| ESRF | **Experiment title:** Influence of water on mineralogy of the lower mantle | **Experiment number**: ES-1071 |
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| **Beamline**: ID15B | **Date of experiment**: from: 17 November 2021 to:21 November 2021 (ID15B) from: 18 November 2021 to:23 November 2021 (ID18) | **Date of report**: 28 March 2022 |
| **Shifts:** 9 | **Local contact(s)**: Michael Hanfland (ID15b), Georgios Aprilis (ID18) | *Received at ESRF:* |

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**Report:**

The aim of the current experiment was to advance our understanding of high-pressure-high-temperature interactions between rock-forming minerals of lower mantle (*i.e.* ferropericlase and bridgmanite) and water by means of *in situ* synchrotron-based X-Ray diffraction (XRD) and Synchrotron Mössbauer Source (SMS). Several diamond anvil cells have been prepared at the Bayerisches Geoinstut (BGI) prior to the beamtime. A single crystal of ferropericlase as well as enstatite glass powder (as a precursor of bridgmanite) were loaded inside separate DACs together with water acting as a pressure-transmitting medium.

The strategy of the experiment was following: 1) XRD and SMS measurments of the compressed samples at ID15b and ID18 beamlines, respectively, prior to laser-heating (LH) sessions; 2) performance of LH at ID18 beamline and collection of SMS data on the heated spot; 3) XRD mapping of the heated area with collection of the powder and single crystal XRD at ID15b beamline; 4) depending on the sample – pressure increase or DAC reload.

In the course of the experiments, we have studied ferropericlase-water interaction in the pressure range 40-65 GPa and temperature range 1400-2300 K. We have discovered that depending on the pressure, ferropericlase decomposes into $(Fe, Mg)_3O_4$ or $(Fe, Mg)_{6.3}O_9$ oxides. Formation of the former oxide has not been known before upon break down of ferropericlase and is of high geological interest. Our preliminary results on decomposition of enstatite $(Mg,Fe)SiO_3$ in water-rich environment at pressures 25-45 GPa and 1500-2000 K at show that phase D is formed along with stishovite and bridgmanite. That implies that the chemical reactions in lower mantle are more complicated than previously thought. Future investigations at pressures up to 135 GPa (pressure of lower mantle-core bondary) are needed to obtain a comprehensive picture of ferropericlase-water anf bridgmaite-water interactions in the geological enviroment. The detailed analysis of the collected data is ongoing.