GEOLOGICAL MAPPING IN THE SANDWICH BAY AREA, SOUTHEASTERN LABRADOR

by M. Cherry

INTRODUCTION

A geological mapping program in the Grenville Province was begun in the Sandwich Bay area of southeastern Labrador. The area examined during the 1977 field season included all or part of map sheets 13H/5, 13H/6, 13H/10, 13H/11, 13H/12, 13H/14 and 13H/15 (N.T.S. 1:50,000).

The geology of southeastern Labrador is only poorly known. Early mapping (Christie, 1951; Kranck, 1953; Douglas, 1953) along the coast has delineated occurrences of gabbro, amphibolite, granite and anorthosite within the granitic gneisses that underlie much of the Grenville Province. Mapping in the interior (Piloski, 1955; Eade, 1962; Kranck, 1966) has defined a discontinuous belt of paragneisses extending from Alexis Bay to Sandwich Bay. Recent mapping by Wardle (1977) has provided a detailed structural and metamorphic history of the geology of the Francis Harbour - Snug Harbour area and proved the previously mapped unit of paragneisses in the Alexis Bay area to be granite and granite gneiss. The present program was begun in terrain previously believed to be underlain partly by the "paragneiss" unit and to be an extension of the area mapped by Wardle.

GENERAL GEOLOGY

Exposure is generally good along the coastal strip but is poor inland, making regional mapping difficult. There are good exposures along the Eagle and Paradise Rivers but these are boulder strewn and can be navigated with difficulty only by experienced canoeists. The inland area is best reached by helicopter.

Contacts between the major rock units are generally gradational and parallel to the regional foliation. Consequently, the relative ages of many of the units are uncertain. Radiometric dating of the gneisses has given the age of the Grenville orogeny; only the anorthosites and the post-Grenville mafic rocks have given radiometric ages interpreted to correspond with their intrusive ages.

Unit 1. Schlieric migmatite gneiss[1]

Schlieric migmatite gneiss is the most extensive rock type in the area. The neosome of this unit is a foliated, gray, medium to coarse grained tonalite ranging to granodiorite and adamellite. The neosome comprises 20 to 60 percent of the rock. Schlieren are composed of fine grained, black, biotite hornblende gneiss and minor amphibolite. They are elongate in the foliation and range from several centimetres to tens of metres in length. Larger schlieren are present in areas with relatively small amounts of neosome.

The texture of this unit varies from agmatitic to mylonitic. Agmatitic zones are composed of directionless leucocratic neosome veins in an amphibolitic gneiss paleosome. These zones are gradational into the typical schlieric migmatite gneiss, which comprises approximately equal amounts of neosome and paleosome. Mylonitic zones are up to 75 m wide but are commonly 20 to 30 m wide. Mylonitic texture overprints the migmatitic texture over a width of approximately 3 m.

The schlieric migmatite gneiss has been intruded by at least two generations of mafic dikes which have been transposed into parallelism with the foliation and recrystallized to biotite hornblende gneiss. In many occurrences these dikes are boudinaged and intruded by the neosome of the migmatite gneiss. Granitic pegmatite

veins 10 cm to 3 m thick and composed of broken and bent crystals crosscut the foliation, as do massive quartz veins.

There are several occurrences of peridotite and pyroxenite within the schlieric migmatite gneiss. These are less than 20 m in largest dimension and are oval in outline. They have massive interiors and foliated margins. Most are garnetiferous, with the garnets being more abundant near the margins. It is not known whether these bodies are xenoliths or plugs intruded into the migmatite.

Isoclinal folding of the foliation can be seen in many outcrops of the schlieric migmatite gneiss. The unit has been metamorphosed to upper amphibolite facies; biotite-garnet-amphibole assemblages are common.

Unit 2. Gabbro (2a) and amphibolitic gneiss (2b)

A medium to very coarse grained foliated gabbro outcrops along the Paradise River south and east of Crooked Lake. The gabbro has recrystallized to a distinctive texture with clots of pyroxene mantled by dark green amphibole (?) and chlorite (?) surrounded by gray to white plagioclase. Similar corona textures with pyroxene mantled by clinopyroxene and spinel have been described by Wardle (1977) in the White Bear Arm norite in the Alexis Bay area. Locally the gabbro grades into amphibolitic gneiss.

The amphibolitic gneiss is fine to medium grained and commonly contains inclusions of a more mafic gneiss aligned in the foliation of the amphibolite gneiss. Northeast of Crooked Lake, outcrops of biotite hornblende gneiss are intruded by a medium grained adamellite. Garnets are developed in the gneiss adjacent to the adamellite.

