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FIELD WORK IN 1968, SUMMARY OF RESULTS

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FIELD WORK

IN

1968

SUMMARY OF RESULTS

GOUVERNEMENT DU QUEBEC

DEPARTMENT OF NATURAL RESOURCES

Honorable PAUL-E. ALLARD Minister

MINES BRANCH

GEOLOGICAL SERVICES

QUEBEC 1970

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Quebec Department of Natural Resources

GEOLOGICAL SERVICES

P.-E. Grenier - Director

FIELD WORK IN 1968 - SUMMARY OF RESULTS

INTRODUCTION

This booklet gives summaries of the results of the technical field program carried out during 1968 by three of the services included in the Geological Services, namely: (1) the Geological Exploration Service; (2) the Mineral Deposits Service; and (3) the Hydrogeology Service.

A total of 50 projects comprised the 1968 field program of the Geological Services, 3 fewer than in 1967. The accompanying index map (No. 1708) shows the general location of each of 23 parties that carried out geologic mapping, or other field studies, in specific areas. The map's marginal notes also indicate the nature of 27 additional diverse projects that involved field investigations but cannot be plotted satisfactorily, owing to their dispersed characted.

The Geological Exploration Service undertook a total of 19 projects. Ten parties carried out geologic mapping, at various scales, in specific areas, and 2 teams studied the unconsolidated surficial deposits in other areas. The remaining 7 projects were of a miscellaneous nature. One geologist carried out special stratigraphic, tectonic and related studies in the Central Labrador Trough. Another group made a detailed study of the Charlevoix Semicircular Structure, which may well have been caused by impact of a meteorite about 375 million years ago. A third geologist continued special studies in the Southern Grenville, including microtectonic research, and the establishment, regionally, of stratigraphic, metamorphic and tectonic correlations. The fourth project comprised investigations pertaining to alluvial prospecting methods. Another officer continued the logging of drill-cores from certain of the boreholes being drilled for water by the Quebec Department of Agriculture and Colonization. In the sixth project, a geologist cooperated with two geophysicists of the Bureau de Recherches Géologiques et Minières (B.R.G.M.) of France in testing a new geophysical procedure in several parts of the Province. Finally, one geologist carried out additional investigations of Mount Royal and vicinity, with the object of preparing a brochure for the 'Popular Geology' series of publications.

The Mineral Deposits Service was responsible for a total of 22 projects. Seven parties carried out standard geologic mapping at the scale of 1" = 1,000' in specific areas. Another geologist did research on some of the opaque oxides deposits related to mafic and ultramafic intrusions of the Grenville Province. Another project pertained to the geochemistry of volcanic rocks in the Chibougamau district. Two engineers were concerned particularly with industrial minerals and building materials, and another with geotechnology and soil mechanics. Another geologist collected data on the asbestos deposits of Quebec. Two officers were engaged in work on peat bogs in various parts of the Province. A geologist and a petroleum engineer kept in close touch with, and assembled information arising from, drilling operations, seismic surveys and other work being done by private companies in their search for petroleum and natural gas. One geologist made special stratigraphic studies in eastern Gaspé Peninsula, concerned mainly with the petroleum possibilities of the Lower Devonian formations. Another officer carried out seismic surveys over the natural gas reservoir of Pointe-du-Lac (St-Maurice Co.) and in the Yamachiche and Sorel districts. Finally, 3 resident geologists - stationed at Rouyn, Val-d'Or and Chibougamau - carried out investigations and supervised mapping programs in their respective districts.

The Hydrogeology Service conducted 8 field projects. They were: (a) 4 separate, in depth, hydrogeologic studies in selected areas; (b) an inventory of the aquiferous formations in 6 rural municipalities; (c) reconnaissance borings in the Lake St-Jean - Saguenay region; (d) an inventory of groundwater resources in St-Hyacinthe and Rouville counties; and (e) spot hydrogeologic surveys for 20 rural municipalities in various parts of the Province, aimed at helping them solve their particular water-supply problems.

The 50th project was that carried out by Dr. H.W. McGerrigle, Technical Adviser in the Geological Services. During 1968 he completed the field investigations required for a geologic, circuit tour of Gaspé Peninsula, following Highway 6 clockwise around the peninsula, a distance of about 560 miles.

During their geologic mapping, certain field parties collected systematically, for geochemical analysis, about 2,200 stream-sediment samples from small watercourses encountered on their traverses. This total results from sampling by 8 parties of the Geological Exploration Service (1,600 samples) and 4 parties of the Mineral Deposits Service (600 samples). The samples, along with information on locations and other pertinent data, were forwarded to the Mineral Deposits Service, one of whose officers is responsible for recording and indexing the material and processing the resultant data. The samples are analysed by the Department's Laboratories Services for total copper, nickel, lead, zinc, molybdenum and uranium, and for various other elements in certain cases. It is already evident that this research (begun by the Geological Services in 1965) can help to delineate localities especially favorable for the finding of certain types of mineral deposits.

1 - GEOLOGICAL EXPLORATION SERVICE

Director - Robert Bergeron

MAPPING PROJECTS

Duplessis County

1# - Natashquan Area - J.P. Bassaget* - (1" = 1 mile mapping)

This map-area borders the north shore of the Gulf of St. Lawrence, about 200 miles east of Sept-Iles. Between longitudes 61°30' and 61°55', it extends north from the coast to latitude 50°30', an average distance of some 20 miles, and covers about 400 square miles. The area comprises the eastern five sixths of two 30' sheets of the federal topographic series - Lac Paimpont (12 K/5) to the north, and Natashquan (12 K/4) to the south. The coastal village of Natashquan is located near the southwest corner of the area.

All the consolidated rocks are Precambrian; they can be divided into two main assemblages. One group forms the basement complex of the area. It includes granitic gneisses, augen gneisses, and massive granites; these rocks are similar in composition, consisting of quartz, potassic feldspar, plagioclase, biotite, hornblende, and accessory minerals. In the south and west hornblende is abundant, whereas biotite is predominant in the northeast part of the area. To this group of rocks can be added pale hornblende gneisses and amphibolites, probably intrusive in origin.

Numbers refer to the accompanying index map (No. 1708) showing general locations of 1968 field parties.

* Indicates full-time staff officer.

The second group, later than the first and on which it seems to be more or less discordant, is extant in the bottoms of synclines where it is often squeezed and laminated. These rocks occupy, among others, two large southeast-trending synclines which crop out widely at Paimpont and Aliecte lakes. This group of rocks comprises detrital sedimentary rocks which are relatively little metamorphosed - mica schists, arkoses, and biotite-muscovite quartzites. Amphibolites, which probably represent former gabbros, are intrusive lit-par-lit into the sedimentary formations. Finally, white pegmatites with a low content of ferromagnesian minerals, but containing sporadic magnetite, cut both the sedimentary rocks and the gabbros.

The whole assemblage of rocks has undergone two tectonic deformations and two accompanying metamorphisms, which mask the primary relations that existed between the different rock facies.

From the economic viewpoint, a few occurrences of magnetite concentration were noted both in the pegmatites of the sedimentary complex and in the crystalline basement rocks. However, owing to both tenor and extent, these concentrations have little economic significance.

South of Aliecte lake, over an area of 100 square feet of an exposure of pegmatite, abnormally high radioactivity was detected by scintillometer. The pegmatite here contains magnetite, but no primary or secondary radioactive mineral was observed at the surface.

Saguenay, Dubuc and Charlevoix Counties

2 - Manicouagan and Outardes Rivers Area - A.F. Laurin* - (1" = 4 miles mapping)

The area proper is bounded by longitudes 68°00' and 70°00', by latitude 51°00' on the north, and by St. Lawrence river on the south. In addition, an irregular area lying within the rectangle limited by longitudes 69°15' and 70°00' and latitudes 51°00' and 51°45' was mapped, in order to cover the ground lying between recent mapping by J.G. Murtaugh (Mouchalagane - Manicouagan Structure Area; Field Work in 1967, Que. Dept. Nat. Res., Publ. S-112, item 8), E.H. Chown (Croix Lake Area; Field Work in 1966, Que. Dept. Nat. Res., Publ. S-103, item 4b), and by Chown and T. Hashimoto (Chown Lake Area; Que. Dept. Nat. Res., P.R. No. 548, maps 1601, 1602, 1603).

The area is about 90 miles east-west and averages some 170 miles north-south, and covers about 15,000 square miles, almost entirely in Saguenay county. It comprises the following map-sheets of the federal topographic series (1:250,000): all of Baie-Comeau (22 F) and Lac Berté (22 K), parts of Lac Manicouagan (22 N) and Rimouski (22 C), and a tiny segment of Edmundston (21 N).

The area includes almost the entire courses of Manicouagan and Outardes rivers and many of their tributaries, and the several dams and power installations built on these rivers by Hydro-Québec. Provincial highway No. 15, linking Quebec City and Sept-Iles, traverses the area northeastward close to the St. Lawrence. The principal towns are Baie-Comeau, Hauterive and Forestville. A road joining Forestville and Labrieville (about 50 miles to the northwest) and its numerous branches facilitate access to much of the southwest part of the area. Likewise, the road linking Baie-Comeau and Manicouagan (Manic-5), about 120 miles to the north, and its branches make entry to the eastern part of the area reasonably easy. However, the northwestern section of the area can be reached readily only by float aircraft.

A few early geologic observations were made in the region by J. Obalski between 1891 and 1894, and again in 1901. The first more detailed work was done for the Quebec Bureau of Mines by C. Faessler from 1929 to 1933, inclusive, but this was limited to areas along the coast. Intermittently between 1950 and 1961, several geologists mapped for the Quebec Department certain selected areas at the scale of 1 inch to 1 mile. Apart from the above work however, prior to the present program the geology of the area was comparatively unknown, except in broad outline.

In this large-scale reconnaissance project, Dr. Laurin was assisted by A. Franconi of the Department's staff, K. Sharma, graduate student at Queen's University, and a field party totalling 26 men. The work was supported by a chartered Beaver aircraft which operated from a base at Outardes-1 (close to Chutes-aux-Outardes) where the party also had its base-camp.

General Geology

All the consolidated rocks of the area are Precambrian and belong to the Grenville metamorphic Province. They can be divided into the following: (1) an assemblage of gneisses and migmatites; (2) an assemblage of charnockitic gneisses;

(3) anorthosites; and (4) massive charnockitic rocks, The gneisses and migmatites, along with the charnockitic gneisses, are the most prevalent rocks in the area. They crop out widely in the southern part, between Baie-Comeau and the mouth of Saguenay river, as well as in the northern half of the area between latitudes 50° and 51°. These gneisses are cut by intrusions of massive rocks such as anorthosites, charnockitic rocks and granites. Among these, the anorthosites are the most prevalent, occurring principally as four large massifs.

