GEOLOGY OF THE GREY RIVER AREA, SOUTHWEST COAST OF NEWFOUNDLAND

by

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ABSTRACT

The Grey River enclave is an east-west trending belt of metamorphic rocks that straddles the Ramea (11P/11) and La Hune (11P/10) map areas; it is bounded to the north and west by the Burgeo granite and to the east-southeast by the Francois granite. Amphibolite facies metamorphism generally increases from north to south in the enclave, culminating in migmatite zones. Felsic metavolcanic and pelitic metasedimentary rocks suggest an affinity with lithologically similar Ordovician rocks found elsewhere along the Hermitage Flexure. Large, pretectonic quartz veins and much smaller, wolframite bearing, posttectonic quartz veins are special features of the Grey River area.

INTRODUCTION

Metamorphic rocks in the Grey River area straddle the Ramea (11P/11) and La Hune (11P/10) map areas on Newfoundland's southwest coast. The study area is located west of Francois and east of Burgeo and Ramea; these three communities, as well as Grey River, are regular stops on CN Marine's south coast ferry run. Burgeo, Ramea and Grey River are serviced by an additional ferry twice a week. A gravel road (route 460) links Burgeo to the Trans Canada Highway near Stephenville.

The present study involved systematic mapping of the metamorphic rocks and adjacent granitoids in the Grey River area on a 1:50,000 scale; it was completed during the 1984 field season. The remainder of the Ramea and La Hune map area was mapped by Dickson et al. (1985) and Poole et al. (1985). Exposure is continuous along the coast and excellent everywhere else in the Grey River area.

The Grey River area was first mapped by the Buchans Mining Company Limited (Bahyrycz, 1957) on a scale of 1 inch to 1320 feet after prospectors discovered quartz veins containing tungsten minerals. This mapping was extended to the La Hune Bay area (Mullins, 1958) and resulted in the definition of most of the major lithologic units, including quartz rich bands described as quartzites. A silica assessment study was done on the quartzites by the Newfoundland Department of Mines, Agriculture and Resources (Fleming, 1967; Bartlett, 1969; Butler and Greene, 1976). The Grey River area was also mapped on a 1 inch to 4 mile scale (Riley, 1959) and 1:250,000 scale (Williams, 1971) by the Geological Survey of Canada as part of the larger Burgeo (11P) map area. Higgins and Smyth (1980) did a regional summary of the area covered by Bahyrycz for the Newfoundland Department of Mines and Energy, partly in conjunction with a Ph.D. study of the tungsten bearing quartz veins by Higgins (1980a,b; Higgins and Kerich, 1982).

GENERAL GEOLOGY

The Grey River area is sited in the south-central 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 an east-west trend in the map area. The metavolcanic, metasedimentary and migmatitic rocks are here informally referred to as the Grey River enclave and assigned a possible Ordovician age. These rocks are separated from the Ordovician Bay du Nord Group (Cooper, 1954; Chorlton, 1980a,b; Blackwood, 1984) to the north, and the Ordovician Baie d'Espoir Group (Jewell, 1939; Colman-Sadd, 1974, 1976) to the east, by Devonian or earlier granitoids.

Grey River enclave (Units 1-8)

The Grey River enclave is a zone of east-west trending units consisting of metavolcanic, metasedimentary and migmatitic rocks, together with pretectonic rocks of possible intrusive origin (Figure 1). The degree of partial melting and lit-par-lit granitoid veining generally increases from north to south.

Unit 1 is a band of felsic metavolcanic rocks that outcrops between the Gulch Cove area of Southeast Arm and La Hune Bay. A small area of Unit 1 outcrops at the western end of Big Pond, north of Grey River. The main area consists mostly of fine grained, pinkish white to grayish white weathering felsic tuffs with scattered 1 to 3 mm quartz and feldspar phenocrysts. The tuffs are commonly laminated with discontinuous 1 to 5 mm laminae defined by color and compositional variations, and accentuated by thin parallel quartz veins or segregations. Locally, 1 to 25 cm thick beds of felsic tuff contain interlayered 1 to 8 cm thick calcareous beds and lenses (Plate 1). Minor translucent quartz clasts occur in the carbonate; the associated volcanics generally contain a profusion of quartz clasts.

