Laurie Barge, Ph.D.

NASA Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive, Pasadena, CA 91109
Email: Laura.M.Barge@jpl.nasa.gov | US Citizen
Research website: https://www.lauriebarge.com/ | Lab website: origins-habitability.jpl.nasa.gov

Relevant Expertise: Barge has 15+ years of experience in conducting laboratory experiments to simulate chemistry in planetary environments; her research has led to development of methods to simulate hydrothermal systems on early Earth and ocean worlds. She co-leads the JPL Origins and Habitability Laboratory, an astrobiology research group which studies how life emerges and can be detected on planets. Barge leads various research teams funded by NASA and others studying topics such as origin of metabolism, habitability of Enceladus and other ocean worlds, and exploration of hydrothermal vents in the lab and in the field. She is a steering committee member for the NASA Astrobiology program's Research Coordination Networks for Ocean Worlds (NOW) and Life Detection (NFoLD), and was named as a 2020 Scialog "Signatures of Life in the Universe" Fellow. Barge is involved in NASA missions as the HiRISE Investigation Scientist for NASA's Mars Reconnaissance Orbiter, and a Participating Scientist for NASA's Mars Science Laboratory (*Curiosity* rover). For her astrobiology work Barge has received the Rosalind Franklin Award for Science in Astrobiology; the JPL Lew Allen Award and JPL Polaris Award; the NASA Early Career Public Achievement Medal; the NASA Diversity, Equity and Inclusion Medal; and the Presidential Early Career Award for Scientists and Engineers.

Research Interests:

- *Astrobiology of ocean worlds*: Assessing the habitability of ocean worlds, particularly in hydrothermal vent systems that may exist / have existed in ocean world interiors. Using terrestrial hydrothermal field sites as ocean world analogs, we develop analysis techniques and science strategies for life detection at vents.
- *Planetary organic geochemistry*: What processes can produce organic signatures on Mars and ocean worlds, and how can organics indicate the geochemical conditions in which they formed? What is the fate of bio-essential elements (e.g. nitrogen, phosphorus) on these worlds? We conduct lab studies of analog minerals to help identify organic / inorganic chemical pathways and produce useful test samples for mission-relevant instruments.
- *Origin of life*: Conducting laboratory simulations of hydrothermal systems on the early Earth, Mars, and ocean worlds, to understand whether these environments could have driven the emergence of life. Studies include organic synthesis, mineral-driven prebiotic chemistry, and emergence of metabolic pathways.

Current Positions:

Research Scientist, NASA Jet Propulsion Laboratory 2015 – present
- PI, Origins and Habitability Laboratory at JPL. Lead astrobiology research team of ~10-15 students / postdocs whose projects span themes such as origin of life, habitability, and life detection. Hold weekly quiet hours with individuals, weekly lab / group meetings; facilitate ongoing program of seminars for the group; manage laboratory.

Program Area Scientist for Ocean Worlds, JPL Planetary Science Directorate 2023 – present
- Represent and lead ocean worlds strategic activities; provide astrobiology strategy & expertise for JPL's Planetary Sciences Directorate.

HiRISE Investigation Scientist, Mars Reconnaissance Orbiter, NASA Jet Propulsion Laboratory 2015 – present
- Act as liason between the High Resolution Imaging Science Experiment (HiRISE) instrument team at University of Arizona and the Mars Reconnaissance Orbiter (MRO) project at JPL.
- Conduct Mars-related research and perform mission-related outreach, e.g. public talks, JPL Open House.
- Mission Operations: MRO Cycle Coordinator (conduct 5-week preparation for MRO's 2-week observing cycles)

NASA Mars Science Laboratory (MSL), Participating Scientist 2022 – present
- Leading investigation of abiotic / prebiotic organic chemistry driven by Mars analog minerals to understand how redox/pH conditions in Gale Crater could have driven formation of organics that were detected by MSL.

