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DEPARTMENT OF ENERGY, MINES AND RESOURCES

PAPER 70-45

GEOLOGY OF ENNADAI LAKE MAP-AREA DISTRICT OF KEEWATIN

(Report, 2 figures and Map 24-1970)

K. E. Eade

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GEOLOGY OF ENNADAI LAKE MAP-AREA (65C), DISTRICT OF KEEWATIN

K. E. Eade

DEPARTMENT OF ENERGY, MINES AND RESOURCES

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ABSTRACT

The map-area, situated in the southwest corner of the District of Keewatin, lies entirely within the Churchill Structural Province. Drift is heavy throughout the area. The Hurwitz Group of Aphebian age, comprising orthoquartzite, argillite, greywacke, carbonates, arkose, and minor volcanic rocks, underlies two broad northeast-trending bands. Conglomerate and greywacke unconformably overlie the Hurwitz Group. Metavolcanics, paragneiss, granodiorite-gneiss and granodiorite of probable Archean age underlie the Hurwitz Group. In the southeast paragneiss and meta-arkose, possibly correlative with the Hurwitz Group, may lie within the northeast extension of the "Wollaston Lake fold belt". Postorogenic (Hudsonian) plutons of quartz monzonite and coarse-grained, porphyritic, fluorite-bearing granite are the youngest exposed rocks.

Folds, in both the sedimentary and older rocks generally trend northeast. All the rocks are extensively faulted.

No significant mineralization was discovered.

GEOLOGY OF ENNADAI LAKE MAP-AREA
DISTRICT OF KEEWATIN

INTRODUCTION

Ennadai Lake map-area, in the southwest corner of the District of Keewatin, is 250 miles north of Lynn Lake, Manitoba, 180 miles northeast of Stony Rapids, Saskatchewan and 260 miles northwest of Churchill, Manitoba. There are no permanent settlements in the area but the Department of Transport meteorological station, Ennadai, is only 10 miles north of the north boundary of the map-area. Lynn Lake, which has both air and rail facilities, was used as a base during the present field work. Air services, available from three charter aircraft companies, provide access to the area.

Travel in summer is by float plane, helicopter, or on foot. Small boats and canoes can be used on the larger lakes but rivers are not navigable. Many lakes are not usable by float planes by reasons of numerous reefs or shallows.

Relief is commonly less than 100 feet but in a few places is as much as 300 feet. Pleistocene deposits are extensive throughout the area and rock exposures are generally scarce.

J.B. Tyrrell (1898) traversed the southwest and northwest corners of the map-area during his 1894 survey but he made few observations on the bedrock geology. In 1952 the Geological Survey mapped this area as a part of the geological reconnaissance of southern District of Keewatin (Lord, 1953; Wright, 1967). Observations on the Pleistocene geology made during this regional study are described by Lee (1959). Aeromagnetic maps covering the area at scales of one inch to one mile and one inch to four miles have been published by the Geological Survey.

The present work started in 1968 with the assistance of E.C. Martin, D.J. Henderson, and D.K. Slessor. The work was completed in 1969 with the assistance of D.S. Pierce, D.P. Smith, R.J. Buchanan, B.D. Calder, and A.J.M. Elliot. During the latter field season the use of a helicopter for five weeks provided transportation to otherwise inaccessible localities and in the west half of the adjoining map-area to the east.

GENERAL GEOLOGY

The oldest rocks in the area, a part of the Churchill Province of the Canadian Shield, are probably metamorphosed basic volcanic rocks and (1) basic intrusive rocks (2) and some of the paragneiss (3) derived from sedimentary rocks interbedded with the volcanic rocks. These rocks, particularly the sediments, have been metamorphosed to form some of the grey granodiorite-gneiss (4). All these rocks, along with the basic intrusives of unit (5) and some of the granitic rocks of unit (6), are probably Archean in age. The sedimentary and volcanic rocks (units 7 to 11) are considered to be Hurwitz Group rocks of Aphebian age. Conglomerate (12) and lithic greywacke (13) unconformably overlie the Hurwitz Group rocks. Quartz monzonite to granodiorite (14) was emplaced

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during the Hudsonian Orogeny and the coarse-grained porphyritic granitic rocks (15) in the post-kinematic phases of this orogeny. Gabbro and metagabbro dykes (16) are rare. They cut the arkose to subgreywacke (11) but have not been found cutting the sedimentary rocks (units 12, 13) or the intrusive rocks (units 14, 15).

Metavolcanic Rocks, Diorite, Minor Iron-formation

Metavolcanic rocks and associated diorite (1), are confined to the northwest side of Ennadai Lake, a small area north of Windy Lake, and several small outliers. Meta-andesite and diorite are most abundant but metadacite, probable tuff, and minor rhyolite and quartz-magnetite iron-formation are also present. Poorly developed pillows and possible flow-top breccias are rarely preserved in the meta-andesite which commonly shows pronounced secondary cleavage.

The meta-andesite is fine grained, dark greyish green to greenish black on both weathered and fresh surfaces, and consists of hornblende, chlorite, and much altered plagioclase, with smaller amounts of tremolite, epidote, biotite, magnetite, quartz and sphene. The few grains of identifiable plagioclase present in the thin sections examined are andesine.

Medium-grained dark greenish grey diorite is intimately associated with the meta-andesite and is mineralogically similar, consisting of andesine, hornblende and chlorite, with some epidote, biotite and quartz. The plagioclase is less altered than that of the fine-grained rocks. Foliation is present in some places in the diorite but cleavage is less pronounced than in adjacent meta-andesite. The diorite in some places is gradational into meta-andesite and may represent the interior part of thick flows or it may be due to irregular zones of recrystallization accompanying the metamorphism. Elsewhere however, small bodies of diorite within meta-andesite have intrusive relationships with apparent chilled margins. These could possibly be feeder dykes of the andesite flows.

Flows of metadacite occur sparsely within the meta-andesite. The fine-grained rock, grey to light greenish grey on fresh and weathered surfaces, contains 10 to 15 per cent quartz but otherwise is similar in composition to the meta-andesite.

Laminated metavolcanic rocks with layers rich in hornblende and plagioclase constitute a small part of unit 1. The rocks are fine to medium grained with grey and green laminae ranging from 1/8 to 3/4 of an inch thick. Mineralogically the rocks are similar to the diorite. The laminations may indicate that these rocks originate from basic volcanic tuffs or the bands may be due to metamorphic differentiation.

A few thin flows of very fine grained white to light grey rhyolite are present with the meta-andesite on the northwest side of Windy Lake. The highly sheared rhyolite, schistose in part, outcrops poorly but abundant boulders are scattered over a small area.

Quartz-magnetite iron-formation is present with meta-andesite in a small area southeast of Kiyuk Lake and occurs as boulders in a drift-covered area at the south end of Ennadai Lake. At the latter locality the aeromagnetic map shows a high linear anomaly that is interpreted as being due to the iron-formation. The white and grey laminations in the iron-formation which is fine grained, are 1/8 to 1/2 inch thick. Specimens from the boulders near Ennadai Lake contain 20 to 25 per cent magnetite, 10 per cent carbonate and the remainder quartz. The iron-formation from east of Kiyuk Lake contains only 10 to 12 per cent magnetite, about 50 per cent quartz, with biotite and epidote as the other major constituents.

