CANADA

DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

GEOLOGICAL SURVEY

PAPER 39-1

PRELIMINARY REPORT

BEAULIEU RIVER AREA, NORTHWEST TERRITORIES

BY

J. F. Henderson

PETROLOGICAL SCIENCES DIVISION

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1939

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Illustration

Preliminary map—Beaulieu River map-area.

Beaulieu River Area, Northwest Territories

INTRODUCTION

Beaulieu River area lies east of Yellowknife Bay, on the north shore of Great Slave Lake between longitudes 112 and 114 degrees and latitudes 62 and 63 degrees. Preliminary geological mapping of the area in 1935[1] showed a wide belt of sediments extending from Gordon Lake south to the shore of Great Slave Lake, and in 1936 high-grade gold-quartz veins were discovered on Gordon Lake. The discovery of these deposits aroused much interest in areas to the south underlain by similar sediments. Field work in 1937 showed that much of Beaulieu River area is underlain by sediments, and that a wide belt of volcanic rocks occurs in the northeastern part. The survey of the area was completed in 1938.

All parts of the area may be reached from Great Slave Lake; no point is more than 40 minutes flying time from the air base at Yellowknife. The area is dotted with lakes and these, with the rivers, make any locality easily accessible by canoe. The inland lakes and rivers are open for travel by canoe or aeroplane from about June 5 to October 1. Great Slave Lake is not free of ice in the spring until about June 15 and begins to freeze over early in October. In normal seasons the ice on the lakes is thick enough for aircraft on skis from the last week in November to the last week in April.

GENERAL CHARACTER OF THE AREA

The topography of Beaulieu River area is typical of the Canadian Shield. The country appears flat when viewed from the top of the higher hills, but in detail the topography is rugged and harsh, with rocky hills and ridges rising abruptly from lake or muskeg to heights of 200 feet.

The area is thickly dotted with rock-bound lakes. The streams draining the lakes flow in poorly defined valleys and are interrupted by many rapids and falls. The shores of lakes lying in areas of sediments, and to a lesser degree of those in areas of greenstone, parallel the strike of the bedding or schistosity, whereas lakes within granite areas are generally irregular in outline.

Areas underlain by granite are somewhat more rugged than those underlain by sediments, but the most rugged topography is formed by the volcanic rocks. The greenstone belts southeast of Gordon Lake and along the northern reaches of Beaulieu River form prominent ranges of hills rising 150 feet or more above the areas of granite and sediments adjoining them.

Throughout most of the area the bedrock has been swept clean of overburden by glaciers and, with the exception of small, swampy areas between the rocky ridges, the surface is almost continuous rock outcrop.

[1] Jolliffe, F.: Geol. Surv., Canada, Preliminary Report 36-5, 1936.

However, in the northeastern part of the area, in the vicinity of Payne and Meander Lakes, many of the hills are composed of glacial material. Although in this locality a large proportion of the bedrock is covered by a veneer of sand and gravel, rock outcrops are fairly numerous.

The country is well wooded, but the trees for the most part are small and stunted. Spruce, Banksian pine, birch, and tamarack are the most common species. The greater part of the area has been burned over within the last 40 years.

Fish are plentiful in the lakes and streams. Northern pike, suckers, and, in the larger lakes, trout and whitefish, are the common varieties. Game is not plentiful in the summer months, although a number of moose and black bear were seen. Caribou are reported to be numerous during the winter months.

GENERAL GEOLOGY

SUMMARY STATEMENT OF FORMATIONS

- Late Precambrian
  - Diorite, gabbro (sills and dykes)
  - Great Slave group
    - Conglomerate, arkose
- Early Precambrian
  - Granite, granodiorite, and allied rocks
  - Diorite, gabbro, etc.
  - Yellowknife group
    - Greywacke, impure quartzite and arkose, slate and argillite, quartz-mica schist and hornfels
    - Basalt, andesite, dacite, rhyolite, tuff, and agglomerate

YELLOWKNIFE GROUP

Volcanic Rocks

The volcanic rocks are most widespread in the northeastern part of the area, where they form several distinct belts. Narrow belts of greenstone also outcrop 6 miles west of Jennejohn Lake near the western boundary of the area, and on the shore of Great Slave Lake northeast of Narrow Island.

In the northeastern part of the area the Cameron River belt of volcanic rocks extends from the northeast shore of Ross Lake northwest to Cameron River and thence northeast, parallel to the northeast branch of the river, to the northern boundary of the area. The rocks are predominantly light to dark green dacites, andesites, and some basalts, with interbedded basic tuffs and agglomerates. A white weathering band of rhyolite and acidic tuff outcrops near the contact with the sediments northwest of Ross Lake. The basic lavas rise several hundred feet above the sediments, and this, together with the contrast in colour of the white tuff and rhyolite with the black weathering flows, forms a striking feature visible for many miles.

