CANADA
DEPARTMENT
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GEOLOGICAL SURVEY OF CANADA
PAPER 51-14

PRELIMINARY MAP

COURAGEOUS LAKE

NORTHWEST TERRITORIES

(Map and Descriptive Notes)

By

J. C. G. Moore

OTTAWA
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DESCRIPTIVE NOTES FOR COURAGEOUS LAKE MAP, N.W.T.

INTRODUCTION

Courageous Lake map-area includes the north-central part of a greenstone belt 40 miles long and 1 mile to 4 miles wide, which, to the south, extends into the adjoining Matthews Lake area[1]. The topographic high formed by the greenstone belt in that map-area continues throughout the Courageous Lake area, although the granodiorite-greenstone contact forms the highest point, 250 feet above Courageous Lake.

[1] Folinsbee, R. E., and Moore, J. C.: Matthews Lake, N.W.T.; Geol. Surv., Canada, Paper 50-2, 1950.

The only available timber in the area consists of stands of black spruce scattered over an area of ½ square mile at the north end of Courageous Lake. Some trees reach a height of 30 feet and a diameter of 10 inches, but more commonly are about 8 inches at the base. Much of the timber is heavy at the butt and of twisted grain, but it was suitable for the construction of a log cabin 15 feet long and 13 feet wide by Newmorth Gold Mines. Break-up of Courageous Lake is known to vary from mid-June to July 10. Heavy ice has been reported along the shore of the bays in Courageous Lake in early September, but ordinarily the lake is not reported to freeze until early October.

Glacial drift covers 90 per cent of the bedrock of the map-area. Through this, sedimentary rocks are best exposed in the southern part of the map-area, and volcanic rocks in the northern part.

Glacial striae indicate a general westerly movement of the ice-sheet. An esker ridge and a series of drumlins or drift ridges elongated in a westerly direction confirm this direction of movement.

GENERAL GEOLOGY

Volcanic Rocks of the Yellowknife Group

The oldest rocks in the area are steeply dipping lava flows

of the Yellowknife group(1-3)[1], with minor interbedded slates, phyllites,

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

and conglomerate(5, 5a, 5b). The mafic lavas(1) are predominantly grey to light green weathering meta-andesites and meta-basalts as contrasted with the dark grey-green flows of the southern part of the belt in the Matthews Lake area, the colour change being due to an increase in amount of one or more of the following minerals: feldspar, chlorite, epidote, and carbonate. The volcanic assemblage varies in width from about 4,000 to 12,000 feet, due principally to the emplacement of the granodiorite batholith, which forms the western boundary of the volcanic belt.

The bodies of lava of various types are characteristically lenticular, a feature that may be exaggerated in places on the map because of the lack of outcrop, but in other places, where exposures are more complete, is definitely established. Pillowed flows, which rarely attain an exposed thickness of 1,500 feet, are found sporadically throughout the belt as contrasted with the continuous zone in the Matthews Lake area. Pillows are poorly preserved, and although no top determinations were possible it is assumed that the homoclinal structure in the southern part of the belt continues northward.

The mafic volcanic rocks(1) are composed principally of hornblende, plagioclase, chlorite, and epidote, with accessory quartz, biotite, white mica, carbonate, apatite, zircon, pyrite, magnetite, titanite, leucoxene, garnet, arsenopyrite, and ilmenite. Mafic minerals comprise from 25 to 95 per cent of the rocks and average about 65 per cent; for this reason the term 'mafic' is used in preference to the customary term 'basic'. The rocks are mainly amphibolites, plagioclase-amphibolites, epidote-plagioclase-amphibolites, and chlorite schists. The ropy weathering and fragmental flows(1e) are less extensive than at the southern end of the belt and, as there, are restricted to the upper part of the sequence. Exposures of amygdaloidal flows(1f) are distributed sporadically for a length of 12,000 feet, and at one place have an exposed

thickness of 800 feet. Minerals filling the vesicles include quartz, calcite, and epidote. The porphyritic lavas(1g), with phenocrysts of feldspar, are confined, with rare exceptions, to a zone within about 2,000 feet of the upper mafic volcanic contact. This porphyritic zone of discrete porphyritic flows, which begins in the Matthews Lake area, has been traced for more than 18 miles. In many places, shearing across fairly large areas has produced a foliated rock(1s) as contrasted with the more massive types.

Lenticular bodies of mafic agglomerate and breccia(2) are distributed throughout the volcanic sequence. They consist of grey fragments in a dark green to black matrix, and commonly are highly sheared. The rock consists of the mafic minerals chlorite, hornblende, and biotite, with lesser amounts of quartz and feldspar, and the secondary minerals carbonate and sericite. The fragments, which form 25 to 45 per cent of the rock, differ from the matrix in containing more felsic minerals. These bodies are almost everywhere in contact with, or associated with, bodies of meta-gabbro(4).

