Spin crossover in ferropericlase and velocity heterogeneities in the lower mantle

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Deciphering the origin of seismic velocity heterogeneities in the mantle is crucial to understanding internal structures and processes at work in the Earth. The spin crossover in iron in ferropericlase (Fp),[1] the second most abundant phase in the lower mantle, introduces unfamiliar effects on seismic velocities.[2,3] First principles calculations indicate that anti-correlation between shear velocity (V_S) and bulk sound velocity (V_ϕ) in the mantle, usually interpreted as compositional heterogeneity, can also be produced in homogeneous aggregates containing Fp.[4] The spin crossover also suppresses thermally induced heterogeneity in longitudinal velocity (V_P) at certain depths but not in V_S. This effect is observed in tomography models at conditions where the spin crossover in Fp is expected in the lower mantle. In addition, the one-of-a-kind signature of this spin crossover in the $R_{S/P}$ ($\partial \ln V_S/\partial \ln V_P$) heterogeneity ratio is a useful fingerprint to detect the presence of Fp in the lower mantle.

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