

CHARULEKA VARADHARAJAN

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RESEARCH INTERESTS

Biogeochemistry related to water, energy and climate change; Monitoring and mitigation of contaminants and greenhouse gases; Sensor-based data collection, data management and geoinformatics.

EDUCATION

Massachusetts Institute of Technology (Sept 2009) **Cambridge, MA**

Ph.D., Department of Civil and Environmental Engineering
Thesis: Magnitude and Spatio-Temporal Variability of Methane Emissions from a Eutrophic Freshwater Lake

Massachusetts Institute of Technology (Feb 2004) **Cambridge, MA**

Master of Science, Civil and Environmental Engineering
Thesis: A Wavelet-Based System for Event Detection in Online Real-Time Sensor Data

Indian Institute of Technology, Madras (2001) **Chennai, India**

Bachelor of Technology, Department of Civil and Environmental Engineering
Thesis: Integrated Coastal Zone Management using Geographic Information Systems (GIS)

EXPERIENCE

Lawrence Berkeley National Laboratory **Berkeley, CA**

Scientist (Mar 2014 – current)

- Working on data management, assimilation and analysis of environmental datasets. Enabling integration of geochemical, biological, hydrological and geophysical data across different semantic, spatial and temporal scales
- Assessing potential environmental impacts of hydraulic fracturing on groundwater in California

Lawrence Berkeley National Laboratory **Berkeley, CA**

Postdoctoral Fellow (2010-2014)

Supervisor: Dr. Peter S. Nico

Studied biogeochemistry of pollutants in shallow underground waters and sediments. Projects involved:

- Assessing impacts of potential leakage of carbon dioxide from geologic carbon sequestration sites to overlying groundwater aquifers
- Determining the mechanisms and effectiveness of chromium (VI) bioremediation using laboratory and spectroscopic methods

Parsons Laboratory for Environmental Science and Engineering, MIT **Cambridge, MA**

Graduate Student (2004-2009)

Thesis Advisor: Prof. Harold F. Hemond

Examined contribution of freshwater lakes to climate change due to the release of methane. Designed and conducted a 3-year field and laboratory study of methane cycle and emissions from a lake, focusing on bubbling. Analyzed time-series sensor data of methane bubbling using several statistical approaches, including a novel, wavelet-based method. Results indicated that methane bubbling was triggered by changes in hydrostatic pressure, and that lakes should be considered important natural sources in the global methane budget.

Department of Civil and Environmental Engineering, MIT **Cambridge, MA**

Teaching Assistant (2005-2008)

Taught "Introduction to Computers and Engineering Problem Solving" (Java programming)

Instructed a total of ~100 students over 3 years. Collaborated with a team of 5-8 teaching assistants and 2 professors to create and review course material, and to conduct tutorials and office hours.

Center for Educational Computing and Initiatives, MIT **Cambridge, MA**

Research Assistant

- **i-Labs project (2003-2005)**
Programmed web services in C#, created a SQL database, and designed APIs and web pages for software used by universities to create online real-time laboratories.
- **Jewish Women's Archive (2001-2003)**
Designed and maintained a Java-based website and a backend Oracle database.

Department of Civil and Environmental Engineering, IIT Madras **Chennai, India**

Undergraduate Student (2000-2001)

Worked on a decision support system based on systems analysis for integrated coastal zone management in the Gulf of Kachchh, India. Created a GIS based tool to assess the impacts of industrialization and urbanization on ecological features of the coast.

SKILLS

- Data processing and software coding: Proficient in statistical analysis, MATLAB, Java, C#, Oracle and SQL databases.
- Environmental sample analysis: Wet-lab chemical methods to analyze gas, metal, nutrient and organic matter concentrations in water and sediment samples. Various lab and synchrotron based techniques to determine mineral properties and metal-mineral associations.
- Field skills: Techniques for gas and water sample collection, water quality testing, sediment coring, and sensor deployment.
- Fabrication of equipment in a machine shop.

FELLOWSHIPS & AWARDS

- Earth Sciences Division Spot Award, Lawrence Berkeley National Laboratory (2014)
- Earth Sciences Division Spot Award, Lawrence Berkeley National Laboratory (2011)
- MIT Linden Earth System Fellow (2008-09)
- National Science Foundation Doctoral Dissertation Research Improvement Grant (2007)
- Geological Society of America Graduate Student Research Grant (2007)
- MIT Martin Family Society Fellow for Sustainability (2005-06)
- MIT Department of Civil & Environmental Engineering, Trond Kaalstad Award for leadership, community building and academic excellence (2005)
- Institute Blues for exceptional extra-curricular and organizational abilities, Indian Institute of Technology, Madras (2001)
- National Talent Search Award for academic excellence, National Council of Educational Research & Training, Government of India (1995)

