

Orlando, T. M., Petrik, N. G., Alexandrov, A. B., & Simpson, W. C. (1999, Feb. 26). Nonthermal processes on oxide surfaces and interfaces. Invited presentation at the Department of Chemistry, University of Utah. Salt Lake City, UT.

Orlando, T. M., Petrik, N. G., Alexandrov, A. B., & Simpson, W. C. (1999, Feb. 24-25). Nonthermal processes on oxide surfaces and interfaces. DOE Laboratory Catalysis Research Symposium. Albuquerque, NM.

Orlando, T. M., Petrik, N. G., Alexandrov, A. B., & Simpson, W. C. (1999, Feb. 24). Nonthermal processes on oxide surfaces and interfaces. Invited presentation at the Los Alamos National Laboratory. Los Alamos, NM.

Orlando, T. M., Petrik, N., Marshman, S., & Camaioni, D. M. (1999, Nov. 14-18). Nonthermal surface processes in the generation of gas in mixed wastes. Invited presentation at the Annual Meeting of the American Nuclear Society. Long Beach, CA.

Petrik, N., Marshman, S., Camaioni, D. M., & Orlando, T. M. (1999, Aug. 22-26). Nonthermal surface and interface processes in the storage of spent nuclear fuel and mixed wastes. Annual Symposium on First Accomplishments of the Environmental Management Science Program. American Chemical Society. New Orleans, LA.

SUBSURFACE CONTAMINATION

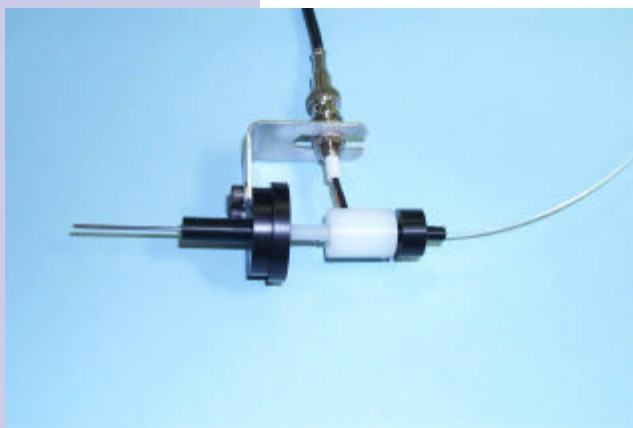
Actinide (Heavy Element) Chemistry

Project: 70050

Title: Novel Optical Detection Schemes for In-Situ Mapping of Volatile Organochlorides in the Vadose Zone

PI: Dr. S. Michael Angel

Institution: University of South Carolina



Prototype coaxial fiber/electrode REMPI probe. [see Project #70050]

Publication Type: Poster

Chinni, R. C., et. al. (2000, Sept.). Resonance-enhanced multiphoton ionization (REMPI) measurements using visible excitation and a compact integrated fiber-optic probe. Federation of Analytical Chemistry and Spectroscopy Societies (FACSS). Nashville, TN.

Publication Type: Presentation

Angel, S. M., et. al. (2000, Nov. 28-30). In-situ resonance-enhanced multiphoton ionization (REMPI) measurements using a fiber-optic probe. FY2001 EMSP Vadose Zone Principal Investigator Workshop. Pacific Northwest National Laboratory. Richland, WA.

Angel, S. M., et. al. (2000, Oct. 12). In-situ resonance-enhanced multiphoton ionization (REMPI) measurements using a fiber optic probe. Invited plenary lecture at the The Tenth International Symposium on Resonance Ionization Spectroscopy & Its Applications (RIS-2000).

Chinni, R. C., et. Al. (2000, Sept.). Fiber-optic resonance-enhanced multiphoton ionization (REMPI) analyses of volatile organic compounds using visible excitation. Paper #SE06-03. The International Society for Optical Engineering (SPIE Opto Southeast). Charlotte, NC.

Chinni, R. C., et. al. (2001, Mar.). A miniature fiber-optic resonance-enhanced multiphoton ionization probe (REMPI) with no focusing optics. Paper #734, The Pittsburgh Conference & Exposition (PiitCon). New Orleans, LA.

Publication Type: Proceeding

Angel, S. M., et. al. (2000, Oct.). In-situ resonance-enhanced multiphoton ionization (REMPI) measurements using an optical fiber probe. Resonance Ionization Spectroscopy 2000. Proceedings of the Tenth International Symposium. Knoxville, TN.

Project: 70132 (Renewal of Project No. 54683)

Title: Speciation, Mobility and Fate of Actinides in the Groundwater at the Hanford Site

PI: Dr. Ken O. Buesseler

Institution: Woods Hole Oceanographic Institute

Publication Type: Journal

Dai, M., et al. (1999, in press). Size fractionated Pu isotopes in a coastal environment. *J. Environmental Radioactivity*.

Yue, Y. K., Wang, J. J., & Dai, M. (2000, Jul. 25). Volumetric and fluorescence studies of aqueous solutions containing n-octylamine, cetyltrimethylammonium bromide, and salt. *Langmuir*. 16(15), 6114-6117.

Publication Type: Presentation

Buesseler, K. O., et. al. (1999, Nov. 16-18). Speciation, mobility, and fate of actinides in the groundwater at the Hanford Site. EMSP PI workshop.

Dai, M., et al. (1998, May). Size fractionated Pu isotopes in the ocean, a pond and groundwater. AGU Spring Meeting, Boston, MA. EOS. 79(17), 138.

Dai, M., et al. (1999, May). Isotopic composition, speciation and mobility of Pu in the groundwater at DOE Savannah River Site. AGU Spring meeting. Boston, MA.

Dai, M.H., et. al. (1998, July 27- 30). Size fractionated Pu isotopes in surface and subsurface waters. American Chemical Society DOE Environmental Management Science Program Workshop. Chicago, IL.

Repeta, D.J., Quan, T. M., Aluwihare, L. I., & Accardi, A. (1999). Dissolved organic matter in fresh and marine waters. Amer. Soc. Limnol. Oceanogr. Annual meeting. Santa Fe, NM.

Project: 70176

Title: Transuranic Interfacial Reaction Studies on Manganese Oxide Hydroxide Mineral Surfaces

PI: Dr. Heino Nitsche

Institution: Lawrence Berkeley National Laboratory

Publication Type: Poster

Nitsche, H., Serne, R. J., Shaughnessy, D. A., Shuh, D. K., & Waychunas, G. A. (2000, Apr. 24-28). Transuranic interfacial reaction studies on manganese oxide hydroxide mineral surfaces. Environmental Management Science Program National Workshop, Atlanta, GA.

Shaughnessy, D. A., et. al. (2000, Aug. 20-24). Interfacial reaction studies of plutonium with manganese oxide hydroxide mineral surfaces (Abstract No. ENVR227). 220th National Meeting of the American Chemical Society, Washington, D. C.

Publication Type: Presentation

Nitsche, H. (2000, Apr. 24-28). Actinides and the environment: The challenge for interdisciplinary research (Abstract No. NUCL30). Chemical and Nuclear Properties of the Heaviest Elements: A Symposium in Memory of Glenn T. Seaborg, 220th National Meeting of the American Chemical Society, Washington D. C.

Project: 73819 (Renewal of Project No. 59996)

Title: Plutonium Speciation, Solubilization, and Migration in Soils

PI: Dr. Mary P. Neu

Institution: Los Alamos National Laboratory

Publication Type: Presentation

Neu, M. P. (1999, Sep. 26-30). The migration behavior of colloidal CE, Eu, Zr, and ionic Am and Np in selected solid-matrix materials. Presentation at Migration-99.

Neu, M. P. (1999, Sep. 26-30). Transport behavior of ionic and colloidal forms of plutonium. Presentation at Migration-99.

Analytical Chemistry & Instrumentation

Project: 54639

Title: Development of an In-Situ Microsensor for the Measurements of Chromium and Uranium in Groundwater at DOE Sites

PI: Dr. Joseph Wang

Institution: New Mexico State University

Publication Type: Journal

Daniele, S., Bragato, C., Baldo, M. A., Wang, J., & Lu, J. (2000, Apr.). The use of a remote stripping sensor for determination of copper and mercury in the Lagoon of Venice. *Analyst*. 125(4), 731-735.

Daniele, S., Bragato, C., Wang, J., & Lu, J. (2000). Remote stripping sensor for determining copper in the lagoon of Venice. 125, 731.

Wang, J. (1997). Remote electrochemical sensors. *Trends Anal. Chem.* 16, 84.

Wang, J. (2000). From remote sensors to submersible labs. Invited paper in *Lab. Robotics and Automation*. 12, 178.

Wang, J., Adeniyi, W., & Kounaves, S. (2000). Adsorptive stripping analysis of trace nickel at iridium-based ultramicroelectrode arrays. *Electroanalysis*. 12, 44.

Wang, J., Bhada, R., Lu, J., & MacDonald, D. (1998). Remote sensor for monitoring TNT in natural waters. *Anal. Chim. Acta*. 361, 85.

Wang, J., et. al. (1997). Adsorptive stripping measurements. *Anal. Chem.* 69, 1657.

Wang, J., et. al. (1997). Renewable reagent electrochemical sensor for monitoring trace metals. *Anal. Chem.* 69, 2640.

Wang, J., et. al. (1997). Simultaneous adsorptive stripping voltammetric measurements of trace chromium, uranium, and iron. *Electroanalysis*. 9, 1247.

Wang, J., et. al. (2000). Lab-on-a-cable for monitoring priority contaminants. *Anal. Chem.* 71, 2659.

Wang, J., Grundler, P., Jasinski, M., & Tian, B. (1999). Hot-wire stripping potentiometric measurements of trace mercury. *Anal. Chim. Acta*. 396, 33.

Wang, J., Lou, D., & Horiuchi, T. (1998). Anodic stripping with collection at integrated carbon film microelectrode arrays. *Electroanalysis*. 10, 107.

Wang, J., Lu, J., Hocesvar, S., Farias, P., & Ogorevc, B. (2000). Bismuth-coated carbon electrodes for anodic stripping voltammetry. 72, 3218.

Wang, J., Lu, J., Luo, D., & Tian, B. (1997). Simultaneous measurements of trace Cr and U using mixed ligand stripping analysis. *Anal. Chim. Acta.* 354, 275.

Wang, J., Lu, J., MacDonald, D., & Augelli, M. (1999). In-situ flow probe for improving the performance of electrochemical stripping analysis. Invited paper in *Fres. Z. Anal. Chem.* 364, 28.

Wang, J., Lu, J., Tian, B., MacDonald, D., & Olsen, K. (1999). Flow probe for in-situ electrochemical monitoring of trace chromium. *Analyst.* 124, 349.

Wang, J., Tian, B., & Lu, J. (1998). Electrochemical flow sensor for in-situ monitoring of total metal concentration. *Anal. Communications.* 35, 241.

Wang, J., Tian, B., Lu, J., & Luo, D. (1998). Renewable reagent enzyme inhibition biosensor for remote monitoring of cyanide. *Electroanalysis.* 10, 1034.

Wang, J., Tian, B., Lu, J., & MacDonald, D. (1998). Remote electrochemical sensor for monitoring trace mercury. *Electroanalysis.* 10, 399.

Wang, J., Tian, B., Lu, J., Olsen, K., & Yarnitsky, C. (1999). Stripping analysis into the 21st century: Faster, smaller, simpler, and better. *Anal. Chim. Acta.* 385, 429.

Publication Type: Patent

Wang, J. & Olsen, K. (1997) Remote Electrochemical Sensor. U.S. Patent No. 5,676, 820.

Wang, J. & Olsen, K. (1997). Remote electrochemical sensor. US5676820.

Wang, J. & Olsen, K. (1999). Renewable Electrochemical Sensors. U.S. Patent No. 5,942, 103.

Wang, J. & Olsen, K. (1999). Renewable electrochemical sensors. US5942103.

Project: 55108

Title: Monitoring Genetic & Metabolic Potential for In Situ Bioremediation: Mass Spectrometry

PI: Dr. Michelle V. Buchanan

Institution: Oak Ridge National Laboratory

Publication Type: Journal

Costello, A. M. & Lidstrom, M. E. (1999, Nov.). Molecular characterization of functional and phylogenetic genes from natural populations of methanotrophs in lake sediments. *Appl. Env. Microb.* 65(11), 5066-5073.

Hurst, G. B., et. al. (1998). MALDI-TOF analysis of polymerase chain reaction products from methanotrophic bacteria. *Analytical Chemistry*. 70, 2693-2698.

Publication Type: Poster

Buchanan, M. V., et. al. (2000, Apr. 24-28). Monitoring genetic and metabolic potential for in situ bioremediation: Mass spectrometry. Poster presentation at the 2nd Annual Environmental Management Science Program Workshop, Atlanta, GA.

Hurst, G. B., et. al. (1998, Jan. 24-27). TOF-MS detection of PCR products. Poster presentation at the 10th Sanibel Conference on Mass Spectrometry. Sanibel Island, FL.

Hurst, G. B., Kim, Y., Weaver, K., & Buchanan, M. V. (1999, Jan. 12-16). PCR product size measurement using MALDI mass spectrometry. Poster presentation at the 7th DOE Human Genome Contractor-Grantee Workshop. Oakland, CA.

Hurst, G. B., Weaver, K., Buchanan, M. V., & Doktycz, M. J. (1997, Jun. 1-5). Analysis of PCR products using delayed-extraction MALDI-TOF. Proceedings of the 45th ASMS Conference on Mass Spectrometry and Allied Topics. Palm Springs, CA. 843.

Publication Type: Presentation

Buchanan, M. V., et. al. (1998, Jul. 27-30). Monitoring genetic and metabolic potential for in situ bioremediation: Mass spectrometry. Proceedings of the DOE Environmental Management Science Program Workshop. Chicago, IL. 252-253.

Hurst, G. B. (1999, Nov. 5-6). Characterization of bacteria using mass spectrometric detection of polymerase chain reaction products. Presentation at the 7th Symposium on Laser Spectroscopy at the Korea Atomic Energy Research Institute.

Hurst, G. B., et. al. (1999, Sep. 22). Monitoring genetic and metabolic potential for in situ bioremediation: Mass spectrometry. Presentation at the DOE-ORO EMSP Workshop, Oak Ridge, TN.

Kim, Y., Hurst, G. B., Doktycz, M. J., & Buchanan, M. V. (1999, Jun. 13-18). Improved spot homogeneity for DNA MALDI matrices. Proceedings of the 47th ASMS Conference on Mass Spectrometry and Allied Topics. Dallas TX.

Publication Type: Proceeding

Hurst, G. B., et. al. (1998, May 31 - Jun. 4). Identification of methanotrophic bacteria using the polymerase chain reaction with MALDI-TOF detection. Proceedings of the 46th ASMS Conference on Mass Spectrometry and Allied Topics. Orlando FL. 1202.

Hurst, G. B., Weaver, K., & Buchanan, M. V. (1997, Nov. 9-13). Improved mass spectrometric resolution for PCR product size measurement. Proceedings of the DOE Human Genome Program Contractor-Grantee Workshop VI, Santa Fe, NM. 39.

Weaver, K., Doktycz, M. J., Britt, P. F., Hurst, G. B., & Buchanan, M. V. (1998, May 31 - Jun. 4). 96-well microtiter-format purification of DNA for MALDI-TOF analysis. Proceedings of the 46th ASMS Conference on Mass Spectrometry and Allied Topics. Orlando FL. 1017.

Publication Type: Theses/Dissertations

Auman, A. (1999). Soluble methane monooxygenase-containing methanotrophs in lake Washington. Lidstrom, M. E. (Advisor). PhD dissertation at the Microbiology Department, University of Washington. Seattle, WA.

Costello, A. (1999, Apr.). Characterization of methanotrophic populations in lake Washington. Lidstrom, M. E. (Advisor). PhD dissertation at the California Institute of Technology, Environmental Engineering Science Department.

Project: 55328

Title: Novel Analytical Techniques Based on an Enhanced Electron Attachment Process

PI: Dr. Lal A. Pinnaduwege

Institution: University of Tennessee at Knoxville

Publication Type: Journal

Ding, W., McCorkle, D. L., & Pinnaduwege, L. A. (1998). Enhanced negative ion formation by electron attachment to highly-excited molecules in a flowing plasma. *J. Appl. Phys.* 84, 3051.

Ding, W., Pinnaduwege, L. A., Tav, C., & McCorkle, D. L. (1999, Aug.). The role of high Rydberg states in enhanced O-formation in a pulsed O₂ discharge. *Plasma Sources Sci. T.* 8(3), 384-391.

Mabel, A. M., Lin, S. H., & Pinnaduwege, L. A. (1998). Potential energy surfaces of H₂. *Chem. Phys. Lett.* 285, 114.

Nagesha, K. & Pinnaduwege, L. A. (1998). O-formation from O₂ via Rydberg-Rydberg electron transfer. *J. Chem. Phys.* 109, 7124.

Nagesha, K. & Pinnaduwege, L. A. (1999, Oct. 15). Magnetic and electric field induced enhancements in laser-induced anion formation. *Chem. Phys. Lett.* 312(1), 19-27.

Pinnaduwege, L. A. & Zhu, Y. (1997). Long-time stability of superexcited high-Rydberg molecular states. *Chem. Phys. Lett.* 277, 147.

Pinnaduwege, L. A. & Zhu, Y. (1998). High-Rydberg fragment formation via core dissociation of superexcited Rydberg molecules. *J. Chem. Phys.* 108, 6633.

Pinnaduwege, L. A., et. al. (1999). Enhanced electron attachment to Rydberg states in molecular hydrogen volume discharges. *J. Appl. Phys.* 85, 7064.

Pinnaduwege, L. A., McCorkle, D. L., & Ding, W. (1997, Dec. 22). Enhanced electron attachment to highly excited molecules using a plasma mixing scheme. *Appl. Phys. Lett.* 71(25), 3634-3636.

Pinnaduwege, L. A., Nagesha, K., Zhu, Y., Buchanan, M. V., & Hurst, G. B. (1999, Oct. 28). Laser-enhanced negative ion mass spectroscopy for weakly electron-attaching species. *Int. J. Mass. Spectrom.* 193(1), 77-86.

Tav, C. & Pinnaduwege, L. A. (2000, in press). Enhanced dissociative electron attachment to laser-excited benzene. *Journal of Applied Physics*.

Publication Type: Presentation

Ding, W. X., Pinnaduwege, L. A., Tav, C., & McCorkle, D. L. (1999, Mar. 20-26). O formation by electron attachment to high Rydberg states. Presentation at the 1999 Centennial Meeting of the American Physical Society. Atlanta, GA.

Nagesha, K. & Pinnaduwege, L. A. (1999, Oct. 5-8). Magnetic and electric field induced enhancements in laser induced anion formation. 52nd Annual Gaseous Electronics Conference. Norfolk, Virginia.

Pinnaduwege, L. A. (1997, Jun. 29-Jul. 7). Implications of electron attachment to highly-excited states in pulsed power discharges. 11th IEEE Pulsed Power Conference. Baltimore, MD.

Pinnaduwege, L. A. (2000, Jun. 19-21). Novel analytical techniques based on an enhanced electron attachment process. Presentation at the Environmental Management Science Program Sensors Initiative Workshop, Idaho Falls, ID.

Pinnaduwege, L. A. (2000, Oct. 24-27). Electron attachment to Rydberg states and its implications for low-temperature plasmas. Invited presentation at the 53rd Annual Gaseous Electronics Conference, Houston, TX.

Pinnaduwege, L. A., Buchanan, M. V., & Hurst, G. B. (1998, Jul. 27-30). Novel analytical techniques based on an enhanced electron attachment process. Presented at the Environmental Management Science Program Workshop. Chicago, IL.

Pinnaduwege, L. A., Buchanan, M. V., & Hurst, G. B. (2000, Apr. 24-28). Novel analytical techniques based on an enhanced electron attachment process. Presentation at the Environmental Management Science Program Workshop, Atlanta, GA.

Pinnaduwege, L. A., Ding, W. & McCorkle, D. L. (1999, Oct. 5-8). Negative ion formation in pulsed plasmas. 52nd Annual Gaseous Electronics Conference. Norfolk, VA.

Pinnaduwege, L. A., Ding, W. X., & McCorkle, D. L. (1999, Mar. 20-26). Enhanced electron attachment to Rydberg states in molecular hydrogen volume discharges. Presentation at the 1999 Centennial Meeting of the American Physical Society. Atlanta, GA.

Pinnaduwege, L. A., Ding, W. X., & McCorkle, D. L. (1998, Jun. 27 - Jul. 3). Enhanced electron attachment to superexcited Rydberg states of molecular hydrogen using a plasma mixing scheme. Pavlo, P. (Ed.), Proceedings of the 1998 International Congress on Plasma Physics. Prague, Czech Republic. 129-132.

Pinnaduwege, L. A., Ding, W. X., McCorkle, D. L., & Ma, C. Y. (1999, Jun. 27-30). Implications of electron attachment to highly-excited states of molecules and its applications in pulsed plasmas. 12th IEEE Pulsed Power Conference. Monterey, CA.

Tav, C. & Pinnaduwege, L. A. (1999, Oct. 5-8). Dissociative electron attachment to laser-excited benzene. 52nd Annual Gaseous Electronics Conference. Norfolk, VA.

Zhu, Y. & Pinnaduwege, L. A. (1997, Oct. 6-9). Long-time stability of superexcited high Rydberg molecular states. 50th Annual Gaseous Electronics Conference. Madison, WI.

Publication Type: Proceeding

Pinnaduwege, L. A., Ding, W. X., & McCorkle, D. L. (1999). Enhanced electron attachment to superexcited Rydberg states of molecular hydrogen using a plasma mixing scheme. Pavlo, P. (Ed). Proceedings of the 1998 International Congress on Plasma Physics. Prague, Czech Republic. 129-132.

Pinnaduwege, L. A. (1997, Jun. 29 - Jul. 2). Implications of electron attachment to highly-excited states in pulsed power discharges. Cooperstein, G. & Vitkovitsky, I. (Eds.). Digest of Technical Papers of the 11th IEEE Pulsed Power Conference held in Baltimore, MD. IEEE Publishing Services, New York, NY. 1048-1053.

Pinnaduwege, L. A., Ding, W. X., McCorkle, D. L., & Ma, C. Y. (1999). Enhanced electron attachment to highly-excited molecules and its applications in pulsed plasmas. Digest of Technical Papers of the 12th IEEE Pulsed Power Conference, IEEE Publishing Services, New York, NY. 1322-1325.

Publication Type: Theses/Dissertations

Tav, C. (2000, Aug.). Enhanced electron attachment to vibrationally and electronically excited molecules. PhD dissertation.

Project: 70010 (Renewal of Project No. 54674)

Title: Spectroelectrochemical Sensor for Technetium Applicable to the Vadose Zone

PI: Dr. William R. Heineman

Institution: University of Cincinnati

Publication Type: Presentation

Bryan, S. A., et. al. (2000, Aug.). Selective ion-exchange films for technetium sensors. 220th American Chemical Society National Meeting. Washington, D. C.

Conklin, S., Heineman, W. R., & Seliskar, C. J. (2000, May 16-19). Evaluation of silica composites containing quarternized poly(4-vinylpyridine) as an anion exchanger of pertechnetate, TcO₄ ions for use in chemical sensors. 32nd American Chemical Society Central Regional Meeting (CMACS). Covington, KY.

Heineman, W. R. (2000, Apr. 29). Strategies for new chemical sensors. Sensor Technology for the New Millenium Symposium. University of Pittsburgh. Pittsburgh, PA.

Heineman, W. R. (2000, Jun. 4-9). Strategies for new chemical sensors. 3rd Mediterranean Basin Conference on Analytical Chemistry (MBCAC III). Antalya, Turkey.

Heineman, W. R. (2000, Sept. 19-20). Chemical sensors for monitoring during stewardship. Post Closure Stewardship Technology Needs Meeting. University of Cincinnati. Cincinnati, OH.

Heineman, W. R., et. al. (2000, Jun. 11-15). Combining electrochemistry and spectroscopy into a single sensor. 8th International Conference on ElectroAnalysis (ESEAC/SEAC 2000). Bonn, Germany.

Heineman, W. R., Seliskar, C. J., Bryan, S. A., & Hubler, T. L. (2000, Apr. 24-27). Spectroelectrochemical sensor for Ferrocyanide and Technetium. Environmental Management Science Program National Workshop. Atlanta, GA.

Maizels, M., et. al. (2000). Novel spectroelectrochemical sensor for ferrocyanide in Hanford waste simulant. In Eller, P. G. & Heineman, W. R. (Eds.). Nuclear Site Remediation: First Accomplishments of the Environmental Management Science Program. American Chemical Society Symposium Series. 778. Washington, D. C.

Rarog, T., Seliskar, C. J., & Heineman, W. R. (2000, May 16-19). Cu²⁺ bait and switch sensor. 32nd American Chemical Society Central Regional Meeting (CMACS). Covington, KY.

Zudans, I., Seliskar, C. J., & Heineman, W. R. (2000, May 16-19). Optical study of thin sol-gel films on ITO for spectroelectrochemical sensor. 32nd American Chemical Society Central Regional Meeting (CMACS). Covington, KY.

Publication Type: Theses/Dissertations

Maizels, M. (2000). Spectroelectrochemical sensor for technetium applicable to the vadose zone. PhD. Dissertation. University of Cincinnati. Cincinnati, OH.

Ross, S. (2000). Spectroelectrochemical sensor for technetium applicable to the vadose zone. PhD. Dissertation. University of Cincinnati. Cincinnati, OH.

Wanamaker, M. (2000). Spectroelectrochemical sensor for technetium applicable to the vadose zone. Masters Thesis. University of Cincinnati. Cincinnati, OH.

Project: 70179

Title: Radionuclide Sensors for Water Monitoring

PI: Dr. Jay W. Grate

Institution: Pacific Northwest National
Laboratory

Publication Type: Journal

DeVol, T. A., Duffey, J. M., & Paulenova, A. (2001, in press). Combined extraction chromatography and scintillation detection for on-line and off-line monitoring of strontium in aqueous solutions. *J. Radioanalytical and Nuclear Chemistry*. 249(2).

DeVol, T. A., Egorov, O. B., Roane, J. B., Paulenova, A., & Grate, J. W. (2001, in press). Extractive scintillating microspheres for ⁹⁹Tc quantification in aqueous solutions. *J. Radioanalytical and Nuclear Chemistry*. 249(1).

DeVol, T. A., Roane, J. E., Williamson, J. M., Duffey, J. M., & Harvey, J. T. (2000). Development of scintillating extraction media for separation and measurement of charged-particle emitting radionuclides in aqueous solutions. *Radioactivity and Radiochemistry*, 11(1), 34-46.

Tan, H., Fjeld, R. A., & DeVol, T. A. (2000, in press). Digital alpha/beta pulse shape discrimination of CsI: Tl for on-line measurement of aqueous radioactivity. *IEEE Trans. Nucl. Sci.*

Publication Type: Presentation

DeVol, T. A. (2000, May 16). Chromatographic separation and measurement of charged-particle emitting radionuclides. Invited speaker at Eichrom Technologies, Inc. Eastern Users' Group Workshop, Augusta, GA.

DeVol, T. A., Duffey, J. M., & Paulenova, A. (2000, Sep. 24-28). Combination extraction chromatography and scintillation detection resin for quantification of strontium in aqueous solutions. *Spectrum 2000*, Chattanooga, TN.

DeVol, T. A., Duffey, J. M., & Paulenova, A. (2000, Apr. 9-14). Combined extraction chromatography and scintillation detection for on-line and off-line monitoring of strontium in aqueous solutions. Fifth International Conference on Methods and Applications of Radioanalytical Chemistry (MARC V), Kailua-Kona, HI.

DeVol, T. A., Egorov, O. B., Roane, J. E., Paulenova, A., & Grate, J. W. (2000, Jul. 16-21). Extractive scintillating microspheres for $^{89,90}\text{Sr}$ quantification in aqueous solutions. Gordon Conference on Nuclear Waste and Energy, New London, NH.

DeVol, T. A., Egorov, O. B., Roane, J. E., Paulenova, A., & Grate, J. W. (2000, Apr. 9-14). Extractive scintillating microspheres for ^{99}Tc quantification in aqueous solutions. Fifth International Conference on Methods and Applications of Radioanalytical Chemistry (MARC V), Kailua-Kona, HI.

Egorov, O. B. & Grate, J. W. (2000, Nov. 12-17). Automated radionuclide separations, analysis, and sensing. Invited presentation at the 46th Annual Conference on Bioassay, Analytical, and Environmental Radiochemistry. Seattle, WA.

Tan, H. & DeVol, T. A. (2000, Jun. 24-29). Development of a digital alpha/beta pulse shape discriminating system utilizing CsI(Tl) /photodiode. 44th Annual Meeting of the Health Physics Society, Denver, CO.

Project: 73808 (Renewal of Project No. 60197)

Title: Microsensors for In-Situ Chemical, Physical, & Radiological Characterization Mixed Waste

PI: Dr. Thomas G. Thundat

Institution: Oak Ridge National Laboratory

Publication Type: Journal

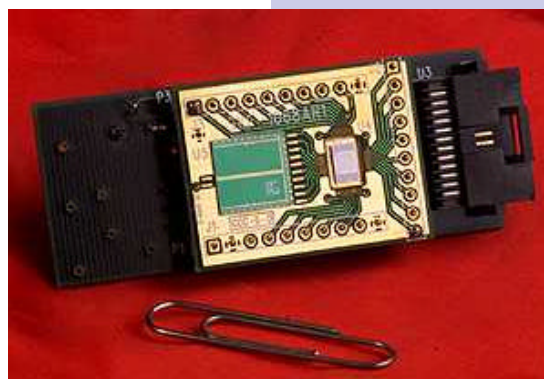
Ji, H. - F., et. al. (2000). A novel self-assembled monolayer (SAM) coated microcantilever for low level caesium detection. *Chem. Commun.* 6, 457-458.

