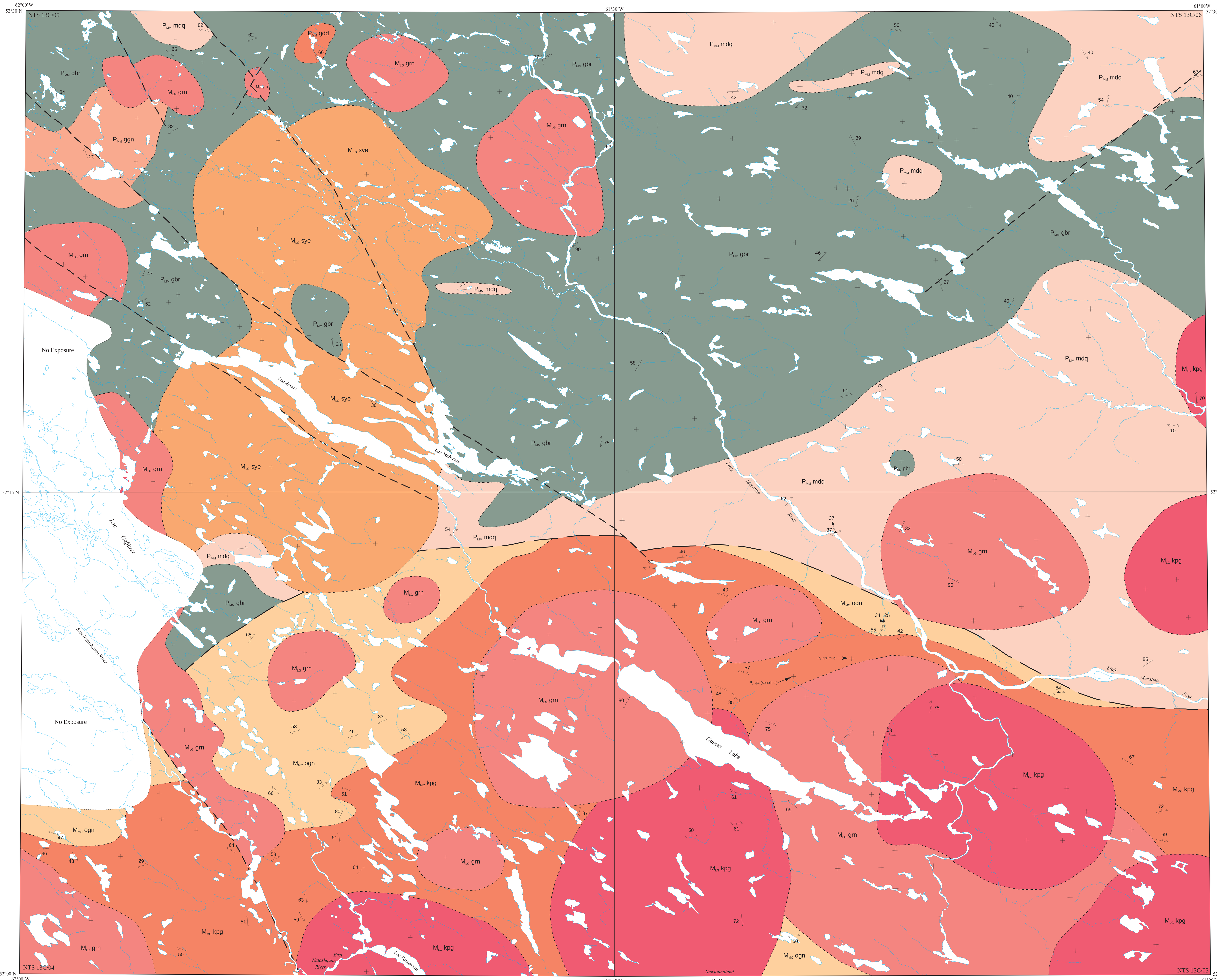
Joint project of the Geological Survey of Newfoundland and Labrador and the Geological Survey of Canada.

