Near surface geophysical survey at Mashiki Town stricken by the 2016 Kumamoto Earthquakes

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We conducted a detailed near surface geophysical survey at Mashiki Town, where was severely damaged by the 2016 Kumamoto twin earthquakes of magnitudes (Mj) 7.3 as the mainshock and 6.5 as a foreshock. The near surface survey comprised “Hybrid” surface wave survey, capacitively coupled resistivity (CCR) measurement using OhmMapper, and GPR measurements using Utility Scan DF or 350 HS tools linked with a VRS-GNSS precise positioning system. A total of 5 short survey lines were set to intersect a branched surface rupture, or placed in the downtown area of Mashiki Town. The purposes of the survey were to provide high-resolution subsurface profiles of the sites where surface structures were sporadically damaged, because most of previous field surveys conducted in Mashiki Town by various research groups had adopted sparse or ill-conditioned parameters to delineate small scale irregular structure for explaining such sporadic damage distribution in the town. In contrast, our GPR survey successfully imaged detailed structures on the surficial zones form 2 m to in case to 5 m in depth, and identified a number of step-like sharp dislocations around the surface rupture, owing its dense spatial sampling at 1 cm. Layered resistivity structures, imaged by CCR surveys up to 10 m in depth, showed a kinked structure around the surface rupture. The “Hybrid” surface wave survey, recently proposed by the authors, reconstructed S-wave structures up to 40 m in depth. In addition, HSWS records were processed through an ordinary seismic reflection data processing flow. As a result, reverse faulting structure was clearly imaged in concordance with the other near-surface survey results. Survey results obtained in the downtown area delineated low velocity and low resistivity surficial layer, and it thickened toward to the lowland area, contrary to the observed house damage. This strongly indicated that the surface soft layer and its thickness was not the major cause of the house damage. Our survey results also demonstrated the importance of high-resolution surveying for the delineation of local irregularity in the near surfaces.

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