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RECONNAISSANCE ASSESSMENT OF BEDROCK AGGREGATE IN CENTRAL NEWFOUNDLAND

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ABSTRACT

This preliminary investigation was undertaken to examine all quarries and roadcuts in central Newfoundland, to assess their bedrock aggregate potential for local use. A total of 325 sites were visited and 249 samples taken. Of the latter, 163 samples show potential for high-quality bedrock aggregate; 53 samples were considered to be marginal and 33 samples were considered to be of poor quality. Geotechnical properties of bedrock, including geological structures, deleterious substances, abrasion, soundness, petrographic number and petrographic analysis are presently under study.

INTRODUCTION

High-quality granular (sand and gravel) aggregate deposits are scarce in central Newfoundland and because of constant depletion of known reserves, a continuation of the reconnaissance study of bedrock aggregate, for potential industrial use, was carried out. During the first half of the 1989 field season, an evaluation of bedrock aggregate potential in central Newfoundland (Gander–Grand Falls) was undertaken. This assessment was done to determine the quantity and quality of bedrock aggregate for local industrial use.

FIELD WORK

The study area covers parts of eight, 1:50,000 map sheets (Figure 1). Field work consisted of detailed examination of quarries, roadcuts and natural bedrock outcrops along highways and side roads. Each site investigation included rock identification, representative sampling, determination of overburden type and thickness, and the description of geological features; the details of the method for site investigations can be found in Bragg (1986, 1989) and Bragg and Norman (1988).

Once the site investigations are completed, an initial quality reference (petrographic number) is given to each site based on deleterious substances present and petrographic factors. Deleterious substances are materials that occur in, or on, the rock, which 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. Common deleterious substances include clay minerals, organic matter, mica, iron and manganise oxide staining, and cherty or fine grained siliceous material. Alteration zones, encrustations and weathering are also factors that are considered to be deleterious to the quality of rock aggregate (Bragg, 1989).

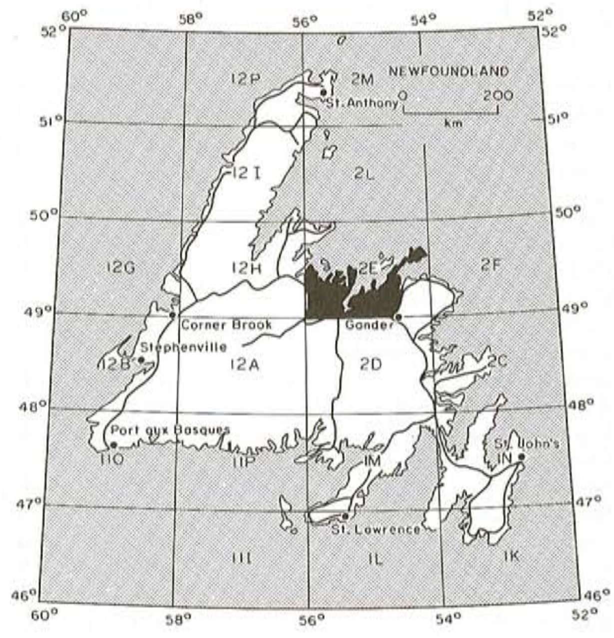

Figure 1. *Location of study area.*

A petrographic number (P.N.) is calculated for each site and this measures 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 factor ranges from 1 (best) to 10 (worst) depending on rock type, freshness, hardness and alterations. Each rock type is given a petrographic factor of 1, 3, 6 and 10 (Canadian Standards Association, 1973; Table 1), and a revised version (Table 2; Bragg, 1986) are factors given to different rock types that indicate the initial assessment of the rock for aggregate use. The petrographic number is the sum of the petrographic factors for each clast and can range between 100 and 1000. The lower the petrographic number the higher the rock quality (e.g., a clean, hard unweathered

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

granite would normally have a petrographic factor of 1, and a petrographic number of 100, whereas a friable, soft shale would normally have a petrographic factor of 10 and a petrographic number of 1000). The petrographic factor/number is usually affected by the degree of weathering (Table 3). Table 4 shows the petrographic number ranges for different rock units found during the field season.

