Anomalous behavior of core phase PKP*bc-df* differential travel times from observations of South Sandwich Islands earthquakes by Alaskan and US seismic arrays

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We report anomalous behavior of core phase PKP*bc-df* differential travel times recorded by stations of the Alaska regional network and current USArray for several South Sandwich Islands (SSI) earthquakes. The data sample the inner- and outer-core for the polar paths, as well as the lowermost mantle beneath eastern Alaska. Our major observations are: (1) the fractional travel time residuals of PKP*bc-df* (residual divided by PKP*df* travel time in the inner-core) increase rapidly from 147°to 149°(up to 0.01, corresponding to travel time of ~1s), and keep almost constant after 149°. (2) From southwest to northeast, there is a decrease in fractional residual at distance larger than 150°. Either a rapid velocity change in the uppermost inner core or existence of a large lateral velocity variation at lowermost mantle, which is seen in a recently tomography model (Young et al., 2013), may explain the observation. The preliminary analysis indicates that modeling for discontinuities with different velocity jump in the inner-core does not seem to reproduce the observed fractional residuals, and that it may suggest a probable complexity at lowermost mantle. One possible interpretation is that PKP*bc* and PKP*df* sample different portions of the heterogeneity at larger distance, which results in the sudden increase of the fractional residuals. The large residuals observed from the polar path data for SSI events are usually explained by strong anisotropy in the uppermost inner-core, which might have been misinterpreted if its affected by some structure at the lowest mantle. Further work including waveform modeling is need to resolve what causes the anomalous behavior of our observation.

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