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Re-examination of the postseismic deformation associated with the 1993 M_w7.7 Hokkaido Nansei-Oki earthquake

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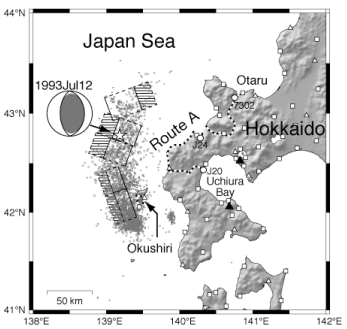
We examined the source mechanism of the postseismic deformation associated with the 1993 M_w7.7 Hokkaido Nansei-Oki earthquake, northern Japan (Fig. 1). Ueda et al. [2003] first noted the postseismic deformation and concluded that viscoelastic relaxation in the upper mantle is a main source. However, leveling data which were collected recently and a transient change of horizontal GPS following the earthquake cannot be explained by Ueda et al. [2003]'s model (Fig. 2). We compared the deformation observed by GPS and leveling with that predicted by three possible mechanisms for postseismic deformation (e.g. afterslip, viscoelastic relaxation, and poroelastic rebound). None of them alone can fit the data adequately. Our preferred model is a combination of afterslip on the downdip extensions of the coseismic faults and viscoelastic relaxation in the upper mantle. The preferred viscoelastic structure consists of a 30 km-thick viscoelastic layer with a viscosity of 2×10^{18} Pa·s sandwiched between a 40 km-thick elastic plate and a viscoelastic half-space with a viscosity of 8×10^{19} Pa·s.

Keywords: Postseismic deformation, Afterslip, Viscoelastic relaxation, GPS



References

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Figure 1. Aftershock distribution of the 1993 Hokkaido Nansei-Oki earthquake. Triangles and squares are GPS stations. Dashed lines are leveling routes. Five open rectangles are the coseismic fault model of Tanioka et al.[1995].

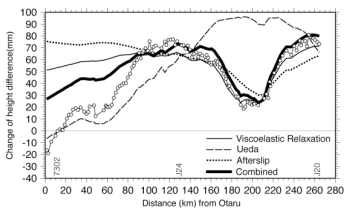

Figure 2. Comparison of observed and calculated cumulative elevation change on leveling route A (Fig. 1) for 11 years after the earthquake. The open circles denote the observed data. The calculated changes include optimal offsets fit to the model-computed level changes. Our preferred model is denoted as "combined".