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RECONNAISSANCE GEOLOGY OF A PART OF THE PRECAMBRIAN SHIELD, NORTHERN QUEBEC AND NORTHWEST TERRITORIES

F. C. TAYLOR

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(NTS 25 SW, NW & NE; 35 SE, SW, NW & NE)

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ABSTRACT

A 20,000-square-mile area of Precambrian rocks was mapped by helicopter in 1973. The area contains elements of the Churchill and Superior Structural Provinces and includes both Archean and Proterozoic rocks. Archean rocks predominate in the southeastern quarter of the area mapped. They are intruded by diabase dykes of possible early Aphebian age. The Cape Smith fold belt extends across the area; it varies from 20 to 50 miles in width. The lithology of this belt is described in some detail and new information on the internal relationships is presented. Like the Archean rocks the Proterozoic succession is cut by diabase dykes that appear to be part of the Franklin dykes that occur throughout much of northern Canada. The Cape Smith belt was explored intensively for nickel in the late 1950's and several major occurrences have been proven up although due to adverse economic conditions the properties were temporarily shut-down in 1971.

RÉSUMÉ

Une région de 20,000 milles carrés formée de roches précambriennes a été cartographiée en 1973 à l'aide d'un hélicoptère. La région renferme des éléments des provinces structurales Churchill et Supérieur et comporte à la fois des roches de l'Archéen et du Protérozoique. Les roches archéennes prédominent dans le coin sud-est de la région cartographiée. Elles ont été pénétrées par des dykes de diabase qui pourraient remonter à l'Aphébien. La zone plissée de Cape Smith traverse la région; elle varie en largeur de 20 à 50 milles. L'auteur décrit la lithologie de cette zone de façon assez détaillée et présente de nouvelles données sur les rapports internes qui existent. Comme dans le cas des roches archéennes, les roches du Protérozoique sont aussi pénétrées pas des dykes de diabase qui semblent faire partie des dykes Franklin que l'on retrouve un peu partout dans le nord du Canada. On a cherché du nickel de façon intensive au cours des années 1950 dans la zone de Cape Smith et on a effectué plusieurs découvertes importantes mais à cause de conditions économiques défavorables les gisements ont été temporairement abandonnés en 1971.

RECONNAISSANCE GEOLOGY OF A PART OF THE PRECAMBRIAN SHIELD, NORTHERN QUEBEC AND NORTHWEST TERRITORIES (25 SW, NW & NE; 35 SE, SW, NW & NE)

INTRODUCTION

Location and Accessibility

This report and its maps provide the preliminary results of Operation Nuvilik, a helicopter-assisted, geological mapping program designed to complete the reconnaissance mapping of northernmost Quebec, and adjoining islands of the Northwest Territories. The area embraces about 20,000 square miles, about one-third of which was previously mapped by officers of the Quebec Department of Mines, now part of the Department of Natural Resources (Beall, 1959, 1960; Bergeron, 1957, 1959; De Montigny, 1959; Gelinas, 1962; Gold, 1962).

Operation Nuvilik utilized two Bell G4A helicopters for traversing and a DHC3, Otter aircraft equipped with oversized wheels for camp moves, minor gas-caching and service flights. Gasoline for the operation was air-lifted from Schefferville, Quebec to Asbestos Hill airstrip in the spring by Electra aircraft.

The use of oversized wheels on the Otter aircraft permitted easy access to the airstrips at Deception Bay and Asbestos Hill and also avoided loss of aircraft utilization during spring break-up period. Sufficient landing sites suitable for the Otter were located within the map-area so that the three camps used were evenly spaced in relation to the general outline of the map-area. However, large parts of the map-area are unsuitable for wheeled aircraft, and similarly, only a few lakes in the region are large or deep enough to use float-equipped aircraft. Break-up of lake ice varies immensely depending upon altitude and general weather conditions, but larger lakes are rarely ice-free before mid-July. Freeze-up is frequently in early September.

Commercial air service is available to either Asbestos Hill or Deception Bay from Montreal via Fort Chimo twice a week. Most of the provisions for the present survey were purchased in Montreal and flown by commercial aircraft to Asbestos Hill on a weekly basis. Heavy supplies can be sent by sea during the summer season. Several small communities are present along the coast at Ivujivik, Saglouc, Maricourt and Koartac. Short airstrips are present at the latter two localities. In the interior, two other airstrips are available, one at Lac Spartan and the other at the property of New Quebec Raglan Mines Limited. The latter is in excellent condition, but the former requires some repair work before being used by heavy aircraft.

In order to produce this report as quickly as possible it has been prepared without re-examination of rock specimens gathered during the survey. A final report embracing laboratory examination of rocks and minerals, and a re-assessment of field data will be forthcoming. Interested readers requiring more detailed data should consult maps and reports issued by the Quebec Department of Natural Resources for those areas covered by the reports.

