

Estimation of Underground Structures beneath Southwest Japan Derived from Receiver Function Analysis of Dense Seismic Array Data

Tomotake Ueno[1]; Takuo Shibutani[1]; Kiyoshi Ito[1]

[1] DPRI, Kyoto Univ.

In this study, we determined the shape of the subducting Philippine Sea Plate (PHP) and the Moho discontinuity, and Ps converter structures in the crust by receiver function analysis. We used array data of dense network stations by the Joint Seismic Observation in Southwest Japan by Japan Universities conducted in 2002-2004. This station array was constructed of 40 temporary stations and 32 routine stations (Hi-net, J-array and JMA). The stations were distributed in a cross-shaped array. One line of the array was about 260 km long in the N25W-S25E direction (NS profile), and the other was about 140 km long in the N70E-S70W direction (EW profile). The two lines intersected at the source region of the 2000 western Tottori earthquake (Mw 6.6). We used 139 teleseismic events occurred at 30 to 80 in angular distance or occurred deeper than 300 km with magnitudes greater than 6.0. Receiver function waves were calculated by multiple-taper method (Park and Levin, 2000) for the teleseismic events. In order to obtain the images of Ps converters in depth sections beneath two profiles, we translated receiver functions to depths along each ray path by the use of the JMA2001 velocity structure. We show obtained the following results from these images:

1. The depth of the Ps converter identified as PHP beneath NS profile is approximately 30 km in the southern Shikoku district and approximately 60 km in the southern Chugoku district. A dip angle of this converter is about 11 degree beneath Shikoku district.

2. The Moho discontinuity beneath NS profile is located above PHP with a depth of approximately 25 km in the southern Shikoku district and approximately 40 km deep in the southern Chugoku district. This Ps converter resembles the image of oceanic Moho discontinuity reported by Yamauchi et al. (2003) and Shiomi et al. (2004) derived from receiver function analysis. In addition, in the northern Chugoku district, the depth of Moho discontinuity is approximately 30 km, and the deepest point of the Moho discontinuity is located at approximately 45 km beneath the central Chugoku district. It is likely that this variation of the depth of Moho discontinuity is affected by the subducting PHP. On the other hand, the depth of Moho discontinuity beneath EW profile is a little deeper than 30 km except for a region at 20 km from the 2000 western Tottori earthquake toward east. There is a possibility of local structures of a Quaternary volcano, Mt. Daisen, which contaminate receiver functions.

3. There are depth variations in the Ps converters of NS and EW profiles in the crust. In addition, a weak Ps converter at the depth of about 60 km was found in the northern Chugoku district. This Ps converter dips to north, and reaches to the depth of around Moho discontinuity in southern Chugoku district.

The upper surface of the seismic PHP has been derived from hypocentral distributions (e.g., Nakamura et al., 1997, Miyoshi and Isibashi, 2004) beneath the southwest Japan. These results did not illustrate the PHP in the Chugoku district, since no earthquakes occur in the mantle in this region. However, it was suggested that the aseismic PHP exists beneath the region (e.g., Nakanishi, 1980). Recently, Yamauchi et al. (2003) and Shiomi et al. (2004) indicated that PHP have subducted beneath southern Chugoku district from receiver function analysis. Furthermore, structures in eastern Shikoku district were reported from seismic survey (Kurashimo et al., 2000) and Network MT investigation (Yamaguchi et al., 1999). However we disagree with the opinion regarding their PHP and Moho discontinuity, because their interpretations of the continental Moho discontinuity have not existed below southern Shikoku district. We interpreted one of the Ps converters as the continental Moho discontinuity.