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S-wave velocity structure in the Nankai accretionary prism derived from Rayleigh admittance

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Two cabled seafloor networks with 22 and 29 stations (DONET 1 and 2: Dense Oceanfloor Network System for Earthquake and Tsunamis) have been constructed on the accretionary prism at the Nankai subduction zone of Japan since March 2010. The observation periods of DONET 1 and 2 exceed more than 5 years and 10 months, respectively. Each station contains broadband seismometers and absolute and differential pressure gauges. 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 S-wave velocity (Vs) structure beneath stations in DONET 1 and 2.

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, 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 $\pm$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 depth. However, some profiles located at the toe of the acceretionary prism have a low-velocity zone (LVZ) at a depth of 5–7 km within the accretinary sediment. The velocity reduction is approximately 5–20 %. Park et al. (2010) reported such a large reduction in P-wave velocity in the region of DONET 1 (eastern network and southeast of the Kii Peninsula), but our result shows the LVZ in the regions of both DONET 1 and 2 (2: western network and southwest of the Kii Peninsula). Similar features could also be obtained by using Rayleigh waves of earthquake-signals only. This indicates lateral variation of Vs structure at the toe of the Nankai accretionary prism.