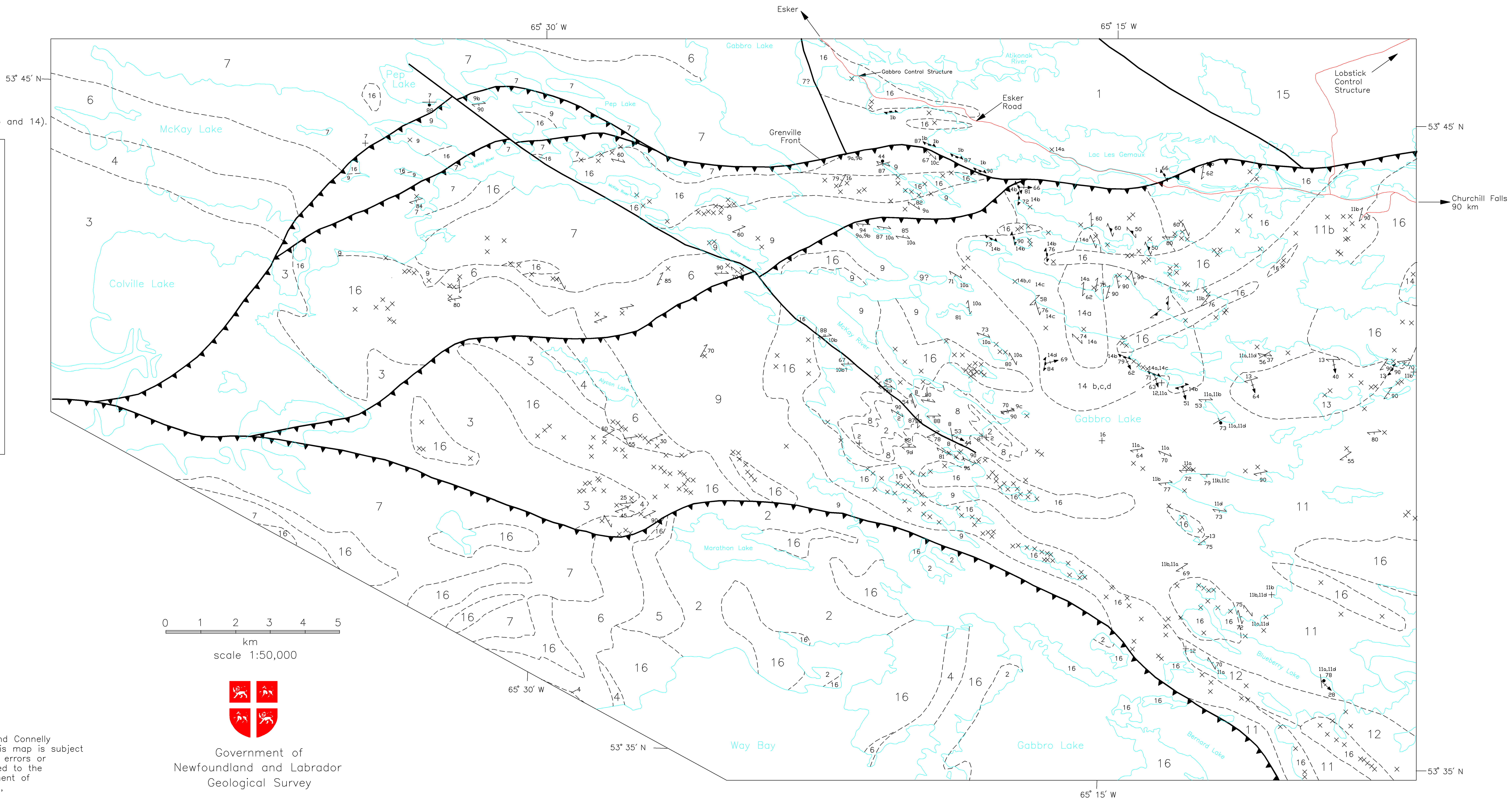
Government of Newfoundland and Labrador
Department of Natural Resources
Geological Survey

GEOLOGY OF THE PALEOPROTEROZOIC BLUEBERRY LAKE GROUP IN THE GABBRO LAKE AREA, WESTERN LABRADOR.

OPEN FILE 023H/0102
(includes parts of NTS areas 23H/11, 12, 13 and 14).



