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GEOLOGY OF THE LANTAGNAC - LA TOUCHE AREA (COMTE D'ABITIBI-EST)

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**MINISTÈRE
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NATURELLES**

DIRECTION GÉNÉRALE
DES MINES

**GEOLOGY OF THE
LANTAGNAC—LA TOUCHE AREA
ABITIBI-EST COUNTY AND ABITIBI TERRITORY**

J. A. MacIntosh

FINAL REPORT

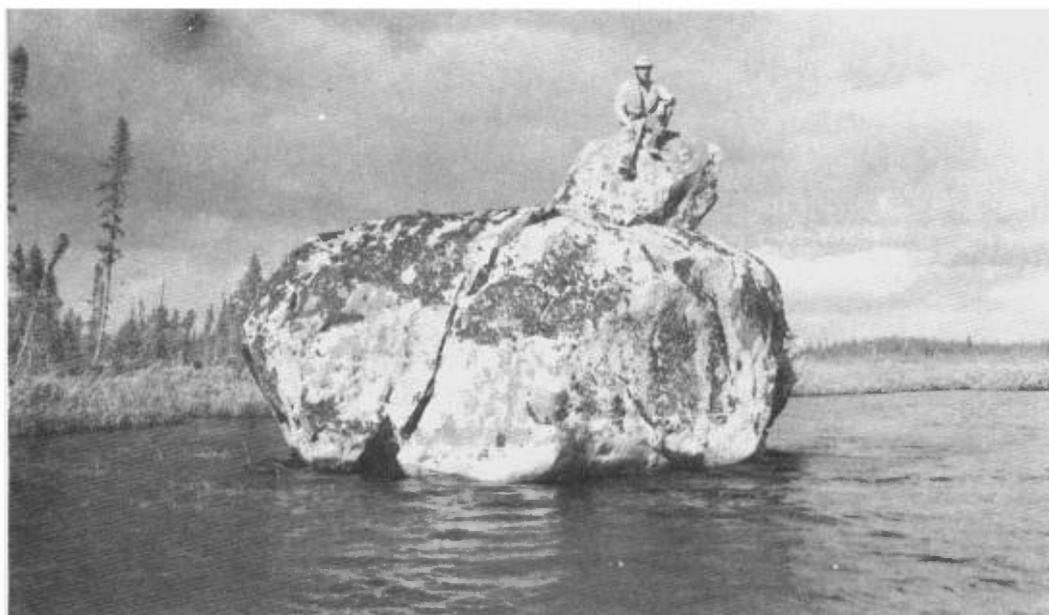
GOUVERNEMENT DU QUEBEC
MINISTERE DES RICHESSES NATURELLES

GEOLOGY OF THE LANTAGNAC-LA TOUCHE AREA
ABITIBI-EST COUNTY AND ABITIBI TERRITORY

Final report
by
J.A. MacIntosh
1977

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Large glacial erratic and smaller superposed block north end of Opataca lake, within the area.

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Geology of the Lantagnac-La Touche Area,

County of Abitibi East

J.A. MacIntosh

INTRODUCTION

General statement

The Lantagnac-La Touche area was mapped during the field seasons of 1964 and 1965. The area lies in the Superior structural province of the Precambrian shield, approximately 50 miles northwest of the Superior - Grenville boundary, and includes parts of the headwaters of the Nottaway and Broadback rivers.

The rock-types found include those volcanic and sedimentary rocks and associated sills that are commonly referred to as of Keewatin and Temiskaming types, and metamorphic rocks, including sillimanite gneiss that may be metamorphic equivalents of these. All are cut by several bodies of acidic, basic, and ultrabasic intrusions the largest of which, a syenodiorite, extends as an east-west band to six miles in width across the northern half of the area and is apparently intrusive into the above mentioned metamorphic rocks and a more northerly area of injection gneiss. The attitudes of the flows and strata are for the most part steep in

dip and they parallel to a notable extent the boundaries of the acidic intrusions. The metamorphic rocks show more variation in attitude. Of a younger age are several diabase and gabbro dikes. There is some evidence that upper Precambrian sedimentary rocks covered at least the north portion of the area. Pleistocene and later deposits cover 95% of the area, but some rocky uplands are present.

No mineral deposits of economic importance are known within the area. Small amounts of copper, gold, cobalt, molybdenum and fluorite, and thick bands of massive pyrite and pyrrhotite have been found. Records on prospecting in the files of the Department date from 1936 (Prospectors Airways) and include 54 diamond drill holes.

Location

The Lantagnac-La Touche area, with an extent of 380 square miles, lies between latitudes North $50^{\circ} 00'$ and $50^{\circ} 15'$ and longitudes West $75^{\circ} 00'$ and $75^{\circ} 30'$, block 32 J/3 of the National Topographic System. Included are the northern parts of Guettard, Lamarck, and Opemisca townships in Abitibi East County and the whole of Julien and parts of Lantagnac, La Touche, Lucière Turgis, and Livillier townships in Abitibi territory. The centre of this region is approximately 40 miles west-northwest of the town of Chibougamau.

Access

The area is most easily reached by float-plane and there

are numerous lakes suitable for float-plane operation. The Chibougamau and Brock rivers are suitable for float planes at several points within the area, even during the period of low water.

The Chibougamau river permits access by canoe from the south, either descending by Opemisca and Michwacho lakes, or, presumably, by ascending from the Chapais-Senneterre highway.

A good portage exists between Brock river and the east end of Eau Noir lake, and between a tributary of West Brock river and Opataca lake. Julien creek is navigable by canoe between Julien and Thomelet lakes. Canoe travel from Mildred creek to Turgis lake makes accessible much of the western half of the area. Pichamobi Arm is a part of Lac La Trêve. Naomi creek is blocked by deadfall.

The two east-west mid-township lines within the area are easily followed as are the north-south lines between Turgis and Livillier, between Guettard and Lamark, between Lamark and Opemisca, and the northern boundary of Lantagnac, Julien, and La Touche townships. The southern boundary of Lantagnac township is difficult to follow, and the southern boundaries of Julien and La Touche townships were not seen.

Several short, summer bush-roads lead to drilling sites. These are on the north bank of the Chibougamau river four miles below the Brock river, crossing the Ruisseau Noir two miles east of Eau Noir lake, on the east shore of Petites Plages lake, east and south of Thomelet lake, south and north of Julien creek near the

felsic volcanic rocks, east of Pichamobi Arm, northeast of the small lake in the extreme southwest corner of the area. A winter road parallels the southeast shore of Maybank lake.

Field work

The base map at a scale of one inch to one half mile was a drainage map of the department of hydraulic resources compiled from aerial photographs taken in 1953-54 by 'Photo-Air Laurentides'. The aerial photographs used in the field were taken by 'Photo Air Laurentides' in 1954 and were at a scale of approximately one inch to one quarter of a mile. Also used were a set of photos at about one inch to one mile supplied by the Royal Canadian Air Force, and a photo-mosaic at approximately one inch to one half mile. Information on the mineral exploration of private companies comes from the files of the Geological Services of the Quebec Ministry of Natural Resources.

Pace and compass traverses were run at a spacing of one half mile, using aerial photographs for control and as a guide to areas of outcrop. All navigable streams and the shores of lakes were traversed by canoe. Outcrops were generally small and widely spaced. The best rock exposure is in Julien township, particularly from Julien lake to Quatre Coins lake, and in Guettard and western Lamarck townships. Outcrop makes up less than 5% of the surface in the area as a whole.

During the traverses samples of stream sediments were taken from the banks a few inches from the water to give a coverage

of approximately one sample per square mile. These were analysed for Cu, Zn, Pb, Mo, and in some cases Ni.

In 1964 student assistants were K. Pendala of McGill University, M. Biron of Laval University, and J.C. Dusmesnil of the University, of Montreal. The cooks P.A. Larouche and D. Drouin, and the canoemen E. Bacon, A. Rondeau, and L. Baillie gave good service. In 1965 the assistant geologist was T. Roach, and the student assistants were Y. DesLauriers of the University of Montreal, A. Spykerman of Carlton University and P. Leman of Loyola University. The cook was P. Caron and the canoemen J.M. Desrochers and S. Biron.

Acknowledgements

Dr. G. Duquette, resident geologist of the Mineral Deposits Service at Chibougamau suggested aspects to be followed up in field work. Opinions and comments of Dr. W.W. Moorhouse of the University of Toronto aided in the petrographic study. Acknowledgement of appreciation is readily made to Dr. Robert Bergeron for assigning the author to this project, and to the members of the field parties for their willingness in bearing the brunt of the work.

Previous work

Low (1906) mapped near the junction of the Brock and Chibougamau rivers. Shaw (1942) mapped the geology of this area as

part of a larger area extending to the west and north, the results being published as a map at a scale of one inch equals four miles. The Department of Mines and Technical Surveys, Ottawa, published in 1957 aeromagnetic map 549 G, NTS 32 J/3, covering this area with the exception of a northern strip, and compiled from data of the Dominion Gulf Company, Toronto, recorded in 1947, 1948, and 1949.

Kindle (1942) mapped the geology immediately to the east, and Beach (1941) mapped to the south in 1937 and 1938, including a strip one half mile wide of the Lantagnac-La Touche area. Norman (1938) comments on outcrops at the junction of the Brock and Chibougamau river. Gillett (1957) mapped an area to the east of, but not immediately adjoining the present area and used the data for a Ph. D. thesis (1962). Gilbert (1955) mapped the area to the southwest of this present area. In 1974, M. Hocq mapped the area 10 minutes of latitude (7 miles) in width between the present area and that of Gillett.

DESCRIPTION OF THE AREA

Settlement and resources

Two dwellings belonging to Indian trappers, one on Eau Noire and the other on Waposite lakes, were the only habitations noted that appeared to be in regular use. Several sites without a permanent dwelling but which appeared to have been used in recent years by Indian families were noted on the larger lakes and streams traversed. A trapper's house built from diamond drill core boxes on Maybank lake appears to have been abandoned. On the east shore of Pichamobi Arm just south of the area a well constructed small

frame building, with a nearby, log core-shack, was in the process of being, dismantled. A long-abandoned log cabin was found nearby to the southwest.

No minerals are exploited in the area. Sand and gravel deposits are extensive and, particularly in the vicinity of two large eskers but also about Petites Plages and northwest of Petites Plages and Quatre Coins lake, they appear to be over 100 feet thick. No thick deposits of clay were seen but a light gray clay or silt is found along the banks of some streams, apparently as deposits a few feet thick.

The principal exploited resource appears to have been beaver and other fur-bearers. Beaver houses were numerous in the lakes and small streams. However there was little sign of recent activity in most cases. The moose population appeared to be faring yet more poorly, few recent signs of moose were seen except in the northwest quarter of the area, where only two moose were seen. Several bears were sighted and visited the party in camp on occasion.

Soil profiles were exposed at only a few points in the area. About Eau Noire lake the banks of the principal streams were generally of clay. The bed of Julien creek for much of its course appears to be reworking silt deposits. Elsewhere sand and gravel were the principal soils exposed beneath a shallow layer of humus. Muskeg swamps make up perhaps 10% of the northern half of the area and are well developed at other points. Boulder till is widespread.

Black spruce is the principal tree and occurs over most



PLATE 1 - Looking 115° from the ridge between Moraine lake and Eau Noire lake, at the Moraine lake granite contact.



PLATE 2 - Looking east across Eau Noire lake from the north end of the diabase dike on the peninsula.

of the area. However thick stands are much more limited in extent, the largest lying west of Thomelet and Boucle lakes. Repeated fire has destroyed large areas of trees. Some stands of large white birch and balsam were noted about and north of Moraine lake. Jack-pine is common over the sandy areas. Along the Chibougamau river the tree flora is marked by the large size of the poplar and jack-pine.

In 1964, average maximum and minimum temperatures for June, July, August and the first three weeks of September were 66 and 40, 77 and 50, 61 and 45, 57 and 42 degrees Fahrenheit. In this period it rained on 58 of the 113 days. Snow fell on the 16th of June and the 11th of September. July was the only month without frost.

Physiography

Seven eighths of the area is a peneplain dominated by features of glacial erosion and deposition with a relief of less than 200 feet, plates 1 and 2. Much of the area in the triangle formed by Julian, Eau Noire and the south shore of Quatre Coins lakes is more rugged, with a local relief of 500 feet, the elevation above little Eau Noire lake of the ridge immediately west of it, plate 3, and has several prominent ridges and isolated hills closely dependent on the bedrock geology for their existence and form. Other prominent hills include a ridge in the southwest corner of the area, the ridge of ultrabasic rock north of Thomelet lake, small hills of felsic volcanics southwest of Porphyre lake,



PLATE 3 - Looking 235° across little Eau Noire lake from same point as for plate 2.



PLATE 4 - Looking along the strike of one of the low ridges forming the washboard moraine, one half mile north of the west end of Moraine lake.

and a westward facing scarp halfway between the north end of Quatre Coins lake and Naomi creek.

The Chibougamau river, whose waters finally enter James Bay by the Nottaway river, is the largest stream in the area and through its principal tributary, the Brock river, drains somewhat more than one quarter of the area, outlined approximately by the eastern and southern boundaries and the line from the northeast corner to the midpoint of the southern boundary. The major part of the drainage, about 50%, is effected to Lac La Trêve by Mildred creek into which empties the chain of lakes north to Turgis lake. This empties eventually into the Nottaway river without passing by the Chibougamau river, as does a small area in the northwest corner that drains west to Omo lake. The remainder of the area drains north from Waposite and Dumas lakes through the Assinica lake system into the Broadback river. The drainage about Eau Noire lake, which empties into the Brock river, is notable in that throughout its length of 12 miles the flow is opposite in direction to that of the Brock and Chibougamau rivers.

Both the Chibougamau and Brock rivers have strong currents. The rapids on the Chibougamau river within the area are abrupt drops of the order of 10 to 30 feet. Those on the Brock river have less steep gradients and are formed by a combination of bedrock and boulder till. The rapids on Noir creek to the east appear to be caused by deposits of eskers and washboard moraine breached by the stream. Mildred creek flows through low, swampy ground after the rapids formed by bedrock near its source from Thomelet lake.

Topographical lineation is dominated by the direction N25E assumed by Dumas, Quatre Coins, and other lakes, Naomi creek, the Brock river, the highest ridge in the area, two large eskers, and numerous, low, cigar-shaped ridges. For the most part this direction is transverse to the strike of the strata and is primarily of glacial origin with only secondary control by the structure of the bedrock. An exception to this is the prominent ridge west of Eau Noire lake in which the strike of the sills parallels the direction of ice movement. The lineation is the result of excavation and deposition by the advancing ice. Granitoid rocks and felsic gneisses are particularly susceptible to this action, probably attributable to multiple joint systems and deep weathering prior to glaciation. A much finer lineation, approximately at right angles to the above, is formed by hundreds of low terminal moraines, 'washboard moraines', deposited from the melting ice, plate 4.

All rock types except the sedimentary rocks form the higher hills, but gabbro and lava form most of these. Nevertheless the topographic expression of many of the ridges about Julien, Eau Noire, and Deux Granites lakes is dependent to a marked degree on the granitic intrusion at Moraine lake about which the rocks to the west and northwest appear to have been folded. An additional effect on the topography over this same granite is the marked rectangular drainage pattern that overlies its northern half, caused by a well-developed washboard moraine imposed on the N25E lineation rather than by a rectangular system of joints. Glacial features may be

the cause of the northeasterly flow of the Eau Noire lake drainage as a large esker and other glacial deposits separate it from the Brock and Chibougamau rivers. However the Brock and Chibougamau rivers as a whole within the area, as well as the Eau noire drainage in its lower part, are incised in soft sedimentary rocks with intervening sills and lava forming discontinuous ridges. The Eau Noire drainage is therefore also controlled by the bedrock and may be a pre-glacial feature accentuated and altered by glaciation.

GENERAL GEOLOGY

All the consolidated rocks of the area are Precambrian. In the southern half of the area pillow lava and associated meta-volcanic rocks and meta-gabbroic sills, of which the gabbroic stock at Julien lake may be a part, form a steeply dipping, east-west band, the pre-Opemisca group. To the east, this band appears to be interbedded with north, central and south zones of greywackes and conglomerates, with probably important amounts of unexposed argillite, which, along with a horizon of mafic porphyritic lavas in the southeast corner of the area, are described as the Opemisca group. Felsic volcanic rocks are important in the western half of the pre-Opemisca group, both as extrusives and as feeder dikes. To the north a band described as the Central Gneiss and divided into quartzofeldspathic and dark, frequently quartzose, gneisses appears to be conformable with the above rocks, with which the boundary is arbitrary as the amount of recrystallization increases northward. These represent metamorphosed sedimentary and mafic

TABLE OF STRATIGRAPHY

CENOZOIC	Recent	Stream and lake deposits, organic soil (muskeg).
	Pleistocene	Ground moraine, drumlins, eskers, washboard moraine, raised beaches, sand dunes.
Erosion		
UPPER PRECAMBRIAN		Gabbroic and diabasic dikes Intrusion: Probably pre- and post-Chibougamau series.
	(?) Chibougamau Series	Sandstone, pebble sandstone
Unconformity		
LOWER PRECAMBRIAN	Intrusive Rocks	Felsic dikes Granites, Porphyry Granites Syenite and Melasyenite Ultramafics stocks Syenodiorite (? migmatite) Metagabbros
	Gneiss Units	Northern Gneiss: paragneiss, injection gneiss, pegmatite. Central Gneiss; quartzo-feldspathic gneiss including staurolite-kyanite-garnet schist, sillimanite gneiss, graphitic gneiss, quartzite; and dark gneiss, including hornblende-feldspar gneiss, hornblende-quartz-feldspar gneiss, meta-agglomerate.
	Folding and Metamorphism	
	Opemisca Group	Metasedimentary rocks including greywacke, conglomerate, argillite, black schists. Metavolcanic rocks including mafic hornblende and feldspar porphyritic flows, mafic flows, agglomerate, possible tuff.
	Probable Interdigitation	
Pre-Opemisca Group	Mafic metavolcanics including pillow lava, dark schists, dark banded schists Metamorphosed mafic sills. Felsic metavolcanics including tuff and feldspar-quartz porphyry flows and dike	

volcanic rocks. Some of the Central Gneiss appears more quartzitic than the Opemisca group, and may be metamorphosed acid volcanic rocks. A final band is described under Northern Gneiss to include quartzofeldspathic gneiss that is often an injection gneiss and occurs largely in isolated localities along the northern border of the area.

The pre-Opemisca rocks, as shown by the attitude of the pillow lava, form a single, steeply dipping to vertical, southerly facing limb of a cross-folded fold. The pre-Opemisca rocks interdigitate to the east with Opemisca rocks in such a manner that the former are both overlain and underlain by sedimentary or metasedimentary rocks that form three zones or fingers coming into the area from the east. Other folds may be present north of the pre-Opemisca group and the Opemisca group may be a synclorium, the lack of stratigraphic top determinations in both these areas precluding more definitive statements.

The granitic and ultrabasic stocks do not appear to have been affected by the regional folding and metamorphism whereas the syenodiorite batholith may have developed during regional metamorphism. The coarse, polymictic conglomerates, on the other hand, contain cobbles and blocks resembling most of the felsic rocks (except ? the syenite) but have been severely deformed. No blocks of gneiss were noted in relatively undeformed conglomerate. For these reasons the Opemisca and pre-Opemisca groups, as well as the units of gneiss, can be related only on a basis of litho-stratigraphy at this time.

Ten intrusive stocks, ultramafic to granitic, to four miles in diameter, and a larger more irregular body of syenodiorite, were mapped. Particularly in the eastern half of the area these have strongly affected the attitude of the pre-Opemisca and Opemisca groups, in particular possibly causing the cross-folding northwest of Moraine lake. The syenodiorite apparently intrudes the gneiss across the northern half of the area and extends south along at least a part of the western border. An area of numerous small feldspar-quartz porphyry dikes in the pre-Opemisca rocks in the southwest corner of the area is of interest in that these dikes may represent feeder dikes for a prominent horizon of felsic volcanic rocks stratigraphically above the dikes. However most of the many non-porphyrific felsic dikes here and elsewhere in the area are probably related to the felsic stocks and syenodiorite, the relations of which to the volcanism remain obscure.

Regional metamorphism has affected prominently all of the above rocks except some of the intrusives. In a general way the grade of metamorphism increases from the southeast to the northwest, from greenschist facies about the Brock and Chibougamau rivers and rising to the upper amphibolite-almandine facies north of Petites Plages lake. The syenodiorite is associated with gneiss throughout most of its extent and is itself somewhat gneissic in part.

Two gabbro dikes of regional extent and several diabase dikes occur in the area, all of upper Precambrian age.

The youngest rock is a sandstone found as fissure-fillings at several points in the northern half of the area, possibly part of the Chibougamau series.

Pleistocene and recent deposits are abundant and varied. On the map the areas of more continuous overburden have been outlined. Glacial lake clay deposits were not observed.

Correlation The major rock units correlate well with Gillett (1962) and with Kindle (1942) as interpreted by Gillett, although the conglomerate is here thought to be present at several horizons.

