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PRELIMINARY REPORT, GEOLOGY OF BOIVIN LAKE AREA, CHICOUTIMI COUNTY

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DEPARTMENT OF NATURAL RESOURCES

RENÉ LÉVESQUE, MINISTER

P.-E. AUGER, DEPUTY MINISTER

Geology

of

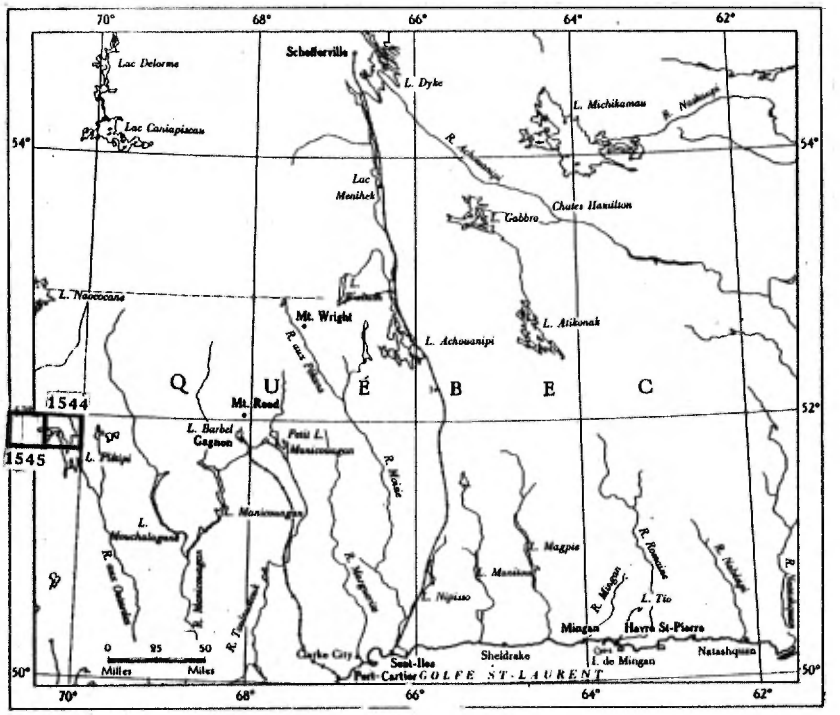
BOIVIN LAKE AREA

CHICOUTIMI COUNTY

PRELIMINARY REPORT

by

E. H. Chown



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QUEBEC DEPARTMENT OF NATURAL RESOURCES

RENÉ LÉVESQUE, MINISTER

P.-E. AUGER, DEPUTY MINISTER

GEOLOGICAL EXPLORATION SERVICE

H. W. MC GERRIGLE, CHIEF

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FOREWORD

The largest single or combined project undertaken by the Geological Exploration Service of the Department during the summer of 1963 was the mapping of some 1,500 square miles in the Plétipi Lake region. A geological party of 23 men, under the overall charge of Jean Bérard, worked from one base camp on the west shore of the eastern arm of Plétipi lake, and used a floatplane (Beaver) for support and for fly camp operations. The area mapped comprised three 30-minute map-sheets in an east-west line, bounded by latitudes 51°45'-52°00' and by longitudes 69°30'-71°00', and of one 30-minute, north-central map-sheet, bounded by latitudes 50°00'-52°15' and by longitudes 70°00'-70°30'. In addition to the present report, two reports have been prepared by Jean Bérard on parts of the project: one on the Matonipi Lake area (latitudes 51°45'-52°00'; longitudes 69°30'-70°00'), and the other on the Upper Outardes River area (latitudes 52°00'-52°15'; longitudes 70°00'-70°30').

PRELIMINARY REPORT

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INTRODUCTION

The Boivin Lake area includes one-half of the project outlined in the Foreword, or two 30-minute map-areas. One, the North Part of Plétipi Lake area, is bounded by longitudes 70°00' and 70°30'; the other, the Deux-Décharges Lake area, is bounded by longitudes 70°30' and 71°00'. Both lie between latitudes 51°45' and 52°00'.

