ESRF	**Experiment title:** 3D-xray diffraction and x-ray line profile analysis of dislocations in MgSiO3 perovskite and post-perovskite	**Experiment number**: hs-4233
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Report:

The goal of this experiment was the study of plastic deformation mechanisms in $MgSiO_3$, in the post-perovskite phase. $MgSiO_3$-pPv is the stable phase of $MgSiO_3$ at pressures above 125 GPa and it is believed to be the most dominant mineral of the D” layer, above the core-mantle boundary. D” is a key region of the deep Earth, with observations of significant seismic anisotropy, which is related to the plastic properties of the constituent materials. As such the study of plastic deformation in $MgSiO_3$-pPv is very relevant for our understanding of the deep Earth.

$MgSiO_3$-pPv cannot be quenched in pressure and, therefore, experimental studies have to be performed at pressures above 125 GPa. Also, single crystals of this phase cannot be made and we have to rely on a polycrystalline analysis.

In this run, we decided to take advantage of our newly developed technique for the study of dislocations in materials under high pressure (Nisr et al, 2012). The method relies on 3D X-ray diffraction to follow individual grains within the material, including their individual orientations, positions, and strain tensors. We then use material X-ray line profile analysis (XLPA) to characterize dislocations in the grains using data collected at high resolution, with the detector placed far away from the sample.

Three samples of pure $MgSiO_3$-pPv were prepared at 135 GPa (sample PL1), 133 GPa (SP1), and 130 GPa (PL2), using the offline laser system at ID09. For each we then collected data in a close detector position, 193 mm away from the sample, for 3D-XRD indexation. For obtaining the high resolution data necessary for XPLA, we recorded data on a 3x3 grid of detector positions, 658 mm away from the sample.

For sample SP1, data were collected in steps of $\Delta\omega = 0.5°$ in the ranges ω=-115° to -60° and 65° to 120° at 135, 143, and 165 GPa.

We attempted a 3D-XRD indexation on sample PL1 but data were of poor quality and could not be improved. The sample was therefore discarded.

For sample PL2, data were collected in steps of $\Delta\omega = 0.35°$ in the ranges ω=-105° to -70° and 75° to 110° at 130, 145, and 175 GPa.

Data analysis is under way and will take time. At this time, data collected in sample PL2 appears to be of extremely high quality, much better than that obtained on $MgGeO_3$ at 90 GPa several years ago (Nisr et al, 2012). We are therefore confident that this dataset will give rise to important results regarding the plasticity of $MgSiO_3$ post-perovskite at deep mantle pressures.

References

C. Nisr, G. Ribárik, T. Ungár, G. B. M. Vaughan, P. Cordier, S. Merkel, High resolution three-dimensional X-ray diffraction study of dislocations in grains of MgGeO3 post-perovskite at 90 GPa, Journal of Geophysical Research 117 pp. B03201 (2012) [doi: 10.1029/2011JB008401]