Thundat, T. G. & Maya, L. (1999). Monitoring chemical and physical changes on sub-nanogram quantities of platinum oxide. *Surf. Sci. Lett.* 430, L546.

Publication Type: Patent

Ji, H.- F., Thundat, T. G., Brown, G. M., Britt, P. F., & Dabestani, R. (2000). Microcantilever ion sensors. (invention disclosure submitted).

Thundat, T. G. & Doktycz, M. J. (2000). Micromechanical scanning differential calorimeter. ESID-1777-X (all claims allowed).



The photograph is a working device of a microcantilever array with 10 individual cantilever elements. All the signal processing electronics is right on the chip. With a battery this device will be able to sense 10 different analytes simultaneously. [see Project #73808, renewal of #60197]

Thundat, T. G. & Wachter, E. A. (2000). Tunable frequency cantilevers. ESID-1739-X (patent pending).

Thundat, T. G. (2000). Micro-mechanical potentiometric sensors. U. S. Patent # 6,016,689.

Thundat, T. G. (2000). Micro-mechanical potentiometric sensors. ERID-0235, (all claims allowed).

Thundat, T. G. (2000). Microcantilever detector for landmines, unexploded ordances, and explosives. U. S. Patent # 5,918,263.

Thundat, T. G. (2000). Uncoated microcantilevers as chemical sensors. ERID-0545 (all claims allowed).

Thundat, T. G., Datskos, P. G., & Oden, P. I. (2000). Noncontact infrared thermometer and IR detection without emissivity correction. U. S. Patent # 6,050,722.

Thundat, T. G., Oden, P. I., & Datskos, P. G. (2000). Wavelength dispersive infrared detector and spectrometer using microcantilevers. (patent pending).

Thundat, T. G., Oden, P. I., Warmack, R. J., & Finot, E. L. (2000). Micromechanical transient sensor for measuring viscosity and specific gravity. ERID-0516 (patent pending).

Thundat, T. G., Warmack, R. J., & Wachter, E. A. (2000). Electromagnetic and nuclear radiation detector using micromechanical sensors. ESID-1604 (all claims allowed).

Publication Type: Presentation

Thundat, T. G. (1997). Microcantilever array sensors. Materials Science Dept. Colloquium, University of Illinois - Urbana, Urbana, IL.

Thundat, T. G. (1997). Microcantilever sensors. 37th ORNL-DOE Conference on Analytical Chemistry in Energy Technology, Gatlinburg, TN.

Thundat, T. G. (1997). Micromechanical array sensors. Alabama Materials Research Society Meeting, Huntsville, AL.

Thundat, T. G. (1998). Imaging and non-imaging applications of scanning probe microscopy. UT Materials Science Dept., Knoxville, TN.

Thundat, T. G. (1998). Micromechanical array sensors for chemical and biological detection. University of Bourgogne, Laboratoire de Photoelectricite, Dijon, France.

Thundat, T. G. (1999). Chemical, physical, biological detection using microcantilevers. Columbus Section American Chemical Society Meeting, Columbus, OH.

Thundat, T. G. (1999). Microcantilever chemical sensors. Micro Nano Technology Conference, Pasadena, CA.

Thundat, T. G. (1999). Microcantilever sensors. Materials Sciences Dept., Ohio State University, Columbus, OH.

Thundat, T. G. (1999). Micromechanical chemical and biological sensors. University of California, Berkeley, CA.

Thundat, T. G. (2000). Microcantilever sensors. 2nd Annual Environmental Management Science Program National Workshop, Atlanta, GA.

Thundat, T. G. (2000). Microcantilever sensors. DOE BES Workshop on Nanotechnology, University of California, Berkeley, CA.

Thundat, T. G. (2000). Microsensors for in-situ chemical, physical, and radiological characterization of mixed waste. 2nd Annual Environmental Management Science Program National Workshop, Atlanta, GA.

Thundat, T. G., Hu, Z., Chen, G. Y., & Warmack, R. J. (1999). Elastic effects of coating films on resonance response of microcantilevers. 1999 APS March Meeting, Atlanta, GA.

Thundat, T. G., Oden, P. I., & Warmack, R. J. (1998). Microcantilever array sensors. WATTEC-98, Knoxville, TN.

Thundat, T. G., Oden, P. I., Doktycz, M. J., & Warmack, R. J. (1998). Micromechanical sensors. Gordon Research Conference, New England College, Henniker, NH.

Thundat, T. G., Oden, P. I., Warmack, R. J., & Brown, G. M. (1998). Microcantilever sensors for environmental monitoring. Electrochemical Society Meeting, San Diego, CA.

Publication Type: Proceeding

Hu, Z., Thundat, T. G., & Warmack, R. J. (2000). Metal coated microcantilever hydrogen and mercury sensors. Butler, M., Yamazoe, N., Vanysek, P., & Aizawa, M. (Eds). Chemical Sensors IV, ECS Proceedings 99-23, 347-354.

Thundat, T. G., et. al. (2000). Highly selective microcantilever sensor for Cs ion detection. Butler, M., Yamazoe, N., Vanysek, P., & Aizawa, M. (Eds.). Chemical Sensors IV, ECS Proceedings 99-23, 314-319.

Publication Type: Theses/Dissertations

Hu, Z. (2000, May). Chemo-electro-mechanical properties by microcantilever sensors. Ph. D. dissertation.

Biogeochemistry**Project: 54790**

Title: Microbial Mineral Transformations at the Fe(II)/Fe(III) Redox Boundary for Solid Phase Capture of Strontium and Other Metal/Radionuclide Contaminants

PI: Dr. F. Grant Ferris

Institution: University of Toronto

Publication Type: Journal

Howell, J. R., Donahoe, R. J., Roden, E. E., & Ferris, F. G. (1998). Effects of microbial iron oxide reduction on pH and alkalinity in anaerobic bicarbonate-buffered media: Implications for metal mobility. *Mineralogical Magazine* 62A, 657-658.

Howell, J. R., Donahoe, R. J., Roden, E. E., & Ferris, F. G. (1998). Effects of microbial iron oxide reduction on pH and alkalinity in anaerobic bicarbonate-buffered media: Implications for metal mobility. *Mineralogical Magazine*. 62A, 657-658.

Leonardo, M. R., Keith, V. K., Ferris, F. G., & Roden, E. E. (1999, Aug. 22). Immobilization of strontium during carbonate mineral formation coupled to microbial reduction of amorphous Fe(III) oxide. *Abstr. Pap. Am. Chem. S.* 218, U1044-U1044, Part 1.

Small, T. S., Warren, L. A., Roden, E. E., & Ferris, F. G. (1999, Dec. 15). Sorption of strontium by bacteria, Fe(III) oxide, and bacteria-Fe(III) oxide composites. *Environmental Science and Technology*, 33(24), 4465-4470.

Publication Type: Presentation

Howell, J. R., Donahoe, R. J., & Roden, E. E. (1997). Effects of microbial iron oxide reduction on pH and alkalinity in anaerobic bicarbonate-buffered media. *American Geophysical Union Fall Meeting*.

Keith, V. K. & Roden, E. E. (1999). Immobilization of aqueous strontium during bacterial reduction of synthetic Fe(III) oxides. *American Society for Microbiology Annual Meeting*.

Leonardo, M. R., Ferris, F. G., & Roden, E. E. (1999). Sr²⁺ immobilization by authigenic carbonate precipitation under iron-reducing conditions. *American Society for Microbiology Annual Meeting*.

Leonardo, M. R., Ferris, F. G., & Roden, E. E. (1998). Analysis of iron-carbonate mineral formation during microbial reduction of synthetic amorphous iron oxide. *American Society for Microbiology General Meeting*.

Maurice, P. A., Warren, L. A., Ferris, F. G. (1998). Calcite precipitation by *B. pasteurii*: AFM imaging of microbial-mineral interactions. *Geological Society of America Annual Meeting*.

Maurice, P.A., Warren, L. A., & Ferris, F. G. (1998). Calcite precipitation by *B. pasteurii*: AFM imaging of microbial-mineral interactions. Geological Society of America Annual Meeting. Toronto, Canada.

Parmar, N., Warren, L. A. & Ferris, F. G. (1998). Solid phase capture of strontium by the iron reducing bacteria *Shewanella* alga. Geological Society of America Annual Meeting. Toronto, Canada.

Parmar, N., Warren, L. A., & Ferris, F. G. (1999). Impact of Fe(III) reduction on Fe(II)/Fe(III) mineral transformation and solid phase capture of strontium. XIV International Symposium on Environmental Biogeochemistry.

Roden, E. E., Leonardo, M. R., & Ferris, F. G. (1999). Immobilization of strontium during carbonate mineral-formation coupled to microbial Fe(III) oxide reduction. XIV International Symposium on Environmental Biogeochemistry.

Roden, E. E., Leonardo, M. R., Keith, V. K., & Ferris, F. G. (1999). Immobilization of aqueous strontium during carbonate mineral formation coupled to microbial Fe(III) oxide reduction. International Symposium on Subsurface Microbiology.

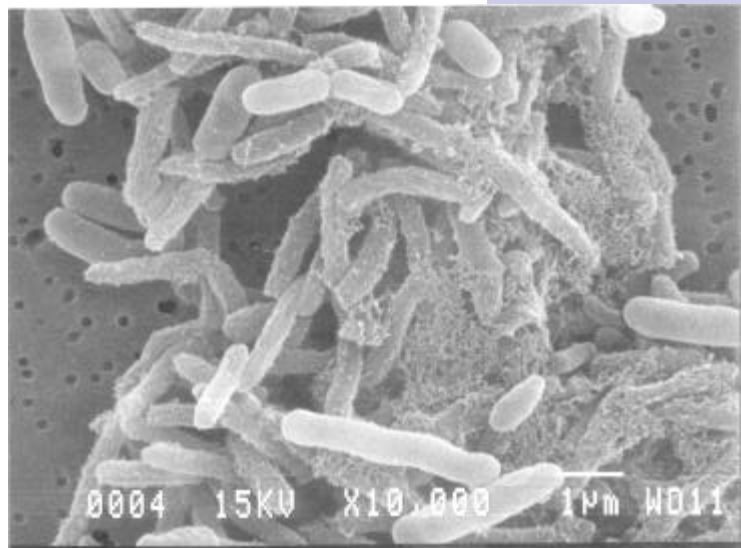
Small, T. D., Warren, L. A., & Ferris, F. G. (1998). Strontium sorption to bacterial and Fe oxide surfaces. Geological Society of America Annual Meeting.

Small, T. D., Warren, L. A., Roden, E. E., & Ferris, F. G. (1999). Sorption of strontium by bacteria, Fe(III) oxide and bacterial-Fe(III) oxide composites. XIV International Symposium on Environmental Biogeochemistry.

Small, T.D., Warren, L. A., & Ferris, F. G. (1998). Strontium sorption to bacterial and Fe oxide surfaces. Geological Society of America Annual Meeting. Toronto, Canada.

Warren, L. A., Ferris, F. G., & Roden, E. E. (1997). Strontium reactions at *Shewanella* and hydrous ferric oxide (HFO) surfaces. Geological Society of America Annual Meeting.

Warren, L. A., Parmar, N., & Ferris, F. G. (1998). Strontium, uranyl, and copper incorporation in bacterially mediated calcite precipitation. Geological Society of America Annual Meeting. Toronto, Canada.



A scanning electron microscope image showing dissimilatory iron-reducing bacteria with adherent hydrous ferric oxide. [see Project #54790]

Publication Type: Proceeding

Warren, L. A. & Ferris, F. G. (1998). Solid phase partitioning of uranium and copper in the presence of hydrous ferric oxide and bacteria. Arehart, G. B. & Hulston, J. R. (Eds.) Proceedings of the 9th International Symposium on Water-Rock Interactions. Balkema, Rotterdam. 115-117.

Publication Type: Theses/Dissertations

Howell, J. R. (1998). Effects of microbial Fe(III) oxide reduction on pH, DIC, and carbonate mineral formation: Implications for metal mobility. M. S. Thesis. Department of Geology, University of Alabama, Tuscaloosa, Alabama.

Keith, V. K. (2000). Immobilization of aqueous strontium during bacterial reduction of synthetic goethite. M. S. Thesis. Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama.

Small, T. D. (2000). Sorption of strontium to bacteria, Fe(III) oxide, and bacteria-Fe(III) oxide composites in relation to contaminant fate. M. S. Thesis, Department of Geology, University of Toronto, Toronto, Ontario, Canada.

Project: 55164

Title: Advanced Experimental Analysis of Controls on Microbial Fe(III) Oxide Reduction

PI: Dr. Eric E. Roden

Institution: University of Alabama

Publication Type: Journal

Roden, E. E. & Urrutia, M. M. (1999). Ferrous iron removal stimulates microbial iron(III) oxide reduction in semicontinuous cultures. *Environ. Sci. Technol.* 33, 1847-1853.

Roden, E. E., Urrutia, M. M., & Mann, C. J. (2000). Bacterial reductive dissolution of crystalline Fe(III) oxide in continuous-flow column reactors. *Appl. Environ. Microbiol.* 66, 1062-1065.

Sobolev, D. & Roden, E. E. (2001). Suboxic deposition of ferric iron by bacteria in opposing gradients of Fe(II) and oxygen at circumneutral pH. *Appl. Environ. Microbiol.* 67, 1328-1334.

Urrutia, M. M., Roden, E. E., & Zachara, J. M. (1999). Influence of aqueous and solid-phase Fe(II) complexants on microbial reduction of crystalline Fe(III) oxides. *Environ. Sci. Technol.* 33, 4022-4028.

Urrutia, M. M., Roden, E. E., Fredrickson, J. K., & Zachara, J. M. (1998). Microbial and surface chemistry controls on reduction of synthetic Fe(III) oxide minerals by the dissimilatory iron-reducing bacterium *Shewanella* alga. *Geomicrobiol. J.* 15, 269-291.

Project: 55388

Title: Stable Isotopic Investigations of In Situ Bioremediation of Chlorinated Organic Solvents

PI: Dr. Neil C. Sturchio

Institution: Argonne National Laboratory

Publication Type: Journal

Dayan, H., Abrajano, T., Sturchio, N. C., & Winsor, L. (1999). Carbon isotopic fractionation during reductive dechlorination of chlorinated solvents by metallic iron. *Organic Geochemistry*. 30, 755-763.

Heraty, L. J., Fuller, M. E., Huang, L., Abrajano, T., & Sturchio, N. C. (1999). Carbon and chlorine isotopic fractionation during microbial degradation of dichloromethane. *Organic Geochemistry*. 30, 793-799.

Holt, B. D., Sturchio, N. C., Abrajano, T. A., & Heraty, L. J. (1997). Conversion of chlorinated organic compounds to carbon dioxide and methyl chloride for isotopic analysis of carbon and chlorine. *Analytical Chemistry*. 69, 2727-2733.

Huang, L., Sturchio, N. C., Abrajano, T., Heraty, L. J., & Holt, B. D. (1999). Carbon and chlorine isotope fractionation of chlorinated aliphatic hydrocarbons by evaporation. *Organic Geochemistry*. 30, 777-785.

Reddy, C. M., et. al. (1999, in press). Stable chlorine isotopes in semivolatile organic compounds. *Environmental Science and Technology*.

Sturchio, N. C., et. al. (1998). Stable chlorine isotope investigation of natural attenuation of trichloroethene in an aerobic aquifer. *Environmental Science and Technology*. 32, 3037-3042.

Publication Type: Patent

Holt, B. D. & Sturchio, N. C. (1999, Aug. 28). Method for isotopic analysis of chlorinated organic compounds. U. S. Patent # 5,942,439.

Holt, B. D. & Sturchio, N. C. Method for isotopic analysis of chlorinated organic compounds. US #5,942,439.

Publication Type: Presentation

Dayan, H., Abrajano, T., Heraty, L., Huang, L., & Sturchio, N. C. (1997). Isotopic fractionation during reductive dehalogenation of chlorinated ethenes by metallic iron. *Geological Society of America Abstracts with Programs*. 29(6), A185.

Heraty, L. J., et. al. (1999, Oct. 25-28). Microbial degradation of chlorinated aliphatic hydrocarbons: Field investigations using stable carbon and chlorine isotopes. *Geological Society of America 1999 Annual Meeting*. Denver, CO.

Holt, B. D. & Sturchio, N. C. (1996). High temperature method for conversion of chlorinated organic compounds to CH₃Cl and CO₂ for isotopic analysis of chlorine and carbon. Abstracts of Papers of the American Chemical Society. 212, 154-ENVR.

Holt, B. D., Heraty, L. J., & Sturchio, N. C. (1999, Aug. 22-26). Extraction of chlorinated aliphatic hydrocarbons from water for isotopic analysis of chlorine and carbon. American Chemical Society 218th National Meeting. New Orleans, LA.

Huang, L., Sturchio, N. C., Heraty, L., & Abrajano, T. (1998, Aug.). Chlorine and carbon isotopic fractionations of aliphatic hydrocarbons in evaporation processes: Implications for biodegradation. 9th International Conference on Geochronology, Cosmochronology, and Isotope Geology. Beijing, China.

Reddy, C. M., et. al. (1999, Aug. 22-27). Chlorine isotope ratios of semi-volatile chlorinated organic compounds. Ninth Annual V. M. Goldschmidt Conference. Cambridge, MA.

Sturchio, N. C., Abrajano, T., Heraty, L., Huang, L., & Clausen, J. (1997). Stable isotope investigation of natural attenuation of trichloroethene at the Paducah Gaseous Diffusion Plant. Geological Society of America Abstracts with Programs. 29(6), A185.

Sturchio, N. C., et. al. (1997, Sept. 22-26). Carbon and chlorine isotopic studies of biodegradation of chlorinated volatile organics. 18th International Meeting on Organic Geochemistry, Maastricht, The Netherlands.

Sturchio, N. C., et. al. (2000, May 22-25). Stable isotope ratios of chlorinated aliphatic hydrocarbons in contaminated aquifers. Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, CA.

Sturchio, N. C., Heraty, L. J., Holt, B. D., Huang, L., & Abrajano, T. (1999, Aug. 22-27). Stable isotope investigations of the chlorinated aliphatic hydrocarbons. Ninth Annual V. M. Goldschmidt Conference. Cambridge, MA.

Sturchio, N. C., Heraty, L. J., Holt, B. D., Huang, L., & Abrajano, T. (1999, Jun. 7-9). Stable isotope investigations of chlorinated aliphatic hydrocarbons. Proceedings of the Second International Symposium on Integrated Technical Approaches to Site Characterization. Argonne, IL. 151-156.

Publication Type: Proceeding

Sturchio, N. C., Heraty, L., Holt, B., Huang, L., & Abrajano, T. (1999). Stable isotope investigations of chlorinated aliphatic hydrocarbons. Proceedings of the Second International Symposium on Integrated Technical Approaches to Site Characterization. Argonne, IL. 151-156.

Project: 70063 (Renewal of Project No. 54666)

Title: Biodegradation of Chlorinated Solvents: Reactions Near DNAPL and Enzyme Function

PI: Dr. Perry L. McCarty

Institution: Stanford University

Publication Type: Journal

Haston, Z. C. & McCarty, P. L. (1999). Chlorinated ethene half-velocity coefficients (K_S) for reductive dehalogenation. *Environmental Science and Technology*. 33(2), 223-226.

Rosner, B., McCarty, P. L., & Spormann, A. M. (1997). In vitro studies on reductive vinyl chloride dehalogenation by an anaerobic mixed culture. *Appl. Environ. Microbiol.* 63(11), 4139-4144.

Yang, Y. & McCarty, P. L. (1998). Competition for hydrogen within a chlorinated solvent dehalogenating mixed culture. *Environmental Science and Technology*. 32(22), 3591-3597.

Yang, Y. & McCarty, P. L. (1999). Response to "Comment on competition for hydrogen within a chlorinated solvent dehalogenating anaerobic mixed culture." *Environmental Science & Technology*. 33(12), 2128.

Yang, Y. & McCarty, P. L. (2000, in press). Biomass, oleate, and other possible substrates for chloroethene reductive dehalogenation. *Bioremediation Journal*.

Yang, Y. R. & McCarty, P. L. (2000, Jul. 15). Biologically enhanced dissolution of tetrachloroethene DNAPL. *Environ. Sci. Technol.* 34(14), 2979-2984.

Publication Type: Theses/Dissertations

Haston, Z. C. (1999). Factors affecting growth and utilization in the anaerobic dehalogenation of chlorinated ethenes. Ph.D. Dissertation. Stanford University. Stanford, CA.

Project: 70165

Title: Integrated Field, Laboratory, and Modeling Studies to Determine the Effects of Linked Microbial and Physical Spatial Heterogeneity on Engineered Vadose Zone Bioremediation

PI: Dr. Fred J. Brockman

Institution: Pacific Northwest National Laboratory

Publication Type: Presentation

Bradley, S. N., Spadoni, T. S., & Brockman, F. J. (2001, May 20-24). Colonization behavior of *Pseudomonas stutzeri* KC in static unsaturated porous media columns. American Society for Microbiology General Meeting. Orlando, FL.

Project: 73784 (Renewal of Project No. 55267)

Title: Microbially Mediated Immobilization of Contaminants Through In Situ
Biostimulation: Scale up of EMSP project 55267

PI: Dr. Philip M. Jardine

Institution: Oak Ridge National Laboratory

Publication Type: Journal

Barnett, M. O., Jardine, P. M., Brooks, S. C., & Selim, H. M. (2000). Adsorption and transport of U(VI) in subsurface media. *Soil Sci. Soc. Am. J.* 64, 908-917.

Brooks, S. C. & Barnett, M. O. (1999, in press). Uranium sorption to bacterial cells as a related to metal reduction capabilities in the presence of porous media. *Appl. and Environ. Micro.*

Brooks, S. C., Carroll, S. L., & Jardine, P. M. (1999). Sustained bacterial reduction of Co(III)EDTA in the presence of competing geochemical oxidation during dynamic flow. *Environ. Sci. Technol.* 33, 3002-3011.

Fendorf, S. E., Jardine, P. M., Patterson, R. R., Taylor, D. L., & Brooks, S. C. (1999, Oct.). Pyrolusite surface transformations measured in real-time during the reactive transport of Co(II)EDTA(2-). *Geochim. Cosmochim. Acta.* 63(19-20), 3049-3057.

Jardine, P. M., et. al. (1999). Fate and transport of hexavalent chromium in undisturbed heterogeneous soil. *Environ. Sci. Technol.* 33, 2939-2944.

Jardine, P. M., et. al. (1999). Quantifying diffusive mass transfer in fractured shale bedrock. *Water Resour. Res.* 35, 2015-2030.

Saiers, J. E., Guha, H., Jardine, P. M., & Brooks, S. C. (2000, in press). Development and evaluation of a mathematical model for the transport and oxidation-reduction of CoEDTA. *Water Resour. Res.*

Publication Type: Other

Jardine, P. M., Brooks, S. C., Wilson, G. V., & Sanford, W. E. (2000, in press). Basic research strategies for resolving remediation needs in contaminated fractured subsurface media. Faybishenko, B. (Ed.), *Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances*. American Geophysical Union, Geophysical Monograph Series.

Jardine, P. M., O'Brien, R., Wilson, G. V., & Gwo, J. P. (1998). Experimental techniques for confirming and quantifying physical nonequilibrium processes in soils. Selim, H. M. & Ma, L. (Eds.), *Physical Nonequilibrium in Soils: Modeling and Application*. Ann Arbor Press, Inc. Chelsea, MI. 243-271.

Jardine, P. M., Wilson, G. V., Luxmoore, R. J., & Gwo, J. P. (2000, in press). Conceptual model of vadose-zone transport in fractured weathered shales. Hsieh, P. A. (Ed.), *Conceptual Models of Flow and Transport in the Fractured Vadose Zone*. National Research Council.

Publication Type: Presentation

Bostick, B. C., Fendorf, S. E., Barnett, M. O., Jardine, P. M., & Brooks, S. C. (2000, Nov. 5-9). Uranyl surface species formed during reactive transport through subsurface media. Soil Science Society of America, Minneapolis, MN.

Brooks, S. C., & Jardine, P. M. (1997, Oct. 26-31). Bacterial reduction of toxic metals during dynamic flow. American Society of Agronomy. Anaheim, CA.

Fendorf, S., Jardine, P. M., & Brooks, S. C. (1997, Apr. 13-17). Sorption induced inhibition of redox reaction involving manganese oxides. American Chemical Society. San Francisco, CA.

Guha, H., Saiers, J. E., Jardine, P. M., & Brooks, S. C. (1998, Dec. 6-10). Development and evaluation of a mathematical model for oxidation, sorption, and transport of Co(II)EDTA 2-. American Geophysical Union. San Francisco, CA.

Jardine, P. M. (1997, Oct. 12). Geochemical processes governing the fate and transport of Cr(III) and Cr(VI) in soils. Soil Science Society of America. Anaheim, CA.

Jardine, P. M. (1997, Oct. 26). Bacterial reduction of toxic metals during dynamic flow. Science Society of America. Anaheim, CA.

Jardine, P. M., et. al. (1999, Feb. 6-10). Basic research strategies for resolving remediation needs in contaminated fractured subsurface media. Symposium on Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances. Lawrence Berkeley National Laboratory. Berkeley, CA.

Jardine, P. M., Wilson, G. V., Sanford, W. E., & Luxmoore, R. J. (1998, May 14-16). Exploring subsurface transport mechanisms in fractured media at laboratory and field scales. Conference on "Mass transport in fractured aquifers and aquitards" Geological Institute, University of Copenhagen, Denmark.

Mayes, M. A., Reedy, O. C., Larsen, I. L., Brooks, S. C., & Jardine, P. M. (1997, Oct. 26-31). Multispecies contaminant transport in undisturbed columns of weathered fractured shale. American Society of Agronomy. Anaheim, CA.

Mayes, M. A., Reedy, O. C., Larsen, I. L., Brooks, S. C., & Jardine, P. M. (1997, Oct.). Multispecies contaminant transport in undisturbed columns of weathered fractured shale. Geologic Society of America.

Mehlhorn, T. L., Jardine, P. M., Brooks, S. C., Fendorf, S. E., & Saiers, J. E. (1997, Oct. 26-31). Geochemical processes governing the fate and transport of Cr(III) and Cr(VI) in soils. American Society of Agronomy. Anaheim, CA.

Sanford, W. E., & Jardine, P. M. (1997, Oct. 26-31). Examining diffusion with multiple tracers to aid remediation of contaminated sites. American Society of Agronomy. Anaheim, CA.

Zhang, C., Brooks, S., Fendorf, S., & Jardine, P. (1998, Aug.). Microbial uranium reduction and biomineralization: Implication for immobilization of toxic metals and radionuclides. 17th Annual Meeting of the International Mineralogical Association. Toronto, Ontario, Canada.

Publication Type: Press release

Evans, R. & Hill, D. (1999). Press release initiated by Department of Energy. One of 5 out of 200 EMSP projects to be featured in a press release package.

Norton, D. (1999, summer). Building a wall of bacteria. Initiatives in Environmental Technology Investment. Publication of the Waste Policy Institute. Blacksburg, VA. 6.

Publication Type: Proceeding

Fendorf, S. E., Jardine, P. M., Taylor, D. L., & Brooks, S.C. (1999). Auto-inhibition of oxide mineral oxidative capacity toward Co(II)EDTA: Time-resolved studies using XANES spectroscopy. Sparks, D. L. & Grundel, T. (Eds.), Kinetics and mechanisms of sorption processes at the mineral-water interface. ACS Symposium Series. 715, 358-371.

Jardine, P. M. (1998, Aug. 24-28). Can basic research on contaminant transport be used to improve the design of remedial strategies? Proceedings of "School of Environmental Science and Technology". Buenos Aires, Argentina.

Jardine, P. M. (1998, Dec. 31). Auto-inhibition of oxide mineral oxidation capacity toward Co(II) EDTA: Time-resolved studies using XANES spectroscopy. Sparks, D. L., & Grundel, T. (Eds.), Kinetics and mechanisms of sorption processes at the mineral-water interface. ACS Symposium Series.

Publication Type: Theses/Dissertations

Bostick, B. (1997). Pyrite chemistry in soils and waters: Reactivity toward radionuclides and heavy metals. Master's Thesis. Soil Science, University of Idaho. Moscow, ID.

Bostick, B. (Projected 2001). Sulfide and carbonate mineral adsorption processes of oxo-ions. Ph. D. candidate. Geological and Environmental Sciences, Stanford University. Palo Alto, CA.

Guha, H. (2000). Development and evaluation of a mathematical model for evaluating time-dependent hydrologic-biogeochemical processes at contaminated sites. M. S. Thesis, Florida International University.

Patterson, R. R. (1996). Iron sulfide reduction of chromate. Master's Thesis. Soil Science, University of Idaho. Moscow, ID.

Engineering Science

Project: 70088

Title: Interfacial Reduction-Oxidation Mechanisms Governing Fate and Transport of Contaminants in the Vadose Zone

PI: Dr. Baolin Deng

Institution: University of Missouri at Columbia

Publication Type: Journal

Kim, C., Zhou, Q., Deng, B., Thornton, E. C., & Xu, H. (2001, in press). Chromium(VI) reduction by hydrogen sulfide in aqueous media: Stoichiometry and kinetics. *Environmental Science and Technology*.

Publication Type: Poster

Thornton, E. C., et. al. (2000). Interfacial reduction-oxidation mechanisms governing fate and transport of contaminants in the vadose zone. EMSP National Workshop 2000. Atlanta, GA.

