GEOLOGY OF THE FACHEUX BAY (11P/9) MAP AREA, NEWFOUNDLAND

by

R. Frank Blackwood

INTRODUCTION

The Facheux Bay (11P/9) map area is located around, and west of, the entrance to Bay d'Espoir on Newfoundland's south coast. It is accessible by small boat out of St. Alban's and Hermitage, the two closest road links. McCallum, the only community in the area, is a regular stop on CN Marine's south coast ferry run.

Nearly all of the land mass lies in the northern part of the map area; a small portion of the Hermitage Peninsula occurs in the southeastern corner. Mapping on a 1:50,000 scale was completed in the northern part during the 1982 field season. Almost continuous coastal exposure occurs throughout the map area, with Facheux Bay and Northern Arm providing two excellent cross-sections. Exposure inland varies from 10%-80%.

The Facheux Bay area was mapped on a 1:250,000 scale by the Geological Survey of Canada (Williams, 1971) as part of the larger Burgeo map area. Parts of the area were briefly examined by Colman-Sadd (1974) as part of a Ph.D. thesis; he also mapped in detail part of the area to the east (Colman-Sadd *et al.*, 1979). Swinden (1980) closely examined the felsic volcanic rocks and associated sulfide occurrences in the Facheux Bay area. Mineral exploration has been carried out by the Newfoundland and Labrador Corporation (Dunlop, 1954) and by Falconbridge Nickel Mines Ltd. (1976).

GENERAL GEOLOGY

The Facheux Bay map area occupies that part of the Hermitage Flexure (Williams *et al.*, 1970) where northeasterly trending rocks of eastern Newfoundland "curve around" to form a generally east-west trending, sinuous configuration along the south coast. Structural and lithostratigraphic elements have a general east by north trend in the eastern part of the map area and a general west by north trend in the western part. Rock units within the area represent a continuation of the Baie d'Espoir Group (Jewell, 1939) as well as metasedimentary rocks, migmatites and granitoids of the Gander Zone (Williams *et al.*, 1974) to the east-northeast (Colman-Sadd, 1974; Swinden, 1980).

Rock units in the Facheux Bay area may be grouped into three broad subdivisions:

1) a central wedge of metasedimentary and metavolcanic rocks of the Bay d'Espoir Group,

2) a southern belt of synkinematic granitoids, and

3) a northern area of little-deformed two-mica granite.

Two formations of the Baie d'Espoir Group are recognizable in the area. The Isle Galet Formation (Colman-Sadd, 1974, 1976) consists largely of volcanic and pelitic rocks (Units 1-5); the Riches Island Formation (Colman-Sadd, 1974, 1976) is mostly semipelite and psammite (Unit 6). Other rocks here included in the Baie d'Espoir Group are metasedimentary rocks and minor migmatites (Units 7 and 8) which were previously designated as Little Passage Gneiss (Colman-Sadd, 1974; Swinden, 1980).

ISLE GALET FORMATION (Units 1 - 5)

The Isle Galet Formation consists of five stratigraphic units which can be traced from Lampidoes Passage in the

Contribution to Canada-Newfoundland co-operative mineral program 1982-84. Project carried out by Newfoundland Department of Mines and Energy.

east to Facheux Bay in the west. These units are disposed in a slightly overturned syncline in the north and a recumbent anticline in the south with both folds overturned to the south (see schematic cross-section on Figure 1). A regionally developed, north-dipping, phyllitic to finely schistose foliation is axial planar to these folds.

Unit 1 occupies the core of the anticline and consists of pelite and lesser felsic tuff. The gray to grayish black pelite is locally thinly laminated but its most pronounced feature is a strongly developed phyllitic foliation. Quartz stringers are common throughout and locally occur as discontinuous blebs outlining isoclinal fold hinges. The pelite is commonly garnetiferous, particularly in the Manuel Arm area, where the size and profusion of garnets decrease to the north.

Grayish white weathering, fine grained, felsic tuffaceous rocks are restricted in the Manuel Arm area to 15-25 m zones interlayered with the pelite. Locally, minor quartz and feldspar crystals, 1-2 mm across, occur in the tuff. A 150-200 m wide, fine grained, felsic tuff band with a pronounced sericitic foliation is bounded by pelite west of Facheux Bay. This band is continuous for most of the strike length of Unit 1 in that area and hosts nearly all of the sulfide showings in that region.

Unit 2 felsic volcanic rocks form four discrete belts in the map area. The two belts north of Unit 1 at and west of Manuel Arm represent a lower unit and an upper unit of felsic volcanic rocks, separated by a narrow band of mostly graphitic pelite and reworked tuff (Unit 3). The volcanic rocks in this area have been informally referred to as the Stanley Cove member by Swinden (1980). These, and their eastward extension to Lampidoes Passage, face north on the normal limb of the recumbent anticline. The two belts south of Unit 1 at and west of Manuel Arm are adjacent to each other and represent a northern belt of little-recrystallized felsic tuff which structurally overlies a belt of recrystallized felsic tuff; the latter contains profuse leucogranite veins. A possible fault, coinciding with the limit of leucogranite emplacement, defines the contact between the two. These belts of tuff and their extension on the north shore of Long Island are interpreted to be on the overturned limb of the recumbent anticline. The volcanic rocks at Long Island, however, do not have a leucogranite emplacement zone. Also, only minor leucogranite emplacement has occurred in the southern felsic volcanic belt west of Facheux Bay. All of these felsic volcanic rocks are here included in the Stanley Cove member of the Isle Galet Formation.

