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INVESTIGATION OF A RED GRANITE FROM ST. LUDGER DE MILOT, P.Q.

by

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Mineral Processing Division

Mines Branch Investigation Report IR 71-64

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SUMMARY OF RESULTS

The rock is a fine-grained red granite composed of pink potassic and sodic feldspars and quartz, with accessory biotite and magnetite. The rock polishes to an irridescence and liveliness that renders it aesthetically excellent.

The rock is massive and free of knots, streaks, and staining. It contains no deleterious materials such as pyrite or soft friable minerals.

The results of physical tests, particularly its outstanding resistance to accelerated freezing and thawing, indicate that this granite is sound, durable, and suitable for use as a building, ornamental, or monumental stone.

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Rapport d'investigations IR 71-64 de la Direction des mines

ÉVALUATION D'UN GRANITE ROUGE PROVENANT DE SAINT LUDGER DE MILOT, P.Q.

par

F. E. Hanes*

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RÉSUMÉ DES RÉSULTATS

La roche est un granite à grains fins composé de quartz ainsi que de feldpaths roses de potassium et de sodium avec des quantités accessoires de biotite et de magnétite. La roche prend un poli aven une iridescence et une vivacité qui la rendent excellente au point de vue esthétique.

La roche est massive et exempte de noeuds, de stries et de taches. Elle ne contient pas de matériels nuisibles tels que de la pyrite ou des minéraux friables.

Les résultats des tests physiques, particulièrement sa résistance marquante à l'action du gel et du dégel accélérés, indiquent que ce granite est solide, durable et convenable pour fins d'utilisation comme roche monumentale, ornementale et de construction.

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INTRODUCTION

Mr. Claude Moreau, President of the Polycarpe Moreau Granite Company, Hebertville Station near Lac St. Jean, Que., requested the assistance of the Mines Branch in assessing the suitability of a fine-grained red granite, from north of Lac St. Jean, as a building and/or ornamental stone.

The quarry is approximately 12 miles north of St. Ludger de Milot and about 35 miles north of Lac St. Jean. The rock quarried at the site is brought out on a logging road to St. Ludger de Milot whence it is transported by truck on hard-surfaced roads to either the Company's dressing plant at Hebertville Station or directly to markets in Quebec City and Montreal.

Appropriately, the stone has been referred to as the "Venus de Milot" granite.

The granite from the St. Ludger de Milot area is within 12 miles of a commercially developed deposit of fine-grained black micro-syenite. Both deposits of fine-grained rocks are surrounded by coarser-grained black anorthositic rocks like those on the Peribonka River not far from the north shore of Lac St. Jean. The fine grain of these rocks suggests they had a different thermal or genetic history than the anorthosites.

The colour of the red "Venus" granite contrasts vividly with that of the darker rocks, and the deposit stands in marked relief over them.

The company prepared samples for the rupture tests and provided samples from which to prepare specimens for other tests.

SCOPE OF INVESTIGATION

The investigation consisted of a petrographic study and the following physical tests:

1. bulk specific gravity and absorption;
2. freeze-thaw cycling, compressive strength, and length measurement;
3. modulus of rupture (wet and dry);
4. impact load (toughness);
5. abrasion by footwear.

LABORATORY PROCEDURES

Sample Preparation

Specimens were cut accurately and ground to obtain precise parallel faces.

Twenty-five 2-in. cubes were made for cyclic freezing and thawing, specific gravity, and absorption tests.

Samples consisting of three parallel cores were taken in each of three directions at right angles to each other. Each core, one inch in length and one inch in diameter, was tested for toughness.

Three 2 x 2 x 1-in. test specimens were prepared for abrasion by footwear tests, and flexure tests were made on six 8 x 4 x 2¼-in. specimens that had been submitted by the company.

Periodically, compression tests were made on the 2-in. cubes during freeze-thaw cycling.

