

Daniel E. Sandborn, Ph.D.

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EDUCATION

University of Minnesota

Ph.D. Limnology and Oceanography

2024

Advisor: Prof. Elizabeth C. Minor

Inorganic carbon cycling in Lake Superior and responses to anthropogenic carbon dioxide

California Polytechnic State University San Luis Obispo

B.S. Chemistry *summa cum laude* with Honors

2020

RESEARCH

University of Washington — School of Oceanography

Postdoctoral Fellowship

Seattle, WA

January 2025 - Present

- Led development of transient tracer-based models of ocean ventilation and carbon accumulation in collaboration with the PMEL Marine Biogeochemistry group.
- Performed shipboard transient tracer measurements of seawater and maintained associated gas chromatographic equipment with the Warner lab.

University of Minnesota — Large Lakes Observatory

Ph.D. Dissertation Research with Prof. E. Minor

Duluth, MN

August 2020 - November 2024

- Designed, built, and tested novel open-source alkalinity measurement instrumentation.
- Created statistical models of anthropogenic carbon accumulation, acidification, and CaCO_3 saturation state in the Laurentian Great Lakes.

California Polytechnic State University

Research Assistant to Prof. E. Bockmon

San Luis Obispo, CA

January 2018 - June 2020

- Assisted with the establishment of a seawater carbonate chemistry time series on the California Central Coast.

Pacific Northwest National Laboratory

Undergraduate Laboratory Internship with Dr. A. Sengupta

Richland, WA

June 2019 - September 2019

- Developed methods for respiration rate analysis of soil and sediment samples and assisted with field study of salinity encroachment upon terrestrial ecosystems.

FIELD EXPERIENCE

Scientific Cruises

- Scientist, SeaGrant sampling campaign, *RV Blue Heron*, May 14-16 2024
- CTD Watchstander, GO-SHIP A13.5, *RV Marcus G. Langseth*, February 2-March 24 2024
- Scientist, GLOS Mooring Deployment, *RV Blue Heron*, June 7-9 2022
- Lead scientist, sampling for CIGLR fellowship, *RV Kingfisher*, June 1 & August 11 2022
- Scientist, SeaGrant sampling campaign, *RV Blue Heron*, August 3-4 2022

Field Research

- EXCHANGE soil and water sampling campaign, Summer 2022
- WHONDRS soil and water sampling campaign, July 2019

PUBLICATIONS

Refereed Publications

1. **Sandborn, D. E.**, Austin, J. A.; Lafrancois, B. M. Developing a particle tracking model in Lake Superior. NPS Reports. *Accepted*.
2. **Sandborn, D. E.**, Minor, E. C., Austin, J. A. (2025). A neural network-based estimate of the seasonal to inter-annual variability of the Lake Superior carbon cycle. *Journal of Geophysical Research: Biogeosciences*. doi: 10.1029/2024JG008610
3. Carter, B. R., Schwinger, J., Sonnerup, R., Fassbender, A. J., Sharp, J. D., Dias, L. M., **Sandborn, D.E.** (2025). Tracer-based Rapid Anthropogenic Carbon Estimation (TRACEv1), *Earth Syst. Sci. Data*. doi:10.5194/essd-2024-560
4. Christensen, V. G., Katona, L. R., Trompeter, H. E., Maki, R. P., Smith, J. C., & **Sandborn, D. E.** (2025). Water quality-based risk assessment for zebra mussel establishment: a case study of single- and multiple-factor methods in northern temperate lakes. *Lake and Reservoir Management*, 1–19. doi:10.1080/10402381.2025.2488829
5. **Sandborn, D. E.** & Minor, E. C. (2024). Underway $p\text{CO}_2$ surveys unravel CO_2 invasion of Lake Superior from seasonal variability. *Journal of Geophysical Research: Biogeosciences*, 129, e2023JG007877. doi: 10.1029/2023JG007877
6. Regier, P. et al. (2023) Coastal inundation regime moderates the short-term effects of sediment and soil additions on seawater oxygen and greenhouse gas dynamics: a microcosm experiment. *Frontiers in Mar. Sci.* doi: 10.3389/fmars.2023.1308590
7. Pennington, Stephanie C., et al. EXCHANGE Campaign 1: A Community-Driven Baseline Characterization of Soils, Sediments, and Water Across Coastal Gradients. OSTI, Feb. 2023. doi: 10.15485/1960313
8. **Sandborn, D. E.**, Minor, E. C., Hill, C. (2023). Total alkalinity measurement using an open-source platform. *Limnol. Oceanogr. Methods*, 21: 334-344. doi: 10.1002/lom3.10549

Submitted and in review

1. **Sandborn, D. E.**, Carter, B. R., Warner, M. J. Dias, L. “TRACE-Python: Tracer-based Rapid Anthropogenic Carbon Estimation Implemented in Python (version 1.0)”. *Submitted*.