Education:

Ph.D., 12 / 2009, Geological Sciences, University of Southern California, Los Angeles, CA
B.S., 8 / 2004, Astronomy and Astrophysics, Villanova University, Villanova, PA

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)
Caltech Postdoctoral Scholar, NAI Icy Worlds Team (6/2010 – 3/2013)
Phoenix/Mars Science Laboratory Landing Site Working Groups, Graduate Researcher, 2004–2006
Marathon Oil Company, Petrophysics Intern, Summer 2008.
NASA Goddard Space Flight Center, NASA Academy Intern, Summer 2004.
Additional training:
2021 JPL Scientist-Mission Interface Workshop
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"*
2006 NASA/ESA International Summer School in Astrobiology: *"Origins: From the Big Bang to Life."*
LAPLACE Astrobiology Winter School: *"Habitable Planets Around Sun-like Stars: Common or Rare?*"
2005 NAI Astrobiology Winter School, U. of Hawaii, *"Water on Earth and in Space"*

Publications:

Italic / Underline = Student / postdoc under my supervision

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Rodriguez, L.E.; Weber, J.M.; **Barge, L.M**. (2024) Evaluating Pigments as a Biosignature: Abiotic / Prebiotic Synthesis of Pigments and Pigment Mimics in Planetary Environments. *Astrobiology*, 24, 8, 767-782.

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Testón-Martínez, S.; Huertas-Roldan, T; Knoll, P.; **Barge, L.M.;** Sainz-Diaz, C.I.; Cartwright, J.H.E. (2023) A microfluidic labyrinth self-assembled by a chemical garden. *Physical Chemistry Chemical Physics* 25, 30469–30476.

Martinez, E.; Rodriguez, L.; Sheppard, R.; Zhang, Y.; Cid, C.; Khodayari, A.; **Barge, L.M.** (2023) Nitrate reactivity in iron (oxy)hydroxide systems: Effect of pH, iron redox state, and phosphate. *ACS Earth and Space Chemistry,* 7, 11, 2287–2297.

Goldman A.D., Weber J.M., LaRowe D.E., **Barge L.M.** (2023) Electron Transport Chains as a Window into the Earliest Stages of Evolution. *PNAS*, 120 (34) e2210924120. https://doi.org/10.1073/pnas.2210924120

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Gaylor M.O.; P. Miro; B. Vlaisavljevich; S K.A. Anuradha; **L. M. Barge**; A. Omran; P. Videau; V. A. Swenson; L. J. Leinen; N. W. Fitch; K. L. Cole; C. Stone; S. M. Drummond; K. Rageth; J. T. Dewitt; S. González Henao; V. Karanauskus. (2021) Plausible Emergence and Self Assembly of a Primitive Phospholipid from Reduced Phospho rus on the Primordial Earth. *Origins of Life and Evolution of Biospheres,* 51, 185–213.

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Aguirre V. P., S. Jocic, P. Webster, C. Buser, J. A. Moss, **L. M. Barge**, Y. Tang, Y. Guo, M. M. Baum. (2020) Synthesis and Characterization of Mixed-valent Iron Double Layer Hydroxides ("Green Rust"). *ACS Earth and Space Chemistry*, 5, 1, 40–54. https://doi.org/10.1021/acsearthspacechem.0c00272

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Jones J.-P., Firdosy S. A., **Barge L. M.**, Bescup J. C., Perl S. M., Zhang X., Pate A. M., Price R. E. (2020) 3D Printed Minerals as Astrobiology Analogs of Hydrothermal Vent Chimneys. *Astrobiology*, 20, 12, 1405-1412, http://doi.org/10.1089/ast.2020.2260.

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Barge L.M., Jones J.-P., Pagano J., *Martinez E.*, Bescup J. (2020) 3-Dimensional Analysis of a Simulated Prebiotic Hydrothermal Chimney. *ACS Earth and Space Chemistry*, 4, 1663-1669. https://doi.org/10.1021/acsearthspacechem.0c00186.

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Wei Y., Chin K., **Barge L.M.**, Perl S., *Hermis N.,* Wei T. (2020) Machine Learning Analysis of the Thermodynamic Responses of In-situ Dielectric Spectroscopy Data in Amino Acids and Inorganic Electrolytes. *J. Phys. Chem. B,* 124, 50, 11491–11500.

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Lam B.R., **Barge L.M.**, Noell A.C., Nealson K.H. (2019) Detecting Microbial Metabolism and Differentiating Between Abiotic and Biotic Signals Observed by Bioelectrochemical Systems in Soils. *Astrobiology*, 20, 1, 39-52, doi: 10.1089/ast.2018.1892.

