May macropores increase contaminant retention?

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Preferential flow is quite usual in natural environments. Non-uniform and preferential flows coexist or alternate, impacting water transport and contaminant transfer through the vadose zone. In this study, we investigated how macropore-induced flow affects manufactured nanoparticles, as emerging contaminants reactive transfer. Previous studies showed that the presence of a macropore into water-saturated soil columns can foster preferential water flow within the macropore. One could expect that this preferential flow may increase contaminant transfer and reduce retention by the matrix in the case of contaminant, as previously reported. In this study, we injected pulses of silver nanoparticles to assess their transfer through sand columns with and without a macropore. Both systems (with and without macropore) were studied under similar conditions. An unexpected result was obtained: more nanoparticles were retained in the system with a macropore, i.e., with a preferential flow. This result is quite counter-intuitive. It appears that the relation between flow homogeneity and contaminant retention is not straightforward. Some possible explanations, related to chemical and physical kinetics, are put forward to explain the experimental results.