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GEOLOGY OF THE SOUTHERN PORTION OF THE BOTWOOD MAP AREA (NTS 2E/3), NORTH-CENTRAL NEWFOUNDLAND

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ABSTRACT

The southern portion of the Botwood map area (NTS 2E/3) lies within the Exploits Subzone of the Dunnage Zone. Most of the major units are Silurian or younger based on paleontological or geochronologic data. The dominant unit is the gabbroic northern portion of the Mount Peyton intrusive suite, which has been dated at about 420 Ma (Ar–Ar hornblende). The gabbro has intruded and metamorphosed the turbidite–shelf sequence, which forms a wide belt around the gabbro. The strata contain a variety of fossils that indicate a Llandoverian age. These Llandoverian strata are tentatively correlated with the upper portion of the Point Leamington Formation and the Goldson Group. The Botwood Group is in probable thrust contact with these units and forms an arcuate belt that extends across most of the northern half of the map area. The Lawrenceton Formation is the lower unit of the Botwood Group and is dominated by a variety of terrestrial mafic volcanic rocks and lesser intermediate and felsic volcanic rocks and sedimentary rocks. The Lawrenceton Formation is stratigraphically overlain by the Wigwam Formation, also of terrestrial origin, which contains a lower unit of green and grey sandstone overlain by a sequence of thick-bedded, red sandstone. Fossils within the red sandstone indicate a Ludlovian to Gedinnian age. In the northwest corner of the map area, Middle Ordovician mafic agglomerate of the Wild Bight Group has been intruded by gabbro and granodiorite of the possibly Silurian Hodges Hill intrusive suite. These two units are juxtaposed with the Botwood Group along the northeast-trending Northern Arm fault.

Extensive deformation of the Point Leamington Formation and the Botwood Group has produced numerous southwest- or northeast-plunging folds and a variably developed steeply dipping cleavage. North-directed thrusting has affected all the Silurian strata. Regional metamorphism is in the lower greenschist facies. However, contact metamorphism around the Mount Peyton intrusive suite has resulted in extensive migmatization of the Point Leamington Formation greywacke and widespread development of biotite porphyroblasts and hornfels.

Potentially significant mineralization is exposed along Jumpers Brook, where extensive arsenopyrite–pyrite–carbonate alteration occurs along the highly deformed, thrust contact between the Point Leamington and the Lawrencton formations. This alteration may be related to known gold mineralization in float, located to the southwest of Jumpers Brook.

INTRODUCTION

The Botwood Group overlies the Exploits Subzone of the Dunnage Zone (Williams *et al.*, 1988). The map area is dominated by the northern termination of the post-kinematic Silurian Mount Peyton intrusive suite (Blackwood, 1982) that has intruded the folded and cleaved, fossiliferous Silurian greywacke assigned to the Point Leamington Formation. Most of the remaining part of the map area is underlain by sandstone and volcanic rocks of the Botwood Group.

The area covered in this report extends from the southern edge of the Botwood map area (NTS 2E/3) north to the latitude of Botwood. That portion of the map area bounded by the Bay of Exploits and Route 340 (to Lewisporte; see Figure 1) is described by Colman-Sadd (*this volume*) and the northeastern and northwestern portions were mapped (B.H. O'Brien, personal communication, 1994). Further information on the paleontology in the area is presented by Boyce and Ash (*this volume*).

The Botwood map area (NTS 2E/3; Dickson and Colman-Sadd, 1993) is located in north-central Newfoundland and contains the towns of Bishop's Falls, Botwood, Lewisporte and Norris Arm and the communities of Norris Arm North (formerly Alderburn) and Peterview. The Trans-Canada Highway (TCH; Route 1) traverses the map area and bypasses Norris Arm and Bishop's Falls. All the communities may be

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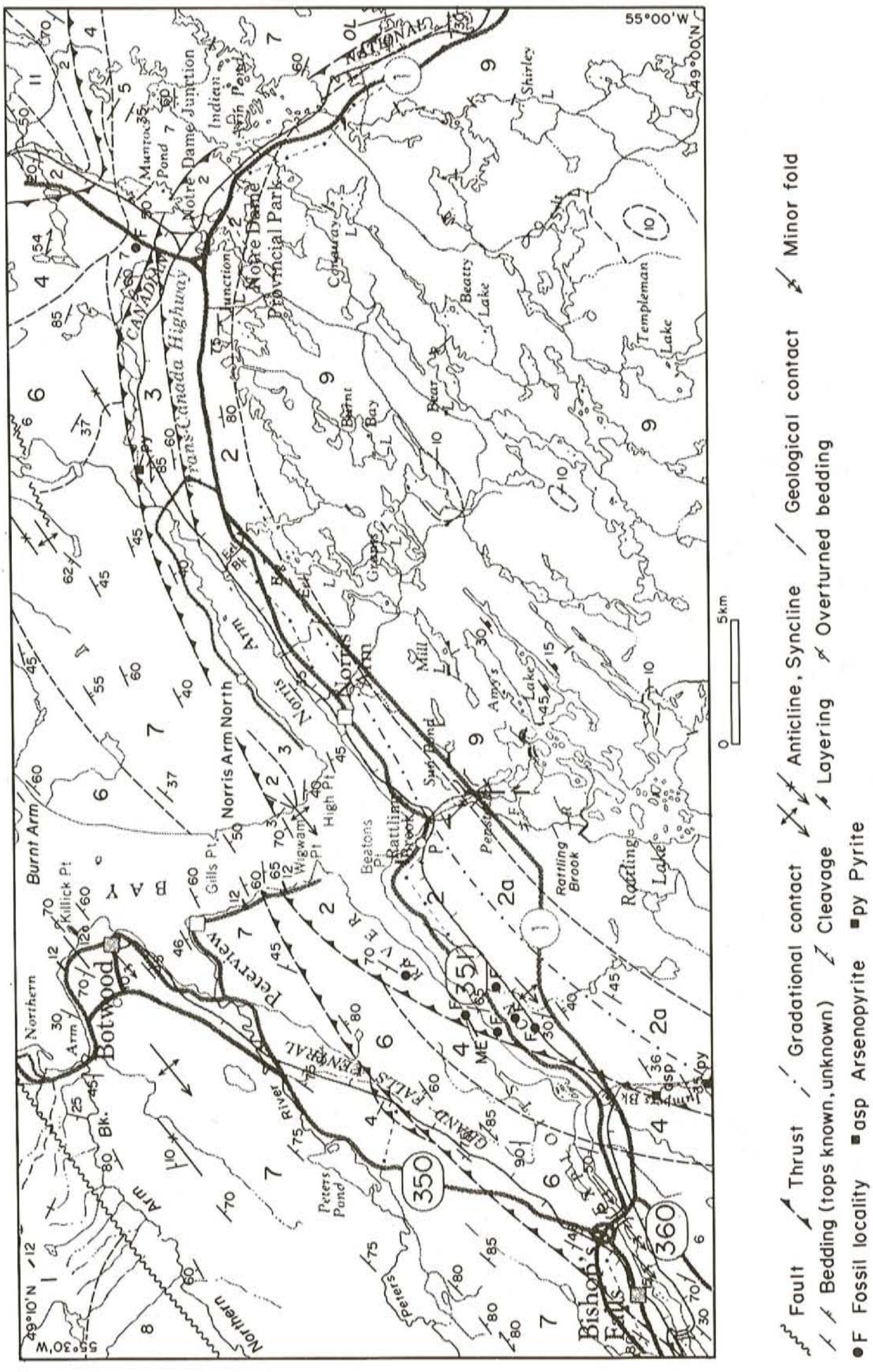
Fault
Thrust
Gradational contact
Geological contact
Bedding (tops known, unknown)
Cleavage
Anticline, Syncline
Layering
Overturned bedding
Minor fold
● F Fossil locality
■ asp Arsenopyrite
■ py Pyrite
ME Martin Eddy Point
OL O'Brien Lake
0
5km
55°00'W
49°00'N
49°10'N
55°30'W
Botwood
Bishop's Falls
Norris Arm
Norris Arm North
Notre Dame Junction
Notre Dame Provincial Park
Trans-Canada Highway
CANADIAN NATIONAL
Burnt Arm
Northern Arm
Killick Pt
Gills Pt
Wigwam Pt
High Pt
Beatons Pt
Rattling Brook
Rattling Lake
Peterview
Peters Pond
Amy's Lake
Mill L
Burnt Bay L
Bear L
Beatty Lake
Templeman Lake
Shirley L
Indian Pond
Munroe's Pond
BAY
350
351
360
1