Physiography and Pleistocene Geology

The area covered by Operation Nuvilik is dominated by the Povungnituk Hills (Bostock, 1970) that transect the region in an east-northeasterly to easterly direction. This feature forms a series of ridges and valleys for the most part, but in many places, especially in the eastern portions, they are very subdued and the surface is nearly a plain. Hilltop elevations range between 900 and 2,275 feet asl and local relief averages about 500 feet. The Povungnituk Hills are bordered on the north by the Sugluk Plateau and on the south by the Larch Plateau (Bostock, 1968). Both of these plateau areas merge with the Povungnituk Hills, almost imperceptibly in the east, whereas in the west a more distinctive break between the physiographic types is more apparent.

The Sugluk Plateau slopes gently southward over much of its area through which a few north-flowing streams have cut steep-walled valleys that end in the coastal area as fiords, such as Sugluk Inlet and Douglas Harbour. Along parts of the north coast precipitous cliffs up to 1,000 feet are present; maximum elevation (+1,900 feet) occur farther inland.

The Larch Plateau presents a gently undulatory surface with elevations between 900 and 2,100 feet. The only major break in a fairly even skyline is the rim of the New Quebec Crater that reaches an altitude of 2,156 feet. To the east, bordering Hudson Strait, an abrupt drop into the sea is characteristic and steep cliffs up to 1,000 feet high are also common. To the west, outside

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of this map-area, this plateau slopes gently to Hudson Bay.

Glacial ice chiefly flowed outward to the sea from the centre of the map-area, but local evidence of what is probably an earlier southern flow in the central part of the map-area is present. Rare boulders of rocks known only to occur in the Cape Smith belt exist in the drift covering Archean rocks to the south. However, the major movement of detritus is northward as Archean rocks are common in the drift well north of any Archean outcrops.

The western coastal area is characterized by numerous abandoned beaches, probably modified annual moraines. These extend inland as much as 20 miles and are present up to between 400 and 500 feet above seal level. In the interior, abandoned lake beaches are locally present some of which are 2,000 feet asl. The extent of these beaches and associated lakes is not known, but vast areas were probably covered by lake waters during the waning stages of glaciation.

Acknowledgments

The successful field work of Operation Nuvilik was the result of whole-hearted co-operation of all the members of the field party. Staff members Drs. T. M. Gordon and J. B. Henderson devoted themselves to the task at hand, bringing to it expert knowledge and fine companionship. As the party was short-handed the extra work load thrust upon these two men was accomplished with cheerfulness and is greatly appreciated. The aircrews of Skyrotors Limited and Bradley Air Services Limited carried out their tasks in an exemplary manner, and all showed an esprit de corps which made the work of others less difficult. The skill of the pilots, Nelson Bentley, Randy Brading, Ken Lee and Harold Mordy contributed immensely to the success of the operation. Similarly, the engineering crew consisting of Colin Munro, Lionel Whiteduck and Gordon McDowel, who kept the aircraft in excellent flying condition, served their roles in an ideal fashion. The thankless and varied tasks performed by student assistants, Larry Lane and Robert Drysdale, were performed with good humour. Dennis Jones capably acted as radio operator, providing valuable communication with aircraft, Asbestos Corporation Limited, and another field party in the region.

The dedication and proficiency of Roland Senneville, cook, who provided an excellent table throughout the season, contributed in no small measure to the comfort and well-being of the entire crew.

The co-operation of the staff of Asbestos Corporation Limited is greatly appreciated. Without their participation in handling various camp supplies and gasoline, and in providing accommodation for the crew, both before and after commencement of field work, the proficiency with which the operation was carried out would have been curtailed. In particular, I wish to thank Mr. S. Luciani, Manager at Asbestos Hill and Mr. J. C. Scott, who made many arrangements regarding logistics in the spring.

GENERAL GEOLOGY

All the bedrock is Precambrian and the only younger rocks encountered consist of a few extremely rare cobbles of lower Paleozoic limestone that occur along the Hudson Strait coast. The area contains elements of the Churchill and Superior Structural Provinces (Stockwell, 1964) and includes both Archean and Proterozoic rocks. The Churchill province area is of particular interest as it contains the Cape Smith fold belt.

ARCHEAN

The main area of Archean rocks forms the southeastern quarter of the map-area, extending from 15 miles west of Juet Lake in the west to Hudson Strait in the east. The same rocks extend along the west shore of Hudson Strait to north of the Cape Smith belt layered rocks and are common in the Wakeham Bay district. They also occur north of the Cape Smith belt west of Wakeham Bay as locally the sedimentary rocks of the Cape Smith sequence lie unconformably on them. The extent of the Archean rocks in this area is not known for certain. Beall et al. (1960) suggest that rocks north of the belt may have been subjected to the Kenoran orogeny on the basis of a single Rb-Sr age of 2270 m.y. Whether Archean rocks form a major part of the terrain north of the belt has not been determined. Limits shown on the accompanying maps are drawn arbitrarily and areal extent of the Archean or re-worked Archean may be much more or much less extensive.

