Current Research (1992) Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 92-1, pages 399-412

GEOLOGY OF THE ALEXIS RIVER MAP REGION, GRENVILLE PROVINCE, SOUTHEASTERN LABRADOR

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ABSTRACT

The Alexis River map region, located in the Grenville Province, southeastern Labrador, is divided into three fault-bound crustal segments. These are the White Bear Arm complex, the Gilbert River belt and the Mealy Mountains terrane.

The White Bear Arm complex comprises gabbro and gabbronorite (consisting of original igneous textures and granulite-facies rocks having metamorphic textures) and enclaves of metasedimentary gneiss and granite. The Gilbert River belt consists of a series of northwest-trending belts of orthogneiss, metasedimentary gneiss, foliated K-feldspar megacrystic granite to granodiorite and non-megacrystic granite to granodiorite, and an extension of the Alexis River anorthosite. The Mealy Mountains terrane is underlain by variably foliated K-feldspar megacrystic granodiorite to granite, diorite, granodiorite and amphibolite orthogneiss, pelitic and psammitic metasedimentary gneiss and a large composite intrusion comprising variably recrystallized and deformed syenite to quartz monzonite (informally named the Upper Paradise River pluton).

Structure in the region is dominated by a northwest regional trend in the Gilbert River belt and a variable east to northwest trend in the Mealy Mountains terrane. Metamorphism attained upper amphibolite facies and there is evidence that granulite-facies conditions were locally reached.

INTRODUCTION

During the 1991 field season, systematic 1:100 000-scale mapping was carried out in the Alexis River region, within the Grenville Province, southeastern Labrador. The region comprises NTS 1:50 000-sheets 13A/11, 12, 13, and 14, and encompasses an area of approximately 3700 km^2 (Figure 1). Previous geological mapping within the region is included in a 1:500 000-scale geological map of Eade (1962). Based on isolated spot landings, he describes the area as being underlain predominantly by undifferentiated granitoid rocks, orthogneiss, and monzonitic to granodioritic rocks. Much of the western portion of the region has remained unmapped until the present study. Complete aeromagnetic map coverage at 1:250 000 and 1:50 000 scale is available for the region (Geological Survey of Canada, 1974a, b). A 1:250 000-scale, colour-shaded relief aeromagnetic map is also available for the region (Kilfoil, 1991). The adjacent Paradise River and Port Hope Simpson map regions to the north and east of the study area were mapped at 1:100 000 scale by Gower *et al.* (1985, 1987).

The western half of the region occupies a large plateau underlain by extensive fluvioglacial deposits, including eskers, dunes and sand plains. The central portion consists of large string bogs, muskeg and heavily wooded areas. Bedrock exposure is limited to elevated areas and along river valleys. The eastern portion, through which the Alexis River (and after which the map area is named) flows, is well exposed, particularly in the southeast corner, where extensive burned-over areas occur.

REGIONAL SETTING

The Alexis River map region is located within the Grenville Province, southeastern Labrador, and straddles three major lithostructural terranes (the Hawke River, Lake Melville and Mealy Mountains terranes, Figure 1; Gower *et al.*, 1987). The terranes are distinguished by different metamorphic, structural and radiometric characteristics. The distribution of rock units in the Alexis River map region is shown in Figure 2. The area has been divided into three major zones, following Gower *et al.* (1987). These include from north to south; the White Bear Arm complex (part of the Hawke River terrane), the Gilbert River belt (included in the Lake Melville Terrane), and the Mealy Mountains terrane. These zones are continuations of units mapped in the Paradise River and Port Hope Simpson map regions to the north and east, respectively, (Gower *et al.*, 1985, 1987). Geochronological data are not available within the area, but

This project is funded by the Canada–Newfoundland Cooperation Agreement on Mineral Development (1990-1994); project carried by Geological Survey Branch, Department of Mines and Energy, Government of Newfoundland and Labrador.

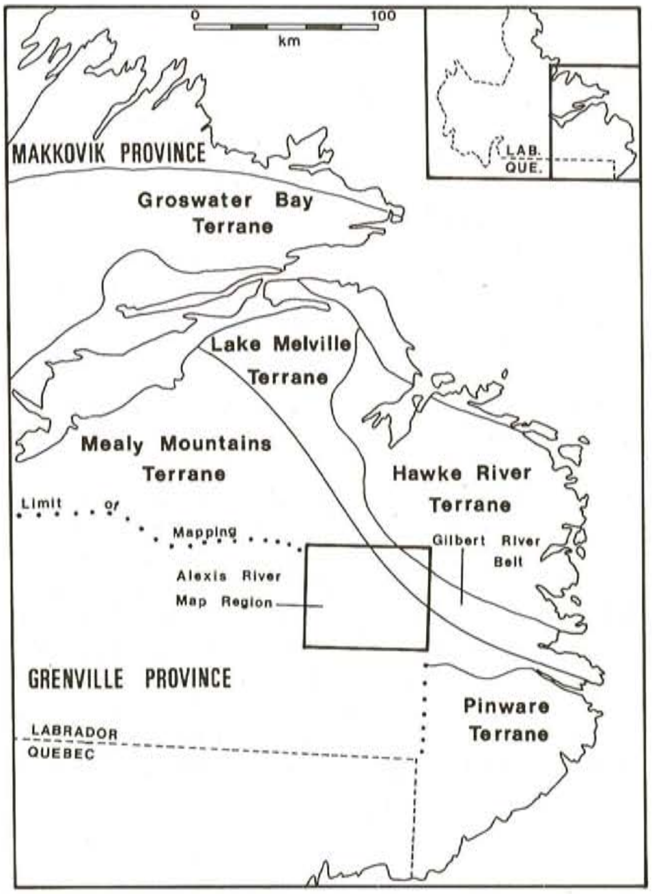


Figure 1. *Regional subdivision of the Grenville Province in eastern Labrador (after Gower* et al., *1988a), and location of the Alexis River map region.*

extrapolating from dated units in the above two regions suggests that the most of the rocks in the study area have ages between 1680 and 1630 Ma.

Figure 2 is a simplified version of a 1:100 000-scale map compiled from approximately 900 data stations. All samples collected were slabbed and stained (specifically for K-feldspar). Unit designators on Figure 2 follow the legend of Gower *et al.* (1988b, c). Age relations are not necessarily implied by the order of the number groups. For example, Unit 1 (orthogneiss) rocks are in some cases only strongly deformed equivalents of Unit 4 (foliated granitoid rocks). Nor are age relations implied by the order in which units are presented within each number group. Units 3 and 5 are omitted from use in the Alexis River map region, as these units are reserved for rocks of the Earl Island domain (Unit 3) farther north and presumed syn-Grenvillian granitoid rocks (Unit 5) to the east in the St. Lewis River map region.

