*Current Research (1989) Newfoundland Department of Mines,
Geological Survey of Newfoundland, Report 89-1, pages 47-53*

MIGUELS LAKE AREA (2D/12): AN UPDATE OF THE GEOLOGY

S.P. Colman-Sadd
Newfoundland Mapping Section

ABSTRACT

New information on the geology of the Miguels Lake area has become available since it was originally mapped at the 1:50,000 scale in 1981. The Spruce Brook Formation has been dated paleontologically as Middle Ordovician (late Llanvirn to early Llandeilo). The subaerial Stony Lake volcanic rocks have been dated radiometrically at 423 ± 3 Ma. New field work in the northeast of the area has located the contact between the Silurian Botwood Group and granitic rocks of the Mount Peyton intrusive suite. New exposures of the fault zone between the Botwood Group and the Spruce Brook Formation have also been discovered; the exposures include altered ultramafic rocks.

INTRODUCTION

The Miguels Lake area, in central Newfoundland, includes the northern boundary between the Mount Cormack Subzone and the Dunnage Zone (Williams *et al.*, 1988) (Figure 1). It was mapped at a scale of 1:50,000 in 1981 and an open file map (Colman-Sadd and Russell, 1981) was released the same year. Shortly after the release of the map, paleontological dating of one of the main units was completed by R. Neuman (United States Geological Survey); this information and the revised interpretation that it necessitated were incorporated into papers by Colman-Sadd and Russell

