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Dedicated to the memory of Academician E.S. Fedorov (1853 - 1919)

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Издание предназначено для специалистов в области минералогии, кристаллографии, спектроскопии и материаловедения.

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Thermal expansion and hydration/dehydration of euchlorine $KNaCu_3O(SO_4)_3$

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Anhydrous copper sulfate minerals with various alkali metals are the most abundant species in the famous for its mineral diversity fumaroles of Second Scoria Cone of the Great Tolbachik Fissure Eruption (1975–1976), and likewise in the Naboko scoria cone of the 2012–2013 Tolbachik Fissure eruption of the Tolbachik volcano on Kamchatka peninsula, Russia.

Euchlorine, ideally $KNaCu_3O(SO_4)_3$, is the most abundant copper sulfate mineral in the hot sulfate-rich zones of the fumaroles. In this work [Siidra et al., 2019], its thermal expansion and hydration/dehydration behavior have been studied. The results of a structure refinement from new single crystal diffraction data are also reported, and a description of the structure based on anion-centered coordination polyhedra is given.

The strongly anisotropic character of the thermal expansion of euchlorine remains essentially unchanged up to its decomposition. The strongest α_{11} expansion is observed approximately perpendicular to the alkali interlayer of the structure, whereas the minimal α_{22} and α_{33} thermal expansion coefficients are parallel to the plane of $\{Cu_3O(SO_4)_3\}^{2-}$ layers.

Hydration experiments controlled by X-ray powder diffraction reveal a very complex behavior with multicomponent phase formation. Some of the identified mineral phases, have not been found prior to our work in the secondary mineral assemblages of SSC, GTFE.

Unexpectedly, the complex mixture of hydrated sulfates gradually reverses and the minerals recombine and reform the primary euchlorine composition upon heating. Minor anhydrous by-phases dolerophanite and wulffite formed at the final stages of dehydration are structurally related to euchlorine, as their structures are also based on oxocentered OCu_4 tetrahedra.

As a side note, the observed multiple transformations of the primary exhalative mineral euchlorine can also be discussed in the light of the "Evolution of minerals" hypothesis developed by Hazen R. M. in the last decade.

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