LEGEND

SILURIAN OR YOUNGER

12 *Massive, diabase dykes;* **12a,** *composite diabase dykes*

SOUTHWEST BROOK GRANITE

11 *Massive, alaskitic, biotite granite and minor granodiorite*

LLANDOVERY OR YOUNGER

MOUNT PEYTON INTRUSIVE SUITE (Units 9 and 10)

10 *Pink and cream, massive, medium- and fine-grained, equigranular, biotite ± hornblende granite*

9 *Grey, massive, dominantly fine-grained, equigranular, pyroxene ± biotite ± hornblende gabbro; minor layered gabbro*

HODGES HILL INTRUSIVE SUITE

8 *Grey and buff, massive, medium-grained, biotite ± hornblende gabbro and hornblende–biotite granodiorite*

SILURIAN

WENLOCK OR YOUNGER

BOTWOOD GROUP (Units 4 to 7)

Wigwam Formation (Units 6 and 7)

7 *Red, thick-bedded, variably cleaved sandstone*

6 *Green-grey, medium-bedded, cleaved sandstone and minor felsic volcanic-clast conglomerate*

Lawrenceton Formation (Units 4 and 5)

5 *Red, laharic breccia of felsic volcanic rocks, felsic-clast conglomerate and felsic tuff*

4 *Grey basalt, including plagioclase-porphyritic, amygdaloidal and massive flows and felsic tuff; minor red sandstone*

LLANDOVERY

GOLDSON GROUP AND EQUIVALENTS

3 *Green, grey and minor red, very thick-bedded to medium-bedded, cleaved, pebble conglomerate containing abundant chert and volcanic clasts and locally fossiliferous limestone clasts and interbedded with coarse-grained sandstone and minor siltstone*

LATE ORDOVICIAN AND EARLY SILURIAN

ASHGILL TO LLANDOVERY

Point Leamington Formation

2 *Grey and green, medium- and thin-bedded, cleaved, locally fossiliferous greywacke, siltstone and conglomerate;* **2a,** *black hornfels and contact migmatite*

MIDDLE ORDOVICIAN

WILD BIGHT GROUP

1 *Grey, fine-grained, basalt breccia and pillow breccia; minor felsic tuff*

Figure 1. *Geology of the southern portion of the Botwood map area (NTS 2E/3).*

reached by paved road. The Bay d'Espoir Highway (Route 360) joins the TCH near Bishop's Falls. Much of the interior may be reached by old woods roads. The Exploits River flows into the Bay of Exploits south of Peterview. Hydro-electric generating stations are located on the Exploits River at Bishop's Falls and at Norris Arm. Most of the map area has been logged for pulpwood over the last 50 years and commercial logging is currently under way southwest, west and east of Peters Pond and west of Jumpers Brook. Minor cutting for sawlogs and firewood occurs throughout the area. Much of the area is covered by second-generation forest and sizeable timber occurs only in the southeastern portion of the map area where selective cutting occurred over 30 years ago. (Helicopter support is available from Canadian Helicopters at Glenwood and Universal Helicopters at Gander; small planes may be hired at Gander and the Botwood Airstrip.)

Most of the area south of the TCH forms the northern portion of an oval-shaped, undulating, high plateau. In the map area, the western half of the plateau is rugged containing northeast-trending, flat-topped ridges along with small, elongate lakes and shallow brooks. The plateau slopes gently to the north but drops off abruptly near the TCH. The highest elevations are found south of Sylt Lake, in the southern portion of the area, where a few hills are over 330 m (1100 ft) high. Hilltops in the dissected plateau range in height from 150 m (500 ft) to about 240 m (800 ft). The valleys generally have elevations above 100 m (330 ft). A thin veneer of till covers the ridges and the valleys contain thicker deposits of till. Rattling Lake is the largest lake and was enlarged by damming Rattling Brook and flooding into Amy's Lake. Due to fluctuations in water levels, soil erosion along the valley sides and islands has produced nearly 100 percent exposure (particularly when the water level is low).

The area northwest of the Exploits River and Norris Arm is a low undulating plane, dominated by northeast-trending ridges. Glacial deposits are generally much thicker in this area and natural outcrop is found mainly along the tops of the ridges and the coastline. Several very large eskers occur along the Peters River valley. A 3-km-wide glacial outwash terrace with an elevation of approximately 12 m (40 ft) extends along the Exploits River valley from Peterview to Bishop's Falls. This terrace is also exposed on the east side of the Bay of Exploits and extends northward to Laurenceton. Extensive peat deposits and marshes occur on this terrace.

The valley east of Norris Arm and the area around Indian Arm Pond contain thick deposits of glacial till and extensive peat bogs and marshes. Extensive outwash deposits of sand and gravel occur 6 km south of Lewisporte. The plateau north of Norris Arm is covered by a thin veneer of till and bedrock exposure in this smooth terrain is most abundant along the woods roads.

PREVIOUS WORK

The earliest geological work in the map area was carried out in 1871 by Alexander Murray and J.P. Howley (Murray and Howley, 1881). They described the locally crossbedded sandstone and conglomerate at Peterview and Norris Arm, fossiliferous conglomerates at 'Martin Eddy Point' (see Figure 1) and on the opposite shore of the Exploits River, 'trap rock' further upstream, and the highly folded sandstone and slate along the river to Bishop's Falls. They noted that the fossils at Martin Eddy Point were identical to those at Goldson's Sound and included various corals, crinoids, brachiopods and a trilobite. These fossils were identified by Billings of the Geological Survey of Canada and indicated a Llandoverian age for the rocks.