Quartz-feldspar porphyry (1a) is restricted to a single small area in the northeast quarter of the map-area, 10 miles east of Ennadai Lake. The fine-grained, brown-weathering grey porphyry contains abundant phenocrysts up to 1/8 inch across of quartz and feldspar. The quartz phenocrysts are normally smaller than those of feldspar. Andesine constitutes most of the feldspar phenocrysts but a few are microcline. The groundmass is fine grained and consists of altered feldspar, hornblende, biotite, epidote, quartz, magnetite and apatite. The isolated outcrops of the porphyry offer no evidence as to relations with adjacent rocks or the mode of emplacement, whether extrusive or intrusive.

Amphibolite and Melanocratic Gneiss

Metamorphic rocks mapped as amphibolite or amphibolite gneiss (2) contain 45 to 50 per cent hornblende with the remainder chiefly plagioclase. Melanocratic gneiss contains less than 45 per cent hornblende, abundant plagioclase, biotite and minor quartz. As gradations exist between (2) and (2a), the designation on the map may be arbitrary.

The amphibolites are dark greenish black on fresh and weathered surfaces, medium to fine grained and massive, gneissose, or rarely schistose. The melanocratic gneiss is medium grained, dark grey to greenish grey on fresh surface, brownish to greenish grey on weathered surfaces and typically has pronounced foliation or banding from 1/2 to 2 inches thick. The biotite content in the melanocratic gneiss varies from one occurrence to another and from band to band in individual outcrops.

The small scattered areas of rocks included in this unit form remnants within the gneisses of unit (4), in the mixed granodiorite and gneiss (6c), and in paragneiss (3) in the northwest corner of the area. The origin of these basic metamorphic rocks is not clear; they may be derived from basic volcanic rocks or intrusive gabbro sills or dykes.

Paragneiss, Metaquartzite and Meta-arkose

Paragneiss, with minor paraschist (3) is found in scattered outcrops in the extreme southeast corner of the map-area and in the northwest corner, where exposures are better. The medium-grained paragneiss is well banded in bands 1/2 to 6 inches thick. Banding in most places is probably a relict of bedding. Granite, medium grained to pegmatitic, is present in the paragneiss either as regular stringers parallel with the banding or as crosscutting dykes or masses of irregular shape and size. Variable amounts of quartz, plagioclase and biotite are the main constituents. Porphyroblasts of feldspar up to 3/4 of an inch in length are commonly abundant. Garnet metacrysts are abundant in the paragneiss in the northwest corner but in the southeast were seen only in the small area of paragneiss exposed on the southwest side of Windy Lake. Typical of the rocks in this unit is the rusty weathering of the biotite-rich bands.

Micaceous paraschist, present as bands within the paragneiss, is a minor part of this unit.

Metaquartzite (3a) is present in one small area in the northeast quarter of the map-area, 10 miles east of Ennadai Lake and adjacent to the quartz-feldspar porphyry (1a), another unusual rock type. The medium- to coarse-grained grey to white quartzite is completely recrystallized and only in a few places is relict bedding visible. The rock consists of 85 to 90 per cent quartz, with some plagioclase, biotite and minor microcline. The weathered surface of the quartzite is rusty in some places apparently due to weathering of the biotite in the rock. Approaching the contacts with adjacent granodiorite-gneiss (4) the percentage of quartz in the quartzite decreases and feldspar and biotite becomes more abundant. The contact is nowhere exposed. Some of the gneiss of unit (4) close to the metaquartzite is an unusual variety containing up to 10 per cent magnetite and 1 to 2 per cent apatite. The metaquartzite almost surrounds the small area of quartz-feldspar porphyry (1a) but no contacts are exposed and the relations between the two units are unknown.

It seems probable that the metaquartzite is in gradational contact with the granodiorite-gneiss (4) and that the quartzite is a remnant in the gneiss. The possible correlations of the metaquartzite with other units is discussed in a later section of this report.

An east-trending band of meta-arkose (3b) in the southeast corner of the map-area extends eastward into the adjoining map-area. The fine- to medium-grained grey to pinkish grey rock is in beds 1 inch to 3 inches thick and consists of about 60 per cent quartz, 30 to 35 per cent feldspar, with minor biotite or hornblende and accessory apatite, magnetite and sphene. The original texture of the rock is almost completely modified by recrystallization but original rounded grain boundaries are preserved in a few places. The meta-arkose is cut by stringers and veins of pink felsic granodiorite (14) and coarse-grained granite (15). Near contacts with the younger intrusive rock, the meta-arkose is completely recrystallized, all primary structure and texture disappear, and the rock is a granodiorite-gneiss.

Grey Biotite Granodiorite-Gneiss

Grey biotite granodiorite-gneiss is the major rock-unit in a broad north-trending belt in the central part of the map-area. This rock, typically medium grained and well foliated with a concentration of biotite in alternating bands, is normally grey, the shade depending on the relative abundance of biotite. Adjacent to granodiorite (6) and mixed granodiorite and gneiss (6c) pink coloration appears in the gneiss and foliation is less prominent. A granular texture is characteristic of the grey gneiss. Quartz, plagioclase (oligoclase to andesine) and biotite are the main constituents. Small amounts of microcline, hornblende, muscovite, garnet, or epidote may be present and magnetite, apatite, zircon, and sphene are accessory minerals. A slight alteration of feldspar to clinozoisite and epidote and of biotite to chlorite is common. The gneisses are homogeneous and contain only scattered xenoliths of amphibolite or biotite-rich gneiss and rare quartz-rich bands. Rocks of unit (4) are apparently in the staurolite - almandine subfacies of the almandine - amphibolite facies (Turner and Verhoogen, 1960). Slight retrogressive metamorphism may be indicated by the alteration of feldspar and biotite.

No direct evidence exists of the origin of the grey biotite granodiorite-gneiss but the prominent banding and the composition of some xenoliths suggests that they are derived from quartzofeldspathic and pelitic sedimentary rocks through metamorphism and metasomatism.

Biotite - sillimanite gneiss (4a), found in one small area in the northeast quarter of the map-area, adjoining the north boundary, grades into the surrounding granodiorite-gneiss (4). Distinctive brown weathering is typical of this grey medium- to coarse-grained gneiss. The gneissic texture is due chiefly to the alignment of biotite grains and, to a lesser extent, quartz and feldspar grains. Quartz, microcline, plagioclase, biotite and sillimanite are the major constituents, with some garnet and minor cordierite and magnetite. The gneiss is in the sillimanite-almandine-orthoclase subfacies of the almandine amphibolite facies of metamorphism (Turner and Verhoogen, 1960).

Both the sillimanite gneiss and the surrounding grey biotite gneiss (4) are probably derived from similar rocks but a sharp, local increase in the gradient of metamorphism is represented by the sillimanite-bearing gneiss.

Diorite and Gabbro

Two plutons on the northwest side of Ennadai Lake are composed of medium-grained, green to greenish black diorite and gabbro (5). The age of the two bodies may differ but their lithologies are similar.

The more northerly pluton, gabbro, with some diorite, is apparently intrusive into the metavolcanics (1) which almost completely surround it as the gabbro is finer grained and crosscuts the meta-andesite at the contact.

Plagioclase in the gabbro is much altered to sericite, clinozoisite and epidote but remnants of the feldspars have compositions ranging from andesine to labradorite. Common green hornblende, the other major constituent, is present in some places but typically it is almost completely altered to chlorite with some epidote and fine magnetite grains. Scattered grains of biotite are present and magnetite, apatite, and sphene are accessory minerals. The intense alteration of much of the gabbro - diorite is considered to be deuteric. The relationship of this pluton to previously described diorites occurring with the metavolcanics (1) is not known but all are possibly related to a single basic igneous event. The small granodiorite (6) body on the northeast side of the gabbro-diorite pluton is younger and intrudes the basic rocks.