(1) - The assemblage of gneisses and migmatites shows a large variety of facies which are distinguished as follows:-

(a) Gray gneiss - Although restricted in exposure, it occurs in the vicinity of Tadoussac and around Baie-Comeau. It is a light-gray, generally coarse-grained, homogeneous gneiss with poorly defined foliation. It contains plagioclase and biotite, with 5-10% quartz.

(b) Layered gneisses - This is the most common facies; it occurs northwest of Baie-Comeau along the lower reaches of Manicouagan and Outardes rivers, and north of latitude 50°. These fine-grained gneisses are characterized by a regular banding caused by an alternation of dark, biotitic layers and light, quartzo-feldspathic layers. They are commonly associated with the gray gneisses, but their textural characteristics indicate lesser metamorphism.

(c) Granitic gneisses - Under this term are grouped a series of fine- and medium-grained, pinkish gneisses composed of quartz, biotite, amphibole, plagioclase and potassic feldspar. They occur south of Labrieville, forming a large dome which extends right to the St. Lawrence.

(d) Biotite-amphibole gneisses - These are very localized; they belong to the amphibolite facies, and are associated with the layered gneisses.

(e) Garnetiferous paragneisses with sillimanite and cordierite - These paragneisses belong to the Grenville Group; they crop out as thin bands at certain places. The principal exposures are found: between the mouth of Saguenay river and Forestville where they occur in a series of tight synclines trending roughly east-west; north of Baie-Comeau; south of Labrieville; and in the northern part of the area in the vicinity of Manicouagan where they form the most extensive exposure. All these gneisses are characterized by garnet and sillimanite, and in places by cordierite. They are fine grained and show good foliation. Frequently associated with these paragneisses are beds of pure quartzite and of crystalline limestone.

(f) Granitic migmatite - This rock crops out at the eastern limit of the area, north of Amariton lake. Here it forms a heterogeneous rock composed of seams of granitic material extending in all directions through biotite gneiss. Also, south of Labrieville, there is an assemblage of granitic migmatite associated with garnet-sillimanite paragneiss.

(2) - The charnockitic gneisses are closely associated with the intrusive charnockitic rocks. They crop out principally to the north of Labrieville, between the Pipmuacan Reservoir anorthosite massif to the west and the Boucher Lake body of mangerites to the east; they also occupy a considerable area between the Tétépisca Lake anorthosite massif and the northern end of the Pipmuacan anorthosite.

These gneisses are fine grained with a granulated texture and show good foliation. Where the percentage of potassic feldspar associated with the plagioclase is large (20-30%), the rock has a pale yellowish hue; on the other hand, where the percentage is small, it is dark green. All these gneisses contain pyroxene.

(3) - The anorthosites form 4 main massifs within the area - in the northwest, the Tétépisca massif; in the northeast, the subcircular one of Berté Lake; the one in the vicinity of Pipmuacan Reservoir; and, in the southeast, a stratiform body which cuts across Outardes, Manicouagan and Toulnustouc rivers. All the various petrographic and textural facies shown by such rocks were noted among these anorthosites.

(4) - The massive charnockitic rocks have a restricted exposure compared to those mapped in 1967 in the region to the southwest. Here they occur as small masses, normally well delimited, scattered throughout the area. The most important is the Boucher Lake mass, to the west of the Outardes-3 dam. Their average mineral composition is that of a pyroxene monzonite (mangerite). However, more acidic varieties (charnockites) and basic types (jotunites) are represented. The rock is homogeneous and massive, with a porphyritic texture; it is dark green on fresh surface but has a whitish patina.

Structural Geology

From a synthesis of data obtained form the ground mapping and photogeology, the area can be divided, in a very general way, into two parts showing particular structural characteristics.

(a) Southern Sector - extending from the St. Lawrence to the latitude of Brochets lake. Here, two structural trends are evident - (1) an early one corresponding to north-trending folds (such as the Brochets Lake anticline); and (2) superimposed thereon, and obscuring the early structures, a more recent trend evidenced by a series of well-marked folds trending northeast and east-northeast (due to the Grenville orogeny).

(b) Northern Sector - Through the mid-courses of Outardes and Manicouagan rivers. Here, all foliations in the gneisses strike roughly northeast. Also, the few folds observed trend north (such as the syncline west of Canton river).

A series of breaks affects the entire area, forming an orthogonal network of faults striking northeast and northwest. They formed later than the tectonic events outlined above.

Economic Geology

The area has few mineralized showings, except for magnetite which almost always occurs associated with the anorthosite masses. The main deposits are the following:

(a) a deposit of specularite at the northeast limit of the area, on the south side of the branch of Mushalagan river that extends northwestward. These showings are associated with crystalline limestones of the Grenville Group.

(b) a deposit of magnetite at La Blache lake. This is the most important deposit known within the map-area. It has been drilled by Terra Nova Explorations Ltd., which holds claims in the region. The magnetite is associated with a gabbroic facies that forms the aureole of an anorthositic massif.

(c) a deposit of magnetite at Outardes-3 dam. This deposit is 200' above the dam; occurring in anorthositic qabbro, it forms a zone about 100' thick that is strongly mineralized with magnetite.

It is pertinent to mention that carbonatite dikes were noted in two separate sections of the area. In the immediate vicinity of Baie-Comeau, dikes of carbonatite cut gray gneisses and augen gneisses along the highway linking Baie-Comeau and Franquelin. The dikes are 2-3 inches wide and pale green, and some are brecciated. In the second locality, near

Argent lake, several carbonatite dikes cut mangerites and granulites that form an aureole around a small body of anorthosite. These dikes are fine grained and dark, and resemble either diabase or amphibolite; however, all effervesce when treated with acid.

Mistassini Territory and Dubuc County

3 - Conflans Lake Area - E.H. Chown - (1" = 1 mile mapping)

This area is bounded by latitudes 52°15' and 52°30' and longitudes 70°30' and 71°00', and covers 365 square miles, mainly in Mistassini territory. It comprises the Lac Conflans federal topographic map-sheet (23 D/7), and the corresponding aeromagnetic sheet (2068G) published (1965) jointly by the Geological Services of Quebec and the Geological Survey of Canada. The area lies about 230 miles northeast of Chibougamau and 115 miles west-northwest of Gagnon; it is readily accessible by float aircraft from bases at those places or at Lake Albanel, 160 miles to the southwest.

The work is part of a program of regional mapping in the Otish (Marie-Victorin) Mountains district begun in 1963 for the Geological Exploration Services by Drs. E.H. Chown and Jean Bérard. The present area is immediately north of the East Peribonca River area (Que. Dept. Nat. Res., P.R. No.535, map 1586 - 1965) mapped by Chown in 1964, and east of the Lake Manet sheet (Field Work in 1967, Q.D.N.R., Publ. S-112, item 5), also mapped by Chown.

Early Precambrian migmatite, and gneissic granodiorite with minor lenses of amphibolite crop out in the north range of hills and also in the low-lying area to the north. One exposure of brecciated amphibolite occurs in the extreme southeast corner of the area.

The Late Precambrian, Otish Mountains Group, comprising the Indicator Lake Formation and an unnamed Upper Division, overlies the granitic basement unconformably. A deep weathering-profile is preserved below the unconformity. The Indicator Lake Formation consists of gray-green, gritty, pebbly arkose and subarkose with two intercalated members of orthoquartzite and well-sorted subarkose. The Upper Division is characteristically red in color, and is subdivided into a lower, pink and gray, dolomite-cemented subarkose, and an upper, purple, argillaceous arkose and conglomerate.

The Otish Mountains gabbro occurs as two main sills and numerous dikes and minor sills. The upper sill, of partly uralitized olivine gabbro, caps most of the hills in the central part of the area. Small remnants of a lower sill are found near the unconformity between the Early and Late Precambrian groups. A few small plugs of peridotite, largely converted to an amphibole rock, intrude the granitic rocks.

Structures in the basement complex are indistinct, but in general strike east and dip 30°-50° south. The Late Precambrian rocks are strongly folded into an asymmetric anticline, overturned to the north, with a broad, open syncline lying immediately to the north. Most of the area is underlain by the south-dipping limb of this syncline. Vertically-dipping faults striking 000° and 060° have broken the younger rocks into numerous small blocks. The faults are probably strike-slip in origin, but may have considerable normal movement.

The lower parts of the area are heavily mantled with ribbed moraine and outwash deposits.

Considerable prospecting activity took place in the area in the 1968 field season, but few claims were staked.

Dubuc County

4 - Lac Rouvray Area - M.M. Kehlenbeck - (1" = 1 mile mapping)

This area is bounded by latitudes 49°15' and 49°30' and longitudes 70°30' and 71°00', and covers about 390 square miles. It corresponds to the Lac Rouvray aeromagnetic map-sheet (1960G) - published (1964) jointly by the Geological Services of Quebec and the Geological Survey of Canada - and to sheet 22 E/7 (unpublished) of the federal topographic series. The center of the area is about 65 miles north-northeast of Chicoutimi and 50 miles west of Labrieville. Parts of Pipmuacan reservoir lake extend into the northeastern and northwestern sections of the area.

The mapping is a westward extension of that done for the Geological Exploration Service by A.T. Anderson in 1962

(Que. Dept. Nat. Res., P.R. No. 504, map 1505 - 1963) and in 1961 (Q.D.N.R., P.R. No. 488, map 1460 - 1962). Moreover, the area is within the southeast quarter of the Péribonca River area mapped in 1966, at the scale of 1" = 4 miles, by A.F. Laurin* for this Service (Field Work in 1966; Que. Dept. Nat. Res., Publ. S-103, item 8 - 1967).

Geologically, the area lies within the Grenville Province and is underlain by high-grade metamorphic Precambrian rocks. These are divided into the following four major groupings: (1) a quartzo-feldspathic gneiss complex covering the central and south-central parts of the map-area; (2) an intimate mixture of metadiorite and augen gneiss in the southwestern corner; (3) a large, massive, igneous complex of porphyritic rocks ranging in composition from quartz monzonite to granite; and (4) various types of anorthosites, with associated gabbroic rocks, which crop out throughout the entire area and surround the other elements.

