GEOLOGY OF THE GANDER (WEST) AREA (2D/15), NEWFOUNDLAND

by

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INTRODUCTION

The west half, and the northwest corner of the east half, of the Gander (2D/15) area was mapped on a 1:50,000 scale during the 1979 field season. Mapping also included the southeast corner of the Mount Peyton (2D/14) area, which is adjacent to and west of the Gander area. This work forms part of the larger Gander Rivers Project that was initiated in 1978 (Blackwood, 1979a).

Access to the area west of The Outflow and Southwest Gander River was provided by wood roads; to the east traversing was done from the Trans Canada Highway and Gander Lake. The Hunts Pond and south area was completed by flycamp (fixed wing) and helicopter.

Bedrock exposure along Gander Lake and in some brook sections is nearly continuous; elsewhere it is dismal.

Alexander Murray in 1874 and J.P. Howley in 1875 (Murray and Howley, 1881) worked along Gander Lake and separated metamorphic rocks in the east from sedimentary rocks in the west and noted intervening ultramafic rocks.

MacClintock and Twenhofel (1940) included the area in a account of surface features and Wisconsin glaciation of Newfoundland.

Phyllites, slates and quartzites along Gander Lake were named the "Gander Lake series" by Twenhofel (1947). He interpreted these rocks to be of Silurian age.

Jenness (1958) mapped and defined the Gander River Ultrabasic Belt, east of Gander River. He interpreted mafic to ultramafic rocks in the belt to be intrusive into Twenhofel's "Gander Lake Series" which he renamed the Gander Lake Group; brachiopods indicated a Middle Ordovician age for the group.

The Gander Lake Group was subdivided into Lower, Middle, and Upper Units by Jenness (1963) and interpreted as a conformable sequence. Ordovician fossils were found only in the Middle and Upper Units. Anderson and Williams (1964) showed the Upper Unit of the Gander Lake Group to be overlain in the west by Silurian sedimentary rocks of the Botwood Group (Williams, 1962).

The fossiliferous Middle and Upper Units of Jenness' Gander Lake Group were redefined as the Middle Ordovician Davidsville Group by Kennedy and McGonigal (1972); it was described as overlying the pre-Middle Ordovician Gander Lake Group (mostly the Lower Unit of Jenness) by an inferred major angular unconformity. The name "Gander Lake Group" was shortened to Gander Group by McGonigal (1973).

Kennedy (1975) described an unconformity between basal conglomerates of the Davidsville Group and altered ultramafic rocks of the Gander River Ultrabasic Belt, on the north shore of Gander Lake.

Currie *et al.* (1979) working northeast of the present area, described rocks previously designated as the Gander Group as conformable with rocks of the Davidsville Group. Blackwood (1978, 1979b) defined the nonconformable nature of the Davidsville Group/Gander River Ultrabasic Belt (GRUB line) contact, northeast of Gander Lake.

LEGEND

DEVONIAN (?)

13 Fine to medium grained, pink granite

12 Fine grained gabbro

11 Medium grained, two-mica, garnetiferous, leucogranite.

SILURIAN

BOTWOOD GROUP

10 Red and gray sandstone and shale, locally micaceous; minor fossiliferous calcareous beds.

MIDDLE ORDOVICIAN AND LATER

DAVIDSVILLE GROUP

9 Fine to coarse grained graywacke, locally with shale intraclasts, interbedded with gray to black siltstone and shale.

8 Gray to black shale and siltstone; minor red slate and minor graywacke.

7 Medium to coarse grained gray sandstone with pebble lenses, minor red sandstone, conglomerate, limestone (marble), and calcareous siltstone

MIDDLE ORDOVICIAN OR EARLIER

GANDER RIVER ULTRABASIC BELT (GRUB)

