ESRF	**Experiment title:** **Elasticity of MgO to 130 GPa; sound velocities from the crust to the core-mantle boundary**	**Experiment number**: HS-1494
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Shifts: 36	**Local contact(s)**: Alain Mermet	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

James Badro*, CNRS, Laboratoire de Minéralogie—Cristallographie, Paris

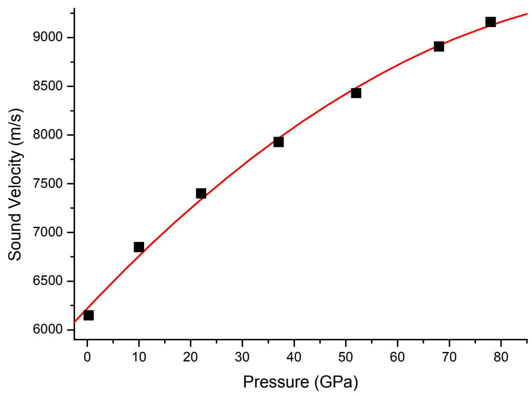
Guillaume Fiquet*, CNRS, Laboratoire de Minéralogie—Cristallographie, Paris
François Guyot*, Univ. Paris 7, Laboratoire de Minéralogie—Cristallographie, Paris

Report:

Given the success we obtained in measuring sound velocities and acoustic phonon dispersion curves in iron up to pressures above a megabar in 2000, we tried to measure the scattering of high energy photons by acoustic phonons at high pressure in MgO powder, which is a model constituent of the Earth's lower mantle. Unfortunately, the scattering signal was too weak due to the low Z numbers (relatively to iron) of Magnesium and Oxygen (the signal is proportionnal to Z^2) and above all, the energy of the longitudinal acoustic phonons was very close to that of the transverse acoustic phonon of diamond. This made the signal unmeasurable and the experiment unfeasible (it will be tried with a single crystal of MgO, where the overlap and signal problems can be solved).

We then tried to measure the same thing on (Mg,Fe)O, with 20% iron content, which is the *real* deep Earth compound and not just a model. The idea was that the Fe content brings sound velocities down (which solves the overlap problem) and that it raises the average Z of the sample, which takes signal up. Unfortunately, we ran through another problem; in fact, the Fe,Mg disorder (it is a substitutional reaction) in the (Mg,Fe)O matrix broadens considerable the contribution from the quasi-elastic signal, to an extent that the phonons cannot be measured once again. In this case, we really do not see how we can solve the problem (an (Mg,Fe)O single-crystal will not solve the problem), except by looking at very large scattering angles, or by looking at very small iron content.

So we finally tried the other end-member, which is FeO. In this case now, the signal was strong enough to be measured, and there was no static disorder. In these conditions, we managed to measure the inelastic scattering spectra up to 78 GPa and we measured the structure by diffraction at the same time. The latter information served to measure the unit cell volume and therefore density, so we could not only plot the sound velocities as a function of pressure but also as a function of density (Birch plot). The result is in the figures below.



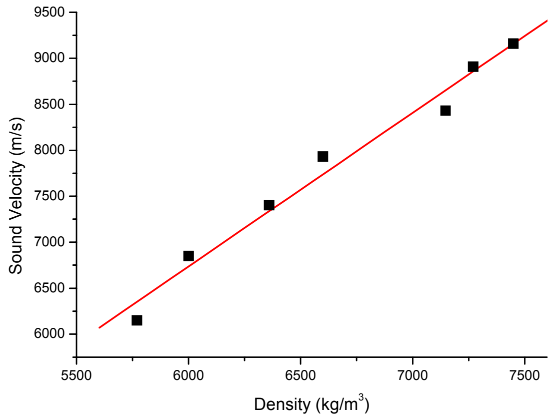


Figure: Compressional sound velocities in FeO at high pressure vrsus pressure (left) and density (right). One can see in the figure on the right that FeO obeys the empirical Birch law that states that compressional sound velocities are a linear function of density.

We also measured the spectrum of FeS at two pressures, in order to check feasibility. The study of FeS will be the topic of a forthcoming proposal at ESRF. These results will be published in the near future.