

Spatial and temporal distribution of repeating earthquakes in and around the source area of 2004 Off-Kushiro earthquakes, Japan

Makoto MATSUBARA[1]; Yuji Yagi[2]; Kazushige Obara[1]; Minoru Kasahara[3]; Kei Katsumata[3]

[1] NIED; [2] BRI; [3] ISV, Hokkaido Univ

(1) Introduction

In the region from off Tokachi to off Etorofu Island along the Kuril trench at the northeastern edge of Japan Islands, many severe earthquakes have occurred. On November 29, 2004, a large earthquake with magnitude (M) of 7.1 occurred off Kushiro (2004 Off-Kushiro earthquake) at a depth of about 40 km. The focal mechanism of this event is thrust with northwest-southeast P-axis. This event is considered located at the plate boundary between Eurasian and Pacific plates. Aftershocks surround the main shock and five large aftershocks with M greater than 5.5 occurred by the end of January 2005. The 2003 Off-Tokachi earthquake occurred on September 26 in 2003 near the 2004 Off-Kushiro event. Matsubara et al. (2004) investigated the repeating earthquake activity and found the extremely slow slip rate of the plate boundary beneath the coseismic slip and afterslip region of the 2003 event.

In this study, we investigate the repeating earthquake activity around the 2004 Off-Kushiro earthquake and estimate the slip rate of this region.

(2) Data and analysis

We used waveform data of 18,130 events with a M greater than 2.0 from October 2000 to December 2004 recorded by National Research Institute for Earth Science and Disaster Prevention's (NIED) high-sensitivity seismograph network of Japan (Hi-net) and those of 21,178 events with a M greater than 3.0 from January 1994 to December 2003 recorded by the Institute of Seismology and Volcanology, Hokkaido University (ISV).

Our target region is defined as 40-45N and 141-148E. Earthquake pairs were defined as earthquakes with epicenter separations of less than 50 km. A total of 9,142,761 pairs were thus defined among the 18,130 events and 22,538,010 pairs among the 21,178 events. Vertical-component bandpass-filtered seismograms with a passband frequency of 1-8 Hz and epicentral distance of less than 300 km were used. If a target earthquake pair included at least one S-wave arrival at a station, the time window was defined as that from 1 s before P-wave arrival to 5 s after S-wave arrival. If no S-wave arrival picking was possible, the time window was fixed at 1 s before P-wave arrival to 40 s later. Repeating earthquakes were identified based on event pairs with waveform cross-correlation coefficients of larger than 0.95 at three or more seismic stations.

(3) Results

We focused the region defined as 144.8-145.7E and 42.8-43.1N since the main shock is located at 145.28E and 42.94N and almost all aftershocks occurred in this region. This region was divided into three areas with 0.3x0.3 degrees (144.8-145.1, 145.1-145.4, and 145.4-145.7 and western, central, and eastern part, respectively). As a result of the analysis, we found 25 groups of repeating earthquakes composed of 59 events from ISV data and 56 groups of repeating earthquakes composed of 146 events from NIED Hi-net data.

Moment was calculated from magnitude and slip amount was estimated with the equation found by Nadeau and Johnson (1998). The western part is near the afterslip and aftershock region of the 2003 Off-Tokachi earthquake. The slip rate of this region was 1.1 cm/yr before the 2003 event and accelerated after the 2003 event and the slip amount was about 10 cm after the 2003 event. After four months from the 2003 event, the slip rate as decelerated, however, that is extremely accelerated after the 2004 Off-Kushiro event and the slip amount is greater than 20 cm after a month of the main shock. The central part includes the 2004 main shock. The slip rate of this area is about 0.5 cm/yr from 1994 to the 2004 main shock and neither accelerated nor decelerated before and after the 2003 event, however, the slip amount is about 28 cm after a month of the 2004 main shock. The slip rate of the eastern area is about 4 cm/yr from 1994 to the 2004 main shock, however, that is accelerated extremely after the 2004 event and slip amount is about 25 cm after a month of the main shock.