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FORTY-SIXTH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

1937

PART III

PROVINCE OF ONTARIO

DEPARTMENT OF MINES

Hon. Paul Leduc, *Minister of Mines* H. C. Rickaby, *Deputy Minister*

FORTY-SIXTH ANNUAL REPORT

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ONTARIO DEPARTMENT OF MINES

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Royal Canadian Air Force Photograph

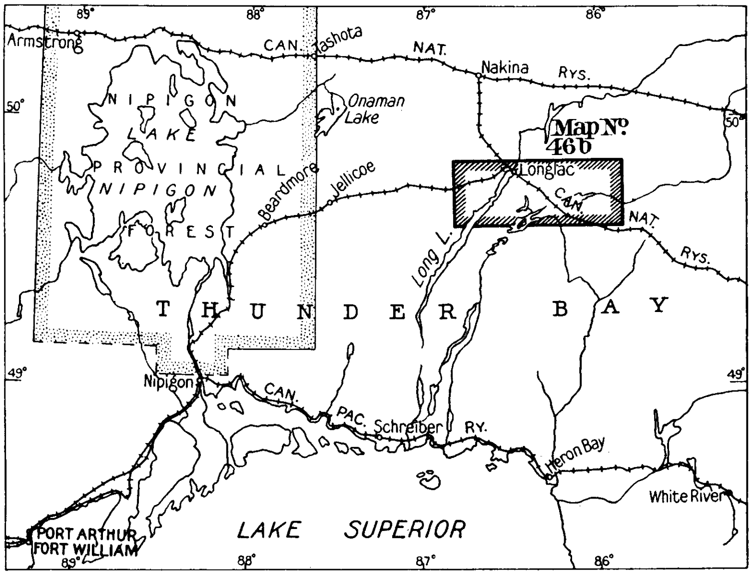
Long lake, looking southwest.

Geology of the Northern Long Lake Area

By H. W. Fairbairn

INTRODUCTION

The recent developments in the Little Long Lac gold area[1] have focused attention on the economic possibilities of the adjoining territory, of which the Northern Long Lake area forms a part. The occurrence of formations and intrusives on Long lake identical with those on Little Long Lac (Kenogamisis lake) has resulted in a considerable amount of prospecting in this vicinity, and the discovery of gold in many places has been an encouraging factor. Although none of these occurrences has yet proved to be of commercial grade, further work or new discoveries may change the outlook.



Key map showing the location of the Long Lake–Pagwachuan Lake map-area. Scale, 50 miles to the inch.

Acknowledgments

The progress of the field work was greatly aided by the co-operation and generous assistance of Longlac residents and property owners, among whom the following deserve particular mention: George Reesor, Ontario Forestry Branch; F. Taylor, Hudson's Bay Company; S. Cockburn, West-Side Long Lac Mines; R. MacFarlane, MacFarlane Long Lac Gold Mines; B. Adair, Long Lac Adair Mines; W. Samuel, Little Long Lac Gold Mines; Murray Watt, Roche Long Lac Gold Mines; E. O. Magnusson, Goldcrest Mines; Jerry Shewchuck, Indian Head Long Lac Mines; Charles Lindbergh, Garnet Long Lac Mines; Anson Cartwright, Coniagas Mines; Messrs. Tomlinson and Perry, N.A. Timmins

[1]E. L. Bruce, "Little Long Lac Gold Area," Ont. Dept. Mines, Vol. XLIV, 1935, pt. 3; "New Developments in the Little Long Lac Area," Ont. Dept. Mines, Vol. XLV, 1936, pt. 2, pp. 118-140.

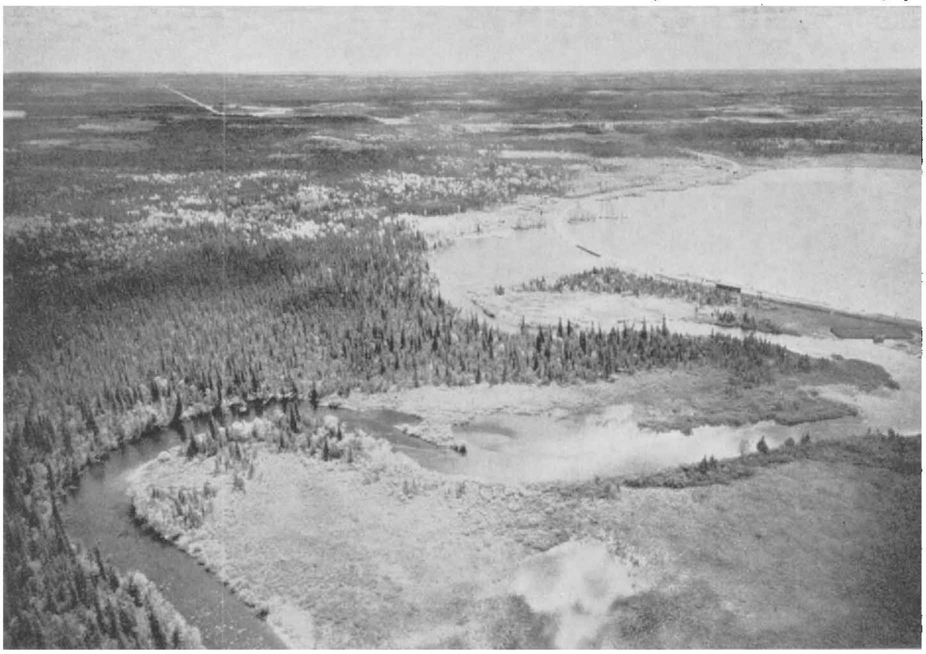
Corporation; Ben. and Gene Killoran; Messrs. Hudson and Nelsen; Messrs. Phillips and Benner, surveyors; John Butterfield, Northern Surveys and Exploration Company.

Credit for a large part of the field work and map compilation is due to R. D. Macdonald, senior assistant. J. W. McBean and J. E. Milne, junior assistants, carried out their duties in a highly satisfactory manner.

General Description of the Area

The northern tip of Long lake lies in the township of Oakes, 70 miles north of Lake Superior, 65 miles east of Lake Nipigon, and 20 miles east of the Little Long Lac gold mine. Long lake strikes in a northeast-southwest direction through

Royal Canadian Air Force Photograph



View looking southeast across the Kenogami river and Long lake, showing the typical low muskeg topography.

the centre of the area, which is bounded on the north by the northern boundaries of Houck and Oakes townships, on the west by the western boundaries of Houck and Croll townships, on the south by an east-west line three miles south of Croll township, and on the east by the Kenogami and Making Ground rivers.

Means of Access

Before the construction of the Canadian Northern (now National) railway, Long lake was accessible by canoe routes only. There were two of these, the terminus of one being Jackfish bay and of the other, Heron bay. The Jackfish bay route traversed 29 miles of portages and small waterways from Lake Superior to the south end of Long lake. The Heron bay route followed the Pic river north to McKay lake and from there the Making Ground river to the north end of Long lake. This route was preferable for southward, downstream navigation only.

Since the construction of the railway, Longlac is the chief point of departure for all parts of the area. Long lake affords excellent water transportation directly from the railway to the southern boundary, 14 miles distant. The northern boundary is reached by means of the Kenogami river or the railway. The eastern section is served by the Making Ground river, a small stream which is navigable without portaging over its whole course within the area. West of Long lake, Hardrock, on the Port Arthur branch of the railway, is the most convenient point of departure for the western part of the area; direct water transportation to the south is provided by Little Long Lac and Eldee lake, and to the northeast by the Kenogamisis river. No part of the area is more than 15 miles from Longlac or Hardrock on the railway, and no part is farther than 4 miles from a navigable waterway. Motor launches and scows operate without difficulty on Little Long Lac and Long lake. In late summer the outlet from Eldee lake into Little Long Lac is navigable only by canoe; this is also true of the Kenogamisis river. On the Kenogami river power transportation can be used up to the first portage, just beyond the northern boundary of the area. The Making Ground river is navigable by motor boat during the whole season for the first 5 miles and in early summer for a greater distance. Practically all the prospects are within half a mile of the waterways and are reached by good trails. There are three short portages on the Kenogamisis river; the portage on the Kenogami river just beyond the area mapped is in poor condition. Summit portage, which runs from the Making Ground river to Seagram lake, is the main route to McKay lake. It is 1¾ miles long and is in good condition. On the Indian reserves there is a network of wood roads and trails, none of which is useful, however, as direct means of transportation.

Previous Work

The first geological exploration of Long lake was made by Robert Bell in 1870.[1] His route followed the Pic river to McKay lake, across Summit portage to the Making Ground river, thence to Long lake and down the Kenogami river. In 1900, E. V. Neelands[2] traversed Long lake from the south, explored the Kenogami river basin, and returned by way of the Making Ground river and McKay lake. In 1907, A. L. Parsons[3] travelled up the Kenogami river, crossed Long lake to the Making Ground river, and left the area by way of McKay lake. In 1908, A. P. Coleman[4] traversed Long lake from the south and crossed the difficult portage route at the north to Little Long Lac. A. G. Burrows[5] commenced the season of 1916 with two weeks' work on Long lake and McKay lake and then moved westward toward Jellicoe. The following year T. L. Tanton reported[6] on an area which includes that described in this report, and a map[7] was later published.

All these investigations were exploratory and of a reconnaissance nature. The topography and waterways were surveyed and the main granite-greenstone contacts outlined. The iron formation was thought at first to be of potential

[1]Robt. Bell, Geol. Surv. Can., Rept. of Progress, 1870-71, pp. 335-337.

[2]E. V. Neelands, "Report of Survey and Exploration of Northern Ontario, 1900," Ont. Dept. Mines, 1901.

[3]A. L. Parsons, "Geology of Thunder Bay–Algoma Boundary," Ont. Bur. Mines, Vol. XVII, 1908, pp. 95-135.

[4]A. P. Coleman, "Iron Ranges of Nipigon District," Ont. Bur. Mines, Vol. XVIII, 1909, pt. 1, p. 141.

[5]A. G. Burrows, "Longuelac to Jellicoe and Orient Bay," Ont. Bur. Mines, Vol. XXVI, 1917, pp. 227-247.

[6]T. L. Tanton, "Canadian Northern Railway between Nipigon and Longuelac, Northern Ontario," Geol. Surv. Can., Sum. Rept. 1917, pt. E, pp. 1-6.

[7]T. L. Tanton, Map 313A, Geol. Surv. Can., 1934.

value, but since none of it proved to be of commercial grade, interest in the whole region subsided. In 1932 a major gold discovery was made on Little Long Lac, which developed into the present Little Long Lac mine. In 1934, owing to the growing importance of the Little Long Lac belt a considerable amount of staking and development work was done east and west of Long lake. There was a lull in 1935, but in 1936 new finds on Little Long Lac gave rise to renewed activity on Long lake.

Topography

Long lake drains northeast by the Kenogami river to James bay. It forms the central part of a narrow embayment cutting south for 50 miles into the Lake Superior drainage basin. The country at the upper end of Long lake, south of the map area, has considerable relief, in common with the topography of the north shore of Lake Superior. Farther north the relief decreases gradually, until at Longlac village there are practically no elevations.

The details of the topography are similar in almost every respect to those of the Little Long Lac area.[1] Lakes are numerous and, with the exception of Long lake, are small and shallow. Owing to the proximity of the height-of-land, drainage between them is poor, the small creeks are sluggish, and the channels are highly contorted. The lake shores are usually low and open into swamps and muskegs in many places. Owing to the inefficient drainage, the water level does not reach its normal height until late in summer.

In the western part of the area the trend of the topography is about N. 40° E., parallel to Long lake. East of the lake it varies considerably. West of Long lake the parallelism of lakes, swamps, and intervening narrow ridges is very marked. These ridges or eskers are composed of gravel and sand, their outlines bearing no relation to the rock exposures. In places the deposits are of irregular shape and show no linear parallelism with the drainage. They are invariably steepsided, resembling oversize railway fills in many respects. East of Long lake the greater abundance of rock outcrops obscures the post-glacial topography to some extent: The esker-like ridges and mounds of unconsolidated material are less abundant, and the small lakes do not lie entirely in basins of glacial deposits, as is the case to the west; rock basins are commoner, and the northeast trend of the lakes is less pronounced. The Making Ground river, which follows a course slightly east of north, drains this side of the area, so that muskegs and swamps are not extensively developed.

Long lake has a length of about 50 miles and a maximum width of 2½ miles, with a direction of N. 40° E. over most of its length. Its basin is formed by glacial deposits and is not determined by the strike of the rock formation, which is east-west. The shores at the north end, where the railway skirts the water, are low and flat, and the lake is shallow. At Seven Mile point, 7 miles to the south, the shores are rocky, especially on the east side, and within a few hundred feet of the water rise 200 feet or more. From this point the lake narrows and deepens for a distance of 4 miles. It is less than half a mile wide in places, and depths of about 100 feet are reported. The shores south of the narrows are for the most part rocky but have less relief than in the area immediately to the north.

Long lake has only one important tributary within the area mapped. This river, the Making Ground, roughly parallels the lake up to a point within two miles of its mouth. Here it bends sharply west and flows sluggishly into the lake. Its shores are low at the north, rise gradually at the Indian Reserve boundary,

[1]E. L. Bruce, Ont. Dept. Mines, Vol. XLIV, 1935, pt. 3, pp. 5-9.

then fall again in the southern part of the area. Its valley, like the basin of Long lake, is not determined by the strike of the rocks. The stream has an even grade, and in only two places is canoe navigation interfered with by a few hundred feet of swift water.

The Kenogami river forms the outlet of Long lake to James bay. It flows through low-lying muskeg country with little rock exposure. The first waterfall is just beyond the map boundary.

Royal Canadian Air Force Photograph

View of Mineral lake showing the northeast-southwest trend of the topography.

The northwestern part of the area includes the northeast arm of Little Long Lac and its outlet to James bay, the Kenogamisis river. The shores here are low except for a few small hills composed of glacial deposits. The lake is shallow, and the shore line changes considerably between early spring and late summer; islands become peninsulas and bays become marshes. The valley of the Kenogamisis river is independent for the most part of the rock structure, and the river crosses bed rock in two places over a series of rapids.

