Current Research (1990) Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 90-1, pages 13-18

A PRELIMINARY ASSESSMENT OF THE SOUTH COAST OF NEWFOUNDLAND AS AN AREA HAVING POTENTIAL FOR BEDROCK AGGREGATE EXPORTS

Dan Bragg, Lawson Dickson[1] and Lloyd St. Croix
Terrain Sciences Section

ABSTRACT

A preliminary study of the Connoire Bay to Bay d'Espoir area, on the south coast of Newfoundland, was carried out to identify sites having material suitable for export as bedrock aggregate. The area is dominated by medium- to coarse-grained granitic and gabbroic rocks and metasediments mainly confined to the Bay d'Espoir area. The region forms a plateau having an average elevation of 250 m and is cut by numerous fiords. The sea is generally ice-free permitting year-round access to the coast.

During this survey, 131 sites were visited and 76 samples of granite, gabbro and metasediments were obtained from the Burgeo, Chetwynd, François, Gaultois, McCallum and North Bay granites, two gabbroic units at Grey River, and metasediments from the Bay d'Espoir Group. The granites and gabbros (23 samples) and one metasediment sample show potential for high-quality aggregates; 20 granite and 5 metasediment samples are considered to be marginal; 20 metasediment and 7 granite samples (mainly from the Gaultois Granite) are considered to be of low or poor quality. Geotechnical properties of bedrock, including geological structures, deleterious substances, abrasion, soundness, petrographic number and petrographic analysis, are presently under study.

INTRODUCTION

The great demand for high-quality aggregate for concrete and other construction uses, along the eastern seaboard of the United States, has led to the depletion of known reserves within this area. As U.S. producers deplete their reserves, new economic, aggregate deposits have to be found. However, the U.S. eastern seaboard aggregate producers are unable to meet the demand in this densely populated region because of stringent environmental constraints and municipal regulations; hence, new supplies of aggregate, outside of this heavily regulated area, need to be located.

New sources of aggregate will require the examination of new regions and the south coast of Newfoundland could be a suitable source, where there is an abundance of accessible and potentially suitable bedrock. The proximity of the south coast of Newfoundland to the eastern seaboard of the U.S. is an important cost factor. From this location, aggregate could be transported to the eastern seaboard and possibly even to Europe, at competative prices. To examine this potential, a reconnaissance survey was initiated.

During 1989, a survey of bedrock potential along the south coast of Newfoundland (Bay D'Espoir to Connoire Bay) was done to determine the aggregate potential of the various bedrock types, and the number of bedrock sites that would be suitable for quarrying and are also accessible by ship.

LOCATION, ACCESS AND PHYSIOGRAPHY

The study area extends westward along the south coast of Newfoundland for nearly 200 km from St. Alban's and Milltown on Bay d'Espoir, to Connoire Bay, 25 km west of Burgeo (Figure 1). There is limited road access to the area. Provincial highways connect Burgeo and St. Alban's to the Trans-Canada Highway at Stephenville and Bishops Falls, respectively. The other communities along the west coast (McCallum, Francois, Grey River and Ramea) can be reached by year-round CN Marine coastal boats, and a Newfoundland Government ferry, which links Grey River and Ramea to Burgeo, or by helicopter. The remains of several abandoned fishing communities are found throughout the area, although some of them are used as summer fishing stations.

The coastline is cut by numerous north-trending fiords, which extend up to 25 km inland. The fiords are restricted to the high plateau region between Burgeo and Bay d'Espoir and dissect the major geological units. West of Burgeo, relief is subdued by low rolling hills and gentle south-dipping slopes and extensive sandy beaches. The south coast of Newfoundland contains numerous deep, safe harbours, which are ice-free during the winter months (allowing year round shipping), and have sufficient relief for the development of large quarries.

