

STEPHANIE L. OLSON

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RESEARCH INTERESTS

Earth system evolution, marine biogeochemistry, astrobiology, exoplanet life detection

EDUCATION

- 2018** **PhD, Geochemistry**
University of California, Riverside
- 2013** **MS, Geosciences**
Pennsylvania State University
- 2011** **BS Geophysics, BS Geology**
University of Minnesota

APPOINTMENTS

- 2020** **Assistant Professor**
Department of Earth, Atmospheric, and Planetary Science
Purdue University
- 2018-
2020** **T.C. Chamberlin Postdoctoral Fellow**
Department of the Geophysical Sciences
University of Chicago

SELECTED HONORS & AWARDS

- Chancellor's Distinguished Fellow, University of California, 2013
- Outstanding Teaching Assistant, University of Minnesota, 2011
- Ralph and Jayne McMillen Scholarship in Geoscience, 2010
- H. Walter and E. Joyce Rembold Institute of Technology Honors Scholarship, 2009-11
- Richard Clarence Dennis Scholarship in Geoscience, 2009

FUNDING (\$1,129,606 total)

- 2020-
2023** *Assessing Atmospheric Seasonality as an Exoplanet Biosignature*
NASA Exobiology | Role: PI | Total amount: \$450,459

- 2020-2023** *Oceanographic Considerations for the Oxygenation of Habitable Worlds: Lessons from Early Earth*
NASA Habitable Worlds | Role: PI | Total amount: \$507,867
- 2018-2020** *T.C. Chamberlin Postdoctoral Fellowship*
UChicago DoGS | Total amount: \$171,280

PEER REVIEWED PUBLICATIONS (*denotes student mentee)

- 2020**
19. Reinhard CT, **Olson SL**, Kirtland Turner S, Palike C, Kanzaki Y, Ridgwell A. Oceanic and Atmospheric Methane Cycling in the cGENIE Earth System Model. *Geoscientific Model Development*.
 18. *Salazar A, **Olson S.L.**, Komacek T., Stephens H., Abbot D.S. The Effect of Substellar Continent Size on the Ocean Dynamics of Proxima Centauri b. *Astrophysical Journal Letters* 896: L16
 17. **Olson SL**, Jansen M, Abbot DS. (2020) Oceanographic Considerations for Exoplanet Life Detection. *Astrophysical Journal* 895: 19.
 16. *Alcubes ODN, **Olson SL**, Abbot DS (2020) Robustness of Gaian Feedbacks to Climate Perturbations. *Monthly Notices of the Royal Astronomical Society* 492: 2572-2577.
 15. Ostrander CM, Kendall B, **Olson SL**, et al. (2020) An expanded $\delta^{98}\text{Mo}$ record permits recurrent shallow marine oxygenation during the Neoproterozoic. *Chemical Geology* 532: 119391.
- 2019**
14. Checlair JH, **Olson SL**, Jansen MF, Abbot DS (2019). No Snowball on Habitable Tidally Locked Planets with a Dynamic Ocean. *Astrophysical Journal Letters* 884: L46.
 13. Gregory DD, Mukherjee I, **Olson SL** et al. (2019). The formation mechanisms of sedimentary pyrite nodules determined by trace element and sulfur isotope microanalysis. *Geochimica et Cosmochimica Acta* 259: 53-68.
 12. Schwieterman E.W., Reinhard C.T., **Olson S.L.**, Harman C.E., Lyons T.W. (2019) A limited habitable zone for complex life. *Astrophysical Journal* 878: 19.
 11. Schwieterman E.W., Reinhard C.T., **Olson S.L.**, Ozaki K., Harman C, Lyons T.W. (2019) Rethinking CO "Anti-Biosignatures" in the Search for Life Beyond Earth. *Astrophysical Journal* 874: 9.
 10. **Olson SL**, Ostrander C, Gregory DD, Roy M, Anbar AD, Lyons TW. (2019) Volcanically modulated pyrite burial and ocean-atmosphere oxidation. *Earth and Planetary Science Letters* 506: 417-427.

