THE GEOLOGY OF THE RIGOLET REGION, LABRADOR

by

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INTRODUCTION

This report summarizes the initial results of reconnaissance mapping at 1:100,000 scale conducted in the Rigolet region during the 1980 field season. The work is part of a broader project to remap the Grenville Province in eastern Labrador. This project was started in the Sandwich Bay area (Cherry, 1978a, 1978b) and continued in the Benedict Mountains region (Gower, 1980).

One specific objective of the 1980 field season was to map as much of the intervening district as possible in an attempt to establish continuity between previous remapping. Another important consideration is that the region is on strike with the Double Mer area (Bailey, 1980), where uranium mineralization has been found.

PREVIOUS WORK

The region is located near the northern margin of the Grenville Province, as recently redefined by Gower *et al.* (1980). The early work in the region was done by Daly (1902), Kindle (1924), Douglas (1953), Christie *et al.* (1953), and Kranck (1939, 1953). Their investigations were mainly confined to descriptions of specific coastal localities.

The first systematic mapping was completed by Eade (1962) and Stevenson (1970). Stevenson's 1:250,000 scale map includes the northern half of the Rigolet region and shows the area as underlain by banded and migmatitic, granitic and amphibolitic gneiss. Poorly exposed areas are generally interpreted as paragneisses. The southern half of the Rigolet region is covered by the 1:500,000 scale map of Eade. The district is shown as mainly granitic gneiss but areas of paragneiss, massive to poorly foliated granitoid rock, and anorthosite/anorthositic gabbro are also delineated.

No geochronological data are available within the region. Grasty *et al.* (1969) report a whole rock K/Ar age of 1128 ± 10 Ma from a hornblende lamprophyre dike on North Stag Island immediately east of the map area (latitude 54°05', longitude 57°10'). Emslie (1976) quotes K-Ar ages of 1533 ± 45 Ma and 1400 ± 57 Ma on hornblendes from the Mealy Mountains Intrusive Suite and Gittins (1972) reports K/Ar whole rock ages of 1123 ± 50 Ma and 1078 ± 48 Ma on basaltic dikes intruding the Mealy Mountains Intrusive Suite.

DESCRIPTION OF UNITS

Paragneisses (Unit 1)

Unit 1 embraces a range of upper amphibolite facies metamorphic rocks interpreted as paragneisses. Rock types include quartzite, marble, sillimanite + garnet pelitic schists, garnet+biotite psammitic schists and some more mafic rich layers which may have been derived from a mafelsic pyroclastic protolith.

The most extensive areas of quartzite occur in the southwest part of the region and are best exposed on the shore of Lake Melville south-southeast of St. John Island. Here they are gray, white, and pink weathering, massive to thickly layered orthoquartzites with some biotite rich partings. About 15 km farther east orthoquartzite is interlayered with rusty weathering quartz + feldspar + biotite + garnet psammitic schists, possibly sillimanite bearing.

LEGEND

HADRYNIAN

14 Double Mer Formation: Red conglomerate and arkose.

HELIKIAN OR EARLIER

13 Gabbro, leucogabbro, diabase; some ultramafite and anorthosite; metamorphosed in part; includes Michael Gabbro.

12 Mealy Mountains Intrusive Suite: Anorthosite and anorthositic gabbro.

11 Medium to coarse grained, pale pink syenite to alkali feldspar quartz syenite; locally monzonite; massive to foliated.

