

## More Data on (Na,K,Ca)<sub>6</sub>[Al<sub>8</sub>Si<sub>8</sub>O<sub>32</sub>]<sub>12</sub>H<sub>2</sub>O, a new Triclinic Phillipsite-type Zeolite From the Bellerberg volcano, Eifel, Germany

Lengauer, Christian L.<sup>1</sup> Kolitsch, Uwe<sup>2</sup> Tillmanns, Ekkehart<sup>1</sup>

<sup>1</sup>Institut für Mineralogie und Kristallographie, Universität Wien - Geozentrum, Althanstr. 14, A-1090 Wien, Austria

<sup>2</sup>Mineralogisch-Petrographische Abteilung, Naturhistorisches Museum, Burgring 7, A-1010 Wien, Austria

Lowering of the structure symmetry of zeolites from their highest topological symmetry is caused by cation ordering on the tetrahedrally coordinated framework sites or of cations and molecules within the extra framework pore system. Chabazite, for example, exhibits random Si-Al ordering on the T-sites with seemingly rhombohedral symmetry. Its dimorph willhendersonite, however, crystallizes in space group *P*-1 due to complete Si-Al ordering and configuration of the non-framework constituent parts (Tillmanns et al. 1984), which rearrange under non-ambient conditions to re-establish rhombohedral symmetry (Fischer et al. 2008). The finding of a new, distinctly triclinic zeolite mineral with phillipsite topology in a Ca-rich xenolith at the Bellerberg, Eifel, sets an illustrative example of such ordering-induced symmetry reduction. Preliminary results on the crystal structure were given by Kolitsch and Blass (2005). Data from subsequent analyses and optical measurements will be presented, as well as a detailed discussion on the structural relationship to phillipsite,  $K_2(Ca_{0.5}Na)_4[Al_6Si_{10}O_{32}] \cdot 12H_2O$ .

The new mineral forms small aggregates of tabular, colourless glassy crystals and, interestingly, is accompanied by willhendersonite. The zeolite crystallizes in space group *P*-1,  $a = 19.965(1)$ ,  $b = 14.271(1)$ ,  $c = 8.704(1)$  Å,  $\alpha = 88.37(1)$ ,  $\beta = 125.08(1)$ ,  $\gamma = 89.57(1)^\circ$ ,  $V = 2028.3(3)$  Å<sup>3</sup> (phillipsite-type cell) and  $Z = 2$ . Structure refinements and chemical analyses yield the almost ideal chemical formula  $(K_{2.9}Ca_2Na)[Al_8Si_8O_{32}] \cdot 12H_2O$ , consequently a K-dominance of the extra framework cations and a Si:Al ratio of 1:1 on the T-sites. Due to the significant deviation from monoclinic metrics, the framework can be described as the lowest symmetry variant of the PHI-type microporous compounds (Baur and Fischer 2006). With respect to phillipsite, Si-Al ordering reduces the framework topology from  $P2_1/m$  to  $P2_1$ , whereas K/H<sub>2</sub>O and Ca/Na ordering is responsible for the doubling of the *a*-parameter. The observed Si-Al order may be attributed to unusual genetic conditions within the Ca-rich xenolithic host, as is also indicated by the paragenesis with willhendersonite.

### References

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submitted by: **Lengauer, Christian**

email: **chris-**

**tian.lengauer@univie.ac.at**

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