Fault activities and their relations to volcanoes in the 2016 Kumamoto earthquake: Insight from InSAR analysis and field observations

*Takeshi Tsuji[1], Kazuya Ishitsuka[2], Tatsunori Ikeda[1], Toshifumi Matsuoka[2]

1.Kyushu University, 2.Fukada Geological Institute

We investigate fault activities during the 2016 Kumamoto earthquake and heterogeneities at the boundary of fault segmentation (or edge of earthquake faults) from field observations, satellite data analyses and seismic data analyses. The fault activities in the Kumamoto earthquake sequence can be clearly identified on the surface deformations from Interferometric SAR (InSAR). We conducted field observations based on the surface deformation derived from InSAR. We mainly focus on the complex fault movements around the Mt Aso. In the results of InSAR analyses, the fault trace can be clearly identified as NE-SW lineament across western part of Kyushu Island (from Kumamoto to Mt Aso), but the fault ruptures are locally influenced by geologic heterogeneity, such as volcano. Before the mainshock (M7.3) on 16 April, the fault system at southwest of Mt Aso was ruptured, and the fault rupture was terminated around Mt Aso. The right lateral slip motion generated extension around Mt Aso region and compression around the Ohtsu-machi northwest of Mt Aso (northern side of the right lateral fault). Indeed, Mt Aso (inside its caldera) largely subsided. Because the large subsidence area roughly corresponds to the predicted magma chamber, the subsidence within caldera could be partially due to extension of magma. Extension of the magmatic body at active volcano was also reported in the 2011 Tohoku earthquake. In the field observations, we identified large fissures in the subsidence area maybe due to the extension. The width of fissures is ~1m, and their strike is NE-SW. On the other hand, several sequential fault movements were observed in the Ohtsu-machi, and there is a possibility that the fault mechanism was reverse motion. In the field observation, we could not identify lateral motion at the fault traces. The interpreted reverse faults could be generated due to compressional stress because the fault rupture rapidly halted at the volcanic body of Mt. Aso.
At the earthquake at Aso region (M5.6) occurred after the mainshock (3:55 on 16 April), rupture region moves to further northeast and terminated around Mt Kuju. At the southwest of Mt. Kuju, we observed linear surface deformation due to fault movement. Because the source mechanisms at Kumamoto-Aso-Kuju region (strike-slip motion) and fault system at Oita region (normal motion; M5.8) are different, the volcanic body of Mt Kuju works as the boundary of tectonic stress.
These results demonstrate that the volcanoes (Mt Aso and Kuju) could work as segmentation boundary of the earthquake rupture. The stiffness of the volcanic body or deposit is different from other regions, and the temperature anomaly influencing frictional property along the fault is abnormally high around the volcano.

Keywords: Field observations in 2016 Kumamoto earthquake, Interferometric SAR, Earthquake and volcano