The age of unit 2 is uncertain. The gneiss is believed to be a marginal phase of the gabbro. No contacts with the surrounding gneisses were seen. The gabbro is similar to the White Bear Arm norite, considered by Wardle (1977) to be related to Elsonian anorthositic magmatism. Unit 2 may, therefore, be the same age as the anorthositic gabbro (unit 7) in the Cartwright area.

Unit 3. Granodiorite augen gneiss

Coarse grained, augen gneiss outcrops in the southeastern corner of the map area and in a tongue extending southeast from the Eagle River. It consists of plagioclase augen in a matrix of quartz, feldspar, biotite, amphibole and, rarely, garnet. Augen are 2 to 8 cm long and usually comprise approximately 50 percent of the rock. The matrix is fine grained and wraps around the large feldspar augen, defining a strong foliation. In the southeast, the augen gneiss contains inclusions of amphibolitic gneiss that are 3 to 5 m long and up to 1 m wide. The inclusions are cut by foliated aplitic veins up to 4 cm wide.

This unit is probably a granodiorite intruded into the schlieric migmatite gneiss (Unit 1) and the amphibolitic gneiss (unit 2b). It is much more mafic than the augen gneiss in the Cartwright area (unit 6b).

Unit 4. Flaggy adamellite gneiss (4a) and migmatitic gneiss (4b)

A flaggy, medium grained, well banded, gray to brick red garnet-muscovite-biotite-quartz-feldspar gneiss outcrops along the eastern shore of Sandwich Bay south of East Arm. The unit is characterized by abundant large (up to 1 cm) muscovite porphyroblasts developed in the foliation. K-feldspar porphyroblasts up to 2 cm in length are present in some outcrops, as are rare concordant amphibolite lenses. More abundant are 10 to 30 cm thick, fine grained, foliated, quartz-rich bands. Granitic pegmatite veins are common; these are both parallel to the foliation and aligned in the axial planes of open folds in the foliation. Some outcrops have remnant stromatic migmatite texture. The foliation in this unit dips shallowly to the south, in contrast with the steeply dipping foliation in the other gneisses.

A migmatitic garnet-muscovite-biotite-quartz-feldspar granodiorite gneiss (unit 4b) outcrops between the flaggy gneiss (unit 4a) and the schlieric migmatite gneiss (unit 1). It contains inclusions of the schlieric gneiss and has gradational contacts with both the flaggy gneiss and the schlieric gneiss. Muscovite and K-feldspar porphyroblasts are present and are more abundant closer to the flaggy gneiss. Fibrous sillimanite intergrown with biotite was found in one outcrop.

These gneisses may be paragneisses, with the quartz-rich layers representing quartzite beds in argillaceous sediments. Alternatively, they may have resulted from the deformation of a granite intruded into the schlieric gneiss. This process can be demonstrated for similar rocks (unit 6) northeast of Cartwright and is the preferred model for the origin of these gneisses, with unit 4b being a contaminated border phase of the granite. Both units (4a and 4b) were migmatized before the development of the banding and foliation.

Unit 5. Tonalite gneiss

A gray tonalite gneiss outcrops on the islands at the mouth of Sandwich Bay. The unit varies from a foliated schlieric migmatite gneiss to a well banded mylonite gneiss. Migmatitic outcrops comprise fine to medium grained, dark green amphibolite restite and schlieren of

dark gray tonalite gneiss in a medium grained, gray biotite-amphibole-garnet-quartz-feldspar tonalite gneiss neosome. K-feldspar porphyroblasts are common. Where mylonitic, the rock comprises alternating mafic and felsic rich bands 5 to 15 cm thick. Garnet and amphibole are more abundant in the mylonitic rocks than in the migmatites. Mylonitic zones have infrequent amphibolite bands which probably represent elongate restite fragments.

The tonalite gneiss has been intruded by unmetamorphosed gabbro (unit 10). The foliation in the gneiss is steepened and banding is better developed adjacent to the gabbro. Garnets are more abundant in the gneiss for approximately 5 m from the gabbro. Aplitic and granitic pegmatite veins are present in the gneiss and have also intruded the gabbro.

Outcrops of the tonalite gneiss on Huntington Island have polyphase folding with at least two fold events. This deformation suggests the rocks to be Paleohelikian or older.

