\textsc{ELECTROMAGNETIC EFFECT GENERATED BY FILTRATION OF FLUID IN PERMEABLE POROUS LAYER}

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An anomalous magnetic field can always be detected during the exploration of oil and artesian wells. The nature of the field is not completely understood as yet, but there is a reason to assume that it arises due to electro-kinetic effects in saturated porous mediums.

The filtration theory studies motion of fluids or gases in porous mediums. Porous medium can be represented as a set of chaotically distributed pores interconnected by micro-channels and cracks. In this medium flow of fluid follows Darcy's law $\vec{q} = -kgradp/\eta$. Taking into account the equation of continuity, the equation of fluid filtration in saturated porous media will be (Barrenblatt G.I. 1972)

$$\Delta p - \frac{c_f \eta}{kK} \frac{\partial p}{\partial t} = 0.$$

Here p is pressure, $\vec{q}$ is fluid flow, K is its bulk module, η is its viscosity, c_f is porosity of medium, k is permeability of porous medium. In order to determine the formational pressure and the fluid flow in a porous layer it is necessary to solve this differential equation for the desired boundary and initial conditions. We consider a cylindrical well in an infinite statistically homogeneous porous layer. As a result we obtain the distributions of pressure and fluid flow around the well.

Electrically charged particles are always present on a boundary between solid and fluid phases in porous media. During the filtration, fluid can carry those particles along, generating an electric current therefore. The phenomenon is known as seismo-electric effect of type II. If a surface density of charge is ρ_e, density of an electro-kinetic current should be $\vec{j} = \rho_e \vec{q}$. A magnetic field caused by this current can be calculated according to the Biot-Savart-Laplace law. Although the magnetic field is much weaker than a magnetic field of Earth, modern high-sensitivity methods of measurement are capable of detecting such the fields, several orders of magnitude weaker than the Earth's. And indeed, such anomalous magnetic fields are detected in a vicinity of active wells, oil and artesian. The present mathematical model can serve as an explanation to this effect.

BIBLIOGRAPHY

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