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Monitoring and Enhancing Anaerobic Benzene Biodegradation in Groundwater Systems

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Background/Objectives. Benzene is a component of crude oil and common industrial chemical. As a result of widespread use, it is also a prevalent groundwater contaminant. Because it is a human carcinogen, drinking water concentrations are strictly regulated. Despite the relative persistence of benzene in groundwater plumes compared to many other petroleum components, particularly at anaerobic sites, monitored natural attenuation remains a cost-effective method, mostly relying on biodegradation. Microbial cultures have been enriched that are capable of degrading benzene in the absence of oxygen. The key organisms in these cultures have also been identified, and these appear to belong to relatively restricted phylogenetic groups. There is considerable interest in developing biomarkers to confirm and monitor *in situ* biodegradation of benzene. However, there is currently scarce evidence linking the presence of benzene-degrading organisms and biodegradation potential. In the current study, we aim to establish clear links between benzene-degrading activity and the presence of microbes known to degrade benzene anaerobically.

Approach/Activities. Our laboratory has enriched several microbial consortia that are capable of degrading benzene under different terminal electron-accepting conditions. In the current study, we are in the progress of scaling up these cultures by periodic transfer into static anaerobic bioreactors for a future pilot-scale bioaugmentation study. We are also using microcosm studies with materials from hydrocarbon-contaminated sites to monitor benzene degradation with or without bioaugmentation. These studies will help to establish links between rates of degradation and microbial community composition and abundance of key species, using quantitative PCR methods to track known benzene-degrading organisms.

Results/Lessons Learned. To date, we have established methods to monitor known anaerobic benzene degraders present in our laboratory cultures or reported in the literature using qPCR. Ongoing microcosm studies will reveal additional correspondence between activity and the presence of targeted molecular biomarkers. We are in the process of scaling-up the benzene-degrading culture to volumes and cell numbers suitable for pilot scale bioaugmentation trials at contaminated sites. Results from this study will provide better tools for monitoring and enhancing in situ biodegradation of benzene and for managing petroleum hydrocarbon contaminated sites.