PROBABLE IDENTITY OF BELYANKITE WITH CREEDITE*

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ABSTRACT

Optical and x-ray data, crystal form, and differential thermal analyses suggest that belyankite (Dorfman, 1950) is creedite and that the analysis of belyankite is incorrect.

In reading the description of an apparently new calcium aluminum fluoride recently described and named belyankite by Dorfman (Dorfman, 1950), it was noticed that the formula, $Ca_2Al_3(F,OH)_{13} \cdot H_2O$, calculated by him was in error, the analysis as given actually yielding the simpler formula $Ca_3Al_2F_{12} \cdot 4H_2O$. In other respects, however, the description of belyankite, which also included optical, x-ray, and differential thermal analysis data, seemed at first sight to be a satisfactory account of a new species.

Dr. W. T. Schaller, in discussing the error of calculation with me, pointed out the great similarity of the crystal drawing of belyankite to those of creedite and suggested that the supposedly new mineral might indeed be creedite.

TABLE 1. COMPARISON OF ANALYSIS OF BELYANKITE WITH ANALYSES OF CREEDITE

	Belyankite, Kazakhstan 1	Creedite Colorado 2	Colorado 3	Bolivia 4	Calculated 5
CaO	34.00	33.57	35.18	34.7	34.17
Al_2O_3	21.88	21.89	21.42	25.9	20.71
SO_3	not det.	15.29	15.91	16.5	16.26
F	49.01	(30.35)	30.30	27.0	30.88
H_2O+	15.35	11.08	10.72	8.5	10.98
H_2O-	0.30	0.72	—	—	—
	120.54	112.90	113.53	112.6	113.00
O=2F	20.63	12.78	12.76	11.4	13.00
	99.91	100.12	100.77	101.2	100.00

1. M. O. Stepan, analyst, in Dorfman, 1950.
2. Recalculated. Wells, analyst, in Larsen and Wells, 1916.
3. Recalculated from Foshag, 1922.
4. Herzenberg, 1949.
5. Calculated for $Ca_3Al_2(SO_4)(F, OH)_{10} \cdot 2H_2O$, with F:OH=8:2.

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A comparison of the properties of belyankite, as given, with those of creedite leaves little doubt as to their identity. The analysis of belyankite is compared with the three analyses of creedite in Table 1. The method of analysis used for the Kazakhstan material is not stated; if sulfate was present but overlooked, it could affect the determination of of fluorine and water seriously. The analysis of belyankite gave determinations of CaO and Al_2O_3 very close to those reported for creedite.

Dorfman's drawing shows the narrow front pinacoid, *a*, which according to Foshag (Foshag, 1922) "sometimes occurs as a very narrow face . . . " on the crystals of creedite.

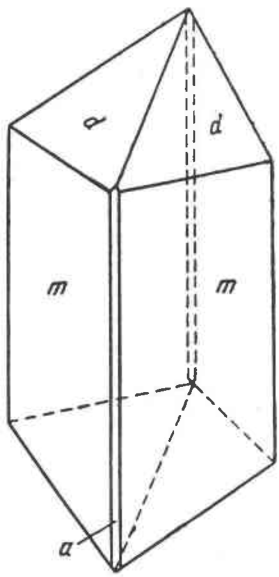

FIG. 1. Crystal drawing of belyankite, after Dorfman.

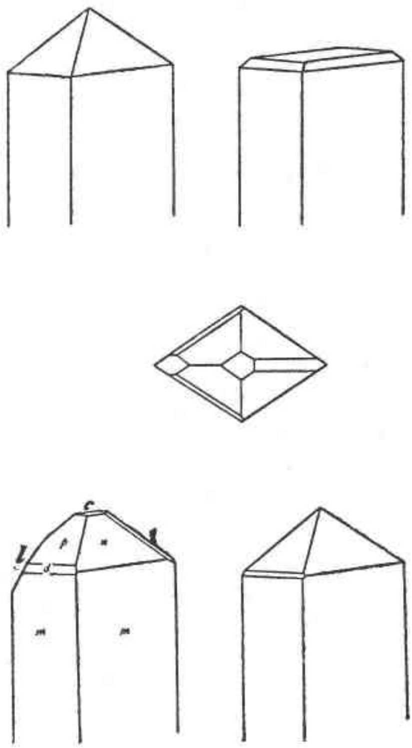

FIG. 2. Crystal drawings of creedite from Colorado after Foshag.

