Origin of seismogenic source faults in the backarc of Honshu, Japan.

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To evaluate the tsunami and seismic hazards along the sea of Japan coast draw a public concern, especially after the devastative tsunami hazards after the M9 2011 Tohoku-oki earthquake. Last decade, seismic surveys have been performed by JAMSTEC and ERI, Univ. Tokyo for mapping the source faults. Seismic velocity structure obtained by earthquake tomography provides the fundamental lithospheric structure beneath Honshu. Those data clearly demonstrate that the present source faults were formed mainly during the period of the rifting and backarc spreading.

Stretched continental crust is located in southern and eastern part of the sea of Japan and backarc of Northern Honshu associated with the saloon door type of opening of the Sea of Japan. The boundary of the two blocks is northern part of the Itoigawa Tectonic line and Kanto tectonic line. The SW Honshu forms a continuous block and arc-parallel trending normal faults and rift basins have been developed associated with the clockwise rotation. The opening of sea of Japan terminated by the collision of Izu-Bonin arc and backarc (young Shikou basin). Due to the northward motion of Philippine Sea plate and high-friction along the subduction zone, a fold-and-thrust belt (Shinji fold belt) has been developed in the stretched continental crust in the backarc at 15-6 Ma. After begging of subduction along the Nankai trough, shortening deformation was terminated. Thus the arc-parallel normal faults reactivated as reverse faults and some of them behave as strike-slip fault under the present stress regime. Eastern part of the SW Honshu block deformed by the collision of Izu-Bonin arc. Due to the horizontal bending in the north of Median Tectonic line, NS-trending normal faults were developed in the zone of Kinki triangle, where presently marked by the concentration of reverse faults.

Northern Honshu is characterized by widely exposed stretched continental crust and distribution of small-scale rifts. Backarc rift basins, such as Northern Fossa-Magna, Niigata, Akita-Yamagata basins, are marked by thick post rift sediments (> 2 km) and floored basalt, high Vp in the lower crust beneath a narrow rift. Commonly an edge of narrow rift is bounded by outward-dipping fault. The origin of the fault is a boundary between continental crust and mafic intrusions. Corresponding to amount of rotation, the southern part of northern Honshu shows wider distribution of rifted structure, such as Kinuagwa river valley, northwestern part of the Kanto plain. Large differential movement of the NE and SW Honshu block, suggested by paleomagnetism, produce thin crust demonstrated by earthquake tomography. Common style of stretched continental crust is marked by half grabens. After the compression since the Pliocene, reactivation of normal fault as reverse fault produced uplifted zones. However, in the rift basin bounded by outward-dipping edge faults, the basin fill strongly deformed and produced fold-and-thrust belts. The size of present length of source faults is strongly controlled by tectonics during the formation of the sea of Japan. The arc parallel rift is displaced by transcurrent faults defining the size of earthquakes. The occurrence of devastative earthquakes along the eastern part of Sea of Japan is correlated with the amount of stretching. Due to the rheology of continental and oceanic crust, shortening deformation is concentrated in the continental crust and especially failed rift zone in the continental crust.

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