

Temporal stress change around the Iwaki-city in northeast Japan before the 2011 Tohoku earthquake

Makoto Otsubo^{1*}, Kazutoshi Imanishi¹, Ayumu Miyakawa¹

¹Geological Survey of Japan/AIST

We present the temporal heterogeneities of the crustal stress before the 2011 Tohoku earthquake around the Iwaki-city using the small magnitude earthquakes. Otsubo et al. (2008; *Tectonophysics*, 457, 150-160) proposed a stress tensor inversion method to separate stresses from earthquake focal mechanism data from spatially and temporary varying state of stress. The method is applied to focal mechanisms of the earthquakes collected by Imanishi et al. (2012; *Geophys. Res. Lett.*, 39, L09306).

The inversion method revealed two normal-faulting stress states, corresponding to two stress periods and the transition between the two stress periods corresponds to the period between 2005 and 2008. In the stress period I from 2003 to 2005, a WNW-ESE trending tri-axial extensional stress is dominant. The stress ratio increases from the stress periods I ($\Phi = 0.5$) to II ($\Phi = 0.8$) in this area. The temporal changes of S3-axis orientation and stress ratio of stress state had induced by the event that occurred during 2005 and 2008. We interpret that the changes of the stress period from I to II are induced by the extension during the post-seismic deformation of the M 7-class earthquake. We estimate the magnitude of the change of differential stress from the Stress B to A. The differential stress of the Stress A is estimated at ~ 3 times as large as at the differential stress of the Stress B under these assumptions.

We revealed that the pre-shock normal-faulting stress regime had been built up by 2003, furthermore the differential stress of the pre-shock normal-faulting stress was increased by the post-seismic deformations of the M 7-class earthquake before the 2011 Tohoku earthquake. The increase of the differential stress has contributed to the stress accumulation that can be sufficient to cause an inland earthquake by amount of stress change of the 2011 Tohoku earthquake around the Iwaki-city.

A part of this research project has been conducted as the regulatory supporting research funded by the Secretariat of Nuclear Regulation Authority (Secretariat of NRA), Japan.

Keywords: multiple inverse method, focal mechanism, large trench type earthquake, post-seismic deformations, active fault, 2011 Iwaki earthquake