In situ X-ray diffraction studies of hydrous aluminosilicate at high pressure and temperature

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Water is transported into the deep Earth’s interior by hydrous minerals in the descending slabs. Previous studies showed that hydrous aluminosilicate would be stable in the mid-ocean ridge basalt and 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 ($Al_2SiO_4(OH)_2$) is stable in the pressure range of 8-12 GPa and transforms to Topaz-OH II and Al-phase D under high pressure condition. However, the phase relation of $Al_2SiO_4(OH)_2$ has not been clarified yet.
In order to determine the phase relation of hydrous alminosilicate experimentally, we have conducted an in situ X-ray diffraction study at high pressure and temperature using Kawai multi-anvil high pressure apparatus and intense X-ray of synchrotron radiation at SPring-8. The truncated edge length of the anvil is 3 mm. The pressure medium was made of ZrO_2 and Co-doped MgO. We used a TiB_2 tube heater with a Boron epoxy window for the X-ray path and the W3%Re–W25%Re thermocouple for monitoring temperature of the experiments. Pressure was calculated from the equation of state of gold.
We found that hydrous phase of δ-AlOOH and stishovite were stable in the pressure range of 22-30 GPa and the temperature range of 800-1500 ℃. Al-phase D was found at 24 GPa, 1500 ℃ coexisting with phase egg. Al/Si ratio of Al-phase D was approximately 1.85, which was less than ideal composition.

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

