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CAPISISIT LAKE AREA, ABITIBI-EAST COUNTY

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GEOLOGICAL REPORT 48

CAPISISIT LAKE AREA

ABITIBI-EAST COUNTY

by

J.-E. Gilbert

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CAPISISIT LAKE AREA

Abitibi-East County

by J.E. Gilbert

INTRODUCTION

Location and General Statement

The Capisisit Lake area is about 110 miles north-northeast of Senneterre, Abitibi-East county, one of the principal towns on the Canadian National Railways' line from Quebec to Cochrane. It extends from 49°45' to 50°00' North latitude, and from 76°00' to 76°15' West longitude, an area of about 200 square miles, and includes most of Montalembert and Davost townships with small parts of La Rouvillière and Monseignat townships to the west.

The area was mapped in the summer of 1947 as part of an extensive programme being carried out by the Geological Surveys Branch of the Quebec Department of Mines in the Waswanipi region of Northern Quebec. Discoveries of gold and sulphide mineralization in the Bachelor Lake area (16)* immediately to the south gave a particular interest to the present area which, at the time of this investigation, had been but little prospected.

A preliminary report (10), accompanied by a map on a scale of two miles to one inch, giving the main results of the work, was published in the fall of 1947.

Means of Access and Conditions of Travel

The area is most readily accessible by air from bases at Senneterre, Amos, or Rouyn. Under normal flying conditions, Capisisit and McDonald lakes can be reached from Senneterre in slightly more than one hour. Landings can be made on either of these lakes, as well as on Maicasagi river, in its lower course near the western boundary of the map-area (Plate I). The air route is by far the simplest, and probably the cheapest, way of reaching the area.

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*Numbers within brackets refer to Bibliography at end of report.

The principal canoe route is from Senneterre northward down Bell river to Mattagami lake, thence eastward up Waswanipi river, through Olga and Goéland lakes, and finally through Maicasagi lake and up Maicasagi river for about thirteen miles to the mouth of Inconnu river, about one mile west of the western limit of the map-area.

From the junction of Inconnu and Maicasagi rivers, the northernmost section of the area is accessible by ascending Maicasagi river, which flows in a westerly direction across most of the area close to its northern boundary. This section of Maicasagi river is a wide and easily navigable waterway, except for a mile and a half stretch near the middle of its course across the area, where its even flow is interrupted by a series of flat rapids (Plates IV and V).

The best route to the central portion of the area is up Inconnu river from its junction with the Maicasagi and across Capisisit lake toward Inconnu lake (east of the present area). For the first ten miles of this route there are only two major rapids along the Inconnu, but farther upstream, and especially along the stretch between Capisisit lake and the western boundary of the area, numerous rapids are encountered and travelling is difficult. All the old portages along the river were cleaned out by the writer's party during the summer of 1947, and some new ones were cut.

McDonald lake, a mile and one-third north of Capisisit lake, empties northward into Maicasagi river through McDonald creek, a small and shallow stream with numerous rapids, especially along the lower part of its course. It is not possible to use an outboard motor along most of its length. A well-cut portage leads from Capisisit lake to McDonald lake.

The southernmost part of the area can be reached by canoe only in periods of high water. The southeastern corner is accessible from a small northward-flowing creek half a mile east of the eastern boundary of the map-area. Access to the southwestern and south-central sections is given by the long stream that drains the country between the southeast corner of the area and a point on Inconnu river a short distance outside its western boundary. This is a muddy, meandering, shallow stream that can be ascended at low water to about its third main fork in the south-central part of the area, two and a third miles north of the southern boundary.

Two east-west surveyed lines have been cut in the area. One of these, the township line just north of Capisisit lake, is in rather poor condition and, in places, difficult to follow. The other, the centre-line of Montalembert and La Rouvillière townships, is five miles to the south; it was cut during the fall of 1947 and provides a good base-line for work in this section of the area. To facilitate work in the south-central part of the area, the writer's party blazed a line, approximately north-south, for a distance of a mile and a half. These three lines, and the main trails and portages, are shown on the accompanying map.

Cross-country travel is, in general, fairly easy, except through occasional small patches where the underbrush is thick and windfalls are abundant.

Field-Work and Acknowledgments

All rock outcrops along the navigable lakes and streams were examined and pace-and-compass traverses, spaced about half a mile apart, were run systematically, mostly in a north-south direction, so as to cross the structural trend of the rock formations, which is predominantly east-west. Extensive use was made of vertical aerial photographs furnished through the Department of Mines and Technical Surveys, Ottawa. Most of the rock exposures visited were plotted on the aerial photographs and from these their positions were plotted directly on the base-map at the time the latter was compiled by the Quebec Department of Lands and Forests, in the fall of 1947. This method ensures a high degree of accurary in the final map. The writer wishes to convey his appreciation to Mr. G. Barrette of the last-named Department, under whose supervision the plotting was done.

The writer wishes, also, to express his indebtedness to Dr. Jacques Claveau, then a member of the permanent staff of the Geological Surveys Branch in Quebec, who spent six weeks in the field with him and helped him both in the planning and the execution of the field-work.

Ian Bain of the University of Toronto acted as senior assistant, and Walter Faessler of Laval University and Bruce Lyall of McGill proved to be very able junior students. Carl Faessler, Jr., as cook, and Aimé Imbeault and Rosaire Bordeleau, as canoemen, performed their duties in a very satisfactory manner.

This report was written at McGill University and the writer is indebted to the staff of the Department of Geological Sciences for their kind assistance. The petrographical work was done under the direction of Dr. F. Fitz Osborne of Laval University.

A small transmitter-receiver short-wave radio set was found very useful as a means of communication with outside points and with other parties in the region.

Previous Work and Related Publications

Although reconnaissance surveys by several investigators have included the area described in this report, no detailed systematic geological mapping had been done prior to 1947. Robert Bell, of the Geological Survey of Canada, made a reconnaissance survey along the main water routes of the Waswanipi region in 1895 and 1896 (2). His report makes little mention of the geological features of the present map-area, but his map, published in 1903 (3), indicates that he may have visited at least the northeastern section. Parts of Maicasagi and Inconnu rivers are included in the area mapped by J.A. Bancroft in 1912 (1). All the geological information gathered prior to 1927 in the Nottaway River basin was compiled by H.C. Cooke and shown on his map published in that year (6). A.H. Lang (15) visited the Waswanipi Lake area in the summer of 1931, during which "the shores of all lakes and streams navigable by canoe were examined in so far as time permitted" (p.36D), but no information on the geology of the Capisisit Lake area is given in his report. The report by G.W.H. Norman in 1936 (17) was the first to discuss the broader aspects of the geology of the area. J.C. Sproule (20), in 1936, did further work and produced a map on which the distribution of some of the acidic intrusives and intruded greenstone formations of the Capisisit Lake area was shown, but his report is devoted almost exclusively to the mineral occurrences of a very large area and contains little information concerning the geological formations of the region.

At the time of the present investigation, the geology of the regions adjacent to the Capisisit Lake area was known only from the reconnaissance surveys mentioned above, the work of Shaw (19) to the north, and the more detailed work of Longley (16) in the Bachelor Lake area, immediately to the south. Subsequent investigations in neighbouring areas by Blake (5), Imbault (14), Graham (13), and the writer (11 and 12), have since contributed to a better knowledge of the geology of the general region in which the present area is included.

Description of the Area

Topography

The general topographical features of the area resemble those of many other parts of the Canadian Shield. The lowest elevation, where Maicasagi river crosses the western boundary of the map-area, is about 850 feet above sea-level. Inconnu river, where it crosses the eastern boundary of the area, stands at about 925 feet and Capisisit lake, at approximately 910 feet. McDonald lake is at a slightly lower level.

In general, the low, rolling hills do not rise more than 150 feet above the water-plane. Notable exceptions are two parallel series of ridges, consisting of gabbro and massive volcanic flows, north and south of Capisisit lake (Plates II and III). In the southern ridge, one hill near the lake rises almost 700 feet above the lake level, and the average height of the ridges on both shores is around 300 feet. Other outstanding elevations are two prominent hills on the north side of Inconnu river, not far west of Capisisit lake, and a knoll, about 300 feet high, which rises abruptly above the flat plain on the north shore of Maicasagi river, opposite the mouth of McDonald creek (Plate I).

A thick blanket of unconsolidated material covers the lower parts of the area and conceals the minor irregularities of the bed-rock surface. In the southwestern and western sections of the map-area, most of this material is very fine, stratified clay and silt that was laid down in glacial lake waters. Elsewhere, it is mostly sand and gravel containing, in places, an abundance of large boulders. Most of the gravel ridges are elongated in the direction of the movement of the ice, that is, S.30°W., and are probably drumlins and small eskers. A relatively small number trend approximately at right angles to the movement of the ice and are taken to represent accumulations of débris left by successive annual advances of the retreating ice-front. A sand-plain, about five square miles in extent, is a conspicuous feature near the western boundary of the area, slightly south of Maicasagi river. Raised beaches were seen at a few places, the most outstanding is on the southern slope of the ridge north of Capisisit lake, some 250 feet above the present level of the lake.

Drainage

The area is, for the most part, well drained. Moderately extensive swamps and muskegs are found in the southwestern corner and west of McDonald lake, close to the western boundary. All the streams empty into Maicasagi river, which flows into Maicasagi and Goéland lakes, and so are part of the Waswanipi-Bell-Nottaway drainage system which discharges into James bay.

The structure of the bed-rock has controlled the direction of the principal streams and the elongation of the lake basins, but the smaller streams are insequent on the glacial depositional surface.

Maicasagi river is the largest stream and is, for most of its length in the present area, a subsequent stream flowing approximately westward in a wide, pre-glacial valley which, close to the mouth of McDonald creek, is about 150 feet deep. The passage of the glaciers left drift accumulations across its channel, and these unconsolidated deposits are particularly thick near the middle of the northern section of the map-area. Here, the river has not yet completely cut through a north-northeasterly-trending sand and gravel ridge about 50 feet high and half a mile wide (Plates IV and V). As a result, the usually deep, slow-running waters become very shallow and the bed is strewn with boulders rolled downstream by the current, so that a flat rapid about one mile long has been produced.

Inconnu river flows generally in the direction of the principal structures of the bed-rock, and its abrupt changes in direction are where weak zones inclined to the general structure are encountered. McDonald creek, on the other hand, flows approximately at right angles to the trend of the underlying formations, and part of its course is determined by a zone of weakness, evidenced by exposures of sheared rocks.

The massive granites of the southwestern part of the area are overlain by clays on which a post-glacial drainage pattern has been developed. The shallow streams of this section are muddy on account of the great abundance of very fine material over which they flow.

Timber, Fish, and Game

Forest fires have swept the area in recent years, sparing only small patches of medium-sized trees, mainly in the lowest sections of the area (Figure 1). Black spruce is the commonest tree in these patches, with birch and jack-pine in lesser abundance. In the better stands, the spruce trees have butt diameters of eight to ten inches and would be quite suitable for pulp and, to a lesser extent, for timber. The regrowth in the burned areas is not yet large enough to be of any commercial value (Plates VI and VII-A).

Pike and pickerel are abundant in the major streams and in the lakes, especially in Capisisit lake. Small speckled brook-trout can be seen in most of the smaller streams, and lake trout have been reported in Capisisit lake and Inconnu river.

Fur-bearing animals appear to be very scarce in the area. A few muskrats were seen and evidence of the presence of bear, otter, and moose was noted. Rabbits and partridges are not numerous.

The low ground underlain by clay, particularly in the western part of the area, may be considered as suitable for farming. Almost everywhere else, the soil cover is rather thin, and coarse detrital material very abundant.

