

CANADA
DEPARTMENT OF MINES AND RESOURCES
MINES, FORESTS AND SCIENTIFIC SERVICES BRANCH

GEOLOGICAL SURVEY OF CANADA

PAPER 49-10

INDIN LAKE MAP-AREA,
(EAST HALF)
NORTHWEST TERRITORIES
(Report and Map)

By
Y. O. Fortier



OTTAWA

1949

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Illustration

Preliminary map - Indin Lake (east half), N.W.T.....In envelope

INTRODUCTION

GENERAL STATEMENT

Indin Lake (East Half) map-area lies north of Great Slave Lake, Northwest Territories. It includes some 2,000 square miles, extending from latitude 64 to 65 degrees north and from longitude 114 to 115 degrees west. The centre of the area is 140 miles north of the town of Yellowknife.

The area was mapped in 1948 between June 20 and September 12. The field party included the following student assistants: Messrs. D. W. Hurd, D. R. Delaporte, H. W. Green, H. D. Carlson, and R. O. McKenzie; the first two were responsible for the mapping of large tracts of the area.

No previous geological mapping had been done by the Geological Survey in the area. However, the areas adjacent to the west were mapped by Wilson and Lord (Lord, 1942)¹, Stanton (1947), Stanton, Tremblay, and

¹ Names and dates, in parentheses, are those of references at the end of this report.

Yardloy (1948), and Tremblay (1948).

ACCESSIBILITY

The area is best reached by aircraft from Yellowknife. A canoe route from the west arm of Great Slave Lake follows Snare River to Indin Lake; a possible canoe route from Yellowknife Bay follows Yellowknife River to its source, thence traverses a series of lakes westward to Snare Lake. A winter tractor road under consideration would follow a linear depression that most probably marks the northward extension of the West Bay fault at Yellowknife to Indin Lake.

HISTORY OF PROSPECTING

According to Lord (1941) gold was discovered at Indin Lake, west of the area, in 1938, and was followed by much staking near this lake in the

winter of 1938-39, after which interest in the district dwindled, to be revived in 1944. Although some gold deposits are being explored in the vicinity of Indin Lake, west of the area, most claims staked within the area have reportedly lapsed. During the summer of 1948 few prospectors were met.

DRAINAGE

The Indin Lake area is part of the drainage basins of Emile, Snare, and Wecho Rivers, which are tributary to the Mackenzie River system. However, Grenville Lake, near the northern boundary of the area, discharges both southwestward into Mesa Lake within the Mackenzie River basin, and northward into Rawalpindi Lake, possibly within the Coppermine River basin.

Much of the northern quarter of the area is tributary to the Emile River drainage basin through Mesa Lake, into which rivers flow southward from Grenville Lake and northward from Shamrock Lake. Drainage through Wecho River affects a very small part of the area in the southeast corner. Most of the area is drained by Snare River or by Indin River, a tributary of the Snare.

Snare River, between Snare Lake and Indin Lake, falls off 270 feet in 15 miles, and its power possibilities have been studied by G. H. Wood (1948).

Indin River, within the area, is a series of rapids interspaced by lakes; northeast of Truce Lake the river is a shallow trickle of water through boulder fields.

Many of the lakes have reefs; some are in part drowned sand plains, and large parts of them, as for example Snare Lake, may be shallow. In the northern part of the area, lakes have bouldery, shallow shores.

CANOE ROUTES

No good canoe routes permit easy access to all parts of the area, as drainage is mostly along east-west lines. The area south of Snare Lake is easily reached through arms of the lake or by a series of lakes.

separated by relatively short portages. An eastern route from Snare Lake northward to the headwaters of Indin River traverses a river with many portages to Pate Lake, and thence follows a series of lakes. Canoe travel along Snare River between Snare and Indin Lakes entails almost continual by-passing of rapids through portages over rough country. Indin River is a poor canoe route, with portages from lake to lake along the river. The trip from Indin Lake to Truce Lake was made by portaging from the north end of Indin Lake into a large lake to the north, thence to a long, narrow lake on Indin River, and northward to Truce Lake by continuous portage along Indin River. From Truce Lake to the headwaters of Indin River, canoe travelling is possible only along lake-like expansions. The stream discharging the waters of Grenville Lake into Mesa Lake has numerous shallow rapids, and near Grenville Lake travelling can be hastened by portaging through a parallel series of small lakes than by following the stream. This was the route followed by Dogrib Indians from Fort Rae to Grenville Lake barren country in August 1948.

TOPOGRAPHY

According to the Indin Lake topographic sheet (Map 675A), Indin Lake, the lowest point within the map-area in the Snare River drainage basin, is approximately 1,025 feet above sea-level, and Whitewolf Lake, near the head of the basin, has an elevation of about 1,430 feet. However, a survey by Wood (1948) indicates an elevation of 886 feet for Indin Lake. The northern part of the area lies at slightly higher elevations than the southern part, but the local relief is greatest in the vicinity of Indin Lake, where hills and ridges composed of granodiorite, diorite, and basic volcanic rocks rise some 500 feet above the lake, whereas elsewhere maximum relief is little more than 200 feet. The terrain is more hummocky and more rocky in the south than in the northern part of the area, where the slopes are generally more gentle and the drift cover more widespread.

