CANADA
DEPARTMENT OF MINES AND RESOURCES
MINES AND GEOLOGY BRANCH
BUREAU OF GEOLOGY AND TOPOGRAPHY

LEGEND

PROTEROZOIC

10 — Diabase, gabbro; 10a, olivine-rich gabbro

ARCHÆAN

9 — Prosperous granite and pegmatite. A, with abundant biotite schist (6)

8 — Granodiorite, granite, and allied rocks; 8a, biotite granodiorite, etc.; 8b, hornblende granodiorite, etc. (A, with biotite schist inclusions; B, with hornblende schist inclusions)

7 — Altered gabbro and diorite

YELLOWKNIFE GROUP

DIVISION C

5, 6 — 5, greywacke, slate; minor quartz-mica schist and phyllite
6, nodular quartz-mica schist and hornfels, mainly derived from 5. (C, chiastolite-bearing; D, cordierite-bearing; E, sillimanite-bearing; G, garnet-bearing; S, staurolite-bearing)

DIVISION B

4 — Argillite, siliceous argillite, grit, greywacke. (C, chiastolite-bearing)

3 — Trachyte, dacite, rhyolite; breccia; agglomerate, tuff; derived arkose and volcanic conglomerate; quartz porphyry, feldspar porphyry, in part part intrusive. (G, garnet-bearing)

2 — Conglomerate, arkosic quartzite

DIVISION A

1 — Andesite, basalt, dacite, rhyolite; porphyry; gabbro, diorite; 1a, mainly acid lavas; 1b, mainly altered basic intrusive rocks (may include some 7)

Drift-covered area (only the larger areas are shown)
Vein (exposed, located by drilling)
Flow contact (commonly marked by chert, tuff, or breccia
Fault (defined, inferred)
Glacial striæ
Bedding
Bedding (inclined, overturned, horizontal, dip unknown)
Bedding (inclined, vertical) upper side of bed unknown