Twenhofel and Shrock (1937) and Shrock and Twenhofel (1939) described the local stratigraphy, structure and the various fossil localities in Notre Dame Bay and Bay of Exploits. The Martin Eddy Point locality of Murray and Howley was examined in detail and a comprehensive list of fossils from the conglomerate and descriptions were presented. The term 'Botwood formation' was introduced by Twenhofel and Shrock (1937) for the sandstones exposed between Peters Arm and Wigwam Point. Based on the structure of this section, they concluded that the fossiliferous conglomerates at Martin Eddy Point overlie the Botwood formation sandstones. The fossils indicated a middle Llandovery age for the conglomerates. Twenhofel (1947) subsequently proposed that the conglomerates were probably Devonian because all the fossils were found in clasts derived from Silurian strata.

Kalliokoski (1953) carried out a regional survey of the mineral potential of the Bay of Exploits region. The area south of Norris Arm was the only part of map area NTS 2E/3 covered in this survey. The presence of hornfels and plagioclase–hornblende–biotite gneiss was noted from the Norris Arm area, and the Exploits River and upper reaches of the Bay of Exploits were shown as red Devonian sandstone.

Williams (1962) produced the first 1:250 000-scale regional map of the map area (NTS 2E, west half). This map indicated the distribution of the main components of the region. The extensive gabbro south of Norris Arm was outlined. The term Botwood Group was introduced and included the Goldson Formation conglomerates of Twenhofel and Shrock (1937). The Botwood Group was noted to contain a lower sequence of mafic volcanic rocks overlain by the sedimentary strata. Grey shale and argillite at Norris Arm and fossiliferous, grey shale, south of the Exploits River, both outcropping south of the Goldson Formation, were added to the Botwood Group. The fossils from the Exploits River shale indicated a Middle Silurian age. The presence of Ordovician strata in the Northern Arm and Lewisporte areas was also shown.

Kay (1969) elevated the Goldson Formation to Goldson Group, thus removing it from the Botwood Group.

Williams (1972) revised the stratigraphy of the Botwood Group and introduced the terms Lawrenceton and Wigwam formations. The basal unit was still the Goldson Formation, which was overlain by volcanic rocks of the Lawrenceton Formation and the Wigwam Formation sandstones, which form the upper unit. The fossiliferous conglomerate and interbedded argillite at Martin Eddy Point were included in the Wigwam Formation. The gabbro intrusion south of Norris Arm was named the Mount Peyton Batholith (subsequently informally renamed 'Mount Peyton intrusive suite' by Blackwood, 1982). Dean (1977) produced a 1:63 360-scale map of the NTS 2E/3 map area that showed only minor changes from Williams (1972), in a compilation of the Notre Dame Bay region. The Goldson Formation was again removed from the Botwood Group.

O'Brien (1993) introduced new concepts to the stratigraphy and tectonic evolution of the Bay of Exploits region. Within the Botwood map area (NTS 2E/3), major thrusts were shown, along which the Early Silurian Botwood Group was juxtaposed with Late Ordovician to Early Silurian strata. Extensive polyphase folding was indicated in both the Botwood Group and the older units. The Goldson Group was informally renamed 'Lewisporte Conglomerate'. The grey sandstones were informally assigned to the 'Campbellton Greywacke' and also removed from the Botwood Group as proposed in several reports on other areas. These changes also removed all known fossil localities from the Botwood Group. (Work by Williams (1993) also took fossiliferous strata near Glenwood from the Botwood Group and reassigned them to the Indian Islands Group.)

Boyce *et al.* (1993) compiled and discussed the published faunal lists of previous workers in the Norris Arm area. The Jumpers Brook locality of Williams (1972) was determined to be probably Llandovery C_1 to C_2 in age, but possibly as young as Llandovery C_5, and the Martin Eddy Point fauna of Twenhofel and Shrock (1937) and Williams (1972) was determined as Llandovery C_3 to C_5.

Strong *et al.* (1974) reported on the regional geochemistry of the Mount Peyton intrusive suite. Its bimodal gabbro–granite composition was reflected in the chemistry, which indicated a clear separation in SiO_2 values. Strong (1979) and Strong and Dupuy (1982) further proposed that the gabbro was derived from the mantle and the granite, by partial melting of continental crust due to heating by the intruding gabbro.

The aeromagnetic map for the Botwood map area (Geological Survey of Canada, 1969) indicates a major magnetic high along the northern contact of the gabbro of the Mount Peyton intrusive suite. Another high coincides with the mafic volcanic rocks of the Exploits Group west of Northern Arm. A wide magnetic high outlines the mafic volcanic rocks east of Laurenceton. Smaller anomalies coincide with outcrops of Lawrenceton Formation volcanic rocks on the Exploits River and east of Peters Pond.

Lapointe (1979) and Reynolds *et al.* (1981) carried out paleomagnetic studies of the Mount Peyton intrusive suite and the adjacent formations of the Botwood Group. Their results indicated that the poles for the granite and gabbro do not match the stable North American poles at 400 Ma. Furthermore, the gabbro pole did not match the granite pole. The difference in their positions was interpreted to be possibly the result of remagnetization at some unknown time.

The Botwood map area was covered by a combined airborne gamma-ray spectrometric, VLF, and magnetic survey in 1987 (Geological Survey of Canada, 1989). No significant radiometric anomalies are apparent.

Miller and Thakwalakwa (1992) modelled the entire Mount Peyton Batholith using gravity, magnetic and lake-sediment geochemical data. From the available geophysical data, a model was proposed comprising a number of inward-dipping blocks extending downward for 5 km.

Tomlin (1982) examined various gabbro outcrops of the Mount Peyton intrusive suite along the Trans-Canada Highway near Rattling Brook and at Rattling Lake to determine their potential for dimension stone. All material examined was considered to be of excellent quality for dimension or monument stone. In recent years, much of the northern portion of the Mount Peyton intrusive suite was staked under the Quarry Materials Regulations of 1977 and consequently submission of reports was not required. However, Reuben Stone Limited (1992a,b) have briefly described a potential dimension-stone site 2 km north of Rattling Lake and at Shirley Lake. The site is adjacent to Goulding's Spillway, which is an overflow channel for the reservoir system. From this site, rough blocks and rubble were obtained for use in nearby dam construction. The gabbro quarry at this site forms part of a 500-m-long, 250-m-wide ridge with a height of 15 to 25 m. A brief description of the fine-grained gabbro east of Shirley Lake is given in Reuben Stone Limited (1992b).

Kirby and Ricketts (1983) indicated the aggregate potential along highway corridors in the Botwood map area (NTS 2/E). The surficial geology of the area was first outlined by Kirby *et al.* (1988). Bragg (1990) carried out a reconnaissance assessment of the bedrock-aggregate quarries and rockcuts in most of the Botwood map area (NTS 2/E). The Wigwam Formation of the Botwood Group and the Mount Peyton intrusive suite are considered to contain aggregate of generally high quality. Ricketts and McGrath (1991) examined granular aggregate deposits in the west half of the Botwood map area (NTS 2/E) and summarized the quality of each major deposit.

Glacial striae were mapped by St. Croix and Taylor (1991) who showed that there was an early eastward flow followed successively by a northward flow, a northeastward flow and finally by an eastward flow. MacKenzie and Catto (1993), who reported on the Pleistocene geology of the map area, showed the distribution of the various surficial deposits and noted that major granular aggregate deposits occur throughout the map area. Major production areas are at Botwood, Jumpers Brook and south of Lewisporte.