The southerly pluton is medium grained greenish grey diorite to quartz diorite composed of andesine, much altered to sericite, hornblende almost completely replaced by chlorite and epidote, and some quartz. Carbonate, probably secondary, is a minor constituent and sphene and magnetite are accessory minerals. Granodiorite (6) apparently surrounds the diorite mass although contacts were seen in only two places. Near the contacts the diorite is finer grained and there is some assimilation of granodiorite by the diorite resulting in an epidote-chlorite-rich hybrid rock. The diorite pluton is therefore assumed to intrude the surrounding granodiorite (6).

Granodiorite to Quartz Monzonite

These rocks (6) are distributed throughout the map-area. In the central and northeast part they are associated with grey biotite granodiorite-gneiss (4); northwest of Ennadai Lake they are intrusive into the metavolcanics (1) and paragneiss (3). Contacts of these rocks are commonly gradational, hence those shown on the map are arbitrary and subjective. Although typically pink and massive, some foliation due to alignment of biotite flakes is present and shades of grey predominate in some places. Major minerals in these medium-grained rocks are quartz, oligoclase, microcline and biotite. Hornblende is locally present but normally it is less abundant than biotite. Sphene, apatite, magnetite, and zircon are accessory minerals. Microcline, as individual grains and perthitic intergrowths, varies in amount from place to place. Plagioclase is slightly altered to sericite, and mafic minerals to chlorite. Feldspar phenocrysts up to 1/2 inch long are present in some places but nowhere is the rock consistently porphyritic. Inclusions and schlieren of amphibolite and biotite-rich gneiss, are rare in the typical rocks of unit 6.

The pink to red quartz monzonite (6) in the pluton adjoining the north boundary of the map-area, northwest of Ennadai Lake, differs from other rocks in this unit. The pluton includes granite in some places. The rock is medium- to coarse-grained and porphyritic in part. Abundant granite pegmatite in dykes and segregations occurs within the quartz monzonite and adjacent paragneiss. Inclusions of paragneiss are plentiful near the contacts of the pluton. Biotite is the only major mafic constituent but muscovite is common both in the quartz monzonite and the pegmatites. In some places the rock resembles in appearance the coarse-grained porphyritic granite (15) and possibly belongs in that map-unit.

A small area of well foliated pink granodiorite (6a) in the central part of the area is compositionally similar to other granodiorite of unit 6 but pronounced alignment of biotite and some layering of quartz and feldspar distinguish these rocks. The foliation is believed to be due to mechanical deformation with some accompanying recrystallization. The only other exposure of unit 6a is a small conformable band within the grey granodiorite gneiss (4) in the extreme northeast corner of the map-area. The distinct pink colour, lack of banding, and abundance of microcline distinguishes the rock from the adjoining grey biotite gneiss.

Northwest of Ennadai Lake granodiorite intrusive into paragneiss (3) and metavolcanics (1) contains abundant inclusions of the adjacent rocks and is distinguished as unit (6b). This granodiorite, grey to pink, typically has some foliation, with the inclusions and schlieren parallel to it. Although some inclusions are much altered and partially absorbed by the granodiorite, many appear unchanged except for scattered feldspar porphyroblasts. The mixed rocks of unit (6b) are interpreted as being the tops of granodiorite plutons where there has been mixing and partial assimilation of the intruded rocks.

Mixed granodiorite and grey biotite gneiss (6c), present in several localities in the central part of the map-area, compose a gradational but mappable unit intermediate to the two component rock types, granodiorite (6) and grey biotite granodiorite-gneiss (4). The gneiss is present as discrete bands up to 20 feet wide or less commonly the bands are broken and gneiss blocks or inclusions, twisted and rotated, form an igneous breccia. Some assimilation of gneiss bands or fragments by granodiorite is evident and small feldspar porphyroblasts are commonly present in the grey gneiss.

Some of the rocks included in unit 6 possibly belong to the younger quartz monzonite to granodiorite (unit 14), although normally rocks of the latter unit are slightly more sialic in composition.

Hurwitz Group

Sedimentary rocks (units 7, 8, 9, 11) and volcanic rocks (10) and their metamorphosed equivalents, present as two broad northeast-trending bands, are considered to be part of the Hurwitz Group (Eade, 1970). No volcanics were recognized in the type Hurwitz succession in the Kognak River area (Eade, 1964, 1966) but Bell (1968) reports their presence in the Hurwitz Group at Kaminak Lake and Taylor (1963) included volcanic rocks in this group in the Snowbird Lake map-area.

Intrusions and faults, more especially the latter, have eliminated the lower part of the stratigraphic succession of the Hurwitz Group in most places.

Orthoquartzite

Orthoquartzite (7), the basal unit of the Hurwitz Group in this region, is found in a single small outcrop area in the northeast quarter of the map-area. This white to light grey, fine- to medium-grained rock consists almost entirely of quartz, with some sericite and minor opaque minerals. Beds, up to 3 inches thick, are finely laminated with bedding planes marked by concentrations of sericite flakes. Recrystallization of the orthoquartzite has almost completely destroyed original grain boundaries and has resulted in a mosaic of interlocking grains. Other than bedding, no primary sedimentary structures have been seen in these rocks. The thickness of the unit could not be determined as the contacts with adjacent rocks are not exposed but at least 350 feet of section is exposed.

Argillite, Phyllite, Greywacke

Finely laminated, grey, fine-grained to very fine grained, argillite and equivalent rocks with pronounced cleavage, the phyllites, constitute the greatest part of map-unit 8. Greywacke interbeds, fine to medium grained, form less than 10 per cent of the unit. Dolomite is interbedded with the argillite and phyllite, particularly in the stratigraphically higher part of the unit, where much of the argillite is limy. Beds in the argillite are typically 1/8 to 1/4 inch thick but the greywacke beds are from 3 to 10 inches thick. Phyllite, with finely spaced (1/8 to 1/4 inch) cleavage planes is more abundant than the argillite. Bedding is visible in the phyllite in some places but commonly it is obscured by the cleavage. In contrast, greywacke interbedded with the phyllite has few widely spaced cleavage planes. Although an accurate estimate of the thickness of unit 8 is impossible, a minimum thickness of 3,600 feet is suggested.

Quartz and biotite are the major constituents of these rocks with lesser amounts of feldspar, sericite, carbonate, chlorite and opaque minerals. The biotite in the phyllite is recrystallized with pronounced alignment parallel with the cleavage planes. Carbonate, a minor constituent in the normal argillite and phyllite, forms as much as 25 per cent of the limy argillite and phyllite in the upper part of the unit.

The metagreywacke and paraschist to paragneiss with minor calc-silicate bands (8a) are metamorphosed equivalents of unit 8 rocks. Bedding planes are retained in the metagreywacke despite almost complete recrystallization of the minerals but only probable relict bedding is visible in the paragneiss and paraschist. In part the fine foliation in the metagreywacke is relict bedding but in part it is the result of metamorphic differentiation. Quartz, biotite and some plagioclase are the main constituents but small hornblende grains are also present in some of the paragneiss. There is some replacement of carbonate by tremolite and diopside in the limy rocks and microcline that occurs as a minor constituent in some of the paragneiss may have been introduced. The carbonate interbeds in the metamorphosed rocks consist of mixed dolomite, tremolite, epidote and minor sericite or in some places, carbonate and diopside.

