GEOLOGY OF THE D'ESPOIR BROOK MAP AREA AND PART OF THE FACHEUX BAY MAP AREA, SOUTH-CENTRAL NEWFOUNDLAND[1]

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Abstract

The D'Espoir Brook map area, in south-central Newfoundland, is dominated by the Silurian North Bay Granite which has intruded a variety of gneissic, metasedimentary and foliated granitoid rocks which range in age from possibly Late Precambrian to Ordovician. Possible Precambrian basement rocks consist of strongly foliated tonalitic and granodioritic biotite ± muscovite gneiss and migmatite which form large screens (up to 2 km^2) within the granitoid terrane. Middle Ordovician metasedimentary rocks of the Baie d'Espoir Group outcrop along the northern and southern margins of the map area and consist of polydeformed and highly metamorphosed biotite-garnet psammites and semi-pelites with minor staurolite-bearing schist. Near the northern margin of the map area, an elongate belt of strongly deformed granitoids has intruded the Baie d'Espoir Group. The North Bay Granite, which has been radiometrically dated at 430 and 427 Ma, cuts all the other major units in the area. The North Bay Granite consists of four major rock types: medium grained, equigranular, biotite ± muscovite granodiorite; medium grained, porphyritic, biotite granite; medium grained, equigranular, biotite ± muscovite granite; and coarse grained, coarsely porphyritic, biotite granite. All units of the North Bay Granite have been variably deformed during the later deformation events of the metasediments. The deformation of the metasediments and North Bay Granite is considered to be Acadian. The North Bay Granite has been intruded by a few massive diabase and microsyenite dykes. No significant metallic mineral occurrences were found. Four large quartz veins (one of which has been assessed at over 1.22 x 10^{6}t) have some potential as a source of silica.

Introduction

Location and Access

The D'Espoir Brook map area is located in south-central Newfoundland between 47°45'N and 48°N and longitudes 56°W and 56°30'W. Facheux Bay map area (11P/9) is located immediately to the south (Fig. 39.1). The town of St. Albans is located about 10 km east of D'Espoir Brook map area. Access to the northeast corner of the map area is gained by the Upper Salmon River hydro-electric project access road.

North Bay, East Bay and Facheux Bay provide access to Facheux Bay map area and the southern part of D'Espoir Brook map area. These fjords, however, are bounded by high, steep cliffs which prevent access to the plateau. Most of the study area was mapped from the helicopter-placed fly camps and by canoe and foot traverses from the road.

Exposure is excellent in the southern and eastern parts of the map area, and along the ridge to the west of D'Espoir Lake. In the remaining areas exposure is poor and much of this area was surveyed by helicopter.

Previous Work

Jewell (1939) mapped the North Bay and East Bay area as part of a survey of the Bay d'Espoir area and introduced the term North Bay Granite. The only other major work carried out in the map area was by Williams (1971) who mapped at 1:250 000 scale and defined the main lithological units. Colman-Sadd (1974, 1980) and Colman-Sadd and Swinden (1981) have briefly described a few aspects of the geology in the North Bay and Facheux Bay areas and postulated that a Late Precambrian gneissic basement is present, mainly as large screens, within the North Bay Granite.

Butler (1973) and Butler and Greene (1976) carried out a detailed geochemical assessment of a large quartz vein near the northern edge of the map area to determine the potential of the vein as a source of silica.

The D'Espoir Brook and Facheux Bay map areas formed part of a reconnaissance lake sediment geochemical survey carried out by Butler and Davenport (1978), Davenport and Butler (1981) and Davenport (1982) to assess the mineral potential of south-central Newfoundland. Only tungsten gave a significant anomaly within D'Espoir Brook map area (Davenport, 1982).

The adjacent map area to the east (1M/13) was mapped by Colman-Sadd (1976). The area to the south (11P/9) was mapped by Blackwood (1983) and part of the map area to the north (12A/1E) was mapped by Colman-Sadd (1983). The map area to the west (11P/15) will be mapped during 1983.

General Geology

The rocks of the D'Espoir Brook map area can be divided into four main units as follows:

Strongly deformed paragneiss, tonalitic gneiss and migmatitic granite and granodiorite which occur as large screens and underlie sizeable areas within the North Bay Granite. These gneisses are concentrated in the east-central and eastern parts of the map area and along the northern margin of the North Bay Granite. Colman-Sadd (1974) has termed some of these deformed rocks the Little Passage Gneisses. The structural complexity of the gneisses compared to the Baie D'Espoir Group led Colman-Sadd (1974, 1976) to suggest that the gneisses were possibly Precambrian.