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Chin K. B., Chi I., Pasalic J., Huang C.-K., **Barge L. M.** (2018) An introductory study using impedance spectroscopy technique with polarizable microelectrode for amino acids characterization. *Review of Scientific Instruments* 89, 045108, https://doi.org/10.1063/1.5020076.

Barge L. M. and White L.M. (2017) Experimentally Testing Hydrothermal Vent Origin of Life on Enceladus and Other Icy/Ocean Worlds. *Astrobiology*, Special Collection on Enceladus, 17(9):820-833 https://doi.org/10.1089/ast.2016.1633.

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. (2016) Self-Assembling Iron Oxyhydroxide / Oxide Tubular Structures: Laboratory-Grown and Field Examples from Rio Tinto. *Proceedings of the Royal Society of London A,* 472, 2195, 20160466.

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Scharf C., 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.

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Submitted:

Weber JM, *Martinez E*, Sheppard RY, Rodriguez LE, Celestian A, *Teece BL*, **Barge LM**. Mars Mineral Weathering Experiments in a Continuous-Flow Reactor. *Geofluids*, in review.

Omran A, *Dzurilla K.A*., Rodriguez L.E., Gonzalez A, Feng T., Abbatiello J, **Barge L.M.,** Pasek M. Far-from-equilibrium polyphosphate generation from phosphite oxidation and its implications for the early Earth and ocean worlds. *ChemSystemsChem*, In review

Velling, S. V.; Rodriguez, L. E.; Oyala, P. H.; Jones, J.-P.; **Barge, L. M.;** Weber, J. M.* Application of Electron Paramagnetic Resonance Spectroscopy for Studies of Prebiotic Metals and Complexes. *28th Volume of Metals in Life Sciences*, in review.

Valadez D, Weber JM, Martinez E, Luna M, Kataria T, **Barge LM.** Redox-buffered systems as a transition to catalysis in a prebiotic iron-mediated organic reaction system. *Nature Communications*, in review.

Funded Projects / Grants:

As PI:

2024 PI, NASA Habitable Worlds, "Feeding Enceladus' Deep Biosphere" ($832K)
2024 PI, JPL Center for Academic Partnerships program, "Joint STEM Pathways Program with Undergraduate Institutes" ($30K)
2023 – 2026 PI, NASA Exobiology, "Simulating the Emergence of Metabolism in an Alkaline Hydrothermal Vent" ($1M)
2022 – 2023 PI, Technical Equipment and Facilities Infrastructure Management (TEFIM) Program, "Astrobiology Elemental Analysis Facility" (ICP-OES) ($174K)
2022 – 2023 PI, JPL Center for Academic Partnerships program, "Peer Mentoring for Student Pathways in STEM" ($50K)
2022 – 2023 PI, Scialog / NASA Astrobiology Program, "Mars Sample Return: Connecting Martian Environmental Geochemistry to Returned Samples" (with F. Rivera-Hernandez, Georgia Tech) ($50K)
2022 – 2023 PI, JPL Researchers on Campus (JROC) program: "New Materials Science Technologies for Testing Origin of Life on Ocean Worlds" ($25K)
2022 – 2025 PI, NASA Mars Science Laboratory Participating Scientist Program, "Investigating Abiotic Mineral-Organic Chemistry to Interpret Organic Detections on Mars" ($382K)
2022 PI, JPL TEFIM, "Planetary Geochemistry Simulation Facility" (Reactors to simulate Venus surface conditions) ($170K)
2022 JPL HBCU / MSI program, "Developing Student Pipelines in Earth, Environmental, and Planetary Science" ($40K)
2019 – 2022 JPL Strategic R&TD "Fate of Organics on Ocean Worlds", PI / Task Lead: "Understanding abiotic organic chemistry driven by minerals in Ceres' and Enceladus' oceans" ($700K)
2021 – 2022 Co-PI (with Laura Rodriguez), JPL Data Science Pilot Project, "Developing machine learning models to facilitate the untargeted identification and classification of organics in complex mixtures via tandem mass spectrometry" ($50K)
2021 – 2022 Co-PI (with Jessica Weber), JPL Spontaneous R&TD "Novel Continuous Flow Reaction Design to Test Martian Weathering" ($40K)
2021 – 2022 PI, Scialog / NASA Astrobiology Program, "Synthetic Mineral Geo-Electrodes for Detecting Life on Ocean Worlds" (with J. Marlow, Boston U.) ($50K)
2020 – 2023 PI, JPL Strategic R&TD, "Venus Science into the Next Decade" ($600K)
2020 – 2025 Co-PI, NSF Improving Undergraduate Student Education (IUSE), "Pathways to STEM" (PI: Marianne Smith, Citrus College) (receiving Space Act funding to JPL) ($2.5M)
2021 – 2022 PI, JROC: "Mineral Catalyzed Enzymatic Reactions for Origin of Life on Rocky and Ocean Worlds" ($20K)
2021 PI, JPL Spontaneous R&TD: "Hydrothermal chemistry test facility for astrobiology experiments" ($44K)
2018 – 2021 PI, NASA Habitable Worlds, "Phosphorus Redox Chemistry on Icy and Rocky Planets" ($945K)