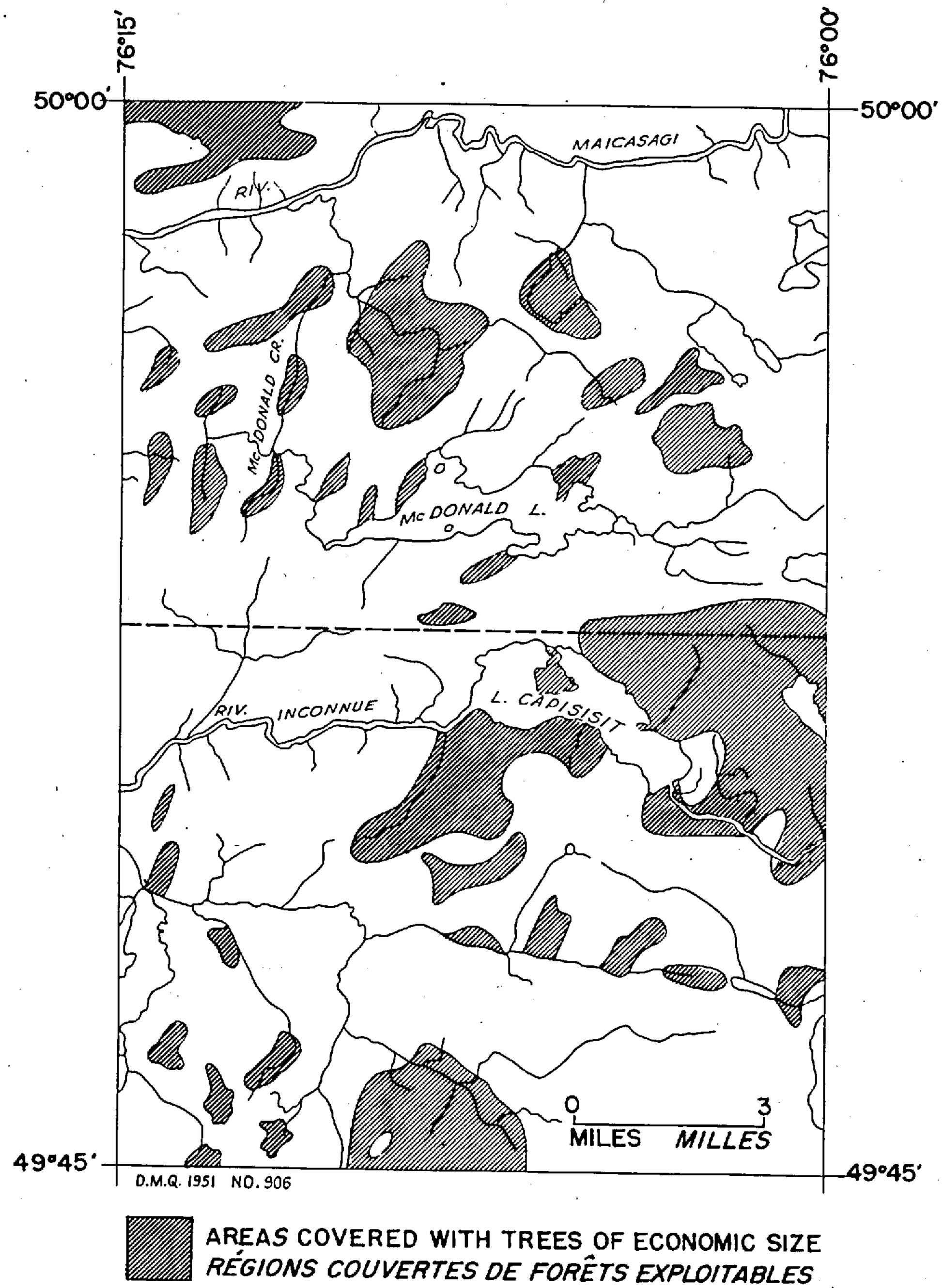


Figure 1.- Map showing distribution of areas covered with trees of economic size.

GENERAL GEOLOGY

General Statement

The southwestern part of the map-area, low and covered with a thick mantle of glacial deposits, offers few rock exposures. In the remainder of the area, although abundant morainic accumulations are encountered, the bed-rock is more extensively exposed than is generally the case in this part of the Canadian Shield.

Rock exposures are particularly numerous on the two parallel series of ridges north and south, respectively, of Capisisit lake (Plates II and III). The southeastern part of the area, from the southern boundary northwestward to Capisisit lake, also shows unusually good exposures of granitic, gabbroic, and volcanic rocks, and in the northeast corner there are numerous exposures of a gneissic quartz diorite.

All the consolidated rocks of the area are of Precambrian age. About 50 per cent of the area is occupied by volcanic and sedimentary rocks, with associated basic intrusives, and the remainder by intrusive granitic rocks of various types which, for the most part, represent marginal zones or lobes of more extensive masses lying mainly outside the map-area. The gneissic quartz diorite of the northeast section of the area is the southern border of a large granite massif. It is separated from the northern edge of a similar massif lying mainly south of the present area by an eleven-mile-wide belt of volcanic, sedimentary, and gabbroic rocks. Intruding these are two elongated bodies of acidic rock, one extending from the west side of the map-area eastward beyond McDonald lake, the other from Capisisit lake southeasterly beyond the limits of the present sheet. Sill-like masses of gabbroic composition are found in particular abundance intruding the volcanic rocks between the McDonald Lake granitic mass and the edge of the large granite massif in the southern section of the area. An olivine diabase dyke of probable Keweenawan age cuts the southern granite and its associated pegmatite dykes.

Table of Formations

Cenozoic	Unconsolidated deposits	Sand, gravel, till, and clay
	Great unconformity	
Precambrian	Unaltered basic intrusives	Olivine diabase dyke, cut by stringers of related aplite (Keweenawan?)
	Intrusive contact	
	Acidic intrusives	Pegmatite, aplite, syenite porphyry, diorite porphyry, quartz porphyry, and granite dykes Waswanipi granite: biotite granite Capisisit Lake granite: hornblende-biotite granite Diorite-syenite complex Gneissic biotite-quartz diorite
	Intrusive contact	
	Altered basic intrusives	Metagabbro, gabbro, hypersthene gabbro, norite, olivine norite, some anorthosite
	Intrusive contact	
	Sedimentary series	Feldspathic greywacke, arkose, banded argillite, slates, some cherty and ferruginous beds Conglomerate Some interbedded volcanics
	Volcanic series	Massive, ellipsoidal, porphyritic and fragmental, basaltic to andesitic flows Some interbeds of volcanic tuffs and basic sedimentary rocks

VOLCANIC SERIES

General Statement

The oldest rocks of the Capisisit Lake area are lava flows, breccias, tuffs, and a few interbeds of basic sedimentary rocks. As they are very similar in appearance to the "Keewatin greenstones" occurring elsewhere in the Canadian Shield, they are assumed to belong to the Keewatin group of rocks.

All of these rocks have been regionally folded and metamorphosed, and their composition is now essentially that of amphibolite. In addition, local effects of more severe metamorphism are commonly recorded in these rocks at their contact with the granitic and, at some localities, with the basic intrusives.

Keewatin-type rocks underlie about one-fifth of the map-area. They fall naturally into two more or less east-west trending belts separated one from the other, across the northern half of the area, by a wide band of sedimentary formations. Both belts are deeply indented by intrusives of various ages.

The southern belt, which is much wider than the northern and, in general, is better exposed, has a width of about a mile and a half at the western limit of the map-area, where it is bounded on both the north and south by large bodies of acidic to intermediate plutonic rock. Eastward, the southern belt widens and, at the west end of Capisisit lake, it crops out over a width of four miles. East of that point, it is split into two minor belts by an elongated body of granitic rock, about two miles wide, extending in a southeasterly direction to the eastern boundary of the map-area. These two minor belts, and to a lesser extent the main belt as well, are intruded by numerous masses of basic intrusive rocks. In the proximity of the southeast corner of the area, only a few outcrops of volcanics occur here and there, mainly between the gabbroic and granitic intrusives.

The northern belt of volcanics trends N.65°W. and is much smaller and less well exposed than the southern belt. On its south side it is bounded by the band of sedimentary rocks mentioned above, except near the eastern limit of the area, where a very small gabbroic intrusive body outcrops between the volcanic and sedimentary rocks. Three miles east of the western boundary of the area, the belt is split into two parts by a wedge-shaped zone made up mainly of basic sedimentary rocks. The northern of these secondary belts of volcanic rocks continues northwestward beyond the northern limit of the area, whereas the southern branch swings southwesterly, decreasing slightly in width to about half a mile at the western edge of the sheet. East of the split, the belt of extrusive rocks is bounded on the north by a body of gneissic acidic intrusive rock, and its width decreases gradually to about 2,000 feet at the eastern boundary of the map-area.

Southern Belt of Volcanic Rocks

The lavas in the southern belt occur as an extensive series of flows of various thicknesses and include massive, ellipsoidal, fragmental, amygdaloidal, vesicular, and porphyritic types. Some of the flows have retained a massive character, but, more commonly, they have a determinable, and locally strong, schistosity. The primary structures are usually fairly well preserved, except in the highly schistose flows, although in ellipsoidal types the pillows are generally much flattened and seldom reliable for determinations of tops and bottoms of flows. Pillowed lavas far exceed all other types in abundance, and this structure proved very useful, in places, to differentiate schistose basic volcanics from fine-grained schistose gabbro.

Vesicular and amygdaloidal lavas are not common, and, in most occurrences, the vesicles and amygdules are flattened. Generally, the amygdules are filled with feldspar and quartz, but some have a low content of carbonates.

Fragmental lavas and flow breccias are relatively abundant in beds from one foot to a few scores of feet thick. Interbeds of tuffs from a few inches to about fifteen feet thick were found in the lavas at various places.

Fine-grained, basic, sedimentary rocks also are frequently interbedded with the volcanic flows, especially south of Inconnu river and the western half of Capisisit lake. In small outcrops, the most basic beds are difficult to distinguish from the lavas with which they are associated. There are, however, excellent exposures of the sedimentary rocks at a few places, as on a low ridge some two miles southwest of the western extension of Capisisit lake, where lavas, tuffs, and sedimentary rocks occur together in a single exposure. The volcanics are slightly-schistose basaltic flows with thin interbeds of tuffs, and within these is a band, ten feet wide, of well-bedded and banded, fine-grained sedimentary rocks with beds ranging in thickness from four inches to one foot. Some good exposures of basic sedimentary rocks are also to be seen in the following places: on the northern slope of the high ridge south of Capisisit lake; on the shore of the western extension of Capisisit lake; and at scattered points near and along Inconnu river from Capisisit lake westward.

Petrography

In general, the massive, ellipsoidal, vesicular, and amygdaloidal flows of the southern belt of volcanics are closer to basalt in composition than those commonly found in this part of the Canadian Shield. Dacite and rhyolite are totally absent, with the possible exception of fragments and inclusions in the basaltic flows.

Several thin sections of the lavas from the southern belt were examined under the microscope and they indicate that, with the exception of the porphyritic flows, the variation in composition is very small throughout the belt. In the relatively massive lavas, such as those about two and a half miles southwest of the western extension of Capisisit lake, the felted pattern of the plagioclase laths, typical of basalts, is plainly visible, and the plagioclase itself is fairly fresh. It has the composition of labradorite (An_{52}-An_{65}) and forms between 20 and 30 per cent of the rock. Amphibole (60 to 80 per cent) is the chief and only other essential constituent. In the more altered and schistose facies of the lavas, the microscope shows a felted mass of secondary amphiboles and highly saussuritized feldspar. The usual accessory minerals are magnetite, ilmenite, epidote, clinozoisite, chlorite, and occasional quartz and carbonate. Magnetite and ilmenite are intimately associated with the amphibole, and disseminated pyrite is common.

The porphyritic flows contain phenocrysts of white plagioclase, up to an inch and a half long, enclosed in a very fine-grained matrix composed mainly of amphibole and epidote, with about 5 per cent secondary quartz. The phenocrysts are, in general, rounded, but some exhibit euhedral to subhedral outlines, and all are altered and finely fractured. Their composition cannot be determined with accuracy under the microscope because of their alteration, but their indices of refraction indicate that they are probably andesine or labradorite. About 2 per cent of the rock is made up of fresh-appearing recrystallized albite in fine grains, mostly around the altered phenocrysts.

Although these porphyritic greenstones are considered as being mostly of extrusive origin, it is realized that the size of their phenocrysts is somewhat larger than in ordinary porphyritic lavas. Recent work on volcanoes and lava extrusion has indicated that a high proportion of the material produced during a period of volcanic activity is of intrusive origin, although comagmatic with the lavas and exceedingly difficult to distinguish from them. It is possible that these rocks with unusually large phenocrysts represent such an intrusive facies comagmatic with the adjacent lavas of normal grain.

Most of the fragmental flows consist of sharply-angular fragments set in a fine-grained basaltic matrix. Some of the fragments are as much as one foot across, but most of them are from two to four inches. Generally, these flows are two to fifteen feet thick, but one south of Capisisit lake is approximately 30 feet thick. A high proportion of the fragments are somewhat lighter coloured than the matrix that encloses them. Those examined under the microscope appear very altered, and are seen to be composed of an aggregate of alteration products and secondary material. One fragment taken from a basaltic flow, the composition of which was 80 per cent hornblende and 15 per cent labradorite (An_{63}), was found to contain 60 per cent epidote and about 15 per cent actinolite, with quartz, carbonates, chlorite, magnetite, ilmenite, and pyrite.

