Spatio-temporal stress states estimated from seismicity rate changes in the Tokai region, central Japan

Shinji Toda[1]; Shozo Matsumura[2]

[1] Active Fault Research Center, GSJ/AIST; [2] NIED

For the prediction of the next Tokai earthquake, we strongly rely on surface uplifting due to a silent precursory slip on the plate interface, which is possibly detected by geodetic monitorings. Because the micro-seismicity does bring direct information from the seismogenic depth instead, we believe seismicity rate changes would be a more useful monitor of stress for such anomalous movement than the geodetic approaches. Here we apply the seismicity-to-stress inversion of Dieterich into the Tokai region that can convert seismicity rate changes to spatio-temporal Coulomb stress changes based on the rate- and state- friction. We then successfully find that stress decrease on the aseismic slip plane in the western Tokai region had proceeded about one year before the continuous GPS network detected.

For the analysis, we use the earthquake catalog observed by the NIED network since 1979. We have examined cumulative number of earthquakes in each 4km x 4km cell to convert to the local stress state and mapped year by year. Analyzed stress history in each cell showing long-term stressing rate changes and positive and negative stress steps appear to be well resolved. The most striking feature we find is that stress under Lake Hamana, western future Tokai source, has been significantly and widely decreasing since 1999. Instead, stresses in the surrounding regions are calculated to have increased by probable stress transfer from Lake Hamana region. This process is clearly associated with the aseismic silent slip firstly detected by GPS network in 2001 by Ozawa et al. We also find the similar stress releasing processes in 1987-1989 and possibly early 1980s when possible slow events are inferred to have been occurred from the past baseline measurements (Kimata et al, 2001). Although the most recent 2000-2003 silent slip event might be one of the repeatable events, enlargement of the stress releasing area would be the most significant and noteworthy for the Tokai prediction.

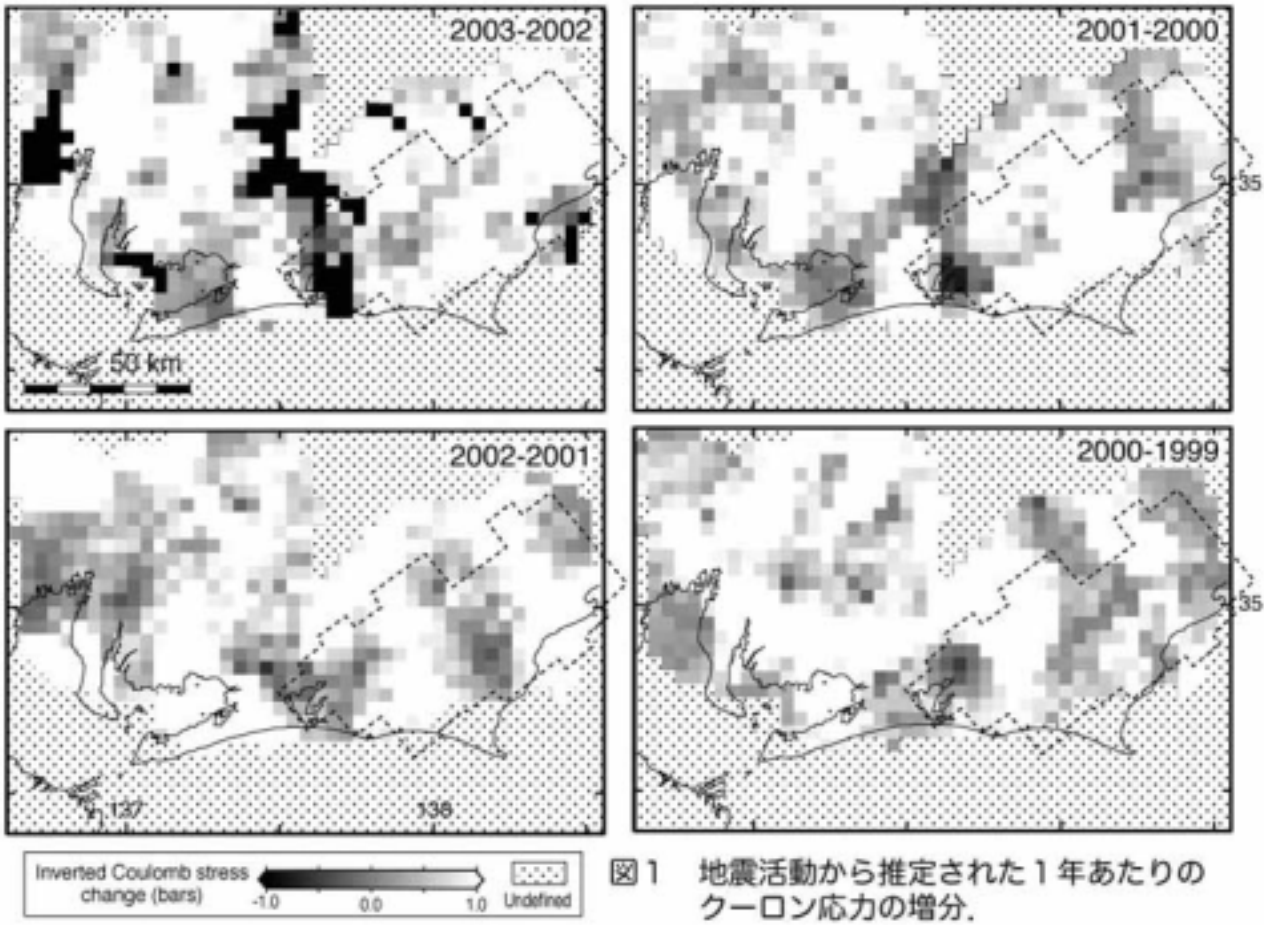

図１　地震活動から推定された１年あたりのクーロン応力の増分.