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Re-evaluation of stress field produced by the plate coupling at the junction of Kuril and northeastern Japan arc.

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Back-slip model has been applied to estimating the spatial distribution of plate coupling from geodetic data observed at the surface. The stress field at depth produced by the back-slip is thus considered as being one of the main factors affecting the observed earthquake-generating stress field. In this paper, we evaluate the effect of plate coupling between Pacific and North-American plates on the earthquake generating stress at the junction of Kuril- northeastern Japan arcs where the bend of plate boundary is large.

For that purpose, we first determined the shape of descending Pacific plate using the earthquake catalogue for 1997-2003 provided by JMA. The configuration of rather complex plate boundary in the range of 37-46N and 137-146E was obtained using CHIKAKU DB, a tool developed by RIKEN. As compared with previous models, the present one shows more sharply-bent plate at the junction, the chine of which passes through a more southerly-located route. It is noted that the dip of descending plate at depths greater than about 130 km changes discontinuously from 30 to 40 degrees beneath the Kitami mountain range. Secondly, we estimated the earthquake- generating stress field by applying Angelier”s method (2002) of stress inversion to as many fault-plane solutions as available at present, F-net, HVU, and USGS being the main sources of those data. A stress regime with maximum principal stress parallel to the direction of plate convergence prevails over the entire region, except for the areas around the chine of the plate bend where thrust-type with the maximum principal stress and normal-type with the minimum principal stress both parallel to the strike of the trench axis exist. At depths greater than about 130 km, maximum principal stresses tend to point in the direction of WNW-ESE on the east of the Kitami mountain range. The boundary of the stress change correlates with the location of discontinuous change in dip of the plate.

In applying the back-slip on the curved plate boundary, we divided the boundary into small rectangular planes that best fit its local strike and dip. A constant back slip with rake consistent with the direction of plate convergence was given to a total of 303 boundary planes shallower than about 50 km. We used Okada”s program (1985) to calculate the stress field caused by the back slip. At depths corresponding to the crustal layers, a stress regime consistent with thrust-type events with the maximum principal stress directing parallel to the direction of convergence prevails over most of the modeling area. However, a stress regime favorable for right lateral strike-slip appears at the fringe of the locked plate boundary along the Pacific coast of eastern Hokkaido. This is consistent with an idea that the sliver in the forearc region moves toward west relative to the block over the volcanic front. We also calculated the stresses on the dipping planes simulating the upper and lower seismic planes of the double-planed seismic zone. The stress regimes are not in agreement with the prevailing down-dip compression and down-dip extension type events on each plane, showing that the back slip is not a dominant factor controlling the earthquake-generating stress field within the subducted slab at depths.