A. Petrography

A thin section and polished specimens were prepared for petrographic study to determine the mineral composition and textural relations of the granite.

B. Physical Characteristics

Procedures for physical tests conform with the following standard methods:

(1) standard method of test for Absorption and Bulk Specific Gravity of Natural Building Stone (ASTM Designation: C97-47);

(2) tentative method of test for Resistance of Concrete Specimens to Rapid Freezing in Air and to Thawing in Water (ASTM Designation: C 291-61T); the method is used to provide comparative values for compressive strength after periods of freeze-thaw cycling

(a) standard Method of Test for Compressive Strength of Natural Building Stone (ASTM Designation: C 170-50), a method of testing for compressive strengths in wet and dry conditions. Further compressive strengths were determined on samples after various periods of freeze-thaw cycling;

(b) length was measured on two-inch cubes.

(3) standard method of test for Modulus of Rupture of Natural Building Stone (ASTM Designation: C 99-52); this method covers the test for determining the modulus of rupture of all types of natural building stone except slate.

(4) standard method of test for Toughness of Rock (ASTM Designation: D 3-52)*; the parameter of toughness is taken to be the resistance to fracture offered by a standard specimen struck by a standard hammer;

(5) standard method of test for Abrasion Resistance of Stone Subjected to Foot Traffic (ASTM Designation: C 241-51); this test method is a procedure for determining a value for abrasion resistance which can be compared with those of other rocks.

A. Petrography**

The rock is a fine-grained granite with a hypidiomorphic texture, i.e., subhedral to euhedral crystals of similar size are randomly oriented. The mineralogical composition is approximately:

Quartz	35 per cent,
K-Feldspar (pink)	30 " " ,
Na-Plagioclase (pink)	30 " " ,
Biotite	4 " " ,
Magnotite	1 " " .

B. Physical

The following results of physical tests refer only to the material submitted for this investigation. However, the material appears to be representative of the rock quarried from the company's deposit.***

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* Not required by present standards.

** Dr. J. A. Soles, Petrographer, Ore Mineralogy Section, Mineral Processing Division, Mines Branch, Ottawa, Ontario.

*** The writer visited the property when the quarry was being opened.

(1) Bulk Specific Gravity .... 2.62 per cent

Absorption .... 0.20 per cent

Each value is the average of three determinations.

(2) Resistance to Cyclic Freezing-Thawing

(a) Compressive Strength

Test cubes exposed to freeze-thaw cycling were tested for compressive strength after specific numbers of cycles. Table 1 shows the compressive strength values obtained on two-inch cubes.

TABLE 1

Compressive Strengths (psi) of Freeze-Thaw Test Specimens

Sample No.	1	2	3	4	Average
Cycles					
0-(Dry)	26,250	26,250	39,000		30,500
0-(Wet)	28,250	30,250	31,500		30,000
150	24,500	28,125	25,500		26,042
300	31,250	32,500	33,500		32,420
450	29,250	23,250	31,000		27,830
600	33,750	32,250	30,500		32,200
750	33,500	34,500	35,500		34,500
1034	30,625	31,675	27,875	32,000	30,544

(b) Length measurements taken on two-inch cubes, prior to and following 720 freeze-thaw cycles, indicate the degree of change in length of this granite after it has been subjected to changing temperatures.

Table 2 gives the length values.

TABLE 2

Length Determinations on Sides of Cubes Before and After Freeze-Thaw Cycling

Cycles	Sample 1 Inches	Sample 2 Inches	Sample 3 Inches	Sample 4 Inches
0	2.0136	2.0258	2.0020	2.0192
720	2.0134	2.0254	2.0021	2.0193

(3) Modulus of Rupture

Six test specimens of rock were broken in tension to determine the modulus of rupture. Three of the samples were tested dry and the remaining three were tested after soaking in water for 48 hr. The values shown in Table 3 were obtained from substituting relevant data in the formula: $R = \frac{3Wl}{2bd^2}$

where R = modulus of rupture,
W = breaking load in pounds,
l = length of span in inches,
b = width of specimen in inches, and
d = thickness of specimen in inches.