Plétipi lake lies about 90 miles northwest of Quebec's Hydro Electric Power Commission Manicouagan-5 dam on Manicouagan river, and is easily reached by float-equipped aircraft from the base. Many lakes in the area are suitable for floatplane landings. Plétipi lake may also be reached by canoe along Outardes river, or from Mouchalagane lake.

The southern part of the North Part of Plétipi Lake area, as well as the southwestern part of the Deux-Décharges area, is a low, rolling, boulder plain, 1,500 to 1,700 feet above sea-level. North of the plain the topography is more rugged, and is dominated by buttes and mesas of gabbro with 300- to 500-foot cliffs. The hills around Deux-Décharges lake rise to 2,800 feet above sea-level.

The entire region drains south to the St. Lawrence: the eastern two-thirds via the Outardes river system, and the western third via Savane river, a tributary of the Peribonka. The major rivers flow through wide, drift-filled valleys most of which are pre-glacial, as indicated by parallel eskers. Minor streams are rapid and are controlled by glacial and bedrock structures.

Little previous geological work has been done in the region.

Valiquette (1908) made some observations on the geology along and near the shores of Plétipi lake on his way to examine "Shining Mountain" farther to the northwest. The possibility that this "mountain", also referred to as "Burning Mountain", might be formed of iron ore had been indicated by Low (1897). The large quartzite-topped hill between Boivin river and Deux-Décharges lake fits Valiquette's description of the mountain. The white quartzite is visible for many miles; water spilling down cliff faces from the bedding planes reflects the sunlight and probably is the origin for the name "Shining" or "Burning". As Valiquette reported, no iron has been found there.

Hammond (1945) made a brief reconnaissance through the area, largely along the major streams.

Eade et al. (1959) mapped the adjoining region north of the 52nd parallel.

GENERAL GEOLOGY

All the consolidated rocks are Precambrian in age. The chronological sequence of the rock units is known only in part because very few contacts are exposed. A complex of anorthositic gabbro, the border facies of a large mass, is exposed in the southern part of the area. Structures in this mass parallel its contacts. A steeply-dipping, west-trending complex of gneiss, migmatite and granite underlies much of the western part of the area, and north-trending biotite schist and gneiss occur in the eastern part. North-trending structures are partly imposed on granitic rocks adjacent to the schist. Two small ultrabasic intrusives cut the granitic and biotite schist complexes. Gently dipping to flat-lying sedimentary rocks (orthoquartzites and arkoses) rest on an irregular surface of granitic rocks, and apparently also on the biotite schists. One (possibly two) thick sill of gabbro is intruded into the sedimentary rocks near their base, cutting across hills in the basement.

Minor folding along northwest-southeast and east-west axes has wrinkled the sheet of gabbro. Normal faults trending east or northeast represent the last orogenic movement.

Much of the areas of lower elevation in the region is mantled by glacial deposits.

TABLE OF FORMATIONS

Cenozoic	Pleistocene and Recent	Beach, swamp and talus deposits Till, sand and gravel
Precambrian	Otish Mountains gabbro	Gabbro, diabase
	Otish Mountains Group	Orthoquartzite, sub-arkose, arkose
	Unconformity	
	Ultrabasic intrusions	Pyroxenite
	Biotite schist complex	Biotite schist and gneiss; minor alaskitic gneiss and amphibolite
	Granitic complex	Biotite gneiss, amphibolite, migmatite, granite and pegmatite
	Anorthosite complex	Anorthositic gabbro

Anorthosite Complex

The border facies of a large anorthosite complex is exposed in the southern part of the area, just south of Bernay lake. The dominant rock in this facies is an anorthositic gabbro composed of 70% plagioclase and 30% brown pyroxene.

Anorthositic gabbro is well exposed in numerous, low, rounded outcrops, many of them light rusty brown and deeply weathered. The fresh rock is mottled owing to the brilliant white of the plagioclase, and the dull brown to black of the pyroxene.

