Geophysical Research Abstracts
Vol. 12, EGU2010-13748, 2010
EGU General Assembly 2010

Assessing the fate of biodegradable volatile organic contaminants in unsaturated soil filter systems

Martin Thullner (1), Cecilia De Biase (1), Joanna Hanzel (1), Daniel Reger (1), Lukas Wick (1), Sascha Oswald (2), Manfred van Afferden (3), Axel Schmidt (4), Nils Reiche (4), and Sven Jechalke (5)

(1) Helmholtz Centre for Environmental Research - UFZ, Department of Environmental Microbiology, Leipzig, Germany (martin.thullner@ufz.de, +49 341 235451338), (2) Helmholtz Centre for Environmental Research - UFZ, Department of Hydrogeology, Leipzig, Germany , (3) Helmholtz Centre for Environmental Research - UFZ, Environmental and Biotechnology Centre, Leipzig, Germany, (4) Helmholtz Centre for Environmental Research - UFZ, Department of Analytical Chemistry, Leipzig, Germany, (5) Helmholtz Centre for Environmental Research - UFZ, Department of Isotope Biogeochemistry, Leipzig, Germany

The assessment of contaminant biodegradation in the subsurface is challenged by various abiotic processes leading to a reduction of contaminant concentration without a destructive mass removal of the contaminant. In unsaturated porous media, this interplay of processes is further complicated by volatilization. Many organic contaminants are sufficiently volatile to allow for significant fluxes from the water phase into the soil air, which can eventually lead to an emission of contaminants into the atmosphere. Knowledge of the magnitude of these emissions is thus required to evaluate the efficiency of bioremediation in such porous media and to estimate potential risks due to these emissions.

In the present study, vertical flow constructed wetlands were investigated at the pilot scale as part of the SAFIRA II project. The investigated wetland system is intermittently irrigated by contaminated groundwater containing the volatile compounds benzene and MTBE. Measured concentration at the in- and outflow of the system demonstrate a high mass removal rate, but the highly transient flow and transport processes in the system challenge the quantification of biodegradation and volatilization and their contribution to the observed mass removal.

By a combination of conservative solute tracer tests, stable isotope fractionation and measurements of natural radon concentration is the treated groundwater is was possible to determine the contribution of biodegradation and volatilization to total mass removal. The results suggest that for the investigated volatile compounds biodegradation is the dominating mass removal process with volatilization contributing only to minor or negligible amounts. These results can be confirmed by reactive transport simulations and were further supported by laboratory studies showing that also gas phase gradients of volatile compounds can be affected by biodegradation suggesting the unsaturated zone to act as a biofilter for contaminants in the soil air.