Volcanic rocks are typically eroded into ridges rising above the surrounding country, and are, therefore, well exposed. Granodiorite and diorite south and east of Indin Lake also form high, rounded hills rising above surrounding granitic and sedimentary terrains. Basic dykes locally form narrow ridges above sedimentary strata and granitic gneisses. Areas underlain by sedimentary rocks are commonly low, although high hills are formed by nodular sedimentary schists on the northeast shore of Indin Lake. Many linear depressions and escarpments mark areas of granite. Some linear draws and escarpments are caused by erosion along faults; for many others this could not be demonstrated. Between Truce and Indin Lakes, and northeast of the latter, the topography is controlled by the structural trend of the bedrocks. From Truce Lake northward to the northern boundary of the area, a general westerly **topographic** trend is the result of glaciation illustrated by 'esker -valleys', roches moutonnées, and especially drumlins of the crag-and-tail type.

TIMBER

The limit of forest is roughly along a line extending from Truce Lake to south of Pate Lake. South of this line, trees can be found everywhere, and are mostly spruce and some birch. Rare, small tamaracks were observed in muskegs along the western margin of the map-area up to latitude $64^{\circ} 15'$. North of the described line, local tracts with trees, especially in stream valleys, are found, but decrease rapidly northward both in number and size. Camping with comfort in these parts requires the carrying of fuel.

WILD LIFE

Caribou were sighted in the first week of August, when mapping had progressed northward to latitude $64^{\circ} 50'$. From then on they were almost constantly in sight, and by September 12 they had migrated southward at least to Indin Lake. From August 14 to 21, a great number were killed around Grenville Lake by a party of Indians who had travelled in eleven canoes from Fort Rae; the latter were apparently interested in saving only

the meat on the ribs.

Rare moose were observed, one a few miles north of Truce Lake. Black bears and foxes were also rarely seen, but white wolves, in packs up to seven, were a common sight. Many muskrats were seen. Ptarmigans are also common, but waterfowl relatively rare. Lake trout, pike, and whitefish were caught during the field season.

The area has probably been the scene of much hunting and trapping. Remains of camps and remnants of birch-bark canoes are widespread up to a line joining Pate Lake with Grenville Lake; almost every cluster of trees bears signs of axe cuttings.

GENERAL GEOLOGY

SUMMARY STATEMENT

More than three-quarters of the map-area is underlain by granitic rocks, and the remainder by sedimentary and volcanic strata of the Yellowknife group and their metamorphic derivatives, which form aureoles against the granitic masses. Such aureoles are composed of nodular quartz-mica schists and gneisses, and of amphibole schists and gneisses. They are narrower in the south where the strata are not traversed by pegmatite dykes, and where bodies of granodiorite and diorite are present. Farther north, paragneisses, in which nodules are rarely if ever visible, outcrop over large tracts separating nodular schists from mixed orthogneisses and paragneisses. In general, amphibole gneisses do not form such mixed or migmatitic gneisses, and they can be traced as a distinct unit into granites. Near their contacts with sedimentary or volcanic rocks, the granitic rocks appear for long distances as fine-grained banded gneisses that may, in part, be inferred to be granitized, stratified formations. The large tracts of granitic rocks are commonly heterogeneous, massive to gneissose, with varying amounts of micas, massive inclusions, and migmatite gneisses, and such mixtures raised problems of granitization and hybridization. However, certain granitic phases with a few variations are recurrent: for

instance, all along the western margin of the area, a fresh looking granite, locally with muscovite and commonly associated with pegmatite, is apparently the latest granitic intrusion and is probably contemporaneous with a similar granite of the Yellowknife-Beaulieu River district.

In their structural trend the Yellowknife rocks form flexures sweeping around axes oriented northwesterly. Gneisses in the eastern half of the northern part of the area trend northeasterly.

Features due to Pleistocene glaciation are diverse and widespread.

YELLOWKNIFE GROUP

Volcanic Rocks

Basic volcanic rocks (1)¹ are by far the most abundant extrusive rocks.

¹ Numbers in parentheses are those of map-units of map-legend.

They consist of andesite, dacite, and basalt, but are mostly metamorphosed to chlorite schist, with amphibole and carbonate, or, more generally, to amphibole schist and gneiss, amphibolite, and hornblende gneiss.

The volcanic rocks occur in bands varying in width from a few feet to nearly 3 miles. Some form lenticular outcrops, probably as a result of plunging folds, but many bands, even the narrower ones, are persistent along strike.

The thicker bands, which are generally the westernmost occurrences and contain the least metamorphosed phases, comprise pillowed lavas, massive flows, lesser bedded rocks - presumed tuffs - and minor breccias or coarse pyroclastic deposits. In such bands the bedded rocks are more abundant near the contacts with adjacent sedimentary bands. Although massive and pillowed lavas occur in the narrower bands, these are predominantly (a few exclusively) composed of bedded, or at least well-banded rocks.

The massive rocks included with this volcanic assemblage are the coarsest grained, with the appearance of gneissose meta-gabbro or

amphibolite, and conform in trend to associated, pillowed lavas so far as could be observed in traversing; they are presumed to be coarse flows although some may be sills and even dykes. Rare bands up to 35 feet wide carry phenocrysts of feldspar as much as 3 inches across, which locally constitute more than 35 per cent of the rock.