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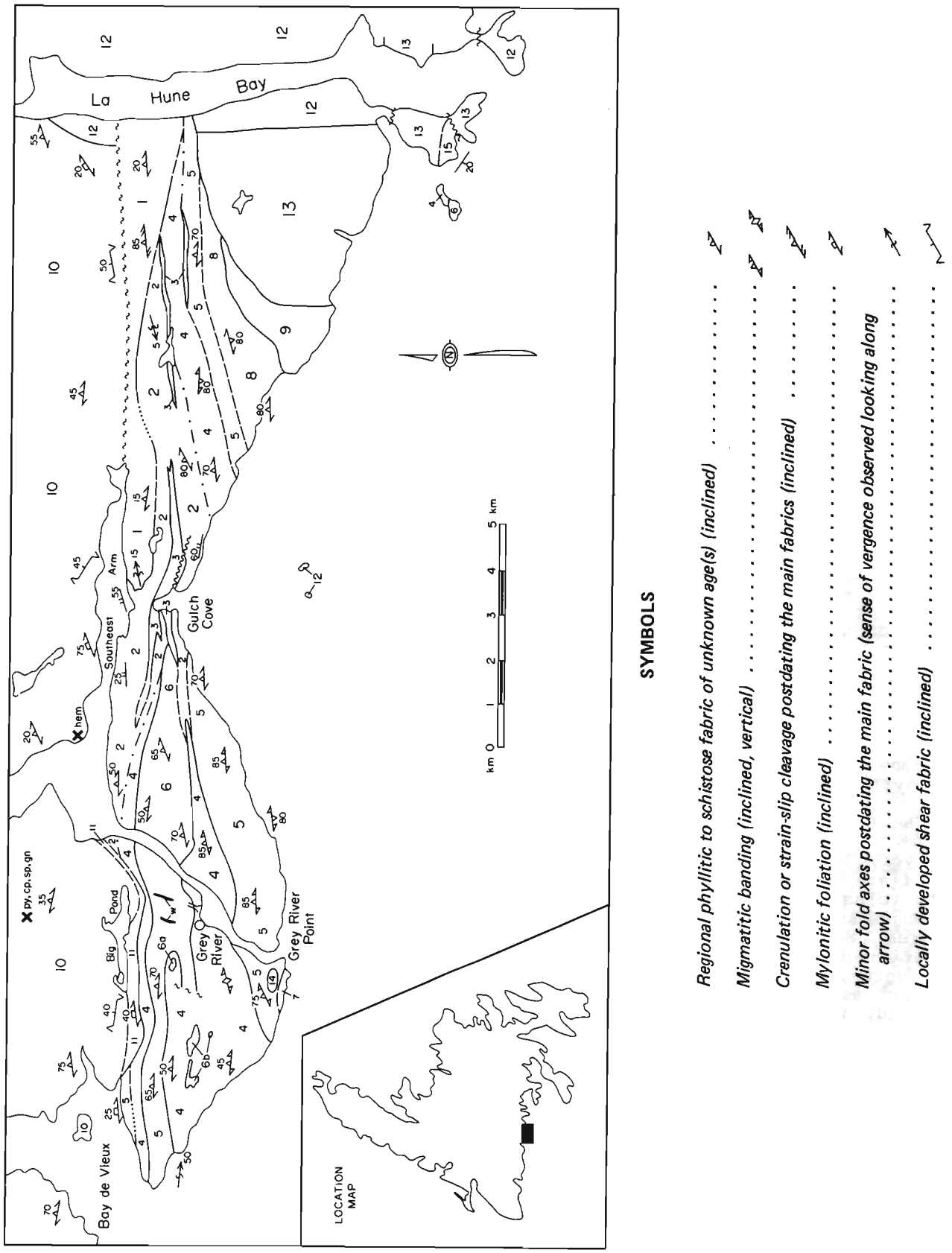

Figure 1: *Geology of the Grey River Area, southwest coast of Newfoundland.*

LEGEND

DEVONIAN OR LATER

Posttectonic quartz veins.

15 *Red and green conglomerate, sandstone, shale and limestone.*

DEVONIAN OR EARLIER

14 *Fine to medium grained, minor hornblende and biotite granite.*

FRANCOIS GRANITE (Units 12 and 13)

13 *Fine to medium grained, feldspar porphyritic syenite.*

12 *Coarse grained, feldspar porphyritic, biotite granite.*

BURGEO GRANITE (Units 10 and 11)

11 *Fine to medium grained granite protomylonite, plus minor mylonite and ultramylonite.*

10 *Commonly foliated, medium to coarse grained, feldspar porphyritic, biotite granite.*

9 *Fine to coarse grained hornblende gabbro, including minor hornblendite, diorite and amphibolite.*

ORDOVICIAN (?)

GREY RIVER ENCLAVE (Units 1 – 8)

8 *Agmatite. Hornblende ± biotite schist, migmatite, and amphibolite, intruded by foliated leucogranite.*

7 *Fine to medium grained granite/granodiorite gneiss containing profuse mafic xenoliths.*

6 *Fine to coarse grained amphibolite, including minor gabbro and hornblendite,* **6a,** *peridotite,* **6b,** *hornblendite and gabbro.*

5 *Amphibolite, hornblende ± biotite schist and hornblende diorite migmatite.*

4 *Migmatized semipelitic, pelitic and psammitic schist, plus minor hornblende ± biotite schist.*

3 *Pretectonic quartz veins (?).*

2 *Pelitic to psammitic phyllite and schist, plus minor quartzite, banded amphibolite, and migmatite.*

1 *Fine grained grayish white and pinkish white felsic tuff, locally containing minor carbonate lenses, medium to coarse grained quartz/feldspar lapilli tuff, and minor conglomerate, sandstone and phyllite.*

Locally, narrow zones of green phyllite occur in the volcanics in the Southeast Arm area. An area of enigmatic volcaniclastic rocks occurs in the eastern part of Unit 1 near La Hune Bay. Interpreted as coarse grained lapilli tuff or fine grained agglomerate/conglomerate, these rocks consist of lithic and crystal clasts in a pelitic matrix. The clasts are matrix supported, angular to round and poorly sorted. Pink feldspar clasts are 0.5 to 3 cm long, white feldspar clasts are 2 to 8 mm across and fine grained pink and gray felsic volcanic clasts are up to 7 cm long. The small area tentatively included in Unit 1 north of Grey River at Big Pond appears to be a large inclusion in the Burgeo Granite (Unit 10). It consists of granule to pebble conglomerate containing profuse felsic volcanic clasts, including quartz porphyry and jasper. Brownish red argillite containing grayish white carbonate lenses is associated with the conglomerate. Minor, possibly flow banded, red rhyolite and white weathering felsic tuff as well as greenish gray quartz and feldspar lapilli tuff also occur in the same small area.

