Subsurface geology beneath downtown Mashiki seriously damaged by the 2016 Kumamoto Earthquake

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Mashiki Town, Kumamoto Prefecture, SW Japan was seriously damaged by the 2016 Kumamoto Earthquake. Downtown Mashiki is located on the slope at the margin of an upland formed by the Aso-4 pyroclastic flow deposits. Particularly, building damage was concentrated at the lower part of the slope. The damage concentration was recognized from downtown Mashiki to Higashi-ku of Kumamoto City with a length of 3 km at least along the margin of the upland. We examined sediment cores and SPT samples drilled at three sites in the damage-concentrated zone and its surroundings (Yoshimi et al., 2016), and also carried out micro-tremor array surveys along sections across the zone.
Detailed examination of the sediment cores and the SPT samples reveals that subsurface geology (to the depth of 70 m) beneath downtown Mashiki is composed of a scoria and volcanic ash bed (Aso-3 pyroclastic flow deposits), a tuffaceous mud bed, a pumice and volcanic ash bed (Aso-4 pyroclastic flow deposits), a tuffaceous mud bed, a tephric loess bed, and an artificial fill in ascending order. Among them, the tuffaceous mud bed above the Aso-4 pyroclastic flow deposits exhibits a high water content and a very soft property. It was due probably to a generally shallow water table in the study area. Furthermore, the Aso-4 pyroclastic flow deposits are thicker beneath the lower slope than the upper slope.
Micro-tremor array surveys also reveal that a relatively soft layer with a S-wave velocity lower than approximately 300 m/s, which correspond to the pumice-dominated part of the Aso-4 pyroclastic flow deposits on the basis of the PS logging data (Yoshimi et al., 2016), becomes thicker beneath the lower slope and that the base of the layer decreases the elevation stepwise from the upper to lower slopes. Such distribution pattern of the strata is considered as one of the major factors involved in the maldistribution of the earthquake damage.
On the other hand, building damage was less conspicuous in the lowland south of the margin of the upland. The micro-tremor array surveys indicate that a soft layer with a lower S-wave velocity is distributed beneath the lowland. Further investigation is needed to understand the relation between the geologic properties and the earthquake damage in the lowland.

Reference: Yoshimi et al. (2016) Abstracts, 2016 Fall Meeting, JSAF, P-17.

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