Plate 1. *Graded lapilli tuff faces up on the normal limbs of the anticline. Stanley Cove member (Unit 2) of the Isle Galet Formation at Stanley Cove.*

The Stanley Cove member consists mostly of strongly foliated, white to grayish white weathering, fine to coarse grained, felsic, crystal tuff. Conspicuous milky white and locally blue quartz

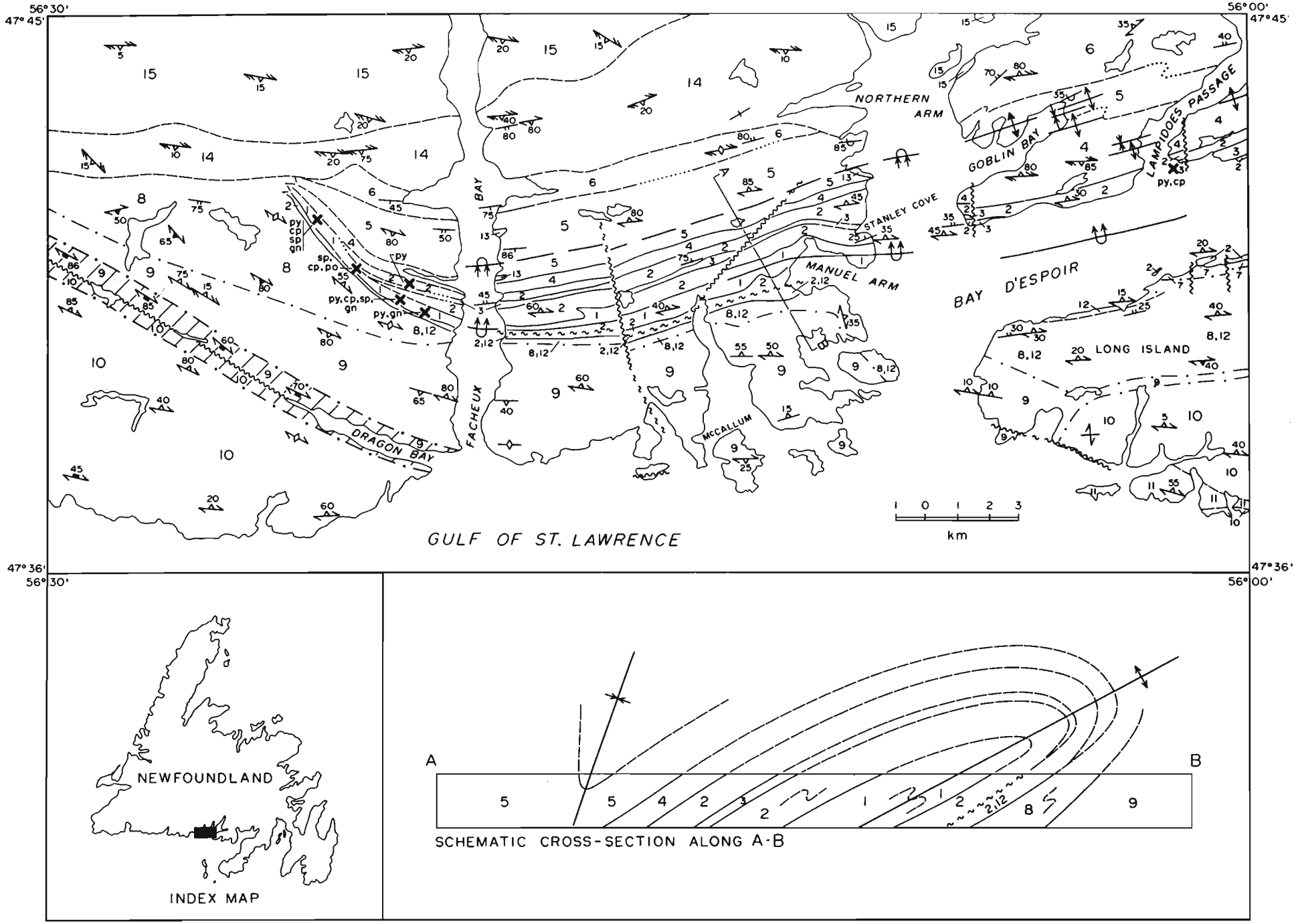


Figure 1. *Geological map of the Facheux Bay area, southern Newfoundland.*

LEGEND

DEVONIAN OR EARLIER

15 NORTH BAY GRANITE. Fine to coarse grained, equigranular to porphyritic, biotite greater than muscovite granite.

14 Intrusion breccia. Rafts of pelitic, semipelitic, and psammitic schist intruded by, or "floating" in, North Bay Granite.

13 Fine to coarse grained gabbro/amphibolite dikes, locally containing coarse grained hornblendite.

12 Fine to medium grained, muscovite greater than biotite, garnetiferous leucogranite.

11 PICCAIRE GRANITE. Medium to coarse grained, equigranular, biotite granite.

10 GAULTOIS GRANITE. Feldspar megacrystic, biotite rich, coarse grained granite; locally includes zones of equigranular granite.

9 McCallum granite (informal name). Fine to coarse grained, commonly layered, porphyritic, to equigranular, granite and granodiorite; locally includes leucogranite.

ORDOVICIAN OR EARLIER

BAIE D'ESPOIR GROUP (no stratigraphic order implied)

8 Recrystallized pelite, semipelite, psammite and amphibolite with profuse concordant leucogranite veins; locally becomes migmatitic.

7 Laminated pelite, semipelite, psammite, amphibolite and minor felsic tuffaceous bands with minor leucogranite.

6 RICHES ISLAND FORMATION. Laminated, semipelitic, staurolite schist and thickly bedded psammite; locally contains coticules.

ISLE GALET FORMATION (1-5)

5 Graphitic pelitic, lithic arenite, semipelite and banded, concordant amphibolite.

4 Mostly graphitic pelite with minor felsic tuff, amphibolite, and arenite.

3 Graphitic pelite, reworked felsic crystal tuff, muddy matrix conglomerate, and minor limestone.

2 Stanley Cove member (informal name). Fine to medium grained, quartz-feldspar crystal tuff, fine grained, laminated felsic tuff, massive rhyolite, minor conglomerate and minor mafic tuff (including amphibolite); southernmost band is recrystallized and contains profuse, concordant leucogranite veins.

