The Effect of Vadose Zone Heterogeneities on Vapor Phase Migration and Aquifer Contamination by Volatile Organics

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Organic vapors migrating through the vadose zone and inter-phase transfer can contribute to the contamination of larger portions of aquifers than estimated by accounting only for dissolved phase transport through the saturated zone. Proper understanding of vapor phase migration pathways is important for the characterization of the extent of both vadose zone and the saturated zone contamination.

The multiphase simulation code T2VOC is used to numerically investigate the effect of heterogeneties on the vapor phase migration of chlorobenzene at a hypothetical site where a vapor extraction system is used to remove contaminants. Different stratigraphies consisting of alternate layers of high and low permeability materials with soil properties representative of gravel, sandy silt and clays are evaluated. The effect of the extent and continuity of low permeability zones on vapor migration is evaluated. Numerical simulations are carried out for different soil properties and different boundary conditions.

T2VOC simulations with zones of higher permeability were made to assess the role of how such zones in providing enhanced migration pathways for organic vapors. Similarly, the effect of the degree of saturation of the porous medium on vapor migration was for a range of saturation values. Increased saturation reduces the pore volume of the medium available for vapor diffusion. Stratigraphic units with higher aqueous saturation can retard the vapor phase migration significantly.