American Mineralogist, Volume 88, pages 1408–1411, 2003

Compressibility of phase Egg $AlSiO_3OH$: Equation of state and role of water at high pressure

CARINE B. VANPETEGHEM,[1] EIJI OHTANI,[1,*] TADASHI KONDO,[1] KENICHI TAKEMURA,[2] AND TAKUMI KIKEGAWA[3]

[1]Institute of Mineralogy, Petrology and Economic Geology, Faculty of Science, Tohoku University, Sendai 980-8578, Japan
[2]National Institute for Materials Science, Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan
[3]High Energy Accelerator Research Organization, Tsukuba, Ibaraki, Japan

ABSTRACT

We have determined the equation of state of phase Egg, $AlSiO_3OH$, at room temperature up to 40 GPa, using X-ray powder diffraction with synchrotron radiation. We determined the isothermal bulk modulus K_{0T} = 157 ± 4 GPa with a pressure derivative K'_{0T} = 6.5 (4) by fitting a third order Birch-Murnaghan equation of state. When K'_{0T} is fixed at 4, we obtain K_{0T} = 183 ± 2 GPa. This value can be compared to other hydrous phases existing in the transition zone as well as to non-hydrous phases, such as kyanite, Al_2SiO_5. We find that despite the presence of hydrogen, the bulk modulus of phase Egg remains high, unlike other low-pressure hydrous minerals. In addition, we found that phase Egg is more compressible along the **b** axis, where the O-H bonds are oriented. Our results are in good agreement with previous theoretical calculations, performed on the similar hydrous phase δ-AlOOH, that show that the O-H bond strengthens with pressure, suggesting that the presence of water stored in these phases does not soften the material at pressures corresponding to lower mantle conditions.