Plate 1: *Felsic tuffs with calcareous interbeds are disposed in a recumbent isoclinal fold. Unit 1 west of La Hune Bay.*

The main regional foliation is penetratively developed throughout Unit 1 and locally is axial planar to isoclinal folds of bedding and laminae. Pretectonic granitoid veins are also folded by this deformation. These early folds are overturned to recumbent (Plate 1) and are commonly overprinted by relatively upright, open to moderately tight folds with a variably developed axial planar crenulation cleavage. The main fabric is a phyllitic foliation in the Southeast Arm and Big Pond areas but fine to coarse grained biotite is developed on fabric planes near La Hune Bay. The volcanics are also recrystallized and contain biotite, muscovite and, locally, hornblende porphyroblasts in the eastern part of the unit.

Unit 2 consists mostly of metasedimentary rocks which occur along Southeast Arm and east of Gulch Cove. It is conformable with, and lies structurally below, Unit 1 felsic volcanics. In the Gulch Cove-Southeast Arm area these rocks are mostly gray or green phyllites and fine grained schists, interlayered with 0.5 to 10 cm wide semipelite, psammite and minor graphitic pelite bands. Locally, concordant, 1 to 8 cm thick, amphibolite layers have gradational boundaries with enclosing psammite, suggesting that originally these were beds of possible mafic to intermediate volcaniclastics. Also, 1 to 2 m zones of chlorite schist, and a more massive dark green rock containing profuse 1 to 4 mm epidote crystals may represent mafic volcanics. Pinkish white weathering felsic tuffs also occur locally in bands up to 60 cm wide and are best developed along the contact with Unit 1. Pink, siliceous lenses, 2 to 10 mm wide, may represent transposed cherty layers in phyllite along Southwest Arm; brownish red carbonate stringers are developed in the same area. Feldspathic quartzite and quartz mica schist occur with banded amphibolite (Plate 2) and pelite in Unit 2 at Gulch Cove.

Plate 2: *Primary (?) layering in amphibolite. Unit 2 at Gulch Cove.*

Locally, Unit 2 contains a profusion of 2 to 4 cm wide quartz segregations which, along with 1 to 2 mm granitoid sweats, developed parallel to the main

foliation, increase toward the southern contact with Unit 4 migmatite. Also, the quartzofeldspathic component of the semipelite becomes recrystallized into distinct quartz and feldspar crystals with proximity to the southern boundary. Muscovite porphyroblasts, common throughout Unit 2, are well developed in pelitic layers in this area and, along with biotite, are locally preferentially sited in pelitic laminae. Plagioclase porphyroblasts are selectively developed in pelitic layers north and east of Gulch Cove (Plate 3). Concordant, pretectonic amphibolite dikes and granite pegmatite are common in Unit 2 as are boudinaged quartz veins and quartz plus white feldspar granitoid.

Plate 3: *Plagioclase porphyroblasts developed in pelite/semipelite. Unit 2 east of Gulch Cove.*

The main fabric in Unit 2 is co-planar to bedding and locally appears composite where it is manifested as a fine but distinct 0.5 mm banding of alternating quartzofeldspathic layers and biotite rich layers in pelite-semipelite. It also appears to transpose an earlier foliation locally. However, no folding was observed associated with this earlier orientation and it may reflect a mimetically recrystallized primary anisotropy. The main foliation is schistose in the south but phyllitic along Southeast Arm; the presence of concordant granitoid sweats at Gulch Cove, however, suggests that the phyllites represent retrogressed amphibolite facies rocks, possibly due to movement along the faulted northern boundary of the Grey River enclave. Commonly the regional foliation is overprinted by a crenulation cleavage that is axial planar to moderately tight folds. Cordierite porphyroblasts, 1 to 4 cm across, also overprint the main fabric at the entrance to Southwest Arm.

