Estimation of subsurface structure in Anamizu, Ishikawa pref. using micro-tremor records

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The peak ground acceleration of 780 Gal was recorded at the K-net Anamizu station (ISK005) during the 2007 Noto-hanto Earthquake. Though the town of Anamizu is located 20 km away from the epicenter, many wooden structures were damaged by this earthquake. The damaged structures, indicated by black dots in the figure, are irregularly distributed with some concentration along rivers. The PS logging at ISK005 reveals a 16 m thick soft soil layer with Vs of less than 130 m/s, which may affect structural damage in the town of Anamizu.

Micro-tremor observation was carried out in Aug. 2007 and Sep. 2008 to capture the characteristics of the subsurface structure in Anamizu. The observation system was composed of portable seismographs (GPL by Akashi), servo-type accelerometers (LS-10C by Rion), and data loggers (DA-20 by Rion). Three component acceleration records of 15 minutes were recorded, where 15 seconds of stationary portions were extracted as samples, and about 10 samples were used to obtain H/V spectra. The H/V spectrum is calculated by an ensemble average of spectral ratio of the horizontal spectrum to the vertical spectrum; the horizontal spectrum is a root of the square sum of two directional horizontal spectra. The figure shows distribution of peak frequency of H/V spectrum and its contour lines.

Peak frequencies of around 0.8 Hz at the south-east side of the town are the lowest; those of 1 Hz to 1.5 Hz at the north-east and the north side of the town are the second lowest. Peak frequencies around ISK005 are 1.5 Hz, which is in accordance with the peak frequency of horizontal to vertical ratio of the particle motion trajectory of the Rayleigh wave fundamental mode based on the PS logging data. The area of about 100 m away from ISK005 at the south and the area west to the Anamizu railway station show peak frequencies above 4 Hz. The central area of the figure shows peak frequency around 10 Hz or no peak. The peak frequencies have large variation in the narrow area of about 500 m square in the figure.

The area indicated in the figure as a circle has almost constant peak frequencies around 2 Hz, whereas the surrounding area except for the north-east direction has higher frequencies with rapid increase at the circumference. Generally, lower peak frequency of H/V spectrum reflects thicker sedimentary layer, which may suggest that the subsurface structure has a sedimentary basin type profile. A number of completely destroyed buildings are found in the circle shown in the figure. One of the reasons of concentrated damage in this area is considered as the amplification of the ground motion due to the topographic effects of the sedimentary basin type profile of the subsurface structure.

Conclusions

Peak frequencies of H/V spectra obtained by micro-tremor observation in the town of Anamizu have large spatial variation. One area with almost constant peak frequencies around 2 Hz was suffered from severe damage during the earthquake. Peak frequencies at the circumference of the area are higher and show rapid increase at the edge, which suggests that the damaged area is located at the center of the small sedimentary basin and the concentrated damage may be attributable to its local topographic effects.

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