Velocity Structure Model of Sedimentary Basins in Toyama Prefecture, Japan, by Microtremor Array Measurements

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Sedimentary plains or basins in Toyama prefecture such as the Toyama plain, the Imizu plain, and the Tonami plain consist of alluvium fans and coastal plains (Fujii, 1992). These sedimentary basins are filled by thick sedimentary layers with thickness of more than several km formed during and after the back-arc rifting of the Sea of Japan in Neogene time (Toyama prefecture, 1992). The bedrock belongs to the Hida metamorphic belt. Many active thrust faults exist along boundary between hills and plains. Sea floor active faults were also identified around the Toyama Trough (Ishiyama *et al.*, 2014). A reliable basin velocity structure model is indispensable for predicting strong ground motions from those onshore and offshore active faults. However, geophysical exploration to survey the S-wave velocity structure down to the seismic bedrock is very few in this area. Thus, we have conducted microtremor array measurements and estimated the S-wave velocity structure models in this area.

The microtremor array measurements were conducted at 15 sites on 27-31 October 2015, 10-13 November 2015, and 9-12 November 2016 (see a map attached). These sites are close to strong motion stations of K-NET, KiK-net, JMA and Toyama prefecture in Nyuzen town (NYZ), Uozu city (UOZ), Namerikawa city (NMK), Tateyama town (TTY), Toyama city (TYB, TYF, YTO, OYM), Imizu city (SIM, DIM, SNM), Tonami city (TNM), Nanto city (FKM, NNT), and Oyabe city (OYB). In order to obtain the S-wave velocity structure continuously from the ground surface to the seismic bedrock, a set of array measurements consisting of several different sizes of array from about 20 m to 1.5 km was conducted at each site. Each array consists of seven Lennartz LE-3D/5s seismometers. The vertial component of microtremor was analyzed by the spatial auto-correlation method (SPAC), and we obtained the phase velocity in the frequency range 0.2-5 Hz. Sites on alluvial fans, NYZ, UOZ, TTY, TYF, YTO, OYM, TNM, FKM, NNT, and OYB have relatively higher phase velocity (0.6-1.0 km/s) even at 2 Hz or higher. On the other hand, other sites (NMK, TYB, SIM, DIM, and SNM) have relatively lower phase velocities (0.2-0.5 km/s).

We estimated the S-wave velocity structure model for each site from the obtained phase velocities assuming that the observed phase velocity represents the fundamental mode of Rayleigh wave. We referred to the nation-wide three-dimensional velocity structure model J-SHIS V2 developed by NIED (Fujiwara *et al.*, 2012), and we assumed a layered velocity structure model composed of homogeneous sedimentary layers and bedrock. The S-wave velocity for each layer was fixed at the value given by J-SHIS V2 model, and we estimated thicknesses of these layers to fit the observed dispersion curve by the genetic algorithm (Yamanaka and Ishida, 1998). We included an additional surface layer above the layer of Vs 0.6 km/s for sites where low phase velocities were observed. We also added a layer of Vs 0.75 km/s for some stations considering data fits. The estimated velocity structure models explain the observed phase velocities better than the present J-SHIS V2 model. The depth of seismic bedrock is approximately 5-6 km in the Toyama and Tonami plains, which is consistent with the deep seismic reflection and refraction survey KT01 crossing the Tonami plain and the Kureha hill by Ishiyama *et al.* (2016).

We are planning to improve the three-dimensional velocity structure model in this area combining our results and other information such as reflection and refraction surveys.

Acknowledgements: This study was conducted by the integrated research project on seismic and tsunami hazards around the Sea of Japan funded by the Ministry of Education, Culture, Sports, Science and

Technology, Japan. The field observation was conducted with help by people participating from Geo-Analysis Institute, Geo-Research Institute and DPRI, Kyoto University.

Keywords: Toyama plain, velocity structure model, microtremor array measurement