A second belt of volcanic rocks extends from Victory Lake southeast to Beaulieu River, and thence northeast along Tumpline and Turnback Lakes. This belt is composed of approximately equal amounts of acid and

basic lavas. The acid, rhyolitic flows are light grey to white weathering rocks similar in colouring and topographic expression to granite. The common variety is a very fine-grained, grey, flinty rock that weathers light grey to pink and locally contains phenocrysts of glassy to opalescent quartz up to one-sixteenth inch in diameter. Not all the rhyolites are flow rocks; some occur as dykes and small, irregular bodies cutting both acid and basic flows. Much of the intrusive rhyolite is porphyritic (quartz porphyry). The close association and similarity in composition and appearance of the extrusive and intrusive rhyolites indicate that they are genetically related. The intrusive phases are probably in part feeder dykes to the flows. It is possible, however, that some of the intrusive porphyries may be younger than the volcanic rocks and related to the granite, but no evidence suggesting this was found. The rhyolitic flows have large quantities of agglomerates and tuffs associated with them. The agglomerates are commonly composed of fragments of rhyolite, from an inch to more than a foot in diameter, in a tuffaceous or fine fragmental matrix. Fine-grained, bedded, siliceous tuffs are also plentiful. The basic flows occur interbedded with the rhyolites and are similar in composition and appearance to the basic flow rocks of the Cameron River belt.

The third and largest belt of volcanic rocks lies along Beaulieu River northeast of Turnback Lake. The lavas of this belt are predominantly fine-grained, light green weathering rocks of andesitic composition. Pillow and flow structures are well developed. Light grey weathering rhyolitic flows with associated rhyolite porphyry dykes occur interbedded with the andesites, but make up a relatively small proportion of the whole. West of Beaulieu River, particularly west of the lake where the east and north branches of the river join, pyroclastic rocks in remarkable variety occur interbedded with the flows. They include agglomerates, flow breccias, and coarse and fine tuffs. The volcanic rocks along the banks of Beaulieu River are highly sheared. Andesites have been altered to chlorite schists and the more acid rhyolites and tuffs to sericite-quartz schists. Small carbonate veinlets are abundant in the basic chlorite schists. Inland, to the east and west of the river, the rocks are more massive and original pillow and flow structures are well preserved.

In general, the contact of the volcanic rocks with large areas of granite is sharp. Although numerous granite dykes cut the greenstones near the contact and the granite contains many large inclusions of greenstone for some distance from the contact, the granite itself shows little or no evidence of contamination and the contact zone is rarely more than one-quarter mile in width. However, the greenstone-granite contact in the northeast corner of the area east of Beaulieu River and west of Payne Lake is marked by a zone of greenstone up to a mile or more in width cut by a variety of granitic dykes. The number of dykes increases as the main body of granite is approached until the amount of granitic material becomes greater than the amount of greenstone and the rock may be better described as granite with greenstone inclusions. Most of the dykes, particularly at some distance from the main granite body, are grey to green, granitic rocks with a large content of hornblende and small content of quartz. Others are more acid and closely akin in composition and appearance to the main granite mass. Green-

stone cut by many granite dykes is commonly recrystallized to a medium-grained, dark green, speckled, dioritic hornblende-feldspar rock, which in places retains original pillow and flow structures. Contacts between granite dykes and recrystallized greenstone are usually sharp and well defined.

The narrow, isolated belt of greenstone crossing the northeast branch of Beaulieu River 2 miles east of the main greenstone belt, is riddled by granite dykes, which in places make up as much as 50 per cent of the whole mass. It grades to the north and south into rocks that are mainly granite, but contain a large proportion of greenstone. This narrow band or zone of mixed rocks extends 8 miles to the southeast, where it joins the main belt of greenstone 2 miles southwest of Payne Lake; it is not differentiated from granite on the map.

Sedimentary Rocks

The sedimentary rocks of the Yellowknife group extend as a belt up to 20 miles in width from the northern boundary of the area south to the shore of Great Slave Lake. On the accompanying map the sediments are divided into two groups: (1) relatively unaltered sediments; (2) knotted quartz-mica shist and hornfels. This division is based on degree of metamorphism and is entirely arbitrary. A complete gradation exists between the two groups.

Relatively Unaltered Sediments. The sediments consist of well-bedded greywacke, impure arkose and quartzite, slate, and argillite. The thickness of the beds averages 1 to 2 feet, although locally in the coarser clastics the beds are so thick and massive that the bedding planes are difficult to recognize. Beds of slaty material are much thinner than those of greywacke, averaging 1 to 6 inches, and many of the beds are finely laminated. All types of sediment occur interbedded one with the other. One type may predominate in one locality, but a large proportion of the other types is usually present.

The most common sediment is greywacke. The greywackes are fine-grained rocks weathering grey to buff. On fresh fracture the individual grains can be distinguished only in the coarser, more gritty beds. On a clean, weathered surface, however, individual grains can be recognized even in the finer grained beds. As a rule the thicker beds are more massive and are composed of coarser, more sandy material than the thinner beds. Beds with grains up to one-eighth inch in diameter occur, but are not common. Many of the beds show a gradation in size of grain. The study of numerous well-exposed folds has shown that the change in grain size within a single bed is from coarse at the bottom to fine at the top. As the beds throughout the area are vertical or inclined at steep angles, gradation in grain size is extremely useful in determining the top and bottom of the beds. Crossbedding, which is also useful in determining the attitude of the beds, occurs at the base of some of the more sandy beds, but is not common.

The greywackes are largely recrystallized and are composed mainly of quartz, some feldspar, and 20 to 30 per cent dark and light mica. Rocks classed as impure arkoses and quartzites have a smaller content

of mica and a larger content of quartz and feldspar. They are somewhat coarser grained than the greywackes and weather a slightly lighter shade of grey, but are otherwise similar. The slates are coal-black to grey, thinly bedded rocks with pronounced cleavage.