Beach's (1941) maps of the Mechamego Lake and Michwacho Lake areas correlate well with the present mapping. The felsic rocks about Pichamobi Arm are here placed in the pre-Opemisca group. Also the altered gabbro, diorite and diabase of the pre-Opemisca are not separated into bands on the present map, except for the metagabbro at Julien lake which may be a lens similar to lenses of altered gabbro shown by Gilbert (1955). The attitude of the pillows as shown on the northern part of the Mechamego Lake sheet, Beach (1941), appears to have been reversed in plotting as they do not agree with the present mapping.

PRE-OPEMISCA GROUP

Lithology and distribution

The principal characteristics of the mafic pre-Opemisca rocks are a dark green to black colour, a fine to aphanitic granularity, and volcanic flow structure as pillows or less definite flowage lines and surfaces. Hardness varies but is often greater than a knife blade. The group includes rock types with characteristics markedly different from the above, principally fine-grained, dark schists and banded schists that are believed from their distribution to have been deposited with the lavas, and massive, frequently medium-grained, dark green, metagabbroic rocks that apparently are in part sills intruded into the above. These rocks are in an east-west trending, irregular band in the southern half of the area with several small, isolated localities of similar rocks adjacent to the main band. In addition several occurrences of metamorphic rocks mapped as 'Central Gneiss' have characteristics that suggest that they may be derived from rocks similar to pre-Opemisca types. A much smaller volume of felsic, volcanic rocks are included in the pre-Opemisca group, but are described and discussed separately below.

Well-developed pillow lavas crop out in four localities; one west of the granitic stock about Moraine lake over an area 8000 feet wide and four miles long; the second southeast of this stock over a width of 1000 feet and a length of one mile; the third a large area west and southwest of Julien lake where the pillows are

usually poorly formed; the fourth, scattered occurrences west, north and east of Pichamobi Arm.

Many of the pillows are well-formed with chilled edges, occasionally underlain by a zone of amygdules one to two centimeters wide, going to a massive, fine-grained centre. Between individual pillows calcite and quartz stringers are common. A few pillows were a pale green. Other ellipsoidal structures more widespread in some of these localities are probably pillows. One mile north north-west from Deux Granites lake an outcrop in an area of dark gneisses consists of such ellipsoidal structures. Top determinations from suitable pillows indicate that the flows dip steeply to vertical with tops facing southerly to easterly, that is that the flows all lie on one limb of a fold that is crossfolded, as is further discussed under Structural Geology.

The most common rock occurring with the pillow lava is aphanitic to fine-grained, massive to finely banded to schistose, dark green to black. When aphanitic with vague flow structures these are taken to be flows. The finely banded rocks are considered as waterlain tuffs. Strongly sheared varieties were seen to be gradational to metagabbroic rocks and to pillow lava, but the majority of these schistose rocks are of uncertain origin. In the hand specimen they appear to consist of amphibole and chlorite with varying amounts of feldspar visible on the weathered surface. Pyrite is frequent in disseminated fine grains as a very minor constituent. Black schists, apparently graphitic, rich in pyrite and similar to those in the Opemisca sediments were seen in outcrop only



PLATE 5 - Looking NNE across a small lake 2 miles north of Julien lake.
Pre-Opemisca mafic flows and sills.



PLATE 6 - Weathered surface of garnetiferous greenish schist, cut by aplite
dike, 5500 feet NNE of Julien lake.

near Deux Granites lake and in drill core at Julien lake. Other occurrences are described in drill logs under 'Economic Geology'

Several outcrops of rocks similar to the pillow lava but lacking definite pillows contain scattered phenocrysts of white feldspar commonly 1 cm. across. These outcrops lie in a band about 5000 feet south of Julien creek and east of the felsic volcanics northeast of Pichamobi Arm, the band conforming to the general trend of the pre-Opemisca rocks here, and an isolated outcrop west of the above felsic rocks near and west of Julien creek where it bends sharply north to Thomelet lake. A second type of porphyritic flow, west of Bluets lake, is described below.

About the felsic rocks running northeast from Pichamobi Arm several outcrops of rocks of not typically pre-Opemisca types were noted. These were paler and softer, schistose, and in part rich in fine calcite (? carbonatized). Such a calcite rich rock occurs 2000 feet north of northeast of Pichamobi Arm.

Metagabbroic rocks are common. These are dark green, massive rocks with white to green feldspar and dark amphibole with a fine to medium granularity. The texture is variable but perhaps the most common seen on the weathered surface consists of about equal proportions of equant hornblende in a matrix of somewhat to much finer feldspar. Commonly these rocks appear to be sills of the order of 100 feet in thickness, but they are rarely exposed across their full width and, especially the fine-grained types, may be massive flows. On the map the fine-grained types are shown as metavolcanic rocks. West of Moraine lake 11,500 feet, about the

small lake here, plate 5, a metagabbroic sill 500 feet in width forms the core of a rocky hill of pre-Opemisca rocks, and south and southwest of Julien lake half of the outcrops are of metagabbroic type. The western half of the northerly trending ridge immediately west of little Fau Noire lake is mainly of metagabbroic rocks, as is the low ridge 4000 feet east of Fau Noire lake. What appears to be a sill of similar metagabbro was noted in the Central Gneiss northeast of Deux Granites lake.

To the north, northeast, and west the lithology of the pre-Opemisca rocks changes, apparently due in part to metamorphism, but marked by the absence of pillow lava. No pillow lava was found east and west of Bluets lake nor over a width of 15,000 feet south of where the presumed contact follows the south shore of Petites Plages lake. On the south shore of Thomelet lake the pre-Opemisca rocks are epidotized, garnetiferous, probable flows cut by aplite and quartz stringers. To the west near and at the rapids on Mildred creek the outcrops are of dark gneisses intruded by aplite and striking northerly. Similar dark gneisses are found to the southwest and northeast of this point and are all included in the Central Gneiss. A zone of garnet, 4000 to 7000 feet wide exclusive of its continuance to the north in the Central Gneiss, extends from Thomelet lake to Bluets lake. A narrower zone of garnet appears to exist about the granitic stock at Moraine lake.

About Bluets lake two rock types are common. Of possible volcanic origin is an aphanitic to very fine-grained, dark green, generally schistose rock, in part finely banded, frequently garneti-

ferous, and occasionally with textural and colour variations arranged in an irregular meandering manner that suggest lava flowage structures. This structure is well exposed about 7000 feet west of the north end of Bluets lake and merits further study as being of a different character than the other pre-Opemisca flows. A dark porphyritic rock banded in $\frac{1}{2}$ inch bands also occurs here. This rock in thin section consists of a white mica matrix with to 20% fine quartz and what are probably porphyroblasts replaced by white mica, and has 10% of fine, metallic mineral disseminated throughout. Minor pyrite and pyrrhotite causing a rusty weathering are common. The second common rock is metadioritic, quartzose, fine to medium, gray, and is probably a sill. These two rock types, the dark, aphanitic, schistose, and the metadioritic are well exposed on the hill immediately west of Bluets lake. At this point the dark schistose rock contains very minor chalcopyrite and in thin-section consists almost entirely of amphiboles, garnet, and calcite. East of Bluets lake for $2\frac{1}{4}$ miles the few outcrops found were mainly quartz metadioritic and quartz: metagabbroic with fine-grained amphibole rock, frequently foliated and carrying minor pyrite and pyrrhotite. An isolated ridge of metagabbroic rock, poorly foliated to massive, occurs a quarter mile south of the east end of Maybank lake.

Petrography

Amphibolitization of the pre-Opemisca rocks is the most striking petrographic character. Amphibole replaces all of the ori-

A thin-section of aphanitic pillow lava from near the southern border of the area consists of long laths of plagioclase (30%), ? albite, with interstitial, finer, acicular to bladed, pale green amphibole (60%) that indents the plagioclase laths, and a very fine, anhedral epidote-group mineral (10%). Chlorite is a minor constituent, as is euhedral epidote (2%), coarser than the feldspar. Two thin-sections from melanocratic, aphanitic rocks associated with pillow lava and metagabbroic rock west of Moraine lake consist of similar amphibole (70-90%) as acicular sheaves or stubby, equant, ragged prisms; plagioclase (5-25%) as very fine, equant, untwinned grains that may be quartz in part, in general interstitial to the amphibole; opaque metallics (5%), very fine, mainly black with some yellow; and minor chlorite, clinozoisite, and epidote. A similar rock 1500 feet southwest of Bluets lake contains acicular to granular blue-green amphibole (50%); andesine, (20%), as irregular long laths that appear to be being replaced by amphibole; quartz (10%); and zoisite group minerals and opaque metallics. The only thin section in which chlorite was a major component was from a specimen of the porphyritic flows described above as outcropping just west of Julien creek. In thin-section this consists of a single coarse crystal of plagioclase to 50% replaced by fine white mica in a felt of chlorite (35%) pale green, and calcite (20%), granular, both these replacing plagioclase; and minor epidote, opaque metallic minerals, and biotite.

The metagabbroic rocks contain amphibole similar to the above, coarser but generally ragged. One specimen has amphibole, with a very regular outline and relatively few acicular outgrowths,

apparently replacing pyroxene without further growth at the expense of the plagioclase. In this specimen the plagioclase is completely replaced by granular clinozoisite, the form of the plagioclase being preserved. In most specimens plagioclase is largely replaced by amphibole and to a lesser extent by saussuritization. In the least altered specimen the plagioclase was a labradorite with 62 molecular % anorthite. Leucoxene in two specimens was present to 5% as among the coarsest grains present and angular to branching and vermicular in form. One of these specimens is a quartz gabbro with 10% quartz and 15% biotite, very fine. To 15% quartz occurs with andesine (30%) in rocks described as metadiorite west of Bluets lake. Brown biotite (5%) is present and was seen elsewhere only in the above mentioned quartz gabbro. This metadiorite differs from the metagabbros in the definite alignment of minerals. Opaque metallic minerals to 5% are present as anhedral grains, generally clusters of fine, black grains. Chlorite was noted in two specimens, to 40% in a specimen from Julien lake. Apatite was seen in only one specimen, a specimen more mafic and coarser grained.

Six thin-sections of dark schists consisted of from 50 to 90% green amphibole with a fine-grained, poorly twinned plagioclase and an uncertain content of quartz. The amphibole is granular and anhedral, not raggedly prismatic as in the metagabbroic rocks and pillow lava. A specimen of the dark schists west of Bluets lake described above contains three amphiboles in addition to garnet (5%), calcite (5-10%), opaque metallics (5-10%), and chlorite (5%). A clino-amphibole (70%) is yellowish green to blue green and granular. A second clino-amphibole (2%) is colourless, a strong bire-

fringence, length fast, prismatic and appears to be partly replaced by the first. An ortho-amphibole (5-10%) is pale yellow to pale green, prismatic, length fast, and has a low birefringence. A garnetiferous specimen from near the contact with the granitic stock about Moraine lake, Plate 6, consists of narrow bands of typical amphibole schist and paler, narrow, irregular bands of garnet and pyroxene. Brown biotite (2-30%) is present in two specimens from the prominent hill in the southwest corner of the area.

Metavolcanics at Petites Plages lake

On the south shore of Petites Plages lake and for 3000 feet to the south are outcrops of what appear in the hand specimen to be altered mafic volcanics and garnetiferous and quartzose dark gneisses. The metavolcanic flows are aphanitic to fine-grained and in two thin-sections consist of aligned to banded amphibole (50-70%) in shades of blue to straw, granular and ragged to acicular; a very fine grained mixture (20-30%) of quartz and plagioclase; and brown biotite (1-15%); with minor carbonate and opaque metallics including some yellow sulphide. On the shore of the lake a few small quartz stringers and pyrite to several % are present. The southeast group of these outcrops includes dark, fine-grained, garnetiferous rocks, weathering schistose to gneissic, with fine, blue quartz grains. A thin-section consists of to 40% combined fine, ragged amphibole, yellowish to colorless; chlorite, pale green; and biotite, greenish brown; to 50% combined feldspar and quartz, the feldspar being irregular in outline and rarely twinned, and the quartz,

angular in outline, with patchy and undulant extinction, is frequently intergrown with feldspar in graphic-like and braided intergrowths; garnet (5%), dull rose, poikiloblastic, elongated, irregular; black opaque metallics (5%), and a few grains of tourmaline. At the first rapids from Petites Plages to Thomelet lake a dark gneiss with black garnets and narrow carbonate and quartz stringers may be a similar rock.

The appearance of considerable biotite and probably quartz is notable in these rocks compared with the main band of pre-Opemisca rocks.

Felsic volcanic rocks at Pichamobi arm

The felsic volcanics running northeast from Pichamobi Arm of Lac la Trêve consist in part of an almost cherty rock exposed discontinuously over a length of three miles and almost continuously over a width of about half a mile as steep ridges to 100 feet in height. The fresh surface is black to dark gray, aphanitic, hard, and weathers pale gray and soft. Anastomosing thin lines of a pale chert-like material appears to be filling closely spaced fractures, in part giving the rock a finely brecciated appearance. Some outcrops have a flaser structure. The outcrop surfaces are frequently rough, being closely fractured into elongated pieces of the order of one inch in length that appears to be a type of schistosity. The fracture surfaces are not conchoidal and have a faint silky lustre. The strike of this fracturing or schistosity and of the anastomosing fine veins is similar to that of the pre-Opemisca pillow lava to the east and west but differs by about 30° from the elongation in plan of these felsic volcanics. No

bedding was seen. In thin section this rock consists of about 75% of very fine-grained, elongated, parallel, ragged grains of quartz and feldspar with 10 to 25% of white mica scattered throughout and filling the fractures. Also present are small lenses of polygonal quartz grains somewhat coarser than the above minerals. Two outcrops of a similar rock were found just west of Porphyry lake, and are separated from the main exposure by outcrops of quartz-feldspar porphyry. This porphyry outcrops to the northeast as far as Julien creek and forms several large outcrops bordering to the east and west the southern end of the felsic volcanics near Pichamobi Arm. The porphyry has a gray, aphanitic groundmass with numerous phenocrysts of quartz to 4 mm., frequently bluish, and more numerous but finer grains of gray feldspar. Some black porphyry was found, with clear quartz phenocrysts less than 1 mm. across. Along Julien creek the few outcrops of porphyry seen were associated with dark green, aphanitic rocks of pre-Opemisca, mafic, metavolcanic type; the porphyry carrying some pyrrhotite. Moderate shearing is a feature of numerous outcrops of the porphyry.

Five thin-sections of these porphyries were examined. Phenocrysts of plagioclase, (5 to 35%) probably sodic andesine, poorly twinned, are much more common than quartz phenocrysts. The plagioclase is 10 to 50% altered to fine white mica, zoisite minerals, chlorite, and carbonate (50-100% of the phenocrysts in one section). The quartz is usually rounded, with smooth to finely ragged edges and occasional fractures. The matrix consists of very fine grains of quartz and plagioclase, 50% of the rock, to which an

oriented texture is given by lines of equally fine white mica (10-30%) swinging about the phenocrysts and as parallel grains scattered throughout. Accessory minerals include sphene, zoisite, and calcite. Opaque minerals are common accessories in two sections. At the edges of phenocrysts a concentration of quartz or plagioclase grains drawn out in lines suggests that these have been torn from the phenocrysts. Extinction is usually uniform. A thin section of the melanocratic, quartz porphyry consists of phenocrysts (15%) of a fine-grained mineral that has been replaced by a dust of opaque mineral, white mica, and possibly albite. Quartz phenocrysts (10%) are generally rounded. The matrix consists of white mica (45%), feldspar and quartz (25%), and minor biotite, chlorite, and carbonate. Biotite and carbonate form small lenses.

Along the southeast shore of Pichamobi Arm, for the most part south of but adjacent to the map area, a sequence of rocks with to the south a conglomerate (Beach, 1938) of pebbles of feldspar porphyry with fine-grained phenocrysts goes to the northeast to felsic volcanics as above, but, in part, with apparent fragments to six inches of similar rock and cut by irregular white quartz veins. This goes to possible feldspathic tuffs now schistose, and to quartz-feldspar porphyry in that order, the last two rock types lying within the present area. As several sills or as beds to 20 feet in thickness in the felsic volcanics there occur a bright green, aphanitic, finely foliated, rusty weathering rock and a lamprophyre-like rock which branched into a dike at one point. A thin-section of the green type consists of 55% carbonate as irregular grains tending to cluster, 20% quartz disseminated and in clusters, 15% white mica as dissemi-

nated grains and as bands of coarser white mica with carbonate that appears to be replacing a mineral much coarser than the present granularity. Less than 1% of a pale green chlorite and a few grains of pyrite are present. The carbonate appears to be weathering to limonite and is probably siderite. A second carbonate may be present. This may be an altered ultrabasic rock. The lamprophyre-like type consists of brown biotite (45%), carbonate (45%), and feldspar (10%), with some quartz and minor fine pyrite. All the minerals are anhedral and granular to ragged. Carbonate and biotite appear to be replacing feldspar. A few grains of fine microcline may be present. The biotite has a sub parallel orientation.

Discussion: These rocks are considered to be an horizon of metamorphosed felsic volcanics in the pre-Opemisca group and are underlain and overlain by pillow lava. The conglomerate or volcanic breccia described above would then be located toward the top of these felsic volcanics as the pre-Opemisca group faces southeast. The monomictic nature of this fragmental rock, and particularly the lack of basic flow fragments, suggest that it is a volcanic breccia. There is a suggestion in the attitude of the pillow lava that the felsic rocks are not conformable with these, but insufficient data was collected, to prove this. However the volcanic breccia exposed on Pichamohi Arm appears to strike across the arm into a bay where pre-Opemisca pillows are well exposed on the shore and islands. Two factors to be considered here are, first, the original form of the felsic rocks which would likely have formed relatively thick and irregular masses of shorter lateral extent as compared with the

mafic lava and, second, the probability of faulting along Pichirobi Arm as suggested by the topography and the sheared nature of the felsic volcanics.

The extension to the north of these felsic rocks is uncertain. Drilling indicates that quartz porphyry extends for at least three miles northeast of Julien creek. It is associated with rocks described as intermediate to acidic and an agglomerate that is not described. Several drill holes from the southeast shore of Petites Plages lake, opposite the islands, to 7000 feet to the southeast, cut rocks described as rhyolite associated with a variety of altered andesitic rocks, as does a hole on the south shore of the lake 7000 feet north of northwest from Kellar lake, 60 feet of rhyolite associated with andesite. The distribution of these suggests that they are thin horizons of felsic volcanics in the pre-Opemisca group. They may be felsic dikes.

Among the fine grained felsic rocks apparently conformable with the pre-Opemisca group are the aphanitic foliated rocks on the islands in Petites Plages lake, described under 'Central Gneiss'. These may be felsic volcanic rocks.

Felsic dikes in Pre-Opemisca rocks

Felsic sills and dikes intrude the pre-Opemisca group at several localities. Those related to felsic stocks are described with these bodies. The remainder are limited to the region south of Thomelet lake and west of Kellar lake. This limited distribution to an area stratigraphically below the felsic volcanics at

Pichimobi Arm is noteworthy, the more so in that many of these dikes are feldspar-quartz porphyries. A feldspar porphyry that is probably a dike was seen in drill core at point (37), see Economic Geology, 6000 feet west northwest of where the Chibougamau river leaves the area.

Feldspar-quartz porphyries are most common, but fine-grained granitic and syenitic types occur. The variety and number of these latter types increases towards the southwest corner of the area, supporting the contention that the western limit of the area here is underlain by a felsic stock or larger intrusive.

The relationship of the supposed intrusions to the host rock is frequently uncertain. A feldspar-quartz porphyry dike at least 35 feet wide and with a chilled contact exposed does cut sharply across pre-Opemisca flows. No thin sections were examined but the porphyries are similar to those associated with the small stock at Thomelet lake, described below.

A section of drill core from a hole in metavolcanics, at point (23), consists of approximately 10 feet of a feldspar porphyry with a very fine matrix and narrow, 2 mm., fissure fillings of epidote and fluorite as fine grains. In thin-section several phenocrysts of ragged perthite lie in a very fine matrix of plagioclase and possibly potassium feldspar with muscovite (10%) and accessories. The fissure fillings are mainly epidote with to 5% fluorite and scattered carbonate in a breccia of the wall rock.

On Thomelet lake a small stock is postulated on the basis of five outcrops of felsic rocks, three being mesocratic green to gray quartz-feldspar porphyries with fine to coarse phenocrysts in an aphanitic matrix, with some shearing associated with small

quartz stringers and disseminated pyrite, and two being medium-grained gray to pink, biotite granite with minor pyrite and quartz phenocrysts only slightly coarser than the matrix.

A thin-section of the rhyolitic rocks consists of fragmented quartz phenocrysts to 3 mm. and numerous (5-10%) plagioclase phenocrysts to 1 mm. largely altered to a fine, granular mineral and associated with muscovite (5%), in a matrix that is a mosaic (80%) of quartz and feldspar with some intermediate-sized microcline (2%) in elongated clusters. Biotite and chlorite to 5% form fine, aligned grains.

A thin section from the coarser rock, the pink variety, consists of a quartz diorite with quartz (30-40%) mainly as patches of fine, strained grains; oligoclase (50%), altered; microcline (1%), as small interstitial grains; chlorite (5%), green to brown; and accessories.

