Andrew D. Czaja

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**Professional Appointments**

2012–present **Assistant Professor**, Paleobiology and Biogeochemistry. University of Cincinnati, Dept. of Geology

2008–2012 **Postdoctoral Research Associate**, Geochemistry, Isotope Geochemistry. University of Wisconsin, Madison, Dept. of Geoscience.

2007 **Lecturer**, University of California, Los Angeles, Dept. of Earth and Space Sciences

2006–2007 **Lecturer**, California State University, Fullerton, Dept. of Geological Sciences

**Education**

Ph.D., University of California, Los Angeles, 2006, Geology (concentration: Paleobiology)

Thesis title: *Characterization of the geochemical alteration of permineralized fossil plants based on macromolecular structure and composition*

B.S., University of Connecticut, 1998, Environmental Sciences and Biological Sciences

 Summa cum laude, Honors Scholar

 Honors thesis title: *Effects of debris-avalanches on surrounding* Betula cordifolia *in*

*Franconia Notch State Park, New Hampshire*

**RESEARCH**

**Research Interests**

I want to know how life originated on Earth, how it evolved, and whether or not life exists elsewhere in the universe. I study Precambrian microfossils with emphasis on those of the Archean and terrestrial/lacustrine and deep marine paleoenvironments. I study the possibility of extraterrestrial life through the search for geochemical and morphological signatures of past terrestrial life that could be applied to past or present extraterrestrial life, particularly on Mars. I am also interested in the evolution of Earth’s surface conditions, particularly the transition from anoxic to oxic conditions at the Neoarchean–Proterozoic boundary. Finally, I am interested in understanding the processes of fossilization. I approach this topic though studies of geochemical alteration of organic matter and inorganic aspects of such fossilization (e.g., permineralization), as well as geochemical, isotopic, and taphonomic studies of ancient sediments and stromatolites to understand their genesis and evidence of past life preserved within.

**Current Projects**

* Trace element biosignature for microorganisms preserved in modern and ancient silica (with Prof. Jeff Havig of U. Minnesota, and Andrew Gangidine of UC)
* Carbon isotope compositions and ecological interpretations of 2.5-billion-year-old coccoidal microfossils from the Kaapvaal Craton, South Africa (with Jeff Osterhout of UCLA; Dr. Ken Williford of JPL; and Prof. John Valley of UW, Madison)
* Taphonomic study of 2.5-billion-year-old filamentous microfossils from the Kaapvaal Craton of South Africa (with Prof. Nic Beukes of the U. Johannesburg and Kira Lorber of UC)
* Thermal alteration of ancient sedimentary rocks as measured by Raman spectroscopy in various lithologies (with several colleagues from UW, Madison)
* Thermal alteration of phosphatized scale-like objects in Neoproterozoic cherts from Tasmania (with Dr. Leigh Anne Riedman and Prof. Susannah Porter of the UC, Santa Barbara)
* Water quality of Mayan reservoirs measured by diatom abundance and diversity (with Prof. David Lentz, UC Biological Sciences)
* Identifying inclusions in garnets in Paleozoic metamorphic rocks from New England (with Prof. Craig Dietsch, UC Geology)
* Mineral compositions of the carapaces of clam shrimp via UV Raman spectroscopy (with Prof. Thomas Hegna of Western Illinois U. and Dr. Christopher Rogers of the Kansas Biological Survey)

**Publications**

*Peer-reviewed articles*

**Czaja AD**, Van Kranendonk MJ, Beard BL, and Johnson CM (2018) A multistage origin for Neoarchean layered hematite-magnetite BIF from the Weld Range, Yilgarn Craton, Western Australia. *Chemical Geology*, 488: 125–137*.*

Muscente, AD, **Czaja, AD**, Tuggle, J, Winkler, C, and Xiao, S (2018) Manganese oxides resembling microbial fabrics and their implications for recognizing inorganically preserved microfossils. *Astrobiology*, 18(3): 249­–258.