Zhou, Q., Kim, C., Deng, B., & Thornton, E. C. (2000, Aug. 20-24). Effects of mineral surfaces on chromium(VI) reduction by hydrogen sulfide. The 220th ACS National Meeting. Washington, D. C.

Publication Type: Presentation

Kim, C., Lan, Y., Deng, B., & Thornton, E. C. (2001, Apr. 1-5). Catalytic effects of goethite on chromium(VI) reduction by hydrogen sulfide in anaerobic aqueous phase. 221st ACS National Meeting. San Diego, CA.

Kim, C., Zhou, Q., Deng, B., & Thornton, E. C. (2000, Aug. 20-24). Chromium(VI) reduction by hydrogen sulfide in the aqueous phase. The 220th ACS National Meeting. Washington, D. C.

Lan, Y., Kim, C., Deng, B., & Thornton, E. C. (2001, Apr. 1-5). Chromium(VI) reduction by sulfide under anaerobic conditions: Catalysis of elemental sulfur product. 221st ACS National Meeting. San Diego, CA.

Thornton, E. C., et. al. (1999). Laboratory evaluation of surface-catalyzed reduction mechanisms in the H₂S-O₂-Cr(VI)-sediment system. Geological Society of America Annual Meeting. Denver, CO.

Project: 73793 (Renewal of Project No. 55013)*Title:* Biofiltration of Volatile Pollutants: Solubility Effects*PI:* Dr. Brian H. Davison*Institution:* Oak Ridge National Laboratory*Publication Type:* Journal

Barton, J. W., Davison, B. H., Klasson, K. T., & Gable III, C. C. (1999). Estimation of mass transfer and kinetics in operating trickle-bed bioreactors for removal of VOCs. *Environmental Progress*, 18, 87-92.

Barton, J. W., Hartz, S. M., Klasson, K. T., & Davison, B. H. (1997). Microbial removal of alkanes from dilute gaseous waste streams: Mathematical modeling of advanced bioreactor systems. *J. Chem. Technol. Biotechnol.* 72, 93-98.

Barton, J. W., Klasson, K. T., & Davison, B. H. (1997). Microbial removal of alkanes from dilute gaseous waste streams: Kinetics and mass transfer considerations. *Biotechnology Progress*, 13, 814-821.

Davison, B. H., Barton, J. W., Klasson, K. T., & Francisco, A. B. (2000, May 5). The influence of high biomass concentrations on alkane solubilities. *Biotechnology and Bioengineering*, 68(3), 279-284.

Publication Type: Presentation

Barton, J. W. (1998, Jul.). Fundamental mechanisms for improved design, long-term operation, prediction, and implementation. EMSP Review Meeting, Chicago, IL.

Barton, J. W. (2000). Fundamental mechanisms for improved design, long-term operation, prediction, and implementation. EMSP Review Meeting, Atlanta, GA.

Barton, J. W., Davison, B. H., Klasson, K. T., Gable, III, C. C. (1997, Nov.). Estimation of mass transfer and kinetics in operating biofilters for removal of VOC's. AICHE Annual Meeting. Los Angeles, CA.

Barton, J. W., Klasson, K. T., & Davison, B. H. (1997, Aug. 6-8). Extended performance and evaluation of trickle bed bioreactors designed for VOC removal. Southern Section Annual Meeting of the Air & Waste Management Association. Gatlinburg, TN.

Barton, J. W., Zhang, X. S., Klasson, K. T., & Davison, B. H. (1998). Predictive mathematical modeling of trickling bed biofilters for elucidating mass transfer and kinetic effects. Presented at the Air & Waste Management Association's 91st Annual Meeting & Exhibition. San Diego, CA.

Davison, B. H. (1999, Mar. 23). Effect of biomass on the measured solubility of sparingly soluble organics in aqueous bioremediation systems. The 217th American Chemical Society Meeting. Anaheim, CA.

Klasson, K. T., Barton, J. W., & Davison, B. H. (1999, Jun.). Performance of a propane-degrading bacterium. 92nd Annual Meeting of the Air and Waste Management Association. St. Louis, MO.

Klasson, K. T., Davison, B. H., Barton, J. W., Just, E. M., & Gable, II, C. C. (1997, Sep.). Biofiltration of chlorinated and non-chlorinated alkanes. Platform presentation at the American Chemical Society's Emerging Technologies in Hazardous Waste Management IX (Enviro Expo '97). Pittsburgh, PA.

Publication Type: Proceeding

Barton, J. W., Klasson, K. T., & Davison, B. H. (1997). Extended operation and control of biomass overgrowth in biofilters designed for VOC removal. Proceedings of the 90th Annual Meeting & Exhibition of Air & Waste Management Association. Toronto, Ontario, Canada.

Barton, J. W., Zhang, X. S., Klasson, K. T., & Davison, B. H. (1998, Jun.). Predictive mathematical modeling of trickling bed biofilters for elucidating mass transfer and kinetic effects. Proceedings of the 91st Annual Meeting of the Air & Waste Management Association. San Diego, CA. Paper 98-WAA.13P.

Barton, J. W., Zhang, X. S., Klasson, K. T., & Davison, B. H. (1998, Oct. 23). Predictive mathematical modeling of trickling bed biofilters. Proceedings of the 1998 USC-TRG Conference on Biofiltration. Los Angeles, CA.

Klasson, K. T., Barton, J. W., & Davison, B. H. (1999, Jun.). Performance of a propane-degrading bacterium. Proceedings of the 92nd Annual Meeting of the Air and Waste Management Association. St. Louis, MO.

Klasson, K. T., Davison, B. H., Barton, J. W., & Jacobs, J. E. (1998, Jun.). Removal of chlorinated and nonchlorinated alkanes in a trickling bed biofilter. Proceedings of the 91st Annual Meeting of the Air and Waste Management Association. San Diego, CA. Paper 98-WAA.06P.

Klasson, K. T., Davison, B. H., Barton, J. W., & Jacobs, J. E. (1998). Removal of chlorinated and non-chlorinated alkanes in a trickle-bed reactor. Proceedings of the 91st Annual Meeting of the Air & Waste Management Association. San Diego, CA.

Publication Type: Theses/Dissertations

DeLozier, G. C. (1998, Dec.). Isolation and identification of VOC metaolizing microorganisms from an active biotrickling filter. Master's Thesis, School of Biotechnology, University of Tennessee. Knoxville, TN.

Geochemistry

Project: 54548

Title: The Efficacy of Oxidative Coupling for Promoting In-Situ Immobilization of Hydroxylated Aromatics in Contaminated Soil and Sediment Systems

PI: Dr. Walter J. Weber, Jr.

Institution: University of Michigan

Publication Type: Poster

Keinath, II, T. M., Selig, H., & Weber, Jr., W. J. (1998, Oct. 16-18). Enzyme catalyzed oxidative coupling: Effect of horseradish peroxidase additions on sorption of phenols on natural organic sorbents. 21st Midwest Environmental Chemistry Workshop. The University of Michigan. Ann Arbor, MI.

Keinath, II, T. M., Selig, H., Payne, C., Suh, J. W., & Weber, Jr., W. J. (1999, Aug. 21-25). Induced sequestration of phenolic compounds by natural sorbents via MnO₂ and oxidoreductase enzymes by coupling: Comparison of equilibrium and non-equilibrium systems. 217th National Meeting of the American Chemical Society. New Orleans, LA.

Orlov, A., Bandhari, A., Selig, H., & Weber, Jr., W. J. (1998, Oct. 16-18). Sequestration of phenolic compounds in natural sorbents through abiotic oxidative coupling reactions: The role of organic matter composition. 21st Midwest Environmental Chemistry Workshop. The University of Michigan. Ann Arbor, MI.

Publication Type: Presentation

Huang, Q., Selig, H., Keinath, II, T. M., & Weber, Jr., W. J. (2000, Mar. 26-31). Horseradish peroxidase-catalyzed phenol coupling in the presence of soil: Effects of enzyme inactivation. 219th ACS National Meeting. San Francisco, CA.

Keinath, II, T. M., Selig, H., Taylor, M., Payne, C., & Weber, Jr., W. J. (2000, Mar. 5-9). Sequestration of phenolic compounds by natural sorbents via Birnessite induced oxidative coupling. 2000 Spring National Meeting of the American Institute of Chemical Engineers. Atlanta, GA.

Project: 54635

Title: Molecular-Level Process Governing the Interaction of Contaminants with Iron and Manganese Oxides

PI: Dr. Scott A. Chambers

Institution: Pacific Northwest National Laboratory

Publication Type: Journal

Brown, G. E. Jr., et. al. (1999). Metal oxide surfaces and their interactions with aqueous solutions and microbial organisms. *Chem. Rev.* 99, 77-174.

Chambers, S. A. & Liang, Y. (1999). Growth of \bullet - MnO_2 films on $\text{TiO}_2(110)$ by oxygen-plasma-assisted molecular beam epitaxy. *Surf. Sci. Spect.* 420, 123.

Chambers, S. A., & Joyce, S. A. (1999). Surface termination, composition, and reconstruction of $\text{Fe}_3\text{O}_4(001)$ and \bullet - $\text{Fe}_2\text{O}_3(001)$. *Surf. Sci. Spect.* 420, 111.

Chambers, S. A., Gao, Y. & Kim, Y. J. (1998). Fe 2p core-level spectra for pure, epitaxial \bullet - $\text{Fe}_2\text{O}_3(0001)$, \bullet - $\text{Fe}_2\text{O}_3(001)$, and $\text{Fe}_3\text{O}_4(001)$. *Surf. Sci. Spect.* 5, 219.

Foster, N. S., Amonette, J. E., & Autrey, S. T. (1999, Jun.). In situ detection of chromate using photoacoustic spectroscopy. *Appl. Spectrosc.* 53(6), 735-740.

Foster, N. S., Autrey, S. T., Amonette, J. E., Small, J. R., & Small, E. W. (1999). Laser photoacoustic spectroscopy: A versatile absorption spectroscopic technique. *Am. Lab.* 31, 96s-108s.

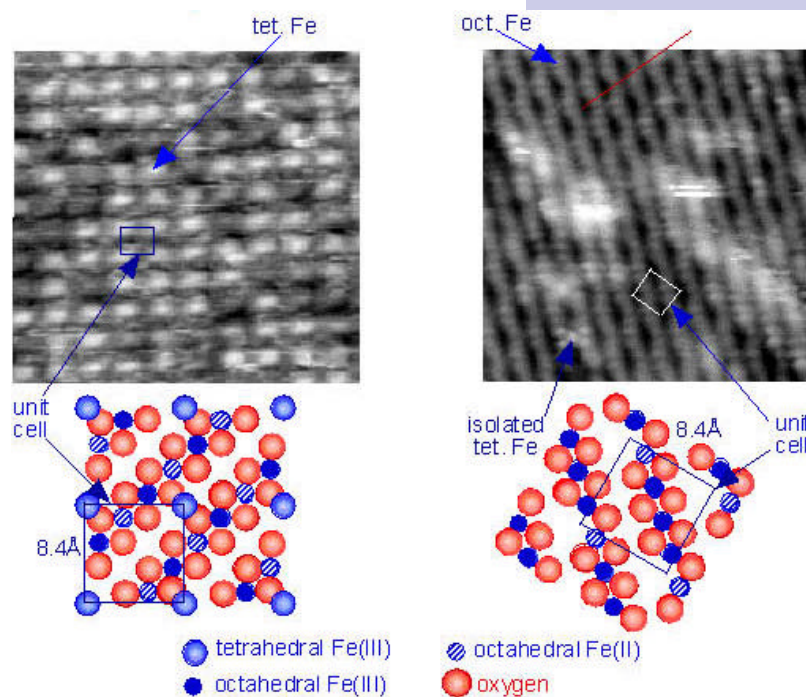
Grolimund, D., et. al. (1999, May 1). Identification of Cr species at the aqueous solution-hematite interface after Cr(VI)-Cr(III) reduction using GI-XAFS and Cr L-edge NEXAFS. *J. Synchrotron. Radiat.* 6, 612-614, Part 3.

Kendelewicz, T., et. al. (1999). X-ray absorption and photoemission study of the adsorption of aqueous Cr(VI) on single crystal hematite and magnetite surfaces. *Surf. Sci. Spect.* 424, 219.

Kendelewicz, T., Liu, P., Brown, G. E. Jr., Nelson, E. J., & Chambers, S. A. (1999). Reaction of water with the (100) and (111) surfaces of Fe_3O_4 . *Surface Science*.

Li, S. I., et. al. (1999, Dec. 20). Morphological and structural investigation of the early stages of epitaxial growth of α - $\text{Fe}_2\text{O}_3(0001)$ on α - $\text{Al}_2\text{O}_3(0001)$ by oxygen-plasma-assisted MBE. *Surf. Sci.* 443(3), 212-220.

Liu, P., Kendelewicz, T., Brown, G. E. Jr., Nelson, E. J. & Chambers, S. A. (1998). Reaction of water vapor with \bullet - $\text{Al}_2\text{O}_3(0001)$ and \bullet - $\text{Fe}_2\text{O}_3(0001)$ surfaces: Synchrotron x-ray photoemission studies and thermodynamic calculations. *Surf. Sci. Spect.* 417, 53.



Left: Top layer consists of tetrahedrally coordinated Fe(III), as shown in the structural diagram. Right: Top layers consist of octahedrally coordinated Fe(II) and Fe(III), along with tetrahedrally coordinated O, as shown in the structural diagram. [see Project #54635]

Rustad, J. R., Dixon, D. A., Kubicki, J. D., & Felmy, A. R. (2000, May 4). Gas-phase acidities of tetrahedral oxyacids from ab initio electronic structure theory. *J. Phys. Chem. A*. 104(17), 4051-4057.

Rustad, J. R., Wasserman, E., & Felmy, A. R. (1999, Jul. 9). A molecular dynamics investigation of surface reconstruction on magnetite (001). *Surf. Sci.* 432(1-2), L583-L588.

Thevuthasan, S., et. al. (1999). Surface structure of MBE-grown α -Fe₂O₃(0001) by intermediate-energy x-ray photoelectron diffraction. *Surf. Sci. Spect.* 425, 276-286.

Yi, S. I., Liang, Y. & Chambers, S. A. (1999). Effect of growth rate on the nucleation of α -Fe₂O₃ on α -Al₂O₃(0001) by oxygen-plasma-assisted molecular beam epitaxy. *J. Vac. Sci. Technol. A*.

Publication Type: Presentation

Amonette, J. E., Foster, N. S., William, B. K., & Taylor, A. E. (1999, Mar. 21-25). Trace-level chromate sorption dynamics at hematite surfaces: A spectroscopic approach. 217th National Meeting of the American Chemical Society. Anaheim, CA.

Amonette, J. E., Foster, N. S., William, B. K., & Taylor, A. E. (1999, Jun.). Competitive trace-level sorption of chromate and phosphate to hematite surfaces: A spectroscopic approach. 36th Annual Meeting of the Clay Minerals Society. Purdue University. West Lafayette, IN.

Brown, G. E. Jr., et. al. (1999, Mar.). Characterization of adsorbed chemical species at mineral surfaces. 217th American Chemical Society Meeting. Anaheim, CA.

Chambers, S. A. (1998, Oct.). Molecular beam epitaxial growth and surface structure determination of Fe and Mn oxides. Invited presentation at the Center for Catalysis and Surface Structure. Northwestern University. Evanston, IL.

Chambers, S. A., Thevuthasan, S., Kim, Y. J., Joyce, S. A., & Liang, Y. (1998, Aug.). Surface structure determination of MBE grown iron and manganese oxides. Invited presentation at the National Meeting of the American Chemical Society. Boston, MA.

Chambers, S. A., Thevuthasan, S., & Joyce, S. A. (1999, Jan.). Structure and reactivity of MBE-grown Fe oxides. Invited presentation at the First International Conference on Oxide Surfaces. Elmau, Germany.

Grolimund, D., et. al. (1998, Jul.). Identification of Cr species at the solution-hematite interface after Cr(VI)-Cr(III) reduction using GI-XAFS and Cr L-edge NEXAFS. 10th International XAFS Conference. Chicago, IL.

Grolimund, D., Fitts, J. P., Trainor, T. P., Brown, G. E. Jr., & Chambers, S. A. (1999, Mar.). Identification of Cr species at the aqueous solution-oxide interface using grazing-incidence XAFS. 217th American Chemical Society Meeting. Anaheim, CA.

Joyce, S. A., Thevuthasan, S., & Chambers, S. A. (1999, Mar. 21-25). Growth and structure of synthetic iron oxide mineral surfaces. 217th National Meeting of the American Chemical Society. Anaheim, CA.

Kendelewicz, T., Liu, P., Brown, G. E. Jr., & Nelson, E. J. (1998, Aug.). Reaction of water with (100) and (111) surfaces of magnetite (Fe₃O₄). International Conference on Surface Science 10. Birmingham, United Kingdom.

Kendelewicz, T., Liu, P., Brown, G. E. Jr., Chambers, S. A., & McCarthy, M. I. (1998, Aug.). "Hydroxylation of the surfaces of simple metal oxides: Spectroscopic and thermodynamic analysis. Goldschmidt Conference. Toulouse, France.

Kendelewicz, T., Liu, P., Brown, G. E. Jr., Nelson, E. J., & Chambers, S. A. (1998, Aug.). Reduction of the (0001) surface of hematite (• -Fe₂O₃) prepared under UHV conditions. International Conference on Surface Science 10. Birmingham, United Kingdom.

Kendelewicz, T., Liu, P., Brown, G. E. Jr., Nelson, E. J., & Chambers, S. A. (1998, Aug.). Fe L_{2,3} and O K near edge structure of iron oxides and hydroxides. International Conference on Surface Science 10. Birmingham, United Kingdom.

Kendelewicz, T., Liu, P., Brown, G. E. Jr., Nelson, E. J., & Chambers, S. A. (1998, Aug.). Reaction of water with clean (0001) and (1-102) surfaces of • -Fe₂O₃. International Conference on Surface Science 10. Birmingham, United Kingdom.

McCready, D. E., (1998, Jun.). Rutherford backscattering and channeling studies of epitaxially grown iron oxide films on various substrates. Surface Analysis/8th Annual Pacific Northwest Symposium.

Rustad, J. R. (1999, Aug.). Molecular simulation of the iron oxide-water interface. Invited presentation at the American Chemical Society Meeting. New Orleans, LA.

Rustad, J. R., Wasserman, E., & Joyce, S. A. (1999, Mar. 21-25). Structure and energetics of the magnetite(001) surface insights from molecular dynamics calculations. 217th National Meeting of the American Chemical Society. Anaheim, CA.

Thevuthasan S. (1998, Nov.). Rutherford backscattering and channeling studies of Al and Mg diffusion in iron oxide thin films. Invited presentation at the Fifteenth International Conference on the Application of Accelerators. Denton, TX.

Thevuthasan, S., et. al. (1998, Jun.). The surface structure determination of • -Fe₂O₃ by intermediate-energy x-ray photoelectron diffraction. Surface Analysis/8th Annual Pacific Northwest Symposium.

Thevuthasan, S., et. al. (1998, Nov.). The surface structure determination of • -Fe₂O₃ (0001) by low-energy x-ray photoelectron diffraction. 45th National Symposium of the American Vacuum Society.

Thevuthasan, S., Jiang, W., McCready, D. E., & Chambers, S. A. (1998, Nov.). Rutherford backscattering and channeling studies of Al and Mg diffusion in iron oxide thin films. 45th National Symposium of the American Vacuum Society.

Thevuthasan, S., McCready, D. E., Jiang, W., Yi, S. I., & Chambers, S. A. (1999, Jul.). Ion beam analysis of interface reactions in iron oxide thin films. Invited presentation at the Fourteenth International Conference on Ion Beam Analysis (IBA-14). Dresden, Germany.

Publication Type: Proceeding

Chambers, S. A., & Liang, Y. (1998, Nov.). Growth of • -MnO₂ films on TiO₂(110) by oxygen-plasma- assisted molecular beam epitaxy. 45th International Symposium of the American Vacuum Society. Baltimore, MD.

Project: 54741

Title: Characterization of Contaminant Transport Using Naturally-Occurring U-Series Disequilibria

PI: Dr. Michael T. Murrell

Institution: Los Alamos National Laboratory

Publication Type: Journal

Ku, T. L., Luo, S., Leslie, B. W., & Hammond, D. E. (1998). Assessing radionuclide migration from natural analog studies: Response to McKinley and Alexander (1996). *Radiochimica Acta* 80. 219-223.

Luo, S., Ku, T. L., Roback, R., Murrell, M., & McLing, T. L. (2000). In-situ radionuclide transport and preferential groundwater flows at INEEL (Idaho): Decay-series disequilibrium studies. *Geochimica et Cosmochimica Acta*, 64, #3.

Publication Type: Presentation

Luo, S., Ku, T. L., Roback, R., Murrell, M., & McLing, T. L. (1999, Nov. 29 - Dec. 3). Decay-series disequilibrium study of in-situ, long-term radionuclide transport in water-rock systems. MRS 1999 Fall Meeting Abstract Volume, Boston, MA. 734.

Luo, S., Ku, T. L., Roback, R., Murrell, M., & McLing, T. (1999, Aug. 21-26). Uranium-series disequilibria in groundwater: Assessing radionuclide migration. 9th International Conference on Isotope Geology, Cosmochemistry and Geochronology. Beijing, China.

Murrell, M. & Ku, T. L. (1998, Jul. 27-30). Characterization of contaminant transport using naturally occurring U-series disequilibria. DOE Environmental Management Science Program Workshop, Rosemont, IL. CONF-980736, Poster 179, 358-359.

Publication Type: Proceeding

Luo, S., Ku, T. L., Roback, R., Murrell, M., & McLing, T. L. (2000). Decay-series disequilibrium study of in-situ, long-term radionuclide transport in water-rock systems. Proceedings on Scientific Basis for Nuclear Waste Management XXIII, Material Research Society.

Luo, S., Ku, T. L., Roback, R., Murrell, M., & McLing, T. (1998, Dec. 6-10). Assessing in-situ radionuclide transport based on uranium-series disequilibrium in groundwater. Fall AGU Meeting. San Francisco, CA. EOS Trans. Amer. Geophys. Un. 79, F354.

Roback, R. C., et. al. (1997). Groundwater mixing, flow-paths and water/rock interaction at INEEL: Evidence from uranium isotopes. Geological Society of America, Abstracts with Programs. 29(6).

Roback, R. C., et. al. (1998, Dec. 6-10). Uranium and thorium series isotopes in fractured rocks at the INEEL. Fall AGU Meeting. San Francisco, CA. EOS Trans. Amer. Geophys. Un. 79, F343.

Project: 54823

Title: Modeling of Cation Binding in Hydrated 2:1 Clay Minerals

PI: Dr. David E. Smith

Institution: New Mexico State University

Publication Type: Journal

Shroll, R. M. & Smith, D. E. (1999). Molecular dynamics simulations in the grand canonical ensemble: Application to clay mineral swelling. J. Chem. Phys. 111, 9025.

Shroll, R. M. & Smith, D. E. (1999). Molecular dynamics simulations in the grand canonical ensemble: Formation of a bias potential for umbrella sampling. J. Chem. Phys. 110, 8295.

Smith, D. E. (1998). Molecular computer simulations of the swelling properties and interlayer structure of cesium montmorillonite. Langmuir. 14, 5959.

Young, D. A. & Smith, D. E. (2000). Simulations of clay mineral swelling and hydration: Dependence upon interlayer ion size and charge. J. Phys. Chem. B. 104, 9163.

Project: 55014

Title: Kinetics and Mechanisms of Metal Retention/Release in Geochemical Processes in Soil

PI: Dr. Robert W. Taylor

Institution: Alabama A&M University

Publication Type: Journal

Shen, S. Y., Taylor, R. W., Bart, H., & Tu, S. (1999). Equilibrium and spectroscopic studies of lead retention in smectite. *Commun. Soil Sci. Plan.* 30(19-20), 2711-2730.

Shen, S., Taylor, R. W., Bart, H., & Tu, S. I. (1999). Equilibrium and spectroscopic studies of lead retention in smectite. *Commun. Soil Sci. Plant Anal.* 30(19-20), 2711-2730.

Taylor, R. W., Shen, S., Bleam, W. F., & Tu, S. I. (2000, in press). Chromate removal by dithionite-reduced clays: Direct XANES evidence of chromate reduction at clay surfaces. *Clays Clay Min.*

Xia, K., Bleam, W. F., & Helmke, P. A. (1997). Studies of the nature of binding sites of first row transition elements bound to aquatic and soil humic substances using x-ray absorption spectroscopy. *Geochim. Cosmochim. Acta.* 61, 2223-2235.

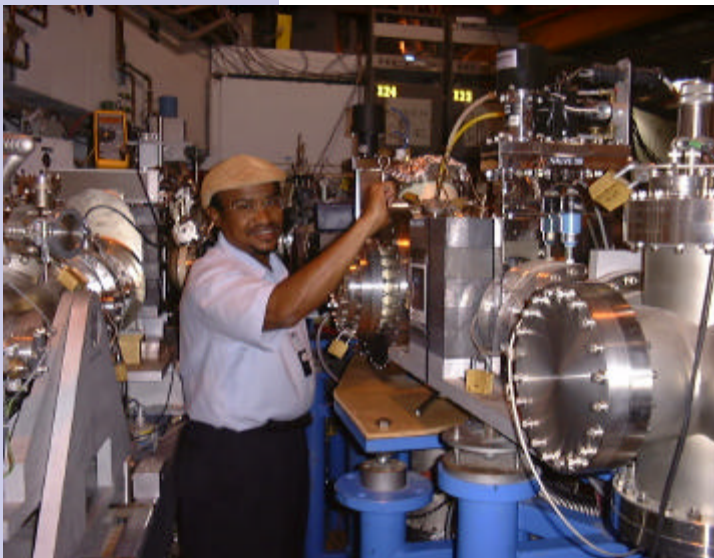
Xia, K., Bleam, W. F., & Helmke, P. A. (1997). Studies of nature of Cu²⁺ and Pb²⁺ binding sites in soil humic substances using X-ray absorption spectroscopy. *Geochim. Cosmochim. Acta.* 61, 2211-2221.

Xia, K., et. al. (1998). XANES studies of oxidation states of sulfur in aquatic and soil humic substances. *Soil Sci. Soc. Am. J.* 62, 1240-1246.

Xia, K., Mehadi, A., Taylor, R. W., & Bleam, W. F. (1997). X-ray absorption and electron paramagnetic resonance studies of Cu(II) sorbed to silica: Surface-induced precipitation at low surface coverages. *J. Colloid Interface Sci.* 185, 252-257.

Xia, K., Skylberg, U. L., Bleam, W. F., & Bloom, P. R. (1999). X-ray absorption spectroscopic evidence for the complexation of Hg(II) by reduced sulfur in soil humic substances. *Environ. Sci. Technol.* 33, 257-261.

Xia, K., Taylor, R. W., Bleam, W. F., & Helmke, P. A. (1998). The distribution of Cu(II) on boehmite and silica surfaces: Correlating EPR signal loss with the effective Bohr magnetron number of sorbed soils. *J. Colloid Interface Sci.* 199, 77-82.



Metal Retention/Release Mechanisms for Geochemical Soil Processing. [see Project #55014]

Publication Type: Presentation

- Bleam, W. (1999). Humic substances in geochemical processes: Metal complexation, redox reaction, and sorption of non-polar organic compounds. Environmental Molecular Sciences Symposium and First EMSL Users Meeting. Pacific Northwest National Lab. Richland, WA.
- Bleam, W. F. (1998). Nano-mineralogy and the chemistry of trace elements in soils. Presentation at Kansas State University. Manhattan, KS.
- Bleam, W. F. (1998). Recent developments in metal complexation by humic substances, 10/24/98. Natural Organic Matter Research in Soils and Water. International Humic Substances Society Workshop. University of Minnesota. St. Paul, MN.
- Bleam, W. F., et. al. (1998). Recent advances in understanding the chemistry of Cr(VI), Pb(II) and Hg(II) in soils: Adsorption to mineral surfaces and complexation by humic substances. Agronomy Abstracts. Baltimore, MD. 36.
- Bleam, W. F., Yoon, S. J., Szulczewski, M. A., Martinez, C. E., & Shen, S. (1998). Environmental chemistry at NSLS, 1998. National Synchrotron Light Source. Brookhaven National Laboratory. Upton, NY.
- Ranatunga, T. D., Taylor, R. W., Bleam, W. F., & McWhinney, H. G. (2000). Lead adsorption on Kaolinite. Annual Meeting. Soil Science Society of America. Minneapolis, MN.
- Shen, S., Taylor, R. W., & Tu, S. I. (1997). Equilibrium and Spectroscopic Studies of Lead Retention in Smectite. Agronomy Abstracts. Anaheim, CA. 190.
- Shen, S., Taylor, R. W., Bleam, W. F., & Tu, S. I. (1998). Coupled reduction-sorption of chromate in dithionite-reduced smectites. Agronomy Abstracts. Baltimore, MD. 189.
- Szulczewski, M. D., Xia, K., Helmke, P. A., Bleam, W. F., & Taylor, R. W. (1998). Evaluating the reductive capacity of humic substances: Reactions between thiol/thio groups and chromate. Agronomy Abstracts, Baltimore, MD. 38.
- Taylor, R. W., Shen, S., Bleam, W. F., & Tu, S. (1999, Jul. 11-15). Chromate removal by dithionite-reduced clays. 5th International Conference on the Biogeochemistry of Trace Elements. Vienna, Austria.

Project: 55148

Title: Hydrologic and Geochemical Controls on the Transport of Radionuclides in Natural Undisturbed Arid Environments as Determined by Accelerator Mass Spectrometry

PI: Dr. Gregory Nimz

Institution: Lawrence Livermore National Laboratory

Publication Type: Journal

McAninch, J. E., et. al. (1998). Detection of ⁹⁹Tc by accelerator mass spectrometry: Preliminary investigations. *J. Radioanal. Nucl. Chem.* 234, 125-129.

