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GHOST LAKE MAP-AREA
NORTHWEST TERRITORIES

(REPORT AND MAP)

By
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Illustration

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INTRODUCTION

This report is a preliminary account of the geology of the Ghost Lake map-area (latitude 63°45' to 64°; longitude 115° to 115°30'), which occupies an area of about 265 square miles in the District of Mackenzie, Northwest Territories.

The writer was ably assisted during the 1949 field season by R.C. Nelson, F.M. Thornton, and D.C. Guthrie. Mr. Nelson very capably performed the duties of senior assistant.

The centre of the Ghost Lake area lies about 100 miles north of Yellowknife. It may be reached by canoe, via the Snare River system, a long and arduous journey; by tractor train during the winter months; or, most readily, by aircraft.

Three large, and many smaller, lakes are found within the area, but good canoe routes are restricted to the Ghost Lake-Ghost River-Wijinnedi Lakes-Snare River system, and this route involves one long and several shorter portages. Other than this, the drainage is quite sluggish, and for practical purposes the many lakes in the western half of the area have no external drainage. Long traverses are required to gain access to the southeast corner of the area; and long traverses, or portages, to reach the northeast corner from East Wijinnedi Lake, although this part of the area can be reached more readily from Daran Lake. Most parts of the area, however, are readily accessible by small aircraft.

Viewed from the air, the country seems monotonously flat, but in detail the topography is rugged, with a maximum relief of about 400 feet. Areas underlain by volcanic and granitic rocks are typically higher and rougher than those underlain by sedimentary rocks.

Bedrock is exposed over a large part of the area, but some parts, particularly east of East Wijinnedi Lake, have a widespread cover of glacial sand and gravel. Patches of swampy ground are common, but mostly small.

Timber, for the most part, is of poor quality; only on sandy terrain are stands of good spruce found. Wild life is abundant and varied. Pike, trout, and grayling were available during part or all of the summer; many varieties of ducks were seen.

GENERAL GEOLOGY

The distribution and relative ages of the formations are shown on the accompanying preliminary map.

The Ghost Lake area is underlain entirely by rocks of Precambrian age. As a rough approximation, 50 per cent of the area is underlain by granitic rocks, 30 per cent by volcanic rocks and their metamorphic derivatives, and 20 per cent by sedimentary rocks and derived schists and gneisses.

The oldest rocks are predominantly intermediate to basic volcanic rocks (1)[1]. They weather dark green, greenish grey, or in shades of brown. For the most part they are considerably altered and recrystallized, forming hornblende and chlorite schists, and amphibolite and amphibolitic schists and gneisses. Minor lenses of agglomerate, breccia, rhyolite, and intercalated sedimentary rocks were observed within the basic volcanic band. The least altered basic volcanic rocks (1a) are found along the south shores of the Wijinnedi Lakes, and these in many places show pillows that are sufficiently well preserved to permit top determinations to be made. Farther south

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[1] Numbers in parentheses are those of the map-units used on the accompanying map.

and east, the rocks become progressively more altered, and near the granite all traces of original internal structures are destroyed, and the rocks are, largely, well-banded amphibolites (1b). The distribution of these metamorphic rocks between the less altered basic volcanic rocks and the granite indicates that the latter was, at least partly, responsible for their metamorphism.

Of common occurrence in the volcanic rocks of the Ghost Lake area are grey, finely sheared types (1c) that appear to grade imperceptibly into both the basic and acidic volcanic rocks. Their assignment to one or other of these groups has been, of necessity, somewhat arbitrary, as it was not found practicable to map them separately. Such intermediate types are most common north and northwest of the canoe-shaped sedimentary band(5) northwest of Rebecca Lake. Northeast of Bob Lake, a complex (1d) has been roughly outlined. Time did not permit its detailed subdivision, but the following rock types were noted: basic volcanic schists and gneisses, cordierite-anthophyllite-tremolite-plagioclase schist, quartz-bytownite granulite, and others. It seems probable that the latter two types were derived from sedimentary rocks.

Feldspar porphyry, quartz porphyry, and rhyolitic rocks (2) are commonly found within the zone of volcanic rocks. They weather white, buff, or pale grey, and in places seem gradational into basic volcanic rocks. In a few places they occur as narrow bands parallel with the trend of the enclosing rocks, and are probably extrusive, the best example being the band that almost completely surrounds the canoe-shaped sedimentary band (5) in the western part of the area. Elsewhere, these acidic rocks occur in irregular bodies, some of which may well be intrusive. Pale weathering muscovite-quartz-feldspar schists (2c) are believed to have been derived from the acidic volcanic rocks.

