

Surface rupture and slip distribution of the 22 Nov. 2014 Mw 6.2 earthquake at Nagano Prefecture, central Japan

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The 22 November 2014 Mw 6.2 Nagano-ken Hokubu earthquake occurred on the Kamishiro fault, consisting of the northern most segment of the Itoigawa-Shizuoka Tectonic Line active fault system (ISTL). The moderate-sized earthquake is associated with a 9-km-long surface rupture, which extends from the northern margin of Hokujo Basin to the middle of Kamishiro Basin from north to south.

We mapped surface rupture and other related deformation produced by the earthquake, and measured coseismic displacement at 42 localities. The results of detailed mapping show that the surface rupture extends mostly along the previously-mapped Kamishiro fault (e.g. Active Fault Research Group, 1990; Shimokawa et al., 1995; Sawa et al., 1999; Togo et al., 1999; Nakata and Imaizumi eds., 2002). All the data at measurement localities exhibit pure reverse fault or thrust component with relative uplift at the eastern side, except for a back thrust and a pop-up structure. The surface rupture consists of main and additional fault sections. The main section of the surface rupture extends from Shiojima to Iida for ca. 6 km long. The general strike of the fault section is N25E. The amount of displacement generally increases to the north on the main section, and the maximum vertical displacement is 90cm at Shiojima. The northern termination of the main section is accompanied by the back thrust and the pop-up structure. Meanwhile, the additional section of surface rupture shows the general strike from N20E to N20W, extending from Iida to Mikkaichiba for ca. 2 km long. The amount of displacement and shortening along this section is less than ~30 cm.

The main shock epicenter is located near the northern most termination of the surface rupture. However, the aftershock distribution exhibits that the seismogenic fault plane extends to the north from the epicenter for >5km long (e.g. The Headquarters for Earthquake Research Promotion, 2014), though significant surface rupture has been reported yet along this fault section. Tectonic landforms associated with the Kamishiro fault are clearly observed at the northern and southern extensions of the surface rupture. Therefore, the earthquake was caused by a part of the Kamishiro fault. Moreover, four paleoseismic events were identified by a pre-existing trench study, and the recurrence interval was estimated to be about 1100 to 2400 years (Okumura et al., 1998). Based on the maximum coseismic displacement of the 2014 earthquake and the average recurrence interval, the vertical slip rate of the Kamishiro fault is presumably at 0.4-0.8 m/kyr. However, it is much smaller than geologic vertical slip rate of 1.5-2.7m/kyr during the late Pleistocene (Shimokawa and Yamazaki, 1987; Imaizumi et al., 1997; Matsuta et al., 2001). To understand the recurrence of the irregular earthquakes on the Kamishiro fault, the reconstruction of displacements during paleoseismic events are necessary.

Keywords: active fault, inland earthquake, ISTL active fault system, Kamishiro Fault, coseismic slip