1 Gray to black laminated pelite and fine grained, laminated felsic tuff.

SYMBOLS

Layering in granite (inclined, vertical)..... 

Recumbent F_1 fold (anticline, syncline)..... 

Upright F_2 fold (antiform, synform)..... 

Regional, penetrative foliation, S_1 (inclined, vertical).....

Weak cleavage in granite, crenulation cleavage to penetrative fabric in country rocks, S_2 (inclined, vertical)..... 

Mylonitic foliation (inclined)..... 

Migmatitic banding (inclined).....

crystals and feldspar crystals occur in a fine grained, light gray (on fresh surfaces), felsic matrix. Crystal concentrations vary from profuse in crudely graded beds of tuff (Plate 1), *e.g.* Stanley Cove, to sparse in fine grained, thinly laminated felsic tuff. As a generalization, the coarsest grained tuffs occur in the belt north of, and adjacent to, Unit 1. Locally porphyritic, steel gray rhyolite also occurs in this belt, particularly in the Manuel Arm area.

Narrow zones of graphitic pelite and laminated mafic tuff, in the order of 10 m wide, occur locally in the felsic tuffs. Some of these thin pelite bands form particular stratigraphic levels which persist from Northern Arm to Facheux Bay; this consistency of rock units is typical for that part of the map area.

In the southern, granite-intruded belt of felsic volcanic rocks, the tuffs are recrystallized, with fine grained biotite developed on the foliation planes. Locally, however, quartz and feldspar crystal clasts are preserved. The granite veins represent as much as 50% of the area outlined in this belt and consist of garnetiferous, leucocratic aplite and pegmatite. Although the contact with the adjacent belt of "granite-free" felsic tuffs is abrupt, small knots of aplite and pegmatite do occur locally, indicating the overall transitional nature of the zone. A penetrative foliation, locally with pronounced flattening and a flaggy-like parting, is common to both the granite veins and the volcanic rocks. Garnet and biotite are common in the "tuff plus granite" zone of the overturned limb but both also occur locally in the "granite-free" belt, *i.e.* north shore of Long Island.

Unit 3 effectively divides the Stanley Cove member into two stratigraphic horizons and, although less than 100 m thick, it can be traced from Lampidoes Passage to west of Facheux Bay. Along parts of its strike length, it consists entirely of black graphitic pelite. Commonly, however, muddy matrix conglomerate and reworked tuff occur. Clasts in the conglomerate range from 2-30 cm and consist of felsic tuff, rhyolite porphyry, and black pelite. The reworked tuff is a fine to coarse grained sandstone and consists of quartz (locally blue) and feldspar clasts in a fine grained black pelite matrix; isolated porphyry pebbles and pelite intraclasts locally "float" in the sandstone. Beds of laminated black pelite and coarser clastic material range from 0.5 to 4.5 cm in thickness and are locally graded. However, bedding is commonly chaotic, with lenses of crystal-rich material surrounded by the pelite. White weathering limestone, 1-3 m thick, occurs at the base of this northward facing unit, having been noted at Facheux Bay, Stanley Cove, Goblin Head and Copper Head. It commonly overlies a gray-white, cherty, pyritiferous horizon and is itself pyritiferous (Plate 2).

Plate 2. *White weathering limestone (marble) overlies gray chert. Base of Unit 3 of the Isle Galet Formation at Goblin Head.*

A phyllitic fabric is developed throughout most of Unit 3. Oriented biotite and hornblende occur in the matrix of Unit 3, east of the entrance to Lampidoes Passage.

Unit 4 consists mostly of graphitic pelite that conformably overlies the Stanley Cove member (Unit 2). The contact between the two is gradational over a few metres such that fine grained, thinly bedded tuff at the top of the member is interbedded with black pelite; tuffaceous beds also occur in the black pelite unit just above the contact. Unit 4 has greater areal extent east of Northern Arm due to refolding by open F_2 folds; minor arenite, felsic tuff and amphibolite are included in the unit in that region.

Unit 5 conformably overlies Unit 4. The fold axis of the slightly overturned syncline is sited in this unit such that rocks in the northern part of the sequence consistently face south. The unit consists of graphitic pelite, lith-arenite, semipelite and amphibolite which mostly occur in separate zones. However, the relative lack of inland exposure and the scale of mapping prevented a detailed subdivision of the unit.

Graphitic pelite commonly separates the other rock types in Unit 5. Dark gray to black, it contains a pronounced phyllitic foliation, axial planar to folded quartz stringers. Locally, feldspathic siltstone forms 3-5 cm interbeds in the pelite. The contacts between the pelite and other rocks types in the unit are conformable. The amphibolite is fine to coarse grained and commonly exhibits a regular 0.5-5 cm banding, defined by varying concentrations and grain size of amphibole. The amphibolite occurs as separate bands up to 20 m wide and may represent mafic tuff zones. The lithic arenite occurs in two bands, approximately 100-150 m wide, on either side of the syncline axis; bedding/cleavage intersections and grading in the Facheux Bay area suggest that they represent a single stratigraphic horizon repeated by the syncline. The fine to coarse grained arenite occurs in locally graded beds some 10-40 cm thick (Plate 3). Feldspar and clear to blue quartz form the matrix to pelite intraclasts. Fine grained biotite is developed on the penetrative foliation.

