Updates on Treatment of Contaminants in Low Permeability Zones

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Abstract. After more than three decades of investments, management of historical chlorinated solvent subsurface releases remains a major technical challenge. Most recently it has been recognized that contaminants stored in low permeability layers can sustain dilute groundwater plumes long after sources in transmissive zones are depleted. Unfortunately, this scenario implies multiple decades of plume management and monitoring at thousands of sites. This research presents a laboratory-scale sand tank experiment that addresses storage, release, and treatment of contaminants in low permeability zones. A two dimensional sand tank with low permeability interbedded clay layers is flushed with water spiked with 100 mg/L fluorescein and bromide for 92 days. During this period, contaminants are attenuated by the clay layers. Subsequently, the tank is flushed with water only for 39 days, illustrating the effect of contaminant release from low permeability zones on effluent water quality. Next, contaminants in the tanks are treated by flushing the tank with alkaline persulfate solution for 8 days. This drives depletion of fluorescein in the heterogeneous media. Lastly, the tank is flushed with water only for 69 days to evaluate post treatment rebound of contaminant levels in the tank effluent. Effluent concentrations of fluorescein and bromide are presented as a function of time. In addition, images and in situ spectrophotometric measuremets of fluorescein concentrations are used to evaluate the fluorescein distribution through heterogeneous media during the four phases of the experiment. Results indicate that in situ treatment with alkaline persulfate was effective in depleting fluorescein in both transmissive and low permeability zones. Extrapolation of results to field-scale applications is constrained by a need to consider the ideality of the system used in the experiments.