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GEOLOGY OF THE NORTHEAST GANDER LAKE MAP AREA (NTS 2D/15) AND THE NORTHWEST GAMBO MAP AREA (NTS 2D/16)

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ABSTRACT

The map area is mostly underlain by metasedimentary rocks of the Gander Group. These rocks are bounded to the west by a structural assemblage consisting of lower members of the Davidsville Group and igneous rocks of the Gander River complex. The westernmost part of the Gander Group is defined, on the north shore of Gander Lake, by a thin sequence of black shale, siltstone and grey sandstone, which passes gradationally eastward into the Jonathans Pond formation. In the eastern part of the mapped area, localized exposures of conglomerate, maroon siltstone and laminated black pelite occur along strike with similar rock types of the Indian Bay Big Pond formation, and therefore, have been included in this formation. Metamorphic aureoles have been partially mapped around granitic intrusive rocks in the south and east. East of Benton, on the Trans-Canada Highway, a narrow zone of silicified–sericitized quartzose sandstone, hosts galena and pyrite mineralization in foliation–parallel stringers and veins. Anomalous gold values have been obtained from quartz veins sampled throughout the Gander Group.

INTRODUCTION

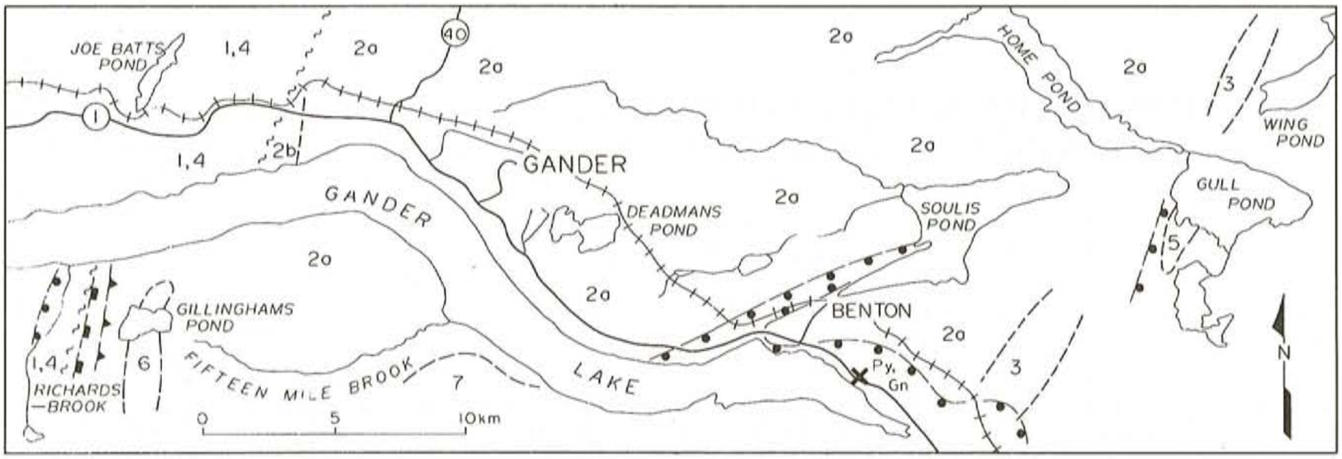
During the 1989 field season, the northeast corner of NTS area 2D/15 (Gander Lake) and the northwest corner of NTS area 2D/16 (northwest Gambo) were mapped at 1:50,000 scale (Figure 1). This project represents a continuation of the mapping of the northeast Gander Zone, initiated in 1986, in the Weir's Pond area (O'Neill, 1987).

Much of the central part of the area is accessible via the Trans Canada Highway (TCH), and Gander Bay Highway and logging roads. The larger lakes, including Gander Lake, Soulis Pond and Home Pond provide access in the east and south of the area. The communities of Gander and Benton are located within the map area.

Physiographically, the region is dominated by a low-lying plateau, which is very flat around Gander but more undulating to the east and west. The flat topography reflects the subhorizontal nature of planar fabrics in the bedrock. Much of the shoreline of Gander Lake is characterized by a rapid change in relief, from about 30 m to approximately 90 to 130 m on the plateau. However, south of Benton the variation in relief is quite gentle, particularly where Soulis Brook enters Gander Lake. This change in relief coincides with a northeast-trending escarpment immediately west of Benton, which strongly controls the trend of Soulis Pond in the south, and may also control its general northeast trend. The topography south of Gander Lake is also characterized by a plateau, dissected by Fifteen Mile Brook and Gillinghams Pond. North of Gander, drainage is poor and marsh and alder swamps are extensive. The natural vegetative cover is spruce, fir and birch, however, much of this has been cut away by logging companies, with virtually no attempt at reforestation. Rock exposure is excellent on the shores of Gander Lake, but varies from very poor, north of Gander to good, east and south of Deadmans Pond. Continuing road-improvement schemes on the TCH, has resulted in several new exposures between Gander and Square Pond.

