Measurements of Elastic and Inelastic Properties of Polycrystalline Samples under Simulated Earth's Mantle Conditions in Large Volume Apparatus

Hans J. Mueller*[1], Frank Schilling[1], Christian Scheffzük[1], and Birgit Müller[1]

[1]Karlsruhe Institute of Technology (KIT) – Adenauerring 20b, Karlsruhe, D-76131, Germany

Abstract

The interpretation of highly resolved seismic data from Earth=s deep interior require measurements of the physical properties of Earth's materials under experimental simulated mantle conditions. More than a decade ago seismic tomography clearly showed subduction of crustal material can reach the core mantle boundary under specific circumstances. Considering this geophysical high pressure research is faced the challenge to increase pressure and sample volume at the same time to be able to perform in situ experiments with geophysical representative complex samples. Recent large volume presses at synchrotrons provide sample volumes 3 to 7 orders of magnitude bigger than in diamond anvil cells far beyond transition zone conditions. The sample size of several cubic millimeters allows elastic wave frequencies in the low to medium MHz range. Together with the small and even adjustable temperature gradients over the whole sample this technique makes anisotropy and grain boundary effects in complex systems accessible for elastic and inelastic properties measurements in principle. The real elastic wave propagation have also no limits for opaque and encapsulated samples. Using triple-mode transducers and the data transfer function technique for ultrasonic interferometry makes transient measurements in complex systems under non-equilibrium conditions possible. Ultrasonic interferometry necessarily requires in situ sample deformation measurement by X-radiography. In situ falling sphere viscosimetry require time-resolved X-radiography. Using a D-DIA even the measurement of elastic and inelastic properties in the seismic frequency range is achievable. The paper presents techniques and results of recent experimental high pressure geophysics in LVPs.

*Speaker