GEOLOGY OF THE WEST HALF OF THE DOLLAND BROOK MAP AREA (11P/15), SOUTHERN NEWFOUNDLAND

by

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Abstract

The Ordovician Bay du Nord Group forms a central wedge of metasedimentary and metavolcanic rocks in the Dolland Brook (11P/15) map area. It is interpreted to represent a turbidite sequence containing distal submarine felsic volcanic rocks. The group underwent D_1 recumbent isoclinal folding and subsequent D_2 upright folding. Metamorphism in the group increased during D_1 toward synkinematic granites and migmatites which occur in the southern part of the map area. The granites were also intruded during the development of D_1 shear zones, now represented by narrow mylonite zones. A post-D_1 - syn-D_2 granite intruded the northern part of the area, resulting in a thermal aureole in the adjacent part of the Bay du Nord Group. Sulfide and scheelite mineralization is associated mostly with the felsic volcanic rocks and the late granite.

Introduction

The Dolland Brook (11P/15) map area is located north of Francois on Newfoundland's south coast. The Grey River flows along its western boundary. The area is accessible by helicopter and fixed wing aircraft; the southern part may be reached by small boat from the coastal community of Grey River. The communities of Grey River and Francois on the coast south of the map area are regular stops on CN Marine's south coast ferry run.

Mapping of the west half of the Dolland Brook area on a 1:50,000 scale was completed during the 1983 field season; the east half was completed by Dickson and Delaney *(this volume)*. Exposure is poor in the northern part of the map area, fair in the central portion, and excellent in the south.

The Dolland Brook area was mapped on a 1:63,360 scale for Buchans Mining Company Limited (Scott and Conn, 1950). This work was updated by the American Smelting and Refining Company in 1968. It was also mapped on a 1:250,000 scale by the Geological Survey of Canada (Williams, 1971) as part of the larger Burgeo map area. A compilation map of Dolland Brook (Smyth, 1979) was based on previous work and some reconnaissance investigations.

General Geology

The Dolland Brook map area (Figure 1) is sited in the eastern part of the Hermitage Flexure (Williams et al., 1970), a generally west trending, sinuous configuration of rock units that occurs in southern Newfoundland. Structural and lithostratigraphic elements have a west or northwest trend in the map area. The metasedimentary and metavolcanic rocks are included in, and continuous with, the Ordovician Bay du Nord Group to the west (Cooper, 1954; Chorlton, 1980a,b; O'Brien, 1983; O'Brien and Tomlin, *this volume)*. They are also the probable equivalent of the Ordovician Baie d'Espoir Group (Jewell, 1939; Colman-Sadd, 1974, 1976) to the east.

Rock units in the west half of the Dolland Brook area may be grouped into three broad subdivisions:

(1) a central wedge of metasedimentary and metavolcanic rocks of the Bay du Nord Group;

(2) a southern terrain of migmatite and foliated granitoids; and

(3) a northern terrain of little deformed biotite and two-mica granite (the North Bay Granite).

Bay du Nord Group (Units 1-5)

The Bay du Nord Group consists of four lithostratigraphic units (Units 1, 3-5) with an outcrop pattern mostly controlled by a west trending, moderately plunging F_2 syncline. The definition and distribution of an additional unit (Unit 2) iscontrolled by the degree of metamorphism and remobilization associated with granite intrusion.

Unit 1 is a belt of metasedimentary rocks that occurs between the narrow band of felsic volcanics (Unit 3) on the northern limb of the F_2 syncline, and the

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LEGEND

DEVONIAN AND EARLIER

North Bay Granite (Units 10 and 11)

11 Medium to coarse grained, equigranular to coarsely porphyritic biotite-muscovite granite; includes minor biotite granite.

10 Medium to coarse grained, equigranular to coarsely porphyritic biotite granite; includes minor two-mica granite.

9 Fine grained, equigranular, minor biotite - rare muscovite granite.

8 Medium to coarse grained, equigranular to finely porphyritic biotite granite.

7 Coarse grained, coarsely porphyritic biotite - minor hornblende granite.

ORDOVICIAN(?)

6 Crudely banded granitoid and migmatite with minor pelite and amphibolite inclusions.

Bay Du Nord Group (Units 1-5)

5 Gray to black slate/phyllite; locally contains thin siltstone and fine grained sandstone beds.

4 Sandstone, siltstone and slate locally containing pebble to cobble conglomerate, including quartz-pebble conglomerate.

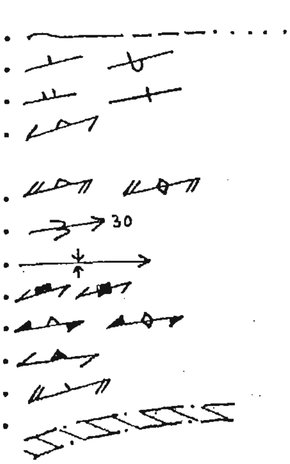
3 Fine grained felsic tuff, minor quartz-feldspar lapilli tuff and minor volcanic breccia; locally contains interbedded graphitic pelite.

2 Pelitic and semipelitic schist and migmatite with concordant leucogranite veins.

1 Psammite, semipelite and pelite with minor sandstone, conglomerate, graphitic pelite, and amphibolite.

SYMBOLS

Geological contact (defined, approximate, assumed).........
Bedding, tops known (inclined, overturned)................
Bedding, tops unknown (inclined, vertical)................
Regional cleavage, schistosity, S_1 (inclined)..............
Crenulation or strain-slip cleavage, S_2 (inclined, vertical)...
Minor F_2 fold axes.......................................
Large scale F_2 fold (syncline)............................
Mylonitic foliation (inclined, vertical)...................
Migmatitic banding (inclined, vertical)...................
Weak to moderate biotite alignment (inclined)..............
Fracture cleavage (inclined)...............................
Mylonite zone..



