Seismic basement structure beneath the western Tokyo Bay area estimated by the seismic interferometry (supplementary report)

Kazuo Yoshimoto[1]; Hisashi Nakahara[2]; Shigeo Kinoshita[3]

[1] Int. Graduate School of Arts and Sciences, Yokohama City Univ.; [2] Geophysics, Science, Tohoku University; [3] Sience, Yokohama City Univ.

Seismic basement structure beneath the western Tokyo Bay area has been investigated by many researches (from the receiver function analysis, microtremor array analysis, etc). However, there is much ambiguity in the seismic basement model of this region, partly because of the lack of deep boreholes. We show the effectiveness of the seismic interferometry (e.g. Nakahara, 2006) for the investigation of seismic basement structure and present our results for the western Tokyo Bay area.

In this study, we analyzed the seismic waveforms recorded by the SK-net that is a strong ground motion array deployed in the Metropolitan area of Japan. This strong motion network provides us with data appropriate for the study of local basement depth variation. We selected the acceleration waveforms with high signal-to-noise ratio from 59 local events. Acceleration waveforms were high-pass-filtered (C.F. = 0.35 Hz), and then were integrated to be converted to displacement waveforms. After the calculation of the autocorrelation function of each SH displacement waveform with a length of 10 s from the S-wave onset, the autocorrelation functions from all events were stacked at each station.

On the most of autocorrelation functions, we observed a distinct phase with negative polarity at a time of 3-7 s. This phase is very small on the autocorrelation function of each event; however, this phase is detected easily on the stacked autocorrelation function. The appearance time of this phase corresponding to the two-way travel time of S waves between the free surface and the seismic basement is characterized only by the S-wave velocity structure of sedimentary layer.

For example, in the Tokyo metropolitan area, the two-way travel time of S waves between the free surface and the seismic basement reaches a maximum value of about 6-7 s in Nerima Ward, indicating a local subsidence of the seismic basement with a maximum depth exceeding 3000 m. This result is consistent with that reported by the Tokyo Metropolitan Government (2004) from the seismic reflection survey. In the southern part of the area studied, the two-way travel time of S waves between the free surface and the seismic basement decreases about 2 s from east to west across the Miura Peninsula, implying a local large variation of the seismic basement depth.

The results obtained by our analysis show that the seismic interferometry of strong ground motion data is quite effective for detecting the reflected S-wave phases from the seismic basement. An appropriate depth conversion algorithm by using adequate sedimentary S-wave velocity models enables us to investigate the local variation of seismic basement depth.