Granodioritic gneiss, granodiorite, migmatite (Agg,gd,mg)

The Archean terrain is dominated by granitic rocks, chiefly granodiorites, that are predominantly light grey, locally medium grey to pink, medium- to coarse-grained rocks. Whereas most of these rocks are moderately well-foliated, massive rocks form extensive areas west of Lac Allemand and north and northeast of Lac Nantais. The two rock types grade into one another but locally dykes of massive granodiorite or pegmatite penetrate the gneissic members. Biotite is by far the commonest mafic mineral. Hornblende accompanies biotite in about 15 per cent of the rock but is not known to be present without biotite. Locally, small amounts of muscovite are present and in a few places epidote forms tiny veinlets and grains

attesting to some retrogressive metamorphism. Widely scattered throughout the granitic terrain in the Archean are small areas of migmatite and even rarer agmatite.

Amphibolite and metasedimentary rocks (Āab and Ās)

Although the granitic rocks form the major part of the Archean, a few metasedimentary and metavolcanic rocks are also present. These predate the granitic rocks as the latter display intrusive relationships in some places with these stratiform rocks which are chiefly present south and east of Lac Rouxel and north of Juet Lake. The former is an extension of rocks mapped by Stevenson (1968) in the map-area to the south.

The Juet Lake strata are composed primarily of medium-grey slate and siltstone and a dark green, medium grey-green to grey, fine-grained volcanogenic sedimentary rock. Small amounts of medium grey-green, fine- to medium-grained schist, and a dark grey-green well-laminated amphibolite occur at the northern end of the unit. A few barren, white quartz veins, up to 6 inches thick, occur in the slate near Juet Lake. Elsewhere, small pegmatites containing muscovite, biotite and tourmaline cut the schist.

In the Lac Rouxel region the main rock type is a fine-grained, dark green, laminated amphibolite, some of which is probably of tuffaceous origin. These layered rocks are intruded by a white to grey, medium-grained, biotite granodiorite. Associated with this amphibolite are smaller amounts of buff biotite schist and grey-green intermediate volcanic rocks.

Farther east, south of Grunerite Lake, dark green, fine-grained amphibolite commonly forms northeasterly trending bands in the granitic rocks. These may be of volcanic origin. Tiny remnants of metasedimentary rocks occur scattered throughout the granitic gneisses. In general both the amphibolite and metasedimentary rocks are too small to show on the present scale of mapping. The hills north of Wakeham Bay are capped in several places by biotite-quartz-feldspar paragneiss, locally containing garnet and amphibole. The same rocks also occur more rarely on some islands and in some valleys. Whether these gneisses are elements of the Archean or metamorphosed remnants of Cape Smith belt rocks is not known.

Gabbro (Āgb)

Gabbro forms sizeable plutons at two localities, one south of the Povungnituk River and the other 15 miles south of Grunerite Lake. The former consists of a massive, equigranular, mottled grey, coarse-grained gabbro, whereas the latter is medium-grained, dark grey-green equigranular rock that contains biotite as well as plagioclase and clinopyroxene. The relationship of the Povungnituk River pluton to the enclosing gneisses is unknown, but as the gabbro is extensively metamorphosed it is probably predeformation. The other pluton is fresh, locally displays a diabasic texture and is probably post-tectonic. It may be a sub-horizontal diabase dyke and part of the same intrusion as the numerous diabase dykes (Adb) in that part of the map-area.

PROTEROZOIC (Aphebian)

Diabase dykes (Adb)

The Archean rocks are intruded by numerous diabase dykes which are particularly common in the area south of Wakeham Bay. These dykes are divisible into two units; those that are confined to the Archean rocks (Adb) and those that intrude the Proterozoic rocks of the Cape Smith belt (Hdb). The former (Adb) are much more abundant than the latter, and in several places the rocks of the Cape Smith fold belt can be seen lying unconformably on these old dykes. These older dykes chiefly show two main trends, northwesterly and northeast, but other less common directions are also represented. These dykes (Adb) are dark-green to black, aphanitic to coarse grained and typically weather to a rusty brown. Where exposures are good, chill contacts are easily located. K-Ar age determinations on six similar diabases in the area to the south (Stevenson,1968) showed an average age of 2149, suggesting an Aphebian age. This figure is probably a minimum age and it is possible that these dykes are early Aphebian.

Cape Smith fold belt

The Cape Smith fold belt extends across the map-area from the southwestern quarter northeasterly and easterly to the Wakeham Bay area. At its widest, in the central part of the map-area, it is 50 miles wide, but toward the extremities it is only 20 to 30 miles wide.

