

Outdoor vs Indoor Geophysics

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Abstract

Research in mineral physics is essential for interpreting observational data from many other disciplines in the Earth Sciences, from geodynamics to seismology to geochemistry to petrology to geomagnetism to planetary science. The field of high-pressure mineral physics is highly interdisciplinary. Mineral physicists do not always study minerals nor use only physics; they study the science of materials which comprise the Earth and other planets and employ the concepts and techniques from solid-state chemistry, condensed matter physics, and materials science..

Observations from geochemistry and geophysics studies lead to the development of petrological, seismic and geodynamical models of the Earth's deep interior. The goal of mineral physics is to interpret such models in terms of variations of pressure, temperature, mineralogy/crystallography, and/or chemical composition with depth.

The discovery in 2004 of the post-perovskite phase of MgSiO_3 at pressures in excess of 120 GPa and high temperatures has led to an explosion of both complimentary experimental and theoretical work in mineral physics and remarkable synergy between mineral physics and the disciplines of seismology, geodynamics and geochemistry. Similarly, the observation of high-spin to low-spin transitions in Fe-bearing minerals at high pressures has important implications for the lower mantle of the Earth.

We focus in this talk on recent advances in the use of ultrasonic interferometry to conduct "indoor seismology" experiments to measure sound wave velocities of minerals under the pressure and temperature conditions of the Earth's mantle. Many of these acoustic experiments are now performed in conjunction with synchrotron X-radiation sources at national and international facilities.

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