The banded tuffs associated with the lavas are generally fine-grained, highly acidic, and greenish-grey in colour, with very narrow dark bands of more basic material. Thin, fragmental volcanic beds are commonly interstratified with them. In general, the tuffs have been extensively altered and, in many places, highly sheared. In thin sections, the acidic types are seen to be composed almost exclusively of quartz and epidote, with very minor amounts of iron oxides and leucoxene. The basic tuffs are made up mostly of chlorite, sericite, and iron oxides, with little quartz.

All the interbedded sedimentaries of the southern volcanic belt are essentially quartz-hornblende schists, and all original features, other than the pronounced banding, have been obliterated by dynamic metamorphism. Individual bands in the schist maintain remarkable uniformity in width and composition, although the difference in composition of the various bands is quite apparent on large weathered surfaces. Some layers contain as much as 75 per cent hornblende, with quartz and feldspar much subordinate, whereas others may contain 90 per cent quartz. Garnet-rich, very thin bands are present in places. In general, however, hornblende and its products of alteration make up about 45 per cent of the rock, with altered feldspar and a varying amount of quartz as the other principal constituents.

One particularly good cross-section of the various types of Keewatin-like rocks of the area is afforded in the well-exposed part of the southern belt of volcanics, south of Capisisit lake. There, as one travels southward from the middle-southern shore of the lake and across the main hill, thin interbeds of basic sedimentaries and basaltic lava flows are first found about 3,000 feet from the lake shore, whence they extend for a quarter of a mile. Continuing south, slightly-schistose, somewhat-pillowed, basaltic flows dominate for about 1,000 feet. These are followed by fine-grained basic intrusives, first in occasional narrow, schistose, concordant, sheet-like bands, and then in increasing number to the top of the ridge, where massive fine- to medium-grained gabbro with inclusions of basaltic lava is the dominant rock. The contact between the gabbro and the volcanics is, in places, very sharp, but elsewhere it is hard to place. Basaltic to andesitic lavas are found again on the southern slope of the ridge. Close to their contact with the gabbro, these volcanic flows have been metamorphosed to a very hard, brittle, and uniform rock having the appearance of hornfels. The rock is somewhat slaty, very fine-grained, and appears under the microscope as a felted aggregate of secondary amphibole, labradorite, and a small amount of iron oxides. The amphibole makes up about 80 per cent of the rock and the plagioclase (An_{52}-An_{54}), about 15 per cent. Southward, this baked basaltic lava grades gradually into more and more schistose volcanic material with a decreasing number of gabbroic intrusions until, at about 8,000 feet from the lake shore, highly-pillowed lavas interbedded with flow breccias, minor volcanic tuffs, and fine-grained greywacke, become predominant. Porphyritic basaltic flows, about 500 feet thick and bounded on both sides by ellipsoidal lavas, occur half a mile north of the contact of the Keewatin-type rocks and the granitic intrusive to the south.

Rounded Inclusions in Lava Flows

Rounded inclusions are very numerous in some of the lava flows. Most of these are much larger than the angular fragments of the fragmental lavas and have more or less the shape of spheroids or ellipsoids (Plates VII-B and VIII-A). The largest seen was three feet long and one foot across. The great majority have their long axis oriented parallel to the schistosity of the enclosing lavas, but, where the schistosity is at an angle to the trend of the flows, their long dimension may be parallel to either the flow structure or the schistosity.

In composition, these inclusions are fine-grained rocks, invariably lighter in colour than the enclosing lava. Their contact with the basaltic matrix is, in general, marked by what appears to be a narrow chilled margin in the lava and a "reaction rim", about a quarter of an inch wide, inside the nodule. Although most of these inclusions are highly cross-fractured, they usually do not weather as readily as even relatively massive basalt (Plates VII-B and VIII-A. Quartz is commonly present in the fractures.

Under the microscope, the nodules appear to be composed of an aggregate of alteration products — epidote (60 per cent, secondary amphiboles (15 per cent), leucoxene, sericite, saussurite, iron oxides, etc. — with varying amounts of quartz and carbonates. Their primary constituents have been completely obliterated, except in one of the thin sections, in which faint relics of phenocrysts of highly altered feldspar are seen. The present composition of the nodules is closely similar to that of the light-coloured angular fragments of the fragmental lava flows.

The problem of the origin of these nodules is a difficult one to solve. They were found in greatest abundance in basaltic flows, some relatively massive or only slightly schistose (Plates VII-B and VIII-A). In composition, however, they are much more acidic than the basaltic matrix in which they occur. If all these acidic constituents were introduced after the solidification of the flows, it seems to the writer that the basalt itself should also be more altered than it is in the vicinity of the nodules. The nodules, in general, have the shape of bombs, but, if they are considered as such, it would seem necessary to conclude -- in view of their acidic composition — that they were either not a product of the volcanic extrusions that produced the basalts, or that they were differentially metamorphosed after their formation.

On the other hand, the similarity in composition between the angular fragments and the rounded inclusions suggests that there may be a relation between the two. It seems to be the rule that the rounded inclusions are rarely present in thin, highly schistose flows; they were found most abundantly in thick, relatively massive beds. The reverse appears to be true for the angular fragments. Also, it was noted that some of the nodules are broken into smaller, angular, more or less scattered fragments. For these reasons, it is considered probable that the angular and rounded fragments are related in origin. It could well be that they represent the breaking up of an already altered, possibly acidic lava, and that the rounded shape of some of the fragments is the result of a partial re-fusion and assimilation of the fragments by the thick flows of a new volcanic extrusion. Alternatively, it is conceivable that the rounded inclusions represent scattered, worn pebbles and boulders of acidic lava incorporated in younger basaltic lava flows.

Northern Belt of Volcanic Rocks

The northern belt of volcanic flows is much narrower and somewhat less well exposed than the southern one. The rocks are, however, not very different from those of the southern belt; they include massive, ellipsoidal, amygdaloidal, and fragmental lavas, with thin interbeds of tuffs and basic sedimentary rocks. Massive, structureless, dark green lavas constitute, however, the predominant type of volcanic flows.

The lavas appear to be slightly less calcic than those of the southern belt and to be closer to andesite than to basalt in composition. The content of hornblende is, in general, from 35 to 60 per cent, slightly lower than in the southern flows. It was not possible by optical observations to determine the composition of the original plagioclase, but it appears to have been a normal andesine. However, in one specimen taken from a very dark-coloured flow, a twenty-foot thickness of which is exposed on an outcrop some four miles north of the eastern end of McDonald lake, hornblende makes up 75 per cent and labradorite (An_{52}) 25 per cent of the rock. Accessory and secondary minerals usually include magnetite, ilmenite, epidote, clinozoisite, sericite, and some chlorite.

SEDIMENTARY SERIES

Sedimentary rocks outcrop in a broad east-west trending belt crossing the northern part of the area and in a minor triangular-shaped zone in the northwest corner. The main belt is more than four and a half miles wide at the eastern boundary of the sheet. Slightly more than two miles west of the boundary it is split and continues westward as two belts separated by a body of acidic to intermediate intrusive rock that extends from the west into the present area and surrounds McDonald lake. East of the Capisisit Lake area, the extension of this belt of sedimentary rocks is well exposed in the Branssat-Kreighoff area (11) and, still farther east, around and south of La Trève lake (12 and 18).

In the present map-area, the sedimentary belt is bounded on the north and south by volcanic rocks, although scattered basic intrusive masses occur at the contact between the two series at a few places, such as along the northern margin of the belt near the eastern boundary of the map-area and along the southern margin two miles northwest of the outlet of Capisisit lake. Of the two belts formed by the splitting of the main belt, the more southerly abuts on the west against the intrusive mass mentioned above; its width is generally between half a mile and one mile. The more northerly has a width of about three and a half miles as far west as McDonald creek, from which point westward it narrows gradually until, at the boundary of the map-area, it is only about a mile and a half wide.

The zone of sedimentary rocks in the northwest corner of the area is about two and a half miles wide at the western boundary, but it narrows rapidly eastward and is believed to terminate within about three miles. Outcrops are sparse so that it is difficult to trace with any reasonable degree of accuracy the boundaries of the zone, even with the help of the physiographical features of the vicinity. The exposures seen are of thin volcanic flows interbedded with basic sedimentary rocks.

To the naked eye, the typical sedimentary rock in all these occurrences appears as a medium-to very fine-grained, usually well-banded, highly-feldspathic rock. In general, it weathers light greenish-grey, except in the more basic facies, and the alternation of dark and light-coloured beds is very conspicuous on weathered surfaces (Plate VIII-B). The medium- to fine-grained types (feldspathic greywacke) tend to occur in massive beds from six inches to ten feet in thickness, whereas the very fine-grained types (argillite) are usually finely banded and show very distinct bedding, a fraction of an inch to a few inches thick.

The great bulk of the sedimentary rocks of the area have been subjected to low-grade regional metamorphism, and they are now essentially albite- or oligoclase-biotite gneisses. In many localities, however, and notably in the vicinity of the large intrusive masses, the andesine-garnet metamorphic grade has been reached. Microscopic examination of the several types shows an alternation of very fine bands differing in grain size and, to a lesser degree, in mineral composition, even in beds that appear quite homogeneous on exposed surfaces. Both in hand specimen and under the microscope, the texture appears equigranular in any particular band but the grain size varies from band to band.

The typical sedimentary rock is composed essentially of feldspar, biotite, and quartz, with, in general, a small amount of chlorite, epidote, zoisite, sericite, magnetite, apatite, sphene and, locally, garnet. The content of feldspar in the uncontaminated facies is usually around 45 per cent. The feldspar varies in composition between albite and andesine, depending upon the grade of regional and local metamorphism attained by the rock. Biotite, the usual ferromagnesian mineral, ranges in amount from 35 per cent in the most basic varieties to 5 per cent in the most acidic. In the very basic facies, hornblende is the dominant ferromagnesian mineral. Normally, the rock contains 10 to 20 per cent of primary quartz, but in some types this mineral is almost totally absent and in others it forms close to 90 per cent of the rock. Some of the garnetiferous varieties contain up to 70 per cent garnet.

Beds of siliceous magnetite and impure chert were seen in various localities, as near the centre of the south shore of McDonald lake, slightly less than two miles north-northeast of the eastern extension of the lake; and along McDonald creek, about one mile south of Maicasagi river.

Near the acidic or intermediate igneous masses, the banding of the sedimentaries, has, in general, been greatly modified, and mineralizing solutions from magmas have somewhat changed the bulk composition. This is particularly true along the northern boundary of the large igneous mass extending from the west into the central part of the map-area. From the western limit of the area to McDonald creek the sedimentary formations close to this intrusive mass have been transformed into an andesine-oligoclase-hornblende gneiss with intense lit par lit injection and abundant quartz-filled fractures.

About 400 feet south of McDonald lake 3,000 feet west of its eastern end there is an exposure, about twenty feet long and ten feet across, of conglomeratic material. The rock contains numerous pebbles, mostly of very basic material, set in a matrix of fine-grained, basic arkose similar to that found on either side of this particular exposure. They are from a fraction of an inch to six inches in diameter and are, with very few exceptions, medium-grained, massive amphibolite with a low content of a light-coloured mineral, probably plagioclase feldspar. Thin sections under the microscope show a fractured aggregate of hornblende (60 per cent and altered plagioclase feldspar (30 per cent), together with a low content of chlorite, biotite, sphene, and iron oxides. Although the pebbles appear very massive in hand specimen, the microscope shows that they were highly fractured before recrystallization took place. The plagioclase is much altered but appears to be labradorite. These pebbles are believed to be fragments of basaltic or gabbroic rocks.

A few small pebbles are more acidic, having the composition of diorite or syenite; they are light grey, medium-grained, and contain light-coloured feldspar with a small amount of hornblende.

The contact between the McDonald Lake intrusive mass and the intruded sedimentary and conglomeratic rock is exposed on the south shore of the lake, a few hundred feet west of the outcrop of conglomerate described above. All along the exposed length of the contact, the sedimentary rocks have been strongly brecciated, and angular fragments, as well as rounded pebbles, of them are present in a granitic matrix.

BASIC INTRUSIVES

An outstanding feature of the area is the presence within the bands of volcanic and sedimentary rocks of a great number of large and small bodies of basic intrusive rock, mostly of gabbroic composition. The scale of the accompanying map does not permit showing at a glance the ubiquity, and thus the full importance, of these rocks. Only the large masses, and a few of the smaller ones, are shown on the map.

The largest and best exposed intrusive bodies of basic composition occur in the following localities: in the section extending from the southeast corner of the map-area northwestward to Capisisit lake; in the series of ridges immediately north of that lake; and slightly south of Inconnu river, about one mile west of the outlet of Capisisit lake, where gabbroic exposures form the backbone of numerous, closely-spaced east-west-trending ridges flanked by volcanic rocks.