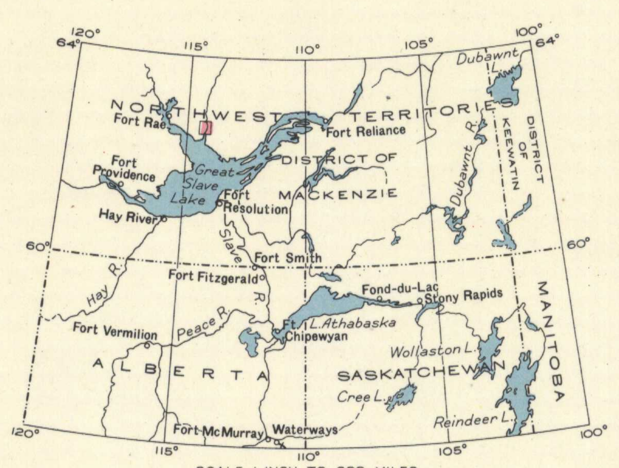
MINERAL OCCURRENCES

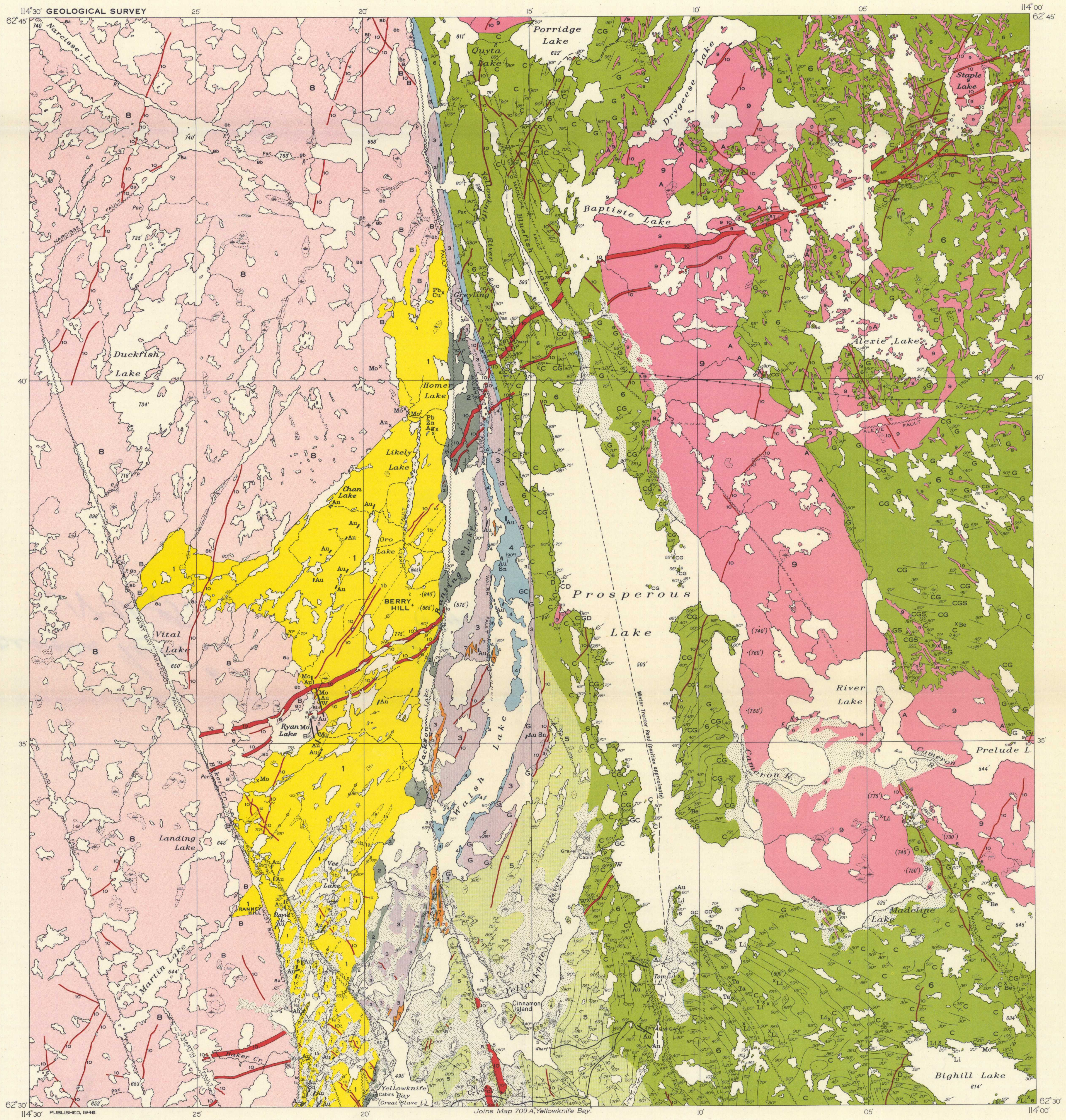
Gold	Au
Lead	Pb
Zinc	Zn
Molybdenum	Mo
Tungsten	W
Tin	Sn
Nickel	Ni
Chromium	Cr
Vanadium	V
Lithium	Li
Tantalum-columbium	Ta
Beryllium	Be
Silver	Ag
Copper	Cu

Road
Winter tractor road
Trail or portage
Building
Shaft
Power transmission line
Stream (position approximate)
Fall and rapid
Marsh
Height in feet above mean sea-level based on datum of 495 feet, Great Slave Lake .... 648′
Less accurate elevations, determined by aneroid .... (575′)

Geology by A.W. Jolliffe, 1940, 1941.

Base-map compiled by the Topographical Survey, 1938, from aerial photographs taken by the Royal Canadian Air Force. Cartography by the Drafting and Reproducing Division, 1945.





MAP 868A

PROSPEROUS LAKE

DISTRICT OF MACKENZIE
NORTHWEST TERRITORIES

Scale, $\frac{1}{63,360}$ or 1 Inch to 1 Mile
Miles

Approximate magnetic declination, 36°30′ East.

