TWILLICK BROOK MAP AREA (2D/4), NEWFOUNDLAND

by S.P. Colman-Sadd

INTRODUCTION

During the 1977 field season 1:50,000 scale mapping was completed in most of the west half of the Twillick Brook map area (2D/4). Four days work still remains to be done in the northwest corner of the area where bad weather during September and October prevented access.

The area can be reached by the road running to the North Cut-off Dam from Bay d'Espoir. It is also possible to drive a four-wheel drive vehicle up the Grand Falls transmission line to within 6 km of the north edge of the area. Boats can be launched onto the Long Pond Reservoir from the North Cut-off Dam or from the South Cut-off Dam in the St. Alban's area (1M/13). Round Pond can be reached from Long Pond (Burnt Pond) by a well used 500 m portage trail. North Steady Pond can be reached from the main part of Long Pond by canoe; there are two short portages on the route.

The Twillick Brook area has been previously mapped at 1:250,000 scale by Anderson and Williams (1970); their field work predated the flooding of the Long Pond Reservoir but all the units separated on their map are still exposed. Part of the area around Round Pond was mapped by Slipp (1952) for an M.Sc. thesis at McGill University.

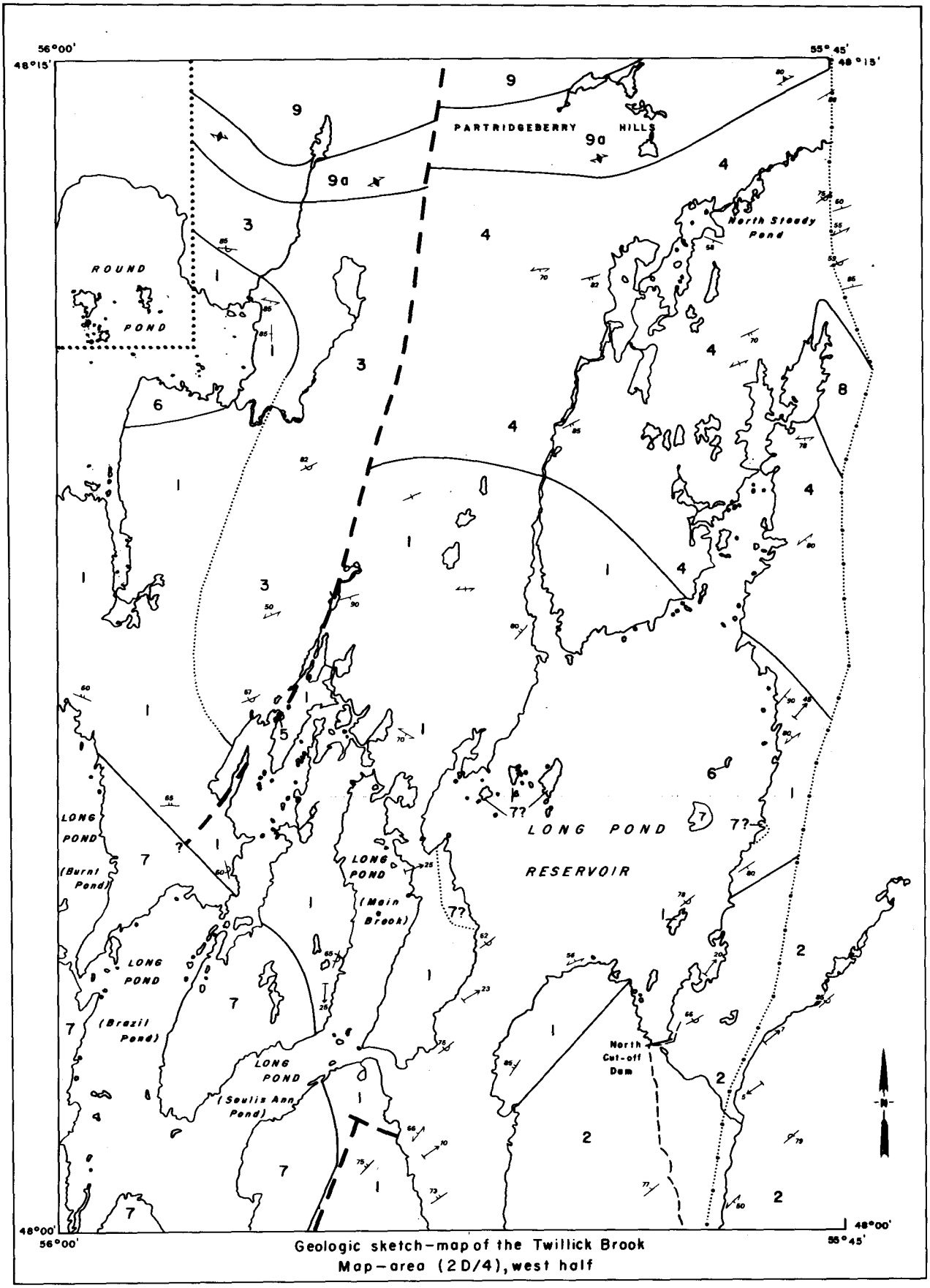
The rocks of the area are divided into two groups: a) sedimentary and volcanic rocks and b) later intrusive rocks. The sedimentary and volcanic rocks are continuous with the Baie d'Espoir Group exposed in the St. Alban's map area (1 M/13) (Colman-Sadd, 1976). They are considered to be Middle Ordovician on the basis of fossil localities at Conne River (Colman-Sadd, 1976) and along strike near Middle Ridge (Anderson and Williams, 1970). The plutonic rocks were all intruded into the Baie d'Espoir Group with the probable exception of a small ultramafic body which appears to have been tectonically emplaced in a fault zone. K-Ar radiometric ages of 406±17 Ma on the biotite phenocryst granite and 342±16 Ma on the North Bay Granite were reported by Anderson and Williams (1970).

