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OPHIOLITES, SEDIMENTARY ROCKS, POSTTECTONIC INTRUSIONS AND MINERALIZATION IN THE EASTERN POND (NTS 2D/11W) MAP AREA, CENTRAL NEWFOUNDLAND

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ABSTRACT

The Eastern Pond (NTS 2D/11W) map area contains components of the Exploits and Mount Cormack subzones that are juxtaposed along the northern margin of the ophiolitic Great Bend Complex. A newly discovered zone of amphibolite schist and mylonitic gabbro represents a basal dynamothermal aureole to the ophiolite. This zone marks the junction of the suite with the Lower Ordovician or older Spruce Brook Formation and the Silurian Botwood Group. Possible Silurian sedimentary rocks are imbricated with the ultramafic rocks.

In the eastern part of the area, the polydeformed turbiditic slate and sandstone of the Middle to Late Ordovician Davidsville Group are possibly overlain by turbiditic, shallow-marine and intertidal sandstone and siltstone of the Silurian Botwood Group. Upper Ordovician graptolite-bearing slate of the Davidsville Group forms a fault-bound block within the Botwood Group. Upper Ordovician graptolite-bearing chert and slate are possibly equivalent to the Lawrence Harbour Formation. Shallow-marine to terrestrial Botwood Group sedimentary rocks underlie the northwestern part of the area and these are in fault contact with the Spruce Brook Formation.

The Mount Peyton Intrusive Suite is composite and consists of postkinematic gabbro that is cut by tonalite, granodiorite and granite. The suite has intruded the Spruce Brook Formation and the Botwood Group. Isotopic dating of the pegmatitic gabbro indicates a Silurian age. Two other layered gabbroic units are possibly related to the suite rather than being part of the ophiolite.

Postkinematic, very thick-bedded, mainly coarse-grained, sedimentary rocks, probably of fluvial origin, unconformably overlie fossiliferous Upper Ordovician chert, the Botwood Group, and a small part of the ophiolite suite.

The southern half of the Great Bend Complex is extensively altered to magnesite and gold mineralization is concentrated in this zone. Massive arsenopyrite mineralization occurs in brecciated serpentinite. The Chiouk Brook showing contains anomalous gold values. Antimony mineralization occurs in graphitic slate of the Davidsville Group and also the postkinematic sandstone and conglomerate at the Xingchang and Hunan deposits, respectively.

INTRODUCTION

LOCATION AND ACCESS

The Eastern Pond (west half) map area (formerly known as the West Gander Rivers map area) is located in central Newfoundland, approximately 40 km southeast of Grand Falls. During 1991, the area was mapped using 1:12 500 colour aerial photographs taken during 1976, 1978 and 1987. Much of the map area is accessible by a network of woods roads, constructed since 1981 (see Figure 1; also Dickson, 1991 for detailed map), from Route 360, which runs along the western edge of the map area. The easternmost portion of the map area can be reached via woods roads from the Trans Canada Highway at Glenwood in map area NTS 2D/15. Road access and the main roads, as of 1987, are shown on the 1:250 000 map (NTS 2D, Edition 3). (It should be noted that the bridge over the Northwest Gander River, 12 km southwest of Gander Lake, has been omitted from this map). The Northwest Gander River may be canoed in the spring but much outcrop is covered by water at this time. By July, in most years, water levels are very low and the river can then be crossed on foot. Helicopter support is available at Gander, Glenwood, Milltown and St. Alban's.

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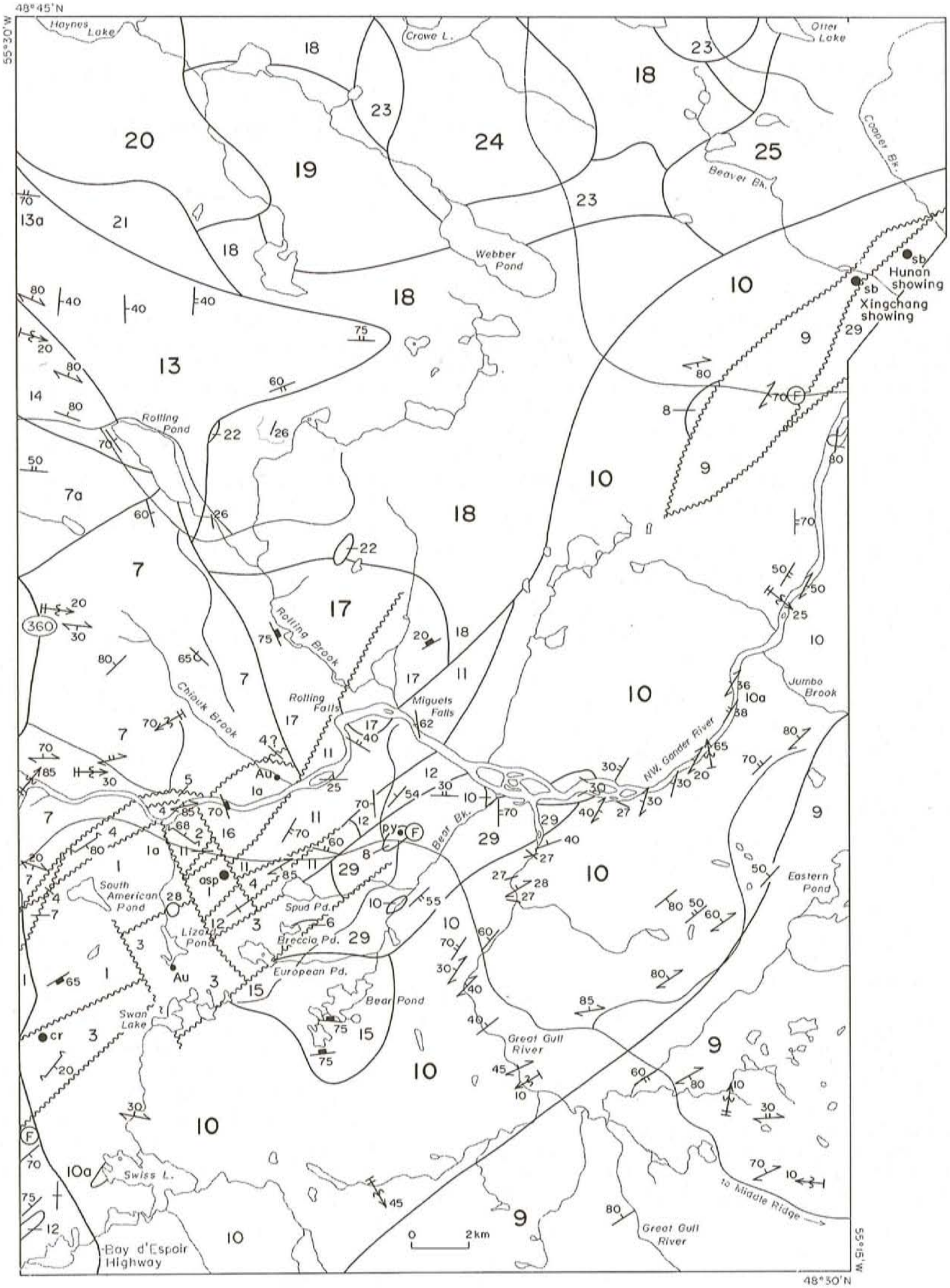

Figure 1. *Geological map of the Eastern Pond (NTS 2D/11W) map area.*

LEGEND

DEVONIAN or YOUNGER

30 *Very thick-bedded, coarse breccia with imbricated slate clasts (derived from Unit 10) and well-rounded polymict pebbles and cobbles*

29 *Very thick-bedded, feldspathic sandstone, siltstone, pebble–cobble conglomerate, red, brown and black shale; contains conspicuous chert clasts derived from Unit 8*

28 *Peridotite-cobble to pebble conglomerate and minor peridotite-clast sandstone*

SILURIAN to DEVONIAN

27 *Fine- to medium-grained diabase dykes*

MT. PEYTON INTRUSIVE SUITE (UNITS 17 TO 26)

26 *Fine- to medium-grained diabase dykes*

25 *Medium- to fine-grained, locally miarolitic, leucocratic biotite granite*

24 *Fine-grained, equigranular, biotite granite*

23 *Medium-grained, equigranular, hornblende–biotite granodiorite*

22 *Fine-grained, equigranular, biotite–hornblende tonalite*

21 *Medium-grained, equigranular, leucocratic, muscovite–biotite granite locally displaying a strong eutaxitic foliation; commonly contains xenoliths of migmatized sediment probably from Unit 13*

20 *Medium-grained, hornblende–biotite gabbro*

19 *Medium-grained, hornblende gabbro cut by abundant granitic dykes and veins*

18 *Medium- to fine-grained, hornblende gabbro; locally contains very coarse pegmatitic hornblende gabbro*

17 *Medium- to coarse-grained, layered to uniform, hornblende gabbro*

16 *Medium- to coarse-grained, layered to uniform, hornblende gabbro*

15 *Coarse-grained, hornblende gabbro and diabase; gabbro locally displays a weak mineral alignment*

SILURIAN

NORTH STEADY POND FORMATION AND BOTWOOD GROUP (Units 10 to 14)

14 *Thin- to thick-bedded, well-cleaved, red and green siltstone, sandstone, conglomerate and breccia*

13 *Buff-weathering, grey, mudcrack-bearing, boudinaged, sandstone hornfels;* **13a,** *migmatized equivalents*

12 *Red and green, weakly cleaved, siltstone and sandstone locally containing mud cracks and rain pits*

11 *Grey, mudcrack-bearing, sandstone hornfels*

10 *Grey to green, well-cleaved, mudcrack-bearing sandstone and siltstone, slate, coarse-grained sandstone and pebbly sandstone, rare calcareous, fossiliferous sandstone; minor sandstone hornfels; thin-bedded, turbiditic sandstone;* **10a,** *pebble conglomerate*

MIDDLE TO LATE ORDOVICIAN

9 Davidsville Group *Polydeformed, greywacke sandstone, black graptolitic slate, granule conglomerate*

8 *Black, pyritic, ribbon chert and minor graptolitic black slate*

EARLY ORDOVICIAN ?

7 Spruce Brook Formation *Polydeformed, greywacke sandstone, siltstone, quartzose sandstone and slate;* **7a,** *thick-bedded, quartz-rich sandstone and siltstone*

CAMBRIAN to EARLY ORDOVICIAN ?

GREAT BEND COMPLEX (Units 1 to 6)

6 *Silicified, red ultramafic breccia*

5 *Chloritized basalt and schistose mafic tuff*

4 *Amphibolite and chloritized amphibolite schist, probably of gabbroic origin, and mylonitic serpentinite*

3 *Mainly schistose magnesite containing minor chromite layers and pods*

2 *Massive to schistose, layered dunite pyroxene and harzburgite*

1 *Massive to sheared, layered to uniform, serpentinized peridotite; includes dunite and minor harzburgite;* **1a,** *Sheared serpentinite–shale or slate melange*

SYMBOLS

Geological contact (not classified, approximate, assumed)

Bedding (tops known, unknown, overturned)

Primary igneous layering or mineral alignment

Cleavage (first, second; inclined, vertical)

Shear or mylonitic fabric (inclined vertical)

Fault (not classified)

Fold axis (first, second generation)

Dyke

Mineral occurrences (gold, arsenopyrite, chromite, pyrite, magnetite, stibnite) Au,as,cr,py,mt,sb

Fossil locality F

Since 1982, the areas that were opened up for logging have been clear-cut for pulp wood. Logging continues in the Webber Pond and Jumbo Brook areas. Most of the cut-over areas and intervening areas of poor-quality trees, west of a line from Haynes Lake to Great Gull River, were ravaged by a forest fire in 1986. Consequently, much more bedrock is now exposed than was available to the pre-1983 geologists, e.g., Colman-Sadd (1982). Extensive portions of the map area are still covered by poor-quality spruce trees, bogs and deadfall.

REGIONAL GEOLOGICAL SETTING

Most of the area lies within the Exploits Subzone of the Dunnage Zone, which is dominated by Ordovician sedimentary and volcanic units and Ordovician ophiolite complexes. The eastern part of the Mount Cormack Subzone, which is included in the Gander Zone (Williams *et al.*, 1988), lies along the western part of the map area. The subzone has been interpreted as lying within a thrust-bound window within the Exploits Subzone (Colman-Sadd and Swinden, 1984) with the fault contacts commonly marked by ultramafic rocks. The Mount Cormack Subzone is dominated by Lower Ordovician and older sedimentary rocks.