Guo Z, **Czaja AD**, Chen S, Ta K, and Peng X (2018) Cellular taphonomy of well-preserved Gaoyuzhuang microfossils: a window into the preservation of ancient cyanobacteria. *Precambrian Research*, 304: 88–98.

\*Vrazo MB, Diefendorf AF, Crowley BE, and **Czaja AD** (2018) Late Cretaceous marine arthropods relied on terrestrial organic matter as a food source: geochemical evidence from the Coon Creek lagerstätte in the Mississippian embayment. *Geobiology*, 16: 160–178.

Kang J, **Czaja AD**, and Guliants VV (2017) Carbon dioxide as feedstock in selective oxidation of propane. *European Journal of Inorganic Chemistry*, 2017(40): 4757–4762.

Smith AJB, BeukesNJ, GutzmerJ, **CzajaAD,** Johnson CM, and Nhleko N (2017) Oncoidal granular iron formation in the Mesoarchaean Pongola Supergroup, southern Africa: Textural and geochemical evidence for biological activity during iron deposition. *Geobiology*, 15: 731–749.

**Czaja AD**, Beukes NJ, and Osterhout JT (2016)Sulfur-oxidizing bacteria prior to the Great Oxidation Event from the 2.52 Ga Gamohaan Formation of South Africa. *Geology*, 44(12): 983­–986.

d'Abzac F-X, **Czaja AD**, Beard, BL, Schauer JJ, and Johnson CM (2014) Iron distribution in size-resolved aerosols generated by UV-femtosecond laser ablation: Influence of cell geometry and implications for *in situ* isotopic determination by LA-MC-ICP-MS. *Geostandards and Geoanalytical Research*, 38(3): 293–309.

Wilmeth DT, Dornbos SQ, Isbell JL, and **Czaja AD** (2014) Putative domal microbial structures in fluvial siliciclastic facies of the Mesoproterozoic (1.09 Ga) Copper Harbor Conglomerate, Upper Peninsula of Michigan, USA. *Geobiology*, 12: 99–108.

d'Abzac F-X, Beard BL, **Czaja AD**, Konishi H, Schauer J, and Johnson CM (2013) Iron isotope composition of particles produced by UV-femtosecond laser ablation of natural oxides, sulfides, and carbonates. *Analytical Chemistry*, 85: 11885–11892.

Li W, **Czaja AD**, Van Kranendonk MJ, Beard BL, Roden EE, and Johnson CM (2013) An anoxic, Fe(II)-rich, U-poor ocean 3.46 billion years ago. *Geochimica et Cosmochimica Acta*, 120: 65–79.

Shen-Miller J, Aung LH, Turek J, Schopf JW, Tholandi M, Yang M, and **Czaja AD** (2013) Centuries-old viable fruits of *Nelumbo nucifera* Gaertn var. China Antique. *Tropical Plant Biology*, 6(2-3): 53–68.

**Czaja AD**, Johnson CM, Beard BL, Roden EE, Li W, and Moorbath S (2013) Biological Fe oxidation controlled deposition of banded iron formation in the ca. 3,770 Ma Isua Supracrustal Belt (West Greenland). *Earth and Planetary Science Letters*, 363: 192–203.

**Czaja AD**, Johnson CM, Roden EE, Beard BL, Voegelin AR, Nägler TF, Beukes NJ, and Wille M (2012) Evidence for free oxygen in the Neoarchean ocean based on coupled iron–molybdenum isotope fractionation. *Geochimica et Cosmochimica Acta*, 86: 118–137.

**Czaja AD**, Johnson CM, Yamaguchi KE, and Beard BL (2012) Comment on “Abiotic Pyrite Formation Produces a Large Fe Isotope Fractionation” by Guilbaud et al. *Science*, 335: 538.

Beard BL, Handler RM, Scherer MM, Wu L, **Czaja AD**, Heimann A, and Johnson CM (2010) Iron isotope fractionation between aqueous ferrous iron and goethite. *Earth and Planetary Science Letters*, 295: 241–250.