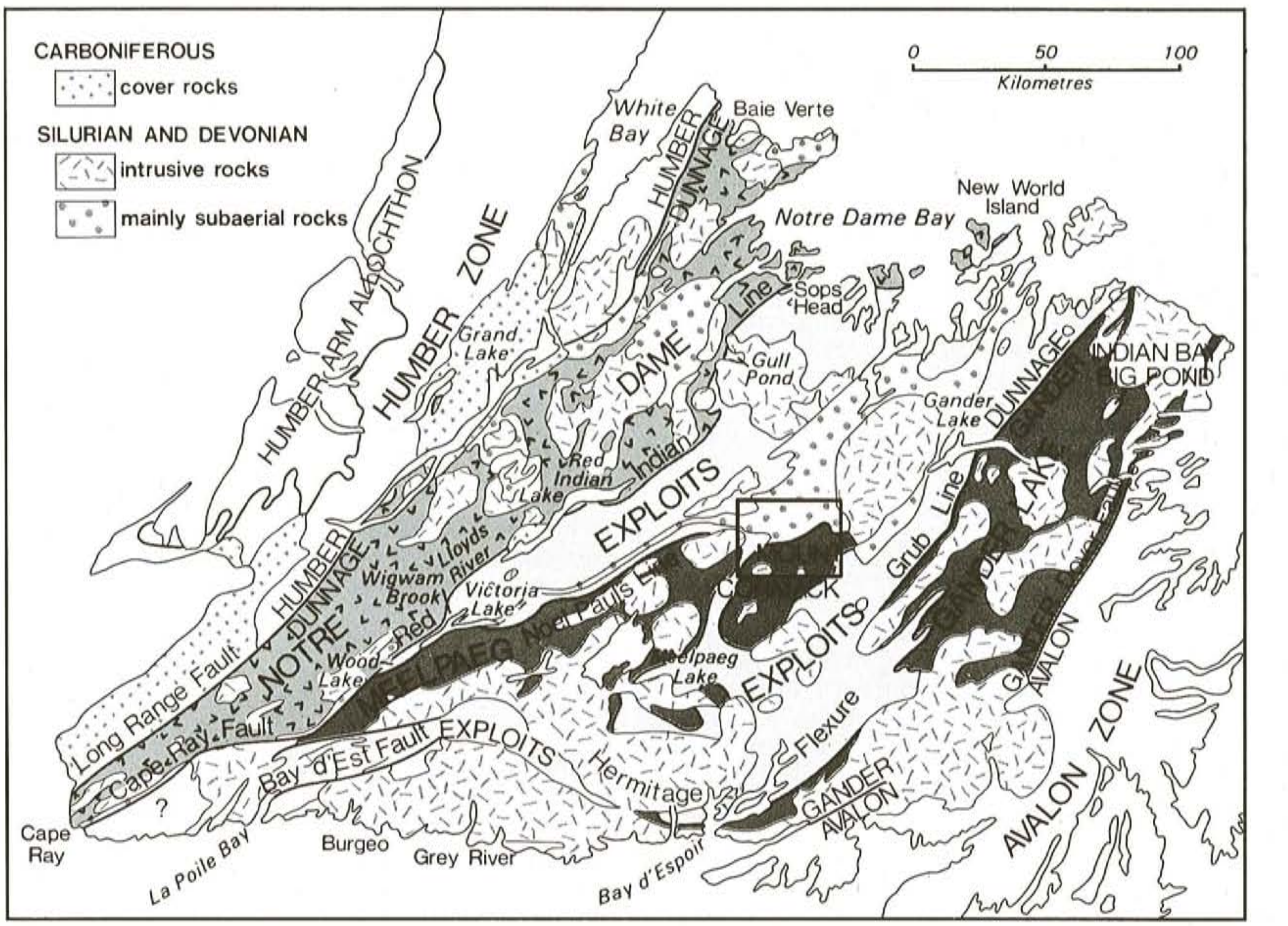

Figure 1. *Zones and subzones of central Newfoundland (from Williams et al., 1988), showing the location of the Miguels Lake area.*

