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EDUCATION

University of California, Davis, CA	Chemical Engineering	B.S. 1992.
University of Wisconsin, Madison, WI	Civil-Environmental Engineering	M.S. 1995
Stanford University, Stanford, CA	Civil-Environmental Engineering	Ph.D. 2000
Stanford University, Stanford, CA	Geological and Environmental Science	Postdoc 7/00-4/01

ACADEMIC POSITIONS AND APPOINTMENTS

Carnegie Mellon University, Pittsburgh, PA.
Department of Civil and Environmental Engineering

Professor (7/09-present)

Deputy Director Center for Environmental Implications for NanoTechnology, CEINT (8/08-present)

Associate Professor (7/06-present)

Assistant Professor (7/01-6/06)

Research and teaching in civil and environmental engineering with an emphasis on the sustainable development of nanomaterials and nanotechnologies including the fate, mobility, and toxicity of nanomaterials in the environmental, remediation/treatment technologies employing nanomaterials, nanoparticle-contaminant/biota interactions, and sustainable energy via carbon capture and storage.

Stanford University, Stanford, CA.
Department of Geological and Environmental Sciences

Post-Doctoral Researcher (7/00-4/01) with Gordon E. Brown, Jr.

Investigated the physical/chemical characteristics of HgS nanoparticles and Hg-bearing colloids released from abandoned Hg mines in the California Coast Range using a variety of analytical and spectroscopic techniques (BET, DLS, EXAFS, TEM, SEM, and FTIR).

Department of Civil and Environmental Engineering, Stanford, CA.

Ph.D. Research Assistant (1/96 – 7/00) with Martin Reinhard

Assessed the technical feasibility of Pd based reactors for in-well destruction of halogenated hydrocarbons contaminants in groundwater. The reaction mechanisms and effects of common groundwater ions, pH, and biological activity on catalyst performance were evaluated including methods for *in-situ* catalyst regeneration.

University of Wisconsin, Madison, WI.
Department of Civil Engineering

MS Research Assistant (8/94-12/95) with Gerald R. Eykholt

Determined the rates of TCE transformation and the potential for production of lesser-chlorinated reaction intermediates by iron filings under various reaction conditions was assessed to aid in the engineering design of *in-situ* permeable reactive barriers for destruction of VOCs.

CONSULTING AND PROFESSIONAL EXPERIENCE

Parsons, Syracuse NY (4/2008-present).

Consulting on sediment remediation for freshwater lake in NY. Provide expert advice on capping technology for containment of VOCs of concern in sediment pore water.

TetraTech EC, San Diegeo, CA (11/08-preent).

Consulting on pilot scale demonstration of an NZVI treatment strategy for a TCE-contaminated aquifer at Alameda Point, CA.

U.S. EPA, National Health and Environmental Effects Research Laboratory, Research Triangle Park, NC (9/05-12/06)

Provide expert knowledge on nanoparticle characterization and methods to stabilize nanoparticle suspersions. Part of an ongoing investigation into the potential toxicity of nanoparticles.

U.S. Department of Defense, Strategic Environmental Research and Development Program (8/04-10/04)

Part of a team preparing a report that details the state of the science and major data gaps for managing contaminated sediments.

U.S. Department of Energy, Washington D.C. (6/04-12/04)

Provided technical assistance on mending the In Situ Redox Manipulation barrier. Review technical data, prepare and review final technical report.

Aluminum Company of America (Alcoa), Pittsburgh, PA (10/01-12/02)

Provided expert knowledge on application of Fenton's Reagent for remediation of VOC DNAPL-impacted sites. Primary focus: TCE oxidation chemistry and potential formation of undesirable byproducts.

RWD Technologies Inc., Columbia, MD

ASSOCIATE ENGINEER, Technology Transfer (1994)

Developed performance-based documentation and training programs for petroleum and chemical processing facilities.

Colorstrip Inc., Richmond, CA

WASTEWATER TREATMENT PLANT ENGINEER/QC SUPERVISOR (1993-1994)

Managed metal preparation section of coil coating paint line and wastewater treatment plant for treatment of heavy metal waste streams.

COURSES TAUGHT

Advanced Issues in Environmental Nanotechnology

This is a new course I developed to introduce the basic science and engineering concepts of nanoscience/nanotechnology and to present the societal and cultural issues surrounding the introduction of nanotechnology into the global market place. Students discuss the opportunities for nanotechnology to improve the quality of life, as well as the potential negative consequences of this emerging field on the environment and human health. The goal is to increase awareness of how nanomaterials/nanotechnology interact with the natural world, and at the same time stimulate students who are focused on careers in environmental engineering to consider possible nanotechnology-based solutions to environmental problems (e.g. energy production, groundwater remediation).

Environmental Engineering/ Environmental Engineering Laboratory

Provides a scientific and engineering basis for understanding environmental issues and problems including environmental chemistry, material and energy balances, physical processes and biological processes affecting surface and ground water quality, and introduces concepts of sustainability and environmental nanotechnology. Simple quantitative engineering models are developed, and qualitative descriptions of environmental engineering control technologies are presented. Laboratory experiments illustrate the basic principles of environmental engineering including environmental chemistry and physical and biological processes. The course provides hands-on experience measuring basic chemical and biological water quality parameters.

Characterizing and Analyzing Environmental Samples and Systems

I developed this course to familiarize graduate students with laboratory protocols for the analysis of water, wastewater, and soil used in scientific research, and to teach them to write scientific papers. The course goals are to 1) introduce students to the principles of environmental sampling and sample analysis, 2) provide familiarity and hands on experience with analytical tools used in environmental engineering

research and practice, and 3) prepare students to write technical papers/reports and make technical presentations. Emphasis is on understanding the theory behind the techniques; rather than simply performing the analyses. The basic elements of an engineering/science publication are presented.

Fate, Transport, and Physicochemical Processes of Organic Contaminants in Aquatic Systems

Presents factors governing the behavior of hazardous organic chemicals in the environment: distribution among air, water, and solids. Provides and understanding of how a chemical's properties, equilibrium and rate principles, and relevant chemical transformations affect the distribution of pollutants in the environment.

Water Quality Engineering/Water Quality Laboratory

Provides an introduction to the fundamentals and engineering aspects of water quality. Basic principles of water chemistry; physical, chemical and biological phenomena affecting water quality are presented, and application of these concepts to a description of water quality changes that may occur in treatment processes and in natural-water environments, including water and wastewater treatment systems and groundwater. Labs demonstrate techniques for measuring and evaluating water quality and pollution parameters, and illustrates principles of dilute aqueous chemistry and processes affecting water quality. Measurements include titrimetric, spectrometric, potentiometric, and reductive/oxidative techniques.

ACTIVE AND PENDING PROJECTS

I have three synergistic areas of research including 1) the sustainable development of nanomaterials and nanotechnologies for water treatment and groundwater remediation, 2) carbon capture and storage for sustainable energy, and 3) innovative sediment capping for the in situ containment and treatment of contaminated sediments. A brief synopsis of each is provided below.

Sustainable development of nanomaterials and nanotechnologies for water treatment and groundwater remediation

Nanomaterials and nanotechnologies offer the potential to improve the quality of life and the environment through e.g. enhanced water treatment, efficient alternative energies, improved drug delivery and diagnostic tools, but responsible and sustainable development of nanotechnologies must include an *a priori* understanding of the risks they pose, including their fate and transport in the environment, and their potential toxicity. I have several projects using designer polymeric surface coatings to improve the efficiency of in situ groundwater remediation using reactive Fe^0-based nanoparticles. The coatings enhance their mobility in groundwater aquifers and provide them an affinity for specific contaminants. Effective implementation of this technology requires a fundamental understanding of the physical and chemical processes controlling the mobility and fate in these nanomaterials in environment. The ability to tailor surface coatings to provide a specific surface chemistry allows for the careful study of how the surface properties of nanomaterials affect their mobility and fate in the environment. This is a multidisciplinary effort involving graduate students and faculty from Environmental Engineering, Chemistry, Chemical Engineering, Biomedical Engineering, and Biology. Other efforts in this area include assessing the potential human and eco-toxicity of nanomaterials, and determining if nanoparticle surface coatings can effectively decrease their toxicity. I collaborate with a toxicologist, Bellina Veronesi, at the US EPA National Health and Environmental Effects Research Laboratory in RTP, NC. A new EPA STAR grant that will begin in 2007 investigates long-term fate of the surface coatings in aquifer media as well as the effect of these nanoparticles on the microbial health and diversity in a groundwater aquifer. This is a collaborative effort between CMU (lead institution) and Rice University's Center for Biological and Environmental Nanotechnology.

