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Seismo-stratigraphy and thermal structure of Earth's core-mantle boundary region

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With 3-D inverse scattering we have begun to explore the deep mantle on an unprecedented spatial scale. We combine concepts from inverse scattering and statistics into an approach toward imaging structure near Earth's core-mantle boundary with large amounts of broad-band, three-component ScS seismograms acquired by global seismograph networks. Extracting structural information requires few restrictive a priori assumptions about the structures of interest, which makes it complementary to forward modeling approaches. We discuss a generalized Radon transform that maps broad-band seismogram windows – comprising the main arrivals and its coda and precursors – into a set of multiple images of a target structure. The 'common image-point gathers' thus produced reveal multiple, piece-wise continuous (and statistically significant) interfaces in the lowermost mantle. Tomographic wavespeed perturbations and the variation in depth to a widespread interface 150-300 km above the CMB are consistent with a post-perovskite (ppv) transformation. Stratification below it may results from multiple phase boundary crossings, and a locally observed wavespeed drop above the CMB may mark the base of a ppv-rich lens. We use thermodynamic properties of these phase transitions to estimate temperatures just above the core-mantle boundary (CMB). We infer a temperature at the CMB of 3,950$\pm$200 K. Beneath Central America, a site of deep subduction, the deep mantle is relatively cold ($\Delta T = 700\pm100$ K) and core heat flux high (q_{cmb}=80-160 mWm^{-2}, for thermal conductivity κ=5-10 Wm^{-1}K^{-1}). Away from it, the heat flux reduces to 35-70 mWm^{-2}.