

## CURRICULUM VITAE

### ZACHARY K. GARVIN

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#### EDUCATION

Ph.D. Candidate, Geosciences (expected May 2024)  
Princeton University, Princeton, NJ

M.A., Geosciences (October 2019)  
Princeton University, Princeton, NJ

Sc.B., Microbiology/Immunology with Honors (May 2017)  
Brown University, Providence, RI

#### RESEARCH INTERESTS

My primary research interests lie at the intersection of microbial ecology, biochemistry, and geochemistry. I utilize techniques from traditional microbiology, metagenomics, and analytical chemistry to study “extreme” terrestrial environments, the microorganisms that inhabit them, and the strategies life employs to survive under such challenging conditions. My research has spanned topics from bacterial ether lipid production in peat environments to microbial trace gas oxidation in desert soils as analogs for the surface environments of early and modern Mars. My current thesis work explores the microbial communities of soils surrounding hot springs in the salt flats of the Andean Altiplano, Chile, and the geothermal basins of Yellowstone National Park.

#### RESEARCH EXPERIENCE

Graduate Student Thesis Research, **Princeton University** (2018- )

Advisor: Professor Tullis C. Onstott

Comparing the microbial communities within soils surrounding Chilean and Yellowstone hot springs to assess the significance of microbial trace gas (CH<sub>4</sub>, CO, H<sub>2</sub>) uptake as a vital metabolic strategy with additional implications for extinct or extant Martian life (skills developed: GC, IC-MS, metagenomics)

Graduate Student 1<sup>st</sup> Year Project, **Princeton University** (2017- 2018)

Advisors: Professor Tullis C. Onstott, Dr. Maggie Lau

Analyzed soils from the ice-free regions of Antarctica for the microbial uptake of trace gases (CH<sub>4</sub>, CO, and H<sub>2</sub>) while performing analyses on global soil metagenomes for characterizing the controls on trace gas-utilizing microbes in soil environments (skills developed: GC, bioinformatics/metagenomics)

Undergraduate Researcher, **Brown University** (2016-2017)

Advisor: Professor Yongsong Huang

Developed suboxic peat incubations to promote and observe the growth of the unidentified brGDGT-producing bacterium; assessed the relationship between various soil properties and brGDGT lipid distributions in U.S. soils (skills developed: accelerated solvent extraction, column chromatography, acid hydrolysis of lipids, HPLC-MS)

Research Intern, **NASA Goddard Space Flight Center** (Summer 2014, 2015)

Advisors: Ms. Melissa Floyd, Dr. Alexander Pavlov, supported by Dr. Paul Mahaffy

Investigated the survival and potential growth of an extremophilic bacterial community in a simulated Martian environment (skills developed: microbial culturing, cell recovery from soil, bacterial staining, operation of Mars Simulation Chamber)

## FIELD WORK

Yellowstone National Park (Fall 2020)

Soil and water sampling trip of phase-separated hot springs in Norris Geyser Basin.

Arica-Tarapacá region, Chile (Spring 2019)

Soil sampling trip of an environmental gradient in the Arica-Tarapacá region of northern Chile, including sampling of a soil transect at Polloquere Hot Springs in the Salar de Surire salt flat.

Moab Khotsong Gold Mine, Orkney, South Africa (Fall 2018)

Installed U-tube water sampling device into a ~400 meter borehole at ~3 km depth to study the chemistry and microbial community in the highly saline water.

## PUBLICATIONS

**Garvin, Z. K.**, Abades, S. R., Trefault, N., Alfaro, F. D., Sipes, K., Lloyd, K. G., & Onstott, T. C. Prevalence of trace gas-oxidizing soil bacteria increases with radial distance from Polloquere hot spring within a high-elevation Andean cold desert. *The ISME Journal* (2024).

**Garvin, Z. K.**, Boyd, E., Floyd, M., Harris, R. L., Kalucha, H., Mahaffy, P., Moores, J. E., Onstott, T. C., Sapers, H. M., & Trainer, M. Mars Trace Gas Fluxes: Critical Strategies and Implications for the Upcoming Decade. *Bulletin of the American Astronomical Society* **53**, 4 (2021).

Harris, R. L., Schuerger, A. C., Wang, W., Tamama, Y., **Garvin, Z. K.**, & Onstott, T. C. Transcriptional response to prolonged perchlorate exposure in the methanogen *Methanosarcina barkeri* and implications for Martian habitability. *Scientific Reports* **11**, 1 (2021).

Carrier, B. L., Beaty, D. W., Meyer, M. A., ..., **Garvin, Z. K.**, et al. Mars Extant Life: What's Next? Conference Report. *Astrobiology* **20**, 6 (2020).

Liang, R., Lau, M. C. Y., Saitta, E. T., **Garvin, Z. K.** & Onstott, T. C. Genome-centric resolution of novel microbial lineages in an excavated Centrosaurus dinosaur fossil bone from the Late Cretaceous of North America. *Environ. Microbiome* **15**, 8 (2020).