PREVIOUS WORK

The earliest geological work in the Gander Lake area was carried out by Murray and Howley (1881), who noted that schists on the lake shore resembled slates of presumed Upper Silurian age, near Gander Bay. They assigned the metasedimentary rocks in the Gander Lake area to the Silurian also, but considered the granitoid bodies south and east of the lake to be Precambrian. They also reported a northeastward-trending belt of mafic and ultramafic rocks extending north and south of Gander Lake. (This belt is referred to as the Gander River complex (O'Neill and Blackwood, 1989) in the main body of this report). This belt of igneous rocks was termed the Eastern Serpentine Belt by Snelgrove (1933, 1934), who examined chromite occurrences in the ultramafic rocks. In the early 1940's and again in 1951 and 1952, the Geological Survey of Newfoundland, re-examined the Eastern Serpentine Belt and documented most of the ultramafic bodies north and south of Gander Lake (Jenness, 1954). Twenhofel (1947) correlated the sequence of phyllite, slate and quartzite along Gander Lake, which he termed the Gander Lake Series, with Silurian rocks east of Hamilton Sound; this series was thought to overlie unconformably, metasedimentary rocks farther east. The Gander Lake area was included in one of the earliest regional mapping surveys in northeastern Newfoundland by Baird *et al.* (1951). They disagreed with Twenhofel's (1947) interpretation of the Gander Lake sedimentary rocks as a single series of Silurian age and suggested that the west half of Gander Lake is underlain by Ordovician rocks.



LEGEND

SILURO–DEVONIAN

7 GANDER LAKE GRANITE: *Non-foliated, K-feldspar porphyritic biotite granite*

6 *Equigranular, muscovite ± biotite granite*

5 *Gabbro, biotite granite and hornblende granite*

ORDOVICIAN

DAVIDSVILLE GROUP

4 *Fine- to coarse-grained sandstone, polymictic conglomerate, black, locally graphitic shale and calcareous layers and lenses*

ORDOVICIAN OR OLDER

GANDER GROUP

3 INDIAN BAY BIG POND FORMATION: *Consists of grey to purple, pebble and cobble conglomerate interbedded with grey sandstone, maroon siltstone, interbedded laminated black and greyish-green pelite and dark grey to grey sandstone*

2 JONATHANS POND FORMATION: **2a,** *interbedded psammite and greyish-green pelite, minor quartzite, quartz granule sandstone and mafic intrusive bodies. Metamorphosed to lower amphibolite grade adjacent to granitoid bodies;* **2b,** *interbedded black shale, locally graphitic, dark grey and laminated siltstone and thinly bedded grey to greyish-white sandstone; passes gradationally (eastward) into* **2a**

GANDER RIVER COMPLEX

1 *Pyroxenite–locally serpentinized, talc–carbonate rock, gabbro and mafic volcanic rock*

SYMBOLS

Geological contact (approximate)............ — — —

Fault (inferred)............ ~ ~ ~ ~

Biotite isograd............ —●—

Garnet isograd............ —■—

Andalusite isograd............ —▲—

MINERAL OCCURRENCE

Py = Pyrite

Gn = Galena

Figure 1. *General geology of study area.*

Jenness (1958) proposed the term Gander Lake Group to replace the term Gander Lake Series (Twenhofel, 1947) and he assigned the group a Middle Ordovician age, based on graptolite and brachiopod fauna. Jenness (1963) subdivided the Gander Lake Group into conformable lower, middle and upper units. The middle unit consisted of sedimentary and volcanic rocks and also included mafic and ultramafic plutonic igneous rocks to which Jenness (1958) had earlier assigned the term Gander River Ultrabasic Belt. Jenness (1954, 1958) provided the first detailed descriptions of the ultramafic rocks north of Gander Lake. The Gander Lake Group was later redefined by Kennedy and McGonigal (1972), so that it consisted only of the lower arenaceous unit of Jenness (1963), and the new term, Davidsville Group, was proposed for the fossiliferous middle and upper units. The term Gander Lake Group was amended to Gander Group by McGonigal (1973).

The geology of the area immediately north and south of Gander Lake was the subject of a Masters thesis by McGonigal (1973). He outlined two contrasting geological terranes, the metasedimentary terrane and the sedimentary and volcanic terrane. The metasedimentary rocks consisted mainly of the Gander Group, as well as a 'mixed member' consisting of psammite, calcareous mica schist, graphitic mica schist and impure marble, which was structurally intercalated with components of the Gander River Ultrabasic Belt. The sedimentary terrane comprised members of the Davidsville Group. Kennedy (1975) interpreted a contact between conglomerate of the Davidsville Group and serpentinized ultramafic rock, on the north shore of Gander Lake, as an angular unconformity. Blackwood (1980), working north and south of Gander Lake, included all the igneous rocks in a redefined Gander River Ultrabasic Belt. He excluded the sedimentary rocks structurally intercalated with these igneous rocks south of Gander Lake from the Gander Group, in contrast to McGonigal (1973) who had included them.

