GEOLOGICAL MAPPING IN THE ASHUANIPI LAKE - LAC PETITE-HERMINE AND RANNIE LAKE AREAS, WESTERN LABRADOR

by

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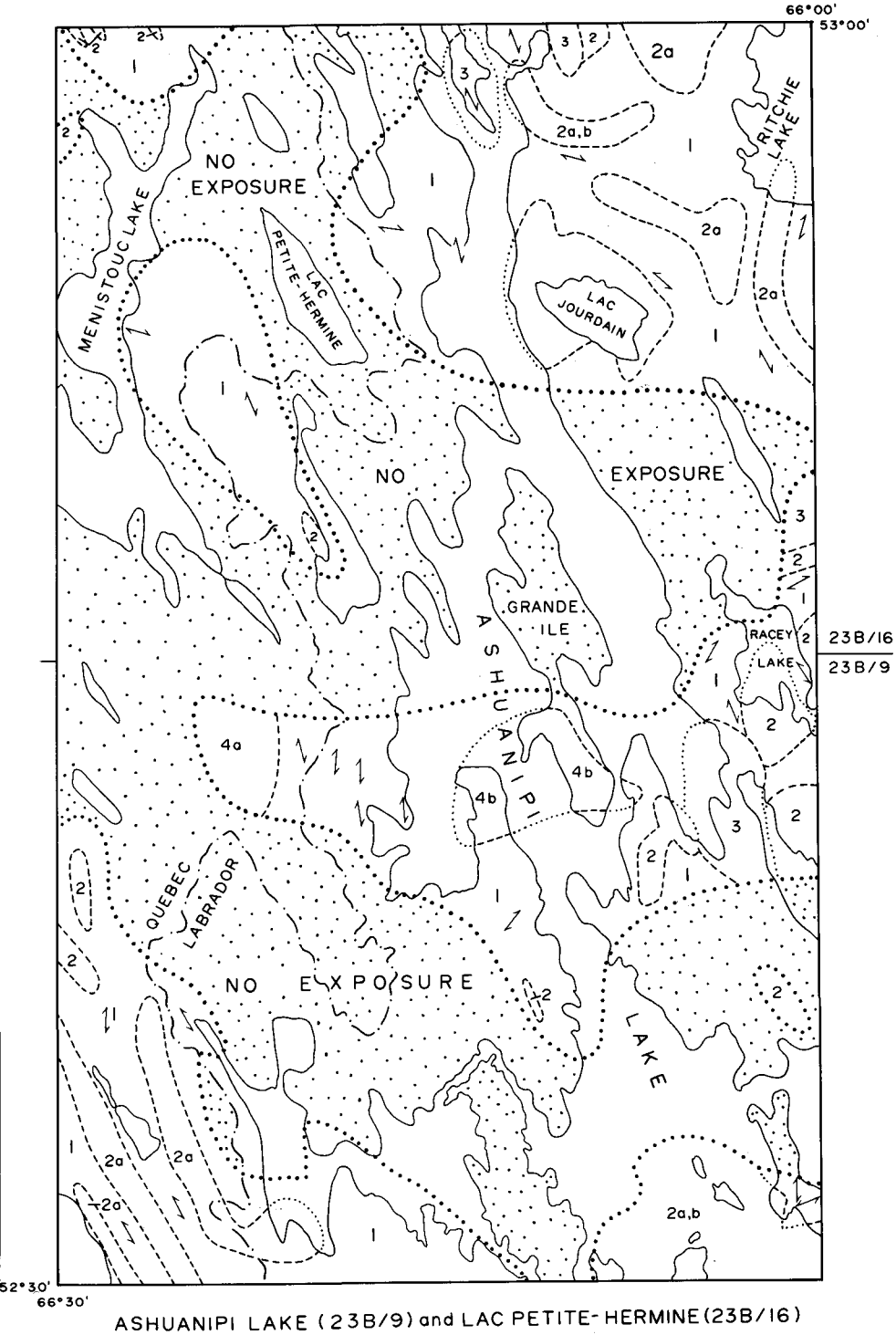
INTRODUCTION

The Ashuanipi Lake (23B/9) - Lake Petite-Hermine (23B/16) area (Figure 1) was mapped at 1:100,000 reconnaissance scale by helicopter during the early part of the summer of 1980, thus completing coverage of the four 1:50,000 map sheets comprising 23B(NE). Additionally some helicopter supported mapping was done in the Rannie Lake area (23G/10, Figure 2) and limited work was also done in the Wightman Lake (23G/1), Molson Lake (23G/8) and Gabbro Lake (23H/11) map areas, which were covered during the 1979 season. Samples for radiometric dating were collected in the Lac Petite-Hermine and Wightman Lake map areas.