In the eastern part of the map-area several outliers of predominantly sedimentary rocks forming part of the Cape Smith belt are present. The most southerly of these is about 30 miles north of the most northerly exposures of rocks forming part of the Kaniapiskau Supergroup (Stevenson, 1968). Stevenson's description of these strata shows them to be identical with the rocks present in the outliers and eastern extremities of the Cape Smith belt. There is little doubt that the rocks comprising the Cape Smith belt are correlative with the Kàniapiskau Supergroup, as suggested by Dimroth et al. (1970) and Bergeron (1957).

The rocks comprising the Cape Smith fold belt have been divided by Bergeron (1959) into two

groups based on unconformable relationships. According to Bergeron, the lower of the two groups, the Povungnituk, lies unconformably on the Archean granitic terrain to the south, whereas the upper group, the Chukotat, lies unconformably on the Povungnituk Group. The existence of an unconformity between the Proterozoic rocks and the Archean is clear. It is exposed in several places where sedimentary rocks, chiefly sandstone, phyllite, iron-formation and slate lie directly on the Archean surface. In some places, however, volcanic rocks form the basal member of the Proterozoic sequence and in the westernmost part, west of Juet Lake, a gabbro intrusive has apparently been emplaced along part of the contact, although drift cover in the area is extensive and sedimentary rocks may occur between the gabbro and the Archean.

The present survey failed, however, to confirm the existence of an unconformity within the rocks of the Cape Smith belt, that is between the Povungnituk and Chukotat Groups. Bergeron (1957) reported the presence of a terrestial conglomerate at the base of the Chukotat Group on a cliff face about 400 feet above the level of Rivière Chukotat in the Bilson Lake map-area. A re-examination of this locality shows this conglomerate to be of interglacial or post-glacial origin, and to contain fragments of twigs, probably from shrubs, in an iron-oxide matrix. Boulders and cobbles in the conglomerate consist of both Archean and Proterozoic rocks. All the Proterozoic strata in this area dip northward at about 70 degrees and no evidence of an unconformity within the sequence is indicated.

Bergeron (1959) shows unconformities in many places on the Povungnituk Mountains area map-sheet. One of these unconformities was based on the supposed basal conglomerate or breccia east of Chukotat Lake. This area was examined carefully and it was concluded that the breccia there, which consists of angular to subangular fragments up to 0.5 m but chiefly less than 7.5 cm long of basic volcanic rocks, rarer silicic volcanics, some of which are vesicular, and dolomite, is of explosion origin and is not basal. A crude layering is apparent in some places, parallel to the regional trend and nowhere is there evidence of discordance. An unusual feature of part of this breccia is the presence of biotite phenocrysts up to 3 cm in diameter scattered through the matrix.

Bergeron (1959) shows discordance between layered rocks and metagabbro at Lac Beauparlant but investigation of this contact showed a complete parallelism of structures and no evidence for an unconformity. Similarly, other localities examined showed no indication of an unconformity.

The validity of Bergeron's thesis regarding the existence of two distinct groups has also been questioned by Stam (1961) who mapped a small part of the Cape Smith belt to the south of the present map-area.

As there are no distinctive mappable rock units in either the Povungnituk or the Chukotat Groups, and no unconformity between them, it is recommended that the division of the Cape Smith belt rocks be dispensed with and the use of the group names be discontinued. For the present report no new names will be introduced and the rocks will be referred to informally as the Cape Smith belt rocks.

Sedimentary Rocks (As)

Sedimentary rocks occurring in the Cape Smith belt consist of a diverse group of lithologies. They can be divided roughly into two groups, those that occur intercalated with the volcanic rocks and those that in general form the basal or near basal units of the belt. The former consist chiefly of black, carbonaceous slates, but also include some dolomite, mudstone, siltstone, fine-grained volcanogenic sediments and very rare chert. These rocks in general form thin interflow beds of little lateral continuity and are, for the most part, too small to show at the present map-scale. However, along Rivière Chukotat east of Carye Lake strongly cleaved carbonaceous slate, with small amounts of ferruginous siltstone and mudstone, is of sufficient dimensions to map. This slate, which is typical of these sedimentary rocks, is poor to well bedded, with beds 0.5 to 2.5 cm thick, dark grey to black, locally pyritiferous and grades into siltstone and mudstone. A dirty chert forms a 3 m bed at one point. Dolomite is typically orange-brown weathering and occurs in thin discontinuous beds. Siltstones and mudstones are various shades of grey or grey-green and are moderately well bedded. Volcanogenic sediments consist of fine-grained, grey-green mafic volcanic detritus that commonly shows thin but poorly defined bedding.

The sedimentary rocks near the base of the Cape Smith belt consist of dolomite, argillite, siltstone, greywacke sandstone, micaceous schists, phyllite and small amounts of iron-formation, conglomerate and chert. These lithologies vary in proportion from place to place both along strike and across it. The fine-grained detrital rocks are the commonest and also most persistent in linear extent. In part, these have been metamorphosed to fine-grained micaceous schists, especially in the easternmost part of the map-area. Characteristically, these rocks are well bedded, with beds ranging from a few mm to 2 cm thick, various shades of grey, less commonly grey-green, and primarily cleaved or schistose. In the Joy Bay-Whitley Bay area garnet-chlorite schists, with garnets up to 3 cm in diameter are present in several places.

