Deformation experiments on akimotoite

*Longli Guan[1], Daisuke Yamazaki[1], Noriyoshi Tsujino[1]

1. Institute for Planetary Materials, Okayama University, Misasa, Japan

The ilmenite structure of $MgSiO_3$, known as akimotoite, is inferred to occur in cold subducting slabs in the bottom of Earth's mantle transition zone and the uppermost lower mantle along a low-temperature geotherm (Akaogi et al., 2002). Akimotoite is thought to be the most anisotropic mineral in the Earth's mantle transition zone (Zhang et al., 2005; Weidner & Ito,1985). The elastic anisotropy caused by the lattice preferred orientation of akimotoite due to slab-induced deformation may be used plausibly to interpret the significant seismic anisotropy observed in mid-mantle (depths 410-670km) (Nowacki et ali.,2015; Foley & Long, 2011). However, previous studies did not determine the slip plane or the dominant slip system precisely (Shiraishi et al., 2008). In this study, therefore, we conducted deformation experiment on akimotoite aggregates to investigate precise and detailed microstructures. For the preparation of starting material of akimotoite aggregates for deformation experiment, high pressure experiments using $MgSiO_3$ glass as starting material have been performed at 20-22GPa and 1400 ℃, in the Kawai-type multi anvil apparatus. The recovered samples were investigated by X-ray diffraction, electron probe microanalysis and scanning electron microscopy to identify phase, measure chemical composition and observe microstructure, respectively, showing that samples were well-sintered and no-crack akimotoite aggregates with grain size of 2-8 μm. These akimotoite aggregates were suitable as a starting material for deformation experiments. We subsequently conducted pure shear deformation experiment on such akimotoite aggregates at ~21 GPa and 1200 °C by using high pressure deformation apparatus, so called D-111 type apparatus, installed at Institute for Planetary Materials, Okayama University. The relationship between displacement and load of D-rams may suggest the mechanism change from elastic to plastic deformation with the progress of deformation. As a result, we observed the plastic deformation on the recovered sample and the strain and average strain rate were estimated to be ~0.12 and ~1.6×10^{-5} s^{-1}, respectively. It is considered that the strain of ~0.12 is sufficient to form the lattice preferred orientation which can be analyzed by electron backscattered diffraction technique.

Keywords: akimotoite, lattice preferred orientation, deformation at high pressure, anisotropy , mantle

