Elasticity and sound velocities of aluminous $MgSiO_3$ perovskite at high-pressure

J.M. JACKSON

Geophysical Laboratory, Carnegie Insititution of Washington, USA; jjackson@gl.ciw.edu

One of the first order observations of the chemical and physical state of Earth's deep interior are seismic waves passing through the Earth, which reveal more complexity than originally thought [e.g. 1]. Inferences of the mineralogy and chemical composition of Earth's lower mantle must in part depend on comparing accurate laboratory-derived equations of state of candidate lower mantle phases with in-situ seismic observations, because our ability to directly sample the deep Earth is severely limited. Aluminum-bearing magnesium silicate perovskite has been proposed to be the most abundant phase in Earth's lower mantle, occupying roughly half of Earth's volume. Despite its major role in the deep Earth, very little is known about how the incorporation of aluminium affects the sound velocities, in particular the shear properties, of silicate perovskite under appropriate lower mantle conditions.

We will present high-pressure measurements on the sound velocities and elasticity of polycrystalline aluminous $MgSiO_3$ perovskite (containing 5 wt.% Al_2O_3) to 45 GPa at room-temperature. The measurements were made by Brillouin spectroscopy with diamond anvil cells using methanol-ethanol-water or neon as pressure-transmitting media [2]. In light of these results and recent Brillouin measurements on single-crystal $(Mg_{0.94}Fe_{0.06})O$ ferropericlase at high-pressure [3], the mineralogy of the lower mantle will be discussed. The results give insight into whether observed lateral variations of seismic wave speeds in the lower mantle are due at least in part to a chemical origin. It is noteworthy that the shear properties of the materials are important factors in the conclusions reached.

References

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