

Ariel D. Anbar

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President's Professor
School of Earth & Space Exploration
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Education

1996 Ph.D. (Geochemistry) California Institute of Technology, Pasadena, CA
1991 M.S. (Geochemistry) California Institute of Technology, Pasadena, CA
1989 A.B. (Geological Sciences and Chemistry) Harvard College, Cambridge, MA

Mentors

Graduate: G. J. Wasserburg & Y. L. Yung; Undergraduate: H. D. Holland

Professional Experience

2013 – present President's Professor
2009 – 2013 Professor
2004 – 2009 Associate Professor
School of Earth & Space Exploration (formerly Dept. of Geological Sciences)
Dept. of Chemistry & Biochemistry
Arizona State University

2009 – present Director, ASU Astrobiology Program
2010 – 2011 Associate Director, ASU Origins Project
2014 – present Distinguished Sustainability Scientist, Global Institute of Sustainability
2010 – 2014 Senior Sustainability Scientist, Global Institute of Sustainability

2002 – 2004 Associate Professor
1996 – 2002 Assistant Professor
Dept. of Earth & Environmental Sciences and Dept. of Chemistry
University of Rochester

Post-Ph.D. Supervisees (alphabetical)

Dr. Gail Arnold, Ph.D. 2004, U. Rochester; ASU. Research Scientist, '05 – '07
Dr. Jane Barling, Ph.D. 1990, Monash University; UR Research Scientist, '98 – '02
Dr. Melanie Channon, Ph.D. 2012, Caltech; ASU Bisgrove Postdoctoral Fellow, '12 – present
Dr. Gwyneth Gordon, Ph.D. 2002, Yale University; ASU Research Scientist '03 – present
Dr. Lev Horodyskyj, Ph.D. 2010, Pennsylvania State University; ASU Instructor '10 – present
Dr. Amy Kelly, Ph.D. 2009, MIT; ASU Postdoctoral Fellow, '11 – '12
Dr. Brian Kendall, Ph.D. 2008, U. Alberta; Agouron Postdoctoral Fellow (ASU), '08 – '12
Dr. Brian Majestic, Ph.D. 2007, U. Wisc.; Dreyfus Env. Sci. Fellow (ASU), '07 – '09
Dr. Amisha Poret-Peterson, Ph.D. 2009, U. Louisville; ASU Research Scientist, '12 – present
Dr. Steven Romaniello, Ph.D. 2012, ASU; ASU Research Scientist, '14 – present
Dr. Mou Roy, Ph.D. 2011, Oregon State; ASU Research Scientist, '12 – '15
Dr. Christopher Siebert, Ph.D. 2002, U. Bern (Switzerland), ASU Postdoct. Fellow, '05 – '06
Dr. Laura Wasylenki, Ph.D. 1998, Caltech; ASU Research Scientist, '04 – '10

Dr. Felisa Wolfe-Simon, Ph.D. 2006, Rutgers; ASU Postdoctoral Fellow, '06 – '07
Dr. Gregory Wortman, Ph.D. 1998, Syracuse University; UR Research Associate, '99 – '01

Awards & Honors

Individual

Fellow, Geochemical Society (Elected 2015)
President-Elect, Biogeosciences Section of the American Geophysical Union, 2014 – present
Howard Hughes Medical Institute Professor, 2014
President's Professor, Arizona State University, 2013
Award for Excellence (education/academic), International Academy of Visual Arts, 2013
Selected "Most Influential Professor" by a graduating athlete, Arizona State University, 2013
Visiting Professor, Hebrew University, Jerusalem, Israel, Spring 2012
Last Lecture Series Award, Arizona State University, 2006
Fellow, Geological Society of America (Elected 2003)
Young Scientist Award (Donath Medal), Geological Society of America, 2002
Cindy Arveson Memorial Award, California Institute of Technology, 1993
NSF Graduate Research Fellowship, California Institute of Technology, 1989 – 1992
Homestake Mining and Economic Geology Award, Harvard University, 1988
Harvard College Scholarship, 1986 - 1989
National Merit Scholarship, 1985

As Mentor

Outstanding Student Poster Award, AGU, Marc Neveu (ASU), 2013
NSF Graduate Student Fellowship, Bryan Rolfe (ASU/Cornell), 2011
Nininger Meteorite Award, Greg Brenneka (ASU), 2010
GSA Outstanding Student Research Award, Greg Brenneka (ASU), 2010
P.E.O. International Scholar Award, Jennifer Glass (ASU), 2010
Student Poster 1st Prize, SoCA Geobiology Symposium, Jennifer Glass (ASU), 2010
Student Poster 2nd Prize, AbSciCon, Jennifer Glass (ASU), 2010
Brian Mason Award of the Meteoritical Society, Greg Brenneka (ASU), 2009
Goldwater Scholarship, Bryan Rolfe (ASU), 2008
Outstanding Student Talk, SoCal Geobiology Symp. Jennifer Glass (ASU), 2007
Student Poster 1st Prize, AbSciCon, Gail Arnold (UR), 2004
Outstanding Student Poster Award, AGU, Matt Polizzotto (UR), 2000
Goldwater Scholarship, Matt Polizzotto (UR), 2000

Major Professional Service

NASA and Related

SETI Institute Scientific Advisory Board, 2014 – present
Member, Planetary Science Subcommittee of the NASA Advisory Council, 2014 – present
Exobiology Program Review Panel Chief, 2014
Astrobiology Roadmap Workshop, 2014
Deputy PI, Life Investigations For Enceladus (LIFE) mission concept, 2012 – present
Member of Science Team, Enceladus Life Finder (ELF), 2014 – present
Member, NASA Astrobiology Institute Executive Council, 2009 – 2014
Member, Supporting Research & Technology SAG, MEPAG, 2010

Member, Mars Mid-Rover SAG, MEPAG, 2009
Member, Science & Technology Committee of the Human Space Flight Review Team, 2009
Chair, Science Steering Committee, Astrobiology Science Conference, 2007 – 2008
Member, Joint Science Definition Team, Europa Jupiter System Mission, 2008 – present
Member, Science Organizing Committee, Pale Blue Dot III, 2006
Member, Science Organizing Committee, AbSciCon, 2006
Member, Science Organizing Committee, NAC Lunar Exploration Science Workshop, 2006
Member, Planetary Science Subcommittee of the NASA Advisory Council, 2006 – 2008
Invited Oral Testimony to President's Commission on Moon, Mars and Beyond, 2004
Member, Mars-Moon Science Steering Group, NASA, 2004
Member, Lunar Exploration Analysis Group (LEAG), NASA, 2005 - present
Co-Chair, Mission to Early Earth Focus Group, NASA Astrobiology Institute, 2001 – 2007
Co-Chair, Deep Time Drilling Project, 2002 – present
Member of Steering Committee, Astrobiology Drilling Program, 2003 – present
Panelist, NASA Early Career Workshop, LPSC Meeting, '04

Other Extramural

President-Elect, Biogeosciences Section of the American Geophysical Union, 2014 – present
Co-Editor, *Chemical Geology Special Issue dedicated to H.D. Holland*, 2012 – 2013
Specialty Chief Editor, *Frontiers in Microbiological Chemistry*, 2010 – present
Advisory Board, *Metallomics* (RSC), 2010 – present
Editorial Board, *Chemical Geology* (Elsevier), 2006 – present
Editorial Board, *Metallomics* (RSC), 2008 – 2010
Editorial Board, *Geology* (GSA), 2003 – 2005; 2006 – 2008
Editorial Advisory Board, *Geobiology* (Blackwell Publishing), 2003 – 2008
Elected Councillor, Int'l Society for the Study of the Origin of Life; ISSOL, 2008 - 2011
Co-Chair, Gordon Conference on Environmental Bioinorganic Chemistry, 2008 – 2010
Member, International Program Committee, Goldschmidt '05, '06
Co-Convener: ~ 25 special sessions at AGU, GSA and Goldschmidt meetings
Invited Participant to various workshops including: Life Detection (NAS, 2000); Geobiology (Amer. Acad. Microbio., 2000); Paleoproxies (NSF, 2005); Biosignatures (NRC, 2006); Oxygen (Agouron, 2006); Deep Drilling (Agouron, 2006); Nitrogen (Agouron, 2009); Geobiology (NSF, 2010); Astrobiology Roadmap (2014)
Reviewer of publications for GCA, EPSL, Chem. Geol., Anal. Chem., Science, Nature
Reviewer of proposals for NSF and NASA

ASU – SESE/GLG

Promotion and Tenure Committee, 2008 – 2009 (sabbatical substitute); 2012 – present
Ad Hoc Bateman Space Allocation Committee, Chair, 2011 – 2013
Search Committee for Isotope Geochemistry Faculty, 2012 - 2013
Heptennial Review Committee, 2010 – 2011
Graduate Committee, 2005 – 2008 (Chair of Oversight Subcommittee, 2007-2008)
Faculty Search Advisory Committee, 2006
GLG/SESE Honors Disciplinary Advisor, 2005 – present
Search Committee for SESE Director, 2005 – 2006
Faculty Safety Officer, 2004 – 2005
Structure/Governance Subcommittee (during SESE conceptualization process), 2004

Active participant of various ad hoc committees for faculty searches and curriculum redesign

ASU – Department of Chemistry & Biochemistry

Committee on Interdepartmental Relations, 2014 – present

Committee on School Formation, 2014 – present

Committee on Online Course Materials and Development, 2014 – present

Personnel and Budget Committee, 2008 – 2009; 2012 – present

Strategic Planning – Chemistry of Global Sustainability – Committee, 2008

Strategic Planning Committee, 2007

Awards Committee, 2007 – 2008

Search Committee for Bioinorganic Faculty, 2005

Septennial Review Committee, 2005

Seminar Committee, 2004 – 2005

ASU – Other

President’s Academic Council, 2014 – present

Advisory Board, Institute for the Science of Teaching and Learning, 2014 – present

Chair, Provost’s Working Group on General Education, 2013 – 2014

Panelist, Funding Success Skills Series, OKED ASU, 2014

Member, General Studies Council, 2013 – present

Arizona Science Education Consortium Executive Committee, 2012 – present

ReSETS Committee, CLAS and Mary Lou Fulton Teacher’s College, 2011 – 2012

Provost’s Committee on Excellence in Digital Learning and Teaching, 2011 - present

Biodesign Graduate Program Committee, 2012 – present

Director, ASU Astrobiology Program, 2009 – present

Origins Project Faculty Advisory Committee, 2009 – present

Origins Symposium Program Committee, 2008 – 2009

Provisional Steering Committee, Environmental Life Science Graduate Program, 2008

Curriculum Development, School of Sustainability (no formal committee), 2006 – 2008

Keck Laboratory Executive Committee, 2004 – present

ASU Provost’s Teaching Awards Committee, 2007

Organizer, Biogeochemistry Interest Group (w/Hilairy Hartnett), 2005 – 2006

U. Rochester

V.P. Campus Affairs, Hillel of Rochester Area Colleges, 2001 – 2002

Faculty Advisor, Sigma Epsilon Fraternity, 2001 – 2004

Freshman Housing Implementation Committee, 2000 – 2002

Residential College Commission, 1997 – 1999

Faculty-in-Residence, 1996 – 1999

Panelist for NSF and NASA funding programs

Significant Public Outreach & Media Coverage

Scientific American coverage of Habitable Worlds, 2015

<http://blogs.scientificamerican.com/observations/2015/01/21/habitable-worlds-course/>

Campus Technology coverage of Inspark Science Network, 2015

<http://campustechnology.com/articles/2015/01/20/college-network-transforming-science-gains-momentum.aspx>

Inside Higher Ed coverage of Habitable Worlds, 2014

<https://www.insidehighered.com/news/2014/10/10/emerging-adaptive-software-puts-faculty-members-charge-course-creation>

Higher Ed Live webcast: Thought Leaders in Ed Tech: The Inspark Science Network
<http://www.higheredlive.com/thought-leaders-in-ed-tech-the-inspark-science-network/>

NSF Discoveries feature on HHMI-supported immersive virtual field trips, 2014
http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=132758

Organizer and panelist for ASU National and Global Issues Forum: Space Exploration: How and Why? November, 2013, National Press Club
<http://forum.asu.edu/forum/space-exploration>
<http://sese.asu.edu/news/success-new-space-era-hinges-publics-interest>

Emerge 2013 Workshop Lead: Is the Truth Out There? Hunting for Habitable Worlds.
<http://emerge2013.asu.edu/workshops/is-the-truth-out-there-hunting-for-habitable-worlds/>

eLiterate feature story, 2013
<http://mfeldstein.com/the-openclass-vision-an-example/>

TED Ed Video, A Needle in Countless Haystacks: Finding Habitable Worlds, 2012
<http://ed.ted.com/lessons/a-needle-in-countless-haystacks-finding-habitable-planets-ariel-anbar>

American Institute of Physics video production on Ca isotopes and bone, 2012
 Filmed in 2012; in production

Channel 8 (PBS), ASU Discovers: Science of Detection, 2012
http://www.youtube.com/watch?v=V6cLr40_4Rw

Chemical Heritage Foundation Podcast: Bones, 2012
<http://www.chemheritage.org/discover/media/distillations/164-bones.aspx>

SIFT Podcast: Define Life, 2012
<http://siftpodcast.com/define-life/>

Channel 12 (NBC), *12 News*: 2012: End of the World? (w/Michael Smith), 2011
<http://www.azcentral.com/video/#/2012%3A+End+of+the+world%3F/1339820820001>

Channel 8 (PBS), *Horizons*: Ocean Chemistry Research (w/Greg Brenneka), 2011
<http://www.azpbs.org/arizonahorizon/detail.php?id=1748#OceanChemistryResearch>

Scottsdale Museum of Contemporary Art: science presentation for “90 Days over 100”, 2010
<http://phxated.com/scott-andrews/90-days-over-100-at-smoca-closing-event/>

KJZZ (PBS), *Interview with Dennis Lambert*: Uncovering Earth’s Oxygenation, 2010
http://archive.kjzz.org/news/arizona/archives/201010/ME_OceanOxygen

Channel 8 (PBS), *Horizons*: New Life on Earth (w/Paul Davies), 2010
<http://www.azpbs.org/arizonahorizon/detail.php?id=1516#NewLifeonEarth>

Channel 8 (PBS), *Minds over Matters*: pilot (w/Phil Christensen), 2009
<http://www.azpbs.org/video/play.php?vidId=1521>

Science Friday: Astrobiology & the Origin of Life (with panel), 2009
<http://www.sciencefriday.com/program/archives/200904032>

Publications and Presentations

* = Anbar-advised student first author

= Anbar-advised postdoc or staff first author

¶ = Anbar-advised visiting student or scientist first author

*Total Refereed Publications in Print or Press (self-counted): 112**Total Citations (Google Scholar): 7259 (5195 since 2009)**h-index (Google Scholar): 45 (39 since 2009)**i10-index (Google Scholar): 87 (80 since 2009)***Refereed Publications in Print or Press:**

