Implications of Persistent Intraplate Deformation in the Niigata-Kobe Tectonic Zone, Central Japan

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We found a persistent localized contraction along the Niigata-Kobe Tectonic Zone (NKTZ) before and after the 2011 Tohoku-oki earthquake through an analysis of GEONET coordinate data (Menese-Gutierrez and Sagiya, 2016). This persistent pattern is identified as short-wavelength components in the strain rate pattern after removing the long-wavelength components. Persistency of deformation pattern under both interseismic and postseismic periods indicates that the localized contraction results from aseismic process driven by the tectonic stress field. Strain rate of this localized contraction is about 0.06 ppm/year, generally consistent with geologically estimated strain rate (Wesnousky et al., 1982, Sato, 1989). The localized pattern can be reproduced by ~10mm/year aseismic slip on a fault cutting the crust up to the depth of a few km. This implies inelastic processes have significant contribution in the crustal deformation of the Japanese island arc. Similar inelastic deformation is expected for other fault zones. However, slip rate of major active faults are smaller and the deeper locking depth makes associated deformation pattern much broader. Thus it is more difficult to detect related signals with a similar approach. The long-wavelength components in the strain rate pattern are considered to be elastic deformation caused by interaction at the plate boundary. Since our precise geodetic observation is limited for the last 20 years, we have not figured out how elastic strain accumulation and release are balanced through an earthquake cycle. Modeling effort of earthquake cycles with realistic lithospheric structure to reproduce the observed deformation pattern is essential to solve the problem.

Keywords: intraplate deformation, inelastic deformation, crustal strain rate