10 Medium grained, gray, monzonite to quartz diorite; strongly foliated and/or lineated.

9 Medium grained, pink to red, syenite to monzonite, grading into hornblende granodiorite; foliated to gneissic.

8 Medium to coarse grained, pink, biotite granite to granodiorite; massive to foliated.

7 Coarse grained, pink to buff, seriate textured hornblende granodiorite; foliated.

6 Coarse grained, pink, megacrystic, biotite granodiorite; augen gneiss in part; foliated to gneissic.

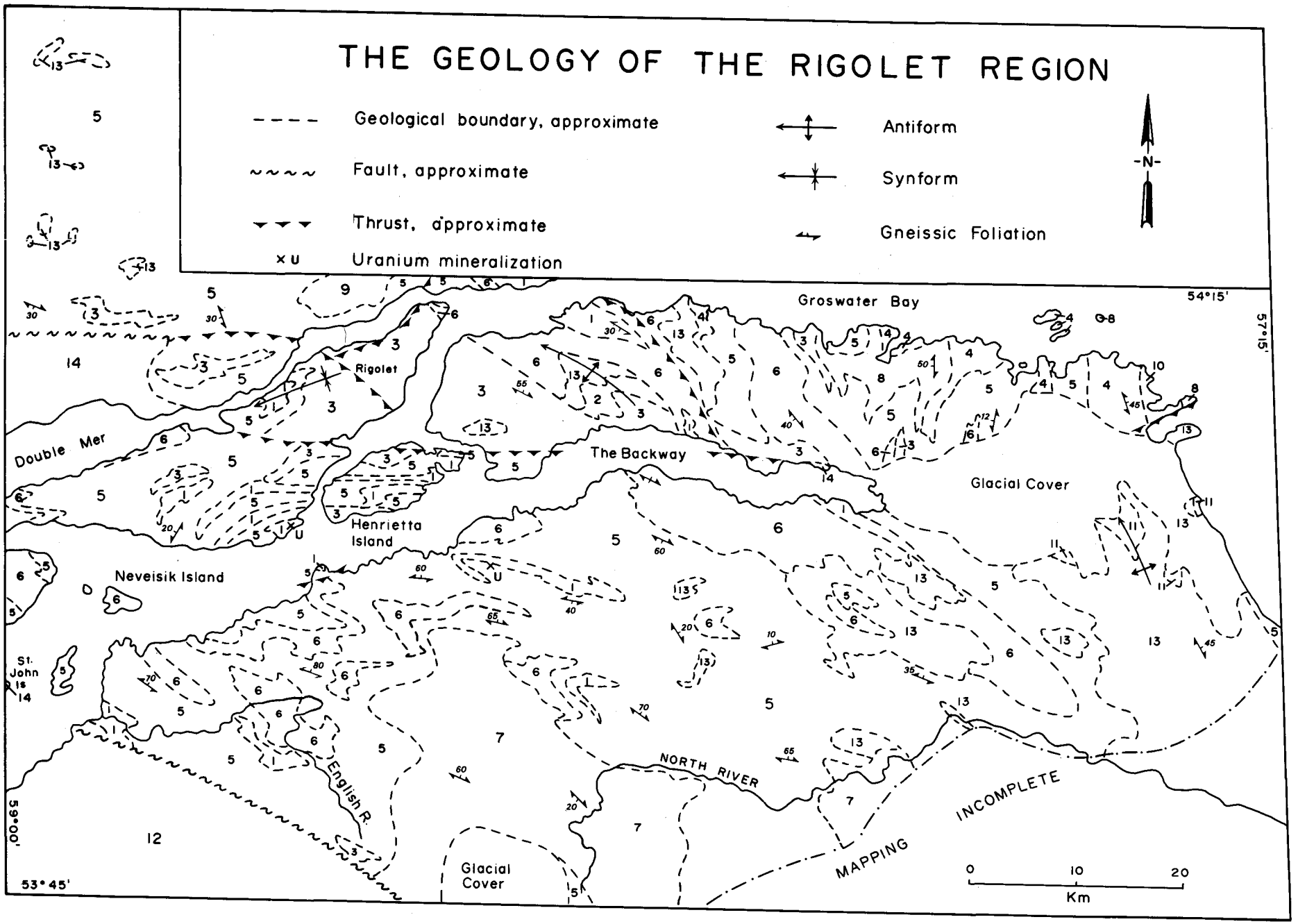
5 Medium grained, gray and pink, biotite and hornblende, granodiorite to tonalite gneiss; foliated to gneissic.

4 Medium grained, gray, biotite tonalite gneiss; discontinuously to well banded.

3 Medium grained, gray, hornblende quartz diorite to tonalite; foliated to gneissic.

2 Intercalated, medium grained, biotitic amphibolite and microgranite/aplite; discontinuous or "lensy" banded fabric (protolith possibly pyroclastic).

1 Quartzite, marble, sillimanite-garnet pelitic schists and garnet-biotite psammitic schists.


THE GEOLOGY OF THE RIGOLET REGION
Geological boundary, approximate
Fault, approximate
Thrust, approximate
Uranium mineralization
Antiform
Synform
Gneissic Foliation
-N-
Groswater Bay
54°15'
57°15'
Rigolet
Double Mer
The Backway
Glacial Cover
Henrietta Island
Neveisik Island
St. John Is
English R.
NORTH RIVER
INCOMPLETE MAPPING
Glacial Cover
59°00'
53°45'
0 10 20
Km

Elsewhere quartzite is a minor lithology and is associated with other metasediments. On the east end of Henrietta Island, white and rusty weathering quartzite occurs as a thinly to thickly layered rock generally less than 1 m wide. These are commonly muscovite, garnet, or sillimanite bearing. On the peninsula between Lake Melville and Double Mer, minor thinly and thickly layered quartzite is interlayered with biotite-rich schist.