Pillows are best observed in the least metamorphosed flows; tops could be inferred commonly from them only in the wide volcanic band north-east of Shamrock Lake. In general the ellipsoidal forms are less than 3 feet long by 16 inches wide. They occur in the finest grained and densest flow rocks, either andesites or very fine-grained, green schists, containing a few, scattered, minute needles of amphibole. The pillows are elongated parallel with the schistosity and banding of the rocks. They are recognized with difficulty in metamorphosed lavas carrying platy amphibole crystals. Extreme squeezing may have induced a banding in pillowed lavas. Among the banded rocks south of Grenville Lake, are thin, dark green, outer bands, $\frac{1}{2}$ inch wide, surrounding lenses, 2 to 3 inches wide and more than 3 feet long, of light green, fine-grained schist; on a horizontal face, such forms are similar to lensy banding observed in actinolitic schists, but on a vertical face they appear as very narrow or squeezed ellipsoidal forms.

Amygdaloidal lavas, with carbonate, quartz, and epidote, were recognized in the least metamorphosed phases. In places, some rough weathered surfaces similar to that of weathered limestone might be interpreted as ropy structures.

Some rocks consist of andesitic fragments enclosed in a matrix of similar material, though commonly of a different shade of green. The fragments are generally less than 10 inches long, and are elongated in the direction of schistosity or banding. Where the volcanic rocks have been metamorphosed to dark, platy, amphibole rocks, with well-developed banding, the fragments may be difficult to distinguish. However, many occurrences were observed where either matrix or fragments were carbonatized

light brown weathering rock, which enhanced the fragmental appearance. In rare occurrences of pyroclastic rocks, the coarse fragments vary from dark green to light grey, almost white.

Stratification and banding are common in the volcanic rocks and schists; in many exposures, especially those of the more metamorphosed types, it is difficult to distinguish these features: banding may simulate bedding or be superimposed on it. Clastic textures, which may be associated with bedding, are destroyed through metamorphism. True beds maintain a uniform width along strike, the widths varying for different beds from several inches to laminae a fraction of an inch thick; an exposure of stratified rocks may include beds showing great variation of colour - dark green, light green, dark grey, light grey, brown, or occasionally almost white. Bands vary in width along strike; some are distinctly lensey and commonly wavy; some consist of thin seams of feldspar, in part epidote green, lying in a dark green amphibole matrix. Layering of coarser grained, dark green amphibole schist with fine-grained, lighter green schist of similar composition is difficult to interpret definitely either as bedding or banding.

The lithology of the basic volcanic rocks varies, depending on the original composition and the degree of metamorphism. The least metamorphosed pillow lavas weather light to medium green, occasionally brown, and are all green on fresh surfaces. They have a very fine grain; in most of them a very fine schistosity can be detected; a silky lustre would indicate the presence of chlorite, and such rocks are, therefore, called chlorite schists. Through metamorphism, they become amphibole schist and gneiss: the amphibole first appears as fine needles; by increase in coarseness the amphibole appears platy, and the rocks become darker green to almost black. Coarser grained, massive, dark green flows have, on the weathered surface, the appearance of gneissose gabbroic rocks or, more commonly, amphibolites; platy amphibole is common in such rocks even where they are associated with pillowed lavas in which no amphibole can be detected megascopically. Most of the bedded

rocks are of medium green colour; in a few places they exhibit a clastic texture, but generally carry actinolitic amphibole and are schists. Through metamorphism these rocks pass into dark amphibole schist and gneiss.

The volcanic bands mapped in the granitic rocks are fine-grained, hornblende gneisses in which the hornblende is black, easily mistaken for biotite, and the plagioclase is commonly granular and vitreous like the associated quartz; in many exposures such gneisses may resemble sedimentary strata, especially if banded or bedded.

Dark green amphibole schist and gneiss and black hornblende gneiss occur near or within areas of granites, but platy, green amphibole schist may occur beside flow rocks, in which no secondary amphibole can be detected megascopically, in areas remote from granitic rocks.

Disseminated carbonate is common in the volcanic rocks. The mineral occurs in stringers, lenses, and veinlets, and may be abundant locally. The volcanic rocks have been intensely carbonatized along some contacts, near valleys that may be loci of faults, or where the rocks are much deformed. Layers of crystalline carbonate occur interstratified with actinolitic amphibole schists; such layers vary from a small fraction of an inch to as much as 2 inches in thickness, and are laminated and contorted; they may represent limy sediments deposited contemporaneously with the volcanic rocks, or may be of hydrothermal origin.

Near some contacts with sedimentary strata, the basic volcanic bands contain some rhyolite; commonly, too, thin layers of biotite schist occur within bedded volcanic rocks at their contacts with the sedimentary strata. All volcanic bands appear conformable with the sedimentary strata. The large band west and north of Indin Lake underlies the surrounding sedimentary strata, as was determined from the directions faced by tops in the strata at or near the contacts; the west part of the volcanic band disappears beneath the sedimentary strata in a plunging anticline. Other bands to the east probably underlie the sedimentary rocks, but some are contemporaneous,

as might be expected from repeated volcanic activity: this would be indicated by the numerous bands of volcanic rocks a few feet to more than 150 feet thick intercalated with sedimentary beds around Mesa Lake, and east of Truce Lake. Definite age relations of the larger volcanic bands could be determined through more detailed structural studies.

Acidic rocks (2) are minor constituents of the volcanic assemblage. Three main exposures have been mapped, and are relatively small compared with those of the basic volcanic types. All occur near the north end of Indin Lake.

