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GEOLOGY OF THE UPPER EAGLE RIVER MAP REGION, GRENVILLE PROVINCE, SOUTHEAST LABRADOR

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ABSTRACT

The Upper Eagle River map region comprises NTS map areas 13B/09, 13B/10, 13B/15 and 13B/16. Much of the area is very poorly exposed, consisting of vast swamps or low wooded hills; riverside outcrops along the Eagle River provide a good section across the northern part of the region.

Rare remnants of sillimanite–garnet-bearing metasedimentary gneiss and abundant granite orthogneisses (having minor granodiorite, quartz diorite and quartz-syenite orthogneiss) are believed to be the oldest rocks present. The orthogneisses link up with similar rocks farther north, which have pre-Labradorian ages between 1780 and 1730 Ma. Foliated to locally gneissic recrystallized granitoid rocks have been divided into three groups, namely, i) a mixed quartz monzonite to granite unit in the northwest part of the region, ii) K-feldspar megacrystic granitoid rocks, and iii) granite to alkali-feldspar granite. If the granitoid rocks are plutons intruded into the gneisses, then an early Labradorian age is most probable, but they could represent less strained and metamorphosed equivalents of the orthogneiss. One of these granitoid bodies, in an adjacent map region, has been dated to be 1631 ± 1 Ma (U–Pb monazite), which is interpreted as its age of emplacement.

Remnants of a granulite-facies layered mafic intrusion were discovered in the north-central area. Rock types include ultramafite, gabbronorite, leucogabbronorite and metamorphosed equivalents. Similar rocks a few kilometres to the southeast may be part of the same intrusion. Small areas of mafic rocks metamorphosed to amphibolite or granulite facies are also present elsewhere in the map region.

The northwest portion of the map region is underlain by the Mealy Mountains Intrusive Suite. Rock types include leuconorite, monzonorite, monzonite, quartz monzonite and granite. The rocks are mostly equigranular and weakly foliated. The mixed quartz monzonite to granite unit could be affiliated to the Mealy Mountains Intrusive Suite.

In the southeast corner, a few sparse exposures of coarse-grained monzonite are interpreted as belonging to the Upper Paradise River pluton, from which, farther east, Wasteneys et al. *(1997) reported ages of 1501 ± 9 Ma and 1495 ± 7 Ma.*

In the northeast part of the map region, metamorphosed and recrystallized metagabbro–diabase has been interpreted as forming sill-like mafic intrusions, emplaced into the enveloping granitic gneisses. Leucocratic variants are also present and hints of layering suggest emplacement as sub-horizontal sheets. Similar mafic rocks in the Upper Paradise River pluton have been included in the same unit. These rocks texturally contrast with a few outcrops of massive, ophitic-textured diabase in the northwestern part of the map region that have been assigned to the northeast-trending 1250 Ma Mealy dykes swarm.

Prominent positive aeromagnetic anomalies, mostly in the southern half of map region, can be correlated with massive, generally coarse-grained, granitoid plutons divisible into three lithological groups; namely hornblende quartz monzonite, megacrystic granitoid rocks and granite to alkali-feldspar granite. The absolute age of these plutons is not known, but it can be reasonably assumed that they are part of a widespread late- to post-Grenvillian (970 to 950 Ma) suite.

A north-northeast lineament in the southeast corner of the region is inferred to be the trace of an unexposed part of a 615-Ma Long Range dyke known both north and south of the present study area.

A major structural feature of the region is an open northeast-plunging antiform that has folded both gneisses and mafic sheets; this structure is clearly evident on aeromagnetic maps. Two northeast-trending brittle faults are inferred to cross the region and to bound the southwestward extension of the Sandwich Bay graben.

The best target for mineral exploration appears to be the metamorphosed layered mafic intrusion, in which two sulphide showings were discovered during mapping. Some of the most fractionated late- to post-Grenvillian granite and pegmatite may have potential for granitophile mineral potential.

INTRODUCTION

The Upper Eagle River map region is located in the Grenville Province in eastern Labrador and is situated between 100 and 150 km southeast of Goose Bay (Figure 1). The region includes 1:50 000 scale NTS map areas 13B/09, 13B/10, 13B/15, 13B/16 (NTS 13B/northeast), collectively embracing an area of about 3700 km^2. Mapping in the region was undertaken as part of the continuing program of geological reconnaissance mapping in Labrador by the Newfoundland Department of Mines and Energy.

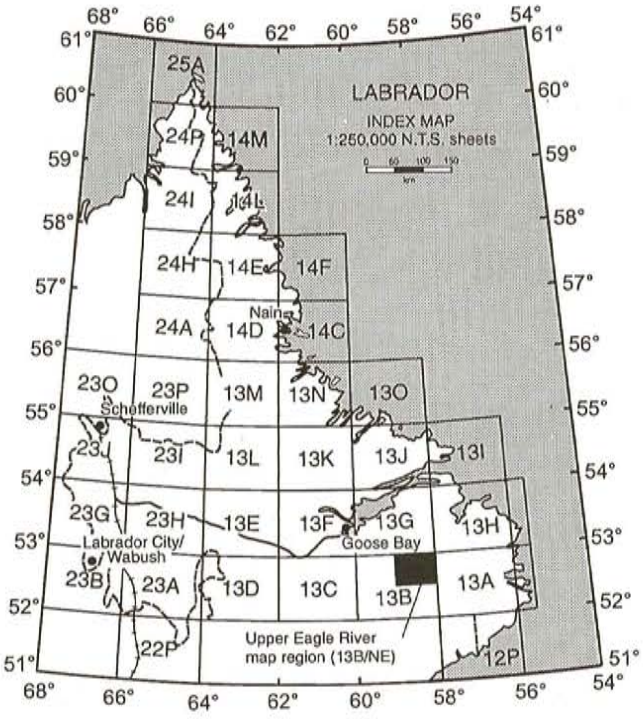


Figure 1. *Location of the Upper Eagle River map region (NTS 13B/northeast) in Labrador.*

The region is part of a 300- to 500-m-high plateau extending throughout much of interior southeast Labrador. It includes parts of the Eagle River, Paradise River and St. Paul River drainage basins. The former two rivers discharge into Sandwich Bay and the latter into the Gulf of St. Lawrence. Much of the northern two-thirds of the map region consists of flat wetlands, characterized by shallow lakes containing numerous boulders and flanked by extensive string bog. Interspersed with the marshes are low, spruce-clad rises and knolls (Plate 1). The rare outcrops to be found in these areas are at the base of the knolls, typically at their western ends (in crag-and-tail features), or on their southern flanks, in keeping with the prevailing west to east, or northeast, ice flow. The dominant underlying bedrock in wetlands areas is quartzofeldspathic gneiss or recrystallized granitoid rocks, which weather much more readily than their later massive, unmetamorphosed compositional equivalents.

In the northwest part of the map region, the topography changes abruptly to wooded uplands, locally with craggy, bare-rock hilltops, separated by densely forested valleys. In the Southeast Mealy Mountains map region to the north (Gower and van Nostrand, 1996), exposure is adequate to show that the topographic change from wetland to wooded uplands defines the boundary between the Mealy Mountains Intrusive Suite (*see below*) and country-rock gneisses. Absence of adequate outcrop control prevents confirmation in this area, but a similar reasoning seems applicable.

The southwest quadrant has more varied, generally higher relief, reaching an altitude of 552 m in the southwest corner of the map region. Higher ground also extends northeastward toward the centre of the region, forming the watershed between the Eagle River to the northwest, and the Paradise and St. Paul rivers to the southeast. The higher relief areas are almost entirely enshrouded in thick spruce forest, but barren, moss-covered hilltops are common. Rock exposures can be found on most of the bare hilltops and locally in the forest on the steeper, generally west-facing flanks of hills. The uplands correlate closely with the distribution of late- to post-Grenvillian plutons and, where protected from glaciation, some of the surrounding country rocks.

Except along the Eagle River, outcrops in stream beds or shorelines are rare. Along the Eagle River, and for about 5 km along the lower parts of its main tributaries, outcrop improves in a downstream direction as the river enters a well-defined gorge. The steep, wooded sides of the Eagle River gorge, however, make much of the exposure inaccessible to aircraft or on foot. Along the river, mapping was carried out partly by a few short foot traverses, but mostly by running the river, with its many rapids, in a Zodiac; anybody considering boat work on the Eagle River is advised that it requires care and backup safety arrangements. Apart from the Eagle River,

Plate 1. *Aerial view of typical marshland topography forming much of the map region.*

access to outcrop was gained by helicopter, which in wooded areas necessitated landings in marshy clearings up to 1 km from the exposure and walking in.

During one month of mapping, 300 data stations were established, a number that is considerably lower than most regions mapped previously in a similar manner. This drop in data acquisition can be almost entirely attributed to extremely poor exposure – most of the time was spent looking for outcrop, rather than at it. Nevertheless, 300 data stations still represents a significant advance on the 13 observations previously recorded from the area by Eade (1962). Samples were collected from all (except three) outcrops, slabbed and then stained to assist in the identification of potassium-bearing minerals.

PREVIOUS WORK

The only previous published non-derivative geological map that includes the area is the 1:506 880-scale map of Eade (1962). In his pioneering study, he depicted most of the region to be underlain by granite to granodiorite, varying from massive or poorly foliated to banded gneiss (his Units 3 and 4). In addition, monzonitic rocks of the Mealy Mountains Intrusive Suite were indicated in the northwest corner of the map region (his Unit 5).

