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透水係数、比貯留係数及び流動電位係数分布推定のための自然電位分布逆解析手法の研究
Simultaneous inversion of self-potential for estimating hydraulic parameters and streaming current coefficient

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In this study, we develop an inversion scheme for the simultaneous estimation of hydraulic conductivity, streaming current coefficient and specific storage, using transient self-potential (SP) data. SP is a natural electrical potential, which is thought to be caused by subsurface fluid flow through the electro-kinetic coupling. Recently, several SP measurements are performed during pumping tests to characterize the parameters of the aquifer. Almost of all SP analysis methods are adaptable to the static SP data, but a huge amount of the transient SP data is not used efficiently. Therefore, we develop an inversion scheme for the analysis of transient SP data. The electrical conductivity, streaming current coefficient, hydraulic conductivity and specific storage are parameters effectively influencing the SP profile on the surface, and can be solved in the inversion. The distribution of electrical conductivity structure can be used if the electrical resistivity tomography (ERT) or other EM measurements are performed with the SP measurement. We employ the relationship between hydraulic conductivity and streaming current coefficient to decreases the number of estimating model parameters, and to enable the simultaneous estimation of hydraulic conductivity and streaming current coefficient. First in this study, we check the sensitivities of the hydraulic conductivity and specific storage obtained at different times. The sensitivities of the hydraulic conductivity and specific storage are different with respect to the phase. The simultaneous inversion of hydraulic conductivity and specific storage from the transient SP profile is turned out possible from the difference in phase. Finally, we apply our inversion scheme to a synthetic SP profile, and reconstruct the subsurface structure of hydraulic conductivity, streaming current coefficient and specific storage simultaneously. As a result, our inversion technique allows us to obtain the hydraulic parameters from SP data on the ground surface, although the conventional hydraulic tomography strongly relies on the borehole data.
Keywords: Self potential, Inversion, Time domain, Hydraulic conductivity, Specific storage, Streaming current coefficient