

	<b>Experiment title:</b> Do rare gases remain inert under deep Earth conditions? The case of Ar and Xe.	<b>Experiment number:</b> <b>HS3158</b>
<b>Beamline:</b> ID27	<b>Date of experiment:</b> from: Nov.3 2006 to: Nov.7 2006 from: Mar.10 2007 to: Mar.13 2007	<b>Date of report:</b> 29/08/2007
<b>Shifts:</b> 21	<b>Local contact(s):</b> M. Mezouar	<i>Received at ESRF:</i>
<b>Names and affiliations of applicants (* indicates experimentalists):</b> C. Sanloup, Université Paris-6 and Institut de Physique du Globe de Paris Now at School of Geosciences and CSEC, University of Edinburgh, UK A. Dewaele, CEA- DPTA/SPMC, B.P. 12, F-91680 Bruyeres-le-chatel, France B. Schmidt, Georg-August Universitaet Goettingen, D-37077 Goettingen, Germany		

## Report:

This proposal was divided in two experimental sessions, as high pressure and temperature conditions were generated by a Paris-Edinburgh press, allowing to work with relatively large samples, and by laser-heated diamond-anvil cells in order to reach higher pressure conditions but also to avoid the contact at high temperature between the samples and a Pt capsule, which is used in large volume experiments.

The chemical systems studied were: Xe-natural olivine ( $\text{Mg}_{0.9}\text{Fe}_{0.1}\text{SiO}_4$ ), Ar-natural olivine, and Ar- $\text{SiO}_2$ .

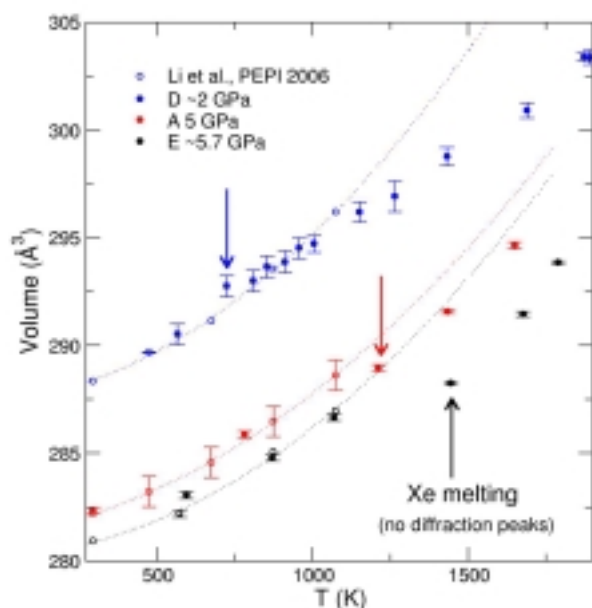


Fig.1: Cell volume of olivine in Xe-olivine runs.

## Results:

### *Paris-Edinburgh cell experiments:*

For the Xe- $(\text{Mg}_{0.9}\text{Fe}_{0.1})_2\text{SiO}_4$  samples, we observed a very similar sequence of events as in the previous Xe- $\text{SiO}_2$  experiments<sup>1</sup>:

- no liquid Xe observed above its melting point
- formation of a Pt-Si liquid quenched as  $\text{Pt}_3\text{Si}$
- distortion of olivine cell-parameters and deviation of its volume from its normal HT equation of state<sup>2</sup> (see Fig.1).

Preliminary chemical analysis on recovered quenched samples show an anti-correlation between the Xe and the Si atomic contents, while none is observed for Fe or Mg. A substitution of Xe to Si in the olivine crystalline network therefore seems to happen at high pressure and temperature, as it was proposed in quartz<sup>1</sup>.

*Diamond-anvil cell experiments:*

Below 6 GPa, results obtained in the Paris-Edinburgh cell were reproduced, i.e. no observation of any other phase besides olivine above the melting point of the rare gas. Cell parameters have been refined for olivine and also show a distortion.

Above 6 GPa, a striking observation for experiments on natural olivine is that, with either Xe and Ar it decomposes upon laser heating into FeO+ HP-pyroxene+ Mg-rich olivine (almost no Fe left). The pressure onset of this decomposition corresponds to the pressure onset of Ar solubility drop in olivine melt<sup>3</sup>. If Ar was behaving in a similar way to Xe in the olivine crystals, this coincidence could help us to provide a physical explanation for the abrupt drop of Ar solubility.

**References:**

- 1- Sanloup et al., Science, **310**, 1174, 2005.
- 2- Liu et al., PEPI, **157**, 188, 2006.
- 3- Chamorro Perez et al., Nature, **393**, 352, 1998 ; Bouhifd and Jephcoat, Nature, **439**, 961, 2006.