The ophiolitic rocks within the map area (Units 1 to 6; Figures 1 and 2) form the eastern portion of an extensive, fragmented ophiolite complex that extends well to the west (see Colman-Sadd and Swinden, 1982, 1984; Swinden, 1988; Dec and Colman-Sadd, 1990). The ultramafic rocks and adjacent gabbro in the map area have been informally termed the Great Bend (± Ophiolite or Ultramafic) Complex (or body). The abrupt change in course of the Northwest Gander River at the mouth of Miguels Brook was informally termed Big Bend by Grady (1953) and then renamed Great Bend by Harrison (1953).

PREVIOUS WORK

The work of Grady (1952, 1953) was the first significant geological work in the area. He outlined the ultramafic and gabbroic rocks and described their relationships to the adjacent sedimentary rocks. The contacts were known to be faulted but were interpreted to have been originally intrusive. The sedimentary rocks were correlated with the Ordovician sedimentary rocks in the Hamilton Sound area of Notre Dame Bay and the igneous rocks were interpreted to be have been intruded during the Ordovician Taconic Orogeny (Grady, 1953, page 40). The extensive deposits of high-quality magnesite within the ultramafic rocks in the Great Bend area were emphasized in his report. Grady *(op. cit.)* also informally named the minor ponds in the area i.e., Lizard Pond, Swiss Lake, South American Pond, Spud Pond, European Pond, and Bear Pond. These names are used on most geological maps of the area (Figure 2).

The ultramafic rocks have received considerable attention from exploration companies interested initially in their magnesite and asbestos potential and more recently in their precious-metal potential. The few, more academic studies have concentrated on the regional significance of the ultramafic and adjacent rocks. The sedimentary and plutonic rocks in the area have received little detailed examination.

Kean (1974) examined the Great Bend Complex and concluded that the ultramafic and gabbroic rocks had intruded the adjacent sedimentary rocks as mantle diapirs. Malpas and Strong (1975) examined chrome–spinel (chromite) crystals from allochthonous ophiolitic complexes of western Newfoundland and from the ultramafic rocks in eastern Newfoundland (cf. Kean, 1974). They suggested that the difference in the Cr:Al ratios of the chrome–spinel from eastern and western Newfoundland supported the diapir hypothesis.

Colman-Sadd and Swinden (1982, 1984) interpreted the Great Bend Complex to be a continuation of the transported ophiolite complex exposed to the southwest at Coy Pond (see e.g., Colman-Sadd, 1981).

Regional mapping at a scale of 1:250 000 was carried out by Anderson and Williams (1970). Colman-Sadd (1982) did reconnaissance 1:50 000-scale mapping in the Rolling Pond–Swan Lake areas. Zwicker and Strong (1986) mapped the Great Bend ophiolitic and adjacent rocks in the southwestern part of the map area. The present study has produced the first 1:50 000-scale map of NTS 2D/11 (west half) map area (Dickson, 1991) and complements the work of Blackwood (1981) who mapped the NTS 2D/11 (east half) map area. Adjacent map areas were mapped by Blackwood (1983, 2D/6) and Colman-Sadd and Russell (1988, 2D/12). The Mount Peyton (NTS 2D/14) map area will be mapped during 1992.

DESCRIPTION OF THE UNITS

GREAT BEND COMPLEX (UNITS 1 TO 6)

Introduction

The term Great Bend Complex is used here for the ultramafic rocks (Units 1, 2, 3 and 6; Plates 1 and 2), along with the newly discovered, intensely deformed, amphibolitic gabbroic and amphibolite schists (Unit 4; Plate 3) at the northern margin of the Complex, and the possibly related, mafic volcanic rocks of Unit 5 (Figure 2). It appears, however, that the gabbroic rocks at Bear Pond and also 2.5 km northwest of Spud Pond, respectively, (Units 15 and 16), may not form a continuous area of gabbro or be genetically related to the ultramafic rocks as is indicated by Grady (1953), Kean (1974), Colman-Sadd and Swinden (1982, 1984) and Colman-Sadd (1982). The ultramafic complex is now generally considered to be part of a dismembered ophiolite suite (Colman-Sadd, 1982).

Age

The age of the Great Bend Complex has not been determined. However, the probably correlative Pipestone Pond Complex (Swinden, 1988) has been dated by Dunning and Krogh (1985). Zircon from plagiogranite in the Complex gave a U–Pb age of 493 $^{+2.5}_{-1.9}$ Ma.

Stratigraphic evidence for the minimum age of the Great Bend Complex comes from the adjacent Mount Cormack Subzone where the Spruce Brook Formation is unconformably overlain by fossiliferous limestone conglomerate that contains chromite grains and serpentine clasts (Dec and Colman-Sadd, 1990). The fossils include brachiopod, trilobite and other bioclastic material (see also Colman-Sadd and Swinden, 1984; Boyce, 1987) that indicate an age between the late Llanvirn and early Llandeilo (approximately 468 Ma). The Spruce Brook Formation is therefore dated as Arenig or older. The presence of the ultramafic-derived detritus in this unit indicates that the ophiolite was exposed and subject to erosion by this date (see Dec and Colman-Sadd (1990) for a full discussion).

A sample of amphibolite from the northern margin of the ophiolite is currently being dated by the Ar–Ar method and this may give an estimate of the age of emplacement of the Complex.

Contact Relationships

All observed contacts of the Great Bend Complex and adjacent units are either brittle faults or shear zones (Figure 2). The southeastern contact of the Complex (Unit 3 against Units 10 and 15) is a brittle fault, which juxtaposes sheared magnesite against a variety of rocks. Siltstone of the North Steady Pond Formation is hydrothermally brecciated and silicified, 2 km northeast of Swiss Lake. Two km west of Bear Lake, medium-grained gabbro is brecciated but not quartz-veined. At Breccia Pond, highly fractured and hematized and silicified breccia (Unit 6) is interpreted to be of ultramafic origin (Figure 2). Highly sheared, chloritic serpentinite is exposed along the road, 1.5 km northeast of Breccia Pond. The shear surfaces are generally steeply dipping.

The northwestern contact has been significantly redefined compared to all previously published work (cf. Colman-Sadd, 1982; Zwicker and Strong, 1986). This is the result of the discovery of widespread amphibolite schist, mylonitic serpentinite and coarse-grained, amphibole-bearing strongly foliated metagabbro, chlorite schist (Plate 3), and a melange composed of shale and altered ultramafic rocks (subunit 1a and Unit 4). These rocks occur within a northeast-trending band, up to 1 km wide, which extends along the previously mapped northwestern boundary of the Complex from the Bay d'Espoir Highway to the Northwest Gander River and eastward to Chiouk Brook (Figure 2; see Burton, 1987 and Mercer, 1988b).

Small outcrops of definite sedimentary rocks occur as apparently fault-bound slivers within the amphibolitic unit. At the western end of the zone, the sedimentary rocks of the Spruce Brook Formation contain well-defined mineral bands possibly reflecting mylonitization. Immediately north of the amphibolitic rocks, the grey, cleaved sandstone and siltstone of the Spruce Brook Formation are complexly deformed and contain conspicuous chlorite, whereas farther north, chlorite is not apparent in hand specimen.

Approximately 1 km northwest of Spud Pond, several outcrops of amphibolite, chlorite schist and banded mylonitic serpentinite (Unit 4) form another northeast-trending block of amphibolite schist and mylonitic serpentinite. This block is apparently displaced to the southeast of the main area of Unit 4 along a northwest-trending fault. These rocks are in fault contact with weakly cleaved red siltstone and grey to buff sandstone of the Botwood Group (Units 10 and 11; Figure 2).

These two areas of intensely deformed and highly metamorphosed rocks are interpreted to be a possible *basal dynamothermal aureole to the Great Bend Complex*)see Williams and Smyth, 1973).

A series of northwest-trending faults, west of Spud Pond, juxtapose various components along the northeastern margin of the Complex with undeformed, layered to uniform gabbro (Unit 16) and the Botwood Group sedimentary rocks (Units 10, 11 and 12). Within the Complex, slivers of sandstone and siltstone, which are part of the Botwood Group, are interpreted to be thrust-bound slices.

A recently released company report (Mercer, 1988b) listed drill-core data from the mineralized area within the Complex, south of Lizard Pond. Here, extensive outcrops of magnesite and silicified magnesite are commonly surrounded by glacial float that contains abundant siltstone clasts. Drilling indicated that the ultramafic rocks were small thrust-bound bodies enveloped in highly sheared or fractured siltstone and shale along with minor sandstone and conglomerate. The ultramafic bodies have apparent thicknesses of about 5 to 75 m and the thicker ultramafic intersections commonly contain shears and schistose bands. Commonly, the ultramafic and sedimentary rocks form imbricated slices. The greatest reported intersection of ultramafic rocks is just over 50 m and this drillhole was terminated in talc–magnesite schist (see Mercer, 1988b for details).

Unit Descriptions

The Great Bend Complex has been divided into 6 main units. Unit 1 is mainly composed of fine-grained massive, layered or uniform, dark-brown weathering, black peridotite (Plate 1). The dominant variety of peridotite is uniformly-textured dunite. On weathered surfaces, chromite is conspicuous as 1- to 2-mm-diameter crystals and up to 1 percent in abundance.

Toward the margins of this unit, the rocks are intensely sheared with a well-developed schistosity (subunit 1a). The sheared contact of peridotite and Unit 3 (magnesite) is well exposed in a trench 1 km east of South American Pond. The mineralogical changes are gradational over 10 m. This is

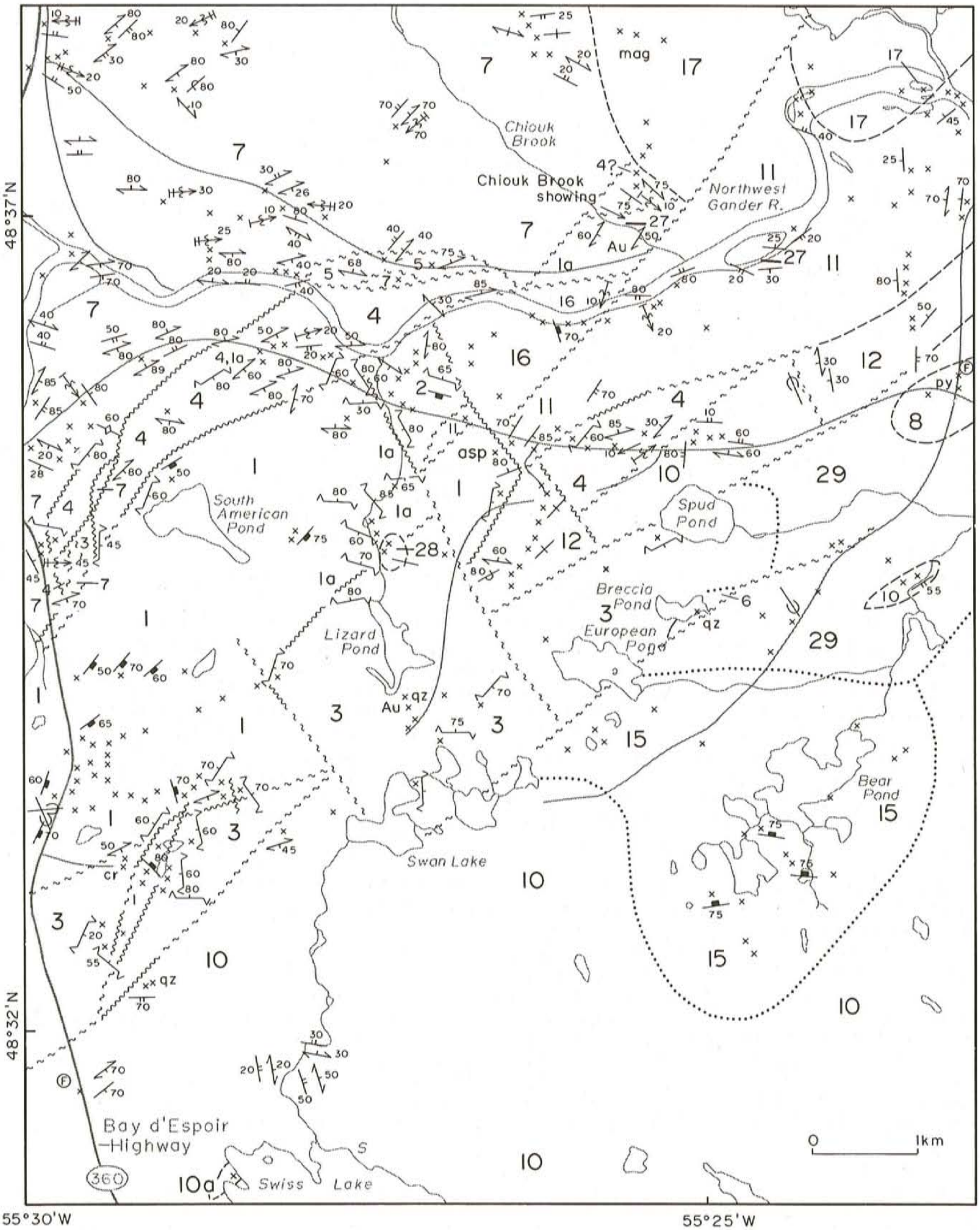

Figure 2. *Geological map of the Great Bend Complex in the Eastern Pond map-area.*

