Current status of high-precision onshore observation on the sea: Zenisu reef GPS campaign observation

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Seafloor observation systems for earthquake, tsunami and crustal deformation have been developed and deployed to monitor ongoing activities in the hypocentral region of the interplate megathrust events around Japan. However, while these systems require a very high cost for deployment and operation, onshore observation techniques are still superior in precision. As for the onshore stationary observation networks deployed over Japan such as Hi-net and GEONET, it is true that there still exist observation gaps of low resolution even in active coastal areas because of the existence of the sea. Using a superiority of the onshore observation in precision, mobile deployments at a tip of the peninsula, isolated island or rock reef should be encouraged to supplement the stationary onshore networks. In this paper we discuss current status and problems of “the onshore observation on the sea” referring to the Zenisu reef GPS campaign observations since 1995.

The Zenisu reef is located at the root of the Zenisu ridge that extends from the southern off Izu peninsula to the southwest. Several geophysical evidences such as structure of oceanic crust across the Zenisu ridge and horizontal GPS velocities in the Izu peninsula suggest that the Izu peninsula and Zenisu ridge have formed a compressive tectonic block (Izu microplate: IMP) 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 IMP. Using displacement rates at seafloor stations deployed along the Nankai Trough, Yokota et al. (2016) have shown strong coupling on the boundary north of the Zenisu ridge. Movement of the Zenisu reef has a key factor to confirm the IMP hypothesis and strain partitioning.

We need to charter a fishing boat to access the Zenisu reef from Kozu island about 40 km apart. The highest point of the reef is as high as 10 m above sea level. Generally landing and operation on the reef are difficult when wave height exceeds 2 m. Moreover the operation time on the reef is limited to within 5-6 hours in the daytime. Because of these conditions, observation time and frequency are quite insufficient. In reality, there are several technical problems to overcome for the realization of long-term continuous GNSS observation: waterproofing and rust prevention of all instruments against sea water, stable anchoring of instruments against physical external forces (storm wind and tidal wave), countermeasure to solar insolation in summer (high temperature and crystallization of salt) and so on. Stable power source and telecommunication for data collection are also important for long-term continuous observation but the above problems make them difficult to realize. We will continue to make efforts to overcome these problems in order to apply high-precision onshore observation techniques to the marine observations.

Keywords: Zenisu, GPS, Crustal deformation

