# SEASONAL CHANGES IN REDUCTIVE DECHLORINATION AND DETECTIONS OF DEHALORESPIRING BACTERIA IN WETLAND SEDIMENTS

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Reductive dechlorination is a major natural attenuation process for plumes of chlorinated ethanes and ethenes that are discharging through anaerobic wetland sediments along West Branch Canal Creek and Lauderick Creek at Aberdeen Proving Ground, Maryland. An understanding of seasonal changes in reductive dechlorination rates and in associated microbial communities is necessary to evaluate natural attenuation and enhanced bioremediation remedies for the plumes in this shallow environment. The natural spatial and seasonal distribution of dehalorespiring bacteria, including *Dehalococcoides ethenogenes*, and the importance of these bacteria relative to other bacteria and methanogens in controlling biodegradation rates in different environments is poorly understood. Microcosms were constructed with wetland sediment collected from the West Branch Canal Creek site in late winter/early spring, summer, and fall to examine seasonal changes in biodegradation of 1,1,2,2-tetrachloroethane (TeCA) and its anaerobic daughter products, 1,1,2-trichloroethane, 1,2-dichloroethane, trichloroethene, 1,2-dichloroethene, and vinyl chloride. Surficial wetland sediment samples were collected seasonally from about 20 locations at the West Branch Canal Creek site and the nearby Lauderick Creek site for molecular analyses using specific primers targeting dehalorespiring bacteria of the *Dehalococcoides* group and the acetate-oxidizing *Desulfuromonas* group.

First-order degradation rate constants for TeCA were greatest in the late winter/early spring microcosms (maximum of 0.16±0.05 per day) and lowest in the summer microcosms (maximum of 0.06±0.03 per day). Slower biodegradation of the daughter products also occurred in the summer microcosms compared to the late winter/early spring microcosms. Molecular analyses of bacterial (16S rDNA) and methanogen communities in the wetland sediments showed generally lower microbial biomass and microbial diversity in the summer than in the winter/early spring. However, targeted molecular analyses for the presence of dehalorespiring bacteria were negative for most sediment samples collected in the winter/spring, whereas positive detections were observed for the same sites in the summer. Although production and degradation of the daughter product vinyl chloride occurred in both the winter/early spring and summer microcosms, a seasonal change in the predominant microbial species or group involved in vinyl chloride production and degradation was indicated by a change in the association between methane and vinyl chloride. Vinyl chloride production and degradation was associated with the onset of rapid methanogenesis in the late winter/early spring and fall microcosms, whereas vinyl chloride production and degradation occurred without significant methane production in the summer. Because methanogens compete for the supply of hydrogen as a substrate, the dehalorespiring bacteria may have been more active in the summer when methanogen activity and biomass were low. Despite the positive detections and possible greater activity of dehalorespiring bacteria in the summer, lower biodegradation rates of TeCA and its chlorinated daughter products were observed. These results have important implications for bioremediation of chlorinated solvents in natural and constructed wetlands, and in other shallow environments where seasonal variations in microbial communities may occur.