Deformation of the seismogenic zone in the northeastern part of the Izu Peninsula, Japan, inferred from GNSS observations

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The Izu collision zone, which is characterized by the collision between the Izu-Bonin arc and the Honshu arc, is located in the northernmost part of the Philippine Sea Plate. Particularly in the northeastern margin of the zone, numerous large earthquakes have occurred throughout history. To clarify the convergent tectonics of this zone related to the occurrence of these large earthquakes, in this study we collected and analyzed Global Navigation Satellite System (GNSS) observation data from the Izu collision zone.

We used observation data from our GNSS sites, as well as other sites, to calculate the velocity vectors and strain rate fields of the region in and around the Izu Peninsula in central Japan. Our calculations provided the following results:
•The GNSS velocity vectors in the eastern and western parts of the Kita-Izu Fault Zone are different; in particular, the sites located farther east have larger northward velocities in the area between the fault zone and the Ashigara Plain.
•There is a shear deformation zone in the area extending from the northeastern part of the Izu Peninsula to south of the Tanzawa Mountains, with maximum shear directions that agree with the left-lateral slip direction of the Kita-Izu Fault Zone.
•Seismic activities in the Tanzawa Mountains and the northeastern part of the Izu Peninsula were correlated. This might suggest that both areas are affected by temporal changes in stress accumulation due to the subduction of the Philippine Sea Plate.
•The deformation rate obtained by GNSS data is almost the same as or twice the geologically determined deformation rate. This fact is important when considering the relationship between the accumulation process of deformation in the shear zone and the occurrence of large earthquakes at the West Sagami Bay Fracture or the Sagami Trough.
•The shear zone can be regarded as the transition zone between plate collision and subduction zones: that is, the northeastern part of the Izu Peninsula is being dragged by the relative motion between the separated Izu Peninsula and the North American Plate, which is coupled to the rigid portion of the Philippine Sea Plate.
•We assumed the existence of a weakly coupled detachment zone beneath the shear deformation zone. This can explain both the northward velocities in the shear zone and the divergent displacement and dyke intrusion in the Higashi-Izu Monogenetic Volcano Group.

Reference

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