ESRF	**Experiment title:** Structure of olivine melts at high pressure	**Experiment number**: ES-95
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Names and affiliations of applicants (* indicates experimentalists):

Dr James Drewitt* (University of Edinburgh)

Mr Philip Dalladay-Simpson* (University of Edinburgh)

Report:

Olivine $(Mg,Fe)_2SiO_4$ is one of the most abundant minerals within the mantle of the Earth and other terrestrial planets. Polymorphic transitions in such minerals at the high pressure (*P*) and temperature (*T*) conditions experienced deep within planetary interiors and corresponding changes in physical properties such as density and compressibility have a large effect on geophysical processes. For example, the 400 km seismic discontinuity in the Earth's mantle results from the phase transition of olivine to its high pressure β-spinel (wadsleyite) phase. A second seismic discontinuity at a depth of 660 km is attributed to the breakdown of the higher pressure γ-spinel (ringwoodite) polymorph into $MgSiO_3$-perovskite and (Mg,Fe)O-magnesiowüstite. However, unlike their crystalline counterparts, little information is available on the structural transformations of these melts at high *P-T* conditions. This is due in part to the inherent stuctural disorder in liquids, and to the challenging nature of high *P-T* experiments. Detailed knowledge of the atomic structure and phase transformations that take place in olivine melts at the high *P-T* conditions experienced within planetary interiors is of fundamental importance for understanding geophysical process such as planetary formation, volcanic activity and the response dynamics of meteorite impacts.

In situ x-ray diffraction measurements, with an incident x-ray wavelength λ=0.3738 Å, were made for molten fayalite, Fe_2SiO_4, at pressures up to 22 GPa and san-carlos olivine, $(Mg_{0.88}Fe_{0.12})_2SiO_4$, at 4 GPa in a diamond anvil cell with Nd-YAG laser heating. The samples were loaded into 250 μm diameter holes in rhenium gaskets and thermally insulated

from the diamonds by crystalline SiO_2. Diffraction patterns were recorded using the MarCCD detector as the samples were gradually heated by increasing the laser power and melting was determined by the absence of crystalline Bragg peaks in the sample scattering signal (see figure 1). To improve the maximum scattering vector, Q_{max}, and hence resolution in real-space, the 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 220.87 mm.

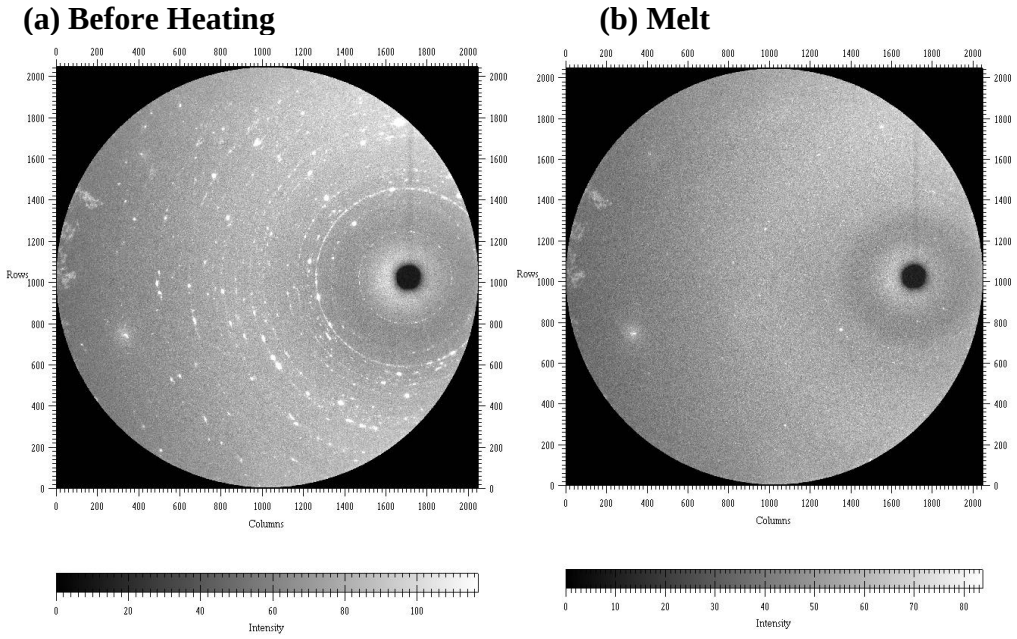

Figure 1: 2D MarCCD diffraction images made for fayalite in the diamond anvil cell at P=15 GPa (a) before heating and (b) during melting at T > 2500 K.

The temperature was monitored by measuring the pyrometric signal emitted from the sample and pressure was determined from the frequency shift of the fluorescence peak of a ruby chip incorporated into the edge of the sample. The two-dimensional diffraction patterns were radially integrated using the program FIT2D.

In order to interpret the liquid structure measurements, the data is corrected for background by subtracting the measured scattering intensity of the diamond anvils with an empty gasket recovered from a high pressure run. The data sets are then normalised to produce the total structure factors, $S(Q)$, and, by Fourier transformation, the total pair distribution functions, $G(r)$ of the molten samples. This analysis is currently in progress.