Rogier Braakman

Research Scientist
Department of Earth, Atmospheric and Planetary Sciences
Massachusetts Institute of Technology

Contact:

https://rogierbraakman.com
braakman@mit.edu

Research Interests:

Metabolic Evolution, Microbial Physiology, Ecology & Evolution, Biological Oceanography, Biogeochemistry, Geobiology, Earth History, Origin of Life

Education:

PhD Chemical Physics, Caltech	2010
MSc Chemistry, *Cum Laude*, University of Amsterdam	2003

Experience:

Research Scientist, Dept of Earth, Atmospheric & Planetary Sciences, MIT	2019 – current
Research Scientist, Dept of Civil & Environmental Engineering, MIT	2018 – 2019
Postdoc, CEE & EAPS, MIT	2013 – 2018
Postdoc, the Santa Fe Institute	2009 – 2013
Graduate Researcher, Dept of Chemistry, Caltech	2003 – 2009
Research Assistant, Dept of Astronomy, Leiden University	2001

Honors and Awards (>$470k awarded):

Martin and Beate Block Award, 'Populations, Evolution and Physics' conference, Aspen Center for Physics	2016
Simons Fellow of the Life Sciences Research Foundation [*$180,000/3yrs*]	2014 – 2017
Charles King Trust Fellowship, the Medical Foundation, MA (declined) [*$100,000/2yrs*]	2014 – 2016
Omidyar Fellow, the Santa Fe Institute [*$180,000/3yrs*]	2010 – 2013
'Quantitative Laws of Genome Evolution' workshop participant and travel award	2013
Astrobiology Graduate Conference oral presentation and travel award	2012
International Astronomy Union 'Molecular Universe' conference travel award	2011
Santa Fe Institute Complex Systems Summer School (in Beijing) participant and travel award	2006
Association of Dutch Chemical Industry award (prize to top 30 1st-year chemistry students in the Netherlands)	1998

Publications:

https://scholar.google.com/citations?user=gzla8vQAAAAJ&hl=en

J.M. Lauderdale, **R. Braakman**, G. Forget, S. Dutkiewicz, M.J. Follows, "Microbial feedbacks optimize ocean iron availability", Proceedings of the National Academies of Sciences USA 117, 4842-4849 (2020)
→ *News coverage at MIT News, Yahoo!, New York Times*

R. Braakman, "Evolution of cellular metabolism and the rise of a globally productive biosphere", Free Radical Biology and Medicine 140, 172-187 (2019)

P.M. Berube, A. Rasmussen, **R. Braakman**, R. Stepanauskas, S.W. Chisholm, "Emergence of trait variability through the lens of nitrogen assimilation in *Prochlorococcus*", eLife 8, e41043 (2019)

P.M. Berube, S. Biller, T. Hackl, S. Hogle, B. Satinsky, J. Becker, **R. Braakman**, S. Collins, L. Kelly, J. Berta-Thompson, A. Coe, K. Bergauer, H. Bouman, T.J. Browning, D. De Corte, C. Hassler, Y. Hulata, J. Jacquot, E. Maas, T. Reinthaler, E. Sintes, T. Yokokawa, D. Lindell, R. Stepanauskas, & S. Chisholm, "Single cell genomes of *Prochlorococcus*, *Synechococcus,* and sympatric microbes from diverse marine environments", Scientific Data 5, 180154 (2018)

R. Braakman, M.J. Follows & S.W. Chisholm, "Metabolic evolution and the self-organization of ecosystems", Proceedings of the National Academies of Sciences USA 114, *E3091-3100* (2017)
→ *News coverage at MIT News, Der Spiegel. Attention Score in 96th percentile of all PNAS articles tracked by Altmetric*

R. Braakman & E. Smith, "Metabolic evolution of a deep-branching hyperthermophilic chemoautotrophic bacterium", PLOS One 9, e87950 (2014)

R. Braakman, "Mapping metabolism onto the prebiotic chemistry of hydrothermal vents", Proceedings of the National Academies of Sciences USA 110, *13236-13237* (2013)

R. Braakman & E. Smith, "The compositional and evolutionary logic of metabolism", Physical Biology 10, 011001 (2013)

R. Braakman & E. Smith, "The emergence and early evolution of biological carbon-fixation", PLoS Computational Biology 8, e2002455 (2012)
→ *News coverage at Yahoo!, Huffington Post, NBC, The Scientist Magazine*

R. Braakman & G.A. Blake, "Principles and promise of Fabry-Perot resonators at THz frequencies", Journal of Applied Physics 109**,** 063102 (2011)

R. Braakman, A. Belloche, G.A. Blake, K. Menten, "Search for interstellar methoxyacetonitrile and cyanoethanol: insights into coupling of cyano- to methanol and ammonia chemistry", The Astrophysical Journal 724, 994-1005 (2010)

