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GEOLOGY OF THE MINIPI RIVER AREA (NTS 13C/NW)

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ABSTRACT

The Minipi River area lies in the interior Grenville Province and contains elements of the Wilson Lake and Mealy Mountains terranes. The Wilson Lake terrane is dominated by sillimanite-bearing metasedimentary gneiss and megacrystic granite. The Mealy Mountains terrane consists of three principal rock-type associations: i) a weakly deformed gabbro–monzonite suite, ii) a variably deformed granite suite, and iii) granite gneiss and strongly foliated granitoid rocks termed the Lower Brook metamorphic suite. The gabbro–monzonite suite is the dominant component of the western Mealy Mountains terrane, and has previously been correlated with the contiguous anorthosite–monzonite association of the Mealy Mountains intrusive suite, in the central and eastern part of the terrane. The present work, however, questions this correlation and suggests that the rocks of the western Mealy Mountains terrane may form part of a separate petrogenetic suite.

The Wilson Lake and Mealy Mountains terranes are separated by the Hamilton shear zone, a major structural feature of the eastern Grenville Province, along which the Mealy Mountains terrane is inferred to have overthrust the Wilson Lake terrane. Field evidence indicates an intrusive contact between the two terranes prior to Grenvillian deformation.

The Wilson Lake terrane was metamorphosed at upper amphibolite to granulite facies. Evidence from adjacent areas suggests that this was accomplished in the Labradorian Orogeny of ca. 1710 to 1630 Ma, however, the terrane also received a variable Grenvillian overprint, the full effects of which have yet to be ascertained. The Mealy Mountains terrane, in contrast, experienced little in the way of Labradorian deformation, but was strongly deformed and metamorphosed at upper-amphibolite facies around its northwestern rim, during the Grenvillian Orogeny.

The Hamilton shear zone is interpreted to be a Grenvillian structure that formed under relatively anhydrous upper-amphibolite- to granulite-facies conditions.

Post-Grenvillian tectonism of Late Precambrian to Early Paleozoic age was associated with the formation of the Lake Melville rift system and a separate series of east–west-trending faults. Intrusion of posttectonic basalt dykes is inferred to have accompanied rift formation.

INTRODUCTION

The Minipi River area lies in the interior Grenville Province of central Labrador, where it forms a southerly continuation of the Goose Bay region, which was mapped in the previous years of this project (Wardle and Ash, 1986; Wardle and Crisby, 1987; Wardle *et al.*, 1988). The area comprises a poorly exposed undulatory plateau, deeply dissected by the Churchill and Minipi rivers. The plateau is thickly mantled by glacial till and muskeg, and exposure is generally confined to steep hillsides and watercourses. The valleys of the Churchill and Minipi rivers are floored by thick accumulations of Pleistocene glaciofluival sand; however, good exposure is locally available on river banks and on the steeper valley walls. Mapping was carried out by helicopter-assisted ground traversing in moderately to well-exposed areas, and by helicopter traversing over the more poorly exposed ground.

The northern and eastern parts of the area were first mapped by the Geological Survey of Newfoundland (Podolsky, 1953, 1955). These and other parts of the area were subsequently covered by reconnaissance mapping during mineral exploration (Willars, 1954; Gillet, 1954). The area was also included in Geological Survey of Canada 1:250,000 reconnaissance investigations of bedrock geology (Stevenson, 1967a) and surficial deposits (Fulton *et al.*, 1981).

Regional Setting

The study area has been heterogeneously deformed and metamorphosed during the Grenvillian Orogeny ca. 1000 Ma, however, it is probable, as in the adjacent areas of the Grenville Province (Thomas *et al.*, 1986; Wardle *et al.*, *in press*) that major crust formation occurred between 1710 and 1630 Ma, during the Labradorian Orogeny (Nunn *et al.*, 1985;