The bedrock of the area has been subjected to high-grade metamorphism. Preliminary data suggest almandine-amphibolite to granulite facies conditions.

Economically, known mineralization comprises minor accumulations of ilmenite and titaniferous magnetite in the anorthosites, and minor amounts of sulfides, mainly pyrite, in the gabbros.

Dubuc, Lac St-Jean and Roberval Counties

5 - Isle Maligne Area - Germain Tremblay - (Quaternary Geology)

Ref. - Field Work in 1966, Que. Dept. Nat. Res., Publ. S-103, item 7 (1967).

The 1968 work is a continuation by Mr. Tremblay of his 1966 investigations. The studies are being used by him for his doctoral thesis in geography at Université Laval. This year his work was within the following two separate map-sheets of the federal topographic series, each covering about 200 square miles: -

(a) St-Ambroise (East Half) - (22 D/11 E)

Lats. - 48°30' - 48°45'
Longs. - 71°00' - 71°15'

(b) Alex River (West Half) - (22 D/13 W)

Lats. - 48°45' - 49°00'
Longs. - 71°45' - 72°00'

Roberval County

6 - Dolbeau Area - M.L. Noiseux - (Unconsolidated Deposits)

This work was done under the direction of Pierre LaSalle of the Geological Exploration Service who, in 1967, made similar studies in the St-Henri-de-Taillon district to the south.

The present investigations were carried out within the area bounded by latitudes 48°40' and 49°05' and longitudes 72°00' and 72°45'. This rectangle comprises the following federal topographic map-sheets (1:50,000): all of Dolbeau (32 A/16). the east half of Normandin (32 A/15), the northern third of Roberval (32 A/9), the southern third of Melançon (32 H/1), and small parts of Notre-Dame-de-la-Doré (32 A/10) and Girardville (32 H/2). The area lies immediately northwest of Lake St-Jean; it extends about 35 miles east-west and 30 miles north-south, and covers some 1,000 square miles.

However, the investigations were concentrated on those parts overlain by sand and gravel - an extent of some 550 square miles. Nevertheless, clays also were studied, principally where they were in contact with sand and gravel, and likewise stretches occupied by marsh.

Deposits of sand and of gravel were sampled at surface (between 1 and 3 feet), at intervals of ½ to 1 mile, for granulometric and mineralogic (heavy minerals) studies in the laboratory. Moreover, at intervals of about 3 miles, the same deposits were sampled at depth with an auger.

In certain sections where the unconsolidated sediments were especially thick, a seismic survey was carried out to determine their actual depth. Also, to establish the sequence and thickness of the various sediments, borings were made with the Department's truck-mounted rotary drill.

The sands studied make up parts of the deltas of Mistassini, Mistassibi and Ashuapmouchouan rivers. The sand normally ranges in thickness from 20 to 50 feet, except in the

central part of the area, along both sides of Mistassini river south of Dolbeau, where the thickness reaches 150 feet in places. At the base of the majority of terraces there are swamp deposits, up to 12 feet thick, which generally rest directly on the sand. The sand lies on clays of the Laflamme sea which reach more than 100 feet in thickness. The clays, in turn, rest either directly on the bedrock, or on a bed of gravel (till) several feet thick.

The large extents of sand in the area have enabled the formation of huge dunes in several localities; they regularly reach 25 feet in height, and even 50 to 75 feet in places.

Heavy minerals - principally magnetite, ilmenite and garnet - were noted at many places. They occur most often in bands, but here and there in pockets.

The layers of heavy-mineral-bearing sands are generally found in ancient beach ridges; the most prominent ridges are those of St-Méthode where they reach 10-15 feet in height and can be followed for at least 1 mile. Similar sands also occur at the summit of most terraces. It was in the terrace immediately south of Mistassini that the greatest thickness of sand containing heavy minerals was found.

In recent deposits, concentrations of heavy minerals occur on the beaches of the Lake St-Jean littoral, as well as on other beaches and sand bars, principally those of Mistassini river.

In the event that economic types are identified among the heavy minerals, the area shows, from the volume viewpoint, an interesting potential.

Témiscamingue and Pontiac Counties

7 - Rowanton Area - Maurice Rive* - (1" = 1 mile mapping)

Between longitudes 77°30' and 78°15' the map-area extends north from Ottawa river to latitude 46°30', an average distance of some 20 miles, and covers about 700 square miles. It comprises the following federal topographic sheets (1:50,000): all of Rowanton (31 K/5); the east half of Maganasipi River (31 L/8 E); and the Quebec part of the Des Joachims sheet (31 K/4). The center of the area is about 120 miles west-northwest of Hull and 40 miles east of Mattawa, Ontario.

All the consolidated rocks are Precambrian and belong to the Grenville geologic Province. The following rock types have been distinguished:

- hornblende gneisses and amphibolites;
- gray, quartz-biotite-plagioclase gneisses with accessory hornblende;
- garnet gneisses, with which are associated biotite-muscovite-sillimanite-garnet-graphite gneisses, finely layered, fine-grained biotite gneisses (some with augen), fine-grained leptynites, charnockitic gneisses, impure quartzites, crystalline limestones, and calc-silicate rocks with diopside;
- pegmatites and migmatized gneisses;
- biotite granite;
- metagabbros and gabbros;
- diabases.

The regional structure is characterized by asymmetric folds (antiforms, synforms), whose limbs may be very upright or even overturned; their curved or sinuous axes have variable plunges. In the northern part of Maganasipi River East and Rowanton West sheets, the folds trend northwest. South and east of these parts, the structure is complicated; the beds first bend towards the south, then southeast.

Ottawa river follows a zone of east-west fractures, some of which are dotted with exposures of brecciated mylonites. Other east-west breaks were noted in the lower part of the Dumoine river valley.

Some mineralizations were noted. They include: magnetite, pyrrhotite and chalcopyrite impregnated in the metagabbros; inclusions of magnetite in the pegmatites; and of graphite, pyrite and chalcopyrite in the biotite-sillimanite gneisses, calc-silicate rocks, and quartzites.

8 - St. Lawrence Lowlands and Other Studies - Yvon Globensky*

Dr. Globensky's work consisted essentially of three parts, as summarized below.

A - Grondines Area - Revision Mapping

Ref.- Clark, T.H., and Lunde, M. (1950): Grondines Map-area; Que. Dept. Mines, P.R. No. 237, map 837.

The Grondines area (sheet 31 I/9 of the federal topographic series) is bounded by latitudes 46°30' and 46°45' and longitudes 72°00' and 72°30', and covers 410 square miles, mainly in Champlain and Portneuf counties. It lies across St. Lawrence river, about 45 miles upstream from Quebec City, but only a very small part in the southeast corner of the sheet is south of the river.

Precambrian rocks of the Grenville Province occupy the northwestern part of the area, and also a very small segment in the northeast corner. They are mainly various types of granitic gneisses. However, these rocks were not studied by Dr. Globensky, as they were mapped in 1949 by M. Lunde whose findings will be included in the final report on the area.

The remainder of the map-sheet (more than half) is underlain by Paleozoic strata of the St. Lawrence Lowlands. The exposed rocks belong to the following Groups, form oldest to youngest: Black River (gray-blue limestone), Trenton (limestone and interbedded shales), Utica (mainly shales), and Lorraine (sandy shales and interbedded sandstones).

This revision work on the Paleozoic included checking the principal outcrops and all contact zones, and other mapping at the scale of 1" = ½ mile, with the aid of recent aerial photographs and enlargements therefrom. Many additional exposures, mostly revealed during recent trenchings for drainage ditches and similar works, were located and studied, and the new data incorporated into the earlier findings.

Moreover, important sections of the Black River and Trenton limestones were systematically sampled at 5-foot intervals. These samples will be treated in the laboratory to obtain insoluble residues to be used in micropaleontologic studies.

In the economic field, attempts so far made to find commercial quantities of natural gas and/or oil have been unsuccessful. At St-Marc-des-Carrières, near the northeast corner of the area, a few operators are engaged in producing building stone and in making lime. At Deschambault, on the south shore of the St. Lawrence, both drainage and chimney tiles are being manufactured from clay taken directly from the cliff bordering the river.

B - Lyster Area - New Mapping (1" = ½ mile)

The Lyster area (sheet 21 L/5 of the federal topographic series) is bounded by latitudes 46°15' and 46°30' and longitudes 71°30' and 72°00'. It lies about 40 miles southwest of Quebec City and covers 410 square miles, mainly within Mégantic and Lotbinière counties.

Dr. Globensky's mapping was confined principally to the northwestern half of the map-sheet. This part is underlain by formations of the St. Lawrence Lowlands, as well as rocks tentatively assigned to a transition zone between that geologic Province and the Appalachian Province. Folded strata of the latter occur in the southeastern part of the map-sheet and were studied by H.C. Cooke in 1955 when he examined the east half of the Lyster area.

The rocks studied by Dr. Globensky fall mainly into the Lorraine (sandy shales and interbedded sandstones) and Richmond (shales, sandstones and limestones) Groups, but Normanskill (slates and limestone, with interstratified volcanics) and Sillery (slates and sandstones) rocks occurring to the southeast also received his attention.

C - Drill-core Logging

In addition to his geologic mapping projects, Dr. Globensky carried out considerable logging of drill-cores collected by various engineering firms in connection with foundation studies for major construction projects (especially bridges and tunnels), mainly in the Montreal district.

Wolfe and Mégantic Counties

9 - Disraeli Area (West Half) - R.-Y. Lamarche - (1" = ½ mile mapping)

This map-area is bounded by latitudes 45°45' and 46°00' and longitudes 71°15' and 71°30'. It comprises the west half of the Disraeli federal topographic sheet (21 E/14 W). The east half was mapped in 1965 by Pierre St-Julien (Field Work in 1965, Que. Dept. Nat. Res., Publ. S-97, item 17).

The area lies in the Eastern Townships, about 60 miles south of Quebec City, and the town of Disraeli is sited near its center. It covers about 210 square miles, mainly in Wolfe county, though a small segment in the northeast is in Mégantic. Lake Aylmer lies in the south-central part.