R. Braakman, B.J. Drouin, S.L. Widicus, G.A Blake, "Extended analysis of hydroxyacetone in the torsional ground state", Journal of Molecular Spectroscopy 264, 43-49 (2010)

R. Braakman, G.A. Blake, "The millimeter-wave spectrum of 2-cyanoethanol", Journal of Molecular Spectroscopy 262, 100-106 (2010)

R. Braakman, G.A. Blake, "The millimeter-wave spectrum of methoxyacetonitrile", Journal of Molecular Spectroscopy 262, 93-99 (2010)

L.-H. Xu, J. Fisher, R.M Lees, H.Y. Shi, J.T. Hougen, J.C. Pearson, B.J. Drouin, G.A. Blake, **R. Braakman**, "Torsion-rotation global analysis of the first three torsional states (vt = 0,1,2) and terahertz database for methanol", Journal of Molecular Spectroscopy 251, 305-313 (2008)

S. L. Widicus, **R. Braakman**, D. R. Kent, IV, G. A. Blake, "The millimeter and submillimeter rotational spectrum of 1,3-dihydroxyacetone", Journal of Molecular Spectroscopy 224, 101-106 (2004)

F. F. S. van der Tak, A. M. S. Boonman, **R. Braakman**, E. F. van Dishoeck, "Sulphur chemistry in the envelopes of massive young stars", Astronomy and Astrophysics 412, 133-145 (2003)

Manuscripts in preparation:

R. Braakman, B. Satinsky, K. Longnecker, J.W. Becker, A. Arellano, K. Dooley, S. Hogle, M.C. Kido Soule, E.B. Kujawinski, S.W. Chisholm, "Niche partitioning of nucleotide cross-feeding among ocean microbes"

K. Longnecker, J.W. Becker, **R. Braakman**, K. Dooley, M.C. Kido Soule, S.W. Chisholm, E.B. Kujawinski, "Composition and diversity of organic carbon excreted by *Prochlorococcus*"

Popular Science:

J.J. Marlow, **R. Braakman**, "Team players. Microbial partnerships turn out to be more common and influential than scientists could have ever imagined", Scientific American 319, 32-39 (2018)

Seminars and Invited Talks:

Seminar, Department of Biology & Molecular Biology and Biochemistry, Dalhousie University (postponed)	3/20
Environmental Geology and Geochemistry Seminary Lecture series, Geosciences, Princeton University	3/20
Seminar, Institute for Advanced Studies	4/19
Seminar, Graduate School of Oceanography, University of Rhode Island	4/19
Seminar, Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution	2/19
Joint seminar, Department of Marine Science & Institute of Bioinformatics, University of Georgia	1/19
Seminar, Earth Systems Science, Stanford University	10/18
Plenary Lecture, Marine Microbes GRC	7/18
Biophysics/Systems Biology Joint Seminar, Boston University	6/18
'The Chemistry of the Ocean Microbiome' seminar series, Woods Hole Oceanographic Institution	4/18
Seminar, Institute for Marine and Coastal Sciences, Rutgers University	2/18
Seminar, Ecosystems Genomics Institute, University of Arizona	2/18
Seminar, Center for Mechanisms of Evolution, ASU	1/18
Plenary Lecture, 6th ELSI International Symposium, Earth-Life Science Institute, Tokyo Tech	1/18
Guest Lecture, Simons Collaboration on the Origin of Life annual meeting, Simons Foundation, NY	11/17
Paleobiology/Geobiology seminar series, Earth & Planetary Sciences, Harvard University	10/17
Seminar, Marine Science, University of North Carolina	9/17
Joint seminar, Biology & Earth and Atmospheric Sciences, Georgia Tech	9/17
'Biogeochemical Dating in Deep Time', UConn/MIT Workshop	5/17
Seminar, Santa Fe Institute	4/17

Department Lecture Series, Earth, Atmospheric and Planetary Sciences, MIT	3/17
EEB seminar, Ecology and Evolutionary Biology, Yale University	2/16
GeoSci Seminar, Geophysical Sciences, University of Chicago	2/16
IGB Seminar, Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign	2/16
Seminar, Dept of Geology and Geophysics, Yale University	1/16
Sack Lunch seminar, Program for Atmospheres, Oceans and Climate, MIT	9/14
Environmental Science and Engineering Seminar, Linde Center for Global Environmental Science, Caltech	4/14
'Quantitative Laws of Genome Evolution' workshop, Lake Como School for Advanced Studies	7/13
Origins of Life workshop, Earth-Life-Science-Initiative, Tokyo Tech University	6/13
'Engines of Life: Thermodynamic Pathways to Metabolism', NASA/ASU Beyond Center workshop	5/13
Seminar, Institute for Marine and Coastal Sciences, Rutgers University	4/13
'Catalytic Mechanisms and the Emergence of Biochemical Networks' (co-organizer), SFI/NSF workshop	5/12
Bauer Forum, Bauer Center for Systems Biology, Harvard University	10/11
Seminar, Geophysical Laboratory, Carnegie Institute of Washington	6/11
Seminar, Center for Biodynamics, Boston University	3/10
Seminar, Santa Fe Institute	2/10

