Are there any regularities in the fluctuated slip behavior of the small repeating earthquakes?

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Spatio-temporal distribution of interplate slip has been estimated from cumulative slip of small repeating earthquakes, assuming that they show the same slip patterns in all the cycles [Igarashi et al., 2003; Uchida et al., 2003, 2004, 2005]. Recently, however, we found that slip patterns of small repeating earthquakes can fluctuate when large afterslip passes by a small asperity or some other asperities are closely located [Ariyoshi et al., 2007; Arao et al., 2007a, 2007b]. Therefore we must find out characteristics and regularities of slip pattern fluctuation of small repeating earthquakes to upgrade scaling laws of the source parameters, and improve the accuracy in estimating the interplate slip using small repeating earthquakes.

In this study, we estimated source parameters of small repeating earthquakes which occurred at (1) an asperity by which large afterslip passed and (2) asperities closely located each other, and examined the spatio-temporal changes in the slip patterns. We also examined relation between recurrence intervals and slip amounts of these small repeating earthquakes, and discussed ratios between seismic and slip amounts of each small repeating earthquake cycle.

We analyzed a small repeating earthquake group by which afterslip of M6.3 earthquake off Miyagi prefecture in 2002 passed [Arao et al., 2007a]. We also analyzed a earthquake cluster in which repeating earthquake groups are closely located each other below Iwate prefecture [Arao et al., 2007b]. We examine these earthquakes using the following methods:

1. Relocate hypocenters using the Double-Difference technique [Waldhauser and Ellsworth, 2000].
2. Estimate seismic moments and corner frequencies using the Multi Window Spectral Ratio method [Imanishi and Ellsworth, 2006]
3. Estimate source sizes, stress drops and slip amounts from seismic moments and corner frequencies.
4. Analyze the correlation between recurrence interval and slip amount of each cycle of small repeating earthquakes to check which model is more appropriate: the slip-predictable or time-predictable model [Shimazaki and Nakata, 1980].

We found following results:

5. A repeating earthquake that occurred when large afterslip passed by showed smaller slip but its source radius was almost the same as usual.
6. We found earthquakes that were probably caused by rupturing plural asperities in an earthquake cluster where several repeating earthquake groups are closely located.
7. Ratio between seismic and aseismic slip amounts at each cycle is invariant for each group.
8. Slip predictable model seems to be more appropriate than time predictable model for the repeating earthquakes but the difference is not significant.