

In situ anaerobic transformation of trichlorofluoroethene in trichloroethene-contaminated groundwater

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ENVIRONMENTAL SCIENCE & TECHNOLOGY

35 (9): 1729-1735 MAY 1 2001

Abstract:

Methods are needed to obtain in situ information on the transformation rates of trichloroethene (TCE), the most commonly detected organic groundwater contaminant. The objective of this research was to investigate the potential for determining TCE transformation rates in groundwater by measuring the transformation rate of its fluorinated surrogate, trichlorofluoroethene (TCFE). To explore this hypothesis, the in situ transport behavior, transformation pathway, and transformation rate of injected TCFE were determined in TCE-contaminated groundwater using single-well, push-pull tests. Although transport behavior varied between wells, TCFE, dichlorofluoroethene (DCFE), and TCE were transported similarly to each other. In the shallow water-bearing zone, TCFE was reductively dechlorinated to cis-DCFE, trans-DCFE, and (E)-1-chloro-2-fluoroethene (CFE), while co-injected TCE was concurrently transformed to cis-dichloroethene (DCE), trans-DCE, 1,1-DCE, and a trace amount of chloroethene (CE). With added formate and the injected TCFE concentration being a factor of 20 higher than that of TCE, the TCFE transformation rate ranged from 0.053 to 0.30 $\mu\text{mol/L-day}$, while that of TCE ranged from 0.009 to 0.012 $\mu\text{mol/L-day}$. Without added formate, the TCFE transformation rate decreased to 0.036 $\mu\text{mol/L-day}$. In the deeper water-bearing zone, TCFE transformation occurred only after a lag time of 55 days with added formate. No TCFE transformation occurred in groundwater that had not previously been exposed to TCE. The potential applicability for TCFE as an in situ transport and transformation surrogate for TCE was demonstrated.