BAIE D'ESPOIR GROUP

Rocks of the Baie d'Espoir Group underlie most of the map area. The outcrop is continuous towards the south with rocks already mapped in the St. Alban's map area (1M/13); it is presumed to extend westwards to Cold Spring Pond (12A/1) (Slipp, 1952; Williams, 1970) and northeastwards to Middle Ridge and beyond (Anderson and Williams, 1970).

The Baie d'Espoir Group in the map area is separated into four divisions. Two of these are northward continuations of the already established Salmon River Dam and St. Joseph's Cove Formations (Colman-Sadd, 1976). The other two divisions are only tentative and are left unnamed until their significance is clarified. They consist of clastic and tuffaceous sediments and, although they are separated by a major fault, their only lithologic difference is the presence of conglomerate in the western division. It seems likely that the eastern unnamed division grades laterally southeastwards, with decreasing tuff content, into the St. Joseph's Cove Formation, but this speculation must be confirmed by mapping in the east half of the map area.

As in the Baie d'Espoir Group mapped in the St. Alban's area, the stratigraphic order of the various formations and divisions remains uncertain because isoclinal, soft sediment, first deformation folds make it



LEGEND

MIDDLE ORDOVICIAN OR LATER

9 **PARTRIDGEBERRY HILLS "GRANITE":** 9a *includes sheets of schist.*

8 *Biotite phenocryst granite.*

7 **NORTH BAY GRANITE:** *Biotite equigranular granite, garnetiferous at margins.*

6 *Hornblende gabbro and diorite.*

5 *Ultramafic rock.*

MIDDLE ORDOVICIAN

BAIE D'ESPOIR GROUP

4 *Phyllite and graded tuff beds; minor agglomerate.*

3 *Phyllite, graded tuff beds and conglomerate.*

2 **ST. JOSEPH'S COVE FORMATION:** *Siltstone and pelite; minor sandstone.*

1 **SALMON RIVER DAM FORMATION:** *Siltstone and sandstone; minor pelite and calc-silicate beds.*

SYMBOLS

Geologic boundary (defined or approximate, assumed)

Bedding (tops known; inclined, vertical, overturned)

Bedding (tops unknown; inclined, vertical)

Cleavage or schistosity (S_1 of Baie d'Espoir Group, age uncertain)

Fold axis (F_1 of Baie d'Espoir Group)

Fault (defined or approximate, assumed)

All-weather road

Transmission line

Limit of 1:50,000 mapping

difficult or impossible to determine detailed structure at division contacts. The northeasterly plunge of most minor F_1 folds suggests that the Salmon River Dam Formation, lying to the southwest around the edge of the North Bay Granite, is stratigraphically overlain by the other divisions.

Salmon River Dam Formation (Unit 1)

This formation typically consists of purplish gray micaceous siltstone and sandstone bedded on a scale of 5 cm to 1 m. Cyclic bedding is recognizable in most places. The lowest division in a typical cycle has fine parallel laminae of clean siltstone and darker pelitic siltsone; it forms about 40 percent of the cycle. It is overlain by a massive and generally structureless siltstone forming 50 percent of the cycle, and at the top is a thin parallel and cross laminated fine grained sandstone. The next cycle has a sharp, but not generally erosive, base. At a few localities a thick massive division of graded biotite sandstone occurs beneath the parallel laminated division. Near the southern edge of the map area the siltstone beds are relatively thin (5 to 10 cm); they consist of the parallel laminated divisions, separated by cross laminated fine grained sandstone and beds of calcareous pelite.

Throughout the area the Salmon River Dam Formation is characterized by thin beds containing green amphibole and locally garnet in a fine grained quartzofeldspathic matrix. In most places sedimentary structures, particularly cross-bedding, are visible in the beds; near the contacts of the North Bay Granite, however, the calcsilicate material is not bedded, but instead forms a network of crosscutting veinlets.