PEER-REVIEWED PUBLICATIONS

- Beller HR, Yang L, **Varadharajan C**, Han R, Lim HC, Karaoz U, Molins S, Marcus MA, Brodie EL, Steefel CI, Nico PS (2014), Divergent Aquifer Biogeochemical Systems Converge on Similar and Unexpected Cr(VI) Reduction Products, *Environmental Science and Technology*
- **Varadharajan C**, Tinnacher R.M., Pugh J.D., Trautz R.C., Zheng L., Spycher N.F., Birkholzer J.T., Castillo-Michel H., Esposito R.A., and P.S.Nico (2013), A laboratory study of the initial effects of dissolved carbon dioxide (CO₂) on metal(loid) release from shallow sediments, *International Journal for Greenhouse Gas Control*, 19: 183-211.
- Trautz RC, Pugh JD, **Varadharajan C**, Zheng L, Bianchi M, Nico PS, N.F.Spycher, D.L. Newell, R.A.Esposito, Y.Wu, B.Dafflon, S.S.Hubbard, and J.T. Birkholzer (2013), Effect of Dissolved CO₂ on a Shallow Groundwater System: A Controlled Release Field Experiment, *Environ. Sci. & Technol.* 47(1)
- Trautz R.C., Pugh J.D., Zheng L., Spycher N.F., Nico P.S., **Varadharajan C.**, Dafflon B., Wu Y., Newell D.L., Esposito R.A., Hubbard S.S., Birkholzer J.T., Tinnacher R.M., Bianchi M., Evaluation of dissolved CO₂-induced metals mobilization in groundwater using a controlled release experiment. Proceedings for 1st International Conference on Greenhouse Gas Technologies (GHGT), November 2012, Japan
- **Varadharajan, C.** and H.F. Hemond (2012). Time -series analysis of high-resolution ebullition fluxes from a stratified, freshwater lake, *J. Geophys. Res.*, 117, G02004. Publication selected as Editors' highlight (April 2012).
- **Varadharajan, C.**, Birkholzer J.T., Kraemer S., Porse S., Carroll S., Wilkin R., Maxwell R., Bachu S., Hovorka S., Daley T., Digiulio D., Carey W., Strasizar B., Huerta N., Gasda S., and W. Crow (2012), Summary Report on CO₂ Geologic Sequestration & Water Resources Workshop, Lawrence Berkeley National Lab Report, LBNL-5346E, January 2012.
- Scandella, B.P., **Varadharajan, C.**, Hemond H.F., Ruppel C., and R. Juanes (2011), A conduit dilation model of methane venting from lake sediments, *Geophys. Res. Lett.*, 38, L06408
- **Varadharajan C.**, Hermosillo R. and Hemond H.F (2010). A low-cost automated trap to measure bubbling gas fluxes, *Limnol. Oceanogr. Methods* 8:363-375.
- Harward, V.J., del Alamo, J.A., Lerman, S.R., Bailey, P.H., Carpenter, J., DeLong, K., Felknor, C., Hardison, J., Harrison, B., Jabbour, I., Long, P.D., Tingting Mao, Naamani, L., Northridge, J., Schulz, M., Talavera, D., **Varadharajan, C.**, Shaomin Wang, Yehia, K., Zbib, R., Zych, D. "The iLab Shared Architecture: A Web Services Infrastructure to Build Communities of Internet Accessible Laboratories," *Proceedings of the IEEE*, vol.96, no.6, pp.931-950, June 2008
- J. Hardison, D. Zych, J. A. del Alamo, V. J. Harward, S. R. Lerman, **C. Varadharajan**, S. M. Wang, K. Yehia, "The Microelectronics Weblab 6.0 – An Implementation Using Web Services and the iLab Shared Architecture", *Proceedings of the iNEER Conference for Engineering Education and Research*, Taiwan March 2005
- Harward J., del Alamo J., de Long K., Hardison J., Lerman S., Northridge J., **Varadharajan C.**, Wang S., Yehia K., Zych D., "iLab: A Scalable Architecture for Sharing Online Experiments", *Proceedings of International Conference on Engineering Education*, Florida October 2004

FIRST AUTHOR PRESENTATIONS

- Varadharajan C., Versteeg R., Faybishenko B., and D. Agarwal. Sustainable Systems SFA Data Management and Assimilation. DOE Subsurface Biogeochemical Research 9th Annual PI Meeting, May 2014.
- Varadharajan C., R. Han, S. Molins, M. Conrad, J. Christensen, M. Bill, C. Steefel, J. Larsen, L. Yang, E. L. Brodie, H. R. Beller, P. S. Nico. Competing evidence for enzymatic versus abiotic reduction of

Cr(VI) in Hanford 100H flow-through columns. DOE Subsurface Biogeochemical Research 7th Annual PI Meeting, April 2012.

