

Typical or fresh basaltic lava is fine-grained, and dark to almost black with a deep greenish tinge. It consists essentially of hornblende and feldspar with small amounts of quartz, epidote, zoisite, magnetite, calcite, sphene, and apatite. Hornblende is the predominant mineral, constituting up to 90 per cent of the rock. The properties of the hornblende vary with the degree of crystallinity of the rock. In rocks where the grains are ragged and shred-like, the hornblende is pale and the birefringence is lower than usual. In rocks characterized by a well-developed granoblastic texture, the hornblende granules show the normal deep-green colour and distinctive pleochroism, and the birefringence is high. The feldspar grains are very clouded and, except for the beginning of a porphyroblastic texture in one thin-section, all are shapeless. The composition of the feldspar was not accurately determined; it seems to be a plagioclase of the albite-oligoclase calcity.

A common variation of this fine-grained basalt is a rock that has a much lighter, distinctly green colour. This colour is a reflection, not of the amount, but of the type of dark minerals present, ordinary hornblende being either replaced by a pale actinolite or partly to completely changed to chlorite with a concomitant formation of epidote. Some of the epidote, however, has undoubtedly formed through the breakdown of the original plagioclase.

In a few places throughout the belt, rocks occur with a much coarser grain (up to 2.5 mm.) than the ones described above. These are dark grey or green and massive. Although it is difficult to separate lavas from concordant intrusives of similar composition it is believed that some of the coarser rocks represent the central parts of rather thick flows. In some of the exposures, faint curved lines suggest pillow structures and, in one case, a coarse massive bed appears to grade laterally into a pillowed border zone.

The flows are porphyritic, consisting mainly of metacrysts of pale hornblende or actinolite, set in a fine-grained, probably granulated groundmass in which epidote, kaolin, and albite predominate. The metacrysts are subhedral and slightly altered to chlorite. Their somewhat ragged borders may be the result of disintegration, in which case these large crystals would be the primary phenocrysts of an originally porphyritic flow.

The influence exerted on the lavas by the main intrusive masses was noted in a few localities in the map-area. Two different types of changes have taken place. Some inclusions have been baked with little or no addition of material. They are now dark, hard, brittle hornblende schists with individual hornblende prisms up to 2.5 mm. long. Many of the grains are bent and broken, testifying to the great external stresses that have acted on the rocks. The other constituents of the hornfels are sodic plagioclase, epidote, sphene, apatite, and some biotite probably derived from hornblende. Other inclusions, as well as the border rocks, have undergone not only recrystallization but addition of material. All stages in the transition from pure lava through intermediate contaminated facies to a pure intrusive rock may be seen.

In accordance with a standard set many years ago in Northwestern Quebec (Cooke, James, and Mawdsley, 1931), lavas in which feldspar predominates over hornblende are called andesites. Rocks of this type here are fine-grained, generally grey, massive to highly schistose, and have a pronounced fluidal texture. Although found in numerous localities in the volcanic belt they do not form consistent bands, and they were not mapped separately from the basalts. They seem to be a reflection of occasional variations in the composition of the magmatic source.

The feldspar of the andesite is a plagioclase of low calcity and constitutes up to possibly 75 per cent of the rock. The feldspar crystals commonly are well-shaped, and are surrounded by filaments of dark minerals. The ferromagnesian mineral is a pale, partly chloritized hornblende. Calcite occurs either as narrow stringers or in lenses and cavity fillings that probably are amygdaloidal in nature.

Two exposures along the highway near mile post 126 probably belong to this group. The rock is light-grey, schistose, and grades laterally into a creamy, highly talcose schist. The less altered type is a mixture of calcite and green chlorite with a small percentage of quartz.

Pyroclastic Rocks

A belt of tuff is exposed on the west shore of Le Royer lake. This belt is more than 5 miles long and from 500 to possibly 1,000 feet thick. The rocks are light coloured, generally pale grey to brown, and show only a very rough stratification. They consist of small angular fragments, a fraction of an inch in size, distributed erratically in an almost aphanitic matrix.

Under the microscope, the tuff appears to be a porphyry. Most of the fragments visible in hand specimen are either fairly complete crystals or pieces of crystals of plagioclase. Large broken grains of quartz occur here and there. The fragments constitute from 10 to almost 60 per cent of the rock. The matrix is composed of quartz, feldspar, calcite, epidote, chlorite, iron oxides, pyrite, sphene, apatite, and sericite. The flaky minerals, namely sericite and chlorite, are generally aligned to give a more or less pronounced schistose structure.

Similar rocks were seen at numerous places in the volcanic belt as thin layers between successive lava flows. In most instances, however, these tuffs show good stratification and strong schistosity. The stronger schistosity here probably resulted from the fact that stresses were more effective on such thin beds than on the thick tuffaceous belt west of Le Royer lake and on the more competent lavas.

A much coarser type of fragmental pyroclastic is exposed on the south shore of Merrill lake. The formation, which may be as much as 500 feet thick, is really a volcanic conglomerate. It consists of rounded to elliptical fragments up to three inches long in a fine-grained, greyish matrix. The matrix is similar to the tuffs that are exposed on the west shore of Le Royer lake whereas the fragments are essentially pinkish feldspar and some chlorite.

Sedimentary Rocks

Rocks of sedimentary origin occur in three main localities within the main belt of Keewatin-type rocks. They seem to represent different stratigraphic horizons in the volcanic sequence. As their composition varies from one locality to another, it is unlikely that they are repeated by folding or faulting.

A sedimentary unit probably close to 2,000 feet thick is indicated by a few exposures on the shores of a south-trending bay of La Dauversière lake, about 2 miles east of mile post 14 on the La Dauversière-Fancamp township line. A similar rock is exposed in the narrows between the two southernmost lakes in Des Trois Lacs bay. It probably constitutes a part of the same formation, and has been interpreted as such on the accompanying geological map.

Because of their proximity to the Dauversière stock, these rocks are highly schistose and contorted. In addition, they have been injected by material of granitic derivation: granitic dykes, quartz veins, epidote stringers and disseminations, and pyrite mineralization.

The rocks are fine-grained, light grey on fresh surfaces, and brown-weathering. The finest-grained types appear dense or glossy whereas the coarser ones are granular and feel gritty.

Feldspar constitutes as much as 80 per cent of these sedimentary rocks. Although generally clouded, it was identified in one section as An_{28} to An_{30}. The other minerals, in order of decreasing importance, are quartz, biotite, hornblende, epidote, pyrite, and magnetite. These rocks may be classed as "biotite hornblende schist", and probably were originally a feldspathic greywacke.

