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GEOLOGY OF THE NORTHWESTERN PART OF THE GLOVERTOWN MAP AREA (NTS 2D/9) AND THE NORTHEASTERN PART OF THE DEAD WOLF POND MAP AREA (NTS 2D/10)

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ABSTRACT

The study area is located within the northeast Gander Zone and is underlain by the Gander Group and a varied suite of syn- and posttectonic granites. The Gander Group consists of interbedded psammite, semipelite and pelite metamorphosed to greenschist and amphibolite facies. Much of the north-central part of the map area is underlain by the posttectonic Siluro-Devonian Gander Lake Granite, a predominantly massive, K-feldspar megacrystic and biotite-rich granite. A static thermal aureole characterized by cordierite and andalusite hornfels occurs peripheral to the granite. The northeastern edge of the Middle Ridge Granite outcrops in the west of the map area and its aureole is characterized by schistose andalusite-bearing rocks.

Southeast of Gambo Pond, the Gander Group is metamorphosed at sillimanite grade and is intruded by a varied suite of granitoid rocks. The latter are typically foliated but the strain is heterogeneous and the fabric ranges from weak to mylonitic. The Hare Bay Gneiss outcrops in a narrow band adjacent to the Gander–Avalon zone boundary.

The Wing Pond Shear Zone, north of Gambo Pond, principally affects metasedimentary rocks of the Gander Group, but on Mint Brook it also deforms a diverse suite of igneous rocks.

INTRODUCTION

During the 1991 field season, the northwestern part of NTS map area 2D/9 (Glovertown; O'Brien *et al.*, 1991) and the northeastern part of NTS map area 2D/10 (Dead Wolf Pond; Blackwood *et al.*, 1991) were mapped at a 1:50 000 scale (Figures 1 and 2). The work represents a continuation of Gander Zone mapping initiated in 1986 in the Weir's Pond area (O'Neill, 1987).

The area south and east of Gambo Pond is accessible from the Trans-Canada Highway (TCH, Route 1), as well as by logging roads and by boat from Maccles Lake and Gambo Pond. The remainder of the area can be reached from Gambo and North ponds and via a system of old logging roads. All-terrain-vehicles were used extensively in the westernmost part of the map area.

The linear nature of Gambo Pond is the most striking physiographical feature in the area. The pond, which is 1 to 2 km wide and approximately 28 km long, is bounded by steep slopes along most of its length, and in the south, near Triton and Riverhead brooks, there are 30- to 60-m-high cliffs. The prominent lineament defined by Gambo Pond appears to continue west-southwest along the valley of Triton Brook. Although no fault breccias were mapped on or near this lineament, it is inferred to mark the locus of a fault. North of Gambo Pond, the country is gently undulating, whereas south and east of the pond, particularly in the vicinity of Gull Pond, the topography is more rugged and reflects, at least partly, the varied geology. Although geologically very significant, the Dover Fault shows no topographic expression. Drainage is mostly east–west and dominated by Triton and Riverhead brooks, which empty into the western end of Gambo Pond. To the north, Mint Brook is the principal waterway draining Mint and North ponds.

Exposure is best north of Maccles Lake and particularly in the area around Gull Pond, where there was a major forest fire in the early 1980's. Despite the steep slopes bordering Gambo Pond, exposure along the north and west shores, especially in the area underlain by the Gander Lake Granite, is poor. The best exposures of the lower-grade part of the Jonathan's Pond Formation occur on Riverhead Brook.

PREVIOUS WORK

The area was surveyed by Jenness (1963) as part of a regional Geological Survey of Canada mapping project. Results of this work were published at four miles to the inch.

