Slickenlines on fault scarps caused by an earthquake in Iwaki-city (Fukushima Prefecture, Japan) on 11 April 2011

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After the occurrence of the 2011 Mw 9.0 off the Pacific coast of Tohoku Earthquake (March 11, 2011), a Mw 6.8 (Mj 7.0) aftershock occurred on April 11, 2011 in Iwaki-city, Fukushima Prefecture, NE Honshu, Japan (Fig. 1). The earthquake on April 11, 2011 (hereafter, 2011 Iwaki earthquake) caused westward dipping normal-fault scarps to appear along the Itozawa and Yunotake Faults with general attitudes of N10°W70°W and N60°W60°S, respectively (Active Fault and Earthquake Research Center, 2011). In this report, the authors show the fault scarps and attitudes of slickenlines on the fault scarps along the Itozawa Fault.

Fig. 1. Geological structure of the area surrounding the epicenter of the 2011 Iwaki earthquake, modified from Geological Survey of Japan (2003) and Active Fault and Earthquake Research Center (2011). The epicenter was situated in the Abukuma region, west of Iwaki-city. Outcrops of metamorphic rocks and granite occur in the area, and are overlain unconformably by Paleogene–Quaternary forearc basin deposits. The fault scarps caused by the 2011 Iwaki earthquake were generated along the western section of the mapped trace of the Itozawa Fault.

Fig. 2. Photographs of fault scarps caused by the 2011 Iwaki earthquake. The scale is 2 m. (A) Fault scarp showing a displacement of 1.8 m, Betto, Iwaki-city (140°41’52”E, 36°58’25”N). At present, the scarp on the outcrop has been repaired, and the fault plane is no longer visible. (B) Fault scarp showing a displacement of 1.9 m, Saido, Iwaki-city (140°41’5°E, 37°0’4”N). (C) Fault scarp showing a displacement of 1.8 m, Shionohira, Iwaki-city (140°41’13”E, 36°59’42”N). Slickenlines on the scarps are shown in Fig. 3.
The trajectory of the fault motion during the 2011 Iwaki earthquake was revealed from slickenlines that appeared on the scarps of the Itozawa Fault (Figs. 2 and 3). The slickenlines show dogleg shapes with a change in the direction of plunge, from plunging to the south on the upper part of the scarps to plunging to the north on the lower part of the scarps (Fig. 3). The direction of fault motion during the rupture of the 2011 Iwaki earthquake, therefore, shifted from a normal faulting with a left-lateral component to that with a right-lateral component. Curved slickenlines from intraplate earthquakes have been reported in other areas (e.g., the 1995 Hyogo-ken Nanbu (Kobe) earthquake; Otsuki et al., 1997).

Slickenlines formed by the 2011 Iwaki earthquake were overprinted on horizontal slickenlines at some localities (Fig. 4). The surfaces of the fault planes with the horizontal slickenlines are partially weathered and exhibit reddish brownish colored slickensides, indicating that a strike-slip faulting event has occurred at least once in the past. Further investigation of the overprint history will reveal the stress state transition in the Iwaki area in the forearc region.

References
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*: in Japanese with English abstract