Geological mapping at 1:100 000 scale has been carried out to the northwest, north, northeast, east and southeast (Nunn and van Nostrand, 1996; Gower and van Nostrand, 1996; Gower *et al.*, 1983; van Nostrand, 1992, and Gower *et al.*, 1993; respectively). The regions to the south, southwest and west remain unmapped. Aeromagnetic coverage of the region is available at 1:250 000 scale (Geological Survey of Canada, 1976a) and 1:63 360 scale (Geological Survey of Canada, 1974a,b; 1976b,c) as uncoloured maps and as a coloured magnetic anomaly map at 1:1 000 000 scale (Geological Survey of Canada, 1985). Shaded-relief coloured aeromagnetic maps based on the Geological Survey of Canada data are available at 1:250 000 and 1:100 000 scale from the Newfoundland Department of Mines and Energy. The study area is also included as part of the 1:500 000 Bouguer anomaly map for Battle Harbour–Cartwright (Thomas, 1974), and the regional lake-sediment and geochemical survey for NTS map area 13B (Friske *et al.*, 1994). The aeromagnetic data, which were not available to Eade (1962) during his work, were an enormous asset in geological interpretation during the present study.

Poor access, poor exposure and lack of geological information have discouraged mineral exploration of this region and very little activity has been reported. The region was completely ignored during the Labrador staking frenzy of 1994–1995.

DESCRIPTION OF MAP UNITS

The region is situated within the Mealy Mountains ter-

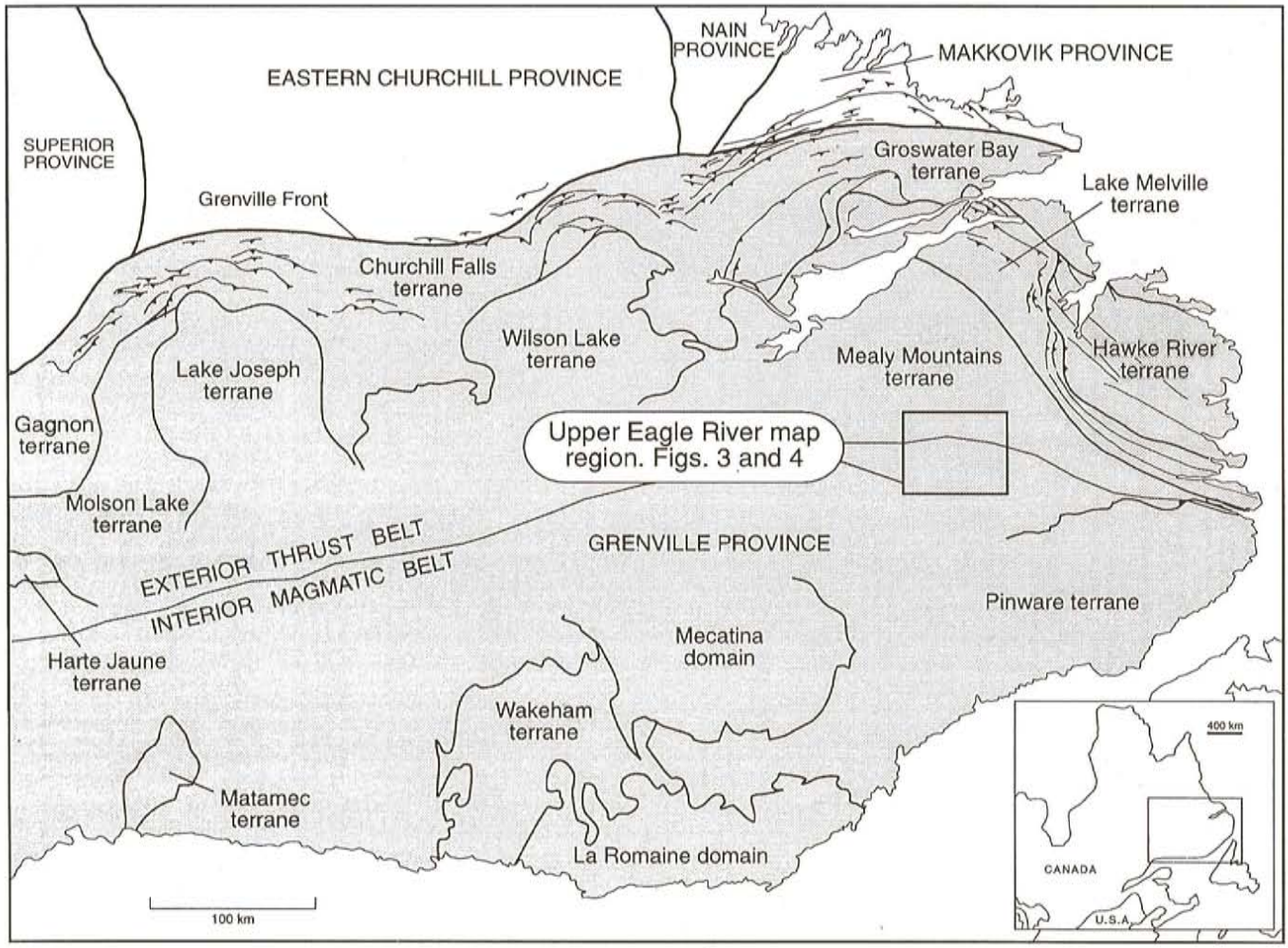


Figure 2. *Geological context of the Upper Eagle River map region in the eastern Grenville Province.*

rane and straddles the ill-defined boundary between the Exterior Thrust Belt and the Interior Magmatic Belt (Figure 2). Geochronological data are currently unavailable for the area, but, by inference from adjacent areas, most rocks are believed to be late Paleoproterozoic or Mesoproterozoic. A geological map of the region is presented as Figure 3 and a shaded-relief aeromagnetic map, from which the geological boundaries are largely interpreted, as Figure 4.

Gneissic rocks are interpreted as the oldest units; rare remnants of metasedimentary gneiss were discovered, but most are orthogneiss. Mafic rocks are a constant, but generally minor, associate of the gneisses, and remnants of a layered mafic intrusion were discovered in the north-central part of the map region. Foliated to gneissic granitoid rocks have been indicated as a separate, possibly younger package and one particular group (the Mealy Mountains Intrusive Suite) has been subdivided from them. Later rocks include a westward extension of the Upper Paradise River pluton, mafic intrusions of uncertain age (but assumed Mesoproterozoic), late- to post-Grenvillian granitoid plutons and an inferred Neoproterozoic Long Range dyke.

METASEDIMENTARY GNEISS

Unequivocal metasedimentary gneiss was discovered at two localities in the map region. One is on the border between NTS map areas 13B/09 and 13B/16 and the other is in the southwest part of 13B/09. At the first locality, the rock is grey- to rusty-weathering, tightly folded, schistose, sillimanite–garnet–biotite metasedimentary gneiss. The schistose pelitic gneiss is in contact with inhomogeneous granite (cf. diatexite) and the association of these two rock types was traced along strike for a total length of about 1 km. The second locality is a garnet- and biotite-rich granitic gneiss with sillimanite concentrated into anastomosing veneers. The two sites are widely separated and not obviously related (Figure 3).

QUARTZOFELDSPATHIC ORTHOGNEISS

The orthogneiss is dominantly granitic, but grades locally into granodiorite, quartz monzonite or diorite compositions. It is assumed to be pre-Labradorian by correlation with similar gneisses farther north, for which ages between 1780 and 1730 Ma have been reported (Krogh *et al.*, 1996).

The rocks weather grey, white, buff, brown, pink, rusty; or locally red or black (the latter two colours depending on hematization and the presence of amphibolite, respectively). They are medium grained to pegmatitic; some contain K-feldspar porphyroblasts, and others have an anomalous sugary texture. The gneisses are generally well-banded and typically inhomogeneous (Plate 2). Banding is defined by pegmatitic leucosome, concordant biotite- and amphibole-rich schlieren, amphibolite layers and more homogeneous granitoid zones. Banding is diffuse, finely laminated or broad and/or irregular, and grades into unbanded but strongly foliated rocks, in places; locally, tight folds are present. The mineral assemblage comprises K-feldspar, plagioclase, quartz, biotite, hornblende, opaque mineral(s) (magnetite and, rarely, pyrite) and garnet. Garnet is uncommon and nowhere large. Most grains are less than 0.2 cm across and the largest seen is 0.4 cm in diameter. Magnetite and hornblende occur as porphyroblastic minerals. Pegmatitic material, locally discordant and/or folded, is rare to abundant. One pegmatite was noted as containing magnetite crystals 2 cm in diameter. Amphibolite is generally rare, but an exception occurs in the St. Paul River headwaters area where a band of amphibolite about 50 m wide was recorded. Apart from pegmatite layers parallel to a strong, schistose foliation, the amphibolite is homogeneous. Presumably it is a metamorphosed intrusion, but, as contacts with the adjacent gneisses are concordant there is no field proof that this is so.

These gneisses were probably derived from granitoid plutonic rocks, but a sedimentary protolith can be entertained for unusually heterogeneous gneisses in the southwest and central parts of the map region. However, the only specific feature in favour of a sedimentary protolith for the gneisses from the southwest area is that they are unusually quartz rich, introducing the possibility that they may be derived from arenites. The sugary texture seen elsewhere could also be advanced as a weak argument supporting an arenaceous protolith for a few of the gneisses, but it is more likely due to recrystallization. In the central area, some gneisses have features reminiscent of metasedimentary diatexite. Where known from other parts of eastern Labrador, such rocks are generally white- or rusty-weathering, heterogeneous pegmatitic rocks and contain abundant, mauve garnet. The closest analogues contain some, but not all of these features, and lack garnet, so a metasedimentary protolith is not favoured here.

