

Laura M. (Laurie) Barge

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Planetary Sciences Section
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Interests / Research Directions:

- Understanding geochemical disequilibria that arise on wet rocky planets and provide chemical energy for life, leading toward understanding habitability on Mars, Europa, Enceladus, and exoplanets.
- Prebiotic chemistry and emergence of life on rocky / ocean worlds.
- Chemical gardens, hydrothermal chimneys, and other self-organizing systems in chemistry / geology.
- Hydrothermal vent laboratory simulations: electrochemistry, organic chemistry, spectroscopic methods and science operational strategies for exploration of vents in the field.
- Iron minerals: iron sulfide / hydroxide synthesis and redox chemistry.
- Developing fuel cells and electrochemical technologies to simulate geological and planetary systems.
- Outreach and mentoring for women / minorities in STEM. Particular focus on women in space science and integrating community college and other non-traditional students into NASA-funded research.

Current Positions:

Research Scientist, NASA Jet Propulsion Laboratory 2015 – present

- Investigation Lead, NASA Astrobiology Institute Icy Worlds team. Lead an Investigation (one of four within the \$8M project) consisting of ~12 Co-I's/collaborators researching the emergence of life in hydrothermal vents. Lead bi-weekly research meetings with external collaborators.
- PI, NASA-NSF Ideas Lab for the Origins of Life, "Becoming Biotic". Lead multi-institution effort to attempt to recapitulate ancient metabolic pathways by replacing protein enzymes with non-protein catalysts in early Earth conditions; supervise lab efforts at JPL involving contractors / postdoc.
- Co-PI, NSF "Bridge to the Geosciences" project. Develop and annually lead 3 one-day "geo-modules" at various institutions in the LA area, for cohorts of 20 community college students to learn about careers in geoscience.
- Lead research group of students at JPL working on various astrobiology / planetary science projects. Hold weekly quiet hours with individual members and weekly lab group meetings. Facilitate ongoing program of seminars / networking events for the group, manage lab procedures / supplies / orders / training of new personnel.

HiRISE Investigation Scientist, Mars Reconnaissance Orbiter, NASA Jet Propulsion Laboratory 2015 – present

- Act as liaison between the High Resolution Imaging Science Experiment (HiRISE) instrument team at University of Arizona and the MRO project at JPL. Duties include: preparing and impacting Mission Change Requests; participating in HiRISE team / Project Science Group meetings; providing MMR inputs; assisting with various tasks such as extended mission proposals.
- Conduct Mars-related research and perform mission-related outreach, e.g. public talks, JPL Open House.
- MRO cycle coordinator. Conduct 5-week preparation for MRO's 2-week observing cycles.

Other Professional Experience:

Oak Crest Institute of Science, Visiting Researcher, 2013 – present.

Blue Marble Space Institute of Science, Research Scientist, 2013 – present.

NASA Jet Propulsion Laboratory

NASA Astrobiology Institute Postdoctoral Fellow (3/2013-3/2015), advisor: Isik Kanik

Caltech Postdoctoral Scholar, NAI Icy Worlds Team (6/2010-3/2013)

Phoenix/Mars Science Laboratory Landing Site Working Groups, Graduate Researcher, 2004-2006

University of Southern California

, Dept. of Earth Sciences, 2004-2009, advisor: Ken Nealson

NASA Harriett G. Jenkins Pre-doctoral Fellow; College Merit Fellow

Graduate Researcher, Geobiology/Astrobiology group

Thesis: "Self-organized chemical precipitates: Laboratory and field studies"

Marathon Oil Company, Petrophysics Intern, Summer 2008.

NASA Goddard Space Flight Center, NASA Academy Intern, Summer 2004.

Villanova University, Dept. of Astronomy and Astrophysics, Undergraduate Researcher, 2002-2004.

Education:

Ph.D., 12/2009, Geological Sciences, University of Southern California, Los Angeles, CA

B.S., 8/2004, Astronomy and Astrophysics (Minor in Physics), Villanova University, Villanova, PA

Additional training:

2011 São Paulo Advanced School of Astrobiology (SPASA), São Paulo, Brazil.

2009 NASA/Nordic Astrobiology Summer School: "*Water, Ice and the Origin of Life in the Universe*" Iceland, July 2009.

2006 International Summer School in Astrobiology: "*Origins: From the Big Bang to Life*." Spain, July 2006.

LAPLACE Astrobiology Winter School: "*Habitable Planets Around Sun-like Stars: Common or Rare?*". Tucson, AZ Jan 2006.

2005 NAI Astrobiology Winter School "*Water on Earth and in Space*", Hawaii, Jan 2005.

2005 Short Course on "*Molecular Geomicrobiology*", 3-4 Dec 2005, University of California at Berkeley.

Publications:

Submitted / in revision:

L. M. Barge, F. C. Krause, J.-P. Jones, K. Billings, P. Sobron. Geo-Electrodes and Fuel Cells for Simulating Hydrothermal Vent Environments. Submitted to *Astrobiology*.

Chin K.B., I. Chi, J. S. Creamer, J. Pasalic, C-K Huang, L.M. Barge, Electrochemical characterization of amino acids using micro-electrode impedance spectroscopy. *Astrobiology*, in revision 2017.

Published:

Barge L. M. and White L.M. Experimentally Testing Hydrothermal Vent Origin of Life on Enceladus and Other Icy/Ocean Worlds. *Astrobiology*, Special Collection on Enceladus, accepted 7/2017.

