Lateral variation of low S-wave velocity zone in the Nankai accretionary prism derived from Rayleigh admittance

*Takashi Tonegawa[1], Eiichiro Araki[1], Toshinori Kimura[1], Takeshi Nakamura[2], Masaru Nakano[1], Kensuke Suzuki[1]

1. Japan Agency for Marine-Earth Science and Technology, 2. National Research Institute for Earth Science and Disaster Resilience

A cabled seafloor network (DONET: Dense Oceanfloor Network System for Earthquake and Tsunamis) has been constructed on the accretionary prism at the Nankai subduction zone of Japan since March 2010. DONET contains 22 stations in DONET1 (eastern network) and 29 stations in DONET2 (western network), and the their observation periods exceed more than 5 years and 10 months, respectively. In this study, using Rayleigh waves of microseisms and earthquakes, we calculate the Rayleigh admittance (Ruan et al., 2014, JGR) at the seafloor for each station, i.e., an amplitude transfer function from pressure to displacement, particularly for the frequencies of 0.1–0.2 Hz (ambient noise) and 0.04–0.1 Hz (earthquake signal), and estimate one-dimensional S-wave velocity (Vs) structure beneath stations in DONET.
Each station contains broadband seismometers and absolute and differential pressure gauges. We calculated the displacement seismogram by removing the instrument response from the velocity seismogram for each station. The pressure record observed at the differential pressure gauge was used in this study because of a high resolution of the pressure observation. In addition to Rayleigh waves of microseisms in ambient noise, we collected waveforms of Rayleigh waves for earthquakes with an epicentral distance of 15–90º, M>5.0, and focal depth shallower than 50 km. In the frequency domain, we smoothed the transfer function of displacement/pressure with the Parzen window of ±0.01 Hz. In order to determine one-dimensional Vs profiles, we performed a nonlinear inversion technique, i.e., simulated annealing.
As a result, Vs profiles obtained at stations near the land show simple Vs structure, i.e., Vs increases with increasing depth. However, some profiles at the toe of the acceretionary prism in southwest and southeast of the Kii Peninsula have a low-velocity zone (LVZ) at a depth of 5–7 km within the sediment. The Vs reduction is approximately at most 30 %. On the other hand, such Vs reductions cannot be seen south of the Kii Peninsula. Park et al. (2010) reported a large reduction in P-wave velocity within the region of DONET1 (eastern network and southeast of the Kii Peninsula), but our result shows the LVZ in the regions of both DONET1 and 2 (2: western network and south-southwest of the Kii Peninsula). This indicates lateral variation of low Vs zone at the toe of the Nankai accretionary prism. We will discuss the spatial relationship between the LVZ distribution and the active regions of very low frequency earthquakes.

Keywords: Low velocity zone, Accretionary prism, Lateral variation