Opemisca Group

Sedimentary Rocks

Lithology and distribution

The general distribution of these rocks having been described under 'General Geology', each strip or zone will be described here in detail.

The south strip is well defined by outcrop along only the Chibougamau and Brock rivers and Crinkle creek. The southern

boundary is drawn between outcrops of greywacke and those of a massive or porphyritic texture believed to be basic, volcanic flows. As shown on the map this southern boundary follows the Chibougamau river for two thirds of its length within the area. The northern boundary of this south strip is not well defined by the few outcrops, and more or less follows the boundary between the lower elevations to the south and the ridges of pre-Opemisca rocks south and east of the Moraine Lake and Eau Noire Lake stocks. The resulting south strip of Opemisca sediments is about one and one half miles wide where it crosses the southern boundary of the area and broadens to a width of six miles at the eastern boundary, presumably having been joined by the central or northern or both strips of sedimentary rocks. On the north bank of Crinkle creek at the eastern boundary of the area an outcrop of schistose feldspar porphyry similar to the schistose, coarse-grained porphyry that forms a thin horizon at the north boundary of the porphyritic flow is part of the small lens of andesite that Kindle (1942) shows as pre-Opemisca. This, however, was the only outcrop noted that had a definite volcanic character although several of the outcrops in Crinkle creek may be sheared volcanic rocks as may be an outcrop four miles to the north on Brock river near the mid-township line. It must also be noted that the schists at the rapids on the Chibougamau River and included in the porphyritic volcanics appear to be sedimentary rocks, and further supporting an interlayering of the sedimentary and volcanic rocks.

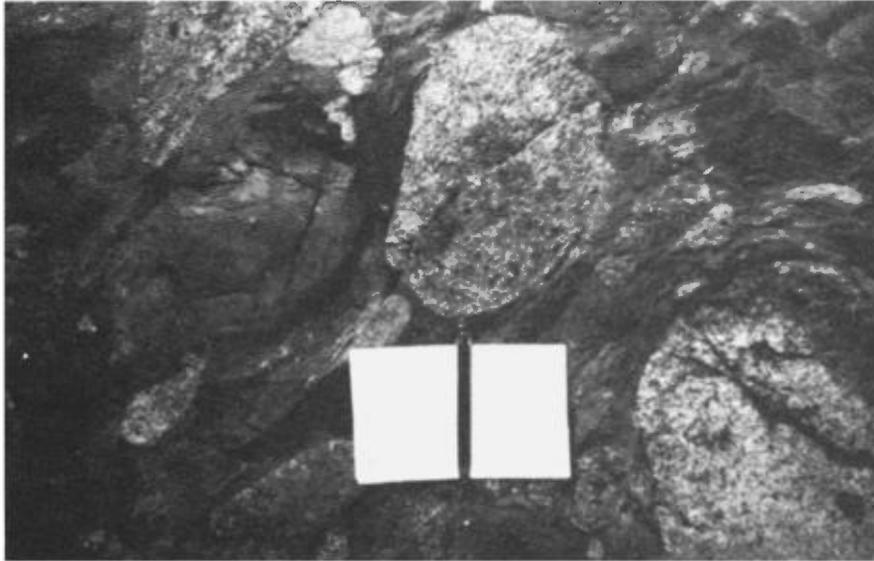


PLATE 7 - Outcrop of conglomerate of the Opemisca Group near the east boundary of the area, about 6500 feet north of Crinkle creek.



PLATE 8 - Glacial erratic of conglomerate, 7000 feet south of the east end of Deux Granites lake.

An outcrop of conglomerate on the Chibougamau River with in part well rounded cobbles of acidic intrusive rock 6 to 10 inches in diameter lies near the presumed boundary between porphyritic flow and sediments. The only other good exposure of conglomerate in this band occurs as a continuation of one of Kindle's (1942) zones of conglomerate near the eastern boundary of the area, one mile north of Crinkle creek, and is very similar in its cobbles, plate 7. A third outcrop occurs between these two, sheared and poorly exposed, 15,000 feet northeast of the first. Conglomerate float is abundant near the southeast border of the ridge of gabbro one mile southeast of the east end of Eau Noire lake and for two or three miles to the southwest. A large erratic in the Chibougamau river one mile above the portage to Eau Noire lake contained a boulder 3 feet across of medium grained metagabbro.

The greywacke is best exposed along the Brock river between the mouth of Crinkle creek and the Chibougamau river. In the hand specimen it resembles a fine-grained feldspar porphyry, mesocratic, gray, and faintly schistose on the weathered surface but has scattered, angular quartz grains and irregular fragments generally less than 1 cm. across of a dark rock, most frequently resembling black slate. These greywackes occur in association with black schists, the best exposure of black schist being a few hundred feet south of and parallel to Crinkle creek. On Brock river at the portage to Chibougamau river greywacke and black schist occur together. The greywacke on one of the islands here appears

to cut across the black schist as a result of slumping or soft sediment erosion, with numerous inclusions one to two feet across of black schist in the greywacke. The attitude of the schistosity in both rocks is the same. The width across the strike of the black schist here is about 25 feet in a single outcrop and the greywacke exposed has a similar width in its largest outcrop. The black schist is a gray to black weathering, aphanitic, black rock with a marked schistosity that in part forms slaty cleavage. Pyrite grains and lenses to 5 mm. across are common. Along the schistosity small drag folds indicate right hand movement and plunge 45° on an azimuth of 302° . Frequent minuscule cross faults with both right and left hand movement strike 120° and dip steeply east and west. The black schist south of Crinkle creek has a fine banding parallel to the schistosity and contains short stringers of a dark gray quartz.

Along the Chibougamau river at and below the rapids there occurs some greywacke, but the principal rocks are melanocratic, green and gray schists and slaty rocks including some mesocratic, chloritic schists rich in white calcite. The shearing at this point makes the separation of the sediments and porphyritic andesites difficult in the field. Drag folds and cross cleavage indicate that the movement has been mainly along the strike of the schistosity and minor banding found here. Many of the schistose rocks here resemble the presumed sheared volcanics along Crinkle creek.

The central strip of Opemisca sediments is defined by narrow outcrops of conglomerate and hornblende-biotite schist out-

cropping for $1\frac{1}{2}$ miles just west of little Eau Noire lake as a low eastward facing scarp that is the eastern limit of the ridge of basic rocks, for the most part metagabbroic sills, that rises 500 feet above the level of the lake. The metasediments, exposed over a width of two to three hundred feet, are separated from the gabbroic rocks by a medium-grained, garnetiferous quartz-amphibole gneiss to five hundred feet in width. This central strip of metasediments is projected to the northeast by small outcrops of dark and mica schists along the same low scarp east of the main ridge and by a single outcrop of staurolite-garnet-kyanite schist. Abundant large boulders of conglomerate occur for a short distance southeast of and along this northeasterly extension of the metasediments.

The conglomerate of this strip is similar to the conglomerate elsewhere in the area and consists of cobbles to 8 inches but generally 4 inches across of acid and basic intrusive rocks in about equal proportions with some smaller, cherty, whitish pebbles. The intrusive rocks are commonly medium-grained, massive to porphyritic, felsic and fine to medium-grained, mafic rocks. In this central strip there is marked elongation of the cobbles, plate 9, and a well developed banding of the matrix in dark gray and black bands that are 1 to 5 mm. in width and appear to flow about the pebbles. Basic pebbles frequently appear to have been drawn out in elongated lenses with a 20 to 1 ratio of length to width, resembling plates with rapidly tapering ends. The deformation does not affect all horizons, suggesting that a fault zone follows along the metasediments near their contact with the gabbro sills. The matrix appears in the hand specimen to be a hornblende to hornblende-plagioclase,

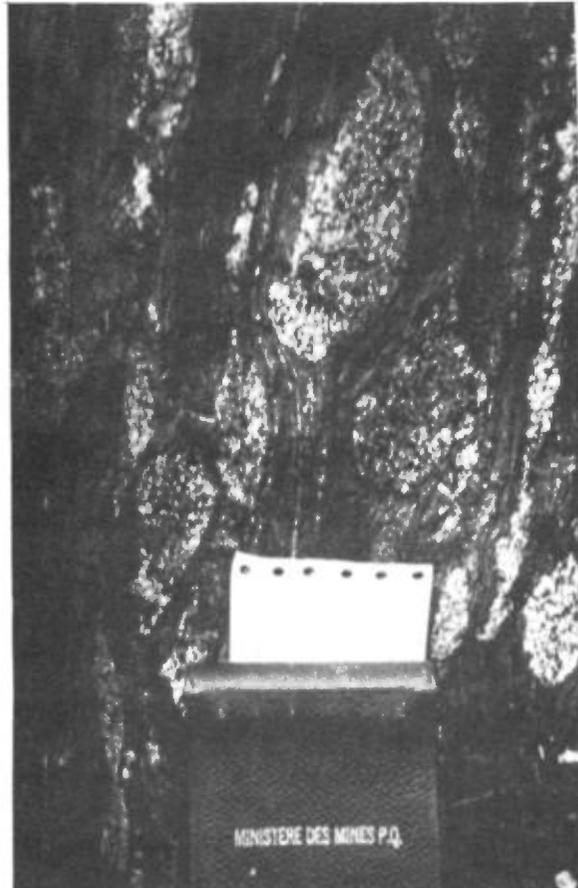


PLATE 9 - Outcrop of conglomerate, strongly deformed, west of little Eau Noire lake.

very fine-grained gneiss. Narrow, irregular, aplitic dikes cut the deformed conglomerates and increase the complex appearance of the outcrop.

South of the EW-running portion of Black creek here there are outcrops of siliceous, pyritiferous, felsic lava, or possibly sediments, point (32), cut by narrow dikes of aplite. These outcrops lie along the southern extension of the ridge of gabbro mentioned above. To the east of these siliceous rocks are outcrops of what appear to be altered intermediate lavas. This disposition of rock types with the change in attitude of these isolated questionable sediments, they strike easterly, suggest faulting along Black creek at this point. These siliceous, pyritiferous outcrops occur for a few hundred feet south of Black creek.

The northern strip of Opemisca sediments includes an outcrop of conglomerate on the north shore of Poudingue lake. One quarter mile south of Poudingue lake a large outcrop of black schist with many quartz lenses and stringers, irregular and cross-cutting, two to three feet in width, occurs and is taken as the southern limit of this strip of metasediments. The projection to the west is uncertain but is shown to include a pyritiferous, siliceous, black schist in the bed of the creek between Bluets and Dumas lakes. Farther west, dark porphyroblastic schists included in the pre-Opemisca rocks may be a part of this sedimentary band and black schists are found at the northern and southern contact of the felsic stock east of Deux Granites lake. Plate 8 shows

one of several blocks of conglomerate float found about 7000 feet south of the east end of Deux Granites lake. North of Poudingue lake the outcrops are mainly of feldspar-quartz-amphibole-mica schists, medium to fine grained, and these are included in the Central Gneiss. Of the few outcrops included in this northern strip of sediments several appear to be metavolcanics of pre-Opemisca type. Also the quartzose rocks included in the Central Gneiss north of Poudingue lake resemble the quartzose gneiss in the central strip of sediments, between the conglomerate and the pre-Opemisca metagabbroic rocks to the west. These relationships emphasize the difficulty of establishing boundaries between pre-Opemisca, Opemisca, and Central Gneiss rocks.

Petrography

Only one thin section from the conglomerates of the southeast strip was examined. This is of a pebble of leucocratic, feldspar quartz porphyry with white oligoclase-andesine phenocrysts (40%) and euhedral quartz (10%) and patches of small flakes of a brownish green biotite (5-10%) with associated apatite in a pale grayish green, microcrystalline matrix. The plagioclase phenocrysts are saussuritized to 80% but frequently show a very narrow, clear rim. The euhedral quartz phenocrysts have a very raggedly undulose extinction. Frequently the border of the quartz grain is finely irregular with a narrow fringe of quartz projecting out from the phenocryst between the surrounding grains.

The greywacke in thin section contains distinctive rock

fragments, angular pieces of fine-grained rocks of igneous texture, usually feldspar porphyry, and of black schists. Chlorite and white mica, very fine grained, are aligned to make a schistose matrix for angular grains of quartz and sericitized, carbonatized plagioclase (albite) that make up to 60% of the thin section. Numerous quartz grains have the characteristic noted for the quartz phenocrysts described above, a fringe of quartz fingers or network going out into the matrix. The quartz grains in the greywacke usually have a uniform extinction. In the coarser grained greywackes several large grains of a micropegmatitic intergrowth of quartz and plagioclase occur, with the quartz showing simultaneous extinction throughout the grain whereas the plagioclase usually does not.

The black schist south of Crinkle creek is a white mica (75%) schist with 15% fine, interstitial quartz and less than 5% of rectangular grains of pyrite, and an opaque, interstitial dust disseminated throughout.

The green schist along Crinkle creek that is thought to be an altered volcanic rock consists in one thin section of 60 to 70% of a colourless, acicular amphibole (tremolite) with 10-20% chlorite, less than 5% of a pale brown biotite, 5-10% quartz, and minor calcite.

The rocks north of Crinkle creek along the Brock river are very fine grained quartz-chlorite schists with less than 5% sericite and or biotite, probably argillites, and a fine-grained feldspar porphyry that is carbonatized and chloritized and probably

is an altered volcanic rock.

A felsic, finely banded, fine-grained portion of the matrix of the conglomerate of the central strip consists of anhedral equant grains of andesine (30%), quartz (20%), chlorite (20%), biotite (5-10%), and epidote (5-10%). The quartz is extremely irregular and partially encloses grains of other minerals. As much of the matrix of the conglomerate here is a biotite schist or fine-grained amphibolite, these felsic portions form strongly contrasting bands.

The quartzose, gray gneisses north of these conglomerates consist of elongated clusters of quartz (40%), green amphibole (30%), sodic plagioclase (20%), and biotite (less than 5%), and 5% opaque metallics. The amphibole is in very irregular grains and short rods.

Porphyritic Volcanic Rocks

Lithology and distribution

These are massive to porphyritic rocks, mesocratic, green, with a fine-grained to aphanitic matrix and equant, dark green ferromagnesian or pale green to white plagioclase phenocrysts. The massive varieties resemble the matrix of the porphyritic types. These rocks outcrop south of the Chibougamau river about the stock of gabbro. A few outcrops occur east of the Chibougamau river. Several outcrops of an agglomerate with similar,

porphyritic rock as rounded clasts and a similar, massive rock as matrix between the clasts were found and may define a narrow horizon cut by the gabbro. This breccia is indicated as conglomerate by Beach (1941) on the Michwacho Lake map-sheet. The conglomerate of rounded, medium-grained, intrusive rocks that outcrops on the north bank of the Chibougamau river near the southern boundary of the area is given the same designation. The distinction is made here between agglomerate and conglomerate because of their distinctly different clast types, the agglomerate seemingly being derived uniquely from mafic volcanic flows or ejecta, and is probably a volcanic breccia.

Most of the rocks of this unit are soft and a few give a slight reaction to hydrochloric acid. A faint schistosity may be seen on the weathered surface. The northern boundary is characterized by two features, a coarse-grained feldspar porphyry schist and a well developed schistosity. The feldspar grains in this coarse-grained porphyry may be 1 cm. in length and appear to be broken and frequently turned across the schistosity. These coarse-grained porphyries may belong to the sedimentary rock unit described above, as an outcrop of similar rocks occurs on the north bank of Crinkle creek; that is to say that these may be thin horizons of volcanic rocks in a dominantly sedimentary rock unit. Also the marked schistosity of these coarse-grained porphyries corresponds with the schistose to slaty metasediments along the Chibougamau river below the rapids.

Where seen in contact with a chilled facies of the gabbro, the porphyritic, volcanic rocks were hard and massive, being

difficult to distinguish in hand specimen from the fine grained gabbro here.

Petrography

A specimen of the non-schistose, volcanic porphyry consists of plagioclase phenocrysts, completely saussuritized to granular zoisite with some white mica and calcite, in a matrix of pale green chlorite (40%), white mica, twinned plagioclase and quartz all very fine grained. Calcite (5-10%) forms the largest grains in the matrix and is associated with very fine grained quartz. Sphene (5-10%) in clusters of fine grains is scattered throughout. Scattered grains of epidote occur.

One specimen of the massive, aphanitic rock consists of saussuritization products (10-20%) obscuring tattered, colourless amphibole, chlorite, and lesser amounts of calcite and quartz, very fine-grained, and scattered grains of epidote.

A porphyry with dark green phenocrysts consists of phenocrysts of a colourless amphibole that is 50% altered to a pale green chlorite and occasionally to as much as 25% calcite. The form of the phenocrysts suggests that they were originally pyroxene. The matrix consists of to 60% saussuritization products in fine grains with the balance as chlorite, a fibrous amphibole, and probably albite.

The plagioclase phenocrysts of the coarse-grained, schistose porphyry at the north boundary of the porphyritic volcanic

rocks is a relatively fresh, well twinned, fractured andesine. It is extensively replaced along fractures by pale green chlorite and is slightly altered throughout to very fine grained white mica. The matrix consists of 40-60% pale green chlorite, some white mica, 30-40% of fine quartz and plagioclase, calcite (5%), and epidote (1%).

A second specimen of a feldspar porphyry with finer grained phenocrysts of a similar andesine contains 20% of a carbonate, probably ankerite as it reacts very slowly to hydrochloric acid. Biotite is present to several % whereas white mica makes up 25-40% of the thin section.

CENTRAL GNEISS

This group of rocks, principally paragneisses but including a large volume of dark gneisses that may be metamorphosed mafic lava, forms an apparently continuous strip from 7000 feet east of Dumas lake west to its widest part between the south shore of Quatre Coins and the southern part of Petites Plages lake, then narrowing to the southwest to a ridge 5000 feet southwest of Thomet lake. West of Boucle lake several isolated outcrops of dark gneiss and a single outcrop of granitic gneiss are included in this group, extending it almost to the western border of the area.

Quartzofeldspathic schists and gneiss

Meso- to melanocratic rocks are more abundant than more obvious quartzofeldspathic rocks but many of the darker rocks are



PLATE 10 - Mica schist, bedded, with cross-schistosity and Z-fold, 3700 feet
NE of Deux Granites lake.

rich in quartz. The main localities of quartzofeldspathic rocks are a small area east and south of the southeast corner of Dumas lake and a much larger area about Petites Plages lake. Near the southeast corner of Dumas lake the rocks are feldspar-quartz-amphibole-mica schists, medium to fine grained, with pyrite and garnet, and form ridges a few tens of feet high. These are associated with dark schists and amphibole rocks which become dominant to the west. A thin-section from a large outcrop 4000 feet east of Dumas lake consists of angular to ragged quartz (40%), sericitized albite (40%), muscovite (to 20%), sulphides (less than 5%), and a few grains of andesine, equant and unaltered. A thin section of the siliceous, rusty weathering, finely banded, schist on the south shore of Dumas lake consists of very fine, equant, angular quartz, to 60% of some bands; ragged, green amphibole; completely saussuritized feldspar; white mica, sulphides, epidote, and biotite in varying proportions. Farther south, 600 feet north of the conglomerate on Poudingue lake, a small outcrop consists of a band 3 feet wide of poorly banded quartzitic rock in contact with a very regularly banded, pale gray, soft rock and a fine-grained, massive, amphibole-feldspar rock.

About the northern boundary of the felsic stock east of Deux Granites lake are rusty weathering schists, generally dark, garnetiferous, and cut by lenses of white quartz and narrow dikes of aplite and pegmatite. Chlorite, biotite, and muscovite are major components in varying proportions in these schists that are commonly banded in bands of the order of one to two inches, Plate 10, apparently meta-sedimentary rocks. In thin-section two specimens consist of quartz plus untwinned plagioclase to 70%, very fi-

ne in a mosaic texture, chlorite (to 40%), pale green to colourless, muscovite to 5%, and minor biotite and garnet. Much of the garnet is altered to a yellowish-green chlorite. The biotite is much finer than the chlorite, and the two are not usually in contact. Opaque metallics (to 5%) are very fine, pyrrhotite in part, and graphite possibly. A black schist occurring at the contact with the felsic stock is rich in pyrite, some as small spheres to 2 mm. in diameter. Marcasite was seen in dark feldspathic gneiss near the east end of the stock. Dark schists 2000 feet north of the stock contain a pale green, granular amphibole (50%), and andesine with 40 molecular % anorthite. These go to the north and east to dark, fine-grained gneisses, described below. At the east end of the stock these appear to be injected 'lit par lit' and cross-cut by the stock. The rocks here, near the contact and near the line of small lakes running east of northeast from Deux Granites the rocks, are leucocratic and sheared. One thin section consists of to 60% quartz, microcline (10%), white mica to 20%, and green biotite (5%) in a mylonitic texture. Potassium feldspar is an uncommon mineral in the Central Gneiss, seen as a major component only in one other specimen, near the northeast corner of Petites Plages lake.