In summary, the principal features of the topography are: (1) the general northeast-southwest trend of lakes, streams, swamps, and gravel ridges; and (2) the fact that these topographic features are independent of the east-west strike of the rock structures.

Natural Resources

The location of two Indian reserves and a Hudson's Bay post at the north end of Long lake has given Longlac village considerable importance as a fur-trading centre. The soil at the north end of Long lake is suitable for garden products and potatoes and is tilled to a considerable extent by the Indians and white population of the village. Grain and hay do not thrive particularly well. There is an abundance of good timber, especially near Little Long Lac and in the southeastern corner of the area. It is restricted in this latitude to poplar, birch, spruce, and jackpine, but would suffice for most purposes should the area develop into a mining centre. Fire has cleared the good timber from a part of the southwestern section; elsewhere the district is heavily forested.

Although the fish and game possibilities of the Long Lake area have not yet won outside recognition, they deserve mention in any description of the natural resources. Moose and grouse are fairly plentiful; pickerel and lake and brook trout are common game fish. Additional favourable factors are the navigability of the lake for 50 miles by motor boat directly from the railway, and the fact that beyond the first 13 miles the territory is uninhabited.

Potential sources of water power are lacking in most of the area, owing to its situation on the height-of-land. On the Kenogamisis river there are a number of small falls that might be utilized in a small way if the need arose. Four miles from Longlac there is a 15-foot fall on the Kenogami river, undeveloped as yet, but of possible value locally.

GENERAL GEOLOGY

The geological section of the Northern Long Lake area is similar in most respects to that of the Little Long Lac area. All the consolidated rocks are pre-Cambrian. These are overlain by sands and gravels of glacial origin and in places by peat of poor quality. The pre-Cambrian rocks include highly altered basic lavas, agglomerate, and hornblende, chlorite, and biotite schists, which are grouped as Keewatin; conglomerate, greywacké, arkose, iron formation, and quartzite, grouped as Timiskaming; granite, granodiorite, quartz diorite, diorite, and quartz and feldspar porphyries, probably later than the sediments; and diabase dikes, which are definitely younger than the other rocks of the area and are grouped in the Keweenawan.

The terms "Keewatin," "Timiskaming," and "Keweenawan" are used in this report provisionally only, since the area is far removed from the type localities for these series. At some future time it may be possible to make a more definite correlation.

Table of Formations

QUATERNARY	
RECENT:	Clay, peat.
PLEISTOCENE:	Sand, gravel.
	Unconformity
PRE-CAMBRIAN	
KEWEENAWAN:	Diabase dikes.
	Intrusive contact
POST-TIMISKAMING:	Feldspar porphyry, quartz porphyry, altered acid porphyry. Diorite and diorite porphyry. Quartz diorite. Granite, granodiorite, granite gneiss.

Intrusive contact

TIMISKAMING:	Greywacké, arkose, quartzite, slate. Iron formation. Conglomerate.

Unconformity

KEEWATIN:	Sediments: Biotite schist, impure quartzite, iron formation. Volcanics: Greenstone, chlorite schist, hornblende schist, agglomerate.

Keewatin

The rocks included in the Keewatin are in part altered basic lavas and are usually schistose in character. Three lithological types are distinguished: a chloritic phase (including agglomeratic and ellipsoidal greenstone), a hornblende phase, and a biotite phase. The chloritic phase is clearly an altered basic lava and predominates in the northwest corner of Croll township on Little Long Lac and in a belt immediately south of the main granite mass. Ellipsoidal structures were observed in the former of these localities and are well developed on the north shore of Little Long Lac. They occur also on the west side of the Birch Bay claims. Agglomerate is of common occurrence and is particularly well exposed on the west shore of Long Lake narrows. On a small spit on this shore the glaciated agglomerate might easily be mistaken for conglomerate. Much of the agglomerate is strongly sheared and elongated and is recognizable only with difficulty. Amygdules are typical of all these rocks.

In thin section the chlorite rocks exhibit a fine, matted texture due to the presence of laths of clouded plagioclase and shreds of chlorite. Varying amounts of hornblende, epidote, carbonate, quartz, biotite, and sericite are also present. Where identified the plagioclase is within the composition range of andesite. As the mineral assemblage indicates, the assumed andesite has been almost entirely altered to the chlorite-carbonate-epidote-sericite phase characteristic of Keewatin greenstone.

The hornblende phase is easily recognized by the predominance of long black hornblende blades over the chlorite flakes. These hornblende rocks occur over a large part of Oakes township as well as in two narrow belts in the southern part of the area. They are uniformly schistose, and no textures or structures are found in them that would identify them as lavas. The minerals present are mostly hornblende and quartz, with lesser amounts of plagioclase, biotite, epidote, carbonate, chlorite, and sericite. The plagioclase is altered and fine grained and has not been identified. The predominance of quartz suggests a sedimentary origin for this hornblende phase.

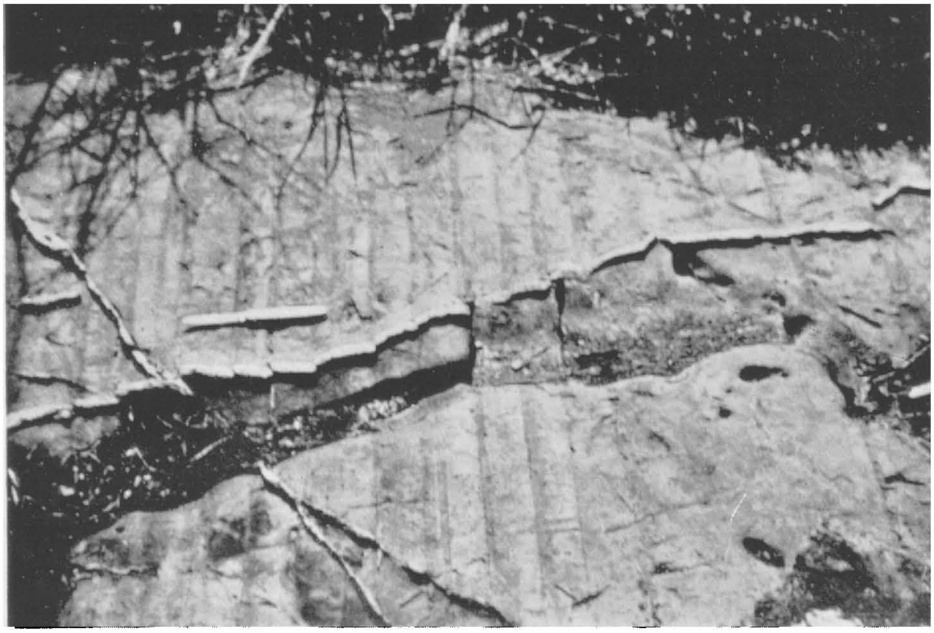
The biotite phase is of local distribution. One zone lies east of the Making Ground river and immediately south of the granite contact. It is highly schistose and lighter in colour than either the chlorite or hornblende phases. Biotite and quartz are the most abundant minerals, with small amounts of plagioclase, hornblende, epidote, chlorite, and sericite. Fine banding in a few of the exposures, as well as the predominance of quartz, points to a sedimentary origin. An entirely similar zone is found on the south side of the area, continuous with a large area mapped to the east. Indications of iron formation are found along Summit portage, but no outcrops have been located.

The field relations of these three types of schist do not yield any information concerning their relative ages. Their boundaries are parallel to the strike of the schistosity wherever observed, top and bottom are unknown, and the character of the mineral alteration is similar for all of them. They are provisionally grouped as Keewatin.

A zone of hybrid rocks is found on the Indian reserve east of the Making Ground river. These are in part schistose greenstones, in part massive and perhaps of igneous origin. Isolated exposures of similar type occur farther south in the neighbourhood of the river. All are here included in the Keewatin.

Timiskaming

Clastic sediments, principally greywacké, make up the greater part of the Timiskaming group. Two belts occur in the area: a small one north of the granite in the neighbourhood of Octopus siding, and a second south of the granite and extending across the area. The latter is the continuation of the main sedimentary zone of the Little Long Lac area.



Banded greywacké intersected by quartz veinlets, Octopus siding.

The northern belt includes the conglomerate mapped by Tanton[1] on the Kenogamisis river, one mile north of Little Long Lac. This conglomerate has been traced eastward into Oakes township but was not observed south of the railway. The large conglomerate outcrop mapped by Bruce in the northeast corner of Lindsley township[2] may belong to the same belt. South of Hutchison lake there are unmapped sediments which may also belong to this zone. In the Long Lake area greywacké is the most abundant sediment, and its banded character may be seen in an excellent exposure at Octopus siding south of the track. No iron formation was seen, and there is no indication of its presence from compass readings. Quartzite and arkose were not observed in this belt. At the Indian Head property the greywacké is very dark in colour and slaty in appearance and resembles very closely material from two nearby outcrops in the Little Long Lac area,[3] mapped by Bruce as slate and included in the Keewatin.

[1]Tanton, op. cit.
[2]E. L. Bruce, op. cit., map No. 44d.
[3]Ibid.

With the exception of the conglomerate and iron formation, the main belt of sediments in the southern part of the area has not previously been differentiated from the chlorite and hornblende schists. It consists largely of greywacké and is characterized by iron formation and conglomerate across its entire northern side.

The conglomerate is the most conspicuous member of the series and contains many boulders measuring from 10 to 15 inches in diameter. A coarse grey granite forms the commonest type of boulder; in addition there are boulders and pebbles of vein quartz and porphyry and of a light-green flinty rock, possibly volcanic in origin. No jasper or iron formation was noted in the boulders. Most of the boulders are severely deformed and elongated, so much so in certain localities that it is difficult to decide the true nature of the rock.

The iron formation consists largely of magnetite layers, rarely more than a few inches thick, interbedded with fine greywacké and, in places, with cherty layers. Hematite and jasper are not of common occurrence in the iron formation of Long lake. Much more iron formation was indicated by compass readings than was actually observed in the outcrops. Excellent exposures may be seen on the east shore of West Side bay and on a point immediately south of Birch bay. The beds are locally thickened and thinned by deformation and show intricate patterns of drag folds in many places. The iron content is variable, in some cases being so low that the rock scarcely merits the term iron formation.

Greywacké and local occurrences of arkose make up the bulk of the Timiskaming series. Greenish-grey colours predominate, and the fine banding of the greywacké is characteristic. A conspicuous feature is the varve-like sorting of coarse and fine grains in individual beds, which makes possible the distinction of top and bottom. In thin section quartz, biotite, and plagioclase make up the greater part of the rock. Sericite, chlorite, epidote, and hornblende occur in minor amounts. The texture is usually fine, but the grain size is uneven, quartz commonly occurring in conspicuous grains. This is particularly true of the arkoses associated with the greywacké. These occur in massive greenish beds, 12 to 15 inches thick, on whose weathered surfaces whitened quartz grains stand out in strong relief.

The greater part of the Timiskaming group of the Long Lake area is of clastic origin, in common with Timiskaming rocks elsewhere. The single exception is that of the iron formation, whose cherty layers are probably of colloidal origin. The iron-rich bands, however, are mostly magnetite and would be of clastic origin.

The thickness of the Timiskaming sediments is unknown, but is probably to be measured in thousands rather than hundreds of feet. Owing to the close folding and deformation of the rocks, the discontinuous nature of the key conglomerate beds, and inadequate exposures, it is not possible to give even an approximate thickness.

Keewatin-Timiskaming Age Relations

The use of the terms Keewatin and Timiskaming implies the existence of evidence that the sediments are younger than, and lie unconformably on, the hornblende and chlorite schists. The evidence in the Long Lake area is for the most part indirect, but on the whole is probably sufficient.

The Octopus band of sediments northeast of the granite dips steeply south on its northern side and steeply north on its southern side. The variation in grain size in individual beds shows that these sediments are younger than the enclosing hornblende and chlorite schists, and a syncline is therefore indicated. At its eastern end it pitches about 50° S.; in the central part 35° E.; for the western part there are no data available. The accumulated evidence points to a closely folded, upright synclinal trough, whose axis is itself strongly folded. No evidence of unconformity with the enclosing schists is found in this section.

The relations of the southern belt of sediments to the hornblende and chlorite schists are not everywhere clear, due in part to lack of exposures and also to inadequate data for determing top and bottom of beds. Grain variation in the sediments immediately south of the main greenstone contact indicates that they are younger. Since the dips in this zone vary from steep north to steep south, these beds must be in part overturned.

A band of hornblende schists lies within the main belt of sediments, but no decisive criteria are available to determine its age. It tapers out on the west side of Long lake and disappears under the drift cover. Eastward it is interrupted by a porphyry stock and then joins the main greenstone belt centring on the Making Ground river. Immediately to the north in this section the sedimentary belt lenses out in a few outcrops of conglomerate. Since the regional pitch is 45°–50° W. these relations suggest indirectly a synclinal form for this part of the sedimentary belt and an anticlinal structure for the tapering tongue of hornblende schist, which would probably be continued in the sediments farther west. The observations of grain variation, although few in number, support the possibility of a syncline in the sediments.

Evidence of unconformity between the schists and sediments is suggestive, but not conclusive. Although the sediments and the schist have the same general trend, there are several marked local embayments along the north boundary of the sediments. The strike of the bedding adjacent to these embayments retains, however, its normal trend of slightly north of east and does not parallel these deviations in the boundary. Thus the overlap of the sediments on the schists occurs parallel to the strike of the bedding. This indicates unconformity rather than conformity of the two groups. The actual contact between them is concealed almost everywhere by intrusions of porphyry and diorite. An exception is the large island at the south end of Long Lake narrows where chlorite-hornblende schist is in direct contact with micaceous quartzite and conglomerate. Superficially this exposure is of no significance, since the same strike and steep dip prevail on both sides of the contact. The steep dip of the contact does not preclude unconformity, however, since extreme deformation of two unconformable formations could involve isoclinal folding of the surface of unconformity as well. This folded surface would then appear over most of its length as a contact showing the same strike and dip as the two formations it separates.

To summarize, the southern belt of sediments is younger and probably unconformable with the schists on its northern boundary; its exact relations to the two smaller tongues of hornblende schist is undetermined. A synclinal axis may lie about half a mile south of the main greenstone contact, and possibly an anticlinal axis in the larger tongue of schist to the south. The pitch of both formations averages 45°–50° W., with considerable variation from these figures in individual exposures. Dips are invariably high and on the average incline south rather than north.

