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Education

Stanford University (Stanford, CA) Geological and Environmental Sci. and Political Sci. B.A.S. 2005
Stanford University (Stanford, CA) Geological and Environmental Sciences M.S. 2006
California Institute of Technology (Pasadena, CA) Geological and Planetary Sciences Ph.D 2016
Washington University in St. Louis (St. Louis, MO) Earth and Planetary Science post-doc 2016-18

Employment

Associate Professor; University of California, Santa Barbara 07/2024 – present
Chief Science Officer; Carboniferous, Inc. 01/2022 – present
Visiting Associate, California Institute of Technology 07/2025 – present
Assistant Professor; University of California, Santa Barbara 07/2018 – 06/2024
Agouron Institute Geobiology Post-doctoral Fellow; Washington U. in St. Louis 2016–2018
Graduate Research and Teaching Assistant; California Institute of Technology 2010–2016
Project Manager / Geologist; Technology, Engineering, and Construction Inc. 2006-2010

Publications

- Crotteau M. A., McParland E. L., Phillips A. A., Kujawinski E. B., Longnecker K., Martinez A. M., Webb S. M., **Raven M. R.** (in review). “Dynamic cycling and redox transformations of dissolved organic sulfur in the surface ocean.” *Limnology and Oceanography*.
- Liu F., Macdonald F., Galy V., Li L., **Raven M.R.**, Li G. J., Chen J., Li G. K. (in review). “Tectonic and climatic controls on organic carbon burial in a tropical arc-continental collision zone over the Mid-to-Late Pleistocene.” *Earth and Planetary Science Letters*.
- Roberts K. E., Rohr T., **Raven M.R.**, Diamond M. S., Visoni D., Heneghan R., Bianchi D., Ortega-Cisneros K., Morrison M., van Heerden V., Wiseman N. A., Anil G., Cannizzo Z. J., Coll M., Coupe J., Freedman R. M., Kravitz B., Krumhardt K., Kwiatkowski L., Lovendusky N., Luo J., Olivarez H., Petrik C., Robock A., Steenbeek J., Harrison C. S. (in review). “Potential impacts of climate interventions on marine ecosystems.” *Reviews of Geophysics*.
- Raven M.R.** (2026). “The marine organic sulfur cycle.” *Annual Review of Marine Science*. doi:10.1146/annurev-marine-040124-105229
- Capece L. R.,* Bailey M.,* Morrison M.,* Phillips A. A., Sharpnack L., Webb S. M., Brenner D. C., Gomes M., **Raven, M. R.** (2025). “Evaluating Sulfurization as a Blue Carbon Sink in a Southern California Salt Marsh.” *Limnology and Oceanography* **70** (7), p. 1981–1991.
- Raven M. R.**, Evans N.,* Martinez A. M.,* Phillips A. A. (2025). “Big decisions from small experiments: Observational strategies for biomass-based marine carbon storage.” *Environmental Research Letters*. 20, 051001. doi:10.1088/1748-9326/adc28d
- Hoogakker B., [58 co-authors including **Raven M.R.**] (2025). “Review of proxies for low-oxygen paleoceanographic reconstructions.” *Biogeosciences*, <https://doi.org/10.5194/egusphere-2023-2981>.

