

PAUL REIMUS

PAUL W. REIMUS

117 MONTE REY DR. N.
LOS ALAMOS, NM 87544
(505) 672-9565

LOS ALAMOS NATIONAL LABORATORY
P.O. BOX 1663, MAIL STOP J514
LOS ALAMOS, NM 87545
(505) 665-2537

EDUCATION

B.S. Chemical Engineering, Michigan Technological University	1981
M.S. Chemical Engineering, New Mexico State University	1984
Ph.D. Engineering, University of New Mexico	1995

EXPERIENCE

Dr. Reimus has worked at Los Alamos National Laboratory as a staff member since July 1989. Prior to joining Los Alamos, he worked at Battelle Pacific Northwest Laboratories as a research engineer from October 1983 to March 1989. He also worked as a consultant to Los Alamos National Laboratory from May 1989 to July 1989. His specific work experience has included:

- Technical Deputy for Testing, DOE Yucca Mountain Project. Dr. Reimus served for a short time (mid 2006 to mid-2008) as the technical deputy for testing for the U.S. Department of Energy Yucca Mountain Project. In this capacity, he was responsible for providing technical direction and oversight for all testing activities conducted by the project, including testing associated with the saturated zone below the repository (hydrology, geochemistry, transport), the unsaturated zone (infiltration, seepage, transport), disruptive events (seismic and volcanism), waste package systems (container corrosion, waste form degradation), and near-field and engineered barrier systems (moisture barriers, coupled heat and mass transport). He was identified as a key member of the team to defend the DOE license application for the Yucca Mountain repository, and he was expected to play a key role in planning and overseeing performance confirmation testing and any testing identified as being necessary to support or defend the license application.
- Team Leader of Geochemistry Team. Dr. Reimus was team leader of the Geochemistry Team of the Isotope and Nuclear Chemistry Group (C-INC) at Los Alamos from April 2002 to July 2006 (when he accepted the Yucca Mountain Project technical deputy position). Prior to that he was team leader of the same team for just over a year in what was the Environmental Technologies Group (E-ET). His responsibilities as team leader included supervising a 15- to 20-person team consisting of staff members, technicians, post-docs, graduate students, and undergraduate students. One of his primary responsibilities was to conduct program development activities for the team, primarily within the U. S. Department of Energy (DOE). He was also a principal investigator on both the Yucca Mountain Project and the Nevada Test Site Underground Test Area (UGTA) Project. He served briefly as chairman of the hydrology committee that advises the DOE on the latter project.
- Field-Scale Groundwater Tracer Transport Experiments. Since December 1994, Dr. Reimus has been responsible for conducting and interpreting several field-scale tracer transport experiments in saturated, fractured media and in saturated alluvium systems for the Yucca Mountain Project. The tracers used in the experiments have included sorbing and nonsorbing solutes and synthetic colloids (polystyrene microspheres). Goals have been to (1) obtain field-scale data that can be used to develop and validate models of radionuclide transport over large scales, (2) test the validity of using laboratory-derived sorption data to predict field-scale reactive transport behavior, and (3) obtain estimates of ambient groundwater flow velocity and direction. In addition to his Yucca Mountain experience, Dr. Reimus has been involved in field tracer experiments with (1) Lawrence Berkeley National Laboratory, using microspheres as tracers in a fractured granite, (2) Nevada Test Site Underground Test Area (UGTA) Project participants, using microspheres as tracers in a fractured

volcanic lava aquifer and a fractured carbonate aquifer at the Nevada Test Site, (3) the Desert Research Institute, using solute tracers in a fractured granite, (4) the University of New Mexico, using solute and colloid tracers in a shallow alluvial aquifer in Albuquerque's South Valley, (5) the Swiss NAGRA program, planning and interpreting tracer tests conducted in fractured granite at the Grimsel test site, and most recently, (6) Chevron Energy Technology Company, developing tracers and designing tracer tests for fractured rock aquifer characterization.

- Laboratory-Scale Solute and Colloid Transport Experiments. Since 1997, Dr. Reimus has been responsible for designing, conducting and interpreting numerous laboratory-scale tracer/contaminant transport experiments in which solute and colloid transport were studied in natural fractures, artificial fractures, packed columns (porous media), or intact pieces of rock (diffusion studies). He has also designed, conducted and interpreted numerous batch or semi-batch sorption and desorption experiments to assess radionuclide and/or tracer sorption isotherms, mechanisms, hysteresis, and general dependence on groundwater chemistry and substrate properties (e.g., mineralogy, surface area). The solutes in these studies have included both radionuclides and non-radioactive tracers - the latter were often used in field experiments. These dynamic transport experiments were typically designed to include multiple species with different properties to help constrain test interpretations (e.g., solutes with different diffusion coefficients, nonsorbing vs. sorbing solutes, or colloids of different sizes or composition), and they were often repeated at different time scales in the same system to obtain information on scaling of transport mechanisms. Batch sorption/desorption experiments and column transport experiments have often been conducted in parallel to assess the ability to predict transport under flowing conditions from batch measurements. Dr. Reimus has also been responsible for conducting several experiments investigating colloid-facilitated transport of Plutonium in natural fractures and alluvium from the Nevada Test Site. These experiments have featured batch sorption measurements of the Pu(V) onto both the colloids and the immobile rock matrix to help constrain test interpretations. His Ph.D. dissertation research was on transport of synthetic colloids (polystyrene microspheres) through saturated fractures.
- Modeling of Contaminant Transport in Groundwater Systems. Since the late 1980s, Dr. Reimus has developed several numerical and semi-analytical models to describe flow and contaminant transport in groundwater systems. Specifically, he has developed: (1) a multicomponent cation-exchange transport model that has yielded significant improvements in predictive and interpretive capability for ion-exchanging solutes over models that assume independent solute (single-component) behavior, (2) semi-analytical models to describe sorbing and nonsorbing tracer transport through fractured media under either linear or radial flow conditions (to interpret field-scale tracer tests), (3) a 2-D finite-difference model describing nonlinear and/or rate-limited sorbing solute transport through fractured media, (4) a 2-D finite-difference model describing colloid-facilitated contaminant transport in fractured rocks, (5) 2-D and 3-D particle-tracking models to describe tracer transport in multiple-well tracer tests under partial- or fully-recirculating conditions, (6) a 2-D finite-difference model of fluid flow through variable-aperture fractures (or heterogeneous media, in general), (7) particle-tracking models for 2-D contaminant transport in heterogeneous media, (8) a 1-D finite-difference model of colloid transport in fractures with up to three reversible first-order kinetic reactions to describe colloid interactions with the matrix, and (9) a 2-D finite-difference model describing the transport of radionuclide decay chains through saturated, porous media.
- Colloid Attachment and Detachment Visualization Studies. Dr. Reimus was involved in the development of an automated microscopic visualization system that has been used to quantify the attachment and detachment kinetics of colloid-sized particles (down to 200-nm diameter) at solid-solution interfaces under flowing conditions. This system has received as U.S. Patent.

- Fracture Void Space Characterization. Dr. Reimus used three different techniques to characterize the void geometry in laboratory-scale natural fractures. He used this information to predict fluid flow and tracer transport through the fractures.
- Vitrification Systems Modeling. Dr. Reimus developed mass balance models of nuclear waste vitrification systems using state-of-the-art computer simulation tools. His models were used to investigate various approaches to (1) waste form qualification and (2) statistical process control.
- Waste Package Systems Modeling. Dr. Reimus was involved in modeling (1) the dissolution of spent uranium dioxide fuel, (2) the dissolution of nuclear waste glasses, (3) the uniform and nonuniform corrosion of metals, and (4) the radiolysis of aqueous solutions. These efforts supported nuclear waste package modeling studies.
- Vitrification and Waste Package Systems Experiments. Dr. Reimus participated in planning and conducting pilot-scale nuclear waste vitrification experiments and laboratory-scale nuclear waste package system experiments. He helped develop a technique for separating calcium-uranium-silicate precipitates from spent fuel fines so that the precipitates could be characterized by radiochemical analysis without interference from the fuel.
- Interfacial Area Generation in Static Mixers. Dr. Reimus M.S. thesis research topic was the generation of interfacial area between two immiscible liquids in a static “tee” mixer.

PROFESSIONAL, ACADEMIC, AND HONORARY AFFILIATIONS

- Previous adjunct faculty member at New Mexico Tech University (Dept. of Earth and Environmental Sciences)
- Current adjunct faculty member at University of New Mexico serving on advisory committee for 1 Ph.D student (Dept. of Chemical and Nuclear Engineering)
- Previously served on advisory committees for 4 M.S. students (U. New Mexico (3), University of Nevada-Reno) and 2 Ph.D. students (New Mexico Tech, U. New Mexico)
- American Institute of Chemical Engineers
- American Chemical Society (lapsed)
- American Geophysical Union (lapsed)
- Geological Society of America (lapsed)
- Tau Beta Pi
- Phi Kappa Phi
- Phi Lambda Upsilon
- Omega Chi Epsilon

PEER-REVIEWED PUBLICATIONS

- Duke, C. L., R. C., Roback, P. W. Reimus, R. S. Bowman, T. L. McLing, K. E. Baker, and L. C. Hull. 2007. “Elucidation of flow and transport processes in a variably saturated system of interlayered sediment and fractured rock using tracer tests,” *Vadose Zone J.*, 6(4), pp 855-867.
- Reimus, P. W., and T. J. Callahan. 2007. “Matrix Diffusion Rates in Fractured Volcanic Rocks at the Nevada Test Site: Evidence for a Dominant Influence of Effective Fracture Apertures,” *Water Resources Res.*, 43, W07421, doi:10.1029/2006WR005746.
- Reimus, P. W., T. J. Callahan, S. D. Ware, M. J. Haga, and D. A. Counce. 2007. “Matrix Diffusion Coefficients in Volcanic Rocks at the Nevada Test Site: Influence of Matrix Porosity, Matrix Permeability, and Fracture Coating Minerals,” *Journal of Contaminant Hydrology* (93), pp 85-95.

- Robinson, B. A., Wolfsberg, A. V., Viswanathan, H. S., and Reimus, P. W. 2007. "A Colloid-Facilitated Transport Model with Variable Colloid Transport Properties," *Geophysical Research Letters*, 34(9), p. L09401.
- Dai, Z., Wolfsberg, A., Lu, Z., and Reimus, P. 2007. "Upscaling Matrix Diffusion Coefficients for Heterogeneous Fractured Rocks," *Geophysical Research Letters*, 34(7), p.L07408.
- Reimus, P. W., G. Pohll, T. Mihevc, J. Chapman, L. Papelis, B. Lyles, S. Kosinski, R. Niswonger, and P. Sanders. 2003. "Testing and Parameterizing a Conceptual Model for Radionuclide Transport in a Fractured Granite using Multiple Tracers in a Forced-Gradient Test", *Water Resources Research*, 39(12), 1350, doi:10.1029/2002WR001597.
- Sullivan, E. J., P. W. Reimus, and D. A. Counce. 2003. "Effects Of Mineralogy, Exchange Capacity, Surface Area and Grain Size on Lithium Sorption to Zeolitic Alluvium near Yucca Mountain, Nevada", *Clays and Clay Minerals*, 51(6), 634-643.
- Reimus, P. W., M. J. Haga, A. I. Adams, T. J. Callahan, H. J. Turin, and D. A. Counce. 2003. "Testing and Parameterizing a Conceptual Solute Transport Model in Saturated Fractured Tuff using Sorbing and Nonsorbing Tracers in Cross-Hole Tracer Tests," *J. Contaminant Hydrology*, 62-63, 613-636.
- Sullivan, E. J., P. W. Reimus, and D. A. Counce. 2003. "Transport of a Reactive Tracer in Saturated Alluvium Described using a Three-Component Cation-Exchange Model," *J. Contaminant Hydrology*, 62-63, 675-694.
- Lu, N., P. W. Reimus, G. R. Parker, J. L. Conca, and I. R. Triay. 2003. "Sorption Kinetics and Impact of Temperature, Ionic Strength and Colloid Concentration on the Adsorption of Plutonium-239 by Inorganic Colloids," *Radiochimica Acta*, 91, 1-8.
- Eddebarh, A. A., G. A. Zvoloski, B. A. Robinson, E. M. Kwicklis, P. W. Reimus, B. W. Arnold, T. Corbet, S. P. Kuzio, and C. Faunt. 2003. The Saturated Zone at Yucca Mountain: An Overview of the Characterization and Assessment of the Saturated Zone as a Barrier to Potential Radionuclide Migration, *J. Contaminant Hydrology*, 62-63, 477-493.
- Reimus, P. W. and S. C. James. 2002. "Determining the Random Time Step in a Constant Spatial Step Particle Tracking Algorithm," *Chemical Eng. Science*, 57(21), 4429-4434
- Abdel-Fattah, A. I., M. S. El-Genk, and P. W. Reimus. 2002. "Automated Video Microscopic Imaging and Data Acquisition System for Colloid Deposition Measurements," *J. Colloid Interface Science*, 246(2), 241-258.
- Abdel-Fattah, A. I., M. S. El-Genk, and P. W. Reimus. 2002. "On Visualization of Sub-micron Particles with Dark-Field Light Microscopy," *J. Colloid Interface Science*, 246(2), 410-412.
- Anghel, I., H. J. Turin, and P. W. Reimus. 2002. "Lithium Sorption to Yucca Mountain Tuffs," *Applied Geochemistry*, 17(6), 819-824.
- Callahan, T. J., P. W. Reimus, R. S. Bowman, and M. J. Haga. 2000. "Using Multiple Experimental Methods to Determine Fracture/Matrix Interactions and Dispersion of Nonreactive Solutes in Saturated Volcanic Rock," *Water Resources Research*, 36(12), 3547-3558.

Becker, M. W., P. W. Reimus, and P. Vilks. 1999. "Transport and Attenuation of Carboxylate-Modified Latex Microspheres in Fractured Rock Laboratory and Field Tests," *Ground Water*, 37(3).

Long, R. L. and P. W. Reimus. 1992. "Interfacial Area Production at a Tee Junction," *Chemical Eng. Communications*, 111, 1-12.

CONFERENCE PROCEEDINGS/TECHNICAL MEETING PRESENTATIONS

Dean, C. A. and P. W. Reimus. 2008. "Effective K_d values for radionuclides in Yucca Mountain saturated alluvium", *Proceedings of the 12th International High Level Radioactive Waste Management Conference*, IHLRWM, Las Vegas, NV, Sept. 7-11, 2008, pp. 171-178, American Nuclear Society, LaGrange Park, IL.

Reimus, P. W. 2007. "YMP Saturated Zone Testing Highlights - 2005 to 2006", *LA-UR-07-3037*, presented at the DOE-Nuclear Waste Technical Review Board Meeting, Arlington, VA, May 15, 2007.

Garcia, E., P. W. Reimus, R. L. Hershey, D. Decker, and S. Earman. 2007. "Laboratory experiments of carbon-14 uptake and release from calcite," *Abstracts of Papers American Chemical Society*, Vol. 233, 233rd ACS National Meeting, Chicago, IL, March 25-29, 2007.

Hershey, R. L., D. Decker, S. Earman, P. W. Reimus, E. Garcia, and C. Papelis. 2007. "Laboratory experiments of carbon-14 uptake on carbonate rocks, calcite, and dolomite," *Abstracts of Papers American Chemical Society*, Vol. 233, 233rd ACS National Meeting, Chicago, IL, March 25-29, 2007.

Scism, C. D., P. W. Reimus, M. Ding and S. J. Chipera. 2007. "Effective partition coefficients for radionuclide transport through saturated alluvium at the proposed high-level nuclear waste repository, Yucca Mountain, Nevada," *Abstracts of Papers American Chemical Society*, Vol. 233, 233rd ACS National Meeting, Chicago, IL, March 25-29, 2007.

Reimus, P., Jones, R., Wasson, E., Kelly, J., Sanchez, A., Slack, W., and Daniels, J. 2006. "Results of Tracer Testing in the Saturated Alluvium South of Yucca Mountain," *Proceedings of the 11th International High Level Radioactive Waste Management Conference*, IHLRWM, Las Vegas, NV, April 30-May 4, 2006, pp. 315-322, American Nuclear Society, LaGrange Park, IL.

Scism, C. D., Reimus, P. W., Ding, M., and Chipera, S. J. 2006. "Uranium and Neptunium Desorption from Yucca Mountain Alluvium," *Proceedings of the 11th International High Level Radioactive Waste Management Conference*, IHLRWM, Las Vegas, NV, April 30-May 4, 2006, pp. 89-96, American Nuclear Society, LaGrange Park, IL.

Kelkar, S., Roback, R., Robinson, B., Srinivasan, G., Jones, C., and Reimus, P. 2006. "Saturated Zone Plumes in Volcanic Rock: Implications for Yucca Mountain," *Proceedings of the 11th International High Level Radioactive Waste Management Conference*, IHLRWM, Las Vegas, NV, April 30-May 4, 2006, pp. 97-104, American Nuclear Society, LaGrange Park, IL.

Ding, M., Reimus, P. W., Chipera, S., and Scism, C. 2006. "Sorption Characteristics of Radionuclides on Clays in Yucca Mountain Alluvium," *Proceedings of the 11th International High Level Radioactive Waste Management Conference*, IHLRWM, Las Vegas, NV, April 30-May 4, 2006, pp. 385-389, American Nuclear Society, LaGrange Park, IL.

- Sedlacek, C.M., Schulmeister, M.K., Reimus, P.W., Scism, C.D., Chipera, S.J., and Ding, M. 2006. "Retardation of Radionuclides in Yucca Mountain Saturated Alluvium, *Geological Society of America, Rocky Mountain Section—58th Annual Meeting* (17–19 May 2006), Gunnison, CO.
- Ding, M., S. J. Chipera, and P. W. Reimus. 2005. "Sorption and attenuation of Uranium and Neptunium on clays from Yucca Mountain volcanics and alluvium", *INCEED 2005*, July 24-30, Charlotte, North Carolina.
- Reimus, P. W., M.Ding, and C. D. Scism. 2004. "Modeling of early breakthrough behavior of Neptunium and Uranium in column transport experiments in Yucca Mountain alluvium," *Geological Society of America 2004 Annual Meeting*, November 7-10, Denver, Colorado, 2004 (LA-UR-04-4797).
- Ding, M., P. W. Reimus, S. J. Chipera, and C. D. Scism. 2004. "The role of clay minerals in Yucca Mountain volcanics and alluvium on transport of radionuclides," *Geological Society of America 2004 Annual Meeting*, November 7-10, Denver, Colorado, 2004.
- Scism, C. D., P.W. Reimus, M.Ding, and H. Kinkead. 2004. "Sorption/desorption behavior of uranium in Yucca Mountain alluvium," *Geological Society of America 2004 Annual Meeting*, November 7-10, Denver, Colorado, 2004 (LA-UR-04-4796).
- Reimus, P. W. 2004. "Colloid and Colloid-Facilitated Contaminant Transport Experiments and Models to Support Assessments of Radionuclide Migration at Yucca Mountain and the Nevada Test Site," *International Electrokinetics Conference (ELKIN 2004)*, June 13-17, 2004, Pittsburgh, PA (LA-UR-04-2314).
- Scism, C. D, Reimus, P. W., and Ding, M. 2004. "Sorption/desorption behavior of uranium in Yucca Mountain alluvium," *Abstracts of Papers American Chemical Society*; v.227, Part 2, p.U88-U89, presented at 227th National Meeting of the American-Chemical Society; March 28-April 01, 2004; Anaheim, CA.
- Ding, M., Chipera, S., Sullivan, E. J., Scism, C., Kinkead, H., and Reimus, P. W. 2004. "Reactivity and mobility of Np(V) in relation to mineralogical characteristics of Yucca Mountain alluvium," *Abstracts of Papers American Chemical Society*; v. 227, Part 2, p. U89, presented at 227th National Meeting of the American-Chemical Society; March 28-April 01, 2004; Anaheim, CA.
- Abdel-Fattah, A. I., M. S. El-Genk, and P. W. Reimus. 2002. "Colloid Deposition onto a Solid Surface Under Low-Flow Conditions in Parallel-Plate Geometry," *International Electrokinetics Conference (ELKIN 2004)*, June 13-17, 2004, Pittsburgh, PA (LA-UR-04-2313).
- Reimus, P. W. 2003. "Using A Sorbing Tracer to Better Characterize Diffusion Processes in Fractured Media." *Geological Society of America 2003 Annual Meeting*, Nov. 2-5, 2003, Seattle, WA (LA-UR-03-5171).
- Reimus, P. W., M. Ding, A.I. Abdel-Fattah, and R. Roback. 2003. "Field and Laboratory Transport Studies for the Yucca Mountain Project at Los Alamos National Laboratory." *Geological Society of America 2003 Annual Meeting*, Nov. 2-5, 2003, Seattle, WA (LA-UR-03-5496).
- Reimus, P. W., S. D. Ware, N. Lu, K. S. Kung, M. P. Neu, S. D. Reilly, and A. B. Kersting. 2003. "Colloid-Facilitated Transport of Plutonium in Saturated Fractures from the Nevada Test Site," *Abstracts of Papers of the American Chemical Society*, 225(1), Abstract IEC 211.