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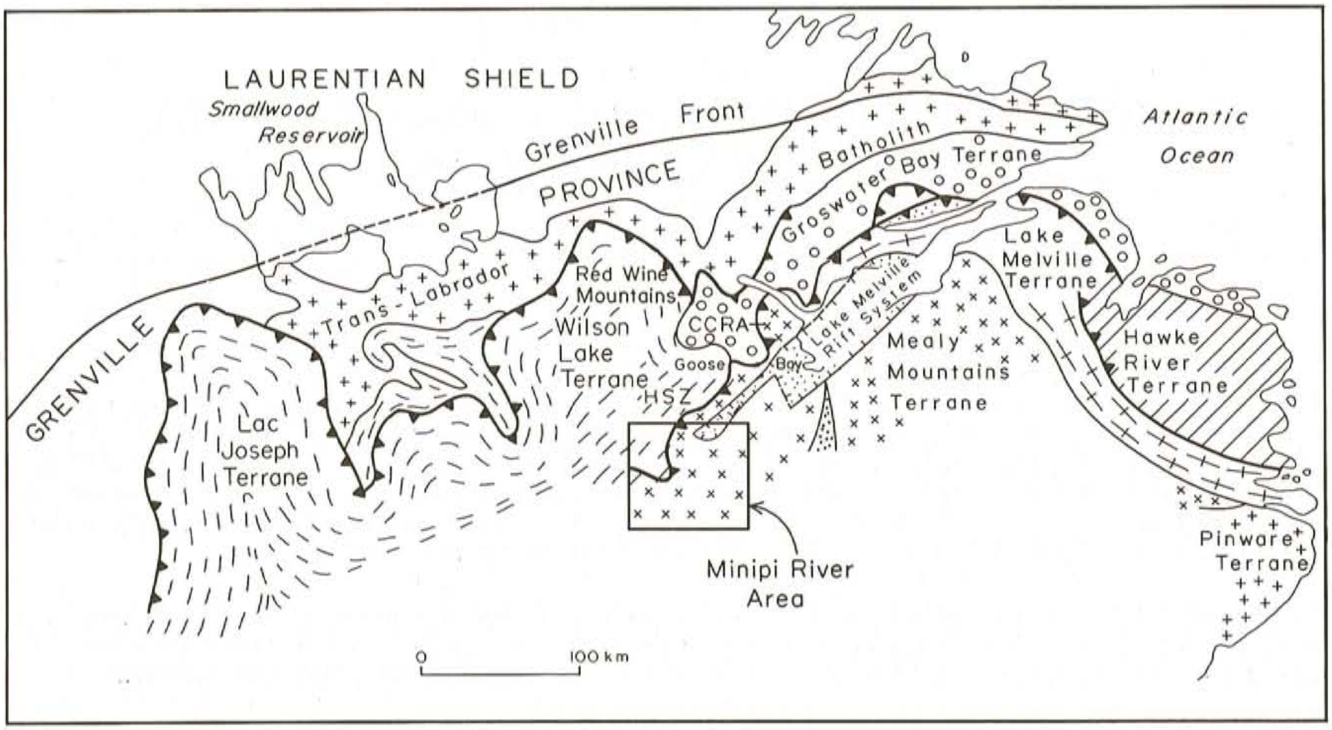


Figure 1. *Location of the map area in relation to the principal tectonic subdivisions of the Grenville Province, Labrador; western part after Rivers and Nunn (1985); central part after Wardle* et al. *(1988) and eastern part after Gower* et al. *(1988). Structural boundaries are for the most part Grenvillian shear zones. CCRA—Cape Caribou River allochthon; HSZ—Hamilton shear zone.*

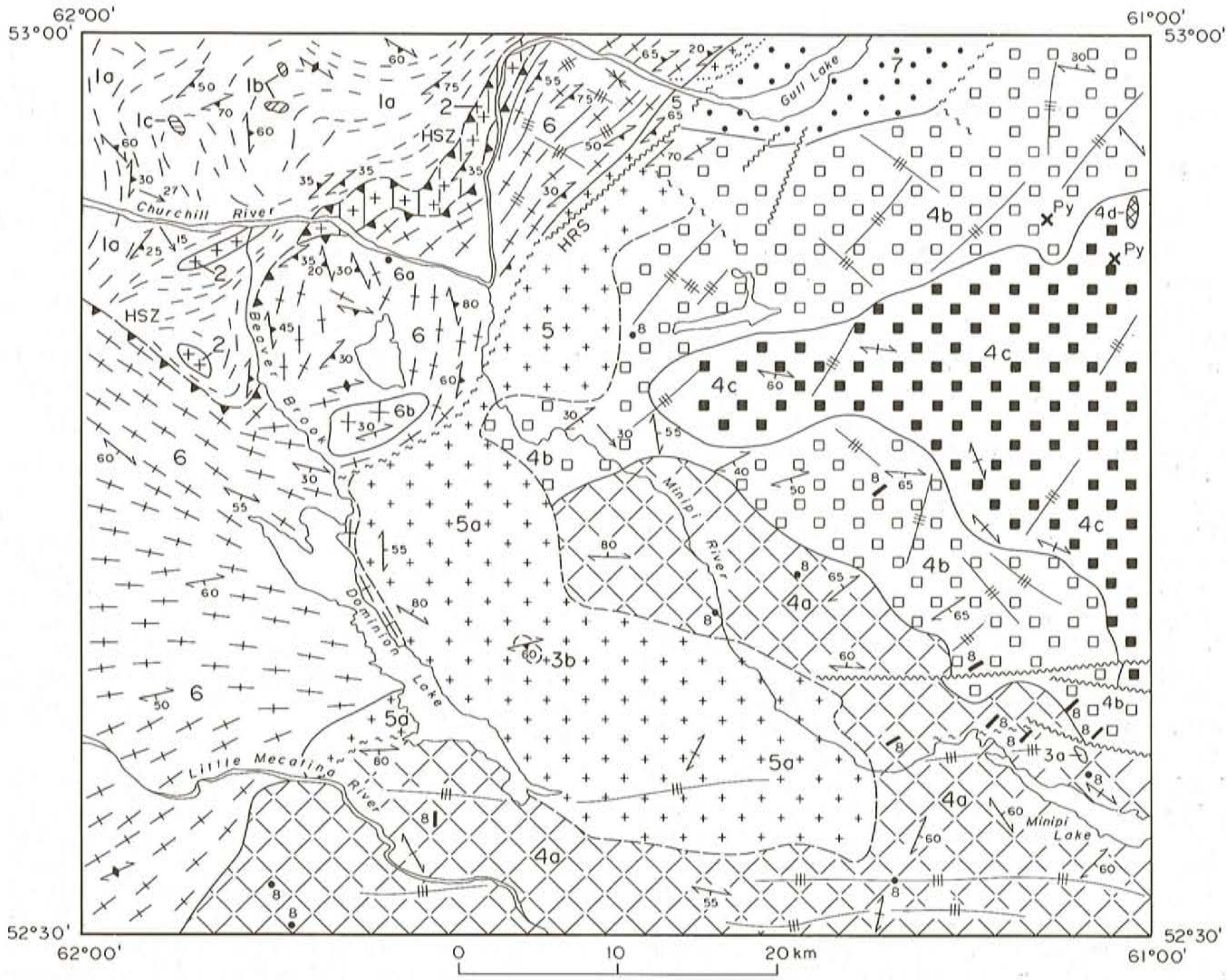
Schärer and Gower, 1988). The Grenville Province in Labrador has, in recent years, been subdivided into a number of lithotectonic terranes (e.g., Gower and Owen, 1984; Rivers *et al.*, 1989 and Wardle *et al.*, *in press*) that are generally separated by major shear zones (Figure 1). The Minipi River map area is underlain by rocks of the Mealy Mountains (MMT) and Wilson Lake (WLT) terranes, which are separated by the Hamilton shear zone (HSZ; Figures 1 and 2).

