In-situ X-ray experiment of post-garnet phase transition in hydrous MORB system.

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1. Introduction

Resent tomographic observations suggest that some subductig slabs stagnate at mantle transition zone. Irifune and Ringwood (1978) show that there is density crossover occurs at the depth 660km to 800km between MORB and peridotite, which causes buoyancy and stagnate slab or tear off upper oceanic crust at 660km. It is important to determine the depth of post-garnet transition occurs in MORB system to discuss the behavior of the slab at 660 km. In the dry condition, Mg-perovskite appears at 1500 ºC and 26 GPa and garnet decomposes completely at 1500 ºC and 27 GPa (Hirose et al. 2002). There should be hydrous condition in subducting slab, so it is important to examine what is occur in MORB system under the hydrous conditions. In this study, we determined post-garnet boundary in hydrous MORB system using in-situ experiment at 20.7 GPa to 25.5 GPa and 1100-1200 ºC under hydrous conditions.

2. Experimental methods

High pressure and high temperature in-situ X-ray diffraction experiments were performed using a uniaxial 800-ton press (MAX III) installed in the synchrotron radiation beamline BL14C at the Photon Factory (PF) at the National Laboratory for High Energy Physics (KEK). Anhydrous glass was loaded in AgPd capsule that one end was welded, and liquid H2O was dropped into capsule using micro-syringe, and then welded another end. Hydrous composition was added by H2O to prevent metastable phase when hydrous compositions are added hydroxide such as blucite or gibbsite. Weight of capsule was measured before and after weld in order to confirm there is no loss of H2O. H2O wt % is about 20wt%. Pressure was calibrated using equation of state for Au (Anderson et al., 1989) from observed unit cell parameter of Au that was mixed with sample.

3. Results

In-situ experiments have been conducted in the hydrous MORB system at pressures of 20.6GPa to 26.3GPa and temperatures up to 1200 ºC to determine the phase boundary of post-garnet. No peak was observed under temperature at 1000 ºC and mineral growth was occurred at 1000 ºC in all run. The mineral assemblages observed at 20.6 GPa and 1100 ºC, 20.8 GPa and 1200 ºC were garnet and stishovite. At 23.5 GPa and 1100ºC, 26.3 GPa and 1100 ºC, one orthorhombic phase nearly cubic was appeared. When temperature rises up to 1100-1200 ºC, it decomposed into high pressure mineral assemblage, Orthorhombic Mg-Perovskite, Ca-Perovskite, NAL phase and stishovite at 23.08GPa and 1200 ºC, 25.5 GPa and 1200 ºC and 21.6GPa and 1100 ºC. This is lower than that of Hirose et al. (2002) about 2GPa that was determined under dry condition. If garnet transit into two-perovskite assemblage at 21GPa, density crossover doesn't occurs and subducting slab could not buoyant and descend into lower mantle without stagnant at the transition zone. It depends on the quantity of hydrogen whether subducting slab stagnates or not.

Reference

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