RHODESITE FROM TRINITY COUNTY, CALIFORNIA[1]

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ABSTRACT

Rhodesite occurs as aggregates of radiating white, silky fibers associated with magadiite and trioctahedral montmorillonite in an altered silicic lava. Indices of refraction are $\alpha = 1.501 \pm 0.001$ and $\gamma = 1.513 \pm 0.001$. A least-squares refinement of X-ray diffractometer powder data resulted in orthorhombic cell dimensions of $a = 23.636 \pm 0.004$ Å, $b = 6.549 \pm 0.001$ Å, $c = 7.037 \pm 0.001$ Å, and $V = 1089.3 \pm 0.3$ Å^3. Chemical analysis yielded the formula: $Ca_{4.23}Mg_{0.27}Na_{0.60}K_{1.95}Si_{17.11}O_{40} \cdot 10.94$ H_2O.

Rhodesite, a hydrous silicate of alkaline earths and alkalis, was described by Mountain (1957) as a new mineral from Kimberley, South Africa. Little is known about the geologic setting of the Kimberley rhodesite except that it was collected at the Bultfontein diamond mine. Except for the locality described herein, no additional occurrences have been reported (E. D. Mountain, 1967, written commun.).

Rhodesite was discovered by the writers during an examination of a magadiite ($NaSi_7O_{13}(OH)_3 \cdot 3H_2O$) deposit (Eugster *et al.*, 1967), located in Trinity County, California, about 35 miles northwest of Redding, California. More precisely, the deposit is about $\frac{1}{4}$ mile east of the East Fork of the Trinity River in SE1/4SE1/4 Sec. 30, T. 37 N., R. 6 W., in the Bonanza King 15-minute quadrangle. The magadiite deposit is localized in altered silicic lavas that may be correlated with the Balaklala Rhyolite of Devonian age. Preliminary study suggests that the magadiite deposit formed relatively recently at or near the surface.

The rhodesite occurs as: (1) irregular segregations (Fig. 1) in the massive finely crystalline magadiite, (2) crusts and flattened rosettes (Fig. 2) on surfaces of angular fragments of the silicic volcanic rock in the magadiite, and (3) fracture-fillings in the angular fragments. Trioctahedral montmorillonite commonly accompanies rhodesite in the crusts and fracture-fillings. The rhodesite seems to have formed later than either magadiite or montmorillonite but apparently has not replaced either mineral.

Rhodesite characteristically occurs as aggregates of radiating white, silky fibers that commonly are 0.1–0.2 mm long but are as much as 0.6 mm long. The fibers have a length to width ratio of about 100. Flattened rosettes (Fig. 2) are 0.5–2.0 mm in diameter. The fibers show parallel extinction and are length slow. Indices of refraction are $\alpha = 1.501 \pm 0.001$ and $\gamma = 1.513 \pm 0.001$.

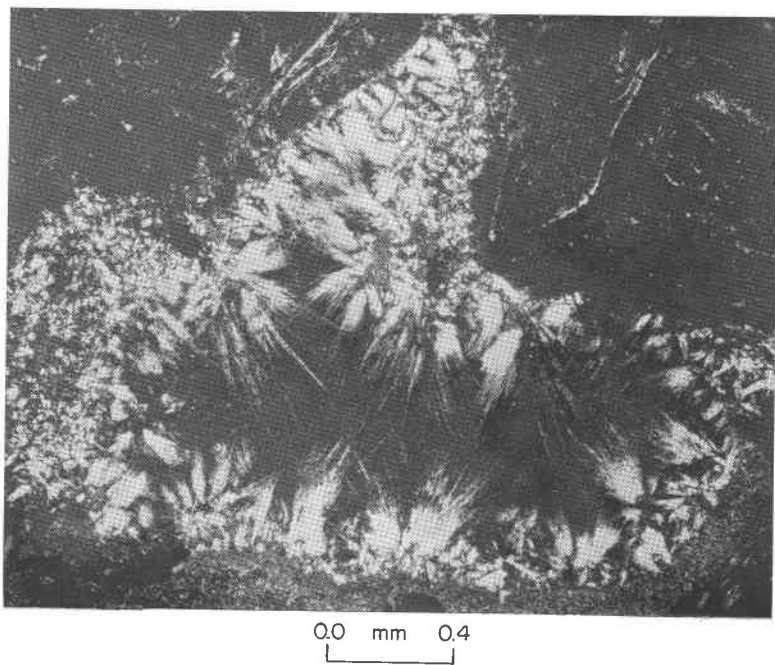[1] Publication authorized by the Director, U.S. Geological Survey.