WHITE BEAR ARM COMPLEX

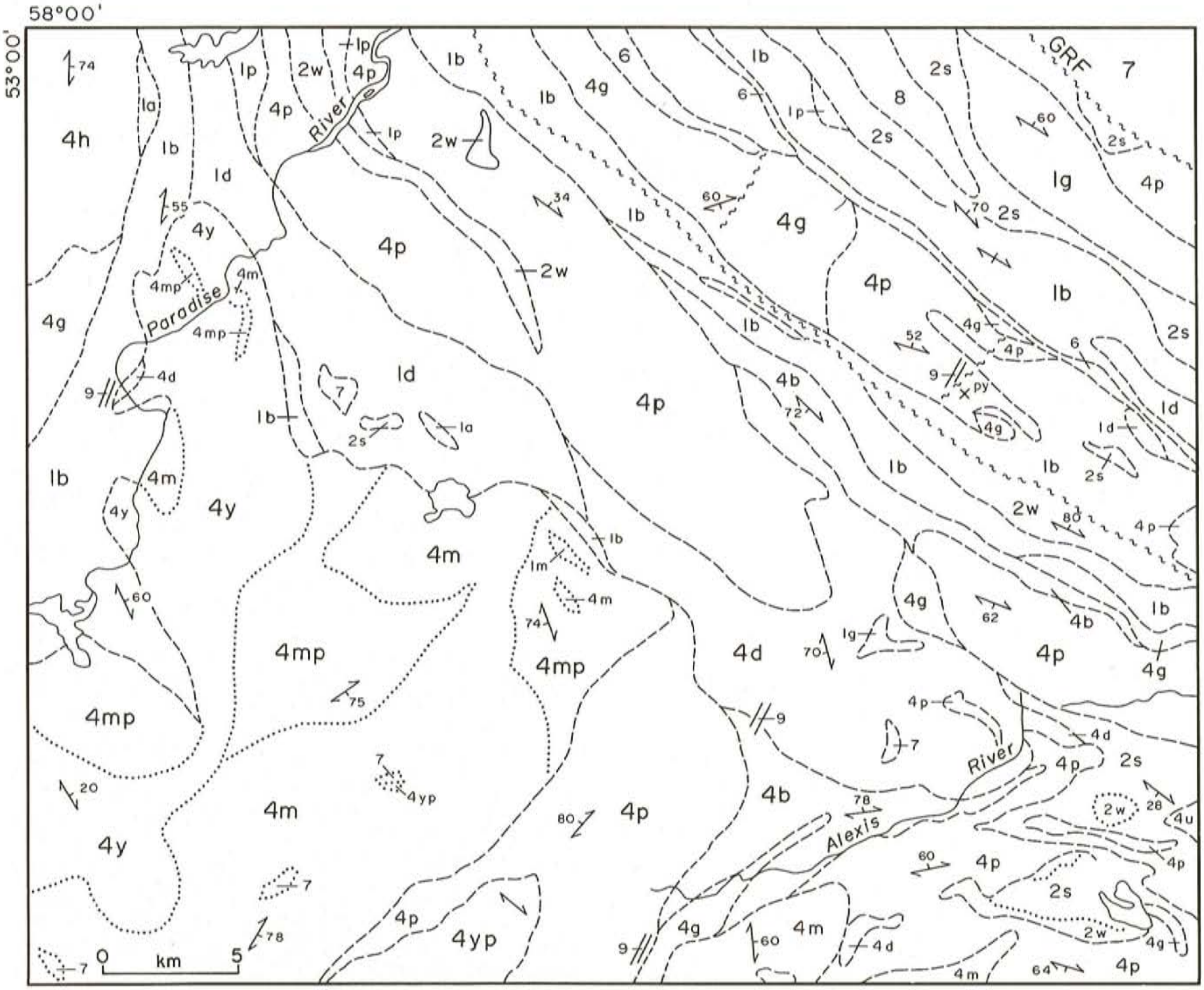
The extreme northeast corner of the map area is underlain by a small segment of the White Bear Arm complex (Unit 7), a large layered mafic intrusion mapped from Sandwich Bay to the southeast coast of Labrador, a distance of 150 km (Gower *et al.*, 1987). Within the area, the White Bear Arm complex comprises gabbronorite having enclaves of K-feldspar megacrystic granite, metasedimentary gneiss and mylonitic granite. The gabbronorite consists of a major and a minor component. The major rock type is a homogeneous, grey-weathering, medium-grained massive rock containing a mauve-coloured plagioclase, light-brown orthopyroxene, light-green clinopyroxene, olivine, hornblende and an opaque mineral. Original (igneous) minerals and textures are commonly preserved, although recrystallized and hydrated metamorphic equivalents occur. Pyroxenes (ortho and clino) are partially replaced by amphibole and, locally, coronitic textures, consisting of olivine cores having orthopyroxene and amphibole rims, are developed. The minor component of the White Bear Arm complex is a grey- to brown-weathering, fine- to medium-grained, equigranular, recrystallized granulite-facies norite. Minerals include a white to grey plagioclase, light- to dark-brown orthopyroxene, pale-green clinopyroxene and an opaque mineral. These rocks occur as small, isolated outcrops within the gabbronorite. Gower *et al.* (1987) interpret similar rocks in the Port Hope Simpson region as feeder dykes for the later gabbronorite.

Within the White Bear Arm complex gabbro, three types of enclaves are present. The first type is a pink- to red-weathering, fine- to medium-grained granite, having a well-developed mylonitic C–S fabric (Plate 1). Minerals present include recrystallized quartz, plagioclase, K-feldspar, garnet, biotite and an opaque mineral. At one locality, a two-pyroxene norite dyke intrudes the granite. The second type of enclave is a white-weathering, strongly recrystallized and foliated, granitic-textured rock containing quartz, plagioclase, K-feldspar, an opaque mineral and garnet. These rocks are similar in appearance to anhydrous metasedimentary gneisses found in contact with the Sand Hill Big Pond gabbronorite (Gower *et al.*, 1986). The third type of enclave is a medium-grained, moderately foliated, K-feldspar megacrystic granite, containing partially recrystallized K-feldspar megacrysts, and a groundmass consisting of quartz, plagioclase, K-feldspar, biotite, hornblende, and an opaque mineral.

GILBERT RIVER BELT

The southern margin of the White Bear Arm complex is marked by an extension of the Gilbert River fault (described by Gower *et al.*, 1987). The fault is a major northwest-trending structure, which marks the boundary of the Hawke River terrane to the north and the Lake Melville terrane to the south. Although not exposed in the Alexis River region, the fault is indicated by a strong, low-aeromagnetic signature and airphoto lineament.

The Gilbert River belt within the region is a 30-km-wide belt comprising foliated to gneissic granite to granodiorite, sillimanite-bearing metasedimentary gneisses, K-feldspar megacrystic granite and a narrow segment of the Alexis River anorthosite (which includes associated dioritic gneiss). Gower *et al.* (1987) proposed the name the Gilbert River shear belt for the extension of these rocks in the Port Hope Simpson



LEGEND

LATE PRECAMBRIAN–EARLY PALEOZOIC

9 *Gabbro, diabase*

MIDDLE TO LATE PROTEROZOIC

8 *Pegmatite*

MAFIC INTRUSIVES

7 *Gabbro, gabbronorite*
6 Alexis River Anorthosite

GRANITOIDS

Upper Paradise River Monzonite
4mp *K-feldspar megacrystic monzonite to quartz monzonite*
4yp *K-feldspar megacrystic alkali feldspar syenite*
4y *Syenite to quartz syenite*
4m *Monzonite to quartz monzonite*

GRF–Gilbert River fault

MIDDLE TO LATE PROTEROZOIC

4p *K-feldspar megacrystic granite to granodiorite*
4g *Granite, alkali feldspar granite*
4u *Muscovite-rich granite*
4b *Granodiorite*
4h *Hornblende syenite*
4d *Diorite to quartz diorite*

PARAGNEISS

2s *Sillimanite-bearing pelitic metasedimentary gneiss*
2w *Psammitic metasedimentary gneiss*

ORTHOGNEISS

1a *Amphibolite gneiss*
1g *Granite gneiss*
1b *Granodiorite gneiss*
1d *Diorite gneiss*
1m *Monzonite gneiss*
1p *K-feldspar megacrystic granite gneiss*

