# The stability of anhydrous phase B, Mg14Si5O24, at mantle transition zone conditions

Liang Yuan*†[1,2], Eiji Ohtani[1], Yuki Shibazaki[3], Shin Ozawa[3], Zhenmin Jin[2], Akio Suzuki[1], and Daniel Frost[4]

[1]Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan – Japan

[2]School of Earth Sciences, China University of Geosciences, Wuhan 430074, China – China

[3]Frontier Research Institute for Interdisciplinary Sciences, Tohoku University, Sendai 980-8578, Japan – Japan

[4]Bayerisches Geoinstitut, University of Bayreuth, Bayreuth 95440, Germany – Germany

**Abstract**

The stability of anhydrous phase B, Mg14Si5O24, has been determined in the pressure range of 14-21 GPa and in the temperature range of 1100-1700 ∘C with both normal and reversal experiments at high pressures and high temperatures. Our results demonstrate that anhydrous phase B is stable at $P$-$T$ conditions corresponding to the shallow depth region of the mantle's transition zone and it decomposes into periclase and wadsleyite at greater depth. The decomposition boundary of anhydrous phase B into wadsleyite and periclase has a positive phase transition slope and can be expressed by the following equation, $P(\text{GPa}) = 7.5 + 6.6 \times 10\text{-}3T(\circ\text{C})$. This result is consistent with a recent result on the decomposition boundary of anhydrous phase B (Kojitani et al., 2017). However, our phase boundary deviates significantly from theirs at temperatures < 1400 ∘C. Considering the spatial and temporal heterogeneity of mantle compositions, several mechanisms are proposed to produce MgO-rich conditions for the formation of anhydrous phase B in the deep mantle. Upon the cooling of a magma ocean likely formed during the early history of the Earth, a distinctive anhydrous phase B enriched layer might have formed through crystallization and accumulation in the upper part of the mantle transition zone. Subducting carbonate can be reduced in the metal-saturated mantle at depth > 250 km and abundant (Mg, Fe)O oxides should be introduced into the surrounding mantle. Hydrous melting of peridotite may also produce MgO-enriched components. In addition, dissociation of chromite in natural high-$P$ chromitite is likely to produced lots of oxides. We propose that directly touching ferropericlase-olivine inclusions found in natural diamonds might be the retrogressive products of anhydrous phase B decomposing via the reaction Anh-B = Olivine + Periclase. This decomposition may occur during the transportation of the host diamonds from their formation depths of < 500 km in the upper part of the mantle transition zone to the surface.

*Speaker

†Corresponding author: yuan.liang.s4@dc.tohoku.ac.jp