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Study Of The Perovskite to Post-Perovskite Transformation Using Multigrain Crystallography

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At P/T conditions of the D" layer, Bridgmanite transforms into its high-pressure phase of (Mg,Fe)SiO_3 post-perovskite(pPv). Observations of seismic anisotropy in D" are inferred to arise from textures and microstructures within pPv. Specifically, mantle flow is though to cause pPv to deform, creating lattice-preferred orientations (Merkel et al, 2006, 2007; Miyagi et al, 2010; Nisr et al, 2012). However, debates emerged in the literature whether experimentally observed textures were induced by plastic deformation of the sample or by phase transformation from a previous phase (Walte et al 2009, Okada et al, 2010, Miyagi et al, 2011) and whether this could explain the observed patterns of anisotropy in the lowermost mantle (Dobson et al, 2013).

Here, we use multigrain crystallography (Sørensen et al, 2012) to characterize hundreds of crystals in a polycrystalline material in-situ as it is transforming. This technique has been recently adapted for Diamond Anvil Cell (DAC) high pressure experiments (Ice et al, 2005; Nisr et al, 2012, 2014; Barton et al, 2012; Zhang et al, 2013, 2016; Rosa et al, 2015, 2016). Potentially, DAC multigrain crystallography is useful for the determination of the orientation and position of individual grains with an average resolution in grain orientation and position below 0.2° and $\sim 5\ \mu$m, respectively (Langrand et al, in press).

We will presents results on the potential resolution of the method with tests on (Mg,Fe)SiO_3 itself and on how the method is now being used for tracking individual grains during the Pv/pPv transition in NaCoF3 up to 25 GPa and at T between 600-900 K. At 600 K, the sample transforms to powder rings and looses the grain microstructure. At 900 K, large grains are preserved as the sample fully transforms to pPv and back to Pv. At the end, the results of such experiments will be used to understand transformation mechanisms between Pv and pPv and the development of microstructures and anisotropy in the Earth's D" layer.