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
Department of Mines and Energy
Geological Survey



LEGEND

MESOPROTEROZOIC

Late- to post-Grenvillian intrusive rocks

M_{LG} kpg — Porphyritic granite: mainly K-feldspar porphyritic biotite granite, locally non-porphyritic; mainly isotropic, although contains a local, weak foliation (relict igneous foliation ?)

M_{LG} grn — Granite: mainly coarse- and medium-grained biotite granite, locally K-feldspar porphyritic granite; mainly isotropic, although contains a local, weak foliation (relict igneous foliation ?)

M_{LG} sye — Syenite and monzonite: pink- to orange-weathering clinopyroxene-bearing syenite and monzonite; mainly coarse grained and massive; includes minor amounts of quartz monzonite and granite.

MESOPROTEROZOIC and PALEOPROTEROZOIC (?)

MECATINA TERRANE (MECT)

Petit Mecatina (AMCG) Intrusive Suite

M_{MC} kpg — Porphyritic granite: recrystallized, foliated and locally gneissic (augen gneiss) K-feldspar porphyritic granite; igneous age - 1493 ±3 Ma; contains deformed gabbro dykes.

M_{MC} ogn — Orthogneiss: heterogeneous, upper-amphibolite-facies orthogneiss includes granite, granodiorite, monzonite and diorite orthogneiss; may be derived in part from porphyritic granite (M_{MC} kpg); igneous emplacement ages of protoliths are undetermined.

Pre-Petit Mecatina supracrustal rocks (Wakeham Group equivalents ?)

P_2 qtz — Quartzite: orthoquartzite, local high-grade pelitic gneiss, and possible metamorphosed mafic volcanic rocks (P_2 qtz mvol).

PALEOPROTEROZOIC

MEALY MOUNTAINS TERRANE (MMT)

Mealy Mountains Intrusive Suite (MMIS)

P_{MM} gbr — Gabbro and gabbronorite: variably foliated, recrystallized and deformed to locally fresh gabbro and gabbronorite; contains minor amounts of leucogabbro, melagabbro and pyroxenite; biotite-bearing gabbro is common in the northeastern part of NTS 13C/5 and the western part of NTS 13C/6.

P_{MM} gdd — Granodiorite: white- to grey-weathering granodiorite; medium grained and weakly foliated; contains xenoliths of grey orthogneiss and amphibolite.

P_{MM} mdq — Monzodiorite and monzonite: heterogeneous and unsubdivided unit consisting of recrystallized, variably foliated and locally gneissic monzodiorite, monzonite, quartz monzonite, granodiorite and diorite; contains minor amounts of metamorphosed gabbro (equivalent to P_{MM} gbr ?); igneous emplacement ages of protoliths are undetermined.

P_{MM} ggn — Orthogneiss: heterogeneous and unsubdivided unit consists of gneissic and foliated granitoid rocks including granite, granodiorite, quartz monzonite, local diorite and rare gabbro; igneous emplacement ages of protoliths are undetermined (equivalent to Lower Brook metamorphic suite orthogneiss ?)

- Geological contact: assumed
- Ductile, high-strain zone (Grenvillian): assumed
- Late- to post-Grenvillian fault (Neoproterozoic ?): assumed
- Outcrop (massive or no fabrics measured)
- Foliation (inclined, vertical)
- Gneissosity (inclined, vertical)
- Mineral elongation lineation
- Planar, mylonitic fabric in ductile high-strain zone; inclined
- Bedding (tops known, tops unknown)
- Igneous layering (tops known, tops unknown)

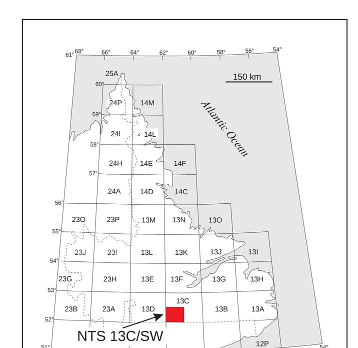


Figure 1. Index map of Labrador showing location of the NTS 13C/SW area.