Two and a half miles north of the eastern end of McDonald lake, a series of good exposures indicates the presence of a lenticular mass of gabbroic rock about two miles long and 3,000 feet wide. Gabbroic outcrops occur, also, along and near the contact between sedimentary and volcanic rocks at the eastern boundary of the map-area, about four and a half miles south of its northern limit.

North and northeast of McDonald lake there are a few small scattered exposures of schistose basic rocks which are interpreted as representing small intrusive masses in the sedimentary rocks. Large gabbro outcrops occur with some sedimentary rock on high ground some two miles east of McDonald lake. Besides the gabbroic outcrops mentioned above, a number of small gabbro bodies, indicated by restricted exposures but large enough to be shown on the map separately from the volcanic and sedimentary rocks, have been outlined with their long dimension parallel to the regional trend, in accordance with the shape and trend of the better-exposed larger masses.

The outlines of the basic intrusive bodies suggest, in general, imperfect tabular masses trending parallel to the intruded volcanic and sedimentary rocks. The gabbroic bodies of the southeastern section of the area may seem to constitute exceptions to this rule but their apparent local discordance with the intruded volcanic rocks is probably due to local complexity of the regional folding and to disturbances created by the emplacement of the granitic intrusive masses to the southwest and northeast.

Broadly speaking, however, the basic intrusive masses have a concordant contact with the volcanic and sedimentary formations and are believed to have been introduced as sheets or sills, prior to the main period of regional folding when they were deformed along with the intruded rocks. In general, the contacts between the intruded rocks and the intrusive masses are quite sharp, but in some cases there is a zone of transition and the boundaries are difficult to draw. This is believed to be mostly the result of dynamic metamorphism subsequent to the emplacement of the basic intrusive masses. This 'transitional' type of contact is well exhibited on a large exposure about a mile and a half north of the eastern end of Capisisit lake. There, the intruded rock is a fine-grained, somewhat schistose, basaltic lava. As one approaches the gabbroic intrusive from the south, the amphibolite schist becomes gradually coarser-grained and less schistose until finally the rock is a massive, medium-grained gabbro.

In general, the large bodies of basic intrusives are quite massive away from their contact with the intruded rocks, whereas they are schistose at the border. The small masses usually display a well defined schistosity concordant with that of the adjoining volcanics or sedimentaries. It is obvious that the gabbro bodies were more resistant to dynamic metamorphism than the volcanic and sedimentary rocks. In a few places, however, massive, thin, sheet-like bodies of gabbro occur within schistose lavas. It is probable that these were not subjected to intense stresses but were emplaced after the culmination of dynamic metamorphism.

The rocks of the gabbro group are usually medium- to coarse-grained and range in colour from dark green to whitish, depending on the relative amounts of ferromagnesian minerals and plagioclase. In the field, the massive varieties ordinarily exhibit a mottled appearance due to differential weathering or alteration of the light-coloured plagioclase and green ferromagnesian minerals. On fresh surfaces of some less altered varieties, a diabasic texture is visible, and the dark minerals do not possess sharp boundaries but appear to blend into each other. In the more altered varieties, the original constituents are scarcely if at all recognizable and it is only with difficulty that the rock can be distinguished from the intruded basaltic lava, which has a very similar mineralogical composition.

The most prevalent type of gabbro is even-grained, with an average grain size of 2 to 4 mm. Locally, however, the rock is very fine- or very coarse-grained. In one small dyke in the northern belt of volcanics, two miles south of the northern, and six miles east of the western, boundary of the area, the crystals are up to half an inch across.

Under the microscope, the less altered typical gabbro appears as a medium-grained rock with faint ophitic texture and composed chiefly of altered diopside and labradorite (An_{60}-An_{65}), with fairly abundant leucoxene, and a small amount of magnetite and ilmenite. The altered diopside forms 60 per cent of the average normal gabbro and is usually present as small remnants or relics surrounded by secondary amphiboles, chiefly hornblende with some actinolite. Labradorite forms between 35 and 40 per cent of the rock. It is usually much altered and replaced by saussurite, but twinning and cleavage cracks are clearly visible in some of the grains, and reliable determinations of the composition were obtained. Epidote and zoisite are usually present as skeleton crystals in the altered plagioclase.

The smaller bodies of these gabbroic rocks have a fairly uniform composition, but the large masses, such as those exposed north and south of Capisisit lake and in the southeastern section of the map-area, commonly show wide variations in the relative proportions of the main constituents. In some facies, orthorhombic pyroxene is so abundant that the rock might well be classed as norite. One of the thin sections studied is a hyperite, another is an olivine norite, and ultrabasic and dioritic or anorthositic facies are common.

It seems, in general, that the northern border facies of the gabbro masses north of Capisisit lake is relatively richer in light-coloured constituents than is the southern marginal facies. A faint banding due to an alternation of plagioclase-rich and mafic-rich layers can be seen at many places along the northern boundary of the gabbro between McDonald and Capisisit lakes. Lenticular segregations from a few inches to a few feet long and, in places, dykelets of creamy-white anorthosite, are present also. The opposite relationship seems to hold for the gabbroic masses south of Capisisit lake; their southern border seems to be more dioritic or anorthositic than the rock farther north, closer to the lake.

Microscopic examination shows that the anorthositic layers and lenses consist almost entirely (about 95 per cent) of highly crushed, calcic plagioclase, in part recrystallized to albite-oligoclase, the balance, about 5 per cent, being secondary mafic minerals. Saussurite is abundantly associated with the crushed plagioclase in many of the sections, and some of them contain introduced quartz.

The presence of anorthositic layers and lenses in some of the gabbro bodies of the area recalls similar but better-developed features described by Freeman (8 and 9) and Black (4 and 9) in the Bell River complex, about 50 miles to the west.

ACIDIC INTRUSIVES

Gneissic Biotite-Quartz Diorite

About 25 square miles in the northeast corner of the area are underlain by a fine-grained, gneissic, border facies of a very extensive acidic intrusive mass lying north of the map-area. In the present area, the rock is a biotite-quartz diorite gneiss. It extends southward along the eastern boundary for about four miles, and from there its southern border can be traced west-northwestward to a point on the northern boundary about three miles west of the centre-line of the map-area.

In the field, the gneiss appears as a medium- to fine-grained, usually somewhat poorly-banded, light to dark grey rock, cut by abundant pegmatites, subordinate aplitic, granitic, and grey gneissic dykes, and some quartz veins. The banding in light and dark grey is due to the relative abundance of mafic minerals, chiefly biotite, with a smaller amount of hornblende.

Greenstone inclusions are common in the gneiss; they are particularly abundant close to its contact with the volcanic rocks to the south. The size of these inclusions varies from a few millimeters to a few feet, and their long dimension is usually parallel to the gneissic banding of the enclosing rock. Their degree of alteration also varies widely, from small agglomerations of recrystallized ferromagnesian minerals to a relatively fresh volcanic rock in which remnants of pillows are still visible. A few hundred feet south of Maicasagi river, at a point about a mile and a half west of the eastern boundary of the map-area, an inclusion of ellipsoidal lava five feet wide is exposed over a length of 100 feet, its trend paralleling the strike of the gneiss. In the central part of this inclusion, the rock is practically unaltered, although cut by numerous pegmatite dykelets, and assimilation by the intrusive is limited to a zone an inch or two wide along its margins.

An outstanding feature of the area underlain by the quartz diorite gneiss is the diversity and abundance of later dykes and small intrusive masses. The oldest type of dyke is represented by a few fine-grained, grey granitic dykes, some of them gneissic. One of those observed showed a faint banding and lineation parallel to the walls of the dyke and not to the gneissic banding of the intruded gneiss. These grey granite dykes are cut by fairly numerous, fine- to medium-grained, aplitic dykes which, in turn, are cut by large numbers of coarse-grained pegmatite dykes and lenses.

In a number of outcrops, pegmatite dykes constitute over 75 per cent of the exposed rock. Although some are concordant with the trend of the banding of the gneiss, the great majority cut across it at all angles. Pegmatite dykes and lenses are also very abundant in the volcanic rocks to the south and southwest, close to their contact with the quartz diorite mass. White quartz veins are associated with the pegmatites, particularly with those in the gneiss.

In the several thin sections of the gneiss that were examined, the rock exhibits, in general, a well-developed protoclastic texture. Quartz forms 20 to 30 per cent of the rock, oligoclase-andesine (An_{28}-An_{33}) 50 to 60 per cent, and biotite 10 to 20 per cent; accessory and secondary minerals are hornblende, epidote, chlorite, allanite, apatite, iron oxides, and leucoxene. In some sections, deuteric microcline is present in small amount. Some of the quartz appears as rounded inclusions in the plagioclase. The biotite, even in gneiss that appears completely free from remnants of inclusions, commonly forms clots with epidote, chlorite, hornblende, iron oxides, leucoxene, and apatite. Chlorite is the main product of alteration of the biotite. Close to the contact between the gneiss and the intruded volcanics, hornblende is, in places, the dominant dark mineral.

The gneissic structure of the quartz diorite is everywhere concordant with the schistosity of the intruded volcanic formations, and, on the basis of a small number of field observations, is believed to be parallel as well to the direction of flow in the adjacent lavas. The gneiss is a border facies of the large intrusive mass to the north where, according to Shaw (19), the rock is a biotite and hornblende granite. The gneissic structure of this more calcic border facies is believed to be mainly the result of movement which the intrusive underwent at a certain stage of its emplacement.

The plagioclase feldspar crystallized before the movement ceased, for the grains show bent lamellae and, in places, have been crushed to fine granular aggregates. The biotite also had already crystallized since some flakes are bent, and the mineral does not occur along definite lines of flow but in poorly-defined agglomerations here and there in the rock. However, as mentioned above, some of these 'schlieren' are considered to be remnants of inclusions of greenstone caught up and partly digested by the intrusive quartz diorite. In large measure at least, the first generation of quartz also crystallized before the stresses ceased, since many quartz grains have the undulatory extinction of strained crystals, and some have been finely granulated at the periphery.

The character of the numerous pegmatites that intrude the quartz diorite indicates that, at the time of the cessation of movement, most of the residual liquids of the consolidating magma had not yet crystallized. Some pegmatite dykes and lenses that trend parallel to the gneissic structure of the quartz diorite and show a striking alignment of fractured quartz and feldspar crystals on the weathered surface are taken to represent pegmatites that crystallized while movement was still in progress. The great majority of the pegmatite bodies, however, appear to have been injected after the movement had ceased, for they cut across the gneissic structure of the rock and are not themselves gneissic or granulated. Similarly, the quartz veins and lenses cut across the gneissosity of the quartz diorite at any angle, and the late generation of deuteric or hydrothermal quartz disseminated in the quartz diorite itself exhibits large, unstrained grains indicating a post-tectonic crystallization.

It is thus believed that a movement that was effective during the consolidation of the magma but ended before the close of the pegmatitic stage was largely responsible for the gneissic character of the quartz diorite.

The gneissic intrusive has, generally, a larger content of dark minerals and of greenstone inclusions at the border of the mass than elsewhere. The inclusions, in various stages of assimilation, tend to emphasize the gneissic character of the rock, and the greater abundance of dark constituents in the border section is probably due to the digestion of small basic inclusions in the gneiss. However, that the amount of digestion or assimilation was very limited is indicated by the fact that all the larger inclusions of greenstone are still preserved almost intact with fairly sharp borders. Similarly, very little lit par lit injection is observed in the zone of contact between the gneissic quartz diorite and the volcanics, but pegmatite dykes and lenses are very abundant there, and are generally at an angle to the trend of the schistosity of the only slightly altered lavas. Therefore, it is improbable that the gneissic character of the quartz diorite as a whole is the result of complete digestion or assimilation in lit par lit fashion of a large proportion of the basic inclusions.

The gneissic quartz diorite of the Capisisit Lake area is similar, in appearance and composition, to the contact facies of the Olga quartz diorite found extensively around Olga lake, some 40 miles to the west, which Freeman (7) has interpreted as being of hydrothermal origin. However, the distance between the two gneissic bodies is much too great, and the rocks are too complex, to justify any tentative correlation of the two.

