Sound velocities of dense hydrous phase A to 10 GPa and 1073K

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Abstract

Water was believed to be transported into deep Earth through dense hydrous magnesium silicate (DHMS) in subduction zones. Among those phase A is of particular interest, as it forms after the breakdown of antigorite serpentine in cold subducted slabs, and may be the dominant hydrous phase within the upper mantle condition. In this study, we present the sound velocities and elastic properties of phase A, $Mg_7Si_2O_8(OH)_6$, as well as their pressure and temperature derivatives. The acoustic measurements were conducted in a 1000-ton uniaxial split-cylinder multi-anvil apparatus using ultrasonic interferometry techniques (Li et al., 1996). The pressures were determined in situ by using an alumina buffer rod as the pressure marker (Wang et al., 2015). A dual-mode piezoelectric transducer enabled us to measure P and S wave travel times simultaneously, which in turn allowed a precise determination of the sound velocities and elastic bulk and shear moduli at high pressures. A fit to the acoustic data using high temperature finite strain analysis yields: K_S = 106 GPa, K_S' = 5.9, $(\partial K_S/\partial T)_P$ = -0.013 GPa K^{-1}, G = 66 GPa, G' = 2.3, $(\partial G/\partial T)_P$ = -0.016 GPa K^{-1}, assuming that $\alpha = 3.74 \times 10^{-5}$ K^{-1}, and $\gamma_0 = 1.19$. These results are quite consistent with those obtained at room temperature (Sanchez-Valle et al., 2008). The high temperature results obtained here could be used to evaluate the hydration grade in the subducted slabs in the upper mantle.

References

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