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A New Approach to Clarify Slow Earthquake Source Regions: Multi-band Receiver Function Analysis Including Local Deep-focus Events

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Slow earthquakes play important roles in the occurrence of megathrust earthquakes in subduction zones. An increasing number of seismic networks have contributed to significant findings and the detection of slow earthquake activities; however, it is still unclear what sort of seismological structures exhibits each slow earthquake activity. We have developed the multi-band receiver function (RF) method, in which the RFs are composed of different higher-frequency contents. We, here, reveal smaller-scale structures from the RFs from local deep-focus earthquakes around the Philippine Sea plate boundary in Southwestern Japan, where numerous slow earthquakes have been detected (e.g., Obara, 2002; Ito et al., 2007; Nishimura et al., 2013).

Deep-focus earthquakes, frequently occurring in the Pacific slab below Southwestern Japan, can be applicable to the multi-band RF analysis because the local deep events and teleseismic events are similar in the slowness of the first-arrival phases. Local deep-focus events, however, have different variations in back azimuths from teleseismic events, which enables us to estimate seismological structures in a wider range of azimuths by stacking traces from both events. We carefully select the deep-focus events with longer S-P time than 40 sec and exclude triplication phases from mantle transition zones. Here we apply this method to short-period 3-component seismograms of Hi-net (NIED, Japan) in the Northeastern Kii Peninsula, where short-term slow slip events (SSEs) and episodic tremors are very active (e.g., Obara et al., 2010; Nishimura et al., 2013; Yabe & Ide, 2014).

Cross-sections of higher-frequency RFs (up to 2 Hz) show sharp and strong negative phases from the plate interface shallower than 35 km depth, which is one of the most active regions of episodic tremors (Obara et al., 2010). At the deeper portion, the higher-frequency RFs exhibit the mantle wedge structure with obscure phases of the plate interface, where minor and continuous tremor activities have been reported (Obara et al., 2010). These results suggest that episodic tremors accompanied by short-term SSEs occur on the interface between the continental crust and the oceanic crust, whereas the source regions of minor tremors are between the oceanic crust and the mantle wedge as indicated in Kato et al. (2010).