

Novel phase transition in orthoenstatite

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ABSTRACT

Single-crystal Brillouin scattering measurements on natural orthoenstatite [OEN] to 1350 °C at 1 atm show significant softening of the elastic moduli C_{33} and C_{55} ahead of a phase transition. To our knowledge, these are the first observations of acoustic mode-softening in orthoenstatite at high temperature and room pressure and could have important implications for Earth's mantle. The phase transition is rapid and shows some hysteresis in the observed transition temperature, T_{tr} . Experiments performed on increasing and decreasing temperature bracket the transition temperature between $1090(10) \text{ °C} \leq T_{tr} \leq 1175(10) \text{ °C}$, and pronounced acoustic mode-softening is evident at temperatures above 900 °C. Backscattering measurements to $T = 1350 \text{ °C}$ show no evidence for additional transitions. OEN was recovered at room temperature. Our results are interpreted in terms of elastic softening ahead of a displacive phase transition. Before the displacive transition can occur, however, the elastic softening appears to trigger the observed reconstructive transition to the more-stable protoenstatite (or high clinoenstatite) structure. We suggest that the displacive phase transition would lead to a previously unreported pyroxene structure with *Cmca* symmetry.