Andrea J. Pain

Assistant Professor
Horn Point Lab
University of Maryland Center for Environmental Science
PO Box 775
Cambridge, MD 21613
https://www.umces.edu/andrea-pain

410-228-9250
apain@umces.edu

I. EDUCATION

2008	B.A. with Honors, Earth & Environmental Sciences, Wesleyan University, Middletown, CT. Thesis title "Sediment Phosphorus Reservoirs in Tropical Bays: Implications for Phosphorus Availability and Bioluminescent Dinoflagellate Populations"
2013	M.Sc., Environmental Systems Science, ETH Zurich, Zurich, Switzerland. Thesis title "Management effects on soil organic matter stabilization in a long-term agricultural field trial"
2017	PhD, Geology, University of Florida, Gainesville, FL. Thesis title "Carbon cycling in subterranean estuaries and implications for oceanic fluxes"

II. PROFESSIONAL EXPERIENCE

2018 - 2020	Postdoctoral researcher, University of Florida, Gainesville, FL
2020 - present	Assistant Professor, University of Maryland Center for Environmental Science, Horn Point Laboratory

Awards and Special Recognition

2008 Departmental Honors, Wesleyan University Department of Earth & Environmental Sciences, 2008

2016 American Water Resources Association (AWRA) Outstanding Student Oral Presentation

2017 John Ridge Award for Outstanding Graduate Student in Academic Excellence, University of Florida Department of Geological Sciences, 2017. Gainesville, FL.

III. RESEARCH

A. Areas of professional expertise

Carbon and nutrient processes across the land-sea interface, Arctic processes, coastal groundwater biogeochemical transformations, stream and groundwater hydrogeochemistry, marine carbon processes

B. Peer-reviewed publications

2025

Glacial retreat converts exposed landscapes from net carbon sinks to sources (2025) **Pain, A.J.**, Martin, J.B., Martin, E.E., Salinas-Reyes, J.T., Bennett, C. Communications Earth & Environment 6 (1), 424

Geochemistry at a Karst Spring Reveals Complex Stormflow Dynamics in an Eogenetic Karst Aquifer (2025). Spellman, P., Pain, A.J., Kim, S., Kamal, M. Groundwater

2024

Martin, J.B., **Pain, A.J.,** Martin, E.E. (2024) Treatise in Geochemistry. Geochemistry of Glaciers.

2023

Spellman, P., **Pain, A. J.**, Breithaupt, C., Bremner, P. (2023) Using multivariate statistics to link major ion chemistry changes at karst springs to agriculture. Science of the Total Environment.

Coastal inundation regime moderates the short-term effects of sediment and soil additions on seawater oxygen and greenhouse gas dynamics: a microcosm experiment. P Regier, ND Ward, A Izquierdo, AH Baldwin, D Day, J McElhinny, K Patel, et al. Frontiers in Marine Science 10, 1308590

2022

P Spellman, J Gulley, **A Pain**, M Flint, S Kim, S Rath (2022) Statistical evidence of recharge and supply controlling nitrate variability at springs discharging from the upper Floridan Aquifer. Science of The Total Environment, 156041

2021

Pain, A.J., Martin, J.B., Young, C.R. Biogeochemical and hydrological drivers of heterogeneous nutrient exports from subterranean estuaries (2021) Frontiers in Marine Science. https://doi.org/10.3389/fmars.2021.699916

Huang, L., Bae, H-S., Martin, J.B., Young, C., **Pain, A.J.**, Ogram, A. (2021) Campylobacterota dominate the microbial communities in a tropical karst subterranean estuary, with implications for cycling and export of nitrogen to coastal waters. Environmental Microbiology. https://doi.org/10.1111/1462-2920.15746

Pain, A.J., Martin, J.B., Martin, E.E., Rennermalm, A.K., Rahman, S. (2021) Heterogeneous CO_2 and CH_4 content of glacial meltwater from the Greenland Ice Sheet and implications for subglacial carbon processes. The Cryosphere 15 (3), 1627–1644. DOI: 10.5194/tc-15-1627-2021.