Granodioritic gneiss has been distinguished from the surrounding granitic gneiss in some parts of the region, but discrimination may not be well founded as compositional contrasts are not drastic (the granodioritic gneisses appear to have more hornblende and a higher plagioclase/K-feldspar ratio), and in all other respects the two types are essentially identical.

FOLIATED GRANITOID ROCKS

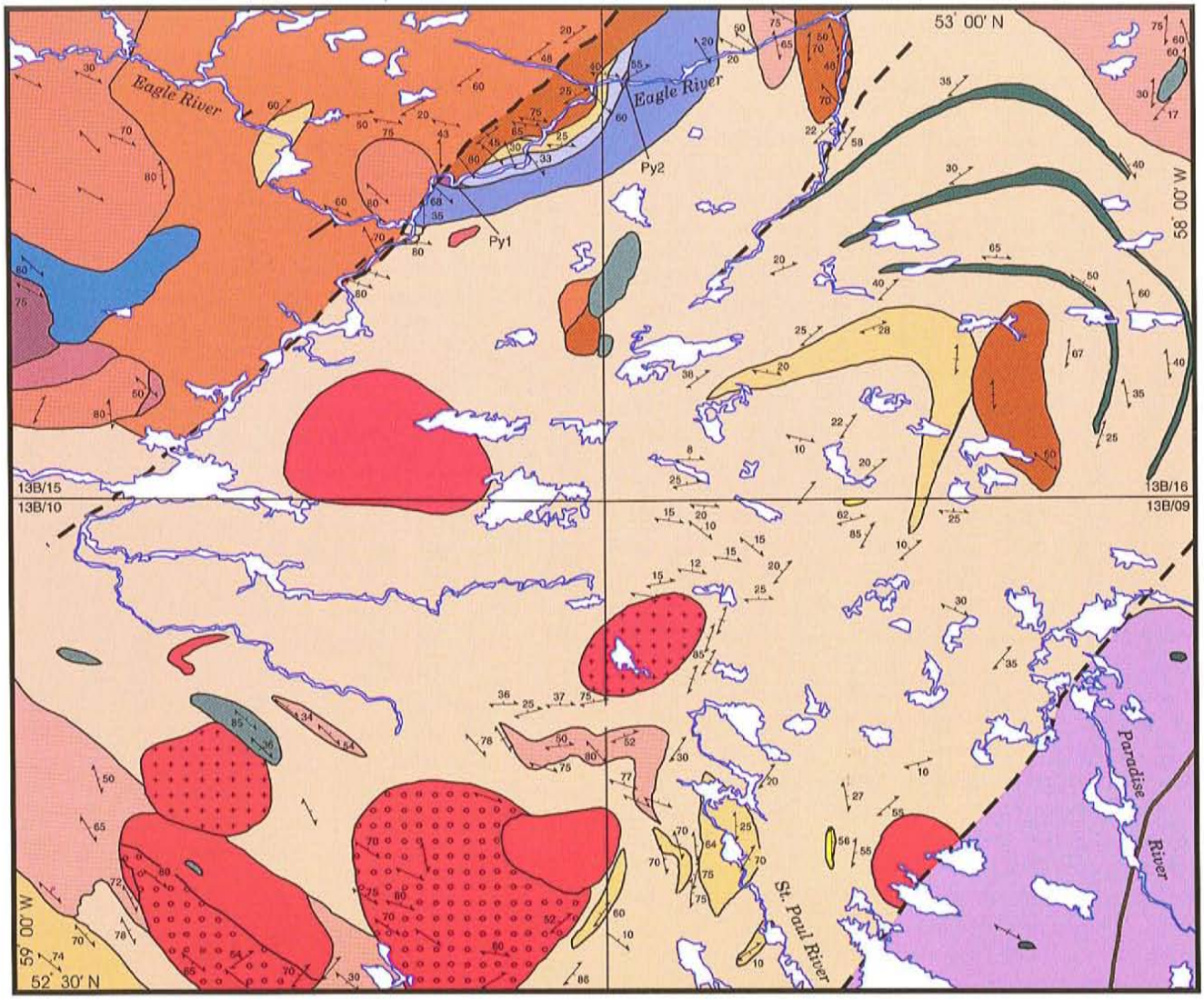
Foliated granitoid rocks have been grouped separately from orthogneisses, although it is emphasized here that a genetic difference is not necessarily implied. The orthogneisses and the foliated granites have similar bulk compositions, so it remains uncertain whether all that was being mapped are variations in state of strain and presence/ absence of partial melts; or whether the orthogneisses were affected by deformation and metamorphism that the foliated granite did not undergo. The foliated granitoid rocks can be classified into three compositional groups, namely i) quartz monzonite to granite, ii) K-feldspar megacrystic granitoid rocks and iii) granite to alkali-feldspar granite.

Quartz Monzonite to Granite

Quartz monzonite and granite occur in the north-central part of the map region west of the northeast-trending brittle fault parallel to part of the Eagle River (Figure 3). The rocks are pink-, buff-, orange-brown-, white-, grey- or creamy-weathering, medium to coarse grained, weakly to strongly foliated, recrystallized, homogeneous and hornblende bearing. The wide range of weathering colours partly reflects alteration along the fault, but may also be a signal that more than one unit has been included. In the field, the outcrops were labeled variously as quartz syenite, quartz monzonite, granite and alkali-feldspar granite, but stained slabs display less compositional variability. The rocks contain rare, diffuse mafic enclaves and irregular pegmatitic patches, as well as later discordant pegmatite. Similar rocks were described in the adjacent area to the north by Gower and van Nostrand (1996), who, as one option, considered that they might represent an early magmatic pulse linked to the Mealy Mountains Intrusive Suite.

K-Feldspar Megacrystic Granitoid Rocks

K-feldspar megacrystic granitoid rocks west of the metamorphosed layered mafic intrusion in the north-central part of the map region are typically pink- to grey-weathering, homogeneous, and weakly to moderately foliated. Variants are strongly foliated to mylonitic, or inhomogeneous due to pegmatitic patches and irregular to elongate mafic enclaves that may be remnants of mafic dykes. The rocks are now medium grained, having been recrystallized from a coarse-grained protolith. K-feldspar megacrysts are up to 3 by 2 cm and comprise up to 30 percent by volume. Quartz grains locally achieve 1 cm in diameter. Both hornblende and biotite



LEGEND

NEOPROTEROZOIC
- Long Range dyke (inferred)

MESOPROTEROZOIC

Late- to post-Grenvilian granitoid rocks
- Granite, alkali-feldspar granite and pegmatite
- Seriate to K-feldspar megacrystic granitoid rocks
- Monzonite, quartz monzonite

Mafic rocks
- Diabase (Mealy?) dykes
- Diabase/metagabbro sheets
- Upper Paradise River monzonite

PALEOPROTEROZOIC

Mealy Mountains Intrusive suite
- Granite
- Monzonite, quartz monzonite
- Monzonorite
- Norite, leuconorite

0 5km

Miscellaneous recrystallized mafic rocks
- Amphibolite, metagabbro, metanorite

Layered mafic intrusion
- Fine-grained leuconorite/granulite
- Leucogabbronorite/leucogabbro, anorthosite
- Gabbronorite and ultramafic rocks

Foliated granitoid rocks
- Granite to alkali-feldspar granite
- K-feldspar megacrystic granitoid rocks
- Quartz monzonite to granite

Gneissic rocks and minor amphibolite
- Granodioritic to granitic (ortho) gneiss
- Granitic (ortho) gneiss
- Sillimanite-garnet pelitic (metasedimentary) gneiss

- Foliation and gneissosity
- Fault
- Mylonite zone

Figure 3. *Geological map of the Upper Eagle River map region. The boundaries of most units have been inferred from aeromagnetic data (cf. Figure 4).*