South of Gander Lake, the Gander River complex was the focus of exploratory work for base and precious metals, by Hudson's Bay Oil and Gas, who carried out regional mapping (Dean, 1978), reconnaissance airborne and magnetic surveys (Aerodat Limited, 1979), geophysical/geochemical/ geological investigations (Fenton, 1980) and geological mapping and diamond drilling (Fenton, 1981). Hudson's Bay Oil and Gas have since dropped all of the concessions. North of Gander Lake, the Gander River complex and eastern part of the Davidsville Group are the focus of intense exploration for base and precious metals, principally by Noranda Limited and Newfoundland Resources and Mining Company Limited.

REGIONAL RELATIONSHIPS

The Gander Lake map area straddles the boundary between the Dunnage and Gander tectonostratigraphic zones of the Newfoundland Appalachians (Williams *et al.*, 1974). The Gander River complex (O'Neill and Blackwood, 1989) and the Davidsville Group represent the eastern margin of the Exploits Subzone, and the Gander Group represents the Gander Lake Subzone of the Gander Zone (Williams *et al.*, 1988). The Early Ordovician and/or older Gander Group (Kennedy and McGonigal, 1972) underlies much of the central and eastern part of the area, and has been mapped northeastward to the Carmanville (NTS 2E/8) map area (Currie and Pajari, 1977) and southwestward, for 100 km, to the Bay d'Espoir area (Dickson 1987). The Gander Group passes gradationally eastward into amphibolite-facies metasedimentary rocks, and is interpreted to be the protolith of the Hare Bay Gneiss (Blackwood, 1978).

The Gander River complex (the Gander River Ultrabasic Belt of Jenness, 1958 and Blackwood, 1982) is an undated assemblage of ultramafic, mafic and felsic igneous rocks that together with members of the basal division of the Davidsville Group, bounds the Gander Group to the west. The complex extends discontinuously northeastward to the coast and occurs sporadically south of Gander Lake. The contact between the Gander Group and the Gander River complex, is poorly exposed but is locally marked by a fault (Blackwood, 1980). The nature of the relationship between the Gander and Davidsville groups is unresolved (Piasecki, 1988). The Gander River complex is structurally interleaved with the Weir's Pond formation (O'Neill and Blackwood, 1989), the basal division of the Davidsville Group.

The Davidsville Group (Kennedy and McGonigal, 1972) forms the eastern part of the Exploits Subzone. Southward, the group passes along strike into the northeastern parts of the Baie d'Espoir Group (Colman-Sadd, 1980; Dickson, 1987) and northeastward, the group is mappable to the coast (Currie *et al.*, 1980).

GENERAL GEOLOGY

A preliminary mapping of units within the Gander River complex and the basal Davidsville Group (previously mapped by Blackwood, 1980), was carried out for continuity between this project and mapping carried out in 1986 and 1987 (O'Neill, 1987; O'Neill and Knight, 1988) and, to define the westernmost extent of the Gander Group in the map area.

Gander River Complex (Unit 1)

As with all units mapped in the area, the best exposures of the Gander River complex occur on the shores of Gander Lake. On the south shore of Gander Lake, exposures of ultramafic rock consist of talc—carbonate assemblages. These are white-weathering, soft rocks, which locally contain coarse rusty siderite crystals. An exposure gap of 2 m, separates 15 to 20 m of talc—carbonate rocks from the westernmost exposures of sedimentary rocks of the Gander Group. Several outcrops of generally massive gabbro also occur on the south shore of the lake. These are locally pegmatitic and in places display a banding defined by alternating feldspar-rich and feldspar-poor layers.

North of Gander Lake, the Gander River complex is more diverse. Fresh pyroxenite is preserved in some places and is generally massive. Most of the ultramafic rocks are typically altered to serpentine $\pm$ carbonate $\pm$ talc assemblages. The altered rocks are invariably characterized by a steep foliation, which locally occurs in zones several metres thick, separated by less intensely foliated areas. In places, these foliated zones are richly pyritiferous. The intensity of the foliation locally indicates high strain. In one exposure, serpentinized ultramafic rocks are cut by diabase dykes that intruded before a late deformation.

The gabbro is generally massive to moderately foliated, medium- to coarse-grained and locally pegmatitic. Pyroxene-rich zones occur locally and in one exposure, trondhjemite is associated with the gabbro; the trondhjemite is characterized by a high-strain foliation.

Exposures of mafic volcanic rock occur sporadically and are strongly foliated. Chloritization is common and thin epidote and/or carbonate veins are ubiquitous.