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4 *Amphibolite and chloritized amphibolite schist, probably of gabbroic origin, and mylonitic serpentinite*

3 *Mainly schistose magnesite containing minor chromite layers and pods*

2 *Massive to schistose, layered dunite pyroxene and harzburgite*

1 *Massive to sheared, layered to uniform, serpentinized peridotite; includes dunite and minor harzburgite;* **1a,** *Sheared serpentinite–shale or slate melange*

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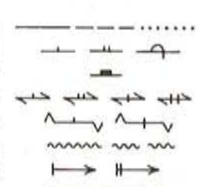

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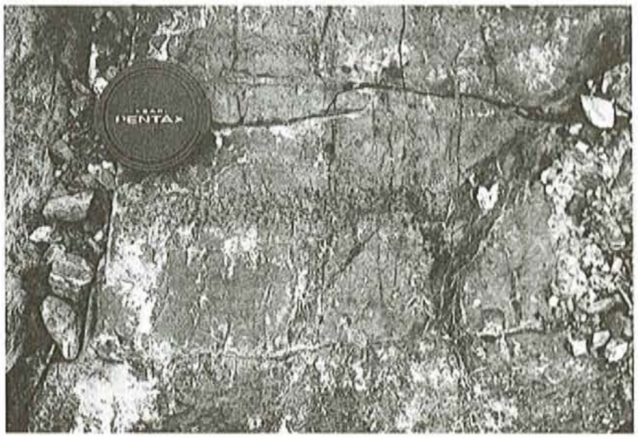

Plate 1. *Massive layered peridotite containing a band of disseminated chromite. Aggregate quarry, Route 360, 2 km south of South American Pond; lens cap in all plates is 5 cm in diameter.*

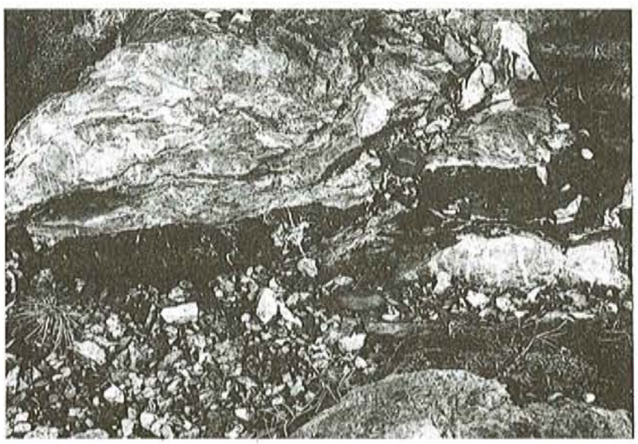

Plate 2. *Magnesite schist containing a chromite layer. Magnesite quarry, 0.75 km east of Route 360, 2 km south of South American Pond.*

Plate 3. *Mafic chlorite schist (Unit 4) from the outer margin of the amphibolitic schist that may form the basal aureole to the Great Bend Complex, 2 km northeast of South American Pond.*

indicated by the change in colour from black to cream, and by the presence of unaltered peridotite fragments in the sheared magnesite. Clearly the magnesite is derived from the adjacent peridotite. Shear zones also occur within the peridotite where the rock is a serpentine schist.

Banding is uncommon in the peridotite and where present is of limited extent. At the roadside quarry, 2.5 km southwest of South American Pond, 10- to 20-cm-thick, rhythmic bands are developed in the dunite with slightly chromite-rich dunite alternating with chromite-poor dunite (Plate 1). Locally the peridotite contains a pyroxene-bearing phase that is apparently harzburgite (Zwicker and Strong, 1986). The pyroxene has one well-developed cleavage and is probably enstatite. Banding is best developed 2 km west of Swan Lake. Here, a fault-bound block of Unit 1 within Unit 3 contains 15- to 50-cm-thick alternating layers of fine-grained dunite and harzburgite containing prominent pyroxene crystals. Overall, the banding is of limited extent and rarely extends from one outcrop to another.

Burton (1987) and Mercer (1988b) reported that massive and sheared serpentinite occur in drill core from the Chiouk Brook gold showing (Figures 1 and 2). The drilling intersected over 150 m of ultramafic rock and most holes ended in ultramafic rocks (see discussion in description of the Spruce Brook Formation).

Unit 2 has been previously mapped as a plug of pyroxenite that intruded the peridotite of Unit 1. Evidence for its intrusive nature is lacking as no contacts are exposed. It does, however, form a mappable unit as it contains a great variety of rocks in a very small area. The rocks include sheared, serpentinized dunite, banded, foliated, chromite-rich dunite and probable harzburgite, and massive, medium- and very coarse-grained, pyroxene-rich peridotite (possibly lherzolite). The western and northern boundaries of the unit are highly sheared. The southern and eastern boundaries are not exposed and are interpreted to be faults.

The southern portion of the Complex is dominated by sheared, magnesitized ultramafic rock (Unit 3, Figure 2; Plate 2). As discussed above, the magnesite is clearly an alteration product of Unit 1. The alteration is nearly complete and only locally is serpentinite seen within the magnesite. The magnesite is generally highly sheared and close to contacts with the adjacent units and the foliation is subparallel to the contact. An isolated occurrence of magnesite is found along the northwestern contact of Unit 1, 0.5 km west of South American Pond. Partially magnesitized serpentinite was also found near the contact with Unit 4, on the main woods road 1.5 km northeast of South American Pond. Quartz veins and disseminated quartz pods are a characteristic feature of parts of the magnesite unit.

Disseminated chromite and chromite layers occur throughout the magnesite. The best known example of chromite layering occurs within the NALCO quarry just east of the Bay d'Espoir Highway, 2 km west of Swan Lake (Figure 2). Here, the chromite forms a layer nearly 2 m long and 15 cm wide, dipping to the west at about 15° (Plate 2).

Approximately 300 m south of Lizard Pond, there is extensive, fine-grained silicification of the magnesite and widespread disseminated sulphide (see Mercer, 1988b; Evans, *this volume*). This general area has been extensively drilled and trenched to assess its gold potential.

Unit 4 forms a wide zone of intensely deformed mafic and ultramafic rocks along the northern margin of the Complex (Figure 2). The mafic rocks are converted to banded amphibolite or chlorite schist (Plate 3). The parental rock of the amphibolite, where it contains abundant granulated plagioclase, is probably of gabbroic origin. This is particularly well exposed along a disused woods road, 1.25 km due north of South American Pond. A series of nearly continuous outcrops exposes, from north to south, fine- to medium-grained, discontinuously banded amphibolite, medium- to coarse-grained plagioclase–quartz–(sericite) amphibolite, chlorite schist, and schistose to banded serpentinite. Regionally, the amphibolite outcrops are closer to the ultramafic rocks than the chlorite schist. Banding is locally well developed in the chlorite schist and the rock has the appearance of laminated, chloritized siltstone and the parental rock is possibly volcanic. The protolith of the fine-grained amphibolites is unknown.

Lineations are not well developed in the amphibolites or mylonites. The foliations are moderately to steeply-dipping to the south or southeast. In several places, folding of the main fabric is apparent (Plate 3) and in the main belt of Unit 4, chlorite schist contains folded second folds. At one locality, a possible C–S fabric was observed and this indicates sinistral shear.

The outcrops of amphibolite and chlorite schist that may have been observed by previous workers were apparently included with the sedimentary rocks of the Botwood Group, the Spruce Brook Formation, or an unnamed unit. The reassignment of outcrops on the north shore of the Northwest Gander River is also the first published indication that the Complex occurs north of the river.

A narrow belt of massive and cleaved, chloritized and epidotized, mafic tuff and basaltic flows (Unit 5; Figure 2) is found along recently constructed woods roads north of the Northwest Gander River. The volcanic rocks lie at the edge of the Spruce Brook Formation but are interpreted to be in tectonic contact with the formation as volcanic rocks are unknown elsewhere in the formation. The tuff contains feldspar fragments in a chloritized, cleaved matrix. Layers and laminations are well preserved in the more massive tuffs. Toward the eastern end of the unit, the rocks are possibly flows as the rocks are more thickly layered and generally lack features indicative of tuffs. Cleavage is also poorly developed.

Along a woods road south of the unit, a small outcrop of grey-green sandstone separates the mafic volcanic rocks from the amphibolites (Unit 4). This sandstone is probably part of the Spruce Brook Formation and is interpreted to form a fault-bound slice within the Complex. The proximity of the volcanic rocks to the Great Bend Complex possibly indicates that they may represent the upper portion of an ophiolite suite. Confirmation that the volcanic rocks are part of an ophiolite suite may be demonstrated by geochemical analyses in progress.

Along the southern margin of the Complex, outcrops of red, hematized and silicified rock (Unit 6) are well exposed in a trench at Breccia Pond. This rock is interpreted to be part of the Complex although Zwicker and Strong (1986) indicate that the rock is an altered sediment. Similar rocks occur in core obtained from the Lizard Pond area (D. Evans, personal communication, 1992). Geochemical analyses should give enhanced Ni and Cr values if the breccia is an altered ultramafic rock.

SPRUCE BROOK FORMATION–UNIT 7

The sedimentary rocks, which constitute the Spruce Brook Formation (Unit 7), were extended into the Eastern Pond map area by Colman-Sadd (1982). Unnamed quartz-rich sedimentary rocks and associated grey siltstone and slate (now part of the Spruce Brook Formation) were distinguished from greywacke and slate, conglomerate and volcanic rocks of the North Steady Pond Formation of the Ordovician Baie d'Espoir Group in the adjacent Burnt Hill map area (Colman-Sadd, 1985). Anderson and Williams (1970) had included these sedimentary rocks in the Silurian Botwood Group. Dec and Colman-Sadd (1990) reported that late Llanvirn to early Llandeilo fossiliferous limestone conglomerate unconformably overlie the Spruce Brook Formation and in combination with the regional association north of Gander Lake and in New Brunswick they suggested an age of Arenig or older for the formation.

The Spruce Brook Formation comprises interbedded, thick-bedded, grey and white sandstone and siltstone, and black slate (Unit 7; Plate 4); sandstone and minor siltstone containing abundant quartz veins constitutes subunit 7a (Figure 1). Parallel laminations are the most common sedimentary structure but locally convolute laminations and graded bedding may be found. Black slate outcrops 500 m north of the Northwest Gander River.

The area underlain by subunit 7a has been added to the Spruce Brook Formation (cf. Colman-Sadd, 1982). Its northern boundary is marked by a series of thick quartz and vuggy quartz–feldspar veins that may have been emplaced along a fault. The trace of this contact to the west would intersect with a faulted melange of mafic volcanic rocks in the southern part of Miguels Lake (see Colman-Sadd and Russell, 1988).

Subunit 7a consists of a monotonous sequence of grey-green, locally faintly red-weathering, thick-bedded, quartz-rich sandstone and minor siltstone. The unit is weakly cleaved parallel to bedding and contains interstitial, fine-grained chlorite. In comparison, the adjacent Botwood Group (Unit 14) contains a greater variety of rocks including red, green, grey and purple polymict conglomerate, and interbedded

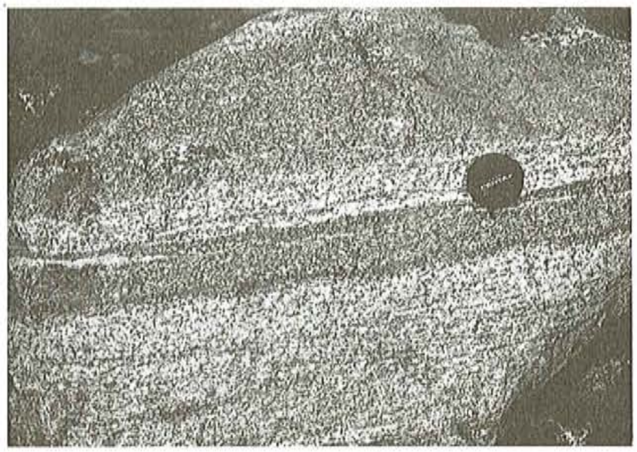

Plate 4. *Complexly folded, grey sandstone of the Spruce Brook Formation. Great Gull River road, 1.5 km northwest of South American Pond.*

pebbly sandstone, sandstone and siltstone. Unit 14 contains a strong cleavage at a high angle to bedding. Thus, subunit 7a is petrographically and structurally distinct from Unit 14.