**Czaja AD**, Johnson CM, Beard BL, Eigenbrode JL, Freeman KH, and Yamaguchi KE (2010) Iron and carbon isotope evidence for ecosystem and environmental diversity in the ~2.7 to 2.5 Ga Hamersley Province, Western Australia. *Earth and Planetary Science Letters*, 292: 170–180.

**Czaja AD**, Kudryavtsev AB, Cody GD, and Schopf JW (2009) Characterization of permineralized kerogen from an Eocene fossil fern. *Organic Geochemistry*, 40(3): 353–364.

Schopf JW, Kudryavtsev AB, **Czaja AD**, and Tripathi AB (2007) Evidence of Archean life: stromatolites and microfossils. *Precambrian Research*, 158(3–4): 141–155.

**Czaja AD**, Kudryavtsev AB, and Schopf JW (2006) New method for the microscopic, nondestructive acquisition of ultraviolet resonance Raman spectra from plant cell walls. *Applied Spectroscopy*, 60(4): 352–355.

Schopf JW, Kudryavtsev AB, Agresti DG, **Czaja AD**, and Wdowiak TJ (2005) Raman imagery: a new approach to assess the geochemical maturity and biogenicity of permineralized Precambrian microscopic fossils. *Astrobiology*,5: 333–371.

Jones CS, Cardon ZG, and **Czaja AD** (2003) A phylogenetic view of low level CAM in *Pelargonium* (Geraniaceae). *American Journal of Botany*, 90: 135–142.

Cardon ZG, **Czaja AD**, Funk JL, and Vitt P (2002) Periodic carbon flushing to roots of *Quercus rubra* seedlings affects soil respiration and rhizosphere microbial biomass. *Oecologia*, 133: 215–223.

Schopf JW, Kudryavtsev AB, Agresti DG, Wdowiak TJ, and **Czaja AD** (2002) Images of Earth’s earliest fossils? – Reply. *Nature*, 420: 477.

Schopf JW, Kudryavtsev AB, Agresti DG, Wdowiak TJ, and **Czaja AD** (2002)Laser-Raman imagery of Earth's earliest fossils. *Nature*, 416: 73–76.

*Manuscripts submitted or in preparation (\* indicates a student led paper)*

**Czaja AD**, Kudryavtsev AB, Cody GD, and Schopf JW (in prep) Kerogen formation during fossilization: a comparison of fossil and experimentally thermally altered modern plants. To be submitted to *Geochimica et Cosmochimica Acta*.

**Czaja AD**, Osterhout JT, Williford KH, and Valley JW (in prep) Stable isotope geochemistry of a late Archean microbial ecosystem: Diversity in the pre-GOE oceans, to be submitted to *Precambrian Research*.

\*Osterhout JT, **Czaja AD**, Fralick PW, and Bartley JK (in prep) Preservation of carbon isotopes in kerogen from thermally altered Mesoproterozoic lacustrine microbialites. To be submitted to *Canadian Journal of Earth Science*.

*Peer-reviewed book chapters/encyclopedia entries*

Muscente AD, **Czaja AD**, Riedman LA, and Colleary C (2017) Organic Matter in Fossils. In *Encyclopedia of Geochemistry*, White WM, Ed. Springer International Publishing.

Schopf JW, Kudryavtsev AB, Tripathi AB, and **Czaja AD** (2011) Three-dimensional morphological (CLSM) and chemical (Raman) imagery of permineralized fossils, in *Taphonomy: Process and Bias Through Time,* 2nd edition, PA Allison and DJ Bottjer, Eds., Springer, New York.

*Invited papers*

**Czaja AD** (2010) Microbes and the rise of oxygen. *Nature Geoscience*, 3: 522–523.

*Book reviews*

**Czaja AD** (2010) Astrobiology of Earth: The Emergence, Evolution, and Future of Life on a Planet in Turmoil, by Joseph Gale. *Quarterly Review of Biology*, 85(1): 88.