Medium-grained detrital rocks consisting of greywacke and sandstone, the latter in part metamorphosed to quartzite, are distributed erratically close to the Archean contact in the central part of the Cape Smith belt. Greywacke and some sandstone are fairly abundant in the vicinity of

Lac Beauparlant. In a few places, quartzite forms mappable units which are described under the heading Quartzite (**Aqz**). Greywacke is typically grey, shows good graded bedding with beds up to 0.6 m thick that locally display sole markings. Sandstone is light grey, well bedded to massive and contains small amounts of metamorphic carbonate, muscovite, biotite and amphibole.

Conglomerate is a rare constituent and chiefly occurs at the base of the Proterozoic rocks in the form of scattered quartz pebbles and small cobbles lying, cemented, on the Archean rocks. Six kms west of the northernmost tip of Lac Allemand well-rounded boulders of quartzite, dolomite and biotite-quartz-feldspar gneiss up to 0.5 m long, but mainly less than 3 cm, in a sandy matrix are intercalated with thin greenstone bands. About 7 m of conglomerate is exposed there. This locality is well above the base of the Cape Smith belt.

Thin beds of iron-formation occur commonly near the Archean contact in the eastern third of the area and also along portions of the north boundary of the belt. It is also present in the outliers in the Joy Bay-Whitley Bay area. The iron-formation is characterized by the presence of grunerite with minor amounts of calcite, stilpnomelane, magnetite and quartz (Hashimoto, 1968).

More detailed descriptions of some of the main rock types are given below:

Quartzite (**Aqz**)

Quartzite is a relatively rare constituent of the Cape Smith belt rocks only rarely forming mappable units. The most prominent quartzite outcrop is just south of the Povungnituk River, 11 kms southwest of Lac Beauparlant, where a hill 100 m high is composed entirely of a blue-grey, poorly bedded quartzite. Good cross-bedded laminae are discernible in two places and on the south side an interbedded, medium grey slate is present, providing structural data. Quartzite north of Lac Rinfret is light grey to white, well bedded to massive, medium grained, and on the flanks of the hill, interlayered with grey slates. Thinner quartzite bands, west-northwest of Lac Yerochant are light grey to white and moderately well bedded. Outcrop is discontinuous and these bands may be much smaller than shown. Small amounts of quartzite occur in map-unit **As**, particularly in the Lac Beauparlant district.

Dolomite (**Adm**)

Dolomite occurs in many places in the Cape Smith belt but is particularly common toward the base where it is interlayered with other sedimentary rocks (**As**). Thin beds of dolomite, commonly associated with dark grey to black shale or slate, occur within the mafic volcanic sequence. These rocks are primarily present in valleys between the erosion resistant volcanic rocks so that some are only exposed during late summer when snow in the valleys has melted. Undoubtedly many more dolomite occurrences are present than are shown on the accompanying map.

Thickness of dolomite horizons is variable, ranging from about a metre to a few hundred metres in the case of the prominent dolomite band southwest of Lac Beauparlant. Typically dolomite horizons do not display any great persistence along strike. Dolomite is white to grey, fine to medium-grained and characterized by a yellowish orange to light brown weathered surface. Bedding is well defined to obscure and in places marked by thin argillaceous laminae.

Volcanic Rocks

Mafic Volcanic Rocks (**Av**)

The major part of the Cape Smith belt is underlain by light to dark grey-green to dark green, chiefly aphanitic, mafic volcanic rocks. Whereas by far the largest portion of them are basaltic in composition, some are andesite and a few rare members are dacites. Many of these rocks can only suitably be described in the field as greenstones, because of their aphanitic texture and low grade, possibly deuteric, metamorphism. Although a massive rock is characteristic, a weak schistosity is present in many places. Most of these rocks are aphanitic, but some are fine grained and a few medium grained. The latter, which are indistinguishable from some of the gabbros (**Agb**), are characteristic of the inner parts of some of the thicker flows. Of all the structures pillows are the most prominent and widespread. Pillows are particularly well displayed in the western part of the belt where hundreds of metres of well-developed pillows are exposed between Rivière Chukotat and Lanyan Lake. Other structures include flow breccias, vesicles, and rare spherulites. Flows range in thickness from a metre or two to about 100 m. A few tuffs are present locally but form only a very minor part of this volcanic unit.

A zone of explosion type breccias is present discontinuously between Chukotat and Esker Lakes. The characteristics of the breccia near Chukotat Lake has been described above and its description is in general applicable to the zone as a whole, except that nowhere else, as far as is known, are there biotite phenocrysts present in the matrix. The areal extent and outline of these breccias is probably irregular, but detailed mapping is necessary to establish precisely their extent and form.