<u>Current projects.</u>

Center for Environmental Implications of Nanotechnology (CEINT)
October 2008-September 2013 (NSF) ($14.4M)
Co-PI, Deputy Director, PI-Wiesenr (Duke), Co-PIs -Jones (Howard), DiGuilio (Duke), Hochella (VT)
Nanoscale Undergraduate Education

September 2008-August 2010 (NSF) ($200k)
Co-PI, PI-Backstallar (MSE), Co-PIs-McHenry, Towe
The effect of surface coatings on the environmental and microbial fate of nanoiron and Fe-oxide nanoparticles
May 2007-April 2010, USEPA ($400k)
PI (Lowry), Co-PIs-CMU-Robert Tilton (CHE), Edwin Minkley (Bio), Pedro Alvarez (Rice University)
NIRT: Targeted Delivery and Microbial Interactions of Polymer-Functionalized Nanoparticles for Groundwater Contaminant Source-Zone Remediation
September 2006-August 2010, National Science Foundation ($1.075M)
PI(Tilton), Co PIs-Greg Lowry(CEE), Edwin Minkley(Bio), Kris Matyjaszewski (Chem)
Fundamental study of the delivery of nanoiron to DNAPL source zones in naturally heterogeneous field systems
April 2006-June 2011, DoD, Strategic Environmental Research and Development Program (SERDP) ($1.13M)
PI (Lowry), Co-PI-Tissa Illangasekare (Colorado School of Mines)

Past Projects
Developing Functional Fe(0)-based Nanoparticles for In Situ Degradation of DNAPL Chlorinated Organic Solvents
June 2003-May 2007, U. S. EPA STAR ($358,000)
PI (Lowry), Co-PIs-Robert Tilton (CHE), Sara Majetich (Physics), Kris Matyjaszewski (Chem)
Transport, Targeting, and Applications of Metallic Functional Nanoparticles for Degradation of DNAPL Chlorinated Organic solvents
Sept 2002-Aug 2005, US DOE-Environmental Management and Science Program ($1.7M, $850k-CMU)
PI (Lowry), Co-PIs-CMU-Robert Tilton (CHE), David Sholl (CHE), Sara Majetich (Physics), Kris Matyjaszewski (Chem); Idaho National Laboratory-George Redden, Paul Meakin, Harry Rollins, Dan Ginosar
Zero Valent Iron (ZVI) Treatability Study at OU-2B, Alameda Point, Alameda, California, Contract Task Order (CTO) 0020
February 2007-May 2008, Office of Naval Research, $86k
PI (Lowry)

Sustainable Energy using Carbon Capture and Storage

Sustainable energy production will ultimately require a shift to renewable energy sources, however this shift will not be rapid due to the high capital costs of changing the current infrastructure for generation and distribution of energy, and due to deficient technical capability to create functional renewable energy technologies. In the interim, we will rely on carbon capture and storage (CCS) to curb CO_2 emissions from fossil fuels. Technologies are needed to capture CO_2 from distributed sources, safely transport the CO_2 collected to a sequestration site, and permanently and safely store it in brine aquifers (geologic sequestration). I have projects that 1) develop and evaluate a novel technologies to capture CO_2 from ambient air using large scale engineered systems or industrial waste streams to safely and cost-effectively decarbonize fossil energy in the U.S. and the world, and that 2) experimentally evaluate the integrity of well casings and cement plugs in active and abandoned wells against leakage of CO_2 from geologic sequestration sites. This entails quantifying the effects of supercritical CO_2 and brine solutions on cement used in well casings and plugs, and understanding the chemistry of acid attack on those cements under geologic sequestration conditions. A pending project set to begin early 2007 will investigate the geochemical reactions between supercritical CO_2/brine solutions and the brine aquifer formations. Understanding how supercritical CO_2 injected into these formations reacts with the aquifer materials is essential to determining the amount of CO_2 that can be stored and the mechanisms of permanent storage via carbonation reactions. It also enables engineering of the infrastructure needed to permanently and safely store the gigatons of CO_2 that require disposal.

Current Projects
Properties and Integrity of seal rocks for CO_2 sequestration
January 2007-June 2010, DOE NETL (ORISE fellowship for minority student)

Co-PIs: Lowry and Dzombak

Past Projects

Degradation of Well Bore Cements by CO_2 and brine solutions
July 2005-June 2008, DOE NETL (ORISE Fellowship for minority student)
Co-PIs: Lowry and Dzombak

Bauxite Residue (Red Mud) Treatment/Neutralization Using Fly Ash and Direct Carbonization with CO_2
July, 2004-June, 2007, National Science Foundation (BES)-$100,000; Alcoa, Inc.-$120,000
Co-PIs: (Lowry (NSF) and Dzombak (Alcoa))

Carbon Management: Geochemical CO_2 Sequestration Using Industrial Wastes
September, 2002-August, 2003, Eden Hall Foundation ($59,000)
PI: (Lowry), Collaborator: David Keith (CMU)

Extracting CO_2 from Ambient Air: Novel Technologies to Mitigate Global Climate Change
September, 2003-December, 2004, Pennsylvania Infrastructure Technology Alliance ($67,000)
PI: (Lowry), Collaborator: David Keith (CMU)

In situ Sediment Capping and Remediation

Remediation of sediment contaminated with hydrophobic organics such as PCBs and PAHs is costly and few options other than dredging are available. The high cost and limited funds available for remediation requires that the sites posing the most risk should be receive first priority. Research in this area has consisted of developing and evaluating sorbent-amended sediment caps capable of cost-effectively containing or treating sediment contaminants in situ, including determination of the physicochemical process affecting the performance and longevity of these enhanced sediment caps, and documenting their ability to perform in the field. These efforts will help to garner public and regulatory acceptance of sobent-amended sediment caps which can provide lower cost alternatives to dredging. Recent efforts include the use of Bayesian Belief Networks (BBNs) to capture the key physical and chemical parameters (i.e. pore water contaminant concentrations, sediment organic carbon content, etc.) that can represent risk at a contaminated site. BBN models can be used to evaluate the efficacy of various surrogate measures of risk (e.g. pore water contaminant concentration) and the effect of specific remedial action strategies on reducing risk. The BBN will also be used in the development and validation of standard protocols to determine reliable surrogate measures of benthic organism toxicity for PAHs and fish bioaccumulation for PCBs which can be used for risk assessment and to support decisions regarding remedial actions at HOC-contaminated sediment sites. A pending project will engineer more cost-effective approaches (e.g. funnel and gate systems) and integrated cap designs that take advantage of the natural redox gradients present in sediment.

Current Projects

PCB Adsorption Isotherms onto AC for in inland lake deposit in NY
May 2008-December 2009, Parsons ($35k)
PI-Lowry, Co-PI Reible

The Development of Funnel and Gate Technology for Containment and In-situ Treatment of Contaminated Sediments
January 2008-December 2010, NIEHS ($600,000-Direct Cost)
PI (Reible, UT Austin), Co-PIs-Greg Lowry, Kelvin Gregory, Joe Hughes (Georgia Tech)

Past Projects

Predicting and Validating the Field Performance of Novel Sorbent-amended Sediment Caps
Sept, 2005-Aug, 2008, Cooperative Institute for Coastal and Estuarine Environmental Technology ($225,000)
PI (Lowry)

Sediment Management in the Anacostia and Grasse River: Evaluating Fe(0) and Coke for PCB Destruction/Sequestration in "Active" Sediment Caps
October, 2002-Spetember 2005, Hazardous Substance Research Center, South & South West ($180k); Aluminum Company of America ($40k)

Gregory V. Lowry

PI (Lowry)

RECENT ORGANIZATIONAL ACTIVITY IN PROFESSIONAL ORGANIZATIONS AND PROFESSIONAL ACTIVITES

Workshop rapportuer at OECD Conference on Potential Environmental Benefits of Nanotechnology: Fostering Safe Innovation-Led Growth, July 15-17, Paris, France. Participant at NNI Workshop on Nanomaterials and the Environment & Instrumentation, Metrology, and Analytical Methods, October 6-7, Arlington, VA.