Publication Type: Proceeding

Caffee, M. W., Nimz, G. J., & Roberts, M. L. (1999). Measurement of iodine-129 in unsaturated soils: Transport properties and distribution of iodine-129 in depth profiles. EOS: Transactions of the American Geophysical Union, AGU Fall Meeting, San Francisco, CA.

Project: 55249

Title: Experimental Determination of Contaminant Metal Mobility as a Function of Temperature, Time, and Solution Chemistry

PI: Dr. Susan A. Carroll

Institution: Lawrence Livermore National Laboratory

Publication Type: Journal

Sahai, N., Carroll, S. A., Roberts, S. & O'Day, P. A. (2000). X-ray absorption spectroscopy of strontium (II) coordination. II. Sorption and precipitation at kaolinite, silica gel, and goethite surfaces. *J. Colloid and Interface Science.* 222, 198-212.

O'Day, P. A., Newville, M., Neuhoff, P. S., Sahai, N., & Carroll, S. A. (2000). X-ray absorption spectroscopy of strontium (II) coordination. I. Static and thermal disorder in crystalline, hydrated, and precipitated solids and in aqueous solution. *J. Colloid and Interface Science.* 222, 184-197.

Project: 55284

Title: Aquifer Transport of Th, U, Ra, and Rn in Solution and on Colloids

PI: Dr. G. J. Wasserburg

Institution: California Institute of Technology

Publication Type: Journal

Tricca, A., Porcelli, D., Wasserburg, G. J., & Baskaran, M. (1998). Transport of U- and Th-series radionuclides in groundwater. 8th Vv. M. Goldschmidt Conference. Toulouse, France. *Mineralogical Magazine.* 62A, 1543-1544.

Tricca, A., Porcelli, D., Wasserburg, G. J., & Baskaran, M. (2001, in press). Transport of U- and Th-series radionuclides in a sandy aquifer. *Geochim. Cosmochim. Acta*.

Tricca, A., Porcelli, D., Wasserburg, G. J., Baskaran, M., & Naidu, J. (1998). Development of a transport model of U-Th decay series nuclides in groundwater and its application to a sandy aquifer. *Eos Trans. Amer. Geophys. U.* 79, F425.

Publication Type: Presentation

Tricca, A., Porcelli, D., Wasserburg, G. J., & Baskaran, M. (2000, Apr.). Transport of U- and Th-series radionuclides in a sandy aquifer. DOE Conference. Atlanta, GA.

Project: 70070

Title: Reactivity of Primary Soil Minerals and Secondary Precipitates Beneath Leaking Hanford Waste Tanks

PI: Dr. Kathryn L. Nagy

Institution: University of Colorado

Publication Type: Presentation

Gamerding, A. P., Kaplan, D. I., & Serne, R. J. (2000, Dec. 15-19). Effect of mobile-immobile water on uranium sorption during transport in unsaturated sand-textured sediments. AGU Fall Meeting. San Francisco, CA.

Kaplan, D. I., Gamerding, A. P., & Serne, R. J. (2000, Dec. 15-19). Effect of rate-limited sorption on uranium mobility in unsaturated silt-textured sediments. AGU Fall Meeting. San Francisco, CA.

Serne, R. J., Last, G. V., Myers, D. A., & Sobczyk, S. M. (2000, Dec. 15-19). Results and interpretation from Hanford's SX tank farm vadose sediment sampling. AGU Fall Meeting. San Francisco, CA.

Sobczyk, S. M. & Serne, R. J. (2000, Dec. 15-19). Subsurface interpretation of the SX tank farm, Hanford site, Washington, based on gamma-ray logging. AGU Fall Meeting. San Francisco, CA.

Steeffel, C. I., Lichtner, P. C., Yabusaki, S. B., Pruess, K. L., & Serne, R. J. (2000, Dec. 15-19). I: Cesium migration in Hanford sediments below leaking HLW tanks. AGU Fall Meeting. San Francisco, CA.

Yabusaki, S. B. (2000, Dec. 15-19). Radioactive and mixed waste in the vadose zone: Characterization, experimental studies, and modeling. Special Session on Hanford Vadose Zone, AGU Fall Meeting. San Francisco, CA.

Project: 70163

Title: The Aqueous Thermodynamics and Complexation Reactions of Anionic Silica Species to High Concentration: Effects on Neutralization of Leaked Tank Wastes and Migration of Radionuclides in the Subsurface

PI: Dr. Andrew R. Felmy

Institution: Pacific Northwest National Laboratory

Publication Type: Journal

Felmy, A. R., Cho, H., Rustad, J. R., & Mason, M. J. (2001, in press). An aqueous thermodynamic model for polymerized silica species to high ionic strength. *J. Solution Chem.*

Publication Type: Presentation

Felmy, A. R., Cho, H., Rustad, J. R., Dixon, D. A., & Choppin, G. R. (2000, Nov. 28). The aqueous thermodynamics and complexation reactions of anionic silica species to high concentration. EMSP Principal Investigator Workshop. Richland, WA.

Felmy, A. R., et. al. (2001). The aqueous complexation of Eu(III) with organic chelates at high base concentration: Molecular and thermodynamic modeling results. *Nuclear Site Remediation - First Accomplishments of the Environmental Management Science Program. ACS Symposium Series 778*, 5.

Felmy, A. R., et. al. (2001, Mar. 12-15). Development of accurate chemical models for tank waste applications. *Tanks Focus Area Mid-Year Review*. Salt Lake City, UT.

Project: 73745 (Renewal of Project No. 54585)

Title: Permanganate Treatment of DNAPLs in Reactive Barriers and Source Zone Flooding Schemes

PI: Dr. Frank W. Schwartz

Institution: Ohio State University

Publication Type: Journal

Seol, Y. & Schwartz, F. W. (2000). Phase-transfer-catalyst applied to the oxidation of nonaqueous phase trichloroethylene by potassium permanganate. *J. of Contaminant Hydrology*. 44(2), 185-201.

Yan, Y. E. & Schwartz, F. W. (1999). Oxidative degradation and kinetics of chlorinated ethylenes by potassium permanganate. *Journal of Contaminant Hydrology*. 37(3-4), 343-365.

Yan, Y. E., & Schwartz, F. W. (2000). Kinetics and mechanisms for TCE oxidation by permanganate. *Environmental Science and Technology*. 34, 2535-2541.

Zhang, H., & Schwartz, F. W. (2000). Simulating the in situ oxidative treatment of chlorinated ethylenes by potassium permanganate. *Water Resources Research*. 36(10), 3031-3042.

Publication Type: Proceeding

Ibaraki, M. & Schwartz, F. W. (2000, May 22-25). On source-zone flooding for treating DNAPL sites. *Treating Dense Nonaqueous Phase Liquids (DNAPLs). The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds*. Monterey, CA. 2(6), 125-132.

Li, X. & Schwartz, F. W. (2000, May 22-25). Efficiency problems related to permanganate oxidation schemes. *Chemical Oxidation and Reactive Barriers. The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds*. Monterey, CA. 2(6), 41-48.

Seol, Y. & Schwartz, F. W. (2000, May 22-25). Phase-transfer-catalysis on the oxidation of trichloroethylene by permanganate. *Chemical Oxidation and Reactive Barriers. The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds*. Monterey, CA. 2(6), 17-24.

Yan, Y. E. & Schwartz, F. W. (1998, May 18-21). Oxidation of chlorinated solvents by permanganate. *Physical, Chemical, and Thermal Technologies. The First International Conference on Remediation of Chlorinated and Recalcitrant Compounds*. Monterey, CA. Battelle Press. Columbus, OH. 1(6), 403-408.

Zhang, H. & Schwartz, F. W. (2000, May 22-25). Simulation of oxidative treatment of chlorinated compounds by permanganate. *Chemical Oxidation and Reactive Barriers. The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds*. Monterey, CA. 2(6), 1-8.

Publication Type: Theses/Dissertations

Yan, Y. E. (1998). Abiotic remediation of ground water contaminated by chlorinated solvents. Ph D. Thesis. Ohio State University. Columbus, OH.



Photographs of 3-D large tank experiment. The experiment was designed to simulate the in-situ remediation of TCE residually saturated in sand aquifer. Reaction occurring in the sand aquifer is subject to monitoring for concentration of TCE, permanganate and chloride as a reaction product. [see Project #73745, renewal of #54585]

Project: 73758 (Renewal of Project No. 60355)

Title: Fixations Mechanisms and Desorption Rates of Sorbed Cs in High Level Waste Contaminated Subsurface Sediments: Implications to Future Behavior and In-Ground Stability

PI: Dr. John M. Zachara

Institution: Pacific Northwest National Laboratory

Publication Type: Presentation

Zachara, J. M. (1999, Aug.). New advances in the understanding of ¹³⁷Cs interactions with micas and implications to Cs geochemistry in the Hanford vadose zone. Keynote address given to the EMSP National Program Workshop. Chicago, IL.

Project: 73773 (Renewal of Project No. 55351)

Title: Isotopic Tracers for Waste Fluid Tracking and Fluid-Soil Interactions: Hanford, Washington

PI: Dr. Donald J. DePaolo

Institution: Lawrence Berkeley National Laboratory

Publication Type: Journal

Geller, J. T., et. al. (2000). Flow dynamics and potential for biodegradation of organic contaminants in fractured rock vadose zone. *J. Contaminant Hydrology*. 33, 63-90.

Publication Type: Other

Conrad, M. E. & Faybishenko, B. (2001, in press). Isotopic tracers of flow and transport through the vadose zone. Looney, B. & Falta, R. (Eds.). *Vadose Zone Technology and Science Solutions*. Batelle Press. Columbus, OH.

Publication Type: Proceeding

Conrad, M. E., DePaolo, D. J., & Dresel, P. E. (2000). Natural isotopic tracers of infiltration through the vadose zone at the Hanford Site, Washington. *Eos. Trans. Am. Geophys. Union*. 81(19), S230.

Conrad, M. E., DePaolo, D. J., Kennedy, B. M., & Miller, E. C. (1997). Carbon isotope evidence for degradation of mixed contaminants in the vadose zone. *Geol. Soc. Am. Abst.* 26(6), A186.

Conrad, M. E., DePaolo, D. J., Song, D. L., & Neher, E. (1999). Isotopic evidence for groundwater flow and biodegradation of organic solvents at the Test Area North site, Idaho National Engineering and Environmental Laboratory. Ninth V. M. Goldschmidt Conference. 58-59. LPI Contribution No. 971. Lunar and Planetary Institute. Houston, TX.

Song, D. L., Alvarez-Cohen, L., Conrad, M. E., & Sorenson, K. (1999). Monitoring of enhanced in-situ bioremediation of trichloroethylene using stable carbon isotopes. Program and Abstracts for the 4th International Symposium on Subsurface Microbiology. Vail, CO.

Project: 73775 (Renewal of Project No. 55396)

Title: Colloid Genesis/Transport and Flow Pathway Alterations Resulting From Interactions of Highly Reactive Waste Solutions and Sediments in the Vadose Zone

PI: Dr. Jiamin Wan

Institution: Lawrence Berkeley National Laboratory

Publication Type: Journal

Veerapaneni, S., Wan, J., & Tokunaga, T. K. (2000). Particle motion in film flow. *Environ. Sci. & Technol.* 34, 2465-2471.

Wan, J. & Tokunaga, T. K. (1998). Measuring partition coefficients of colloids at air-water interfaces. *Environ. Sci. Technol.* 32, 3293-3298.

Geophysics

Project: 54655

Title: Collaborative Research: Hydrogeological-Geophysical Methods for Subsurface Site Characterization

PI: Dr. Gary M. Mavko

Institution: Stanford University

Publication Type: Presentation

Wempe, W. L. & Mavko, G. (1999, Oct.). The propagation of errors in Archie's water saturation equation: The influence of an a-m relationship. Presentation at the Geological Society of America 1999 Conference.

Publication Type: Proceeding

Corona, W. W. & Mavko, G. (1999, Mar.). Predicting clay content and porosity from gamma-ray and conductivity logs. SAGEEP Proceedings.

Wempe, W. L. & Mavko, G. (2000, Feb.). The electrical resistivity - acoustic velocity relationship: A method for constraining porosity. SAGEEP Proceedings.

Publication Type: Theses/Dissertations

Wempe, W. L. (2000). Predicting flow properties using geophysical data: Improving aquifer characterization. Ph.D. dissertation. Stanford University, Stanford, CA.

Project: 55011

Title: Surface and Borehole Electromagnetic Imaging of Conducting Contaminant Plumes

PI: Dr. James G. Berryman

Institution: Lawrence Livermore National Laboratory

Publication Type: Journal

Berryman, J. G. (2000). Analysis of approximate inverses in tomography II. Iterative inverses. *Optimization and Engineering*, Volume 1, #1.

Berryman, J. G. (2000). Analysis of approximate inverses in tomography I. Resolution analysis of common inverses. *Optimization and Engineering*, Volume 1, #1.

Borcea, L., Berryman, J. G., & Papanicolaou, G. C. (1996). High contrast impedance tomography. *Inverse Problems*, 12, 835-858.

Borcea, L., Berryman, J. G., & Papanicolaou, G. C. (1999). Matching pursuit for imaging high contrast conductive media. *Inverse Problems*. 15, 811-849.

Dorn, O., Bertete-Aguirre, H., Berryman, J. G., & Papanicolaou, G. C. (1999, Dec. 19). A nonlinear inversion method for 3D-electromagnetic imaging using adjoint fields. *Inverse Probl.* 15(6), 1523-1558.

Publication Type: Patent

Berryman, J. G. (1998, Dec. 8). Robust discrimination of porosity and fluid saturation using seismic velocity analysis. Patent disclosure #IL-10437.

Berryman, J. G. (1998, Nov. 6). Joint inversion of electrical and electromagnetic tomography data for mapping saturation level and connectivity of conducting fluids underground. Patent disclosure #IL-10412.

Publication Type: Presentation

Berge, P. A. & Berryman, J. G. (1999, Mar. 24-27). Developing rock physics algorithms for velocity-porosity relations with environmental geophysics applications. Invited presentation at the Fifth SIAM Conference on Mathematical and Computational Issues in the Geosciences. San Antonio, TX.

Berryman, J. G. (1997, Aug. 25-29). Challenges for computational physics in underground imaging of electrically conducting contaminant plumes. Invited presentation P2.03 in special session on Geological Phenomena at the International Conference on Computational Physics. American Physical Society, Division of Computational Physics. Santa Cruz, CA.

Berryman, J. G. (1998, Oct. 19-23). Underground imaging of electrically conducting plumes. Invited presentation at the International Advanced Studies Institute, First International Symposium on Detection and Analysis of Subsurface Objects and Phenomena, Naval Postgraduate School. Monterey, CA.

Berryman, J. G., Berge, P. A. & Bonner, B. P. (1999, Nov. 4). Role of lambda-diagrams in estimating porosity and saturation from seismic velocities. Invited presentation at SEG, Houston, TX.

Publication Type: Proceeding

Berge, P. A., Berryman, J. G., Bonner, B. P., Roberts, J. J., & Wildenschild, D. (1999, Mar. 14-18). Comparing geophysical measurements to theoretical estimates for soil mixtures at low pressures. Invited presentation in the 1999 Conference Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Oakland, CA. 465-472.

Berge, P. A., Roberts, J. J., Berryman, J. G., & Wildenschild, D. (1998, Jul. 27-30). Joint inversion of geophysical data for site characterization and restoration monitoring. Abstract #188 in Proceedings of Environmental Sciences Management Workshop. Chicago, IL. 378-380.

Berryman, J. G. (1998, Jul. 27-30). Surface and borehole electromagnetic imaging of conducting contaminant plumes. Abstract #189 in Proceedings of Environmental Sciences Management Workshop. Chicago, IL. 380-382.

Berryman, J. G., Champagne II, N. J., & Buettner, H. M. (1999, Oct. 27-29). A 3D finite-difference frequency-domain code for electromagnetic induction tomography. Proceedings of the Second International Symposium on Three Dimensional Electromagnetics, University of Utah. Salt Lake City, UT.

Buettner, H. M. & Berryman, J. G. (1999, Mar. 14-18). An electromagnetic induction tomography field experiment at Lost Hills, CA. Invited presentation at the 1999 Conference Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Oakland, CA. 663-672.

Champagne II, N. J., Berryman, J. G., Buettner, H. M., Grant, J. B. & Sharpe, R. M. (1999, Mar. 14-18). A finite-difference frequency-domain code for electromagnetic induction tomography. Poster and paper in 1999 Conference Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Oakland, CA. 931-940.

Project: 55332

Title: A Hybrid Hydrologic-Geophysical Inverse Technique for the Assessment and Monitoring of Leachates in the Vadose Zone

PI: James R. Brainard

Institution: Sandia National Laboratories -
Albuquerque

Publication Type: Journal

Alumbaugh, D. L., Paprocki, L., Brainard, J., Glass, R. J., & Rautman, C. (2000, in press). Estimating in-situ moisture contents using cross-borehole ground penetrating radar; a study of accuracy, repeatability and resolution. Applied Geophysics.

Hughson, D. L. & Yeh, T. -C. J. (1998). A geostatistically based inverse model for three-dimensional variably saturated flow. *Stochastic Hydrology and Hydraulics*. 12, 285-298.

Hughson, D. L. & Yeh, T. -C. J. (2000). An inverse model for three dimensional variably saturated flow. *Water Resources Research*. 36(4).

LaBrecque, D. J. & Yang, X. (2000, in press). Difference inversion of ERT data - a fast inversion method for 3-D in-situ monitoring. *J. Environ. Eng. Geophys.*

Li, B. & Yeh, T. -C. J. (1999). Cokriging estimation of the conductivity field under variably saturated flow conditions. *Water Resour. Res.* 35(12), 3663-3674.

Vargas-Guzman, J. A. & Yeh, T. -C. J. (1999). Sequential kriging and cokriging: Two powerful geostatistical approaches. *Stochastic Environmental Research and Risk Assessment*. 13(6), 416-435.

Publication Type: Presentation

Alumbaugh, D. & Paprocki, L. (2000). Monitoring infiltration within the vadose zone using cross-borehole ground penetrating radar. *Proceedings of the Symposium on the Application of Geophysics for Environmental and Engineering Problems (SAGEEP)*. 273-281.

Brainard, J. R., et. al. (1999). Evaluation of geophysical and hydrologic measurements of an induced saturation field within heterogeneous deposits. *Abstracts from the American Geophysical Union Annual Fall Meeting*. San Francisco, CA.

LaBrecque, D. J., Yang, X., Alumbaugh, D. L., & Paprocki, L. (1999). Three-dimensional monitoring of vadose zone infiltration using ERT and cross-borehole ground penetrating radar. *Proceedings of the Second International Symposium on Three-Dimensional Electromagnetics*. Salt Lake City, UT. 329-332.

Paprocki, L. & Alumbaugh, D. (1999, Mar. 14-18). An investigation of cross-borehole ground penetrating radar measurements for characterizing the 2D moisture content distribution in the vadose zone. *Proceedings of the Symposium on the Application of Geophysics to Environmental and Engineering Problems (SAGEEP) '99*. Oakland, CA. 583-592.

Yang, X. & LaBrecque, D. (1998, Mar. 22-26). 3-D stochastic inversion of ERT data. *Proceedings of the Symposium on the Application of Geophysics to Environmental and Engineering Problems (SAGEEP) '98*. Chicago, IL. 221-228.

Yang, X. & LaBrecque, D. (2000, Feb. 20-24). Estimation of 3-D moisture content using ERT data at the Socorro infiltration site. Proceedings of the Symposium on the Application of Geophysics for Environmental and Engineering Problems (SAGEEP) '00. Arlington, VA.

Yang, X. & LaBrecque, D. (2000, Feb. 20-24). Three-dimensional complex resistivity tomography. Proceedings of the Symposium on the Application of Geophysics for Environmental and Engineering Problems (SAGEEP) '00. Arlington, VA.

Yeh, T. -C. J., Alumbaugh, D., Liu, S., & Paprocki, L. (1998). A stochastic hydrogeophysical joint inversion technique for monitoring and characterizing the vadose zone. AGU Fall Meeting 1998. San Francisco, CA.

Yeh, T. -C. J., LaBrecque, D., Alumbaugh, D., Li, B., & Yang, X. (1997). A stochastic hydrogeophysical joint inversion technique for monitoring movement of water and characterizing the vadose zone. AGU Fall Meeting 1997. San Francisco, CA.

Publication Type: Proceeding

Yang, X. & LaBrecque. (1999, Mar. 14-18). Comparison between stochastic and Occam's inversion of 3-D ERT data. Proceedings of the Symposium on the Application of Geophysics to Environmental and Engineering Problems (SAGEEP) '99. Oakland, CA. 979-988.

Publication Type: Report

Brainard, J. R., et. al. (2000, in press). The Sandia-tech vadose zone facility: Experimental design and data report of a constant flux infiltration experiment. Sandia National Laboratories.

Publication Type: Theses/Dissertations

Paprocki, L. T. (2000). Characterization of vadose zone in-situ moisture content and an advancing wetting front using cross-borehole ground penetrating radar. Master's Thesis. Department of Hydrology, New Mexico Institute of Mining and Technology. Socorro, New Mexico.

Yang, X. (1999). Stochastic inversion of 3-D ERT data. Ph. D. dissertation. Department of Mining and Geological Engineering, University of Arizona. Tucson, AZ.

Project: 60162

Title: Enhancements to & Characterization of the Very Early Time Electromagnetic (VETEM) Prototype Instrument & Applications to Shallow Subsurface Imaging at Sites in the DOE Complex

PI: Dr. David L. Wright

Institution: U.S. Geological Survey -
Denver

Publication Type: Journal

Cui, T. J. & Chew, W. C. (1999, Jun.). Fast algorithm for electromagnetic scattering by buried conducting plates of large size. *IEEE Trans. on Antennas and Propagation*. 47(6), 1116-1118.

Cui, T. J. & Chew, W. C. (1999, Mar.). Fast evaluation of sommerfeld integrals for EM scattering and radiation by three-dimensional buried objects. *IEEE Trans. on Geoscience and Remote Sensing*, GE-37(2), 887-900.

Cui, T. J. & Chew, W. C. (1999, Sept.). Fast algorithm for electromagnetic scattering by buried 3D dielectric objects of large size. *IEEE Trans. on Geoscience and Remote Sensing*. GE-37(5), 2597-2608.

Cui, T. J. & Chew, W. C. (2000, Apr.). Accurate model of arbitrary wire antennas above ground. *IEEE T. Antenn. Propag.* 48(4), 482-493.

Cui, T. J. & Chew, W. C. (2000, Jan.). Modeling of arbitrary wire antennas above ground. *IEEE T. Geosci. Remote*. 38(1), 357-365, Part 2.

Publication Type: Paper

Cui, T. J. & Chew, W. C. (1999, Aug. 15-22). Fast algorithm for electromagnetic scattering by buried 3D dielectric objects of large size. XXVIth General Assembly of the International Union of Radio Science, 982. Toronto, Canada.

Cui, T. J. & Chew, W. C. (1999, Jul. 12-15). Accurate model of arbitrary wire antennas in free space, above or inside ground. *Digest of IEEE Antennas and Propagation Society International Symposium*. 2, 982-985. Orlando, FL.

Wright, D. L. et. al. (1999, Aug. 13-21). An assessment of the prototype very early time electromagnetic system (VETEM). XXVIth General Assembly of the International Union of Radio science. Toronto, Canada.

Wright, D. L., et. al. (1999, Mar. 14-18). New field and modeling results from a simulated waste pit using the enhanced very early time electromagnetic (VETEM) prototype system. *Proceeding of the 12th Annual Symposium on the Applications of Geophysics to Environmental and Engineering Problem (SAGEEP)*. Oakland, CA.

Publication Type: Report

Cui, T. J. & Chew, W. C. (1999, Aug.). Novel diffraction tomographic algorithm for imaging two-dimensional dielectric objects buried under a lossy

earth. Research Report, Electromagnetics Laboratory, University of Illinois at Urbana-Champaign. No. CCEM-21-99. Also submitted to IEEE Trans. on Geoscience and Remote Sensing.

Cui, T. J. & Chew, W. C. (1999, Jan.). Accurate model of arbitrary wire antennas in free space, above or inside ground. Electromagnetics Laboratory, University of Illinois at Urbana-Champaign, Research Report No. CCEM-2-99. Also submitted to IEEE Trans. on Antennas and Propagation.

Cui, T. J. & Chew, W. C. (1999, Jul.). Frequency-spatial domain inverse scattering of two-dimensional dielectric objects buried under a lossy earth. Research Report, Electromagnetics Laboratory, University of Illinois at Urbana-Champaign. No. CCEM-19-99. Also submitted to IEEE Trans. on Microwave Theory and Techniques.

Cui, T. J., et. al. (1999, Mar.). Numerical modeling of an enhanced very early time electromagnetic (VETEM) prototype system. Research Report, Electromagnetics Laboratory, University of Illinois at Urbana-Champaign. No. CCEM-7-99. Also submitted to IEEE Antennas and Propagation Magazine.

Cui, T. J., et. al. (1999, May). Nonlinear inverse scattering of two-dimensional dielectric objects buried under a lossy earth. Research Report, Electromagnetics Laboratory, University of Illinois at Urbana-Champaign. No. CCEM-12-99. Also submitted to IEEE Trans. on Geoscience and Remote Sensing.

Project: 60328

Title: High Frequency Electromagnetic Impedance Measurements for Characterization, Monitoring and Verification Efforts

PI: Dr. Ki-Ha Lee

Institution: Lawrence Berkeley National Laboratory

Publication Type: Presentation

Lee, K. H., Becker, A., & Frangos, W. (2000, Apr.). High frequency impedance measurements for characterization, monitoring, and verification efforts. 2nd EMSP National Workshop. Atlanta, GA..

Lee, K. H., Becker, A., Pellerin, L., & Frangos, W. (1998, Jul.). High frequency impedance measurements for characterization, monitoring, and verification efforts. 1st EMSP National Workshop. Chicago, IL.

Song, Y., Morrison, H. F., & Lee, K. H. (1997). High frequency electromagnetic impedance for subsurface imaging. Symposium for Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Reno, NV.

Publication Type: Report

Frangos, W. & Becker, A. (1998). Magnetic fields of AM band radio broadcast signals at the Richmond Field Station. Lawrence Berkeley National Lab Report LBNL-42654.

Project: 70108 (Renewal of Project No. 55411)

Title: Effects of Fluid Distribution on Measured Geophysical Properties for Partially Saturated, Shallow Subsurface Conditions

PI: Dr. Patricia A. Berge

Institution: Lawrence Livermore National Laboratory

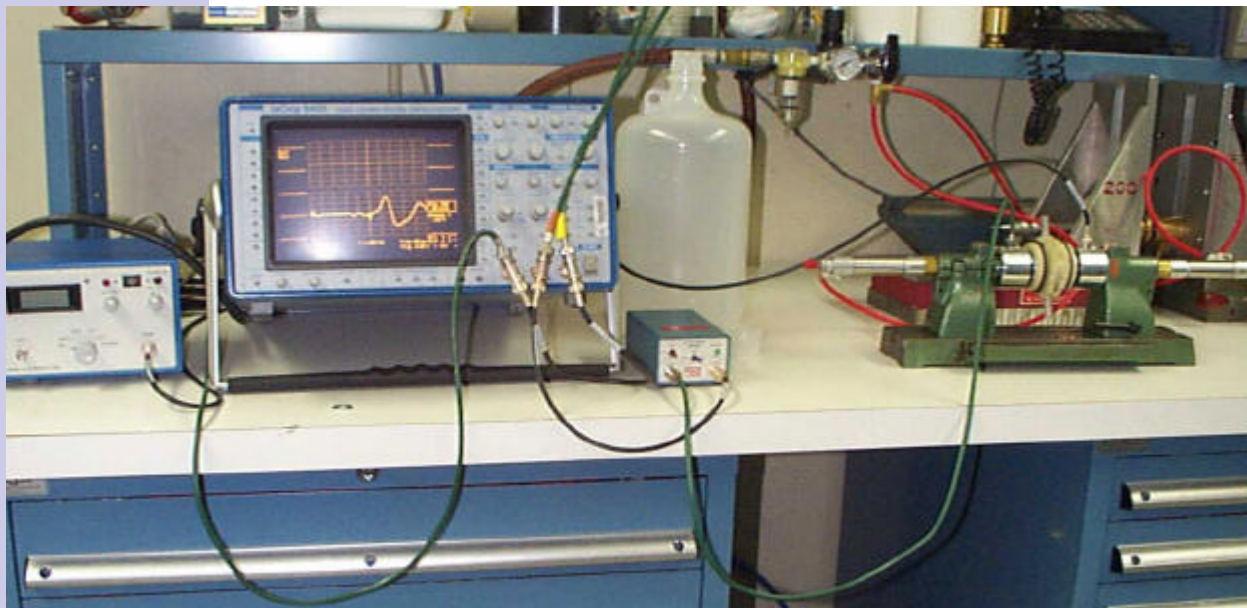
Publication Type: Journal

Berryman, J. G. & Pride, S. R. (1998). Volume averaging, effective stress rules, and inversion for microstructural response of multicomponent porous media. LLNL report UCRL-JC-127248, *Int. J. Sol. Struct.* 35, 4811-4843.

Berryman, J. G., Berge, P. A., & Bonner, B. P. (2000). Transformation of seismic velocity data to extract porosity and saturation values for rocks: LLNL Report UCRL-JC-136703. *Journal of the Acoustical Society of America.* 107, 3018-3027.

