Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SSS01-11 Room:419 Time:May 2 17:00-17:15

Lithospheric stress and deformation, and megathrust prediction

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Lithospheres respond to stress load that is a major cause of earthquakes. Thus, understanding the lithospheric response before and during the megathrusts may allow us to find a way to predict megathrusts. We investigate the lithospheric responses for megathrusts with magnitudes greater than 8.7 since 2000 from precursory and coseismic events. The seismicity presents the cumulation or release of stress before and after megathrust, and discriminative spatial distribution of stress. Normal-faulting earthquakes were increased particularly around large slip regions at shallow depths after the megathrusts, which may be associated with lithospheric rebound and splay-fault development. The earthquake occurrence rate (b value) displays a characteristic slip-dependent feature. The earthquake occurrence rates were decreased with slip amount by forthcoming megathrust due to continuous accumulation of plate-driven stress and tectonic loading around the future rupture planes on slab

surface. The slip dependency of earthquake occurrence rates is enhanced with time until the occurrence of megathrust. The level of seismicity after megathrust is inversely proportional to that before megathrust, yielding the compatible average seismicity before and after megathrust over rupture regions regardless the slip amount of each subregion due to difference of accumulated stress depending the rock properties. It was also observed that the dynamic lithospheric response is highly associated with slip distribution on the rupture plane. Temporal changes of slip-amount-dependent b values are fitted well with an exponential function, suggesting an exponential increase of normal stress with time on locked region until the occurrence of megathrust.

Keywords: lithospheric stress, lithospheric deformation, megathrust, prediction, seismicity