Post-Timiskaming Intrusives

Rocks of four types are included in the group "Post-Timiskaming Intrusives": granite, quartz diorite, feldspar porphyry, and diorite. The porphyry and diorite are definitely post-sedimentary; the age of the others is uncertain, and they are included here provisionally only. The trend is in general slightly north of east, conforming to the strike of the older rocks. The porphyry and diorite are similar to the types described in the Little Long Lac area[1]; the granite and quartz diorite are not found there.

[1]E. L. Bruce, op. cit., pp. 20-25.

Granite, Granodiorite, Granite Gneiss

The various types of granite, granodiorite, granite gneiss, and altered granite are mapped as a unit but may possibly represent various ages and times of intrusion. The boundaries of the granite mass are irregular and form an elongated tongue ranging from 2 to 6 miles in width and extending in a northeast-southwest direction across the area. Excellent exposures occur on the Canadian National right-of-way and on the shores of Long lake; elsewhere the forest cover makes a detailed study difficult. The granite-greenstone boundary in the southwest corner of the area is conjectural as no outcrop has been found over a distance of two miles. Since compass indications of iron formation have been found, however, at half-mile intervals across this drift-covered zone, it is not probable that the main mass of the granite extends farther to the southwest. The nose may, indeed, not project as far southwest as indicated by the boundary, since there is no evidence of the width of the greenstone.

Hornblende granite and granite gneiss are the commonest types represented Both pink and white feldspars are found, and in many cases the hornblende is chloritized. The texture is medium to coarse, in places porphyritic. Biotite gneiss is also commonly found. Biotite-muscovite granite has been found but is not abundant. Granodiorite may be more common than the preliminary mapping has indicated. In addition, there are dark hybrid phases in which mica, hornblende, or chlorite have developed at the expense of the primary constituents. A coarse hornblende porphyry of this type occurs at the Longlac Forestry station, in which large hornblende porphyroblasts lie in a matrix of altered minerals which has little resemblance to the granite from which it probably originated. Large inclusions are found in several localities, the most prominent occurring on the west shore of Long lake 4 miles from the village. It consists of a fine, compact hornblende schist similar to many of the hornblende schists found elsewhere in the area.

The granite-granodiorite gneiss intrudes the rocks mapped as Keewatin and is itself cut by diabase. Its relation to the other intrusives and to the sediments is not known. Little is known of its structure, since observations of its linear elements are too scattered to be of much value. The few data at hand indicate a linear parallelism of the minerals on the steep foliation surfaces and a pitch of about 45° N.E. This contrasts with the uniform west pitch of the linear elements in the schists and sediments. Although the significance of this feature cannot be evaluated at present, it may be found to have an important bearing on the age of the granite.

Quartz Diorite

Quartz diorite occurs in two localities in the area. One occurrence is on the Mat-A-Lac claims west of the granite; the other and larger one is on the Making Ground river. Two types are found, one gold-bearing, the other apparently barren. The former is a hornblende-quartz diorite and forms the central part of the group of exposures on the Making Ground river. The remainder of the outcrops here and on the Mat-A-Lac claims to the west lack hornblende almost completely.

The rocks are of medium-grained granitic texture, massive, and not greatly altered. The hornblende-free type is a light-grey colour and easily passes in the field as a granite. It is slightly porphyritic, as shown by the larger grain size of some of the quartz and plagioclase. The plagioclase is an andesine; alteration products include epidote, chlorite, carbonate, and sericite. Biotite is usually present in small amounts, and tourmaline is accessory in one section examined. The hornblende-quartz diorite contains the same group of secondary minerals but in general is less altered. Milky-blue quartz is commonly seen. The plagioclase in one thin section is andesine. Hornblende occurs in conspicuous, stout, criss-crossing laths. In the Making Ground river locality, it is possible that some of the numerous exposures mapped as quartz diorite should be differently classified. A definite determination will only be possible when more of the exposures are opened up by prospecting.

The quartz diorite boundaries have a pronounced trend slightly north of east, parallel to the granite, and the rock is exposed over a width of about one mile. It intrudes greenstone and agglomerate; no contact with the sediments is known.

Altered Diorite

An entirely different type of diorite is found as small dikes and sills intruding the greenstone and sediments. Conspicuous exposures occur on the Maralgo property in Croll township, on the south shore of Birch bay, and half a mile west of Rocky Shore lake. The width seldom exceeds a few hundred feet, and the bodies conform to the strike of the intruded rocks. The rock is in some places difficult to separate from the coarser-textured phases of the greenstone and hornblende schist, and errors have undoubtedly been made in mapping. The localities in the sediments, however, show very clearly the intrusive character of the diorite.

The rocks are for the most part highly altered. They are of a uniform grey-green, blackish-green, to chlorite-green, and for the most part the plagioclase is inconspicuous. The texture is medium to coarse, and porphyritic varieties are common. There is usually a pronounced foliation or linear parallelism of the grains, which is conformable to the regional structure. In thin section plagioclase is seen to be the commonest mineral, although usually inconspicuous in the outcrops. An average from five sections shows it to be andesine. Hornblende is the other chief constituent, and the parallelism of the laths, or lack of it, determines the degree of foliation of the rocks. The porphyritic diorites contain hornblende as the principal phenocryst. Epidote, chlorite, quartz, and carbonate are found commonly in all the diorites; biotite and sericite occur in lesser amounts.

The age of the diorite is clearly post-Timiskaming and pre-Keweenawan, assuming that the diorite associated with the greenstone and lava is the same as that found in the sediments. The intrusive character is easily established, and since the diorite has also suffered deformation, it must be older than the unmetamorphosed diabase. It is the same type as that described by Bruce[1] in the Little Long Lac area and has similar age relations.

Acid Porphyries

The acid porphyries of the area are divided into three easily recognizable types, which, together with a number of other small acidic intrusives of indefinite character, are mapped in the same colour. With the exception of one large mass west of the Making Ground river, the porphyries occur as small dikes or sills, which intrude the sediments and schistose lavas parallel to the regional strike. The outcrops are shown on the map mostly as discontinuous dikes, and, except in a few cases, no attempt has been made to join them up. There is undoubtedly much more porphyry than has been mapped, but, unless the forest and drift cover is removed, the continuity of individual dikes will not be known.

The first type is a medium- to coarse-textured, white to grey feldspar porphyry. A typical exposure may be seen on the MacFarlane property on Long

[1] E. L. Bruce, op. cit., pp. 20, 21.

lake. The dikes are seldom more than 50 feet wide and intrude both sediments and greenstone. The white plagioclase phenocrysts are albite-oligoclase. The porphyry is usually massive and not much altered.

The second type is a fine-textured, highly schistose quartz porphyry. It is associated with the feldspar porphyry and is apparently more abundant than the latter. The schistose quartz porphyry occurs in dikes as wide as 300 feet, and several have been traced along the strike for two miles. The best examples are the three parallel dikes that traverse the peninsula between Birch and West Side bays. The porphyry has a characteristic waxy lustre and varies in colour from yellow-brown to grey-green. The eyes of quartz are distributed irregularly between the foliation surfaces and are usually clear and transparent. In thin section plagioclase is seen to be the dominant mineral, especially in the groundmass, its average composition from six sections being oligoclase-andesine. Sericite is the commonest secondary mineral. Carbonate, biotite, and chlorite are fairly abundant; epidote is less commonly found.

A feature of this schistose porphyry is the manner in which it impregnates the sedimentary wall rocks. This impregnation is usually characterized by the development of quartz or feldspar phenocrysts. Such recrystallization, particularly in the case of sheared greywacké, makes it difficult to distinguish true porphyry from the invaded sediments. The porphyry-greywacké boundaries are therefore in many places not very definite. If there were any doubt in some instances that these eyes in the greywacké were of igneous origin, the question could be settled by studying the impregnation of a boulder conglomerate on the West-Side property. The porphyry contact has been thoroughly exposed in this locality, and the eyes of quartz may be seen in the boulders as well as in the matrix of the sediments. Their secondary origin is thus clearly shown.

The third type is also a quartz porphyry and occurs principally in a large stock-like mass midway between Long lake and the Making Ground river. It is a fine-textured, light-grey, dense porphyry with poorly developed foliation. The quartz eyes are not particularly common, and the rock is easily mistaken for a quartzite. Although it is finely streaked with biotite, platy minerals are not abundant enough to give it a true schistosity. Four determinations indicate the plagioclase to be an andesine. Sericite, biotite, carbonate, and, rarely, chlorite are found in addition to the quartz and feldspar. The age relations of this porphyry stock are not yet established, but, since it straddles the Keewatin-Timiskaming boundary, it has been tentatively placed with the post-Timiskaming intrusives.

Examples of the first two porphyry types in the Little Long Lac area are described by Bruce.[1] The plagioclase is of almost identical composition, and the physical characters correspond very closely. The massive quartz porphyry is apparently not found farther west.

Keweenawan

Diabase

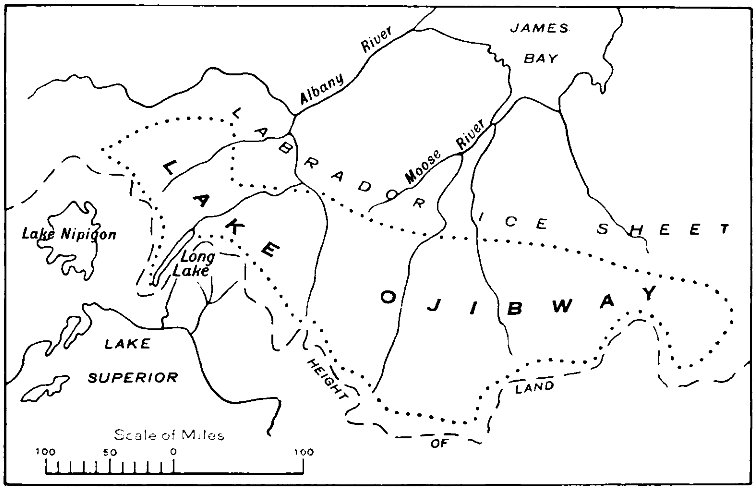
The youngest rocks of the area are diabase dikes. None appear to be wider than 200 feet and none have been traced continuously for more than three-quarters of a mile. As in the case of the porphyry dikes, the diabase is probably much more abundant than is indicated on the map. The dikes trend in general north-south and are apparently rather discontinuous. They are the quartz diabase type, although in many of them quartz is not abundant. In thin section they

[1]E. L. Bruce, op. cit., pp. 21-25.

show the usual plagioclase laths and blocky pyroxene grains. Although the composition of the plagioclase varies considerably, an average andesine-labradorite is indicated. Sericite, chlorite, epidote, biotite, carbonate, magnetite, and quartz are the accessory minerals. Large blebs of epidotized plagioclase are characteristic of the diabase in some localities; elsewhere it is fresh and relatively unaltered. The quantity of magnetite is usually too small to cause appreciable deviation of the compass needle.

Pleistocene

No rocks of any age occur between the diabase and unconsolidated gravels, sands, and clays of the area. Glacial erosion is shown by striae in a few localities, principally on outcrops on the shores of Long lake. The strike of these glacial grooves follows the northeast-southwest trend of the lake. Glacial deposits are widespread and in some places reach a thickness of 50 feet or more. The form of



Long lake in the Pleistocene (after Coleman).

the deposits varies. One type consists of irregular mounds or knolls of approximately oval shape; another, of elongated steep-sided ridges, undoubtedly eskers. These deposits are composed of sand and gravel and are most widespread in the area south of Croll township. Bruce,[1] reporting on similar glacial deposits from the adjacent Little Long Lac area, states that the irregular knolls are unstratified, and that the eskers are distinctly stratified. No sections through these deposits have been opened up in the Long Lake area, but it is probable that the same conditions obtain. At the north end of Long lake there are considerable deposits of fine sand and clay, which rise 15 to 20 feet from the shores of the lake. Away from the lake these are largely concealed by the recent cover of swamp and muskeg.

Long lake in Pleistocene time was a long narrow bay of Lake Ojibway, considered by Coleman[2] to be the last of the glacial lakes. The accompanying sketch map shows its relation to the present height-of-land. The absence of prominent beaches around Long lake is believed to be due to the narrowness of the bay and

[1]E. L. Bruce, op. cit., pp. 25, 26.
[2]A. P. Coleman, "Lake Ojibway: Last of the Great Glacial Lakes," Ont. Bur. Mines, Vol. XVIII, 1909, pt. 1, p. 284.

consequent negligible wave action. When the ice to the north melted, Lake Ojibway was drained into James bay leaving relic bodies of water such as Long lake, which likewise drain northward from the height-of-land.

Recent

Recent deposits consist largely of organic material, which collects in the lakes, swamps, and muskegs. Several feet of moss and peat lie in the muskegs, and, as the drainage is poor over most of the area, the accumulation takes place rapidly. Since there are no large streams, no important stream deposits of sand or clay occur.

STRUCTURAL GEOLOGY

Folds and Foliation

Direct evidence of folding is meagre in the area mapped. As already indicated, the northern belt of sediments is probably synclinal; the southern, main belt, on the contrary, has not yielded any definite information concerning the location of the main folds. Foliation and bedding planes are essentially parallel, and, since the variation in dip from place to place is slight, it may be concluded that the folding is uniformly close and in many localities isoclinal. Small drag folds are not abundant, and the pitch of the structure was determined almost wholly from the attitude of the parallel linear elements in the foliation surfaces. These average 45°–50° W. in both the greenstones and the sediments. The possible unconformity of the Keewatin and Timiskaming has already been discussed.

Faults

No major fault has been discovered in the Northern Long Lake area. In tracing formations where outcrops are scanty, curved boundaries have been assumed. The position of the two contacts on the west side of the narrows on Long lake indicates a possible horizontal displacement of half to three-quarters of a mile with reference to the contacts on the east side. The rocks on either shore, however, do not indicate any cross-fault of this type. Furthermore, a mile or so to the south the sediments and porphyry dikes are apparently conformable on either shore and on the intervening islands. Until more direct evidence of faulting in the narrows is available, therefore, these two boundaries are best considered as continuous.