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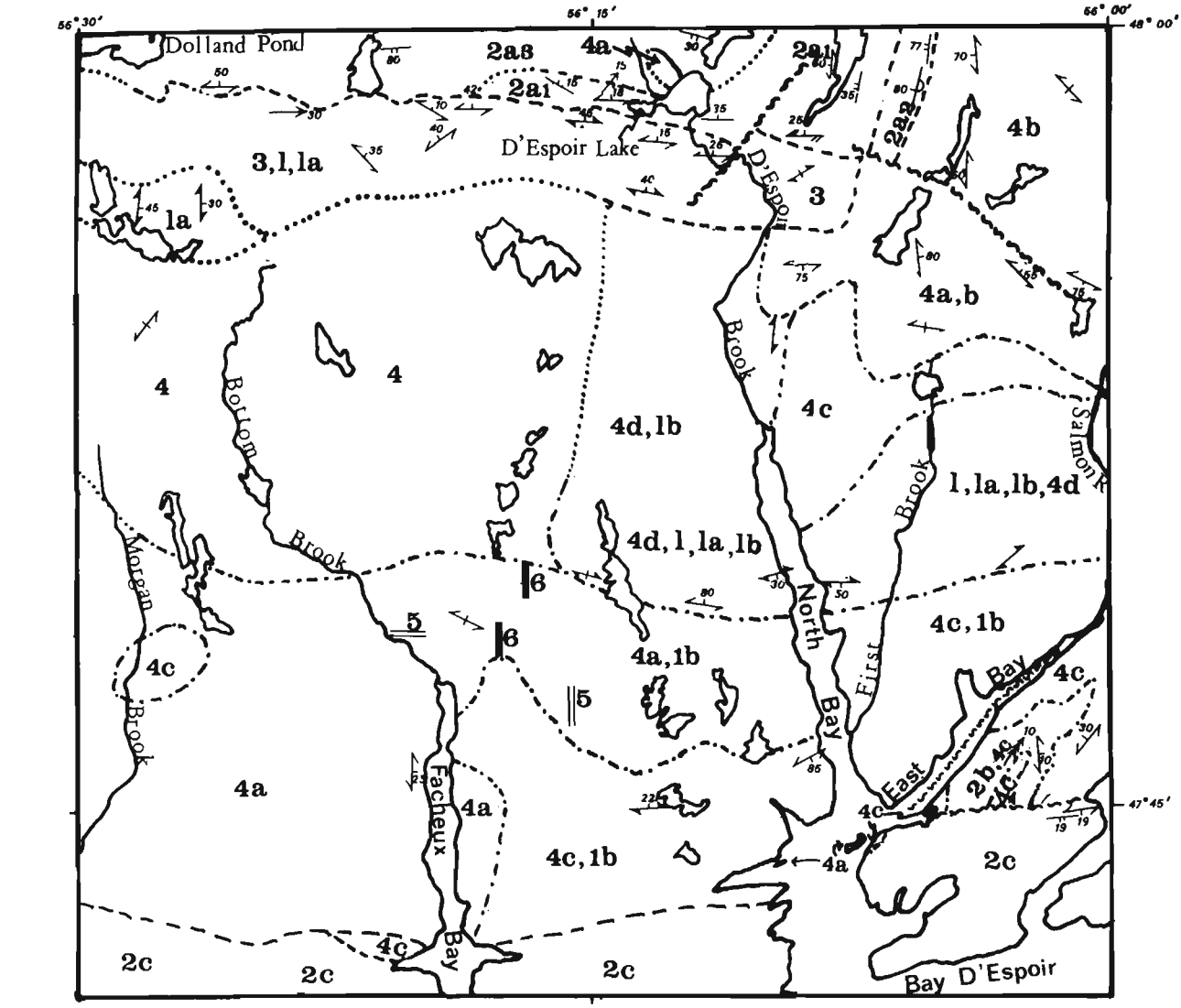