- Fakhraee M., Crockford P., Pasquier V., Sugiyama I., **Raven M.R.**, Gomes M., Katsev S., Bauer K., Crowe S., Tarhan L., Lyons T., Planavsky N. (2024). "The history of Earth's sulfur cycle." *Nature Reviews Earth & Environment*, 6, 106–125. <https://doi.org/10.1038/s43017-024-00615-0>.
- Raven M.R.**, Crotteau M.A.,* Evans N.,* Girard Z.C.,* Martinez A.M.,* Young I.,* Valentine D.L. (2024). "Biomass Storage in Anoxic Marine Basins: Initial estimates of geochemical impacts and CO₂ sequestration capacity." *AGU Advances* 5 (1), 2023AV000950.
- Phillips A.A.*, Ulloa I.*, Hyde E., Agnich J., Sharpnack L., O'Malley K.G.*, Webb S.M., Schreiner, K.M., Sheik C.S., Katsev S., **Raven M.R.** (2023). "Organic sulfur from source to sink in low-sulfate Lake Superior." *Limnology and Oceanography* 68 (12), 2716–2732. <http://doi.org/10.1002/lno.12454>.
- Raven M.R.**, Crockford P., Hodgskiss M., Lyons T., Tino C., Webb S. (2023) "Organic matter sulfurization and organic carbon burial in the Mesoproterozoic." *Geochimica et Cosmochimica Acta* 347, p102–115. doi: 10.1016/j.gca.2023.02.020
- Tingle K.,* Porter S., **Raven M.R.**, Czaha A., Webb S., Bloeser B. (2023). "Organic preservation of vase-shaped microfossils from the late Tonian Chuar Group, Grand Canyon, Arizona, USA." *Geobiology*, January 18, 2023, gbi.12544. <https://doi.org/10.1111/gbi.12544>.
- Raven M.R.**, Keil R. G., Webb S. M. (2021). "Rapid, concurrent formation of organic sulfur and iron sulfides during experimental sulfurization of marine particles." *Global Biogeochemical Cycles* 35, e2021GB007062.
- Raven M.R.**, Keil R.G., Webb S.M. (2021). "Microbial sulfate reduction and organic sulfur formation in sinking marine particles." *Science* vol. 371 (6525) p178-181. doi://10.1126/science.abc6035
- Bryant R.N., Jones C., **Raven M.R.**, Owens J. D., Fike D.A. (2020) "Shifting modes of iron sulfidization at the onset of OAE-2 drive regional shifts in pyrite $\delta^{34}\text{S}$ records." *Chemical Geology* 553, 119808. doi://10.1016/j.chemgeo.2020.119808
- Raven M.R.**, Fike D.A., Bradley A.S., Gomes M.L., Owens, J.D., Webb S.M. (2019). "Paired organic matter and pyrite $\delta^{34}\text{S}$ records reveal mechanisms of carbon, sulfur, and iron cycle disruption during Ocean Anoxic Event 2." *Earth and Planetary Science Letters* vol. 512, p27-38. doi://10.31223/osf.io/k97bw
- Bryant R.N., Jones C., **Raven M.R.**, Gomes M.L., Berelson W. M., Sessions A.L., Bradley A.S., Fike D.A. (2019). "Sulfur isotope analysis of microcrystalline iron sulfides using SIMS imaging: Extracting local paleo-environmental information from modern and ancient sediments." *Rapid Communications in Mass Spectrometry*. doi:10.1002/rcm.8375.
- Raven M.R.**, Fike D.A., Gomes M.L. (2019) "Chemical and isotopic evidence for organic matter sulfurization in redox gradients around mangrove roots." *Frontiers in Earth Science–Biogeosciences* vol. 7. doi: 10.3389/feart.2019.00098
- Raven M.R.**, Fike D.A., Gomes M.L., Webb S.M., Bradley A.S., McClelland H.L.O. (2018). "Organic carbon burial during OAE2 driven by changes in the locus of organic matter sulfurization." *Nature Communications* 9: 3409. doi://10.1038/s41467-018-05943-6
- Raven M.R.**, Sessions A.L., Adkins J.F., Thunell R.C. (2016). "Rapid organic matter sulfurization in the water column of Cariaco Basin." *Geochimica et Cosmochimica Acta* vol. 190, p175–190. doi://10.1016/j.gca.2016.06.030
- Raven M.R.**, Sessions A.L., Fischer W.F., Adkins J.F. (2016). "Sedimentary pyrite $\delta^{34}\text{S}$ differs from porewater sulfide in Santa Barbara Basin: Proposed role of organic sulfur." *Geochimica et Cosmochimica Acta* vol. 86, p120–134. doi://10.1016/j.gca.2016.04.037