Metacarbonate horizons associated with the metasediments range from almost pure marble to pale or dark green calc-silicate rocks containing abundant diopside and grossularite, and locally forsterite, spinel, and phlogopite. A spectacular white marble is exposed on the south side of Groswater Bay 15 km east-northeast of Rigolet. It has been intruded by pegmatite and a mafic dike, with both minor intrusions subsequently disharmonically deformed. Pink marble occurs as 20-30 cm wide layers associated with psammitic and pelitic schists west of Henrietta Island. Farther east, along strike, the rock contains abundant diopside with sphene, apatite, phlogopite, and forsterite. The calc-silicate layers occur as boudins enveloped in a quartzofeldspathic leucosome, probably derived from partial melting of the surrounding sillimanite + garnet pelitic schists.

A complete gradation exists between the biotite-rich pelites and the granoblastic quartz + feldspar psammites but both rocks are characterized by a mauve-colored (? spessartine) garnet. There is little doubt that the pelitic schists were derived from sediments, but it is by their common association with marble or quartzite that the psammites are also interpreted as metasediments.

Flaggy quartzofeldspathic schists, with parallel partings defined by hornblende rich layers, occur on the north side of Groswater Bay, 10 km northeast of Rigolet. These rocks contain 20-30% garnet and are locally scapolite bearing. Some rocks have a mesoscopic lensoid fabric suggestive of a pyroclastic origin; elsewhere, they are plagioclase rich and resemble layered anorthositic gabbro. These rocks are shown on the map as part of Unit 1 but a more complete subdivision of units can be anticipated pending more detailed study.

White weathering, inhomogeneous and homogeneous diatexites are closely associated with the pelitic schists. The best outcrops occur west of Henrietta Island on the north shore of Lake Melville. The rocks have a variable pegmatoid appearance related partly to extreme grain size variation, mineralogical inhomogeneity, and irregular rafts of restite materials. The diatexites extend for tens of metres across strike and hundreds of metres along strike.

Banded mafic gneiss (Unit 2)

The principle lithology is a hornblende + plagioclase + biotite + garnet rock which is generally medium grained, dark weathering, and has a well banded appearence due to alternation with a quartzofeldspathic leucosome. Commonly, the rock has a 'clotty' appearance and exhibits lensoid garnet rich enclaves. Three possible protoliths are being evaluated, namely, (i) a mafic to mafelsic pyroclast, (ii) a mafic rich graywacke, and (iii) an injected and metasomatized mafic intrusion.

Quartz diorite (Unit 3)

The most extensive development of quartz diorite is in the Rigolet area where it has been deformed into a west plunging synform. It also occurs along the north shore of The Backway, on the south side of Henrietta Island, and is interpreted to underlie the unexposed area immediately east of Rigolet.

The gneissic fabric varies from foliated to well banded and, characteristically, the rock contains irregular discontinuous, pink weathering, leucosome patches that appear to be the product of *in situ* partial melting. In places, these patches are flattened and accentuate layering. Zones containing abundant amphibolite are also present and some layers are recognizable as relict mafic dikes. Elsewhere, they have suffered injection and deformation resulting in amphibolitic gneiss.

Other textural variants include rare, sparsely megacrystic (K-feldspar), quartz diorite and hornblende-bearing granodioritic gneiss, similar to Unit 5 in part.

Tonalitic and granodioritic gneiss (Units 4 and 5)

Biotite tonalitic gneiss (Unit 4) has been distinguished provisionally from granodioritic gneiss (Unit 5) but it is probable that considerable overlap exists between these two units. Refinement of their distribution pattern can be expected after examination of stained slabs and thin sections. Both units encompass a wide range of foliated and gneissic rocks with migmatitic fabric embracing the complete spectrum from agmatite to nebulite. Banding is enhanced by amphibolite enclaves and 5-30% leucosome. Biotite, hornblende and garnet are ubiquitous mafic phases and magnetite is the most common opaque mineral. As a broad generalization, Unit 5 can be considered as equivalent to Unit 4f of Gower (1980).

These gneisses are unequivocally the product of both pre-Grenvillian and Grenvillian deformation. This is demonstrated by the presence of mafic dikes that discordantly intrude gneisses but are themselves metamorphosed to amphibolite facies rocks and reworked to become part of a later (Grenvillian) gneissosity.