Hybrid gneiss and granodiorite (8b), present only in the southeast part of the map-area, form a contact zone between metagreywacke and phyllite (8) and granite (15). Normally the contact zones of the granite (15) plutons are extremely narrow but in this locality the zone is approximately two miles wide, possibly indicating a more shallowly dipping contact of the pluton than is usual. The rock in this sub-unit is heterogeneous, grey to pink, massive to foliated, medium grained, and porphyritic in part. Pink massive granodiorite is intimately mixed with grey biotite gneiss which occurs as discrete bands or, where it is almost completely assimilated, as vague schlieren. Quartz, plagioclase, microcline and biotite are the major constituents with the percentages of microcline and biotite present depending on relative amounts of pink granodiorite and gneiss respectively. In outcrop, rocks of this sub-unit bear a resemblance of those of unit (6c), mixed granodiorite and grey biotite gneiss.

<u>Dolomite and Limestone with Minor Argillite and Phyllite</u> (9)

With increasing abundance of carbonate interbeds relative to the argillite and phyllite, unit 8 passes gradationally and stratigraphically upward into dolomite and limestone with minor argillite or phyllite interbeds. No accurate estimate of the thickness of unit 9 is possible but 4,500 feet is considered to be a minimum figure. Dolomite is more abundant than limestone in this unit. The dolomite, white to dark grey on fresh surfaces and weathering light buff to dark brown, is medium to fine grained. The thickness of beds ranges from 1/2 inch to at least 4 feet but a thickness of 2 to 3 inches is most common. Lenticles of grey chert or very fine grained white quartz, both concordant and crosscutting, are common in the dolomite. The white dolomite contains only scattered sericite grains with dolomite but the darker grey dolomite contains quartz, sericite and some biotite as well as dolomite. Under the microscope the dolomite is seen to be recrystallized with no preservation of original grain boundaries.

The limestone is typically a grey to dark grey rock with a dark brownish grey weathered surface. Beds are 8 to 10 inches thick. The rock consists of calcite with some quartz and minor sericite and biotite. In places it is fine grained but commonly is coarsely crystalline.

The argillite and phyllite interbeds in the dolomite and limestone are similar to the limy varieties present in the upper part of unit 8.

The calc-silicate rocks (9a) vary in composition, depending on the degree of metamorphism. In some, the mineral constituents are dolomite (or more rarely calcite), tremolite, and epidote, with scattered quartz grains, but elsewhere they are diopside, with some carbonate, biotite and quartz. The metamorphic grade of this unit ranges from greenschist facies to the lower part of the almandine - amphibolite facies.

In one locality southwest of Windy Lake where the calc-silicate rock is adjacent to quartz monzonite (14), scapolite is abundant with diopside, plagioclase, biotite and some carbonate. The scapolite is the result of contact metamorphism accompanying the intrusion of the quartz monzonite.

Latite, Quartz Latite, Dacite and Tuff (10)

Volcanic rocks of the Hurwitz Group are present only in a small area about seven miles east of Kasba Lake. These fine-grained light green lavas, weathering light green to yellowish green, are in flows from several inches to approximately 4 feet thick. No primary structures were seen other than possible flow banding. A dense, massive appearance and subconchoidal fracturing are characteristic. Fine-grained, finely laminated light green tuffs overlie the lavas.

The very fine grained character of the flows combined with much secondary alteration makes the identification of their minerals in thin sections difficult. Quartz (8 to 12 per cent), altered plagioclase, epidote and microcline are major constituents, with some tremolite, biotite and carbonate. Remnants of plagioclase suggest composition from oligoclase to andesine but most of the feldspar is almost completely altered to sericite and clinozoisite. In places there are some small phenocrysts of quartz. One thin section contains small shard-shaped masses of very fine quartz, which are probably devitrified glass. The tuffs are similar in composition but show some concentration of minerals in bands. The maximum thickness of unit 10 is approximately 700 feet. The volcanic rocks occur as apparently conformable lenses in the arkose to subgreywacke (11).

Arkose to Subgreywacke

Arkose to subgreywacke (11) overlies, apparently conformably, dolomite (9) although outcrops are rare close to the contact. Near the contact the dolomite is more siliceous and the arkose contains more carbonate in its matrix. The arkose, white to light grey, grey or greyish pink, with a light grey weathered surface, is medium to fine grained, and finely bedded (beds 2 to 5 inches thick) although in some places it is massive or thick-bedded. Crossbedding and ripple-marks (both symmetrical and assymetrical) are not abundant and graded bedding occurs here and there. The grains are commonly subrounded to rounded but some beds contain subangular grains. Size sorting is moderate to good. Quartz, in two distinct grain sizes, sand and silt, forms from 45 to 60 per cent of the rock. Feldspar, usually much altered, constitutes 20 to 35 per cent with plagioclase most abundant but also some microcline and perthite. Rock fragment content ranges from 5 to 25 per cent. The most abundant varieties are quartzite or chert. The matrix, usually 10 to 12 per cent of the rock, consists of fine grains of sericite, biotite or less abundantly chlorite, mixed with silt-sized quartz grains. In a small area in the northeast quarter of the map-area, 11 miles east of Rehel Lake, where rock exposures are particularly good, observations on crossbedding in the arkose show that direction of transport is from the northeast (azimuth trend 200°-210°). The crests of ripple-marks trend normal to this transport direction. In the western part of the map-area at least 7,500 feet of unit 11 is preserved but in the eastern part the preserved section is probably less.

Conglomerate

Conglomerate (12) disconformably overlies arkose (11) in the western half of the map-area but in the east the conglomerate unconformably overlies several units, arkose (11), dolomite, limestone, argillite (9), argillite, phyllite, greywacke (8), and metavolcanics (1). The conglomerate in the west is more consistent in character than that in the east. It consists of tightly packed, rounded to subangular pebbles and boulders from 1/4 inch to 10 inches but most commonly, about 3 inches in diameter. The grey to greenish grey, fine- to medium-grained matrix is of greywacke composition, in some places containing abundant carbonate. Lenses of greywacke, bedded and rarely crossbedded, occur within the conglomerate. Clasts, in order of decreasing abundance, consist of grey to white quartzite, grey to pink granodiorite-gneiss, pink granodiorite, white quartz, jasper and grey dolomite, with a few rare felsite and quartz-feldspar porphyry pebbles. The majority of the largest clasts consist of granodiorite-gneiss.

In the east, the conglomerate is extremely variable. The matrix may be greywacke, siliceous dolomite or almost pure dolomite. The clasts range from 1/4 inch to at least 30 inches in maximum length and have a wide range in shape and roundness. Near-spherical boulders are mixed with blocks showing rectangular outline. The dominant type of clast is commonly locally derived. For example, southeast of Kiyuk Lake where the conglomerate overlies metavolcanics with some associated iron-formation, iron-formation blocks in the conglomerate are so abundant that the unit appears as an anomaly on the aeromagnetic map. Similarly, the carbonate-matrix conglomerate is usually found overlying dolomite-limestone (unit 9). Grey to pink granodiorite-gneiss clasts are commonly present with the locally derived clasts but in some places only arkose (11) clasts are found in the conglomerate.

Secondary cleavage is found almost everywhere in the conglomerate. Metamorphism has, in some places, resulted in complete recrystallization of greywacke matrix and conversion of carbonate matrix to diopside, tremolite, dolomite and quartz. About two miles east of the north end of Kiyuk Lake a granodiorite (14) dyke or sill occurs along the contact of greywacke (13) and conglomerate (12). The conglomerate originally had a carbonate matrix but the rock now consists of angular to subrounded clasts of arkose (11) and granodiorite-gneiss (4) in coarsely crystalline diopsidic skarn rock.