St. Joseph's Cove Formation (Unit 2)

Most of the formation consists of thinly interbedded, slightly calcareous, brown siltstone and dark gray pelite. The siltstone beds are generally about 3 to 6 cm thick while the pelite beds are up to 60 cm thick. Typical Bouma (1962) turbidite cycles are recognizable, but most of them contain the upper division only; siltstone beds are cross laminated and pass upwards through a parallel laminated siltstone and pelite division into structureless dark gray pelite. The lower divisions, consisting of parallel laminated brown siltstone and graded, fine grained gray sandstone, do occur but are more commonly absent.

A lens of coarser sedimentary rock occurs southeast of North Cut-off Dam. It consists of fine sandstone and siltstone beds, 20 to 30 cm thick, separated by pelitic beds 2 to 5 cm thick. Turbidite cycles are again recognizable but the lower divisions are thicker than the upper. The lower halves of the sandstone and siltstone beds consist of graded sandstone and the upper halves of parallel and cross laminated siltstone. The thin pelitic division generally has a sharp contact with both the siltstone beneath it and the fine sandstone at the base of the next cycle above it.

Phyllite, graded tuff beds and conglomerate (Unit 3)

The characteristic lithology of Unit 3 is pale green phyllite with white weathering silty beds 1 mm to 1 cm thick. The silty beds have a fine parallel and cross lamination, and may have erosional bases with load casts developed. Included in the phyllite, particularly in the northern part of the area, are graded beds of acidic crystal tuff. The beds range from 5 cm to 1 m in thickness, and grain size rarely exceeds 3 mm; lapilli occur in some of the thicker beds. The tuff beds are generally slightly calcareous.

Southeast of Round Pond two exposures of conglomerate have been found and it is on the basis of these that Unit 3 has been tentatively separated from Unit 4. The conglomerate is interbedded on a 30 cm to a 2 m scale with graded tuff beds. It is polymict with clasts consisting of argillite, siltstone, psammite, vein quartz, chert, and acidic volcanic fragments in decreasing order of abundance. The clasts, with the exception of the vein quartz, which is well rounded, are angular to subrounded and oblate or bladed; they form an intact framework and range in size from 2 mm to 15 cm. The long axes of the clasts lie in the plane of the bedding but have no linear preferred orientation. The matrix consists of gray calcareous siltstone; sparry calcite fills fractures and voids.

Phyllite, graded tuff beds, minor agglomerate (Unit 4)

The phyllite and graded tuff beds of Unit 4 are similar to those described from Unit 3. They are excellently exposed on the Grand Falls transmission line north of Long Pond. The tuff beds become more common northwards towards the Partridgeberry Hills, while southwards around Long Pond there is an increasing number of brown weathering, cross laminated siltstone beds similar to those in the turbidites of the St. Joseph's Cove Formation.

A single exposure of probable agglomerate occurs just south of the Partridgeberry Hills and adjacent to the major north-northeast trending fault.

Structural Geology

There have been two regional deformations of the Baie d'Espoir Group within the map area. The first deformation (D_1) was apparently of equal intensity everywhere. It caused isoclinal folding which is readily observable in the St. Joseph's Cove Formation southeast of the North Cut-off Dam and can be inferred on the transmission line north of Long Pond from repeatedly reversed younging directions. Associated with the folding is a penetrative cleavage which, except on fold hinges, is subparallel to bedding. On fold hinges the more competent beds have been dismembered during deformation; the fragments have smooth outlines, are elongated in the plane of the cleavage, and in some cases have been injected along it; within the fragments, sedimentary laminae show contorted folding. It is concluded that the sediments were unconsolidated at the time of the first deformation.

Structures attributed to the second deformation are inconsistently developed throughout the area. They are most intense south and east of North Cut-off Dam and around the margins of the Partridgeberry Hills "Granite", although it is not absolutely certain that the structures developed in these two parts of the area are in fact correlative. In the south open crenulations and a crenulation lineation are present in rocks of the St. Joseph's Cove Formation and there is a related strain-slip cleavage in pelitic beds. The cleavage is strongly refracted, so that in detail the dip varies greatly between beds; the overall dip, however, is nearly horizontal. These structures are continuous with second deformation structures described from the St. Alban's area (Colman-Sadd, 1976) and become more intense southwards. Northwards they fade out, partly because of a decrease in intensity and partly because the massive sandstone and siltstone of the Salmon River Dam Formation is less susceptible to deformation.

