TANJA BOSAK

Curriculum Vitae

Department of Earth, Atmospheric and Planetary Sciences
Massachusetts Institute of Technology E25-649
Cambridge, MA 02139

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Degrees:

Ph.D., Geobiology, California Institute of Technology, 2004, Advisor: Dianne K. Newman

B.S., Geophysics, Zagreb University, 1998

Employment:

Associate Professor of Geobiology, Massachusetts Institute of Technology, 2012-

Cecil and Ida Green Assistant Professor of Geobiology, Massachusetts Institute of Technology, 2007-2012

Postdoctoral Department: Microbial Sciences Initiative, Harvard University, Supervisors: Ann Pearson and Richard Losick

Meteorologist, Zagreb International Airport, 1999

Honors:

AGU Fellows Committee, 2013-2014

UROP Faculty Mentor of the Year, MIT, 2012

The Harold E. Edgerton Award for outstanding achievement in research, teaching, and service to the MIT community, 2012

AGU Fellow, 2011

AGU James B. Macelwane Medalist, American Geophysical Union, 2011

Solomon J. Buschbaum Faculty Initiatives Fund Award, Massachusetts Institute of Technology, 2009

Cecil and Ida Green Career Development Chair, Massachusetts Institute of Technology, 2007

The Subaru Outstanding Woman in Science Award, Geological Society of America, 2007

Invited Participant in Chinese-American Frontiers of Sciences Symposium, the United States National Academy of Sciences and the Chinese Academy of Sciences, 2005-2006

Microbial Sciences Initiative Fellow, Harvard University, 2005-2007

Everhart Distinguished Graduate Student Lecturer Award, California Institute of Technology, 2004

Student Travel Grant for Short Course in Biomineralization, American Mineralogical Society, 2003

Student Travel Award, American Society of Microbiology, 2003

Summer Undergraduate Research Fellowship, California Institute of Technology, 1998

The Award of the Dean of Studies, Faculty of Natural Sciences, Zagreb, Croatia, 1998

UROP Students Supervised:

Diana LaScala-Grunewald, Fall 2007, Spring 2008, Fall 2008, Spring 2008, Spring 2009, graduated May 2011, going to graduate school

Kristen Whaley, Spring 2008, graduated May 2011

Anastasia Maheras, Summer 2008, graduated May 2011, working on a 5th year Master's in EAPS

Jose L. O. Lugo, University of Puerto Rico, Summer 2008

Joan Chen, Fall 2008, Spring 2009, senior

Barry D. Bannon, Spring 2009, Fall 2009, Spring 2010, graduated May 2011

Kevin Gildea, Spring 2010, junior

Matthew Archer, Spring 2010, Summer 2010, junior

John Bardeen, Spring 2010, junior

Lilly Dalton, Smith College, Summer 2010, senior

Eileen Molzberger, University of Wisconsin, Summer 2010, Summer 2011, senior

Emily Chen, Summer 2010, junior

Rachel Harris, Wellesley College, Summer 2011, sophomore

Duane Dennis, Fall 2011, Spring 2012, sophomore

Madeleine O'Grady, Summer 2013, rising sophomore

Camila Ramirez-Arau, Summer 2013, rising sophomore

Ph.D. Students Supervised:

Petroff, Alexander, thesis title "Streams, stromatolites, and the geometry of growth", co-advised with D. Rothman (EAPS), defended in May 2011, Postdoctoral Fellow at The Center for Studies in Physics and Biology at The Rockefeller University.

Sim, Min Sub, thesis title "Physiology of Multiple Sulfur Isotope Fractionation during Microbial Sulfate Reduction", co-advised with S. Ono (EAPS), defended in May 2012, Agouron Postdoctoral Fellow at Northwestern U. and Caltech.

Antler, Gilad, second year graduate student at Cambridge University, UK, co-advised on a project with S. Turchyn (Cambridge), S. Ono (EAPS)

Wang, David, third year graduate student at Woods Hole Oceanographic Institute, co-advised with S. Ono (EAPS)

Yi, Robert, fourth year graduate student at MIT, secondary advisor

Evans, Alex, seventh year graduate student at MIT, secondary advisor (Ph.D. in Planetary Sciences)

Matys, Emily, second year graduate student at MIT, secondary advisor

Newman, Sharon, second year graduate student at MIT, primary advisor, co-advised with R. Summons (EAPS)

Postdoctoral Researchers Supervised:

Florence Shubotz, 2012-present, advisor on a project

Mariotti, Giulio, 2013-present, Crosby postdoctoral fellow in EAPS

Cohen, Phoebe, 2012, assistant professor, Williams College, MA

Templer, Stefanie, 2009-2010, now a unit leader at Roche, Switzerland

Liang, Biqing, 2008-2010, postdoctoral scholar, Academia Sinica, Taiwan

Teaching Experience

12.007 Geobiology, Spring 2008, Spring 2009, Spring 2010, Spring 2011, Spring 2012, Spring 2013

12.080 EAPS Undergraduate Seminar, Spring 2011

12.420 Recitation Instructor for Physics and Chemistry of the Solar System, Spring 2009

12.601 Essentials: Planetary Science, Spring 2009

12.490 Microbial Sediments, Fall 2009

12.092 Seminar in Geobiology and Astrobiology (undergraduate), Fall 2008

12.490 Seminar in Geobiology and Astrobiology (graduate), Fall 2008
12.491 Advanced Seminar in Geology and Geochemistry, Fall 2011
12.471 Fundamentals of Geobiology (graduate), Fall 2012

Service

Internal to MIT:
Freshman advisor 2013-
EAPS *ad hoc* visioning committee 2013
Hooding ceremony, 2012
Speaker in a workshop of high school teachers run by HHMI, MIT, 2011
Host to a high school teacher intern through HHMI, 2010
Foreign Scholarships Committee, 2008-present
EAPS Undergraduate Committee, 2007-present
Thesis advisory committee: four WHOI students, three EAPS students
Generals examination committee: ten MIT and WHOI students, 2007-present
Thesis defense committee: two WHOI students, four EAPS students
Hooding ceremony, 2011
Graduate Women and MIT mentor, 2010-present

External Service:

AGU Fellows Committee member, 2013-2014

Session convener, Astrobiology Science Conference 2012, Atlanta, GA

NOVA Science Café Speaker, Cambridge, MA, 2012

Member of the review editorial board for Frontiers in Microbiological Chemistry, 2011-

Session Convener, "Taphonomy and Organic Geochemistry", V. M. Goldschmidt Conference, Prague, Chech Republic, 2011

Session Convener and Chairwoman, "Geomicrobiology and Fossil Biosignatures", V. M. Goldschmidt Conference, Davos, Switzerland, 2009

Speaker, Girls' Angle, math club for girls 8-13 years old, Cambridge, MA February 2009

Referee, *Applied and Environmental Microbiology*, *Astrobiology*, *Chemical Geology*, *Earth and Planetary Science Letters*, *Geobiology*, *Geology*,

Journal of Bacteriology, Journal of the Royal Society Interface, Journal of Sedimentary Research, Palaios, Science, Nature Scientific Reports, Sedimentology, Geochimica and Cosmochimica Acta, Terra Nova

Science Review Panel, NASA Exobiology Program

External Reviewer: NSF Geobiology and Low-Temperature Geochemistry, NASA Exobiology, NSF Sedimentary Geology and Paleontology

Lecturer, Program in Astrophysics at the Department of Physics, Split, Croatia, 2008

Member of the editorial board of *Geobiology*, 2008-

Speaker at the Geological Society of America mentoring program for women in geology, Denver, CO, 2007

Member of the Organizing Committee of Chinese-American Frontiers of Sciences Symposium, 2006-2007

Publications (asterisk indicates work produced in the MIT Laboratory for Geobiology and Microbial Sedimentology, diamond indicates graduate students and postdocs from this lab):

*◊Petroff, A. P. P., Rothman, D. H., Beukes, N., and *T. Bosak*, Biofilm growth and fossil form, *Physical Review X, in press.*

**Bosak, T.*, ◊Mariotti, G., Perron, J. T., Macdonald, F. A., Pruss, S. B. Microbial sedimentology of stromatolites in the Neoproterozoic cap carbonates, Ecosystems Paleobiology and Geobiology, Paleontological Special Papers, v. 19, Paleontological Society, *in press.*

◊Sim, M. S., ◊Wang, D. T., Semkiw, E. S., Jane, G. M., Wall, J. D., *Bosak, T.* and S. Ono (2013) Fractionation of sulfur isotopes by *Desulfovibrio vulgaris* mutants lacking hydrogenases or type I tetraheme cytochrome c_3, *Frontiers in Microbiological Chemistry*, **4**: doi: 10.3389/fmicb.2013.00171.

Bosak, T.*, Knoll, A. H., and A. P. P. ◊Petroff (2013) The meaning of stromatolites, *Annual Reviews of Earth and Planetary Sciences*, **41, 21-44.

