

Laura E. Rodriguez, PhD.

Lunar and Planetary Institute
Universities Space Research Association
3600 Bay Area Blvd, Houston, TX 77058

e-mail: lrodriguez@lpi.usra.edu

PROFESSIONAL APPOINTMENTS

Lunar and Planetary Institute **Oct. 2022-Present**
Staff Scientist | MSL Participating Scientist | Mars Sample Return Campaign Group

NASA Jet Propulsion Laboratory Aug. 2019 – Oct. 2022
JPL Postdoctoral Fellow | MSL Participating Scientist | EVE Science Co-lead

EDUCATION

JPL [Mission Design] Planetary Science Summer School May-Aug 2022
Gelato: Comet Surface Sample Return

The Pennsylvania State University May 2019
Penn State STEM Scholar | Ford Fellow | Alfred P. Sloan Scholar
Ph.D. Geochemistry & Astrobiology
Dissertation: The Reactivity of *N*-Heterocycles in Complex Prebiotic Mixtures: Using Chemical Trends to Evaluate Plausible Structures of Primitive Genetic Material on Early Earth

Rice University
NASA Early Career Collab Award | Rice ESCI Outstanding Undergrad | NASA intern | Lamont intern
B.S. Earth Science-Geochemistry, Minor in Biochemistry & Cell Biology May 2013

RESEARCH INTERESTS

- Leveraging chemometrics & machine learning to facilitate the autonomous pre-processing, deconvolution, and analysis of complex spectra acquired from prebiotic experiments, natural materials (e.g. hydrothermal vents, meteorites, returned samples), and planetary missions
- The chemical evolution of organic materials throughout the solar system and beyond (from Mercury ices to the deep subsurface on exoplanets)
- The formation of genetic precursors in deep sea environments relevant to ocean worlds
- Elucidating how geochemical environments/events drive prebiotic chemistry
- Computational simulations of prebiotic organic reactions
- Developing autonomous means to facilitate exploration of oceanic environments

MANUSCRIPTS (ACCEPTED AND IN REVISION)

LE Rodriguez, T. Altair, NY. Hermis, TZ. Jia, TP. Roche, LH. Steller, JM. Weber. A Geological and Chemical Context for the Origins of Life on Early Earth, Chapter 4 of the Astrobiology 3.0 Primer; **Ch Ed: LE Rodriguez**; *Astrobiology* 2022 (In Revision).

S Colón-Santos, A Vázquez-Salazar, A Adams, JA Campillo-Balderas, R Hernández-Morales, R Jácome, I Muñoz-Velasco, **LE Rodriguez**, MJ Schaible, N Szeinbaum, JL Thweatt, G Trubl., What is Life? (Ch. 2), *Astrobiology* 3.0 Primer. Ch Eds: S Colón-Santos, A Vázquez-Salazar. *Astrobiology* 2022 (In Revision).

M Prakash, JM Weber, **LE Rodriguez**, R Sheppard, LM Barge. Database on Mineral Mediated Carbon Reduction: Implications for Future Research. *International J. Astrobiology* 2022;21(6): 423-440. <https://doi.org/10.1017/S1473550422000052>

C Lee, JM Weber, **LE Rodriguez**, RY Sheppard, LM Barge, EL Berger, AS Burton. Chirality in Organic and Mineral Systems: A Review of Reactivity and Alteration Processes Relevant to Prebiotic Chemistry and Life Detection Missions. *Symmetry* 2022;14(3):460. <https://doi.org/10.3390/sym14030460>

LM Barge, **LE Rodriguez**, JM Weber, BP Theiling. Determining the “Biosignature Threshold” for Life Detection on Biotic, Abiotic, or Prebiotic Worlds. *Astrobiology* 2022;22(4):481-493. <http://doi.org/10.1089/ast.2021.0079>

LM Barge, **LE Rodriguez**. Life on Enceladus? It depends on its origin. *Nature Astronomy* 2021;5:740. <https://doi.org/10.1038/s41550-021-01382-4>