Among the rocks mapped with acidic volcanic types are rhyolite flows, tuffs, and breccia, with lesser amphibole schists. These rocks weather light yellow to light grey, almost white, or rusty brown. The rhyolite is aphanitic and dense, has a conchoidal fracture, and is grey with white streaks or flow lines. Such rocks are best exposed on a large island on Indin Lake. North of this lake an acidic volcanic assemblage includes, besides rhyolite flows and breccias, some fine-grained schists with sericite, others with disseminated biotite, and, near the western contact with sedimentary strata, a mixture containing fragments of rhyolite in a matrix of greywacke and biotite schist. The third and easternmost exposure (2a) is tentatively grouped with rhyolitic rocks, but contains, in addition to rhyolite and sericite schist, much amphibole schist and fine-grained, gneissic, biotite granite, the exact proportions of which could not be ascertained.

Sedimentary Rocks

Sedimentary strata of the Yellowknife group have been mapped under three units, according to their degree of metamorphism: greywackes, argillites, slates, lesser impure quartzites, arkoses, tuffs with amphibole, and quartz-mica schists are the least metamorphosed types (3a); quartz-mica schists and gneisses, with nodules or metacrysts, and gneisses in which nodules are no longer or rarely observed form a second unit (3b); and

quartz-mica schists and gneisses mixed with some 25 to 75 per cent granitic rocks constitute the third (A). The contacts of the members of the third unit (A) are arbitrary; the contacts between rocks of the first (3a) and second units (3b) are marked by the first occurrences of nodules or metacrysts; in the southern part of the map-area strata with small, plentiful plates of biotite, marking an intermediate zone between nodular and non-nodular rocks, have been mapped with the members of the first unit.

The greywackes are grey to light brown weathering rocks, with a grey fracture, a fine, sandy texture, and with quartz, biotite, chlorite, sericite, and feldspar, constituting the principal minerals, the chlorite passing to biotite by metamorphism. They may form beds more than 10 feet thick, but are generally less than 3 feet. By widespread grain gradation within individual beds, the greywackes pass upwards into a very fine-grained, darker, sandy rock or, commonly, to a dark argillite. Beds of grey to black slates are thinner than those of greywacke, apparently contain much graphitic material, and are more schistose.

A few bands up to 50 feet thick, in which neither bedding nor grain gradation is obvious, consist of rocks weathering light grey, light brown, or almost white; such rocks are siliceous, apparently devoid of mica, and are fine grained, with individual quartz grains hardly discernible. They may be either fine quartzite or arkose, or possibly rhyolite.

Layers 1 inch to 3 inches thick, occurring in greywacke beds, consist of green actinolitic amphibole, feldspar, and quartz, and may represent accumulations of tuff contemporaneous with the sediments.

Near granitic masses, the sedimentary strata have been metamorphosed into schists and gneisses, with a coarsening of grain size, notably of quartz and biotite, and the formation of nodules or metacrysts. The latter are commonly round to ovoid aggregations up to 4 inches long, of quartz and biotite, or of cordierite with inclusions of quartz and biotite; well-formed crystals of andalusite, up to 6 inches or more long, many with

the chiastolite dark cross of graphite impurities, are locally plentiful; red garnets, in small grains, are common, and locally abundant; in a few places metacrysts of staurolite were observed; sillimanite has also been reported in such rocks. Southeast of Truce Lake, the sedimentary strata have been recrystallized to quartz-mica schists and coarser gneisses in which nodules are rare or absent, and bedding is poorly preserved over large areas; similar rocks (A) are associated with granitic bodies of all sizes, some forming migmatitic assemblages, and have also been intruded by pegmatites. Scarcity of exposures in many localities prevents an establishment of the proportions of sedimentary and igneous materials in these mixed rocks.

GRANODIORITE, DIORITE, SYENITE

Medium-grained rocks (4), generally strongly gneissic, grey to dark grey weathering, pink in some exposures, and containing 20 to 50 per cent dark minerals, form hills rising above sedimentary strata and other granitic rocks. Megascopically they resemble gneissic biotite granodiorite, biotite-hornblende granodiorite, hornblende granodiorite, diorite, and syenite, depending on the presence and relative amount of quartz, plagioclase feldspar, biotite, and hornblende. The feldspars, mainly plagioclase, are generally grey, but may all be pink in some hornblende-bearing types.

Inclusions of pre-intrusion rocks are not plentiful; but where biotite schists are included the contacts are marked by mixed gneisses. These intrusive rocks are traversed by dykes of pegmatite and fine-grained granite similar to granitic rocks exposed to the east.

An oligoclase granite (4b), in the southern part of Indian Lake, and a fresh looking hornblende syenite (4a), 2 miles south of Truce Lake along the western margin of the map-area, have been grouped for convenience with the above described rocks; mutual relations are not known. They form small bodies in the sedimentary strata. The oligoclase granite has been described by Stanton (1946). It is associated with feldspar porphyry: similar rocks, and aplite, occur as sills in the strata surrounding the

main granite body. The hornblende syenite is a fresh-looking, pink rock, with lathy grains of feldspar, $\frac{1}{8}$ inch long and oriented subparallel. Chloritized hornblende constitutes about 10 per cent of the rock. Small grains of sphene are disseminated in the syenite; they are more concentrated in fine-grained patches of feldspar and hornblende lying in narrow feldspar pegmatite dykes traversing the syenite. Sedimentary strata at the contacts and in inclusions have been altered to chloritic schists.

GRANITIC ROCKS AND GNEISSES

The granitic rocks (5) within the area are of variable types, and over large tracts form heterogeneous complexes. They vary in content of biotite, muscovite, chlorite, quartz, and feldspar. The most widespread varieties resemble biotite granite and granodiorite - the latter in part porphyritic - coarse porphyritic granite or granodiorite, granite with scant grains of chlorite, alaskite, muscovite granite grading into muscovite-biotite granite, and, finally, biotite granite. In places the granitic rocks with small amounts of quartz may be quartz monzonites. Hornblende syenite and diorite occur locally.