Unit 6. Adamellite (6a) and deformed augen gneiss equivalent (6b)

A medium to coarse grained garnet bearing adamellite outcrops along the coast north of Cartwright. The texture of this unit varies from poorly foliated hypidiomorphic granular (6a) to augen gneiss (6b). Fine grained, well banded mylonite zones are common. The adamellite contains rafts of schlieric migmatite gneiss (unit 1) and of fine grained biotite-garnet amphibolitic gneiss. On the west side of Hare Bay, the adamellite changes to a well banded, fine grained, biotite-muscovite-garnet-quartz-feldspar gneiss over approximately 30 m. Muscovite occurs as large porphyroblasts in the foliation, which has shallow dips and is folded into open warps. Quartz rich layers 10 to 20 cm thick are common. This gneiss, which closely resembles the flaggy adamellite gneiss (unit 4a), is a mylonitized portion of the adamellite (unit 6a).

The augen gneiss contains abundant plagioclase and potassium feldspar augen in a fine grained biotite-amphibole-garnet-quartz-feldspar matrix. Many of the potassium feldspar augen have rapakivi mantles. Quartz rich layers similar to those in the adamellite are common. This gneiss contains rafts of schlieric migmatite gneiss (unit 1) and grades into anorthositic gabbro (unit 7a). It is considered to be a crushed portion of the adamellite.

Unit 7. Anorthositic gabbro (7a) and gabbro (7b)

Ophitic anorthositic gabbro (80 percent plagioclase, 20 percent pyroxene) outcrops immediately north of Cartwright. The gabbro is fresh, undeformed and coarse grained (pyroxene grains up to 5 cm long) in the center of the oval mass but fine grained, strongly foliated and garnetiferous at its margins. Veins of light gray adamellite are common near the margins and and veins of a more mafic gabbro intrude the anorthositic gabbro.

Coarse grained diabasic gabbro (unit 7b) intrudes leucocratic tonalite gneiss (unit 5) near Shoal Point on the south shore of Huntington Island. The gabbro grades into strongly foliated, medium grained amphibolite gneiss which is in sharp, parallel contact with the tonalite gneiss. Corona textures similar to those in the gabbro of unit 2 are common on the pyroxenes. Garnets are abundant in both the gabbro and the amphibolite gneiss. Both are also intruded by biotite-quartz-feldspar pegmatite veins up to 2 m wide.

The anorthositic gabbro grades into adamellite (unit 6a) along the shore north of Cartwright. The gabbro lightens in color and acquires an appreciable quartz content over a distance of 10 to 20 cm. No intrusive relationships were established between the two units.

The anorthositic gabbro is correlated with the Elsonian anorthositic magmatic event of Labrador and the gabbro on Huntington Island is believed to also be related to this event.