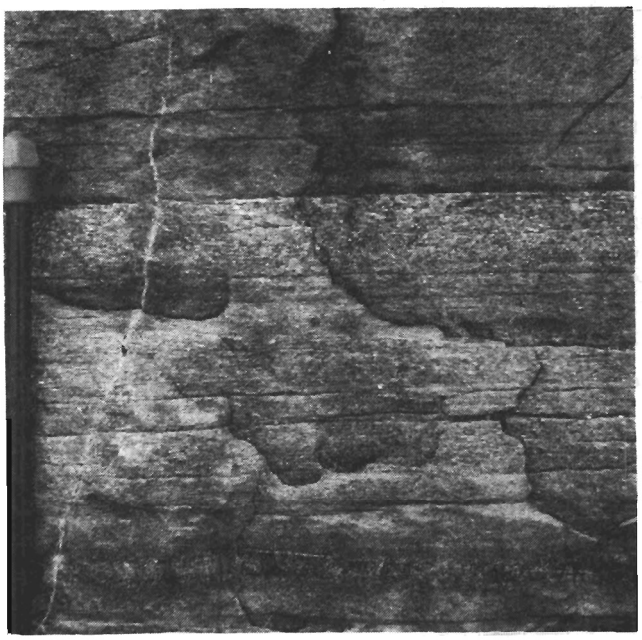


Plate 3. *Graded arenite is downward facing in cores of F_2 folds. Unit 5 of the Isle Galet Formation at Goblin Bay.*

RICHES ISLAND FORMATION (Unit 6)

The Riches Island Formation forms a single mappable unit along the northern boundary of the Isle Galet Formation. It appears to be older than Unit 5 along the contact and is almost certainly the time-stratigraphic equivalent of older units in the Isle Galet Formation. Lack of information on fold closures north of the syncline in Unit 5 and in Unit 6 prevent a more meaningful assessment of the stratigraphic relationships between the two formations.

Unit 6 consists of gray semipelite, psammite and minor arenite; the lack of amphibolite and the presence of only minor graphitic pelite are the strongest contrasts between it and Unit 5 of the Isle Galet Formation. The semipelite contains extremely uniform 1-10 mm laminations. These laminations are accentuated by late biotite and garnet porphyroblast growth, since Unit 6 is nearly everywhere in the aureole of the North Bay Granite (Unit 15). Regular garnet-quartz beds (coticules), 2-10 mm thick, occur with laminated semipelite north of Goblin Bay. Minor litharenite, locally graded and similar to that in Unit 5, is interbedded with the semipelite in the Facheux Bay area. The other prominent rock type in Unit 6 is fine grained, thickly bedded psammite; a clastic texture is not discernable in these 15-50 cm thick beds. Thin pelitic interbeds are common in the psammite.

UNITS 7 AND 8

Units 7 and 8 are included in the Baie d'Espoir Group and represent the higher metamorphic and granite-intruded equivalents of other rocks in the group. Unit 7 differs from Unit 8 in that only minor granite veining has occurred and the metamorphic grade is lower; both units appear to be on the overturned limb of the recumbent anticline along the north shore of Long Island.

Unit 7 consists of pelite, semipelite, psammite, amphibolite and minor felsic tuff. Most of these rocks weather dark green, dark gray or black and exhibit various degrees of recrystallization. The semipelite and psammite predominate and commonly form 4 to 20 cm beds containing 1-10 mm laminations. Black, graphitic pelite and banded, concordant amphibolite occur locally. Minor bands of felsic material, approximately 25 cm thick, form interlayers with black pelite adjacent to felsic tuffs of Unit 2. Some of the laminated semipelite/psammite beds preserve quartz and feldspar clasts 1-3 mm across; these are strongly reminiscent of laminated felsic tuff beds seen elsewhere in the Isle Galet Formation. Concordant knots and lenses of granite aplite and pegmatite, ranging from 2 to 5 cm in thickness, occur throughout Unit 7. Thicker, concordant granite veins are few. A pronounced, fine grained schistosity is subparallel to bedding and is defined by fine grained muscovite and biotite. A strong flattening component is obvious where the same fabric deforms the granite.

Unit 8 represents the continuation of Unit 7 on Long Island where there is a marked increase in the amount of concordant leucogranite veins; half or more of the outcrop area is garnetiferous leucogranite. The fine grained semipelitic and psammitic schist of Unit 7 is progressively and coarsely recrystallized towards the south such that medium to coarse grained muscovite/biotite schist occurs; banded amphibolite zones are common. Muscovite, biotite, and garnet commonly form porphyroblasts. Diffuse to sharp bounding planes are quite regular and separate pelitic to psammitic compositional varieties that are 4 to 20 cm thick. This layering is interpreted as primary as are 1-10 mm laminations that occur throughout. Along the north shore, the regional foliation dips more gently to the north than bedding, confirming the structural position of these rocks on the bottom limb of the overturned anticline.

Unit 8 is in contact with felsic volcanic rocks of the southernmost belt of Unit 2, west of Manuel Arm. The contact is abrupt but conformable; granite veins are common to both units.

Migmatite (Plate 4) is developed in Unit 8 and is generally spatially related to the McCallum granite (Unit 9). However, migmatite is more widespread in the western part of the area west of Facheux Bay. Quartz and granite sweats occur in the metasediments near the migmatite zones. These increase in volume such that concordant remnants of the pelitic to psammitic protolith

"float" in a crudely banded granitoid host. The foliation in the granitoid is defined by discontinuous 0.5 to 1 mm concentrations of biotite that alternate with 2-5 mm granitoid zones. In this way, the granitoid is more of a gneissic granite than a granite gneiss.

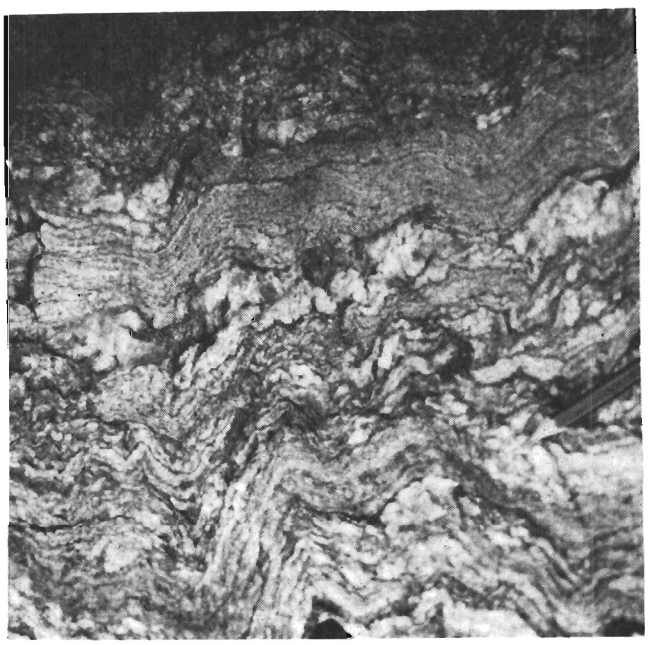


Plate 4. *Migmatite. Unit 8 of the Baie d'Espoir Group at Facheux Bay.*

McCallum granite (Unit 9)

The McCallum granite is an informal name used here for an inhomogeneous granitoid zone that occurs throughout the south-central part of the map area. It was originally included in the Gaultois Granite (Colman-Sadd, 1974). However, the name Gaultois Granite is reserved for the more homogeneous megacrystic granite (Unit 10) that outcrops to the south.

