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Postseismic deformation associated with the Iwate-Miyagi Nairiku Earthquake in 2008 as inferred from dense GPS observation

Takeshi Iinuma[1]; Yusaku Ohta[1]; Mako Ohzono[1]; Satoshi Miura[1]; Tomomi Okada[1]; Keisuke Yoshida[1]; Norihito Umino[1]; Akira Hasegawa[1]

[1] RCPEV, Graduate School of Sci., Tohoku Univ.

1. Introduction

The Kitakami-Teichi-Seien Fault Zone (KTSFZ) is an active fault zone located in the middle of the Tohoku district, NE Japan. The Headquarters of Earthquake Research Promotion of Japan reported that the fault zone acted at least twice in the recent 3,000 years, and they estimated the magnitude of the potential earthquake as 7.8. Recent GPS observation revealed that this fault zone locates in the strain accumulated zone. In order to grasp the precise strain accumulating process around the fault zone, we newly constructed a dense GPS array crossing the Dedana Fault (DF), which composes the southernmost tip of the KTSFZ, in October 2007.

The 2008 Iwate-Miyagi Nairiku Earthquake (Mj 7.2, hereafter we call it *IMNE*.) occurred on 23:43, 13 June 2008 (UT) around the boundary between the Iwate and Miyagi Prefectures, Tohoku district. The hypocenter locates at about 20 km southwest to the DF, and no active fault of high seismic risk had not been confirmed in the neighborhood of the hypocenter until the IMNE occurred.

We present the postseismic deformation associated with the IMNE deduced from GPS observation and discuss the origin of the deformation. We will also introduce the results of the analysis based on latest GPS data and comparisons between the slip, seismic velocity structure, and aftershock distributions on the day of presentation.

2. Postseismic deformation

Ohta et al. (2008, EPS) estimated source faults of the IMNE and confirmed that the DF did not slip coseismically. However, we found significant site coordinate changes that apparently point the occurrence of an aseismic slip event on the DF by analyzing GPS data. The time series of sites nearby the DF clearly show opposite moving directions between co- and post- seismic periods. They jumped westward coseismically reflecting that these sites belong to the foot wall side of the westerly dipping reverse fault, while their eastward movements after the mainshock suggest that they locate on the hanging wall side of the fault. This strongly suggests that an aseismic slip event have occurred on a different fault other than the source faults of the IMNE. The moving directions invert after the mainshock around the surface trace of the DF. Thus, we concluded that the DF has slipped aseismically induced by the IMNE.

We examined whether poro-elastic rebound and visco-elastic relaxation can explain the postseismic deformation or not. The estimated dilatation change due to the IMNE mainshock, however, seems not to be able to invert the moving directions at the sites around the DF. It is also not plausible that visco-elastic relaxation produced the deformation around the DF.

3. Results of the inversion analyses and discussions

We carried inversion analyses out to infer where and when the slips occurred. We also estimated coseismic slip distribution based on coseismic displacements estimated by Ohta et al. (2008). The results show three distinctive features; 1) there is no significant coseismic slip on the DF, while accumulated aseismic slip reaches 20 cm on it after the mainshock, 2) most aftershocks occurred at zones of small co- and post- seismic slip, and 3) the regions of large postseismic slip surrounds the region of large coseismic slip.

Features 2) and 3) strongly suggest that the zonal partitioning of sliding behavior on the inland active fault stands as well as on the plate boundary. This means that the zones where unstable sliding coseismically occurs and where fault coupling is strong in the inter-seismic period – we call such zone *asperity* hereafter – eliminate areal overlap with the zones where stable sliding dominantly occurs. The region where the aseismic slip occurred as reported in this study occurred must be a non-asperity and must be partitioned from asperities on the DF or KTSFZ, if the partitioning of sliding behavior stands with respect to inland active faults as well as the source fault of the IMNE.