Software and Data

1. **Sandborn, D. E.**, Barrett, R., & Carter, B. R. (2025). d-sandborn/TRACE: Tracer-based Rapid Anthropogenic Carbon Estimation (TRACE) (v1.0.0). Zenodo. doi: 10.5281/zenodo.17822675
2. **Sandborn, D. E.**, Carter, B. R., Warner, M. J., Erickson, Z., & Dias, L. (2025). Global ocean anthropogenic carbon concentrations from preindustrial to 2500 c.e. estimated using TRACE-Python [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.17246805>
3. Carter, B. R., Schwinger, J., Sonnerup, R., Fassbender, A. J., Sharp, J. D., Dias, L. M., **Sandborn, D.E.** (2025). TRACEv1. doi: 10.5281/zenodo.15692787
4. **Sandborn, D. E.**, Minor, E. C., Austin, J. A. (2025). Lake Superior inorganic carbon cycling reconstruction 2019-2023. Data Repository for the University of Minnesota. doi: 10.13020/5qx4-zx91
5. **Sandborn, D. E.** & Carter, B. (2025). Tracer-based Rapid Anthropogenic Carbon Estimation (TRACEv0.1.0-Python) (v0.1.0-beta). Zenodo. doi:10.5281/zenodo.15597123
6. Humphreys, M. P., Schiller, A. J., **Sandborn, D. E.**, Gregor, L., Pierrot, D., van Heuven, S. M. A. C., Lewis, E. R., and Wallace, D. W. R. (2022). PyCO2SYS: marine carbonate system calculations in Python. Zenodo. doi:10.5281/zenodo.3744275
7. **Sandborn, D.E.** RPi-Alkalinity: Publication Release. Zenodo. doi:10.5281/zenodo.7864447

PRESENTATIONS

Invited Presentations

1. **Sandborn, D.E.**, Warner, M., Carter, B. Erickson, Z. “Observing Shifting Transient Gas Disequilibria in the Surface Ocean”. GO-SHIP webinar. October 2025.
2. **Sandborn, D. E.**; Minor, E.C.; Austin, J. “Drivers of Dreissenid Habitat: Moving Beyond Calcium and Temperature”. Invasive Mussel Collaborative meeting. December 2024.
3. **Sandborn, D. E.** & Minor, E.C. “The Breath of Lake Superior and Observation of “The Other CO₂ Problem”. Twin Ports Freshwater Folk meeting. December 2024.
4. Minor, E.C.; **Sandborn, D. E.**; Brinkley, G. 2022. “Are increasing atmospheric CO₂ concentrations causing lake acidification in Lake Superior?”. MN AWWA Annual Conference. September 2022. Duluth, MN. [*Minor, invited oral presentation*]

Abstracts

1. Carter, B., Xinyu L., **Sandborn, D.E.**, Warner, M., Feely, R., GO-SHIP Team. “Observation-based Estimates of Ocean Carbon Accumulation Variability”. Ocean Sciences Meeting 2026. Glasgow, Scotland.
2. **Sandborn, D.E.**, Warner, M., Carter, B. Erickson, Z. “Observing Shifting Transient Gas Disequilibria in the Surface Ocean”. Meeting of the American Geophysical Union, 2025. New Orleans, LA.
3. Minor, E.C. & **Sandborn, D.E.** “A preliminary view of the carbon cycle in the five largest freshwater lakes” Meeting of the American Geophysical Union, 2024. Washington, D.C.
4. **Sandborn, D.E.**; Austin, J. “Patterns of Lake Superior AIS dispersal illustrated by particle tracking.”. Meeting of the Association for the Sciences of Limnology and Oceanography. June 2024. Madison, WI.
5. **Sandborn, D.E.**; Austin, J. “Patterns of Lake Superior AIS dispersal illustrated by particle tracking.”. Meeting of the International Association for Great Lakes Research. May 2024. Windsor, ON.
6. Kittaka, P. K.; **Sandborn, D.E.**; Minor, E.C. “Diel, Seasonal and Storm-related Changes in Carbonate System Variables in Lake Superior Tributaries”. Meeting of the American Geophysical Union. December 2022. Chicago, IL.

