Mineral Elasticity and Thermal Diffusivity: Crystal Physics and State of Earths Interior

Brown, J. Michael[1]
[1]Earth and Space Sciences, University of Washington, Seattle USA

Laser-induced transient-grating spectroscopy in the form of Impulsive Stimulated Light Scattering is a versatile tool to explore elastic and thermal properties of minerals under extremes of pressure and temperature. Velocities of both body and interfacial elastic waves in single crystals loaded in diamond anvil cells have been reported to very high pressures. Anisotropic thermal diffusivities have been measured to temperatures in excess of 1400 K. These results provide new insight into crystal physics and interpretations of Earth's compositional and thermal state from its seismic structure. The observed high temperature behavior of lattice thermal conductivity in a number of minerals is interpreted with a model for the mean-free path of phonons that takes into account crystal structure and inter-atomic spacing. Thermal anisotropy remains significant at the highest temperatures. In the plagioclase mineral group, all twenty-one triclinic elastic constants of albite, anorthite, and several intermediate compositions have been determined. Relative magnitudes and trends with composition can be rationalized on the basis of feldspar crystal structure. A high degree of seismic anisotropy is predicted in rocks containing feldspars with strong lattice-preferred orientation. The pressure-induced high-spin to low-spin (HSLS) transition in ferropericlase has been established in a number of studies. All three cubic elastic constants were determined to a pressure of 63 GPa in a sample with an iron concentration of 6%. The spin transition is non-first-order and all elastic constants were found to undergo significant softening in the transition region between 40 and 60 GPa. A thermodynamic solution model is consistent with experiments for the loss of magnetization, volume change and pressure of transition, and elastic properties through the transition. In particular, the decrease of the bulk modulus results from stress coupling to the volume change of transition. A change in local site symmetry (the Jahn-Teller distortion) between high-spin and low-spin iron provides a possible mechanism for coupling the transition to the shear modulus. The HSLS thermodynamic theory is used to estimate properties of Earth constituents at high pressures and temperatures. A previously enigmatic change in seismic properties centered near a depth of 1500 km may be associated with this transition.

→

Abs. No. **576**
Meeting: **DMG 2008**
submitted by: **Brown, J. Michael**
email: **brown@ess.washington.edu**
date: **0000-00-00**
Req. presentation: **Vortrag**
Req. session: **S08**