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Precursory and coseismic lithospheric responses to megathrusts

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The lithospheric responses to megathrusts with magnitudes greater than 8.7 since 2000 are investigated from temporal variations of seismic properties. The fault-type compositions were changed greatly after the megathrusts. The seismicity was increased after megathrusts with characteristic fault-type-dependent spatial distribution on the rupture planes. The postseismic thrustal events were populated around the down-dip rupture margins due to concentration of shear stress after coseismic ruptures. 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.