Selected recent conference presentations:

R. Braakman, B. Satinsky, K. Longnecker, J.W. Becker, K. Dooley, A. Arellano, S. Hogle, M.C. Kido Soule, E.B. Kujawinski, S.W. Chisholm, "Nucleotide cross-feeding links the marine microbial carbon and nitrogen cycles" Ocean Sciences 2020, February 2020 (talk)

R. Braakman, B. Satinsky, K. Longnecker, J.W. Becker, K. Dooley, A. Arellano, S. Hogle, M.C. Kido Soule, E.B. Kujawinski, S.W. Chisholm, "Emergence of a cryptic nitrogen cycle in the co-evolution of *Prochlorococcus* and sympatric heterotrophs" AGU Fall meeting, December 2018 (talk)

R. Braakman, B. Satinsky, K. Longnecker, J.W. Becker, K. Dooley, S. Hogle, M.C. Kido Soule, E.B. Kujawinski, S.W. Chisholm, "*Prochlorococcus* as a model system for evolutionary biogeochemistry: insights from comparative metabolomics" 4D Workshop: Deep-time Data Driven Discovery and the Evolution of Earth, June 2018 (poster, *invited*)

R. Braakman, B. Satinsky, K. Longnecker, J.W. Becker, K. Dooley, S. Hogle, M.C. Kido Soule, E.B. Kujawinski, S.W. Chisholm, "Linking metabolic regulation of *Prochlorococcus* to global niche partitioning of heterotrophs", Boston Bacterial Meeting, June 2018 (poster)

R. Braakman, K. Longnecker, J.W. Becker, K. Dooley, M.C. Kido Soule, E.B. Kujawinski, S.W. Chisholm, "Evolutionary metabolomics suggests *Prochlorococcus* drives an oceanic nucleotide economy", IMBIZO 5: Marine biosphere research for a sustainable ocean: Linking ecosystems, future states and resource management**,** October 2017 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Evolutionary self-organization of oceanic microbial ecosystems and Neoproterozoic ocean oxygenation", 1st Geobiology Society Conference, June 2017 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Metabolic evolution and the self-organization of ecosystems", 2016 Annual Life Science Research Foundation meeting, October 2016 (talk)

R. Braakman, M.J. Follows, S.W. Chisholm, "Metabolic evolution and the organization of ecosystems: insights from the microbial oceans", Gordon Research Conference on Unifying Ecology Across Scales, July 2016 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Metabolic evolution and the organization of ecosystems: insights from the microbial oceans", Gordon Research Conference on Marine Microbes, June 2016 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Evolution of electron flows and the organization of ecosystems", Boston Bacterial Meeting, June 2016 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Evolution of electron flows and the organization of ecosystems", Northeastern Geobiology Symposium, April 2016 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Evolution of electron flows and the emergence of ecosystems", Gordon Research Conference on Geobiology, January 2016 (poster)

R. Braakman, M.J. Follows, S.W. Chisholm, "Evolution of electron flows and the emergence of ecosystems", Populations, Evolution, and Physics Conference, Aspen Center for Physics, January 2016 (poster)

Outreach and Teaching:

Massachusetts Institute of Technology

Guest Lecturer, 12.090/12.S492: the Phylogenomic Planetary Record	2017

Santa Fe Institute

Science consultant on origins of life exhibit at NM Museum of Natural History, Albuquerque	2011 – 2013
Lecturer at SFI Complex Systems Summer School	2012
Lecturer and panelist at NSF-sponsored origins of life workshop for high school teachers, Washington, DC	2011

California Institute of Technology

Summer research mentor: Oversaw the summer research of 3 undergraduate students	2005 – 2007
Teaching Assistant, Ch 21ab: Physical Chemistry: Quantum Mechanics, Atomic and Molecular Spectra	2003, 2005 – 2006
Teaching Assistant, Ch 6 ab: Physical Chemistry lab	2004

Service:

Manuscript peer review

PLOS Computational Biology, Chemical Society Reviews, Proceedings of the National Academy of Sciences, Life, Frontiers in Microbiology, ISME Journal, Proceedings of the Royal Society B: Biological Science, Nature Microbiology, Nature Communications, Philosophical Transaction of the Royal Society B: Biological Sciences, Communications Biology, Science

Grant peer review

NSF Biological Oceanography, NASA Exobiology & Evolutionary Biology (panel reviewer)

Santa Fe Institute

Chair, Colloquium committee	2010 – 2013
Member, Omidyar Fellows selection committee	2010 – 2012

California Institute of Technology

Panel member, International Student Orientation panel on integration and cultural adjustment	2004 – 2006
Member, Foreign Students and Scholars Committee	2005 – 2007