Berryman, J. G., Berge, P. A., & Bonner, B. P. (2001, in press). Estimating rock porosity and fluid saturation using only seismic velocities: LLNL report UCRL-JC-135507. *Geophysics.*

Pride, S. R. & Berryman, J. G. (1998). Connecting theory to experiment in poroelasticity. *J. Mech. Phys. Sol.* 46, 719-747.



Photograph of experimental apparatus for measuring ultrasonic compressional and shear wave velocities in soils at low pressures. The oscilloscope screen displays an amplified signal from the pulse generator at the far left. This signal travelled through the soil sample in the sample holder assembly to the right. [see Project #70108, renewal of #55411]

Wildenschild, D., Roberts, J. J., & Carlberg, E. D. (2000, in press). On the relationship between microstructure and electrical and hydraulic properties of sand-clay mixtures: LLNL Report UCRL-ID-136122. Geophysical Research Letters.

Wildenschild, D., Roberts, J. J., & Carlberg, E. D. (2000). On the relationship between microstructure and electrical and hydraulic properties of sand-clay mixtures: LLNL report UCRL-ID-136122. Geophysical Research Letters. 27,3085-3088.

Publication Type: Paper

Berryman, J. G. & Berge, P. A. (1999, Mar. 24-27). Mixture theory for predicting geomechanical coefficients of heterogeneous reservoirs. Fifth Society for Industrial and Applied Mathematics (SIAM) Conference on Mathematical and Computational Issues in the Geosciences. San Antonio, TX. 110.

Publication Type: Patent

Berryman, J.G. (1999, Oct. 4). Robust discrimination of porosity and fluid saturation using seismic velocity analysis. DOE Patent Docket No. S-92015, LLNL Patent disclosure IL-10437.

Bonner, B. P., Boro, C., & Hart, D. J. (1999, Oct. 28). Anti-waveguide for ultrasonic testing of granular media under elevated stress. DOE Patent Docket No. S-94182, LLNL Patent disclosure IL-10607.

Publication Type: Presentation

Roberts, J. J. (2000, Apr.). Preliminary results of the effects of fluid distribution on measured geophysical properties for partially saturated, shallow subsurface conditions. Environmental Management Science Program National Workshop, Atlanta, GA.

Roberts, J. J. (2000, Jan. 19-20). Results of the joint inversion of geophysical data for site characterization and restoration monitoring. Advanced Vadose Zone Characterization Workshop, Richland, WA.

Roberts, J. J. (2000, Jan.). Preliminary results of the effects of fluid distribution on measured geophysical properties for partially saturated, shallow subsurface conditions. Advanced Vadose Zone Characterization Workshop, Richland, WA.

Publication Type: Proceeding

Berge, P. A., Bonner, B. P., Aracne-Ruddle, C., Trombino, C., & Berryman, J. G. (1999). Compressional and shear wave velocities of soils at low pressures— Theoretical estimates, and comparison of laboratory and field data. LLNL report UCRL-JC-133211 Abs, Proceedings of the Seismological Society of America (SSA) 94th Annual Meeting, Seismological Research Letters. 70, 226.

Bonner, B. P., et. al. (1999, Mar. 14-18). Ultrasonic characterization of synthetic soils for application to near surface geophysics. Powers, M. H., Cramer, L., & Bell, R. S. (Eds.), Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Oakland, CA. Environmental and Engineering Geophysical Society. Wheat Ridge, CO. 455-463.

Bonner, B. P., et. al. (2001, in press). Linear and nonlinear ultrasonic properties of granular soils: LLNL report UCRL-JC-136207. Materials Research Society Spring Meeting, April 24-28, 2000. San Francisco, CA.

Bonner, B. P., Wildenschild, D., Berge, P. A., Ruddle, D., & Aracne-Ruddle, C. M. (2000). Ultrasonic velocities of artificial sediments with minimal overburden (abstract): LLNL report UCRL-JC-140230-ABS. Eos, Transactions of the American Geophysical Union, Fall Meeting Supplement. Proceedings of the Fall Annual Meeting, held in San Francisco, CA. Dec. 15-19, 2000. 81, F1105.

Publication Type: Report

Aracne-Ruddle, C. M., et. al. (1999). Ultrasonic velocities in unconsolidated sand/clay mixtures at low pressures: LLNL Report UCRL-JC-135621. Lawrence Livermore National Laboratory. Livermore, CA. Abs, Eos, Transactions of the American Geophysical Union, 80, Fall Meeting Supplement, F397.

Aracne-Ruddle, C., Wildenschild, D., Bonner, B., & Berge, P. (1998). Direct observation of morphology of sand-clay mixtures with implications for mechanical properties in sediments. LLNL report UCRL-JC-131702 Abs, Eos, Transactions of the American Geophysical Union, 79, Fall Meeting Supplement, F820.

Aracne-Ruddle, C., Wildenschild, D., Bonner, B., & Berge, P. (1998, Oct. 15-16). Direct observation of fluid-clay interactions with implications for mechanical and electrical properties. LLNL report UCRL-JC-131116 Abs. Presentation at the LLNL Women's Technical and Professional Symposium. San Ramon, CA.

Berge, P. A. & Berryman, J. G. (1999, Mar. 24-27). Developing rock physics algorithms for velocity-porosity relations with environmental geophysics applications. LLNL report UCRL-JC-132054 Abs, Fifth Society for Industrial and Applied Mathematics (SIAM) Conference on Mathematical and Computational Issues in the Geosciences. San Antonio, TX. 108.

Berge, P. A. & Bertete-Aguirre, H. (2000, Feb. 20-24). Laboratory velocity measurements used for inferring soil distributions from field seismic data: LLNL Report UCRL-JC-135132. In Powers, M. H., Ibrahim, A. -B., & Cramer, L. (Eds.). Proceedings of the 13th Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Arlington, VA. Environmental and Engineering Geophysical Society. Wheat Ridge, CO. 185-194.

- Berge, P. A. (2000). Final report for EMSP project 55411, Joint inversion of geophysical data for site characterization and restoration monitoring: LLNL report UCRL-ID-128343. Lawrence Livermore National Laboratory. Livermore, CA.
- Berge, P. A. (2000). FY2000 annual report for EMSP project 70108, Effects of fluid distribution on measured geophysical properties for partially saturated, shallow subsurface conditions: LLNL report UCRL-ID-137130. Lawrence Livermore National Laboratory. Livermore, CA.
- Berge, P. A. (2000). Powerpoint presentation on effects of fluid distribution on measured geophysical properties for partially saturated, shallow subsurface conditions: LLNL report UCRL-VG-137423 rev. 1. Advanced Vadose Zone Characterization Workshop. PNNL Hanford Groundwater/Vadose Zone Integration Project, held Jan. 19-20, 2000. Richland, WA.
- Berge, P. A. (2000). Powerpoint presentation on EMSP project 70108: Effects of fluid distribution on measured geophysical properties for partially saturated, shallow subsurface conditions: LLNL report UCRL-VG-137423. EMSP Principal Investigator Orientation Meeting, held Nov. 16-18, 1999. Richland, WA.
- Berge, P. A. (2000, Apr. 25-27). EMSP project 70108: Effects of fluid distribution on measured geophysical properties for partially saturated, shallow subsurface conditions: LLNL report UCRL-JC-137130-ABS rev. 1. Science Advancing Solutions EMSP National Workshop Guidebook for the Environmental Management Science Program (EMSP) National Workshop.
- Berge, P. A., Berryman, J. G., Bonner, B. P., Roberts, J. J., & Wildenschild, D. (1998, Oct. 15-16). Preliminary results from an environmental geophysics project for improving geophysical imaging of fluid distribution in the shallow subsurface. LLNL report UCRL-JC-131209 Abs. Presentation at the LLNL Women's Technical and Professional Symposium. San Ramon, CA.
- Berge, P. A., Berryman, J. G., Bonner, B. P., Roberts, J. J., & Wildenschild, D. (1999, Mar. 14-18). Comparing geophysical measurements to theoretical estimates for soil mixtures at low pressures. LLNL report UCRL-JC-132893. Powers, M. H., Cramer, L., & Bell, R. S. (Eds.), Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP), Oakland, CA. Environmental and Engineering Geophysical Society. Wheat Ridge, CO. 465-472.
- Berge, P. A., Berryman, J. G., Roberts, J. J., & Wildenschild, D. (1998, Jul. 27-30). Joint inversion of geophysical data for site characterization and restoration monitoring. EMSP project summary/progress report for FY98 for EMSP project 55411. LLNL report UCRL-JC-128343, presented at the DOE Environmental Management Science Workshop, Chicago, IL.

Berge, P. A., Berryman, J. G., Roberts, J. J., & Wildenschild, D. (1997). Joint inversion of geophysical data for site characterization and restoration monitoring. Carrigan, C. R. & Jackson, K. J. (Eds.), Environmental Management Science Program: Fiscal Year 1997 Progress Report, Lawrence Livermore National Laboratory (LLNL) report UCRL-ID-129562, LLNL, Livermore, CA.

Berryman, J. G., Berge, P. A., & Bonner, B. P. (1999, Oct. 31-Nov. 5). Role of lambda diagrams in estimating porosity and saturation from seismic velocities (expanded abstract): LLNL Report UCRL-JC-134224. Society of Exploration Geophysicists International Exposition and 69th Annual Meeting Technical Program. Houston, TX. Vol. I, 176-179.

Berryman, J., Dvorkin, J., Le Ravalec, M., & Nur, A. (1997). Effective moduli of particulates with elastic cement. LLNL report UCRL-JC-128340.

Bertete-Aguirre, H. & Berge, P. A. (1999). Laboratory ultrasonic measurements of sand-clay mixtures used to recover clay content in silty sands (abstract): LLNL Report UCRL-JC-135643. Abs, Eos, and Transactions of the American Geophysical Union, 80, Fall Meeting Supplement. F395-396.

Bonner, B. P., Hart, D. J., Berge, P. A., & Aracne, C. M. (1997). Influence of chemistry on physical properties: Ultrasonic velocities in mixtures of sand and swelling clay. LLNL report UCRL-JC-128306abs, Eos, Transactions of the American Geophysical Union, 78, Fall Meeting Supplement, F679.

Rowe, C. D. (1997, summer). Joint inversion of geophysical data for site characterization and restoration monitoring. In Williams, B. (Ed.), The Associated Western Universities Summer Participant Program at the Lawrence Livermore National Laboratory, Summer 1997: LLNL report UCRL-ID-128721-97, LLNL. Livermore, CA. 75-78.

Trombino, C. N. (1998). Elastic properties of sand-peat moss mixtures from ultrasonic measurements. LLNL report UCRL-JC-131770. LLNL, Livermore, CA.

Wildenschild, D., Roberts, J. J. & Carlberg, E. D. (1998). Transport and microstructural properties of sand-clay mixtures. LLNL report UCRL-JC-131703 Abs, Eos, Transactions of the American Geophysical Union, 79, Fall Meeting Supplement, F820.

Wildenschild, D., Roberts, J. J., & Carlberg, E. (1999, Mar. 14-18). Influence of microstructural properties on geophysical measurements in sand-clay mixtures. LLNL report UCRL-JC-131557. Powers, M. H., Cramer, L., & Bell, R.S. (Eds.), Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Oakland, CA. Environmental and Engineering Geophysical Society. Wheat Ridge, CO. 445-454.

Wildenschild, D., Roberts, J. J., & Carlberg, E. D. (1999, Oct. 31-Nov. 5). Electrical properties of sand-clay mixtures: The effect of microstructure (expanded abstract): LLNL Report UCRL-JC-135208. Society of Exploration Geophysicists International Exposition and 69th Annual Meeting Technical Program. Houston, TX. Vol. I, 461-464.

Project: 73731 (Renewal of Project No. 60199)

Title: Automating Shallow Seismic Imaging

PI: Dr. Don W. Steeples

Institution: University of Kansas

Publication Type: Journal

Baker, G. S., Schmeissner, C., Steeples, D. W., & Plumb, R. G. (1999). Seismic reflections from depths of less than two meters. *Geophys. Res. Lett.* 26(2), 279-282.

Baker, G. S., Steeples, D. W., & Schmeissner, C. (1999). In-situ, high-frequency P-Wave velocity measurements within 1 m of the Earth's surface. *Geophysics.* 64(2), 323-325.



(a)



(b)

Field Layout. (a) View from one end of the plow. The channel iron with geophones and wiring attached runs from lower right to just above center of photo. (b) Plow with test-line geophones planted in the ground under the rear of the plow. Comparison-line geophones with normal plants are about 75cm to the right of the test line. [see Project #73731, renewal of #60199]



(a)



(b)

Automatic geophone-planting device. (a) Folded plow, ready for transport. Channel iron welded to V-shaped blades can be seen at top right. (b) Plow ready for automatic geophone planting. Channel iron with geophones attached can be seen in the foreground as a white line running from left to right. [see Project #73731, renewal of #60199]

Baker, G. S., Steeples, D. W., Schmeissner, C., & Spikes, K. T. (2000, Apr.). Source-dependent frequency content of ultrashallow seismic reflection data. *B. Seismol. Soc. Am.* 90(2), 494-499.

Baker, G. S., Steeples, D. W., Schmeissner, C., & Spikes, K. T. (2000). Ultrashallow seismic reflection monitoring of seasonal fluctuations in the water table. *Environ. Engrg. Geosci.* 6, 271-277.

Baker, G. S., Steeples, D. W., Schmeissner, C., & Pavlovic, M. (2000, in press). On coincident seismic and radar imaging. *Geophysics*.

Baker, G. S., Steeples, D. W., Schmeissner, C., Pavlovic, M., & Plumb, R. (2001). Coincident imaging using seismic and GPR data. *Geophys. Res. Lett.* 28(4), 627-630.

Steeple, D. W. & Baker, G. S. (1998, Jun.). Near-surface contributions to seismic static corrections. *AAPG Explorer*. 19, 20-21, 29.

Steeple, D. W., Baker, G. S., & Schmeissner, C. (1999). Toward the autojuggie: Planting 72 geophones in 2 seconds. *Geophysical Research Letters*. 26(8), 1085-1088.

Steeple, D. W., Baker, G. S., Schmeissner, C., & Macy, B. K. (1999). Geophones on a board. *Geophysics*. 64(3), 809-814.

Publication Type: Poster

Plumb, R. G., Steeples, D. W., Baker, G. W., Schmeissner, C., & Pavlovic, M. (1999, Jun.). A combined ground-penetrating radar and shallow seismic reflection approach to characterizing hydrological flow. International Geoscience and Remote Sensing Society (IGARSS) meeting. Hamburg, Germany.

Publication Type: Presentation

Baker, G. S., Plumb, R. G., Steeples, D. W., Pavlovic, M., & Schmeissner, C. (1998). Coincident GPR and ultrashallow seismic imaging in the Arkansas River Valley, Great Bend, Kansas. SEG Expanded Abstracts, SEG 1998 International Meeting. New Orleans, LA. 859-861.

Baker, G. S., Steeples, D. W., Schmeissner, C., & Macy, B. K. (1998). In-situ, high-resolution P-wave velocity measurements within 1 m of the Earth's surface. SEG Exp. Abstr., SEG 1998 International Meeting. New Orleans, LA. 856-858.

Steeple, D. W., Baker, G. S., & Schmeissner, C. (1998, Dec. 6-10). Toward the autojuggie: Planting 72 geophones in 2 seconds. (1998). American Geophysical Union, 1998 Fall Meeting. San Francisco, CA.

Steeple, D. W., Baker, G. S., Schmeissner, C., & Macy, B. K. (1998). Geophones on a board. SEG Exp. Abstr., SEG 1998 International Meeting. New Orleans, LA. 852-855.

Publication Type: Proceeding

Baker, G. S., McIntyre, C., Walczak, L., & Steeples, D. W. (2000, Aug. 6-11). Improving ultrashallow seismic reflection data by reducing source energy. Exp. Abstr. SEG Intl. Exposition and 70th Annual Meeting. Calgary, Alberta, Canada. II, 1267-1270.

Baker, G. S., Steeples, D. W., Schmeissner, C., & Spikes, K. T. (2000). Collecting seismic-reflection data from depths shallower than three meters. Proceeding of the Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Washington, D. C. 1207-1214.

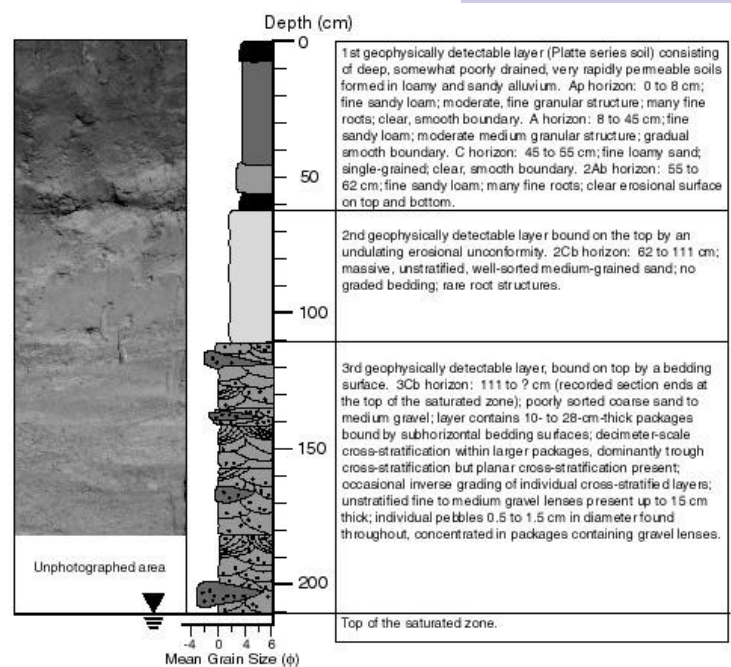
Schmeissner, C., Steeples, D. W., Pavlovic, M., Prado, R., & Spikes, K. T. (2000, Aug. 6-11). Recording seismic reflections using rigidly interconnected geophones. Exp. Abstr. SEG Intl. Exposition and 70th Annual Meeting. Calgary, Alberta, Canada. II, 1279-1282.

Spikes, K. T., Steeples, D. W., Schmeissner, C., & Prado, R. (2000, Aug. 6-11). Varying the effective mass of geophones. Exp. Abstr. SEG Intl. Exposition and 70th Annual Meeting. Calgary, Alberta, Canada. II.

Steeple, D. W., Schmeissner, C. M., & Baker, G. S. (2000, Apr. 10-12). Applications of and recent developments in shallow seismic reflection. Abstract, SSA 95th Annual Meeting. San Diego, CA. Seismological Research Letters. 71(2), 231.

Publication Type: Theses/Dissertations

Baker, G. S. (1999, May). Seismic imaging shallower than three meters. Ph. D. dissertation. The University of Kansas. Lawrence, KS.



Photograph, stratigraphic column, and description of hand-dug hole located approximately 15m from seismic and GPR lines. Ground-penetrating radar successfully imaged the two upper interfaces but not the top of the saturated zone. The seismic-reflection technique imaged the three main interfaces. Both techniques imaged some reflectors within the main layers, interpreted as cross-bedding or unidentified lenses. [see Project #73731, renewal of #60199]

Pavlovic, M. (2000). Ground-penetrating radar in shallow aquifer detection and monitoring. Master's Thesis. University of Kansas. Lawrence, KS.

Project: 73776 (Renewal of Project No. 60328)

Title: High Frequency Electromagnetic Impedance Measurements for Characterization, Monitoring and Verification Efforts

PI: Dr. Ki-Ha Lee

Institution: Lawrence Berkeley National Laboratory

Publication Type: Patent

Becker, A. (1998, Jan. 8). High-frequency electric field measurement using a toroidal antenna. Provisional Application Ser. No. 60/070,850.

Publication Type: Presentation

Lee, K. H., Becker, A., Pellerin, L., & Frangos, W. (1998, Jul.). High frequency impedance measurements for characterization, monitoring, and verification efforts. 1st EMSP National Workshop. Chicago, IL.

Lee, K. H., Becker, A., Pellerin, L., & Frangos, W. (2000, Apr.). High frequency impedance measurements for characterization, monitoring, and verification efforts. 2nd EMSP National Workshop. Atlanta, GA.

Song, Y., Morrison, H. F., & Lee, K. H. (1997). High frequency electromagnetic impedance for subsurface imaging. Symposium for Application of Geophysics to Engineering and Environmental Problems (SAGEEP). Reno, NV.

Publication Type: Report

Frangos, W. & Becker, A. (1998). Magnetic fields of AM band radio broadcast signals at the Richmond Field Station. Lawrence Berkeley National Lab Report LBNL-42654.

Lee, K. H. (1997). High-frequency electric field measurement using a toroidal antenna. Lawrence Berkeley National Lab Report LBNL-39894, UC-2040.

Project: 73830 (Renewal of Project No. 55218)

Title: Seismic Surface-Wave Tomography of Waste Sites

PI: Dr. Timothy L. Long

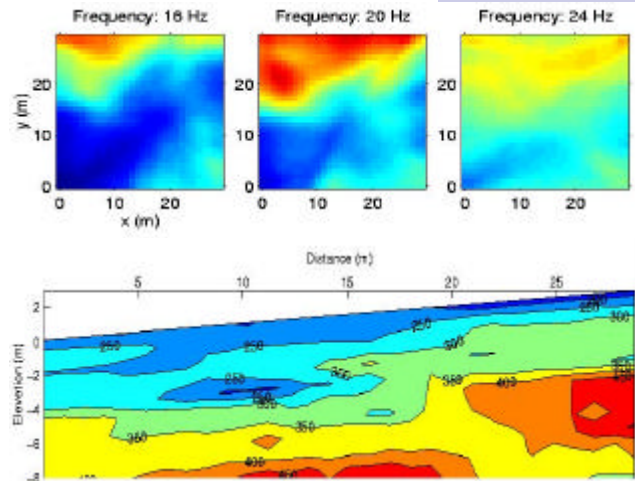
Institution: Georgia Institute of Technology

Publication Type: Journal

Long, L. T. & Kocaoglu, A. (2001, in press) Surface-wave group-velocity tomography for shallow structures. Journal of Environmental and Engineering Geophysics.



Ever wonder what is under here? Generate a set of Group Velocity images (upper right), then invert the dispersion curves at each position to get an image of the shear-wave structure (lower right). The low velocity at 10m and 4m depth is a suspected burial trench, or the high uplifted under 25m could indicate a thrust fault. [see Project #73830, renewal of #55218]



Publication Type: Other

Long, L. T. (1999, Feb.). Seismic surface wave tomography at waste sites. Research Note in Fast Times, the EEGS Newsletter.

Publication Type: Presentation

Long, L. T. & Kocaoglu, A. (1999, Oct. 16-20). A tomographic inversion method for near-surface structure. Eastern Section Seismological Society of America Annual Meeting. Memphis, TN.

Long, L. T., Kocaoglu, A., Doll, W. E., Chen, X. Q., & Martin, J. (1999, Oct.). Surface-wave group-velocity tomography for shallow structures at a waste site. SEG Expanded Abstract, Annual Meeting. Houston, TX.

Publication Type: Proceeding

Long, L. T., & Kocaoglu, A. (1999, Mar.). Surface-wave group-velocity tomography for shallow structures. Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems, Environmental and Engineering Geophysical Society (SAGEEP99).

Martin, J., Long, L. T., & Kubota, T. (2000, Sept. 10-13). Imaging near-surface buried structure with high-resolution surface-wave group-velocity tomography. Proceedings of the IEEE Signal Processing Society, International Conference on Image Processing. Vancouver, British Columbia, Canada.

Project: 73962 (Renewal of Project No. 60115)

Title: Advanced High Resolution Seismic Imaging, Material Properties Estimation and Full Wavefield Inversion for the Shallow Subsurface

PI: Dr. Alan R. Levander

Institution: Rice University

Publication Type: Journal

Zelt, C. A., Hojka, A. M., Flueh, E. R., & McIntosh, K. D. (1999, Aug. 15). 3D simultaneous seismic refraction and reflection tomography of wide-angle data from the central Chilean margin. *Geophys. Res. Lett.* 26(16), 2577-2580.

Zelt, C. A., Optimal utilization of sub-optimal 3D wide-angle data. *Seis. Res. Lett.* 70, 255.

Publication Type: Presentation

Akerberg, P., Dana, D., Levander, A., Zelt, C., & Henstock, T. (1998). High resolution shallow seismic imaging at an open pit copper mine. 10th Annual IRIS Workshop. Santa Cruz, CA.

Dana, D., Akerberg, P., Levander, A., Zelt, C., & Henstock, T. J. (1998). Shallow-seismic investigation at an open pit copper mine: A comparison with drill data. *EOS, Trans. Am. Geophys. Union.* 79, F652.

Dana, D., Akerberg, P., Zelt, C., Levander, A., & Henstock, T. (1998). High resolution seismic imaging at a porphyry copper mine. Society of Exploration Geophysicists. New Orleans, LA.

Dana, D., Zelt, C., & Levander, A. (1999). High-resolution seismic survey over a near-surface contamination site. SEG International Exposition and Sixty-Ninth Annual Meeting.

Passmore, P., Keller, G. R., Miller, K. C., Levander, A., & McMechan, G. (1999). Single-channel recorder test results from two different active source experiments. *Seism. Res. Letters.* 70, 243.

Zelt, C. A. & Hojka, A. M. (1998). 3D simultaneous seismic refraction and reflection tomography of wide-angle traveltimes data from the central Chilean margin. *EOS.* 79, F638.

Health/Risk**Project: 55033**

Title: Characterization of Chemically Modified Hyperthermophilic Enzymes for Chemical Syntheses and Bioremediation Reactions

PI: Dr. Brian H. Davison

Institution: Oak Ridge National Laboratory

Publication Type: Journal

Kim, C., Brereton, P. S., Verhagen, M. F. J. M., & Adams, M. W. W. (2000, in press). Ferredoxin from *Pyrococcus furiosus*. *Meths. Enzymol.*

Kim, C., Woodward, C. A., Kaufman, E. N., & Adams, M. W. W. (1999). Stability and sulfur reduction activity in organic media of hydrogenase from the hyperthermophilic *Pyrococcus furiosus*. *Biotechnologies & Bioengineering.* 65, 108-113.

Ma, K. & Adams, M. W. W. (2000, in press). Hydrogenase I and hydrogenase II from *Pyrococcus furiosus*. *Meths. Enzymol.*

Ma, K., Weiss, R., & Adams, M. W. W. (2000). Characterization of hydrogenase II from the hyperthermophilic archaeon *Pyrococcus furiosus* and assessment of its role in sulfur reduction. *J. Bacteriol.* 182, 1864-1871.

Sapra, R., Verhagen, M. F. J. M., & Adams, M. W. W. (2000). Purification and characterization of a membrane-bound hydrogenase from the hyperthermophilic archaeon *Pyrococcus furiosus*. *J. Bacteriol.* 182, 3423-3428.

Telser, J., Davydov, R., Kim, C-H., Adams, M. W. W., & Hoffman, B. M. (1999). Investigation of the unusual electronic structure of *Pyrococcus furiosus* 4Fe ferredoxin by EPR spectroscopy of protein reduced at ambient and cryogenic temperatures. *Inorganic Chemistry.* 38, 3550-3553.

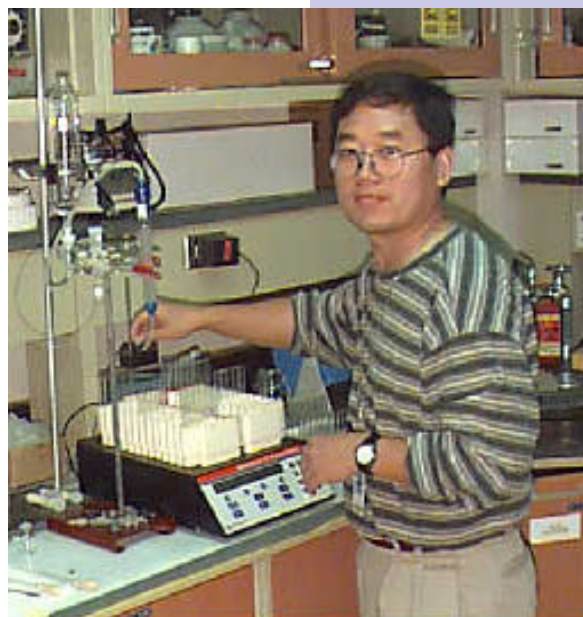
Wang, P., Woodward, C. A., & Kaufman, E. N. (1999). Poly(ethylene glycol)-modified ligninase enhances pentachlorophenol biodegradation in water-solvent mixtures. *Biotechnologies & Bioengineering.* 64, 290-297.

Publication Type: Poster

Adams, M. W. W. (1995). Properties of polyethylene glycol-modified proteins in aqueous and organic media. *Inorganic Biochemistry Summer Workshop '95.* Athens, GA.

Adams, M. W. W. (1996). Polyethylene glycol-modified hydrogenase from *pyrococcus furiosus* that is soluble and active in organic solvents. *Thermophiles '96: International Conference on the Biology, Ecology, and Biotechnology of Thermophilic Microorganisms.* Athens, GA.

Wang, P., et. al. (1998, May). PEG-modified ligninase enhances pentachlorophenol biodegradation in water-solvent mixtures. *NSF Thermophile Workshop.* Seattle, WA.



Purification of the PEG-modified enzymes using gel permeation chromatography. [see Project #55033]

Publication Type: Presentation

Adams, M. W. W. (1996). Enzymatic catalysis in organic solvents: Polyethylene glycol modified hydrogenase is soluble in toluene and retains sulfur-reducing activity. The 18th Symposium on Biotechnology for Fuels and Chemicals. Gatlingburg, TN.

