Simultaneous mHz and MHz Elastic Moduli Measurements at High P & T

Donald J. Weidner, Li Li, Matthew L. Whitaker, Haiyan Chen, and Richard Triplett
Mineral Physics Institute, Stony Brook University

We present an experimental protocol using a DDIA at a synchrotron that simultaneously yields Young's modulus at mHz frequencies and the bulk and shear moduli at MHz frequencies. Mineral physics has gathered a vast library of elastic properties for minerals that allow calculations of P and S velocities along with elastic anisotropy at temperatures and pressures that span those of the Earth. However, most of these results are obtained at MHz frequencies or higher using ultrasound, Brillouin spectroscopy, or density functional theory. However, seismology determines these properties at Hz to mHz frequencies for the Earth's interior. In most cases mHz and Mhz elastic properties are the same. However, some processes can disperse acoustic waves yielding a frequency dependence in the acoustic velocities and attendant attenuation. Here we demonstrate a new experimental protocol that yields simultaneous measurements of mHz and MHz elastic properties at the COMPRES beamline, 6BMB at the APS. The high frequency data are obtained from ultrasonic measurements using the DIASCoPE probe while low frequency (mHz) data are obtained from stress/strain measurements with forced oscillations. Together, amplitude and phase yield Young's modulus and Q. Examples of data obtained will be presented.