

## Depth variation of the hemispheric seismic structure of the inner core inferred from global seismic array data

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The Earth's inner core is located at the center of the earth and it is widely considered that it results from the solidification of the liquid iron of the outer core with cooling of the earth. Seismological studies have revealed complex features of the inner core.

In this study, I focus on the hemispherical heterogeneous structure of the inner core. Although the understanding of the attenuation and velocity structures is an important key to give constraint on the physical state and the growth process of the inner core, the depth dependent profiles of the attenuation and velocity have not been well constrained because of the poor resolution due to difficulties in analyzing complex core phase data. I apply a waveform inversion method based on simulated annealing to core phase data observed by globally deployed seismic arrays and estimate continuous attenuation and velocity structure in the top half of the inner core. Moreover, involving frequency dependent attenuation models to inversion, the frequency dependence of attenuation is investigated. Attenuation profiles are estimated by using measured attenuation parameters. Whereas measured attenuation parameters show consistent trend for the data which sample the eastern hemisphere, for western hemisphere there is remarkable difference between the data which sample the inner core beneath Africa (W1) and beneath the north America (W2). Obtained attenuation models suggest hemispherical heterogeneities appear to be confirmed in the top 300 km. The model for the eastern hemisphere has a high attenuation zone at top 150 km and gradually decreases with depth, model for the W1 shows constant low attenuation and model for W2 represents the gradually increase from ICB and have a peak around a 200 km depth. Velocity models are obtained by using traveltimes anomaly of differential traveltimes between PKP(DF) and PKP(CD, BC). Measured traveltimes show the consistent trend within the same hemisphere except for the data that pass through the boundary of two hemispheres. Obtained velocity structures for the eastern hemisphere and for the western hemisphere have about 1% faster and slower than the reference model at the top of the inner core and reach to same velocity at 200 km depth. The results from frequency dependent attenuation analysis suggest that whereas the attenuation for the eastern hemisphere does not depend on the frequency, the attenuation for the western hemisphere show the frequency dependent attenuation. If the cause of the attenuation is considered due to the scattering of the seismic wave, the strongest attenuation and velocity dispersion occur when the wavelength is about the grain size. Adopting this assumption to observations, the grain size in the eastern hemisphere become larger than the western hemisphere and grain size for W2 increase with depth. By applying the waveform inversion approach, it is revealed that hemispherical heterogeneities are restricted in the top 300 km of the inner core and the existence of the heterogeneities in the western hemisphere.

Keywords: seismology, inner core, attenuation, frequency dependence