

ANDREW R. BABBIN

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APPOINTMENTS

Massachusetts Institute of Technology, Cambridge, MA – Jan 2017 – present

Department of Earth, Atmospheric & Planetary Sciences (EAPS)

Cecil and Ida Green Career Development Chair (July 2021 – present)

Doherty Chair in Ocean Utilization (July 2018 – June 2020)

Associate Professor (Jul 2022 – present)

Assistant Professor (Jan 2017 – Jun 2022)

Massachusetts Institute of Technology, Cambridge, MA – Nov 2014 – Oct 2016

NSF Postdoctoral Research Fellow, Department of Civil and Environmental Engineering

EDUCATION

Columbia University, New York, NY – Bachelor of Science, *Summa Cum Laude*, 2008

Earth and Environmental Engineering with a minor in Applied Mathematics

- Concentration in Water Resources and Climate Risks

Princeton University, Princeton, NJ – Master of Arts, 2010; Doctor of Philosophy, 2014

Geosciences Department

- Concentrations in Chemical Oceanography and Environmental Microbiology
- Advisor: Bess B. Ward

HONORS & AWARDS

National Science Foundation CAREER Award 2022–2027

Simons Foundation Early Career Investigator in Marine Microbial Ecology and Evolution
2019–2023

MIT Cecil & Ida Green Career Development Assistant Professor 2021–present

Dr. Bruce Heflinger '69 Award 2017–present

MIT First Year Advising Rookie of the Year 2019

MIT Sea Grant Doherty Assistant Professor in Ocean Utilization 2018–2020

MIT Ally of Nature Award 2018

NSF Postdoctoral Fellowship in Biology, Intersections of Biology and Math 2014–2016

National Defense Science and Engineering Graduate Fellowship 2008–2011

PUBLICATIONS

(MIT °undergraduate; *graduate student; †postdoc or research scientist advised on project)

°Shen, R., †B. Borer, †D. Ciccarese, M.M. Salek, and **A.R. Babbin**. Physical structure and interstitial flows govern microbial life in microenvironments. Submitted. Available at *bioRxiv*: <https://doi.org/10.1101/2023.09.19.558408>

†Zhao, R., **A.R. Babbin**, J. Gong, J.F. Biddle, and S.L. Jørgensen. Novel microbes mediating a cryptic nitrogen cycle in anoxic marine sediments. In revision.

Xu, M., K.M. Cobb, A.H.V. Timmerman, H.R. Sayani, H. Levy, J.L. Conroy, M. Newman, **A.R. Babbin**, and C.A. Morris. $\delta^{18}\text{O}$ -sea surface salinity relationships across the 2015/16 ENSO extremes. Submitted.

†Ciccarese, D., O. Tantawi, *I.H. Zhang, D. Plata, and **A.R. Babbin**. Microscale dynamics promote segregated denitrification in diatom aggregates sinking slowly in bulk oxygenated seawater. *Communications Earth and Environment*, **4**: 275 (2023).

*Zhang, I.H., X. Sun, A. Jayakumar, S.G. Fortin, B.B. Ward, and **A.R. Babbin**. Genome-resolved metagenomics reveals abundant nitrate reducers and partitioning of nitrite usage within global oxygen deficient zones. *ISME Communications*, **3**: 76 (2023).

†Zhao, R., S. Le Moine Bauer, and **A.R. Babbin**. “*Candidatus* Subterraneanammoxibiaceae,” a new anammox bacterial family in globally distributed marine and terrestrial subsurfaces. *Applied and Environmental Microbiology*, **89**: e00800-23 (2023).

Abada, A., R. Beiralas, D. Narvaes, M. Sperfeld, Y. Duchin-Rapp, V. Lipsman, L. Yuda, B. Cohen, R. Carmieli, S. Ben-Dor, J. Rocha, *I.H. Zhang, **A.R. Babbin**, and †E. Segev. Aerobic bacteria produce nitric oxide through denitrification and trigger algal population collapse. *ISME Journal*, **17**: 1167-1183 (2023).

Tracey J.C., **A.R. Babbin**, E. Wallace, X. Sun, K.L. DuRussel, C. Frey, *D.E. Martocello, *T. Tamasi, S. Oleynik, and B.B. Ward. All about nitrite: exploring nitrite sources and sinks in the eastern tropical North Pacific oxygen minimum zone. *Biogeosciences*, **20**: 2499-2523 (2023).