Maps for the adjacent map areas have been published at a scale of 1:50 000. These are NTS 2D/13 by Kean and Mercer (1977), NTS 2D/14 by Dickson (1993), NTS 2E/2 and

Table 1. Published radiometric ages for the Mount Peyton intrusive suite. Ages have been recalculated to currently-used decay constants, where necessary (from Mandville, 1991)

Rock type[1]	Age (Ma)	Method	Location	Reference
Diorite	418 ± 21	K-Ar biotite	Burnt Lake NTS 2D/14	Wanless *et al.*, 1965
Granodiorite	270 ± 52	K-Ar hornblende	SW Glenwood NTS 2D/14	Wanless *et al.*, 1967
Granodiorite	369 ± 21	K-Ar biotite	Rattling Lake NTS 2E/3	Wanless *et al.*, 1967
Granite, gabbro	380 ± 30 390 ± 15	Rb-Sr whole rock Rb-Sr whole rock	North end of pluton NTS 2E/3	Bell *et al.*, 1977 revised by Bell and Blenkinsop, *in*, Reynolds *et al.*, 1981
Granodiorite	428 ± 5[2]	Ar-Ar biotite	Frozen Ocean L. NTS 2D/14	Reynolds *et al.*, 1981
Gabbro	423 ± 5	Ar-Ar hornblende	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Gabbro	417 ± 5	Ar-Ar biotite	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Gabbro	410 ± 5	Ar-Ar hornblende	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Gabbro	414 ± 5	Ar-Ar biotite	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Gabbro incl.	412 ± 8	Ar-Ar biotite	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Gabbro incl.	400 ± 7	Ar-Ar hornblende	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Granitic matrix	422 ± 8	Ar-Ar biotite	Trans-Canada NTS 2E/3	Reynolds *et al.*, 1981
Gabbro	424 ± 2	U-Pb zircon	Rolling Brook NTS 2D/14	Dunning (1992)

Notes: [1] rock types as reported in original paper
[2] considered to be anomalously high by Reynolds *et al.* (1981).

2D/15 by Blackwood (1982), NTS 2E/2 by Evans *et al.* (1992), parts of NTS 2E/2,3,6 by O'Brien (1993). The area described in this report, along with that of Colman-Sadd (*this volume*) is published in Dickson and Colman-Sadd (1993).

RADIOMETRIC DATING

Wanless *et al.* (1965, 1967) provided the first radiometric ages for the gabbro and granite of the Mount Peyton intrusive suite (see Table 1). Bell and Blenkinsop (1975) and Bell *et al.* (1977) dated some of the granite samples collected by Strong *et al.* (1974). This date was subsequently revised and was reported by Reynolds *et al.* (1981; see Table 1) along with new Ar–Ar dates for the suite. These dates clearly indicated a Late Silurian age for the gabbro. However, layered gabbro to the south, in the Eastern Pond map area (NTS 2D/11) (Dickson, 1992), has been dated at 424 ± Ma (U–Pb zircon; Dunning, 1992). No satisfactory dates have been obtained from the granite and recent dating of zircons from the granite at Red Rock Brook (NTS 2D/14; Dunning and Manser, 1993) indicates a Late Ordovician age. However, another interpretation of the data (suggested by Dunning and Manser, *op cit.*) is that the granite is mid-Silurian.

DESCRIPTION OF THE STRATIFIED UNITS

The area described in this report extends southward from the latitude of Botwood. Parts of NTS 2E/3 to the north are described by Colman-Sadd (*this volume*).

The *Wild Bight Group (Unit 1)* is represented by a sequence of very thick-bedded, interbedded, mafic agglomerates and minor massive flows, and felsic tuff. The group covers a much larger area to the north and west of the map area where it is overlain by Caradocian chert and slate. The unit is truncated to the south and east by the Northern Arm Fault and is intruded by the probably Silurian Hodges Hill intrusive suite (Unit 4) to the southwest.

The clasts in the agglomerates are dominantly fine-grained basalt but locally fragments of pillowed basalt are abundant. The fragments are angular, poorly sorted, and range from 1 to 30 cm in diameter with little matrix material. Bedding is rarely apparent but at one locality a laminated tuff has a strike of 116°. Fine-grained crystal–lithic felsic tuff is apparently interbedded with the mafic agglomerates. The tuff contains fragments of felsic tuff, up to 25 cm in length, and plagioclase crystals. The tuff is cut by diabase dykes.

Penetrative fabrics are not apparent in this area of the Wild Bight Group and metamorphic minerals, e.g., chlorite, epidote and sericite, are indicative of low greenschist-facies metamorphism.

Sedimentary strata tentatively assigned to the Late Ordovician to Early Silurian *Point Leamington Formation (Unit 2)* outcrop mainly along a northeast-trending, arcuate belt that, in the map area, extends from Jumpers Brook to O'Brien Lake. The unit extends south of the map area for over 40 km into the Mount Peyton (NTS 2D/14) and Eastern Pond (NTS 2D/11) map areas (see Dickson 1992, 1993) where it was termed 'Samson (Sansom) Formation' and Botwood Group hornfels, respectively. To the southeast of Lewisporte, the formation contains a variety of sedimentary rock types. The unit also outcrops west of Norris Arm North where it is overlain by the Goldson Group.

Unit 2 comprises thin- to medium-bedded siltstone and sandstone sequences locally containing medium- to thick-bedded conglomerate. The more stratigraphically complex area south of Lewisporte consists of a highly folded sequence of coarse sandstone, pebble and cobble conglomerate and shale. This unit is termed the 'Campbellton Greywacke' by O'Brien (1993). In the upper reaches of the Bay of Exploits, Unit 2 is dominated by thin- and medium-bedded sandstone and siltstone, and contains minor conglomeratic horizons. No fossils have been found in this area. However, Evans et al. (1992) indicate a fossil locality 2 km east of the map area. The fossils include brachiopods that give an Ashgillian age for the unit (D. Boyce, personal communication, 1993).

O'Brien (1993) indicates that the unit is stratigraphically overlain to the north by the Lewisporte Conglomerate. The western and southern contact is a curved thrust fault that juxtaposes the 'Campbellton Greywacke' with the Lawrenceton Formation of the Botwood Group. The 'Southwest Brook Granite' (Unit 11; O'Brien, 1993) has intruded the greywacke but the effects of contact metamorphism are not apparent.

Graded beds, parallel- and crosslaminations and scours are common in the coarser rocks; the shale and siltstone contains parallel-laminations and poorly developed grading. Chaotic slump-folding of interbedded shale and sandstone is apparent in one of the bedrock aggregate quarries. The conglomerate contains abundant clasts of chert and jasper with lesser amounts of sandstone, vein quartz and granite. The coarse sandstone contains similar rock types.

Unit 2 outcrops along the steep rise to the plateau from Eel Brook (3 km east of Norris Arm) to Jumpers Brook. The unit is also well exposed along rockcuts, in aggregate quarries, small isolated hills and along the former railway line.

The dominant rock-type is parallel-bedded, medium-bedded grey to buff, fine-grained sandstone. South of Norris Arm, the beds locally display graded bedding, parallel- and crosslamination, scours and lenses of coarser sandstone. These features are indicative of turbidite deposition. No fossils were found here.