These rocks vary from massive to gneissic; the granite with low mafic content, the muscovite granite, and the alaskite, are commonly massive, whereas the biotite-rich varieties, especially those with plagioclase, are commonly gneissic. The former are in many parts associated with pegmatite satellites or grade into pegmatitic phases and appear to be the youngest granitic intrusions in their immediate vicinity, but it is not known if they are phases of the same intrusion. They traverse and contain inclusions of gneissic granite and granodiorite, with noticeably more biotite. However, the crosscutting relationships are not everywhere evident, and commonly a massive, mafic-free granite grades into a gneissic, biotite-rich granite or granodiorite.

Heterogeneity over large tracts of granite has resulted from inclusion of, and mixing with, various types of rocks. Some exposures are composed

of fine to coarse, grey, black, or brown weathering quartz-biotite schist and gneiss, locally with much garnet; in other exposures granite occurs along planes of gneissosity of such rocks, or form parallel lenses, or bands, or thin seams characteristic of a migmatite assemblage, or a mixed gneiss is formed with numerous thin lenses of coarse, brown biotite. On the other hand, exposures of schists, by increasing amounts of metacrysts of grey to pink feldspar, pass into a granitic rock. Some massive inclusions devoid of granitic dykes or others traversed by a plexus of dykes with sharp contacts, consist of fine-grained, black, massive rocks resembling a fine diorite on the weathered surface, with black hornblende and granular grains of feldspar and quartz, and are probably derived from the metamorphism of basic volcanic rocks; locally, where the latter are well banded, sills of granite with sharp contacts have intruded them lit-par-lit, but no fine migmatitic mixture is formed as with the paragneiss. Also contributing to the heterogeneity of the granitic complex are very fine-grained, grey, granitic, banded gneisses.

Granites with Few Inclusions, Pegmatites

Areas of granites (5a) with few inclusions and in part without gneissosity occur in the vicinity of Pate Lake, Drumlin Lake, Grenville Lake, north and east of Truce Lake, and in small exposures in the sedimentary strata south of Truce Lake. The granites may be megascopically classified as alaskite, biotite granite, muscovite granite, and muscovite-biotite granite. They are fresh looking, medium to fine grained, and commonly equigranular.

The muscovite-bearing types (m) are of local occurrence, mainly along the western margin of the map-area where they are associated with pegmatite dykes. There is much variation in the muscovite content; in a few exposures the light mica is associated with tourmaline; it may occur to the exclusion of biotite, or both micas may occur together in various proportions, or, again and more commonly, biotite may be the sole mica; and it is probable

Most of the hornblende schist and gneiss are probably the metamorphic equivalents of basic volcanic rocks occurring to the south and west, where there is no granite; the main differences are a coarsening of the grain and development of dark hornblende in the more metamorphosed rocks included and traversed by granites. However, some bands, 25 to 40 feet wide on the average, occurring in granitic gneisses, maintain a uniform width along strike; they are composed of gneissic rocks that on weathered surface resemble fine- to medium-grained gabbros or diorites, or are amphibolites; a few have feldspar phenocrysts; they are traversed by narrow dykes of pegmatite and granite; their gneissosity and trend is parallel with that of the associated granitic gneisses; borders of the bands are more gneissic than the central parts and may contain biotite, but do not permit a study of grain gradation nor of the nature of the grain at the contact. However, it is probable that such meta-gabbroic bands are dykes cutting granite and granodiorite-gneiss and traversed by pegmatite and granite dykes.

Areas of Heterogeneous Granitic Rocks, Gneisses, and Inclusions

In the southern part of the map-area north and south of Snare Lake, are various mixtures of granitic rocks with inclusions of schists and gneiss (5c). Pink, fine- to medium-grained, massive granites are without mafic minerals or may contain up to 3 per cent biotite or chlorite, others of similar composition may be gneissic. The distribution of biotite is patchy, in contrast with feldspar and quartz. Such patchy occurrences of biotite may be a result of granitization: some biotite-bearing patches, otherwise of similar composition to the surrounding granite, are gneissic, in contrast with the granite itself, which is structureless; or the grain size of the patches may be different; or, again, patches a few inches to fractions of an inch across occur in which the biotite is associated with larger proportions of grey quartz than in the surrounding granite, or the small areas with oriented biotite flakes

may appear as ~~skeleton~~ remnants of schist or gneiss incorporated in the granite. The pink granite also commonly includes, and intimately intrudes, quartz-biotite schist and gneiss and forms with them mixed gneisses; near such areas the granitic rocks with more biotite may also hold grains of red garnet. In some exposures the pink granite has the coarser grain of a pegmatite, or contains dykelets of granite-pegmatite. In areas of included biotite schists and mixed gneisses the rocks may exhibit all gradations from pegmatitic lenses to schists with feldspar metacrysts.

Similarly, the pink granite transects, includes, is intimately associated with, and grades into, fine-grained, banded, grey, biotite granitic gneiss.

The pink granite and its pegmatitic dykelets are also associated with, and cut across the gneissosity of, a medium-grained, grey to pink granodiorite, with common striated plagioclase and some 10 per cent biotite. The latter rock in part has phenocrysts of feldspar $\frac{1}{4}$ to $\frac{1}{2}$ inch across. Both rocks are widespread; unless they are seen in contact, they may not be easily distinguished.