*Dalton, L., *Bosak, T.*, Macdonald, F. A., Lahr, D. G., and S. B. Pruss (2013) Preservational and morphological variability of assemblages of

agglutinated eukaryotes in cap carbonates of the Rasthof Formation, northern Namibia, *Palaios,* **28**, 67–79.

*◊Sim, M. S., ◊Liang, B., ◊Petroff, A. P., ◊Evans, A., Klepac-Ceraj, V., Walter, M. R., Flannery, D. T., and *T. Bosak* (2012) Oxygen-dependent morphogenesis of modern clumped photosynthetic mats and implications for the Archean stromatolite record, *Geosciences,* http://www.mdpi.com/2076-3263/2/4/235

*◊Sim, M.S., *Bosak, T.*, and S. Ono (2012) Effects of iron and nitrogen limitation on sulfur isotope fractionation during microbial sulfate reduction*, Applied and Environmental Microbiology,* doi:10.1128/AEM.01842-12

**Bosak, T.*, ◊Templer, S., Wu, T.-D., ◊Liang, B., Guerquin Kern, J.-L., Mui, J., Vali, H., ◊Evans, A., ◊Sim M. S., Friedman, J., and V. Klepac-Ceraj. (2012) Cyanobacterial composition and activity in modern conical microbialites, *Geobiology*, DOI: 10.1111/j.1472-4669.2012.00334.x.

Bosak, T.*, Lahr D. J. G., Pruss, S. B., Macdonald, F. A., Gooday, A. J., Dalton, L., ◊Matys, E. D. (2012) Possible early foraminiferans in post-Sturtian (716-635 Ma) cap carbonates, *Geology*, **40, 47-50.

*◊Petroff, A. P. P., Wu, T-D., ◊Liang, B., Mui, J., Guerquin-Kern, J.-L., Vali, H., Rothman, D. H., and *T. Bosak* (2011) Reaction-diffusion model of nutrient uptake in a biofilm: theory and experiment, *Journal of Theoretical Biology,***289**, 90-95.

Bosak, T.*, Lahr, D., Macdonald, F. A, ◊Matys, E.D. (2011) Putative Cryogenian ciliates from Mongolia, *Geology*, **39, 1123-1126.

*◊Sim, M. S., *Bosak, T.* and S. Ono (2011) Large sulfur isotope fractionation does not require disproportionation, *Science,* **333**, 74-77.

*◊Sim, M. S., Donovan, K. A., Ono, S., Templer, S. P. and *T. Bosak* (2011) Effect of electron donors on the fractionation of sulfur isotopes by a marine *Desulfovibrio* sp., *Geochimica et Cosmochimica Acta,* **75**, 4244-4259, dx.doi.org/10.1016/j.gca.2011.05.021.

Bosak, T.*, Lahr, D., Pruss, S. B., Macdonald, F. A., Dalton, L. and ◊Matys, E. (2011) Agglutinated tests in post-Sturtian cap carbonates from Namibia and Mongolia, *Earth and Planetary Science Letters,* **308, 29-40, doi:10.1016/j.epsl.2011.05.030.

Bosak, T. (2011) Microbial contribution to the precipitation of calcium carbonate minerals, *Encyclopedia of Geobiology*, H.W. Fritz, J. Reitner, A. Kappler, V. Thiel, K. Konhauser, P. Reid, X. Zhang (editors), Springer Verlag, Germany.

Pruss, S. B., *Bosak, T.*, Macdonald, F. A., McLane, M., P. F. Hoffman (2010) Microbial facies in a Sturtian cap carbonate, the Rasthof Formation, Otavi Group, northern Namibia, *Precambrian Research*, **181**, 187-198.

*◊Petroff, A. P., ◊Sim, M. S., Maslov, A., Krupenin, M., Rothman, D. H., and *T. Bosak* (2010) Biophysical basis for the geometry of conical stromatolites, *Proceedings of the National Academy of Sciences of the U.S.A.*, **107**, 9956-9961.

Bosak, T.*, Bush, J., Flynn, M., ◊Liang, B., Ono, S., ◊Petroff, A. P., and ◊M. S. Sim (2010) Formation and stability of oxygen-rich bubbles that shape photosynthetic mats, *Geobiology*, **8, 45-55.

Brocks, J. J., *Bosak, T.*, and A. Pearson (2009) Oligoprenyl-curcumanes and other new aromatic isoprenoids from the 1.64 billion years old Barney Creek Formation, *Organic Geochemistry* **40**, 795-801.

