ESRF	**Experiment title:** Structure and density of silicate melts at deep mantle conditions.	**Experiment number:** **HD212**
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Report:

The structure of silicate liquids over most of the mantle pressure regime is unknown. Except one *in situ* study up to 6 GPa[1], our information on structural changes under pressure comes from the study of glasses, either P-quenched or under pressure. **This proposal was designed to start filling the important gap in our knowledge of the properties of silicate melts at deep mantle conditions.** It aimed at measuring the structure and density of simple silicate melts: fayalite (Fe_2SiO_4), natural olivine ($(Mg,Fe)_2SiO_4$), the major mineral of the upper mantle, and almandine ($Fe_3Al_2(SiO_4)_3$) to check the effect of Al.

Experiments were conducted using laser-heated diamond-anvil cells equipped with Boelher-Almax seats. We worked at the iodine K-edge (33 keV), and data were recorded on a CCD-MAR.
Preliminary results have been processed for fayalite melt obtained at 10 GPa and 2500 K. The liquid scattering raw signal (Fig.1) has been processed by substracting the background signal taken from the closest point before melting. Structure factor and radial distribution function (Fig.2) were then calculated.
Our data can be compared to ambient pressure molecular dynamics calculations on liquid fayalite[2], and to the 6 GPa data[1] previously obtained on molten $MgSiO_3$.

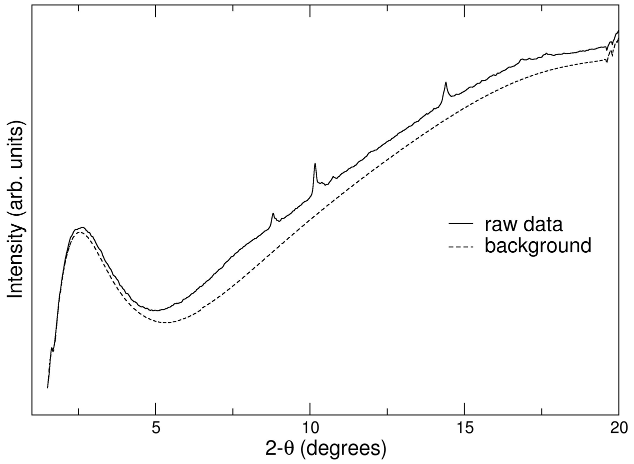

Fig.1: Diffraction signal from molten fayalite at 10 GPa (raw data); solid diffractin peaks come from the MgO pressure transmitting medium.

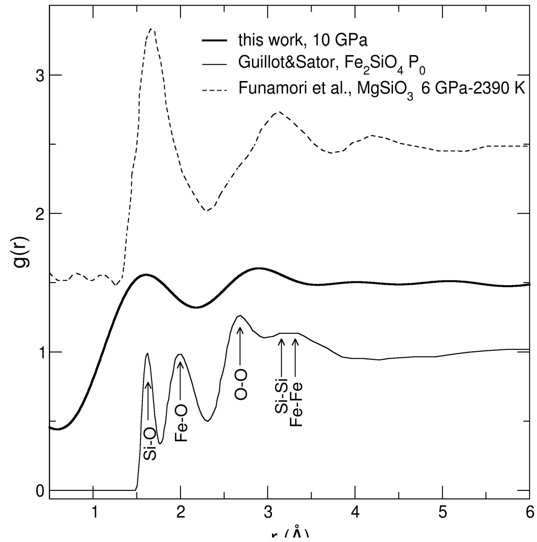

Fig.2: Radial distribution functions.

As noticed by Funamori et al.[1], there is a significant broadening of the peaks in g(r) at high pressure. The position of the first coordination shell in g(r) is 1.61 Å for liquid fayalite at 10 GPa, attesting that Si is still in tetrahedral configuration. Using the x-ray diffraction based method[3] as implemented by[4], we find a density of 3724 $kg.m^{-3}$.

Quench sample was analyzed by Raman spectroscopy and scanning electron microscopy. They revealed the co-existence of magnesiowustite $(Mg_{0.5-0.6},Fe_{0.5-0.4})O$ and of γ-$(Mg_{0.5-0.7},Fe_{0.5-0.3})_2SiO_4$ in the heated zone. Fe was therefore exchanged between the pressure transmitting medium, MgO, and fayalite upon heating. The density we obtain for this composition is in very good agreement with theoretical predictions, being intermediate between values calculated for natural olivine and fayalite[5].

Conclusion and perspectives:

These preliminary results show that it is possible to get x-ray diffraction data on molten silicates using diamond-anvil cell techniques, and that these data are of high quality allowing us to extract structural information. These data are also a record in pressure for molten silicates. We wish to pursue these experiments on molten olivine at higher pressures in order to reach the Earth's lower mantle domain, and then to extend them to other silicate melts, less Fe-rich but closer to natural compositions.

References:

1- Funamori et al., J. Geophys. Res., 109, B03203 (2004).
2- Guillot et Sator, GCA, 71, 1249 (2007).
3- Eggert et al., Phys. Rev. B, 65, 174105 (2002).
4- Sanloup et al., Phys. Rev. Lett., 100, 075701(2008).
5- Guillot et Sator, GCA, 71, 4538 (2007).