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MINERALOGICAL NOTES

CRYSTALLOGRAPHY OF FAHEYITE, SAPUCAIA PEGMATITE MINE, MINAS GERAIS, BRAZIL[1]

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Faheyite, (Mn, Mg, Na)$Be_2Fe_2(PO_4)_4 \cdot 6H_2O$, $Z=3$, a hexagonal mineral with $a=9.43$, $c=16.00$ Å, was originally described from matted radiating fibers from which no single crystal data were obtainable (Lindberg and Murata, 1953). Clusters of radiating needle-like fibers became available during the study of roscherite, $(Ca, Mn, Fe)_3Be_3(PO_4)_3(OH)_3 \cdot 2H_2O$, another beryllium phosphate from the same locality, the Sapucaia pegmatite mine, Minas Gerais, Brazil (Lindberg, 1958, Fig. 1). The symmetry relationships of faheyite have been reinvestigated after noting that the unit cell edge, *a*, faheyite (9.43 Å) is the same length as the unit cell edge, *a*, of a rare-earth apatite (9.43 Å), now under investigation.

X-ray crystallographic data derived by single-crystal Weissenberg and precession camera techniques show that faheyite belongs to the Laue symmetry group 6/*mmm*, whereas apatite belongs to 6/*m*; despite the similarities in *a*, the two minerals have different symmetry relations in projection on $hk\bar{i}0$. Possible crystal classes for faheyite include 622,

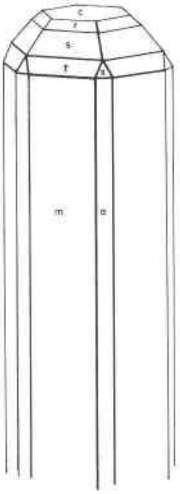

FIG. 1. Crystal habit of faheyite. Radiating clusters of needle-like crystals of faheyite grow on euhedral quartz crystals and in the interstices between intersecting books of muscovite; symbols of crystal faces from Table 1.

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

TABLE 1. CRYSTALLOGRAPHY OF FAHEYITE

Symmetry: Hexagonal
Laue-symmetry group: 6 *mm*
Preferred crystal class: 622

Preferred space group: No. 180, $P6_222$ or no. 181, $P6_422$
$a=9.43$ Å, $c=16.00$ Å
$a:c=1:1.697$ $p_o:r_o=1.959:1$

Forms[1]	Observed[2] frequency	Quality	φ				$\rho=C$				M	A_2
			Measured			Calculated	Measured			Calculated		
			Range		average		Range		average		Calc.	Calc.
c 001	2	Poor	~	~	~	~	0°35′	1°10′	0°53′	0°00′	90°00′	90°00′
m $10\bar{1}0$	45	Good	29°15′	30°45′	30°00′	30°00′[3]	88 50′	91 04	89 54	90 00	60 00	90 00
a $11\bar{2}0$	6	Good	−1 16	+1 24	0 18	0 00	88 38	92 15	90 45	90 00	60 00	60 00
r $10\bar{1}2$	3	Poor	28 55	31 10	30 12	30 00	42 16	44 04	43 20	44 24	69 31	90 00
s $20\bar{2}3$	10	Fair	28 35	31 03	29 45	30 00	51 18	52 45	52 08	52 32	66 37	90 00
t $10\bar{1}1$	2	Poor	29 20	30 56	30 08	30 00	61 28	63 12	62 20	62 58	63 33	90 00
x $11\bar{2}1$	2	Poor	−1 16	+1 48	0 16	0 00	78 08	75 14	74 41	73 35	90 00	33 50

[1] $a:c$, $p_o:r_o$, and φ, ρ, M, and A_2 angles calculated from unit cell constants.

[2] Observed frequency on 10 crystals; single crystals are very small, and optical signals observed during goniometric measurements are poor.

[3] Average measured φ=calculated φ for $10\bar{1}0$ since this form is used to determine 0°00′ position of the vertical circle.

$6mm$, $\bar{6}m2$ and $6/mmm$. The observed $00l$ reflections, $l=3n$ (on precession photographs) (no other extinction conditions) are characteristic of space groups no. 180, $P6_222$ and no. 181, $P6_422$ in crystal class 622.