Journal of Environmental Quality (Soil Science Society of America Journal)-Organizing and guest editing a special issue of JEQ on the impact of manufactured nanomaterials on the environment.

Reviewer for NRC-NAS report on EHS research strategies for Nanotechnology, August 2008.

Review Panelist for EPA's Draft Nanomaterial Research Strategy (NRS), April 2008.

External Advisory Board member for the Superfund Basic Research Center at Duke University

External Advisory board member for the Center for Biological and Environmental Nanotechnology (CBEN)

Co-organizing first international iCEIN meeting, Washington DC, September 9-11, 2009. Co-organizing a symposium on Interdisciplinary Approaches to Safe Nanotechnologies at the Materials Research Society (MRS) Fall Meeting, Boston, MA Nov 30-Dec 1, 2010. Co-organizing ACS session on Environmental Applications and Implications of nanotechnology for the *Division of Environmental Chemistry* at PacificChem, Hawaii, December 2010. Co-organizing a session at AGU Fall Meeting on Fate and Transport of Nanomaterials in porous media, San Francisco, CA, December 2009. Co-organized a Workshop February 25-27, 2007 on Nanotechnology and Water Treatment (NeWT) sponsored by CBEN (Rice University). Co-organized and chaired a 4-day session on Environmental Nanotechnology for the *Division of Environmental Chemistry* at the 228th National Meeting of the American Chemical Society. Co-organizers included Dion Dionysiou, Pratim Biswas and Mark Wiesner.

REFEREED JOURNAL PUBLICATIONS

Working papers submitted or to be submitted shortly

Fairey, J., Lowry, G. V. Sorption of PCBs to activated carbon: The importance of PCB complexes with natural organic matter at low flow velocities applicable in sediment capping. *Water Research (submitted)*

Zong-ming Xiu, Zhao-hui Jin, Tie-long Li, Shaily Mahendra, Gregory V. Lowry, Pedro J. J. Alvarez. Effect of nano-scale zero-valent iron particles on a mixed culture dechlorinating Trichloroethylene. *Biotech.* (submitted)

Khaitan, S., Lowry, G., Dzombak, D. Field evaluation of the effects of carbon dioxide/vegetation/amendment on neutralization of bauxite residue," *J. Environ. Eng.*

In Press or Published

Auffan Mélanie, Rose Jérôme, Bottero Jean-Yves, Gregory V. Lowry, Jolivet Jean-Pierre, Wiesner, Mark R.. Towards a definition of nanoparticles based on novel size-dependent properties (**2009**). *Nature Nanotechnology (in press)*

Mark R. Wiesner, Gregory V. Lowry, Kimberly Jones, Michael F. Hochella, Richard T. Di Giulio,, Elizabeth Casman, Emily Bernhardt (**2009**). Decreasing Uncertainties in Assessing Environmental Exposure, Risk and Ecological Implications of Nanomaterials *Environ Sci. Technol.(in press)*

Tanapon Phenrat, Hye-Jin Kim, Fritjof Fagerlund, Tissa Illangasekare, Robert D. Tilton, Gregory V. Lowry (**2009**). Particle Size Distribution, Concentration, and Magnetic Attraction Affect Transport of Polymer-modified Fe0 Nanoparticles in Sand Columns. *Environ. Sci. Technol.43 (13)* 5079-5085.

Kim, H-J., Phenrat, T., Tilton, R. D., Lowry, G. V (**2009**). Desorption of Anionic Polyelectrolyte Coatings from Nanoscale Fe^0 Used for Environmental Remediation. *Environ. Sci. Technol. 43 (10)* 3827-3830.

Kevin M. Sirk, Navid B. Saleh, Tanapon Phenrat, Hye-Jin Kim, Bruno Dufour, Jeongbin Ok, Patricia L. Golas, Krzysztof Matyjaszewski, Gregory V. Lowry, Robert D. Tilton (**2009**). Effect of Adsorbed Polyelectrolytes on Nanoscale Zero Valent Iron Particle Attachment to Soil Surface Models. *Environ Sci. Technol.43 (10)* 3803-3808.

Barbara G. Kutchko, Brian R. Strazisar, Nicolas Huerta, Gregory V. Lowry, David A. Dzombak, Niels Thaulow (**2009**). CO2 Reaction with Hydrated Class H Well under Geologic Sequestration Conditions: Effect of Admixtures. *Environ. Sci. Technol.* 43 (10) 3803-3808.

Khaitan, S., Lowry, G., Dzombak, D. (**2009**). Chemistry of the Acid Neutralization Capacity of Bauxite Residue. *Environ. Eng. Sci. 26 (5),* 873-881.

Khaitan, S., Dzombak, D., Lowry, G. (**2009**). Red Mud Neutralization by CO_2, *J. Environ. Eng*. 135 (6) 433-483.

Phenrat, T., Liu, Y., Tilton, R. D., Lowry, G. V. (**2009**). Adsorbed Polyelectrolyte Coatings Decrease Fe^0 Nanoparticle Reactivity with TCE in Water: Conceptual Model and Mechanisms. *Environ. Sci. Technol.* 43 (5) 1507-1514.

Khaitan, S., Lowry, G., Dzombak, D (**2009**). Neutralization of Bauxite Residue with Acidic Fly Ash. *Environ. Eng. Sci.* 26 (2) 431-440.

Phenrat, T., Long, T., Lowry, G., Veronesi, B. (**2009**). Partial oxidation ("aging") and surface modification decrease the toxicity of nano-sized zero valent iron. *Environ. Sci. Technol.* 43 (1) 195-200.

Kutchko, B., Strazisar, B., Lowry, G., Dzombak, D., Thaulow, N. (**2008**). "Rate of CO_2 Attack on Class H Well Cement under Geologic Sequestration Conditions". *Environ. Sci. Technol*. 42 (16) 6237-6242.

Veronesi, B., Tajuba, J., Saleh, N., Ward, W., Hester, S., Carter, J., Lowry, G. V. (**2008**). Functionally Charged Polystyrene Particles Activate Immortalized Mouse Microglia (BV2): Cellular and Genomic Response, *Nanotoxicology* 2 (3) 130-143.

Stolaroff, J. K., Keith, D. W., Lowry, G. V. (**2008**). Carbon dioxide capture from atmospheric air using sodium hydroxide spray. *Environ. Sci. Technol.* 42 (8) 2728-2735.

Navid Saleh, Hye-Jin Kim, Krzysztof Matyjaszewski, Robert D. Tilton, and Gregory V. Lowry. (**2008**). Ionic Strength and Composition affect the mobility of surface-modified NZVI in water-saturated sand columns. *Environ. Sci. Technol.* 42 (9) 3349-3355.

Phenrat, T., Saleh, N., Sirk, K., Kim, H., Matyjaszewski, K., Tilton, R., Lowry, G.V. (**2008**). Stabilization of Aqueous Nanoscale Zerovalent Iron Dispersions by Anionic Polyelectrolytes: Adsorbed anionic polyelectrolyte layer properties and their effect on aggregation and sedimentation. *J Nanoparticle Res*. vol. 10 p.795-814.

McDonough, K., Fairey, J., Lowry, G. (**2008**). Adsorption of polychlorinated biphenyls to activated carbon: equilibrium isotherms and a preliminary assessment of the effect of dissolved organic matter and biofilm loadings. *Water Research* 42 (3) 575-584.

Liu, Y., Phenrat, T., Lowry, G. V. (**2007**). Effect of TCE concentration and dissolved groundwater solutes on NZVI-promoted TCE dechlorination and H_2 evolution. *Environ. Sci. Technol*. 41(22); 7881-7887.

Long, Thomas C, Tajuba, Julianne, Saleh, Navid, Sama, Preethi, Parker, Joel, Swartz, Carol, Lowry, Gregory V, and Veronesi, Bellina. (**2007**). "Nanosize Titanium Dioxide Stimulates Reactive Oxygen Species In Brain Microglia And Damages Neurons In Vitro." *Environmental Health Perspectives* vol. 115 (11) pg 1131-1138.

Kutchko, B., Strazisar, B., Dzombak, D., Lowry, G., Thaulow, N. (**2007**) "Degradation of Wellbore Cement by CO_2 under Geologic Sequestration Conditions". *Environ. Sci. Technol.* 41 (13) 4787-4792.

