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Lateral variations in travel times of reflected from the inner core waves and their connection with thermal and gravitational fields

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The inner core (IC) remains the most difficult object of our planet to study, the only one for which no unified and consistent picture of the description of its properties has been formed so far. The main process determining the dynamics of formation of structural features of the inner core is apparently its growth, which results in the development of various surface relief profiles, anisotropy of P wave velocity, gravitational anomalies and heat flow anomalies. The most suitable means with high spatial resolution to study these features are IC reflected PKiKP waves.

In this work, we have analyzed the differential travel times $\delta\tau$ = t(PKiKP)-t(PcP) of more than 1300 pairs of PcP and PKiKP waves reflected, respectively, from the outer and inner core at epicentral distances up to 40^{o}. The probed core regions are located under Eurasia, Southeast Asia, Central and South America. Three-dimensional models LLNL [1] and Detox-P3 [2], with low and high resolution in the lower mantle, were used to exclude the influence of mantle inhomogeneities. In the Northern Hemisphere at east longitude 40^{o}, a sharp change in $\delta\tau$ of ~1 s is observed, which may be related to a 0.6% P wave velocity jump at the top of the inner core [3] and a change in geoid height [4]. Under South America, according to [4], a structure with anisotropy strength up to 5% is present in the upper part of the inner core, which is absent under Central America. Different gravity anomalies [4] and values of $\delta\tau$, differing by ~1 s, correspond to the regions probed under South and Central America. In the west of Eurasia, low heat flow [5] corresponds to regions with higher values of the analyzed differential travel times. The use of a high-resolution 3D model of the mantle does not reduce the discrepancy, which averages 0.5 s, but new trends are detected that can be interpreted as a weak change in the relief of the inner core surface.

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