

STEFFEN BUESSECKER

Stanford University · Dept. of Earth System Science
Green Earth Sciences Building
367 Panama St., Room 124, Stanford, CA 94305
(650) 721 5585 · sbuessecker@stanford.edu

Personal
www.crypticbiology.com
3002 Millar Ave, Santa Clara, CA 95051
(602) 785 8536 · s.buessecker@icloud.com

EDUCATION

ARIZONA STATE UNIVERSITY, TEMPE, AZ 2013 - 2020
Ph.D. in Environmental Life Sciences

Thesis: Coupled abiotic and biotic cycling of nitrous oxide

Advisor: Hinsby Cadillo-Quiroz, Committee: Jennifer Glass, Hilairy Hartnett, Sharon Hall

UNIVERSITY OF TÜBINGEN, BW, GERMANY 2009 - 2013
B.S. in Geoecology

Thesis: Methane- and iron-oxidizing bacteria in an aphotic ecosystem

Supervisors: Merle Eickhoff, Sebastian Behrens, Andreas Kappler

SELECTED RESEARCH EXPERIENCE

STANFORD UNIVERSITY, STANFORD, CA 2020 - PRESENT
NASA Postdoctoral Program (NPP) Fellow, Dept. of Earth System Science, PI: Anne Dekas

- Investigation into trace metal utilization of anaerobic, thermophilic archaea
- Characterization of the methanogenic pathway found in an *Archaeoglobus* species
- Determination of the metabolic activity limit of microbial methanogenesis in halophiles

Techniques learned/applied: Fluorescence in-situ hybridization (FISH), Nanoscale secondary ion mass spectrometry (nanoSIMS), metagenome analysis, protein structural modeling, stable isotope analysis

ARIZONA STATE UNIVERSITY, TEMPE, AZ 2013 - 2020
NExSS Graduate Research assistant, School of Life Sciences, PI: Hinsby Cadillo-Quiroz

- General geochemical and microbiological description of unexplored tropical wetlands
- Identification of abiotic N₂O fluxes across tropical soils and their link to microbial N₂O respiration
- Constraining effects of mineral-catalyzed NO and N₂O formation on the Archean ocean-atmosphere system

Techniques learned/applied: DNA extraction, Polymerase chain reaction (PCR), Amplicon sequence analysis (16S rRNA, *mcrA*, *nosZ*), Ion chromatography, Gas chromatography, Chemiluminescence-based analysis, Spectrometric techniques, In-situ gas flux analysis, μ -Raman spectroscopy

UNIVERSITY OF TÜBINGEN, BW, GERMANY 2010-2013
Undergraduate Researcher, Geoscience Institute, PI: Andreas Kappler

- Cultivation of Fe cycling bacteria (Fe reducers, Fe oxidizers, photoferrotrophs)
- Testing biomarker preservation of bacteriohopanoids

Techniques learned/applied: Aerobic and anaerobic microbial culturing, Microelectrode measurements, X-ray diffractometry (XRD)

U.C. BERKELEY, BERKELEY, CA 2007
High School Intern, Dept. of Molecular and Cell Biology/Integrative Biology, PI: Nipam Patel
• Description of primordial disc cell clusters in *Junonia* butterflies
Techniques learned/applied: Dissection techniques, epifluorescence microscopy, antibody staining

UNIVERSITY OF HEIDELBERG, HEIDELBERG, BW, GERMANY 2006
High School Intern, German Cancer Research Center (DKFZ)
• Mutagenesis manipulations in *E. coli*
Techniques learned/applied: DNA cloning, DNA deletion and insertion, gel electrophoresis

TEACHING EXPERIENCE

ARIZONA STATE UNIVERSITY, TEMPE, AZ 2014 - 2017
Teaching assistant, School of Life Sciences, General Biology (BIO-181), General Genetics (BIO-340), Animal Physiology Lab (BIO-361), Microbiology Lab (MIC-206), Bacterial diversity (MIC-470)
• Designed and led practicals, review sessions, and paper discussions
• Taught lab classes (~30 students) for two semester
• Assisted in the design of assignments and exams
• Graded assignments, exams, lab reports, and student presentations

SHADES MULTICULTURAL PROGRAM, TEMPE, AZ 2014 - 2018
Certified Mentor in support of BIPOC students at ASU
• Help with homework and assignments
• Advice on career paths and long-term goals