†Zhao, R., **A.R. Babbin**, D. Roerdink, I.H. Thorseth, and S.L. Jørgensen. Nitrite accumulation and anammox bacterial niche partitioning in Arctic Mid-Ocean Ridge sediments. *ISME Communications*, **3**: 26 (2023).

†Borer, B., *I.H. Zhang, A. Baker, G.A. O’Toole, and **A.R. Babbin**. Porous marine snow differentially benefits chemotactic, motile, and non-motile bacteria. *PNAS Nexus*, **2**: pgac311 (2022).

*Cinay, T., *D. Dumit, R.J. Woosley, °E.L. Boles, °J.V. Kwiecinski, °S. Mullen, *T.J. Tamasi, *M.J. Wolf, C.L. Kelly, N.M. Travis, K.L. Casciotti, and **A.R. Babbin**. Coincident biogenic nitrite and

pH maxima arise in the upper anoxic layer in the Eastern Tropical North Pacific. *Global Biogeochemical Cycles*, **36**: e2022GB007470 (2022).

°Kwieceński, J.V. and **A.R. Babbin**. A high-resolution atlas of the eastern tropical Pacific oxygen deficient zones. *Global Biogeochemical Cycles*, **35**: e2021GB007001 (2021).

*Zhang, I.H., †S. Mullen, †D. Ciccarese, *D. Dumit, *D.E. Martocello, M. Toyofuku, N. Nomura, †S. Smriga, and **A.R. Babbin**. Ratio of organic carbon to fixed nitrogen regulates metabolic specialization and denitrification dynamics in *Pseudomonas aeruginosa*. *Frontiers in Microbiology*, **12**: 711073 (2021).

†Smriga, S., †D. Ciccarese, and **A.R. Babbin**. Denitrifying bacteria respond to and shape microscale gradients within particulate matrices. *Communications Biology*, **4**: 570 (2021).

*Wang, P., J. Scott, S. Solomon, J. Marshall, **A.R. Babbin**, M. Lickley, D.W.J. Thompson, T. DeVries, Q. Liang, and R.G. Prinn. On the effects of the ocean on atmospheric CFC-11 lifetimes and emissions. *Proceedings of the National Academy of Sciences*, **118** (2021).

Babbin, A.R., *T. Tamasi, *D. Dumit, L. Weber, M.V.I. Rodríguez, *S.L. Schwartz, M. Armenteros, S.D. Wankel, and A. Apprill. Discovery and quantification of anaerobic nitrogen metabolisms among oxygenated tropical Cuban stony corals. *ISME Journal*, **15**: 1222-1235 (2021).

Hardisty, D., T.J. Horner, N. Evans, R. Moriyasu, **A.R. Babbin**, S.D. Wankel, J.W. Moffett, and S.G. Nielsen. Limited in situ iodate reduction within the Eastern Tropical North Pacific oxygen deficient zone. *Earth and Planetary Science Letters*, **554**: 116676 (2021).

Babbin, A.R., °E.L. Boles, J. Mühle, R.F. Weiss. On the natural spatio-temporal heterogeneity of South Pacific nitrous oxide. *Nature Communications*, **11**: 3672 (2020).

[Selected as Editors' Highlight]

*Wolf, M.J., M. Goodell, E. Dong, °L.A. Dove, C. Zhang, L.J. Franco, C. Shen, °E.G. Rutkowski, °D.N. Narducci, °S. Mullen, **A.R. Babbin**, and D.J. Cziczo. A link between the ice nucleation activity of sea spray aerosol and the biogeochemistry of seawater. *Atmospheric Chemistry and Physics*, **20**: 15341-15356 (2020).

Babbin, A.R., C. Buchwald, F.M.M. Morel, S.D. Wankel, and B.B. Ward. Nitrite oxidation exceeds reduction and fixed nitrogen loss in anoxic Pacific waters. *Marine Chemistry*, **224**: 103814 (2020).

Evans, N., °E.L. Boles, °J.V. Kwieceński, °S. Mullen, *M.J. Wolf, R. Moriyasu, S. Nam, **A.R. Babbin**, and J.W. Moffett. The Role of Water Masses in Shaping the Distribution of Redox Active Compounds in the Eastern Tropical North Pacific Oxygen Deficient Zone and Influencing Low Oxygen Concentrations in the Eastern Pacific Ocean. *Limnology and Oceanography*, **65**: 1688-1705 (2020).

