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Numerical modeling on the propagation of seismic electromagnetic signals

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Study on propagation of seismic electromagnetic signals (SEMS) plays an important role in understanding earthquake-related electromagnetic phenomena. In this paper, we simulate the propagation characteristics of SEMS in some typical 3-D models using COMSOL Multiphysics, a software of finite element method (FEM). After some validation tests of the above FEM software, we investigated the possible effects on the propagation characteristics of SEMS from the model parameters such as frequency, source, boundary conditions and medium conductivity. Then, we considered a model with a conductive fault buried in a three-layered media, and an electric dipole source located close to the center of the fault. The simulation results indicated that the amplification effect of a conductive channel, which has been adopted as a possible explanation of some SEMS observations, can be expected only at a much lower frequency, e.g. below 1Hz in our model simulations. We also simulated the possible ocean effect on the propagation of SEMS. As a case study, we modeled the Greek archipelago, in which numerous SEMS have been reported. The numerical results showed a decayed pattern of SEMS at a frequency lower than the cut-off frequency, and a rippled propagation pattern at a frequency higher than the cut-off frequency. These results are consistent with some previous analogue experimental results (Huang and Ikeya, 1998). The numerical simulations combined with the analogue experiments may provide possible explanation of field SEMS data, as well as some useful information of designing field observation of SEMS network.

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