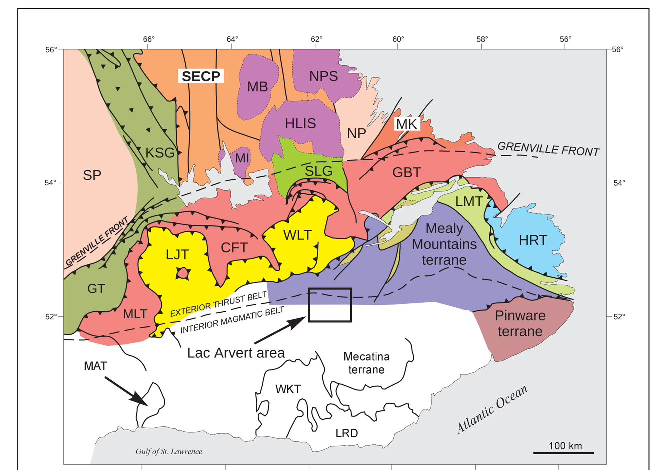


Figure 2. Location of the Lac Arvert area (NTS 13C/SW) in relation to the tectonic and major lithotectonic units of northeastern Laurentia. Grenville Province: HRT - Hawke River terrane, LMT - Lake Melville terrane, GBT - Groswater Bay terrane, WLT - Wilson Lake terrane, CFT - Churchill Falls terrane, LJT - Lac Joseph terrane, MLT - Molson Lake terrane, GT - Gagnon terrane, MAT - Matamec terrane, WKT - Wakeham terrane, LRD - La Romaine domain. Archean divisions: SP - Superior Province, NP - Nain Province (Hopedale Block). Archean and Paleoproterozoic divisions: MK - Makkovik Province, SECP - Southeastern Churchill Province (core zone), KSG - Kaniapiskau Supergroup (2.25-1.86 Ga). Mesoproterozoic units: NPS - Nain Plutonic Suite, HLIS - Harp Lake intrusive suite, MB - Mistastin batholith, MI - Michikamau Intrusion, SLG - Seal Lake Group.

DESCRIPTIVE NOTES

INTRODUCTION

The southwestern part of NTS map area 13C (Figure 1) was mapped at a scale of 1:100 000 in the 1999 and 2000 field seasons (James and Nadeau, 2000, 2001). The area includes 1:50 000-scale NTS map areas 13C/3, 13C/4, 13C/5 and 13C/6. In general, bedrock in the study area is very poorly exposed; outcrops are found mainly on hilltops or along small streams. The area is densely vegetated or is covered by extensive areas of bog. Some of the western and southern parts of the area, especially the Little Mecatina River valley in NTS areas 13C/3 and 13C/6, contain thick accumulations of Quaternary glaciofluvial sand. Lakes and rivers are shallow, rocky, and generally lacking in shoreline outcrops. Mapping was accomplished by making helicopter landings on isolated outcrops. Ground traversing at this scale of mapping, and with such poor exposure, is very inefficient. Contacts between rock units are not exposed; in some cases contacts are interpreted from aeromagnetic anomaly patterns.

NTS map area 13C was previously mapped by Stevenson (1967) at a scale of 1: 253 440. To the east, NTS map area 13C/SE was mapped by James and Nadeau (2000). NTS map area 13C/NW was mapped by Wardle *et al.* (1990, 2000).

REGIONAL SETTING

The area is situated in the northeastern Grenville Province and includes parts of the Mealy Mountains (MMT) and Mecatina (MECT) terranes (Figure 2). The terranes are Grenvillian (ca. 1000 Ma) tectonic divisions.

