Impact of ferropericlase' spin crossover on the lower mantle geotherm

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The spin crossover in ferropericlase introduces anomalies in its thermodynamics and thermoelastic properties. Here we investigate how these anomalies affect the lower mantle geotherm. The effect is examined in mantle rocks consisting of mixtures of bridgmanite, ferropericlase, and CaSiO3-perovskite, with different Mg/Si ratios varying from pyrolitic to perovskitic (Mg/Si~1.3 to 0.8). The thermodynamics properties of (Mg,Fe)SiO3 bridgmanite and of (Mg,Fe)O ferropericlase were obtained using *ab initio* LDA+U calculations within quasiharmonic approximation QHA, while the Mie-Debye-Grüneisen approach was used for Ca-perovskite. We find that the anomalies introduced by the spin crossover, increase the adiabatic gradient and thus the geotherm proportionally to the amount of ferropericlase. The geotherms can be as ~200K hotter than the conventional adiabatic geotherm [1] at deep lower mantle conditions. Aggregate elastic moduli and seismic velocities are also sensitive to the spin crossover and the geotherm, which impacts analyses of lower mantle velocities and composition.

[1] J.M. Brown and T.J. Shankland (1981), Thermodynamic parameters in the Earth as determined from seismic profiles, Geophys. J. R. astr. Soc., 66, 579596.