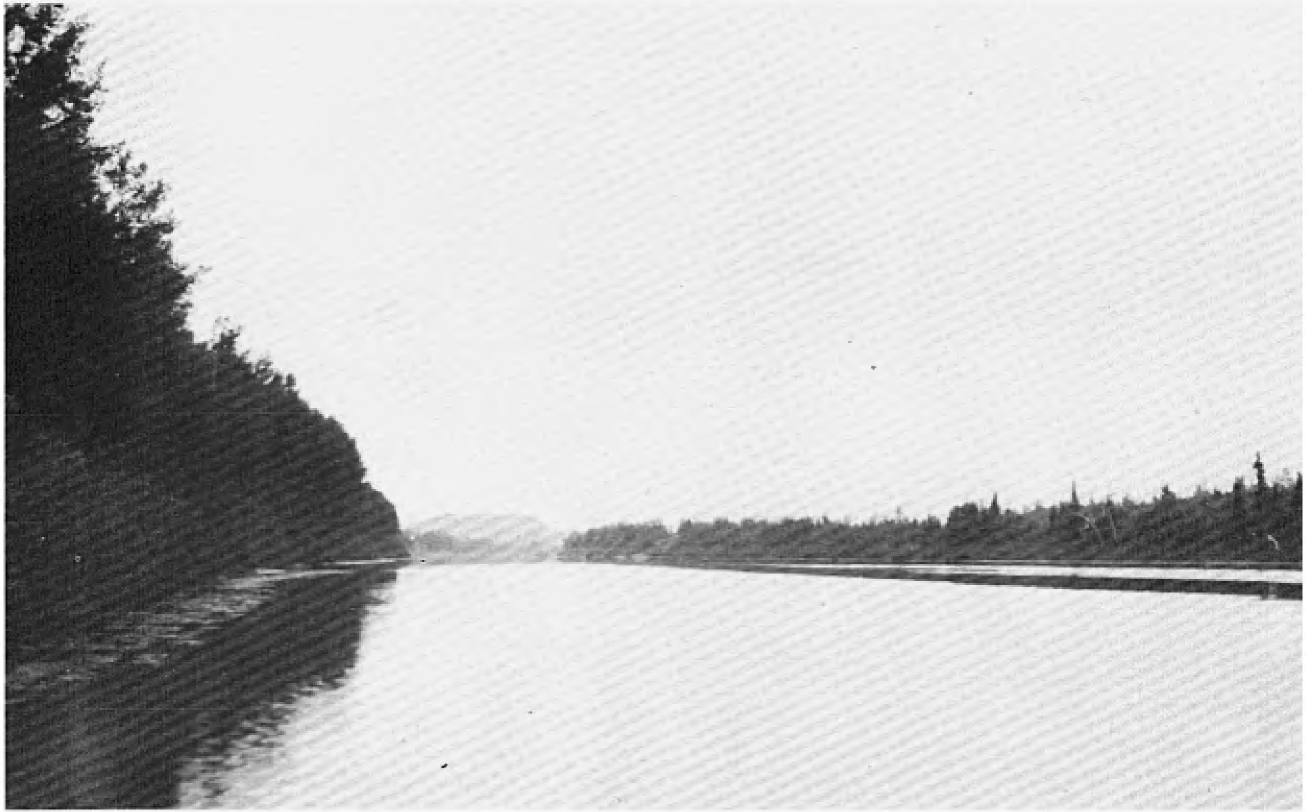
Diorite-Syenite Complex

The rocks mapped as 'diorite-syenite complex' underlie approximately 50 square miles. They occur in a triangular area having its apex a mile and a half east of McDonald lake and its base, some six miles long, extending along the western boundary of the map-area from Inconnu river northward.

In general, the rocks are massive and show a well-defined granular texture. Primary flow structures are visible in a few exposures, however, and a gneissic facies occurs along a shear zone that follows the contact with the volcanic-sedimentary rocks along the south shore and southwest of McDonald lake.

The main portion of the complex is a coarse-grained rock containing from 35 to 50 per cent dark minerals and having, except for a

PLATE I



Maicasagi river near the western boundary of the Capisisit lake area. In background, hill on north shore of river.

Ridges north of Capisisit lake.

PLATE II

Ridges south of Capisisit lake.

PLATE III

PLATE IV

Flat rapid on Maicasagi river, about three miles east of the mouth of McDonald creek.

PLATE V

Flat rapid on Maicasagi river, some three miles east of the mouth of McDonald creek.

Large "brulé" north of McDonald lake. On horizon, ridges south of Capisisit lake.

PLATE VI

PLATE VII

A.—Large "brulé" north of McDonald lake. On horizon, ridges south Capisisit lake.

B.—Rounded fragments in massive basalt. Note chilled contacts and cross-fractures in fragments, some filled with quartz.

PLATE VIII

A.—Rounded inclusions in massive basalt. Note white quartz in factured inclusion.

B.—Banded, fine-grained sedimentary rock, north of McDonald Lake.

subordinate gabbroic facies, the appearance of a diorite or of a mesocratic syenite. Coarse-grained rock of this type underlies that part of the triangular area lying west of a north-south line passing a mile east of the outlet of McDonald lake. Eastward from this line, and with no gradation or contact exposed, the rock is finer grained, and its content of dark minerals appears somewhat lower than that of the coarse-grained facies. This medium- to fine-grained facies of the complex has more the appearance of a normal syenite.

Two occurrences of fine-grained granite were seen intruding the coarse-grained facies of the complex. Dykes and small masses of pegmatite are found throughout the intrusive; they are more abundant in the coarse than in the fine-grained facies. Two altered and mineralized lamprophyre dykes, about a foot wide, cut both the coarse-grained dioritic rock and the younger pegmatite dykes intruding it at a point about 500 feet east of the western boundary of the map-area and one mile south of the east-west surveyed township line.

Gabbroic Facies

The gabbroic facies is found in the southwestern part of the triangular area underlain by rocks of the complex. The best exposures (3a on the accompanying map) are at a point about half a mile east of the western boundary of the area and a few hundred feet north of the surveyed township line. The rock has a fresh appearance and is a medium- to coarse-grained aggregate of dark minerals and purplish-grey plagioclase in about equal amounts.

In thin section, this facies is seen to be composed of 50 per cent calcic plagioclase, 45 per cent pyroxene, and 2 per cent biotite, with some chlorite, uralite, actinolite, apatite, hematite, and a little pyrite and quartz. The plagioclase is fresh, markedly twinned, and has been identified as labradorite (An_{55}).

Two types of pyroxene are present, monoclinic and orthorhombic. The former, which makes up about 25 per cent of the rock, is pale greenish with very faint pleochroism, and exhibits, in general good cleavages. It has positive elongation, extinction $Z \wedge \underline{c}$ 39^{o}-42^{o}, and birefringence 0.025 - 0.028. The optic axial plane is parallel to (010), and the optical sign is positive, with 2V about 60^{o}. These characters identify it as diopside. The orthorhombic pyroxene, hypersthene, is intimately associated with the diopside and forms about 20 per cent of the rock. It is pleochroic from pale reddish to very pale green, shows good cleavages in many grains, and has a lower birefringence (0.010 - 0.014) than the diopside but higher refractive indices, around 1.72. It is biaxial negative with axial angle about 75°, and the optic axial plane is parallel to (010). The dispersion is rather low, with r greater than v.

Both types of pyroxene are surrounded by a narrow rim of alteration products. Around the hypersthene, this rim is mostly iron oxide, probably hematite, whereas the diopside is surrounded by a pale bluish-green to almost colourless amphibole, chiefly in small needles. Small grains of iron oxides are present also as inclusions, particularly in the hypersthene. Most of the biotite appears to be a product of alteration of the diopside, whereas chlorite is associated more commonly with hypersthene. A small amount of apatite is present, and pyrite also is widely disseminated throughout the rock.

The fabric of the rock is generally granitic but, in places, it is micropoikilitic with small, rounded, diversely-oriented grains of pyroxene in the labradorite.

Dioritic Facies

In the field, the gabbroic facies of the complex is seen to grade into, and is surrounded by, a slightly more acidic facies, generally dioritic in appearance (3b on the accompanying map). Scattered outcrops of this dioritic facies are found for a distance of about two miles north of the exposures of gabbro mentioned above, and for 1,200 feet south of it. Eastward, the diorite extends to the contact with the volcanic and sedimentary rocks, and westward it continues to and beyond the limit of the map-area.

The diorite appears to have a slightly lesser content of dark minerals than the gabbroic facies, and the plagioclase in the unaltered rock is light grey, with only a very slight purple tint. The grain is slightly coarser, and the granular texture is more apparent, than in the gabbroic facies.

Four thin sections of the dioritic facies were examined. In the freshest of these, of a specimen collected half a mile due west of the gabbroic exposures mentioned previously, the rock is a medium- to coarse-grained aggregate of fresh andesine (An_{34}-An_{38}), with pyroxene, biotite, secondary amphiboles, apatite, epidote, magnetite, quartz, and microcline. The andesine makes up close to 50 per cent of the rock; monoclinic pyroxene, chiefly augite, about 25 per cent; orthorhombic pyroxene, 2 per cent; and biotite about 15 per cent. Both types of pyroxene are surrounded by rims of uralite, and biotite also is intimately associated with them. Iron oxide is fairly abundant in and around the pyroxene crystals, in association with small grains of apatite.

About 2 per cent of the rock is quartz and microcline, in about equal amounts. These two minerals are in fine grains and crystallized late: the microcline corrodes the andesine, and the quartz is common along cleavage and fracture planes in the biotite and pyroxenes. Epidote is mostly a product of alteration of the pyroxenes.

In all the other thin sections of the dioritic facies, the feldspar is somewhat lighter in colour and is andesine (An_{32}-An_{42}). It is clouded, saussuritized, and surrounded by rims of microcline and a more albitic plagioclase. The pyroxenes also are much altered and are largely changed to amphibole. An orthorhombic pyroxene is identifiable in only one section, but the cores of all the larger crystals of amphibole are either lighter in colour and less pleochroic than the periphery, or still contain relics of monoclinic pyroxene and abundant iron oxide. Quartz and microcline are, in general, more abundant in this altered dioritic facies than in the fresh type, and chlorite with titanite and leucoxene occur in small amount in association with the ferromagnesian minerals.

Syenitic Facies

The remainder of the intrusive complex is essentially a coarse- to medium-grained rock of syenitic composition. The coarse-grained syenite facies contains, generally, between 30 and 40 per cent dark minerals, whereas hornblende and biotite form ordinarily about 25 per cent of the medium-grained type.

Several thin sections of the syenitic facies were examined. All were found to have essentially similar textural characteristics and mineral associations. Mafic minerals, however, are more abundant in the coarse than in the medium-grained facies. Some of the sections contain identifiable andesine.

Two specimens taken from the coarse-grained facies at a point some 3,000 feet east of the western boundary of the map-area and 1,500 feet south of the east-west township line, were found to be composed of andesine (An_{35}), 25 per cent; albite (An_9), 25 per cent; hornblende, 30 per cent; and biotite, 10 per cent. Late microcline forms about 7 per cent of the rock, and late quartz 2 per cent. The accessory and secondary minerals are apatite, leucoxene, epidote, allanite, sericite, and a few scattered crystals of brown tourmaline. The andesine is, in general, much clouded but reliable determinations of its composition were obtained. The albite, which is fresh, surrounds and corrodes the andesine and obviously was introduced after the crystallization of the latter. The microcline is younger than both the andesine and the albite and apparently is of the same age as the quartz. Vermicular microcline occurs in many of the albite grains.

The hornblende is generally highly pleochroic from dark bluish-green to pale brown, but the cores of many of the larger grains are lighter coloured, less pleochroic, and contain abundant iron oxide inclusions. Some amphibole is clearly pseudomorphous after pyroxene, and it is believed that most, if not all, of it is a product of alteration of that mineral. The biotite appears to be largely secondary after hornblende.

In all the other sections examined, the rock is a granular aggregate of albite-oligoclase, microcline, hornblende, biotite, and a little quartz. The sodic plagioclase (An_8-An_{18}) content ranges from 25 to 65 per cent, with the average about 40 per cent. The mineral is generally fresh and, in the coarse-grained facies, occurs either in small grains or as rims around highly-saussuritized cores, the indices of which are distinctly higher than albite or oligoclase. Accurate determination of the calcicity of the saussuritized plagioclase was not possible, but the writer has little doubt that the cores are remnants of a plagioclase similar to that identified as andesine in less-altered specimens of the diorite-syenite complex. In one section of the coarse-grained syenitic facies, a slightly-broken, euhedral crystal of feldspar shows a highly-clouded core surrounded by an albitic zone, which, in turn, is rimmed by microcline. The albite corrodes and projects into the saussuritized core, and is itself corroded by the microcline that rims it. This is obviously not primary zoning but rather a secondary phenomenon. These features are easier to observe in the coarse-grained facies, because of the relatively large size of the grains. They undoubtedly occur in the fine-grained type also, but in this, probably owing to the finer texture of the rock, the change of the primary plagioclase to albite-oligoclase has been more complete.

Microcline makes up between 10 and 20 per cent of the average syenite and was one of the last light-coloured minerals to crystallize.

Hornblende forms between 15 and 30 per cent of the rock and, in most of the sections examined, it evidently formed from pyroxene. Augite was recognized in the centre of large hornblende crystals in two sections of the coarse-grained facies, and in all of them the core of the larger hornblende grains is lighter in colour, less pleochroic, and richer in iron oxide inclusions than the periphery.

