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Reanalysis of motion of forearc sliver along the southern Kuril arc using the F3 solution of site coordinates of GEONET

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Previously, we investigated the motion of forearc sliver along the southern Kuril trench, using the F2 solution of GPS site coordinates of GEONET in Hokkaido. Thereafter, newly determined site coordinates called F3 solution have been provided by GSI. Since the errors of F3 solution are considered to be smaller than those of F2 solution, we reanalyze the motion of forearc sliver using the F3 solution.

We employ a kinematic model which is basically similar to the previous one. It assumes that the observed site velocities in Hokkaido are affected by the motion of forearc sliver as well as by the slip deficit on the interface of the subducted Pacific plate. Thus the model parameters are the slip deficits on the megathrust plate boundary, the rate of rigid motion of the forearc sliver, and the slip deficits on the boundary of forearc sliver. The slip direction on the megathrust plate boundary at the base of forearc sliver is assumed to be different from that in the surrounding region. In contrast to the previous case in which we dealt with the site velocities relative to Sarufutsu (950101), a site located at the northern tip of Hokkaido, we deal with the velocities in the reference frame of ITRF2005. Presuming that the GPS sites are placed on an unknown microplate, perhaps Okhotsk plate, we determine the Euler vector of the microplate such that the GPS site velocities represented in the reference frame of the miroplate can best be fit by the slip deficit on the megathrust plate boundary between the microplate and Pacific plate. This is done simultaneously with the inversion for the other model parameters. Thus we can deal with the problem without assuming the plate on which the GPS sites are placed. Moreover, a correction is made for the effect of the slip deficit on the convergent plate boundary along the eastern margin of the Japan Sea before the inversion, since it became clear in the previous study that the effect is significant. As a result, the standard deviation of residuals reduced greatly in comparison with the previous case.

As in the previous study, the results show that it is difficult to determine the motion of forearc sliver and the slip direction of the subducted Pacific plate relative to the forearc sliver independently, though the standard deviation of residuals is reduced appreciably by allowing for the discrepancy between the slip direction of the subducted Pacific plate relative to the forearc sliver and slip direction on the megathrust plate boundary in the surrounding region. The model of partitioning of oblique plate convergence cannot explain the inverted correlation between the motion of forearc sliver and slip direction of the subducted Pacific plate relative to the forearc sliver. It is suggested that the slip direction on a severely deformed megathrust boundary may not simply be represented by the rigid rotation of horizontal plate convergence vector about the local strike of subducted slab.

Keywords: motion of forearc sliver along the southern Kuril arc, F3 solution of GPS site coordinates of GEONET, plate tectonics in far-east Asia region, oblique plate convergence boundary, crustal deformation in Hokkaido, slip deficit on the subducted Pacific plate