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AREAS OF EXPERTISE AND RESEARCH INTERESTS

Medical geology, epidemiology, health effects, and geochemistry of radionuclides and metals; statistical analysis of environmental geochemical data, innovative methods in environmental remediation and water treatment; development of risk assessment methods to support formulation of environmental and public health regulations.

RESEARCH AND MANAGEMENT EXPERIENCE

- **Adjunct Assistant Professor, School of Medicine, University of New Mexico, Albuquerque, NM. (2006-2014).**

I recently completed work in environmental epidemiology research in the Dept. of Internal Medicine, Division of Epidemiology, Biostatistics and Preventive Medicine. The project examines the synergistic effects of exposure to sunlight and arsenic in drinking water and the development of melanoma (skin cancer) in New Mexico. I have taught courses in the Department of Family and Community Medicine: Environmental Health (2006), Water and Public Health (2007).

- **Vice President, LJS Consulting, Inc., Sandia Park, NM (2008-2014)**

I am responsible for statistical and GIS analyses of public health and environmental data and for developing projects in environmental science and education. Most recently, I carried out analyses of performance metrics for the UNM-Envision 2011-2012 end-of-year report on School-Based Health Centers, environmental health data for the 2010 Bernalillo Community Health profile, and designed a treatment study to evaluate the effectiveness of a novel material for removal of radionuclides from water.

- **Technical Staff, Sandia National Laboratories, Albuquerque, NM. (1981 - 2011).**

As a Senior and later a Principal Member of the Technical Staff at Sandia National Laboratories from 1981 to 2011, I led research teams involved in studies supporting probabilistic risk assessment, statistics-based hydrochemical studies, environmental contamination and water treatment. Most recently, I headed a NM Small Business Assistance program dealing with environmental characterization and treatment of groundwaters with high uranium, radionuclide and arsenic levels

Small Business Assistance Programs for Water Treatment and Uranium Mining (2007-2011):

I served as Principal Investigator for this project which helped over 20 small New Mexico businesses by applying innovative approaches for identifying new markets, stakeholder interactions, testing low-cost radioanalytic techniques and evaluating innovative modeling and water treatment methods.

Arsenic Water Technology Partnership Project (2003 - 2006):

The goal of this large, multi-agency project was to develop innovative low-cost methods to remove arsenic in drinking water sources through laboratory research, pilot treatment studies and community outreach. I served as Chairman of the Multiagency Project Management Committee, Technical Manager for the Sandia Arsenic Treatment Technology Demonstration Project and member of the Sandia Arsenic Sorbent Development Team.

D.O.E. Innovative Treatment and Remediation Demonstration (ITRD) Program (1999-2003):

I was Technical Coordinator for this large project which was part of the D.O.E. Environmental Remediation Program. The program goal was to facilitate the introduction of innovative environmental technologies into sites in the DOE complex that had been contaminated during Cold War production of nuclear weapons. The ITRD process involved: 1) facilitating negotiations among all stakeholders (community, regulatory agencies, site managers, technology businesses) and 2)

evaluation of innovative remediation and monitoring technologies through laboratory and field pilot studies.

Waste Isolation Pilot Plant Site (WIPP). (1987-1990; 1995-1999):

I was Principal Investigator for experimental studies of radionuclide retardation and actinide precipitation in saline waters and Principal Investigator for regional hydrogeochemical studies of the Culebra dolomite aquifer at the Waste Isolation Pilot Plant site in SE New Mexico. During the projects, I set up radiochemistry and sorption laboratories, coordinated supporting geochemical research at several universities and developed innovative approaches to characterize regional water compositions in support of performance assessment programs.

D.O.E. High Level Nuclear Waste Disposal at Yucca Mountain, Nevada. (1990-1995, 2006-2007).

I was Principal Investigator for several large to mid-sized projects to validate models for radionuclide transport in support of performance assessment of nuclear waste disposal. The projects involved development of reactive transport models, laboratory studies of trace element sorption by geologic materials and field tests of solute transport. I also served as member of several national and Sandia teams tasked with evaluating contaminant transport model validity, international research in nuclear waste disposal, and near-field disposal models.

U.S. Nuclear Regulatory Commission High Level Nuclear Waste Program (1981-1988).

I served on several project teams and was Principal Investigator for geochemical sensitivity analysis for high-level waste (HLW) performance assessment to determine most important geochemical processes in waste isolation.

- **Technical Staff, Israel Oceanographic and Limnological Institute, Haifa, Israel (1976-1977)**

I was scientist in the chemistry department and worked on studies of mercury pollution in waters near the Israeli coast in the year between my Masters and PhD studies at Harvard University.