The clasts become smaller, better rounded and more sparse as the conglomerate passes gradationally into the overlying pebbly lithic greywacke to subgreywacke. The conglomerate, unit (12) is estimated to be approximately 2,000 feet thick as a maximum.

Lithic Greywacke to Subgreywacke

Greywacke (13) overlying the conglomerate is grey to pinkish grey with a buff to light grey weathered surface. Commonly it is thick-bedded but in places beds 4 to 6 inches thick are typical and in these crossbeds may be present. Pebbles occur throughout the greywacke, in pebble-rich beds, as pebble trains or as scattered, isolated clasts. White quartz, jasper, and pink to grey granodiorite are the most common types of pebbles. Arcuate shaped mud chips are also found in the greywacke but are not abundant.

Subangular to subrounded grains showing little sorting are characteristic of this rock. Quartz, feldspar and rock fragments, in variable amounts, are the main constituents. The matrix, consisting of fine biotite, chlorite and sericite, constitutes from 12 to 20 per cent of the rock. Quartzite or chert fragments are abundant but others, particularly granitoid quartz-feldspar fragments, are also common. The feldspar grains in the greywacke are less altered than those in the arkose (11). Data from crossbeds at two different localities in the western part of the map-area indicate a transport direction from the northeast (050°-060°). Texturally and compositionally the greywacke is more immature than the arkose of unit 11. It is estimated that a section at least 3,300 feet thick of greywacke (13) is preserved.

Quartz Monzonite to Granodiorite

In the southeast quarter of the map-area plutons of quartz monzonite to granodiorite (14) intrude the Hurwitz Group. A sill or dyke of granodiorite (14) cuts conglomerate (12) and greywacke (13) east of the north end of Kiyuk Lake. Typically, the rock in this unit is pink to salmon pink, medium-grained, and commonly has a faint foliation due to alignment of quartz, feldspar and biotite, the main constituents. Magnetite is always present in minor amounts in the rock. White feldspar phenocrysts up to 3/4 inch long are scattered through the rock in some parts of the plutons but elsewhere the rock is equigranular. Quartz, typically in lenticular grains, is either clear or a dark, smoky grey. Near the contacts of the plutons with metasedimentary rocks and gneisses, biotite-rich bands or inclusions occur in the quartz monzonite.

Some plutons of granodiorite (6) in the northeast quarter of the map-area may possibly be granodiorite (14).

In the extreme southeast part of the map-area there are small areas of white to light grey granodiorite (14a). These rocks, typically with a distinctive white weathered surface, are medium to coarse grained, commonly porphyritic although equigranular in part, and massive to very slightly foliated. Biotite is the major mafic constituent, with minor hornblende and magnetite. Both clear and dark grey smoky quartz are present. Micaceous inclusions or bands occur in the granodiorite near its contacts with paragneiss (3) but elsewhere the rock is homogeneous.

A few very small bodies of syenodiorite (14b) intrude the Hurwitz Group rocks in the northeast quarter of the map-area. This unusual white rock consists of about 90 per cent oligoclase-andesine, some muscovite, minor quartz and microcline, and accessary magnetite, apatite and sphene. Nearly everywhere the rock is strongly sheared, with a resultant granular texture. These minor intrusions are considered to be related in origin to the quartz monzonite (14) or the coarse-grained granite (15).

Granite to Quartz Monzonite (Nueltin Lake Granite)

Coarse-grained, porphyritic granite to quartz monzonite (15), informally named the Nueltin Lake granite by Wright (1967) is a distinctive and areally extensive rock. It is red to pink, or rarely grey and contains microcline phenocrysts up to 2 1/2 inches long although 1 inch is probably an average size. Quartz is of two types, clear or white and dark smoky or bluish, with both varieties always present. The microcline, present as both phenocrysts and in the groundmass, is normally more than two thirds of the total feldspar content but in parts of some plutons plagioclase may be as much as 50 per cent of the total feldspar. Biotite forms about 10 per cent of the rock and minor amounts of hornblende and magnetite are commonly present. Purple fluorite in fine to coarse grains usually associated with the biotite, occurs sparingly but consistently in most of these rocks.

Near contacts the granite becomes medium grained and equigranular and may contain scattered inclusions of adjacent country rock. Away from the contacts the rock is extremely homogenous with only rare, one- or two-foot-wide, biotite-rich schlieren or inclusions and dykes or segregations of aplite or medium-grained grey diorite. Foliation is rare or absent but prominent jointing, particularly a subhorizontal sheeting, is typical. Weathering of the jointed rock results in jumbles of angular blocks and slabs that rapidly weather into a sandy gravel.

The granite seems to have little or no associated pegmatite. Near the contact of the granite east of Windy Lake some large (3 feet by 3 feet) angular boulders of rose quartz may be derived from a pegmatite associated with the granite.

On the aeromagnetic maps areas underlain by the granite have a typical recognizable contour pattern. In a few places, for example just east of the central part of Windy Lake, the contours suggest there is some zoning or segregation in the granite. The surface bedrock however is homogeneous and gives no indication of any variation in mineralogy.

The granite (15) intrudes the Hurwitz Group rocks and overlying conglomerate (12) and greywacke (13) are cut by a granodiorite (14) dyke or sill in one locality. The quartz monzonite-granodiorite (14) is probably intruded by granite (15) but at the contacts there is much mixing and relationships are not positive. The argillite (8) and dolomite-limestone (9) near granite (15) contacts are converted to hornfels and skarn respectively. Arkose (11) near the granite is less affected but coarse microcline porphyroblasts are abundant and the rock is completely recrystallized.

An age determination by the potassium argon method on a specimen of granite from the body just east of Ennadai Lake gives an age of 1800 m.y. (GSC 60-30). A strontium-rubidium isochron on specimens of fluorite granite equivalent to unit 15, from the southwest corner of Kognak River map-area (the northeast end of the large mass of granite that extends along the northwest side of Nueltin Lake) indicates an age of 1967 m.y. An isochron determined from specimens of quartz monzonite in the Kognak River area, similar to that of unit 14 in this map-area, indicates an age of 1776 m.y. (R.K. Wanless, pers. comm.).

The coarse-grained porphyritic granite is believed to be a "high level", post-tectonic granite emplaced during the final phase of the Hudsonian Orogeny. The 1697 m.y. age on the fluorite granite therefore is considered to accurately date the final stages of the Hudsonian Orogeny in this region.

Gabbro and Metagabbro Dykes

Basic dykes (16) are not abundant in this map-area, they are narrow (75 feet wide or less) and probably short as only scattered isolated outcrops of these rocks have been found. All dykes trend northeast to north except one east-trending dyke in quartz monzonite (6) in the northwest corner of the map-area. East of Kasba Lake a dyke cuts arkose (11) but everywhere else the dykes intrude granodiorite-gneiss (4) or granodiorite (6). No dykes have been found cutting the sedimentary rocks (units 12, 13) or the intrusive rocks (units 14, 15). It is possible that the base dykes are older than the intrusive rocks and the two youngest sedimentary formations.

The medium- to fine-grained dark grey to greyish green dyke rocks are massive or porphyritic with plagioclase phenocrysts up to 1/2 inch long. Ophitic texture occurs in some but it is not typical. Plagioclase and hornblende, normally both much altered, are the major constituents, with accessory magnetite and aphatite. Metamorphism has resulted in recrystallization and in some places a slight foliation in some of the dyke rocks but there is not discernible pattern to the metamorphism. The location of dykes is not apparent on the published aeromagnetic maps.

