Tectonic Loading of the Atera Fault inferred from Dense GNSS Observation

*Koki Kumagai[1], Takeshi Sagiya[2], Nobuhisa Matsuta[3]

1. Earthquake and Volcano Research Center Graduate School of Environmental Studies, Nagoya University, 2. Disaster Mitigation Research Center, Nagoya University, 3. Okayama University Graduate School of Education

The Atera Fault is in the east of Gifu Prefecture is a major active fault in Japan. The fault is left-lateral strike slip in the NW-SE direction, consistent with E-W trending P-axes of earthquakes. The geological slip rate is 2~4mm/year and the seismic recurrence interval is estimated to be about 1700 years. However, a hydraulic fracturing experiment and the GEONET F3 solution suggested the Atera Fault undergoes right-lateral displacement (Yamashita et al. 2010), which is not consistent with the long-term activity of the fault. In this study, We study crustal deformation and stress filed of the Atera Fault by GNSS observation and numerical modeling. For this purpose, we install using dense GNSS network near the fault trace with an average interval of several kilometers in order to reveal detailed crustal deformation pattern. Based on GNSS daily coordinate from is January 2014 to October 2016, we calculate average horizontal velocity at each GNSS site. The velocity pattern is dominated by the postseismic deformation of the 2011 Tohoku-oki earthquake and interplate coupling at the Nankai Trough. Therefore we correct overall deformation pattern in order to extract displacements related the fault activity. After the correction, a left-lateral displacement pattern is identified. Then I conclude the Atera Fault is dislocating left-lateral. Comparison with the elastic dislocation model showed that our observation is consistent with geological estimated fault slip rate (2~4mm/year) and the seismologic layer thickness (~15km) in central Japan. We also evaluate the topographic perturbation on the crustal stress filed under a lithostatic equilibrium. The calculation suggests that the topographic effect is significant at shallow depth (~5km) and greatly affects the crustal stress pattern. The calculated maximum compressional axis at the hydraulic fracturing site depth of 350m is directed to the north-south with a differential stress of about 1.70~3.86MPa, consistent with the observation. The results demonstrate that the motion of the Atera Fault is left-lateral, consistent with the regional stress filed. It is also suggested that tectonic loading of a crustal fault does not change even under elastic perturbation due to postseismic deformation and interplate coupling. It is essential to estimate stress flied at the seismogenic depth in order to discuss fault activity.

Keywords: Atera Fault, GNSS, Tectonic Loading, stress, Boussinesq

