Re-analysis of Seismic Quiescence and Slow Slip in Hamanako region

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We have shown a remarkable spatial correlation between the seismic quiescence in the Philippine Sea plate and the Long-term Slow Slip Event (LSSE) in the plate boundary beneath Hamanako region, though did not have shown a clear time correlation between them (SSJ, 2015). Against this, according to JMA (since September 2014), the seismicity in the crust of the central western Shizuoka becomes low simultaneously with two times of LSSE in the plate boundary beneath Hamanako region, which suggests a clear time correlation between the seismic quiescence and LSSE. On the other hand, Kobayashi and Yoshida (2004) and Yamamoto et al. (2005) have pointed out occurrence of LSSE in the period from 1988 to 1990. If LSSE are repeating similarly in this region, it is important to clarify how LSSE can be caused at the same time when the quiescence in the crust of the central western Shizuoka appears, and to make clear the reason why we cannot observe a clear time correlation between the seismicity and LSSE beneath Hamanako region.

We used the eMAP technique (Aketagawa and Ito, 2008; Hayashimoto and Aketagawa, 2010) for space time analyses of seismic quiescence and activation. The attached figure shows source distribution maps of seismic quiescence and activation detected by the eMAP for the earthquakes with the magnitude equal to and larger than 1.1 in the central western Shizuoka and around Hamanako. The epicenter map (a) shows concentration of quiescence areas near the Suruga bay and around Hamanako. The vertical cross section (b) shows a clear quiescence beneath Hamanako region and activation zones beneath the central western Shizuoka both in the crust and the plate. The activation seems to reflect the seismic activity in a part of the locked zone of the plate boundary inferred by Matsumura (1997). The space time plot (c) shows activation in the SE part continues from 2006 to 2012, whereas it becomes relatively low in the periods from 2001 to 2005 and from 2013 to present, at the same time when LSSE is observed, which supports correspondence of the low seismicity in central western Shizuoka with LSSE as it was pointed out by JMA. Against this, quiescence around Hamanako region is not clearly correspondent with LSSE, though the area of quiescence seems inferior for the rest of LSSE from 2006 to 2012.

We then searched seismic quiescence that previously occurred in the same area from January of 1983 for the earthquakes with the magnitudes equal to and larger than 2.3. As a result of this we confirmed an example also in the period from 1988 to 1990 in a small region of the same area. This result may indicate the possibility that the quiescence in the locked zone occurred with LSSE in the plate boundary beneath Hamanako region as many as three times.

It is possible to explain the mechanism for the correspondence of the quiescence with LSSE if the stress reduction in the locked zone occurs at the same time when LSSE makes stress release in the plate boundary, though it is still complicated to tell the reason why no clear time correlation is found between quiescence and LSSE in the plate beneath Hamanako region. It may be necessary to make more analysis for the seismic activity based on stress distribution caused by heterogeneity within the crust and the plate.

Keywords: Seismic quiescence, Seismic activation, Slow slip event

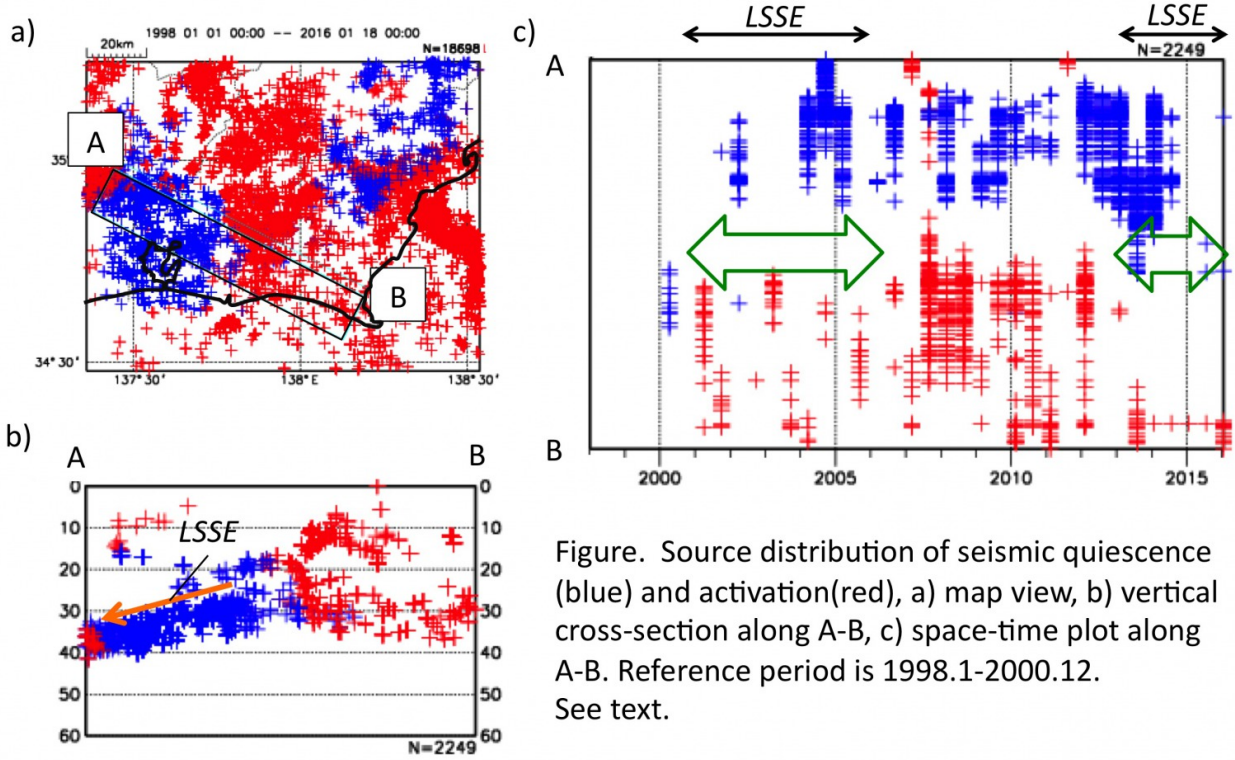

Figure. Source distribution of seismic quiescence (blue) and activation(red), a) map view, b) vertical cross-section along A-B, c) space-time plot along A-B. Reference period is 1998.1-2000.12.
See text.

