Deep structure of the Nojima fault by a borehole observation of Trapped-Waves

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Analyses of fault-zone trapped-waves are expected to be one of the effective approaches for imaging a deep fault structure. Trapped-waves are usually detected by surface array observations. In these observations, however, seismograms are disturbed by attenuation and strong scattering near the surface. Fault zone structure should be estimated more precisely by a borehole observation of trapped-waves. In this study, we used high signal-to-noise ratio seismograms recorded in the DPRI, Kyoto Univ., 1800-m-deep borehole at Toshima, southern end of the Nojima fault.

We analyze 698 events occurred from January 1, 1999 to May 14, 2000. The aftershocks are distributed along the Nojima and Rokko fault system, at depths ranging from 3 to 20 km. In this analysis, we use relocated hypocenter data by Nagai et al. (2001) and event information provided by DPRI, Kyoto University. To detect the trapped-waves with Love wave type, we analyzed polarization of S-wave part in each seismogram, and calculated envelopes for several frequency bands to obtain dispersion curves of trapped-waves. In this study we calculated synthetic dispersion curve for trapped waves propagating along a vertical low-velocity layer sandwiched between two half-spaces. We assumed the S-wave velocity of the surrounding rock to be 3.4 km/s in this study. The S-wave velocity and the width of the low velocity fault-zone are estimated by comparing observed and synthetic dispersion curves.

We found 36 (5.2 %) seismograms whose S-wave part contains a dispersive and fault- parallel polarized wave train. 86% of the analyzed earthquakes did not have a dispersive wave train in the fault-parallel component. This result suggests that at least 86 % of earthquakes is not located near the fault. Events for which we found trapped-waves are located in the Awaji Island. This suggests that the Nojima Fault does not connect to the Rokko fault system. We cannot see any developments of trapped-waves with distance. This result suggests that the velocity contrast of the fault zone becomes smaller with depth. A more quantitative discussion will be required in the future.

We estimated also the S-wave velocity and the width of the low-velocity fault-zone. The velocity takes values between 2.2 and 2.8 km/s, while the width ranges from 40 to 160 m. These values show occasionally a large scatter, which may imply a strong lateral and vertical variation of the fault zone structure.