Raven, M.R., Adkins, J.F., Werne, J.P., Lyons, T.W. Sessions, A.L. (2015). “Sulfur-isotopic compositions of individual organic compounds from Cariaco Basin sediments.” *Organic Geochemistry* vol. 80, p53-59. 10.1016/j.orggeochem.2015.01.002

Greenwood, P., Amrani, A., Sessions, A., **Raven, M.R.**, Grice, K. (2014). “Development and Initial Biogeochemical Applications of Compound-Specific $\delta^{34}\text{S}$ Analysis.” in *Principles and Practice of Analytical Techniques in Geosciences*, Royal Society of Chemistry (UK)

**NOISE Lab student or advisee*

Awards and Honors

NSF CAREER Award: CAREER: Cryptic sulfur cycling and organic matter preservation in marine oxygen deficient zones, 2022

Invited Fellow: ‘Scialog – Signatures of Life in the Universe’, Research Corporation for Science Advancement and Heising-Simons Foundation (2020–2024).

Selected Invited Presentations (recent only)

National Academies of Science Engineering and Medicine, marine CO₂ removal standing committee meeting presenter, September 2025. “Marine anoxic carbon storage.”

Departmental Seminars: USC (planned fall 2025), ETH Zürich (2024), MARUM, U. of Bremen (2024), Scripps Institute of Oceanography (2023), MIT (2023), Stanford (2022), Woods Hole Oceanographic Institution (2022), Oklahoma State (2022).

Earth and Environmental Science in Action for a Rapidly Changing World Symposium speaker, Northwestern University, June 2025. “Marine anoxic carbon storage (MACS).”

Gordon Research Conference, Chemical Oceanography, 2023. “Sulfur and the organic carbon cycle in marine particles and sediments.”

Agouyon Geobiology Summer Course, Sulfur Symposium, Caltech, 2022. “Organic sulfur through a prism: Sources and transformations of organic S in the environment.”

AGU Fall Meeting, 2023. “Monitoring, modeling, and minimizing the ecosystem impacts of biomass-based marine CDR.”

Patents and Other Products

UC case ID 2022-771 (international filing 12/01/2023). “Application of organic matter sulfurization for enhanced marine carbon sequestration.”

Kowek D., 27 co-authors including **Raven M.R.** (2022) “Answering Critical Questions about Sinking Macroalgae for Carbon Dioxide Removal.” Ocean Visions, Monterey Bay Aquarium Research Institute. *Peer-reviewed working group white paper.*

Selected Contracts and Grants (personal share \$ listed)

2021–2024: NSF Low-Temperature Geochemistry and Geobiology (\$497,604). “Carbon storage in mangroves via organic matter sulfurization.”

2021–2023: Hellman Faculty Fellowship Fund (\$45,893). “Organic sulfur and the search for early and extraterrestrial life.”

2022–2027: NSF Chemical Oceanography (\$954,249). “CAREER: Particle-hosted sulfur cycling and organic matter burial in oxygen deficient zones.”

2022–2024: Grantham Foundation for the Protection of the Environment (\$600,000). “CO₂ removal via biomass storage in anoxic basins.”

2023–2023: Research Corporation for Science Advancement (\$50,000). “Constraining the Abiotic Sulfur Cycle on Temperate Terrestrial Planets.”

2023–2024: Research Corporation for Science Advancement (\$50,000). “Sulfur Assimilation: a novel proxy for redox transitions in the early Biosphere.”

2023 – 2026: NSF Major Research Instrumentation (shared \$637,661). “MRI: Track 1: Acquisition of an Isotope-Ratio Mass Spectrometer for biogeochemical and ecological education and research in an era of global change.”

2025–2028: NASA Habitable Worlds (\$108,023). “Unraveling interactions between sulfur and organic matter in ancient surface environments: Implications for organic preservation on Mars.”

Other Professional Contributions

Chief Science Officer: Carboniferous Inc, applications of anoxic basins for biomass storage CO₂ removal, 2021 – present

Scientific Advisor: Seafields Inc, applications of sargassum seaweed for CO₂ removal, 2021– present.

