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Properties of the Earth's inner – outer core transition by characteristics of seismic waves of PKIIKP and PKPc-diff

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The Earth's core plays an important role in physical and chemical processes of its entrails. Good knowledge of distribution of mechanical parameters in the outer core (OC) leads to better understanding of geodynamo, while structure of the inner core (IC) keeps the key to solidification and postsolidification processes in iron that compounds the solid core. Much of our knowledge about the inner core boundary (ICB) and structure of its vicinity has been obtained from analysis of seismic phases of PKPdf , PKPbc and PKiKP. However, much can be done using the rarely used almost antipodal phases of PKIIKP and PKPc-diff that are reflected from the underside of the ICB and travel along the ICB on the liquid side, respectively. It was shown that the former is strongly sensitive to slight variation in shear velocity just below the ICB, while the latter – to fine structure of the OC bottom. We used the Lomonosov supercomputer of Moscow State University to model almost antipodal seismic wavefield and compare it with experimental waveforms. The DSM and AXISEM numerical methods were invoked, and either method yields essentially similar results for the considered models of the liquid-solid transition. Few experimental waveforms of PKIIKP and PKPc-diff were obtained for the IC regions under Western Canada and China. To detect the sought waveforms in digital seismic data and estimate their relative amplitudes and time delays, we invoked the method of stochastically optimized search for the signal with known shape. The method was proved to be efficient as a result of testing on synthetic seismograms with addition of noise correlated with PKPdf. We infer that some regions of the ICB may feature lower shear velocity in the top of the IC, for example, under Canada. We also find anomalously large amplitudes of PKIIKP and PKPc-diff below China. They can be synthesized with respect to a model where the P-wave velocity in the bottom of the OC is by 2% below the one in IASP91, and the shear velocity in the top of the IC is decreased by 1 km/s.