In the western part of the area mapped, north of Gander Lake, the approximate trace of the contact between the Gander Group and Gander River complex is marked by a lineament along most of its length. Exposures of the actual contact were not found. South of Gander Lake, there is a significant decrease in volume of outcrop of igneous rocks of the Gander River complex. The approximate trace of the contact has also been displaced westward approximately 6 km (on the shores of Gander Lake). Exposures are small and scattered, partly reflecting the extensive drift cover in the area, south of Gander Lake, and partly reflecting the decrease in outcrop. Air-photo lineaments do not appear to coincide with the contact as mapped in the field.

Gander Group (Units 2 and 3).

Jonathans Pond formation (Unit 2). Most of the area mapped is underlain by arenaceous rocks of subunit 2a of the Jonathans Pond formation. This unit mainly comprises sandstone, siltstone and pelite and has minor mafic sills or dykes. The sandstone is grey-weathering, thin to thick bedded and sedimentary structures are absent or poorly preserved. Grading occurs rarely, where bedding is well defined, and is accentuated by refraction of the foliation. The majority of sandstone beds are fine to medium grained. The sandstones are commonly quartz-rich and in beds characterized by coarse-grained to granule size, angular bluish-grey quartz clasts occur sporadically. The sandstone beds are typically in sharp contact with the finer grained silty or shaley beds. A strong, pervasive, tectonic foliation (Plate 1) has destroyed most of the sedimentary structures in these finer grained beds. Concordant mafic bodies occur throughout the Jonathans Pond formation. On average, they are 1-m thick, but range up to several metres thick. They are especially common in the western part of the formation and form up to 15 to 20 percent of exposures on the southern shore of the lake.

On the north shore of Gander Lake, immediately east of exposures of altered ultramafic rock of the Gander River complex, subunit 2b of the Jonathans Pond formation outcrops over approximately 1.5 km of shoreline. This unit consists predominantly of black, dark grey and minor green shale

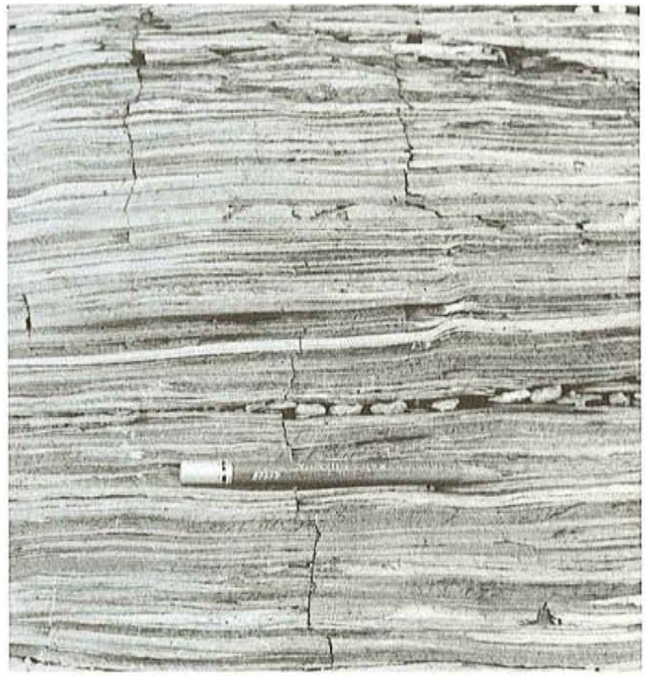


Plate 1. *Principal tectonic foliation (flay-lying here) in the Jonathans Pond formation has obliterated primary sedimentary structures; intrafolial folds are locally discernible.*

interbedded with thinly bedded grey sandstone. The black shale units range up to several tens of metres thick, and contain scattered layers, up to 10-cm thick, of fine grained grey-green sandstone and less commonly 1- to 2-m-thick beds of greyish-white sandstone. Some of these sandstone beds are rusty-weathering. Green siltstone commonly containing laminations, is locally interbedded with black pelite. The rocks of subunit 2b pass gradationally eastward into grey sandstone and grey green pelite of subunit 2a.

Indian Bay Big Pond formation (Unit 3). Approximately 1 and 2 km west of Wing Pond, exposures of red siltstone and conglomerate occur respectively, and are assigned to the Indian Bay Big Pond formation. The exposure of red siltstone is small and the contact relationships with surrounding rocks are unknown.

Clasts in the conglomerate (Plate 2) range from pebble to cobble in size. The pebbly beds, mostly on the western side of the exposure, are predominantly greyish-white weathering, whereas the cobble-rich beds on the eastern side, have a maroon or mottled maroon–white weathering. Cobbles in the conglomerate are well rounded and range up to 20 cm across. In the cobble conglomerate, the matrix appears to consist of the same material as the clasts. Some of the cobbles have thin (5 mm or less) weathering rinds; it is not known if this is a pre-incorporation feature, therefore implying a subaerial depositional environment, or a late (i.e., recent) effect of weathering. On the western side of the exposure, pebbly beds appear to be conformable with quartzose sandstone of the Jonathans Pond formation.