McDonough, K., Murphy, P. J., Olsta, J., Zhu, Y., Reible, D., Lowry, G. V. **(2007)**. Development and Placement of an "Active" Sorbent-amended Thin Layer Sediment Cap in the Anacostia River. *Journal of Soil and Sediment Contamination, an International Journal* 16 (3) 313-322.

Phenrat, T., Saleh, N., Sirk, K., Tilton, R., Lowry, G. V. (**2007**) Aggregation and Sedimentation of Aqueous Nanoiron Dispersions. *Environ. Sci. Technol*., 41 (1) 284-290.

Saleh, N., Sirk, K., Liu, Y., Phenrat, T., Dufour, B., Matyjaszewski, K., Tilton, R., Lowry, G. V. **(2007)** "Surface Modifications Enhance Nanoiron Transport and DNAPL Targeting in Saturated Porous Media." *Environ. Eng. Sci.* 24 (1) 45-57.

Liu, Y., Lowry, G.V. **(2006)** "Effect of Particle Age (Fe^0 content) and Solution pH on NZVI Reactivity: H_2 Evolution and TCE Dechlorination". *Environ. Sci. Technol*., 40 (19) 6085-6090.

M. R. Wiesner, G. V. Lowry, P. Alvarez, D. Dionysiou, and P. Biswas. **(2006)** "Progress and research needs towards assessing the risks of manufactured nanomaterials." *Environ. Sci. Technol.*, 40 (14) 4336-4345.

Long, T., Saleh, N., Tilton, R., Lowry, G. V., Veronesi, B. **(2006)** "Titanium Dioxide (P25) Produces Oxidative Stress in Immortalized Brain Microglia (BV2): Implication of Nanoparticle Neurotoxicity" *Environ. Sci. Technol.* 40 (14) 4346-4352.

Murphy, P., Marquette, A., Reible, D., Lowry, G. V. (**2006**). "Predicting the Performance of Sediment Caps Amended with Sorbing Media", *Journal of Environmental Engineering*, 132 787-794.

Saleh, N., Phenrat, T., Sirk, K., Dufour, B., Ok, J., Sarbu, T., Matyjaszewski, K., Tilton, R., Lowry, G. V. **(2005)**. "Adsorbed Triblock Copolymers Deliver Reactive Iron Nanoparticles to the Oil/Water Interface." *Nano Lett.* 5 (12) 2489-2494.

Liu, Y., Choi C., Dionysiou, D., Lowry, G. V. (**2005**) "TCE Hydrodechlorination by Amorphous Monometallic Nanoiron." *Chem. Mat.* 17, 5315-5322.

Saleh, N., Traian Sarbu, Kevin Sirk, Gregory V. Lowry, Krzysztof Matyjaszewski and Robert D. Tilton (**2005**). Oil-in-Water Emulsions Stabilized by Polyelectrolyte-Grafted Nanoparticles. *Langmuir* 21, 9873-9878.

Liu Y., Majetich, S. A., Tilton, R. D., Sholl, D. S., Lowry, G.V. (**2005**). "TCE Dechlorination Rates, Pathways, and Efficiency of Nanoscale Iron Particles with Different Properties", *Environ. Sci. Technol.* 39 (5) 1338-1345.

Stolaroff, J. K., Lowry, G. V., Keith, D. (**2005**). "Using CaO- and MgO-rich Industrial Waste Streams for Carbon Sequestration", *Energy Conversion and Management*, 46 (5) pp 687-699.

Lowry, G.V., Shaw, S., Kim, C., Rytuba, J., Brown, Jr., G. E. (**2004**). "Macroscopic and Microscopic Observations of Particle-Facilitated Mercury Transport from New Idria and Sulphur Bank Mercury Mine Tailings", *Environ. Sci. Technol*. 38(19) 5101-5111.

Lowry, G. V., Johnson, K. M. (**2004**). "Congener-Specific Dechlorination of Dissolved PCBs by Microscale and Nanoscale Zerovalent Iron in a Water/Methanol Solution", *Environ. Sci. Technol*. 38(19) 5208-5216.

Lowry, G.V., Reinhard, M. (**2001**). "Pd Catalyzed TCE Dechlorination in Groundwater: Effect of $[H_2]_{(aq)}$ and H_2-Utilizing Competitive Solutes on the TCE Dechlorination Rate and Product Distribution", *Environ. Sci. Technol*. 35 (4), 696.

Lowry, G.V., Reinhard, M. (**2000).** "Pd Catalyzed TCE Dechlorination in Groundwater: Solute Effects, Biological Control, and Oxidative Catalyst Regeneration", *Environ. Sci. Technol.* 34 (15), 3217.

Lowry, G.V., Reinhard, M. (**1999**). "Hydrodehalogenation of 1- to 3-Carbon Halogenated Organic Compounds in Water Using Palladium Catalyst and Hydrogen Gas", *Environ. Sci. Technol*. 33 (11), 1905.

BOOK CHAPTERS

Tanapon Phenrat, Daniel Schoenfelder, Mark Losi, June Yi, Steven A. Peck, and Gregory V. Lowry. Treatability Study for a TCE Contaminated Area at Alameda Point, CA using Nanoscale- and Microscale-Zerovalent Iron Particles: Reactivity and Reactive Life Time. ACS Publications. (submitted).

Lowry, G. V. and Casman E. A. (**2009**). Nanomaterial Transport, Transformation, and Fate ion the Environment: A Risk-based Perspective on Research Needs. In *Risk, Uncertainty and Decision Analysis for Nanomaterials: Environmental Risks and Benefits and Emerging Consumer Products*. Eds. Igor Linkov and Jefferey Stevens. Springer Verlag. pp. 125-139.

Phenrat, T. and Lowry, G. V. (**2008**). Physicochemistry of Polyelectrolyte Coatings that Increase Stability, Mobility, and Contaminant Specificity of Reactive Nanoparticles used for Groundwater Remediation. William Andrews Publishing (now Elsevier). December.

Lowry, G.V. and Wiesner, M. R. (**2007**). Environmental Considerations: Occurrences and Fate of Nanomaterials in the Environment. In *Nanotoxicology: Characterization, Dosing, and Health Effects.* Eds. N. Monteiro-Riviere and C. Long Tran. Informa Health Care USA, Inc., New York, NY 2007 p. 369-390.

Lowry, G. V. (**2007**). Groundwater Remediation Using Nanoparticles. In *Environmental Nanotechnology: Applications and Impacts of Nanomaterials*. Eds. M. Wiesner and F. Bottero, McGraw-Hill, New York, NY, 2007 p.297-333.

Lowry, G. V., Reible, D., Novitsky, M. (**2006**). "In situ cap and treat technologies for contaminated sediments". In Assessment and Remediation of Contaminated Sediments, Eds. D. Reible, T. Lanczos and K. Demnerova, Springer-Verlag. 2006.

Lowry, G. V., Murphy, P. J., Marquette, A., Reible, D. (**2006**). "Sorbent-amended 'Active' Sediment Caps for In-Place Management of PCB-contaminated Sediments". In Contaminated Soils, Sediments and Water, Eds. E. Calabrese, P. Kostecki, and J. Dragun. Springer New York, NY.

INVITED TALKS

Lowry G. V., Phenrat, T., Kirshling, T., Tilton, R (**2009**). Title TBD. Soil Science Society of America (SSSA) Fall Meeting, Nov 1-5.

Lowry, G. V. (**2009**). Key Uncertainties in Assessing the Transport of Nanomaterials in the Environment, NNI Workshop on Nanomaterials and the Environment & Instrumentation, Metrology, and Analytical Methods, Oct 6-7.

Lowry, G. V. (**2009**). Fate, transport, and Transformation of nanomaterials in the Environment-A Center Approach, 1st International iCEIN Annual Meeting Washington, DC, Sept 10.

Lowry, G. V., (**2009**). Title TBD. 4th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials University of Vienna, Vienna, Austria, Sept 6-9.

Lowry, G. V. Phenrat, T. Kim, H., Saleh, N., Matyjaszewski, K., Tilton, R. (**2009**). Reactive Nanoparticles for In Situ Groundwater Remediation: Role of Macromolecular Organic Surface Coatings on Reactivity, Aggregation, and Deposition on Surfaces, International Union of Pure and Applied Chemists (IUPAC), August 6.

Lowry, G. V. Phenrat, T. Greden, K., Li, Z., Kim, H., Saleh, N., Tilton, R. (**2009**). The Strong Influence on NP Surface Coatings on Aggregation, Deposition, and Environmental Effects of NPs., Association of Environmental Engineering and Science Professors (AEESP), July 28.

