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PHYSICAL TESTS AND PETROGRAPHIC STUDY OF A DOLOMITE FROM NOGIES CREEK, ONTARIO

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The fine-grained, dark-coloured dolomitic rock contained 55 to 60 per cent dolomite and 35 to 40 per cent calcite.

Specific gravity of the rock was 2.76 and its absorption was 0.76 per cent. The compressive strength of 2-in. cubes averaged 17,210 psi when tested dry and 15,186 psi when tested wet.

The rock showed no deterioration after it was subjected to 502 cycles of freezing and thawing, and is acceptable for use in exposed weathering conditions.

The rock should make a suitable building stone when used for wall blocks, veneer and patio slabs. Its ability to take a high polish might enhance its value as a decorative facing stone.

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INTRODUCTION

A dark, maroon- to green-coloured dolomitic rock was submitted by A. Metcalfe of the Black River Limestone Products, Peterborough, Ontario, for evaluation for use as a building stone.

This stone is being quarried in the Nogies Creek area, lots 21-22, 14th Conc., and lots 28, 29, 30, 13th Conc., Harvey Township, Peterborough County, several miles northeast of Bobcaygeon, Ontario.

The property, called Johnson's Farm, has been leased by Mr. A. Metcalfe to quarry the dolomitic rock for use as a building stone in the form of wall facing blocks, patio slabs and various veneer applications.

Samples for this investigation were submitted at different dates. The initial sample of the stone was submitted in 1961. The main sample of the rock was delivered to the Mines Branch by Mr. Metcalfe in the fall of 1962. At another date, 2-in. drill cores were submitted for durability tests.

PREPARATION OF SAMPLES

Samples for polishing and specific gravity determinations were prepared from the first sample submitted for evaluation.

The larger rock fragments and blocks 4 to 6 in. thick from the main shipment of rock samples were used to prepare the 2-in. test cubes.

Of the six 2-in. drill cores submitted, three cores were drilled parallel to the bedding and three perpendicular to the bedding. All cores were lapped to a 2-in. length. Thin sections were prepared for mineralogical examination from rock pieces of the sample designated as SR-86-A, and identified as TS-22-61.

DESCRIPTION AND PETROGRAPHIC STUDY*

The rock is pinkish- to rusty-coloured, fine-grained with intermittent banding. Weathered surfaces are minutely rough, pebbly in banded areas. The thin section was stained with sodium cobaltinitrite, potassium rhodizonate and alizarine red to selectively differentiate potassium feldspar, calcium feldspar, and calcite.

The rock is a fine-grained, calcitic dolomite. Rhombohedral crystals of dolomite make up most of the thin section, and the interstices are largely filled with calcite. The bands contain relatively large grains of quartz and feldspar. Both of these minerals are also scattered sparsely through the unbanded dolomite, but the grain sizes are predominantly the same as those of the dolomite rhombs.

The feldspar is albite ($Ab_{95}.An_5$). Borders of the grains are often stained by the sodium cobaltinitrite solution, indicating that some potassium metasomatism has occurred.

Approximate mineral composition of the rock is shown in Table 1.

TABLE 1

Mineral Composition

Mineral	Percentage	Grain Size
Dolomite	55-60	10 to 100 μ
Calcite	35-40	5 to 60 μ
Quartz	3	30 to 50 μ
Albite	2	Same as quartz

* Petrographic Study by Dr. J. A. Soles, Petrologist, Mineral Processing Division.

The stone is amenable to taking a good polish. A high polish was obtained by buffing with tin oxide on a fine-honed prepared surface. However, slight differential wear is noted where the thin bands containing most of the larger quartz and feldspar grains stand out in relief compared with the bands of less resistant dolomite. Dolomite will wear differentially compared with quartz or feldspar.

PHYSICAL TESTS AND RESULTS

The following tests were made on this rock:

1. Specific gravity and absorption tests,
2. Compression tests (dry and wet),
3. Freezing and thawing tests,
4. Final compression tests on freeze-thaw samples.

1. Specific Gravity and Absorption

Results obtained were from tests made in accordance with the Standard Methods of Test for Absorption and Bulk Specific Gravity of Natural Building Stone, ASTM Designation: C97-47 (re-approved in 1958 without change).

