Deep structure of the Nojima fault estimated from an observation of the trapped waves at the GSJ Hirabayashi borehole

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A number of observational studies of the fault-zone trapped waves have been done, and imaged an averaged fault-zone structure from hypocenter to receiver. Recently, it became possible to model trapped waves propagating along the heterogeneous fault zone structure, and the spatial variation of fault zone structure can be inferred from waveform modeling such as the 3-D FDM. However, most of the previous studies did not infer variation of the fault zone structure along the fault because of the insufficient coverage of traveling path of trapped waves due to insufficient station and hypocenter distribution. There are two borehole stations, TOS2 and HRB, along the Nojima fault. TOS2 is at the southwest end of the Nojima fault, and HRB is at the location where the largest surface displacement of 2.5 m was observed. Each stations are about 5 km apart along the Nojima fault, and we can infer the spatial variation of the fault zone structure of the Nojima fault using both stations. In this study, we estimated averaged fault-zone structure around the HRB from the analysis of trapped waves. We then compared the averaged structure around HRB with TOS2 that estimated by Mizuno et al. (2002), and discuss a possible variation of the fault zone structure along the Nojima fault.

We analyzed 4 events that show typical trapped wave characteristics. The duration of the trapped waves are ranging from 0.3 – 0.4 s, and it became longer with hypocentral distances, suggesting that the trapped waves were originally generated at the hypocenter and propagated along the low-velocity fault zone. The dominant frequency of trapped waves at HRB are about 10 – 20 Hz, which is higher than that for the TOS2 (10 Hz). In order to obtain the averaged fault zone structure from hypocenter to HRB, we assumed a fault-zone structure to be a 2-D uniform low-velocity wave-guide, and modeled the wavefrom of trapped waves using analytical solution of trapped waves developed by Ben-Zion and Aki (1990). The width, shear-wave velocity, and Qs of the fault zone were estimated to be 20 –110 m, 1.5 – 2.9 km/s, and 30 – 90, respectively. The width of the fault zone at HRB is narrower than that for the TOS2 (150 – 240 m), suggesting that the width of the Nojima fault changes along the Nojima fault strike.