Barge L.M., Cardoso S.S.S., Cartwright J.H.E., Doloboff I.J., Flores E., Macías-Sánchez E., Sainz-Díaz C.I., Sobrón P. Self-Assembling Iron Oxyhydroxide / Oxide Tubular Structures: Laboratory-Grown and Field Examples from Rio Tinto. *Proceedings of the Royal Society of London A*, Published 9 November 2016. DOI: 10.1098/rspa.2016.0466.

Barge L.M., Branscomb E., Brucato J.R., Cardoso S.S., Cartwright J.H., Danielache S.O., Galante D., Kee T.P., Miguel Y., Mojzsis S., Robinson K.J., Russell M.J., Simoncini E., Sobron P. (2016) Thermodynamics, Disequilibrium, Evolution: Far-From-Equilibrium Geological and Chemical Considerations for Origin-Of-Life Research. *Origins of Life and Evolution of Biospheres*. 2016 Jun 6, DOI: 10.1007/s11084-016-9508-z.

O. Steinbock, J. H. E. Cartwright, **L. M. Barge**. (2016) The Fertile Physics of Chemical Gardens. *Physics Today*, 69(3), 44, doi: 10.1063/PT.3.3108. (Featured on cover of March 2016 issue)

C. Scharf, N. Virgo, H. J. Cleaves II, M. Aono, N. Aubert-Kato, A. Aydinoglu, A. Barahona, **L. M. Barge**, S. A. Benner, M. Biehl, R. Brasser, C. J. Butch, K. Chandru, L. Cronin, S. Danielache, J. Fischer, J. Hernlund, P. Hut, T. Ikegami, J. Kimura, K. Kobayashi, C. Mariscal, S. McGlynn, B. Menard, N. Packard, R. Pascal, J. Pereto, S. Rajamani, L. Sinapayen, E. Smith, C. Switzer, K. Takai, F. Tian, Y. Ueno, M. Voytek, O. Witkowski, H. Yabuta (2015) A Strategy for Origins of Life Research. *Astrobiology* 15(12):1031-1042, DOI: 10.1089/ast.2015.1113.

L. M. Barge, Y. Abedian, M. J. Russell, I. J. Doloboff, J. H. E. Cartwright, R. D. Kidd, I. Kanik. (2015) From Chemical Gardens to Fuel Cells: Generation of Electrical Potential and Current Across Self-Assembling Iron Mineral Membranes. *Angewandte Chemie International Edition*, 54, 28:8184-8187, DOI: 10.1002/anie.201501663.

L. M. Barge, S. S. S. Cardoso, J. H. E. Cartwright, G. J. T. Cooper, L. Cronin, A. De Wit, I. J. Doloboff, B. Escibano, R. E. Goldstein, F. Haudin, D. E. H. Jones, A. L. Mackay, J. Maselko, J. J. Pagano, J. Pantaleone, M. J. Russell, C. I. Sainz-Díaz, O. Steinbock, D. A. Stone, Y. Tanimoto, N. L. Thomas. (2015) From Chemical Gardens to Chemobionics. *Chemical Reviews*, 115 (16), pp 8652–8703, DOI: 10.1021/acs.chemrev.5b00014.

L. M. Barge, Y. Abedian, I. J. Doloboff, J. E. Nunez, M. J. Russell, R. D. Kidd, I. Kanik. (2015) Chemical Gardens as Flow-Through Reactors Simulating Natural Hydrothermal Systems. *Journal of Visualized Experiments*, 105, DOI: 10.3791/53015.

B. T. Burcar, **L. M. Barge**, D. Trail, E. B. Watson, M. J. Russell, L. B. McGown. (2015) RNA Oligomerization in Laboratory Analogues of Alkaline Hydrothermal Vent Systems. *Astrobiology*, 15(7): 509-522. doi:10.1089/ast.2014.1280.

L. M. Barge, T. P. Kee, I. J. Doloboff, J. M. P. Hampton, M. Ismail, M. Pourkashanian, J. Zeytounian, M. M. Baum, J. Moss, C.-K. Lin, R. D. Kidd, I. Kanik (2014) The Fuel Cell Model of Abiogenesis: A New Approach to Origin-of-Life Simulations. *Astrobiology*, 14(3):254-70.

Russell, M. J., **Barge, L. M.**, Bhartia, R., Bocanegra, D., Bracher, P., Branscomb, E., Kidd, R., McGlynn, S., Meier, D., Nitschke, W., Shibuya, T., Vance, S., White, L. (2014) The Drive to Life on Rocky and Icy Worlds. *Astrobiology*, 14, 4, 308-343.

Cover designer, *Astrobiology* Journal, April 2014 issue.

Barge, L. M., Doloboff, I. J., Russell, M. J., VanderVelde, D., White, L. M., Stucky, G. D., Baum, M. M., Zeytounian, J., Kidd, R., Kanik, I. (2014) Pyrophosphate Synthesis in Iron Mineral Films and Membranes Simulating Prebiotic Submarine Hydrothermal Systems. *Geochimica Cosmochimica Acta*, 128, 1-12.

