Stanford

Erik Sperling

Associate Professor of Earth and Planetary Sciences, Senior Fellow at the Woods Institute for the Environment and Associate Professor, by courtesy, of Oceans

Earth & Planetary Sciences

Bio

ACADEMIC APPOINTMENTS

- Associate Professor, Earth & Planetary Sciences
- Senior Fellow, Stanford Woods Institute for the Environment
- Associate Professor (By courtesy), Oceans
- 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

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

COURSES

2025-26

- Departmental Seminar in Earth & Planetary Sciences: EPS 290 (Aut)
- Introduction to Geology: EARTHSYS 11, EPS 1 (Spr)
- Mining and the Green Transition: EARTHSYS 171, EARTHSYS 271, ENERGY 161, ENERGY 261, EPS 171, EPS 271 (Aut)

2024-25

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

2023-24

- Departmental Seminar in Earth & Planetary Sciences: EPS 290 (Aut)
- Fundamentals of Geobiology: EARTHSYS 205A, EPS 205, ESS 205 (Aut)
- Mining and the Green Economy: EPS 10SC (Sum)

2022-23

- Breathless in the Oceans: GEOLSCI 330 (Aut, Win)
- Geology of Oman Field Trip: GEOLSCI 293A (Aut)
- Introduction to Geology: EARTHSYS 11, GEOLSCI 1 (Spr)
- Mining and the Green Economy: GEOLSCI 10SC (Sum)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Timmy Lui, Sofia Mantilla Salas

Doctoral Dissertation Advisor (AC)

Lucy Webb

Master's Program Advisor

Hunter Olson

Doctoral (Program)

Kemi Ashing-Giwa, Emily Ellefson, Lucy Webb

Publications

PUBLICATIONS

- **Differentiating persistent and intermittent euxinia from the molecular derivatives of green sulfur bacteria carotenoids** *GEOCHIMICA ET COSMOCHIMICA ACTA*
  French, K. L., Hackley, P. C., Sperling, E. A.
  2026; 415: 130-145

- **Investigating the response of Glycymeris septentrionalis (Bivalvia) and Terebratalia transversa (Brachiopoda) to euxinia: Implications for mass extinctions** *GEOLOGY*
  Ashing-Giwa, K., Payne, J. L., Sperling, E. A.
  2026; 54 (2): 138-142

- **Thallium isotopic evidence for the Tonian rise and Cryogenian fall of Neoproterozoic oxygen levels** *GEOLOGY*
  Webb, L. C., Macdonald, F. A., Halverson, G. P., Ostrander, C. M., Nielsen, S. G., Sperling, E. A.
  2026

- **Trace elements and iron speciation analysis of Paleoproterozoic phyllite from the Gandarela Syncline: Implications for salinity and redox conditions in the Quadrila<acute accent>tero Ferrifero, Brazil** *CHEMICAL GEOLOGY*
  de Paula, J., Wei, W., Caxito, F. A., Snihur, K. N., Lazowski, C. N., Konhauser, K. O., Sperling, E. A., Alessi, D. S.
  2025; 690

- **Dynamic deep marine oxygenation during the Early and Middle Paleozoic.** *Science advances*
  Ostrander, C. M., Clemente, J. N., Stockey, R. G., Strauss, J. V., Fraser, T., Nielsen, S. G., Sperling, E. A.
  2025; 11 (36): eadw5878

- **Thallium Isotopes Suggest the Global Deep Ocean Did Not Approach Modern Oxygenation During Cambrian Age 3 Metazoan Radiation.** *Geobiology*
  Clemente, J. N., Fan, H., Ostrander, C. M., Zhang, H., Wen, H., Sperling, E. A., Nielsen, S. G.
  2025; 23 (4): e70028

- **Deep-Time Marine Sedimentary Element Database** *EARTH SYSTEM SCIENCE DATA*
  Lai, J., Song, H., Chu, D., Dal Corso, J., Sperling, E. A., Wu, Y., Liu, X., Wei, L., Li, M., Song, H., Du, Y., Jia, E., Feng, et al
  2025; 17 (4): 1613-1626

- **Prediction of organic geochemical parameters from inorganic geochemical data in the Cretaceous-Danian Moreno Formation, San Joaquin Basin, California** *CHEMICAL GEOLOGY*
  Olson, H. C., Scheirer, A., Ritzer, S. R., Sperling, E. A.
  2025; 674

- **The relationship between total organic carbon and bottom water redox state in North American black shales** *PALAEOGEOGRAPHY PALAEOCLIMATOLOGY PALAEOECOLOGY*
  Ritzer, S. R., Schoepfer, S., Bussian, B., Farrell, U. C., Fraser, T., Henderson, C. M., Kang, J., Mwinde, C. N., Patch, A., Sperling, E. A.
  2024; 649

- **Temperature-dependent hypoxia tolerance of purple sea urchin Strongylocentrotus purpuratus across biogeography and ontogeny** *MARINE ECOLOGY PROGRESS SERIES*
  Duncan, M. I., Micheli, F., Marquez, J., Lowe, C. J., Hamilton, S. L., Sperling, E. A.
  2024; 739: 129-146