Geologically, the area is within the Appalachian Province, and is underlain mainly by folded Paleozoic rocks. In ascending stratigraphic order, the principal formations of volcanic and sedimentary origin are:

(a) Bennett Schists - of Cambrian (?) age, formed mainly of sericite-chlorite schists, and phyllite and meta-quartzite;

(b) Caldwell Formation - of Cambrian (?) age, composed of sandstone, red and green slates, and pale quartzite;

(c) Ascot (Weedon Schists) and St-Daniel Formations - of Cambro-Ordovician age, comprising volcanic rocks of felsic, intermediate and mafic composition, phyllites, phyllites with sandstone blocks, and sandstones;

(d) Beauceville and St-Victor Formations - Middle Ordovician, composed of clastic sedimentary rocks varying in grain size, with some interbeds of rhyolitic tuff;

(e) Sherbrooke Formation - Upper Ordovician, composed of an assemblage of pelites, siltstone and sandstone;

(f) Lake Aylmer Formation and St. Francis Group - of Siluro-Devonian age, comprising a basal conglomerate overlain by a thick sequence of arenaceous limestone, siltstone, and more or less calcareous sandstone.

The northwestern part of the area is crossed by an ultramafic igneous complex, locally serpentinized, of pre-Middle Ordovician age; it is the extension of the rocks that host the asbestos deposits of the Thetford - Black Lake district, a few miles north of the area. The Mont Aylmer and Winslow granitic intrusions, of Upper Devonian age, crop out in part in the southeast corner of the area.

Within the area, two stratiform sulfide orebodies are being mined - those of Solbec Copper Mines, Ltd., and of Cupra Mines, Ltd. Both occur in schists of the Ascot Formation and, though 2.6 miles apart, are presumably at the same stratigraphic level. These mines produce mainly copper and zinc, but also some lead, silver, gold, etc.

Certain exploration work has been carried out on other mineralized occurrences - including sulfides, asbestos, and chromite - elsewhere in the area.

Québec, Lévis, Lotbinière, Dorchester and Other Counties

10 - Québec - Chaudière Area - Pierre St-Julien* (1" = ½ mile mapping)

Ref.- (1) Field Work in 1966, Que. Dept. Nat. Res., Publ. S-103, item 12 (1967); (2) Field Work in 1967, Q.D.N.R., Publ. S-112, item 13 (1969).

This mapping project, begun in 1966, was continued by Dr. St-Julien during the 1968 field season.

The map-srea is bounded by latitudes 46°30' and 47°00' and longitudes 71°00' and 71°30'. It comprises two sheets of the federal topographic series - Québec (21 L/14) to the north, and Chaudière (21 L/11) to the south. The area lies across St. Lawrence river at Quebec City, and covers 820 square miles.

The northwestern fifth, roughly, of the map-area is underlain by Precambrian rocks of the Grenville Province - the remainder by Lower Paleozoic rocks belonging in part to the St. Lawrence Lowlands and in part to the Appalachian Uplands. The 1968 studies were confined to the Appalachian rocks.

The Lowlands strata comprise Trenton limestones overlain by a sequence of Utica-Lorraine shales, all of Ordovician age.

The Appalachian rocks consist of sedimentary strata of the Sillery, Lauzon and Lévis Groups, as well as rocks of two newly differentiated formations - the Vieille Capitale and the St-Antoine-de-Tilly Formations.

The Sillery Group, of Cambrian age, consists of green, red and gray shales, with diverse interbeds of siltstone, impure sandstone, quartzose sandstone, glauconitic sandstone, and small-pebble conglomerate.

The Lauzon Group - Cambrian and Lower Ordovician - includes a sequence of highly glauconitic mudstones and siltstones, siltstones, gray, green, and red shales, gray sandstones, limestone conglomerates and, locally, an alternation of thin beds of limestone and shale.

The Lévis Group, of Lower Ordovician age, consists predominantly of dolomitic mudstones and shales, with interbeds of limestone conglomerate and graded-bedded, calcareous sandstones.

The Vieille Capitale Formation consists of thick beds of argillaceous limestone and calcareous shale, and thick bands of "shale with blocks". This Formation is assigned to the Normanskill (?).

The St-Antoine-de-Tilly Formation is characterized by friable calcareous mudstones containing $\frac{1}{4}$" - 1" laminae of friable lithic sandstone. There are also bands formed of an alternation of calcareous mudstone and calcareous sandstone or calcarenite, in beds 2 inches to 3 feet thick. At many places in this flysch-like sequence, thick bands of "shale with blocks" occur. This assemblage, of "Canajoharie" (?) age, forms isoclinal folds overturned towards the northwest.

From the work to date, it is believed that the Appalachian rocks form a sequence of allochthons. The Sillery Group constitutes the uppermost unit of the structural pile of nappes, and overlaps indiscriminately the Lévis Group (Tremadoc, Arénig), the Vieille Capitale Formation (Normanskill), and the St-Antoine-de-Tilly Formation (Canajoharie). Likewise, the Cambrian glauconitic rocks marking the base of the Lauzon Group rest on Lower and Middle Ordovician terranes.

Bellechasse and Dorchester Counties

11 - St-Malachie Area (West Half) - Claude Hubert - (1" = ½ mile mapping)

This map-area is bounded by latitudes 46°30' and 46°45' and longitudes 70°45' and 71°00', and comprises the west half of the St-Malachie federal topographic sheet (21 L/10 W). It lies a short distance south of St. Lawrence river, about 20 miles southeast of Quebec City, and covers about 200 square miles, almost entirely in Bellechasse and Dorchester counties. Highways Nos. 53 and 25A trend southeasterly across the area.

Geologically, the area lies in the Appalachian Province. The bedrock consists of northeast-trending, tightly folded and closely faulted sedimentary and volcanic formations of Cambro Ordovician age. These rocks are divided into the following 7 distinct stratigraphic units:

(1) Rosaire Group - comprising red, gray and green phyllites, interstratified with impure, white sandstones;

(2) Armagh Group - comprising red and green feldspathic sandstones. To the northwest, this sequence corresponds to a suite of red, green and gray slates interstratified with green feldspathic sandstone; these, in turn, are overlain by a series of impure, graded-bedded sandstones;

(3) Kamouraska Formation - which overlies concordantly unit No.(2) and consists of white quartzite with some interbeds of limestone conglomerate and of gray slate;

(4) a sequence of rocks, probably of Lower Ordovician age, comprising siltstones and gray, green and red slates, which overlies concordantly the Kamouraska Formation;

(5) a suite of Lower Ordovician rocks, consisting of green dolomitic mudstones with some interbeds of gray limestone, which, in the western part of the area, overlies with tectonic discordance units Nos. (2), (3) and (4);

(6) a sequence of Middle Ordovician rocks, comprising green dolomitic mudstones with layers of red mudstones and of volcanic flows, which overlies concordantly unit No. (5);

(7) a series of green volcanic flows interstratified with green and red tuffs, which lies with angular discordance on units Nos. (6), (5), (4), (3) and (2) in the west part of the area.

Disseminated pyrite in small amounts was noted in several exposures of sandstones of the Armagh Group and in the volcanic flows of unit No. (7). The area is strewn with deposits of gravel and of sand, but only certain ones are being exploited.

Rivière-du-Loup County

12 - St-Modeste Area (West Half) - M.-A. Léonard - (1" = ½ mile mapping)

This map-area is bounded by latitudes 47°45' and 48°00' and longitudes 69°15' and 69°30'. It comprises the west half of the St-Modeste federal topographic sheet (21 N/14 W) and covers about 200 square miles. The area borders the south shore of the St. Lawrence about 115 miles northeast of Quebec City and just below Rivière-du-Loup. The principal center is Cacouna, on highway No. 10 at the west edge of the area.

The area is immediately southwest of that mapped by Mr. Léonard in 1967. His detailed stratigraphic studies are being used by him as the basis for his doctoral thesis at Université de Montréal.

Geologically, the map-area lies at the northwestern margin of the Appalachian Province, and the consolidated rocks are sedimentary strata of Cambro-Ordovician age. Most of the beds mapped are purplish, green and gray slates, interstratified with one another and with siltstones. There occur also, mainly in the northwest part of the area, some beds of quartzo-feldspathic sandstone and of lithic conglomerate. The whole sequence is tightly folded along northeast-trending axes.

No mineralization of economic importance was noted. However, in the western part of the area are several deposits of peat, some of which are being exploited.

MISCELLANEOUS PROJECTS

New Quebec

A - Central Labrador Trough - Erich Dimroth*

Dr. Dimroth began a new program of mapping and investigation in the central part of the Labrador Trough. During the previous 5-year period (1963-67, inclusive), his researches covered the Romanet - Castignon Lakes Region, bounded by latitudes 56°00' and 56°30' and longitudes 67°30' and 69°00' (Field Work in 1967; Que. Dept. Nat. Res., Publ. S-112, item 2 - Castignon Lake Area; Q.D.N.R., P.R. 571, maps 1654, 1655, 1656, 1654A, 1655A, 1656A, B-901 - 1969). In 1968, his investigations were carried out within that part of the Trough extending from latitude 56°00' southward to the height of land, near latitude 55°00' - an area covering some 5,000 square miles.

The work is to serve as the basis for the preparation of a new compilation map of this region, at the scale of 1:125,000, and to produce stratigraphic and tectonic correlations between it and the previously mapped block north of 56°00'. The field study includes two phases: (1) measuring of stratigraphy sections; and (2) mapping of areas that had not been previously mapped by either mining companies or the Geological Survey of Canada, or that were not covered satisfactorily, and also of key stratigraphic and structural localities.

In 1968 a 10-man party carried out the following work: -

(1) stratigraphic sections were measured at some 20 localities in the zone between Schefferville and Wakuach Lake, and in the Hurst Lake - Lac Chassin zone, and some stratigraphic work was done at Murdoch Lake, Irene Lake, and Doublet Lake.

(2) various parts of the area were mapped at the scale of 1:50,000; they comprise: (a) the northeastern half of the Granite Falls map-sheet (23 N/16); (b) much of the zone following Swampy Bay and Ferrum rivers in the Wakuach Lake map-sheet (23 0/12); (c) areas of 20 - 100 square miles each, in the north, and southwest of Cramolet Lake, east of Minowean Lake, at Lac Pellegrin and Sanderson Lake, at Tait Lake, at Pauperet Lake, and at Lac Louis; and (d) previously unmapped areas south of

Dunphy Lake, southeast of Lac Low, and east of Lac Harvut.

It is planned that the work will be continued in 1969.

Economic Geology

The area is of great economic interest. The producing iron mines of the Schefferville district are in the southern part of the area, and a number of presently unexploited, direct-shipping iron-ore bodies occur northwest of Schefferville. Beneficiating iron ores containing more than 30% iron are present, likely in large quantity.

A considerable amount of prospecting for Cu, Ni, and asbestos has been done in the eastern part of the area. underlain mainly by gabbroic rocks with ultrabasic sills. Zn mineralization has been observed in dolomites.