- J. Petruska and **L. M. Barge**. (2013) Bilaterally Symmetric Facial Morphology Simulated by Diffusion-Controlled Chemical Precipitation in Gel. *Chemical Physics Letters* 556, 315–319.
- L. M. Barge**, A. A. Pulschen, A. P. M. Emygdio, C. Congreve, D. E. Kishimoto, A. G. Bendia, A. Teles, J. DeMarines, D. Stoupin (2013) Life, the Universe, and Everything: An Education Outreach Proposal to Build a Traveling Astrobiology Exhibit. *Astrobiology*, Vol. 13, No. 3, DOI: 10.1089/ast.2012.0834.
- L.M. Barge**, I. J. Doloboff, L. M. White, G. D. Stucky, M. J. Russell, I. Kanik. (2012) Characterization of Iron-Phosphate-Silicate Chemical Garden Structures. *Langmuir*, 28 (8), pp 3714-3721 (Featured on cover of Feb 28, 2012 issue)
- M. A. Chan, S.L. Potter, B.B. Bowen, W. T. Parry, **L. M. Barge**, W. Seiler, E.U. Petersen, J. R. Bowman (2012) Characteristics of terrestrial ferric oxide concretions and implications for Mars. In J. Grotzinger and R. Milliken, *Sedimentary geology of Mars: SEPM Special Publication No. 102*, p. 253-270.
- B. Schoepp-Cothenet, W. Nitschke, **L. M. Barge**, A. Ponce, M. J. Russell, A. I. Tsapin (2011) Comment on “A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus” *Science*, vol. 332, no. 6034, pl 1149.
- L. M. Barge**, D. E. Hammond, M. A. Chan, S. Potter, J. Petruska, K. H. Nealson (2011) Precipitation Patterns Formed by Self-Organizing Processes in Porous Media. *Geofluids*, 11: 124-133.
- L. M. Barge**, K. Nealson, J. Petruska (2010) Organic Influences on Inorganic Patterns of Diffusion-Controlled Precipitation in Gels. *Chemical Physics Letters*, Vol. 493, Issues 4-6, pp. 340-345.

Grants/Awards:

- 2017 PI, NASA/NSF Ideas Lab for the Origins of Life, “Becoming Biotic: Recapitulating the Origin of Ancient Metabolic Pathways” (with USC and Oberlin College)
- 2017 PI, JPL Spontaneous Research & Technology Development (R&TD), “Which Came First, Proteins or Cofactors? Recreating Metabolic Reactions on the Early Earth”
- 2017 Co-I, JPL Spontaneous R&TD, “Hydrothermal Vent Instrument Anchoring Platform” (PI: Chris Yahnker)
- 2017 Co-I, JPL Spontaneous R&TD, “New Electromechanical Technique for Detecting Life in Simulated Ocean World Environments using a Portable In-Situ Electrochemical Impedance Spectroscopy (EIC) System” (PI: Keith Chin)
- 2016 PI, NASA Astrobiology Institute Director’s Discretionary Fund, “Catalytic Diversity at the Emergence of Metabolism: Hydrothermal Carbon Dioxide Reduction on Fe/Ni-Sulfide Catalysts”
- 2016 PI, JPL Spontaneous R&TD, “Geo-Electrodes for Astrobiology Experiments”
- 2016 Co-Lead, JPL Blue Sky Origin of Life Study
- 2015-2019 Investigation Lead / Co-I, NASA Astrobiology Institute, Cooperative Agreement Notice (CAN-7), “Icy Worlds: Astrobiology at the Water-Rock Interface and Beyond...” (PI: Isik Kanik)
- 2015-2018 Co-PI, NSF Improving Undergraduate STEM Education (IUSE), “GP-EXTRA - Bridge to the Geosciences for Community College Students”, (PI: Marianne Smith, Citrus College)
- 2015 JPL Advanced Concept Development: “Sulfate and amino acid absorption in Mars analog minerals”
- 2014 JPL Planetary Instrument Advanced Concept Development, “Simulated Seafloor Systems for Origin of Life Studies”, L. Barge and M. Russell.
- PI, NASA Astrobiology Institute Early Career Collaboration Grant: “Prebiotic Phosphorus Chemistry”, Collaboration with the UK Astrobiology Society and University of Illinois at Urbana-Champaign.
- 2013 Co-I, JPL Strategic University Partnership Program award, “Microbial Fuel Cells for in-situ life detection” (JPL PI: Aaron Noell, USC PI: Ken Nealson)
- PI, NASA Astrobiology Institute Early Career Collaboration Grant: “Effects of Catalytic Iron-Containing Minerals on RNA Synthesis”, Collaboration with the New York Center for Astrobiology.
- 2007 PI, NASA Astrobiology Institute Lewis and Clark Fund for Exploration and Field Research: “A Study of Precipitation in Diffusion-Controlled Systems: Implications for Concretion Formation in Terrestrial and Martian Systems”

Activities, Service, Leadership Experience:

- Co-lead, 2017 JPL Space Life Sciences study for Astrobiology**, leading 4-month study with Scott Perl to assess Astrobiology expertise at JPL, develop an astrobiology community, and strategize paths forward.
- PI, “Geo-Electrodes for Astrobiology” project, JPL Spontaneous R&TD**. Led ~6 month project to develop PEM fuel cells to use geo-materials as catalysts and simulate hydrothermal vent chemistry.
- Co-lead, 2016 JPL Blue Sky Study for the Origin of Life**. Helped lead a ~6-month study to recommend JPL’s institutional investment and strategies for origin of life research. Organized workshops for technical brainstorming and strategic planning; co-authoring report that will make recommendations to JPL.
- Co-chair, NASA Astrobiology Institute Focus Group: “Thermodynamics, Disequilibrium, Evolution”**. Organize two workshops per year in cooperation with other astrobiology and planetary science institutes around the world: including Centro de Astrobiologia (Madrid); Earth-Life Science Institute (Japan); Brazilian Synchrotron Light Laboratory (LNLS); INAF-Astrophysical Observatory of Arcetri (Italy).
- ELSI Origins Network (EON) Advisory Board, 2014-present**. Member of a 12-person international advisory board for the ELSI Origins Network, an international origin of life institute run by the Earth-Life Science Institute of Tokyo

Tech, funded by the Templeton Foundation. Advise on strategic planning and facilitate collaborations.