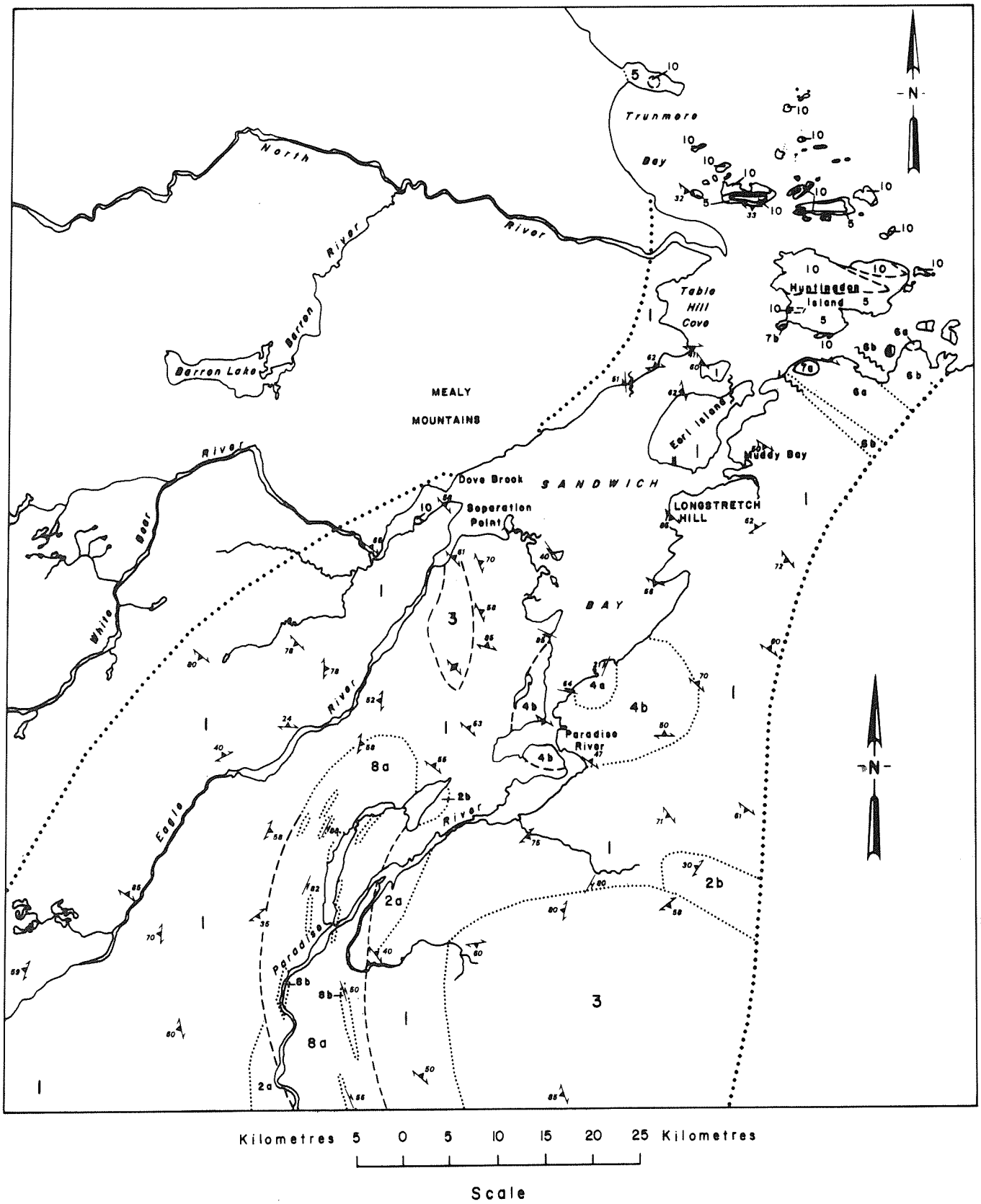
Unit 8. Crooked Lake gneisses

Quartzofeldspathic gneisses outcrop in a linear (25 x 8 km) belt around Crooked Lake south of Sandwich Bay. The gneisses occur as migmatitic (unit 8a) and mylonitic (unit 8b) garnet-biotite-quartz-feldspar granitic gneisses and were previously recorded as paragneisses (Eade, 1962).

The leucocratic migmatitic gneiss contains abundant biotite amphibolite gneiss layers that are 5 to 30 cm thick and comprise 10 to 50 percent of the rock. Biotite concentrations define a crude internal layering in the leucocratic bands of the gneiss. Two discontinuous bands approximately 60 m wide of a very weakly foliated, white graphite-garnet-quartz rock composed dominantly (90 to 95 percent) of quartz outcrop on the ridge between Crooked Lake and the Paradise River within the migmatite gneiss. Contacts are sharp and parallel to the foliation in the surrounding migmatite gneiss.

Zones of leucocratic, fine grained, well banded mylonite gneiss (unit 8b) are common in the migmatite gneiss. These are composed of alternating biotite rich and quartzofeldspathic bands from 5 to 25 cm thick. Amphibolite gneiss layers are present but are less abundant than in the migmatite gneiss.

The origin of these gneisses is uncertain. The


Trunmore
Bay
North
River
Barren
River
Barren Lake
MEALY
MOUNTAINS
Table
Hill
Cove
Huntingdon
Island
Earl Island
Muddy Bay
Dove Brook
SANDWICH
BAY
Seperation
Point
LONGSTRETCH
HILL
White
Bear
River
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Scale

LEGEND

PHANEROZOIC

10 **GABBRO:** *Undeformed plugs and sills.*

9 **DIABASE:** *Undeformed dikes.*

NEOHELIKIAN OR OLDER

8 **CROOKED LAKE GNEISSES: 8a,** *Migmatitic;* **8b,** *mylonitic.*

7 **ANORTHOSITE SUITE: 7a,** *Anorthositic gabbro;* **7b,** *deformed gabbro.*

6 **ADAMELLITE: 6a,** *Poorly foliated;* **6b,** *deformed augen gneiss equivalent.*

PALEOHELIKIAN OR OLDER

5 **TONALITE GNEISS:** *Leucocratic schlieric migmatite gneiss.*

4 **GRANODIORITE GNEISS: 4a,** *Flaggy, well banded, muscovite bearing gneiss;* **4b,** *muscovite bearing, schlieric migmatite gneiss.*

3 **AUGEN GNEISS**

2 **GABBRO: 2a,** *Deformed leucogabbro;* **2b,** *amphibolite gneiss.*

ARCHEAN

1 **SCHLIERIC MIGMATITE GNEISS**

SYMBOLS

Geological contact (defined, approximate, assumed) .....

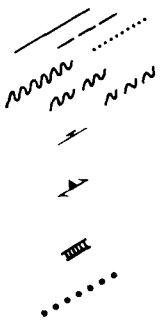
Mylonite/shear zone (defined, approximate, assumed) .....

