

ABSTRACT

The relative concentrations TBA to MTBE in ground water samples from a gasoline spill site in Orange County, California suggested that MTBE was being transformed to TBA. In some of the most heavily contaminated wells, the concentration of TBA was higher than the concentration of MTBE (MTBE 2 $\mu\text{g/L}$ and TBA 40,000 $\mu\text{g/L}$; MTBE 3 $\mu\text{g/L}$ and TBA 14,300 $\mu\text{g/L}$; MTBE <1 $\mu\text{g/L}$ and TBA 1730 $\mu\text{g/L}$). Stable carbon isotope analysis of MTBE in groundwater from these wells indicated that MTBE was being biologically degraded ($\delta^{13}\text{C} = +27.0\text{‰}$, -18.63‰ and -15.0‰ respectively). In one heavily contaminated well at the site, the concentrations of MTBE and TBA were essentially equivalent (MTBE 1840 $\mu\text{g/L}$ and TBA 1660 $\mu\text{g/L}$), and there was no evidence from stable carbon isotope analysis that MTBE had been biodegraded ($\delta^{13}\text{C} = -28.9\text{‰}$). Sediment was collected from the site for a microcosm study. Microcosms were prepared in an anaerobic glove box under an atmosphere containing 5% to 7% hydrogen. They were incubated at room temperature. The removal of MTBE in the microcosms was rapid; within two months the initial concentration of MTBE (1300 $\mu\text{g/L}$) was depleted to the analytical detection limit (<3 $\mu\text{g/L}$). The first order rate constant of MTBE biodegradation was 25 ± 4 per year at 95% confidence level. As the MTBE was removed from the pore water of the microcosms, an equivalent amount of TBA was produced. After complete removal of the MTBE, the pore water in the microcosms contained low concentrations of methane (0.17 mg/L) and high concentrations of sulfate (390 mg/L). As MTBE was removed during the incubation, ^{13}C was enriched in the remaining MTBE. The value of $\delta^{13}\text{C}$ in MTBE in the microcosms increased from -29.7‰

to +40 ‰ during depletion of MTBE in the microcosms. The isotopic enrichment factor ϵ was -8.5 ± 3.6 ‰ at 95% confidence level, and the most negative enrichment factor estimated in this study was -13.4 ‰, which is close to the value (-13 ± 1.1 ‰) reported in recent studies. There was no evidence of TBA biodegradation in the microcosms.