Environmental & Engineering Geologists Meeting,
Wednesday, November 12, 1997 • Rice University • 6:30 p.m.

THE 1997 NATIONAL GROUND WATER ASSOCIATION'S HENRY DARCY DISTINGUISHED LECTURE:
Water, Microbes, and Rocks: The Geochemical Ecology of Contaminated Ground Water.

by Dr. Philip C. Bennett,
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Chairman's Note: This lecture will be held at Rice University's Duncan Hall. A reception in Dr. Bennett's honor will be given at 6:30, with the lecture beginning at 7:00. Please park in visitor parking near the stadium and take the campus shuttle bus to Duncan Hall.

Preview of Talk

Understanding biodegradation of contamination in ground water and soils is vital to staying current in today's environmental geology and engineering workplace. Dr. Philip Bennett of the Univ. of Texas at Austin Department of Geosciences introduces the fundamentals of microbial degradation of hydrocarbons in this lecture, but then delves deep into the geochemical changes in the aquifer and explores the implications of microbial activity upon the weathering of silicates. The presentation will feature excellent visual presentations and some humorous learning devices. A real site where a crude oil pipeline ruptured spilling thousands of gallons of crude oil into the environment, will be analyzed.

Dr. Philip Bennett is a top-notch scientist receiving rave reviews on his outstanding presentation. You are invited to attend The Henry Darcy Distinguished Lecture which is fully funded by the National Ground Water Association and Association of Ground Water Scientists and Engineers (NGWA/AGWSE) to foster interest in ground water at the academic level. This free lecture also sponsored by the Rice University's Energy & Environmental Systems Institute (EESI) and the Houston Geological Society's Environmental & Engineering Geologists Committee.

ABSTRACT

When an organic substance, either natural or anthropogenic, infiltrates into an aquifer it becomes a component of a dynamic bio-geochemical system. From the perspective of the subsurface microbe, these compounds may be benign, toxic, or a rich source of carbon in an otherwise carbon-poor environment. Microbes consume this carbon, producing energy, cell mass, and geochemically reactive byproducts. The transformation of organic toxicants by native microorganisms, sometimes known as intrinsic bioremediation, is considered one of the most promising remediation approaches for contaminated ground water. From a geologic perspective, however, rapid metabolic transformation of organic substances also results in dramatic changes in the geochemical ecology of that aquifer, changing the native microbial consortia, aquifer mineralogy and permeability, vadose-zone gas composition, and water chemistry.

This lecture will examine the geology and geochemistry of microbial transformation of hydrocarbons using laboratory experiments, geochemical modeling, and field observations of contaminated aquifers, including results from the collaborative U.S. Geological Survey's Bemidji research program. Hydrocarbon degradation produces bicarbonate, acidity, and organic waste products, potentially changing the bulk geochemistry of the aquifer over wide areas, or more subtly, producing reactive micro-environments near attached microbes. How does oil degrade in ground water, what are the degradation byproducts, and what is the nature of the micro-environment created around an attached microbe? Are these biogeochemical reactions a significant contribution to subsurface mineral diagenesis? Is mineral weathering enhanced only by surface colonizing microbes, or do microbes affect equilibria by altering "bulk" pore-water chemistry? Do microbes colonize mineral surfaces in order to leach necessary nutrients, or is colonization controlled by surface charge and surface roughness? The goal of this lecture is to examine the geochemical consequences of subsurface microbial processes.

BIOGRAPHICAL SKETCH

Dr. Philip C. Bennett is an associate professor in the Department of Geological Sciences at the University of Texas at Austin. He received a B.S. from Evergreen State College; an M.S. in environmental science from the State University of New York College of Environmental Science and Forestry, and a Ph.D in geology from Syracuse University. Since 1984 Dr. Bennett has been working at the U.S. Geological Survey's Bemidji research site as part of the multidisciplinary "Toxic Substances Hydrology Program." His research projects at the University of Texas include silicate weathering kinetics, vadose zone gas transport and chemistry, geochemical fate of high explosives, sediment transport in karst aquifers, reactive solute transport in fractures, and computational quantum-chemical descriptions of silicate surfaces.