Biotite varies in amount from 1 to 15 per cent and most of it appears to be secondary after hornblende. The content of quartz is of the order of 5 per cent, except in one section, of a specimen taken near the contact of the syenite with the adjacent sedimentary rocks, which contains 25 per cent quartz. Epidote, allanite, titanite, sericite, iron oxides, apatite, and chlorite are the common secondary and accessory minerals, and tourmaline was observed in two sections.

Granite is exposed at two places (3d on the accompanying map) within the area of outcrop of the intrusive complex under consideration. One of these outcrops is about a mile and one-third east of the western boundary of the area and one mile north of the east-west surveyed line; the other is slightly over half a mile east of the western boundary and some 2,000 feet south of the surveyed line. The northern exposure is very low, partly covered, and does not furnish any evidence of the age relationship of the granite to the nearby syenite. The southern occurrence, however, is along a small ridge which exposes a plug-like mass, about 300 feet in diameter, of fine-grained grey granite intruding the coarse-grained syenitic facies of the complex. The granite consists essentially of a granular aggregate of microcline, albite, quartz and biotite. The albite (An_8), which makes up about 25 per cent of the rock, is slightly saussuritized and was apparently the first mineral to crystallize, since it occurs, in part, as small inclusions in the quartz which, in general, fills the interstices between the plagioclase grains and forms about 12 per cent of the rock. The microcline, last mineral to form, occurs in large grains which contain numerous diversely-oriented inclusions of quartz and albite; it also corrodes the albite in myrmekitic fashion.

Biotite, in small flakes (about 5 per cent), is the only ferromagnesian mineral in the granite. Apatite is associated with the biotite which is seen, in places, going over to sericite. Magnetite is present in relatively large euhedral crystals.

Origin of the Diorite-Syenite Complex

The border facies of the intrusive mass tends to be slightly gneissic and contains partly-digested inclusions of greenstone. The intruded formations themselves have been altered near their contact with the intrusive. Lit par lit injections are common in the sedimentary rocks along the northern border of the intrusive, from McDonald creek westward to the western boundary of the map-area and along the south shore of McDonald lake and southwestward. Highly altered and lit par lit- injected volcanic rocks also are found along Inconnu river from the western boundary of the area eastward for a distance of at least two miles and north of the same river close to the southeastern boundary of the complex.

On the other hand, the tenor of quartz in the intrusive is usually much greater near its contact with the sedimentary rocks than it is close to the volcanics; this suggests that some of the intruded rocks have been incorporated by the intrusive. It can be seen on the accompanying map that the outcrops of the gabbroic, and of most of the dioritic, facies of the complex are somewhat in line with the east-west-trending gabbro bodies north of Capisisit lake. This suggests that the gabbroic and the dioritic facies may have been formed from a similar gabbro body which has been left largely intact at its centre, but outward has been re-worked to yield a diorite. On this hypothesis it is, however, difficult to explain the remarkable freshness of the constituents of the gabbroic and of some of the dioritic facies. Furthermore, the plagioclase in the gabbro bodies north of Capisisit lake has the composition An_{60}-An_{65}. It is scarcely conceivable that the anorthite content of the plagioclase could be reduced from An_{65} to An_{55}, and even An_{35} in the fresh diorite, without any trace of the former plagioclase being left, and without any extensive alteration of the pyroxenes, which are quite fresh in the gabbroic and in part of the dioritic facies. In the gabbro bodies north of Capisisit lake, the pyroxenes are much altered and have been converted to hornblende and tremolite. The same is true for the much larger gabbro masses in the southeast corner of the area.

Some exposures of the dioritic facies are north of the line of trend of the above-mentioned gabbro bodies north of Capisisit lake, and, furthermore, relics of a calcic plagioclase are still visible in thin sections of almost all specimens from the intrusive complex that were examined microscopically, even those taken very close to the contact with sedimentary rocks.

The hypothesis that the fresh gabbro could be part of a younger basic intrusive cutting through the dioritic-syenitic complex is incompatible with the field relationships. The gabbro was observed grading into fresh diorite, and small pegmatite dykes were seen intruding both of these rocks.

It is suggested that, when emplaced, the intrusive mass was in the main, if not wholly, dioritic in composition, but with a gradational gabbroic facies in at least one place. Under the influence of later, more acidic magmatic products, the diorite was altered and made over to a rock with the composition of a mesocratic syenite. This hypothesis would explain the relationships, as now seen under the microscope, between the constituent minerals of the several facies. The original calcic plagioclase (labradorite or andesine) was extensively altered and partly or wholly made over to oligoclase or albite. The pyroxenes were changed to hornblende, which in turn was, in places, altered to biotite and chlorite. Microcline and quartz were introduced, and hydrothermal epidote, sericite, and chlorite were produced.

The fine-grained granitic plug-like mass mentioned above as cutting the syenitic facies, and the relatively numerous pegmatite dykes, are other manifestations of the presence of a later acidic magma. The _lit par lit_ injections and quartz veins in the adjacent volcanics and sedimentary rocks are also a result of this later, more acidic intrusion. It is not possible to state whether the original gabbroic and dioritic facies are early differentiates of the same magmatic mass that generated the later more acidic products, but it is possible that the small granitic bodies, one of which was actually seen intruding the syenite, are cupolas from a larger acidic mass lying below the dioritic-syenitic complex and genetically related to the much larger granitic intrusions to the south and southeast. This conclusion is reinforced by the abundance of pegmatite dykes, quartz veins, and lit par lit injections along Inconnù river between the Capisisit Lake granite and the western boundary of the area, as well as in the volcanics between the coarse-grained granitic mass in the southwestern section of the area and the altered dioritic intrusive under consideration.

Capisisit Lake Granite

A fine- to medium-grained, pink, altered granite outcrops in the form of an elongated, southeasterly-trending mass almost completely surrounding Capisisit lake and extending about one mile into the Branssat-Kreighoff area (11) to the east. Good exposures of the Capisisit Lake granite occur along the northern shore of the lake, especially on the large peninsula slightly west of its centre, and south of Inconnu river in an area some five square miles in extent and adjacent to the eastern limit of the map-sheet.

In the exposures around Capisisit lake, the granite is a relatively fresh and massive aggregate of quartz, pink feldspar, and hornblende. The microscope shows that the rock consists of about 50 per cent albite (An_8), between 15 and 35 per cent microcline, 10 to 25 per cent quartz, about 15 per cent hornblende and biotite, and small amounts of chlorite, epidote, allanite, titanite, apatite, sericite, and iron oxides. South of Inconnu river, the granite is, to the naked eye, a highly altered pink rock composed mainly of feldspar, quartz, and minute flakes of biotite. Accessory minerals are the same as in the fresher facies around Capisisit lake.

The albite is fresh in specimens from the shores of the lake, but in the rock farther southeastward it is much altered and difficult to identify accurately. Dark green, highly-pleochroic hornblende makes up about 15 per cent of the fresh granite but, where the albite is saussuritized, the hornblende is altered to biotite. In some specimens of the granite collected south of Inconnu river, in which the albite is much altered, no hornblende is left and biotite and chlorite are the only dark minerals. In many specimens, the hornblende is surrounded by a rim of biotite, numerous inclusions of which are also present in the amphibole. In the more altered granite, biotite flakes are themselves surrounded by rims of chlorite which also penetrates along the cleavage planes of the biotite. Sericite occurs as a product of alteration of both the biotite and albite.

The potassic feldspar, microcline, is invariably fresh and well twinned. It is common in large grains containing rounded and angular inclusions of albite and quartz and, in a few of the specimens examined, of hornblende, biotite, and sericite. The quartz is, in general, intimately associated with microcline.

The Capisisit Lake granite, especially in that part of the mass underlying the area south of Inconnu river, has been deformed, so that its constituent minerals are now strained or fractured. A well-developed protoclastic texture is almost everywhere evident, and the albite, hornblende, biotite, and to a lesser extent the quartz, show the effects of stress. In general, however, the microcline is remarkably free from granulation or crushing, and it very frequently occurs in large unstrained grains containing fragments of all the other minerals of the granite. This is true also of some of the quartz, but in general this mineral has been stressed and fractured. Most of the microcline and some of the quartz undoubtedly crystallized after the culmination of the stresses that produced the shattering and granulation of the granite.

Waswanipi Granite

Some 45 square miles of the southwestern and south-central section of the map-area is underlain by a large granitic mass, which is a marginal facies of the more extensively exposed body to the west and south of the present area. This granite was examined by Longley (16) in the Bachelor Lake area immediately south of the area herein described, and was named by him 'Waswanipi granite' (2).

Exposures of the Waswanipi granite occur abundantly in the south-central section of the present area, and its contact with the intruded gabbroic and volcanic rocks can be traced along the eastern half of the mass. Toward the west, however, the boundaries of the intrusive body are covered with thick glacial deposits, exposures are very scanty, and, consequently, the contact can be traced only approximately.

Considerable variations in appearance, composition, and texture were observed in the Waswanipi granite within the limits of the present area. It may be stated, however, that normally it is a medium- to coarse-grained, quartz-rich, leucocratic rock containing abundant pale pink feldspar and a low tenor of dark minerals, mostly biotite and its products of alteration. The rock is in general massive, but a distinct foliation is visible in the contaminated contact facies along the eastern border of the mass. In some other places, farther away from the intruded rocks, the biotite flakes may show some degree of alignment, but generally the granite is quite massive. Pegmatitic dykes and lenses are abundant in the whole area underlain by the granite.

Under the microscope, the rock appears as a granular aggregate of albite (An_8-An_{10}), microcline, quartz, and biotite as the main constituents, with chlorite, sericite, epidote, allanite, zoisite, titanite, apatite, zircon, and iron oxides as secondary and accessory minerals. Albite makes up between 35 and 70 per cent of the rock and is usually fairly fresh. Many of the plagioclase grains show zoning. In these, the clouded core has refractive indices slightly higher than the surrounding albite and presumably is slightly more calcic. The content of potassic feldspar, mostly microcline but with a small amount of orthoclase, varies widely even within the limits of a single exposure. In some specimens it is practically absent, whereas in others it forms more than 50 per cent of the rock. The microcline is everywhere fresh and well-twinned and, locally, is in large grains containing, in poikilitic fashion, scattered unoriented grains of albite. In practically all the thin sections examined, the potassic feldspar corrodes the albite, and it appears that for the most part, the microcline crystallized after the albite.

Quartz makes up between 15 and 35 per cent of the rock and is also of late crystallization. It fills the interstices between albite grains and contains inclusions of plagioclase and mica. Biotite, the only primary dark mineral, forms from 2 to 15 per cent of the rock. It is brown, highly pleochroic, and in general partially altered to chlorite, with inclusions of sagenitic networks of, probably, rutile crystals. Sericite, allanite, epidote, and zoisite are, locally, fairly abundant. Primary muscovite was noted in a specimen of the pegmatitic facies of the granite, and large cubes of pyrite occur in the gneissic contaminated contact facies.

A cataclastic texture is a conspicuous feature of this facies of the Waswanipi granite; most of the larger grains of quartz and albite have been either granulated at the periphery or completely shattered. The albite seems, however, to have resisted the stresses much better than the quartz, and in the gneissic contact facies it frequently occurs as large, well-aligned 'augen', whereas the quartz has been completely granulated. In many specimens, the biotite shows bent lamellae, and, in some, quartz and potassic feldspar grains have grown along the cleavage planes of the biotite and have pushed them apart. Some of the quartz and microcline is obviously of post-kinematic crystallization, however, since grains of these minerals are seen that are unstressed and contain fragments of all the other constituents of the granite.

Dyke Rocks

As already noted, pegmatite dykes are abundant, and aplite dykes are fairly numerous, cutting the major acidic intrusive masses of the area, but are not so conspicuous in the Capisisit Lake granite as in the other bodies. In the volcanic, sedimentary, and gabbroic rocks, they are generally limited to the vicinity of the contact between the intruded rocks and the plutonic bodies. Farther away from the acidic intrusives, few occurrences of pegmatite or aplite are to be seen. A small exposure of coarse-grained pegmatite makes a very low island in Inconnu river at the bottom of the second rapid about one mile down-stream from the outlet of Capisisit lake. Some two miles farther fown the river, small pegmatite dykes cut through a highly hybrid rock of granitic appearance, and small pegmatitic dykelets occur in the lit par lit-injected volcanic rocks near the middle of the one-mile-long rapid about two miles east of the western limit of the area.