†Ranjan, S., Z.R. Todd, P.B. Rimmer, D.D. Sasselov, and **A.R. Babbin**. Nitrogen oxide concentrations in natural waters on early Earth. *Geochemistry, Geophysics, Geosystems*, **20**: 2021-2039 (2019).

Babbin, A.R., B.D. Peters, C.W. Mordy, B. Widner, K.L. Casciotti, and B.B. Ward. Multiple metabolisms support the anaerobic nitrite budget in the Eastern Tropical South Pacific. *Global Biogeochemical Cycles*, **31**: 258-71 (2017).

Peters, B.D, **A.R. Babbin**, B.B. Ward, K. Lettman, C.W. Mordy, O. Ulloa, and K.L. Casciotti. Vertical modeling of the nitrogen cycle in the eastern tropical south Pacific ODZ using high resolution concentration and isotope measurements. *Global Biogeochemical Cycles*, **30**: 1661-1681 (2016).

Babbin, A.R., A. Jayakumar, and B.B. Ward. Organic matter loading modifies the microbial community responsible for nitrogen loss in estuarine sediments. *Microbial Ecology*, **71**: 555 (2016).

Babbin, A.R., D. Bianchi, A. Jayakumar, and B.B. Ward. Rapid nitrous oxide cycling in the suboxic ocean. *Science*, **348**: 1127-1129 (2015).

Ji, Q., **A.R. Babbin**, A. Jayakumar, S. Oleynik, and B.B. Ward. Nitrous oxide production by nitrification and denitrification in the Eastern Tropical South Pacific oxygen minimum zone. *Geophysical Research Letters*, **42**: 10755-10764 (2015).

Ji, Q., **A.R. Babbin**, X. Peng, J.L. Bowen, and B.B. Ward. Nitrogen sources of nitrous oxide in salt marsh sediments. *Journal of Marine Research*, **73**: 71-92 (2015).

Babbin, A.R., R.G. Keil, A.H. Devol, and B.B. Ward. Organic matter stoichiometry, flux, and oxygen control nitrogen loss in the ocean. *Science*, **344**: 406-408 (2014).

Bianchi, D., **A.R. Babbin**, and E.D. Galbraith. Enhancement of anammox by the excretion of diel vertical migrators. *Proceedings of the National Academy of Sciences*, **111**: 15653-15658 (2014).

Bowen, J.L., **A.R. Babbin**, P.J. Kearns, and B.B. Ward. Connecting the dots: Linking nitrogen cycle gene expression to nitrogen fluxes in marine sediment mesocosms. *Frontiers in Microbiology*, **5**: 429 (2014).

Babbin, A.R. and B.B. Ward. Controls on nitrogen loss in Chesapeake Bay sediments. *Environmental Science & Technology*, **47**: 4189-4196 (2013).

[Selected as Editors' Choice, "Lost N Found" in *Science*, **340**: 408]

Newell, S.E., **A.R. Babbin**, A. Jayakumar, and B.B. Ward. Ammonia oxidation rates and nitrification in the Arabian Sea. *Global Biogeochemical Cycles*, **25** (2011).

INVITED SEMINARS AND WORKSHOPS

Rutgers University, Department of Marine & Coastal Sciences seminar 2023

Woods Hole Oceanographic Institution, Department of Biology seminar 2023

University of Southern California, Marine and Environ. Biology department seminar 2023

University of British Columbia, Department of Biology department seminar 2023

Miami University, Department of Microbiology department seminar 2023
Weizmann Institute of Science, New Horizons in Microbial Biogeochemistry workshop, 2023
Princeton University, Space the Final Frontier Microbiology workshop 2023
California Institute of Technology, Environmental Science and Engineering seminar 2023
UCLA, Biogeochemistry Meeting 2023
Simons Foundation, Early Career Investigators Meeting 2022
University of Hawai'i at Mānoa, Oceanography Department Series 2022
IOC UNESCO, Working Group Global Ocean Oxygen Network Webinar 2022
MIT, Earth, Atmospheric and Planetary Sciences Departmental Lecture 2021
UCLA, Atmospheric & Oceanic Sciences Seminar 2019
Gordon Research Conference in Chemical Oceanography 2019
Xiamen Symposium on Marine Environmental Sciences 2019
OCB Workshop on Oceanic Methane and Nitrous Oxide 2018
Symposium for the Joint Cuba/USA Study of the Gardens of the Queen, Havana, Cuba 2018
MIT, Program in Atmospheres, Oceans, and Climate Colloquium 2017
American Geophysical Union Fall Meeting 2016
Woods Hole Oceanographic Institution, Marine Chemistry and Geochemistry Seminar 2016
ETH Zürich, Biogeochemistry and Pollutant Dynamics Seminar 2015
MIT, Earth, Atmospheric and Planetary Sciences Sack Lunch Seminar 2015
Dissertations in Chemical Oceanography 2014
Stanford University, Earth Systems Special Seminar, 2014
Princeton University, Environmental Geology & Geochemistry Seminar 2013
Surface Ocean / Lower Atmosphere Study Summer School 2013
International Conference on Nitrification 2013

