Paleo-seismological survey on surface rupture with small amount of displacement associated with the 2016 Kumamoto earthquake

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Recently, surface ruptures associated with inland earthquakes were precisely detected by synthetic aperture radar interferometry (InSAR). In 2016, Kumamoto earthquake occurred in Kumamoto Prefecture, Kyushu, and many surface ruptures were detected by InSAR (Fujiwara et al., 2016). Fujiwara et al. (2016) suggested not only main surface ruptures on the Futagawa and Hinagu fault zones but also triggered surface ruptures on the known and unknown fault traces. Kumahara et al. (2016) and Goto et al. (2017) conducted field surveys, using InSAR images, and recognized small surface ruptures and/or subtle deformations at the far places from main faults. Additionally, at Aso valley in Aso caldera, surface failures with liquefaction and lateral spreading were recognized and their mechanisms were discussed (Tsuji et al., 2017; Fujiwara et al., 2017). However, characteristics of such small surface ruptures not related with main fault ruptures were not revealed, and information on their repetitions and subsurface structures is insufficient. In this study, we report a trench survey at small surface rupture at Miyaji, Aso City, about 10 km far from the eastern end of surface ruptures on the Futagawa fault.

Detailed surface ruptures around Miyaji were reported in Ishimura et al. (in press). Small surface failures (Vertical offset: less than 10 cm, Right lateral offset: less than 5cm) were recognized and we excavated a 10-m-long, 5-m-wide, 3-m-deep trench on the northern trace. On the upper trench wall, we identified continuous soil sequence, including Ojodake scoria (OjS) and Nakadake N2 scoria (N2S). On the lower trench wall, we identified fluvial deposits containing much Kishimadake scoria (KsS). Tephra ages of KsS, OjS, and N2S are 4.0 ka, 3.6 ka, 1.5 ka, respectively (Miyabuchi, 2009).

We read two faulting events on the trench wall. The latest event is the 2016 event associated with the 2016 Kumamoto earthquake. A fault cuts up to the bottom of cultivation soil cultivated after the 2016 Kumamoto earthquake and its vertical separation is 10-15 cm. The penultimate event is estimated between N2S and OjS. Branch fault cuts OjS, but is covered by N2S. Vertical separation using layers below the OjS is 25-35 cm. Its value is twice of the 2016 event.
Penultimate event age is corresponding to the ages of open cracks on the archeological site in Aso valley (Kumamoto Prefectual Board of education, 2010), paleoseismicity on the Futagawa fault and Hinagu fault zone (Okamura et al., 2017; Takahashi et al., 2017), indicating that penultimate event at the our trench site is related with the activity of Futagawa fault or Hinagu fault zones.

Keywords: 2016 Kumamoto earthquake, Active fault, Trench survey, Tephra, Aso volcano