2018 – 2021 Science-PI, NASA Planetary Science and Technology Through Analog Research, "In-Situ Vent Analysis Divebot for Exobiology Research" (PI: Pablo Sobron) ($5M)
2017 – 2020 PI, NASA/NSF Ideas Lab for the Origins of Life, "Becoming Biotic: Recapitulating the Origin of Ancient Metabolic Pathways" ($1M)
2020 PI, JROC program: "Investigating mechanisms of carbon reduction and abiotic methane generation on Mars" ($20K)
2019 PI, JPL Spontaneous R&TD, "Can nitrates on Mars drive subsurface organic chemistry?"($30K)
2019 PI, JPL Researchers on Campus program: "Fate of nitrate/nitrite in an ancient ocean on Mars" ($20K)
2019 JPL Lew Allen Award proposal; "Studying Venus to Understand Astrobiology of Terrestrial Planets" ($20K)
2015 – 2019 Co-PI, NSF Improving Undergraduate STEM Education (IUSE), "GP-EXTRA - Bridge to the Geosciences" ($600K)
2017 – 2019 PI, JPL Topical R&TD, "Planetary Habitability Test Beds" ($400K)
2018 PI, JPL Spontaneous R&TD, "Phosphorus Chemistry on Early and Present Day Mars" ($30K)
2017 PI, JPL Spontaneous R&TD, "Which Came First, Proteins or Cofactors? Recreating Metabolic Reactions on the Early Earth" ($30K)
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"
2015 JPL Advanced Concept Development: "Sulfate and amino acid absorption in Mars analog minerals"
2014 PI, NASA Astrobiology Institute Early Career Collaboration Grant: "Prebiotic Phosphorus Chemistry",
2013 PI, NASA Astrobiology Institute Early Career Collaboration Grant: "Effects of Catalytic Iron-Containing Minerals on RNA Synthesis"
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"

<u>As Co-I:</u>

2023 – 2025 Co-I, NASA SMD Bridge Program Seed Funding, "Environmental Pollution Reduction Inspired by Planetary Science"
2022 – 2025 Co-I, JPL Strategic R&TD, "Assessing Origin of Life (OOL) Scenarios for Exoplanet Studies"
2020 – 2023 Co-I, NASA Habitable Worlds: "Habitability of saponite-rich hydrothermal systems of early Mars"
2015 – 2019 Investigation Lead / Co-I, NASA Astrobiology Institute, Cooperative Agreement Notice (CAN-7), "Icy Worlds: Astrobiology at the Water-Rock Interface and Beyond"
2018 – 2021 Co-I, NASA MaTISSE, "In-situ Spectroscopic Europa Explorer (iSEE)"
2019 Co-PI, JPL Technical Equipment and Facilities Infrastructure Management (TEFIM) Program, "Geobiology Analysis Suite" (suite of laboratory Raman and LIBS instruments for geobiology research)
2019 Co-I, JPL Spontaneous R&TD, "Power Generation from Hydrothermal Vent Energy for Robotics and In Situ Sensing Operations"
2018 Co-I, JPL Topical R&TD, "Developing an Electrochemistry-Based Geochemical Framework for Organic Systems"
2018 Co-I, JPL Topical R&TD, "Prebiotic and Microbial Bioindicators for Exoplanet Discovery"
2018 Co-I, JPL Presidents & Director's Fund, "Biogeochemical signatures of hypersaline brine systems"
2018 Co-Lead, JPL Blue Sky Study: Planetary Soils
2017 Co-I, JPL Spontaneous R&TD, "Hydrothermal Vent Instrument Anchoring Platform"
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 (EIS) System"
2016 Co-Lead, JPL Blue Sky Study: Origin of Life
2014 JPL Planetary Instrument Advanced Concept Development, "Simulated Seafloor Systems for Origin of Life Studies"
2013 Co-I, JPL Strategic University Partnership Program award, "Microbial Fuel Cells for in-situ life detection"