**Professional Presentations**

*Invited Talks*

2018 “Discovering the Mars 2020 Rover”, University of Cincinnati, Alumni Weekend, *Explore UC* program

2017 “Geological fieldwork on another world: plans for Mars sample return and the search for extraterrestrial life”, University of Cincinnati, Undergraduate Astronomy Club meeting

2017 “Selecting a field work site from 50 million kilometers away: the landing site selection process for the Mars 2020 mission”, University of Cincinnati, Department of Geography Colloquium Series

2017 “Mission to Mars: the landing site selection process for the Mars 2020 mission”, University of Cincinnati, College of Arts & Sciences, Dean’s Advisory Board Meeting

2017 “Micron-scale organic geochemical and fluorescence imaging of Earth's most ancient life”, University of Cincinnati School of Design, Art, Architecture, and Planning, Architecture colloquium

2017 “Sulfur oxidation, biodiversity, and oxygenation in the Archean”, Harvard University, Department of Earth and Planetary Sciences, Geobiology Seminar

2016 “Life in the Archean: Increasing the diversity”, Ohio University, Department of Geological Sciences colloquium

2016 “Life in the Archean: Increasing the diversity”, Kent State University, Department of Geology, Palmer Lecture Series

2015 “Life in the Archean: Increasing the diversity”, University of South Florida, School of Geosciences colloquium

2014 “Possible large planktonic fossil microbes preserved in Neoarchean deep water sediments”, Virginia Tech, Department of Geosciences colloquium

2013 “Geochemical and paleontological evidence for photosynthesis on the early Earth”, Marine Biological Laboratory (MBL) Microbial Diversity Summer Course

2013 “Micron-scale organic geochemical and morphological analyses of Earth's ancient biosphere”, Univ. of Cincinnati, School of Energy, Environment, Biological and Medical Engineering

2011 “Evidence for significant free oxygen in the ocean prior to the Paleoproterozoic Great Oxidation Event”, University of Illinois, Chicago, Department of Earth and Environmental Sciences colloquium

2011 “Evidence for significant free oxygen in the ocean prior to the ~2.4 Ga
Great Oxidation Event”, University of Wisconsin, Madison, Department of Geoscience Weeks Lecture

2009 “Iron and carbon isotope evidence for ecosystem and environmental diversity in the ~2.7 to 2.5 Ga Hamersley Province, Western Australia”, University of Wisconsin, Milwaukee, Department of Geosciences colloquium

2006 “Understanding the paleobiological afterlife: a modern approach to an ancient problem”, California Institute of Technology, Division of Geological and Planetary Sciences Geology Club colloquium

2006 “Understanding the paleobiological afterlife: a spectroscopic comparison of modern and permineralized plant axes”, Carnegie Institute of Washington, Washington, DC, Geophysical Laboratory

2004 “Illuminating the black box that is fossil kerogen”, NASA Astrobiology Institute, Forum for Astrobiological Research seminar series

*First-author oral presentations at conferences*

2018 **Czaja AD.** Searching for signs of life: Morphological and geochemical biosignatures on Earth (and Mars?). Gordon Research Conference on Geobiology, Galveston, TX. (**Invited**)

2016 **Czaja AD** and Riedman LA. Mineralogical control on apparent thermal alteration of ancient organic matter as measured by Raman spectroscopy. Geological Society of America Annual Meeting, Denver, CO. *Abstracts with Programs*, Vol. 48, 7.

2015 **Czaja AD**, Osterhout JT, and Beukes NJ. Exceptionally large Neoarchean spheroidal microfossils from South Africa: possible contributors to the GOE. Geological Society of America Annual Meeting, Baltimore, MD. *Abstracts with Programs.* Vol. 47, No. 7.

2014 **Czaja AD**, and Lorber KN. *In situ* Raman spectroscopy and confocal microscopy of 2.5 billion-year-old fossil microorganisms: viable nondestructive techniques for the study of returned Martian samples. American Geophysical Union Fall Meeting, San Francisco, CA. (**Invited**)

2013 **Czaja AD**, Johnson CM, Beard BL, Roden EE, Li W, and Moorbath S. Anoxygenic photosynthesis recorded in 3.8 Ga BIFs of the Isua Supracrustal Belt. NASA Astrobiology Institute Early Earth Focus Group, Workshop without Walls.