Unit 9 comprises several phases of granitoid rocks. The most common is a medium to coarse grained, feldspar porphyritic, biotite rich, pink to pinkish-white weathering granite. The mostly potassic feldspar pheoncrysts are rectangular to square in section and range from 1 to 3 cm across. This type of granite forms a fairly homogeneous phase on the islands east of McCallum. Elsewhere it is commonly interlayered on a scale of 10 cm to 1 m with a similar, but less biotite-rich phase. Rarely, large feldspar crystals overprint the contact between two granite phases, indicating that some of the "phenocrysts" have a porphyroblastic component. Other layers are defined by variations in grain size and in the proportions of feldspar phenocrysts. Fine to medium grained, grayish-white weathering, granodiorite and dark gray diorite are also common phases. Contacts between these phases are abrupt but do not appear intrusive, *i.e.*, a regular plane marks the slight variation changes which can continue for several metres along strike as regular bands and, where observable, persist in cross-section (Plate 5). Locally the banding becomes wispy and "migmatitic looking" except that there is no metamorphic component; textures are completely igneous. Cross-cutting, garnet-tourmaline, granite aplite and pegmatite veins occur throughout.

The contact of the McCallum granite with Unit 8 is gradational over several metres and marked by partially assimilated xenoliths of metasedimentary rocks in the granite. The grain size of the granite is finer, and veins of biotite equigranular granite locally intrude, the metasedimentary rocks north of the contact. Both units are intruded in the contact area by a profusion of garnetiferous leucogranite aplite and pegmatite which generally persists into Unit 8. A moderate to strong foliation is developed throughout the McCallum granite. It is generally parallel to the different granite bands in plan but locally cross-cuts the layering in cross-section. West of Dragon Bay the regional foliation becomes mylonitic within the Dragon Bay fault zone.

Plate 5. *Layering in the McCallum granite. Unit 9 at Facheux Bay.*

GAULTOIS GRANITE (Unit 10)

The Gaultois Granite (Colman-Sadd, 1974, 1980) outcrops on the southern side of Long Island as well as south and west of Dragon Bay. It consists of coarse grained, biotite-rich, feldspar megacrystic granite. Feldspar megacrysts are 1 to 6 cm long and rectangular to square; most are pink weathering potassic feldspars but a few plagioclase megacrysts do occur. Minor unseparated biotite equigranular granite is also included in Unit 10. The texture of the Gaultois Granite is generally dominated by a pervasive foliation which in some places has a cataclstic component; the megacrysts form augen in an oriented matrix of biotite and flattened quartz. Although mostly an "S" fabric, an "L-S" fabric was noted on the coast at Long Island. Mylonite zones a few metres wide occur locally, particularly on the coast west of Dragon Bay. The Gaultois Granite is also reduced to mylonite in the Dragon Bay fault zone, which separates the Gaultois from the McCallum granite west of Facheux Bay. Granite veins similar to equigranular phases in the McCallum granite intrude the Gaultois Granite on Long Island. However, interlayered porphyritic granite in the McCallum is similar, and probably related to, the Gaultois Granite. Garnetiferous leucogranite dikes intrude both granites in the contact area.

PICCAIRE GRANITE (Unit 11)

The Piccaire Granite (Colman-Sadd, 1980; Colman-Sadd *et al.*, 1979) intrudes the Gaultois Granite on the south shore of Long Island. It is a grayish-white weathering, medium to coarse grained, equigranular granite/granodiorite.

Minor feldspar phenocrysts occur locally. Biotite is common throughout and in some areas muscovite, possibly secondary, is developed. A weak foliation, defined by crudely oriented biotite, is developed in Unit 11 parallel to the regional trend. It does, however, grade into zones of intense flattening locally.

LEUCOGRANITE (Unit 12)

Unit 12 forms a gently northward dipping sheet of concordant leucogranite on the north shore of Long Island. It intrudes the metasedimentary rocks of Unit 8 and is representative of the many similar veins that occur throughout Unit 8 as well as the structurally lowest belt of Unit 2 felsic tuffs. The shallow dip combined with the parallelism of strike and shore line make this particular unit mappable on this scale.

The leucogranite is fine to medium grained and pink to white (more commonly white) weathering. Muscovite occurs throughout, both as oriented flakes and as disoriented "books", 2-5 mm across. Small red garnets are ubiquitous; tourmaline, other than in pegmatite patches, occurs rarely. A pronounced, penetrative foliation with associated quartz and

feldspar augen is developed throughout; it locally weathers out as a flaggy-like parting.

GABBRO/AMPHIBOLITE (Unit 13)

Unit 13 mafic rocks form three small outcrop areas: two in Facheux Bay and one in Northern Arm. Lack of observable continuity inland has led to the interpretation that these rocks are intrusive. However, the possibility that they are recrystallized mafic tuffs is not ruled out.

The southern body in Facheux Bay has essentially a medium grained gabbroic texture. The northern one contains fine grained, banded amphibolite along its largely concordant contacts, but grades over 4-6 m into coarse grained, massive amphibolite. The centre of this body is marked by coarse grained hornblendite with 1-3 cm hornblende crystals. The body of Unit 13 in Northern Arm also varies from a fine grained amphibolite along its contacts to a medium grained, gabbro-like texture in its centre. All three are overprinted by the regional foliation.