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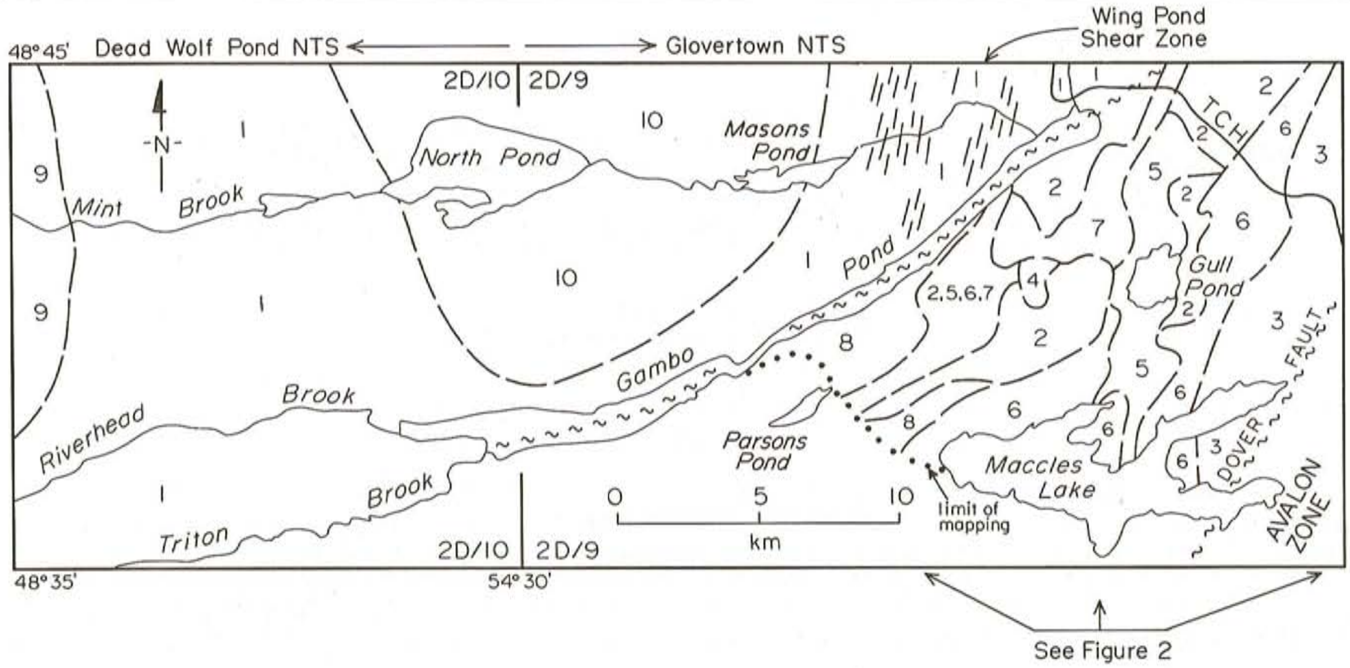

Figure 1. *Simplified geology of the northeast corner of Dead Wolf Pond (NTS 2D/10) map area and the northwest corner of Glovertown (NTS 2D/9) map area.*

The area between Gambo Pond and Gull Pond was interpreted to be underlain by an outlier of the Ackley batholith *(sensu lato)*. Mica quartz paragneiss and mica schist farther east were attributed to the lower unit of the Gander Lake Group. West of Gambo Pond, gneiss, schist and lower-grade equivalents were included in the same unit, and the Gander Lake Granite, which intrudes them, was considered to be another outlier of the Ackley batholith.

Strong *et al.* (1974) carried out a regional lithogeochemical survey of the Gander Zone. They proposed the name Gander Lake pluton to denote a coarse-grained to megacrystic granite outcropping on the Trans-Canada Highway and the shores of Gander Lake. Based on reconnaissance mapping near Maccles Lake, they gave the name Freshwater Bay pluton to exposures of megacrystic granite north of Maccles Lake. Part of the area was also mapped by Blackwood (1976), during a study of the relationships between the Gander and Avalon zones; he renamed the Freshwater Bay pluton as the Maccles Lake granite.

The northwest portion of the Dead Wolf Pond map area, underlain by the Middle Ridge Granite and the Gander Group, was mapped by Blackwood and Green (1982a) and adjoins the present project area.

REGIONAL RELATIONSHIPS

The area lies within the Gander Lake Subzone of the Gander Zone (Williams *et al.*, 1988). The Ordovician and/or older Gander Group (Kennedy and McGonigal, 1972) underlies approximately 30 percent of the map area. These rocks have been traced northeastward to the Carmanville (NTS 2E/8) map area (Currie and Pajari, 1977) and southwestward, for approximately 80 km, to the Mount Sylvester (NTS 2D/3) map area (Dickson, 1987). To the east, the Gander Group passes gradationally into the Square Pond and Hare Bay gneisses and to the west, the group is juxtaposed with the Gander River Complex and Davidsville Group of the Exploits Zone (Blackwood, 1978).