0.0   mm   0.4

Fig. 1. Photomicrograph of fibrous rhodesite that lines an irregular cavity in finely crystalline magadiite. Crossed polars.

X-ray diffractometer powder data and unit-cell dimensions for the Trinity Country and Kimberley rhodesites are given in Table 1. The powder data were indexed by computer using the orthorhombic cell constants of Gard and Taylor (1957, p. 617) as initial parameters. Cell dimensions were obtained by a least-squares refinement utilizing the U. S. Geological Survey's FORTRAN IV Program W9214. The a and b dimensions of the Trinity County rhodesite are smaller than those of the Kimberley material; however, the c dimension is larger. The cell volume of the Trinity County sample is slightly smaller than that of the Kimberley sample. A consideration of the systematic extinctions and the observed reflections for the powder data suggests that the space group of rhodesite is $Pmn2_1$ (or $Pmmn$). Gard and Taylor (1957, p. 617) showed an observed reflection at 7.1 Å for the Kimberley rhodesite. This reflection is indexed as (001) and violates the symmetry conditions for the proposed space group; however, we have not observed a reflection in this position for rhodesite from either locality.

A chemical analysis and semiquantitative spectrographic analysis of the Trinity County rhodesite are given in Table 2, along with an average

0.0   mm   2.0

FIG. 2. Photograph of hand sample showing flattened rosettes of white,
silky rhodesite on silicic volcanic rock.

of three chemical analyses of the Kimberley material reported by Mountain (1957) and Gard and Taylor (1957). This new analysis was made on 1.5 grams of material that had been hand picked from crusts and then scrubbed in an ultrasonic bath. The composition of the Trinity County rhodesite is similar to that of the Kimberley material although there are some obvious differences. Contents of SiO_2 and MgO are higher but Na_2O is lower for the Trinity County rhodesite. Total H_2O, however, is remarkably similar for rhodesite from both localities.

The calculated formula for the Trinity County rhodesite based on 40 oxygens is $Ca_{4.23}Mg_{0.27}Na_{0.60}K_{1.95}Si_{17.11}O_{40} \cdot 10.94$ H_2O. Minor contents of Al_2O_3 and Fe_2O_3 were neglected in calculation of the formula.

