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Interplate Quasi-Static Slip Estimated from Repeating Earthquake Analyses in the Northeastern Japan Subduction Zone (Extended Abstract)

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We estimated spatio-temporal distribution of interplate quasi-static slip in the northeastern Japan subduction zone using small repeating earthquake data. We found more than 2,700 repeating earthquakes with magnitude 2.5 or larger. Examples of waveforms of repeating earthquakes are shown in Fig. 1. These repeating earthquakes have almost identical waveforms with each other and thought to be caused by repeating rupture of small asperities surrounded by stable sliding areas on the plate boundary. This means that we can estimate quasi-static slip around each small asperity from the slip history of the repeating earthquake sequence (Nadeau and McEvilly, 1999).

In order to detect repeating earthquakes, we performed waveform similarity analy-

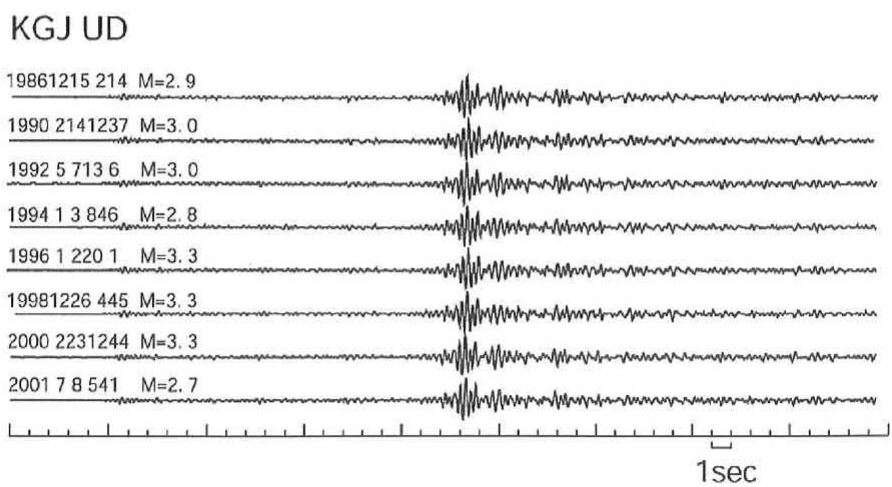

Fig. 1. Examples of waveforms for repeating earthquakes. The traces are 1-4 Hz band-pass filtered vertical component waveforms observed at station KGJ. Waveform amplitude is normalized by the maximum amplitude for each trace.

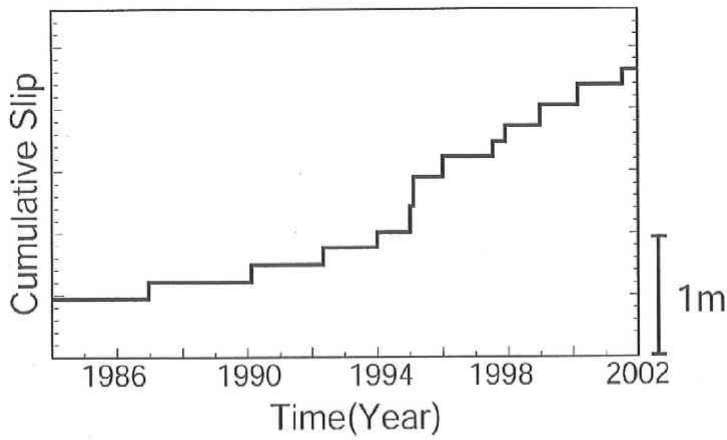

Fig. 2. An example of cumulative slips estimated from repeating earthquakes. The cumulative slip rate is interpreted to be nearly consistent with the quasi-static slip rate occurring around the asperity, whose repeating slips correspond to repeating events.

sis: a method which is the same as Igarashi *et al.*, (2002). We used waveform data recorded by the microearthquake observation network of Tohoku University for 17 years. We identified event pairs whose band-pass (1-4 Hz) filtered seismograms for 40s window from P arrival showed cross-correlation coefficients >0.95 at two or more stations as repeating earthquakes. By using the relationship between seismic moment and seismic slip proposed by Nadeau and Johnson (1998), we estimated slip amount for each repeating event. Fig. 2 shows an example of cumulative slips for repeating earthquakes. The slope of cumulative slip can be interpreted as quasi-static slip rate near the location of the sequence on the plate boundary. To obtain smooth and reliable spatio-temporal distribution of quasi-static slips, we calculated the spatial moving averages of cumulative slips of repeating sequences.