Another horizon of probable recrystallized greywacke crops out near mile post 129 along the highway. These rocks also are fine-grained and light grey, but are lighter-weathering and much more dense than the ones described above. They consist essentially of albite (75%), pale green hornblende (15%) and quartz (less than 10%). Sericite and sphene are accessory. The grains of hornblende are aligned to produce a faint schistosity. Interbeds of chert are common. They consist of pale-green, aphanitic layers alternating with generally thicker layers of greyish-green, slightly coarser rock.

Darker rocks of sedimentary origin are exposed at two places along the highway short distances north and south of Dufresne lake near the eastern boundary of the map-area. They are fine-grained, dark-grey to black, and schistose. Because of the uniformity of grain size and composition, bedding is generally quite inconspicuous. In a few places, however, alternating beds, a fraction of an inch in thickness, are apparent.

Hornblende and quartz are the essential minerals of the sedimentary schists. In the lighter beds, the proportions of these two constituents are approximately 60 to 40; whereas, in the darker layers, the ratio may be as high as 90 to 10. The hornblende is the normal dark green variety and is found as parallel sub-idioblastic crystals. Quartz occurs mostly as elongated masses without lattice orientation. In some of the lighter beds, the two minerals often form narrow bands, less than 2 mm. wide, and the rock appears gneissic.

Other minerals of this sedimentary unit are epidote, calcite, pyrite, and magnetite. The calcite and epidote did not result from the breakdown of an original plagioclase, as is shown by two facts. Firstly, no remnants of feldspar have been detected under the microscope. Secondly, the two minerals occur in well-shaped grains along the planes of schistosity, in a manner that suggests hydrothermal introduction rather than development in situ.

Sills? of Diorite and Gabbro

Rocks that have a coarser grain than the average lava occur in many places throughout the volcanic series. Some of them have already been interpreted and described as representing the cores of thick flows. Others are believed to be diorites and gabbros of intrusive origin. The lavas and sills (?) seem to be concordant, although contacts are seldom exposed. The intrusives (?) are probably related both in age and magmatic affiliation to the lavas. Such interlayering of lavas and concordant intrusives probably resulted from parts of the parent magma having been injected between flows along horizontal planes of weakness developed in the flows while cooling.

The rocks belonging to this group of old intrusives are characterized by a medium to coarse grain, a rather basic composition which is reflected by dark colour, a more massive structure than the enclosing lavas, and a complete absence of flow banding.

Actinolite is the predominant mineral in the gabbroic facies, and is the only mineral to have grains with definite crystal faces. The outlines, of course, vary in perfection, but in all thin sections the grains stand out quite distinctly amidst shapeless masses of other minerals, thus giving the rock a porphyritic appearance. Some of the grains have rectangular outlines with well-defined boundaries. Others terminate in hair-like filaments that seem to represent a non-completed stage of secondary (metamorphic) growth. Chlorite alteration is common in all the specimens.

Feldspar, the only other important mineral, is now almost completely altered to anhedral masses of kaolinite, epidote, clinozoisite, albite and sericite. Titanite, leucoxene, chalcopyrite, and quartz occur erratically and in accessory quantities only. These four minerals were probably introduced through hydrothermal solutions.

A dioritic facies was noted in a few localities. The rock is black and medium-grained, and its minerals are fresher than those of the gabbroic facies. The two essential constituents are hornblende (70%) and feldspar (25%). Hornblende is of the ordinary green variety and occurs in small subhedral grains, some of which form clusters. The feldspar grains are irregular in shape and broken. They are deeply embayed, and even separated into fragments, by small stringers of hornblende. Saussuritization of the feldspar is widespread although a few fresh grains are present and have been identified as An_{37}. The remainder of the rock consists of quartz, epidote, sericite, magnetite, and pyrite.

Southeastern Schists

The southeast corner of the map-area forms the apex of a small triangular area of about one square mile underlain by dark hornblende schists of doubtful origin. The northeast extension of the schists is exposed along the highway, east of the area, where it is about one mile wide. The rocks thus seem to form a large inclusion in the surrounding granitic gneisses.

The schists in general are fine-grained, granular, and have a pepper-and-salt appearance. A well-developed schistosity is imparted by an alignment of small flakes of hornblende. This mineral, constituting about 60 per cent of the rock, has a deep-green pleochroic colour.

Too few specimens are available to permit definite conclusions on the nature of these schists. They are made up of at least two interbedded types: (1) a fine-grained, granoblastic rock that contains no garnet and in which a calcic feldspar predominates over quartz; (2) a coarser, garnetiferous rock, in which a less calcic feldspar is about equal to quartz. The first type could be a lava, and the second, a sedimentary rock. However, the distinctions are vague.

The first of these types contains white, lenticular nodules of quartz and feldspar. The nodules are up to one-quarter inch long, and are reminiscent of the amygdules of the volcanic series. These schists consist essentially of a granoblastic assemblage of hornblende and feldspar. The feldspar is andesine, An_{40}. In addition to being disseminated throughout the rock, the feldspar is concentrated in places to form the greater part of the white nodules seen in hand specimens. Quartz forms about five per cent of the rock.

In the second type, the amount of quartz is about equal to that of feldspar (oligoclase, An_{25}). This type, in addition, contains about ten per cent of red garnet. The garnet crystals are more or less rounded and attain one-quarter of an inch in diameter. They contain poikilitic inclusions of hornblende and quartz, but none of feldspar.

These schists are not unlike some of the recrystallized Keewatin-type rocks in the map-area. They are more metamorphosed than the rocks of the volcanic group, but, on the other hand, they do not resemble any of the normal Grenville rocks. Unless they are given a separate position in the geological column, a step that is obviously unadvisable for the present, it is preferable to consider them as representing a higher metamorphic facies of the lavas and sedimentary rocks of the region.

Intrusive Rocks

Gabbro-anorthosite

Rocks of this group underlie two segments of the northern part of the map-area. The larger one has the form of a crescent and covers about 8 square miles south of the southeast bays of Chibougamau lake. The second and smaller section is poorly defined and consists of a few exposures near mile post 134 on the highway and in a small cliff on the southeast shore of the big island in Queylus bay.

