Shallow Resistivity Structure across the Futagawa-Fault Nishihara Area and the Reliability

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At the 2016 Kumamoto earthquake, Japan, many surface ruptures occurred. They are distributed along the Futagwa fault already known as an active fault. In the Nishihara area, Kumamoto prefecture, the Futagwa fault consists of two parallel sub-faults with E-W strike, and large displacements were observed along the southern one. The analysis of InSAR data, a large deformation zone is presumed in the area between the two sub-faults (Fujiwara et al., 2016). InSAR results also showed a linear surface rupture located south of the Futagwa fault, which is not equivalent to the known active faults. Thus, the distribution of ground displacement/rupture at the 2016 Kumamoto earthquake is complicated, and the reason should be due to the complexity of the geological structure along the active fault. However, the shallow structure around the Futagwa fault has not been estimated in this area.

In this study, electromagnetic survey (AMT exploration) was carried out in the Nishihara area for exploration of the shallow resistivity structure. The equipment used is MTU-5A by Phoenix Geophysics. The total number of AMT sites is 14, arranged on a N-S survey profile across the Futagwa fault. High-quality AMT responses were obtained at 11 site, and a inversion scheme by Uchida and Ogawa (1993) for estimation of two-dimensional resistivity model was applied. In the correction of static shift, we focused on the spatial smoothness of Zssq phase, and applied the spatial filtering to observed apparent resistivity.

The obtained resistivity structure indicated two buried low-resistive zones along the two sub-faults, with depth from 0m to 500m or more. One of the low resistive zone along the northern one of sub-faults has a north dip with about 60 degrees, consistent with the previous geological survey. On the other hand, another low resistivity zone along the south sub-faults has a larger width (about 400 m) than the northern one, and has a south dip. The reliability of the low resistive zones was evaluated based on the principal component analysis method and the Markov chain Monte Carlo method (Koji and Goto, 2019). As a result, the sensitivity of southern low-resistive zone is high enough. The two parallel low-resistive zones, one of which has a south dip, were not reported in the previous geophysical and geological studies. However, such features are consistent with the InSAR results. As a conclusion, geophysical explorations for evaluating of shallow structure at active faults are effective to understand and predict the ground displacement and shaking at earthquakes.

Keywords: Kumamoto Earthquake, Futagawa Fault, Resistivity