Rhyolite (**Arl**)

Rhyolite outcrops in the central part of the map-area chiefly south and north-northeast of Nuvilik Lakes. In general, it occurs as thin bands

within the mafic volcanic rocks ranging from 0.5 m to about 100 m thick. The large area of rhyolite shown west of Lac Watts embraces a much thicker and more extensive horizon of rhyolite than encountered elsewhere. In general, bands are short or of irregular shape within the mafic rocks. Within the rhyolite unit there are a few mafic sills and dykes of intermediate to basic composition, probably related to the mafic volcanic rocks.

The rhyolite is white or light grey to black, and in part shows discrete feldspar phenocrysts. Locally it is a rhyolite breccia with fragments of rhyolite up to 5 cms long. Elsewhere excellent but discontinuous banding is present. The rhyolite in the Lac Watts area has all been metamorphosed and has a sugary texture rather than the very fine grained aphanitic texture of the rhyolite in the greenschist metamorphic facies zone present in the Nuvilik Lakes area. A breccia is also recognizable locally in the Lac Watts occurrences.

Besides the rhyolite shown on the accompanying map smaller areas of rhyolite and rhyodacite occur sporadically in the central part of the map-area in areas; these are shown as **Av**.

Mafic Intrusive Rocks

The layered rocks of the Cape Smith belt have been intruded by mafic rocks, chiefly as sills, but also locally crosscutting at low angles. These intrusive rocks are predominantly gabbros with somewhat lesser amounts of ultrabasic rocks and only rare pyroxenite. Whereas many sills consist of either gabbro or ultrabasic rocks, others show a gradation from gabbro through pyroxenite to peridotite. As previously reported by Beall (1959) many contacts between gabbroic and volcanic rocks are gradational. Some gabbros mapped by Beall as sills are probably massive flow rocks that have cooled slowly enough to acquire textures similar to the intrusive rocks. Others, however, show narrow fine-grained borders with the host rocks and are clearly intrusives.

Gabbro (**Agb**)

The gabbros are chiefly light grey-green medium-grained sub-ophitic to hypidiomorphic massive rocks. Locally fine-grained or more rarely coarse-grained varieties occur, the latter mainly in the more highly metamorphosed rocks. Whereas clinopyroxene is abundant in the gabbros in the southern part of the Cape Smith belt, hornblende is characteristic to the north in the amphibolite facies. Plagioclase content ranges from about 30 to 60 per cent.

Pyroxenite (**Apx**)

Pyroxenite consists of a fine- to medium-grained, equigranular, bright green, massive rock. Plagioclase content is variable but rarely exceeds 5 per cent. Gradations exist with neighbouring gabbro and peridotite. Only rarely does pyroxenite occur without associated gabbro or ultrabasics and this is chiefly in the northern part.

Peridotite and Serpentinite

Peridotite and serpentinite are commonly associated with gabbroic intrusions, but also occur alone. Peridotite is dark green, reddish brown weathering, massive rock that commonly forms prominent linear hills. Grain size is variable, but fine- to medium-grained rocks are by far the commonest. Serpentinites in contrast with the peridotites, are light grey or yellowish orange weathering. Most of the serpentinites occur in the amphibolite metamorphic zone, but a few small plutons are present in the greenschist zone. These rocks are fine grained, dark to yellowish green, massive to schistose.

Gneissic and Granitoid Areas (mainly north of Cape Smith fold belt

Metamorphic Rocks

Amphibolite, Hornblende Gneiss (**Aab**)

Amphibolite and hornblende gneiss occupy an extensive area in the northern part of the Cape Smith belt. Smaller areas occur scattered throughout the Proterozoic gneissic terrain and on the east end of the belt.

Amphibolite is chiefly a greyish green to dark green, fine- to medium-grained, massive to thinly laminated rock. Although composed almost entirely of plagioclase and hornblende locally actinolite is dominant, and garnet occurs in some places particularly within the gneissic terrain. Locally, chlorite is developed in the amphibolite, chiefly in zones of shearing. This is common to the northeast of Lac Chassé.

In the vicinity of Lac Vanasse and to the northeast, a hornblende gneiss consisting of medium- to coarse-grained plagioclase and hornblende, commonly containing biotite, is the dominant rock type. This rock is well foliated, partly layered and in places displays prominent radiating hornblende clusters. Within the area of hornblende gneiss, notably north of Lac Belleau, local zones of hornblende, in part coarse grained, are present.

The boundary shown between the basic volcanic rocks **Av** and amphibolites **Aab**, is subject to revision as small areas of greenstones are present in the area shown as **Aab** and similarly some amphibolitic rocks occur in the area shown as **Av**.

The vast majority of the rocks in the area shown as **Aab** are derivatives of mafic volcanic rocks as volcanic structures are present in a few places. For example, 17 kms west of Lac Watts a well-banded rock of obvious tuffaceous origin is present and elsewhere scattered occurrences of

relict pillows and flow breccias exist. Some of the hornblende gneiss may be derived from intrusive rocks of dioritic composition, and others from sedimentary strata. The latter are prevalent in the Lanyan Lake and Bilson Lake areas, but occur elsewhere sporadically. Those hornblende gneisses of possible intrusive origin are nearly massive and display an idiomorphic texture.

