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Mechanism of transformation from perovskite to post-perovskite

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The nature of (Mg,Fe)SiO3 compound is quite important to understand the dynamics of the lower mantle, because it is dominantly composed of (Mg,Fe)SiO3-perovskite (Pv), which occupies the volume of the lower mantle to ~75 %, and ferro-periclase, (Mg,Fe)O. Recently, Murakami et al. (2 004) first reported the pressure-induced phase transformation in MgSiO3 from Pv to a higher pressure phase with the CaIrO3 type structure named "post-perovskite" (PPv) at 120 GPa and 23 00 K by using the laser heated diamond anvil cell (LHDAC). Therefore, it is widely accepted that the ubiquitous presence of PPv phase at the bottom of the lower mantle is responsible for formation of the D" layer because many seismic anomalies such as velocity jumps and anisotropy observed in D" layer (e.g., Wysession et al., 1998; Panning and Romanowicz, 2004) can be explained by physical properties of the PPv phase (Iitaka et al., 2004; Murakami et al., 2007a; Murakami et al., 2007b; Merkel et al., 2007; Yamazaki et al., 2006a).
In this study, we conducted two series of high pressure and temperature experiments. Firstly, we observed the phase transition from single crystal of MgSiO3 perovskite to post-perovskite by in situ X-ray high pressure experiment using laser-heated diamond anvil cell. Secondary, we observed the microstructure on the recovered samples partially transformed to post-perovskite of CaSnO3 synthesized by a Kawai-type multianvil apparatus. As a result, we obtained the preliminary result that the mechanism of phase transition from perovskite to post-perovskite at experimental conditions seems to be nucleation and growth.
Although the experimental conditions are limited and only preliminary data is available, this mechanism inferred in the present study is a key factor for understanding the rheology of the core mantle boundary region. For example, the dominant deformation mechanism may be diffusion creep rather than dislocation creep in the region where phase transition initiated in subducted slab reached the core mantle boundary because of small grain size.