The Spruce Brook Formation is highly deformed with good examples of refolded folds and intersecting cleavages (Plate 4). West of Chiouk Brook, tight second folds of bedding and cleavage plunge gently to the east or west. This may indicate that a third generation of folds is present with a northerly trend. These sediments are virtually unmetamorphosed. Near the contact with the amphibolites (Unit 4) the sediments contain a fabric defined by chlorite. East of Chiouk Brook, a sequence of well-exposed psammites and semipelites are tightly folded into overturned folds that plunge to the southeast. The sequence is contact metamorphosed by the Mount Peyton Intrusive Suite with the progressive development of biotite, cordierite, and cordierite+garnet toward the contact.

At the Chiouk Brook gold showing, all published work (including Dickson, 1991) indicates that the area is underlain by sedimentary rocks. The black slate on Chiouk Brook is of particular significance as it contains significant pyrite–arsenopyrite mineralization and associated highly anomalous gold values (Zwicker and Strong, 1986; see also mineralization section). However, Burton (1987) and Mercer (1988b) reported that drilling in the vicinity of the Chiouk Brook gold showing intersected various types of ultramafic rock including serpentinite, magnesite, ultramafic schist and diabase, and also great thicknesses of graphitic breccia (subunit 1a; Figure 2). The latter is possibly equivalent to the graphitic, sulphide-bearing slate exposed in the brook. There are no exposures of serpentinite in the area but several angular glacial erratics were located north of the showing.

It is also possible that the sedimentary rocks exposed at the showing are not part of the Spruce Brook Formation but may form part of a melange zone that overlies the till-covered continuation of the Great Bend Complex. The strongly foliated rocks located to the north of the showing may not simply be part of the Spruce Brook Formation; they could represent the tectonic equivalent of the amphibolitic aureole (Unit 4) exposed 2 km to the southwest, along the Northwest Gander River (Figure 2).

BEDDED FOSSILIFEROUS CHERT–UNIT 8

Unit 8 occurs 1 km west of Bear Brook and also 4.7 km southeast of Webber Pond (Figure 1) where it is exposed in woods roads. These two widely separated areas are regionally along strike from each other. The unit is characterized by black chert that forms 1- to 2-cm-thick beds that are separated by 1- to 5-mm-thick laminae of graphitic, black shale. The Bear Brook occurrence consists of two outcrops of which the northern outcrop is a large disused road aggregate quarry. This occurrence was included in the Botwood Group by Zwicker and Strong (1986). However, at the Bear Brook occurrence, graptolites were found in the slate laminae and these have been identified by S.H. Williams of Memorial University. These indicate that the unit is late Caradocian in age. This age would indicate that the chert and slate are too young to be an integral part of the Great Bend Complex. Williams *(op. cit.)* suggests that the unit is probably equivalent to the upper part of the Lawrence Harbour Formation (*D. clingani* zone) (S.H. Williams, written communication, 1992).

DAVIDSVILLE GROUP–UNIT 9

The Davidsville Group occurs in the southeastern portion of the map area and also 5 km east of Webber Pond (Figure 1), where graptolite-bearing slates are correlated with the group. In the southeastern area, the Davidsville Group is assumed to be in stratigraphic contact with the Botwood Group along the valley southeast of Eastern Pond. Tallman (1989, 1990, 1991) indicates that the contact is a reverse fault that places the Botwood Group over the Davidsville Group. This fault coincides with a geophysical anomaly and also with a fault exposed in trenches at the Aztec showing, 6 km north-northeast of Eastern Pond (see Tallman, 1991).

The dominant rock types, in the southeastern area, are medium- to thick-bedded, grey to black slate and siltstone and grey to buff-coloured sandstone. Granule conglomerate and pebbly sandstone are minor components (Plate 5). The finer grained sedimentary rocks are commonly parallel laminated and locally contain crosslaminations. At one locality, a possible partial Bouma sequence was found that consisted of a lower, graded unit overlain by a massive central unit and a parallel laminated upper unit. The granule conglomerate and pebbly sandstone are poorly graded, and contain 2- to 4-mm-long, fragments of black chert, fine-grained felsic volcanic and abundant detrital feldspar (Plate 5). The chert fragments are similar to the chert in Unit 8.

East of Webber Pond, a 1-km-thick section of grey slates is exposed along the woods road. The slates are interpreted to be in fault contact with Unit 29 (Figure 1) although an unconformity is also a possibility. The contact coincides with a stream and there is an abrupt change in lithology. The sediments are also highly jointed, which may reflect late faulting. The nature of the western contact with the Botwood

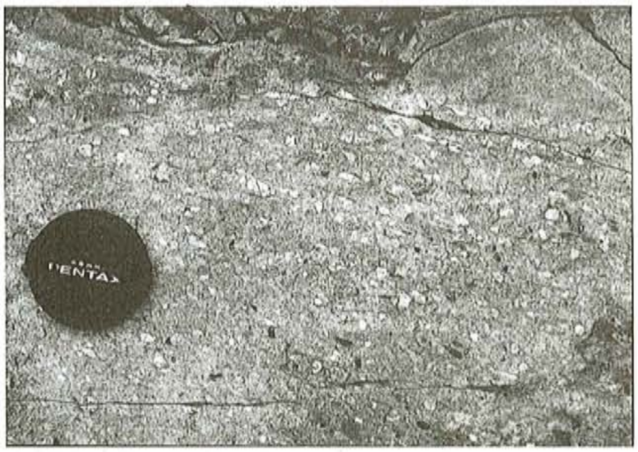

Plate 5. *Coarse sandstone of the Davidsville Group containing chert, feldspar and volcanic clasts (Unit 9). Great Gull River road, 6 km east of Great Gull River.*

Group (Unit 10) is uncertain but it is assumed to be stratigraphic.

The slates east of Webber Pond contain a strong cleavage that is parallel to bedding. Certain horizons in the slate contain abundant graptolites. The graptolites have been examined by S.H. Williams and they indicate that the unit is late Caradocian to early Ashgill in age (S.H. Williams, written communication, 1992). This occurrence is probably a correlative of similar slates located 3 km to the northeast, on Beaver Brook, which contain the Caradocian graptolites *Climacograptus bicornis* (Hall), or *spiniferous* (Ruedemann), *Hallograptus?, Orthograptus?* and a stipe of *Dicellograptus* (J. Riva, written communication, 1980, in Blackwood, 1981). These strata have been included in the Davidsville Group by Blackwood (1981).

The Davidsville Group in the map area is not significantly metamorphosed. A prominent feature of the southeastern area of the Davidsville Group is the presence of two intersecting cleavages. The first cleavage is parallel to bedding and, where not affected by the second folds, is steeply dipping to the northeast. The second cleavage is axial planar to small, gently plunging, subhorizontal, second folds. The direction of plunge of the second folds is highly variable, indicating that they are also folded about open third folds. Quartz veins are locally concentrated along the axes of the second folds.

BOTWOOD GROUP (UNITS 10 TO 14) AND NORTH STEADY POND FORMATION (UNITS 10 AND 12)

Introduction

Units 10 to 14 have been assigned to the Botwood Group following the work of Anderson and Williams (1970), Blackwood (1981) and Colman-Sadd and Russell (1988). Units 10 to 12 lie east of the Mount Peyton Intrusive Suite and are generally continuous with units mapped by Blackwood (1981). Units 13 and 14 lie west of the Mount Peyton Intrusive Suite and form the southern termination of units mapped by Colman-Sadd and Russell (1988).

The Botwood Group has until recently been considered to be entirely of Silurian age and constitute a sequence of dominantly subaerial sedimentary and mafic and felsic volcanic rocks and minor, shallow-marine strata. Recent structural and stratigraphic analyses in the Bay of Exploits area indicate that the Botwood Group may contain a variety of marine sedimentary and mafic volcanic rocks (O'Brien, 1991). Moreover, recent fossil discoveries in turbidites of the Botwood Group have extended its range into the Upper Ordovician (Boyce *et al.*, 1991). In the Eastern Pond map area, rocks similar to those described by O'Brien (1991) are exposed in the central part of the map area although volcanic rocks are absent. The increased age range and variety of rocks may eventually require a revision of the Botwood Group.

Several areas have been removed from the Botwood Group where the underlying sedimentary rocks are poorly bedded, uncleaved, and poorly lithified; Units 29 and 30; cf. Anderson and Williams (1970), and Zwicker and Strong (1986).

The North Steady Pond Formation has normally been included in the Baie d'Espoir Group (e.g., Dec and Colman-Sadd, 1990). This has been based on an interpreted gradational contact of the formation with other units of the group. The North Steady Pond Formation (part of Units 10 and 12), outcrops in the southwestern corner of the map area, in the vicinity of Swiss Lake, where it forms the continuation of the strata in map areas NTS 2D/5 (Colman-Sadd, 1985) and 2D/12 (Colman-Sadd and Russell, 1988).

To the northeast of Swiss Lake, the formation appears to be continuous with and contain the same rocks as the various units of the Botwood Group. However, stronger support for the correlation of the North Steady Pond Formation with some units of the Botwood Group comes from a new fossil locality on the Bay d'Espoir Highway (Figure 2). At this locality, one bed of calcareous sandstone contains abundant fragments of crinoid stems, one brachiopod fragment, and bryozoa (W.D. Boyce, personal communication, 1991). This locality contains a fauna similar to that described by Anderson and Williams (1970) and Blackwood (1981). They reported that on Cooper Brook (Figure 1), a calcareous siltstone contains corals, crinoid stems and brachiopods interpreted to be indicative of a Silurian age.

Unit Descriptions

Unit 10 is well exposed along the Great Gull River and along the eastern part of the Northwest Gander River. Sporadic exposures occur along and near the woods roads east of the Great Gull River. The eastern part of the unit comprises a sequence of northwest-dipping, medium- to thick-bedded grey, brown-weathering sandstone and coarse-grained sandstone, white quartz-rich sandstone and minor, thin-bedded, grey-green and purple siltstone. Two areas of concentrated black slate float are exposed along the main branch road. The source of the float is not apparent. Slump structures, convolute lamination, graded bedding, crossbedding, parallel and crosslaminations all occur in these sediments. Evidence for shallow-water sedimentation is not apparent and these sediments are interpreted to be possibly proximal turbidites. The sedimentary features generally indicate younging to the northwest.

Along Great Gull River, the most southerly exposures of Unit 10 comprise a sequence of relatively schistose, sericitic and chloritic sedimentary rocks with numerous small folds. Immediately to the northwest, a monoclinal, northwest-dipping sequence of fine- to medium-grained sandstone and minor siltstone and slate are exposed nearly to the mouth of the river. These strata are much less deformed and sedimentary structures are well preserved. The sandstone is medium- to thick-bedded, grey-green and green and rarely brown.

The most conspicuous sedimentary structures are mudcracks and ripple marks. The mudcrack polygons are on average about 20 cm in diameter but they are commonly stretched. The length to width ratio is 2:1, in a few places, with the long axis plunging to the north. The ripple marks are mainly symmetrical and have wavelengths of 20 to 40 cm and amplitudes of 2 to 3 cm. The rare asymmetrical ripples (Plate 6) indicate current flow towards 063 and 276°. Other sedimentary features include parallel laminations, sand lenses, disrupted laminations, crosslaminations, scours and graded beds.

