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# Pressure-induced velocity softening in natural orthopyroxene at mantle temperature

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## ABSTRACT

In this study, we have measured the compressional and shear wave velocities of $(Mg_{1.77}Fe_{0.22}Ca_{0.01})Si_2O_6$ natural orthopyroxene up to 13.5 GPa and 873 K using ultrasonic interferometry in conjunction with in situ synchrotron X-ray diffraction and imaging techniques. Previous acoustic experiments on orthoenstatite (OEn) $MgSiO_3$ indicated that both compressional and shear velocities ($V_P$ and $V_S$) of OEn undergo continuous velocity softening above 9 GPa at room temperature, which has been attributed to the phase transition from OEn to the metastable, high-pressure clinoenstatite HPCEn2. For the first time, our results suggest that pressure-induced velocity softening can occur in natural orthopyroxene at high-temperature conditions relevant to the Earth's cold subduction zones. Estimates of the impedance and velocity contrasts between orthopyroxene (Opx) and high-pressure clinopyroxene (HPCpx) have been calculated, and the possibility of this phase transformation being a plausible candidate for seismic X-discontinuities at depth around 250–350 km is re-evaluated.

**Keywords:** Orthopyroxene, velocity softening, high pressure and high temperature, ultrasonic interferometry