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Zooming in on the core-mantle boundary

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The boundary between the iron core and the rocky mantle (the core-mantle boundary, CMB) is the strongest contrast within the Earth; it is in terms of density jump comparable to that between the crust and the oceans. The CMB is also the interface between two convection regimes: the vigorously convecting liquid outer core, which is the source for our geodynamo, and the sluggishly convecting solid mantle, which drives plate tectonics and causes intra-plate volcanism. The extent and variability of thermal and chemical fluxes are uncertain, but the interactions both control and depend on the composition and structure near to the boundary, and play a major role in the thermal and dynamical evolution of our planet.
In this lecture, I will present our latest observational constraints on both sides of the boundary and discuss open questions. On the mantle side, we have new constraints on small-scaled ($\sim$10s km) ultra-low velocity zone on the CMB and we are pushing to use high frequency diffracted waves to map even thinner structures (<10 km). Additionally, correlation between the large ultra-low velocity zones and hotspots of the surface, suggests their potential as a root to mantle plumes and potential source of anomalous geochemical signatures. On the outer core side, a longstanding debate is if a stable stratified layer exists, which would disconnect outer core convection from lateral variability at the CMB. One aspect to this debate is if seismology can and does observe such a layer. I will present our new mineral-physically self-consistent model for the outer core, which fits normal modes well without a need for a stably stratified layer (Irving et al. 2018).