All of the sandstone along the slope and on the plateau (subunit 2a) has been contact metamorphosed by the gabbro of the Mount Peyton intrusive suite. The sandstone is converted to a black hornfels locally containing biotite and rarely actinolite porphyroblasts. Within 1 km of the batholith, dykes and plugs of gabbro and granodiorite, veins of pegmatite and quartz veins disrupt the sandstone beds. Remobilization of the beds is also apparent where complexly folded and boudinaged bedding is displayed, e.g., adjacent to the Rattling Brook generating station and on the TCH, 1 km west of the contact (Plate 1). Within 200 m of the contact, migmatization of the sediments is widespread and the beds form large blocks engulfed by gabbro and granodiorite dykes.

Plate 1. *Disrupted beds of Point Leamington Formation sandstone (subunit 2a) enclosed in a gabbro matrix typical of the aureole of the Mount Peyton intrusive suite; Trans-Canada Highway, 1.5 km west of the contact. Lens cap is 5 cm in diameter. (LD930044; UTM grid reference 211329)*

In the low-lying terrain near the Exploits River, the effects of contact metamorphism are less apparent, and Unit 2 outcrops in large, isolated rôches moutonées along and near

Table 2: Body and trace fossil localities in the southern portion of the Botwood (NTS 2E/3) map area

SITE NO.	UTM COORD.	HOST ROCK(S), UNIT	COMMENTS
a: Low hills, 200 m north of railway line, 5 km W of Rattling Brook			
LD930546	619820 5434460	sandstone, Unit 2	Williams (1972)
LD930547	619750 5434480	sandstone, Unit 2	new locality
LD930548	619680 5434480	sandstone, Unit 2	new locality
b: Low hill, 400 m south of Route 351, 6 km W of Rattling Brook			
LD930555	619000 5433800	sandstone, Unit 2	new locality
c: Rock cut along railway track, 6.5 km W of Rattling Brook			
LD930549	618590 5433250	sandstone, conglomerate, Unit 2	new locality
LD931236	618500 5433050	sandstone, conglomerate, Unit 2	new locality; in woods 250 m SW of LD930549
d: Martin Eddy Point–north side of Exploits River			
LD930786	618910 5435190	pebble conglomerate, sandstone, Unit 3	Murray and Howley (1881), Shrock and Twenhofel (1937), Twenhofel and Shrock (1939), Williams (1972)
LD930787	618900 5435100	pebble conglomerate, Unit 3	Island off M.E. Point
e: 2 km northeast of Martin Eddy Point, in woods			
LD931127	620020 5436880	pebble conglomerate, sandstone, shale, Unit 3	new locality, poorly preserved corals
f: South side of Exploits River–1 km SW of Martin Eddy Point			
LD930807	618450 5434210	pebble conglomerate, Unit 3	new locality; shoal in river
LD930808	618590 5434150	pebble conglomerate, sandstone, Unit 3	new locality; point on shore, c.f. M.E. Point
LD930809	618760 5434390	pebble conglomerate, Unit 3	new locality; Island in river
g: Exploits River Bridge, south side of Exploits River			
LD930795	613530 5430840	sandstone, Unit 6	new locality; possible trace fossil–tracks
h: East side of Camp Emmanuel, 2 km N of Notre Dame Jct., Route 340			
LD930124	639640 5444450	sandstone, Unit 7	new locality; bivalves in Wigwam Fm.
i: East shore of Indian Arm Pond, 1 km northeast of rail line			
LD930600	644280 5439900	sandstone, Unit 7	new locality; possible trace fossil–burrows

to the former rail line. The most extensive rock type is fine-grained, grey, medium-bedded sandstone that locally contains parallel-lamination. A strong upright cleavage is present and its intersection with bedding indicates gently southwest-plunging folds. At locality LD930555 (see Table 2) the form of the hill is partly controlled by the fold shape.

The fossil occurrences are of particular significance as they accurately constrain the age of this unit. One of these occurrences is termed the Jumpers Brook locality by Williams (1972; see Table 2, site LD930546 for location). This sandstone outcrops between the old Trans-Canada Highway and the former railway line and was assigned to the Wigwam Formation of the Botwood Group but it is here tentatively reassigned to the upper portion of the Point Leamington Formation. Williams (1972) reported that the fauna includes bivalves, brachiopods, gastropods and corals, namely, *Pentamerus oblongus* (Sowerby), *Eophacops* cf. *marklandensis* (McLearn), *Goniophora* or *Pterinea* sp., *Pleurotomaria* sp., *Parmorthis* sp. (Schuchert and Cooper 1931), *Leptaena rhomboidalis*, *Rhabdocyclus* sp., and *Hormotoma* sp.

Re-examination of the Williams (1972) locality and the discovery of several new occurrences resulted in the identification of other fossils including ostracodes and crinoids (see Table 2). Boyce and Ash (*this volume*) subsequently made extensive collections at these fossil localities and greatly increased the number of species known from this area (see Table 2a, 2b for localities). The reader is referred to Boyce and Ash (*op. cit.*) for a comprehensive list of fossils. The revised faunal list also indicates a late Llandoverian age for this sequence.

Sedimentary structures are rare but parallel-laminations and parallel beds are common, and rarely crosslaminated lenses are preserved. At fossil locality LD930555, one bedding plane is coated with numerous brachiopods (mainly *Leptaena* sp.) in life positions. These features suggest that shelf sedimentation locally disturbed by storms was the environment of deposition (R. Hiscott, personal communication, 1993).

Along, and to the south of the old rail line, several outcrops of beige- and orange-weathering medium- to thick-bedded pebble conglomerate and interbedded coarse-grained sandstone are interpreted to overlie the sandstone. The rocks are dark grey on fresh surfaces possibly indicating minor contact metamorphism. The dominant clasts in the conglomerate are well-rounded pebbles of quartz, chert and fine-grained felsic volcanic pebbles in a coarse-grained sandstone matrix. Resedimented fossils including gastropods, brachiopods, crinoids, trilobites, corals and bivalves are also a significant component of the railway outcrop (see Boyce and Ash, *this volume*). Another fossil locality was found 250 m along strike by David Evans, Robert Lane and Peter Tallman in 1993. Collections were made from several horizons in the area but did not reveal any fossils different from those at the railway cutting. Preliminary identifications of the fossils indicate that the strata are late Llandoverian in age (Boyce and Ash, *this volume*). The fossiliferous conglomerate of Unit 2 is interpreted to be stratigraphically overlain by very thick-bedded cobble conglomerate that is assigned to the Goldson Group (Unit 3).

The *Goldson Group (Unit 3)*, including the Lewisporte conglomerate of O'Brien (1993), outcrops mainly north of the Exploits River and isolated outcrops are found in the Norris Arm North area. The conglomerate at Martin Eddy Point and its newly discovered, lateral equivalent on the south side of the Exploits River (see Table 2d, e and f) are interpreted to form the upper portion of the Goldson Group in this area. Re-examination of the faunal lists of Shrock and Twenhofel (1939), Twenhofel and Shrock (1937) and Williams (1962, 1972), supplemented by new collections by W.D. Boyce and J.S. Ash in 1990 and 1993 from the previously known and new occurrences, indicate that the Martin Eddy Point fauna is late Llandoverian in age (Boyce and Ash, *this volume*).

