Crustal deformation at the shear zone of the southern part of Kyushu region accompanied with the 2016 Kumamoto earthquake (Preliminary report)

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From an estimation of strain rate using the recent GPS crustal velocities, two remarkable regions with high shear strain rate of the $1.0x10^{-7}$/yr order exist in the Kyushu district (Wallace et al., 2009). The first region spreads out from Iyo Nada to the sea of Ariake with 60 km in width and 120 km in length. The region contains major active faults such as the Beppu-Haneyama fault zone and the Futagawa fault zone, which corresponds to the northern part of the Shimabara-Beppu rift zone. The 2016 Kumamoto earthquakes seemed to be occurring at the distal area the first region with the high shear strain rate. The second region cuts through the Kyushu district along latitude 32 degrees north with 30 km in width and 120 km in length. We call this region a shear zone of the southern part of Kyushu region, where active left-lateral crustal deformation is detected by GPS observations and it is going on. Although the focal areas of the 1997 Northwest Kagoshima earthquakes (M6.6, M6.4) are included in the shear zone, the existence of active faults corresponding to those seismic activities and to the high shear strain rate is unrevealed till now. Therefore, in order to develop the numerical modeling techniques for crustal deformation, we started GNSS observation at 10 sites in February or March in 2016. Then, we investigate crustal deformation precisely and clarify the formation process of the high shear strain rate zone. On April 14 and 16, about one month after the observation started, the earthquakes with M6.5 and M7.3 continuously occurred at the Kumamoto region. We could detect the southward co-seismic displacement of approximately 6 cm accompanied with the M7.3 earthquake at a GNSS sites about 60 km away from the epicenter of the earthquake. In this study, we show the preliminary result of the GNSS observation. Then, we estimate the strain rate using the GEONET F3 solution provided by the Geospatial Information Authority of Japan and discuss spatiotemporal variation of strain rate before and after the earthquakes and the income and outgo of elastic strain in the Kyushu district. In addition, based on the result of geological strain rate using the active fault database of the National Institute of Advanced Industrial Science and Technology, we compare the strain rates in geological time scale and those in geodetic time scale and discuss the deformation process of the upper crust in the region.

Reference

Wallace et al. (2009): Enigmatic, highly active left-lateral shear zone in southwest Japan explained by aseismic ridge collision, Geology, vol.37, 2009, pp.143-146.

This study was carried out under a contract with Agency of Natural Resources and Energy (ANRE), a part of Ministry of Economy, Trade and Industry (METI) of Japan as a part of its R&D supporting program for developing technology of geological disposal of high-level radioactive waste. We used GEONET F3 solution provided by the Geospatial Information Authority of Japan, the active fault database of the National Institute of Advanced Industrial Science and Technology, and RTKLIB ver. 2.4.3 (RTKLIB: An open source program package for GNSS positioning developed by T. Takasu, Tokyo University of Marine Science and Technology) for the analysis. In addition, we hope people suffered from the 2016 Kumamoto earthquake will make a swift recovery.

Keywords: shear zone of the southern part of the Kyushu region, spatiotemporal variation of strain rate, geodetic strain rate, geological strain rate

