

NOTES ON SOME MINERALS FROM THE RHODOLITE QUARRY NEAR FRANKLIN, NORTH CAROLINA

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INTRODUCTION

Near the summit of Mason Mountain, on the southern slope, about 8 miles north of Franklin, North Carolina, is an old quarry from which rhodolite garnet has been collected. Abandoned for many years, this quarry was recently re-opened by Mr. Burnham S. Colburn of Biltmore, N.C., but after a number of attractive specimens of rhodolite had been obtained operations were discontinued. Excellent samples of rock which contain much gedrite are still to be found on the dump which, however, has been so carefully picked over for rhodolite that good samples are scarce.

The aggregate of minerals is very coarse grained and there is considerable variation in the proportion of the contained minerals so that hand samples differ greatly in appearance. A chemical analysis of such a mixture would be of little value unless the sample analyzed was representative of the quarry face. The essential minerals are rhodolite, gedrite, hypersthene and biotite. Small masses of quartz are present but this is not an important constituent. The following estimate of the quantity of each mineral present was made upon a polished sample approximately half of a square foot in size.

Rhodolite	55-60 per cent
Gedrite	15-20 " "
Hypersthene	15-20 " "
Biotite	10-15 " "

GEOLOGY

The rock containing these minerals occurs in a dike-like mass some 15-20 feet wide, striking in a northerly and southerly direction with an almost vertical dip. The schists immediately in contact on both the east and west are badly altered and decomposed. The dike, however, is perfectly fresh and has completely escaped the attack of weathering agents. It is difficult to closely compare these badly altered schists but the weathered exposures suggest that there is a slight difference in the direction of the schistosity. The

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schist to the west contains a greater quantity of large garnets than that to the east and according to verbal reports from some of the workmen employed during the recent operations, several rather good pink garnets were found in this rock. Such minor differences suggest that the rhodolite-gedrite rock has been intruded along a fault where there has probably been some displacement.

The presence of hypersthene and garnet suggests that the original rock probably had a composition somewhat similar to eclogite, but the present aggregate containing gedrite, indicates a later metamorphism and perhaps deeper along the dike a normal eclogite may be found.

MINERALOGY

The minerals described in the following pages were extracted from material No. 92684, U. S. National Museum.

RHODOLITE. This variety of garnet was first brought to the attention of the public by A. M. Field of Asheville and Kunz² states: "Mr. Field also found 118 garnets worth \$117.00 in Burk and Mason County, North Carolina. The value, per carat, was from \$1 to \$10.00." The first specimens were found in Cowee Creek and other streams originating in Mason Mountain, the gravels of which were worked by hydraulic processes. W. E. Hidden and J. H. Pratt³ described this garnet and suggested the name *rhodolite* from two Greek words, one meaning rose and the other, stone. Such a name is particularly appropriate since the color of this garnet varies much the same as do the rhododendrons which are so common in the district. The color is pale rose pink on the exposed surface, but when freshly broken these garnets often show a distinct purplish tint. These same authors⁴ described the minerals associated with the rhodolite in the stream beds and referred to a ledge of rock exposed near the summit of Mason Mountain which was composed almost entirely of rhodolite and biotite with a considerable quantity of disseminated iron sulphides. This description does not apply to the exposure visited by the writer with Mr. William Colburn, in that the sulphides in this quarry occur in very limited quantities. The masses of rhodolite vary considerably in size; in Mr. Colburn's collection there are several specimens with a maximum

² Mineral Resources of the United States, 1893, U. S. Geol. Survey.

³ Amer. Jour. Sci., vol. 5, 1898, p. 294.

⁴ Amer. Jour. Sci., vol. 6, 1898, p. 463.

cross section of over two inches. Euhedral garnet crystals from this place are apparently quite rare, if not unknown, for in the visit to the quarry none was seen nor are they represented in the mineral collections examined. The average size of these garnet masses is probably between one and two centimeters. The rhodolite is badly fractured, but small pieces are perfectly transparent and free from mineral inclusions. In a number of thin sections the rhodolite is seen inclosing irregularly bounded small fragments of hypersthene in parallel orientation.

The following two analyses of this garnet have been published.⁵

TABLE I
RHODOLITE FROM MASON'S BRANCH, NORTH CAROLINA
J. H. Pratt, Analyst

	I	II	III	Average	Ratios	
SiO ₂	41.54	41.65		41.59	.689	.689=2.90
Al ₂ O ₃		23.26	23.10	23.13	.226	.237=1
Fe ₂ O ₃	1.88	1.92		1.90	.011	
FeO	15.48	15.63		15.55	.216	.659=2.78
MgO		16.90	17.48	17.23	.427	
CaO	1.02	.86		.92	.016	

Specific gravity 3.837-3.838.

The composition was found by calculation to correspond to two molecules of pyrope and one of almandite.

A ferrous iron determination was made upon the recently collected rhodolite for comparison with Pratt's results. An average of two determinations gave 16.06% FeO, which is only 0.51% higher than the value previously given. With such close agreement, it is evident that this garnet is the same as that described by Hidden and Pratt.