The Goldson Group is composed dominantly of pebble- and cobble-conglomerate with a small proportion (possibly <10 percent) of interbedded coarse-grained sandstone in the form of continuous beds and elongate lenses, and rarely grey, laminated siltstone. The conglomerate beds mainly contain well-rounded and well-sorted clasts. The proportion of matrix is highly variable; the conglomerate beds north of the Exploits River and west of Norris Arm North are clast-supported with very little sand matrix but to the east of Norris Arm North the conglomerate is matrix supported (Plate 2). Bed thicknesses in the conglomerate range from about 1 m to over 10 m but the sandstone beds are generally less than 1 m thick. Grading is locally apparent in both the conglomerate and sandstone and crosslamination is common in the sandstone; the conglomerate beds commonly have erosional bases. Arnott (1983) and Arnott *et al.* (1985) proposed that the Goldson Group conglomerates, 60 km to the northeast in the New World Island area, were deposited on submarine fan-deltas, which prograded onto shelf siltstone.

Plate 2. *Pebble conglomerate of the Goldson Group (Unit 3) containing rounded jasper, chert and volcanic fragments; Norris Arm North road, 4 km by road from the TCH. Lens cap is 5 cm in dimeter. (LD930288; UTM grid reference 305427)*

The clast composition of the conglomerate is remarkably consistent throughout the study area and brief examinations of the unit near Lewisporte indicate similar compositions. The most conspicuous clasts are bright red jasper and green chert. Other components include vein quartz, felsic volcanic rocks, medium-grained granite, mafic volcanic rocks, red sandstone, laminated calcareous sandstone, limestone, and sericite-rich fragments.

In the Martin Eddy Point area, the conglomerate contains abundant calcareous sandstone and limestone blocks along with the components commonly seen elsewhere. Coarse sandstone and siltstone are interbedded with the conglomerate. The calcareous blocks vary in size up to 60 cm, are angular to subrounded, and commonly contain fossils. Williams (1972) noted that the finer grained sandstone contains fossils identical to those in the clasts. The Martin Eddy Point strata are interpreted to form the upper portion of the Goldson Group in this area.

The *Botwood Group* (Williams, 1972; Units 4 to 7) is divided into the older Lawrenceton Formation (Units 4 and 5) and the younger Wigwam Formation (Units 6 and 7). Only a small portion of the Lawrencton Formation outcrops in the area described in this report. The reader is referred to Colman-Sadd (*this volume*) for a description of the formation in the northern portion of map area NTS 2E/3.

Unit 4 of the Lawrenceton Formation is composed mainly of fine-grained, grey, amygdaloidal and/or vesicular or featureless, variably plagioclase-porphyritic, basalt flows. Most of the basalt flows are massive and others are composed of large blocks of massive lava (Plate 3). Felsic volcanic rocks and sandstone also occur in the unit.

Plate 3. *Blocky basaltic lava of the Lawrenceton Formation (Unit 4); Exploits River, 3.25 km downstream from the TCH. (LD930791; UTM grid reference 165321)*

The unit is well displayed along Jumpers Brook where its fault contact with the sandstone of the Point Leamington Formation is exposed. The sandstone dips southward away from the contact and shows little deformation. The contact area displays extensively folded, brecciated, silicified, mineralized argillite and red sandstone that are interpreted to structurally overlie the basalt exposed nearby. This contact is interpreted as a north-directed thrust that extends northeastward to Peterview. Unit 4 pinches out north of the Exploits River and reappears as a thrust-bound slice of fine-grained porphyritic basalt and agglomerate that forms a prominent hill, southeast of Peters Pond. In the eastern part of the map area, a thick sequence of massive and amygdaloidal basalt is exposed.

In some flows, the basalt clasts have yellow-altered margins and dark-green cores indicative of hyaloclastite breccia. This is well displayed along the Exploits River, 400 m north of Jumpers Brook. Steeply dipping flow-layering is displayed in some flows. Unit 4 contains several horizons of flow-layered, felsic volcanic rock and rarely sandstone. The sandstone occurs locally on flow tops, and on the Exploits River, bedded sandstone occurs near the top of the section. The attitude of bedding in the sandstone is conformable with that in the overlying Wigwam Formation sandstone.

Unit 5 of the Lawrenceton Formation outcrops in the eastern part of the map area where a 500-m-thick sequence contains felsic volcanic lahar, volcanic breccia, conglomerate and fine-grained, pink felsic tuff. Each component is of limited lateral extent. The lahar contains blocks of flow-layered rhyolite in a red siltstone matrix. Blocks attain lengths of 1 m. The breccia is dominated by small, angular felsic volcanic clasts and may be the lateral equivalent of the lahar. The conglomerate contains pebbles and cobbles of fine- and medium-grained basalt, red sandstone and siltstone in a sandy matrix. In the eastern portion of the unit, the conglomerate overlies amygdaloidal basalt and contains numerous jasper and chert pebbles.

The Lawrenceton Formation is a subaerial succession that locally interacted with surface water. Oxidized tops of some basalt flows (Colman-Sadd, *this volume*) also indicate subaerial weathering. There is no evidence for submarine volcanism.

The Wigwam Formation (Units 6 and 7) of the Botwood Group forms a wide belt that extends from Bishop's Falls to O'Brien Lake. The formation has been divided into a lower division (Unit 6) of green, beige, grey and red sandstone and an upper division (Unit 7) of red, thick-bedded sandstone and minor siltstone.

At locality LD930795 (Table 2g) on the Exploits River, Unit 6 sandstone contains aligned linear marks on a bedding plane, similar to glacial chatter marks that are possible trace fossils. There are several sets of these patterns on the one bed. At the Camp Emmanuel complex near Notre Dame Junction, a fossil horizon was discovered in 1992 by Tomasz Dec in red thick-bedded sandstone (Unit 7) 2 m stratigraphically above a felsic flow (see Table 2h). Subsequent examination of the locality by Boyce and Ash (this volume) resulted in the discovery of three more horizons containing the same fauna. Boyce and Ash (*this volume*) have identified the fossils as the bivalves *Goniophora consimilis* Billings and *Goniophora transiens* Billings. These are the only fossils known to occur in the Wigwam Formation as presently defined (following the reassignment of other fossil localities to the Indian Islands Group by Williams, 1993). The fossils indicate a Ludlovian to Gedinnian (Early Devonian) age for the Wigwam Formation sandstone (Boyce and Ash, *this volume*).

Unit 6 of the Wigwam Formation occurs in two separate areas. The western portion forms part of a thrust-bound block extending from Bishop's Falls to the Bay of Exploits. The thrust contacts are not exposed but the effects of north-directed thrusting are apparent along the Exploits River, 400 m west of the railway bridge, where sheared, yellow, phyllitic siltstone is exposed. About 1 km north of Wigwam Point, the southern thrust has resulted in extensive brecciation and quartz veining of grey sandstone (possibly Unit 2 or Unit 6) and a diabase dyke. This thrust has excised the Lawrencton Formation and juxtaposes the Wigwam Formation with the Point Leamington Formation and Goldson Group along an assumed thrust contact.

