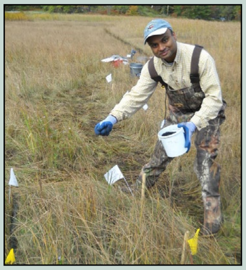
Superfund Research Program

Individual Projects to Address Biogeochemical Interactions

R01ES024284 — University of Maryland, Baltimore County
Upal Ghosh, Ph.D., ughosh@umbc.edu

Development of In-situ Mercury Remediation Approaches Based on Methylmercury Bioavailability



Ghosh tests his remediation approach in a New England tidal marsh.
(Photo courtesy of Upal Ghosh)

Researchers are developing an empirical model of the factors influencing mercury and methylmercury bioavailability in contaminated areas. Using this model, they plan to identify biogeochemical characteristics that make sites suitable for remediation with sorbent remediation approaches, such as activated carbon amendments. The researchers will also design sorbent amendment/thin capping strategies that reduce methylmercury bioavailability. The main study site is a salt marsh in Berry's Creek, New Jersey, where they are conducting a field trial of in situ sorbent remediation using activated carbon and also evaluating the relative efficacy of a wider range of black carbons.

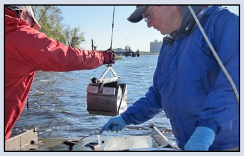
R01ES024255 — University of California, Berkeley
Lisa Alvarez-Cohen, Ph.D., alvarez@ce.berkeley.edu

Metabolic Interactions Supporting Effective TCE Bioremediation Under Various Biogeochemical Conditions

Scientists are using a combination of molecular, biochemical, and analytical tools to evaluate how microbes used for trichloroethene (TCE) bioremediation interact with co-existing organisms in various geological, chemical, and biological conditions. The researchers are constructing simplified groups of microbes living symbiotically that they will expose to stresses such as changes in pH and salinity as well as the introduction of potential competitive electron acceptors to the system (e.g., sulfate ions) to see how TCE bioremediation is affected. They will also combine intercellular data gained from both microarray and RNA sequencing techniques to develop mechanistic models that describe the effects of geochemical parameters on bioremediation.

R01ES024245 — Virginia Institute of Marine Science
Michael Unger, Ph.D., munger@vims.edu; **Aaron Beck, Ph.D.,** abeck@vims.edu

Impact of Groundwater-surface Water Dynamics on In-situ Remediation Efficacy and Bioavailability of NAPL Contaminants



Unger (left) measures PAH bioavailability on Elizabeth River sediments with Elizabeth River Project collaborator Joe Rieger (right). *(Photo courtesy of George Vadas)*

Researchers are developing new techniques to evaluate and quantify the biogeochemical mechanisms controlling the transport from sediment to water, and bioavailability of DNAPLs and dissolved hydrophobic compounds within groundwater and at the groundwater-surface water interface. They are also testing the hypothesis that advection dynamics and seawater intrusion increase bioavailable PAH flux and NAPL transport in permeable cap materials used for in situ remediation at contaminated sites in the Elizabeth River in Virginia.

Progress in Research

The National Institute of Environmental Health Sciences (NIEHS) Superfund Research Program (SRP) funds a wide range of university-based research to address public health concerns arising from hazardous substances in the environment. In addition to funding multiproject center grants and small business grants, the SRP has an individual research grant program (R01) to address specific pressing issues.

In 2013, the NIEHS SRP initiated a targeted research program to better understand how contaminants in the environment are affected by complex biological, geological, and chemical processes. By understanding these complex interactions, we are better equipped to optimize remediation strategies and, therefore, improve science-based decision making for site management, priority-setting, and remedy selection. The following eight grants support for problem-solving research on the mechanisms of biogeochemical interactions that may impact remediation of contaminated soil, sediment, surface water, or groundwater.

NIEHS Contacts:

Heather Henry, Ph.D.
Program Administrator
Superfund Research Program
henryh@niehs.nih.gov
919-541-5330

William Suk, Ph.D.
Director
Superfund Research Program
suk@niehs.nih.gov
919-541-0797

Legislative Authority:

Section 311(a) of the Superfund Amendments and Reauthorization Act (SARA) of 1986.