Paragneiss (Apg)

Rocks mapped as paragneiss are chiefly well-foliated biotite-quartz-feldspar gneisses of various shades of grey. In part they are layered and range in grain size from fine to coarse. Feldspars are locally porphyritic, but in general, texture is equigranular. Whereas biotite is the commonest mafic mineral, hornblende occurs in many places with it, or less commonly, alone. Garnet, up to 1 cm, is present sporadically. Sillimanite is confined to more schistose parts of the paragneiss and its presence is therefore limited. Cordierite was positively identified at only one locality, 35 kms southeast of Erik Cove, but may be more common than field identification would indicate.

In the northwestern part of the area bordering Hudson Strait and on Digges Island local rusty graphite-bearing paragneiss occurs rarely. In the same general area even rarer crystalline limestone is present.

In many places small amphibolite bands occur within this map-unit and granitic gneiss also forms a significant part in some places. Other paragneiss occurrences are hosts for barren irregular pegmatite dykes up to 10 m thick.

Granulite (Agl)

Granulite, which is most common in the northeast portion of the map-area, is characterized primarily by a rusty weathered surface that is readily recognizable from the air. This rock is medium to coarse grained, equigranular for the most part and commonly well banded or foliated although locally massive. Hypersthene occurs sporadically, but a diligent search reveals its presence in most outcrops and in a few it is abundant, and in part coarse grained. Biotite and/or hornblende are present in most places and garnet occurs in many parts of the granulite terrain.

Thin bands of granitic rocks are present throughout the area shown as granulite and these typically are pink, fine to medium-grained, and either devoid of, or contain only small amounts of, mafic minerals. Also present are areas of fine- to medium-grained amphibolite or hornblende gneiss, some of which contains garnet.

Granitic Gneiss (Agg)

Proterozoic granitic gneisses to the north of the Cape Smith belt are generally similar in appearance to many of those in the Archean to the south. They display better layering in some places, however, particularly close to the Cape Smith belt. These rocks range in composition from quartz diorite to granite, with the majority being granodioritic. Whereas most rocks are medium grained, coarse- and fine-grained varieties occur locally. They range from grey to pink, contain biotite and rarely hornblende, and are in general equigranular. Locally, augen type gneisses occur and in some places migmatite is common over short distances. Inclusions of metasedimentary rocks and amphibolite are also present in parts of the area, especially near mappable units of these rock types.

Intrusive Rocks

Granodiorite, diorite, granite (Agd, dr, gr)

Several small areas, both within and north of the Cape Smith belt, are underlain by dominantly massive granitic rocks. These range in composition from quartz diorite to granite. Most of these rocks are medium grained, but some of the smaller plutons intruding amphibolites of the Cape Smith belt are coarse grained to pegmatitic. Whereas most of these rocks are massive, equigranular and grey to pale pink, in part they are foliated, particularly near the margins of some plutons, and pink to dark pink. Either biotite or hornblende are common in almost all of these plutons and in many both are present. Locally, chlorite is present and a few grains of epidote occur in some parts.

Good intrusive relationships with rocks of the Cape Smith belt are present in some places, notably north of Nuvilik Lakes, but elsewhere the granitic rocks adjacent to the layered rocks are foliate and concordant with them. However, it is probable that these rocks all post-date the Cape Smith belt strata.

PROTEROZOIC (Hadrynian)

Diabase

Diabase dykes (Hdb) cutting the Proterozoic rocks of the Cape Smith belt are lithologically similar to the older diabase Adb. In general, these younger dykes trend northwest to west-northwest. Two of these dykes have been dated using K-Ar method (Fahrig, 1967, 1968) and their ages 507±85 and 534±74, plus their orientation, suggest that these diabases form part of a major swarm, the Franklin dykes, that occur throughout much of northern Canada.

STRUCTURAL, METAMORPHIC AND ECONOMIC GEOLOGY

Structure

The present maps and report has been prepared without analyzing the structure so that only a few remarks with regard to regional structural elements follow.

In the Archean foliation trends are predominantly northerly although locally, such as in the western extremity of the map-area, northwest trends exist. Similarly, a northeast direction is conspicuous south of Grunerite Lake and an east trend north of Wakeham Bay. These trends contrast sharply, in most places, with those of the Cape Smith belt rocks that lie unconformably above them. No well-defined folds or major faults were recognized in the Archean rocks.

Within the Cape Smith belt two major fold directions occur, one, the earliest is generally parallel with the Archean-Proterozoic unconformity on the south and a second, younger series of folds trending northwest (Beall, 1960). The former includes isoclinal folds, commonly overturned to the south (Beall, 1960) although in some places they are also overturned to the north. Plunges of these east-west folds are generally low angles to either east or west and in part horizontal. The latter are open folds and particularly well defined in the Lac Mequillon area. These northwest-trending folds show plunges to the northwest of about 45 degrees as opposed to the low plunges of the east-west folds.