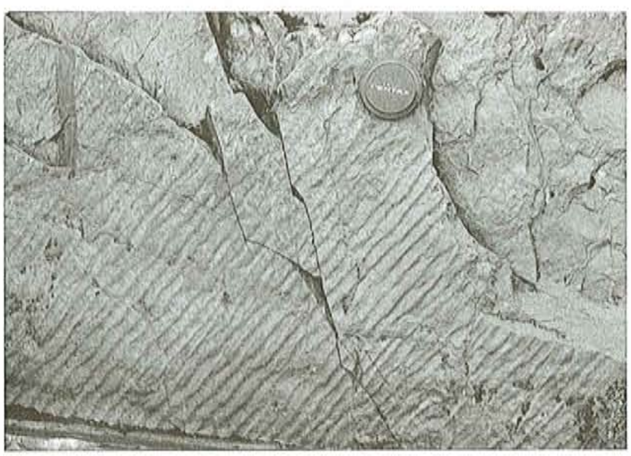

Plate 6. *Asymmetric ripple marks in sandstone of the Botwood Group (Unit 10). Great Gull River, 3 km south of the mouth of the river.*

In the vicinity of Miguels and Rolling falls, Unit 11 (the hornfels equivalent of Unit 10) is a sequence of medium- to thick-bedded sandstone that contains mudcracks, parallel- and crosslaminations, graded beds, scours, and siltstone rip-ups. The effects of contact metamorphism by the adjacent gabbro (Unit 17) are reflected in the grey rather than buff or green colour of the sandstone, and toughening of the rock up to 2 km from the contact. At the contact at Miguels Falls, the rock is partially melted for about 1 m from the contact. The succession at Miguels and Rolling falls is similar to that along Great Gull River with medium- to thickly-bedded sandstone that commonly display sedimentary features including abundant mudcracks.

Near the mouth of Bear Brook, a well-exposed sequence of thin-bedded, hard, green sandstone and minor siltstone dips steeply to the east. Elongated, sandy limestone nodules form strings parallel to bedding at one locality. The sequence generally lacks sedimentary structures but the thin, parallel beds, commonly 5 to 20 cm thick having thin silty partings are a prominent feature. This sequence is almost continuously exposed for 300 m upstream to where it is probably unconformably overlain by soft, massive, poorly bedded, coarse-grained sandstone and red and green, thin-bedded shale (Unit 29). Three kilometres upstream, a similar sequence of thin-bedded sandstone is exposed.

Along the Northwest Gander River, 1.7 km east of Great Gull River, a sequence of green, thin- to medium-bedded, parallel-bedded sandstone, siltstone and slate is nearly continuously exposed downstream for 4 km. The sediments only rarely display sedimentary features such as graded beds and crosslaminations. These features indicate that the sequence is consistently younging to the west.

One kilometre south of Jumbo Brook (Figure 1), grey-green thin to medium-bedded sandstone is in faulted contact with very thick-bedded pebble conglomerate and sandstone units (subunit 10a) that are several metres thick. The thick-bedded sandstone and conglomerate structurally underlie the thinner bedded sandstones. Across the fault, there is an abrupt change in the dip of bedding. The thin beds dip gently to the west at 30 to 45° whereas the conglomerate dips to the east at 70°. This fault may represent the trace of tight overturned folds and thrust structures. The strata exposed discontinuously downstream for about 6 km consistently dip to the east at high angles. Sedimentary features such as grading, crossbedding and scours in the thick-bedded sandstones and pebble conglomerates and scours in the thin-bedded sandstones indicate that the sequence is overturned to the west. The thick-bedded strata form lenses within the thin-bedded strata.

The thin-bedded strata comprise a sequence of grey, parallel-bedded, sandstone and minor siltstone that forms long outcrops of continuous beds. Locally, ovoid nodules of sandy limestone form bands in the thin-bedded sandstones. The nodules and the thin, parallel beds are very similar to those on Bear Brook. A similar conglomerate sequence is exposed at the southwestern end of the belt around Swiss Lake. The thick-bedded sandstones and conglomerates on the Northwest Gander River (subunit 10a) contain clasts of black chert, siltstone and red jasper. The chert fragments resemble the bedded chert exposed southeast of Webber Pond and the jasper is presumably derived from the Gander River ophiolite complex to the east (see Blackwood, 1982). At Swiss Lake, the conglomerate contains abundant felsic volcanic clasts along with conspicuous jasper. The volcanic fragments are probably derived from the North Steady Pond Formation southwest of the map area (Colman-Sadd, 1985).

Southeast of Webber Pond, the grey sandstone and siltstone along the contact with the Mount Peyton Intrusive Suite are tentatively included in Unit 10 of the Botwood Group. The unit here consists of medium-bedded grey sandstone and slate that generally lack sedimentary structures but a few ripple-marked surfaces are present. Outside of the contact aureole, the sandstone and slate are strongly cleaved.

The sedimentary features of Unit 10 indicate that much of the lower part of the sequence was deposited as possibly proximal turbidites. The thick sandstone and conglomerate beds (subunit 10a) may represent debris flows. The turbidites were then overlain by progressively shallower water deposits in very shallow-marine conditions and it is probably an intertidal sequence from Great Gull River to Rolling Falls.

The Botwood Group strata along the lower portion of the Northwest Gander River requires further study. In particular, the relationship of the turbiditic sandstone and associated conglomerates to the green slates and shallow-water strata is uncertain. Blackwood (1982) describes thin-bedded sandstones of the Davidsville Group (see Plate 12) that are virtually identical to the thin-bedded sandstones exposed along the Northwest Gander River and considered to be part of the Botwood Group.

A feature of Units 10 and 11 is the presence of a variably developed cleavage parallel to bedding. Variations in direction of dip along the Northwest Gander River indicate that the cleavage and bedding are folded into open folds that plunge gently to the north. This plunge coincides with small folds along the Northwest Gander River, 4 km northeast of Great Gull River, that plunge toward 342° at 16°. As cleavage is also folded by these folds, the main cleavage must reflect a recumbent first fold and the open folds are second folds. The presence of beds that are overturned to the west may be interpreted to indicate that the first fold is a recumbent syncline. Locally, folds of cleavage plunge gently to the southwest or moderately to the west and this may reflect a third phase of folding that forms open folds that mainly plunge to the east at 40 to 70°. A cleavage is rarely associated with the second folds.

Regional metamorphism of Unit 10 is in the lower-greenschist facies with the widespread occurrence of chlorite reflected in the green colour of the rocks. Contact metamorphism has converted the strata to hornfels near the contact with the Mount Peyton Intrusive Suite and small cordierite porphyroblasts are found in the sandstones 6 km east of Webber Pond.

Unit 12 comprises a thin- to medium-bedded sequence of red and minor grey and beige siltstone and sandstone that appears to lie within Unit 10. The unit is a steeply dipping to overturned sequence that is well-exposed along woods roads and adjacent cut-over areas west of Spud Pond. This area of Unit 12 is a fault-bound block that is surrounded by components of the Great Bend Complex; the contacts are not exposed. To the northeast of Spud Pond, the unit youngs toward the sandstone of Unit 11. However, there is a change in the orientation of bedding that possibly indicates that there is a faulted contact.

The sedimentary features of Unit 12 include crosslaminations, mudcracks, graded beds, shale rip-ups and rain pits. These clearly indicate very shallow water and, by association with the marine Unit 10, possibly intertidal conditions. The unit is unmetamorphosed and west of Spud Pond contains a poorly developed, east-trending cleavage that is at an angle to bedding. The intersection of these planes indicate a fold that plunges due north at 80°.

West of the Mount Peyton Intrusive Suite, a sequence of buff-weathering, grey sandstone hornfels (Unit 13) forms part of the Botwood Group. The areal distribution of the unit is quite different from that shown by previous workers as it actually forms a large east-trending embayment into the intrusive suite (cf. Anderson and Williams, 1970).

Unit 13 consists of medium-bedded, parallel laminated sandstone locally containing abundant mudcracks, and minor slate and felsic volcanic rocks. The sandstones are extremely hard and this is interpreted to be the result of widespread contact metamorphism by the Mount Peyton Intrusive Suite. At the northern end of the unit, where the sandstone is in contact with granite (Unit 21), the sandstone is metamorphosed in a much narrower zone. However, there is clear evidence of partial melting of the sandstone. Small veins and patches of tourmaline–biotite–muscovite granite and pegmatite occur in the sandstone (subunit 13a) within 300 m of the contact. Abundant xenoliths of partially melted and/or granite-veined sandstone define the northern margin of Unit 13. Within the adjacent granite, sandstone xenoliths are locally abundant.

Extensive subcrop of felsic volcanic rocks occur along a branch woods road, 2.2 km northeast of Rolling Pond. The rock is red, fine-grained, massive porphyritic rhyolite. One km northeast of Rolling Pond, crystal-lithic tuff is exposed at the end of a woods road. This rock is, however, similar to the glacial erratics of tuff that occur throughout the map area and the occurrence may be a partially buried erratic.

The beds in Unit 13 are generally parallel but have been boudinaged, possibly tectonically, as well as by soft-sediment processes. The minor slates possess well-developed cleavage and a spaced cleavage is locally present in the sandstone beds.

Unit 13 is similar to Unit 11 and the western portion of Unit 10 and is probably a correlative. All are dominated by grey, medium-bedded sandstone, contain mudcracks and exhibits various types of lamination.

Unit 14 comprises a highly variable sequence of well-cleaved, red, purple or grey-green conglomerate, sandstone and siltstone in strong contrast to Unit 13. The change is abrupt although not exposed. There is also no indication of contact or regional metamorphism. The stratigraphically lowest part of the unit in the map area is a poorly sorted, pebble and cobble conglomerate located near the contact with subunit 7a. The clasts consist mainly of grey sandstone, quartz-veined green sandstone, and of quartz-rich sandstone. The beds vary in thickness from 1 to 3 m and are probably lenses.

The sandstone is also polymict and displays parallel, convolute and crosslaminations, scours, rip-ups, and sandstone dykes. The siltstone includes purple, green, red and grey varieties that contain the same types of laminations as the sandstone. Beds vary in thickness from 1 cm to 1 m. The sequence probably represents fluvial deposits.

A prominent feature of the siltstone and sandstone is the strong cleavage at a high angle to bedding (Plate 7). Minor folds of bedding plunge steeply to the east-southeast and contain an axial-planar cleavage.

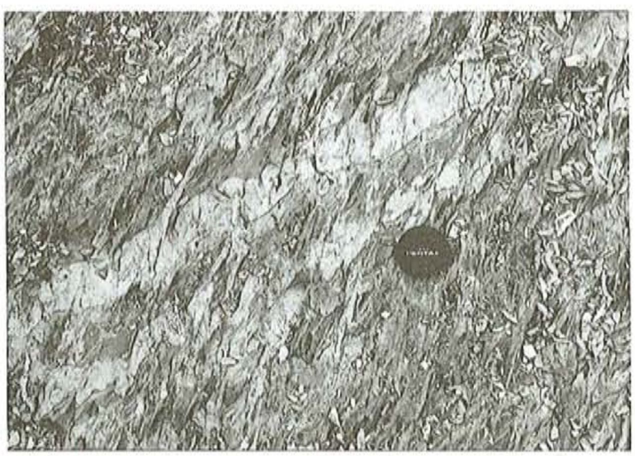

Plate 7. *Strongly cleaved, thin-bedded sandstone of the Botwood Group (Unit 14), 2 km northwest of Rolling Pond.*

The distinctly different rocks of Units 13 and 14 and other factors such as the extensive contact metamorphism of Unit 13 and the strong cleavage in Unit 14 may indicate that there is an unconformable relationship between them. Unit 13 was possibly metamorphosed by the intrusive suite before deposition of Unit 14. The deformation that produced the cleavage in Unit 14 may not have been of sufficient intensity to produce a penetrative fabric in the hornfels of Unit 13.

POST-KINEMATIC SEDIMENTARY ROCKS

Four areas of post-kinematic sedimentary rocks have been defined in the southeastern part of the map area. These rocks lack any penetrative fabric, metamorphism or minor intrusions and a Devonian or younger age is assumed.

Unit 28 forms a prominent hill, 2.5 km west of Spud Pond (see also Colman-Sadd, 1982) that is underlain by poorly bedded, sand- to boulder-size clasts. The largest clast found is about 5 m long. The clasts are composed entirely of ultramafic rocks and the dominant variety is peridotite (Plate 8). The peridotite includes layered and massive types, and also asbestos-bearing and quartz-veined clasts. Colman-Sadd (1982) reported the presence of magnesite clasts. Bedding is defined by poorly developed, gradual changes in clast size over a thickness of 2 m.

Plate 8. *Peridotite-cobble conglomerate of Unit 28. Small isolated hill, 0.5 km north of Lizard Pond.*

The conglomerate overlies schistose peridotite which outcrops immediately to the north of the hill, and sheared magnesite that lies to the south of the hill. These two ultramafic units are in sheared contact. The ultramafic clasts are derived from massive peridotite and the nearest exposed source is 1 km to the west, near South American Pond.