MESOPROTEROZOIC
- 16 Shabogamo gabbro

PALEOPROTEROZOIC

Trans-Labrador batholith
- 15 Atikonak River pluton: plagiocalse-porphyritic quartz monzonite
- 14 K-feldspar megacrystic syenogranite, quartz syenite (14a) and highly strained equivalents (14b), granitoid gneiss (14c) of uncertain correlation and highly strained granitoid gneiss (14d)
- 13 isotropic syenogranite, quartz syenite and local megacrystic granite

Blueberry Lake group
- 12 dacite porphyry
- 11 felsic volcanic rocks including felsic crystal- and lithic-tuff (11a), rhyolite and rhyolite breccia (11b), minor amounts of mafic volcanic rocks (11c), and local tuffaceous sandstone, wacke and conglomerate (11d)
- 10 quartz wacke - shale (phyllite) turbidites commonly interbedded with minor amounts of felsic tuff and tuffaceous sandstone (10a), shale (phyllite) (10b), fine-grained turbiditic sandstone (10c)
- 9 quartz wacke and sandstone (9a), conglomeratic quartz wacke (9b), quartz wacke containing beds of felsic tuff and tuffaceous sandstone (9c), quartz wacke - shale (phyllite) turbidites (9d), phyllite (9e)
- 8 polymictic conglomerate

Knob Lake Group
- 7 Menihek Formation: grey- to black-weathering schist, phyllite and slate, and quartzofeldspathic schist
- 6 Sokoman Formation: oxide iron formation, ferruginous quartzite, carbonate iron formation, cherty magnetite iron formation with tuff bands and fragments
- 5 McKay River Formation: tuffaceous sediments (chloritic schists), volcanogenic conglomerate, garnetiferous amphibolite
- 4 Denault Formation: dolomitic and calcitic marble, impure siliceous carbonate, dolomitic marble and chloritic schist
- 3 Attikamagen Formation: quartzofeldspathic schists, wacke, slate and phyllite

ARCHEAN
- 2 Superior Province (?): granitoid gneiss and migmatite
- 1 Rae Province: granitoid gneiss and migmatite (1a), and highly strained equivalents (1b)

SYMBOL LEGEND

- OUTCROP – massive or no data (e.g. subcrop)
- OUTCROP – compiled
- BEDDING top: unknown, known, overturned
- FOLIATION generation: 1st, 2nd, 3rd
- GNEISSOSITY
- SHEAR ZONE planar fabric in ductile high-strain zone (C-fabric)
- L-FABRIC mineral elongation lineation
- FOLD AXIS LINEATION generation: 1st, 2nd, 3rd
- FOLD AXIS LINEATION U fold, S fold, Z fold

0 1 2 3 4 5
km
scale 1:50,000

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OPEN FILE: 023H/0102
OPEN FILE MAP: 95 – 04

Compiled by Donald T. James from James and Connelly (1995), Rivers (1985) and Wardle (1979). This map is subject to review and revision. Comments concerning errors or omissions are invited and should be addressed to the Executive Director, Geological Survey, Department of Natural Resources, P.O. Box 8700, St. John's, Newfoundland A1B 4J6.

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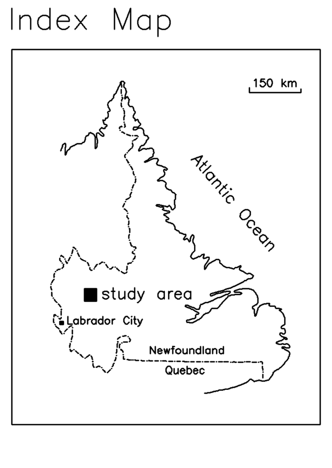
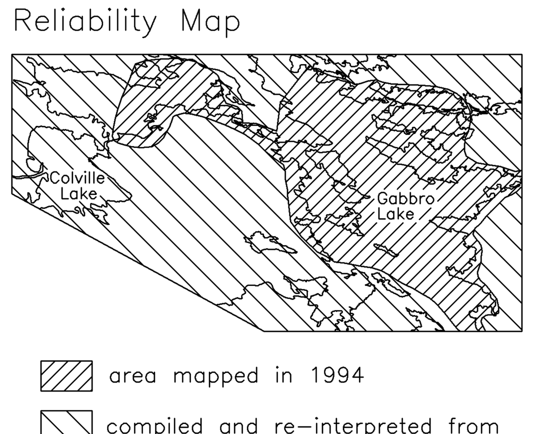
Index Map