Minor faults have been found and are doubtless common, but from the standpoint of structural interpretation they are of little importance. They invariably accompany any major deformation and are important only when they intersect an ore body.

Joints

Only one system of joints in the area has regional significance. The fractures have been developed by tensional forces and lie approximately at right angles to the foliation surfaces and to the pitch of the parallel linear elements. The average strike is therefore slightly west of north and the dip about 45° E. In places where the linear parallelism of the grains in the foliation surfaces was difficult to detect, it was found that the direction perpendicular to these joint planes was a good approximation of the pitch of the structure.

It is probable that the intrusions of diabase have been controlled to a large extent by this system of tension joints. Two of the three dikes whose strike is known continuously for several thousand feet trend slightly west of north. Of the remaining individual outcrops it can only be said that they have a general north-south trend.

HISTORICAL GEOLOGY

The geological history of the area is only partially known. Although the main outline corresponds with that of other pre-Cambrian sections of Northern Ontario, many details are lacking at Long lake. It may be summarized as follows: The earliest period, the Keewatin, is represented by great intrusions, in part submarine, of andesitic lavas and agglomerate. Locally, muds and sands were laid down. Deformation followed, which may have been accompanied by granite and quartz diorite intrusions. The region was then uplifted and eroded. Then followed submergence and deposition of sands, gravels, clays, muds, and iron formation. The subsequent deformation was accompanied by intrusion of sills and dikes of porphyry and diorite, and possibly of granite and quartz diorite. Direct evidence of the age of these latter two igneous types is lacking, as no locality is yet known where they intrude the sediments. At a much later time, when there was no accompanying deformation, diabase was injected along a north-south regional system of fractures.

No evidence of post-Cambrian sedimentation remains in the area. In the Pleistocene period, continental ice-sheets covered Long lake, removed most of the soil and plant cover, and striated the bed rock underneath. Its retreat northward gave rise to deposition of great quantities of gravel, sand, and clay along the melting front, and to the formation of many residual lakes. Since the glacial period organic deposits, chiefly peat, have formed in the swamps and muskegs.

ECONOMIC GEOLOGY

Gold is the only mineral occurring in the Long Lake area which has possible economic importance. Sand and gravel deposits are abundant and are used at present for railway maintenance. Their further development for road construction is dependent, however, on the existence of a mining industry, which has not as yet materialized. The iron formation found in the area is much too low in grade to have economic possibilities, and the known exposures do not indicate sufficient quantity even if the grade were high.

Gold

The gold deposits are associated with sheared diorite and acid porphyries in the sediments and greenstones and with the massive quartz diorites. The greater part of the gold occurs as native metal associated with quartz. Arsenopyrite and pyrite are the commonest associated sulphides. Wall-rock alteration is not marked in most localities. Sediments in particular are little affected, whereas the more basic greenstones are in places heavily carbonatized and chloritized. Silicification is present in only a few of the deposits.

No definite statement can be made as to the age of the deposits. Most of them are clearly younger than any rocks of the area except the diabase. The diabase cuts across the zones of regional shearing, and it seems probable that it is also younger than the mineralization that occurs in the shear zones. Since the time of the granite intrusion is not definitely known, it is likewise impossible to establish a definite age relation, on the assumption that the gold-bearing solutions are genetically related to the granite. The existing evidence indicates, therefore, post-sedimentary and pre-diabase time limits for the gold mineralization.

Other Metallic Minerals

The occurrences of the non-auriferous metallic minerals are described for the most part under the individual properties. The list includes pyrite, arsenopyrite, pyrrhotite, chalcopyrite, galena, sphalerite, specular hematite, and petzite. In addition, molybdenite is reported by Tanton[1] as occurring at Longlac station "in pink syenite dikelets which cut coarse-grained amphibolite." None of these minerals is of economic importance, and it is improbable that they ever will be. They are listed solely to complete the mineralogy of the area.

Iron Formation

The iron formation of Long lake is the eastward extension of the much larger iron ranges of Lake Nipigon, described by Coleman.[2] Assays of the best samples of one of these ranges, as given by Coleman, show a metallic content of 38.06 per cent., which is too lean to be of commercial value. Since both quantity and quality diminish to the east, there is little possibility of any workable deposit occurring in the iron formation of the Long Lake area.

Sand and Gravel

The thick and widespread deposits of glacial material include abundant supplies of sand and gravel. These are largely undeveloped at present but, as a potential source of cheap road metal, may be an important factor in the future of the area. Since many of the occurrences lie close to the main rail and water transportation routes, development would not be costly.

Future of the Area

Since none of the gold prospects at Long lake has yet proved to be of commercial grade, any forecast must necessarily be tentative. All of the gold occurrences are associated either with porphyries in the sediments and greenstone or with hornblende-quartz diorite. In the former type the favourable influence of the brittle sediments is probably just as marked in the Long Lake as in the Little Long Lac area, and a majority of the prospects lie in these rocks. The occurrences in the hornblende-quartz diorite have no counterpart in the Little Long Lac area. The biotite schist south of the area, despite its sedimentary origin, is apparently poor prospecting territory. Although the examination of these rocks was confined to the shores of Long lake, no porphyry or diorite intrusions were seen, and little sign of mineralization. These observations are in general agreement with those of other workers to the west.

In view of the successful development of the Little Long Lac, MacLeod-Cockshutt, and Hard Rock properties from small initial showings, further work in the Long Lake area is justified on many of the holdings occurring in the sedimentary belt. Prospects in the greenstone have proved on the whole to be less encouraging than those in the sediments, but should not be prematurely condemned on that account. The hornblende-quartz diorite mineralization also merits further systematic exploration, since the gold content is reported as particularly encouraging. In conclusion, it may be said that surface development in the area has not yet been carried far enough on most of the properties. The area is not without possibilities and should receive serious consideration.

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[1]T. L. Tanton, op. cit., p. 5E.

[2]A. P. Coleman, "Iron Ranges of Nipigon District," Ont. Bur. Mines, Vol. XXVIII, 1909 pt. 1, pp. 141-153.

DESCRIPTION OF PROPERTIES

A considerable number of companies are prospecting and developing properties held in the Long Lake area, although no deposits of commercial grade have yet been discovered. The following descriptions refer to conditions as they were at the end of the field season in September, 1936; developments since that time are not recorded. Descriptions of a few properties that lie just west of the map area are included in this report.

N.A. Timmins Corporation

The N. A. Timmins Corporation holds thirty-seven claims immediately south of the Indian reserve on the Making Ground river. These are in three groups: the Caouette group, claims T.B. 16,373, 16,374, 17,783, 17,784, 18,612–18,614, 18,228, 18,229, 18,434, 19,743; the Indian group, claims T.B. 15,774–15,779, 16,375, 16,851, 16,852, 17,655; and the McKay group, claims T.B. 14,449–14,451, 17,160–17,162, 17,237–17,239, 17,449, 17,450, 18,179–18,183. No important development work has been done on the last-named group.

The most important showing is on claims T.B. 16,373 and 17,784 of the Caouette group, about a quarter of a mile west of the Making Ground river. A steep-dipping shear zone, averaging 5 feet in width over a length of 300 feet, strikes N. 40° E. along the contact of a sheared agglomerate and massive hornblende-quartz diorite. The agglomerate is on the northwest, the diorite on the southeast. The shear zone contains a quartz vein averaging about one foot in width and shows coarse visible gold in many places. Pyrite and tourmaline are associated minerals. The zone has been traced at least 650 feet and apparently dies out to the southwest. The results of surface sampling and of preliminary drilling are reported to warrant more extensive operations.

The two best showings on the Indian group are No. 2 vein on claim T.B. 16,851 and No. 3 vein on claim T.B. 15,777. The former consists of a network of small quartz stringers spread over a zone 10 feet wide on the contact of hornblende-quartz diorite and a fine, highly altered, greyish dike rock. The contact strikes N. 85° E. and dips 55° N. A thin section of the dike rock shows a fine felted mass consisting mostly of calcite, quartz, feldspar, sericite, and accessory biotite, chlorite, and epidote. The feldspar is indeterminable, and much of the quartz may be secondary. The veinlets occur mostly in this altered rock and contain coarse visible gold, with minor amounts of chalcopyrite, pyrrhotite, bornite, and pyrite. A novelty is the occurrence with the gold of small amounts of the gold-silver telluride, petzite. Tellurides have not been reported elsewhere in this area. The vein zone forks at the southwest end and is continuous for a maximum distance of 100 feet.

No. 3 vein is highly deformed and discontinuous. The showing on the east end consists of an altered hybrid rock, probably greenstone, which contains a drag-folded quartz vein about 3 feet wide. This vein has been traced for 65 feet and contains irregular gold values. On the west end values are scattered over a width of 10 feet and a length of 200 feet. The shear zone contains, in addition to the vein, contorted hybrid greenstone and sheared dioritic material.

Goldfinders, Limited

The holdings of Goldfinders, Limited, lie west of the Making Ground river and consist of nine claims: T.B. 18,449, 18,452–18,457, 20,454, and 20,455. Development work had just commenced at the time of examination and was being carried out in order to locate the source of gold-bearing boulders of hornblende-quartz diorite found in the immediate vicinity. Coarse visible gold is reported in the boulders of the intrusive, with little or no accompanying quartz mineralization. On the property a 3-foot shear zone in hornblende-quartz diorite striking N. 35° E. had been uncovered for about 130 feet. The diorite at the break contained blue milky quartz grains, a few scattered 2-inch quartz stringers, and a considerable amount of pyrite. No gold values were reported.

Smith-Elliott Group

The Smith-Elliott group comprises claims T.B. 13,635–13,637, 13,808–13,822, and 13,988–13,996 on the east side of Long lake. The principal showing is on the lake shore on claim T.B. 13,813 and consists of irregular quartz-tourmaline stringers in fine, sheared feldspar porphyry. The enclosing rock is a coarse hornblende schist, striking N. 65° E., with a vertical dip. There is abundant pyrite, very finely disseminated arsenopyrite, and visible gold. The showing is uncovered over a maximum width of 30 feet and is traced for a quarter of a mile northeast from the lake.

Coniagas Mines, Limited

The Long Lake holdings of Coniagas Mines, Limited, comprise claims T.B. 21,137, 21,138, and 21,373–21,377 on the east side of the lake. The showing has been trenched and sampled for 200 feet parallel to the strike and consists of an altered greywacké band 35 to 50 feet wide enclosed by coarse hornblende schist and gneiss. In thin section the schist is seen to consist of sheared feldspar and hornblende grains with secondary interstitial quartz. Biotite, calcite, chlorite, sericite, and pyrite occur in minor amounts. The rocks are highly sheared, strike N. 75° E., dip 80° S., and pitch 45° W. The altered greywacké is mineralized parallel to the schistosity with very fine arsenopyrite. Quartz occurs in a few scattered irregular veinlets, which contain pyrite, pyrrhotite, bornite, and chalcopyrite. Gold values are reported as fair but erratic.

MacFarlane Long Lac Gold Mines, Limited

MacFarlane Long Lac Gold Mines, Limited, holds 9 claims, T.B. 13,003–13,011, on the east side of Long lake. Work has been done principally on two showings. The first of these is on claim T.B. 13,004 near the lake shore and consists of two coarse white feldspar porphyry dikes, 2 feet and 4 feet wide, separated by 5 feet of altered sedimentary material. The feldspar in the dikes is albite-oligoclase. The dikes are enclosed by sheared boulder conglomerate, which strikes N. 75° E., dips 80° N., and pitches 35° W. Coarse visible gold is reported from the porphyry contact. The contact is exposed for 125 feet, and a 40-foot shaft has been sunk at the west end.

Some 35 chains northeast along the strike from the above showing is a pit 12 feet wide in fine sheared quartz porphyry. The wall rock is sheared, porphyritized conglomerate. An irregular quartz lens about 3 feet thick, containing some pyrite, is found in the porphyry. No visible gold is reported.

A considerable amount of drilling has been carried out on this property.

McNeil Long Lac Gold Mines, Limited

McNeil Long Lac Gold Mines, Limited, holds claims T.B. 11,643–11,648 and 13,051–13,053 north of Birch bay. The main showing is on claim T.B. 11,647 and consists of a rusty-weathered zone about 100 feet wide in a massive dioritic rock. There are irregular small quartz masses as well as abundant disseminated pyrite. At the west end of this rusty zone there is an acid porphyry dike 2 feet wide. The country rock is agglomerate. No visible gold has been reported.

Farther south drilling intersected the eastward continuation of the Birch bay vein, but assay values are reported as discouraging.

Birch Bay Gold Mines, Limited

The holdings of Birch Bay Gold Mines, Limited, comprise claims T.B. 10,773–10,779 and 10,938–10,942, situated immediately northwest of Birch bay. A considerable amount of stripping and trenching has been done, and the main showing on claim T.B. 10,773 has been drilled. The showing consists of a 375-foot shear zone containing a system of small quartz veins, which have a maximum width of one foot. The zone strikes N. 75° E., dips 80° S., and lies in a coarse, sheared amygdaloidal agglomerate. Parallel to it and several feet to the north is a highly sheared diorite porphyry dike about 3 feet wide. The quartz veins in the shear zone contain abundant coarse pyrite, tourmaline, and visible gold. The quartz is honeycombed and strongly fractured, and the sheared portions range from 1 inch to 1 foot in width. Drilling disclosed encouraging values, but the zone was not wide enough to warrant further development.

Long Lac Adair Mines, Limited

Claims T.B. 10,470–10,475 and 11,511–11,515, immediately south of Birch bay, are held by Long Lac Adair Mines, Limited. The main showing lies on claims T.B. 10,473 and 10,474 and consists of a rusty-weathering pyritic shear zone about 40 feet wide in altered greywacké. No visible gold is reported. Immediately to the north is a coarse white feldspar porphyry dike 30 feet wide. The shear zone contains an irregular quartz vein having a maximum width of 8 feet. Trenching and sampling for 500 feet along the strike failed to indicate a workable deposit.

