

# Stanford

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## Erik Sperling

Assistant Professor of Geological Sciences and, by courtesy, of Biology and Center Fellow, by courtesy, at the Woods Institute for the Environment

### Bio

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#### ACADEMIC APPOINTMENTS

- Assistant Professor, Geological Sciences
- Center Fellow (By courtesy), Stanford Woods Institute for the Environment
- Assistant Professor (By courtesy), Biology
- Member, Bio-X

#### HONORS AND AWARDS

- Explorer, National Geographic (2017)
- Ocean Sciences Fellowship, Alfred P. Sloan Foundation (2017)
- Pre-tenure award, GSA Geobiology and Geomicrobiology Division (2016)
- NAI Postdoctoral Fellowship, NASA Astrobiology Institute (2012-2014)
- Geobiology Fellowship, Agouron Institute (2010-2012)

#### BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Editorial Board, *Palaios* (2017 - present)
- Editorial Advisory Board, *Geobiology* (2016 - present)

#### LINKS

- Lab website: <https://historical-geobiology.stanford.edu/>

### Research & Scholarship

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#### CURRENT RESEARCH AND SCHOLARLY INTERESTS

The research interests in the Sperling Lab are Earth history and the evolution of life, and the interactions between the biosphere and the geosphere. As such this research can generally be considered paleontology, insofar as paleontology encompasses all aspects of the history of life.

Consequently, we define our research agenda by the questions we are interested in, rather than the tools used. This research incorporates multiple lines of evidence, and multiple tools, to investigate questions in the history of life. These lines of evidence include fossil data, molecular phylogenetics, sedimentary geochemistry, and developmental and ecological data from modern organisms. Ultimately, the goal is to link environmental change with organismal and ecological response through the lens of physiology.

Our field research takes place all over the world--current areas include:

-NW Canada (Yukon and Northwest Territories): Research has been conducted on the early Neoproterozoic Fifteenmile Group, Cryogenian and Ediacaran Windermere Supergroup, and on the Ordovician-Devonian Road River Group in the southern Richardson Mountains

-Southern Canadian Cordillera: Work here has focused on the early Cambrian Mural Formation and its soft-bodied fauna.

-England and Wales: Cambrian-Silurian successions in the Welsh Basin

-Namibia: Ediacaran Nama Group

-Upwelling zones: We study the oxygen minimum zone offshore California as an analogue for ancient low-oxygen oceans.

## Teaching

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### COURSES

#### 2021-22

- Departmental Seminar in Geological Sciences: GEOLSCI 290 (Aut)
- Evolution of the Laurentian Margin: GEOLSCI 293D (Aut)
- Introduction to Geology: EARTHSYS 11, GEOLSCI 1 (Spr)
- Sedimentary Geochemistry and Analysis: GEOLSCI 135, GEOLSCI 235 (Win)

#### 2020-21

- Departmental Seminar in Geological Sciences: GEOLSCI 290 (Spr)
- Introduction to Geology: EARTHSYS 11, GEOLSCI 1 (Spr)

#### 2019-20

- Introduction to Geology: EARTHSYS 11, GEOLSCI 1 (Spr)
- Topics in Organismal Paleobiology: GEOLSCI 206 (Win)

#### 2018-19

- Departmental Seminar in Geological Sciences: GEOLSCI 290 (Aut, Win, Spr)
- Fundamentals of Geobiology: ESS 205, GEOLSCI 205 (Aut)
- Geology of Oman Field Trip: GEOLSCI 293A (Aut)
- Introduction to Geology: GEOLSCI 1 (Spr)