Felsic lavas(3) are found predominantly at the top of the volcanic series, where they reach a thickness of 1,200 feet or more. The upper band forms the northern extremity of a felsic assemblage that is continuous for 14 miles. Other, narrower and lenticular bands are found at various horizons interbedded with the mafic lavas. The felsic lavas weather light grey, cream, and buff. They are composed mainly of quartz, feldspar, sericite, and carbonate, but hornblende, biotite, chlorite, epidote, and apatite were observed in some thin sections. They are commonly porphyritic, with embayed phenocrysts of quartz and rare phenocrysts of feldspar, which are generally altered to saussurite or sericite. The agglomeratic phase(3b) consists of lenses of felsic fragments, 1 inch to 6 inches long, which in places weather lighter than the groundmass and project slightly above it.

Interbedded with the volcanic series are several bodies of meta-gabbro(4). Contacts were nowhere exposed, and no chilling effects

were observed at the inferred edges of the bodies, most of which parallel the regional structure and may be sills or coarse-grained flows. The largest body, which is more than 4 miles long and attains a width of 1,000 feet, pinches out at one end and terminates rather abruptly at the other. It, and what appears to be a dyke-like branch, transect the granodiorite(8). A few, small, dyke-like bodies also appear to cut the granodiorite. The remainder lie within the volcanic rocks and may or may not be post-granodiorite. Thin sections reveal that some of these bodies have an ophitic texture and are probably intrusive. The rocks consist mainly of hornblende and labradorite, but pyroxene, chlorite, and magnetite may also be present. The feldspar is commonly subhedral, and is generally altered to saussurite or epidote. The porphyritic meta-gabbro contains rounded phenocrysts of feldspar up to 2 inches in diameter, which are generally altered to epidote.

Sedimentary Rocks of the Yellowknife Group

The main period of Yellowknife sedimentation followed the final phase of volcanic activity. Earlier sedimentation produced a band of slates, phyllites, and conglomerate, interbedded with the volcanic rocks. This band extends for 5,000 feet, and has an average width of 400 feet. The pebbles in the conglomerate range up to 3 inches in diameter and average $\frac{1}{2}$ inch. They consist of chert, quartz, mafic lava, slate, and greywacke, embedded in a matrix composed mainly of quartz, feldspar, and biotite.

Minor volcanic activity continued into the main period of sedimentation, and is represented by a few outcrops of mafic and felsic lavas. The sedimentary series(5) is essentially conformable with the underlying volcanic rocks. Beds range in thickness from a few inches to several feet. They are well sorted, and where well exposed tops can be determined by grain gradation. Crossbedding is rare. The dense cover of lichen hinders top determinations and makes it impossible to trace single beds.

The sedimentary rocks have been altered by dynamic and thermal metamorphism. In the northern part of the map-area, they grade from slates and greywackes through phyllites into dark grey, nodular, quartz-mica schists, which in places are garnetiferous. The nodules are composed mainly of cordierite and, rarely, andalusite. Accompanying the formation of nodules in the rock is an increase in the amount of biotite, and a decrease in the amount of chlorite and white mica. The metamorphism is associated with a granitic body outside the map-area, and is in contrast with the lack of alteration around the granitic pluton in the southern part of the area.

Diorite and Granodiorite

Diorite bodies occur as small plutons everywhere associated, or in contact, with granodiorite. The biotite-hornblende-quartz diorite(7c) is a dark greenish grey rock consisting of 30 to 40 per cent andesine, 10 to 20 per cent each of hornblende and biotite, 10 per cent quartz, and 5 to 10 per cent chlorite, titanite, and apatite. It grades into hornblende-quartz diorite(7a) and hornblende diorite(7b). Their constant association with granodiorite suggests that these diorite bodies may represent volcanic rocks recrystallized and altered by the granodiorite intrusions.

The granodiorite(8) is a light grey to cream and pink weathering, medium- to coarse-grained rock. It intrudes all the rocks of the Yellowknife group, and appears to be younger than the diorite. The rock consists of 25 per cent quartz, 40 per cent plagioclase feldspar, mostly oligoclase, about 15 per cent microcline, 20 per cent biotite, and minor hornblende.

In addition to the normal granodiorite, there are small bodies of hornblende-biotite granodiorite(8a) and granodiorite(8b) with inclusions derived from mafic lava(1) and meta-gabbro(4).

Porphyry Intrusions

The porphyry intrusions(A) are irregular bodies, which in part parallel the strike of the adjacent flows and in part transect them. They resemble the massive phase(3a) of the felsic lavas; are medium grey rocks, weathering light grey and cream; are rarely schistose; and consist of quartz and feldspar phenocrysts in a fine-grained groundmass of quartz, feldspar, biotite, and sericite. The quartz phenocrysts, as in the felsic lavas, are embayed. The feldspar phenocrysts are rarely unaltered, but albite and subordinate microcline have been identified. At one point along the contact the porphyry appears to grade into granodiorite(8).

