# Tracking Silica in Earth's Upper Mantle using New Sound Velocity Data for Coesite to 5.8 GPa and 1073 K

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Coesite and other structural varieties of silica are abundant rock-forming minerals in the Earth's crust and mantle. Recently, a seismic discontinuity within 250-350 km depths in the upper mantle has been observed in a number of studies, and coesite to stishovite phase transition has been proposed to be a plausible candidate for the cause of this "X" discontinuity. To date, the elastic wave velocities of coesite at simultaneous high pressure and high temperatures have never been assessed experimentally. In this study, the compressional and shear wave velocities for coesite have been measured simultaneously up to 5.8 GPa and 1073 K by ultrasonic interferometry for the first time. The shear wave velocity decreases with pressure along all isotherms. The resulting contrasts between coesite and stishovite reach ~34% and ~45% for P and S wave velocities, respectively, and ~64% and ~75% for their impedance at mantle conditions, making coesite-stishovite transition an excellent candidate to explain the seismic X-discontinuity. The P and S wave velocity jumps show no apparent dependence on depths within 7-13 GPa along a realistic P-T path corresponding to a cold subducting slab. The velocity jump dependences on silica, $d(lnV_P)/d(SiO_2)$ = 0.38 $(wt\%)^{-1}$ and $d(lnV_S)/d(SiO_2)$ = 0.52 $(wt\%)^{-1}$, are utilized to place constraints on the amount of silica in the upper mantle, and provide a geophysical approach to track mantle eclogite materials and ancient subducted oceanic slab.