Seismic basement structure beneath the Metropolitan Tokyo area: Seismic interferometry for the Tsukuba-Yokohama line (MeSO-net)

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Seismic basement structure beneath the Tsukuba-Yokohama observation line of the MeSO-net (Metropolitan Seismic Observation network) was investigated on the basis of the seismic interferometry.

In this study, the seismic waveforms of the local earthquakes recorded by 45 MeSO-net stations that are in line between Tsukuba and Yokohama at about 3 km intervals were newly analyzed. The observation system of this network has a wide dynamic range (135 dB) and wide frequency band (DC to 80 Hz). To avoid surface ground noise, sensors are installed in boreholes at depth of about 20 m. The acceleration waveforms with high signal-to-noise ratio from 16 local events were selected in this analysis. These 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 to obtain the reflection response of S-waves for shallow underground structure.

On the most of the reflection responses, we observed a clear seismic basement phase with negative polarity. Since the appearance time of this phase corresponds to the two-way travel time of S-waves between the free surface and the seismic basement, it can be used as a measure of seismic basement depth and its local variation. In the south part of the observation line (northeastern Yokohama City to Katsushika Ward), the appearance time of seismic basement phase is 5 s approximately, implying the nearly flat seismic basement with depth of about 3 km. In contrast to this, the appearance time of seismic basement phase decreases on the north part of the observation line: approximately 4 s at Kashiwa City, 3 s at Tsukubamirai City, and 2 s at Tsukuba City. This result indicates that the depth of seismic basement decreases about 2 km along this part of the observation line.

Our result shows that the seismic interferometry for the seismic waveforms of local earthquakes is quite effective for investigating the local variation of seismic basement depth even in the densely populated area with high ground noise.