NORTH BAY GRANITE (Units 14 and 15)

The North Bay Granite (Jewell, 1939) outcrops in the northern part of the map area. It is subdivided into two units: a contact zone of intrusion breccia (Unit 14) and the granite proper (Unit 15).

Unit 14 consists of North Bay Granite and metasedimentary country rocks of approximately equal proportions. The granite zones and metasedimentary rafts, up to 0.5 km wide, have a regional east-west strike. However, smaller disoriented xenoliths, several metres across, are spectacularly displayed in the cliffs of Facheux Bay and Northern Arm. The country rocks are mostly psammite, semipelite and pelite. All are recrystallized and biotite, garnet, and staurolite porphyroblasts are common. Locally, granite has so pervaded inclusions that an agmatite is produced. The granite zones consist of white to pale pink weathering, fine to medium grained, equigranular, biotite granite, locally containing minor muscovite and tourmaline. Offshoots from the larger granite zones cross-cut the regional foliation in the country rocks. The contact between Unit 14 and Baie d'Espoir Group rocks is relatively abrupt; a few garnetiferous leucogranite dikes occur within metres of the main intrusion breccia zone. However, a metamorphic aureole extends for a kilometre or more in the Bay d'Espoir Group, being most splendidly developed in the Riches Island Formation. Biotite, garnet and staurolite porphyroblasts (Plate 6) are common throughout this formation; most appear to overprint the main regional foliation.

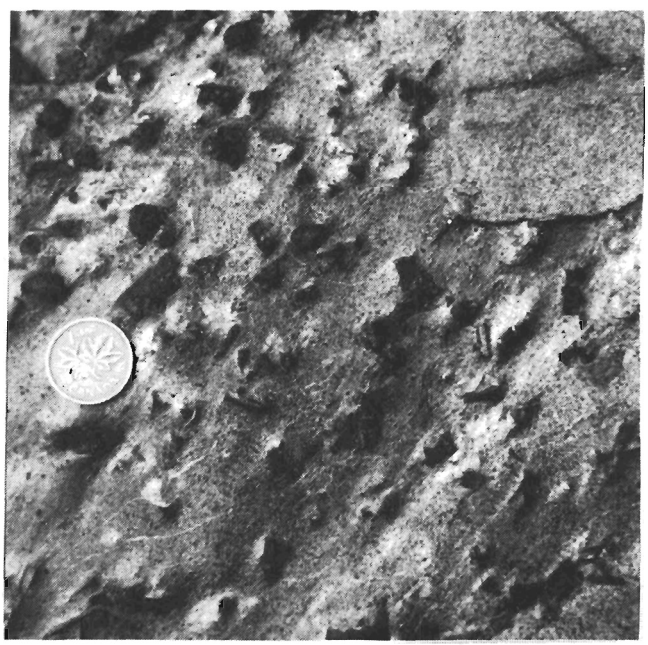


Plate 6. *Staurolite porphyroblasts in semipelite within metamorphic aureole of North Bay Granite. Riches Island Formation (Unit 6) at Facheux Bay.*

Unit 15 represents an area that is fairly consistently underlain by granite; however, samll xenoliths are present locally. The granite is white to pale pink weathering, fine to coarse grained, and commonly porphyritic. Pink

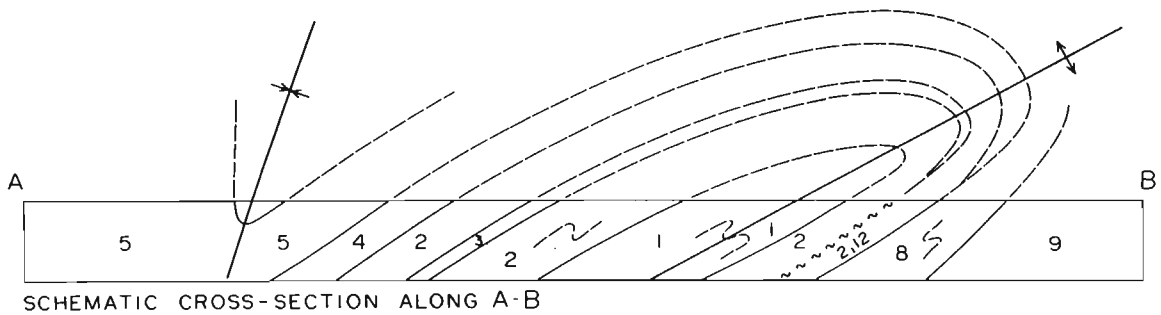
weathering feldspar phenocrysts, 1-3 cm long, occur sparsely east of Facheux Bay but the granite is markedly porphyritic west of the bay. Biotite is ubiquitous and minor muscovite occurs sporadically. Circular to elliptical clots of translucent quartz, 0.5 to 3 cm in diameter, were noted along Facheux Bay.

A weak to moderate biotite alignment occurs locally in the North Bay Granite, mostly along contacts in the intrusion breccia zone. For the most part, however, the granite is not penetratively foliated. An east-west trending, gently southward dipping, fracture cleavage is developed throughout Units 14 and 15. Discontinuous in any one outcrop, it is observable in most areas of granite exposure, particularly where weathering has accentuated the 0.5 to 1 cm spaced, "flaky" parting. For a more detailed report on the North Bay Granite, the reader is referred to Dickson and Tomlin (1983).