B - Charlevoix Semicircular Structure - Jehan Rondot* and Denis-W. Roy

References - all Rondot, Jehan:

(1968a) - Nouvel impact météoritique fossile? La structure semi-circulaire de Charlevoix; Can. Jour. Earth Sci., vol. 5, No. 5, pp. 1305-1317, Oct. 1968;

(1968b) - La Structure de Charlevoix - The Charlevoix Structure; contribution to congress of the Meteoritical Society, Oct. 1968;

(1969) - Rivière Malbaie Area; Que. Dept. Nat. Res., P.R. 576, maps 1669, 1670.

Mr. Rondot and Mr. Roy carried out extensive studies on this structure and vicinity. The center of the structure is represented by Mount Eboulements (47°31'48" N., 70°17'43" W.), about 65 miles northeast of Quebec City. The structure occurs at the southern limit of the Precambrian Shield, between the towns of Baie-St-Paul and La Malbaie. It has an average diameter of about 35 miles, though the southeastern part is cut off by St. Lawrence river. The feature was first conjectured from Mr. Rondot's mapping of the Rivière Malbaie area in 1965 and 1966.

Much of the area is mantled by unconsolidated material comprising glacial, fluvioglacial and marine sediments. Beneath these, in places, occur outliers of Paleozoic sedimentary rocks, including schist at the top, limestone, arkosic conglomerate, quartzite, and diverse basal units. This assemblage rests on a Precambrian basement, which can be divided into three main groupings - a metasedimentary and granitic series, a charnockitic series, and a massif of anorthosite.

The structure itself is characterized by an outer escarpment, a ring-shaped graben with outcrops of Ordovician limestone, and an inner part (flat to slightly undulating) 20 miles in diameter, in the middle of which rises a central peak, Mount Eboulements, to 2,525' elevation.

Thirteen shatter-cone sites were located and studied within a radius of 6 miles around Mount Eboulements. The shatter cones occur in both the Paleozoic strata and the Precambrian basement rocks. Other superimposed structures, including planar fractures and shears, were also studied.

The principal aim of the work is to establish the sequence of events that caused the structure. It is believed that it was formed through meteoritic impact, dated about 375 million years ago - that is, between Lower and Middle Devonian. However, it may be cryptovolcanic in origin. Mr. Roy plans to use his research as the basis for his doctoral thesis at Princeton University.

Some of the Ordovician limestones of the region are used for aggregate. Ilmenite deposits and disseminated sulphides (pyrite, chalcopyrite, sphalerite, galena) may possibly be linked with the structure.

C - Southern Grenville Studies - Jacques Martignole

Dr. Martignole continued has special studies at the southern border of the Grenville Province, west of St-Maurice river. During 1968 two types of work were carried out: (1) broad-scale mapping, effected mainly by observations along roads; and (2) detailed work, corresponding in general to 1:15,000 mapping.

(1) The broad-scale work took in the region extending from St-Maurice river westward to the approaches of the Morin massif, a coverage of some 1,000 square miles. The area includes all or parts of three federal topographic map-sheets - St-Gabriel-de-Brandon (31 I/6), Sorel (31 I/3), and Rawdon (31 I/4).

The purpose of this work was a revision of the geology of the above areas, systematic sampling of the rocks, and the establishment, regionally, of stratigraphic, metamorphic and tectonic correlations. The rocks include paragneisses of the Grenville Group, granulites that are structurally above them, and two major types of intrusions - granitic (St-Didace massif) and anorthositic-noritic (Shawinigan, St-Edouard, and other massifs).

(2) The purpose of the detailed work was to study particular problems in certain areas believed to be of special interest.

(a) The Lake Sacacomie monzonite massif, about 40 square miles in extent, was remapped by K. Schimann, within the area bounded by latitudes 46°30' and 46°35' and longitudes 73°10' and 73°22' (Lac au Sorcier map-sheet - 31 I/11). It lies a few miles north of St-Alexis-des-Monts, Maskinongé county. The purpose of the work was to study the monzonite massif itself, and also its relations with the enclosing gneisses, on the one hand, and with the noritic intrusions on the other hand. This project may extend over several years, and will be the basis for a doctoral thesis.

(b) N. Goulet undertook the study of the eastern flank of the St-Gabriel anticlinorium, between latitudes 46°20' and 46°30' and longitudes 73°15' and 73°25', covering some 50 square miles between the villages of St-Alexis-des-Monts and St-Gabriel-de-Brandon (Berthier county). The aim of this work (also the basis for a doctoral thesis) is to verify the structure of the St-Gabriel anticlinorium, and to trace towards the east the isograds revealed by K. Schryver in the St-Michel-des-Saints area (31 I/12) to the northwest. The rocks of the area are essentially paragneisses, leptynites, amphibolites and granulites.

D - Alluvial Prospecting Methods - Pierre LaSalle* and J.-C. Dubé

In 1968, the Quebec Department of Natural Resources and the "Bureau de Recherches Géologiques et Minières" (B.R.G.M.) of France began a joint program of research into methods of prospecting by means of sampling and analysing glacial alluvium. The aim of the work is to try to determine suitable procedures that could be useful to private companies in their searches for certain types of ore deposits.

The region chosen for the initial studies is bounded by latitudes 48°00' and 49°00' and extends from longitude 77°50' westward to the Quebec-Ontario boundary, close to longitude 79°31'. It covers some 5,300 square miles of Abitibi-

East, Abitibi-West and Rouyn-Noranda counties, but for easy reference is termed "Abitibi Project". The principal urban centers in the area are Rouyn and Noranda in the southwest, Malartic in the southeast, Amos in the east-central part, and La Sarre in the northwest.

During this first year of a proposed continuing program the research was confined to the sampling of certain eskers, mostly trending in a general north-south direction over the area. Each esker studied was sampled at approximately half-mile intervals along or near its crest. At each site a 10'-deep trench was dug by power shovel. From the "B" horizon (illuvial) samples of about ½-lb. were taken for geochemical analysis. Also, from the "C" horizon (unweathered zone) 100-lb. samples were collected; these will undergo chemical analysis for certain elements (such as Cu, Ni, Pb, Zn), and heavy minerals will also be separated from them for study under the binocular microscope.

In principle, this research is akin to that carried out by A.H. Lee of the Geological Survey of Canada on the Munro esker in the Sudbury district of Ontario.

From the data obtained from the various qualitative and quantitative chemical and mineralogical analyses, it is hoped to establish a preliminary outline of methods of alluvial prospecting applicable to regions heavily covered by glacial deposits.

E - Drill-core Logging - Bertrand Warren*

Ref.- Field Work in 1965, Que. Dept. Nat. Res., Publ. S-97, item C (1966). The aims and methods of Mr. Warren's work are given therein.

Mr. Warren continued the study of cores obtained from certain of the boreholes being drilled for water by the Quebec Department of Agriculture and Colonization. From May to December he visited, at intervals of about a month, each of 8 drills that were operating in the southwestern part of the Province, north of Ottawa and St. Lawrence rivers. This district comprises, approximately, the territory bounded by the following centers: St-Paulin (Maskinongé Co.), St-Jovite (Terrebonne Co.) Grand-Remous (Gatineau Co.), Maniwaki (Gatineau Co.), and Chapeau (Pontiac Co.).

F - Geophysical Tests - Bertrand Warren*

During August and September Mr. Warren accompanied two geophysicists of the "Bureau de Recherches Géologiques et Minières" (B.R.G.M.) of France who were testing a new electromagnetic method (MELOS) for measuring the conductivity of the subsoil. The trials were carried out in several parts of the Province. They included tests over certain mineralized deposits in the Abitibi region, on marine clays in the St-Hyacinthe district, over a natural gas reservoir near Trois-Rivières, and on clay and sand deposits north of Alma (Lac St-Jean Co.).

G - T.H. Clark

As during recent years, Dr. Clark did certain miscellaneous work for the Department. In 1968, his field studies were concerned mainly with two projects, namely:

(a) Mount Royal and Vicinity - Popular Geology Series

Dr. Clark is preparing the text for this booklet, one of a new series of geologic publications, the first three of which were issued in December 1968. In this connection he spent considerable time on and around Mount Royal checking field data (1) and accumulating notes suitable for this manual.

(b) Portneuf Area - Checking

Dr. Clark also spent some time checking his earlier work in this area which was originally mapped by him in 1948 (Que. Dept. Mines, P.R. No. 225, map 694 - 1949). Jointly with Dr. Yvon Globensky of the Geological Exploration Service (Field Work in 1967; Que. Dept. Nat. Res., Publ. S-112, item A) a revised final report on this area is to be published.

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(1) During the period 1938-41. Dr. Clark did most of the field work that led to his voluminous geologic report on the entire Montreal Area, namely: Que. Dept. Mines, G.R. 46, maps 791, 799, 800, 801 - (1952).

II - MINERAL DEPOSITS SERVICE

WORK BY THE GEOLOGY DIVISION

Detailed Mapping Projects

13 - Northwest Quarter of McCorkill Township, Abitibi-East County - A. Mathieu* and G. Duquette*

During the summer of 1968, A. Mathieu and G. Duquette mapped the geology of the northwest quarter of McCorkill township. The area, 2 miles north of the northeast end of Chibougamau lake, is centered around the intersection of longitude 73°58' and latitude 50°00'.

The bedrock is made up mainly of a volcanic sedimentary assemblage, bordered on the southeast by anorthositic rocks of the layered Doré Lake Complex and on the northeast by a granodioritic mass which has been named the "France Lake Granite."

The mapping of the north half of McCorkill township represents the final phase in a mapping program undertaken to study the local petrographic and tectonic relations of the greenstones of the district. Having been started in 1962, this program already covered the north halves of McKenzie and Roy townships.

McAdam Mining Corporation Ltd. recently outlined more than 165,000,000 tons of asbestos-bearing rock, containing between 4 and 5% fiber, in the serpentinite band at Roberge lake in the center of the map-area. Concentration tests on more than 500 pounds of samples were successfully run at the pilot plant of the Quebec Department of Natural Resources.

14 - Northwest quarter of Lemoine township, Abitibi-East County - G.O. Allard

The northwest quarter of Lemoine township is largely covered by the waters of Chibougamau lake save for a small triangular area of mainland in the southeast corner. Numerous islands provide excellent outcrops.

The area straddles the contact between the Lac Doré Complex and the Lac Chibougamau Pluton, and lies on the northern limb of the Chibougamau anticline, an easterly trending structure dominating the Chibougamau Greenstone Belt.

