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Crustal structure of the fold-and-thrust belt, Chuetsu, central Japan: result of 2012 Muikamachi-Naoetsu seismic survey

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Associated with the opening of the Japan Sea, volcanic rift-basins have been developed along the Japan Sea coast of northern Honshu. The Niigata basin, central Japan, is one of such basins and filled by thick (< 8 km) Neogene sediments. By subsequent convergence since the Pliocene, an arc-parallel fold-and-thrust-belt has been developed along the Miocene rift-basins. In this belt devastative earthquakes, such as 1964 Niigata (M7.5), 2004 Chuetsu (M6.8) and 2007 Chuetsu-oki (M6.8) earthquakes, occurred by reverse faulting. Due to thick Neogene sediments, relationship between active faults/folds at near the surface and deep-sited seismogenic source faults is poorly understood. To reveal the crustal architecture, in particular geometry of source faults, onshore-offshore integrated deep seismic profiling was undertaken since 2008 for five-years-project. The 2011 Muikamachi-Naoetsu seismic line cut through the south of the epicentral area of the 2007 Chuetsu-oki earthquake.The seismic sources were air-gun (3020 cu. inch), four vibroseis trucks and explosives (100 kg) and seismic signals were recorded by ocean bottom cables, cable-connected-recording system and offline recorders, forming a maximum 2040 channels receiver array. The velocity profile obtained by P-wave refraction tomography portrays the depth of the top of Mesozoic metasedimentary rocks (Vp>5.4 km/s). Pre-Neogene rocks cropping out at near surface in the Echigo Mountain area and increasing its depth on the hanging wall of the Muikamachi fault.As the Muikamachi fault is a reverse active fault, the vertical offset of the top of pre-Neogene suggests that the fault reactivation since the Pliocene. The base of Neogene fill under the Higashikubiki hills ranges from 5 to 7 km below the sea level and shows swell beneath the western part of the hills.Based on the velocity profile and pattern of reflectors, the relationship between deep-sited source faults and active faults and folds, are clearly identified. Shallow detachment commonly developed in the lower Teradomari Formation.Due to this detachment, a source fault in the thick-skinned part does not connect straight to a fault in the thin-skinned part.