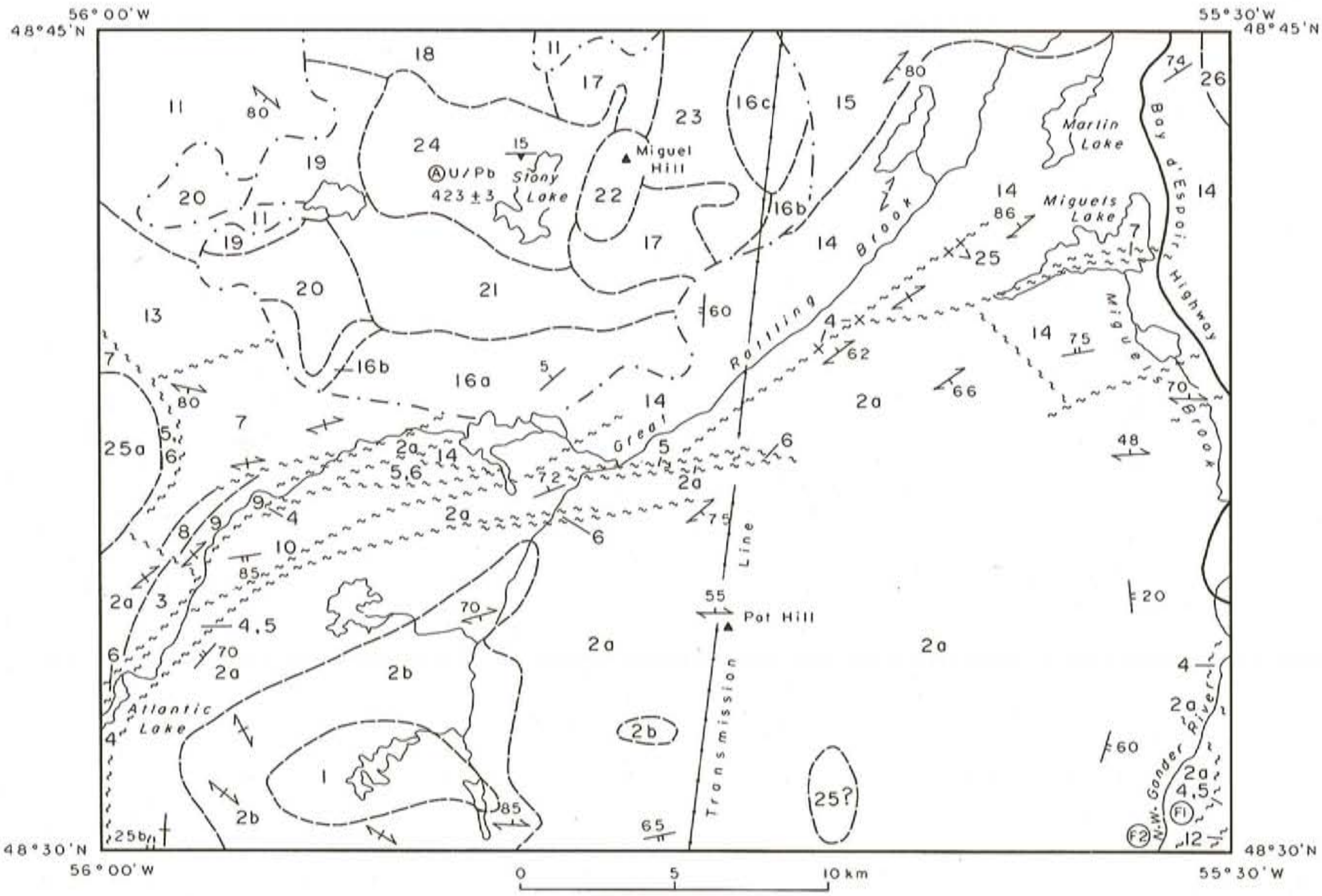

Figure 2. *Geological sketch map of the Miguels Lake area (after Colman-Sadd and Russell, 1988).*

(1982) and Colman-Sadd and Swinden (1984). Since then, one of the other main units has been radiometrically dated (Dunning *et al.*, 1988) and has been found to be substantially older than previously thought. As well as these revisions, which only affect the map legend, there have been changes in the map pattern (Figure 2) resulting from field work carried out during 1988, along a system of newly built logging roads. All of the new information is included in a revised version of the 1:50,000 map (Colman-Sadd and Russell, 1988) and is described in this paper.

PALEONTOLOGICAL DATING

Two fossil localities were found in limestone conglomerate in the southeast of the area during the original mapping. The conglomerate exposures are along strike from each other, and appear to form a horizon that is interbedded with shale and quartzite of the Spruce Brook Formation. However, actual contacts have never been observed, so this relationship is not completely certain. Brachiopods, in both the matrix and the pebbles of the conglomerate from the Northwest Gander River locality (Fl, see Figure 2), were identified by R. Neuman, and the identifications were reported by Colman-Sadd and Swinden (1984). Neuman (*in* Colman-Sadd and Swinden, 1984) concluded that both faunas indicate an Ordovician age, ranging from the late Arenig to the early Caradoc, but most probably Llanvirn. The second locality (F2, see Figure 2), on a tributary of the Northwest Gander River, was sampled in 1985 and yielded a rich fauna of cephalopods, gastropods, trilobites and brachiopods. Boyce (1987) reported an age determination of late Llanvirn to early Llandeilo based on the cephalopods and trilobites, and Neuman (personal communication, 1987) produced a similar result from an examination of the brachiopods.

Colman-Sadd and Russell (1981) originally suggested a Silurian age for the Spruce Brook Formation, which the fossil data now clearly show to be incorrect. The Middle Ordovician age presented problems of tectonic interpretation because the Spruce Brook Formation is mainly of continental derivation, whereas surrounding rocks are oceanic or island arc in character, but are also thought to be Middle Ordovician. The conflict was resolved by considering the latter rocks to be allochthonous, as described by Colman-Sadd and Russell (1982) and Colman-Sadd and Swinden (1984).

RADIOMETRIC DATING

The Stony Lake volcanics were listed as 'Devonian or younger' by Colman-Sadd and Russell (1981), because they appear to lie on the Silurian Botwood Group with angular unconformity and to be posttectonic. However, Dunning *et*

LEGEND

DEVONIAN OR OLDER

26 MOUNT PEYTON INTRUSIVE SUITE: *porphyritic biotite granite*

25 *Granite:* 25a, *biotite–garnet granite of* OVERFLOW POND GRANITE; 25b, *muscovite–garnet pegmatitic granite*

SILURIAN

STONY LAKE VOLCANIC ROCKS (UNITS 16 TO 24)

24 *Dark-grey to black feldsparphyric rhyodacite; mainly pyroclastic, locally flow-banded*

23 *Dark-grey to dark-green feldsparphyric rhyodacitic lapilli tuff*

22 *Grey and purple flow-banded or brecciated rhyolite*

21 *Purple and pink rhyolite; mainly pyroclastic, locally flow-banded*

20 *Light purple, feldsparphyric rhyolite; mainly pyroclastic, locally flow-banded*

19 *Grey rhyolite; mainly lapilli tuff, locally flow-banded*

18 *Medium grained quartz and feldspar rhyolitic crystal tuff*

17 *Mainly buff, but locally green and purple, feldsparphyric, pyritiferous rhyolite; mainly flow-banded, but locally pyroclastic*