GENERAL GEOLOGY

The Ashuanipi Lake - Lac Petite-Hermine map area lies within the Grenville Province, some 50 - 150 km south of the Grenville Front Tectonic Zone (terminology of Wynne Edwards, 1972). Bedrock is principally composed of quartzofeldspathic-pelitic schists and gneisses believed to be part of the Attikamagen Formation, the lowest unit of the Aphebian Knob Lake Group in the Grenville Province (Rivers, 1978, Rivers and Massey 1979, Rivers 1980c). However, the distinctive, overlying platformal sequence of the Knob Lake Group including dolomitic marble, quartzite and iron formation has not been found in the map area, and it is also possible that the schists and gneisses at least in part represent the Menihek Formation, a younger shale unit which overlies iron formation in the Knob Lake Group stratigraphy of the Labrador Trough. In view of the uncertainty, however, this unit is referred to as the Attikamagen Formation here. Intrusive into these schists and gneisses are a large number of gabbroic and granitoid intrusions, interpreted to be of Helikian age. The gabbros are considered to be part of the Shabogamo Intrusive Suite (Rivers 1980b). Some of the granitoid rocks may also belong to this suite, but the affiliation of other bodies is not well known, nor is the relative timing of emplacement of the gabbroic and granitoid rocks.

The Rannie Lake area lies more than 100 km north of the Ashuanipi Lake - Lac Petite-Hermine area, and spans the junction between the Superior and Churchill tectonic provinces. Mapping in this area was restricted to the contact region along the border between the two provinces, where gneisses of the Archean Ashuanipi Metamorphic Complex in the Superior Province are unconformably overlain by quartzite, iron formation, and slate of the Wishart, Sokoman and Menikek Formations respectively of the Knob Lake Group. Although no exposures of the unconformity were found, its position can be defined to within 200 m or so in several places.



SYMBOLS

Geological boundary (approximate, assumed)

Limit of areas of exposure

Provinical boundary

Trend of foliation

HELIKIAN

4 GRANITOID INTRUSIVES
4a, adamellite, 4b, porphyritic granodiorite

3 SHABOGAMO INTRUSIVE SUITE
diorite

2 2a gabbro, 2b peridotite

APHEBIAN KNOB LAKE GROUP

1 ATTIKAMAGEN FORMATION-
quartzo, feldspathic and pelitic schists and gneisses

FIGURE 1

ASHUANIPI LAKE (23B/9) and LAC PETITE-HERMINE (23B/16)

PREVIOUS WORK

In the Ashuanipi Lake - Lac Petite-Hermine area previous mapping is limited to the work of Newfoundland and Labrador Corporation (Wall, 1953) at 1 inch to 1/2 mile scale in the north east corner of the Ashuanipi Lake area, and the regional reconnaissance survey by the Geological Survey of Canada at 1:125,000 scale (Jackson, 1976).

The Rannie Lake area has been previously mapped in part, at 1 inch to 1/2 mile scale, by the Iron Ore Company of Canada (Tiphane, 1951) and is also covered by the Geological Survey of Canada regional maps at 1 inch to 4 mile scale by Fahrig (1967).

ASHAUNIPI LAKE - LAC PETITE-HERMINE AREA

DESCRIPTION OF UNITS

Attikamagen Formation (Unit 1)

The Attikamagen Formation is typically composed of banded, biotite bearing quartzofeldspathic or pelitic schist/gneiss, with muscovite, K-feldspar, garnet, sillimanite or kyanite being additional significant phases locally. The compositional banding, which may be on a metre scale or greater, is not always apparent in small outcrops; where present, however it is generally parallel to S_1 the regional foliation defined by micas and other minerals, indicating that the unit has been penetratively folded and deformed. Locally, however, outcrops in which S_0 is not parallel to S_1, have been found, which are interpreted to be situated in fold hinges.

