Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

STT13-03 会場:102A 時間:5 月 27 日 14:45-15:00

Reliability of hydraulic conductivity and specific storage structures estimated by Self - potential inversion.

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The objective of this study is evaluation of reliability of estimated hydraulic conductivity and specific storage structure from self-potential (SP) data under the realistic condition. The hydraulic conductivity and specific storage could be estimated from a transient SP inversion with the information of flux data. We have demonstrated that these parameters could be estimated with high resolution numerically in ideal case such that the required data is enough and artificial structure can be negligible. However, such condition is rarely satisfied in many field cases. As one of difficulties, the lack of flux data is assumed. The sampling rate of the measurement of flux data could be too low because of the difficulty of measurement. We adopt the spline interpolation to a sparse sampling data, and evaluate the reliability of estimated image using numerical tests. We calculate the SP signals following to the fluctuated pumping rate. We use the calculated SP signals with same sampling rate as calculation as an input data in the numerical test. The down sampled flux data is assumed to be the measured data in the test. Our numerical test shows that both hydraulic conductivity and specific storage structure can be estimated correctly from the interpolated deficient flux data with the trend almost same as the true variation. When the interpolated deficient flux data does not reconstruct the trend of the true variation, only the hydraulic conductivity structure can be estimated with low resolution while the specific storage could not be estimated at all.

In addition to the lack of flux data, the existences of artificial structures are also the obstacles for the SP inversion in a real field. For example, a high-conductive metallic casing pipe leads the SP signal far from the SP source without decrease of the electrical potential. Therefore, the estimated image ignoring this effect would be biased. We also evaluate this effect by numerical tests. The SP singles affected by the metal casing are used for the inversion test without considering the effect. Both hydraulic conductivity and specific storage near the metal casing in the inversion image are estimated to be a little lower than those of the test model. In addition, the strong artifact appears in the estimated image of specific storage. From these results, we conclude that the estimated image of hydraulic conductivity structure is robust under such unrealistic conditions. For the correct estimation of specific storage structure, the flux data with high quality is necessary.

キーワード: Self potential, Inversion, Hydraulic conductivity, Storage coefficient, Metal casing, Interpolated data
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