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Simple model to estimate electric and magnetic fields generated by electrokinetic processes in a conductive crust

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The results of different models of electrokinetic sources of ULF disturbances, mostly based on numerical calculations, can be reproduced with a much simpler analytical model with an elliptic-shaped inhomogeneity. Moreover, the suggested model enables one to estimate the screening effect of the back conductivity currents and the influence of the ground-atmosphere boundary. The estimates show that the expected magnitudes of seismo-electromagnetic signals in ULF band from an elementary electrokinetic source may reach the detection level for a favourable set of crust parameters.

The model enables us to estimate another possible effect. Micro-cracking in the earthquake preparation zone is accompanied by the generation of acoustic emission (AE). Even low-intensity AE can essentially modify the underground fluid dynamics owing to the influence of high-frequency acoustic field on filtration process. Laboratory experiments show that acoustic impact on pour sample destroys a film with bounded water and results in a steep increase of its permeability up to 2 orders of magnitude and decrease the effective viscosity of fluid. The occurrence in the crust under pressure of a region with distinct hydrodynamic and electrokinetic parameters will result in an appearance of anomalous telluric and magnetic fields on the surface above. This effect is estimated analytically using a simple model with an elliptic-shaped inhomogeneity. The suggested hypothesis indicates a possible coupling between AE and geoelectical anomalies.