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Seismic evidence for high attenuation zone in the western hemisphere of the inner core

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We employ the method of simulated annealing (SA) to extract traveltimes, amplitudes, and attenuation parameters from seismic core phases recorded by Hi-net. One of the advantages of utilizing SA for core phase studies is that SA enables us to analyze events with complicated incoming waveforms (i.e., large or shallow earthquakes) to a seismic array (Chevrot, 2002, GJI; Garcia et al., 2004, JGR), thus to greatly increase the number of events to be analyzed. Events in South America with epicentral distances of 140-160 degrees are analyzed. The resultant data set is about six times larger compared with that of our previous study (Kazama et al., 2008, PEPI). While the observed attenuation parameters appear to have a similar trend for all of the analyzed events, the observed differential travel times (BC-DF) strongly fluctuate among events. After concluding that these fluctuations are likely due to the heterogeneities in the vicinity of the observed stations, we inverted for both velocity structure and site effects. The obtained velocity and attenuation models for the South America events represent those of the western hemisphere of the inner core (Tanaka and Hamaguchi, 1997, JGR). The velocity model is generally consistent with the previous studies (Kaneshima et al., 1994, GRL; Kazama et al., 2008, PEPI), but the data show a signature that can be attributed to either a velocity increase around a depth of 300km beneath the ICB or a velocity decrease at the bottom 50km of the outer core. The attenuation model shows a moderate attenuation (Q=500) for a shallow part of the inner core; the attenuation gradually increases with depth to have a peak around a depth of 250km (Q=~200), and then decreases down to a depth of ~450km below which the attenuation becomes insignificant. The analysis of data of NECESSArray (Kawakatsu et al., 2010, JpGU) in northeast China, whose core phases from a South America sample a different part of the western hemisphere, indicates a similar attenuation structure (Iritani, 2010, MS thesis), and thus the observed high attenuation zone may be a common feature of the western hemisphere of the inner core. A preliminary analysis of South Sandwich events recorded by Hi-net does not show a similar signature, indicating the eastern hemisphere of the inner core may have a different attenuation structure.