The index of refraction was determined to be 1.758 and the index given by Larsen for the originally described rhodolite is 1.76.

GEDRITE. Gedrite is the most interesting mineral in this aggregate. It occurs in coarse prismatic crystals some of which measure 15 mm. long and 5 mm. wide. It is almost transparent and has a bright clove brown color.

The following analysis and optical study was made upon a pure

⁵ *Op. cit.*

sample prepared by handpicking. The indices of refraction are: $\alpha = 1.642$, $\beta = 1.655$, $\gamma = 1.661$, all $\pm .003$, birefringence .019, optical character (-), axial angle, large. The molecular ratio for SiO_2 exactly equals the total ratios for the RO constituents, such close

TABLE II
GEDRITE FROM MASON'S MOUNTAIN
E. P. Henderson, Analyst

Analysis		Ratios	
SiO_2	44.22	.7333	.7333
Al_2O_3	23.79	.2328	.2328
FeO	9.21	.1282	.7334
CaO	0.62	.0110	
MgO	20.69	.5131	
MnO	0.16	.0023	
H_2O	1.42	.0788	
Fe_2O_3	0.20		
	100.31		
Sp. Gr. 3.178			

agreement being unusual in gedrites. Most of the analyses of this mineral give ratios which differ considerably from the normal 1:1 ratios for these constituents. The Al_2O_3 content is higher than that reported in any of the described gedrites and is molecularly almost one third that of either SiO_2 or RO.

The above analysis can be expressed in the following manner:

	Per cent
FeSiO_3	16.94
MgSiO_3	51.63
CaSiO_3	1.28
H_2SiO_3	6.18
MnSiO_3	0.29
Al_2O_3	23.79
Fe_2O_3	0.20
Total	100.31

When the molecular ratios of the gedrite from Mason Mountain are compared with the ratios of the rhodolite (see Table III), it was found that they are very similar.

TABLE III

Rhodolite, Mason's Branch, North Carolina		Gedrite, Mason Mountain, North Carolina	
	Ratios		Ratios
SiO ₂	.689=2.90		.7333=3.14
R ₂ O ₃	.237=1.		.232 =1.
RO	.659=2.78		.7334=3.14

From the above table it can be seen that the ratios in gedrite are essentially 3:1:3, yielding the type formula of the garnets. In fact the ratios come as near having the garnet formula as those of the rhodolite. However, in the gedrite there are certain minor elements grouped under RO, such as water and alkalis, which are not found in the garnets. The rhodolite molecularly contains approximately one third as much of the iron garnet as it does of the magnesium garnet. The gedrite also contains about one third as much of FeSiO₃ as it does of MgSiO₃. It is unusual to find two of the essential constituents of a rock having such close similarity in their molecular proportions.

Evans⁶ described a gedrite from Haliburton County, Ontario, which occurs with a garnet but he makes no reference to the composition of the garnet.

HYPERSTHENE. This mineral has a greenish-gray color and occurs in small masses the larger ones scarcely exceeding two centimeters in maximum direction. Frequently there are small inclusions of biotite in the hypersthene.

The following analysis and indices of refraction were determined upon a carefully selected sample.

$$\alpha = 1.685, \beta = 1.696, \gamma = 1.699, \text{ all } \pm .003;$$

birefringence .014, optical character (-). These ratios conform to the general hypersthene formula although the discrepancy between the RO and SiO₂ ratios is slightly greater than it should be. No attempt was made to place the Al₂O₃ in the formula. However, if it is added to the SiO₂ the ratio between the SiO₂+Al₂O₃:RO be-

⁶ *Amer. Jour. Sci.*, vol. 25, 1908, p. 511. This analysis was found, by calculation, to be considerably different from the normal ratios of a gedrite and no indices of refraction were given so it could not be compared with the North Carolina material.

comes .9103:9040, and this is nearer to the normal 1:1 ratio for these elements. The molecular proportion between FeO and MgO is 1:2.73.

TABLE IV
HYPERSTHENE FROM MASON'S MOUNTAIN
E. P. Henderson, Analyst

Analysis		Ratios
SiO ₂	52.36	.8683 = .8683
Al ₂ O ₃	4.29	.0420 = .0420
FeO	16.90	.2352
CaO	0.44	.0078
MgO	25.89	.6421
H ₂ O	0.34	.0189
	100.22	

BIOTITE. The black mica is considered to be a biotite; it may, however, be a phlogopite. Nothing particularly unusual was noted about it and since the purpose of this paper is to discuss the relationship of gedrite and rhodolite, a complete chemical study of the mica was not undertaken.

This mica occurs in coarse irregular plates some of which measure two and one half centimeters on a cleavage face. The color is very dark brown to black when seen in the matrix but thin cleavage sheets are amber-brown. The FeO content is 5.78% and the Fe₂O₃ content is 0.72%. The indices of refraction are: $\alpha = 1.565$, $\beta + \gamma = 1.607$, all $\pm .003$, optical character (-), 2E is 15°.