Workshop Creator and host: First international Marine Anoxic Carbon Storage (MACS) CO₂ removal workshop, Bucharest, Romania, February 2025.

Working Group Member: Ocean Visions, sinking seaweed working group (monthly work sessions, 2021-2022)

Working Group Member: Puro.Earth Ocean Storage of Biomass (CO₂ removal verification development)

Workshop Participant: Southern California Coastal Water Research Project (SCCWRP), Scoping the Development of a Comprehensive mCDR Assessment Framework for California Coastal Waters, October 2024.

Workshop Participant: NSF Workshop on Climate Interventions: Ethical Considerations and Future Governance Requirements, fall 2024.

Public / Industry Outreach for CO₂ Removal: “State of mCDR”panelist / speaker for Ocean Visions Biannual Summit, Vancouver, March 2025; New York Climate Week Puro.Earth panel moderator (2024); Frontier/Stripe Knowledge Gap Database Ocean CDR community session panelist, 2023; Ocean Observing Strategy *Climate Intervention Strategies* session co-host, 2023; LowerCarbon Capital workshop speaker, 2022.

Associate Editor: Marine Chemistry (Elsevier), 2021 – present;

Creator and host of “Ocean Solutions: a NOISE Lab Podcast.” Episodes available on all major platforms, transcripts at www.ravennoiselab.com/podcast.

Faculty host and organizer: Southern California Geobiology Symposium, 2023.

Science Communication and Media: Dialogue.Earth, Scientific American, PBS NewsHour, ScienceNews, BBC, Science, etc.

Community Service: Reviewer for 8 journals (Scientific Reports, Earth and Planetary Science Letters, Frontiers in Earth Science, Chemical Geology, Organic Geochemistry, Geochimica et Cosmochimica Acta, Geology, Biogeosciences Discussions); **Ad-hoc reviewer** for funding agencies (NSF-EAR Low-temp Geochemistry and Geobiology, Marsden Fund – New Zealand Royal Society); **Panel reviewer** (NASA Exobiology, NSF Chemical Oceanography).

Undergraduate Research Mentor: Senior thesis students (yr. compl.) Max Morrison* (2021), Izzy Young* (2022), Melea Bailey* (2022), Zephyr Girard* (2023), Imanol Ulloa* (2023); Katrina Doyle-Jacobsen* (2025), Angela Larson (2025), David Nims (2025). Undergraduate researchers Sophia Wei (2021), Megan Sun (2022), Carly Lam (2021), Cameron Allen (2022), Jordan Fishburn* (2024), Avery Leppones* (2025), Gwen Conway* (2023), Max Pacatte (2024), Sylvia Li (2025), Kaley Weis (2026)* = *co-author on complete or in prep publication*

Graduate Student Research Mentor: Primary PhD advisees Lena Capece (2025), Molly Crotteau (2027), Marianna Karagiannis (2028), Alicia Sadowski (2030); primary MS advisee Katherine O'Malley (2022); visiting PhD advisee (one-year visit, Brazilian govt exchange program) Caio Gonçalves (2022); supporting PhD advisees (4) and MS advisees (3).

Postdoctoral Scholar Mentor: Molly O'Beirne (2021), Alexandra Phillips (2022), Natalya Evans (2025), Aaron Martinez (2025).

Selected Student Field Research Experiences. At Sea: Chief / Co-Chief Scientist, UNOLS Research Vessels: R/V *Sally Ride*, Santa Barbara Basin, (SR1919, Nov 2020); R/V *Pelican*, Gulf of Mexico (PE23-19, April 2023); R/V *Pt. Sur*, Gulf of Mexico (PS24-02, July 2023); R/V *Rachel Carson*, Vancouver fjords (RC-107, October 2023), R/V *Pt. Sur*, Gulf of Mexico (PS24-13, November 2023); R/V *Pelican*, Gulf of Mexico (PE24-17, May 2024). **On Land:** Rookery Bay National Estuarine Research Reserve (July–Aug. 2022); Little Ambergis Caye, Turks and Caicos Islands (June 2022).