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Simulation of coseismic electromagnetic signals due to piezoelectricity of rocks (1)

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Observations of coseismic electromagnetic(EM) signals have been reported (e.g. Oshiman,1995). Although there have been various studies on the mechanisms of their generation, we have calculated behavior of expected EM fields due to piezoelectricity of crustal rocks under some limited conditions(e.g. Ogawa and Utada, 1998). However, we could not construct realistic models which could be compared with observational results. We will present examples of simulation of EM fields due to piezoelectricity of crustal rocks and some geophysical information which can be presumed from expected EM fields, on the basis of FDTD simulation of the coseismic stress field variation in the crust.

Observations of coseismic electromagnetic(EM) signals have been reported (e.g. Oshiman,1995). As the mechanism of their generation, several physical processes, such as piezomagnetism, piezoelectricity of rocks and electrokinetic phenomena, have been studied. Among them, we suppose piezoelectricity of rocks as their mechanism, and have calculated behavior of expected EM fields (e.g. Ogawa and Utada, 1998). However, since they based on some simple models on the rupture process of the fault and the conductivity and velocitiy structure of the space, they could only show fundamental characteristics of EM fields due to piezoelectricity of rocks, which could not be compared with observational results with calculations of EM fields on the basis of their realistic models. We will present examples of simulation of EM fields due to piezoelectricity of crustal rocks and discuss some geophysical information which can be presumed from expected EM fields, on the basis of FDTD simulation of the coseismic stress field variation which excites EM fields due to their piezoelectricity, with more realistic models of the rupture process of the fault and the conductivity and velocity structure of the space. We apply the finite difference method (time domain and frequency domain) and the integral equation method to simulate EM fields. The finite difference method is a code which needs larger memories but can calculate them more efficiently for the complex structure compared with the integral equation method. We show effectiveness of the FDTD method for calculating EM fields, and effect of the inhomogeneous structure to the observed EM fields in the realistic crust of our problem which contain high inhomogeneity of the conductivity structure.