

Christopher T. Hayes

515 Spartan Dr., Apt. 7204, Slidell, LA 70458; cell: (203)-535-4765
christopher.t.hayes@usm.edu www.usm.edu/marine

Appointments:

Assistant Professor, **University of Southern Mississippi**, Stennis Space Center, MS 2016–
W.O. Crosby Postdoctoral Fellow, **Massachusetts Institute of Technology**, Cambridge, MA
2013–2015

Education:

PhD, **Columbia University**, New York, NY, 2013, Earth and Environmental Sciences
Thesis: “Marine thorium and protactinium distributions: Tools for past and present chemical flux”
MA, **Columbia University**, New York, NY, 2010, Earth and Environmental Sciences
Thesis: “Opal accumulation rates in the equatorial Pacific and deglacial mechanisms”
BSc, **McGill University**, Montreal, QC, 2008, Honours Chemistry (Environmental)
Thesis: “Ice nucleation activity of organic aerosols”

Research Interests: Chemical oceanography, natural radionuclides, biogeochemical cycles
Aerosols in the climate system, marine carbon cycle
Paleoceanography, paleoclimate, proxy development and validation

Research Skills: Isotope geochemistry, mass spectrometry, radiation counting
Sea-going expeditions, sediment coring, seawater and aerosol sampling
Marine science modeling, data compilation, remotely sensed products

Teaching:

Courses given:	Isotope Biogeochemistry (USM, MAR683)	Spring 2017
Guest Lecturing:	The Oceans and Climate (USM, MAR491)	Fall 2016
	Oceans and Climate Change (USM, MAR689)	Spring 2016
	Paleoceanography (MIT)	Spring 2014
Training:	Kaufman Teaching Certificate Program (MIT)	Spring 2015

Student Mentoring: Laura Whitmore, PhD committee member (USM) 2015–
Haley Anderson, MS committee member (USM) 2016–
Nina Schulze, MS committee member (USM) 2016–
Jeffrey Rosen & Ashling Neary, Undergraduate assistants (MIT) 2015
Clio Macrakis, High School intern (MIT) 2014

Awards: Best Student Oral Presentation, R. Duce Symposium, AMS Meeting 2013
Gary Comer Abrupt Climate Change Fellow, 2010

HAYES Curriculum vitae 2

Faculty Fellow, Columbia University, 2008–2013

Funded Research:

2015: PI: Tracing continental inputs and organic matter export using the long-lived thorium isotopes on the Western Antarctic Peninsula. Antarctic Science Bursary (£2380), Antarctic Science Ltd.

2013–2015: W. O. Crosby Postdoctoral Fellowship. Independent projects on trace metal biogeochemistry at the Hawaii Ocean Time-series station, the Northwestern Atlantic and the Southern Ocean (\$134,000), MIT.

Pending Proposals:

(6/1/2017-5/31/2020). NOAA RESTORE Act Science Program. Lead PI, with co-PI's A. M. Shiller (USM), E. N. Powell (USM) and L. Guo (U. Wisconsin-Milwaukee): Submarine groundwater discharge, hypoxia and acidification impacts on Mississippi-Alabama oyster reefs. (\$798,801). Submitted Sept. 2016.

(1/1/2017-12/31/2019). NSF-Marine Geology and Geophysics Program. Sole PI: Uranium isotopes and past changes in Southern Ocean circulation. (\$239,539). Submitted Aug. 2016.

(11/1/2017-10/31/2019). Mississippi Department of Marine Resources, Tidelands Trust Fund. Lead PI, with co-PI Shiller, A. M. (USM): Submarine groundwater, hypoxia and acidification impacts on oysters. (\$175,141). Submitted July 2016.

Publications:

20. **Hayes, C. T.**, D. McGee, S. Mukhopadhyay, E.A. Boyle, A. C. Maloof (2017), [Helium and thorium isotope constraints on African dust transport to the Bahamas over recent millennia](#), *Earth and Planetary Science Letters* 457, 385-395.
19. Baker, A. R., W. M. Landing, E. Bucciarelli, M. Cheize, S. Fietz, **C. T. Hayes**, D. Kadko, P. L. Morton, N. Rogan, G. Sarthou, R. U. Shelley, Z. Shi, A. Shiller, M. M. P. van Hulst (alphabetical order, after first 2 authors) (2016), [Trace element and isotope exchange at the air – sea interface: progress and research needs](#), *Philosophical Transactions of the Royal Society A* 374, 20160190.
18. Anderson, R. F., H. Cheng, R. L. Edwards, M. Q. Fleisher, **C. T. Hayes**, K.-F. Huang, D. Kadko, P. J. Lam, W. M. Landing, Y. Lao, Y. Lu, C. I. Measures, P. L. Morton, S. B. Moran, D. C. Ohnemus, L. F. Robinson, R. U. Shelley (alphabetical order) (2016), [How well can we quantify dust deposition to the ocean?](#), *Philosophical Transactions of the Royal Society A* 374, 20150285.
17. Lerner, P., P. J. Lam, O. Marchal, R. F. Anderson, K. Buesseler, M. A. Charette, R. L. Edwards, **C. T. Hayes**, K.-F. Huang, Y. Lu, L. Robinson, A. Solow (2016), [Testing models of thorium and particle cycling in the Ocean using data from station GT11-22 of the U.S. GEOTRACES North Atlantic Section](#), *Deep-Sea Research I* 113, 57–79.
16. Fitzsimmons, J. N., **C. T. Hayes**, S. al-Subiai, P. L. Morton, R. Weisend, F. Ascani, E. A. Boyle (2015), [Daily to decadal variability of size-fractionated iron and iron-binding ligands at the Hawaii Ocean Time-series Station ALOHA](#), *Geochimica et Cosmochimica Acta* 171, 303–324.

15. **Hayes, C. T.**, J. N. Fitzsimmons, E. A. Boyle, D. McGee, R. F. Anderson, R. Weisend, P. L. Morton (2015), [Thorium isotopes tracing the iron cycle at the Hawaii Ocean Time-Series Station ALOHA](#), *Geochimica et Cosmochimica Acta* 169, 1–16. → Featured on [MIT News](#)
14. The GEOTRACES Group: E. Mawji, R. Schlitzer, E. Masferrer Dodas, and 133 others, including **C.T. Hayes** (2015), [The GEOTRACES Intermediate Data Product 2014](#), *Marine Chemistry* 177, 1–8.
13. **Hayes, C. T.**, R. F. Anderson, M. Q. Fleisher, S. M. Vivancos, P. J. Lam, D. C. Ohnemus, K.-F. Huang, L. F. Robinson, Y. Lu, H. Cheng, R. L. Edwards, S. B. Moran (2015), [Intensity of Th and Pa scavenging partitioned by particle chemistry in the North Atlantic Ocean](#), *Marine Chemistry* 170, 49–60. → Featured on [geotraces.org](#)
12. Anderson, R. F., **C. T. Hayes** (2015), [Characterizing marine particles and their impact on biogeochemical cycles in the GEOTRACES program](#), *Progress in Oceanography* 133, 1–5.
11. **Hayes, C. T.**, R. F. Anderson, M. Q. Fleisher, K.-F. Huang, L. F. Robinson, Y. Lu, H. Cheng, R. L. Edwards, S. B. Moran (2015), [²³⁰Th and ²³¹Pa on GEOTRACES GA03, the U.S. GEOTRACES North Atlantic Transect, and implications for modern and paleoceanographic chemical fluxes](#), *Deep-Sea Research II* 116, 29–41.
10. **Hayes, C. T.**, A. Martinez-Garcia, A. Hasenfratz, S. L. Jaccard, D. A. Hodell, D. M. Sigman, G. H. Haug, R. F. Anderson (2014) [A stagnation event in the deep South Atlantic during the last interglacial period](#), *Science* 346, 1514–1517.
9. **Hayes, C. T.**, R. F. Anderson, M. Q. Fleisher, S. Serno, G. Winckler, R. Gersonde (2014), [Biogeography in ²³¹Pa/²³⁰Th ratios and a balanced ²³¹Pa budget for the Pacific Ocean](#), *Earth and Planetary Science Letters* 391, 307–318.
8. Serno, S., G. Winckler, R. F. Anderson, **C. T. Hayes**, H. Ren, R. Gersonde, G. H. Haug (2014), [Using the natural spatial pattern of marine productivity in the Subarctic North Pacific to evaluate paleo-productivity proxies](#), *Paleoceanography* 29, 438–453.
7. Serno, S., G. Winckler, R. F. Anderson, **C. T. Hayes**, D. McGee, B. Machalett, H. Ren, S. M. Straub, R. Gersonde, G. H. Haug (2014), [Eolian dust input to the Subarctic North Pacific](#), *Earth and Planetary Science Letters* 387, 252–263.
6. **Hayes, C. T.**, R. F. Anderson, M. Q. Fleisher, S. Serno, G. Winckler, R. Gersonde (2013), [Quantifying lithogenic inputs to the North Pacific Ocean using the long-lived thorium isotopes](#), *Earth and Planetary Science Letters* 383, 16–25. → Highlighted on [geotraces.org](#)
5. **Hayes, C. T.**, R. F. Anderson, S. L. Jaccard, R. François, M. Q. Fleisher, M. Soon, and R. Gersonde (2013), [A new perspective on boundary scavenging in the North Pacific Ocean](#), *Earth and Planetary Science Letters* 369–370, 86–97. → Highlighted on [geotraces.org](#)
4. Jaccard, S. L., **C. T. Hayes**, A. Martinez-Garcia, D. A. Hodell, R. F. Anderson, D. M. Sigman, and G. H. Haug (2013), [Two modes of change in Southern Ocean productivity over the past million years](#), *Science* 339, 1419–1423.
3. **Hayes, C. T.**, R. F. Anderson, and M. Q. Fleisher (2011), [Opal accumulation rates in the equatorial Pacific and mechanisms of deglaciation](#), *Paleoceanography* 26, PA1207. →Featured in [Eos](#)