E. Flores, E. Martinez, **LE. Rodriguez**, JM. Weber, A. Khodayari, DG. VanderVelde, LM. Barge. Effects of Amino Acids on Phosphate Adsorption onto Iron (Oxy)hydroxide Minerals under Early Earth Conditions. *ACS Earth and Space Chemistry* 2021;5:1048. <https://doi.org/10.1021/acsearthspacechem.1c00006>

SM. Perl, AJ. Celestian, CS. Cockell, FA Corsetti, LM. Barge, D. Bottjer, J. Filiberto, WM. Berelson, AL. Sessions, BK. Baxter, I. Kanik, S. Potter-McIntyre, T. Kataria, P. Chen, JM. Weber, **LE. Rodriguez**, M. Melwani Daswani. A Proposed Geobiology-driven Nomenclature for Astrobiological In-Situ Observations and Sample Analyses, *Astrobiology* 2021;21(8):954-967. <http://doi.org/10.1089/ast.2020.2318>

LE. Rodriguez, CH. House, KE. Smith, MR. Roberts, and MP. Callahan, Nitrogen heterocycles form peptide nucleic acid precursors in complex prebiotic mixtures, *Scientific Reports* **9**, 9281 (2019). <https://doi.org/10.1038/s41598-019-45310-z>. *Named Top 100 in Chemistry

MANUSCRIPTS IN PREPARATION

LE. Rodriguez, CH. House, and MP. Callahan, The robust glycosylation of nitrogen heterocycles under aqueous conditions. *In Prep for Astrobiology*.

LE Rodriguez, AL Reyes-Newell, DM Delapp, NL Lanza, SM Clegg, DS Kelley, KH Simon, EJ Eshelman, PS Sobron, LM Barge. Deconvoluting Geochemical and Organic Gradients in Hydrothermal Vent Precipitates by LIBS and Machine Learning. *In Prep for JGR Planets*.

LE Rodriguez, JM Weber, ML Cable, H Ono, M Ingram, K Carpenter, LM Barge, et al. A Science Traceability Matrix for a Mission to Enceladus. *In Prep for JGR planets*.

WHITE PAPERS

Generalized assessment framework for biosignatures. V Meadows & H Graham (leads). One of 74 co-authors of the six chapters. Paper is live on NASA’s NfoLD for input from the community and can be found here: <https://www.nfold.org/soe-report-in-progress>.

LM Barge, **LE Rodriguez**, JM Weber, BP Theiling. Beyond “Biosignatures”: Importance of Applying Abiotic/Prebiotic Chemistry to the Search for Life on Other Planets. *Bulletin of the AAS*, 53(4). <https://doi.org/10.3847/25c2cfcb.b66ffca4>. Planetary Science & Astrobiology Decadal Survey 2023-32.

GRANTS & FELLOWSHIPS (AWARDED)

2022 Awarded: **Science-PI, NASA Mars Science Laboratory Participating Scientist Proposal**

- Title: Long-Range Tracking of CHONPS hotspots and Organic Compounds on the Martian Surface via ChemCam: Developing Novel Data Science Tools for Uncovering Hidden Molecular Signals
- Details: Apr 2022 - Sept 2025, 0.3 FTE; ~\$285K

2022 Awarded: **Science-PI, JPL Data Science Pilot Project**

- Title: Machine Learning and High-Resolution Mass Spectrometry for Planetary Exploration: Automating the Analysis of Organic Trends in Complex Samples
- Details: Jan-Sept 2022, \$50K

2021-Awarded: **Co-I, JPL R&TD**

- Title: Novel Continuous Flow Reaction Design to Test Martian Weathering
- Details: Feb-Sept \$50K

2020-Awarded: **Co-I, JPL R&TD**

- Title: A New Magnetic Electron Detection Technique for Astrobiology
- Details: Mar-Jun 2020; \$50K

2016-Awarded: Alfred P. **Sloan Graduate Fellowship**

- Title: Evaluating robust genetic precursors on early Earth
- Details: 2016-2018; \$40K