Member, Roadmap for Ocean Worlds (ROW) team, NASA Outer Planet Assessment Group (OPAG), 2016-present.
Lead “Detection of Life” theme and participate in ROW meetings, to produce documents of science goals relating to specific targets, for use in future studies of / missions to ocean worlds.

NASA Proposal Review Panels, Small Innovative Missions for Planetary Exploration (SIMPLEx), Maturation of Instruments for Solar System Exploration (MaTISSE), Habitable Worlds.

Referee, *Nature Scientific Methods*, *Journal of Physical Chemistry*, *Langmuir*, *Chemical Physics*, *Journal of the American Chemical Society*, *Journal of Molecular Evolution*, *Origins of Life and Evolution of Biospheres*.

Co-Organizer, Geochemical requirements for the emergence of life: VIII TDE Focus Group workshop, Earth-Life Science Institute (ELSI), Tokyo, Japan, Nov. 2014.

Co-Organizer, Workshop on “Engines of Life: Thermodynamic Pathways to Metabolism”. Beyond Center, Arizona State Univ. and the NAI TDE Focus Group, 5/2013.

Organizing committee, 2012 Astrobiology Graduate Conference (Los Angeles, CA).

Organizing committee, 2012 Astrobiology Research Focus Group (USC Wrigley Center, Catalina Island, CA).

Organizing committee, Research Focus Group at the 2009 Astrobiology Graduate Conference, Seattle, WA. (Funded by the NAI Conference and Workshop Fund.)

Memberships: International Society for the Study of the Origin of Life (ISSOL), American Chemical Society (ACS).

Outreach:

Featured in Scientific American, “Life’s Origins by Land or Sea? Debate Gets Hot” by Rachel Brazil, ChemistryWorld on May 15, 2017. <https://www.scientificamerican.com/article/lifes-origins-by-land-or-sea-debate-gets-hot/>

Featured in Engadget, “The search for a habitable second Earth”, by Steve Dent, May 27, 2017, <https://www.engadget.com/2017/05/27/search-habitable-planets-second-earth-exoplanets/>

Featured in NOVA web short, “Make your own hydrothermal vent”, By Karishma Desai and Ari Daniel, <http://www.pbs.org/wgbh/nova/earth/make-your-own-vent.html>

Featured in New Scientist, “Genesis in a jar: How chemical gardens may lead us to alien life”, Aug 10 2016 by Joshua Sokol, <https://www.newscientist.com/article/2100538-genesis-in-a-jar-how-chemical-gardens-may-lead-us-to-alien-life/>

Featured in Nautilus Magazine, “The Fly in the Primordial Soup”, by Nathaniel Comfort, June 23, 2016, <http://nautil.us/issue/37/currents/the-fly-in-the-primordial-soup>

Appeared in *How the Universe Works* (Discovery Channel), S04E05 “Dawn of Life”, aired 12/15

Invited speaker, “Findings of Water on Mars”, Space Fest 2015, California Science Center (Los Angeles).

JPL Feature Story, “Researchers Use Seafloor Gardens to Switch on Light Bulb”, August 5, 2015, by Whitney Clavin, <http://www.jpl.nasa.gov/news/news.php?feature=4679>.

Astrobiology Magazine News Exclusive, “Could ‘Green Rust’ be a Catalyst for Martian Life?”, May 21, 2015, by Elizabeth Howell, <http://www.astrobio.net/news-exclusive/could-green-rust-be-a-catalyst-for-martian-life/>

Orange County Register, “Did sea-floor battery spark life on Earth?”, by Pat Brennan, April 26, 2014.

Invited Guest, Planetary Radio, “Was a Natural Fuel Cell Key to the Origin of Life on Earth?”, with Matt Kaplan: <http://www.planetary.org/multimedia/planetary-radio/show/2014/0701-was-a-natural-fuel-cell-key-to-the-origin-of-life-on-earth.html>.

JPL Feature Story, “New Study Outlines ‘Water World’ Theory of Life’s Origins”, April 15, 2014, by Whitney Clavin, <http://www.jpl.nasa.gov/news/news.php?release=2014-115>.

NASA Astrobiology Institute Research Highlights, “The Seafloor Electric”, 04/15/2014, <http://astrobiology.nasa.gov/articles/2014/4/15/the-seafloor-electric/>

Radio Interview, KPFT-FM Houston, *Weltanschauung* weekly show with Michael DeLeonardis, April 10, 2014.

JPL Feature Story, “How Did Life Arise? Fuel Cells May Have Answers”, March 13, 2014, by Whitney Clavin, <http://www.jpl.nasa.gov/news/news.php?release=2014-079>

Astrobiology Magazine News Exclusive, “Life’s Fuel Cells”, March 13, 2014, by Sheyna Gifford, <http://www.astrobio.net/exclusive/6062/life%E2%80%99s-fuel-cells>

NASA Astrobiology Institute Research Highlights, “Life’s Origins in a Prebiotic Fuel Cell”, 03/14/2014, by Aaron Gronstal, <http://astrobiology.nasa.gov/articles/2014/3/14/lifes-origins-in-a-prebiotic-fuel-cell/>

University of Leeds press release, “Simulating how the Earth Kick-Started Metabolism”, by Sarah Reed, 03/13/14, http://www.leeds.ac.uk/news/article/3504/simulating_how_the_earth_kick-started_metabolism

Daily Galaxy, “What We Might Find in Europa’s Alien Ocean World”, 03/2014, http://www.dailygalaxy.com/my_weblog/2014/03/what-we-might-find-in-europas-alien-ocean-world.html