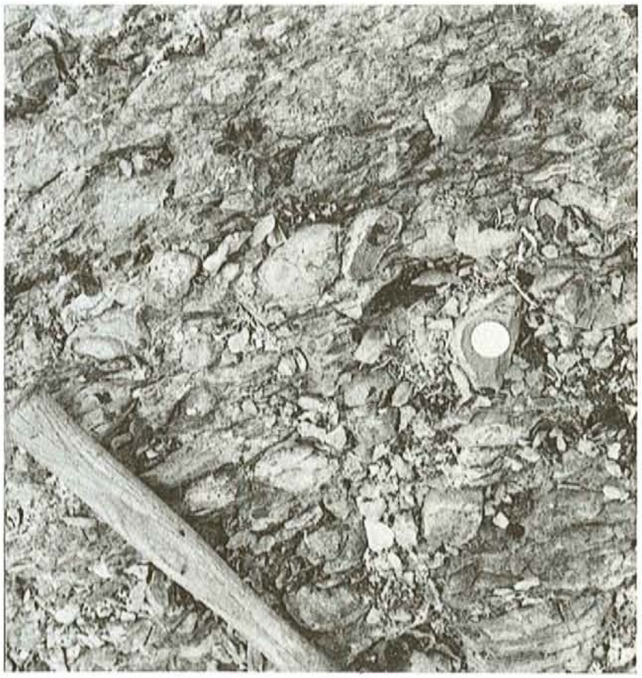


Plate 2. *Conglomerate of the Indian Bay Big Pond formation.*

The clasts mostly consist of fine- to medium-grained psammite and if the most immediate source is the Jonathans Pond formation, then a disconformity should exist between the Jonathans Pond and Indian Bay Big Pond formations. The absence of any evidence of such a disconformity in the exposure, may be a result of transposition associated with the development of the intense penetrative fabrics present. Alternatively, the source of the quartz and feldspar in the Jonathans Pond formation may also be the source for the clasts in the conglomerate of Unit 3.

Four kilometres northeast of the east end of Gander Lake, black pelite occurs in a several-km-wide cross-strike zone. These rocks occur approximately on strike with other units of the Indian Bay Big Pond formation and are also lithologically similar to units of that formation mapped previously (O'Neill and Knight, 1988) near Indian Bay Big Pond. This black pelite unit is therefore included in this formation. The black pelite contains grey to white siltstone–sandstone laminations, generally less than 2-cm thick, and is intercalated with thin- to medium-bedded, greyish-white to dark-grey sandstone. In one locality, black cherty quartz veins, 1- to 35-cm thick, cut thin-bedded, white-weathering psammite and laminated black pelite.

Davidsville Group (Unit 4)

North of Gander Lake, the Davidsville Group comprises fine- to coarse-grained sandstone, conglomerate and black to greyish-green shale. On the southern shore of Gander Lake, the group consists of interbedded black shale (locally graphitic), conglomerate, dark grey, medium- to coarse-grained greenish-grey sandstone, siltstone and brown-weathering sandstone. These sandstones contrast with those of the Gander Group in that they tend to be relatively quartz-poor and lack the regular alternation with pelitic and semipelitic units that is typical of the Jonathans Pond formation. Locally, black shale layers contain 1-cm-thick hornblende- and biotite-rich bands. The black shale passes into thin-bedded, fine- to coarse-grained black layers. The coarse grained layers are characterized by bluish-grey quartz grains, up to 5 mm across, which tend to be dispersed throughout a black silty–sandy matrix. These rocks, which crop out several hundred metres east of the mouth of Richards Brook (Figure 1), contain a very strong foliation, mostly defined by elongation of feldspars but also by elongate quartz. Grey-green, fine- to medium-grained sandstone beds containing biotite and muscovite are interbedded with the black layers. Recessive-weathering, thin (generally less than or equal to 10 cm) calcareous layers and lenses, are interbedded with greenish-grey sandstone in one locality. Thin-bedded calc-silicate or mafic layers are locally abundant and form up to 50 percent of exposure in places. Near the mouth of Richards Brook, 5 to 10 m of a distinctive, pebbly conglomerate containing numerous black shale flakes and white quartz or quartz plus feldspar grains, is interbedded with several tens of metres of black shaly siltstone. The clasts in this rock are intensely flattened. A granular white rock, several metres thick, is exposed in one locality and contains distinctive bright green layers. South of the lake, exposures of the Davidsville Group are scarce and represented by black shale.

The units described above formed the 'mixed member' of McGonigal (1973), which he included in the Gander Group. Blackwood (1980) included these rocks in the Davidsville Group and here they are assigned to the Weir's Pond formation, the basal division of the Davidsville Group (O'Neill and Blackwood, 1989).

