Near-Podal Observations of PKPPKP Waves and Implications for Central Inner Core Structure

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The amplitude and radial dependence of hypothesized inner core anisotropy are not well known. Apart from previously observed complexity in geometry, some recent results suggest changes in anisotropic properties in the regions of the inner core close to the planetary center. With the spatial distribution of large earthquakes and current configuration of seismographic stations worldwide, it is difficult to achieve sampling of the deep interior of the inner core, except for paths nearly parallel to the equatorial plane. Figure 1 demonstrates this property. Even if a large earthquake occurs at extreme latitudes, say at -50°s, although possible to find antipodally positioned locations on the globe, such geometries could not produce angles between the PKP leg and the Earth’s rotation axis (ksi) smaller than 35 degrees. This makes interpretation of anisotropic properties near the planet’s center, at a minimum, very challenging.

PKPPKP and even more exotic seismic waves are used to examine inner core structure. Breger et al. (2000) reported that the travel times of PKPPKP waves recorded at NORSAR network with polar geometries sampling the top 400 km of the inner core were not anomalously advanced. The near-podal PKPPKPdP waves show much promise for studying inner core structure. Figure 2 illustrates an example of one near-podal PKPPKPdP observation, recorded by the Kyrgyz Seismic Telemetry Network for an Afghanistan-Tajikistan border earthquake. Preliminary results from analyzing near-podal PKPPKPdP travel times suggest that the central part of the inner core is not fast in the direction parallel to Earth’s axis, which is in contradiction with presently hypothesized anisotropy models. Painstakingly collected data points from near-podal PKPPKPdP travel times will thus have very important implications for our understanding of the anisotropy and other properties of the deep inner core.