6 Brecciated quartz porphyry

5 Fine grained volcaniclastic rocks; minor porphyritic mafic flows

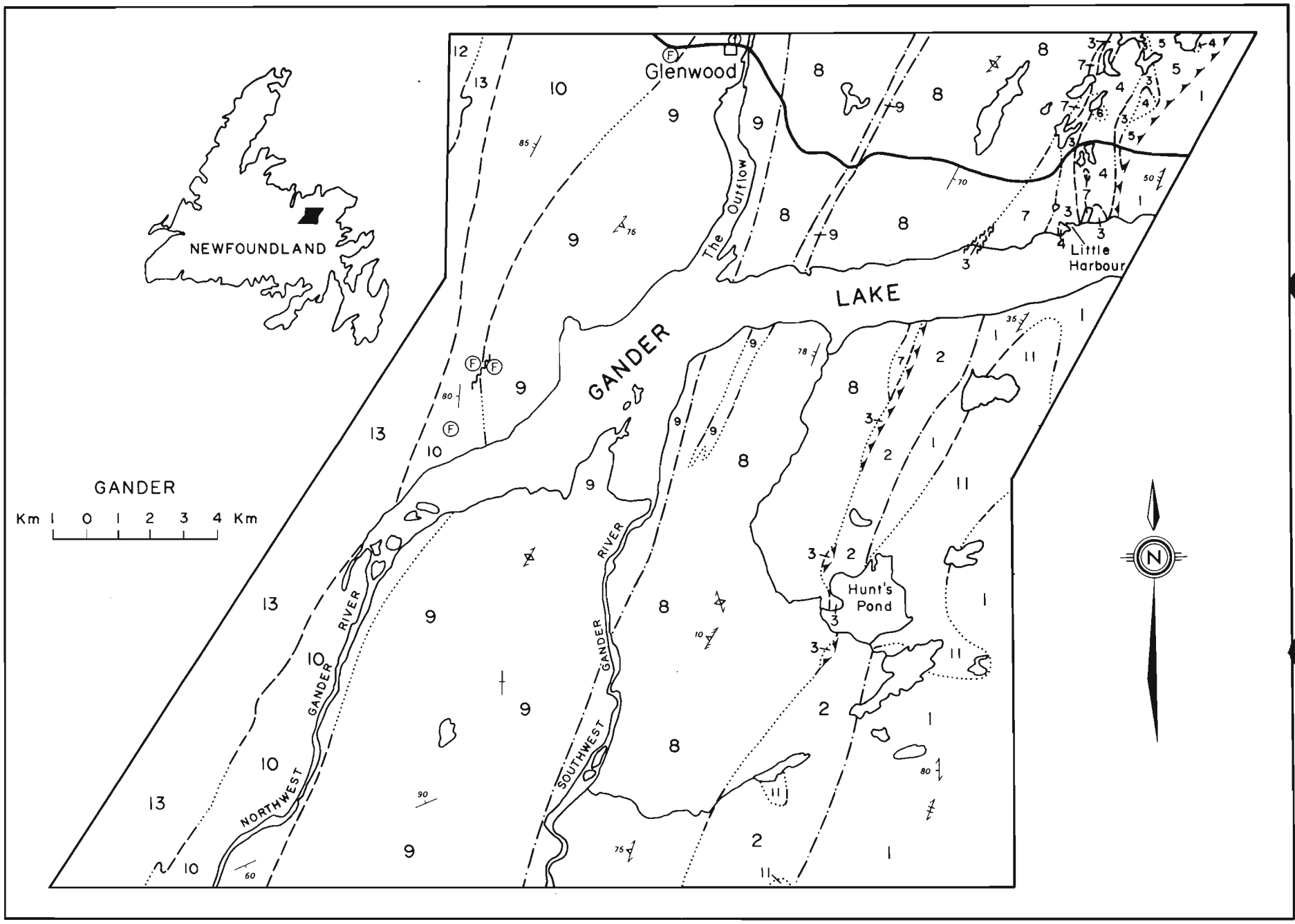
4 Fine to coarse grained gabbro

3 Pyroxenite, minor dunite and periodite, serpentinite, magnesite, and talc-actinolite schist.

GANDER GROUP

2 Semipelite, pelite, minor psammite, and concordant amphibolite bands.

1 Psammite and semipelite; minor mafic tuffs.



Several exploration companies have mapped in the area, concentrating on the GRUB line.

GENERAL GEOLOGY

The area comprises four tectono-stratigraphic subdivisions: the Gander Group (1-2), the Gander River Ultrabasic Belt (3-6), the Davidsville Group (7-9), and the Botwood Group (10). The Gander Group is intruded by leucogranite (11). Gabbro (12) is intruded by pink granite (13) which also intrudes the Botwood Group.

