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MINERALOGY

KURNAKOVITE, A NEW BORATE

By M. N. GODLEVSKY

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During my visit to the Inder deposit in 1938, I found in the dump of one of the pits in deposit No. 33 a solid colourless mineral which proved to be a borate, of the composition 2 $MgO \cdot 3B_2O_3 \cdot 13H_2O$. The new mineral was named kurnakovite in honour of N. S. Kurnakov.

According to the kind information of J. J. Yarjemsky, a primary occurrence of kurnakovite, in the form of irregular lenses among ascharite, was discovered later on in pit No. 5 of deposit No. 33.

The kurnakovite forms dense white coloured aggregates. On the walls of small irregular caverns, there may be seen segregations of coarser grains (about 1 mm) with a vitreous lustre. The kurnakovite grains are isometric, with an indistinct cleavage along (010). The *Ng Np* plane is parallel to (010), why the measurement of *Nm* is rather difficult. One of the optical axes is almost normal to (001). Sections along (001) have pseudohexagonal outlines, in connexion with the appearance of the (110) faces. There were observed simple twins, but the twinning law could not be stated.

Chemical Composition of the Kurnakovite (Analyst E. N. Egorova)

Oxides	Weight %	Molecular amounts	Theor. composition $2MgO \cdot 3B_2O_3 \cdot 13H_2O$ (weight %)
MgO	15.46	0.383	15.36
B_2O_3	37.58	0.540	40.02
H_2O	47.09	2.614	44.62
CaO	0.16	0.003	—
R_2O_3	0.20	—	—
SiO_2	0.10	0.002	—
F_2	0.14	0.008	—
Σ	100.73	—	100.00
$-O=F_2$	0.06		
Σ'	100.67		
Insoluble residue	0.20		

On the base of the optical ellipsoid orientation one may suggest, that the kurnakovite belongs to the monoclinic syngony.

Optical constants of the kurnakovite are as follows. Biaxial; negative; $2V = 80°$; $Ng = 1.525$; $Nm = 1.510$; $Np = 1.489$ (measured to ± 0.002). Hardness 3, density 1.85.

Before the blow pipe the mineral fuses to enamel, in a sealed pipe it is easily dehydrated. Insoluble in H_2O. Soluble in acids at heating. The chemical analysis of kurnakovite is given in the table.

Just as in the case with ascharite (²), part of the B_2O_3 contained in kurnakovite is volatilized together with water, but in small test portions the B_2O_3 determination is not so accurate as to remove the error involved in the estimation of H_2O. Therefore the content of H_2O in the analysis is somewhat higher than the actual content, which accounts for a comparatively high total of the analysis.

The ratio of the main oxides $MgO : B_2O_3 : H_2O$ is 2 : 2. 81 : 13.64. In writing the formula of this mineral account is to be taken of the deficiency of boron anhydride, common for Inder borates, as compared to the stoichiometrical ratio. Thus, the ratio $RO : B_2O_3$ for hydroboracite is 2 : 2.83, for inyoite 2 : 2.88, for colemanite 2 : 2.92 and for inderite 2 : 2.87 (¹, ²). Consequently, we may adopt the ratio $MgO : B_2O_3 = 2 : 3$ for kurnakovite, as we do for the above-mentioned borates.

Besides, we have to bear in mind, that part of the H_2O may be attributed to hygroscopic moisture. It is impossible to separate this free water from the combined water of the mineral, as its dehydration temperature is very low. Therefore we have to make allowance for the hygroscopic water, besides of the generally exagerated value of the H_2O in the analysis, and we may admit that 13 water molecules correspond to 1 anhydride molecule.

Accordingly, the empirical formula of kurnakovite may be expressed as follows: $2MgO \,.\, 3B_2O_3 \,.\, 13H_2O$.

Thus, the total composition of the kurnakovite proves, that it belongs to the extensive group of hydrous Ca- and Mg-hexaborates:

Colemanite	$2CaO \cdot 3B_2O_3 \cdot 5H_2O$
Hydroboracite	$CaO \cdot MgP \cdot 3B_2O_3 \cdot 6H_2O$
Meyerhofferite	$2CaO \cdot 3B_2O_3 \cdot 7H_2O$
Inyoite	$2CaO \cdot 3B_2O_3 \cdot 13H_2O$
Kurnakovite	$2MgO \cdot 3B_2O_3 \cdot 13H_2O$
Inderite	$2MgO \cdot 3B_2O_3 \cdot 15H_2O$

The thermal characteristics of kurnakovite is extremely simple: on the heating curve (Ch. S. Nikogosian) there is only one endothermal effect in the low temperature field: at 81—105.4°, corresponding to the dissociation of the mineral.

The dehydrated product is faintly transparent, isotropic or with a feeble aggregative polarization; $n = 1.445$, density $= 1.62$. The lowering of the refraction and of the density proves the amorphization of the substance. For borates such an amorphization was already stated by A. V. Nikolaev who attributed this effect to the disproportion in the rate of dehydration and in the lattice formation of the new phase (³).

As to the ease of dehydration the kurnakovite is analogous to inderite and inyoite (66—159° and 47—159°, respectively), but it differs from these minerals (and from all other borates with the ratio $RO : B_2O_3 = 2 : 3$) by the lack of other endo- and exothermal effects. The monothermal character of the heating curve and the volatilization of boron together with H_2O places the kurnakovite next to the ascharite, but the dissociation temperature of these minerals differs substantially, being 81—105.4° for kurnakovite and 611—657° for ascharite.

Consequently, the kurnakovite belongs to those few borates which are devoid of the exothermal effect, called by A. V. Nikolaev (³) «borate retardation», and depending on the alteration of amorphous anhydride into crystalline.

The powdergrams of kurnakovite (E. F. Alexeeva) show a great number of lines (up to 71), many of which are very diffuse. This abundance of lines points indirectly to the low symmetry of kurnakovite. The kurnakovite X-ray diagrams are very different from those of others borates.

A comparison of kurnakovite with other borates, even with the inderite ([1]), most similar in composition, permits to state that the kurnakovite represents a separate phase in the system MgO, B_2O_3, H_2O and, consequently, it must be considered as an independent mineral species.

Proceeding from the general notions on the genesis of Inder borates ([2]), one may suggest that the kurnakovite was formed in the gypsum cap at the expense of Mg-bearing borates of the saline series—kaliborite and hydroboracite. Further dilution of the solutions resulted in the altering of kurnakovite to ascharite. In the zone of surface water percolation the kurnakovite is replaced by secondary carbonates.

All-Union Geological Institute.
Leningrad.

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