The Wilson Lake terrane is mainly composed of sillimanite-bearing metasedimentary gneiss (e.g., Podolsky, 1955) and associated megacrystic granitoid rocks. Nunn *et al.* (1985) originally defined it as a klippe in the Red Wine Mountains area (Figure 1), however, Thomas and Blomberg, (*this volume*) have recently shown the klippe model to be inappropriate. In the present interpretation, it is suggested that the terrane extends south to the boundary of the Mealy Mountains terrane (Figure 1). This expanded use of the term Wilson Lake terrane, replaces part of what was provisionally referred to as the Metasedimentary Gneiss terrane by Wardle *et al.* (1988, *in press*).

The Mealy Mountains terrane extends 200 km to the east and is composed of predominantly weakly deformed plutonic rocks, notably massif-type anorthosite and related monzonite of the Mealy Mountains intrusive suite (Emslie, 1976) dated at ca. 1640 Ma (Emslie *et al.*, 1983). The western part of the Mealy Mountains terrane, including that part lying within the map area, was recognized by previous workers (e.g., Podolsky, 1955; Stevenson, 1967b) as a distinctive plutonic massif and is mainly composed of monzonite and granite, typically containing numerous enclaves of metagabbroic rock (Wardle and Crisby, 1987). The northwestern margin of the Mealy Mountains terrane is formed by a belt of granitic gneiss, termed the Lower Brook metamorphic suite by Wardle and Ash (1986), and interpreted by Philippe *et al.* (1989) and Wardle *et al.* (*in press*) to have been derived from the plutonic rocks of the terrane, during high-grade Grenvillian metamorphism.

The two terranes are separated by the Hamilton shear zone (new term taken from the old name for the Churchill River). This is a major ductile shear zone extending 60 km to the northeast, along which the Mealy Mountains terrane is inferred to have overthrust the Wilson Lake terrane. The shear zone coincides in most respects with the boundary recognized by Podolsky (1955) between sillimanite gneiss (WLT of this report) and hornblende—biotite gneiss (Lower Brook metamorphic suite).

Post-Grenvillian development in the region is represented (Figure 1) by the western arm of the upper Proterozoic—lower Paleozoic Lake Melville rift system (Gower *et al.*, 1986), which extends into the northeastern corner of the map area (Figure 1).



UPPER PROTEROZOIC–LOWER PALAEOZOIC

8 *Basalt, diabase and microgabbro (mainly as dykes)*

7 *Area inferred to be underlain by Double Mer Formation sandstone and conglomerate*

MIDDLE TO LOWER PROTEROZOIC

MEALY MOUNTAINS TERRANE

6 Lower Brook metamorphic suite: *Pink granitic gneiss and lesser amphibolite;* **6a**, *meta-pyroxenite;* **6b**, *foliated alkali feldspar granite*

5 Granite suite: *Pink biotite granite;* **5a**, Dominion Lake pluton: *pink, medium- to coarse-grained biotite granite*

4 Gabbro–monzonite suite: **4a**, *Grey biotite gabbro and gabbro, varying to lesser monzogabbro and monzonite; minor syenite, quartz monzonite and granite;* **4b**, *grey monzogabbro varying to biotite gabbro, gabbro and gabbronorite; minor monzonite, quartz monzonite, syenite and granite;* **4c**, *buff to grey monzonite; lesser monzogabbro and gabbro–minor syenite, quartz monzonite and granite;* **4d**, *plagioclase porphyritic micromonzonite*

Metamorphic enclaves within Mealy Mountains terrane plutonic rocks

3a *Agmatite gneiss of amphibolite and granite gneiss;* **3b**, *amphibolite schist and metagabbro*

WILSON LAKE TERRANE

2 *Foliated to gneissic K-feldspar megacrystic granite; minor granite gneiss*

1a *Migmatitic, quartz–feldspar–biotite ± sillimanite ± garnet metasedimentary gneiss; locally also contains hypersthene and cordierite; minor amphibolite;* **1b**, *amphibolite and mafic granulite;* **1c**, *granitoid gneiss*

SYMBOLS

Ductile shear zone; teeth indicate direction of dip..........

Airphoto lineament..........

Figure 2. *Geology of the Minipi River map area (13C/11,12,13 and 14). HSZ–Hamilton River shear zone; HRS–Horeshoe Rapids shear zone.*

GEOLOGICAL DESCRIPTIONS

Map units are shown on Figure 2 and are italicized where referred to in the following text.