A few outcrops of true anorthosite occur just along the southern boundary of the area. In this rock, a few large (5 to 6 cm. long) crystals of blue plagioclase are preserved in the fine mosaic of granulated white plagioclase. The few large, brown pyroxene crystals present are elongated and converted at their rims to black hornblende. In some rocks the pyroxene has a double corona of garnet and hornblende, although either or both minerals may be absent.

As the border of the complex is approached, the gabbro becomes finer grained and the pyroxene content increases. In most places the rock is completely foliated, the foliation being caused by elongation of the pyroxene grains into elliptical discs or smears. The resulting orthogneiss has an extremely even layering 1 mm. to 1 cm. thick, with a pronounced lineation on the foliation plane. The dark mineral in the "smears" is commonly aggregates of fine hornblende.

Some primary layering is preserved in the coarse-grained portion of the complex as pyroxene-rich layers 6 inches to 10 feet thick striking northwest and dipping steeply.

Granitic Complex

Rocks of the granitic complex underlie the western part of the North Part of Plétipi Lake area, and almost all of the Deux-Décharges Lake area. They are, however, covered in part by the Otish Mountains sedimentary and igneous rocks. The complex ranges from biotite gneiss through migmatite and gneissic granite to massive granite. Small amounts of amphibolite are present. Subdivision of the unit on the map has been restricted to a general indication of the dominant phase of the complex present in each area.

The biotite gneiss is drab, even-grained (1 to 2 mm.), and almost massive. Biotite is well oriented, but shows little or no concentration into layers. The biotite content of 10 - 20% is constant within vague layers 2 to 6 inches thick. A fine mosaic of quartz and oligoclase forms the rest of the rock. Small pegmatite sills and irregular lenses up to 1 foot thick lie parallel to the layering in the gneiss. Although the gneiss is widespread, it is rarely the dominant rock of the complex.

Migmatite is the most common member of the complex, and is also the most variable. All mixtures of granite and biotite gneiss containing 20-80% granite fall into this category. Migmatites are layered for the most part, consisting of alternating layers of gneiss and granite or pegmatite. Granitic dykes and sills are common and range in thickness from less than an inch to 5 feet or more. Migmatite is folded in almost all localities. In most exposures the axes of the folds have a constant trend, but in some of the more granitic rock, the fold axes are completely at random.

The biotite gneiss in the migmatite is similar to that described above except that some biotite is commonly concentrated in large (up to 1 cm. in diameter) flakes at the contact with the granite or pegmatite. In some migmatites, the biotite gneiss is represented only as numerous small schlieren of coarse-grained biotite schist.

Granite is mainly massive, but some of it has a slight foliation, or contains numerous aligned inclusions. With an increase in the number of inclusions, it grades into granite-rich migmatite. Most of the massive granite occurs near latitude 52°, but large masses are also found south of Cran-Cassé lake and north of Plétipi lake. The granite weathers pink to grey and is mottled pink and white on fresh surfaces. It is coarse grained, in places grading to pegmatite. Potash feldspar (some visibly perthitic) forms 50-60% of the rock; quartz, 30%; oligoclase, 5-15%; and biotite and muscovite form 5% or less. In some areas, the granite is coarse to medium grained rather than pegmatitic, and plagioclase forms 20-30% of the rock.

Shearing of granite in local zones has resulted in partial breakdown of the feldspars and mafic minerals to micaceous minerals, chiefly muscovite and chlorite. The crush zones anastomose and rejoin through the rock to form crude diamond patterns on the surface.

Amphibolite occurs in minor amounts. One thin band south of Courtot lake can be traced for about one mile. The amphibolite is blue-black on a fresh surface, very fine grained, and contains plagioclase, hornblende, and some biotite. It is well foliated, non-layered, and in most outcrops is cut by thin (1 to 5 cm.) veins of medium-grained pegmatite composed of quartz and grey feldspar.