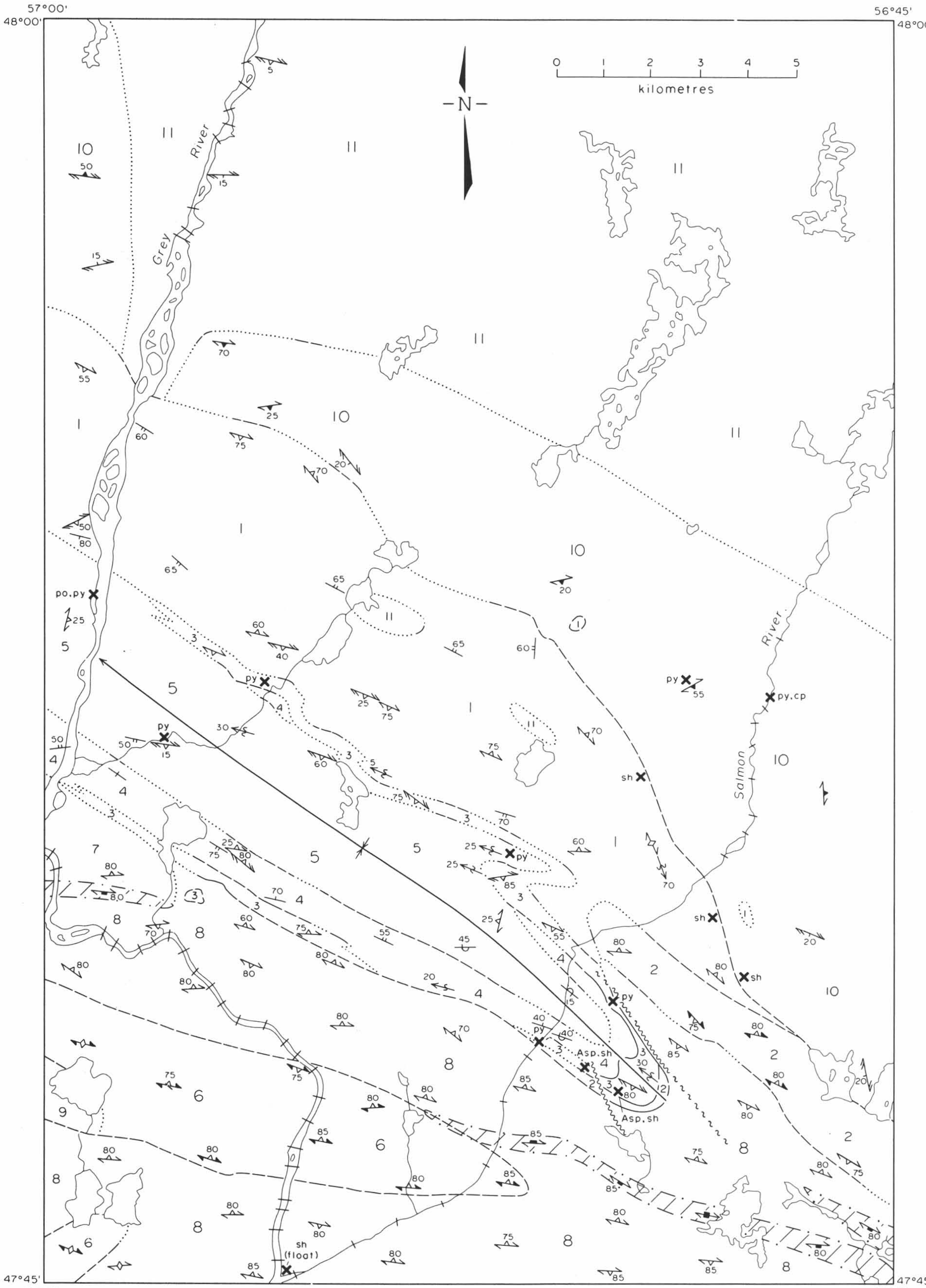


Figure 1: *Geological map of the west half of the Dolland Brook (11P/15) map area, southwestern Newfoundland.*

southern boundary of the North Bay Granite. Consequently, it is dominated by the recrystallization and porphyroblast development that occurs within the granite's thermal aureole. Garnetiferous leucogranite veins are also common. The unit consists predominantly of laminated pelite, semipelite and psammite. Thin (0.5 to 1.0 mm) pelitic laminations in the gray psammites are accentuated by porphyroblastic biotite growth. Where interbedded, psammite beds are 2 to 6 cm thick and the pelite/semipelite beds are 0.5 to 2 cm thick. Minor graphitic pelite and amphibolite occur in some exposures; an approximately 1 m thick band of quartz-pebble conglomerate was found in one outcrop. Locally a clastic texture is discernible in the more siliceous psammite and in minor thin beds of quartzite. Graded sandstone and interbedded siltstone beds, 1 to 10 cm thick, form the southernmost outcrop of Unit 1 on Grey River; they are the likely protoliths for the more metamorphosed rocks elsewhere in the unit.

Fine to medium grained biotite and muscovite occur on the foliation planes of the pelite and semipelite which range from phyllite to schist depending upon proximity to the North Bay Granite. The quartzofeldspathic rocks commonly exhibit a granoblastic texture. Locally, along the granite contact, quartz segregations and granite veining give a migmatitic aspect to the schists. Biotite, muscovite, garnet, andalusite and hornblende commonly occur as porphyroblasts throughout Unit 1. These overprint a fine, penetrative foliation that is generally coplanar to bedding and axial planar to small scale F_1 folds. A second strain-slip cleavage variably transposes S_1 and is axial planar to small-scale F_2 folds which locally produce Type 3 interference patterns (Ramsay, 1967) (Plate 1).

