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S-wave attenuation structure in southwestern Japan and Nankai trough

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Seismic waves at high frequency (>1 Hz) of local earthquakes are complex and broadened due to wave scattering and attenuation in the lithosphere. Three dimensional imaging of random velocity inhomogeneity and intrinsic attenuation structures is important to describe such complex wave trains. We have proposed imaging methods of random inhomogeneities (Takahashi et al., 2009) and attenuation (Takahashi, 2012) on the basis of a statistical method called the Markov approximation. This study estimated the 3-D distribution of S-wave attenuation in southwestern Japan by applying the inversion analysis of S-wave maximal amplitudes (Takahashi, 2012). We have analyzed seismic waveforms recorded by onshore and offshore stations. Onshore stations are composed of Hi-net and F-net stations that are developed and maintained by the National Research Institute for Earth Science and Disaster Prevention of Japan. Offshore stations are the ocean bottom seismograms (OBS) that were deployed by the Japan Agency for Marine-Earth Science and Technology for passive seismic observations. Some of the OBS observations were conducted as a part of "Research concerning Interaction between the Tokai, Tonankai and Nankai Earthquakes" funded by the Ministry of Education, Culture, Sports, Science, and Technology, Japan. We measured S-wave maximal amplitudes of RMS envelopes that were composed of velocity seismograms of horizontal components at 4-8Hz, 8-16Hz and 16-32Hz. Apparent amplitude attenuation due to multiple forward scattering was evaluated by using the random velocity inhomogeneities in this study area (Takahashi et al. 2014, AGU fall meeting).

Estimated attenuation structure shows relatively high-attenuation around the top of the subducted Philippine Sea plate. At 0-20km depth, high 1/Q areas are imaged at the most of Nankai trough from Enshu-nada to Hyuga-nada. 1/Q near the top of subducted slab decreases as depth increases. At 40-60km depth, high 1/Q area is imaged only beneath west Shikoku. Attenuation structure of overriding plate shows high 1/Q beneath the Quaternary volcanoes and around the Osaka-Plain. High attenuation beneath the volcanoes would reflect magma intrusions. High-attenuation in Osaka-Plain distributes from the crust to the top of the subducted Philippine Sea plate. In a recent study, Kusuda et al. (2014) concluded that non-volcanic hot-spring in this area can be explained by a dehydrated component of subducted Philippine Sea slab. This spatial coincidence implies that high 1/Q around the Osaka-Plain is related with the dehydration process.

Keywords: Nankai trough, attenuation structure, random media