

Focal Mechanism Solutions of the Tohoku-Oki Earthquake Sequence and Their Geodynamical Implications

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The stress state around Japan Sea region and the evolution of Japan Sea are both concerned by Geoscientists. In this paper, we study the stress state around Tohoku-Oki area by analyzing Harvard CMT solutions of the Tohoku-Oki Earthquake Sequence, which may be divided into four groups. The first one includes low-angle thrust events, which are similar with the main shock. They mainly occurred on the interface between the Pacific Plate and the North American Plate, concentrating on deeper depth of the main rupture zone as well as its north/south ends. The second one contains normal-fault earthquakes with principal extensional direction roughly pointing W-E direction. Most of these earthquakes located in the fore-arc uplift region of the Pacific plate. Some others occurred in the fore-arc accretionary wedge. The third one encompasses normal-fault earthquakes too although their principal extensional directions are roughly parallel the Japan Trench. They occurred in the fore-arc accretionary wedge too. The fourth one includes reverse fault earthquakes whose principal compressional directions are roughly parallel the Japan Trench. They took place mostly in the middle of the main rupture zone as well as its south side. We find that the focal mechanisms of the event sequence occurred in the fore-arc accretionary wedge are obviously different from the foreshocks. Tohoku-Oki Earthquake Sequence has released most of accumulated elastic stress. As a result, Pacific Plate and North America Plate has decoupled in the main rupture zone. Moreover, it might lower the E-W compress stress level in Japan Sea and Northeastern China. We conclude that the release of accumulated stress in regions around Japan Sea and Northeastern China could lower the seismic risk and enhance the volcanic activity, especially in Honshu, where may have volcanic eruption in the near future. However, the Pacific Plate and North American Plate near Honshu are not completely decoupled, even though their stress level is low as yet. Whether the stress state of the fore-arc accretionary wedge can be restored to the stress state before the Tohoku-Oki Earthquake Sequence, how long it will take, as well as if Japan Sea might further expand mostly depend on concrete boundary conditions which need further observation.

Keywords: 2011 Tohoku-Oki Earthquake, Back arc basin, Subduction zone, Japan Sea, Focal Mechanism Solution