Relation between seismic quiescence from 2003 in the Tamba region and the long-term slow slip event in the Tokai region

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The seismicity in the Tamba region in southwest Japan, started to decrease in 2003. The region is located to the northeast of the rupture zone of the 1995 Hyogo-ken Nanbu Earthquake (M_{JMA}7.3). In the region, the seismicity was activated by a static stress change due to the event. Recent occurrence rate of microearthquakes has been lower than that before 2003. Such a seismic quiescence was shown at the period during two and a half years before the event. It has, therefore, been controversial whether a major earthquake follows the quiescence or not (e.g. Umeda et al., 2005).

The attenuation property of coda waves, coda Qˆ-1 or Qcˆ-1, reflects the scattering environment in the crust (Aki and Chouet, 1975). Qcˆ-1 correlates with the tectonic activity. Qcˆ-1 is a good indicator of the stress condition (Aki, 1985; Hiramatsu et al., 2000). We monitor the crustal heterogeneity using coda waves in the region.

In this study, we investigate a relation between a temporal variation in Qcˆ-1 and seismicity from 1987 to 2005 and discuss a cause of the quiescence from 2003. We use the same analysis method as Hiramatsu et al. (2000) for the estimation of Qcˆ-1. We examine the quiescence based on the brittle-ductile interaction hypothesis (Aki, 2004).

The hypothesis shows that a simultaneous temporal correlation between Qcˆ-1 and N (Mc), a number of a characteristic magnitude contributing to a temporal variation in b-value, is disturbed before a major earthquake. Such a temporal variation indicates that the temporal variation in Qcˆ-1 reflects a variation of fractures in the ductile part of the lithosphere and that in N (Mc) represents a response of the brittle part to the ductile fracture. An observed temporal delay of Qcˆ-1 relative to N (Mc) before a major earthquake can be explained simply by the idea that the strain energy stored in the brittle part of lithosphere reaches a saturation limit and starts to flow back to the ductile part (Aki, 2004).

At the quiescence in the Tamba region before the 1995 Hyogo-ken Nanbu earthquake, such a delay was observed. In contrast, at the quiescence from 2003 in the Tamba region, no such a delay is found. We, therefore, consider that the crustal condition from 2001 to 2005 differs from that in the quiescence before the event. We show that the recent decrease in seismicity in the region seems to be associated with the long-term slow slip event in the Tokai region. We, therefore, consider that this ongoing quiescence differs from that before the 1995 Hyogo-ken Nanbu Earthquake and may be a reduction stage of seismicity affected by the perturbation of the stress field caused by the long-term Tokai slow slip. We have to monitor the crustal stress condition, because we examine an occurrence of a major earthquake within a few years using the brittle-ductile interaction hypothesis.