Unit 6 of the Wigwam Formation is well exposed along the Exploits River from the Bishop's Falls dam to 2 km east of the TCH and in the Bishop's Falls area. The dominant rock type is variably coloured (red, green, beige), medium- to thick-bedded sandstone. Minor components are thin-bedded sandstone and siltstone and very thick-bedded pebble conglomerate. Cross- and parallel-laminations, graded bedding and rippled surfaces are common and well displayed at the Bishop's Fall's dam, along the shore at Peterview, and along the south side of the TCH (Plate 4). Deformed mudcracks are exposed near the Bishop's Falls dam. White mica is a locally conspicuous component of the sandstone. Conglomerate outcrops along the Bay d'Espoir Highway (Route 360) and is composed entirely of fine-grained, felsic volcanic clasts.

Plate 4. *Rippled surface on red-grey sandstone of the lower part of the Wigwam Formation (Unit 6) at Peterview. (LD930285; UTM grid reference 212406)*

The eastern portion of Unit 6 forms a curved belt that extends from the east side of the Bay of Exploits to near Notre Dame Junction. This portion is interpreted to be in stratigraphic contact with the underlying Lawrenceton Formation and the overlying Unit 7 of the Wigwam Formation (O'Brien, 1993; Colman-Sadd, *this volume*) and is described in more detail by Colman-Sadd (*op cit.*). At Burnt Arm, 4 km northeast of Botwood, the unit contains grey and minor red, thick-bedded, sandstone containing rippled surfaces, cross- and parallel-laminations, and locally mudcracks. White mica is locally conspicuous.

Unit 7 of the Wigwam Formation includes most of the type area of the former Botwood Formation of Shrock and Twenhofel (1939). This well-bedded, southeast-dipping section extends from Peters Arm along the shore of the Bay of Exploits to 1 km north of Wigwam Point. The exposed section is estimated at 3 km in length and, with a average dip of 55°, a true thickness of 2500 m is exposed discontinuously along the shoreline. The Wigwam Formation is further exposed north of Peters Arm as far as Northern Arm but estimates of the thickness of the section are complicated by folding, faulting and a general lack of primary structures.

In the type section (of Twenhofel and Shrock, 1937), Unit 7 of the Wigwam Formation is dominated by medium- to thick-bedded, red sandstone that is commonly grey inside the thicker beds. Sedimentary features such as cross- and parallel-lamination, trough crossbedding, scours, graded bedding, mudcracks, rippled surfaces and intra-formational shale-flake breccia occur throughout this section (Plate 5). Toward the southern end of the section, the sandstone becomes grey and green. These strata are included in Unit 6 of the Wigwam Formation. The strata in the town of Botwood are more monotonous and commonly lack many of these features and even bedding may be difficult to detect. This facies extends southwest from Botwood beyond the map area. Along Northern Arm Brook and Northern Arm, the sandstone is similar to that in the 'type section' containing well-developed crossbedding, cross- and parallel-laminations and erosional bases on some beds.

Plate 5. *Crossbedded sandstone of the upper part of the Wigwam Formation (Unit 7) at Peterview. Lens cap is 5 cm in diameter. (LD930273; NTS grid reference 216418)*

Unit 7 is poorly exposed on the plateau that extends eastward from the Bay of Exploits to O'Brien Lake. The strata generally dip moderately southward where the unit is in probable thrust contact with the Point Leamington Formation and Goldson Group. The sequence is dominated by medium-bedded, red sandstone and siltstone; pebble conglomerate forms part of the sequence at Monroes Pond. At Camp Emmanuel, fine-grained, red, felsic tuff outcrops adjacent to red sandstone. At Indian Arm Pond, the sandstone appears to be bioturbated and what are possibly burrows are preserved (see Table 2i). The Wigwam Formation is interpreted to be a terrestrial sequence dominated by fluvial sedimentation. T. Dec (personal communication, 1993) has suggested a lacustrine origin for part of the sequence.

The Botwood Group is folded into a series of mainly gently south-southwest-plunging, asymmetric, open folds with an associated steeply north-northwest-dipping cleavage. Along the Exploits River, upstream from the TCH, the steep limbs of the folds dip to the northwest; below the bridge, and along the Bay d'Espoir Highway, bedding is steeper on the southeastern limb of the folds (Plate 6). The various stretching

Plate 6. *Asymmetric anticline in Unit 6 of the Wigwam Formation showing steeper east limb (left) and gently inclined west limb. Fold plunges to the southwest at 8°. Exploits River. 500 m east of TCH. (LD930792; NTS grid reference 139311).*

and intersection lineations confirm measurements on small folds that indicate that the major fold plunges toward the south–southwest at 10 to 20°. This simple system is complicated by crossfaults and reverse asymmetry is locally apparent.

In the Botwood area, bedding and cleavage generally dip steeply to the southeast whereas in the vicinity of Northern Arm Brook, beds dip steeply to the northwest. Cleavage–bedding intersection lineations and small folds plunge gently to the southwest but locally gently northeast-plunging open folds are exposed. Sedimentary structures also indicate that the folds are locally overturned to the northwest. East of the Bay of Exploits, bedding dips are shallow to steep but are consistently to the south. Cleavage is consistently subparallel to bedding. A few small second folds are exposed at Monroes Pond and these plunge gently to either the east or the west.

DESCRIPTION OF THE INTRUSIVE UNITS

The easternmost portion of the *Hodges Hill intrusive suite (Unit 8)* outcrops in the northwestern portion of the map area. It is poorly exposed. The few outcrops indicate that it is composed of massive, medium-grained, locally plagioclase-porphyritic, biotite ± hornblende gabbro and a lesser component of hornblende–biotite granodiorite. Granodiorite dykes and veins are common in the gabbro. One diabase dyke (Unit 12) was found in the granodiorite. The gabbro and granodiorite are brecciated near the Northern Arm Fault.

The northern 250 km² of the 1400 km² *Mount Peyton intrusive suite (Units 9 and 10)* dominate the southern portion of the map area. Contacts with the adjacent country rock (subunit 2a) are not sharp. In the Norris Arm–Rattling Brook area, there is a zone of dyking and partial assimilation of the country rock up to 500 m in width, similar to that seen to the south in the Mount Peyton map area (see Dickson, 1993). East of Norris Arm, this zone is not present. Beyond this zone, a wide zone of contact metamorphism locally containing gabbro and granodiorite plugs and veins is exposed. The extent of the aureole, particularly in the Norris Arm to Jumpers Brook area where it is up to 2 km in width, is indicative of a gently inclined, near-surface upper contact, dipping to the northwest at about 15°.

By far the largest component of the suite is fine-grained, grey, equigranular, massive gabbro (Plate 7). The mafic minerals are augite and hornblende and biotite is commonly conspicuous. Plagioclase occurs rarely as small phenocrysts. There is little variation in grain size or colour index. Only in isolated occurrences are veins or pods of medium- or coarse-grained gabbro found. Layered gabbro is well exposed on the south branch of Amy's Lake where variations in the plagioclase–ferromagnesian mineral ratio define individual layers up to 4 cm in thickness. The layers dip to the southeast at around 30°.

Plate 7. *Massive, fine-grained gabbro of the Mount Peyton intrusive suite (Unit 9); TCH, 3 km east of the western turn-off to Norris Arm. (LD930009; UTM grid reference 265363)*

Veins and small dykes of medium-grained hornblende–biotite granodiorite and granite are common in the gabbro. These are best exposed along the TCH near Rattling Brook where they form inclined to subhorizontal sheets. Locally, quartz ± feldspar pegmatite veins cut the gabbro.