- Reimus, P., M.J. Umari, R. Roback, J. Earle, J. Darnell, and I. Farnham. 2003. "Estimates of Ambient Ground-Water Velocity in the Alluvium South of Yucca Mountain, Nye County, Nevada, from Single-Well Tracer Tests," *Proceedings of the 10th International High-Level Radioactive Waste Management Conference*, American Nuclear Society, March 30-April 2, 2003, Las Vegas, NV, pp. 102-113.
- Reimus, P. W. 2003. "A Refined Approach to Estimating Effective Flow Porosity from Cross-Hole Tracer Tests in Fractured Media," *Proceedings of the 10th International High-Level Radioactive Waste Management Conference*, American Nuclear Society, March 30-April 2, 2003, Las Vegas, NV, pp. 159-170.
- Ding, M., P.W. Reimus, S. D. Ware, and A. Meijer. 2003. "Experimental Studies of Radionuclide Migration in Yucca Mountain Alluvium," *Proceedings of the 10th International High-Level Radioactive Waste Management Conference*, American Nuclear Society, March 30-April 2, 2003, Las Vegas, NV, pp. 126-135.
- Viswanthan, H. S., A. V. Wolfsberg, P. W. Reimus, D. Ware, and G. Lu. 2003. "Colloid Facilitated Transport in Fractured Rocks: Parameter Estimation and Comparison with Experimental Data," *Proceedings of the 10th International High-Level Radioactive Waste Management Conference*, American Nuclear Society, March 30-April 2, 2003, Las Vegas, NV, pp. 1337-1343.
- Ding, M., E. J. Sullivan, P. W. Reimus, A. Meijer, and C. D. Scism. 2002. "Preliminary Study of Mineralogical Characteristics of Yucca Mountain Alluvium and Effects on Neptunium(V) Retention," *Abstracts of Papers of the American Chemical Society*, 224(1), U537.
- Scism C.D., M. Ding M., and P. W. Reimus. 2002 "Uranium Sorption Behavior in Yucca Mountain Alluvium," Presented at *Fall 2002 Geological Society of America Meeting*, October 2002, Denver, CO.
- Sullivan, E. J., P. W. Reimus, and M. Ding. 2001. "Effects of Mineralogy, Grain Size, and Solution Composition on Lithium Sorption to Saturated Alluvium South of Yucca Mountain, Nevada." *Abstracts of Papers of the American Chemical Society*, 222(1).
- Ding, M., P. W. Reimus, E. J. Sullivan, S. D. Ware. 2001. "Transport of Neptunium-237 in Saturated Alluvium South of Yucca Mountain, NV." *Abstracts of Papers of the American Chemical Society*, 222(1).
- Ding, M., N. Schroeder, and P. Reimus. 2001. "Zero-Valent Iron as a Reducing 'Getter' for Immobilization of Technetium." *Abstracts of Papers of the American Chemical Society*, 222(1).
- Sullivan, E. J., P. W. Reimus, R. Roback, and D. Gonzales. 2001. "Column and Batch Tracer Testing to Support Radionuclide Transport Modeling in Saturated Alluvium near Yucca Mountain, Nevada". Presented at the *Spring 2000 Geological Society of America Regional Meeting*, April 2000, Albuquerque, NM.
- Callahan, T. J., P. W. Reimus, and P. C. Lichtner. 2000. "Multicomponent transport modeling of laboratory and field tracer transport data in fractured rocks using a cation exchange approach." Presented at the *Fall American Geophysical Union Meeting*, Dec. 2000, San Francisco, CA.
- Kosinski, S., G. Pohll, and P. W. Reimus. 2000. "A Monte-Carlo Analysis of the Effects of Fracture Network Statistics on Two-Well Tracer Tests." Presented at the *Fall 2000 Geological Society of America Meeting*, October 2000, Reno, NV.

- Conca, J. L., M. Ding, P. W. Reimus, N. Lu, G. Parker. 2000. "Radionuclide Sorption Behavior of Saturated Alluvium Located Down-Gradient of Yucca Mountain, NV." Presented at the *Fall 2000 Geological Society of America Meeting*, October 2000, Reno, NV.
- Callahan, T. J. and P. W. Reimus. 2000. "Interpreting field transport data of a reactive tracer using a multicomponent transport model with ion exchange reactions." Presented (by T. J. Callahan) at the *Fall 2000 Geological Society of America Meeting*, October 2000, Reno, NV.
- Wolfsberg, A. V., G. Lu, A. Olson, P. Reimus, M. McGraw, and C. Shirley. 2000. "A Field-Scale, Reactive, Colloid-Facilitated, Solute Transport Model for Heterogeneous Fractured Volcanic Rock." Presented at the *Fall 2000 Geological Society of America Meeting*, October 2000, Reno, NV.
- Anghel, I., P. W. Reimus, and K. S. Kung. 2000. "Colloid Transport in Fractured Rock: Comparison of Polystyrene and Silica Microspheres." *Abstracts of Papers of the American Chemical Society*, 220(1), U232.
- Reimus, P. W., M. J. Haga, A. I. Adams, H. J. Turin, and D. A. Counce. 2000. "The Use of Multiple Tracers to Test Conceptual Models and obtain Transport Parameter Estimates for Radionuclide Migration in Saturated, Fractured Tuffs," LA-UR-00-861. Presented at the *Spring 2000 American Geophysical Union Meeting*, May 30-June 3, 2000, Washington, D.C.
- Reimus, P. W., M. J. Umari, W. Arnold, M. F. Fahy, M. J. Kelley, L. C. Meigs, and J. D. Earle. 2000. "Planning for Hydraulic and Transport Testing in Saturated Valley-Fill Deposits South of Yucca Mountain, Nevada," LA-UR-00-992. Presented at the *Spring 2000 American Geophysical Union Meeting*, May 30-June 3, 2000, Washington, D.C.
- Callahan, T. J., P. W. Reimus, M. J. Haga, I. Anghel, and D. A. Counce. 2000. "Laboratory Transport Studies to Support Field Testing Efforts to Validate Conceptual Radionuclide Transport Models in Saturated, Fractured Tuffs," LA-UR-00-862. Presented at the *Spring 2000 American Geophysical Union Meeting*, May 30-June 3, 2000, Washington, D.C.
- Reimus, P. W. and T. J. Callahan. 1999. "From Laboratory to Field: Scaling of Matrix Diffusion and Sorption Processes in Fractured Volcanic Rocks." Presented at the *Fall 1999 Geological Society of America Meeting*, October 1999, Denver, CO.
- Abdel-Fattah, A. I., M. S. El-Genk, and P. W. Reimus. 1999. "An Experimental Investigation of Colloid Deposition on Solid Surfaces." Presented (by A. I. Abdel-Fattah) at the *WERC Conference on the Environment*, April 26-29, 1999, Albuquerque, NM.
- Reimus, P. W. and M. W. Becker. 1999. "Transport and Attenuation of Carboxylate-Modified-Latex Microspheres in Fractured Rock Field Tracer Tests." Presented at the *American Chemical Society 217th National Meeting*, March 21-25, 1999, Anaheim, CA.
- Abdel-Fattah, A. I., M. S. El-Genk, and P. W. Reimus. 1999. "Preliminary Investigation of Colloid Deposition in a Parallel-Plate Cell." Presented (by A. I. Abdel-Fattah) at the *American Chemical Society 217th National Meeting*, March 21-25, 1999, Anaheim, CA.
- Callahan, T. J., P. W. Reimus, M. J. Haga, and R. S. Bowman. 1998. "Using Multiple Experimental Methods to Estimate Mass Transport Parameters in Fractured Rock." Presented (by T. J. Callahan) at the *Fall 1998 American Geophysical Union Meeting*, Dec. 1998, San Francisco, CA. (*EOS Trans. AGU*, 79(45), Fall Meet. Suppl., F256.)

- Becker, M. W., P. W. Reimus, and P. Vilks. 1997. "Microsphere Transport and Attenuation at Laboratory and Field Scales." Presented (by M. W. Becker) at the *Fall 1997 American Geophysical Union Meeting*, December 8-12, 1997, San Francisco, CA.
- Holmbeck-Pelham, S. A., K. Vought, and P. W. Reimus. 1997. "Effects of Recirculation Ratio on Tracer Tests in Heterogeneous Media." Presented (by S. A. Holmbeck-Pelham) at the *Fall 1997 American Geophysical Union Meeting*, December 8-12, 1997, San Francisco, CA.
- Callahan, T. J., P. W. Reimus, H. J. Turin, and R. S. Bowman. 1997. "Tracer Tests in Fractured Tuff Core: Sorption, Dispersion, and Matrix Diffusion Processes." Presented (by T. J. Callahan) at the *Fall 1997 American Geophysical Union Meeting*, December 8-12, 1997, San Francisco, CA.
- Haga, M. J., T. J. Callahan, P. W. Reimus, and H. J. Turin. 1997. "Estimating Diffusion Coefficients in Saturated Tuff Matrices under Static and Flowing Conditions." Presented at the *Fall 1997 American Geophysical Union Meeting*, December 8-12, 1997, San Francisco, CA.
- Turin, H. J. and P. W. Reimus. 1997. "Multi-Component Tracer Testing in Fractured Tuff at the C-Wells Complex, Yucca Mountain, Nevada." Presented (by H. J. Turin) at the *1997 Geological Society of America Annual Meeting*, October 1997, Salt Lake City, UT.
- Ware, S.D., I.R. Triay, H.J. Turin, and P.W. Reimus. 1997. "Effects of Fracture Coatings on Radionuclide Transport Through Fractured Tuff." *GSA Abstr.*, 29(6):369. Presented (by S. D. Ware) at 1997 Geological Society of America Annual Meeting, October 1997, Salt Lake City, UT.
- Reimus, P. W and H. J. Turin. 1997. "Field Validation of Reactive Tracer Transport in Saturated, Fractured Tuff." Presented at the *Spring 1997 American Geophysical Union Meeting*, May 27-30, 1997, Baltimore, MD.
- Turin, H. J., P. W. Reimus, and B. A. Robinson. 1997. "Lithium: A Surrogate Tracer for Ion-Exchanged Radionuclides in Field-Scale Reactive Transport Tests." Presented (by H. J. Turin) at the *Spring 1997 American Geophysical Union Meeting*, May 27-30, 1997, Baltimore, MD.
- Reimus, P. W. 1996. "Colloid Transport in Fractures and Packed Columns." Presented at the *Fall 1996 American Geophysical Union Meeting*, Dec. 15-19, 1996, San Francisco, CA.
- Becker, M. W., P. W. Reimus, B. Freifeld, K. Karasaki, and J. Clyde. 1995. "Microsphere Tracer Studies in a Fractured Granite." Presented (by M. W. Becker) at the *Fall 1995 American Geophysical Union Meeting*, Dec. 11-15, 1995, San Francisco, CA.
- Reimus, P. W., B. A. Robinson, H. E. Nuttall, and R. Kale. 1995. "Simultaneous Transport of Synthetic Colloids and a Nonsorbing Solute Through Single Saturated Natural Fractures," *Mat. Res. Soc. Symp. Proc.*, 353:363-370, Materials Research Society.
- Reimus, P. W., B. A. Robinson, H. E. Nuttall, and R. Kale. 1994. "Transport of Synthetic Colloids and a Nonsorbing Solute Through a Saturated Natural Fracture," in *Preprints of Papers Presented at the 207th ACS National Meeting*, 34(1), American Chemical Society, Division of Environmental Chemistry.
- Reimus, P. W., Robinson, B. A., and Glass, R. J. 1993. "Aperture Characteristics, Saturated Fluid Flow, and Tracer Transport Calculations for a Natural Fracture," in *High-Level Radioactive Waste*

Management, Proceedings of the 4th Annual International Conference, American Nuclear Society, LaGrange Park, Illinois.

Long, R. L., I. Tavarez, W. Lin, and P. W. Reimus. 1992. "Interfacial Area Production in Tees and Jets," in *Process Mixing: Chemical and Biochemical Applications*, G. B. Tatterson and R. V. Calabrese, eds., AIChE Symposium Series, American Institute of Chemical Engineers, New York, NY.

Nuttall, H. E., R. Jain, P. W. Reimus, R. S. Rundberg, and I. Triay. 1990. "Electrokinetic Model for Colloid Transport in Fractures." Presented (by H. E. Nuttall) at the *Fall 1990 AIChE National Meeting*, Chicago, IL, Nov. 11-16, 1990.

Reimus, P. W. and W. L. Kuhn. 1990. "Modification of Grambow's Model for Hydration of Nuclear Waste Glass." Presented (by W. L. Kuhn) at the *92nd Annual Meeting of the American Ceramic Society*, Dallas, TX, April 22-26, 1990.

Piepho, M. G., P. J. Turner, and P. W. Reimus. 1989. "The Importance of Variables and Parameters in Radiolytic Chemical Kinetics Modeling." *Mat. Res. Soc. Symp. Proc. - Scientific Basis for Nuclear Waste Management XII*. W. Lutze, ed. PNL-SA-15797, Materials Research Society, Pittsburgh, PA.

Long, R. L. and P. W. Reimus. 1988. "Interfacial Area Production by a Tee Jet for the Kerosene/Water System." *Mixing XI Symposium* (sponsored by the Engineering Foundation). New England College, Henniker, New Hampshire, August 2-4, 1988.

Reimus, P. W., A. M. Liebetrau, M. J. Apted, and D. W. Engel. 1988. "Performance Assessment for Spent Fuel Waste Packages in Hydrologically Unsaturated Geologic Media." *SPECTRUM '88 Proceedings - Nuclear and Hazardous Waste Management International Topical Meeting*, Pasco, WA, Sept. 1988. PNL-SA-15624, American Nuclear Society, La Grange Park, IL.

Reimus, P. W. and W. L. Kuhn. 1987. "Simulation Used to Qualify Nuclear Waste Glass for Disposal," *Proceedings of the 1987 Winter Simulation Conference* (Atlanta, GA, December 1987), A. Thesen, H. Grant, W. D. Kelton, eds., The Society for Computer Simulation, San Diego, CA.

Kuhn, W. L., P. W. Reimus, R. D. Peters, and B. A. Pulsipher. 1987. "A Method for Qualifying Vitrified High-Level Waste Canisters for Disposal," *Proceedings of the American Nuclear Society Topical Meeting on Waste Management and Decontamination and Decommissioning (SPECTRUM '86)* (Niagara Falls, NY, Sept. 1986), J. M. Pope, I. M. Leonard, E. J. Mayer, eds., American Nuclear Society, LaGrange Park, IL.

TECHNICAL REPORTS

Reimus, P. W., R. L. Hershey, D. L. Decker, E. Garcia, S. Earman, J. Ryu, R. C. Roback, G. Pohll, and C. Papeis. 2008. "Laboratory Experiments of ^{14}C Uptake and Release on Calcite and Dolomite to Support Groundwater Radionuclide Transport Modeling for the Nevada Test Site Underground Test Area Program," *LA-UR-07-6962*, Los Alamos National Laboratory, Los Alamos, NM.

Reimus P. W. 2007. "Saturated Zone In-Situ Testing," Yucca Mountain Site Characterization Project Analysis Report in support of Yucca Mountain License Application, *ANL-NBS-HS-000039*, Rev 1., ACN 1, published for the U.S. Dept. of Energy by Sandia National Laboratories, Albuquerque, NM.

Reimus, P. W. 2007. "Semi-Analytical Interpretations of the ER-6-1 Multiple-Wells Tracer Test Results," *LA-UR-07-1410*, Los Alamos National Laboratory, Los Alamos, NM.

- Reimus, P. W., S. D. Ware, A. Abdel-Fattah, M. Ding, C. Sedlacek, M. Haga, E. Garcia, and S. Chipera. 2007. "Radionuclide Sorption and Transport in Fractured Rocks of Yucca Flat, Nevada Test Site: Experimental Results and Interpretations," *LA-UR-07-1061*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., R. L. Hershey, D. L. Decker, S. D. Ware, C. Papelis, S. Earman, A. I. Abdel-Fattah, M. J. Haga, D. A. Counce, S. Chipera, and C. Sedlacek. 2006. "Tracer transport properties in the lower carbonate aquifer of Yucca Flat", *LA-UR-06-0486*, Los Alamos National Laboratory, Los Alamos, NM.
- Ware, S. D., A. I., Abdel-Fattah, M. Ding, P. W. Reimus, C. Sedlacek, M. J. Haga, E. Garcia, and S. Chipera. 2005. "Radionuclide sorption and transport in fractured rocks of Yucca Flat, Nevada Test Site," *LA-UR-05-9279*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., M. Murrell, A. I. Abdel-Fattah, E. Garcia, D. Norman, S. Goldstein, A. Nunn, R. Gritz, and B. Martinez. 2005. "Colloid characteristics and radionuclide associations with colloids in source-term waters at the Nevada Test Site (FY 2005 Progress Report)," *LA-UR-05-8612*, Los Alamos National Laboratory, Los Alamos, NM.
- Abdel-Fattah, A. I., D. Smith, M. Murrell, S. Goldstein, A. Nunn, R. Gritz, B. Martinez, and P. Reimus. 2005. "Colloid characteristics and radionuclide associations with colloids in source-term waters at the Nevada Test Site," *LA-UR-05-5312*, Los Alamos National Laboratory, Los Alamos, NM.
- Kersting, A. B. and P. W. Reimus, eds. 2003. "Colloid-Facilitated Transport of Low-Solubility Radionuclides: A Field, Experimental, and Modeling Investigation," *UCRL-ID-149688*, Lawrence Livermore National Laboratory, Livermore, CA.
- Hershey, R. L., W. Howcroft, and P. W. Reimus. 2003. "Laboratory Experiments to Evaluate Diffusion of ^{14}C into Nevada Test Site Carbonate Aquifer Matrix," *DOE/NV/11508-55*, Desert Research Institute Publication No. 45180, Las Vegas, NV.
- Reimus, P. W., S. D. Ware, A. R. Humphrey, A. I. Adams, B. R. Wilson, D. Gonzales, R. G. Warren, and F. C. Benedict. 2002. "Diffusive and Advective Transport of ^3H , ^{14}C , and ^{99}Tc in Saturated, Fractured Volcanic Rocks from Pahute Mesa, Nevada," *LA-13891-MS*, Los Alamos National Laboratory, Los Alamos, NM.
- Abdel-Fattah, A. I. and P. W. Reimus. 2000. "Colloid Attachment and Detachment Kinetics from Direct Visualization Experiments," *Underground Test Area Project Report*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. and M. J. Haga. 1999. "Analysis of Tracer Responses in the BULLION Forced-Gradient Experiment at Pahute Mesa, Nevada," *LA-13615-MS*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., A. Adams, M. J. Haga, A. Humphrey, T. Callahan, I. Anghel, and D. Counce (with contributions from USGS staff). 1999. "Results and Interpretation of Hydraulic and Tracer Testing in the Prow Pass Tuff at the C-Holes," *Yucca Mountain Site Characterization Project Milestone Report SP32E7M4*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., Haga, M. J., Humphrey, A. R., Anghel, I., Counce, D., Callahan, T. J., and Ware, S. D. 1999. "Laboratory Experiments to Support Interpretation of the BULLION Forced-Gradient

- Experiment: Update Report," *Underground Test Area Project Report*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., Haga, M. J., Callahan, T. L., Anghel, I., Turin, H. J., Counce, D. 1998. "C-Holes Update Report: Reinterpretation of the Reactive Tracer Test in the Bullfrog Tuff and Results of Laboratory Testing," *Yucca Mountain Site Characterization Project Milestone Report SP32E2M4SZ*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., T. J. Callahan, M. J. Haga, H. J. Turin, D. Frostenson, K. Vought, and D. Counce. 1997. "Results of Laboratory Characterization of Reactive Tracer Sorption to Prow Pass Tuffs," *Yucca Mountain Site Characterization Project Milestone SP2379M4*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. and H. J. Turin. 1997. "Results, Analyses, and Interpretation of Reactive Tracer Tests in the Lower Bullfrog Tuff at the C-Wells, Yucca Mountain, NV," *Yucca Mountain Site Characterization Project Milestone SP2370M4*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. and H. J. Turin. 1996. "Results of Reactive Tracer Testing at the C-Holes," *Yucca Mountain Site Characterization Project Milestone 4270M*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. 1996. "Predictions of Tracer Transport in Interwell Tracer Tests at the C-Hole Complex," *LA-13160-MS*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. 1995. "The Use of Synthetic Colloids in Tracer Transport Experiments in Saturated Rock Fractures," *Ph.D. Dissertation*, University of New Mexico, Albuquerque, NM (also LA-13004-T).
- Reimus, P. W. 1995. "Transport of Synthetic Colloids through Single Saturated Fractures: A Literature Review," *LA-12707-MS*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. 1991. "Accident Sequence Modeling for the DOE Weapons Safety Program." *Classified Internal Report*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W., et al. 1989. "Independent Safety Review of the Oak Ridge Y-12 Plant Enriched Uranium Conversion Facility," *Los Alamos Report to Department of Energy*, Los Alamos National Laboratory, Los Alamos, NM.
- Reimus, P. W. and S. O. Bates. 1988. "Assessment of the Ability of the Grambow Model to Predict HWVP Glass Dissolution Behavior Based on F& 1987 Durability Test Results," *Interim Milestone Report HWVP-88-V320201A*, Pacific Northwest Laboratory, Richland, WA.
- Reimus, P. W. 1988. "Modeling of Nonuniform Corrosion in Salt Brines," *PNL-6661*, Pacific Northwest Laboratory, Richland, WA.
- Reimus, P. W. and C. F. Windisch. 1988. "Development of a Mechanistic Model for the Release of Radionuclides from Spent Fuel in Brines," *PNL-6666*, Pacific Northwest Laboratory, Richland, WA.
- Reimus, P. W. 1988. "Localized Corrosion of Mild Steel Nuclear Waste Package Containers," *PNL-6662*, Pacific Northwest Laboratory, Richland, WA.
- Reimus, P. W. and S. A. Simonson. 1988. "Radionuclide Release from Spent Fuel under Geologic Disposal Conditions: An Overview of Experimental and Theoretical Work Through 1985,"

PNL/SRP-5551, Prepared for the Salt Repository Project by Pacific Northwest Laboratory, Richland, WA.