The Gander Group is interpreted to be in fault contact with the GRUB line which is nonconformably overlain by the Davidsville Group. The exact relationship between the Davidsville and Gander Groups is not known; they may be conformable in areas where the GRUB line is missing. The Botwood and Davidsville Groups are apparantly conformable, however the close proximity of Middle Ordovician and Silurian fossil localities may suggest a disconformity between the two groups.

Gander Group (Units 1-2)

The Gander Group underlies the eastern margin of the area and forms two mappable units south of Gander Lake. Psammites, semipelites and pelites with interbedded feldspathic quartzites comprise Unit 1, north of the lake. The light gray feldspathic quartzite beds range in thickness from 15 cm to 1.5 m and commonly form sharp boundaries with light to greenish gray, laminated psammite. Pelitic material occurs as 5-10 cm intercalations but locally predominates in areas underlain by light to dark gray pelite and semipelite. Close to the contact with the GRUB line, minor mafic volcaniclastics containing epidote knots and stringers are conformable with the pelites.

Unit 1 is of low greenschist metamorphic grade north of Gander Lake and middle amphibolite facies grade south of the lake. Coarse cordierite or andalusite porphyroblasts range in length from 2-8 cm. Biotite and garnet are common; hornblende and staurolite also occur. Narrow pelitic laminations in psammite are accentuated by a concentration of biotite porphyroblasts. The phyllitic fabric north of the lake is replaced by a fine to coarse grained schistosity south of the lake. Porphyroblasts are mostly posttectonic but may form weak augen structures; the muscovite-biotite schistosity is a preferred orientation caused by mimitic crystalization. The higher metamorphic grade is related to the emplacement of late synkinematic to posttectonic leucogranite (11).

The structural top of the Gander Group, south of Gander Lake, is marked by pelitic to semipelitic schists containing concordant amphibolite bands (Unit 2). These bands are common and vary from 20 cm to 4 m in width. The amphibolites are interpreted to be the higher metamorphic equivalent of mafic tuffaceous bands that occur north of the lake; however, some bands are discordant in detail suggesting that they were originally mafic dikes. Units 1 and 2 are gradational and are overprinted by the same metamorphic event.

The Gander Group is polydeformed. A fine, first fabric (S_1) is best developed in pelitic zones and is generally parallel to bedding. It is axial planar to rarely seen, small scale, isoclinal F_1 folds. A composite fabric (S_2) is pervasive and clearly transposes S_1 in pelitic zones. This second foliation is axial planar to recumbent, tight to isoclinal, small and large scale F_2 folds. Axial planes generally dip gently to moderately to

the west-northwest; *i.e.*, folds are overturned to the southeast. Where small scale F_2 folds overprint F_1 folds, type 3 interference patterns are produced. Locally, upright, open to tight, F_3 structures are developed. A crenulation cleavage is axial planar to these latest folds.

Gander River Ultrabasic Belt or GRUB line (Units 3-6)

The GRUB line forms a linear, northeast trending, 2-3 km wide zone north of Gander Lake. It largely comprises mafic to ultramafic plutonic and volcanic rocks that are continuous with identical rock types in the Gander River map area (Blackwood, 1979b). The contact between these rocks and the Gander Group is not exposed in the Gander map area but elsewhere it is a fault (Blackwood, 1979a, 1979b).

Ultramafic rocks and their altered equivalents (unit 3) are the oldest rocks in the GRUB line. Medium to coarse grained pyroxenite predominates but minor dunite and peridotite also occur. Serpentinization is widespread and produces massive serpentinite zones as well as a patchy alteration pattern where pods of unaltered ultramafic rock "float" in a serpentinite matrix. Similarly, fragments of large pyroxene crystals are isolated and surrounded by antigorite. Magnesite is also a common alteration product but is less extensive in the Gander map area than to the northeast. Both altered and unaltered ultramafic rocks locally have a crude banding, best seen on weathered surfaces.

Fine to coarse grained gabbro (Unit 4) is intrusive into the ultramafic rocks and forms a central core to the GRUB line in this area; for the most part the ultramafic rocks are disposed around it. Pods and rafts of pyroxenite locally occur as xenoliths within the gabbro but generally contacts are poorly defined. A peculiar, fragmental texture is developed in the gabbro body west of Little Harbour on the north shore of Gander Lake. It produces oligomictic zones of angular to well-rounded gabbro clasts that are gradational into massive gabbro protolith. The same pattern is developed in trondhjemite dikes which cut the gabbro; massive dike centers grade into "clastic-like" margins which form sharp boundaries with fragmental gabbro. Unseparated, minor, mafic volcaniclastic pods are associated with the gabbro and included in Unit 3.

