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Effects of low post-perovskite viscosity on thermal-chemical-phase structures and heat flow across the CMB

T. Nakagawa and P. Tackley
Institute of Geophysics, ETH Zurich, Zurich, Switzerland (ntakashi@ethz.ch)

Recent first principle calculations make it possible to infer rheological properties such as activation energy and volume in deep mantle phases, including perovskite [Ammann et al., 2008] and post-perovskite, which is expected to have a much lower viscosity than perovskite [J. Brodholt, personal communication] as well as other mineral phases with different rheological properties [e.g. Yamazaki and Karato, 2001]. The expected low viscosity of post-perovskite should have strong dynamical effects, which would influence structures in the CMB region. Thus, we here we expand our numerical models of thermo-chemical mantle convection with post-perovskite [Nakagawa and Tackley, 2008, 2006, 2005; Tackley et al, 2007] to include different rheological parameters for different mantle phases. The dynamical effects are investigated using simulations in a two-dimensional spherical annulus [Hernlund and Tackley, 2008] and/or a full 3-D spherical shell [Tackley, 2008] with different viscosity prefactors for the post-perovskite phase and including a composition-dependent post-perovskite phase transition. We focus on how seismic structures generated by combined thermal, compositional and phase change effects are influenced by the low viscosity of post-perovskite. In addition to studying spatial Vs structures, we also calculate diagnostics such as the spectrum of seismic wave anomalies, and compare results to seismic observations [Lay et al., 2006; van der Hilst et al., 2007], in order to determine whether the mineral physics findings and seismic images can be reconciled using a consistent dynamical calculation. Furthermore, we test the theory of [Buffett, 2007] regarding the influence of the post-perovskite transition on heat flux through the CMB. Finally, we calculate histograms of model seismic wave anomalies, which have recently been used to make inferences about compositional anomalies in the deep mantle, [Hernlund and Houser, 2008] to determine how well these statistical diagnostics actually give information about the structures that cause them. Detailed findings will be provided in the presentation.

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