1. #G. W. Gordon, J. Monge, M. B. Channon, Q. Wu, J. L. Skulan, A. D. Anbar and R. Fonseca (2014). Predicting multiple myeloma disease activity by analyzing natural calcium isotopic composition. *Leukemia* doi:10.1038/leu.2014.193.
2. ¶K. T. Goto, A. D. Anbar, G. W. Gordon, S. J. Romaniello, G. Shimoda, Y. Takaya, A. Tokumaru, R. Nozaki, K. Suzuki, S. Machida, T. Hanyu and A. Usui (2014). Uranium isotope systematics of ferromanganese crusts in the Pacific Ocean: Implications for the marine $^{238}\text{U}/^{235}\text{U}$ isotope system. *Geochim. Cosmochim. Acta* **146**: 43-58.
3. *M. Neveu, A. T. Poret-Peterson, Z. M. P. Lee, A. D. Anbar and J. J. Elser (2014). Prokaryotic cells separated from sediments are suitable for elemental composition analysis. *Limnol. Oceanogr.: Methods* **12**: 519-529.
4. P. A. Young, S. J. Desch, A. D. Anbar, R. Barnes, N. R. Hinkel, R. Kopparapu, N. Madhusudhan, N. Monga, M. D. Pagano, M. A. Riner, E. Scannapieco, S-H. Shim and A. Truitt (2014). Astrobiological stoichiometry. *Astrobiology* **14**: 603-626.
5. S. J. Desch, P. A. Young, A. D. Anbar, N. Hinkel, M. Pagano, A. Truitt and M. Turnbull (2014). Report on a NASA Astrobiology Institute-funded Workshop Without Walls: Stellar Stoichiometry. *Astrobiology* DOI: 10.1089/ast.2014.1157.
6. C. P. McKay, A. D. Anbar, C. Porco and P. Tsou (2014). Follow the plume: the habitability of Enceladus. *Astrobiology* DOI: 10.1089/ast.2014.1158.
7. T. F. Nägler, A. D. Anbar, C. Archer, T. Goldberg, G. W. Gordon, N. D. Greber, C. Siebert, Y. Sohrin, and D. Vance (2014). Proposal for an international molybdenum isotope measurement standard and data representation. *Geostand. Geoanal. Res.* **38**: 149-151.
8. *J. B. Glass, A. Chappaz, B. Eustis, A. C. Heyvaert, D. Waetjen, H. E. Hartnett and A. D. Anbar (2013). Molybdenum geochemistry in a seasonally dysoxic Mo-limited lacustrine ecosystem. *Geochim. Cosmochim. Acta*, **114**: 204-219.

9. *J. B. Glass, A. T. Poret-Peterson, F. Wolfe-Simon and A. D. Anbar (2013). Molybdenum limitation induces expression of the molybdate-binding protein Mop in a freshwater nitrogen-fixing cyanobacterium. *Adv. Microbiol.* **3**: 9-15.
10. T. Goldberg, G. Gordon, G. Izon, C. Archer, C. R. Pearce, J. McManus, A. D. Anbar and M. Rehkämper (2013). Resolution of inter-laboratory discrepancies in Mo isotope data: an intercalibration. *J. Anal. At. Spectrom.* DOI: 10.1039/C3JA30375F.
11. #B. Kendall, G. A. Brennecka, S. Weyer and A. D. Anbar (2013). Uranium isotope fractionation suggests oxidative uranium mobilization at 2.50 Ga. *Chem. Geol.* **362**: 105-114.
12. Y. Marusenko, J. Shipp, G. A. Hamilton, J. L.L. Morgan, M. Keebaugh, H. Hill, A. Dutta, X. Zhuo, N. Upadhyay, J. Hutchings, P. Herckes, A. D. Anbar, E. Shock and H. E. Hartnett (2013). Bioavailability of nanoparticulate hematite to *Arabidopsis thaliana*. *Environ. Pollut.* **174**: 150-156.
13. *C. Mead, J. R. Lyons, T. M. Johnson and A. D. Anbar (2013). Unique Hg stable isotope signatures of compact fluorescent lamp-sourced Hg. *Env. Sci. Tech.* **47**: 2542-2547.
14. *C. Mead, P. Herckes, B. J. Majestic and A. D. Anbar (2013). Source apportionment of aerosol iron in the marine environment using iron isotope analysis. *Geophys. Res. Lett.* **40**: 5722-5727.
15. *S. Romaniello, A. D. Herrmann and A. D. Anbar (2013). Uranium concentrations and $^{238}\text{U}/^{235}\text{U}$ isotope ratios ($^{238}\text{U}/^{235}\text{U}$) in modern carbonates from the Bahamas: assessing a novel paleoredox proxy. *Chem. Geol.* **362**: 305-316.
16. C. Scott, N. J. Planavsky, C. L. DuPont, B. Kendall, B. C. Gill, L. J. Robbins, K. F. Husband, G. L. Arnold, B. A. Wing, S. W. Poulton, A. Bekker, A. D. Anbar, K. O. Konhauser and T. W. Lyons (2013). Bioavailability of zinc in marine systems through time. *Nature (Geoscience)* **6**: 125-128.
17. *G. L. Arnold, T. W. Lyons, G. W. Gordon and A. D. Anbar (2012). Extreme change in sulfide concentrations in the Black Sea during the Little Ice Age reconstructed using molybdenum isotopes. *Geology* **40**: 595-598.
18. A. Chappaz, T. W. Lyons, G. Gordon and A. D. Anbar (2012). Isotopic fingerprints of anthropogenic molybdenum in lake sediments. *Env. Sci. Tech.* **46**: 10934-10940.
19. #A. D. Herrmann, B. Kendall, T. J. Algeo, G. W. Gordon, L. E. Wasylenki and A. D. Anbar (2012). Anomalous molybdenum isotope trends in Upper Pennsylvanian euxinic facies: Significance for use of $\delta^{98}\text{Mo}$ as a global marine redox proxy. *Chem. Geol.* **324-325**: 87-98.

20. *J. L. L. Morgan, J. L. Skulan, G. W. Gordon, S. J. Romaniello, S. M. Smith and A. D. Anbar (2012). Rapidly assessing changes in bone mineral balance using natural stable calcium isotopes. *Proc. Nat. Acad. Sci.* **109**: 9989-9994.
21. J. D. Owens, T. W. Lyons, X. Li, K. G. Macleod, G. Gordon, M. M. M. Kuypers, A. Anbar, W. Kuhnt and S. Severmann. (2012). Iron isotope and trace metal records of iron cycling in the proto-North Atlantic during the Cenomanian-Turonian oceanic anoxic event (OAE-2). *Paleoceanography* **27**, PA3223, 13 pp.
22. †S. K. Sahoo, N. J. Planavsky, B. Kendall, X. Wang, X Shi, C. Scott, A. D. Anbar, T. W. Lyons and G. Jiang (2012). Ocean oxygenation in the wake of the Marinoan glaciation. *Nature*, **489**: 546-549.
23. P. Tsou, D. E. Brownlee, C. P. McKay, A. D. Anbar, H. Yano, K. Altwegg, L. W. Beegle, R. Dissly, N. J. Strange and I. Kanik (2012). LIFE: Life Investigation For Enceladus, A Sample Return Mission Concept in Search for Evidence of Life. *Astrobiology* **12**: 730-742.
24. *G. A. Brennecka, A. D. Herrmann, T. J. Algeo and A. D. Anbar (2011). Rapid expansion of oceanic anoxia immediately before the end-Permian extinction. *Proc. Nat. Acad. Sci.* **108**: 17631-17634; doi/10.1073/pnas.1106039108.
25. †T. W. Dahl, D. E. Canfield, M. T. Rosing, R. Frei, G. W. Gordon, A. H. Knoll and A. D. Anbar (2011). Molybdenum evidence for expansive sulfidic water masses in ~750 Ma oceans. *Earth Planet. Sci. Lett.* **311**: 264-274.
26. †T. W. Dahl, E. U. Hammarlund, A. D. Anbar, D. P. G. Bond, B. C. Gill, G. W. Gordon, A. H. Knoll, A. T. Nielsen, N. H. Schovsbo and D. E. Canfield (2011) Reply to Butterfield: Devonian rise in atmospheric oxygen correlated to the radiations of terrestrial plants and large predatory fish. *Proc. Nat. Acad. Sci.* **108**: E29; doi: 10.1073/pnas.1018818108.
27. *J. L. Morgan, G. W. Gordon, C. Arrua, J. Skulan, T. D. Bullen and A. D. Anbar (2011). High precision measurement of variations in calcium isotope ratios in urine by multiple collector inductively coupled plasma mass spectrometry (MC-ICP-MS). *Anal. Chem.* **83**: 6956-6962.
28. #B. Kendall, G. W. Gordon, S. W. Poulton and A. D. Anbar (2011). Molybdenum isotope constraints on the extent of late Proterozoic ocean euxina. *Earth Planet. Sci. Lett.* **307**: 450-460.
29. #L. E. Wasylenki, C. L. Weeks, J. R. Bargar, T. G. Spiro, J. R. Hein and A. D. Anbar (2011). The molecular mechanism of Mo isotope fractionation during adsorption to birnessite. *Geochim. Cosmochim. Acta* **75**: 5019-5031.
30. E. S. Boyd, A. D. Anbar, S. Miller, T. L. Hamilton, M. Lavin and J. W. Peters (2011). A late methanogen origin for molybdenum-dependent nitrogenase. *Geobiology* **9**: 221-232. doi: 10.1111/j.1472-4669.2011.00278.x

31. *G. Brennecka, L. E. Wasylenki, S. Weyer and A. D. Anbar (2011). Uranium isotope fractionation during adsorption to manganese oxides. *Env. Sci. Tech.* **45**: 1370-1375. dx.doi.org/10.1021/es103061v
32. †B. D. Duval, P. Dijkstra, S. A. Natali, J. P. Megonigal, M. E. Ketterer, B. G. Drake, M. T. Lerdau, G. Gordon, A. D. Anbar and B. A. Hungate (2011). Plant-soil distribution of potentially toxic elements in response to elevated atmospheric CO₂. *Env. Sci. Tech.* **45**: 2570-2574. dx.doi.org/10.1021/es102250u
33. L. J. Liermann, R. Mathur, L. E. Wasylenki, J. Nueter, A. D. Anbar and S. L. Brantley (2011). Extent and isotopic composition of Fe and Mo release from two Pennsylvania shales in the presence of organic ligands and bacteria. *Chem. Geol.* **281**: 167-180.
34. F. Wolfe-Simon, J. Switzer Blum, T. R. Kulp, G. W. Gordon, S. E. Hoefft, J. Pett-Ridge, J. F. Stolz, S. M. Webb, P. K. Weber, P. C. W. Davies, A. D. Anbar and R. S. Oremland (2011). A bacterium that can grow by using arsenic instead of phosphorus. *Science* **332**: 1163 – 1166.
35. F. Wolfe-Simon, J. Switzer Blum, T. R. Kulp, G. W. Gordon, S. E. Hoefft, J. Pett-Ridge, J. F. Stolz, S. M. Webb, P. K. Weber, P. C. W. Davies, A. D. Anbar and R. S. Oremland (2011). Response to Comments on “A bacterium that can grow by using arsenic instead of phosphorus”. *Science* DOI: 10.1126/science.1202098
36. R. Raiswell, C. T. Reinhard, A. Derkowski, J. Owens, S. H. Bottrell, A. D. Anbar and T. W. Lyons (2011). Formation of syngenetic and early diagenetic iron minerals in the late Archean Mt. McRae Shale, Hamersley Basin, Australia: New insights on the patterns, controls and paleoenvironmental implications of authigenic mineral formation. *Geochim. Cosmochim. Acta* **17**: 1072-1087; doi:10.1016/j.gCA2010.11.013.
37. *G. A. Brennecka, S. Weyer, M. Wadhwa, P. Janney, A. D. Anbar and J. Zipfel (2010). ²³⁸U/²³⁵U variations in meteorites: extant ²⁴⁷Cm and implications for Pb-Pb dating. *Science* **327**: 449-451; doi: 10.1126/science.1180871.
38. *G. A. Brennecka, L.E. Borg, I. D. Hutcheon, M. A. Sharp and A. D. Anbar (2010). Natural variations in uranium isotope ratios of uranium ore concentrates: Understanding the ²³⁸U/²³⁵U fractionation mechanism. *Earth Planet. Sci. Lett.* **291**: 228-233; doi: 10.1016/j.epsl.2010.01.023.
39. †T. W. Dahl, A. D. Anbar, G. W. Gordon, M. T. Rosing, R. E. Frei and D. E. Canfield (2010). The behavior of molybdenum and its isotopes across the chemocline and in the sediments of sulfidic Lake Cadagno, Switzerland. *Geochim. Cosmochim. Acta* **74**: 144-163; doi: 10.1016/j.gCA2009.09.018.
40. †T. W. Dahl, E. U. Hammarlund, A. D. Anbar, D. P. G. Bond, B. C. Gill, G. W. Gordon, A. H. Knoll, A. T. Nielsen, N. H. Schovsbo and D. E. Canfield (2010) Devonian rise in

- atmospheric oxygen correlated to the radiations of terrestrial plants and large predatory fish. *Proc. Nat. Acad. Sci.* **107**: 17911-17915; doi: 10.1073/pnas.1011287107.
41. *Y. Duan, A. D. Anbar, G. L. Arnold, T. W. Lyons, G. W. Gordon and B. Kendall (2010). Molybdenum isotope evidence for mild environmental oxygenation before the Great Oxidation Event. *Geochim. Cosmochim. Acta* **74**: 6655-6668; doi: 10.1016/j.epsl.2009.11.052.
 42. *Y. Duan, A. D. Anbar, G. Gordon, S. Severmann, T. W. Lyons and B. Sageman (2010). Isotopic evidence for Fe cycling and repartitioning in ancient oxygen-deficient settings: Examples from black shales of the mid-to-late Devonian Appalachian basin. *Earth Planet. Sci. Lett.* **290**: 244-253; doi: 10.1016/j.epsl.2009.11.052.
 43. *J. Glass, F. Wolfe-Simon, J. J. Elser and A. D. Anbar (2010). Molybdenum–nitrogen co-limitation in freshwater and coastal heterocystous cyanobacteria. *Limnol. Oceanogr.* **55**: 667-676.
 44. #B. Kendall, A. J. Kaufman, C. Reinhard, T. W. Lyons and A. D. Anbar (2010). Pervasive oxygenation along late Archean ocean margins. *Nature (Geoscience)* **3**: 647-652; doi: 10.1038/NNGEO942.
 45. K. J. Knudson, H. M. Williams, J. E. Buikstra, P. D. Tomczak, G. W. Gordon and A. D. Anbar (2010). Introducing $\delta^{88/86}\text{Sr}$ analysis in archaeology: a demonstration of the utility of strontium isotope fractionation in paleodietary studies. *J. Archeol. Sci.* **37**: 2352-2364; doi:10.1016/j.jas.2010.04.009.
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Published Abstracts:

1. A. Anbar, G. Bruce, S. Semken, R. Summons, S. Buxner, L. Horodyskij, B. Kotrc, J. Swann, S. Klug Boonstra, and C. Oliver (2014). Virtual exploration of Earth's evolution. Abstract ED34A-03 presented at the 2014 Fall Meeting, AGU, San Francisco, CA, 15-19 Dec.
2. [#]G. Bruce, A. Anbar, S. Semken, R. Summons, C. Oliver, and S. Buxner (2014). iVFTs - immersive virtual field trips for interactive learning about Earth's environment. Abstract ED52A-1141 presented at the 2014 Fall Meeting, AGU, San Francisco, CA, 15-19 Dec.
3. ^{*}X. Chen, S. Romaniello, A. Herrmann, L. Wasylenki and A. Anbar (2014). Uranium isotope fractionation during coprecipitation with aragonite and calcite. Abstract PP51C-1141 presented at the 2014 Fall Meeting, AGU, San Francisco, CA, 15-19 Dec.

