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THE INFLUENCE OF THE ROCK FILTRATION PROCESSES ON GEOACOUSTIC EMISSION

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Abstract. This paper considers physical effects and mechanisms of influence of external electromagnetic radiation with amplitude of about several mV/m on the intensity of geoacoustic emission registered in the deep, more than 200 m, boreholes. The theoretical estimates based on a simple model of the electrical double layer show that the modulating effect of the weak audio-frequency electromagnetic fields on the intensity of geoacoustic emission is connected with the changes in forces of viscous friction between the mobile fluid layer and the surface of the solid phase. These forces vary with a frequency of the external electromagnetic field and with amplitude proportional to the field amplitude. At the scale of a macroscopic volume of the medium, each periodical decrease in friction forces increases the number of acts of motion of the solid phase relative to the fluid under the existing mechanical stresses. In the real geological medium, geoacoustic emission intensity variations are statistically connected with variations in electromagnetic radiation in the case of small electric field. The geoacoustic signal recorded in the borehole is a superposition of radiation from a very large number of separate point sources of geoacoustic emission; they act simultaneously at different points of the zone controlled by the geophone.

The results of the experiment on the water pumping from the borehole led to the conclusion that with the changes in the pore pressure gradient, variations in the amplitudes of geoacoustic responses to the external electromagnetic radiation are related to the intensity of filtration flows in the zone of the near-hole environment controlled by the geophone. For the saturated rock with rather high permeability, the variations in amplitudes of geoacoustic responses can be primarily related with the variations in the total area of rock surfaces contacting with a fluid. For the compact rock with low permeability, the variations in amplitudes of geoacoustic responses are governed by the electrokinetic processes.

The experimental results obtained are qualitatively consistent with the long-term multi-instrumental geophysical measurements in the boreholes in time vicinities of strong earthquakes that demonstrate significant increase in the strain rate in the medium and consequently, the processes of redistribution of the pore pressure and intensification of the filtration processes.

Keywords: geoacoustic emission, filtration processes, electromagnetic radiation, fluid saturation, borehole, earthquake.

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