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A comparison of different combinations of geochemical, microbiological and modelling methods to assess natural attenuation processes for site remediation at six chlorinated solvent field sites

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Monitored or enhanced natural attenuation (MNA/ENA) are becoming more and more accepted environmental management strategies for contaminated site remediation. Acceptance of MNA, suitable for plume remediation, by the responsible local authorities requires low risk, plume stability and documentation of accepted and sustainable attenuation processes, like biotic or abiotic degradation, sorption, volatilization or dispersion. ENA measures can be used for plume and source treatment, and generally require prognoses on treatment efficiencies with respect to meet site-specific remediation goals. To fulfill these MNA or ENA requirements multiple lines of evidence are necessary to evaluate the efficiacy of MNA or ENA as a potential remedy. The key properties of these proofs include charactierization and to some extent quantification of the site specific flow and transport regime, the spacial and temporal contaminant distribution, the geochemical situation and the identification of relevant and active NA processes. To meet all these quality assessment aspects, MNA and ENA site investigations are often based on a large variety of state-of-the art as well as innovative techniques.

Field investigations at the six sites, which have been studied in the framework of the German funding priority KORA (Retention and degradation processes to reduce contaminations in groundwater and soil) included geophysical approaches, application of direct-push devices and flux measurements by e.g. immission pump tests. To assess

the NA capacity geochemical data from redox and contaminant concentrations were combined with results from microcosm studies and molecular tools, e.g. PCR methods (polymerase chain reaction). Furthermore C and Cl isotope analysis were developed for source identification and to quantify degradation rates. To establish prognoses on NA duration and plume development, different site-specific analytical and numerical model approaches were applied. In addition numerical studies based on a virtual aquifer approach were used to evaluate monitoring and investigation concepts with respect to sufficient number of wells or utilization of erreneous data.

The presentation gives an overview and assessment of the various methodical combinations applied to investigate and assess NA at the six sites. Advantages and limitations of the different methods are discussed to delineate suitable method combinations for a cost-effective site investigation and assessment. The results shown are currently summarized in a guideline, which will be available by midth of 2008.