2. Ariya, P. A., J. Sun, N. A. Eltouny, E. D. Hudson, **C. T. Hayes**, and G. Kos (2009), [Physical and chemical characterization of bioaerosols - Implications for nucleation processes.](#) *International Reviews in Physical Chemistry* 28, 1–32.
1. Mortazavi, R., **C. T. Hayes**, and P. A. Ariya (2008), [Ice nucleation activity of bacteria isolated from snow compared with organic and inorganic substrates.](#) *Environmental Chemistry* 5, 373–381.

Manuscripts submitted or in preparation:

Hayes, C. T., D. McGee, J. Rosen, E. A. Boyle (2016), Thorium distributions in high and low dust regions and the significance for iron supply (submitted to *Global Biogeochemical Cycles*).

Hayes, C. T., L.-S. Wen, C.-P. Lee, P. H. Santschi, K. Johannesson (2016), Metals in the Gulf of Mexico: synthesis and future directions (in preparation for *Chemical Oceanography of the Gulf of Mexico*, Texas A&M University Press, eds. T. S. Bianchi, H. Bustos-Serrano).

Invited talks:

Texas A&M University: Oceanography seminar (November 2016)

Tulane University: Earth and Environmental Science seminar (October 2016)

MIT: Sack Lunch Seminar (April 2015)

University of Southern Mississippi: Special Lecture (April 2015)

Caltech: Environmental Science and Engineering Seminar (February 2015)

University of Michigan: Smith Lecture (November 2014)

MIT: Chemical Oceanography and Geobiology seminar (November 2014)

Stony Brook University: SOMAS seminar (August 2013)

MIT: Chemical Oceanography and Geobiology seminar (March 2013)

Woods Hole Oceanographic Institution: “Climate and Paleo” seminar (March 2013)

Dissertations Symposium in Chemical Oceanography XXIII (Hawaii, October 2012)

Princeton University: mini-conference on Fe fertilization (May 2012)

Service & professional activities:

Outstanding Student Paper Awards Coordinator, Ocean Sciences Section, AGU Fall Meeting 2016

USM-Committee service: Division of Marine Science Outreach and Website committees (2016–); School of Ocean Science and Technology Governance committee (2016–); and College of Science and Technology Faculty council (2016–)

Volunteer, National Ocean Sciences Bowl: Hurricane Bowl, Ocean Springs, MS, 2016–2017

Volunteer, Peter Anderson Festival Outreach, Ocean Springs, MS, 2016

NSF-Ocean Sciences Review Panel Member, 2015

Officer, Professional Development Organizing Committee for the Center for Microbial Oceanography: Research and Education (C-MORE), 2014–2015

HAYES Curriculum vitae 5

Organizer, Lamont-Doherty Earth Observatory's weekly departmental seminar for Geochemistry, 2012–2013

Co-chair, Session on marine micro-nutrients from the GEOTRACES program for the AGU Fall Meeting, 2012

American Geophysical Union, member: 2009–present

Geochemical Society, member: 2010–present

Association for the Sciences of Limnology and Oceanography, member: 2016–present

Peer Reviewer: *Nature Communications*; *Geophysical Research Letters*; *Earth and Planetary Science Letters*; *Journal of Geophysical Research-Oceans*; *Geochimica et Cosmochimica Acta*; *Limnology & Oceanography*; *Geochemistry, Geophysics, Geosystems*; *Paleoceanography*; *Analytica Chimica Acta*; *Marine Geology*; *Estuarine, Coastal and Shelf Science*; *Journal of Industrial and Engineering Chemistry*; *NSF and NSERC proposals*

Ocean and Field Research Expeditions (~147 days at sea):