STRUCTURE AND METAMORPHISM

Distribution and facing directions of most rock units in the Baie d'Espoir Group are controlled by the large scale overturned syncline and anticline in the Isle Galet Formation (Fig. 2). The regional penetrative foliation has developed axial planar to these southward facing folds; the phyllitic to finely schistose fabric has gentle northward dips in the south and moderate to steep dips in the north. The change in dip reflects the progressive overturning from the syncline in the north to the anticline in the south. The foliation is consistently steeper than bedding on the normal or upper limb of the anticline and locally this combines with northward facing directions (Plate 1) to confirm the overall structure; vergence of small scale F_1 folds also indicates closure to the south. Fabrics are commonly parallel with primary elements on the overturned or bottom limb of the anticline. However, along the north shore of Long Island both bedding-cleavage intersections and vergence of small scale folds (Plate 7) indicate these rock are on the overturned limb. Rock units on the bottom limb are also attenuated such that felsic tuffs of Unit 2 form considerably thinner belts. Also, the graphitic pelite and reworked tuff of Unit 3 is missing, the probable site of some fault movement between the two tuff belts. Unit 4 pelite, as well, does not form a distinct mappable unit on the bottom limb; it may be caught up in the remobilized rocks of Unit 8 or may be locally faulted out.

The regional metamorphic grade appears to increase slightly from middle greenschist facies on the upper limb of



SCHEMATIC CROSS-SECTION ALONG A-B

Figure 2. *Schematic cross-section along A-B. Section line is on Figure 1.*

Plate 7. *Small scale F_1 "z" fold on the bottom limb of the large scale, overturned anticline. Unit 8 of the Baie d'Espoir Group, looking west along the north shore of Long Island.*

the anticline to upper greenschist-lower amphibolite facies on the lower limb. Garnets and oriented biotite occur in felsic volcanic rocks on the lower limb but were not observed on the upper limb, where sericite defines the foliation. Also, Unit 1 pelites in the core of the anticline at Manuel Arm are slightly more coarsely recrystallized, contain more and larger (2-4 mm) garnets, and a greater profusion of quartz sweats adjacent to the overturned limb. The increase in grade is also spatially related to leucogranite intrusion (Unit 12), which has pervaded to slightly different levels the structurally deeper rocks represented by the lower limb; these granite veins intrude the felsic volcanics at Manuel Arm but have not cut the same horizon on the north shore of Long Island. Northward, the overprinting effect of the North Bay Granite aureole camouflages the earlier regional metamorphism.

Felsic volcanics (Unit 2) of the Isle Galet Formation were previously separated from semipelite and psammite (Unit 7) on the north shore of Long Island by the Day Cove Thrust; rocks south of the thrust were interpreted as a possible basement complex called the Little Passage Gneiss (Colman-Sadd, 1974; Colman-Sadd *et al.*, 1979; Swinden, 1980). However, the structural pattern outlined above indicates that although the semipelitic and pelitic rocks of Unit 7 lie structurally below the felsic volcanics of Unit 2 they are actually stratigraphically younger than the volcanics. Also there are several indications of continuity across the zone including metamorphic grade, structural style and gradational rock types. Unit 7, of course, passes southward into the higher grade rocks of Unit 8, culminating locally in migmatite. Thus this zone is interpreted as a conformable sequence with metamorphism progressing structurally downward on the overturned limb. Also an analysis of the fold geometry shown in Figure 2 suggests that Unit 5, if folded around the nose of the anticline, would occupy a structural position equivalent to Unit 8; indeed, the highly metamorphic rock types in Unit 8 did have a protolith similar to Unit 5. Finally, although black graphitic pelite of Unit 4 is apparently missing along section AB at Manuel Arm, its structural position on the bottom limb at Long Island would be the contact area between Unit 7 and Unit 2. This area is the site of a topographic low as well as the previously assumed trace of the Day Cove Thrust; the single exposure found in this zone was black graphitic pelite.

The highest grade rocks of Unit 8 are spatially related to the McCallum granite (Unit 9) and the banding in the granite is mostly parallel to the regional foliation. This could suggest a synkinematic relationship between the granite and tectonism of the area. Leucogranite veins (Unit 12 and equivalents) are relatively later than the

initial onset of deformation since, locally, xenoliths of McCallum granite show an internal foliation that has been rotated slightly in a leucogranite dike, which itself contains the same strong regional fabric as the McCallum granite (north of McCallum).

The regional foliation in the McCallum and Gaultois granites, west of Facheux Bay, culminates in a mylonite zone that extends northwestward from Dragon Bay and is informally referred to here as the Dragon Bay fault. The mylonite zone is approximately 1 km wide and the McCallum or Gaultois Granite protolith is recognizable on either side of a narrow central zone, 100-200 m wide,of ultramylonite. Every gradation from protomylonite to ultramylonite occurs within the zone; the latter locally has the appearance of a gray flinty chert.

A crenulation to strain-slip cleavage (S_2) is weakly to strongly developed throughout the area, superimposed upon the main foliation (S_1). It is preferentially developed in the pelitic rocks west of Northern Arm with little or no associated folding; it is mainly resolved as a widely spaced (1 to 4 mm), east-west trending, variably dipping fabric. It also forms a coarse fracture cleavage, overprinting the penetrative fabric of the regionally foliated granitoid rocks.

The S_2 cleavage is more penetrative east of Northern Arm such that it locally becomes a composite foliation with complete transposition of the earlier fabric. It is also steeply dipping in that area and axial planar to open, upright F_2 folds (Plate 8). The axial trace of these later, gently plunging folds is parallel or subparallel to the regional D_1 structures, but of considerably shorter wavelengths than the F_1 folds. Where superimposed upon the overturned limb of F_1 folds (Fig. 3), downward facing F_2 folds have developed (Goblin Bay). The distribution of lithological units is also influenced by the gentle F_2 folds in the Goblin Bay - Lampidoes Passage area, so that the moderately dipping, narrow belt of Unit 4 in the west becomes openly refolded in the east to produce the larger outcrop area.

Plate 8. *Small scale F_2 fold with steeply dipping, axial planar strain-slip cleavage. Unit 5 of the Isle Galet Formation at Goblin Bay.*

The North Bay Granite intruded after (or very late during) the first regional deformation of the Baie d'Espoir Group. Porphyroblasts in the aureole clearly overprint the main foliation. Locally, in the intrusion breccia zone, the "flaky" cleavage in the granite is equivalent to the strain-slip cleavage in the recrystallized metasedimentary rocks. Also, it would appear that the porphyroblasts in the granite aureole form augen within the strain-slip fabric planes. Thus the granite is interpreted as being post S_1 and pre to syn S_2; possibly the intrusion of the granite caused the shortening in the area that produced S_2.