Bosak, T.*, ◊Liang, B., ◊Sim, M. S., and ◊A. P. Petroff (2009) Morphological record of oxygenic photosynthesis in conical stromatolites, *Proceedings of the National Academy of Sciences of the U.S.A.*, **106, 10939-10943.

Kontnik, R., *Bosak, T.*, Butcher, R. A., Brocks, J. J., Losick, R., Clardy, J., and A. Pearson (2008) Sporulenes, heptaprenyl metabolites from *Bacillus subtilis* spores, *Organic Letters*, **10**, 3551-3554.

Bosak, T., Losick, R. and A. Pearson (2008) A polycyclic terpenoid that alleviates oxidative stress, *Proceedings of the National Academy of Sciences of the U.S.A.*, **105**, 6725-6729.

Maloof, A. C., Kopp, R. E., Grotzinger, J. P., Fike, D. A., *Bosak, T.***,** Vali, H., Poussart, P. M., Weiss, B. P. and J. L. Kirschvink (2007) Sedimentary iron cycling and the origin and preservation of magnetization in platformal carbonate muds, Andros Island, Bahamas, *Earth and Planetary Science Letters*, **259**, 581-598.

Bosak, T., Greene, S., and D.K. Newman (2007) A likely role for anoxygenic photosynthetic microbes in the formation of ancient stromatolites, *Geobiology*, **5**, 119-126.

Bosak, T. and D. K. Newman (2005) Microbial kinetic controls on calcite morphology in supersaturated solutions, *Journal of Sedimentary Research*, **75**, 190-199.

Bosak, T., Souza-Egipsy, V., and D. K. Newman (2004) An abiotic model for peloid formation, *Geobiology*, **2,** 189-198.

Bosak, T., Souza-Egipsy, V., Corsetti, F.A., and D. K. Newman (2004) Micron-size porosity as a biosignature in carbonate crusts, *Geology*, **32**, 781-784.

Bosak, T. and D. K. Newman (2003) Microbial nucleation of calcium carbonate in the Precambrian, *Geology*, **31**, 577-580.

Bosak, T. and A. P. Ingersoll (2002) Shear instabilities as a probe of Jupiter's atmosphere, *Icarus*, **158**, 401-409.

Submitted and In Progress Publications:

*◊Cohen, P., ◊Matys, E. D., Macdonald, F. A., Pruss, S. B., and *Bosak, T.* Putative macroalgal fossils from the Cryogenian of Mongolia, *submitted*.

◊Meredith, L. K., Rao, D., *Bosak, T.*, Hansell, C. M., Ono, S., Prinn, R. G., Consumption of atmospheric H_2 during the life cycle of soil-dwelling *Actinobacteria*, *in revision*.

**Bosak, T.,* ◊Matys, E., Byrd, L., Freeman, K., and Macdonald, F. Record of marine surface productivity in isotopically extreme Cryogenian carbonates, *in preparation*.

*◊Liang, B., Wu, T.D., Guerquin-Kern, J.L., Vali, H., Sun, H.-J., ◊Sim, M.S., Wang, C.-H., *Bosak, T.* Cyanophycin mediates the accumulation and storage of carbon in non-heterocystous filamentous cyanobacteria from coniform mats, *to be submitted*.

*McNeill, D., ◊Matys, E., *Bosak, T.* Raman spectroscopic evaluation of the thermal maturity of agglutinated foraminifera, *in preparation*.

Schubotz, F., ◊Sim, M.S., Ono, S., Summons, R., *Bosak, T*. Production of ornithine lipids in nitrogen-fixing cultures of a sulfate reducing δ-Proteobacterium, *in preparation*.

*◊Mariotti, G., Perron, T. and *Bosak, T.* Elongation of stromatolites through feedbacks between flow, sediment motion and microbial growth on sand bars, *to be submitted*.

*◊Mariotti, G., Pruss, S.B., Perron, J.T., O'Grady, M. and Bosak, T. Microbial shaping of wrinkle structures in siliciclastic deposits, *in preparation*.

