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GROSSULARITE-SPESSARTITE GARNET FROM THE VICTORY MINE, GABBS, NEVADA[1]

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ABSTRACT

Analyses and physical properties are given for three garnets from the Victory mine, Gabbs, Nevada. Each of these garnets contains high molecular per cents of both grossularite and spessartite. The most unusual of the three has the following molecular per cent composition: grossularite, 41.4; spessartite, 42.8; almandine, 12.4; and andradite, 3.4. Grossularite-spessartite garnets are rare in the literature and do not appear to be typical of any special rock type.

INTRODUCTION

The geology of the Victory mine has been described by Humphrey and Wyatt (1958), and the reader is referred to their discussion for a detailed account of the rock types exposed in the mine area. Briefly, the garnets there are found in the sheared and feldspathized portion of a granodiorite stock, where they were formed at high temperatures along with such minerals as scheelite, fluorite, diopside and phlogopite. The present paper presents the analyses of three separate specific gravity fractions of this garnet, together with the physical properties determined on the material analyzed. These specific gravity fractions were selected to show the range in the composition of the garnet from this area. As described below (under Garnet Analyses) two of the samples analyzed are from the workings of the Victory mine, and the third is from an aplite shear zone about 400 feet northeast of the mine.

The only materials available for the present study were two heavy concentrates, each containing about 40 per cent of minerals other than garnet, mostly scheelite. These concentrates represented an uncontrolled sampling of the mine workings and of the aplite shear zone, but in spite of this, the garnet in the concentrates was thought worthy of study because the combination of physical properties exhibited by it suggested an unusual composition.

GARNET ANALYSES

Final purification of the materials analyzed was accomplished by grinding to a particle size of about 0.02 mm. and centrifuging in Clerici solution. Specific gravity values were determined in Clerici solution at room temperature by means of the suspension method, and indices of refraction listed were measured in sodium light by means of the immersion method.

Only a few grains of garnet from the Victory mine concentrate have a

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specific gravity outside the range 3.80–3.95. The distribution of specific gravity values within these limits is fairly uniform, and the color of the clean garnet, a dark peach-tan in grains of 200-mesh size, does not vary perceptibly from lighter to heavier material. Two fractions of garnet from the mine concentrate were selected for analysis, and for convenience of reference, these will be called garnet "A" and garnet "B" (Table 1).

The aplite shear zone concentrate was collected from the hanging wall of the shear about 100 feet north of Survey station F, or at coordinates 7450 N., 4870 E. (Humphrey and Wyatt, 1958, map p. 41). Almost all the garnet from this concentrate has a specific gravity within the range 3.76–3.84. The color of this garnet is the same as that described for garnets "A" and "B" from the mine concentrate. A pure fraction of garnet from the aplite shear zone concentrate was prepared for analysis, and this mineral will be referred to here as garnet "C" (Table 1).

Table 1 lists the analysis for each of garnets "A," "B," and "C," the amounts submitted for analysis and measured and calculated values for index of refraction, specific gravity and unit cell size. Average values measured for index of refraction are in good agreement with calculated values, whether calculated values are based on the data of Ford (1915) or on the data of Skinner (1956). Average values measured for specific gravity are in good agreement with values calculated according to the data of Fleischer (1937); they are somewhat lower than values calculated according to the data of Skinner.

Measured values for unit cell edges, however, are in poor agreement with both sets of calculated values, and the writer is unable to explain the large discrepancies. The measured values were determined from films, using FeKα radiation. The forward reflection lines are sharp, indicating well-ordered crystals; in the back-reflection region the lines for α_1, and α_2 are fuzzy and poorly defined, and more precise measurements were not possible.

As indicated in Table 1, two separate phases are present in garnet "A." Lines listed for the two phases of different cell size are similar in intensity. There appears to be only one phase present in garnet "B" and in garnet "C," although in each case it is possible that a weak α_1 line falls between the α_1 and α_2 lines of the principal phase and that this fact causes the lack of resolution in the back-reflection region.

