Crustal movement of the Zenisu Ridge: A key factor for kinematic model of the northern margin of the Philippine Sea plate

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The northernmost part of the Philippine Sea plate provides one of the best examples of a plate convergence in transition from simple subduction to broadly distributed deformation within oceanic lithosphere. Characteristic tectonic features in and around the Izu peninsula are collision of the Izu-Bonin Arc to central Japan in the north, subduction of oceanic slab at the Suruga trough in the west, and existence of the Zenisu ridge nearly parallel to the trough in the south. Several geophysical evidences such as distribution of shallow seismic activity, structure of oceanic crust across the Zenisu ridge, and horizontal GPS velocities in the Izu peninsula suggest that the Izu peninsula and Zenisu ridge form a compressive tectonic block being detached from the main part of the Philippine Sea plate. Thus plate convergence between the Philippine Sea plate and central Japan may be partitioned into deformations at both sides of and within the block. However, this hypothesis has been under discussion because eastern and southern boundaries of the block have not been identified clearly.

In this paper we discuss the above hypothesis mainly based on horizontal GPS velocities from the nationwide continuous GPS array of GSI and our campaign-style GPS observation at Zenisu. Since 1995 we have conducted eight campaign measurements on the Zenisu reef. The largest event in the observation period was the earthquake swarm activity in the northern Izu Islands during the summer, 2000. Zenisu was displaced by about 18cm to the southwest associated with this event. On the other hand, motion of Zenisu before and after the event seems steady, which is significantly deflected to the west-northwest compared to steady motion of the Philippine Sea plate but very similar to the motion of the southern part of the Izu peninsula. GPS velocity field is consistent with the existence of the Izu-Zenisu tectonic block. However, other geophysical data with different temporal-spatial scale and resolution should be integrated to construct a realistic kinematic model of the northernmost part of the Philippine Sea plate.