The MMT (Gower and Owen, 1984) consists primarily of late Paleoproterozoic (Labradorian-age) crust of the Mealy Mountains intrusive suite (MMIS) (*see* Emslie, 1976; Emslie and Hunt, 1990; Krogh *et al.*, 1996), minor amounts of Paleoproterozoic pre-Labradorian crust, and Pinwarian (1510 to 1450 Ma) and late- to post-Grenvillian intrusions (Gower, 1996). The MMIS consists mainly of an older group of anorthositic, leucogabbroic and leucotroctolitic rocks, not present in NTS 13C/SW, and a younger group of pyroxene-bearing monzonite and quartz monzonite intrusions. Emplacement ages for units of MMIS monzodiorite orthogneiss, porphyritic quartz monzodiorite and pyroxene-bearing monzonite, occurring in the Kenamu River area (NTS 13C/NE) and determined by U–Pb geochronology of zircon, are 1659 ± 5 Ma, 1650 ± 1 Ma, and 1643 ± 2 Ma, respectively (James *et al.*, 2000). In addition, pyroxene monzonite and pyroxene granite, inferred to be from the younger group of MMIS rocks and occurring in the northeastern part of the MMIS, have emplacement ages of 1646 ± 2 Ma and 1635 +22/ 8 Ma (Emslie and Hunt, 1990), respectively. Emplacement ages of MMIS rocks overlap with regionally significant tectonothermal and magmatic events of the Labradorian Orogeny, which occurred in northeastern Laurentia in the interval between 1720 and 1600 Ma (*see* Gower, 1996).

Rocks in the western part of the MMT, including the NTS 13C/SW area, are variably foliated and locally gneissic. In general they have northeast- to east northeast-striking planar fabrics that are inferred to be Labradorian in age (James and Nadeau, 2000). However, the local occurrence of deformed Pinwarian-age (ca. 1514 Ma) granite in the Kenamu River area (James *et al.*, 2000) demonstrates the western part of the terrane has also been locally affected by Pinwarian and/or Grenvillian deformation.

The MECT has not been studied in much detail. The oldest rocks, which make up a very minor amount of the terrane, are upper amphibolite-facies supracrustal rocks including quartzite, pelitic gneiss and rare occurrences of mafic gneisses. The supracrustal rocks are provisionally correlated with the >1500 Ma Wakeham Group, which make up a significant component of the Wakeham terrane (Figure 2). The supracrustal rocks are intruded by granitoid orthogneiss, deformed granitic and monzonitic rocks, gabbro, anorthosite and local troctolite. The igneous rocks are assigned to the Mesoproterozoic (Pinwarian-age) Petit Mecatina AMCG suite. The principal foliation and gneissosity in MECT rocks are mainly west-southwest- to west-northwest-striking. On the basis of U–Pb geochronological data (James *et al.*, 2001), metamorphism and attendant deformation of MECT rocks are interpreted to be Grenvillian.

The location of the boundary between the MMT and the MECT terrane is somewhat uncertain. In the Fourmont Lake area (NTS 13C/SE), rare occurrences of mylonitic rocks having an undetermined kinematic history, suggest the boundary is a south-dipping high-strain zone, possibly Grenvillian in age. However, the area inferred to contain the terrane boundary is very poorly exposed and reliable field data are lacking.

The MMT and the MECT are intruded by plutons consisting of unmetamorphosed, massive to weakly foliated granite. These plutons are interpreted to be part of a widespread suite of 980 to 950 Ma granitoid intrusions occurring in the northeastern Grenville Province (*see* Gower, 1996).