Wilson Lake Terrane

Migmatitic quartz–feldspar–biotite ± sillimanite ± garnet gneiss (Unit la), locally containing cordierite and hypersthene, underlies most of the Wilson Lake terrane and is similar in most respects to the large expanse of metasedimentary gneiss described by Wardle *et al.* (1988) to the north, and by Thomas and Blomberg (*this volume*) to the northwest. Sillimanite-rich and sillimanite-deficient gneiss are interlayered on a variety of scales but are texturally similar. A minor variant exposed in Beaver Brook, consists of a grey, well-banded, quartz–feldspar–hornblende gneiss locally containing clino- and ortho-pyroxene. This resembles the Beaver gneiss of Thomas and Blomberg (*this volume*) and may be derived from a volcaniclastic protolith. Two outcrop areas of *amphibolite and mafic granulite (subunit lb)* occur within the dominant metasedimentary gneiss. The northern outcrop locally retains a gabbroic texture, including primary orthopyroxene cores. The southern outcrop area consists of granoblastic amphibolite to mafic granulite, in which orthopyroxene is partially retrogressed to hornblende. A small outcrop area of *grey granitoid gneiss (subunit lc)* of quartz monzonite composition also occurs near the centre of the metasedimentary gneiss. The texture of this gneiss suggests that it is a metaplutonic rock, but its contacts with the surrounding metasedimentary gneiss are not exposed.

The other major rock type of the Wilson Lake terrane is *megacrystic granite (Unit 2)*. The intimate association of this rock type with metasedimentary gneiss has been described elsewhere from the Grenville Province of Labrador (e.g., Gower and Owen, 1984) and may indicate a genetic relationship. The granite forms a series of lensoid bodies, the largest of which is located within the Hamilton shear zone. The unit is characterized by large (up to 4-cm long) K-feldspar augen that are strongly attenuated and partially recrystallized to subgrain aggregates within high-strain zones. These are set in a ground mass of quartz, feldspar (predominantly plagioclase) biotite and Fe–Ti oxide. The granite, locally, displays a weak migmatitic gneissic layering that is overprinted by high-strain mylonitic fabrics, in the footwall of the Hamilton shear zone. The body of megacrystic granite, located within the Hamilton shear zone contains thin (<50 m), elongate intercalations of mylonitic metasedimentary gneiss. These are in tectonic contact with the enclosing granite, but it is uncertain whether they represent tectonic intercalations or deformed xenoliths. The granite also contains interbands of biotite–amphibole–plagioclase gneiss (relict mafic inclusions or dykes) and a highly strained quartz–feldspar–biotite ± garnet gneiss of uncertain origin.

All rock types within the Wilson Lake terrane are intruded by irregular masses of pre- to syn-kinematic pegmatite, and by rectilinear dykes of posttectonic pegmatite.

Mealy Mountains Terrane

The Mealy Mountains terrane, within the map area, consists largely of plutonic rocks and derived gneiss. Found within the plutonic rocks, are two small *metamorphic enclaves (Unit 3)*, which are exposed in two areas. A single, small outcrop in the centre of the Dominion Lake pluton exposes an agmatite gneiss composed of *hornblende–plagioclase amphibolite and granite gneiss (subunit 3a)*, in which the leucocratic granite gneiss is a younger (mobilizate?) component. The other area, located about 3 km north of Minipi Lake, contains three exposures of *amphibolite schist (subunit 3b)* of possible metavolcanic origin, in addition to plagioclase, porphyritic metagabbro. The origin of these enclaves is uncertain, as is their structural relationship to the surrounding less deformed plutonic rocks. It is conceivable, however, that they represent part of the host-rock to the plutons of the Mealy Mountains terrane.

The remainder of the Mealy Mountains terrane comprises three principal associations of rock types: i) a gabbro–monzonite suite (Unit 4) forming the eastern and southern parts of the terrane, ii) a belt of granite (Unit 5) lying to the northwest of the gabbro–monzonite suite, and iii) granite gneiss and related granitoid of the Lower Brook metamorphic suite (Unit 6), which forms the northwestern part of the terrane.

The *gabbro–monzonite suite (Unit 4)* is composed of gabbro, biotite gabbro, monzogabbro and monzonite, and lesser amounts of quartz monzonite, granite and syenite. Three main map units are recognized: *biotite gabbro and gabbro (subunit 4a), equigranular monzogabbro (subunit 4b), and monzonite (subunit 4c)*. These are compositionaly heterogeneous units that are characterized by the predominance of a particular rock type rather than a uniform composition. Repeated variation from gabbro through monzogabbro to monzonite is found within each of these units and probably indicates compositional zoning or layering. The overall distribution of units suggests a monzonite core that grades outward into monzogabbro and then (in the south) biotite gabbro and gabbro. A genetic link between units of the gabbro–monzonite suite is indicated by common mineralogical characteristics such as the presence of clinopyroxene and poikilocrystic biotite. The zoning (or layering) of the suite is most likely related to differentiation processes.