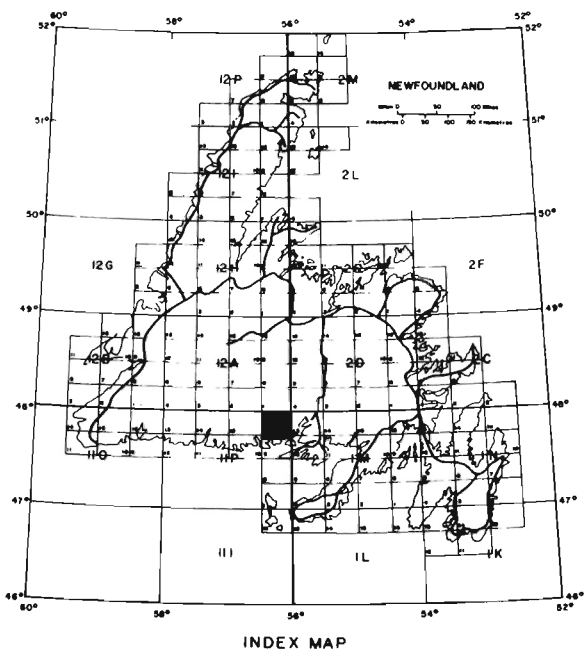

Scale
miles 0 5
kilometers 0 5

SYMBOLS

- gneissic layering or foliation
- bedding (top known/overturned/unknown)
- cleavage (first / second)
- plunge of fold
- dyke – diabase
- dyke – syenite
- fault
- geological contact (approximate / gradational / assumed)

Figure 39.1. *Geology of D'Espoir Brook map area (11/P16) and part of Facheux Bay (11/P9), Southern Newfoundland.*

Variably deformed and metamorphosed metasediments of the Salmon River Dam Formation and the Riches Island Formation which form part of the Ordovician Baie d'Espoir Group.

Strongly deformed granitic gneiss, foliated granite and leucogranite which are located along the northern margin of the North Bay Granite.

The North Bay Granite consisting of a variety of granitoids that range in composition from biotite granodiorite to garnet-muscovite leucogranite. The granitoids also vary in degree of deformation from locally strongly schistose granitoids in the northeast of the map area to weakly deformed or massive in the remainder of the map area.

Rb-Sr (whole rock) age dates from the eastern end of the North Bay Granite (east of the map area) have been determined by Elias (1981) who obtained Rb-Sr (whole rock) ages of 430 ± 4 Ma and 427 ± 11 Ma. These dates indicate a Silurian age for the North Bay Granite.

LEGEND FOR FIGURE 39.1

CARBONIFEROUS ?

6 Massive, fine grained, diabase dykes.

DEVONIAN ?

5 Massive, fine grained, leucocratic biotite-hornblende microsyenite dykes.

SILURIAN

4 North Bay Granite:

4a, Massive, medium grained, porphyritic biotite granite;

4b, medium to coarse grained, porphyritic biotite granite;

4c, medium grained, equigranular to slightly porphyritic biotite ± muscovite granodiorite;

4d, massive, medium grained, equigranular biotite ± muscovite granite.

3 Strongly foliated, equigranular to porphyritic biotite-muscovite and biotite granite, and garnet-muscovite leucogranite.

ORDOVICIAN

2 Baie d'Espoir Group:

2a, Salmon River Dam Formation;

2a1, Thin to medium bedded, grey sandstones, calcareous sandstones; minor limestone;

2a2, thin bedded black, rusty pelites and semi-pelites;

2a3, strongly deformed and metamorphosed equivalent of 2a1-upper greenschist facies;

2b, Riches Island Formation: Interbedded pelites, semi-pelites and psammites. Variably metamorphosed from lower greenschist to upper amphibolite facies;

2c, Undivided Baie d'Espoir Group: Includes metasediments, metavolcanics, migmatites, and minor granitic dykes from the North Bay Granite.

PRECAMBRIAN ?

1 Strongly foliated orthogneiss and paragneiss.

1a, banded, pink, medium grained, biotite granodioritic migmatite;

1b, strongly schistose, semi-pelites, psammites, amphibolites, orthoquartzites.

The area has been substantially modified by glacial action. The central part of the map area is covered by a thick blanket of till, which contains well rounded boulders up to 3 m in diameter. Ultramafic boulders were found throughout the map area and indicate a minimum transportation of 40 km from the nearest known source of ultramafics. Several southerly trending eskers occur in northern part of the map area; the largest is 5 km in length. Glacial striae and stoss and lee surfaces indicate a southerly direction of ice movement.