A narrow band of conglomerate outcrops along the contact between sediments and volcanic rocks northeast of Victory and Ross Lakes. The plane of contact is vertical and marked by a cliff about 150 feet in height. The conglomerate outcrops along the side and base of the southwestward facing cliff. It is exposed over a width of 150 feet and may underlie part of a drift-filled valley that parallels the foot of the cliff. The conglomerate extends southeast along the contact, from the south end of a small lake 500 feet east of Ross Lake for 4 miles to a point about 2 miles northwest of the southeast end of Victory Lake. The conglomerate consists of well-rounded pebbles of granite, greenstone, light grey felsite, and grey quartzite in a matrix of a coarse, limy sandstone or grit. The pebbles average 2 to 3 inches in diameter, with occasional boulders up to 1 foot in diameter. As the contact with the volcanic rocks is approached the sandy matrix changes to a green, basic, fine-grained, fragmental material that has a tuffaceous appearance, but which may have been derived from the underlying volcanic rocks. The change in the character of the matrix is accompanied by an increase in the proportion of greenstone pebbles until, near the contact with the volcanic flows, no other pebbles are present. The conglomerate of greenstone pebbles grades in turn through a rock that may be agglomerate to the topmost flow rock, which is here ropy andesite. Similarly, east of the southeast end of Ross Lake the base of the conglomerate grades into the underlying volcanic rock, which is here a rhyolite breccia composed of fragments of rhyolite in a matrix of smaller fragments.

On Tumpline Lake and along Beaulieu River the volcanic rocks grade into tuffaceous sediments, which in turn grade into true sediments. Narrow bands of lava occur interbedded with sediments stratigraphically above the main body of volcanic rocks on Ross Lake and on the west side of Cameron River 1 mile south of the mouth of the stream that drains Gordon Lake. Along volcanic sedimentary contacts throughout the area excellent determinations of tops of beds of sediments and tuffs by gradation in size of grain from coarse at the base to fine at the top indicate that the main body of sediments stratigraphically overlies the volcanic rocks.

The relations described above imply no structural unconformity between the volcanic rocks and the overlying sediments. The presence of a conglomerate along the contact near Ross Lake that contains granite pebbles suggests that a period of erosion may separate the volcanic rocks from the sediments in some localities. Throughout the greater part of the area, however, the relations suggest that the period of vulcanism gave place to the period of sedimentation with little or no intervening period of erosion.

Knotted Quartz-mica Schist and Hornfels. The sediments over large areas have been altered to knotted quartz-mica schist and hornfels. The degree of metamorphism is probably closely connected with proximity to granite batholiths, although other factors may also be important.

A perfect gradation exists between the relatively unaltered sediments and the quartz-mica schist and hornfels. As the degree of metamorphism increases small flakes of mica gradually increase in number and size along the cleavage planes in the sediments, so that the rocks when split along these planes have a glistening, micaceous surface. In the more massive, sandy beds, although the micas tend to develop with their flat surfaces parallel to one another, the rock does not cleave readily. This type possessing little or no schistosity is more properly called a quartz-mica hornfels than a schist.

In more highly altered forms, spherical or ovoid knots of harder, lighter coloured material develop in the schist and hornfels. The knots vary in size from very small to 2 inches or more in length, the average size being ¼ to ½ inch. The knots are in most cases more resistant than the rock as a whole, and stand out conspicuously on the weathered surface. In some beds, however, the knots are less resistant than the enclosing material and weather out to give the rock a pitted appearance. The knots develop in all kinds of sediments, but tend to form first and most abundantly in the more argillaceous beds. The knots represent the initial stages of the development of new minerals in the sediments. In the early stage little difference is apparent in the mineral composition of the knot and the enclosing rock. In the more advanced stage some of the knots have been identified as cordierite packed full of inclusions of biotite, muscovite, quartz, and feldspar. In some of the highly altered, argillaceous beds well-developed crystals of chiastolite have been found.

The knotted micaceous schists retain original sedimentary structures to a remarkable degree. Bedding and crossbedding are perfectly preserved and gradation in size of grain may be recognized on the weathered surface in many of the coarser, more sandy beds.

Granite and pegmatite dykes cut the schist and hornfels, but are rare except near contacts with granite. Large areas contain no granitic material whatever. Contacts of the quartz-mica schist and hornfels with granite are in most cases sharp. At some localities, in particular along the granite sedimentary contacts near Prelude, Reid, Jennejohn, and Harding Lakes, a zone of injection gneisses ¼ to 1 mile or more in width is developed along the contact. The injection gneisses are more highly altered phases of the schists coarse enough in grain to be called gneisses and containing much granitic material as lit-par-lit injections and dykes. They are not differentiated from the knotted quartz-mica schist and hornfels on the map.

Structure

The sedimentary rocks lie in a series of tight, closely spaced, isoclinal folds. The dip of the strata is, consequently, steep to vertical in most parts of the area, and in many places the beds are overturned. The trend of the axes of the folds varies in different parts of the area. Thus, the axes of the folds and general strike of the beds at and to the east of Gordon Lake is northeast, to the west of Gordon Lake is northwest, to the north of Pensive Lake is west, and between Hearne and Tibbitt Lakes is north. In a small area east of Tibbitt Lake, where the structure was worked out in some detail, the distance between anticlinal crests is about 1 mile.

Where argillaceous, slaty beds are more plentiful, as at Gordon Lake and north of Pensive Lake, the distance between crests is much less. The volcanic rocks dip at steep to vertical angles, but the folds within them are not as closely spaced as those within the sediments. Thus, numerous observations of the attitudes of the volcanic rocks east of Cameron River indicate that the flows face west and northwest across the whole belt.

