Structure of the Earth’s liquid outer core and seismic waveform modeling of antipodal station

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The seismological structure of the boundary at Earth’s liquid outer core and solid inner core has been extensively studied with models suggesting broad regional variability in P-wave velocity gradients approaching this boundary, as well as a locally patchy, partially liquid transition layer forming a mosaic structure at the boundary.

Here we use broadband seismograms recorded at an antipodal station, where the epicentral distance is more than 179 degrees, and show that the amplitude of a PKIIKP phase (single reflection within the inner core at the inner core boundary) can be modeled by the existence of thin (20km) slow P-wave velocity (-10% at the inner core boundary from PREM) layer at the bottom of the outer core. We calculate theoretical seismograms for fully three dimensional Earth model using the Spectral-Element method on the Earth Simulator. We found that the current Earth model cannot reproduce the amplitude of PKIIKP phase. Because the amplitude of PKIIKP phase is sensitive to seismological impedance (product of the density and the seismic wave velocity) contrast at the inner core boundary, it is suggested that the reduction of P-wave velocity within this layer should not accompany a reduction of density.