16 *Siltstone and sandstone:* 16a, *grey;* 16b, *red;* 16c, *grey and red containing blocks of flow-banded rhyolite and pyroclastic rocks*

BOTWOOD GROUP (UNITS 14 AND 15)

15 *Red sandstone and siltstone*

14 *Green-grey sandstone and siltstone with minor red siltstone beds*

13 ROGERSON LAKE CONGLOMERATE: *Unexposed, extrapolated from outcrop in Noel Paul's Brook area*

DUNNAGE ZONE

MIDDLE ORDOVICIAN AND OLDER

VICTORIA LAKE–BAIE D'ESPOIR GROUPS

12 NORTH STEADY POND FORMATION: *Unexposed, extrapolated from outcrop in Burnt Hill area*

11 TALLY POND FORMATION: *Interbedded felsic crystal tuff and lapilli tuff*

10 SALMON RIVER DAM FORMATION(?): *Interbedded purple-grey sandstone, siltstone and minor shale*

Pipestone Pond–Great Bend Complexes and other ophiolitic rocks

9 *Black shale interbedded with fine grained sandstone*

8 *Conglomerate, composed mainly of mafic volcanic clasts*

7 *Mafic pillow lava, breccia and tuff*

6 *Gabbro and minor trondhjemite*

5 *Pyroxenite*

4 *Peridotite and altered ultramafic rocks*

GANDER ZONE

ORDOVICIAN OR SILURIAN

3 *Strongly foliated granite*

MIDDLE ORDOVICIAN AND OLDER

2 SPRUCE BROOK FORMATION: 2a, *interbedded grey sandstone, siltstone and shale and minor conglomerate and limestone beds, metamorphosed in the greenschist and amphibolite facies;* 2b, *migmatite and granitoid gneiss thought to be derived from* 2a.

1 *Interbanded, migmatized, granitic, amphibolitic, semipelitic and psammitic gneisses*

SYMBOLS

Geological contact

Presumed unconformity

Fault

Bedding, tops known (inclined)

Bedding, tops unknown (inclined, vertical)

Eutaxitic layering in volcanic rocks (inclined)

Cleavage (inclined, vertical)

Location of radiometric dating sample Ⓐ

Fossil localities (F1) (F2)

Newly discovered fault exposures mentioned in text X *al.* (1988) have reported a U–Pb zircon date of 423 ± 3 Ma from the volcanics, which places them at the top of the Wenlock stage of the Silurian (Haq and van Eysinga, 1987). Since the Botwood Group contains Wenlock fossils, the main deformation of this group and perhaps many of the older units in the area, is much more closely constrained than was previously thought. This conclusion is dependent on there actually being an angular unconformity between the Stony Lake volcanics and the Botwood Group, a relationship that has yet to be demonstrated.

The new date on the Stony Lake volcanics shows them to be approximately contemporaneous with the other main Silurian volcanic sequences in Newfoundland; in north-central Newfoundland, the Springdale Group has been dated at 429^{+6}_{-5} Ma (Chandler *et al.*, 1987) and in southwest Newfoundland the La Poile Group has yielded several ages between 426 and 419 Ma (Dunning *et al.*, 1988). The variable intensity of deformation in these other groups indicates that orogeny had not ended at the time that the Stony Lake volcanics were deposited, and the posttectonic appearance of the volcanics is therefore either fortuitous or suspect.

FIELD WORK 1988

Since the original mapping in 1981, logging operations by Abitibi-Price have resulted in the construction of a network of woods-roads in the northeast quadrant of the map area. These roads were investigated during 1988 for the new exposures created, and some of the problems raised by these new exposures were followed up by re-examination of several stream sections.