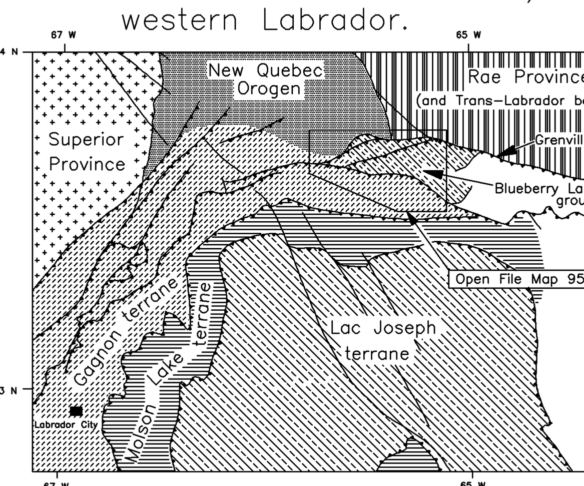


Reliability Map



- area mapped in 1994
- compiled and re-interpreted from Wardle (1979) and Rivers (1985).

Principal Tectonic Subdivisions of the Grenville Province, western Labrador.



The Gagnon terrane is a low- to high-grade Grenvillian fold-and-thrust belt consisting of Paleoproterozoic rocks of the Knob Lake Group, reworked pre-Knob Lake Group (Superior Province) basement, Blueberry Lake group rocks, intrusions of Trans-Labrador batholith, and Shabogamo Gabbro. The Molson Lake terrane is a medium- to high-grade Grenvillian thrust nappe consisting mainly of Trans-Labrador batholith rocks and Shabogamo Gabbro. The Lac Joseph terrane is a Grenvillian nappe consisting mainly of Labradorian (ca. 1.67 to 1.62 Ga) high-grade metasedimentary gneisses and mafic intrusions.

GEOLOGY OF THE PALEOPROTEROZOIC BLUEBERRY LAKE GROUP IN THE GABBRO LAKE AREA, WESTERN LABRADOR

INTRODUCTION

In the Gabbro Lake area, western Labrador, the Blueberry Lake Group includes greenschist-facies clastic sedimentary and felsic volcanic rocks. The sedimentary sequence consists of a basal polymictic conglomerate which is overlain by a succession of massive quartz wacke, conglomeratic wacke, turbiditic quartz wacke, and quartz wacke - shale turbidites. The felsic volcanic rocks consist mainly of felsic crystal and lithic tuff and lesser amounts of rhyolite, and an andesite to dacite porphyry. The presence of layers of felsic tuff and tuffaceous sandstone in the sedimentary succession demonstrates that Blueberry Lake group sedimentation and felsic volcanism were contemporaneous. A U - Pb zircon age of 1652 +/-5 Ma (James and Connelly, 1995) obtained from a Blueberry Lake group felsic volcanic rock is interpreted to represent the age of volcanism.

The Blueberry Lake group is contained in a northwest-vergent imbricate thrust structure which makes up the northeastern part of the Grenvillian Gagnon terrane. Thrusting also involved rocks of the Paleoproterozoic Knob Lake Group and sub-Knob Lake Group gneisses inferred to be Archean. The thrusts are ductile to brittle greenschist-facies structures. Rocks within the thrust sheets contain penetrative Grenvillian fabrics. The structurally lowest thrust is defined as the Grenville Front.

PREVIOUS WORK

Felsic volcanic and sedimentary rocks occurring around the northern end of Gabbro Lake were mapped by Wynne-Edwards (1961). He correlated these rocks with the basal units of the Labrador Trough sequence (Paleoproterozoic Knob Lake Group) based on lithologic similarities, and the fact that the sedimentary rocks at Gabbro Lake rested unconformably on granitoid gneisses, which occur near the outlet of the McKay River on the west side of Gabbro Lake. Frarey (1961) had previously noted the unconformable relationship between the Knob Lake Group and gneisses of the Archean Superior Province. In effect, Wynne-Edwards correlated the McKay River unconformity with the sub-Knob Lake Group unconformity.