Intrusive Rocks (Units 5, 6 and 7)

Unit 5. Included in Unit 5 are gabbro, hornblende granite and biotite granite that crop out near Gull and Wing ponds. The gabbros coincide with a northeast-trending, positive aeromagnetic anomaly. There are two principal exposures of gabbro; these are on the west shore of Wing Pond and the southwest side of Gull Pond. The Wing Pond gabbro is medium- to coarse-grained and is strongly foliated. Locally, granitic veins intrude the gabbro (Plate 3) and these are also foliated.

On the southwest shore and south of Gull Pond, fine- to medium-grained gabbro intrudes amphibolite facies metasedimentary rocks of the Gander Group. Gabbro pegmatite patches occur in places. The gabbro generally displays a foliation that varies from weak to strong. The foliation is commonly defined by elongation of feldspar and hornblende but in one locale, quartz clots were also elongated parallel to the fabric. Relationships between the gabbro and granite are ambiguous; the gabbro contains granite blocks locally and is intruded by granitic veins. Some of these veins are strongly foliated.

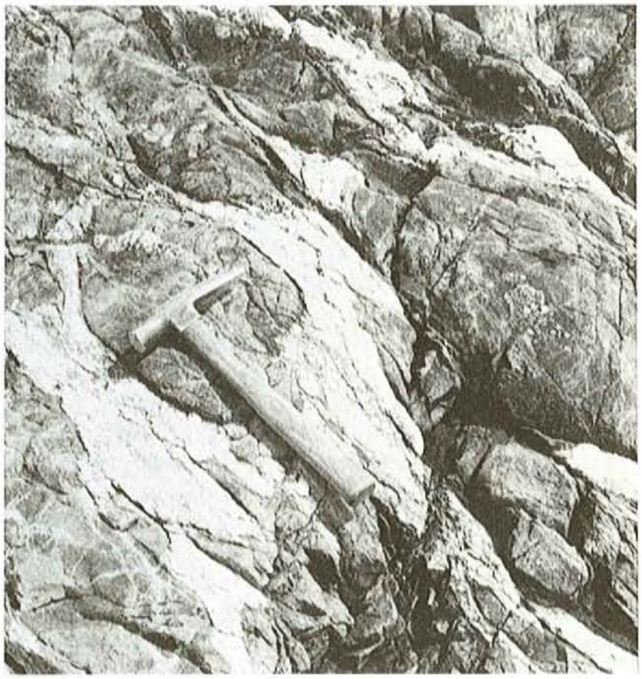


Plate 3. *Medium- to coarse-grained gabbro (Unit 5) intruded by foliated granitic sheets.*

Granitoid rocks exposed on the southwest side of Gull Pond are compositionally varied and include muscovite-bearing, muscovite- and biotite-bearing to hornblende-rich phases. The granitoid rocks locally contain numerous inclusions of metasedimentary rocks. Many of the granitic sheets are parallel to the regional foliation and most contain a foliation. The hornblende granite, which occurs in one outcrop, has a strong foliation.

Unit 6. Unit 6 is an unnamed leucocratic, muscovite granite that outcrops south of Gander Lake, near Gillinghams Pond. No definite exposures occur on the shore of Gander Lake, although there are numerous large boulders of the granite present. Near Gillinghams Pond, there are extensive granite boulder fields having scattered exposures of granite identical to that in the boulders. Locally, northeast of Gillinghams Pond, the approximate contact between metasedimentary rocks and the granite was defined by boulder composition. The granite is white-weathering, equigranular (grains range up to 5 mm across), garnetiferous, muscovite-rich (15 to 20 percent) and apparently unfoliated. Biotite rarely occurs. Pegmatitic and granitic veins, typically 1-m thick or less, intrude metasedimentary rocks on the southern shore of Gander Lake and may be related to the muscovite granite. Some of these veins are foliated.

Unit 7. Unit 7 represents the northernmost extension of the Gander Lake granite, which is exposed in the area mapped. Only one exposure of the granite was noted although boulders of a similar granite are quite common in the area. The granite is characterized by K-feldspar megacrysts that range up to several centimetres long, in a biotite, quartz and feldspar matrix. The granite in the exposure is unfoliated, however, a lineation produced by mica and quartz occurs in some boulders.

METAMORPHISM

Much of the area north of Gander Lake lies in the chlorite zone. South of Gander Lake and west of Soulis Pond, higher grade metamorphism is predominantly caused by granite intrusions.

Kyanite-, sillimanite- and andalusite-bearing schists occur in small exposures on the west shore of Wing Pond, close to the gabbro of Unit 5, and probably represent a continuation of the medium pressure facies-series metamorphism documented immediately northeast (O'Neill and Knight, 1988). Less than 1 km farther west, the rocks are apparently at chlorite grade, implying either a steep metamorphic gradient or a major tectonic break is present. Lack of exposures south of Wing Pond precludes better definition of this zone.