SELECTED CONFERENCE PROCEEDINGS (PRESENTER)

Gordon Research Conference in Marine Microbes 2022
Gordon Research Conference in Ocean Biogeochemistry 2022
Ocean Sciences Meeting 2020
Gordon Research Conference in Chemical Oceanography 2017
Aquatic Sciences Meeting 2017
Ocean Sciences Meeting 2016
Gordon Research Conference in Chemical Oceanography 2015
Aquatic Sciences Meeting 2015

MIT ADVISING

Graduate students

Timur Cinay (2021–present), MIT Atmospheres, Oceans, and Climate Ph.D. Program

Irene Zhang (2019–2023), MIT Microbiology Ph.D.

Now Postdoctoral Fellow, University of Southern California

Tyler Tamasi (2017–2019), MIT/WHOI Chemical Oceanography Joint M.S. 2019

Now Solutions Engineer, Carbon Lighthouse

Research scientists and technicians

Dr. Steven Smriga (2018–2020), now Senior Scientist and Biology Lead, PhAST Diagnostics

Susan Mullen (2018–2019), now Ph.D. student at UC Berkeley

Postdoctoral researchers

Dr. Benedict Borer (2020–present), Researcher in biophysics and microfluidics

Dr. Rui Zhao (2021–present), Researcher in geobiology and microbial ecology

Dr. Yuval Jacobi (2023–present), Researcher in marine microbiology

Dr. Nhan-An Tran (2023–present), Researcher in microbial interactions

Dr. Davide Ciccarese (2020–2022), now Senior Postdoc, University of Lausanne, Switz.

Dr. Elizabeth Troein (2019–2020), now Head of Science, Isometric

Dr. Einat Segev (2017), now Senior Research Scientist (faculty) at Weizmann Institute, Israel

Undergraduate students (° indicates ARB as primary direct supervisor)

Eric Bi (2022–present), Class of 2026; Chemistry

Katherine Kitzinger (2022–present), Class of 2024; Bioengineering

°**Laura Schmidt-Hong (2020–2023)**, Class of 2023; Bioengineering
now Ph.D. student at Harvard University

°**Lin Hou (2020–2022)**, Class of 2022; Earth, Atmospheric & Planetary Sciences / Biology
now Ph.D. student at Scripps Institution of Oceanography / Univ. California, San Diego

Rachel Shen (2020–2022), Class of 2022; Biology
now Scientist at Mozza Foods

Joseph Nocua (2022), Cornell University Class of 2024 (Microbiology), McNair Scholar

°**Jarek Kwiecinski (2017–2021)**, Class of 2021; Civil & Environmental Engineering
now Ph.D. student at Caltech

°**Luke Anderson (2021)**, Class of 2024; Chemistry / Biology

°**Timothy Kostolansky (2020)**, Class of 2023; Physics
now Ph.D. student at MIT

°**Jose Gomez (2020)**, Class of 2023; Chemical Engineering
now Associate Consultant, Chartwell Consulting

°**Alex Miller (2020–2021)**, Class of 2021; Physics
now Ph.D. student at MIT

°**Elisabeth Boles (2017–2018)**, Class of 2018; Earth, Atmospheric & Planetary Sciences
now Ph.D. student at Stanford University

Janice Shiu (2017), Class of 2020; Earth, Atmospheric & Planetary Sciences
now Senior Analyst at Compass Lexecon

