Oblique Subduction of the Pacific Plate along the Kuril Trench and Crustal Deformation of the Forearc

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Northeast-southwest trending Kuril forearc in the northwest Pacific is formed by oblique subduction of the Pacific plate at the Kuril Trench. Its northwestern boundary corresponds to a volcanic front and southwestern front collides with the northeast Japan arc in the central Hokkaido.

We estimate lateral movement of the forearc in two ways. At first we combine relative plate motion vectors with slip vectors of major interplate earthquakes at the southern Kuril Trench. Plate motion vector is evaluated at each epicenter using the most recent global model REVEL-2000 (Sella et al., 2002), and decomposed into two components: one parallel to the earthquake slip vector that is related to interplate earthquake cycle and margin-parallel residual that may be taken up by the forearc lateral movement. The residuals show that the southern Kuril forearc moves southwestward at a mean rate of 12mm/yr. In more detail, northeastern part of the forearc moves at a faster rate of about 20mm/yr, and the rate decreases to 10mm/yr at the southwestern front. This implies a deceleration due to the collision with the northeast Japan arc.

Next we estimate forearc movement using crustal velocities from nationwide continuous GPS array though data are limited only in Hokkaido region. In horizontal velocity field the most dominant is a crustal shortening of the forearc in the direction of plate convergence, which can be modeled as an elastic deformation caused by back slip vectors acted on plate interface. We determine plate interface geometry with 10 segments referring to high-precision unified hypocenters by Japan Meteorological Agency and apply plate motion vectors from REVEL-2000 on the plate interface. Moreover, plate coupling is changed to 0-100%, and the tectonic erosion rate is changed to 0-30mm/yr. The best-fit model shows that the plate coupling is strong on the depth of 10-40km. The erosion rate are estimated about 10mm/yr.