Seismic Structure near the Inner Core boundary around the South Pole

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To consider the flow pattern in the outer core and the growth of the inner core, it is very important to know the seismological structure near the inner core boundary (ICB) around the spin axis of the earth. However, because of the restriction of events and stations, there are a little ray paths which pass through around the spin axes, and the obtained seismic structure near the ICB represents the structure in the low- and mid-latitude. We deployed the broadband seismic network in central and western Indonesia (called JISNET) (Ohtaki, 1998). Seismic rays of earthquakes beneath South America to Indonesia pass through in the inner core beneath Antarctica. Using the waveforms of South America earthquakes observed at JISNET stations with other broadband stations around Indonesia, we analyze the seismic structure near inner-core boundary beneath the Antarctica.

We analyze vertical component broadband seismograms of JISNET, OHP ad IRIS for earthquakes from 1998 to 2002. We selected the data whose PKPdf ray turns in the inner core or cross the ICB in the region of 70 degrees or more south, and of good S/N ratio. In this analysis, we selected 15 earthquakes whose core phases that meet the above-mentioned criteria are observed in several JISNET stations. The number of the waveforms we analyzed is 89. The epicentral distances are from 130 to 161 degrees, which is suitable for analyzing seismic structure around the ICB.

We handpicked the peaks of the observed core phases, and calculated the differential travel time of PKP(BC or Cdiff) minus PKP(DF), and of PKP(CD) minus PKP(DF), and the amplitude ratio of PKP(DF) to PKP(BC or Cdiff). We model dVp at the ICB, Vp gradient in the inner core, and Vp at the base of the outer core. The synthetics are calculated using the Direct Solution Method (Takeuchi et al., 1996). PREM is chosen as the reference models. Qp is fixed to 300 in the inner core based on the average value of Qp in the inner core of Li and Cormier (2000). Vs in the inner core, density contrast at the ICB, and the radius of the inner core are fixed to the values of PREM because these do not affect our results.

The observed differential travel times and amplitude ratios require a constant Vp in the lowermost 75 km of the outer core, 0.1 km/s slower velocity at the top of the inner core, and a 3 times larger velocity gradient than that of PREM in the uppermost 150 km of the inner core. The Vp (10.31 km/s) at the base of the outer core we obtained is larger than the previous values of ak135 (10.29 km/s), of Song and Helmberger (1995) (10.28 km/s), of Naknishi (1990) (10.27 km/s), of Souriau and Poupinet (1991) (10.27 km/s), and of Ohtaki and Kawakatsu (2005) (10.27 km/s), although Kaneshima et al. (1994) obtained larger value (10.33 km/s). These results except for ours are based on the global data set or the observation in Japan from S. America events, which means the results except for ours are mainly based on the waves which pass thorough in the inner core at the low and mid latitude. The differences between our result and other studies may suggest the velocity at the lowermost outer core is faster in the polar region than in the low and mid latitude.