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

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To estimate parameters of source faults, it is important to obtain the net slip on faults from active faults. For this purpose, it is required to evaluate the shallow subsurface geometry of faults. The surface rupture associated with the 2014 Nagano-ken-hokubu earthquake (Mw = 6.2) occurred along the Kamishiro fault. To reveal the geometry of faults to a depth of tens of meters, we performed shear-wave seismic reflection surveys along three seismic lines across the surface rupture.

The shear-wave seismic reflection surveys were performed in Hakuba Village from November 3 to 10 in 2017 along the three seismic lines, named Shiojima, Oide and Wing 21. All of these seismic lines were trending east-west, located to the west of the Hime River, and crossing the surface rupture trending NNE-SSW. This area is covered with the fluvial terrace deposits.

We performed shear-wave seismic reflection surveys using a seismic acquisition system combined with Electrodynamic Vibrator System and a land streamer. The seismic source ELVIS (Electrodynamic Vibrator System) manufactured by GEOSYM, was used in Shear-wave mode to generate horizontally polarized shear waves (SH-waves). The sweep length was 10 seconds, and its frequency was 20-80 Hz. Seismic signals were recorded by a land streamer equipped with 96 SH geophones. The source intervals were 1 m (2 m only in the Wing 21 seismic line), and the receiver intervals were 0.5 m. We selected the recording system GEODE (GeoMetrics), and its sampling rate was 1 msec. The Shiojima seismic line to the north of the Matsu River had 60 shot points, 168 receiver points, and a length of 83.5 m. The Oide seismic line to the north of the Onara River had 239 shot points, 476 receiver points, and a length of 237.5 m. The Wing 21 seismic line to the south of the Onara River had 108 shot points, 236 receiver points, and a length of 117.5 m. In this seismic line, we performed hammer-impacts at intervals of 2 m to compare the performance with ELVIS.

In the Oide seismic line, CMP stacking after NMO corrections using 0.3 km/s for S-wave velocity reveals the geometry of a fault. The obtained seismic section demonstrates the eastward dipping seismic event, which corresponds to the subsurface extension of surface rupture up to a depth of approximately 50 m. Shear-wave seismic reflection surveys using Electrodynamic Vibrator System and a land streamer were very effective to obtain great detailed subsurface images of active faults.

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

