Stability of hydrous aluminosilicates at the transition zone and the lower mantle

Ryota Abe[1], Yuki Shibazaki[2], Shin Ozawa[1], Itaru Ohira[1], Hiromu Tobe[1], *Akio Suzuki[1]

1. Department of Earth Science, Graduate School of Science, Tohoku University, 2. Frontier Research Institute for Interdisciplinary Sciences, Tohoku University, Tohoku University, Sendai 980-8578, Japan

Water is transported into the deep Earth’ s interior by hydrous minerals in the descending slabs. Previous studies showed that hydrous aluminosilicates would be stable in the sedimentary layer of subducting slab. Discovery of phase Egg in the diamond inclusion also supports that hydrous aluminosilicate could exist in the earth’ s deep interior. Topaz-OH II was synthesized by Kanzaki (2010 Am. Mineral.) at the pressure of 14 GPa and the temperature of 1400 ˚C. In the high pressure and high temperature experiment using starting materials of $Al_2SiO_4(OH)_2$ composition have reported stable regions only at 26 GPa (Pamato et al., 2014 Nature Geoschi.). The phase relation of $Al_2SiO_4(OH)_2$ aluminosilicates between 14 and 26 GPa is important for the discussion of water transport from the mantle transition layer to the shallow part of the lower mantle. In this study, quench experiments and in situ X-ray diffraction studies on the phase relation of $Al_2SiO_4(OH)_2$ were conducted in the pressure range of 12.0–32.2 GPa and in the temperature range of 800–1600 ˚C. We observed the coexistence of delta-AlOOH and stishovite at 31.0 GPa and 1500 ˚C and the formation of phase Egg together with corundum at 30.6 GPa and 1600 ˚C. These results indicate that phase Egg is stable at least up to 30.6 GPa and 1600 ˚C, which is higher pressure and temperature condition than that reported previously. Phase Egg should be the important water carrier after the avalanche of the stagnant slab up to the depth of approximately 900 km in the lower mantle.

Keywords: hydrous alminosilicate, phase Egg, synchrotron X-ray diffraction, lower mantle, subducting slab

