

# Christopher T. Hayes

99 Hancock St., Apt 8, Cambridge MA 02139; cell: (203)-535-4765  
[cthayes@mit.edu](mailto:cthayes@mit.edu) <http://cthayes.mit.edu>

## 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 Experience:

|                          |   |                    |
|--------------------------|---|--------------------|
| Training:                | Kaufman Teaching Certificate Program (MIT)        | Spring 2015        |
| Mentoring:               | Undergraduate research assistants (MIT)           | Spring–Summer 2015 |
|                          | Cambridge Rindge & Latin High School Intern (MIT) | Spring 2014        |
| Guest Lecturing:         | Paleoceanography (MIT)                            | Spring 2014        |
| Teaching Assistantships: |   |                    |
|                          | Chemistry of Continental Waters (Columbia):       | Spring 2012, 2010  |
|                          | Introduction to Chemical Oceanography (Columbia): | Spring 2011, 2009  |
|                          | Introduction to Oceanography (Columbia):          | Fall 2009          |
|                          | Organic Chemistry I (McGill):                     | Summer 2008        |

**Awards:** Best Student Oral Presentation, R. Duce Symposium, AMS Meeting 2013  
Gary Comer Abrupt Climate Change Fellow, 2010  
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 aerosol dust deposition at the Hawaii Ocean Time-series station and the Northwestern Atlantic and Southern Ocean biogeochemistry (\$134,000), MIT.

**Publications:**

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*, in press.
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), [<sup>230</sup>Th and <sup>231</sup>Pa 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 <sup>231</sup>Pa/<sup>230</sup>Th ratios and a balanced <sup>231</sup>Pa 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](http://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](http://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:**

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 (2015), Testing models of thorium and particle cycling in the Ocean using data from station GT11-22 of the U.S. GEOTRACES North Atlantic Section (submitted).

**Hayes, C. T.**, D. McGee, E.A. Boyle, S. Mukhopadhyay, A. C. Maloof (2015), Isotopic accounts of African dust deposition to the Bahamas over recent millennia (in preparation).

**Invited talks:**

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)

University of Bern, Switzerland: Workshop on Past Ocean Dynamics (October 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:**

NSF-Ocean Sciences Review Panel Member

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

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

Geochemical Society, member: 2010–present

American Geophysical Union, member: 2009–present

Peer Reviewer (total of 13 manuscripts and 2 proposals): *Geophysical Research Letters*; *Earth and Planetary Science Letters*; *Journal of Geophysical Research-Oceans*; *Limnology & Oceanography*; *Geochemistry*, *Geophysics*, *Geosystems*; *Paleoceanography*; *Analytica Chimica Acta*; *Marine Geology*; *NSF and NSERC proposals*

### **Ocean and Field Research Expeditions (~140 days at sea):**

- |                        |  |
|------------------------|--|
| July–August 2015       | SCOPE/C-MORE Summer Cruise<br>Simons Collaboration of Ocean Processes and Ecology<br>R/V <i>Kilo Moana</i> (KM1513): Honolulu, HI to Honolulu, HI<br>12 days at sea; Water sampling and filtration/ultrafiltration |
| May–June 2014          | UNOLS Chief Scientist Training Cruise<br>R/V <i>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)<br>Water and sediment coring in tidal flats; 3 days in field  |
| September 2013         | Hawaii Ocean Experiment – Phosphorus Rally II (HOE-PhoR II)<br>R/V <i>Kilo Moana</i> (KM1316): Honolulu, HI to Honolulu, HI,<br>12 days at sea; Water sampling and filtration/ultrafiltration                      |
| November–December 2011 | U. S. GEOTRACES: North Atlantic Zonal Transect, Leg 2<br>R/V <i>Knorr</i> (KN204-1A+B): Woods Hole, MA to St. Georges,<br>Bermuda to Praia, Cape Verde, 35 days at sea<br>Water Sampling Manager                   |
| October 2010           | U. S. GEOTRACES: North Atlantic Zonal Transect, Leg 1<br>R/V <i>Knorr</i> (KN199-4): Lisbon, Portugal to Mindelo, Cape Verde,<br>20 days at sea; Water Sampling Manager  |
| July–August 2009       | The Innovative North Pacific Experiment (INOPEX)<br>R/V <i>Sonne</i> (SO-202): Tomakomai, Japan to Busan, South Korea,<br>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.**, 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, *2016 Ocean Sciences Meeting* (New Orleans, LA, February).
- 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. *2014 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. *93<sup>rd</sup> Annual AMS Meeting: Robert A. Duce Symposium* (Austin, TX, January). Oral Presentation.
- 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. *2012 Ocean Sciences Meeting* (Salt Lake City, UT, February). Oral Presentation.

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**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  $^{230}\text{Th}$  and  $^{231}\text{Pa}$  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 Paleoceanography (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.