Fig. 3 shows two-year snapshots of quasi-static slip distributions for four periods. Grid (spatial window) size of the moving average is 0.3 by 0.3 degrees, and the moving step is 0.1 degrees. Slip amount for each grid is shown by color patch of 0.1 by 0.1 degrees at the center of the grid. Here we plotted slip amounts for only the grids that contain three or more repeating earthquake sequences. We can see quasi-static slip areas were widely distributed on the plate boundary. Most of those areas have slipped episodically, but the areas close to the western limit of low-angle thrust type earthquakes (heavy line in Fig. 3) have slipped almost stably throughout the analyzed periods. This result is consistent with the interpretation that the plate boundary is decoupled to the west of this line. The 1994 Far-off Sanriku earthquake (M7.6) was followed by a large afterslip (Fig. 3D). Swarm activities off Sanriku in 1989 (Fig. 3B), 1992 (Fig. 3C), and off Fukushima prefecture in 1987 (Fig. 3A), were also accompanied with large quasi-static slips. Most of interplate earthquakes with magnitudes six or larger (red stars in Fig. 3) were followed by quasi-static slips in the northeastern Japan subduction zone.

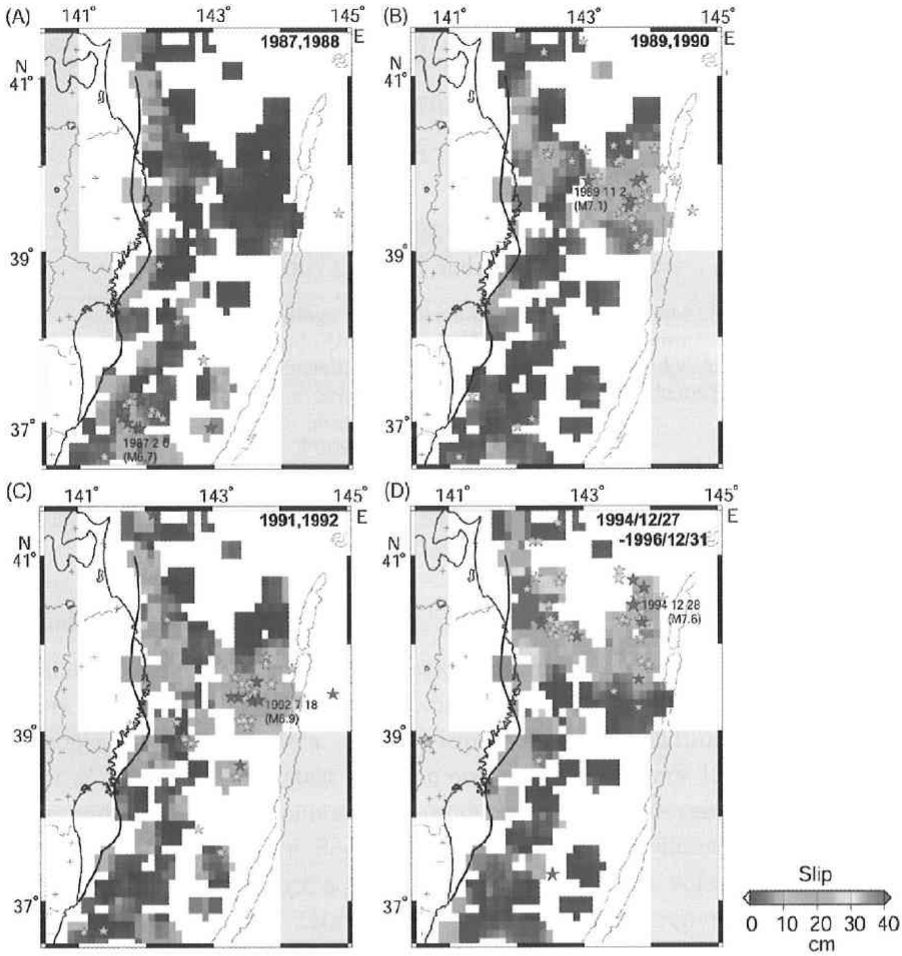

Fig. 3. Space-time distributions of quasi-static slips in the NE-Japan subduction zone for four periods: (A) from 1987 to 1988, (B) from 1989 to 1990, (C) from 1991 to 1992, and (D) from December 27, 1994 to December 31, 1996. Averaged slip in each grid is shown by color. Red and yellow stars denote the events with $M \geq 6$ and $M = 5$, respectively. Heavy line denotes the western limit of low-angle thrust type earthquakes (Igarashi *et al.*, 2001)

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