Faulting in the map-area is dominated by a major strike fault system that extends from south of Lanyan Lake eastward to south of Asbestos Hill. A fault-line scarp marks the locus of this break for much of its extent. Other parallel faults are present but are less conspicuous because of the absence of topographic expression. It may be that these latter faults are not as continuous nor as structurally disruptive as the most prominent one. These strike faults have been referred to as thrust faults by Bergeron (1959) and Stam (1961) even though dips in the schists bordering the scarp are between 70 and 80 degrees north. Stam (1961) used this and other faults to account for what he considered a repetition of strata at the southwest end of the belt a few miles south of the present map-area.

Northwest of Lac Watts a south-dipping fault, with dips between 35 and 50 degrees, marks the contact between rocks of the Cape Smith belt and granitic gneisses to the north. Foliation in both rock units is parallel with the fault plane in many places.

Locally a few cross-faults, younger than the strike faults are present. Gelinas (1960) shows an oblique fault northeast of Lac Watts but in general this type of fault is rare.

Metamorphism

All the rocks, except for diabase dykes, show some effects of metamorphism. The Archean rocks are chiefly in the almandine-amphibolite facies with very local and minor retrogression to albite-epidote amphibolite subfacies. The Proterozoic rocks, however, span a much broader range of metamorphism ranging from lower greenschist facies to granulite facies rocks. The layered Proterozoic strata show an increase in metamorphic grade, both to the north and to the east. North of the Archean-Proterozoic unconformity, these rocks lie in the greenschist facies except in the eastern part of the map-area, where amphibolite facies is present east of approximately 72° 30'W longitude.

Northward the greenschist rocks pass into amphibolite facies approximately along a line from just south of Baie Kovik to the south end of Lac Watts and towards Lac Letendre. The precise location of this metamorphic boundary will require extensive rock laboratory examination. North of this line amphibolite facies rocks continue to the coast of Hudson Strait, except for a few local areas of granulite southeast of Ivujivik and a large area east and north of Douglas Harbour. A small area of granulite is also present at Cape Hopes Advance so that the major area of granulite lies in the northeast. It may be that the Cape Hopes Advance granulite is continuous with that at Douglas Harbour, forming a semicircular shaped body of granulite chiefly covered by the sea.

Economic Considerations

The Cape Smith belt was the scene of extensive exploration, chiefly for nickel, in the late 1950's. Since that time, exploration has been at a slower pace and has been concentrated on and in the vicinity of the properties of New Quebec Raglan Mines Limited and Asbestos Corporation Limited. The latter company has a producing asbestos mine at Asbestos Hill.

The exploration for nickel has been concentrated along contacts between ultrabasic rocks (Aub) and slates or other sedimentary rocks of the Cape Smith belt with certain success. New Quebec Raglan Mines Limited has outlined a total of 16,050,000 tons of ore averaging 2.58% Ni and 0.71% Cu at several locations, but chiefly at the Donaldson Mine and the Katiniq deposit (Canadian Mines Handbook 1973). Extensive surface and underground facilities were established at the Donaldson property prior to closure in the autumn of 1971 due to adverse economic conditions.

An additional 10,050,000 tons averaging 1.55% Ni and 0.78% Cu is not included in the reserves due to metallurgical factors. Numerous other nickel occurrences have been reported in

the same general part of the Cape Smith belt and an annotated bibliography and map of these occurrences, and those of other metals, has been prepared by Dugas (1971).

The Asbestos Hill Mine, of Asbestos Corporation, was scheduled to produce 300,000 tons of asbestos fibre concentrate per year, which is to be shipped overseas during the summer months from Deception Bay. At present this mine is an open-pit operation, but future underground work is anticipated.

The present survey did not reveal any major sulphide occurrences. Of significance, however, is the presence of rhyolite breccias that are commonly associated with exhalative types of sulphide deposits. The areas in which these silicic rocks occur are worthy of the prospectors attention. Similarly, extensive zones of carbonatization of the basic volcanic rocks to the north and west of Nuvilik Lakes suggest this part of the map-area merits examination. Within this zone of carbonatization a gossan, about 50 m thick and 10 m long, carrying pyrrhotite and pyrite with small amounts of chalcopyrite is present 14 kms northwest of Lac Spartan. In the same area an irregular quartz mass is heavily mineralized with pyrite. Other mineralized rocks may also be present in these carbonatized zones.

A third area deserving investigation is the zone of major volcanic breccias which extends from Chukotat Lake east-northeast to just south of Esker Lake. Although this survey did not locate any mineralization in this area, the geological environment is of sufficient lithological variety, including chert and carbonate as well as the breccia, to warrant careful search.

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