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Joint Inversion of Phase Velocity and Receiver Function for Estimation of Sedimentary Layers near the Tachikawa Fault

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Tachikawa fault is one of the most activity faults in the Tokyo metropolitan area and when large earthquake will occur by this fault in the near future, it is expected that large economic and human loss will happen around this area. However, three dimensional subsurface structural model is not clear still enough for the estimation of the strong ground motions in this area. In this study, we estimated the three dimensional subsurface structural model using the joint inversion of Rayleigh wave phase velocity and receiver functions.

To accomplish it, we first conducted the array observations of microtremors at eight sites around the Tachikawa fault. Rayleigh-wave phase velocity at periods from 0.5 to 5.0 seconds was estimated from a frequency-wave number spectral analysis of the microtremors. We next analyzed the earthquake records observed at 60 stations of the K-NET, KiK-NET and SK-net to derive a receiver function. We calculated the receiver functions from 20 to 50 seismic records obtained at each station.

Finally, we conducted the joint inversion of the phase velocity and the receiver function to a P and S-wave velocity profile based on the simulated annealing method. Based on numerical experiments, the inverted phase velocities and receiver function displayed good agreement with the observed ones. P-wave velocities ,S-wave velocities and thickness of individual layers are inverted very well, and the S-wave velocities of the inverted profile are 0.5, 0.9, 1.5, 2.7, and 3.2km/s.

Moreover, we constructed the three dimensional subsurface structural model in this area obtained from P-wave and S-wave velocity profiles of thick sediments at each station. The results indicate that a basement depth in those profiles at down-thrown side of the fault is larger than that at up-thrown side with a difference of about 1.8km.

Keywords: Tachikawa fault, joint inversion, receiver function, array microtremor exploration, Rayleigh wave phase velocity