As the a and c dimensions derived from the new single crystal studies ($a=9.42\pm0.02$, $c=15.98\pm0.03$ Å) agree within their ± error with the previously published values given above, the original values are retained as the unit cell dimensions for faheyite. The tentative indexing of the $00l$ reflections given in Table 2 (Lindberg and Murata, 1953), does not agree with the $00l$ reflections observed on precession photographs (Table 2,

TABLE 2. ADDITIONAL X-RAY DIFFRACTION DATA FOR FAHEYITE[1]

Symmetry: Hexagonal
New $00l$ reflections observed by precession camera techniques[3]

I	d meas. (Å)	Indices *hkl*	*hkil*	d calc.[2] (Å)	I	d meas. (Å)	Indices *hkl*	*hkil*	d calc.[2] (Å)
M	5.31	003	0003	5.33					
S	2.653	006	0006	2.657					
M	1.327	00.12	000.12	1.333					
W	0.888	00.18	000.18	0.889					
Previous indexing of $00l$ reflections[4]					Additional possible *hkl*				
$\frac{1}{2}$	8.00	002	0002	8.00			100	$10\bar{1}0$	8.17
$\frac{1}{2}$	4.02	004	0004	4.00			200	$20\bar{2}0$	4.09
$\frac{1}{2}$	3.173	005	0005	3.200					
Recalculation as beta reflections[5]					Corresponding Kα reflections[4]				
I	d calc. from meas. sin θ, λ KαFe=1.9373 Å		d calc. from meas. sin θ, λ KβFe=1.7568 Å						
$\frac{1}{2}$	8.00		7.25		9	7.28	101	$10\bar{1}1$	7.28
$\frac{1}{2}$	4.02		3.645		2	3.636	202	$20\bar{2}2$	3.638
$\frac{1}{2}$	3.173		2.877		2	2.877	212	$21\bar{3}2$	2.880

[1] Supplements Table 2, x-ray powder spacing data for faheyite (Lindberg and Murata, 1953).

[2] Calculated from $a=9.43$ Å, $c=16.00$ Å.

[3] Film measurements corrected for shrinkage; Mo/Zr radiation, MoKα=0.7107 Å.

[4] From Table 2 (Lindberg and Murata, 1953); $00l$ indices listed in that table as outside sphere of reflection when crystal was rotated about the c-axis, and hence reflection not observed on the rotation pattern.

[5] Intensities of reflections from pattern taken with Mn-filtered Fe radiation, Kα =1.9373 Å; these reflections, and others, are enhanced by using unfiltered white radiation, suggesting they are beta reflections.

this study). Although stronger single crystal patterns may show additional weak reflections, it appears unlikely that the 002 and 004 reflections are correctly indexed on the powder pattern, since they would never become stronger than the 003 reflection, present in the precession photograph, but not observed in the powder photograph. The intensity of the $00l$ reflections in the powder photograph may be weakened by preferred orientation of the fibers, parallel or at small angles to the spindle axis. The very weak 8.00 and 4.02 Å reflections on the stronger powder photograph may correspond to possible (110) and (200) reflections, missing on the weaker precession photographs, but the 3.173 Å reflection cannot be indexed as an FeKα reflection. All three reflections, as well as other reflections known to be beta reflections, are enhanced in white radiation; therefore, the d-spacings of the three reflections have been recalculated from the measured 2θ using λ, FeK$\beta = 1.7568$ (Table 2).

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LITHIAN HUREAULITE FROM THE BLACK HILLS

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In 1946 the writer published an abstract describing what was thought to be a new pegmatite "phosphate of lithium, with iron and manganese" which was given the name *bastinite.* On the basis of work with the Universal stage it was decided the mineral was triclinic. At this time the mineral had not been examined with x-rays. Weissenberg pictures taken late in 1947 indicated that the mineral was monoclinic and powder pictures (Table 1) taken a few months later confirmed that it was a variety of hureaulite. At this time I was too busy with other things to finish the study of this mineral, and unfortunately the name got preserved by Chudoba (in Hintze) and in Strunz's tables, although later communications to these gentlemen corrected the matter.

A few samples of hureaulite were discovered in 1825 by the ceramist Alluaud in the pegmatite quarry of Huréaux at St. Sylvestre, according to LaCroix (1962). After the original discovery no more samples were found here. LaCroix states that from 1849–52 samples now in museum collec-