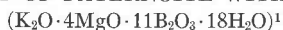


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THE IDENTITY OF PATERNOITE WITH KALIBORITE



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Paternoite was named and described by Millosevich (1920) as a new hydrous magnesium borate mineral ( $MgO \cdot 4B_2O_3 \cdot 4H_2O$ ) from Monte Sambuco, Calascibetta, Sicily. Although intensive studies of magnesium borates and other borates from Korea, Japan, eastern Siberia, Inder region of USSR, Argentina, Alaska and California have been conducted in recent years, no mineral with the composition suggested for paternoite has been reported from any other locality.

Doubts as to the validity of paternoite as a distinct mineral species with the formula assigned to it by Millosevich (1920) were raised by Schaller (1942) when he noted that the indices of refraction reported by Barth and Berman (1930) for "sicherlich authentisch" paternoite (HMM 89270) were identical, within the errors of measurement, to those of kaliborite,  $K_2O \cdot 4MgO \cdot 11B_2O_3 \cdot 18H_2O$ , originally described by Feit (1889), thirty-one years before Millosevich's paper. A subsequent test for potash on the Harvard specimen of paternoite (HMM 89270) indicated the presence of from 5 to 10 per cent  $K_2O$ , comparable to that reported in the literature for kaliborite; this convinced Schaller (1942) that "the supposed paternoite described by Barth and Berman is kaliborite."

<sup>1</sup> Publication authorized by the Director, U. S. Geological Survey.

In recent years a number of specimens labeled paternoite, all from the type locality in Sicily, were obtained from several mineral collections. The availability of these specimens for comparative study purposes revived interest in the paternoite-kaliborite problem. We are greatly indebted to the following individuals for the gift or loan of specimens of paternoite and kaliborite used in the present study: Prof. Ettore Onorato, University of Rome, Italy; Prof. Stefano Bonatti, University of Pisa, Italy; Prof. Clifford Frondel, Harvard University, Cambridge, Massachusetts; Dr. George Switzer, U. S. National Museum, Washington, D. C.; and Mr. John B. Jago, private mineral collector, San Francisco, California. We are very grateful to two colleagues at the U. S. Geological Survey, W. Wallace Brannock, for potassium determinations, and Harry J. Rose, Jr., for confirmatory spectrographic analyses.

All five specimens of paternoite used in the present study consisted of loose, fine-grained, white powder. The optical, chemical, and  $x$ -ray results obtained on these specimens are given in Table 1 and are compared therein to those of kaliborite from Leopoldshall, Germany, and from Sallent, Spain. The data in Table 1 clearly indicate that every specimen labeled paternoite is kaliborite.

Because Millosevich's  $x$ -ray film of type paternoite was destroyed during World War II (Onorato, written comm., 1958), it was impossible to make a direct comparison of it with that of kaliborite. An enlarged reproduction of the small printed  $x$ -ray pattern of paternoite (Millosevich, 1930) was made, but the enlarged reproduction was so poor that no definite conclusions could be reached. However, nothing was seen to indicate that Millosevich's published  $x$ -ray pattern of paternoite differed from that of kaliborite.  $X$ -ray powder diffraction data for paternoite from Monte Sambuco, Calascibetta, Sicily (JBJ 832.2) and kaliborite from Leopoldshall, Germany (USNM R5845), are tabulated for comparison in Table 2. The interplanar spacings for the two minerals are in excellent agreement and further support the suggestion that paternoite and kaliborite are the same compound.

