Spatiotemporal change in source parameters of repeating earthquakes due to the 2011 Tohoku-oki earthquake

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Many repeating earthquakes occur at Pacific plate boundary in NE Japan. Many studies reported that the behavior of these repeating earthquakes have changed due to afterslip of the 2011 Tohoku-oki earthquake. The numerical simulation showed that recurrence interval, seismic moment, and stress state of repeating earthquakes vary with increment in loading rate (Chen et al., 2010). In this study we systematically investigate on the fluctuation of recurrence of repeating earthquakes occurred at Pacific plate boundary before and after the Tohoku-oki earthquake. We first estimated stress drop of repeating earthquakes by spectral ratio method and investigated characteristics of spatiotemporal distribution of stress drop. Additionally, we estimated aseismic slip rate around seismic patch, verified whether our results are consistent with those of numerical simulation obtained by Chen et al. (2010), and discussed frictional properties of plate boundary.

Stress drops of repeating earthquakes occurred at off-Hidaka and off-Iwate are small. Those at off-Fukushima are high. These characteristic areas are consistent with some previous studies on the general interplate earthquake. Our results showed that many repeating earthquakes whose stress drop is high located in and around asperities of large earthquakes, suggesting the relation between the locked area of large earthquakes and high stress drop area.

We found that seismic moment tends to increase with shortening in recurrence interval when stress drop increases with increment in aseismic slip rate. Also we found that seismic moment tends to decrease with shortening in recurrence interval when stress drop decreases with increment in aseismic slip rate. This trend is consistent with the numerical simulation results of Chen et al. (2010), and we can conclude that we confirmed the usefulness of their numerical simulation.

The slope of regression line for a relationship between recurrence interval and seismic moment (q-value) tends to be negative at off-Iwate and positive at off-Hidaka and Kanto region. Small b-a might be the cause of negative q-value at off-Iwate and high normal stress might be the cause of positive q-value at off-Hidaka and Kanto region.

As described above, it is suggested that spatial changes of source parameters and q-value are closely related with frictional properties of plate boundary.

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