Description of units

Precambrian?, strongly foliated, orthogneiss and paragneiss - Unit 1

A variety of strongly deformed and metamorphosed granitoid and metasedimentary rocks occur throughout the North Bay Granite in the study area. Two main areas of these rocks can be defined. One area, to the south and west of D'Espoir Lake within unit 3, contains strongly banded, biotite granodiorite gneiss which occurs as abundant large xenoliths in the strongly foliated granitoids. The other area is located south of D'Espoir Lake, within units 3 and 4, and consists of several square kilometres of granodioritic gneiss which is cut by numerous thin pegmatite dykes and massive granodiorite dykes (subunit 4c). On the east side of North Bay, the gneiss is tonalitic and locally garnetiferous and has a well developed vertical L-S fabric. No metasedimentary xenoliths were found in the orthogneiss.

Subunit 1a consists of a pink, medium grained, biotite granodiorite with an abundance of slightly contorted, well-aligned, discontinuous layers of biotite, up to 6 cm long and 1 to 3 mm thick. The granodiorite matrix has a weak foliation which is parallel to the aligned biotite layers. The rock is possibly an injection gneiss or migmatite. This rock type is best exposed on the west side of North Bay and near the northwest corner of D'Espoir Brook map area.

Subunit 1b is tentatively included within unit 1. The rock types include strongly schistose amphibolite facies semi-pelites, psammites, amphibolites, and orthoquatzites, which are locally migmatized. Biotite psammite, the most common rock type within subunit 1b, occurs as screens which range in length from a few centimetres to about 100 m. Sillimanite-bearing, biotite-rich semi-pelite also forms a few screens. The southern portion of the North Bay Granite, mainly within subunit 4c, contains an abundance of metasedimentary screens. Throughout the map area, the screens contain a strong tectonic foliation which is commonly folded. The main deformation of the screens clearly predates their incorporation into the North Bay Granite. In areas where the granite contains a tectonic fabric, this fabric can also be traced into the sedimentary screens at an angle to the main fabric in the metasediments.

Colman-Sadd (1974, 1976, 1980) has included the metasediments, which are spatially associated with the orthogneisses (unit 1), within a Precambrian basement terrane. However, the strong similarity in grade of metamorphism, degree and style of deformation, and lithology of these metasediments with those of the Riches Island Formation to the south indicates that the paragneiss may be Ordovician rather than Precambrian in age (see Blackwood, 1983).

Ordovician Baie d'Espoir Group - Unit 2

This unit was not examined in detail within map area 11P/9 in this project. Blackwood (1983) mapped this unit in 11P/9 and has described it as pelitic, semi-pelitic and psammitic schists, with concordant, leucogranite veins and migmatites, which are probably Ordovician in age. The unit is cut by the North Bay Granite in map area 11P/9.

Ordovician Salmon River Dam Formation - Unit 2a. The Salmon River Dam Formation (unit 2a), within the map area, is located along the northern margin of the North Bay Granite and unit 3 and forms the lower part of the Baie d'Espoir Group (Colman-Sadd, 1976). In the lesser deformed areas of the formation (subunit 2a1), the rocks consist of thin to medium and parallel bedded, grey sandstones and calcareous sandstones, with poorly developed parallel laminations, graded beds, local flame structures and convolute laminations. Most beds are massive. One isolated thick, massive bed of limestone also occurs at the southern edge of the subunit, close to the contact with unit 3, southwest of D'Espoir Lake. Subunit 2a2, conformably overlies subunit 2a1 and consists of thinly bedded, and strongly cleaved, rusty siltstones and sandstones with locally well developed parallel laminations. Subunit 2a3 is probably a higher grade metamorphic equivalent of subunit 2a1. It is also more intensely deformed with tight isoclinal folds, transposed bedding, and commonly contains two strong schistosities. Subunit 2a3 also contains minor metatuff. Granitoid veins and dykes are common within subunit 2a3, and these are also strongly deformed.

The Salmon River Dam Formation, within the map area, can be divided into two structural units. To the west of D'Espoir Lake, the Salmon River Dam Formation bedding and cleavage generally have a strong easterly trend. S_1 is generally parallel to S_0, and near the contact with unit 3 bedding dips gently to the north at about 15° A second step cleavage, axial planar to open folds, trends towards the northeast. To the east of D'Espoir Lake, the metasediments have a northerly trend with a steep S_1 cleavage parallel to S_0. S_2 transposes S_1 and has an easterly trend. Lack of exposure has obscured the intermediate area but from an aerial photo interpretation there appears to be a gradual change in structural orientation which indicates the presence of a major gently plunging northerly trending synform.