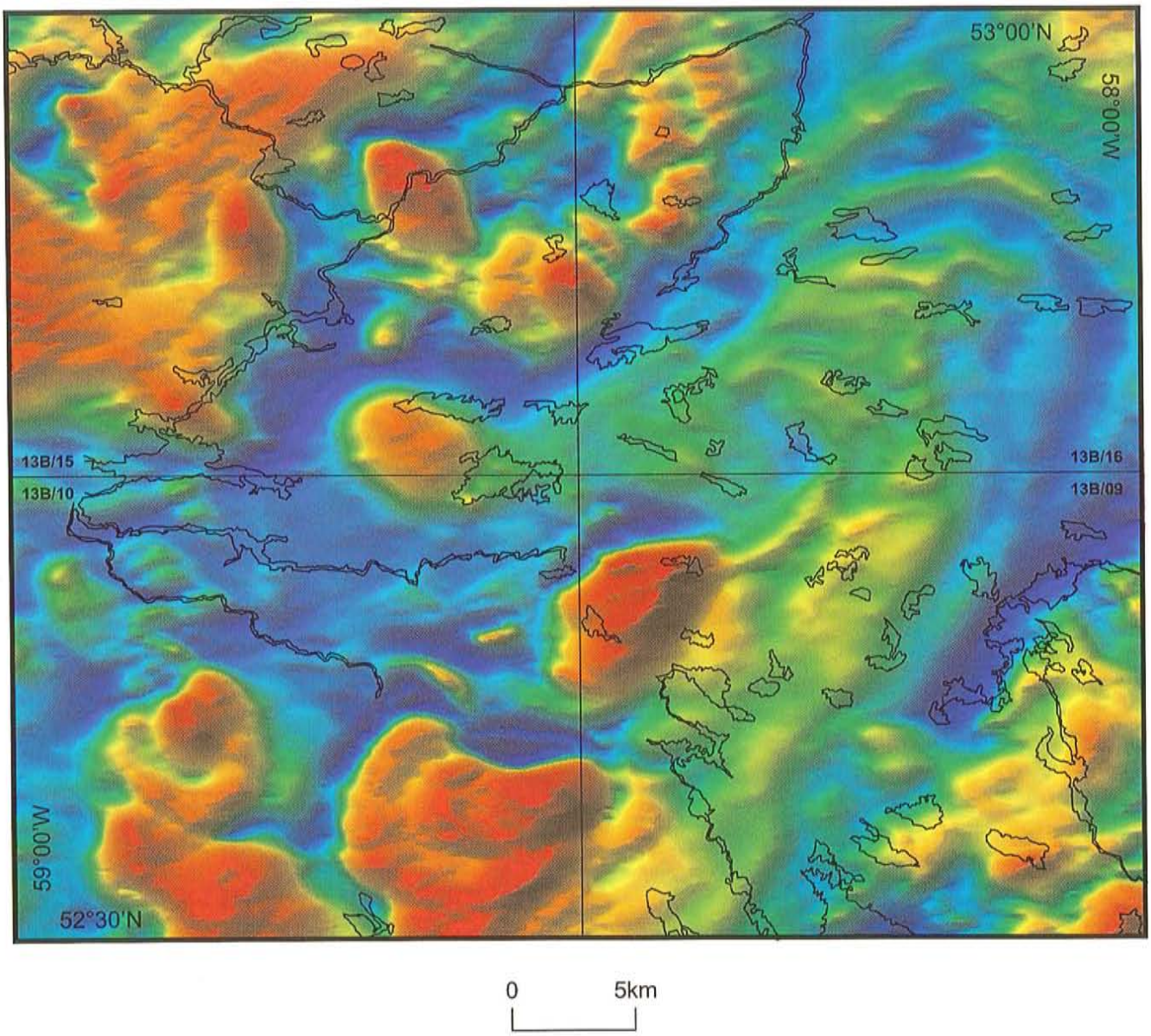


Figure 4. *Coloured shaded-relief aeromagnetic map of NTS 13B/northeast. Red end of spectrum–magnetic highs; blue end of spectrum–magnetic lows; (map prepared by G. Kilfoil, Geological Survey of Newfoundland and Labrador).*

are present and opaque minerals include magnetite and pyrite. The megacrystic rock is intruded by allanite-bearing pegmatite and rare microgranite dykes.

Farther east, K-feldspar seriate to megacrystic quartz monzonite was seen on the shore of Eagle River and its major tributary in NTS map area 13B/16. The rock is pink, homogeneous and coarse grained and distinctive in having a higher proportion of mafic minerals (biotite and hornblende) than is typical for most of the monzonites in the map region. The rock grades into a 0.5-km-wide mylonite zone on its eastern side. The southern extent of this unit is not known and it is possible that it continues through an area lacking exposure to join up with an outcrop of megacrystic granitoid rock mapped some 25 km to the southwest.

In the southeast part of NTS map area 13B/16, two outcrops of granitoid rock lacking gneissosity have been tentatively grouped together as representatives of a pluton emplaced into gneisses. One is a pink, homogeneous, weakly to moderately foliated K-feldspar megacrystic hornblende monzonite, and the other is a non-megacrystic to seriate, somewhat more strongly foliated hornblende quartz monzonite. The shape of the body, as depicted in Figure 3, is based on an area of low magnetic intensity that appears to disrupt anomalies that outline a regional fold (Figure 4).

Granite to Alkali-Feldspar Granite

Pink, buff or white, homogeneous alkali-feldspar granite was mapped in the northeast corner of NTS map area 13B/16.

Plagioclase, biotite and an opaque mineral are accessory phases. The granite is interpreted to be part of a pluton previously mapped to the north and east. The dominant rock type in this body has been previously referred to as, i) syenite to quartz syenite in the east (van Nostrand, 1992), ii) granodiorite in the northeast (Gower *et al.*, 1985), and iii) hornblende–quartz monzonite to granite in the north (Gower and van Nostrand, 1996). Schärer *et al.* (1986) reported a U–Pb monazite age of 1631 ± 1 Ma for this body outside the present study area with minimum ages for two zircon fractions of 1718 and 1735 Ma. The zircon fractions were interpreted as inherited and the monazite as representing the time of emplacement of the pluton. The granite can be subdivided into two compositionally similar groups on the basis of texture. A coarse- to very coarse-grained group in the east is weakly foliated. In this group, quartz grains are equant and may exceed 1 cm in diameter and K-feldspar grains are up to 2 cm long. The other group, in the west, is fine to medium grained and strongly foliated to mylonitic. Quartz grains are elongate slivers and K-feldspar grains lensoid aggregates. It would seem that a major ductile structure likely occurs west of the exposed granite.

Foliated granite on the border between NTS map areas 13B/09 and 13B/10, depicted as a folded lensoid body on Figure 3, is pink- or locally grey-weathering, medium to coarse grained, recrystallized, and generally fairly homogeneous, except for discontinuous, uncommon quartz-rich layers. Although two-feldspar biotite granite is dominant, it grades into minor hornblende granite and quartz syenite locally. The rocks are moderately to strongly foliated (nowhere well-banded) and the foliation is folded into northeast-plunging minor folds in places. These foliations and minor folds, in context with a major northeast-plunging regional antiform, are the basis for grouping the outcrops as shown. Two outcrops of similar granite occur 10 km farther west, although the rocks are more gneissic. Without intervening exposure, any relationships cannot be determined, although the regional structural pattern gives reason to suppose that they might be linked.

Areas of pink- to buff-weathering, strongly foliated, but not gneissic granite to alkali-feldspar granite occur in southwest NTS map area 13B/10 and collectively may originally have belonged to a single northwest-trending body, prior to separation by a late- to post-Grenvillian granite pluton (if the regional northwest-trending foliation direction can be taken as a guide to the trend of rock units). The granite is medium to coarse grained, recrystallized, and inhomogeneous due to subtle grain-size variations and pegmatitic layers. The granite in the south-central part of NTS map area 13B/10 is somewhat more homogeneous and only weakly deformed (Plate 3). A characteristic of the granite is that it is very rich in K-feldspar having subsidiary quartz and sodic(?) plagioclase. Both biotite and amphibole are present. The rock is intruded by deformed pegmatite.

RECRYSTALLIZED MAFIC ROCKS

Layered Mafic Intrusion

A southwest-trending zone of extremely variable mafic to anorthositic rocks parallel to the Eagle River in the north-central part of the study area is considered here to represent the remnants of a disrupted layered mafic intrusion that has been metamorphosed to medium- and high-grade assemblages. Rock types at various outcrops include ultramafite, melanorite, gabbronorite, leucogabbronorite, anorthosite, mafic granulite and amphibolite. This menu of names partly reflects genuine lithological variation, but also the struggle to find an appropriate appellation. Figure 3 shows a tentative subdivision into three units, namely i) gabbronorite and ultramafic rocks, ii) leucogabbronorite–leucogabbro and anorthosite, and iii) fine-grained leuconorite–granulite. The rocks are texturally and compositionally diverse. Parts are homogeneous, but diffuse or sharply defined primary layering (1 to 20 cm thick layers) is also present in some outcrops (Plate 4). The grain size varies from fine to very coarse, embracing obvious ophitic textures and thoroughly recrystallized granular fabrics. The ubiquitous minerals are plagioclase, orthopyroxene, clinopyroxene and an opaque mineral; biotite and hornblende are also common. Pods, lenses, and "sweats" of plagioclase-rich leucosome are pervasive in some outcrops, but absent elsewhere. These may contain orthopyroxene. A variety of melanocratic pods, veneers and lenses, locally consisting solely of clinopyroxene, are also present. A sulphide-rich zone containing some chalcopyrite was found in association with an ultramafic layer. The history envisaged for these rocks is as follows: i) formation as a layered mafic intrusion; ii) metamorphism to granulite facies with local and irregular partial melting accompanied by deformation, iii) retrogression to amphibolite facies during subsequent tectonism, and iv) further disruption during late-stage brittle faulting.

Outside the confines of the Eagle River valley the body is unexposed. It was not even suspected during mapping of the area to the north (Gower and van Nostrand, 1996). Unfortunately, magnetic patterns in the vicinity of the intrusion and to the north do not assist greatly in delineating boundaries.

