Deep Seismic profiling of the back-arc fold-and-thrust belt, central Japan

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Associated with the opening of the Japan Sea, back arc basins have been developed along the Japan Sea coast of northern Honshu and the eastern part of the Japan Sea during the early Miocene time. These basins were filled by thick Noeogene sediments. By subsequent convergence since the Pliocene, an arc-parallel fold and thrust belt has been developed along the Miocene rift-basins. Along this belt devastative earthquakes, such as 1964 Niigata (M7.4), 2004 Chuetsu (M6.8) and 2007 Chuetsu-oki (M6.8) earthquakes, occurred by reverse faulting. Also, this belt is marked by high-rate of convergence strain observed by dense GPS network and triangle geodetic measurements for past 100 years. 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 (Sato et al., 2008 poster presentation). Diving wave tomography analysis revealed the P-wave velocity structure down to 15 km in depth. Seismic reflection profile portrays the west dipping reverse faults (the western boundary fault of the Nagaoka plain) along the coast of the Niigata plain and east dipping reverse fault (the eastern boundary fault of the Niigata plain) down to 7 to 9 km in depth.

During the formation of the Japan Sea, the central part of the Honshu island experienced the complicated tectonic movement, due to the factors of large amount of rotation and displacement, and the collision of Izu-Bonin arc. In the Niigata basin, NW-SW-trending fault systems were formed during the back-arc basin opening stage associated with the formation of NNW-SSW-trending normal fault systems. Judging from the focal area of past earthquakes and geologic structure, the lateral extension of the source fault is strongly controlled by such Miocene geologic structure. Together with the information of geometry of possible source faults by direct imaging, the geometry of source fault will be clearly identified through the modeling to produce 3D geologic structure.

For better understanding the mechanisms of development of the fold-and-thrust belt, deep structure including the upper most mantle is important. To obtain the deeper structure of the failed rift, onshore-offshore seismic experiment will be carried out along the Aizu and off-Sado seismic line under collaboration with JAMSTEC in 2009.