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GEOLOGICAL NOTES ON EASTERN DISTRICT OF MACKENZIE NORTHWEST TERRITORIES

(Report and Map 17-1956)

By

G. M. Wright

OTTAWA
1957

Price, 50 cents

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INTRODUCTION

The following is an account of the geological reconnaissance of eastern District of Mackenzie (Operation Thelon). In this operation five geologists using two helicopters mapped about 61,000 square miles in 92 days during the 1955 field season. The area covered lies mainly between 102 and 108 degrees west longitude, and extends from practical tree-line north to latitude 66 degrees. In the northeast corner, a small area within the District of Keewatin (Pelly and Garry Lakes) is included. This work constitutes a westward culmination of the geological reconnaissance by helicopter in the barren grounds west of Hudson Bay, initiated by Operation Keewatin in 1952 (Lord, 1953a)[1] and continued by Operation Baker in 1954 (Wright, 1955b). The objectives desired, field methods used, operational problems encountered, and results obtained in these airborne surveys have been described and discussed elsewhere by Lord (1953b) and Wright (1955a).

The centre of the map-area lies approximately 300 miles east of Yellowknife, Northwest Territories; 300 miles north of Uranium City, Saskatchewan; and 500 miles northwest of Churchill, Manitoba. The area is traversed by three main canoe routes, but all are long, and in part at least, difficult. The Dubawnt River cuts through the southeastern section of the map-area from Wholdaia to Dubawnt Lakes. The Lockhart, Hanbury and Thelon Rivers provide a canoe route from Artillery Lake across the centre of the map-area, and beyond through Baker Lake to Chesterfield Inlet and Hudson Bay. Back River, through Ptarmigan, Clinton-Colden and Aylmer Lakes, constitutes another route from Artillery Lake to the north-western part of the area, and thence eastward to Pelly and Garry Lakes, and beyond to Chantrey Inlet on the Arctic coast. Elsewhere streams are seldom usable for any great distances; large lakes provide local canoe routes, particularly in the southern and western parts of the map-area.

Parts of the area may be reached by bush-type aircraft based at Churchill, Stony Rapids, Uranium City, and Yellowknife. From these bases, the one-way flight distance varies from 125 to 300 miles, to the nearest point within the map-area. Large scale use of aircraft for mineral prospecting could be facilitated by using Fort Reliance as an operational base and establishing major caches of gasoline and supplies there by water transportation a year in advance of field work. If desirable subsidiary caches could be established

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

within the map-area by ski-equipped DC 3's or other aircraft shortly before break-up, when snow, ice, and map-reading conditions would probably be most favourable. At present, there are no landing strips for wheel-equipped aircraft within the area.

Terrain varies considerably over the area mapped. The southeast part in places shows little outcrop but much glacial rubble in highly irregular hummocks. West and northwest from Dubawnt Lake, to Thelon River, and beyond are great expanses of grassland, with some large areas of sand. There are few outcrops, and the country is mainly gently rolling to monotonously flat. Hills of Dubawnt sandstone (15)[1], however, southwest of Grassy Island, rise to more than 500 feet above Thelon River. Between Clinton-Colden and Moraine Lakes and south to Sifton Lake are extensive rock-barrens, in large part of very low relief and with abundant outcrop. The regional trend of bedrock structural and erosional features in this area gives rise to many close-spaced, north-northeasterly trending lineaments (mainly narrow lakes), which from the air give to the country a most impressive grain. Near Western River, in the northwestern corner of the map-area, Proterozoic quartzites (13) form rolling hills that rise to a maximum of almost 1,000 feet above the bottom of the Bathurst trench (lineament of Western River). Elsewhere, conditions are generally more typical of the Canadian Shield, with moderate to abundant outcrop in terrain of gentle, or locally rugged relief. No large areas of swamp were seen.

Most of the area is treeless, barren grounds. The so-called tree-line is a sinuous indefinite zone in which the trees decrease in concentration and size towards the northeast. It extends northwesterly, across the southern part of the map-area, from southeast of Boyd Lake to near the south end of Artillery Lake. However, the valley of Thelon River, particularly from Grassy Island to the eastern edge of the map-area, is fairly densely wooded in a narrow band along the river. The trees seen are mainly spruce and are of no commercial value, except that locally they could be used for constructing cabins and for firewood.

Wildlife varies considerably in types and numbers over the area. Caribou were seen, singly or in small groups, during much of the field season. Late in May abundant caribou were migrating northward along and parallel to the Dubawnt River; on July 23, large herds, variously estimated to contain 15 to 30,000 animals, were moving south across Thelon River near longitude 105 degrees; and during early August scattered groups of caribou, probably totalling a few thousand head, were seen in the general region of Beechey Lake. The central and northern parts of the map-area appear to have a

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

substantial number of musk-oxen. During the field season of 1955, 176 musk-oxen were counted from low-flying helicopters in or near the valley of Thelon River, and 104 in the Clinton-Colden Lake and Back River areas. A few of these observations may be duplications, but a probable minimum figure for the number of musk-oxen within the map-area is 250. A few wolverines (near tree-line), wolves and white foxes, and one barren ground grizzly bear were seen. Lake trout could be obtained in many of the lakes, and geese were abundant on Thelon River in late July and early August.

The Thelon Game Sanctuary (Clarke, 1940), originally established as a protected range for musk-oxen, lies astride the map-area. Its revised (1956) boundaries are shown on the accompanying geological map. Prospecting and staking are forbidden within the sanctuary.

With the single exception of a small mission post at Garry Lake, there are no settlements or facilities of any kind in the map-area. No Indians and only one group of Eskimos were seen during the entire field season.