Unit 3, originally mapped as quartzite (Bahyrycz, 1957), is mostly confined to Unit 2 and the main zone occurs in the Gulch Cove area. It forms an approximately 350 m wide zone at the top of the cliff on the east side of Gulch Cove (Plate 4) and has an overall length of 5.8 km. It thins and pinches out in either direction along strike, bifurcating west of Gulch Cove. Other discontinuous, thinner bands occur east of the Gulch Cove zone and on an island in the southeast. Unit 3 consists mostly of white to grayish white weathering, fine to coarse grained quartz. Locally, it is coarsely recrystallized to granular translucent quartz. Minor, but conspicuous, coarse grained muscovite is common. Blebs and stringers of massive to disseminated magnetite, 1 to 6 mm wide and up to 50 mm long, occur locally. Disseminated magnetite is also concentrated in 2 to 20 mm wide parallel bands that are continuous over tens of centimeters but end abruptly, e.g., on the eastern hill overlooking Gulch Cove. Distinct, mostly pink weathering feldspar occurs with the quartz in a number of places in Unit 3, particularly where the main zone tapers off along strike. The feldspars are 1 to 12 mm across and are either spottingly distributed or profuse enough that the rock resembles a leucogranite. This particular observation suggests an intrusive or quartz vein origin for Unit 3 and is consistent with a leucogranite sill interpretation by Higgins and Smyth (1980). Also, discontinuous metasedimentary zones interpreted as rafts or xenoliths are common in Unit 3 and consist mostly of pelitic to psammitic phyllite and schist. Interbedded quartzite, psammite, semipelite and amphibolite, with beds 1 to 10 cm wide, form a concordant zone in Unit 3 on the west side of Gulch Cove. These inclusions range from less than a metre across to several metres wide and tens of metres long. The smaller inclusions look convincingly like xenoliths although it could be argued that the larger ones represent original interbedded material. The main contacts of Unit 3 are generally sharp and abrupt but locally interdigitating occurs and the quartz appears to form tongues that pervade the semipelite and psammite inclusions. Also, small quartz veins which cross-cut beds in Unit 2 adjacent to Unit 3 locally contain minor feldspar and some are texturally identical to quartz in Unit 3.

A pronounced penetrative foliation is developed throughout most of Unit 3. It is commonly resolved as a 1 to 4 mm parting with minor muscovite concentrated on the fabric planes. Locally flecks of magnetite are oriented parallel to the main fabric. The foliation is also more intense along

Plate 4: *Looking east from Gulch Cove along the main quartz vein (Unit 3).*

the contact with Unit 2 and appears to be the same regional fabric in both. Minor, open to tight folds of the main fabric in the quartz unit are consistent with the later refolding observed in the metasedimentary rocks. Amphibolite and granite dikes intrude Unit 3 pretectonically in some places.

Unit 4 occurs throughout the enclave, generally structurally below and south of Unit 2. It is a migmatized metasedimentary unit that essentially is the higher grade metamorphic equivalent of Unit 2. Along its northern boundary with Unit 2, a clear gradation between the two units is evident. A crude migmatitic banding is developed in Unit 4, defined by granitoid sweats, lenses of metasedimentary protolith, granite veins and the penetrative foliation (Plate 5). The quartzofeldspathic component of the semipelite protolith becomes recrystallized such that the rock locally resembles a fine grained, strongly foliated, biotite ± minor hornblende granitoid. The discontinuous granitoid sweats are white weathering, wispy and truncated by granite ptygmas. Where the development of migma is greatest, the migmatite is a crudely banded tonalite containing muscovite and biotite rich schlieren. Pelitic portions are locally garnetiferous with some porphyroblasts up to 1 cm across. Plagioclase, muscovite and cordierite porphyroblasts are also developed in pelitic bands within the migmatite. Areas of less migmatized metasedimentary protolith, particularly the more siliceous material, occur throughout Unit 4. One such zone occurs on the coast west of Grey River Point where interbanded psammite and minor quartzite, probably reflecting original bedding, are intruded by lit-par-lit granite veins. Concordant amphibolite bands occur throughout Unit 4 but increase in profusion towards its southern boundary. Some of these are clearly pretectonic dikes but bands marked by gradational boundaries with interlayered pelitic material are interpreted as primary in origin, i.e., mafic tuffs or flows.

Plate 5: *Quartz/granitoid segregations and veins in migmatite. Unit 4 on shore north of Grey River.*

The regional foliation is strongly developed throughout Unit 4 and most lithological elements in the migmatites are parallel to it. It is overprinted by a crenulation or strain-slip cleavage which is axial planar to moderately tight folds.

Amphibolite and mafic migmatite of Unit 5 form a linear zone south of and structurally below Unit 4; the contact between the two units is concordant and apparently conformable. Unit 5 is narrower east of Gulch Cove where it is limited southward by an agmatite zone. Fine grained banded amphibolite occurs in Unit 5 along its northern boundary where similar amphibolite layers also occur in Unit 4. The banding is interpreted as primary layering and is defined by variations in the color, grain size, and amount of amphibole. In hornblende-poor layers, plagioclase and minor quartz are strongly oriented along the layer parallel foliation. The banding is also accentuated by epidote rich lenses and concordant granite aplite or pegmatite veins. The amphibolites become more coarsely recrystallized and leucocratic to the south, a feature well displayed in the section south of Grey River harbour. The

leucocratic component consists of 2 to 6 cm plagioclase porphyroblasts and a profusion of 1 to 8 cm wide segregations of plagioclase plus quartz; these give the mostly dark weathering rock a streaky migmatitic appearance. Cross-cutting veinlets of epidote are also common. Towards Grey River Point, this rock grades into a crudely banded, fine to medium grained, hornblende ± minor biotite, diorite schist or migmatite. It contains 2 to 15 mm wide, hornblende rich lenses and bands as well as local welts of hornblendite several centimeters across. In places, patches of quartz and plagioclase granitoid, 1 to 4 cm across, have diffuse margins with the enclosing hornblende schist or gneiss and are interpreted as *in situ* granitoid sweats (Plate 6). Lit-par-lit granite veins add to the banded migmatitic aspect of Unit 5 in this area. These rocks also grade eastward into less migmatized amphibolite in the area west of Gulch Cove. Hornblende schist and migmatite characterize the unit east of Gulch Cove.