STRUCTURAL GEOLOGY

The structure in the older pre-Hurwitz Group rocks is known in only the broadest outlines due to the lack of outcrop and because primary structures are not preserved. Foliation and gneissosity probably coincide with the trend of original structures and in much of the area this trend is northeast. An exception is the part of the area on the northwest side of Ennadai Lake where an eastward trend is prominent in all the rocks. The eastward trend extends into the adjoining part of the Snowbird Lake map-area as noted by Taylor (1963). In the southeast corner of the area the variable east-to-northeast trend may be due to modification of an original northeast trend by plutons of younger (14, 15) intrusive rocks. The structural style of the belt of older rocks in the central part of the map-area comprises a dominant northeast trend modified by the granodiorite (6) bodies around which gneiss (4) and mixed gneiss and granodiorite (6c) are wrapped.

The Hurwitz Group and younger sedimentary rocks (12, 13) also have a dominant northeast trend and in both the east and west belts major northeast plunging folds are the major structures. In the eastern area of sedimentary rocks there are minor east-trending cross-folds.

The northeast-fold trend in the sedimentary rocks results from deformation during the Hudsonian Orogeny but it cannot be determined if the similar trend in the older rocks is Hudsonian deformation or if it is related to an older orogeny.

Several major faults and a number of minor faults occur in the map-area. In some mylonite and breccia are present along the fault zones but elsewhere the faults are inferred from offset of lithologic contacts. One to three miles south of the north boundary of the map-area segments of east-trending faults are present across the map-area. The fault segments probably represent an early zone of faulting disrupted by younger faults and plutons, with some late movement on the segments.

A major northeast-trending fault separating the Hurwitz Group rocks and the metavolcanics in the northwest corner of the area, is for the most part covered by drift and the waters of Ennadai Lake. This is considered to be a major regional fault that extends to the southwest into the Snowbird Lake area and joins major northeast-trending faults mapped by Taylor (1963). To the northeast, it is probably a part of the zone of northeast faults that extends through the northwest corner of the Kognak River map-area (Eade, 1966). Another major northeast-trending fault forms the west boundary of the eastern belt of Hurwitz Group rocks. Both major northeast faults are normal faults with the east side down.

Faults trending north to slightly west of north are probably younger and offset the northeast faults. A major northwest fault across almost the centre of the area appears to be the youngest of the major faults. Movement on most of the faults appears to post-date the youngest intrusive rocks but this may well be late movement on pre-existing faults. However the many small faults cutting the sedimentary rocks near Kiyuk and Hogarth Lakes are probably late and directly related to dislocations accompanying the intrusion of the granite (15) on the east side of Windy Lake.

ECONOMIC GEOLOGY

Early mineral exploration in the area was concentrated on the metavolcanic rocks, the "greenstones", on the northwest side of Ennadai Lake. In 1947-48 Kasba Explorations Ltd. examined these rocks in some detail and staked the Little Hughie Group of claims. Some trenching was carried out and gold in limited amount was found in small quartz-filled shears. No recent work has been done on these occurrences.

No further systematic exploration work was done in the area until 1969 when seven prospecting permits were issued for NTS map-areas 65 C/1, 2, 5, 7, 9, 11, and 12. These permits cover most parts of the map-area underlain by sedimentary and metasedimentary rocks. The primary interest is apparently in exploration for uranium mineralization, and is an extension of exploration efforts in the Henik Lakes-Padlei areas to the northeast and of the work to the southwest in the Wollaston Lake belt.

Small shear zones containing abundant pyrite occur in one locality in the metavolcanic outlier at the north end of Windy Lake. Nearby, along the edge of a swamp, large angular boulders of sheared metavolcanics containing abundant pyrite are scattered through the glacial drift.

A Rank model ND 148A scintillometer was used to take readings on outcrops of meta-arkose (3b), orthoquartzite (7), arkose (11), conglomerate (12), and greywacke (13) but in all places readings were only slightly above background. Readings on coarse-grained granite (15) however were consistently above background (5-8) μR/hour over muskeg and till), commonly 15 to 20 μR/hour and in some localities up to 40 μR/hour. An analysis of a composite sample of similar coarse-grained granite from the Kasmere Lake area, just to the south, gives 42.2 ppm thorium and 4.9 ppm uranium (Eade and Fahrig, in press). This thorium content is much above normal for granites and it is suggested a similar high thorium content may be present in the granite (15) which would account for the high readings on the scintillometer.

As mentioned by Wright (1967), the common association of fluorite with minerals of beryllium and tin and to a lesser extent molybdenum and tungsten, suggests the fluorite-bearing coarse-grained granite may have some economic significance. Two specimens of granite, one from just north of Kasba Lake and the other northeast of Windy Lake, were analyzed spectrochemically in the laboratories of the Geological Survey for a number of trace elements amongst which were tin and molybdenum. In both specimens the two elements were present but in a quantity less than the limits of detection of the method used. Both specimens were from the central parts of large masses. If concentrations of trace elements are to be found, it is most likely to be in the contact zones of the plutons, in possible greisen zones in adjacent rocks or in pegmatites that may accompany the granite. Unfortunately, outcrop is extremely poor near the contacts of the granite and pegmatites are rare or absent. Although presently there is no indication of any mineralization accompanying the granite, some consideration should be given to the possibility.

DISCUSSION

Geological History of the Hurwitz Group and Younger Sedimentary Rocks

The lower part of the Hurwitz Group with the typical orthoquartzite - carbonate facies is the product of sedimentation marginal to a low-lying, stable landmass. The extreme maturity of the sands that formed the orthoquartzite is evidence of this stability. From evidence in the areas to the northeast (R.T. Bell, pers. comm.), the source of the sediments was probably some distance east of the Ennadai Lake area. The argillite-greywacke formation overlying the orthoquartzite contains clastic and immature material that suggests some rejuvenation of the source area but the overlying carbonate beds indicate a return to quiet, stable conditions. The total thickness of the lower part of the Hurwitz Group and in particular the orthoquartzite unit, is thinner than it is in the Kognak River area to the northeast. Brief volcanic activity, represented by intercalated flow rocks in the lower part of the arkose (11), was absent in the Kognak River area.

The immaturity of the arkose (11) as compared to the lower part of the Hurwitz Group sediments indicates marked rejuvenation of the source area and a relative shallowing of the basin of deposition. The rejuvenation was probably a prelude to the end of the deposition of the Hurwitz Group.

In the eastern part of the area it is suggested that considerable tectonic activity characterized by much faulting with subsequent erosion of uplifted fault blocks marked the period between deposition of the arkose (11) and the conglomerate rate (12). A fluviatile environment of deposition for the conglomerate is indicated, with transport of the material from limited source areas by short, steep mountain streams and deposition on a piedmont alluvial plain. In the western part of the area the conglomerate is again of fluviatile origin but the source area was less mountainous and deposition took place in a normal alluvial flood plain. The greywacke overlying the conglomerate represents a later stage of the fluviatile cycle.

During the Hudsonian Orogeny the Hurwitz Group and younger sedimentary rocks were folded and faulted and underwent some metamorphism. Late in the orogeny igneous plutons invaded some of the sedimentary rocks.

The probable continuation of Hurwitz Group rocks to the west and southwest of the map-area can be interpreted from published maps

(Taylor, 1963; Fraser, 1962; Tremblay, 1960). The possible extent of these rocks is shown on Figure 1. In Snowbird Lake area Taylor (1963) included dolomite, quartzite and dacite in the Hurwitz Group. Only scattered outcrops are present in that area but it seems likely that dolomite and dacite are equivalent to units 9 and 10 respectively and that the quartzite is equivalent to the arkose 11 in the Ennadai Lake area.

