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Relation between Seismicity and Stress Change Associated with Interplate Slips off Boso Peninsula: Part 2

HIROSE, Fuyuki[1*] ; MAEDA, Kenji[1]

[1]Meteorological Research Institute

Hirose & Maeda (2012, 2013, JpGU; 2013, SSJ) investigated a relation between temporal variation of seismicity rate or b-value of the G-R law (Gutenberg and Richter, 1944, BSSA) and stress change associated with slow slip events (SSEs) around Boso peninsula. For example, there are three characteristic stages about seismicity: (S-1) activation during SSE, (S-2) quiescence before 2002 and 2007 SSE, and (S-3) seismicity rate increases after 2007 SSE. On the other hand, b-value repeats a cycle as follows: (b-1) small during and just after SSE, (b-2) gradually increases up to the next SSE.

By considering the correlation of seismicity rate with stress increase and inverse correlation of b-value with stress obtained in laboratory experiments (Dieterich, 1994, JGR; Scholz, 1968, BSSA), they interpreted their result as follows: for (S-1, b-1) during SSE, the slip rate at the edge of SSE on the plate boundary where is seismically active becomes higher (We can confirm it from the distribution of slip deficit and SSE estimated by GNSS data). Then because a strain accumulation rate increases, the stressing rate increases. Thus, seismicity rate increases, and b-value decreases at the same time. On the other hand, for (S-2, b-2) in SSE interval, because the slip rate on the plate boundary becomes lower than that during SSE, the seismicity rate decreases, and b-value increases at the same time. For (S-3) seismicity rate increases after 2007 SSE, the distribution of slip deficit after 2007 SSE is not much different from that before SSE. When we consider a frame of Dieterich (1994), only steady slip rate should become higher without changing of slip deficit rate so that seismicity rate changes under this situation because slip deficit on the plate boundary is independent of the value of steady slip rate (Savage, 1983, JGR). That means the drop of the coupling rate on plate boundary (slip deficit rate / steady slip rate). Therefore, the temporal change of the seismicity and b-value is comprehensively consistent with the perturbation of the slip rate on the plate boundary.

By the way, Boso SSEs had occurred every 4-7 years, but the latest interval of occurrence has a shorter period because those occurred in the end of 2011 and early in 2014. It is considered that the shortening of interval is mainly caused by the influence of the 2011 off the Pacific Coast of Tohoku Earthquake (Mw9.0, hereinafter Tohoku earthquake). We extended data period and investigated whether the same characteristics as before are also seen for the 2014 SSE. As a result, it showed such the same characteristics that (S-1) activation during SSE, (S-3) seismicity rate increases after 2007 SSE, (b-1) small during and after SSE, and (b-2) gradually increase up to the next SSE. On the other hand, (S-2) quiescence before SSE was not recognized because the perturbation of stress caused by the Tohoku earthquake may affect the seismicity.

Keywords: Boso peninsula, slow slip event, b value, stress, temporal change