Adams, M. W. W. (1998, Jul.). Characterization of chemically modified enzymes for bioremediation reactions. EMSP Review Meeting. Chicago, IL.

Adams, M. W. W. (2000, Apr.). Characterization of chemically modified enzymes for bioremediation reactions. EMSP Review Meeting. Atlanta, GA.

Davison, B. (1998, May). A new phase for nonaqueous biocatalysis. Oak Ridge National Laboratory Showcase Seminar.

Kaufman, E., et. al. (1996, Nov.). Enzymatic catalysis in organic solvent: Polyethylene glycol modified hydrogenase retains sulfohydrogenase activity in toluene. AIChE Annual Meeting.

Wang, P., et. al. (1998, May). Modification of enzymes for non-aqueous catalysis: Bioremediation of chlorinated pollutants in organic solvents. 1st Annual Conference on the Remediation of Chlorinated and Recalcitrant Compounds. Columbus, OH.

Wang, P., et. al. (1998, Nov.). Activation and stabilization of ligninase for remediation of polychlorinated pollutants in organic solvents. AIChE Annual Meeting. Miami Beach, FL.

Publication Type: Proceeding

Adams, M. W. W. (1996). Hyperthermophilic proteins from *Pyrococcus furiosus* that are soluble and active in a pure organic solvent. The 3rd Annual National Science Foundation Hyperthermophile Symposium. Raleigh, NC.

Adams, M. W. W. (1997). Enzymatic catalysis in organic solvents. The 4th Annual National Science Foundation Hyperthermophile Symposium. Del Mar, CA.

Adams, M. W. W. (1998). Catalytic and spectroscopic studies of polyethylene glycol-modified, hyperthermophilic proteins in organic solvents. The 5th Annual National Science Foundation Hyperthermophile Symposium. Seattle, WA.

Adams, M. W. W. (1999). Properties of the ferredoxin iron-sulfur cluster from the hyperthermophilic archaeon *Pyrococcus furiosus* in organic solvents. The 6th Annual National Science Foundation Hyperthermophile Symposium. Athens, GA.

Hydrogeology

Project: 54576

Title: On the Inclusion of the Interfacial Area Between Phases in the Physical and Mathematical Description of Subsurface Multiphase Flow

PI: Dr. William G. Gray

Institution: University of Notre Dame

Publication Type: Journal

Gray, W. G. & Miller, C. T. (2000, Feb.). Comment on 'Dynamics of wetting fronts in porous media' by Mitkov, I., Tartakovsky, D. M., & Winter, C. L. *Physical Review E*. 61(2), 2150-2151.

Gray, W. G. (2000, Mar.). Macroscale equilibrium conditions for two-phase flow in porous media. *Int. J. Multiphas. Flow*. 26(3), 467-501.

Hazlett, R. D., Chen, S. Y., & Soll, W. E. (1998, Jun.). Wettability and rate effects on immiscible displacement: Lattice Boltzmann Simulation in Microtomographic Images of Reservoir Rocks. *J. of Petroleum Science and Engineering*. 20(3-4), 167-175.

Hou, S., Shan, X., Zou, Q., Doolen, G. D., & Soll, W. E. (1997). Evaluation of two Lattice Boltzmann models for multiphase flow. *J. of Computational Physics*, 138. 695-713.

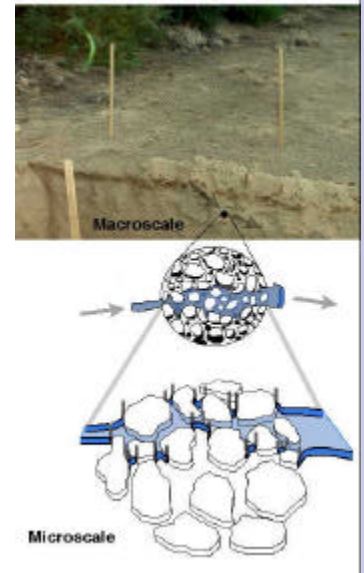
Soll, W. E., Gray, W. G., Janecky, D. R., & Thompson, A. F. B. (1997, Nov. 4). Meeting Report: Linking the pore and continuum scales through theory, modeling, and experimentation. *EOS, Transactions, American Geophysical Union*. 78(44), 495.

Publication Type: Other

Gray, W. G. (1999, Apr.). Elements of a systematic procedure for the derivation of macroscale conservation equations for multiphase flow in porous media. Hutter, K. & Wilmanski, K. (Eds.). *Kinetic and Continuum Thermodynamical Approaches to Granular and Porous Media*. CISM Courses and Lectures No. 400, International Centre for Mechanical Sciences. Springer-Verlag, Vienna, Austria. 67-129.

Hassanizadeh, S. M. & Gray, W. G. (1997, Oct.). Basic equations of flow and transport in porous media. Sikdar, S. K. & Irvine, R. L. (Eds.). *Bioremediation: Principles and Practice, Vol. I, Fundamentals and Applications*. Technomic Publishing Company, Inc. 19-57.

Soll, W. E., Gray, W. G. & Tompson, A. F. B. (1998). Influence of wettability on constitutive relations and its role in upscaling. V. N. Burganos, et. al. (Eds.), *Computational Methods in Water Resources XII, Computational Mechanics Publications, Southampton*. Vol. 1, 413-420



The specific effects of interfacial behavior between interfaces that separate different fluids or separate fluids from solids is being more carefully studied so that their net impacts on fluid flow the macroscopic scale can be better understood. [see Project #54576]

Publication Type: Paper

Gray, W. G. (1999, Jan.). Thermodynamics and constitutive theory for multiphase porous-media flow considering internal geometric constraints. *Advances in Water Resources*. 22(5), 521-547.

Gray, W. G., & Hassanizadeh, S. M. (1998, July). Macroscale continuum mechanics for multiphase porous-media flow including phases, interfaces, common lines, and common points. *Advances in Water Resources*. 21(4), 261-281.

Muccino, J. C., Gray, W. G., & Ferrand, L. A. (1998, Aug.). Toward an improved understanding of multiphase flow in porous media. *Reviews of Geophysics*. 36(3), 401-422.

Project: 54908

Title: Partitioning Tracers for In Situ Detection and Quantification of Dense Non-aqueous Phase Liquids in Groundwater Systems

PI: Dr. Mark L. Brusseau

Institution: University of Arizona

Publication Type: Journal

Brusseau, M. L. (1992, Dec.). Factors influencing the transport and fate of contaminants in the subsurface. *J. Hazard. Mater.* 32(2-3), 137-143.

Brusseau, M. L., Nelson, N. T., & Costanza, M. S. (1999, in press). Partitioning tracer tests for characterizing immiscible-fluid saturations and interfacial areas in subsurface systems.

Nelson, N. T., et. al. (1999, Dec.). A gas-phase partitioning tracer method for the in situ measurement of soil-water content. *Water Resour. Res.* 35(12), 3699-3707.

Nelson, N. T., Oostrom, M., Wietsma, T. W., & Brusseau, M. L. (1999, Nov. 15). Partitioning tracer method for the in situ measurement of DNAPL saturation: Influence of heterogeneity and sampling method. *Environ. Sci. Technol.* 33(22), 4046-4053.

Project: 55036

Title: Colloid Transport and Retention in Fractured Deposits

PI: Dr. John F. McCarthy

Institution: Oak Ridge National Laboratory

Publication Type: Journal

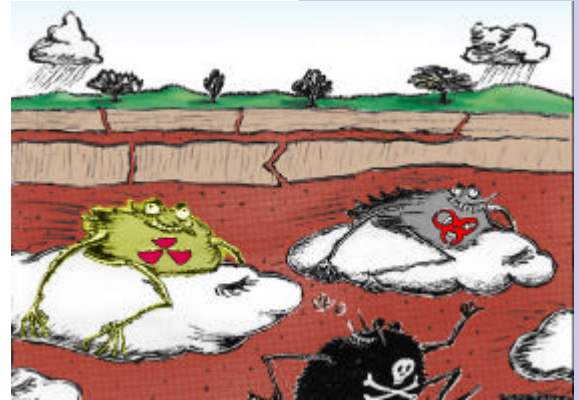
Cumbie, D. H. & McKay, L. D. (1999). Influence of diameter on particle transport in a fractured shale saprolite. *J. Contam. Hydrol.* 37, 139-157.

McCarthy, J. F. & Shevenell, L. (1998). Obtaining representative ground water samples in fractured and karst formations. *Ground Water*. 36(2), 251-260.

McCarthy, J. F. & Shevenell, L. (1998). Processes controlling colloid composition in a fractured and karstic aquifer in eastern Tennessee, USA. *J. Hydrol.* 206(3-4), 191-218.

McCarthy, J. F., Howard, K. M., & McKay, L. D. (1999, in press). Effect of pH on transport of flourobenzoic acid groundwater tracers. *J. Contam. Hydrol.*

McCarthy, J. F., Howard, K. M., & McKay, L. D. (2000, in press). Influence of pH on the behavior of fluorobenzoic acids as groundwater tracers. *J. Environ. Qual.*



Mobile colloids in the subsurface environment may alter the transport of contaminants. [see Project #55036]

Publication Type: Theses/Dissertations

Cumby, D. H. (1997). Influence of diameter on particle transport in a fractured shale saprolite. Master's Thesis. University of Tennessee. Knoxville, TN.

Haun, D. D. (1998). The influence of ionic strength and cation valence on transport of colloi-size microspheres in fractured shale saprolite role of electrostatic attachment on particle transport in fractured shale saprolite. Masters thesis at the University of Tennessee.

Haun, D. D. B. (1998). Influence of ionic strength and cation valence on trasport of colloid-sized microspheres in fractured shale saprolite. Master's Thesis. University of Tennessee. Knoxville, TN.

Howard, K. H. (1997). Behavior of flourobenzoic acid groundwater tracers in a highly fractured shale saprolite. Masters thesis at the University of Tennessee.

Howard, K. H. (1998). Influence of pH on the behavior of fluorobenzoic acids as groundwater tracers. Master's Thesis. University of Tennessee. Knoxville, TN.

Oswald, J. (1999). Numerical modeling of colloid transport in discretely fractured porous media. PhD dissertation at Ohio State University.

Oswald, J. (projected 2000). Migration of colloids in discretely-fractured porous media: Effect of matrix diffusion. Ph. D. dissertation. Ohio State University. Columbus, OH.

Project: 55083

Title: Behavior of Dense, Immiscible Solvents in Fractured Clay-Rich Soils

PI: Dr. Larry D. McKay

Institution: University of Tennessee at
Knoxville

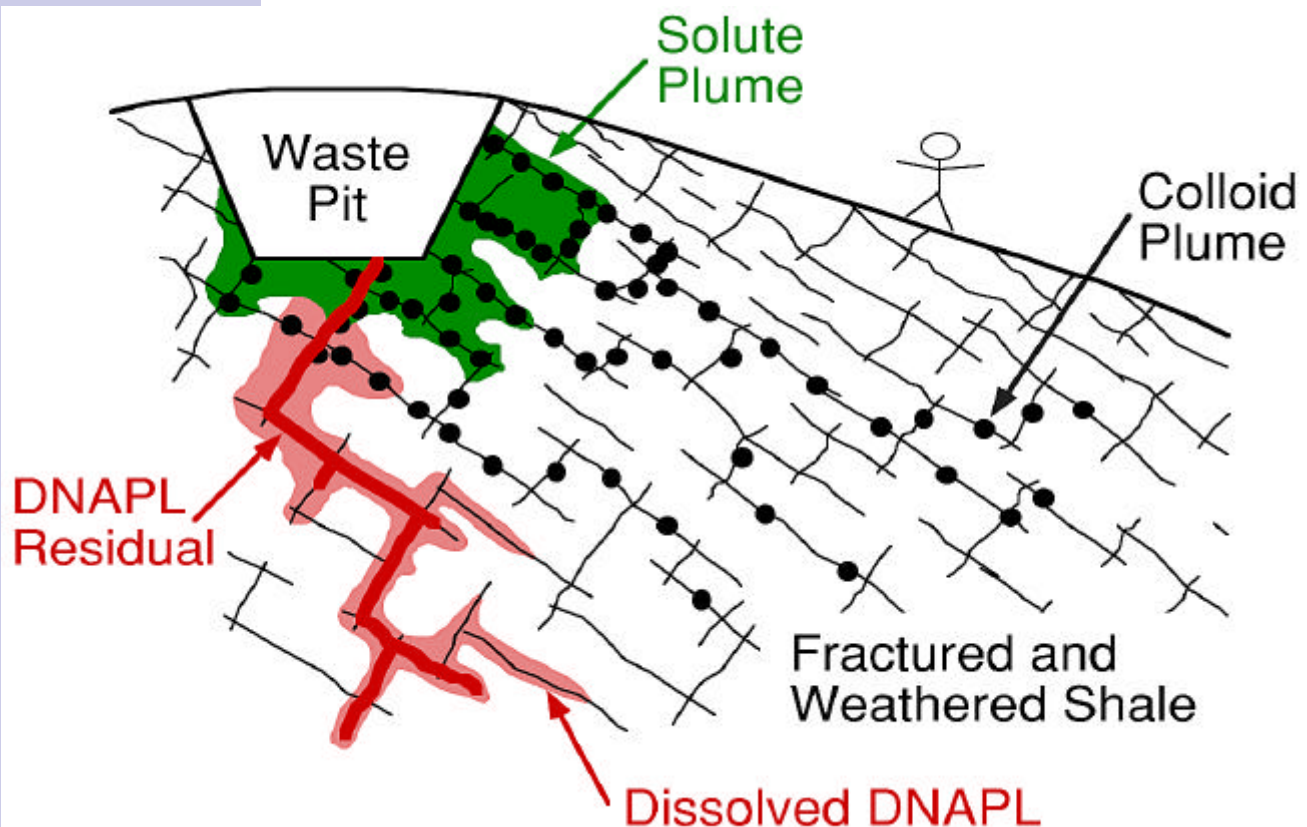
Publication Type: Journal

O'Hara, S. K., Parker, B. L., Jorgensen, P. R., & Cherry, J. A. (2000, Jan). Trichloroethene DNAPL flow and mass distribution in naturally fractured clay: Evidence of aperture variability. *Water Resour. Res.* 36(1), 135-147.

Publication Type: Presentation

Lenczewski, M., McKay, L. D., Sanseverino, J., & Knight, C. (1998, May 14-16). Sorption and microbiological factors controlling the fate and transport of TCE in fractured shale saprolite. Conference on Mass Transport in Fractured Aquifers and Aquitards, Univ. of Copenhagen, Denmark.

Lenczewski, M., McKay, L. D., Sanseverino, J., & Layton, A. (1999, May 30 - Jun. 3). Biodegradation of TCE in fractured weathered shale in east Tennessee. Annual Meeting of the American Society of Microbiology. Chicago, IL.



Migration of different contaminant types in fractured shales at Oak Ridge National Laboratory. Colloids migrate fastest, up to 200 m/day, because they are largely confined to fast-flow pathways in the fractures. Solutes, such as tritium, are strongly retarded relative to colloids because of diffusion into the relatively immobile pore water in the fine-grained matrix between fractures. DNAPLs can rapidly infiltrate downwards through the fractures, and then slowly dissolve forming plumes in the fractures and matrix pores. [see Project #55083]

Lenczewski, M., McKay, L. D., Sanseverino, J., & Layton, A. (1999, Apr. 12-14). Biodegradation of TCE in fractured shale saprolite. Annual Meeting of the Tennessee Water Resources Association. Nashville, TN.

McKay, L., et al., (1998, Jul. 27-30). Behavior of dense, immiscible solvents in fractured clay-rich soils. Poster presented at DOE/EMSP Workshop. Chicago, IL.

McKay, L.D. (1998, May 14-16). Contaminant transport in highly weathered and fractured shales. Conference on Mass Transport in Fractured Aquifers and Aquitards. Univ. of Copenhagen, Denmark.

McKay, L.D. (1999, May 11-13). Field and laboratory studies of DNAPL behavior in fractured and highly weathered shale. University Consortium Solvents-in-Groundwater Workshop, Queen's University. Kingston, Ontario, Canada.

O'Hara, S. (1999, May 11-13). Characterizing solvent DNAPL migration pathways in fractured clay using a large column laboratory experiment. University Consortium Solvents-in-Groundwater Workshop, Queen's University. Kingston, Ontario, Canada.

O'Hara, S. K., Parker, B. L., Slough, K. J., & Sudicky, E. A. (1998, Dec.). Characterizing solvent DNAPL migration pathways in fractured clay using a numerical model and a large column laboratory experiment. American Geophysical Union (AGU) Fall Meeting, San Francisco, CA.

Parker, B. L., O'Hara, S. K., & Kirkpatrick, G. A. (1998, May 18-21). Solvent DNAPL flow in naturally fractured clay: Laboratory and field experiments. Presented at the First International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, CA.

Parker, B.L. (1998, May 14-16). Diffusion profiles for identifying DNAPL migration pathways in a glaciolacustrine fractured clay. Conference on Mass Transport in Fractured Aquifers and Aquitards. Univ. of Copenhagen, Denmark.

Pitner, A., McKay, L. D., & Lenczewski, M. (1999, Apr. 12-14). DNAPL entry, dissolution, and diffusion in fractured shale saprolite. Annual Meeting of the Tennessee Water Resources Association. Nashville, TN.

Publication Type: Theses/Dissertations

Cropper, S.C. (1998). Experimental observations of capillary pressure - saturation drainage of air and DNAPL in fractured shale saprolite. MS Thesis, Univ. of Tennessee. Knoxville, TN.

Lenczewski, M. E. (2000). Biodegradation of TCE in fractured shale and saprolite. Ph. D. Dissertation. University of Tennessee. Knoxville, TN.

O'Hara, S. K. (1997). Solvent DNAPL flow and matrix diffusion in natural fractured clay: A large column experiment. MS thesis, Univ. of Waterloo. Ontario, Canada.

Pitner, A. H. (2000). Experimental investigations of factors controlling DNAPL transport and dissolution in fractured shale saprolite. MS Thesis. University of Tennessee. Knoxville, TN.

Project: 55196

Title: In Situ, Field Scale Evaluation of Surfactant Enhanced DNAPL Recovery Using a Single-Well, Push-Pull Test

PI: Dr. Jonathan D. Istok *Institution:* Oregon State University

Publication Type: Journal

Field, J. A. & Istok, J. D. (1998). Comment on estimation of nonaqueous phase liquid-water interfacial areas in porous media following mobilization by chemical flooding. *Environmental Science and Technology*, 32(2), 3836-3837.



Graduate students collaborate on a field-scale evaluation of Surfactant Enhanced DNAPL Recovery using a single-well, push-pull test. [see Project #55196]

Field, J.A., & Istok, J. D. (1999). Comment on estimation of nonaqueous phase liquid-water interfacial areas in porous media following mobilization by chemical flooding. *Environmental Science and Technology*. 32(2), 3836-3837.

Haggerty, R., Schroth, M. H., & Istok, J. D. (1998, Mar. - Apr.). Simplified method of "push-pull" test data analysis for determining in situ reaction rate coefficients. *Ground Water*. 36(2), 314-324.

Istok, J. D., Field, J. A., Schroth, M. H., Sawyer, T. E., & Humphrey, M. D. (1999). Laboratory and field investigation of surfactant sorption

using single-well, "push-pull" tests. *Ground Water*, 37, 589-598.

Istok, J. D., Field, J. A., Schroth, M. H., Sawyer, T. E., & Humphrey, M. D. (1999, Jul. - Aug.). Laboratory investigation of surfactant-enhanced trichloroethene solubilization using single-well 'push-pull' tests. *Ground Water*. 37(4), 581-588.

Project: 55359

Title: Chaotic-Dynamical Conceptual Model to Describe Fluid Flow and Contaminant Transport in a Fractured Vadose Zone

PI: Dr. Boris A. Faybishenko *Institution:* Lawrence Berkeley National Laboratory

Publication Type: Journal

Finsterle, S. & Faybishenko, B. (1999). Design and analysis of an experiment to determine hydraulic parameters of variably saturated porous media. *Advances in Water Resources*. 22(1), 431-444.

Pruess, K., Faybishenko, B., & Bodvarsson, G. S. (1999). Alternative concepts and approaches for modeling flow and transport in thick unsaturated zones of fractured rocks. *Journal of Contaminant Hydrology-Special Issue*. 38, 281-322.

Publication Type: Other

Benito, P. H., Cook, P. J., Faybishenko, B., Freifeld, B., & Doughty, C. (1999). Cross-well air-injection packer tests for the assessment of pneumatic connectivity in fractured, unsaturated basalt. In Amadei, Kranz, Scott, & Smeallie (Eds.). *Rock Mechanics for Industry*. Balkema, Rotterdam. 843-851.

Publication Type: Presentation

Carrigan, C. R., et. al. (1999). Lessons on transport and monitoring from the LLNL Vadose Zone Observatory. *Proceedings of the 1999 Spring AGU Meeting*. Boston, MA.

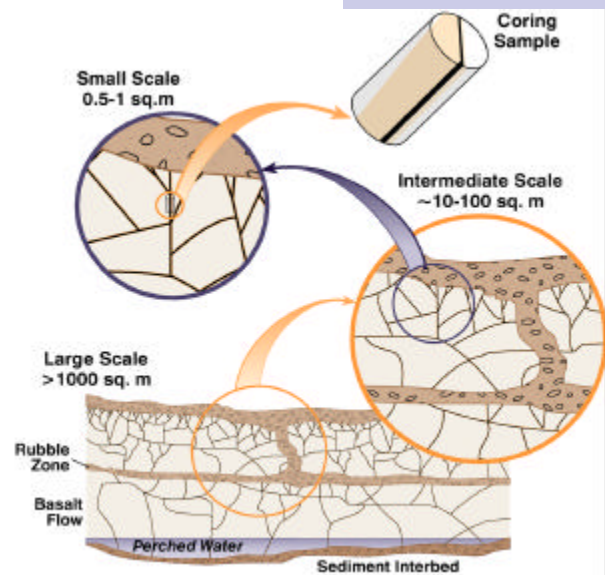
Faybishenko, B. & Finsterle, S. (1999). On the physics of tensiometry in heterogeneous soils and rocks. *Proceedings of the 1999 Spring AGU Meeting*. Boston, MA.

Faybishenko, B. & Geller, J. (1999). Analysis of observed chaotic data for flow through capillary tubes. *Experimental Chaos Conference*.

Faybishenko, B. (1998, May). Theory and numerical evaluation of the parameters of the chaotic behavior of flow in unsaturated soils and rocks. *Chapman Conference on Fractal Scaling, Non-Linear Dynamics, and Chaos in Hydrologic Systems*. Clemson University. Clemson, SC.

Faybishenko, B. (1998, Oct.). A fuzzy-chaotic analysis of water flow and chemical transport in unsaturated-saturated soils. *16th World Congress of Soil Science*. Montpellier, France.

Faybishenko, B. (1999). On nonlinear, chaotic dynamics of flow in unsaturated fractured rocks. *Fall AGU 1999 Meeting*. San Francisco, CA.



A four-level hierarchy of scales of hydrogeological components in fractured basalt. [see Project #55359]

Faybishenko, B. (Ed.) (1999, Feb. 10-12), Proceedings of the International Symposium Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances. Berkeley, CA.

Faybishenko, B. On nonlinear, chaotic dynamics of flow in unsaturated fractured rocks. Fall AGU 1999 Meeting. San Francisco, CA.

Faybishenko, B., et. al. (1997). Conceptual model of geometry and physics of liquid flow in unsaturated fractured basalt at Box Canyon Site. Proceedings of the 1997 Fall Meeting of AGU. San Francisco, CA.

Faybishenko, B., et. al. (1998). Multi-scale investigations of flow in fractured rocks. Proceedings of the 1998 Fall Meeting of AGU. San Francisco, CA. F377-378.

Faybishenko, B., Wood, T. R., Stoops, T. M., Doughty, C., & Jacobsen, J. (1997). A conceptual model of tracer transport in fractured basalt: Large Scale Infiltration Test revisited. Proceedings of 1997 GSA Annual Conference. Salt Lake City, UT.

Geller, J. T., Borglin, S. E., & Faybishenko, B. (1998, May). Experimental study and evaluation of dripping water in fracture models. Chapman Conference on Fractal Scaling, Non-Linear Dynamics, and Chaos in Hydrologic Systems. Clemson University. Clemson, SC.

Geller, J. T., Borglin, S. E., & Faybishenko, B. (1998). Experimental study and evaluation of dripping water in fracture models. Proceedings of the 1998 Fall Meeting of AGU. San Francisco, CA. F383.

Podgorney, R. K., Faybishenko, B., & Wood, T. (1999). Field evidence of unstable infiltration into variably saturated fractured basalt on a 1-meter scale. Fall AGU 1999 Meeting. San Francisco, CA.

Publication Type: Press release

Faybishenko, B. (1999, Dec. 17). Water travels chaotically through the ground. A Chaotic-Dynamical Conceptual Model to Describe Fluid Flow and Contaminant Transport in a Fractured Vadose Zone (see Web site: <http://www.eurekalert.org/releases/ineel-wtcttg.html>).

Publication Type: Proceeding

Faybishenko, B. (1999). Comparison of laboratory and field methods for determination of unsaturated hydraulic conductivity of soils. LBNL Report-42022. Proceedings of the International Conference - Characterization and Measurement of the Hydraulic Properties of Unsaturated Porous Media.

Faybishenko, B. (1999). Evidence of chaotic behavior in flow through fractured rocks, and how we might use chaos theory in fractured rock hydrogeology. Proceedings of the International Symposium Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances. Berkeley, CA. 207-212.

Finsterle, S. & Faybishenko, B. (1998). What does a tensiometer measure in fractured rocks? LBNL Report-41454. Proceedings of the International Conference - Characterization and Measurement of the Hydraulic Properties of Unsaturated Porous Media.

Nikraves, M., Cox, L., Faybishenko, B., & Aminzadeh, F. (1999, Mar.). Characterization of contaminated sites using sparse well data. SPE Paper 49330.

Podgorney, R. K. & Wood, T. R. (1999). Observations of water movement in variably saturated fractured basalt and its possible implications on predictive modeling. Proceedings of the International Symposium Dynamics of Fluids in Fractured Rocks: Concepts and Recent Advances. Berkeley, CA. 300-304.

Publication Type: Report

Babchin, A. J., Faybishenko, B., Sivashinsky, G. I., Frenkel, A., & Halpern, D. (1999). A model of chaotic time evolution of a slow liquid film on an inclined plane: One-dimensional solution. LBNL Report 42884.

Benito, P., Cook, P., Faybishenko, B., Freifeld, B., & Doughty, C. (1999). Box canyon air-connectivity study. Preliminary Data Analysis, LBNL Report 42359. CRWMS M&O 2000. Natural analogs for the unsaturated zone. MDL-NBS-HS-000007. Las Vegas, NV.

Faybishenko, B. (1999, Jun. 6-11). Short-term and long-term vadose zone monitoring: Current technologies, development, and applications. Subsurface Remediation: Improving Long-Term Monitoring & Remedial Systems Performance. LBNL Report 43408.

Faybishenko, B., et al. (1997). A chaotic-dynamical conceptual model to describe fluid flow and contaminant transport in a fractured vadose zone. Environmental Management Science Program Awards Fiscal Year 1997 Annual Report Progress. Lawrence Berkeley National Laboratory Report, LBNL-41192.

Faybishenko, B., et al. (1999). Multi-scale investigations of liquid flow in a fractured basalt vadose zone. LBNL Report 42910.

Faybishenko, B., et al. (1997). A chaotic-dynamical conceptual model to describe fluid flow and contaminant transport in a fractured vadose zone. 1997 Annual Report. Report No. LBNL-41223.

Faybishenko, B., et al. (1999). Conceptual model of the geometry and physics of water flow in a fractured basalt vadose zone: Box Canyon site, Idaho. LBNL Report 42915.

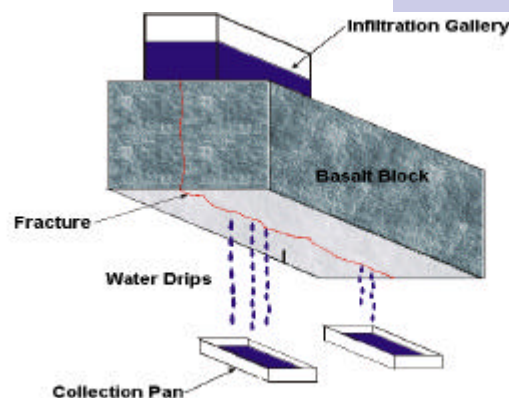


Illustration of the infiltration test design at the Hell's Half Acre site, Idaho, to investigate a key problem of infiltration in fractured rocks - water dripping through fractures. [see Project #55359]

Podgorney, R. K., Whitmire, D. L., Wood, T. R., & Stoops, T. M. (1999). Basalt outcrop infiltration tests to evaluate chaotic behavior of unsaturated flow in fractured rock, Data Summary Report, 1999 Field Season (Draft). INEEL/EXT-99-01204.

Podgorney, R. K., Wood, T. R., & Stoops, T. M. (1998). Basalt outcrop infiltration tests to evaluate chaotic behavior of unsaturated flow in fractured rock. INEEL Data Summary Report 1997 Field Season.

Podgorney, R. K., Wood, T. R., & Stoops, T. M. (1999). Basalt outcrop infiltration tests to evaluate chaotic behavior of unsaturated flow in fractured rock. INEEL Data Summary Report 1998 Field Season.

Pruess, K., Faybishenko, B., & Bodvarsson, G. S. (1997). Alternative concepts and approaches for modeling unsaturated flow and transport in fractured rocks. Chapter 24 of The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, for the Viability Assessment.