---

[1] Newfoundland Mapping Section, Newfoundland Department of Mines and Energy

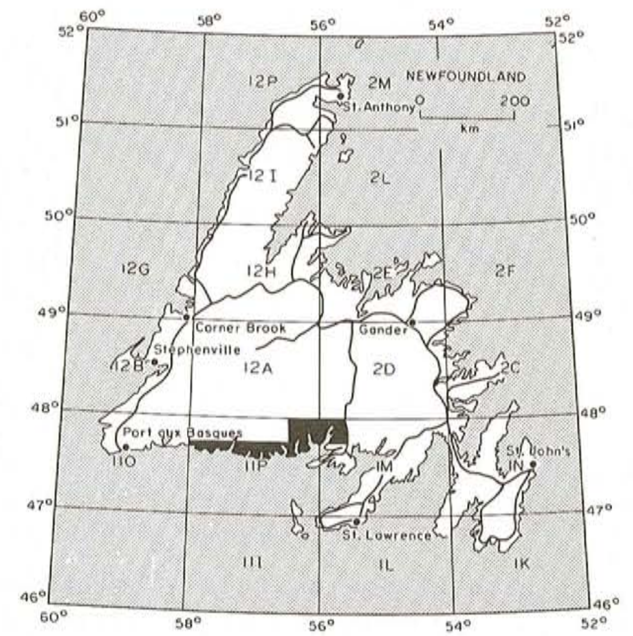

Figure 1. *Location of study area.*

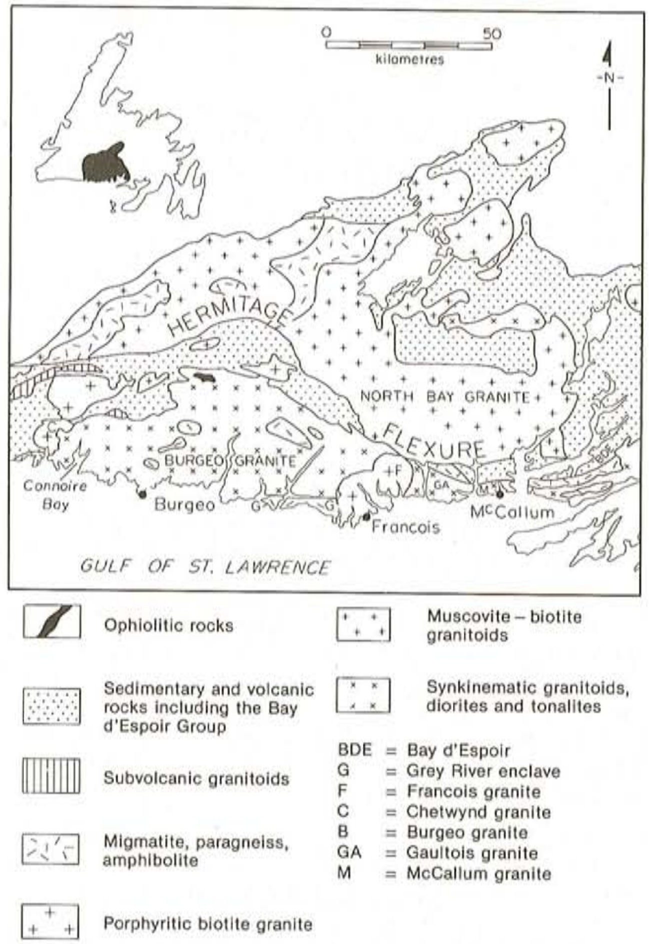

Figure 2. *General geology of the study area.*

GENERAL GEOLOGY

The rocks along the south coast of Newfoundland can be divided into three major units. These are the Grey River Enclave, the Bay d'Espoir Group, and the Chetwynd, Burgeo, François, McCallum and Gaultois granites (Figure 2).

The *Grey River Enclave* (Blackwood, 1985a) consists of a steep north-dipping sequence of greenschist to amphibolite facies, schistose metasedimentary and felsic volcanic rocks that have been intruded by, and deformed with, elongate gabbro intrusions and major quartz veins. The major quartz veins were assessed by Butler and Greene (1976) as a potential source of silica. The metasedimentary rocks are extensively migmatized and form complex mixtures of hornblende, semipelitic and psammitic schist and foliated biotite–hornblende tonalite. A massive hornblende gabbro cuts the eastern portion of the enclave.

The *Bay d'Espoir Group* is dominated by well-bedded, highly variable, strongly schistose metasedimentary and less abundant schistose felsic volcanic rocks, which form a series of recumbent folds and thrust slices. Numerous granitic and pegmatitic dykes cut the Bay d'Espoir Group along contacts with the adjacent granite batholiths. The metasediments are strongly schistose with abundant mica in the semipelitic and pelitic units. Psammites are less schistose but still contain significant mica. All units are highly fractured and secondary minerals are common on fracture planes. Quartz veining is also common.

The *Chetwynd Granite,* at Connoire Bay, is an extensive, massive, leucocratic biotite granite composed of two main phases. The most extensive phase is an equigranular to variably porphyritic granite containing about 1 to 2 percent biotite. The granite is well jointed and fresh. This granite is cut by fine grained aplitic granite, which occurs as small dykes and plugs. This granite is highly jointed but is fresh.