### STANFORD ADVISEES

#### Doctoral Dissertation Reader (AC)

Pulkit Singh

#### Postdoctoral Faculty Sponsor

Murray Duncan

#### Doctoral Dissertation Advisor (AC)

Samantha Ritzer, Richard Stockey

#### Doctoral Dissertation Co-Advisor (AC)

Cecilia Endriga

#### Doctoral (Program)

Emily Ellefson, Andres Marquez, Lucy Webb

## Publications

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### PUBLICATIONS

- **Eukaryogenesis and oxygen in Earth history.** *Nature ecology & evolution*  
Mills, D. B., Boyle, R. A., Daines, S. J., Sperling, E. A., Pisani, D., Donoghue, P. C., Lenton, T. M.  
2022
- **A prolonged, two-step oxygenation of Earth's early atmosphere: Support from confidence intervals** *GEOLOGY*  
Hodgskiss, M. W., Sperling, E. A.  
2022; 50 (2): 158-162
- **Marine sponges in the once and future ocean.** *Global change biology*  
Mills, D. B., Sperling, E. A.  
1800
- **Decreasing Phanerozoic extinction intensity as a consequence of Earth surface oxygenation and metazoan ecophysiology** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
Stockey, R. G., Pohl, A., Ridgwell, A., Finnegan, S., Sperling, E. A.  
2021; 118 (41)
- **Decreasing Phanerozoic extinction intensity as a consequence of Earth surface oxygenation and metazoan ecophysiology.** *Proceedings of the National Academy of Sciences of the United States of America*  
Stockey, R. G., Pohl, A., Ridgwell, A., Finnegan, S., Sperling, E. A.  
2021; 118 (41)
- **The Sedimentary Geochemistry and Paleoenvironments Project.** *Geobiology*  
Farrell, U. C., Samawi, R., Anjanappa, S., Klykov, R., Adeboye, O. O., Agic, H., Ahm, A. C., Boag, T. H., Bowyer, F., Brocks, J. J., Brunoir, T. N., Canfield, D. E., Chen, et al  
2021
- **A long-term record of early to mid-Paleozoic marine redox change.** *Science advances*  
Sperling, E. A., Melchin, M. J., Fraser, T., Stockey, R. G., Farrell, U. C., Bhajan, L., Brunoir, T. N., Cole, D. B., Gill, B. C., Lenz, A., Loydell, D. K., Malinowski, J., Miller, et al  
2021; 7 (28)
- **Isotopic analyses of Ordovician-Silurian siliceous skeletons indicate silica-depleted Paleozoic oceans.** *Geobiology*  
Trower, E. J., Strauss, J. V., Sperling, E. A., Fischer, W. W.  
2021
- **Variable redox conditions as an evolutionary driver? A multi-basin comparison of redox in the middle and later Cambrian oceans (Drumian-Paibian)** *PALAEOGEOGRAPHY PALAEOCLIMATOLOGY PALAEOECOLOGY*  
LeRoy, M. A., Gill, B. C., Sperling, E. A., McKenzie, N., Park, T. S.  
2021; 566
- **Thallium isotope ratios in shales from South China and northwestern Canada suggest widespread O-2 accumulation in marine bottom waters was an uncommon occurrence during the Ediacaran Period** *CHEMICAL GEOLOGY*  
Ostrander, C. M., Owens, J. D., Nielsen, S. G., Lyons, T. W., Shu, Y., Chen, X., Sperling, E. A., Jiang, G., Johnston, D. T., Sahoo, S. K., Anbar, A. D.  
2020; 557
- **Redox and paleoenvironmental conditions of the Devonian-Carboniferous Sappington Formation, southwestern Montana, and comparison to the Bakken Formation, Williston Basin** *PALAEOGEOGRAPHY PALAEOCLIMATOLOGY PALAEOECOLOGY*  
Browne, T. N., Hofmann, M. H., Malkowski, M. A., Wei, J., Sperling, E. A.  
2020; 560
- **The Road River Group of northern Yukon, Canada: early Paleozoic deep-water sedimentation within the Great American Carbonate Bank** *CANADIAN JOURNAL OF EARTH SCIENCES*  
Strauss, J., Fraser, T., Melchin, M. J., Allen, T. J., Malinowski, J., Feng, X., Taylor, J. F., Day, J., Gill, B. C., Sperling, E. A.  
2020; 57 (10): 1193–1219