After the results of our investigations on the various specimens of paternoite had been obtained, we learned that all of these, including that on which Millosevich (1920) made his determinations, had come out of the one jar of paternoite now in the University of Rome's mineral collection (UR 23218/1). While Schaller was in Rome, in September, 1960, Prof. Onorato showed him this jar, still with its original label in Millosevich's handwriting, out of which had been taken all the distributed specimens of paternoite. To satisfy himself of the identity of paternoite with kaliborite, Prof. Onorato independently made a flame photometer determination of the potash content of the material remain-

TABLE 1. DATA FOR SAMPLES LABELED PATERNOITE COMPARED TO KALIBORITE,  
 $K_2O \cdot 4MgO \cdot 11B_2O_3 \cdot 18H_2O$ 

Specimen identification <sup>1</sup>	Locality	K <sub>2</sub> O	X-ray identification	Indices of refraction
Paternoite: HMM 89270 (purchased from R. Palumbo, Rome)	Monte Sambuco, Calascibetta, Sicily	5-10	kaliborite (f. 17012)	$\alpha=1.509$ $\beta=1.528$ $\gamma=1.548$ (Barth and Berman, 1930)
Paternoite: UR 23218/1 (jar sample at Univ. of Rome)	<i>idem</i>	7.2	—	—
Paternoite: UR 23218/1 (from Prof. Onorato, Univ. of Rome)	<i>idem</i>	6.1	kaliborite (f. 13442)	all $n > 1.505$ and $< 1.552$
Paternoite: UP, unnumbered specimen (from Prof. Bonatti, Univ. of Pisa)	<i>idem</i>	6.3	kaliborite (f. 12817)	$\alpha=1.51$ $\beta=1.525$ $\gamma=1.55$
Paternoite: JBJ 832.2 (purchased from R. Palumbo, Rome)	<i>idem</i>	6.1	kaliborite (f. 13414)	all $n > 1.505$ and $< 1.552$
Paternoite: USNM R5862 (purchased from R. Palumbo, Rome)	<i>idem</i>	5-10	kaliborite (f. 17928)	$\alpha=1.508$ $\beta=1.527$ $\gamma=1.550$
Kaliborite: USNM R5845	Leopoldshall, Germany	—	kaliborite (f. 13477)	$\alpha=1.508$ $\beta=1.527$ $\gamma=1.549$
Kaliborite: USNM R9422	Sallent, Spain	6.4-7.0	kaliborite (f. 13478)	$\alpha=1.508$ $\beta=1.527$ $\gamma=1.549$

<sup>1</sup> HMM: Harvard Mineralogical Museum, Harvard University, Cambridge, Mass.; UR: University of Rome, Italy; UP: University of Pisa, Italy; JBJ: John B. Jago private mineral collection, San Francisco, Calif.; USNM: U. S. National Museum, Washington, D. C.

TABLE 2. X-RAY POWDER DATA COMPARED FOR PATERNOITE (= KALIBORITE) AND KALIBORITE,  $K_2O \cdot 4MgO \cdot 11B_2O_3 \cdot 18H_2O$