Mount Peyton Intrusive Suite

In the extreme northeast of the map area, logging has exposed an intrusive contact of granite into sandstone, siltstone and shale of the Botwood Group. The contact effects of the intrusion on the country rocks are very restricted. An exposure 1.5 km from the contact is similar in texture to the rest of the group, but has unusually rusty weathering, apparently caused by more pyrite than is normal for these rocks. This is possibly the result of fluid action related to the intrusion. An exposure of the Botwood Group, which is about 400 m from the nearest granite exposure, shows clear evidence of contact metamorphism and has been baked to form a black, uncleaved rock with a porcelaneous appearance. At the contact itself, green-grey to black sedimentary rock has been net-veined by fine grained, white granite containing white feldspar phenocrysts, 3 to 5 mm across (Plates 1 and 2). Scattered patches of coarser, pink pegmatite with tourmaline, occur at the edges of some of the veins. The main part of the granite is only exposed in one location within the map area, and even here it is close enough to the contact to contain abundant xenoliths of country rock. The granite is dark grey, medium grained, and contains biotite and phenocrysts of white feldspar. A granitic phase on the west side of the Mount Peyton intrusive suite was recognized by Kean and Mercer (1981) in the Grand Falls area (2D/13) and by Colman-Sadd (1982) in the West Gander Rivers area (2D/11). The new exposure in the Miguel's Lake area demonstrates the continuity of this phase, but still does not indicate the location of the contact with gabbro that outcrops in the northern part of the suite (Tomlin, 1982).

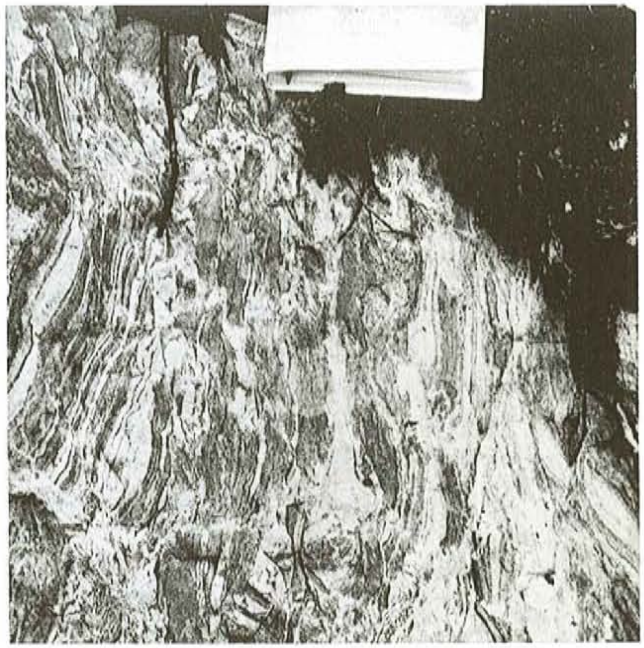

Plate 1. *Metasedimentary rocks of the Botwood Group, net-veined by granite of the Mount Peyton intrusive suite.*

Plate 2. *Feldspar–porphyritic granite of the Mount Peyton intrusive suite, containing xenoliths of Botwood Group metasedimentary rocks.*

Botwood Group

Most of the new exposures created since 1981 are in the more southerly unit of the Botwood Group (Unit 14) and consist of green-grey sandstone, siltstone and shale, with thin interbeds of maroon shale. Ripple marks are common and most beds show fine-scale cross-lamination (Plates 3 and 4); mud cracks occur in a few places. All the rock types in the unit are maroon on weathered surfaces. A single cleavage is present (Plate 5) and some exposures show tight folding.