DESCRIPTION OF ROCK UNITS

MEALY MOUNTAINS TERRANE (MMT)
Mealy Mountains Intrusive Suite (MMIS)
Orthogneiss (P_{MM} ggn)

Gneissic and foliated, amphibolite-facies granitoid rocks, mainly including biotite ± hornblende granite and granodiorite, occur in the northwestern part of NTS 13D/5. These rocks are continuous into NTS 13D/NE, where they make up a significant part of the MMT. P_{MM} ggn rocks are somewhat similar to gneissic P_{MM} mdq granitoid rocks, which comprise part of the MMIS in the Kenamu River (NTS 13C/NE) and Fourmont Lake (NTS 13C/SE) areas (*see* James, 1999; James and Nadeau, 2000). However, P_{MM} ggn consists mainly of granite and granodiorite gneiss, whereas P_{MM} mdq consists mainly of clinopyroxene-bearing quartz monzonite or monzonite gneiss. P_{MM} ggn rocks are provisionally interpreted to be equivalent to the Lower Brook metamorphic suite orthogneisses defined by Wardle *et al.* (1990). Igneous emplacement ages of P_{MM} ggn rocks are undetermined.

Outcrops of P_{MM} ggn rocks are commonly composite; they may contain xenoliths of grey-weathering hornblende + biotite diorite, and younger aplite dykes which are less deformed than the gneiss. In addition, P_{MM} ggn gneisses are locally cut by deformed and metamorphosed mafic dykes. Weakly deformed and massive pegmatites form a minor part of the unit.

Monzodiorite, Quartz Monzodiorite and Monzonite (P_{MM} mdq)

Unit P_{MM} mdq is a compositionally and texturally varied unit making up a significant part of the western MMIS. It includes monzodiorite, quartz monzodiorite, monzonite, diorite, granodiorite, quartz monzonite and granite. The unit probably consists of many intrusions having relatively uniform composition and texture, although rocks are so poorly exposed the unit cannot be subdivided at the present scale of mapping. U–Pb zircon dating of a weakly gneissic quartz monzodiorite from the unit, occurring in NTS 13C/NE, gave a preliminary age of 1659 ± 5 Ma, interpreted to be the age of igneous emplacement (James *et al.*, *2000*).

Unit P_{MM} mdq rocks are texturally varied, even at the outcrop scale, from massive and having complete preservation of igneous textures, to recrystallized and foliated; gneissic varieties also occur. Generally, rocks are fine to medium grained, and they are most commonly recrystallized and foliated. The unit includes a wide variety of rock types, although almost all rocks from the unit contain some proportion of clinopyroxene, which is variably replaced by hornblende and biotite. Magnetite is a common accessory mineral.

Granodiorite (P_{MM} gdd)

Two outcrops of white-weathering granodiorite, occurring in the northern part of NTS 13C/5, define unit P_{MM} gdd. These rocks are provisionally correlated with the MMIS, although their age is unknown.

Outcrops of P_{MM} gdd consist of white- to grey-weathering granodiorite containing less than 10 percent biotite. Rocks are medium grained and have a granoblastic to slightly recrystallized texture. They have a weak foliation defined by biotite and by alignment of xenoliths consisting of grey orthogneiss and amphibolite.

Gabbro and Gabbronorite (P_{MM} gbr)

In the NTS 13C/SW area, MMIS mafic intrusive rocks are collectively defined as Unit P_{MM} gbr. The unit has a wide range in composition, textures, structures, and aeromagnetic signatures suggesting it consists of a number of different intrusions. However, it could not be subdivided at the present scale of mapping.

Unit P_{MM} gbr consists mainly of gabbro and gabbronorite. It contains subordinate amounts of leucogabbro, leucogabbronorite, pyroxenite, diorite and very minor amounts of monzogabbro, monzogabbronorite and amphibolite. Rocks consist of varied amounts of clinopyroxene, orthopyroxene and plagioclase. Olivine occurs rarely. Locally, plagioclase is pale pink on fresh surfaces. Biotite is a common accessory mineral; biotite-bearing rocks are most common in the western part of NTS 13C/6 and the eastern part of NTS 13C/5. Trace amounts to several percent of pyrite are common throughout the unit.

Rocks are varied from massive and unrecrystallized, containing preserved igneous mineral textures, to foliated and pervasively recrystallized. Locally, rocks display relict igneous layering defined by concentration of mafic minerals. In some rocks, the foliation may represent a modified relict igneous lamination.