A small area of mafic rock is depicted south of the layered mafic intrusion. The rocks here consist of melagabbronorite, amphibolite and leucoamphibolite. All are black-weathering and homogeneous within their respective outcrops, but are texturally disparate. The melagabbronorite is massive and shows obvious ophitic texture, in contrast to the other two rocks in which primary textures are poorly preserved. One of these is medium grained and has a well developed fabric; the other is fine grained and only shows a weak fabric. The relationships between the three mafic rocks

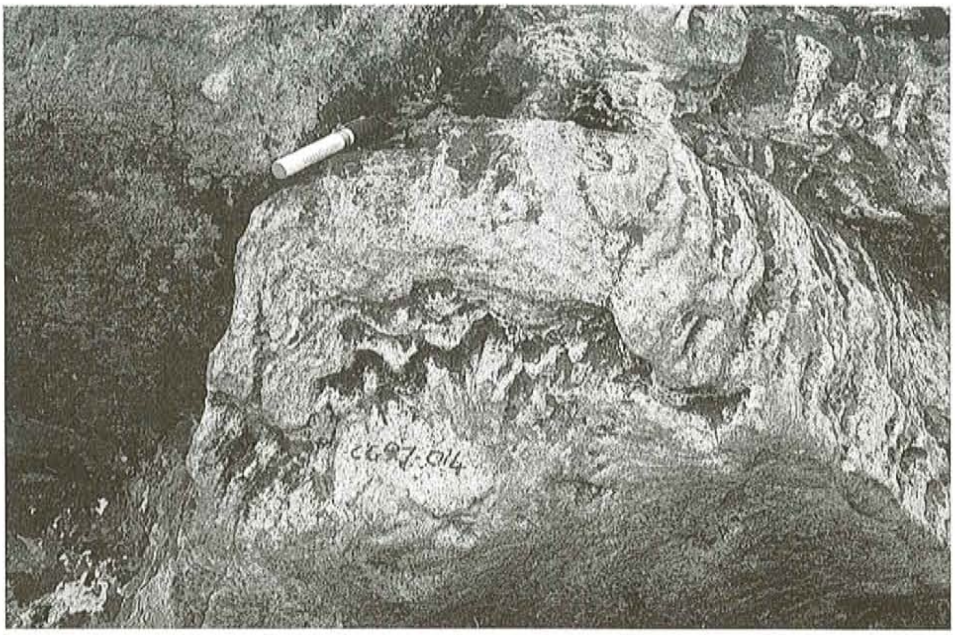


Plate 2. *Folded granitic to granodioritic orthogneiss of possible pre-Labradorian age; central NTS 13B/15.*

remains unknown. Their variability is no more than that seen in the above-described layered mafic intrusion, and, indeed, they could be a dismembered part of it. One alternative to the way the layered mafic intrusion has been depicted in Figure 3 is that it is a half-ring-shaped body that bulges considerably more to the southeast, being coincident with an arcuate series of discontinuous magnetic highs (Figure 4).

Miscellaneous Recrystallized Mafic Rocks

Recrystallized mafic rocks occur sporadically elsewhere in the map region, locally in sufficient volume to be shown on Figure 3. They are termed amphibolite, metagabbro and metanorite in the legend. In northeast NTS map area 13B/16, black-weathering, medium- to coarse-grained, homogeneous, moderately to strongly foliated amphibolite was mapped within a strongly foliated to mylonitic granite. Two outcrops were seen and are almost identical. They are distinct in containing common garnet up to 1 cm in diameter and typically over 0.5 cm in diameter. In the southwest, alignment of four outcrops of black- to dark-green-weathering amphibolite parallel to the prevailing northwest foliation trend is considered sufficient justification to group them. The rocks are fine to medium grained, weakly to strongly foliated, recrystallized, homogeneous and show vestiges of ophitic texture. All have been injected by narrow felsic veinlets. The rocks do not have any noteworthy magnetic expression.

A porphyritic amphibolite occurs within foliated granite in the northwest. It is grey-brown-weathering, has a fine- to medium-grained matrix and contains plagioclase phenocrysts up to 4 by 3 cm. The matrix is recrystallized and there are some plagioclase-rich melt patches containing orthopyroxene. No similar rock was found elsewhere within the map region.

MEALY MOUNTAINS INTRUSIVE SUITE

Rocks assigned to the Mealy Mountains Intrusive Suite are subdivided into four units on Figure 3, but compositional and spatial relationships are better served by describing them in two groups. U–Pb zircon ages of 1645.5 ± 1.5, 1635 $^{+22}_{-8}$ (Emslie and Hunt, 1990) and ca. 1730 Ma (Krogh *et al.*, 1996) have been obtained from the Mealy Mountains Intrusive Suite north of the Eagle River map region.

Norite, Leuconorite and Monzonorite

Norite, leuconorite and monzonorite were seen together in some outcrops and both occur in the same area. The leuconorite is grey-, black- or buff-weathering, fine to medium grained, homogeneous and contains plagioclase, clinopyroxene and orthopyroxene. The monzonorite is pale-pink- to creamy-weathering, also fine to medium grained and homogeneous, and, in addition to the minerals in the leuconorite, contains minor quartz, K-feldspar and hornblende. The monzonorite also contains irregular veins of clinopyroxene- and K-feldspar-rich material. The norite could form dykes rather than the more extensive areas shown on Figure 3, but no contacts were seen to resolve these alternatives.

Monzonite, Quartz Monzonite and Granite

The monzonite is white- to creamy-weathering, homogeneous, medium to coarse grained and partially recrystallized. It is massive to weakly foliated, the foliation direction being parallel to a regional northwest trend. The mineral assemblage consists of feldspar and clinopyroxene with lesser hornblende, Fe(Ti) oxide and minor orthopyroxene. In places, relict cores of grey mesoperthite are present and mantled by pale pink recrystallized, granular K-feldspar. The rocks are nowhere megacrystic, no enclaves were seen and minor intrusions are lacking.

The quartz monzonite to granite is pale- to dark-pink-weathering, homogeneous, massive to mildly foliated and not extensively recrystallized. Quartz is an obvious mineral, occurring in grains up to 0.5 cm in diameter and locally having a bluish hue. The granite at one locality has clearly

Plate 3. *Foliated granite, perhaps postdating formation of orthogneisses and of early Labradorian age; southeastern NTS 13B/10.*

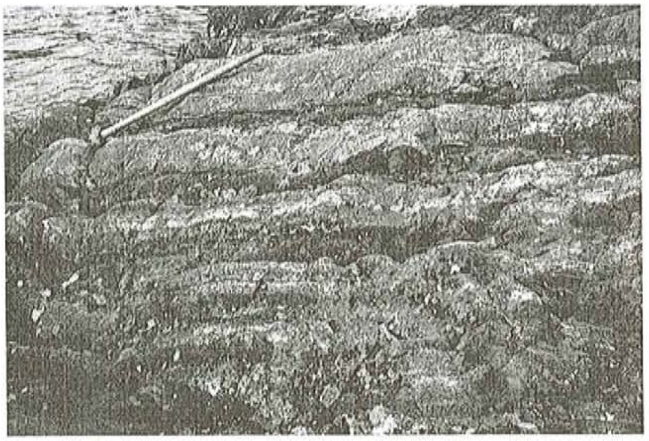


Plate 4. *Layering in metamorphosed layered mafic intrusion; eastern NTS 13B/15.*

been injected into the monzonite, forming an agmatite in which blocks of monzonite are completely enveloped by granite (Plate 5). At another locality, numerous enclaves of presumed country rock were observed. Rock types include well-banded quartzofeldspathic gneiss, fine-grained quartzofeldspathic rock (derived from aplite or felsic volcanic rocks?), and amphibolite. This locality is the easternmost exposure in the vicinity and close to a topographic contrast between hills to the west and flat marshland to the east. The break in topography, coupled with the presence of enclaves, is taken as evidence for the margin of the pluton in this area.

Outcrop is too poor to determine whether the above described rocks belong to one or more plutons. Neither aeromagnetic patterns, topography nor foliation directions furnish clarification. Monzonitic rocks in the Southeast Mealy Mountain map region (Gower and van Nostrand, 1996) correlate fairly closely with high topographic and positive magnetic relief. In the western part of NTS map area 13B/15, aeromagnetic highs extend 5 to 10 km beyond the topographic break, and two small exposures suggest that much of the low-lying area east of the hills may be underlain by rocks affiliated with the Mealy Mountains Intrusive Suite, which begs the (unanswered) question, "Why did it not resist erosion?".

Five outcrops of homogeneous monzonite in the north central part of NTS map area 13B/15 have been inferred to be a satellite intrusion linked to the Mealy Mountains Intrusive Suite. The rocks are creamy- to buff-grey-weathering, medium to coarse grained, weakly to moderately foliated and appear to be slightly recrystallized. They contain relict mesoperthite and have clinopyroxene, orthopyroxene and hornblende as mafic minerals and contain a few pegmatitic veinlets.

UPPER PARADISE RIVER MONZONITE

Four outcrops of monzonite found in the southeast part of the map region are interpreted to belong to the Upper Paradise River pluton. Physiographically, the area is one of low, heavily wooded hills with flanking marshland, and it is probable that ground traverses in the hills would result in the discovery of additional outcrops. This still incompletely mapped body is known to underlie an area of at least 2000 km^2 and to consist of unmigmatized, moderately deformed and recrystallized megacrystic and non-megacrystic monzonite, syenite and granite, with subsidiary anorthosite and leucogabbronorite (van Nostrand, 1992; Gower *et al.*, 1993). Two samples from the body dated by Wasteneys *et al.* (1997) in the Alexis River area (van Nostrand, 1992) yielded ages of 1495 ± 7 and 1501 ± 9 Ma.

In NTS map area 13B/09, the dominant rock type is a grey-weathering, coarse- to very coarse-grained, weak to moderately foliated, homogeneous, recrystallized, locally megacrystic monzonite. K-feldspar and plagioclase proportions are roughly equal; quartz is absent. Mafic minerals are hornblende, clinopyroxene, orthopyroxene, biotite and magnetite. A grey-weathering, fine- to medium-grained, rather lensy-textured, foliated rock was seen at one outcrop. It contains patches and spindles of K-feldspar- and quartz-rich material in a granulitic matrix of orthopyroxene, clinopyroxene, plagioclase, hornblende and biotite. The rock is interpreted to be an enclave of mafic to intermediate granulite containing melt segregations, but field relationships with the associated coarse-grained monzonite were not seen.

