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# High-pressure single-crystal structural analysis of $AlSiO_3OH$ phase egg

**Kirsten Schulze[1,*], Martha G. Pamato[2], Alexander Kurnosov[1], Tiziana Boffa Ballaran[1], Konstantin Glazyrin[3], Anna Pakhomova[3], and Hauke Marquardt[1,4]**

[1]Bayerisches Geoinstitut, University Bayreuth, 95440 Bayreuth, Germany
[2]Department of Earth Sciences, University College London, WC1E 6BT London, U.K.
[3]FS-PE, Deutsches Elektronen Synchrotron, Hamburg 22607, Germany
[4]Department of Earth Sciences, University of Oxford, OX1 3AN Oxford, U.K.

## Abstract

We present the first equation of state and structure refinements at high pressure of single-crystal phase egg, $AlSiO_3OH$. Phase egg is a member of the $Al_2O_3$-$SiO_2$-$H_2O$ system, which contains phases that may be stable along a typical mantle geotherm (Fukuyama et al. 2017) and are good candidates for water transport into Earth's deep mantle. Single-crystal synchrotron X-ray diffraction was performed up to 23 GPa. We observe the **b** axis to be the most compressible direction and the β angle to decrease up to 16 GPa and then to remain constant at a value of ~97.8° up to the maximum experimental pressure reached. Structure refinements performed at low pressures reveal a distorted octahedron around the silicon atom due to one of the six Si-O bond lengths being significantly larger than the other five. The length of this specific Si-O4 bond rapidly decreases with increasing pressure leading to a more regular octahedron at pressures above 16 GPa. We identified the shortening of the Si-O4 bond and the contraction of the vacant space between octahedral units where the hydrogen atoms are assumed to lie as the major components of the compression mechanism of $AlSiO_3OH$ phase egg.

**Keywords:** Phase egg, single-crystal, X-ray diffraction, compressibility, structure refinement