The *Burgeo granite* is the largest batholith in the region and is exposed along the coast between Connoire Bay and La Hune Bay. The batholith is dominated by coarse grained, feldspar porphyritic, biotite granite and granodiorite (O'Brien *et al.*, 1986). The granitic rocks between Burgeo and Grey River are strongly brecciated along numerous faults in a zone that parallels the coastline and extends up to 5 km inland. The brecciation and shearing has resulted in alteration of the granites by extensive chloritization, sericitization of the mafic minerals and feldspars, and fracturing of the feldspars. Joint surfaces are coated with secondary minerals. To the west of Burgeo and north of the brecciated zone, the granites and granodiorites are much fresher and competent. Alteration of the granites is minor. Weathering of these granites has locally penetrated the rock to about 10 cm resulting in soft, friable exposed surfaces.

The *François granite* is well exposed along the coast from the Grey River enclave eastward to Devil Bay. The granite is dominated by coarse grained, slightly porphyritic granite and minor but significant fine grained, porphyritic granite and medium granodiorite (Poole *et al.*, 1985; Dickson *et al.*, 1985). The coarse grained granites show widely spaced jointing with no associated alteration. It is also cut by numerous faults, but brecciation is of a very limited nature. The fine grained porphyritic granite is located at the western end of the Grey River enclave. This granite is extremely tough with fine grained interlocking quartz and feldspar. The granite is well jointed and commonly forms 1 x 1 x 0.5-m loose blocks. Weathering of joint and exposed surfaces is only superficial. The granodiorite is grey, medium grained, plagioclase porphyritic, biotite granite with about 5 to 8 percent fine grained biotite. Like the coarse grained granite, the rock is friable on exposed weathered surface, but it is fairly tough where it is constantly washed by the sea. The feldspars and biotite are fresh with minor secondary sericite and chlorite.

The *Gaultois granite* is exposed along the coast between Hare Bay and the southern portion of Bay d'Espoir. It is similar to the Burgeo granites, but contains a very strong foliation defined by feldspar augen and well-aligned and flattened feldspars, quartz and biotite (Blackwood, 1985b; Dickson *et al.*, 1985). Biotite forms up to 30 percent of the rock and is commonly altered to chlorite and epidote. Feldspars are variably altered to sericite and locally epidote. Shear and mylonite zones are common in the Gaultois granite.

The *McCallum granite* forms an elongate pluton that extends from Hare Bay to southern Bay d'Espoir and lies to the north of the Gaultois granite with which it is in fault contact along the Dragon Bay Fault. The granite is a composite pluton containing dioritic to granitic phases (Blackwood, 1985b). Compositional layering, mainly defined by varying proportions of biotite, is a prominent feature of the pluton. The granite locally contains a prominent foliation defined by aligned biotite and locally flattened quartz (Blackwood, 1985b).

The *North Bay Granite* is well exposed along the coast between Facheux Bay and Bay d'Espoir. Extensive coarse talus deposits occur at the eastern margin of the granite. The dominant rock type in this region is a medium grained, equigranular, muscovite–biotite granite, which contains a weak tectonic fabric. Mica (dominantly biotite) forms up to 5 percent of the granite. The biotite and feldspars are only slightly altered to chlorite and sericite (Dickson, *in press*). Jointing is well spaced and consists of several sets. Weathering of the exposed surfaces and along joints is minor.

RESULTS

Field work consisted of a detailed examination of representative coastal sites. Each site investigation consisted of rock identification, rock sampling, determination of type and thickness of overburden, and the recording of significant geological features (Plate 1; Bragg, 1986). One hundred and thirty-one sites were examined and 76 samples were obtained.

Following the site investigation, an initial quality reference (petrographic number or P.N.) was given to each site based on the following considerations. The rock types were rated on the basis of the amount of deleterious substances present and the petrographic number. Deleterious substances are materials that occur in or on the rocks and are capable of producing adverse effects; e.g., chemical reactions with other minerals resulting in a deterioration of the rock or cement binder used in concrete or asphalt. Some common deleterious substances include clays, organic matter, mica, iron and manganese oxide staining and cherty or fine grained siliceous material. Alteration zones, encrustations and the degree of weathering are also factors considered to be deleterious to the rock. The petrographic number was calculated for each site and this measured the initial quality of material for aggregate purposes. The petrographic number is calculated by sampling 100 clasts and assigning a petrographic factor to each clast. The petrographic factors range from 1 (best) to 10 (worst) depending on rock types, weathering, and hardness. Each clast is given a petrographic factor of 1, 3, 6 and 10 (Canadian Standards Association, 1973; Table 1). A modified petrographic series of factors (from Bragg, 1986) is given in Table 2. These factors provide an initial assessment of the rock for aggregate use. The petrographic number of a rock is the sum of the petrographic factors for the 100 clasts and thus can range between 100 and 1000. The petrographic factor/number is usually affected by the degree of weathering (Table 3). Table 4 shows the petrographic number ranges of different rock units found in the study area.

