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Shear-strain energy change in inland seismogenic layer caused by the interplate coupling along the Nankai Trough, southwest Japan

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The Philippine Sea Plate subducts beneath the Eurasian plate in the Nankai Trough, southwest Japan. The coupling, or the slip deficit, on the plate interface causes stress change in the seismogenic zone in the inland area. This stress change does not always result in stress accumulation but can cause stress release in some places. Whether or not the stress change encourages earthquake occurrence is not determined only from the stress change itself but also depends on the background stress field. This study developed a method estimating the shear-strain energy increase/decrease distribution and evaluated the influence of the interplate coupling on inland earthquakes. We at first conducted a stress tensor inversion analysis to estimate the background stress in and around the Nankai Trough by analyzing ∼8,000 focal mechanisms of small earthquakes (e.g., Yoshida et al. 2015 Tectonophysics). The result showed that the minimum compression axis was in the N-S direction in a wide area of the inland. We then estimated the slip-deficit rate at the plate interface by analyzing GNSS data and calculated the stress change caused by the slip deficit (e.g., Noda et al. 2013 GJI). The interplate coupling causes the maximum compression in the direction of plate convergence (N-S direction). By using the background stress field and the stress change, we calculated the shear-strain energy change due to the interplate coupling. In the region called Chugoku region, the shear-strain energy decreases due to the interplate coupling. This is because the N-S compressional stress caused by the interplate coupling compensates the N-S minimum compression stress in the background. In some regions (Kyushu and Kinki regions), the shear-strain energy increases in the seismogenic layer. By statistically comparing the shear strain energy change with the seismicity in the inland seismogenic zone, we found that the seismicity tends to be high where the interplate coupling increases the shear-strain energy. Because the stress change caused by the interplate coupling is not consistent with the background stress field, we suppose that the interplate coupling is not a dominant factor in the background stress field. However, the stress change by the interplate coupling disturbs the inland seismicity in southwest Japan.