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Structure of the Deep Inner Core From Antipodal PKPPKP Waves

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For about two decades, seismic studies have demonstrated that the inner core is acoustically anisotropic. However, until the present day the amplitude and radial dependence of inner core anisotropy remain unknown and somewhat controversial. Apart from previously observed complexity in geometry, some recent results suggest changes in the anisotropic properties in the deepest part of the inner core, close to the planetary center. While there is a large number of seismological studies focusing on the uppermost part of the inner core, there is a disproportionate number of studies concerning the bulk of the inner core, especially its center. One reason for this is highly the attenuative nature of the inner core for compressional waves. Another reason lies in the inadequate sampling of the inner core by PKP waves, whose travel times are traditionally used to study inner core properties. In order to sample the central regions of the inner core, PKP waves must be nearly antipodal, and with the spatial distribution of large earthquakes and current configuration of seismographic stations worldwide, this is difficult to achieve, except for paths nearly parallel to the equatorial plane. Thus, the center of the inner core remains unsampled by near-polar PKP paths, which makes interpretation about anisotropic properties near the planet's center, at minimum, very challenging. Here we present our efforts to study the center of the inner core using near-antipodal PKPPKP waves. These phases are generated by large earthquakes or explosions and travel through the inner core, reflect from the free surface of the Earth and travel back through the inner core to a recording station near the source. Our preliminary results show that these waves are extremely difficult to observe at very short epicentral distances (less than 10 degrees). However every new observation is precious, as it represents unique spatial sampling of the inner core. We will present findings from our search on a global scale, utilizing both earthquakes and explosions and analyses in time and frequency domains, from both individual and array records. We will discuss our findings in light of current perception of inner core anisotropy and the physical state of the inner core in general.

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