Geophysical Research Abstracts, Vol. 9, 07048, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07048

An integrated approach to assess in situ degradation of chlorinated ethenes in several geological units of a groundwater system

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Chlorinated aliphatic compounds are encountered as groundwater contaminants and constitute the most abundant group in the former industrial and lignite mining area of Bitterfeld/Wolfen, Germany. Recent evidences for the accumulation of dichloroethenes and vinyl chloride in the anaerobic contaminated geological units support the occurrence of reductive dechlorination as a key process for the depletion of chlorinated ethenes. In this study, several lines of evidence for in situ degradation of chlorinated ethenes were evaluated in both the Tertiary and Quaternary Bitterfeld aquifers over two years. The distribution of hydrogeochemical variables and chlorinated ethenes was characterized using multivariate analysis. The effective in situ degradation was assessed by stable isotope fractionation approach and biomarkers (16S rDNA) were employed to detect the presence and to investigate the distribution of specific halorespiring genera. In parallel, DGGE analysis was applied to analyze community composition changes in the contaminated aquifers. These changes were interpreted on the basis of the in situ geochemical variables and the contaminant concentration. The isotope fractionation analysis revealed that chlorinated ethenes were subjected to substantial biodegradation in both aquifers, despite the heterogeneous distribution of the compounds in the plumes. Taxon-specific investigation indicated the simultaneous presence of various halorespiring populations (*Dehalococcoides*, *Desulfuromonas*, *Dehalobacter*) in both aquifers. The bacterial community structure analysis combined with statistical analysis revealed that 56.3% of the changes could be attributed to the chlorinated ethenes concentrations. This integrated approach provided several lines of evidence for natural attenuation of the chlorinated ethenes in various

geological units.