Reimus, P. W. 1988. "Corrosion of Carbon and Low-Alloy Steel Weldments in Brines: A Literature Review," *PNL-6641*, Pacific Northwest Laboratory, Richland, WA.

Reimus, P. W. 1987. "MASBAL: A Computer Program for Predicting the Composition of Nuclear Waste Glass Produced by a Slurry-Fed Ceramic Melter," *PNL-6244*, Pacific Northwest Laboratory, Richland, WA.

Reimus, P. W., W. L. Kuhn, R. D. Peters, and B. A. Pulsipher. 1986. "Demonstration of an Approach to Waste Form Qualification Through Simulation of Liquid-Fed Ceramic Melter Process Operations," *PNL-5919*, Pacific Northwest Laboratory, Richland, WA.

Reimus, P. W. 1983. "A Model for Predicting the Sauter Mean Droplet Diameter of Kerosene-in-Water Dispersions Generated by Tee Mixers," *M.S. Thesis*, New Mexico State University, Las Cruces, NM.

PATENTS

Abdel-Fattah, Amr I. and Reimus, Paul W. 2004. "Automated video-microscopic imaging and data acquisition system for colloid deposition measurements," *Official Gazette of the United States Patent and Trademark Office Patents*, Patent No.: US 06836559.

JOSEPH RIVERS

JOSEPH W. RIVERS, JR.
President, Jason Associates Corporation
55 Woods Bay Road
Bluffton, SC 29910

EDUCATION

B.S., Mechanical Engineering, University of Florida, 1982
Post Graduate work, Engineering Science & Mechanics, University of Tennessee

SUMMARY OF QUALIFICATIONS

Mr. Rivers is the President of Jason Associates Corporation. He is currently the Project Manager for the contract to prepare a Supplement to the Final Environmental Impact Statement (FEIS) for the repository proposed to be constructed and operated at Yucca Mountain. He also served as Project Manager for Jason for the development of the FEIS for the repository. He was named Project Manager in 1999 after serving in the role of Deputy Project Manager. Jason's contract to prepare this EIS was valued at more than \$35 million. While Project Manager for the FEIS (one of the U.S. Department of Energy's [DOE's] most important and high profile *National Environmental Policy Act* [NEPA] documents), Jason was evaluated by the Department to be Outstanding (the highest possible rating) in all review categories in their Contractor Performance Report. In May 2001, Mr. Rivers managed the preparation and issuance of a Supplement to the Draft EIS. The Secretary of Energy presented the FEIS to the President in February 2002.

Mr. Rivers previously served as Technical Director of Jason's Eastern Operations. He was responsible for project management and business development for clients in the eastern U.S. He also supported the development and completion of the Yucca Mountain Draft EIS. He prepared the accident analysis portion of EISs at Savannah River for High-level Waste Tank Closure and Salt Disposition Alternatives. Mr. Rivers was also Project Manager for Jason's Technical Support Services Contract with the DOE-Ohio Field Office, and has supported various Jason safety analysis projects. He was a primary contributor and interim project manager for the development of the Safety Analysis Report (SAR) and Technical Safety Requirements (TSR) document for the Pit 9 Comprehensive Demonstration Project at the Idaho National Engineering and Environmental Laboratory (INEEL). He also supported development and preparation of a Risk-Based Cost Management Report for the Radioactive Waste Management Complex at the INEEL, and authored a Double Contingency Analysis Report for H-Canyon at the DOE's Savannah River Site (SRS). Mr. Rivers performed an independent assessment of maintenance work practices at Virginia Power's North Anna Power Station.

Mr. Rivers supported safety document development at the SRS for over nine years and for four years served simultaneously as the Operations Manager and Technical Support Services Project Manager for VECTRA-GSI in Aiken. He was responsible for overall management of Aiken operations, including technical and administrative project management, marketing and business development, utilization of corporate resources, project staffing and development, compliance with Quality Assurance and security guidelines, and client coordination on technical and contractual issues. Projects included Safety Analysis Technical Support Services (TSS), Radioactive Material Packaging TSS, and Natural Phenomena Hazards Analysis. He has managed various teams of 30-50 engineers and scientists in the preparation of safety related documentation for various DOE facilities.

He gained extensive commercial nuclear power plant experience during nearly seven years with the Tennessee Valley Authority (TVA) with an emphasis in systems engineering, licensing and regulatory compliance, plant start-up, design baseline verification, vibration analysis, and component analysis.

PROFESSIONAL EXPERIENCE

- Project Manager for the Analysis of Postclosure Groundwater Impacts for the proposed repository at Yucca Mountain, Nevada. This Analysis was originally prepared as a Supplement to the Final EIS in response to the Adoption Determination Report prepared by the Nuclear Regulatory Commission.
- Project Manager for the Supplement to the Final Environmental Impact Statement for the proposed geologic repository for spent nuclear fuel and high-level waste at Yucca Mountain, Nevada. Including support as a subject matter expert for all public and tribal interactions associated with this NEPA process.
- Senior Technical Adviser for the preparation of an environmental analysis for the Department of Energy Office of Civilian Radioactive Waste Management. This analysis, eventually framed as an Environmental Report, was intended to accompany the DOE's License Application for Yucca Mountain to the Nuclear Regulatory Commission. The report was never formally issued and was incorporated as part of the Supplement to the FEIS.
- Project Manager and primary author for an Environmental Assessment of the Lignite Enhancement Demonstration Project for the National Energy Technology Laboratory on a Clean Coal Power Initiative Project at Coal Creek Station in North Dakota.
- Project Manager for a contract with the Public Service Commission of the Commonwealth of Kentucky for technical expertise relating to the review of Site Assessment Reports required for applications for merchant electric generating facilities. Provided expert witness testimony at Siting Board public hearings.
- Author of *Review and Evaluation of a Site Assessment Report for Kentucky Pioneer Energy: Case Number 2002-00312*, (issued to the public February 6, 2003) that evaluated the impacts of constructing and operating an integrated gasification combined cycle electric power facility in Trapp, Kentucky that would use a synthesis gas formed from the gasification of coal and refuse-derived-fuel (RDF) pellets. Represented the Commonwealth in recommending mitigation measures to ensure that impacts were minimized and the newly enacted Kentucky Revised Statutes were satisfied.
- Project Manager for the Final EIS (issued in February 2002) for the proposed geologic repository for spent nuclear fuel and high-level waste at Yucca Mountain, Nevada.
- Project Manager for the Supplement to the Draft EIS (issued in May 2001) for Yucca Mountain. Proposed an innovative approach to focus the scope of the Supplement on changes in the proposed repository design and the resultant environmental impacts. This innovation was recognized by the DOE.
- Primary author for documentation supporting the Draft EIS for Yucca Mountain including preparation of Appendix A, "Inventory and Waste Characteristics," and the appendix documenting accident analysis.
- Primary author for the accident analysis appendices and chapter sections for the High-Level Waste Tank Closure EIS and the Salt Disposition Alternatives EIS at Savannah River Site.

- Supported preparation of accident analyses for various Safety Analysis Reports at the SRS. These included a Final SAR for the In-Tank Processing Facility and a Preliminary SAR for the Actinide Packaging and Storage Facility.
- Project manager for the Technical Support Services Contract with the DOE Ohio Field Office. Coordinated task-staffing requirements, identify/resolve technical issues, and maintain client relations for DOE support at Miamisburg Environmental Management Project, Fernald, Ashtabula, Battelle Columbus, and West Valley.
- Interim Project Manager and technical contributor to the Pit 9 Comprehensive Demonstration Project at the INEEL. Supported the preparation of PSAR and FSAR Chapters and TSRs. Coordinated review and approval of chapters as well as provided initial scoping and staffing for Design Baseline Document Development.
- Participated in, and served as primary author for a Risk Based Cost Management Report for the INEEL Radioactive Waste Management Complex (RWMC). Evaluated budgeted activities from RWMC's Work Breakdown Structure for its mission criticality with regard to potential health risk and financial risk. This evaluation was then integrated with an activity based cost estimate to yield potential cost savings for RWMC with little or no risk impact.
- Performed an INPO-style independent assessment of maintenance work practices at Virginia Power's North Anna Power Station. The Site Nuclear Safety reporting practices had indicated significant weaknesses in the plant's maintenance work practices. Mr. Rivers completed a performance-based assessment of the maintenance organization and its related interfaces. He performed a review of the reporting criteria used by Site Nuclear Safety.
- Responsible for development of the Double Contingency Analysis report for the H-Canyon at SRS. Worked with a team of senior criticality and process professionals to verify the existence of adequate controls to prevent inadvertent criticality in accordance with DOE Order 5480.24.

Mr. Rivers served as the Operations Manager with overall responsibility for the operations of the VECTRA-GSI Aiken, SC office, responsible for day-to-day administrative and technical management. As the Operations Manager, he:

- Maintained a cost-effective operation that achieved established standards for revenues and profitability, administered all office overhead costs within predetermined budgetary constraints, managed contracts to ensure that costs remained within proposed limits or negotiated applicable contract changes, and closely coordinated accounts receivable to within contractual guidelines. These contracts were managed under government accounting and Cost Accounting Standards.
- Managed Human Resources responsibilities including managing all personnel in the Aiken office (which fluctuated between 35 and 60 employees), evaluating personnel performance, and directing the salary administration, project staffing, and career development programs. He maintained the employees' morale and job focus in the midst of significant DOE downsizing.
- As TSS Project Manager for VECTRA-GSI in Aiken, he managed a select team of 30-50 engineers and scientists performing various risk analysis and safety-related services for DOE facilities at Savannah River Site. He provided final review and approval for all deliverables produced under these contracts. He participated in the performance of many tasks including; Defense-in-Depth functional classification of DWPF safety systems, Technical Safety Requirements for HB-Line, NSR/PSF, USF, DWPF, F/H-Canyons, and Bases for Interim Operation for several SRS facilities. Mr. Rivers and his staff prepared many safety evaluations

and screenings for potential Unresolved Safety Questions (USQs) in accordance with DOE Order 5480.21.

- As Project Manager, he was responsible for monitoring all tasks for adequacy of performance, project staffing, and adherence to schedule and cost commitments. This included the preparation of monthly status reports for the client as well as close client coordination and early identification and resolution of problems. He provided the single point of contact for the client with regard to resource loading, schedule prioritization, and task planning.
- Served as project manager for a Radioactive Material Packaging Technical Support Services contract. Support included Design and Analysis of Type A and Type B Packages at the DOE's Savannah River Plant. He supervised development of a Spent Nuclear Fuel database, which collected pertinent information on all spent nuclear fuel stored at Savannah River facilities.
- As the Engineering Section Manager of ABBGSI's Operations and Licensing Division, he selected, hired, and managed a staff of 8 Senior Engineers in the preparation of Operational Safety Requirements (OSRs) for 14 DOE nuclear material processing facilities. OSRs provide the Technical Specifications within which these facilities must operate to remain bounded by the safety analysis. Mr. Rivers assisted in the development of SRS's methodology employed to implement draft DOE Order 5480.ZZ in February 1990 with the production of the HB-Line OSR, which eventually became the first OSR approved by DOE for an operating facility. Upon approval of DOE Order 5480.22, Mr. Rivers coordinated the translation of OSRs to TSRs for various SRS facilities.
- As a Senior Engineer, he was responsible for the preparation of various technical chapters of the Safety Analysis Reports for the Uranium Solidification Facility and H-Canyon Separations Facility. He performed technical reviews of reactor maintenance procedures for an overall procedure assessment project.

As an employee of the Tennessee Valley Authority for over six years, Mr. Rivers' job responsibilities included the following:

- Lead Systems Engineer, Technical Support at Sequoyah Nuclear Plant. As a Systems Technical Expert, he was responsible for investigation, special testing, and final resolution of all system-related problems that affected performance of assigned systems. He prepared and reviewed 10CFR50.59 reviews and safety evaluations for changes to system physical characteristics or operations. He had overall technical responsibility for operational characteristics, testing, and maintenance. He supervised other systems engineers. During this period at Sequoyah, he was heavily involved in the successful plant start-up after an extended three-year shutdown. During this evolution, plant experience was gained in three distinct periods, shutdown, start-up, and operation.
- As a Piping Vibration Specialist, he was responsible for reviewing modifications for impact on operational piping vibration, preparing post-modification scoping documents, assisting in the performance of these tests and in the troubleshooting of plant vibration problems.
- As a Component Analysis Engineer in Design Engineering, he was responsible for the seismic qualification of safety-related components and equipment for TVA's four nuclear power plants.

WORK HISTORY

1996 - present

Jason Associates Corporation

1989 - 1996 VECTRA Government Services, Inc. (formerly Combustion Engineering and
ABB Government Services, Inc.)
1983 - 1989 Tennessee Valley Authority

CLEARANCE

DOE Security Clearance “Q” (inactive)
DOE Security Clearance “L” (active)

RELEVANT PUBLICATIONS

Analysis of Postclosure Groundwater Impacts, Project Manager – Jason Associates Corporation, Department of Energy, Las Vegas, Nevada, August 2009, RWEV-REP-001, MOL.20090707.006.

Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Nuclear Waste at Yucca Mountain, Nye County, Nevada, Project Manager – Jason Associates Corporation, Department of Energy, Las Vegas, Nevada, June 2008, DOE/EIS-0250F-S1.

Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Nuclear Waste at Yucca Mountain, Nye County, Nevada, Project Manager – Jason Associates Corporation, Department of Energy, Las Vegas, Nevada, October 2007, DOE/EIS-0250F-S1D.

Revised Site Assessment Report for East Kentucky Power Cooperative, Inc. PSC Case No. 2005-0053, The Construction of a 278 MW (nominal) Circulating Fluidized Bed Coal Fired Unit in Clark County, Kentucky and the Addition of Five 90 MW (nominal) Combustion Turbines, Project Manager – Jason Associates Corporation, July 2006, East Kentucky Power Cooperative, Winchester Kentucky.

Supplement Analysis for Legal-Weight Truck Casks on Railcars, Project Manager – Jason Associates Corporation, Department of Energy, Las Vegas, Nevada, March 2004, DOE/EIS-0250/SA-1.

Environmental Assessment, Lignite Fuel Enhancement Project Coal Creek Station, Great River Energy, Underwood North Dakota, Project Manager – Jason Associates Corporation, Department of Energy, November 2003, DOE/EA-1477.

Review and Evaluation of: A Site Assessment Report for Kentucky Pioneer Energy Case Number 2002-00312, Project Manager – Jason Associates Corporation, Kentucky State Board on Electrical Generation and Transmission Siting, Trapp, Kentucky.

Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Nuclear Waste at Yucca Mountain, Nye County, Nevada, Project Manager – Jason Associates Corporation, Department of Energy, Las Vegas, Nevada, February 2002, DOE/EIS-0250F.

Supplement to the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Nuclear Waste at Yucca Mountain, Nye County, Nevada, Project Manager – Jason Associates Corporation, Department of Energy, Las Vegas, Nevada, May 2001, DOE/EIS-0250D-S.

CEDRIC SALLABERRY

Cédric SALLABERRY

Home

7325, Avenida La Costa
Albuquerque, NM 87109
☎(505) 821-1994
c.sallaberry@free.fr

Work

Sandia National Laboratories, New Mexico
PO Box 5800, Albuquerque, NM 87185-1369
☎(505) 284-4813
cnsalla@sandia.gov

September 2009

WORK INTERESTS

Sensitivity and uncertainty analysis for safety calculation. Statistics. Finite differences and finite volume schemes in 2D and 3D.

EDUCATION

- 2001** **Ph.D. - University of Bordeaux I, France, Dept. of Applied Mathematics.**
Thesis subject: "Direct numerical simulation of incompressible flows in 2 and 3 dimensions", supervised by Professor C.-H. BRUNEAU.
- 1996** **M.S. - University of Bordeaux I, France, Dept. of Applied Mathematics.**
Thesis subject: "Numerical study of non-strictly hyperbolic problems". Analysis of the Saint-Venant shallow water equations. Application to flow problems with variable bottom shapes.
- 1994** **B.S. - University of Bordeaux I, France, Dept. of Applied Mathematics.**

PROFESSIONAL EXPERIENCE

- Oct. 2003 / Current** **Sandia National Laboratories, Albuquerque – Technical Staff**
- TSPA-LA (*Total System Performance Assessment- License Application*) for the Yucca Mountain Project. *data fitting, sensitivity and uncertainty analysis, Stability analysis, implementation of efficient probabilistic calculation with separation of aleatory and epistemic uncertainty.*
 - xLPR (*Extremely Low Probability of Rupture*) project for NRC (Nuclear Regulatory Commission). *Development and implementation of probabilistic approach.*
- Feb. 2002 / July 2003** **ANDRA (Agence Nationale pour la Gestion des Déchets Radioactifs) – Post-Doc.**
Sensitivity and uncertainty analysis for safety models.
- *International study of the sensitivity and uncertainty analysis used by ANDRA foreign counterparts for their safety calculations with a three months mission (from August to October 2002) in the United States for studying methods and tools used in the WIPP and the Yucca Mountain projects.*
 - *Study of several methods used in sensitivity and uncertainty analysis (probabilistic, FORM/SORM, response surface, fuzzy logic...).*
 - *Implementation of several methods for sensitivity and uncertainty analysis in the ALLIANCES safety calculation platform by developing a statistical code (~ 7000 lines in C)*
- Oct. 2001 / Jan. 2002** **Transcription of book for Science Active society (<http://www.scienceactive.com>).**
Transcription of a cryptography book into numerical format with MathCad. Creation of interactive exercises and cryptographic algorithm in MathCad.
- Sept 1999 / June 2001** **Research Assistant, University of Bordeaux I, France, Dept. of Applied Mathematics.**
Teaching of probability (56 h.) and statistics (56h.) to Ordinary Degree students (4 groups of 25 to 30 students). Teaching of C++ builder language to undergraduate students in mechanical engineering (40h., 2 groups of 10 students).

SKILLS

- Languages:** C, Visual C++, Fortran (77 et 90), Pascal, Delphi
Notions of parallelism (HPF and PVM).
- Software:** Mathcad, XMGR, AVS, LaTeX, office package (Word, Excel Powerpoint), Goldsim.

Cédric SALLABERRY

Home

7325, Avenida La Costa
Albuquerque, NM 87109
☎(505) 821-1994
c.sallaberry@free.fr

Work

Sandia National Laboratories, New Mexico
PO Box 5800, Albuquerque, NM 87185-1369
☎(505) 284-4813
cnsalla@sandia.gov

PUBLICATIONS

Refereed Journals

"Implementation and Evaluation of Nonparametric Regression Procedures for Sensitivity Analysis of Computationally Demanding Models" . C. STORLIE, J.C. HELTON, L.SWILER, AND C.J. SALLABERRY – *Reliability Engineering and System Safety* **94** (2009) pp. 1735- 1763.

"Representation of Analysis Results Involving Aleatory and Epistemic Uncertainty" J. C. HELTON, J.D. JOHNSON, W.L. OBERKAMPF, AND C.J. SALLABERRY – *accepted by International Journal of General Systems*

"Computational implementation of sampling-based approaches to the calculation of expected dose in performance assessments for the proposed high-level radioactive waste repository at Yucca Mountain, Nevada" J. C. HELTON AND C. J. SALLABERRY - *Reliability Engineering and System Safety* **94** (2009) pp. 699- 721.

"Conceptual basis for the definition and calculation of expected dose in performance assessments for the proposed high-level radioactive waste repository at Yucca Mountain, Nevada" J. C. HELTON AND C. J. SALLABERRY - *Reliability Engineering and System Safety* **94** (2009) pp. 677- 698.

"Extension of Latin Hypercube Samples with Correlated Variables", C. J. SALLABERRY, J. C. HELTON, AND S.C. HORA - *Reliability Engineering and System Safety* **93** (2008) pp. 1047-1059.

"Survey of Sampling-Based Methods for Uncertainty and Sensitivity Analysis", J. C. HELTON, J.D. JOHNSON, C. J. SALLABERRY, AND C.B. STORLIE – *Reliability Engineering and System Safety* **91** (2006) pp. 1175-1209 (most cited article in RESS (36 citations) for the period 2004-2009)

"Sensitivity Analysis in Conjunction with Evidence Theory - Representations of Epistemic Uncertainty", J. C. HELTON, J.D. JOHNSON, W.L. OBERKAMPF, AND C.J. SALLABERRY –*Reliability Engineering and System Safety* **91** (2006) pp. 1414-1434

Conference proceedings

"Yucca Mountain 2008 Performance Assessment: Conceptual Structure and Computational Organization" J. HELTON, C. HANSEN & C. SALLABERRY *2008 IHLRW* (09/07-09/11 2008) Las Vegas, NV - USA

"Yucca Mountain 2008 Performance Assessment: Uncertainty and Sensitivity Analysis for Expected Dose" C. HANSEN, K. BROOKS, J. GROVES, J. HELTON, K. LEE, C. SALLABERRY, W. STATHAM & C. THOM *2008 IHLRW* (09/07-09/11 2008) Las Vegas, NV - USA

"Yucca Mountain 2008 Performance Assessment: Uncertainty and Sensitivity Analysis for Physical Processes " C. SALLABERRY, A. ARAGON, A. BIER, Y. CHEN, J. GROVES, C HANSEN, J. HELTON, S. MEHTA, S. MILLER, J. MIN & P. VO *2008 IHLRW* (09/07-09/11 2008) Las Vegas, NV - USA

"Sensitivity Analyses of Radionuclide Transport in the Saturated Zone at Yucca Mountain, Nevada" B. ARNOLD, T. HADGU & C. SALLABERRY *2008 IHLRW* (09/07-09/11 2008) Las Vegas, NV - USA

"Aleatory and Epistemic Uncertainty in the Analysis of Complex Systems", (1 hour tutorial) C. SALLABERRY & J. C. HELTON, *IMAC XXV* (02/19-02/22 2007) Orlando, FL - USA.

