Geophysical Research Abstracts, Vol. 9, 10208, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10208

Biogeochemical modeling of constructed wetlands for large scale contaminated groundwater remediation

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Industrialised countries expose a huge number of locations with contaminated soil and groundwater. While active remediation by pump and treat or excavation of a such large number of sites is not economical, passive methods that utilise natural attenuation processes such as phytoremediation can help to mitigate the situation. Pre-conditions to apply such remediation strategies are detailed knowledge about the site, contaminants and attenuation processes. Constructed wetlands have been in use for wastewater treatment for a number of years. Plants offer the potential to enhance contaminant attenuation processes, e.g. by specific uptake of pollutants from the soil water and their storage in plant tissue or volatilization to the atmosphere, or by delivery of oxygen to inundated root zones by aerenchyma, allowing for aerobic biotransformation processes in the direct vicinity of roots. A major goal of the project SAFIRA (SAnierungs Forschung in Regional kontaminierten Aquiferen, i.e. remediation research in regionally contaminate aquifers) is to identify and quantify the processes leading to compartment transfer (groundwater - plant, groundwater - volatilization, groundwater – biodegradation, e.g.) in constructed wetlands at the mega site Leuna, Germany. A conceptual computer model is under construction that accounts for flow and transport in the variably saturated porous medium as well as biogeochemical change reactions. The most concentrated contaminants such as BTEX, MTBE and gasoline hydrocarbons and dissolved as well as mineral phase electron acceptors have to be considered. The influence of marsh plants on microbial activity, gas transport, water balance and contaminant fate in general is matter of investigation.