Universe Today, “Did Life on Earth As We Know It Come From Geological Life?”, by Elizabeth Howell, 03/13/14, <http://www.universetoday.com/110310/did-life-on-earth-as-we-know-it-come-from-geological-life/>

Oak Crest Institute of Science, press release, “How the Earth Kick-started its Metabolism Simulated in a Laboratory”, by Lisa Lucio, 03/2014. <http://oak-crest.org/oakcrest-news/how-the-earth-kick-started-its-metabolism-simulated-in-a-laboratory/>

Featured in Chemical & Engineering News: "Gardens of Eden", by Carmen Drahl, March 18, 2013. Vol. 91, Issue 11, pp. 44-45, <http://cen.acs.org/articles/91/i11/Gardens-Eden.html>
Invited panelist, Citrus College Careers in Math and Science workshop, 2013.
Invited panelist, "Women in Planetary Sciences" panel at the YSS Undergraduate Planetary Science Research Conference at LPSC, 2011 and 2013.

Awards:

2016 Selected to attend the NSF-NASA Ideas Lab for the Origins of Life (proposal was selected in 2017)
2016 Jet Propulsion Laboratory Voyager Award (for leadership in astrobiology activities visible outside JPL)
2015 NASA Group Achievement Award (Icy Worlds Team)
2013-2015 NASA Astrobiology Postdoctoral Fellowship
2012 Finalist, Harry Lonsdale Origin of Life Prize
2012, 2011 American Astronomical Society International Travel Grant
2009 Women in Science and Engineering (WiSE) Travel Grant
NASA Harriet G. Jenkins Pre-doctoral Fellowship
USA Funds Access to Education Scholarship
2008 Women in Science and Engineering (WiSE) Merit Fellowship
USC Dean Joan M. Schaefer Research Award
Phi Kappa Phi Love of Learning Award
2007 American Astronomical Society International Travel Grant
USC Dean Joan M. Schaefer Merit Scholarship / Research Award
USC Dept. of Earth Sciences Outstanding Teaching Assistant Award (2007 & 2006)
2006 Mars Exploration Program Student Travel Grant
2004 Keck Fellowship, University of Southern California
College Merit Award Fellowship, USC College of Letters and Sciences
National Merit Scholarship, Villanova University (2000-2004)
Blue White Scholarship, Villanova University (2003-2004)

Seminars, Invited Talks, Oral Presentations

Upcoming:

Invited Speaker, 2018 Gordon Research Conference on the Origins of Life (January 2018)
Solicited talk, COSPAR 2018 Scientific Event F3.2: The Evolving Chemical Universe: From Proto-stars to the Origin of Life.

Past:

Caltech Planetary Science Seminar, May 2017, "Recognizing Life and its Origin: Emergent Phenomena in Abiotic Organic-Mineral Gradient Systems"
Invited talk, Astrobiology Science Conference, session on Origin of Life in Hydrothermal Vents, "Prebiotic Chemistry in Chemical Garden Structures at Hydrothermal Vents: The Importance of Gels and Gradients". Mesa, AZ, 2017, Abstract #3477.
Invited talk, American Geophysical Union session on Enceladus: "Simulating Prebiotic Chemistry in Alkaline Hydrothermal Vents on Enceladus and other Ocean Worlds", San Francisco, Dec 2016.
Invited speaker, "Emergence of Metabolism in Alkaline Hydrothermal Vents: An Analog for Enceladus?" Enceladus Focus Group meeting, UC Berkeley, June 2016.
NASA Astrobiology Institute Early Career Seminar, "Chemical Gardens, Chimneys, and Fuel Cells: Simulating Prebiotic Chemistry in Hydrothermal Vents on Ocean Worlds". June 1, 2016 <http://nai.nasa.gov/seminars/featured-seminar-channels/early-career-seminars/2016/6/1/chemical-gardens-chimneys-and-fuel-cells-simulating-prebiotic-chemistry-in-hydrothermal-vents-on-ocean-worlds/>
Invited seminar, Cal State Northridge. May 4, 2016.
Invited STEM Industry Panelist, USC Beyond the PhD 2016: PhD and Postdoctoral Career Conference.
Invited seminar, "From Geochemistry to Biochemistry: Emergence of Life in Alkaline Hydrothermal Vents", University of Tulsa, April 15 2016.
Invited seminar, "From Geochemistry to Biochemistry: Simulating Prebiotic Chemistry Driven by Geochemical Gradients in Alkaline Hydrothermal Vents". Johns Hopkins and Space Telescope Science Institute "Planets, Life and the Universe" NAI-sponsored Series, March 3 2016.
Invited speaker, "Hydrothermal chimneys as flow-through chemical reactors: Laboratory simulations of far-from-equilibrium systems at seafloor interfaces", Conference on Re-conceptualizing the origin of life, Carnegie Institute, Washington DC, 2015.
Invited Seminar, Sept. 2015, *Experimentally Simulating Seafloor Systems for Origin of Life and Planetary Habitability*. Caltech Division of Geological and Planetary Sciences, Yuk Lunch Seminar.

Invited Speaker, University of Washington Astrobiology Colloquium Series, *Self-Organizing Chemical Systems: From Materials Science to Astrobiology*, Seattle, WA, May 2015.

Invited Speaker, Chemistry Seminar Series, Florida State University, *Self-Organization in Far-From-Equilibrium Systems: From Materials Science to Astrobiology*, Tallahassee, FL, May 2015.

Invited Plenary Speaker, *Habitability in the Universe: From the Early Earth to Exoplanets*; First conference of the COST (European Cooperation in Science and Technology) ORIGINS Action, Portugal, March 2015.

