

FEM simulation of postseismic deformation induced by pore fluids flow - the 2000 Western Tottori Earthquake -

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Following a large earthquake, postseismic deformation has been observed around the focal region by GPS, leveling measurements and the other geodetic ones. Some physical mechanisms that explain the postseismic deformation have been proposed. Afterslip and Viscoelastic relaxation have been often assumed to be the main causes of postseismic deformation. There have been, however, few studies which consider poroelasticity. In this study, we explored the postseismic deformation due to pore fluids flow in a poroelastic medium.

We used the finite element program 'CAMBIOT3D' originally developed by Geotech. Lab. Gunma University (2003). Because this program was developed for soil mechanics, we modified it so as to calculate deformation due to earthquake faulting by implementing the 'split node technique' (Melosh and Refsky, 1981). We examined the accuracy of FEM poroelastic calculation in the following way. We compared the coseismic deformation in a poroelastic material calculated by FEM with that in an elastic one with the corresponding undrained Poisson's ratio calculated by Okada's program (1985) to confirm the accuracy of FEM calculation.

We evaluated the postseismic deformation in a poroelastic material to show that the poroelastic deformation is different from that from afterslip and viscoelastic relaxation models. The distinctive postseismic deformations are the horizontal displacement perpendicular to the fault, the uplift in areas of dilation and the subsidence in areas of compression. These may explain the strange displacement that can not be explained by afterslip and viscoelastic relaxation models.

The GPS observations were carried out following the 2000 Western Tottori Earthquake to show clear postseismic deformations. We compared the poroelastic deformation with the observed postseismic deformation. Since we assumed a very simple fault model at present, they did not agree with each other. However, the calculated poroelastic deformation has the amount comparable to the observed one, which suggests the importance of poroelasticity.

We found that the change of the coulomb failure function (dCFF) in the poroelastic material is different from one in the elastic material because of the effect of the pore pressure. Comparing the pattern of aftershock distribution with calculated dCFF, poroelastic calculations seem to better explain the aftershock occurrence than the elastic ones.

Further tuning model parameters such as the geometry of fault, coseismic slip amount and permeability, in addition to afterslip, poroelastic FEM simulation would explain the observed postseismic deformations and aftershock distribution.