Biotite gabbro and gabbro (subunit 4a) are generally grey, medium grained rocks that show continuous variation from sub-ophitic to equigranular texture. Gabbro and lesser gabbronorite are generally sub-ophitic in texture. Biotite gabbro has a predominantly equigranular granoblastic texture and is characterized by large (up to 4 cm diameter) biotite poikilocrysts. The random orientation of these large, biotite crystals and their obvious pretectonic character, indicate a late-stage magmatic origin. The groundmass is an intergrowth of amphibole, biotite, Fe–Ti oxide and clinopyroxene. Layered gabbro–leucogabbro is present in the Minipi Lake area and at one locality contains blocks, up to 1 m across, of anorthosite.

Biotite gabbro and gabbro grade into *grey monzogabbro (subunit 4b)*. This is a dark-grey-weathering rock that generally has an equigranular granoblastic texture but locally contains large isolated xenocrysts of dark-grey K-feldspar. K-feldspar is also an interstitial phase that is intergrown with biotite, clinopyroxene and Fe–Ti oxide. This unit is also characterized by abundant poikilocrystic biotite.

Buff to grey monzonite (subunit 4c) is a more homogeneous unit that has transitional contacts with the monzogabbro of subunit 4b. It varies from a grey, equigranular rock, which is very similar to the monzogabbro, to a buff, inequigranular and locally porphyritic rock. The latter occurs mostly in the interior of the unit and contains large K-feldspar crystals set in a matrix of plagioclase, Fe–Ti oxide and clinopyroxene. The northern margin of the monzonite unit contains an enclave of *plagioclase porphyritic micromonzonite (subunit 4d)*. Other small enclaves of non-porphyritic micromonzonite are also found within the monzonite unit. The fine grained texture of these rock types may indicate formation at high crustal level. The contacts of the enclaves, however, are not exposed and it is unclear whether they represent minor intrusions or foundered cognate blocks.

Textures indicative of magma-mixing are common to all units of the gabbro–monzonite suite. The most typical texture consists of gregarious masses of small, rounded inclusions, dispersed within normal medium grained host rock. The inclusions are fine grained, of apparent mafic composition, have scalloped and embayed margins, and exhibit various stages of digestion and assimilation into the host. Another, less common, texture is fine-scale injection of gabbro and biotite gabbro by thin veinlets of pegmatitic monzonite. Blurred contacts and growth of hornblende porphyroblasts in the monzonite appear to record progressive contamination of the monzonite. These textures are interpreted to result from co-mingling and consequent local hybridization of felsic and mafic magma phases (cf., Wiebe, 1988) of the gabbro–monzonite suite.

The gabbro–monzonite suite contains numerous small masses and dykes of granite (including alkali-feldspar granite) and syenite. These are possibly the products of late-stage differentiation within the gabbro–monzonite suite. Some, however, may be related to the nearby Unit 5 granite.

Pink biotite granite (Unit 5) forms a broad belt on the northwestern side of the gabbro–monzonite suite. North of the Minipi River, the unit consists of pink, variably foliated biotite granite that grades northwestward into granite gneiss assigned to the Lower Brook metamorphic suite. South of the Minipi River, the granite suite forms a lobate protrusion into the gabbro–monzonite suite that is referred to here as the *Dominion Lake pluton (subunit 5a)*. The contacts of this pluton are unexposed but have been drawn to conform with the margins of a pronounced aeromagnetic low extending east and southeast of Dominion Lake (Geological Survey of Canada, 1971). The area of the aeromagnetic low is also topographically distinct and consists of large, isolated, smoothly rounded hills, in contrast to the rugged nature of the adjacent gabbro–monzonite suite. Outcrops within the area of the aeromagnetic low are, with one exception, formed by granite. This rock type is interpreted to underlie all of the aeromagnetic low, however, given the poor exposure, the alternative explanation of Stevenson (1967a) that the granite forms several separate intrusions, remains viable. In this scenario, the single exposure of agmatite gneiss (Unit 3a) within the granite may represent the host rock.

The principal rock types of the Dominion Lake pluton are, i) pink, medium grained, equigranular, biotite granite, which is very similar to granite of Unit 5, north of Minipi River; and ii) coarse grained, inequigranular, biotite granite containing large tabular K-feldspar crystals. The pluton appears largely undeformed, though this may be due to the preferential exposure of its undeformed and therefore more erosionally resistant parts.

The third major component of Mealy Mountains terrane comprises the granitic gneiss and associated metaplutonic rocks of the *Lower Brook metamorphic suite (Unit 6)*, which forms a belt extending diagonally across the western part of the area. The unit has a transitional contact with granite of Unit 5, in the area west of Gull Lake, but farther to the southwest the contact may be faulted (Figure 2). The dominant rock type in the Lower Brook metamorphic suite is a pink, banded and migmatitic granite gneiss, intercalated with foliated granite and abundant lenses and interbands of black amphibolite. Biotite is the predominant mafic phase in the granite gneiss but hornblende and clinopyroxene are locally present. A single large outcrop of coarse grained *metapyroxenite (subunit 6a)*, found on the Churchill River, is presumed to form an enclave within the Lower Brook metamorphic suite. Foliated augen-textured granite gneiss also forms a minor variant probably derived from an inequigranular or porphyritic protolith similar to the granite of the Dominion Lake pluton. Concordant and discordant masses of pegmatite are also common.