"Introduction to variance decomposition methods", C. SALLABERRY & J. C. HELTON, *IMAC XXIV* (01/30-02/02 2006) St Louis, MO - USA.

"A Method for extending the size of a Latin Hypercube Sample", C. SALLABERRY & J. C. HELTON, *IMAC XXIII* (01/31-02/03 2005) Orlando, FL - USA.

Cédric SALLABERRY

Home

7325, Avenida La Costa
Albuquerque, NM 87109
☎(505) 821-1994
c.sallaberry@free.fr

Work

Sandia National Laboratories, New Mexico
PO Box 5800, Albuquerque, NM 87185-1369
☎(505) 284-4813
cnsalla@sandia.gov

“An approach of Sensitivity and Uncertainty Analysis Methods Installation in a Safety Calculation”, G. PEPIN & C. SALLABERRY, *International Conference on Supercomputing in Nuclear Applications - SNA'03* (2003) Paris, France.

“Sensitivity and Uncertainty Analysis Methods Installation in a Safety Calculation”, C. SALLABERRY, *Probabilistic Safety Assessment Conference - PSA'02* (2002), Detroit, USA.

“Schémas d'ordre élevé pour la résolution des équations de Navier-Stokes incompressibles”, C.-H. BRUNEAU & C. SALLABERRY, *CANUM 1999 proceedings* (French numerical analysis conference).

Book Chapter

“Treatment of Uncertainty in Performance Assessments for the Geologic Disposal of Radioactive Waste” – J. C. HELTON & C. SALLABERRY in **Geological repositories for safe disposal of spent nuclear fuels and radioactive materials** to appear (*Woodhead Publishing*)

SAND Report

“Representation of analysis results involving aleatory and epistemic uncertainty”, J. C. HELTON J.D. JOHNSON, W. L. OBERKAMPF AND C. J. SALLABERRY – Sand report– *SAND2008-4379* (2008)

“Illustration of sampling-based approaches to the calculation of expected dose in performance assessments for the proposed high level radioactive waste repository at Yucca Mountain, Nevada”, J. C. HELTON AND C. J. SALLABERRY– Sand report– *SAND2007-1353* (2007)

“Measurement and modeling of energetic-material mass transfer to soil-pore water – Project CP-1227 final technical report”, S. WEBB, J. STEIN, C. SALLABERRY, T. HADGU– Sand report– *SAND2006-2611* (2006)

“Technology transfer to Taiwan for geologic repository science and performance assessment-coupling INPAG-N & INPAG-FL to Goldsim”, P. D. MATTIE, C. J. SALLABERRY, H. JOW, F. CHANG, S. JU, C. SHIH– Sand report– *SAND2004-4698A* (2004)

Andra internal publications

“International Review of uncertainty and sensitivity analysis methods used in long term safety of deep geological repository”, C. SALLABERRY– Andra report – *CNT ACSS 02-024* (2003)

“Presentation of Various Methods for uncertainty and sensitivity analysis”, C. SALLABERRY – Andra report – *CNT ACSS 02-025* (2003)

Other publications

“Albuquerque – Richness of Statistics Profession Felt During Annual Meeting”, S. MICHALAK & C. SALLABERRY – *Amstat News* – n. 341 (Nov. 2005) – p. 49

AWARDS

Employee Recognition Award 2005 (Sandia National Laboratories) : Member of the Team “ *Total System Performance Assessment: License Application/Safety Analysis Report* ”

‘Spot’ Recognition Award (Sandia National Laboratories) – development of Exdoc software (July 2005)

‘Spot’ Recognition Award (Sandia National Laboratories) – technical support for infiltration project (Sept. 2006)

Cédric SALLABERRY

Home

7325, Avenida La Costa
Albuquerque, NM 87109
☎(505) 821-1994
c.sallaberry@free.fr

Work

Sandia National Laboratories, New Mexico
PO Box 5800, Albuquerque, NM 87185-1369
☎(505) 284-4813
cnsalla@sandia.gov

‘Spot’ Recognition Award (Sandia National Laboratories) – conducting uncertainty analysis (Sept. 2007)

‘Spot’ Recognition Award (Sandia National Laboratories) – contribution to PA for the SAR (June 2008)

‘Spot’ Recognition Award (Sandia National Laboratories) – contribution to RAI Process (August 2009)

PROFESSIONAL SOCIETIES

2004 - current Member of the American Statistical Association (<http://www.amstat.org>)

2005 - 2008 Member of the Society of Experimental Mechanics (<http://www.sem.org>)

2006 Founding Member of the Mu-Sigma-Rho society affiliated chapter in Albuquerque

PROFESSIONAL SERVICE

02/2007 Organizer and Chair for two sessions on Uncertainty Quantification at the upcoming IMAC XXV conference

01/2006 Organizer and Chair for two sessions on Uncertainty Quantification at the IMAC XXIV conference

2005 -
09/2005 – 09/2006 Member of the Committee for the Mu-Sigma-Rho society affiliated chapter in Albuquerque
09/2004 - 09/2005 President of the Albuquerque Chapter of the American Statistical Association
Vice-President of the Albuquerque Chapter of the American Statistical Association

2005, 2006 Science Fair Judge for Statistics Awards for the New Mexico State Science Fair

Reviewer for *Stochastic Environmental Research & Risk Assessment* (SERRA)
Reviewer for *Reliability Engineering and System Safety* (RESS)

REFERENCES

C.-H. BRUNEAU Full Professor, University of Bordeaux I.
✉ University of Bordeaux I, Department of Applied Mathematics.
351, cours de la Libération – 33405 TALENCE (France).
☎ (+33) 556 846 963
📧 Charles-Henri.Bruneau@math.u-bordeaux.fr

J. C. HELTON Professor Emeritus, Arizona State University – Consultant (Sandia National Labs)
✉ Sandia National Laboratories, New Mexico
PO Box 5800, M.S. 0779 Albuquerque, NM 87185-0779
☎ (505) 284-4808
📧 jchelto@sandia.gov

G. OUZOUNIAN Director, International Relationship, ANDRA
✉ 1/7 rue Jean Monnet
Parc de la Croix-Blanche – 92298 Châtenay-Malabry (France).
📧 Gerald.Ouzounian@andra.fr

ADDITIONAL INFORMATION

French citizen – US Permanent Resident since 2008
Fluent in French and English.

DAVID SASSANI

DAVID C. SASSANI, Ph.D.

Sandia National Laboratories – Yucca Mountain Project

1251 North Town Center Drive, Bldg. #3

Las Vegas, NV 89144-6352

(702) 295-5470 (phone)

(702) 295-7742 (fax)

dsassan@sandia.gov (e-mail)

Curriculum Vitae

Current Employer: Sandia National Laboratories
Title: Principle Member of Technical Staff
Years: 2.6

EDUCATION:

Ph.D., 1992, Geology, Washington University, St. Louis, MO

M.A., 1985, Geology, University of California, Berkeley, CA

B.A., 1983, Geology, LaSalle College, Philadelphia, PA

Scholastic Awards

1988-1989 – Graduate Teaching Award of Excellence, Washington University

1983-84 – Chevron Fellowship, University of California. Berkeley

1983 – Graduated *Maxima Cum Laude* LaSalle College

1979-83 – Christian Brothers Fellowship, LaSalle College

Additional Specialized Training

- Specialized security training for clearance, 2009.
- License Defense Training, Yucca Mountain Project, 2008
- Licensing and Regulatory Interaction Training, Yucca Mountain Project, 2003.
- *GoldSim*TM Short Course Training, Golder Associates Short Course for Development of Stochastic Models Using the *GoldSim*TM Computer Code, Rick Kossik, GAI, 2000
- Technical Specialist Training for Quality Assurance Audits, OCRWM Quality Assurance Department, 2000.
- MSA Short Course: Reactive Transport in Porous Media, P. C. Lichtner, C. I. Steefel, and E. H. Oelkers, Chairmen, 1996.
- MSA Short Course: Oxide Minerals: Petrologic and Magnetic Significance, D. H. Lindsley and B. R. Frost, Chairmen, 1991.
- Pew Midstates Consortium Geology Field Workshop, Minnesota Geology, 1990.
- Workshop on Mineral Deposit Models Applicable to Minnesota, University of Minnesota, 1989.
- GSA-SEG Short Course: Ore Deposition Associated with Magmas, J.A. Whitney and A.J. Naldrett, Chairmen, 1988.

PROFESSIONAL HISTORY:

2/2007 to present

Sandia National Laboratories

Las Vegas, Nevada

*Upper Barrier System (UBS) Technical Deputy for the Lead Laboratory
(01/2009 – present)*

Lead Laboratory technical point-of-contact on the Yucca Mountain Project covering geochemical and chemical conditions within the unsaturated zone(UZ), Near Field Environment, and In-drift Chemistry. Performed as Technical Lead on responses to US NRC requests for additional information (RAI) on the Climate/Infiltration, the Near-Field Environment, and the In-drift Chemistry topics. Supported a number of other RAI responses in areas outside of UBS (covering volcanic gases, seismic effects on geochemistry; multiple barriers, waste-form; and colloid generation and transport). Responded to State of Nevada contentions in the areas of UZ geochemistry and In-drift environment for the UBS. Supported/constructed a number of other DOE Responses to State of Nevada contentions in the Corrosion area. Provided technical support to waste form degradation, colloids, and engineered barrier system transport in the Lower Barrier System (LBS). Contributed technical input to redefine the US DOE (client) OCRWM procedure for Tracers, Fluids, and Materials management at the Site.

Nuclear Energy Advanced Modeling and Simulation program (NEAMS)—Waste Forms and Systems Integrated Performance and Safety Code (IPSC) Development – contributed to Team 2, Team 3, and participated in Team 4 meetings. Produced a table of relevant phenomena from the sub-continuum scale to the continuum scale and at locations from the waste form to the transport pathway through the engineered system. Produced a narrative for the sub-continuum-scale phenomena from within the waste form to the transport pathway in the engineered system.

*Post-closure Science Integration for the Lead Laboratory
(10/2008 – 01/2009)*

Provided support and facilitated integration to the technical area managers for responses to Requests for Additional Information (RAI) sent from the US NRC to the US DOE regarding the Safety Analysis Report (SAR) of the License Application that the US DOE submitted to the US NRC for construction authorization of a repository at Yucca Mountain. Coordinated the technical strategy where needed for RAI that cut across a number of areas of the SAR or that need more than a simple clarification as response.

*Acting Near-Field Environment Manager for the Lead Laboratory
(7/2008 – 10/2008)*

Managed technical work in the areas of thermalhydrology, seepage into emplacement drifts, near-field and in-drift geochemistry, chemical evolution within waste packages, waste form degradation and transport of radionuclides within the emplacement drifts for the Yucca Mountain OCRWM Lead Laboratory for Repository Systems. Directed technical work and interfaced with technical management counterparts within the US DOE. Ensured corrective action planning and implementation for conditions adverse to quality, and other conditions, were executed within the Corrective Action Program to resolve those issues satisfactorily. Provided support and guidance to Project technical personnel regarding direction of the Program and the adjustment from developing the Safety Analysis Report (SAR) to supporting and defending the License Application that the US DOE submitted to the US NRC for construction authorization of a repository at Yucca Mountain.

Geochemistry Lead on the Performance Assessment System Integration Team for the Lead Laboratory
(2/2007 – 7/2008)

Solved detailed integration issues within and among the process and total system models representing of thermalhydrology, seepage into emplacement drifts, near-field and in-drift geochemistry, chemical evolution within waste packages, waste form degradation and transport of radionuclides within the emplacement drifts and throughout the unsaturated and saturated zones. Prepared the Report on the models of colloids within the engineered barrier system. Performed technical work for reactivation of cancelled data qualification report “TDR-EBS-MD-000012, Data Qualification Report for Thermodynamic Data File, Data0.ymp.R0 for Geochemical Code EQ3/6.” Briefed DOE Technical Leads on technical content of reports to facilitate their acceptance review of these Project deliverables. Conducted presentations to the IPAR on the models for waste form degradation and release.

1/2000 to 2/2007

Golder Associates Inc.,

Las Vegas, Nevada

Senior Geochemist

Performing as Geochemist for the Post-closure Safety Assessment (Performance Assessment/Science) for the Management and Technical Support Services Contractor (MTS) that provides direct technical support to the United States Department of Energy (USDOE) Office of Civilian Radioactive Waste Management (OCRWM) Program. Contributing geochemical expertise within this group of scientists dedicated to assisting DOE in planning, guiding, monitoring and reviewing the scientific tests conducted at the Yucca Mountain site and various laboratories, and the modeling and analyses activities, performed by the Management and Operating Contractor for the Yucca Mountain Project. Managed as Lead for the MTS Performance Assessment and Science organization from July 2003 to October 2004. Organized work and managed personnel (in Las Vegas and home office support) contributing to technical support to the USDOE direction and oversight of science and performance assessment activities on the Yucca Mountain Project. Performing as lead consultant to DOE on geochemical aspects of the thermally-driven, coupled processes and the radionuclide source term with specialization in aqueous geochemistry, fluid-rock/materials reaction, controls on waste form degradation, radionuclide solubility-limited concentrations, and transport of radionuclides through engineered and geologic media to the accessible environment. Evaluate and provide technical direction/oversight for the testing strategies and methodologies for thermal testing of coupled processes in the laboratory and field. Organized and conducted external expert reviews of technical work products in the areas of coupled processes and the source-term. Performed as Technical Peer Reviewer of the projects within the Source-Term Thrust area of the Office of Science and Technology and International. Chaired the working group on *Alteration of Non-metallic Barriers and Evolution of Solution Chemistry* in the NEA/OECD Workshop on *Engineered Barrier Systems on Process Issues* in 2004. Reviewed and provided technical direction for the process and abstraction models within the Unsaturated Zone Coupled Processes, Near-Field Environment, and Engineered Barrier System groups for production of the Site Recommendation. Providing this same technical coverage in these areas, as well as in the Waste-form Degradation and Release technical area, for the activities that will lead to a License Application for Construction Authorization as part of the Repository Development Project. Evaluated Project responses to Key Technical Issues (KTI) from the US Nuclear Regulatory Commission (USNRC) and represented USDOE technical positions in meetings.

8/1993 to 1/2000

Duke Engineering & Services (formerly INTERA Inc.),
Senior Scientist (Geochemistry)

Las Vegas, Nevada

Conducted Performance Assessment of the USDOE Yucca Mountain site as a potential geologic (permanent) repository for high-level radioactive waste. Performance Assessment Lead for the development of the near-field geochemical environment models used in the Total System Performance Assessment for the Viability Assessment for the Yucca Mountain Site. Performed technical management and development of the models for the geochemical environment within the potential emplacement drifts at the site, including potential reactions driven by thermal or introduced materials perturbations. Evaluated waste form degradation processes and controls on dissolved concentrations of radionuclides for use within Performance Assessment models. Conducted evaluations of potential impacts to the waste isolation capabilities of the USDOE Yucca Mountain site from tracers, fluids and materials used at the site during site characterization activities and construction of the underground Exploratory Studies Facility. Integrated the activities within the USDOE Yucca Mountain Project Geochemistry Program (experimental and process-level modeling) with the Performance Assessment Operations group models for inclusion in the Total System Performance Assessment (TSPA) of the Yucca Mountain site. Presented technical bases for the TSPA work to the US Nuclear Regulatory Commission (USNRC) and its contractors in public meetings.

4/1992 to 8/1993

Department of Earth and Planetary Sciences, Washington University
Post-Doctoral Research Associate

St. Louis, Missouri

Conducted research in theoretical aqueous geochemistry for geological systems. Modified aqueous speciation and mass-transfer modeling codes EQ3NR and EQ6 for supercritical conditions and applied these to geologic systems. Developed techniques and computer algorithms for estimating 25°C and 1 bar standard-state thermodynamic data for aqueous ions and complexes of both inorganic and organic ligands. Evaluated fluid-rock reaction at crustal conditions for mafic intrusive rocks in both continental and mid-ocean ridge settings. Evaluated and synthesized thermochemical data on actinide ions and complexes in aqueous solution to assess the controls on transport of actinides in natural systems. Applied theoretical aqueous geochemical techniques to the synthesis of internally consistent data sets for aqueous rare earth element (REE) species for evaluating controls on REE in natural systems. Continued developing consistent thermodynamic data set for platinum-group-element (PGE) minerals, aqueous ions, and aqueous complexes. Dissertation research included evaluating theoretical geochemistry of aqueous complex formation. Produced correlations to estimate standard partial molal entropies of aqueous ions at 25°C and 1 bar. Applied modified HKF equation-of-state to evaluate high-pressure/-temperature aqueous solution behavior of PGE and supercritical mass-transfer during aqueous alteration of mafic intrusive rocks. Developed proficiency in using/modifying thermochemical software (and databases) SUPCRT92 and EQ3/6 on MS Windows™/DOS, VMS, and UNIX systems, as well as experience using alternative codes such as PHREEQE, SOLVEQ, and MINTQA2. Investigated petrology and geochemistry of PGE distribution, Cu-Ni-Fe sulfide occurrences, oxide deposits and hydrothermal alteration of mafic intrusive rocks at Duluth Complex, Minnesota. Developed skills in petrographic microscopy (reflected and transmitted light) and mastered analytical techniques such as electron microprobe analysis of silicates, oxides, phosphates, and sulfides.

Professional Awards

- 2008 – Certificate of Accomplishment for contribution and support to the OCRWM Lead Laboratory for Repository Systems and the completion of a quality License Application delivered to the Department of Energy from Edward Sproat, III, Director of OCRWM, US DOE and Sidney Gutierrez, Director, Sandia National Laboratories.
- 2008 – ‘Spot’ Recognition Award for technical leadership and excellence as a member of the Performance Assessment System Integration Team (PASIT) on the Yucca Mountain Project from M. K. Knowles, Performance Assessment Manager, Lead Laboratory, Sandia National Laboratories.

- 2008 – ‘Spot’ Recognition Award for contribution to the Performance Assessment for the Safety Analysis Report for the Yucca Mountain Project from J. McNeish, Total System Performance Assessment Manager, Lead Laboratory, Sandia National Laboratories.
- 2007 – Certificate of Appreciation for Dedicated Support and Contribution to the PASIT mission of managing technical integration across Postclosure Science and Performance Assessment on the Yucca Mountain Project from M. K. Knowles, Performance Assessment Manager, Lead Laboratory, Sandia National Laboratories.
- 2004 – Commitment to Performance Excellence for Regulatory Integration Team effort, from John Arthur, Deputy Director, Office of Repository Development, YMP USDOE.
- 2002 – Contribution to the Yucca Mountain Site Recommendation with Support to NRC Key Technical Issues, from J. Russell Dyer, Project Manager, YMSCO USDOE.
- 2002 – Excellence in Integrated Teamwork for Drift-Scale Test water samples evaluation, from J. Russell Dyer, Project Manager, YMSCO USDOE.
- 1999 – Meritorious Achievement Yucca Mountain TSPA-VA Team, from C. Paul Robinson, President Sandia National Laboratories.
- 1999 – Division 6000 Employee Recognition Award to the Yucca Mountain Total System Performance Assessment Team, from Joan b. Woodard, Vice President, Div. 6000, Sandia National Laboratories.
- 1999 – Certificate of Appreciation for Viability Assessment, from J. Russell Dyer, Project Manager, YMP USDOE.
- 1999 – Task Achievement Program, George E. Dials, President and General Manager, CRWMS Management and Operating Contractor.
- 1998 – M&O Total quality Management for Viability Assessment Workshop, Jean Younker, CRWMS Management and Operating Contractor.
- 1998 – Task Achievement Program, Dr. Robert L. Strickler, President and General Manager, CRWMS Management and Operating Contractor.
- 1997 – Task Achievement Program, Dr. Robert L. Strickler, President and General Manager, CRWMS Management and Operating Contractor.