The rocks exposed southeast of Chibougamau lake consist mostly of gabbro with minor amounts of anorthosite and a few inclusions of hornblende schist that are believed to be of volcanic origin. Mawdsley and Norman (1935) studied two exposures located on the northeast extension of this body. They expressed the opinion that these rocks may originally have been a part of the anorthositic rock that forms a large belt north of Chibougamau and Doré lakes. This hypothesis finds some confirmation in the fact that similar rocks are found in the northwestern part of the map-area and farther to the northwest, at least as far as mile 136 along the highway. The two separate masses within the map-area are close to the southern rim of the Chibougamau granite. It thus is probable that, at one time, rocks of gabbro-anorthositic descent formed a large, more or less circular, body which was later injected and in part displaced by the granite.

Most of this basic group is massive and medium-grained. However, coarse-grained types are found at two localities. On the westernmost of the three small points at the head of Line bay, a gabbro consists of crystals of amphibole up to three-quarters of an inch long and of grains of feldspar that are about half that size. At mile 134 on the highway an anorthosite is made up of altered plagioclase in grains up to one inch in length.

The colour of the rock depends on the mineral composition and also on the stage of alteration of the different constituents. The lightest-coloured facies of the group is an anorthosite consisting essentially of white feldspar and its grey alteration products. In places, this grey material is concentrated as clots and small lenses in a crystalline mesh of feldspar. In others, it surrounds individual crystals and the rock takes on a porphyritic appearance. In one specimen, the grey products compose the greater part of the rock and shapeless masses of white feldspar are distributed in this matrix. Under the microscope, the important minerals are seen to be clinozoisite, epidote, pale

chlorite, calcite, and white mica, all of which are clearly secondary. They form the bulk of the grey material. The partly clouded feldspar has been identified as oligoclase, An_{16}. The obvious conclusion is that the rock has been so altered that its primary constituents have been almost completely obliterated. The high proportion of calcium-bearing secondary minerals indicates that the original plagioclase was quite calcic. It may have been labradorite similar to that found in the fresh specimens of the main mass to the north (Mawdsley and Norman, 1935).

Darker members of this basic group are represented by rocks that have a general gabbroic appearance. They are commonly massive, although in a few places a faint gneissic structure, probably due to local movements, has been noted. Dark minerals constitute from 50 to almost 100 per cent of the total composition. A representative specimen studied in thin section revealed that this rock has undergone alteration similar to that of the anorthosite. The original texture might have been hypidiomorphic, but now only a few ragged grains remain. The amphibole is a discoloured hornblende partly changed to chlorite. The feldspar is completely saussuritized and clinozoisite is abundant.

These light and dark rocks occur so erratically that it is impossible to separate them, on the map, into distinct units. Moreover, their age relationships are not known with certainty. The only observation bearing on that problem was made on an exposure southeast of Line bay, where a dark gabbro is cut by a light-coloured dyke presumably related to the anorthosite. Both groups, however, are intruded by the granitic rocks described under the next heading.

Chlorite Granite

More than half of Chibougamau lake is underlain by granitic rocks that are intrusive into lavas and anorthosite. As described by Mawdsley and Norman (1935), the main part of the Chibougamau Lake mass consists of biotite granite with sodic plagioclase, in which the transformation of biotite into chlorite varies from slight to complete. Dioritic types form, in places, marginal phases of moderate extent.

The chlorite granite of the present map-area constitutes the southern extension of the Chibougamau Lake body. Its southern boundary is masked by heavy and continuous overburden and can only be inferred. It seems to enter the map-area near the northwest corner and to trend southeast as far as Inlet bay. In this distance the granite is in contact with the volcanic series. From Inlet bay the southern boundary strikes northeast to Line bay, following the northern contact of the larger of the two gabbro-anorthosite masses.

The rocks of this group are variable in composition, but quartz is sufficiently abundant throughout to warrant their being classed as granitic. Some phases are dioritic. The granites are generally grey or pinkish-grey, medium-grained, mostly massive, and possess an interlocking texture. Dark minerals vary from zero to 15 per cent, and, generally, they lack definite crystal boundaries; indeed, they appear as greenish stains rather than separate grains.

In thin section, the granite is characterized by a type of alteration similar to that of the gabbro-anorthosite group. The only dark mineral present is a light-green chlorite occurring as small flakes and large shapeless masses which, in some cases, contain a brownish, pleochroic core that is presumed to be biotite. It is thus inferred that biotite has been changed into chlorite through hydrothermal or deuteric action. The feldspars (50-70%) are extensively saussuritized and now consist mostly of a mixture of albite, white mica, and epidote. Epidote is also found in association with chlorite. Quartz is interstitial and forms 20 to 30 per cent of the rock. A slight granulation of the quartz indicates that the granite, after its consolidation, was subjected to dynamic stresses.

The position of the chlorite granite in the intrusive sequence is not known definitely. The granite is younger than the gabbro anorthosite, which it intrudes in several places, but its relations with the Dauversière stock can only be inferred. Inasmuch as the Chibougamau Lake mass is generally more highly altered than the Dauversière stock, the former might be older.

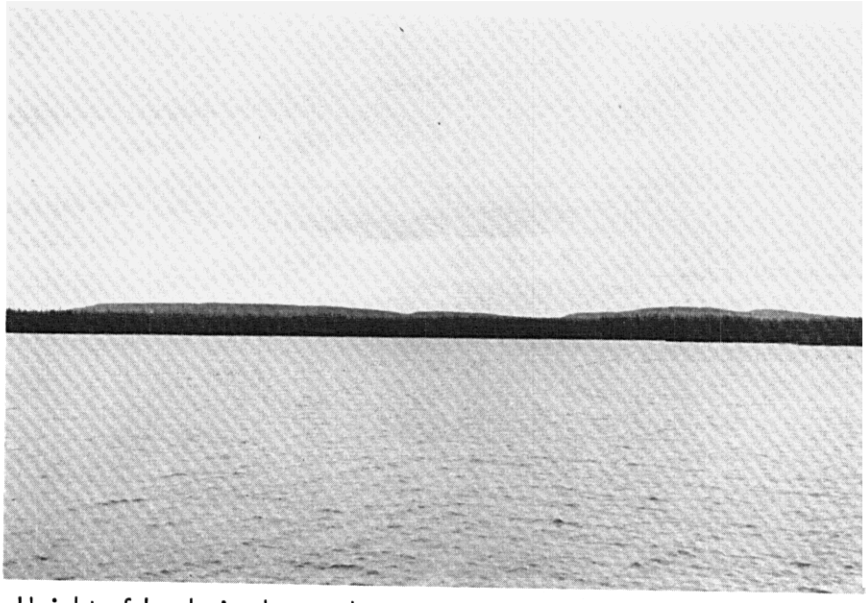
Dauversière Stock

This roughly-circular granitic body underlies approximately 60 square miles in the central part of La Dauversière township. It is well exposed along the shores of the chain of lakes and of their numerous islands (Plate III-B). Inland, the granite forms low rounded hills, most of which are partly or wholly covered by glacial debris. The stock is a concordant mass in that its gneissic structure and the schistosity of the surrounding Keewatin-type rocks are parallel to their common boundary. This boundary is rather well defined all around the stock except in the southeastern part where there are very few exposures.