In 1955, snow covered most of the area until the last week in May. Break-up, during which neither ski- nor float-equipped aircraft could be used safely, lasted from approximately June 8 to 18, in the large, irregularly-shaped lake 10 miles east of the south end of Whitefish Lake. But Whitefish Lake and most usable lakes to the east and north were still largely ice-covered on June 18, so that, as of this date, the use of float-equipped aircraft or canoes would have been restricted to widely scattered small lakes, isolated portions of larger lakes, or segments of rivers. Of the 92 days spent in the operational area, about 75 were suitable or acceptable for geological traversing by helicopter.

ACKNOWLEDGMENTS

The writer gratefully acknowledges the able assistance and cooperation of J. W. Hoadley, J. A. Fraser, K. E. Eade, and B. G. Craig. Dr. Hoadley acted as deputy-leader of the operation, and Dr. Craig was primarily responsible for the study of the surficial geology. The hospitality, cooperation, and willing assistance of personnel of the Department of Transport at Ennadai and Baker Lakes, of the Royal Canadian Mounted Police and Royal Canadian Corps of Signals at Fort Reliance, of the Hudson's Bay Company at Baker Lake and elsewhere, and of the Department of National Defence at Fort Churchill were of vital importance to the operation, and are acknowledged with sincere thanks.

Helicopters and crews were supplied by Spartan Air Services Limited of Ottawa, and Norsemen and other support aircraft by Arctic Wings Limited of Churchill.

PLEISTOCENE FEATURES

By

B. G. Craig

A mantleof loose blocks and boulders covers much of the area. Deposits of till, mostly sandy, and of outwash sand and gravel are widespread. Glacial landforms such as eskers, drumlins, flutings, and 'roches moutonées' are common, and, together with striated and grooved bedrock, provide a clear indication of the direction of glacier movements.

Figure 1, on which eskers, striae, drumlins, and related forms are shown, indicates two distinct patterns of glacier movement that are separated along a line trending northwestward from the south end of Dubawnt Lake. Ice that entered the southeastern side of the map-area moved westward and fanned out to the northwest and southwest. Ice that occupied the northern part of the map-area moved generally northwestward and fanned out to the north and southwest. In between the areas occupied by these two major ice lobes the ice-flow features indicate some south-southwesterly movements that do not appear to have been directly associated with the retreat of the northern lobe.

The eskers and ice-flow features resulting from the two ice lobes show differences not only in direction of movement but also in their character and distribution. The eskers in the area of the southern lobe are long and numerous, and their pattern closely resembles that of an integrated stream system. Much of the north side of this area is bordered by a large, more or less continuous esker that closely parallels the ice-flow features adjacent to it. The eskers in the area of the northerly lobe are shorter, fewer, and less continuous. The drumlins in the south are mostly individual ice-moulded hills and except in a few places are relatively uniformly distributed. In the area crossed by the northern lobe, ice-flow features are extremely dense in the eastern part of the map-area and are very rare in the western part. Furthermore, in the eastern part, south of about 65 degrees, these features form a closely-spaced pattern of very long ridges and furrows, i. e. flutings.

Interruption of the natural easterly drainage of the map-area by the glaciers brought about the formation of temporary glacial lakes that decreased in elevation as the ice front receded eastward and lower outlets became available.

Successions of shorelines of these former lakes are common, particularly within the basins of the Thelon and Dubawnt Rivers. Along the Thelon River the elevations of the uppermost strand lines increase from 700* feet as reported by Fyles (Wright, 1955b p. 3) at the east side of the map-area to 800 feet at latitude 64 degrees. Immediately southwest of this locality the highest beaches are at an elevation of about 1,150 feet and farther up the basin at about 1,250 feet. Raised strand lines are also common within the basin of the Dubawnt River but they do not indicate lowering water levels in a single basin as the ice margin retreated. The more rugged topography of this area as compared with the basin of the Thelon River provided for the formation of small isolated proglacial lakes. In the vicinity of Mosquito and Carey Lakes shorelines are found up to an elevation of about 1,200 feet. No strand lines are found directly associated with Dubawnt Lake.

The pattern of ice movement within and east of the map-area and the strand lines extending up the basin of the Thelon River indicate that the two ice movements were not contemporaneous. Reference to the work of Lee (Lord, 1953a) and Fyles (Wright, 1955b) shows that the northern lobe overrode features produced by the southern lobe in the area of the ice divide southeast of Dubawnt Lake. The Thelon proglacial lake, which was formed when the drainage was blocked by the northern lobe, extended into part of the area crossed by the southern lobe.

GENERAL GEOLOGY

Geological data presented in this report and shown on the accompanying map were gathered almost entirely on helicopter traverses. The data is based on some 1,500 landings, about 3,000 low passes (below 50 feet), and on essentially continuous high-level observation (above 50 feet).

The geology of eastern District of Mackenzie differs in several major respects from that of southern and central District of Keewatin (Lord, 1953a; Wright 1955b). In eastern Mackenzie, the Dubawnt group (14-17) is composed largely of sandstone with little conglomerate or igneous rocks; the Hurwitz group (4) is apparently represented by only one outcrop; and several groups of rocks occur that are not recognized as such in southern and central Keewatin (Yellowknife (1-3), Nonacho (5) Great Slave (11), Goulburn (12, 13)). Even the granitic rocks (8, 9, 10) present some differences, and lend themselves somewhat more readily to subdivision in mapping.

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*Elevations are based on measurements by aneroid barometer.