Dorfman does not give any goniometric measurements, but he quotes a determination of the unit cell constants, by S. S. Kvitka, as follows: $a_0=13.47\pm0.10$ Å., $b_0=8.46\pm0.05$ Å, $c_0=9.89\pm0.05$ Å, $\beta=93°\pm30'$. These yield the axial ratio $a:b:c=1.59:1.00:1.17$, $\beta=87°$, which agree closely with those given by Foshag for creedite, namely, $a:b:c=1.612:1.000:1.160$, $\beta=85\frac{1}{2}°$.

Other properties likewise are very close, as shown in Table 2. Dorfman's value for α is probably intermediate between β and the true α.

As neither x-ray powder data nor differential thermal analysis curves for creedite have been published, these were obtained on a sample, U.S.N.M. 93,117, from Wagon Wheel Gap, Colorado, part of the material studied by Foshag (Foshag, 1922).

The x-ray powder patterns were taken by F. A. Hildebrand with a North American Phillips Debye-Scherrer powder camera (114.59 mm.

TABLE 2. COMPARISON OF OPTICAL PROPERTIES OF BELYANKITE AND CREEDITE

	1 Belyankite, Kazakhstan	2 Creedite Colorado	3 Creedite Nevada
α	1.468	1.461	1.462
β	—	1.478	1.478
γ	1.483	1.485	1.483
Optic sign	neg.	neg.	neg.
2V	64°	64°	Med. large
Sp. gr.	2.720	2.713 2.720	—

1. Dorfman, 1950.
2. Larsen and Wells, 1916; Foshag, 1922.
3. Foshag, 1932.

diameter), using the Straumanis technique and ethyl cellulose spindles with Cu K (Ni filter), λ-1.5418 Å. The data are given in Table 3 and although many lines measured on this film are not recorded by Dorfman, the agreement is good except for the six innermost spacings, missing from the data for belyankite. It was thought that the differences might be due to our having used a camera of 114.6 mm. diameter, whereas Dorfman's data were obtained with a camera of 57.3 mm. diameter. However, five of these six lines were still measurable on a film taken in this laboratory with a camera of 57.3 mm. diameter. A third photograph, taken with a camera of 57.3 mm. diameter with the beam catcher removed, gave a pattern with three of the six innermost spacings missing and the other three scarcely measurable, and it may be that this corresponds approximately to the conditions used by Dorfman. His data for gearksutite agree fairly well with those of Ferguson (Ferguson, 1949), but similarly show many lines missing.

A differential thermal analysis curve was kindly run on the Colorado creedite by Dr. G. T. Faust of this laboratory. His curve is reproduced in Fig. 4, that of Dorfman in Fig. 3. One of the two small exothermic reactions shown by the curve for the material from Kazakhstan is not present on the curve for creedite.

Belyankite occurs in veins associated with fluorite, kaolin, and pyrite in kaolinized granite adjacent to quartz-topaz greisen. Creedite at Wagon Wheel Gap, Colorado, is closely associated with fluorite and

TABLE 3. *X*-RAY POWDER DIFFRACTILN DATA FOR CREEDITE, WAGON WHEEL GAP, COLORADO (F. A. HILDEBRAND) AND FOR BELYANKITE, KAZAKHSTAN, (DORFMAN)