The stock is essentially a biotite granite, generally pink, and rarely grey in colour, medium to coarse in grain and, as a rule, hypidiomorphic-granular in texture. The changes in granularity do not follow any systematic pattern; they occur within one outcrop and in successive outcrops. Porphyritic and augen were observed in a few localities; they are of local importance only. The mineral composition, as determined

PLATE I

A- Northeast lineation resulting from glacial action in Queylus township. Reprint of vertical aerial photograph taken by Photographic Surveys, Limited, in 1947.



B- Height of land, in the southeast section of La Dauversière township, looking southeast across La Dauversière lake.

PLATE II

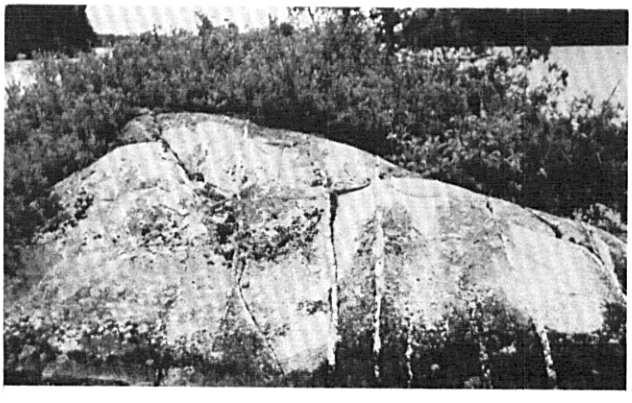
A- Slender black spruce. Indian winter-hut in foreground.

B- Chibougamau highway, looking southeast from the top of a gravel hill near mile post 130. Note the tall birches on the left, with black spruce downhill.

PLATE III

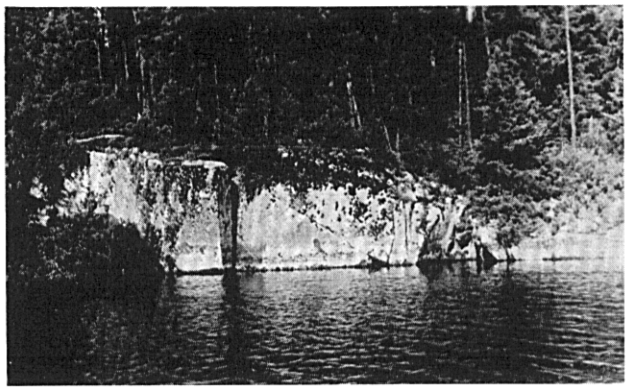
A- Jack pine growing on bare rock. Small island in a bay on the south shore of La Dauversière lake.

B- Typical granitic outcrops, southwest shore of La Dauversière lake.

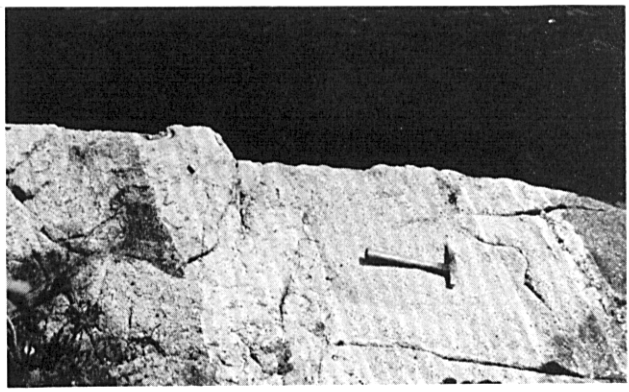


C- Quartz veinlets filling joints in Dauversière granite. Dauversière lake.

PLATE IV



A- Smooth, jointed surface of Dauversière granite, Weaver Island.



B- Aplite dykes intruding Dauversière granite.

C- Glacial erratic in a gravel pit on the east shore of Queylus bay near the highway.

under the microscope, is given in the following table:

Plagioclase	40-65	per cent
Microcline	0-30	" "
Quartz	15-35	" "
Biotite	5-15	" "
Epidote	accessory . -10	" "
Hornblende, Muscovite	occasionally present in small amounts.	
Accessory minerals:	chlorite, sericite, sphene, calcite.	

The plagioclase crystals are mostly subhedral with microcline and quartz extending into, and even absorbing, the plagioclase in many places. Further modifications to the shapes of the grains were brought about by the influence of dynamic stresses which caused a partial granulation of the feldspars and further breaking of the quartz.

The composition of the plagioclase varies throughout the mass, and again the variations are irregular. Generally, the fresh crystals near the centre of the stock are sodic albite, grading to oligoclase-andesine near the margin. In detail, the fresh specimens, from the core outwards, contain the following plagioclases: An_5, An_{20}, An_{20-32}, An_6, An_{15-26}.

Distinct zoning was observed in two thin sections taken one mile and half a mile away from the contact. In one, the core is An_{32} and the rim is An_{20}; in the other, the core is An_{26} and the rim is An_{15}. Unzoned grains in the same slide are An_{20}. About half the thin-sections examined contain fresh crystals. In the others, the plagioclase has been almost completely saussuritized. It is now made up of epidote, zoisite, sericite, albite, and some chlorite. The albite undoubtedly results from the breakdown of originally more calcic grains. In one section of altered rock, an albite grain contains a more basic core, about An_{20}. Some of the decomposed grains show a faint zoning through a roughly-circular concentration of minute secondary particles.

Thus, the problem of determining the original composition of the plagioclase, and of assigning the enclosing rock its most suitable petrographic name, is a complex one. The presence of epidote is of little help in solving this problem. This mineral is ubiquitous and may make up as much as ten per cent of the rock. Some of it occurs as small grains and specks in the plagioclase. These small grains owe their origin to the breakdown of the plagioclase, but the amount of epidote so formed is quite unimportant. Most of the epidote occurs in large grains, many of which are subhedral or rounded. Some of them have a

core of allanite. This epidote is found, as a rule, outside the plagioclase crystals, in association with biotite and hornblende. Furthermore, there seems to be a relationship between the perfection of the gneissic structure and the quantity of epidote, the epidote being more abundant in the very gneissic rock than in the less gneissic. Actually, in the specimens compared, the plagioclase is fresher in the very gneissic rock. The large proportion of epidote found in this granite, therefore, probably is of late, hydrothermal origin, replacing the ferromagnesian minerals along the planes of the gneissic structure.