DIABASE–METAGABBRO SHEETS

With the aid of aeromagnetic data (Figure 4), scattered outcrops of metamorphosed and recrystallized metagabbro–

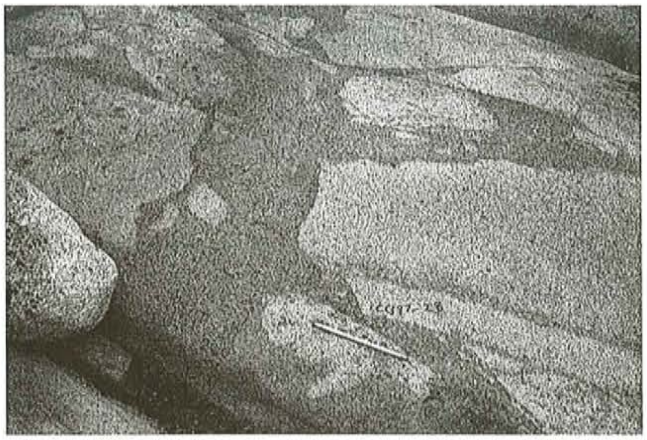


Plate 5. *Mealy Mountains Intrusive Suite: monzonite (pale shade) agamatically intruded by granite; southwestern NTS 13B/15.*

diabase in NTS map area 13B/16 have been interpreted as sill-like mafic intrusions, emplaced into the enveloping granitic gneisses. The rocks are black-weathering, fine to coarse grained, and generally weakly foliated or massive. Leucocratic variants are also present and suggestions of layering imply emplacement as sub-horizontal sheets. Minerals include primary and recrystallized plagioclase, pyroxene and opaque minerals, and metamorphic hornblende and sporadic garnet. From hand sample and stained slab identifications, the pyroxene is clinopyroxene. Psuedomorphs of olivine were tentatively identified in slabs. The fine-grained varieties, despite the recrystallization, still preserve ophitic textures, including evidence of quench plagioclase textures, and it is probable that such rocks represent chilled margins of the intrusions. The coarser grained rocks are generally more recrystallized, but also show relict ophitic textures, although lacking quench features. Coronas resulting from the breakdown of plagioclase and clinopyroxene to give hornblende (and locally garnet) are ubiquitous in the coarse-grained rocks, but less evident in the fine-grained varieties.

Two outcrops of black-weathering, medium- to coarse-grained mafic rocks within the Upper Paradise River pluton have been included in the same unit. The rocks are recrystallized, but show relict ophitic texture. Minerals present are clinopyroxene, orthopyroxene, plagioclase, garnet, hornblende, biotite and magnetite. A similar rock from the Alexis River area to the east (van Nostrand, 1992) is well enough exposed to be recognized as a dyke discordantly intruding foliated monzonite and having a chilled contact against it.

DIABASE (MEALY) DYKES

Two outcrops, each exceeding 10 m in width, on the southeast-flowing part of the Eagle River are interpreted to belong to the Mealy dyke suite, which has been dated to be 1250 ± 2 Ma (U–Pb baddeleyite; Hamilton and Emslie, 1997). Both exposures comprise grey- to black-weathering, medium- to coarse-grained, massive, homogeneous, ophitic-textured mafic rocks containing plagioclase, clinopyroxene and an opaque mineral (Plate 6). Contacts with the surrounding rocks are not exposed, thus preventing verification that the bodies are dykes and, if so, what their orientation might be. It is only on the basis of internal joint trends that they are inferred to strike northeast.

Four outcrops of black- to brown-weathering, massive, homogeneous ophitic-textured diabase showing quenched plagioclase features and rare plagioclase phenocrysts (1 by 0.2 cm) were recorded on a tributary of the Eagle River in the centre of NTS map area 13B/15. These four outcrops have been depicted as belonging to a single northeast-trending Mealy dyke, but it will be appreciated that the lack of outcrop away from the northeast-trending river, or any independent evidence (such as magnetic expression), means that the four outcrops could belong to a body having an entirely different shape. The rocks are inferred to predate brittle faulting because, i) they are injected by a few quartz-feldspar veins, ii) they are transected by late fractures along which alteration has occurred, and iii) they are heavily jointed. The fracturing, jointing and alteration are regarded as effects of late Neoproterozoic faulting. The presence of quartz-feldspar veins implies an earlier, pre-late Grenvillian time of emplacement.

LATE- TO POST-GRENVILLIAN GRANITOID ROCKS

Although this is the first mapping of late- to post-Grenvillian plutons in this map region, their existence and distribution was first inferred from their aeromagnetic signature by Gower *et al.* (1991, their Figure 4). Other features that identify them as late- to post-Grenvillian intrusions are their circular to ovoid shape, generally coarse-grained, massive appearance, lack of, or only slight recrystallization, resistance to weathering relative to the surrounding rocks, and a characteristic horizontal jointing pattern. All these features have been observed in granitoid plutons that have been dated. Despite being more resistant to erosion than the surrounding rocks, their coarse grain size and high feldspar content makes them somewhat susceptible to crumbly weathering, producing rounded hills covered in trees that have taken advantage of the relatively favourable soil and drainage conditions. Although the most qualitative, the horizontal jointing is an excellent field criterion for classifying individual outcrops to this group. The joints tend to be regularly spaced and continuous over long distances and the intervening rock weathers to a smooth, convex-outward shape between the joints, giving outcrop faces that resemble vertically stacked sausages (Plate 7).

Monzonite, Quartz Monzonite

The circular outline of the monzonite pluton in NTS map area 13B/10 has been inferred entirely from its aeromagnetic

Plate 6. *Ophitic texture in diabase assumed to belong to the 1250 Ma Mealy dyke swarm; central NTS 13B/15.*

Plate 7. *Horizontal jointing characteristic of the late- to post-Grenvillian granitoid plutons; southeast NTS 13B/15.*

signature, as only one outcrop was found, despite a thorough search. Given that most of the late- to post-Grenvillian plutons are homogeneous throughout, the lone outcrop can probably be accepted as representative of the bulk of the body. The monzonite is pink- to buff-grey-weathering, coarse grained, massive and homogeneous, and quite distinct from the late- to post-Grenvillian granite against which it abuts to the south. Felsic minerals are anhedral K-feldspar and plagioclase, both ranging in size from between 0.5 and 1.0 cm; quartz is absent. Mafic minerals are pyroxene, hornblende, biotite, and magnetite. As has been found elsewhere in southeast Labrador in late- to post-Grenvillian plutons, the deficiency of quartz correlates with rarity of exposure.

Three outcrops of the monzonite pluton, located mostly in NTS map area 13B/09, were found, but the terrain in this area is sufficiently varied to anticipate discovery of additional exposures with more detailed mapping. The monzonite forms an ovoid, north-east-trending pluton, the outline of which can be inferred from an aeromagnetic high, topographic lineaments and country-rock outcrop control. The aeromagnetic anomaly is displaced about 1 km in a northeast direction, with respect to the mapped pluton. The monzonite is buff- to pale pinkish cream-weathering, medium to coarse grained, homogeneous and massive to weakly foliated. It contrasts from the other late- to post-Grenvillian plutons in not being so coarse grained. The largest crystals do not exceed 1 cm. The rock consists of K-feldspar and plagioclase in approximately equal proportions, minor quartz (less than 3 percent), hornblende, biotite and magnetite. The horizontal jointing feature described above is particularly well developed in this pluton, especially at an outcrop near its western margin.

Seriate to K-Feldspar Megacrystic Granitoid Rocks

Two seriate to K-feldspar megacrystic granitoid late- to post-Grenvillian plutons were mapped in the southern part of NTS map area 13B/10 and their mutual similarity suggests that they are magmatic kindred.

Plate 8. *Seriate to megacrystic late- to post-Grenvillian granite – note zoning in feldspars; southeast NTS 13B/10.*

The pluton in the southeast part of NTS map area 13B/10 is grey-pink- or pink-weathering, coarse grained and homogeneous. It is mostly massive, but is locally weakly to moderately foliated, the foliation being either parallel to the inferred margin of the body or consistent with the prevailing northwest trend. The texture varies between uniform, seriate and megacrystic, but with insufficient textural contrasts to merit subdivision. Minerals present include K-feldspar, plagioclase, quartz, biotite and magnetite. The K-feldspar grains range up to 5 by 3 cm, but are generally less than 2 by 1 cm. The crystals are euhedral to anhedral and show zoning in some instances (Plate 8). Mantled feldspars are common, mostly K-feldspar mantling plagioclase, but locally the reverse. No minor granitic or mafic minor intrusions were seen and enclaves are also rare. One exception, recorded from the southwest part of the pluton, is a 5 by 1 m, foliated, fine-grained quartzofeldspathic xenolith of uncertain protolith.

The pluton in southwest NTS map area 13B/10 is pink-weathering, coarse grained and generally massive. It is probably best described as homogeneous, but terms such as seriate, megacrystic or rapakivi can also be applied with some justification. The rock consists of ovoid to euhedral alkali-feldspar (commonly 1.5 to 2 cm long), anhedral to subhedral quartz and plagioclase (up to 1 cm in diameter), biotite, common magnetite, subsidiary hornblende, and rare sulphide. The body is generally free of minor granitoid or mafic intrusions or enclaves, but one microgranite dyke and a few small (10 by 5 cm), medium-grained, elliptical biotite–plagioclase xenoliths were recorded in the southern part of the body. An isolated exposure of black- to buff-weathering, medium-grained, homogeneous, foliated, recrystallized plagioclase–hornblende rock, having subsidiary biotite and K-feldspar (leucomonzodiorite) from near the centre of the body, is interpreted as a roof pendant.

An outcrop that departs from the above description of the pluton, but grouped with it, consists of massive, homogeneous, K-feldspar-poor monzonite associated with microgranite situated at the interpreted western margin of the intrusion. The rock is texturally distinctive, having subhedral plagioclase grains up to about 1 cm across in a matrix composed almost entirely of hornblende and K-feldspar. The rocks lack similarity with the surrounding country rocks, therefore the outcrop is considered to indicate a more melanocratic border phase of the pluton.