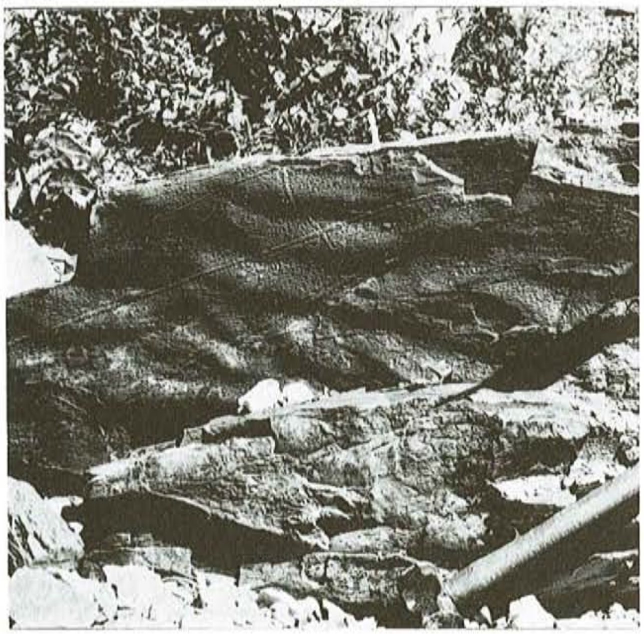

Plate 3. *Ripple marks on the surface of a Botwood Group sandstone bed.*

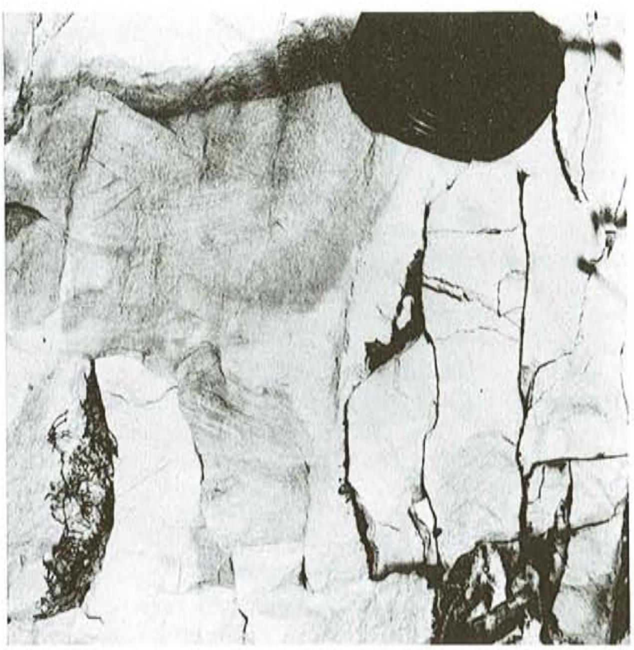

Plate 4. *Cross-laminations in a sandstone bed of the Botwood Group.*

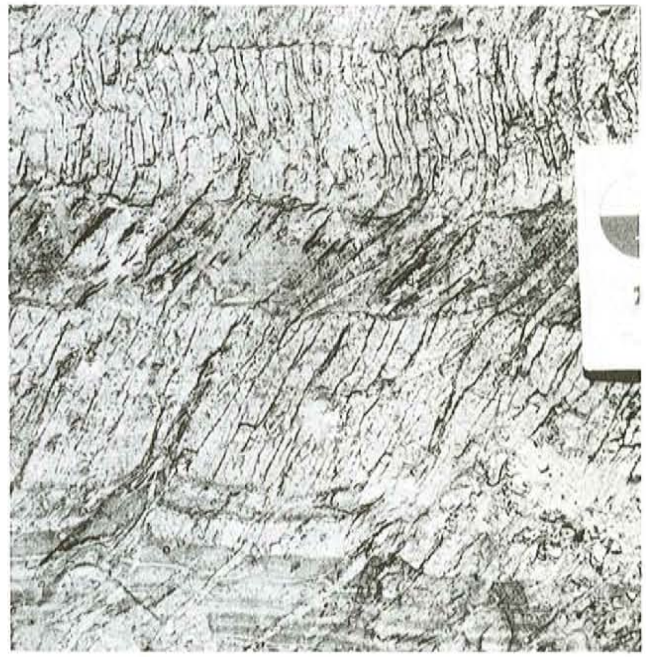

Plate 5. *Cleavage in the Botwood Group, showing refraction from shale to sandstone beds.*

Rocks exposed in Miguels Brook west of the Bay d'Espoir highway were briefly re-examined and are now provisionally included in the Botwood Group, pending further work in 1989.

Spruce Brook Formation

Interbedded white-weathering quartzite and dark-grey shale of the Spruce Brook Formation are newly exposed on woods-roads, west and south of Miguels Lake. In both cases, the rocks are at about the biotite grade of metamorphism and are distinctly more deformed than the Botwood Group. West of Miguels Lake, the exposures are small and consist principally of parallel-laminated shale with only a few thin quartzite beds; there appear to be two penetrative cleavages in the pelitic beds. South of Miguels Lake, the quartzite beds are up to 1-m thick, slightly boudined and have a fracture cleavage; the pelite beds are much thinner, strongly cleaved, and contain dismembered fragments of thin quartzite layers.

Boundary Faults

In previous publications, the fault zone assumed to separate the Botwood Group from the Spruce Brook Formation has been projected northeast, from pyroxenite and gabbro exposures near the confluence of North and South Great Rattling brooks, to the mylonitized mafic volcanics at Miguels Lake. This fault zone is now exposed on woods-roads west and northwest of Miguels Lake, and also has been found in a stream section where it was missed in the earlier mapping. Its actual location is about 2 km northwest of where it was predicted to be, and it coincides with and explains a prominent northeast-trending linear aeromagnetic anomaly (Geological Survey of Canada, 1968).