Selected Activities, Service, Leadership:

Panel Member, National Academies of Science, Engineering, Medicine, "A Science Strategy for the Human Exploration of Mars: Panel on Astrobiology", 2024 - 2025
Committee member, Mars Search for Life Science Analysis Group (SFL-SAG), 2024-2025.
Professional Societies

- Scientific Society for Astrobiology (SSA): Co-founder and Executive Board Co-Chair
- American Chemical Society, Southern California Section, Executive Committee member (2021-2023)
- Memberships: American Chemical Society (ACS), American Geophysical Union (AGU)

Steering Committee member, NASA Network for Ocean Worlds (NOW) and NASA Network for Life Detection (NFoLD)

Selected Conference Leadership

- Scientific Organizing Committee member, Astrobiology Science Conference (AbSciCon) 2022
- Session chair at various national meetings: AbSciCon 2019, AGU 2018; AGU 2017; Goldschmidt 2018
- 2018 Gordon Research Conference on Geobiology, Discussion Leader (Life Detection)

Steering Committee member, NSF Research Coordination Network on the Exploration of Life's Origins. Award led by The Santa Fe Institute hosted a series of core meetings / topical working groups over a 5-year period that explored the rules under which life is assembled.

ELSI Origins Network (EON) Advisory Board, 2014-2018. 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.

Member, Roadmap for Ocean Worlds (ROW) team, NASA Outer Planet Assessment Group (OPAG), 2016. Led "Detection of Life" theme / participated in ROW meetings, to produce documents of science goals relating to specific targets for use in future studies of / missions to ocean worlds.

JPL Study Lead:

- 2018 JPL Blue Sky Study for Planetary Soils. Creating chemical analogs of Mars and icy world soils / sediments for use in life detection studies.
- 2017 JPL Space Life Sciences study for Astrobiology, Co-led study to assess Astrobiology expertise at JPL, develop an astrobiology community, and strategize paths forward.
- 2016 JPL Blue Sky Study for the Origin of Life. Co-led a study to recommend JPL's institutional investment and strategies for origin of life research.

2012-2017 Co-chair, **NASA Astrobiology Institute Focus Group: "Thermodynamics, Disequilibrium, Evolution".** Organized 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 Synchotron Light Laboratory (LNLS); INAF-Astrophysical Observatory of Arcetri (Italy).

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

Referee, *Nature Scientific Methods, Nature Astronomy, Nature Communications, Journal of Physical Chemistry, Langmuir, Chemical Physics, Journal of the American Chemical Society, Angewandte Chemie, Journal of Molecular Evolution, Astrobiology, Origins of Life and Evolution of Biospheres, Geophysical Research Letters, Earth Science Reviews*.

Selected Recent Outreach:

- Guest on NASA's Gravity Assist Podcast, "Gardens at the Bottom of the Sea", Aug 2020: https://www.nasa.gov/mediacast/gravity-assist-gardens-at-the-bottom-of-the-sea-with-laurie-barge
- Featured on NASA's "Ask an Astrobiologist" series, https://astrobiology.nasa.gov/ask-an-astrobiologist/episodes/32/
- Intrepid Sea, Air and Space Museum (NYC): Invited guest speaker, 2019 World Water Day Europa; Family Astronomy Night series ("The Search for Life on Mars"), 2018.
- Invited speaker, "Findings of Water on Mars", Space Fest 2015, California Science Center (Los Angeles)

Media Features:

Los Angeles Times, "Algae here, alien life out there — Cal State L.A.-JPL partnership connects engineers to astrobiology", https://www.latimes.com/environment/story/2024-08-20/cal-state-la-jpl-partnership-connects-engineers-to-astrobiology