The Lac Doré Complex is a stratiform layered complex of the Bushveld-type made up of a wide variety of rock types. Greenschist facies metamorphism has affected all the rocks of the complex and produced unusual rock types. Within the map-area, only the meta-anorthosite and gabbroic meta-anorthosite members of the "Anorthosite Zone" are represented. No good layering was observed in those units and the general easterly strike has been deduced from aeromagnetic information on the magnetite-bearing layers located just north of the map-area.

The rocks of the Lac Chibougamau Pluton show definite intrusive relations with the lower meta-anorthosite zone of the Lac Doré Complex. The southern part of the "Anorthosite Zone" is intruded by abundant dikes ranging from meladioritic to pegmatitic and aplitic types. The northernmost belt of the pluton is an intrusive breccia with innumerable angular fragments of meta-anorthosite and gabbroic meta-anorthosite in a matrix ranging from meladiorite to leucotonalite. The Lac Chibougamau Pluton shows a marked regional zoning from meladiorite on the outside to hornblende diorite to hornblende tonalite to biotite tonalite and granodiorite towards the center. The gradual increase in quartz and biotite toward the center is accompanied by a decrease in the quantity of hornblende and epidote and the calcic nature of the plagioclase. A faint to well-developed foliation has been noted in nearly all the rocks of the pluton. Few areas of biotite granodiorite do not show this foliation. The strong foliation may be a result of the pre-kinematic nature of the pluton. All rock types mentioned above are cut by late pegmatitic and quartzose zones preferentially injected along shear zones and gneissose zones.

The regional assemblages described above are cut by the following major dikes: (a) the Gabbro Island gabbro dike (N.25°E.); (b) the Henderson Mine pyroxenite dike (N.45°W.), and

(c) the Chibougamau Lake olivine diabase dike (N.50-60°E.)

The area is transected by very pronounced shears belonging to three regional sets already observed in adjacent areas. These sets are oriented N.70°W., N.60-80°E. and N.25°E.

The northwest half of the area has been extensively investigated by Campbell Chibougamau Mines Ltd. with geophysical surveys and drilling; very interesting ore zones have been indicated which are awaiting underground development.

The southeast half of the area has not been thoroughly investigated but the quantity, intensity, and complexity of the fractures should be a good incentive to very detailed geophysical work with instruments capable of deep penetration. Depths of waters are not excessive. Very narrow (¼-1") mineralized shears were observed in a few places but no commercial values were obtained. However, one would expect to find the best mineralized zones in deeper water where sheared and altered rocks have been more heavily gouged out by glacial action.

15 - Southwest Quarter of Verneuil Township, Abitibi-East County - M. van de Walle*

The map-area is located immediately east of Quévillon lake and approximately 5 miles east of the new town of Lebel-sur-Quévillon, which lies about 53 miles north of Senneterre on the road to Chibougamau. The present study is the initial phase in a program of detailed mapping of the formations in the vicinity of Quévillon lake.

About 80% of the area mapped is underlain by volcanic greenstones of the Keewatin type. The remainder is occupied by three granitic massifs, of varying size, which have acted as important structural controls.

The first, a biotite granite massif, outcrops on Lodge island in the eastern arm of Quévillon lake. Elsewhere, it is exposed only in a few places on the east shore of the lake.

A second granitic massif, made up of slightly porphyritic biotite granite, is closely confined to the large loop formed by Wilson river some 2 miles before it empties into Quévillon lake. This massif, well defined on its south side, may extend to the north beyond the map-area.

The third granitic massif, in the extreme south part of the area, represents the northern extension of a large batholith which underlies almost 80% of Holmes township. This granite is poor in ferromagnesian minerals. A few rare exposures were noted along the boundary between Verneuil and Holmes townships.

The greenstones underlie the area between the granitic massifs, and their foliation closely parallels the outlines of these intrusive bodies. They include volcanic and pyroclastic rocks, the latter represented mainly by fine- and coarse-grained tuffs and, locally, by agglomerate. This assemblage has a fairly uniform composition, tending toward trachyandesites or dacitic trachytes. Within the area, the greenstones are distributed as follows:

(a) A band of clearly siliceous tuff, 2,000 feet wide and about 8,000 feet long, forms a distinct topographic feature in the northwest part of the area, i.e., between the eastern shore of Quévillon lake and the Canadian National Railways line.

(b) A poorly defined band of porphyritic volcanic rocks, of intermediate composition, lies south of, and parallel to, Kiask river.

(c) Farther to the south is a parallel band of amphibolitic rocks, the metamorphism of which could be related to the Holmes granitic massif.

Two groups of parallel dikes or sills, trending N.45-55°E. and varying from 100 to 200 feet thick, cut the above-mentioned formations. They only partly coincide with the magnetic anomalies indicated on the aeromagnetic map (1434G).

Disseminated pyrite mineralization is fairly common, but does not seem to be accompanied by economic quantities of base or precious metals. Very fine grained chalcopyrite and coatings of malachite were seen in the siliceous tuffs of the northwest part of the area.

Drilling and trenching were carried out in the 1950's by Midrim Mining Company Ltd., Moneta Porcupine Mines Ltd., Amax Exploration Inc. and Roybar Uranium and Gold Mines Ltd. in the Quévillon Lake area. Gold and silver values were reported here and there in shear zones and quartz-carbonate veins. Midrim Mining Co. mentioned the presence of copper, zinc and lead mineralization. This work, however, could not be accurately located in the field.

Nearly 100 stream-sediment samples were taken and analysed for copper, zinc, lead and molybdenum.

16 - North Half of Clericy Township, Rouyn-Noranda County - J.A. MacIntosh*

This area is 10 miles northeast of the town of Rouyn. Mapping, at a scale of 1,000 feet to the inch, began in the northwest quarter of the township in 1967.

A band of sandstone and shale, 2½ miles wide and belonging to the Kewagama Group, trends across the area from northwest to southeast. The dips and the tops of the beds making up this band are almost invariably toward the southwest.

Northeast of the Kewagama Group are the volcanic rocks of the Malartic Group. These rocks are distributed around an anticlinal axis trending west-northwest. A zone of shearing and carbonatization seems to indicate that the Porcupine-Destor fault cuts across the volcanic rocks between the anticlinal axis and the rocks of the Kewagama Group. North of the anticlinal axis and the Malartic Group, a band of sandstone and shale, trending east-west, appears to represent an area of Kewagama Group rocks within the anticlinal fold. The rocks of this band, which is less than a mile wide, have steep to vertical dips. Along the northern boundary of the township, an east-west band of volcanic rocks, partly carbonatized and possibly belonging to the Blake River Group, overlies the rocks of the Kewagama Group.

Small bodies of granitic rocks are abundant and cut all of the formations. Outcrops of Upper Precambrian diabase dikes are numerous. Several sills of serpentinite, all apparently less than 100 feet wide, were observed in the northwest part of the area.

Traces of chalcopyrite and asbestos minerals were noted. About 60 stream-sediment samples and 60 rock samples were taken for analysis.

17 - Roquemaure Township, Abitibi-West County - P.R. Eakins

Roquemaure township was mapped, at a scale of 1,000 feet to the inch, during the summer of 1968. The local Precambrian geology can be summarized as follows:

(1) The central and center-east parts of the area are underlain by an anticlinal zone of rhyolitic to andesitic volcanic rocks.

(2) The southern third of the area comprises a zone of pillow lavas and massive volcanic rocks, mafic to ultramafic in composition, accompanied by their related intrusive bodies.

(3) The northern zone is similar to the southern zone, but these rocks are cut by acidic and mafic dikes and sills and by bodies of granite and granodiorite.

Although broadly simple, the detailed structure of the area is extremely complex, with several periods and types of deformation. The absence of reference horizons makes an understanding of the structure all the more difficult.

There has been little exploration for base metals in the township since the end of the second world war. The most important work was that done in the eastern half of Range I, by Canadian Johns-Manville Company Ltd., where showings of chrysotile asbestos proved to be of interest.

Minor copper mineralization was discovered near the andesite-rhyolite contact which extends from the southeast corner of Range I to the western part of Range V. Exploration is difficult here, however, because of the lack of outcrop and the thickness of the clay and till overburden. The presence of ultramafic pillow lavas and bodies of peridotite could indicate that the area is favorable for nickel or copper-nickel mineralization.

18 - Southwest Quarter of Baby Township, Témiscamingue County - L. Imreh*

Systematic geologic mapping of Baby township, at a scale of 1,000 feet to the inch, began with the mapping of the southwest quarter. East of the boundary of this quarter township, the total area covered in 1968 was 30 square miles.

The area can be divided into four main geologic units, as follows:

(a) an undifferentiated volcanic sequence;

(b) a basic intrusive series made up of various types of gabbro;

(c) an acidic hypovolcanic series made up mainly of quartz porphyry;

(d) a granodiorite body.

The distribution of these units reflects the general fold pattern of the area. The basic series forms the limbs of a syncline, with a northeast-trending axis, which passes through the center of the area. The acidic series and particularly its intrusive facies outcrop within the syncline, which is bounded on the south by the granodiorite body at the extreme southern end of the map-area.

The basic series is the only one of the above rock units which might have any economic importance. It is this series which contains the "favorable gabbro" horizon - a potential host-rock for copper and nickel mineralization. Falconbridge Nickel Mines Ltd. and Midrim Mining Company Ltd. are among the companies which have probed these rocks by drilling. This work was concentrated mainly on the south limb of the syncline, particularly in the vicinity of Robinson and Croche lakes.

In all, 233 stream-sediment samples were taken during the course of the mapping.

19 - The Rivière Madeleine-Nord Area, Boisbuisson, Deslandes and Lesseps townships, Gaspé-Nord County - H.S. de Römer

The Rivière Madeleine-Nord area, which covers about 30 square miles, was mapped at a scale of 1,000 feet to 1 inch. It comprises parts of Lesseps, Deslandes and Boisbuisson townships and is bounded by latitudes 48°54' and 49°01' and longitudes 65°50' and 65°55'. The area lies about 25 miles southeast of Ste-Anne-des-Monts and immediately north of the Madeleine Lake area mapped by the writer in 1967.

Topographically, the area comprises the steep eastern slopes of the McGerrigle mountains and a rather flat, featureless upland surface in the eastern part. The slopes and the upland correspond, geologically speaking, to the granitic massif of the McGerrigle mountains and the Quebec Complex of Lower Paleozoic age.

