

Reflection seismology of Inner core using near vertical PKiKP

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Clear observation of near-vertical (pre-critical) PKiKP (reflection from the top of the inner core) is known for its rareness, preventing detailed seismological investigation of the top part of the inner core. Here we present an entire network observation of such near-vertical PKiKP from a recently deployed Japanese seismic network (Hi-net). The record section of an intermediate depth (298 km) earthquake in Mariana (2001/07/03 13:10:43, Mw 6.5) shows remarkably clear arrivals of PKiKP in a epicentral distance range of 14-24 degrees. From more than 170 individual picks of PKiKP, we could further perform array analysis of PKiKP related seismic phases, as well as more commonly observed phases such as PcP, with unprecedented high quality.

Both PKiKP and PcP show remarkable similarity in waveform up to a frequency of 2 Hz, which suggests that ICB may be as sharp as CMB and no thicker than 2 km. The slant stack for a 1-2 Hz frequency band where PKiKP and PcP show the peak energy, SKiKP can be identified with the appropriate slowness guaranteeing extremely high quality of this data set. In this band where the background noise level is 2-3 % of PKiKP, however, no other conspicuous phase is identified except a slight indication of pPKiKP. We also note that no gradual energy build up of ICS (inner core scattering) signal is observed. Thus the inner core of this part appears highly transparent seismically in this frequency range.

In the lower frequency band of 0.5-1.0 Hz (now the background noise level is about 10-15 %), on the other hand, the slant stack shows three clear signals above the three standard deviations level. Two of those signals are observed with a slowness similar to that of PKiKP at about 75 and 85 seconds after PKiKP. The former phase is likely to be pPKiKP. The later phase, which has a slightly higher frequency content and even larger amplitude (20 %), may be explained as a pPKiKP water/crustal layer reverberation phase; however, no corresponding phase is seen in PcP stack while pPcP is seen at 75 sec after PcP. Alternatively, it may be interpreted as an 3 % reflection from a slightly dipping discontinuity inside of the inner core around a depth of 470 km below ICB. The third signal is observed at about 30 seconds after PKiKP with a slightly negative slowness. This is can be 1.5 % reflection from a horizontal reflector/discontinuity around a depth of 170 km below ICB. Besides these signals, we observe no other candidate for a global sharp discontinuity of 1 % reflection level.