EUROPEAN SYNCHROTRON RADIATION FACILITY

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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** **In situ monitoring of Iodine's degassing at pressure and temperature**	**Experiment number**: EC656
Beamline: Id27	**Date of experiment**: from: 09/06/2010 to: 14/06/2010	**Date of report**: 20/02/2012
Shifts: 18	**Local contact(s)**: M. Mezouar	*Received at ESRF:*

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Report:

Among the volatile elements present in our solar system, iodine is involved in mechanisms of primary importance during planet's evolution. The different isotopic signatures of $^{129}Xe/^{132}Xe$ for mantle and atmosphere between the Earth and Mars may reflect an early fractionation of xenon with respect to iodine. The role of fluids and more especially water is seriously envisaged to generate such a fractionation because whereas iodine is hydrophilic, xenon is not. Therefore iodine's early degassing with a water-rich fluid from a magma ocean is a good hypothesis to explain iodine, but also chlorine and bromine losses during early differentiation stages of the Earth. It was also shown that iodine is involved in natural ozone destruction in the Earth's atmosphere. Today we are able to detect iodine in volcanic emissions. The intensive subduction-zones volcanic degassing may explain the presence of iodine in the atmosphere if degassed together with water. The combination of synchrotron X-Ray characterization with diamond anvil cells, applied as magmatic and mantelic reactors to simulate pressure and temperature conditions of the planet interiors allows: (1) the characterization of fluids (aqueous, melt, supercritic) existing in the Earth; (2) element transfers via such fluids from depths to planets surfaces.

Here, we have experimentally monitored iodine degassing from high pressure hydrous melts in situ in diamond anvil cells DAC by measuring iodine partitioning between aqueous fluids and hydrous melts during decompression (Figure 1). DAC experiments have been combined with high energy Synchrotron X-Ray Fluorescence, and high energy Synchrotron X-Ray

Diffraction at the Id27 beam line. Temperature was measured thanks to thermocouples attached to the diamond anvils, pressure was monitored by SXRD measurements on gold, and by using the equation of state of water (Saul and Wagner, 1989).

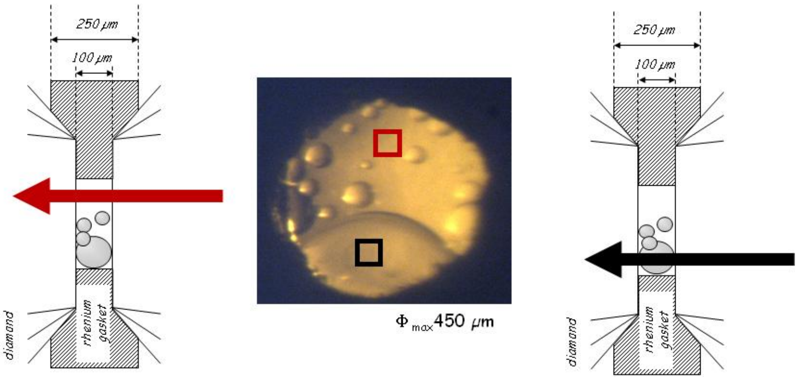

Figure 1 : central :picture of the sample chamber at pressure and temperature. Left side: sketch of the diamond anvils, gasket and sample chamber crossed by the X-Ray micro-beam, analysis of the fluid phase, in red. Right side : same than left side, the melt phase is analysed, in black.

The first runs were devoted to experiments performed with internally heatted diamond anvil cells IHDAC. We use a magma analogue: haplogranite, and saline solutions containing iodine, an example of results is presented figure 2.

The last runs were devoted to an attempt to combine IHDAC with laser heatting *in situ* in the DAC in order to characterize natural basalts.

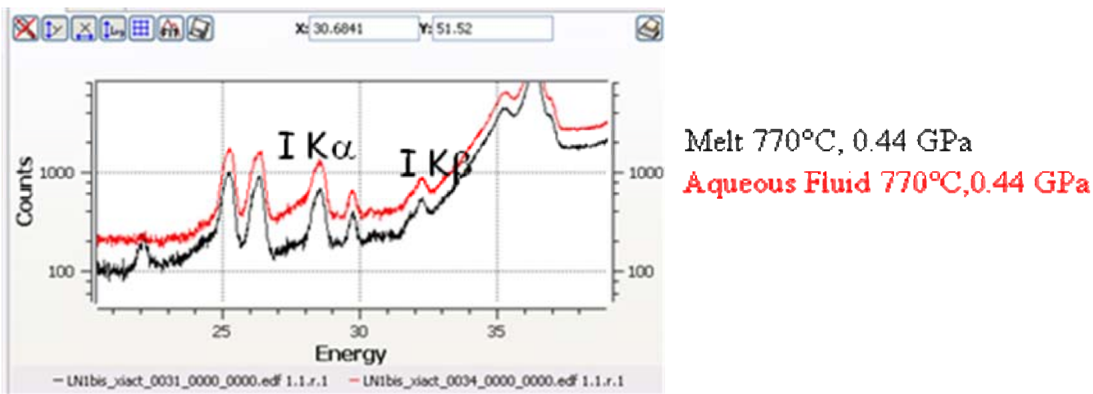

Figure 2: SXRF spectra obtained in situ in a IHDAC at 770°C and 0.44 GPa during equilibrium between the silicate melt (black) and the aqueous fluid (red). Iodine K alpha and K beta rays allow the determination of the iodine contents in both phases thanks to the PyMCA software(Solé t al., 2007).

Partition coefficients ($D^{I}_{fluid/melt} = C^{I}_{fluid}/C^{I}_{melt}$) have been measured in situ from 700 to 910 °C and from 0.5 to 1.8 GPa. First results show that they are ranging from 1.9 (1.4 GPa) to 20 (0.5 GPa) and seem to tend to unity close to total miscibility between melts and aqueous fluids. At low pressure conditions iodine partition coefficients are higher than those of bromine (Bureau et al., 2010,) confirming the higher affinity of iodine for water. These results are in agreement with the hypothesis of iodine early magmatic degassing process to generate I fractionation from Xe.

References

Bureau et al., 2010, GCA 74, 3839-3850.
Saul and Wagner, 1989, J. Phys. Chem. Ref. Data 18, 1537-1564.
Solé et al., 2007, Spectrochim. Acta B 62, 63-68.