ESRF	**Experiment title:** High-pressure High-temperature Angle Dispersive X-ray diffraction study of $MgSiO_3$ perovskite	**Experiment number:** HS189
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Report:

We report new measurements of the equation of state of $MgSiO_3$ perovskite at pressures up to 86 GPa and temperature up to 2700 K. The pressure and temperature field explored has thus been largely extended compared to the one described in the previous report (HS133). Laser-heating techniques have been improved, thanks for instance to the use of the ECC (Extreme Conditions Consortium) high-power multimode infrared YAG laser, that allowed us to reach higher pressures. The water-cooled channel-cut Si (111) monochromator was used to produce a bright monochromatic X-ray beam from two phased undulators, and angle dispersive X-ray diffraction data were collected from the laser-heated samples at a wavelength of 0.5087 Å over a 29 interval from 4 to 25". Data collection and transfer have been made much easier and efficient, owing to the on line image plate reader (FastScan) available at that time on ID30.

Silicate perovskite $MgSiO_3$ samples were synthesized from synthetic $MgSiO_3$ enstatite crystals or synthetic $MgSiO_3$ glass mixed with platinum powder. These starting materials were loaded in a large aperture diamond-anvil cell and transformed at high-pressure and high-temperature either with a CO_2 or a YAG infrared laser, depending of the pressure transmitting medium used. Temperatures were measured from the analysis of the thermal emission of the samples, recorded during the X-ray diffraction pattern acquisition. Pressure conditions were inferred from the PVT equation of state of platinum, used as internal pressure calibrant.

Le Bail profile refinements were applied to the diffraction patterns, in order to obtain reliable high-pressure high-temperature cell parameters for $MgSiO_3$ as well as for the pressure calibrant up to the pressure of 86 GPa and temperatures of 2700 K. One of the most remarkable result is that Rietveld structural refinements could be achieved on selected patterns at these extreme pressure and temperature conditions, thus giving for the first time precious structural informations on these compounds. One can observe for instance an increase of the internal distortion of the SiO_6 octahedra with increasing pressure.

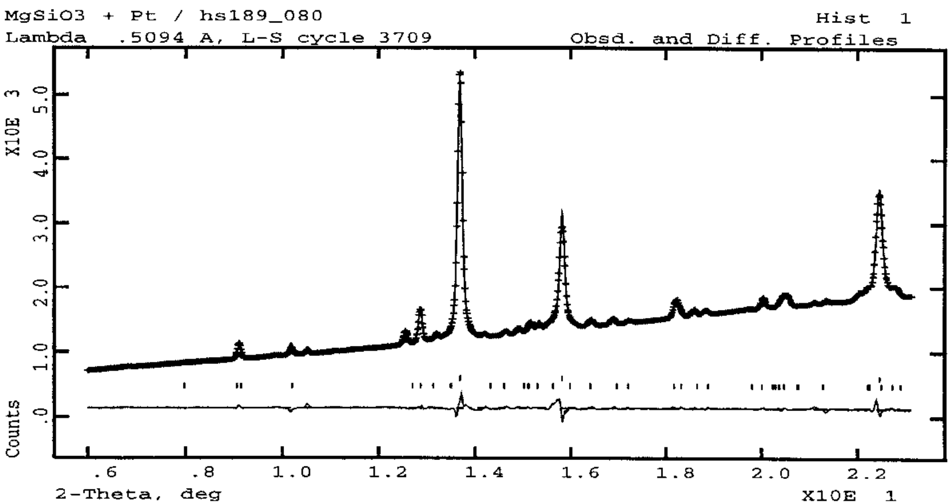

Figure I - Rietveld full structure refinement of a diffraction spectrum of $MgSiO_3$ at 86 GPa and 2310 K integrated from an image plate exposed for 10 mn using a monochromatic beam (0.5087 A) focused to 10 x 20 μm^2. Sample reflections (lower ticks) are mixed with reflections from platinum, the internal pressure calibrant (upper ticks).

Data analysis allowed us to identify a set of thermoelastic parameters, in order to constrain the compositional model of the Earth's lower mantle. Assuming that the thermoelastic parameters obtained from this study are applicable to perovskites with moderate iron content, the comparison of the density and K_T profiles calculated for a mixture of perovskite and magnesiowiistite and for PREM model indicates that a pure perovskite lower mantle is very unlikely. On the other hand, we obtain a very good match with PREM density and K_T profiles for a mixture of 83 vol% $(Mg_{0.93},Fe_{0.07})SiO_3$ perovskite and 17 vol% $(Mg_{0.79}Fe_{0.21})O$ magnesiowüstite.

References

Fiquet G., D. Andrault, A. Dewaele, T. Charpin, M. Kunz and D. Haüsermann. P-V-T equation of state of $MgSiO_3$ perovskite. ***Phys. Earth Planet. Int.,*** in press.

Fiquet G., D. Andrault, A. Dewaele, M. Kunz, T. LeBihan and D. Haüsermann. Thermoelastic properties and crystal structure of $MgSiO_3$ perovskite up to 86 Gpa and 2700 K, in preparation.