SEDIMENTARY AND VOLCANIC ROCKS

Yellowknife Group (1-3)

The rocks of the Yellowknife group occur along the western border of the map-area, north of Artillery Lake and are more or less continuous with similar rocks mapped to the west by Folinsbee (1952), and Lord and Barnes (1954). The group comprises greenstones (altered basic lavas) (1),acidic, probably mainly volcanic rocks (2), and slightly to strongly metamorphosed sedimentary rocks (3). Little definite information was obtained within the map-area as to the stratigraphic sequence of the three units, and the succession given is that established to the west. These rocks are believed to be Archaean in age.

Greenstones (1)

The greenstones (1) are probably derived largely from dacitic and andesitic lavas, and minor undifferentiated sedimentary rocks. The greenstones are not abundant, but occur near and northeast of Clinton-Colden Lake, and at Regan Lake. In these localities they are associated with sedimentary rocks (3) of the Yellowknife group, which, in places, appear to overlie them. The lavas generally form relatively massive outcrops in rugged, hummocky terrain of considerably higher relief than that of the sedimentary rocks.

The greenstones are mainly light to dark green, fine-grained rocks that weather various shades of brown and green. They may be massive, schistose, or foliated; many are amygdaloidal, and some show pillow structures. Breccia and agglomerate are present in a few places. Probably the most common rock-type is a fine-grained, green amphibole schist, not uncommonly garnetiferous. Some irregular veins of milky quartz have been observed in the greenstones.

A small area of greenstones (1a) and associated gneisses, not known to be of Yellowknife age, lies east of Whitefish Lake, and highly altered greenstones are included in places with the gneisses (6) in the southern and southeastern parts of the map-area.

Porphyritic (quartz feldspar) Felsite, Rhyolite, Agglomerate (2)

The acidic igneous rocks (2) of the Yellowknife group comprise a considerable area of relatively high and rugged outcrop southwest of Regan Lake, on the western border of the map-area.

For the most part these rocks are massive and featureless in outcrop, so much so that even from a low altitude the outcrops in many places appear granitic. The rocks are mainly white, greenish grey, or pale green on fresh surfaces, and they weather white to pale grey. Most of them are highly silicic, aphanitic to fine grained, hard and brittle, and they break with conchoidal fracture; a few are schistose. Many contain small scattered phenocrysts of rounded quartz and/or euhedral feldspar. Agglomerate, containing fragments of the porphyritic acidic types, was seen in several places. Many of these rocks, particularly those associated with agglomerates, are probably rhyolitic lavas, but the more massive, porphyritic types may be intrusive in part.

Sedimentary Rocks and Derived Schists (3)

The sedimentary rocks and derived nodular schists (3) are the most abundant rocks of the Yellowknife group. They underlie several localities near Clinton-Colden Lake, and much of the northwestern part of the map-area.

Some of these sedimentary rocks are relatively unaltered; others have been highly metamorphosed. The relatively unaltered types are mainly impure, fine-grained quartzites, greywackes, and minor slates. Colours vary from light grey or greenish grey in the quartzites, to dark grey in the greywackes, to black in the slates. The quartzites contain grains of quartz and some of feldspar in fine-grained matrices, and they grade into greywackes with decrease in quartz content. Many of these rocks are relatively thin bedded, but some beds of quartzite are up to several feet thick.

The sedimentary strata dip between approximately 40 degrees and vertical. Tops of beds are generally not determinable, but in a few places the beds are known to be overturned. Many of these rocks, particularly the highly metamorphosed types, are schistose. The schistosity commonly appears to be parallel with bedding, but in some places schistosity and bedding diverge by as much as 80 degrees. No detailed structural information is available, but it seems likely that the strata are isoclinally folded, and no true estimate of their thickness can be made.

A small body of massive and structureless rocks (3a), which under the microscope shows a fine-grained clastic texture, is present in the extreme northwest corner of the map-area. In outcrop they are characterized by a light yellow-brown weathered surface and by a lack of the prominent slabby surface so commonly displayed by many exposures of Yellowknife strata. These rocks are mainly impure quartzites.

The sedimentary rocks (3) southwest of Regan Lake are intertongued with acidic volcanic rocks (2), and on the northeast shores of Clinton-Colden Lake they lie along the flanks of ridges of greenstone (1). The contacts between the sedimentary rocks (3) of the Yellowknife group and granitic rocks (8, 10) are varied. In places zones of gneissic rocks (6) or mixed intrusive and metamorphic rocks (7) are formed, but northeast of Malley Rapids, the intrusion of massive biotite granite(10b) into the Yellowknife strata has produced a 'wrap-around' structure with relatively sharp contacts.

Many of the sedimentary rocks (3) of the Yellowknife group have been strongly metamorphosed with the production of much medium-grained quartz-mica schist, in part coarsely nodular. The main nodule-forming minerals are euhedral pink andalusite and greasy brown staurolite, and a blue-grey micaceous aggregate (pinite) that appears to have formed from andalusite and probably cordierite. Cordierite has been identified in only two sections and its relative scarcity may be due to the ease with which it alters to pinite.

In general, the metamorphic effects seem to be much more marked towards the south, particularly around Clinton-Colden Lake, where many of the rocks are coarsely nodular quartz-mica schists that under the microscope show no remnants of clastic texture. To the north, although scattered outcrops contain metacrysts of andalusite and staurolite, the sedimentary rocks appear to be much less altered, and their clastic nature is still quite discernible in many cases.

Hurwitz Group (4)

Approximately 5 miles east of the north end of Eyeberry Lake is a ridge of quartzite about 300 feet high and several miles long. The quartzite (4) is white or pale pink, fine grained, and more or less massive. It strikes slightly east of north, parallel with the elongation of the ridge, and dips steeply east. Along its eastern edge the quartzite is much sheared. No rocks were seen in contact with it.