PROJECT EXPERIENCE:

Thermal Testing, Coupled Processes Modeling, and Engineered Barrier Systems

Yucca Mountain, Nevada. Chaired the working group on Alteration of Non-metallic Barriers and Evolution of Solution Chemistry in the NEA/OECD Workshop on Engineered Barrier Systems on Process Issues in 2004. Subject Matter Expert for the panel performing the Value Engineering Study of Emplacement Drift Ground Control. Lead scientist for review of model validation for models of thermally coupled processes and evolution of engineered barrier system environment. Lead scientist for MTS technical review of the Near-Field Environment (NFE) Process Model report (PMR) and co-lead scientist for MTS technical review of the Engineered Barrier System (EBS) Process Model report (PMR) as part of the Project Site Recommendation. Contributed technical input and critical review to the development of thermochemical databases for geochemical models using both the ion association and ion interaction models for aqueous solutions. Reviewed geochemical and coupled-process (e.g., thermal-hydrologic-chemical and thermal-hydrologic-mechanical) testing and modeling within these technical areas, and provided technical planning of work conducted in these areas. Provided technical direction for field and laboratory testing that defined the source of fluoride in condensed gas samples taken from high-temperature zones of the Drift Scale Test host rock. Contributed to the planning of the Cross-Drift Thermal Test, the third reactive tuff column test at the Atlas facility, and the reactive column tests for cement grout properties. Performed in the EBS PMR Quality Assurance Performance Audit (2/2000, ARP-M&O-00-06) as Technical Specialist auditing the analysis model report titled *In-Drift Thermal-Hydrological-Chemical Model* (ANL-EBS-MD-000026 REV 00). Performed in the NFE PMR Quality Assurance Performance Audit (7/2000, M&O-ARP-00-08) as Technical Specialist auditing the analysis model report titled *Drift-Scale Coupled Processes (DST and THC Seepage) Models* (MDL-NBS-HS-000001 Rev. 00). Performed in the EBS Quality Assurance Performance Audit (2/2001, M&O-ARP-01-01) as Technical Specialist auditing the analysis model report titled *Engineered Barrier System: Physical and Chemical Environment Model* (ANL-EBS-MD-000033 Rev 01). Participated in developing an integrated approach to quantify the uncertainties in process models, model abstractions, and total system models for evaluating the performance of a potential repository at the Yucca Mountain Site.

Waste form Degradation and Radionuclide Release (Source-term)

Yucca Mountain, Nevada. Performed as Technical Peer Reviewer of the projects within the Source-Term Thrust area of the Office of Science and Technology and International. Synthesized data and models for solubility controls on Neptunium dissolved concentrations for presentation to scientists at international technical conferences. Lead scientist for review of model validation for models of waste form degradation, dissolved radionuclide solubility controls, evolution of environment inside the waste package, colloid stability and transport, and radionuclide transport through the engineered barrier system. Organized and conducted independent external expert reviews of model and analyses for in-package chemistry, solubility limitations, and radionuclide release and transport. Provided direction and oversight of ongoing waste-form testing work designed to evaluate fate of Np in degrading spent nuclear fuel (SNF) and in phases forming after alteration of SNF. Presented/published Project testing and modeling technical bases for approaches included within total system performance assessment models at international technical conferences.

Site Investigation/Characterization/Performance Assessment

Yucca Mountain, Nevada. Lead scientist for the In-Drift Geochemical Environment and Engineered Barrier System Transport component to the Total System Performance Assessment for the Site Recommendation (TSPA-SR) and for the modeling and analysis work that will lead to a License Application for Construction Authorization. Responsibilities included managing staff of scientists and leading development of models for potential chemical effects to the potential repository system from thermal and materials perturbations inside the drift. Lead development of models using Pitzer ion interaction approach for evaluating evaporative effects on water composition resulting in concentrated brines. Directed model validation efforts for models of brines

and of microbial growth that used laboratory and field measurements to corroborate independently developed model predictions to demonstrate the usefulness of the models. Lead development of analyses evaluating potential effects of introduced design materials within the drifts. Developed abstracted model for water and gas compositions entering the potential emplacement drifts based on results of coupled thermal-hydrologic-chemical modeling for the host rock. Developed approach for integrating geochemical boundary condition models with the models for the in-drift geochemical environment.

Yucca Mountain, Nevada. Lead scientist for the Near-Field Geochemical Environment component models for the Total System Performance Assessment for the Viability Assessment (TSPA-VA). Responsibilities included managing staff of scientists and leading development of models for potential chemical effects to the potential repository system from thermal and materials perturbations. Developed models for thermally perturbed gas and fluid compositions entering emplacement drifts through time. Evaluated potential changes to gas composition within emplacement drifts from reactions with materials. Lead development of models for nutrient and energy constraints on microbial growth, build-up of precipitates and salts within the drifts, water compositions that from cement/concrete reaction, stability limits on colloid concentrations, and water reaction with corrosion products. Collaborated on model development for the effects of spent fuel on water compositions within the waste packages. Organized and ran the Near-Field Geochemical Environment workshop that provided the foundation for development of the models included within the TSPA-VA. Lead responsibilities included integrating Design and Site Characterization data and models into Performance Assessment process models, abstractions, and the TSPA-VA model, as well as presenting the results at Technical meetings with the NRC and the TSPA Peer Review panel.

Yucca Mountain, Nevada. Performed as contributing scientist for the Waste Form Degradation and Engineered Barrier System Transport component model for the Total System Performance Assessment for the Viability Assessment (TSPA-VA). Synthesized experimental data from a variety of spent fuel studies, both batch and flow-through testing methods, to compare with models for neptunium phase stability. Provided revised conceptual model and quantified results for dissolved neptunium concentrations limited by phase solubility for use within TSPA. Developed an integrated approach for reviewing and revising distributions of solubility-limited radioelement concentrations using a consistent process-level conceptual framework as part of work in the Waste Form component model of the TSPA-VA.

Yucca Mountain, Nevada. Performance assessment analyst for evaluation of potential geochemical impacts from site characterization/construction activities. Work included evaluations of geochemical perturbations at the potential repository horizon from materials such as diesel exhaust, wood, organic grouts, cementitious materials, and fire extinguishing agents. Results are used as input/support of the Design Program to guide the design controls on activities at the site to ensure that inherent waste isolation capabilities are not compromised by the characterization/construction activities. All such work is conducted under a Nuclear Quality Assurance (QA) Program.

Yucca Mountain, Nevada. Integrator for the incorporation of the data gathered by the Geochemistry Program into Project Performance Assessment. Work included being a representative on the Geochemistry Integration Team (GIT) to coordinate site and laboratory activities with Performance Assessment needs and findings. This included co-planning of the Model Validation Workshop. Worked as organizing member of the Solubility Working Group (SolWoG) to address issues concerning experimental/thermochemical constraints on aqueous radionuclide concentrations. This effort included synthesis of laboratory work on actinide solubility limits and planning of data qualification activities for radionuclide thermochemical data to be used in project models. Performed synthesis of data for dissolved radionuclide concentrations and generated abstractions for inclusion into the calculations of total system performance assessment. Contributed section to the TSPA –Viability Assessment documentation that described current status and path forward for solubility-limited dissolved radionuclide concentrations.

Research and Process Modeling

Yucca Mountain, Nevada. Developed models for the potential repository system representing potential chemical effects from thermal and materials perturbations and incorporated those models into assessments of site performance. Led the development of models for: (a) evolving water and gas chemistry within the drift as a result of processes of boiling/evaporation, reaction with cement/concrete, reaction with waste forms, and reaction with alloys and fill materials within the drift; (b) constraining the amount of microbial growth in the emplacement drifts; and (c) estimating colloid stability in the drift environment. Organized and led the Near-Field Geochemical Environment workshop that provided the foundation for development of the models included within the total system performance assessment for the viability assessment of the site. Directed the next stage of model improvements for the initial formulation of the total system performance model for the site recommendation.

Washington University, Missouri. Post-doctoral research associate in charge of evaluation of aqueous actinide thermochemical data. Work included evaluation of literature data, both experimental determinations and estimation techniques, on the thermochemical properties of aqueous actinide ions and producing an internally consistent data set for use in geochemical models. Further work included modeling the solubility of uraninite in geologic fluids under varying conditions of temperature, oxygen fugacity, and fluid composition. Continued work on theoretical geochemistry of aqueous solutions and behavior of ions and complexes in high-temperature, high-pressure solutions in the crust. Applied reactive mass-transfer modeling approaches to alteration of mafic intrusive rocks and mobilization of platinum-group elements in supercritical hydrothermal solutions.

SELECTED PROJECT REPORTS:

- 2007 Buck, E., and Sassani, D.C., Lead Laboratory, *Waste Form And In-Drift Colloids-Associated Radionuclide Concentrations: Abstraction And Summary* MDL-EBS-PA-000004, Rev 03. Las Vegas, NV, Lead Laboratory Technical Document, DOC.20071018.0019
- 2001 Rogers, R., Greenberg, H., Nutt, M., Sassani, D., Wong, F., Linden, R., Salness, R., Savino, J., and Zwahlen, E., *Evaluation of Uncertainty Treatment in the Technical Documents Supporting TSPA-SR*, Las Vegas, Nevada, Management and Technical Support Services, May 2001, 482 pp., MOL.20010502.0084.
- 2000 Francis, N. and Sassani, D. C., CRWMS M&O, *Abstraction of Drift-Scale Coupled Processes*. ANL-NBS-HS-000029 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000525.0371.
- 1998 Sassani D. C., Jolley, D. Mariner, P. E., Donski, P., Stockman, C., and Chen, Y., CRWMS M&O "Near-Field Geochemical Environment." Chapter 4 of Total System Performance Assessment – Viability Assessment (TSPA-VA): Analyses Technical Basis Document. B00000000-01717-4301-00004 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981008.0004.
- 1998 Sassani, D. C. and Siegmann, E., CRWMS M&O, *Constraints on Solubility-Limited Neptunium Concentrations for Use in Performance Assessment Analyses*. B00000000-01717-2200-00191 REV 00. Las Vegas, Nevada: CRWMS M&O. MOL.19980213.0484.
- 1997 Sassani, D. C., CRWMS M&O, *Near-Field Geochemical Environment Abstraction/Testing Workshop Results*. B00000000-01717-2200-0188. June 13, 1997. Las Vegas, Nevada: CRWMS M&O. MOL.19980612.0027
- 1996 Sassani, D. C., CRWMS M&O, *Status/Summary Report for Fiscal year 1996 Activities within the Performance Assessment Overview Study on the Consequences of Cementitious Materials*, September 30, 1996, MOL.19971016.0203. (Note: this informal report was an attachment to transmittal letter "Status/Summary Report for Fiscal Year 1996 Activities Within the Performance Assessment Overview Study on the Consequences of Cementitious Materials (SCPB: N/A)", from J. L. Younker, CRWMS M&O to S. J. Brocoum, US DOE YMSCO, LV.PA.DCS.09/96-038, September 30, 1996, MOL.19971016.0202).
- 1995 Miller, L. and Sassani, D. C., Determination of importance evaluation for C-Hole Complex testing, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BAAAD0000-01717-2200-00008*, Las Vegas, NV, 12 pp.
- 1995 Gwynn, D. W., Sassani, D. C., and Agnew, J. D., Determination of importance evaluation for subsurface Exploratory Studies Facility, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BAB000000-01717-2200-00005*, Las Vegas, NV, 115 pp.
- 1995 Sassani, D. C., Waste isolation evaluation: Borehole workover, instrumentation and testing of UE-25 UZ#4, UE-25 UZ#5, USW UZ-7, USW UZ-13, USW SD-7, USW SD-12, and USW UZ-7a, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BAAAA0000-01717-2200-00005*, Las Vegas, NV, 9 pp.
- 1995 Sassani, D. C., Waste isolation evaluation: Tracers, fluids, and materials, and excavation methods for use in the Package 2C Exploratory Studies Facility construction, *Civilian Radioactive Waste Management System,*

Management and Operating Contractor, Yucca Mountain Site Characterization Project, BABE00000-01717-2200-00007, Las Vegas, NV, 57 pp.

- 1995 Andrews, R. W., Atkins, J. A., Duguid, J. O., Houseworth, J. E., Lee, J. H., Lingineni, S., McNeish, J. A., Mishra, S., Sassani, D. C., and Sevougian, S. D., Total system performance assessment - 1995: An evaluation of the potential Yucca Mountain repository, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, Las Vegas, NV, 702 pp.*
- 1995 Sassani, D. C., Waste isolation evaluation: Tracers, fluids, and materials for Exploratory Studies Facility (ESF) Phase 1A construction, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BABE00000-01717-2200-00007, Las Vegas, NV, 57 pp.*
- 1994 Sassani, D. C., Waste isolation evaluation for use of non-committed fluids and materials at the site surface, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, B00000000-01717-2200-00098, Las Vegas, NV, 13 pp.*
- 1994 Sassani, D. C., Waste isolation evaluation: Installation of streamflow gaging stations in upper Drillhole wash, upper Pagany wash, and upper Wren wash for the surface-water monitoring network, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BAA000000-01717-2200-00005, Las Vegas, NV, 7 pp.*
- 1994 Sassani, D. C., Waste isolation evaluation: Drilling of Borehole USW SD-7, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BAAAE0000-01717-2200-00001, Las Vegas, NV, 8 pp.*
- 1993 Sassani, D. C., Waste isolation evaluation: Tracers, fluids, and materials for the ESF North Portal pad 69 - 12.47 kV electrical power, site grounding and lightning systems, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, B00000000-01717-2200-00036, Las Vegas, NV, 11 pp.*
- 1993 Sassani, D. C., Waste isolation evaluation: Tracers, fluids, and materials for the radiological and environmental field monitoring program, *Civilian Radioactive Waste Management System, Management and Operating Contractor, Yucca Mountain Site Characterization Project, BAA000000-01717-2200-000391, Las Vegas, NV, 10 pp.*

PUBLICATIONS:

In preparation:

1. "Potential Impacts of Alternative Waste Forms on Long-Term Repository Performance", Peter N. Swift, Clifford W. Hansen, Ernest Hardin, Robert J. MacKinnon, David Sassani, S. David Sevougian, for 10th International Probabilistic Safety Assessment & Management (PSAM) Conference 2010, Seattle WA, June 7-11, 2010.
2. "Which Radionuclides Matter and Why: Risk Insights from the 2008 Performance Assessment for Yucca Mountain", Clifford W. Hansen, David Sassani, S. David Sevougian, Peter N. Swift, for Integrated Radioactive Waste Management in Future Fuel Cycles, Charleston, SC, November 8-12, 2009.

3. "Thermal Management in Geologic Disposal: the Yucca Mountain Strategy", Ernest Hardin, Teklu Hadgu, David Sassani, for Integrated Radioactive Waste Management in Future Fuel Cycles, Charleston, SC, November 8-12, 2009.
- 2006 Sassani, D. C., Van Luik, A., and Summerson, J., Neptunium Solubility in the Near-Field Environment of a Proposed Yucca Mountain Repository, in *Scientific Basis for Nuclear Waste Management XXIX*, ed. by P. Van Iseghem, (Mater. Res. Soc. Symp. Proc. **932**, Warrendale, PA) pp. 991-998.
- 2005 Sassani, D. C., Coupled processes in performance assessment source-term models for geologic repository systems, invited abstract in *Proceedings of 15th Annual Goldschmidt Conference Abstracts with Program*, Moscow, Idaho, A409.
- 1999 Sassani, D. C., Jolley, D. M., and Howard, R., Natural Analogue Constraints in Total System Performance Assessment of a Potential Repository at Yucca Mountain, Nevada, abstract in *Scientific Basis for Nuclear Waste Management XXIII*, D. Shoesmith and R. Smith, eds., 757.
- 1998 Sassani, D. C., and Shock, E. L., Solubility and transport of platinum-group elements in supercritical fluids: Summary and estimates of thermodynamic properties for ruthenium, rhodium, palladium, and platinum solids, aqueous ions, and complexes to 1000°C and 5 kbar, *Geochimica et Cosmochimica Acta*, **62(15)**, pp. 2543-2671.
- 1997 Van Luik, A., Sassani, D. C., and Mukhopadhyay, B., Incorporating chemical processes at Yucca Mountain into project performance assessments, *1997 National American Chemical Society Meeting, Las Vegas, Nevada*.
- 1997 Chen, Y., Sassani, D. C., Andrews, R., and McNeish, J., An Analysis on the Dissolution Behavior of DHLW Glass Using the Reactive-Transport Simulator AREST-CT, *EOS, Transactions, American Geophysical Union*, **78(46)**, p. F200.
- 1997 Jolley, D. M., Houseworth, J. E., Sassani, D. C., and Mattie, P. D., Analyses of Potential Impacts of Site Characterization/Testing Activities: Protecting the Waste Isolation Capabilities of the Potential High-Level Radioactive Waste Repository at Yucca Mountain, Nevada, *Association of Engineering Geologists Annual Meeting*.
- 1997 Shock, E. L., Sassani, D. C., and Betz, H., Uranium in geologic fluids: Estimates of standard partial molal properties, oxidation potentials and hydrolysis constants at high temperatures and pressures, *Geochimica et Cosmochimica Acta*, **61(20)**, pp. 4245-4266.
- 1997 Shock, E. L., Sassani, D. C., Willis, M., and Sverjensky, D. A., Inorganic species in geologic fluids: Correlations among standard molal thermodynamic properties of aqueous cations, oxyanions, acid oxyanions and hydroxide complexes, *Geochimica et Cosmochimica Acta*, **61(5)**, pp. 907-950.
- 1995 Sassani, D. C. and Houseworth, J. E., Bounding potential diesel exhaust impacts produced from North Ramp excavation, *International High Level Radioactive Waste Management Conference Proceedings*, 615-617.
- 1995 Haas, J. R., Shock, E. L., and Sassani, D. C., Rare Earth elements in hydrothermal systems, Estimates of standard partial molal thermodynamic properties of aqueous complexes of the rare earth elements at high pressures and temperatures, *Geochimica et Cosmochimica Acta*, **59(21)**, pp. 4329-4350.

- 1995 Pasteris, J. D., Harris, T., and Sassani, D. C., Interactions of Mixed Volatile-Brine Fluids in Rocks of the Southwestern Footwall of the Duluth Complex, Minnesota: Evidence from Aqueous Fluid Inclusions, *American Journal of Science*, **295**, 125-172.
- 1994 Sassani, D. C., and Shock, E. L., Errata: Estimation of standard partial molal entropies of aqueous ions at 25°C and 1 bar, *Geochimica et Cosmochimica Acta*, **58**, 2756-2758.
- 1994 Pasteris, J. D., Harris, T., and Sassani, D. C., Dual immiscibility of dominantly aqueous fluids in rocks of the southwestern footwall of the Duluth Complex, NE Minnesota, *Proceedings of the 40th Meeting of the Institute of Lake Superior Geology*, 364.
- 1993 Sassani, D. C., Betz, H., and Shock, E. L., Predicted speciation of uranyl-chloride and -fluoride complexes and variations in uraninite solubility in heated pore fluids, *EOS, Transactions, American Geophysical Union*, **74(16)**, 328.
- 1993 McCollom, T. M., Shock, E. L., and Sassani, D. C., "Igneous" assemblages produced by aqueous alteration in the lower oceanic crust, *EOS, Transactions, American Geophysical Union*, **74** (43), 666.
- 1993 Haas, J. R., Shock, E. L., and Sassani, D. C., Predictions of high-temperature stability constants for aqueous complexes of the rare earth elements, 1993 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **25**, A437.
- 1993 Sassani, D. C., Betz, H., and Shock, E. L., Predicted effects of temperature, oxygen fugacity, pH, and solution composition on the speciation of aqueous uranium and the solubility of uraninite, 1993 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **25**, A438.
- 1993 McCollom, T., Shock, E. L., and Sassani, D. C., Mass transfer of rock-forming elements during contact metamorphism, 1993 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **25**, A263.
- 1992 Pasteris, J.D., Harris, T., and Sassani, D.C., Involvement of aqueous fluids in the rift environment of the Duluth Complex, Minnesota, 1992 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **24**, A61.
- 1992 Sassani, D.C., and Shock, E.L., Estimation of standard partial molal entropies of aqueous ions at 25°C and 1 bar, *Geochimica et Cosmochimica Acta*, **56**, 3895-3908.
- 1992 Sassani, D.C., *Petrologic and Thermodynamic Investigation of the Aqueous Transport of Platinum-Group Elements During Alteration of Mafic Intrusive Rocks*, Ph.D. Dissertation, Washington University, St. Louis, 1100 p.
- 1992 Pasteris, J.D., and Sassani, D.C., DDH FHL-1 and FHL-2, *Drill Core Library Newsletter*, **2**, Minnesota Dept. Nat. Res., p. 10-12.
- 1992 Sassani, D.C., and Pasteris, J.D., Three-phase intergrowths in an oxide horizon of the basal zone of the Duluth Complex, extended abstract for 1991 Spring Seminar on Microprobe for PGM and Heavy Mineral Concentrates, *Drill Core Library Newsletter*, **2**, Minnesota Dept. Nat. Res., p. 5.