Fine to medium grained volcaniclastic rocks (Unit 5) form part of the GRUB line north of Gander Lake. Greenish-gray tuffaceous bands contain epidote blebs and calcite stringers; rare porphyritic mafic flows are interlayered with the laminated, reworked tuff.

A small body of quartz porphyry (Unit 6) intrudes gabbro north of the Trans Canada Highway. Small quartz phenocrysts are conspicuous in a fine grained, gray, siliceous matrix. The porphyry is pervaded by anastomosing breccia zones several metres wide; on white weathered surfaces the rock resembles an acid pyroclastic. Similar autobrecciated porphyry and trondhjemite bodies occur in the GRUB line to the northeast and are interpreted to be related. In the Gander map area no trondhjemite plutons occur but trondhjemite dikes are common.

The GRUB line varies abruptly between the north and south sides of Gander Lake. A 20-30 m talc schist zone with minor actinolite, serpentinite, and pyroxenite (Unit 3) defines the line south of the lake. More massive pyroxenite, amphibolite and minor gabbro occur at Hunts Pond. The GRUB line is not exposed southwest of Hunts Pond in the Gander map area.

A well developed, low greenschist tectonic fabric overprints most of the GRUB line. It is most intense in fine grained gabbro, volcaniclastic rocks and altered ultramafics. Locally, narrow

mylonite zones are developed in the gabbro. Posttectonic talc and amphibole rosettes are developed in the narrow schist zone south of the lake; the GRUB line is affected by the same higher grade metamorphism as the Gander Group in that region.

Davidsville Group (Units 7-9)

The Davidsville Group underlies the central part of the map area and is subdivided into three lithologic units. It sits nonconformably upon the GRUB line but may be conformable with the Gander Group where the GRUB line is not developed.

The base of the Davidsville Group (Unit 7) is marked by minor, polymictic conglomerate, an outlier of which produces the classic nonconformity between the Davidsville Group and serpentinite of the GRUB line just east of Little Harbour. The conglomerate sits directly upon the altered ultramafic rock and contains clasts of all the GRUB line rock types. Medium to coarse grained, gray and minor red sandstones also occur in outliers on the GRUB line as well as adjacent to it in the west. The sandstone is rich in quartz and feldspar; in some areas quartz-porphyry pebbles form conglomeratic beds and isolated clasts, surrounded by a sandy matrix. Conspicuous bright green serpentinite, trondhjemite, and garnet detritus also occur. Interbedded with the sandstone are 4-6 cm thick, calcareous siltstone beds on the north side of the lake. Limestone (marble) beds 3-25 cm thick are interbedded with quartzites on the south shore of Gander Lake.

Rocks of Unit 7 grade abruptly westward into gray and minor red shales and siltstones (Unit 8). The shales are locally laminated; interbedded siltstone beds are 2-12 cm thick and have sharp boundaries. Coarser, minor graywacke beds occur at some localities. Unit 8 appears gradational with Unit 2 of the Gander Group, southwest of Hunts Pond.

Well bedded, fine to coarse grained graywacke with interbedded siltstone and minor shale (Unit 9) constitute the westernmost part of the Davidsville Group. Graywacke beds are 5 cm to 1 m thick and have sharp coarse grained bases that grade into laminated siltstone and shale. Black and red shale intraclasts are common in the graywacke. Gray siltstone and black shale, without any graywacke beds, occur as zones within the unit. One black shale horizon near Glenwood contains Middle Ordovician graptolites (Williams, 1964). Locally, poorly sorted conglomerate lenses are developed. Coarse graywacke and interbedded siltstone also underlie a narrow, discontinuous band in Unit 8.

A pronounced slaty cleavage, axial planar to variably plunging, tight, asymmetrical folds, is developed in most of the Davidsville Group. A strain-slip cleavage/schistosity overprints the first cleavage of the Davidsville Group and is best developed south of Gander Lake. It has moderate westerly dips but is locally flat lying; recumbent folds are commonly associated. These fabrics become phyllitic to schistose in Units 7 and 8; a gradational increase in metamorphic grade continues into the Gander Group with proximity to leucogranite in the east. In the Hunts Pond and south area, phyllites and pelitic schists of the Davidsville Group are overprinted by andalusite, biotite and garnet porphyroblasts. There is apparantly no structural or metamorphic break between the Davidsville and Gander Groups in the Hunts Pond area.