On the basis of subsequent mapping, Wardle (1979) named the felsic volcanic and sedimentary rocks at Gabbro Lake the Blueberry Lake group. He also recognized the lithologic similarities between the Blueberry Lake group and the Knob Lake Group (Seward and Attikamagen formations), but noted that there are no contact relations between rocks of the Blueberry Lake group and those of the Knob Lake Group. This prompted Wardle (op cit) to speculate that the Blueberry Lake group was unrelated to the Labrador Trough sequence, and that it might be correlative with the lithologically similar Bruce River group (Smyth et al, 1975) in eastern Labrador.

Brooks et al. (1981) dated a felsic volcanic rock from the Blueberry Lake group at 1540 +/- 40 Ma using Rb - Sr methods. This data confirmed that the Blueberry Lake group is not correlative with the Knob Lake Group. Based on the geochronological data, and the spatial relationship between the Blueberry Lake group and rocks of the Labradorian-age Trans-Labrador batholith, Wardle et al. (1986) inferred that the Blueberry Lake group felsic volcanic rocks were the extrusive equivalents of the younger, high-level components of the Trans-Labrador batholith. This is consistent with the chemistry of the volcanic rocks, which suggests that they were derived from upper-crustal level magmas that were tapped by fractures (Gower and Ryan, 1986). Wardle (1979) inferred the Blueberry Lake group sediments to be the distal-facies equivalents of the volcanic rocks based on the presence of felsic volcanic detritus in the sediments.

REGIONAL FRAMEWORK

The Blueberry Lake group occurs in several thrust sheets, which make up the northeastern part of the Gagnon terrane (Rivers et al, 1989) in the Grenville Province of western Labrador. In the study area, the Gagnon terrane is a northwest vergent, Grenvillian fold-and-thrust belt and includes Paleoproterozoic rocks of the Knob Lake Group, ca. 1650 Ma granitic rocks of the Trans-Labrador batholith, ca. 1450 Ma Shabogamo Gabbro, and some granitoid gneisses of inferred Archean age. The Gagnon terrane is thrust over autochthonous pre-Grenvillian Laurentia including Archean rocks of the southeastern Rae Province, Paleoproterozoic rocks which make up the New Québec Orogen (Knob Lake Group) and granite plutons of inferred Labradorian age.

The age of Grenvillian deformation in western Labrador is constrained by U - Pb geochronological data to be ca. 1010 - 980 Ma (Connelly and Heaman, 1993). In the study area, Grenvillian deformation is attendant with greenschist-facies metamorphism.

DESCRIPTION OF UNITS

RAE PROVINCE GRANITOID GNEISS: Unit 1

Unit 1 is a heterogeneous division consisting of polydeformed, pink and grey- or white-weathering granitoid gneisses that contain biotite and local hornblende. The rocks contain relics of mafic dykes, which predate the oldest deformation and high-grade metamorphism in the host rocks, variable amounts of pink granitic leucosome, and several generations of variably deformed, fine-grained granitic dykes. The rocks also contain dykes of K-feldspar megacrystic granite.

Unit 1 also includes several outcrops of megacrystic granite containing biotite. The granite is foliated and locally sheared, and contains more than 15% coarse-grained K-feldspar megacrysts. On the basis of lithology, the megacrystic granite is correlated with the ca. 1650 Ma granitic rocks of the Trans-Labrador batholith.

The granitoid gneisses of Unit 1 are derived from Archean granitic intrusions (James and Connelly, 1995). The age of leucosome formation and attendant high-grade deformation is also inferred to be Archean. The ages of the granitic dykes, which postdate the leucosome, are unconstrained; they could be Archean, Paleoproterozoic (ca. 1.84 - 1.80 Ga), Labradorian (ca. 1.65 - 1.62 Ga) or Grenvillian.

SUPERIOR PROVINCE GRANITOID GNEISS: Unit 2

Several outcrops of granitoid gneiss and migmatite occur near the outlet of the McKay River (e.g. 344790E, 5949376N UTM coordinates), south of the Grenville Front. The rocks consist of alternating layers of grey- to rusty-weathering quartzofeldspathic paleosome containing biotite, and white-weathering granitoid leucosome. The outcrops contain approximately 20% leucosome. They also contain numerous mafic dykes, up to 2-metres-thick, which are discordant to the gneissosity in the host rocks but are themselves deformed and metamorphosed to greenschist facies. The mafic dykes are mainly north-northeast striking.