Gneissic banding .....

Gneissic foliation .....

Dike .....

Limits of geological mapping .....



mylonitic gneiss is believed to be a crushed portion of the migmatite gneiss. The quartz rich bands may be metaquartzite beds in paragneiss or deformed massive quartz veins in orthogneiss. Sedimentary structures, conglomerates and calcsilicate layers previously reported (Piloski, 1955; Eade, 1962; Kranck, 1966) in these gneisses were not found. In some outcrops the amphibolitic gneiss bands can be identified as transposed, recrystallized mafic dikes; some of these are boudinaged and some cross the foliation in the leucocratic granitic gneiss at a very low angle. All of the units in the Crooked Lake gneiss belt have been intruded by biotite-quartz-feldspar pegmatite veins.

Unit 9. Diabase dikes

Several diabase dikes intrude the schlieric migmatite gneiss (unit 1) on Earl Island in Sandwich Bay. These are fresh, undeformed and have chilled margins. The dikes are usually less than 1 m wide; the largest is 30 m wide. Both the diabase dikes and the schlieric migmatite gneiss are intruded by feldspar phyric, aphanitic mafic dikes. An excellent example of back veining is displayed on the east side of Sandwich Bay south of East Arm where an aphanitic mafic dike has intruded the schlieric migmatite gneiss.

A K/Ar biotite age of 544±22 Ma has been obtained (Wanless *et al.*, 1970) from a similar diabase dike on the west side of Hare Harbour.

Unit 10. Gabbro sills

Coarse grained, ophitic gabbro has intruded the tonalite gneiss (unit 5) on the islands from Sandwich Bay north to Cape Porcupine. The gabbro occurs as sill-like masses with shallow dips, forming caps on the islands. Pegmatitic quartzofeldspathic veins extend into the gabbro from the tonalite gneiss.

Similar gabbro occurs as small pluglike bodies intruded into the schlieric migmatite gneiss (unit 1) on Earl Island and into the migmatitic adamellitic gneiss (unit 4b) near the community of Paradise River.

A K/Ar whole rock age of 505±8 Ma was obtained (Grasty *et al.*, 1969) for a sample of this gabbro from Shag Island north of Sandwich Bay.

STRUCTURE AND METAMORPHISM

Small scale isoclinal folding of the foliation can be seen in outcrops of all of the gneisses. The axial planes of these folds have steep to vertical dips, with the exceptions of those in the adamellite gneiss (unit 4) and the tonalite gneiss (unit 5). Exposures of the tonalite gneiss (unit 5) have polyphase folding, with at least two fold events.

The regional structure is probably a synform plunging to the southeast with the fold hinge passing through Sandwich Bay. This fold has a steeply dipping south limb and a shallowly dipping north limb. This regional structure has also been suggested by Eade (1962).

The ages of the folding and migmatitic events are uncertain. Migmatization occurred before the emplacement of the anorthositic suite, which is correlated with the Elsonian event. It seems most probable that much of the terrain is reworked Archean gneisses, retrograded from granulite facies metamorphism by the Grenville orogeny. All of the units except the younger mafic intrusions have been cataclastically deformed and have been metamorphosed to upper amphibolite (biotite-amphibole-garnet) facies. This deformation and metamorphism represent the Grenville orogeny.

ECONOMIC POTENTIAL

Malachite staining is present on the schlieric migmatite gneiss at Paradise Arm and chalcopyrite and malachite were reported (Douglas, 1953) in the same gneiss on the Eagle River. The Eagle River occurrence has been explored by diamond drilling by the British Newfoundland Exploration Company (BRINEX, 1966). Pyrite and pyrrhotite are common as scattered grains in the gabbro plugs and sills (unit 10). Several occurrences of pyrite, pyrrhotite and chalcopyrite were found in the Crooked Lake gneisses, commonly adjacent to pegmatite veins.

Small gossan zones up to 30 m long and 10 m wide are scattered throughout the schlieric migmatite gneiss. These are apparently due to disseminated pyrite and pyrrhotite in mafic rich layers of the gneiss.

Pegmatite veins in the map area have been reported to contain mica books up to 1 m in diameter. A mica occurrence in pegmatite near the Paradise River was handworked in 1910 (Douglas, 1953). A reported occurrence of large micas in pegmatite on Partridge Island (BRINEX, 1953) was not found. A scintillometer survey made of the pegmatites during the present mapping revealed no anomalously high radioactivity.

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Footnote

[1] The terminology used in this report to describe the textures of the migmatites is taken from Mehnert (1971).

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