

Importance of high-resolution seismic reflection surveying for the detailed delineation of on- and off-fault deformation structure

INAZAKI Tomio (Inazaki@pwri.go.jp)

Geology and Geotechnical Engineering Department, Public Works Research Institute,
Tsukuba, Japan

Summary

Geomorphological surveying, which has been widely adopted in fault researches in Japan, is not appropriate to understand faulting behavior of active faults, because most of active faults are concealed with thick surface deposits even in active tectonic zone. Recurrence intervals are not so short even for active faults compared with the high rate of such surface geomorphic processes as erosion, deposition, weathering, collapsing. Artificial modification might erase surface evidences of recent seismogenic deformation in high population areas. In contrast, subsurface sediments are the most worthwhile recorder of the deformation behavior of active faults. Accordingly, detailed geophysical surveying plays an important role for delineating near-surface deformation structure around concealed faults. In particular, high-resolution seismic reflection method is powerful to image near-surface deformation structure on- and off-fault zones. The author has conducted research and development on the near-surface geophysics over the last 35 years to obtain high quality data and to provide high reliable results. SH-wave reflection survey using Land Streamer, SV phase reflection processing for active surface wave survey records are the distinguished contributions by the author to the near surface geophysics field.

Figure 1 and 2 shows a result of recent case studies on the near surface geophysics. The survey was conducted at Mashiki Town, Kumamoto Prefecture, western Japan, where had been severely damaged by the 2016 Kumamoto earthquakes. A 300 m long short survey line (FR242) was set to intersect a surface rupture, which occurred along the known an active fault segment named Futagawa fault. Futagawa fault and Hinagu fault showed right-lateral strike-slip displacements about 50-100 cm with slight upheavals of southern side blocks associated with the earthquakes. The surface rupture along the Futagawa fault was very clear at the site and traced in aerial photographs too. Figure 2 is a migrated depth section along FR242 line. P-wave seismic reflection processing was applied to the seismic survey records. Owing to dense setting of geophones at 1-m intervals, detailed deformation structure was delineated up to 250 m in depth, as characterized as right side upthrown (reverse faulting) flexure structure around the surface rupture. Cumulative displacements and a triangular shaped kink structure are also characteristically identified in the section. Thus, high-resolution seismic reflection survey is quite useful to interpret near surface deformation structure or on- and off-fault flexure of active faults.

Keywords: Near surface geophysics, Active faults, Flexure, Seismic reflection method

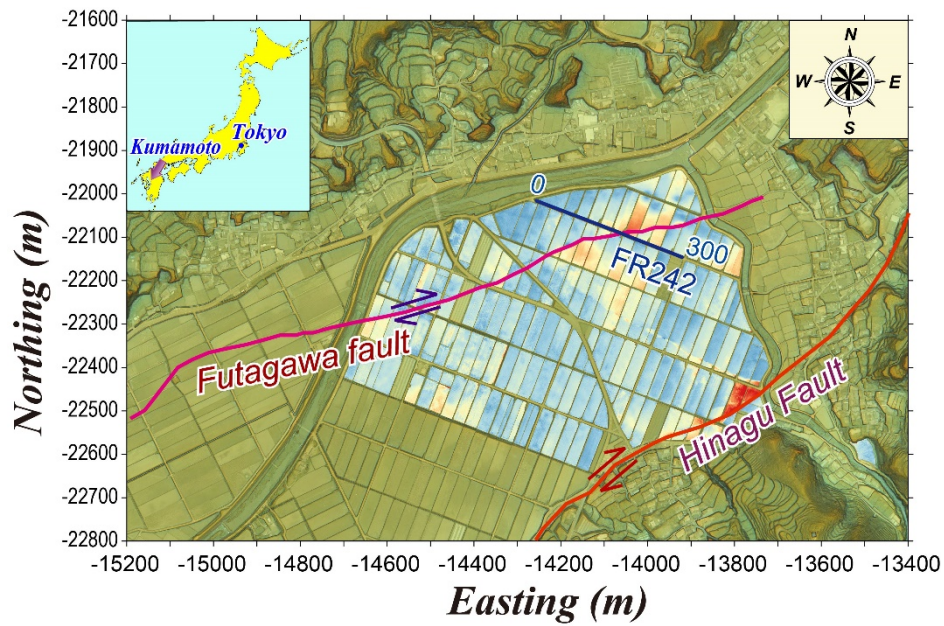


Figure 1. A map showing a survey line set to intersect Futagawa fault and accompanying Hinagu fault both moved with the 2016 Kumamoto earthquakes. (surface aerial photo and DSM data courtesy of Nakanihon Aero Service Co., Ltd)

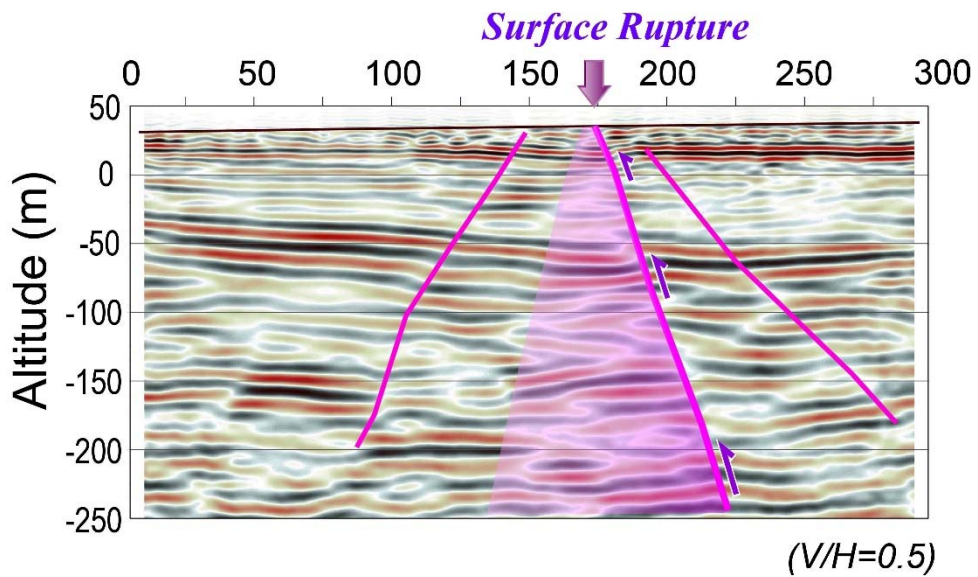


Figure 2. A migrated P-wave depth section along FR242 line. A dipping horizon at -50 m in altitude is sharply dislocated by reverse faulting. Cumulative displacements are clear associated with triangular kink zone.