2012 **Czaja AD**, Johnson CM, Beard BL, and Moorbath S. Early Archean Fe oxidation revealed by meso- and micron-scale Fe isotope analyses of the 3.7–3.8 Ga Isua BIFs. *Mineralogical Magazine*, 76(6): 1612. Abstracts of the 22nd Annual V.M. Goldschmidt Conference Montreal, Quebec Canada.

2012 **Czaja AD**, Johnson CM, and Beard BL. Meso- and micron-scale Fe isotope analyses of the 3.7–3.8 Ga Isua BIFs reveal Early Archean Fe oxidation. NASA Astrobiology Science Conference, Atlanta, GA.

2011 **Czaja AD**, Johnson CM, Roden EE, Beard BL, Voegelin AR, Nägler TF, Beukes NJ, and Wille M. Evidence for free oxygen in the Neoarchean ocean based on coupled iron–molybdenum isotope fractionation. American Geophysical Union Fall Meeting, San Francisco, CA.

2011 **Czaja AD**, Johnson CM, Roden EE, Beard BL, Voegelin AR, Nägler TF, Beukes NJ, and Wille M. Evidence for free oxygen in the Neoarchean ocean. Gordon Research Conference, Geobiology, Ventura, CA. **(Invited)**

2010 **Czaja AD**, Johnson CM, Beard BL, and Van Kranendonk MJ. Iron isotopes reveal an abiological origin for a 2.75 Ga BIF from the Yilgarn Craton, Western Australia. *Geochimica et Cosmochimica Acta*, 74 (12, S1): A201. Abstracts of the 20th Annual V.M. Goldschmidt Conference Knoxville, TN.

2010 **Czaja AD**, Johnson CM, Beard BL, Eigenbrode JL, Freeman KH, and Yamaguchi KE. Iron and carbon isotope evidence for ecosystem and environmental diversity in the ~2.7 to 2.5 Ga Hamersley Province, Western Australia. NASA Astrobiology Science Conference, League City, TX.

2009 **Czaja AD**, Johnson CM, Beard BL, Eigenbrode JL, Freeman KH, and Yamaguchi KE. Iron and carbon isotope evidence for ecosystem and environmental diversity in the ~2.7 to 2.5 Ga Hamersley Province, Western Australia. Geological Society of America Annual Meeting, Portland, OR.

2007 **Czaja AD**, Kudryavtsev AB, Cody GD, and Schopf JW. Comparison of fossil fern kerogen from two Eocene cherts. Geological Society of America Annual Meeting, Denver, CO.

2007 **Czaja AD**, Kudryavtsev AB, Cody GD, and Schopf JW. Fine-scale analysis of permineralized kerogen. 3rd Astrobiology Graduate Conference, San Juan, Puerto Rico.

2006 **Czaja AD**. Raman spectroscopic analysis of permineralized organic-walled fossils, Eocene to Archean. 3rd Annual Southern California Geobiology Symposium, University of California, Riverside. Riverside, CA.

2005 **Czaja AD**, Kudryavtsev AB, and Cody GD. Toward a better understanding of the paleontological afterlife: a spectroscopic comparison of modern and permineralized plant axes. Geological Society of America Annual Meeting, Salt Lake City, UT.

2005 **Czaja AD**. Fossil organic matter: a better understanding of its history. Astrobiology Graduate Conference, Scripps Institution of Oceanography, La Jolla, CA.

2004 **Czaja AD**, Cody GD, Kudryavtsev AB, and Schopf JW. Turning ferns into fossils: biogeochemical alchemy. Geological Society of America Annual Meeting, Denver, CO.

*First author poster presentations at conferences*

2018 **Czaja AD**, Osterhout, JT, and Gangidine, AJ. Mineralogical control of organic matter thermal alteration: Implications for biosignature preservation in returned martian samples, 2nd International Mars Sample Return Conference, Berlin, Germany.

2015 **Czaja AD**, Osterhout JT, and Beukes NJ. Fossil evidence of possible contributors to the Great Oxidation Event: Exceptionally large Neoarchean microfossils from South Africa. Fourth Annual Midwest Geobiology Symposium, Bloomington, IN.

