

Dr. Virginia Isabel Rich

Assistant Professor

Department of Microbiology, The Ohio State University

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RESEARCH INTERESTS

I am a molecular microbial ecologist interested in how microbial communities impact biogeochemistry and global change. I examine microbial community-environment interactions in both terrestrial and marine habitats, and bring molecular microbial research to collaborations with biogeochemists and modelers in a systems approach.

EDUCATION AND TRAINING

University of California, Berkeley

Integrative Biology and *Molecular and Cell Biology: Genetics*

B.A. 1998

Massachusetts Institute of Technology / Woods Hole Oceanographic Institute

Joint Program in Biological Oceanography: Microbial Oceanography

Ph.D. 2008

University of Arizona, Dept. of Ecology & Evolutionary Biology

Post-Doctoral Researcher

12/08 – 8/11*

*half-time Feb '10 – Mar '11, for birth of 1st child

PROFESSIONAL APPOINTMENTS

University of Washington, Seattle

1999 – 2002

Lecturer, Teaching Associate, Laboratory Technician, Intern

University of Arizona, Dept. of Soil, Water and Environmental Sciences

9/11 – 5/15*

Assistant Professor (Joint Appointments in Dept.s of Ecology & Evolutionary Biology, and Molecular & Cellular Biology; Co-Founder of the Ecosystem Genomics Institute; Member of the Institute of the Environment)

*part-time Nov '11 – Nov '12, for birth of 2nd child

The Ohio State University, Dept. of Microbiology

6/15 – present*

Assistant Professor

*70%-time

PUBLICATIONS

McCalley CK, Woodcroft BJ, Hodgkins SB, Wehr R, Kim E-H, Mondav R, Crill PM, Chanton JP, **Rich VI**, Tyson GW, Saleska SR. 2014. Methane dynamics regulated by microbial community response to permafrost thaw. *Nature*. 514: 478-481.

Hodgkins SB, Tfaily MM, McCalley CK, Logan T, Crill PM, Saleska SR, **Rich VI**, Chanton JP. 2014. Changes in peat chemistry associated with permafrost thaw increase greenhouse gas production. *Proceedings of the National Academy of Sciences, USA*. 111: 5819–5824.

Mondav* R, Woodcroft* BJ, Kim E-H, McCalley MK, Hodgkins SB, Crill PM, Chanton JP, Hurst GB, VerBerkmoes N, Saleska SR, Hugenholtz P, **Rich VI**, Tyson GW. 2014. Discovery of a novel methanogen prevalent in thawing permafrost. *Nature Communications*. 5: 3212. doi:10.1038/ncomms4212

Rich, V, Pham V, Eppley J, Shi Y, DeLong EF. 2011. Time-series analyses of Monterey Bay coastal microbial picoplankton using a 'genome proxy' microarray. *Environmental Microbiology*. 13: 116-134.

Rich, V, Konstantinidis K, DeLong EF. 2008. Design and testing of "genome proxy" microarrays to profile marine microbial communities. *Environmental Microbiology*, 10: 506-521.

- Faculty of 1000 "Must Read" paper, 4 Feb 2008.

DeLong EF, Preston CM, Mincer T, **Rich V**, Hallam SJ, Frigaard NU, Martinez A, Sullivan MB, Edwards R, Brito BR, Chisholm SW, Karl DM. 2006. Community genomics among stratified microbial assemblages in the ocean's interior. *Science*. 311:496-503.

- Faculty of 1000 "Recommended" paper, 17 Feb 2006

Horz, H-P, **Rich V**, Avrahami S, and Bohannan BJ. 2005. Methane-oxidizing bacteria in a California upland grassland soil: diversity and response to simulated global change. *Applied and Environmental Microbiology*. 71(5): 2642-2652.

PUBLICATIONS – IN PREPARATION / REVIEW

Hodgkins SB, Chanton JP, Langford L, McCalley CK, Saleska SR, **Rich VI**, Crill PM, Cooper WT. Peat geochemistry shapes methane dynamics in an Arctic wetland. *In review at Biogeochemistry*.

Angly FE, Pantos O, Morgan TC, **Rich VI**, Bourne DG, Mercurio P, Negri AP, Tyson GW. Diuron tolerance and potential degradation in pelagic microbiomes from the Great Barrier Reef lagoon. *In review at Peer J*.

Brum J*, Kim E-H*, Ignacio-Espinoza JC*, Jones R, Trubl GT, VerBerkmoes N, **Rich VI**, Sullivan MB. Virion structural metaproteomics sheds light on ocean 'viral dark matter'. *Planned submission September 2015*.

Angly FE, Heath C, Morgan TC, Tonin HE, **Rich VI**, Schaffelke B, Bourne DG, Tyson GW. Marine microbiomes of the Great Barrier Reef lagoon are influenced by riverine floodwaters and seasonal weather events. *Planned submission October 2015*.