MIT TEACHING

- 12.373/777** | Field Oceanography (Spring 2018, 2020, 2024)
12.742 | Marine Chemistry (Fall 2020, 2021, 2022, 2023)
12.S492 | Field Methods in Geobiology (Spring/Summer 2023)
20.054 | NEET Living Machines Research Immersion (faculty mentor; Spring 2023)
12.S597 | Great Papers in EAPS (Fall 2018, 2019)
12.S992 | Nitrogen in the Marine Environment (Spring 2019)
12.007 | Geobiology: History of Life on Earth (Spring 2019, guest; Spring 2020, 2021, 2024)
12.A01 | Climate and Life (Fall 2019)
[no number] | Field Methods in Microbial Oceanography, in Bermuda (Winter 2020)

MIT SERVICE

Departmental Service, Earth, Atmospheric and Planetary Sciences

- Climate System Science and Engineering (Course 1-12) steering committee, co-chair
 (2023–present)
 EAPS Committee on Educational Program (2023–present)
 EAPS Graduate student admissions committee (2019–2023)
 EAPS Program in Atmospheres, Oceans, and Climate graduate admissions (2017–2023);
 Chair (2019–2023)
 MIT/WHOI Joint Committee in Biology (2017–2023)
 EAPS Faculty Search Committee (2022–2023)
 EAPS Diversity Council / DEI Committee (2017–2021)
 PAOC/Houghton access committee (2020)
 Crosby Fellow Committee (2020)
 EAPS 2023 Taskforce (2019–2020)
 EAPS Communications (2017–2019)
 Course XII Major Advisor (2018–present) [10 students advised]
 Azzo Seguin, Lin Hou, Megan Xu, Michael Teodros, Alexander Bean, Youran Gao,
 Koko Kummel, Isabella Yeung, Ananda Santos [1-12], Derek Allmond [1-12]
 Secondary graduate student mentor (2022–present) [5 students advised]

Institutional Service

- Committee to establish Biosystems and Biotechnology minor, co-chair (2022–present)
 MIT Undergraduate admissions reader (2021–present)
 MIT ESI Martin Fellows for Sustainability selection committee (2021–present)
 First Year Advisor (2017–present) [35 student advised]
 MIT Alumni Travel Program Enrichment Lecturer [3 trips conducted, with 2–3 lectures per trip]
 MIT Alumni Association, Cardinal and Gray Society, and Emma Rogers Society engagements
 [3 California events in January 2020, 1 remote event in December 2020]

Ph.D. Thesis Committees**Julia Huggins (2023)**; Univ. British Columbia, Department of Biology (external examiner)**Chloe Dean (2023–present)**; Chemical Oceanography**Iulia-Madalina Streanga (2022–present)**; Chemical Oceanography**Peidong Wang (2021–present)**; Climate Dynamics**Emmett Culhane (2021–present)**; Biological Oceanography**Shavonna Bent (2021–present)**; Chemical Oceanography**Jaida Elcock (2021–present)**; Biological Oceanography**Elise Ledieu (2021–2022)**; Civil & Environmental Engineering**Kalina Grabb (2020–2022)**; Chemical Oceanography**Christopher Parsons (2019–present)**; Geology, Geochemistry, Geobiology**Lei Ma (2019–2022)**; Biological Oceanography**Emilie Skoog (2019–2021)**; Geology, Geochemistry, Geobiology**Mingwei Li (2019)**; PhD defense chair, Climate Dynamics**Lydia Babcock-Adams (2018–2022)**; Chemical Oceanography**Cynthia Becker (2018–2020)**; Biological Oceanography**Martin Wolf (2017–2020)**; PhD defense chair, Atmospheric Chemistry**Jennifer Karolewski (2017–2022)**; Chemical Oceanography**B. B. Cael (2018)**; PhD defense chair, Physical Oceanography**Emily Zakem (2017)**; PhD defense chair, Atmospheres, Oceans, and Climate**S.M. Thesis Committees****Christine Padalino (2022–2023)**; MS defense chair, Atmospheres, Oceans, and Climate

AWARDS EARNED BY LABORATORY ADVISEES

*Undergraduate students***Elisabeth Boles**, Christopher Goetze Prize for Undergraduate Research**Elisabeth Boles**, NSF Graduate Research Fellowship**Jarek Kwiecinski**, Henry Ford II School of Engineering Scholar Award**Jarek Kwiecinski**, CEE Best Undergraduate Research Award**Jarek Kwiecinski**, NSF Graduate Research Fellowship**Alex Miller**, Hertz Fellowship**Laura Schmidt-Hong**, NSF Graduate Research Fellowship*Graduate Students***Sarah Schwartz** (microbiology rotation student), NDSEG Fellowship**Tyler Tamasi**, NSF Graduate Research Fellowship Program Honorable mention**Irene Zhang**, Mathworks Science Fellowship**Timur Cinay**, Phillips Fellowship in Environmental Sustainability*Postdoctoral researchers*