TABLE 1. X-RAY DIFFRACTION DATA FOR RHODESITE

Trinity County, Calif.				Kimberley, South Africa			
hkl	d (calc.) (Å)	d (obs.) (Å)	I	hkl	d (calc.) (Å)	d (obs.) (Å)	I
200	11.82	11.78	18	200	11.90	11.84	71
101	6.744	6.727	10	101	6.721	6.696	8
010	6.549	6.548	100	010	6.587	6.573	100
110	6.311	6.302	32	110	6.348	6.334	42
400	5.909	5.901	34	400	5.948	5.937	77
210	5.728	5.734	6	210	5.762	5.749	8
301	5.248	5.245	5	301	5.251	5.251	7
310	5.036	5.032	28	310	5.067	5.058	29
011	4.794	4.789	12	011	4.799	4.794	9
111	4.698			111	4.704		
211	4.443			211	4.451		
410	4.387	4.386	47	410	4.414	4.412	48
311	4.096	4.096	10	311	4.106	4.109	9
600	3.939	3.941	4	600	3.965	3.962	12
501	3.924	3.929	4	501	3.936	3.936	5
510	3.833	3.834	8	510	3.857	3.855	7
411	3.723	3.722	5	411	3.735	3.738	4
002	3.518	3.517	3	002	3.503		
610, 202	3.376	3.376	20	610	3.399	3.398	22
511	3.366			511	3.379		
				202	3.360		
020	3.275	3.274	7	020	3.294	3.295	8
120	3.244	3.242	16	120	3.262	3.264	19
220	3.156			220	3.174		
012	3.100			012	3.093		
112	3.073	3.071	19	112	3.067	3.066	11
701	3.044			701	3.058		
611	3.044			611	3.057		
320, 402	3.023	3.023	22	320	3.042	3.042	23
710	3.001	3.002	21	710, 402	3.020	3.022	39
212	2.998			212	2.994		
021	2.969			021	2.981		
800	2.954	2.955	15	800	2.974	2.975	23
121	2.946	2.947	12	121	2.958	2.960	14
312	2.884	2.887	16	221	2.891		
221	2.879			312, 420	2.882	2.883	38
420	2.864	2.864	25				
321	2.7782	2.7784	6	321	2.7901	2.7910	9
711	2.7606	2.7617	23	711	2.7736	2.7759	29
412	2.7448	2.7444	12	412	2.7441	2.7493	15
810, 520	2.6918	2.6922	4	810	2.7104		
				520	2.7081		
421	2.6529			421	2.6647	2.6642	4
602	2.6242	2.6240	4	602	2.6253	2.6270	5
512	2.5920			512	2.5933		
620	2.5182	2.5176	5	620	2.5335		
811, 521	2.5142	2.5135	6	811, 521	2.5278	2.5286	10
901	2.4605	2.4609	3	901	2.4732	2.4747	3
910	2.4375			910	2.4532		
612	2.4359	2.4338	3	612	2.4388	2.4441	4
022	2.3971			022	2.3996		
122	2.3849	2.3858	2	122	2.3875		
621	2.3710			621	2.3825		
10.0.0	2.3636			10.0.0	2.3790		
720	2.3507	2.3510	2	720	2.3562		

Diffractometer: nickel-filtered CuKα_1 radiation, tube at 35 KV and 20 ma, 1° divergence slit, 0.01 inch receiving slit, scanning speed of 1/2° 2θ per minute, fluorite internal standard.

TABLE 1. (Continued)

Trinity County, Calif.	Kimberley, South Africa
a (Å) = 23.636 ± 0.004	a (Å) = 23.79 ± 0.01
b (Å) = 6.549 ± 0.001	b (Å) = 6.587 ± 0.002
c (Å) = 7.037 ± 0.001	c (Å) = 7.006 ± 0.005
(Å³) = $1,089.3 \pm 0.3$	(A³) = $1,098.0 \pm 0.7$

TABLE 2. CHEMICAL ANALYSES AND SEMIQUANTITATIVE
SPECTROGRAPHIC ANALYSIS OF RHODESITE

	1	2		3
SiO_2	61.75	64.30	B	300
Al_2O_3	.19	.12	Ba	7
Fe_2O_3	—	.07	Cr	5
FeO	.17	—	Cu	5
MgO	.05	.69	Mn	70
CaO	14.97	14.83	Ni	3
Na_2O	5.01	1.16	Sr	20
K_2O	5.52	5.75	Ti	15
H_2O+		7.72		
	12.43			
H_2O-		4.60		
TiO_2	—	.00		
Total	100.09	99.24		

1. Average of three analyses of Kimberley rhodesite reported by Mountain (1957, p. 609) and Gard and Taylor (1957, p. 619).

2. Trinity County, Calif. Serial No. D 102028; analyst: Vertie C. Smith. Al_2O_3 content includes P_2O_5, and total iron is reported as Fe_2O_3.

3. Semiquantitative 6-step spectrographic analysis of Trinity County rhodesite; analyst: Nancy Conklin. Results are reported in parts per million and are to be identified with geometric brackets whose boundaries are 1.2, 0.83, 0.56, 0.38, 0.26, 0.18, 0.12, and so forth, but are reported arbitrarily as midpoints of these brackets, 1.0, 0.7, 0.5, 0.3, 0.2, 0.15, 0.10, and so forth. The precision of a reported value is approximately plus or minus one bracket at 68%, or two brackets at 95% confidence.

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