Analyses Compared

In order to point up the unusual composition of these garnets from Gabbs, analyses of four grossularite-spessartite garnets from the literature which most nearly resemble them are listed in Table 2. Garnet I of

TABLE 1. ANALYSES AND PHYSICAL PROPERTIES OF GARNETS FROM GABBS, NEVADA

		Garnet "A"	Garnet "B"	Garnet "C"
Weight of material analyzed		1.25 gm	1.29 gm	1.09 gm
	SiO_2	36.52	36.22	36.84
	TiO_2	.18	.28	traces
	Al_2O_3	20.74	21.96	19.78
	Fe_2O_3	1.07	.64	2.44
	FeO	5.72	4.58	5.49
	MgO	traces	traces	traces
	MnO	19.66	15.63	12.02
	CaO	16.25	20.43	23.68
	Total	100.14	99.74	100.25
	Si	2.92 } 2.94	2.87 } 2.96	2.92 } 2.92
	Al	1.95 { .02 } 2.94; { 1.93 } 2.00	2.05 { .09 } 2.96; { 1.96 } 2.00	1.85 } 1.99
	Fe^{+++}	.07	.04	.14
	Ti	.01	.02	—
	Fe^{++}	.39	.30	.36
	Mg	— } 3.13	— } 3.10	— } 3.17
	Mn	1.33	1.05	.80
	Ca	1.40	1.73	2.01
n	Measured	1.777–1.783 (AVE=1.780)	1.771–1.775 (AVE=1.773)	1.770–1.776 (AVE=1.773)
n	Calc. (Ford)[1]	1.780	1.770	1.774
n	Calc. (Skinner)[2]	1.779	1.769	1.773
G	Measured	3.89–3.95 (AVE=3.92)	3.80–3.86 (AVE=3.83)	3.78–3.82 (AVE=3.80)
G	Calc. (Fleischer)[3]	3.92	3.84	3.81
G	Calc. (Skinner)	3.95	3.87	3.85
a (in Å)	Measured	11.756±.005; 11.725±.005	11.762±.005	11.788±.005
a (in Å)	Calc. (Fleischer)	11.721	11.748	11.776
a (in Å)	Calc. (Skinner)	11.719	11.744	11.770
Molecular percent composition[4]	An	3.4 } 100.0	1.9 } 100.1	7.2 } 100.0
Molecular percent composition[4]	Gr	41.4	54.3	56.1
Molecular percent composition[4]	Sp	42.8	34.0	25.3
Molecular percent composition[4]	Al	12.4	9.9	11.4

[1] Calculated according to data of Ford (1915).
[2] Calculated according to data of Skinner (1956).
[3] Calculated according to data of Fleischer (1937).
[4] An—andradite, Gr—grossularite, Sp—spessartite and Al—almandine.
Analyst: W. H. Herdsman, Glasgow, Scotland.

TABLE 2. PREVIOUS ANALYSES OF GROSSULARITE-SPESSARTITE GARNETS

		I	II	III	IV
Weight per cent	SiO_2	38.08	36.59	39.05	37.57
	Al_2O_3	18.30	19.63	19.92	18.98
	Fe_2O_3	3.13	0.60	2.07	3.47
	FeO	15.02	11.77	6.01	7.45
	MgO	0.63	1.20	1.23	0.23
	MnO	15.61	19.18	21.69	16.50
	CaO	10.00	8.82	11.26	15.80
	Total	100.77	97.79	101.23	100.00
Molecular per cent composition[2]	n[1]	N.D.	1.783	N.D.	N.D.
	G	N.D.	N.D.	4.10	N.D.
	An	12.3	5.3	5.9	10.7
	Gr	16.8	20.6	26.3	34.5
	Sp	35.8	44.5	49.2	37.4
	Al	32.6	24.7	13.7	16.4
	Py	2.5	4.9	4.9	1.0

[1] N.D. = No data.

[2] Molecular per cents as calculated by Trögger (1959).

Numbers I, II, III and IV of this table are numbers 321, 374, 373, and 378, respectively, of Trögger's Table 9.

I Buttgenbach, 1922, p. B 253, anal. b., W. Melon, analyst.
II Ross, 1935, p. 63–64, anal. 3., J.G. Fairchild, analyst.
III Fermor, 1934, p. 340, anal. 6., S.N. Godbole, analyst.
IV Fermor, 1934, p. 340, anal. 8., S.N. Godbole, analyst.

Table 2 is from a hornfels, II is from a pyrite vein deposit, III is from a gondite (garnet-quartz rock) and IV is from a kodurite (potash feldspar-garnet-apatite rock). Thus the very few analyses of grossularite-spessartite garnets in the literature are not typical of any special rock type. Trögger (1959), in a comprehensive study, divides 480 of the most reliable garnet analyses available into 28 paragenetic groups. Garnet I of Table 2 falls in Trögger's (1959, p. 18) group XX, which is made up mainly of spessartite-containing garnets from mica schists. Garnets II, III and IV of Table 2 are included in Trögger's (1959, p. 21) group XXVII, which is composed mainly of garnets from gondites and similar calc-silicate rocks. Further careful work is needed before we can assign any special significance to garnets that have predominantly the spessartite and grossularite compositions, especially in view of the unexplained differences between observed and calculated values for the unit cell edge of the Gabbs garnets described here.

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