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

GENERAL GEOLOGY

The Gander–Grand Falls area, including Notre Dame Bay, consists primarily of Silurian, Ordovician and Cambrian

Table 4. Petrographic number ranges of different rock units found in the field area

Group/formation	Number of samples	Petrographic number range	Petrographic number <160	Petrographic number >160	Average petrographic number
Botwood Group	3	130-275	1	2	195
Davidsville Group	13	300-1000	0	13	946
Dunnage mélange	15	110-350	2	13	261
Fogo batholith	17	100-140	17	0	115
Gander Group	4	110-350	1	3	256
Gander River complex	10	110-150	10	0	124
Goldson Group	8	130-185	3	5	168
Horwood Formation	4	350	4	0	350
Lawrenceton Formation	5	145-325	1	4	217
Loon Bay granodiorite	9	120-150	9	0	127
Loon Harbour volcanics	2	165	2	0	165
Mount Peyton intrusive Suite	18	110-210	15	3	133
New Bay Formation	7	115-190	3	4	161
Sansom Formation	16	110-350	13	3	159
Stoneville Formation	14	110-375	3	11	278
Summerford Group	19	110-325	17	2	149
Tims Harbour Formation	8	125-600	5	3	283
Twillingate granite	21	110-350	17	4	155
Wigwam Formation	22	115-1000	13	9	229
Miscellaneous	27	100-1000	17	10	238

sedimentary, metamorphic and igneous rocks. The Silurian consists of volcanic and sedimentary rocks of the Botwood Group (Williams, 1962), Indian Islands Group (Baird, 1950), Goldson Group (McKerrow and Cocks, 1978), Fogo batholith (Williams, 1957) and the Mount Peyton intrusive suite (Blackwood, 1981). The Ordovician consists of sedimentary, metamorphic and igneous rocks of the Davidsville Group (Kennedy and McGonigal, 1972), Gander Group (McGonigal, 1973) and the Gander River complex (O'Neill and Blackwood, 1989). The Cambrian consists of igneous rocks of the Twillingate granite (Baird, 1953).

The Notre Dame Bay area consists primarily of the Botwood Group, which is divided into the Lawrenceton (mafic and felsic volcanic flows, pyroclastics, sandstones and minor conglomerate) and Wigwam (sandstones, siltstones and mudstones) formations (Williams, 1972). The Indian Islands Group is divided into the Tims Harbour (sandstone, shale, metasediment and quartzite) and Horwood (phyllite, slate, siltstone) formations (Dean, 1978) and the Stoneville (sandstone, siltstone, conglomerate and slates) formation (McCann and Kennedy, 1974). The Goldson Group is divided into the Toogood (conglomerate), Burnt Island (sandstone, siltstone), Green Cove (siltstone), and Herring Head (conglomerate) formations (McKerrow and Cocks, 1978) and Pike Arm (argillite, sandstone and conglomerate) formation (Twenhofel and Shrock, 1937). The Fogo batholith (Williams, 1957) consists of diorite and granodiorite. The Dunnage mélange (Hibbard and Williams, 1979) consists of meta-sediments having large mafic-volcanic blocks.

The Gander—Grand Falls area consists primarily of the Gander Group, which is divided into the Jonathans Pond (psammite, semipelite, pelite and minor sandstone and mafic sills or dykes) and Indian Bay Big Pond (metasedimentary and metavolcanic rocks) formations (O'Neill and Blackwood, 1989); the Davidsville Group, which is divided into the Outflow (sandstone, shale, siltstone, slate and minor conglomerate), Hunt's Cove (slate and minor conglomerate) and Weir's Pond (fossiliferous sandstone, conglomerate, limestone and graphitic shale) formations (O'Neill and Blackwood, 1989); the Gander River complex (gabbroic and mafic volcanic—volcaniclastic rocks, felsic plutonic rocks, pyroxenite) (O'Neill and Blackwood, 1989); and the Mount Peyton intrusive suite (gabbro, diorite, granodiorite and syenite) (Blackwood 1981). All rocks in the field area show various degrees of weathering, metamorphism and jointing.