MECATINA TERRANE (MECT)
Metasedimentary Rocks (P_2 qtz)

The unit P_2 qtz is defined on the basis of occurrences of quartzite and pelitic gneiss in the Fourmont Lake area (NTS 13C/SE). In the NTS 13C/SW area, an outcrop of amphibolite-facies mafic gneiss, interpreted to be derived from mafic volcanic rocks, is provisionally correlated with the P_2 qtz unit. The mafic gneiss, identified as P_2 qtz mvol on the map, occurs in the northwestern part of NTS 13C/3 (UTM 616253E, 5780508N). In addition, deformed M_{MC} kpg granitic rocks, occurring 3.5 km southwest of the P_2 qtz mafic gneiss occurrence, contain abundant inclusions of quartzite correlated with the P_2 qtz unit. Unit P_2 qtz rocks are tentatively correlated with rocks of the >1500 Ma Wakeham Group.

The mafic gneiss in NTS 13C/3 is a fine-grained and well-layered, clinopyroxene and biotite-bearing amphibolite gneiss. Layering is defined by concentration of mafic minerals. The outcrop also contains a minor amount of calc-silicate gneiss, and biotite-bearing quartzofeldspathic gneiss, which may have a sedimentary protolith. The mafic rocks are intruded by abundant amounts of medium-grained biotite granite.

Orthogneiss (M_{MC} ogn)

In NTS 13C/SW, the MECT includes a heterogeneous and unsubdivided unit of upper-amphibolite-facies orthogneiss and foliated, meta-plutonic rocks defined as Unit M_{MC} ogn. The unit is interpreted to be derived from a variety of protoliths including granite, granodiorite, monzonite and diorite. Locally, the M_{MC} ogn unit also includes gneissic K-feldspar porphyritic granite that could be a gneissic version of the M_{MC} kpg porphyritic granite unit.

The rocks contain minor amounts of biotite, and local clinopyroxene or hornblende. Rocks have a granoblastic texture and a variably developed gneissosity.

Porphyritic Granite (M_{MC} kpg)

In NTS 13C/SW, the MECT includes a widespread unit of recrystallized and foliated, K-feldspar porphyritic granite, defined as Unit M_{MC} kpg. U-Pb data from zircons, collected from a sample of the granite occurring in the Fourmont Lake area, gave an igneous crystallization age of 1493 ±3 Ma (James *et al.*, 2001). Foliated and recrystallized gabbro dykes occur throughout the unit but are too small to be shown on the map.

The rocks are light pink on the fresh and weathered surfaces. They consist of abundant, coarse-grained K-feldspar phenocrysts and finer grained quartz, plagioclase, biotite and local hornblende. Rocks contain less than 10 percent combined biotite and hornblende. The unit has a remarkably consistent composition throughout the area. In every outcrop, rocks are recrystallized and they have a foliation defined by elongated K-feldspar phenocrysts and biotite. Many rocks have an augen texture defined by extensively recrystallized and elongated phenocrysts up to 15 cm long. Foliation in the unit is west-northwest striking. Based on U-Pb dating of titanite, deformation and metamorphism of the granite is interpreted to be Grenvillian (ca. 1043 Ma) (James *et al.*, 2001).

MESOPROTEROZOIC UNITS
Late- to post-Grenvillian Intrusive Rocks
Syenite and Monzonite (M_{LG} mzt)

The central part of NTS 13C/5 includes a large pluton consisting of pyroxene-bearing syenite, monzonite and minor amounts of quartz monzonite. Contacts of the pluton are unexposed and age relationships with surrounding units are uncertain. In NTS 13C/5, the unit consists of distinctively pink- to orange-weathering monzonite and syenite. Rocks are medium to coarse grained and massive. They contain less than 10 percent clinopyroxene and accessory magnetite.