West-Side Long Lac Gold Mines, Limited

West-Side Long Lac Gold Mines, Limited, holds four groups of claims in the Long Lake area. The chief development work has been carried out on claims T.B. 11,165–11,167, immediately east of West Side bay. Two shear zones have been systematically trenched and drilled. The north zone is traced for 800 feet east from the shore of the bay on a strike of N. 75° E. The western 200 feet close to the shore is well exposed, has a maximum width of 20 feet, and lies in banded iron formation. A feldspar-quartz porphyry dike, ranging in thickness from 1 to 12 feet, is associated with the shear zone. Quartz stringers and sheared lens-like veinlets carry a considerable amount of pyrite. The pyrite is particularly abundant where the zone intersects iron-rich layers of the country rock. There is no visible gold. Results of drilling are reported as encouraging.

The south shear zone lies in porphyritized boulder conglomerate immediately north of a coarse white feldspar porphyry. It is 40 feet wide in the main trench; 250 feet distant its width averages about one foot. Small stringers and lenses of quartz carry pyrite over a zone whose maximum width is 20 feet. No visible gold has been reported. Fine arsenopyrite is disseminated throughout the showing, and galena occurs with calcite in minor amounts. Drilling results are reported as less encouraging than those obtained from the northern shear zone in the iron formation.

Big Long Lac Gold Mining Company, Limited

The Big Long Lac Gold Mining Company, Limited, holds claims T.B. 10,311–10,320, 10,500, 10,501, 10,548, and 10,549 west of West Side bay. A considerable amount of stripping has been done, and porphyry, iron formation, conglomerate, and greywacké have been exposed. Coarse visible gold is found in a 2-inch shear zone in one locality.

Mat-A-Lac Gold Mines (1936), Limited

Claims T.B. 12,544–12,552 in Croll and Ashmore townships are held by Mat-A-Lac Gold Mines (1936), Limited, and adjoin the Roche Long Lac claims. Operations commenced relatively late in the summer. A small area of quartz diorite in greenstone is the most important feature of the geology. Galena and pyrite are present in small amounts. No important gold values are reported.

Garnet Long Lac Mines, Limited

The holdings of Garnet Long Lac Mines, Limited, comprise claims T.B. 13,233–13,241, situated in the northwest corner of Croll township. Several small irregular masses of quartz lying in greenstone have been opened up. Tourmaline, arsenopyrite, and pyrite are present in small quantities. No appreciable gold values have been reported.

Indian Head Long Lac Mines, Limited

Indian Head Long Lac Mines, Limited, holds claims T.B. 13,218–13,226, situated south of the Garnet Long Lac claims. A considerable amount of stripping has been done, and several small altered porphyry dikes have been uncovered in the greywacké. There is little vein quartz or pyrite and no continuous shear zone. No appreciable gold values have been reported.

Killoran-Labine Group

The Killoran-Labine group consists of claims T.B. 12,949–12,966 immediately south of Eldee lake in Ashmore township. A rusty-weathering shear zone averaging about 15 feet in width has been partially uncovered over a length of about 800 feet. The zone strikes approximately east-west and dips steeply south. It lies in greywacké, and the entire structure pitches 45° W. The shear zone contains small quartz stringers, and in places there is abundant carbonaceous material Fine disseminated pyrite is particularly abundant in the carbonaceous schist. Gold values are reported to warrant further development. Two hundred feet north of the main shear zone is a smaller irregular zone intimately associated with highly altered sheared diorite. The shear zone contains large, folded, irregular masses of quartz; massive, black, fine-grained tourmaline; and abundant coarse arsenopyrite. Gold values are reported to be negligible.

Roche Long Lac Gold Mines, Limited

The property of Roche Long Lac Gold Mines, Limited, which is situated east of the north end of Eldee lake in Ashmore township, was described in Bruce's report.[1] The present report is concerned only with a summary of developments since that time. Since the main vein was believed to extend westward rather than eastward, drilling was carried out on Eldee lake in 1936 in an effort to intersect

[1]E. L. Bruce, op. cit., p. 54.

the shear zone. The sediments-greenstone boundary has a northerly trend through the lake, and it was considered possible that gold values would be higher where the vein entered the sediments. The work to date indicates that neither the width of the shear zone nor the values obtained can be considered as encouraging.

Maralgo Mines, Limited

Maralgo Mines, Limited, owns a group of claims lying in the eastern part of Croll township and extending west to Little Long Lac in Ashmore township. These claims were formerly owned by Langmuir Long Lac Gold Mines, Limited, but no development work has been done on them since 1934.[1]

Goldcrest Mines, Limited

Claims T.B. 10,720, 10,721, 10,780, 11,345–11,352, 12,737, 12,738, 13,252, 14,189–14,193, 14,031, 14,032, 14,189–14,193, and 14,506–14,508, south of Hardrock on Little Long Lac, are held by Goldcrest Mines, Limited. As there is little rock exposed on this property, drilling was carried out in order to intersect the greenstone-sediments contact. The contact is marked by chloritic diorite and quartz porphyry lenses intercalated with the intruded rock. Gold values are reported as negligible. A 50-foot zone rich in pyrrhotite was intersected in one hole and traced for about a mile by dip-needle survey.

Hutchison Lake Gold Mines, Limited

Hutchison Lake Gold Mines, Limited, holds the following claims, situated 3 miles north of Geraldton: T.B. 14,228, 14,229, 14,660–14,663, 15,088–15,094, and 15,582–15,584. The two main showings are on claim T.B. 14,229; both shear zones strike approximately east-west and dip 70°–75° S. The southern showing (zone No. 1) is 4 to 5 feet wide and has been uncovered for 100 feet. It is bounded by a chlorite schist on the south and by a banded tuff on the north. The rock composing the shear zone is highly altered and may contain intrusive diorite mixed with the wall rock. Quartz veinlets and lenses with a maximum width of 10 inches occur in the shear zone. Pyrite is found in the quartz and in the sheared wall rock, and solid layers one inch thick are found in places. Large ankerite rhombs are also found in the quartz, and coarse galena and sphalerite are abundant. The quartz is drusy, and coarse visible gold is reported. The zone is offset 4 feet horizontally by a local north-south fault.

Zone No. 2 lies 80 feet north of No. 1 and is bounded both north and south by a fine-grained, massive, chloritized rock, probably an altered andesite. The zone is 4 to 5 feet wide and has been traced for 175 feet. It has a single quartz vein with a maximum width of one foot, containing essentially the same minerals as No. 1. In addition, pyrrhotite and copper sulphides are found in small quantities. The mineralization is leaner as a whole than in No. 1. As a result of drilling prior to August, 1936, gold values are reported as high but erratic.

[1]E. L. Bruce, op. cit., p. 55.

Geology of the Pagwachuan Lake Area

By R. D. Macdonald

INTRODUCTION

The Northern Long Lake area, district of Thunder Bay, was mapped during the summer of 1936 by H. W. Fairbairn. Mapping was continued eastward nto the Pagwachuan Lake area in the summer of 1937. Prospecting activities have resulted in the discovery of several gold-bearing veins, but up to the present none of these has proved to be of commercial value. Gold occurs in quartz or quartz-carbonate veins, which occupy fracture or shear zones in basic lava, diorite, and quartz diorite. Pyrite is the main mineral associate of gold; chalcopyrite and arsenopyrite are present in minor amounts in some veins.

Acknowledgments

The willing co-operation and assistance of individuals working in the area greatly facilitated the season's mapping. Mr. George Reesor, of the Ontario Forestry Branch at Longlac, afforded conveniences to the party at the beginning and end of the field season. A. Ward, W. Morrow, and J. Rankin supplied valuable information concerning trails and portage routes in the area. Many helpful courtesies were offered by W. Laponen, S. Cockburn, F. Jamieson, and G. Lahti. To E. L. Bruce, Miller Research Professor of Queen's University, the writer expresses his appreciation of the many helpful suggestions offered during the preparation of the report and for the careful criticism of the manuscript.

Much of the field work was done by the senior assistant of the party, J. W. McBean. Able assistance was given by R. Hoiles and G. W. Matheson. The writer expresses his appreciation of the conscientious co-operation offered by each member of the party during the field season.

General Description of the Area

The area is situated in the district of Thunder Bay east of the northern part of Long lake. The main line of the Canadian National Railways runs through its south-central and western parts. Caramat, the main point of departure for the area, is situated 23 miles east of Longlac. The area is bounded on the west by the Making Ground river, on the south by an east-west line running through McKay lake, on the north by the southern boundaries of Klotz and Fernow townships and a line running southwest to mile-post 98 on the railroad. The eastern boundary runs through Klotz and the Kassagimini lakes.

Means of Access

The railway provides an easy means of access to the south-central and northwest sections. Trails, portages, and water routes connect with the railroad and afford means of access to the other sections. Rocky Shore, Hollow Rock, Seagram, Little McKay, and McKay lakes afford water transportation in the western and southwestern parts. Summit portage running west from Seagram lake connects with the Making Ground river and is a link in the transportation route to Long lake. With one portage Rocky Shore creek is navigable by canoe during seasons of high water. A portage connects Rocky Shore lake with the north end of Hollow Rock lake. A chain of lakes and portages runs from McKay lake to mileage 85.6 on the railroad, and a portage from the north end of the Laponen lakes to mileage 89.5.

Pagwachuan lake is the main water route for the eastern part of the area. Two portages connect it with the railroad. One runs from the southwest corner of the lake to mile-post 80; the other runs from the west end of the lake to mileage 85.6. The former is in better condition. Pagwachuan river and the Kassagimini lakes form a canoe route to the east. An alternate route includes portages from the east end of Pagwachuan lake to Adel lake and from Adel lake to Klotz lake. The river draining Klotz lake gives access to the section north of the lake.

Trails made by prospectors form the only means of reaching the north-central part of the area. Hoiles creek is large enough to form a canoe route, but it is badly choked with fallen timber.

Topography

The general topographic trend is N. 75° E., in accordance with the structure of the rock formations. This trend is obscured in the glaciated parts of the area. The height-of-land between James bay and Lake Superior runs in a northeasterly direction north of Seagram lake, between Hollow Rock and Rocky Shore lakes, north of the Sandlink lakes, and then south beyond the limits of the area. The streams to the north of the height-of-land form tributaries of the Kenogami river. Rocky Shore creek flows into the Making Ground river, which in turn flows into Long lake, from which the Kenogami river drains. The Pagwachuan river, draining Pagwachuan lake, runs northeastward to the Kenogami river. Hoiles creek and its tributaries drain the north-central part to Klotz lake, which in turn drains through the Flint river to the Kenogami river. South of the height-of-land the lakes and rivers drain to McKay lake, which is drained southward by the Pic river, which in turn empties into Lake Superior.

The relief of the area is moderate. Rock ridges north of the west end of Pagwachuan lake are about 200 feet above the lake level. Glacial hills west of Klotz lake have a relief of about 100 feet. The hills in the western part of the area are rock ridges. In the eastern part most of the hills consist of glacial material.

Consolidated rocks are well exposed in the western part of the area. Irregularities in topography are mainly due to differential erosion. A valley of this type extending northeastward from Hollow Rock lake is more than 100 feet deep; it is underlain by sediments and separates two masses of granite and syenite. A granite-greenstone contact lies near the east shore of Rocky Shore lake, and the lake basin is probably the result of the deeper erosion of the greenstone, which is less resistant to weathering than the granite. A few glacial hills are found north of McKay lake, but most of the hills between McKay and Seagram lakes are of rock. Prominent rock hills also occur north of Coulter creek and south of the eastern part of Pagwachuan lake.

Glacial deposits are common in the eastern part of the area. North of Hoiles creek and south of Coulter creek the consolidated rocks are overlain by extensive and, in many places, deep overburden of sand and gravel. The area surrounding the Sandlink and Laponen lakes constitutes a relatively flat sand plain. A few low ridges on the west side of the Laponen lakes have the appearance of eskers.

The shapes of some of the lakes are due to rock structures; others, to glacial deposits. Seagram lake and the lower part of Rocky Shore lake lie in rock basins and are of the first type. McKay lake and Pagwachuan lake are elongated in a direction at a slight angle to the strike of the rocks. Possibly the normal structural control is modified by the effect of the glacial deposits. Little McKay, Hollow Rock, the Laponen, and the Sandlink lakes show a north-south trend, for which no explanation has been found. The other lakes of the area, most of which are small and shallow, lie in glacial deposits.

As the area is on the height-of-land the streams draining it are small, and only a few of them can be used as canoe routes. There are several large sections of muskeg, but they probably do not make up more than one-fifth of the area.

Natural Resources

The natural resources of the area are similar to those of the neighbouring Northern Long Lake area. Owing to the relative inaccessibility of some parts, moose, deer, grouse, and fish are more plentiful than in most other parts of the region.

The only possibility for water-power development in the vicinity of the area is on the Pagwachuan river, southwest of the Kassagimini lakes. At Purgatory chute the river drops 150 feet in a short distance. At this site the estimated capacity at 80 per cent. efficiency is 710 horsepower at ordinary minimum flow, and 770 horsepower at ordinary six months' flow.[1]

GENERAL GEOLOGY

The general geology of the area is similar to that of the Long Lake area, the chief difference being the absence of the belt of conglomeratic sediments of the Long Lake and Little Long Lac area. This belt, which Fairbairn[2] and Bruce[3] have classed as Timiskaming was shown by Fairbairn[4] to lens out west of the Making Ground river; it does not reappear in the Pagwachuan Lake area. This necessitates a different tabulation for some of the later intrusives, even though they probably are of the same age as Fairbairn's post-Timiskaming intrusives. In the absence of a Timiskaming formation they are here classed as post-Keewatin.

The Keewatin rocks, consisting of greenstone, chlorite schist, volcanic fragmentals, and agglomerate and hornblende schists, are similar to the Keewatin of the Long Lake area. On structural evidence a group of sedimentary rocks is included with the Keewatin. In the following discussion they are termed the "quartzite group," since they consist mainly of impure quartzites. Mica schists and micaceous hornblende schists, occupying the southern belt of the area, are considered to be more highly metamorphosed equivalents of the Keewatin sediments and volcanics.

Granite, granodiorite, diorite, quartz diorite, and other types of igneous rocks intrude the Keewatin. Diabase is the youngest intrusive and is classed tentatively as Keweenawan.

Table of Formations

QUATERNARY	
RECENT:	Silt, clay, peat.
PLEISTOCENE:	Sand, gravel.
PRE-CAMBRIAN	
KEWEENAWAN(?):	Quartz diabase dikes.