Much of the central part of the map area is underlain by the Gander Lake Granite, a large posttectonic megacrystic intrusion. The northeastern edge of the Middle Range Granite (Strong *et al.*, 1974) was mapped in the western portion of the area. This granite forms a northeast-trending, late kinematic, linear intrusion and is divisible into several phases (Blackwood and Green, 1982a).

The Gander Group is separated into two belts by the Wing Pond shear zone, a major structural feature that extends northward from Gambo Pond to the region north of Wing Pond (O'Neill, 1991).

GENERAL GEOLOGY

JONATHAN'S POND FORMATION (UNITS 1 AND 2)

Approximately 50 percent of the area is underlain by metasedimentary rocks belonging to the Jonathan's Pond Formation of the Gander Group. This formation consists of psammite, semipelite and pelite and, in this area, is separated into two units of contrasting metamorphic grade.

Unit 1 is metamorphosed at chlorite grade, except close to the Gander Lake and Middle Ridge granites, where the rocks are hornfels and fine- to medium-grained schists, respectively. Psammite is weathered light-grey and is typically

LEGEND

DEVONIAN

GANDER LAKE GRANITE

10 *Massive, coarse-grained, K-feldspsar megacrystic, biotite granite*

SILURO-DEVONIAN

MIDDLE RIDGE GRANITE

9 *Massive, coarse-grained, feldspar porphritic, muscovite–biotite granodiorite; minor aplite and pegmatite*

MACCLES LAKE GRANITE

8 *Massive, coarse-grained, K-feldspar megacrystic, biotite granite*

SILURIAN(?)

7 *Foliated, fine- to medium-grained, muscovite–biotite, garnetiferous leucogranite; locally contains unseparated metasedimentary rocks (< 30 percent of exposure) and megacrystic granite*

6 *Foliated, K-feldspar megacrystic, biotite granite: locally intruded by minor leucogranite (Unit 7); locally contains minor metasedimentary rocks*

5 *Foliated, fine-, medium- and coarse-grained leucogranite; coarse-grained to K-feldspar megacrystic, biotite granite; contains minor unseparated metasedimentary rocks*

SILURIAN AND OLDER

4 *Foliated, predominantly fine- to medium-grained leucogranite and metasedimentary rock occurring in equal proportions*

EARLY ORDOVICIAN OR OLDER

HARE BAY GNEISS

3 *Unseparated paragneiss and orthogneiss; minor amphibolite*

GANDER GROUP

JONATHAN'S POND FORMATION (Units 1 and 2)

2 *Predominantly coarse-grained, sillimanite-bearing, pelitic and semipelitic schists; minor amounts of unseparated, foliated, fine- to coarse-grained, and megacrystic granite*

1 *Chlorite-grade psammite, semipelite and pelite; unseparated hornfels and schist in the aureoles of the Gander Lake and Middle Ridge granites; minor unseparated quartzite and metabasic rocks*

SYMBOLS

Geological contact

Foliation, second deformation (inclined)

Foliation, third deformation (inclined, vertical)

Foliation, high strain (inclined)