Benedict Borer, Swiss National Science Foundation Postdoc.Mobility Fellowship

Rui Zhao, Mario Molina Fellowship

LEADERSHIP TRAINING

Keystone Partners, Executive Coaching (2020–2021)

MIT Professional Education, Leadership Skills for Engineering and Science Faculty (2022)

SERVICE TO THE COMMUNITY

Steering Committee, UNESCO Global Ocean Oxygen Network, 2023–present

Discussion Leader, Gordon Conference on Marine Microbes, 2024

Associate Editor, *Frontiers in Microbiology*, 2021–2023

Reviewer, Miscellaneous journals and funding agencies, 2014–present

Panelist, National Science Foundation, Division of Ocean Sciences, 2019

Session Chair, Aquatic Sciences Meeting, 2019; Ocean Sciences meeting, 2016, 2014

Evaluation Panelist, National Defense Science & Engineering Graduate Fellowship, 2015

OUTREACH ACTIVITIES

Annual American Junior Academy of Science

Meet the scientists mentoring event, 2023

High Technology High School Genders and Sexualities Alliance and ReconX

Memoirs of a gay professor and climate scientist, 2023

High Technology High School

Miscellaneous oceanography, Antarctica, and climate talks [5 talks], 2011–present

Woods Hole Oceanographic Inst. Postdoc Association

Negotiations and startup, 2022

Somerville High School, Oceanography and climate, 2021–present

Boston University Academy, Life of an oceanographer, 2019

New England Aquarium, Ocean biogeochemistry, 2017 – 2020

RESEARCH CRUISES AND EXPEDITIONS

Bermuda, St. George's, Bermuda. Jul 2008 (3 days) [Class field trip]

Eastern Tropical North Pacific, Manzanillo, Mex. to San Diego, CA. Mar–Apr 2012 (26 days)

Subtropical Atlantic, St. George's, Bermuda. Aug 2012 (4 days)

Eastern Tropical South Pacific, Valparaíso, Chile. Jun–Jul 2013 (33 days)

Subpolar North Atlantic, Narragansett, RI to Reykjavik, Iceland. Apr–May 2014 (24 days)

Subtropical Pacific (UNOLS Chief Scientist Training cruise), San Diego, CA. Feb 2016 (8 days)

Pacific P18 Transect, San Diego, CA to Punta Arenas, Chile. Nov 2016–Feb 2017 (75 days)
East Pacific Rise, Manzanillo, Mexico to Puntarenas, Costa Rica. Apr–May 2017 (21 days)
Gardens of the Queen, Jucaro, Cuba to Ft. Lauderdale, FL. Nov 2017 (14 days)
Florida Straits, Key West, FL. Mar 2018 (4 days) [**Class field trip; Chief Scientist**]
Eastern Tropical North Pacific, San Diego, CA. Jun–Jul 2018 (23 days) [**Chief Scientist**]
McMurdo Dry Valley Lakes, Antarctica. Oct–Dec 2022 (43 days)
Eastern Tropical South Pacific, Valparaíso, Chile. Oct–Nov 2023 (38 days)

DATA SETS

Sievert, S.M., **Babbin, A.R.** (2018) CTD data from 9 casts at the oxygen-deficient zone of the Eastern Tropical North Pacific (ETNP), RV/Atlantis cruise AT37-12, April–May 2017. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2018-06-21. doi:10.1575/1912/bco-dmo.739098.1

Babbin, A.R., Casciotti, K.L., Woosley, R.J. (2021). Bottle data and chemical analysis from Falkor cruise FK180624 in the Eastern Tropical North Pacific Ocean in 2018. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-12-02. doi:10.26008/1912/bco-dmo.832389.1

Babbin, A.R., Kwiecinski, J.V. (2021). An atlas of depth-gridded and density-gridded interpolated and un-interpolated oxygen deficient zones (ODZs) in the Eastern tropical and subtropical Pacific Ocean. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-11-30. doi:10.26008/1912/bco-dmo.865316.1