

## Paleoseismic study on the Kamishiro Fault that triggered the 2014 Mw 6.2 Nagano earthquake, Japan

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The Mj 6.8 (Mw 6.2) Nagano (Japan) earthquake of 22 November 2014 ruptured the preexisting Kamishiro Fault along the Itoigawa-Shizuoka Tectonic Line, in the northern Nagano Prefecture, central Japan. Field investigations reveal that the earthquake produced a 9.3-km-long surface rupture zone with a thrust-dominated displacement that is characterized by distinct fault scarps with vertical offsets of up to 1.5 m, that are duplicated on the preexisting fault scarps (Lin et al., 2015).

Historical and instrumentally-records show that five large earthquakes of  $M > 6.0$  occurred in the study area around the Matsumoto Basin during the past 1200 years, which were almost located upon the active Kamishiro Fault (841 M 6.5, 1714 M 6.3, 1791 M 6.8, 1918 M 6.5 and M 6.1 (Headquarters for Earthquake Research Promotion, 2000), in which the 1918 M 6.5 earthquake caused the ground deformation along the active fault with a high dip angle, the northern part of the ISTL (Tada and Hashimoto, 1988). Based on geologic and seismic data, it is inferred that the active faults developed in the eastern margin of the Matsumoto and Kamishiro basins have a potential to trigger a large earthquake of  $M > 8.0$  (Headquarters for Earthquake Research Promotion, 2000).

To better understand the nature of the Kamishiro Fault, we carried out paleoseismic study immediately on the seismogenic fault by fieldworks including fault outcrop investigations within one week after the earthquake. Field investigations and analyses of excavated outcrops reveal that at least two morphogenic earthquakes have occurred on the Kamishiro Fault in the past millennium. Paleoseismic evidence, historical records, and radiocarbon age data show that (1) the penultimate large-magnitude earthquake (i.e., prior to the 2014 Nagano earthquake) occurred within the past 400 yr, probably corresponding to the 1918 M 6.5 or 1791 M 6.8 earthquake; and (2) the third most recent event occurred between A.D. 550 and A.D. 1000, probably corresponding to the 841 M 6.5 earthquake, suggesting at least three large earthquakes associated with surface rupture of the Kamishiro Fault in the past ~1500 years with an average recurrence interval of ~300-500 years. Our results reveal that the style and magnitude of thrust displacements indicate that the present-day shortening strain on the Itoigawa-Shizuoka Tectonic Line, the Eurasian-North American plate boundary in the study area, is released mainly by seismic thrust displacements along the active Kamishiro Fault.

Keywords: 2014 Mw 6.2 Nagano earthquake, paleoearthquake, Kamishiro fault, Itoigawa-Shizuoka Tectonic Line, plate boundary, thrust