In the northern part of the area second deformation structures are well developed in rocks of Unit 4 and to a lesser extent in those of Unit 3. Around the edge of the Partridgeberry Hills "Granite", close or open mesocopic folds are formed with an associated strain-slip cleavage. Folds are absent more than 5 km from the granite but the cleavage is still faintly visible in pelitic beds. The cleavage and the axial planes of folds dip southwards immediately adjacent to the granite but flatten out about 3 km south of it, and farther south assume a consistent northward dip of about 45°

A major fault cuts and offsets the units of the Baie d'Espoir Group south and east of Round Pond, and is inferred to offset the Partridgeberry Hills "Granite"; its relationship to the North Bay Granite is uncertain. The fault zone is exposed at the north end of Long Pond (Brazil Pond) where a breccia of sandstone and pelite fragments occurs. The breccia is intruded by a pale gray cherty rock which is also intensely fractured; a small ultramafic body outcrops nearby. Inland, farther north, the line of the fault is marked by a series of exposures of Salmon River Dam Formation forming what may once have been a westward facing fault scarp; the former relief has since been levelled by glacial erosion and deposition.

Metamorphism

The Baie d'Espoir Group has been subjected to low grade regional metamorphism throughout the area. The cleavage formed during the first deformation has a phyllitic sheen in most places, probably indicating mimetic growth of muscovite and chlorite. Biotite flakes are also recognizable in many of the sediments but microscope work will be required to determine whether they are of clastic or metamorphic origin. The calcsilicate beds in the Salmon River Dam Formation contain green amphibole which, by analogy with similar rocks in the St. Alban's area, is probably tremolite.

Higher grade metamorphism has affected the Salmon River Dam Formation around the edges of the North Bay Granite. The calcsilicate beds contain garnet and have been mobilized into a network of crosscutting veins. Amphibole and a skeletal blue mineral (possibly andalusite) are found in the sandstone and siltstone.

INTRUSIVE ROCKS

Five groups of intrusive igneous rocks occur in the area. They were all emplaced after the first deformation of the Baie d'Espoir Group, but their relative ages are unknown since they do not intrude each other anywhere. Also, a single granitic pegmatite dike intrudes the gabbro in the middle of Long Pond.

Ultramafic rock (Unit 5)

A single body of ultramafic rock occurs on the major fault line at the north end of Long Pond (Brazil Pond). The exposure is only about 2 m across and the *in situ* position of the rock is not absolutely certain. It is brecciated and silicified and crosscut by numerous quartz veins. Black, euhedral crystals of chromite are scattered throughout and relict olivine or pyroxene phenocrysts show an alignment that predated brecciation.

Gabbro and diorite (Unit 6)

Gabbro forms a small island in the eastern part of Long Pond, and gabbro grading into diorite and quartz diorite occurs on the southeast shore of Round Pond. Typically the gabbro consists of plagioclase (40 to 50 percent), hornblende (20 percent), and biotite (20 percent); relict pyroxene crystals, apparently altering to hornblende, were observed at Round Pond, and inland from that locality the rock contains substantial amounts of quartz and may be a quartz diorite. A linear fabric occurs locally at Round Pond but otherwise there is no indication of deformation.

North Bay granite (Unit 7)

This granite outcrops in the southwest corner of the map area; a related stock forms an island in the eastern part of Long Pond. The outcrop area of this stock is inferred to extend to other islands and to the eastern shore of the pond on the evidence of boulder distributions, and metamorphism and dike emplacement in neighboring country rocks. The typical granite is fine to medium grained and equigranular; it consists of quartz (30 percent), white feldspar (50 percent) and biotite (10 percent). In the southwestern outcrop, the granite contain euhedral, equidimensional potassium feldspar phenocrysts up to 4 cm across. Aplite and pegmatite dikes cut both the granite and country rock near its margins; they contain muscovite, garnet and tourmaline. There is no measurable tectonic fabric anywhere in the granite outcrops.

Biotite phenocryst granite(Unit 8)

This granite is well exposed at the northeast end of Long Pond; boulder distributions indicate that it may extend southeastward across the Grand Falls transmission line. It consists of an equigranular fine to medium grained matrix of white quartz and feldspar with phenocrysts of biotite 3 to 5 mm across. In a few places the biotite grains are aligned but generally there is no preferred orientation.

Partridgeberry Hills "granite" (Units 9, 9a)

This "granite" forms the Partridgeberry Hills along the north edge of the map area. It consists of quartz (20 to 30 percent), white feldspar (50 to 70 percent), muscovite and chloritized biotite (less than 10 percent); a more precise classification of rock type awaits the determination of the feldspar. The rock is medium to coarse grained and generally equigranular, although there are some euhedral phenocrysts of potassium feldspar between 2 and 3 cm long. A 2 to 3 km wide zone around the edge of the granite consists of anastomosing schistose foliae of country rock in a fine grained granitic matrix; the granite itself appears to be undeformed.

MINERALIZATION

No mineral occurrences are yet known in the map area.

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