SYMBOLS

– – – ······ *Geological contact (approximate, assumed)*
~~~~~ *Undifferentiated faults (mostly strike-slip)*
Gneissosity, foliation
$\times_{py}$ *Pyrite occurrence*

Figure 2. *Geology of the Alexis River map region.*
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Plate 1. *Mylonitic granite showing C–S fabric suggesting dextral (west over east movement); enclave in gabbro of White Bear Arm complex. S–foliations; C–shear band.*

map region to the east. However, subsequent detailed mapping of this belt of rocks on the coast of Labrador by Hanmer and Scott (1990), suggests that although the belt is a zone of strong deformation, the proportion of intensely strained rocks within the coastal section is small, and preferred the name Gilbert River belt to describe the zone. In the Alexis River map region, most of the units within the belt are strongly deformed; however, in the northwest part of the belt, deformation is generally only moderate, and zones of intense deformation are very localized. Thus, the name Gilbert River belt will be used throughout this report.

Most rocks within the Gilbert River belt are extensions of units mapped in the Paradise River and Port Hope Simpson map regions (Gower *et al.*, 1985, 1987). All rocks within the zone have a variable northwest-trending fabric, excluding some minor dykes that are probably late-stage intrusions.

The oldest rock unit is a pelitic, sillimanite-bearing metasedimentary gneiss (Unit 2s). The paragneiss occurs as a Y-shaped wedge continuous across the northwest corner of the region and as enclaves (m to km scale) within other units of the Gilbert River belt. Three types of metasediments are present. The first type is a pink- to brown- to cream-weathering, schlieric to layered migmatite, exhibiting complex and variable fold styles. The fabric is defined by alternating quartz, feldspar-rich leucosome and a biotite–sillimanite–garnet–opaque mineral-rich melanosome. Retrograde muscovite is locally present and typically postdates the time of fabric formation. Garnet and sillimanite are commonly present in the leucosome, probably as melt products. Within the wedge-shaped body of pelitic gneiss immediately south of the Gilbert River fault, veins of K-feldspar megacrystic granite contain small enclaves and schlieren of sillimanite-bearing gneiss. These commonly contain only the restitic phase, suggesting a high degree of assimilation of the pelitic gneiss by the intruding megacrystic granite. The second type is a white- to rusty-weathering homogeneous, diatexitic rock, which occurs as gradations from the well-layered paragneiss. Garnet, biotite, sillimanite and opaque mineral assemblages are present, typically as thin, discontinuous restitic seams. The third rock type is a well-banded, medium- to coarse-grained, typically garnetiferous psammite that is also present as small-scale intercalations within the pelitic gneiss. This rock type is subordinate amphibolitic gneiss associated with the metasediments, and minor K-feldspar megacrystic granite are present as kilometre-scale enclaves.

A major rock type within the zone is a pink- to red-weathering, granodiorite gneiss. The gneiss varies from fine grained and well banded to medium grained and diffusely banded. Banding is defined by alternating quartz + K-feldspar + plagioclase layers, and biotite + hornblende + garnet + opaque phase-rich segregations. Small, concordant granite and alkali-feldspar granite pegmatite veins are common, and in many areas enhance the gneissic appearance (Plate 2). In some areas, gradations from well-banded gneiss to foliated granodiorite on outcrop and kilometre-scale suggest inhomogeneous strain within the Gilbert River belt. Several enclave types are present within the gneiss, including sillimanite-bearing pelitic gneiss, K-feldspar megacrystic granite, weakly foliated to massive granite, and dioritic gneiss.

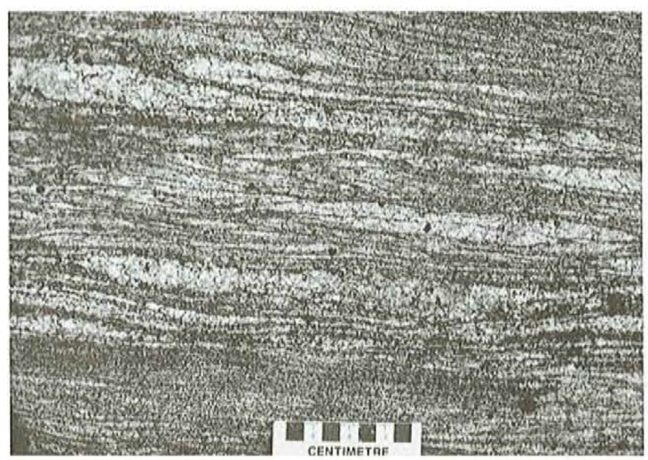

Plate 2. *Banding in granodiorite gneiss enhanced by concordant granite veins (Gilbert River belt).*

Granite gneiss (Unit 1g) occurs as a wedge-shaped body in the northeast corner of the region. These rocks are typically pink weathering, fine to medium grained, recrystallized, and well banded. Banding is defined by alternating quartz, plagioclase, K-feldspar-rich layers and biotite, hornblende, garnet and opaque mineral-rich layers (Plate 3). Gradations into a more granodioritic composition occur on outcrop scale, although not depicted on the map. In some areas, the gneissosity is enhanced by intruding, concordant, locally complexly folded granitic veins. Discordant granite veins and coarse pegmatites are a minor, but common, intrusive phase in this unit. Enclaves within the gneiss include amphibolitic gneiss, psammitic metasediments, foliated granodiorite and K-feldspar megacrystic granite.

The K-feldspar megacrystic granodiorite to granite (Unit 4p) underlies a large portion of the Gilbert River belt. The

Plate 3. *Well-banded granite gneiss, intruded by discordant pegmatite veins (Gilbert River belt).*

unit occurs as a northwest-trending belt immediately south of the Gilbert River fault, and as an irregularly shaped body south of, and within, the core zone of the Alexis River anorthosite in the northwest. The rock varies from medium to coarse grained, moderately to strongly foliated, pink-white- to red-weathering and having K-feldspar megacrysts comprising 10 to 50 percent of the total rock. Mafic minerals include biotite ± hornblende ± garnet ± muscovite + an opaque phase. The megacrysts are typically recrystallized, although relatively fresh, unrecrystallized grains are present in some areas. Gneissic equivalents were observed as gradations from the foliated megacrystic rock in a few localities. Foliated granodiorite, granite and sillimanite-bearing pelitic gneiss are present as map-scale enclaves.

In contact with the K-feldspar megacrystic unit to the northwest is an extensive body of weak to moderately foliated granite (Unit 4g). The rock is pink- to red-weathering, medium to coarse grained, weak to moderately foliated, with rare diffuse banding. Mafic minerals include biotite ± hornblende ± garnet + an opaque mineral. Although outcrop is poor, the similarity of the texture of this granite, and the matrix texture of K-feldspar megacrystic granite to the southeast, suggest that the two units may be gradations of one another. Small areas of granodiorite and granite gneiss are present in this unit.

A zone of coarse-grained to pegmatitic, pink- to white-weathering, massive to weakly foliated alkali-feldspar granite (Unit 8) occupies the core area of the metasedimentary wedge in the northeast of the belt. The granite is characterized by graphic texture of K-feldspar and quartz, and amphibolite occurs as associated enclaves within. The unit is an extension of a pegmatite field mapped to the north in the Paradise River map region (Gower *et al.*, 1985).

Alexis River Anorthosite (Unit 6)

A distinct unit in the Gilbert River belt is the Alexis River anorthosite (Gower *et al.*, 1987). The unit has a strike length of approximately 150 km. The anorthosite occurs as a 1- to 2-km-wide linear belt extending across the northeast section of the area, and correlates with the unit previously mapped in the Paradise River and Port Hope Simpson map regions (Gower *et al.*, 1985, 1987). Although outcrop is poor, low-magnetic signatures that characterize the unit allow extrapolation across the area.