Within the area about Gordon Lake, where more detailed work has been done than elsewhere, two well-defined sets of faults have been recognized, one set striking about north 60 degrees east and the other about north 20 degrees west. Two sets of basic dykes occur parallel to the faults. In places the faults displace the dykes, but not uncommonly the dykes are younger than the faults and have been intruded along them. Possibly the development of the faults and the intrusion of the dykes were more or less contemporaneous.

DIORITE, GABBRO, ETC.

The largest body of basic intrusive rocks within the area lies 1 mile east of François River, ½ mile north of the shore of Great Slave Lake. The mass is a complex of gabbro, diorite, and anorthosite, all of which are probably differentiation products of the same parent magma. In places gabbro, anorthosite, and titaniferous magnetite occur as alternating bands, from an inch to several feet in thickness. The François River basic intrusive rocks are older than the surrounding granite.

Several dykes and sills of diorite and gabbro cut the sediments in the vicinity of Tibbitt and Tumpline Lakes. The larger dykes, such as outcrop near Tibbitt Lake, are massive, dark green weathering rocks of medium to coarse grain. They are composed of dark green hornblende, secondary amphibole, and altered plagioclase. The composition is somewhat variable, with local segregations of material of coarser grain and of either more basic or more acid composition than the average. The smaller dykes, 100 feet or less in width, are of similar composition, but of finer grain and in general more schistose and highly altered than the larger bodies.

Two dykes southeast of Tumpline Lake are cut by granite which is definitely younger. The dykes in the vicinity of Tibbitt Lake are also assumed to be pre-granite in age, although definite proof is lacking.

GRANITE, GRANODIORITE, AND ALLIED ROCKS

The granitic rocks include a wide variety of acid intrusives that are characterized by light grey to pink colours and medium to coarse grain, and are composed of quartz, feldspar, and biotite, muscovite, or hornblende. The two most common types may be classed as biotite granite and muscovite granite. Both granites intrude the rocks of the Yellowknife group, but no satisfactory evidence of the age relationship between the two types was obtained. The biotite granite is the more common; it forms the larger batholiths and the small stocks and bosses south and east of Tumpline Lake and on Watta, Hearne, and Tibbitt Lakes. It is commonly a light grey to pink weathering, medium-grained rock composed of 25 to 35 per cent quartz, 55 to 65 per cent albite-oligoclase with a small proportion

of microcline, and 5 to 10 per cent black biotite mica. The biotite is generally present as well-formed hexagonal plates, and may be accompanied by some hornblende.

The muscovite granite forms many of the smaller batholiths or bosses, such as those outcropping within the knotted quartz-mica schist on and between Hidden, Sparrow, and Wedge Lakes, the long granite tongue southwest of Tumpline Lake, and the boss to the west of this tongue. It is essentially similar to the biotite granite except that the grain is generally coarser, a pale greenish yellow muscovite mica is present in place of the biotite, and the proportion of microcline to plagioclase is somewhat greater.

A third type, which may be called a chlorite granite, forms the oval mass surrounded by greenstone in the northeast quarter of the area west of Beaulieu River. It is a light grey to pinkish, medium-grained rock, which on fresh fracture breaks along slip planes coated with chlorite. The average composition is about 25 to 35 per cent smoky to opalescent quartz, 55 to 65 per cent sericitized microcline, microcline-perthite, and albite-oligoclase, and 5 to 10 per cent chlorite. The chlorite granite differs from the biotite and muscovite varieties in the greater degree of alteration and granulation, and the preponderance of potash feldspar over plagioclase.

The contact of the chlorite granite with the greenstone is extremely sharp; a few granite dykes cut the greenstone near the contact, but they are not common. A peculiar fragmental phase of the granite occurs along the northeast contact, one-half mile southeast of two small lakes at the northern end of the granite body. The fragmental phase where observed in contact with the greenstone is about 2 feet thick. On the west side it grades within a space of a few feet into normal granite. On the east side it is sharply separated from the greenstone, which dips steeply to the east away from the granite. The fragmental rock is composed of angular to sub-rounded granite fragments in a coarse greenish matrix of smaller fragments of granite. The rock has the appearance of a conglomerate or recomposed granite, but may be merely a brecciated zone along the contact of the granite and greenstone. Granite dykes cut the greenstone, 100 feet to the south, establishing the intrusive relation of at least some of the granite to the greenstone, and thus suggesting that the fragmental rock is merely a brecciated zone rather than a conglomerate. However, it is possible that granite of more than one age is present at this locality.

A number of dykes of aplite and quartz-feldspar porphyry cut the sediments near the small granite bodies 4 miles northwest of Hearne Lake, and on Tibbitt Lake. Most of the dykes are only a few feet wide and can be traced for only short distances. The largest one observed outcrops on the west shore of Hearne Lake, ½ mile from the north end. Similar small dykes of quartz porphyry occur near the small granite body 6 miles south 20 degrees east of François Lake, and some were also noted in the sediments 4 miles west of François Lake. Some of the dykes contain arsenopyrite, pyrite, and other sulphides. The dykes are unlike the extrusive quartz porphyries associated with the volcanic rocks of the Yellowknife group. They are probably related to the granites.