In the northwest corner of the Kasmere Lake area, Fraser (1962) found argillite and siltstone overlain by dolomite and limestone, both units being metamorphosed to some degree. The argillite - siltstone unit is considered to be correlative with unit 8 in the Ennadai Lake area and the dolomite - limestone with unit 9. The argillite - siltstone overlies pink augen-gneiss but it is not clear whether the contact is an unconformity, i.e. the augen-gneiss is old "basement" or if the contact is metamorphic and the augen-gneiss is derived from rocks equivalent to the lower part of unit 8. On Figure 1, the augen-gneiss has not been included with the Hurwitz Group and it is assumed that the argillite - siltstone unconformably overlie gneisses. This implies that the orthoquartzite (7) was absent at the base of the group in this region.

The argillite - siltstone and carbonate units extend southwest from Kasmere Lake area into the adjoining Phelps Lake area in two separate northeast-trending synforms. Both rock-trends and aeromagnetic-trends support this interpretation although Tremblay (1960) suggested that the sedimentary rocks are of Archean age. The argillite - siltstone in Phelps Lake area overlies granitic gneisses and the contact is interpreted as an unconformity. It may be a metamorphic contact, as in the Kasmere Lake area but it seems extremely unlikely that if the underlying gneisses developed during the Hudsonian Orogeny there could be such a sharp contact with the overlying sedimentary rocks.

The orthoquartzite unit (7), so typical of the Hurwitz Group in the Kognak River area is apparently absent in the Kasmere Lake and Phelps Lake areas. This suggests that the lack of this unit in much of the Ennadai Lake area, particularly in the western belt, may not be due to loss from faults and intrusions but that it may not have been deposited in this part of the basin.

The conglomerate (12) and greywacke (13) overlying the Hurwitz Group have only been found in the Ennadai Lake area. This limited distribution may be the result of small restricted basins of deposition as compared to the major basin in which the Hurwitz Group was deposited.

The extension of the eastern belt of Hurwitz Group rocks southward into Kasmere Lake area is uncertain. Possible relationships with metasedimentary rocks and paragneiss of the Wollaston Lake fold belt (Money, 1968) are discussed in a following section.

The Metaquartzite (3a)

The metaquartzite, although restricted in extent to a single locality, is of considerable interest in regard to its derivation. Three obvious possibilities exist; (a) from rocks equivalent to the orthoquartzite (7) of the Hurwitz Group; (b) from pre-Hurwitz Aphebian quartzite, perhaps equivalent to the Montgomery Lake sedimentary rocks in the Kognak River area (Eade, 1964, map-unit 7); (c) from Archean quartzite. Field relations are such that it could not be determined with certainty if the quartzite is a remnant within the granodiorite-gneiss (4) or if it is an infolded outlier of sedimentary rocks overlying the granodiorite. The change in composition of the quartzite approaching the gneiss contact suggests that it grades into the gneiss and is a remnantal band in the gneiss.

If derived from an Archean quartzite, then the gneisses are probably Archean in age and slightly modified during the Hudsonian Orogeny. If the quartzite is Aphebian in age and a remnant in the gneisses then the gneisses must have been formed during the Hudsonian Orogeny. This points out one of the major problems in the Churchill Province, the distinction of pre-Aphebian gneisses and those formed during the Hudsonian Orogeny.

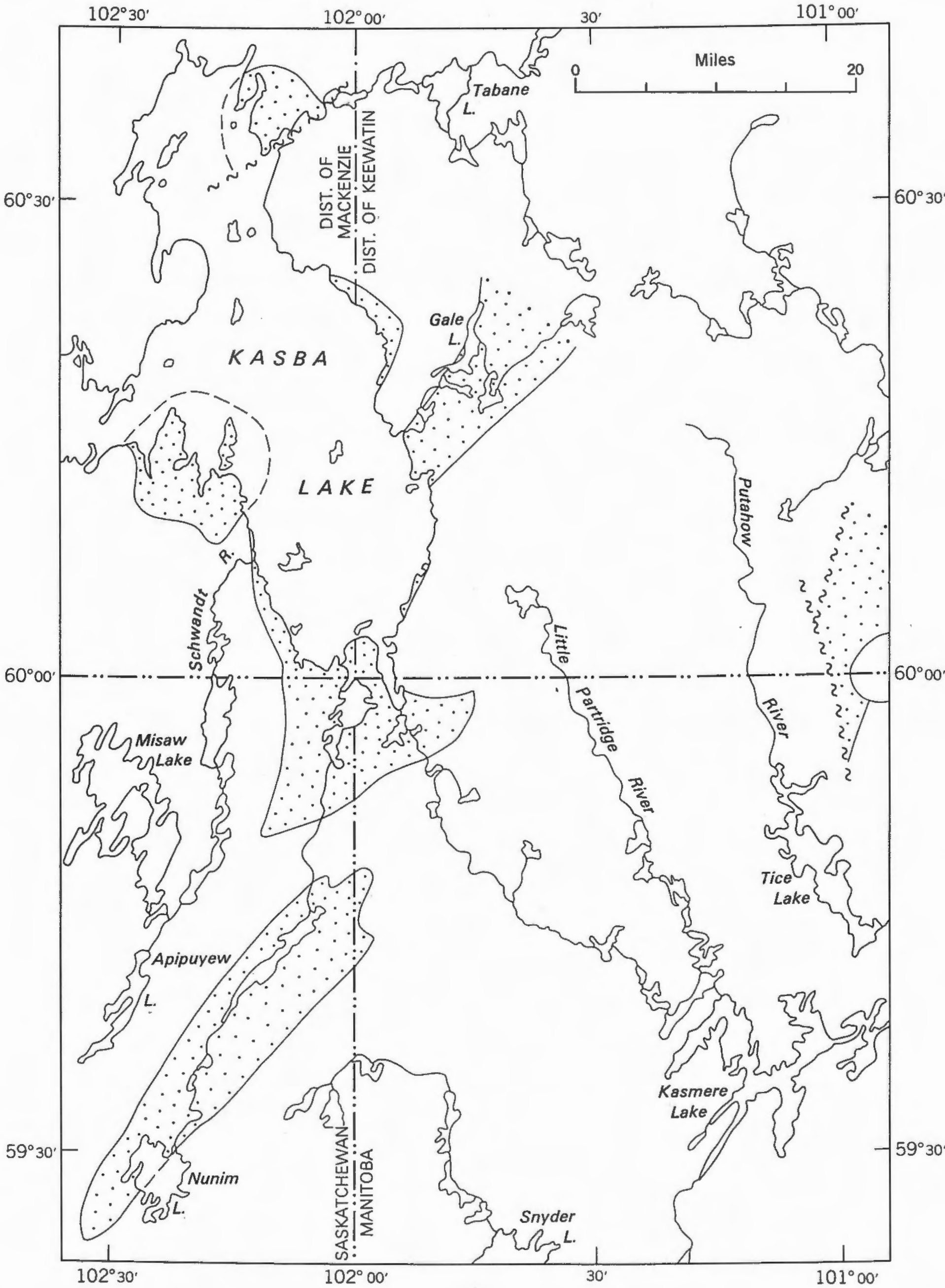

Figure 1. Probable Hurwitz Group rocks south and west of the Ennadai Lake area.

