ESRF	**Experiment title:** P/T phase diagram an inner-core analogue: high P/T behaviour of an Mg-Zn-Al alloy	**Experiment number**: ES-630
Beamline: ID 06	**Date of experiment**: from: 02-feb-2018 to: 05-feb-2017	**Date of report**: 5-mar-2018
Shifts: 9	**Local contact(s)**: Kristina Spektor	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Sébastien MERKEL (Unité Matériaux et Transformations, CNRS, Université Lille 1, France)

Julien CHANTEL (Unité Matériaux et Transformations, CNRS, Université Lille 1, France)

Nadège HILAIRET (Unité Matériaux et Transformations, CNRS, Université Lille 1, France)

Report:

In this proposal, we wanted to evaluate the high P/T phase diagram and equation of state of Mg-Zn-Al alloys up to 10 GPa and 1000°C using the ID6 multi-anvil press and in-situ x-ray diffraction.

We focused our work on a AZ61A alloy, with a composition of 93-6-1 wt% in Mg-Al-Zn (and other minor elements). In the 3 days of beamtime (9 shifts), we worked on 5 different sample. For each sample, we used approximately 6 hours for increasing pressure, 6 hours for data collection, and 6 hours for lowering pressure.

The beamline was tuned to a wavelength of 0,2296 Å. We used a linear dectector, placed 2043 mm from the sample, and collected data continuously during pressure increases and temperature ramps (Fig. 1)

Each sample was loaded in the multi-anvil press at ID06, with a sample assembly allowing for confining the Mg-alloy sample, heating, a keeping the sample inside the assembly while melting. The highest pressure and temperature conditions reached during the experiment was approximately 9 GPa and 1300 K (Fig. 2).

In one loading, we placed a sample, BN, and Pt. The P-V-T equations of states of BN and Pt will be used using the cross-calibration method to calibrate the temperature vs. power relationship in our assembly. In the other loading, and in order to avoid chemical reactions between Pt and the Mg-alloy, the Mg-alloy was placed alone inside a BN sleave. For T, we will use the calibration described above. P will then be determined from the P-V-T equation state of BN.

The data is now being processed and will allow us to characterise the phase diagram and P-V-T equation of state of this Mg-alloy. They will also be used as a reference for a deformation experiment coming up in April 2018.

The long term goal of this project is to investigate the effect of high temperature and partial melting on the plasticity of an hcp metal, analogue to hcp-Fe, under pressure. This is relevant for understanding the mechanical behaviour and anisotropy of the metal alloy of the Earth's inner core. Now that the phase diagram and equation of state of our Mg analogue is validated, we will start the study of its plastic properties during our next beamtime.

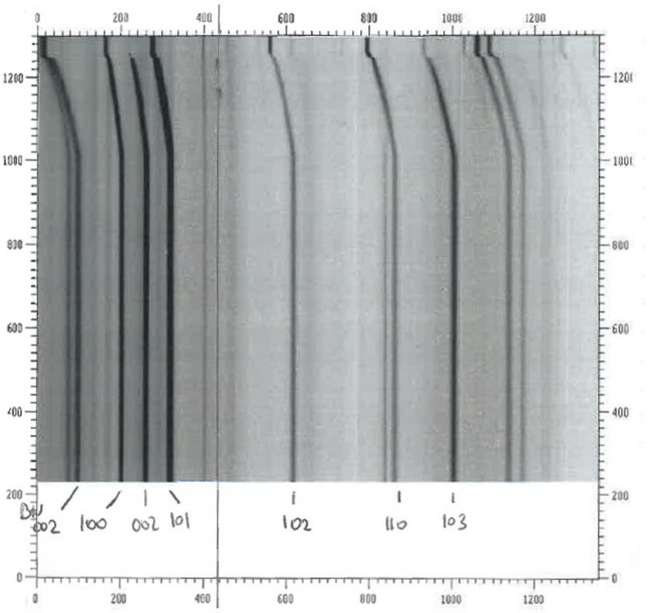

Figure 1: Sample in-situ x-ray diffraction data collected during the cold-compression of the Mg-alloy. Diffraction peaks from the sample are labelled in the image. The image is a composite of ~1000 diffraction images collected during compression.

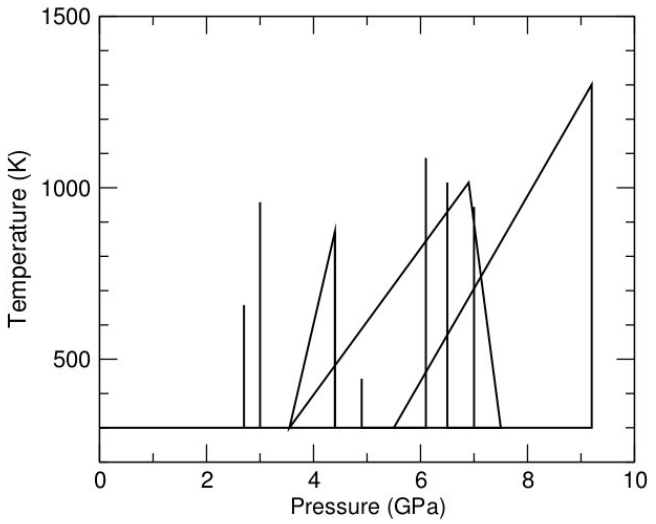

Figure 2: first estimate for P/T space covered with the 5 samples in this study. The coverage is good a will allow to constrain the P-V-T equation of state and phase diagram of the alloy in this range.