High-Vp/Vs zone accompanying non-volcanic tremors, short-term and long-term slow slip events beneath the southwestern Japan.

Makoto MATSUBARA[1]; Kazushige Obara[1]; Keiji Kasahara[1]

[1] NIED

With regard to the PHS plate beneath southwestern Japan, deep low-frequency non-volcanic tremors (DLTs) are observed at depths of approximately 30 km along the strike of the PHS plate from Tokai to the western Shikoku regions (Obara, 2002). Accompanying the DLTs short-term slow-slip events (S-SSEs) are also observed beneath the Tokai region, eastern Kii peninsula, and Shikoku region (Obara et al., 2004).

DLTs beneath the SW Japan are located along a high-Vp/Vs zone revealed by seismic tomography (Honda and Nakanishi, 2003; Wang et al., 2006; Matsubara et al., 2007). In the mantle wedge above the PHS plate, Kamiya and Kobayashi (2000) suggested the existence of serpentine beneath the Kanto region and Matsubara et al. (2005) estimated that there is 20-30 % serpentinized peridotite.

Beneath the Tokai region, Ozawa et al. (2002) detected a long-term slow slip event (L-SSE) that started during late 2000 and ended in 2005 (Ohta et al., 2004; Yamamoto et al, 2006). Beneath the Bungo channel, at the west side of the Shikoku region, L-SSE also observed during 1999 (Hirose et al., 1999). Addition to the DTL, S-SSE, and L-SSE, and very low-frequency earthquakes (VLFE) were found beneath the SW Japan by Ito et al. (2007).

The National Research Institute for Earth Science and Disaster Prevention (NIED) has deployed the high-sensitivity seismograph network of Japan (Hi-net). Plenty arrival time data enable us to clarify the fine-scale 3D Vp and Vs structure beneath the SW Japan. In this study we estimate the relationship with velocity structures and DLTs, S-SSE, L-SSEs, and VLFEs.

The target region, 29-37N and 129-139E, covers the SW Japan from Tokai to Kyushu region. A total of 1,198,906 P-wave and 966,496 S-wave arrival times for 31,751 earthquakes recorded at 466 Hi-net stations are available for use in the tomographic method (Matsubara et al., 2004; 2005) introduced spatial velocity correlation to the original code of Zhao et al. (1992). We assume that artificial velocity discontinuities are absent since an incorrect configuration of the boundary would lead to an incorrect solution.

Horizontal grid spacing is 0.1 degree and resolution is 0.2 degree. The 1-D structure used in the routine determination of earthquake hypocenters at NIED (Ukawa et al., 1984) is used as the initial model. Also, we solve the hypocentral parameters for all the earthquakes as well as 108,133 P-wave and 98,223 S-wave slowness parameters. The traveltime inversion reduced the root mean square of the P-wave traveltime residual from 0.216 s to 0.162 s and that of the S-wave data from 0.328 s to 0.202 s.

DLTs, S-SSEs, L-SSEs are caused by the high pore fluid pressure dehydrated from the oceanic crust of the PHS plate beneath the SW Japan and they are distributed along the high-Vp/Vs zone. DLTs and S-SSEs are located at the downdip landward end of the zone beneath the Tokai region and southern Kii peninsula and at the updip seaward end of the high-Vp/Vs zone beneath the northern Kii peninsula and the western Shikoku region and in a little high-Vp/Vs zone beneath the eastern Shikoku region. Beneath the Tokai and the Shikoku region, the mantle wedge has high-Vp/Vs zone and 10-30 % serpentinized peridotite exist if there is serpentinized. The S-SSE may occur at the plate boundary between the PHS plate and the serpentinized wedge mantle. Beneath the southern Kii peninsula, the high-Vp/Vs zone exist at the ocenic crust of the PHS plate and the lower crust of the EUR plate and does not exist in the mantle wedge. The mantle wedge is not serpentinized and the S-SSE is not observed there yet.

The fluid also exists in the high-Vp/Vs zone of the oceanic crust beneath the Tokai and the Bungo channel and L-SSEs occur owing to the high pore pressure. Beneath the Kii peninsula, Vp/Vs is high as 1.80 but lower than that beneath the Tokai region as 1.84 and L-SSE is not observed.