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Seismic basement structure beneath the Metropolitan Tokyo area inferred from pseudo seismic reflection profiles

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Seismic basement structure beneath the seismic observation lines in the Metropolitan Tokyo area (e.g., Tsukuba-Fujisawa observation line of the Metropolitan Seismic Observation network (MeSO-net)) was investigated by the pseudo seismic reflection profiles from the seismic interferometry. In this study, the seismic waveforms of the local earthquakes recorded by the MeSO-net stations and the SK-net stations were analyzed to obtain pseudo seismic reflection profiles. High spatial density of the seismic observation stations in the Metropolitan Tokyo area enables us to construct many seismic observation lines for seismic basement structure analysis. Station interval along these seismic observation lines is less than about 2-3 km. Twenty thousand acceleration waveforms with high signal-to-noise ratio from local events were used in this analysis. These waveforms were high-pass-filtered, 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. The pseudo seismic reflection profile is constructed by depth converting this reflection response according to the S-wave velocity model from the VSP observations at 14 points in the Metropolitan Tokyo area.
On the all of the pseudo seismic reflection profiles, we observed a clear seismic basement phase. The clearness of this phase shows a relatively large regional variation probably due to the regional difference of the impedance contrast at seismic basement. Short interval of seismic stations enables us to trace the horizontal variation of seismic basement depth beneath pseudo seismic reflection lines. For example, along the Iruma-Choshi line, the seismic basement has a depth of about 1km around Narita City, and increases its depth to the west having maximum depth of about 3km around the point of intersection with the Arakawa river. The pseudo seismic reflection profile which traverses the mid part of the Tokyo metropolitan area from the west to the east shows a local maximum of seismic basement depth of about 3 km beneath Shinjuku Ward.
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.

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