- Varadharajan, C., R. Han, S. Molins, M. Conrad, J. Christensen, M. Bill, C. Steefel, J. Larsen, L. Yang, E. L. Brodie, H. R. Beller, P. S. Nico. Competing evidence for enzymatic versus abiotic reduction of Cr(VI) in Hanford 100H flow-through columns. DOE Subsurface Biogeochemical Research 7th Annual PI Meeting, April 2012.
- Varadharajan C., Beller H.R., Han R., Marcus M.A, Steefel C., Yang L., Nico P.S. *Spectroscopic studies of chromium bioremediation products in flow-through column sediments*. American Chemical Society Spring Meeting, March 2012.
- Varadharajan C., Nico P.S., Yang L., Han, R., Bill, M., Larsen, J.T., Van Hise, A., Molins, S. Steefel C., Conrad, M., Lim H., Brodie E.L. and Beller H.R. *Evaluating the risk of chromium reoxidation in aquifer sediments following a reductive bioremediation treatment*. American Geophysical Union Fall Meeting, December 2011.
- Varadharajan C., Nico P.S., Yang L., Marcus M.A, Han, R., Bill, M., Larsen, J.T., Van Hise, A., Molins, S. Steefel C., Conrad, M., Brodie E and Beller H.R. *Evaluation of chromium reductive immobilization and oxidative remobilization in flow-through aquifer sediment columns*. Goldschmidt, August 2011.
- Varadharajan C., Birkholzer J.T., Esposito, R., Hubbard, S., Nico, P.S., Pugh, J., Spycher, N., Trautz R., Wu, Y., and Zheng, L. *Evaluating the effects of CO₂ intrusion on trace metal mobility in freshwater aquifers*, Annual Carbon Capture and Sequestration Conference, May 2011
- Varadharajan C., Nico P.S., Yang L., Marcus M.A, Steefel C., Larsen J.T., Beller H.R., Brodie E. *Spectroscopic analysis of chromium bioremediation products*. American Geophysical Union Fall Meeting, December 2010.
- Varadharajan C., Nico P.S., Pugh J.D., Zheng L., Spycher N., Birkholzer J.T., and Trautz R. *Evaluating the effects of CO₂ intrusion on trace metal mobility in freshwater aquifers*, Geological Society of America Annual Meeting, October 2010
- Varadharajan C., Tcaciuc A.P., Borja E., and Hemond H.F. *Methane export from a eutrophic temperate freshwater lake*. ASLO/NABS Summer Meeting, June 2010.
- Varadharajan C. and Hemond H.F. *Analysis of high-temporal-resolution methane ebullition fluxes from a eutrophic, dimictic, freshwater lake*. American Geophysical Union Fall Meeting, December 2009.
- Varadharajan C., Borja E., Tcaciuc A.P. and Hemond H.F. *High-temporal-resolution measurement of methane ebullition from a stratified, eutrophic lake*. European Geosciences Union General Assembly, April 2009.
- Varadharajan C., Borja E., Tcaciuc A.P. and Hemond H.F. *Temporal and spatial variation in methane bubbling from a stratified, eutrophic lake*. American Geophysical Union Fall Meeting, December 2008.
- Varadharajan C. and Hemond H.F. *Magnitude and spatio-temporal variability of methane export from a seasonally stratified, eutrophic lake*. American Geophysical Union Fall Meeting, December 2007.

PROFESSIONAL ASSOCIATIONS

Member of American Geophysical Union, American Chemical Society, Geochemical Society

PROFESSIONAL ACTIVITIES

- Technical Coordinator, EPA/LBNL CO₂ Geologic Sequestration & Water Resources Workshop, Berkeley, Jun 2011. Organized the workshop and was involved in determining workshop themes, selecting and inviting participants, coordinating logistics and writing a report for the EPA.
- Lead, Sustainable Systems SFA Junior Staff Discussion Group, Earth Sciences Division, Lawrence Berkeley National Lab. Organized talks and discussions for ESD early career staff involved in subsurface biogeoscience remediation projects sponsored by DoE.
- Reviewer for Greenhouse Gases: Science and Technology, Chemical Geology, SBIR grants

LEADERSHIP AND ACTIVITIES

- President, MIT Natya [MIT's classical Indian dance club] (Feb 2006 – May 2007). Organized 3 dance shows and redesigned group website. Performed south Indian classical dance in 15 shows in the Boston area between Feb 2004 and May 2007.
- Graduate student representative for Dept. of Civil & Environmental Engineering (CEE) (May 2004 – Oct 2005). Organized several events including first-ever department-wide orientation for incoming students. Co-founded GW1, the CEE graduate women's group. Advocated for CEE students with faculty and the MIT Graduate Student Council.
- Athletics Officer of Ashdown House, MIT (May 2004 – May 2005)
- Managing Editor, MIT Graduate Student News (May 2003 – May 2004). Managed staff of ~25 people and published 10 newsletter editions circulated to ~5000 graduate students. Participated in student government as a member of the MIT Graduate Student Council Executive Committee.
- Treasurer, Green Hall dormitory, MIT (Apr 2002 – May 2003). Responsible for budgeting, accounting and distribution of dormitory and housemaster funds.
- Joint secretary, Civil Engineering Association, IIT Madras (Sept 2000 - Jun 2001)