Foreslip, coseismic slip and afterslip accompanied with 2008 Off-Tokachi earthquake

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1. Introduction

On September 11, 2008, a large thrust earthquake with magnitude (JMA) of 7.1 occurred off Tokachi, southeastern Hokkaido, northern Japan. The hypocenter of the 2008 event is located at the southeastern edge of the coseismic slip region of the giant 2003 Off-Tokachi Earthquake with magnitude of 8.0 (Yagi, 2004). In this study, we estimate the foreslip, coseismic slip, and afterslip of the 2008 event in order to discuss the relationship between the aseismic slip, the 2003 event, and the 2008 event which occurred at the shallower edge of the region of interplate earthquake.

2. Data and method

We used waveform data of the high-sensitivity seismograph network of Japan (Hi-net) operated by National Research Institute for Earth Science and Disaster Prevention (NIED) from October 2000 to November 2008 for finding the repeating earthquakes and analyzing the interplate slip history near the hypocenter in order to estimate the aseismic slip. The method to determine the repeating earthquake is the same as Matsubara et al. (2005). We used waveforms of distant body wave observed at FDSN and GSN in the IRIS-DMC in order to clarify the coseismic slip of the 2008 event.

3. Result

In the analyzed period, 85 repeating earthquakes consisted of 24 groups occurred in the target region-30-38N and 129-139E-surrounding the hypocenter of the 2008 event. Aseismic slip rate was accelerated just after the 2003 event and slip amount reached approximately 18 cm at the end of 2003. The slip rate is gradually decreased, however, the total slip amount reached approximately 37 cm in February 2006. From 2004 to February 2006, middle-class event with magnitude larger than 5.0 occurred in March, June, and November 2004 and approximately 2 cm aseismic slips accompanied these events were observed.

There was also a large aseismic slip independent to the middle-class event. This event occurred in March 2006 and continued over three months. The slip amount during this event reached approximately 5 cm. After this large aseismic event, slip rate was decreased again. There were two repeating earthquakes from July 2008 to the 2008 event in September, aseismic slip seemed to be accelerated. After the 2008 event, slip amount of aseismic slip reached approximately 7 cm during the two moths from September to November.

Coseismic slip of the 2008 event began the region where the repeating earthquakes actively occur and end near the coseismic region of the 2003 event.

4. Conclusion

The 2008 event broke the plate interface on the southeastern (shallower) side of the coseismic region of the 2003 event. Aseismic slip in this region is large just after the 2003 event and slip rate is decreased, however, slip rate varied independently of the middle (M 5.0) earthquakes. We clarified that the acceleration of slip rate occurred in March 2006 and that the acceleration might occur just before the 2008 event.