[1]"List of Water Powers in the Province of Ontario," Ont. Dept. Surveys, 1931, page 36.
[2]Pages 9 and 10 of this volume.
[3]E. L. Bruce, Ont. Dept. Mines, Vol. XLIV, 1935, pt. 3, pp. 18-20.
[4]Page 10.

Intrusive contact

POST-KEEWATIN:	Feldspar porphyry, quartz porphyry. Quartz diorite, porphyritic granodiorite. Altered diorite (diorite and diorite porphyry). Granite, granite gneiss, granodiorite, quartz diorite, syenite and porphyritic syenite, granite pegmatite, aplite.

Intrusive contact

KEEWATIN:	QUARTZITE GROUP: Impure quartzite, greywacké, arkose, slate, iron formation, conglomeratic grit. VOLCANIC GROUP (part older, part younger than the sediments): Greenstone, chlorite schist, hornblende schist, agglomerate, volcanic fragmentals, iron formation. MICA SCHIST GROUP (metamorphosed equivalents of sediments and volcanics): Massive and banded granular biotite schists, garnetiferous biotite gneiss, iron formation; massive hornblende-biotite schists.

Keewatin

Rocks assigned to the Keewatin in this area include clastic sediments, volcanics, and other schistose equivalents. The sediments are present in two groups. One will be referred to as the quartzite group; the other, consisting mainly of micaceous schists, will be called the mica schist group. In a belt crossing the area with a general trend of N. 75° E. the quartzite group lies between a southern and a northern volcanic band. The mica schists form a belt to the south of the southern volcanics and quartzite group.

VOLCANIC GROUP

As in the Long Lake area the volcanics are made up chiefly of schistose basic lavas. These are now chlorite schists and hornblende schists and gneisses. Amygdaloidal lava, agglomerate, and volcanic fragmentals occur in lesser amounts.

The schistose types have been described by Fairbairn as follows:[1]—

In thin section the chlorite rocks exhibit a fine, matted texture due to the presence of laths of clouded plagioclase and shreds of chlorite. Varying amounts of hornblende, epidote, carbonate, quartz, biotite, and sericite are also present. Where identified the plagioclase is within the composition range of andesite. As the mineral assemblage indicates, the assumed andesite has been almost entirely altered to the chlorite-carbonate-epidote-sericite phase characteristic of Keewatin greenstone.

The hornblende phase is easily recognized by the predominance of long black hornblende blades over the chlorite flakes, . . . It is uniformly schistose, and no textures or structures are found in it that would identify it as a lava. The minerals present are mostly hornblende and quartz, with lesser amounts of plagioclase, biotite, epidote, carbonate, chlorite, and sericite. The plagioclase is altered and fine grained and has not been identified.

These rocks form the greater part of the northern greenstone belt and are present also in the belt to the south of the quartzite group. The hornblendic phase varies from a fine hornblende schist to a coarse hornblende gneiss that appears much like the sheared diorite of the area. A biotitic phase is of minor and local occurrence, usually associated with the hornblende phase.

Massive greenstone occurs with the schistose volcanics. Most of it is fine-grained and dark-green in colour. It is an andesite consisting of andesine feldspar, quartz, and chlorite. Outcrops of this rock occur at the narrows of Rocky Shore lake. A more acidic type, in the volcanic belt to the south of the quartzite group, is massive, very fine grained, and light-green in colour. In thin section it shows a greater proportion of quartz and less chlorite than the basic type. Secondary minerals are epidote, clinozoisite, and carbonate. The fine-grained nature of the rock makes an accurate determination of the feldspar impossible, but it is probably a medium oligoclase. If so, the rock is a dacite.

[1]Page 7.

Ellipsoidal structures in the greenstone are rare. A few ellipsoids of medium size were observed one mile northwest of Gabbro lake. Amygdules are locally quite common in the greenstone of both belts. Agglomerate is present in the volcanics but does not form continuous bands. A striking occurrence of fragmental volcanics with minor amounts of associated tuffaceous material forms the greater portion of an outcrop 2 miles northwest of Rankin bay on Pagwachuan lake.

Fairbairn[1] notes the presence of a zone of hybrid rocks on the Indian reserve east of the Making Ground river. This zone extends eastward and is extensively developed west of the northern arm of Rocky Shore lake. From field evidence and microscopical determinations it is considered that these hybrid rocks have been formed by the action of the granite as it intruded the overlying greenstones. The rocks of this zone grade from fairly fine grained, dark, massive types, which are not unlike the basic greenstones, to coarsely crystalline massive types with granitic texture. The latter type is characteristically present near granite. A thin section of a coarse hybrid type shows the rock to be composed of altered oligoclase, hornblende, some quartz, and alteration products, sericite, chlorite, and clinozoisite. Some of the quartz may be secondary. A section of the hybrid rock near the contact is similar to the one just described, but the feldspar is more highly altered, hornblende is not as abundant, and quartz forms approximately 20 per cent. of the rock. Alteration products are sericite, chlorite, epidote, and clinozoisite. The typical granite is an equigranular assemblage of quartz and feldspar with approximately 10 per cent. of biotite. The feldspar is comparatively fresh. Alteration products, sericite, epidote, and chlorite, are present in minor amounts.

A few small, discontinuous bands of iron formation occur in the greenstones.

QUARTZITE GROUP

Clastic sediments form a narrow belt within the Keewatin. The belt runs in a northeasterly direction from Seagram lake. Five miles east of the railroad it splits into two branches. The northern branch extends east to a point 1½ miles southeast of the east end of Klob lake; the southern branch extends east past Gabbro and Adel lakes to the east boundary of the map area.

The sediments vary in character from conglomeratic grit to slaty types. The only outcrop of conglomeratic grit encountered in the area is situated 1¼ miles southeast of Klob lake. Coarse and angular grains of quartz and feldspar form the greater part of the rock. They lie in a fine-grained matrix of quartz, feldspar, biotite, sericite, carbonate, and chlorite. A few pebbles with a maximum length of 5 inches occur in the gritty matrix. A microscopic examination of one of these pebbles showed it to be feldspar porphyry.

Impure quartzites are the commonest type in this group. These are usually granular and massive, ranging in colour from light- to dark-grey. In some specimens a poorly developed schistosity is seen. Thin sections of four specimens contain quartz, plagioclase, and biotite; minor constituents are magnetite and apatite, and secondary minerals are sericite, chlorite, epidote, and clinozoisite. Quartz constitutes from 55 to 70 per cent. of the rock.

Massive and coarse, grey to brownish sediments were classed in the field as arkose. They are of local distribution and usually occur in association with the impure quartzites. In thin section they appear much like the quartzites but have a higher feldspar content and are really arkosic quartzites.

[1]Page 8.

Greywackés are fairly common and occur as massive or banded greenish-grey rocks, which weather light-grey. The banded type commonly shows varving. Thin sections show the common characteristic of a matrix composed of grains of quartz and feldspar of different sizes and irregular shapes. Biotite and chlorite are present in varying amounts throughout the matrix. Sericite and epidote may be present.

Some of the greywackés on Seagram lake, where they lie close to the northern granite mass, contain up to 15 per cent. biotite and are distinctly schistose. The rock is coarser than the ordinary greywacké and apparently has been entirely recrystallized.

Slates form a minor portion of the sedimentary series. They are usually associated with greywacké, from which they differ in their finer texture and darker colour.

The iron formations of the area have been studied by J. W. McBean.[1] He describes them as follows:—

> The iron formations in the quartzite group of the Pagwachuan Lake area consist of regular and persistent magnetite-rich bands in greywackés, quartzites, and grits. The bands have an average width of 2 inches and occur in zones up to 25 feet wide. The main minerals of the iron-rich bands are magnetite, chlorite, biotite, and quartz. In the individual bands a magnetite-rich portion grades to a chlorite-rich portion, which in turn grades to a quartz-rich portion. The magnetite occurs as euhedral grains; the quartz forms a crystalline mosaic. Analysis of a specimen shows chlorite to form 25 per cent., magnetite 38 per cent., biotite 19 per cent., and quartz 18 per cent., of the rock. The iron formation is considered to have formed in shallow water, the iron of the magnetite being originally present in limonite or iron carbonate. The mosaic texture of the quartz, in contrast to the fragmental character of the quartz in the associated sediments, indicates that originally it may have been present as chert.

AGE RELATIONS OF THE QUARTZITE AND VOLCANIC GROUPS

Two main problems are apparent in connection with the age relations of the quartzite, volcanic, and mica schist groups. The first of these involves the relationship of the quartzite group to the volcanic group; the other involves the relation of the quartzite and volcanic groups to the mica schist group. In the following discussion the terms Keewatin and Timiskaming are used in a provisional sense as used by Bruce and Fairbairn in areas to the west.

Lithology

The rocks of the quartzite group of the Pagwachuan Lake area are lithologically different from the Timiskaming sediments to the west. The most pronounced difference is the practically non-conglomeratic character of the Pagwachuan quartzite group. The one outcrop of conglomerate observed in it contains scattered pebbles of feldspar porphyry only. Pebbles of granite, quartz, jasper, chert, and lava, which have been described as the common types in the conglomerates of the Timiskaming[2] are not present in the Pagwachuan conglomerate.

Massive impure quartzites form the dominant rock type in the quartzite group of the Pagwachuan Lake area; banded greywacké is the most important type in the Timiskaming of the Long Lake and Little Long Lac areas. The slates and slaty greywackés, which are fairly common in certain parts of the Long Lake area, are present in minor amounts in the Pagwachuan area. The iron formations of the two areas present a point of difference that may be of decided significance in the separation of the two groups. Whereas the iron formation in the quartzite group of the Pagwachuan Lake area consists entirely of banded magnetite and greywacké, the iron formation of the sediments assigned to Timiskaming in the

[1] J. W. McBean, "Iron Formations of the Pagwachuan Lake Area," thesis, Queen's University, 1938.

[2] E. L. Bruce, op. cit., p. 13.

western areas contains hematite and jasper in addition to the banded magnetite and greywacké.

The southern band of volcanics contains considerable amounts of acidic lava,[1] a type that is not present in the northern band.

Structure

The Timiskaming in areas to the west have been described by Bruce[2] and Fairbairn[3] as being separated from the Keewatin by a major unconformity. Tanton[4] states that the two show a slight structural discordance. In contrast to this the field relations of the quartzite group in the Pagwachuan Lake area indicate that it is conformable with the volcanics that lie to the north and south of it.

On Seagram lake the quartzite group occupies a belt approximately 1,600 feet wide. The dips vary from steep to the north to as much as 60 degrees to the south, but variations in grain size indicate that the tops face north in all cases. The quartzite group and the northern belt of the volcanic group are intruded by granite.

Discussion and Conclusions

The quartzite group, lying as it does between two volcanic bands, presents two possibilities as to structure: (1) It lies above the volcanics in a synclinal trough; or (2) it is interbedded between underlying and overlying lavas.

These possible structural relations may be explained in various ways:—

1. If the quartzite group lies above the lavas, and is separated from them by an unconformity, it has relations similar to those of the Timiskaming of the type area and may be so termed with, of course, the understanding that they are not necessarily exactly contemporaneous.

2. With the same structural conditions as outlined in the preceding paragraph and no unconformity, the quartzite group may be considered to be so closely related to the volcanics that both should be grouped in the same series, i.e. Keewatin, with the reservation that the term does not necessarily imply exact correlation with the original Keewatin.

3. If the quartzite group is interbedded with the lavas with no unconformity, the whole succession may be considered as Keewatin.

4. If there is an unconformity, say at the base of the quartzite group, the southern volcanics may be classed as Keewatin, and the quartzite group and northern lavas as Timiskaming.

The possibility that the quartzite group is Timiskaming necessitates structural conditions that are not substantiated by field evidence. There is the negative evidence that no unconformity is recognizable. Where tops and bottoms of beds are determinable, the tops are invariably to the north. Hence, unless there is a major fault the structure is monoclinal, not synclinal. It seems unlikely that a fault of such magnitude would not be recognizable at some point along the belt. In the Long Lake and Little Long Lac areas the Timiskaming rocks are not intruded by granite; in the Pagwachuan Lake area the granite north of Seagram lake intrudes the quartzite group. This evidence is decidedly negative and not of itself of much weight.

The possibility of a monoclinal rather than a synclinal structure is further substantiated by a difference in the lithology of the two volcanic bands, since a more acidic type of lava occurs in the southern volcanics. The westward exten-

[1]See page 26.
[2]E. L. Bruce, op. cit., p. 18.
[3]Pages 9 and 10.
[4]T. L. Tanton, Geol. Surv. Can., Sum. Rept. 1917, pt. E, p. 1.

sion of the northern volcanic band has been classed as Keewatin.[1] Hence it appears that the southern volcanics, the quartzite group, and the northern volcanics form a single monoclinal succession in which there are no unconformities. All are therefore included in the Keewatin series.

MICA SCHIST GROUP

Mica schists and gneisses form the third lithological group of the Keewatin series. They occupy a belt in the southern part of the area parallel to and south of the volcanic and quartzite groups. In their westward extension they lie south of the Northern Long Lake area.

The mica schists show lithological variations that are probably due in part to original differences and in part to the metamorphism they have undergone. Their colour varies from dark-grey to light-brown; the weathered surface is commonly rusty-brown. Texturally, they grade from banded, fine-grained schists with rounded grains to massive, medium-grained gneisses with subangular grains. Quartz is the dominant mineral in most of the thin sections examined; fresh-looking acid plagioclase is the next most abundant mineral. In some cases feldspar equals or exceeds quartz in amount. Biotite constitutes from 10 to 20 per cent. of the rock in this type of schist. Pink garnet is a conspicuous minor constituent in many of the schists; in others an iron-poor epidote and clinozoisite are the important minor constituents.

Three outcrops of banded iron formation were observed in the mica schists. These consist of alternating magnetite-rich bands and hornblendic quartzose bands associated with granular mica schist. One of these occurs one mile southeast of the east end of McKay lake; the other two are a short distance north of McKay lake 1½ to 1¼ miles west of Yankee bay. They are similar to the iron formation occurring with the quartzites and greywackés except that hornblende is present rather than chlorite and biotite. The difference is probably a result of the metamorphism that took place during the formation of the mica schists. Several outcrops of magnetite-rich schists containing disseminated grains of magnetite in the matrix were also observed within the mica schist belt.