The granite gneiss component locally displays evidence of polydeformation in the form of granite dykes that truncate an earlier gneissic fabric but are themselves foliated. The regional significance of this relationship, in particular the problem of whether it represents polyorogenic or polyphase deformation is unclear, and will only be resolved through radiometric dating. An inclusion of mafic granulite, partly altered to amphibolite, was also observed at one locality on the Churchill River. Outcrops in the vicinity of the Churchill River also contain scarce enclaves of sillimanite-bearing gneiss, generally similar in appearance to that of the Wilson Lake terrane. Gneissic foliation in the enclaves is locally crosscut by foliated granite veins emanating from the granite gneiss. The enclaves probably originated as xenoliths in the plutonic protolith of the Lower Brook metamorphic suite.

Buff-coloured, strongly *foliated alkali-feldspar granite (subunit 6b)* forms a distinct subunit within the Lower Brook metamorphic suite near the north end of Dominion Lake. The granite contains fresh ortho- and clino-pyroxene that has recrystallized or grown during regional metamorphism.

From its transitional contact, it is presumed that the greater part of the Lower Brook metamorphic suite is derived from granite of Unit 5.

Upper Proterozoic to Lower Paleozoic Rocks

The lowlands around Gull Lake are inferred to form part of the Lake Melville rift system (Gower *et al.*, 1986). The sedimentary rocks of the *Double Mer Formation (Unit 7)* that normally form the graben-fill are unexposed within the map area, the nearest exposures being 13 km to the northeast along the Churchill River valley (Stevenson, 1967b; Wardle *et al.*, 1988). Similar rocks, however, probably underlie the Gull Lake area.

Small exposures of fresh ophitic-textured *basalt, diabase and microgabbro (Unit 7)* are common within the gabbro–monzonite suite of the Mealy Mountains terrane. These are generally seen as thin dykes (<1 m), characterized by chilled margins (locally slightly sheared) crosscutting penetrative fabrics within their host rocks. They also form small mounds and ridges that may be the expression of plugs or large dykes. Observed dyke contacts have an overall northeasterly trend, consistent with dyke trends northeast of the map area (Wardle and Crisby, 1987).

STRUCTURE AND METAMORPHISM

Wilson Lake Terrane

Gneissic fabrics in the Wilson Lake terrane display an overall northeasterly trend modified by late folding (Figure 2). Fabrics within metasedimentary gneiss are typically composite, consisting of an early migmatitic gneissic layering that is variably transposed by isoclinal folding into an axial planar S_1 fabric. Lineation, generally an S_1/S_2 intersection fabric, plunges moderately south to south east. Along the southern margin of Wilson Lake terrane gneissic fabrics within metasedimentary gneiss and megacrystic granite are transposed into the Hamilton shear zone.

The Hamilton shear zone is approximately 2- to 3-km wide, in the vicinity of the Churchill River, but narrows to less than 0.9 km at Beaver Brook. West of Beaver Brook, it is unexposed and its projected trend (Figure 2) is based upon a linear aeromagnetic low. The shear zone is developed predominantly within footwall megacrystic granite (Unit 2) and metasedimentary gneiss (Unit 1) and is characterized by the development of high-strain, straight fabrics, and local mylonite (augen mylonite in megacrystic granite). The poor quality of exposure in the map area precludes detailed analysis of the shear zone and its boundaries; however, work on the extension of the shear zone to the northeast (Wardle *et al.*, 1988) indicates ductile shearing to be a D_2 event, developed in association with isoclinal folding of metasedimentary gneiss. The shear zone dips at 10 to 20 degrees south to southeast and a down-dip stretching lineation is generally well-developed in granitic rocks. In metasedimentary gneiss, however, sillimanite is commonly randomly orientated on foliation surfaces and only defines a lineation in the most highly strained rocks. Reliable kinematic indicators for determining the sense of shear movement were not found. The only indications for shear sense come from northeast of the map area, in the Cape Caribou River allochthon (Figure 1), a structure bounded by the probable extension of the Hamilton shear zone. Kinematic indicators in the allochthon demonstrate a south-side-up sense of movement, signifying northwest-directed overthrusting (Wardle *et al.*, 1986b). This is consistent with juxtaposition of granulite-facies gneiss in the hanging wall of the allochthon against an amphibolite-facies footwall.

The variability of planar and linear fabric elements within the shear zone, and the major deflection of the shear zone into a northwesterly trend west of Beaver Brook, are features attributed to a late period of open folding (F_3) about gentle southeast-plunging axes. Small-scale, open F_3 folds are locally visible in outcrop. The F_3-fold episode has affected fabric trends throughout the Wilson Lake terrane and the Hamilton shear zone, as shown by variation in foliation directions (Figure 2).

The predominant metamorphic assemblage within the metasedimentary gneiss is quartz–K-feldspar–sillimanite–biotite $\pm$ garnet (plus melt), which is indicative of upper-amphibolite-facies conditions. Locally, however, the assemblage sillimanite–quartz–hypersthene $\pm$ garnet $\pm$ cordierite (plus melt) is also developed. This is indicative of high-pressure, high-temperature granulite-facies metamorphism, although not as high as in areas to the northwest of the map area, where the assemblage sapphirine + quartz is present (Thomas and Blomberg, *this volume*) indicating extreme conditions ($>$10Kb at 900°C; Currie and Gittins, 1988). Relict hypersthene in mafic rocks within the metasedimentary gneiss also attests to the local attainment of granulite-facies conditions. Insufficient petrographic analysis has been carried out to determine whether the granulite-facies zones represent local prograde metamorphic nodes, or areas of relict granulite preserved during widespread upper-amphibolite-facies retrogression.

