ESRF	**Experiment title:** Structure of liquid aluminosilicates at high pressure: an exploratory study	**Experiment number**: ES-31
Beamline: ID27	**Date of experiment**: from: 19 Jul 2013 to: 23 Jul 2013	**Date of report**: 29/01/2014
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Report:

Magma-related processes are governed by structural transformations that take place in silicate liquids under the high pressure and temperature conditions experienced deep within the Earth. However, despite their importance, the high pressure structure of silicate melts is relatively unknown; the few *in situ* measurements which have been reported are limited to low pressures < 10 GPa [1-4]. However, we recently reported *in situ* diffraction measurements of an iron bearing liquid silicate at pressures up to 60 GPa by employing a YAG laser-heated diamond anvil cell (LH-DAC) [5].

Anorthite ($CaAl_2Si_2O_8$), the calcium-rich endmember of the plagioclase solid solution series, the most common rock forming minerals, is an ideal candidate for further investigation of the high-pressure structure of liquid magmas. However, it is not possible to melt this composition using a conventional YAG laser-heating setup without the addition of a metallic coupler. To overcome this we made the first CO_2 LH-DAC measurements for liquid anorthite at pressures up to 32.4 GPa at the ID27 beamline.

The *in situ* CO_2 LH-DAC x-ray diffraction measurements of liquid $CaAl_2Si_2O_8$ were made with an incident x-ray wavelength of 0.3738 Å. To improve the maximum scattering vector, Q_{max}, and hence resolution in real-space, the type IIac diamonds were mounted on wide opening (70°) Boehlmer-Almax seats and the direct beam was centered at one edge of the MarCCD detector with a sample to detector distance of 221.13 mm. A 20 μm thick

compressed platelet of $CaAl_2Si_2O_8$ glass was placed between two platelets of KCl, for thermal insulation, in a 250 μm hole in the Re gasket separating the diamond anvils. With the x-ray beam aligned at the center of the laser spot, the laser power was increased. X-ray diffraction patterns were taken with acquisition times of 10 s and melting was determined from the absence of crystalline Bragg peaks in the sample intensity. Pressure was determined from the PVT equation of state of KCl [6]. The two-dimensional diffraction patterns were radially integrated using the program FIT2D, employing a mask to eliminate the crystalline Bragg peaks arising from the KCl thermal insulation layers and the single crystal diamonds. The data were corrected for background by subtracting the measured scattering intensity of the diamond anvils with an empty gasket, recovered from a high pressure run.

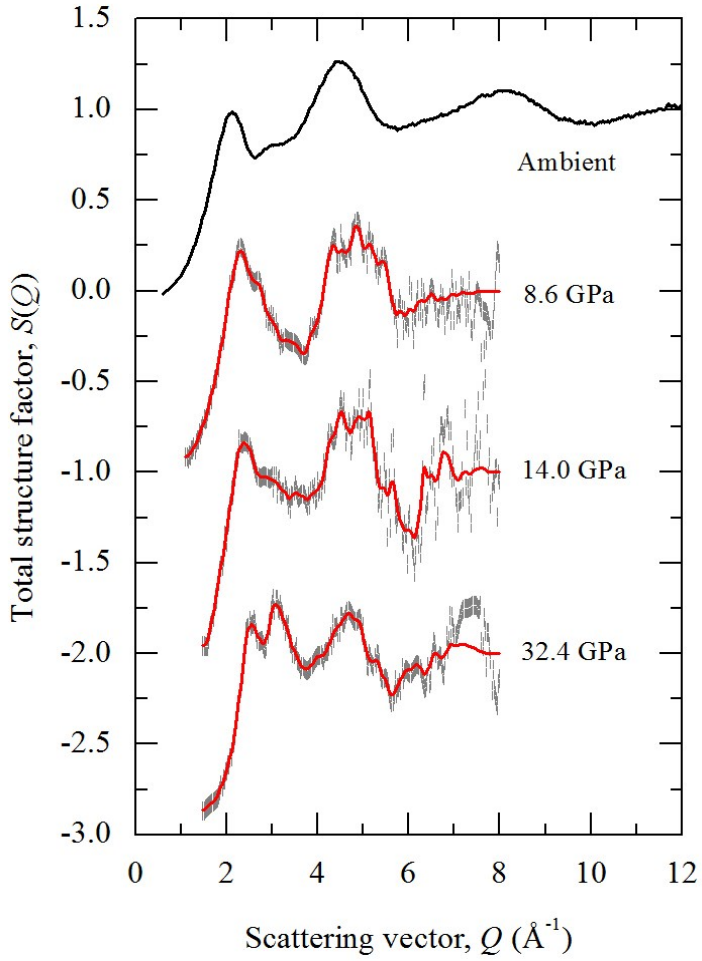

Figure 1: The total structure factors, $S(Q)$, for liquid anorthite measured at ID27 at 8.6, 14.0, and 32.4 GPa (error bars and red curves). For comparison, the ambient pressure $S(Q)$ for liquid anorthite previously measured at ID11 is also shown (black curve).

The measured total structure factors, $S(Q)$, for liquid Anorthite at 8.6, 14.0 and 32.4 GPa are shown in figure 1. There are measurable changes between the $S(Q)$ functions with increasing

pressure e.g. the first peak at 2.1 $Å^{-1}$ at ambient pressure reduces in intensity and shifts to higher *Q*-values with the appearance of a second peak at 3 $Å^{-1}$.

A full real-space analysis of the high pressure liquid measurements is underway and will be complemented by molecular dynamics simulations over the full pressure range.

References

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