2015 **Czaja AD**, Osterhout JT, and Beukes NJ. Large planktonic microfossils preserved in a deep water facies of the 2.52-GA-old Gamohaan Formation, South Africa. NASA Astrobiology Science Conference, Chicago, IL.

2014 **Czaja AD**, Lorber KN, Beukes NJ. Filamentous microfossils from the Neoarchean Gamohaan Formation of South Africa: Implications for the history of photoautotrophy. Origins2014 Meeting, Nara, Japan.

2010 **Czaja AD**, Johnson CM, Beard BL, and Van Kranendonk MJ. Iron isotope evidence for an abiological origin of a BIF from the Yilgarn Craton, Western Australia. 5th International Archean Symposium, Perth, WA, Australia.

2008 **Czaja AD**, Kudryavtsev AB, Cody GD, and Schopf JW. Similar fossil ferns having dissimilar organic geochemical preservation, *Geochimica et Cosmochimica Acta*, 72 (12, S1): A193. Abstracts of the 18th Annual Goldschmidt Conference Vancouver, Canada.

# 2008 Czaja AD, Kudryavtsev AB, Cody GD, and Schopf JW. Geochemical characterization of permineralized kerogen: similar fossils having dissimilar degrees of preservation. NASA Astrobiology Science Conference, San Jose, CA.

# 2006 Czaja AD and Kudryavtsev AB. Raman spectroscopic characterization of the thermal history of permineralized fossils. Astrobiology Science Conference, Washington, DC.

2006 **Czaja AD.** Spectroscopic analysis of the thermal alteration of permineralized organic matter. *Origins of Life and Evolution of the Biosphere*, 36(3): 311. Abstracts of the 14th International Conference on the Origin of Life and 11th International Society for the Study of the Origin of Life (ISSOL) Meeting, Tsinghua University. Beijing, PRC.

2005 **Czaja AD**, Kudryavtsev AB, and Cody GD. Raman spectroscopic analysis of the thermal alteration of permineralized organic matter. NASA Astrobiology Institute Conference, University of Colorado at Boulder, Boulder, CO.

2004 **Czaja AD**, Cody GD, and Schopf JW. Turning ferns into fossils: biogeochemical alchemy. *International Journal of Astrobiology*, 3(Suppl. S1): 27. Abstracts of the Astrobiology Science Conference, NASA Ames Research Center, Moffett Field, CA

2003 **Czaja AD,** Schopf JW, Storrie-Lombardi MC, and Cody GD. Multi-spectra analysis of geochemical alteration through natural and artificial fossilization. NASA Astrobiology Institute Conference, Arizona State University. Tempe, AZ.

2002 **Czaja AD,** Schopf JW, Storrie-Lombardi MC, Kudryavtsev AB, and Bhartia R. Laser Raman spectroscopic analysis of chemical changes caused by fossilization. 13th International Conference on the Origin of Life and 10th International Society for the Study of the Origin of Life (ISSOL) Meeting, Oaxaca, Mexico.

2002 **Czaja AD,** Schopf JW, Storrie-Lombardi MC, Kudryavtsev AB, and Bhartia R. Laser Raman spectroscopic analysis of biochemical changes caused by fossilization. Astrobiology Science Conference, NASA Ames Research Center, Moffett Field, CA.

*Student presentations at conferences* (\* – graduate; † ­– undergraduate)

2018 \*Gangidine AJ, **Czaja AD**, Havig J. Developing a trace element biosignature for early Earth and Mars. 2nd International Mars Sample Return Conference, Berlin, Germany.

2017 \*Osterhout JT and **Czaja AD**. Stable isotope geochemistry of a late Archean microbial ecosystem: Diversity in the pre-GOE oceans, Geological Society of America Annual Meeting, Seattle, WA.

2017 †Perfetta C, **Czaja AD**, and Lentz D. Contaminated water and the collapse of the ancient Maya: Microbiome analyses of reservoir sediments from Tikal. Undergraduate Research Forum, University of Cincinnati, OH.