West of D'Espoir Lake, within subunit 2a1, a tight isoclinal fold occurs within a thinly bedded unit. The axial plane is subparallel to bedding and the fold axis plunges gently to the northeast. This is probably an F_1 fold and indicates that subunit 2a1 has been recumbently folded.

Ordovician Riches Island Formation - Subunit 2b. To the southeast of East Bay (within map area 11P/16), a sequence of interbedded pelites, semi-pelites, and orthoquartzites (subunit 2b), which have been polydeformed and invaded by thick granite dykes (subunit 4c), is tentatively assigned to the Ordovician Riches Island Formation of Colman-Sadd (1976). The sequence is dominated by highly metamorphosed biotite-muscovite schists which locally contain garnet and staurolite. Interbedded with the schists is a sequence of strongly cleaved orthoquartzites which is concentrated in a northeasterly trending belt in the centre of the area.

To the south of the easterly trending fault near the southeast corner of map area 11P/16, the Riches Island Formation consists of thin to medium bedded, black pelites which structurally underlie a thick sequence of psammites found mainly within map area 11P/9.

The Riches Island Formation is polydeformed with two main tectonic fabrics and two readily apparent fold generations. S_1 is a gently dipping schistosity, which is subparallel to bedding and is also axial planar to F_1 folds. The fold axes of the F_1 folds plunge to the northeast at a low angle. The S_1 schistosity is folded by F_2 and forms upright to slightly overturned folds with a moderate to steeply dipping axial planar cleavage. The F_2 folds also plunge to the northeast at a low angle.

Granite and pegmatite dykes are abundant throughout the Riches Island Formation and have been deformed during the second deformation of the metasediments.

Undivided foliated granites and granodiorites - Unit 3

Unit 3 consists of a variety of strongly foliated, mainly leucocratic granites which range in composition and texture from medium grained, equigranular, biotite granite and porphyritic biotite granite to equigranular muscovite-garnet granite and pegmatite.

Southeast of Dolland Pond, medium grained, biotite-muscovite granite intrudes metasediments of the Ordovician Salmon River Dam Formation. Southeast of D'Espoir Lake, the leucogranite contains small xenoliths of grey psammite which are clearly derived from the Salmon River Dam Formation to the north. The contact is otherwise unexposed and is generally marked by a pronounced break in slope from the granite to the metasediments. Tonalitic gneiss (unit 1) commonly occurs as screens in unit 3, particularly south of D'Espoir Lake and 6 km east-southeast of Dolland Pond. Unit 3 is cut by weakly foliated biotite granodiorite dykes similar to subunits 4c and 4d.

The generally poor exposure of unit 3 and the presence of a great variety of granites has prevented a meaningful subdivision of the various varieties of foliated granite.

The granites of unit 3 are strongly deformed, with a well developed foliation defined by aligned mica and flattened quartz and feldspar. Locally, a second fabric or folding of the first fabric may be found. The first fabric generally dips gently to the north. In the vicinity of D'Espoir Lake, the granites are more intensely deformed than the adjacent metasediments. It is possible that the metasediments and the granites in the D'Espoir Lake area are in fault contact.

North Bay Granite - Unit 4

The North Bay Granite has been subdivided into four subunits (4a-4d) based on rock type and texture. Contacts are generally gradational and only subunit 4c has a clear intrusive relationship with the other subunits. Dykes of subunit 4c have intruded subunits 4a and 4b. The contacts between the other units are considered to be gradational as grain size, colour, proportion of muscovite and the proportion of phenocrysts may vary over distances of about 1 km. Granitoid dykes from the other units are generally absent.

The undivided area of the North Bay Granite (unit 4 on Fig. 39.1) is an area of very poor exposure with a number of varieties of granite. The widely scattered outcrops prevent a meaningful subdivision of this area.

Massive, medium grained, porphyritic, biotite granite - Subunit 4a. Subunit 4a is mainly located in the southern, southwestern and eastern parts of the map area. The dominant rock type is pink to white, porphyritic biotite granite with 10 to 20% phenocrysts of alkali feldspar, 1 to 2 cm in length, in an equigranular matrix of quartz, plagioclase, alkali feldspar and biotite and rare muscovite. In the southwest corner of the map area, the granite contains a prominent but weak fabric defined by poorly aligned biotite and phenocrysts of alkali feldspar.