TABLE 3

Modulus of Rupture (psi)

Sample No.	1	2	3	Average
Dry	2768	2830	2775	2791
Wet	2620	2730	2690	2680

(4) Impact Load Test for "Toughness"

Table 4 shows the number of blows required to fracture one-inch long cores. Each orientation of coring is represented by three samples.

TABLE 4

Blows Required to Fracture 1 x 1-Inch Long Cores

Orientation	'x'	'y'	'z'
Sample 1	14	15	15
Sample 2	13	16	13
Sample 3	15	15	15
Average	14	15.3	14.3

(5) Abrasion Resistance of Stone Subjected to Foot Traffic

The results of resistance-to-abrasion tests for three different samples tested in three different positions on the testing equipment are shown in Table 5.

TABLE 5

Abrasion Resistance to Stone (Ha)*

Sample	1	2	3
Position of Sample in Machine	(A) 80.80 (B) 104.70 (C) 101.00	(B) 83.30 (C) 91.40 (A) 85.80	(C) 78.90 (A) 91.50 (B) 105.10
Individual Average	95.50	86.83	91.83
Average (H_a)		91.39	

*Empirical number calculated from Kessler's formula

$$H_a = \frac{10G(2000 + Ws)}{2000\ Wa},$$

where Ws = average weight of sample before and after test,
Wa = loss in weight, and
B = specific gravity.

DISCUSSION

The results of physical tests made on this red granite show it to be of good quality. High values of compressive strength, ranging from 26,000 to 34,500 psi throughout 1034 cycles of freezing and thawing (F/T), attest to the rock's durability and soundness. Maximum compressive strength was reached at 750 cycles of F/T. Consistent values of flexural strength, approximately 10 per cent of the compressive strength, are comparable with normal values for sound granitic rocks.

A low absorption value (0.20 per cent) reflects low porosity, a factor which is responsible for its stability during cyclic freezing and thawing. Variation in length measurements during 720 F/T cycles was no more than 0.02 per cent, a negligible amount.

The rock's resistance to abrasion, shown by a high average (H_a) value of 91.39, is greater than those of normal granitic rocks which have (H_a) values ranging from 80 to 85.

Results of impact tests indicate that this red granite is as tough as other well-crystallized types of granites, for example, one of the sound grey granitic rocks from the Stanstead, P.Q. area withstood 11 blows under similar testing. A rock of the "Venus" type cannot, on the other hand, be rated with the very fine-grained trap rocks whose tightly bonded textures give them high toughness values ranging from 20 to 30 blows, i.e., approaching the toughness required for curling stones.

The rock shows good contrast between honed and polished surfaces, making it an excellent rock for monument letter and embellishment carving. The polished surface, besides having a very pleasing red colour, has an added sparkle and depth due to light reflecting from external and internal surfaces of clear quartz. The rock takes a very high polish, with only a slight plucking of some of the mafic (biotite) minerals. Magnetite is principally associated with the biotite and does not decrease the aesthetic appeal of the granite.

The rock is most acceptable by aesthetic standards, finding immediate favour with most people who see it for the first time and with those who have worked with it.

CONCLUSION

All physical tests performed on this fine-grained red granite from St. Ludger de Milot indicate that the rock is highly suitable for use as either a building or an ornamental/monumental stone. Its use in locations exposed to severe weather conditions can be accepted on the basis of its excellent resistance to cyclic freezing and thawing.

From personal observation at the quarry site, it appears to be available in any size of block necessary to meet most demands. The quarry is not so remote as to raise serious transportation difficulties. The character of the deposit ensures reasonably economic quarrying.

The rock has an aesthetic quality that ranks high with those of other acceptable building and ornamental dimension stones.

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