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On seismic properties in the deep mantle in mantle convection with the self-consistetly calculated mineralogy

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Numerical thermo-chemical mantle convection simulations in a spherical geometry with mineral assemblages self-consistently calculated using the free energy minimization are used to check the validity of detection on the post-perovskite phase as the seismic discontinuity in the deep mantle, in terms of 1-D seismic profiles at various locations. The assumed compositions of mid-ocean-ridge-basalt (MORB) and harzburgite are composed of six oxides (Na2O-CaO-FeO-MgO-Al2O3-SiO2: NCFMAS) system but the harzburgite composition is calculated from ideal mantle (pyrolite) and MORB compositions. Results indicate that the post-perovskite can be detected as a consequence of the anti-correlation between S and P profiles in the deep mantle, which has the faster jump in S but slower jump in P. The 1-D seismic profiles calculated from our simulations also suggest that the multiple discontinuities in the deep mantle can be interpreted as the folding of subducting slabs above the basaltic piles but, at some exceptional points, they can be interpreted as the multiple crossing due to the post-perovskite phase transition, which would be consistent with various seismic waveform analyses. The anti-correlation of seismic anomalies between S and P in the basaltic piles is also found in our simulations but not very clear because the P anomalies calculated from our models are very noisy. In conclusion, the various seismic properties in the deep mantle could be reproduced from numerical mantle convection with a self-consistently calculated mineralogy, which includes the multiple crossing related to the post-perovskite phase and anti-correlation between S and P anomalies as an evidence for existing the compositional heterogeneities in the deep mantle.

Keywords: core-mantle boundary, thermo-chemical mantle convection, post-perovskite, 1-D seismic structure, seismic discontinuity