Proterozoic Diabase and Gabbro Dykes

Pale reddish brown and dark green weathering diabase and gabbro dykes are the youngest Precambrian rocks in the map-area, and are probably of Proterozoic age. Their texture is diabasic; fresh surfaces are greenish grey to black, and the rocks consist of 50 per cent labradiorite and 40 per cent pyroxene, with varietal quartz, accessory magnetite and apatite, interstitial myrmekitic intergrowths of quartz and feldspar, and secondary chlorite, hornblende, leucoxene, epidote, and sericite. The dykes are nearly veritcal, where determinations can be made, and vary in width from 25 to 225 feet. Most of them trend between north 5 and 35 degrees west, and roughly parallel the regional trend. Two of these can be traced for 10 miles. A few in the granodiorite trend between north 15 and 30 degrees east. A third set trends north 85 degrees east.

STRUCTURAL GEOLOGY

No structural determinations were possible in the volcanic rocks, but it is assumed that the homoclinal structure found in the Matthews Lake area continues northward into the Courageous Lake area, and that the volcanic rocks underlie the main sedimentary series.

The flows vary in strike from north 30 degrees east through north to north 80 degrees west, and approximately parallel the granodiorite contact to the west. The flows are steeply dipping to vertical, rarely dipping as low as 75 degrees west. Schistosity, which is much more prominent than bedding, with which it is commonly parallel, dips steeply to vertically and, rarely, as low as 55 degrees west.

Structures within the sedimentary series are more complex. The sedimentary rocks have been deformed into a series of steeply plunging, isoclinal folds, the limbs of which dip steeply, rarely as low as 80 degrees, and in most places vertically. The strata conform with the contact with the volcanic rocks to the west.

Determinations of attitude were made by observation of graded bedding within the greywacke beds, and the distance between adjacent fold axes thus determined varies from 400 to 5,000 feet, but is commonly about 2,000 feet. Fold axes parallel the volcanic contact, and in part conform with the contact of the granodiorite pluton in the southeast corner of the map-area. A slaty cleavage dips essentially parallel with the bedding and, rarely, parallels the fold axes. It conforms more closely with the granodiorite contact than do the fold axes, and it was probably produced by forces associated with the emplacement of the granodiorite pluton.

Major and minor shear zones parallel the strike of the enclosing beds, and are more common in the sedimentary than the volcanic rocks. The moderately drag-folded sedimentary band in the volcanic rocks supplies evidence of left-hand shearing movement.

ECONOMIC GEOLOGY

The principal mineral occurrences in the area are gold-bearing quartz veins in mineralized shear zones. Those on the claims of Newnorth Gold Mines Limited and of Frobisher Exploration Company, in the northern part of the area, lie in volcanic rocks, whereas those on the Kennedy claims, about 2 miles east of the northeast bay of Courageous Lake, and on the Payne claims in the southeast part of the area, are in sedimentary rocks.

The most northerly showing is on the Newnorth claims, which extend beyond the area mapped. Shear zones, varying in width from a few inches to 8 feet, have been exposed by trenching in massive, mafic volcanic rocks and meta-gabbro; they contain quartz veinlets mineralized with gold and arsenopyrite.

The Frobisher showing, in massive, mafic volcanic rocks, consists of a mineralized shear zone, which varies in width between 1 foot and 2 feet. The quartz in this zone is white and blue to black and, although mainly in the form of lenticular veinlets, attains a width of 2 feet. The ore minerals are visible gold, arsenopyrite, pyrite, and chalcopyrite. The vein is reported to have assayed 1.98 ounces a ton across 20 inches for a length of 115 feet.

The Kennedy showings comprise stringers and veinlets of pink and milky to grey quartz, up to 3 inches wide, in moderately to highly sheared greywackes. The shear zones commonly parallel the strike of the bedding and in some places are heavily gossaned. In places the veinlets parallel the bedding; in other places they parallel the strike of the beds but dip as low as 70 degrees; and in still other places the veinlets occupy fractures that cross the bedding. Gold can be seen in these cross-fractures, and is reported to occur in the parallel veins. Other minerals include arsenopyrite, pyrite, chalcopyrite, galena, and ankerite. A pinkish quartz, which appears to be barren, veins the gold-bearing quartz.

The most important Payne showing lies in slate within a series of high quality slates and greywacke beds. A network of quartz veinlets, which pinch and swell to 3 inches, forms a zone that attains a width of 2 feet in places. The zone is approximately vertical, whereas the enclosing slate beds dip 80 degrees west. Gold and arsenopyrite constitute the visible ore minerals, the arsenopyrite occurring mainly as scattered crystals in the slate, up to 6 inches from the vein walls.