The relatively unmetamorphosed sedimentary rocks (3) of the Yellowknife group are largely well-bedded argillites and greywackes. Individual beds in the argillites are commonly an inch or less thick; in the greywackes the beds are thicker, but rarely exceed a few inches. In many instances the fine-grained, grey to buff coloured, argillitic upper part of a bed is seen to grade downward rather abruptly into the dark grey, coarser, sandy-textured and quartzose greywacke of the lower part, and where exposures are good the tops of the beds are thus readily determinable. Neither ripple-marks nor crossbedding was observed. Massive beds of impure sandstone and arkose, as much as several feet thick, were occasionally seen. Of common occurrence in this zone are very fine-grained, highly schistose, light-coloured phyllites. In places, also, are narrow bands of black slate. These phyllites and slates are low-grade metamorphic derivatives of clay-rich sediments, and in their present state consist largely of chlorite, sericite, and quartz.

The sedimentary rocks (3-5) have been differentiated on the basis of megascopically visible metamorphic features. In traversing from the relatively unmetamorphosed sedimentary rocks toward the granite, the first appearance of small spots in the phyllites was taken to mark the end of the relatively unmetamorphosed sedimentary rocks (3), and the beginning of the spotted phyllites of the biotite zone (4). Fine-grained quartz-mica schists also occur in the biotite zone. On nearing the granite, nodules, or 'knots', gradually increase in size, and their first appearance was taken to mark the beginning of the zone of 'knotted' schists (5). The nodules at first consist of aggregates of quartz and biotite, but gradually, metacrysts of cordierite, andalusite, garnet, and sillimanite make their appearance. Neither staurolite nor kyanite was seen. Impure andalusite metacrysts up to 3 inches in length were noted. As the metamorphic rank of the rocks in this zone increases, the quartz-mica schists become, in places, coarsely and irregularly gneissic. In many occurrences, the 'knotted' schists exhibit the same duality within individual beds as mentioned above in connection with the argillites and greywackes. This is clearly brought out (as is the bedding itself) by the development of numerous metacrysts in the upper, originally argillitic, part of the bed, but not in the lower, originally quartzose, part. The grain gradation in the rocks is thus reversed during metamorphism, and, occasionally, the tops of beds are still determinable in coarsely 'knotted' schists. Post-deformational growth of andalusite has been observed in thin sections; this suggests that thermal metamorphism followed regional metamorphism in the area.

Several elongated bands of mixed rocks (6) were found within the Ghost Lake map-area. The 'mixing' may take any one of three different forms. Within a vaguely banded zone, amphibolite or paragneiss may appear to have been 'soaked' by granitic solutions; the intimate, streaky feldspathization and the gradually developed granitic look of the rock are characteristic. This type of mixed rock is common in the well-defined band on the south side of the basic volcanic rocks in the western part of the area. On the other hand, the mixed zone may consist of well-banded injection gneisses (migmatites) associated with widely varying proportions of other rocks. Finally, the mixed rocks may consist of granitic rocks containing abundant discrete inclusions of 'foreign' rock, which may vary widely in size and shape. The southern band of mixed rocks near the west boundary of the map-area contains many rocks of the latter two types. The mapping of zones of mixed rocks in the field is, of course, highly subjective; in general, the zones have arbitrarily defined limits of from 25 to 75 per cent granitic material. An attempt has been made to subdivide the rocks of this group into those in which the non-granitic part is believed to be of primarily sedimentary origin (6a), and those in which the non-granitic part is thought to have been derived from basic volcanic rocks (6b). In general, gneissic granites are not included in the 'mixed' rocks.

Large areas in the southern and eastern parts of the Ghost Lake area are underlain by a variety of granitic and dioritic intrusive rocks (7), which may be of widely varying ages. The most common type in this group is a medium-grained, gneissic, biotite granite; but biotite granodiorites and diorites are also represented. In the vicinity of Morrison Lake, much fine- to medium-grained, light-coloured, massive, alaskitic granite was encountered. Just south of the basic volcanic band on Ghost River, the granite is almost white, and has a faint but regular gneissosity that simulates stratification. No attempt has been made to differentiate the various types of granitic rocks on the map, except in the case of the sill (or dyke) of diorite-gneiss (7b), and the folded sill (or phacolith) of gneissic granodiorite (7a) associated with the band of sedimentary schists between Nelson and Guthrie Lakes. In many instances the granitic rocks are gneissic and impure, and are gradational to the mixed rocks (6). Small pegmatite and aplite dykes are of common occurrence throughout the granitic rocks here discussed. Only in the area immediately east of the lake expansions of Ghost River are pegmatite dykes found that are large enough to be mapped separately. These are highly irregular sill- or dyke-like bodies. Mineralogically, they consist of potassium feldspar, quartz, albite, biotite, and muscovite, and in a few instances segregations of beryl and of black tourmaline were observed in them.

Along the northern part of the east boundary of the map-area, and occupying a large area south of Ghost Lake, there occurs a pink, coarse-grained, porphyritic, biotite granite (8), which is completely different from the granitic complex (7) mentioned above. The rock is almost entirely free of inclusions, and rarely shows any gneissosity, although a lineation may be in evidence, as shown by the subparallel arrangement of crystals of microcline, which may be as much as 4 inches long. In one place this granite was seen to decrease in grain size near its contact with the gneissic granites (7), and for this reason, and because of its lack of impurities and gneissosity, is thought to be younger.