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12. A. I. Sheen, B. Kendall, C. Reinhard, A. D. Anbar, R. A. Creaser, J. Lyons, A. Bekker, S. W. Poulton (2014). Quantitative constraints on the extent of Middle Proterozoic ocean anoxia from modeling of the oceanic mass balance of rhenium. *Geological Society of America Abstracts with Programs* **46**: 581.
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 18. D. R. Bell and A. D. Anbar (2013). Oxygen titration of continental lithosphere and the rise of atmospheric O₂. Abstract V41E-05 presented at the 2013 Fall Meeting, AGU, San Francisco, CA, 8-13 Dec.
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 20. *M. Neveu, A. T. Poret-Peterson, A. D. Anbar and J. J. Elser (2013). Ordinary stoichiometry of extraordinary microbes. Abstract B23F-0605 presented at the 2013 Fall Meeting, AGU, San Francisco, CA, 8-13 Dec.
 21. S. K. Sahoo, G. Jiang, N. J. Planavsky, B. Kendall, J. D. Owens, A. D. Anbar and T. W. Lyons (2013). Ediacaran redox fluctuations. Abstract PP44B-05 presented at the 2013 Fall Meeting, AGU, San Francisco, CA, 8-13 Dec.
 22. [#]G. W. Gordon, J. Monge, M. B. Channon, Q. Wu, J. Skulan, A. D. Anbar and R. Fonseca (2013). Calcium isotopic composition and its association with multiple myeloma disease activity. Abstract presented at the 55th American Society of Hematology Annual Meeting and Exposition, New Orleans, LA, Dec. 7-10.
 23. A. D. Anbar, L. Horodyskyj, D. Ben-Naim and S. Semken (2013). Innovation online: inverting the lecture-lab paradigm in science education. *Geological Society of America Abstracts with Programs* **45**: 656.
 24. [#]G. Bruce, A. D. Anbar, K. E. Karlstrom and L. J. Crossey (2013). Virtual field exploration of Grand Canyon geology and geologic history. *Geological Society of America Abstracts with Programs* **45**: 399.

25. M. Elrick, T. J. Algeo, V. J. Polyak, L. Zhao, Z. Q. Chen, A. Herrmann Y. Asmerom and A. D. Anbar (2013). Late Permian through early Triassic marine redox and continental weathering flux patterns interpreted from U and Nd isotopes: implications for end-Permian extinction models. *Geological Society of America Abstracts with Programs* **45**: 89.
26. S. K. Sahoo, G. Jiang, N. J. Planavsky, B. Kendall, J. D. Owens, A. D. Anbar and T. W. Lyons (2013). Turbulent times for early animals? *Geological Society of America Abstracts with Programs* **45**: 754.
27. A. Anbar and T. Lyons (2013). Redox-sensitive metals and their isotopes: the Holland legacy of early ocean exploration. Abstract presented at the 23rd V. M. Goldschmidt Conference, Florence, Italy, 25-30 August. *Mineralogical Magazine* **77**: 590.
28. [#]M. Channon, G. Gordon, Q. Schollenberger, J. Morgan, S. Smith and A. Anbar (2013). Understanding controls on Ca isotopes in human blood and urine. Abstract presented at the 23rd V. M. Goldschmidt Conference, Florence, Italy, 25-30 August. *Mineralogical Magazine* **77**: 853.
29. G. Gordon, J. Skulan, M. Channon, R. Fonseca and A. Anbar (2013). Early detection of osteolytic lesions in multiple myeloma using natural Ca isotopes. Abstract presented at the 23rd V. M. Goldschmidt Conference, Florence, Italy, 25-30 August. *Mineralogical Magazine* **77**: 1198.
30. A. Herrmann, T. Algeo, S. Romaniello, G. Gordon and A. Anbar (2013). Molybdenum and uranium isotope dynamics in a paleozoic epicontinental black shale. Abstract presented at the 23rd V. M. Goldschmidt Conference, Florence, Italy, 25-30 August. *Mineralogical Magazine* **77**: 1293.
31. R. Fonseca, J. Skulan, G. Gordon, and A. D. Anbar (2013). Early detection of osteolytic lesions in multiple myeloma using natural Ca isotopes. 14th International Myeloma Workshop, Kyoto, Japan. April 3-7.
32. A. D. Anbar, J. Skulan, G. Gordon and J. Morgan (2013). Metallomic markers in medicine. Abstract presented at the Pittcon 2013 Conference, Philadelphia, PA, March 17-21. **Invited.**
33. A. D. Anbar, B. Kendall, C. Reinhard and T. W. Lyons (2012). Evidence of environmental oxygenation before the Great Oxidation Event: a status report. Abstract B54B-02 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
34. M. P. Field, S. J. Romaniello, G. W. Gordon and A. D. Anbar (2012). Automated sample preparation for radiogenic and non-traditional metal isotope analysis by MC-ICP-MS. Abstract V23B-2823 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.

35. A. D. Herrmann, G. W. Gordon, S. J. Romaniello, T. J. Algeo and A. D. Anbar (2012). Spatial heterogeneity of uranium isotope variations in a Phanerozoic, epicontinental black shale (Hushpuckney Shale, Swope Formation). Abstract B11G-04 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
36. A. Marcotte, B. J. Majestic, A. D. Anbar and P. Herckes (2012). The effect of particle size on iron solubility in atmospheric aerosols. Abstract A33D-0203 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
37. *C. Mead, P. Herckes, B. J. Majestic and A. D. Anbar (2012). Quantifying anthropogenic Fe in marine aerosols using Fe stable isotope analysis. Abstract OS41A-1698 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
38. *A. A. Monroe, P. Williams and A. D. Anbar (2012). Sampling and analysis of organic molecules in the plumes of Enceladus. Abstract P32A-07 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
39. *M. Neveu, A. T. Poret-Peterson, Z. M. Lee, A. D. Anbar and J. J. Elser (2012). Cell-sediment separation and elemental stoichiometries in extreme environments. Abstract B51D-0583 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
40. #A. T. Poret-Peterson, S. J. Romaniello, M. Bose, P. Williams, J. J. Elser, E. Shock, A. D. Anbar and H. E. Hartnett (2012). Abstract B51G-0646 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
41. P. Tsou, I. Kanik, D. Brownlee, C. McKay, A. Anbar, D. Glavin and H. Yano (2012). Returning samples from Enceladus. Abstract P33A-1920 presented at the 2012 Fall Meeting, AGU, San Francisco, CA, 3-7 Dec.
42. H. Pacheco, W. L. Taylor, S. Semken, A. E. Benbow, C. Mably, I. MacGregor, A. D. Anbar and W. Burelson (2012). Leveraging resources: AGI-ASU-NASA triad model for Earth and space science teacher professional development. *Geological Society of America Abstracts with Programs* **44**: 574.
43. A. Herrmann, S. Romaniello, P. Reid and A. Anbar (2012). U isotopes in marine calcareous algae: a paleo-redox proxy? Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June.
44. #A. Kelly, T. Lyons, E. Alsop, G. Love, N. Planavsky, B. Kendall and A. Anbar (2012). Geochemical perspectives on local versus global ocean redox at 1.64 Ga. Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June. **Invited.**
45. #B. Kendall, A. Anbar, R. Creaser, T. Lyons, A. Bekker and S. Poulton (2012). Rhenium data from shales confirms ferruginous Proterozoic deep oceans. Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June.

46. N. Monga, S. J. Romaniello and A. D. Anbar (2012). Isotopic fractionation of U(VI) during reduction by sulphide. Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June.
47. *S. J. Romaniello, A. D. Herrmann and A. D. Anbar (2012). Incorporation and early diagenesis of Mo and U isotope records in Bahamian carbonate sediments. Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June. **Invited.**
48. *S. R. Romaniello, G. Gordon, D. Wiederin, M. P. Field and A. D. Anbar (2012). Automated sample purification: Radiogenic and non-traditional metal isotopes in the 21st century. Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June.
49. S. Sahoo, N. Planavsky, B. Kendall, X. Wang, X. Shi, A. Anbar, T. Lyons and G. Jiang (2012). Ocean redox changes in the wake of the Marinoan glaciation. Abstract presented at the 22nd V. M. Goldschmidt Conference, Montreal, Canada, 24-29 June.
50. A. D. Anbar, Y. Duan, B. Kendall, C. Reinhard, S. Severmann and T. W. Lyons (2011). A Multi-Proxy Paradigm in the Pursuit of Ocean Paleoredox. Abstract PP41E-05 presented at the 2011 Fall Meeting, AGU, San Francisco, CA, 4-9 Dec. **Invited.**
51. *G. L. Arnold, T. W. Lyons, G. W. Gordon and A. D. Anbar (2011). Extreme change in sulfide concentrations near the Bosphorus Inlet (Black Sea) during the Little Ice Age tracked using molybdenum isotopes. Abstract PP51B-1846 presented at the 2011 Fall Meeting, AGU, San Francisco, CA, 4-9 Dec.
52. #L. Horodyskyj, D. Ben-Naim, A. D. Anbar and S. Semken (2011). Hunting for habitable worlds: engaging students in an adaptive online setting. Abstract ED24B-08 presented at the 2011 Fall Meeting, AGU, San Francisco, CA, 4-9 Dec.
53. K. Noonan, A. D. Anbar, F. Garcia-Pichel, A. T. Poret-Peterson and H. E. Hartnett (2011). Six siderophore-producing microorganisms identified in biological soil crusts. Abstract B32A-04 presented at the 2011 Fall Meeting, AGU, San Francisco, CA, 4-9 Dec.
54. J. Skulan, G. W. Gordon, J. Morgan, S. J. Romaniello, S. M. Smith and A. D. Anbar (2011). Natural Ca isotope composition of urine as a rapid measure of bone mineral balance. Abstract B54D-08 presented at the 2011 Fall Meeting, AGU, San Francisco, CA, 4-9 Dec.
55. *C. Mead, S. Semken and A. D. Anbar (2011). Identifying misconceptions about biogeochemistry among undergraduates. *Geological Society of America Abstracts with Programs* **43**: 68.

56. A. D. Anbar, B. Kendall, C. T. Reinhard and T. W. Lyons (2011). Whither the whiff? *Mineral. Mag.* **75**: 433. **Keynote.**
57. [#]B. Kendall, T. Komiya, T. W. Lyons, S. M. Bates, G. Jiang, R. A. Creaser, S. Xiao, K. McFadden, Y. Sawaki, M. Tahata, D. Shu, J. Han, Y. Li, X. Chu and A. D. Anbar (2011). First episode of widespread ocean oxygenation 551 Myr ago. *Mineral. Mag.* **75**: 1168. **Invited.**
58. T. W. Lyons, G. L. Arnold, A. Chappaz, B. C. Gill, N. J. Planavsky, C. T. Reinhard, N. Riedinger, C. T. Scott and A. D. Anbar (2011). Molybdenum as a paleoredox proxy: An update. *Mineral. Mag.* **75**: 1373. **Keynote.**
59. ^{*}J. L. L. Morgan, G. W. Gordon, S. J. Romaniello, J. L. Skulan, S. M. Smith and A. D. Anbar (2011). Rapidly assessing changes in bone mineral balance using natural stable calcium isotopes. *Mineral. Mag.* **75**: 1501.
60. [#]A. T. Poret-Peterson, S. J. Romaniello, N. Zolotova, Z. Martinez, J. J. Elser and A. D. Anbar (2011). Methylophony in Yellowstone National Park hot springs. *Mineral. Mag.* **75**: 1660.
61. ^{*}S. J. Romaniello, H. E. Hartnett, A. D. Anbar, J. J. Elser and E. L. Shock (2011). Nitrogen limitation in extremophilic hydrothermal ecosystems of Yellowstone National Park. *Mineral. Mag.* **75**: 1746.
- S. K. Sahoo, G. Jiang, B. Kendall, N. J. Planavsky, X. Wang, X. Shi, A. D. Anbar and T. W. Lyons (2011). An oxygen window for early Ediacaran animal life. *Mineral. Mag.* **75**: 1778.
62. C. T. Scott, N. Planavsky, B. Kendall, B. Wing, A. Bekker, A. D. Anbar and T. W. Lyons (2011). Tracking Archean seawater trace metal inventories through multi-proxy analysis of euxinic black shales. *Mineral. Mag.* **75**: 1831. **Invited.**
63. L. E. Wasylenki, E. B. Wilkes and A. D. Anbar (2011). Is your clean lab full of zinc? *Mineral. Mag.* **75**: 2135.
64. S. Weyer, C. Montoya-Pino, G. W. Gordon, B. van de Schootbrugge, W. Oschmann, J. Pross and A. D. Anbar (2011). The extent of oceanic anoxic events revealed by correlated Mo- and U isotopes records. *Mineral. Mag.* **75**: 2151.
65. J. Owens, T. W. Lyons, S. Severmann, B. Gill, H. Jenkyns, M. M. M. Kuypers, G. Gordon, A. Anbar and W. Kuhn (2011). Global Perturbation of the Marine Iron Cycle During OAE-2. Climate and Ocean Dynamics of the Cretaceous Greenhouse World
66. A. E. Kelly, G. D. Love, T. W. Lyons and A. D. Anbar (2010). An integrated organic-inorganic geochemical study of the 1.64 Ga Barney Creek Formation in Australia. Abstract B51G-0429 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec. **Invited.**