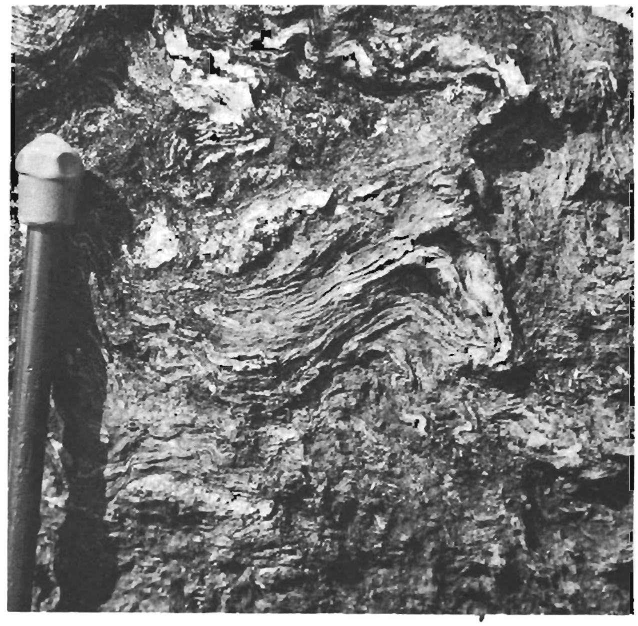


Plate 1: *F_2 refolding of isoclinal F_1 folds producing Type 3 interference patterns in quartz-injected pelite (unit 1). Note axial planar S_2 crenulation cleavage.*

Unit 2 is interpreted as the higher grade metamorphic version of Unit 1. It occurs as a narrow band between two granitoids (Units 8 and 10) east of Salmon River and as a narrower band around the hinge of the F_2 fold. The unit consists mostly of semipelitic schists that are intruded by a profusion of concordant leucogranite veins and foliated, equigranular biotite granite. Biotite, muscovite and garnet porphyroblasts are common throughout. A significant portion of the larger band may best be described as migmatite; wispy, partially assimilated pelitic inclusions occur as schlieren in a crudely banded granitoid host. Locally large rafts of graphitic pelite and semipelite with quartz and granitoid sweats occur within the migmatite zone. The regional S_1 foliation is axial planar to small scale isoclinal F_1 folds which are commonly defined by garnetiferous leucogranite veins. In the large scale F_2 fold hinge, both limbs of F_1 isoclines are overprinted by the second crenulation or strain-slip cleavage.

Unit 3 is an approximately 200 to 300 m wide band of pinkish to grayish white weathering, very fine grained, generally siliceous felsic tuff that provides a useful marker in delineating the F_2 syncline in the map area. Although zones of lapilli tuff rich in quartz and feldspar crystals occur, most of the tuffs are either free of macroscopic crystals or contain just a few 'eyes' of quartz and feldspar 1 to 4 mm across. Laminations and discontinuous color and/or compositional variations, 1 to 2 mm thick, are interpreted as primary structures (Plate 2). Minor light gray chert and massive rhyolite occur locally. In the hinge zone of the F_2 fold, volcanic breccia is well developed and consists of elongate 1 to 15 cm long clasts of light gray felsic tuff in a very fine grained darker gray felsic matrix. Some of the clasts have primary banding. Black graphitic pelite locally occurs interbedded with the felsic volcanics. A conformable contact between the tuffs and the overlying sedimentary rocks is indicated by the gradational change in color and composition of the tuffs such that they become less siliceous and of a darker gray color near the contact with the gray sandstone, slate and pelite. Quartz veining, mostly concordant with the primary laminations, is common throughout Unit 3. Locally, rusty zones occur in the tuffs.

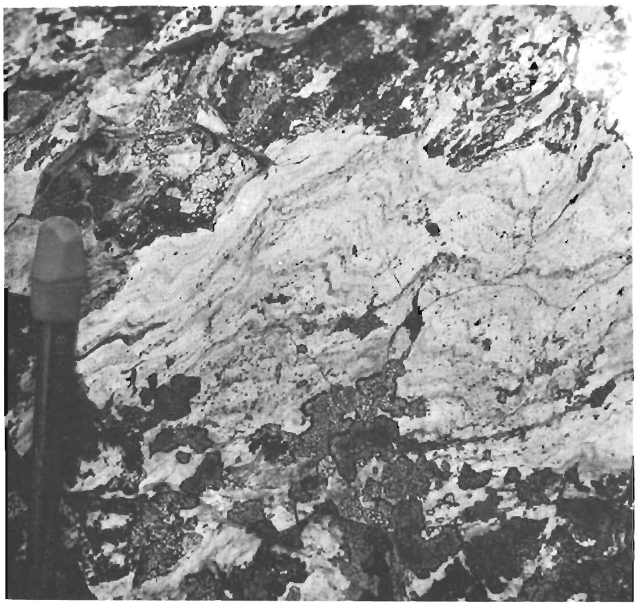


Plate 2: *Laminated felsic tuff showing F_2 folds (unit 3).*

A penetrative fabric is developed parallel to the laminations and is axial planar to isoclinal F_1 folds of the laminations and concordant quartz veins. Biotite streaks and minor muscovite occur on the S_1 fabric planes. A fracture cleavage is axial planar to small scale F_2 folds which typically produce Type III interference patterns (Ramsay, 1967). The moderate westward plunge of the large scale F_2 structure produces the widest areal extent of Unit 3 volcanics in the hinge zone of the fold.

Unit 4 is a laterally discontinuous clastic sequence that structurally and stratigraphically overlies the felsic volcanics of Unit 3. It consists mostly of fine to coarse grained, 4 to 30 cm thick, gray sandstone beds with interbedded siltstone and gray slate. Interpreted as turbidites, these rocks include sandstone beds which, on Salmon River, have sharp bases and grade over several centimetres into laminated siltstone with shale caps (Plate 3), interpreted as partial Bouma sequences (Bouma, 1962). Quartz and white feldspar comprise the sandstone which, west of Salmon River, is massive and contains interbeds of conspicuous white quartz-pebble conglomerate and pebbly sandstone. Minor felsite clasts and shale intraclasts also occur in the pebble conglomerate which varies from clast- to matrix-supported. Pebble and cobble conglomerate, mostly matrix-supported, occurs in the turbidites on Salmon River (Plate 4). Clasts are mainly felsic volcanics but also include quartz, fine to medium grained plagiogranite, sandstone, siltstone, shale and quartz-feldspar porphyry. Locally, isolated cobbles 'float' in interbedded, coarse grained sandstone. Some of the felsic volcanics show pre-inclusion quartz veins, a possible source for the quartz pebble horizons. Associated granule conglomerate forms channel scours in underlying laminated sandstone and siltstone.