TEACHING EXPERIENCE

- **University-level Teaching Experience (course syllabus available on request)**

Adjunct Assistant Professor, Department of Family and Community Medicine, University of New Mexico, Albuquerque, NM. (2006-2008). Courses: Environmental Health (2006), Water and Public Health (2007).

Adjunct Assistant Professor, Department of Civil Engineering, University of New Mexico, Albuquerque, NM. (1995 – 1997). Courses: Environmental Surface Chemistry (1995); Geochemical Modeling (1996).

Thesis advisory committees: Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM (1994 –1998); Department of Civil Engineering, University of New Mexico, Albuquerque, NM. (1995 – 2007); Department of Earth and Environmental Sciences, New Mexico Tech (2005 – 2007).

Teaching Fellow: Department of Geological Sciences, Harvard University (1977-1979). Courses: Economic Geology (1977-1978), Resources, Energy and Society (1979).

- **Professional Short Courses and Conferences (detailed title list available on request)**

Short Course Chair and Instructor: New Mexico Environmental Health Conference Short Courses: "Arsenic Compliance: New Mexico's Challenge!" (2001), Arsenic Treatment Technology Forums, (2003, 2004, 2005).

Session Chair: MEDGEO 2013 Annual Conference of International Medical Geology Association (Radioactivity, Geochemistry and Health, 2013); Rocky Mountain Section, Geological Society of America Annual Meeting (2012); Geological Society of America Annual Meeting (2010); Geophysical Union Joint Assembly (2007); American Association Advancement of Science Annual Meeting (2004); DOE Technology Information Exchange Workshop (2000, 2001); Geological Society of America Annual Meeting (1993).

Recent Invited/Guest Lectures: Engineers Without Borders Annual Meeting (2010); Instructor, Taiwan Typhoon & Flood Research Institute -Reactive Transport Modeling (2009); Keynote Speaker, NM Society Professional Engineers E-Week (2009); New Mexico Rural Water Association Conference (2005, 2008); Duke University Water Seminar Series (2007); Navajo Nation Environmental Protection Agency Conference (2007); Nevada Rural Water Association Annual Meeting (2007); American Chemical Society Annual Meeting (2006); National Groundwater Association Naturally-occurring Contaminants Meeting, (2006, 2007); American Water Works Association Inorganic Contaminants Conference (2006); Interstate Technology Regulatory Committee Annual Conference, Plenary Speaker (2004).

- **Other Educational Programs**

Project Learning Tree: Facilitator Trainer 2012-2014

Environmental Education Association of New Mexico, Board Member 2011-2014

Explora Museum: Portal to the Public (PoP) Program, docent (2009-2013).

New Mexico Museum of Natural History and Science, docent (2012-2013); President-elect of Volunteers Association (2014-2015).

Manos, Hands-on Science and Engineering Program (Albuquerque Public Midschools)

ACTS, Academies Creating Teacher Scientists (Albuquerque Public Schools)

Sandia School Science Partnership (San Antonito Elementary School).

Engineers Without Borders (Pine Hill School, Ramah Navajo Reservation).

Contemporary Issues in Science (Albuquerque Public High Schools)

EDUCATION

- Junior-Year Abroad Program, Tel Aviv University, Ramat Aviv, Israel, 1971-1972.
- B.A. Chemistry, Columbia University, New York, NY, 1973.
- M.A. Geological Sciences, Harvard University, Cambridge, MA, 1975.
- Ph.D. Geological Sciences, Harvard University, Cambridge, MA, 1981.
- Masters of Public Health in Epidemiology, University of New Mexico, Albuquerque, NM, 2003.

WEB SITES

Sandia National Laboratories Arsenic Water Technology Partnership Pilot Demonstration Project, <http://www.sandia.gov/water/arsenic.htm>.

SELECTED PUBLICATIONS (A complete list of more than 65 publications is available on request.)

Siegel, M. D. and Anderholm, S., 1994. "Geochemical Evolution of Groundwater in the Culebra Dolomite Near the Waste Isolation Pilot Plant, Southeastern New Mexico, USA," *Geochimica et Cosmochimica Acta*, 58-10: 2299-2323.

Bryan, C. and Siegel, M. D., 1998. "Irreversible Adsorption of Uranium onto Iron Oxides: A Mechanism for Natural Attenuation at Uranium-Contaminated Sites?" Proceedings of *Contaminated Soils and Groundwater- Analysis, Fate, Environmental and Public Health Effects*, March 8 - 12, 1998, Oxnard, CA.

Yeh, G-T., Siegel, M.D., and Li, M.H., 2001. "Numerical Modeling Of Coupled Variably-Saturated Fluid Flow And Reactive Transport With Fast And Slow Chemical Reactions," *Journal of Contaminant Hydrology* 47: 379-390.