Biotite Schist and Gneiss

The biotite schist and gneiss unit is distinguished from the biotite gneiss of the granitic complex by its much coarser grain size and by its concentration of biotite into layers alternately rich and poor in biotite. Both the schist and the gneiss facies weather grey to pale tan, but are streaked black and white on a fresh surface.

Schist and gneiss are not distinguishable mapping units and there is a complete gradation between the two rocks. The biotite content of the two rocks varies from 50% in some schist layers to as low as 5% in some quartzo-feldspathic layers in the gneiss. Quartz and oligoclase in roughly equal quantities compose most of the rest of both rocks. Prismatic crystals of hornblende are present in the mafic layers of many of the gneisses. Epidote grains 1 to 2 mm. in diameter are present in the biotite-rich layers of all the rocks.

The biotite flakes in both schist and gneiss are bent and elongated, forming a marked lineation in the plane of the foliation. In most localities this lineation is parallel to the axes of small folds in the rocks, but in some places it diverges and crosses the fold axes.

Thin layers of amphibolite are present in the sequence, and both laminated, biotite amphibolite and massive, garnet amphibolite occur locally.

Alaskitic gneiss is present in a sill just north of the eastern arm of Plétipi lake. This rock is composed of coarse-grained quartz and potash feldspar (95%) and 1 to 2% of muscovite with a few crystals of garnet and lazulite. The sill has border zones of migmatite between it and the schist. A zone of similar migmatite, lacking the alaskitic gneiss, occurs just east of Outardes river 7 miles north of Plétipi lake.

Ultrabasic Intrusions

Two small plugs of ultrabasic rock intrude the gneisses east of Outardes river. Similar ultrabasic rocks cut the schist and gneiss complex extending to the east (Bérard, 1964a).

The intrusions are composed of coarse-grained pyroxenite, very similar in appearance to the Otish Mountains gabbro. The rock is black and weathers brown with a knobby surface. Large (2-3 cm.) crystals of pyroxene form 70% or more of the rock. Pyroxene in the eastern plug has been uralitized and is strongly magnetic.

Otish Mountains Group

Sedimentary rocks of the Otish Mountains Group exposed in the area include orthoquartzite, subarkose and arkose. The rocks range in colour from white to light tan. In some localities they are stained red along certain layers, and in others, bright green along fractures. Small amounts of blue lazulite are present in quartz veins cutting the sedimentary rocks and in the groundmass of the rocks themselves.

Rocks of the Group are thick bedded, and the bedding is best seen in the general attitude of the outcrop. Thin beds are present in only a few outcrops.

The orthoquartzite is composed of well rounded, well sorted quartz grains 1 to 2 mm. in diameter. Subarkose is not so well sorted, the grains are more angular, and the rock has a dull, grey-green colour. Arkose is composed of more angular grains, and is a deeper grey. There is a decrease in the sorting and an increase in the angularity of the grains from quartzite to arkose. Grains in the arkose range in diameter from .5 mm. to 1 cm.

The individual grains of the sedimentary rocks are obscured by a strong cleavage in many localities. Orthoquartzite is converted to a vitreous, subtranslucent rock with very fine grain size. Subarkose and arkose acquire a phyllitic to schistose texture as the feldspar is converted to well oriented, sericitic mica, and coarse-grained flakes of muscovite. The cleavage has a crenulated surface, and in many of the rocks two cleavages intersect at angles of 30 degrees or less.

The sedimentary rocks are irregularly distributed throughout the area. Apparently they were deposited on a surface of some relief. For example, the thick sequence north of Boivin lake abuts against granite to the east and to the west. Sheared arkose is preserved in hollows in the granite basement east of Savane river and south of Cran-Cassé lake. The actual contact between the sedimentary rocks and the underlying basement is not exposed in the area.

Otish Mountains Gabbro

Otish Mountains gabbro is widespread and is the best exposed unit in the area. It forms a thick sill, in general dipping gently to the northwest. Dissection of the sill by stream erosion has produced many cliffs, most of them facing southeast.