South and east of Gull Pond, the metasedimentary rocks are schistose and coarse grained and intruded by numerous granitic sheets and by the gabbro of Unit 5. Here, the rocks reach amphibolite grade. A biotite isograd (Figure 1) west of Gull Pond, approximately parallels the margin of the Middle Brook Granite. The metamorphism at Gull Pond may be related to this granite.

North of the east end of Gander Lake, rocks of the Gander Group are thermally metamorphosed and are in marked textural contrast with those at Gull Pond. A biotite isograd (Figure 1) parallels the margin of the Gander Lake granite. The metamorphism is apparently a product of the intrusion of the Gander Lake granite.

An anomalous metamorphic culmination occurs on a southeast-facing escarpment, west of Benton. Here, rocks of the Jonathans Pond formation achieve andalusite grade in a 1-km-wide zone that extends northeast from the TCH to Soulis Pond. The rocks are slightly schistose. The metamorphism may be related to an unexposed extension of the Gander Lake granite, although no granitic sheets were noted within the rocks. Alternatively, the metamorphic rocks may have been exposed through uplift along a narrow high-strain zone (*cf.*, Wing Pond high-strain zone, O'Neill and Knight, 1988). The latter would help to explain the marked change in relief across the zone and may be partly responsible for the form of Soulis Pond. However, no high-strain rocks were noted during the field mapping of the area.

On the south side of Gander Lake, most of the metasedimentary rocks of the Gander Group are within the andalusite zone. Between Hunts Cove and Gillinghams Pond, biotite, garnet and andalusite isograds were defined; note that the biotite isograd lies within the Davidsville Group. In the garnet zone, garnets are widespread but not profusely developed. In contrast, andalusite growth is very profuse in the andalusite zone (Plate 4) and crystals range up to 8 cm long and generally lie randomly on the main foliation. The rocks are generally slightly schistose in this zone. Outcrop south of the Gander Lake is poor and the northeastward trend of the biotite, garnet and andalusite isograds shown on Figure 1, is in part interpretive. However, the grade of metamorphism does increase toward the leucocratic, garnetiferous granite (Unit 6), which has been shown by previous authors (McGonigal, 1973; Blackwood, 1980) as a northeast-striking body. The presence of andalusite in most pelitic exposures from north of Gillinghams Pond to Sandy Point, i.e., 9 km from the granite, may imply that this granite has a much greater distribution at depth. Negative aeromagnetic anomalies, which coincide with the actual outcrop pattern of the muscovite granite, also extend northeastward to Bluff Head and east across the plateau, again suggesting that the granite is widespread in the subsurface. Exposure on the plateau south of Bluff Head/Sandy Point is sparse but granite boulders are quite common.

Plate 4. *Andalusite porphyroblasts in mica schist in the aureole of the muscovite garnet granite (Unit 6) south of Gander Lake; Jonathans Pond formation.*

Exposures of metasedimentary rock near the Gander Lake Granite (Unit 7) are rare and definition of the aureole (south of Gander Lake) requires more field work.

DEFORMATION

Gander Group

One principal tectonic foliation is defined in metasedimentary rocks of the Gander Group. This fabric is designated S_2 and conforms therefore with fabric description established in the Weir's Pond area (O'Neill and Knight, 1988) immediately to the north (McGonigal, (1973), also designated the main foliation, in the Gander Lake area, S_2). Immediately east of the contact with the Davidsville Group and the Gander River complex, S_2 in the Gander Group is steep to vertical, strikes north-south to north-northeast and gradually becomes shallower eastward. The S_2 foliation is ubiquitously developed in exposures at Gander Lake (Plate 5), where it is seen to be a composite fabric comprising an almost completely transposed earlier fabric and an axial planar foliation. F_2 folds associated with this axial planar fabric, are isoclinal (Plate 6) and have variably plunging axes where foliation is steep. South of Gander and eastward for approximately 12 km, foliations are gently dipping and shallow to recumbent folds typically plunge northeastward. These folds are the oldest that have been recognized in the area; the fabric that is transposed is bedding and/or an earlier tectonic S_1 foliation. Folds older than F_2 were not found. West of Home and Soulis ponds, the S_2 foliation trends north-south and is generally moderately west-dipping. Southwest of Soulis Pond, S_2 trends northeast and is steeply west-dipping where it is coincident with the metamorphic culmination described above.

Plate 5. *The regional tectonic foliation (flat-lying here) is termed S_2 and is a composite foliation; Jonathans Pond formation.*

Local variations in the attitude of S_2 are a result of overprinting by asymmetrical F_3 folds, which typically have a subhorizontal, northeast plunge.

ECONOMIC GEOLOGY

Table 1 presents a list of the most interesting mineral occurrences found in the map area, during the 1989 field season.