Lowry, G. V. Phenrat, T. Kim, H., Saleh, N., Tilton, R. Illangasekare, T. (**2009**). Reactive Nanoparticles for In Situ Groundwater Remediation: Optimizing the Benefits and Mitigating the Risks with Surface Coatings, Organization for Economic Cooperative Development (OECD), Paris, France, July 16.

Lowry, G.V., Phenrat, T., Kim, H., Saleh, N., Illangasekare, T., Tilton, R. (**2009**). Reactive Nanoparticles for Groundwater Remediation: Optimizing the Benefits and Mitigating the Risks with Surface Coatings. EAWAG, Zurich, Switzerland, June 27.

Lowry, G. V., Phenrat, T., Titlon, R. (**2009**). Semi-empirical Correlation to Predict the Collision Efficiency of Natural Organic Matter (NOM) - and Polymer-coated Nanoparticles in Porous Media, Environmental Implications and Applications of Nanotechnology, UMASS Amherst, June 12.

Lowry, G. V., Phenrat, T., Tilton, R. (**2009**). Semi-Empirical Correlation to Predict the Collision Efficiency of Nanoparticles Coated with NOM or polymer, International Water Association, Particle Separations Conference, Raleigh, NC, June 5.

Lowry, G. V., Wiesner, M., Casman, E. (**2009**). Nano-mythbusting: common misconceptions regarding nanomaterial interactions with organisms and their toxicity., Division of Industrial & Engineering Chemistry for the 235th ACS National Meeting, Salt Lake City, UT, March 22.

Lowry, G. V., Phenrat, T., Reinsch, B., Veronesi, B. (**2009**). Nanomaterials in the Environment: What are Organisms Really Exposed To?, Society of Toxicology Meeting, Baltimore, MD. March 16.

Lowry, G. V., Phenrat, T. Kim, H., Saleh, N., Tilton, R. (**2009**). Potential Impacts of Nanotechnology on the Environment., Remtech 2009, Atlanta, GA, March 4.

Lowry, G. V., Phenrat, T., Tilton, R. (**2009**). Predicting Deposition of Macromolecule-modified NPs. CEINT and iCEINT joint meeting, CNRS, Aix-en-Provence, France, February 25.

Lowry, G.V., Phenrat, T., Kim, H., Saleh, N., Illangasekare, T., Tilton, R. (**2009**). Reactive Nanoparticles for In Situ Groundwater Remediation: Effect of Surface Coatings on Reactivity, Transport, and Emplacement. Stevens Institute of Technology, Department of Civil & Environmental Engineering, Hoboken, NJ. February 18.

Lowry, G. V., Phenrat, T., Illangasekare (**2008**). Correlation to Predict Collision Efficiency of Natural Organic Matter (NOM)- and Polymer-coated Nanoparticles in Porous Media. AGU Fall Meeting Hydrology Division. December 2008.

Lowry, G. V. (**2008**). Environmental Fate, Transport, and Exposure to Manufactured Nanomaterials: Importance of Coatings ENSEP, University of Delaware, November 2008.

Lowry, G. V. (**2008**). Nanoparticle Surface Chemistry: Impacts on Aggregation (and other stuff too!). GDRI meeting, Washington D.C. October 2008.

Lowry, G. V. (**2008**). Reactive Nanomaterials for In Situ Aquifer Remediation: Effect of Surface Coatings on Reactivity, Transport, and Emplacement. UCSB Brenn School of the Environment, October 2008.

Lowry, G. V. (**2008**). Molecular Scale Understanding of the Impact of Nanoparticle Surface Coatings on Agglomeration, and Particle-Surface and Particle-Cellular Interactions. UCLA Molecular Toxicology and Nanotoxicology Training Programs-Division of Nanomedicine, UCLA, October, 2008.

Lowry, G. V., (**2008**). Nanotechnology and the Environment: Is there really a risk?

Keynote given at the Franco-American Young Environmental Scientist Symposium (YESS), Washington D.C., July 2008.

Lowry, G. V., Wiesner, M. (**2008**). A Multi-institutional Collaboration to Study Environmental Nanotechnology. US EPA National Exposure Research Laboratory (NERL), July 2009.

Lowry, G. V. (**2008**). Aggregation, deposition, and mobility of electrosterically stabilized polyelectrolyte-modified reactive nanoparticles for in situ groundwater remediation. Invited talk at the Gordon Conference on Transport in Porous Media, Oxford, England, July 13-18, 2008.

Lowry, G. V. (**2008**). Nanomaterials as emerging contaminants. Invited talk at the Gordon Conference Environmental Sciences-Water, Holderness School, June, 2008.

Lowry, G. V. (**2008**). Transport and Applications of Nanomaterials for Groundwater Remediation. Keynote lecture to be presented at the nanoECO conference in Ascona, Switzerland, March 2-7, 2008.

Gregory V. Lowry, Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Navid Saleh, Tissa Illangasekare, Robert D. Tilton (**2007**). "Controlled placement of polyelectrolyte modified engineered nanomaterials in the subsurface: Correlating modifier layer properties and geochemistry with mobility". Invited Lecture at the American Geophysical Union Fall Meeting, Hydrology Division, San Francisco, CA, December 10-14.

Lowry, G. V. (**2007**). Environmental Applications and Exposures to Engineered Nanomaterials., To be presented at the 2007 Nanoscale Science and Engineering Conference, National Science Foundation, Washington DC, December 6, 2007.

Gregory V. Lowry, Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Navid Saleh, Tissa Illangasekare, Robert D. Tilton (**2007**). "Delivering Reactive Nanoparticles to Subsurface DNAPL Source Zones". To be presented at the SERDP Partners in Technology Symposium, Washington, D.C., December 4, 2007.

Lowry, G.V. (**2007**). "Hydrogeochemical Parameters Controlling the Emplacement, Reactivity, and Longevity of Nanoscale Zerovalent Iron (NZVI) for in-situ Groundwater Remediation". Keynote Lecture at the 3rd International Symposium on Permeable Reactive Barriers and Reactive Zones, Rimini, Italy, November, 8-9, 2007.

Lowry, G.V. (**2007**). "Optimizing the Reactivity and Mobility of Reactive Nanomaterials for In Situ Groundwater Remediation". To be presented at the Department of Civil and Environmental Engineering at the University of Illinois-Urbana Champaign, November 2, 2007.

Lowry, G.V. (**2007**). "Nanoparticle and Geochemical Properties Controlling the Mobility of Surface-Modified Nanomaterials in the Environment". Department of Civil and Environmental Engineering at the Pennsylvania State University, October 3, 2007.

Lowry, G.V. (**2007**). "Assessing Nanomaterials Fate in the Environment". Presented at the American Bar association Teleconference on RCRA, CERCLA, and Nanotechnology, American Bar Association Section of Energy, Environment, and Resources, July 11, 2007.

Lowry, G.V. (**2007**). "Surface Functionalized Reactive Nanoparticles for in situ DNAPL Source Zone Treatment". Stanford University, Civil and Environmental Engineering, March 16, 2007.

Lowry, G. V., (**2007**). "The role of surface coatings on the fate and mobility of nanomaterials in the Environment". Duke University, Civil and Environmental Engineering, February 21, 2007.

Lowry, G. V., (**2007**). "Occurrences and fate of nanomaterials in the groundwater". Presented at the US EPA National Health and Environmental Effects Research Laboratory in RTP, NC, February 22, 2007.

Lowry, G. V. (**2006**). "In Situ DNAPL Remediation using Zero-valent Nanoiron". Presented at the International Symposium on Environmental Implications and Applications of Nano-sized Materials, National Chung Hsing University, Taichung, Taiwan, December 14-15, 2006.

Lowry, G. V. (**2006**). The Mobility and Fate of Nanomaterials in the Environment. Presented at the 2006 Nanoscale Science and Technology Grantee Conference, National Science Foundation, Arlington, Virginia, December 4-6, 2006. (Note: This was an invited talk on the implications of nanotechnology in the environment rather than as a NIRT grantee).

Lowry, G.V. **(2006)**. "NZVI for groundwater remediation: the importance of surface coatings for mobility and targeting." In the Proceedings of the EPA Region 5 Nanotechnology for Site Remediation Workshop. US EPA Region 5. Chicago IL, September 6-7, 2006.