The calcity of the original plagioclase was undoubtedly higher than in the present, altered specimens. However, and with a few exceptions, it is considered unlikely that the anorthite content would have exceeded 20 per cent of the feldspar molecule. The Dauversière stock may be considered as a soda-rich granite, similar to most of the large granitic bodies in northwestern Quebec. In many features (habit, grain size, texture, composition), it resembles the Goéland batholith that underlies the greater part of Goéland lake, over 100 miles west of the present map-area (Imbault, 1952).

Only two specimens contain microcline in important quantities. These two specimens were collected in the central part of the stock. Elsewhere, microcline is either lacking or occurs in quantities never exceeding five per cent of the total mineral composition of the rock. This potassic feldspar is fresh and shows typical grid-twinning. It is interstitial to the plagioclase which, in places, it embays and corrodes. Microcline is thus later than plagioclase.

Quartz generally occurs as shapeless masses of broken grains in a complex-sutured pattern. Most of the grains display noticeable undulose extinction. In addition, the quartz in a few specimens shows evidence of granulation. A small amount of late quartz is present. This was introduced along narrow fractures that cut across the older minerals. The late quartz is probably related to the quartz veins and stringers that are common throughout the granite. In one exposure, such quartz stringers are in closely-spaced joints and stand out because of differential weathering (Plate III-C).

Both brown and green varieties of biotite are found in the granite. The flakes are well-developed, but many show signs of stress in that they are bent and, in places, broken. In the more altered specimens, the biotite is leached and partly converted to chlorite. Small quantities of muscovite are found erratically in the mass, always closely associated with the biotite. The white mica may thus be secondary after biotite.

All the biotite examined contains inclusions of zircon. All the zircon crystals and some of the sphene, which occurs in idiomorphic crystals, display pleochroic halos.

Near the contact, the typical features of the granite fade out and are replaced by a wide variety of contaminated facies. Generally, the rock becomes darker as the proportion of ferromagnesian minerals increases. The most common of such minerals is ordinary hornblende, more or less leached, and locally converted to biotite or chlorite. It occurs either in large sub-idiomorphic crystals or in clusters of small grains without orientation. This hornblende appears to be derived from assimilation of the intruded lavas, and, as its concentration increases, the rock grades toward a coarse-grained gabbro.

The Dauversière stock is cut by two consistent sets of joints, one striking northeast, the other, southeast (Plate IV-A). The two sets dip steeply and appear to be contemporaneous. Of more restricted occurrence are joints dipping less than 50 degrees. No evidence of movement has been noted along the joints. They probably are tension fractures and many of them are filled with end products of the granitic magma, namely, pegmatite, aplite, quartz, and some carbonate.

Verneuil Stock

The two southernmost bays on the western boundary of the map-area are parts of Verneuil lake. In the more northern bay, there is a low reef of light grey, medium-grained, massive biotite granite. According to previous mapping (Mawdsley and Norman, 1938), this exposure is part of a stock that underlies all of Verneuil lake.

This holocrystalline, equigranular rock consists of plagioclase (40%), microcline (25%), quartz (20%). biotite (10%), and epidote (5%) with some sphene. A few grains of apatite were noted within the flakes of biotite. The plagioclase crystals are fresh, subhedral, and some of them are zoned, a more calcic core surrounded by well-defined rims that are successively more sodic outwards. The composition of the zoned crystals ranges from An_{28} in the core to An_{16} at the rim. An unzoned grain has an axial angle of about 90 degrees, so that the average composition of the plagioclase in the rock is not much above An_{20}. Microcline occurs as large, grid-twinned grains, some of which contain small remnants of plagioclase. Microcline is also found in narrow stringers that mantle, and sometimes penetrate, some of the plagioclase crystals. Thus, microcline is later than plagioclase in the Dauversière stock.

The Dauversière and Verneuil granites cannot be positively correlated, particularly in view of the scant information available on the latter body. For that reason, they are given separate names. However, their similarity in appearance and composition suggests that they are genetically related.

Southeastern Gneiss

Granitic gneisses underlie a northeast-trending tract, about 2 miles wide, covering approximately 6 square miles in the southeastern part of the map-area. They lie between dark, garnetiferous schists on the southeast and a presumed belt of volcanic and sedimentary rocks on the northwest. The gneisses are of two types: biotite granite gneiss, which is the predominant rock, and muscovite granite gneiss, which forms a small intrusion in Keewatin-type rocks around and south of Dufresne lake.

The biotite granite gneiss is generally grey and medium-grained. Its gneissic structure is well-developed everywhere and is marked by the alignment of biotite flakes. In a few localities east of the map-area alternation of narrow layers of different composition has produced a well-banded gneiss.

Under the microscope, in addition to the gneissic structure, a pronounced cataclastic texture can be seen. This texture resulted from complete attrition of the original quartz and partial granulation of the feldspar grains along their borders. As shown by the orientation of twins and cleavages, the sub-rounded grains of feldspar lie in all directions with respect to the gneissic structure. Such spatial relationships indicate that the rock was deformed into its present state after the consolidation of its essential minerals.

The composition of the biotite granite gneiss is as follows:

Plagioclase	60 - 65 per cent
Quartz	25 - 30 " "
Biotite	10 - 15 " "
Accessory minerals:	epidote, muscovite, potassic feldspar, pyrite.

The plagioclase is generally fresh and so clear that, in some hand specimens, it can be distinguished from quartz only with difficulty. Its composition is that of a sodic-oligoclase, An_{14-15}. Sericite and potassic feldspar are found in minute quantities in some of the grains. Sericite occurs as small rectangular flakes along the cleavage

planes. The potassic feldspar is grid-twinned microcline in one specimen; in another, the grains are smooth, untwinned, and may be orthoclase. Both occur as small specks erratically distributed in the plagioclase.

Under the microscope, biotite is greenish-brown to brown in its position of maximum absorption. Its flakes are well-formed and are mostly concentrated in definite parallel planes. A few flakes of muscovite are found closely associated with the biotite.