Fault

High-strain zone

Shear sense as implied by kinematic indicators in granitoid

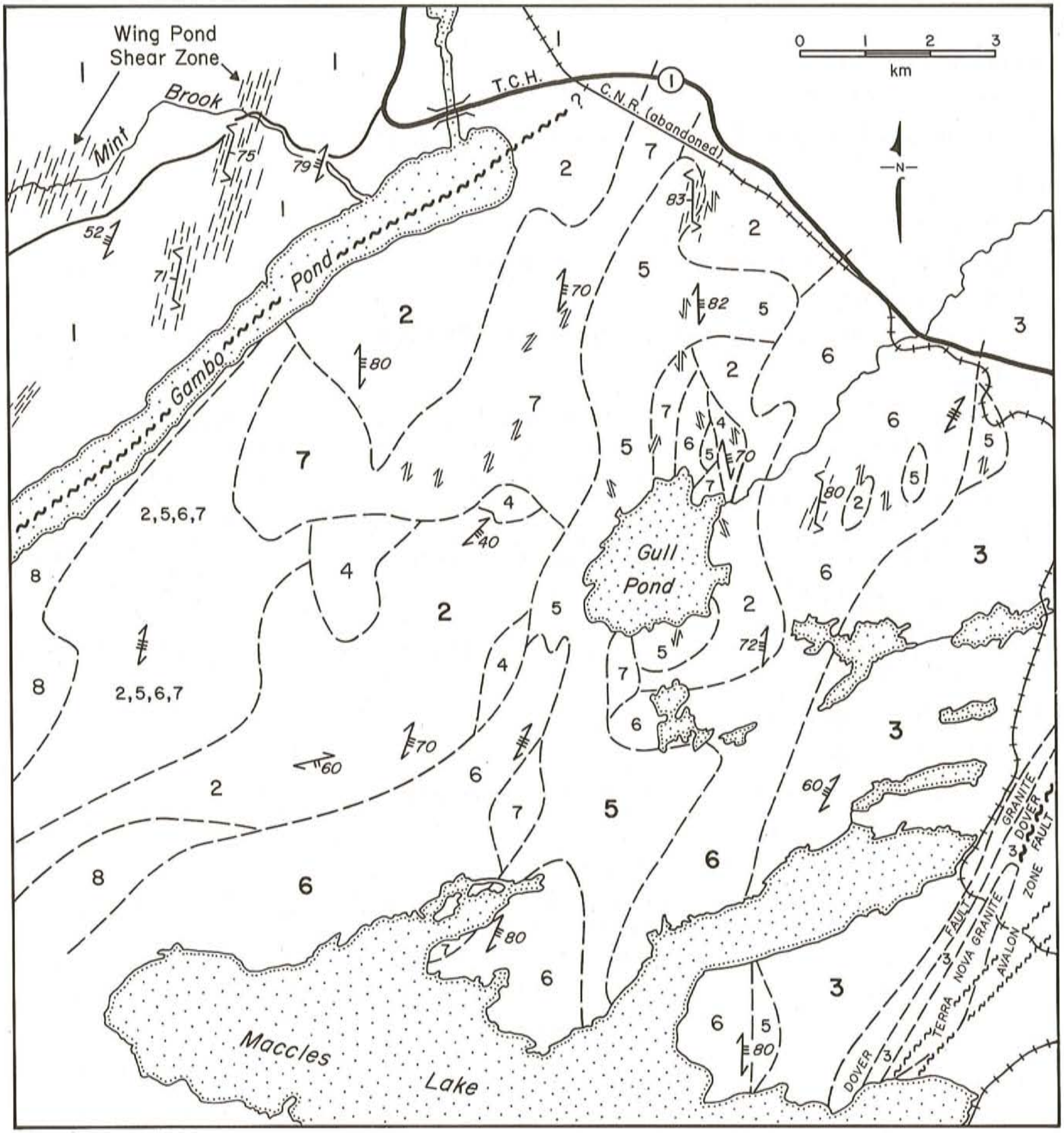

Figure 2. *Detailed geological map of the Gambo Pond–Gull Pond–Maccles Lake area in the Glovertown (NTS 2D/9) map area.*

grey to greyish-green on fresh surfaces. Semipelite and pelite are weathered light-green and are dark greyish-green on fresh surfaces. Quartzitic beds and mafic bodies form a minor component of the formation. Sedimentary features, other than bedding, are generally masked by the pervasive tectonic foliation and metamorphic recrystallization.

The thermal aureole of the Gander Lake Granite is approximately 2 km wide. The hornfels weathers greyish-white and is pitted; fresh surfaces are dark-blue to black and, in the higher grade areas, purplish, because of the biotite content. Fine- to medium-grained andalusite was noted in several localities. Within 2 to 3 km of the Middle Ridge Granite, the rocks of the Jonathan's Pond Formation are fine- to medium-grained and schistose.

Unit 2 includes rock of the Jonathan's Pond Formation east of Gambo Pond, which are generally coarse-grained

LEGEND

SILURO-DEVONIAN

MACCLES LAKE GRANITE

8 *Massive, coarse-grained, K-feldspar megacrystic, biotite granite*

SILURIAN(?)

