

Deep seismic profiling across the Niigata basin, central Japan: 2008 Sanjo-Yahiko seismic survey

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In the fold-and-thrust belt along the along the Japan Sea coast of northern Honshu, devastative earthquakes, such as 1964 Niigata (M7.5), 2004 Chuetsu(M6.8) and 2007 Chuetsu-oki(M6.8) earthquakes, occurred by reverse faulting. To investigate seismogenic source fault is important for better estimation of strong ground motions and mechanisms of earthquake occurrence. However, due to thick Neogene sediments, relationship between active faults/folds at near the surface and deep sited seismogenic source faults is poorly understood. Multi-disciplinal research project to understand the structure and crustal deformation processes along this zone of high-strain rate started in 2008 as a five years project.

In 2008, we conducted the deep seismic profiling to reveal the geometry of active-seismogenic fault systems across the Niigata basin. In the seismic survey, four vibroseis trucks, air guns (1,500 cu inch), and 100 kg explosives were used as seismic sources. Along a 63-km-long seismic line, about 240 vibroseise shots, 400 air-gun shots, 11 high energy shots up to 100 stationary sweeps at each shot point by vibroseis trucks and air-guns, and 2 explosive shots were recorded by 25-100 m spacing receivers, including ocean bottom cable, a cable-linked recorder and off-line recorders. The seismic data were acquired in September 2008.

Common Mid-point reflection analysis, low-fold stacking of high-energy shot records and diving wave tomography were carried out. Diving wave tomography revealed the P-wave velocity structure beneath the Niigata sedimentary basin. The top of the pre-Neogene basement (V_p is larger than 5.4 km/s) is located 7.5 km in depth at the middle part of the basin. Such velocity structure demonstrated the boundary between pre-Neogene basement and volcanic rocks, so called Green Tuff. Based on the pattern of reflectors, the western boundary fault of the Nagaoka plain was imaged as west-dipping fault at 45 degrees down to 9 km. The eastern boundary fault of the Niigata plain is identified beneath the Shitada hills as eastward dipping at 30 degrees.