- **Mesoproterozoic paleo-redox changes during 1500-1400 Ma in the Yanshan Basin, North China** *PRECAMBRIAN RESEARCH*  
Chen, X., Li, M., Sperling, E. A., Zhang, T., Zong, K., Liu, Y., Shen, Y.  
2020; 347
- **Extending the record of the Lomagundi-Jatuli carbon isotope excursion in the Labrador Trough, Canada** *CANADIAN JOURNAL OF EARTH SCIENCES*  
Hodgskiss, M. W., Lamothe, K. G., Halverson, G. P., Sperling, E. A.  
2020; 57 (9): 1089–1102
- **A high-TOC shale in a low productivity world: The late Mesoproterozoic Arctic Bay Formation, Nunavut** *EARTH AND PLANETARY SCIENCE LETTERS*  
Hodgskiss, M. W., Sansjofre, P., Kunzmann, M., Sperling, E. A., Cole, D. B., Crockford, P. W., Gibson, T. M., Halverson, G. R.  
2020; 544
- **Uranium Isotope Fractionation in Non-sulfidic Anoxic Settings and the Global Uranium Isotope Mass Balance** *GLOBAL BIOGEOCHEMICAL CYCLES*  
Cole, D. B., Planavsky, N. J., Longley, M., Boening, P., Wilkes, D., Wang, X., Swanner, E. D., Wittkop, C., Loydell, D. K., Busigny, V., Knudsen, A. C., Sperling, E. A.  
2020; 34 (8)
- **Calibrating the coevolution of Ediacaran life and environment.** *Proceedings of the National Academy of Sciences of the United States of America*  
Rooney, A. D., Cantine, M. D., Bergmann, K. D., Gomez-Perez, I., Al Baloushi, B., Boag, T. H., Busch, J. F., Sperling, E. A., Strauss, J. V.  
2020
- **SMALL SHELLY FOSSILS AND CARBON ISOTOPES FROM THE EARLY CAMBRIAN (STAGES 3-4) MURAL FORMATION OF WESTERN LAURENTIA** *PAPERS IN PALAEOLOGY*  
Skovsted, C. B., Balthasar, U., Vinther, J., Sperling, E. A.  
2020
- **Ediacaran reorganization of the marine phosphorus cycle.** *Proceedings of the National Academy of Sciences of the United States of America*  
Laakso, T. A., Sperling, E. A., Johnston, D. T., Knoll, A. H.  
2020
- **Persistent global marine euxinia in the early Silurian.** *Nature communications*  
Stockey, R. G., Cole, D. B., Planavsky, N. J., Loydell, D. K., Fryda, J., Sperling, E. A.  
2020; 11 (1): 1804
- **On the co-evolution of surface oxygen levels and animals.** *Geobiology*  
Cole, D. B., Mills, D. B., Erwin, D. H., Sperling, E. A., Porter, S. M., Reinhard, C. T., Planavsky, N. J.  
2020
- **Sources of C30 steroid biomarkers in Neoproterozoic-Cambrian rocks and oils.** *Nature ecology & evolution*  
Love, G. D., Zumberge, J. A., Cardenas, P., Sperling, E. A., Rohrsen, M., Grosjean, E., Grotzinger, J. P., Summons, R. E.  
2019
- **New insights on the Orosirian carbon cycle, early Cyanobacteria, and the assembly of Laurentia from the Paleoproterozoic Belcher Group** *EARTH AND PLANETARY SCIENCE LETTERS*  
Hodgskiss, M. W., Dagnaud, O. J., Frost, J. L., Halverson, G. P., Schmitz, M. D., Swanson-Hysell, N. L., Sperling, E. A.  
2019; 520: 141–52
- **Statistical inference and reproducibility in geobiology** *GEOBIOLOGY*  
Sperling, E. A., Tecklenburg, S., Duncan, L. E.  
2019; 17 (3): 261–71
- **Oxygen, temperature and the deep-marine stenothermal cradle of Ediacaran evolution.** *Proceedings. Biological sciences*  
Boag, T. H., Stockey, R. G., Elder, L. E., Hull, P. M., Sperling, E. A.  
2018; 285 (1893): 20181724
- **Oxygenated Mesoproterozoic lake revealed through magnetic mineralogy.** *Proceedings of the National Academy of Sciences of the United States of America*  
Slotznick, S. P., Swanson-Hysell, N. L., Sperling, E. A.  
2018
- **Oxygen, temperature and the deep-marine stenothermal cradle of Ediacaran evolution** *PROCEEDINGS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES*

