

## Active tectonics of the Futagawa fault zone over the last 300 ka

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The Futagawa fault zone which ruptured during the 2016 Kumamoto earthquake has several characteristic features in its seismicity, fault geometry and kinematics. We propose these features arise from transient properties due to the recent change of tectonics in this region. During a geological survey after the 2016 Kumamoto earthquake, we found four fault outcrops along the Futagawa fault zone, which considered to ruptured with the earthquake (Kamijin, Sugidou, Kawahara, and Kuwazuru outcrop). The Kamijin outcrop is located between the places where surface ruptures of 2 m (dextral movement) are found. The sharp fault plane, which trends N66°E and dips 90°, juxtaposes cohesive(lower unit) and incohesive(upper unit) Aso-4 pyroclastic flow deposits. The fault displaces modern ground surface and shows dextral displacement of 2 m in maximum due to the 2016 Kumamoto earthquake. Based on the spatial distribution of the Aso-4 pyroclastic flow deposits, we estimate that the accumulated displacement of 10 m after the formation of the Aso-4 pyroclastic flow deposits. In convined with the results from other three outcrops, the recent average vertical slip rate of the Futagawa fault (< 90,000 yBP) ranges from 0.1~0.07 m/ky, which is much smaller than that obtained from the offset of the geological markers older than 90,000 yBP (1 m/ky, Watanabe et al., 1979, The Quaternary Research). In observations of minor faults in basement rocks, striations on fault gouges show almost horizontal direction while that in cataclasites show almost vertical direction. Hence we conclude that the vertical slip rate of the Futagawa fault zone becomes slower due to the recent change of slip direction from normal sense to dextral sense.

Keywords: The 2016 Kumamoto earthquakes, average slip rate, Striation, Fault rocks, Aso pyroclastic deposits