

## **STEPHANIE L. OLSON**

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### **RESEARCH INTERESTS**

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

### **EDUCATION**

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

### **APPOINTMENTS**

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- 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

### **FUNDING**

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

### **SELECTED HONORS & AWARDS**

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- 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

**PEER REVIEWED PUBLICATIONS** (\*denotes student mentee)

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- Forthcoming**
18. **Olson SL**, Droser ML, Gehling J, Lyons TW. Ediacaran Oxygen Oases Encouraged the Emergence of Bilaterian Burrowing Behavior, *in review for Geobiology*.
  17. **Olson SL**, Jansen M, Abbot DS. Oceanographic Constraints on Exoplanet Life, *in revision for Astrophysical Journal*. arXiv:1909.02928 [astro-ph.EP]
  16. \*Alcibes ODN, **Olson SL**, Abbot DS, Typical Climate Perturbations Unlikely to Disrupt Gaia Hypothesis, *in revision for MNRAS*. arXiv:1906.01112 [astro-ph.EP]
- 2019**
15. Ostrander CM, Kendall B, **Olson SL**, et al. An expanded d98Mo record permits recurrent shallow marine oxygenation during the Neoproterozoic, *Chemical Geology*, accepted.
  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

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- 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.  
*LUVUOIR 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**

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- 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-O<sub>2</sub> feedbacks and Proterozoic pO<sub>2</sub> 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)

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\*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 N<sub>2</sub>O 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-O<sub>2</sub> feedbacks and Proterozoic pO<sub>2</sub> 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

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**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 (O<sub>3</sub>) 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**

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- Sagan Workshop 2019: Astrobiology for Astronomers, Caltech.
- Rossbypalooza 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**

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### **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**

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### **Megan Barnett, 2019—present**

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

### **Camilla Liu, 2019—present**

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

### **Andrea Salazar, 2019—present**

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

### **Olivia Alcabes, 2018—present**

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

### **Haynes Stephens, 2018-2019**

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

### **Elise Darragh-Ford, 2018**

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

## SERVICE TO PROFESSION

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### 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*
- *Astrophysical Journal Letters*
- *Chemical Geology*
- *Earth and Planetary Science Letters*
- *Geobiology*
- *Geochimica et Cosmochimica Acta*
- *Geology*
- *Nature*
- *Nature Geoscience*
- *Precambrian Research*
- *Science Advances*

## UNIVERSITY SERVICE

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- Organizer, Joint Geo-Astro Exoplanet Journal Club, 2019—
- Search Committee, T.C. Chamberlin Postdoctoral Fellowship, 2018, 2019

## OUTREACH

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- 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**

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- 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** (Feature), 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