The dominant rock type of the Alexis River anorthosite in the region is a white-weathering, medium- to very coarse-grained, massive to gneissic, recrystallized anorthosite to leucogabbro–norite. Variable states of recrystallization and strain are evident in some outcrops. The rock ranges from one having a massive, mottled appearance due to patchy distribution of mafic phases to one having a strongly foliated to gneissic, lenticular texture, defined by recrystallized aggregates of mafic phases in a plagioclase-rich matrix. Minerals include plagioclase, amphibole, orthopyroxene, clinopyroxene, biotite and magnetite. Corona reaction textures having orthopyroxene cores rimmed by amphibole and biotite, are locally developed. All phases show variable states of recrystallization, depending on degree of strain. Mafic mineral content varies from less than 1 to 30 percent of the total rock. Pyroxene and amphibole crystals up to 40 cm in length are present in places. Well-developed igneous layering is preserved in some areas, defined by cm-scale alternations of hornblende- and plagioclase-rich layers (Plate 4). At one locality, discordant and concordant, fine- to medium-grained amphibolite dykes were emplaced into the anorthosite.

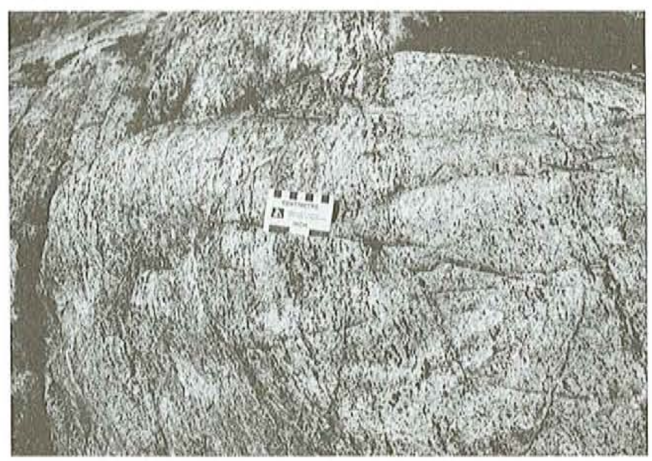

Plate 4. *Igneous layering in Alexis River anorthosite; dark layers consist of hornblende, pyroxene and opaque minerals (Gilbert River belt).*

Associated with the anorthosite is a dioritic to amphibolitic gneiss, which in the eastern portion of the belt flanks both sides of the anorthosite. These rocks are dark-weathering, diffuse to well-banded, medium grained and contain hornblende, biotite and an opaque mineral as mafic phases. Although relationships between the anorthosite and diorite units within the region are not defined, Gower *et al.* (1987) note a similar association in the Port Hope Simpson map region, and suggest that the dioritic gneisses are metamorphic derivatives of anorthosite-related rocks.

MEALY MOUNTAINS TERRANE

The Mealy Mountains terrane is distinguished from the Gilbert River belt by a less intense and more variable regional deformation (except near the northern margin) and more diverse rock types. The terrane is described here in terms of four separate areas, the central portion, the southeast corner, the Upper Paradise River pluton, and the western portion.

Central Portion

The central portion of the Mealy Mountains terrane is underlain by northwest-trending units of variably deformed K-feldspar megacrystic granodiorite to granite, foliated diorite to quartz diorite, granodiorite orthogneiss, psammitic gneisses and foliated granodiorite and granite.

Immediately south of the Gilbert River belt, the boundary with the Mealy Mountains terrane is marked by a northwest-trending fault. The fault is an extension from the Port Hope Simpson region to the west and from the Paradise River region to the north (Gower *et al.*, 1987, 1985), and defines the boundary between the Lake Melville terrane (including the Gilbert River belt) in the northeast and the Mealy Mountains terrane to the southeast. In the southeast of the study area, the fault is marked by breccia, extensive chloritization and hematization and a strong airphoto lineament. In the northwest, a more ductile regime is indicated by the presence of a mylonitic fabric and attenuated and rotated garnets, showing a dextral sense of movement (Plate 5). The presence of brittle and ductile zones suggests that either the northwestern portion represents a deeper section of the fault or that the brittle deformation is a result of a later (Grenvillian ?) reactivation along the fault.

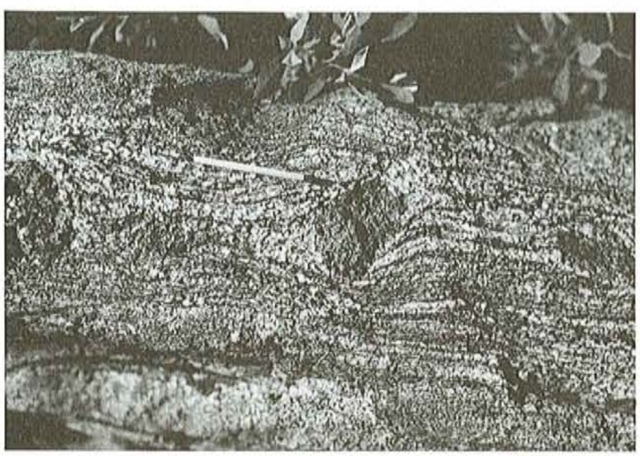

Plate 5. *Rotated garnet porphyroblast in quartz diorite gneiss; implies dextral sense of movement (boundary of Gilbert River belt and Mealy Mountains terrane).*

South of the boundary, a 1- to 5-km-wide zone is underlain by northwest-trending belts of orthogneiss, metasedimentary gneiss and foliated granitoid rocks. In the southeast, a wedge of psammitic gneiss (Unit 2w) is bounded to the north by the fault. The rock is white- to rusty-weathering, medium to coarse grained, layered to diatexitic and locally contains thin (cm to m scale) intercalations of sillimanite-bearing pelitic gneiss. Garnet is common as a restitic phase, along with biotite, and an opaque mineral. Within the psammitic gneiss, km-scale zones of pelitic gneiss and rare calc-silicate rocks are present. The pelitic gneiss is white- to pink-weathering, well banded, and contains sillimanite, biotite, garnet and an opaque phase. A small zone of muscovite-rich pelitic gneiss occurs immediately south of the fault in the east part of the map area. The calc-silicate rock (observed in only two outcrops) is dark-weathering, fine to medium grained, thinly banded, strongly folded and comprises layers containing plagioclase, quartz and minor K-feldspar, alternating with hornblende, and locally clinopyroxene, biotite and opaque mineral-rich layers (Plate 6). Gower *et al.* (1987) noted calc-silicate rocks within pelitic and semipelitic gneiss to the east in the Port Hope Simpson region. A thin zone of foliated granodiorite was also mapped as a continuous belt across the northern portion of the region. The rock is pink- to white-weathering, medium grained, moderate to strongly foliated. The minerals present include biotite, hornblende, minor garnet, and an opaque phase.

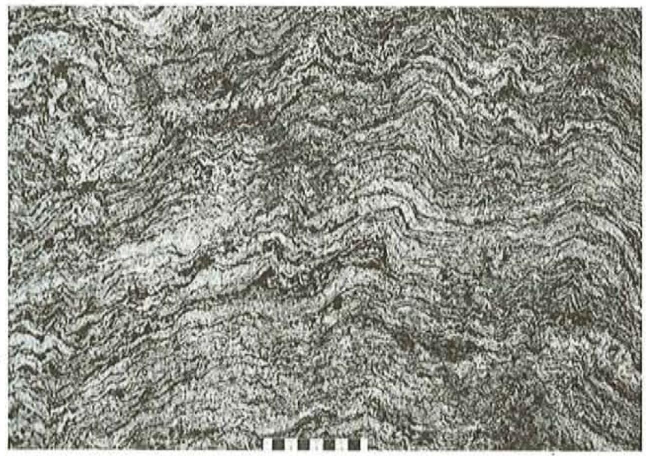

Plate 6. *Thinly banded calc-silicate rock; dark layers consist of hornblende, biotite, pyroxene and opaque minerals (Mealy Mountains terrane).*

South of these rocks are large elongate to oblate-shaped intrusions of K-feldspar megacrystic granodiorite to granite, foliated diorite and foliated granodiorite and granite. These intrusions lack the typical pervasive fabric developed in the rocks to the north, suggesting lower strain southward from the Gilbert River fault.

The K-feldspar megacrystic granite to granodiorite (Unit 4p) is the dominant rock type and occurs as two elongate, northwest-trending intrusions. The map pattern suggests that the intrusions were originally a continuous body and subsequently intruded by diorite, granodiorite and granite, however, no field relations were observed to support this. The rock is red-, pink- to white-weathering, medium to coarse grained, weak to strongly foliated. It has K-feldspar megacrysts ranging from 2 to 10 cm and comprising 10 to