Buff to dark grey porphyritic dykes are to be seen in all parts of the map-area and are especially numerous in the sections underlain by volcanic, sedimentary, and gabbroic rocks. They very in thickness from a few inches to about five feet. Most of them were introduced in a concordant fashion into the usually steeply-dipping intruded formations. The larger dykes generally show chilled margins, and most of them have been altered by dynamic metamorphism to a degree comparable to that of the rocks they intrude; others, however, are massive and unsheared. Obviously, the majority of the porphyritic dykes were introduced in a sheet-like fashion prior to the main culmination of the dynamic metamorphism that affected the area.

In most of the porphyritic dykes, the phenocrysts are euhedral to subhedral crystals of plagioclase. These are distributed through a darker-coloured, finer-grained, feldspathic matrix. In the thin sections examined, they range in composition, from one dyke to another, from An_8 to An_{25}. Where they are albite or sodic oligoclase, the rock is usually lighter in colour than that containing the more calcic oligoclase phenocrysts. Small quartz porphyry dykes were seen at various places in the area, one of the largest being at the contact between the coarse-grained facies of the diorite-syenite complex and the intruded sedimentary rocks, at a point about 3,000 feet south of the outlet of McDonald lake. The great majority of these porphyritic dykes, and especially the schistose and sheared types, are altered and contain secondary quartz and carbonate, with scattered pyrite.

Olivine Diabase Dyke (Keweenawan ?)

An olivine diabase dyke trending N.35°E. intrudes coarse-grained Waswanipi granite at a point about midway across the map-area and a mile and a half from its southern boundary. It is well exposed for nearly a quarter of a mile, with a maximum width of about 50 feet. Stringers of pink aplitic material from four inches wide to almost paper thinness are scattered through the exposures of the dyke and cut both the diabase and the granite.

The diabase is a medium-grained, dark grey, massive rock with a rather faint diabasic texture, except for a width of about five inches adjacent to its contact with the granite where, due to chilling, the rock is fine-grained and almost black. The weathered surface is rusty brown due to the abundance of iron present in the rock.

Under the microscope, the diabase is seen to contain about 40 per cent labradorite (An_{58}-An_{63}), 45 per cent pale green augite, 5 per cent colourless olivine, and 5 per cent hypersthene. The diabasic texture is very apparent in thin section. The rock is fresh, with only slight alteration of the augite and hypersthene to tremolite and a narrow rim of chrysotile bordering the rounded olivine grains. Biotite, chlorite, ilmenite, magnetite, and pyrite are present in small amount.

In one of the thin sections examined, the diabase is traversed by a narrow, plagioclase-rich aplitic stringer. This has a granitic texture, contrasting with the ophitic texture of the diabase. Its chief constituent is an acidic plagioclase, probably oligoclase, which, however, is almost opaque due to the extreme abundance of very fine grains of red iron oxide disseminated through it. The only other essential minerals are quartz, in small amount, and an occasional flake of biotite, but long needles of dark green hornblende appear at the contact between the aplite and diabase. The writer is of the opinion that the aplite is a product of differentiation of the same magma that produced the olivine diabase, and that this diabase is part of the system of basic dykes common in this part of the Canadian Shield and believed to be of Keweenawan age.

CENOZOIC DEPOSITS

The southwestern part of the area and a large patch near the western boundary, opposite McDonald lake, are covered by a thick blanket of clay deposited in post-glacial lakes. The remainder of the map-area, although containing morainic accumulations, has relatively abundant rock exposures for this part of the Canadian Shield. Around

Capisisit lake and in the southeastern and northeastern parts of the area, the glacial deposits are very thin, and on the hills considerable bed-rock protrudes through the light mantle of unconsolidated deposits — gravel, sand, and till.

The drainage as a whole has not been greatly disturbed by the passage of ice-sheets, except in the southern part of the area. Morainic deposits have obstructed the main streams and are not yet completely eroded away, but in general the glacial débris was not thick enough to fill completely the main river valleys, and the streams were able, after the disappearance of the ice, to re-occupy their former beds. An outstanding exception is McDonald creek, which is believed to be of post-glacial origin. In pre-Pleistocene times, the lake probably drained into Inconnu river through the tributary coming in from the northeast and joining the river about a mile east of the western boundary of the map-area.

Many glacial striae were observed in the area. They indicate a general direction of ice movement about 30° west of south.

STRUCTURAL GEOLOGY

Folding

The volcanic and sedimentary formations and the sill-like gabbroic intrusives of the area have been intensely deformed by dynamic metamorphism, possibly at several periods. The resultant structure is complex, and considerable difficulty was encountered in trying to ascertain the attitude of the numerous folds and the position of their axes. Because of the similarity between the beds of arkose and greywacke, and also by reason of their sparse and restricted exposure, it is very seldom possible to trace a given bed beyond the limits of a single outcrop. Cherty and iron-bearing formations are of no greater assistance because of the lack of a sufficient number of exposures of these types of sedimentary rocks.

Similarly with the volcanics, very few of the flows yield any information on the fold structures of the area. This is because of the difficulty in determining tops and bottoms of the individual flows on account of the considerable thickness of the lava beds, the similarity in composition between flows, and the abundance of dykes and sills of rock similar in both composition and grain to the lavas themselves. These are many pillowed flows in the area, but deformation of the pillows has made all but a few unreliable for the determination of tops and bottoms of flows. The numerous folded and concordant bodies of basic intrusive rocks in the volcanic and sedimentary series are not suitable for structural determinations, either because of their lenticular shape or due to the partial or complete recrystallization of their constituent minerals, which has made them uniform in appearance.

Thus, the areal structure cannot be worked out by following a single bed or a series of beds, a definite flow or series of flows, or a concordant intrusive. It must be determined by other means, such as observations on strikes and dips, cross-bedding, grain gradation, drag folds, pillows, and other minor structural features of the rocks. Strike and dip observations give only scanty information because of the steepness of the dips, and because the beds and flows are, in many places, undoubtedly overturned.

The larger structural features of the area trend generally east-west. Almost everywhere, there is concordance in strike and dip of the bedding and the schistosity of the folded and deformed volcanic and sedimentary rocks and, where this is not the case, the divergence is small. The dips of the formations are, as stated above, generally steep.

North of McDonald lake, the general trend is roughly east-southeast. The strike of the schistosity of the volcanic rocks of the northern belt is closely parallel to the strike of the adjacent sedimentary beds on the south, as well as to the gneissic structure of the quartz diorite on the north. In this part of the area the dips are very steep, from 70°N. to 70°S., with most of them vertical.

East and immediately south of McDonald lake, the sedimentary beds strike east-west; east of the lake they dip steeply or vertically and just south of the lake,between 45°N. and 70°N. Close to the diorite-syenite intrusive complex, south of the western extension of the lake, the strike of the sedimentary formations is, in places, close to northeast. Flow structures and gneissic structures in the complex are everywhere nearly parallel to the bedding of the intruded sedimentary series, and, in general, to the contact between these and the diorite-syenite.

In the southern belt of volcanics, the strike of the flows and of the interbeds of sedimentary and tuffaceous rocks is generally east-west in the section of the area west of Capisisit lake. Eastward, their strike veers to a general east-southeast direction although with considerable variations locally, such as around the western extension of the Capisisit Lake granite body and in the southeastern part of the area. In this latter section, the occurrence of gabbroic masses much more resistant to dynamic metamorphism than the adjacent volcanics has produced a wrapping effect of the schistose lavas around the gabbroic bodies, so that the schistosity may strike in almost any direction. Locally, in the southern belt of volcanics, there is an angle between the strike of the flows and the schistosity, especially where shearing has occurred, but, in general, this difference in strike does not exceed ten degrees. The dips of the flows and of the schistosity are between 45° and 75° northward, in the whole of the southern belt of volcanic rocks.

Cross-bedding was not observed in the sedimentary and tuffaceous rocks of the area, and grain gradation was nowhere sufficiently pronounced to afford a reliable criterion for determination of tops and bottoms of either beds or flows.

Numerous drag folds were seen, but most of them are so small that it is very difficult to draw any satisfactory conclusion from them; furthermore, their axes have inconsistent and highly variable trends and plunges, even within the limits of a single outcrop. Thus, the smaller drag folds had to be rejected as indicators of the attitude of the major folds.

In two localities, however, observations on relatively large drag folds gave what is considered to be fairly reliable information on the major structure of at least a section of the area. One of these localities is some three miles north-northeast of McDonald lake, in sedimentary rocks, about 1,000 feet south of their contact with the northern belt of volcanics. One drag fold there has a length, along its axis, of 50 feet and is 25 feet wide. The axis of the fold strikes S.75°E. and plunges 45° southeast; its axial plane dips 85°S. The shape of the fold suggests that the beds on the north have moved eastward relative to those on the south, indicating that the drag fold is on the northern limb of an anticline or on the southern limb of a syncline.

At the other locality, about a quarter of a mile north of the western end of Colette lake, there are smaller but relatively well-developed drag folds in fine-grained, buff-coloured sedimentary beds. The average strike of the axes of the folds is east-west, and their plunges average 65° east; their axial planes dip from 85°S. to vertical. The shape of these folds seems to indicate the presence of a synclinal axis to the north. It is thus possible that a synclinal axis and an anticlinal axis of folding lie between these two localities of drag-folded sedimentary beds, and that the lavas and sedimentary rocks of the northern section of the map-area at least have been tightly folded into a series of closely-spaced synclines and anticlines, trending close to east-west and plunging more or less steeply east.

Despite the great abundance of ellipsoidal lava flows among the volcanic rocks of the area, less than a dozen reliable top determinations by pillows were made during this investigation. Three of these were obtained on a series of small, low exposures of basaltic flows interbedded with sediments, about 4,000 feet southwest of the first of the drag folds mentioned above. These pillows indicate that the tops of the flows are to the south; i.e., that the flows are right-side-up. It is thus possible that an anticlinal axis lies between these basaltic exposures and the drag-folded sedimentary formations to the northeast, and that between the basalts and the series of smaller drag folds just north of Colette lake there is a synclinal axis.

The only other relatively reliable top determinations by pillows were made in highly ellipsoidal flows, about two and a half miles south of the central part of Capisisit lake. There, the ellipses indicate that tops are to the north and that the flows are right-side-up.

In addition, the shape and distribution of some of the intrusive masses permits inferences to be made. It may be seen that the gabbroic intrusive bodies north of Capisisit lake are somewhat similar to those south of the lake. The gabbro is believed to have been introduced as sill-like masses into the volcanics and sedimentary rocks prior to their folding. The pattern of the gabbro bodies suggests the presence of a fold axis passing through the Capisisit Lake granite body and continuing westward slightly north of Inconnu river. The Capisisit Lake granite may have been introduced along an anticlinal fold plunging west. Such a fold would explain the curved strike of the intruded formations around the nose of the intrusive at the west end of Capisisit lake. If this hypothesis is adopted, however, the attitudes of the fold axes in the southern half of the area would be different from those in the northern half since, in the latter part of the area, the axes are believed to plunge east.

It is quite possible, on the other hand, that the active force attending the granitic intrusion was sufficient to 'dome' the overlying volcanic and gabbroic rocks, and that subsequent erosion produced the pattern actually seen in the district around Capisisit lake. The distribution of the mafic and plagioclase-rich facies of the gabbro south and north of Capisisit lake also suggests the presence of an anticlinal structure in this section of the area.

The areal pattern of the rock masses may also be considered as an indication of the structure of the rocks themselves. The general picture of the two belts of volcanic rocks separated by a band, five to six miles wide, of water-laid sediments points to the presence of a broad synclinal basin in which the lavas were extruded and subsequently overlain conformably by sediments. Volcanic and sedimentary formations were found interbedded at many places close to the contact between the two series, especially along the northern limit of the sedimentary belt.

Work in the Branssat-Kreighoff area (11) to the east has indicated the presence of a large synclinal basin in which the clastics were deposited, apparently conformably, on the underlying volcanics, but more work is necessary before an exact picture can be drawn of the complex structural details of the region.

Shearing and Faulting

There are probably many faults in the area. It is unlikely that the lava flows, the sedimentary beds, and, to a lesser extent, the gabbroic sills could have been so closely and complexly folded without the development of fractures. Many shear zones were seen during the field work, but direct evidence of faulting is very meagre because of the complexity of the structures, the lack of key beds or flows, the thickness and similarity in composition of the flows, and, above all, the heavy drift cover over the weak and easily-eroded zones of fractures and breaks. Strike faults especially would be detectable only under extraordinarily favourable circumstances.

