Experimental determination of Post-spinel Transition in Mg2SiO4-H2O system and Implication for 660 km Seismic Discontinuity

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The 660 km discontinuity is one the most important structural boundaries in the Earth's interior. It divides upper and lower mantle and is usually attributed to the dissociation of Mg_2SiO_4 spinel to $MgSiO_3$ perovskite and MgO periclase (post-spinel transition, PST). Previous studies of PST in dry system (both simplified and complex systems) have shown that the claypron slope (dP/dT) is very gentle and negative. Seismic studies show that 660 km discontinuity is depressed in subduction zone. Recently Litasov et al. (2005) have studied the PST in hydrous peridotite system and observed the shift of PST boundary is about 0.6 GPa compare to anhydrous peridotite system at 1473 K. To check the effect of water on PST boundary we need to study this boundary using simplified water bearing system.

In situ X-ray diffraction experiments were conducted in synchrotron facility SPring-8 at Hyogo prefecture, Japan. We used a Kawai-type multi-anvil apparatus, SPEED-1500, installed at bending magnet beam line BL04B1. The starting material was synthetic crystals of forsterite, and enstatite representing Mg2SiO4 mixed with the Au-pressure marker at 20:1 by weight. Water (2 wt.%) was added as $Mg(OH)_2$ in the starting material adjusting to the proportion of MgO. Co-doped MgO was used as a pressure medium and a cylindrical LaCrO3 heater in a furnace assembly. Temperature was measured by a W3%Re-W25%Re thermocouple with a junction located at nearly the same position as X-ray path through the sample. AgPd and graphite capsule were used as a sample container in hydrous and dry systems, respectively. The generated pressure was calculated from Au equation of state (EOS) proposed by Anderson (1989).

We have carried out several experiments with Mg_2SiO_4 + 2 wt% H_2O and Mg_2SiO_4 systems at different P-T conditions. The phase relations were determined between 19 to 24 GPa and temperature up to 1973 K. Our results show that the PST boundary in Mg_2SiO_4 + 2 wt.% H_2O shifts to higher pressure by ˜1.4 GPa compare to Mg_2SiO_4 system. In this study, we present the experimental results of the phase boundary of the post-spinel transition in the Mg_2SiO_4-H_2O system by in-situ X-ray diffraction experiments using Kawai type multi anvil apparatus and try to understand the effect of water on the PST.