Lowry, G.V. **(2006)**. "Environmental Fate and Transport of Nanomaterials." In the Proceedings of the Nanotechnology and OSWER: New Opportunities and Challenges. US EPA OSWER. July 12-13, 2006.

Lowry, G.V. **(2006)**. "Fate and Transport of Nanomaterials in the Environment." Presented at Nanotoxicology 2006, Boston MA, April 25, 2006.

Lowry, G.V. **(2006)**. "Surface-functionalized Reactive Nanoparticles for Groundwater Remediation." Presented at the University of Delaware, Department of Civil and Environmental Engineering March 10, 2006.

G. V. Lowry, B. Dufour, H. Kim, Y. Liu, S. Majetich, K. Matyjaszewski, T. Phenrat, N. Saleh, K. Sirk, R. Tilton **(2005)**. Groundwater Remediation Using Nanoparticles. Presented at the Franco-American Workshop: Nanotechnologies for a sustainable environment. Rice University, Houston, TX December 15-16, 2005.

G. V. Lowry, Y. Liu, S. Majetich, K. Matyjaszewski, T. Phenrat, N. Saleh, K. Sirk, B. Dufour, R. Tilton, B. Veronesi Lowry **(2005)**. Environmental Nanotechnology: A block copolymer-based strategy delivers nanoiron to subsurface DNAPL. Presented at the University of Minnesota, Department of Civil Engineering, November 4, 2005.

Lowry, G. V. **(2005)**. "Nanoiron in the Subsurface: How far will it go and how does it change? US EPA Workshop on Nanotechnology for Site Remediation, Department of Commerce, Washington, DC, October 20-21, 2005.

Lowry, G. V., Reible, D.D., Novitsky, M. **(2005)**. In situ cap and treat technologies for contaminated sediments ARW NATO workshop on Assessment and Remediation of Contaminated Sediments, Bratislava, Slovak Republic, May 18-21, 2005.

Lowry, G. V. (**2004**). Nanoscale ZVI for DNAPL Source Zone Treatment: Targeted Delivery and Iron Longevity, US Department of Defense Strategic Environmental Research and Development Program, Washington DC. December 2, 2004.

Lowry, G. V. (**2004**). Nanoscale ZVI for DNAPL Source Zone Treatment: Targeted Delivery and Iron Longevity, Alcoa Inc. Workshop on is situ remediation of CVOCs, Pittsburgh, PA. November 11, 2004.

Lowry, G. (**2004**). Nanoscale Zero-valent Iron: Developing Remedial Alternatives for DNAPL- and PCB-impacted Areas. Johns Hopkins University, Department of Geography and Environmental Engineering, Baltimore, MD. March 23, 2004.

Lowry, G., Murphy, P., Johnson, K. (**2004**). Development and In Situ Application of Sorbent/reagent-amended "Active" Sediment Caps for Managing HOC-contaminated Sediments. University of Michigan, Ann Arbor, MI. March 25, 2004.

Lowry, G. (**2004**). Nanomaterials: Novel Applications for DNAPL and PCB Impacted Sites. Three Rivers Chapter of the Academy of Certified Hazardous Materials Managers, Pittsburgh, PA. April 8, 2004.

Lowry, G., Liu, Y. (**2004**). Nanoscale ZVI for DNAPL Source Zone Treatment. Department of Defense, Strategic Environmental Research and Development Program, Washington D.C., December 2, 2004.

Lowry, G. V., Johnson, K. M., (**2003**) "Fe(0) and Coke as "Active" Cap Media for PCB Destruction/Sequestration". EPA Technology Innovation Office Web Seminars, March 12th, 2003. (http://www.clu-in.org/conf/tio/capping_031203/).

Lowry, G. V., (**2003**) "Managing the Risk of PCB-contaminated Sediments without Dredging: Developing In Situ "Active" Sediment Caps". The Ohio State University, Department of Civil and Environmental Engineering, Columbus, OH, November 3.

Lowry, G.V., (**2003**) "In Situ Remediation of CVOCs: ISCO and Nanoscale Iron". Alcoa Chlorinated Solvent Remediation Meeting, Pittsburgh, PA, November 17.

Lowry, G. V. **(2002)** "Fe(0)- and carbon-based reactive media for in situ "active" sediment caps. Presented at Louisiana State University/Hazardous Substance Research Center South and Southeast Science Advisory Committee Meeting, Baton Rouge LA, November 8.

Lowry, G.V., **(2001)** "Novel Fixed-Bed Catalytic Treatment Reactor for Groundwater Remediation". Pittsburgh Cleveland Catalysis Society Fall Meeting, Cranberry Township, PA.

PUBLISHED CONFERENCE PROCEEDINGS AND ABSTRACTS

Fritjof Fagerlund, Manka Mittal, Tanapon Phenrat, , Hye-Jin Kim, Tissa Illangasekare, Gregory V. Lowry (**2009**). Dissolution of a Spatially Variable Non-Aqueous Phase Liquid Source: Experimental Study, Model Development and Upscaling. TOUGH Symposium 2009, Lawrence Berkeley National Laboratory (LBNL), September 14–16.

Li, Z., Gregory, K., Xiu, Z., Alvarez, P., Lowry, G. (**2009**). On the Prevention of Nanomaterial Toxicity Through Stabilization with Organic Particle Surface Coatings. AEESP Biannual Meeting, Iowa City, IA July 26-28.

Lowry, G., Phenrat, T., Kim, H., Tilton, R. (**2009**). The Strong Influence on NP Surface Coatings on Aggregation, Deposition, and Environmental Effects of NPs. AEESP Biannual Meeting, Iowa City, IA July 26-28.

Fairey, J., Wahman, D., Lowry, G. V. (**2009**). PCB sorption to activated carbon: Relevance of external mass transfer limitations and implications for sediment capping, Association of Environmental Engineering and Science Professors (AEESP), July 27.

Phenrat, T., Tilton, R., Lowry, G. (**2009**) Semi-empirical Correlation to Predict the Collision Efficiency of Natural Organic Matter (NOM) - and Polymer-coated Nanoparticles in Porous Media, International Conference on the Environmental Implications and Applications of Nanotechnology, UMASS, June 9-11, 2009.

Tissa Illangasekare, Tanapon Phenrat, Menka Mittal, Sidika Pinar Turkbey Cihan, Hye-Jin Kim, Fritjof Fagerlund, Gregory V. Lowry (**2009**). Roles of Particle Properties, Subsurface Geochemical/Geophysical/ Hydrological Conditions, and Delivery Strategies on the Emplacement of Polymeric Modified Nanoscale Zerovalent Iron (NZVI) for In situ Subsurface Remediation. *Eos Trans.* AGU, 90 (22), Jt. Assem. Suppl., Abstract H34A-03.

Brian Carl Reinsch, Greg V. Lowry, and Christopher S. Kim (**2009**). E XAFS investigation of the oxidation and Fe-oxide speciation of Fe0 Nanoparticles (NZVI) under geochemically relevant conditions. Division of Colloid Science and Environmental Chemistry for the 235th ACS National Meeting, Salt Lake City, UT March 22-26, 2009.

Gregory V. Lowry, Mark Wiesner, Elizabeth Casman (**2009**). Nano-mythbusting: common misconceptions regarding nanomaterial interactions with organisms and their toxicity. Division of Industrial & Engineering Chemistry for the 235th ACS National Meeting, Salt Lake City, UT March 22-26, 2009.

Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Robert D. Tilton, Gregory V. Lowry (**2009**). Transport Characteristics of Polyelectrolyte-modified Fe0 Nanoparticles at High Particle Concentration in Sand Columns. Presented at RemTec 2009, Atlanta, GA March 3-5, 2009.

Casman, E., Lowry, G., Wiesner, M. (**2009**). Rethinking environmental risk assessment for nanomaterials. Division of Industrial & Engineering Chemistry for the 235th ACS National Meeting, Salt Lake City, UT March 22-26, 2009.

Zongming Xiu, Zhaohui Jin, Gregory V. Lowry, Tielong Li, and Pedro J. Alvarez. (**2009**). Effect of nano zero-valent iron on TCE degradation by a mixed dechlorinating culture. Division of Industrial & Engineering Chemistry for the 235th ACS National Meeting, Salt Lake City, UT March 22-26, 2009.