Ignacio-Espinoza JC, Anderson D, Sederholm M, Woodcroft B, Hodgkins SH, Chanton JP, Saleska SR, Tyson GW, **Rich VI**. A novel sulfate reducer (*Candidatus Cryoserica*) regulates the onset of methane emission at the initial stages of permafrost thaw. *Planned submission October 2015*.

Hodgkins SB, Tfaily MM, McCalley CK, **Rich VI**, Saleska SR, Crill PM, Chanton JP, Cooper WT. Changes in dissolved organic matter cycling in a thawing subarctic peatland inferred from molecular composition and optical properties. *Planned submission October 2015*.

Kim E-H, DeLeon K, Woodcroft BJ, Jones RM, Shah M, Tyson GW, VerBerkmoes NC, and **Rich VI**. Optimizing soil metaproteomic methods to capture natural microbial community expression. *Planned submission November 2015*.

Fairbanks D, Shepard C, Murphy M, Rasmussen C, Chorover J, **Rich V**, Gallery R. Topographic controls on soil microbial enzyme activity following fire disturbance in the Jemez River Basin Critical Zone Observatory. *Planned submission November 2015*.

Massey LM, Vining SR, Gregory A, Roux S, Tyson GW, Sullivan MB, **Rich VI**. The potential role of viruses in buffering the Great Barrier Reef from coastal pollution. *Planned submission December 2015*.

Emerson JB, DeLeon K, Kim E-H, Woodcroft BJ, McCalley C, Hodgkins S, Logan T, Wehr R, Crill PM, Chanton JP, Saleska SR, Shah M, Tyson GW, VerBerkmoes NC, and **Rich VI**. Microbial carbon cycling across a natural permafrost thaw gradient through the lens of biogeochemistry and metaproteomics. *Planned submission December 2015*.

Emerson JB, Varner RK, Johnson JE, Owusu-Dommey A, Binder M, Woodcroft BJ, Wik M, Freitas N, Boyd JA, Crill PM, Saleska SR, Tyson GW, **Rich VI**. Linking sediment microbial communities to carbon cycling in high-latitude lakes. *Planned submission December 2015*.

BOOK CHAPTERS

Rich, V, Maier RM. 2015. Chapter 6 – Aquatic Microbiology, In: Ian L. Pepper, Charles P. Gerba, Terry Gentry, Editor(s), Environmental Microbiology (Third Edition), Academic Press, San Diego.

FUNDING - CURRENT

DOE Genomic Science program, Biological Systems Research on the Role of Microbial Communities in Carbon Cycling. "Pathways to carbon liberation: a systems approach to understanding carbon transformations and losses from thawing permafrost". **Co-PIs: S Saleska and V Rich**. CIs: G Tyson, N Verberkmoes, G Hurst, R Varner, M Sullivan, P Crill, J Chanton, C Li, S Frolking. Amount: \$3.9 M. Duration: 2013-2016.

National Science Foundation – Earth Sciences. "Transformative Behavior of Energy, Water and Carbon in the Critical Zone II: Quantifying the Interactions between Long- and Short-term Processes that Control Critical Zone Services". J Chorover (PI), S Papuga, J McIntosh, P Brooks, M Litvak, C Rasmussen, D Breshears, G Barron-Gafford, G-Y Niu, J Pelletier, M Schaap, P Troch, T Meixner, T Ferre, **V Rich**, R Gallery. Amount: \$5.0 M. Duration: 2013-2018.

Joint Genomic Institute / Pacific Northwest National Labs Environmental Molecular Sciences Laboratory Collaborative Science Award. "Systems-level insights into carbon transformations in thawing permafrost by parallel high-resolution organic matter and microbial community characterization". EMSL Proposal ID: 48467. **V Rich (PI)**, M M Tfaily, S Saleska, G W Tyson, R Varner, J Chanton. Amount: Instrumentation user award for: 14 metaproteomes (Rich Lab: worth \$28,000-49,000, plus expert PNNL collaboration on analyses), with 18 matched DOM characterizations and 18 matched SOM characterizations by 12T FT-ICR MS (Chanton Lab), and targeted plant matter characterization (Saleska Lab). Duration: 2014-2016.

Pacific Northwest National Labs Environmental Molecular Sciences Laboratory Annual Science Theme Award: Terrestrial and Subsurface Ecosystems. "Systems-level insights into carbon transformations in thawing permafrost by parallel high-resolution organic matter and microbial community characterization". EMSL Proposal ID: 48467. J Chanton (PI), M M Tfaily, **V Rich**, S Saleska, G W Tyson, R Varner. Amount: User proposal for 42 metaproteomes (Rich Lab: worth \$84,000-147,000, plus expert PNNL collaboration on analyses), with 42 matched

DOM characterizations and 42 matched SOM characterizations by 15T FT-ICR MS (Chanton Lab), and targeted plant matter characterization (Saleska Lab). Duration: 2014-2016.

