EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

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**: BM30B CRG
Beamline: FAME	**Date of experiment**: from: 19/10/2010 to: 26/10/2010	**Date of report**: 20/02/2012
Shifts: 18	**Local contact(s)**: D. Testemale	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

H. Bureau, IMPMC, CNRS-UPMC, Paris

M. Marocchi, IMPMC, CNRS-UPMC, Paris

A. Ricolleau, IMPMC, CNRS-UPMC, Paris

P. Munsch, IMPMC, CNRS-UPMC, Paris

C. Raepsaet, CEA Saclay

M. Carrière, CEA Grenoble

Report:

Among the volatile elements present in our solar system, iodine is involved in mechanisms of primary importance during planet's evolution. The understanding of iodine's behaviour in terrestrial or extra terrestrial magmas, in present, and past geochemical cycles (magma ocean stages), at deep and shallow levels, is of crucial importance. 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.

This project aims at monitoring iodine's degassing from hydrous silicate magmas during decompression (i.e. magma ascent from depth). Due to the volatile properties of water and iodine, such a study has to be performed at pressure and temperature. 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.

This experiment was following the experiment EC656 performed at the Id27 beam line in June 2010. We have followed the same strategy in order to 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, at the FAME beam line.

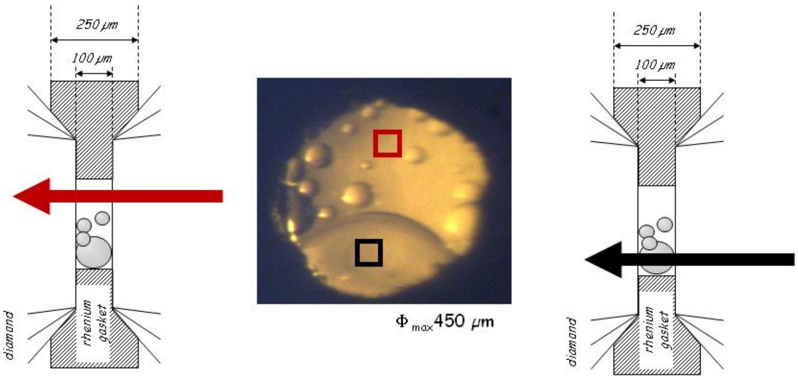

Figure 1 : central :picture of the sample chamber at pressure and temperature. Left side: sketch of the diamond anvils, gasket and sample chamber crossed by the X-Ray micro-beam, analysis of the fluid phase, in red. Right side : same than left side, the melt phase is analysed, in black.

All of the runs were devoted to experiments performed with internally heatted diamond anvil cells IHDAC. We use a magma analogue: haplogranite, and saline solutions containing iodine. We focussed on the pressure and temperature conditions missing after the EC656 experiment in order to complete the set of data we obtained in june.

This time, partition coefficients ($D^{I}_{fluid/melt} = C^{I}_{fluid}/C^{I}_{melt}$) have been measured in situ from 480°C to 735°C and from 0.1 to 1.3 GPa (compared to EC656 conditions : 700 to 910 °C; 0.5 to 1.8 GPa). All of the results show that partition coefficient range from 1.9 to 35.
Thanks to the data obtained in FAME we are able to confirm that (1) the partition coefficient tend to be equal to one close to total miscibility between melts and aqueous fluids. (2) At low pressures (< 0.5 GPa) iodine partition coefficients are higher than those of bromine (Bureau et al., 2010,) for similar pressure and temperature conditions, confirming the stronger affinity of iodine for water during magma degassing.

These results show that a iodine early magmatic degassing process has possibly generated I fractionation from Xe. They also evidence that for modern volcanism, iodine is efficiently degassed during volcanic eruption, which may be the source of iodine mesaured in the stratosphere and strongly involved in ozone depletion.
A publication is in preparation.

References
Bureau et al., 2010, GCA 74, 3839-3850.