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Relation between Temporal Variation of b-value and Recurring Slow Slips off Boso Peninsula

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1. Introduction

Slow slip events with Mw6.3-6.5 have occurred repeatedly in every several years (1983, 1990, 1996, 2002, 2007, and 2011) on the plate boundary between the land and Philippine Sea plates off Boso peninsula (National Research Institute for Earth Science and Disaster Prevention, 2011). Duration times of those slow slips are from a week to ten days. In addition, it is known that the seismicity at northern margin is synchronized with the slow slips. In this study, we investigated a relation between temporal variation of b-value and recurring slow slips, and interpreted it as a manifestation of stress change associated with the slow slips by considering the inverse correlation between b-value of the G-R law (Gutenberg and Richter, 1944, BSSA) and stress obtained in laboratory experiments (Scholz, 1968, BSSA).

2. Data and Method

We used the JMA catalogue in the period from January 1, 1990 to December 31, 2011 (M ? 1.5, Depth ? 40 km). We estimated the temporal variation of b-value by using REASA (Aketagawa et al., 2007). We set 200 events as the calculation unit in order to estimate the temporal variation of b-value and shifted them at every 50 events.

3. Result and Discussion

The following results are obtained.

1) b-value increases before slow-slip event.

2) b-value decreases during and just after slow-slip event.

3) b-value increases little by little until next slow-slip event. And it returns to 1) again.

The above procedure is repeated. By considering the inverse correlation between b-value and stress obtained in laboratory experiments (Scholz, 1968, BSSA), we can interpret these results as follows. A b-value in Boso peninsula is high because stress applied to the region is low due to low plate coupling rate (Sagiya, 2004, Pageoph). This corresponds to 1). Stress increases around the slow slip source by the occurrence of a slow slip. Seismicity in the northern margin of the source is activated due to stress increase. A b-value for this region decreases because the margin is under high stress in this period. This corresponds to 2). Since the slow slip terminates with duration time from a week to ten days, the overall stresses applied to the marginal area begin to fall down (b-value begin to increase). These correspond to 3) and 1). And then, next slow-slip event occurs and stress increases again around the source.

By the way, seismicity at the shallower southern margin of the slow slips is less active than that at the deeper northern margin although it increased slightly in sync with the 1990 and 2011 slow slips. Judging from the magnitude-frequency diagram, we can detect the earthquakes more than M1.6 enough. Therefore, it is true that seismicity is inactive at the shallower southern margin. Sagiya (2004, Pageoph) estimated the slip deficit distribution on the Sagami Trough subduction zone by basing on the GPS velocity data. The result delineates a strongly coupled region on the plate interface, northern part of which corresponds to the 1923 Kanto earthquake. The strongly coupled region is also located at shallower region of the slow slips off Boso peninsula. From this evidence, we suppose that seismicity at south shallow margin is inactive even stress there increases somewhat because adherence of the plate boundary is considered strong at that region.

Keywords: Boso peninsula, Slow slip, b value, Stress, Temporal variation