Metamorphic mineral assemblages in the Attikamagen Formation suggest that metamorphic grade increases towards the east, a trend that has also been reported in the adjacent area to the north (Rivers 1980a). Kyanite is present in pelitic horizons in the west of both map areas, and is replaced by sillimanite in the east. Kyanite and fibrolitic sillimanite were found together in a thin section of a specimen from the east shore of Menistouc Lake. Muscovite is also present in the rock, and microstructural relations indicate that sillimanite is replacing kyanite. Furthermore, muscovite and quartz occur in the west of the map area, and are replaced by the equivalent mineral pair aluminum silicate - K-feldspar in the east. In the north of the Ashuanipi Lake map area, near the Labrador-Quebec border, the assemblage quartz-kyanite-biotite-plagioclase-garnet-magnetite-K-feldspar-muscovite (ragged and out of equibrium) was observed, whereas in the northeast of the Lac Petite-Hermine map area the equivalent assemblage is quartz-sillimanite-biotite-plagioclase-garnet-magnetite-perthite. Granitic veins and sweats are common throughout the map area in the Attikamagen Formation; they are typically small, discrete features parallel to the regional foliation (S_1), and have been described as lit-par-lit migmatites elsewhere (Rivers (1978).

The Attikamagen Formation is considered to be predominantly sedimentary in origin (Rivers, 1978) and probably represents a thick graywacke-shale sequence. At high metamorphic grades, however, it is difficult to distinguish metasedimentary from metaigneous rocks of similar composition, especially in areas of poor exposure, and some granitic sills and other small intrusions may be incorporated in the unit.

Shabogamo Intrusive Suite (Units 2 and 3)

Metagabbro, amphibolite and metapyroxenite (Unit 2)

The predominant lithology of the Helikian Shabogomo Intrusive Suite is massive to foliated, coarse grained metagabbro and subordinate amphibolite (Unit 2a). In most exposures the composition was noted as leucogabbroic, with plagioclase feldspar composing 60%

or more of the rock. Relict subophitic igneous textures are visible in many of the specimens, although in a few of the more deformed examples this is partially to completely obliterated by the tectonic foliation and amphibolite mineralogy. Metamorphic corona structures composed of colourless to green amphibole, garnet and less commonly biotite are ubiquitous, and frequently visible to the naked eye. They are interpreted to be due to reaction between primary plagioclase feldspar and mafic minerals (olivine, ortho-and clino-pyroxene and opaques) during metamorphism and partial hydration of these dry rocks (Rivers, 1980a). Ultramafic lithologies (Unit 2b) were noted in a few localities - these metapyroxenites, which are composed of orthopyroxene, clino-pyroxene, hornblende and minor carbonate, may represent basal cumulate units in some of the layered intrusions.

Although in this area of poor exposure, field relationships are difficult to determine in detail, the outline of the various bodies of gabbro in relation to the regional foliation suggests that many of them have the form of sills and thick sheets, especially in the southwest of the Ashuanipi Lake area. In the east of the map area two bodies have curved outlines at high angles to the regional strike, and may be situated in fold hinges. Stock-like forms are indicated by the shapes of some of the intrusions near the northeast corner of the Lac Petite-Hermine map area, a feature which is consistent with observations made elsewhere (Rivers, 1980a). Sills and sheets appear to be the typical mode of emplacement near the Grenville Front Tectonic Zone, with stocks becoming more common in the interior Grenville Province.

Many of the gabbroic bodies are associated with a characteristic high magnetic signature, which has enabled them to be traced through regions of poor exposure.