Megacrystic granodiorite (Unit 6)

The megacrysts (1-5 cm) in this unit occur as unrecrystallized single crystals or polygonal aggregates. Deformation has converted both megacryst types to augen and, in extreme cases, has produced augen gneiss. Locally, e.g. 10 km east of Rigolet, two generations of K-feldspar megacrysts are present. Biotite is the principle mafic phase of this unit.

There are some areas, *e.g.* Neveisik Island, where the megacrystic granodiorite is a homogeneous, extensive unit quite distinct from the granodiorite gneiss of Unit 5. However, the two units commonly have gradational boundaries and may occur as interlayered lithologies within a single outcrop. The megacrystic granodiorite may be partly a younger unit emplaced into an older gneiss terrane and partly equivalent in age to the gneisses.

Hornblende granodiorite (Unit 7)

A large portion of the central part of the southern half of the map area is underlain by a coarse grained, homogeneous granodiorite. The unit was identified originally by Eade (1962) but its extent depicted here is greatly expanded from that previously shown.

The unit is characteristically a pinkish buff/orange weathering rock. Hornblende is the dominant mafic phase, though biotite and, more rarely, garnet are also found. The unit is homogeneous and moderately to strongly foliated. It seems to lack the deformed mafic dikes that characterize previously described units and, hence, is possibly younger.

Biotite granite (Unit 8)

Pink weathering granite is exposed on the south side of Groswater Bay, 40 km east of Rigolet. A similar lithology is present farther east along the coast and on offshore islands, and is grouped as part of the same unit.

The granite is medium to coarse grained, leucocratic and homogeneous. Biotite and magnetite are the principle mafic phases. The fabric varies from massive to strongly foliated and/or lineated. In places, the rock contains diffuse, streaked out, K-feldspar-enriched segregations. The rock has been intruded by up to three generations of mafic dikes, all of which have been affected by amphibolite facies metamorphism.

Syenite to monzonite (Unit 9)

Unit 9 occurs in only one area northwest of Rigolet. It is generally pink weathering and medium grained and contains recrystallized plagioclase crystals up to 1 cm in diameter. These are set in a matrix composed of K-feldspar, hornblende, biotite, and quartz. The fabric varies from massive or weakly foliated to nebulitic or schlieritic.

Monzonite to quartz diorite (Unit 10)

Typically, this unit is a honey weathering, coarse grained rock with a strong lineation. Its mineralogy is primarily hornblende, plagioclase and K-feldspar with lesser amounts of biotite, quartz and garnet. Apart from rare mafic enclaves, the rock has a uniform appearance.

Syenite to alkali feldspar syenite (Unit 11)

Unit 11 occurs exclusively in the eastern part of the map area and, from limited data, seems to have a spatial association with the gabbroid rocks of Unit 13. Hornblende is the dominant mafic phase. In places, a finer grained, slightly more mafic syenite is present. The unit is locally interlayered with a coarse grained, pink weathering granite.

Mealy Mountains Intrusive Suite (Unit 12)

The Mealy Mountains Intrusive Suite has been mapped recently by Emslie (1976) and was only briefly examined during the present project. Emslie's sketch map shows most of the Mealy Mountains Intrusive Suite in the map area as comprising anorthosite and leucogabbro, but he also shows a northeast fringe of pyroxene quartz monzonite. He notes that, elsewhere, dikes of pyroxene quartz monzonite intrude anorthosite.

The shoreline in the map region was examined during the present project and found to consist of pyroxene and hornblende bearing anorthosite containing enclaves of amphibolite and quartzofeldspathic gneiss. East-northeast trending olivine diabase dikes, previously described by Emslie (1976) and dated by Gittins (1972), are also present.

Gabbroid rocks (Unit 13)

A range of gabbroid lithologies and of varied probable age are included within Unit 13. Only the large areas are shown on the accompanying sketch map but mafic sheets and irregular bodies are ubiquitous.

The gabbros in the southeast part of the region were assigned by Eade (1962) to the Anorthosite Suite but Stevenson (1970) grouped these gabbros, and all others in the region as part of the Michael Gabbro (Fahrig and Larochelle, 1972). The southeastern gabbros are thick sheets folded about north trending axes. They are massive, homogeneous, medium or coarse grained, and tend to anorthositic composition. They may be genetically distinct from the smaller gabbroid masses characteristic of the north side of Groswater Bay.