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6 *Foliated, K-feldspar megacrystic, biotite granite: locally intruded by minor leucogranite (Unit 7); locally contains minor metasedimentary rocks*

5 *Foliated, fine-, medium- and coarse-grained leucogranite; coarse-grained to K-feldspar megacrystic, biotite granite; contains minor unseparated metasedimentary rocks*

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SYMBOLS

Geological contact

Foliation, second deformation (inclined)

Foliation, third deformation (inclined, vertical)

Foliation, high strain (inclined)

Fault

High-strain zone

Shear sense as implied by kinematic indicators in granitoid

schists. Dykes of foliated leucogranite and more rarely, megacrystic granite commonly intrude the metasedimentary rocks. The schists occur predominantly in three areas around Gull Pond (Figure 2) and are separated by granitic units. They commonly contain sillimanite, the only metamorphic index mineral observed in the local area. The sillimanite occurs profusely in the exposures in the southern part of the unit, but was not noted in hand specimen farther north, adjacent to Gambo Pond. Generally, it is more profuse eastward in the pelitic and semipelitic rocks. Sillimanite also occurs north of Gull Pond in metasedimentary rocks, which form a minor component in units dominated by leucocratic and megacrystic granite.

HARE BAY GNEISS (UNIT 3)

The Hare Bay Gneiss occurs in a 2- to 3-km-wide band west of the Dover Fault, which forms the Gander–Avalon zone boundary. In the western half of Unit 3, the gneisses are typically coarse grained and of semipelitic composition. Farther east, they are finer grained, tend to be less gneissic in appearance and are characterized by a straight, higher strain foliation.

FOLIATED GRANITES AND METASEDIMENTARY ROCKS (UNITS 4 TO 7)

Unit 4 consists of equal proportions of foliated granite and metasedimentary rocks. Fine- to medium-grained leucogranite is the predominant granitic rock, and it typically contains a foliation that varies widely in intensity. The metasedimentary rocks are coarse-grained schists similar to those of Unit 2 and they locally contain sillimanite.

Unit 5 comprises fine-, medium- and locally coarse-grained leucogranites, and coarse-grained to megacrystic biotite granites. They occur in an irregular-shaped outcrop area that extends north and south from the west side of Gull Pond. Metasedimentary rock containing coarse-grained biotite and muscovite occurs in minor amounts, generally as xenoliths in the granite; no leucosome was noted. The megacrystic granite is invariably cut by the leucogranite, which locally encloses sharply defined blocks of megacrystic biotite granite, containing some tourmaline.

Near the southwest corner of Gull Pond, a white-weathering, medium- to coarse-grained leucogranite exhibits a flow foliation defined by euhedral prisms of feldspar, 0.5 to 1.5 cm across. The foliation is parallel to the regional deformational fabric. One of several subordinate granitic phases in this exposure contains fine-grained tourmaline, which forms up to 20 percent of the rock. Pegmatite veins are common and cut all granite types.

Unit 6 consists of foliated megacrystic granite and occurs principally in two areas, one east of Gull Pond and the other north of Maccles Lake. Feldspar forms 50 to 60 percent of the rock, including abundant megacrysts up to 3 cm long. Anhedral quartz grains, about 1 cm across, form 20 to 30 percent of the granite, and biotite content varies from approximately 5 to 15 percent. Muscovite occurs in only trace amounts.

Metasedimentary material is included in granite of Unit 6 in some places, and it is generally coarse-grained and psammitic to semipelitic in composition. Sillimanite occurs in these rocks but, perhaps because of the composition, is not common.

Some of the granite in the area east of Gull Pond was previously included in the Lockers Bay Granite, a large elongate body of foliated megacrystic granite, which outcrops immediately to the north of the Glovertown area (Blackwood, 1977). Further detailed mapping and geochronological work is required to substantiate this correlation.

A distinctive, high-strain foliation, mostly defined by ribboned quartz, is present in Unit 6. The intensity of this foliation decreases westward. In areas of lower strain, the granite is not readily distinguishable from the megacrystic Maccles Lake Granite (Unit 8).