Kim, H-J., Phenrat, T., Tilton, R., Lowry, G. (**2009**). Fe0 nanoparticles remain mobile in porous media after eight months aging due to slow desorption of polymeric surface modifiers. Division of Environmental Chemistry for the 235th ACS National Meeting, Salt Lake City, UT March 22-26, 2009.

Wiesner, M., Lowry, G. (**2009**). Myth-busting: Nanoparticle behavior in the environment. Division of Environmental Chemistry for the 235th ACS National Meeting, Salt Lake City, UT March 22-26, 2009.

Barbara Kutchko1, Brian Strazisar, Nicolas Huerta, Gregory Lowry, David Dzombak, Niels Thaulow (**2008**). Chemical Reactions of Wellbore Cement under CO_2 Storage Conditions: Effects of Cement Additives. *Eos Trans. AGU, 89(53),* Fall Meet. Suppl., Abstract . U44A-06.

Tissa Illangasekare, Fritjof Fagerlund, Menka Mittal, Pinar Cihan, Gregory V. Lowry, Tanapon Phenrat, Hye-Jin Kim (**2008**). Effects of DNAPL source morphology on contaminant mass transfer and the zone of effective treatment using nano-scale zero-valent iron. *Eos Trans. AGU, 89(53),* Fall Meet. Suppl., Abstract H34C-08.

Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Gregory V. Lowry (**2008**). Two-Dimensional Transport of Concentrated Dispersions of Polyelectrolyte-modified Fe0 Nanoparticles in Saturated Sand. *Eos Trans. AGU, 89(53),* Fall Meet. Suppl., Abstract H43E-1052.

Gregory V. Lowry, Tanapon Phenrat, Charlotte M. Cisneros, Daniel P. Schoenfelder, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Robert D. Tilton (**2008**). Correlation to Predict Collision Efficiency of Natural Organic Matter (NOM)- and Polymer-coated Nanoparticles in Porous Media. *Eos Trans. AGU, 89(53),* Fall Meet. Suppl., Abstract H52A-02.

Gregory V. Lowry, Tanapon Phenrat, Hye-Jin Kim, Fritjof Fagerlund, Tissa Illangasekare (**2008**). Effect of Aggregation, Hydrogeochemistry, and Clay on NZVI Emplacement in the Subsurface. SERDP Partners in Technology Meeting, Washington DC. December 2-4.

Craig Griffith, Greg Lowry, David Dzombak, Yee Soong, Sheila Hedges. (**2008**). Mineral and Physical Characteristics of Geological Seals at Sites Considered for CO2 Sequestration in Saline Reservoirs. 25th Annual International Pittsburgh Coal Conference, Pittsburgh, PA October 1, 2008.

Tanapon Phenrat, Robert D. Tilton, Gregory V. Lowry. (**2008**). A Correlation for Predicting Collision Efficiency of Colloidal Particles Coated with Natural Organic Matter (NOM) in Porous Media: The Role of Adsorbed NOM Layer Properties and Electrosteric Stabilization. ACS 82nd Colloids and Surface Science Symposium, NC State University, Raleigh, NC June 15-18, 2008.

Hye-Jin Kim, Navid Saleh, Tanapon Phenrat, Robert D. Tilton, and Gregory V. Lowry. (**2008**). Effect of pH and clay on the transport of anionic polyelectrolyte surface-modified NZVI in saturated sand columns. ACS 82nd Colloids and Surface Science Symposium, NC State University, Raleigh, NC June 15-18, 2008.

Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Gregory V. Lowry (**2009**). "Two-Dimensional Transport of Polyelectrolyte-Modified Fe0 Nanoparticles in Heterogeneous Saturated Sand: Effects of Particle Concentration, Excess Polymer, Fe0 Content, and Adsorbed Polymer Layer Properties" 13th IACIS International Conference on Surface and Colloid Science and 83rd ACS Colloid and Surface Science Symposium, Columbia University, NY, June 14-19, 2009.

Patricia L. Golas, Gregory V. Lowry, Robert D. Tilton, and Krzysztof Matyjaszewski. (**2008**). Preparation of Novel Polyelectrolyte Stabilizers for Iron Nanoparticles used in groundwater remediation. In the Proceedings of the Division of Polymer Chemistry for the 234th ACS National Meeting, Philadelphia, PA August, 2008.

F Fagerlund *, TH Illangasekare, T Phenrat, H-J Kim, G Lowry. (**2008**). Simultaneous DNAPL dissolution and dechlorination by nanoscale zero-valent iron particles. Presented at MODFLOW and More: Ground Water and Public Policy. Colorado School of Mines, Golden Colorado, May 19-21, 2008.

Julian L. Fairey, Kathleen M. McDonough, Gregory V. Lowry (**2008**). Biogeochemical Effects on the Performance of Activated Carbon Sediment Caps for in situ management of PCB-contaminated Sediments. Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 19-22.

Gregory V. Lowry, T. Phenrat, Dan Schoenfelder, Mark Losi, June Yi, Steven A. Peck (**2008**). NZVI Treatability Study for a TCE Source Area at Alameda Point, CA. Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 19-22.

Gregory V. Lowry, Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Robert D. Tilton (**2008**). Effect of Nanoparticle Aggregation, Polydispersity, and Concentration on Transport of Surface-Modified NZVI in Saturated Porous Media. Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 19-22.

Lowry, G., Phenrat, T., Kim, Hye-Jin, Tilton, R. (**2008**). Effect of adsorbed polyelectrolyte and humic acid on TCE dechlorination by Fe0/Fe-oxide nanoparticles. In the Proceedings of the Division of Environmental Chemistry for the 234th ACS National Meeting, New Orleans, LA April 6-10, 2008.

Phenrat, T., Kim, Hye-Jin, Tilton, R. Lowry, G. (**2008**). Developing a new model to predict the mobility of nanoparticles in the subsurface. In the Proceedings of the Division of Environmental Chemistry for the 234th ACS National Meeting, New Orleans, LA April 6-10, 2008.

Kim, Hye-Jin, Phenrat, T., Tilton, R. Lowry, G. (**2008**). Desorption of adsorbed polyelectrolytes from Fe0 nanoparticles. In the Proceedings of the Division of Environmental Chemistry for the 234th ACS National Meeting, New Orleans, LA April 6-10, 2008.

Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Robert D. Tilton, Gregory V. Lowry (**2007**). Effect of Nanoparticle Aggregation, Polydispersity, and Concentration on Transport of Surface-Modified Nanoscale Zerovalent Iron (NZVI) Particles in Saturated Porous Media. Hydrology Division, American Geophysical Union Fall Meeting, San Francisco, CA December 10-14. Eos Trans. AGU, 88(52), Fall Meet. Suppl., Abstract H51G-0853.

Gregory V. Lowry, Tanapon Phenrat, Fritjof Fagerlund, Hye-Jin Kim, Tissa Illangasekare, Robert D. Tilton (**2007**). Controlled placement of polyelectrolyte modified engineered nanomaterials in the subsurface: Correlating modifier layer properties and geochemistry with mobility. Hydrology Division, American Geophysical Union Fall Meeting, San Francisco, CA December 10-14. Eos Trans. AGU, 88(52), Fall Meet. Suppl., Abstract H54C-01 INVITED.

Barbara Kutchko, Brian Strazisar, Gregory Lowry, David Dzombak, Niels Thaulow (**2007**). Impact of Wellbore Cement Degradation on CO2 Storage Integrity. American Geophysical Union Fall Meeting, San Francisco, CA December 10-14. Eos Trans. AGU, 88(52), Fall Meet. Suppl., Abstract U43C-1398.

Tanapon Phenrat, Hye-Jin Kim, Robert Tilton, Fritjof Fagerlund, Tissa Illangesakera, Gregory V Lowry (**2007**). Polyelectrolyte-Modified Nanoscale Zerovalent Iron: Characteristics of the Adsorbed Polyelectrolyte Layer and Their Effects on Dispersion Stability and TCE Dechlorination. SERDP Partners in Technology Meeting, Washington, DC, December 4-6.

Hye-Jin Kim, Navid Saleh, Tanapon Phenrat, Robert D. Tilton, Fritjof Fagerlund, Tissa Illangasekare, Gregory V. Lowry (**2007**). Effect of pH, pore water velocity, grain size, and clay content on the transportability of surface-modified NZVI in saturated sand columns. SERDP Partners in Technology Meeting, Washington, DC, December 4-6.

