Study Of Perovskite / Post-Perovskite Phase Transformation Mechanism By Using Multigrain Crystallography

Christopher Langrand*[1], Nadège Hilairet[1], Angelika Rosa[2], Volodymyr Svitlyk[2], David Dobson[3], and Sébastien Merkel*[1,4]

[1]Unité Matériaux et Transformations (UMET) – CNRS : UMR8207, Institut National de la Recherche Agronomique - INRA, Ecole Nationale Supérieure de Chimie de Lille (ENSCL), Université de Lille – 59000 Lille, France

[2]European Synchrotron Radiation Facility (ESRF) – ESRF – 6 rue Jules Horowitz BP220 38043 GRENOBLE CEDEX, France

[3]Department of Earth Sciences, University College London – Gower street, London, WC1E 6BT, United Kingdom

[4]Insitut Universitaire de France (IUF) – Institut universitaire de France – 75005 Paris, France

Abstract

At P/T conditions of the D" layer, bridgmanite transforms into its high-pressure phase of (Mg,Fe)SiO3 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. 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 and whether this could explain the observed patterns of anisotropy in the lowermost mantle.

Here, we will focus on the mechanism of transformation on a low-pressure fluoride analogue system (NaCoF3) for which it was suggested that pPv could inherit texture from the parent perovskite (Pv) phase. This inheritance of texture, combined with lattice-preferred orientation in pPv, could explain the observed patterns of anisotropy in the lowermost mantle.

We rely on a novel experimental method, Multigrain Crystallography, to characterize thousands of crystals in a polycrystalline material in-situ, as transformation proceeds. Here, we monitor individual grains during the Pv/pPv transition in NaCoF3 with P/T conditions up to 25 GPa and between 600-1500 K. We follow the distributions of grain sizes and orientations while the sample transforms from the Pv to the pPv structure, and when it transforms back from pPv to Pv. These results allow us to decipher the transition mechanism between both phases, whether it is martensitic or not, and the effect of the transformation on microstructures and grain size distributions, with important implications for our understanding of D" dynamics and anisotropy.

*Speaker