Random inhomogeneities in the southwestern Japan related to the Quaternary volcanoes and S-wave reflector

Tsutomu Takahashi[1]

[1] IFREE, JAMSTEC

High-frequency seismic waves are collapsed and broadened as travel distance increases. This envelope broadening is caused by the multiple forward scattering and diffraction due to random inhomogeneities in the vicinity of the ray-path. The studies of envelope broadening in the northeastern Japan reported the spatial variation of random inhomogeneities related to the volcanic front (Obara and Sato, 1995) and the Quaternary volcano distribution (Takahashi et al. 2007). This study investigates the spatial distribution of random inhomogeneities in the southwestern Japan from the inversion analysis of the peak delay time.

The waveform data of 291 microearthquakes recorded at 508 Hi-net stations and 37 OBS stations are used in this study. The magnitude and focal depth ranges are 1.1-5.4 and 35-200km, respectively. The total number of ray-paths is approximately 16000. We composed the root mean square (RMS) envelope of velocity seismograms from the horizontal components in 2-4Hz, 4-8Hz, 8-16Hz and 16-32Hz bands. We measured the peak delay time which is defined as the time lag from the S-wave onset to the maximum amplitude arrival of S-wave envelope. This peak delay time is the best measure to quantify the accumulated scattering effect due to random inhomogeneities. Examining the path-dependence of RMS envelopes and their peak delay times, we found the following remarkable characteristics; (1) envelopes propagating beneath the Hida-area, Izu-Peninsula and Yufu-Aso area are strongly broadened in higher frequencies (2) The region from Osaka-plain to Biwa-lake also indicates strong broadening in higher frequency.

We apply the inversion analysis of the peak delay time assuming the spatially non-uniform isotropic random media with impulsive seismic sources (Takahashi et al., 2006, JPGU meeting). The power spectral density function of random media is assumed to be von Karman type. There are two unknown parameters representing the spectral decay in short-wavelength component and the spectral level in long wavelength component. The strongly inhomogeneous regions are estimated in the following regions; (1) from western Chugoku-district to northeastern Kyushu (Depth 0-20km), (2) Izu-peninsula (Depth 40-60km) and (3) from Osaka-plain to Biwa-lake (Depth 20-40km). The strong inhomogeneities beneath the Quaternary volcanoes are similar to the northeastern Japan. However, strong inhomogeneities in region (1) are located in shallower part, meanwhile northeastern Japan and Izu show stronger inhomogeneities in deeper part. The region (3) is also imaged as strongly inhomogeneous by the Coda-wave analysis (Nishigami, 2006). The reflector of S-wave is detected in this region (Katao, 1993). Similar coincidence of random inhomogeneities and reflector is also found in the northern Izu-Bonin arc (Takahashi et al., 2007, JPGU meeting). These results imply that the distribution of reflectors is related to the medium inhomogeneities.