These types of schists are believed to be of sedimentary origin, since some show remnants of sedimentary banding and their mineral assemblages are typical of metamorphosed sediments.

Rocks believed to be metamorphosed volcanics occur in the mica schist group. An attempt was made in the field to separate the schists of volcanic origin from the schists of sedimentary origin, but, since the two types do not form definite zones and the coarser-grained volcanic types appear much like the sedimentary types, they have not been differentiated on the map. Those of volcanic origin vary from massive, fine-grained, siliceous to medium-grained, granular, schistose rocks. Megascopically, the fine-grained varieties look much like andesites. Microscopic examination shows them to be highly quartzose, with acid plagioclase as the second most abundant mineral. Biotite may constitute as much as 10 per cent. of the rock, but commonly the flakes have not the good crystal outlines so characteristic of the constituents of the sedimentary schists. Hornblende is present in minor amounts. A fine-grained type, examples of which occur in McKay lake west of Yankee bay, commonly contain chlorite. Other minerals present are sericite, epidote, and clinozoisite. Evidently the fine-grained types resisted metamorphism to a greater degree than the rocks of original coarse grain.

[1]H. W. Fairbairn, pages 8 and 9.

Examination of thin sections of the coarser varieties show them to be composed of subangular grains of quartz and feldspar in approximately equal proportions. Hornblende and biotite are characteristically present and form from 15 to 30 per cent. of the rock. The hornblende is in blocky and acicular crystals. It shows an alteration to biotite. Minor amounts of sericite, epidote, clinozoisite, and garnet are present.

The width of the mica schist zone, and in part the type of mica schist, bears an apparent relation to the granite by which they are intruded. The texture of the schist is coarse in the contact phases. Reasoning from this direct evidence of the metamorphic effect of the granite, the extent of the mica schist zone can also be attributed to the metamorphic action of the granite. The mica schist zone includes an area of fairly uniform width north of the granite intrusives and shows a general gradation from coarse, highly schistose types near the granite to finer-grained more massive types on the northern border. In the contact zone between the mica schist group and the volcanic and quartzite groups the degree of schistosity and amounts of biotite show a general decrease from the mica schist types to the volcanic and quartzite types.

AGE RELATIONS OF THE MICA SCHIST GROUP

The mica schist group has been shown to consist of schists, mainly sedimentary in origin. There are two possibilities as to their age relationships. Since they exhibit a high grade of metamorphism they may be a sedimentary series older than those just referred to the Keewatin or they may be an equivalent series which has been subjected to more intense metamorphism, either dynamic or contact.

Lithology

The sedimentary mica schists are similar to the sediments of the quartzite group in that both consist mainly of quartz-rich feldspathic types with ferromagnesian impurities. Schistosity is more pronounced in the mica schists, and original structures, such as bedding, are mainly obliterated. The schists are coarser grained, especially in phases close to granite. Whereas the biotite of the schists is present in well-formed flakes and the feldspars are clear, the biotite of the quartzite group is poorly formed and the feldspars are clouded with alteration products.

Megascopically, the iron formation of the mica schists is similar to the iron formation of the quartzite group, since both show the alternate banding of iron-rich bands and quartzose bands; the iron formation in the mica schists is seen under the microscope to contain hornblende, whereas that in the quartzite group contains chlorite and biotite. The apparent absence of conglomerate in the mica schists is in general agreement with the conditions as found in the quartzite group.

A group of fine-grained, massive to medium-grained, schistose rocks, which are considered to be of volcanic origin,[1] occur in the mica schist group. The lithology of the fine-grained type compares with that of the massive andesites of the volcanic group, except that in the former biotite is present and chlorite is less abundant. The coarser phase corresponds in type to the quartzose hornblende schists of the volcanic group. Hornblende commonly occurs in blocky crystals rather than in the acicular crystals common to the quartzose hornblende schist. Biotite is a common constituent in the coarser volcanic schists of the mica schist group.

[1]See page 30.

Structure

The exact relation of the mica schist group to the volcanic and quartzite groups is obscured by lack of outcrops in the contact zone. The direction of schistosity of the mica schist group is apparently parallel to that of the volcanic and quartzite groups. The direction in which the tops of the original beds faced is not determinable. The available information indicates that the mica schist group is conformable with the northern groups that are classed as Keewatin.

In the western part of the area the rocks immediately north of the mica schist group are volcanics; in the eastern part the rocks to the north of the mica schist group are rocks of the quartzite group. In the outcrop of greywacké a quarter of a mile east of Gabbro lake the beds face north.

Discussion and Conclusions

As nearly as can be estimated the compositions of the two groups are similar. Presumably the greater degree of schistosity and the coarser grain of the mica schists are effects of the greater metamorphism to which they have been subjected. The iron formation in the mica schists has evidently been subjected to sufficient metamorphism to cause the development of hornblende in place of chlorite and biotite. Although the almost complete lack of conglomerate in both groups indicates a similarity, it is possible that any conglomerates of the mica schists might now be unrecognizable owing to the shearing that has taken place.

The rocks of volcanic origin in the mica schist group, in hand specimen, resemble types of the volcanic rocks associated with the quartzite group. Mineralogical differences are a lesser amount of chlorite and a greater amount of biotite and hornblende. The presence of biotite necessitates a source of potash for its formation. It may have been introduced by solutions from the granite that intrudes the mica schist group or it may have come from the sericite that is present in the altered feldspars of the volcanic group. Winchell[1] states that oligoclase can contain as much as 7 per cent. $KAlSi_3O_8$ and andesine as much as 8 per cent. Analyses listed by Johannsen[2] show an average of 1.60 per cent. K_2O in dacites. Daly's average for andesites, which he also lists, show a K_2O content of 2.04 per cent. An average of biotite analyses taken from Dana[3] gives a K_2O content of 8.23 per cent. If all the K_2O of a dacite or andesite were combined in the molecular constitution of biotite, it would give a possible content of 24.9 per cent. biotite in the andesite or 19.4 per cent. biotite in the dacite. These proportions are in excess of the maximum of 10 per cent. biotite in the fine-grained volcanic type and of 15 per cent. biotite in the coarse-grained type. Thus, although the total K_2O of the original rock would probably not be included in the biotite of the schistose rock, a portion of it might give a possible source for the K_2O in the biotite present.

These lithological similarities indicate that the mica schist, volcanic, and quartzite groups could have been originally parts of the same series. Furthermore the contact zone between the mica schist group and the volcanic and quartzite groups is gradational both in the degree of schistosity and in the relative amounts of biotite and hornblende present. Local irregularities in the general gradation can be explained as the result of variations in the original composition of the sediments.

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[1]N. H. and A. N. Winchell, "Elements of Optical Mineralogy," pp. 371, 372.

[2]A. Johannsen, "A Descriptive Petrography of the Igneous Rocks," Vol. II, p. 395; Vol. III, p. 168.

[3]E. S. Dana, Dana's System of Mineralogy, 1892, p. 630.

Since the mica schist group lies against volcanics in the western part of the area and against sediments of the quartzite group in the eastern part, there are three possibilities as to their relationships:—

1. The mica schist group owes its character mainly to its original composition and overlaps the southern volcanic and quartzite groups or is faulted against them.

2. The mica schist is a metamorphosed part of the quartzite and southern volcanic groups as a result of the granite intrusion.

3. The mica schist group lies against the quartzite group in the eastern part of the area because the southern volcanic belt lenses out in the middle of the area.

If the mica schists are a separate group, they apparently overlap the quartzite and southern volcanic groups. Unless they are faulted against the southern volcanic and quartzite groups they would be unconformable with them and younger. There is no indication of a fault. Furthermore, the tops of the beds in the quartzite group invariably face north, not south as they should were the mica schists a younger group.

Since the width of the schistose group bears an apparent relation to the intruding granite, there is a possibility that the mica schist group is a part of the quartzite and southern volcanic groups which have been metamorphosed by the granite. Although the effects of thermal metamorphism are noticeable close to the granite bodies, it is doubtful whether this metamorphism could be effective over the width of the mica schist group unless granite occurs at shallow depths under a large part of the schists. Any dynamic metamorphism associated with the intrusion of the granite could form a zone of metamorphism related in position to the granite bodies. Although this possibility is based on conjectural evidence, it indicates a means by which the mica schist group could show an apparent transgression of the volcanic and quartzite groups and yet be Keewatin in age.

The apparent transgression of the mica schist group is most satisfactorily explained by a lensing of the lower volcanic group. The quartzite group, being formed later than the time of extrusion of the lower volcanic group, would lie on volcanics where they were present and elsewhere on rocks that are now mica schists. Since the possibility does not conflict with field evidence and requires no special conditions, it is accepted as the most likely explanation.

Hence, the mica schist group is believed to be conformable with the Keewatin quartzite and volcanic groups and to represent a more highly metamorphosed phase of the Keewatin rocks. The evidence, however, is not altogether conclusive.

Post-Keewatin Intrusives

The intrusive rocks of the area have been divided into five groups. Diabase forms one group and is assigned to the Keweenawan; the others are post-Keewatin but pre-Keweenawan. These are grouped as granite and allied rock types, diorite and diorite porphyry, quartz diorite and porphyritic granodiorite, and quartz and feldspar porphyries.

The first group includes granite, granite gneiss, granodiorite, quartz diorite, syenite and porphyritic syenite, granite pegmatite, and aplite. They occur as four intrusive bodies occupying approximately one-fifth of the area. The intrusive rocks of the various masses may differ in age but, in the absence of definite evidence for this, they have been grouped together.

Granite and Allied Rock Types

A granite mass occurs to the south of Pagwachuan lake. Dike-like bodies of granite, which are probably related to the mass, occur in the mica schist belt throughout the length of the area. The granite varies from a medium-grained, even-textured, pinkish type to a coarse, grey muscovite granite and to pink pegmatitic granite. The last-mentioned is the commonest variety. An outcrop of this type forms the small island off the north shore of Pagwachuan lake 2 miles from its west end. The rock is composed of large crystals of orthoclase, quartz, and mica. The granite on the shores of McKay lake is more commonly a coarse grey type with grey feldspars and bluish quartz. Large crystals of muscovite and garnet are present as accessory minerals in some dikes.

The second intrusive mass of the group forms an elliptical area, the long direction of which trends northeastward from Rocky Shore lake. The rock is markedly uniform in character, massive, pink, and medium grained with a granitic texture. A thin section of a specimen obtained from the end of the long point in Rocky Shore lake is composed of quartz, feldspar, and biotite. Quartz forms approximately 30 per cent. and biotite approximately 10 per cent. of the rock. The greater proportion of the feldspar is oligoclase; microcline occurs in the interstices of the larger crystals. After removal of biotite, a chemical analysis of this specimen showed that K_2O forms 1.12 per cent. and Na_2O, 5.3 per cent. of the specimen. Hence the potash feldspar forms 11.8 per cent. of the total feldspar content, and the rock is then, according to strict definition, a quartz diorite or tonalite.

A variation from the normal appearance of the intrusive was noted in a few places along its southern border. In these places the quartz is coarser and appears as phenocrysts in a granitic groundmass. Contact zones, however, are absent, and the light-coloured granite has a sharp contact with the enclosing rocks.

The third mass of granite, situated in the northern part of the area, represents the eastward continuation of the Long Lake granite mass. As is the case in the Long Lake area, the mass includes various rock types, such as granite, granite gneiss, granodiorite, quartz diorite, and dark hybrid phases. In appearance they correspond to those types described by Fairbairn as follows:[1]—

> Hornblende granite and granite gneiss are the commonest types represented. Both pink and white feldspars are found, and in many cases the hornblende is chloritized. The texture is medium to coarse, in places porphyritic. Biotite gneiss is also commonly found. . . . Granodiorite may be more common than the preliminary mapping has indicated.

Although hornblende granite is the dominant type in the Pagwachuan Lake area, biotite granite and biotite-muscovite granite appear to be more common than in the Long Lake area. A specimen of the igneous rock collected west of the north arm of Rocky Shore lake contains quartz, oligoclase, biotite, and minor amounts of potash feldspar. Hybrid border phases occurring west of Rocky Shore lake in association with the greenstone belt have been described in connection with the greenstones which they intrude. Several outcrops of porphyritic granite occur east of the Sandlink lakes. The rock contains feldspar phenocrysts in a granitic groundmass of quartz, feldspar, and hornblende.

The northern granite mass extends across the area. From the western boundary to 1½ miles east of the Sandlink lakes outcrops are sufficiently numerous to determine fairly accurately the position of the southern boundary of the mass. Farther east glacial deposits cover the bed rock, and the position of the contact is more conjectural. One outcrop of granite was found three-quarters of a mile north of Klob lake. Other outcrops, considered to be of the same mass, occur north and east of the map area, on the shore of Castlebar lake, the eastern bay of Klotz lake, and at a point approximately one mile down the outlet of Klotz

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[1]Page 11.

lake. The position of these outcrops and the trend of the greenstone allows a fair approximation to the position of the contact to be made.

A small irregular mass of granodiorite intrudes the greenstone in the area one mile southwest of Klob lake. The rock is dark-grey to pinkish in colour, consisting mainly of plagioclase and quartz. Chlorite is the only ferromagnesian mineral present. Some phases of the rock are porphyritic.

It is difficult to estimate the relative amounts of granite, granodiorite, and quartz diorite in the masses just described, since proper differentiation can be made only by optical and chemical means. The rocks appear alike because the plagioclase feldspar may be stained pink in colour and simulate the potash feldspar of granite. The evidence obtained indicates a greater proportion of granodiorite and quartz diorite types than of granite. This evidence, however, is based on a few selected samples, and even though the samples chosen were thought to be representative of the rock types, a systematic sampling might show the masses to be essentially granitic in composition. Hence, the term granite has been used, especially since that term would be the one normally applied to these rocks in the field.