2015-Awarded: **Ford Foundation Predoctoral Fellowship:**

- Title: The Plausibility of an Fe-S linked pre-RNA
- Details: 2015-2018; \$72K

ANALYTICAL EXPERIENCE

- Statistics & Machine learning (R and Python)
- (Tandem) Mass Spectrometry
- Raman Spectroscopy
- *ab initio* molecular modeling
- Laser Induced Breakdown Spec. (LIBS)
- Air Free techniques
- Continuous Flow
- Nuclear Magnetic Resonance (NMR)
- Infrared spectroscopy (IR)
- Ion Chromatography (IC)
- High Pressure Liquid Chromatography
- Conducting spark-discharge experiments

AWARDS & SCHOLARSHIPS

2020 Elected **Co-Chair for the 2022 Gordon Research Seminar** on the Origins of Life

2017 **Poster Award** at the XVIIIth International Conference on the Origin of Life

2016 **NASA Scholarship** to attend Josep Comas iSola International Summer School in Astrobiology

2015 **NASA Scholarship** to attend the Nordic-NASA summer school in Iceland

2015 **Penn State Geosciences Paul D. Krynine Travel Scholarship**

2015 **Penn State Astrobiology Richard Standish Good Graduate Scholarship** in Geosciences

2014 **NASA Pennsylvania Space Grant Consortium Fellowship**

2013-2018 Penn State **STEM Scholars Graduate Award**

2013 **Rice University Earth Science's Alex Tula Award for outstanding undergraduate in Geology**

2012 **NASA Astrobiology Early Career Collaboration Award**

Laura E. Rodriguez, Ph.D.

2012 **Rice University** Earth Science Chevron Minority **Scholarship**
2012 **Rice University** Earth Science The Devlin-Schnable Memorial **Award in Geology**
2008 National Hispanic Scholar

INVITED TALKS

Division for Planetary Sciences 54th Annual Meeting: Plenary Speaker	2022
Southwest Research Institute: Planetary Sciences Seminar	2022
University of Texas at El Paso: Earth, Environmental & Resource Sciences Seminar	2021
Boise State University Geosciences Club	2021
Brown Endowed Guest Lecturer, Rice University	2021, 2022
College of the Atlantic, Chemistry Undergraduate Seminar	2021
Caltech, Yuk Lunch Seminar, Dept. Geological and Planetary Sciences	2020
Rice University, "Inhabiting Planet Earth" class (Prof. Kirsten Siebach)	2020
Rice University, Clever Planets Seminar	2020
AbGradE Keynote Speaker	2020
University of Texas at Austin, Center for Planetary Systems Habitability	2020
Los Alamos National Laboratory: Los Alamos, NM	2020
University of Texas at Austin, Jackson School of Geosciences: Austin, TX	2019
Nordic-NASA Summer School, "Water, Ice, and the origin of Life": Reykjavík, Iceland	2015

SERVICE AND PROFESSIONAL ACTIVITY

Reviewer: Science, Nature Communications, Mars Exploration Program Office Student Travel Grant, Science Advances, Geochimica et Cosmochimica Acta, ACS Omega, ACS Earth and Space Chemistry, Astrobiology, FEBS Letters, NASA FINESST Graduate Grants, NASA SSWs Grants, NASA Small business innovation research grants	
Executive Secretary on review panel for NASA Roses proposals	2021
NASA-ESA Mars Sample Return Campaign Group	2022-
<ul style="list-style-type: none">• Selected to join international group of 16• Goal: maximize the scientific potential of Mars returned samples• Held first workshop Sept. 28+30: MSR Sample Depot Science Community Workshop	2022
2024 Origins of Life Gordon Research Seminar	2021-
<ul style="list-style-type: none">• Title: Challenging Paradigms in Prebiotic Chemistry (Date: Jan 2024)• Elected Co-chair; organizing & fundraising for conference	
NOW Ocean World Analog Field Site Assessment Workshop (leads: J. Stern & H. Graham)	2022
<ul style="list-style-type: none">• Member of the Science Organizing Committee	
NASA Goddard Science Task Group	2022
<ul style="list-style-type: none">• Data Exploration for Future Astrobiology Missions (lead: Bethany Theiling)	