The fact that Unit 2 gneisses occur in a thrust sheet, which also contains greenschist-facies Knob Lake Group rocks, suggests that the Unit 2 rocks have an affinity with the Archean Superior Province.

BLUEBERRY LAKE GROUP

Unit 8: Conglomerate

Near the outlet of the McKay River, granitoid gneisses of Unit 2 are unconformably overlain by polymictic conglomerate of the Blueberry Lake group. The unconformity was not observed, although it is inferred on the basis of unequivocal clasts of Unit 2 granitoid gneiss in the conglomerate.

The unit consists mainly of unsorted, framework-supported conglomerate containing clasts from 1 cm to 75 cm in diameter. The clasts include: a white-weathering, fine-grained granitoid rock presumed to be derived from the leucosome of Unit 2, white- to grey-weathering granitoid gneiss clasts (Unit 2 paleosome), white-weathering, K-feldspar megacrystic granite of uncertain correlation, quartz inferred to be derived from quartz veins, quartz wacke and grey- to black-weathering shale. Clasts of felsic lithic tuff occur locally. The presence of beds of quartz wacke and shale in Unit 8 suggests that derivation of the quartz wacke and shale clasts was probably quite local. On the basis of lithology, the felsic lithic-tuff clasts are correlated with the Blueberry Lake group felsic volcanic rocks (Unit 11).

Units 9 and 10:

The conglomerate (Unit 8) is overlain by fine-grained clastic sedimentary rocks that have been broadly subdivided into two units. Unit 9, which is the most abundant of the two, consists of thick-bedded quartz wacke and lesser amounts of interbedded quartz wacke and shale, conglomeratic quartz wacke, felsic tuff and tuffaceous sandstone, and shale (phyllite). Unit 10 mainly consists of shale (phyllite) and interbedded quartz wacke and shale, which are interpreted as turbidites.

It is not possible to map a continuous stratigraphic section through the sedimentary units (units 8 to 10), although the presence of quartz wacke beds in the stratigraphically highest levels of Unit 8, and of local, thin (< 2m) beds of conglomeratic quartz wacke in the lowest parts of Unit 9 suggest that the relationship between units 8 and 9 is transitional. The conglomeratic quartz wacke in Unit 9 contains clasts less than 10 cm long. The clasts consist of quartz, quartz wacke, shale, black-weathering slate, and felsic volcanic rocks. Unit 9 is inferred to be unconformable upon the Knob Lake Group (units 4 to 7).

The quartz wacke, which makes up a large part of Unit 9, is grey to pale-brown weathering, and is commonly fine-grained, massive (i.e. non-graded) and thick (> 1m) to thin (10cm to 15cm) bedded. It is locally interlayered with thin (< 1m) beds of grey- to pale green-weathering shale (phyllite) and white- to grey-weathering felsic tuff and tuffaceous sandstone. The beds of tuff and tuffaceous sandstone are equally distributed throughout Unit 9, whereas the amount of shale appears to increase upwards in the stratigraphic section, and suggests a transitional relationship between units 9 and 10.

Unit 10 consists of grey- to pale green-weathering shale (phyllite), interbedded quartz wacke and shale, and a minor amount of felsic tuff. The quartz wacke - shale couplets consist of alternating beds of fine-grained quartz wacke (< 50 cm) and thin, parallel laminated quartz wacke and shale. Fine grained, parallel-laminated and graded sandstones occur locally. In the study area, Unit 10 is inferred to underlie much of the central part of Gabbro Lake.

Volcanic Rocks

Unit 11: Felsic Volcanic Rocks

The felsic volcanic rocks principally occur in the eastern part of the study area. Unit 11, which is the most abundant volcanic unit, consists mainly of white- to grey-weathering felsic lithic and crystal tuff. These rocks are commonly bedded (1cm to 15cm) but locally massive. They also contain abundant, felsic lithic fragments (up to 1cm long), and locally, fine-grained quartz crystals. The felsic tuffs are locally interbedded with minor amounts of tuffaceous sandstone and conglomerate. In one outcrop, felsic tuffs are interbedded with a mafic to intermediate volcanic flow having a spherulitic texture.