- **Sustained increases in atmospheric oxygen and marine productivity in the Neoproterozoic and Palaeozoic eras** *NATURE GEOSCIENCE*
  Stockey, R. G., Cole, D. B., Farrell, U. C., Agic, H., Boag, T. H., Brocks, J. J., Canfield, D. E., Cheng, M., Crockford, P. W., Cui, H., Dahl, T. W., Del Mouro, L., Dewing, et al
  2024

- **A shift in redox conditions near the Ediacaran/Cambrian transition and its possible influence on early animal evolution, Corumb4Group, Brazil** *GEOSCIENCE FRONTIERS*
  Caxito, F. A., Sperling, E., Fazio, G., Adorno, R., Denezine, M., Do Carmo, D., Giorgioni, M., Uhlein, G. J., Sial, A. N.
  2024; 15 (4)

- **Lithium isotopic constraints on the evolution of continental clay mineral factory and marine oxygenation in the earliest Paleozoic Era.** *Science advances*
  Wei, G. Y., Zhao, M., Sperling, E. A., Gaines, R. R., Kalderon-Asael, B., Shen, J., Li, C., Zhang, F., Li, G., Zhou, C., Cai, C., Chen, D., Xiao, et al
  2024; 10 (13): eadk2152
- **Deep-water first occurrences of Ediacara biota prior to the Shuram carbon isotope excursion in the Wernecke Mountains, Yukon, Canada.** *Geobiology*
  Boag, T. H., Busch, J. F., Gooley, J. T., Strauss, J. V., Sperling, E. A.
  2024; 22 (3): e12597
- **Constraining the oxygen requirements for modern microbial eukaryote diversity.** *Proceedings of the National Academy of Sciences of the United States of America*
  Mills, D. B., Simister, R. L., Sehein, T. R., Hallam, S. J., Sperling, E. A., Crowe, S. A.
  2024; 121 (2): e2303754120
- **Thermal optima in the hypoxia tolerance of marine ectotherms: Physiological causes and biogeographic consequences.** *PLoS biology*
  Endress, M. A., Penn, J. L., Boag, T. H., Burford, B. P., Sperling, E. A., Deutsch, C. A.
  2024; 22 (1): e3002443
- **Oxygen availability and body mass modulate ectotherm responses to ocean warming.** *Nature communications*
  Duncan, M. I., Micheli, F., Boag, T. H., Marquez, J. A., Deres, H., Deutsch, C. A., Sperling, E. A.
  2023; 14 (1): 3811
- **Species of Dickinsonia Sprigg from the Ediacaran of South Australia** *PALAEONTOLOGY*
  Evans, S. D., Hunt, G., Gehling, J. G., Sperling, E. A., Droser, M. L.
  2023; 66 (1)
- **Integrated Litho-, Chemo- and Sequence Stratigraphy of the Ediacaran Gametrail Formation Across a Shelf-Slope Transect in the Wernecke Mountains, Yukon, Canada** *AMERICAN JOURNAL OF SCIENCE*
  Busch, J. F., Boag, T. H., Sperling, E. A., Rooney, A. D., Feng, X., Moynihan, D. P., Strauss, J. V.
  2023; 323
- **Breathless through Time: Oxygen and Animals across Earth's History** *BIOLOGICAL BULLETIN*
  Sperling, E. A., Boag, T. H., Duncan, M. I., Endriga, C. R., Marquez, J., Mills, D. B., Monarrez, P. M., Sclafani, J. A., Stockey, R. G., Payne, J. L.
  2022
- **Integrative Approaches to Understanding Organismal Responses to Aquatic Deoxygenation** *BIOLOGICAL BULLETIN*
  Woods, H., Moran, A. L., Atkinson, D., Audzijonyte, A., Berenbrink, M., Borges, F. O., Burnett, K. G., Burnett, L. E., Coates, C. J., Collin, R., Costa-Paiva, E. M., Duncan, M. I., Ern, et al
  2022: 85-103
- **Mesoproterozoic surface oxygenation accompanied major sedimentary manganese deposition at 1.4 and 1.1 Ga.** *Geobiology*
  Spinks, S. C., Sperling, E. A., Thorne, R. L., LaFountain, F., White, A. J., Armstrong, J., Woltering, M., Tyler, I. M.
  2022
- **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. S. 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. S. 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. S. 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 PALAEONTOLOGY*
  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., Rohrssen, 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. S. W., Dagnaud, O. M. 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*
  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., Rohrssen, 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., Rohrssen, 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
- **A Permian-Triassic boundary section at Quinn River Crossing, northwestern Nevada, and implications for the cause of the Early Triassic chert gap on the western Pangean margin** *GEOLOGICAL SOCIETY OF AMERICA BULLETIN*
  Sperling, E. A., Ingle, J. C.
  2006; 118 (5-6): 733-746