- Session Convener for Astrobiology Science Conference, Atlanta, GA** 2022
- **Session title:** Prebiotic/Abiotic Chemistry in Alternative Solvents
- Science Communication Team for PCE₃** 2021-
- Prebiotic Chemistry & Early Earth Environments Consortium (NASA RCN)
- Co-organized JPL workshops** to develop science traceability matrix for an Enceladus mission 2021
- NASA Biosignature Framework Workshop (leads V. Meadows & H. Graham)** 2021-
- Participated in weeklong workshop to develop community standards for biosignatures
 - Contributed to weekly writing sessions towards a paper in prep to publish these standards
 - Wrote section on abiotic sources for potential biosignatures
- NASA Life Detection Knowledge Database (Curator: Alfonso Davila)** 2021-
- Contributing weekly to database regarding biological feature strength of amino acid enantiomers
- Future Leaders of Ocean Worlds (FLOW) organizing committee member** 2021-
- Early career group affiliated w/NASA's RCN: Network for Ocean Worlds
 - Elected Chair of Coffee Hour Committee (for FLOW and open to the public)
 - Past coffee hours I organized include: a career in government (July 2021), a career in academia (Dec 2021), life cycle of missions & how to get involved (Mar 2022), How to get field work funded (Apr 2022), The Art of Networking (June 2022), Behind the Scenes of the Decadal Survey (Nov 2022). Details listed at: <https://oceanworlds.space/flow/>
- Astrobiology 3.0 Primer (Astrobiology special issue for primer)** 2019-
- Ch. 4 (Origins of life) Editor and author; author for Ch 2 (Defining life)
- Session Convener for AGU Convener, Virtual** 2020
- **Session title:** Geologically Relevant Syntheses on the Building Blocks of Life
- 51st Lunar and Planetary Science Conference, Woodlands, TX (Cancelled)** 2020
- Session chair for Astrobiology: Life Detection and Prebiotic Chemistry

MENTORING EXPERIENCE (JPL Interns)

- Jazmine Robledo** (Undergrad at UC Riverside) 2021
- Topic: Biogeochemical analysis of vent precipitates; this involved field work at Axial Seamount with Rodriguez (Aug 2021 on the *R/V Thomas G. Thompson*)
- Sarah Lamm** (MSc student Kansas State; now PhD student Univ of Kansas) Mar 2021 –
- Topic: Developing machine learning models for rapid classification of iron oxyhydroxide and iron sulfide minerals using mission-ready spectroscopic techniques
 - Sarah gave talk on this work at GSA (Oct 2022); Abstract: S Lamm, LE Rodriguez, A Celestian, S Perl, LM Barge. Classification of Iron (Oxy)Hydroxides and Sulfides Using Mission-Ready Spectroscopic Techniques and Machine Learning.
 - Work to be one of Sarah's PhD dissertation chapters
- Eduardo Martinez** (MSc grad student at Cal State LA) Jun 2020 – 2022
- Topic: Monitoring nitrate reduction and Fe mineral oxidation via ion chromatography, UV-Vis colorimetry, NMR, LIBS, and Raman analysis

SELECTED CONFERENCE PRESENTATIONS

LE Rodriguez et al. Astrobiology in the Era of Big Data. 54th Division for Planetary Sciences Meeting. Invited Plenary Speaker. Oct 2022 (**Talk**).

LE Rodriguez et al. LIBS, Raman, and Chemometrics for Exploration of Ocean Worlds. SciX. Oct 2022 (**Talk**)

LE Rodriguez et al. InVADER: Testing the feasibility of LIBS, Raman, & Machine learning for underwater exploration of ocean worlds. Outer Planets Assessment Group Annual Mtg. June 2022 (**Talk**)

LE. Rodriguez, et al. Are Mixed Fe/Mn(oxy)hydroxides Key to Enabling Aqueous Phosphorylation via Fenton-Phosphite Chemistry? AbSciCon, GA, 2022 (**Talk**).