GENERAL GEOLOGY

Bedrock is well exposed in the map-area. Ridges and hills with much outcrop are separated by depressions occupied by lakes, muskegs, or wooded stretches of drift. However, even where exposures are practically continuous, most faults, shear zones, and veins weather to form lineal, drift-filled depressions. Few hills rise more than 200 feet above adjacent valleys. Areas underlain by granitic rocks (8, 9) show the least local relief and commonly stand at a higher average elevation than areas underlain by rocks of the Yellowknife group. Among the latter, the volcanic rocks (1, 1a) and associated intrusions (1b) are the most resistant to erosion. The main body of Prosperous granite and pegmatite (9) forms a marked upland that drops abruptly as much as 250 feet into Prosperous Lake on the west and slopes gently down to the northeast. The larger pegmatite stocks (9) farther east stand 50 to 100 feet above the surrounding areas of altered sedimentary rocks (6). Diabase dykes (10) commonly erode more readily than the enclosing rocks, and are marked by valleys whose walls remain about equidistant along gently sinuous courses. On the other hand, a relatively flat-lying body of this rock (10, 10a) forms a prominent ridge east of the north end of Yellowknife Bay. The highest point in the map-area is Berry Hill, which is about 370 feet above the level of Yellowknife Bay, and is composed of carbonatized volcanic rocks (1). Other notable elevations are Ranney Hill and certain hills of granite and pegmatite (9) along the east shore of Prosperous Lake. Abandoned beaches flank these hills to at least 240 feet above Great Slave Lake, or about 735 feet above mean sea-level.

The rocks of Division A of the Yellowknife group are mainly fine- to medium-grained, grey to dark green weathering, pillowed and massive andesites, cut by dykes and sills of about the same composition and showing much the same degree of alteration (1). Bands of chert, tuff, and rhyolite up to 50 feet thick are fairly common between the basic flows; they are light-coloured rocks, but are commonly rusty on weathered surfaces due to disseminated pyrite and pyrrhotite. In places light weathering, commonly porphyritic rhyolite, latite, and dacite flows are sufficiently abundant to permit separate mapping (1a). Only the larger basic intrusive bodies (1b) are shown on the map; most of them doubtless belong to the same period of volcanism as the flows (1), but some may be younger. The majority are diorite, but anorthosite occurs 1½ miles northeast of Ryan Lake. The rocks of Division A are coarsely crystallized and albitized near contacts with granitic rocks (8), and are extensively replaced by ferruginous carbonate, particularly in the vicinity of Berry Hill. Schists are not common except along local shear zones; original structures such as pillows, spherulites, vesicles, and amygdules in the flows, and chill contacts in the intrusive rocks (1b) are well preserved.

An unconformity separates the rocks of Division A from the rest of the Yellowknife group. The evidence for this is most obvious around the southwest bay of Walsh Lake, where basal conglomerate (2) truncates not only flows (1, 1a) and intervening chert and tuff bands, but also altered basic dykes (1b) cutting these. Furthermore, a band of acid lavas (1a) entering Jackson Lake from the southwest is probably of about the same age as porphyritic rhyolite, trachyte, and dacite (1a) southwest of the north end of Yellowknife Bay. At the latter locality these acid flows (1a) are separated from the conglomerate (2) by several thousand feet of andesite and dacite (1), which are lacking in the section from Jackson Lake northwards and may have been eroded away prior to deposition of Division B rocks. In most places bedding in the conglomerate and arkosic quartzite (2) departs less than 15 degrees from the strikes of flow contacts in the underlying lavas (1), and along the northwest side of Yellowknife Bay they are essentially parallel.

The oldest member of Division B is mainly a cream weathering, carbonatized, arkosic quartzite and argillite (2). Bedding is rather poor, but pitted weathering, crossbedded bands are not uncommon. Many beds carry sparsely distributed pebbles; these increase in size and number westward towards the base of the formation. Most pebbles are composed of felsite, quartz, and impure quartzite, but the basal conglomerate carries many that are similar to the underlying basic flows (1) and intrusions (1b), and, southwest of Walsh Lake and west of Yellowknife Bay, granitic and ferruginous carbonate pebbles. Conglomerate bands at the south end of Walsh Lake and on Yellowknife River west of the north end of Bluefish Lake have unknown structural relations with surrounding rocks.

A considerable thickness of predominantly acidic volcanic rocks (3) probably overlies the basal conglomerate and arkosic quartzite (2), although contact relations are obscured by drift or faulting. The flows and tuffs (3) are commonly light weathering, variably porphyritic, and discontinuously streaked. Most of such rocks in the band extending north from the Akaitcho fault west of Walsh Lake are pink, grey, and buff augen gneisses with abundant feldspar and sparse quartz in a strongly foliated groundmass of sericite, chlorite, and carbonate. Microscopic examination indicates that these rocks are chiefly carbonatized and mylonitized rhyolite and trachite porphyries with minor andesite, tuff, and arkose. The band lying east of Walsh Lake is more variable. Some of the lavas weather white and show quartz phenocrysts in greatly elongated pillows; others have small, bright green pillows. Clastic rocks are common, and include breccia, agglomerate, and tuff, as well as arkose and impure quartzite. Most of these are notably siliceous and light coloured, but all contain patches and streaks of green material studded with wine-coloured garnets.

