Cecilia B. Sanders, PhD

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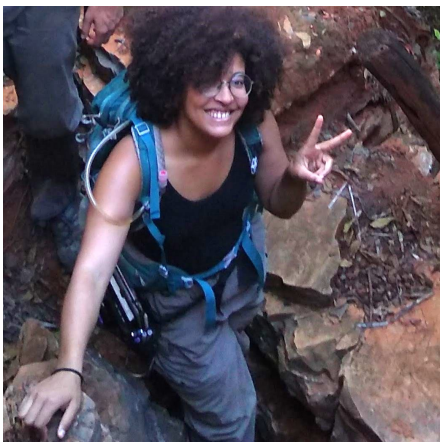

Deep Time Peter Buck Postdoctoral Fellow

Smithsonian National Museum of Natural History

Starting Summer 2024

Assistant Professor

University of Maryland Department of Geology

Starting 2025

Education

2018 – 2022 **Ph.D. Geobiology, Caltech** Geological and Planetary Sciences.
Doctoral Thesis: *Geological and Geochemical Explorations of the Salitre Formation Phosphorite, Eastern Brazil.* https://doi.org/10.7907/rd4m-7x08

2016 – 2018 **M.Sc. Planetary Science, Caltech** Geological and Planetary Sciences.

2012 – 2016 **B.A. Earth and Planetary Sciences and Astrophysics, Harvard University**
Senior thesis title: *Impact gardening as a mechanism for hydrothermal alteration and atmospheric evolution on Noachian Mars*.
Junior thesis title: *When planets breathe – Models constrain the circumstances for detection of biomarker gases on the terrestrial exoplanets of M Dwarfs*.

Awards

Awards and Achievements

2024 – present **Deep Time Peter Buck Postdoctoral Fellowship**, Smithsonian National Museum of Natural History.

2022 – 2024 **Morton K. Blaustein Postdoctoral Fellowship**, Johns Hopkins Department of Earth and Planetary Sciences.

2016 – 2022 **NSF Graduate Research Fellowship**, National Science Foundation.

2020 **Award for educational outreach**, Caltech Division of Geological and Planetary Sciences.

2018 **Ian Campbell Award for outstanding achievement in field geology courses**, Caltech Division of Geological and Planetary Sciences.

2015 **Leo Goldberg Prize in Astronomy**, Harvard-Smithsonian Center for Astrophysics. Junior thesis award.

Research Publications

Journal Articles

1 **Sanders**, **C. B.**, Present, T., Marroquin, S., & Grotzinger, J. (2024). Sulfur geochemistry of the salitre formation phosphorites: Implications for the role of microbial ecology and sulfur cycling in phosphogenesis on an ediacaran carbonate platform. *Geochimica et Cosmochimica Acta, 367*.
https://doi.org/10.1016/j.gca.2023.12.033

2 **Sanders**, **C. B.**, Eiler, J., & Grotzinger, J. (2023). Paragenesis of an ediacaran carbonate-platform phosphorite: Constraints from optical petrography and texture-specific clumped isotope paleothermometry. *Sedimentary Geology*, *444*. https://doi.org/10.1016/j.sedgeo.2022.106316

3 **Sanders**, **C. B.**, & Grotzinger, J. P. (2021). Sedimentological and stratigraphic constraints on depositional environment for Ediacaran carbonate rocks of the São Francisco Craton. *Precambrian Research*, *363*. https://doi.org/10.1016/j.precamres.2021.106328

4 Wordsworth, R., Kalugina, Y., Lokshtanov, S., Viagasin, A., Ehlmann, B., Head, J., **Sanders**, **C. B.**, & Wang, H. (2014). Transient reducing greenhouse warming on early mars. *Geophysical Research Letters*, *44*(2), 665–671. https://doi.org/10.1002/2016GL071766

Conference Proceedings

1 **Sanders**, **C. B.**, Smith, E., Lonsdale, M., Moore, K., Mustapayeva, S., Mamanov, Y., & Talgatbeck, A. (2024). Invited oral presentation: Comparative analysis of two Lower Cambrian phosphorites in Central Asia: Relating paleoenvironment, paleoecology, and phosphorite formation in deep time, In *Geological Society of America Connects 2024*, Anaheim, CA.

2 **Sanders**, **C. B.** (2023). Oral presentation: Interrogating the role of microorganisms in the genesis of sedimentary phosphorite deposits at the Precambrian-Cambrian boundary, In *Mid-Atlantic Geobiology Symposium*, Newark, DE.