Unit 29 occurs in two extensive areas. The main area lies west of the Great Gull River and the other smaller but potentially economically significant unit is located to the north, 7 km east of Webber Pond (Figure 1). The dominant rock type in the southern area is poorly sorted feldspathic sandstone accompanied by minor red and black shale, pebble and cobble conglomerate. Bedding is extremely poorly developed and this is a characteristic feature of the unit. The sandstone unconformably overlies Unit 10 on Bear Brook and pebble conglomerate nonconformably overlies a diabase dyke (Unit 27) 300 m east of Bear Brook (see Dickson, 1991). The contacts with the other adjacent units are unexposed.

The cobble conglomerates outcrop 200 to 500 m west of the mouth of Great Gull River. The main clast type is grey sandstone (similar to the sandstone hornfels of Unit 11 of the Botwood Group) pink felsic volcanic clasts, chert and quartzite. The matrix is rich in feldspar and small sandstone clasts. The pebble conglomerate contains conspicuous red jasper and black chert fragments, along with beige and pink felsic volcanic fragments, quartz-rich sandstone, quartz-veined sandstone, and fine-grained pink granite. The black chert is similar to Unit 8; the felsic volcanic rocks have presumably been derived from the North Steady Pond Formation, west of the map area (Colman-Sadd, 1985); the jasper is possibly derived from an ophiolite complex (see e.g., Blackwood, 1982). The quartz-rich and quartz-veined sandstone fragments are probably derived from the Spruce Brook Formation.

The cobble conglomerate is assumed to be in contact with red shale and this is in assumed contact with black shale. No shale bedrock is exposed but thick talus slopes of shale are found along the woods road.

The sandstone is dominated by 2- to 4-mm-long plagioclase feldspar fragments and mafic mineral detritus. The proportions are similar to that found in the nearby gabbro intrusions (Units 15, 17 and 18), which are presumed to be the main source of sand-sized clasts.

A rather unusual unit is exposed along the Northwest Gander River for 1.5 km east of Great Gull River. The unit is a pebble to cobble conglomerate having well-aligned larger clasts set in a coarse sand- to granule-conglomerate matrix. The unit is poorly lithified and is easily fragmented. However, the conglomerate has sufficient competence to be cut by a fault that is filled with a quartz vein. This also indicates that the unit is probably not Pleistocene.

The unit contains a wide variety of clasts; these include grey, green and red sandstone, quartz-veined sandstone, grey coarse-grained sandstone, red siltstone, green slate, and amphibolite schist. The slate fragments are angular and the other clasts are rounded and elongate. All these rocks can be matched with the nearby units. The flatter, large fragments are aligned and this is assumed to represent bedding. However, it is also possible that the fragments are imbricated and the bedding planes dip at shallower angles. One 30 cm boulder is surrounded by flat clasts that are wrapped around its structurally lower margin. The unit bears a strong resemblance to the overlying Pleistocene glaciofluvial gravels and a fluvial source is likely.

MOUNT PEYTON INTRUSIVE SUITE AND ASSOCIATED INTRUSIONS (UNITS 15 TO 27)

Units 15 and 16 are gabbro intrusions that are located at Bear Pond and along the Northwest Gander River, respectively. Most earlier workers assigned these units to the Great Bend Complex mainly because of their spatial relationship to the ultramafic rocks. Zwicker and Strong (1986) indicated that the gabbro near Bear Pond was spatially separated from the ultramafic rocks by sedimentary rocks and, therefore, unrelated to the ultramafic rocks. Recent woods-road construction, however, has exposed several gabbro outcrops that indicate the gabbro is in contact with the ultramafic rocks. The gabbro near the contact is extensively brecciated indicating that the contact is faulted. The contact of the gabbro with the Botwood Group is probably intrusive as diabase dykes cut the Botwood Group, northeast of Bear Pond. Widespread unmetamorphosed, red siltstone float overlies the gabbro and is possibly related to Unit 29.

The contact of the gabbro with the ultramafic rocks is assumed to be a fault but E. Çogulu (Geological Survey of Canada, personal communication, 1991) has suggested that the adjacent ultramafic rocks are contact metamorphosed indicating an intrusive contact. It is unlikely that the gabbros are related to the Great Bend Complex, as similar rocks occur within the Mount Peyton Intrusive Suite, but chemical analyses should resolve this.

The gabbro of Unit 15 ranges in grain size and texture from medium-grained, equigranular diabase and very coarse-grained gabbro, with a weak alignment of pyroxene and plagioclase, to very coarse-grained massive gabbro. The very coarse-grained gabbro contains 2-cm-long plagioclase crystals and 1-cm^2 interstitial hornblende.

Unit 16 gabbro is dominantly medium- to coarse-grained and equigranular but at one locality, on the south side of the Northwest Gander River, three outcrops of the gabbro are layered. The eastern contact with the Botwood Group is faulted and the gabbro is weakly foliated and brecciated for about 100 m west of the contact. The remainder of the gabbro is undeformed. The layered gabbro contains parallel and continuous bands that have varying proportions of plagioclase and pyroxene (Plate 9); some layers are pegmatitic. The bands vary in thickness from 30 to 60 cm. They are also laminated and dip steeply to the southeast. Generally, the gabbro is quite massive forming large homogeneous blocks of white-weathering, grey gabbro.

Plate 9. *Layered, massive gabbro of Unit 16. Northwest Gander River, 2 km northwest of Spud Pond.*

THE MOUNT PEYTON INTRUSIVE SUITE

The Mount Peyton Intrusive Suite comprises 10 contiguous units of massive plutonic rocks in the Eastern Pond map area. Intrusive relationships indicate that the granitic rocks are younger than the gabbroic rocks and that the more leucocratic granites are the youngest intrusions. The age relationships of the various gabbroic units are uncertain due to lack of intrusive contacts.

Previous radiometric age determinations on the suite have been made to the north of the map area on samples from map areas NTS 2D/14 and 2E/3 (Table 1). The 270 ± 52 Ma

Table 1. Published radiometric ages for the Mount Peyton Intrusive Suite. Ages have been recalculated to current decay constants where necessary (from Mandville, 1989)

Rock type	Age (Ma)	Method	Location	Reference
Diorite	418 ± 21	K−Ar biotite	Burnt Lake	Wanless *et al.*, 1965
Granodiorite	270 ± 52	K−Ar hornblende	NW Gander R.	Wanless *et al.*, 1967
Granodiorite	369 ± 21	K−Ar biotite	Rattling Lake	Wanless *et al.*, 1967
Granite, gabbro	380 ± 30	Rb−Sr whole rock	N. end pluton	Bell *et al.*, 1977
	390 ± 15	Rb−Sr whole rock		revised by Bell and Blenkinsop, *in* Reynolds *et al.*, 1981
Granodiorite	428 ± 5	Ar−Ar biotite	Frozen Ocean L.	Reynolds *et al.*, 1981
Gabbro	423 ± 5	Ar−Ar hornblende	Trans-Canada	Reynolds *et al.*, 1981
Gabbro	417 ± 5	Ar−Ar biotite	Trans-Canada	Reynolds *et al.*, 1981
Gabbro	410 ± 5	Ar−Ar hornblende	Trans-Canada	Reynolds *et al.*, 1981
Gabbro	414 ± 5	Ar−Ar biotite	Trans-Canada	Reynolds *et al.*, 1981
Gabbro incl.	412 ± 8	Ar−Ar biotite	Trans-Canada	Reynolds *et al.*, 1981
Gabbro incl.	400 ± 7	Ar−Ar hornblende	Trans-Canada	Reynolds *et al.*, 1981
Granitic matrix	422 ± 8	Ar−Ar biotite	Trans-Canada	Reynolds *et al.*, 1981

(K−Ar hornblende; recalculated) date is considered to be suspect as the hornblende is apparently chloritized. Similarly, the 410 ± 5 Ma is suspect due to the replacement of hornblende by fibrous amphibole and sericite. Reynolds *et al.* (1981) note that the dated biotite is quite fresh and suggest an age of 420 Ma for the gabbro. They also report a revised age of 390 ± 15 Ma (K. Bell and J. Blenkinsop, personal communication, 1980) for the granite phase.

Preliminary U−Pb (zircon) work on pegmatitic hornblende gabbro (Plate 10) in massive, medium-grained gabbro (Unit 18) on Rolling Brook, 1 km south of Rolling Pond (dated under contract by G.R. Dunning, 1991) also indicate a Silurian age. When completed, this work will provide a precise age of part of the Mount Peyton Intrusive Suite. As the contact metamorphic aureole overprints the fabrics in the adjacent sedimentary units, including the Spruce Brook Formation and Units 10, 11 and 13 of the Botwood Group, all these units must be older than the intrusion and have been deformed before it.

Unit 17 is assumed to be the oldest unit of the suite in the map area. It is characterized by well-developed, parallel igneous layers and a generally coarse grain-size. The layering strikes northerly and is apparently truncated to the north by poorly layered to uniform, medium-grained gabbro (Unit 18; Plate 11). This is taken to indicate that Unit 17 is the older unit.

The eastern and western contacts of Unit 17 with the Botwood Group (Unit 11) are exposed on the Northwest Gander River at Rolling Falls and Miguels Falls. The contacts are fairly sharp with minor assimilation of the adjacent sandstone. The gabbro is slightly finer grained within 50 cm of the contact and medium-grained away from the contact; it also displays a swirly flow foliation. Ophitic intergrowths of plagioclase and hornblende occur in patches. Small, round xenoliths of sandstone are found in the gabbro up to 30 cm from the contact. The contacts are steeply dipping and at Miguels Falls the gabbro is concordant with, and appears to underlie, the sandstone layers. No contact metamorphic minerals were observed and the sandstone is a hornfels.

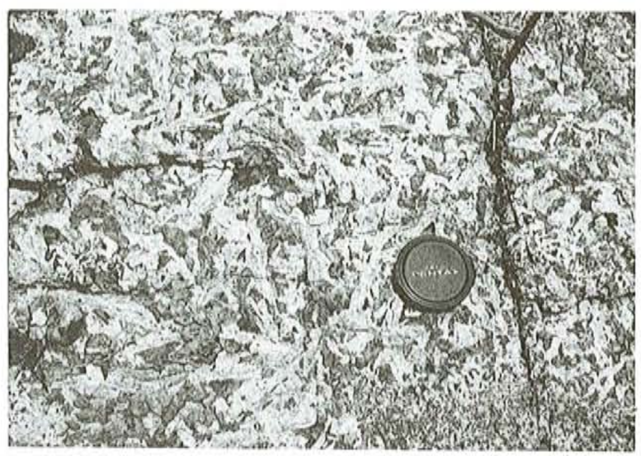

Plate 10. *Pegmatitic gabbro of the Mount Peyton Intrusive Suite (part of Unit 18). Rolling Brook, 1 km south of Rolling Pond.*

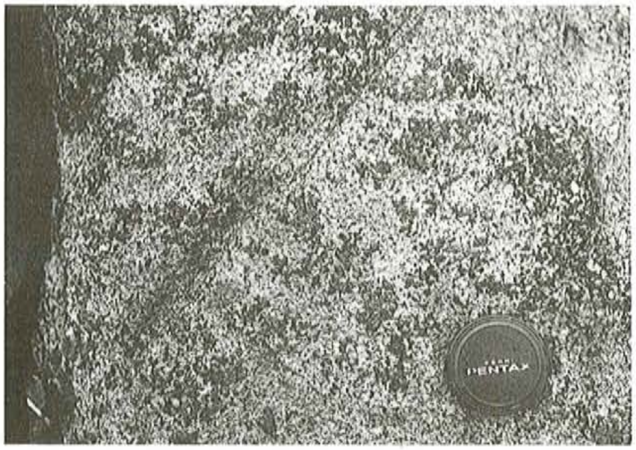

Plate 11. *Massive, medium-grained hornblende gabbro. Unit 18 of the Mount Peyton Intrusive Suite, 1 km east of Rolling Pond.*

The contact with the Spruce Brook Formation is exposed in the woods, 500 m north of the Chiouk Brook gold showing. Fine-grained massive diabase cuts strongly foliated, quartz-rich sandstone. There is also a metamorphic aureole about 1 km wide in the Spruce Brook Formation, 2.8 km south of Rolling Pond, which is defined by the progressive development of biotite, cordierite, and lenses containing garnets toward the contact. Within the gabbro, veins of possibly autobrecciated gabbro cut through the massive fine-grained gabbro and may indicate that the gabbro is a high-level intrusion.