- 2018**
9. **Olson SL**, Schwieterman EW, Reinhard CT, Ridgwell A, Meadows VS, Lyons TW. (2018) Atmospheric seasonality as an exoplanet biosignature. *Astrophysical Journal Letters* 858: L14.
 8. Schwieterman EW, Kiang NY, Parenteau MN, ... , **Olson SL**, et al. (2018) Exoplanet Biosignatures: A Review of Remotely Detectable Signs of Life, *Astrobiology* 18: 663-708.
 7. **Olson SL**, Schwieterman EW, Reinhard CT, Lyons TW (2018). Earth: Atmospheric Evolution of a habitable planet, in Deeg HJ & Belmonte JA (eds), *Handbook of Exoplanets*.
 6. Krissansen-Totton J, **Olson SL**, Catling D (2018). Disequilibrium biosignatures on Earth through time and implications for remote life detection, *Science Advances* 4: eaao5747.
- 2017**
5. Reinhard CT, **Olson SL**, Schwieterman EW, Lyons TW (2017) False Negatives for Remote Life Detection on Ocean-Bearing Planets: Lessons from the Early Earth. *Astrobiology* 17:287–297.
- 2016**
4. **Olson SL**, Reinhard CT, Lyons TW (2016b) Cyanobacterial Diazotrophy and Earth's Delayed Oxygenation. *Frontiers in Microbiology* 7:1526.
 3. **Olson SL**, Reinhard CT, Lyons TW (2016a) Limited role for methane in the mid-Proterozoic greenhouse. *Proceedings of the National Academy of Sciences* 113:11447–11452.
 2. Reinhard CT, Planavsky NJ, **Olson SL**, Erwin DH, Lyons TW (2016) Earth's oxygen cycle and the evolution of animal life. *Proceedings of the National Academy of Sciences* 113:8933–8938.
- 2013**
1. **Olson SL**, Kump LR, Kasting JF (2013) Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *Chemical Geology* 362:35–43.

SEMINARS & COLLOQUIA

- 2019**
- Exo-oceanography and the Search for Life in Uncharted Waters
Department of the Geophysical Sciences, University of Chicago
Chicago, IL, October 2019
- Resolving Ambiguities in the Search for Life in the Universe
Earth and Ocean Sciences, University of Victoria
British Columbia, Canada, March 2019
- Resolving Ambiguities in the Search for Life in the Universe
Earth, Atmospheric, and Planetary Sciences, Purdue University
West Lafayette, IN, February 2019

- 2018** Characterizing Ozone Detectability and Seasonality on Weakly Oxygenated Terrestrial Exoplanets: Lessons from Early Earth.
LUVOIR Seminar, NASA Goddard (remote), April 2018
- Atmospheric Seasonality as an Exoplanet Biosignature
Center for Space and Habitability, University of Bern
Bern, Switzerland, February 2018
- Leveraging Earth Science in the Search for Life Elsewhere
Department of the Geophysical Sciences, University of Chicago
Chicago, IL, January 2018

KEYNOTES & INVITED TALKS

- 2020** Exo-oceanography and the Search for Life in Uncharted Waters
Invited, What makes a planet uninhabitable? Virtual Conference
- 2019** Exo-oceanography and the Search for Life in Uncharted Waters
Keynote, Goldschmidt 2019, Barcelona, Spain
- Distinguishing biological and geological methane
Invited, Sagan Workshop 2019, Pasadena, CA
- Higher ocean salinity significantly warms Archean climate
Invited, NASA AbSciCon 2019, Seattle, WA
- 2018** Co-evolution of Oceanic and Atmospheric Chemistry
Invited, Comparative Climatology of Terrestrial Planets III, Houston, TX
- 2016** Nutrient-O₂ feedbacks and Proterozoic pO₂ regulation
Invited, Goldschmidt 2016, Yokohama, Japan
- 2014** Oxygen oases before and after the GOE: insights from metals and models
Invited, AGU Fall Meeting 2014, San Francisco, CA

CONTRIBUTED ABSTRACTS (*denotes student mentee)

Checlair JH, Hayworth BPC, **Olson SL**, Komacek TD, Villanueva G, Popovic P, Yang H, Abbot DS. (2020) Non-detection of O₂/O₃ informs frequency of Earth-like planets with LUVOIR but not HabEx. *AGU Fall Meeting* [virtual]

*Barnett M, **Olson SL** (2020) High orbital obliquity promotes planetary oxygenation. *AGU Fall Meeting* [virtual]

Liu X, **Olson SL** (2020) Modelling Early Earth Ocean Mixing Timescales: Implications for the Oxygenation of Habitable Worlds. *LPSC*. [virtual]

*Barnett M, Olson SL (2019) Nutrient Cycling in Exoplanet Oceans. *AGU Fall Meeting*, San Francisco, CA.

