On the Reliability of Constraining Surface Conductivity through Induced Polarization Measurements

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# Abstract

In the last several decades, substantial advancements have been made in understanding the induced polarization (IP) method, leading to improvements in the interpretation of hydraulic properties from electrical measurements. Separating out the effect of surface conduction from conduction via the electrolyte filling the interconnected pore spaces has been a major challenge in the interpretation of field-scale electrical resistivity datasets. Certain mechanistic models have proposed that this limitation can be overcome by utilizing the coefficient that describes the ratio between IP measurements and surface conductivity. Although a clear proportionality between IP measurements and surface conductivity is observed in many datasets, there is considerable variability in this proportionality coefficient when examining different types of sediments and rocks. Here, we examine the variability in the coefficient using a broad dataset of both published and unpublished samples consisting of unconsolidated sediments, consolidated sandstones, carbonates and mudstones. While our observations indicate that IP provides a valuable field-scale proxy of the surface conductivity, using it to quantitatively improve the prediction of petrophysical parameters, such as the electrical formation factor, remains a significant challenge.