R01ES024344 — Duke University; Heileen Hsu-Kim, Ph.D., hsukim@duke.edu

Biogeochemical Framework to Evaluate Mercury Methylation Potential During In-situ Remediation of Contaminated Sediments

Scientists are studying sediment dwelling microorganisms that methylate mercury, and identifying factors that may be used to control and reduce toxic methylmercury production. The research is focusing on two critical drivers of methylmercury production: the environmental conditions that promote the growth of sediment microorganisms that produce methylmercury and the processes that influence the bioavailability of mercury for these microorganisms. The researchers are working at the Berry's Creek Study Area, a site in New Jersey with historical mercury contamination, as well as other sites to implement the research, interpret results, and establish a guiding framework for assessments at specific field sites and the selection of remediation strategies.

R01ES024313 — University of California, Riverside; Jay Gan, Ph.D., jgan@ucr.edu**; Daniel Schlenk, Ph.D.,** daniel.schlenk@ucr.edu

Exploring the Importance of Aging in Contaminant Bioavailability and Remediation

Researchers are developing a simple method for measuring and accounting for contaminant aging in risk assessments and remediation. They will apply the method to sediment samples collected from various depths (reflecting deposition at different historical times) and locations (reflecting different sediment properties) at the Palos Verdes Shelf Superfund site off the Los Angeles coast. Sediments at this site contain high levels (up to 200 mg/kg) of DDTs and PCBs deposited from as far back as 60 years ago.

Los Angeles County Sanitation District staff work with University of California, Riverside researchers to collect sediment samples in the Palos Verdes Shelf. *(Photo courtesy of Jay Gan)*

R01ES024279 — Johns Hopkins University; Edward Bouwer, Ph.D., bouwer@jhu.edu

Dual-biofilm Reactive Barrier for Treatment of Chlorinated Benzenes at Anaerobic-Aerobic Interfaces in Contaminated Groundwater and Sediments

Scientists are evaluating a novel technology — a flow-through barrier containing granular activated carbon coated with anaerobic and aerobic microorganisms — to see if it can completely break down chlorobenzenes and benzene contaminants, which are known or suspected carcinogens. The researchers seek to understand the environmental processes and conditions that influence interactions among contaminants and the barrier to improve its effectiveness in contaminated groundwater. Laboratory and field tests are being conducted at the Standard Chlorine of Delaware, Inc. Superfund site where dense non-aqueous phase liquid (DNAPL) chlorobenzene contamination is present in wetland sediments and groundwater.

R01ES024294 — University of Tennessee; Frank Loeffler, Ph.D., frank.loeffler@utk.edu

Biogeochemical Controls Over Corrinoid Bioavailability to Organohalide-Respiring Chloroflexi

The research team is designing and validating the B12-qChip — an innovative, high-throughput quantitative PCR tool — that can be used to recognize when the bioavailability of nutrients called corrinoids limit the ability of chloroflexi bacteria to dechlorinate solvents such as tetrachloroethene (PCE) and TCE. Using samples from Third Creek, a polluted creek in Knoxville, Tennessee, they are conducting detailed studies that combine cultivation-based approaches, high-throughput sequencing, bioinformatics analyses, and state-of-the art analytical procedures to reveal the best biogeochemical conditions for bioremediation.

R01ES024358 — Colorado School of Mines; James Ranville, Ph.D., jranvill@mines.edu

Investigating Biogeochemical Controls on Metal Mixture Toxicity Using Stable Isotopes and Gene Expressions

The research team is developing and refining techniques — including environmental molecular diagnostics and stable isotope assays — used to detect, assess, and evaluate the bioavailability of metals that occur in mixtures and can be taken up by aquatic organisms, including nickel, zinc, copper, and cadmium. They will test these approaches in a metals-contaminated stream at the North Fork Clear Creek Superfund site in central Colorado. This project will improve knowledge on the risks posed by mixtures of contaminant metals.

Ranville's team places the clean river rocks (shown here) in a contaminated stream at the North Fork Clear Creek Superfund site to study rates of metal deposition in experimental plots. *(Photo courtesy of James Ranville)*

For more information on the National Institute of Environmental Health Sciences, visit **www.niehs.nih.gov**.

For more information on SRP, visit **www.niehs.nih.gov/srp**.

To read more about the individual research projects, visit **http://1.usa.gov/1AppLZg**.