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Self-potential inversion for the permeability and streaming current coefficient using the rock physical empirical law

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Recently, several quantitative analysis methods of Self-Potential (SP) profile have been developed for the estimation of groundwater flow. SP is a function of the permeability, the streaming current coupling coefficient and the electrical conductivity in the subsurface. For the accurate analysis of SP data, it is, therefore, important to have the rock physical relationship between these parameters either theoretically or empirically. The integration of the rock physical relationship, however, in the analysis of SP data has not been tried. It is known that the streaming current coefficient and permeability satisfy an empirical power law relationship regardless of the soil and rock types. We used this empirical law as the rock physical relationship to integrate our inversion method. Our inversion modifies both the permeability structure and streaming current coefficient according to this power law. For the test of our inversion program, we used the SP profile numerically simulated on the heterogeneous model of permeability, streaming current coefficient and electrical conductivity structure. Our inversion program successfully reconstructed the given permeability structure and streaming current coefficient structure from the calculated SP profile. From our result, we conclude that both permeability and streaming current coefficient structure, which includes the information of zeta potential, can be estimated from the SP profile and a priori estimated electrical conductivity structure.

キーワード: Self-Potential, Inversion, Permeability, Streaming current coefficient
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