A positive aeromagnetic anomaly is associated with this pluton and spatially correlates closely with a border that has been independently inferred from topography and outcrop distribution.

Granite, Alkali-Feldspar Granite and Pegmatite

An elevated area of low, rounded and wooded hills rising above the surrounding marshlands can be accepted as defining the extent of a late- to post-Grenvillian granite pluton in southeast NTS map area 13B/15. The pluton is a pink-weathered, massive coarse- to very coarse-grained granite. Only near the marshland–wooded hill interface does it grade into a medium-grained compositional equivalent – a variation that serves to confirm that the topographic break is, indeed, at the pluton margin. Throughout most of the pluton, alkali feldspar is perthitic, subhedral and 1 to 2 cm in diameter; quartz and plagioclase are anhedral, and both are 0.5 to 1.0 cm across. The plagioclase is bright pink in outcrop and staining is required to demonstrate that not all the pink feldspar is potassium-bearing. Mafic minerals are biotite, magnetite, traces of pyrite and possibly minor hornblende. Fluorite is also present. No minor granitoid or mafic minor intrusions or mafic enclaves were observed in any part of the body. The pluton can also be correlated with a positive magnetic anomaly, although the anomaly is displaced 3 km to the east-southeast relative to the outline of the body.

Aeromagnetic patterns have been interpreted to mean that a small, nested pluton intruded the northeast flank of the above-described seriate to megacrystic granite in southeast NTS map area 13B/10 (Figures 3 and 4). The two outcrops found within the designated nested pluton are distinct enough to justify this interpretation. One is a pink-weathering, coarse-grained, homogeneous biotite granite in which both the K-feldspar and plagioclase weather pink (very similar to the granite at the southern margin of NTS map area 13B/15); the other is a pink- and white-weathering, coarse-grained granite and graphic-textured pegmatite. Noteworthy in the pegmatite are biotite books up to 7 cm across and magnetite crystals up to 1.5 cm in diameter. The simplest interpretation for this body is that it represents a fractionated derivative of the larger seriate to megacrystic granite pluton that it intrudes.

Four outcrops found in the south-central part of NTS map area 13B/09 are interpreted to belong to a small, circular, late- to post-Grenvillian pluton. The rocks are all pink-weathering, medium- to coarse-grained, homogeneous, massive biotite granite. They show more textural variability than typical of most of the late- to post-Grenvillian plutons, both in average grain-size variation (0.5 to 1.0 cm) and in texture (homogeneous, seriate or tending to megacrystic). K-feldspar and plagioclase are present in roughly equal proportions (K-feldspar greater than plagioclase) and the amount of quartz almost matches that of plagioclase. Biotite is the dominant mafic mineral, but minor hornblende is present. The rocks also contain magnetite. Although there is little doubt that all the other late- to post-Grenvillian plutons exist more-or-less as depicted, the same cannot be said of this body. All the other plutons correlate with obvious positive aeromagnetic anomalies situated directly over the bodies, or displaced from them in a systematic way. As interpreted here, this intrusion is surrounded by a discontinuous positive magnetic anomaly in the enveloping country rocks, but is, itself, a magnetic low. This hypothesis is supported by arcuate foliation trends in the surrounding gneisses that wrap around the northwestern side of the interpreted body. A post-Grenvillian fault has been interpreted on its southeastern flank (*see below*), and probably contributes magnetic interference.

Although a minor component of many exposures in the region, pegmatite in the southwestern part of the map region (NTS 13B/10) is singled out for special mention because there is so much of it. It forms the sole rock type in a hook-shaped cluster of outcrops that form low, steep-sided hills surrounded by marshland lacking exposure. The pegmatites are pale-pink- to white-weathering, coarse to extremely coarse grained, massive and inhomogeneous, but characterisitically graphic textured. The lack of any indication of deformation suggests that they are part of the late- to post-Grenvillian suite, perhaps representing the roof of a small pluton, analogous to the nested pluton described previously.

Interestingly, the only other graphic-textured pegmatite recorded in the map region occurs as a dyke intruding gneissic granite at an outcrop between the pegmatite cluster and the nested pluton. In passing, it is noted that other granitic minor intrusions, such as microgranite and aplite are very rare in any rock type in the region.

LONG RANGE DYKE (INFERRED)

No exposures were found of the north-northeast-trending Long Range dyke indicated in the southeast part of NTS map area 13B/09 (Figure 3). The dyke's presence is inferred from a photo lineament in the area that is on line with exposures of a Long Range dyke farther north (van Nostrand, 1992; Gower *et al.*, 1985). The dyke intersects the shoreline of Sandwich Bay west of the mouth of Eagle River, where it has been dated by Kamo *et al.* (1989) to have an age of 615 ± 2 Ma. In a south-southwestward extrapolation, it is aligned with a major dyke mapped by Davies (1968) in the Baie des Moutons area on the north shore of the Gulf of St. Lawrence. This is the westernmost, longest and largest dyke of the Long Range swarm.

STRUCTURE

The dominant structural feature of the map region is a northeast-trending regional antiform that swings round into a more northerly orientation at its northeastern end, to continue into the Southeast Mealy Mountains map region (Gower and van Nostrand, 1996). Especially at its northeastern end, this antiform is clearly evident on the aeromagnetic map of the area (Figure 4). Gneissosity indicates that the limbs of the fold dip outward at between 20 and 50°. Farther southwest, the form of the fold is less obvious. Along the inferred crest of the fold, the dips are shallow and irregular and do not permit any regional plunge direction to be determined. In the south-central part of the map region, the eastern limb appears to be vertical or even overturned. The age of the structure is unknown, but metamorphic patterns in the Southeast Mealy Mountains map region led Gower and van Nostrand (1996) to conclude that the continuation of the antiform in that region may have predated emplacement of the Mealy Mountains Intrusive Suite. Isoclinal and tight folding within the gneisses that do not have any obvious geometric relationship to the major northeast-trending fold are probably even older features.

Late- to post-Grenvillian plutons disrupt the regional fold pattern defined by the gneisses. Foliations in the country rocks close to pluton borders tend to be parallel to them. If country-rock foliations at the present earth's surface are indicative of three-dimensional form of plutons, then the quartz-monzonite pluton straddling the border between NTS map areas 13B/09 and 13B/10 has a northeast-plunging cylindrical shape and the small body intruding the margin of

the Upper Paradise River pluton has inward dipping margins. The 3-km displacement of the aeromagnetic anomaly relative to the surface expression of the granite pluton in the southern part of NTS map area 13B/15 suggests it might have a cylindrical shape plunging to the east-southeastward.

A regional northwest-trending foliation direction is also characteristic of the map region. This is particularly evident in the southwest, where lithological boundaries have been drawn (possibly entirely erroneously) parallel to this direction. The same orientation is also evident in the Mealy Mountains Intrusive Suite to the north. As this trend occurs in the late- to post-Grenvillian plutons it must have formed late in the geological history. Wasteneys *et al.* (1997) dated one pluton in the Pinware area that is folded about a northwest-trending axial surface as having an age of 983 ± 3Ma, arguably providing a maximum time for the formation of the similar-trending foliations in this region.

A 500-m-wide, west-dipping mylonite zone was seen on Eagle River at its northernmost point within the map region. The mylonites are very finely laminated and strongly lineated and contain common K-feldspar porphyroclasts in a very fine-grained, comminuted matrix. One of the protoliths is the adjacent hornblende quartz monzonite, but variations in the mylonite suggest that other rock types are probably also represented. The mylonite is an enigma. Such a wide mylonite must surely represent a significant zone of deformation, yet there is neither topographic nor aeromagnetic expression of its existence. It must continue north into the adjoining map region (Gower and van Nostrand, 1996), but complete lack of exposure in the area of its projected trend would have made it impossible for them to recognize it, even if they had suspected its existence. Gower and van Nostrand (1996) did report mylonitization in the southeast part of the Southeast Mealy Mountains map region, but these mylonites do not approach the width of the zone in the Upper Eagle River region. A linear magnetic low to the southwest may represent the extension of the mylonite zone in that direction, but the low can be explained in other ways (e.g., it is also on trend with a brittle fault).

On the basis of brecciation and greenschist-facies retrogression, brittle faults are inferred along parts of the Eagle River and one of its tributaries. The altered rocks are sheared, slickensided and mottled in various shades of pink–red or green as a result of hematization or chloritization and epidotization. Late fractures are filled with quartz and/or albite reflecting concomitant silicification and albitization. The faults have a northeast trend and can be readily interpreted to be an extension of the Sandwich Bay graben. Southwest of the middle of NTS map area 13B/15, exposure is entirely lacking and extrapolation of the fault is assumed, based on the alignment of the river.

A parallel brittle fault has been indicated as marking the northwest boundary of the Upper Paradise River pluton, using information from the Alexis River map region (van Nostrand, 1992; van Nostrand *et al.*, 1992). Although van Nostrand (*op. cit.*) does not indicate a fault on his map, the location of fault breccia is shown and, in the text, he describes northeast brittle to ductile faults marked by extensive hematization, chloritization, quartz veining and fracturing. Mention is also made of quartz veins up to 5 m wide. van Nostrand *et al.* (1992) note that the fault breccia localities are on line with the Paradise River fault (Gower *et al.*, 1985) to the north, which, therefore, probably continues through the Upper Eagle River map region. The extrapolated Paradise River fault is parallel to the brittle fault along Eagle River, and only a small jump in reasoning is required to conclude that these two faults define the southwestward continuation of the Sandwich Bay graben. Most rift systems have a width of 50 ± 15 km (cf. Kumarapeli and Saull, 1966); the width of the inferred Sandwich Bay graben in the Upper Eagle River area is 47 km. One cannot help wondering if pockets of red bed correlatives of the easily weathered Double Mer Formation (the fill in the coeval Lake Melville Rift system; Gower *et al.*, 1986), might be present under some of the wetlands and be an additional reason for poor outcrop.