Metadiorite (Unit 3)

The several intrusions of diorite which have been recorded in the map area show some variation in composition, though it is probable that they are all genetically related. These rocks are typically grayish with grain size varying from coarse to fine. The most common mafic minerals are biotite and hornblende, but many of the specimens examined also contain clinopyroxene and more rarely orthopyroxene (hypersthene), with the latter two minerals showing signs of replacement by the former. Relict plagioclase phenocrysts (composition not determined) are visible in some of the specimens, but quartz has not been observed. Several bodies contain rounded inclusions 1 cm to 1 m in diameter of more mafic igneous rocks, which generally show sharp contacts with their host. A "Neohelikian" basic metavolcanic mapped by Jackson (1976) appears to be fine grained diorite

Several features suggest that the metadiorites are genetically associated with the metagabbros of Unit 2, and therefore should be included within the Shabogamo Intrusive Suite. The two lithologies are frequently closely associated in the field, and the presence of clinopyroxene and orthopyroxene in the metadiorite invites comparison with these minerals in the metagabbro. Microchemical analyses of pyroxenes from both lithologies are required to confirm this hypothesis. Lastly, the mafic enclaves in the metadiorite are gabbroic in composition, and resemble fine grained gabbro of the Shabogamo Intrusive Suite north of the map area (Rivers, 1980a). This suggests that the two magmas were intimately associated, with the metadiorites being either a younger differentiate or a hybrid contaminated rock. Geochemistry is needed to resolve this problem.

Granitoid Intrusions (Unit 4)

Two distinct types of granitoid rocks occur in the map area, which are grouped together as Unit 4 in this report.

Unit 4a is an adamellite or type 3b granite in the terminology of Streckeisen (1976). It was observed at the south end of Menistouc Lake near the Labrador - Quebec border, where it is a medium to coarse grained, leucocratic, weakly foliated rock consisting of plagioclase and K-feldspar in approximately equal proportions, quartz, biotite and minor muscovite and magnetite. A weakly developed gneissic layering is seen in some outcrops. An interesting feature of one of the outcrops is the presence of small, coarse grained elongate inclusions of biotite, garnet and kyanite and numerous coarse grained pegmatitic sweats, both of which are aligned approximately north/south parallel to the regional foliation. The pelitic inclusions are presumably derived from the Attikamagan Formation, and their refractory composition suggests that there may be a genetic association between the two units, and that Unit 4a is an S-type granitoid (terminology of Chappell and White, 1974).

Unit 4b, metamorphosed porphyritic granodiorite is exposed at the south end of Grande Ile in Ashuanipi Lake. Phenocrysts of microcline and zoned plagioclase feldspar up to 6 cm long are aligned in a strongly foliated matrix of ribbon quartz, feldspar and biotite with minor magnetite. Large poikilitic crystals of sphene, locally associated with garnet and apatite, are also a feature of this unit. The relationship of Unit 4b with Unit 4a or the Shabogamo Intrusive Suite (Units 2 and 3) is not known, but the presence of a foliation in the unit indicates that it was emplaced prior to the Grenvillian Orogeny.

STRUCTURAL GEOLOGY

Structural trends in the area are predominantly north to northwest, with a few measurements being at high angles to these directions. These are interpreted to be the locations of fold closures in a region of tight to isoclinal folding.

Comparison of the structural pattern with that mapped in areas to the north and northeast (Rivers, 1978; 1980a; 1980c) suggests that these interpreted fold closures are the regional F_3 structures, which here, as elsewhere, do not have a penetrative axial planer fabric associated with them. The foliation and subparallel compositional layering which is folded by the F_3 folds is considered to be a D_1 feature. Regional D_2 structures have not been observed in the map area, and it appears that these may be developed mainly in the Grenville Front Tectonic Zone (Rivers, 1978; 1980c; Rivers and Massey, 1979).

METAMORPHISM

Schists and gneisses in the Attikamagen Formation of pelitic composition furnish several indications of the grade of metamorphism during the Grenvillian Orogeny. The presence of kyanite in the west of the map area indicates that pressures were above the aluminum silicate triple point, and occurrences of sillimanite in the south and east of the map area indicate that metamorphic grade was increasing in that direction (*i.e.* towards the interior Grenville Province). The disposition of the kyanite - sillimanite isograd appears to be a rather wavy line, but may trend approximately northeast.

