

Modeling deformation processes of the island arc crust and mantle during the postseismic periods of the Tohoku-oki earthquake considering the heterogeneous rheological structure

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This paper investigates postseismic viscoelastic deformation in the island arc crust and mantle and postseismic slip of the Tohoku-oki earthquake considering the heterogeneous rheological structure. We first calculated the effective viscosity distribution of the Japanese island arc crust and upper mantle. Then, we calculate the viscoelastic deformation of the Japan island arc during the postseismic period of the Tohoku-oki earthquake considering the coseismic slip distribution obtained by our inversion analysis using a finite element method. After removing the viscoelastic deformation from the observed displacement data, we performed inversion analysis to obtain postseismic slip distribution.

For calculation of the effective viscosity distribution of the Japanese island arc crust and upper mantle, we first considered the thermal structure obtained by dense geothermal observations from Hi-net boreholes (Matsumoto, 2007) and by Tanaka et al. (2004). The model could not reproduce well a postseismic strain anomaly (decreases in areal strain) along the volcanic front after the 2011 Tohoku-oki earthquake, which was found by Miura et al. (2014). Therefore, we considered local low viscosity region beneath volcanoes. In this case, a postseismic strain anomaly (decreases in areal strain) along the volcanic front can be reproduced. We also obtained postseismic slip by the inversion analysis. The results indicate large postseismic slip occurred below the deeper part of the coseismic slip region. We test several viscoelastic structures and report a model which explains well the postseismic deformation in the inland region of northeastern Japan.

Keywords: the Tohoku-oki earthquake, postseismic deformation, heterogeneous rheological structure , the island arc crust and mantle