3 **Sanders**, **C. B.**, & Grotzinger, J. (2020). Invited oral presentation: Sedimentary context and diagenetic history of phosphatic microbialites, Ediacaran Una-Bambuí carbonate platform, Eastern Brazil, In *American Geophysical Union Fall Meeting (ICEEE 2020)*, Virtual.

4 **Sanders**, **C. B.**, Orphan, V. J., Ehlmann, B. L., & Grotzinger, J. P. (2019). Oral presentation: Sweet Honey in the Rock – Cultivating and characterizing the biosignatures of chemolithotrophic microorganisms on Mars analog substrates, In *16th Annual Southern California Geobiology Symposium*, Pasadena, CA.

5 **Sanders**, **C. B.**, Orphan, V. J., Ehlmann, B. L., & Grotzinger, J. P. (2018a). Poster: Sweet Honey in the Rock – Cultivating and characterizing the biosignatures of chemolithotrophic microorganisms on Mars analog substrates, In *American Geophysical Union Fall Meeting 2018*, Washington, DC.

6 **Sanders**, **C. B.**, Orphan, V. J., Ehlmann, B. L., & Grotzinger, J. P. (2018b). Poster: Sweet Honey in the Rock – Cultivating and characterizing the biosignatures of chemolithotrophic microorganisms on Mars analog substrates, In *Simons Collaboration on the Origins of Life*, New York, NY.

7 **Sanders**, **C. B.**, & Wordsworth, R. (2016). Oral presentation: Impact gardening as a mechanism for hydrothermal alteration and atmopspheric evolution on Noachian Mars (Abstract 2634), In *47th lunar and planetary science conference*, The Woodlands, TX.

8 **Sanders**, **C. B.**, & Ciesla, F. (2014). Poster: Explaining the noble gas content of the planets – Theoretical models for argon-trapping by amorphous ices in the solar nebula, In *American Geophysical Union Fall Meeting (ICEEE 2014)*, San Francisco, CA.

Teaching, Outreach, and Science Communication

2023 – 2024 **Instructor**. *The Johns Hopkins University Dept. of Earth & Planetary Sciences*. Curriculum design, lecture, and lab instruction for graduate/undergraduate course, *How to Live Forever: The Making of the Geologic Record of Life*.

2022 – 2023 **Instructor**. *The Johns Hopkins University Dept. of Earth & Planetary Sciences*. Curriculum design, lecture, and lab instruction for Special Opportunities in Undergraduate Learning (SOUL) Course 23, *Beyond Bones: Microorganisms in the Rock Record*.

Oct. 2023 **Content Consultant and Interviewee for PBS NOVA**. *PBS NOVA and The BBC*. Scientist appearing in *Ancient Earth: Frozen* television episode.

Teaching, Outreach, and Science Communication (continued)

2022 – 2023 **Diversity Postdoctoral Alliance Committee (DPAC) HBCU Mentoring Program**. *The Johns Hopkins Postdoctoral Association*. Mentoring/advising for undergraduate students at Mid-Atlantic HBCUs

2017 – 2021 **Visiting Scientist Program**. *Caltech Center for Teaching, Learning, and Outreach* (CTLO) and *Pasadena Unified School System* (PUSD). Science curriculum design and both in-person and virtual in-class teaching experience with Grades K-5.

2017 – 2020 **Science Night Exhibitions**. *Caltech Center for Teaching, Learning, and Outreach* (CTLO) and *Pasadena Unified School System* (PUSD). Series of extra-curricular STEM expos for K-12 students and families in Pasadena.

2018 – 2019 **Teaching Assistant**. *Caltech Division of Geological and Planetary Sciences*. Ge 11b/104: Introduction to Geobiology.

2017 – 2018 **Teaching Assistant**. *Caltech Division of Geological and Planetary Sciences*. Ge 116: Analytical Methods.

Jul. 2019 **Caltech Astro Virtual Lecture Series**. *Caltech Astronomy*. Virtual public lecture. *You'll know it when you see it: Defining, describing, and detecting life in the universe*. https://youtu.be/VyzQpk2m5Hk

Jun. 2019 **Real Science**. CaltechLive! virtual public talk, discussion mediation for Grades 3-8. *Beyond Bones: Interrogating the fossil record of small, soft, profoundly Earth-shaping organisms in the Precambrian*.