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- Boag, T. H., Stockey, R. G., Elder, L. E., Hull, P. M., Sperling, E. A.  
2018; 285 (1893)
- **Demosponge steroid biomarker 26-methylstigmastane provides evidence for Neoproterozoic animals.** *Nature ecology & evolution*  
Zumberge, J. A., Love, G. D., Cardenas, P., Sperling, E. A., Gunasekera, S., Rohrsen, M., Grosjean, E., Grotzinger, J. P., Summons, R. E.  
2018; 2 (11): 1709–14
  - **Demosponge steroid biomarker 26-methylstigmastane provides evidence for Neoproterozoic animals** *NATURE ECOLOGY & EVOLUTION*  
Zumberge, J., Love, G. D., Cardenas, P., Sperling, E. A., Gunasekera, S., Rohrsen, M., Grosjean, E., Grotzinger, J. P., Summons, R. E.  
2018; 2 (11): 1709–14
  - **The Temporal and Environmental Context of Early Animal Evolution: Considering All the Ingredients of an "Explosion".** *Integrative and comparative biology*  
Sperling, E. A., Stockey, R. G.  
2018; 58 (4): 605–22
  - **On the edge of exceptional preservation: insights into the role of redox state in Burgess Shale-type taphonomic windows from the Mural Formation, Alberta, Canada.** *Emerging topics in life sciences*  
Sperling, E. A., Balthasar, U., Skovsted, C. B.  
2018; 2 (2): 311-323
  - **Temperature-dependent hypoxia explains biogeography and severity of end-Permian marine mass extinction.** *Science (New York, N.Y.)*  
Penn, J. L., Deutsch, C., Payne, J. L., Sperling, E. A.  
2018; 362 (6419)
  - **Oxygen, facies, and secular controls on the appearance of Cryogenian and Ediacaran body and trace fossils in the Mackenzie Mountains of northwestern Canada** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*  
Sperling, E. A., Carbone, C., Strauss, J. V., Johnston, D. T., Narbonne, G. M., Macdonald, F. A.  
2016; 128 (3-4): 558-575
  - **Biotic replacement and mass extinction of the Ediacara biota.** *Proceedings. Biological sciences / The Royal Society*  
Darroch, S. A., Sperling, E. A., Boag, T. H., Racicot, R. A., Mason, S. J., Morgan, A. S., Tweedt, S., Myrow, P., Johnston, D. T., Erwin, D. H., Laflamme, M.  
2015; 282 (1814)
  - **Statistical analysis of iron geochemical data suggests limited late Proterozoic oxygenation** *NATURE*  
Sperling, E. A., Wolock, C. J., Morgan, A. S., Gill, B. C., Kunzmann, M., Halverson, G. P., Macdonald, F. A., Knoll, A. H., Johnston, D. T.  
2015; 523 (7561): 451-454
  - **The Ecological Physiology of Earth's Second Oxygen Revolution** *ANNUAL REVIEW OF ECOLOGY, EVOLUTION, AND SYSTEMATICS, VOL 46*  
Sperling, E. A., Knoll, A. H., Girguis, P. R.  
2015; 46: 215-235