50 percent of the total rock. Mafic minerals include biotite, hornblende, and an opaque mineral, minor garnet and muscovite. The K-feldspar megacrysts vary from being relatively unrecrystallized to showing a 'pseudo-megacrystic' texture. In the latter, megacrysts are strongly recrystallized and grain boundaries are barely recognizable (Plate 7). This texture is characteristic at or near the margins of the intrusions, reflecting more intense deformation (i.e., recrystallization). Attenuated and recrystallized megacrysts exhibit a gneissic appearance in outcrops where the megacrysts reach 10 cm in length. Another characteristic feature of this unit is inhomogeneous strain shown by the rock. Gradations from massive to gneissic texture within single outcrops were observed in several localities (Plate 8). In the northwest part of the larger intrusion, a thin zone of K-feldspar megacrystic granite gneiss was mapped as a separate unit (Unit 1p) The rock is pink- to red-weathering, medium to coarse grained, and is characterized by a strong gneissic fabric, defined by strongly attenuated and recrystallized K-feldspar megacrysts and alternating quartz, plagioclase, feldspar-rich and biotite-rich selvages. These rocks are similar to gneissic gradations observed at several outcrop localities. Map-scale enclaves within this unit include pelitic and psammitic metasedimentary gneiss, granodiorite gneiss and coarse-grained, recrystallized leucogabbro. A thin arcuate zone of dominantly psammitic gneiss occurs within a large body of K-feldspar megacrystic granite. The rock is similar to psammitic gneiss described earlier and contains small enclaves of semipelitic gneiss. One locality of pelitic gneiss contains the assemblage garnet + cordierite + sillimanite + biotite. The presence of cordierite is a diagnostic feature of pelitic gneiss of the Paradise metasedimentary belt in the Hawke River terrane (Gower *et al.*, 1986, 1987), however, it is a rare occurrence in the Mealy Mountains terrane. The cordierite occurs as small (1 to 2 mm) grains, partially replaced by muscovite, biotite, magnetite and quartz. Only a few thin sections of pelitic gneiss have been examined thus far, hence the occurrence of cordierite may be more widespread than that indicated.

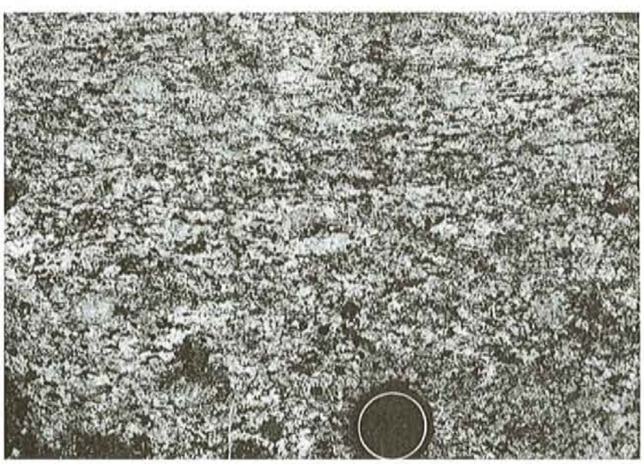

Plate 7. *'Pseudo-megacrystic' phase of K-feldspar megacrystic granite (Unit 4p); note diffuse contacts of K-feldspar megacrysts (Mealy Mountains terrane).*

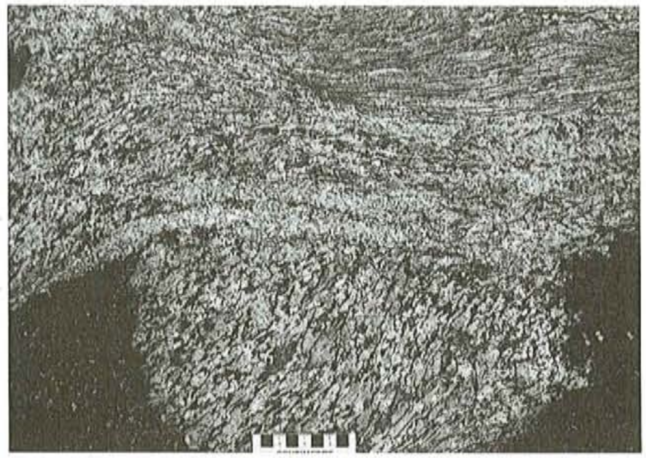

Plate 8. *Inhomogeneous strain in K-feldspar megacrystic granite (Units 4p and 1p, south of the Alexis River, Mealy Mountains terrane).*

A large intrusion of foliated diorite to quartz diorite (Unit 4d) flanking an intrusion of megacrystic granite occurs in the central portion. A homogeneous diorite is the dominant rock type and is grey-, green- to brown-weathering, fine to medium grained, homogeneous to agmatitic, and weak to strongly foliated. The minerals present are plagioclase + minor quartz + hornblende + biotite ± garnet ± pyroxene + an opaque mineral (Plate 9). Hornblende is the dominant mafic phase, constituting up to 40 percent of the total rock. Garnet is common, although not a ubiquitous phase, and crystals up to 5 cm in diameter are locally present near the contact (Plate 10). These grains are typically rimmed by plagioclase + quartz, a texture that suggests a partial replacement of the garnet. Diorite to quartz-diorite gneiss occurs near the margins of the body and probably represents a more deformed equivalent of the foliated diorite. Amphibolite bands are common, in some areas giving the rock a gneissic appearance, probably representing deformed mafic dykes. At a few localities, orthopyroxene and clinopyroxene are stable in a strongly recrystallized phase of the diorite, an association that is suggestive of granulite-facies conditions. Abundant enclaves and/or minor intrusions of granodiorite, K-feldspar megacrystic granite, metasedimentary gneiss, granodiorite gneiss, and minor leucogabbro are present.

The intrusion is a lithological anomaly within the region, being of more calcic-alkaline composition compared with the dominant potassic-rich granitoids.

Southeast Corner

The southeast corner of the region consists dominantly of interfingering K-feldspar megacrystic granodiorite to granite and pelitic to psammitic metasedimentary gneisses.

The pelitic gneiss (Unit 2s) is cream, buff- to rusty-weathering, medium grained and characterized by schlieric to layered migmatitic texture (Plate 11). The rock comprises a K-feldspar, plagioclase, quartz leucosome, and sillimanite,

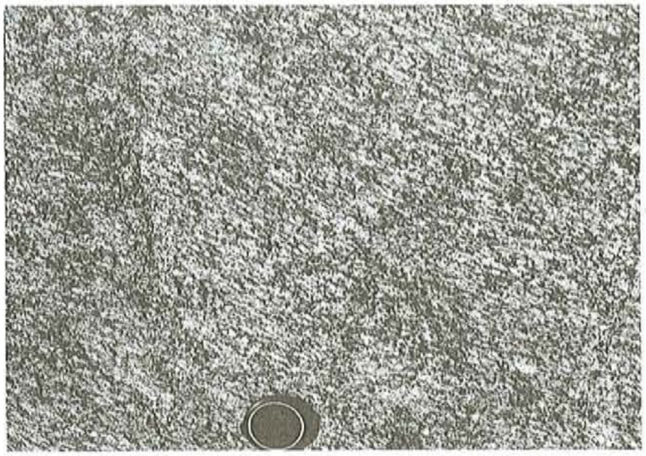

Plate 9. *Strongly foliated, homogeneous diorite (Unit 4d; Mealy Mountains terrane).*

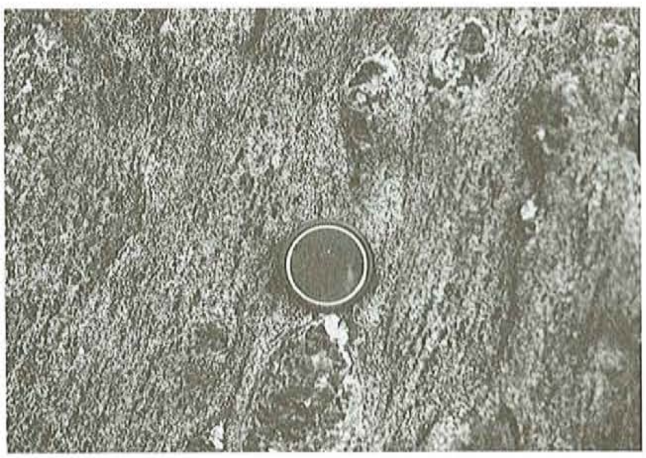

Plate 10. *Large garnet porphyroblasts in foliated diorite (Unit 4d). Note plagioclase + quartz reaction rims around garnets. (Near contact of diorite intrusion, Mealy Mountains terrane).*

Plate 11. *Well-banded, strongly folded sillimanite-bearing metasedimentary gneiss (Unit 2s; Mealy Mountains terrane).*

garnet, biotite, muscovite and an opaque mineral in the restite. Sillimanite is widespread, and locally occurs as aggregates in layers up to 2 cm wide. Garnet is a near ubiquitous phase and occurs as euhedral grains up to 3 cm in diameter. In some areas, a white-weathering diatexitic component is associated with the pelitic gneiss. The rock is typically homogeneous, although irregular selvages of biotite + garnet + an opaque mineral are common. Garnet is a common mineral, occurring both in the quartz + feldspar-rich zones and in the restite component. Granite and pegmatite veins are normally associated with this rock type. Mappable units of psammitic gneiss as gradations from the pelitic gneiss were distinguished. The psammite (Unit 2w) is rusty-, white- to buff-weathering, medium to coarse grained, and ranges from well banded to diatexitic. Minerals present include K-feldspar, plagioclase, quartz, biotite, garnet, and an opaque mineral and locally sillimanite and muscovite. Thin (cm scale), intercalated layers of sillimanite-bearing pelite occur in some areas. Concordant granite and alkali feldspar granite veins are common and in many areas, enhance the overall gneissic appearance (Plate 12).

Plate 12. *Well-banded psammitic metasedimentary gneiss (Unit 2w). Intruded by concordant and discordant granite veins; south of the Alexis River, Mealy Mountains terrane.*

Associated with both the pelitic and psammitic gneiss are small (m scale) intrusions of a white-weathering, garnet-bearing alkali feldspar granite. The consistent association with metasediments and the presence of garnet implies a derivation from the sediments.

The K-feldspar megacrystic granitoid rocks (Unit 4p) are pink- to white-weathering, medium to coarse grained, and weak to strongly foliated (rarely gneissic). These occur as irregular-shaped bodies intruding the host metasediments. Biotite, garnet and hornblende are the dominant mafic phases. Garnet is near ubiquitous in these rocks in contrast to megacrystic rocks in other parts of the region. This is interpreted to be a result of assimilation of the granite and the host, garnet-bearing metasediments. In some areas (notably near the contact), a 'pseudo-megacrystic' texture is developed where grain boundaries of recrystallized K-feldspar megacrysts are diffuse and partially incorporated into the matrix component of the rock. Contacts with the sediments are typically diffuse and in some areas being gradational over hundreds of metres. Such a relationship implies extensive mixing and assimilation of the units, probably at considerable depth. Strain gradients within the megacrystic unit are highly variable and gradations from massive to gneissic are locally developed at outcrop scale.

Both the metasediments and the K-feldspar megacrystic granitoid rocks contain abundant enclaves and/or intrusions (m to km scale) of the following rock types: (i) foliated hornblende + biotite diorite, which is related to the large intrusion in the central portion, (ii) foliated, sugary-textured biotite granite to granodiorite, a common intrusive phase into the K-feldspar megacrystic granite to granodiorite and, (iii) a small body of leucogabbro. Noteworthy, is a small intrusion of muscovite-rich granite (Unit 4u) along the eastern edge of the area. The rock is distinct from other foliated granites in that it contains up to 20 percent muscovite. It is pink-weathering, medium grained, moderate to strongly foliated and contains abundant partially assimilated sillimanite-bearing pelitic gneiss enclaves. Gower *et al.* (1988a) used the term the Southwest Pond domain for a zone of K-feldspar megacrystic granitoid rocks, and metasedimentary gneiss, in the northwest corner of the St. Lewis map area. At the time, inclusion of this area in the Mealy Mountains terrane was withheld pending further mapping. Subsequent mapping in the Alexis River region now allows the domain to be included as part of the Mealy Mountains terrane, and therefore, the name Southwest Pond domain should be abandoned.