Creedite		Belyankite		Creedite		Belyankite		Creedite		Belyankite	
d	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*	*d*	*I*
7.3	9	—	—	2.19	6	—	—	1.439	2	1.433	w.
6.9	9	—	—	2.161	9	2.152	str.	1.418	1	—	—
5.79	8	—	—	2.103	4	—	—	1.407	1	—	—
4.98	6	—	—	2.062	2	—	—	1.390	1	—	—
4.18	4	—	—	2.023	5	2.025	str.	1.320	2	1.318	w.
4.08	4	—	—	2.002	3	—	—	1.283	4	1.282	w.
3.92	9	3.861	med.	1.975	4	—	—	1.256	1	—	—
3.67	7	3.652	w.	1.937	5	1.928	w.	1.245	1	—	—
3.48	10	3.430	str.	1.918	3	—	—	1.232	2	1.225	w.
3.27	7	3.245	w.	1.884	4	—	—	1.217	1	1.204	w.
3.07	8	3.039	med.	1.852	5	1.840	w.	1.189	1	—	—
3.01	4	—	—	1.817	1	—	—	1.178	1	—	—
2.98	4	—	—	1.789	1	—	—	1.159	3	—	—
2.90	5	2.876	w.	1.751	5	1.743	w.	1.156	1	—	—
2.82	4	—	—	1.711	1	—	—	1.143	1	—	—
2.76	7	—	—	1.678	3	1.677	w.	—	—	1.106	w.
2.71	7	2.709	med.	1.644	3	—	—	—	—	0.917	w.
2.61	6	2.602	w.	1.610	4	1.604	w.	—	—	0.882	w.
2.50	6	—	—	1.580	3	1.586	med.				
2.44	6	2.424	w.	1.547	1	—	—				
2.41	2	—	—	1.517	3	1.507	med.				
2.35	3	—	—	1.504	1	—	—				
2.32	5	2.300	v.w.	1.479	1	—	—				
2.29	6	—	—	1.457	1	—	—				

str. = strong, med. = medium, w. = weak, v.w. = very weak. *d* values are Ångstrom units; intensities are relative to the strongest line, taken as 10.

halloysite in a fluorite-barite vein; at Granite, Nevada, creedite is similarly associated with fluorite and halloysite in a gold-bearing vein.

In summary, all lines of evidence point to the identity of belyankite with creedite, and indicate that its analysis is in error owing to the presence of sulfate having been overlooked. The possibility has been considered that belyankite is a sulfate-free creedite with perhaps an isomorphous series existing. The nearly perfect identity of properties is evidence against this rather unlikely hypothesis, but the question can be settled only by re-analysis of belyankite.

It should be noted that another mineral, also named for D. S. Bely-

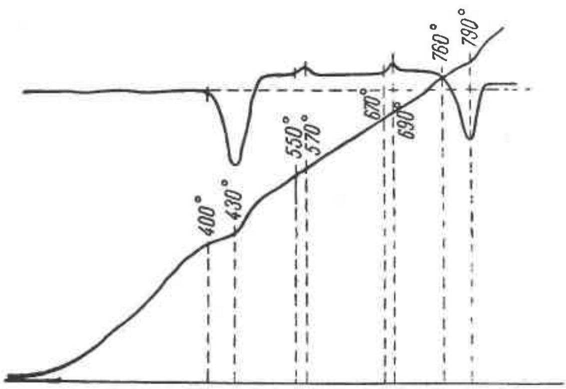

FIG. 3. Differential thermal analysis curve of belyankite (reproduced from Dorfman).

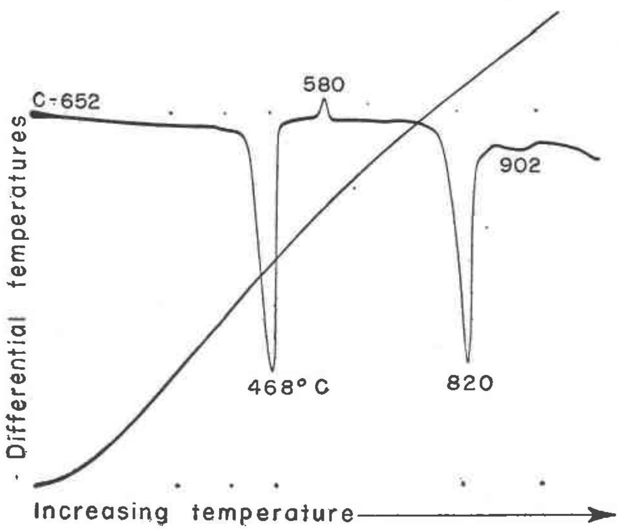

FIG. 4. Differential thermal analysis curve of creedite, Wagon Wheel Gap, Colo. Data of G. T. Faust.

ankin, has recently been described under the name belyankinite (see p. 882). This hydrous calcium titanate should not be confused with belyankite.

It is obvious that my colleagues W. T. Schaller, F. A. Hildebrand, and

G. T. Faust have contributed practically all of the new data in this paper. As they decline to be co-authors of record, I can only thank them for their kind help. I also thank Dr. George Switzer of the U. S. National Museum, who furnished the creedite from Colorado.

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