GREAT SLAVE GROUP

Sediments belonging to the Great Slave group form Blanchet and Seton Islands, in Great Slave Lake.[1] An area of sediments, probably belonging to the Great Slave group but too small in extent to show on the map, outcrops on the shore of the small, northeasterly trending lake 5 miles south of Payne Lake. An arkosic conglomerate outcrops for 300 feet along the northwest shore of the lake 1,200 feet southwest of the north end. The rock is grey to purple and composed of scattered, well-rounded pebbles up to 4 inches in diameter of vein quartz, quartzite, and granite in a rather coarse, arkosic, sandstone matrix. A thin veneer of conglomerate also occurs on the nearby granite and on the two small islands to the south. The conglomerate is younger than the granite and rests unconformably upon it.

Another patch of conglomerate, 100 by 600 feet in area resting unconformably on granite, was observed 8 miles north 30 degrees west of the area of conglomerate described above. These small areas of conglomerate are probably remnants of the Great Slave group of sediments, which at one time covered a much larger area than they do now.

DIORITE AND GABBRO

Basic dykes that range in composition from diorite to gabbro are the youngest known rocks within the area. The dykes are common throughout the area, but are particularly numerous in the Gordon Lake section and in the southeast quarter of the map-area between François and Great Slave Lakes. Most of the dykes are from 20 to 80 feet in width, but some are as much as 500 feet wide. The more detailed mapping near Gordon Lake has shown that the dykes there occur as two well-defined sets, one striking about north 60 degrees east, and the other about north 20 degrees west.

The basic dykes weather a characteristic rusty reddish brown. On fresh fracture the rock is mottled dark grey to greenish grey, with about equal amounts of basic, grey plagioclase and black to greenish augite. Many of the dykes have well-developed ophitic texture. The contact of the dykes with the enclosing rock is always sharp and well defined, with the dyke at the margin chilled to a dense, fine-grained rock. The grain size at a distance from the margin depends on the size of the dyke—the smaller dykes are dense black trap rocks across their entire width, whereas in the larger dykes the crystals are ¼ inch or more in length.

The granite northeast of Victory Lake is cut by hundreds of hornblende gabbro dykes from 2 to 50 feet or more in width, with a fairly uniform strike of south 20 degrees east. These dykes are older than the basic dykes described above. They weather dark green to black, and are medium- to fine-grained rocks composed of approximately equal proportions of hornblende and plagioclase. Many of the dykes are porphyritic, with scattered white weathering feldspar phenocrysts up to 1¼ inches in size. The dykes, in appearance and composition, resemble the basic intrusives near Tibbitt and Tumpline Lakes, some of which are pre-granite in age. However, as the dykes cut the granite, they are probably younger than these basic intrusives.

[1] Geol. Surv., Canada, Map 377A.

ECONOMIC GEOLOGY

CAMLAREN MINES, LIMITED

Camlaren Mines, Limited, was organized in 1937 to acquire part of the claims on Gordon Lake held jointly by Mining Corporation of Canada and the A.X. Syndicate. The property consists of forty-eight claims, and includes the original discovery vein, known as the "Hump," the "31" vein, and the "H" vein.

The rocks in the vicinity of the "Hump" vein are thinly bedded slates and greywackes striking north 30 to 35 degrees east and dipping easterly at angles of 75 to 80 degrees. The sediments lie in a tightly compressed, overturned, anticlinal fold inclined to the east and plunging northeasterly at an angle of about 50 to 55 degrees. The outcrop of the vein, from which its name is derived, forms an islet about 10 feet in diameter lying a few feet east of the southern tip of the north-south trending island in Gordon Lake, at the northern boundary of the map-area. The islet consists of vein quartz belonging to an outcrop that extends beneath the waters of the lake and measures about 18 feet by 20 feet. This mass is the shape of a saddle and, as indicated by banding in the quartz and other features, it lies immediately over the axis in the anticlinal fold. It continues as a saddle reef along the axis of the fold, but as the fold plunges northeasterly at an angle of 50 to 55 degrees the saddle reef disappears underground in that direction.

Less than 1 foot east of the islet constituting the "hump," the Hump vein is visible on the lake bottom. This vein is 3 to 4 feet wide, strikes parallel to the enclosing sediments, and like them dips at high angles (80 to 85 degrees) to the west. The saddle reef is connected with and is a branch from the northeasterly striking, steeply inclined vein.

A shaft has been sunk to a depth of 380 feet and levels established at 200 and 350 feet. The underground workings show that the saddle-like branch of the vein continues to the 350-foot level without any signs of ending, and that to this depth it maintains about the same dimensions as at the surface, i.e., it is a sheet 25 to 30 feet wide and 12 to 13 feet thick.

By September 1938 more than 450 feet of drifts had been completed along the steeply inclined, main part of the vein on the 200-foot level, and more than 500 feet on the 350-foot level. The width of the vein as exposed in the drifts varies from less than 1 foot to 3 feet; the dip is vertical to very steep northwest. Ore shoots within the vein apparently plunge, like the quartz saddle and the anticlinal fold, at about 50 to 55 degrees northeast.

