Temporal Partitioning of a Chlorinated Solvent Release Between Transmissive and Low Permeability Zones

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Abstract. This paper explores the hypothesis that chlorinated solvent releases evolve temporally and spatially. A two-layer system is considered involving a transmissive layer (e.g. sand) situated above a low permeability layer (e.g. silt). A DNAPL like source is present in the transmissive layer at the upgradient edge of the model domain at the contact between the two layers. A constant source is active for 1000 days. Subsequently the source is shut off and the problem is studied for an additional 2000 days. Total contaminant mass in transmissive and low permeability layer along with total mass in selected profiles of the soil are evaluated. Calculations also take into account the effect of retardation. At 1000 days, with no retardation in the low permeability zone, 32% of the released contaminant mass is present in the low permeability layer. Given the same conditions and retardation factor of 10 in the low permeability zone, 58% of the released contaminant is present in the low permeability layer after 1000 days. Overall, the results illustrate that the nature of the problem evolves from one of dense non-aqueous phase liquids (DNAPLs) in the transmissive layer at early time to one of aqueous and sorbed phases in the low permeability layer at late time. Given that appropriate technologies for DNAPL versus contaminants in low permeability zones can be very different. Understanding the evolutionary status, a release can be a key factor in selecting remedies. Furthermore, results indicate that the distribution of contaminants in the low permeability zone evolves with time. This support an observation that the domain in which significant contaminant mass is present in low permeability zone is a subset of the overall plume. Critically, this observation suggests that treatment of contaminants in low permeability zones can be limited to a subset of the overall plume domain.