Paternoite (=Kaliborite) Monte Sambuco, Calascibetta, Sicily (JBJ 832.2)		Paternoite (=Kaliborite) Monte Sambuco, Calascibetta, Sicily (JBJ 832.2)		Kaliborite Leopoldshall, near Staussfurt, Germany (USNM R5845)		Kaliborite Leopoldshall, near Staussfurt, Germany (USNM R5845)	
I <sup>1</sup>	d(Å) <sup>2</sup>	I <sup>1</sup>	d(Å) <sup>2</sup>	d(Å) <sup>2</sup>	I <sup>1</sup>	d(Å) <sup>2</sup>	I <sup>1</sup>
7	9.124	9	1.945	9.130	7	1.981	7
5	7.661	13	1.917	—	—	1.949	9
100	7.218	7	1.890	7.222	100	1.916	11
5	6.985	18	1.866	6.989	5	1.889	6
11	6.578	9	1.850	6.580	9	1.866	21
100	6.211	13	1.832	6.215	100	—	—
35	5.458	13	1.819	5.463	35	1.833	11
4	5.238	4	1.795	—	—	1.821	13
9	5.075	13	1.778	5.079	9	1.793	3
5	4.935	2	1.762	4.940	5	1.778	11
2	4.480	13	1.746	4.484	2	—	—
2	4.374	15	1.725	4.370	2	1.749	9
18	4.225	15	1.701	4.222	18	1.728	9
7	3.946	13	1.680	3.950	8	1.705	8
50	3.834	13	1.653	3.837	50	1.681	8
50	3.775	15	1.631	3.770	50	1.656	9
3	3.715	2	1.606	—	—	1.634	11
9	3.644	21	1.594	3.640	9	—	—
18	3.586	7	1.551	3.591	25	1.596	25
35	3.492	9	1.533	3.498	35	1.554	7
42	3.363	7	1.512	3.359	50	1.535	8
3	3.289	13	1.495	—	—	—	—
25	3.242	5	1.481	3.245	21	1.497	11
4	3.174	9B	1.439	—	—	1.482	3
71	3.106	8	1.413	3.104	71	1.443	8
2	3.041	13	1.400	—	—	1.415	8
21	2.995	3	1.385	2.998	18	1.401	9
6	2.960	3	1.376	2.956	6	—	—
6	2.897	9	1.363	—	—	1.377	2
35	2.868	5	1.349	2.864	35	1.366	9
42B	2.735	5	1.337	2.733	35	1.352	5
25	2.663	3	1.321	2.658	30	1.337	5
18	2.619	5	1.312	2.619	21	—	—
13	2.571	5	1.278	2.565	13	—	—
85	2.488	7	1.266	2.488	71	1.280	4
7	2.445	2	1.251	2.446	7	1.268	5
3	2.409	8	1.241	2.408	4	—	—
25	2.382	8	1.224	2.386	25	1.242	7
60	2.350	2	1.211	2.350	50	1.224	7
25	2.298	7	1.205	2.298	21	—	—
25	2.279	4	1.196	2.283	21	1.203	4B
42	2.236	4	1.187	2.236	35	—	—
7	2.177	6	1.170	2.176	6	1.189	3
9	2.149	6	1.157	2.148	6	1.172	4
7	2.114	6	1.138	2.113	5	1.158	5
5	2.090	—	—	2.090	5	1.138	3
60	2.071	—	—	2.073	50	1.125	2
3	2.050	—	—	2.055	2	1.115	3
35	2.025	—	—	2.028	35	1.099	5
13	2.000	—	—	2.006	18	1.088	5
6	1.977	—	—	—	—	1.080	5

Plus additional weak lines with  $I \leq 5$ .  
Film no. 13981; corrected for film shrinkage.

Plus additional weak lines with  $I \leq 5$ .  
Film no. 13978; corrected for film shrinkage.

<sup>1</sup> Intensities estimated visually by direct comparison to a calibrated intensity strip. B = broad.

<sup>2</sup> Camera diameter 114.59 mm; Ni-filtered Cu radiation,  $\lambda(\text{CuK}\alpha) = 1.5418 \text{ \AA}$ . Lower limit of  $2\theta$  measurable, approximately  $7^\circ$  ( $12.6 \text{ \AA}$ ).

ing in the jar; the results showed 7.2 per cent  $K_2O$  (Onorato, oral comm., 1960).

The results of our investigations indicate that the original analysis on which the formula for paternoite is based (Millosevich, 1920) must in part be in error, and that the supposed new mineral is kaliborite; Prof. Onorato (oral comm., 1960) concurs with us. We suggest, therefore, that the name paternoite be relegated to synonymy.

The Commission on New Minerals and Mineral Names, IMA, has voted its approval of adding paternoite to the 1964 list of discredited mineral names.

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AN INTERMEDIATE MEMBER OF THE BINARY SYSTEM  $FeS_2$   
(PYRITE)— $CoS_2$  (CATTIERITE)

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## INTRODUCTION

Examination of a mineral sample from Chibuluma (one of the Rhodesian Selection Trust Group mines on the Northern Rhodesian Copperbelt) proved it to be a high cobalt-bearing pyrite, approximately midway between the two end members of the binary system  $FeS_2$  (pyrite)— $CoS_2$  (cattierite). It is reported here because no specimen from the mid-range of the series has been described previously.

Microchemistry indicated major iron and cobalt only, and a semi-quantitative optical spectrographic examination showed the presence of minor quantities of silicon, nickel and arsenic. The material was checked for phase monotropy using a metallographic technique and was found