Hydrology and Earth System Sciences Discussions

Interactive comment on "Impact of controlled changes in grain size and pore space characteristics on the hydraulic conductivity and spectral induced polarization response of "proxies" of saturated alluvial sediments" *by* K. Koch et al.

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General comment This discussion paper presents some high quality spectral induced polarization and grain size hydraulic conductivity datasets that have been collected following a systematic variation of physical properties of artificial alluvial soils. This nicely collected dataset deserves to be published as it yields further phenomenological

insights into the relationship between SIP measurements/parameters and soil grain size characteristics and hydraulic properties. However, I have identified some specific technical issues that I feel must be addressed prior to publication: 1. Cole-Cole type interpretations of SIP spectra go a lot further back than Vanhala (1997) – suggest referring to classic Pelton et al (1978) paper on the subject 2. Reference to Wenner-type spacing is misleading and should be changed. Wenner configuration is based on point electrodes and the Wenner geometric factor used to convert resistances to resistivity is based on point electrodes. This geometric factor is not correct for your samples and I hope it was not used. 3. How was surface area calculated from the laser particle size analyzer? Your work is a bit confusing in that you repeatedly talk about surface area whereas it is surface area to pore volume that is the parameter sensitive to hydraulic conductivity. Your figure 4 suggests that you have normalized your surface area to a volume – but what volume, and how do you get to this from the laser particle size analyzer measurements? 4. Compaction will increase surface area per unit volume but not total surface area. Throughout the paper be careful in that you should be considering surface area to pore volume or total volume rather than just surface area measured with your laser particle size analyzer. This needs to be clarified on page 6066. Also, make it clear that the discussion of changes in surface area that you are referring to here were not measured changes in surface area using your laser diffraction approach. Similarly, it is surface area to pore volume that is assumed to represent the inverse of hydraulic radius in Kozeny-Carmen type models for hydraulic conductivity characterization and not simply surface area as measured with the particle size analyzer. Perhaps you realize this, but this is not clear from the text of the paper. 5. Why do you consider it "interesting" and (apparently) "surprising" that the measured K values (using a constant head test) provide a stronger correlation with sample time constant than if K is estimated from grain size parameters? Of course, grain size parameters often provide poor estimates of K as they are so simple in terms of formulation, so would this result not be expected? Binley et al. (2005) already pointed out that time constant appears to be better correlated with K than with other

measures of the interfacial surface (e.g. surface area) and discussed this interesting observation. Some reference to this is probably warranted.