Immediately to the north of First Brook, subunit 4a contains a relatively high proportion of garnets (approximately 1%), which range in diameter from less than 1 mm to over 1 cm. The large garnets are highly shattered and are slightly altered. Inclusions of quartz are commonly present in the large garnets. The granite also contains minor muscovite. Screens of schist are also locally abundant in this area.

Dykes of grey, equigranular, biotite granodiorite, similar to subunit 4c, cut subunit 4a. These are particularly prominent along North Bay. However, the contacts between th main bodies of subunits 4a and 4c are apparently gradational over 1 km.

Small pegmatite dykes, which locally contain muscovite, are common throughout subunit 4a. Two microsyenite dykes (unit 5) and two diabase dykes (unit 6) also cut subunit 4a.

Medium- to coarse-grained, porphyritic, biotite granite - Subunit 4b. Subunit 4b is located in the northeast corner of the map area and mainly consists of coarse grained, highly porphyritic, biotite granite which generally contains a weak foliation and/or alignment of potassium feldspar phenocrysts. The unit is cut by a southeast trending fault along which the granite is strongly foliated.

Contacts with the metasediments to the west are not exposed and granite dykes were not found to cut the country rock metasediments. However, screens of strongly schistose biotite psammite and semi-pelite, with minor limestone occur along the fault trace within the granite and these are cut by granite dykes. The contact with subunit 4c is difficult to define. Dykes of subunit 4c cut subunit 4b but no sharp contact was found between the subunits. Towards the southern limit of subunit 4b, in the northeast corner of the map area, the granite becomes finer grained and the size of the phenocrysts is smaller. However, the change is so gradual that in this area subunit 4a is probably equivalent to subunit 4b. Along Salmon River, subunit 4b also occurs as screens in subunit 4c.

The granite consists of essential quartz, microcline, plagioclase and biotite. Muscovite is rarely present. In subunit 4b, phenocrysts range in length from 2 cm to over 10 cm, with an average of 6 cm.

The fabric in the weakly foliated granite is generally defined by the orientation of phenocrysts and a weak parallel alignment of biotite and slightly flattened quartz. The strongly deformed granite along the fault has a mylonitic fabric which dips to the northeast at about 60°. This fabric decreases in intensity to the south over 2 km.

Medium grained, equigranular to slightly porphyritic, biotite ± muscovite granodiorite - Subunit 4c. Subunit 4c is mainly located in the southeastern half of the map area. The dominant rock type is grey, massive to weakly foliated, medium grained, equigranular, biotite granodiorite which locally contains up to 1% muscovite. Screens of migmatite, schist, and granitic gneiss are common, particularly near the entrance to North Bay and East Bay. Some screens are over 100 m in length and, on the cliffs at North Bay, large screens are completely surrounded by granodiorite. Williams (1971) has described this area of abundant screens as a zone of intrusion breccia.

Fine grained, biotite granodiorite dykes and thin pegmatite dykes are common throughout the subunit. Well developed, parallel, alternating biotite-rich and biotite-poor layers, 2 to 3 mm wide, occur in a few outcrops of generally massive granodiorite and are possibly a result of flow foliation.

The granodiorite contains a weakly developed, steeply dipping, easterly trending, tectonic fabric which is defined by poorly aligned biotite.

Minor beryl mineralization occurs in a thin granite pegmatite vein north of East Bay. Pegmatite and quartz veins are particularly abundant south of East Bay, in the vicinity of the contact with the Riches Island Formation.

Massive, medium grained, equigranular, biotite ± muscovite granite - Subunit 4d. This unit is predominately a buff, massive, medium grained, equigranular, biotite granite, which locally contains less than 1% muscovite. The granite locally contains a weak tectonic fabric defined by aligned mica.

West of North Bay, the central part of the unit contains a large proportion of foliated granite, gneiss and migmatite screens. Pegmatite dykes and locally garnetiferous granite veins occur throughout the unit. Quartz veins and segregations are common in the screens but are rare within the granite.

Microsyenite dykes - Unit 5

Massive, fine grained, leucocratic, biotite-hornblende microsyenite dykes were found north and east of Facheux Bay and cut subunit 4a of the North Bay Granite. North of Facheux Bay, the microsyenite forms thin anastomosing veins which cut pegmatites and aplites. Northeast of Facheux Bay, a 10 m wide, northerly trending dyke underlies a prominent northerly trending lineament. This dyke can be traced for over 300 m. These dykes may be related to the Devonian Cape La Hune "Granite" which is described as a syenite by Williams (1971).