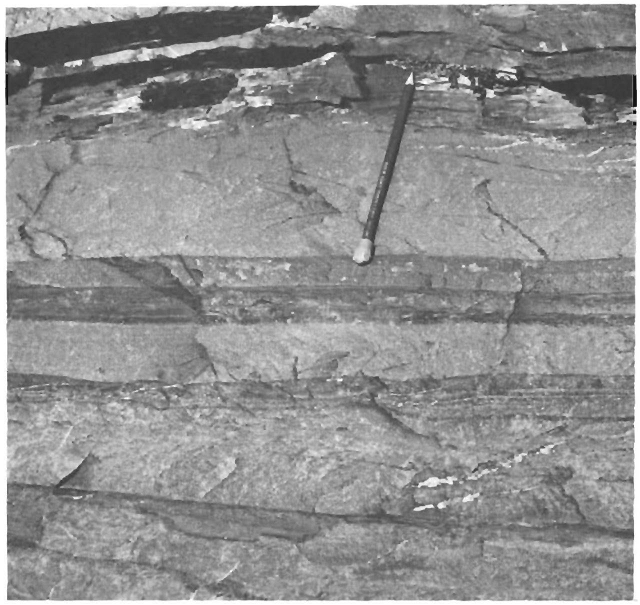


Plate 3: *Sandstone beds grade into laminated siltstone and shale (unit 4).*

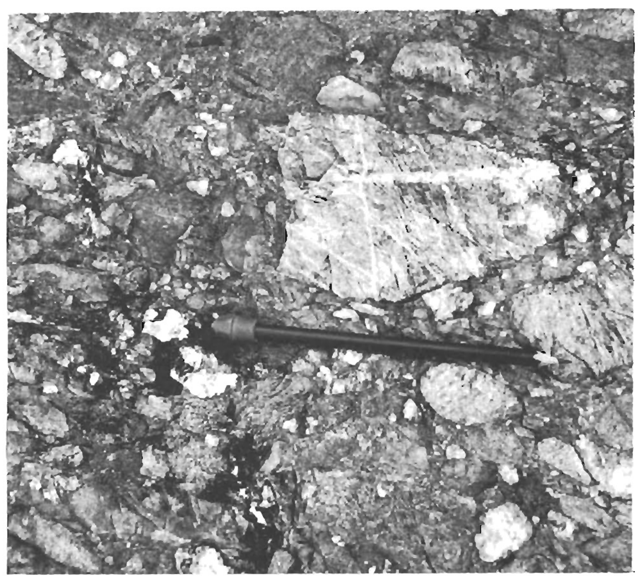


Plate 4: *Partially clast-supported polymictic conglomerate (unit 4). Note pre-inclusion quartz veining in felsic volcanic clast.*

Large, rounded to angular fragments of felsic volcanics, up to 2 m long, occur as isolated clasts in laminated sandstone and siltstone along the contact between Units 3 and 4 (Plate 5). Graded sandstone beds also appear to be right way up close to the felsic volcanics. These observations suggest that Unit 4 clastics stratigraphically overlie Unit 3 volcanics and that the large scale F_2 fold is in fact a syncline as well as a synform. Overturned isoclinal F_1 folds in Unit 4 along Salmon River locally produce overturned beds but these are small scale, second order structures (wavelength of 10 m or less) and do not appear to have affected the overall stratigraphy. A penetrative S_1 foliation is coplanar with bedding and axial planar to the F_1 folds. The S_2 strain-slip cleavage is locally developed. The metamorphic grade increases within Unit 4 towards the felsic volcanics of Unit 3 along both limbs of the F_2 fold as these areas are influenced by intrusive granitic rocks. Porphyroblastic muscovite commonly occurs in the southern parts of Unit 4.

Plate 5: *Felsic volcanic clasts in sandstone at base of unit 4.*

Unit 5 is disposed in the core of the F_2 syncline and consists mostly of gray or black slate and phyllite. Along the contact with Unit 4, fine grained sandstone and siltstone are interbedded. Elsewhere, thin sandstone beds occur (Plate 6), and range from 0.5 to 3 cm in thickness with an average of 1 cm; these are commonly reddish brown.The slate is characterized by a pronounced slaty cleavage (S_1) which is variably dipping due to F_2 folding. This main fabric becomes phyllitic in areas of slightly higher metamorphic grade; small corderite and/or andalusite porphyroblasts are locally developed in the phyllite. The second fabric is a locally developed strain-slip or crenulation cleavage with variable dip and strike.

Plate 6: *Slate containing thin, fine grained sandstone beds (unit 5).*

Southern Migmatite - Granitoid Terrane (Units 6-9)

The area south and southeast of the Bay du Nord Group is underlain by migmatite (Unit 6) and foliated granitoids (Units Unit 2, it is not included in the Bay du Nord Group since it is surrounded by granite and its exact relationship with the group is equivocal.

Unit 6 occurs in two zones that appear to form large rafts within the foliated granitoids. It consists mostly of an irregularly banded granitoid which has a wispy or streaky appearance rather than a regular gneissic fabric. Although persistent on a outcrop scale, the banding is defined in detail by discontinuous biotite-rich zones alternating with lenses of granitoid. The biotite 'streaks' range from 0.5 to 15 cm in length and are generally less than 2 mm in width; locally 0.5 cm biotite clots occur. The granitoid lenses are 1 to 4 mm wide. Disoriented, porphyroblastic muscovite and biotite are common. Metasedimentary inclusions of pelitic to psammitic composition occur locally (Plate 7). These are mostly concordant with the crude banding and have indistinct boundaries. However, in some areas, clearly outlined xenoliths occur with an internal foliation that forms various angles with the external banding in the host granitoid. Some inclusions display a regular 4 to 10 cm layering of alternating pelite and psammite that is interpreted as primary in origin. Psammitic inclusions are generally granoblastic and the biotite-rich pelitic zones locally contain feldspar porphyroblasts and profuse granitic veins. Amphibolite xenoliths are less common; rare pods and lenses of pure biotite with crystals 0.4 to 3 cm across also occur. The banding in the migmatite is locally tightly folded and regionally concordant with the main penetrative foliation in the granitoid rocks.

