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On the origin of large-scale heterogeneity in the deep mantle: Thermo-chemical mantle convection in a spherical geometry

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The origin of large-scale heterogeneous structure in the deep mantle, that is, large low shear velocity provinces (LLSVP) is still debated, which is between thermo-chemical [e.g. Nakagawa et al., 2012] and purely thermal [e.g. Davies et al., 2012]. If the large-scale heterogeneous anomalies in the deep mantle are generated by basaltic piles, the large-scale anomalies such as LLSVP may be enhanced for huge amount of heat source compared to the ambient mantle. Current efforts of geoneutrino observations attempt to detect the large-scale anomalous region of radioactive elements in the deep mantle [personal communication with H. Tanaka], which may have large-scale enhanced region of radioactive element in the deep mantle beneath the southern Pacific from test simulations of geoneutrino detectors. In addition, this approach could give an answer for the origin of large-scale heterogeneous structure in the deep mantle. Here we introduce our current numerical modeling of thermo-chemical mantle convection in a spherical geometry with self-consistently calculated mineralogy. The advantage of this approach is to include all phase transitions in the mantle without any linearization of physics of phase transition in mantle minerals and calculate seismic anomalies from thermo-chemical structure obtained from numerical modeling directly. In this presentation, we will show several important information on resolving this issue.

Keywords: thermo-chemical mantle convection, large-scale heterogeneity, mineral physics, radioactive heat source