Seminar, Georgia Tech Planetary Seminar Series, *Prebiotic Chemistry at Water-Rock Interfaces: Implications for Habitability on Rocky and Icy Worlds*. March 3, 2015.

Seminar, UCLA iPLEX Lunch series, UCLA Institute for Planets and Exoplanets, February 2015.

Seminar, Oak Crest Institute of Science, *"From Geochemistry to Biochemistry: Emergence of Metabolism in Hydrothermal Vents on Rocky and Icy Worlds"*, December 2014.

Seminar, Earth Life Science Institute (ELSI), *"Laser Fuel Cells Simulating Hydrothermal Vents"*, Japan, Nov 2014.

Oral presentation, Origins 2014 / 2nd ISSOL – Bioastronomy Joint International Conference, *Simulating Hydrothermal Vents as Geochemical Fuel Cells*, Nara, Japan, July 2014.

JPL Postdoc Seminar, *Hydrothermal Vents as Geochemical Fuel Cells and Origin of Life*. 6/2/2014.

Seminar speaker, University of Southern California Geobiology Seminar Series, 04/2014.

Invited speaker, 2nd Earth Life Science Institute (ELSI) International Symposium, Tokyo, Japan, 3/2014.

Invited seminar, Institute for Genomic Biology, University of Illinois Urbana-Champaign. *Chemical Gradients, Disequilibrium, and the Origin of Life*. 2/2014.

Seminar, *Harnessing Geochemical Gradients at the Origin of Life*, University of Leeds, School of Chemistry, Leeds, UK, 10/2013.

Invited seminar, *The Emergence of Metabolism from Geochemical Fuel Cells on Wet Rocky Planets*. ELSI and Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Tokyo, Japan, 12/2013.

Invited seminar, *Harnessing Geochemical Gradients at the Origin of Life*. Georgia Tech, Center for Ribosomal Origins and Evolution, 9/2013.

Oral Presentation, *Self-Assembly and Emergence in Prebiotic Hydrothermal Systems*. Emergence in Chemical Systems 3.0 International Conference, University of Alaska, Anchorage, 6/2013.

Oral Presentation, *From Fuel Cells to Life*, Workshop on "Engines of Life: Thermodynamic Pathways to Metabolism", Arizona State Univ. and the NAI TDE Focus Group, 5/2013.

Invited speaker, *Testing the Emergence of Bioenergetics in Hydrothermal Vents*. Princeton Origin of Life Workshop, Princeton Center for Theoretical Science, January 2013.

JPL Postdoc Seminar, *Emergence of Bioenergetics in Hydrothermal Systems on Icy Worlds*. Nov 29, 2012, NASA Jet Propulsion Laboratory.

Oral presentation, *Emergence of Bioenergetics*, European Astrobiology Network (EANA) meeting, Stockholm, Sweden, Oct. 2012.

Invited Seminar, *Fuel Cell Simulations of the Origin of Life*. University of Budapest, October 2012.

Invited Speaker, *Energetics of Chemical Gardens in Prebiotic Systems*, Lorentz Center workshop on "Chemical Gardens", Leiden University, the Netherlands, May 2012.

Invited Speaker, *What it Means to be an Astrobiologist*. NASA Space Science Workshop "Explore: Life on Mars?", University of Wisconsin-Madison / UW Geology Museum, April 2012.

Seminar, Apr. 2012, *Chemical Gardens as Energy Traps for the Emergence of Metabolism in Hydrothermal Systems*. University of Wisconsin-Madison Geology Department.

Seminar, Nov.2011, *Electrochemistry of Self-Assembling Inorganic Membranes: Simulating the Origin of Metabolism in Hydrothermal Systems*. Inorganic-Organometallics Seminar, Caltech Division of Chemistry and Chemical Engineering.

Seminar, Sept. 2011, *From Self-Assembling Inorganic Membranes to Pre-Biotic Chemistry: A Hydrothermal Origin-of-Life Model for Icy Moons*. Caltech Division of Geological and Planetary Sciences, Yuk Lunch Seminar.

Oral Presentation, *Characterizing the Proton-Motive Force in Self-Assembling Inorganic Membranes*. 2nd workshop of the NAI TDE Focus Group, Florence, Italy, 9/2011.

Oral Presentation, *Pyrophosphate Generation in A Proton Gradient*. NAI TDE Focus Group, Centro de Astrobiologia, Madrid, March 2011.

Seminar, *Driving Pyrophosphate Synthesis by an Ambient Proton-Motive Force?* Part of double seminar ("*Life Emerges Through Entropy Trapping*") with L. M. White and M. J. Russell, Jet Propulsion Laboratory, 2/3/2011.

L. M. Barge, J. Petruska, S. Potter, M. A. Chan, J. Cho, K. Nealson (2008) *Mineral Precipitation in Porous Media: Laboratory Diffusion Experiments as Analogues for Concretion Formation in Utah and on Mars*. Keynote presentation at the 2008 Australian Earth Sciences Convention, Perth, Western Australia, 7/2008.

L. M. Barge, J. Petruska, K. Nealson (2007) *Experimental Observations of Diffusion-Driven Mineral Precipitation: Implications for Concretion Formation on Earth and Mars*. Oral presentation at the 2nd International Workshop on Exploring Mars and its Terrestrial Analogues, Trento, Italy.