Upper Paradise River Pluton

The western area is underlain largely by a lobate-shaped intrusive body, informally named the Upper Paradise River pluton. The body consists of syenitic to quartz monzonitic rocks, having associated gabbro norite and minor granite enclaves. Outcrop distribution in this area is relatively sparse and relationships between units are poorly exposed. The rocks exhibit variable degrees of deformation and recrystallization and are characterized by a high aeromagnetic anomaly. Eade (1962) reported outcrops of monzonitic to granodioritic rocks within what have now been mapped as the margins of the body.

The intrusion has been subdivided into three major rock types, namely monzonite (Unit 4m); syenite to quartz syenite (Unit 4y); and K-feldspar megacrystic monzonite to quartz monzonite (Unit 4mp).

The dominant rock type underlying the central portion of the pluton is a brown- to grey-weathering, moderately to strongly foliated, medium- to coarse-grained, variably recrystallized monzonite. Minerals include biotite + hornblende ± clinopyroxene + zircon + titanite. Gradations to quartz monzonite on an outcrop scale are common.

The western margin of the pluton is underlain by a brown, pink- to white-weathering, medium- to coarse-grained, moderate to strongly foliated, recrystallized alkali-feldspar syenite to quartz syenite, containing hornblende + biotite + clinopyroxene + an opaque mineral. In some areas, a sub-gneissic fabric is developed, defined by thin (0.25 cm) quartz-rich lenses parallel to main fabric. Rocks within this unit, although showing variable fabric intensity, are consistently strongly recrystallized. Mafic mineral content is also variable, but the similar bulk-rock composition of the rocks suggests they are part of the same intrusion.

A distinctive and homogeneous subunit within the Upper Paradise River pluton, is a K-feldspar megacrystic monzonite to quartz monzonite. The rock is honey-brown weathering, medium to coarse grained, massive to weakly foliated and characterized by the presence of grey-weathering K-feldspar megacrysts, constituting 10 to 30 percent of the total rock (Plate 13). The K-feldspar megacrysts are generally unrecrystallized, although in some areas, a thin rim of polygonal recrystallized grains is developed. Minerals include plagioclase, quartz, K-feldspar, hornblende, biotite clinopyroxene, and an opaque phase. Enclaves and/or intrusions of foliated monzonite, diorite and monzonite gneiss are present.

Plate 13. *Weakly foliated to massive K-feldspar megacrystic monzonite (Unit 4mp). K-feldspars locally have recrystallized rims; Mealy Mountains terrane.*

In the southeast corner, two apparently isolated intrusions of monzonite were mapped. Although these intrusions occur exterior to the main monzonite body, they are identical, both texturally and mineralogically, to rocks within the main body, and thus, are considered a part of the Upper Paradise River pluton. One of the intrusions consists of foliated monzonite having core zones of a K-feldspar megacrystic phase. This may represent a more slowly cooled portion of the exterior recrystallized monzonite.

Other units, mapped as variants of the three major units include a K-feldspar megacrystic alkali feldspar syenite (Unit 4yp) and a monzonitic gneiss (1m). The syenitic to quartz-syenitic rock occurs as a small body within the foliated monzonite unit and as a separate intrusion flanking the southeast edge of the Upper Paradise River pluton. Similarities between these rocks and the three main rock types suggest that they are part of the Upper Paradise River pluton. The rock is brown- to grey-weathering, medium to coarse grained and characterized by a strong foliation and recrystallized K-feldspar augen. Hornblende, clinopyroxene, minor biotite and an opaque mineral are the mafic phases. An elongate body of monzonite gneiss (Unit 1m) occurs within the K-feldspar megacrystic monzonite unit of the Upper Paradise River pluton. A single outcrop of this rock also occurs along the Paradise River, although its limited extent prevents it from being depicted on the map. The rock is brown- to grey-weathering, medium grained, strongly recrystallized and well banded. The gneissosity is defined by alternations of cm-scale mafic-rich and plagioclase + quartz-rich bands. The isolated occurrence and the limited extent of these rocks suggest that they are strongly deformed enclaves within a less-deformed host rock. Associated with the three main units are map-scale bodies (intrusions ?) of gabbro and gabbronorite, which typically underlie small topographic highs in the area. The rocks are mineralogically and texturally similar to gabbroic units in the northeast corner of the region, within the White Bear Arm complex. Gower *et al.* (1987) noted a similar association of monzonitic, granitic and gabbronoritic rocks in the White Bear Arm complex. They observed layered units showing transitions from gabbronorite to monzogabbro to monzonite, as well as enclaves of gabbronorite in monzonite and suggested that several periods of gabbronorite and monzonite emplacement have occurred. Although relationships between the gabbro and monzonite units are not exposed in the Alexis River region, a similar interpretation may be applicable here.

Speculation can be made regarding age relations between these units, based on their degree of deformation and km-scale enclaves or intrusions of the K-feldspar megacrystic monzonite and foliated monzonite units in the Upper Paradise River pluton. The pervasively strong foliation and extensive degree of recrystallization present in the syenite to quartz-syenite unit suggest that it is older than the foliated monzonite and the weakly deformed, K-feldspar megacrystic units. Similarly, the monzonite unit would appear to be older than the megacrystic phase. Both the foliated monzonite and the megacrystic phase of the pluton occur within the strongly foliated syenite as km-sized bodies. However, contacts between these rocks were not observed and to choose between enclaves or small intrusions would only be speculative. In one locality, in the northeast portion of Upper Paradise River pluton, a small enclave of strongly foliated quartz syenite was found hosted by the K-feldspar megacrystic unit. Diffuse contacts of the enclave suggest that the two rocks types may be of similar age. Intended U–Pb radiometric dating of samples collected from the Upper Paradise River pluton will presumably establish age relations and time of emplacement of the various intrusive units.

