

Stress field within the crust beneath the landward trench slope off Tokachi formed by the plate motion of the Kuril forearc sliver

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Many aftershocks occurred around the focal area of the 2003 Tokachi-Oki earthquake. A majority of the aftershocks are distributed on/near the plate boundary between the subducting Pacific Plate and the overriding landward plate. However, a few of them are evidently distributed above the plate boundary within the landward crust. In this study, we first apply a method that is referred to as the hybrid method that employs both the observed waveform and travel times of P and S waves in order to determine the hypocenter and focal mechanism of the earthquakes. We then apply the stress tensor inversion method to obtain focal mechanisms and estimate the stress field within the crust beneath the landward slope of the Kuril Trench.

In the hybrid method, we use both the observed waveforms and travel times of P and S waves. First, we estimate the focal depth and focal mechanism at the initial epicenter by the moment tensor inversion method by using the waveforms observed at the NIED F-net broadband and Hi-net tiltmeter networks. While fixing the focal depth estimated by the moment tensor inversion method, we determine the epicenter by using the travel times obtained by the least square method. With regard to the hybrid method, we repeatedly use the moment tensor inversion and the least square methods.

The earthquakes that occur within the landward crust indicate a reverse or strike-slip fault with the P axis along the NE-SW direction, which is sub-parallel to the Kuril Trench. The estimated stress field also shows the maximum principal axis in the NE-SW direction, which is consistent with the direction of the plate motion of the Kuril forearc sliver. In addition, we calculate the changes in the Coulomb failure function (CFF) on the fault planes obtained by the stress tensor inversion method for a coseismic fault model of the 2003 Tokachi-Oki earthquake, to investigate the possible relationship between the occurrence of the main shock and the following increase in seismicity within the landward crust. The calculated CFF increased in the case of most of the earthquakes. The result suggests that the earthquake within the landward crust may have occurred in the stress field formed by the collision between the Kuril forearc sliver and the North-American Plate along the Hidaka collision zone, and that it may have been triggered by the coseismic slip of the 2003 Tokachi-Oki earthquake.