The *granite (Unit 10)* occurs as very large dykes and plugs that have intruded the gabbro. Very rarely, small plugs of granite occur in the sedimentary country rocks, e.g., TCH, 200 m west of Eel Brook. The granite is buff to pink, leucocratic and contains tiny biotite flakes. The dykes commonly trend northeastward, are steeply dipping, and parallel the northeast-trending ridges in the northwestern part of the pluton. Widths of up to 500 m are estimated for some of the larger dykes. The ends of the dykes are not exposed but a maximum length of 1.5 km can be estimated for the larger dykes. The plugs are more equant in shape and contacts are commonly exposed. The largest underlies an area of about 3 km². Granite veins are common in the adjacent gabbro.

The *Southwest Brook granite (Unit 11;* informal name of O'Brien, 1993) is an elongate intrusion of pink, massive but highly jointed, alaskitic granite and aplite; a minor amount of brecciated, grey granodiorite is spatially associated with this unit. The granite has intruded the Point Leamington Formation (Unit 2) but contact metamorphism is minimal. A few granite veins cut the argillite. Nearby, a small plug of quartz–feldspar-porphyry that has intruded Unit 2 has a granophyric texture.

None of the granite or gabbroic units are known to cut the Botwood Group. There is also no indication of contact metamorphism of the group even where it is close to the highly metamorphosed Point Leamington Formation. This may simply be a function of distance from the plutonic rocks during intrusion. The distance could also have been reduced by thrusting, which brought the Botwood Group closer to the intrusion.

Diabase dykes (Unit 12 and subunit 12a) occur only rarely in the study area. Unit 12 is composed of massive, uniform, apparently fresh diabase that forms dykes up to 2 m in width. The age of these dykes is uncertain as all the stratigraphic units in the map area are cut by similar massive diabase dykes. Subunit 12a is composed of texturally zoned mafic dykes. These are known from northern side of Killick Point, near Botwood, and Martin Eddy Point. The Killick Point dyke cuts the Wigwam Formation and is about 1.2 m wide. It contains finely (1 mm diameter) vesicular 10-cm-wide chilled margins, adjacent 20-cm-wide zones of massive diabase and a 50-cm-wide core containing larger vesicles up to 5 mm in diameter (Plate 8). A 15-cm-wide, finely amygdaloidal, offshoot from this dyke contains smaller-scale layers and is cut by closely spaced joints at right angle to the plane of the dyke. A similar 40-cm-wide dyke cuts the fossiliferous Martin Eddy Point strata and contains a highly vesicular core. The age of these dykes is also uncertain but they may be related to the Jurassic lamprophyre dykes of Notre Dame Bay described by Strong and Harris (1974).

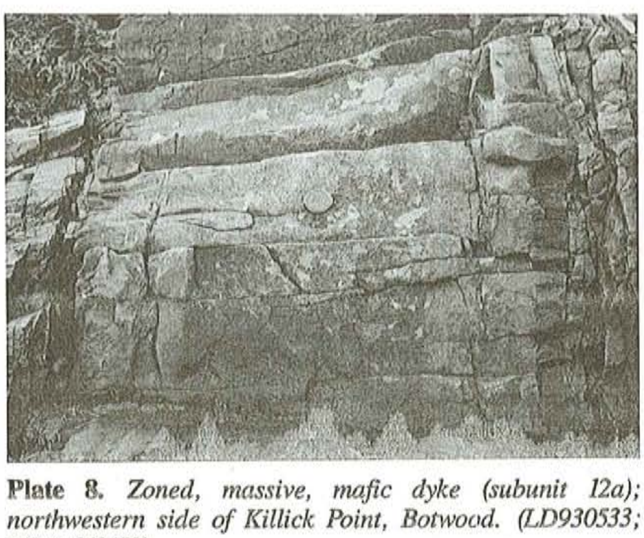

Plate 8. *Zoned, massive, mafic dyke (subunit 12a); northwestern side of Killick Point, Botwood. (LD930533; UTM 211459)*

ECONOMIC POTENTIAL

The map area contains significant deposits of aggregate (see Ricketts and McGrath, 1991) that are currently being used for concrete and mortar, asphalt, and fill. The remnants of an immense esker (MacKenzie and Catto, 1993) composed of well-washed deposits of sand and gravel outcrops for several kilometres to the southwest of Botwood and is currently used by several companies. There are also similar, sizeable high-quality deposits along the ridge south of Northern Arm Brook. Several companies operate pits in this area. To the north of Northern Arm Brook, there are large deposits of sand and gravel along the valley side. Sizeable deposits of sand with lesser gravel occur along the Southwest Brook valley and these are being worked by several companies. The granite and basalt in this area could provide a source of high-quality bedrock aggregate. A lower quality, poorly sorted deposit, containing abundant sand and silt, outcrops south of the TCH at Jumpers Brook, where it is worked by several companies. In all of these areas, washed gravel is of high quality.

A major peat deposit is currently being worked northeast of Bishop's Falls. The peat is used for a variety of purposes including agriculture and as an absorbent for oil spills.

The dimension-stone potential has been described in the section on previous work. Currently, there are no operating quarries. Dark-grey gabbro having good potential for dimension stone is exposed along woods roads near to the TCH, 2 km east of the western turn-off to Norris Arm. This ridge is the continuation of that described by Reuben Stone Limited (1992a).

The southeastern corner of the map area formed a very small part of Noranda's exploration program for gold (Tallman, 1990). No significant anomalies were found in this area.

Outcrops of mineralized and/or altered rock are rare. Pickett (1990) reported that pyrite- and arsenopyrite-bearing sandstone hornfels (subunit 2a) along Jumpers Brook contained slightly elevated gold values.

Sparkes (1990) and Lee (1990) briefly described exploration activity in the area west of Jumpers Brook. This formed part of a larger exploration program for gold. No significant anomalies were obtained from their geochemical and geophysical surveys.

Two km to the north along the brook, the highly deformed sedimentary rocks along the thrust contact between the Lawrenceton and Point Leamington formations are highly mineralized. Arsenopyrite, pyrite, silica and carbonate mineralization are conspicuous over a strike-length of 50 m. Assays for 5 samples collected over a distance of 20 m indicated arsenic (As) values ranging from 4,500 to 11,300 g/t and antimony (Sb) values ranging from 11.3 to 16.6 g/t. However, gold values were below the detection limit. The presence of this mineralized zone may still be of some significance as Noranda Exploration Limited (Sparkes, 1990), Tallman and Sparkes (1991), and Evans (1992) report that visible gold has been found in float only a few km to the southwest in map area NTS 2D/14.

Another rusty zone is the associated laminated sandstone that overlies felsic volcanic rocks, 300 m farther downstream on Jumpers Brook. Mineralization includes finely disseminated pyrite and possibly arsenopyrite.

An outcrop of mineralized sandstone and conglomerate was discovered by B.H. O'Brien in 1993 about 1 km east of the Norris Arm North road and 100 m north of the rail bed. The sandstone is rusty and is net-veined by quartz containing pyrite and carbonate. The prospect had been blasted by persons unknown presumably for prospecting and sampling. There is no known report on this prospect.

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