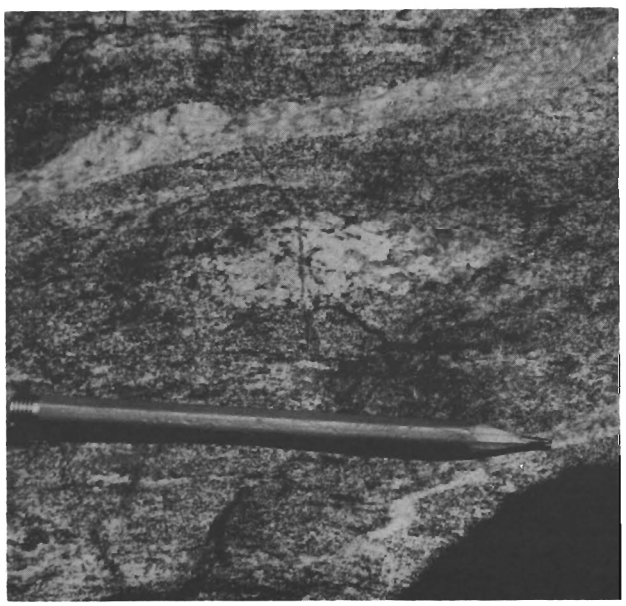

Plate 6: *In Situ granitoid welt of plagioclase and quartz in hornblende schist. Unit 5 north of Grey River Point.*

Unit 5, particularly in an area centered around the entrance to Grey River, is intruded by a profusion of dikes which locally may represent more than 50% of the sea cliff exposures. These include pretectonic, concordant to cross-cutting, amphibolite and granite aplite or pegmatite. The foliated amphibolite dikes generally predate the foliated granite dikes. Posttectonic granitic dikes cut the foliated dikes and are in turn intruded by fine grained, locally porphyritic, diabase dikes. The posttectonic mafic dikes are generally thinner than the early amphibolites and locally form vertical pipes from which many offshoots follow internal contacts and other zones of weakness in the host rock.

A penetrative foliation, parallel to the crude migmatitic banding and well developed layering, occurs throughout Unit 5. It is locally axial planar to isoclinal folds of the banding. Variably oriented, minor shear zones, 1 to 4 cm wide, offset the banding or have the banding rotated into them in some areas. Amphibolite dikes, commonly at a high angle to the crude gneissic banding, have a margin parallel or slightly divergent foliation which locally is axial planar to folds in the adjacent migmatite. Granitoid segregations and quartz veins have developed parallel to the foliation in these dikes which were either intruded into active shear zones (Higgins and Smyth, 1980), or the dikes preferentially sited shearing after intrusion (Plate 7).

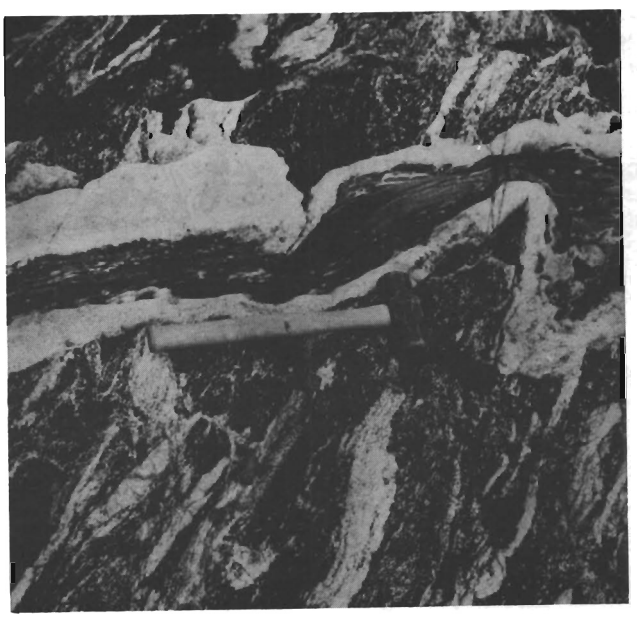

Plate 7: *Foliated amphibolite dike truncates banding in mafic migmatite. Note rim of leucogranite of enigmatic origin along the margins of the mafic dike. Unit 5 east of Grey River Point.*