Botwood Group (Unit 10)

The Botwood Group underlies a narrow belt near the western margin of the map area. It is presumed to be conformable with the Davidsville Group; primary and tectonic structures are regionallly concordant between the graywackes of Unit 9 and graywackes, sandstones and shales of Unit 10. In one river section west of Gander Lake, the contact between the two groups is sheared and separates

sandstone (Botwood Group) containing Silurian brachiopods from graywacke and black shale (Davidsville Group) containing *cf.Protovirgularia* sp. an Ordovician trace fossil (identified by R. Pickerill, University of New Brunswick 1979). Silurian sandstones and Middle Ordovician shales are in close proximity near Glenwood.

Red and minor gray sandstone and shale form the Botwood Group north of Gander Lake. The sandstone is fine to medium grained and commonly contains detrital muscovite. Beds range in thickness from 15 cm to 2 m and locally have erosive bases. Flame and slump structures, crossbedding, load casts, and small sandstone dikes also occur. Calcareous sandstone and shale beds are richly fossiliferous at some localities. Graywacke with shale intraclasts, gray, well bedded sandstone, and minor red sandstone and shale comprise the Botwood Group southwest of Gander Lake.

A strong slaty cleavage, axial planar to tight, variably plunging folds, overprints the Botwood Group. A strain-slip fabric is rarely developed.

Leucogranite (Unit 11)

A linear pluton of leucogranite underlies tha area between Hunts Pond, northeast to Gander Lake. Smaller bodies occur to the southwest. The granite is fine to medium grained and is characterized by a white weathering, quartz, white feldspar, muscovite assemblage. Biotite occurs locally; small, rose-colored garnets are also common. Garnetiferous aplites and pegmatites are associated with the pluton, intruding it and country rocks in the vicinity of the largest body. The main body of leucogranite is restricted to the Gander Group, however garnetiferous leucogranite veins intrude GRUB line ultramafic rocks at Hunts Pond.

The larger bodies of leucogranite are massive and unfoliated, but some of the related veins have a weak mica alignment parallel to S_2 in the Gander Group. Porphyroblasts related to the granite mostly overprint fabrics in the country rock but locally define slight augen structures.

Gabbro (Unit 12) and Pink Granite (Unit 13)

Fine grained, equigranular gabbro underlies a small area in the northwest corner of the map area. Small mafic clots, 1-3 cm across, occur locally. The gabbro is unfoliated.

Medium grained, pink, equigranular granite (Unit 13) intrudes the Botwood Group along the western margin of the map area. The actual contact is nowhere exposed but alaskitic dikes posttectonically cut red sandstone of the Botwood Group. The granite consists of pink K-feldspar and quartz; minor plagioclase and hornblende occur locally. Granodiorite and diorite phases form a small part of Unit 13. The pink granite also intrudes gabbro of Unit 12; chilled margins are not developed in the granite.

Units 12 and 13 form part of the much larger Mount Peyton batholith (Strong et al., 1974).

MINERALIZATION

Mineralization mostly occurs along the GRUB line. Picrolite (fibrous antigorite) is common in the serpentinized ultramafics. It occurs as 0.5 - 1 cm wide cross-fibre in discontinuous veins; longer slip-fibre is locally developed. Chromite occurs in altered ultramafics 1.0 km southwest of Gander Lake as disseminations, pods 1 cm to 10 cm in diameter, and lenses 2 cm wide by 1 m long.

Chalcopyrite and pyrite are disseminated throughout the quartz porphyry (Unit 6) north of the Trans Canada Highway. They also are concentrated in the comminuted matrix of breccia zones within the porphyry.

SUMMARY AND CONCLUSIONS

The Gander Group is defined as quartz-rich metasedimentary rocks, including some pelite and semipelite, that largely lie to east of, and structurally below, the Gander River Ultrabasic Belt. Sections along Gander Lake and the Trans Canada Highway in the vicinity of Gander and east are typical of the group. Mafic to ultramafic, plutonic and volcanic assemblages of the 2-4 km wide GRUB line are faulted (thrust?) against the Gander Group. The GRUB line is continuous from the Gander River map area to Gander Lake; south of the lake it thins considerably and may not have been emplaced south of Hunts Pond.

