Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)


AGE03-03 会場:213 時間:4 月 30 日 10:30-10:45

# 不飽和層の影響を考慮した透水係数推定のための自然電位分布逆解析手法の研究
# Self-potential inversion for the estimation of hydraulic conductivity in the presence of unsaturated zone

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Self-potential (SP) is the electrical potential naturally generated in and on the earth. The positive electrical charge in the diffuse layer of the electrical double layer is conveyed by the groundwater flow. The electrical potential is generated when the groundwater flow through the porous medium. This electrical potential directly reflects on the Darcy velocity in the porous material, and therefore the hydraulic conductivity can be estimated from the SP data. The hydraulic conductivity has non-linear characteristics as functions of the water saturation, and so does SP. These features suggest that the effect of the unsaturated zone should be considered for much quantitative analysis of SP. However, the dependency of the SP on the water saturation makes the development of inversion difficult. We solved this problem with the adjoint state method for the calculation of the sensitivity matrix that could save the calculation time. The characteristic of water saturation in SP based on Van-Genuichen model is adapted to our inversion. We applied our inversion to a synthetic SP profile to test the performance of our inversion scheme to compare the results with and without the consideration to unsaturated zone. When the effects of the unsaturated zone are not considered, the value of estimated hydraulic conductivity is underestimated. On the other hands, more accurate image could be derived from the inversion with the consideration to the unsaturated zone. Therefore, our inversion technique would allow us to obtain the accurate hydraulic conductivity structure from SP data at the ground surface, although the SP is affected by the distribution of saturation.

キーワード: 自然電位, インバージョン, 透水係数, 不飽和層
Keywords: Self potential, Inversion, Hydraulic conductivity, Unsaturated zone