Unit 6 forms a linear zone of amphibolite that is mostly surrounded by Unit 4 in the area west of Gulch Cove. It is generally greenish black weathering, and fine to coarse grained. Plagioclase crystals are 1 to 5 mm across and form augen in the foliation planes. Locally the feldspar exceeds hornblende in zones of leuco-amphibolite; variations in the hornblende/feldspar ratio also produce a crude banding in some areas. The more hornblende rich areas tend to be less well foliated and locally pods of coarse grained, dark green hornblendite

occur. Minor biotite was observed in a few places as was fine grained quartz in the groundmass. Locally, along its boundaries, the main amphibolite zone is fine grained with a 0.5 to 30 cm wide banding which appears concordant with the surrounding migmatized metasedimentary rocks. This might suggest a conformable relationship with the enclosing rocks and Unit 6 may have originated as a mafic volcaniclastic or flow. However, away from the margins it resembles a foliated medium grained gabbro including hornblendite pods. The occurrence of small mafic-ultramafic plugs (6a, 6b), here included with Unit 6, further suggests an intrusive origin. Subunit 6a is mostly variably foliated to massive, medium to coarse grained hornblendite, with variable amounts of gabbro. It is quite similar to small hornblendite pods in the main amphibolite zone. Subunit 6b is a coarse grained, relatively unfoliated, ultramafic containing 0.5 to 1 cm pyroxene crystals and minor biotite. Unit 6 is intruded by pretectonic leucogranite veins and both pretectonic and posttectonic mafic dikes; posttectonic quartz veins are common north of Grey River.

The penetrative regional foliation in Unit 6 is locally axial planar to folds of pretectonic dikes and minor banding in the amphibolite. A small zone of intensely foliated, grayish black weathering phyllite on the southeast side of Bay de Vieux contains scattered feldspar and quartz augen and is interpreted as mylonitized amphibolite. Within that zone, medium grained lenses of amphibolite protolith is preserved.

Unit 7 forms a small area west of Grey River Point. It consists of light gray to pinkish gray weathering, fine to medium grained, granite to granodiorite gneiss and migmatite. The banding is defined by discontinuous 1 to 5 mm wide layers, rich in biotite and/or hornblende. Commonly, biotite is the only dark mineral present. The banding or gneissosity either has a regular trend or is quite contorted with a diffuse schlieric outline. Profuse amphibolite lenses in the leucocratic gneiss are oriented parallel to the crude banding. Rarely, pelitic and quartz rich inclusions occur. Some of the amphibolite inclusions must represent mobilized pretectonic dikes since in detail they truncate the schlieric banding and are folded with it. However similar inclusions also truncate oriented mafic lenses that are interpreted as either restite or xenoliths of the hornblende schist/migmatite unit (5) to the north. The leucocratic gneiss is locally concordant with banding in the adjacent more mafic gneiss but locally intrudes and truncates the banding in the latter, e.g., east of Grey River Point (Plate 8). The myriad dikes which intrude Unit 5 also intrude Unit 7.

Plate 8: *Granodiorite migmatite (Unit 7) with schlieren structure intrudes regularly banded hornblende migmatite (Unit 5). Unit 5 at eastern entrance to Grey River harbour.*

Unit 8 is an agmatite zone which occurs east of Gulch Cove. Foliated amphibolite and hornblende ± biotite schist and migmatite of Unit 5 are intruded by fine to medium grained quartz and white feldspar granitoid. The intrusion breccia is accentuated by having black weathering, mafic rafts in the white weathering granitoid. Generally the granitoid predominates and locally contains minor biotite. The regional penetrative foliation is common to both rock types.

Gabbro (Unit 9)

Unit 9 is a fine to coarse grained, black weathering gabbro that intrudes the agmatite zone along its northern boundary. The contact is sharp and the gabbro is fine to medium grained along its margin. A moderate foliation is developed in the contact area where Unit 9 is locally amphibolitic. Generally, however, it is massive and where coarse grained, hornblende crystals are up to 1 cm long. Locally, zones of nearly hornblendite composition contain minor plagioclase; rare diorite also occurs in some places. The gabbro is intruded by pink granite aplite dikes.

Burgeo granite (Units 10 and 11)

The Burgeo granite, an informal name used here to replace the Burgeo batholith of Williams (1978), includes a vast area of granitoids to the north and west of the Grey River map area (Dickson et al., 1985; O'Brien and Tomlin, 1985). It intrudes the

Grey River enclave along its northern boundary. Unit 10 is a medium to coarse grained feldspar porphyritic biotite granite. Feldspar phenocrysts are 1 to 5 cm long. A penetrative foliation defined by oriented biotite and minor quartz elongation is commonly developed north of Southwest Arm and in the Bay de Vieux areas; however, local areas of weakly foliated to unfoliated biotite-poor granite also occur. The granite is dominated by cataclastic textures along its contact with the Grey River enclave. Narrow zones of protomylonite to mylonite occur where original feldspar phenocrysts are reduced to pink streaks. Commonly, however, the granite is brecciated or highly fractured, consisting of orange pink feldspar, 0.5 to 3 cm long, in a light to dark green weathering chloritized matrix. The fractures are anastomosing, locally chlorite filled, and cross-cut the penetrative foliation. The contact area west of Southwest Arm locally contains zones of dark gray weathering sheared granite/granodiorite that were originally mapped as metasedimentary rocks (Bahyrycz, 1957).

Unit 11 is a fine to medium grained granite protomylonite containing pink feldspar and minor biotite. It is tentatively included with the Burgeo granite and may represent a contact phase of the larger body. Feldspar porphyroclasts are 1 to 2 mm long and have a pronounced augen structure along with flattened quartz in zones of mylonite. Black weathering flinty zones of ultramylonite occur in some areas along the contact between Units 10 and 11. The protomylonite contains minor amphibolite xenoliths locally.