SUMMARY

A total of 325 sites were visited and 249 samples taken. Of these, 163 samples show potential for high-quality bedrock aggregate, 53 samples were considered to be marginal and 33 samples were considered to be of poor quality.

Table 5 shows the initial quality of the different rock groups and formations investigated during the field season, based on field observations and petrogrpahic number.

The Botwood Group, Fogo batholith, Gander River complex, Summerford Group, Loon Bay granodiorite, Mount Peyton intrusive suite, Twillingate granite and Samson

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

(1) Botwood Group	–Lawrencton Formation (5 samples) 1 H.Q., 3 M.Q., 1 P.Q. –Wigwam Formation (22 samples) 14 H.Q., 6 P.Q., 3 M.Q. –Undivided (3 samples) 2 M.Q., 1 H.Q. Total: 30 Samples
(2) Davidsville Group	–Outflow Formation (13 samples) 13 P.Q. –Hunt's Cove Formation (0 samples) –Weir's Pond formation (0 samples) Total: 13 Samples
(3) Dunnage mélange	–15 samples taken (2 samples) 1 H.Q., 1 M.Q. (13 samples) P.Q. Total: 15 Samples
(4) Fogo batholith	–17 samples taken (17 samples) H.Q. Total: 17 Samples
(5) Gander Group	–Jonathans Pond formation (3 samples) 1 H.Q., 3 P.Q. –Indian Bay Big Pond formation (1 sample) 1 M.Q. Total: 4 Samples
(6) Gander River complex	–10 samples H.Q. Total: 10 Samples
(7) Goldson Group	–Toogood Formation (1 sample) 1 M.Q. –Burnt Island Formation (1 sample) 1 M.Q. –Green Cove Formation (1 sample) 1 M.Q. –Pike Arm Formation (4 samples) 2 H.Q., 2 M.Q. –Herring Head (1 sample) 1 M.Q. Total: 8 Samples
(8) Indian Islands Group	–Tims Harbour Formation (8 samples) 5 H.Q., 3 P.Q. –Horwood Formation (4 samples) P.Q. –Stoneville Formation (14 samples) 3 H.Q., 3 M.Q., 8 P.Q. Total: 26 Samples
(9) Summerford Group	–Undivided –19 samples (17 samples) H.Q.; (2 samples) 1 M.Q., 1 P.Q. Total: 19 Samples
(10) Loon Bay Granodiorite	–(9 samples) 9 H.Q.
(11) Loon Bay Volcanics	–(2 samples) 2 M.Q.
(12) Mount Peyton intrusive suite	–(18 samples) 15 H.Q., 3 M.Q.
(13) Twillingate Granite	–(21 samples) 17 H.Q., 2 M.Q., 2 P.Q.
(14) New Bay Formation	–(7 samples) 2 H.Q., 5 M.Q.
(15) Sansom Formation	–(16 samples) 13 H.Q., 1 M.Q., 2 P.Q.
(16) Undivided	–(34 samples) 24 H.Q., 6 M.Q., 4 P.Q.

H.Q.–High Quality
M.Q.–Marginal Quality
P.Q.–Poor Quality

formation are all considered to be of potentially high-quality bedrock aggregate sources. A total of 141 samples were taken from these units, of which 116 are high quality (P.N. 110 to 130), 13 are considered marginal (P.N. 150 to 210) and 12 were considered to be of poor quality (P.N. 250 to 600), and just over half of the latter samples (7) are from the Botwood Group.

The Goldson Group, Loon Bay volcanics and New Bay Formation are considered to be of marginal quality. A total of 17 samples were taken from these units, of which 13 are marginal (P.N. 150 to 210) and 4 were high quality (P.N. 110 to 135).

The Davidsville Group, Dunnage mélange, Gander Group and Indian Islands Group are all considered to be of poor quality for aggregate materials. A total of 58 samples were taken from these units, of which 43 were of poor quality (P.N. 250 to 600), 5 samples were of marginal quality (P.N. 150 to 210) and 10 samples are considered to be of high quality (P.N. 110 to 135). Eight of these latter samples are from the Tims Harbour Formation in the Indian Island Group.

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