University of Arizona Institute for the Environment, & Water, Environmental, and Energy Solutions “University of Arizona Ecosystem Genomics Institute”. S Saleska, V Rich, M Sullivan. Institute seed funding. Amount: \$90,000. Duration: 2014-5.

FUNDING – PRIOR

Department of Energy (DOE), Genomic Science program, Biological Systems Research on the Role of Microbial Communities in Carbon Cycling. “Genes, isotopes, and ecosystem biogeochemistry: dissecting methane flux at the leading edge of global change”. **Co-PIs: S Saleska and V Rich.** CIs: G Tyson, P Crill, J Chanton, C Li, S Frolking. Amount: \$2.9 M. Duration: 2010 – 2013, extension through 2015.

University of Arizona Institute for the Environment, & Water, Environmental, and Energy Solutions “Workshop Funding: Compost Use for Sustainable Land Management in Arizona: Mapping New Research, Obstacles, and Opportunities”. **V Rich (PI),** J van Haren, C Phillips, T Hollar. Amount: \$5000. Duration: 2012-3.

ADVISEES

Post-doctoral (n=4): Joanne Emerson Jan '15-present at 50% time; Cesar Ignacio Espinoza Mar '15-present; Ben Bolduc May '15-present at 75% time; Dr. Eun-Hae Kim, Nov '11 – May '14.

Graduate (n=7): Gareth Trubl, PhD, July '13-present; Moira Hough, PhD, co-advised by S. Saleska (U Arizona), Aug '13-present; Dawson Fairbanks, PhD, co-advised by Rachel Gallery (UA), Feb '14-present; Kristine de Leon, PhD, Mar '14-present, Margretta Murphy, MS, co-advised by Rachel Gallery (UA), Aug '14-present; Completed: Lynn Massey, MS, Aug '12-May '14; Vytas Pabedinskas, MS, Aug '13-Aug '14;

Post-baccalaureate (n=3): Kristina Solheim (summer '12); Robert Jones (June '12-Aug '14); Adam Nighswander (Sep '14-present)

Undergraduate (n=14): Current: Darya Anderson (*Undergraduate Biology Research Program* fellow, *BRAVO! fellow*, Honors thesis, May'13-present), Krystalle Diaz (*Honors College fellow*, May'13-present), Sarah Rose Vining (*Undergraduate Biology Research Program* fellow, May '14-present), Maya Sederholm (Sep '13-present). Former: Nancy Freitas (Oct '11-Mar '12), Erin Smith (summer '12), Reilly McManus (fall '12), Alex Lopez (spring '13), Rachel Tsong (spring '13-present), Margretta Murphy (summer '13, Jan '14-Aug-14), Bree Gomez (*Undergraduate Research Opportunities Consortium – Summer Research Institute* fellow, summer '13), Akosua Owusu-Domney (Aug '13-May '14), Morgan Binder (Aug '13-May '14), Maya Cross-Killingsworth (*Honors College fellow*, Jan '14-Sep '14);

Graduate thesis committees (n=10): Marianyoly Ortiz (PhD, Maier Lab, graduated Dec '12); Linnea Herbertson, (PhD, Maier Lab, Dec '12-present); Christopher Berglund (MS, Sep '13-present); Alexis Valentin, (PhD, Maier Lab, graduated Oct '13); Bradley Schmitz (PhD, Pepper Lab, Oct '13-present); Gayle Frost (Biotech MS, Dec '13-present); Ann Gregory (PhD, Sullivan Lab, Aug '12-present); Brunno Da Silva Cerozi (PhD, Fitzsimmons Lab, April '14-present); Robert Danczak (PhD, Wilkins Lab, May '15-present); Jordan Angle (PhD, Wrighton Lab, July '15-present)

TEACHING

- *Instructor* for (all at University of Arizona):
 - Environmental Microbiology, Co-Instructor (with R. Maier),** graduate/undergraduate (40:60) course SWES 425/525, SWES Dept. / Micro Program (Fall 2012, Fall 2013, Fall 2014), recurring annually
 - Microbial Biogeochemistry and Global Change, Co-Instructor (with S. Saleska),** graduate/undergraduate (70:30) course, SWES 427/527, SWES Dept. (new Spring 2014), recurring annually
 - Microbial Ecology and Environmental Microbiology Graduate Seminar, Instructor,** graduate course SWES 696E, SWES Dept. (Co-Instructed in Fall 2012, solo in Spring 2014), recurring biennially
 - Global Change, Co-Instructor (with J. Cole and S. Saleska),** graduate/undergraduate course GEOS 478/578, Geosciences Dept. (Fall 2009)
- *Guest Lecturer* for (all at University of Arizona):
 - Minority Biomedical Research Colloquium (April 2013), Undergraduate Biology Research Program “Conversations with Faculty” course (Spring 2013), Environmental Careers (Fall 2012 & '13, Spring '13, Spring 2014), Global Change (Fall 2010 & '12), Biology of the Oceans (Fall 2008 & '10), Marine Biology (Spring 2011)
- *Lecturer and Teaching Associate* for (all at University of Washington)
 - Introductory Biology: Genetics and Biochemistry, Dept. of Biology (2000, 2001)
 - Cellular and Molecular Biology, Dept. of Biochemistry (2001)
 - Research Apprenticeship on *Acetabularia* Morphogenesis & Development, Friday Harbor Labs (2001 & '02)