67. [#]B. Kendall, G. W. Gordon, S. Poulton and A. D. Anbar (2010). Molybdenum isotope constraints on the extent of late Paleoproterozoic ocean euxinia. Abstract OS33E-1513 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec.
68. ^{*}C. Mead, A. D. Anbar, J. R. Lyons and T. M. Johnson (2010). Mass-independent fractionation of mercury isotopes in compact fluorescent light bulbs. Abstract V31B-2325 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec.
69. [#]A. T. Poret-Peterson, R. Schwegel, J. J. Elser, E. Shock and A. D. Anbar (2010). Diversity of membrane-bound nitrate reductase genes in geothermal springs. Abstract B51A-0335 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec.
70. R. Raiswell, C. Reinhard, A. Derkowski and A. D. Anbar (2010). Environmental changes recorded by syngenetic and early diagenetic iron minerals in the late Archean Mt. McRae Shale. Abstract B52B-03 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec.
71. [#]L. E. Wasylenki, G. Brennecka, J. Bargar, S. Weyer and A. D. Anbar (2010). EXAFS reveals the mechanism of U isotope fractionation during adsorption to Mn oxyhydroxide. Abstract PP22A-07 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec.
72. W. B. Wilkes, L. E. Wasylenki and A. D. Anbar (2010). Zinc finger takes on a whole new meaning: reducing and monitoring zinc blanks in the isotope lab. Abstract V51B-2183 presented at 2010 Fall Meeting, AGU, San Francisco, CA, 13-17 Dec.
73. A. Herrmann, T. J. Algeo and A. D. Anbar (2010). Do uranium isotopes of epicontinental black shales reflect global oceanic conditions? *Geological Society of America Abstracts with Programs* **42**: 467.
74. T. W. Lyons, A. D. Anbar, A. Bekker, B. Kendall, C. Li, G. D. Love, P. Mcgoldrick, N. J. Planavsky, R. Raiswell, C. T. Reinhard, C. Scott (2010). New view of the old ocean: a prevalence of deep iron and marginalized sulfide from the late archean through the proterozoic. *Geological Society of America Abstracts with Programs* **42**: 560.
75. R. Raiswell, C. Reinhard, A. Derkowski, J. Owens, S. Bottrell, A. D. Anbar and T. W. Lyons (2010). Formation of syngenetic and early diagenetic iron minerals in the late Archean Mt. McRae Ahale: paleoceanographic implications. *Geological Society of America Abstracts with Programs* **42**: 560.
76. [#]L. E. Wasylenki, L. J. Liermann, J. Nuester, A. D. Anbar, S. L. Brantley (2010). Fe isotope fractionation and kinetics of Fe release during dissolution of two very different amphiboles. *Geological Society of America Abstracts with Programs* **42**: 557.
77. A. D. Anbar, Y. Duan and B. Kendall (2010). Early oxygen. GeoCanada 2010, Calgary, Alberta, CA, 10-14 May. **Invited**.

78. K. Alexander, K. Lui, T. Viliboroghi, A. Anbar, F. Garcia-Pichel, and H. E. Hartnett (2010). Response of biological soil crusts to porewater metal additions. Astrobiology Science Conference 2010, League City, TX, 26-29 April.
79. A. D. Anbar (2010). Habitable Worlds: astrobiology meets sustainability in the virtual realm. Astrobiology Science Conference 2010, League City, TX, 26-29 April. **Invited.**
80. A. D. Anbar, Y. Duan and B. Kendall (2010). Early oxygen. Astrobiology Science Conference 2010, League City, TX., 26-29 April. **Invited.**
81. A. D. Anbar, E. S. Boyd, R. Buick, M. Claire, D. Des Marais, D. Domagal-Goldman, J. Eigenbrode, D. Erwin, K. Freeman, R. Hazen, C. Johnson, T. Lyons, V. Meadows, H. Ohmoto, S. Ono, J.W. Peters, B. Shapiro, R. Summons and M. Walter (2010). An Archean Biosphere Initiative. Astrobiology Science Conference 2010, League City, TX, 26-29 April. **Invited.**
82. E. S. Boyd, A. D. Anbar, S. Miller, T. L. Hamilton, M. Lavin and J. W. Peters (2010). An early origin for molybdenum-nitrogenase. Astrobiology Science Conference 2010, League City, TX, 26-29 April.
83. #J. B. Glass, F. L. Wolfe-Simon, A. T. Poret-Peterson and A. D. Anbar (2010). Signatures of low-Mo ancient ocean may be preserved in cyanobacterial genomes. Astrobiology Science Conference 2010, League City, TX. Astrobiology Science Conference 2010, League City, TX, 26-29 April.
84. H. E. Hartnett, S. Romaniello, B. Johnson, M. Kyle, T. Anderson, A. D. Anbar, J. Elser and E. Shock (2010). Geochemical evidence for denitrification in a Yellowstone National Park hot spring. Astrobiology Science Conference 2010, League City, TX, 26-29 April.
85. #B. Kendall, G. Brennecka, S. Weyer and A. D. Anbar (2010). Onset of oxidative uranium mobilization on the late Archean Earth? Astrobiology Science Conference 2010, League City, TX, 26-29 April.
86. #A. T. Poret-Peterson, R. Schwegel, M. Knowlton, J. J. Elser, E. L. Shock and A. D. Anbar (2010). Denitrification in hot environments: a gene perspective. Astrobiology Science Conference 2010, League City, TX, 26-29 April.
87. J. D. Blum, A. D. Anbar (2010). Mercury isotopes in the late Archean Mount McRae Shale, *Geochim. Cosmochim. Acta* **74**: A98.
88. T. W. Dahl, E. Hammarlund, A. H. Knoll, A.D. Anbar, D. E. Canfield (2010). Ocean oxygenation after the rise of animals. *Geochim. Cosmochim. Acta* **74**: A202.

89. *C. Mead, A. D. Anbar, T. M. Johnson (2010). Mass-independent fractionation of Hg isotopes resulting from photochemical self-shielding, *Geochim. Cosmochim. Acta* **74**: A693.
90. S. Severmann, J. Mcmanus, R. Poulson-Brucker, J. Owens, T. Lyons, A. Anbar, G. Gordon (2010). Of modern lakes and ancient oceans: Trace metals and their isotopes in an anoxic African rift lake. *Geochim. Cosmochim. Acta* **74**: A936.
91. #L. E. Wasylenki, G. A. Brennecka, J. R. Bargar, A. D. Anbar (2010). The mechanism of uranium isotope fractionation during adsorption to Mn oxyhydroxide. *Geochim. Cosmochim. Acta* **74**: A1116.
92. K. Alexander, D. Lui, A. D. Anbar, G. Garcia-Pichel and H. E. Hartnett (2009). Effect of nitrogen and metal additions on nitrogen fixation activity in biological soil crusts. *EOS Trans. AGU* **90**, Fall Meeting Supplement, Abstract EP53C-0628.
93. #B. Kendall, C. Reinhard, T. W. Lyons, A. J. Kaufman and A. D. Anbar (2009). Late Archean surface ocean oxygenation. *EOS Trans. AGU* **90**, Fall Meeting Supplement, Abstract B12A-01. **Invited**.
94. C. Reinhard, R. Raiswell, C. Scott, A. D. Anbar and T. W. Lyons (2009). Oxidative weathering and euxinia in the Late Archean. *EOS Trans. AGU* **90**, Fall Meeting Supplement, Abstract B12A-03. **Invited**.
95. *S. J. Romaniello, G. Brennecka, A. D. Anbar and A. S. Colman (2009). Natural isotopic fractionation of $^{238}\text{U}/^{235}\text{U}$ in the water column of the Black Sea. *EOS Trans. AGU* **90**, Fall Meeting Supplement, Abstract V54C-06.
96. #L. E. Wasylenki, G. Montanez and A. D. Anbar (2009). Cd isotope fractionation during adsorption varies with salinity. *EOS Trans. AGU* **90**, Fall Meeting Supplement, Abstract V11C-1977.
97. S. Weyer, G. Brennecka, C. Montoya Pino, J. Noordmann, E. A. Schauble, M. Wadhwa and A. D. Anbar (2009). Natural variation of $^{238}\text{U}/^{235}\text{U}$ in geo- and cosmochemistry. *EOS Trans. AGU* **90**, Fall Meeting Supplement, Abstract V54C-05.
98. *G. A. Brennecka, A. D. Herrmann, M. R. Saltzman and A. D. Anbar (2009). Using $^{238}\text{U}/^{235}\text{U}$ ratios in carbonates as a paleoredox indicator: variations across the Permian-Triassic boundary. *Geological Society of America Abstracts with Programs* **41**: 566.
99. #B. Kendall, C. Reinhard, T. W. Lyons, A. J. Kaufman and A. D. Anbar (2009). Surface ocean oxygenation preceded the Great Oxidation Event. *Geological Society of America Abstracts with Programs* **41**: 45.

100. [†]T. W. Dahl, A. D. Anbar, G. W. Gordon, M. T. Rosing, R. E. Frei, and D. E. Canfield (2009). Do $\delta^{98}\text{Mo}$ values in marine euxinic sediments reflect seawater? *Geochim. Cosmochim. Acta* **73**: A257 Suppl.
101. B. C. Gill, B. C., T. W. Lyons, T. Dahl, M. Saltzman, G. Gordon and A. D. Anbar (2009). Multiple geochemical proxies reveal a Late Cambrian ocean anoxic event. *Geochim. Cosmochim. Acta* **73**: 436 Suppl. **Invited**.
102. T. W. Lyons, C. Scott, C. Reinhard and A. D. Anbar (2009). Euxinia in the Proterozoic ocean, trace metal abundances, and the potential impacts on life. *Geochim. Cosmochim. Acta* **73**: A807 Suppl. **Invited**.
103. C. Montoya Pino, S. Weyer, B. van de Schootbrugge, A. D. Anbar, H. W. Arz, W. Oschmann and J. Pross (2009). Global versus regional anoxia during the OAE-2 and the T-OAE. *Geochim. Cosmochim. Acta* **73**: A897 Suppl.
104. [#]L. E. Wasylenki, C. L. Weeks, T. G. Spiro, J. R. Bargar and A. D. Anbar (2009). How Mo isotopes fractionate during adsorption to Mn and Fe oxyhydroxides. *Geochim. Cosmochim. Acta* **73**: A1419 Suppl. **Keynote**.
105. S. Weyer, G. Brennecke, J. Zipfel, M. Wadhwa and A. D. Anbar (2009). U isotope variations in CAIs: Implications for the age of the Solar System. *Geochim. Cosmochim. Acta* **73**: A1433 Suppl.
106. E. A. Prevedorou, M. Diaz-Zorita Bonilla, J. E. Buikstra, G. Gordon, A. Anbar and K. J. Knudson (2009). Residential mobility and dietary patterns at the prehistoric site of Gatas, Southeastern Spain. Annual Meeting of the American Association of Physical Anthropologists.
107. T. Algeo, G. Gordon, A. Anbar, P. Sauer, L. Schwark, S. Bates, T. Lyons, S. Turgeon, R. Creaser, B. Nabbfeld and K. Grice (2008). New insights on the Frasnian/Famennian mass extinction: a role for soil erosion? *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract PP33D-04.
108. A. D. Anbar and F. Wolfe-Simon (2008). The bioinorganic bridge between life and environment. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract PP14A-01. **Invited**.
109. K. Bradley, B. Weiss, L. Carporzen, A. Anbar and R. Buick (2008). Paleomagnetism of the Astrobiology Drilling Project 8 drill core, Pilbara, Western Australia: implications for the early geodynamo and Archean tectonics. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract V12B-04.
110. J. Crawford, J. Black, L. Wasylenki, G. Gordon, A. Anbar and A. Kavner (2008). Electrochemical fractionation of molybdenum stable isotopes. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract B21B-0361.

111. *J. B. Glass, F. Wolfe-Simon and A. D. Anbar (2008). Molybdenum storage in cyanobacteria: “mopping” up excess Mo. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract B21B-0343.
112. T. W. Lyons, C. Scott, B. C. Gill and A. D. Anbar (2008). Trace Metals in the Early Ocean, Biological Implications, and Evolving Biospheric Redox. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract B24C-02.
113. C. T. Reinhard, R. Raiswell, A. Anbar and T. Lyons (2008). An Episode of Late Archean Euxinia and Enhanced Continental Weathering Revealed by Iron Speciation in the Mt. McRae Shale. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract PP21B-1411.
114. M. A. Saito, E. M. Bertrand and A. Anbar (2008). Neoproterozoic Oxygenation of Earth Surface Environments Reflected in the Late Evolution of the O₂-Dependent Vitamin B12 Biosynthesis Pathway. *Eos Trans. AGU* **89**, Fall Meet. Suppl., Abstract B24C-04.
115. A. D. Anbar and M. Claire (2008). O₂ variability in Archean environments: do whiffs trump tiffs? *Geochim. Cosmochim. Acta* **72**: A22 Suppl. **Invited**.
116. A. D. Anbar and G. W. Gordon (2008). Redox renaissance. *Geochim. Cosmochim. Acta* **72**: A22 Suppl. **Keynote**.
117. *G. Brennecka, L. E. Wasylenki, S. Weyer and A. D. Anbar (2008). Experiments demonstrate that Uranium isotopes fractionate during adsorption to Mn-oxides. *Geochim. Cosmochim. Acta* **72**: A114 Suppl.
118. †T. W. Dahl, A. D. Anbar, G. W. Gordon, M. T. Rosing, R. E. Frei and D. E. Canfield (2008). Molybdenum isotope variations in a redox-stratified lake; Removal mechanism and preservation in euxinic sediments. *Geochim. Cosmochim. Acta* **72**: A194 Suppl.
119. *Y. Duan, G. L. Arnold, G. W. Gordon and A. D. Anbar (2008). Evidence from Mo isotopic compositions for "A whiff of oxygen" before the Great Oxidation Event. *Geochim. Cosmochim. Acta* **72**: A228 Suppl.
120. J. Neuster, L. J. Liermann, L. E. Wasylenki, A. D. Anbar and S. L. Brantley (2008). Does Iron dissociation from siderophores lead to Iron isotope fractionation? *Geochim. Cosmochim. Acta* **72**: A692 Suppl.
121. C. Reinhard, R. Raiswell, A. Anbar and T. Lyons. (2008). Oxidative weathering and the Fe-S balance of the late Archean ocean. *Geochim. Cosmochim. Acta* **72**: A784 Suppl.
122. L. E. Wasylenki, C. L. Weeks, T. G. Spiro, J. R. Bargar and A. D. Anbar (2008). How does metal adsorption cause isotopes to apportion? *Geochim. Cosmochim. Acta* **72**: A1007 Suppl.