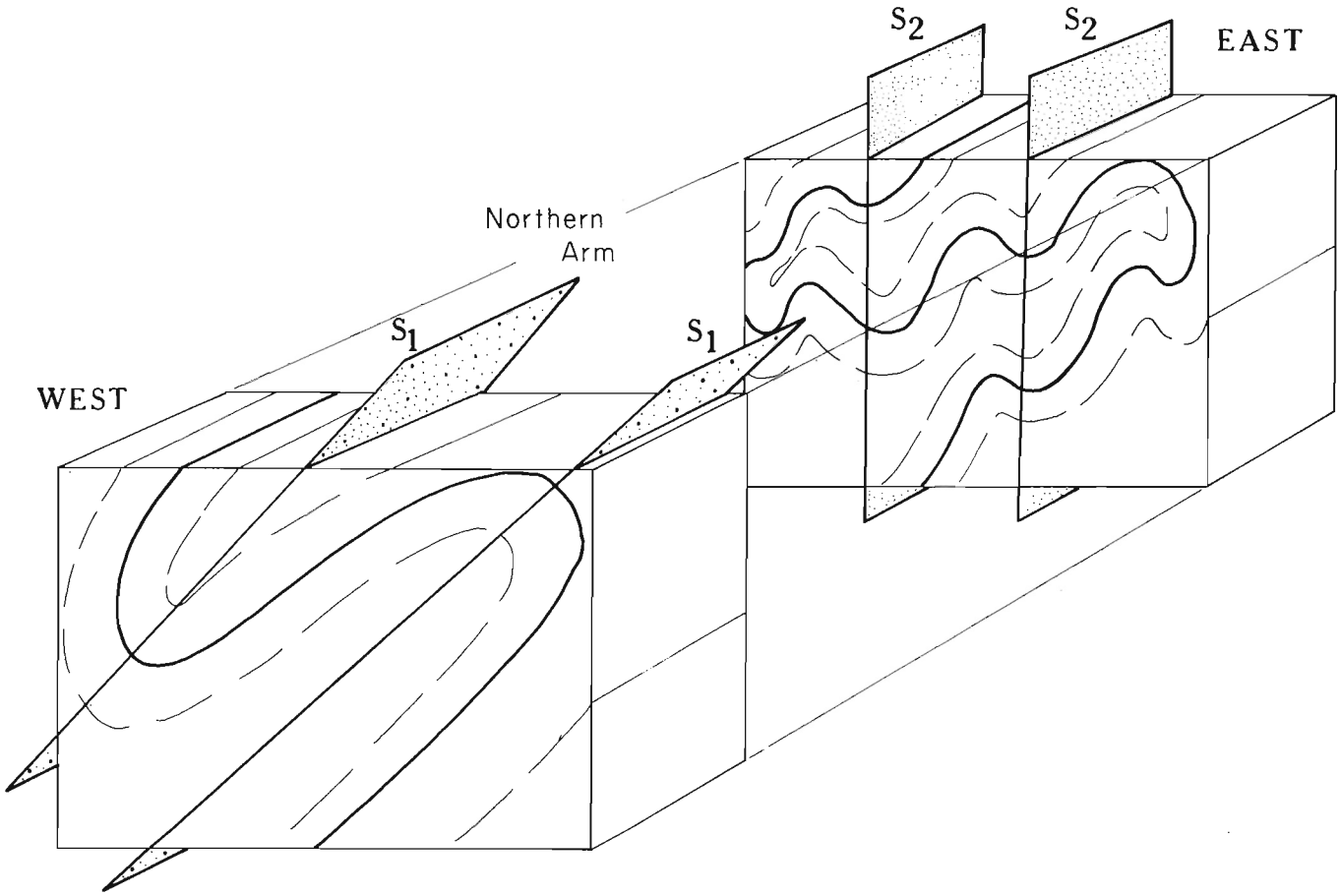


Figure 3. *A diagrammatic representation of the refolding of D_1 structures by F_2 folds east of Northern Arm.*

MINERALIZATION

All the known mineral showings in the map area occur in the Isle Galet Formation. The most important of these are a number of sulfide occurrences (Dunlop, 1954) in Unit 1, west of Facheux Bay. These are restricted to a 100-200 m wide band of fine grained, sericitized, felsic tuff within the largely pelitic unit; most contain pyrite with minor chalcopyrite, galena and sphalerite. The reader is referred to Swinden (1980) whose report on "Economic Geology of the Eastern Hermitage Flexure" deals specifically with mineralization in the Facheux Bay area, and to a more general discussion in a report by Colman-Sadd and Swinden (1981) on the "Geology and Mineral Potential of South-Central Newfoundland".

Pyrite was the only new mineral occurrence found in the map area. A pyrite showing occurs in Unit 2 felsic volcanics west of Facheux Bay. Massive, fine grained, white to dark gray weathering, rhyolite or chert contains a 25-30 cm wide zone rich in pyrite. The vocanics are fragmental in this zone with pyrite forming anastomosing stringers and pods around relatively pyrite free fragments of felsic material.

Pyrite occurs at or near the base of Unit 3 south of Goblin Bay. The thin limestone (marble) horizon (that locally marks the base) contains concordant pyrite lenses 1-4 mm wide parallel to lamellae in the carbonate. Disseminated pyrite also occurs throughout the carbonate and in an underlying white chert

band. The same unit is displaced along a north-south fault at Lampidoes Passage where disseminated pyrite mineralization in the underlying white chert produces the Copper Head showing (See also, Swinden, 1980). Disseminated pyrite, of course, is ubiquitous in the graphitic pelite throughout the map area.

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