高温高圧下におけるphase Eggの安定領域
～Phase Eggはマントル遷移層における水の貯蔵庫になり得るか～
Stability field of phase Egg under high temperature and high pressure: Possibility of phase Egg as a water reservoir in mantle transition zone

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Water in the earth’s interior is one of the main research topics because the water is known to affect physical properties of materials in the earth’s interior such as rheology, electric conductivity, seismic velocity, density, and melting point. The sedimentary layer of the oceanic crust transfers water into the deep earth mantle via subducting slabs (Peacock, 1990). Phase Egg, $AlSiO_3(OH)$, is one of the important hydrous phases in the mantle originating from the sedimentary layer and can contain H_2O of 7.5 wt% as hydroxyl. However, two previous studies (Sano et al., 2004; Pamato et al., 2014) have reported different stability fields about phase Egg. This inconsistency leads to different earth-scientific outlooks on water cycling system via subducting slabs: whether the phase Egg can reserve water in the top of the lower mantle or not and where the superdeep diamond containing phase Egg originates (Wirth et al., 2007). Phase Egg as an inclusion in diamond might indicate a possibility that a top of the lower mantle might be wet.

Here, we conducted high-pressure experiments using Kawai-type 3000 ton multi-anvil apparatus and 1000 ton multi-anvil apparatus at Tohoku University in order to determine the stability field of phase Egg. Experiments were performed in the pressure range of approximately 17-21GPa and in the temperature range of 1000-1200℃. Starting material was a mixture of Al_2O_3, $Al(OH)_3$, and SiO_2 compounded similarly to ideal phase Egg composition, which was different from those of two previous studies (Sano et al., 2004; Pamato et al., 2014).

In this study, we found that phase Egg decomposed under the pressure corresponding to the mantle transition zone at 1000℃. This indicates that phase Egg is unstable in the top of lower mantle and can be a water reservoir in the mantle transition zone. In addition, this implies that the superdeep diamond, which Wirth et al. (2007) reported, does not originate from the lower mantle but from the wet mantle transition zone.

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