*Alcabes ODN, Olson SL, Abbot DS (2019) Typical Climate Perturbations Unlikely to Disrupt Gaia Hypothesis. *AGU Fall Meeting*, San Francisco, CA.

Checlair J, Abbot DS, Jansen MF, Menou K, **Olson SL**, Paradis A, Salazar A (2019) The Snowball Bifurcation on Tidally Locked Planets. *AGU Fall Meeting*, San Francisco, CA.

Abbot DS, Alcabes ODN, Checlair J, Hayworth B, Komacek TD, **Olson SL**, Popovic P (2019) What HabEx and LUVOIR can tell us about Habitability, Inhabitation, and Biosigning. *AGU Fall Meeting*, San Francisco, CA.

Olson SL, Checlair J, Abbot DS (2019) Ocean Heat Transport and Glaciation Dynamics on Tidally Locked Planets. *Goldschmidt*, Barcelona, Spain.

Schwieterman EW, Reinhard CT, **Olson SL**, Harman CE, Lyons TW (2019) A Limited Habitable Zone for Complex Life. *Goldschmidt*, Barcelona, Spain.

Olson SL, Jansen M, Abbot DS (2019) Exo-oceanography and the Search for Life in Uncharted Waters. *NASA AbSciCon*, Seattle, WA.

Lyons TW, **Olson SL**, Reinhard CT, Schwieterman EW (2019) How Earth's Early Oceans and Atmosphere Help Guide the Search for Life Beyond our Solar System. *NASA AbSciCon*, Seattle, WA.

Schwieterman EW, Reinhard CT, **Olson SL**, Harman CE, Lyons TW (2019) A Limited Habitable Zone for Complex Life. *NASA AbSciCon*, Seattle, WA.

Olson SL, Droser ML, Gehling J, Lyons TW (2018) Ediacaran oxygen oases and the emergence of bilaterian burrowing. *Midwest Geobiology Symposium*, Evanston, IL.

Olson SL, Schwieterman EW, Reinhard CT., Ridgwell A, Meadows VS, Lyons TW (2018) Atmospheric Seasonality as an Exoplanet Biosignature. *Goldschmidt*, Boston, MA.

Krissansen-Totton J, **Olson SL**, Garland R, Irwin P, Catling D (2018) Disequilibrium Biosignatures on the Early Earth and their Detectability with the James Webb Space Telescope. *Goldschmidt*, Boston, MA.

Schwieterman EW, **Olson SL**, Reinhard CT, Lyons TW (2018) The Importance of Ozone and UV Capability in Detecting Biosignatures on Planets with Intermediate Oxygenation States. *Goldschmidt*, Boston, MA.

Olson SL, Droser ML, Gehling J, Lyons TW (2018) Benthic Oxygen Oases and Early Animal Evolution. *Southern California Geobiology Symposium*, Riverside, CA.

Olson SL, Schwieterman EW, Reinhard CT, Ridgwell A, Meadows VS, Lyons TW (2017) Atmospheric seasonality on early Earth and Earth-like exoplanets. *AGU Fall Meeting*, New Orleans, LA.

