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Use of the spectral induced polarization method to characterise hydrological parameters: Results from laboratory measurements for a range of sandy materials under saturated conditions

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Amongst all common geophysical exploration techniques, electric and electromagnetic methods have arguably the greatest sensitivity to hydrological relevant parameters. Of particular interest in this context are induced polarisation (IP) measurements, which essentially capture the capacity of a probed subsurface region to store electrical energy in terms of local charge accumulations. In the absence of metallic conductors the IP response of fluid-saturated porous rocks is largely affected by current flow in the vicinity of grain surfaces. This offers the perspective to link such measurements, in particular if performed in a spectral manner, to the grain diameter and/or the specific surface of the pore space. Hence, at least for unconsolidated sediments, the approach should allow for first-order estimates of the permeability structure. While the IP effect is reasonably well explored through laboratory experiments and in part verified through field data for clay-rich environments, the applicability of IP-based characterizations to clay-poor aquifers is not clear. In order to improve our understanding of the nature and origin of spectral IP (SIP) signals in such environments as well as their correlation with pertinent hydrological parameters, various laboratory measurements have been conducted. In doing so, we consider saturated quartz samples with a grain size spectrum varying from fine sand to fine gravel, that is grain diameters between 0.09 and 5.6 mm, as well as corresponding pertinent mixtures. While the employed current frequencies range from between 1 mHz to 45 kHz, particular attention in re-

lating the SIP response and grain size characteristics is given to the lower part of the spectrum relevant for field measurements.