Basic intrusive rocks are of common occurrence, and have been divided into two main groups. Gabbro, hornblendite, and meta-pyroxenite (9a-9c) comprise the older group, which generally forms plug-like or sill-like masses cutting Yellowknife volcanic (1) and younger intrusive rocks (7). The large circular mass near the east end of Nelson Lake consists essentially of coarse-grained gabbro (9a) with crystals of hornblende and feldspar up to 1 inch, or more, in length. The central core of the mass is surrounded by a hybrid zone containing various gabbroic, and recrystallized volcanic, rocks (9b). The contacts as drawn are arbitrary.

Medium-to coarse-grained, deep green hornblendite and meta-pyroxenite (9c) occur in several places, but most prominently in the islands of Guthrie Lake.

The youngest rocks (10) in the map-area are dykes and rare sills of gabbro and diabase, and minor amphibolitic rocks. The gabbro dykes cut all other rocks. They are dark green to black, and weather reddish brown to black. They occur in well-defined dykes up to 275 feet in width, and many of them can be traced for miles. Microscopically, the gabbro consists of about equal amounts of plagioclase (generally labradorite) and pyroxene (pigeonite), with a small proportion of black, metallic mineral, probably magnetite. Olivine and quartz are rare; in one thin section a little quartz-feldspar intergrowth was seen.

The regional orientation of these gabbro dykes is marked. They occur in three well-defined sets: one set trends northwest, another northeast, and a third, lesser set trends north. No particular pattern in their age relationships was discernible, and most of them appear to occupy regional tension fractures.

STRUCTURAL GEOLOGY

Folds

Structural features are rarely well preserved in either the sedimentary or volcanic rocks of the map-area. However, along the south shores of the Wijinnedi Lakes, tops could be determined in several places, by grain gradation in the sedimentary rocks and by undeformed pillows in the volcanic rocks. Such determinations indicate that the sedimentary rocks are younger than the basic volcanic rocks, and that the former appear to have been isoclinally folded. Dips are steep to vertical.

Farther south within the basic volcanic band, structural features have been completely destroyed or masked by a prominent east-west shear zone, which, toward the east, gradually swings to the north, parallel with the contacts of the band.

Approximately half-way between Nelson and Guthrie Lakes there is a canoe-shaped depression, in the centre of which lies a band of 'knotted' quartz-mica schists (5). Both schistosity and bedding strike east-west and dip steeply north. Assuming that the age relationship established at the Wijinnedi Lakes for the volcanic and sedimentary rocks also applies here, the structure is that of a closely folded syncline. To the east, the sedimentary band disappears, to reappear again on the shores of Ghost River. Apparently the keel of the syncline has been bent upward between the two areas, and erosion has removed a part of the sedimentary band.

The main mass of the basic volcanic band forms a pronounced hook-shaped fold. It may be that this large fold is due to a later folding of the previously closely folded sedimentary and volcanic rocks; if so, two periods of folding are indicated.

Faults

Many minor faults were observed. Some were occupied by diabase dykes; in others, the offset of diabase dykes illustrated the faulting.

It seems probable that a persistent fault occupies the pronounced lineament formed by Ghost River and the long arm on the north side of East Wijinnedi Lake. No significant horizontal displacement appears to have taken place along this fault, however, as neither the sedimentary-volcanic contact on the south shore of the lake nor the southernmost contact between acidic and basic volcanic rocks on Ghost River is appreciably offset. What offset there is indicates that the east side moved south relative to the west side.

ECONOMIC GEOLOGY

During the summer of 1949, no exploration, development, or mining operations were in progress in the Ghost Lake map-area, although considerable surface work and diamond drilling had been done in former years in various parts of the area.

In general, the most likely areas for prospecting for gold deposits are those underlain by volcanic rocks. Occurrences of quartz veins and silicified shear zones are fairly common in such rocks, although the effects of mineralization are rarely pronounced, and some quartz veins and stringers are completely barren.

The contact between sedimentary and volcanic rocks along the south shores of the Wijinnedi Lakes is, in places, highly sheared, silicified, carbonatized, and iron-stained. Considerable surface work and drilling have been done along this contact, but the results obtained are not known to the writer.

Around the nose of the canoe-shaped syncline previously mentioned are several bands of highly garnetiferous schist mineralized with pyrrhotite. Pyrrhotite-bearing volcanic schists and gneisses also occur to the south, on the north shore, and near the west end, of Rebecca Lake. Some work has been done in both areas.

Yellowknife Volcanic Gold Mines, Limited

This company has investigated a group of claims situated east of East Wijinnedi Lake. The main showings are near the sedimentary-volcanic contact about 2 miles east of the islands in the lake. Within the garnetiferous quartz-mica schists at this place are several narrow bands of crumpled, garnet-amphibole rock, which may represent highly altered tuffaceous beds. Cutting these bands are numerous, irregular veins and patches of quartz, which carry a little pyrite and, possibly, some pyrrhotite. Considerable stripping, trenching, and blasting, and about 2,000 feet (oral communication) of drilling have been carried out by the Company. Good showings of gold were reported to, but not seen by, the writer.