A mass of syenite encloses the large bay at the east end of Seagram lake and extends in a northeasterly direction past Little McKay lake. Various rock types occur in the mass, but the main one is a pink, commonly coarsely crystalline rock with a granitic texture. Porphyritic phases of the typical syenite are common. Phenocrysts of microcline with a maximum length of 3 inches occur in the syenite along the east bay of Seagram lake. A specimen of the porphyry taken from this locality shows, in thin section, phenocrysts of microcline in a medium-grained groundmass composed of microcline, oligoclase, and hornblende with minor amounts of biotite and magnetite. Although sericite and chlorite are present, epidote is the chief alteration product. Quartz is present in amounts up to 5 per cent. of the rock.

Much of the eastern part of the mass is composed of dark, granular, hybrid phases in which hornblende and biotite form more than 50 per cent. of the rock. In thin section the rock appears more altered than the normal syenite. An example of the same type of rock as that chosen for thin section occurs on the small island near the outlet of Seagram lake. The feldspars, microcline and oligoclase, are clouded and altered. The hornblende crystals are both blocky and acicular. The alignment of the acicular types gives a gneissic appearance to the rock. Magnetite is an important accessory mineral; considerable amounts of epidote, chlorite, and sericite are present as alteration products.

The syenite mass also contains many small inclusions of greenstone, which, for the most part, have not been differentiated on the map. At the large point on Seagram lake the northern border of the mass shows an injection zone of syenite into greenstone with the outer phases of the syenite occurring as dikes in the greenstone. One of these dikes contains titanite as an accessory mineral.

Small dikelets of aplite occur in the intrusive mass on Rocky Shore lake. The best examples were seen on the narrows of the lake, where the fine-grained, dull-red aplite intrudes the granite.

Diorite and Diorite Porphyry

Dikes of dark-green diorite occur in the sediments and volcanics. It usually has a medium to coarse granitic texture; in many cases large blocky crystals of hornblende occur as phenocrysts. The porphyritic type forms several of the islands in Seagram lake. Numerous outcrops of both types occur in the sedimentary belt east of Adel lake.

The diorite is highly altered and in many cases distinctly sheared. Hornblende and plagioclase are the chief constituents. Biotite is present in small crystals; their fibrous nature indicates a secondary origin. Other constituents are chlorite, quartz, carbonate, sericite, and epidote.

Quartz Diorite and Porphyritic Granodiorite

Granodiorite has been noted as occurring in the large northern granite mass, which extends eastward from Long lake; it also occurs as a separate mass immediately west of Klotz lake. The greater part of the mass is covered by drift and glacial material but outcrops indicate an oval-shaped body approximately 5 miles long and 1½ miles wide. The texture of the rock is dominantly porphyritic. Phenocrysts of orthoclase are set in a granitic groundmass of oligoclase, quartz, biotite, and orthoclase. The potash feldspar comprises approximately 25 per cent. of the total feldspar; basic constituents make up from 10 to 15 per cent. of the rock. The colour varies from dark-grey in specimens with grey feldspar to pink in specimens with pink and light-coloured feldspar.

South of this porphyritic granodiorite, and apparently forming a border phase of the mass, is quartz diorite which occurs at the northeast end of Paglamin lake and three-quarters of a mile southwest of Secon lake. The quartz diorite is finer-grained and darker-coloured than the granodiorite. The texture is porphyritic. It consists of phenocrysts of feldspar or feldspar and quartz in a fine-grained groundmass of quartz and feldspar together with biotite, sericite, epidote, chlorite, and carbonate.

The quartz diorite mass lying across the south boundary of the Indian reserve in the western part of the area is the eastward extension of the mass centring on the Making Ground river. Several dike-like bodies of quartz diorite intrude greenstone to the east of the mass. It is a hornblende-free type.

Quartz and Feldspar Porphyries

Small dike-like bodies of porphyritic rock intrude the sediments and volvanics. Many of the dikes are less than one chain wide and are too small to map. The sizes of some dikes have been exaggerated in order that they could be indicated on the map. No attempt was made to trace them.

Two varieties of porphyry occur. One is a quartz porphyry; the other and more common type is a quartz-feldspar porphyry. An outcrop of the typical quartz porphyry occurs on the prominent point on the south shore of Adel lake. The rock is light-brown in colour and schistose. In thin section quartz phenocrysts are seen to lie in a sheared and sericitized groundmass of quartz and acid plagioclase. Biotite and carbonate are present in minor amounts.

The quartz-feldspar porphyry resembles the quartz porphyry in appearance but is generally less sheared. Phenocrysts of quartz and feldspar lie in a fine-grained groundmass of quartz and acid plagioclase, with minor amounts of biotite.

Keweenawan

Diabase

Diabase occurs in irregular and discontinuous dikes intruding all the consolidated rocks previously described. The dikes have the same northerly trend as similar dikes in the Long Lake area but are less numerous and apparently smaller in size. The most prominent dike extends in a north-south direction near the east shore of Little McKay lake.

The diabase is medium- to fine-grained and shows the typical ophitic texture. An average of feldspar determinations indicates a composition between andesine and labradorite. It contains quartz. The diabase along Little MacKay lake differs from the general type in that some portions of it are distinctly coarser in texture.

Pleistocene

Unconsolidated glacial deposits of sand and gravel which overlie the pre-Cambrian rocks in many parts of the area are of two main types. The flat or low-rolling sand plains' surrounding the Sandlink and Laponen lakes are considered to be glacial outwash deposits. Small, v-shaped stream valleys form the only topographical breaks in these plains. It is not known whether these deposits are stratified, since no fresh cuts were observed. The more extensive type of glacial deposit, occurring mainly in two parts of the area, consists of unsorted sand and gravel. The major part of the area north of Hoiles creek and west of Klotz lake is a typical morainal area with irregular hills and pot-hole lakes. The hills west of Klotz lake reach an elevation of more than 100 feet above the valley of Hoiles creek. Although the shape of individual hills is irregular, there is a general alignment of hills and lakes parallel to the structure of the underlying rocks. Similar glacial deposits occur south of Divide creek between Pagwachuan lake and the railroad. The hills in this area probably do not exceed 75 feet in elevation.

The effects of glacial erosion are evident in the rounded and polished surfaces of some rock outcrops. Glacial striae on Pagwachuan lake strike S. 55° W. to S. 60° W. The variation of this strike from the general strike of S. 35° W. at Long lake may be a reflection of the control of glacial movement in the area by the pronounced east-west rock ridges.

Recent

Recent deposits consist mainly of organic material. One occurrence of stratified silt was observed on the north shore of McKay lake near the east end. This is probably the occurrence that was described by Coleman as a "terrace of stratified silt, evidently a lake deposit, rising about 8 feet above the water."[1]

STRUCTURAL GEOLOGY

The structure of the Keewatin rocks is inferred from information that cannot be taken in most places as conclusive. Pillow structures in the lavas are almost non-existent, and no other structures occur which would indicate with certainty the tops of flows. Variations in grain size that occur in the sediments were used to determine tops. The schistosities of the volcanics and sediments appear to parallel the boundaries of the formations. Dips of bedding and schistosity are generally steep but in the vicinity of Rocky Shore lake are as low as 30° W.

Faulting

No direct evidence of any major faulting was obtained. The alignment of the Sandlink and Laponen lakes may possibly be due to a major fault. The formations on the east side of the Laponen lakes are displaced 3,000 feet to the north relative to those on the west side. This may be due to a north-south fault along which the lakes lie or it may be due to folding. The absence of outcrops makes it impossible to draw definite conclusions.

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[1]A. P. Coleman, "Iron Ranges of Nipigon District," Ont. Bur. Mines, Vol. XVIII, 1909, pt. 1, p. 151.

Folding

The sediments are closely infolded with the volcanics in the form of a monocline. The granite mass north of Seagram lake has been intruded between the sediments and the northern volcanic band, causing the volcanic band to arch northward from the monoclinal structure. Three miles east of the railroad the sedimentary band splits to form a northern and southern band, which are separated by volcanic rock. Owing to the absence of structural criteria in the massive quartzitic sediments and the lack of outcrops in many parts of this area, no direct evidence was obtained for the structure. The southern belt of sediments are probably re-exposed in the northern belt by a minor fold. The greenstone between the two belts of sediments would then be an infolded part of the northern greenstone belt. The disappearance of the northern sediments 1½ miles southeast of Klob lake can be explained if the minor fold has an eastward plunge. The sediments would pass below the greenstone, where the crest of the fold intersects the present topographic horizon.

ECONOMIC GEOLOGY

The establishment of a producing gold camp in the Little Long Lac area lent impetus to further prospecting in areas to the east. The belt of Timiskaming sediments and Keewatin volcanics of the Little Long Lac area extend eastward into the Long Lake area. In the Long Lake area the Timiskaming sediments nose out, and the belt from there eastward consists of Keewatin volcanics and sediments. Prospecting activities have been confined mainly to this belt. Gold is the only mineral of economic importance. The iron formations are much too lean to form a source of iron ore. In the event of the establishment of a mining camp in the Pagwachuan Lake area the abundant sand and gravel deposits would be of economic importance in construction work.

Gold has been found in quartz and quartz-carbonate veins in association with pyrite, chalcopyrite, and arsenopyrite. The veins occupy shear and fracture zones in greenstone, diorite, and porphyritic quartz diorite. Wall-rock alteration is characterized by the development of carbonate, sericite, and chlorite.

Future of the Area

An estimation at the present time of the future possibilities of the area is difficult, since none of the known deposits have yet proved to be of commercial value. Despite certain limitations and prospecting difficulties, the gold discoveries so far made warrant further investigations of the mineral possibilities of the area. Prospecting is seriously handicapped by the glacial deposits and muskeg, which cover the rocks in a large part of the area. The mica schists are dense, uniform, and apparently impervious, so that veins probably will not be found in them. The large intrusive bodies are also unfavourable due to their homogeneity. The Timiskaming sediments, which are the most favourable rocks of the Long Lake and Little Long Lac areas to the west are lacking in this area.

DESCRIPTION OF PROPERTIES

Caramat Gold Mines, Limited

The claims of Caramat Gold Mines, Limited, lie to the north and west of Adel lake. Surface exploration was carried on during the summer of 1936, and a diamond-drilling campaign was completed in the following winter. The showing is situated at the northeast end of Paglamin lake and consists of a carbonated quartz vein in sheared porphyritic quartz diorite. The wall rock contains abundant sericite and some carbonate. The shear zone, which has been traced on the surface for 300 feet, strikes east-west and dips steeply south. The vein ranges in width from 6 to 12 feet. Pyrite and chalcopyrite occur fairly evenly throughout the quartz. Visible gold is present. Assay values from surface work were sufficient to warrant a diamond-drilling campaign.

Ward-Morrow Group

The claims held in the Ward-Morrow group are T.B. 20,090–20,095, 20,304, and 20,305. The group is situated 3 miles north of the west end of Pagwachuan lake. The main showing is on claim T.B. 20,092. It consists of a quartz-carbonate vein occupying a fracture zone in a fine biotite-chlorite-carbonate schist, which strikes N. 65° E. and dips steeply. The fracture zone averages 4 feet in width and has been uncovered for approximately 150 feet. An outcrop of what is thought to be the westward extension of the vein has been picked up some 500 feet to the west. The vein material contains disseminated pyrite, chalcopyrite, and some biotite. Pyrite and chalcopyrite also occur in the wall rock. A thin section of the wall rock shows it to be a fine-grained chlorite schist containing appreciable amounts of carbonate and biotite. Magnetite and pyrite occur in minor amounts. The rock one chain to the south of the vein is a quartz-hornblende gneiss. The average of 6 channel samples show gold values of $19.76 per ton over 7 feet. A similar type of vein on claim T.B. 20,305 has returned an assay value of $10.50 per ton over 13 inches. Surface work so far is considered to be sufficiently encouraging to warrant further exploration.

A second group of claims situated 1½ miles northeast of Gabbro lake lie in greenstone, which is intruded by quartz diorite. Assay values running between $4.00 and $5.00 were obtained from a heavily mineralized shear zone. This group was not worked during 1937.

Pagwachuan Lake Mining Syndicate

The Pagwachuan Lake Mining Syndicate holds a group of 15 claims situated immediately west of Adel lake. The rock on the claims includes sediments and porphyritic quartz diorite. Surface exploration was carried on during 1936 and 1937. Several small shear zones were found in the porphyritic quartz diorite. Visible gold is reported from one of these. Pyrite is disseminated throughout the silicified shear zones. Assay results indicated a trace of gold.

Kenogamisis Gold Mines, Limited

The claims held by Kenogamisis Gold Mines, Limited, are situated 2 miles northeast of Rankin bay on Pagwachuan lake. The main showing occurs on claims T.B. 22,375 and 22,380. Stripping and trenching was carried on during the fall of 1936. The rock in the vicinity of the showing consists of finely sheared andesite and coarse hornblende gneiss, which strike N. 75° E. and dip steeply. The coarse hornblende gneiss may be an intrusive hornblende diorite, but no distinct intrusive relations were seen. The coarse gneiss apparently grades to the fine andesite type. Gold values were obtained from an irregular quartz vein which lies in the andesite. Pyrite, chalcopyrite, and arsenopyrite are disseminated in the quartz with chlorite. Assay values as high as $29 to the ton over narrow widths were obtained, but the average of values was much lower. The property was not worked during the summer of 1937.

Fish Lake Group

The Fish Lake group is not situated within the area but was examined during the field season. The property, which was staked by Messrs. A. Ward, W. Morrow, and F. Powers early in the summer of 1937, lies south of Fish lake, which is situated 1¼ miles southeast of the east end of Klotz lake. The showing consists of irregular quartz stringers occupying a discontinuous fracture in diorite. The diorite is a dark-grey, medium-grained rock composed of oligoclase, hornblende, biotite, and quartz. Alteration products are sericite, clinozoisite, epidote, and kaolin. Hornblende and biotite form approximately 25 per cent. of the rock; quartz forms less than 5 per cent. of the rock. A porphyritic phase of the diorite occurs 30 feet south of the showing. The diorite mass is intrusive into greenstone, which strikes slightly north of east. The quartz veinlets are mineralized with native gold, pyrite, and some chalcopyrite. Very high assay results were obtained from the quartz veinlets, but the wall rock appears to be barren. The quartz veinlets pinch out within a short distance, and the fracture was not picked up along the strike. Two other indications of gold have been obtained on the property.

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