GARNETS FROM VESICLES IN RHYOLITE NEAR ELY, NEVADA

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The occurrence of garnet in rhyolite near Ely, Nevada, has been described by Spencer[1] and by Melhase.[2] The youngest igneous rock in the Ely district is a tertiary (probably pliocene) rhyolite. In the area north of Lane Valley, marked "garnet fields" on the map of the Ely quadrangle, the rock is "characterized by more or less globular vesicles" lined with a continuous coating of white glassy quartz. Garnet crystals from a few millimeters to over 10 millimeters in diameter are implanted on this coating or partly intergrown with the quartz. No other minerals were found in the vesicles. The garnet crystals are deep red, very shiny, and perfectly clear. They show the trapezohedron (211) with occasional faces of the dodecahedron.

Through the courtesy of Mr. John Melhase of Berkeley the writer obtained specimens showing the garnets in vesicles in rhyolite. A grant for the chemical analysis from the Board of Research of the University of California is gratefully acknowledged.

After a preliminary spectroscopic examination by Dr. T. G. Kennard of Claremont, California, which showed no chromium and only a minute trace, probably 0.00x% of titanium, the garnet was analyzed by W. H. Herdsman with the results given below.

TABLE 1. ANALYSIS OF GARNET FROM RHYOLITE NEAR ELY, NEVADA

		molecular quotients	
SiO_2	36.28	.6041	6041
Al_2O_3	21.27	.2087	2103
Fe_2O_3	0.24	.0015	
FeO	29.46	.4101	5917
MnO	11.96	.1686	
MgO	0.14	.0035	
CaO	0.53	.0095	
$H_2O-105°C$	nil		
$H_2O+105°C$	nil		
	99.88		

$RO : R_2O_3 : SiO_2$

2.82 : 1 : 2.87

The departure of the molecular ratio from the ideal garnet formula, $3RO \cdot R_2O_3 \cdot 3SiO_2$, is similar to the discrepancies that have been found

[1] Spencer, A. C., *U. S. Geol. Survey, Professional Paper* **96**, p. 42, 1917.

[2] Melhase, John, *The Oregon Mineralogist*, vol. **2**, no. 11, p. 6, 1934.

in many garnet analyses. Fleischer[3] has recently pointed out that this sort of a departure might be due to the presence of titanium in the garnet or to the misdetermination of FeO as Fe_2O_3. This will not explain the difference in the present case. Assuming 96 oxygens in the unit cell, one may calculate that there are on the average 23.37 R″, 16.60R‴, and 23.86 Si in a unit cell of this Ely garnet. If, as has been suggested, Al is placed partly in R″ and in Si positions then the discrepancy may be greatly reduced.

The specific gravity of the garnet was determined on selected fragments by pycnometer, giving the value 4.26.

The lattice constant, as determined from a powder pattern corrected with halite, using a casette of 8 inch radius and Mo radiation screened with zirconium oxide, is 11.531 ± 0.010Å.

The refractive indices were determined on several cut and polished prisms by the minimum deviation method, using a small Leitz monochromator.

N_{Li}	N_{Na}	N_{Tl}
1.820	1.824	1.828
$N_{Na} - N_{Li} = 0.004$		$N_{Tl} - N_{Na} = 0.004$

Fleischer[4] has recently discussed the relations of composition and properties in the garnet group and from the properties of the end members as given by him one may calculate the properties of a complex garnet. The second column of Table 2 gives the results of such a calculation.

TABLE 2. CALCULATED AND OBSERVED PROPERTIES OF GARNET FROM RHYOLITE NEAR ELY, NEVADA

	Observed	Calculated	Difference
Specific gravity	4.26	4.27	0.01
Lattice constant	11.531Å	11.529Å	0.002Å
N_{Na}	1.824	1.822	0.002

The observed values of all properties agree within the limits of error with the calculated values. Nevertheless an accurate determination of the composition cannot be made from the properties of garnets of this type. The discrepancy of only 0.002 in the index determination, for instance, corresponds to a difference in the proportion of the spessartite molecule of about 7%.

The only other analysis of garnet in lithophysae in rhyolite known to the writer is one of material from near Nathrop, Colorado, published by

[3] Fleischer, M., The relation between composition and physical properties in the garnet group: *Am. Mineral.*, vol. **22**, pp. 751–759, 1937.

[4] *Op. cit.*

Cross.[5] This garnet is similar in color, habit and size to that found near Ely. It is even richer in manganese and is associated with sanidine, quartz and topaz in the lithophysae, whereas the vesicles in the Ely rhyolite carry only quartz and garnet.

Garnets rich in the spessartite molecule or belonging to the almandite-spessartite series are characteristic of granite pegmatites. A pegmatite garnet closely similar to the Ely garnet in composition has been recorded by Shannon[6] near Avon, Latah County, Idaho.

Table 3 shows the comparison of the composition of the Ely garnet with those just mentioned.

TABLE 3. COMPOSITION OF GARNETS FROM RHYOLITE VESICLES AND FROM GRANITE PEGMATITE

Garnet	Pegmatite Avon, Idaho	Rhyolite Ely, Nevada	Rhyolite Nathrop, Colorado
Almandite	63.0	69.3	31.3
Spessartite	32.8	28.5	65.4
Pyrope	4.2	.6	—
Grossularite	—	.8	2.3
Andradite	—	.8	1.0

[5] Cross, W., On the occurrence of topaz and garnet in lithophyses of rhyolite: *Am. Jour. Sci.*, 3rd series, vol. **31**, pp. 432–438, 1886.

[6] Shannon, E. V., Note on garnet from a pegmatite in Idaho, *Am. Mineral.*, vol. **7**, pp. 171–173, 1922.