This quartzite ridge is probably the extreme westerly outcrop of the prominent white quartzite unit of the Hurwitz group, mapped to the east by Wright (1955b, map-unit 2) and Lord (1953a, map-unit 5). No other units of the Hurwitz group were recognized anywhere in the map-area.

Nonacho Group (5)

Extending northeast from Tent Lake to near the northwest bay of Whitefish Lake is a narrow, hook-shaped band of folded sedimentary rocks (5) that probably represents the north-easterly extension of the Nonacho group as mapped by Henderson (1939) and Wright (1952) to the southwest.

These sedimentary rocks include quartzite and arkosic quartzite, schistose greywacke and phyllite, and pebbly quartzite and conglomerate. Most of them are sheared, in some places strongly so, and they contain much sericitic mica. Dips are steep to vertical, and tops of beds are generally not determinable. The rocks appear to form a southwesterly plunging syncline.

Nonacho rocks occur within gneissic granitic rocks (8). In some places the contacts are sharp, but in others they are not, and zones of mixed gneisses (7) occur at and near them. The sedimentary strata are also known to pass concordantly across their strike into pink, fine-grained, well foliated to stratiform, feldspathic gneisses of doubtful origin that have been included with the granitic gneisses (8) for mapping purposes.

None of the Nonacho rocks are highly metamorphosed. In many localities their clastic texture is quite evident both in outcrop and under the microscope. To a certain extent they resemble the less metamorphosed parts of the sedimentary rocks (3) of the Yellowknife group to the north.

Pebbles of granite are present in the conglomerate of this group, proving that at least some granite of the region is older than the rocks of the Nonacho group.

Gneisses (6)

Several types of gneissic rocks (6) are present in many parts of the map-area, and are probably largely derived from sedimentary rocks, but cannot be assigned to specific rock units previously discussed.

Many of these rocks are more or less well banded, pink to grey, quartz-feldspar-biotite gneisses of medium grain that commonly carry red garnets as accessories. They are completely recrystallized, so that no microscopic evidence of original sedimentary nature remains. The main occurrence of this type of gneiss is in the elongated band that trends slightly east of north from Sifton to Tourgis Lakes. In addition to feldspathic gneiss this body contains some bands of amphibolite. It is bordered by, and in part grades into, impure, almost stratiform granite gneisses (8), or into mixed gneisses (7), so that the boundaries as mapped are arbitrary.

Other gneisses, more obviously altered sedimentary or volcanic rocks, characteristically occur as isolated, irregular bands or patches within gneissic granite (8), or to a minor extent within more massive granites (10). The gneisses shown in the extreme northwest part of the map-area (6a) are probably derivatives of Yellowknife schists (3). Those mapped in the southeast section appear to be derived from and to contain both sedimentary rocks and greenstones.

Great Slave Group (11)

Crystal Island and nearby smaller islands in Artillery Lake are underlain by buff-weathering dolomitic limestone, in part much brecciated. One sample weathers pale buff, and is light grey on fresh surface. It contains tiny, scattered grains of quartz in a fine-grained dolomitic matrix. Quartz stringers containing clusters of small clear quartz crystals have been reported in these rocks by J. W. Tyrrell (1902, p. 18).

These carbonate rocks presumably represent the northeasterly extension (and termination) of the dolomitic limestones of the East Arm of Great Slave Lake, and if so they are probably of early Proterozoic age.

Goulburn Group (12, 13)

The Goulburn quartzite of the Bathurst Inlet region was originally described by O'Neill (1924) as a sequence, more than 4,000 feet thick, of pink and grey quartzites with many conglomeratic layers.

In the northwestern corner of the map-area a group of rocks, predominantly quartzites, is probably the southern extension of the Goulburn quartzite. Aerial reconnaissance indicates that these rocks extend well north of latitude 66 degrees, but actual continuity to the outcrop areas of the Goulburn quartzite has not been shown. The name Goulburn group (12, 13) is here tentatively assigned to these rocks, and, south of latitude 66 degrees, the group has been divided for mapping purposes into a lower unit (12) of quartzites, slates, and limestones, and an upper unit (13), of quartzite and conglomerate.

The rocks of the Goulburn group form relatively rugged hills that overlook the granitic gneisses to the east of the Bathurst trench and the sedimentary lowlands to the south and west. The lower unit (12) is probably hundreds of feet thick and

and the upper unit (13) thousands of feet thick.

The lower unit (12) appears to have, at or near its base, a grey-green, impure pebbly quartzite overlain by a mixed succession of thin- to thick-bedded, grey to green quartzites and pebbly quartzites, varicoloured limestones, and green to red shales, argillites and slates. At the intersection of Western River and the Bathurst trench a complex (12a) is outlined in which sills of diorite (18c) are present in folded quartzite and limestone of this unit (12).

The upper unit (13) of the Goulburn group consists essentially of massive, pink to grey, medium-grained, sandy quartzite, impure arkosic grit, and pebbly quartzite, with many gradations to conglomerate. A common cobble-forming rock in the conglomerates is a pure white quartzite. The upper unit is areally much more extensive than the lower unit, and is exposed for many miles in rolling hills west of the Bathurst trench.

The two units of the Goulburn group, so far as known, are conformable. They are moderately folded, and dips of strata range up to about 45 degrees. Pronounced canyons within the outcrop area probably represent faults, and the Bathurst trench appears to be the locus of a major fault that has abruptly cut off the sedimentary strata on the east. The gently dipping beds of the lower unit (12) were seen resting on the upturned edges of the Yellowknife sedimentary rocks (3) in several places, and it is presumed the same relationship applies to the vertically dipping granitic gneisses (8) of the region. No granitic rocks are known to intrude the Goulburn strata in the map-area, and the unconformity beneath the group represents a major break in both sedimentation and igneous activity.

