Underground structure around source region of slow earthquakes in western Shikoku obtained by receiver function analysis

Akira Hikita[1], Aitaro Kato[1], *Kazushige Obara[1], Akiko Takeo[1], Takeshi Akuhara[1]

1. Earthquake Research Institute, The University of Tokyo

Various types of slow earthquakes have been observed at subduction zones surrounding the Pacific Ocean. It has been suggested that elevated pore fluid pressure plays an essential role in the generation of slow earthquakes because low velocity or high Vp/Vs zones have been also reported along the plate boundaries where they occur. In Tokai region of the Nankai subduction zone, Kato et al. (2010) revealed that long-term slow slip event (SSE) occurs at the boundary between the continental lower crust and the subducting Philippine Sea plate and episodic tremor and slip (ETS) occurs between the mantle wedge and the subducting plate. Kato et al (2010) also revealed that oceanic crust indicates higher Vp/Vs in the long-term SSE region than in the ETS region. In contrast, Toya et al. (2017) reported that the oceanic crust indicates higher Vp/Vs in the ETS region than in the long-term SSE region in western Shikoku of the same subduction zone. In this study, we revealed configurations of continental Moho discontinuity and subducting oceanic crust and investigated relationship between slow earthquakes and the surrounding seismic velocity structure by receiver function analysis using a dense seismic array in western Shikoku.

As a result, continuous continental Moho and oceanic crust are clearly imaged along both north-south and east-west oriented seismic lines. The plate boundary in the south part, where the distinct continental Moho is not imaged, has steeper slope than the north part along the north-south line. ETS occurs between the mantle wedge and the subducting plate, and long-term SSE occurs along a contact between the continental crust and the oceanic crust.
We show that the oceanic crust indicates much higher Vp/Vs than the hanging wall by using also the reverberation phases. This high Vp/Vs means the elevated fluid pore pressure within oceanic crust due to dehydration. Vp/Vs in the oceanic crust is higher in the deep part of the long-term SSE region than in the ETS region like as the case of Tokai. It is assumed that fluid would accumulate within the oceanic crust owing to low permeability of the continental crust in the long-term SSE region. In contrast, serpentinization of the mantle wedge just above the ETS region could reduce fluid pressure in the oceanic crust. Furthermore, Vp/Vs in the oceanic crust becomes lower in the deeper part beyond the ETS depths, suggesting that eclogization is completed at the depths.

Keywords: Receiver function, episodic tremor and slip, long-term slow slip event, low seismic velocity layer