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239. Y. L. Yung and A. D. Anbar (1994). Marine CH₃Br: The effect of temperature on the ocean-atmosphere flux. *1994 American Geophysical Union Spring Meeting, Baltimore, MD.*
240. A. D. Anbar, R. A. Creaser, D. A. Papanastassiou, and G. J. Wasserburg (1992). Rhenium in seawater: Confirmation of generally conservative behavior. *1992 American Geophysical Union Fall Meeting, San Francisco, CA*
241. A. D. Anbar, M. Allen, M-T. Leu, H. A. Nair and Y. L. Yung (1992). The impact of temperature dependent CO₂ cross section measurements: a role for heterogeneous chemistry in the atmosphere of Mars? *1992 Conference on Mars Surface and Atmosphere Through Time (MSATT), Kona, HI.*
242. A. D. Anbar, M-T. Leu and Y. L. Yung (1991). Adsorption of HO_x on surfaces in the atmosphere of Mars. *1991 Conference of the Division of Planetary Science of the Astronomical Society, San Francisco, CA*
243. M-T. Leu, J. Blamont, A. D. Anbar, L. F. Keyser and S. P. Sander (1991). Sticking coefficients of CO on aerosols; implications for the Martian atmosphere. *1991 American Geophysical Union Spring Meeting, Baltimore, MD.*

244. A. D. Anbar, G. A. Blake, and G. R. Rossman (1990). Nonlinear spectroscopy of silicate minerals: Hole-burning in muscovite. *1990 Pacific Conference on Chemistry and Spectroscopy*, San Francisco, CA

Invited Presentations/Colloquia (unpublished)

1. *Virtual Exploration of Earth's Evolution*. Spirit of the Senses (Phoenix community group), September, 2014.
2. *Detecting Exoplanetary Ecosystems*. Invited plenary talk at the 3rd International Geobiology Conference, Wuhan, China, June 2014.
3. *A Non-Traditional Application of Non-Traditional Isotopes: Can Calcium Isotopes Detect Cancer?* Chinese Academy of Geological Sciences, Beijing, June, 2014.
4. *A Non-Traditional Application of Non-Traditional Isotopes: Can Calcium Isotopes Detect Cancer?* University of Science and Technology of China, Hefei, June, 2014.
5. *The Uranium Isotope Paleoredox Proxy: A Primer and Future Prospects*. University of Science and Technology of China, Hefei, June, 2014.
6. *Are We Alone?* Invited presentation to the ASU Faculty Emeritii Association, April, 2014.
7. *Early Detection of Osteolytic Lesions in Multiple Myeloma using Natural Calcium Isotopes*. Dept. of Earth and Planetary Sciences, University of New Mexico, September, 2013.
8. *Astrobiology*. 100 Year Starship Symposium, September, 2013.
9. *A Whiff of Oxygen in the Anoxic Archean*. Astrobiology Lecture Series, Rensselaer Polytechnic Institute, May, 2013.
10. *Metallomic Markers in Medicine*. ASU Biodesign Program Presentation, April, 2013.
11. *ASU and OpenClass: Are We Alone? Teaching Science Through Exploration*. Cite 2013 Conference, Chicago, IL, April, 2013
12. *Metal Stable Isotopes as Environmental Source Tracers: Fe & Hg Isotope Case Studies*. Dept. of Soil, Water and Environmental Science, University of Arizona, March, 2013.
13. *Looking at Earth from a Different Perspective*. Tempe Chamber of Commerce Hot Topics and Lunch, Tempe, AZ, February, 2013. (<http://azscitechfest.org/node/1545>)
14. *The Great Poisoning: How Oxygen Transformed our Planet*. Beyond workshop on Oxygen and Cancer, Scottsdale, AZ, November, 2012.

15. *Astrobiology at ASU*. Tempe South Rotary Club, Tempe. AZ, November, 2012.
16. *Habitable Worlds: A HiFi Online Course*. Presentation with Adrian Sannier (Pearson) at EDUCAUSE, Denver, CO, October, 2012.
17. *Extracting Features of the History of Life on Earth from the Geologic Record*. Guest Lecture (video), Montana State University Astrobiology Course, October, 2012.
18. *Flipping to Avoid Flopping: Inverting the Lecture-Lab Paradigm*. Keynote presentation at Adaptive eLearning Forum, University of New South Wales, Sydney, Australia, July 2012.
19. *Calcium Isotope Biomarkers in Biomedicine and Human Space Exploration*. Dept. of Earth & Space Sciences, University of California – Los Angeles, May, 2012.
20. *Catalyzing Creative Connections*. Keynote presentation at Sustainability Symposium, School of Environmental Studies, The Hebrew University of Jerusalem, Israel, May, 2012.
21. *Driving Digital Disruption: How I learned to stop worrying and embrace online education*. Institute of Earth Sciences, The Hebrew University of Jerusalem, Israel, May, 2012.
22. *Every Breath You Take: An Early Whiff of Oxygen on the Ancient Earth*. Interuniversity Institute for Marine Sciences, Eilat, Israel, April, 2012.
23. *Paleoredox Proxies: Molybdenum and Uranium Isotopes*. 4th Kaplan Symposium, Ein Gedi, Israel, March, 2012.
24. *A Whiff of Oxygen in the Anoxic Archean*. Dept. of Geological Sciences, Ben Gurion University, Beer-Sheba, Israel, March, 2012.
25. *A Whiff of Oxygen in the Anoxic Archean*. Dept. of Environmental Sciences, Weizmann Institute of Science, Rehovot, Israel, March, 2012.
26. *Calcium Isotope Biomarkers in Biomedicine and Human Space Exploration*. Institute of Earth Sciences, The Hebrew University of Jerusalem, Israel, March, 2012.
27. *Oxygen Evolution: Scratching the Surface*. Keynote presentation at NERC Workshop on Volatiles and Fluids, Oxford, UK, February, 2012.
28. *Putting the “Geo” in Astrobiology*. Institute of Earth Sciences, The Hebrew University of Jerusalem, Israel, February, 2012.
29. *A Whiff of Oxygen in the Anoxic Archean*. Institute of Earth Sciences, The Hebrew University of Jerusalem, Israel, January, 2012.
30. *Origins of Life: Earth and Beyond*. ASU President’s Community Engagement Program, Scottsdale, AZ, February, 2011.

31. *An Early Whiff of Oxygen*. Origins Workshop, ASU Origins Project, Tempe, AZ, March, 2011.
32. *Calcium Isotopes in Biomedicine and Human Space Exploration*. School of Earth & Space Exploration Colloquium, Arizona State University, February, 2011.
33. *NASA, Astrobiology and Continental Scientific Drilling: The Astrobiology Drilling Program*. DOSECC Workshop, Washington, DC, May, 2011.
34. *Isotopic Inferences*. Guest Lecture (video), Montana State University Astrobiology Course, October, 2011.
35. *Follow the Elements: An Early Whiff of Oxygen?* Dept. of Geosciences, Lawrence Livermore National Laboratory, Livermore, CA, December, 2010.
36. *Follow the Elements: An Early Whiff of Oxygen?* Space Telescope Science Institute, Baltimore, MD, October, 2010.
37. *Follow the Elements: An Early Whiff of Oxygen?* Dept. of Geosciences, Pennsylvania State University, State College, PA, October, 2010.
38. *Nutrients and Trace Elements through Time*. NAI Anaerobic Photosynthetic Ecosystems Workshop, Fayetteville, NY, October, 2010.
39. *Follow the Water?* Scottsdale Museum of Contemporary Art, Scottsdale, AZ, September, 2010.
40. *Deep Time Drilling as a Window into Earth's Early History*. NSF Workshop, Carnegie Institute of Washington, Washington, DC, August, 2010.
41. *Drilling Deep Time: Windows into Earth's Early Biosphere*. NSF Headquarters, Washington, DC, July, 2010.
42. *The Early Breath of Life: Evidence of O₂ in the Late Archean Eon*. Australian Centre for Astrobiology, University of New South Wales, Sydney, Australia, April, 2010.
43. *Photosynthesis and the rise of O₂: constraints from the geologic record*. 19th Western Photosynthesis Conference, Pacific Grove, CA, January, 2010.
44. *Searching for Life at ASU*. Spirit of the Senses (Phoenix community group). October, 2009.
45. *Follow the Elements: Astrobiology at ASU*. Canada Institute for Advanced Research (CIFAR) workshop on astrobiology, Toronto, Canada, April, 2009.

46. *Follow the Elements: Astrobiology at ASU*. NASA Astrobiology Institute Team Overview Seminar, Videocon broadcast, March, 2009.
<http://nai.arc.nasa.gov/library/uploads/AB090316.mov>
47. *Elements and Evolution*. School of Life Sciences Seminar Series, Arizona State University, Tempe, AZ, April, 2009.
48. *Follow the Elements: Astrobiology at ASU*. School of Earth & Space Exploration Colloquium, Tempe, AZ, January, 2009.
49. *Science & Technology Education: The University of Tomorrow?* Presentation to the American Technion Society, September, 2008.
50. *The Origin of the Earth*. Temple Emmanuel (Tempe) Science & Religion Event, May, 2008.
51. *Alternative Earths*. Presentation in the *Final Word* symposium series, ASU Kerr Cultural Center, February, 2008.
52. *Alternative Earths*. Presentation to the Humanist Society of Greater Phoenix, February, 2008.
53. *Life in the Universe: Lessons from a Dead World*. Invited presentation to the ASX Symposium “Expanding Canada’s Frontiers: Lunar Exploration”, Toronto, Canada, January, 2008.
54. *A Whiff of Oxygen before the Great Oxidation Event?* Department of Geological Sciences, University of Toronto, Toronto, Canada, January, 2008.
55. *A Whiff of Oxygen before the Great Oxidation Event?* NASA Astrobiology Institute Director’s Seminar Series, Videocon broadcast, November, 2007.
http://nai.arc.nasa.gov/seminars/seminar_detail.cfm?ID=112
56. *A Whiff of Oxygen before the Great Oxidation Event?* Astrobiology Seminar Series, University of Arizona, Tucson, AZ, November, 2007.
57. *Evidence for a Whiff of Oxygen before the Paleoproterozoic Great Oxidation Event*. Department of Geological Sciences, University of Michigan, Ann Arbor, MI, October, 2007.
58. *A Whiff of Oxygen before the Great Oxidation Event?* NASA Astrobiology Institute Biosignatures Workshop, Sudbury, ON, Canada, September, 2007.
59. *An Early Whiff of Oxygen and a Late Stench of Sulfide?* Department of Earth & Space Sciences, University of California, Los Angeles, May, 2007.

60. *Insights into Ocean Redox Evolution from Metals and Metal Isotopes*. Department of Geology, University of Texas, El Paso, TX, April, 2007.
61. *A Whiff of Oxygen before the Great Oxidation Event?* Department of Geoscience, University of Nevada, Los Vegas, NV, March, 2007.
62. *A Whiff of Oxygen at the Archean-Proterozoic Boundary*. School of Earth & Space Exploration Colloquium, Tempe, AZ, February, 2007.
63. *A Whiff of Oxygen at the Archean-Proterozoic Boundary*. Department of Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA, January, 2007.
64. *A Whiff of Oxygen before the Great Oxidation Event*. Department of Geosciences, Virginia Polytechnic Institute and State University, Blacksburg, VA, January, 2007.
65. *Alternative Life: Let's Get Elemental!* Alternative Life Workshop, ASU, December, 2006.
66. *Redox Revelations: An Early Whiff of Oxygen and a Late Stench of Sulfide?* Department of Geological and Environmental Sciences, Stanford, November, 2006.
67. *Alternative Earths*. Astrobiology Lecture Series, New Mexico Institute of Technology, October, 2006.
68. *Oxygenation of the Surface Ocean at the Archean-Proterozoic Boundary*. Astrobiology Class Lecture, New Mexico Institute of Technology, October, 2006.
69. *Drilling in Western Australia: Progress and Prospects*. Agouron Foundation Drilling Workshop, Pasadena, CA, October, 2006.
70. *The Earth through Time: The Earth's Coevolution with the Biosphere*. Pale Blue Dot III, Chicago, IL, September, 2006.
71. *The Evolution of the Earth*. Spirit of the Senses (Phoenix community group), September, 2006.
72. *Follow the Elements!* Gordon Research Conference on the Origin of Life, Lewiston, ME. July, 2006.
73. *"Non-traditional" Isotopic Biosignatures*. NRC Biosignature Workshop, Washington, DC, May, 2006.
74. *The Rise of Oxygen and the Evolution of the Metallome*. Agouron Foundation O2 Workshop, Santa Fe, NM, April, 2006.
75. *Hot Night in the City? The Present, Past and Future of Earth's Climate System*. The Last Lecture Series, Arizona State University, Tempe, AZ, April, 2006.

76. *Insights into Ocean Redox Evolution from Metals and Metal Isotopes*. Scripps Institute of Oceanography, March 2006.
77. *Molybdenum Isotopes as Paleoredox Proxies*. NSF Workshop on Paleoproxies, San Francisco, CA December, 2005.
78. *Good Golly, It's Moly! Insights into the Evolution of Life and Environment from Molybdenum, Mass Spectrometry and Metallomics*. Department of Chemistry, Northern Arizona University. October, 2005.
79. *Transition Metal Stable Isotopes*. 1st I. R. Kaplan Workshop: New Developments in Environmental Isotope Research, Hagoshrim, Israel. September, 2005.
80. *Insights into Redox Evolution of the Oceans from Molybdenum and Iron Isotopes*. 1st I. R. Kaplan Workshop: New Developments in Environmental Isotope Research, Hagoshrim, Israel, September, 2005.
81. *Environmental Geochemistry of Novel Stable Isotopes: Systematics, Surprises and Solutions*. Environmental Bioinorganic Chemistry Group, Princeton University, April, 2005.
82. *Good Golly, It's Moly! Insights into the Evolution of Life and Environment from Molybdenum, Mass Spectrometry and Metallomics*. Department of Chemistry, Bryn Mawr College. April, 2005.
83. *Testimony before the President's Commission on Implementation of U.S. Space Exploration Policy*. Public Hearing, May, 2004.
84. *Molybdenum Stable Isotopes: Observation, Interpretations and Directions*. MSA Short Course on the Geochemistry of Non-traditional Stable Isotopes, Montreal, Canada, May, 2004.
85. *Microbes and Metal Isotopes: Building a Bioinorganic Bridge*. Gordon Research Conference on Environmental Bioinorganic Chemistry, Bates College, NH, July, 2004.
86. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. Department of Earth and Space Sciences, University of Washington. October, 2003.
87. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. Agouron-Wrigley-USC Geobiology Summer Course, the Wrigley-USC Institute for Environmental Studies, Catalina Island, CA July, 2003.
88. *Molybdenum Isotopes in Biology and the Environment*. Gordon Research Conference on Molybdenum and Tungsten Enzymes, Meridan, NH. June, 2003.

89. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. Department of Geophysical Sciences, University of Chicago. June, 2003.
90. *Microbes and Metal Isotopes: Building a Bioinorganic Bridge*. Department of Geology, Arizona State University. May, 2003.
91. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. Department of Geosciences, Princeton University. March, 2003.
92. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. Department of Earth and Atmospheric Sciences. Cornell University. March, 2003.
93. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. Department of Geology, Arizona State University. February, 2003.
94. *Good Golly, It's Moly! Insights into Ocean Chemistry and Evolution from Molybdenum and its Isotopes*. USGS- Menlo Park. February, 2003.
95. *Stable Isotope Geochemistry of Transition Metals: Methods, Mechanisms and the need for Models*. Department of Geosciences, Princeton University. December, 2002.
96. *In Pursuit of Proterozoic Paleoredox: Insight from Molybdenum Isotopes*. Center for Astrobiology, University of Colorado (Boulder). October, 2002.
97. *Proterozoic Ocean Chemistry and Evolution: A Bioinorganic Bridge?* Department of Chemistry, University of Cincinnati. October, 2002.
98. *Molybdenum Isotopes: In Pursuit of Proterozoic Paleoredox*. New York Center for Studies on the Origins of Life, Rensselaer Polytechnic Institute. September, 2002.
99. *Ocean Chemistry & Evolution: Insight from Molybdenum and its Isotopes*. Dept. of Chemistry, University of Rochester. September, 2002.
100. *Molybdenum Isotopes: In Pursuit of Proterozoic Paleoredox*. Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology. April, 2002.
101. *Novel Isotopic Biosignatures: Promise and Progress*. NAI Director's Seminar Series Webcast. March, 2002.
102. *Novel Isotopic Biosignatures: Promise and Progress*. Gordon Research Conference on the Origin of Life, Ventura, CA January, 2002.
103. *Earth, Mars and Beyond: The Search for Life in Difficult Places*. Kodak Research & Engineering Retirees Organization, Rochester, NY. January, 2002.

104. *Iron Isotopes and the Search for Life on Mars*. Department of Chemistry, Alfred College, October, 2001.
105. *Iron Isotopes and the Search for Life on Mars*. Department of Chemistry, SUNY Brockport. September, 2001.
106. *Earth, Mars and Beyond: The Search for Life in Difficult Places*. University of Rochester Alumni Association. September, 2001.
107. *Transition Metal Isotope Fractionation: Promise and Progress*. Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology. September, 2001.
108. *Transition Metal Isotope Fractionation: Promise and Progress*. Gordon Research Conference on Chemical Oceanography, Tilton, NH. August, 2001.
109. *Mission to Early Earth: Overview*. 2001 Meeting of the NASA Astrobiology Institute, Carnegie Institution of Washington. April, 2001.
110. *Iron Isotopes and the Search for Life on Mars: Promise and Progress*. Department of Geology and Geophysics, University of Minnesota. March, 2001.
111. *Molybdenum Isotopes: Potential Paleoredox Probes?* Department of Geology and Geophysics, University of Minnesota. March, 2001.
112. *Iron Isotopes and the Search for Life on Mars: Promise and Progress*. Department of Geological Sciences, University of Missouri. January, 2001.
113. *Iron Isotopes and the Search for Life on Mars: Promise and Progress*. Department of Geology, Arizona State University. October, 2000.
114. *Iron Isotopes and the Search for Life on Mars: Promise and Progress*. Department of Earth Sciences, Syracuse University. September, 2000.
115. *Iron Isotopes and the Search for Life on Mars*. Department of Chemistry, SUNY Geneseo. September, 2000.
116. *Iron Isotopes: Promise and Progress*. Department of Geophysical Sciences, University of Chicago. May, 2000.
117. *Iron Isotopes: Biomarker Prospects*. NRC Workshop on Life Detection (Committee on the Origin and Evolution of Life of the NAS Space Studies Board and Board on Biology), Carnegie Institution of Washington. April, 2000.

118. *Fractionations of Transition Metal Stable Isotopes: Promise and Progress*. Geochemical Perspectives on Environmental Processes – 2000, Washington University. April 2000.
119. *Stable Isotope Geochemistry of Transition Metals: Iron Isotope Inferences*. Department of Geological Sciences, Cornell University. March, 2000.
120. *Stable Isotope Geochemistry of Transition Metals: Iron Isotope Inferences*. Department of Geosciences, Pennsylvania State University. March, 2000.
121. *The Search for Life: Inferences from Iron Isotopes?* Dept. of Physics, University of Rochester. January, 2000.
122. *Stable Isotope Geochemistry of Transition Metals: Iron Isotope Inferences*. Division of Geological and Planetary Sciences, California Institute of Technology. December, 1999.
123. *Life in the Geologic Record: Inferences from Iron Isotopes?* Department of Geology and Geophysics, Yale University. October, 1999.
124. *The Search for Life in Far-off Places*. Laboratory for Laser Energetics, University of Rochester. September, 1999.
125. *The Extraterrestrial Mass Flux on the Early Earth: Implications for Life*. Department of Geology and Geophysics, Yale University. April, 1999.
126. *Determination of Cu and Mo Isotope Fractionations Using MC-ICP-MS (poster w/J. Barling and J. E. Roe)*. Gordon Research Conference on Chemical Oceanography, Barga, Italy. May, 1998.
127. *Trace Element Frontiers*. Dept. of Earth and Atmospheric Sciences, University of Alberta. January, 1998.
128. *Fractionation of transition metal stable isotopes: A new approach for the study of life in the geologic record (poster w/J. Barling, J. E. Roe, K. A. Knab and K. Nealson)*. Gordon Research Conference on the Origin of Life, Ventura, CA February, 1999.
129. *The Environmental Chemistry of Iridium: Providing Perspective on Dinosaur Doom*. Department of Chemistry, Canisius College. February, 1997.
130. *Trace Element Frontiers*. Dept. of Earth and Planetary Sciences, Harvard University. December, 1996.
131. *The Environmental Chemistry of Iridium: Providing Perspective on Dinosaur Doom*. Meeting of the W. New York Section of the American Chemical Society. November, 1996.
132. *Iridium in Natural Waters*. Dept. of Geology, Woods Hole Oceanographic Institution. August, 1996.

133. *Iridium in Natural Waters*. Dept. of Earth and Planetary Sciences, Harvard University. May, 1996.
134. *Iridium in Natural Waters*. Dartmouth College, Department of Earth Sciences. May, 1996.
135. *The Photochemistry of Manganese and the Origin of Banded Iron Formations (poster w/H. D. Holland)* Gordon Research Conference on the Origins of Life, Concord, NH. August, 1990.

Funding History

Active Awards:

Source of Support: Howard Hughes Medical Institute

Principal Investigator: A. D. Anbar

Co-Investigators: None

Project Title: Virtual Exploration of Earth's Evolution

Award Amount: \$1,000,000

Period of Award: 9/1/14 – 8/31/19

Source of Support: NASA (Exobiology Program)

Principal Investigator: A. D. Anbar (ASU)

Co-Investigators: A. Herrmann (LSU); T. Algeo (U. Cincinnati)

Project Title: Uranium Isotope Variations in Carbonates: Validating A New Paleoredox Proxy

Award Amount: \$619,292

Period of Award: 9/1/2013 – 8/31/16

Source of Support: NASA (Human Research Program)

Principal Investigator: A. D. Anbar (ASU)

Co-Investigators: G. Gordon, J. Skulan (ASU)

Project Title: Stable calcium isotopes in urine as a biomarker of bone mineral balance in spaceflight

Award Amount: \$550,000

Period of Award: 12/01/13 – 11/30/15

Source of Support: NSF (Frontiers in Earth System Dynamics Program)

Principal Investigator: A. D. Anbar

Project Title: FESD Type I: Dynamics of Earth System Oxygenation

Award Amount: \$5,000,000

Period of Award: 9/01/13 – 8/31/18

Source of Support: Flinn Foundation

Principal Investigator: A. D. Anbar (ASU); K. Cannon (Mayo Clinic)

Project Title: Improving the clinical utility of Ca isotope analysis by assessing population level variation in the Ca isotope composition of blood

Award Amount: \$100,000

Period of Award: 9/01/13 – 8/31/15

Source of Support: NSF TUES

Principal Investigator: A. D. Anbar (ASU)

Co-Principal Investigators: S. Semken (ASU)

Project Title: Exploration-Driven Online Science Education: Habitable Worlds 2.0
Award Amount: \$600,000
Period of Award: 1/1/13 – 12/31/15

Source of Support: NSF OCE
Principal Investigator: A. Herrmann (LSU)
Principal Investigator: Lisa Levin (UCSD)
Co-Principal Investigators: A. D. Anbar and G. Gordon (ASU)
Project Title: Ocean Acidification Category 2: Collaborative Research - Development of geochemical proxies to evaluate larval pH-exposure history
Award Amount: \$99,633 to ASU
Period of Award: 6/1/11 – 5/31/14

Source of Support: NSF EAR
Principal Investigator: A. Herrmann (ASU)
Co-Principal Investigators: A. Anbar (ASU)
Principal Investigators: T. Algeo (U. Cinn.), J. Barrick (U. Texas), B. Haupt (PSU)
Project Title: COLLABORATIVE RESEARCH: Integrated Paleooceanographic Analysis of the Late Paleozoic Midcontinent Sea
Award Amount: \$78,000 to ASU (award to date; not yet fully funded)
Period of Award: 6/1/11 – 5/31/14

Source of Support: NSF OCE
Principal Investigator: A. Herrmann
Co-Principal Investigators: A. D. Anbar, L. E. Wasylenki (now at U. Indiana)
Project Title: Uranium isotopes in carbonate sediments: Assessing a novel paleoredox proxy
Award Amount: \$368,544
Period of Award: 6/1/10 – 5/31/14 (now in NCE)

Source of Support: NSF AGS
Principal Investigator: B. Majestic (NAU; now Denver University) *LEAD INSTITUTION*
Principal Investigator: P. Herckes (ASU)
Co-Principal Investigator: A. D. Anbar (ASU)
Project Title: Collaborative Research: Atmospheric processing of iron - does particle size influence iron solubility?
Award Amount: \$220,238 to ASU
Period of Award: 5/1/10 – 4/30/14 (now in NCE)

Source of Support: NASA
Principal Investigator: S. Semken
Co-Investigators: A. D. Anbar, W. Burelson, K. Hodges, W. Taylor
Project Title: NASA Triad: A Triangulated Program to Promote NASA Stem Education Nationwide
Award Amount: \$733,743
Period of Award: 9/1/10 – 8/31/14 (now in NCE)

Source of Support: NASA Astrobiology Program

Principal Investigator: A. D. Anbar (ASU)

Co-Investigators: S. Desch, J. Elser, J. Farmer, B. Grigsby, K. Hodges, S. Neuer, S. Semken, E. Shock, F. Timmes, M. Wadhwa, M. Zolotov (all at ASU); T. Lyons (UC Riverside); J. Raymond (UC Merced); J. Siefert (Rice)

Project Title: Follow the Elements: A proposal for membership in the NASA Astrobiology Institute

Award Amount: \$6,506,153

Period of Award: 1/01/09 – 12/31/14 (now in NCE)

Expired Awards:

Source of Support: NSF OCE

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Principal Investigator: B. Majestic (NAU; now Denver University)

Co-Principal Investigator: P. Herckes (ASU)

Project Title: Collaborative Research: Source apportionment of iron in the marine atmosphere - application of stable iron isotopic measurements

Award Amount: \$225,202 to ASU

Period of Award: 10/1/10 – 09/30/12

Source of Support: NSF MRI

Principal Investigator: P. Williams

Co-Principal Investigators: A. D. Anbar, J. Anderson, J. Elser, R. Hervig, E. Shock, M. Wadhwa, W. Vermaas

Project Title: Acquisition Of A Nanosims 50L Imaging Secondary Ion Mass Spectrometer

Award Amount: \$3,267,586

Period of Award: 2010 – 2012

Source of Support: NSF EAR (Sedimentary Geology and Paleobiology)

Principal Investigator: A. D. Anbar (ASU)

Principal Investigator: G. Jiang (UNLV) *LEAD INSTITUTION*

Principal Investigator: T. Lyons (UC Riverside)

Principal Investigator: S. Xiao (VA Tech)

Project Title: Collaborative Research: Ocean Redox Evolution at the Dawn of Animal Life: An Integrated Geological and Geochemical Study of the Ediacaran Yangtze Platform in South China

Award Amount: \$97,209 to ASU

Period of Award: 8/01/08 – 7/31/12

Source of Support: ASU-Mayo Pilot Funding

ASU Investigator #1: A. D. Anbar

ASU Investigator #2: G. W. Gordon

Mayo Investigator #1: R. Fonseca

Project Title: Calcium isotopes: Inorganic Signatures of Multiple Myeloma Progression

Award Amount: \$40,000
Period of Award: 7/01/12 – 6/30/13

Source of Support: NSF EAR

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Principal Investigator: T. W. Lyons (UCR)

Co-Principal Investigator: B. Kendall (ASU)

Project Title: Collaborative Research: Examining the evolution of biospheric oxygenation in Late Archean to Middle Proterozoic oceans through high-resolution trace metal chemostratigraphy

Award Amount: \$142,143 to ASU

Period of Award: 7/1/10 – 6/30/12

Source of Support: NASA Astrobiology (Exobiology & Evolutionary Biology)

Principal Investigator: A. D. Anbar (ASU)

Collaborator: T. Lyons (UC Riverside)

Project Title: In search of early oxygen: Investigation of redox sensitive metal abundances and isotopes in Neoproterozoic drill cores

Award Amount: \$560,428

Period of Award: 10/01/07 – 9/30/12

Source of Support: NASA Human Research Program

Principal Investigator: A. D. Anbar (ASU)

Collaborators: J. Skulan (U. Wisconsin); S. Smith (JSC); T. D. Bullen (USGS)

Project Title: Rapid measurements of bone loss using tracer-less calcium isotope analysis of blood and urine

Award Amount: \$1,096,853

Period of Award: 7/01/08 – 6/30/12

Source of Support: NSF OCE (Chemical Oceanography)

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Co-Principal Investigator: L. E. Wasylenki (ASU)

Principal Investigator: Thomas Spiro (U. Washington)

Project Title: Collaborative Research: Systematics of Zn Isotopes in the Oceans: Assessing the Roles of Surfaces and Speciation

Award Amount: \$458,912 to ASU; \$112,784 to U. Washington

Period of Award: 9/01/08 – 8/31/11

Source of Support: NSF EAR (Sedimentary Geology and Paleobiology)

Principal Investigator: T. Algeo (U. Cincinnati) *LEAD INSTITUTION*

Co-Principal Investigator: A. D. Anbar (ASU)

Co-Principal Investigator: R. A. Creaser (U. Alberta)

Co-Principal Investigator: L. Schwark (U. Cologne)

Co-Principal Investigator: P. Sauer (U. Indiana)

Project Title: Middle and Upper Devonian Black Shales: Testing the Productivity-Anoxia Feedback and Land Plant-Weathering Rate Hypotheses

Award Amount: ~\$20,000 to ASU (subcontract)
Period of Award: 9/01/06 – 8/31/10

Source of Support: Dreyfus Foundation (Environmental Postdoc Program)

Principal Investigator: A. D. Anbar (ASU)

Co-Investigator #1: H. Hartnett (ASU)

Co-Investigator #2: P. Herckes (ASU)

Co-Investigator #3: E. Shock (ASU)

Project Title: Mass Dependent Isotope Fractionation of Bioessential and Toxic Metals: A New Perspective on the Environmental Chemistry of Metals

