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Techniques for measuring the elastic Properties of hydrous Minerals and Melts in Multi-Anvil Devices

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During the last few years the resolution and amount of seismic data from the Earth's deep interior increased dramatically. The interpretation of these data requires measurements of the physical properties of Earth materials under experimental simulated mantle conditions. Discovering the huge water storage capacity of nominally anhydrous minerals (NAMs) under high pressure conditions dramatically changed our image of state and dynamics of Earth's deep interior [1]. Corresponding to the available geophysical tools for getting data from great depths elastic and electrical data are of special interest for mineral physics. Seismology is characterized by high resolution, MT techniques by strong sensitivity to hydration effects and melts.

Diamond anvil cells (DAC) and multi-anvil devices (MAD) are the most important high pressure tools for mineral physics. Especially Brillouin scattering [2] and double-sided laser heating made DACs a powerful tool for measuring elastic properties under extreme conditions of pressure and temperature. In fact MADs are more limited in pressure, but use samples 3 to 7 orders of magnitude bigger, they have small temperature gradients over the whole sample size and their values can even be controlled, they can investigate anisotropy effects, they can study structural effects in complex systems, they have no limits for opaque samples, they can use encapsulated samples, they allow to measure both elastic wave velocities by ultrasonic interferometry, they also allow recording of acoustic emissions during phase transition and dehydration, they allow tomography measurements at high pressures, and they are even able to measure elastic attenuation in the seismic frequency range [3], recently. An indispensable condition for this full performance of a MAD is its installation at an up to date

synchrotron. Only synchrotron radiation allows in situ pressure measurement, in situ X-ray diffraction (XRD), in situ deformation measurement, as well as in situ density and viscosity measurements of melts. We review recent techniques and present developments and results for MADs [4, 5].

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