Argillite is the chief rock type in a band (4) occupying the basin of Walsh Lake. It is poorly bedded, and is interbanded with soft, light weathering, very fine-grained rocks that may represent sericitized and carbonatized argillite as well as minor amounts of greywacke and impure quartzite. These rocks appear to be younger than the acid volcanic rocks (3) on either side, although relations are largely masked by extensive introduction of pyrite and pyrrhotite along and near the contacts. North from Banting Lake rocks included in this map-unit (4) are too sheared and altered to permit determination of relative age. It may be that these argillitic rocks (4) should be placed at the base of Division C, but they differ from the sedimentary rocks of that division in their greater content of argillite and in their generally non-nodular character, although garnet (G) and chiastolite (C) were found in one or two places.

Most of the rocks of Division C of the Yellowknife group approach a shale or sandy shale in composition. They commonly show excellent bedding, and weather buff to grey (on wave-washed surfaces) to red-brown (in recent brûlés or near faults and late diabase dykes). Most of the beds are from an inch to several feet in thickness, and show a gradation from light weathering, sandy greywacke at the base of a bed to dark weathering, soft argillite at the top. In some places, particularly in the older rocks of this division, beds tens of feet thick may consist wholly of either thinly banded argillite or massive greywacke. Minor, impure arkose, quartzite, and grit are present, as well as bands up to 5 feet thick of interbedded, greenish grey and black argillite and hornblendic gneiss, which may represent tuffs although some of the gneiss may be altered diorite (7). In the less altered sediments (5) the greywacke consists of a fine-grained mixture of quartz, chlorite, sericite, and feldspar, and the argillite is a dense, black, graphitic rock of indeterminate mineral composition. With increasing alteration the argillite changes to a grey, lustrous phyllite with a wavy sheen, and the greywacke becomes sandy and friable and speckled with black biotite crystals or aggregates up to one-eighth inch across.

Further alteration of these rocks is marked (6) by the development of nodules of secondary minerals, particularly within the argillitic beds or tops of beds. The nodules appear on weathered surfaces as oval areas averaging an inch across and commonly standing in relief. Andalusite (C), cordierite (D), sillimanite (E), garnet (G), and staurolite (S) have been found in the nodules, but in most places the latter consist of nebulous micaceous clusters that, presumably, represent hydrothermal alteration products of earlier formed metamorphic minerals. The matrix surrounding the nodules is a quartz-mica schist or hornfels with fine needles of tourmaline. The distribution of nodular sedimentary rocks (6) around the main body of Prosperous granite and pegmatite (9) indicates that this intrusion effected the alteration, but that the type of metacryst mineral developed depends more on the composition of the enclosing beds than on their proximity to the intrusive body (9). Garnet has the greatest range of stability, as it occurs in both volcanic and sedimentary rocks not only in inclusions within the granite but also well out in the apparently little-altered sedimentary rocks (5). In the latter its occurrence is restricted to minor, green weathering, hornblendic beds. Andalusite (var. chiastolite) is most common in the aluminous argillitic beds. If an exception is made in the case of garnet, the boundary between nodular and non-nodular rocks is commonly definable within 200 feet. There is some evidence that the thermal metamorphism that developed the nodules was superimposed on an earlier dynamic or regional metamorphism and was followed in turn by a hydrothermal or retrograde metamorphism that reduced the metacryst minerals to predominantly micaceous aggregates.

Altered gabbro and diorite intrusions (7) are common cutting all rocks of Division B of the Yellowknife group, but bodies of mappable dimensions are found only in the volcanic member (3). They resemble many of the altered basic intrusive rocks (1b) in Division A. Weathered surfaces are buff, brown, and grey, thickly speckled with dark green, poikilitic clots up to one-half inch across. Albite-oligoclase, hornblende, epidote, and chlorite are the chief minerals present. Most bodies are massive and uniform, but some have been sheared to a basic augen-gneiss.