The saddle or "hump" branch of the vein is composed of rather coarsely crystalline white quartz, whereas the quartz of the vein proper has a somewhat bluish grey colour. Slip surfaces within and along the walls of the vein and of the saddle-like branch are coated with black graphite. Brown weathering carbonate is plentiful as veinlets cutting the quartz. Pyrite and chalcopyrite are the most abundant sulphides, although galena and sphalerite are common. The sulphides are rather coarsely crystalline; cubes of pyrite and galena occur up to one-quarter inch in size. The sulphides are sparsely distributed throughout the quartz

and probably constitute less than 1 per cent of the whole. Visible gold is present as a fine powder in the quartz, usually in close association with the sulphides. Sphalerite and, to a lesser degree, galena are almost invariably associated with quartz that is high in gold, but the presence of sphalerite and galena does not necessarily imply the presence of gold.

The "31" vein outcrops on the northeast shore of the large island in Gordon Lake, one mile southwest of the " Hump " vein. The sediments in which it occurs are greywackes and slates, with a general strike of north 35 degrees east and vertical or very steep dip. The steeply dipping beds on either side of the vein zone face in opposite directions. The vein quartz has come in along the crest of the fold where the beds are ruptured and sheared as a series of irregular, discontinuous, quartz lenses nearly parallel to the axial plane of the fold. The vein matter is similar to that of the " Hump " vein, but sulphides are not so plentiful and are much more erratic in distribution. At the surface, one of the larger quartz lenses contained a pocket from which spectacular specimens of visible gold were obtained. Several shallow diamond drill holes intersected bodies of quartz of variable widths. Some of the drill intersections returned high, but erratic, assays in gold. A shaft was sunk to a depth of 200 feet during the summer of 1938 and development work was to be carried out from this shaft.

The " H " vein was discovered in August 1938 on a small island about 3,000 feet west of the " Hump " vein. The vein is in a massive bed of greywacke 20 feet thick, striking north 30 degrees to 35 degrees east, dipping vertically, and having the top of the bed facing east. The vein follows the bed about one foot from the top and has a similar strike and dip. It is exposed over a length of 110 feet, and extends into the lake at both ends. The width of the vein ranges from 5 to 30 inches, with an average width of 15 inches. The company reports that surface sampling of the vein indicates a gold content of 2·09 ounces a ton, or if occasional high assays are excluded, 1·22 ounces a ton. The quartz and sulphides of the " H " vein are similar to those of the " Hump " vein. In many places the vein has a banded appearance, due to numerous elongated inclusions of graphitic material, which are probably, in part, incompletely replaced country rock. Pyrite is the most abundant sulphide, but sphalerite and galena are also present. Much carbonate occurs as veinlets cutting the quartz. Visible gold is present as a fine powder in the quartz.

DOME MINES, LIMITED

The Dome property was staked in July 1938. Surface trenching and diamond drilling were in progress at the time of the writer's visit in August 1938. The main showing is about 800 feet east of the northwest end of the S-shaped lake lying 3 miles north of the northeast end of Pensive Lake.

The deposit consists of bodies of quartz that lie in highly contorted greywackes and slates striking northwest and dipping northeast at angles of 75 to 80 degrees. Where the quartz outcrops the strata lie in an S-shaped drag-fold, such that proceeding northwestward the strike of the beds curves from northwesterly around through westerly to southerly and again back through westerly to northwesterly. The drag-fold plunges

southeast at an angle approaching 90 degrees and is traversed by a fault striking northwest along the middle limb of the drag-fold. The main mass of quartz lies along and southwest of the fault in the southwest (anticlinal) part of the drag-fold, but at the northwest and southeast ends of the quartz body the vein material crosses over to the northeast side of the fault to form two hook-shaped masses of quartz extending along the strike of the strata in the northeast (synclinal) part of the drag-fold. This whole irregular body of quartz outcrops over a length of about 200 feet, with a maximum width of about 40 feet. Much quartz also occurs as lenses and stringers in the disturbed, drag-folded zone along the strike of the main mass of quartz.

The quartz is massive and bluish grey; it is cut in places by a few veinlets of glassy white quartz from a fraction of an inch to several inches in width. Occasional grey to white feldspar crystals up to one-eighth inch in size occur throughout the quartz, particularly near the margins. Sulphides are erratically distributed throughout the quartz, but the greater part is well, and in places heavily, mineralized with arsenopyrite, pyrrhotite, galena, pyrite, chalcopyrite, and sphalerite. The surface outcropping of quartz is remarkably free from the rusty capping that would normally be expected from the oxidation of such heavily mineralized quartz as is exposed in the trenches. This may be due to the rather high proportion of arsenopyrite, galena, and sphalerite, which leave little iron stain on oxidation. Visible gold is reported to occur, but is not common. Channel samples from the trenches are reported to return good assays in gold.

About 1,000 feet southeast of the main showing, within an area of about 80 by 100 feet, gold-bearing vein quartz occurs as irregular stringers and lenses within the crumpled and broken axial part of a fold in greywacke and slate. The amount of vein quartz material within this area is variable, and makes up only a relatively small proportion of the whole. Arsenopyrite is very abundant in both country rock and vein quartz where trenching has been done. Some pyrrhotite and chalcopyrite were also observed.

About 150 feet north of the main showing a quartz vein that varies in width from less than 1 foot to 2 feet contains visible gold and can be traced about 100 feet. The vein lies in sediments along a northwest trending fault, of small apparent displacement. The vein in places contains much galena, sphalerite, pyrrhotite, pyrite, chalcopyrite, and arsenopyrite.