The presence of the mineral pair, muscovite + quartz, in the west of the map area, and the equivalent mineral pair, aluminum silicate + K-feldspar, in the east is another useful metamorphic indicator, in particular since both aluminum silicates (kyanite and sillimanite) were observed to coexist with K-feldspar. These observations pinpoint the P-T conditions on a petrogenetic grid quite precisely, as the position where the steep positive slope of the muscovite (in the presence of quartz) breakdown reaction intersects the more gentle slope of the kyanite - sillimanite reaction. Inspection of the theoretically and experimentally

calibrated P-T grid of Hess (1969) suggests that pressures were 6-7 kb and temperatures were 700 - 750°C during the Grenville Orogeny.

ECONOMIC GEOLOGY

No showings of economic interest were observed in the map area. Concentrations of magnetite occur in gabbro of the Shabogamo Intrusive Suite, but these are thought to be of insufficient size to warrant follow-up investigations.

RANNIE LAKE AREA

DESCRIPTION OF UNITS

Ashuanipi Metamorphic Complex (Unit 1)

The Archean Ashuanipi Metamorphic Complex is composed of a banded migmatitic gneiss of granodioritic to dioritic composition, similar to that mapped further south (Rivers and Massey, 1979; Rivers, 1980c). Bands, lenses and boudins of foliated dioritic gneiss are typically included in pyroxene bearing granitic rocks with igneous textures.

Knob Lake Group (Units 2 - 4)

In the boundary region with the Ashuanipi Metamorphic Complex, only the upper part of the Knob Lake Group, *i.e.* the Wishart, Sokoman and Menihek Formations, is present.

Wishart Formation (Unit 2)

The Wishart Formation was found in a single large outcrop close to the anticipated position of the Archean - Aphebian unconformity. In this locality it is predominantly composed of a coarse conglomeratic quartzite (granule conglomerate), which is essentially of identical composition to the underlying gneisses. Clasts consist of single grains and small grain aggregates of gneissic material, and at first glance the lithology appears similar to the gneisses themselves. Prominent features include blue quartz pebbles and feldspar phenoclasts up to 3 cm in size derived from the coarse grained leucocratic phase of the basement gneisses. The thickness of the conglomeratic quartzite unit could not be measured in the field, but it is unlikely to exceed 20 m.

The local provenance and thin vertical extent of this unit suggest that it may be infilling depressions on an irregular unconformity surface, and thus is not everywhere present. If this is the case, the younger Sokoman Formation may have locally onlapped over the Wishart Formation onto the basement.

Sokoman Formation - Unit 3

The Sokoman Formation is principally composed of carbonate and cherty carbonate iron formation in this area. Carbonate iron formation weathers a characteristic orange-red colour, rendering the unit highly distinctive. Massive chert beds are commonly interlayered with the carbonate, and these have recrystallized to quartzite; carbonate pisoliths in a cherty quartzite matrix have been observed in some outcrops. Magnetite and hematite rich layers occur locally, and the unit as a whole has a strong magnetic signature. Although outcrop distribution is poor, it appears that iron oxides become more abundant away from the unconformity, suggesting that the lower iron formation lithologies are predominantly of the cherty carbonate variety.

Many outcrops show evidence of leaching and secondary mobilization of iron and manganese oxides, which by analogy with similar alteration elsewhere, probably took place in the Cretaceous (see Rivers, 1978).

Menihek Formation (Unit 4)

The Menihek Formation is composed of featureless gray slate in this area, with S_0 compositional layering subparallel to S_1 slaty cleavage in some