Nov. 2019 **Southern California Paleontological Society Lecture Series**. Public lecture for all ages. *Micropaleontology: Interrogating the fossil record of small, soft, profoundly Earth-shaping organisms in the Precambrian*.

May 2019 **Astronomy On Tap – Los Angeles**. Public talk. *Pebbles on the shore: Reconstructing ancient alien habitats on Earth and Mars*.

Apr. 2019 **Science Symposium Talk**. Lecture at Sequoyah High School Science Symposium. *Geomicrobiology*.

Reel Science. CaltechLive! Public talk, discussion mediation for Grades 3-8. *Galapagos: The islands that changed the world*.

Feb. 2017 **Caltech Astro Lecture Series**. *Caltech Astronomy*. Panelist, facilitating discussion after public lecture. *The Science of Star Trek – Michael Wong, Ph.D.*

Reviewer Experience

2022 – present *Proceedings of the National Academy of Sciences* (3 articles), *Precambrian Research* (1 article), *Sedimentary Geology* (1 article), *Global and Planetary Change* (1 article), *Acta Geochimica* (1 article)

Skills

Analytical Methods	SEM/EDS/EBSD; XRF; XRD; Raman Spectroscopy; micro CT; SIMS/nanoSIMS; IRMS for Δ_{47}, $\delta^{13}C$, and $\delta^{18}O$ of carbonate in calcite, dolomite, and francolite, $\delta^{34}S$ of sulfate in calcite, dolomite, and francolite, and $\delta^{34}S$ of sulfide in pyrite and extracted chromium-reducible sulfur; optical imaging and characterization of petrographic thin sections; chemical assays for sulfur and iron species, maintenance of microbial cultures; preparation of mineralogical and biological samples for any of the previously listed methods; field geology (campaign logistics, mapping, description, measurement, geological sample collection and archiving); CRS extraction; bulk CAS and PAS extraction and purification; and trace CAS extraction and purification.
Coding	Python, Matlab, LaTeX
Misc.	Scientific writing, hand and digital illustration, graphic design (logos, posters, documents, infographics), public speaking, in-classroom teaching (K-12, undergraduate, and graduate-level courses)

References

- **Kay Behrensmeyer**, *Curator of Vertebrate Paleontology*

  Smithsonian National Museum of Natural History (NMNH) Department of Paleobiology
  PO Box 37012
  Washington, DC 20013

  E-mail: **behrensa@si.edu**
  Phone: +1 (571) 269 7688

  Relationship: Postdoctoral Fellowship Adviser

- **Gabriela Farfan**, *Coralyn W. Whitney Curator of Gems and Minerals*

  Smithsonian National Museum of Natural History (NMNH) Department of Mineral Sciences
  PO Box 37012
  Washington, DC 20013

  E-mail: **farfang@si.edu**
  Phone: +1 (608) 334 1244

  Relationship: Postdoctoral Fellowship Adviser

- **Emmy Smith**, *Associate Professor*

  Johns Hopkins University Department of Earth & Planetary Sciences
  3400 N. Charles Street, Olin Hall 208
  Baltimore, MD 21218

  E-mail: **efsmith@jhu.edu**
  Phone: +1 (214) 384 8884

  Relationship: Postdoctoral Fellowship Adviser

- **John P. Grotzinger**, *Harold Brown Professor of Geology, Ted and Ginger Jenkins Leadership Chair*

  Caltech Division of Geological and Planetary Sciences
  1200 E California Blvd, MC 170-25
  Pasadena, CA 91125

  E-mail: **grotz@gps.caltech.edu**
  Phone: +1 (626) 395 6785

  Relationship: Doctoral Thesis Adviser, Collaborator

- **John Eiler**, *Robert P. Sharp Professor of Geology and Geochemistry*

  Caltech Division of Geological and Planetary Sciences
  1200 E California Blvd, MC 100-23
  Pasadena, CA 91125

  E-mail: **eiler@gps.caltech.edu**
  Phone: +1 (626) 395 6942

  Relationship: Doctoral Thesis Committee Member, Collaborator

- **Kathryn "Kitty" Cahalan**, *Outreach Program Manager*

  Caltech Center for Teaching, Learning, & Outreach
  1200 E California Blvd, MC 369-86
  Pasadena, CA 91125

  E-mail: **kcahalan@caltech.edu**
  Phone: +1 (626) 395 2468

  Relationship: Coordinator/Advisor for Education/Outreach Volunteer Work