

# What causes crustal deformations in Kyushu?

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Displacement fields at GPS stations in Kyushu relative to some point to the east of the Itoigawa-Shizuoka Tectonic Line, for example, Ogata in Niigata Prefecture, are characterized by eastward movement in the northern part, anti-clockwise rotation in the eastern side of the middle part, and southeastward motion in the southern part. It has been considered so far that the first one represents eastward movement of the Amurian plate, the last one is produced by a block motion due to expansion of the Okinawa Trough (Watanabe and Tabei, 2004) or dragging of the crust by the mantle flow to that direction (Seno, 1999; Takayama and Yoshida, 2003), and the rotation is caused by decrease of interplate coupling from north to south in Hyuganada as well as the southeastward motion in the southern Kyushu. Basing on such an interpretation we tried to model the interplate coupling and the dragging effect (Takayama and Yoshida, 2004). It seems, however, that the southward displacement in the middle Kyushu which is contributing substantially to the rotational movements, can not be accounted for by the above-mentioned three causes of crustal deformation in Kyushu, for both the interplate coupling and the expansion of the Okinawa Trough work in the WNW-ESE direction which are considered not enough to yield the south- or southwestward displacement as large as the observed one. Standing on the viewpoint, we examined in what region the southward displacements are observed and found that it was an area between the Beppu-Shimabara graben and a line in the east-west direction connecting Izumi and Miyazaki. Years ago Tada (1985) estimated that middle Kyushu is in the north-south extensional field from the data of geodetic measurements and earthquake mechanisms, and the field is produced by the expansion of the Beppu-Shimabara graben that corresponds to the extension of the Okinawa Trough. Although the estimation was based on far less data than those now available, it was an insightful idea penetrating a truth. We consider that the rotational motion, conspicuous in the eastern side of middle Kyushu, is produced not only by the change in the strength of the interplate coupling from north to south in Hyuganada and southeastward movement in southern Kyushu, but the southward displacement in the region to the south of the Beppu-Shimabara graben contributes to it substantially. It is interesting to note that seismic activity is active along the Izumi-Miyazaki line that corresponds to the southern limit of the region of the southward displacement field. Focal regions of the 1997 northwestern Kagoshima Prefecture earthquake, the 1994 earthquake near Okuchi, and the 1968 Ebino earthquake swarm are distributed in the zone along the line.

We propose that crustal deformations in Kyushu are caused by the eastward movement of the Amurian plate, expansions of the Okinawa Trough and the Beppu-Shimabara graben, and the interplate coupling in Hyuganada, and try to model the sources evaluating their contributions to the displacement fields quantitatively.