Similar heterogeneous granitic rocks and inclusions occur around Grenville Lake and between areas of more uniform, massive, granitic rocks (5a) and others of banded, mixed gneisses (5b).

Granite and Banded Gneisses

Outcrop areas of granite, granitic gneisses, and of locally abundant gneisses derived from sedimentary and volcanic rocks, include many exposures where banding and migmatization have resulted in a stratified appearance. Such an assemblage (5b) commonly occurs as a zone peripheral to the granitic complex (5), or where the number of inclusions within the granite complex suggests the former proximity of pre-granitic rocks now eroded away.

A zone of this type extends from the southern margin of the map-area northward to Indian Lake. It contains a fine- to medium-grained pink granite, in part pegmatitic, intruding gneisses of all types. The granite

weathers light pink to salmon-pink, or brownish pink in a few exposures. It carries a high percentage of feldspar. Commonly it contains no mafic mineral; exceptionally it contains some muscovite or, in other parts, variable amounts of biotite or chloritized biotite up to about 5 per cent. It is either fresh looking and massive, or may be gneissic. Some pink gneiss, with scant biotite is even banded: thus lenses, 1/16 by 1 inch, of grey quartz lie in a feldspar-rich groundmass, and some of the feldspar is segregated in thin lines.

The pink granitic rock and its pegmatitic satellites transect a grey, medium- to fine-grained gneissic, in part banded, biotite granitic rock with plagioclase, a very fine-grained feldspar-biotite granitoid gneiss, biotite-quartz paragneiss, and fine, granular hornblende gneiss. Banding is enhanced by the migmatitic layering, down to 1/16 inch, of the pink granite with the gneisses. In addition to the banding within the pink and biotite granite, the fine-grained, granitoid, feldspar-biotite gneiss also has a banding resulting from the differential content of biotite, and contacts between bands of different biotite content are locally sharp. The grain of this gneiss is less than 1/32 inch, and the rock may resemble a greywacke-gneiss except for the large amount of feldspar, which imparts a granitoid texture to the rock: it is possibly derived from greywacke by the formation of feldspar in part at the expense of the original quartz. It is associated with biotite-rich quartz schist and gneiss with which granite forms migmatites.

Contacts of pink granite in migmatite-gneiss are either gradational or sharp. In part the granite appears as a segregation of, or replacement of host rock by, feldspar in lenses; in part the thin layers or lenses of pink granite truncate foliae of biotite in the gneisses. In some exposures a mottling results from the patchy association of biotite granite-gneiss and pink granite.

Similar foliated and migmatitic gneisses occur east and south of the volcanic strata at Shamrock Lake. Here pegmatitic lenses and foliae are abundant in the gneiss, as are coarse metacrysts of pink feldspar in dark,

coarse biotite schists and gneisses, suggesting pegmatitization of the latter.

Again, mixed and foliated gneisses with a more common dissemination of biotite paragneiss in the migmatitic assemblage, occurs from Truce Lake along Indin River northeastward to the eastern boundary of the map-area. Over large areas a brownish grey weathered, plagioclase-bearing, granitic gneiss carries much coarse, brownish biotite, which commonly forms thin foliae; the rock is in part contorted. Exposures of included hornblende gneiss are common. The width of this band of gneiss is not known.

DIABASE, DIORITE, AND GABBRO

Basic dykes (6), the youngest rocks exposed, are plentiful. They range up to 260 feet in thickness, but most of them are less than 125 feet thick. Many are eroded to low ridges where they traverse sedimentary strata and granitic gneisses; elsewhere, they have no special topographic expression. They trend northwesterly and north-northeasterly except in the northern part of the area where many strike northerly; all have steep to vertical dips. Their contacts are marked by chilled, aphanitic zones up to 6 inches wide; elsewhere their grain size varies from fine to $\frac{1}{4}$ inch. Surfaces weather dark brown to dark green. The texture is ophitic to sub-ophitic in most of the finer grained dykes, which may be classified as diabase, and gabbroic in the coarser dykes, which are gabbro or diorite.

Phenocrysts of feldspar are not uncommon: when present they are generally only slightly coarser than other grains, but in few dykes they are as much as $\frac{1}{2}$ inch long even in a fine-grained groundmass.

The dyke rocks are fresh looking and massive. However, feldspar grains may be epidote green, and chlorite may be widespread in some exposures; such alteration is not common, and is the product of local hydrothermal action, especially near late faults.

GLACIAL DEPOSITS

Features of glacial origin are widespread and varied. Fanning of the

ice cover in its westerly advance is indicated by the gradual change in orientation of striae and grooves, roches moutonnees, drumlins, eskers, and crevasse fillings, from a southwesterly direction in the south part of the area to a direction slightly north of west in the northern part of the area. The westerly progression of the ice cover is inferred from trains of erratics followed easterly to their points of origin, from the eastern stoss ends of drumlins, and from the gentle eastern slopes of roches moutonnées.

Glacial till or drift is widespread. Some has the appearance of ground moraine, with scattered boulders and erratics, and without any particular topographic expression. Much of the coarse material of the till is derived from massive granitic rocks and gneisses. However, it was repeatedly observed that in areas underlain by sedimentary strata or mixed gneisses, fragments of such rocks are abundant in the till. It is, therefore, permissible to suggest that much of the till is of local derivation.

Three types of glacial deposits are worth describing in more detail, namely, drumlins, eskers, and ice-crevasse fillings.