The exposure on a new road, about 5.5 km west of Miguels Lake and 1 km southeast of Great Rattling Brook, is marked by a prominent accumulation of red-weathering boulders formed of magnesite-rich altered ultramafic rock, net-veined by quartz. This rock type does not occur in the *in situ* exposure at this locality, which is instead formed of dark-green, mylonitized serpentinite schist. The schist contains sheared fragments, some of which appear to have been derived from mafic volcanic rock, and has numerous rootless isoclinal folds. A lineation plunges moderately toward the northeast and steep, northeast–southwest-striking CS fabrics indicate a sinistral sense of shear (Plate 6). The Botwood Group is exposed about 500 m to the west (a cross-strike distance of about 250 m) and the Spruce Brook Formation about 1.5 km to the southeast.

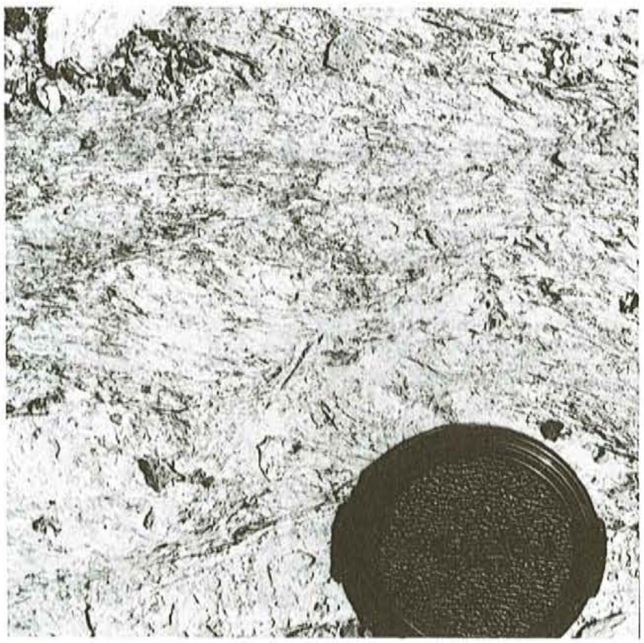

Plate 6. *Tectonic fabrics in serpentine schist, marking the fault zone exposed beside a woods-road, 5.5 km west of Miguels Lake.*

The boundary fault is better exposed 2 km to the southwest in a stream section. In the northern part of the stream, cleaved green-grey sandstone and shale of the Botwood Group dip southeast. At its southeast contact, the dip reverses through a tight syncline to a northwesterly direction and the sediments overlie massive magnesite-rich altered ultramafic rock along a sharp irregular boundary. The contact is assumed to be a fault rather than an unconformity because of its sheared nature, both here and along strike, and because there is no variation in the composition or grainsize of the sedimentary rocks. The massive magnesite at the contact is only about 2-m wide and gives way southeast to about 5 m of cleaved magnesite with boudins of the massive material, and then passes into black pyritic slate. The slate occupies a zone about 500-m wide and terminates at an exposure of bedded quartzite and pelite of the Spruce Brook Formation, which occurs at the north end of the first pond above Great Rattling Brook. The slate is in fact a mélange in which the cleavage is frequently crosscut by shear zones. Bedding is unrecognizable and quartzite occurs as boudins or rootless isoclinal fold closures. Tectonized fragments of magnesite or serpentine-rich altered ultramafic rock are also common in certain parts of the zone and are generally 10- to 30-cm across; an exception is a large block of serpentinite, several metres wide at about the midpoint in the mélange unit. Variably deformed quartz veins occur sporadically throughout the zone.