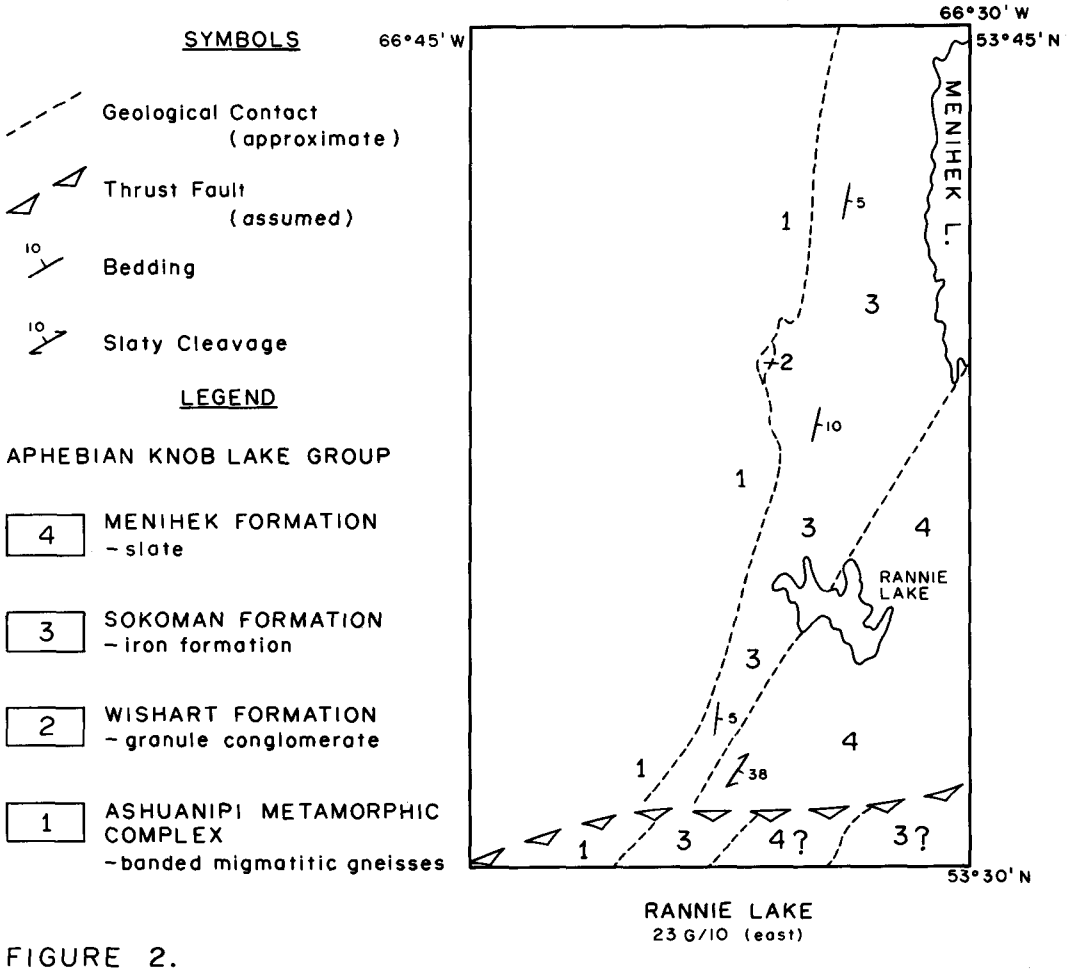

SYMBOLS
Geological Contact (approximate)
Thrust Fault (assumed)
Bedding
Slaty Cleavage
LEGEND
APHEBIAN KNOB LAKE GROUP
4 MENIHEK FORMATION - slate
3 SOKOMAN FORMATION - iron formation
2 WISHART FORMATION - granule conglomerate
1 ASHUANIPI METAMORPHIC COMPLEX - banded migmatitic gneisses
66°45' W
66°30' W
53°45' N
53°30' N
MENIHEK L.
RANNIE LAKE
RANNIE LAKE
23 G/10 (east)

FIGURE 2.

outcrops, but discordant in others. Locally, small non-penetrative F_2 folds with northeast to easterly trends and steep axial surfaces were seen.

STRUCTURAL GEOLOGY AND METAMORPHISM

With the exception of the Menihek Formation, the Aphebian units appear undeformed. The Menihek Formation, however, which is exposed in the south of the map area, carries the imprint of two deformations which are interpreted to be of Grenvillian age. S_1 slaty cleavage is a penetrative feature, whereas F_2 folds and crenulations are nonpenetrative; similar relationships were observed in the map area to the south (Rivers 1980d). These fabrics occur over 30 km north of the previously known northerly limit of Grenvillian deformation.

Grenvillian metamorphism in the map area is of very low grade. Quartz in iron formation has recrystallized, and the slate of the Menihek Formation consists of very fine grained, quartz-muscovite-feldspar slates with opaques (including graphite) disseminated along slaty cleavage planes.

ECONOMIC GEOLOGY

The four lithologies in the map area are not considered to have economic potential; iron formations present are of lower grade and thinner than elsewhere in the Labrador Trough.

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