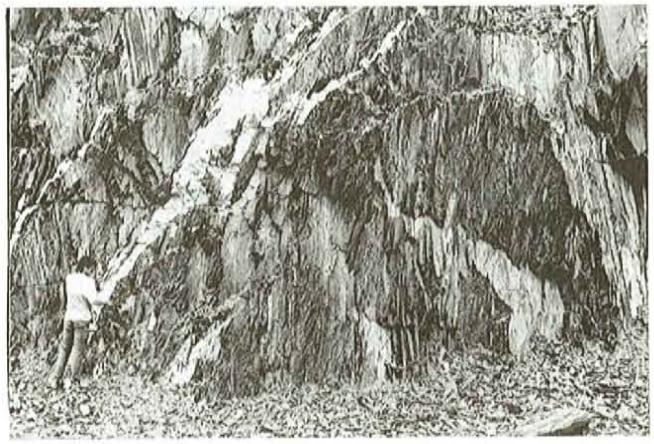

Plate 1. *Quartz veining and cleavage in a deformed sediment.*

Table 5 shows the initial assesment of the quality of the different rock groups based on field observations and petrographic numbers. The Burgeo, François and McCallum granites and the gabbros of the Grey River Enclave are all considered to be of high potential for concrete aggregate (Table 4) and should be investigated further. The majority of samples (50) came from these units, and 23 samples were considered to be of high potential (P.N. 110–130), 20 samples were considered to be marginal quality (P.N. 150–200) and only 7 samples, 5 of which were from the Burgeo granite, were considered poor quality (P.N. 215–300).

Table 1. Rock type and petrographic factors

Rock type	Classification	Factor
Carbonates (hard)	good	1
Carbonates (sandy, hard)	good	1
Sandstone (hard)	good	1
Gneiss (hard)	good	1
Quartzite (coarse grained)	good	1
Greywacke–arkose	good	1
Volcanic (slightly weathered)	good	1
Granite–diorite	good	1
Trap	good	1
Magnetite	good	1
Pyrite (disseminated in trap)	good	1
Iron-bearing quartzite	good	1
Sedimentary conglomerate (hard)	good	1
Carbonates (slightly weathered)	fair	3
Carbonates (sandy, medium hard)	fair	3
Sandstone (medium hard)	fair	3
Crystalline carbonates (hard)	fair	3
Crystalline carbonates (slightly weathered)	fair	3
Gneiss (soft)	fair	3
Chert and cherty carbonates	fair	3
Granite (friable)	fair	3
Volcanic (soft)	fair	3
Pyrite (pure)	fair	3
Flints and jaspers	fair	3
Carbonates (soft, slightly shaly)	poor	6
Carbonates (soft, sandy)	poor	6
Carbonates (deeply weathered)	poor	6
Carbonates (shaly clay)	poor	6
Carbonates (ochreous)	poor	6
Chert and cherty carbonates (weathered)	poor	6
Sandstone (soft, friable)	poor	6
Quartzite (fine grained)	poor	6
Crystalline carbonates (very soft, porous)	poor	6
Gneiss (friable)	poor	6
Granite (friable)	poor	6
Encrustations	poor	6
Cementations	poor	6
Schist (soft)	poor	6
Ochre	deleterious	10
Shale	deleterious	10
Clay	deleterious	10
Decomposed volcanics	deleterious	10
Slates	deleterious	10
Talc–gypsum	deleterious	10
Iron formations (very soft)	deleterious	10
Sibley formation	deleterious	10

Table 2. Revised petrographic factors for some rock types

Rock type	Petrographic factor range	Usual factor
1. Sandstone	1-6	1
2. Shale	10	10
3. Mudstone	3-6	6
4. Siltstone	1-6	1
5. Conglomerate	1-10	6
6. Arkose	1-6	1
7. Argillite	3-6	6
8. Greywacke	1-6	1
9. Chert	1-3	1
10. Limestone	1-6	1
11. Dolomite	1-6	1
12. Quartzite	1-6	1
13. Granite	1-6	1
14. Gabbro	1-6	1
15. Diorite	1-6	1
16. Granite-diorite series	1-6	1
17. Felsic volcanics	1-6	1
18. Mafic volcanics	1-6	1
19. Intermediate volcanics	1-6	1
20. Felsic–mafic volcanics	1-6	1
21. Pyroclastics	3-6	3
22. Metavolcanics	3-6	3
23. Gneiss	1-6	3
24. Schist	3-10	6
25. Phyllite	6-10	6
26. Marble	1-6	1
27. Slate	10	10
28. Amphibolite	6-10	6
29. Ultramafic	6-10	6
30. Metasediments	1-6	3
31. Iron formation	6-10	6
32. Drift deposits	Any or all of the above	Any or all of the above

