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SCG65-P10 Room:Convention Hall Time:May 20 17:15-18:30

3D seismic velocity structure around Philippine Sea slab subducting beneath Kii Peninsula

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1. Introduction

Deep low frequency events (DLFEs) are distributed widely from western Shikoku to central Tokai (Obara, 2002; Kamaya and Katsumata, 2004; Obara and Hirose, 2006). 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 Vp/Vs ratio (Hirose et al., 2007; Ueno et al., 2008). Hot springs with high 3He/4He ratios are found in an area between central Kinki and Kii Peninsula despite in the forearc region (Sano and Wakita, 1985; Wakita and Sano, 1987). These phenomena suggest the process that H2O 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 deployed seismometers along profile lines with an average spacing of ~ 5 km. We applied receiver function analyses and obtained images of S wave velocity discontinuities. In the previous presentation (Shibutani et al., 2010), we reported results for four profile lines in the NNW-SSE direction, that is the dip direction of the Philippine Sea plate and for a profile line in the NNW-SSE direction that is almost perpendicular to the dip direction. In this presentation we will report results of a seismic tomography in which we used information of seismic velocity discontinuities derived from the receiver function images and observed travel times at stations of the dense linear arrays.

2. Seismic travel time tomography

We implemented three dimensional geometry of the continental Moho, the upper surface of the oceanic crust and the oceanic Moho derived from the receiver function analyses to the velocity model. We used a fast marching method (de Kool et al., 2006) based on wavefront tracking for the theoretical travel time calculation. We also used observed travel times at temporary stations in the dense linear arrays in addition to permanent stations. A dense distribution of the temporary stations contributed to higher resolutions of tomographic images.

3. Structure around Philippine Sea slab

A result of the seismic tomography is shown in Fig.1. At the depth of 40 km the oceanic crust shows low velocity anomaly. As we go up to shallower depths, the low velocity anomaly seems to continue to the mantle wedge and to the lower crust. It becomes a large low velocity region at the depth of 16 km under the northwestern part of the Kii Peninsula. It is known that seismic activity is very high in the upper crust above the low velocity region. The low velocity anomaly is more significant in a western part of the Kii Peninsula.

We found differences also in the receiver function images between in the central to western part and in the eastern part. Beneath the former part, a low velocity region swells out into the mantle wedge from a dehydration area in the oceanic crust; the oceanic Moho becomes unclear below 40 km depth; the slab shows a convex upward bending shape. On the other hand, beneath the latter part, the oceanic Moho is uniformly clear down to 70 km depth; the slab shows a linear shape (Shibutani et al., 2010).

These features in the tomographic images and the receiver function images show that hydrous minerals in the oceanic crust are broken down by dehydration at the DLFE area, then the dehydrated fluids flow into the mantle wedge and the lower crust, and reduce the velocity in the regions. 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 'water' discharged into the mantle wedge and that left in the oceanic crust beneath 40 km depth through the dehydration.

We used waveform data from permanent stations of NIED; JMA; ERI, Univ. of Tokyo; Nagoya Univ. and DPRI, Kyoto Univ.

Keywords: tomography, receiver function, Philippine Sea slab, Kii Peninsula, slab-derived fluid

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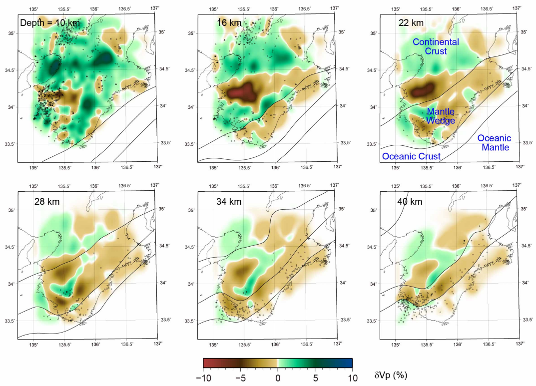

Figure 1 P wave velocity perturbation from an initial model at the depths of 10, 16, 22, 28, 34 and 40 km. The inital model is constructed basically on JMA2001 (Ueno et al., 2002) with an modification of -5 % velocity in the oceanic crust and +5 % velocity in the oceanic mantle and the mantle wedge. Circles indicate earthquakes which were used in the seismic tomography and occurred in the vicinity of each depth. The thick lines denote the continental Moho, the upper surface of the oceanic crust and the oceanic Moho from north to south.