- | | |
|------------------------|--|
| October 2016 | USM Graduate Student Field Trip and Sampling Expedition
<i>R/V Point Sur</i> : Gulfport, MS to Deepwater Horizon well site, 2 days at sea. Water sampling and student training. |
| April, November 2016 | Mississippi Sound and Barrier Island Sampling
Assisted Drs. Hannah Box and DongJoo Joung (USM) in sampling of seawater and groundwater. 4 Day trips to Ship and Horn Islands |
| July–August 2015 | SCOPE/C-MORE Summer Cruise
Simons Collaboration of Ocean Processes and Ecology
<i>R/V Kilo Moana</i> (KM1513): Honolulu, HI to Honolulu, HI
12 days at sea; Water sampling and filtration/ultrafiltration |
| May–June 2014 | UNOLS Chief Scientist Training Cruise
<i>R/V Atlantic Explorer</i> (AE1410): Bridgetown, Barbados to St. Georges, Bermuda, 9 days at sea; Aerosol and water sampling |
| March 2014 | Northwest Andros Island, Bahamas (Three Creeks area)
Water and sediment coring in tidal flats; 3 days in field |
| September 2013 | Hawaii Ocean Experiment – Phosphorus Rally II (HOE-PhoR II)
<i>R/V Kilo Moana</i> (KM1316): Honolulu, HI to Honolulu, HI,
12 days at sea; Water sampling and filtration/ultrafiltration |
| November–December 2011 | U. S. GEOTRACES: North Atlantic Zonal Transect, Leg 2
<i>R/V Knorr</i> (KN204-1A+B): Woods Hole, MA to St. Georges, Bermuda to Praia, Cape Verde, 35 days at sea
Water Sampling Manager |
| October 2010 | U. S. GEOTRACES: North Atlantic Zonal Transect, Leg 1
<i>R/V Knorr</i> (KN199-4): Lisbon, Portugal to Mindelo, Cape Verde, 20 days at sea; Water Sampling Manager |

HAYES Curriculum vitae 6

July–August 2009 The Innovative North Pacific Experiment (INOPEX)
R/V *Sonne* (SO-202): Tomakomai, Japan to Busan, South Korea,
50 days at sea; Water, sediment, and plankton sampling

Prior Research Experience:

2007–2008 Research Assistant for Dr. Parisa Ariya (Chemistry and
Atmospheric and Oceanic Sciences, McGill University) – Bio-
aerosols and ice nucleation – Air and snow sampling

Summer 2006 Research Assistant for Dr. Claire Rutledge (Entomology,
Connecticut Agricultural Experiment Station) – Chemical ecology
of wood-boring insects – State-wide tree survey, bio-assays, trap
maintenance

Conference Presentations and Abstracts (first author only):

Hayes, C. T., J. N. Fitzsimmons, P. L. Morton, D. McGee, E. A. Boyle (2017), Diel trace metal variations in the North Pacific subtropical gyre, *ASLO Aquatic Sciences Meeting* (Honolulu, HI, February).

Hayes, C. T., S. Severmann, A. Anderson (2016), Uranium-234 anomalies in authigenic uranium as a new oxygenation proxy in the Southern Ocean, *AGU Fall Meeting* (San Francisco, CA, December).

Hayes, C. T., D. McGee, E. A. Boyle, S. Mukhopadhyay, A. C. Maloof (2016), Isotopic accounts of mineral dust deposition in the northwestern subtropical Atlantic from seasons to recent millennia, *AGU Ocean Sciences Meeting* (New Orleans, LA, February). Oral Presentation.

Hayes, C. T., D. McGee, E. A. Boyle (2015), Thorium isotope observations for the dust proxy from Barbados to Bermuda and at Station ALOHA, *Royal Society Meeting on ocean trace element chemistry* (London, December). Poster Presentation.

Hayes, C. T., A. Martinez-Garcia, A. P. Hasenfratz, S. L. Jaccard, D. A. Hodell, D. M. Sigman, G. H. Haug, R. F. Anderson (2014), A millennial-scale reduction in ventilation of the deep South Atlantic during the last interglacial period, *AGU Fall Meeting* (San Francisco, CA, December). Oral Presentation.

Hayes, C. T., E. A. Boyle, D. McGee, J. N. Fitzsimmons, R. F. Anderson (2014), $^{232}\text{Th}/^{230}\text{Th}$ at the Hawaii Ocean Time-Series Station ALOHA: A tool for iron cycling. *AGU Ocean Sciences Meeting* (Honolulu, HI, February). Poster Presentation.