Drumlins

A belt of drumlins extends from Truco Lake to the north boundary of the map-area, where the drift cover is widespread. The orientation of the drumlins reflects the fanning of the ice cover as mentioned above, and has resulted in a linear topography in which ridges, valleys, and lakes have a general westerly trend.

The drumlins are elongated ridges from a few hundred feet to perhaps 2 miles long, and are as high as 150 feet. The intervening valleys are in many places muskegs. Lakes bordered by drumlins have shallow shores. The drift of the drumlins is an unassorted mixture of clay, gravel, and disseminated boulders. Solifluction of such material, even on the gentlest slopes, produces countless circular terraces up to some 25 feet in diameter. The down-slope periphery of many such terraces is a faint ridge, on the inner side of which the material may be arranged in narrow, concentric bands or ridges.

In most drumlins the eastern end or stoss slope is decidedly steeper than the western or lee end, which slopes gently. In a great many drumlins, too, this steep eastern end is made of bedrock, and the drift material slopes gently westward away from the rocky nose and forms a long tail. Some drumlins also have exposures of bedrock along the sides. Over large parts of the map-area, outcrops are most common on drumlins.

Eskers and 'Esker-Valleys'

Eskers vary from single, well outlined ridges to a complex of ridges, plains, and terraces, and in many parts are associated with piles of cobbles and coarse boulders in a very hummocky terrain.

Their general trend conforms to that of other glacial features, and reflects the fanning of the ice cover. No major topographic features would have controlled the location of the esker streams, which thus appear as superimposed. However, the eskers occupy low areas locally, such as valleys and lakes, but their bases were commonly observed to lie on the valley sides or above the level of the lakes. In some parts the eskers may trend as much as 30 degrees or so across drumlins, but they resume their general trend, crossing hills from low areas without regard to present drainage. In the southern and more hummocky part of the map-area, eskers may follow for some distance deep rock valleys that lie at an angle to the general glacial trend; glacial striae were observed to parallel the course of some of these valleys, which suggests that such valleys are pre-Glacial.

Eskers may be single, continuous, winding ridges, some 25 feet high and up to 100 feet wide. Curved strata have been observed in such eskers. More generally, however, the eskers are complex forms, varying from such as are flat topped and of irregular width, to others that may merge with sand and gravel plains and terraces all with many kettle-holes; in places they may be represented by a group of ill-defined, curved, subparallel ridges, as would result from a braided channel, or the ridges, well to poorly defined,

may diverge as in a deltaic deposit. In other places, an esker may be a discontinuous ridge interspersed with widespread deposits of sand and gravel in the form of plains or terraces, with their surfaces flat or uneven, commonly with kettle-holes. Some are faint sinuous ridges spreading out like tentacles, and may have resulted from deltaic accumulation. In some deep valleys, esker ridges were observed to merge with, or spread into, flat-topped terraces a mile wide and about 100 feet high, with well-marked kettle-holes; downstream such terraces may end abruptly, projecting 100 feet above the floor of the valley, but the esker ridge continues southwestward. In many places the esker ridges contain, in addition to gravel, a large proportion of well-rounded boulders up to 24 inches, but mostly 8 to 10 inches, in diameter, whereas associated terraces and plains consist of fine gravel and sand. The gravel and sand deposits along Snare Lake are associated with an intermittent esker ridge, the whole more than 2 miles wide.

Other types of deposits associated with eskers are accumulations of cobbles and coarse boulders occurring either in a very hummocky terrain or in a kame and kettle topography with a maximum relief of about 125 feet. In the northern part of the map-area, such deposits are each associated with a single or complex esker in bands up to 2 miles wide, and traverse in a westerly direction the drumlin belt, which has approximately the same trend. Drumlins are not evident within these bands or 'esker-valleys'. Most of the esker ridges lie in the northern part of the bands. Along such bands are areas of well-polished bedrock outcrops free of drift. The hummocky deposits contain many small lakes, many of which fill kettle depressions, but such kettle lakes are most numerous along and within the eskers. The minutely hummocky topography of the 'esker-valleys' is in contrast with the smooth slopes of the intervening areas of drumlins, and were easily outlined on the map from air photographs. The stereoscopic appearance of the hummocky, coarse debris somewhat resembles a scoria, or pitted mass, with rivulets. In a few instances a drumlin bordering such an 'esker-valley'

appeared in part eroded away, as in the side of a stream valley. Commonly the floor of the 'esker-valley' is below the level of the drumlins although repeatedly it rises high above outcrops.

Such 'esker-valleys' and eskers were the result of glacial streams superimposed on pre-glacial topography and on deposits formed by advancing ice, that is, on drumlins. Apparently, the slopes followed by the stream were along the direction of the advancing ice, as eskers, drumlins, roches moutonnees, and glacial striae are parallel. Apparently, too, such streams at first flowed on ice, as their deposits now lie in some parts up hill or on valley slopes far above the floor of the valleys. They developed valleys in the ice, and it appears that the ice on the north side of the valleys, which were more exposed to the sun's rays, thin down faster, and the channel of the glacial stream migrated northward as would be implied by the esker ridges now lying in the northern part of the bands or former 'esker-valleys'. The waters from the stagnant ice concentrated in the valleys and towards the channels, washing away the finer debris, leaving behind the coarser material and much dead ice in masses buried under coarse debris. Cobbles and boulders up to 24 inches in diameter, but mostly less than 10 inches, were evidently water transported, as they are well rounded, and eventually accumulated in the main channels. Commonly there were many channels as in braided rivers, as many ridges now lie side by side. Much ice was buried, as kettle-holes are abundant. When or where the retaining ice walls disappeared, the waters lost their carrying power, pools were formed, and the finer debris was deposited in terraces and plains, some embedding ice blocks and some accumulating in forms simulating deltas.