In the area of quartzofeldspathic rocks about Petites Plages lake there seems to be distinctive, rusty weathering, frequently sillimanite bearing rocks north of the creek joining Deux Granites and Petites Plages lakes and west to the west shore of Boucle lake. The sillimanite occurs as fibrolite that in hand specimen appears as soft, whitish lenses with a waxy lustre in foliated quartzose rock. The distribution of this rock and the varia-

tions in attitude of the gneiss indicates that the structure here is more complex than in the Central Gneiss to the east.

In this area as a whole the rocks are quartz-feldspar-muscovite-biotite-garnet rocks. On the islands in the southeast corner of Petites Plages lake the grain size is aphanitic but increases to the north to fine and medium grained. White and gray quartz stringers are common, and narrow, aplitic to pegmatitic dikes are frequent north of Petites Plages lake. Farther north dark gneisses become dominant and these are described below. A small area of amphibole-feldspar rock occurs 5000 feet east northeast of Boucle lake. In the quartzofeldspathic gneiss 2000 feet south of the east-west narrows in Quatres Coins lake fine-grained graphite to 10% was present in bands several inches wide.

A thin-section from the aphanitic rocks in southern Petites Plages lake consists of quartz (50%) in mosaic texture; white mica (15-30%) interstitially; biotite (5-10%); plagioclase (? 5%); epidote (5%); and minor microcline, chlorite, and carbonate. Much more plagioclase may be present than indicated. These rocks may be felsic volcanic rocks.

A thin-section from a large outcrop of melanocratic, green, fine, foliated, garnetiferous rock at the narrows in Petites Plages lake consists of brown biotite (20%); green amphibole (15%), poikilitic and anhedral; to 60% quartz plus plagioclase; garnet (5%), extremely poikiloblastic; black opaque metallics, and apatite. East northeast from this point an outcrop of fine-grained

feldspathic schists consists of 75% quartz and plagioclase, white mica (25%), and minor pyrite, pyrrhotite, and epidote group minerals.

Three thin-sections of quartzofeldspathic rocks free from sillimanite north of the creek from Deux Granites to Petites Plages lake, but all within 5000 feet of this creek, have chlorite as the principal dark mineral and andesine with 37 molecular % anorthite. Quartz plus plagioclase from 60 to 85% form a mosaic texture in grains less than 0.5 mm. Chlorite, 0 to 30%, is very pale green and brown in anhedral grains less than 0.3 mm. To 5% garnet and pyrite are present. Minor minerals include epidote, black metallics, sphene, apatite, muscovite, and microcline.

A typical quartzofeldspathic rock forms a prominent scarp, facing west, 3000 feet northeast of Petites Plages lake; being massive in appearance, thickly banded, and with low to moderate dips. One specimen is leucocratic, fine, and consists of 75% of quartz and untwinned plagioclase in a mosaic texture of grains less than 0.2 mm., with to 10% alteration of the plagioclase; microcline to 10% in irregular bands of fine grains, muscovite (10%) coarser than the above minerals, non-oriented; a green spinel, sphene, epidote, black opaque metallic minerals. Less than 1% interstitial calcite is present. The second specimen is mesocratic, fine-grained, streaked with white and green and consists of quartz (40%), less than 0.2 mm., in mosaic texture with plagioclase (40%) with much alteration to a colourless chlorite; a green chlorite (20%), as isolated grains, possibly replacing biotite and inter-

grown with minor white mica. To 1% calcite is present as interstitial grains less than 0.3 mm., as well as minor opaque black metallics, garnet, epidote, and apatite. The presence of minor interstitial calcite may be of interest in that 12 feet of carbonate was reported in a drill hole, (9) see Economic Geology, 1500 feet south of this scarp, associated with quartzite.

Six thin-sections of fibrolite gneiss were examined. The fibrolite (5-10%) is closely associated with muscovite in all but one specimen, and occurs as sheaves of thin needles to 3 mm. in length intergrown with and penetrating muscovite and quartz. It is colourless with high relief, birefringent in yellow, and gives parallel extinction. Quartz and plagioclase, and in some quartz alone, 60-75%, form a mosaic texture of grains less than 0.5 mm. and often less than 0.2 mm. The plagioclase is generally unaltered but may be partially to completely altered to white mica. Brown biotite to 20% is the principal dark mineral. Pale green chlorite (15%) was present with biotite (5%) in one specimen and was coarser (to 1 mm.) than the biotite (less than 0.5 mm.). One outcrop, a leucocratic, medium-grained quartzite, consists of 75% quartz, 20% fibrolite, and 5% muscovite. Muscovite varies from 0 to 10%, being absent in one section. Accessory minerals include epidote, garnet, black opaque metallics, sphene, and in one section, from the northwest corner of Boucle lake, tourmaline.

Dark gneiss

Dark gneisses, amphibole-feldspar-quartz rocks, form a



Plate 11 - Glacial erratic of probable Central Gneiss, Boucle lake, feldspar-biotite-amphibole-quartz with garnet knots to 6 mm.

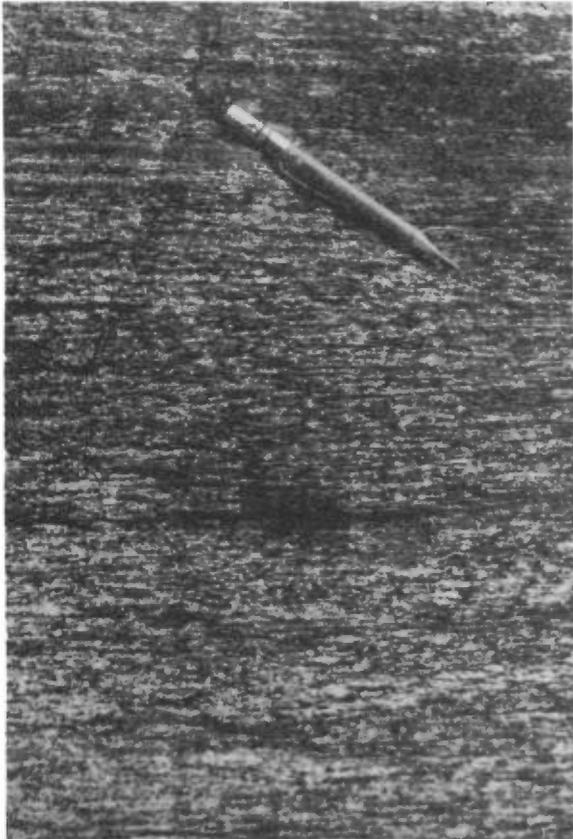


PLATE 12 - Lamellae in granetiferous, quartzose dark gneiss, 8000 feet NE of Deux Granites lake.

distinct band, north of the quartzofeldspathic rocks, from the southwest corner of Dumas lake to the southwest corner of Quatre Coins lake. Dark gneiss forms the majority of outcrops southwest of Boucle lake and northwest of Egarés lake. A small area of amphibole-feldspar was found rocks 7000 feet south of the southwest corner of Quatre Coins lake. Plate 11 is of banded gneiss, as a large glacial erratic, found centrally in the southeast expansion of Boucle lake.

At the mouth of the creek from Bluets to Dumas lake an outcrop on the shore is of an amphibole schist, fine grained, weathering to an irregular surface of narrow ($\frac{1}{2}$ inch) bands contorted in small (6 inch) folds. Going west to the south of Sperme lake, dark gneiss is well exposed over a width of 3000 feet and can be followed westward to the north of the felsic stock east of Deux Granites lake, where it has the same width. These rocks, plate 12, are fine, well foliated, in narrow (2 mm.) lenses, with 50% amphibole, and 50% gray feldspar and quartz, feldspar exceeding quartz. Garnet as fine, reddish grains is a major constituent in many of the northerly outcrops here. What appears to be a metagabbro sill occurs near the southern border of the dark gneisses. North and northwest of Deux Granites lake the dark gneiss includes some possible metagabbro, pyrite-rich, black schists, and one outcrop of what resembled pillow lava, 5500 feet north of northwest from the northwest corner of the lake. Northwest 11,000 feet from the lake a dark, fine, biotite-feldspar, banded gneiss goes to a meta-clastic band, four feet wide, of pebbles to three inches of medium-grained amphibole-feldspar rock, this band in contact with a fine-grained amphibole-feldspar gneiss. At the southeast corner of Qua-

tre Coins lake outcrop cliffs of amphibole and amphibole-feldspar rock, faintly foliated and medium grained. A small outcrop of similar rock is found at the southwest corner of this lake.

A thin-section of this last outcrop consists of an olive-green to very pale green amphibole (60%) in equant to elongated anhedral grains less than 1.5 mm.; andesine (30%) with to 40 molecular % anorthite, partly altered to white mica and a zoisite; brown biotite (5%), less than 0.3 mm; possibly some quartz and accessory sphene and apatite.

A thin-section of the fine-grained garnetiferous gneiss 9000 feet northeast from Deux Granites lake consists of amphibole (50%), probably ferrohastingsite with a small (-)2V, and pleochroic in very dark green to olive green and deep yellow; oligoclase to andesine to 10%, largely altered to white mica; quartz (30%); garnet, less than 5%, pale pink, extremely sieve-like; opaque black metallics; and minor apatite, calcite, epidote, and chlorite. The specimen was from an outcrop apparently richer in quartz than nearby outcrops. The plagioclase in thin-section is seen to be associated with the amphibole whereas the quartz is largely in almost monominerallic lenses. A thin-section from about 3000 feet south of the west end of Sperme lake consists of essentially the same minerals, the structure being more planar and possibly sheared. Quartz may therefore exceed plagioclase in much of these rocks.

The attitude of the dark gneisses south of Boucle lake suggests that they are a continuation of the mafic metavolcanics on the south shore of Petites Plages lake. The few outcrops west and southwest of Thomelet lake are less obviously a continuation

of the main body of pre-Opemisca rock. Fine-grained dark gneiss at the west corner of Boucle lake consists of hornblende with 10% plagioclase and 10% quartz. To the south the content of feldspar and the grain size increases. A thin section consists of fine-grained hornblende (75%), with andesine (20%) of 43 molecular % anorthite, and 5% of black opaque metallics commonly rimmed with sphene.

At the top of the rapids below Thomelet lake an outcrop of fine grained, garnetiferous, amphibole schist is cut by aplite dikes that are ptymatically folded. A ridge 5000 feet south southwest of here consists of a poorly foliated amphibole rock, fine-grained, in part brecciated by white aplite as small irregular stringers to two feet in length. In thin-section the mafic rock consists of hornblende (55%) less than 0.3 mm., granular and equant; andesine (40%) with 39 molecular % anorthite; epidote to 10%, anhedral; and minor opaque metallics, black and yellow.

NORTHERN GNEISS

These gneisses merge with the Central Gneiss west of Quatre Coins lake, but occur also as three isolated areas across the northern limit of the map-area. All border the syenodiorite intrusive. They appear to be paragneiss, medium to fine-grained, intruded by granitic rock and pegmatite, and this more commonly so in the western exposures, by which feature, in addition to their isolation, they are separated from the Central Gneiss. Chemically and mineralogically, however, they appear to be similar to the quartzofeldspathic Central Gneiss. The absence of garnet and more

abundant epidote are characteristic of the northern Gneiss.

In the northeast corner of the area about Ovest Brock and Opataca lakes scarcity of outcrops limits the understanding of feldspathic gneisses with biotite, amphibole, and chlorite and with quartz as a major mineral. The granularity is usually fine and the gneissic structure ill-defined. A well-banded gneiss outcrops at the second portage going from Dumas to Opataca lakes and is darker than the less well-banded gneisses to the north. Four thin-sections were examined. Their mineralogy was similar with the exception of one from half-way up the east shore of Opataca lake that contained to 1% very fine-grained, radiating clusters of what appears to be fibrolite (sillimanite), in a more quartzose band, and microcline plus minor perthite to 10%, also concentrated in a band. Sodic andesine (55-70%), equant, ragged grains to 3 mm., generally less than 1 mm., with narrow alteration at the edges in some specimens and almost complete alteration in others to a pale brown cloudiness with some white mica; and quartz (20-35%), elongated with irregular, serrated edges and patchy extinction, are the principal minerals. Chlorite (10%), less than 0.5 mm., interstitial, ragged, was the principal dark mineral with the fibrolite, and in one other specimen, with only a few grains of biotite; and biotite (5%), dull greenish brown, less than 1 mm., clustered to interstitial, with no chlorite, in the other two. Black, opaque metallics rimmed with sphene and fine white mica, apatite, epidote as numerous anhedral grains less than 0.5 mm., white mica, and sphene are accessories.

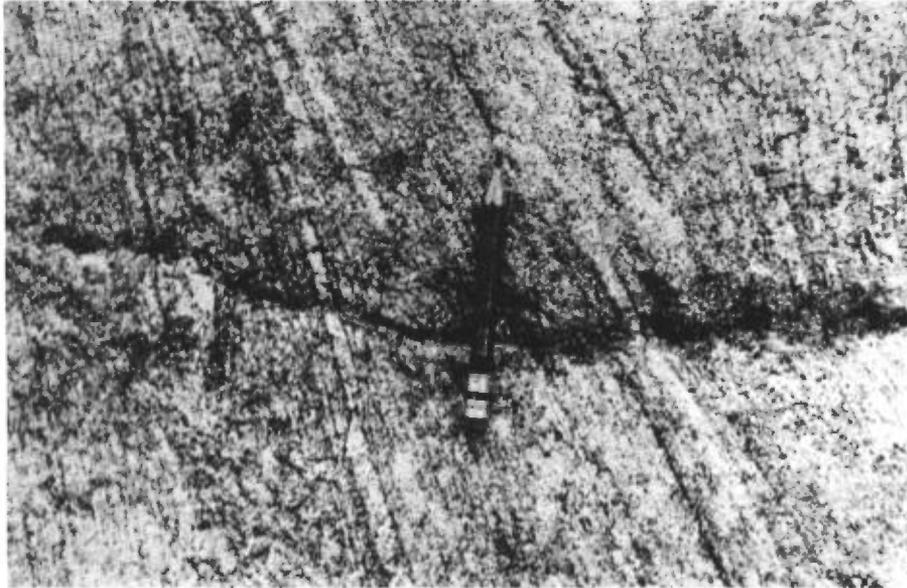


PLATE 13 - Banding and foliation in feldspar-quartz-biotite gneiss 8000 feet west of Quatre Coins lake near EW township line.



PLATE 14 - Injection gneiss, near the same point as plate 13, with folding and later felsic dike.

The remaining areas of Northern Gneiss are similar paragneisses with perhaps more amphibole, but better exposed and frequently as injection gneisses with what appear to be granitoid sills and ptygmatic folding, plates 13 and 14. Amphibole and amphibole-feldspar bands to two feet thick were noted in these areas. Small dikes of pegmatite are common as are white quartz stringers. The largest pegmatite noted occupied half of an outcrop, 100 by 100 feet, 9000 feet northwest of the north end of Quatre Coins lake and was a feldspar-quartz pegmatite in a porphyroblastic feldspar-amphibole-biotite gneiss.

No contact with the syenodiorite body was found. The most northerly outcrop on the shore of Quatre Coins lake, shown as syenodiorite, may belong to the Northern Gneiss.

Two thin sections of mesocratic, fine to medium grained gneiss were examined. Amphibole, medium green to olive green to yellow and anhedral occurs disseminated as 10% of one specimen and in narrow bands in the second. Chlorite, green to pale green, exceeds biotite, brown to yellow-brown, in both specimens. To 40% quartz and to 50% sodic andesine are similar to these minerals in the specimens to the east.

ULTRABASIC TO GRANITIC STOCKS

Ultrabasic rocks

Three bodies of ultrabasic rocks were found; in the northeast, southeast, and southwest quarters of the area.

The northeastern body outcrops along the West Brock river



PLATE 15 - Aspect in outcrop of the pyroxenite one half mile west of Brock
Ouest river.

and to the northwest and southeast as a dark brown to black, coarse-grained pyroxenite with, in part, 1 to 2% black biotite, plate 15. The most easterly exposures are of an amphibole-feldspar rock and a fine grained metagabbro. An outcrop of amphibole-feldspar rock with several stringers one to five millimeters wide of quartz and magnetite occurs at the northwest corner. Strong compass deflections were noted at two points just east of the West Brock river. The relation of this ultrabasic rock to other rocks is not known, but it appears to be a westward continuation of a strip of sedimentary rocks mapped by Kindle (1942). A questionable outcrop of ultrabasic rock occurs 8000 feet northwest of the southwest corner of Brock Ouest lake.

Petrographically this pyroxenite has a gray clinopyroxene with $2V$ of 70° , a very closely spaced parting, and very fine black metallics along cleavage planes. Amphibole (2%) replaces pyroxene. Olivine (5-10%) is fresh, with black metallics and chlorite in the fractures. No feldspar was found.

The southeastern body is a grouping of mafic to ultramafic rocks that appear to have been brecciated and intruded by a diorite, the whole causing a broad magnetic anomaly (Map 549G) immediately northeast of Anomalie lake. These rocks form a flat, broad hill that begins on the east side of a vertical-walled valley running north of northeast from the northwest corner of Anomalie lake. The principal rock is a melanocratic, massive, medium-grained (1-4 mm.) amphibole rock. This is cut and brecciated by a dioritic rock, medium to fine grained, in part quartzose, and consisting of a white feldspar and a dark green hornblende. The breccia is best exposed on the floor and east wall of the above

valley and persists eastward for several hundred feet. East of this main breccia zone the host rock for a distance of $1\frac{1}{2}$ miles is frequently intruded by similar dioritic rock as narrow (1-8 inches), irregular lenses and stringers that seem isolated from their companions, that is they do not form an interconnecting stockwork when seen in two dimensions, plate 16. The texture of the diorite is fluidal, in part, with what appear to be flow lines of aligned amphibole about the host rock inclusions. In the main breccia zone the fragments were up to two feet across. In addition to the angular amphibole rock fragments they include rounded fragments of probable pre-Opemisca volcanic rock. Much of the hornblende of the diorite appears in the hand specimen to be fine fragments of the amphibole rock.

The limits of the complex were not established in detail in the field and the limits shown on the map are largely based on the magnetic anomaly. Towards the east the amphibole rock becomes finer-grained and possibly less basic, but it was noted to the limit of the body shown. A band of massive pyrrhotite with fine, disseminated chalcopyrite (less than 1%), that had been trenched, was reported at the southeast corner of the complex, 6000 feet east of Anomalie lake. An extension of the anomaly to the northwest of the above mentioned valley lies over what appears to be a sill of the pre-Opemisca gabbro that is intruded and brecciated by a biotite granite in similar fashion to the amphibole rock. This is not included on the map in the mafic complex but is included in the north-south strip of pre-Opemisca rocks. South of this brecciated gabbro on the west side of the above-described valley is a ridge of what appear to be



PLATE 16 - Complex of felsic dikes in amphibole-pyroxene rock, looking 10° along the strike of a diabase dike, 2 feet wide, the right of the notebook, near Anomalie lake.

pre-Opemisca dark, hard, very fine-grained volcanic rocks that are cut by a stockwork of dikes a few inches wide.

Petrographically the amphibole rock is a pale olive-green amphibole (80%) replacing a colourless clinopyroxene (20%) with a 2V of approximately 70° , and less than 1% of opaque metallic minerals, black, scattered as fine grains and clusters of fine grains. The diorite consists of an oligoclase-andesine (65%) generally less than 10% altered, probably sericitized, and olive-green, subhedral amphibole (35%), and apatite (less than 1%). An inclusion in this specimen is a cluster of colourless pyroxene surrounded by a rim of amphibole similar to the amphibole of the diorite.

Large blocks of a similar amphibole rock were found on the northeast shore of Black Water lake and suggest that the magnetic anomaly (Map 549G) northeast of Black Water lake may in part at least be caused by a similar ultrabasic body.

The southwestern body underlies a hill and magnetic anomaly at the west end of Icon lake. It trends northwest for 7,000 feet and is up to 3,500 feet wide. The rock is black, dark gray weathering (with rusty spots and pits 1-2 mm. across), medium grained pyroxenite with minor olivine. Except for a few small patches of coarse gabbro the rock is uniform. The only contact seen was with a diabase dike which, farther north, also cuts metagabbro. A northerly extension of the ultramafic mass, not shown on the map, may account for the continuation of the magnetic anomaly over the low ground here, which

anomaly may continue farther north, as suggested by compass deviation at a point approximately 2000 feet northeast of des Egares lake.

Two thin-sections consist of 45% of pale brown clinopyroxene, (+)2V 70-80°, to 1 mm., altering to a clinoamphibole (45%), pale green to pale greenish brown, to colourless, (-)2V 80°, to 1 mm. Opaque metallics (5%), mainly black but with some yellow are irregularly distributed, a notable concentration occurring as an outer border of fine dust and larger grains in the pyroxene crystals in contact with amphibole. Olivine to less than 5% forms irregular, elongated grains to 3mm. with minor alteration to serpentine and black metallics. Minor leucroxene is present.