Table 3. Effect of weathering on petrographic factors

Petrographic factor	Weathering grade	Final petrographic factors
1	1, 2	1,2
	3	3,4,5
	4, 5	6,7,8,9
	6	10
3	1, 2	3,4,5
	3, 4	6,7,8,9
	5, 6	10
6	1, 2	6,7,8,9
	3, 4, 5, 6	10
10	1, 2, 3, 4, 5, 6	10

Table 4. Summary of petrographic numbers of the different rock groups found in the study area

Group/formation	Number of samples taken	Petrographic number range	Petrographic number <160	Petrographic number >160	Average petrographic number
Bay D'Espoir Group	17	110-600	5	12	277
Burgeo granite	20	110-230	13	7	111
François granite	13	110-350	5	8	232
Gaultois granite	9	110-210	1	8	168
Grey River Enclave	9	110-210	7	2	130
McCallum granite	8	110-145	7	1	126

Table 5. Initial quality of the differnt rock groups found in field area

(1) Bay D'Espoir Group	–pelite (10 samples), poor quality –granite (1 sample), high quality –shale (2 samples), poor quality –altered volcanics (4 samples), marginal Total: 17 Samples
(2) Burgeo granite	–fine granite (5 samples), high quality –granodiorite (2 samples), high quality –biotite granite (5 samples), poor quality –coarse granite (8 samples), marginal Total: 20 Samples
(3) François granite	–fine granite (4 samples), high quality –coarse granite (6 samples), marginal –granodiorite (1 sample), high quality –coarse granite (2 samples), poor quality Total: 13 Samples
(4) Grey River Enclave	–foliated gabbro (7 samples), high quality –gneiss (2 samples), marginal Total: 9 Samples
(5) McCallum granite	–granite (4 samples), high quality –foliated granite (4 samples), marginal Total: 8 Samples
(6) Gaultois granite	–biotite granite (8 samples), poor quality –granite (1 sample), marginal Total: 9 Samples

Of the 26 samples taken from the Bay d'Espoir metasediments and the Gaultois granite, only 1 sample of metasediment is considered high quality (P.N. 110); 5 samples are considered marginal (P.N. 155–200) and the remainder 12 are considered to be of poor quality (P.N. 225–600). These two groups of rocks appear to have little potential as high-quality concrete aggregate.

SUMMARY

The granitic rocks (apart from the Gaultois granite) and the gabbroic rocks at Grey River have the highest potential as high-quality aggregate for concrete, whereas, the metasedimentary rocks, biotite-rich and/or highly fractured granites have little potential.

ACKNOWLEDGMENTS

Mr. Sidney Parsons and Mr. Wayne Ryder are thanked for their logistical support and special thanks go to Mr. Ted Hall. Martin Batterson and David Liverman are thanked for their critical reviews.

REFERENCES

Blackwood, R.F.
1985a: Geology of the Grey River area, southwest coast of Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-1, pages 153-164.

1985b: Geology of the Facheux Bay area (11P/9), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-4, 56 pages.

Bragg, D.
1986: Reconnaisance study of bedrock aggregate potential for offshore and industrial use. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 86-1, pages 297-301.

Butler, A.J. and Greene, B.A.
1976: Silica resources of Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 76-2, 68 pages.

Canadian Standards Association
1973: Canadian Standards Association A23.2.30.

Dickson, W.L.
In press: The geology of the North Bay Granite Suite and Ordovician-Silurian metasedimentary rocks in southern Newfoundland (Map areas 11P/15E, 11P/16 and 12A/2E). Newfoundland Department of Mines and Energy, Geological Survey Branch Report.

Dickson, W.L., Delaney, P.W. and Poole, J.
1985: Geology of the Burgeo Granite and associated rocks in the Ramea (11P/11) and La Hune (11P/10) map areas, southern Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 85-1, pages 137-144.

O'Brien, S.J., Dickson, W.L. and Blackwood, R.F.
1986: Geology of the central portion of the Hermitage Flexure area, Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 86-1, pages 189-208.

Poole, J., Delaney, P.W. and Dickson, W.L.
1985: Geology of the François Granite, south coast of Newfoundland. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division Report 85-1, pages 145-152.