MENTORING/SUPERVISING EXPERIENCE

Melanie Quan, Stanford undergraduate student	since 2022
Jillian Ayers, ASU undergraduate student	2019
Francisco Campa, ASU undergraduate student	2017-2018
Jordan Canning, ASU undergraduate student	2016-2019
Nabil Fidai, ASU undergraduate student	2016-2017
Carlos Courtney, ASU undergraduate student	2015
Jack Liu, ASU undergraduate student	2015
Martin Gonzalez, ASU undergraduate student	2015
Kaitlyn Tylor, ASU Honors undergraduate student, <u>supervised Honors thesis</u> <i>Ferrous iron, organic matter, and pH as drivers of chemodenitrification in tropical peat soil</i>	2015-2016

Amit Anilkumar, ASU undergraduate student	2015
Rohini Nott, SCENE project High school student (<u>2nd place in Science Fair category Microbiology</u>)	2013-2014
Priyanka Konan, SCENE project High school student (<u>2nd place in Science Fair category Microbiology</u>)	2013-2014
Logan Kurgan, ASU undergraduate student	2014
Tiffany Maksimuk, ASU undergraduate student	2014-2015
Zacary Zamora, ASU Honors undergraduate student	2014-2016
Hannah Miao, SCENE project High school student	2013-2014
Jeba Sania, SCENE project High school student	2013-2014

FELLOWSHIPS, HONORS & AWARDS

<u>NASA Postdoctoral Program (NPP) Fellowship</u>	2021-2024
ASU School of Life Sciences Graduate Completion fellowship	2019
Sagan Summer Workshop travel award	2019
NASA Astrobiology Program, AbSciCon travel grant to Seattle	2019
<u>USAID Global Development Research scholarship</u>	2017-2018
APS/NAI Lewis & Clark Fund for Exploration and Field Research in Astrobiology, \$5,000	2017
NASA (NAI) Astrobiology Early Career Collaboration Award, \$4,500	2016
ASU's Graduate and Professional Association <u>Outstanding Mentor Award</u>	2016
ASU School of Life Sciences-RTI Graduate Training Grant, \$2,500	2016
Edward and Linda Birge Graduate Award	2016
NASA Astrobiology Program, AbSciCon travel grant to Chicago	2015
ASU School of Life Sciences <u>Interdisciplinary Research Award</u>	2015
DAAD (German Research Exchange Service) Doctoral fellowship	2014-2015
DAAD (German Research Exchange Service) RISE worldwide scholarship	2012
<i>eFellows</i> Online Scholarship, <i>eFellows</i> Munich, Germany	2009-2013
Life Science Lab Heidelberg Alumni Award for outstanding research	2008

PUBLICATIONS

Peer - Reviewed Publications

- 2023 **S. Buessecker**, G.L. Chadwick, M.E. Quan, B.P. Hedlund, J.A. Dodsworth, A.E. Dekas. Mcr-dependent methanogenesis in *Archaeoglobaceae* enriched from a terrestrial hot spring. *The ISME Journal* 17, 1649-1659.