The gabbro is dominated by plagioclase, pyroxene and locally conspicuous hornblende. In the layered units, the plagioclase : pyroxene ratio varies from 10:1 to 1:2. The layering is parallel and straight but the junction of the layers is generally ragged. The layers are 4 to 30 cm thick. Along Rolling Brook, the layers are nearly vertical and trend north-northwest but to the north of Rolling Falls the layers dip gently to the northwest. Thin veins and patches of magnetite occur in the gabbro 1.8 km west-northwest of Rolling Falls. Near the northwest contact of the unit, the gabbro outcrops are altered to mounds of extremely friable and rusty gossan.

Unit 18 is the most extensive unit of the suite in the map area occurring in three apparently separate areas. The texture is also highly variable and ranges from fine-grained, uniform gabbro having clots of amphibole (Plate 11) to coarse-grained, trough-layered gabbro. The eastern and northern portions are dominantly uniform gabbro and the layered gabbro is restricted to the Rolling Pond area.

Unit 19 is distinguished from Unit 18 only by the presence of abundant granite dykes, which form about 10 percent of Unit 19. The dykes are probably correlatives of the granodiorite and granite of Units 23 and 24, respectively, with which the gabbro is in contact. The contacts with the country rocks are not exposed but the extensive sandstone hornfels of Unit 13 and the narrow hornfels in Unit 10, east of Webber Pond, are almost certainly metamorphosed by Unit 18.

Generally, the gabbro is fine- to medium-grained pyroxene $\pm$ hornblende gabbro containing widely scattered inclusions of medium- to medium coarse-grained poikilitic gabbro. Locally, the gabbro contains conspicuous 3-mm-long hornblende needles that are strongly aligned. The layered gabbro contains highly irregular layers of medium, coarse-grained and pegmatitic gabbro. The pegmatitic gabbro contains abundant hornblende crystals locally over 10 cm long. The pegmatitic gabbro is in gradational contact with the finer grained gabbro and forms layers rather than veins. Pegmatite also forms patches of various sizes throughout the unit.

The dykes that cut Unit 19 are all granitic and occur throughout the unit. The proportion of dykes varies from 1 to 20 percent and they range in thickness from about 5 cm to 2 m. Individual dykes may vary in orientation and thickness. The dykes are white to grey, massive, leucocratic, fine- to medium-grained, biotite $\pm$ hornblende granite. Ovoid and angular gabbro xenoliths from Unit 19 are abundant in the adjacent granite (Unit 25), south of Otter Lake.

The gabbro of Unit 20 is probably cut by the granite of Unit 21; exposures of these units are in close proximity along woods roads 2.5 km southwest of Haynes Lake in map area NTS 2D/12 (see Colman-Sadd and Russell, 1988). Unit 20 is also in exposed intrusive contact with the Botwood Group along the woods roads in this area. The gabbro contains abundant sedimentary xenoliths and gabbro dykes cut the sandstone and is converted to hornfels.

The gabbro of Unit 20 is distinguished from that of Unit 18 by the presence of variable amounts of 1- to 2-mm diameter biotite flakes in an otherwise similar matrix. The gabbro contains medium-grained and slightly coarser-grained varieties as xenoliths and is cut by several granitic dykes and hornblende gabbro pegmatite veins. It contains recognizable hornblende in hand specimens but the main ferromagnesian mineral is probably pyroxene.

Unit 21 is a fine- to medium-grained, massive, leucocratic muscovite–biotite granite that occurs along the western margin of the suite. The actual extent of the unit is a matter of definition. This is due to the presence of locally extensive sandstone outcrops that are cut by abundant granite veins and also granite having abundant sandstone inclusions. Furthermore, many of the xenoliths are migmatized and contain sizeable patches of granite. The large protrusion of Unit 13 sandstone into the suite reflects the interpretation of a series of sandstone outcrops, some of which are veined by granite, as part of Unit 13. The outcrops along the northern portion of the protrusion were mapped as part of the granite by Colman-Sadd (1982) rather than as part of the Botwood Group.

The granite is in intrusive contact with Unit 13 south-southwest of Haynes Lake. Several granite and granite pegmatite veins cut the sediments adjacent to the contact and there is incipient migmatization. The neosome is similar to the main granite but also contains conspicuous tourmaline and fine-grained muscovite and biotite. It forms isolated patches in the sandstone and is clearly not derived directly from the main granite.

The formation of the migmatite by intrusion of the granite is possibly unlikely as the area underlain by the granite (Unit 21) is quite small and also quite narrow where migmatization has occurred. This volume of granite is unlikely to have contained sufficient heat to migmatize the country rocks. An alternative scenario is that both the granite of Unit 21 and the migmatization are related to the intrusion of the adjacent gabbro, which caused extensive partial melting of the adjacent sedimentary rocks. The gabbro is much more extensive, would have been emplaced at a much higher temperature, and therefore would have contained more heat. This also would explain the presence of extensive areas of sandstone xenoliths, migmatization and granite veining of the sandstone inclusions within the granite unit and adjacent to the gabbro. This scenario also would indicate that Unit 21 granite is the oldest granite in the map area.

Unit 22 consists of two small areas of grey, massive, fine-grained, biotite–hornblende tonalite. The smaller area is located along the contact of the suite with the sandstone of Unit 13. The contacts of both areas of tonalite with the adjacent gabbro (Unit 18) are not exposed but the tonalite is interpreted to be the younger unit as it is not cut by any mafic dykes and one area is surrounded by gabbro.

The granodiorite of Unit 23 is located to the north of Webber Pond where it forms part of an area dominated by granitic rocks. The unit is mainly a grey, medium-grained, massive, biotite–hornblende granodiorite that is locally coarser grained. The unit is cut by granite dykes from Unit 25 and is intruded by Unit 24. The contacts with Unit 24 are exposed southwest of Crowe Lake and northeast of Webber Pond. The contacts are sharp and veins of Unit 24 cut the granodiorite.

Unit 24 is a grey to pink, leucocratic, massive, fine-grained, biotite granite that is well exposed along the main road north of Webber Pond. Small, angular, mafic xenoliths occur locally in the unit. The unit appears to form a roughly circular plug that has intruded all adjacent units.

Unit 25 underlies an extensive area in the northeastern portion of the map area. This unit is shown by Blackwood (1981) as continuing to the northeast and forming the eastern portion of the intrusive suite. The contact of the granite with the adjacent sandstone of Unit 10 is not exposed but the sandstones are contact metamorphosed. A pink granite dyke (see Dickson, 1991) cuts Unit 10, 2.5 km southeast of Webber Pond and although the dyke is 4 km from Unit 25 it is probably related to it. The granite is in sharp contact with the gabbros of Units 18 and 19, northeast of Webber Pond. Adjacent to the contact with Unit 25, east of Webber Pond, the granodiorite (Unit 23) is cut by numerous pink granite dykes that are clearly derived from Unit 25.

Unit 25 is consistently a pink, massive, fine-grained, leucocratic, biotite granite (Plate 12) that locally contains miarolitic cavities. Biotite forms less than 1 percent of the rock. Blackwood (1981) notes that micrographic intergrowths are apparent in thin section. These features indicate that the granite is a high-level intrusion. Unit 25 is probably the youngest unit of the suite, at least in the map area.

Plate 12. *Massive, fine-grained granite of Unit 25 of the Mount Peyton Intrusive Suite. Woods road, 3.5 km south of Otter Lake.*

Unit 26 comprises all the diabase dykes found within the Mount Peyton Intrusive Suite. Several 10-cm-thick, gently dipping, light-grey, diabase dykes cut the gabbro (Unit 18) along Rolling Brook. These truncate layers and commonly have thin offshoots. Farther to the east, several 1-m-thick, dark-grey, medium-grained diabase dykes also cut the gabbro. These dykes have irregular margins and their trend is inconsistent.

Unit 27 comprises all the diabase dykes found outside the Mount Peyton Intrusive Suite. These dykes are all grey, medium-grained and massive. One cuts the Botwood Group sandstone hornfels (Unit 11), 2 km southwest of Rolling Falls. Several dykes cut the green slates and sandstones along Great Gull River and 2 km to the east and 1.5 km west of the river. A gently dipping dyke cuts the Spruce Brook Formation at the Chiouk Brook gold showing. Another dyke is interpreted to have intruded the ultramafic rocks along the Northwest Gander River (see Dickson, 1991 for locations of all these dykes).

SURFICIAL GEOLOGY

The glacial history and striation data for the map area are contained in reports by Taylor and St. Croix (1989), St. Croix and Taylor (1990). The data indicate an early ice flow to the south, with subsequent flows to the east and then north. Extensive glacial outwash and till deposits occur throughout the map area but sand and gravel outwash deposits are most extensive along the Northwest Gander River valley (this study). Glacial erratics are abundant and boulders of the Stony Lake Volcanics (Colman-Sadd and Russell, 1982) are particulary conspicuous and widespread. Some of these have travelled a minimum distance of 30 km.

MINERALIZATION

Mineral exploration of the area began following the report of magnesite by Grady (1953). The Great Bend area received a cursory examination by Harrison (1953) and was mapped in detail by Coleman (1954), both of the Newfoundland and Labrador Corporation Limited (NALCO). A bulk sample of magnesite was obtained for metallurgical testing (Newfoundland and Labrador Corporation Limited, 1953) and subsequently reported to contain pervasive fine-grained silica that presented a problem in obtaining high-quality magnesite (Newfoundland and Labrador Corporation Limited, 1954; Stewart, 1957).

In 1963, three magnesite showings and an outcrop of sheared serpentinite, in the vicinity of Lizard Pond, were drilled to depths of 17 to 87 feet (approximately 5 to 26 m; Bell Asbestos Mines Limited, 1963). It is here assumed that this was an assessment of the magnesite potential of the area as NALCO had never indicated that asbestos was significant in the Great Bend area.

Magnesite rock from the Great Bend area was petrographically analyzed by Soles (1972) for NALCO. Soles reported that fine-grained talc and variable amounts of quartz along with minor chromite, magnetite and pyrite occur with magnesite. He also concluded that beneficiation of the magnesite ore could be difficult.

More recent exploration in the map area has concentrated on the gold potential of the Great Bend Ultramafic Suite. In particular, the magnesite has been the focus of extensive prospecting, mapping, trenching, drilling, geochemistry and geophysics by several companies.

Zwicker and Strong (1986) reported significant gold values from mineralized boulders in Chiouk Brook. Subsequently, the Chiouk Brook gold showing was optioned from L. Murphy by U.S. Borax (Burton, 1987). The area was prospected, and geophysical, geochemical and drilling programs carried out. The same data were also reported in Mercer (1988a,b). Mineralized boulders located in the brook gave a high gold value of 0.6 oz./ton gold (approximately 18 g/t). They also reported that core assays indicated limited Au enrichment (maximum 2.2 g/t over 1 m) with local antimony and arsenic anomalies.

Falconbridge Limited (Vaskovic, 1987; Butler, 1988) examined the ultramafic suite adjacent to the main highway and reported anomalous Ni and minor Au values.

Mercer (1988a,b) reported that the Lizard Pond prospect gave generally much higher values than the Chiouk Brook prospect with one 50-m-long intersection averaging over 0.5 g/t with a high value of 2.6 g/t. The high gold values are commonly in fine-grained, silicified, sulphide-bearing magnesite and are accompanied by enhanced antimony and arsenic values.

The Spruce Brook Formation and the Great Bend Complex were subsequently staked by L. Murphy and optioned by B.P. Resources Canada Limited and BP Canada Limited (Graham, 1989a,b, 1990). Their extensive exploration work including drilling, trenching, geophysics, bedrock mapping and assaying. The reports are currently confidential.

Noranda Exploration Company Limited (Tallman, 1989, 1990, 1991) reported the discovery and geology of widespread antimony (stibnite) mineralization in the Cooper Brook area (Figure 1). Tallman (1991) reported that trenching and drilling indicated that stibnite and stibnite–quartz veins occur in coarse sandstone, pebble conglomerate and siltstone (Unit 29) at the Hunan deposit. A grade of 35.6 percent Sb over 1 m from a trench is the highest grade reported. Spectacular specimens of bladed antimony with the 20-cm-long blades forming rosettes have been obtained from the showing. The Xingchang showing is described as highly fractured graphitic shale and siltstone cut by stibnite and stibnite–quartz veins with an intersection of 33 percent Sb over 1 m in drill core.

A 15-m-long trench located 1.5 km west-northwest of Spud Pond was discovered to contain massive arsenopyrite veins in brecciated serpentinite (Figure 1). This trench was apparently dug by BP Resources Canada Limited in 1990. The occurrence is close to the faulted eastern contact of the serpentinite (Unit 1) with sandstone (Unit 11). A high-grade sample of arsenopyrite contains 10.1 percent arsenic and 1.1 g/t gold and 579 g/t antimony (this study). A channel sample gave 0.304 g/t Au, 3.88 percent As, and 228 g/t Sb. No other new significant metallic mineralization has been observed.