2020

Pain, A.J., Martin, J.B., Martin, E.E., Rahman, S., Ackermann, P. (2020) Differences in the quantity and quality of organic matter exported from Greenlandic glacial and deglaciated watersheds. Global Biogeochemical Cycles 34 (10). DOI:10.1029/2020GB006614

Martin, J.B., **Pain, A.J.,** Martin, E.E., Rahman, S., Ackermann, P. (2020) Comparisons of nutrients exported from Greenlandic glacial and deglaciated watersheds. Global Biogeochemical Cycles. DOI: 10.1029/2020GB006661

Pain, A.J., Martin, J.B., Young, C.R., Valle-Levinson, A., and Mariño-Tapia, I. (2020) Carbon and phosphorus processing in a carbonate karst aquifer and delivery to the coastal ocean. Geochimica et Cosmochimica Acta 269, 484-495. https://doi.org/10.1016/j.gca.2019.10.040

2019

Pain, A.J., Martin, J.B., Young, C., Huang, L., Valle-Levinson, A. (2019). Organic matter quantity and quality across salinity gradients in conduit- versus diffuse flow-dominated subterranean estuaries. Limnology & Oceanography 64, 1386-1402. https://doi.org/10.1002/lno.11122

Pain, A.J., Martin, J.B., Young, C. (2019) Sources and sinks of CO_2 and CH_4 in siliciclastic subterranean estuaries. Limnology & Oceanography 64, 1500-1514. https://doi.org/10.1002/lno.11131

2018

Chamberlin C. A., Bianchi T. S., Brown A. L., Cohen M. J., Dong X., Flint M. K., Martin J. B., McLaughlin D. L., Murray A. B., **Pain A.J.,** Quintero C. J., Ward N. D., Zhang X. and Heffernan J. B. (2018) Mass balance implies Holocene development of a low-relief karst patterned landscape. Chemical Geology. DOI: 10.1016/j.chemgeo.2018.05.029.

Li L., He Z., Shields M. R., Bianchi T. S., **Pain A.J.** and Stoffella P. J. (2018) Partial least squares analysis to describe the interactions between sediment properties and water quality in an agricultural watershed. Journal of Hydrology 566, 386–395.

Young, C., J. B. Martin, Branyon, J., **Pain, A.J.**, Valle-Levinson, A., Mariño-Tapia, I., Vieyra, M.R. (2018) Effects of short-term variations in sea level on dissolved oxygen in a coastal karst aquifer, Quintana Roo, Mexico. Limnology & Oceanography 63: 352–362.

2010

Pain, A.J., and Hastings, H. (2010) Nutrient limitation in Bahia Fosforescente, Puerto Rico: Evidence from seagrass C:N:P ratios in Thalassia Testudinum. Acta Cientifica 24 (1-3): 14-25.

C. Invited seminars and presentations

1. Invited conference presentations

Pain, A.J., Martin, J.B., Martin, E.E, Rahman, S, Ackermann, P. (2020) Riverine export of carbon and nutrients from deglaciating Arctic landscapes: Implications for past and future climate transitions. Ocean Carbon Biogeochemistry webinar series. December 15, 2020

Pain, A.J., Martin, J.B., Martin, E.E, Rahman, S (2019) Shifts in riverine phosphorus fluxes and storage with ice sheet retreat. Goldschmidt Annual Conference. Barcelona, Spain.

Pain, A.J., Rahman, S., Martin, J.B., Martin, E.E (2019) Implications of ice sheet retreat for nutrient export from periglacial landscapes in Greenland (Paper number: 1110). Southeastern Regional Meeting of the American Chemical Society. Savannah, GA

2. Invited departmental seminars

Chesapeake Biological Laboratory (November 2024): Glacial sources and sinks of greenhouse gases and implications for a warming Arctic

University of Florida (November 2023): Biogeochemical mineral weathering in the warming Arctic and implications for Arctic carbon cycling.

