Crustal structure across the Yuri hills, northern Honshu, Japan: opening and closing of the northern Honshu rift system.

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The northern Honshu rift system, located along the Japan Sea coast of Northern Honshu, was formed in the middle Miocene (ca. 17-14 Ma), probably younger than the Yamato basin (ca.?25-20 Ma). Due to the shortening deformation since the Pliocene, the basin fill, showing the 8 km of maximum thickness, is folded and faulted trending parallel to the arc. Along this rift system, the amount of shortening since the Pliocene shows its maximum along the northern Honshu rift system. To reveal the kinematics of the formation of this rift system and processes of shortening deformation, deep seismic reflection profiling was carried out across the Yuri Hills by a 40 km-long seismic line. Seismic source was four vibroseis trucks and explosive sources. Processed CMP reflection profile demonstrates the east-dipping low-angle reflector at 3.5-5.5 seconds TWT beneath the Yuri Hills. Together with the seismic reflection profiles in the eastern part of the Japan Sea, wide-angle reflection profile by the Joint Japanese university team in 1997, and distribution of micro-earthquakes, the kinematics of the formation of this rift system and shortening deformation were synthesized. Before the rifting, due to the pre-existed volcanism upper curst is considered to be warm enough to make shallow (ca. 8-10 km) brittle-ductile transition. The rift was formed by simple shear using the shallow low-angle normal-fault located brittle-ductile transition zone, which corresponds to the detected reflector beneath the Yuri Hills. As a result, deep sedimentary basin was formed in the west of Yuri Hills, which was roll over anticline forming a Miocene basement high with thin sedimentary cover.

Due to the subsequent shortening deformation, the low-angle normal fault was reactivated as a thrust producing shortening deformation in the basin fill. Westward migration of thrusting is clearly demonstrated in seismic sections. The hypocentral distribution of micro-earthquakes beneath the Yuri Hills accords well to the geometry of the reactivated thrust.