Geophysical Research Abstracts
Vol. 18, EGU2016-11079-1, 2016
EGU General Assembly 2016

Back-arc basin opening and closure along the southern margin of the Sea of Japan

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Following the tsunami disaster produced by 2001 Off-Tohoku earthquake (M9) along the Pacific coast of Japan, the Japanese government started an intense evaluation of tsunami hazards. This evaluation spanned along the full Japanese coast, including the Sea of Japan coast on the western side of the Japan arc. In the Sea of Japan, tsunamis are produced by crustal faults. As the longer interval of faulting activity, the historical records of tsunamis in the Sea of Japan are not enough for the evaluation of tsunami height. Thus, the evaluation is carried out based on structural analyses of the margin of the Sea of Japan. To get better understanding of the present-day structural geometry and develop a source-fault model in this region, intense seismic reflection profiling has been carried out since 2013. We introduce the results of the seismic reflection profiles and discuss the structural evolution of the southern margin of the Sea of Japan. 2D seismic reflection profiles were acquired using 1950 cu. in. air-gun and 2100 m streamer cable. The seismic profiles provide the image image up to 3 seconds TWT. The southern margin of the Sea of Japan was produced by back-arc opening and post-rift deformation, and the structural evolution of this area is divided into several stages: rifting (25 – 14 Ma), post-rift compression (14 – 5 Ma), weak thrusting (5 – 1 Ma), and strike-slip deformation (1 Ma to present). During the rifting stage that is associated with the fan-shaped opening of the Sea of Japan, grabens and half-grabens were formed trending parallel to the extension of SW-Japan arc. These grabens were filled by syn-rift sediments, and the maximum thickness of basin fill is observed along the southern margin of the rifted crust. The opening of the Sea of Japan ceased as a result of the collision of Izu-Bonin-Mariana arc system at the Izu collision zone on the central part of Honshu, Japan. Soon after the this event, the young Shikoku basin within the Philippine Sea plate (PHS) moved northward towards the Nankai trough on the southeastern side of the SW-Japan arc. Due to the high thermal regime of the Shikoku basin, the resistance along the Nankai trough was so large that shortening deformation occurred along in the failed marginal rift zone that was developed previously along the southern margin of the Sea of Japan. This resulted in the Shinji fold belt. After the start of the subduction of the Shikoku basin along the Nankai trough, the rate of shortening in the Shinji fold belt was decreased and the folded strata were covered by sub-horizontal Pliocene sediments. Reverse faulting of the arc-parallel faults from Pliocene to early Pleistocene along the small number of faults suggests that the compression from the Nankai trough still has been continued in this stage. A change in the direction of the motion of PHS at 1 Ma produced major change in stress regime from NS compression to EW compression in the back-arc. Following the change of stress regime, the former reverse faults reactivated as strike-slip faults. The structural evolution and inherited structure presented here provide essential information for constructing the tsunami source-fault model along southern margin of the Sea of Japan.