The most significant mineralization found during the 1989 field season, occurs within quartz-rich sandstone of the Gander Group, in a fresh roadcut on the TCH, east of the Benton junction. The mineralized zone is approximately 7-m

Table 1. List of mineral occurrences found in the map area

Sample number	Grid ref.	Map area	Au	Ag	As	SB	W	Mo	Pb	Comments
89-09	668880E 5423920N	2D/15	-	-	49.0	-	2.0	-	-	Pyritiferous sandstone
89-16	668280E 5426120N	2D/15	-	-	22.0	0.8	-	-	-	Pyrite-rich altered ultramafic
89-33	675100E 5423800N	2D/15	140.0	-	3.0	-	10.0	-	-	Pyrite-rich quartz vein (gossan)
89-37	682400E 5419160N	2D/15	92.0	4.7	3.5	0.8	-	-	-	Pyrite-rich quartz vein (gossan)
89-42	685950E 5421500N	2D/16	18.0	-	26.0	1.0	-	46.0	-	Pyrite-rich quartz vein (gossan)
89-58	676520E 5421300N	2D/15	3.0	-	10.0	-	4.5	-	-	Rusty sandstone
89-129	704200E 5429440N	2D/16	43.0	-	48.0	39	5.5	2.0	-	Pyritiferous silicified zones in sandstone
89-144	695840E 5421640N	2D/16	4.7	-	13.0	3.8	4.8	-	-	Rusty quartz veins/sandstone
89-158	662280E 5420380N	2D/15	29.0	-	3.9	-	-	37.0	-	Mafic rock
89-161	662100E 5420320N	2D/15	-	-	51.0	-	-	-	-	Talc-carbonate rock
89-205	687920E 5418180N	2D/16	-	7.5	-	-	3.2	9.0	-	Pyritiferous quartz vein
89-206	688440E 5418020N	2D/16	2.0	-	14.0	1.2	8.7	-	-	Pyritiferous quartz vein
89-210	690500E 5416760N	2D/16	4.1	-	36.0	-	228.0	36.0	-	Pyritiferous quartz vein
89-213	690940E 5416650N	2D/16	41.0	5.2	13.0	6.5	3.8	12.0	2.6	Sericite and silica-rich alteration in psammite; with Py and Gn
89-217	690940E 5416650N	2D/16	34.0	28.0	7.0	41.2	2.4	38.0	15	Galena-rich vein
89-218	690940E 5416650N	2D/16	13.0	-	164.0	1.8	5.7	-	-	Rusty zone in psammite
89-223	691980E 5416050N	2D/16	4.5	-	10.0	-	10.0	6.0	-	Pyrite-rich quartz vein

Au in ppb; Ag, As, Sb, W, No in ppm; Pb in percent.

Plate 6. *The main phase of F_2 folding resulted in isoclinal, locally recumbent folds, best exposed on the shore of Gander Lake; Jonathans Pond formation.*

wide and is characterized by disseminated and vein pyrite and galena. The mineralization appears to postdate development of the main tectonic foliation in the rocks, because it locally follows the solution seam cleavage. Extensive sericitization occurs in places within the rusty zones. A chip sample from this zone (Sample 89-213, Table 1) yielded 41 ppb Au, 5.2 ppm Ag and 2.6 percent Pb. On the east edge of the zone, a galena-rich vein, varying from 2 cm to less than 1-cm thick (Sample 89-217, Table 1), yielded 34 ppb Au, 28 ppm Ag, 41 ppm Sb and 15 percent Pb. This mineralization appears to be concordant with the regional strike, however, no attempt was made to map out the occurrence. The mineralization occurs within the aureole of the Gander Lake granite, but it is unknown whether fluids generated by the granite were important in the mineralizing event.

Many of the quartz veins sampled elsewhere in the Gander Group, also contain anomalous Au concentrations; the best being 140 ppb from a pyritiferous vein. Anomalous As, Ag, Sb, W and Mo values also occur. The best W value was 228 ppm from a pyritiferous quartz vein. Many of these quartz veins are subconcordant to the regional foliation and may have been generated during the regional greenschist facies metamorphic event. Most of the quartz veins sampled were less than 0.5-m thick, but quartz veins up to 6-m thick occur. The anomalous metal concentrations may have been derived by metamorphism-induced fluids leaching metals from the host sedimentary rocks. Quartz veins and locally quartz vein networks are ubiquitous in the Gander Group, occurring in virtually every outcrop (a function of the pervasive greenschist facies metamorphism). The sample survey documented here (not by any means an exhaustive survey of veins) suggests that the potential for significant precious-metal concentration exists within the Gander Group, which is as yet, a relatively unexplored unit. Recently, significant gold discoveries have been made in quartz vein systems in Silurian quartzites in western Ireland (McArdle, 1989).

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NOTE: Geological Survey Branch file numbers are included in square brackets.