Project: 60158

Title: Development of Radon-222 as a Natural Tracer for Monitoring the Remediation of NAPL Contamination in the Subsurface

PI: Dr. Lewis Semprini

Institution: Oregon State University

Publication Type: Journal

Semprini, L., Hopkins, O. S., & Tasker, B. R. (2000, Jan.). Laboratory, field, and modeling studies of radon-222 as a natural tracer for monitoring NAPL contamination. *Transport Porous Med.* 38(1-2), 223-240.

Publication Type: Other

Semprini, L., Cantaloub, M., Gottipati, S., Hopkins, O., & Istok, J. (1998). Radon-222 as a natural tracer for quantifying and monitoring NAPL remediation. Wickramanayake, G. B. & Hinchee, R. E. (Eds.), *Nonaqueous-phase Liquids: Remediation of Chlorinated and Recalcitrant Compounds*. Battelle Press, Columbus, OH. 137-142.

Publication Type: Presentation

Cantaloub, M. (1998, Nov. 16-19). The role of cocktail solvent on radon measurement by liquid scintillation analysis. Packard Instrument Co. Environmental LSC Workshop at the 44th Annual Conference on Bioassay, Analytical, and Environmental Radiochemistry. Albuquerque, NM.

Cantaloub, M., Higginbotham, J., Istok, J. & Semprini, L. (1998, Nov. 16-19). Interaction of sample, cocktail and headspace volume when measuring aqueous Rn in small volume samples. 44th Annual Conference on Bioassay, Analytical, and Environmental Radiochemistry. Albuquerque, NM.

Cantaloub, M., Humphrey, M., Istok, J., & Semprini, L. (1998, Dec. 6-10). Monitoring NAPL remediation using Rn-222 as an in-situ indicator. 1998 Fall Meeting of the American Geophysical Union. San Francisco, CA.

Cantaloub, M., Istok, J., & Semprini, L. (1998, Dec. 1-3). Radon-222 as a natural tracer for monitoring the remediation of NAPL contamination in the subsurface. Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) Technical Symposium and Workshop. Arlington, VA.

Cantaloub, M., Istok, J., & Semprini, L. (1998, Jul. 20-23). Investigations of Radon-222 as an internal tracer for monitoring NAPL remediation. Symposium on Environmental Models and Experiments Envisioning Tomorrow; Behavior and Remediation of Nonaqueous Phase Liquid Contaminants in the Subsurface. UC Irvine, CA.

Cantaloub, M., Istok, J., & Semprini, L. (1998, Oct. 20-23). Site assessment and remediation monitoring using naturally occurring Rn-222. The 5th International Petroleum Environmental Conference. Albuquerque, NM.

Semprini, L., Istok, J., & Cantaloub, M. (1998, Jul. 27-30). Development of Rn-222 as a tracer for monitoring the remediation of NAPL contamination in the subsurface. Department of Energy Environmental Management Science Program Scientific Workshop, Rosemont, IL.

Project: 70149 (Renewal of Project No. 54950)

Title: The Dynamics of Vadose Zone Transport: A Field and Modeling Study Using the Vadose Zone Observatory

PI: Dr. Charles R. Carrigan

Institution: Lawrence Livermore National Laboratory

Publication Type: Journal

Carrigan, C. R. & Nitao, J. J. (2000). Predictive and diagnostic simulation of in situ electrical heating in contaminated, low-permeability soils. Cover article for *Environmental Science & Technology*. 34, 4835-4841.

Publication Type: Other

Carrigan, C. R. (1999). Calibration and testing of predictive models of gas-phase transport in the vadose zone: An example from the Nevada Test Site in EM sponsored book - *Vadose Zone, Science and Technology Solutions*. Battelle Press.

Carrigan, C. R. (1999). Understanding the fate and transport of multiphase fluid and colloidal contaminants in the vadose zone using an intermediate-scale field experiment in EM sponsored book - *Vadose Zone, Science and Technology Solutions*. Battelle Press.

Publication Type: Presentation

Carrigan, C. R. & Hudson, G. B. (1998). Characterization of contaminant transport by gravity, capillary, and barometric pumping in heterogeneous vadose regimes. Extended Abstract Volume (144), DOE/EMSP Program Review. Chicago, IL.

Carrigan, C. R., et. al. (1998). The vadose zone observation: Dynamic characterization of liquid- and gas-phase contaminant transport in a heterogeneous soil regime. Transactions of the AGU (EoS). 79(45), F384.

Carrigan, C. R., et. al. (1998, May). The vadose zone observatory: Monitoring the contaminant fast track to the water table. Presentation given to LLNL visiting Environmental Programs Science Advisory Committee (EPSAC).

Carrigan, C. R., et. al. (1999, May 31-Jun. 4). Lessons about transport and monitoring at the vadose zone observatory at LLNL. Appeared Transactions of the AGU (EoS), Spring Meeting. Boston, MA.

Ekwurzel, B., et. al. (1999, May 31-Jun. 4). Deuterium, Br, I, and ¹⁸O used as tracers of infiltration water movement through the vadose zone. Appeared Transactions of the AGU (EoS), Spring Meeting. Boston, MA.

Hudson, G. B. (1997, Apr. 5). Isotope tracers for tracking groundwater recharge. California Water Reuse Association, Artificial Water Recharge Workshop. Newport Beach, CA.

Hudson, G. B. (1997, Jun. 10-11). The Xe-124 water infiltration experiment at Anaheim Lake. Santa Ana River Quality and Health Effects Study. Orange County Water District. Fountain Valley, CA.

Ralston, D. K., et. al. (1999, May 31-Jun. 4). Implications of modeling for gas-phase transport at the LLNL vadose zone observatory. Appeared Transactions of the AGU (EoS), Spring Meeting. Boston, MA.

Project: 70193

Title: Influence of Clastic Dikes on Vertical Migration of Contaminants in the Vadose Zone at Hanford

PI: Dr. Christopher J. Murray

Institution: Pacific Northwest National Laboratory

Publication Type: Presentation

Fayer, M. J., et. al. (2000, Dec. 15). Hydrogeological measurements and hydrofacies models of clastic dikes at the Hanford Site, Southcentral Washington. EOS Trans. American Geophysical Union Fall Meeting. San Francisco, CA. 81(48), F412.

Murray, C., et. al. (2000, Sept. 24-27). Hydrogeological measurements and hydrofacies models of clastic dikes at the Hanford Site, Southcentral Washington. SEPM/IAS Research Conference on Environmental Sedimentology: Hydrogeology of Sedimentary Aquifers. Santa Fe, NM.

Project: 73732 (Renewal of Project No. 54680)

Title: Migration and Entrapment of DNAPLs in Heterogeneous Systems: Impact of Waste and Porous Medium Composition

PI: Dr. Linda M. Abriola *Institution:* University of Michigan

Publication Type: Journal

Bradford, S. A. & Abriola, L. M. (2001). Dissolution of residual tetrachloroethylene in fractional wettability porous media: Incorporation of interfacial area estimates. *Water Res. Res.* 37(5), 1183-1195.

Bradford, S. A., Abriola, L. M., & Leij, F. J. (1997). Wettability effects on two- and three- fluid relative permeabilities. *Journal of Contam. Hydrol.* 28, 171-191.

Bradford, S. A., Abriola, L. M., & Rathfelder, K. M. (1998). Flow and entrapment of dense nonaqueous phase liquids in physically and chemically heterogeneous aquifer formations. *Adv. Water Res.* 22, 117-132.

Bradford, S. A., Vendlinski, R. A., & Abriola, L. M. (1999, Oct.). The entrapment and long-term dissolution of tetrachloroethylene in fractional wettability porous media. *Water Resour. Res.* 35(10), 2955-2964.

Lord, D. L., Demond, A. H., Salehzadeh, A., & Hayes, K. F. (1997). Influence of organic acid solution chemistry on subsurface transport properties. 2. Capillary pressure- saturation. *Environ. Sci. Technol.* 31, 2052-2058.

Lord, D. L., Hayes, K. F., Demond, A. H., & Salehzadeh, A. (1997). Influence of organic acid solution chemistry on subsurface transport properties. 1. Surface and interfacial tension. *Environ. Sci. Technol.* 31, 2045-2051.

Salehzadeh, A. & Demond, A. H. (1999, Apr.). Pressure cell for measuring capillary pressure relationships of contaminated sands. *J. Environ. Eng-Asce.* 125(4), 385-388.

Publication Type: Other

Lord, D. L., Demond, A. H., Hayes, K. F., & Salehzadeh, A. (1998). Effects of surfactant chemistry on interfacial tension, wettability, and capillary pressure in multiphase subsurface systems. Chrysikopoulos, C. V., Bear, J., & Harmon, T. C. (Eds.). *Enviromeet 98- Behavior and Remediation of Non-aqueous Phase Contaminants in the Subsurface*. University of California at Irvine. Irvine, CA.

Publication Type: Paper

Bradford, S. A., & Abriola, L. M. (1998). Entrapment and dissolution of organic liquids in chemically heterogeneous porous media. IAHS Publication no. 250, Groundwater Quality: Remediation and Protection. Tubingen, Germany. 167-172.

Publication Type: Presentation

Bradford, S. A., Abriola, L. M., & Rathfelder, K. M. (1997). The impact of fractional wettability and grain size distribution on the long-term dissolution of residual tetrachloroethylene. Eos, Transactions, American Geophysical Union. 78(17), 78:S158-159.

Bradford, S. A., Abriola, L. M., & Rathfelder, K. M. (1997). The impact of fractional wettability and grain size distribution on the long-term dissolution of residual tetrachloroethylene. Eos, Transactions, American Geophysical Union. 78(46), 78:F331.

Bradford, S. A., Abriola, L. M., Demond, A. H., & Lord, D. L. (1999, Aug. 22-26). Migration and entrapment of DNAPLs in chemically heterogeneous aquifer environments. American Chemical Society, National Meeting. New Orleans, LA.

Echols, R. T. & Demond, A. H. (1999). Impact of soil organic matter on the transport of organic liquids in soil. Midwest Environmental Chemistry Workshop. Houghton, MI.

Lord, D. L., Demond, A. H., & Hayes, K. F. (1997). The impact of solution chemistry on capillary pressure-saturation relationships for two-phase systems containing solutes. Eos, Transactions, American Geophysical Union. 79(45), 97:H41E-08.

Lord, D. L., Demond, A. H., & Hayes, K. F. (1998, Apr. 20-24). The impact of speciation, partitioning, and sorption on the migration of multiple fluid phases in the subsurface. European Geophysical Society Hydrology and the Earth's Crust Symposium, XXIII General Assembly. Nice, France.

Lord, D. L., Demond, H., & Hayes, K. F. (1998, Oct. 16-18). Effects of solute chemistry on soil transport properties. 21st Midwest Environmental Workshop. Ann Arbor, MI.

Lord, D. L., et. al. (1998). Impacts of organic acid and base solution and interfacial chemistry on NAPL transport in the subsurface. Eos, Transactions, American Geophysical Union. 79(45), 79:F247.

Lord, D. L., Hayes, K. F., & Demond, A. H. (1997, Apr. 13-17). The impacts of solution and interfacial chemistry on organic liquid migration in the subsurface. American Geochemical Society, National Meeting. San Francisco, CA.

O'Carroll, D. M., Bradford, S. A., & Abriola, L. M. (2000, Sep. 27-28). Infiltration and redistribution of PCE in a system containing spatial wettability variations. 6th International Symposium on Evaluation of Reservoir Wettability and Its Effect on Oil Recovery. Socorro, NM.

Phelan, T. J., O'Carroll, D. M., Bradford, S. A., & Abriola, L. M. (2000). Evaluation of DNAPL transport parameters in fractionally wet porous media. *Eos, Transactions, American Geophysical Union*. 81(48), H71B-07.

Publication Type: Proceeding

Bradford, S. A., Abriola, L. M., & Leij, F. J. (1999, in press). Multi-fluid hydraulic properties for fractional wettability porous media. In Van Genuchten, M. Th., Leij, F. J., & Wu, L. (Eds.), *Characterization and Measurement of the Hydraulic Properties for Unsaturated Porous Media*, University of California. Riverside, CA.

Bradford, S. A., Abriola, L. M., & Rathfelder, K. M. (1998). Simulated entrapment and dissolution of organic liquids in chemically heterogeneous porous media. Chrysikopoulos, C. V., Bear, J., & Harmon, T. C. (Eds.), *Enviromeet 98- Behavior and Remediation of Nonaqueous Phase Contaminants in the Subsurface*. University of California. Irvine, CA. 7-16.

Demond, A.H., Hayes, K. F., Lord, D. L., Desai, F., & Salehzadeh, A. (1999). Impact of organic compound chemistry on capillary pressure relationships of sands. Van Genuchten, M.Th., Leij, F. J., & Wu, L. (Eds.), *Characterization and Measurement of the Hydraulic Properties for Unsaturated Porous Media*. University of California. Riverside, CA. 229-240.

Lord, D. L., Demond, A. H., Hayes, K. F., & Salehzadeh, A. (2000, Jan.). Effects of organic base chemistry on interfacial tension, wettability, and capillary pressure in multiphase subsurface waste systems. *Transport. Porous. Med.* 38(1-2), 79-92.

Publication Type: Theses/Dissertations

Lord, D. L. (1999). Influence of organic acid and base solution chemistry on interfacial and transport properties of mixed wastes in the subsurface. Ph.D. dissertation. Department of Civil and Environmental Engineering, The University of Michigan. Ann Arbor, MI.

Project: 73812 (Renewal of Project No. 55395)

Title: Physics of DNAPL Migrations and Remediation in the Presence of Heterogeneities

PI: Dr. Stephen H. Conrad

Institution: Sandia National Laboratories -
Albuquerque

Publication Type: Report

Borchers, B., Conrad, S. H., Webb, E. K., Glass Jr., R. J., Cox, R. (1997). A simulation and decision analysis approach to locating DNAPL in subsurface sediments. Sandia Report SAND97-2261.

Inorganic Chemistry**Project: 54834**

Title: An Investigation of Homogeneous and Heterogeneous Sonochemistry for Destruction of Hazardous Waste

PI: Dr. Inez Hua

Institution: Purdue University

Publication Type: Journal

Beckett, M. A. & Hua, I. (2000). Elucidation of the 1,4-dioxane decomposition pathway at discrete ultrasonic frequencies. *Environmental Science and Technology*. 34(19), 3944-3953.

Hoffmann, M. R., Hua, I., & Hochemer, R. (1996). Application of ultrasonic irradiation for the degradation of chemical contaminants in water. *Ultrasonics Sonochemistry*. 3(3), 163-172.

Hua, I. & Hoffmann, M. R. (1996). Kinetics and mechanism of the sonolytic degradation of CCl₄: Intermediates and by-products. *Environmental Science and Technology*. 30(3), 864-871.

Hua, I. & Hoffmann, M. R. (1997). Sonochemical production of hydroxyl radical and hydrogen peroxide: The effect of frequency and saturating gas. *Environmental Science and Technology*. 31(8), 2237-2243.

Hua, I. & Thompson, J. (2000). Inactivation of *Escherichia coli* by sonication at discrete ultrasonic frequencies. *Water Research*. 34(15), 3888-3893.

Hua, I. & Zhang, G. M. (1999, Mar. 21). Cavitation chemistry of polychlorinated biphenyls. *Abstr. Pap. Am. Chem. S.* 217, U623-U623, Part 1.

Hua, I., Hochemer, R. H., & Hoffman, M. R. (1995). The sonochemical degradation of p-nitrophenol in a parallel-plate near-field acoustical processor. *Environmental Science and Technology*. 29(11), 2790-2796.

Hua, I., Hochemer, R. H., & Hoffmann, M. R. (1995). Sonolytic hydrolysis of p-nitrophenylacetate: The role of supercritical water. *Journal of Physical Chemistry*. 99(8), 2335-2342.

Schramm, J. & Hua, I. (2000). Ultrasonic irradiation of dichlorvos: Decomposition mechanism and mass balances. *Water Research*. 35(3), 665-674.

Weavers, L. K., Hua, I., & Hoffmann, M. R. (1997). A new advanced oxidation process: Photoassisted oxidation of triethanolamine by periodate. *Water Environment Research*. 69(6), 1112-1119.

Zhang, G. & Hua, I. (2000). Ultrasonic degradation of trichloroacetonitrile, chloropicrin, bromobenzene: Design factors and matrix effects. *Advances in Environmental Research*. 4(1), 211-218.

Zhang, G. M. & Hua, I. (2000, Apr. 15). Cavitation chemistry of polychlorinated biphenyls: Decomposition mechanisms and rates. *Environ. Sci. Technol.* 34(8), 1529-1534.

Publication Type: Presentation

Hua, I. (1999, Feb.). The use of ultrasonic irradiation in environmental engineering processes. Borchardt Conference, The University of Michigan. Ann Arbor, MI.

Pfalzer, U. & Hua, I. (1997, Nov. 9). Sonochemical degradation of carbofuran in a parallel-plate near-field acoustical processor. 20th Annual Midwest Environmental Chemistry Workshop, Indiana University. Bloomington, IN.

Schramm, J. & Hua, I. (1997, Sept.). Degradation of dichlorvos by sonolysis. American Chemical Society Meeting. Las Vegas, NV.

Zhang, G. & Hua, I. (1998, Mar.). Destruction of polychlorinated biphenyls in acoustically cavitating systems. American Chemical Society Meeting. Dallas, TX.

Project: 55119

Title: Phase Equilibria Modification by Electric Fields

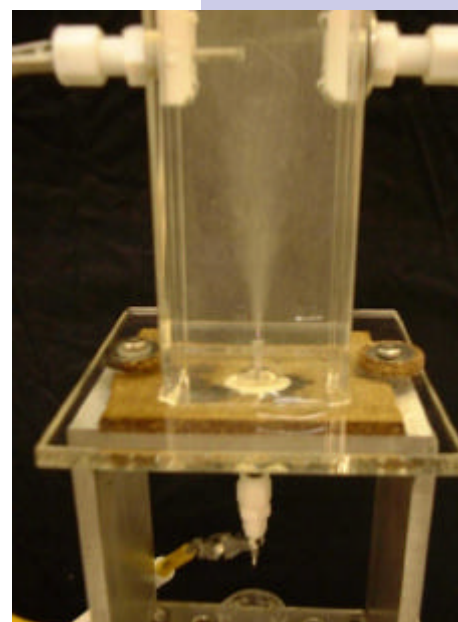
PI: Dr. Costas Tsouris

Institution: Oak Ridge National Laboratory

Publication Type: Journal

Blankenship, K. D., DePaoli, D. W., Hylton, J. O., & Tsouris, C., (1999). Effect of electrode configurations on phase equilibria with electric fields. *Separation and Purification Technology*. 15, 283-294.

Blankenship, K. D., Shah, V. M., & Tsouris, C. (1999). Distillation under electric fields. *Separation Science and Technology*. 34, 1393-1409.



Simultaneous pumping, spraying, and mixing of a gas in an aqueous solution by means of an electric field can be used for the removal of contaminants from the solution. [see Project #55119]

- Norato, M. A., Tsouris, C., & Tavlarides, L. L. (1998). Phase inversion studies in liquid-liquid dispersions. *The Canadian Journal of Chemical Engineers*. 76, 486-494.
- Shin, W.- T., Yiacoumi, S., & Tsouris, C. (1997). Experiments on electrostatic dispersion of air in water. *Industrial and Engineering Chemistry Research*. 36, 3647-3655.
- Starkweather, B. A., Connell, B. L., & Counce, R. M. (1998, Jul.). Experimental effects help cleaning success. *Precision Cleaning*. 5(7).
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- Tsouris, C. & Dong, J. (2000). Effects of electric fields on phase inversion of liquid-liquid dispersions. *Chemical Engineering Science*. 55, 3571-3574.
- Tsouris, C., Shin, W.- T., Yiacoumi, S., & DePaoli, D. W. (2000, in press). Effects of electric fields on bubble and particle velocities in water and alcohols. *Journal of Colloid and Interface Science*.
- Tsouris, C., & Dong, J. H. (2000, Sept.). Effects of electric fields on phase inversion of liquid-liquid dispersions. *Chemical Engineering Science*. 55(17), 3571-3574.
- Tsouris, C., Borole, A. P., & Kaufman, E. N., DePaoli, D. W. (1999). An electrically driven gas-liquid-liquid contactor for bioreactor and other applications. *Industrial and Engineering Chemistry Research*. 38, 1877-1883.
- Tsouris, C., DePaoli, D. W., Shor, J. T., Hu, M. Z.- C., & Ying, T. -Y. (2000). Electrocoagulation for magnetic seeding of colloidal particles. *Colloids and Surfaces*, 177, 227-237.
- Tsouris, C., Shin, W.- T. & Yiacoumi, S. (1998). Pumping, spraying, and mixing of fluids by electric fields. *The Canadian Journal of Chemical Engineers*. 76, 589-599.
- Tsouris, C., Shin, W.-T., Yiacoumi, S., & DePaoli, D. W. (2000). Electrohydrodynamic velocity measurements in water and alcohols. *Journal of Colloid and Interface Science*. 229, 335-345.

Publication Type: Paper

- Tsouris, C., & Dong, J. (1999, Jun. 13-16). Electric-field effects on fluid interfaces. 73rd ACS Colloid and Surface Science Symposium, Massachusetts, Institute of Technology. Cambridge, MA.

Publication Type: Patent

DePaoli, D. W. & Tsouris, C. (1999). Continuous flow, electrohydrodynamic micromixing apparatus and methods. Patent Application No. 09/398,675.

DePaoli, D. W. & Tsouris, C. (1999). Continuous flow, electrohydrodynamic micromixing apparatus and methods. Application No. 09/398,675.

Tsouris, C. & Dong, J. (1999). Methods to control phase inversions and enhance mass transfer in liquid-liquid dispersions. Patent Application No. 09/397,281.

Tsouris, C. & Dong, J. (1999). Methods to control phase inversions and enhance mass transfer in liquid-liquid dispersions. Application No. 09/397,281.

Tsouris, C., DePaoli, D. W., & Shor, J. T. (1999). A method to electrolytically produce high-purity magnetite powder. Application No. 09/371,638.

Tsouris, C., DePaoli, D. W., & Shor, J. T. (1999). A method to electrolytically produce high-purity magnetite powder. Patent Application No. 09/371,638.

Publication Type: Presentation

Blankenship, K. D., DePaoli, D. W., Hylton, J. O., & Tsouris, C. (1998, Nov. 15-20). Distillation with applied electric fields. AIChE Annual Meeting, Miami, FL.

Blankenship, K. D., Shah, V. M., & Tsouris, C. (1997, Oct. 20-24). Distillation under electric fields. Tenth Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

DePaoli, D. W., Tsouris, C., & Hu, M. Z.- C. (1999, Aug. 15-20). Electrohydrodynamic mixing and reaction in multiphase and miscible systems. MIXING XVII, Banff, Canada.

Dong, J. & Tsouris, C. (1999, Oct. 17-20). A novel solvent extraction approach using electric fields. Eleventh Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

Dong, J. & Tsouris, C. (1999, Oct. 31-Nov. 5). Effect of electric fields on phase inversion in liquid-liquid dispersions. AIChE Annual Meeting, Dallas, TX.

Perkins, L., Fu, B., Counce, R. M., DePaoli, D., & Hu, M. (1999). Phase separation of oil/water emulsions in the presence of surfactants. 11th Symposium on Separation Science and Technology for Energy Applications. Gatlinburg, TN.

- Rowe, A., Counce, R. M., DePaoli, D., & Hu, M. (1999). pH effects on adsorption aqueous surfactants. 11th Symposium on Separation Science and Technology for Energy Applications. Gatlinburg, TN.
- Tsouris, C. (1997, Jul.). Status and directions in electroseparations. EPRI Chemicals & Petroleum Target Strategic Research Meeting, Electric Power Research Institute, Palo Alto, CA.
- Tsouris, C. (1998, Feb.). Pumping, spraying, and mixing of fluids by electric fields. School of Civil and Environmental Engineering, Georgia Institute of Technology.
- Tsouris, C. (1999, Oct.). Electrohydrodynamic micromixing reactors. Department of Chemical Engineering, Auburn University.
- Tsouris, C., Blankenship, K. D., DePaoli, D. W., Shin, W.- T., & Hylton, J. O. (1998, Jun. 21-24). Electric-field effects on gas-liquid and liquid-liquid systems. 72nd Colloid and Surface Science Symposium,
- Tsouris, C., Blankenship, K. D., Dong, J., & DePaoli, D. W. (1999, Oct. 17-20). Distillation with electric fields. Eleventh Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.
- Tsouris, C., DePaoli, D. W., & Yiacomou, S., (1999, Jun. 1). Novel environmental technologies driven by electric and magnetic fields. Environmental Technologies and Opportunities Forum. Oak Ridge, TN.
- Tsouris, C., DePaoli, D. W., Shor, J. T., Hu, M. Z.- C., & Ying, T.- Y. (1998, Jun. 21-24). Electrochemical methods for magnetic seeding of wastewaters. 72nd Colloid and Surface Science Symposium, University Park, Pennsylvania State University, State College, PA.
- Tsouris, C., Dong, J., & DePaoli, D. W. (1999, Aug. 15-20). Novel phenomena in liquid-liquid systems under the influence of electric fields. MIXING XVII, Banff, Canada.
- Tsouris, C., et. al. (1998, Jul. 27-30). Phase equilibria modification by electric fields. Environmental Management Science Program National Workshop, Chicago, IL.
- Tsouris, C., Shin, W. -T., & Yiacomou, S. (1997, Jun. 29-Jul. 2). Formation of microbubbles using electric fields for environmental applications. 71st Colloid and Surface Science Symposium, Newark, DL.
- Worden, R. M., Bredwell, M. D., & Tsouris, C. (1998, May 3-7). Synthesis gas fermentations: Mass transfer improvement in butyribacterium methylotrophicum fermentations. 20th Symposium on Biotechnology for Fuels and Chemicals.

Yiacoumi, S., Ying, T.- Y., Yang, K.- L., & Tsouris, C. (1999, Oct. 31-Nov. 5). Electrosorption of metal ions from aqueous solutions. AIChE Annual Meeting, Dallas, TX.

Ying, T.- Y., Yang, K.- L., Yiacoumi, S., & Tsouris, C. (1999, Oct. 17-20). Electrosorption of metal ions from aqueous solutions. Eleventh Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

Ying, T.- Y., Yiacoumi, S., Tsouris, C., Shor, J. T., & DePaoli, D. W. (1999, Oct. 17-20). Electrocoagulation, magnetic seeding, and high-gradient magnetic filtration. Eleventh Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

Publication Type: Theses/Dissertations

Blankenship, K. D. (1999, Apr.). Distillation with applied electric fields. Masters Thesis, Department of Chemical Engineering, University of Tennessee. Knoxville, TN.

Shin, W.- T. (2000). Electric-field enhanced separations. PhD dissertation. Georgia Institute of Technology.

Yang, K.- L. (2002). Electrosorption modeling of equilibrium and kinetics. Georgia Institute of Technology.

Ying, T.- Y. (2001). Electrosorption of metal ions from aqueous solution. Georgia Institute of Technology.

Microbial Science

Project: 54681

Title: Dynamics of Coupled Contaminant and Microbial Transport in Heterogeneous Porous Media

PI: Dr. Timothy R. Ginn

Institution: University of California at Davis

Publication Type: Journal

VanSchie, P. M., Boone, D. R., & Fletcher, M. (1999). Adhesion of biodegradative anaerobic bacteria to solid surfaces. *Appl. Env. Microbial.* 65, 5082-5088.

Publication Type: Poster

VanSchie, P. M. & Fletcher, M. (1999). Characterization of the adhesive behavior of anaerobic bacteria with bioremediation potential. *Amer. Soc. Microb.* 131/Q Q-164.

VanSchie, P. M., Boone, D. R., & Fletcher, M. (1998). Adhesion of biodegradative anaerobic bacteria to solid surfaces. *Amer. Soc. Microb.* 118/Q Q-60.

Project: 55031

Title: Genetic Analysis of Stress Responses in Soil Bacteria for Enhanced Bioremediation of Mixed Contaminants

PI: Dr. Kwong-Kwok Wong

Institution: Pacific Northwest National Laboratory

Publication Type: Journal

Markillie, L. M., Varnum, S., Hradecky, P., & Wong, K. K. (1999). Targeted mutagenesis by duplication insertion in the radioresistant bacterium *Deinococcus radiodrans*: Radiation sensitivities of catalase (*katA*) and superoxide dismutase (*sodA*) mutants. *Journal of Bacteriology*. 181, 666-669.

Romine, M., et. al. (1999). Complete sequence of a 184.5-kb. catabolism plasmid from *Sphingomonas aromaticivorans* strain F199. *Journal of Bacteriology*. 181, 1585-1602.

Wong, K. K., Markillie, L. M., & Saffer, J. D. (1997). A novel method for producing partial restriction digestion of DNA fragments by PCR with 5-methyl-dCTP. *Nucleic Acids Res.* 25, 4169-4171.

Wong, K. K., Stillwell, L. C., Dockery, C. A., & Saffer, J. D. (1996). Use of tagged random hexamer amplification (THRA) to clone and sequence minute quantities of DNA-application to a 180-kb. plasmid isolated from *Sphingomonas* F199. *Nucleic Acids Res.* 24, 3778-3783.

Project: 55105

Title: Complete Detoxification of Short Chain Chlorinated Aliphatics: Isolation of Halorespiring Organisms and Biochemical Studies of the Dehalogenating Enzyme Systems

PI: Dr. James M. Tiedje

Institution: Michigan State University

Publication Type: Journal

Löffler, F. E., Ritalahti, K. M., & Tiedje, J. M. (1997). Dechlorination of chloroethenes is inhibited by 2-bromoethanesulfonate in the absence of methanogens. *Appl. Environ. Microbiol.* 63, 4982-4985.