Presentations

1. **Sandborn, D.E.**; Minor, E.C. “The Other CO₂ Problem in the Saltless Seas: High-Resolution Observations in Lake Superior”. June 2023. Poster presentation. Ocean Carbon Biogeochemistry Summer Workshop. Woods Hole, MA, USA.
2. **Sandborn, D.E.**; Minor, E.C.; Errera, R.M. “CaCO₃ Saturation State: The Case for a Comprehensive Dreissenid Chemical Predictor”. October 2022. Poster presentation. Cooperative Institute for Great Lakes Research All Partners Meeting. *Virtual*.
3. **Sandborn, D.E.**; Minor, E.C. “CO₂ Acidification in Lake Superior: Developing a Chemical Forecast”. May 2022. Poster presentation. Joint Aquatic Sciences Meeting, Grand Rapids, MI, USA.
4. **Sandborn, D.E.**; Minor, E.C. “Quantifying Spatiotemporal Heterogeneity in Inorganic Carbon Chemistry of Lakes Superior and Michigan”. June 2021. Oral presentation. Association for the Sciences of Limnology and Oceanography Meeting. *Virtual*.
5. **Sandborn, D.E.**; Sengupta, A. “Developing methods for sediment carbon flux measurement via incubation”. August 2019. Poster presentation. Pacific Northwest National Laboratories Undergraduate Symposium. Richland, WA, USA.
6. Bockmon, E.; **Sandborn, D.E.**; Schmidt, G.; Norgaard, A. “Improving instrumentation for characterizing the carbon dioxide system in seawater”. August 2018. Poster presentation. Cal Poly Frost Symposium. San Luis Obispo, CA, USA.
7. Bockmon, E.; **Sandborn, D.E.**; Schmidt, G.; Norgaard, A. “Seawater carbonate chemistry at the Cal Poly Pier, Avila Beach”. August 2018. Poster presentation, Cal Poly Frost Symposium. San Luis Obispo, CA, USA.

8. **Sandborn, D.E.**; Lehr, C.R.; "Solubility behavior of Cyanuric Acid". May 2018. Southern California Undergraduate Research Conference. Pomona, CA, USA.

TEACHING

University of Minnesota Duluth

Duluth, MN

Graduate Teaching Assistant

August 2020 - December 2023

- CHEM 2212: Environmental Chemistry — 3 semesters

Redeveloped laboratory experiment manual to promote student engagement and application of environmental chemistry concepts to real-world contexts. Designed and delivered lectures on analytical methods. Planned and led field science activities.

- CHEM 1153: General Chemistry I — 2 semesters

Led discussion groups with undergraduate students.

- CHEM 1154: General Chemistry I Laboratory — 3 semesters

Led laboratory activities with undergraduate students.

California Polytechnic State University

San Luis Obispo, CA

Undergraduate Learning Assistant

August 2019 - January 2020

- CHEM 124: General Chemistry I — 1 quarter

HONORS & AWARDS

Postdoctoral Tracer Fellowship

2025-2027

Global Ocean Ship-Based Hydrographic Investigations Program

Student Conference Award

2023

Northeastern Association of Marine and Great Lakes Laboratories

Graduate Research Fellowship

2022-2023

Cooperative Institute for Great Lakes Research

Outstanding Graduate Teaching Assistant Award

2022

Swenson College of Science and Engineering

Early Career Travel Award

2022

Association for the Sciences of Limnology and Oceanography

Learning Assistant of the Year

2020

Cal Poly Department of Chemistry and Biochemistry

COAST Undergraduate Research Award

2019

Central Coast Center for Marine Sciences

Award for Excellence in Analytical Chemistry

2018

Cal Poly Department of Chemistry and Biochemistry

PROFESSIONAL SERVICE AND AFFILIATIONS

Professional Affiliations

ACS 2016–, ASLO 2020–, IAGLR 2022–, AGU 2025–

Professional Service

Student Fees Coordinator, Large Lakes Observatory 2022-2024

Water Resources Students in Action Coordinator 2021-2022

Outreach

RV *Blue Heron* Science on Deck Volunteer 2023

LLO Open House Volunteer 2023

UMN Day of Data Presenter 2022

UMD Chemistry Mole Day Volunteer 2022

CCMS Pier Open House Volunteer 2019