In the St. Lewis River Map region (southeast of the Alexis River region), the Pinware terrane was defined by Gower *et al.* (1988a). The Pinware terrane is a distinct zonation in the Grenville Province in southeastern Labrador composed principally of granitoid plutons of pre-Grenvillian and Grenvillian ages (Gower and Loveridge, 1987). Grenvillian and post-Grenvillian plutons have syenite to monzonite to alkali-feldspar-granite compositions and are characterized by a donut shaped aeromagnetic plateau having high rims and low interiors. Although the Pinware terrane has not been mapped west of the St. Lewis River map region, Gower *et al.* (1988a) have extrapolated the northern limit of the terrane to just south of the Alexis River region (on the basis of the characteristic circular aeromagnetic anomalies).

A similar, although less well-pronounced anomaly, is characteristic of one of the satellite intrusions of the K-feldspar megacrystic monzonite. High aeromagnetic anomalies also characterize the Upper Paradise River pluton as a whole. Signatures, however, are variable, and not well defined, presumably due to the composite nature of the intrusion. The characteristics of the K-feldspar megacrystic monzonite unit (low degree of strain and recrystallization, and aeromagnetic signature) invites the possibility of the rocks having a Grenvillian or late syn-Grenvillian age.

Western Portion

In the northwest, flanking the northern arm of the Upper Paradise River pluton, are bodies of amphibolitic (Unit 1a) to dioritic orthogneiss (Unit 1d), granodiorite gneiss (Unit 1b), hornblende-rich, strongly recrystallized syenite to quartz syenite (Unit 4h), and foliated granite (Unit 4g). Characteristic of the units in this area is a pervasive, north-northwest to north-trending fabric, which is distinct from the typical northwest regional trend. Amphibolitic to dioritic gneisses underlie an open arcuate belt. These rocks are black- to grey-weathering, fine to medium grained, and typically well banded. Hornblende is the dominant mafic phase comprising up to 60 percent of the total rock.

Enclaves within the gneisses include leucogabbro, granite and a west-trending enclave of sillimanite-bearing metasediment. The locality of this outcrop of metasediments is anomalous in the region in that it is isolated from similar rocks that are associated with K-feldspar megacrystic granitoid rocks farther to the northeast.

Flanking the western edge of the Upper Paradise River pluton is a north-trending belt of granodiorite to granite gneiss. These rocks are medium grained, diffusely to well banded, and recrystallized. The gneissosity is concordant with the western margin of the intrusion, suggesting that the trend of the gneisses is at least partly a result of emplacement of the later body. Enclaves hosted in the gneisses include foliated diorite to diorite gneiss.

The extreme northwest corner of the region is underlain by the extension of a hornblende-bearing intrusion in the Paradise River map region (Gower *et al.*, 1985), where it was mapped as a granodiorite to monzonite. In the Alexis River region, syenitic to quartz syenitic rocks dominate. The rock is cream- to rusty-brown-weathering, medium grained, and characterized by a strong, recrystallized fabric. Ubiquitous hornblende is the dominant mafic phase, biotite, clinopyroxene, orthopyroxene and an opaque phase are also present.

Enclaves and/or intrusions in this unit include; metagabbro, foliated granite and minor granite gneiss. The metagabbro is a distinct rock that is black-weathering, coarse grained, massive, and intruded by abundant pegmatitic and granite veins. Minerals include plagioclase, opaque, and hornblende pseudomorphs of clinopyroxene. Coarse pegmatite veins intruding the gabbro are strongly deformed and sheared, locally showing gradation from undeformed pegmatite to a mylonite at the immediate contact with the gabbro, although the gabbro retains an apparently massive texture. Small veins of recrystallized granite to quartz syenite intruding the gabbro may be related to the host syenite, suggesting remelting during gabbro emplacement.

In the extreme southwestern part of the Paradise River map region, this unit has been dated at 1735 and 1718 Ma from U–Pb determinations on two zircon fractions, and 1631 $\pm$ 1 Ma from two monazite fractions (Scharer and Gower, 1988). As the rocks show no indication of a high-grade overprint that would explain the new growth of monazite, they concluded that the monazite dates the time of rock crystallization and the zircons, grown coevally with monazite, include inherited older components. A $^{40}Ar/^{39}Ar$ plateau age of 980 $\pm$ 3 Ma was obtained from hornblende from the same rock (van Nostrand, 1988). The age is interpreted as a Grenvillian cooling, below approximately 550°C.

POST-GRENVILLIAN MAFIC DYKES

Two suites of post-Grenvillian mafic dykes were mapped within the Alexis River map region. The first suite includes 2 separate northeast-trending gabbro dykes, which are extensions of dykes mapped farther to the north in the Paradise River and Sand Hill River map regions (Gower *et al.*, 1985, 1986). Exposure is limited to a single outcrop for one of the dykes in the west and 3 outcrops for the other in the eastern portion. The rock is typically a brown-weathering, massive, coarse grained, ophitic to sub-ophitic textured gabbro. Plagioclase, clinopyroxene, opaque and olivine are the mineral phases present. Characteristic interstitial K-feldspar, present in all localities, varies from less than 5 percent in the eastern dyke to 15 percent in the western dyke. The high proportion of K-feldspar in the western dyke is matched only by that present in the same dyke in the Paradise River map area. The variation in K-feldspar content may reflect the relative depths of intrusion, being concentrated in the fractionated top part of the dykes.

The western most dyke is on strike with a 100-km-long dyke, extending from north of Cape Porcupine to the southwest corner of the Paradise River region (Gower *et al.*, 1985). Extrapolation into the Alexis River region continues the strike length of the dyke to approximately 150 km. A strong airphoto lineament in the southwest of the area is on strike with the exposed dyke on the Paradise River, and probably extends the dyke to the southwest corner of the map area. The dyke in the eastern part of the area, extrapolated to the northeast, links up with a gabbro dyke in the Sand Hill River region to have a strike length of at least 100 km.

The second suite of dykes mapped are brown- to black-weathering, fine grained, undeformed, massive and show sharp chilled margins with the country rock (Plate 14). The dykes were observed only in two localities. A 20- to 60-cm-wide, 060°-trending dyke intrudes a foliated diorite along the Paradise River in the west and a single similar trending dyke postdates a granite gneiss in the east of the region. In thin section, the rock comprises a diabasic texture defined by fresh, euhedral plagioclase laths with intergranular clinopyroxene, olivine, opaque and biotite. Very local alteration is evidenced by replacement of mafic phases by epidote. Similar dykes have been mapped in the Port Hope Simpson area, in the southern parts of Sandwich Bay. A K–Ar whole-rock date of 327 $\pm$ 13 Ma for one dyke in Sandwich Bay was reported by Murthy *et al.* (1989).

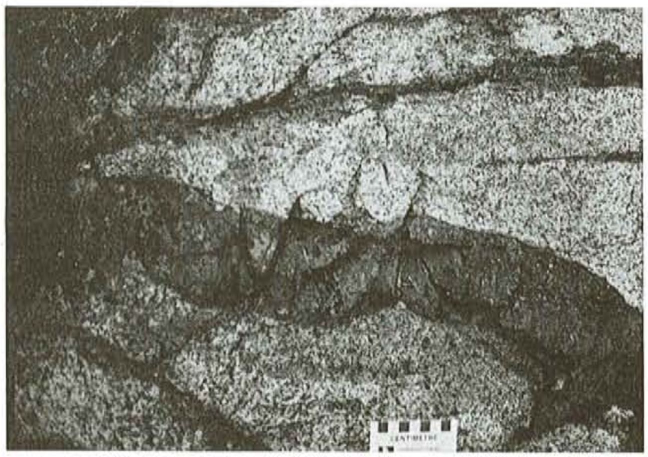

Plate 14. *Fine-grained, post-Grenvillian diabase dyke (Unit 12), intruding foliated quartz diorite (Unit 4d); Upper Paradise River, Mealy Mountains terrane.*

STRUCTURE

The regional structure of the Alexis River map region is dominated by a pervasive northwest trend in the northeastern area and a variable west to northwest trend in the southern and northwestern areas. The trends are developed in all units with the exception of post-Grenvillian dykes. Regional fabric trends within the region are indicated on Figure 3.

