

## An outcrop showing recent cumulative slip on a normal fault co-ruptured with the Futagawa fault at the 2016 Kumamoto earthquake

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The 16 April 2016 Mw = 7.0 Kumamoto earthquake accompanied ~31-km-long surface rupture along the NE part of the Hinagu fault and the Futagawa fault (Kumahara et al, 2016). The surface rupture zone along the Futagawa fault mostly exposed right-lateral strike slip up to 2 m. A unique feature of the 2016 surface rupture is an ~10-km-long normal faulting surface rupture with a maximum of 2-m vertical separation mostly along the previously mapped Idenokuchi fault located 1-2 km south of and sub-parallelled to the Futagawa fault.

Here we report an outcrop at the normal faulting surface rupture at the riverbed of Kanayama river which runs through Shimojin, Mashiki City. The site is located 300-m south-east of the Futagawa fault and a 50-60 cm normal coseismic slip occurred at the 2016 Kumamoto earthquake. Although we only had a brief time to observe this outcrop due to levee wall construction, we observed a normal fault (f1) which was responsible for the 16 April earthquake and recent gravel units (Fig. 1). Along the f1 strand, the top of bedrock shows about 2.5 m of vertical separation that corresponds to roughly four or five times the amount of coseismic vertical separation. It allows us to infer that there have been several earthquakes that the normal fault have ruptured together with the Futagawa fault simultaneously.

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