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When growing on methane and oxygen, methanotrophic bacteria possess a non-specific enzyme, methane monooxygenase, that has been shown to oxidize halogenated solvents in cell extracts. Methanotrophic bacteria were cultured in batch&column reactors to test their ability to oxidize a number of organic contaminants. Transformation pathways and rates will be determined using the instrumentation funded by OSR.

The fundamental concepts derived from laboratory experiments and data are being formulated into a computer biofilm model to predict regions in a contaminated subsurface where the proper environment occurs for contaminant biotransformation. This model will aid the design of biological in situ treatment processes that hold promise to permanently clean up contaminated aquifers.

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EDWARD J. BOUWER (301) 338-7437
THE DEPARTMENT OF GEOGRAPHY
AND ENVIRONMENTAL ENGINEERING

February 2, 1988

Major T.J. Cervemy
Program Manager
Life Sciences Directorate
Air Force OSR
Bollings Air Force Base
Washington, D.C. 20332-6448

Dear Major Cervemy:

I am grateful for the support awarded under the Department of Defense University Research Instrumentation Program entitled "Biotransformation of Hazardous Organic Pollutants" (Grant No. AFOSR-86-0215). The grant funds were exclusively used to purchase the following instrumentation:

Liquid Scintillation Counting System, Model 3801 $23,530
Manufacturer: Beckman Instruments
8920 Route 108
Columbia, MD 21045
Includes: CPM to DPM conversion on single or dual labelled nuclides, reverse coincidence monitor, and dual rack system for standard and minivials.

Gas Chromatograph/Mass Selective Detector System, Model 5970B $74,711
Manufacturer: Hewlett Packard Company
2 Choke Cherry Road
Rockville, MD 20850
Includes: Gas chromatograph, interface, mass selective detector, computer data station, system software, printer, and NBS mass spectral library.

Purge and Trap Sample Concentrator for GC/MSD, Model LSC-2 $6,816
Manufacturer: Tekmar Company
P.O. Box 37202
Cincinnati, OH 45222
Includes: Sample chamber, heated tenax trap, interface for GC/MSD, and timer control. This device introduces samples into the GC/MSD system.

Total Cost of Instrumentation:	$105,057
AFOSR Funds	$104,500
American Cyanamid Cost-Share	$557

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Recommend acceptance of final report. J Cervemy

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The Johns Hopkins University provided renovated laboratory space to house the above instrumentation at a cost of $100,000. The instrumentation purchased has greatly assisted our research program aimed at understanding biotransformation as a fate process for hazardous organic contaminants and to develop biological process treatment strategies for detoxification and destruction of hazardous wastes. Batch and biofilm column reactor studies that mimic contaminated groundwaters are being conducted to evaluate biotransformation potential of halogenated aliphatic compounds under conditions of denitrification, sulfate respiration, and methanogenesis. Several of the compounds are nearly completely transformed at concentrations around 10 ppb under methanogenic conditions. Fewer compounds degrade under denitrification. The GC/MSD and Liquid Scintillation Counter permitted identification of the major reaction pathway as reductive dehalogenation where a carbon-halogen bond is replaced with a carbon-hydrogen bond. The relative reduction potentials of the halogenated compounds is consistent with the relative rates of degradation observed in the biofilm columns. Efforts will continue to develop such structure-reactivity relationships.

When growing on methane and oxygen, methanotrophic bacteria possess a non-specific enzyme, methane monooxygenase, that has been shown to oxidize halogenated solvents in cell extracts. Methanotrophic bacteria are being cultured in batch and column reactors to test their ability to oxidize a number of organic contaminants. Transformation pathways and rates will be determined using the instrumentation funded by AFOSR.

The fundamental concepts derived from the laboratory experiments and data are being formulated into a computer biofilm model to predict regions in a contaminated subsurface where the proper environment occurs for organic contaminant biotransformation. This model will aid the design of biological in situ treatment processes that hold promise to permanently clean up contaminated aquifers. Various scenarios of nutrient and substrate addition could be evaluated with the model.

Continued use of the instrumentation in our research aims to provide information on transport and fate of different classes of organic pollutants, such as halogenated phenols, pesticides, and petroleum hydrocarbons. An exploratory study will begin in March 1988 to test the ability of extremely thermophilic archaebacteria to degrade several model organic contaminants. The higher temperature should greatly enhance transformation rates. The results might eventually lead to biological treatment processes useful for handling toxic organic contamination. The outcome is beneficial to Department of Defense and the engineering community in their quest to control organic contamination in the environment.

With research support becoming difficult to obtain, I greatly appreciate the AFOSR Grant as it has allowed me to be much more productive in the most critical area of my research. Thank you for DoD support and consideration for future funding.

Sincerely,

Edward J. Bouwer
Assistant Professor

cc: Dr. M. Gordon Wolman, Chairman