The McGerrigle massif, which is in intrusive contact with the rocks of the Quebec Complex, is made up of medium- to coarse-grained rock of granitic or granodioritic composition. Near its contact with the country rocks, the igneous rock is commonly mica-rich and contains numerous, partly digested xenoliths. At places, it is characteristically a hybrid rock.

The Quebec Complex comprises mostly northeasterly striking and steeply eastward dipping metasediments, as well as a belt of metavolcanics. The metasediments consist generally of gray to black calcareous slates, phyllites, dark argillaceous limestones and quartzitic sandstones. The metavolcanics form a concordant belt of altered andesites in the northern part of the area.

The strike of the contact line between the McGerrigle massif and the Quebec Complex is very irregular in places, although it maintains a general N.-S. trend throughout the area. The intrusive body is flanked by a 1 - 1.5 mile-wide zone of alteration within the country rocks, consisting of an inner belt of hornfels, skarn and cordierite schist and an outer belt of argillite. Typical contact metamorphic effects in this aureole are superimposed on the regionally metamorphosed metasediments and metavolcanics of the Quebec Complex. As the contact with the igneous rock is approached, the NE. strike of the Quebec Complex swings abruptly to the NW., along a north-directed concave curve. This fact strongly suggests that the McGerrigle granitic massif was intruded from the south.

Several showings of chalcopyrite and pyrite have been located within the alteration zone. The mineralization is erratic and of the fracture-filling type; it is largely confined to hornfels and skarn.

Miscellaneous Projects

Opaque oxides in the mafic and ultramafic intrusions of the Grenville Province - L. Kish*

During the 1968 field season, L. Kish visited some of the opaque oxide deposits in the Grenville geological province of Quebec. This work constitutes the first part of a systematic study of the genetic, chemical and economic aspects of those Fe- and Ti-oxide concentrations that are associated with basic and ultrabasic rocks and anorthosite bodies.

Geological relations were investigated and samples collected at the following places:

1- Sept-Iles bay - anorthosite and gabbro;

2- Ste-Marguerite river, near Clarke City - anorthosite;

3- W. of St-Jean river and NE. of Magpie lake;
4- Raudot lake - layered massif;
5- N. of Hart-Jaune river - ultramafic rocks;
6- Lise lake, near Labrieville - anorthosite;
7- W. of La Blanche lake - anorthosite;
8- N. of Chicoutimi - gabbro and syenite;
9- Vicinity of St-Charles, near Jonquière - gabbro;
10- Near St-Urbain - anorthosite;
11- Morin massif, near Ste-Agathe - anorthosite.

Geochemistry of volcanic rocks, Chibougamau district - B. Gunn

In May and September 1968, a total of 200 samples was collected in the Chibougamau district area for the purpose of analyzing them for major elements (Na, Mg, Al, Si, P, Ti, K, Mn, Fe) and also for Rb, Sr, Ba, Cu and Zn. These analyses are being carried out in the hope of proving or disproving relationships between the various volcanic rocks in the Chibougamau district and to identify them as to types.

Samples have been collected along lines drawn:

1- From Waconichi lake to Chibougamau lake;
2- From the Opémisca dioritic pluton into the adjacent volcanic rocks;
3- From the Waconichi dioritic pluton into the adjacent volcanic rocks;
4- From the Chibougamau granitic pluton into the adjacent volcanic rocks;
5- Across the Lac Doré Complex.

A few samples were also collected in the area of the Obatagamau pluton, near the Grenville Front.

The results obtained so far (Dec. 1968) indicate that the Chibougamau greenstones are metamorphosed tholeiitic basalts, including picrites, olivine tholeiites, and tholeiites.

The tuffaceous rocks of the region belong to an unrelated series, probably of crustal origin, and have probably been altered by sedimentary processes so that they are best termed volcanic greywackes. No gradational variations were found from the bottom to the top of a section 55,000 feet thick.

The sills intruded into the lavas and tuffs are closely related chemically to the lavas, and include gabbros, norites and quartz norite. Fractionation trends can be plotted, but are erratic due to the alteration of the rocks during metamorphism and albitisation. The zinc and copper contents of the series of lavas are similar to that found in tholeiitic lavas elsewhere, i.e. 80 to 200 p.p.m.

A special study is being made to ascertain whether the Cu and Zn are lower in the contact metamorphosed belt around the younger dioritic plutons, i.e. to establish whether the Cu and Zn have been driven out from the lavas close to the diorites; the results of this study are not yet complete.

Analyses of the diorites themselves indicate a very unusual high-soda, low-potash type, suggesting a fundamental difference in composition between primitive (2.6 billion years) continental crust and the average continental crust of the present.

WORK OF THE INDUSTRIAL MINERALS AND BUILDING MATERIALS DIVISION

The field work of this Division, as in past years, consisted in visits to the workings and prospects which involved industrial minerals and building materials, as well as various studies related to soil mechanics.

The chief of the Division, O.D. Maurice*, visited granite quarries in Papineau, Portneuf and Témiscamingue counties and limestone quarries in Matapédia and Bonaventure counties. He also visited a copper prospect in the Eastman area, a manganese prospect near Matane and gold placers near Mégantic. In the fall, he spent a few days in the field in the company of geophysicists from France who had come to Quebec to test a new geophysical instrument. Dr. Maurice also spent two months, from February to April, in French Africa, where he assisted geologists from the

Bureau de Recherches Géologiques et Minières of France in their exploration work in Mauritania, Senegal, the Ivory Coast and the Cameroons.

Roger Sirois*, who is concerned mainly with building materials, visited numerous quarries in the Lac Saint-Jean area and in the counties of Labelle, Stanstead, Rouville and Shefford. In June and July, he accompanied officers of l'Association des Producteurs de Granit du Québec on a study mission to European quarries.

Jean-Yves Chagnon* also carried out field work during the season. Within the framework of an ARDA project, he continued the work undertaken in 1967 in the Lac Saint-Jean area. This involved: (a) taking continuous drill-samples of clay at Desbiens, Saint-Jean-Vianney, Albanel, Lac-à-la-Croix and Sacré-Coeur; (b) measuring the shear resistance of clays at 12 different locations in the Desbiens area; and (c) carrying out seismic surveys in the Desbiens area. Under the auspices of the Waters Branch of the Department, he carried out soil studies at Yamachiche and at Sainte-Monique-de-Nicolet and studied dam sites on Sainte-Anne river (in the Gaspé) and on Yamaska Nord river.

Dr. Chagnon examined landslide sites at Rivière-de-la-Mare (Baie-Saint-Paul), Saint-David-d'Yamaska and Saint-Vallier. He also sampled the kaolin deposit at Château-Richer (16 drill-holes to an average depth of 15 feet), and sampled the trenching which had been done.

Marcel Tiphane, of Université de Montréal, made numerous visits to the Asbestos-producing operations of the Eastern Townships and to prospects in Abitibi. These visits were intended to gather information for a publication on the asbestos deposits of the Province of Quebec.

WORK BY THE PEAT-BOGS DIVISION

The 1968 field work of the Peat-bogs Division consisted mainly in topographic surveys and preliminary examinations of various Quebec peat-bogs, as well as drainage surveys and some special studies.

Topographic surveys and preliminary examinations

The topographic surveys were carried out by a team of nine men, under the direction of Ghislain St-Pierre*. This work involved six peat-bogs on Manicouagan peninsula, Saguenay county, thus completing the previous year's survey of the 20 peat deposits of the peninsula.

Preliminary examinations were carried out on peat-bogs in the following counties:

Compton county	1 peat-bog in Sawyerville parish;
Rimouski county	1 peat-bog in Saint-Eugène-de-Ladrière parish;
Lac-Saint-Jean-Ouest county	1 peat-bog at Saint-Ludger-de-Milot, 2 peat-bogs in Albanel parish; 3 peat-bogs in Gérardville parish, and 1 peat-bog in Normandin parish;
Lac-Saint-Jean-Est county	1 peat-bog in L'Ascension parish, and 1 peat-bog in Hébertville Station parish;
Chicoutimi county	1 peat-bog in Saint-Honoré parish;

In all, 210 peat samples were taken during this work.

Special studies

A special study was carried out by Antoine Simard*, chief of the Division, on the peat-bogs of the Mingan archipelago, offshore from Havre-Saint-Pierre, Duplessis county. He visited Niapisca, A la Proie, Grande, Perroquet, Saint-Charles, A la Chasse and Sainte-Geneviève islands to study the basis of an early report to the effect that the organic deposits of this area had a highly fertilizing value because of the accumulation of guano from marine birds.

Mr. Simard also visited the peat-bogs on the mainland near Havre-Saint-Pierre in order to make a comparison with

the peat of the Islands. During the course of these studies, he took samples at 15 different locations.

Finally, Mr. Simard continued to follow the Deschambault experiments, which are in their fourth consecutive year. These experiments consist in comparing stable litter and peat, in different stages of decomposition, in order to determine their respective merits as fertilizer.

Drainage surveys

Surveys of drainage trenches were carried out by Messrs. St-Pierre and Simard on 21 peat-bogs at Ile-aux-Coudres, Rivière-du-Loup, Saint-Charles-de-Bellechasse, Les Escoumains, Saint-Marc and Grondines.

WORK BY THE PETROLEUM AND NATURAL GAS DIVISION

This Division has two professional men on its permanent staff: W.B. Skidmore* and Paul-P. Simard*.

During the course of the summer, Dr. Skidmore made several trips to Gaspé to: (a) supervise the geologic work and associated diamond drilling in eastern Gaspé (see summary below); (b) provide field support to the geologists of the Department and other organizations; and (c) guide a group of young French students.

Mr. Simard closely followed the work of the oil companies particularly the drilling of Sun Exploration et al. No. 1 La Rédemption and Shell Saint-Simon No. 1. He also followed the seismic work carried out by British American Oil Company Ltd. in the Gaspé area and by Sisque Québec Limitée near Saint-Jean-d'Iberville. Along with personnel from B.R.G.M., he participated in tests of a ground electromagnetic instrument in the Pointe-du-Lac area. Mr. Simard supervised the start of seismic work by a crew in the Pointe-du-Lac and Sorel areas (see summary below). He also went to Saint-Sulpice and to Pointe-aux-Trembles, where gas was leaking from old wells, and he checked out reported discoveries of natural gas or petroleum on private properties.

