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A MICROCOSM STUDY OF DEGRADATION OF CHLORINATED SOLVENTS FROM A CONTAMINATED AREA IN CENTRAL ITALY

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Abstract

Perchloroethene (PCE), Trichloroethene (TCE) and other chlorinated solvents are widespread groundwater pollutants. They are among the most common pollutants in industrial sites due to their extensive application in chemicals production, metal degreasing and dry cleaning. These compounds are environmentally persistent and carcinogenic.

PCE and TCE form DNAPLs that sink through permeable groundwater aquifers until non-permeable zone is reached. The typical resulting distribution of the DNAPL is highly complex and non uniform. Entrapped DNAPL mass tends to dissolve slowly into flowing water, serving as a long-term source of groundwater contamination. All these factors lead to a strong interest in the transformations occurring to these compounds in the environment and in remediation processes. Chlorinated solvents, once released into the environment, are subject to both chemical-physical and, in particular, microbial degradation. They often behave as electron acceptors because of their substituents' electronegativity, and then are reduced. In particular the Reductive Dehalogenation occurs mostly in compounds with a high number of halogen substituents (as Tetrachloroethene and Trichloroethene), which are totally unaffected by aerobic microorganisms.

In Italy many situations of serious contamination of groundwater that might compromise their use in industry, agriculture and private are present. These include the critical case of a Central Italy valley located in the province of Teramo ("Val Vibrata"), characterized by a significant contamination by chlorinated solvents.

Microcosms were prepared by using soil and groundwater samples from this contaminated site, by adding suitable elector donors and carbon source (lactate or butyrate) and a mineral medium containing resazurin, a metal solution and calcium, magnesium and potassium ions. In addition, some microcosms were inoculated with an anaerobic sludge from a wastewater treatment system. All the studied electron donors promoted enhanced dechlorination of chlorinated compounds. Several of live microcosms are positive for dechlorination, but only the amended ones, in particular. This indicates the presence of an active native dechlorinating population in the subsurface, but possibly insufficient. Microcosms bioaugmented with the anaerobic sludge dechlorinate PCE to DCE, Vinyl Chloride and also Ethene. In conclusion, this microcosm study indicate that in the contaminated site is possible an Enhanced anaerobic dechlorination of PCE and TCE, through an appropriate addition of electron donors and/or through bioaugmentation with dechlorinating cultures, even originating from an anaerobic sludge.