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Elastic properties of anhydrous and hydrous wadsleyite and ringwoodite at high pressures by Brillouin scattering

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Anhydrous and hydrous forms of wadsleyite and ringwoodite, high pressure phases of (Mg,Fe)2 SiO4 +- H2O, are major constituents of the transition zone of Earths mantle, and are likely abundant in many subducting slabs. Therefore, the seismic properties of these phases are essential to understand the chemical and thermal state of these regions, as well as the seismic signature of water in the mantle to 660 km depth. We have measured the acoustic wave velocities of several key anhydrous and hydrous forms of these minerals to transition zone pressures by Brillouin spectroscopy on samples compressed in a diamond anvil cell. Hydrous samples contained about 2 percent by weight of H2O. These experiments allow us to assess the effects of pressure, Fe, and H 2O on the elastic properties of these phases. These measurements should provide insight on key questions such as the olivine content and hydration state of the transition zone and slabs. It appears that one of the critical issues in addressing the effects of hydration on these phases is the accurate measurement of water content. Our results indicate that determinations of the structurally-bound hydrogen content by SIMS and IR spectroscopy on these samples can vary greatly, by up to a factor of two.

Keywords: water in mantle, elasticity, ringwoodite, wadsleyite, Brillouin scattering