- 1992 Sassani, D.C., and Shock, E.L., A Critical Evaluation of methods to estimate standard state association constants for aqueous complexes at 25°C and 1 bar, 1992 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **24**, A325.
- 1991 Sassani, D.C., and Shock, E.L., A theoretical interpretation of platinum-group-mineral (PGM) solubility experiments, 1991 American Geophysical Union Fall Meeting, *EOS, Transactions, American Geophysical Union*, **72** (44), 538.
- 1991 Sassani, D.C., and Pasteris, J.D., Hydrothermal alteration of an oxide horizon in the basal zone of the southern Duluth Complex, Minnesota: Constraints on fluid evolution, 1991 American Geophysical Union Spring Meeting, *EOS, Transactions, American Geophysical Union*, **72** (17), 146.
- 1990 Sassani, D.C., Shock, E.L., and Pasteris, J.D., Hydrothermal alteration of mafic intrusive rocks and the potential transport of platinum-group elements in supercritical aqueous solutions, *1990 V.M. Goldschmidt Conference, Programs and Abstracts*, 78.
- 1990 Sassani, D.C., and Shock, E.L., Speciation and solubility of palladium in aqueous magmatic-hydrothermal solutions, *Geology*, **18**, 925-928.
- 1989 Sassani, D.C., Shock, E.L., and Pasteris, J.D., Solubility of platinum-group elements in late-stage magmatic/hydrothermal solutions, 1989 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **21**, A262.
- 1988 Sassani, D.C., and Shock, E.L., Speciation of platinum-group elements in hydrothermal solutions, 1988 Annual Meeting, *Geological Society of America, Abstracts with Programs*, **20**, A241.
- 1988 Sassani, D.C., and Pasteris, J.D., Preliminary investigation of alteration in a basal section of the southern Duluth Complex, Minnesota, and the effects on the sulfide and oxide mineralization, *in*, G. Kisvarzanyi and S.K. Grant, eds., *North American Conference on Tectonic Control of Ore Deposits and the Vertical and Horizontal Extent of Ore Systems, Proceedings Volume*, University of Missouri-Rolla, 280-291.
- 1987 Sassani, D.C., and Pasteris, J.D., Preliminary investigation of the sulfide and oxide mineralization in a basal section of the Duluth Complex, Minnesota, 1987 Annual Meeting North-Central Section, *Geological Society of America, Abstracts with Programs*, **19**, 242.
- 1987 Sassani, D.C., and Pasteris, J.D., Preliminary investigation of alteration in a basal section of the southern Duluth Complex, Minnesota, and the effects on the sulfide and oxide mineralization, *North American Conference on Tectonic Control of Ore Deposits and the Vertical and Horizontal Extent of Ore Systems, Abstracts and Programs Volume*, University of Missouri-Rolla, 62.

DAVID SASSANI

PUBLICATIONS

In preparation:

1. “Potential Impacts of Alternative Waste Forms on Long-Term Repository Performance”, Peter N. Swift, Clifford W. Hansen, Ernest Hardin, Robert J. MacKinnon, David Sassani, S. David Sevougian, for 10th International Probabilistic Safety Assessment & Management (PSAM) Conference 2010, Seattle WA, June 7-11, 2010.
2. “Which Radionuclides Matter and Why: Risk Insights from the 2008 Performance Assessment for Yucca Mountain”, Clifford W. Hansen, David Sassani, S. David Sevougian, Peter N. Swift, for Integrated Radioactive Waste Management in Future Fuel Cycles, Charleston, SC, November 8-12, 2009.
3. “Thermal Management in Geologic Disposal: the Yucca Mountain Strategy”, Ernest Hardin, Teklu Hadgu, David Sassani, for Integrated Radioactive Waste Management in Future Fuel Cycles, Charleston, SC, November 8-12, 2009.

Published:

- 2006 Sassani, D. C., Van Luik, A., and Summerson, J., Neptunium Solubility in the Near-Field Environment of a Proposed Yucca Mountain Repository, in Scientific Basis for Nuclear Waste Management XXIX, ed. by P. Van Iseghem, (Mater. Res. Soc. Symp. Proc. 932, Warrendale, PA) pp. 991-998.
- 2005 Sassani, D. C., Coupled processes in performance assessment source-term models for geologic repository systems, invited abstract in Proceedings of 15th Annual Goldschmidt Conference Abstracts with Program, Moscow, Idaho, A409.
- 1999 Sassani, D. C., Jolley, D. M., and Howard, R., Natural Analogue Constraints in Total System Performance Assessment of a Potential Repository at Yucca Mountain, Nevada, abstract in Scientific Basis for Nuclear Waste Management XXIII, D. Shoesmith and R. Smith, eds., 757.

DAVID SEVOUGIAN

S. DAVID SEVOUGIAN, Ph.D.
Sandia National Laboratories
Principal Member of the Technical Staff

1180 Town Center Drive
Las Vegas, NV 89144

(702) 295-6273 ph.
sdsevou@sandia.gov

EXPERIENCE SUMMARY

Dr. Sevougian has more than 30 years of professional experience as an earth scientist and engineer in the fields of nuclear waste management, hydrogeology, geophysics, chemical engineering, and petroleum engineering. He is currently the Technical Lead for the Lower Natural Barrier Department of the Yucca Mountain Lead Lab for the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM). In his current role Dr. Sevougian oversees the technical content of DOE responses to Requests for Additional Information (RAIs) from the Nuclear Regulatory Commission (NRC) regarding the DOE's Yucca Mountain License Application in the subject areas of Radionuclide Release Rates and Solubility Limits, Waste Form Degradation and Mobilization and Engineered Barrier System and Flow and Transport, and Radionuclide Transport in the Saturated Zone. He also summarizes the DOE's proposed responses for these RAIs at the initial public clarification calls between the NRC and DOE. Compliance with the postclosure public health and safety standards in 10 CFR Part 63 for the analyzed repository of nuclear waste at Yucca Mountain (YM) is primarily based upon the results of performance assessment modeling using the Yucca Mountain Total System Performance Assessment (TSPA) Model and is documented in Section 2.4 (Volume 15) of the 8650-page Safety Analysis Report (SAR) that comprises the primary part of the License Application. Dr. Sevougian is the lead author of this 600-page Section 2.4 of the SAR. Prior to authoring Section 2.4 of the SAR, he managed the technical development and design of the TSPA model, which is based on a probabilistic Monte-Carlo methodology that samples the estimated uncertainties in the physical-chemical parameters and models that represent the evolution of the repository system. The Yucca Mountain TSPA model is also the basis for the Final Environmental Impact Statement (FEIS) for the site. Prior to his responsibilities for development and design of the TSPA-FEIS and TSPA Site Recommendation (SR) models, Dr. Sevougian managed the technical development and design of the TSPA model for the Yucca Mountain Viability Assessment (VA) in 1998, a major milestone in the Yucca Mountain site recommendation and characterization process.

Dr. Sevougian has 15 years of experience in the nuclear waste management field, which has included a variety of interactions and collaborations with scientists from various national and international government agencies and panels, including the DOE, NRC, Nuclear Waste Technical Review Board (NWTRB), and the European Nuclear Energy Agency (NEA). Dr. Sevougian served as the U.S. DOE Technical Representative for the OECD/NEA Initiative on Engineered Barrier Systems in the Safety Case in 2005 and 2006 at various meetings in Europe and Japan, and as the U.S. DOE Technical Representative for the OECD/NEA Working Group for the Handling of Time Scales in Assessing Post Closure Safety from 2002 to 2005 at various meetings in Europe. Besides his contributions to the overall design of the YM integrated total system model and his current role as the technical lead for models and analyses related to the Lower Natural Barrier, he previously had more specific responsibility as the TSPA technical expert for a number of the performance assessment subsystem models, such as the Engineered Barrier System (EBS) reactive-transport model. Prior to his work on Yucca Mountain, he spent ten years in mathematical and numerical modeling of multiphase reactive flow and transport processes in permeable media, including hydrocarbon reservoirs and groundwater aquifers. This included the modeling of aquifer remediation, in-situ uranium leaching, acid stimulation of oil and gas wells, and the transport of heavy metals and radionuclides. He also has more than five years of field experience in borehole geophysical logging and log interpretation of petroleum reservoirs in North America.

Dr. Sevougian also served as the acting IT Manager for the YM TSPA Department for several years, with responsibility for the design, purchase, and configuration of the computer system for the YM TSPA Model. He has been employed by Sandia National Laboratories since May 2003.

EDUCATION

- Ph.D., Petroleum Engineering, The University of Texas at Austin, 1992, Dissertation Title: “Partial Local Equilibrium and the Propagation of Mineral Alteration Zones”
- M.S., Petroleum Engineering, The University of Texas at Austin, 1986, Thesis Title: “Optimization of Vertical Acid Fractures”
- A.B., Physics, Cornell University, 1975

PROFESSIONAL HISTORY

Technical Deputy, Lower Barrier System Dept. 01/09 – present, Las Vegas, NV
Lead Lab, Sandia National Laboratories

Technical Deputy Manager for the Lower Natural Barrier Department, responsible for guiding/reviewing/scheduling technical work for approximately 15 technical staff members in the areas of waste-form degradation and mobilization, engineered barrier system flow and transport, unsaturated zone transport, and saturated zone flow and transport.

Member of PASIT; Lead Author of SAR Section 2.4 12/06 – 01/09, Las Vegas, NV
Lead Lab, Sandia National Laboratories

Member of the Performance Assessment Systems Integration Team (PASIT), which is responsible for providing guidance and prioritization for the technical and scientific work conducted by the Lead Lab. Author of Section 2.4 of the Safety Analysis Report for the Yucca Mountain license application, entitled “Demonstration of Compliance with the Postclosure Public Health and Environmental Standards.”

Deputy Technical Lead 10/06 – present, Las Vegas, NV
TSPA Department, Lead Lab
Sandia National Laboratories

Deputy technical lead in the TSPA Department, responsible for guiding the technical development and design of the TSPA Model and providing guidance to TSPA analysts regarding the design and results of analyses derived from the TSPA Model.

Senior Staff 2/05 – 10/06, Las Vegas, NV
TSPA Department, Bechtel SAIC Company
Sandia National Laboratories

Senior technical consultant in the TSPA Department, responsible for guiding the technical development and design of the TSPA Model and providing guidance on the design and results of analyses derived from the TSPA Model. Led a major scientific effort to integrate colloidally-facilitated radionuclide transport and radionuclide sorption (including kinetically-limited reactions) across both natural and engineered barrier subsystem models. Developed a new methodology for incorporating uncertain and spatially variable Alloy 22 localized corrosion processes in the total system model.

Lead, TSPA Model Design/Analysis 1/02 – 2/05, Las Vegas, NV
TSPA Department, Bechtel SAIC Company
Sandia National Laboratories

Led a group of senior scientists and analysts responsible for the design of the TSPA-LA integrated system model and associated analyses to be used for the Yucca Mountain License Application (LA). Acting IT

manager for TSPA, responsible for the configuration and purchase of the computer system to be used to run the TSPA computer model (budget of about \$1 million per year).

Section Manager, TSPA Model
TSPA Department, Bechtel SAIC Company
Duke Engineering & Services/Framatome-ANP DE&S

4/01 – 1/02, Las Vegas, NV

Acting Lead, TSPA Implementation Group
Performance Assessment Department, CRWMS M&O
Duke Engineering & Services

1/00 – 4/01, Las Vegas, NV

In these two job positions, I managed the development and implementation of the TSPA integrated system model and associated sensitivity analyses for three major DOE deliverables related to the Site Recommendation (SR) of the potential repository at Yucca Mountain: the TSPA-SR, the SSPA (Supplemental Science and Performance Analyses), and the FEIS (Final Environmental Impact Statement). Also, participated in and gave presentations for NRC-DOE Technical Exchanges and KTI meetings, the TSPA International Peer Review Panel, and various Project technical meetings. Interfaced with NRC, NWTRB, CNWRA, and DOE staff scientists on TSPA issues. Represented YM TSPA modeling at the DOE-ANDRA Bilateral Exchange in Paris, France, October 30-31, 2001. Integrated colloidal radionuclide transport modeling across several of the component TSPA models. Designed and delivered TSPA analyses in support of the Yucca Mountain Repository Safety Strategy (RSS).

IT Manager for Performance Assessment, with responsibility for an IT budget of about \$400K per year. Developed the IT plan for PA and designed and purchased the PA computer systems. Key mover behind the parallelization of the TSPA-SR model, which allowed it (and associated subsystem software, such as FEHM, ASHPLUME, WAPDEG, and SZ_Convolute) to run on multiple processors over the TSPA departmental LAN using Windows networking software.

Member of TSPA Synthesis Team
Performance Assessment Department, CRWMS M&O
Duke Engineering & Services

8/98 – 1/01, Las Vegas, NV

TSPA lead modeler for the areas of Waste Package/Drip Shield Modeling and Engineered Barrier System/Near Field Environment Modeling. Co-organizer and TSPA lead of TSPA-SR Integration Meetings in these two areas, which were critical for integrating work in these disciplines across the Project to ensure its proper representation in the TSPA-SR.

Total System Department Manager
Performance Assessment Operations, CRWMS M&O
Duke Engineering & Services

11/97 – 8/98, Las Vegas, NV

Managed 20 scientists working in the Total System Department. Responsible for the overall design of the TSPA-Viability Assessment (VA) Total System Model and the quality and accuracy of the associated simulations and sensitivity studies. Coordinated with a large team of scientists and engineers at various national laboratories and contractors. One of several key authors of the TSPA-VA Report, a major milestone/deliverable imposed by the U.S. Congress for assessing the suitability of the Yucca Mountain site as a repository for the Nation's commercial spent nuclear fuel and the DOE's high-level nuclear waste.

Senior Engineer, Performance Assessment
Duke Engineering & Services/INTERA

09/94 – 10/97, Las Vegas, NV

Member of the TSPA-VA Core Team, a four-member group of senior scientists responsible for integrating the technical data and models of various project scientists into a defensible total systems model for the 1998 YM

Viability Assessment. Conducted performance assessment analyses for TSPA-1995. Managed and designed major pieces of the TSPA-1995 Total System Model. Ran the TSPA-1995 computer simulations. One of several key authors of the TSPA-1995 Report. Conducted the performance assessment analyses and participated in expert-elicitation workshops in support of the 1995 Calico Hills System Study. Conducted performance assessment analyses and participated in expert-elicitation workshops in support of the 1995 Systems Engineering Backfill Study.

Postdoctoral Research Associate
Pacific Northwest National Laboratory
Earth and Environmental Sciences Center

07/93 – 09/94, Richland, WA

Research scientist in the Interfacial Geochemistry Group, where I developed geochemical-reaction software to model detailed chemical kinetics and equilibria of subsurface water/rock reactions. Coupled this software to a three-dimensional transport code to investigate the breakthrough behavior of reactive contaminants, such as Co-EDTA, in a physically and chemically heterogeneous aquifer. Also, researched the accuracy of higher-order numerical transport algorithms when coupled to complex chemistry software, with the goal of minimizing numerical dispersion.

Research Engineer
The University of Texas at Austin

12/92 – 07/93, Austin, TX

Wrote recommendations and guidelines for the integration of two reaction-transport simulators: UTCHEM and KGEOFLOW. Responsibilities also included software development, wherein I wrote a user-friendly preprocessor to facilitate problem specification and initialization in KGEOFLOW and to interface it with several thermodynamic databases, including EQ3/6.

Consultant
Ecodynamics Research Associates, Inc.

12/92 – 02/93, Albuquerque, NM

Responsible for writing guidelines for the development and use of a general multiphase, reactive-transport computer code for gas generation and flow in the WIPP low-level nuclear waste repository and for flow and transport through the Culebra formation.

Graduate Research Assistant
The University of Texas, Department of Petroleum Engineering

01/85 – 12/92, Austin, Texas

Applications of geochemical modeling to oil and gas well treatments, including near-wellbore matrix acidization and scale removal, and acid fracturing of hydrocarbon-bearing carbonate reservoirs.

Computer Scientist
Lawrence Livermore National Laboratory

06/89 – 09/89, Livermore, CA

Summer internship involving research on the modeling of geochemical flow processes in high-level nuclear waste repositories.

**Mining Consultant
Malapai Resources Company**

06/87 – 11/89, Austin, TX

Engineering research consultant for Malapai's in-situ uranium leaching mines in Wyoming and Texas. The deliverables were two extensive reports evaluating the most effective leaching solution to dissolve uranium ore, and also the most effective post-mining remediation process. The evaluations were made with state-of-the-art reactive-transport computer models and field data from the mining sites. The work also included the modeling of laboratory column-leach tests, leading to recommendations for further in-situ water analyses, in-situ mineral analyses, and laboratory column tests.

**General Field Engineer
Schlumberger Well Services**

04/77 – 11/82, North America

Open- and cased-hole wireline logging and log interpretation in oil and natural gas reservoirs, with field experience in Prudhoe Bay, Alaska; Permian Basin, Texas; and Alberta, Canada. Work included data analysis and acquisition, modeling and interpretation, performance assessment of oil and gas wells, and calibration and maintenance of measuring devices. Responsibilities included personnel management, as a supervisor and instructor for a crew of three equipment operators and as an instructor for new engineer trainees.

PUBLICATIONS

Sevougian, S. D. and M. B. Gross, "Representing THMC Effects In The Seismic Scenario Class For The Yucca Mountain Repository Performance Assessment," *Proceedings of the European Commission TIMODAZ and THERESA Projects Conference on Impact of Thermo-Hydro-Mechanical-Chemical Processes on the Safety of Underground Radioactive Waste Repositories*, Luxembourg, September 29 – October 1, 2009, www.timodaz.eu/conference09.

Lord, M. E., S. Mehta, and S. D. Sevougian, 2008, "Modeling Diffusive Transport Between Single and Dual Continuum Media," submitted to *Advances in Water Resources*.

Sevougian, S. D., V. Jain, R. J. MacKinnon, P. D. Mattie, and K. G. Mon, 2008, "Implementation of Localized Corrosion in the Performance Assessment Model for Yucca Mountain," *Nuclear Technology*, **163**, 92-100.

Sevougian, S. D., G. A. Behie, V. D. Chipman, M. B. Gross, S. Mehta, and W. Statham, 2008, "Yucca Mountain 2008 Performance Assessment: Modeling Disruptive Events and Early Failures," 2008, *Proceedings of the 2008 International High-Level Radioactive Waste Management Conference*, Las Vegas, NV, September 7-11, 2008, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

MacKinnon R. J., G. A. Behie, V. D. Chipman, Y. Chen, J. Lee, K. P. Lee, P. D. Mattie, S. Mehta, K. G. Mon, J. D. Schreiber, S. D. Sevougian, C. Stockman, and E. D. Zwahlen, 2008, "Yucca Mountain 2008 Performance Assessment: Modeling the Engineered Barrier System," 2008, *Proceedings of the 2008 International High-Level Radioactive Waste Management Conference*, Las Vegas, NV, September 7-11, 2008, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

Swift P. N., C. Hansen, R. L. Howard, M. K. Knowles, R. J. MacKinnon, J. A. McNeish, and S. D. Sevougian, 2008, "Yucca Mountain 2008 Performance Assessment: Summary," 2008, *Proceedings of the 2008 International High-Level Radioactive Waste Management Conference*, Las Vegas, NV, September 7-11, 2008, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

Swift P. N., M. K. Knowles, J. A. McNeish, S. D. Sevougian, M. Tynan, and A. Van Luik, 2008, "Broader Perspectives on the Yucca Mountain Performance Assessment," 2008, *Proceedings of the 2008 International*

High-Level Radioactive Waste Management Conference, Las Vegas, NV, September 7-11, 2008, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

Van Luik A. and S. D. Sevougian, "Practical Lessons Learned on the Role of the Engineered Barrier System in a Total System Performance Assessment," 2006, *Workshop Proceedings, Engineered Barrier Systems (EBS) in the Safety Case: Design Confirmation and Demonstration*, Tokyo, Japan, September 12-15, 2006, Nuclear Energy Agency, OECD Publications, Paris, France, (www.oecd.org), ISBN 978-92-64-03995-7.

Sevougian, S. D., V. Jain, and A. Van Luik, "The Integration and Abstraction of EBS Models in Yucca Mountain Performance Assessment," 2005, *Workshop Proceedings, Engineered Barrier Systems (EBS) in the Safety Case: The Role of Modelling*, La Coruna, Spain, August 24-25, 2005, Nuclear Energy Agency, OECD Publications, Paris, France, (www.oecd.org), ISBN 978-92-64-00664-5.

Sevougian, S. D., 2004, "An Introduction to the Use of GoldSim for Total System Performance Assessment (TSPA) Modeling of the Yucca Mountain Nuclear Waste Repository," *Third International GoldSim User Conference*, October 10-13, 2004, Las Vegas, NV, www.goldsim.com.

Saulnier, G. J., K. P. Lee, S. Mehta, S. D. Sevougian, D. A. Kalinich, and J. A. McNeish, 2003, "Use of One-On Analysis to Evaluate Total System Performance of the Proposed Yucca Mountain Nuclear Waste Repository," *Proceedings of the 2003 International High-Level Radioactive Waste Management Conference*, Las Vegas, NV, March 30 – April 3, 2003, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

Sevougian, S. D., 2003, "Mechanistic Model for Reactive Transport of Radionuclides on Iron-(Oxy)Hydroxide Colloids at the Yucca Mountain Repository," *Second International GoldSim User Conference*, June 17-20, 2003, Seattle, WA, www.goldsim.com.

Saulnier, G. J., K. P. Lee, D. A. Kalinich, S. D. Sevougian, and J. A. McNeish, 2002, "Total System Performance Assessment Model for the Final Environmental Impact Statement for the Potential High-Level Nuclear Waste Repository at Yucca Mountain," *Proceedings of ICONE10, Nuclear Energy Engineering Today the Power for Tomorrow*, Arlington, Virginia, April 14-18, 2002, ICONE10-22322, American Society of Mechanical Engineers.

Sevougian, S. D., J. A. McNeish, K. Coppersmith, K. E. Jenni, L. D. Rickertsen, P. N. Swift, and M. L. Wilson, 2002, "Supplemental Performance Analyses for the Potential High-Level Nuclear Waste Repository at Yucca Mountain," *Proceedings of Waste Management 2002, February 24-28, 2002, Tuscon, Arizona*.

