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Seismic basement S-wave reflection beneath the Tokyo Metropolitan Area inferred from seismic interferometry

Kazuo Yoshimoto[1*], Naoshi Hirata[2], Keiji Kasahara[2], Kazushige Obara[2], Hiroshi Sato[2], Shin'ichi Sakai[2], Hiroshi Tsuruoka[2], Shigeki Nakagawa[2], Hisanori Kimura[3], Toshikazu Tanada[3], Tamotsu Aketagawa[4], Hisashi Nakahara[5], Shigeo Kinoshita[1]

[1]Yokohama City Univ., [2]ERI, Univ. of Tokyo, [3]NIED, [4]Hot Springs Res. Inst. of Kanagawa Pref., [5]Tohoku Univ.

The properties of the seismic basement S-wave reflection beneath the Tokyo Metropolitan Area were investigated by the seismic interferometry. Twenty-seven thousand seismic waveforms of the local earthquakes recorded by the MeSO-net stations and the SK-net stations were analyzed in this study. 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. Our waveform analysis revealed that the seismic basement reflection phase can be found on the most of the reflection responses obtained.

Adopting Qs value in the sedimentary layer reported by Kinoshita and Ohike (2002), we estimated the S-wave reflection coefficient for the seismic basement beneath the Tokyo Metropolitan Area. The magnitude of the reflection coefficient shows a large regional variation, possibly because of the regional difference of the impedance contrast at the seismic basement surface. The values of the reflection coefficient up to 0.5 were estimated in southern Ibaraki Prefecture and northern Chiba Prefecture, whereas the values about 0.1 and less were estimated in Kanagawa Prefecture. Small reflection coefficients observed in Kanagawa Prefecture is likely related to the low S-wave velocity in the seismic basement rocks that are the part of the Shimanto Belt (a Cretaceous-Neogene accretionary complex). Although there is a large scatter in the refection coefficients estimated, it is worthy to note that the magnitude of the reflection coefficient shows apparent depth dependence. The magnitude of reflection coefficient is approximately 0.3 for the seismic basement depth shallower than about 2km. However, the magnitude of the reflection coefficient decreases down to 0.2 and less as the seismic basement depth increases, implying the magnitude of the impedance contrast at the seismic basement surface decreases with increasing depth.

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

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