

High-resolution shear-wave seismic reflection surveys across the Kamishiro fault, Itoigawa-Shizuoka Tectonic Line active fault system, central Japan

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Coseismic net fault slip based on very shallow fault trajectories offers insights to understand properties of source faults for assessing seismic risk from crustal earthquakes in the overriding plate. To illuminate very shallow fault geometries, we carried out new shear-wave very shallow seismic reflection profiling across coseismic surface ruptures emerged along the Kamishiro fault, a northernmost segment of the Itoigawa-Shizuoka tectonic line (ISTL) active fault system, during the 2014 Nagano-ken-hokubu earthquake (Mw = 6.2) (c.f., Hirouchi et al., 2015; Ishimura et al., 2015; Katsube et al., 2017; Okada et al., 2015).

We collected seismic data along six seismic lines (Shiojima, North-Oide, South-Oide, Wing-21, Iimori, Horinouchi, respectively) in 2017 and 2018 by using Electrodynamic Vibrator System (ELVIS; GEOSYM) as an SH seismic source, a land streamer composed of 96 channels, and recording system GEODE (GeoMetrics). Acquisition parameters are: sweep length, 10 sec; sweep frequency, 20-120 Hz; source intervals, 1 m (2 m only in the Wing 21 seismic line); receiver intervals: 0.5 m; sampling rate: 1 msec.

By correlation of processed depth sections based on standard CMP stacking with surface geology and drill-hole data, the seismic sections up to a depth of approximately 100 m resolve thrust geometries extending from the 2014 coseismic surface ruptures that are mostly consistent with previous results in field mapping (e.g., Togo and Hasegawa, 2015; Lin et al., 2015; Okada et al., 2015), ground-penetrating radar (Kimura and Taniguchi, 2015; Nakano and Une, 2015). Our new seismic sections also successfully illuminate previously unrecognized blind thrust faults deforming Quaternary sediments which were not activated during the 2015 event. Our results show that shear-wave seismic reflection surveys using Electrodynamic Vibrator System and a land streamer are very effective to obtain detailed subsurface images of not only active faults but also unrecognized blind thrust structures.

Keywords: seismic reflection survey, Kamishiro fault, active fault, coseismic surface rupture, Itoigawa-Shizuoka Tectonic Line, subsurface structure