The relationship between the penetrative foliation in the Burgeo Granite and the main fabric in the Grey River enclave is not clearly understood. They are regionally concordant along part of the contact but the fabric in the granite appears to have a similar attitude to the strain-slip fabric in the metasedimentary rocks along part of Southwest Arm. Also, pelitic rocks at the entrance to Southwest Arm locally have a flinty hornfels texture and large cordierite porphyroblasts that overprint the main foliation. If the porphyroblasts are related to the Burgeo granite, it suggests that the granite in this area postdates the main deformation of the Grey River enclave.

Francois granite (Units 12 and 13)

The Francois granite (Poole et al., 1985) intrudes the Burgeo Granite, the Grey River enclave and Unit 9 gabbro in the eastern part of the map area. Granite similar to Unit 12 occurs on Gulch Cove Islands. The main area of the Francois granite is exposed east of the map area and is described by Poole et al. (1985). Unit 12 is a pink weathering, coarse grained, feldspar porphyritic, biotite granite. The feldspar phenocrysts are 0.5 to 3 cm long and biotite commonly forms 2 to 6 mm phenocrysts. Coarse grained quartz, 2 to 10 mm across, and finer grained white feldspar occur throughout. The granite is texturally uniform and apart from a local fracture cleavage, quite massive.

Unit 13 is a pink weathering, fine to medium grained, feldspar porphyritic, biotite syenite. Minor, fine grained quartz is locally visible in a pink feldspar-rich matrix which contains 0.4 to 2.0 cm long K-feldspar phenocrysts and 1 to 5 mm biotite phenocrysts. White to pale green plagioclase phenocrysts are smaller than the pink feldspar. A feldspar porphyry phase containing minor quartz phenocrysts occurs along the syenite's northern contact. The K-feldspar phenocrysts are commonly zoned and euhedral in the porphyry. Away from the contact, feldspar phenocrysts are profuse to sparsely developed. Locally some biotite is altered to chlorite. Along the eastern contact with Unit 12 granite, a porphyry phase included in Unit 13 contains conspicuous quartz phenocrysts 2 to 8 mm across with square to round cross-sections. The size and number of phenocrysts decrease away from the contact over several metres where it merges with the regular syenite. Unit 13 is unfoliated except for a locally developed contact parallel cleavage along its northern boundary.

Granite (Unit 14)

Unit 14 is a fine to medium grained, pinkish white weathering, granite plug that intrudes Unit 5 of the Grey River enclave on the hill above Grey River Point. It contains minor hornblende and even less biotite; locally pegmatitic patches occur. Completely unfoliated, it is a posttectonic granite of the same age and composition as many of the granite dikes in the same area.

Devonian(?) sedimentary rocks (Unit 15)

A small area of mostly gently dipping, upward facing, sedimentary rocks occurs on the western peninsula at the entrance to La Hune Bay. The most common rock type is pale green to gray weathering and minor reddish brown weathering granule to pebble conglomerate. Generally the conglomerate has a matrix of rounded pink feldspar and quartz granules which supports a variety of pebbles. Minor calcareous patches occur in the matrix locally. The pebbles consist of quartz and/or feldspar porphyry, pink, medium grained granite, flow banded rhyolite, red and purple fine grained felsic volcanics, argillite, sandstone, and quartz. Clasts range from 1.5 to 2.5 cm

across. Some of the argillite and felsic volcanic clasts have a parting or cleavage that predated incorporation into the conglomerate. Locally, trough cross-bedding occurs in the conglomerate and where interbedded with sandstone, the conglomerate beds range from 20 cm to 3.5 m thick. The interbedded sandstone and siltstone are reddish brown weathering, fine grained and graded. Commonly calcareous, they grade into white weathering carbonate rich layers containing interconnecting lenses of reddish brown siltstone; in other layers the clastic material d... ates with anastomosing stringers and ...ods of carbonate (Plate 9). Interpreted as some type of caliche deposit, these rocks occur along the northern boundary of Unit 15 where it is in contact with the Francois granite (Unit 13).

Plate 9: *Carbonate pods in fine grained sandstone. Unit 15 near northern contact with Unit 14, western entrance to La Hune Bay.*

The contact between the sedimentary rocks and the Francois granite was originally interpreted as intrusive (Williams, 1971), but it appears, in fact, to be a nonconformity. The contact is steeply dipping and what appears to be a highly fractured "rubble" zone is developed in the underlying feldspar porphyry of Unit 13. Carbonate fills the fractures in the porphyry which is overlain by calcareous siltstone and sandstone with lenses of carbonate. The caliche-like zone directly overlies this and contains pebbles and boulders (up to 2 m across) of the porphyry; cracks in the boulders are also filled with carbonate. The sedimentary rocks are relatively unmetamorphosed but are overprinted by a slaty cleavage which locally is axial planar to open to moderately tight folds. These rocks are posttectonic with respect to the deformation in the Grey River enclave and may be Devonian or later in age (Williams, 1971).