In the study area, rhyolite is less abundant than felsic tuff. The rhyolite is pink weathering and massive. Unit 11 also contains several occurrences of rhyolite breccia. The best exposures of breccia occur in the northeastern part of the study area, north of the Esker Road (353938E, 5956299E UTM coordinates). The breccia consists of more than 50 percent angular clasts of pink-, white- and black-weathering rhyolite up to 20cm long.

Unit 11 also contains a very minor amount of clastic sedimentary rocks, which are similar to rocks in units 9 and 10. Of particular interest is an outcrop at Blueberry Lake (357427E, 5941626N UTM coordinates), consisting of trough cross-laminated quartz wacke overlain by parallel-laminated quartz sandstone and pelite. The sandstone contains several beds (15cm to 30cm thick) of a parallel-laminated rock consisting mainly of diopside and minor epidote and carbonate.

Unit 12: Dacite Porphyry

The Blueberry Lake group also contains a unit of grey- to pale brown-weathering dacite porphyry. The rocks have an aphanitic groundmass and 20% to 30%, medium to coarse-grained, subhedral to anhedral feldspar phenocrysts. They also contain less than 10 percent epidote and plagioclase-filled amygdules.

One outcrop of Unit 12 porphyry, which occurs along the eastern shore of Gabbro Lake (352806E, 5950203N UTM coordinates), consists of a porphyritic flow overlain by breccia, conglomerate lithic wacke, and parallel-laminated and graded lithic wacke. The breccia contains clasts of the underlying porphyry. The sedimentary rocks are overlain by a second flow of Unit 12 porphyry. These relations demonstrate that at this location, the porphyry is an extrusive rock. However, elsewhere in the Blueberry Lake group, these porphyritic rocks could be intrusive.

TRANS-LABRADOR BATHOLITH

Units 13 and 14

Unit 13 consists mainly of pink weathering, fine- to medium-grained isotropic syenogranite and quartz syenite. The rocks contain a minor amount of biotite. Unit 13 appears to be locally gradational into K-feldspar megacrystic granite similar to Unit 14 megacrystic granite. Inclusions of older units were not found in Unit 13 granite. The contact relations between units 13 and 14 are undefined.

Unit 14 mainly includes variably deformed, K-feldspar megacrystic syenogranite and quartz syenite, and lesser amounts of granitoid gneiss. The granitic rocks are pink weathering, and contain abundant, coarse grained, anhedral K-feldspar megacrysts. They also contain medium- to coarse-grained blue quartz, and less than 10 percent fine-grained biotite.

The Unit 14a megacrystic granite is overprinted by a high-strain planar fabric with increasing intensity towards the margins of the body. This results in the transformation of the megacrystic granite to an augen gneiss and to mylonite. The highly strained rocks are defined as Unit 14b. The increase in strain from Unit 14a to Unit 14b is heterogeneous and there are several examples of mylonitic granite, which contain relics of lesser strained megacrystic granite, near the margin of the body. The margins of the body also contain some occurrences of granitoid gneiss (units 14c and 14d) of uncertain age and correlation.

Inclusions of country rocks in Unit 14 are not common, although a few xenoliths of quartz wacke occur in the highly strained margins of the body. The inclusions are provisionally correlated with Unit 9.

STRUCTURE

The Blueberry Lake group is contained within an imbricate thrust structure, which makes up the northeastern part of the Grenvillian Gagnon terrane. The thrusts have not been mapped but are inferred principally on the map pattern of the rock units.

Highly strained Rae Province gneisses, located 3 km southeast of the Gabbro Control structure are inferred to occur along the structurally lowest thrust in the study area. This structure is defined as the Grenville Front. The rocks contain greenschist-facies mylonitic fabrics, which are overprinted by brittle cataclastic structures. Kinematic indicators were not mapped. The other thrusts are presumed to also be greenschist-facies ductile to brittle structures. The fact that the unconformity between Blueberry Lake group conglomerate and Unit 2 gneisses is preserved within one of the thrust sheets, demonstrates that thrusting involves all of the rock units along the southern margin of pre-Grenvillian Laurentia.