Northeast of the east end of Beechey Lake, along the southward extension of the Bathurst trench, is a narrow, folded belt of massive bedded, pink quartzites (13a) with conglomerate lenses. In the same area, one outcrop of conglomerate contains boulders of conglomerate. These rocks probably belong to the upper unit (13) of the Goulburn group, but it is possible that they are related to the Dubawnt sandstones (15) to the southeast.

The age of the Goulburn rocks is not definitely known. They are much younger than the Yellowknife strata (Archaean), and probably somewhat older than the late Proterozoic rocks of the Coppermine River series and the Dubawnt group. They are more disturbed and apparently more highly indurated than either of the latter, and are less disturbed and less metamorphosed than the rocks of the Hurwitz group (Wright, 1955b) that may be of early Proterozoic age. The rocks of the Goulburn group are probably of late Proterozoic age.

Dubawnt Group (14-17)

The rocks of the Dubawnt group (Wright, 1955b) underlie a large region west and northwest of Dubawnt Lake. The group consists mainly of sandstone (15), with lesser amounts of conglomerate (14), volcanic rocks (16) and unfossiliferous carbonate rocks (17).

These rocks appear to form a blanket over the granitic terrain of the region. They are mainly flat lying to gently warped; in no place are they known to be strongly folded. No evidence of other than minor low-grade metamorphism has been seen in these rocks.

No fossils have been found in any of the sedimentary rocks of this group, either here or to the east. With the exception of minor Palaeozoic limestone (19), and possibly but not probably, the Goulburn quartzite and associated rocks (12, 13), they are the youngest sedimentary rocks in the map-area. The rocks of the Dubawnt group are believed to be of late Proterozoic age, although it is possible that the dolomite (17) may be Palaeozoic in part.

Conglomerate (14)

In contrast with its abundance in central Keewatin, conglomerate is rare in the Dubawnt group in eastern Mackenzie.

Two of the six known outcrops or outcrop areas of Dubawnt conglomerate occur near the west shore of Dubawnt Lake, and are of coarse boulder conglomerate with interstratified pebbly sandstone. These are believed to be a basal conglomerate (14), for they contain cobbles and boulders of granite gneiss and quartz, and grade upward into sandstone (15). No other basal conglomerate was seen along the entire western and northern limits of the Dubawnt outcrop area.

Four small outcrops of conglomerate (14a) were found near the western and northern borders of the Dubawnt sandstone. They are not as coarse as the basal conglomerate and they contain cobbles of Dubawnt sandstone (15) in arkosic matrices. These outcrops represent either intraformational conglomerates within the sandstone, or conglomerates younger than the sandstone.

Sandstone (15)

The Dubawnt sandstone underlies an area of about 15,000 square miles in the central-eastern part of the map-area. Over much of this region it occurs as scattered outcrops or outcrop areas separated by wide expanses of flat or gently rolling grassland or sand; some extensive areas, presumably underlain by sandstone, contain no outcrops. Elsewhere, particularly near Steel Lake, it forms prominent hills that rise to more than 500 feet above Thelon River. The thickness of the sandstone is not known, but probably ranges from moderately thin to at least 400 feet.

The sandstone varies from a fine-grained, equigranular almost pure quartz sandstone, in places with an argillaceous or carbonate-rich matrix, to a medium- to coarse-grained arkosic grit. Scattered pebbles are fairly common. Most of these rocks are light grey, pink or light purple. Crossbedding is common in good outcrops, but ripple-marks were not generally observed. The degree of induration varies considerably; some specimens crumble readily but others are thoroughly indurated and hard. In a few places along Thelon River, thin-bedded, fine-grained sandstone and siltstone are interbedded with seams of shaly material.

In several localities along the zone of contact between the Dubawnt sandstone (15) and gneissic granites (8), the sandstone is altered and apparently highly sheared, hence it is possible that the perimeter contact is a fault zone at least in part. The contact line along the western border of the Dubawnt sandstone is marked by a discontinuous escarpment, at which the ground rises appreciably from the sandstone on the east to the granite gneiss on the west.

Volcanic Rocks (16)

The volcanic rocks of the Dubawnt group are much less abundant in eastern Mackenzie than in central Keewatin. They underlie an area west of Lookout Point (on Thelon River) and other small bodies occur some 30 miles northeast of the Point. In most localities the volcanic rocks appear to be less than 100 feet thick.

The most common rock type is a massive, dull purplish brown, fine-grained rock that in several places carries greenish amygdules up to a few mm. in diameter. The groundmass consists largely of plagioclase microlites, with some of potassium feldspar, muscovite, ferromagnesian minerals and an indeterminate brownish material in varying amounts. These rocks probably range in composition from trachytes to andesites. Northeast of Lookout Point a small area of massive porphyritic syenite is included in this unit.

The relatively flat-lying volcanic rocks (16) have not been found in contact with the Dubawnt sandstone (15) or conglomerate (14), but topographically they appear to overlie the sandstone. In one place dolomite (17) apparently overlies the volcanic rocks.

Dolomite (17)

Carbonate rocks containing no known fossils form a large area of widely scattered outcrops on high ground south of Thelon River between Hornby and Lookout Points. The maximum thickness known is less than 100 feet. This rock is mainly dark grey, fine-grained and hard dolomite or dolomitic limestone (17) that occurs in beds from a few inches to a foot or more thick. From the air, outcrops and disintegration rubble of this rock are distinguished by their buff weathered surfaces. In places the dolomite contains abundant concretions a few inches in diameter. Most specimens effervesce gently in acid. The rock has a fine-grained, equigranular fabric, probably due to recrystallization, and contains scattered grains of quartz.