Much of the quartz occurs as small grains and constitutes a part of the cataclastic matrix that surrounds the rounded crystals of plagioclase. Large individual grains are also present. They are generally elongated and broken into fragments that show a strong undulose extinction. These larger grains, being less crushed than the quartz of the matrix, appear to be younger, and probably formed towards the end of the period of deformation.

The muscovite granite gneiss around and south of Dufresne lake is highly sheared. Shearing is so intense on the west shore of the lake that the rock is slaty and, when weathered, is easily crumbled in the hand. Eastward, the shearing becomes less intense although the whole zone is only half a mile wide in the vicinity of the lake.

This gneiss is medium-grained, pale pink or grey, and the surfaces of foliation glisten with white mica. The cataclastic texture is more pronounced than in the gneissic biotite granite; the remnants of plagioclase grains are smaller and less numerous. Plagioclase is again the predominant mineral. It is slightly clouded, constitutes about 60 per cent of the rock, and has been identified as An_{10}.

The general compositions of the two granites are essentially similar, the main difference resulting from the predominance of muscovite in one and of biotite in the other. However, as the rock becomes less crumpled eastward, muscovite is gradually superseded by biotite. Thus, apparently the muscovite granite gneiss is only a local, sheared facies of the biotite granite gneiss.

Observations bearing on the nature of the gneiss, within the limits of the map-area, were inconclusive. To the east, however, along the highway, the gneiss seems to be composed of two members: (a) granitic gneisses of intrusive origin (orthogneisses); (b) granitic gneisses, garnet-bearing, that are probably the result of recrystallization of former sedimentaries and volcanics (paragneisses). That part of the gneiss shown on the accompanying map probably is related to the orthogneisses.

Satellitic Intrusives

Acidic Dykes

Most of the acidic dykes are related to the Dauversière stock. Those concentrated along the contact generally range in composition from granite to feldspar porphyry. Within the stock, many of the dykes are aplitic or pegmatitic (Plate IV-B). Gradations between these two types were observed here and there and, in one case, a pegmatite grades laterally into a quartz-rich phase.

The majority of the satellitic bodies are concordant with the structure of the rocks in which they are found. Cross-cutting is local and mainly in the form of branches that link small, separate, tabular bodies.

The southeastern gneisses are also injected by late magmatic products. The most spectacular type is an augen pegmatite that consists of nodules of pink feldspar up to eight inches in diameter, surrounded by stringers of biotite with quartz.

Basic Dykes

The most prominent satellitic body of the map-area is a diabase dyke in the southwest quadrant of La Dauversière township. It strikes northeast and is exposed for a length of some 2 1/2 miles. Its width decreases from about 2,000 feet in the southwest to not more than a few hundred feet at its northern tip. The dyke cuts across the southeast-trending contact between the lavas and the Dauversière granite.

The diabase is dark, medium- to coarse-grained, massive, and generally equigranular. It is composed essentially of pyroxene and feldspar in almost equal quantities. The pyroxene is pale and appears to belong to the clinoenstatite-pigeonite series. Most of the grains are partly uralitized, the secondary products being hornblende with some biotite, epidote, and magnetite. The feldspar is creamy and the crystals appear to be more or less equidimensional, although some spindle-like crystals are found scattered in the black matrix, giving the rock a faint ophitic texture. Under the microscope, the ophitic texture is much more conspicuous and is seen in all the thin-sections. In composition, the feldspar is a plagioclase having the calcity of labradorite, An_{60-65}. Most specimens contain a small percentage of interstitial quartz.

Another diabase dyke cuts the Dauversière granite a few hundred feet west of the large dyke. It is dark, massive, fine-grained, and ophitic. Partly uralitized diopside is the predominant mineral. The plagioclase (andesine, An_{40}) constitutes only about ten per cent of the rocks and occurs as small scattered needles. Magnetite dust is abundant.

A third diabase dyke intrudes the Dauversière granite about 600 feet east of Hamel lake and 300 feet north of the highway. The dyke is 20 feet wide, strikes N.50°E., and dips vertically. The rock is dark, fresh-looking, and massive. Along its chilled borders, it is very fine-grained and ophitic texture is well developed, with the feldspar laths oriented parallel to the contact. One foot inward, the ophitic texture is still clear although the feldspar grains are not conspicuously aligned; in the centre of the dyke, the ophitic texture is faint. The predominant mineral is uralite consisting of remnants of pyroxenes that form pale cores surrounded by hornblende with small amounts of brown biotite. Feldspar constitutes only about 15 per cent of the rock; it is a plagioclase on the andesine-labradorite boundary. Magnetite is present as a late mineral surrounding and replacing uralite.

The age of these dykes is not definitely known. Similar diabase to gabbro dykes have been found at many places within the Canadian Shield and have been assigned to the Keweenawan period. It thus seems reasonable to infer that the diabase dykes in this map-area are also Keweenawan age.

Age Relationships

As is commonly the case in the Precambrian Shield, the relationships between the different intrusions of the map-area are obscure. The similarity in composition between the various granitic rocks precludes the use, for purposes of correlation, of the numerous dykes (granite, pegmatite, and aplite) that cut them. The dykes may be, and probably are in most cases, offshoots from the same magma that gave rise to the intrusion in which they are found. The only definite cross-cutting relationships observed among the intrusions of the map-area are: (1) the chlorite granite, south of Chibougamau lake, intrudes the gabbro-anorthosite rocks; (2) the Dauversière granite is intruded by several basic dykes that may be late Precambrian (Keweenawan?) in age. Less-definite relationships have been suggested above in two instances. If mineral alteration could be accepted as a

criterion, the chlorite granite would be older than the Dauversière stock. The Verneuil and Dauversière masses are believed to be of the same age.

The most important problem of correlation within the map-area is that of the relationship between the southeastern gneiss and the nearby sedimentaries and volcanics. Up to the present, the gneiss has been generally considered as belonging to the Grenville sub-province. Thus, its northwest contact would mark the boundary between two sub-provinces of the Canadian Shield: Grenville on the southeast, and Temiscaming on the northwest.

The location and nature of this boundary have long challenged Canadian geologists. Depending on personal field observations, some call it gradational (Freeman, 1943; Lowther, 1936), while others presume a fault zone (Norman, 1936). The information collected within and east of the present map-area tends to indicate that the southeastern gneisses are orthogneisses, and that they are intrusive into rocks that may well represent recrystallized remnants of Keewatin (?) lavas and sedimentary rocks.