SYNERGISTIC ACTIVITIES

- **Co-founder of the University of Arizona Ecosystem Genomics Institute**
- **'IsoGenie' Project Coordinator** ('IsoGenie' is the DOE-funded project in Sweden), USA-Australia-Sweden, Aug 2010 – present. Includes coordination of annual field campaigns, organization of 15-25-person annual international project workshops, data sharing, budget issues, etc.
- **Steering Committee member for the "NSF STC: Genomics Examined at the Nexus with Ecosystems (GENE)"** National Science Foundation Science and Technology Center preproposal and full proposal, May 2014 – present; proposal currently under review.
- **UA Organic Land Stewardship Program - Compost Research Group Coordinator**, Jan 2012 – May 2015. Included co-organization of 35-person workshop, "Compost Use for Sustainable Land Management in Arizona: Mapping New Research, Obstacles, and Opportunities" at the Biosphere 2, in April 2013.
- **Invited talks** at the American Geophysical Union Mtg session "Natural Wetlands and Open Waters in the Global Methane Cycle II" (12/14); Soil Science Society of America Annual Mtg session "Climate Change Impacts on Soil Carbon: Understanding and Estimating the Extent and Rates of Reactions, Processes, Interactions and Feedbacks" (11/14); American Geophysical Union Mtg session "How is the Critical Zone driven by and responding to Global Climate Change?" (12/13); the DOE Genomic Science Mtg, Breakout Session B: "Using – Omics to Dissect Microbial Community Processes in Soils" (2/13); Arizona State University's *Genome@ASU Seminars* (4/13); the University of Arizona's Plant Sciences Department (9/11); Ecology and Evolutionary Biology Department (9/11), and Molecular and Cellular Biology Department (10/13).
- **Talks and posters** at domestic and international meetings including: American Geophysical Union Mtg (12/14), American Society for Mass Spectroscopy Conf (6/13), American Society of Microbiology Mtg, (5/13), American Society for Microbiology Southwest Regional Mtg (4/13), DOE Genomic Science Mtg (2/13), the American Geophysical Union Mtg (12/12), International Assoc. for Ecology International Wetlands Conf (6/12), the Gordon Conference on Applied and Environmental Microbiology (7/11), the DOE BER C-Cycling Grantees Workshop (2/11), the 12th International Symposium on Microbial Ecology Conf (8/08), the Gordon Conference for Marine Microbes (7/08), the 11th International Symposium on Microbial Ecology (8/06), the 3rd Microbial Observatories and Microbial Interactions and Processes Program Principal Investigators' Workshop ('04).
- Service committee member (all UA) on (1) *Curriculum Development Committee for the Dept. of Soil, Water and Environmental Science*; (2) *Peer Review Committee for the Dept. of Soil, Water and Environmental Science*; (3) *University Executive Committee of the Joint Committee on Undergraduate Microbiology*; Chair of website development subcommittee.
- **Reviewer** for: *Environmental Microbiology*; *International Society of Microbial Ecology Journal*; *Applied and Environmental Microbiology*; *Plant and Soil*; German-Israeli Foundation for Scientific Research and Development; UA Water, Environmental and Energy Solutions funding initiative; UA Institute of the Environment
- **Faculty Mentor** for (1) the Undergraduate Biology Research Program; received Honorable Mention for Best Faculty Mentor, in 2013 & 2014; and (2) the Undergraduate Research Consortium Summer Research Institute
- **Path of Professorship Workshop** Organizer, MIT, 10/06, and consultant, 10/07: This two-day workshop for **graduate and postdoctoral women scientists and engineers** aimed to improve the retention of Science, Technology, Engineering, and Math (STEM) women in Academia. The workshop received very positive reviews, and has been repeated each year since from the foundation of the materials I developed.

REFERENCES

Brendan Bohannon, PhD rotation advisor, University of Oregon, bohannon@uoregon.edu
Ed DeLong, PhD advisor, MIT, delong@mit.edu
Scott Saleksa, post-doc advisor, University of Arizona, saleska@email.arizona.edu
Gene Tyson, post-doc advisor, University of Queensland, g.tyson@uq.edu.au