The gabbro typically weathers light brown and forms gently rounded outcrops. Many exposures are quite fresh, owing to sloughing of joint blocks from the cliffs, and fresh surfaces are black or greenish.

The gabbro ranges in grain size from aphanitic (chilled) at its contacts to medium and, rarely, to coarse-grained ophitic. Small zones of very coarse-grained gabbro with a hypidiomorphic granular texture are present near the centre of the thick parts of the sill. For the most part, however, there is little variation in grain size within the sill. Most of the gabbro is medium-grained and contains about 60% labradorite and 40% pyroxene. The content of opaque minerals cannot be estimated in hand specimen, but chilled contact zones are strongly magnetic. Areas where the base of the sill is not buried deeply, such as southwest of Castor-Noir lake, have strong compass deviations. Minor zones, of small lateral and vertical extent, of pyroxene-rich gabbro were noted near the centre of the sill.

Deuteric alteration occurs chiefly along small quartz and granophyre veins and dykes which are usually controlled by a joint set, but which have random distribution. Gabbro adjacent to these veins is slightly altered, the pyroxene converted to amphibole of chlorite and epidote, and the plagioclase to sericite and epidote. The gabbro, like all the older rocks in the sequence, is cut by the normal faults. Adjacent to the faults the gabbro is extensively sheared and is cleaved; the pyroxene is retrograded to amphibole or chlorite and oriented in the cleavage plane, and plagioclase appears to be completely granulated and converted to fine sericite. Complete conversion from a massive fresh gabbro to a chlorite schist takes place within 3 feet.

The gabbro occurs in a subhorizontal body that intrudes the Otish Mountains Group sedimentary rocks parallel to their bedding, near the base of the sequence. As the Otish Mountains sediments were laid down on a very irregular basement, the igneous body also traverses some hills of basement rock which jut into the sedimentary sequence. This relationship is shown north of Boivin lake where a deep valley in the basement filled with sedimentary rocks is exposed on the north flank of a gentle anticline. The gabbro sill lies parallel to the bedding of the sedimentary rocks and cuts across the hills of granite. The granite-sedimentary rock contact is pushed apart by the sill, forming a dilation offset.

Apparently most, if not all, of the gabbro in the area belongs to one sill. The thickest succession, 500+ feet, is in the cliffs east of Deux-Décharges lake, and there is no evidence of multiple intrusion there. The sill thins slightly east and south of the lake. To the east, a granitic basement is exposed at the base of the sill, and remnants of it also appear on top of the sill. There is a suggestion of a second sill in the area north of Boivin lake, where several outcrops of gabbro occur stratigraphically above the main sill, but this may be the main sill repeated by faulting.

Dykes

Several dykes of fine-grained gabbro and diabase, commonly striking east, are exposed, most of them in a zone stretching from Courtot lake through Boivin lake. One small dyke near Boivin river cuts through the sill, and is a possible feeder for younger sills higher in the sequence. A dyke cutting granite lying on top of the sill south of Castor-Noir lake also suggests this. Two thick dykes, one northeast of Castor-Noir lake and the other on the east shore of Deux-Décharges lake, display a strong joint set perpendicular to the dyke walls. This feature marks these dykes clearly on aerial photographs.

Few contacts between gabbro and other rocks were seen. The dyke east of Deux-Décharges lake contains inclusions of orthoquartzite and is chilled against the sedimentary rocks. Gabbro-granite contacts are also chilled and contain inclusions, but in many instances these are the loci of extensive shearing which obscures the relations. The chilled zone at gabbro contacts is 2-5 feet thick.

Pleistocene

Glacial deposits cover much of the North Part of Plétipi Lake area and the southwest corner of the Deux-Décharges area, and fill many of the valleys in the rest of the region. Most of the glacial material is till, some of it covered by extensive boulder fields. Grooves cut in the till sheet show the direction of glaciation, and exert a moderate control on the drainage locally.

Two directions of glaciation, the dominant one at S.20°W. and the other at south to S.15°E., are shown by glacial striae. Both sets are preserved in a few outcrops of quartzite north of Boivin lake, where the set trending S.15°E. cuts the southwest set. This variation in the trend may be local, as the result of diversion of some of the ice by the various mountains in the area, rather than regional.