Plate 7: *Distinct and indistinct amphibolite and pelite inclusions in irregularly banded migmatite (unit 6).*

Unit 7 is a coarse grained biotite granite that intrudes the Bay du Nord Group and outcrops in a small area along Grey River on the western boundary of the map area. It is characterized by large feldspar phenocrysts that are 2 to 6 cm long in a biotite-rich, coarse grained groundmass. Both potassium feldspar and plagioclase form megacrysts; minor hornblende and sphene also occur. Locally, fine grained diorite and/or gabbro form mafic clots, interpreted as cognate inclusions, that are 1 to 20 cm across and have a round or elliptical outline.

Unit 7 is not penetratively foliated in its northern exposures, except for minor anastomosing 1 to 50 cm wide shear zones, within which the granite is reduced to mylonite. These shear zones increase in width and profusion toward the south where they are up to 8 m wide and regularly oriented, parallel to the regional east-west foliation. Away from the shear zones the granite is progressively foliated, developing into protomylonite that gradually merges into a mylonite zone along the granite's southern boundary (Plate 8).

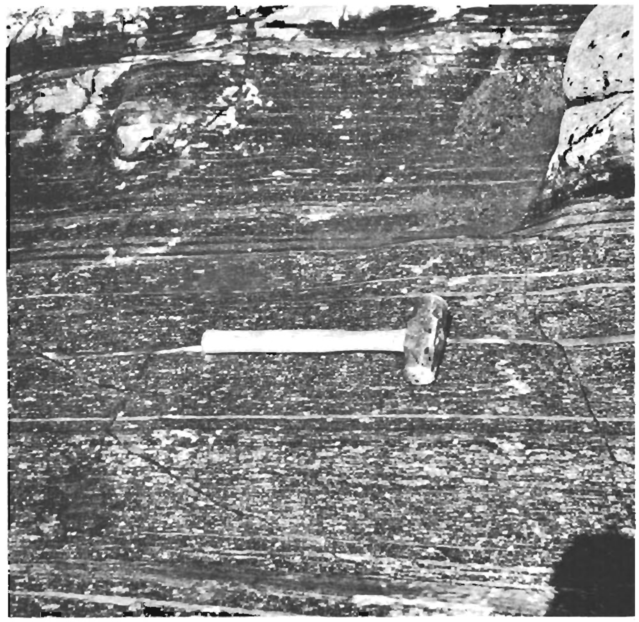


Plate 8: *Protomylonite and mylonite from shear zone in unit 7.*

Unit 8 is a medium to coarse grained, equigranular to porphyritic granite that forms the largest granitoid area in the southern terrain. It intrudes the Bay du Nord Group along the granite's northern boundary and encloses the large rafts of Unit 6 migmatite; dikes of equigranular biotite granite are common in Units 2 and 6. The relationship of Unit 8 to Unit 7 is unclear since the two are separated by a mylonite zone. However, fine grained, biotite granite dikes that intrude Unit 7 may be related to Unit 8.

The porphyritic variety of Unit 8 contains pink and white feldspar phenocrysts that are 0.5 to 3 cm long with most around 1.5 cm. Rarely, there are phenocrysts up to 5 cm long. The change from equigranular to porphyritic granite is diffuse, and is marked by a gradual increase in phenocryst content. The distribution of the porphyritic variety is also irregular: even the mostly equigranular material has isolated phenocrysts scattered throughout. Overall, biotite is less profuse than in Unit 7 although small areas of biotite-rich granite, where the mica is concentrated in patches along the foliation planes, do occur. Locally a regular layering is developed in the granite, defined by variations in the amount of biotite,feldspar phenocrysts and grain size, similar to layering in the McCallum granite

(Blackwood, 1983) to the southeast. This layering is generally concordant with the tectonic fabric.

The regional foliation in Unit 8 varies from weakly to strongly developed and is mostly defined by oriented biotite. The fabric has a distinct cataclastic component near the contact with the Bay du Nord Group west of Salmon River. Foliated granite also grades into protomylonite adjacent to and within mylonite zones east of Salmon River. The granite is also the protolith for mylonite and minor ultramylonite within the shear zones. In one area south of Grey River, foliated equigranular biotite granite is intruded by relatively unfoliated equigranular biotite granite, suggesting that Unit 8 was intruded synkinematically, with respect to the main regional deformation. A later, gently dipping fracture cleavage is also locally developed in the granite.

Unit 9 forms a small area of pink weathering, fine grained, equigranular, minor-biotite granite south of Grey River on the western border of the map area. Rare muscovite also occurs. Included within this area is a zone of quartz-feldspar-biotite porphyry that is presumably related to the fine grained granite. A moderate biotite alignment is developed in the granite as well as a local fracture cleavage. Veins of this composition are common throughout Units 6 and 8.

North Bay Granite (Units 10 and 11)

The northern and east-central portion of the map area is underlain by granitic rocks that form part of the North Bay Granite (Jewell, 1939), a large intrusive body that extends to the north and east (Dickson and Delaney, *this volume;* Dickson and Tomlin, 1983). Within the map area, the granite intrudes the Bay du Nord Group and is divisible into two phases.

Unit 10 is a biotite-rich phase that occurs along the contact with Unit 1 of the Bay du Nord Group and locally contains large rafts of metasedimentary rocks. It is medium to coarse grained and varies gradationally from equigranular to porphyritic granite, with the latter texture predominating. Feldspar phenocrysts are both pink and white and range from 0.5 to 6 cm in length with most between 1 and 3 cm. Some of the plagioclase phenocrysts are zoned. Minor, possibly secondary, fine grained muscovite occurs; disseminated pyrite was noted in some eastern exposures. Biotite is generally disoriented but weak to moderate alignments do occur. Locally a fracture cleavage is developed.