In the White Bear Arm complex, fabrics are limited to a weak foliation in metagabbro and gneissosity in paragneiss and granite enclaves. Granite enclaves within the gabbro are characterized by a strong, submylonitic fabric. In one outcrop, a well-developed C–S fabric suggests a east over west (dextral) sense of movement (Plate 1). This is consistent with the regional dextral movement proposed by Gower *et al.* (1987) and Hanmer and Scott (1990). Although no outcrop was mapped along the Gilbert River Fault (Gower *et al.*,

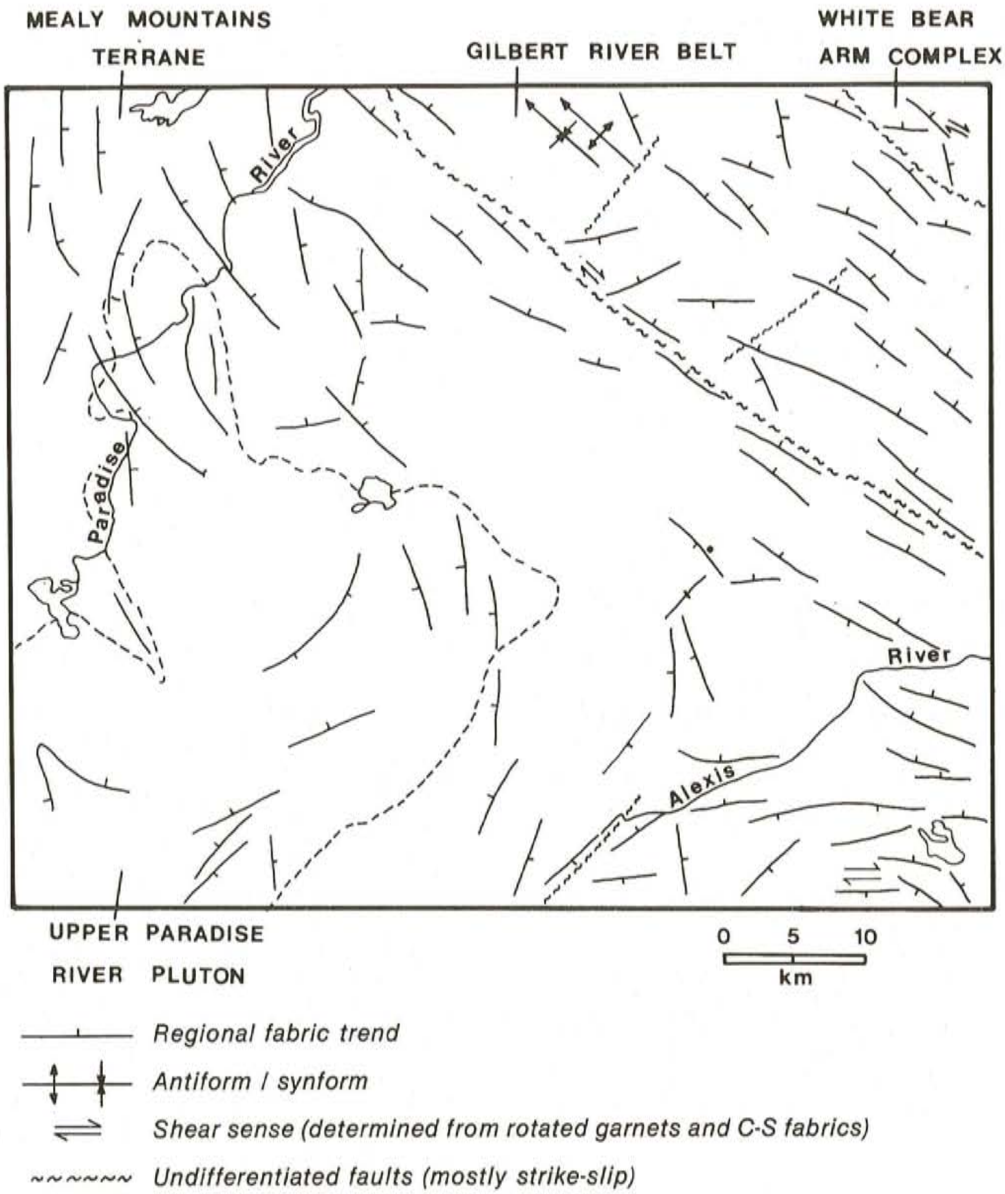

Figure 3. *Major structural features and lithostructural subdivisions in the Alexis River map region.*

1987), a strong airphoto and aeromagnetic signature and extrapolation from adjacent map regions, defines the fault.

The Gilbert River belt is characterized by a pervasive, northwest-trending foliation and gneissosity. The northwest portion of the Alexis River anorthosite, is interpreted on the map as a northwest-plunging antiformal/synformal structure. Mapping by Gower *et al.* (1985) to the north and aeromagnetic signatures suggest that the southern limb of the anorthosite has thickened as a result of folding about northwest-plunging axes. Fabrics in the Mealy Mountains terrane show a regional trend varying from northwesterly, near the boundary with the Gilbert River shear belt, west to northwest in the southeast corner of the region to a northward curvature of the fabric in the west and northwest areas.

Fold styles are typically complex, ranging from open to tight Z and M folds in orthogneiss and granitoid rocks to isoclinal and typically transposed in metasedimentary gneiss (Plates 15 and 16). Fold axes generally show a shallow to moderate plunge toward the northwest, although locally trend steeply toward the northeast. Mineral lineation and rodding, measured on foliation planes typically plunge moderately toward the northwest in the Gilbert River shear belt and vary from a shallow to moderate plunge toward the northwest to north in the Mealy Mountains terrane.

Kinematic indicators, in particular rotated porphyroblasts, strong lineations, and rare C–S fabrics found along or near contacts, suggest a dextral shear sense (Plate 5), and are indicated on Figure 3. Attenuated garnets in orthogneisses along the southern boundary of the Gilbert River shear belt show aspect ratios up to 15:1. Gower *et al.*

Plate 15. *Z-folds in well-banded metasedimentary gneiss; Mealy Mountains terrane.*

Plate 16. *Open M-folds in well-banded granite gneiss; Banding enhanced by concordant granite veins; Gilbert River belt.*

(1987) proposed a regional kinematic framework in which the Lake Melville terrane (including the Gilbert River belt) has moved dextrally with respect to the Mealy Mountains terrane. Hanmer and Scott (1990) suggested a similar sense of movement within the Gilbert River belt, on the coast of Labrador. Late (post-Grenvillian) northeast-trending, brittle faults, are marked by extensive hematization, chloritization, quartz veining and fracturing. Amount of displacement (if any) along these faults is undetermined. In the northwest corner of the map region, a 5- to 10-m-wide quartz vein, trending 030 to 050° occurs along the Paradise River. The quartz vein is on strike with the Paradise River fault to the north (Gower *et al.*, 1985). The Paradise River fault is interpreted to define (in part) the Sandwich Bay graben, and is probably of similar age to the Double Mer and Lake Melville grabens farther northwest (Gower *et al.*, 1983).

METAMORPHISM

Metamorphic grade in the region ranges from middle to upper amphibolite facies with evidence that granulite facies was locally attained. Garnet is a common metamorphic mineral in metasedimentary gneiss, orthogneiss, granitoid rocks and associated mafic rocks. Variable degrees of partial melting are present in most units, ranging from small (cm scale) segregations in granitoids, orthogneiss and mafic rocks to extensive, and locally complete anatexis in metasediments. The presence of metamorphic orthopyroxene in a few localities suggests that granulite-facies conditions were reached.

Metasedimentary gneiss is characterized by the assemblage biotite + sillimanite + garnet + K-feldspar + plagioclase + quartz, with magnetite as a common accessory phase. Garnet and biotite are commonly found in the leucosome component. One locality of pelitic gneiss in the Mealy Mountains terrane contains cordierite + garnet + sillimanite + biotite. Some of the cordierite porphyroblasts are partially retrogressed according to the reaction:

cordierite + K-feldspar = sillimanite + quartz ± biotite

Other grains are partially to completely pinitized, having no evidence of replacement by the above phases. Gower *et al.* (1987) note that cordierite is a widespread metamorphic mineral in the Paradise metasedimentary gneiss belt but was not seen in the Gilbert River belt or the metasedimentary gneiss in the southwest area of the Port Hope Simpson region (Mealy Mountains terrane).

Granitoid rocks and orthogneiss contain biotite ± hornblende ± garnet ± clinopyroxene + an opaque mineral as constituent mafic minerals. Recrystallized clinopyroxene is present in syenitic and monzonitic rocks of the Upper Paradise River monzonite. Retrogression to lower or middle amphibolite facies is indicated by the presence of post- to syn-fabric muscovite in metasedimentary gneiss and orthogneiss, and replacement of hornblende and/or clinopyroxene by chlorite, biotite and epidote in granitoid and mafic rocks.

Mafic rocks of the Alexis River anorthosite and the White Bear Arm complex partially preserve primary (igneous) minerals, but commonly show hydration and replacement of pyroxene by amphibole and recrystallization of plagioclase. Coronitic textures are developed in some areas in gabbroic rocks as olivine cores, mantled by orthopyroxene and amphibole rims. Small bodies of granulite facies, two pyroxene-bearing gabbronorite and diorite occur in the White Bear Arm complex and the Mealy Mountains terrane, respectively.

ECONOMIC POTENTIAL

The economic mineral potential of the Alexis River Region is limited to, (i) local rusty-weathering zones associated with metasedimentary gneiss, (ii) minor pyrite found within late (post-Grenvillian) brittle fault zones in the eastern portion of the region, (iii) trace amounts of pyrite occurring in a Paleozoic dyke in the western portion of the area, and (iv) local anomalous scintillometer readings (200 to 400 cps) determined on few of the pegmatites. Noteworthy are large magnetite crystals (up to 6 cm in diameter) associated with a late alkali-feldspar granite pegmatite intruding a metagabbro enclave just north of the Alexis River.

ACKNOWLEDGMENTS

Thanks are due to able and enthusiastic field assistants Joe Anderson, Mark Blake and Bob Patey who were always ready, willing and able throughout the season. Canadian Helicopters, through pilot Sean Tucker, provided excellent service and resourcefulness. Labrador Airways are thanked for reliable service throughout the summer. Charlie Gower is especially thanked for his mapping contribution and field insights during the final week. The usual efficient logistic services were expedited by Wayne Tuttle and Richard White out of Goose Bay. The manuscript was reviewed and improved by Charlie Gower.

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