The following values of specific gravity and absorption apply to this rock:

Specific Gravity (average of 2 samples)

Saturated Surface Dry Method = 2.76

Absorption (average of 2 samples) = 0.76%

2. Compression Tests (Dry and Wet)

The 2-in. test cubes were prepared for testing both in dry and wet condition. Samples were tested with the direction of loading normal to the bedding in accordance with the Standard Method of Test for Compressive Strength of Natural Building Stone, ASTM Designation: C170-50.

The results obtained from the two series of compression tests are shown in Table 2.

TABLE 2

Compressive Strength of Rock Specimens
(2 x 2 x 2 in. cubes)

Test No.	Conditions of Test Specimens	
	Saturated Compr. Strength, psi	Oven - Dry Compr. Strength, psi
1	15250	17240
2	15123	17180
Average	15186	17210

3. Freezing and Thawing Tests

Three test cores drilled perpendicular (Series A) and three drilled parallel (Series B) to the bedding of the rock were tested for durability by exposing them to 502 rapidly repeated cycles of freezing in air and thawing in water in accordance with the ASTM Test Method C291-61T. The automatic freeze-thaw unit used in this investigation performs 8 cycles a day. One complete cycle, from 40 ± 3°F to 0 ± 3°F, and back to 40 ± 3°F, requires about 3 hours.

Weight, length and untrasonic pulse velocity measurements were made periodically during the freeze-thaw cycling. Test cylinders were soaked in water for 3 days before commencing the cycling. The test results on one test specimen from each of the two series are shown in Table 3.

TABLE 3

Results of Freeze-Thaw Tests

Test Specimen No.	Freeze-Thaw Cycle Nos.	Weight of Specimen, g	Length of Specimen, in.	Ultrasonic Pulse Velocity, fps
A_1	0	254.4 (dry)	1.9973	-
		255.3 (wet)		
	62		1.9961	19710
	107		1.9862	19980
	198	255.3	1.9864	20020
	280		1.9862	20600
	439	255.3	1.9863	20600
	502	255.2	1.9861	20600
B_1	0	255.0 (dry)	1.9990	-
		255.8 (wet)		
	62	255.9	1.9997	19400
	107		1.9900	19480
	198	255.9	1.9893	19980
	280		1.9895	20050
	439	255.9	1.9891	
	502	255.8	1.9892	20050

At the completion of freeze-thaw cycling, core specimens of both series A and B were tested in compression. Test results are shown in Table 4.

TABLE 4

Compressive Strength of Freeze-Thaw Cores

Series A (⊥ bedding)	Compressive Strength, psi	Series B (// bedding)	Compressive Strength, psi
A_1	28590	B1	24010
A_2	26650	B2	23320
A_3	19810	B3	19650
Average	25020	Average	22330

DISCUSSION

Samples submitted for the investigation were restricted to deposits of thinly-bedded rock (up to 6-8 inches) which appear to be reasonably consistent in thickness.

The rock is slightly drab in colour, in shades of maroon and green with phases where the two colours have intermingled; these darker shades might have an unfavourable influence on the user where comparison with a brighter stone might be made. The colouring, which is very much a personal factor in the selection of a rock, may be enhanced by polishing; the stone takes a good polish, although differential wear is noted where quartz grains, imbedded in the thin bands, stand out in relief against the less resistant dolomite. The quartz grains appear dark, adding character to the polished surface.

Physical characteristics of the rock, as shown by tests, indicate that the dolomite submitted for investigation is suitable for uses as a building stone.

The results of freezing and thawing tests showed no loss of weight or detrimental volume changes.

Ultrasonic pulse measurements showed a slight increase in pulse velocity, which is an indication that no deterioration was sustained by the test specimens during exposure to 502 cycles of freezing and thawing.

Compressive strength of the cylindrical test specimens after freeze-thaw cycling showed considerably higher values (Table 4) than those obtained on cubes (Table 2), and seems not to have suffered a reduction of strength due to freezing and thawing.

The considerable strength difference between the two sets of test specimens must be attributed to different locations in the deposit, from which samples were taken.

CONCLUSIONS

The rock, as submitted, is a dark-coloured, dense, massive dolomite, acceptable for use as a building stone in the form of patio slabs, veneer and rough-faced ashlar.

The production of larger blocks would depend on the bed thickness and structural soundness of the deposit. Popularity of the stone will likely be influenced to a large extent by its colour, a factor governed only by the public's fancy.

The rock, as submitted, tested satisfactorily for durability and soundness.

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