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Single-crystal elasticity of phase Egg $AlSiO_3OH$ and δ-AlOOH by Brillouin spectroscopy

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Abstract

Phase Egg and δ-AlOOH are two typical hydrous phases that might exist in the wet sedimentary layer of subducted slabs under mantle conditions. They are thus regarded as potential water carriers to Earth's deep mantle. In this report, we report the full elastic constants of both phases determined by Brillouin scattering and X-ray diffraction measurements under ambient conditions. Our results indicate that the hydrogen-bond configurations in the crystal structures of the two phases have a profound effect on their principal elastic constants. The adiabatic bulk modulus (K_S) and shear modulus (G) calculated from the obtained elastic constants using the Voigt-Reuss-Hill averaging scheme are 158.3(201) GPa and 123.0(60) GPa for phase Egg and 162.9(31) GPa and 145.2(13) GPa for δ-AlOOH, respectively. These results allow us to evaluate elastic moduli and sound velocities of hydrous minerals in the Al_2O_3-H_2O-SiO_2 ternary system (simplified composition of subducted wet sedimentary layer) at ambient conditions, including the contrast of the acoustic velocities V_P and V_S for the reaction $AlSi_3OH$ = δ-AlOOH + SiO_2 (stishovite) and the evolution in the elastic moduli and sound velocities of hydrous minerals as a function of density.

Keywords: Phase Egg, δ-AlOOH, elasticity, anisotropy, Brillouin spectroscopy