Crustal deformation of the 2016 Kumamoto earthquake sequence (4)
― Geomorphological and geological settings of triggered surface ruptures ―

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A lot of linear surface displacements (LSDs) derived by the 2016 Kumamoto Earthquake were detected by InSAR analysis around the northwest of the outer rim of the Aso caldera, southwestern Japan (Fujiwara et al., 2016). While many of the LSDs appeared along the known active faults, some of them appeared at the location of no fault displacement topography. These LSDs caused incidentally with the main fault activity of the Kumamoto Earthquake without earthquakes. Fujiwara et al. (2016) inferred that many of the LSDs in this area were surface ruptures of half-graben-like normal faulting induced by local north-south extension associated with the change of tectonic stress field by the earthquake. No proceeding study has been seen concerning how such triggered non-seismogenic surface ruptures contribute in forming fault displacement topography. Therefore, we are investigating the detailed topography, geology and the shallow subsurface structure of these LSDs zones to clarify it. In this presentation, the results of topographical and geological survey, trench survey at the foot of the fault scarp and ground-penetrating radar (GPR) survey at the active fault where displacement occurred along the known active fault were introduced.

In the Matoishi-bokujo-1 Fault site (Fig.1), Fujiwara et al. (2016) showed that the LSD along the active fault has relatively north-up and south-down displacement of approximately 10 cm offset. In this site, a knick line with the small opening of the surface soil was identified on the slope near the foot of fault scarp although clear surface rupture was not found. As a result of trench survey at the foot of fault scarp, white color volcanic pyroclastic deposit presumed to be Aso-4 pyroclastic flow deposit (89ka) with a gradient larger than that of the ground surface was found near 3-4 m underground (Fig.2). Also, the results of GPR survey across the active fault before trench survey showed that a clear reflection profiles of 3-4 m underground on the southern side of the active fault is inclined to the deeper part as it approaches the fault. This clear reflection corresponds to the upper surface of white color volcanic pyroclastic deposit and gravel layer covering it inconsistently. As a result of topographical and geological investigation around this site, the shape of the upper surface of the white color volcanic pyroclastic deposit was found to be roughly the same shape as the current topographic surface, however the amount of displacement of the white color volcanic pyroclastic deposit was larger than that of current topographic surface in the vicinity of the fault displacement topography. These results suggest the cumulative fault displacement. However, it is unknown whether the cumulative displacement is due to seismogenic activity of an active fault or passive aseismic displacement triggered by the adjacent large earthquake like this time. If both type displacements cumulate on a single active fault, it may be necessary to reconsider the conventional activity evaluation method of active fault. The part of this work was supported by JSPS KAKENHI Grant Number JP17K01234.

Reference: Fujiwara et al. (2016): Small-displacement linear surface ruptures of the 2016 Kumamoto earthquake sequence detected by ALOS-2 SAR interferometry, Earth Planets Space, 68: 160, doi:10.1186/s40623-016-0534-x.