The inclusions found in the gneisses have been described earlier in this report. The dark hornblende schists, occasionally garnetiferous, are wholly unlike any of the rocks found in the typical Grenville areas. Their metamorphic grade is higher than that of the Keewatin-type rocks and perhaps lower than that of the Grenville para-gneisses. Were it not for the presence of garnet, the schists would closely resemble some of the inclusions that are found in great number within the granite of the Temiscaming sub-province. Garnet, however, may form in basic igneous rocks, e.g. basalts, particularly if such rocks are subjected to intense pressure in addition to high temperatures.

If the schists are metamorphosed remnants of Keewatin-type rocks, the granite gneiss does not truly belong to the Grenville sub-province. However, it may belong to a wide expanse of granite that may have been emplaced between rocks typical of the two sub-provinces. The existence of such a granitic series has been suggested by numerous writers and would help to explain the great difficulty in determining the boundary between the Grenville gneisses and the Keewatin-type rocks.

This boundary once may have been a fault but, if so, the injection of granite has obliterated it completely. Recurrence of movement, however, along the original lines of weakness could have

produced the present system of northeast faults near the contact. The faults would be late features and their importance, in spite of the magnitude of some of them, would be local only. The younger age of the faults is well shown northeast of the map-area, in the Bignell Area (Gilbert, 1958), where a northeast-striking fault that separates the lavas and the gneisses in the north curves westward and into the lavas in its southern part.

A corollary to the preceeding remarks is that the existence of a faulted contact between the two sub-provinces, at a period antedating the granitic gneisses, would probably place the Grenville in the pre-Huronian period. A similar conclusion has been reached by Gillies in the Canimiti River Area (Gillies, 1952).

Quaternary

The locations and forms of the glacial deposits of the map-area have been described in a previous section of this report. It only remains here to present a few short comments on the nature of these unconsolidated deposits.

Sand and gravel constitute the bulk of the Pleistocene deposits. Almost everywhere, some clay seems to be mixed with the sands but its proportion is generally low enough so that the deposits can be used for road-building. Glacial erratics are common in the ground moraine, some of them attaining a diameter of many feet (Plate IV-C).

The fluvio-glacial deposits consist of a few eskers that have rounded cross-sections and typical sinuous courses. A fox hole near the top of one of them is lined with fine sand with which is mixed a small percentage of clay and a few cobbles. No stratification was observed in this limited exposure.

A striking characteristic of the mantle is the absence of extensive beds of clay. The fine deposits of the Clay Belt are not seen within the map-area. Clearly, Lake Barlow-Ojibway did not extend this far eastward. Clays are present in the bottoms of some of the present lakes but they do not extend away from the lakes. They probably constitute only a thin cover of Recent lake deposits over the glacial gravels and sands.

STRUCTURAL GEOLOGY

Folding

In the Keewatin-type rocks the schistosity is, as a rule, quite pronounced in the lavas and clastic rocks, but faint or even absent in the concordant diorite and gabbro bodies. As far as could be ascertained, the schistosity is everywhere parallel to the bedding and lava flows. The dips are steep to vertical.

Except for local divergences, these Keewatin-like formations of the map-area have a general east-west trend, as is usually the case in the Temiscaming sub-province.

Some of the divergences are readily attributable to the influence of the intrusive masses. It should be noted in particular that the schistosity of the Keewatin(?) rocks curves completely around the Dauversière stock. Other divergences in the trend of the schistosity were observed within the main belt north of the stock. In numerous localities, separated from one another by east-west distances of 2 to 3 miles, restricted sections of the belt have a general north-south schistosity. Due to the absence of key horizons and the small number of exposures, the true meaning of these structures is not certain. They could be the result of large-scale drag folding (cross-folding), or they could represent successive formations along the nose of a plunging fold.

The overall structure of the predominantly volcanic belt north of the Dauversière stock is synclinal. The axis of the syncline is an arcuate line that crosses the western boundary of Queylus township just south of mile-post 4, whence it trends eastward to the highway and then swings southeastward. Top determinations, obtained from the outlines of pillows, indicate that the beds north of the axis face south whereas those on the south limb face north. In addition, the non-vertical strata on either side dip generally toward the axis. As mentioned above, complications exist in the structure and it is possible that the belt is not as thick as the present syncline would indicate it to be.

Shearing

Shear zones parallel to the schistosity or the gneissic structure of the rocks are numerous throughout the Keewatin-type

rocks, particularly in the southern half of that part of the belt north of the Dauversière stock. The widths of the zones range from less than a foot to more than 20 feet. In places, closely spaced shears form a wide zone, as, for instance, on the property of New Mosher Longlac Mines Limited (see below), but none of them can as yet be confidently grouped into a major regional 'break'. Intense movement along the zones has generally produced rocks that are highly chloritic and very slaty. Stringers, gashes, and veins of quartz are abundant. Their importance is discussed in the section on Economic Geology.

Faulting

Faults transverse to the structure of the rocks all strike northeasterly although the direction and amount of displacement is variable.

Just east of mile-post 128 on the highway, the contact between the lavas and a sill of gabbro is displaced some 50 feet along a northeast fault. As indicated by drags, the southeast block has moved northward relative to the northwest block.

On the south shore of Line bay, a coarse gabbro is intruded by a two-foot dyke of pink granite that strikes N.10°W. and dips vertically. A fault striking N.60°E. offsets the dyke about six feet, the northwest block moving northward relatively.

A more important fault is indicated close to the southern boundary of the map-area, south of the easternmost bay of Dauversière lake. At this locality the northern flank of a hill is cut by a deep gully that trends N.40°E. across the schistosity of the lavas. The mouth of the gully is about 200 feet wide and its centre is occupied by a dyke of granite exposed over a width of 20 feet. Since both walls of the gully show volcanic rocks of similar composition, it is not possible to determine the amount of movement along the fault. On the northwest side of the fault, the schistosity bends quite sharply southward. If this bending is the result of dragging, the northwest block has moved northward relative to the southeast block.

Another important fault is suggested along the highway between mile-posts 126 and 127, where two exposures of highly talcose rocks, about 1,000 feet apart, strike S.80°E. If these are parts of the same bed, the repetition could be due to folding, or, more probably, to faulting, since, near the southeast exposure, the strike of

the schistosity of the rocks is north to northeast and probably represents dragging. In that case, the fault would strike northeast and the apparent horizontal displacement along it would be about 1,000 feet, with the west block having moved northward relative to the east block.