- 2022 **S. Buessecker**, H. Imanaka, T. Ely, R. Hu, S.J. Romaniello, and H. Cadillo-Quiroz. Mineral-catalyzed formation of marine NO and N₂O on the anoxic early Earth. *Nature Geoscience* 15, 1056-1063.
- accepted V. Nickeleit, A. Mellage, G. Bianchini, L. Sauter, **S. Buessecker**, S. Gotterbarm, M. Schad, K.O. Konhauser, A. Zerkle, P. Sanchez-Baracaldo, A. Kappler, and C. Bryce. Inhibition of photoferrotrophy by nitric oxide in ferruginous environments. *Nature Geoscience* xx (y), zz.
- 2022 **S. Buessecker**, A.F. Sarno, M.C. Reynolds, R. Chavan, J. Park, M. Fontanez Ortiz, A.G. Perez-Castillo, G. Panduro Pisco, J.D. Urquiza-Munoz, L.P. Reis, J. Ferreira-Ferreira, J.M. Furtunato Maia, K.E. Holbert, C.R. Penton, S.J. Hall, H. Gandhi, I.G. Boechat, B. Gücker, N.E. Ostrom, and H. Cadillo-Quiroz. Coupled abiotic-biotic cycling of nitrous oxide in tropical peatlands. *Nature Ecology & Evolution* 6, 1881-1890.
- 2022 **S. Buessecker**, M. Palmer, D. Lai, J. Dimapilis, X. Mayali, D. Mosier, J.-Y. Jiao, D.R. Colman, L.M. Keller, E. St. John, M. Miranda, C. Gonzalez, L. Gonzalez, C. Sam, C. Villa, M. Zhuo, N. Bodman, F. Robles, E.S. Boyd, A.D. Cox, B. St. Clair, Z.-S. Hua, W.-J. Li, A.-L. Reysenbach, M.B. Stott, P.K. Weber, J. Pett-Ridge, A.E. Dekas, B.P. Hedlund, J.A. Dodsworth. An essential role for tungsten in the ecology and evolution of a previously uncultivated lineage of anaerobic, thermophilic Archaea. *Nature Communications* 13, 3773.
- 2021 **S. Buessecker**, Z. Zamora, A.F. Sarno, D.R. Finn, A.M. Hoyt, J. Van Haren, J.D. Urquiza-Munoz, and H. Cadillo-Quiroz. Microbial communities and interactions of nitrogen oxides with methanogenesis in diverse peatlands of the Amazon basin. *Frontiers in Microbiology* 12 (659079), 1-15.
- 2020 D. Glaser, H.E. Hartnett, S.J. Desch, C.T. Unterborn, A. Anbar, **S. Buessecker**, T. Fisher, S. Glaser, S.R. Kane, C.M. Lisse, C. Millsaps, S. Neuer, J.G. O'Rourke, N. Santos, S.I. Walker, and M. Zolotov. Detectability of life using oxygen on pelagic planets and water worlds. *The Astrophysical Journal* 893 (2), 163.
- 2019 **S. Buessecker**, K. Tylor, J. Nye, K.E. Holbert, J.D. Urquiza-Munoz, J.B. Glass, H.E. Hartnett, and H. Cadillo-Quiroz. Effects of sterilization techniques on chemodenitrification and N₂O production in tropical peat soil microcosms. *Biogeosciences* 16 (23), 4601-4612.

Manuscripts in Review or in Preparation

- sub-* C. Pozarycki, K.M. Seaton, E. Crawford, C. Novak, N. Nuñez, M. Castillo, E. Ingall, B. *mitted* Klempay, A. Pontefract, L.A. Fisher, E.R. Paris, **S. Buessecker**, C.E. Carr, J.B. Glass, P.T. Doran, J.S. Bowman, B.E. Schmidt, and A.M. Stockton. Persistence, accumulation, and enrichment of biosignature molecules in extreme brines with implications for planetary exploration.
- in* **S. Buessecker**, R.S.R. Salcedo, N.Y. Wagner, J. Ayers, C. Pozarycki, C.P. McKay, S. Stewart *Prep.* Johnson, D.T. Andersen, A.E. Dekas, and H. Cadillo-Quiroz. N₂O-respiration as energy source for anaerobic life in an icy ocean analog.
- in* G.L. Chadwick, **S. Buessecker**, A.M.N. Joiner, A.A. Garcia, K.E. Shalvarjian, F.M. Ferrer, *Prep.* J.A. Dodsworth, B.P. Hedlund, P.V. Welander, A.E. Dekas, and D.D. Nayak. Isolation and characterization of *Methanoglobus nevadensis* XG-1, the first methanogenic isolate in the class Archaeoglobi.

