

ALTERNATIVE NATURAL ATTENUATION PROCESSES FOR CHLORINATED HYDROCARBONS: FACT OR FICTION?

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Natural attenuation surveys at sites contaminated with volatile chlorinated hydrocarbons (VOCl) such as PCE and TCE are usually aimed at obtaining evidence for the occurrence of reductive dechlorination. Extensive experience with VOCl-contaminated sites in Western Europe has shown that in almost 50% of the cases, the natural reductive dechlorination stalls at cis-dichloroethene (cDCE) or vinyl chloride (VC). Since these degradation products are more mobile and more toxic than the original contaminants, MNA is generally considered not to be a viable option for these cases.

Scientific research has shown that destructive processes other than biological reductive dechlorination may play a role in the natural attenuation of VOCl. Laboratory evidence has been presented for the anaerobic biological oxidation of cDCE and VC under several redox conditions. More recently, studies have shown that VOCl can also be degraded via abiotic reduction, a process involving iron(II)minerals. The relevance of these alternative natural attenuation processes is largely unknown since they are not considered in the traditional MNA surveys.

In a research project partly financed by SKB, a consortium of Tauw, the VU University Amsterdam, TNO and VITO is developing a toolbox for demonstrating the occurrence of these alternative NA processes. This toolbox consists of GCMS screening for alternative degradation products from abiotic reduction and of compoundspecific stable carbon isotope analysis for both processes.

In laboratory experiments, abiotic reductive dechlorination by a number of minerals is being investigated. Unexpectedly rapid reduction of PCE and TCE by iron sulfide (FeS) was observed, while several other minerals also resulted in significant dechlorination. The carbon isotope fractionation factors are presently being determined. The carbon isotope fractionation factors for anaerobic oxidation of VC and cDCE will be estimated using the kinetic isotope effect (KIE) method.

To determine the practical significance of these alternative NA mechanisms, six VOCl contaminated sites are being studied; the interpretation of the isotope results will be done with an isotope fractionation reactive transport model developed at the VU University Amsterdam.