Teaching/Mentoring:

- 2013-present: Mentor for various JPL/NASA undergraduate intern programs, typically 4-5 students per year, including: JPL Student Independent Research Internship (SIRI) Program, Minority Student Programs, NASA Undergraduate Internship (UI) program, JPL Visiting Student Research Program (JVSRP), Caltech SURF Summer Intern Program), JPL Student Internship Program.
- 2014-present Mentor, Tulsa Community College / JPL intern program
- 2014-present Mentor, Citrus College / JPL intern program (with Dr. Marianne Smith)
- 2014 Mentor, Blue Marble Space undergraduate intern program. Developed and implemented pilot program for a new science summer undergraduate internship, combining research, ethics, and communication modules.
- 2013 Postdoc Mentor, Women Mentoring Women Program at Caltech
Interviewee, *Gigniks* (non-profit film project interviewing professionals for high school career guidance).
- 2007 Teaching Assistant, GEOL 125 – Earth History (USC Dept. of Earth Sciences)
Teaching Assistant, GEOL 240 – Earthquakes (USC Dept. of Earth Sciences)
- 2006 Assistant Science Instructor (Astronomy), Sally Ride Science Camp at UCLA.
- 2001-2004 Teaching Assistant, AST 1073 – Stellar Lab (Villanova Dept. of Astronomy and Astrophysics)
Teaching Assistant, AST 1075 – Planets Lab (Villanova Dept. of Astronomy and Astrophysics)
Teaching Assistant, PHY 2601 – Computational Physics Lab (Villanova Dept. of Physics)

Published Abstracts:

- L. M. Barge**, F. C. Krause, J.-P. Jones, K. Billings, P. Sobron (2017) Geo-Electrodes and Fuel Cells for Simulating Hydrothermal Vent Environments. *Astrobiology Science Conference 2017*, Abstract #3470.
- L. M. Barge**, O. Steinbock, J. H. E. Cartwright (2017) Prebiotic Chemistry in Chemical Garden Structures at Hydrothermal Vents: The Importance of Gels and Gradients. *Astrobiology Science Conference 2017*, Abstract #3477
- Y. Abedian, D. VanderVelde, E. Flores, **L. M. Barge** (2017) Phosphorus and Amino Acid Adsorption in Iron Oxyhydroxides Representing Early Earth Seafloor or Hydrothermal Chimney Systems. *Astrobiology Science Conference 2017*, Abstract #3484
- E. Flores, D. VanderVelde, K. Kallas, M. J. Russell, M. M. Baum, **L. M. Barge** (2017) Amino Acid Synthesis Under Alkaline Hydrothermal Chimney Conditions. *Astrobiology Science Conference 2017*, Abstract #3491
- R. D. Cameron, K. Chin, E. Flores, G. LeBlanc, **L. M. Barge** (2017) Simulating Electrochemistry of Iron-Nickel Sulfide Hydrothermal Chimneys. *Astrobiology Science Conference 2017*, Abstract #3502
- A. C. Hammer, B. C. Corbit, I. J. Doloboff, **L. M. Barge**. Mineralogy, Morphology, and Organic Modifications of Iron-Based Hydrothermal Chimney Simulants. *Astrobiology Science Conference 2017*, Abstract #3036
- J. H. E. Cartwright, **L. M. Barge**, S. S. S. Cardoso, S. Vance. Self-Assembling Ice Membranes: Brinicle Properties, Field Examples, and Possible Energetic Systems in Ocean Worlds. *Astrobiology Science Conference 2017* (2017), Abstract #3512.
- G. LeBlanc, D. M. Wirth, H. D. Whitehead, J. Yungbluth, G. Ludewick, **L. M. Barge**, R. Cameron. Electrochemical and Rapid Prototyping Strategies for more Precise Analysis of Geo-Electrochemical Environments of Interest to Astrobiology. *Astrobiology Science Conference 2017*, Abstract #3168.
- L. B. McGown, B. T. Burcar, **L. M. Barge**, M. J. Russell, E. B. Watson. Exploring Alkaline Hydrothermal Vent Environments for Abiotic RNA Polymerization. *Astrobiology Science Conference 2017*, Abstract #3294.
- D. M. Wirth, G. LeBlanc, H. D. Whitehead, J. Yungbluth, G. Ludewick, **L. M. Barge**, R. D. Cameron. Electrochemical Deposition of Iron Sulfides and Iron Hydroxides: Mimicking Hydrothermal Vent Systems Relevant to Origin of Life Studies. *Astrobiology Science Conference 2017*, Abstract #3210.
- H. D. Whitehead, G. LeBlanc, D. M. Wirth, J. Yungbluth, G. Ludewick, **L. M. Barge**, R. D. Cameron. Unique Electrochemical Cells for the Analysis of Hydrothermal Vent Prebiotic Chemistry Experiments. *Astrobiology Science Conference 2017*, Abstract #3208.
- M. Smith, V. Sloan and **L. M. Barge** (2017) "Partnering for Diversity: A Year-Round Experiential Learning Project to Engage Community College Students in the Geosciences" American Meteorological Society's 26th Symposium on Education, part of the 97th Annual Meeting, January 2017, Seattle, WA.
- Cameron R. D., **Barge L. M.**, Chin K. B., Doloboff I. J., Flores E., Hammer A. C., Sobron P., Russell M. J., Kanik I. (2016) Catalytic Diversity in Alkaline Hydrothermal Vent Systems on Ocean Worlds. 2016 DPS / EPSC meeting abstract.
- Flores E., **Barge L. M.**, VanderVelde D., Kallas K., Baum M. M., Russell M. J., Kanik I. (2016) Amino Acid Synthesis in Seafloor Environments on Icy Worlds. 2016 DPS / EPSC meeting abstract.
- L. M. Barge, M. J. Russell, P. Sobron, M. M. Baum, I. Kanik. Designing Far-From-Equilibrium Experiments for Origin of Life and Planetary Habitability. 2015 Astrobiology Science Conference.
- L. M. Barge**, P. Sobron, E. Flores, M. J. Russell, A. Wang, I. Kanik. Phase Transformations of Green Rust: Laser Raman Characterization With Implications for Origin of Life and Mars Astrobiology. 2015 Astrobiology Science Conference Abstract #7617.
- P. Sobron, **L. M. Barge**, M. J. Russell, R. Price, T. Schneiderman, K. Takai, M. Yamamoto. Hydrothermal Mineral Precipitates as Habitable Environments: A Synergistic Imaging, Raman, and LIBS Approach to Exploring Underwater Chimney Materials. 2015 Astrobiology Science Conference.

