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Seismic wave velocity of Al-rich hydrous phases at Earth's core mantle boundary

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The incorporation of Al enhances the thermostability of hydrous phases and makes them possible carriers of water to Earth's deep mantle. The elastic properties of Al rich hydrous phases are thus important to detect deep water and may explain the complex seismic structures at Earth's core mantle boundary. Using first-principles calculation, we measure the thermoelastic properties of Al-bearing hydrous phase H. We found its seismic wave velocities are readily distinguished from pyrolitic mantle composition and therefore, they can possibly be detected from the surface. Near the core mantle boundary, our results suggest that the dehydration of Al-enriched phase H will induce the redistribution of Al from the hydrous component to dry silicates, raising the V_S at approximately 100-150 kilometers beneath the bridgmanite (Pv)-pPv transition boundary. Dehydration also releases diffusive H and produces protonic current, which are possibly sources of electrical conductivity anomaly. The results are helpful to explain the abnormal shear velocity raises at the bottom of Farallon subduction plate.