If the quartzite is of Aphebian age, it could be economically significant whether it is Hurwitz Group or the approximate equivalent of the Montgomery Lake sediments. In the Kognak River - Padei regions, the Montgomery Lake sediments would appear to be of more interest in the search uranium mineralization than the Hurwitz Group orthoquartzite.

The lack of other quartzite bands within the gneisses (4) most of which are assumed to be Archean in age, although probably modified during the Hudsonian Orogeny, suggests that Archean quartzites were rare or absent. The location of the quartzite occurrence, isolated between the two large bands of Hurwitz Group rocks, may indicate it is not a part of the Hurwitz Group. It is suggested, without supporting evidence, that the metaquartzite is derived from Aphebian age rocks, approximately equivalent to the Montgomery Lake sediments. These rocks underwent deformation and erosion prior to deposition of the Hurwitz Group, and perhaps were the source of the orthoquartzite. This remnant of quartzite, unconformable on the Archean granodiorite-gneiss (4) was modified and partially converted to gneiss during the Hudsonian Orogeny.

Meta-arkose (3b) and Paragneiss (3)

This section is concerned only with the meta-arkose and paragneiss present in the southeast corner of the map-area. It is unfortunate that outcrop is extremely sparse there for solutions must be found there to some problems of regional interpretation. Some of the problems are as follows:
(a) the relationship of the paragneiss and the meta-arkose; are they part of the same sedimentary sequence? (b) are the meta-arkose and/or paragneiss derived from rocks of the Hurwitz Group or from an older sedimentary sequence? (c) the relationship of the paragneiss and meta-arkose to rocks of the "Wollaston Lake fold belt" (Money, 1968), and the relationship of the Hurwitz Group to the fold belt.

Paragneiss and meta-arkose are not found in contact but the trend of foliation (or relict bedding) in the gneiss and of bedding in the arkose are approximately parallel in this area and in the adjoining area just to the east. It is suggested that both originate from the same sedimentary sequence, the paragneiss from an argillite - greywacke unit originally associated with an arkose.

At its west end, the meta-arkose is separated by drift from a band of mixed hybrid gneiss and granodiorite (8b) which is on the north side of granite (15) and quartz monzonite (14) plutons. To the north of the granodiorite and gneiss band is metagreywacke and phyllite (8) and it seems likely the granodiorite and gneiss unit is derived from the argillite - greywacke by metamorphism and metasomatism accompanying the intrusion of the plutons. The trend of the gneiss - granodiorite band suggests the meta-arkose band is also a part of this sequence, i.e. a part of the Hurwitz Group, and perhaps stratigraphically below the argillite - greywacke. The composition of the meta-arkose is such that metamorphism associated with the granite (15) pluton has probably had less obvious effect on it than on the argillite - greywacke (8a).

Just west of Charlie Lake, near the south boundary of the map-area, micaceous paragneiss (3) is present on the southeast side of a small granodiorite (14a) pluton. Metagreywacke to paragneiss (8a) is on the northwest side of the pluton. The two units (3, 8a) are similar except that unit (3) is slightly more converted to gneiss and its original character indeterminant. The question is, whether they are derived from the same sedimentary unit, with the pluton intruded within the unit or whether they are separate units with the pluton intruded along an unconformity. Although the rocks on the southeast side of the pluton are certainly more affected by metamorphism, they both have approximately similar trends and similar compositions. With presently available information the problem cannot be resolved but it is suggested the paragneiss (3) in this locality is derived from rocks equivalent to the phyllite and greywacke (8) of the Hurwitz Group.

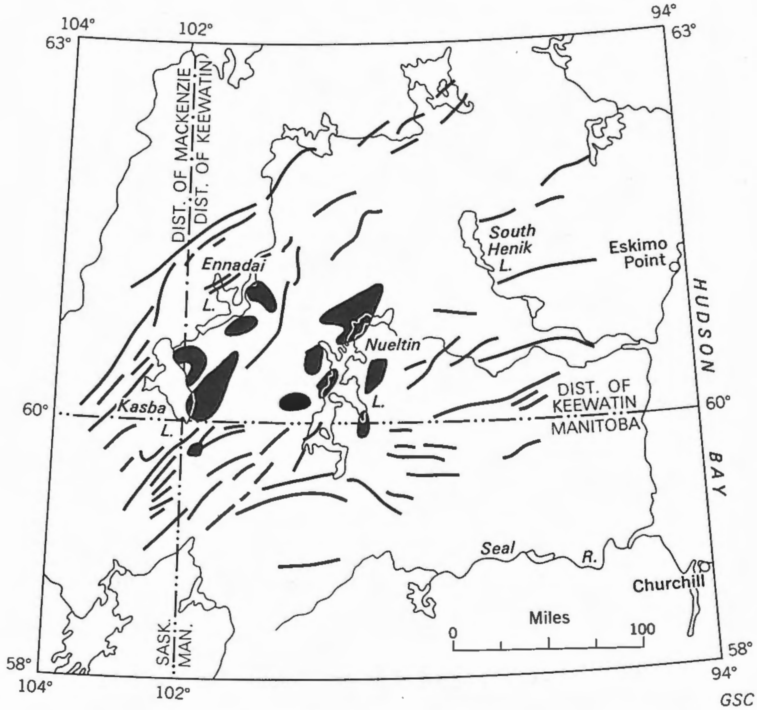

Figure 2. Regional structural trends and coarse-grained granite plutons (black areas) in the Kasba - Ennadai - Nueltin Lakes region.

The paragneiss extends south into the adjoining Kasmere Lake area (Fraser, 1962) and east into the Nueltin Lake map-area. Money (1968) suggested that these metasedimentary rocks are in the northeast extension of the "Wollaston Lake fold belt". If this fold belt is considered to be a structural belt, a mobile belt or zone of deformation, the conclusion may be valid. However, there is no evidence to suggest it is a depositional basin and that the sedimentary rocks in the belt are necessarily correlatives. To the east of Kasmere Lake area, in the Munroe Lake map-area (Davison, 1963), quartzite, arkose, and carbonate rocks occur, apparently beyond the fold belt, and may be equivalent to the meta-arkose and paragneiss and/or the Hurwitz Group rocks.

The "Nueltin Lake" Granite (15)

As discussed by Wright (1967), coarse-grained porphyritic granite, commonly fluorite-bearing, is widely distributed in this part of the Churchill Province. The significance of these late-orogenic plutons in relation to the regional structure poses an interesting problem. The locations of the plutons are shown on Figure 2 with the regional structural trends taken from the Tectonic Map of Canada (Geol. Surv. Can., Map 1251A, 1969). The structural trends, including bedrock trends (gneissosity, foliation and bedding) and magnetic anomaly trends are primarily the result of the Hudsonian Orogeny. Two prominent trends, northeast and east, apparently meet in the region where the granite plutons are located. It is suggested the location of the plutons may be related to the convergence of the trends. The plutons were emplaced during the final phase of the Hudsonian Orogeny, apparently under conditions of dilatency as there is little evidence of disruption around the plutons.

As previously stated, an age determination by the Sr/Rb method on the northeast mass of granite gives 1697 m.y. A similar age determination on the small granite mass in the northwest corner of the Kasmere Lake map-area gives 1717 m.y. A Sr/Rb determination on acid volcanic rocks of the Pitz Formation (Donaldson, 1965) in the Dubawnt Lake region gives 1732 m.y., an age remarkably close to that of the granite. Although the volcanic rocks are some distance north (a minimum of 100 miles) of the coarse-grained granite, it is possible the granite and acid volcanics are related to a single igneous event. The association of post-tectonic, high level granite masses and acid intrusive rocks is a common one in the Phanerozoic.

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