Granodiorite, granite, etc., (8) in the western half of the map-area weathers pink to grey and commonly carries less than 10 per cent biotite as its chief dark mineral constituent (8a). Much of its contact with Yellowknife group rocks (1, 1a, 1b) lies along faults; in such places it weathers a deep red to orange-brown. Elsewhere the granodiorite (8) intrudes these rocks, and the contact is sharp except near Ryan Lake, northeast of Vital Lake, and northwest of Greyling Lake. In these areas the granodiorite holds numerous inclusions of basic rocks (B), which resemble the andesites and basalts (1) and associated basic intrusions (1b) of the Yellowknife group, and is itself very variable, approaching a diorite or quartz diorite in composition, with hornblende as the main dark mineral present (8b). West of Homer Lake dark minerals are scarce or absent in the granodiorite (8) and the border phases are porphyritic. Many quartz-feldspar porphyry dykes and sills in the basic lavas (1) may be related to the granodiorite, granite, etc. (8), but some may be of the same age as the acid lavas (1a). Pegmatites are rare or absent throughout most of the granodiorite (8) and adjacent rocks.

Granite predominates in the larger bodies of Prosperous granite and pegmatite (9) and pegmatite in the smaller. The granite is medium- to coarse-grained, and contains variable amounts of both muscovite and biotite in addition to feldspar, quartz, and, in some places, tourmaline needles. The pegmatite consists chiefly of pink, white, and grey feldspar, milky quartz, honey-yellow to colourless muscovite, and black tourmaline. The feldspar includes both microcline and cleavelandite. Other minerals identified in pegmatites in and near the map-area are beryl, spodumene, amblygonite, lithiophilite, petalite, lepidolite, cassiterite, tantalite-columbite, garnet, gahnite, graphite, lazulite, arsenopyrite, pyrite, and molybdenite. The largest concentrations of these rare-element minerals noted in the area during the field mapping are in dykes south of Prosperous Lake where spodumene occurs in crystals up to 3 feet long and makes up about 5 per cent of the intrusions. A small granitic stock east of the north end of Walsh Lake is tentatively included with the Prosperous granite (9); it carries abundant disseminated arsenopyrite in places.

All the above rocks are cut by brown weathering, basic dykes up to 350 feet wide (10). Most of these belong to three sets, trending northwest, east-northeast, and north-northeast respectively, the last of which appears to be the youngest. The dykes follow gently sinuous courses, and, with one exception, stand about vertical. They include both quartz and olivine gabbro; diabasic texture is obvious in their finer grained margins. Two gabbro bodies on either side of the Hay-Duck fault at the south border of the map-area represent faulted parts of a once continuous basic intrusive sheet about 250 feet thick that dips about 15 degrees to the east. The lower (western) part contains about 50 per cent olivine and serpentine (10a), the upper (eastern) part is a quartz gabbro (10). All the late, basic intrusive rocks are relatively fresh except in the vicinity of late faults, where they are green weathering due to development of epidote and chlorite and resemble the older intrusions (1b and 7).

