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Bioremediation of an Organically Contaminated Bedrock Aquifer

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research BRIEF

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As annual water consumption increases and more subsurface water resources are tapped to capacity, the interest in reclaiming contaminated groundwater becomes greater. Bacterial biodegradation is a cost-effective means of cleaning up contaminated aquifers where substances, such as pollutants, are broken down through bacterial action into different, and often less harmful, components. The objective of my senior thesis research was to determine if the addition of a supplemental organic carbon source (lactate) to an aquifer contaminated with chlorinated solvents, including trichloroethylene (TCE), improves bacterial biodegradation. I also looked at the effect of protists on the rate of bacterial biodegradation.

TCE is primarily released into the subsurface environment through improper disposal of waste from metal degreasing facilities. It has been found in some water supplies, and has the potential to cause health problems if its levels exceed those deemed safe by the Environmental Protection Agency (1). Protists are small organisms, typically 2–3 micrometers in size (in aquifers), known to prey on bacteria and conduct many functions common to larger organisms. This predation characteristic was critical to my research.

I conducted this research at Dr. Nancy Kinner's lab on the UNH campus, and at the Bedrock Bioremediation Center (BBC) field site at Pease International Tradeport in Portsmouth, NH. To simulate the groundwater environment, I created a glass microcosm consisting of weathered bedrock fragments suspended from the lid of a jar and placed it in an oxygen-free environment. It was in this context that I studied the bacterial and protistan population dynamics. TCE was added to the water daily, and sampling occurred every other day during Phase I of my research, and daily during Phase II.

The addition of lactate to the microcosm resulted in a decrease in total organic carbon (TOC) and TCE concentrations. This indicates that biodegradation of TCE does, in fact, require higher organic carbon levels than those in the natural environment. Although biodegradation occurred in the lactate-amended microcosms, the addition of carbon did not appear to have a significant effect on bacterial abundance. However, the overall protistan population did appear to decrease upon addition of the lactate. I suggest that future research focus on more frequent sampling, as I observed that microbe cycling may occur within hours.

I would like to acknowledge my advisor Nancy E. Kinner, Ph.D. for her continuous support and understanding. She dedicated numerous hours to my research both in its development and its execution. She never tired of answering my questions and provided endless guidance. Thanks also to the BBC crew, Stephen Druschel, Jennifer Jencks, Whitney Blanchard and Andy Rippert. They all provided great support, energy and enthusiasm throughout my research. Without their guidance and advice my research would not have been such an amazing experience for me. I would also like to acknowledge all of my friends who supported me through many days and nights of research. They never hesitated to help in any way I needed or to provide advice and support. I would also like to acknowledge my family, whose never-ending support was much needed. They provided me with the foundation I needed to continue this research and to strive to do my best.

REFERENCES

1. Consumer Fact Sheet on Trichloroethylene. U.S. Environmental Protection Agency. http://www.epa.gov/OGWDW/contaminants/dw_contamfs/trichlor.html (February 2006)

Author Bio

*A Rindge, NH native, **Maureen Lewis** graduated from UNH in December 2004 with a degree in environmental engineering and an emphasis on municipal processes. An interest in groundwater contamination inspired her to complete this research for her senior honors thesis, with funding provided by the Undergraduate Research Opportunities Program (UROP). "I learned that science is very dynamic and [scientific research] requires constant monitoring. It was unexpected to me how interesting the research would actually be and how attached to it I became…I would have loved to continue the research for longer." Maureen is now serving in the Air Force, as a member of the Civil Engineering Squadron in Mountain Home, Idaho. She hopes to pursue a graduate degree in an engineering discipline, and to someday travel the world.*

Mentor Bio

*Dr. **Nancy Kinner** is a professor of civil and environmental engineering at UNH, where she has taught since 1983. Working with Maureen marked the first time Dr. Kinner mentored a student conducting research through the Undergraduate Research Opportunities Program (UROP), and she found it to be a positive experience: "Maureen was a wonderful student and a delight to work with." Dr. Kinner specializes in environmental engineering and is the director of the Bedrock Bioremediation Center in Portsmouth.*