Crevasse Fillings

Groups of parallel to subparallel sand strips are locally associated with eskers and sand plains. Such occurrences have been observed from the southern to the northern boundary of the map-area, and the strips are oriented almost at right angles to roches moutonnees, glacial striae, and

eskers, and again reflect the fanning of the ice cover. The strips are from 25 to 50 feet wide and from a few hundred feet to a mile long. Most of them are straight; a few are curving; rare ones are at an angle to others. They rise only a few feet above surrounding country, but along strike they go up hill or down according to the underlying topography. They are composed of fine- to medium-grained sand, very light in colour. Local piles of boulders may protrude through the sand. In places the strips are 150 to 250 feet apart. On air photographs, they appear as narrow, white strips, some with sharp borders. They are thought to have resulted from the filling of ice crevasses by fine sediments available from eskers and associated sand plains, when the ice cover was stagnant and concentration of gravel and sand had taken place in the esker valleys. The fineness of the sand of such strips, compared with the mixed sand and gravel of other deposits associated with eskers, suggests that wind was the agent of transport rather than water.

STRUCTURAL GEOLOGY

FOLDS

In the western part of the map-area, the strata are flexed around axes trending northwesterly; this regional trend is well outlined by bands of volcanic rocks. It is also the trend of granitic gneisses bordering the areas of sedimentary and volcanic rocks.

No data were obtained to determine the type and amount of folding within the volcanic bands, although in banded and bedded volcanic rocks drag-folding is locally common. The sedimentary strata are isoclinally folded, as indicated by the local alternation of stratigraphic tops in a series of beds dipping in the same direction. It is probable that many volcanic bands are along the axes of anticlines; where top determinations could be made at or near the contacts between volcanic and sedimentary strata the latter appear as the younger rocks.

Dips are generally steep. However, the band of volcanic hornblende gneiss 8 miles east of Truce Lake has gentle dips, some approaching the

horizontal.

FAULTS

Faults trending north to west of north transect all rocks in the vicinity of Indin Lake and to the south. Strata east of the faults have moved northward relative to those on the west side. The faults dip steeply to vertically. The total apparent horizontal displacement due to three faults crossing Snare River is in the order of 3 miles. Such faults have caused brecciation rather than shearing. Near the faults, some schists have been contorted. Results of chloritization, epidotization, and silicification were observed locally: at the fault surface, a fine-grained pink granite has been altered to a dense, grey rock, not unlike a hornfels, and which flies into fragments when hit with a hammer. Veinlets of milky quartz are present locally. No appreciable amounts of sulphides were observed along such faults.

Halfway between Grenville and Shamrock Lakes a fault trending northeasterly is indicated by the truncation of some rock units and by their local hydrothermal alteration and contortion. The rocks north of the fault have moved easterly relative to those on the south side, and the apparent horizontal displacement is more than 2 miles.

The above-described faults lie in linear draws, but elsewhere faults have not been inferred along the many such draws in the area unless displacement of rock units was noted. It is probable, however, that many other faults exist, especially in the granitic rocks.

Contacts between sedimentary and volcanic rocks are in places local of shear zones. No major displacement has been measured along those.

ECONOMIC GEOLOGY

The writer knows of no ore deposits within the map-area. Although claims have been staked in the vicinity of Indin Lake, most have reportedly lapsed. Except in this vicinity, few marks left by prospectors were observed. The area, however, has features that should interest prospectors.

It adjoins a district where gold-bearing deposits are being explored underground. It contains belts of volcanic and sedimentary rocks that elsewhere in the Canadian Shield are hosts to mineral deposits. Within it are contacts between volcanic and other rocks such as elsewhere have been the loci of differential movement and have controlled mineralization: repeatedly at such contacts silicified rocks were observed to be mineralized with disseminated pyrrhotite, pyrite, and, more rarely, chalcopyrite; locally these sulphides may occur in massive pods some 12 square inches in surface area, and lenses of dark blue quartz may be present; such contacts weather rusty brown across widths varying from a few feet to some 100 feet, and may extend for hundreds of feet or may form a series of patches along a contact. They have been observed widely scattered throughout the area. Assays, to date, of small grab samples casually collected from such rusty zones have shown only traces of gold and small fractions of an ounce in silver. On the north shore of Indian Lake, sheared sedimentary strata have been mineralized with pyrite and pyrrhotite, either disseminated or in small, solid lenses on the edge of a low area beneath which might be hidden a band of rhyolitic volcanic rocks. This zone had been investigated by prospectors. A small grab sample contained only traces of gold and silver. Narrow, rusty quartz veins in sedimentary strata contain disseminated pyrite along their walls; similarly disseminated pyrite was observed in rusty zones a few feet wide in the sedimentary strata; such occurrences may contain gold but are generally narrow. The wall-rocks of some depressions carry much carbonate; and such depressions warrant investigation as they may be loci of faults, and possibly contain ore minerals.

Along the western part of the map-area are many pegmatite dykes either in the sedimentary or volcanic strata or within the massive granite or the granitic and mixed gneisses. They are similar in part to those of the Yellowknife-Beaulieu River region, some of which contain rare-element minerals such as tantalite-columbite, beryl, cassiterite, spodumene, and amblygonite (Jolliffe, 1944). In the course of geological mapping only

one dyke was observed with a few small crystals of beryl.

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