Relationship between fault-related folds in the focal area of the Hokkaido Nansei-Oki Earthquake and the aftershock distribution

*Hiroshi Mori[1], Shintaro Abe[1], Yasuhira Aoyagi[2]

1.National Institute of Advanced Industrial Science and Technology (AIST), 2.Central Research Institute of Electric Power Industry (CRIEPI)

Reverse faults formed by E-W compression after the late Pliocene are developed in the eastern margin of the Japan Sea and consist of a contraction deformation zone[6]. Some large earthquakes with magnitudes larger than 7 had been occurred by the fault activities in this zone since 20th century. The 1993 Hokkaido Nansei-Oki Earthquake with magnitude of 7.8 occurred in the sea area around the Okushiri Island located in the central part of eastern margin of the Japan Sea. Many studies for analyses of observed seismic data[e.g.[2],[3]], modeling of earthquake faults[e.g.[1],[4]], and numerical simulations of tsunami[e.g.[5]] for this earthquake event are presented. In contrast, the geological structures including fault geometries at shallow depth in this area are not clear. We therefore conducted structural analyses of seismic reflection profiles obtained in the sea area around the Okushiri Island, which aims to clarify the geological structures of this focal area and their relationships with the seismic faults (observed seismic data) related to the earthquake.
We used profiles obtained by single channel seismic reflection survey conducted by AIST (GSJ) during the GH94 and GH95 cruses—which mainly aim to construct marine geological maps. The study area covers a range of ~170 km (N–S; ~41º 20’–42º50’N) x~130 km (E–W; ~138º 50’–140º 20’E) where the Okushiri Island is located at the central part of this area.
The geological structures are generally correlated to seafloor topography, e.g., remarkable rises of acoustic basements along the steep escarpment at the eastern margin of the Japan Basin and at the western margin of the Okushiri Spur. In addition, fault-related folds, which are generally recognized as one of the main characteristic structures in the eastern margin of the Japan Sea, are well developed also in this study area. Distributions of faults inferred from structures such as fault-related folds and height differences of basements show the developments of the reverse faults roughly trending N-S direction with length more than several tens km. Faults to the south of the Okushiri Island (which we call here as “south fault group”) dominantly dip to the east while those to the north side (“north fault group”) dip to the west. From their distributions, the south fault group is sub-divided into three groups roughly running parallel to each other while the north fault group seems consisting a single fault zone.
Comparisons between the faults recognized in this study and the aftershock earthquakes shown by Aoyagi *et al.* (2000) show a good correlation in their distributions: the aftershock earthquakes are aligned along the fault with eastward dipping developed in the western margin of the Okushiri Spur to the south of the study area and those along the fault with westward dipping developed within the Japan Basin to the north. In addition, the fault geometries inferred from seismic reflection profiles in this study are also correlated to those of the earthquake faults estimated by using the aftershock data, showing consistency between the structures at shallow depth and those at deeper depth.

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