Gabbros

A complex mapped by Beach (1941) is represented in the southeast corner of the present area by a coarse-grained, gabbroic to diabasic, mesocratic rock consisting of flat tablets of white feldspar to 1 cm. in length, a dark green pyroxene, and a few % of a coarse-grained biotite. A leucocratic variety with 30% ferromagnesian was noted. Near the contacts the granularity may be fine and the texture porphyritic so that the gabbro resembles the Opemisca porphyritic volcanic rocks that it intrudes. The gabbroic texture of the matrix is more evident however than in the volcanic rocks. The gabbro has a generalized pale green colour that suggests partial chloritization and much of the biotite has a silver colour. Specks of chalcopyrite were noted in two of the hand spe-

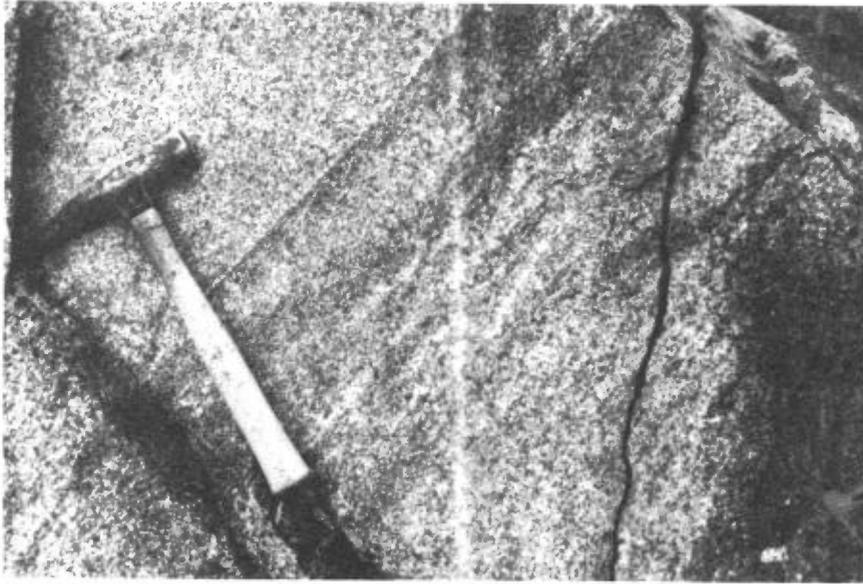


PLATE 17 - Rough banding in leucogabbro, hill east of Julien lake.



PLATE 18 - Pegmatitic gabbro, hill east of Julien lake.

cimens. The only contact noted with the Opemisca rocks was of fine and coarse-grained dikes of gabbro cutting an indurated, very fine-grained rock going to typical Opemisca porphyritic volcanics.

Petrographically the gabbro consists of a labradorite, sericitized to 50% and cut by narrow fractures lined with chlorite; and clinopyroxene replaced to 50% by a pale green chlorite and a small amount of fibrous amphibole. A coarse grain of well formed amphibole, brownish green, is possibly late magmatic. The biotite is in part opaque, probably to be attributed to very fine grains of iron oxide. Opaque black metallics and apatite are present to less than 1% each. The leucogabbro was more completely altered, the feldspar saussuritized and sericitized to 70%, the pyroxene almost completely chloritized.

An elliptical mass of metagabbro 9,000 feet long and to 3,000 feet wide trends east northeast through Julien lake. As exposed on Julien lake this is a leucogabbro of medium granularity with in part some poorly defined segregations of light and dark minerals into bands to a foot in width striking consistently east of northeast with northerly dips. On the ridge to the northeast of Julien lake this leucogabbro is associated with more mafic gabbro, frequently coarse-grained, and some very coarse-grained hornblende "porphyry" and quartz gabbro, plates 17 and 18. Insufficient mapping was done to establish whether the more basic rocks parallel the banding in the leucogabbro, but the length of the metagabbro body as a whole parallels this banding and prominent quartz grains are common along the northern slope. As the Moraine Lake stock is

approached the rock type is a garnetiferous, amphibole gneiss with fine-grained quartz. The strike of the gneissosity here suggests that these latter are a continuation of the pre-Opemisca rocks and separate the gabbro from the Moraine Lake granite. The garnetiferous rocks are cut by numerous, narrow dikes of aplite. This relationship leaves the relative age of the metagabbro uncertain. It appears to cut across the pre-Opemisca rocks to the north but is not known to be in contact with the Moraine Lake granite. As it appears to be conformable with the Pre-Opemisca rocks to the south, it may be of the same age as the pre-Opemisca sills, as is suggested by its degree of metamorphism.

Petrographically the leucogabbro consists of completely saussuritized plagioclase (55%), and a pale green to colourless amphibole (45%), anhedral, in short, rectangular crystals replaced in part by a colourless chlorite. Opaque metallics are almost completely absent, the only opaque material being a small amount of ragged leucoxene. The darker metagabbro contains more amphibole, less than 1% quartz and less than 1% black metallic minerals. A quartzose stringer cutting melanocratic amphibole porphyry consists of a graphic intergrowth of quartz and saussuritized feldspar with acicular amphibole, sieve-like opaque metallic minerals (5%), and small apatite grains occurring with the metallic minerals and in the graphic intergrowths. The amphibole porphyry consists of strongly pleochroic, green hornblende (60%), saussuritized feldspar, and 5% opaque black metallic minerals, cubic, frequently as inclusions in the hornblende phenocrysts. A single specimen of the

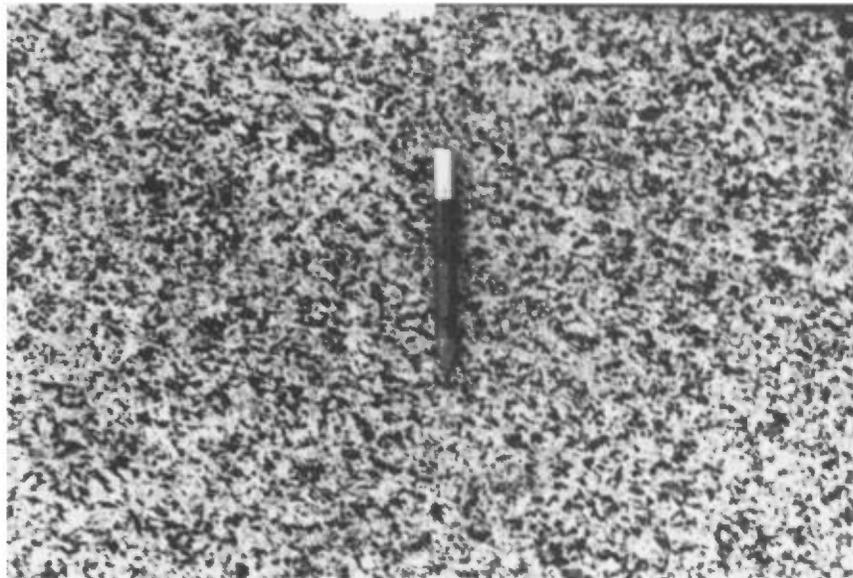


PLATE 19 - Syenodiorite, faintly foliated, feldspar-hornblende with 5% biotite,
island at south end of Turgis lake.

garnetiferous gneiss consists of quartz (40%), a granular, ragged amphibole (40%), pleochroic in yellow, deep green, and blue-green, and some scattered garnet, black metallic minerals, and apatite.

On the point on the east shore of Julien lake there is a carbonatized zone of leucogabbro twenty five feet in width with shearing on the northern edge striking 125° and dipping steeply south to vertical. Shearing at the northwest corner of Julien lake, striking 65° and dipping steeply north, occurs in probable pre-Opemisca volcanic rocks and is associated with numerous white quartz stringers. What appears to be a chilled phase of the Julien Lake metagabbro, cut by stringers of coarse-grained quartz metagabbro, outcrops on the west shore of the lake at the presumed north contact. A magnetic high (Map 549G) centred over the lake is not explained by the rocks exposed. Drilling, Economic Geology points (10) and (22), has intersected some pyrrhotite on the south and east shores of the lake.

Syenodiorite

This rock is readily recognizable in the field although it is variable in mineralogy, as described below. The granularity, medium-grained, is remarkably constant despite the large size of the body extending across the northern half of the area. In hand specimen it generally appears massive although in outcrop a faint to well developed foliation, a parallelism of irregular clots of mafic and felsic minerals, is commonly seen over the western part of the area, plate 19. Two types dominate and both may occur in the same outcrop, probably as wide bands, though their mutual relations were

not established. The difference in aspect appears to be due to alteration of the feldspar for both types have about 50% of feldspar that in one is gray to clear making the rock meso-melanocratic and in the other white to buff making the rock much paler. In the second type the mafic mineral is generally amphibole, whereas pyroxene and biotite and amphibole occur together in the first type. To 20% biotite is present, usually coarser than the other dark minerals, and appearing as thin, coarse-grained, irregular flakes. Quartz to less than 5% is frequent. The occasional granitic, pegmatitic, or syenitic dike, a few inches in width, is present. Northwest 5,500 feet from the point where Noir creek crosses the east boundary a prominent ridge outcrops as a pale pinkish weathering, mesocratic, green, hornblende-feldspar porphyry with phenocrysts of hornblende to 5mm. in an apparently microcrystalline groundmass. On the east shore of Ruth lake an outcrop of an ultramafic variety consists of similar ferromagnesian but no more than 10% feldspar.

Outcrops define fairly well the extent of this body about and east of Dumas lake, about and northwest of Turgis lake, and about Ruth lake. Between Ruth and Turgis lakes a band of Northern Gneiss may separate the syenodiorite into a western and eastern part. Two features of the gneiss here, first the similarity of the mineralogy of some of the outcrops northeast of Ruth lake to that of the syenodiorite, but strongly gneissic, and second the presence of pegmatitic bodies larger than found elsewhere in the area, suggest that the syenodiorite is either continuous through or underlies the gneiss here.

Near the southern contact some inclusions of probable arkosic gneisses were seen on the shore of Dumas lake. West 3000

feet from 3000 feet north of the south end of Eau Claire lake a single outcrop of a fine grained gneissic amphibole-feldspar rock occurs. South southwest 5000 feet from this is an outcrop of a greenish feldspar-quartz-hornblende-biotite gneiss near an outcrop of typical syenodiorite.

A good exposure of typical syenodiorite just west of the area, on the small lake 17,000 feet south of Ruth lake, and a small exposure of a typical, strongly altered syenodiorite 6000 feet west of the south end of des Egarés lake are used to extend the syenodiorite along the western limit of the area. Extension south of this last outcrop is more speculative and is based on an outcrop of a typical melasyenite 12,000 feet north northeast of the southwest corner of the area, an outcrop of pink hornblende syenite and hornblende porphyry 7000 feet north-northeast of the southwest corner, this latter apparently intruding pre-Opemisca rocks, plus a pattern to the isomagnetic lines, Map 549G, suggestive of a change in rock type and similar to that over much of the syenodiorite. The postulated intrusive here may be more syenitic than the syenodiorite. The above hornblende porphyry, however, consists of 20% coarse, poikilitic hornblende in a matrix of fine clinopyroxene (65%) and 15% microcline and intermediate plagioclase.

Twelve thin-sections were studied. A specimen of the altered feldspar type from Dumas lake consists of 40% anhedral, green amphibole with fine inclusions of quartz and apatite; a cloudy (sericitized) feldspar (20%); unaltered microcline (5-10%); fine, unaltered andesine with 37 molecular % anorthite. The amphibole is altering to chlorite (5%) that forms some coarse grains. Apatite, epidote, and opaque metallic minerals make up less than 2%. Quartz was not seen outside of the amphibole and a few grains

of probable pyroxene are residual in the amphibole. A second specimen of this type from north of Quatre Coins lake has no microcline but 55% of altered andesine and minor sphene, leucoxene and calcite.

A specimen of the unaltered feldspar type from east of Dumas lake consists of a colourless clinopyroxene (25%); brown biotite (20%); calcic oligoclase (25%), altered to 20% to a sub-microscopic almost opaque alteration; 5% of microcline and perthite; 5% quartz, some myrmekite; chlorite to 5%; a few grains of amphibole, and minor apatite, rutile and opaque metallics. A second specimen from an island in Turgis lake consists of 40% of a similar clinopyroxene, very pale brown; sodic andesine, 55%; potassium feldspar, 5%, biotite, 1%, and minor apatite, amphibole, chlorite, and opaque metallics.

In six specimens stained for K-feldspar the amount of K-feldspar ranged from 5 to 20% and apparently commonly ranges from 5 to 10%. Plagioclase makes up 20 to 50% of these specimens. A specimen from 9000 feet west of the eastern limit of the area contains 30% microcline and 30% plagioclase.

Syenite and melasyenite

The 1900 gamma isomagnetic line over Black Water lake (Map 549G) approximately defines the limit as shown in outcrop of a medium to fine-grained, pinkish to grayish, leucocratic, feldspathic rock carrying to 10% hornblende and biotite and to 5% quartz. About this syenite the outcrops on the shore of the lake and the few found inland are coarser in granularity (to 5mm.) and



PLATE 20 - Aspect in outcrop of the Eau Noire syenite.

richer in hornblende or biotite or both (to 40%), and carry no visible quartz. None of these melasyenites outcrop within the regions of isomagnetic lines above 2500 gammas that form a horseshoe-shaped anomaly about Black Water lake, most of the outcrops being found to correspond to values of 1900 to 2300 gammas. Several outcrops of similar melasyenites were found in the magnetic valley between the above horseshoe-shaped anomaly and the Anomalie Lake anomaly, in areas where the magnetic values range from 2100 to 2300 gammas. Here in part they are associated with two outcrops of an olivine gabbro believed to be a dike.

Both the syenites and melasyenites are massive, plate 20. In a given outcrop of the melasyenite the feldspar is dominantly either pink or gray. Inclusions similar to those seen in the Moraine Lake porphyroid granite are common but were not seen to carry feldspar phenocrysts. On the small island at the east end of the lake a mesocratic, green, medium-grained metagabbroic rock with a yellowish green feldspar suggesting epidotization is intruded by narrow dikes of melasyenite, the whole exposure being about 30 feet across. On the peninsula between Eau noire and little Eau Noire lakes melasyenite, often porphyritic and crowded with pinkish, feldspar phenocrysts averaging 4 mm. is in contact with a diabase dike at both its contacts. Melasyenite makes up most of the outcrops on this peninsula but a diabase dike forms the largest single outcrop that runs as a ridge across the peninsula.

Petrographically the syenite consists of to 90% feldspar of which half may be sodic plagioclase, with very fine albite twin lamellae in part and some pericline twinning, that is almost completely clouded with a fine alteration product and intergrown

with microcline in an antiperthitic texture. Microcline and perthite are equally common and are generally much less altered than the plagioclase. The feldspars are anhedral and have sutured contacts with intricate rounded and angular embayments. The plagioclase is frequently subhedral. The amphibole (to 10%) is pleochroic in yellow, green, and blue-green and forms anhedral, ragged prisms much replaced by a green chlorite and epidote. Quartz (1 to 5%) and minor sphene and opaque metallics are present. Some yellow to red stain fills fractures in the feldspar.

The melasyenite may have either amphibole, clinopyroxene, or biotite as its major ferromagnesian mineral. The pyroxene occurs to 20%, colourless with a $2V$ greater than 60° , in the gray feldspar variety of melasyenite with a green biotite (20%) and the remainder of the rock made up of potassium and sodium feldspars similar to that found in the syenite but with much less alteration of the plagioclase. The pyroxene is altering to a green amphibole (less than 5%) and chlorite. Epidote, opaque black metallic minerals, and apatite are present. In some specimens amphibole is the more common major ferromagnesian mineral and is replacing pyroxene, colourless, that is seen at the center of the occasional grain of amphibole.

Granite

Four stocks of granite are shown, the largest about Moraine lake, a much smaller one of, in part, a similar granite just east of Deux Granites lake, a small plug at the junction of Crinkle creek and the Brock river, and dissimilar felsic outcrops shown



PLATE 21 - Moraine lake porphyroid granite, 7500 feet NNE of the lake.



PLATE 22 - Jointing systems in the Moraine Lake granite 700 feet NW of the east end of the lake.

as a plug on the south shore of Thomelet lake and described under 'Felsic Dikes in Pre-Opemisca Rocks'.

The stock about Moraine lake is a feldspar porphyroid-granite, leucocratic, with pink to gray feldspar phenocrysts, frequently reaching 1 cm. in length, making up 20% of the rock. The groundmass consists of 20% of fine to medium-grained biotite and hornblende and 80% of medium-grained (1-2mm.) quartz and a white, buff, or pink feldspar. There is some variation in granularity and colour but the body appears remarkably uniform in mineral composition and texture. Outcrops are characterized by closely spaced horizontal to sub-horizontal jointing that give scarp faces a stone-wall appearance, plates 21 and 22. Two contacts of the main body were seen, one with dark, pre-Opemisca schists northwest of Moraine lake, the other with the metagabbro mapped as pre-Opemisca 1500 feet north of Noir creek. No change in the character of the granite was noted at these contacts. The metagabbro appeared faintly gneissic and was cut by irregular, narrow stringers of fine-grained granite and some pegmatite. The dark schists were cut by sills and dikes of porphyry-granite to two feet in width, mainly within 50 feet from the contact. West of Moraine lake and 1000 feet west of the contact as shown a 12 foot wide sill of similar "porphyry" in banded schists showed no change in grain size at either contact. At the northeast end of the Julien Lake gabbro the garnetiferous rock here was cut by a profusion of aplitic dikes within 100 feet of the assumed contact, marked by a scarp 20 feet high. The diabase dike southwest of Anomalie lake has on the north face a thin layer of a leucocratic feldspar-quartz porphyry, the feldspar a salmon pink in colour and the ground-mass micro-

crystalline. The probable age relations of this diabase and the Moraine Lake granite preclude the possibility that this rock is a phase of the Moraine Lake granite chilled against the diabase, but it is possible that the diabase is cutting a dike of, or the border of, the Moraine Lake granite.

A characteristic feature of this granite is the presence of numerous, rounded and sub-angular inclusions, fine-grained and mesocratic, with frequently a gabbroic texture. These inclusions are of the order of 6 inches across but range from one inch to two feet. Frequently they contain pinkish feldspar crystals to 1 cm. in length.

Petrographically microcline and perthite make up 40% of the thin section. Perthite forms the single large "phenocryst" present in the section and the zoning, visible in the hand specimen, is caused by patch perthite. Sodical plagioclase, finely twinned, sericitized to 30%, and zoned by inclusions and alteration makes up 30% of the groundmass. Also present are quartz (15-20%), a green amphibole (5-10%) and a brown to brownish green biotite (5-10%) with black, cubic metallic minerals (less than 1%), apatite, epidote, and sphene.

The stock east of Deux Granites lake includes two distinct rock-types, one a porphyroid granite very similar to the stock about Moraine lake and the second a typical granite that outcrops over a diameter of 4000 feet on the hill southeast of the lake, and has as its boundaries the porphyroid granite to the northeast and

pre-Opemisca rocks to the southwest and southeast. This granite is cream-coloured, faintly pink, fine to medium-grained, with quartz (25%) and biotite (5-10%). Feldspathic dikes to one foot wide are common. Near the contact with the pre-Opemisca rocks the granite is foliated with a moderate dip to the southeast and with one inch wide anastomosing quartz stringers. No inclusions were seen which is in contrast to the accompanying porphyroid granite which has numerous inclusions similar to those in the stock about Moraine lake. A thin-section consists of 40% microcline and perthite; 40% plagioclase, zoned, altered and faintly twinned; 15% quartz; less than 5% brown biotite altering to chlorite and muscovite; and minor sphene, black metallics, apatite, and zircon.

The associated porphyroid granite is in contact with the Central Gneiss to the north and east, and with pre-Opemisca rocks to the south. The northern contact is in general conformable but locally cross-cutting with some decrease in granularity of the granite at the contact. White quartz stringers, aplite, granite, and granite porphyry dikes are common for 100 to 200 feet from the contact. To the east the contact appears more complex with 'lit par lit' injection and shearing, especially north of and adjacent to the first two lakes in the narrow valley striking east of northeast from Deux Granites lake.

North of Crinkle creek near its junction with the Brock river, on a small, round hill 1000 feet in diameter, outcrops a fine to medium grained, gray, biotite granite, massive, with several per cent pyrite as cubes to 2 mm., with minor muscovite, and

some carbonate.

Petrographically this rock contains albite to 60%, replaced to 10 or 20% by muscovite and calcite. Muscovite to 5 or 10% and 5% calcite also occur as larger grains outside the plagioclase. A greenish brown biotite (10%) and strained quartz (10%) and pyrite (1%) make up the remainder of the rock.

LATER DIABASE AND GABBRO DIKES

Gabbro dikes

A quartz gabbro dike , see Economic Geology point (18), shown, as an olivine gabbro by Beach (1941) and Gilbert (1955), to cross the northern part of the Mechamego Lake area from the south shore of Lac La Trêve is extended in this area to a point 4000 feet southwest of Anomaly lake. As to the southwest, this dike has no magnetic expression in this area on the aeromagnetic map. The dike, in places, appears to be a sill dipping north and varies in texture, structure, and width. Commonly it is a greenish gray, medium-grained gabbro with coarse-grained poikilitic, pale green clino-pyroxene enclosing fine labradorite, and a few fine grains of quartz. A black, fine-grained phase at the south contact consists in thin-section of laths of plagioclase and clinopyroxene, similar in form and size, and largely altered to fine chlorite, amphibole, and opaque metallics with to 5% quartz, apparently primary. Not more than 1% opaque metallic, mainly black and altering to leucoxene is present in the first specimen above, which is more typical of the dike although altered to chlorite and saussuritized to 30%, whereas, in the second, 5 to 10% of opaque, metallic mineral appears partly as fine grains in fractures and cleavages in the plagioclase and pyroxene and partly associated with angular, branching leucoxene.