Award Amount: \$120,000

Period of Award: Two+ year fellowship; began 10/2007; no cost extension through 12/10

Source of Support: NSF EAR (Instrumentation & Facilities)

Principal Investigator: A. D. Anbar (ASU)

Co-Principal Investigator: N. Grimm (ASU)

Co-Principal Investigator: L. Leshin (ASU)

Co-Principal Investigator: E. Shock (ASU)

Project Title: Technician Support: ICP-MS Research in the W. M. Keck Foundation Laboratory for Environmental Biogeochemistry

Award Amount: \$224,996

Period of Award: 9/01/05 – 9/31/08 (now in second one year no-cost extension)

Source of Support: NSF EAR (Low-Temperature Geochemistry and Geobiology)

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Co-Principal Investigator: L. Wasylenki (ASU)

Co-Principal Investigator: S. L. Brantley (PSU)

Project Title: COLLABORATIVE RESEARCH: Investigation of Fe and Mo Isotope Fractionation During Weathering

Award Amount: \$299,621 (\$301,690 to PSU)

Period of Award: 9/01/05 – 9/31/09

Source of Support: NSF OCE (Chemical Oceanography)

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Co-Principal Investigator: L. Wasylenki (ASU)

Co-Principal Investigator: T. Spiro (Princeton)

Project Title: COLLABORATIVE RESEARCH: Transition Metal Isotope Fractionation During Adsorption to Authigenic Oxides

Award Amount: \$300,074 to ASU (\$150,003 to Princeton)

Period of Award: 9/01/05 – 9/31/09

Source of Support: NSF EAR (Biogeosciences)

Principal Investigator: H. Hartnett (ASU)

Co-Principal Investigator: A. D. Anbar (ASU)

Co-Principal Investigator: F. Garcia-Pichel (ASU)

Project Title: Biogeochemistry of Desert Crust Communities: Organic Carbon and Trace Metal Dynamics

Award Amount: \$389,331

Period of Award: 7/01/05 – 6/30/09

Source of Support: NSF EAR (Low-Temperature Geochemistry and Geobiology)

Principal Investigator: A. D. Anbar (ASU)

Principal Investigator: T. Lyons (UC Riverside) *LEAD INSTITUTION*

Project Title: Collaborative Research: A Comparative Geochemical Study of the Late Cambrian (SPICE) and Toarcian (Jurassic) Positive Carbon Isotope Excursions as a Window to Paleozoic Oceanic Anoxic Events

Award Amount: \$74,517 to ASU

Period of Award: 9/01/07 – 8/31/09

Source of Support: NASA Astrobiology Institute

Principal Investigator: A. D. Anbar (ASU)

Project Title: Proposal for Curation of ADP Drill Cores

Award Amount: \$212,954 + \$30,000 supplement

Period of Award: 01/05 – 12/31/09

Source of Support: Agouron Foundation

Principal Investigator: A. D. Anbar (ASU)

Project Title: The Rise of Oxygen and the Evolution of the Metallome

Award Amount: \$100,00

Period of Award: 3/01/07

Source of Support: NSF OCE (Marine Geology and Geophysics)

Principal Investigator: A. D. Anbar (ASU)

Principal Investigator: S. Severmann (UC Riverside) *LEAD INSTITUTION*

Principal Investigator: J. McManus (Oregon State University)

Project Title: Collaborative Research (UCR, OSU and ASU): Combined Fe-S stable isotopes in modern anoxic environments and the effect of Fe versus S limitation

Award Amount: \$38,422 to ASU

Period of Award: 3/01/06 – 2/29/08 (now in one year no-cost extension)

Source of Support: ASU-Mayo Pilot Funding

ASU Investigator #1: A. D. Anbar

ASU Investigator #2: G. Gordon

Mayo Investigator #1: Larry Miller

Mayo Investigator #2: Patricia Carrigan

Project Title: Environmental Factors and Pancreatic Cancer

Award Amount: \$40,000

Period of Award: 9/01/05 – 9/31/06

Source of Support: NSF (Geology & Paleontology)

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Project Title: COLLABORATIVE RESEARCH: Presaging Paleoproterozoic Global Change: Geobiology of the Late Archean Eon

Award Amount: \$74,624 to ASU (\$425,000 to MIT, Harvard, Missouri, Maryland, Harvard)

Period of Award: 9/15/04 – 9/14/06

Source of Support: NASA (Exobiology)

Principal Investigator: A. D. Anbar (ASU)

Co-Investigator #1: J. Barling (formerly at UR)

Co-Investigator #2: T. W. Lyons (U. Missouri)

Project Title: Mechanisms of Mo Isotope Fractionation: Assessing a New Tool for the Study of Ancient Ocean Redox

Award Amount: \$363,617

Period of Award: 5/03 – 4/06

Source of Support: NSF- EAR (Geology & Paleontology)

Principal Investigator: A. D. Anbar (ASU) *LEAD INSTITUTION*

Principal Investigator: T. W. Lyons (U. Missouri)

Co- Principal Investigator: J. Barling (formerly at UR)

Project Title: Collaborative Proposal: Molybdenum Isotopes as Paleoredox Proxies

Award Amount: \$224,918 to Rochester (\$74,544 to Missouri)

Period of Award: 1/03 – 12/06 (incl. one year no-cost extension)

Source of Support: Astrobiology Science & Technology

Principal Investigator: A. D. Anbar (ASU)

Project Title: Upgrade of MC-ICP-MS Instrumentation

Award Amount: \$210,000

Period of Award: 9/04 – 8/06 (incl. one year no-cost extension)

Source of Support: NSF- Academic Research Infrastructure

Principal Investigator: A. Basu (UR)

Co-Principal Investigator(s): A. D. Anbar, R. Poreda (UR)

Project Title: Request for a Technical Associate to Support the Isotope Geochemistry Laboratories at the University of Rochester

Award Amount: \$150,000 (original grant); ~ \$150,000 (renewal)

Period of Award: Original award: 3/98 - 2/02; Renewal + extension: 2/02 – 1/05

Source of Support: NASA Astrobiology Institute

Principal Investigator: Andrew Knoll (Harvard)

Co-Investigator(s): A. D. Anbar (UR) and researchers at Harvard, MIT & Smithsonian

Project Title: The Planetary Context of Biological Evolution

Award Amount: ~\$350,000 total to Rochester

Period of Award: 5 years + extension (7/98 – 10/04)

Source of Support: NASA Astrobiology Institute

Principal Investigator: Kenneth Nealson (JPL/Caltech)

Co-Investigator(s): A. D. Anbar (UR) and groups at Caltech/JPL, USGS and U. Wisc.

Project Title: Coevolution of Planets and Biospheres: Lessons from Earth and Mars
Award Amount: ~\$250,000 total to Rochester
Award Award: 5 years + extension (7/98 – 10/04)

Source of Support: UR-NIEHS Center for Environmental Health Sciences
Investigators: A. D. Anbar and E. Puzas (UR); J. Skulan (U. Wisconsin)
Project Title: Pilot Project: Ca Isotopes and Osteotoxicology
Award Amount: \$23,110
Period of Award: 9/02 – 3/04

Source of Support: Rochester Gas and Electric Co.
Principal Investigator: A. D. Anbar (UR)
Co-Investigator(s): R. J. Poreda (UR)
Project Title: Determination of Tc-99 in Aqueous and Soil Samples by ICP-MS
Award Amount: \$71,041
Period of Award: Expired in 2004

Source of Support: NSF- EAR (Geology & Paleontology)
Principal Investigator: A. D. Anbar (UR) *LEAD INSTITUTION*
Principal Investigator: S. L. Brantley (Penn. State)
Project Title: Collaborative Research: Iron & Molybdenum Isotope Fractionation during Mineral Weathering
Award Amount: \$100,000 to Rochester
Period of Award: 24 months (5/01 - 4/04; includes one year no-cost extension)

Source of Support: NSF- EAR (Geology & Paleontology)
Principal Investigator: J. Barling (UR)
Co-Principal Investigator: A. D. Anbar
Project Title: Molybdenum Isotopes in the Geologic Record: Paleoredox Proxies?
Award Amount: \$100,000
Period of Award: 12 months (8/01 - 7/02; no cost extension to 7/03)

Source of Support: NSF- Life in Extreme Environments (LExEn)
Principal Investigator: A. D. Anbar (UR) *LEAD INSTITUTION*
Co- Principal Investigator: Kenneth Nealson (JPL/Caltech)
Project Title: Biogenic Fractionations of Transition Metal Isotopes: Novel Methods for the Examination of Life in Extreme Environments
Award Amount: \$270,000
Period of Award: 36 months (10/97 - 9/00)

Source of Support: NSF- Academic Research Infrastructure
Principal Investigator: A. D. Anbar (UR)
Co- Principal Investigator(s): A. Basu, R. Poreda, J. Tarduno, U. Fehn (UR)
Project Title: Acquisition of a High-Resolution Inductively-Coupled Plasma Mass Spectrometer for Research in Trace Element Geochemistry & Biogeochemistry
Award Amount: \$294,772 + \$50,000 supplement

Period of Award: 24 months (7/96 - 6/98)

Source of Support: Princeton-NSF Center for Environmental Bioinorganic Chemistry

Investigators: A. D. Anbar (UR); T. Spiro and A. Jarzecki (Princeton)

Project Title: Pilot Project: Theoretical Investigations of Transition Metal Isotope Fractionation

Award Amount: \$22,000 (internal at Princeton)

Period of Award: 9/02 – 8/03

Source of Support: National Institute of Dental Research

Principal Investigator: T. Clarkson (UR- Med. Center)

Co-Investigator(s): A. D. Anbar, G. Watson (UR- Med. Center)

Project Title: Health Effects of Dental Amalgam in Children

Award Amount: ~\$25,000 to Anbar

Period of Award: expired June, 2004

Educational Activities

Research Students Supervised

Graduate Students (as lead or co-mentor)

Ph.D. Degrees in Progress (at Arizona State University)

Bradford, Kristi (Ph.D. student in Exploration Systems Design, 2nd year)
Research Areas: Ca isotopes via laser fluorescence; planetary protection

Bruce, Geoffrey (Ph.D. student in Exploration Systems Design, 3rd year)
Research Area: Engineering effective Virtual Field Trips

Emick, Hillary (Ph.D. student in Environmental Life Sciences, 3rd year)
Research Area: Mo limitation of eukaryote N-cycle (co-mentored w/James Elser)

Johnson, Aleisha (Ph.D. student in Geological Sciences, 1st year)
Research Area: Mineral weathering

Neveu, Marc (Ph.D. student in Astrophysics, 5th year)
Research Area: Biological Stoichiometry and Planetary Science (co-mentored w/Steve Desch)

Rochelle, Sam (Ph.D. student in Geological Sciences, 1st year)
Research Area: Proxies for plant weathering

Sherry, Alyssa (Ph.D. student in Chemistry, 1st year)
Research Area: Environmental metal isotopes

Zhang, Feifei (Ph.D. student in Geological Sciences, 1st year)
Research Area: Metal isotope paleoredox proxies

Xinming Chen (Ph.D. student in Chemistry, 3rd year)
Research Area: Environmental isotope geochemistry

Completed Degrees

Mead, Christopher (Ph.D. in Geological Sciences, ASU, 2014)
Research Area: Environmental Hg and Fe stable isotopes; biogeochemistry concept inventory
Present Position: Postdoctoral Fellow, University of Nebraska

Romaniello, Stephen (Ph.D. in Geological Sciences, ASU, 2012)
Research Area: U isotopes as paleoredox proxies

Present Position: Staff Scientist, ASU

Brennecka, Gregory (Ph.D. in Geological Sciences, ASU, 2011)

Research Area: U stable isotopes in geochemistry

Present Position: Postdoc, Lawrence Livermore National Laboratory

Glass, Jennifer (Ph.D. in Geological Sciences, ASU, 2011)

Research Area: Mo in biology and evolution

Present Position: Assistant Professor, Georgia Institute of Technology

Morgan, Jennifer (Ph.D. in Chemistry, ASU, 2011)

Research Area: Ca and Fe isotopes in biomedicine

Present Position: Staff Scientist, Proctor and Gamble

Arnold, Gail L. (Ph.D. Geological Sciences, UR, 2004)

Research Area: Trace metals, Mo and Fe isotopes and Precambrian paleoenvironments

Present Position: Research Professor, University of Texas – El Paso

Duan, Yun (Ph.D. Geological Sciences, ASU, 2010)

Research Area: Fe and Mo isotopes in the geologic record

Present Position: Physical therapist, Physiotherapy Associates

Domagal-Goldman, Shawn (M.S. Geological Sciences, UR, 2002)

Research Area: Fe isotope fractionation in sediments; atmosphere evolution

Present Position: Research Space Scientist, NASA Goddard Space Flight Center

Holman, Elizabeth S. (M.S. Geological Sciences, UR, 2001)

Research Area: Theoretical modeling of Fe isotope fractionation

Present Position: Staff, Boston Museum of Science

Jones, Greg (M.S. Geological Sciences, UR, 2003)

Research Area: Distribution of fissionogenic ⁹⁹Tc in Western New York

Present Position: Environmental Safety Officer, R. E. Ginna Nuclear Plant

Klochko, Katerina (M.S. Geological Sciences, UR, 2003)

Research Area: Mo isotope fractionation in the environment

Present Position: Postdoctoral Fellow, Carnegie Institute of Washington

Knab, Karen A. (M.S. Chemistry, UR, 1999)

Research Area: Development of MC-ICP-MS methods for measuring Mo isotope fractionations

Present Position: Program Manager/Counselor, Ocean Recovery LLC.

Ramon, Erick (M.S. Geological Sciences, UR, 1999)

Research Area: Redox evolution of the Earth's surface environment

Present Position: Staff Scientist, Lawrence Livermore National Laboratory

Roe, Jo E. (Ph.D. Chemistry, UR, 2003)

Research Area: Development of MC-ICP-MS methods for studying Fe isotope fractionation

Present Position: Analyst, Excellus Corp.