Stratigraphic study, East Gaspé Basin - G. David Mason

Mr. Mason, a graduate student at Carleton University,Ottawa, completed a second summer of field work on the stratigraphic relations and petroleum potential of some of the Lower Devonian formations of eastern Gaspé, namely, the York River and Grande Grève Formations, the Fortin Group and the York Lake Series. The field area is roughly 60 miles from west to east and 20 miles from north to south, and includes the towns of Murdochville, Gaspé and Percé. The Gaspé Limestone - Gaspé Sandstone transition was studied at 29 new localities in 1968 (38 in 1967). Special emphasis was placed on the Fortin Group in Fortin and Joncas townships during this field season. Detailed stratigraphic work was carried out at the best exposed study areas found this summer and last. Nearly 800 lbs. of fossiliferous rock was collected from 6 different areas for study by Professor A.J. Boucot at the University of Pennsylvania.

During October and November diamond drilling was carried out across the limestone-sandstone transition at widely separated localities. A total of 1,120 feet of core was obtained.

Preliminary results indicate that the York River Formation becomes coarser upwards and also to the southeast, suggesting a source of sediments to the southeast and transgression from the same direction. The Grande Grève Formation shows little megascopic variation except in bedding character and thickness, but has been carefully sampled in its upper part for close petrographic study. Boucot's brachiopod studies indicate that the formation is oldest in the southeast. The Fortin Group is well exposed in its type area. Siliceous limestones similar to those of the York Lake Series occur in all sections in transition zones below the sandstones and conglomerates of the York River Formation. Areal distribution of the York Lake Series (consisting of interbedded Grande Grève and York River lithologies) is still poorly understood because of inadequate surface exposures.

Seismic Surveys at Pointe-du-Lac, Yamachiche and Sorel - Marc Germain*

During November and December, Mr. Germain carried out a seismic survey in the area of the Pointe-du-Lac natural gas reservoir. Here, the very fine sand overlying the bedrock is covered by about 160 feet of clay. The purpose of the survey

was to prove the hypothesis that the accumulation of natural gas at this locality is related to a domal configuration of the bedrock surface. If such a dome is indeed indicated, the use of seismic surveys to locate these structures would aid greatly in finding similar reservoirs.

Surveys were also carried out in the Yamaska and Sorel areas, where drilling in the past had revealed the presence of natural gas and where overburden conditions are believed to be as favorable as at Pointe-du-Lac.

These surveys were carried out by means of a portable instrument (RS-4), with a penetrating power of about 350 feet.

WORK BY RESIDENT GEOLOGISTS

Rouyn-Noranda District

J.A. MacIntosh* continued the mapping of the geology of the northern half of Clericy township (see Project No. 16). He also began a detailed geological study at Delbridge Mines, visited a dozen mining properties, studied the drill-core from the water drilling work done by the Department of Agriculture and Colonization, and accompanied many geologists visiting or working in the area.

Val-d'Or District

Maurice Latulippe* made some traverses in Senneterre township in order to define more clearly the geology of the area.

Chibougamau District

Gilles Duquette* directed the geological mapping in the northwest quarter of McCorkill township (see Project No. 13).

III - HYDROGEOLOGY SERVICE

Raymond Roy, Director

The following projects were undertaken by the Hydrogeology Service during the year: (1) a hydrogeologic study of the basin of Eaux Volées brook, Montmorency forest; (2) a hydrogeologic study of the Aylmer Lake - Saint-François Lake area; (3) a hydrogeologic study of the Eaton River basin; (4) an inventory of the water-bearing formations in six rural municipalities of Quebec (ARDA #765); (5) reconnaissance drilling in the Lac-Saint-Jean - Saguenay area (ARDA #1017); (6) a groundwater inventory in Saint-Hyacinthe and Rouville counties (ARDA #1053); (7) a hydrogeologic study of the Island of Orleans and the area north of Quebec; and (8) local hydrogeologic surveys.

Project No. 1 (No. 20 on the index map) - Hydrogeologic Study of the Basin of Eaux Volées Brook, Montmorency Forest - François Rochette*

This drainage basin covers 3.54 square miles and is centered around the intersection of longitude 71°09'10" and latitude 47°16'20". The purpose of the study, which was a contribution to the International Hydrological Decade, was to determine the hydrologic cycle of the area and, eventually, the influence of the forest cover.

In 1968, the Service continued the studies of the previous year, involving reconnaissance drilling, a seismic survey and the installation of piezometers. In all, ten holes were drilled and an equal number of piezometers, 1¼ inch in diameter, were installed. This represented 612 feet of drilling - 324 feet in overburden and 288 feet in bedrock. This network of piezometers will allow observers to follow the fluctuations in water level in the different surficial deposits and explain the behaviour of the aquifer under the existing climatic conditions.

Project No. 2 (No. 21 on the index map) - Hydrogeologic Study of the Aylmer Lake - Saint-François Lake Area - Georges Simard*

The area covers 265 square miles and is bounded by longitudes 71°05' and 71°25' and latitudes 45°45' and 46°00'. This study, continuing the work of 1966 (Report S-103) and 1967 (Report S-112), was intended to locate flowing or drainage zones, in the north-sloping watershed.

During 1968, the Service completed the seismic survey which had revealed the existence of four preglacial valleys. As well, thermometric studies indicated possible anomalies in Aylmer lake at the points of convergence of the preglacial valleys. This phase of the work remains to be verified by drilling, by installing piezometers and by test wells in order to determine the aquifer potential of these valleys.

Project No. 3 (No. 22 on the index map) - Hydrogeologic Study of the Eaton River Basin - Georges Simard*

This study, another contribution to the International Hydrological Decade, is in its fourth year. It covers an area of 250 square miles between longitudes 71°10' and 71°45' and latitudes 45°10' and 45°30'.

During 1968, the Service continued exploration work in the valleys of Eaton and Clifton rivers. Seven piezometric stations are in operation, and pumping tests have been carried out in the alluvium (semi-confined aquifer) and in the deep sands and gravels (confined aquifer).

The major problem consists in tracing the preglacial valleys, which, generally, seem to lie beneath the present valleys. It has been possible to locate deep sands and gravels underlying a second cover of till which extends for about 10 miles. Wells producing between 125 and 250 gallons per minute could easily be developed in this confined aquifer.

It is believed that the features of this basin are reproduced elsewhere in the Eastern Townships and that it is therefore important to confirm the presence of the preglacial valleys, which seem to be favorable for the capture of groundwater.

Project No. 4 - Inventory of the Water-bearing Formations in Six Rural Municipalities of Quebec (ARDA #765) - Claude Grenier*

This work, begun in 1967, was completed in 1968 with the study of six municipalities: Saint-Augustin (Portneuf), Saint-Justin (Maskinongé), Sainte-Emélie (Joliette), Saint-Damien (Berthier), Saint-Cléophas (Joliette) and Notre-Dame-du-Nord (Témiscamingue). In each, the Service attempted to locate an aquifer capable of supplying water of acceptable quality and sufficient quantity for the local population. Favorable results were obtained in five of the municipalities. At Saint-Justin, unfortunately, the hydrogeologic conditions mitigate against the development of wells with an adequate supply of water.

Project No. 5 - Reconnaissance Drilling in the Lac Saint-Jean - Saguenay Area (ARDA #1017) - Raynald Dessureault*

This was also a continuation of a study begun in 1967. During the year, close to 7,000 feet of drilling was recorded and a seismic survey was carried out. The interpretation of the survey was based on control drilling work. The municipalities which benefited particularly from this regional study were: Roberval parish, Roberval and Lac Bouchette (in Lac-Saint-Jean-Ouest county) and Saint-Coeur-de-Marie (in Lac-Saint-Jean-Est county). Although this project has not yet been completed, the work done so far has confirmed the presence of favorable aquifers in Roberval parish; at Lac Bouchette and at Saint-Coeur-de-Marie. At Roberval itself, there are no aquifers which could lead to the development of a well with a strong supply of water.

Project No. 6 - Groundwater Inventory in Saint-Hyacinthe and Rouville Counties (ARDA #1053) J.-M. Prévôt*

The project, begun in 1967 in conjunction with the Quebec Water Board, was continued during 1968.

The work consisted in completing the inventory of 250 wells in the two counties. Some water samples were taken for analysis. The results enabled the Service to map accurately the

variation in chloride content of the water and brought to light the existence of horizons of soft water in Rouville county. The Service also took 150 electric soundings and ran a few seismic profiles, followed by a program of stratigraphic drilling (43 holes). Two test wells and 14 piezometers were dug.

Although the work is not yet complete, the following observations can be recorded. The aquifers in Saint-Hyacinthe county are generally saline; the most interesting water-bearing formations, as far as quantity and quality are concerned, are in Rouville county.

The Service took advantage of its field location to undertake local surveys at Saint-Paul-d'Abbotsford, Saint-Césaire, Rougemont and Saint-Jean-Baptiste-de-Rouville. Hydrologic conditions are excellent at the first three locations, but favorable aquifers could not be found at Saint-Jean-Baptiste-de-Rouville.

Project No. 7 (No. 23 on the index map) - Hydrogeologic Study of the Island of Orleans and the Area North of Quebec - Claude Grenier*

During the summer of 1968, P. Gélinas, an engineer working on a part-time basis under the direction of Claude Grenier, began a general study of the area. He concentrated most of his work on the Island of Orleans, where he made an inventory of the existing wells and took water samples from them.

Unconsolidated deposits are generally not very abundant, except in some glacial valleys. The bedrock is made up mainly of schist, limestone, conglomerate and quartzite in beds which dip steeply to the east and are cut by numerous faults.

This study will be continued in 1969 and will be extended to the area north of Quebec in order to determine the flow pattern of the groundwater and, if possible, delineate the various aquifers. The work will likely involve drilling, a seismic survey and, if necessary, some piezometers.

Project No. 8 - Local Hydrogeologic Surveys - A. Marot

Although the Service's hydrogeologic research was based on regional studies, the Service was able to carry out a few local groundwater surveys in some municipalities. In this regard, A. Marot, technical cooperator from France, attached to the Hydrogeology Service, visited 20 rural municipalities in the Province in order to learn of the water problems which they face and, if necessary, propose solutions. Our Services were therefore extended to municipalities in the following 15 counties (in parantheses are the number of municipalities visited): Abitibi (1), Beauce (2), Dorchester (1), Gatineau (1), Laprairie (1), Lévis (1), l'Islet (1), Lotbinière (4), Montcalm (1), Montmorency (1), Nicolet (1), Québec (1), Rivière-du-Loup (1), Saguenay (1) and Témiscamingue (2).