METAMORPHISM

Metamorphic grade in the gneissic rocks is amphibolite to granulite facies. Quartz–plagioclase–K-feldspar–biotite–sillimanite–garnet-accessory minerals characterize the two outcrops of pelitic gneiss discovered during mapping. Some of the heterogeneous coarse-grained to pegmatitic gneisses in their general proximity could be diatexites derived from a metasedimentary parentage, but this interpretation is not deemed most probable here. Most of the gneisses are likely derived from igneous granitoid plutons and have correspondingly straightforward mineral assemblages, consisting of quartz–plagioclase–K-feldspar ± biotite ± amphibole ± garnet ± various accessory minerals. Garnet is not common and rarely exceeds 0.2 cm in diameter in these rocks.

The layered mafic intrusion has been recrystallized to a granular-textured rock in places and shows evidence of partial melting with the development of metamorphic orthopyroxene in plagioclase-rich sweats. Other mafic rocks are mostly amphibolite, in part preserving relict ophitic textures. These also contain garnet, which, in places, has been completely retrograded to plagioclase-rich pseudomorphs. The foliated granitoid rocks, although not showing evidence of melting, contain the same mineral assemblage as the orthogneiss and may have gone through the same metamorphic event(s). The Mealy Mountains Intrusive Suite shows some recrystallization fabrics – possibly static rather than dynamothermal and attributable to emplacement as a large, high-temperature body. The northwest-trending foliation is an indication of later dynamothermal imprint.

Northeast-trending ophitic dykes, tentatively assigned to the Mealy dyke swarm, are undeformed and have well-preserved ophitic textures, including evidence of quenching. Clearly these rocks have not experienced major metamorphism. Late- to post-Grenvillian granites are unmetamorphosed and have only weak fabrics; it is clear that they also escaped major tectonism. The final chapter in the metamorphic history of the area involved greenschist-facies or lower grade alteration associated with brittle faulting during the development of the Sandwich Bay graben.

ECONOMIC POTENTIAL

No mineral occurrences have been previously reported from this map region and no staking has been carried out within it. Two specific targets recommended for future exploration are the layered mafic intrusion and large graphic-textured pegmatite bodies.

Two gossans were discovered within the layered mafic intrusion during this study and, based on a speculative interpretation offered here, may represent river intersections of a single horizon about 20 km long; however, the two outcrops have little in common. At Py-1 (Figure 3) a roughly 10-m-wide rusty zone extends across the outcrop into the river bank and consists of a very fine-grained K-feldspar–plagioclase–sulphide-rich rock. The fault probably juxtaposes layered mafic rocks against K-feldspar megacrystic granite, but the sulphide-rich rock does not resemble either rock type and may be a comminuted/reconstituted derivative of both. The sulphides form about 5 percent of the rock as grains less than 1 mm in diameter disseminated throughout. In contrast, at Py-2, the outcrop clearly comprises layered ultramafic–mafic–anorthositic rocks, in which individual layers are 1 to 20 cm thick. The sulphide-rich layer sampled is 50 cm thick and the host rock is a leucogabbronorite containing 5 to 10 percent disseminated sulphides in grains up to 3 mm across, both within the mafic and felsic minerals. The sulphides were tentatively identified in the field as pyrite, pyrrhotite and minor chalcopyrite.

Two large graphic-textured pegmatite bodies were mapped. One is interpreted as a nested pluton on the flank of a late- to post-Grenvillian K-feldspar megacrystic granite in the southeast part of NTS map area 13B/10; and the other is in the northwest part of NTS map area 13B/10, where it has been depicted as a hook-shaped intrusion. The only features of interest discovered in these bodies were books of biotite up to 7 cm across in the nested pluton, but neither body received more than a cursory examination and deserve more thorough investigation by explorationists for granitophile mineralization.

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REFERENCES

Davies, R.
1968: Geology of the Mutton Bay intrusion and surrounding area, north shore, Gulf of St. Lawrence, Quebec. Unpublished Ph.D. thesis, McGill University, Montréal, Québec, Canada, 321 pages.

Eade, K.E.
1962: Geology, Battle Harbour - Cartwright, coast of Labrador, Newfoundland. Geological Survey of Canada, Map 22-1962.

Emslie, R.F. and Hunt, P.A.
1990: Ages and petrogenetic significance of igneous-charnockite suites associated with massif anorthosites, Grenville Province. Journal of Geology, Volume 98, pages 213-231.

Friske, P.W.B., McCurdy, M.W., Gross, H., Day, S.J., Balma, R.G., Lynch, J.J. and Durham, C.C.
1994: National geochemical reconnaissance lake sediment and water data, southern Labrador (NTS 13G). Geological Survey of Canada, Open File 2791.

Geological Survey of Canada
1974a(b): Aeromagnetic Map, 13B/9 (13B/16); Geological Survey of Canada, Map 5977G (5988G), scale 1:63 360.

1976a: Aeromagnetic Map, 13B, Upper Eagle River, Newfoundland. Geological Survey of Canada, Map 7378G, scale 1:250 000.

1976b(c): Aeromagnetic Map, 13B/10 (13B/15). Geological Survey of Canada, Map 5976G (5989G), scale 1:63 360.

1985: Cartwright. Geological Survey of Canada, Magnetic Anomaly Map NN-21-M.

Gower, C.F., Heaman, L.M., Loveridge, W.D., Schärer, U. and Tucker, R.D.
1991: Grenvillian magmatism in the eastern Grenville Province, Canada. Precambrian Research, Volume 51, pages 315-336.

Gower, C.F., Noel, N., Gillespie, R.T., Finn, G. and Emslie, R.
1983: English River map region. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 8344.

Gower, C.F., Noel, N. and van Nostrand, T.
1985: Geology of the Paradise River region, Grenville Province, eastern Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-1, pages 19-32.

1986: Paradise River map region. Newfoundland Department of Mines, Mineral Development Division, Map 86-73.

Gower, C.F. and van Nostrand, T.
1996: Geology of the southeast Mealy Mountains region, Grenville Province, southeast Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 96-1, pages 55-71.

Gower, C.F., van Nostrand, T., Peckham, V. and Anderson, J.
1993: Geology of the Upper St. Lewis River map regions, southeast Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 93-1, pages 17-34.

Hamilton, M.A. and Emslie, R.F.
1997: Mealy dykes, Labrador, revisited: U–Pb baddeleyite age and implications for the eastern Grenville Province. Geological Association of Canada - Mineralogical Association of Canada, Joint Annual Meeting, Abstract Volume 22, page A62.

Kamo, S.L., Gower, C.F. and Krogh, T.E.
1989: Birthdate for the Iapetus Ocean? A precise U–Pb zircon and baddeleyite age for the Long Range dikes, southeast Labrador. Geology, Volume 17, pages 602-605.

Krogh, T.E., Gower, C.F. and Wardle, R.J.
1996: Pre-Labradorian crust and later Labradorian, Pinwarian and Grenvillian metamorphism in the Mealy Mountains terrane, Grenville Province, eastern Labrador. *In* Proterozoic Evolution in the North Atlantic Realm (*compiled by* C.F. Gower). COPENA-ECSOOT-IBTA conference, Goose Bay, Labrador, July 29-Aug 2, 1996, Program and Abstracts, pages 106-107.

Kumarapeli, P.S. and Saull, V.A.
1966: The St. Lawrence Valley system: a North American equivalent of the East African rift valley system. Canadian Journal of Earth Sciences, Volume 3, pages 639-658.

Nunn, G.A.G. and van Nostrand, T.
1996: Geology of the Kenemich River map area (NTS 13G/SW), Labrador. *In* Current Research. Newfoundland Department of Natural Resources, Geological Survey Branch, Report 96-1, pages 73-83.

Schärer, U., Krogh, T.E. and Gower, C.F.
1986: Age and evolution of the Grenville Province in eastern Labrador from U–Pb systematics in accessory minerals. Contributions to Mineralogy and Petrology, Volume 94, pages 438-451.

Thomas, M.D.
1974: The correlation of gravity and geology in southeastern Quebec and southern Labrador. Earth Physics Branch, Department of Energy, Mines and Resources, Ottawa, Gravity Maps Series Nos. 64-67, 96-98, 49 pages.

van Nostrand, T.
1992: Geology of the Alexis River region, Grenville Province, southeastern Labrador. Newfoundland Department of Mines and Energy, Report 92-3, 27 pages.

van Nostrand, T., Dunphy, D. and Eddy, D.
1992: Geology of the Alexis River map region, Grenville Province, southeastern Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 92-1, pages 399-412.

Wasteneys, H., Kamo, S., Moser, D., Krogh, T.E., Gower, C.F. and Owen, J.V.
1997: U–Pb geochronological constraints on the geological evolution of the Pinware terrane and adjacent areas, Grenville Province, southeast Labrador, Canada. Precambrian Research, Volume 81, pages 101-128.

NOTE ADDED IN PROOF:

Recently received analytical results from samples of weathered gossan from localities Py1 and Py2 give the following values for selected base metals.

Sample	Cu (ppm)	Zn (ppm)	Pb (ppm)	Co (ppm)	Ni (ppm)
Py1	282	1085	265	27	230
Py2	894	47	n.d.*	72	124

* not detected