Royer, Nicole (M.S. Natural Sciences, ASU, 2007)

Research Area: Mo isotopes in the environment

Present Position: Unknown

Graduate Students (secondary project)

Garello, Dominique (Ph.D. Geological Sciences, 3rd year)

Monga, Nikhil (Ph.D. Astrophysics, 4th year)

Monroe, Adam (Ph.D. Chemistry, completed in 2014)

Shkolyar, Svetlana (Ph.D. Geological Sciences, 4th year)

Smith, Harrison (Ph.D. Geological Sciences, 2nd year)

Truitt, Amanda (Ph.D. Astrophysics, 3rd year)

Undergraduate Students (alphabetical)

Beemiller, Peter (Junior Research, Biology B.S., UR, 2000)

Bercel, Trystyn (Junior Research, Earth & Space Exploration B.S., ASU, expected 2015)

Carti, Shani (Senior Research, Environmental Studies B.A., UR, 2000)

Diamond, Ashley (Junior Research, Biology B.S., ASU, 2008)

Fancher, Michael (Freshman Research, Chemistry B.S., ASU, 2011)

Fetterhoff, Kristy (Senior Thesis, Chemistry B.S., UR, 1997)

Glukhova, Alisa (Senior Research, Biochemistry B.S., ASU, 2013)

Goldman, Shawn (Senior Research, Physics B.S., UR, 2001)

Gosse, Julie (Summer Research 1998, Chemistry B.S. at U. Mass Amherst, 1999)

Kaplan, Mark (Senior Thesis, Chemistry B.S., UR, 1997)

Knab, K. A. (Senior Thesis, Environmental Science B.S.; Chemistry B.A., UR, 1998)

LaRossa, Gina (Summer Research 1997; Electrical Engineering B.S. at Yale, 2001)

Manubay, Grace (Senior Research, Environmental Studies B.A., UR, 1999)

Marciano, Santo (Laboratory Asst., Geological Sciences B.S., UR, 2003)

Marshall, Lisa (Senior Thesis, Chemistry B.S., UR, 2001)

Martin, Joe (Senior Research, Environmental Science B.S., UR, 1999)

Martinez, Zuriyema (Senior Research, Biochemistry B.S., ASU, 2012)

Missell, Christine (Summer Research 1999, Geology B.S. at U. Maryland, 2001)

Montanez, Gabriela (Senior Research, Chemical Engineering B.S., ASU, 2010)

Murray, Joseph (Undergraduate Research, Chemistry B.S., ASU, 2011)

Ostrander, Chad (Undergraduate Research, Geological Sciences B.S., ASU, expected 2016)

Peters, K. (Senior Research, Environmental Science B.S., UR, 1997)

Polizzotto, Matt (Senior Research, Environmental Science B.S., UR, 2001)

Ramon, E. (Senior Research, Biology-Geology B.S., UR, 1997)
Roche, Erik (Senior Research, Chemistry B.A., UR, 1999)
Rolfe, Bryan (Freshman – Junior Research, Chemical Engineering B.S., ASU, 2009)
Sabin, Christie (Senior Research, Biochemistry B.S., ASU, expected 2013)
Schultz, Laura (Senior Research, Chemistry B.S., ASU, 2008)
Shollenberger, Quinn (Undergraduate Research, Chemistry B.S., ASU, 2014)
Spaul, Hannah (Senior Research, Environmental Studies B.A., UR, 1998)
Stewart, Audrey (Laboratory Asst., Environmental Sciences B.S., UR, 2004)
Webber, Ben (Senior Research, Chemistry B.S., UR, 2004)
Williams, Teidra (Junior Research, Life Sciences, B.S., ASU, 2008)

Courses Taught
(most recent listed first)

Arizona State University

GLG 106- Habitable Worlds

Semesters Taught: Fall '10, '11, '12, '14 (4 credits; counts toward ASU SQ requirement)

Using the search for life on other worlds as motivation, introduces students to basic concepts in astronomy, geosciences, chemistry, and biology needed to understand what makes the Earth a planet conducive to supporting life. Equips students to understand the future of our inhabited world and the search for life beyond our own. Class size: Offered as a pilot hybrid course to ~ 30 students in 2010, fully online to ~ 150 students in 2011, and fully online to ~ 400 students in 2012.

GLG 591- Archean Geophysics

Semesters Taught: Fall '14 (1 credit)

An overview of Archean geophysical processes and their environmental consequences.

GLG/CHM 598/494- Biogeochemical Evolution of Earth

Semesters Taught: Spring '14 (3 credits)

An graduate seminar covering basic concepts and key topics pertaining to Earth's habitability, its evolution over time, and co-evolution with life.

CHM 302- Environmental Chemistry

Semesters Taught: Fall '08, '09, '11 (3 credits)

An introduction to chemistry in the environment. Explores major environmental issues, problems, and solutions from analytical and chemical perspectives. Class size: ~ 100

GLG 581/CHM 598- Isotope Geochemistry

Semesters Taught: Spring '05, '07, '09, '11, '13 (3 credits)

An introduction to the basic concepts of stable and radiogenic isotope geochemistry. The course includes lectures, reading-and-discussion sessions and laboratory tutorials/demonstrations. Class size: ~ 10.

CHM 501- Current Topics in Geochemistry and Environmental Chemistry

Semesters Taught: Fall '07, '08, '09, '13, Spring '11 (1 credit)

Topical reading and research seminar/practicum in geochemistry an environmental chemistry.

SOS 513/GLG 490- Science for Sustainability (cross-listed as CHM 598/494, Chemistry for Sustainability)

Semesters Taught: Spring '08 (3 credits)

An orientation to natural science concepts and paradigms necessary to understand critical topics in sustainability, particularly related to global climate change. Subjects covered include the carbon cycle, nutrient cycles, carbon and nutrients in the oceans, climate change, oxygen and ozone, solid waste pollution, urban air pollution. Class size: 24.

GLG 191- Alternative Earths: Past, Future and Beyond (1st Year Seminar)

Semesters Taught: Fall '07 (1 credit)

It is only a matter of time before Earth-like planets are discovered orbiting stars other than the Sun. Will we find that environments like ours hospitable to life are common? Through examination of the four billion years of "coevolution" of life and the environment on this planet, students will gain perspective on how our civilization is shaping the Earth's future and on the prospects for life on the alternative Earths that lie beyond. Class size: ~ 10.

ASU 101- The ASU Experience

Semesters Taught: Fall '07 (1 credit)

A required class for all ASU students to teach skills needed for success in college. Class size: ~ 10.

CHM 113- General Chemistry

Semesters Taught: Fall '05, '06 (3 credits + lab)

A college-level introduction to the basic concepts of chemistry. First course in a two-semester sequence. The course includes lectures, discussion sessions and a laboratory. Class size: ~ 200.

GLG 598/490- Habitable World (cross-listed as CHM 582)

Semesters Taught: Spring '06 (3 credits)

A first course in Earth System Science for graduates and advanced undergraduates. Topics covered include planetary climate, Earth history, biogeochemical cycles; atmosphere and ocean chemistry. Class size: ~ 10.

University of Rochester

EES 103- Habitable World: An Introduction to Environmental Science

Semesters Taught: Spring '02, '03, '04 (4 credits)

An introduction to the natural physical, chemical, biological and geological processes that shape conditions at the Earth's surface, their interrelationships, and the modification of these processes by human activity. Students will learn to critically analyze scientific hypotheses and the data on which they are founded. The content of this course is similar to that of the AP Environmental Science curriculum. Class size: 25 – 40.

EES 218- The Chemistry of Global Change

Semesters Taught: Fall '01, '02, '03 (4 credits)

Quantitative survey of the processes controlling environmental conditions at the Earth's surface today, how they have changed with time, and how they are expected to change in the future. The course emphasizes the chemical composition of the atmosphere and oceans, and the chemical, biological and geological processes which affect this composition. Specific topics include: greenhouse gases and global warming; photochemistry and stratospheric ozone; geochemical cycles and feedbacks; the effects of human activities; and the methods used to study the chemical evolution of the atmosphere and oceans. Class size: 15 – 25.

EES 261/461- Aqueous Geochemistry

Semesters Taught: Fall '98, Fall '00 (4 credits)

An introduction to the chemistry of water in the environment, including both pristine and polluted systems. The composition and behavior of atmospheric waters, groundwaters and seawater will be studied through the application of principles of inorganic chemistry and geology. Offered alternate fall semesters. Class size: ~ 15

EES 216- Environmental Geochemistry

Semesters Taught: Spring '97, '98, '99, '00 (4 credits)

A course in the chemical and physical processes that shape our environment. These include groundwater flow and contaminant migration, chemistry of lakes, streams and the ocean, ocean-atmosphere interactions, (ozone depletion) global warming and the greenhouse effect. Class size: 30 - 50

EES 466- Stable Isotope Geochemistry: Beyond the Light Elements

Semesters Taught: Spring '00 (4 credits)

Historically, research in stable isotope geochemistry has focused on isotope fractionation of H, B, O, C, N and S. However, recent work at Rochester and elsewhere has shown that the isotopes of many heavier elements also undergo measurable fractionation in nature. This research seminar will focus on these emerging stable isotope systems, with a focus on analytical methods and potential applications. Specific isotope systems to be covered include (at least): Ca, Se, Fe, Cu, Zn and Mo. Students will be expected to keep up with reading assignments, prepare informal presentations, and participate in discussions. A term project or paper is also required. Class size: ~ 5

EES 263/463- Seminar in Biogeochemistry (Astrobiology)

Semesters Taught: Spring '96, '99, '02 '03 (4 credits)

Current topics in biogeochemistry, focusing on the interface between biological and geological processes in ancient and modern environments. Coursework includes readings from the primary research literature, presentations, student-led discussions and a term paper or project. Class size: 5 - 10

EES 265/465- Chemistry of Atmospheres

Semesters Taught: Fall '97, Fall '99 (4 credits)

An introduction to the chemistry of the Earth's atmosphere, and the atmospheres of the other planets and their satellites. Special emphasis on photochemistry and chemical kinetics, and modeling of these processes in atmospheres. Effects of life and of human activities on the atmosphere will be examined, as well as the chemical evolution of the atmosphere through Earth history. Offered alternate fall semesters (odd years). Class size: ~ 15.

EES 100Q- The Early Earth and the Origin of Life (1st Year "Quest" Course)

Semesters Taught: Fall '96 (4 credits), Spring '97 (EES 200), Spring '98 (2 credits)

Students will focus on conditions of the early Earth and theories of the origin of life through presentations, discussions and debates, guided by their readings of primary research articles. This course is designed to reinforce basic concepts in chemistry, biology and earth science in a

problem-oriented manner, and to demonstrate the interrelationships between specific disciplines. Students will learn to critically and quantitatively analyze scientific hypotheses, and the data on which they are founded. Class size: ~ 15.

CAS 160- Public Speaking

Semesters Taught: Fall '97 (2 credits)

The intent of this course is to provide students the opportunity to improve their oral presentation and interview skills. Various presentation types will be covered, including scientific, business and instructional presentations, speeches, and extemporaneous speaking. Students will develop skills as both interviewers and interviewees. Class size: ~ 10.

Other Significant Educational Activities

Arizona State University

Online Course Development

School of Earth & Space Exploration and ASU Online, 2009 – present

Articulated curricular and pedagogical goals for an interactive online quantitative science course that would be part of the BA curriculum in Earth and Environmental Studies, leading to the development and offering of Habitable Worlds (GLG 106). Effort dovetailed with development of the Arizona Science Education Collaborative (ASEC) between CLAS and the Mary Lou Fulton Teacher's College. Software development was supported by funds from ASU Online, CLAS, and the NASA Astrobiology Program. This course was offered by Anbar as a hybrid course in Fall '10, then fully online in Fall '11 and Fall '12. It was offered by development partner Dr. Lev Horodyskyj in Spring '12. See: <http://habworlds.org>.

General Education Curricular Reform

Arizona State University, 2013 – 2014

In Fall Semester, 2013, chaired a Working Group charged by Provost Elizabeth Phillips to reconceptualize the ASU general education curriculum required of all ASU students. The group included 6 faculty from across the university's knowledge domains. Our recommendations, explained in a draft report submitted to the Provost's Office in December, 2012, called for a general studies curriculum in which courses across knowledge domains would be organized around, and motivated by, thematic, transdisciplinary, multi-year projects.

TED-Ed Video – Finding Habitable Worlds

School of Earth & Space Exploration, Spring-Summer-Fall 2012

Devised concept and script for a TED-Ed video, and associated “flipped” lesson, about the search for habitable worlds beyond the Earth. See: <http://ed.ted.com/lessons/a-needle-in-countless-haystacks-finding-habitable-planets-ariel-anbar>.

Education Research

School of Earth & Space Exploration, 2010 - present

Developed a funded research plan for the NSF program *Transforming Undergraduate Education in STEM*, centered on modification and assessment of effectiveness of Habitable Worlds (GLG

106) as a platform to teach scientific reasoning. Awarded \$600,000 (Co-PI: Prof. Steven Semken). Project begins in January, 2013. Also served as Co-I with PI Steven Semken on a NASA project to infuse NASA science content into the national K-12 geoscience curricula.

Virtual Field Trip Development

School of Earth & Space Exploration and AZ Sci. Ed. Collaborative (ASEC), 2010-present

With financial support from NASA, ASU Online, and the Mary Lou Fulton Teachers College, oversaw effort by the ASU Astrobiology Program to develop a suite of scientific “virtual field trips”. These products, developed by technologist Mr. Geoffrey Bruce, are being used in Habitable Worlds, by ASEC, and by faculty in the School of Human Evolution and Social Change (SHESC). See: <http://vft.asu.edu>.

Curriculum Development

School of Sustainability (SOS), 2006 - 2008

Helped Profs. Charles Redman and Charles Perrings devise curricula for ABOR approval of SOS curriculum, based on the syllabi for EES 103 (“Habitable World”) and EES 218 (“Chemistry of Global Change”). These provided models for SOS 513 (“Science for Sustainability”) and SOS 110 (“Sustainable World”). Also served as the first instructor for SOS 513 in Spring, 2008.

Curriculum Development

Dept. of Chemistry & Biochemistry, 2008 - 2009

Worked with faculty in the environmental/geochemistry division of the Department as well as faculty on the department’s Committee on Sustainability to explore reinventing the Environmental Chemistry undergraduate degree program as a Sustainable Chemistry program.

Honors Disciplinary Advisor

Dept. of Geological Sciences and School of Earth & Space Exploration, 2005 - present

Worked with faculty in the Dept. of Geological Sciences (later the School of Earth & Space Exploration) and staff at the Barrett Honors College to facilitate connections between Barrett students and the Dept. Includes connecting Honors majors with potential thesis advisors and raising awareness of geosciences among Honors students.

University of Rochester

Faculty-in-Residence

Crosby Hall: '96 – '97; Hoeing Hall: '97 – '98; '98 – '99

Lived in undergraduate residence hall. Planned and executed programming designed to stimulate student/faculty interactions outside the classroom.

Residential College Commission

Residential Life Subcommittee, Fall '97 – '99

Participated as one of two faculty representatives, and co-author of final report. The subcommittee was charged with developing recommendations to improve the collegiate experience for students in residence at UR. The major recommendation of the report was to call for unified freshman housing.

Freshman Housing Implementation Committee/Freshman Advisory Committee

Spring '00 – Spring '02

Participated in planning for freshman housing implementation. Chaired subcommittee dealing with impact on fraternities and special interest housing, subcommittee elucidating mechanisms to link the freshman class and the College, and subcommittee on modifying freshman orientation experience.

Faculty Advisor, Sigma Epsilon Fraternity

Spring '01 – present

Worked with students to develop academically-oriented programs.

Hillel of Rochester Area Colleges, V.P.- Campus Affairs

Fall '01 – Fall '02

Oversaw review of Hillel-supported campus programming for undergraduate Jewish students.