In one place this dolomite directly overlies volcanic rock (16), but elsewhere it is not known to be in contact with either volcanic rocks (16) or sandstone (15). However, its outcrops occur on high ground overlooking the sandstone and volcanic rocks, and as all three appear to be conformable and more or less flat lying, it is highly probable that the dolomitic rocks are the youngest in this area.

Several small outcrops of carbonate rocks lie to the north of Thelon River. They are mainly pink, arenaceous dolomites or limestones with buff weathered surfaces and sandy textures. In one outcrop the dolomite contains abundant crystalline quartz in thin bands or as vug fillings. These rocks are thinner bedded, coarser in grain, and contain more abundant quartz grains than the carbonate rocks south of Thelon River. In one place they are capped by a few feet of sandstone (15), but elsewhere appear to overlie it.

The northern arenaceous dolomite is probably near the top of the sandstone (15) and may represent a facies change within it, but the major body of dolomitic rocks south of Thelon River appears definitely to overlie the sandstone conformably. It probably represents the youngest unit in the Dubawnt group of late Proterozoic age.

Palaeozoic Limestone (19)

The rocks described in this section are restricted to the islands and shorelines of Nicholson Lake.

A small island at the north end of the lake is underlain by pale buff-weathering, fine-grained limestone (19). The limestone is gently dipping, well bedded, and contains scattered fossils. This outcrop and its fossils were first described by J. B. Tyrrell (1898, p. 54F). No other outcrops of the limestone were seen, but at two places on the west shore of the lake fossiliferous limestone rubble was found. The fossil assemblage in these occurrences is Ordovician in aspect, and in age it might be anywhere from middle Trenton to Richmond, inclusive[1].

Small, low outcrops that in part appear to be highly weathered conglomerate (19), and in part rhyolite tuff and breccia (19) that overlie granite gneiss (8), and occur in several places south of the limestone outcrop. The relationship of these rocks to the Palaeozoic limestone is obscure, but they have been grouped with it for mapping purposes. It is possible, however, that the conglomeratic and tuffaceous rocks belong to the Dubawnt group.

INTRUSIVE ROCKS

Granitic Rocks (8, 9, 10, 7)

Large parts of the map-area are underlain by granitic rocks of wide variety. For mapping purposes they have been divided into: a heterogeneous group of mainly gneissic and impure granitic rocks (8) that commonly contain irregular patches of undigested 'foreign' rocks; relatively massive and clean granitic rocks (9) that occur within gneissic granite terrane (8); fresh appearing, very massive granites (10) that seem on the whole to be younger than the gneissic granites (8); and minor mixed or hybrid gneisses (7) that in part are made up of granitic material. The boundaries of these units, as mapped, are arbitrary in most places.

Gneissic and Impure Granitic Rocks (8)

The rocks included in this unit are abundantly distributed throughout much of the region mapped. They vary

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[1] The fossil collection was examined by G. W. Sinclair, Geological Survey of Canada.

widely in colour, texture, degree of gneissosity, content of impurities, and probably in age. Predominant colours are shades of grey and pink; textures vary from fine grained, equigranular to coarse grained porphyritic; gneissosity from faint to stratiform; and content of impurities from nil to more than 50 per cent. Microscopic examination of 47 of these rocks, including a few of the more massive types (9), revealed 26 granites, 4 syenites, 6 quartz-monzonites, 1 monzonite, 5 granodiorites, 3 quartz-diorites and 2 diorites. However, some of the 26 granites are mylonitized rocks whose original actual composition is doubtful.

The stratiform varieties of these rocks are mainly fine- to medium-grained, equigranular, well-banded gneisses containing quartz, feldspar and biotite. In several places it seems probable that they have been formed locally by granitization of sedimentary rocks. Some of the rocks bordering the Nonacho strata (5) southeast of Whitefish Lake may well be of this origin. Elsewhere similar rocks occur for long distances across the regional trend and granitization, if involved in their production, must have been active on a regional scale. An example is found in the wide expanse of granitic gneiss (8) between Moraine and Cruickshank Lakes, north of Hanbury River. Pyroxene-bearing granulites have been included locally in gneissic granites.

Small aplite and pegmatite dykes are common in the gneissic granites (8), but large dykes are relatively rare. A concentration of muscovite-bearing pegmatite lenses was noted near the northwest shore of Howard Lake.

Massive Granites (9) in Gneissic Terrane

There are many bodies of essentially massive and clean granitic rocks (9) within the areas of gneissic granites (8). These may be simply more massive phases of the gneissic granites, or possibly they may be related to the clean, massive, and presumably younger granites (10) north of Artillery Lake.

A large body of mainly massive granitic rocks (9) extends northeasterly from Carey Lake. The southwestern third of this body is a complex (9a) of medium- to coarse-grained syenites, granites, diorites and minor gabbro that forms relatively high, mammillary outcrops.

Massive Granites (10) north of Artillery Lake

These granitic rocks occur west of a line running approximately from the northeast end of Artillery Lake to the southeast end of Beechey Lake. Most of them are massive, free of inclusions, medium grained, equigranular and unaltered.

The rocks range from white muscovite granites (10a), which in some places carry considerable green apatite, to pink or grey biotite granites and quartz-monzonites (10b), to red hornblende granodiorites or quartz-diorites (10c). The first two types appear in part to be gradational to one another though binary (two-mica) granites, but it is not known whether the main rock-types represent essentially one intrusive mass, discrete intrusions from an extensive granitic body of the same age or completely separate and unrelated intrusions. No attempt has been made to draw contacts within this group, but a few locations where the different types were observed in the field are shown on the map.