Horn Point Lab (February 2022): Impacts of continental ice retreat on carbon and nutrient fluxes from land to (air and) sea: insights from Greenland

Appalachian Lab (September 2021): Impacts of continental ice retreat on carbon fluxes from land to air & sea: insights from Greenland

Kent State (March 2021): Riverine export of carbon and nutrients from deglaciating Arctic landscapes: Implications for past and future climate transitions

3. Conference presentations

<u>2024</u>

Pain, A.J., Bomar, C., Flint, M., Martin, E.E., Martin, J.B., Christner, B. Variability and controls of methane oxidation rates from subglacial discharge of the Greenland Ice Sheet. American Geophysical Union Annual Meeting. Washington, DC

Flint, M.K., Salinas, T., Black, M., Deuerling, K., Pain, A.J., Martin, J.B., Martin, E.E. Organic Carbon Quantity and Quality Dictate Nitrous Oxide Dynamics in Active Layer Water Across an Exposure Age Gradient,

Southwest Greenland. American Geophysical Union Annual Meeting. Washington, DC

2023

Pain, A.J., C Bomar, M Flint, JB Martin, BC Christner, EE Martin, T Salinas. Microbial and chemical weathering processes alter dissolved CO_2 and CH_4 concentrations of subglacial discharge from the Greenland Ice Sheet. American Geophysical Union Annual Meeting. San Francisco, CA.

2022

Pain, A.J., Martin, J.B., Martin, E.E. (2022) The impact of redox biogeochemistry on the magnitude and pathway of CO_2 sequestration via mineral weathering in a partially glaciated Greenlandic watershed. American Geophysical Union Annual Meeting. December 13-16, Chicago, Illinois.

Pain, A.J., Martin, J.B., Martin, E.E., Bomar, C., Flint, M. (2022) Heterogeneous CH_4 content of glacial meltwater from the Greenland Ice Sheet and implications for subglacial carbon processes. Center for Arctic Gas Hydrate, Environment, and Climate International Conference. Tromsø, Norway. September 14-16, 2022.

Bomar, C., Christner, B., **Pain, A.J.,** Flint, M. (2022) Methane Oxidation in Subglacial Discharge from land-terminating outlet glaciers of the Greenland Ice Sheet. Center for Arctic Gas Hydrate, Environment, and Climate International Conference. Tromsø, Norway. September 14-16, 2022.

2021

Pain, A.J., Martin, J.B (2021) Hydrogeologic controls on organic and inorganic carbon processes in karst subterranean estuaries. Geological Society of America Fall Meeting. Portland, Oregon.

Martin, J.B., **Pain, A.J.,** Martin, E.E. (2021) Greenland Revisited: Lake Effects on Coastal Nutrient Fluxes. Geological Society of America Fall Meeting. Portland, Oregon.

E.E. Martin, Martin, J.B., **Pain, A.J**., An, E. (2021) Weathering, Radiogenic Isotopes, and Marine Records of Glacial Dynamics. Geological Society of America Fall Meeting. Portland, Oregon.

2020

Hensley, R.T., Martin, J.B., Martin, E.E., **Pain, A.J.,** Cohen, M.J. (2020) Estimating metabolism and nutrient assimilation in high latitude (Arctic and Antarctic) streams. AGU Fall Meeting 2020

Pain, A.J., Martin, J.B., Martin, E.E. (2020) Effects of mineral weathering on iron, sulfur and phosphorus geochemistry along a deglaciated chronosequence in southwest Greenland. Geological Society of America Fall Meeting, Montreal, Canada

Martin, J.B., **Pain, A.J.,** Martin, E.E. (2020) Changes in dissolved nutrient export with continental ice sheet retreat. Geological Society of America Fall Meeting, Montreal, Canada

