technique is as accurate a method of feldspar K_2O determination as is the conventional flame photometer technique.

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THE UNIT CELL OF CARMINITE

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The mineral carminite was described by Sandberger (1958) from Horhausen, Rhine Province, Germany. On the basis of an approximate chemical analysis he gave the composition as $Pb_3Fe_{10}(AsO_4)_{12}$, and the specific gravity as 4.10. Foshag (1937) reported the composition of carminite as approximating $PbFe_2(AsO_4)_2(OH)_2$ for carminite from Mapimi, Durango, Mexico and from an unstated locality in Colorado, but makes no mention of the specific gravity of his material. Le Mesurier (1939) described carminite from the Ashburton District, Western Australia which agreed in composition with Foshag's formula, and for which he reported a specific gravity of 5.22. The original papers of Sandberger and Le Mesurier were not available to the authors, the reported specific gravities having been noted in Dana's System of Mineralogy (1951), page 912.

Samples of carminite from Mapimi, Durango were examined for their suitability for specific gravity determination. These samples consisted of aggregates of minute (<0.5 mm. long) lath-shaped crystals very similar to those described by Foshag. Clusters of carminite crystals were used

TABLE 1. UNIT CELL DATA FOR CARMINITE

$a_0=12.25\pm0.04$ Å	space group: *Amaa* or *A2aa*
$b_0=16.52\pm0.04$ Å	cell volume: 1528 Å^3
$c_0=7.64\pm0.04$ Å	cell formula: $Pb_8Fe_{16}(AsO_4)_{16}(OH)_{16}$
$a_0:b_0:c_0=0.741:1:0.456$	cell weight: 5046

TABLE 2. *X*-RAY POWDER DATA FOR CARMINITE

Obtained with FeK_α radiation in a 114.6 mm. diameter camera

d_{obs} Å	I_{obs}	d_{calc} Å	*hkl*	d_{obs} Å	I_{obs}	d_{calc} Å	*hkl*
6.73	1	6.87	011	1.888	2	1.888	004
6.05	1	6.13	200	1.834	1	1.833	433
5.94	4	5.99	111	1.816	<1	1.815	471
4.88	1	4.92	220	1.799	8	1.804	204
4.54	6	4.58	211			1.800	462
4.41	2	4.45	031			1.797	353
4.16	3	4.18	131			1.796	602
4.10	3	4.13	040	1.768	1	1.765	191
3.57	<1	3.599	231	1.743	<1		
3.50	7	3.509	311	1.719	6		
3.29	<1	3.304	122	1.694	1		
3.20	10	3.212	202	1.678	4		
3.05	5	3.062	400	1.649	2		
3.01	5	3.027	051	1.636	3		
		3.008	331	1.610	3		
2.929	8	2.939	151	1.598	1		
2.784	5	2.797	411	1.553	1		
2.705	7	2.714	251	1.543	1		
2.622	1	2.627	322	1.532	2		
2.580	9	2.595	242	1.517	4		
2.510	2	2.511	260	1.488	<1		
2.481	1	2.488	013	1.477	<1		
2.456	4	2.460	440	1.465	1		
2.429	4	2.432	351	1.446	3		
2.307	2	2.308	511	1.434	2		
2.283	3	2.285	422	1.396	<1		
2.229	<1	2.225	062	1.378	<1		
2.190	1	2.188	162	1.369	2		
2.154	7	2.153	451	1.361	5		
2.067	3	2.066	271	1.346	2		
		2.065	080	1.338	1		
2.000	2	2.002	053	1.321	1		
1.978	3	1.976	153	1.307	2		
		1.972	371	1.287	2		
1.954	2	1.956	611	1.273	1		
		1.953	362	1.258	1		
1.907	5	1.905	551	1.244	1		
		1.903	253	1.236	1		

for a rough specific gravity determination with the Berman balance. Since these clusters were very porous and the heaviest of them weighed less than ten milligrams, no great degree of accuracy could be expected. The measured specific gravity ranged from 5.03 to 5.18. Although this

is not in very good agreement with Le Mesurier's data, it clearly indicates that a specific gravity of 4.10 is too low.

Single crystal x-ray diffraction patterns of carminite were obtained by both the precession and Weissenberg methods using CuK_α radiation. The levels $h0l$, $h1l$, $0kl$, and $1kl$ were recorded by the precession method, and $hk0$, $hk1$, and $hk2$ by the Weissenberg method. The crystallographic axes were assigned according to the convention $b>a>c$, yielding axes which corresponded in orientation and ratio to those reported by Foshag on the basis of the morphology. Systematic extinctions indicate that the space group is either $Amaa$ or $A2aa$ (C_{2v}^{13} or D_{2h}^{20}). $Amaa$ is the more likely, since no piezoelectric effect could be detected by the Geibe-Schiebe method and the morphology is holohedral. The unit cell data is given in Table 1. Powder diffraction data, using FeK_α radiation, is given in Table 2. All intensities were estimated visually.

On the basis of the unit cell data obtained and the composition $PbFe_2(AsO_4)_2(OH)_2$, the number of formula weights per cell were calculated using both reported values of the specific gravity. For specific gravity 4.10, $Z=5.99$, and for specific gravity 5.22, $Z=7.64$. Examination of the two possible space groups shows that crystallographically equivalent atoms must lie in four-, eight-, or sixteen-fold positions. These positions provide no arrangement which would accommodate six lead atoms per unit cell. On the basis of the space group, it seems reasonable to assume that eight formula weights per cell is the correct figure. The calculated specific gravity for $Z=8$ is 5.46, a 4.5% deviation from Le Mesurier's value and a 5% deviation from the maximum value obtained for the Mapimi material.

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SUBSTITUTION OF Fe^{3+} FOR Al^{3+} IN SYNTHETIC SPESSARTITE

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With a view toward producing garnets with magnetic ions in only the dodecahedral and octahedral sites (see Refs. 1 and 2), we have attempted