ECONOMIC GEOLOGY

General Statement

The mineralization observed in the map-area consists of disseminated sulphides in quartz (sometimes accompanied by tourmaline) and silicified schists. Carbonate is very rare and unimportant. In all cases, the mineralization is associated with shearing or, to a lesser extent, with drag folding accompanied by shearing. Within the shear zones, quartz occurs as blebs, small lenses, clean-cut veins, and zones of silicification up to 20 feet wide. Quartz often replaces the noses of drag folds and, in places, extends for short distances into the adjacent rocks, following minor subsidiary shears that branch out from the noses of the folds. In general, the quartz is white, glassy, dense, and looks barren. The sulphides (pyrite with small amounts of chalcopyrite and/or pyrrhotite) are concentrated mostly near silicified remnants of schist, or within and close to tourmaline, where present.

Within the map-area, to date (1950), four different companies have partly explored five showings. All five are in the Keewatin-type formation, four to the north and one to the south of the Dauversière stock. Gold values have been reported from all these showings, as well as from at least thirteen others south and west of the map-area as far as Caopatina lake.

Description of Properties

Calmor Mines Limited (1 and 2).*

This company owns a group of 20 claims, covering approximately 1,066 acres, in the southwest section of Queylus township. The greater part of Calmor lake lies within the boundaries of the property. Two showings are being investigated, under option, by Teck Exploration Company, Limited.

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* Numbers within brackets correspond to showings indicated on accompanying map.

The original discovery, the west showing, is at the head of the small U-shaped bay on the west side of Calmor lake. Schistose lavas and rather massive diorite, striking N.70°W., are exposed in five trenches for about 200 feet. The rocks are highly crumpled along two shear zones parallel to the schistosity. The smaller one, on the south, is a foot wide; the larger one, up to 3 feet. The latter actually is a fault breccia in which the fragments are cemented by rock flour, quartz, and calcite. Both zones contain quartz veins, from less than an inch to about a foot wide. The mineralization is mainly auriferous pyrite with subordinate chalcopyrite.

The second occurrence, the east showing, is about 900 feet north of the northeast end of Calmor lake and 200 feet west of post No. 1 of C-40707, claim No. 5. The main vein, composed of quartz with some tourmaline and a few remnants of partly silicified schist, has been exposed by stripping for about 100 feet. The vein is mineralized with auriferous pyrite and chalcopyrite mostly concentrated in the vicinity of the tourmaline and schist.

One hundred feet south of the vein just mentioned, a trench about 15 feet wide exposes a quartz lens that replaces the nose of a ten-foot drag fold. The outline of the fold can be followed within the glassy quartz which is slightly mineralized with pyrite. From this trench, a picket-line has been cut in a direction S.65°E. Four trenches, spaced from 10 to 75 feet apart along the picket-line and trending in a general northerly direction, expose highly schistose and sheared lavas with the direction of the structure changing from north to N.60°E. Vein material and sulphides are scarce in these four trenches.

Austman Syndicate (3)

The ground held by this Syndicate is just east of the Calmor property. The work done here, at the time of the writer's visit, consisted of stripping, mostly on the north side of the extension of the picket-line mentioned above.

The rocks are lavas with subordinate amounts of gabbro and porphyry. The structure is complex; the dips are nearly always vertical and the strike of the schistosity ranges from north-south to east-west. These variations, however, seem to follow a regular pattern and the structure is believed to be a continuation of the zone of drag folding observed on the Calmor property. The picket-

line would follow approximately the axial line of the drag folds.

Quartz stringers and lenses up to 2 by 6 feet occur erratically. Pyrite is present, not only in the quartz but also within the sheared lavas.

Conwest Exploration Company Limited (4)

This showing is on the southwest shore of the small lake that lies 7,000 feet north of Hamel lake in the northeast part of La Dauversière township. Early in the summer of 1950, a narrow trench, about 150 feet long, was opened by stripping and blasting.

Sheared andesites and tuffs are injected and partly replaced by quartz. The zone of silicification is irregular, but probably averages 4 feet in width. Disregarding minor irregularities, the structure trends more or less east-west and dips vertically. Mineralization, which is scanty, consists of pyrite, chalcopyrite, and probably some pyrrhotite.

New Mosher Longlac Mines, Limited (5)

The showing that initiated the influx of prospectors into the region south of the Dauversière stock is on the east shore of the small lake that lies just inside the southern boundary of the map-area about 2 1/2 miles east of Nemenjiche river. It is on the northwest flank of a hill that rises gently eastward to a height of 250 feet above the level of La Dauversière lake.

Some stripping and trenching have been done along and near two picket-lines. One line starts 15 feet south of post No. 3 of C-45723, claim No. 3, strikes N.53°E., and is 380 feet long. The other begins at a point 150 feet S.40°W. from the same claim post, strikes N.72°E., and is 400 feet long.

The rocks are a complex of basalts, fine-grained diorites and gabbros, and granite porphyry. Shearing is common and is particularly intense along the picket-lines. In addition, there are indications of numerous drag folds. It is possible that there is a major area of drag folding between the lines.

Silicification was effected in the sheared rocks partly through injection of quartz veins and partly by replacement of the

country rock. The main individual zones of silicification (as yet not correlated) range from 4 to 20 feet in width. Many stringers less than a foot wide also were observed, and a few lenses of quartz fill the noses of some drag folds. Sulphides, mainly pyrite with some chalcopyrite, are erratically distributed, although they seem to be more abundant near, and in, the silicified schist than in the glassy quartz.

Specimens containing numerous specks of free gold were collected by the company's prospectors from the face of a large erratic about half a mile east of the north end of the lake. At the time of the writer's visit, the source of this boulder had not been located.

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APPENDIX to G. R. 83

ECONOMIC GEOLOGY, 1950-1959

by J.-E. Gilbert

An important amount of exploration work was carried out in La Dauversière and Queylus townships between the years 1950 and 1959 following the discovery and development of the Chibougamau Explorers copper-gold orebody, immediately to the south of the Queylus area.

This work, which consisted mostly in geological and geophysical surveys was mainly concentrated in the south part of La Dauversière and in the southern three-quarters of Queylus where the Keewatin-type greenstones commonly contain sulphide mineralization in disseminations or veins. A few companies also carried out diamond drilling programmes, the largest of which were those of New Jersey Zinc Exploration Company (Canada), Limited; Dramiska Mines Limited, on the former New Mosher Longlac Mines, Limited, property; Marbenor Malartic Mines, Limited, and Glencona Mining Company, Limited, in the southern quarter of La Dauversière township, and Valco Mines, Limited, east of the Southwest Arm of Chibougamau lake, in the northwest quarter of Queylus township.

Quebec, Jan. 31, 1959.

ALPHABETICAL INDEX