Mattie, P. D., J. A. McNeish, S. D. Sevougian, and R. W. Andrews, 2001, "Methods and Techniques Used to Convey Total System Performance Assessment Analyses and Results for Site Recommendation at Yucca Mountain, Nevada, USA," *Proceedings of VALDOR 2001, The Second VALDOR Symposium Addressing Transparency in Risk Assessment and Decision Making*, Stockholm, Sweden, June 10-14, 2001, edited by Kjell Andersson, pp. 461-467. Swedish Nuclear Power Inspectorate. Congrex Sweden AB/Kista Snabbtryck.

Sevougian, S. D., S. Mishra, P. D. Mattie, M. L. Wilson, and J. H. Gauthier, 2001, "Robustness Analyses for Total System Performance Assessment at Yucca Mountain," *Proceedings of the 9th International High Level Radioactive Waste Management Conference*, April 29 - May 3, 2001, Las Vegas, Nevada, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

Gauthier, J. H., M. L. Wilson, S. D. Sevougian, P. D. Mattie, and S. J. Maheras, 2001, "Preliminary Analysis of Groundwater Protection for the Potential Repository at Yucca Mountain," *Proceedings of the 9th International High Level Radioactive Waste Management Conference*, April 29 - May 3, 2001, Las Vegas, Nevada, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.

- Li, C., S. D. Sevougian, E. Devonec, and P. D. Mattie, 2001, "Implementing EBS Random Release Model in FEHM," *Proceedings of the 9th International High Level Radioactive Waste Management Conference*, April 29 - May 3, 2001, Las Vegas, Nevada, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.
- Devonec, E., S. D. Sevougian, P. D. Mattie, J. A. McNeish, and S. Mishra, 2001, "Methodology Used for Total System Performance Assessment of the Potential Nuclear Waste Repository at Yucca Mountain (USA)," *Proceedings of the Ninth International Conference on Nuclear Engineering, Nice Acropolis-France, April 8-12, 2001*, SFEN, 67, rue Blomet, 75015 Paris, France, (www.sfen.fr).
- Sevougian, S. D., J. A. McNeish, R. W. Andrews, M. L. Wilson, J. H. Gauthier, H. A. Dockery, and R. W. Barnard, 1999, "Recent Analyses of the Long-Term Performance of the Potential Yucca Mountain Repository," *Proceedings of the International Conference on Future Nuclear Systems, Global '99, August 29 - September 3, 1999, Jackson Hole, Wyoming*, American Nuclear Society (www.ans.org), La Grange Park, Illinois 60526.
- Chen, Y., E. Siegmann, P. Mattie, J. McNeish, S. D. Sevougian, and R. Andrews, 1999, "A Mechanism Model of Spent Fuel Dissolution, Secondary Mineral Precipitation, and Np Release," *Mat. Res. Soc. Symp. Proc. Vol. 556*, 471-478.
- RamaRao, B.S.; S. Mishra, S. D. Sevougian, and R. W. Andrews. 1998. "Uncertainty Importance of Correlated Variables in the Probabilistic Performance Assessment of a Nuclear Waste Repository," *SAMO 98: Second International Symposium on Sensitivity Analysis of Model Output, Venice, Italy, April 19-22, 1998*, edited by Chan, K., S. Tarantola, and F. Campolongo, pp. 215-218. Luxembourg, Belgium: Office for Official Publications of the European Communities. TIC: 237987.
- Sevougian, S. D., R. W. Andrews, and J. A. McNeish, 1996, "Total System Performance Predictions (TSPA-1995) for the Proposed High-Level Waste Repository at Yucca Mountain," *Proceedings of the Seventh Annual International Conference on High Level Radioactive Waste Management*, April 29 - May 3, 1996, Las Vegas, Nevada, American Nuclear Society, La Grange Park, Illinois.
- Atkins, J. E., S. D. Sevougian, J. H. Lee, R. W. Andrews, and J. A. McNeish, 1996, "Important Parameters in the Performance of a Potential Repository at Yucca Mountain (TSPA-1995)," *Proceedings of the Seventh Annual International Conference on High Level Radioactive Waste Management*, April 29 - May 3, 1996, Las Vegas, Nevada, American Nuclear Society, La Grange Park, Illinois.
- Sevougian, S. D., L. W. Lake, and R. S. Schechter, 1995, "KGEOFLOW: A New Reactive Transport Simulator for Sandstone Matrix Acidizing," *SPE Prod. & Facil.*, 10(1), 13-19.
- Sevougian, S. D., C. I. Steefel, and S. B. Yabusaki, 1994, "Enhancing the Design of In Situ Chemical Barriers with Multicomponent Reactive Transport Modeling," *In Situ Remediation: Scientific Basis for Current and Future Technologies*, proceedings of the 33rd Hanford Symposium on Health and the Environment, Pasco, WA, 883-911.
- Sevougian, S. D., R. S. Schechter, and L. W. Lake, 1993, "Effect of Partial Local Equilibrium on the Propagation of Precipitation/Dissolution Waves," *Ind. Eng. Chem. Res.*, 32(10), 2281-2304.
- Novak, C. F. and S. D. Sevougian, 1993, "Propagation of Dissolution/Precipitation Waves in Porous Media," in *Migration and Fate of Pollutants in Soils and Subsoils*. NATO ASI Series. Series G: Ecological Sciences, Vol. 32, edited by D. Petruzzelli and F.G. Helfferich, pp. 275-307, Springer-Verlag, Berlin, Germany.
- Sevougian, S. D., L. W. Lake, and R. S. Schechter, 1992, "A New Geochemical Simulator to Design More Effective Sandstone Acidizing Treatments," SPE 24780, *Proceedings of the 67th Annual Technical Conference and Exhibition of the Society of Petroleum Engineers*, pp. 161-175, SPE, Richardson, TX 75083.

Sevougian, S. D., R. S. Schechter, and K. Sepehrnoori, 1987, "Optimization of Vertical Acid Fractures in Steady-State Flow," SPE 16242, *Proceedings of the 1987 SPE International Symposium on Oilfield Chemistry*, pp. 67-80, SPE, Richardson, TX 75083.

TECHNICAL REPORTS:

DOE (U.S. Department of Energy) (2008). *Yucca Mountain Repository License Application*. DOE/RW-0573, Update No. 1. Docket No. 63-001. *Safety Analysis Report*, Section 2.4. Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management

SNL 2008. *Total System Performance Assessment Model/Analysis for the License Application*. MDL-WIS-PA-000005 REV 00 ADD 01. Las Vegas, Nevada: Sandia National Laboratories. ACC: DOC.20080312.0001.

BSC (Bechtel SAIC Company) 2002. *Total System Performance Assessment – License Application: Methods and Approach*. TDR-WIS-PA-000006 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20020923.0175.

BSC (Bechtel SAIC Company) 2002. *Use of One-on Analysis to Evaluate Total System Performance*. TDR-WIS-PA-000011 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. August, 2002.

BSC (Bechtel SAIC Company) 2001. *FY01 Supplemental Science and Performance Analyses, Volume 2: Performance Analyses*. TDR-MGR-PA-000001 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20010724.0110.

CRWMS M&O 2000. *Total System Performance Assessment - Site Recommendation*. TDR-WIS-PA-000001 REV 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20001220.0045

CRWMS M&O 2000. *Total System Performance Assessment (TSPA) Model for Site Recommendation*. MDL-WIS-PA-000002 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20001226.0003

CRWMS M&O 2000. *Repository Safety Strategy: Plan to Prepare the Safety Case to Support Yucca Mountain Site Recommendation and Licensing Considerations*. TDR-WIS-RL-000001 REV 04 ICN 01. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20001122.0186

CRWMS M&O 2000. *Waste Form Colloid-Associated Concentrations Limits: Abstraction and Summary*. ANL-WIS-MD-000012 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000525.0397.

CRWMS M&O 1999. *Total System Performance Assessment-Site Recommendation Methods and Assumptions*. TDR-MGR-MD-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990916.0105.

DOE 1998. *VA Volume 3 - Viability Assessment of a Repository at Yucca Mountain: Total System Performance Assessment*. DOE/RW-0508. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. MOL. 19981007.0030.

CRWMS M&O 1998. *Total System Performance Assessment-Viability Assessment (TSPA-VA) Analyses Technical Basis Document. Chapter 11, "Summary and Conclusions"*. B0000000-01717-4301 -00011 REV 01. Las Vegas, Nevada. CRWMS M&O. MOL. 19981008.0011

CRWMS M&O 1997. *Total System Performance Assessment - Viability Assessment (TSPA-VA) Methods and Assumptions*. B00000000-01717-2200-00193 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980213.0418.

CRWMS M&O 1997. *Near-Field Geochemical Environment Abstraction/Testing Workshop Results*. B00000000-01717-2200-0188. June 13, 1997. Las Vegas, Nevada: CRWMS M&O. MOL.19980612.0027.

CRWMS M&O 1997. *Unsaturated Zone Radionuclide Transport Abstraction/Testing Workshop Results*. B00000000-01717-2200-00185 REV 00. Las Vegas, Nevada: CRWMS M&O. MOL.19980528.0035.

CRWMS M&O 1996b. *Description of Performance Allocation*. B00000000-01717-2200-00177 REV. 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970116.0052.

Sevougian, S. D., J. A. McNeish, Q. L. Wang, J. E. Atkins, and V. Vallikat, 1995, "Natural Barrier Release and Dose," in *Total System Performance Assessment 1995: An Evaluation of the Potential Yucca Mountain Repository*, B00000000-01717-2200-00136, Rev. 01, Civilian Radioactive Waste Management System, Management and Operating Contractor [CRWMS M&O], Las Vegas, Nevada. ACC: MOL.19960724.0188.

Sevougian, S. D., 1995, "Sensitivity of Total System Performance to Variations in the Proportion of Matrix and Fracture Flow in the Calico Hills and other Hydrogeologic Barriers," in *Systems Study of Options for Characterizing the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada*, B00000000-01717-5705-00021, Rev. 00A, Civilian Radioactive Waste Management System, Management and Operating Contractor [CRWMS M&O], Las Vegas, Nevada.

Sevougian, S.D., and L.W. Lake, 1989, "The Computer Simulation of Groundwater Restoration Alternatives Following In Situ Uranium Leaching at O'Hern Production Grid II, Webb County, Texas," report to Malapai Resources Co., Phoenix, AZ, 270 pp.

Sevougian, S.D., and L.W. Lake, 1988, "The Computer Simulation of Heavy Metal Mobilization During In Situ Uranium Leaching at Christensen Ranch Willow Creek R&D Project," report to Malapai Resources Co., Phoenix, AZ, 146 pp.

Sevougian, S.D., 1981, "The Geology of Pennsylvanian and Lower Permian Formations in Southeast New Mexico," Schlumberger GFE Report, 92 pp.

SAXON SHARPE

Saxon Elisabeth Sharpe
Division of Earth and Ecosystem Sciences
Desert Research Institute
2215 Raggio Parkway
Reno, Nevada 89512-1095
(775) 674-7006
(775) 673-7397 fax
Saxon.Sharpe@dri.edu
<http://www.dri.edu/People/ssharpe/>

Education

- ◆ Ph.D. Department of Geological Sciences 1998. University of Nevada, Reno.
- ◆ M.S. Quaternary Studies 1991. Northern Arizona University, Flagstaff.
- ◆ B.A. Environmental Planning 1976. The Colorado College, Colorado Springs.

Professional Experience

- ◆ Associate Research Professor, Earth and Ecosystem Sciences, Desert Research Institute, Reno, Nevada 2006-present.
- ◆ Assistant Research Professor, Earth and Ecosystem Sciences, Desert Research Institute, Reno, Nevada 2000-2006.
- ◆ Senior Research Scientist, URS Greiner Woodward Clyde, Las Vegas, Nevada, 1999-2000 (part-time).
- ◆ Walker River Watershed Planner, Nevada Division of Water Planning, Carson City, Nevada 1998-2000.
- ◆ Staff Paleoecologist, Quaternary Sciences Center, Desert Research Institute, Reno, Nevada 1992-1998.

Relevant Research Interests

My research focuses on biotic, hydrologic, and climatic system interactions, primarily in the desert southwest. In particular, how closely hydrology and climate are linked and how they affect individual species and communities. I use the paleoenvironmental record, specifically packrat middens and mollusks, to estimate past vegetation, landscape, hydrology, and to infer climate change. Paleoecology can be used to help solve problems such as water quality and availability, natural versus human induced climate variation, loss of biodiversity, and restoration of terrestrial and aquatic communities in urban and natural areas.

I have not provided testimony at trial or by deposition in the previous four years.

Memberships

American Association of University Women
American Geophysical Union
American Quaternary Association
Association for Women Geoscientists
Association for Women in Science
Geological Society of America

Relevant Publications and Reports

- Sharpe, S.E. and Forester, R.M. (2008) Continental-aquatic mollusk hydrochemical occurrence patterns: Implications for population dynamics and paleoenvironmental reconstruction. *Quaternary International* 188: 105-116.
- Sharpe, S.E., Cablk, M.E., and Thomas, J.M. (2008) The Walker Basin, Nevada and California: Physical Environment, Hydrology, and Biology. Rev. 01. Desert Research Institute Technical Report #41231, April 2008, 63 p.
- Sharpe, S.E. (2007) Using modern through mid-Pleistocene climate proxy data to bound future variations in infiltration at Yucca Mountain, Nevada, in Levich, R.A., and Stuckless, J.S., eds., *The Geology and Climatology of Yucca Mountain and Vicinity, Southern Nevada and California: Geological Society of America Memoir* 199, p. 155-205, doi: 10.1130/2007.1199(05).
- Johnson, W.G., Sharpe, S.E., Bullard, T.F. and Lupo, K. (2005) Characterizing a First Occurrence of Bison Deposits in Southeastern Nevada. *Western North American Naturalist* 65(1): 24-35.
- Sharpe, S.E. (2004) Chapter 6, Climate: Past Present and Future, Yucca Mountain Site Description Revision 02. Civilian Radioactive Waste Management System Management and Operating Contractor. Yucca Mountain Project.
- Sharpe, S.E. (2004) Solute Composition: A Parameter Affecting the Distribution of Freshwater Gastropods In Conference Proceedings. Spring-fed Wetlands: Important Scientific and Cultural Resources of the Intermountain Region. <http://www.wetlands.dri.edu>
- Waugh, J., S. Link, E. McDonald, D. Rhode, and S. Sharpe. (2003) Characterization of the Environmental Envelope for the Design of Long-Term Covers: Closeout Report. GJO-2003-485-TAC, Environmental Sciences Laboratory, U.S. Department of Energy, Grand Junction, CO.
- Sharpe, S.E. (2003) Future Climate Analysis – 10,000 to 1,000,000 Years After Present. Office of Civilian Radioactive Waste Management. MOD-01-001 Rev. 01. Yucca Mountain Project.
- Young, M., Cooper, C., Sharpe, S. Miller, J., Shafer, D. (2002) Upward Advection: Dynamic Simulation of Vadose Zone Moisture Flux. National Nuclear Security Administration Nevada Operations Office. May 2002.
- Sharpe, S.E. (2002) Future Climate Analysis – 10,000 to 1,000,000 Years After Present. Office of Civilian Radioactive Waste Management. MOD-01-001 Rev 00. Yucca Mountain Project.
- Sharpe, S.E. (2002) Constructing Seasonal Climograph Overlap Envelopes From Holocene Packrat Midden Contents, Dinosaur National Monument, Colorado. *Quaternary Research* 57:306-313.
- Sharpe, S.E. and Forester, R.M. (2001) Reconstructing Past And Forecasting Future Climate At Yucca Mountain, Nevada In "Back to the Future - Managing the Back End of the Nuclear Fuel Cycle to Create a More Secure Energy Future," Proceedings of the 9th International High-Level Radioactive Waste Management Conference (IHLRWM), April 29 - May 3, 2001, Las Vegas, Nevada. La Grange Park, Illinois: American Nuclear Society.
- Sharpe, S.E. (2000) Section 6, Climatology and Meteorology, Yucca Mountain Site Description, Civilian Radioactive Waste Management System Management and Operating Contractor. TDR-CRW-GS-000001 Rev 01 ICN 01. Yucca Mountain Project.

Forester, R.M., Bradbury, J.P., Carter, C., Elvidge-Tuma, A.B., Hemphill, M.L., Lundstrom, S.C., Mahan, S.A., Marshall, B.D., Neymark, L.A., Paces, J.B., Sharpe, S.E., Whelan, J.F., and Wigand, P.E. (1999) The Climatic and Hydrologic History of Southern Nevada During the Late Quaternary. Open-File Report 98-635. Denver, Colorado: U.S. Geological Survey.

Firby, J.R., Sharpe, S.E., Whelan, J.F., Smith, G.R., and Spaulding, W.G. (1997) Paleobiotic and Isotopic Analysis of Mollusks, Fish, and Plants from Core OL-92: Indicators for an Open or Closed Lake System. In "An 800,000-Year Paleoclimatic Record from Core OL-92, Owens Lake, Southeast California". G.I. Smith and J.L. Bischoff, eds. Geological Society of America Special Paper 317, Boulder, CO, pp. 121-125.

Sharpe, S.E., Whelan, J.F., Forester, R.M., and McConnaughey, T. (1994) Molluscs as Climate Indicators: Preliminary Stable Isotope and Community Analysis. In "The 5th Annual International High-Level Radioactive Waste Management Conference and Exposition", May 22-26 1994, Las Vegas, NV. p. 2538-2544.

Selected Abstracts and Presentations

Sharpe, S.E. Forester, R.M. (2008) The Accuracy of Paleoenvironmental Reconstructions Based on Spring and Wetland Gastropod $\delta^{18}\text{O}$ Values: A Field Study. In "AGU Fall Meeting Abstracts with Programs, 15-19 December, 2008. San Francisco, CA.

Sharpe, S. E. (2007) Using the Precession Methodology to Time Past Glacial and Interglacial Climates In "GSA Abstracts with Programs, Vol. 39", 28-31 October, 2007. Denver, CO. ISSN 0016-7592. (Poster).

Sharpe, S.E. (2006) Climate change at a snail's pace: Paleoescargot register past climate. In "Proceedings Climatic Variability of the Eastern North Pacific and Western North America" March 26-29, 2006, Pacific Grove, CA. (Invited speaker).

Sharpe, S., McCurdy, G., Chambers, M., Kemp, H. (2004) Climate Summaries: Yucca Mountain DOE Meteorological Monitoring Sites. In "Program and Abstracts GSA Annual Meeting", 7-10 November, 2004. Denver, CO. (Invited speaker).

Sharpe, S.E. (2004) Yucca Mountain Climate: Past, Present, and Future. U.S. D.O.E. Office of Civilian Radioactive Waste Management. March 9-10 Las Vegas, NV. (Invited Presentation to the Nuclear Waste Technical Review Board Panel).

Sharpe, S.E. (2004) How Accurately Does Freshwater Mollusk Shell $\delta^{18}\text{O}$ Record Climate? In "Proceedings Climatic Variability of the Eastern North Pacific and Western North America" March 28-31, 2004, Pacific Grove, CA. (Poster).

Sharpe, S.E. (2003) Yucca Mountain Climate: Past Present and Future. In "Program and Abstracts GSA Annual Meeting", 2-5 November, 2003. Seattle, WA. (Invited speaker).

Jayco, A.S., Forester, R.M., Sharpe, S., and Smith, G.I. (2001) Constraints on the lacustrine environment during the last pluvial highstand (Late Wisconsin, Tioga Age) in Panamint Valley, southeast California. In "Program and Abstracts American Geophysical Union Fall Meeting, December, 2001. San Francisco, CA. (Poster).

Sharpe, S.E. (2001) Performance Assessment – Natural System Future Climate Analysis – 10,000 to 1,000,000 Years After Present. U.S. D.O.E. Office of Civilian Radioactive Waste Management. May 8-9, Arlington, VA. (Invited Presentation to the Nuclear Waste Technical Review Board Panel).

DAVID SHOESMITH

DAVID WILLIAM SHOESMITH

Professor

Department of Chemistry
The University of Western Ontario
London, Ontario, N6A 5B7
Tel. 519-661-2111 (6366)
FAX 519-661-3022
e-mail dwshoesm@uwo.ca

CURRICULUM VITAE

Degrees and Fellowships

- Fellowship of International Association of Corrosion Engineers (1997)
- Senior Visiting Scientist, Department of Electrochemistry, University of Southampton, UK (1985-1986)
- Fellowship of the Canadian Society for Chemistry (1985)
- Postdoctoral Fellowship, 1970-73 with Professor R.G. Barradas at Carleton University, Ottawa
- Ph.D. (1970) University of Newcastle-upon-Tyne
- B.Sc. (1967) Chemistry (Honours), University of Newcastle-upon-Tyne, England

Work Experience

- From June 2009, Cross appointed to the Department of Chemical Engineering, University of Western Ontario.
- From November 2000; NSERC/Ontario Power Generation Industrial Research Chair holder in Fuel Disposal Chemistry; University of Western Ontario
- From June, 1998, Professor, Electrochemistry and Corrosion Science Department of Chemistry, University of Western Ontario, London, Ontario.
- From July, 1991, Principal Research Officer, Atomic Energy of Canada Ltd. Whiteshell Laboratory, Pinawa, MB.
- Jan., 1987- July, 1991, Senior Research Officer, AECL (Pinawa).
- Sept. 1985 - Aug. 1986; Senior Visiting Scientist, Department of Electrochemistry University of Southampton (UK).
- Feb., 1985- Sept 1997; Head of the Electrochemistry and Corrosion Section, AECL(Pinawa).
- Jan. 1, 1982, Research Officer, AECL (Pinawa).
- Jan. 1, 1976, Associate Research Officer, AECL(Pinawa).
- July 1, 1973; Assistant Research Officer, AECL (Pinawa).