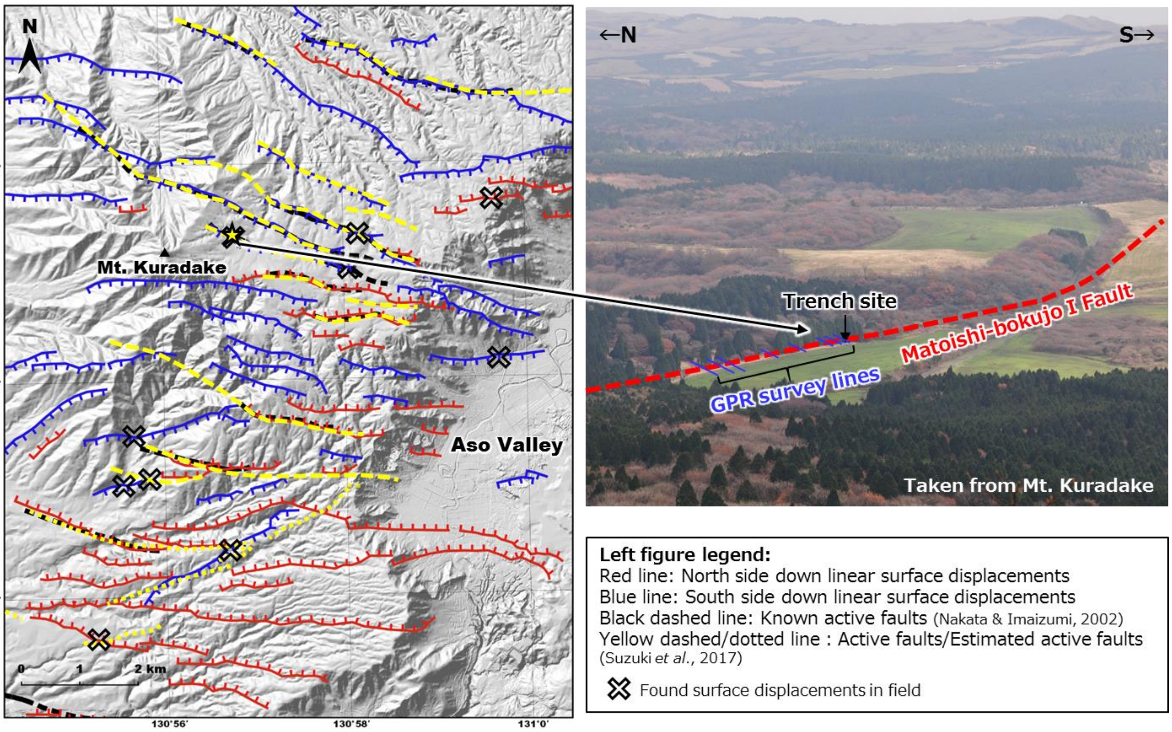

Fig.1 Location of Matoishi-bokujo I Fault site. Left figure was modified from the displacement map in the northwest of the outer rim of Aso caldera of Fujiwara et al. (2016).

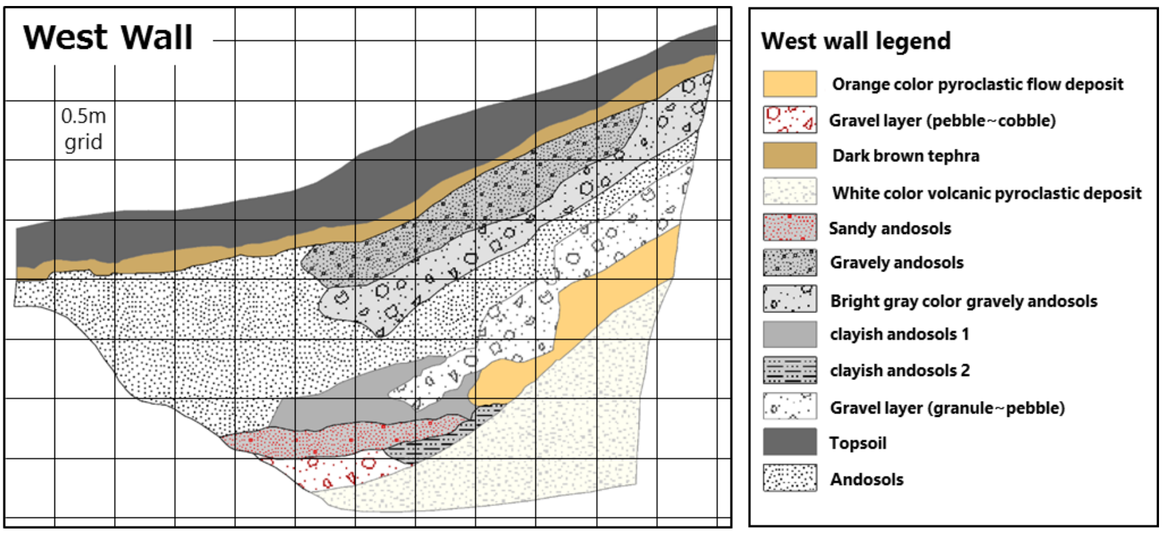

Fig.2 Sketch of west wall of trench.