2019

Pain, A.J., Martin, J.B., Martin, E.E, Rahman, S. (2019) Carbon feedbacks under the Greenland Ice Sheet and implications for greenhouse gas exchange. American Geophysical Union Fall 2019 Meeting. San Francisco, CA

Rahman, S., Martin, J.B., Martin, E.E., **Pain, A.J.** (2019) Nutrient fluxes from deglaciated versus proglacial Greenlandic watersheds. American Geophysical Union Fall 2019 Meeting. San Francisco, CA

Martin, J.B., **Pain, A.J.,** Young, C. (2019) Coastal Carbonate Critical Zones: An example from the Yucatan peninsula. Geological Society of America Fall 2019 Meeting. Phoenix, AZ.

Pain, A.J., Martin, J.B., Martin, E.E, Rahman, S (2019) Shifts in riverine phosphorus fluxes and storage with ice sheet retreat. Goldschmidt Annual Conference. Barcelona, Spain.

2018

Pain, A.J,, Martin, J.B., Martin, E.E, Rahman, S. (2018) Shifts in quantity and quality of dissolved organic carbon delivered to the ocean as continental ice sheets retreat. American Geophysical Union Fall 2018 Meeting. Washington, D.C.

Martin, J.B., **Pain, A.J.,** Martin, E.E., Robbins, M., Hall, H.G., Schnur, S. (2018) Diel variations in high-latitude stream water chemistry. American Geophysical Union Fall 2018 Meeting. Washington, D.C.

Rahman, S., Martin, J.B., Martin, E.E., **Pain, A.J.** (2018) Dissolved and reactive Si fluxes from deglaciated and proglacial watersheds in West and South Greenland. American Geophysical Union Ocean Sciences Meeting, Portland, OR.

2017

Pain, A.J., Martin, J.B., Martin, E. (2017) Implications for carbon processing beneath the Greenland Ice Sheet from dissolved CO_2 and CH_4 concentrations of subglacial discharge. American Geophysical Union Fall 2017 Meeting. New Orleans, LA.

2016

Pain, A.J., Young, C. R., Martin, J.B. (2016) Impact of organic carbon quality on methanogenesis in subterranean estuaries and implications for greenhouse gas production American Geophysical Union Fall 2016 Meeting. San Francisco, CA.

Pain, A.J., Martin, J.B., Young, C.R. (2016) Phosphorus storage in coastal sediments: Will sea-level rise mobilize P and elevate coastal fluxes? American Water Resources Association 2016 Annual Meeting. Orlando, FL

Huang, L., Young, C., **Pain, A.J.**, Martin, J.B., Ogram, A. (2016) Analysis of microbial communities associated with groundwater discharge in the Yucatan Peninsula. American Water Resources Association 2016 Annual Meeting. Orlando, FL

Chamberlin, C., Heffernan, J., Cohen, M., Quintero, C., **Pain. A.J.** (2016) Evolution of a Lowland Karst Landscape; A Mass-Balance Approach. American Geophysical Union Fall 2016 Meeting. San Francisco, CA

Pain, A.J., Martin, J.B., Young, C. (2016). Heterogeneously distributed nutrient loading from groundwater to Indian River Lagoon, Florida. 2016 North Florida Marine Science Symposium, Cedar Key, FL

Huang, L., Young, C., **Pain, A.J.,** Martin, J.B., Ogram, A., (2016) The responses of key nitrogen cycling genes to seasonal and tidal variations in a tropical estuary, 5th UF Water Institute Symposium, Gainesville, Florida.

2015

Pain, A.J., Martin, J.B., Young, C., and Brown, A. (2015) Organic carbon quality in submarine groundwater discharge and implications for mineral dissolution in a coastal carbonate aquifer, Geological Society of America, Abstract with program, v. 47, p. 845.