Unit 11 is a two-mica phase of the North Bay Granite, which generally, occurs north of Unit 10, but also forms a narrow tongue that transects Unit 10 and intrudes Unit 1 of the Bay du Nord Group at Grey River. Two small plugs of similar granite intrude Unit 1 between Grey and Salmon Rivers. Unit 11 is a medium to coarse grained granite with an equigranular to porphyritic texture. Feldspar phenocrysts are either pink or white and vary from 1 to 6 cm in length. Unit 11 contrasts with Unit 10 in that it has less biotite and variable amounts of muscovite. Generally the biotite exceeds muscovite but locally muscovite is more abundant. Commonly muscovite is coarser grained than biotite, forming conspicuous 2 to 4 mm flakes; at one locality, muscovite crystals are approximately 1 cm across. Rare garnets also occur. Unit 11 is unfoliated except for a locally developed fracture cleavage. Two-mica garnetiferous pegmatites and aplites of composition similar to Unit 11 intrude Units 1, 10 and 11.

Structure and Metamorphism

The Bay du Nord Group is overprinted by a fine penetrative foliation, (S_1) that developed during the first regional deformation (D_1) of the area. This fabric is axial planar to second order, isoclinal F_1 similar folds; consequently it is generally coplanar with bedding in the Bay du Nord Group. Although, F_1 folds on F_2 fold limbs must have undergone further tightening during the second deformation, isoclinal F_1 folds in F_2 fold hinges indicate the original isoclinal nature of these early structures (Plate 9).

Plate 9: *S_2 strain-slip cleavage (parallel to pencil) overprints both limbs of a recumbent isoclinal F_1 fold in the hinge zone of the major F_2 structure.*

The main foliation in the southern granitoid terrain is regionally concordant with that in the Bay du Nord Group and can be shown to be a D_1 structure. Veins of equigranular granite (Unit 8) that intrude the group show the first fabric as do garnetiferous leucogranite veins common to both. These leucogranite veins commonly define F_1 folds that have both limbs overprinted by the subsequent D_2 fabric. The mostly penetrative biotite orientation in Unit 8 granite is generally subparallel to layering in that pluton and is locally axial planar to tight folds of the layering. The fabric can also be traced into Unit 6 migmatites where it is approximately parallel to the crude banding or axial planar to folds of the banding and partially assimilated inclusions.

The D_1 foliation in granite of Units 7 and 8 locally intensifies and merges into two narrow mylonite zones. The one along the southern boundary of Unit 7 at Grey River is approximately 0.25 km wide and is continuous to the west for some several kilometres (O'Brien and Tomlin, *this volume*). Its eastward trace appears truncated by Unit 8 granite although the development of a moderate cataclastic fabric along the northern boundary of Unit 8 with the Bay du Nord Group may represent a continuation of this zone of shearing. A second mylonite zone, 0.2 to 0.6 km wide, is developed in Unit 8 in the southeast. It clearly is a continuation from the southeast of the Dragon Bay Fault zone (Blackwood, 1983); within the southeastern corner of the map area it occurs as two subparallel zones, separated by a thin wedge of foliated biotite granite of Unit 8. The northern zone narrows westward for 2.5 km, where it ends in moderately foliated biotite granite. The southern zone is continuous to Salmon River where it becomes coincident with the contact between Unit 6 migmatite and Unit 8 granite. At that point it ceases to be a clearly definable shear zone in homogeneous granite and its westward trace is lost. However, shearing probably continued preferentially along the contact between Units 6 and 8, resulting in a less obvious zone of mylonitization.

Unit 8 granite is interpreted to be synkinematic with respect to the first deformation. It locally appears to truncate D_1 mylonite zones, e.g. east of Grey River, and has mylonite zones developed within it. In the latter case, a distinct zone of mylonite was observed along strike to narrow and terminate within the granite, e.g. southeast corner of the map area. These relationships suggest diachronous intrusion of Unit 8 granite into an area of active cataclastic deformation. The synkinematic nature of the granite is also indicated elsewhere where a strongly foliated phase of the pluton is intruded by a later, less deformed phase.

The original attitude of D_1 structures is not readily determinable in the map area. Southeastwards, in the Facheux Bay map area (Blackwood, 1983), large scale F_1 folds and associated second order folds are demonstrably overturned towards the south. A similar orientation is suggested for the Dolland Brook area. A model of initial recumbent folding is supported by the occurrence of overturned beds with a shallower S_1 cleavage in the core of the large scale, upright F_2 syncline. Thus, probable large scale, recumbent, F_1 folds, generally overturned toward the south, are interpreted to have developed during the first deformation (Figure 2). The Bay du Nord Group within the map area would thus represent the normal limb of such a first order recumbent fold since the lithostratigraphic units are upward facing; local overturning is due to small scale, second order F_1 folds.

The grade of metamorphism associated with the first deformation in the Bay du Nord Group varies from greenschist to upper amphibolite facies, depending upon proximity to the southern synkinematic granitoid terrain. Within the core of the F_2 syncline, S_1 is a phyllitic or slaty cleavage. The metamorphic grade increases toward the south, which is interpreted as structurally downward; this is first indicated by the occurrence of porphyroblastic muscovite in sandstones of Unit 4. Adjacent to Unit 8 foliated granite, fine grained biotite appears on S_1 fabric planes in Unit 3 felsic tuff, and fine to medium grained, biotite-muscovite schists are developed in Unit 2. Locally Unit 2 is migmatitic near the contact with Unit 8 granite. The culmination of metamorphism is represented by Unit 6 migmatites which are completely isolated within the granitoid terrain.

The second deformation (D_2) resulted in the large scale, first order F_2 fold delineated by felsic volcanic rocks (Unit 3) of the Bay du Nord Group (Figure 3). It is a mostly upright structure that plunges 20° to 30° to the west-northwest. Facing directions in the sedimentary rocks indicate that it is a syncline. Smaller, second order folds are associated with the syncline, particularly on its northern limb, and show a vergence consistent with the overall structure. Third order F_2 folds are developed throughout the Bay du Nord Group and commonly produce Type III interference patterns (Ramsay, 1967) where small scale F_1 folds are refolded; one Type I interference pattern was noted on Salmon River.