Rothman, D. H. and *Bosak, T*. Reconciling the stability and final rise of free oxygen on the seafloor, *in preparation.*

Invited Presentations:

"The meaning of stromatolites", Origins of Life symposium at the Max Plank Institute, Dresden, July 2013, *invited talk*

"The meaning of stromatolites", University of California, Berkeley, May 2013

"Records of early metabolisms and biological evolution in stromatolites", Geological Association of Canada Annual Meeting, May 2012, St. John's, Canada, *invited talk*

"Stromatolites and biofilms", "Celebrating a dynamic planet", the Kongsberg seminar, Kongsberg, Norway, May 2012, *invited talk*

"Signs of photosynthesis on the Early Earth", NASA Astrobiology Science Conference, April 2012, Atlanta, GA, *invited talk*

"The meaning of stromatolites", Department of the Geophysical Sciences, University of Chicago, February 2012

"Towards a theory of stromatolites", "Unique opportunities in Geobiology" symposium of the International GeoBiology Summer Course, Golden, CO, 2011

"Modern eukaryotes between the two Snowballs", annual meeting of the NASA Astrobiology Institute team, MIT, Cambridge, MA, 2011

"Towards a theory of stromatolites", Department of Geology and Geophysics, Yale University, 2011

"Towards a theory of stromatolites", a series of three lectures at Petrobras, Rio de Janeiro, Brazil, 2011

"What they eat is how they fractionate: controls on sulfur isotope fractionations during microbial sulfate reduction in culture and nature", *invited talk,* AGU Fall Meeting, San Francisco, CA, 2010

"Evolution of modern eukaryotes and the Cryogenian global changes", *invited talk,* AGU Fall Meeting, San Francisco, CA, 2010

"Life between the Snowballs", Department of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, 2010

"Life between the Snowballs", Program in Organismic and Evolutionary Biology, University of Massachusetts, Amherst, MA, 2010

"Evolution of photosynthesis", Science for the Public televised seminar series, 2010

"Life between the Snowballs", Microbial Science Initiative Seminar Series, Harvard University, Cambridge, MA, 2010

"Growth geometry of modern conical stromatolites", Goldschmidt Conference, Knoxville, TN, 2010

"Life between the two Snowballs", annual geobiology symposium "Advent of Complex Life and the Neoproterozoic-Cambrian transition", Harvard University, Cambridge MA, 2010

"Growth geometry of modern and ancient photosynthetic biofilms", Earth System Initiative Young Faculty Talk Series, MIT, 2010

"Surviving the Snowball", MIT alumni breakfast, 2009

"Growth geometry of modern sedimentary structures", OEB and EPS, Harvard University, 2009

"The evolution of photosynthesis", MIT Darwin Bicentennial Symposium, 2009

"Conical stromatolites as records of microbial processes", Department of Environmental Sciences and Engineering, MIT, 2008

"Zivot na mladom planetu", popular science lecture, Split, Croatia, 2008

"What do geostable lipids do in modern bacteria?", Faculty of Physics, University of Split, Croatia, 2008

"What do geostable lipids do in modern bacteria?", Chemical Oceanography Seminar Series, Woods Hole Oceanographic Institute, Woods Hole, MA, 2008

” Conical stromatolites as records of microbial processes”, Department of Earth Sciences, University of California, Santa Cruz, CA, 2008

“Conical stromatolites as records of microbial processes”, Department of Geosciences, Princeton University, Princeton, NJ, 2008

“Morphology of microbial aggregates as a biomarker”, Plenary Session, NASA Astrobiology Science Conference, San Jose, CA, 2008

“What do geostable lipids do in modern bacteria?”, Faculty of Geosciences,University of Tübingen, Tübingen, Germany, 2007

“Stromatolites as records of early life on Earth”, Department of Earth Sciences, University of Washington, Seattle, WA, 2006

“What do polycyclic terpenoids do in modern bacteria?”, Department of Earth Sciences, University of Washington, Seattle, WA, 2006

“Stromatolites as records of early life on Earth”, Department of Earth, Atmospheric and Planetary Sciences, MIT, 2006

“What do polycyclic terpenoids do in modern bacteria?”, Department of Earth, Atmospheric and Planetary Sciences, MIT, 2006

“Stromatolites as records of early life on Earth”, Department of Geosciences, Dartmouth College, Hanover, NH, 2006

“What do polycyclic terpenoids do in modern bacteria?”, Department of Geosciences, Dartmouth College, Hanover, NH, 2006

“Laboratory models of ancient stromatolites”, Everhart Lecture, California Institute of Technology, Pasadena, CA, 2005

“Laboratory models of ancient stromatolites”, Department of Geology and Geophysics, Yale University, New Haven, CT, 2005

“Finding microbial imprints in the Precambrian stromatolites”, mini-symposium, Geobiology Summer Course, Agouron Institute and USC, Bozeman, MT, 2003