This is clear evidence of at least two phases of pre-Grenvillian mafic dike activity. The older dikes have been deformed into tight to open folds and are discordantly intruded by younger dikes.

East-northeast trending mafic dikes intrude gneisses formed during the Grenvillian Orogeny, implying a later period of diking. These have the same

trend as a suite of dikes that intrudes the Mealy Mountains.

In the eastern part of the area, there are pronounced north-northeast trending aeromagnetic anomalies which, east of Cartwright (outside the map area), are clearly related to mafic dikes. Farther south (*e.g.* Belle Isle), these dikes have been demonstrated as related to early Paleozoic volcanism (Strong and Williams, 1972).

Double Mer Formation (Unit 14)

The Double Mer Formation is a sequence of post-Grenvillian red arkoses and conglomerate described by Kindle (1924) and Stevenson (1970). A previously unrecognized outlier of Double Mer conglomerate was mapped near the east end of The Backway. The conglomerate is polymictic with clasts of gabbro (the dominant lithology), anorthosite, augen granodiorite, amphibolite, and quartzite.

Several neptunian dikes containing Double Mer material were identified on Neveisik Island and along the shoreline immediately to the south. Emslie (1976) reports neptunian dikes at lake level within the Mealy Mountains Anorthosite Suite, and points out that this implies that the Mealy Mountains (and presumably the surrounding gneisses) were uplifted prior to the deposition of the Double Mer Formation.

STRUCTURE AND METAMORPHISM

The fold pattern is extremely complex and no overall synthesis has been attempted so far. From detailed structural relationships, it is clear that final stages of deformation developed a dome and basin structural pattern. This is Grenvillian in age and is superimposed on older gneisses containing many examples of refolded folds.

Thrust faults in the area are defined by zones of brecciation or mylonitization and abundant secondary epidote and hematite. Aeromagnetic lows assist in tracing the position of some thrusts. The east trending thrust extending from Double Mer to The Backway is probably the best defined. Recumbent, north-verging folds are associated with the thrust and are well exposed at the east end of Henrietta Island and the shoreline immediately east. Aeromagnetic data and contrasting geological style suggest that there may be an additional thrust, or strike-slip fault, extending southeast from the east end of The Backway.

A fault is inferred to bound the northeast side of the Mealy Mountains Intrusive Suite on the basis of contrasting aeromagnetic trends on either side of a strong topographic lineament.

Metamorphic grade is at upper amphibolite facies but retrograde greenschist effects have developed along zones of thrusting. Some of the more diagnostic mineral assemblages include: calcite + grossularite $\pm$ diopside $\pm$ forsterite $\pm$ spinel $\pm$ phlogopite; quartz + plagioclase + biotite $\pm$ garnet $\pm$ sillimanite; quartz $\pm$ biotite $\pm$ garnet $\pm$ muscovite; and hornblende + plagioclase $\pm$ garnet $\pm$ quartz $\pm$ biotite. There is evidence of incongruent partial melting with the formation of hornblende or garnet porphyroblasts. As in many metamorphic terranes, partial melting seems to have acted as a buffer against granulite facies metamorphism.

MINERALIZATION

The paragneisses offer the greatest economic mineral potential in the region, especially for uranium mineralization. Diatexites associated with paragneiss commonly gave total count readings over 10,000 counts per second (cps). At two localities, readings of 21,000 cps and 34,000 cps were recorded. In the latter case, the diatexite was stained yellow by what are believed to be secondary uranium minerals.

In addition, the paragneisses are extremely pyritic and show minor malachite staining. In three localities, specks of molybdenite were noted; namely, in diatexite, a calc-silicate layer, and a quartz vein. A 3 m thick pyritic layer was found associated with amphibolite and microtonalite (probably a metagraywacke) on the south side of Groswater Bay 15 km east of Rigolet.

Mineral occurrences in other lithologies are rare. Chalcopyrite was found in pegmatite within a gabbro near the east end of Groswater Bay and is associated with calcite, tourmaline, quartz, and magnetite-ilmenite. Similar mineralization, malachite staining of quartz-calcite veins within gabbro, was found at the east end of The Backway.

ACKNOWLEDGEMENTS

Excellent field assistance was given by L. Green, A. Hopkins, M. Roberts, and M. Tubrett. Pilot services were provided by M. Burns of Labrador Airways and D. Abrahams and J. Danby of Universal Helicopters. Logistical support from Goose Bay was provided by E.W. Tuttle and E.J. Tuttle of the Department of Mines and Energy.

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