

Paleoseismic study on the Kamishiro Fault, the northern segment of the Itoigawa-Shizuoka Tectonic Line, Japan

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The M_j 6.8 (M_w 6.2) Nagano (Japan) earthquake of 22 November 2014 produced a 9.3-km-long surface rupture zone with a thrust-dominated displacement of up to 1.5 m, that duplicated the preexisting Kamishiro Fault along the Itoigawa-Shizuoka Tectonic Line (ISTL), the plate-boundary between the Eurasian and North American plates, in the northern Nagano Prefecture, central Japan. To better understand the nature of the seismogenic fault zone, we carried out paleoseismic study on the Kamishiro Fault. Field investigations and trench excavations reveal that seven morphogenic earthquakes (E1~E7) prior to the 2014 M_w 6.2 Nagano earthquake have occurred on the Kamishiro Fault during the past ~6000 years, in which the timings of three recent events (E1~E3) corresponding to historical-recorded earthquakes occurred in the past ~1200 years are well constrained, suggesting an average recurrence interval of ~300-500 years on the seismogenic fault of the 2014 Kamishiro earthquake. The most recent event (E1) prior to the 2014 earthquake occurred within the past 200 yr, and corresponds to the 1918 M 6.5. The penultimate faulting event (E2) occurred in the period between AD1800 and AD 1400 and is probably associated with the 1791 M 6.8 earthquake. The antepenultimate faulting event (E3) is inferred to have occurred in the period between AD ~700 and AD ~1000, corresponding to the AD 841 M 6.5 earthquake. The oldest faulting event (E7) is identified to be occurred in the period during ~5600-6000 yr BP in this study area. The vertical slip rate during the early Holocene is estimated to be 1.2-3.3 mm/yr with an average of 2.2 mm/yr. When compared with the active intraplate faults of Honshu Island, Japan, the relatively high slip rates and short recurrence intervals for morphogenic earthquakes within the Kamishiro Fault developed along the ISTL indicate that the present activity of this fault is closely related to seismic faulting along the plate boundary between the Eurasian and North American plates.

Keywords: 2014 M_w 6.2 Nagano earthquake, paleoseismicity, Kamishiro Fault, recurrence interval, morphogenic earthquake, plate boundary

References

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Keywords: Kamishiro Fault, paleoseismicity, 2014 Mw 6.2 Nagano earthquake, Itoigawa-Shizuoka Tectonic Line active fault system