Unit 7 is a very well-exposed body of foliated leucogranite, which underlies a 5-km-wide area between Gull Pond and Gambo Pond. The granite, which is typically white-weathering and fine- to medium-grained, contains up to 85 percent quartz and feldspar and approximately 15 percent muscovite. Garnet and biotite, although widespread, occur in small amounts, and the biotite is generally restricted to the medium-grained varieties. Tourmaline is locally abundant in garnetiferous pegmatitic veins, which are ubiquitous within the granite.

Coarse-grained, sillimanite-bearing metasedimentary inclusions form 30 to 40 percent of many leucogranite exposures. One outcrop of a fine- to medium-grained, equigranular granite contains numerous micaceous clots that may contain sillimanite. These centimetre-scale aggregates are elliptical and aligned approximately north—south. They may represent restite material derived from pelitic layers of the Jonathan's Pond Formation. Metasedimentary material in the xenoliths does not show evidence of partial melting but quartzofeldspathic veins are common. Megacrystic granite inclusions form up to 30 percent of leucogranite exposures.

LATE SYN- TO POSTTECTONIC GRANITES (UNITS 8 TO 10)

Maccles Lake Granite (Unit 8)

Massive, homogeneous, coarse-grained to megacrystic granite outcrops between the west end of Maccles Lake and Gambo Pond. This granite, which is best exposed on a brook between Parsons Pond and Gambo Pond, was included in the Maccles Lake granite by Blackwood (1976). The granite is compositionally inhomogeneous but in this area contains only minor amounts of mica and traces of magnetite. Metasedimentary xenoliths are present in a few places. A heterogeneous foliation indicates that the granite is late syn-tectonic.

Middle Ridge Granite (Unit 9)

Exposures of granodiorite along the western edge of the area represent the northeastern termination of the Middle Ridge Granite of Blackwood and Green (1982b). The portion of the pluton mapped in this study corresponds to Unit 10 of these authors. The granodiorite is massive and homogeneous, weathers pink and contains 40 percent (or less) quartz, up to 6 mm across, and up to 60 percent feldspar crystals, 2 cm or less in length. Muscovite forms up to 15 percent of the rock, whereas biotite and tourmaline occur in trace amounts only. The granodiorite is intruded by thin dykes of aplite and pegmatite.

Petrography reveals that most of the feldspar is plagioclase, which is extensively hematized and shows minor sericitization. K-feldspar, which forms about 10 percent of the rock, occurs as slightly hematized crystals up to 3 mm across, and contains inclusions of plagioclase and quartz; it is locally perthitic. All grain boundaries are curved, straight or scalloped. Most of the biotite is chloritized.

Gander Lake Granite (Unit 10)

The Gander Lake Granite underlies the central part of the map area and is very poorly exposed. The granite is massive, and is characterized by abundant K-feldspar megacrysts up to 6 cm in length, in a coarse-grained, quartz–feldspar–biotite matrix. The megacrysts commonly contain small inclusions of biotite. White-weathering feldspars form 60 to 70 percent of the rock and are commonly compositionally zoned. Greyish-blue quartz constitutes approximately 20 percent of the matrix. Outcrops of the granite on the small island on the west side of North Pond contain up to 40 percent modal quartz and are cut by abundant quartz veins. Biotite forms 10 to 15 percent of the granite. Accessory tourmaline is locally concentrated in small patches, 5 to 10 cm across. The contact between the granite and the Gander Group is not exposed in the map area.

METAMORPHISM

Sedimentary rocks of the Gander Group west of Gambo Pond are metamorphosed at chlorite grade. Superimposed on this regional metamorphism are two distinct types of contact metamorphism. Rocks adjacent to the Middle Ridge Granite are schistose and contrast texturally with the andalusite-bearing hornfels that surrounds the Gander Lake Granite.

Between Mason's Pond and the northeastern end of Gambo Pond, the Gander Group and spatially associated igneous rocks are mylonitized within the Wing Pond shear zone (O'Neill, 1991). Gander Group phyllonites within this zone contain sillimanite, kyanite and andalusite.

