Assimilation Capacity of Low-k zones

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Abstract. It has been recognized within groundwater remediation that subsurface media has the ability to absorb and degrade various materials, a process known as assimilative capacity. Within the realm of chlorinated solvents and other persistent contaminants there is a poor understanding of assimilative capacity of aquifers, specifically within low permeability (k) zones. Contaminants within low-k zones can back diffuse into transmissive (high-k) zones causing long term impacts on water quality and reversing many current remediation efforts within contaminated aquifers. Assimilation processes of low-k zones, including reaction and sorption, have been observed in field sites, but the inability to close the mass balance causes many uncertainties with the observed data. To overcome the limitation of field data we are conducting mathematical modeling and experimental laboratory studies. The mathematical model captures diffusion, sorption, and reaction processes. Laboratory studies will include both short-term and long-term column studies to validate the model and determine parameter values. For the research presented herein, short-term column reactor studies are being conducted to test initial aquifer conditions and sampling methods for future long-term studies (~3-5 years). The initial short-term studies will be conducted using inert (i.e., non-reactive and non-sorptive) laboratory media, modified with select reactive and sorptive agents, and using a model contaminant of tetrachloroethylene (PCE). Studies will evaluate two initial conditions: 1) a zero concentration boundary layer at the top with a uniformly-contaminated soil column, and 2) a zero initial-concentration throughout the soil column with a PCE-saturated boundary condition beneath the layer. In both cases, the soil within the column reactors will be amended with select reactants and sorbents. Contaminant concentrations above the low-k soils will be analyzed to determine the rate of contaminant release. In support of the short-term column studies, batch studies will be conducted to determine model parameter values and to allow for a larger matrix of treatments to be evaluated than would be feasible in the column experiments. The laboratory experiments and modeling described herein will advance our knowledge of the importance of assimilative processes and assist in determining the assimilative capacity of low-k zones.