Hayes, C. T., R. F. Anderson, M. Q. Fleisher, L. F. Robinson, K. F. Huang, D. C. Ohnemus, P. J. Lam, R. L. Edwards, H. Cheng, S. B. Moran (2013), Scavenging intensity and elemental fractionation in the North Atlantic. *Gordon Research Conference: Chemical Oceanography* (Biddeford, ME, August). Poster Presentation.

Hayes, C. T., R. F. Anderson, M. Q. Fleisher, R. Gersonde (2013), Quantifying lithogenic inputs to the North Pacific Ocean using the long-lived thorium isotopes. *93rd Annual AMS Meeting: Robert A. Duce Symposium* (Austin, TX, January). Oral Presentation.

HAYES Curriculum vitae 7

Hayes, C. T., R. F. Anderson (2012), Rapid uranium enrichment in the South Atlantic during Marine Isotope Stage 5e. *Gary C. Comer Abrupt Climate Change Conference* (Leeward Farm, WI, September). Oral Presentation.

Hayes, C. T., R. F. Anderson, M. Q. Fleisher, L. F. Robinson, K. F. Huang, D. C. Ohnemus, P. J. Lam, R. L. Edwards, H. Cheng, S. B. Moran (2012), Scavenging and fractionation of $^{231}\text{Pa}/^{230}\text{Th}$ in the U. S. North Atlantic GEOTRACES transect. *AGU Fall Meeting* (San Francisco, CA, December). Oral Presentation.

Hayes, C. T., R. F. Anderson, M. Q. Fleisher, R. Gersonde (2012), The nature of boundary scavenging in the North Pacific Ocean. *Mineralogical Magazine*, 75, 1825. (Goldschmidt Conference, Montreal, Canada, June). Oral Presentation.

Hayes, C. T., R. F. Anderson, M. Q. Fleisher, L. F. Robinson, H. Cheng, R. L. Edwards, and S. B. Moran (2012), Pa and Th distributions along the GEOTRACES North Atlantic Transect. *AGU Ocean Sciences Meeting* (Salt Lake City, UT, February). Oral Presentation.

Hayes, C. T., S. L. Jaccard, A. Martinez-Garcia, E. D. Galbraith, D. A. Hodell, R. F. Anderson, D. M. Sigman, G. H. Haug (2011), Southern Ocean dynamics regulate atmospheric $p\text{CO}_2$ variability over the past million years. *Gary C. Comer Abrupt Climate Change Conference* (Leeward Farm, WI, September). Oral Presentation.

Hayes, C. T., R. F. Anderson, R. Gersonde (2011), The influence of boundary scavenging and particle composition on dissolved and buried ^{230}Th and ^{231}Pa in the subarctic North Pacific. *Mineralogical Magazine*, 75, 994. (Goldschmidt Conference, Prague, Czech Republic, August). Oral Presentation.

Hayes, C. T., R. F. Anderson (2010), Wind-driven upwelling in the Southern Ocean during glacial terminations. *Gary C. Comer Abrupt Climate Change Conference* (Leeward Farm, WI, September). Oral Presentation.

Hayes, C. T., R. F. Anderson (2010), Wind-driven upwelling in the Southern Ocean across Termination II. *Tenth International Conference on Paleooceanography (ICP-X)* (La Jolla, CA, August). Poster Presentation.

Hayes, C. T., R. F. Anderson, M. Q. Fleisher (2009), Deglacial opal accumulation in the equatorial Pacific and signatures of the Southern Ocean. *AGU Fall Meeting* (San Francisco, CA, December). Oral Presentation.

Workshops:

NOAA Office of Exploration and Research workshop: Honolulu, HI: From Seafloor to Surface: Exploration of the Water Column (March 2017)

National Academies Keck Futures Initiates, Irvine, California: NAKFI conference: Discovering the Deep Blue Sea: Research, Innovation, Social Engagement (November 2016)

University of Hawaii, Honolulu, Hawaii: COME ABOARD: Chemical Oceanography Meeting: A Bottom-Up Approach to Research Directions (October 2016)

La Jolla, California: GEOTRACES cruise planning meeting for Alaska-Tahiti section (October 2016)

HAYES Curriculum vitae 8

Lamont-Doherty Earth Observatory, Palisades, New York: GEOTRACES synthesis meeting on internal cycling of trace elements in the ocean. Discussion group co-chair (August 2016)

London and Chicheley, United Kingdom: Royal Society Meeting on synthesis of GEOTRACES data: sources and sinks of trace elements in the ocean (December 2015).

University of Bern, Switzerland: IPODS Workshop on Past Ocean Dynamics (October 2014)