

Long-term postseismic deformation at the eastern margin of the Japan Sea implied by temporal changes in areal strain rates and background seismicity rates

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Magnitude-8 class earthquakes have frequently occurred on the back-arc side of the Tohoku region, especially on the eastern margin of the Japan Sea. For the eastern margin of the Japan Sea, there had been a lot of discussion about its tectonics. For example, Nakamura (1983) hypothesized that the eastern margin of the Japan Sea is a convergence boundary (and beginning trench) between the North American Plate and the Eurasian Plate. Okamura (2002) also hypothesized that the eastern margin of the Japan Sea is a strain concentration zone where a lot of faults had been formed within the plate. In this study, we analyze crustal deformation and seismicity data from recent observation system, to investigate decadal activity of the eastern margin of the Japan Sea before perturbation due to the 2011 Tohoku earthquake.

In terms of crustal deformation analysis, we investigate temporal changes in areal strain of the Tohoku region using the F3 solution of GNSS data provided by Geospatial Information Authority of Japan. We find compressional trends possibly originating from the eastern margin of the Japan Sea especially in the north of the Oga Peninsula. In terms of seismicity analysis, we estimate stress loading rates within the eastern margin of the Japan Sea by applying the ETAS model (Ogata, 1988) to the earthquake catalogue provided by Japan Meteorological Society. These analyses imply that long-term postseismic deformation of two major earthquakes (the 1983 Nihonkai-Chubu earthquake and the 1993 southwest-off Hokkaido earthquake) had continued until around 2010 in the eastern margin of the Japan Sea.

We model this long-term postseismic deformation using a three-dimensional viscoelastic simulation based on Fukahata and Matsu'ura (2006). The result suggests that the asthenosphere beneath the eastern margin of the Japan Sea, especially around the source region of the 1983 Nihonkai-Chubu earthquake, does not have low viscosity as that for the Pacific Plate subduction zone.

Keywords: Japan Sea, GNSS, ETAS model, postseismic deformation