Vertical deformation and repeating earthquakes in southeastern Hokkaido in the last 100 years

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In the southernmost part of the Kuril subduction zone, six large to giant interplate earthquakes have occurred in the last 400 years. This includes the two M_w ~ 8 Tokachi-oki earthquakes that occurred in 1952 and 2003. In Hokkaido, instrumental seismic and geodetic observations began in the late 19th to early 20th centuries. Therefore, we are able to investigate more than a single M8 class earthquake cycle there using the observation data.
In this study, we investigated leveling data and repeating earthquakes in southeastern Hokkaido in the last 100 years. For the leveling data, we chose the survey route around Cape Erimo because the survey was conducted in 1952 and 1953 after the 1952 earthquake, the route has not changed since the first survey and is located near the coast, and there is likely no subsidence due to the pumping of underground water. We also estimated the crustal deformation due to medium-sized (M larger than or equal to 6.5) earthquakes since 1908 by simple uniform slip models. For some earthquakes, we estimated the focal mechanisms by analyzing the analog seismograms and the first motion polarity data.
For the investigation of the historical occurrences of repeating earthquakes, we chose two groups around Hokkaido whose average M_{JMA} is 5.4 from the catalogs of Uchida and Matsuzawa (2013) and Seismology and Volcanology Research Department of Meteorological Research Institute et al. (2014). Using the JMA catalog, we selected earthquakes occurring prior to 1993, whose epicentral distance from the known repeating earthquakes was less than 20 km and whose M_{JMA} was between 5.1 and 5.7. In addition, we checked a few earthquakes whose epicentral distances were less than 30 km. We used the the Headquarters for Earthquake Research Promotion data retrieval system to obtain copies of the analog seismograms and determined the repeating earthquakes by visual comparisons. We also estimated the aseismic slip rate around the groups.
The results of these investigations reveal that the afterslip of the 1952 earthquake may have continued until around 1980. Moreover, in the Tokachi-oki region, the state of the plate interface prior to the 1952 earthquake may be similar to that prior to the 2003 earthquake. Furthermore, the acceleration of aseismic slip around 1980 can be found in the west of Cape Erimo.

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