Visible gold has also been found in quartz veins in the sediments about one-third mile west of the northwest end of the "S"-shaped lake mentioned above. Here the quartz occurs as lenses and stringers, some of which are as much as 3 feet wide, injected parallel to the bedding of the sediments, which strike north 35 degrees west and dip 80 degrees northeast. The quartz stringers and lenses occur within a zone 20 feet wide that can be traced more than 60 feet and continues much farther than this as a narrower, less well-defined zone of small quartz stringers. Pyrrhotite, arsenopyrite, galena, chalcopyrite, sphalerite, and pyrite are plentiful in some of the quartz lenses

SENTINEL MINES, LIMITED

Sentinel Mines hold a group of claims north of the large bay on the west side of Gordon Lake. A large amount of trenching and surface work

have been done on the property, and visible gold has been found in two localities.

The original showing is located about 600 feet inland from the north shore of the bay. A large body of quartz occurs in the sediments in a drift-filled, northeasterly trending valley. The greywacke and slate beds to the northwest and southeast of the valley strike north 75 to 80 degrees east and dip 80 to 85 degrees northwest. The dimensions of the quartz body as outlined by trenching are about 140 by 80 feet, but much of the quartz contains a large proportion of slate. The slate beds within the quartz strike at right angles to the strike of the sediments on either side of the valley. This suggests that the valley marks a drag-fold or contortion in a slaty band in the sediments. The quartz is a glassy, grey type sparsely mineralized with pyrite, pyrrhotite, and arsenopyrite; a few white weathering feldspar crystals occur in the quartz.

Visible gold has been found in quartz in sediments one-half mile northwest of the deposit described above. The quartz outcrops as a series of lenses following the strike of the sediments, which strike southeast and dip 85 degrees southwest. One lens has been crossed by trenches at close intervals over a length of 275 feet, and in the trenches ranges in width from 9 feet at the northwest end to a few inches at the southeast end. Another quartz lens, measuring 17 to 35 feet, outcrops 10 feet northeast of the main body. The most common metallic minerals in the quartz are pyrite, arsenopyrite, and pyrrhotite, but on the whole sulphides are scarce. Visible gold accompanied by galena and sphalerite has been found in two trenches.

Visible gold has also been found about one-quarter mile south of the showing described above. The gold occurs in a narrow quartz vein that lies in sediments, and varies from a few inches to 2½ feet in width. The sulphides associated with the gold are similar to those in the other occurrences that have already been described.

OTHER GOLD OCCURRENCES

A gold occurrence has been staked by Miller and Williamson near the northeast end of a small lake 2 miles north of Pensive Lake. The gold occurs in vein quartz lying along a faulted drag-fold in overturned slates and greywackes that strike north 80 degrees west and dip 75 to 80 degrees northeast. The faulted zone along which most of the quartz is found is largely drift covered, but scattered outcrops of quartz occur over a length of 350 feet, and at one point quartz outcrops over a width of 30 feet. The quartz is a glassy, bluish grey variety and contains a few small feldspar crystals. Sulphides are not plentiful, but in one small trench arsenopyrite is fairly abundant close to the wall-rock and in and around fragments of country rock, and galena is irregularly distributed through the quartz as cubes up to one-eighth inch in size.

The Ruth claims were staked by D. F. Kidd at the southeast end of Victory Lake in July 1937. The claims include a point of land extending into Victory Lake that is underlain by sediments and a narrow belt of volcanic rocks. A heavily mineralized shear zone occurs along the northeast contact of the lavas with the sediments. The sediments are fine-grained, knotted, quartz-mica schist. The volcanic rocks are green

weathering andesites and light grey to buff weathering, fine-grained, banded rhyolites, which in places contain small phenocrysts of quartz and feldspar. Some of the rhyolite may be intrusive. Aplitic dykes, probably related to the small granite body to the southeast, occur near the southeastern end of the claims. A fine-grained, light weathering, banded rock, which is probably a rhyolite flow, has been altered to a sericite schist along a contact with sediments, and the schist is heavily impregnated in places with pyrite, chalcopyrite, and pyrrhotite. A number of veins or lenses of bluish quartz, heavily mineralized in places with galena, pyrite, chalcopyrite, and some arsenopyrite and sphalerite, lie in the shear zone. No work had been done on the claims at the time of the writer's visit in July 1937, and because of the covering of heavy iron gossan the dimensions of the mineralized zones and the proportion of vein material to schist could not be determined. Considerable trenching and stripping have since been done on the property, and assays of channel samples are reported to have shown gold to be present.

The Irma claims were staked in July 1937 by D. F. Kidd. They lie one-half mile south of Victory Lake, to the southwest of the Ruth claims, along the northeast contact of the belt of volcanic rocks. Sulphides and vein quartz occur in shear zones along the contact of rhyolite flows with the sediments.

The Bobjo claims, staked by Blaisdale and McLeod in July 1937, adjoin the Irma claims on the northwest and include the northwest and western contact of the volcanic belt with the sediments. Shear zones along the contact contain much pyrite and chalcopyrite, accompanied by quartz veins and lenses containing galena, sphalerite, chalcopyrite, and pyrite.