- P. Sobron, **L. M. Barge**, J. Amend, M. Church, L. Dubord, K. Fristad, B. Kirkwood, A. Misra, K. Nealson, M. Parente, R. Price, M. Russell, M. Smith, K. Zacny, R. Leveille, B. Reese, B. Thornton, K. Takai. A Multi-Sensor Payload Concept for the Exploration of Planetary Underwater Hydrothermal Systems. 2015 Astrobiology Science Conference.
- L. M. Barge**, M. J. Russell, S. Vance, P. Johnson, I. Kanik. The Detection of Disequilibria and/or Life in a Europa Plume. Workshop on the Potential for Finding Life in a Europa Plume, NASA Ames Research Center, 2015.
- L. M. Barge**, E. Flores, P. Sobron, M. J. Russell. Spectroscopic Characterization of Green Rust and its Implications for Mars Astrobiology. AGU Joint Assembly, Montreal, Canada, May 2015.
- P. Sobron, **L. M. Barge**, R. Bhartia, M. Yamamoto, K. Takai. (2014) Mineralogy at Hydrothermal Fields in the mid-Okinawa Trough: Laser Raman Spectroscopy Characterization of Black Smoker Chimney Materials. 11th International GeoRaman Conference, St. Louis, 2014.
- L. M. Barge**, P. Chellamuthu, I. Kanik. Fuel Cell Simulations of Geochemical Energetics on Rocky / Icy Worlds. Workshop on Habitability of Icy Worlds, Pasadena, 2014.
- L. M. Barge**, M. J. Russell, I. Kanik (2013) Fuel Cell Simulations of Hydrothermal Vents on Europa. 44th LPSC, #1719.
- L. M. Barge**, I. J. Doloboff, I. Kanik, M. J. Russell. Inorganic Precipitates as Electrochemical Energy Traps at Alkaline Vents on the Early Earth. Astrobiology Science Conference, Georgia Tech, April 2012.
- L. M. Barge**, I. J. Doloboff, I. Kanik, M. J. Russell. (2012) Electrochemistry of Inorganic Membranes at Alkaline Hydrothermal Vents – Energy Sources for Emerging Life on Wet Rocky Planets. 43rd LPSC, Abs. #2489.
- L. M. Barge**, L. M. White, I. Doloboff, I. Kanik, M. J. Russell. (2011) Pyrophosphate Generation Via an Ambient Proton-Motive Force: Laboratory Tests of an Alkaline Hydrothermal Origin-of-Life Scenario. *Origins 2011: Joint ISSOL and Bioastronomy International Conference*, Montpellier, France, July 2011.
- L. M. Barge**, M. J. Russell, I. Kanik. (2011) Precipitation Patterns of Iron Minerals in a Chemical Gradient: A Laboratory Analog to Hydrothermal Environments on the Early Earth. *LPSC XLII*, Abs #1099.
- L. M. Barge** (2009) Ability of Biochemicals to Induce Pattern Formation in Inorganic Precipitates. *Astrobiology*, Vol. 9, No. 5, AGC09-p08.
- L. M. Barge** and J. Petruska. (2009) Experimental Tests of Micro-concretion Nucleation in Porous Media. *LPSC XL*, Abs #1910.
- L. M. Barge**, J. Petruska, M. A. Chan, S. Potter, K. Nealson. (2008) Formation of Spherical Precipitates in Diffusion-Controlled Systems - A Possible Laboratory Analogue for the Martian Hematite Concretions. *LPSC XXXIX*, Abs. #1414.
- L. M. Barge** and J. Petruska. (2007) Iron Precipitation Patterns in Gels: Implications for the Formation of Hematite Concretions at Meridiani Planum, Mars. *LPSC XXXVIII*, Abs. #1676.
- L. M. Barge**, J. Petruska, S. Potter, M. A. Chan, J. Cho, K. Nealson (2007) Mineral precipitation in porous media: Laboratory diffusion experiments as analogues for concretion formation on Earth and Mars. *Eos Trans. AGU*, Abstract P21A-0224B.
- L. M. Barge** and T. J. Parker. (2006) Landing Site Map Compilation and Hazard Assessment for Phoenix. *LPSC XXXVII* Abs. #2341.
- L. M. Barge** and K. Nealson (2005). Photosynthesis via Mineral Fluorescence in Harsh UV Radiation Environments, *Eos Trans. AGU*, 86(52), Abstract P51D-0953.
- F. P. Maloney, E. F. Guinan, **L. M. Barge**, R. A. Mardling (2003) Revisiting the Anomalous Apsidal Motion of the Eccentric Eclipsing Binary DI Herculis. *BAAS* 35, no. 5, p.1224.
- Barge, L. M.**, Ribas, I., Maloney, F. P.; DeWarf, L. E.; Fitzpatrick, E. L.; Guinan, E. F. (2003) The LMC Eclipsing Binary HV2241: Fundamental Properties and Evolution. *BAAS* 35, no. 3, p. 708.