Julian Fairey, Kathleen McDonnough, Gregory V Lowry (**2007**). Effects of Biogeochemical Factors on the Performance of in situ Activated Carbon Sediment Caps for PCB Sequestration. SERDP Partners in Technology Meeting, Washington, DC, December 4-6.

Gregory V. Lowry, T. Phenrat, D. Schoenfelder, Mark Losi and June Yi, Steven A. Peck (**2007**). NZVI Treatability Study for a TCE Source Area at Alameda Point, CA SERDP Partners in Technology Meeting, Washington, DC, December 4-6.

Fritjof Fagerlund, Tanapon Phenrat, Hye-Jin Kim, Tissa Illangesakera, Gregory V Lowry (**2007**). Nanoscale zero-valent iron treatment of a DNAPL source zone in sandy soils SERDP Partners in Technology Meeting, Washington, DC, December 4-6.

Fairey JL, McDonough KM, Lowry, GV. (**2007**). Evaluation of activated carbon for PCB sequestration in sediment caps: Batch isotherm tests, column studies, and the impact of dissolved organic carbon. Association of Environmental Engineering and Science Professors (AEESP) Education and Research Conference, July 27-August 1, 2007, Blacksburg, VA.

Hye-Jin Kim, Tanapon Phenrat, Navid Saleh1, Kevin Sirk, Robert D. Tilton, Gregory V. Lowry (**2007**). Desorption of Polyelectrolyte Coatings from Nanoscale Fe^0 Used for Environmental Remediation. ACS Division of Colloid and Surface Science, 81st Colloid & Surface Science Symposium. University of Delaware, Newark, DE, June 24-27, 2007.

Kevin M. Sirk, Navid B. Saleh, Tanapon Phenrat, Hye-Jin Kim, Gregory V. Lowry, and Robert D. Tilton. (**2007**). Amphiphilic Block Copolymer Surface Modification of Nanoscale Zero Valent Iron (NZVI) for Source Zone DNAPL Remediation. ACS Division of Colloid and Surface Science, 81st Colloid & Surface Science Symposium. University of Delaware, Newark, DE, June 24-27, 2007.

Tanapon Phenrat, Hye-Jin Kim, Navid Saleh, Kevin Sirk, Robert D.Tilton, and Gregory V. Lowry. (**2007**). Polyelectrolyte-Modified Nanoscale Zerovalent Iron : Characteristics of the Adsorbed Polyelectrolyte Layer and Dispersion Stability. ACS Division of Colloid and Surface Science, 81st Colloid & Surface Science Symposium. University of Delaware, Newark, DE, June 24-27, 2007.

Tanapon Phenrat, Yueqiang Liu, Hye-Jin Kim, Navid Saleh, Kevin Sirk, Robert D. Tilton, Gregory V. Lowry. (**2007**). Effect of adsorbed polyelectrolytes on TCE dechlorination and product distribution by Fe^0/Fe-oxide nanoparticles. In the Proceedings of the Division of Environmental Chemistry for the 233rd ACS National Meeting, Chicago, IL March 25-29, 2007.

Yueqiang Liu and Tanapon Phenrat, Gregory V. Lowry (**2007**). Effect of Groundwater Constituents on H_2 evolution and TCE reduction by reactive Fe^0/Fe-oxide nanoparticles. In the Proceedings of the

Division of Environmental Chemistry for the 233rd ACS National Meeting, Chicago, IL March 25-29, 2007.

Gregory V. Lowry, Hye-Jin Kim, Yueqiang Liu, Tanapon Phenrat1, Kris Matyjaszewski, Navid Saleh, Kevin Sirk, Robert D. Tilton. (**2007**). Functionalized Fe^0 nanoparticles for targeted in situ degradation of entrapped DNAPL. Division of Industrial Engineering & Chemistry for the 233rd ACS National Meeting, Chicago, IL March 25-29, 2007.

Tanapon Phenrat, Navid Saleh, Kevin Sirk, Hye-Jin Kim, Yueqiang Liu, Robert D. Tilton, Gregory V. Lowry (**2007**). Polyelectrolyte-Modified Nanoscale Zerovalent Iron: Characteristics of the Adsorbed Polyelectrolyte Layer and Dispersion Stability. Division of Colloid and Surface Chemistry for the 233nd ACS National Meeting, Chicago, IL March 25-29, 2007.

Saleh, N. B., Phenrat, T., Tilton, R.D., Lowry, G. V. (**2007**). Porewater velocity and collector grain size affects the mobility of surface-modified nanoiron in water-saturated porous media. Division of Colloid and Surface Chemistry for the 233nd ACS National Meeting, Chicago, IL March 25-29, 2007.

Julian L. Fairey, Kathleen M. McDonough, and Greg V. Lowry (**2007**). Performance of activated carbon amended sediment caps for PCB sequestration. Division of Colloid and Surface Chemistry for the 233nd ACS National Meeting, Chicago, IL March 25-29, 2007.

Lowry, G. and Liu, Y. **(2006)** Lifetime and Reactivity of NZVI in Groundwater. Partners in Environmental Technology Technical Symposium & Workshop, Washington, D.C. November 28-30, 2006.

Lowry, G.V., Navid Saleh, Tanapon Phenrat, Hye-jin Kim, Kevin Sirk, Robert D. Tilton, Tissa Illangasekare **(2006)**. Effects of Polymeric Surface Coatings on NZVI Mobility in Saturated Porous Media and Reactivity with TCE. Partners in Environmental Technology Technical Symposium & Workshop, Washington, D.C. November 28-30, 2006.

Lowry, G.V., Saleh, N., Phenrat, T., Liu, Y., Kim, H., Sirk, K., Matyjaszewski, K., Tilton, R. **(2006)**. Delivering Polymer-modified Fe0 Nanoparticles to Subsurface Chlorinated Organic Solvent DNAPL. US EPA Nanotechnology and the Environment: Applications and Implications Progress Review Workshop III, Washington D.C., November 8-9, 2006.

Lowry, G. V., Liu, Y. **(2006)**. Nanoiron: Reactant or Catalyst? In the Proceedings of the Division of Environmental Chemistry for the 232nd ACS National Meeting, San Francisco, CA, September 10-14, 2006.

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Lowry, G.V. **(1995)** "Kinetics of Enhanced Dechlorination of Trichloroethylene Using Zero-Valent Iron," M.S. Thesis, University of Wisconsin, Madison, WI.

PROFESSIONAL AFFILIATIONS

American Chemical Society (ACS)
American Society of Civil Engineers (ASCE)
Association of Environmental Engineering and Science Professors (AEESP)
Air & Waste Management Association (AWMA)
American Geophysical Union (AGU)

COLLABORATORS AND OTHER AFFILIATIONS (LAST 4 YEARS)

Alvarez, Pedro (Rice University), Diguilio, Rich (Duke), Dionysiou, Dion (University of Cincinnati), Dzombak, David (CMU), Hochella, Mike, (VT), Hughes, Joe (Georgia Tech), Illangasekare, Tissa (Colorado School of Mines), Johnson, Rick (OHSU), Jones, Kim (Howard), Keith, David (CMU), Kim, Christopher, (Chapman University), Majetich, Sara (CMU), Matyjaszewski, Krzysztof (CMU), Reible, Danny (University of Texas, Austin), Tratnyek, Paul (UHSU), Tilton, Robert (CMU), Wiesner, Mark (Duke University).

STUDENTS SUPERVISED

Current PhD students (6): Mei Sun, Brian Reinsch, Teresa Kirschling, Trish Golas, Craig Griffith (CMU/NETL), Hye-Jin Kim.
Current post docs (1): Tanapon Phenrat
Graduated PhD students (6): Navid Saleh (University of South Carolina-CEE), Sameer Khaitan (Cal Trans, SF, CA), Joshuah Stolaroff (AAAS Fellow, Washington, DC), Yueqiang Liu (Weston Solutions, NH) Barbara Kutchko (DOE-NETL) Tanapon Phenrat (Post Doc-CMU)
Graduated MS students (4): Kathleen Johnson (SAIC, Las Vegas, NV), Paul Murphy (NY City Dept. of Education), Raghunuth Kurnool (Langan I Eng. & Env. Services, NJ), Karl Greden
Recent Post docs (2): Kathleen McDonough (Retec/ENSR, Pittsburgh, PA), Julian Fairey (U. Arkansas-CEE)
Sixteen graduate students total (4 M.S., 12 Ph.D.)
Three post docs total