

Time-dependent crustal deformation associated with the 2004 Chuetsu and the 2007 Chuetsu-Oki earthquakes

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There is an ongoing concentrated deformation along the Japan Sea coast, which has been identified as Niigata Kobe Tectonic Zone (Sagiya et al., 2000). Large historical earthquakes have occurred in this area, and in recent years, Niigata has suffered the impact of two important events, known as the 2004 Mid-Niigata Prefecture earthquake (MJ 6.8) and The 2007 Niigata-ken Chuetsu- Oki earthquake (MJ 6.6), which considerably affected the crustal deformation pattern. For this reason, we review temporal variation of crustal deformation pattern in the mid Niigata region based on daily coordinates of 28 GPS sites from the GEONET network for three time windows: before 2004, 2004-2007 and after 2007 until March 2011, to avoid the post deformation associated with Tohoku-Oki earthquake. We observed a migration of the deformation pattern in the East-West direction through the contraction belts for the above time windows. Before 2004, we can recognize a clear shortening of 0.3ppm/yr in the area between the source regions of 2004 and 2007 quakes. After the 2004 Chuetsu earthquake, this shortening rate decreased. On the other hand, an accelerated contraction occurred to the east of this region, around the source region of the 2004 earthquake. After the 2007 earthquake, another contraction zone appeared to the northwest, near the 2007 source region. These time-dependent behaviors suggest there exists strong interaction between parallel fault segments in this area. It is crucially important to reveal such interaction to understand crustal deformation and seismogenesis in this region. We construct kinematic deformation models to interpret the time-dependent deformation pattern for each time period and to investigate mechanical interaction of coseismic as well as probably aseismic fault slips.

Keywords: Crustal deformation, Niigata Kobe Tectonic Zone, Kinematic model, Aseismic fault slips, GPS measurement