STRUCTURAL GEOLOGY

The structure of the area is complex. Broadly considered, rocks of Division A appear to be neither tightly folded nor widely sheared, those of Division B are so highly sheared and mylonitized that folding (if present) cannot be recognized, and those of Division C are most intricately folded but are not notably foliated. These features are regarded as the result of two or more periods of folding acting on rocks of widely varying competency. So far as faulting is concerned, the youngest faults are so widespread and were formed by earth movements of such magnitude that older faults can rarely be differentiated. Most or all faults shown on the map are late faults. Some moderately dipping shear zones in the map-area, such as those holding gold-bearing orebodies west of the north end of Yellowknife Bay, are cut by diabase dykes, and are considered older than the steeply dipping, late faults. The latter strike north to northwest, and within the map-area have caused a total, left-hand, post-diabase (east-northeast dykes), horizontal displacement of about 11 miles. About half this displacement occurs along the West Bay-Akaitcho fault, and a quarter along the Hay-Duck fault. Where two or more late faults join to form a single fault, the latter shows an apparent lateral displacement about equal to the sum of the offsets on the branch faults. Available information suggests that the vertical component of the late faulting is small, and that the rocks to the east of some late faults moved downwards relative to those on the west. Many of the faults are marked by rectilineal topographic features (lineaments) such as straight valleys, shorelines, and edges of areas of outcrop. The character of a late fault may change considerably along its course. Thus, northwest of the outlet of Baker Creek the West Bay fault is marked by an east-facing scarp up to 50 feet high; drill-hole intersections here showed no vein matter in the fault and only a few inches of gouge. The same fault 1½ miles to the north lies in an insignificant, drift-filled trench about a foot across, and 2½ miles farther north the fault holds a quartz-hematite vein breccia and stockwork about 200 feet wide. The bulk of the vein matter is milky, cherty, and comb quartz, with abundant earthy and specular hematite. Some of the comb quartz is amethystine, particularly along the Vega fault, and some carries chalcopyrite and pyrite in crystals up to one-quarter inch across. The age of the late faulting can be established only within very wide limits. The tremendous offsets now observable along the faults doubtless resulted from innumerable small movements throughout one or more periods that may have been very long. All the diabase dykes (presumably Late Precambrian in age) are cut and offset by the faults. Along the West Bay-Akaitcho fault, east-northeasterly trending olivine diabase dykes show the same lateral left-hand displacement as other more ancient markers, such as granite-volcanic rock contacts, indicating that no appreciable displacement occurred before these dykes were intruded. On the other hand, a north-northeasterly trending dyke east of Prosperous Lake swings sharply northwest to follow the Madeline fault for about half a mile before resuming its normal course. That part of the dyke within the fault is in part chilled against gouge and in part is itself sheared, indicating that movements occurred both before and after emplacement of the dyke. It is noteworthy that shear zones are not characteristic of the late faults. They are marked either by an inch or two of gouge, or by quartz vein breccias and stockworks in which rock inclusions are brecciated and silicified but not sheared.

ECONOMIC GEOLOGY

Limited prospecting was carried on in the map-area from 1928 to 1935. In the succeeding years, following gold discoveries at Yellowknife Bay to the south and at Gordon Lake 50 miles to the northeast, the area was actively prospected, and some gold was recovered at two properties (Ptarmigan and Giant), until shortages in labour and equipment caused suspension of almost all work in 1942. In 1944 important gold-bearing bodies were found by diamond drilling on the property of Giant Yellowknife Mines, Limited, west of the north end of Yellowknife Bay, resulting in greatly increased interest in the area.

Quartz deposits of at least three different types and ages are widespread, chiefly in areas underlain by rocks of Division C of the Yellowknife group. Irregular, discontinuous stringers and lenses of grey to rusty quartz containing chalky feldspars are particularly common near fold axes. Where the country rock is nodular (6) similar irregular quartz bodies may carry pink to mauve andalusite in aggregates up to a foot across. Sillimanite occurs in such aggregates and, outside the map-area, blue corundum (sapphire) is not uncommon. Quartz lenses south of the outlet of Prosperous Lake contain aggregates of light brown garnet and some white scheelite. Younger quartz veins, which either carry tourmaline or are bordered by black weathering, tourmalinized country rock, may also be freely mineralized with arsenopyrite, pyrrhotite, and pyrite. The youngest quartz of all is the vuggy and cherty type containing hematite, chalcopyrite, and pyrite, which is found along the late faults.

The tourmaline-bearing veins (some of which carry gold) seem to be genetically connected with the Prosperous granite and pegmatite (9). A mile north of Ptarmigan mine a granite-pegmatite dyke carrying feldspar, quartz, and muscovite can be traced into a similar body with narrow, tourmalinized borders, and finally into a quartz-tourmaline vein. Again, single crystals of some of the typical pegmatite minerals, such as beryl, spodumene, and lazulite, have been found in certain quartz-tourmaline veins. The earlier quartz stringers and lenses may be connected with the older granodiorite (8); the latest vuggy and cherty quartz represents hydrothermal mineralization unrelated to any known intrusion, as it post-dates the late faults, which cut all rocks of the map-area.