- Olson SL**, Schwieterman EW, Reinhard CT, Ridgwell A, Lyons TW (2017) Atmospheric seasonality on Earth: Implications for remote life detection. *Goldschmidt*, Paris, France.
- Olson SL**, Droser ML, Gehling J, Lyons TW (2017) Ediacaran trace fossils map benthic oxygen oases. *Geobiology*, Banff, AB.
- Olson SL**, Droser ML, Gehling J, Lyons TW (2017) Ediacaran trace fossils map benthic oxygen oases. *NASA AbSciCon*, Mesa, AZ.
- Krissansen-Totton J, **Olson SL**, Catling DC (2017) Atmospheric Disequilibrium Biosignatures on Earth Through Time. *NASA AbSciCon*, Mesa, AZ.
- Schwieterman EW, **Olson SL**, Reinhard CT, Lyons TW (2017) Evaluating N₂O as an Exoplanet Biosignature: Combining Biogeochemical, Photochemical, and Spectral Models. *NASA AbSciCon*, Mesa, AZ.
- Reinhard CT, **Olson SL**, Schwieterman EW, Lyons TW (2017) False Negatives for Remote Life Detection on Ocean-Bearing Planets: Lessons from the Early Earth. *NASA AbSciCon*, Mesa, AZ.
- Olson SL**, Reinhard CT, Lyons TW (2016) Nutrient-O₂ feedbacks and Proterozoic pO₂ regulation. *Southern California Geobiology Symposium*, Pasadena, CA.
- Olson SL**, Reinhard CT, Lyons TW (2015) Biosignature blind spots: lessons from early Earth. *ExSoCal*, Pasadena, CA, USA.
- Olson SL**, Roy M, Ostrander C, Lyons TW, Anbar AD (2015) Inorganic hints of Archean oxygenation in the ~2.7 Ga Roy Hill Shale. *Goldschmidt*, Prague, CZ.
- Olson SL**, Reinhard CT, Lyons TW (2015) A mid-life crisis for Earth's greenhouse. *NASA AbSciCon*, Chicago, IL, USA.
- Olson SL**, Reinhard CT, Lyons TW (2015) A mid-life crisis for Earth's greenhouse. *Southern California Geobiology Symposium*, Riverside, CA.
- Olson SL**, Reinhard CT, Lyons TW (2014) Exploring the effects of oxidant availability on the early methane cycle. *Goldschmidt*, Sacramento, CA.
- Olson SL**, Kump LR, Kasting JF (2013) Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *NASA AbGradCon*, Montreal, QC.
- Olson SL**, Kump LR, Kasting JF (2012) Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *NASA AbSciCon*, Atlanta, GA.

WHITE PAPERS & REPORTS

- Unterborn CT, Byrne PK, ... **Olson SL**, *et al.* (2020) Exogeoscience and Its Role in Characterizing Exoplanet Habitability and the Detectability of Life. [arXiv:2007.08665](https://arxiv.org/abs/2007.08665) [astro-ph.IM]

Reinhard C.T., Planavsky N.J., Cole D.B., ... , **Olson S.L.**, *et al.* (2020) Environmental drivers of increasing biological complexity on Earth.

Olson S.L. & Schwieterman E.W. (2019) Leveraging planetary seasonality to recognize habitability and to detect the pulse of a biosphere. *LUVOIR Report*, Appendix A.16

Lisman D., Schwieterman E.W., Seager S., ... , **Olson S.L.**, *et al.* (2019) The Occulting Ozone Observatory (O₃) Mission.

Lisman D, Schwieterman EW, Reinhard CT, **Olson SL**, *et al.* (2019) Surveying the solar neighborhood for ozone in the UV at temperate rocky exoplanets. *Bulletin of the American Astronomical Society*.

Krissansen-Totton J, Arney G., Catling C., ... , **Olson SL**, *et al.* (2019) Atmospheric disequilibrium as an exoplanet biosignature: Opportunities for next generation telescopes. *Bulletin of the American Astronomical Society*.

Arney G, Batalha N, Britt AV, ... , **Olson SL**. *et al.* (2019) The Sun-like Stars Opportunity. *Bulletin of the American Astronomical Society*.

Reinhard CT, Schwieterman EW, **Olson SL**, *et al.* (2019) The remote detectability of Earth's biosphere through time and the importance of UV capability for characterizing habitable exoplanets. arXiv:1903.05611 [astro-ph.EP]

Checlair JH, Abbot DS, ... , **Olson SL**, *et al.* (2019) A Statistical Comparative Planetology Approach to Maximize the Scientific Return of Future Exoplanet Characterization Efforts. arXiv:1903.05211, 2019 [astro-ph.EP]

Schwieterman EW, Reinhard CT, **Olson SL**, Lyons TW (2018) The Importance of UV Capabilities for Identifying Inhabited Exoplanets with Next Generation Space Telescopes. arXiv:1801.02744 [astro-ph.EP]

SHORT COURSES & WORKSHOPS

- Sagan Workshop 2019: Astrobiology for Astronomers, Caltech.
- Rossbyalooza 2018: Understanding Climate Through Simple Models, University of Chicago.
- Searching for Life Across Space and Time, National Academy of Sciences, 2016.
- Josep Comas i Solà International Summer School in Astrobiology, Santander, Spain, 2016.
- Building a Habitable Earth, University of Tübingen, Germany, 2016.
- Upstairs Downstairs: Consequences of Internal Planet Evolution for the Habitability and Detectability of life on Extrasolar planets, Arizona State University, AZ, 2016.
- Beyond Habitability: Life and the Early Earth, Smithsonian Institution, DC, 2014.