MINERALIZATION

Most of the known mineralization in the Grey River area occurs in association with posttectonic quartz veins (Bahyrycz, 1957; Higgins, 1980) that are chiefly concentrated in the amphibolite unit (6) north of the town of Grey River. The veins are of variable size, from 2 cm wide veinlets to large 1 m wide veins that are up to 400 m long. Two of the larger veins are shown on Figure 1. The veins follow north to northeast trending faults, joints and fissures that sharply truncate the foliation in the host rocks. Wolframite is the most important tungsten mineral but scheelite also occurs. Other ore minerals include pyrite, chalcopyrite, minor arsenopyrite, molybdenite, sphalerite, galena, bismuth and marcasite. Small, sulphide bearing quartz veins also cut sheared and mylonitized Burgeo granite (Unit 10) to the north, the largest of which on Dog Cove Brook contained pyrite, chalcopyrite, sphalerite and galena (Bahyrycz, 1957). Specular hematite forms thin coatings on fractures in the Burgeo Granite at the entrance to Southwest Arm.

A silica assessment (Bartlett, 1969) on the main quartz zone (Unit 3) east of Gulch Cove proved, by diamond drilling, a total tonnage of 12 million short tons with an average grade of 95.5 percent SiO_2 and 1.9 percent Al_2O_3 (Butler and Greene, 1976). The re-interpretation of the silica deposit as vein quartz could make it a possible target for gold exploration.

Disseminated pyrite mineralization occurs locally in the newly delineated felsic volcanic zone (Unit 1) and in metasedimentary rocks of Unit 2. Felsic volcanic and associated rocks are important hosts for gold and base metal mineralization throughout the Hermitage Flexure and represent the best potential in the Grey River map area.

SUMMARY AND CONCLUSION

Felsic metavolcanic rocks (Unit 1) and pelitic to psammitic metasedimentary rocks (Unit 2) form a conformable sequence in the northern part of the Grey River enclave. The volcanics structurally overlie the metasediments but their stratigraphic relationships are unknown; the presence of thin felsic volcanic bands in the underlying metasediments near the contact might suggest that Unit 1 volcanics are older and grade into Unit 2. Thick quartz rich bands (Unit 3), confined mostly to Unit 2, were

previously interpreted as bedded quartzites. However, field relationships suggest that these originated as pretectonic quartz veins, possibly from quartz released from the host rocks during regional metamorphism. The metasedimentary rocks of Unit 2 are progressively metamorphosed southward and form the protolith for a zone of migmatite (Unit 4). Banded amphibolite is concordant with the southern boundary of Unit 4 and grades through a zone (Unit 5) of granitoid segregation and *lit-par-lit* injection to a well banded migmatite at the entrance to Grey River harbour. The protolith for the hornblende migmatite may be mafic volcaniclastics and flows or a mafic intrusion, perhaps similar to the relatively homogeneous zone of amphibolite (Unit 6) that is confined mostly to Unit 4. The mafic migmatite is locally intruded by a granite to granodiorite gneiss or migmatite (Unit 7) which contains profuse mafic inclusions. It is possible that this more leucocratic migmatite originated as an agmatite similar to Unit 8, where a mafic host is pervaded by leucogranite; subsequent or progressive deformation and metamorphism could produce the relationships seen in Unit 7.

Relatively massive gabbro (Unit 9) in the southeast intrudes the Grey River enclave, which is bounded to the north by the Burgeo granite (Units 10 and 11). A regional penetrative foliation in the Burgeo granite locally merges with mylonites in the contact between the granite and metamorphic rocks. Along this contact, the Grey River enclave appears retrogressed as chlorite and sericite phyllites contain remnant quartz and granitoid segregations, typical of the lower to upper amphibolite facies rocks to the south. Thus the final tectonic positioning of the granite postdates the main pulse of metamorphism in the Grey River enclave. However, displacement along the contact was probably not great since original intrusive relationships, indicated by xenoliths and porphyroblasts, are evident in the map area. The posttectonic Francois granite (Units 12 and 13) is mostly massive and truncates the eastward trace of the above units. A small plug of hornblende-biotite granite (Unit 14) is representative of the posttectonic granitoid veining in the migmatite units. Finally, a mostly conglomeratic sequence (Unit 15) was deposited nonconformably upon the Francois granite.

Felsic volcanic rocks occur with mostly pelitic rocks in the Grey River area. This is a common association throughout the Hermitage Flexure, particularly in the Baie d'Espoir and Bay du Nord Groups. The style of deformation and metamorphism (Blackwood, 1984) is also similar; the main period of folding in the Grey River area resulted in isoclinal, possibly recumbent folds, although present attitudes may not reflect the original style. A crenulation cleavage, axial planar to upright, gently plunging folds overprints the earlier structures. Metamorphism increases southward or structurally downward, culminating in migmatites. These observations would tend to suggest that rocks of the Grey River enclave are the equivalent of Ordovician rocks that occur elsewhere along the Hermitage Flexure. A postulated Avalon Zone connection, based on correlating presumed orthoquartzites in the Grey River area with similar rocks elsewhere in the Avalon Zone (Smyth, 1981) is invalid if the present vein quartz interpretation is correct.

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