Evaluation on Influence of Shallow Subsurface Structures to Earthquake Ground Motions in the Kumamoto Plain, Using the Borehole Seismic Data

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The Kumamoto Plain, located in the Northern part of Kumamoto prefecture, Kyushu island, is consist of diluvial plateau in the west slope of Mt. Aso and alluvial lowland formed by Shirakawa and Midorikawa. It is suggested that the earthquake ground motions are amplified largely and intricately, due to the complex and soft soil sediments.

To investigate characteristics of earthquake ground motions in the Kumamoto Plain, we installed temporary seismic stations along the north-south line in Kumamoto Plain, immediately after the 2016 Kumamoto earthquake. We obtained seismic data of the main shock (Mj 7.3, occurred on 4/16 2016) at 2 sites near Mt. Hanaoka, in the northern edge of the Kumamoto Plain. We showed that the strong ground motions observed at the 2 sites during the main shock, were affected by the non-linearity and the polarization to direction of north-south.

To clarify the cause of these distinctive trends of the ground motions, we conducted detailed observations and surveys the site where the main shock was recorded. We installed seismometers simultaneously on the ground and on the engineering bedrock at a depths of 40m, with a sample rate of 1000 Hz. We calculated the Fourier spectral ratio of the seimic data on the ground to the data on the engineering bedrock. As a result, we confirmed that the characteristics of the NS and EW component of the spectral ratio are clearly different around 1-4 Hz. It is suggested that complex shallow subsurface structure affects the polarization to direction of north-south.

In addition, we performed P-S logging to understand shear wave velocity of the alluvial soils to the engineering bedrock at this site. We compared site amplification factors estimated from weak ground motion data to those calculated from P-S logging data and S-wave velocity structures estimated by array microtremor observations. Finally, we discussed the influence of shallow subsurface structure to the earthquake ground motions in complex and soft soil sediments.

Keywords: 2016 Kumamoto earthquake, borehole seismometer, shallow subsurface structures