LE. Rodriguez, et al. Considerations of Pulsed Raman Spectroscopy for the Analysis of Ocean World Analog Samples. LPSC, TX, 2022 (**Poster**).

LE. Rodriguez, et al. Raman-LIBS Data Fusion for Ocean World Exploration, 5th Planetary Data Workshop and 2nd Planetary Science Informatics & Data Analytics meeting, Virtual, June 2021 (**Talk**).

LE. Rodriguez, et al. Novel Chemometric Analysis Elucidates Elemental and Mineralogical Gradients within Hydrothermal Vent Precipitates using LIBS: An Investigation of Analytical Techniques to Facilitate the Search for Life on Ocean Worlds, AGU, Virtual, Dec. 2020 (**Talk**).

LE. Rodriguez, An Investigation of the Feasibility for Coupling Fenton-Phosphite Oxidation with Organophosphorylation in Aqueous Solutions under Early Earth Conditions. 50 Congreso Internacional de Astrobiología Virtual, Nov. 2020 (**Talk**).

LE. Rodriguez, et al Phosphorus Redox Geochemistry on Rocky Worlds: Exploring Phosphite Oxidation and Organic Phosphorylation Catalyzed by Fe and Mn Oxyhydroxides, LPSC, 1667, 2020 (**Cancelled**).

LE. Rodriguez, MP. Callahan, and CH. House, The Aqueous Glycosylation of Nucleobases, AbSciCon, Bellevue, WA, July 2019 (**Talk**).

LE. Rodriguez and CH. House, The Plausibility of an Fe-S linked pre-RNA, Goldschmidt, 2018 (**Talk**).

LE. Rodriguez, CH. House, and MP. Callahan, Nitrogen Heterocycles in Miller-Urey Spark-Discharge Mixtures: Using Chemical Trends to Elucidate Plausible Pre-RNAs on the Early Earth, The XVIIIth International Conference on the Origin of Life, San Diego, CA, July 2017. (**Poster Won Award**)

LE. Rodriguez, CH. House, and MP. Callahan, Reactions of Nitrogen Heterocycles in Plausible Prebiotic Mixtures, 5th ELSI International Symposium, Tokyo, Japan, Jan. 2017. (**Poster**)

LE. Rodriguez, CH. House, and MP. Callahan, Hints of the earliest genetic molecules for the origin of life, Conference of Ford Fellows, Washington, D.C., Sept. 2016. (**Talk**)

LE. Rodriguez, CH. House, and MP. Callahan, Reactions of Nitrogen Heterocycles in Plausible Prebiotic Mixtures, Astrobiology Science Conference, Chicago, IL, June 2015. (**Poster**)

LE. Rodriguez, DH. Abbott, and B. Dee, Distal Impact Ejecta from the Gulf of Carpentaria: Have We Found Cometary Fragments as Part of the Ejecta Suite? AGU, San Francisco, CA, Dec 2011. (**Poster**)

WORKSHOPS ATTENDED

- 2021 **Ocean Hack Week**: project lead for developing an app to pull & visualize large oceanographic data from OOI Regional Cabled Array's online database
- 2019 & 2020 NASA JPL Mission Incubation Workshop
- 2020 **R and Python** for Environmental Data Science, **Cloud-based** NASA Earth Observations Data & Tools, Python for Remote Sensing, Machine Learning and Deep Learning for Geosciences
- 2019 **Basic Chemometrics, Intro to Raman with Imaging Applications, and Non-Linear Methods for Regression and Classification** short courses taught by Eigenvector at SciX.
- 2016 Compact for Faculty Diversity: 23rd **Institute on Teaching and Mentoring**, Tampa, FL
- 2016 Josep Comas iSola International Summer School in Astrobiology, "**Earth Analog Environments and the Search for Life Beyond Earth**," Santander, Spain
- 2015 Jul. Nordic-NASA Summer School, "**Water, Ice, and the origin of Life**," Reykjavík, Iceland