- in Prep.* **S. Buessecker**, B. Klempay, M. Wang, C.L. Dupont, B.E. Schmidt, J.S. Bowman, J.B. Glass, and A.E. Dekas. Zinc is indispensable for protein structural integrity in halophiles.
- in Prep.* **S. Buessecker**, F. Nichols, B.K.D. Pearce, E. Paris, L. Fisher, B. Klempay, M. Wang, C. Pozarycki, A. Odenheimer, T. Plattner, E. Quartini, S. Som, P.T. Doran, E. Ingall, A. Stockton, H. Cadillo-Quiroz, S.M. Hörst, B.E. Schmidt, J.B. Glass, J.S. Bowman, M.R. Osburn, and A.E. Dekas. Atmospheric tholins as sustainable substrate for early methanogens.
- in Prep.* N.O. Nou, M. Palmer, R. Doss, J.K. Covington, J. Johnston, J.-Y. Jiao, D. Mosier, A.R. Muok, A. Briegel, T. Woyke, E. Eloë-Fadrosch, N. Shapiro, **S. Buessecker**, A.E. Dekas, N. Torosian, A. Cook, S. Bryan, X. Mayali, J.-F. Chen, Y. Yoshikuni, J. Pett-Ridge, P.K. Weber, W.-J. Li, J.A. Dodsworth, B.P. Hedlund. Genome-enabled isolation of *Candidatus* Feravidibacter sacchari, an aerobic, hyperthermophile specializing in polysaccharide catabolism.
- in Prep.* **S. Buessecker**, M.E. Quan, and A.E. Dekas. Nitrous oxide reductase transcription in the oceans of the Proterozoic.
- in Prep.* E.R. Paris, A. Odenheimer, P.T. Doran, E.D. Ingall, **S. Buessecker**, J.S. Bowman, B.E. Schmidt, and A.E. Dekas. Environmental controls on microbial metabolism in the acidic brines of Western Australia.

INVITED SEMINARS & LECTURES

Stanford ESS-205 “Fundamentals of Geobiology”, Guest Lecture (coming up)	11/2023
Stanford MMB’s Bug Club	10/2023
NASA Jet Propulsion Laboratory (JPL), carbon club	08/2023
NASA Ames Research Center, Exobiology seminar series	08/2023
NASA Postdoctoral Fellows symposium	11/2022
Marine Biology Seminar, Scripps Institution of Oceanography	10/2022
Lester Newman Seminar Series, Biology Dept. at Portland State University	10/2022
New Lineages of Life (NeLLi) symposium, DOE Joint Genome Institute	09/2021
Arizona State University, NExSS coffee hour (organized by Steve Desch)	04/2019
Arizona State University, Biodesign Institute, grad student lectures	05/2018
Arizona State University, Exoplanetary Sciences Guest Lecture	03/2017
Arizona State University/ University of Arizona, Amazon working group lecture	06/2016
Arizona State University, Biodesign Institute, grad student lectures	01/2016
Max Planck Institute for Astronomy, Exo coffee seminar series	06/2015
University of Tuebingen, Geoscience Institute – Geomicrobiology group meeting	02/2013

CONFERENCE PRESENTATIONS

- 2023 **S. Buessecker**, G.L. Chadwick, M.E. Quan, B.P. Hedlund, J.A. Dodsworth, A.E. Dekas. Mcr-dependent methanogenesis in Archaeoglobaceae enriched from a terrestrial hot spring (Poster). *Northern California Geobiology Symposium*, Stanford, CA.

- 2022 **S. Buessecker**, M. Palmer, D. Lai, J. Dimapilis, X. Mayali, D. Mosier, P.K. Weber, J. Pett-Ridge, A.E. Dekas, B.P. Hedlund, J.A. Dodsworth. Tungsten is essential in novel thermophilic archaea (Talk). *Astrobiology Science Conference AbSciCon*, Atlanta, GA.
- 2022 **S. Buessecker**, M. Palmer, D. Lai, J. Dimapilis, X. Mayali, D. Mosier, P.K. Weber, J. Pett-Ridge, A.E. Dekas, B.P. Hedlund, J.A. Dodsworth. Tungsten is essential in novel thermophilic archaea (Invited Talk). *66th Biophysical Society Annual Meeting*, San Francisco, CA.
- 2019 **S. Buessecker**, H. Imanaka, T. Ely, R. Hu, S.J. Romaniello, and H. Cadillo-Quiroz. Abundance and fate of abiotically derived N₂O in the ferruginous ocean of the Archean (Talk). *Astrobiology Science Conference AbSciCon*, Bellevue, WA.
- 2017 **S. Buessecker**, N.R. Fidai, J.L. Canning, J. Nye, K.E. Holbert, H.E. Hartnett, J.B. Glass, and H. Cadillo-Quiroz. Abiotic N₂O production: A prevalent phenomenon on anoxic worlds? (Poster). *Astrobiology Science Conference AbSciCon*, Mesa, AZ.
- 2017 Z. Zamora, **S. Buessecker**, and H. Cadillo-Quiroz. Effects of copper addition on microbial N₂O reduction in acidic peat soils (Poster). *American Society for Microbiology (ASM) Conference*, New Orleans, LA.
- 2015 **S. Buessecker**, J.B. Glass, and H. Cadillo-Quiroz. Origin and fate of nitrous oxide in a putative coupled abiotic-biotic denitrification process in tropical peatlands (Talk). *Astrobiology Science Conference AbSciCon*, Chicago, IL.
- 2013 **S. Buessecker**, T. Lösekann-Behrens, A. Kappler, K. Hanselmann, and S. Behrens. Evaluation of potential methanotrophy in an iron mine (Poster). *Monte Verità Conference for Iron Biogeochemistry*, Ascona, Switzerland.