The building-stone potential of gabbro from the Mount Peyton Intrusive Suite has been studied for several years (Tomlin, 1982) with some recent positive impressions of the quality of the stone (Meyer, 1991). The gabbro in the map area does not appear to be of good quality because of closely spaced fractures, xenoliths and textural variations. The gabbro of Unit 16 is light coloured and contains widely spaced joints. Large piles of massive blocks are found near the woods roads. The pyroxenite (Unit 2) exposed along the road to Great Gull River consists of black, fresh massive rock with a complete absence of light-coloured minerals. Blasted blocks range in size up to 10 m^3. The extent of the fresh, massive rock is uncertain because of the thick till cover.

SUMMARY

The Eastern Pond (west half) map area contains the highly faulted Great Bend Complex that forms part of an ophiolite suite. The Complex is in faulted (probably overthrust) contact with the Early Ordovician Spruce Brook Formation. A 1-km-wide zone of steeply dipping, polydeformed mylonitic and amphibolite schist may represent the basal aureole of the suite. It also appears that possible Silurian sedimentary rocks are also imbricated with the ultramafic rocks.

The eastern part of the map area is underlain by turbiditic slate and sandstone of the Ordovician Davidsville Group. The lower parts of the Botwood Group consists of turbiditic sandstones and siltstone that are overlain by shallow marine to intertidal, sandstone and siltstone of the Silurian Botwood Group. A different succession of shallow marine to terrestrial Botwood Group sedimentary rocks underlies the northwestern part of the map area. The Mount Peyton Intrusive Suite is a composite, postkinematic intrusion of gabbro, tonalite, granodiorite and granite. Preliminary dating of pegmatitic gabbro indicates a Silurian age. Two other gabbroic units are possibly related to the suite. Three units of postkinematic, mainly coarse-grained, sedimentary rocks unconformably overlie the Ordovician chert, the Botwood Group, and a small part of the ultramafic suite.

The southern half of the ultramafic suite is extensively altered to magnesite and most significant gold mineralization occurs in silicified magnesite within this zone. Massive arsenopyrite mineralization occurs in brecciated serpentinite. The Chiouk Brook gold showing contains anomalous gold values in ultramafic rocks discovered in drill core. The surface outcrops of siltstone and diabase may represent a melange overlying imbricated ultramafic and sedimentary rocks. Antimony mineralization occurs in graphitic slate of the Davidsville Group and also the postkinematic sandstone and conglomerate at the Xingchang and Hunan deposits, respectively.

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REFERENCES

Anderson, F.D. and Williams, H.
1970: Gander Lake (west half), Newfoundland. Geological Survey of Canada, Map 1195A.

Bell, K., Blenkinsop, J. and Strong, D.F.
1977: The geochronology of some granitic bodies from eastern Newfoundland and its bearing on Appalachian evolution. Canadian Journal of Earth Sciences, Volume 14, pages 454-476.

Bell Asbestos Mines Limited
1963: Diamond drilling data, Reid Lot 238, Big Bend, Northwest Gander River, Newfoundland. Unpublished data, 4 pages. [2D/11(60)]

Blackwood, R.F.
1981: West Gander Rivers (2D/11 east half) and Dead Wolf Pond (2D/10 west half). Newfoundland Department of Mines and Energy, Mineral Development Division, Map 81-100.

1982: Geology of the Gander Lake (2D/15) and Gander River (2E/2) area. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 82-4, 56 pages.

1983: Notes on the Geology of the Great Gull River map area (2D/6), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division. Accompanies Map 82-71.

Boyce, W.D.
1987: Cambrian-Ordovician trilobite biostratigraphy in central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 87-1, pages 335-341.

Boyce, W.D., Ash, J.S. and O'Brien, B.H.
1991: A new fossil locality in the Bay of Exploits, central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 91-1, pages 83-84.

Burton, W.B.
1987: First year assessment report on geological, geophysical and diamond drilling exploration for Licence 2738 on the Chiouk Brook prospect in the Great Bend area, Newfoundland. U.S. Borax Ltd., unpublished report, 8 pages. [2D/11(171)]

Butler, D.J.
1988: First year assessment report on geological and geochemical exploration for Licence 3182 on claim block 5489 in the Great Bend area on the Northwest Gander River, central Newfoundland. Falconbridge Limited, unpublished report, 28 pages. [2D/11(202)]

Coleman, L.C.
1954: The Great Bend area, Northwest Gander River, Newfoundland. Newfoundland and Labrador Corporation Limited, St. John's, Newfoundland. Unpublished report, 4 pages. [2D/11(27)]

Colman-Sadd, S.P.
1981: Geology of the Burnt Hill map area (2D/5), Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 81-1, pages 40-49.

1982: West Gander Rivers (2D/11W), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 82-59.

1985: Geology of the Burnt Hill map area (2D/5) area. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-3, 94 pages.

Colman-Sadd, S.P. and Russell, H.A.J.
1982: Geology of the Miguels Lake map area (2D/12), Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 82-1, pages 30-50.

1988: Miguels Lake (2D/12), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 88-50.

Colman-Sadd, S.P. and Swinden, H.S.
1982: Geology and mineral potential of south-central Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 82-8, 102 pages.

1984: A tectonic window in central Newfoundland? Geological evidence that the Dunnage Zone may be allochthonous. Canadian Journal of Earth Sciences, Volume 21, pages 1349-1367.

Dec, T. and Colman-Sadd, S.P.
1990: Timing of ophiolite emplacement onto the Gander Zone: evidence from provenance studies in the Mount Cormack Subzone. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 90-1, pages 289-303.

Dickson, W.L.
1991: Eastern Pond (west half) map area (2D/11W), Newfoundland. Newfoundland Department Mines and Energy, Geological Survey Branch, Map 91-166.

Dunning, G.R. and Krogh, T.
1985: Geochronology of ophiolites of the Newfoundland Appalachians. Canadian Journal of Earth Sciences, Volume 22, pages 1659-1970.

Evans, D.T.
This volume: Gold metallogeny of the eastern Dunnage Zone, central Newfoundland.

Graham, D.R.
1989a: Report on geology, soil geochemistry and channel sampling. BP Canada Limited, unpublished report, 5 pages plus data lists and maps. [2D/11(216)]

1989b: A geochemical and geological assessment report on Great Bend—Murphy Option claims. BP Canada Limited, unpublished report, 17 pages plus data lists and maps. [2D/11(217)]

1990: An assessment report on prospecting and geochemical surveys, trenching and diamond drilling performed at the Great Bend—Murphy Option, central Newfoundland. BP Resources Canada Limited, unpublished report, 10 pages plus data lists and maps. [2D/11(232)]

Grady, J.C.
1952: Preliminary report on southern ultrabasic party. Geological Survey of Newfoundland, unpublished report, 7 pages. [2D(54)]

1953: The geology of the southern half of the serpentine belt in east-central Newfoundland. Geological Survey of Newfoundland, unpublished report, 63 pages. [2D/11(5)]

Harrison, W.D.
1953: Northwest Gander River area. Newfoundland and Labrador Corporation Limited, St. John's, Newfoundland. Unpublished report, 4 pages. [2D/11(23)]

Kean, B.F.
1974: Notes on the geology of the Great Bend and Pipestone Pond ultramafic bodies. *In* Report of Activities 1973. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 74-1, pages 33-42.

Malpas, J.G. and Strong, D.F.
1975: A comparison of chrome-spinels in ophiolites and mantle diapirs of Newfoundland. Geochimica et Cosmochimica Acta, Volume 39, pages 1045-1060.

Mandville, L.W.J. (compiler)
1989: Newfoundland Geochronology Database, Version 1.0. Newfoundland Department of Mines and Energy, Geological Survey Branch, Open file Nfld (1881).

Mercer, B.J.
1988a: N.D.M.E. 2nd year assessment report on geological, geochemical and geophysical exploration surveys. Great Bend area. A.C.A. Howe International Limited, unpublished report, 18 pages. [2D/11(169)]

1988b: N.D.M.E. assessment report on diamond drilling at Chiouk Brook and Lizard Pond, Great Bend area. A.C.A. Howe International Limited, unpublished report, 15 pages. [2D/11(170)]

Meyer, J.
1991: Dimension stone: 1991 update. *In* Report of Activities for 1991. Newfoundland Department of Mines and Energy, Geological Survey Branch Report, pages 93-95.

Newfoundland and Labrador Corporation Limited
1953: Annual report of mining department. Newfoundland and Labrador Corporation Limited, St John's, Newfoundland. Unpublished report, 32 pages. [NFLD/105]

1954: Annual report of mining department. Newfoundland and Labrador Corporation Limited, St John's, Newfoundland. Unpublished report, 21 pages. [NFLD/106]

O'Brien, B.H.
1991: Geological development of the Exploits and Notre Dame subzones in the New Bay area (parts of NTS 2E/6 and 2E/11), map area, Notre Dame Bay, Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 91-1, pages 155-166.

Reynolds, P.H., Taylor, K.A. and Morgan, W.R.
1991: $^{40}Ar/^{39}Ar$ ages from the Botwood–Mount Peyton region, Newfoundland: possible paleomagnetic implications. Canadian Journal of Earth Sciences, Volume 18, pages 1850-1855.

St. Croix, L. and Taylor, D.M.
1990: Ice flow in north-central Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 90-1, pages 85-88.

Soles, J.A.
1972: Petrography of samples of magnesite rock from Northwest Gander River, Newfoundland. Unpublished report, Department of Energy, Mines, and Resources, Mines Branch Investigation Report IR 72-15, 4 pages. [2D/11(86)]

Stewart, K.J.
1957: Outline for future mineral exploration. Newfoundland and Labrador Corporation Limited. Unpublished report, 51 pages. [NFLD/116]

Swinden, H.S.
1988: Geology and economic potential of the Pipestone Pond area (12A/1NE, 12A/8E), central Newfoundland. Newfoundland Department of Mines, Geological Survey Branch, Report 88-2, 88 pages.

Tallman, P.
1989: First year assessment report on Licences 3536 and 3811, Noront–Hunan (4723), 2D/11. Noranda Exploration Company Limited, unpublished report, 14 pages. [2D/11(224)]

1990: Second year assessment report on diamond drilling at Noront–Beaver Brook project (6723), Licence 4012, NTS 2D/11. Noranda Exploration Company Limited, unpublished report, 9 pages. [2D/11(240)]

1991: The 'Hunan Line' discoveries: antimony mineralization in central Newfoundland. *In* Ore Horizons. Volume 1. Newfoundland Department of Mines and Energy, Geological Survey Branch, pages 11-21.

Taylor, D.M. and St. Croix., L.
1989: Glacial striations in north-central Newfoundland. Newfoundland Department of Mines and Energy, Geological Survey Branch, Open File (NFLD) 1875, Map 89-108.

Tomlin, S.L.
1982: Potential of the Mount Peyton Batholith as a source of granite as dimension stone and memorial stone (parts of 2D & 2E). Newfoundland Department of Mines and Energy, Mineral Development Division, Open File (NFLD) 1281.

Vaskovic, M.S.
1987: Geological and geochemical exploration on licences 2939 and 2940 held by Kidd Creek Mines Ltd. Great Bend Properties, Newfoundland. Falconbridge Limited, unpublished report, 9 pages. [2D/192]

Wanless, R.K., Stevens, R.D., Lachance, G.R. and Edmonds, C.M.
1967: Age determinations and geological studies: K-Ar isotopic ages, Report 7. Geological Survey of Canada, Report 66-17, 120 pages.

Wanless, R.K., Stevens, R.D., Lachance, G.R. and Rimsaite, R.Y.H.
1965: Age determinations and geological studies: Part 1–Isotopic ages, Report 5. Geological Survey of Canada, Report 64-17, 126 pages.

Williams, H. Colman-Sadd, S.P. and Swinden, H.S.
1988: Tectonic-stratigraphic subdivisions of central Newfoundland. *In* Current Research, Part B. Geological Survey of Canada, Paper 88-1B, pages 91-98.

Williams, H. and Smyth, W.R.
1973: Metamorphic aureoles beneath ophiolite suites and Alpine peridotites: tectonic implications with west Newfoundland examples. American Journal of Science, Volume 273, pages 594-621.

Zwicker, E.J. and Strong, D.F.
1986: The Great Bend Ophiolite, eastern Newfoundland. *In* Current Research. Geological Survey of Canada, Paper 86-1A, pages 393-397.

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