Siegel, M., Frost, F. and Tollestrup, K., 2002. "Ecological Study of Bladder Cancer in Counties with High Levels of Arsenic in Drinking Water", *Annals of Epidemiology* 12-7: 512.

- Siegel, M. D., Cheng, W. C., and Krstich, M., 2003. *Hanford 200 West Area DNAPL Characterization Technology Review, SAND2003-0271P*, Sandia National Laboratories, Albuquerque, NM.
- Thomson, B.M., Smith, C.L., Busch, R.D., Siegel, M.D., and Baldwin, C., 2003. "Removal of Metals and Radionuclides Using Apatite and Other Natural Sorbents" *J. Environmental Engineering*, 129-6: 492 – 499.
- Siegel, M. D. and Bryan, C. R., 2003. "Environmental Geochemistry of Radioactive Contamination", in B. Sherwood, ed. *Vol. 9, Environmental Geochemistry*, in H. D. Holland and K. Turekian eds., *Treatise on Geochemistry*, Elsevier, North-Holland, New York, pp. 205-262.
- Siegel, M. D., 2004. *An Ecological Study of Arsenic-Related Bladder Cancer in U.S. Counties: Effects of Reference Populations and Confounders on the Calculated Risks. SAND2004-1379P*, Sandia National Laboratories, Albuquerque, NM.
- Siegel, M., McConnell, P., Ilges, A., Chen, H., Ghassemi, A. and Thompson, R., 2006. "Development and Evaluation of Innovative Arsenic Adsorption Technologies for Drinking Water by the Arsenic Water Technology Partnership"; *Proc. National Groundwater Association Meeting on Naturally Occurring Contaminants, February 6, 2006*, Albuquerque, NM, National Groundwater Association Press, Westerville, OH.
- Siegel, M., Holt, K., Misra, S., and Hunter, W., 2007. "Pilot Testing of Technologies to Remove Arsenic and Radium from a Drinking Water Source at the Pine Hill School on the Ramah Navajo Reservation", *Proc. NGWA Naturally Occurring Contaminants Conference, Charleston, SC, March 23, 2007*.
- Siegel, M., Vengosh, A., and Kottenstette, R., 2007. "Radium in Groundwater Aquifers in the United States and Middle East: Occurrence, Treatment and Implications for Inland Desalination", SAND2007-2888C, Presented at NGWA Groundwater Summit. Albuquerque, NM., April 30, 2007.
- Siegel, M., Aragon, A., Zhao, H., Nocon, M., and Aragon, M., 2008. "Prediction of the Performance of Arsenic Adsorbent Media: A Comparison of Field and Laboratory Studies" SAND2007-1923P; in: *Arsenic Contamination of Groundwater: Mechanism, Analysis, and Remediation*, ed. Satinder Ahuja, John Wiley and Sons, Inc, Hoboken, NJ.
- Davis, P., Heikoop, J. Longmire, P., Siegel, M. and Simmons, A., 2009. *Uncertainties in the Ability of Natural Attenuation to Reduce Uranium Migration from In Situ Uranium Recovery Fields. SAND2009-0622 P*. Sandia National Laboratories, Albuquerque, NM.
- Siegel, M.D. and Castello, K., 2012. "Selection of Arsenic Treatment Technologies for Small Community Water Systems in New Mexico: Geochemical (and other) Determinants", abstract Geological Society of America Rocky Mountain Section Annual meeting, Albuquerque, NM, May 9 -12, 2012.
- Bryan, C.R., Siegel, M.D., Vinson, D.S., Vengosh, A., Raanan, H., and Dwyer, G.S., 2012. "Use of Radium Isotopes to Evaluate Uranium and Radium Sources and Behavior in New Mexico Groundwaters: Examples from Three Sites", abstract Geological Society of America Rocky Mountain Section Annual meeting, Albuquerque, NM, May 9 -12, 2012.
- Myers, O.B., Siegel, M., Sanchez A., Erdei, E., Berwick, M., Yager, J., 2012. "Estimating Environmental Exposure to Arsenic and Ultraviolet Radiation for a Health Study of Melanoma Among Non-Hispanic Whites in New Mexico", abstract Geological Society of America Rocky Mountain Section Annual meeting, Albuquerque, NM, May 9 -12, 2012.
- Siegel, M.D., 2013. "Uranium Mining in the American Southwest: Can Medical Geologists Ask the Right Questions?", MEDGEO 2013, Washington, DC, August 25-29, 2013.
- Siegel, M. D. and Bryan, C. R., 2014. "Radioactivity, Geochemistry and Health", in B. Sherwood, ed. *Vol. 9, Environmental Geochemistry*, in H. D. Holland and K. Turekian eds., *Treatise on Geochemistry, 2nd edition*, Elsevier, North-Holland, New York.