Non-characteristic surface rupturing earthquakes on the ISTL active fault system, Japan

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Intraplate earthquakes generally have recurrence intervals of a few thousands to tens of thousands of years, in contrast to interplate earthquakes, which repeat at intervals shorter than a few hundred years. We here report the first evidence for an extremely short recurrence time on an intraplate fault in Japan. The Kamishiro fault consisting of the northern end of the Itoigawa-Shizuoka Tectonic Line active fault system generated a Mw 6.2 earthquake on 22 November 2014. The surface rupture extends for about 9 km long mostly along the previously mapped active faults, but the source fault is inferred to be about 20 km long by aftershock distribution. It indicates that the 2014 event was partially ruptured and non-characteristic event comparing with the total length of the Kamishiro fault for about 24 km long. A paleoseismological trench excavation across the 2014 surface rupture showed a down-dip increase in displacement along the fault strands of the 2014 earthquake and two prior paleoearthquakes. The slip of the penultimate earthquake was similar to the slip of 0.5 m with the 2014 earthquake at the trench site, and the timing was constrained to be after AD 1645. The antepenultimate event might be correlated with the historical AD 762/841 earthquake. Judging from the timing, the damaged area, and the amount of slip, we infer that the penultimate earthquake corresponds to the AD 1714 historical earthquake. Therefore, the Kamishiro fault has generated moderate sized earthquakes both in AD 1714 and 2014, with a recurrence interval of about 300 years. This recurrence interval of surface rupturing earthquakes is extremely short compared with intervals on other intraplate active faults known globally. In addition, the spatial extent of the 2014 surface rupture accords with the distribution of a serpentinite block. The relatively low coefficient of friction of serpentinite may account for the unusually frequent earthquakes. These findings would affect long-term forecast of earthquake probability and time-dependent seismic hazard assessment under the various geological settings in Japan.