Commonly these rocks show relatively sharp contacts, in a few places with narrow 'mixed' zones, against the rocks of the Yellowknife group. Inclusions of gneissic rocks (6) are not nearly so abundant as within the gneissic granites (8).

Dykes of coarse white pegmatite, containing muscovite and in places black tourmaline, are fairly common in or near the borders of this large body of massive granites.

The age of these rocks is not known. They intrude the rocks of the Yellowknife group (Archaean), and gneissic granite has been found locally as inclusions in massive granite. They appear on the whole to be much fresher and less disturbed than most of the rocks included in the gneissic granites (8). For these reasons it is believed that they are separate from and younger than the gneissic granites. In part at least they may be Proterozoic in age.

Mixed Gneisses (7)

A few small areas of mixed gneisses are shown on the western part of the map. These rocks consist of granitic and metamorphic rocks in varying proportions, and they tend to grade into one or other of the end-members. Some are 'lit-par-lit' injection gneisses, others are areas of granitic rocks with abundant discrete or partly assimilated inclusions of schist or gneiss. Such rocks occur mainly at or near the contacts between sedimentary rocks and granitic rocks intrusive into them.

Basic Intrusive Rocks (A, B, 18 a-c)

Several types of basic intrusive rocks, occurring as dykes, sills, plugs, and larger irregularly-shaped bodies are present in the region, but they are neither abundant nor extensive. The ages of the plug-like bodies (A, B) are not generally known, but the sills and dykes of diorite (18c) appear to be at least post-Goulburn, and the dykes of diabase (18a) and other intrusive rocks (18b) are probably post-Dubawnt in age.

Small bodies of diorite and gabbro, and minor anorthosite and hornblendite (A) are present in and appear to intrude gneissic granites (8). These basic intrusive rocks are mainly dark green and medium grained. They are considerably altered, and commonly contain abundant hornblende, in part at least derived from pyroxene. A few small dykes of metadiorite or amphibolite were found cutting granitic rocks, but are not shown on the map.

A large hilly outcrop area of massive, biotite-hornblende diorite (B) lies about 25 miles south of Regan Lake. The rocks in this intrusive mass are grey to greenish grey, medium grained and dense. They vary somewhat in composition; the main constituents are andesine feldspar and hornblende, with up to 15 per cent biotite and, in some cases, minor quartz and potassium feldspar. The different rock-types probably represent variations within one intrusive body, rather than separate intrusions.

Dykes and sills of intermediate to basic intrusive rocks (18 a-c) are fairly common in the map-area, but few of them are of sufficient size or continuity to be shown on the map.

A few dykes of dark green to black, medium-grained diabasic gabbro (18a) were mapped in part. These are similar to and appear to be the equivalent of the 'late' diabase of the Yellowknife region. On the whole, diabase dykes appear to be less common than to the west of this map-area, but they are present in swarms in granite east to the mid-part of Clinton-Colden Lake.

Two large, vertically-dipping dykes (18b) trend northwesterly from near Lookout Point in Thelon River through country of little outcrop but presumably underlain by Dubawnt sandstone (15). Both dykes are at least 200 feet wide, and along parts of their lengths they stand up as walls up to 40 feet above the surrounding country. The rocks are mainly red weathering with a mottled red and green fresh surface. They are dense, medium grained, and equigranular with sub-ophitic textures. The feldspar minerals are highly altered, but the samples appear to range from micropegmatite to albite andesite, and gabbro. Pyroxene is generally absent, but much of the amphibole in these rocks may be derived from it. In the main these dyke rocks (18b) are thus substantially different in composition from the late diabasic gabbro (18a) of Yellowknife type, and it is possible that they are the intrusive equivalents of the volcanic rocks (16) of the Dubawnt group. The most northerly outcrop of the eastern dyke, however, is anomalous. It is fresh gabbro, with about 40 per cent each of pyroxene and labradorite feldspar, and an ophitic texture; a typical 'late' diabase. Because outcrops are not continuous, it is not known whether it is two different dykes or one dyke with marked compositional variations.

West of Bathurst trench and its southern extension are dykes, sills, and larger masses (18c), consisting mainly of diorite, that are believed to be related despite some differences in composition, texture, and geological expression.

Between Ellice and Western Rivers a large area of basic intrusive rocks (18c) was outlined. The southern part of this area has scattered, rounded outcrops of massive, fine- to medium-grained, dark green hornblende diorite, and in the central part the diorite is apparently interfingered as narrow, sill-like bodies in sedimentary schist of the Yellowknife group. At the northern edge of this body are thick sills of dark green diorite and diabasic gabbro, which outcrop in bluffs and show good columnar jointing. Just to the north, at the sharp bend in Western River, sills of the diorite are intimately intruded into the folded strata of the lower part of the Goulburn group (12) and this intrusive-sedimentary assemblage has been mapped separately (12a).

To the west, north of Western River, two sills of basic igneous rock (18c) are present in rocks of the Goulburn group (12, 13). The eastern sill consists of brown-weathering, mottled red on dark green, massive, medium-grained hornblende diorite with a granitoid to sub-ophitic texture. The western sill is similar but finer grained.

MAJOR STRUCTURAL FEATURES

Large-scale structural features include regional trends in granitic gneisses, the Bathurst trench, the McDonald fault (west of the map-area), and its possible extension to the northeast.