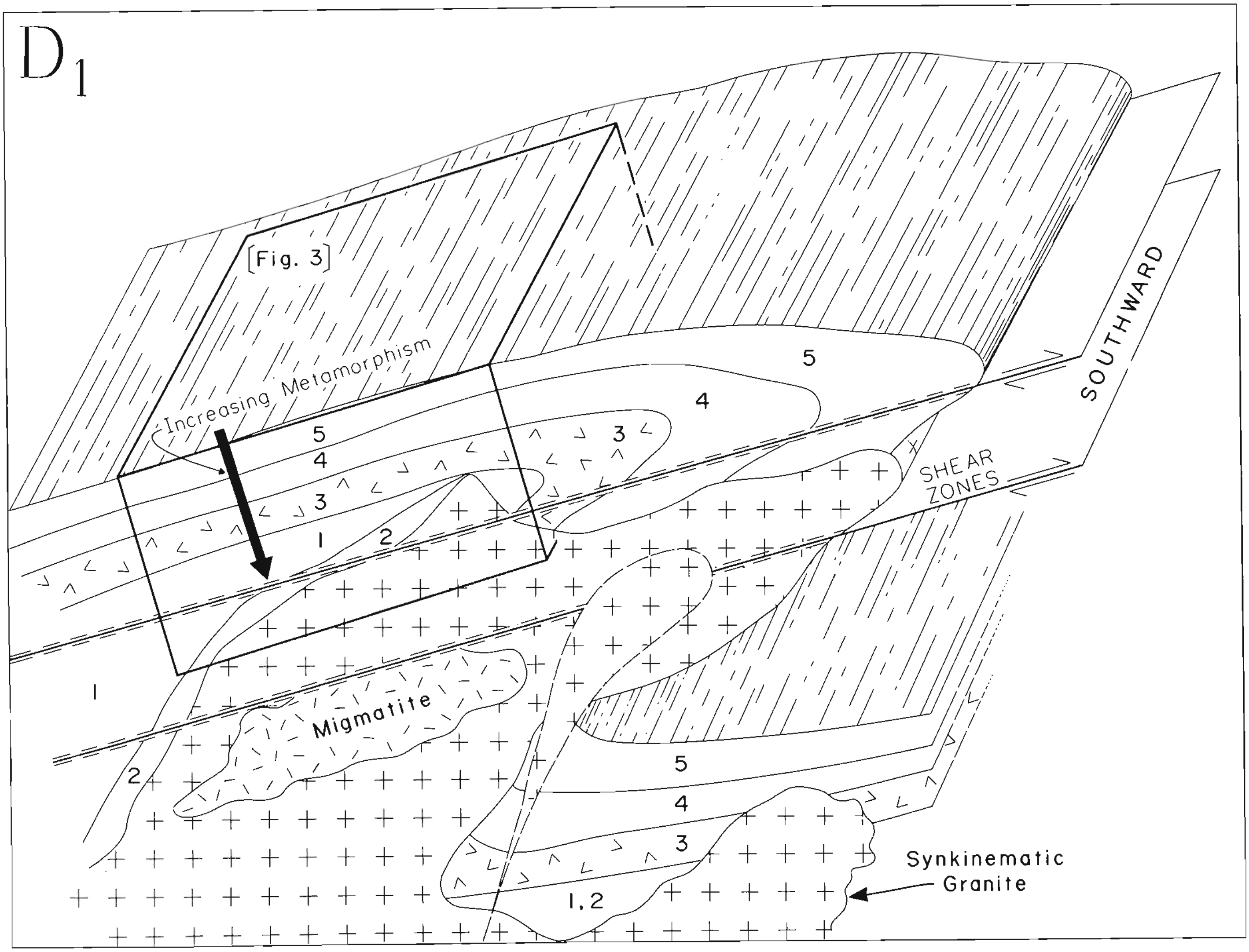


Figure 2: *An interpretive diagram showing the style and orientation of D_1 structures and their relationship to synkinematic granite.*

A variably developed strain-slip or crenulation cleavage (S_2) is commonly axial planar to the small scale F_2 folds and in a regional way to the large scale structure. It locally transposes the first schistosity and primary laminations in rocks of pelitic composition and forms a fracture cleavage in some areas within the felsic volcanics. Within the core of the syncline, the strain slip cleavage is variably oriented in Unit 5 slates, suggesting an inhomogeneous D_2 stress field.

The intrusion of the North Bay Granite (Units 10 and 11) occurred after the first deformation and during the second; it may have contributed to the shortening that resulted in the F_2 folds. Within the granite's aureole, a profusion of biotite, garnet, andalusite and hornblende porphyroblasts overprint the penetrative S_1 foliation in pelite and semipelite.

Mimetically recrystallized biotite and muscovite are developed on the S_1 fabric planes and become coarser grained with proximity to the North Bay Granite. Granoblastic recrystallization textures dominate in the quartzofeldspathic rocks. The S_2 strain-slip cleavage postdates the main episode of recrystallization within the granite's aureole and generally shows no new mineral growth along its cleavage traces. However, locally within the aureole, fine grained biotite developed along S_2 indicating the synkinematic relationship between the North Bay Granite and D_2. Weak biotite alignments and a coarse