Young, C., Martin, J.B., **Pain, A.J.,** Huang, L., and Ogram, A. (2015) Microbially driven nitrogen cycling in Yucatan cenotes, Geological Society of America, Abstract with program, v. 47, p. 56

Huang, L, Young, C., **Pain, A.J.,** Martin, J.B., Ogram, A., (2015) The responses of key nitrogen cycling genes to seasonal and tidal variations in a tropical

estuary, Florida Branch of the American Society for Microbiology meeting, Cocoa Beach, FL, Oct. 9 – 11.

Martin J., Brown, A., Ezell, J., **Pain, A.J.,** and Young, C., (2015) Weathering in modern carbonate terrains: Biological controls on redox conditions, dissolution and atmospheric CO_2 fluxes, Goldschmidt meeting, Prague, Czech Republic.

Martin, Jonathan B., Young, Caitlin, Branyon, Jackie, Valle-Levinson, A., **Pain, A.J.,** Marino-Tapia, I, and Rebolledo-Vieyra, M., (2015) Sea level rise impacts on coastal karst aquifers, Geological Society of America, Abstract with program, v. 47, p. 556.

D. Active membership in professional organizations
American Geophysical Union (since 2016)
Geological Society of America (since 2015)
Interagency Arctic Research Policy Committee (since 2019)
Association of Polar Early Career Scientists (since 2019)

IV. TEACHING AND TRAINING

A. University System of Maryland Courses Taught

MEES 640 Interconnected Earth Systems: Land, Ocean, and Estuary (**Fall 2024**). Co-instructors: Michael Gonsior (CBL), Joe Jurisa (HPL; lead instructor), Laura Lapham (CBL), Cindy Palinkas (HPL). This 4-credit foundational course discusses land-to-sea hydrological and biogeochemical processes. Students read primary literature, complete quantitative analyses in problem sets, and develop soft skills (writing, public speaking, debating) in case studies. Enrollment: 10 students.

MEES 640 Interconnected Earth Systems: Land, Ocean, and Estuary (**Fall 2023**). Co-instructors: Michael Gonsior (CBL), Joe Jurisa (HPL), Laura Lapham (CBL), Cindy Palinkas (HPL; lead instructor). This 4-credit foundational course discusses land-to-sea hydrological and biogeochemical processes. Students read primary literature, complete quantitative analyses in problem sets, and develop soft skills (writing, public speaking, debating) in case studies. Enrollment: 8 students.

MEES615 Scientific Writing and Communication (**Fall 2023**). Co-instructors: Elizabeth North (HPL, lead instructor), Nayani Vidyarantha, Michael Sieracki. This 2-credit course trains students in techniques and strategies for effective scientific writing and communication. Enrollment: 25 students.

MEES698K: Biogeochemistry (**Spring 2023**). Co-instructors: Sairah Malkin (HPL, lead instructor), Eric Davidson (AL), Halimeda Kilbourne (CBL). This 4-credit course explores land-to-sea biogeochemical cycles. Students read primary literature and produce a term paper discussing a key topic in biogeochemical research. Enrollment: 9 students.

MEES 640 Interconnected Earth Systems: Land, Ocean, and Estuary (**Fall 2022**). Co-instructors: Michael Gonsior (CBL; lead instructor), Joe Jurisa (HPL), Marc Castro (AL), Laura Lapham (CBL), Cindy Palinkas (HPL). This 4-credit foundational course discusses land-to-sea hydrological and biogeochemical processes. Students read primary literature, complete quantitative analyses in problem sets, and develop soft skills (writing, public speaking, debating) in case studies. Enrollment: 8 students.

MEES 627 Environmental Geochemistry II (**Spring 2021**). Co-instructors: Sairah Malkin (HPL, lead instructor), Eric Davidson (AL), Halimeda Kilbourne (CBL). This 4-credit course explored land-to-sea biogeochemical cycles. Students read primary literature and produced a term paper discussing a key topic in biogeochemical research. Enrollment: 4 students.