FIELD EXPERIENCE

- 2021 Sample collection on *R/V Thompson*: **Axial Seamount, Juan de Fuca Ridge** (12 d with intern).
- 2015 Sampled **Frasassi Caves** (Genga), Serramazzoni cold seeps (Modena, Italy), Grotta Termale Hot Springs (Italy), ophiolites Bonassola Beach, Liguria. PSU Italy Astrobiology Field Experience (10 d)
- 2015 Sampled from local cave, hypersaline ponds with microbialites, and around coast of **San Salvador**, Bahamas as part of the Marine Biogeochemistry course (7 d)
- 2015 Collected samples from Sólheimajökull Glacier, **Iceland** & Eldfell lava field in Heimaey, Iceland for NASA-Nordic Astrobiology Short Course (1 d each)
- 2013 Research sample collection from **Atacama Desert**, Chile (5 d in the field)
- 2012 Field Geology in **China** Course (3-week field camp)

MEDIA / OUTREACH

- Hey Listen: Science/Video game Podcast: What would alien life look like?** 2021
- Interviewed by journalist (Brendan Caldwell) about astrobiology and looking for life on other worlds
 - <https://heylesson.net/podcast/what-would-alien-life-look-like-mass-effect/>
- American Public Media: Brains On! Aliens & UFOs: Making Sense of Myths, pt. 4** 2020
- Interviewed about astrobiology for a podcast aimed at teaching children about science
- Amazing Aliens: The Stellar Science of Life in Space by Zachary Woodard** 2020
- Expert content reviewer for a children's astrobiology book published by American Reading Co.
- NSF Bridge to the Geosciences Volunteer (Citrus Community College, PI: Marianne Smith)** 2020
- Gave a JPL tour and spoke about my experiences in STEM
 - Helped lead a field module to Catalina Island, where students collected and analyzed seawater
- Ann Richards School for Young Women Leaders, Austin, TX; instr. Joanna Lucero** 2020
- Virtual lecture about astrobiology, planetary missions, and graduate school to a high school class
- Women in STEM Career Day, CSU Dominguez Hills** 2020
- Spoke to high school girls about my experiences in STEM & hosted JPL booth
- Demonstrated Miller-Urey experiment at 5th grade science fair (State College, PA)** 2015

- Pennsylvania Junior Academy of Science state competition judge** 2014
- Penn State University Volunteer**
- Shake Rattle Rocks: taught 5th grade students about astrobiology 2015
 - Science-U Alien Astronomysteries Astrobiology summer camp volunteer 2014

TEACHING EXPERIENCE

- Teaching Assistant**, The Pennsylvania State University Spring 2019
EARTH 103: Earth in the Future
- Laboratory Instructor TA**, The Pennsylvania State University Fall 2016
GEOSCI 001: Physical Geology (3 labs/wk: wrote lab exams, graded, made lectures, & led field trips)
- Teaching Assistant**, Rice University Fall 2011
SOCI 101 Intro to Sociology, Dr. Justin Denney
- TestMasters, Houston, TX** Dec 2012 – Aug 2013
• Professional math and science tutor for middle and high school students
- Nehemiah Center, Houston, TX** Jan 2010 – May 2013
• Math and science tutor for at-risk children in grades K-7

PROFESSIONAL MEMBERSHIPS

- NASA Future Leader of Ocean Worlds
- Deep Ocean Observing Strategy (DOERS)
- Early Career Ocean Professionals
- Geochemical Society
- American Chemical Society (ACS)
- American Geophysical Union (AGU)

ADDITIONAL SKILLS

- NAUI Certified SCUBA Diver
- Graphic Design: Adobe Illustrator CC, Inkscape, ChemDoodle drawing software