Determination of the stability field of delta-AlOOH

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Delta-AlOOH is high pressure polymorph of diaspore and first synthesized by Suzuki et al.(2000). The crystal structure of this phase is similar to CaCl2-type SiO2 which is a high-pressure polymorph of Stishovite; edge-sharing Al-O octahedra make single-chain along c-axis. This phase is marked by its high compressibility. The isothermal bulk modulus is K0=228 (K0'=4) and this is comparable to that of corundum although this phase has hydrogen bond in its structure. Sano et al. (2004) made in-situ multianvil experiments and confirmed that delta-AlOOH was stable up to 32GPa, 1473K. In this study, we investigated the stability field of delta-AlOOH at higher pressure range.

The high-pressure experiments were performed using a laser-heated diamond-anvil cell. Pressures were measured with ruby-fluorescence technique before and after heating. The sample was heated from both sides by a Nd:YAG laser operated in multimode. The starting material was Al2O3 powder with distilled water or Al(OH)3 powder. Platinum black as a laser absorber was mixed with the sample in both cases. After experiment, stable phase in each condition was determined using X-ray diffraction or Raman spectroscopy method. Angle dispersive X-ray diffraction experiments were carried out for both the laser-heated sample at the maximum pressure and the recovered samples at BL-13A in Photon Factory.

The experimental conditions were in the range of 13-75GPa and 1273-1773K. We observed existence of delta-AlOOH in the recovered sample from 40GPa and 1573K, whereas corundum was appeared in the sample from 50GPa, 1773K. As a result, the dehydration temperature of delta-AlOOH was elevated at higher pressure, and the expected dehydration process was described as 2AlOOH = Al2O3+H2O. Delta-AlOOH was observed as a stable phase up to the maximum pressure of 75GPa and 1673K in this study, suggesting the stability field seems to spread further.