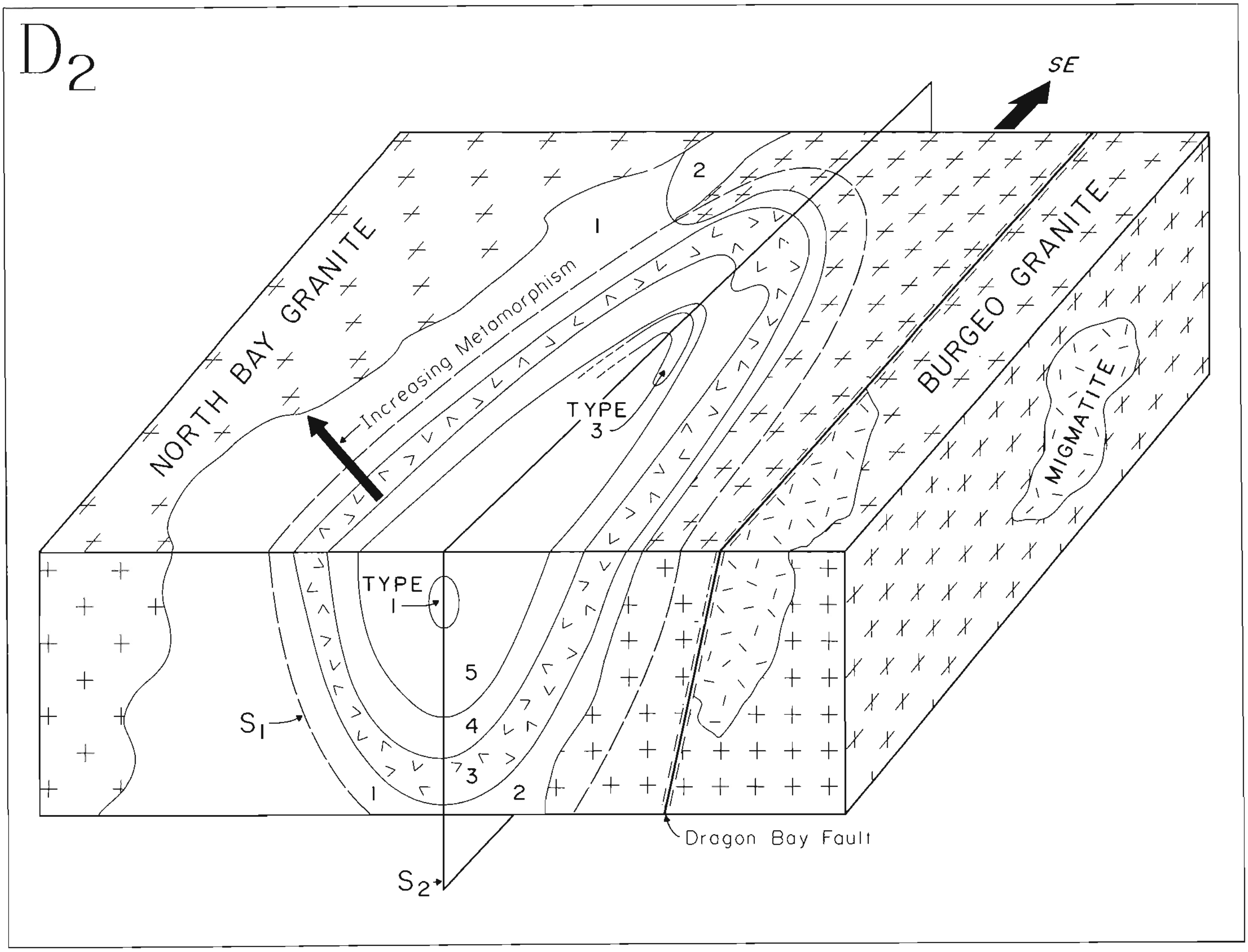


Figure 3: *A representative diagram of D_2 structures showing how the large scale F_2 fold controls the disposition and orientation of rock units and D_1 structures in the Dolland Brook map area.*

coarse fracture cleavage in the granite may also be related to the strain-slip fabric in the country rocks.

Two steeply dipping faults occur on either side of the F_2 fold hinge. Units 2 and 3 are demonstrably displaced by the southern fault; the northern one parallels the boundary between Unit 3 volcanics and Unit 8 granite. Both faults continue southeastward into the granite which is locally brecciated and chloritized within the fault zones. These faults may be related to the F_2 folding.

Mineralization

A number of scheelite occurrences were shown on the Buchans Mining Company maps (Scott and Conn, 1950) and on Smyth's (1979) compilation map. Although not confirmed during this study, their approximate locations are given on Figure 1. Most are associated with the contact between the North Bay Granite and the Bay du Nord Group and presumably occur in granite dikes that cut the metasedimentary rocks. These could be a significant indication of the Sn-W potential of the North Bay Granite and of possible uranium mineralization; O'Brien and Tomlin *(this volume)* reported anomalous radioactivity associated with scheelite-bearing granite in the adjacent White Bear River (11P/14) map area. Disseminated pyrite was found in minor two-mica granite included in Unit 10 biotite granite west of Salmon River. Pyrite and minor chalcopyrite also occur in metasedimentary xenoliths in Unit 10 granite on Salmon River.

All of the mineral occurrences found in the Bay du Nord Group during this study were of pyrite. Fine grained disseminated pyrite is common in the felsic tuffs of Unit 3, locally producing gossan zones, e.g. just east of Grey River. Pyritiferous, rusty weathering felsic tuff is infolded with black graphitic pyritiferous pelite west of Salmon River. Scott and Conn (1950) indicated arsenopyrite and scheelite in Unit 3 volcanics east of Salmon River. Pyrite is also common in Unit 5 slates and siltstones; Smyth (1979) indicated pyrrhotite in this unit on Grey River. Thus the best potential for base metal mineralization lies in the distal submarine felsic volcanics of the Bay du Nord Group and the associated graphitic pelites and slates. The restriction of volcanic breccia and/or agglomerate to the area east of Salmon River may suggest the proximity of a feeder vent.

Conclusion

Part of the Bay du Nord Group is interpreted to represent a turbidite sequence consisting of thin and thick bedded turbidites, resedimented conglomerate and pebbly sandstone. Felsic volcanic rocks form a distal facies within the sedimentary sequence. The first deformation of the group resulted in recumbent isoclinal folds that were probably overturned towards the south. These structures are presumed to have been related to large scale, first order folds similar to those in the Facheux Bay area. The upward facing direction of stratigraphic units in the Bay du Nord Group suggests that these rocks were confined to the normal limb of such a large scale recumbent fold. Metamorphism increased during D_1 towards synkinematic granites, culminating in partial melting and granite injection of the deeper levels of the deforming pile (Figure 2). Narrow D_1 cataclastic zones may mark thrust faults that developed during this period of folding and granite intrusion. Post-D_1 granite intrusion and upright F_2 folding resulted in the steepening of D_1 structural elements and produced the present outcrop pattern in the Dolland Brook area (Figure 3).

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Note: Unpublished reports are followed by numbers in square brackets, which refer to Mineral Development Division files.

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