JPL / NASA press release, "NASA Grant Brings Students at Underserved Institutions to the Stars", https://www.jpl.nasa.gov/news/nasa-grant-brings-students-at-underserved-institutions-to-the-stars

JPL / NASA press release featuring two recent publications, "Removing Traces of Life in Lab Helps NASA Scientists Study Its Origins", https://www.jpl.nasa.gov/news/removing-traces-of-life-in-lab-helps-nasa-scientists-study-its-origins

USC Dornsife College of Letters, Arts, and Sciences, Profile: Searching for the Origins of Life: https://dornsife.usc.edu/news/stories/3603/profile-searching-for-the-origins-of-life/

Featured in University of Southern California News, "Could alien worlds hold life? One USC Dornsife alumna aims to find out", by Margaret Crable, https://dornsife.usc.edu/news/stories/3423/could-alien-worlds-hold-life/

Appeared in BBC Reel, "The mystery of how life began on Earth", https://www.bbc.co.uk/reel/video/p08xl4d6/the-mystery-of-how-life-began-on-earth, 9 Nov 2020

Featured in Knowable Magazine, "Searching high and low for the origins of life", by Anne N. Connor: https://www.knowablemagazine.org/article/physical-world/2020/searching-high-and-low-origins-life

Appeared in CBS Mission Unstoppable, "Nets, Neighborhoods and NASA": https://www.cbs.com/shows/mission-unstoppable/video/cLLoupSSWqojCjcog2xv0hsmZm2whbzU/mission-unstoppable-nets-neighborhoods-and-nasa/

JPL Feature Story, “NASA Study Reproduces Origins of Life on Ocean Floor”, 2/25/2019, by Arielle Samuelson, https://www.jpl.nasa.gov/news/news.php?feature=7340

Appeared in PBS “Second Genesis: The Quest for Life Beyond Earth”, http://www.pbs.org/the-farthest/second-genesis/ (start at 12:37)

Featured in Astrobiology Magazine, “Hydrothermal Experiments Bring Enceladus to Earth”, by Charles Choi, Nov 30, 2017, https://www.astrobio.net/news-exclusive/hydrothermal-vent-experiments-bring-enceladus-earth/

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/

Appeared 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

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. https://www.ocregister.com/2014/04/28/did-sea-floor-battery-spark-life-on-earth/

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, *Weltanshauung* weekly show with Michael DeLeionardis, 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

Selected Honors / Awards:

2024 NASA Diversity, Equity, and Inclusion Medal
2023 JPL Polaris Award for Exceptional Contributions to DEIA
2023 Rosalind Franklin Society Award in Science for Astrobiology
2020 Scialog “Signatures of Life in the Universe” Fellow (received funded awards in 2020, 2021)
2019 Presidential Early Career Award for Scientists and Engineers (PECASE), for innovative fuel cell-based research
2019 NASA Early Career Public Achievement Medal (for advances in origin of life research)
2019 NASA Group Achievement Award, InSight EDL Communications Team
2018 JPL Lew Allen Award for Excellence, for pioneering research on the application of electrochemistry to studies of the origin and emergence of life. (Awarded to 4 JPL-ers annually to recognize and encourage significant individual

accomplishments or leadership in scientific research or technological innovation by JPL employees during the early years of their professional careers.)
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, 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)