The Hamilton shear zone is similarly characterized by the prevalence of sillimanite-bearing, upper-amphibolite-facies assemblages developed in stable association with mylonite fabrics. Locally, however, the shear zone contains the assemblages sillimanite–quartz–hypersthene $\pm$ garnet $\pm$ cordierite in pelitic gneiss, and hypersthene–clinopyroxene hornblende in mafic bands. Hypersthene shows stable co-existence with mylonitic fabrics and indicates the local attainment of granulite-facies conditions during ductile shearing. This feature has also been described from the extension of the shear zone to the northeast (Wardle and Ash, 1986; Wardle *et al.*, 1988) and is clearly a regional phenomenon. The presence of randomly orientated sillimanite within high-strain fabrics of the shear zone indicates that upper-amphibolite–granulite-facies recrystallization outlasted dynamic shearing except in local zones of intense mylonitization.

Minor low-grade retrogression within the shear zone is demonstrated by local muscovite (after sillimanite), and epidote−chlorite alteration and is likely related to a late stage of brittle shearing.

Mealy Mountains Terrane

The interior of the Mealy Mountains terrane comprising the gabbro−monzonite suite is only weakly deformed. The structure typically consists of thin (10 cm or less) brittle shear zones and weak biotite fabrics. Fabric trends are highly irregular but have an overall east−west trend.

Deformation increases in intensity to the northwest. In the northern part of the area, near the Churchill River, there is a steep but progressive strain gradient from granite of Unit 5, through foliated granite, into granite gneiss of the Lower Brook suite. To the southwest, however, toward Dominion Lake, the transition is more abrupt across a ductile shear zone. This structure is marked by a gorge extending southeastward from the vicinity of Gull Lake and is referred to here as the Horseshoe Rapids shear zone (HRS; Figure 2; the name is taken from a nearby rapids on the Churchill River). The southwestern portion of the shear zone is unexposed but its position is inferred from a linear aeromagnetic low (Geological Survey of Canada, 1971). A series of topographic linears in the area of Lower Brook metamorphic suite west of Gull Lake (Figure 2) may mark the sites of other shear zones. A tight northeast-trending synform present in the northeast part of the Lower Brook metamorphic suite is probably an F_2 structure developed in association with ductile shearing. Mineral lineation within the Lower Brook metamorphic suite plunges generally to the southeast at moderate attitudes, and is collinear with that in the Wilson Lake terrane and the Hamilton shear zone.

Rocks of the Mealy Mountains terrane are poorly exposed in the vicinity of the Hamilton shear zone and development of mylonitic fabrics is seen only in small subsidiary shear zones. Comparison with the better exposed area to the northeast (Wardle *et al.*, 1988) suggests that mylonitic derivatives of the Lower Brook metamorphic suite exist in the hanging wall of the Hamilton shear zone.

The effects of southeast-trending F_3 folds are seen in the Lower Brook metamorphic suite as local aberrations in fabric trends, and more importantly as a major swing in strike from the regional northeasterly trend to a northwesterly trend west of Dominion Lake (Figure 2).

Metamorphic conditions within the Mealy Mountains terrane apparently varied from low-grade within the gabbro−monzonite suite, to upper-amphibolite facies (in association with migmatization) and locally granulite facies (hypersthene-bearing assemblages in subunit 6a) in the Lower Brook suite.

Post-Grenvillian Structure

The existence of late Precambrian−early Palaeozoic fault systems has been recognized to the northeast of the area in the Lake Melville rift system (Gower *et al.*, 1986). Part of this fault system extends along the Churchill River valley into lowlands of the Gull Lake area. The lowlands are associated with an asymmetric aeromagnetic low that has a steep gradient and deep linear trough on its northwestern side; and a smoother, gentler slope on its southwestern margin. The linear trough appears to mark the extension of the Horseshoe Rapids shear zone; the smooth gradient on the southeastern side may correspond to the inferred unconformity beneath the Double Mer Formation. The Gull Lake lowlands are thus interpreted as a half-graben having a northwestern boundary fault that was probably formed by re-activation of the Horseshoe Rapids shear zone.

The interior of the Mealy Mountains terrane, in particular the area underlain by the gabbro−monzonite suite, is characterized by a pronounced reticulate pattern of drainage and airphoto linears. These are probably controlled by a system of northeast- and northwest-trending joints and/or faults superimposed upon Grenvillian penetrative fabrics. Collinearity of the northeast-trending joint/fault set with the late dyke trend and the boundary fault of the half-graben suggests, but does not confirm, a common Late Precambrian−Early Paleozoic age.

A prominent set of east−west-trending faults occupies a series of linear valleys north of Minipi Lake. The faults are characterized by brittle shearing and epidote−chlorite alteration of wall rock. No evidence was found concerning sense of movement. At one locality, a late basalt dyke is involved in shearing and indicates a post-Grenville age for fault development. A subparallel set of linears visible on aerial photographs and landsat imagery, extends across the southern part of the map area and may be similarly related to east−west-trending faults.

Mineralization

Two small pyrite occurrences have been reported from the northeastern part of the map area within monzonite and monzogabbro (Douglas, 1976). These, however, were not relocated. Small areas of pyrite enrichment within metasedimentary gneiss, the gabbro−monzonite suite, and the late dykes were sampled during the course of mapping but failed to yield any significant results upon assaying for a wide range of trace elements, including precious and base metals. The area has also been covered by a regional lake sediment geochemistry program (Geological Survey of Canada, 1983) and minor anomalies have been found to exist. No follow-up work has been carried out.