The coincidence of the observed fault zone with a linear aeromagnetic anomaly allows the fault to be traced where exposure is poor or ambiguous. The fault clearly extends into the area northwest of Miguels Lake where the Botwood Group is exposed on both sides of it, providing further evidence that the contact between the Botwood Group and the ultramafic rocks is tectonic. In this area, two exposures of foliated granite have been found along the projected fault trace and, since their lithology and state of deformation are anomalous in the context of the surrounding Botwood Group, it is assumed that they have been tectonically introduced along the fault zone. The granite is grey or pink, equigranular and inhomogeneously deformed, and has accessory black tourmaline or amphibole. Typically, it has an anastomosing fabric with sericite coating the cleavage surfaces. The more easterly of the two exposures contains a lens of massive pyrite, 10 by 30 cm, aligned along the cleavage and is cut by posttectonic vuggy quartz veins. The fault zone that has now been defined southeast of Great Rattling Brook is not aligned with the fault previously mapped on the islands in Miguels Lake (Colman-Sadd and Russell, 1981). It is uncertain how the two are related, but it is considered most likely that the Miguels Lake fault is a splay off the main system, and this is how it is depicted by Colman-Sadd and Russell (1988). Both faults are presumed or seen to juxtapose the Botwood Group against the Spruce Brook Formation and both extend into the main outcrop area of the Botwood Group; both are marked by strongly tectonized slithers of presumed ophiolitic rocks.

CONCLUSIONS

The Miguels Lake area contains an unusual variety of rock units ranging from successions typical of both the Gander and Dunnage zones, to Silurian overlap sequences that apparently span the main deformation in this part of Newfoundland. A full understanding of the relationships in the area is some way off and can be expected to contribute considerably to our knowledge of Newfoundland geology and the history of Appalachian orogeny. Perhaps the most critical unresolved problem is the nature of the contact between the Botwood Group and the Stony Lake volcanics. Paleontological and radiometric dating have been essential ingredients in the mapping, both for constructing an accurate map legend and for highlighting the regional implications. The follow-up field work during 1988 has confirmed the rough predictions of the original mapping and has greatly improved the map's accuracy. It has also defined a major fault zone, containing deformed ultramafic rocks, which is analogous to faults along the Gander River Ultrabasic Belt and the Baie Verte Line. The comparison suggests high potential for gold mineralization (Tuach *et al.*, 1988).

ACKNOWLEDGMENTS

Greg Dunning, Doug Boyce and Bob Neuman have showed a continuing interest in the geology of the Miguels Lake area and without their efforts the age relationships would still be a mystery. I thank Doug Boyce and Pat O'Neill for critically reading and improving the original manuscript.

REFERENCES

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.

Chandler, F.W., Sullivan, R.W. and Currie, K.L.
1987: The age of the Springdale Group, western Newfoundland, and correlative rocks–evidence for a Llandovery overlap assemblage in the Canadian Appalachians. Transactions of the Royal Society of Edinburgh: Earth Sciences, Volume 78, pages 41-49.

Colman-Sadd, S.P.
1982: West Gander Rivers (west part) (2D/11), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File Map 82-59.

Colman-Sadd, S.P. and Russell, H.A.J.
1981: Miguels Lake area (2D/12), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File Map 81-108.

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, Geological Survey Branch, Open File Map 88-50.

Colman-Sadd, S.P. and Swinden, H.S.
1984: A tectonic window in central Newfoundland? Geological evidence that the Appalachian Dunnage Zone may be allochthonous. Canadian Journal of Earth Sciences, Volume 21, pages 1349-1367.

Dunning, G.R., Krogh, T.E., O'Brien, S.J., Colman-Sadd, S.P. and O'Neill, P.P.
1988: Geochronological framework for the Central Mobile Belt in southern Newfoundland and the importance of Silurian orogeny. Geological Association of Canada, Mineralogical Association of Canada and Canadian Society of Petroleum Geologists Joint Annual Meeting, St. John's, Program with Abstracts, Volume 13, page A34.

Geological Survey of Canada
1968: Miguels Lake, Newfoundland. Geophysics Paper 186.

Haq, B.U. and van Eysinga, W.B.
1987: Geological time table. Elsevier Science Publishers B.V., Amsterdam.

Kean, B.F. and Mercer, N.L.
1981: Grand Falls area (2D/13), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 81-99.

Tomlin, S.L.
1982: Memorial and dimension stone. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 82-1, pages 219-222.

Tuach, J., Dean, P.L., Swinden, H.S., O'Driscoll, C.F., Kean, B.F. and Evans, D.T.W.
1988: Gold mineralization in Newfoundland: a 1988 review: *In* Current Research. Newfoundland Department of Mines, Mineral Development Division, Report 88-1, pages 279-306.

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