Poster

Laser-heated rapid decompression of enstatite ($Mg_2Si_2O_6$): Constraining impact barometry

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The high velocity bombardment of planetary bodies via asteroid, comet, and meteorite impacts contributes to various processes in planetary genesis, evolution, and habitability [1–3]. The determination of the peak shock pressures and temperatures is an essential step to derive the original properties of the impactor and target, interpret magnetic signatures, and study the collision history of planetary bodies in our solar system. Numerous classification schemes have been developed in the past to quantify the shock pressure and temperature conditions based on shock induced alterations in the atomic and microstructural level of minerals and rocks. These classifications are very robust for shock stages S1-S4 across a broad set of rocky meteorites. Controversy remains for the classification schemes of highly shocked meteorites in the shock classes S5 (45-55 GPa) and S6 (>60 GPa) due to the fact that these classifications are mainly based on the localized phenomena of melt veins, and the high pressure phases therein. However, the use of high pressure minerals and their equilibrium pressure-temperature stability fields as proxies for shock-thermo-barometry remains controversial, since the shock conditions inferred from the high pressure minerals are significantly lower than those concluded from the S5 and S6 shock classification and the general shock deformation features found in rock forming minerals [4].

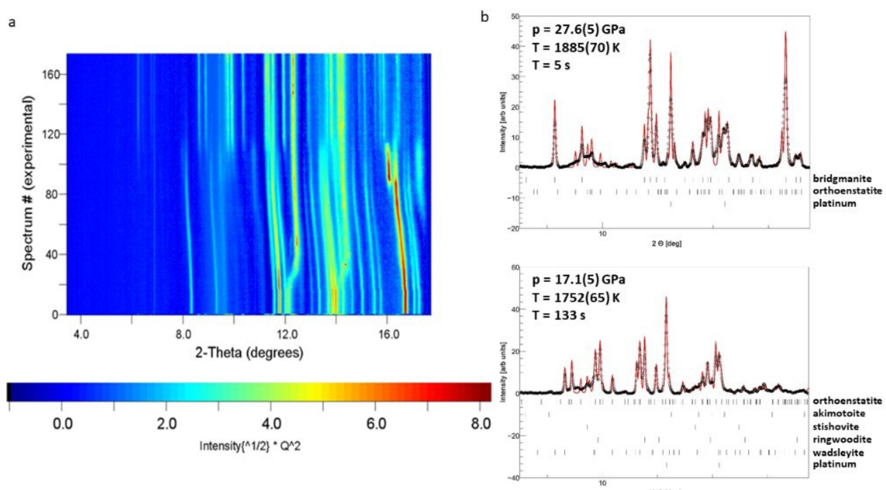

Figure 1. (a) Contour plot showing the evolution of diffraction patterns with time (spectrum # is equivalent to time in seconds) at high temperature (~1700 K) with a rapid decompression rate of 0.15 GPa/s. Phase transitions are clearly visible in the plot by the appearance and disappearance of diffraction signal. (b) Fits of selected data points at 5 and 133 seconds into the decompression run. The observed data are shown as black circles, the red line represents the calculated pattern, and the peak positions of the identified phases are shown below the patterns as tick marks.

Here, we present the results of time-resolved X-ray powder diffraction experiments of enstatite during fast decompression at high-temperature. Although these experiments don't replicate the dynamic conditions during shock, they provide unique insight into changes and processes along the decompression pathway.

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