Society Memberships

- Chemical Society of Canada
- Electrochemical Society
- International Society of Electrochemistry
- National Association of Corrosion Engineers (International).
- Materials Research Society
- American Society for Metals

Awards

- Electrochemical Society Lash Miller Award for Electrochemistry (1979)
- AECL Discovery Award for the development of a model to predict used fuel dissolution rates under waste disposal conditions (1994).
- Canadian Chemical Society (Manitoba) Outstanding Chemist Award (1997)
- Cohen Award for Contributions to Corrosion Science (Canadian Metallurgical Society, (2001)
- Distinguished Research Professor, University of Western Ontario, 2004-2005.

Positions Held

- Canadian National Secretary for the International Society of Electrochemistry, 1983-91
- Adjunct Professor, Department of Chemistry, University of Manitoba, Winnipeg., 1984.
- Associate Editor, *Electrochimica Acta*, 1986-97,
- Sectional Editor (Electrochemistry, Surface Science and Solution Chemistry) *Canadian Journal of Chemistry*, 1989-93.
- Member of the Advisory Board of the *Russian Journal of Physical Chemistry*, 1993-8.
- Member of the USDOE Waste package degradation expert elicitation panel, 1997.
- Member of the USDOE Mined Geological Disposal System Board, 1997-99.
- Consultant to the Electrical Power Research Institute (EPRI), Palo Alto, CA on waste disposal, 1997- 2004.
- Member of the USDOE Waste Forms Degradation expert elicitation panel., 1997
- Editorial Board (*Corrosion* 2000 – 2002)
- Member of the NACE International Research Committee (1999 – present)
- Co-Chairman of the MRS Symposium on “The Scientific Basis of Nuclear Waste Management”, Boston, MA, Nov 29-Dec 2, 1999.
- Vice-chairman of the NACE Research in Progress Symposium, Orlando, FL, March, 2000.
- Chairman, NACE Topical Research Symposium on “Modeling and Prediction of Lifetimes for Corrodible Structures, San Diego, CA, March 2003
- Chairman NACE International Research Committee (2003 –2004)
- Co-Chairman, Canadian Institute of Mining and Metallurgy International Symposium on “Environmental Degradation of Materials and Corrosion Control in Metals, Vancouver, BC, August, 2003

- Co-Chair, Nuclear Waste Management Organization Workshop on “The Technical Aspects of Nuclear Fuel Waste Management, McMaster University, ON, September 2003.
- Co-Chair of the USA Department of Energy (Fundamental Sciences Division) Workshop on “The Fundamental Research Requirements in Corrosion Science”, Washington, DC, December 2003.
- Session Chair, Gordon Conference on Aqueous Corrosion, New London, NH, USA, July 2004.
- Chairman, NACE Topical Research Symposium on “Corrosion Resistant Materials in Extreme Environments, Houston, TX, April 2005.
- Advisory Committee member, Materials Research Society Symposium (Scientific Basis for Nuclear Waste Management, Mol, Belgium, September 2007
- Canadian Neutron Beam Centre (Chalk River, Ontario) Oversight Committee (2006 – Present).
- Co-Organizer; Symposium on Electrochemical Materials Science and Molecular Electrochemistry, 58th Annual ISE Conference, Banff, AB, Canada, Sept-9-14, 2007
- Invited Participant at the USDOE Science and Technology Workshop on Novel Nuclear Wasteforms and Modelling and Simulation Procedures for Waste Disposal Systems, Ann Arbor, Michigan, January 2008.
- Co-chairperson, NACE International Topical Research Symposium on Corrosion Issues in Nuclear Waste Systems, New Orleans, March 2008.
- Gordon Conference (Aqueous Corrosion) Session Chair, Modelling Aqueous Corrosion Processes, New Hampshire, July 2008.
- Invited member of the International Science Advisory Board for the French Spent Nuclear Fuel Research Program, French Atomic Energy Agency, Saclay, September 2008.
- Symposium Organizer, International Corrosion Congress meeting, Las Vegas, NV, USA, October 2008.
- Gordon Conference (Aqueous Corrosion) Co-Chairman, New Hampshire, July 2010
- Chairman and Organizer, International Spent Fuel Workshop, Toronto, May 7-8, 2009.
- Advisory Editorial Board, Journal of Nuclear Materials, (from February 2009).

Post Graduate Supervision (1998-2008)

Student	Program	Period of Supervision
Xihua He	Ph.D.	May 1999 – November 2003
Amy Lloyd	Ph.D	September 1999 – December 2004
Charmaine Lee	Ph.D.	May 1999 – February 2006
Heather Jensen	M.Sc.	May 1999 – September 2001
Billy Santos	Ph.D.	September 2000 – December 2005
Jon Goldik	Ph.D.	September 2000 – January 2006
Woo-Jae Cheong	Ph.D.	September 2001 – January 2006

Li Yan	Ph.D.	January 2002 – August 2007
Jared Smith	Ph.D.	September 2003 – October 2007
Michael Broczkowski	Ph.D.	September 2003 – May 2008
Derrick Ofori	M.Sc.	September 2005 – July 2008
Yimin Zeng*	Ph.D.	January 2004 – May 2009
Pellumb Jakupi	Ph.D.	September 2004 -
Xiangrong Zhang	Ph.D.	September 2006 -
Brent Sherar	Ph.D.	September 2006 -
Heming He	Ph.D.	September 2004 -
Katayoun Yazdanfar*	M.Sc.	January 2007 -
Catherine Nowierski*	M.Sc.	May 2007 -
Ajit Mishra	Ph.D.	September 2008 -
Mayuri Razdan	Ph.D.	January 2009 -
Yannick Beauregard	M.Sc.	July 2009 -
Dhar Bhuvaneshwar	M.Sc.	September 2009 -
Linda Wu	M.Sc.	September 2009 -

*Joint Supervision

Student Theses

- David Mancey; The Dissolution of Magnetite Films from Carbon Steel Surfaces; M.Sc. University of Manitoba, Winnipeg, MB, July 1985
- Jodi Luht; M.Sc., Anodic Dissolution of Uranium Dioxide in Simple Electrolyte Solutions and Simulated Groundwaters; University of Manitoba, Winnipeg, MB, April 1998.
- James Noel; Electrochemistry of Titanium Corrosion; Ph.D., University of Manitoba, Winnipeg, MB, 1999.
- Heather Jensen; M.Sc. Properties of Anodic Oxide Films on Zirconium Alloys; M.Sc., University of Western Ontario, London, ON, December 2001
- Xihua He; Ph.D.; Effects of Temperature, Impurities, and Alloying Elements on the Crevice Corrosion of Alpha Titanium Alloys, University of Western Ontario, London, ON, November 2003.
- Amy Lloyd, Ph.D., The Effects of Temperature and Potential on the Passive Corrosion properties of Ni-Cr-Mo Alloys, UWO, London, ON, December 2004.
- Billy Santos, Ph.D., The Influence of Surface Films on the Electrochemistry of Uranium Dioxide, December 2005
- Jon Goldik, Ph.D., Electrochemistry of Uranium Dioxide in peroxide Solutions, January 2006.
- Woo-Jae Cheong, Ph.D., Development of a Protective Coating on the Magnesium AZ91D Alloy, February 2006.
- Charmaine Lee, Ph.D. The Corrosion of Carbon Steel within a Failed Nuclear Waste Container, April 2006.

- Li Yan, Ph.D., The Absorption of Hydrogen into Alpha Titanium Alloys under Crevice Corrosion and Passive Conditions, August 2007.
- Jared Smith, Ph.D. The Corrosion and Electrochemistry of Copper in Anoxic Aqueous Sulphide Solutions, October 2007.
- Michael Broczkowski, Ph.D. The Effects of Hydrogen and Temperature on the Electrochemistry and Corrosion of Uranium Dioxide, May 2008
- Derrick Ofori, M.Sc. The Influence of Corrosion Product Deposits on UO₂ Corrosion/Dissolution, July 2008
- Yimin Zeng, Ph.D. Passive Film Properties and Their Influence on Hydrogen Absorption into Titanium, May 2009

Graduate Student awards

- Dr. Joseph Soltys Graduate Award in Chemistry 2009 [Katy Yazdanfar](#)
- Student Poster Award (1st) 2008 [Catherine Nowierski](#) Electrochemical Society (Canadian Section) meeting, Montreal, QB
- Student Poster Award (Joint 1st) 2008 [Heming He](#) Electrochemical Society (Canadian Section) meeting, Edmonton, AB
- Poster Award (Joint 1st) 2008 [Brent Sherar](#) Electrochemical Society (Canadian Section) meeting, Edmonton, AB
- Marcel Pourbaix Student poster award (2nd) 2008 [Heming He](#) NACE* International Conference, New Orleans, LA
- Marcel Pourbaix Student poster award (3rd) 2008 [Pellumb Jakupi](#) NACE international conference, New Orleans, LA
- Student Poster award (3rd) 2007 [Michael Broczkowski](#) ECS/NACE Northern Area Eastern Conf., Ottawa
- R.E. Jervis Award (Joint) 2007 [Michael Broczkowski](#) , Canadian Nuclear Society, Toronto
- R.E. Jervis Award (Joint) 2007 [Jared Smith](#) , Canadian Nuclear Society, Toronto
- Student Poster award (1st) 2007 [Derrick Ofori](#) ECS/NACE Northern Area Eastern Conference, Ottawa
- Best Ph.D Student Presentation 2006 [Michael Broczkowski](#) 30th Canadian Nuclear Society Conference, Toronto, ON
- Student Poster Award (1st) 2005 [Woo-Jae Cheong](#) 207th Electrochemical Society, Quebec City, QB
- Harvey Herro Award (2nd) 2005 [Jared Smith](#) NACE International conference, Houston, TX
- Student poster award (1st) 2005 [Charmaine T. Lee](#) WINS workshop, London, ON
- Mars Fontana Award (3rd) 2004 [Woo-Jae Cheong](#) NACE International conference, New Orleans, LA
- R. E. Jervis award 2004 [Billy Santos](#) Canadian Nuclear Society, Toronto
- Student Poster award (2nd) 2004 [Jared Smith](#) Electrochemical Society (Canadian Section) symposium, Guelph, ON

- Student Award 2004 [Amy Lloyd](#) Canadian Section of the Electrochemical Society
- Student presentation (Honorable Mention) 2004 [Jon Goldik](#) 87th Canadian Chemistry Conference, London ON
- Best Student Presentation/Paper 2003 [Amy Lloyd](#) 28th Canadian Nuclear Society student conference, Toronto, ON
- Marcel Pourbaix student poster award (2nd) 2002 [Charmaine T. Lee](#) NACE International conference, Denver, Colorado
- Best Student Paper 2002 [Xihua He](#), Canadian Society for Metallurgy annual meeting, Montreal, QB
- Student poster award (Honorable Mention) 2002 [Amy Lloyd](#) Electrochemical Society Centennial meeting., Philadelphia, PA
- Student Poster award (1st) 2001 [Xihua He](#), Electrochemical Society (Canadian Section) meeting, London, ON
- Student Poster award (2nd) 2001 [Amy Lloyd](#) Electrochemical Society (Canadian Section) meeting, London, ON
- Marcel Pourbaix student poster award (3rd) 2001 [Heather Jensen](#) NACE international conference, Houston, TX
- Marcel Pourbaix student poster award (1st) 2001 [Amy Lloyd](#) NACE International conference, Houston, TX
- *NACE – International Association of Corrosion Engineers

Research Funding (since 2000)

Duration	Granting Agency (Type)	Title	Total funding
2000 - 2004	NSERC (Discovery Grant)	Electrochemistry of Passive Films and Corrosion Processes	\$165,000
2003-2004	Monitor Scientific, Denver, CO (Commercial)	Modelling Nuclear Waste Container Corrosion	\$44,000
2004	Ifire, Toronto (Consulting)	Electrochemical Methods	\$5,000
2004	SKB, Stockholm, Sweden (Consulting)	Review of Nuclear Fuel Disposal	\$7,146
2000-2005	NSERC/Ontario Power Generation (Industrial Research Chair)	Chemistry of Nuclear Fuel Disposal	\$1,550,000
2000-2005	Bechtel SAIC, Las Vegas,NV (Consulting)	Nuclear Fuel Disposal Issues	\$168,000
2002-2005	SKB, Stockholm, Sweden (Commercial)	Corrosion of Copper in Bentonite Clay	\$253,000
2002-2005	NOVA Research and Technology, Calgary (Research Grant)	Corrosion of Carbon Steel under Gas Transmission Conditions	\$55,000

2004	Canadian Foundation for Innovation (Equipment; 14 co-applicants)	National Neutron Reflectometer	\$2,464,455
2004-2007	USA Department of Energy (Commercial)	Crevice Corrosion of Alloy 22	\$492,000
2007-2012	NSERC (Major Facilities Award; 14 co-applicants)	Canadian Neutron Beam Laboratory (Chalk River)	\$6,590,000
2004-2008	NSERC (Discovery Grant)	Electrochemistry of Passive Films and Corrosion Processes)	\$235,000
2006-2010	NSERC/Nuclear Waste Management Organization, Toronto (Industrial Research Chair renewal)	Chemistry of Nuclear Fuel Disposal	\$1,497,000
2005	Bruce Power, Tiverton, Ontario (Consulting)	Review of Low Void Reactivity Fuel	\$10,000
2007-2009	SKB, Stockholm, Sweden (Commercial)	Corrosion of Copper in Waste Vault Conditions	\$269,000
2007-2008	Sandia National Laboratory, Albuquerque, NM (Consulting)	Waste Container Issues	\$45,400
2006-2008	Nagra, Wetingen, Switzerland (Consulting)	Container Materials review Board	\$24,760
2007-2012	NSERC (Infrastructure Operating Fund; 14 co-applicants)	National Neutron Reflectometer	\$259,000
2005-2008	USA Department of Energy Science and Technology Fund (Commercial)	Evolution of Physical Damage due to Crevice Corrosion on Alloy 22	\$328,000
2005-2008	USA Department of Energy Science and Technology Fund (Commercial)	Kinetics of Oxygen Reduction on Alloy 22	\$328,000
2007-2008	OCE Centre for Materials and Manufacturing (Proof of Concept) PI – Sohrab Rohani	Water Splitting for Hydrogen Production on Titania Nanotubes	\$50,000
2008-2010	SKB, Stockholm, Sweden (Commercial)	Electrochemical Studies on Uranium Dioxide	\$319,800
2008-2012	Ontario Research Foundation; (Commercial)	Nuclear Ontario –A University (5)-based Network	\$4,437,000
2009- 2014	NSERC (Discovery Grant)	Electrochemistry of Passive Films and Corrosion Processes	\$200,000

* Primary Applicant

Research Achievements.

(a) Redox Chemistry of UO₂

Uranium dioxide is of critical industrial importance as the major nuclear fuel form. Its extractive metallurgy, in-reactor chemical reactivity, and eventual disposal as waste, are all dependent on the interfacial redox chemistry of the solid. The author is internationally recognized as the expert in this field. Since 2000 he has written four extensive reviews. In 2000 he was awarded the Industrial Research Chair in Fuel Disposal Chemistry (NSERC/Nuclear Waste Management Organization) (renewed in 2005). He is an invited participant in the on-going European Commission project on modeling fuel corrosion, and contracted to SKB (Sweden) to study specific aspects of the subject. In 2008 he was an invited reviewer of the French program on research related to fuel disposal. Key contributions include the following;

- Development of an understanding of enhanced reactivity at non-stoichiometric sites
- Determination of the influence of rare earth doping on chemical reactivity
- Demonstration of the ability of dispersed metallic particles to enforce the separation of anodes and cathodes
- Determination of the mechanisms of H₂O₂ and O₂ reduction

These contributions are of general significance to the understanding of the redox chemistry of oxides, minerals and other non-metallic solids.

(b) Experimental and Computational Methodologies for Studying Corrosion Processes

Corrosion processes are multi-faceted and no single technique can yield a comprehensive understanding. A wide range of electrochemical and analytical methodologies have been developed for, or adapted to, the study of these processes. The author has pioneered the application of scanning electrochemical microscopy (SECM) to corrosion systems, the development of in-situ neutron reflectometry-electrochemical impedance spectroscopy (NER-EIS) to determine thin film properties immeasurable by other techniques, the use of current sensing atomic force microscopy (CS-AFM) to determine the distribution of corrosion-supporting surface locations, and the development of a galvanic coupling technique to monitor the progress of crevice corrosion up to $T > 200^{\circ}\text{C}$.

- SECM has been applied to the determination of grain boundary reactivities in titanium and zirconium alloys and the determination of the corrosion rates of inhomogeneously-distributed defect structures in uranium dioxide.
- NER-EIS allows the dielectric and impedance properties of, and hydrogen profiles in, thin oxide films to be depth-profiled. The technique has been applied to titanium and zirconium surfaces.
- The galvanic coupling technique has been used to develop damage functions for a range of titanium and nickel alloys, and, presently confocal laser scanning microscopy is being used to confirm the results from electrochemical measurements.
- CS-AFM has been used to demonstrate the existence of anisotropic conductivity in non-stoichiometric uranium dioxide grains.

(c) Corrosion Properties of Titanium Alloys

A comprehensive understanding of the electrochemistry and corrosion properties of α -, and near- α Ti alloys has been developed. Major contributions include;

- The development of a fundamental understanding of crevice corrosion, especially the influence of minor impurities and alloying additions.
- The determination of the influence of grain boundaries on corrosion initiation events
- The determination of the permeability of oxide films and the influence of secondary precipitates on hydrogen absorption into the substrate alloy.
- The influence of temperature on the form and frequency of oxide film breakdown-repair events.

The electrochemical/corrosion properties developed, or under development, are of universal importance in the materials selection process for a range of industrial applications. Since 2000, the author has written 4 authoritative reviews on the subject.

(d) Corrosion of Materials Important in Nuclear Waste Systems.

The applicant is acknowledged as an international leader in the development of corrosion performance models for nuclear waste disposal systems, and recently (2006) wrote an authoritative review of the area. He has been contracted to experimentally study, computationally model, or review container issues by Sweden, Switzerland and the USA. Most recently, he has published,

- a performance assessment model for the engineered barriers system proposed by the Yucca Mountain Project (YMP) (2001),
- a deterministic model for the corrosion of fuel inside a failed Cu container (2003),
- a probabilistic model for the corrosion of Ti Grade-7 drip shields proposed for the YMP (2008). A version of this model has been used by the US DOE in their license application to use Yucca Mountain as a disposal site.

These models have been supplemented by extensive experimental studies on a range of candidate materials including Cu, carbon steel, Ti and Ni-Cr alloys. Many of the procedures and model formats developed are adaptable more generally to other industrial corrosion scenarios.

Present Research Interests

(1) Electrochemistry of Nuclear Fuel

The kinetics of nuclear fuel dissolution processes, and how they are influenced by corrosion of the carbon steel container liner within a failed nuclear waste container, are being studied in a range of conditions designed to simulate the anticipated conditions in a nuclear waste repository. The primary goal is to develop, and provide data for, computational models to predict the long-term behaviour of fuel inside a failed nuclear waste container.

(2) **In-situ Electrochemistry-Neutron Reflectometry**

This novel technique provides a non-destructive method to investigate a multitude of surface reactions under in-situ electrochemical control. Presently, we are using this technique to investigate processes occurring in thin oxide films on metals, such as the absorption and transport of hydrogen in titanium and zirconium. Using isotopic labeling techniques, we are also investigating defect transport processes during anodic oxide film growth.

(3) **Development of Deterministic and Probabilistic Models for Engineered Barrier Failure Processes under Nuclear Waste Disposal Conditions**

A range of models for various corrosion processes have been published or are being developed. These include hydrogen-induced cracking models for Ti-Pd Alloys and localized corrosion models for Ni-Cr-Mo alloys. The primary goal is to assess the consequences of various uncertain variables on the times to failure of the engineered barriers in a nuclear waste repository. A finite difference model to predict the corrosion rates of nuclear fuel inside a failed nuclear waste container has also been developed.

(4) **Properties of Passive Films on Titanium and Ni-Cr-Mo Alloys**

These alloys are some of the most corrosion resistant materials developed, and rely on the presence of thin defective oxide films (1 to 5 nm) to maintain their corrosion performance. We are investigating the properties of a series of these alloys using electrochemical and surface analytical techniques (Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS), X-ray Photoelectron Spectroscopy (XPS), Confocal Scanning Laser Microscopy (CSLM), Scanning Electrochemical Microscopy (SECM), Neutron Reflectometry, Raman Microspectroscopy and Imaging) to determine how the alloy composition influences passive behaviour. The primary goals are to determine whether available film growth models, developed for simpler materials, are consistent with observed experimental behaviour, and the importance of grain boundaries in the initiation of localized corrosion.

(5) **Current/Potential Signal Analysis and SIMS Imaging of Materials Undergoing Localized Corrosion .**

The size, frequency, and shape of electrochemical current and potential signals generated during localized corrosion processes are indicative of the physical/electrochemical/ chemical events within local, often microscopic, corroding sites. By coupling the analysis of these signals to electrochemical impedance and SIMS imaging studies of the corroded sites we are trying to determine the redistribution of alloying/impurity elements as a consequence of corrosion and how this influences the site behaviour. These studies are being performed as a function of temperature up to ~220°C.