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Seismic structures in the Earth's inner core below Southeastern Asia

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Studying seismic heterogeneities in the Earth's inner core is important in terms of understanding its history and dynamics. Measurements of body waves refracted in the vicinity of the inner core boundary yield a powerful tool for studying properties and spatial structure of such heterogeneities. We present investigation of the eastern hemisphere of the solid core by means of PKP(BC)–PKP(DF) differential travel times that sample depths from 140 to 360 km below its boundary. The study includes 292 polar and 133 equatorial residuals measured over the traces that probe roughly the same volume of the inner core in both planes. Equatorial residuals show slight spatial variations in the sampled inner core volume mostly below the level of 0.5%, whereas polar residuals are up to 1.3% and exhibit higher local variations and direction dependency. On the base of these measurements we report fast changes in seismic velocity within a restricted volume of the inner core. The observations are interpreted in terms of anisotropy and checked against several anisotropy models. Few models are capable of fitting the residuals scatter, and one of such models features a dipping discontinuity that separates fully isotropic roof of the inner core from its anisotropic body. The depth of the isotropy-anisotropy transition in the model increases in southeast direction from 190 km below Southeastern Asia (off the coast of China) to 350 km beneath Australia. Another acceptable model invokes localized anisotropic heterogeneities. It is valid if 33 largest polar measurements over the rays sampling a small volume below Southeastern Asia and the rest of polar data are treated separately. This model envisages almost isotropic eastern hemisphere of the inner core at least down to the depth of 360 km below the inner core boundary and constrains the anisotropic volume only to the ranges of North latitudes from 18 to 23 degrees, East longitudes from 125 to 135 degrees and depths exceeding 170 km. The strength of anisotropic volume in the former model is estimated as 1.7 $\div$ 2 percent, while in the latter as 2 $\div$ 2.3 percent.