The width of this dike varies from 100 to 400 feet, and

on a ridge where the dike was 100 feet wide it was cut by a parallel, anastomosing system of fifty or more fine-grained, dark dikes a few inches in width. Several chilled contacts were seen with pre-Opemisca rocks that were altered to a hornfels for 10 to 20 feet from the contact. At two points on the north contact small amounts of pink feldspar-quartz rock, porphyritic to pegmatitic may be derived from the dike magma.

An olivine gabbro dike, part of Gillett's (1962) Reid Dike, outcrops on the ridge 11,000 feet north northeast from Julien lake and strikes west of southwest, apparently a continuation of a prominent linear on aeromagnetic map 549G running northeast from the north shore of Pichamobi arm and cut by drill hole 5 of Diomar Mining (see Economic Geology). A thin section consists of clinopyroxene (30%), (+)2V 50-70⁰, with some alteration to biotite; sodic labradorite (50%), saussuritized to 20%; olivine (5%) going to chlorite; black metallics (5-10%); reddish brown biotite (1%), very fine; and numerous rods of apatite to 1.5 mm. Gilbert (1955) describes similar biotite bearing olivine diabase in a comparable position with regard to the above described quartz gabbro dike. The aeromagnetic maps strongly support this and suggest the extension of this olivine gabbro to the east end of Inconnu lake where there may be an offset or sharp southerly bend of the dike to the north shore of Inconnu lake.

Two outcrops of olivine gabbro with a few % of reddish biotite occur 9000 feet northeast of Anomalie lake. In the field one outcrop appears more mafic than the other and contains 20% of olivine as rounded grains to 3mm., clinopyroxene (50%), (+)2V 60-



PLATE 23 - Circular jointing shown on vertical contact of diabase dike, Eau Noire lake.

70°, plagioclase (25%), finer and interstitial; to 10% saussuritized; biotite, less than 5%; opaque metallics, less than 5% and chlorite (1%). The less mafic specimen has similar minerals with less olivine and a few grains of a clear mineral with an index of refraction lower than balsam. Several large blocks of a similar rock were found at the southeast corner of Anomalie lake. Whether the outcrops are a continuation of the above described olivine gabbro dike is a problem as they appear to be on strike with the quartz gabbro dike to the southwest, described above.

Diabase dikes

Two northerly striking diabase dikes are well exposed. The best exposed crops out discontinuously for over six miles and trends northwesterly through the west end of Eau Noire lake. This dike, about 150 feet wide, appears to be offset to the left at several points. Near and northwest of little Eau Noire lake an outcrop of diabase with a pale, altered eastern border appears to end on strike against a scarp of sheared conglomerate and to reappear 100 feet to the west. No shearing was seen in the diabase exposed 20 feet from the schist into which it strikes, suggesting that the offset results from an echelon intrusion. On the peninsula in Eau Noire lake circular jointing, horizontal, perpendicular to the walls, is well developed, and forms stacks of cylinders 5 to 10 feet in diameter, plate 23. Many of the joints are sinuous in that they pass from a lower cylinder to the one above.

Two thin sections consist of a clinopyroxene (50%), (+) 2V moderate; labradorite (40%); opaque metallics (5 to 10%); leucoxene (1%); amphibole (5%); quartz (1-5%). A fine alteration in the pyroxene and plagioclase, to 25% saussuritized, makes the sections semi-opaque. Pyroxene is altering to fine chlorite and possibly amphibole. Some amphibole is interstitial. The texture is diabasic.

The second, northerly striking diabase dike, about 150 feet wide, runs north of northeast along the top of a ridge north of Thomelet lake. A single outcrop on Boucle lake may be part of this dike. A dike 50 feet wide and with an easterly strike occurs northeast of this on the shore of the small lake south of the portage south of Quatre Coins lake. A dike occurs on the ridge 2500 feet south of the west end of Thomelet lake. Two narrow (4 feet) dikes with northerly strikes were seen, one in the gabbro south of the Chibougamau river and the other in the ultrabasic body 3500 feet northeasterly from Anomaly lake, plate 16. About 4000 feet northwest of the southwest corner of little Eau Noire lake (a medium grained diabase) appears to strike west of north.

The diabase dike shown as striking east of northeast just north of Eau noire lake is based on two outcrops with no exposed contacts. The small western outcrop is typical diabase, whereas the eastern outcrop is a ridge of apparently altered diabase. A northeasterly trending dike, apparently about 20 feet wide, only one contact seen, occurs 18,500 feet northeast of the southwest corner of the area, near the township line.

SANDSTONE FISSURE-FILLINGS

Four occurrences of what appear to be fissure fillings of sandstone, a graywacke, in the Northern Gneiss and the syenodiorite were found, one 8,500 feet northwest and two 23,000 and 26,500 feet northeast of the north end of Quatre Coins lake, and one on the eastern shore of Waposite lake, only the first being visited by the author. The four outcrops fall roughly along an east-northeast striking line, and three are in areas of relatively high relief possibly residual features of the base of the Proterozoic sedimentary rocks. If so this implies that the Proterozoic here was deposited on an erosion surface close to the actual erosion surface. There is nothing to suggest a younger age.

These fillings are two inches to one foot wide and one was exposed over a length of 50 feet. Three of them had an east-westerly strike. The hand specimen is a mesocratic, gray-green, fine-grained, leucocratic weathering, massive rock with prominent clear, angular quartz and feldspar grains to 1 mm. and in some specimens numerous pebbles to 1/2 inch of dark aphanitic rock.

A thin section consists of to 75% angular to conchoidal quartz and feldspar fragments between less than 0.1 and 1 mm. plus several rock fragments to 4 mm. in a brownish matrix, submicroscopic, with a high relief and low birefringence. About half of the crystal fragments are quartz and half are microcline and plagioclase in equal amounts. There is minor alteration of the plagioclase to chlorite. The quartz has undulant extinction and is biaxial. The rock fragments are mainly of felsic, fine-grained

rocks, apparently felsic volcanics, and a few more rounded pebbles of mafic rocks, now largely chlorite, albite, and opaque metallics. No shearing or orientation of minerals is present, except that some of the rock fragments are foliated.

Explosive igneous or other emplacement remains a possible origin for this rock. They may be a feature of the little studied large granitic-gneissic area north of the present area.

PLEISTOCENE AND RECENT

In the area there are two eskers that make a notable contribution to the local relief and one type of glacial deposit, the washboard moraine, that gives a strong pattern to drainage and aerial photographs. Along the Brock river and the west side of Eau Claire lake are meandering eskers, 50 to 100 feet in height, flanked by sand deposits of much wider extent, generally as flat plains or gentle slopes. Also associated with the eskers are rounded hills of sand, gravel and boulders equal in height to the eskers and probably of similar origin.

The esker along the Brock river crosses this river twice within the area and fades out below the junction of the Brock with the Chibougamau river, although broad, sand deposits and sand hills occur on both sides of the Chibougamau river below this point. The esker makes abrupt turns, one of which makes it colinear with Crinkle creek below the mouth of this creek, that give the impression of two eskers intersecting. In part this esker has a succession of bulges along its length that give it a beaded appearance.

East of the esker to the limit of the area there is a flat sand plain. Toward the north and south the esker enters an area of sand hills and kettle lakes.

The esker west of Eau Claire lake is generally a lower and more rounded feature. At Opataca lake it passes through an area of steep-sided sandy hills with kettle lakes and at its southern end it appears to end north of the prominent, rocky hill southwest of Sperme lake.

The washboard moraines and the effects of glacial scouring are described under 'Physiography'. Washboard moraines are present in most parts of the area. In a given portion of the area they are markedly uniform in their orientation, but in different portions of the area they may have 10 to 15 degrees difference in their average orientation.

Glacial striae were noted at several points, mainly along lakes and streams. Good striae were found on the ridge of diabase southwest of Julien lake. The striae indicate a southwesterly direction for the advance of the ice.

On the hill of metagabbro east of Julien lake two well formed cobble beaches were seen just below the crest of the hill. These are estimated to be 300 or more feet above the level of Julien lake.

Boulder moraine is met throughout the area, but is perhaps more impressive east and west of Dumas lake and especially about Opataca lake and westward to south of Waposite lake where, in this topography of low relief, ridges a few tens of feet in height may be formed mainly of boulders of gneissic rocks, many of

the boulders being ten to twenty feet across.

Recent features in the area include sand dunes along the Chibougamau river at and south of its junction with the Brock river. The dunes, occurring on the north bank of the river, are of the order of ten feet in height. The Chibougamau river has been developing meanders at several points by reworking the sand plain and esker deposits. Especially over the northern half of the area muskeg swamps up to two to three square miles in area, with numerous smaller ones, have developed.

An area of low relief, yet with relatively thin glacial deposits and resulting good exposure of bedrock, is that area south of a line from Julien to Porphyre lakes.

A detailed study of Pleistocene features on the aerial photographs was not made. Such a study to the east by Gillett (1962) covers an area with similar deposits.

STRUCTURAL GEOLOGY

Gillett (1962) describes the structure to the east of this area as a synclinorium with greywacke and conglomerate for the most part overlying an andesitic unit that is best developed to the south as the north-facing limb of the synclinorium. This andesite may reappear to the north, as thinner horizons interbedded with the metasediments, as the northern limb. Between these principal occurrences of andesite the conglomerate-greywacke unit forms several folds. The metamorphic grade increases to the north and gneiss makes up the northern third of his area. Gillett (1962) does not believe that this gneiss, the andesite and the sediments can be separated into stratigraphically distinct groups other than on a lithological basis.

The above interpretation, with reservations as to the multiple folding of the greywacke-conglomerate unit, is supported by the present report, with the following differences in the disposition of the rock types. Andesite, pre-Opemisca mafic volcanics, form a larger unit in the Lantagnac-La Touche area and the southward facing limb is the only limb represented in so far as stratigraphic tops could be determined. This limb becomes less prominent to the northeast, as is required by the mapping to the east. The conglomerate-greywacke unit is poorly exposed in this area but appears to thin rapidly to the southwest. Interdigitation of this unit with the volcanic unit is the simplest explanation for the outcrop disposition found, more so when the effects of the felsic stocks at Moraine and Eau Noire lakes are allowed for. Por-

phyritic, mafic volcanics lithologically distinct from the pre-Opemisca mafic volcanics occur in the southeast corner of the area, in apparent conformity with and interbedded with the sedimentary unit. The absence of stratigraphic top determinations in rocks of the Opemisca group makes tentative this interpretation of folding. There is some evidence that the felsic volcanic unit in the southwest corner differs in strike from the adjacent pillowed flows. The lack of an established horizon as a reference surface in the mafic volcanics - the basic flows with coarse phenocrysts may be such a horizon - precludes for the time being the acceptance of unconformity.

The metamorphic grade increases to the northwest, and the gneisses are divided into two units, both quartzofeldspathic; the more southern unit, the Central Gneiss, also including much dark gneiss that may be metamorphosed pre-Opemisca rocks. Finally, a syenodiorite, not demonstrated by contact relationships to be of magmatic origin, outcrops quasi-continuously through the gneisses across the northern half, and appears to underlie the western margin, of the area.

That the intrusion of the porphyroid granitic stock at Moraine lake has been accompanied by some deformation of pre-Opemisca rocks seems certain. The manner in which the metagabbro at Julien lake occupies the point of divergence of the strike of pre-Opemisca rocks is of interest. Lower pressure at this point may have been a factor in the emplacement of the metagabbro. However, while cross-cutting relationships were not observed, the Moraine Lake stock is probably younger. Frequent inclusions of mafic to metagabbroic rocks in the granite and the massive appearance



PLATE 24 - Folds in sedimentary rocks, Crinkle creek, looking 285° . The cross-schistosity strikes 40° and dips 70° N.

of dikes from the granite cutting foliated pre-Opemisca rocks indicate that stoping was active and that the volcanics were already deformed when intruded by the granite.

Shaw (1940) and Kindle (1942) indicate a fault striking northeast and passing near the junction of the Brock and Chibougamau rivers. This is supported by the strong schistosity and cross cleavage in the rocks along the Chibougamau river here suggesting strike faults. A branch of this fault probably runs along Crinkle creek where a similar schistosity was noted on the south shore, as was a drag fold 15 feet across, plunging 50 degrees along a bearing of north 10 degrees east and indicating right hand movement, plate 24. The north bank was not examined.

Shaw (1940) postulates a fault striking north of northeast, through the sandy region west of the Brock river, which projected southwesterly enters a region of northeasterly faulting indicated by Beach (1941). The only evidence seen in the field to support this was an outcrop of conglomerate $1\frac{1}{2}$ miles north of northwest from the junction of the Brock and Chibougamau rivers. This outcrop is strongly sheared and contorted with drag folds and cross cleavage indicating left hand movement. The schistosity has a northeasterly strike.

Other linear features in the area that may mark the trace of fault planes include a line from the northwest corner of Anomalie lake to little Eau Noire lake marked by intrusive breccia; the line of lakes and streams running east of northeast through Deux Granites Lake toward Dumas lake, or possibly to Poudingue lake as

the conglomerate here is sheared; and Pichamobi Arm of Lac la Trêve, which linear is accompanied by shearing in the felsic pre-Opemisca volcanic rocks and by the probable olivine gabbro dike which, from aeromagnetic map 549G, passes on through the west end of Porphyre lake. Drill hole 5 of Diomar Mining cut what is described as quartz diorite with magnetite, see Economic Geology.

A structural-petrological study of central importance for this area would be detailed work on the three felsic intrusions of Deux Granites, Moraine and Eau Noire lakes, and the basic to ultrabasic intrusions of Julien and Anomalie lakes, with their steeply dipping to overturned "wrappers" of meta-volcanics and meta-sedimentary rocks.

ECONOMIC GEOLOGY

Review of Mineral Exploration

Prospecting has been carried on in this area since at least the 1930's. An airborne magnetometer survey by the Federal government in 1957 revealed well defined patterns of magnetic susceptibility that renewed interest in mineral exploration. The following review of past work in the area is based on files in the Mineral Deposits Branch of the Department, to 1975, and on field work by the writer. These indicate showings of gold, copper, and nickel, which have been the main objects of exploration in this area. Cobalt and molybdenum are also reported, and there are interesting widths of massive pyrrhotite and pyrite, Very minor fluorite was found in drill core.

Most of the exploration has been along a wide band extending northeastward from Pichamobi Arm of La Trêve lake to Dumas

and Maybank lakes. Massive sulphides are generally closely related to the felsic volcanics at Pichamobi Arm but occur elsewhere. Carbonatized green rocks occurring with these sheared felsic rocks may be altered ultramafic sills. The area of pre-Opemisca rocks lying south of Thomelet lake and west of Keller lake, in the southwest corner of the area, appears to have received relatively little attention. It differs in character from the remaining area of pre-Opemisca rocks by the presence of numerous small silicic intrusions, a factor suggesting that this locality warrants closer prospecting. The higher ground here appears to be covered with only a thin layer of soil. Drilling indicates that the felsic volcanic rocks extend north-northeasterly toward Deux Granites lake, and they may merge with the Central Gneiss north of the stock here. This draws attention to the rusty weathering quartzo-feldspathic rocks of the Central Gneisses.

During the traversing, samples of stream sediment were taken from the banks of streams near the water's edge. A sampling density of one sample per square mile was sought. These samples were assayed for Cu, Pb, Zn, and Mo, and in some cases for Ni. The results are plotted on the map and the more anomalous values are mentioned below.

In the following summary, given alphabetically by company name, the numbers in brackets refer to numbered localities on the map. These numbers appear in numerical order in this section. Some drill holes are shown only on figures 1 to 4. In general the intersections given are totals for a given rock type, except for sections rich in sulphides where individual lengths are given.

TABLE 2 - TERRAINS MINIÉPS / MINING PROPERTIES

Terrain / Properties	Canton/Township	Quart/Quarter	Références/References
Arrow Inter-America	Lamarck	NE	GM 27537
Burrex Mines	Julien	centre	GM 3438-A
Canadian Nickel	Guettard	NE	GM 7337A
	Julien	SW,SE,NW	GM 67;147;148;151;157; 158
	Lantagnac	SE	GM 161;163;172;174
	La Touche	centre	GM 7337-B, 7337-C
Copper Prince Mines	La Touche	NE	GM 7702
Cross Canada Expl.	Julien	W	GM 5282
	Lantagnac	NE	GM 5282
Dadson Lake Chibougamau	Opemisca	NW	GM 4552
Diomar Mining Expl.	Guettard	NE	GM 5158;1849;2353
Flint Rock Mines	Lantagnac	SE	GM 27661
Fortunata Mines	Guettard	NE	GM 5367 A
Kenmac Chibougamau	Lamarck	N	GM 4958
Merrill Island Mining	Julien	NE	GM 22424;22485;22824
	Lamarck	NW	GM 16030
	La Touche	SW,NW	GM 22425;22522;22523; 22557
Mining Corporation	Julien	SW	GM 9006
McIntyre Porcupine	Julien	S	GM 11193
New York and Honduras	Guettard	NW	GM 7255, 7278
Sagamore Explorations	Julien	SW	GM 5625; 5626
Sevigny claims	Guettard	NE	GM 1374-B
Sporran Mines	Julien	SW	GM 7755;7859. 7858
	La Touche	NW	GM 7767; 7858
Talisman Mines	Guettard	N	GM 25798;26536
	Julien	W	GM 25798;26536
	Lamarck	N	GM 25798;26536
Tomiska Copper Mines	Lamarck	NW	GM 4881;7521-A; 7521-B

Arrow Inter-America Corporation explored in 1971 the quartz gabbro dike in northeastern Lamarck township, within and southwest of the present area by magnetometer, EM and geologic surveys. The best showing was one mile southwest of the present area and eight feet of mineralisation, of which 7 feet were in the gabbro, averaged 2% pyrite, pentlandite and chalcopyrite, the best 5 feet assaying 0.29% copper and 0.287% nickel. Seven trenches were dug along 1200 feet of the south contact. Five assays for gold and silver were not encouraging. (see Kenmac Chibougamau and Tomiska Copper).

Burrex Mines Limited. A company report (1955) is available on a claim group in central Julien township staked on the basis of a gossan zone on the east-west center line. No claims are now held there (1966).

Canadian Nickel Company Limited. The logs of 17 drill holes are summarized here.

Point (1) Lantagnac township; DDH 10276; 1957; bearing S80°W; inclined 45°; length 533 feet; casing 15 feet; graphitic tuff, 465 feet; tuff with pyrite and pyrrhotite bands, 42 feet.

(2) Lantagnac township; DDH 5979, 1957; bearing N48°W; inclined 45°; length 645 feet; casing 12 feet; andesite 540 feet; rhyolite 60 feet; graphitic tuff with pyrite and pyrrhotite, 30 feet; massive pyrite and pyrrhotite, 17 feet.

(3) Lantagnac township; DDH 10280; 1957; bearing N20°E; inclined 45°; length 658 feet; casing 52 feet; andesite, 200 feet; aplite 12 feet; graphitic tuff with pyrite bands, 20 feet; graphitic tuff, 151 feet.

(4) Lantagnac township; DDH 10249; 1957; bearing N10°E; inclined 45°; length 348 feet; casing 25 feet; andesite and graphitic tuff, 152 feet; graphite with stringers of pyrite and pyrrhotite, 19 feet; graphitic tuff, 152 feet.

(5) Julien township; DDH 13290; 1957; bearing S45°W; inclined 45°; length 470 feet; casing 29 feet; graywacke 20 feet; rhyolite 270 feet; chlorite and mica schist, 140 feet; massive pyrite and pyrrhotite 1.5 feet.

(6) Julien township; DDH 13292; 1957; bearing S45°W; inclined 45°; length 585 feet; casing 22 feet; garnetiferous sedimentaries, 122 feet; sheared tuff, 441 feet;

DDH 13295; 1957; bearing N45°E; inclined 50°; length 397 feet; casing, 23 feet; rhyolite 53 feet; tuff 155 feet; tuff with pyrrhotite stringers 76 feet; breccia with sulfides, 89 feet. This hole is 600 feet west of hole 13292.

(7) Julien township; DDH 13293; 1957; bearing N52°E; inclined 45°; length 475 feet; casing 79 feet; tuff 370 feet; breccia, 8 feet; scattered pyrite and pyrrhotite.

(8) Julien township; DDH 14801; 1957; bearing N10°W; inclined 50°; length 412 feet; casing 101 feet; andesite 150 feet; tuff breccia, 76 feet; tuff breccia with bands of pyrite and pyrrhotite, 14 feet; graphitic tuff, 70 feet.

(9) Julien township; DDH 13298; 1957; bearing N55°W; inclined 50°; length 398 feet; casing 14 feet; quartzite 368 feet; carbonate, 12 feet; massive pyrrhotite, 4 feet.