South of Gambo Pond, pelitic and semipelitic rocks of the Gander Group are coarse grained, schistose and contain sillimanite. The sillimanite commonly forms more than 50 percent of pelitic rocks, and is the sole aluminosilicate mineral noted in this area. Exposures of the Gander Group near the north end of Gambo Pond contain no sillimanite.

DEFORMATION

One principal tectonic foliation is defined throughout much of the Gander Group. This fabric is here designated S_2, so as to conform with fabric description established in the Weir's Pond, Gander Lake and Gambo areas to the north (O'Neill, 1990, 1991). S_2 is a slatey cleavage in pelitic rocks and a solution-seam cleavage in psammites. It generally strikes northeast to north-northeast. East and south of the Gander Lake Granite, the fabric dips moderately to steeply northwest or southeast. Between the Middle Ridge and Gander Lake granites, the foliation dip is moderate to shallow to the northwest, and strikes north-northeast. The foliation is steeper near the contact with the granites.

In places, S_2 is folded by mesoscopic-scale, open to tight F_3 folds that are associated with a crenulation lineation. F_3 fold axes plunge shallowly to the north-northeast or south-southwest.

The most prominent structural feature in Unit 1 of the Jonathan's Pond Formation is the Wing Pond Shear Zone, a high-strain zone that extends at least 40 km northward from the north shore of Gambo Pond to the Weir's Pond map area (O'Neill, 1991). In the study area, the shear zone is best exposed east of Mason's Pond, on Mint Brook (Figure 1). Metasedimentary rocks within the shear zone are medium- to coarse-grained phyllonitic schists, and igneous rocks, ranging in composition from gabbro to granite, have a heterogeneous high-strain foliation. Near the eastern edge of the shear zone in Mint Brook, the regional S_2 fabric of the Gander Group is intensely folded by tight to isoclinal folds of psammite and semipelite. These folds have an axial-planar fabric that parallels the high-strain fabric in the adjacent phyllonites and deformed igneous rocks. This suggests that the high-strain foliation may be correlated with S_3 and that the shear zone is related to the D_3 event. The high-strain fabric is typically steep but the presence of moderate dips in some places implies subsequent open folding. Farther east, near the Trans-Canada Highway, at the north end of Gambo Pond, phyllonitic, chlorite-grade rocks of the shear-zone margin pass eastward into low-strain, low-grade, Gander Group pelite and semipelite.

Schists of the higher grade part of the Jonathan's Pond Formation (Unit 2) southeast of Gambo Pond, typically do not show a well-developed foliation. The originally equigranular nature of the psammitic rocks hindered fabric development, whereas fabrics that did form in pelitic beds have been largely obscured by the subsequent development of sillimanite. These features suggest that metamorphism outlasted deformation.

Southeast of Gambo Pond, a weak- to high-strain foliation is developed in most of the granitic rocks and is parallel to a fabric in adjacent metasedimentary rocks. As the latter is axial planar to F_3 folds of the regional S_2 fabric, the foliation developed in the granitic rocks must be younger than the principal tectonic foliation of the Gander Group. Thus, the regional fabric of the granitic intrusions is designated S_3. The intensity of S_3 rocks ranges from weak in the southwest to mylonitic in the northeast.

Well-foliated, fine- to medium-grained granites commonly exhibit good shear-sense criteria. C–S fabrics, associated shear bands and, more rarely, asymmetrical tails on feldspar megacrysts have been used to define three regional zones with differing senses of shearing. C–S fabrics are best displayed in a several-kilometre-wide area of Unit 7 leucogranite northwest of Gull Pond (Figure 2), where the dextral sense of shear is consistent. Farther east, in a mixed complex of granitic and metasedimentary rocks around Gull Pond, the sense of shear is consistently sinistral. East of Gull Pond, however, the sense of motion implied by C–S fabrics, developed mostly in megacrystic granite, is again consistently dextral.

Weakly deformed pegmatite that commonly cuts the granites and the high-strain foliation, may be used to constrain the upper age limit of the deformation. It will require further detailed structural study, however, to determine the relative timing of dextral and sinistral deformations. More detailed study is also required to establish the timing relationships between the Wing Pond and the Dover Fault shear zones, the latter described elsewhere in this volume (O'Brien and Holdsworth, *this volume*).

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