DISCUSSION

Comparison with adjacent areas suggests that crust formation and attendant high-grade metamorphism (up to granulite facies) in the Wilson Lake terrane occurred in association with the Labradorian Orogeny ca. 1700 to 1630 Ma. The terrane has also suffered a Grenvillian overprint, however, in the absence of geochronological information it is difficult to correlate this event with specific structural fabrics.

In contrast, the Mealy Mountains terrane appears to have experienced very little Labradorian deformation. U–Pb dating by Philippe *et al.* (1989) to the northeast indicates that metamorphism within the Lower Brook metamorphic suite and ductile shearing within the Hamilton shear zone were predominantly Grenvillian events, although the possibility of earlier deformation cannot be ruled out. The Hamilton shear zone is believed to have developed through overthrusting of the Mealy Mountains terrane northwestward over the Wilson Lake terrane, although the evidence for this assumption is circumstantial. The occurrence of granulite-facies mylonites within the shear zone is a regional feature that presents problems of interpretation. The simplest explanation is that the shear zone was the site of elevated thermal conditions and progressive (Grenvillian) metamorphic dehydration; this, however, is the converse of normal behaviour in shear zones. Alternatively, the shear zone may have brought up slices of (Labradorian) granulite-facies crust from deeper structural levels; such slices, however, clearly remained stable during mylonitic recrystallization. Both models require a high-pressure, high-temperature and anhydrous environment for shear zone generation.

Enclaves of previously-deformed (Labradorian?) metasedimentary gneiss within the Lower Brook metamorphic suite suggest an original intrusive relationship between the Mealy Mountains terrane granite and the Wilson Lake terrane. Therefore, the Hamilton shear zone is unlikely to represent a fundamental crustal suture. The granite–metasedimentary gneiss contact perhaps served to localize the Hamilton shear zone during Grenvillian deformation.

On a preliminary basis, the plutonic rocks of the Mealy Mountains terrane are divided into a gabbro–monzonite suite and a granitic suite. The gabbro–monzonite suite is a relatively anhydrous series, as indicated by the prevalence of clinopyroxene as the primary mafic phase, and appears to be enriched in potassium on the basis of the ubiquitous late biotite. The granite suite, including its inferred metamorphic equivalents within the Lower Brook metamorphic suite, is geographically discrete, being concentrated around the northwestern rim of the Mealy Mountains terrane. It is possible, therefore, that the granites form part of a separate petrogenetic series. The granites and gabbro–monzonite of the western Mealy Mountains terrane are continuous to the northeast with similar rocks (Wardle and Crisby, 1987), which are in turn continuous with the monzonite and massif-type anorthosite of the Mealy Mountains intrusive suite in the central Mealy Mountains terrane. Monzonite of this suite is proposed by Emslie (1976) to bear a close temporal relationship to anorthosite intrusion and has been dated at 1640 $\pm$ 3 Ma (Emslie *et al.*, 1983). In previous accounts of the Mealy Mountains terrane (e.g., Wardle and Crisby, 1987), it was convenient to assign all monzonitic and related rocks of the Mealy Mountains terrane to the Mealy Mountains intrusive suite. As more work is done in the western parts of the Mealy Mountains terrane, however, it is becoming apparent that this assumption may be invalid. Several characteristics of the western Mealy Mountains terrane that are strongly atypical of massif-type anorthosite suites are:

i) The presence of voluminous amounts of gabbro, biotite gabbro and intermediate rocks such as monzogabbro. These rocks are generally subordinate in massif-type anorthosite suites (Emslie, 1978). The biotite-rich nature of many of the rocks in the western Mealy Mountains terrane is also intriguing and may indicate an alkalic or shoshonitic affinity (e.g., Corriveau and Gorton, 1988; Beard and Barker, 1989).
ii) The magma-mixing textures in the western Mealy Mountains terrane are atypical of massif-type anorthosite suites but are not unknown (e.g., Wiebe, 1980).
iii) The granitoid component of the western Mealy Mountains terrane is dominantly monzonite–monzogabbro, in contrast to the quartz monzonite and granite that predominate in most massif-anorthosite suites (e.g., Emslie, 1978).

It is possible (cf., Emslie, 1989) that these differences may be in part a function of crustal level; i.e., deeper level intrusions tend to be monzonitic whereas higher level intrusions are dominantly granitic. Geochemical and geochronological work is in progress to further test correlations with the rocks of the Mealy Mountains intrusive suite.

Post-Grenvillian tectonism, related at least in part to the Lake Melville rift system, has had an important influence on the map area. The late dykes are probably much more numerous than indicated by outcrop, and form an extensive suite, possibly even a swarm, within the Mealy Mountains terrane. The age of these dykes is unknown and they may represent more than one suite. Two major periods of Middle to Late Proterozoic dyke intrusions are recognized in the southeastern Grenville Province: i) Mealy dykes intruded ca. 1380 Ma (Park and Emslie, 1983) in the central Mealy Mountains terrane, and ii) Late Precambrian dykes of the Long Range swarm intruded along the Labrador coast ca. 615 Ma. (Kamo *et al.*, 1989). Representatives of both suites may exist within the map area; however, the fresh state of most of the Minipi River-area dykes and the posttectonic nature of the better exposed examples favours an association with the Long Range swarm.

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