(10) Julien township; DDH 13283; 1957; bearing S25°E; inclined 50°; length 303 feet; water, 8 feet; casing, 43 feet;

quartz with pyrite and pyrrhotite, 12 feet, between gabbro, 90 feet, and greenstone agglomerate, 140 feet.

(11) Julien township; DDH 13280, 13280 A, and 13280 B; casings 89, 67, and 39 feet; abandoned.

(12) Julien township; DDH 13285; 1957; bearing S47° E; inclined 50°; length 335 feet; casing 34 feet; tuff 145 feet; graphitic tuff with pyrrhotite and pyrite, 54 feet; peridotite, 10 feet, with occasional chalcopyrite streaks through 5 feet; quartz diorite, 86 feet.

(13) Guettard township; DDH 10250; 1957; bearing N90° W; inclined 45°; length 370 feet; casing 8 feet; andesite 170 feet; graphite, 15 feet, with minor pyrite, pyrrhotite, and chalcopyrite; quartz breccia and carbonate, 5 feet, with minor pyrite, pyrrhotite, and chalcopyrite; tuff 170 feet.

(14) Latouche township; DDH 13296; 1957; bearing west; inclined 50°; length 404 feet; casing 23 feet; O.D. (? olivine diabase) 274 feet, minor pyrite and pyrrhotite; graphitic zone, 5 feet; andesite, 102 feet, with siliceous zones and minor pyrite and pyrrhotite.

(15) Latouche township; DDH 13297; 1957; bearing north; inclined 50°; length 500 feet; casing 22 feet; graywacke 322 feet at 45° to core; tuff 48 feet; graphitic tuff with bands of pyrite and pyrrhotite, 108 feet.

DDH 13299; 1957; bearing north; inclined 45°; length 462 feet; casing 30 feet; graywacke 345 feet at 45° to core; tuff with pyrite and pyrrhotite, 44 feet; graphitic tuff, 26 feet; tuff, 17 feet.

Copper Prince Mines Limited A company report (1958) on an electromagnetic survey in the northeast quarter of LaTouche township, mentions a few outcrops, just east of the present area, of quartz-biotite schistose slate and graphitic slate with minor pyrite and pyrrhotite.

Cross Canada Exploration Limited A company report (1957) gives the location of two claim groups in Julien and Lantagnac townships about Boucle lake and Petites Plages lake, and mentions a nickel - copper discovery made nearby by Trans Canada Explorers. No claims are now held in these localities (1966).

Dadson Lake Chibougamau Mines Ltd reports, 1958, on an area in northern Opemisca township, apparently about the gabbroic body, but gives no locations for indicated sulphides and anomalous zones of resistivity.

Diemar Mining Exploration Syndicate drilled 10 holes in the vicinity of Pichamobi Arm., Guettard township in 1956. Holes 5, 7 and 10 were located within the present map area, the remainder within half a mile of the south boundary of the area, figure 1.

ddh 5; bearing S55°E; dip 40°; casing 11 feet; length 396 feet; chloritized andesite going to 260 feet of quartz diorite with magnetite, to chloritized magnetite.

ddh 7; bearing S55°E; dip 40°; casing 7.5 feet; length 597 feet; chlorite schist with scattered pyrite, some silicification and carbonatization.

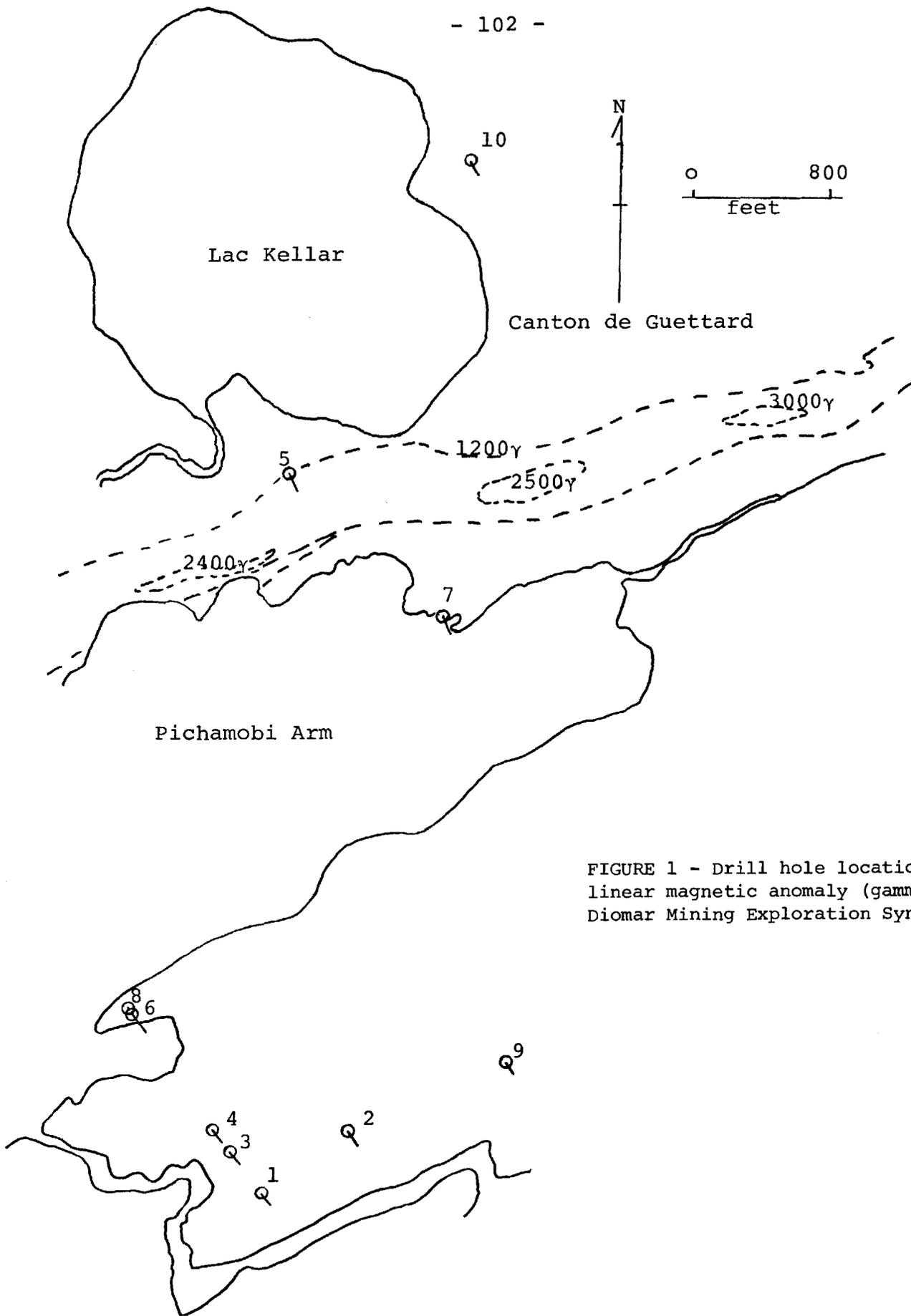


FIGURE 1 - Drill hole locations and linear magnetic anomaly (gammas). Diomar Mining Exploration Syndicate.

ddh 10; bearing S55°E, dip 45° to 32°; casing 32 feet; length 614 feet; chloritized and schistose andesite; pyrite scarce; locally strongly carbonatized.

The remainder of the holes cut rocks striking into the present area, including 450 feet of 50% pyrite-pyrrhotite (ddh 6), schistose chloritized graywacke and graphitic schist.

Flint Rock Mines Ltd in 1972 carried out a magnetometer and EM survey in southeast Lantagnac township, on the ultramafic-diabase contact area. The report mentions pyrite, chalcopyrite, and nickeliferous pyrrhotite on claims 314872-3 and 314881-3 at the east contact of a diabase dike with gabbro. A composite sample averaged 0.46% copper 0.25% nickel and 0.002 oz. per ton of platinum.

Three anomalous areas of magnetic susceptibility are suggested as drill targets near the showing. No anomalies were revealed by the electromagnetic survey. During traversing the writer noted a few grains of chalcopyrite in a coarse-grained gabbro stringer, trenched and drilled, point (16), near a diabase - ultrabasic contact.

Fortunata Mines Limited Claims held by this company in the northeast corner of Guettard township included a quartz vein discovered and trenched over about 1,500 feet by Prospectors Airways in 1936. A geologic report was made for Central Chibougamau Mines Limited in 1952, and a report was made in 1953 to Brunswick Quebec Development Limited of further stripping and sampling. The latter report gives the assays of six samples from quartz veins (\$3.46 to \$24.25 in

gold, widths not stated), both the quartz and the wall rock carrying the gold. Reference is also made to a wide, carbonated shear zone 1000 feet to the southeast in porphyritic andesite.

A visit to a vein in this area (17) revealed that many drill holes were put down along the trenched vein and nearby, much of the core being on the property. The vein as now exposed is trenched continuously for about 300 feet. It occurs at the northern contact of a thoroughly altered dike, possibly metadiorite, striking N35°E and cutting steeply dipping pillow lava striking N75°E. The quartz vein averages 2 to 3 feet wide, but is split into several irregularly parallel parts across a width of about 5 feet, the parts being separated by dike and possibly by sheared volcanic rock. The quartz is white to gray with irregularly distributed pyrite. The southern contact of the metadiorite dike was not exposed.

Claims presently held by Fortunata Mines Limited are:

Certificate 88734	claims 2, 3, and 4
Certificate 88735	claims 2, 3, and 4
Certificate 88736	claims 2, 3, and 4

These claims were held by the Maxwell-Angus-Kellar group in 1946. Other claims are held by individuals.

A geologic compilation map (1946) outlining prospecting in the "Lac La Trêve Mining Area", including the southwestern corner of the present map-area (mainly in Guettard township), indicates some zones of sulfides, gossans, and quartz veins.

(1957) shows the location of this company's claims, now abandoned, staked to cover part of the quartz gabbro dike in Lamarck township, and the location of other companies' showings along the dike, including those on the Latulippe claims, one of which lies within the present area. This last showing may be near (18) which lies on the Latulippe claims and where, in traversing, a few grains of chalcopyrite, pyrite, and pyrrhotite were seen in a dark phase at the south contact of the dike.

Merrill Island Mining Corp. Ltd did exploration in LaTouche, Julien, and Lamarck townships.

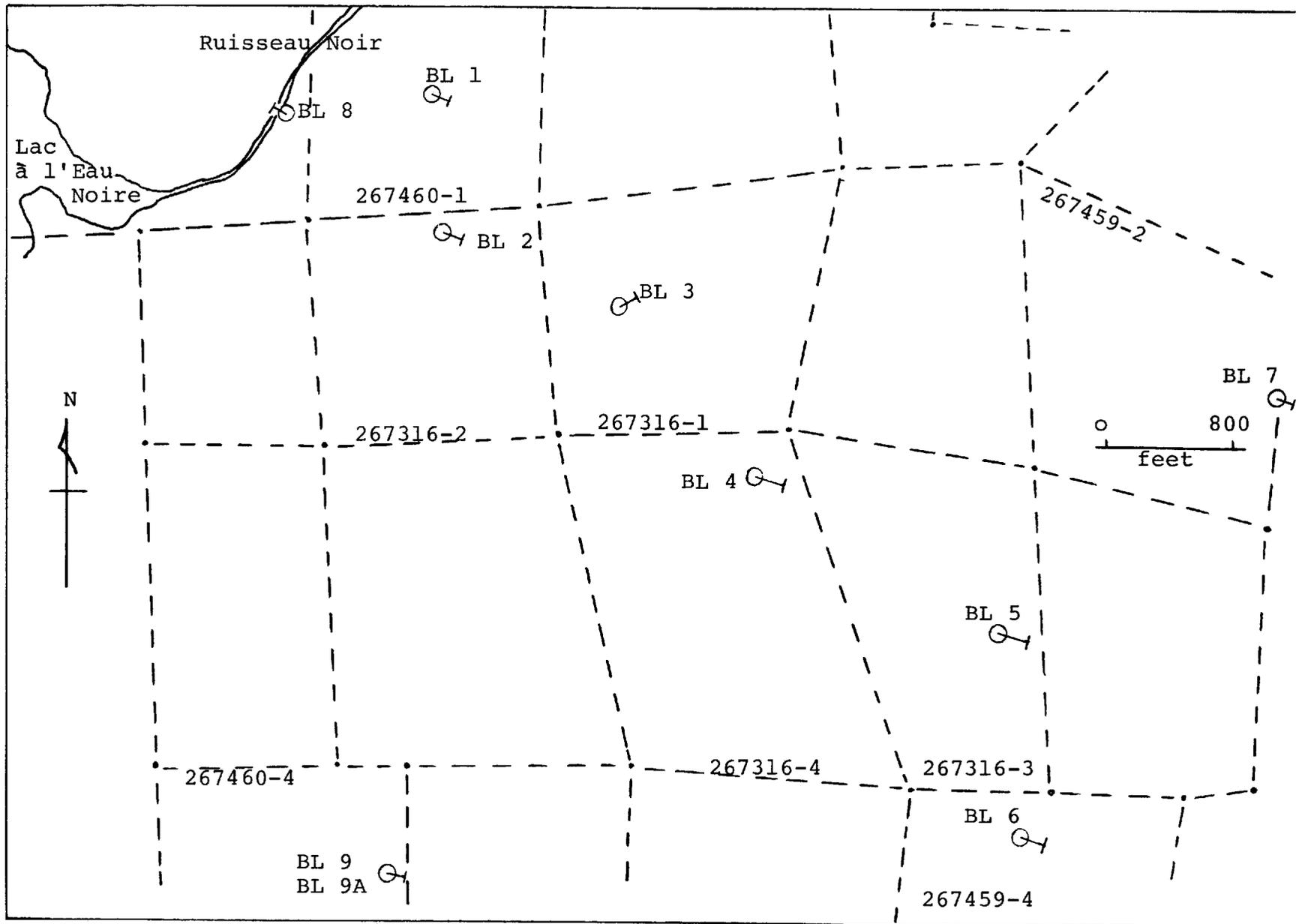
In LaTouche township at the east end of Eau Noire lake data is available for magnetometer and EM 16 surveys done in 1968, indicating 28 conductors to 6000 feet long with a northeasterly trend. The geophysical plan also shows the location of 2 drill holes of Icon Syndicate and one of Patino Mining Corp. Eleven holes were drilled in 1968 and are shown in figure 2. Hole BL 10 was to the north-northeast, 2.5 miles, point (19).

ddh BL 1; bearing $S70^{\circ}E$; dip 45° ; casing 35.4 feet; length 201 feet; diorite, hornblende granite, and granitized gabbro in alternation. 4 to 6% pyrite, some pyrrhotite and magnetite, occasional stringer of sulphide.

ddh BL 2; bearing $S70^{\circ}E$; dip 45° ; casing 54 feet; length 216 feet; diorite-metadiorite; granite dikes; to 6% disseminated pyrite and pyrrhotite for 40 feet, in metadiorite.

ddh BL 3; bearing $N66^{\circ}E$, dip 45° ; casing 10 feet; length 202 feet; gabbro, fine grained, to 15% pyrrhotite stringers for 4.2 feet (0.15% Cu, nil Ni), 25% pyrrhotite for 3.1 feet (0.10

FIGURE 2 - Drill hole locations, Merrill Island Mining Corp. Ltd. LaTouche Township.



% Cu, Tr. Ni).

ddh BL 4; bearing S70°E; dip 45°; casing 3 feet; length 297'; gabbro, garnetiferous in part; variable pyrrhotite mineralization as stringers and disseminations (0.15% Cu for 1.5 feet).

ddh BL 5; bearing S70°E; dip 45°; casing 9 feet; length 201 feet; graphitic schist and shale, to 10% pyrrhotite as stringers and disseminations; 4 feet of feldspathic sediments, minor pyrite and pyrrhotite. Trace Cu and Ni.

ddh BL 6; bearing S70°E; dip 50°; casing 46.5 feet; length 222 feet; sediments, variable amounts of graphite (to 70% graphitic sections over 80 feet), calcite stringers, to 3% pyrite. No assays.

ddh BL 7; bearing S70°E, dip 60°; casing 11 feet; length 301 feet; sediments, some graphite, to 4% pyrite, some pyrrhotite, some graywacke. 0.10% Cu for 5.6 feet with 5% pyrite.

ddh BL 8; bearing N70°W; dip 55°, casing 28.5 feet; length 149 feet; red granite gneiss, 5-40% hornblende, minor pyrite. No assays.

ddh BL 9; bearing S70°E, dip 45°; casing 9.2 feet; length 72.5 feet; sediments; some graphitic; 10% pyrrhotite and pyrite, blobs and stringers.

ddh BL 9A; bearing S70°E, dip 45°; 2 feet west of BL9; casing 8 feet; length 200 feet. To 158 feet sediments as above, to 20% pyrrhotite and pyrite over short (2-3 feet) lengths. To diorite, fine grained, some garnet, some pyrrhotite and pyrite.

In these 10 holes the best assay for silver was 0.24 oz/

ton, for gold 0.01 oz/ton.

Point (19); ddh BL 10; bearing north; dip 45° ; casing 22 feet; length 432 feet; mostly graywacke with some fine pyrite; to 20% pyrite and pyrrhotite for 3 feet, 43 feet of graphitic schist, 28 feet of gabbro.

In northeast Julien township EM 16 and magnetometer surveys, 1968, resulted in seventeen conductive zones, ten said to be along the gneiss-volcanic rock contact. Trenching yielded minor sulphides.

In western Lamarck township along Dempster creek CEM and magnetometer surveys indicated one weak electromagnetic anomaly, 1965.

Mining Corporation of Canada Limited drilled the following 2 holes; Point (20) Julien township; DDH JU-1-1; 1959; bearing $N25^{\circ}E$; inclined 51° ; length 464 feet; casing 29 feet; siliceous and chloritized andesite and tuff, garnetiferous, with minor pyrite and pyrrhotite and with three sections of 77, 3, and 17 feet with, respectively, 10-65%, 50%, and to 65% pyrite and pyrrhotite. Assay values for Au, Cu, and Ni were nil.

(21) Julien township; DDH JU-1-2; 1959; bearing $N41^{\circ}E$; inclined 51° ; length 400 feet; casing 35 feet; andesite and tuff, chloritized and in part silicified and carbonatized, with scattered pyrite and pyrrhotite, 181 feet; andesite tuff, to 60% pyrite and pyrrhotite, 46 feet; graphitic tuff, minor sulfides, 11 feet; rhyolite, quartz eyes, 120 feet. Assay values for Au, Cu

and Ni were nil.

McIntyre Porcupine Mines Limited drilled the following 2 holes. Point (22) Julien township; 1961; DDH 158-S-1; bearing north; inclined 45° ; length 252 feet; casing, 9 feet; andesite, minor quartz, calcite, pyrite, and pyrrhotite, 95 feet; sericite-talc schist, 5 feet, with to 20% pyrrhotite, minor chalcopryite; graphitic schist, 29 feet, with sulfides to 40%, and two sections of massive sulfides of 4 and 5 feet; quartz-sericite schist, 2 feet; chlorite schist, 51 feet, with pyrite and pyrrhotite to 20%, minor chalcopryite at one point; tuff, 28 feet, pyrite and pyrrhotite, scattered chalcopryite; fine-grained diorite, 29 feet, at end of hole.

DDH 158-S-2; 990 feet west of the above; bearing north, inclined 45° , length 296 feet; casing 8 feet; andesite-basalt, 249 feet, with quartz and carbonate stringers, minor pyrite and pyrrhotite; brecciated basalt, 40 feet, with sulfides to 50%, including minor chalcopryite, in a quartz-chlorite-sulfide matrix; felsite, dark gray to dark brown, in ten sections, 37 feet; quartz-talc, 7 feet, with sulfides 50%; the hole ending in massive andesite or possibly fine-grained diorite.

The core for these holes is stacked nearby.

New York and Honduras Rosario Mining Company. Company reports on prospecting, a magnetometer and electromagnetic survey (1957) and on three diamond drill holes (1958) in the northwest corner of Guettard township are available.

Two main sulfide showings are described. One, at least 100 feet wide and 500 feet long, shows pyrite, pyrrhotite, and small amounts of chalcopyrite in sheared, silicified, volcanic rock. The second is an exposure 30 by 30 feet of coarse-grained gabbro cut by two shears with small masses and disseminated grains of pyrrhotite and pyrite, the pyrrhotite being at least partly nickeliferous. Other occurrences of sulfides are mentioned. In the course of traversing, two drill holes with the core stacked nearby were found. The writer noted minor fluorite in a thin section from a piece of this core. These are probably holes 1 and 2, indicated as being about 500 feet northwest of the first showing and about 2,000 feet west northwest from the third hole. A summary of the drill logs follows.

Point (23) D.D.H. 1: bearing $N30^{\circ}E$; inclination 45° ; length 356 feet; 290 feet of intermediate volcanics with scattered pyrite and pyrrhotite; 62 feet of silicic to intermediate dikes in eleven sections.