Eskers are prominent and many follow the valleys presently occupied by major streams. Some divergence is noted. For example the glacial Outardes river flowed west of the peninsula in the centre of Plétipi lake, whereas the present river debouches into the lake on the east side.

Extensive terrace deposits partly surround Boivin and Plétipi lakes. The terraces are at levels up to 50 feet above the present lakes, and indicate the expanded sizes of the lakes in late glacial time. Outardes river has modified the terrace north of Plétipi lake and built and extensive delta into the lake since the retreat of the ice.

Structural Geology

Folds.- Nearly horizontal small fold axes and steeply-dipping foliations suggest that the granitic complex is tightly folded along axes trending about N.70°E. Lacking marker beds, none of these folds may be outlined.

The biotite schists are folded along axes that swing from a north trend at the south border of the area to east-west north of Plétipi lake. North-trending folds affected rocks of the granitic complex in the southern part of the area from Boivin lake eastward. Foliation trends in this region are confused, and in some outcrops the east-trending foliation is bent into small chevron folds by a north-south cleavage. The divergent foliations around the east arm of Plétipi lake suggest that the biotite schists are folded into a tight isoclinal anticline and syncline with axes swinging from north to east in the north.

Later cross-folds along northwest axes are indicated by the divergence of lineations based on small fold axes and by the trace of the base of the gabbro body. Thus three cross-anticlines and two cross-synclines are shown in the Deux-Décharges Lake area; and a cross-anticline and a syncline in the southeast corner of the North Part of Plétipi Lake area. Cross-folding along northwest axes is probably not limited to these seven folds, but these are ones which can be seen readily.

A later folding along nearly east-west axes is associated with normal faulting. This produced the anticline south of Boivin lake and the anticline and syncline north of Castor-Noir lake.

Faults.- Four normal faults trending about N.70°E. and two trending N.30°E. are shown on the maps. Many smaller faults may also be present. The faults west of Savane river and Deux-Décharges lake are continuations of faults mapped by Eade et al. (1959) to the north. The topographic expressions of all the faults are deep linear valleys. Exposures of granite and gabbro near the Savane River fault are strongly sheared. Elsewhere along the various faults an abrupt change in lithology can be seen across narrow straight valleys. The various rocks of the region have local zones of cleavage, mostly trending parallel to one or other of the fault directions.

Two small east-west faults cut the sedimentary rocks of the small syncline east of Deux-Décharges lake, and can be seen readily on aerial photographs. An extensive zone of sheared granite just east of Boivin river near latitude 52°00' may also be a fault.

Joints.- The Otish Mountains gabbro has a well-developed, cubic, joint system. Joints vary locally, but the common trends over the region are one set dipping horizontally or gently to the northwest, and the other two dipping vertically or nearly so and striking northeast in one case and northwest in the other. Joints are also well developed in the massive granite, and trend parallel to those in the gabbro. The gneisses and schists tend to break into slabby joint blocks, as the foliation plane is the best developed joint.

ECONOMIC GEOLOGY

Very little prospecting has been done in the area. Some claims staked in the eastern part of the North Part of Plétipi Lake area adjoin the iron prospects in the Matonipi Lake Area (Bérard 1964a).

Small amounts of sulphide minerals, chiefly pyrite, are found in the gabbro and rocks of the granitic complex. The anorthosite also contains disseminated sulphides in most outcrops. Some concentrations of sulphides are noted in the granitic complex adjacent to the gabbro sill, and in sheared and altered zones within the sill. Much of the mineralization, which includes pyrite, pyrrhotite and chalcopyrite, appears related to small veins in and around the gabbro. Several outcrops of mineralized amphibolite occur south of Castor-Noir lake. Much of the region is worthy of detailed prospecting, in particular the area south of Castor-Noir lake.

Eskers and terrace deposits would provide sand and gravel for construction purposes.

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