TEACHING

Teaching assistant for:

- *Geochemistry of Natural Waters*, UCR, 2015, 17;
- *Oceanography*, UCR, 2014-16;
- *Earth and Life: Origin and Evolution*, PSU, 2012;
- *The Earth System*, PSU, 2011;
- *Earth and its Environments*, UMN, 2010-11

STUDENT MENTORSHIP

Megan Barnett, 2019—present

PhD student, Geophysical Sciences, University of Chicago (primary advisor: Fred Ciesla)

Camilla Liu, 2019—present

PhD student, Geophysical Sciences, University of Chicago (primary advisor: Nicolas Dauphas)

Andrea Salazar, 2019-2020

Undergraduate, Physics, University of Chicago (primary advisor: Dorian Abbot)

Olivia Alcabes, 2018-2019

Undergraduate, Physics, University of Chicago (primary advisor: Dorian Abbot)

Haynes Stephens, 2018-2019

PhD student, Geophysical Sciences, University of Chicago (primary advisor: Dorian Abbot)

Elise Darragh-Ford, 2018

Undergraduate, Astrophysics, University of Chicago; now a PhD student in Physics at Stanford

SYNERGYSTIC ACTIVITIES

- Steering Council, NASA Nexus for Exoplanet System Science (NExSS), 2020—
- Co-Lead, NExSS Biosignatures Science Working Group, 2020—
- Scialog Fellow, 2020—
- NASA panelist (x3), 2019—

Session organizer/convener for:

- 2019** Astrobiogeochemistry: Modelling biology and its co-evolution with the environment on Earth and implications for exoplanets. *NASA AbSciCon 2019*, Seattle, WA
- Astrobiogeochemistry: Emerging links between Earth Sciences, Astrophysics, and the Search for Habitability and Life. *Goldschmidt 2019*, Barcelona, Spain
- 2018** Leveraging Earth Science Approaches in the Search for Life in the Universe. *Goldschmidt 2018*, Boston, MA

- 2017** The Co-Evolution of Life and Its Environment during the Precambrian: The Rise of Oxygenic Photosynthesis and the Great Oxidation Event. *Geological Society of America 2017*, Seattle, WA
- 2014** The Co-evolution of Life and its Environments from the GOE to the Rise of Complex Life. *AGU Fall Meeting 2014*, San Francisco, CA

Reviewer for:

American Journal of Science, Astronomical Journal, Astrophysical Journal Letters, Chemical Geology, Communications Earth and Environment, Earth and Planetary Science Letters, Geobiology, Geochimica et Cosmochimica Acta, Geology, Interface Focus, Nature, Nature Geoscience, Paleoceanography and Paleoclimatology, Planetary Science Journal, Science Advances

SERVICE

- Organizer, UChicago Geo & Astro Exoplanet Journal Club, 2019-2020
- Search Committee, T.C. Chamberlin Postdoctoral Fellowship, 2018, 2019

OUTREACH

- Mentor, Ossining Science Research Program, 2019—
- Volunteer instructor, Python Club at Noble Academy, 2018
- Mentor, Summer Experience in Earth and Mineral Sciences/Upward Bound Math & Science, 2012

SELECTED MEDIA COVERAGE

- 2019** Exoplanets could have better conditions for life than Earth, study says, **CNN**, August 2019
- Alien Life on Exoplanets May be 'More Abundant and Active' Than on Earth, Say Scientists, **Forbes**, August 2019
- Alien Planets Could be Better Suited for Life than Earth: Study, **Fox News**, August 2019
- Earth 2.0: same same, but better, **Cosmos Magazine**, July 2019
- Extraterrestrial life could be scarcer than first thought, study says, **Fox News**, June 2019
- 2018** The clues to finding alien life could lie in Earth's deep past, **New Scientist** September 2018

Seasonal changes in exoplanet's atmosphere could signal alien life, ***Fox News***, May 2018

The search for life on other planets could get a boost from biosignatures, ***Los Angeles Times***, Jan. 2018

2017 Finding Signs of Alien Life Might be Harder Than We Thought. Here's Why, ***NBC News***, April 2017