The Baltic claims, staked for D. F. Kidd in August 1937, are located at the northwest end of Hearne Lake. A quartz-feldspar porphyry dyke striking north cuts the sediments on the west shore of the lake one-half mile from the north end. It ranges from 75 to 250 feet in width and extends north from the shore of Hearne Lake for at least a mile. The dyke is extremely irregular in outline; it contains many sharply defined inclusions of the sediments and sends many branches into the surrounding sediments. The porphyry weathers white to light grey and is composed of light grey feldspar and smoky quartz crystals up to one-eighth inch in size in a fine-grained, light grey groundmass. In places the phenocrysts are so closely packed that the rock has a granitic appearance. The porphyry is cut, and apparently to some extent replaced, by an intricate stockwork of blue quartz veins from 4 feet to a fraction of an inch in width; they make up perhaps 5 to 7 per cent of the dyke. Most of the quartz is a glassy, smoky blue variety with no metallic minerals, but in places it contains coarse crystals of arsenopyrite. Small amounts of galena, sphalerite, and molybdenite are also reported to be present. No work had been done on the property when visited in the early part of August 1937. Assays of grab samples of quartz containing arsenopyrite are reported to have shown gold to be present.

A large number of gold discoveries in addition to those described above were made within the area during the past year, but have not been examined by the writer and hence are not described. However, the locations

of these gold discoveries, where known, together with two recently discovered base metal deposits, are shown on the map accompanying this report.

NICCOLITE VEIN NEAR FRANÇOIS RIVER

This deposit has been described by Stockwell.[1] No further work has been done on the property since his examination, but as his report is out of print the description is repeated here.

The deposit occurs in augite diorite east of François River, about 1½ miles south of Caribou Lake. The augite diorite of the basic intrusive body is cut by granite, and the niccolite veins cut both diorite and granite dykes. The niccolite occurs in two veins lying within a few hundred feet of each other. They strike about east, dip from 70 to 80 degrees south, and have a maximum width of 15 inches. The larger vein has been trenched at intervals for 230 feet along its strike; the smaller parallel vein is exposed in only one trench. The veins are formed chiefly of massive niccolite with some smaltite and chloanthite, in a carbonate gangue. The surfaces of the nickel and cobalt arsenides are coated with green and pink nickel and cobalt bloom.

PROSPECTING NOTES

Quartz veins are numerous throughout both the sedimentary and volcanic rocks of the Yellowknife group. The quartz of the veins in the less altered sedimentary rocks, and in the volcanic rocks, is generally white to milky, and in the least altered rocks, such as those underlying Gordon Lake, it contains much rusty weathering carbonate. In the more highly metamorphosed sediments and the knotted quartz-mica schist and hornfels most of the veins are composed of glassy blue to white quartz; scattered, small, chalky white to pink weathering feldspar crystals occur in places along the margins of the veins, and many of the veins contain black, needle-like tourmaline crystals. The main factor in the development of the knotted quartz-mica schist and hornfels is proximity to granite batholiths, with attendant higher temperatures and pressures. The change in the character of the quartz veins from milky white quartz with carbonate in the less altered sediments to glassy blue quartz with feldspar and tourmaline in the knotted quartz-mica schist and hornfels is also due to differences in temperature and pressure at the time of formation of the veins. The veins in the knotted schists were formed at higher temperatures and pressures than those in the less altered sediments.

The number of gold occurrences so far found within the knotted quartz-mica schist and hornfels is about equal to that in the less altered sediments and volcanics. Therefore, the prospector must regard all ground underlain by the Yellowknife group of sediments and volcanics, irrespective of the degree of metamorphism, as potentially favourable for the occurrence of gold-bearing quartz veins.

Structural control has played an important rôle in the localization of gold-bearing veins so far found within the area. Most bodies of vein quartz occurring within the sediments can be classified as belonging to one of the following types.

[1] Stockwell, C. H.: Great Slave Lake-Coppermine River Area, Northwest Territories; Geol. Surv., Canada, Sum. Rept. 1932, pt. C, pp. 37-64.

(1) Quartz bodies introduced along the axial planes of tight, isoclinal folds. In this type the quartz in places forms a saddle on the crest of an anticline, as exemplified by the "Hump" vein, Camlaren Mines. More commonly the anticlinal crest is ruptured and irregular lenses of quartz have been introduced along the broken and sheared axis, as at the "31" vein, Camlaren Mines.

(2) Quartz bodies introduced along faulted drag-folds, as illustrated by the main showing on the Dome property.

(3) Quartz bodies introduced within an incompetent, slaty bed or beds lying between massive greywackes and quartzites. In this type the quartz occurs as stringers and small quartz saddles in the dragged and mashed, slaty material. Many such quartz bodies occur in the area, but most of them are small.

(4) Quartz bodies introduced parallel to the bedding of the sediments, as illustrated by the "H" vein, Camlaren Mines.

In many places shearing has been most pronounced along contacts between different types of rock. Thus, contacts between sediments and volcanic rocks have been the loci of strong shearing movements, and the resulting shear zones have afforded channelways for vein-forming solutions. Sulphides and vein quartz are plentiful along contacts between volcanics and sediments throughout the area, and these contacts deserve careful prospecting.

A large number of small granite stocks have intruded the sediments throughout the area. The sediments around these small granite bodies are theoretically favourable for mineral deposits.

A number of aplite and quartz porphyry dykes cut the sediments northwest of Hearne Lake and south and west of François Lake. Most of the dykes are small, but both the dykes and the sediments in their vicinity are worth investigation.

Faults may also contain mineral deposits. Detailed mapping about Gordon Lake has revealed a number of faults, and others, not recognized in reconnaissance mapping, probably occur in other parts of the area. The highly schistose greenstones along the upper reaches of Beaulieu River in the northeast quarter of the area may mark a north-south fault parallel to the river. Elsewhere in the area rectilineal topographic features, such as straight river courses, lake basins, etc., may likewise indicate faults.