The Davidsville Group is defined as a graywacke, siltstone, shale sequence that sits nonconformably upon and largely west of the GRUB line; basal conglomerate and sandstone contain profuse GRUB line detritus. South of Gander lake, where the GRUB line is missing, the Davidsville Group is apparantly conformable with the Gander Group; a change in lithofacies, however, marks the boundary between the two groups. In the west, red and gray sandstones and shales of the Botwood Group are apparently conformable with the Davidsville Group.

The Gander Group, parts of the GRUB line, and parts of the Davidsville Group are polydeformed. The Davidsville Group has a similar deformational history to the Gander Group in their contact area south of Gander Lake. An increase in metamorphic grade is related to late, synkinematic leucogranite emplacement that also affects the Davidsville Group along its eastern margin.

The Gander Group may represent a clastic wedge that was deposited in a relatively stable area. GRUB line rocks are pre-Llanvirn (Blackwood, 1978) in age and possibly represent a dismembered ophiolite. The time of final emplacement of the GRUB line is not known, but these rocks must have been exposed as a basement to the Davidsville Group by the Middle Ordovician; conceivably the GRUB rocks could have been part of a basement to the Gander Group as well. The Davidsville Group represents a distal to proximal turbidite sequence; possibly the deeper water facies equivalent of the upper parts of of the Gander Group. These rocks pass upwards into shallower water deposits of the Botwood Group.

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REFERENCES

Anderson, F.D. and Williams, H.
1964: Gander Lake (west half), Newfoundland. Geological Survey of Canada, Map 1195A (geologic map and descriptive notes).

Blackwood, R.F.
1978: Northeastern Gander Zone, Newfoundland. *In* Report of Activities for 1977. *Edited by* R.V. Gibbons. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 78-1, pages 72-79.

1979a: Geology of the Gander River area (2E/2), Newfoundland. *In* Report of Activities for 1978. *Edited by* R.V. Gibbons. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 79-1, pages 38-42.

1979b: Gander River, Newfoundland. Mineral Development Division, Newfoundland Department of Mines and Energy, Map 7929 (geologic map and descriptive notes).

Currie, K.L., Pajari, G.E., Jr., and Pickerill, R.K.
1979: Tectono-stratigraphic problems in the Carmanville area, northeastern Newfoundland. *In* Current Research, Part A, Geological Survey of Canada, Paper 79-1A, pages 71-76.

Jenness, S.E.
1958: Geology of the Gander River Ultrabasic Belt, Newfoundland. Geological Survey of Newfoundland, Report 11, 58 pages.

1963: Terra Nova and Bonavista map areas, Newfoundland. Geological survey of Canada, Memoir 327, 184 pages.

Kennedy, M.J.
1975: Repetitve orogeny in the northeastern Appalachians- New plate models based upon Newfoundland examples. Tectonophysics, 28, pages 39-87.

Kennedy, M.J. and McGonigal, M.H.
1972: The Gander Lake and Davidsville Groups of northeastern Newfoundland: New data and geotectonic implications. Canadian Journal of Earth Sciences, 9, pages 452-459.

MacClintock, P. and Twenhofel, W.H.
1940: Wisconsin glaciation of Newfoundland. Geological Society of American Bulletin, 51, pages 1729-1756.

McGonigal, M.H.
1973: The Gander and Davidsville Groups: Major tectonostratigraphic units in the Gander Lake area, Newfoundland. M.Sc. Thesis, Memorial University of Newfoundland, St. John's, 121 pages.

Murray, A. and Howley, J.P.
1881: Geological Survey of Newfoundland (Reports for 1864 through 1880). Edward Stanford, London, 536 pages.

Strong, D.F., Dickson, W.L., O'Driscoll, C.F. and Kean, B.F.
1974: Geochemistry of eastern Newfoundland granitoid rocks. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 74-3.

Twenhofel, W.H.
1947: The Silurian of eastern Newfoundland with some data relating to physiography and Wisconsin glaciation of Newfoundland. American Journal of Science, 245, pages 65-122.

Williams, H.
1962: Botwood (West Half) map area, Newfoundland. Geological Survey of Canada, Paper 62-9, 16 pages.

1964: Botwood, Newfoundland. Geological Survey of Canada, Map 60-1963 (geologic map and descriptive notes).