(23) D.D.H. 2: bearing $S45^{\circ}E$; inclination 45° ; length 357 feet; 4 feet casing; 262 feet of intermediate volcanics with three sections, 22', 21', 18', carrying 5-10%, 2-3%, and 10% respectively of sulfides, mainly pyrrhotite; 83 feet of silicic to intermediate dikes in four sections.

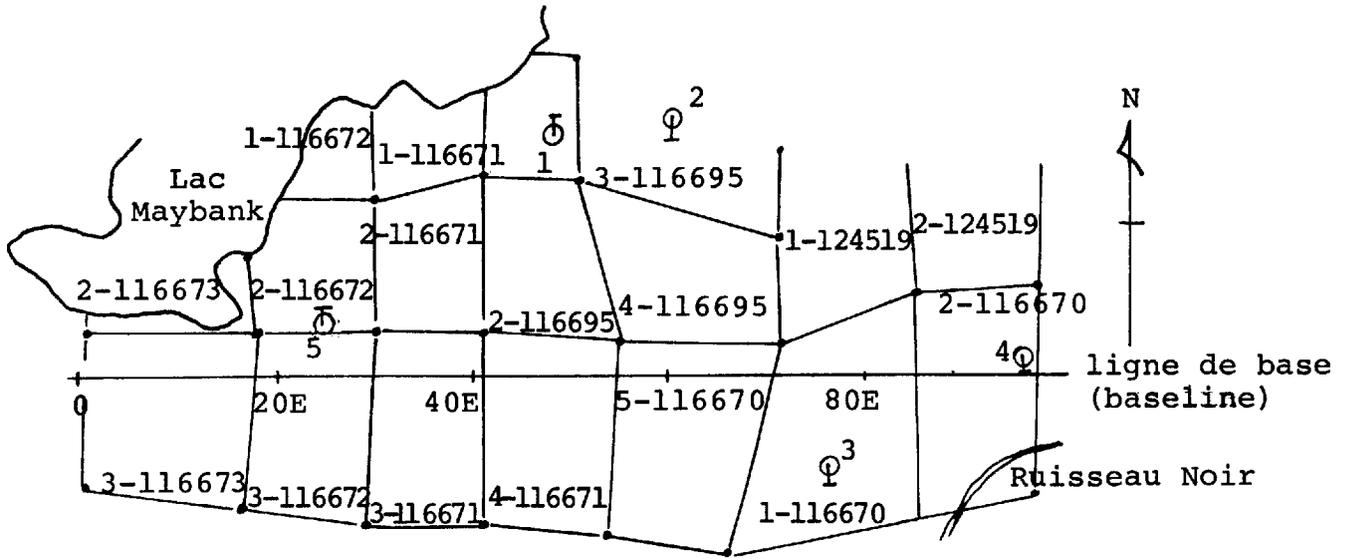
D.D.H. 3; bearing $S50^{\circ}E$; inclination 45° ; length 312 feet; casing 4 feet; 226 feet of intermediate volcanics with two sections, 9 and 30 feet, of 10% and 5% sulfides respectively; 26 feet of pyroxenite with pale inclusions; 3 feet of pyroxenite with 2% pyrrhotite; 45 feet of quartz-feldspar porphyry.

Sagamore Explorations Limited. Available are two company reports (1957) on electromagnetic surveys in Julien township near the east end of Icon lake. Mention is made of previous drilling along the probable extension of some of the anomalies yielding graphitic slates and minor sulfides. During traversing a diamond drill hole probably drilled by Canadian Nickel Company was found, point (8), and roads indicate that several holes have been drilled nearby. No claims are now held here (1966).

Sevigny Claims One drill hole log is available and is summarized here. Point (24); Guettard township; the hole is probably south somewhat of this location, on claim 4, certificate 45236, since abandoned, the ground now being held by individuals; drilled in 1951; bearing S22°E; inclination 75°; length 1005 feet; 360 feet of conglomerate and silicic sediments with 210 feet carrying 10-60% sulfides; 15 feet of quartz diorite; 540 feet of graywacke; 20 feet of slate.

Sporran Mines Limited An electromagnetic survey in west-central LaTouche township, in 1957, outlined 19 conductors striking east-west, apparently near vertical, 400 to 4600 feet in length and 50 to 75 feet in width. A report on drilling, 1958, and the logs of nine holes indicate that six holes cut sulphides, three cut graphite without sulphides. The best intersection was in hole 9, 42 feet of 30% sulphides. Twenty-three samples gave only traces of gold, copper and nickel. The location of these holes is shown on figure 3a and 3b.

ddh 1; bearing 0°, dip 50°, casing 10 feet, length 351



0 2000
pieds (feet)

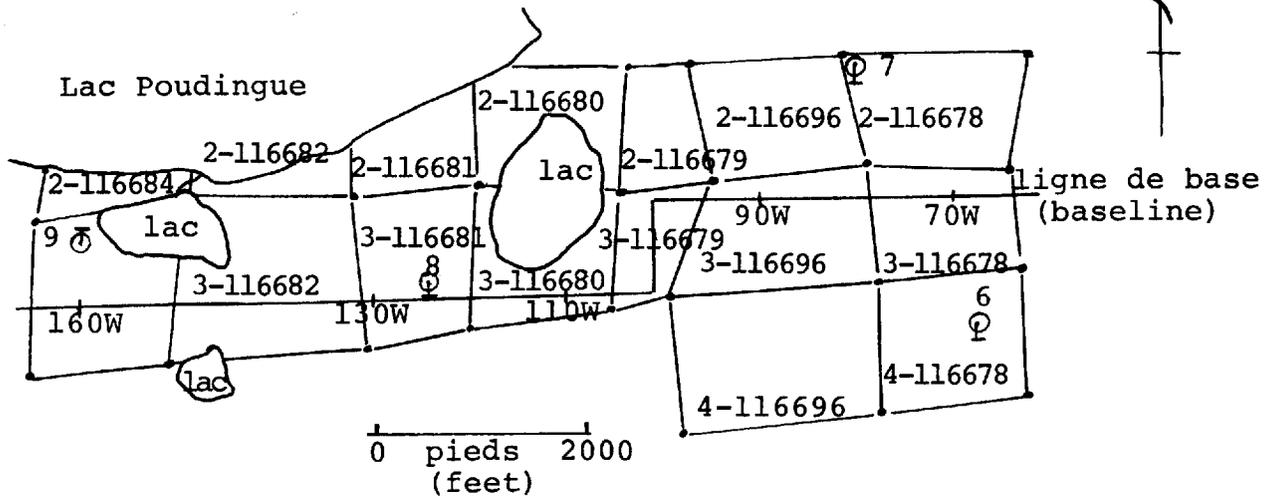


FIGURE 3 A et B - Sporrán Mines Ltd. Drill hole locations, LaTouche township.

feet; gabbro, 205 feet; andesite, 70 feet; chlorite schist, 43 feet with minor massive pyrrhotite; pyrrhotite, 40% at 294 to 302; quartz diorite, 15 feet at the end of the hole.

ddh 2; bearing 180° , dip 50° , length 350 feet, casing 23.4 feet; andesite, 322 feet, with pyrrhotite and magnetite locally; to 20% for 2.5 feet, epidotized; gabbro, 1 foot:

ddh 3; bearing 180° , dip 50° , length 281.5 feet, casing 39 feet; diorite, 164 feet; graphitic schist, 49 feet, to 5% pyrrhotite-pyrite over short sections; hole ends in graywacke, 30 feet, some graphite.

ddh 4; bearing 180° , dip 50° , length 250 feet, casing 45 feet; gabbro, 53 feet; slate, 20 feet; graywacke, 92 feet; graphitic schist, 5 feet; quartz diorite, 27 feet.

ddh 5; bearing 0° , dip 50° , length 285 feet, casing 29 feet; graywacke, 110 feet; volcanics, 27 feet; graphitic schist, 112 feet, minor pyrite and pyrrhotite; slate, 7 feet, to 3% pyrrhotite.

ddh 6; bearing 180° , dip 50° , length 299 feet; casing 16 feet; graywacke, pyrrhotite veinlets to 0.3 feet locally, 2.3 feet of 70% pyrite, minor graphite.

ddh 7; bearing 180° , dip 50° , length 239 feet, casing, 32 feet; graywacke with narrow siliceous to basic dikes, graphitic from 175 to 227 feet, very fine pyrite throughout.

ddh 8; bearing 180° , dip 50° , length 241 feet, casing 25 feet; gabbro, cut by several siliceous to basic narrow dikes, minor sulphides throughout.

ddh 9; bearing 180° , dip 50° , length 221 feet, casing 8

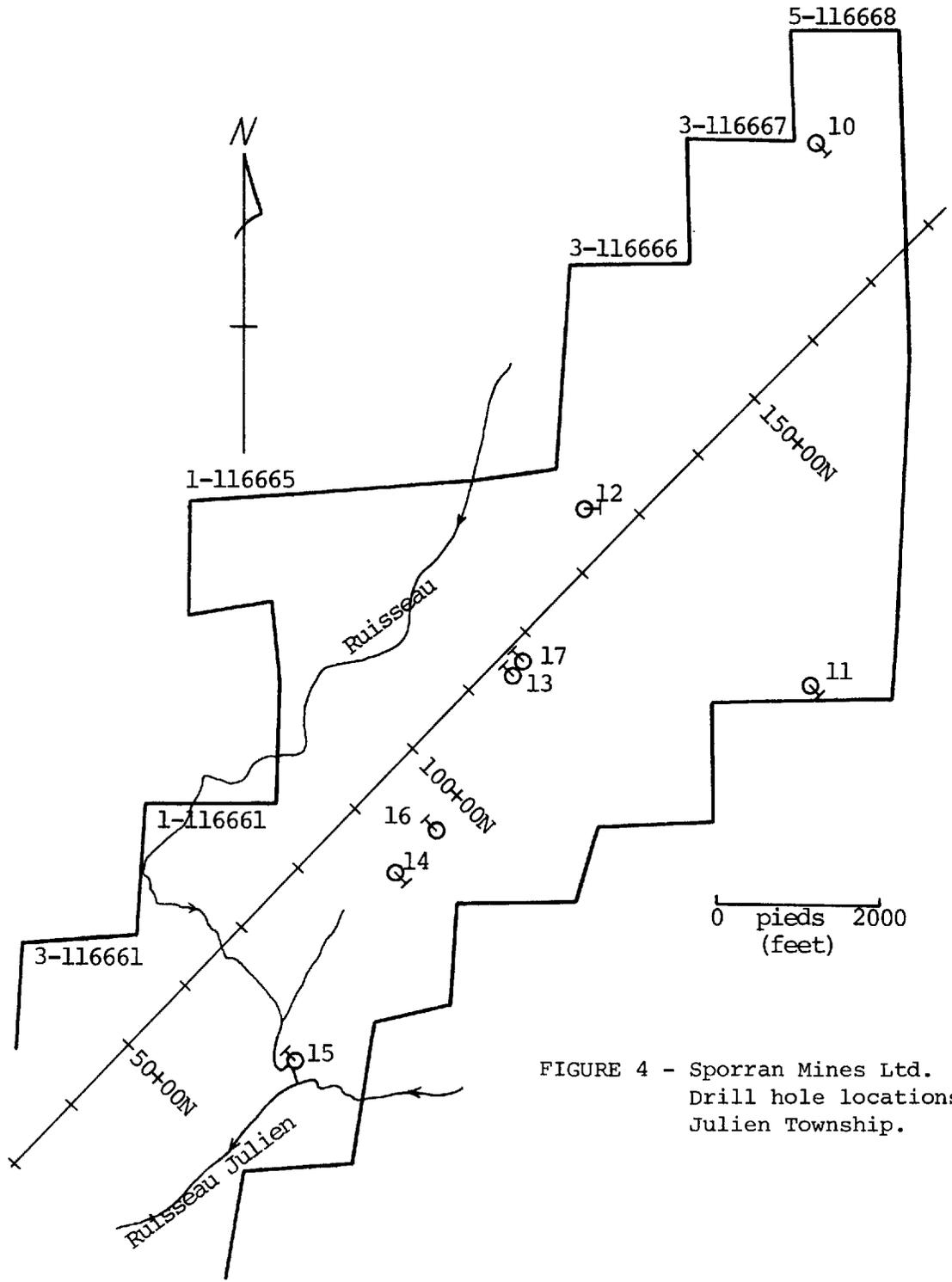


FIGURE 4 - Sporrán Mines Ltd.
Drill hole locations,
Julien Township.

feet; gabbro, 98 feet; graywacke, 51 feet, from 71.5 to 106.4 with 15 to 80% pyrrhotite; graphitic schist, 64 feet.

A pile of core at (25) on the south shore of Maybank lake, consists of black schist and altered mafic rocks, in part with pyrite.

In the southwest quarter of Julien township this company drilled 8 holes to test six electromagnetic conductors to 14,000 feet in length near and northeast of (26). The locations of the drill holes are shown on figure 4. Holes 13 and 17 cut massive pyrite and pyrrhotite about 65 feet wide and dipping 75° to the southeast. Thirty samples gave only traces of gold, copper and nickel.

ddh 10; bearing 180° , dip 50° , casing 26 feet, length 228 feet; mainly andesite; pyrrhotite to 20% and 25% for 1.1 and 4.4 feet, elsewhere irregular, to 5% for less than one foot; graphitic schist, 12.7 feet, 5% pyrrhotite.

ddh 11; bearing 135° , dip 50° , casing 30 feet; length 262 feet; mainly andesite, three graphitic sections, 3, 2, and 3.3 feet in length, with to 10% of pyrrhotite.

ddh 12; bearing 270° , dip 50° , casing to 56 feet; hole abandoned. (bearing on plan is shown as east).

ddh 13; bearing 270° (shown as 315° on plan), dip 60° , length 291 feet, casing 85.4 feet; core begins in 60% of pyrite and pyrrhotite and averages better than 60% sulphides to 192.6 feet, the non-sulphide material not being described in general; volcanic and siliceous sections are mentioned; to 291 mainly agglomerate, pebble-like fragments in breccia ground mass, best sulphides

10% for 6 feet, mainly pyrrhotite.

ddh 14; bearing 135° , dip 50° , casing 50.8 feet; length 316 feet; intermediate volcanics with local foliation, local pyrrhotite; quartz porphyry, 35 and 16 feet in length; from 239 feet shearing common, (sericitic to graphitic sections to 8 feet, to 10% pyrrhotite).

ddh 15; bearing 270° (shown as 315° on plan), dip 60° , casing 41 feet, length 343 feet; intermediate volcanic rock (? flow), 130 feet; agglomerate, 44' sheared, some sulphide fragments, 15% pyrite and pyrrhotite for 2.5 feet; graphitic schist, 9, 36, and 10 feet, variable pyrite and pyrrhotite, best section 15% pyrrhotite for 4 feet; quartz porphyry, 80 feet, fine to medium grained. Shearing at $30 - 40^{\circ}$ to core axis.

ddh 16; bearing 270° (315° on the plan), dip 60° , casing, 55 feet; end of hole at 375 feet; intermediate volcanics, some shearing, pyrite and graphite; going to quartz porphyry, 10 feet with interlayered 2 feet of massive sulphide, mainly pyrite; to feldspar porphyry for 19 feet; to shear zone at 70° to core axis for 36 feet with 19 feet bearing graphite and pyrite including 8 inches of 50% pyrite and pyrrhotite; to 96 feet of graywacke, minor sulphides and magnetite; to 33 feet of rhyolite; to 3 feet of agglomerate; to 4 feet of pyrite and pyrrhotite to 70%; to 29 feet of agglomerate (4 inches of quartz and tourmaline).

ddh 17; bearing 270° (315° on the plan), dip 70° , casing 112 feet; end of hole at 446 feet; to 170.4 feet mixed intermediate to acid volcanics (? flow) and tuff with some graphite;

170.4 to 266.0 siliceous matrix with 20 to 60% pyrite and pyrrhotite, low sulphides in chert at 176 to 187 and 212.5 to 225.5, and quartz porphyry at 202.4 to 206.8; agglomerate and some sulphides, 266 to 337.5 (15% sulphides at 266 to 275); 337.5 to 436.5 dark volcanic going to agglomerate; 436.8 to 446.0, rhyolite, gray.

Talisman Mines Ltd covered parts of Julien, Lamarck and Guettard township with airborne magnetometer and Mark V Input Surveys in 1970. The Input anomalies have been plotted optically on figure 5, using the geology of this report as base, and omitting 1 channel and flanking magnetic correlation.

Tomiska Copper Mines Limited. This company had two showings on the previously described quartz gabbro dike just south of the Lantagnac Latouche area in the northwest quarter of Lamarck township on ground now held by individuals. Available is a company report (1956) on an electrical resistivity and magnetometer survey, and a company report (1957) on prospecting, trenching, and six packsack drill holes. Both showings are on the southern contact of the dike. One is mineralized over a width of 12 feet with pyrrhotite, chalcopyrite, pentlandite, and a cobalt mineral in scattered blebs and disseminated grains, a chip sample giving 0.73% Ni, 0.65% Cu, and 0.20% Co. The second, 950 feet to the west, was exposed over a width of 6 feet with similar mineralization. The drill holes indicate a width of about 10 feet to a depth of 75 feet down the dip, with values of 0.35 - 0.75% Ni and 0.20 - 0.90% Cu; no cobalt was reported. Mention is made of discoveries in 1956 on this

dike to the east and west (see Arrow Inter-America and Kenmac Chibougamau).

Additional Indications of Mineralisation

The following were noted during the traverses. Point (27); a rusty weathering outcrop. 10 by 30 feet, of mafic gneiss; bands of hornblende with 10% garnet; amphibolite with 15% pyrite. An assay gave a trace of gold. Northern Lantagnac township.

(28); a small outcrop of black schist rich in narrow streaks of pyrite, 5000 feet southeast of Deux Granites lake.

(29); a small outcrop of black, silicified schist rich in narrow streaks of pyrite. In creek north of Bluets lake.

(30): pyritiferous black schist with numerous pyrite spheres up to $\frac{1}{2}$ inch diameter, 5000 feet northeast of Deux Granites lake.

(31); a few grains of chalcopyrite in chloritized and silicified metagabbroic rocks, associated with aplite west of Petit Noir lake.

(32); a few grains of chalcopyrite and molybdenite with pyrrhotite in sheared, siliceous, fine-grained, dark rocks cut by aplite; previously trenched, Noir creek, west portion.

(33); a boulder of epidotized melasyenite carrying several, $\frac{1}{2}$ inch, short stringers of chalcopyrite apparently as fracture fillings, north of Eau Noire lake.

(34); a few grains of chalcopyrite in a carbonatized chlorite schist, on the Chibougamau river.

(35); a few grains of chalcopyrite in white quartz stringers in a sheared, andesitic hornblende-porphyr, south of the Chibougamau river.

(36); massive pyrrhotite with disseminated, very fine-grained chalcopyrite in a trenched showing 5-10 feet wide in siliceous, dark, fine-grained rock, 6000 feet east of Anomaly lake.

(37); drill core, on the drill site, with massive pyrite and pyrrhotite and black schist. The 500 feet of hole ended in 25 feet of dark, feldspar porphyry with coarse phenocrysts and some pyrite; apparently a dike. In northeast Lamarck township.

(38); float beside a trench in overburden on the east shore of Julien lake. Several quartzose boulders one foot across with massive pyrrhotite and streaks of chalcopyrite. Two samples assayed traces of gold, copper, and nickel.

(39); a small pond and lake the bottoms of which are covered by $\frac{1}{2}$ inch of limonite, in west Livillier township.

(40); a small stream draining muskeg with similar limonite deposits, in southeastern corner of Turgis township, northwest of the same esker.

(41); a few grains of chalcopyrite in pale, coarse-grained gabbro, south of the Chibougamau river.

(42); silicified, pyrite-bearing, sheared, fine-grained pre-Opemisca lava cut by white quartz veins and some brown carbonate stringers. Trenched and blasted. A sample assayed a trace of gold. In northeastern Lamarck township.

(43); a few grains of chalcopyrite associated with a small stringer of bluish quartz in a fine-grained metagabbro, between Petites Plages and Icon lakes.

(44); a stream sediment sample with high values in molybdenum, lead, and zinc, northwest of Petite Eau Noire lake.

(45); a thin gossan over a band of massive, pyritiferous gray quartz, partly brecciated, with lesser amounts of siliceous black schist, apparently conformable with the Central Gneiss and exposed over a width of 50 feet and a length of 100 to 200 feet, 3,500 feet northeast of Petites Plages lake.

(46); a calcite bleb one inch across with fine-grained chalcopyrite, in mafic pre-Opemisca flows giving a strong reaction to HCl on the west shore of the first lake south of Thomelet lake.

(47); a hand specimen from an outcrop described as 200 feet wide and giving a strong compass deflection is a serpentinite with 15 to 20% of opaque black metallics, 6000 feet east southeast from Anomalie lake.

(48); minor chalcopyrite in a melanocratic fine-grained schist that is 80% amphibole with 5-10% pyrrhotite and black metallic minerals, on hill west of Bluets lake.

(49); stream sediment sample giving a high value in zinc, south of Ruth lake, Lantagnac twp.

(50); as for (48), east of Boucle lake.

(51); as for (48), northeast 7,500 feet from Pichamobi Arm.

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