FIELDWORK & EXPEDITIONS

Orca Basin, Gulf of Mexico, deep hypersaline anoxic basin	2023
Perth, Merredin, Esperance, Western Australia, hypersaline lakes	2022
Great Boiling Springs, Gerlach, Nevada, terrestrial hot springs	2021
Panama, Costa Rica, Minas Gerais & Amazonia (Brazil), unexplored tropical peatlands	2018
Iquitos, Pucallpa, Puerto Maldonado (Peru), unexplored tropical peatlands	2017
Cadiz Playas, Southern Mojave Desert, desert brines and soils	2016
Iquitos, Buena Vista (Peruvian Amazon), unexplored tropical peatlands	2015
Iquitos, San Jorge (Peruvian Amazon), unexplored tropical peatlands	2014
Gonzen mine, Sargans (Switzerland), geomicrobiology of an aphotic ecosystem	2011
Lake Cadagno (Switzerland), geochemistry of an alpine high-altitude lake	2011
Engadin (Switzerland), geomicrobiology of mountain springs	2010
Langeoog Island (Germany), zoology of tidal marshes	2007

SYNERGISTIC ACTIVITIES & OUTREACH

Additional Education

How to write NASA ROSES proposals, workshop for NPPs	2022
Astrobiology Summer School 2018 by NASA/NAI, Santander, Spain	2018
Spring course in Stable Isotope Biogeochemistry, Ostrom Lab, MSU	2016
Astrobiology Winter School 2016 by NASA/NExSS, Biosphere 2, Oracle, AZ	2016
<i>Tandem</i> Program at University of Tübingen, learning languages mutualistically, for Portuguese and French	2010-2013
Synergistic working groups of the Heidelberg Life Science Lab	2004-2006

Professional

Panelist reviewer for the NASA Exobiology Program	09/2023
Reviewer, manuscripts:	
<i>Geology</i>	since 2023
<i>Environmental Microbiology Reports</i>	since 2023
<i>Frontiers in Microbiology</i>	since 2023
<i>Plant and Soil</i>	since 2022
<i>Nature Communications</i>	since 2022
<i>Soil Biology & Biochemistry</i>	since 2022
Reviewer, proposals: APS/NAI Lewis & Clark Fund for Exploration and Field Research in Astrobiology, NSF (Div. of Environmental Biology)	since 2022
Conference session co-chair: Session <i>Alive or not? New strategies and techniques for recognizing biological signatures from the abiotic noise</i> , AbSciCon 2019 in Seattle	2019
Conference poster judge at the Astrobiology Science Conference	2019, 2022

Community

Giant Kelp Restoration Project – Volunteer diver, Monterey	since 2022
Science fair judge, Broadmor Elementary school, Tempe	2017-2019
Student development - Life as a scientist, outreach day, Mesa Middle school	2016
Astrobiology reading group, ASU Tempe campus	2015-2019
Working group <i>Cuatro Ciénegas</i> , PhD student synergistic project	2014-2015

PERSONAL

I enjoy lap swimming year-round, play soccer competitively in a San Jose team, and like to challenge friends in Badminton or Chess. I also love the outdoors, go hiking, and recently started diving. I am a pet friend, like to go on longer walks with my dogs, get visits from a hummingbird family every spring, and keep a chameleon named *Dino*. Biographies of famous scientists are my favorite books. I currently live in Santa Clara.