Granite (M_{LG} grn and M_{LG} kpg)

The MMT and MECT are intruded by plutons mainly consisting of medium- to coarse-grained granite (Unit M_{LG} grn) and K-feldspar porphyritic granite (Unit M_{LG} kpg). The units are similar in composition and are defined primarily on the basis of texture. Both contain rocks that are mainly undeformed and have fresh, phaneritic textures, although weakly foliated rocks occur locally. In some outcrops, the foliation may be a relict igneous foliation formed during emplacement. Of particular distinction, rocks contain unrecrystallized quartz. Some outcrops contain a prominent horizontal jointing.

Based on correlation of rock types, the similarity of aeromagnetic signatures, and that the rocks are essentially undeformed, Units M_{LG} grn and M_{LG} kpg are correlated with bodies of late- to post-Grenvillian granite that occur to the east of NTS 13C/SW. Where dated, these intrusions have emplacement ages between ca. 980 and 950 Ma (*see* Gower, 1996). U-Pb data from zircons from a sample of M_{LG} grn granite, occurring on the Joir River (in NTS map area 13B/5), gave an igneous crystallization age of 964 ±3 Ma (James *et al.*, 2001).

The medium- to coarse-grained granite unit (M_{LG} grn) consists of pink-weathering biotite syenogranite. Rocks contain less than 10 percent biotite. Equal-grained rocks are most common, although K-feldspar porphyritic rocks also occur. In general, outcrops have a consistent composition, texture and lack xenoliths. However, some outcrops are composites and include two or more separate granite phases that can be distinguished on the basis of grain size and subtle compositional differences. Locally, the granite is gradational into quartz monzonite.

The K-feldspar porphyritic granite unit (M_{LG} kpg) consists of pink-weathering biotite syenogranite identical in composition to the M_{LG} grn granite. Phenocrysts are up to 5 cm long, and locally display concentric zoning. In some outcrops, phenocrysts display a weak igneous lamination.

The NTS 13C/SW area also includes pink- to white-weathering granite pegmatites that intrude all of the map units. The pegmatites do not form map units at the present scale of mapping and are not shown on the map. They locally contain very coarse-grained K-feldspar crystals up to 30 cm long. The pegmatites are massive, undeformed and commonly occur around, or within M_{LG} grn and M_{LG} kpg granite intrusions. They are interpreted to be late- to post-Grenvillian on the basis of their undeformed and unrecrystallized character.

STRUCTURE AND METAMORPHISM

In NTS 13C/SW, MMIS rocks are variably recrystallized and deformed, although in general they cannot be characterized as having a strong or ubiquitous tectonic fabric. Relict igneous textures and minerals are common in deformed MMIS rocks throughout the area. In some occurrences of foliated P_{MM} gbr gabbronorite, for example, plagioclase and pyroxenes that preserve a relict intergranular texture are pseudomorphed by granoblastic plagioclase and pyroxene, respectively. The fact that these rocks retain their original textures and minerals may suggest they were deformed and recrystallized immediately following or during the late stages of emplacement. Thus, fabrics in these rocks may be igneous fabrics or accentuated igneous fabrics more related to emplacement processes than having a tectonic origin.

Unit P_{MM} mzt (monzonite and syenite) rocks are mainly unrecrystallized and undeformed. However, there are pervasively recrystallized and well-foliated P_{MM} mdq and P_{MM} gbr rocks that do not retain igneous textures; the fabrics in these rocks are interpreted as entirely tectonic. In addition, some Unit P_{MM} mdq rocks have a gneissosity, which is most easily interpreted as a thermotectonic feature. Planar fabric elements, whatever their origin in MMIS rocks, are east-northeast to north-northeast striking. The age of the tectonic fabric is uncertain but presumed to be Labradorian. However, the fact that the MMT in NTS map area 13C/NE includes an occurrence of foliated Pinwarian granite, and that the late- to post-Grenvillian granite plutons have a local, weak foliation, leaves open the possibility that some fabrics in MMT rocks are Grenvillian.

