Strong ground motion prediction for the source fault model of Futagawa and Hinagu active fault zones (1) -Construction of the basin velocity structure model-

*Kimiyuki Asano[1], Tomotaka Iwata[1], Masayuki Yoshimi[2], Hiroe Miyake[3], Haruko Sekiguchi[1], Shinichi Matsushima[1], Hiroshi Kawase[1], Fumiaki Nagashima[1], Hiroaki Yamanaka[4], Kosuke Chimoto[4], Nobuyuki Yamada[5], Tatsuo Kanno[6], Michiko Shigefuji[6], Shigeki Senna[7], Takahiro Maeda[7], Atsushi Wakai[7], Asako Iwaki[7], Kaoru Jin[9], Hidetaka Saomoto[2], Seiji Tsuno[8], Masahiro Korenaga[8], Takeshi Sugiyama, Haruhiko Suzuki[9], Hisanori Matsuyama[9], Shunpei Manabe[9], Atsushi Yatagai[9], Shigeru Okamoto[10], Masaki Suehiro[10]

1. Disaster Prevention Research Institute, Kyoto University, 2. Geological Survey of Japan, AIST, 3. University of Tokyo, 4. Tokyo Institute of Technology, 5. Kochi University, 6. Kyushu University, 7. National Research Institute for Earth Science and Disaster Resilience, 8. Railway Technical Research Institute, 9. OYO Corporation, 10. Hanshin Consultants Co., Ltd.

The sub-theme #3 of the Comprehensive Research Project for the Major Active Faults Related to the 2016 Kumamoto Earthquake by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) developed a three-dimensional underground seismic velocity structure model in the Yatsushiro plain and other areas for improving strong motion prediction for future earthquakes along the Futagawa and Hinagu fault zones because there are still un-ruptured segments remained on these two fault zones.
In the Yatsushiro plain, which is located along the Hinagu fault, seismic reflection surveys using a P-wave vibrator were conducted along two lines in 2017 (Uki line and Yatsushiro line) to investigate the underground structure down to the seismic bedrock. Temporary strong motions stations were installed at 37 sites covering the whole area of the Yatsushiro plain. Small-size microtremor array survey was also conducted at these temporary stations. Large-size microtremor array surveys were carried out at 29 sites with a maximum array radius of 500-600 m in the whole area of the plain. Miniature and irregular array microtremor observations were conducted to survey shallow subsurface structure at 32 sites in the southern part of the Yatsushiro plain. Single-station microtremor H/V observations were carried out at 31 sites in the boundary area between the Yatsushiro and the Kumamoto plains.
Microtremor array measurements were also conducted at most of strong motion stations in the Amakusa Islands, the Minamata-Ashikita area, the Hitoyoshi basin, the Izumi plain, the Tamana plain, the Kikuka basin, Aso area, and the southern part of the Shimabara peninsula, which consists of 23 Large-size arrays and 76 small-size arrays. Single-station microtremor H/V observations were conducted at 47 sites in the Izumi plain and 44 sites the Tamana plain to investigate the spatial variation in the bedrock depth. Miniature and irregular array microtremor observations were also conducted at 48 sites in the Hitoyoshi basin. Hot-springs boring well-logs were collected in the Yatsushiro plain, the Mianamata-Ashikita area and the Hitoyoshi basin.
We modeled the 3D velocity structure above the seismic bedrock using these survey data and existing information. For the Yatsushiro plain, the Rayleigh wave phase velocity and H/V spectra from the microtremor observations were jointly analyzed to obtain the S-wave velocity profile at each measurement site. When we analyzed microtremor data, we referred to seismic reflection profiles and boring log as constraint information for bedrock depth. The sedimentary layers were modeled by two layers with S-wave velocities of 0.6 and 0.9 km/s. Shallow low-velocity layers were also considered above the layer of 0.6 km/s, and we assumed a layer of Vs 2.7 km/s at the top of the seismic bedrock (Vs 3.1 km/s). The top depth of Vs 2.7 km/s is well correlated with the bedrock depth from the reflection surveys, and its depth

ranges from 0.3 to 0.6 km. The thickness of Vs 0.9 km/s is relatively large along the Yatsushiro line compared to the Uki line, which is consistent with interval velocities along these survey lines. Initial velocity model was constructed by the results of microtremor array analysis, and it was revised with H/V spectra at sites where phase-velocity dispersion curve was not available after checking consistency with gravity anomaly and boring well data.
Deep sedimentary velocity structure models were also constructed in the Hitoyoshi basin, the Amakusa Islands, Izumi plain and others using microtremor array surveys. The sedimentary layers were modeled by three layers with Vs 0.6, 0.9 and 1.6 km/s. Hot-spring borehole logs were also used in the Hitoyoshi basin. The seismic bedrock depth (Vs 3.1 km/s) is relatively deep in the eastern part of the Hitoyoshi basin (1.0~1.5 km). The top depth of Vs 1.6 km/s is relatively shallow around Amakusa Kamishima Island, which is consistent with high Bouguer anomaly in this area. The bedrock in the Izumi plain deepens toward the coast.
The final product of the 3D deep sedimentary velocity structure model and its validation by ground motion simulations will be presented in this presentation.

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Keywords: deep sedimentary velocity structure model, strong motion prediction, Hinagu fault zone, Futagawa fault zone

