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Stability of Hydrous phase H MgSiO2(OH)2 in the lower mantle

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Subducting slabs transport water to Earth's deep interior and its circulation on a global scale is the key to understanding the evolution of the planet. However, it is still a matter of debate how deep water can be transported. Therefore, there are many studies on phase relationships in hydrous minerals or MORB-H2O systems. Most dense hydrous magnesium silicates (DHMS) are stable up to 50 GPa (e.g., Komabayashi et al., 2004). Recently, the synthesis of Mg- and Si- bearing δ-AlOOH, which is a solid solution between 2AlOOH-MgSiO2(OH)2, was reported and it might be transported with Mg-perovskite or Mg-post perovskite up to 135 GPa (Ohira et al., 2012, AGU). Tsuchiya (2013) theoretically reported Phase H, the end member of the system, was stable above 45 GPa and up to 55 GPa. And also it was experimentally synthesized at 50 GPa (Nishi et al., 2014). Although the previous studies claimed that Phase H was broken down above 55 GPa, it may be a host phase of water in the deep Earth interior. Here, we report the stability field of a new candidate phase of water reservoir at the lower mantle conditions by investigating the MgO-SiO2-H2O system up to 75 GPa and 2000 K.

A mixture of quartz and brucite (molar ratio 1 : 1) powders were used as starting materials. The high pressure and high temperature experiments were performed by using a double-sided Laser heated diamond anvil cell. A pellet with thickness of about 15 μm was made by a cold compression technique. In situ XRD experiments in the MgO-SiO2-H2O system were performed at BL10XU, SPring-8. In this study we confirmed that hydrous phase H does exist in the MgO-SiO2-H2O system and its stability fields expands at least up to 75 GPa and above 2000 K in contrary with previous reports (Tsuchiya, 2013; Nishi et al., 2014).

If Phase H exists under high pressure conditions corresponding to the pressure of CMB, it may transport water to CMB and thus the core may contains hydrogen as a light element.

Keywords: hydrous phase, hydrous phase, subduction