In the MECT, rocks in the orthogneiss (M_{MC} ogn) and K-feldspar porphyritic granite (M_{MC} kpg) units are extensively recrystallized, variably gneissic, and contain a well-developed west-northwest-striking foliation that, in general, dips steeply to the north-northeast. Foliation is defined by recrystallized K-feldspar phenocrysts, biotite and hornblende. Deformation was attendant with upper amphibolite-facies metamorphism. The age of deformation and metamorphism in MECT rocks is tentatively interpreted as Grenvillian. Growth of new titanite at 1043 ±6 Ma (U-Pb data) in a sample of foliated M_{MC} kpg granite is consistent with this interpretation (James *et al.*, 2001).

In the NTS 13C/SW area, the boundary between the MMT and the MECT is not exposed, and the location shown on the map is determined primarily from subtle aeromagnetic patterns. It is assumed to be a Grenvillian tectonic feature based on two outcrops of mylonitic rocks occurring along the interpreted boundary in the Fourmont Lake area (NTS 13C/SE). The mylonitic rocks, which have an undetermined kinematic history, suggest the boundary is a south-dipping high-strain zone (*see* James and Nadeau, 2000).

EXPLORATION POTENTIAL

The Grenville Province of southern Labrador is under explored, although the region has some exploration potential (*see* Swinden *et al.*, 1991; Gower, 1992; and Gower *et al.*, 1995). Paleoproterozoic gabbro and gabbronorite intrusions in NTS 13C/SW have potential to host Ni-Cu sulphide and PGE mineralization. Several outcrops in the study area contain a few percent pyrite, although no significant sulphide occurrences were discovered during mapping.

Granitic rocks may also be of some exploration interest. Late- to post-Grenvillian granite plutons in southwestern Norway host Mo mineralization and are locally anomalous in U and F. Also associated with these intrusions are fault-controlled polymetallic (Au–Ag–Cu–Pb–Zn) veins (*see* Gower, 1992). There is no known Mo mineralization in the late- to post-Grenvillian granite plutons in NTS 13C/SW, although typically these intrusions are very poorly exposed and have not been mapped in any detail.

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Recommended citation:
James, D.T. and Nadeau, L. 2001. Geology of the Lac Arvert area (NTS 13C/SW), Grenville Province, southern Labrador. Geological Survey of Newfoundland and Labrador, Department of Mines and Energy, Map 2001-20, Open File 013C/0044, 1:100 000-scale map with descriptive notes.

Last modified: March 2001.

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This map represents a preliminary interpretation of the geological field data and is subject to change without notice. Comments regarding revisions or errors are invited and should be directed to the Director, Geological Survey of Newfoundland and Labrador, P.O. Box 8700, St. John's, Newfoundland, Canada. A1B 4J6

NOTE: This map supercedes Open File 013C/0041 (James, D.T. and Nadeau, L. 2000. Geology of the Minipi Lake area (NTS 13C/South), Grenville Province, southern Labrador. Geological Survey of Newfoundland and Labrador, Department of Mines and Energy, Open File 013C/0041, 1:100 000-scale map with descriptive notes.)

BEDROCK GEOLOGY

OPEN FILE 013C/0044

MAP 2001-20

GEOLOGY OF THE LAC ARVERT AREA (NTS 13C/SW), GRENVILLE PROVINCE, SOUTHERN LABRADOR.

scale: 1:100 000

0 1 2 3 4 5
kilometres

DATA POSITIONING

On this map, structural and outcrop data are plotted in the position where the data were collected in the field (i.e., symbols representing tectonic structures or primary features are not offset from the outcrop location). The centre of the symbol representing a planar fabric element (e.g., foliation or gneissosity) or a planar primary feature (e.g., bedding or igneous layering) is plotted in the position where the data were collected in the field. The + symbol represents an outcrop that has a massive (i.e., isotropic) structure or one that does not contain a measurable fabric (e.g., frost heave or an extensively fractured outcrop).

Data are plotted using a NAD 1927 projection, UTM Grid Zone 20.