Selected Invited Talks

Invited talk, NASA Planetary Science & Astrobiology Decadal Survey panel on Ocean Worlds and Dwarf Planets, "Laboratory Experiments in Support of Ocean World Exploration", 3/12/2021
Invited speaker, NASA Prebiotic Chemistry and Early Earth Environments (PCE3) community workshop, "Formation of Precursors, Simple Molecules, Selection"; https://www.youtube.com/watch?v=0RVRhWqnJDg&list=PLvogKQh-bBnUgZJ0scf1nLkMKFjPDS1l8&index=4
Invited speaker, COST Chemobrionics meeting (Prague, Jan 2020)
Astrobiology Science Conference 2019: Plenary panel speaker, "Plenary Session: Unresolved Issues in the Origins of Life: Multidisciplinary Perspectives", Seattle, WA
Invited speaker, Molecular Origins of Life – Center for Advanced Studies (CAS) Conference 2018, "Simulating Prebiotic Chemistry in Hydrothermal Systems on Early Earth and Ocean Worlds", Munich, Germany, Oct 2018.
Goldschmidt 2018, Keynote Speaker (Prebiotic Chemistry and Habitability in Serpentinizing Hydrothermal Systems on Early Earth and Other Worlds), Session: Microbe-Fluid-Rock Interaction in Hydrothermal Systems.
COSPAR 2018 invited talk, Scientific Event F3.2: The Evolving Chemical Universe: From Proto-stars to the Origin of Life. ("Experimental Simulations of Prebiotic Chemistry Driven by Hydrothermal Gradients in Ocean Worlds")
2018 Gordon Research Conference on the Origins of Life, Invited Speaker (Session: Prebiotic Environments)
2018 NASA/ESA International Summer School in Astrobiology, Invited Lecturer (Biomarkers: Signs of Life Through Space and Time), Santander, Spain. Lectures: "Ocean Worlds: Geochemistry, Redox Cycling, and Habitability"; "Ocean Worlds: Defining Biosignatures and Developing Strategies for Life Detection".
Invited Speaker, International Symposium on *Environments of Terrestrial Planets Under the Young Sun: Seeds of Biomolecules*, ("Exploring Environmental Conditions for Prebiotic Chemistry on Early Terrestrial Planets"), Goddard Space Flight Center, April 2018.
Astrobiology Science Conference 2017: Invited talk, 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
American Geophysical Union 2016 Fall Meeting Invited talk, session on Enceladus: "Simulating Prebiotic Chemistry in Alkaline Hydrothermal Vents on Enceladus and other Ocean Worlds".
Conference on Re-conceptualizing the origin of life, Carnegie Institute: Invited speaker, "Hydrothermal chimneys as flow---through chemical reactors: Laboratory simulations of far-from-equilibrium systems at seafloor interfaces", Washington DC, 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.
Princeton Origin of Life Workshop, Invited speaker, *Testing the Emergence of Bioenergetics in Hydrothermal Vents*. Princeton Center for Theoretical Science, January 2013.
Invited Speaker, *Energetics of Chemical Gardens in Prebiotic Systems*, Lorentz Center workshop on "Chemical Gardens", Leiden University, the Netherlands, May 2012.

University seminars / lectures:

- 2024: WHOI, Rutgers, UC Riverside, College of Charleston

- 2023: Earth-Life Science Institute (Tokyo Tech); Caltech geoclub seminar; CU Boulder geology seminar; NASA GSFC seminar; NASA Headquarters seminar; Harvard Origins seminar
- 2022: Boise State chemistry seminar, UCLA Earth & Planetary Sciences colloquium, U Penn Earth & Environmental Sciences colloquium, Florida Tech astrobiology seminar
- 2021: Caltech Astrobiology course, UCLA / UCB planetary science seminar series, Georgia Tech Earth and Atmospheric Sciences seminar, U. of Hawaii planetary science seminar
- 2020: McGill Astronomy Seminar Series; Queens University Astronomy seminar; Caltech Yuk Lunch Seminar
- 2019: University of Southern California and Caltech astrobiology course guest lecturer; U. of Nevada Las Vegas Geoscience department seminar; Earth-Life Science Institute (ELSI, Tokyo Tech)
- 2018: Johns Hopkins University Applied Physics Lab; U. of Tulsa
- 2017: Caltech Planetary Science Seminar
- 2016: CSU Northridge astronomy seminar; U. of Tulsa; Johns Hopkins and Space Telescope Science Institute
- 2015: Caltech Yuk Lunch Seminar; University of Washington Astrobiology Colloquium Series; Florida State University Chemistry Seminar Series; Georgia Tech Planetary Seminar Series; UCLA iPLEX Lunch series
- 2014: Oak Crest Institute of Science (Monrovia, CA); USC Geobiology Seminar Series; Institute for Genomic Biology, University of Illinois Urbana-Champaign; ELSI
- 2013: Georgia Tech, Center for Ribosomal Origins and Evolution; ELSI and Japan Agency for Marine-Earth Science and Technology (JAMSTEC); University of Leeds, School of Chemistry
- 2012: University of Budapest; University of Wisconsin-Madison Geology Department
- 2011: Caltech Inorganic-Organometallics Seminar; Caltech Yuk Lunch seminar

Student and Postdoc Supervision:

Bold = postdoc; *Italic / underline = thesis committee member*

2024-present: Christian Mendoza, M.S. civil engineering (iron redox chemistry)
2024-present: Osama Alian, JPL Postdoc (origin of life in hydrothermal vents)
2023-present: Seneca Velling, Ph.D. materials science, Caltech (hydrothermal chimneys)
2023-present: Cathy Trejo, M.S. civil engineering (hydrothermal organic chemistry)
2022-present: Bonnie Teece, JPL Postdoc (hydrothermal vents)
2022-present: Katherine Dzurilla, JPL Postdoc (phosphorus chemistry)
2022-present: Matt Luna, undergraduate (Citrus College / USC)
2019-2022: Jessica Weber, JPL Postdoc (origin of life)
2019-2022: Laura Rodriguez, JPL Postdoc (hydrothermal vents)
2020-2022: Rachel Sheppard, JPL Postdoc (Mars redox environments)
2022-present: Nancy Carman, Ph.D. candidate, UNLV (Geosciences) (+member of Ph.D. committee)
2022-present: Billal Zayat, Ph.D. candidate, USC Chemistry (electrochemistry / ocean worlds)
2021-present: Dennise Valadez, M.S. Physics, CSULA (origin of metabolism)
2021-present: Julia Chavez, M.S. Environmental Engineering, CSULA (saponite precipitation)
2020-present: Tess Marlin, Ph.D. candidate / graduate student intern, Caltech (origin of metabolism)
2018-present: Eduardo Martinez, M.S. candidate, CSULA (nitrate/phosphate chemistry)
2013-present: Erika Flores, M.S. candidate / graduate student intern, CSULA (reductive amination in iron hydroxides)
2020: Sarah Lamm, graduate student intern, U. of Kansas (Raman and LIBS of iron minerals)
2020: Medha Prakash, undergraduate intern, U. of Virginia (carbon redox chemistry)
2017-2020: Ninos Hermis, M.S. candidate / graduate student intern, CSULA (fuel cells, temperature gradients)
2018-2019: Jonathan Major, M.S. candidate, University of Tulsa, (phosphorus on Mars / ocean worlds)
2019: Sarah Crucilla, undergraduate intern, Caltech (origin of metabolism)
2019: Ph.D. committee member for Chris Mehta, University of South Florida
2017-2019: Michelle Hooks, NASA STAR fellow, USC (organic effects on chemical gardens)
2018: Angel Chavez, undergraduate intern, UC Irvine (Mars soil simulations)
2018: Hiroki Nishimura, undergraduate intern, Tokyo University of Marine Science and Technology (phosphorus)
2017: Thora Maltais, Postdoctoral researcher (TCA cycle reactions on early Earth)
2016-2017: Ryan Cameron, undergraduate intern, Tulsa Community College / CSU-Northridge (electrochemistry)
2013-2017: Lily Abedian, undergraduate intern, UC San Diego (electrochemistry, phosphorus chemistry)
2017: Liz Miller, undergraduate intern, Bard College (reductive amination in iron hydroxides)
2016: Arden Hammer, undergraduate intern, Oberlin College (organic effects on chemical gardens)
2016: Kayo Kallas, undergraduate intern, Santa Monica College (reductive amination in iron hydroxides)
2011-2015: Ivria Doloboff, undergraduate intern, CSU-Long Beach (chemical gardens; phosphorus chemistry)
2013-2015: Timothy Lin, undergraduate intern, UC Riverside (carbon reduction on hydrothermal sulfide minerals)
2015: Arlette Valencia, undergraduate intern, Citrus College (iron hydroxides)
2014: Jessica Nunes, undergraduate intern, Citrus College (iron hydroxide chemical gardens, organics, phosphorus)

2012-2013: Nery Rafael, undergraduate intern, CSU-Long Beach (iron hydroxides)
2012: John Zeytounian, undergraduate intern, University of Southern California (electrochemistry of iron sulfides)

Mentoring:

2013-present: Mentor for various JPL/NASA undergraduate and graduate intern programs, typically 10+ 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.

Published Abstracts:

Over 170 published abstracts for national and international conferences (Lunar and Planetary Science Conference, American Geophysical Union, American Chemical Society, Astrobiology Science Conference, Goldschmidt, International Conference for the Origin of Life, American Astronomical Society, AAS Division of Planetary Sciences, and others).