Löffler, F. E., Sun, Q., Li, J., & Tiedje, J. M. (2000, in press). PCR detection of *desulfuromonas* and *dehalococcoides*, two environmentally important groups of tetrachloroethene (PCE)-dechlorinating anaerobic bacteria. *Appl. Environ. Microbiol.*

Löffler, F. E., Tiedje, J. M., & Sanford, R. A. (1999). The fraction of electrons consumed in electron acceptor reduction (FE) and hydrogen thresholds as indicators of halorespiratory physiology. *Appl. Environ. Microbiol.* 65, 4049-4056.

Project: 55152

Title: Molecular Profiling of Microbial Communities from Contaminated Sources: Use of Subtractive Cloning Methods and rDNA Spacer Sequences

PI: Dr. Frank T. Robb

Institution: University of Maryland at Baltimore

Publication Type: Journal

Spiro, A., Lowe, M., & Brown, D. (2000). A bead-based method for multiplexed identification and quantification of DNA sequences using flow cytometry. *Appl. Environ. Microbiology* 66(10), 4258-4265.

Project: 55416

Title: Control of Biologically Active Degradation Zones by Vertical Heterogeneity: Applications in Fractured Media

PI: Dr. Frederick S. Colwell

Institution: Idaho National Engineering and Environmental Laboratory

Publication Type: Journal

Lehman, R. M., Colwell, F. S., & Bala, G. A. (2001). Attached and unattached microbial communities in a simulated basalt aquifer under fracture- and porous-flow conditions. *Appl. Environ. Microbiol.* 67, 2799-2809.



During a tour of the INEEL Research Center labs, INEEL scientist Rick Colwell explained to DOE Deputy Secretary T.J. Glautheir, DOE-Idaho Manager Bev Cook, Merna Hurd, senior adviser for Glautheir, and Linda McCoy, DOE chief scientist, Environmental Management Science Program funded research into remediating the TAN aquifer using microbes, and what controls microorganisms that are degrading contaminants in the aquifer. [see Project #55416]

Tobin, K. J., Colwell, F., Onstott, T. C., & Smith, R. (2000). Recent calcite spar in an aquifer waste plume: A possible example of contamination driven calcite precipitation. *Chem. Geol.* 169, 449-460.

Tobin, K. J., Onstott, T. C., DeFlaun, M., Colwell, F., & Fredrickson, J. (1999). In situ imaging of microorganisms in geologic material. *J. Microbiol. Meth.* 37, 201-213.

Publication Type: Other

Colwell, F. (2001). Constraints on the distribution of microorganisms in subsurface environments. Fredrickson, J. & Fletcher, M. (Eds.). *Subsurface Microbiology and Biogeochemistry*. John Wiley and Sons. New York, NY.

Publication Type: Poster

Colwell, F. S. (1999, Jan. 15). Control of biologically active degradation zones by vertical heterogeneity: Applications in fractured media. NABIR Investigator's Workshop.

Publication Type: Presentation

Colwell, F. S. (1999). Chaotic-dynamical conceptual model to describe fluid flow and contaminant transport in a fractured vadose zone. Poster presentation at the Berkeley Dynamics of Fluids and Fractured Rock Conference. Berkeley, CA.

Colwell, F. S., Tobin, K., & Wilson, M. (1999, Jan. 7). Control of biologically active degradation zones by vertical heterogeneity: Applications in fractured media. Idaho Water Resources Research Institute (IWRRRI) meeting.

Publication Type: Proceeding

Lehman, R. M., O'Connell, S. P., Garland, J. L., & Colwell, F. S. (1997). Evaluation of remediation by community-level physiological profiles. Insam, H. & Rangger, A. (Eds.). *Microbial Communities: Functional Versus Structural Approaches*. Springer-Verlag. Berlin, Germany.

O'Connell, S. P., Lehman, R. M., Colwell, F. S., & Watwood, M. E. (1997). Microbiological monitoring of contaminants in a fractured basalt aquifer. In *Situ and On-site Bioremediation*, Vol. 4. The Fourth International Symposium. Batelle Press. Columbus, OH. 111-116.

Publication Type: Theses/Dissertations

Lehman, R. M. (2000). Attached and unattached microbial communities in saturated terrestrial subsurface environments. Ph. D. Dissertation. Idaho State University. Pocatello, ID.



Understanding the chemical and microbial conditions in the subsurface helps identify potential treatment solutions. [see Project #55416]

Project: 59786

Title: Design and Construction of *Deinococcus radiodurans* for Biodegradation of Organic Toxins at Radioactive DOE Waste Sites

PI: Dr. Michael J. Daly

Institution: Uniformed Services Univ. of the Health Sciences

Publication Type: Journal

Brim, H., et. al. (2000, Jan.). Engineering *Deinococcus radiodurans* for metal remediation in radioactive mixed waste environments. *Nat. Biotechnol.* 18(1), 85-90.

Daly, M. J. (2000). Engineering radiation-resistant bacteria for environmental biotechnology. *Current Opinion in Biotechnology.* 11, 280-285.

Frederickson, J. K., Kostandarithes, H. M., Li, A. W., Pyle, A. E., & Daly, M. J. (2000). Reduction of Fe(III), Cr(VI), U(VI), and Tc(VIII) by *Deinococcus radiodurans*. *Appl. Environ. Microbiol.* 66, 2006-2011.

Lange, C., Wackett, L., Minton, K. & Daly, M. J. (1998). Engineering a recombinant *Deinococcus radiodurans* for organopollutant degradation in radioactive mixed waste environments. *Nature Biotech.* 16, 929-933.

Lin, J., et. al. (1999, Sep. 3). Whole-genome shotgun optical mapping of *Deinococcus radiodurans*. *Science.* 285(5433), 1558-1562.

Makarova, K. S., Aravind, L., Daly, M. J., & Koonin, E. (2000, in press). Specific expansion of protein families in the radioresistant bacterium *Deinococcus radiodurans*. *Genetica.*

Makarova, K. S., Wolf, Y. I., Minton, K. W., White, O., & Daly, M. J. (1999). Short repeats and insertional elements in *Deinococcus radiodurans* and comparison to other bacterial species. *Res. Microbiol.* 150, 711-724.

Venkateswaran, A., et. al. (2000). Physiologic determinants of radiation resistance in *Deinococcus radiodurans*. *Appl. Environ. Microbiol.* 66, 2620-2626.

White, O., et. al. (1999). Sequencing and functional analysis of the *Deinococcus radiodurans* genome. *Science.* 286, 1571-1577.

Plant Science

Project: 54898

Title: Molecular Dissection of the Cellular Mechanisms Involved in Nickel Hyperaccumulation in Plants

PI: Dr. David E. Salt

Institution: Purdue University

Publication Type: Journal

Krämer, U., Pickering, I. J., Prince, R. C., Raskin, I., & Salt, D. E. (2000, Apr.). Subcellular localization and speciation of nickel in hyperaccumulator and non-accumulator *Thlaspi* species. *Plant Physiol.* 122(4), 1343-1353.



Thlaspi Goesingense growing in its native ultramafic habitat near RedSchlag/Austria. The Northern Arizona University team is investigating, at the molecular level, the role of histidine biosynthesis in hyperaccumulation in *Thlaspi goesingense*. [see Project #54898]

Krämer, U., Smith, R. D., Wenzel, W., Raskin, I., & Salt, D. E. (1997). The role of nickel transport and tolerance in nickel hyperaccumulation by *Thlaspi goesingense* Hálácsy. *Plant Physiol.* 115, 1641-1650.

Persans, M. W., Xiang, Y., Patnoe, J. M. M. L., Krämer, U., & Salt, D. E. (1999, Dec.). Molecular dissection of the role of histidine in nickel hyperaccumulation in *Thlaspi goesingense* (Hálácsy). *Plant Physiol.* 121(4), 1117-1126.

Persans, M., Yan, X., Smith, R., & Salt, D. E. (1998). Cloning of two cDNA's from the Ni hyperaccumulator *Thlaspi goesingense*: Histidinol dehydrogenase (Accession No. AF023141) and imidazolglycerol-phosphate dehydratase (Accession No. AF023140), two enzymes in the histidine biosynthetic pathway. *Plant Physiol Plant Gene Register.* 117, 332.

Pickering, I. J., et. al. (2000, Apr.). Reduction and coordination of arsenic in Indian mustard. *Plant Physiol.* 122(4), 1171-1177.

Salt, D. E., Prince, R. C., Baker, A. J. M., Raskin, I., Pickering, I. J. (1999). Zinc ligands in the metal hyperaccumulator *Thlaspi caerulescens* as determined using X-ray absorption spectroscopy. *Environmental Science and Technology.* 33, 713-717.

Salt, D. E., Smith, R. D., & Raskin, I. (1998). Phytoremediation. *Ann Rev Plant Physiol Plant Mol Biol.* 49, 643-668.

Publication Type: Other

Salt, D. E. (1999, in press). Phytoextraction: Present applications and future promise. Wise, D. L., Trantolo, D. J., Inyang, H. I., & Cichon, E. J. (Eds.), *Remediation of Hazardous Waste Contaminated Soils*, 2nd Edition, Marcel Dekker, Inc.

Salt, D. E., & Baker, A. J. M. (1999, in press). *Phytoremediation of metals*. Rehm, H. -J. & Reed, G. (Eds.), *Biotechnology* 2nd Edition, Wiley-VCH. New York, NY.

Salt, D. E., & Krämer, U. (1999, in press). Mechanisms of metal hyperaccumulation in plants. Ensley, B. D. & Raskin, I. (Eds.), *Phytoremediation of Toxic Metals: Using Plants to Clean-Up the Environment*, Chapter 13, John Wiley & Sons, Inc., New York, NY.

Salt, D. E., Kato, N., Krämer, U., Smith, R. D. & Raskin, I. (1999). The role of root exudates in nickel hyperaccumulation and tolerance in accumulator and non-accumulator species of *Thlaspi*. Terry, N. & García-España, X. (Eds.), *Phytoremediation of Contaminated Soil and Water*, Chapter 10, CRC Press LLC. Boca Raton, FL. 189-200.

Wenzel, W., Salt, D. E., Smith, R. D., & Adriano, D. C. (1999). *Phytoremediation: A plant-microbe-based remediation system*. Adriano, D. C., et. al. (Eds.), *Bioremediation of Contaminated Soils*. American Society of Agronomy Inc., Crop Science Society of America, Inc., Soil Science Society of America, Inc., Madison, Wisconsin. 18, 457-508.

Publication Type: Paper

Special Symposium - Phytoremediation. (1999, Jul. 11-15). Progress towards a molecular understanding of metal hyperaccumulation in plants. 5th International Conference on the Biogeochemistry of Trace Elements. Vienna, Austria.

Publication Type: Presentation

Plenary Address - Phytoremediation as a Clean-Up Technology for the Next Millennium (1999, Jun. 23-25). The Researcher's Perspective - Progress and Bottlenecks. 4th IBC Annual International Conference on Phytoremediation, Toronto, Canada.

Remediation Mini-Symposium. (1999, Jul. 24-28). Towards a molecular understanding of the mechanism of Ni hyperaccumulation in *Thlaspi*. American Society of Plant Physiologists Annual Meeting. Baltimore, MD.

Project: 55041

Title: Molecular Characterization of a Novel Heavy Metal Uptake Transporter from Higher Plants & its Potential for use in Phytoremediation

PI: Dr. Julian I. Schroeder

Institution: University of California at San Diego

Publication Type: Journal

Clemens, S., Kim, E. J., Neumann, D., & Schroeder, J. I. (1999). Tolerance to toxic metals by a gene family of phytochelatase synthases from plants and yeast. *EMBO J.* 18, 3325-3333.



LCT1 Mediates Cadmium Uptake. Expression of the wheat gene, LCT1, in *S. cerevisiae* leads to dramatic hypersensitivity to cadmium, and increased intracellular accumulation. [see Project #55041]

Project: 55097*Title:* Heavy Metal Pumps in Plants*PI:* Dr. Jeffrey F. Harper*Institution:* The Scripps Research Institute*Publication Type:* Theses/Dissertations

Wang, Y. (2000, May). Identification of a molybdenum uptake pump in arabidopsis plants. Ph.D Dissertation. Scripps Research Institute.

Project: 55278*Title:* Molecular Genetics of Metal Detoxification: Prospects for Phytoremediation*PI:* Dr. David W. Ow*Institution:* U.S. Dept. of Agriculture*Publication Type:* Journal

Ow, D. W. (1996). Heavy metal tolerance genes: Prospective tools for bioremediation. *Resources, Conservation, and Recycle*. 18, 135-149.

Perego, P., VandeWeghe, J., Ow, D. W., & Howell, S. B. (1997). The role of determinants of cadmium sensitivity in the tolerance of *Schizosaccharomyces pombe* to cisplatin. *Molecular Pharmacology*. 51, 12-18.

VandeWeghe, J. & Ow, D. W. (1999). A fission yeast gene for mitochondrial sulfide oxidation. *Journal of Biological Chemistry*. 274, 13250-13257.

Publication Type: Other

Ow, D. W. (1998). Prospects of engineering heavy metal detoxification genes in plants. In Shewry, P. (Ed.), *Engineering Crops for Industrial Uses*. Portland Press. 111-124.

Publication Type: Presentation

Ow, D. W. (1996, Sept. 16-18). Prospects of engineering heavy metal detoxification genes in plants. Abstracts of the Symposium on Engineering Crops for Industrial End Uses. Bristol, England.

Ow, D. W. (1997, Sept. 29 - Oct. 1). Heavy metal tolerance genes as tools for phytoremediation. Abstracts of the International Symposium on Environmental Engineering. Kyongju, Korea.

Ow, D. W., Clark, S., Henstrand, J., & Kim, J. (1998, Jun. 19-20). Molecular genetics of heavy metal tolerance. Abstracts of the University of Connecticut Agricultural Biotechnology Symposium, Storrs, CN.



Picture 1 - shows a set of plants grown in high zinc concentration. Control plant (C) produces low biomass and suffers severe stress, as indicated by early flowering. In contrast, plants transgenic for genes Bj4 and Bj6 show healthy growth. [see Project #55278]

Ow, D. W., et. al. (1997, Sept. 21-27). Heavy metal tolerance genes for phytoremediation. Abstracts of the 5th International Congress of Plant Molecular Biology, Singapore.

Ow, D. W., et. al. (1998, Jul. 27-30). Heavy metal tolerance genes. Abstracts of the DOE Environmental Remediation Meeting. Chicago, IL.

Ow, D. W., Kim, J. H., Fox, T., & Sin, M. (2000, Apr. 25-27). Cloning heavy metal tolerance genes. Presentation at the Environmental Management Science Program National Workshop. Atlanta, GA.

VandeWeghe, J. & Ow, D. W. (1996, Aug. 6-11). An oxidoreductase-like gene required for cadmium tolerance in *Schizosaccharomyces pombe*. Abstracts of the 1996 Yeast Genetics & Molecular Biology Meeting. Univ. of Wisconsin. Madison, WI. 309.

VandeWeghe, J., Ow, D. W. (1997, Apr. 7-8). A novel mitochondrial oxidoreductase required for phytochelatin accumulation and cadmium tolerance in fission yeast. Abstracts of the Society for Experimental Biology Annual Meeting, Session on Metals and Genes. Canterbury, England. 80.

Zankel, T. C. & Ow, D. (1996, Mar. 17-23). Homologs of the human BTF3 and Wiskott-Aldrich syndrome proteins are involved in the metal stress response of *S. pombe*. Abstracts of the 1996 Keystone Symposium on Transcriptional Mechanisms. Taos, NM. 67.

Zankel, T. C., Ow, D. W. (1997, Mar. 31 - Apr. 6). A *Schizosaccharomyces pombe* homolog of the Wiskott-Aldrich syndrome protein is involved in stress adaptation and mating. Abstracts of the 1997 Keystone Symposium on Temporal and Spatial Determinants of Specificity in Signal Transduction, Keystone, CO.

Publication Type: Proceeding

Perego, P, Vandeweghe, J, Ow, D, & Howell, S B. (1997). Role of determinants of cadmium sensitivity in the sensitivity of *Schizosaccharomyces pombe* to cisplatin. Eighty-eighth Annual Meeting of the American Association for Cancer Research, San Diego, CA. Also in the proceedings of the American Association for Cancer Research Annual Meeting. 38, 393.

Perego, P, VandeWeghe, J., Ow, D., & Howell, S. B. (1996, Apr. 20-24). Mechanisms of resistance to cisplatin (DDP) in *Schizosaccharomyces pombe*. 87th Annual Meeting of the American Association for Cancer Research. Washington, D. C. Proceedings of the American Association for Cancer Research Annual Meeting. 37, 336.

Publication Type: Theses/Dissertations

VandeWeghe, J. G. (1997). A mitochondrial sulfide dehydrogenase required for heavy metal tolerance in fission yeast. Ph.D. Dissertation. University of California at Berkeley. Berkeley, CA.

Project: 60271*Title:* Characterization of a New Family of Metal Transport Proteins*PI:* Dr. Mary Lou Guerinot*Institution:* Dartmouth College*Publication Type:* Journal

Eng, B. H., Guerinot, M. L., Eide, D., & Saier, M. H. J. (1998). Sequence analyses and phylogenetic characterization of the ZIP family of metal ion transport proteins. *J. Membr. Biol.* 166, 1-7.

Gitan, R. S., Luo, H., Rodgers, J., Broderius, M., & Eide, D. (1998). Zinc-induced inactivation of the yeast ZRT1 zinc transporter occurs through endocytosis and vacuolar degradation. *J. Biol. Chem.* 273, 28617-28624.

Guerinot, M. L. & Eide, D. (1999). Zeroing in on zinc uptake in yeast and plants. *Curr. Opin. Plant Biol.* 2, 244-249.

Korshunova, Y. O., Eide, D., Clark, W. G., Guerinot, M. L., & Pakrasi, H. B. (1999). The IRT1 protein from *Arabidopsis thaliana* is a metal transporter with broad specificity. *Plant Mol. Biol.* 40, 37-44.

Project: 70054 (Renewal of Project No. 54837)*Title:* Phytoremediation of Ionic and Methyl Mercury Pollution*PI:* Dr. Richard B. Meagher*Institution:* University of Georgia*Publication Type:* Journal

Heaton, A. C. P., Rugh, C. L., Wang, N. -J., & Meagher, R. B. (1998). Phytoremediation of mercury and methylmercury polluted soils using genetically engineered plants. *J. Soil Contam.* 7, 497-509.

Rugh, C. L., Gragson, G. M., & Meagher, R. B. (1998). Toxic mercury reduction and remediation using transgenic plants with a modified bacterial gene. *Hort. Sci.* 33, 12-15.

Rugh, C. L., Senecoff, J. F., Meagher, R. B., & Merkle, S. A. (1998). Development of transgenic yellowpoplar for mercury phytoremediation. *Nature Biotech.* 16, 925-928.

Publication Type: Other

Rugh, C. L., Bizily, S. P., & Meagher, R. B. (1999). Phytoremediation of environmental mercury pollution. Ensley, B. & Raskin, I. (Eds.), *Phytoremediation of toxic metals: Using plants to clean-up the environment.* Wiley and Sons, New York, NY.



Transgenic merA9 tobacco efficiently remove mercury from hydroponic media. [see Project #70054, renewal of #54837]

Publication Type: Paper

Meagher, R. B. (1998). Phytoremediation: An affordable, friendly technology to restore marginal lands in the twenty-first century. *Plants and Population: Is there time?* Natl. Acad. Sci. Colloquium. Irvine, CA.

Publication Type: Proceeding

Bizily, S., Rugh, C. L., Summers, A. O., & Meagher, R. B. (1999). Phytoremediation of methylmercury pollution: MerB expression in *Arabidopsis thaliana* confers resistance to organomercurials. *Proc. Natl. Acad. Sci. USA* 96, 6808-6813.

Meagher, R. B. & Rugh, C. L. (1996). Phytoremediation of heavy metal pollution: Ionic and methylmercury. *OECD Biotechnology for Water Use and Conservation Workshop. Organization for Economic Co-Operation and Development. Cocoyoc, Mexico.* 305-321.

Meagher, R.B., Rugh, C. L., Kandasamy, M. K., Gragson, G., & Wang, N. -J. (1998). Engineered phytoremediation of mercury pollution in soil and water using bacterial genes. Ishndar, I. K., Hardy, S. E., Chang, A. C., & Pierzynski, G. M. *Fourth International Conference on the Biogeochemistry of Trace Elements* pp. Ann Arbor Press, Inc. Berkeley, CA. 203-221.

Rugh, C. L., et. al. (1996). Mercuric ion reduction and resistance in transgenic *Arabidopsis thaliana* plants expressing a modified bacterial merA gene. *Proc. Natl. Acad. Sci. USA* 93, 3182-3187.

Project: 73843 (Renewal of Project No. 55118)

Title: Mechanisms of Heavy Metal Sequestration in Soils: Plant-Microbe Interactions and Organic Matter Aging

PI: Dr. Teresa W. M. Fan

Institution: University of California at Davis

Publication Type: Journal

Fan, T. W. -M., Pedler, J., Lane, A. N., Crowley, D., & Higashi, R. M. (1997). Comprehensive analysis of organic ligands in whole root exudates using NMR and GC-MS. *Analytical Biochemistry.* 251, 57-68.

Higashi, R. M., Fan, T. W. -M., & Lan, A. N. (1998). Association of desferrioxamine with humic substances and their interaction with cadmium(II) as studied by pyrolysis gas chromatography mass spectrometry and nuclear magnetic resonance spectroscopy. *Analyst.* 123(5), 911-918.



Genetically altered seeds are placed in mercury-contaminated soil to see if they will grow. [see Project #70054, renewal of #54837]

Publication Type: Other

Fan, T. W. -M. & Lane, A. N. (1999, in press). NMR in the plant-soil environment. In Encyclopedia of NMR Spectroscopy, John Wiley and Sons, New York, NY.

Fan, T. W. -M. (1996). Recent advancement in profiling plant metabolites by multi-nuclear and multi-dimensional NMR. Shachar-Hill, Y., & Pfeffer, P. E. (Eds.), Nuclear Magnetic Resonance in Plant Biology. American Society of Plant Physiologists. Rockville, MD. 181-254.

Publication Type: Presentation

Fan, T. W. -M., Higashi, R. M., & Crowley, D. E. (1998, Jul.). Plant rhizosphere effects on metal mobilization and transport. DOE EMSP Symposium. Chicago, IL.

Fan, T. W. -M., Shenker, M., Higashi, R. M., Crowley, D. E., & Lane, A. N. (1999, Mar.). Rhizosphere mobilization of heavy metals via plant root exudation. Semi-Annual Meeting of American Chemical Society, Anaheim, CA.

Fan, T. W. -M., Shenker, M., Lane, A. N., Crowley, D., & Higashi, R. M. (1998, Apr.). Comprehensive determination of root exudates under combined Fe deficiency/CD stress by NMR and GC-MS. Society of Environmental Toxicology and Chemistry-Europe. Bordeaux, France.

Fan, T. W. M., Lane, A. N., & Higashi, R. M. (1999, Aug. 22). Structure analysis of soil humates by liquid-state, multinuclear, and multidimensional NMR. Abstr. Pap. Am. Chem. S. 218, U649-U649, Part 1.

Higashi, R. M. & Fan, T. W. -M. (1998, May). Ternary interactions of Cd(II), ligands, and humic substances - implications for metal ion bioavailability. EPA, DOE, ONR, & NSF Joint Workshop.

Higashi, R., Fan, T., Baraud, F., & Lane, A. (1999, Mar.). Ternary interactions of biogenic ligands and Cd(II) with humic substances, with implications for metal ion bioavailability. Semi-annual meeting of the American Chemical Society, Anaheim, CA.

Project: 73858 (Renewal of Project No. 54889)

Title: Chlorinated Hydrocarbon Degradation in Plants: Mechanisms and Enhancement of Phytoremediation of Groundwater Contamination

PI: Dr. Stuart E. Strand

Institution: University of Washington

Publication Type: Proceeding

Doty, S. L., et. al. (2000). Enhanced metabolism of halogenated hydrocarbons in transgenic plants containing mammalian cytochrome P450 2E1. Proc. National Academy of Sciences. 97, 6287-6291.

Separations Chemistry

Project: 54122

Title: A Broad Spectrum Catalytic System for Removal of Toxic Organics from Water By Deep Oxidation

PI: Dr. Ayusman Sen

Institution: Pennsylvania State University

Publication Type: Journal

Chlistunoff, J. B. & Johnston, K. P. (1999). UV-Vis spectroscopic determination of the dissociation constant of bichromate from 160°C to 400°C. *Journal of Phys. Chem. B.* 102, 3993-4003.

Hogan, T., Simpson, R., Lin, M., & Sen, A. (1996). A broad spectrum catalytic system for removal of toxic organics from water by deep oxidation using dioxygen as the oxidant. *Catal. Lett.* 40, 95.

Hogan, T., Simpson, R., Lin, M., Sen, A. (1997). The deep oxidation of chemical warfare agent models: Facile catalytic oxidative cleavage of phosphorus-carbon and sulfur-carbon bonds using dioxygen. *Catal. Lett.* 49, 59.

Pifer, A. & Sen, A. (1998). Chemical recycling of plastics to useful organics by oxidative degradation. *Angew. Chem. Int. Ed.* 37, 3306.

Pifer, A., et. al. (1999). A broad spectrum catalytic system for the deep oxidation of toxic organics in aqueous medium using dioxygen as the oxidant. *J. Am. Chem. Soc.* 121, 7485.

Project: 54926

Title: Novel Ceramic-Polymer Composite Membranes for the Separation of Hazardous Liquid Waste

PI: Dr. Yoram Cohen

Institution: University of California at Los Angeles

Publication Type: Journal

Castro, R. P., Monbouquette, H. G., & Cohen, Y. (1996). Polyvinylpyrrolidone-silica membranes for the treatment of oil-in-water emulsions. *J. Membrane Science.* 115, 179-187.

Faibish, R., Elimelech, M., & Cohen, Y. (1998). Effect of intraparticle electrostatic double layer interactions on permeate flux decline in crossflow membrane filtration of colloidal suspensions: An experimental investigation. *J. Colloid and Interface Science.* 204, 77-86.

Jou, J. -D., Yoshida, W., & Cohen, Y. (1999, Sep. 1). A novel ceramic-supported polymer membrane for pervaporation of dilute volatile organic compounds. *J. Membrane Sci.* 162(1-2), 269-284.

Publication Type: Other

Cohen, Y., Deng-Jeng, J., Yoshida, W., & Bei, N. (1999, in press). Surface modification of oxide surfaces by graft polymerization. Wingrave, J. A. (Ed.). Oxide Surfaces. Marcel Dekker.

Cohen, Y., Faibish, R., & Rovira, M. (1999). Size exclusion chromatography with graft polymerized silica resins. Pefferkorn, E. (Ed.). Surface Interactions in Size Exclusion Chromatography. Marcel Dekker.

Publication Type: Poster

Cohen, Y., Yoshida, W., & Jou, J. -D. (1998, Jul. 27-30). CSP membranes. Invited poster presentation at the DOE First Annual Environmental Management Science Program Scientific Workshop. Rosemont, IL.

Publication Type: Presentation

Cohen, Y. & Jou, J. -D. (1998, May 19-20). Ceramic-supported polymer pervaporation membranes for VOC removal. 10th Annual Meeting of the North American Membrane Society. Cleveland, OH.

Cohen, Y. (1997, Jul.). Graft polymerized ceramic membranes. Gordon Research Conference on Membrane: Materials and Synthesis. New Hampshire.

Cohen, Y. (1998, Sep. 16-17). Polymeric resins for VOC removal from aqueous systems. Volatile Organic Compounds (VOC) Recovery Seminar, EPA/625/R-99/005, ORD, EPA National Risk Management Research Laboratory.

Cohen, Y. (1999, Feb. 9). Polymer surfaces for selective separations. Invited seminar at the DOE Environmental Molecular Surface Laboratory.

Cohen, Y. (1999, Oct. 31 - Nov. 5). Environmental multimedia distributions of toxics (mend-tox). 1999 AIChE Annual Meeting. Dallas, TX.

Cohen, Y. (2000, Jan. 29 - Feb. 2). Polymer at solid surfaces for novel membranes. Invited presentation at the Chemistry for a Cleaner Environment Conference. Santa Fe, NM.

Cohen, Y., Castro, R. P., Jou, J. -D., & Monbouquette, H. G. (1996, Nov. 10-15). Ceramic-supported polymer membranes for ultrafiltration. AIChE Annual Meeting. Chicago, IL.

Cohen, Y., Faibish, T., & Elimelech, M. (1997, Mar.). Flux decline in cross-flow filtration of colloidal silica. North America Membrane Society Annual Meeting. Baltimore, MA.

Faibish, R. & Cohen, Y. (1999, Oct. 31 - Nov. 5). Crossflow ultrafiltration of oil-in-water microemulsions with polymer-modified ceramic membranes. 1999 AIChE Annual Meeting. Dallas, TX.

Rovira, M., Giralt, F., & Cohen, Y. (1998, Nov. 15-20). Protein fouling reduction on ceramic membranes via graft polymerization. AIChE Annual Meeting. Miami Beach, FL.

Yoshida, W., Cohen, Y., & Jeng-Deng, J. (1998, Nov. 15-20). Graft polymerization and application to ceramic supported polymer pervaporation membranes for VOC removal. AIChE Annual Meeting. Miami Beach, FL.

Yoshida, W., Jou, J. -D., Liang, Y., & Cohen, Y. (1999, Oct. 31 - Nov. 5). Graft polymerized poly (vinyl acetate) and poly (vinylpyrrolidone) layers on inorganic substrates for membrane separations. 1999 AIChE Annual Meeting. Dallas, TX.

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