The most prominent fault seen in the area is close to the south shore of Capisisit lake. A sharp, V-shaped depression, more than 300 feet deep, is visible in the series of ridges south of the lake, slightly east of its centre. This depression is a very conspicuous feature and can be seen best from the air as a very straight break, about a mile and a half long, trending N.45°E. The rocks on either side of the depression are well exposed. They are basaltic lavas intruded conformably by numerous sill-like gabbroic bodies, most of them small but one relatively large, which are offset by the fault. The strike separation along the fault, as shown by the offset of the large body of gabbro, is about 1,500 feet, and the relative movement is that of the west block northeastward. No slickensides were observed along the sides of the depression, and the fact that the hill on the west side of the fault is somewhat higher than that on the east is not considered as indicative of the vertical component of the movement along the fault plane. This difference in altitude between the two hills is undoubtedly the result of differential erosion, the hard, brittle, hornfels-like rock of the western hill being much more resistant to weathering than the relatively soft amphibolite schist of the eastern hill.

Slightly south of the summit of the ridge, on the west side of the fault, and about two miles from Capisisit lake along the trail leading southwestward, there is a series of outcrops showing two well-developed intersecting shear zones. One of the shears strikes N.45°E., i.e., parallel to the V-shaped depression between the two hills, whereas the other is parallel to the local bedding and schistosity, that is,at about S.45°E. The northeast-striking shear is the older since it is displaced by the southeasterly-striking shear. The offset is about fifteen feet and the southern wall has moved northwestward relative to the northern wall.

The distribution of exposures of volcanic rocks and granite about three-quarters of a mile west-southwest of the two shear zones just discussed points to the presence of a 'break' extending across the granite-volcanics contact in a probable northeast direction, on the east side of which the volcanics are offset to the southwest. There is, however, no physiographic expression of such a 'break'. Its direction is assumed as northeast because that is the prevailing trend of the known fractures in the vicinity, such as the large fault to the northeast and one prominent set of joints in the granite. The evidence of movement along the strike shear, as indicated above, points to the possibility that the two faults may be parts of one and the same 'break', the southern extension of which was displaced westward — or the northern eastward — by later movement parallel to the local strike of the rock formations.

At the northern end of the fault, less than a mile south of Capisisit lake, physiographic features, as well as the general trend of some of the joints in the Capisisit Lake granite, seem to warrant the inference that the fault is post-granitic and extends into the granite in the general manner shown on the accompanying map.

From a point on the western boundary of the map-area about half a mile south of Inconnu river, a major shear zone appears to extend northeastward to about a mile north of the northwest bay of McDonald lake. Its course is marked by a northeasterly-trending depression, occupied in part by the southwesterly-flowing tributary of Inconnu river. Most of the exposures of volcanic and sedimentary rocks of this section of the area show considerable shearing and fracturing. The usually massive rock of the coarse-grained facies of the diorite-syenite complex becomes gneissic close to this zone of fracturing and its gneissic structure parallels the trend of the depression.

An east-west zone of shearing follows the south shore of McDonald lake and extends to the eastern limit of the map-area. This zone, in its western part, also follows approximately the contact between the diorite-syenite complex and the intruded sedimentary rocks. Exposures of sedimentary rocks on the south shore of McDonald lake, slightly east of the end of the portage from Capisisit lake, show strong shears and fractures. At the actual contact between the intrusive complex and the sedimentary rocks, close to the south shore of the lake, movement has occurred, as evidenced by brecciation of the intruded sedimentary formations prior to their granitization and by highly-fractured zones in the intrusive itself. Evidence of movement is seen also in the interruption of a dyke cutting through the sheared and altered intrusive rock along the south shore of the lake, three-quarters of a mile from its eastern end. The strike separation, as evidenced there by the fractured dyke, is of the order of three feet, with relative displacement of the north wall westward. Eastward from McDonald lake, a rather sharp depression extends to Colette lake, at the eastern boundary of the area, and outcrops of gabbroic rocks there are highly schistose and altered.

Sheared sedimentary rocks are exposed at numerous points along the lower half of McDonald creek, especially along the stretch one mile to a mile and a half south of Maicasagi river. These rocks — fine-grained greywacke, slate, and ferruginous chert — as well as feldspar porphyry dykes that intrude them, have been intensely fractured and, in places, reduced to a gouge-like, soft mass. The shearing strikes northwesterly. Very little evidence of direction of actual movement was found in these exposures of sheared rocks, but faint slickensides seem to indicate that the eastern side was displaced northwestward relative to the western side.

Numerous other, smaller, shear zones, most of them parallel to the local strike of schistosity or bedding, were seen in the volcanic and sedimentary rocks, especially in the southeastern section of the area. The gabbroic rocks, also, in some of their exposures, are sheared, and a good number of the small porphyritic intrusive bodies of the area are either moderately schistose or highly sheared.

Jointing

The rocks of the area are not much jointed and definite patterns are seen only in the massive intrusive rocks, *i.e.*, in the diorite-syenite complex, in the Waswanipi and Capisisit Lake granite bodies, and, less well developed, in the large gabbroic masses. The gneissic quartz diorite of the northeast section of the area and the sedimentary and volcanic rocks show very little jointing.

Most of the joints are either vertical or dip at a steep angle. Whether they were formed by tension or by shear is not clear; however, most are believed to be the result of the regional stresses that produced the folding, schistosity, and shearing in the volcanic, sedimentary, and the greater portion of the gabbroic, rocks. Close to contacts between the massive intrusive bodies and the intruded schistose rocks, two sets of joints have generally developed, one parallel or nearly so to the schistosity of the intruded rocks, the other about at right angles to this and, in some cases, evidently in line with cross-fractures and shears.

There are good exposures of jointed granite on the north shore of Capisisit lake. In the granite near the western intrusions of the lake, two intersecting sets of joints closely parallel the schistosity and bedding of the volcanic rocks on, respectively, the north and the south side of the nose of the intrusive mass. Farther eastward, one set of joints is still parallel to the schistosity of the adjacent volcanics, but the other set tends to become aligned with the northeasterly-trending fault south of Capisisit lake. Similar relationships are seen in the jointed diorite-syenite complex on McDonald creek. In other sets of joints these relations are not so clear, but it is believed that the majority of the steeply-dipping joints are the result of regional stresses acting on brittle rocks, in which lateral relief was easiest.

Flat-lying joints were observed at a few points in the intrusive rocks of acidic and intermediate composition. Where these rocks are gneissic, the flat-lying joints occur usually at right angles to the banding.

ECONOMIC GEOLOGY

General Statement

Until 1947, there had been very little prospecting in the Capisisit Lake area. In 1946, however, the attention of prospectors was drawn to the Bachelor Lake area adjoining on the south, which was mapped in that year by W.W. Longley, and gold and other mineralization of interest was discovered at a number of points in the southern part of that area (13, 16). Then, toward the end of the 1947 field season, prospectors working for O'Brien Gold Mines, Limited, discovered a narrow quartz vein, rich in gold, in sheared gabbroic rock at a point only about half a mile southwest of the southeast corner of the Capisisit Lake map-area. In subsequent weeks, a considerable number of claims were staked northward from this discovery into the southern half of the present area.

The Bachelor Lake and Capisisit Lake areas lie within, and are underlain by rocks that form a part of, the wide zone of volcanic and sedimentary rocks that extends from beyond Mattagami lake in the west to Chibougamau lake in the east. To some extent the two map-areas have similar geological characteristics; this is particularly true for the northern section of the Bachelor Lake area and the southern half of the Capisisit Lake area.

Much disseminated sulphide mineralization was observed in the map-area during this investigation, and many of the volcanic and, to a lesser degree, the sedimentary and altered gabbroic rocks show scattered pyrite crystals, with concentrations of sulphides at a few places. Iron staining of the volcanic, sedimentary, and gabbroic rocks was quite frequently seen, with copper 'colours' at a few scattered points. Several shear zones containing pyrite were observed.

White quartz veins are fairly well distributed throughout those parts of the area underlain by pre-granitic rocks and are particularly numerous in the section between the Waswanipi granite and the Capisisit Lake granitic body, from Capisisit lake to the southeastern corner of the map-area. Those observed by the writer range in width from ten feet to a fraction of an inch, and some show concentrations of sulphides. In addition, the schistose volcanic and tuffaceous formations at many points in that section of the area exhibit replacement by silica or pyrite, or by both. It is obvious that hydrothermal solutions were active there, causing a deposition, in tension cracks, of quartz with, in places, sulphides, as well as silicification and pyritization of the schistose country rocks.

The better mineralized exposures of rock, as well as some of the quartz-carbonate bearing shears, are indicated on the accompanying map by a small circle surrounding a number which corresponds to one of the individual occurrences described below.

Mineralized Exposures

1- Sheared and silicified volcanic tuffs, about half a mile north of Capisisit lake, containing scattered pyrite mineralization with a small amount of white quartz and carbonates.

2- Sheared, fine-grained gabbro in the southeast corner of the area. Heavy pyrite, pyrrhotite, and magnetite mineralization.

3- Small, slightly-mineralized, sheared volcanic exposure, about a mile north of the east end of Capisisit lake.

4- Sheared, porphyritic andesite, iron- and copper-stained, with lenses of quartz and containing disseminated pyrite, pyrrhotite, and chalcopyrite, about two and a half miles south of the western part of Capisisit lake.

5- Silicified and fractured lava along Inconnu river, two and a quarter miles west of Capisisit lake; scattered pyrite mineralization.

6- Heavy pyrite replacement in sheared greywacke on the south shore of McDonald lake near its eastern end.

7- Mineralized and sheared andesitic lava, one mile south of Maicasagi river, near the centre of the map-area.

8- Iron-stained, garnetiferous sedimentary bed with abundant pyrite, one mile southwest of No. 7.

9- Mineralized and sheared porphyritic intrusive, one mile northwest of No. 8.

10) Sheared and mineralized slates, porphyry dyke, ferruginous chert,
11) and fine-grained feldspathic sedimentary rocks, along McDonald
12) creek, about one mile south of Maicasagi river.

13) Slightly-mineralized quartz lenses in sheared volcanics, a mile and
14) a quarter west of Capisisit lake.

15) Heavy pyrite replacement in ferruginous, cherty sedimentary beds,
16) two and one-quarter miles north-northeast of the eastern end of McDonald lake.

17- Highly altered and carbonatized lamprophyre dykes, close to the western boundary, and near the centre, of the area.

Recommendations

On account of the abundance of mineralized outcrops observed, the writer believes that the present area deserves careful search, not only for gold and silver, but also for base metals such as zinc, lead, copper, and nickel.

The structurally complex southeastern section of the area appears to be the most promising for the occurrence of mineral deposits, for the following reasons:

(a) Its position between two granitic bodies, both of which show indications of advanced differentiation. This is especially true for the Waswanipi granite in which pegmatites, aplites, and quartz veins are very abundant.

(b) The complex distribution and structure of the gabbroic, volcanic, tuffaceous, and sedimentary formations outcropping in that section of the area.

(c) The presence there of a large fault and of abundant cross-fractures.

(d) The abundance of quartz veins, one of which, in the fall of 1947, was found to contain gold, and the frequent occurrences of replacement of some minerals of the greenstone rocks by silica, quartz, and carbonate.

The search for economic minerals should be concentrated as much as practicable in the areas of low ground where sheared and schistose volcanic and, to a lesser extent, gabbroic rocks are likely to occur. It is believed that the volcanic and tuffaceous rocks will prove to be the best host-rocks for the occurrence of larger amounts of metallic minerals. In the more massive gabbroic rocks, tension cracks are abundant and are commonly filled by quartz, but they are generally short and lenticular and the rock between them is massive and unaltered. The small, schistose gabbroic bodies are, of course just as promising as the adjacent volcanic formations.

Porphyry dykes also appear to deserve a good share of the prospector's attention since they are, in many places, sheared and mineralized; they may easily have played a part in the localization of mineral deposits.

The highly-sheared rocks of the western section of the area from south of Inconnu river to McDonald lake and those of the district surrounding the lower course of McDonald creek should, on account of their structure and the presence there of quartz veins and mineralized zones, not be neglected by prospectors.

Recent Developments

As mentioned previously (p.43), a gold-bearing quartz vein was discovered, in the fall of 1947, just south of the present area. Following this discovery, an intensive programme of staking and prospecting was carried on by a number of companies, syndicates, and individuals throughout the field season of 1948. Toward the end of the summer, gold was discovered by prospectors for N.A. Timmins (1938), Limited, at a locality about half a mile north of the southern boundary, and one mile west of the eastern limit, of the present area.

Careful prospecting northward along the projected strike of the last-named find led to the discovery by the same Company, in 1949, of coarse, visible gold in a number of quartz veins, most of them in shear zones in volcanic or gabbroic rocks. The gold is reported to occur in cross-fractures in the quartz veins, some of which are quite large, and in silicified, schistose greenstone adjacent to the veins. Fine galena is said to occur in some of the veins. The mineralized structures apparently trend close to north-south.

It is expected that a programme of diamond drilling will be carried out during the summer of 1950 in order to test the depth and lateral extensions of the zones already discovered. Undoubtedly, additional surface work will be done in the vicinity in the search for other ore structures.

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