## **PROFESSIONAL PRESENTATIONS**

**Garvin, Z. K.**, Abades, S. R., Trefault, N., Alfaro, F. D., Huang, Y., Onstott, T. C. Assessment of lipids as a life detection strategy in low biomass desert soils surrounding an Andean hot spring. Virtual oral presentation at AbSciCon 2022. May 18, 2022.

**Garvin, Z. K.**, Abades, S. R., Trefault, N., Alfaro, F. D., Arnold, J., Kennedy, M., Onstott, T. C. Using Soil Trace Gas Flux as a Signature for Life: A Terrestrial Case Study in Martian Life Detection. Poster presented virtually at AGU Fall Meeting. December 9, 2020.

**Garvin, Z. K.** Trace Gas Consumption as a Metabolic Strategy for Life Beneath the Martian Surface and the Means to Detect It. Presented virtually at Mars Exploration Program Analysis Group (MEPAG) Meeting 38. April 16, 2020.

**Garvin, Z. K.**, Abades, S. R., Trefault, N., Alfaro, F. D., Onstott, T. C. High-Affinity Trace Gas Consumption by Soil Microbial Communities Around Hot Springs in the Andean Altiplano with Implications for Early Mars. Poster presented at AGU Fall Meeting. San Francisco, CA. December 10, 2019.

**Garvin, Z. K.**, Abades, S. R., Trefault, N., Alfaro, F. D., Onstott, T. C. High-Affinity Trace Gas Consumption by Soil Microbial Communities Around Hot Springs in the Andean Altiplano: Implications for the Evolution of Martian Metabolisms. Oral presentation at Mars Extant Life: What's Next? Carlsbad, NM. November 7, 2019.

**Garvin, Z. K.**, Huang, Y. Inducing the bacterial production of brGDGT lipids in a suboxic peat environment. Presented at the Brown University Undergraduate Honors Thesis Oral Presentation Forum. May 1, 2017.

**Garvin, Z. K.**, Floyd, M. Life on Mars: extremophilic bacteria in a simulated martian environment. Presented at the NASA Goddard Summer Intern Poster Competition. July 30, 2015.

## **HONORS AND AWARDS**

Mars Mission Ideation Factory (2023)

Selected as one of 30 early career participants for an intensive program at NASA Goddard to begin designing a mission to Mars for the detection of extant life.

Princeton Geosciences Graduate Student Research Fund (2022)

Selected to support research in collaboration with Dr. Amy Williams (UF) comparing lipid detection via typical laboratory techniques and Mars Curiosity Rover methods.

Walbridge Fund Graduate Award for Environmental Research (2020)

Competitively selected by the Princeton Environmental Institute (PEI) to support Ph.D. dissertation research focused on environmental topics.

NASA Astrobiology Early Career Collaboration Award (2019)

Received travel grant to conduct field research along an environmental gradient across the Arica-Tarapacá region of northern Chile and to perform trace gas analyses in the lab of Dr. Eric Boyd at Montana State University.

W. Michael Blumenthal Family Fund Fellowship, Princeton University (2017-2018)

Selected by the Geosciences Graduate Studies Work Committee to receive the named fellowship to support full-time graduate study for the 2017-2018 academic year.

Sigma Xi, Brown University Chapter, Associate Membership (2017)

Inducted into the Brown University Chapter of the Society of Sigma Xi for a high level of competence in science and demonstration of significant scientific research.

Brown University Voss Undergraduate Research Fellowship (2016-2017)

Fellowship awarded by the Institute at Brown for Environment and Society to support environmental research to be completed for a senior honors thesis project.

NASA Goddard Space Flight Center Intern Poster Competition, 1<sup>st</sup> Place (2015)

Awarded 1<sup>st</sup> place among all NASA Goddard interns in the *Science* category for summer research poster presentations (title: "Life on Mars: Extremophilic Bacteria in a Simulated Martian Environment").

## **TEACHING AND ADVISING**

Environmental Microbiology (GEO 417), Princeton University Fall 2023  
Guest Lecturer on microbiology in extreme environments

Princeton University Undergraduate Junior Project Mentor Fall 2021-Spring 2022  
Mentor for Princeton undergraduate Junior project research  
Isabel Rodrigues, Class of 2023

High Meadows Environmental Institute Summer Internship Program Summer 2021  
Mentor and project lead for Princeton undergraduate intern  
Isabel Rodrigues, Class of 2023

Princeton Environmental Institute Summer Internship Program Summer 2020  
Mentor and project lead for Princeton undergraduate interns  
Janelle Arnold, Class of 2023  
Mae Kennedy, Class of 2023

Natural Disasters (GEO 103), Princeton University Spring 2019  
TA, lab instructor and grader