



Large-scale topography of the core-mantle boundary constrained by normal modes

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Dynamic processes in Earth's mantle and core give rise to deformation of the core-mantle boundary (CMB) itself. This CMB topography plays a critical role in the mechanical coupling between the outer core and mantle and may also affect outer core flow. In addition, constraints on the CMB topography provide clues towards the nature of seismic anomalies, as the relationship between topography and velocity structure aids in constraining lower mantle density variations. However, existing models feature a range of topography patterns and amplitudes and predictions from geodynamic simulations are generally incompatible with seismological observations.

Here, we review constraints on the CMB topography provided by observations of Earth's free oscillations or normal modes. Due to their low frequencies, these data are particularly suitable for investigating density variations within the deep Earth, including those arising from perturbations of internal boundaries. Particularly, Stoneley modes that are confined to the liquid-solid interface of the CMB provide an invaluable tool for determining CMB topography variations.

We present the results of a straightforward model space search, in which we determine the probability of a large number of density and CMB topography models (Koelemeijer et al., 2017). Irrespective of lower mantle density structure, we observe consistent topography patterns featuring an elevated CMB underneath the Pacific and African large-low-velocity provinces (LLVPs). With a peak-to-peak amplitude of 4.4 km at long wavelengths, these topography models are within the bounds of earlier studies. Geodynamic simulations (Deschamps et al., 2018) imply that the concurrence of elevated topography and low shear-wave velocities can be explained by dominantly thermal structures, i.e. that the density contrast between the LLVPs and ambient mantle is $< 100 \text{ kg/m}^3$.

Deschamps, F., Y. Rogister & P.J. Tackley (2018). Constraints on core-mantle boundary topography from models of thermal and thermochemical convection. *Geophys. J. Int.*, Vol. **212**, 164-188, doi:10.1093/gji/ggx402.

Koelemeijer, P., A. Deuss & J. Ritsema (2017). Density structure of Earth's lowermost mantle from Stoneley mode splitting observations. *Nature Comm.*, Vol. **8**, 15241, doi:10.1038/ncomms15241.