Within the thrust sheets, Blueberry Lake group rocks are variably foliated. Most rocks contain a moderate to strong, penetrative S1 foliation defined by parallel alignment of phyllosilicate (metamorphic) minerals, or they have a pressure solution cleavage. S1 is generally east- to southeast-striking and is axial planar to F1 folds of bedding in the Blueberry Lake group and Shabogamo Gabbro intrusions. Locally, S1 and F1 are overprinted by an east-northeast- to southeast-striking foliation defined as S2. Bedding and F1 structures are locally folded about S2 producing F2 folds. The superposition of F2 folds on F1 has produced Type II and III interference patterns, which occur as map-scale structures near the outlet of the McKay River into Gabbro Lake. There are several occurrences of a north-striking S3 crenulation cleavage, which overprints S2 in Blueberry Lake group sedimentary rocks.

Mylonite and porphyroclastic gneiss occur around the margin of the megacrystic granite (Unit 14) intrusion. Based on field examinations, formation of the high-strain fabric was attendant with greenschist- to amphibolite-facies metamorphism. Kinematic indicators were not mapped. The fact that dykes of Shabogamo Gabbro appear to cross-cut the high-strain structures demonstrates that the structures are not Grenvillian. Instead, these high-strain structures are thought to be Labradorian.

ECONOMIC POTENTIAL

Several occurrences of grey-weathering phyllite from Unit 10 (e.g.'s 347342E 5952340N, and 348478E 5950883N UTM coordinates) contain several percent of disseminated pyrite and very minor amounts copper-bearing sulphides. These occurrences suggest that the fine-grained clastic rocks in units 9 and 10 have potential to host SEDEX base-metal sulphide mineralization, although samples from these locations do not contain significant amounts of base metals. The average copper content in sulphide-bearing rocks from the two outcrops noted above is less than 50 ppm.

The Blueberry Lake group felsic volcanic rocks may have some potential for volcanic-hosted massive sulphide mineralization, although occurrences of sulphide mineralization were not observed in the Gabbro Lake area. Moderate lake-sediment geochemical anomalies in As, Zn, Ni and Pb are present over the Blueberry Lake group (Swinden et al. 1991).

A DEPOSITIONAL MODEL for the BLUEBERRY LAKE GROUP

The sedimentary rocks of the Blueberry Lake group were deposited unconformably along the southern margin of pre-Labradorian Laurentia consisting of Knob Lake Group rocks and sub-Knob Lake Group gneisses of the Superior and Rae provinces. The deposition of the Blueberry Lake group may have occurred in a back-arc basin floored by pre-Labradorian Laurentian crust. This is suggested by the association of the Blueberry Lake group with the Trans-Labrador batholith, interpreted to be a subduction-related continental magmatic arc (see James, 1994 and references therein).

The Blueberry Lake group succession although not studied in detail consists of three principal elements namely: 1) a local basal conglomerate, 2) a middle sequence that is dominated by quartz wacke, conglomeratic quartz wacke and shale, and minor amounts of felsic pyroclastic and epiclastic rocks, and 3) an upper sequence of dominantly felsic pyroclastic to epiclastic rocks, and lesser amounts of mafic to intermediate volcanic flows, and some sedimentary rocks similar to the middle sequence. This tripartite sequence suggests a marine basin fill of mixed provenance. The quartz wacke and conglomerates containing clasts of granitoid gneiss and granite support a source in the Archean basement complexes of the Superior and Rae provinces. This is in marked contrast to the felsic volcanic rocks of the upper part of the group. Intercalation of sedimentary and volcanic rocks throughout the group indicates that the two source areas are penecontemporaneous with each other.

The basal and middle sequences are essentially derived from the Archean basement to the west and north. The localized basal conglomerate is interpreted as a submarine canyon fill. The well-bedded nature of the quartz wacke and shale, and the types of sedimentary structures, support gravity-driven turbiditic sedimentation along a rifted margin. Tuffaceous sandstone interbedded throughout the middle sequence suggests contemporaneous epiclastic sedimentation of tuffaceous volcanic rocks into the basin.

There is insufficient data to allow further interpretation of the depositional environments of the turbidites. However, the fining upwards nature of the middle sequence and the distribution of map units 9 and 10, which overstep the canyon fill (Unit 8) and onlap the basement, suggest that the basin foundered with rifting. Relative sea level rise drowned the Laurentian margin cutting off the Archean source. This consequently allowed the volcanic arc to supply most of the detritus for the youngest part of the basin fill.

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