Diabase dykes - Unit 6

Two diabase dykes cut subunit 4a of the North Bay Granite, northeast of Facheux Bay. The dykes are 15 cm and 30 cm to 1 m wide respectively. The dykes trend about 180° and are fresh, massive and fine grained, with well developed, chilled margins. Similar dykes occur throughout the Gander Zone and have been considered to be Carboniferous in age (Jayasinghe and Berger, 1976).

Mineralization

Trace amounts of pyrite were found at scattered localities in the North Bay Granite. At one locality, west of Facheux Bay tourmaline associated with the pyrite, occurs along a joint surface. However, an examination of the area failed to reveal further mineralization.

Pyrite-rich pelites occur within the Riches Island Formation in fault contact with the granite. Two generations of pyrite can be determined. Highly flattened pyrite occurs along cleavage planes and euhedral pyrite forms veins on joint surfaces in the pelites. The pelites possibly have some potential for copper mineralization.

A small outcrop of highly silicified, rusty gossan occurs close to the contact between the Salmon River Dam Formation and the unit 3 granitoids (Williams, 1971). Apart from pyrite, no metallic mineralization was found, although Williams (1971) speculated on the possibility of molybdenite mineralization.

Large quartz veins occur along the contact between unit 3 and the Salmon River Dam Formation and cut both units. The largest vein is 12 km west of D'Espoir Lake and cuts the metasediments. Another vein cuts strongly foliated granite 10 km west of D'Espoir Lake, close to the contact with the metasediments. Two smaller veins are located close to the contact between unit 3 and the Salmon River Dam Formation, south of D'Espoir Lake. The largest vein is 600 m in length and up to 100 m in width; the smallest of the major veins is aout 50 m wide and 100 m in length.

Butler (1973) and Butler and Greene (1976) have described and geochemically sampled and largest vein, 12 km east of D'Espoir Lake, and assessed a silica content of 1.22×10^6t. The average analysis of the vein is 97.1% SiO_2, 1.9% Al_2O_3 and 0.5% Fe_2O_3.

The two veins south of D'Espoir Lake are similar to the largest quartz vein west of D'Espoir Lake and probably have a similar chemistry but the vein 10 km west of D'Espoir Lake contains abundant screens of granite and, therefore, has little potential as a source of silica.

Davenport (1982) reported anomalous tungsten values in lake sediment samples taken from the northeast corner of the map area and also southeast of East Bay. A careful examination of the granitoids in these areas did not uncover any wolframite mineralization or alteration. The anomaly in the northwest corner of the map area is within an area of migmatitic granodiorite gneiss (subunit 1a), close to the contact with units 3 and 4. The East Bay anomaly lies within an area of high grade metasediments, biotite-muscovite granite and garnet-tourmaline pegmatite which are cut by numeorus small quartz veins.

Geochemistry

Samples of granitoid rocks were collected from 260 sites using a 2 km grid system from the North Bay Granite in map areas 11P/15, 11P/9 and 12A/1. These samples will be analyzed for major elements and about 20 trace elements including Sn, W, F, Mo, Li and U and will be reported in the final report of this project.

Summary and Conclusions

The Ordovician metasedimentary rocks of the Baie d'Espoir Group have reached the amphibolite facies of metamorphism and have a complex structural history which mainly predates the North Bay Granite. Small recumbent folds and gently dipping cleavage and schistosity indicate that the major folds in these units are also recumbent and verge to the southeast. The gently dipping schistostiy in the strongly foliated granites of unit 3 may also be related to the recumbent folds or possibly to thrusting.

The gneissic granitoids (unit 1) may be older than the Ordovician metasediments and could be basement rocks. Most of the high grade paragneisses are probably Ordovician. However, the situation is still not clear. Samples of the gneissic granitoids have been collected for age dating and may clarify the relationships.

The North Bay Granite is a composite body with a wide variety of granitoids. The granite was syntectonically intruded into the Baie d'Espoir Group, as both contain similarly oriented cleavages. Screens of metasediment are abundant in the granite along a 1 to 2 km wide belt along the southern contact. The latest fabric in the screens is also found in the granite.

A few minor pyrite occurrences occur within the North Bay Granite. However, no other metallic mineralization or any significant alteration of the granite was found. Sizeable quartz veins in the north of the map area have some potential as a source of silica.

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