Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SCG060-18 Room:302 Time:May 25 14:30-14:45

Structure around Philippine Sea slab beneath Kii Peninsula inferred from receiver function analysis

Takuo Shibutani[1*], Taishi Fukui[2], Yoichiro Nakagawa[3], Kazuro Hirahara[2], Setsuro Nakao[1], Kazuhiro Nishimura[1], Masayo Sawada[1]

[1]DPRI, Kyoto Univ, [2]Science, Kyoto Univ, [3]Hitachi Ltd

1. Introduction

Deep low frequency events (DLFEs) are distributed widely from western Shikoku to central Tokai (Obara, 2002). Results from seismic tomographies and receiver function analyses revealed that the oceanic crust of the Philippine Sea plate has a low velocity and a high V_P/V_S ratio (Hirose et al., 2007; Ueno et al., 2008). Hot springs with high ^{3}He/^{4}He ratios are found in an area between central Kinki and Kii Peninsula despite in the forearc region (Sano and Wakita, 1985). These phenomena suggest the process that H_2O subducting with the oceanic crust dehydrates at the depths of 30 - 40 km, causes the DLFEs, and uprises to shallower depths.

We carried out seismic observations in Kii Peninsula since 2004 in order to estimate the structure of the Philippine Sea plate and the surrounding area. We deploy seismometers in linear order with the average spacing of ˜ 5 km and record waveforms of teleseismic events. We applied receiver function analyses shown below to the waveform data, and obtained images of S wave velocity discontinuities. In the previous presentation (Shibutani et al., 2009), we reported the results for three profile lines in the NNW-SSE direction along which the Philippine Sea plate is subducting. In this presentation we will report the results for two new profile lines, one in the NNW-SSE direction and the other in the ENE-WSW direction. We will also discuss the structure around Philippine Sea plate subducting beneath Kii Peninsula based on the receiver function images.

2. Receiver function analysis

Receiver functions are calculated by deconvolving the vertical component from the horizontal component of teleseismic P codas. They consist of PS converted waves generated at S wave velocity discontinuities beneath stations. The relative travel times between the PS converted waves and the direct P wave depend on the depths of the discontinuities and the P and S wave velocities above them, and the relative amplitudes depend on the S wave velocity jump at the discontinuities. In this study we converted the time axis of the receiver functions to the depth axis with the velocity model JMA2001 (Ueno et al., 2002), stacked the amplitudes of the receiver functions on the common conversion points, and obtained images of S wave velocity discontinuities.

3. Structure around Philippine Sea slab

A pair of blue and red lines dipping to northwest can be found as a common feature among the four profiles in the subduction direction. These can be interpreted as the upper surface of the Philippine Sea slab and the oceanic Moho, respectively. The oceanic crust sandwiched in between them shows remarkable low velocity (darker blue) up to the depths of 30 ? 40 km where the DLFEs occur. The degree of the low velocity in the oceanic crust decreases beyond the depths.

We can find that another blue line branches off near the DLFE area and extends in the mantle wedge in the receiver function images for three profiles in central to western part of the peninsula. This indicates that the mantle wedge is widely low velocity. The red line showing the oceanic Moho becomes unclear beneath 40 km depth, which suggests that the velocity gap between the oceanic crust and the oceanic mantle becomes small. The configuration of the slab seems to be convex upward.

On the other hand, for the profile in the eastern part of the peninsula, we cannot see that low velocity in the oceanic crust extends to the mantle wedge. The oceanic Moho is uniformly clear from 30 km depth at the southeastern edge to 70 km depth at the northwestern edge. The geometry of the slab is linear.

The differences in the structure and geometry of the slab and the mantle wedge between the central to western part and the eastern part of the peninsula can be explained by the amount of H_2O in the oceanic crust beneath 40 km depth after the dehydration.

Keywords: Philippine Sea slab, Mantle wedge, Slab-derived fluid, Receiver function image, Linear array seismic observation, Kii Peninsula