Many gold occurrences have been reported in the area; to date two properties have produced. The chief deposit on the property of Ptarmigan Mines, Limited, is a quartz vein up to 25 feet wide exposed at intervals in a northwesterly direction for a length of about 1,300 feet. The vein lies about parallel to fold axes in the enclosing nodular, sedimentary rocks, whose bedding planes trend northerly and are steeply overturned to the east. Most of the quartz is glassy; some is milky to grey with rare vugs less than an inch across lined with comb-quartz crystals and partly filled with dark brown sphalerite. Tiny needles of brown tourmaline, pale green feldspar, carbonate, and scheelite are present. Metallic minerals are comparatively rare and include pyrrhotite, arsenopyrite, pyrite, chalcopyrite, sphalerite, galena, native copper, and gold. The ore-shoots within the vein are highly irregular. In some places tourmaline, in other places sphalerite are regarded as favourable indicators of gold content. Underground work has not been extended to the east far enough to expose relations between the vein, the ore-shoots, and the Ptarmigan fault. However, on the 450- and 600-foot levels of the eastern workings, a minor slip, with the same northwest strike and the same left-hand offset as the late faults, cuts across the vein and is lined with sericite and chlorite carrying coarse gold. The mine has six levels down to 900 feet, with about 6,000 feet of drives and crosscuts. It operated for about 9 months in 1941 and 1942; 11,921 ounces of gold were recovered from 34,429 tons treated. Hydroelectric power is supplied from a 4,700 H.P. hydroelectric plant completed in 1940 at the outlet of Bluefish Lake.

The property of Giant Yellowknife Gold Mines, Limited, lies chiefly in Division A rocks west of the north end of Yellowknife Bay. Between 1935 and 1942 surface prospecting and some diamond drilling disclosed numerous small quartz veins and lenses carrying visible gold as well as a few north-northeasterly-trending shear zones tens of feet wide containing varying proportions of chlorite, sericite, ferruginous carbonate, and quartz, with much finely disseminated pyrite and arsenopyrite, and carrying variable, moderate to low, values in gold. During this period 74 tons of ore mined from quartz veins and lenses at the Brock zone (immediately east of the West Bay fault at the extreme south end of the map-area) yielded 647 ounces of gold on treatment at Trail, B.C. About 1,000 feet to the northeast of the Brock showing, a wide shear zone was found to contain about one-half ounce of gold across 13 feet for a length of 250 feet. Following detailed geological mapping, intensive surface diamond drilling was commenced early in 1944, designed chiefly to explore under the prominent, north-northeasterly-trending, drift-filled valleys in the vicinity of Baker Creek. By the end of 1945 about 80,000 feet of drilling had been completed. Company officials report that this had indicated a possible reserve, within about 300 feet of the surface, of 2,373,200 tons carrying 0.28 ounce gold a ton, contained in a series of blocks and lenses within quartz-chlorite-sericite-carbonate shear zones over a total length of nearly 2 miles. Available evidence indicates that the shear zones and gold-bearing bodies within them dip moderately to steeply west, and are cut and displaced by steeply dipping diabase dykes (10) and late faults that enter the West Bay fault from the southeast.

A wide variety of vein types occurs east of Ryan Lake. A milky quartz vein zone up to 25 feet wide (with included bands of country rock) has been trenched at intervals for a length of nearly 2,000 feet. It strikes north-northwest through massive, recrystallized, volcanic rocks (1) and stands about vertically. Brown weathering carbonate, calcite, a little feldspar, and possibly scheelite, are present. Metallic minerals sparsely and irregularly distributed through the vein include molybdenite, pyrite, arsenopyrite, chalcopyrite, and hematite. Values in gold have been reported from parts of the vein. Two veins, about parallel to the above zone, lie to the southwest in hybrid granodiorite (8b) and are generally similar except that the quartz is more glassy and its content of molybdenite and feldspar is higher. One-quarter mile southeast of Ryan Lake an ore-shoot is reported to have been established by diamond drilling in a quartz vein striking northeasterly. In places this vein carries abundant aggregates of a soft, grey, acicular, metallic mineral that may be jamesonite.

Lead and zinc sulphides replace sheared volcanic rocks (1) west of Homer Lake. So far as known these deposits contain only negligible amounts of precious metals, but the presence of indium has been established by spectrographic examination.

Molybdenite is common in quartz veins within and near the eastern edge of the granodiorite (8); the greatest concentrations seen during the field mapping lie in a sheared, porphyritic salient of this intrusion west of Homer Lake.

Traces of tin have been found by assay in some of the gold-quartz deposits. These are of interest in that they suggest a genetic connection with the Prosperous granite and pegmatite (9), some bodies of which elsewhere carry appreciable amounts of cassiterite.

Rock chips taken from near the base of the olivine gabbro body (10a) east of Yellowknife Bay assayed 0.13 per cent nickel, 0.11 per cent chromium, and a trace of vanadium.