In the western half of the map-area the regional trend in granitic gneisses (8), and in general the orientation of long axes of bodies of sedimentary gneisses (6) and associated rocks, forms a wide arcuate zone concave to the west. This zone trends southeasterly in the area east of the Bathurst trench, southerly in the Tourgis-Hunger Lakes section, south-southwesterly in the region from Sifton Lake east, and southwest in the area south of

Artillery Lake. The southwest trend continues outside the map-area, south of the east arm of Great Slave Lake. In general, the inside of this arcuate zone is delineated by the Bathurst trench in the north and by the McDonald fault in the southwest.

The Bathurst trench, north of Ellice River, is a long, straight lineament of square cross-section. It is almost certainly the locus of a major fault, and it extends to the northwest as an outstanding topographic feature for many miles beyond the map-area, but to the southeast its topographic expression gradually fades. The fault may die out about 15 miles north of Back River, or perhaps continue far to the southeast, to disappear under Dubawnt sandstone (15). Near the north edge of the map-area this great fault separates younger sedimentary strata of the Goulburn group (12, 13) to the southwest, from the older granite gneiss (8) to the northeast. The strike of the fault is parallel with the gneissosity in the granites.

More than 200 miles to the south-southwest, just beyond the map-area, the McDonald fault, on the south side of the east arm of Great Slave Lake (Wright, 1952), is expressed by a straight, fault-line scarp several hundred feet high, and farther east by a marked depression that dies out south of Artillery Lake. Here also a major fault separates younger sedimentary rocks (Great Slave group) to the northwest, from granite gneiss, to the southeast, and, again, the general trends of gneissosity in the granites and associated gneisses are approximately parallel with the strike of the fault. It has been suggested by Wilson et al. (1956, p. 557) that the McDonald fault may extend northeasterly, across the central barren grounds, to join up with prominent lineaments in the Wager Bay area on the east coast of Hudson Bay. However, reconnaissance mapping has not produced definite evidence of a northeasterly extension of the McDonald fault beyond the south shore of Campbell Lake, where a zone of highly gneissic to mylonitized rocks, about 4,000 feet wide, was mapped along its strike.

The regional trends in granite gneisses probably pre-date the sedimentary strata of the Goulburn and Great Slave groups (both of which are intruded by basic sills), and these sedimentary rocks in turn apparently predate their respective boundary faults.

Perusal of topographic and geological maps of the region between the east arm of Great Slave Lake and Western River and to the east, strongly suggests a relationship between the arcuate zone of gneissosity connecting these two areas, and the major faults and geological associations found in them. But the apparent great gap in age between the regional gneissosity and the major faulting seems to preclude any direct causal connection between them.

Yet this arrangement can hardly be without significance. For example, the predominantly gneissic granites (8) near and beyond the inner edge of the arcuate zone differ in composition from and are probably older than, many of the relatively fresh and massive granitic rocks (10) inside the arc: white muscovite granite is almost unknown to the east and southeast, but is relatively common to the west. The arcuate zone of gneissosity also marks the eastern limit of the Yellowknife group.

At the present stage of geological knowledge of this region, one can do little more than point out this interesting arrangement of major structural features, and speculate on its significance. Detailed mapping in selected areas, and determination of ages in the granitic rocks, will no doubt shed much light on the problem.

ECONOMIC GEOLOGY

No prospecting parties were known to be in the map-area during the 1955 season, and little work has been done in the past, partly because of the remoteness of the region. Previous to 1955, no systematic geological mapping had been carried out anywhere in the map-area.

It is apparent (Lord, 1953a) that the detailed search for mineral deposits is not compatible with the operational needs of wide-ranging geological reconnaissance by helicopter. However, general assessment can be made of the area from an economic point of view particularly as regards separating the more likely areas or rock-units from the less likely.

No obviously important mineral deposits were actually seen in the map-area. Gossans, however, were found in many places and most of these are indicated on the map. Ten grab samples, taken mainly from sulphide zones in gossans, were assayed for gold and silver by the Mines Branch with near-negative results. No base-metal mineral occurrences were seen.

The presence or absence of gossans, mineral occurrences, quartz veins, pegmatite dykes and suggestive structural features, and comparisons with geological conditions in other areas (e.g. Yellowknife region), lead to a tentative arrangement of the more important rock-units in a general order of apparent decreasing economic interest; areas underlain by rocks of the Yellowknife group (1-3), some areas of intruded gneisses (6) as at Eileen Lake, and to a somewhat lesser degree areas of Nonacho strata (5); areas of gneisses (6), mixed gneisses (7) and greenstones (1a), occurring generally within gneissic granite terrane; gneissic granites (8) themselves, in the sense that they characteristically contain zones of older gneisses and schists that are not shown on the map; massive, clean granitic rocks (9, 10); and, finally, rocks of the Goulburn

(12, 13) and Dubawnt (14-17) groups. In the last two groups, no indications of possible ore deposits were found.

Basic intrusive plugs (A) should be investigated for base metals, although no specific occurrences of such were seen. Dykes of white, muscovite-bearing pegmatite associated with the massive granites (10) should also be examined.

Scintillation counters were carried in the helicopters, and although not used for systematic traversing, they were used to spot-check many rock specimens and some major fractures in granitic rocks. No high readings were obtained.

In general, the western third of the area mapped (106 to 108 degrees west longitude) appears to be potentially the most interesting economically, and it has the decided advantage of being closest to Fort Reliance and water transportation. From Fort Reliance the area between Eileen and Clinton-Colden Lakes could be relatively easily covered.

A gold prospect, north of Regan Lake, has been examined by Algood Gold Mines Limited (Lord 1951, pp. 68-70). Detailed mapping and drilling were carried out in 1947. The gold deposits occur in sedimentary rocks (3) of the Yellowknife group.

Prospecting and staking are prohibited within the Thelon Game Sanctuary.

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