

## Elucidation of geological structure in the Uchinomaki hot spring area using microtremor array measurement: Insight into horizontal deformation during 2016 Kumamoto earthquake

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The 2016 Kumamoto earthquake (Mw7.0) caused serious damages to a wide range of Kumamoto prefecture centering on the Hinagu fault and Futagawa fault. One of the disasters is the dormant of hot springs in Uchinomaki area located in the northwest of the Aso caldera. Several geophysical surveys, such as satellite data analyses, borehole camera observations, logging operations and drilling operations, were conducted after the 2016 earthquake (Tsuji et al., 2017). As a result of these surveys, horizontal sliding could occur along the geological formation about 50 m in depth, and kilometer-scale geologic block could move more than 1.5 m to north-west direction without any strain accumulation and gravitational instability. However, spatial variation of the underground structure in the Uchinomaki hot spring area had not been explored, and the mechanism of horizontal sliding had not been clearly elucidated. In order to estimate more detailed underground structure, we performed microtremor array measurements at 70 sites in the Uchinomaki area for 11 days. We applied Spatial Auto Correlation (SPAC) method (Aki, 1957; Okada, 2006) for observed microtremor data to estimate surface wave dispersion curves of phase velocity. S-wave velocity profiles were then obtained by inversion of the observed dispersion curves using non-linear least square method. The spatial distribution of the S-wave velocities demonstrated that horizontal layered structure around 50 m in depth as previous study (Tsuji et al., 2017) suggested, and both S-wave velocity and gamma ray data at the same location indicate lithology boundary at 50 m. We also see the other characteristic S-wave velocity structures in the Uchinomaki area, such as a consolidated rock near the somma of Mt Aso caldera, soft sediments of caldera lake on the inner flat area, and anomalous high S-wave velocity in central of the Uchinomaki hot spring maybe due to the precipitation of hot spring minerals. In addition, our results revealed range of horizontal deformation by several indications of the edge of geologic block. These results demonstrate that horizontal deformation occurred along the lithology boundary at 50 m in depth, and the horizontally displaced geologic block is surrounded by lithological boundary (i.e., discontinuity in S-wave velocity).

Keywords: Kumamoto earthquake, microtremor array measurement, horizontal deformation