2017 \*Gangidine AJ, **Czaja AD**, and Havig J. A novel trace element biosignature for life on early Earth and Mars. NASA Astrobiology Science Conference, Mesa, AZ.

2017 \*Manning-Berg AR, Tuite M, Williford K, **Czaja AD**, and Kah LC. Exceptional preservation of biomarkers in the 1.2 Ga Angmaat Formation chert, Bylot Supergroup, Baffin Island. NASA Astrobiology Science Conference, Mesa, AZ.

2016 \*Gangidine AJ, **Czaja AD**, and Havig J. Developing a trace element biosignature in modern and ancient silica deposits – implications for the search for ancient life on Mars. Fifth Annual Midwest Geobiology Symposium, Cincinnati, OH.

2016 \*Vrazo MB, Diefendorf AF, Crowley BE, and **Czaja AD.** Late Cretaceous marine arthropods relied on terrestrial organic matter as a food source: geochemical evidence from the Coon Creek lagerstätte in the Mississippian embayment. Geological Society of America Annual Meeting, Denver, CO. *Abstracts with Programs*, 48(7).

2016 \*Lorber KN, **Czaja AD**, and Lee P. Variations in Biosignature Preservation: Geochemical Analysis of Kerogen Comparing Two Mars Analog Environments. Biosignature Preservation and Detection in Mars Analog Environments Conference, Lake Tahoe, NV.

2016 \*Osterhout JT and **Czaja AD.** Organic geochemistry of a 1.4-billion-year-old evaporitic lake: insights for the Mars 2020 SHERLOC instrument. Biosignature Preservation and Detection in Mars Analog Environments Conference, Lake Tahoe, NV.

2015 \*Osterhout JT, **Czaja AD**, and Beukes NJ. Isotopic evidence of photoautotrophy in an open marine ecosystem preceding the Great Oxygenation Event. Geological Society of America Annual Meeting, Baltimore, MD. *Abstracts with Programs.* 47(7): 705.

2015 \*Lorber KN, **Czaja AD**, and Beukes NJ. Geochemical analysis of 2.5 billion-year-old microfossils exhibiting varying degrees of preservation. Fourth Annual Midwest Geobiology Symposium, Bloomington, IN.

2015 \*Osterhout JT, **Czaja AD**, and Fralick, PW. Organic geochemistry of stromatolites in a 1.4 billion-year-old evaporitic lacustrine ecosystem. Fourth Annual Midwest Geobiology Symposium, Bloomington, IN.

2015 \*Holbrook C, **Czaja AD**, and Boolchand P. Topological phases in modified oxides, 14th International Conference on the Physics of Non-Crystalline Solids, Niagara Falls, NY.

2015 \*Holbrook C, Boolchand P, and **Czaja AD.** Onset of rigidity and thresholds in physical properties of barium-borate glasses," XXIV International Materials Research Congress, Cancun, Mexico.

2015 \*Lorber KN, **Czaja AD**, and Beukes NJ. Preservational variations of 2.5 billion-year-old filamentous microfossils from the Gamohaan Formation of South Africa. NASA Astrobiology Science Conference, Chicago, IL.

2015 \*Osterhout JT, **Czaja AD**, and Beukes NJ. Morphological and geochemical diversity of deep water microfossils from the 2.52 Ga-old Gamohaan Formation, South Africa. NASA Astrobiology Science Conference, Chicago, IL.

2015 \*Holbrook C, Boolchand P, and **Czaja AD**. Topological phases in Ba-borate glasses," American Physical Society March Meeting, San Antonio, TX.

2014 \*Lorber KN, and **Czaja AD**. Investigation of Archean microfossil preservation for defining science objectives for Mars sample return missions. American Geophysical Union Fall Meeting, San Francisco, CA.

2014 \*Lorber KN, and **Czaja AD**. Current and future technologies employed in the search for Precambrian fossils with possible implications for astrobiology. Gordon Research Conference on the Origin of Life, Galveston, TX.

*Selected coauthored presentations at conferences*

2018 Van Kranendonk M, Baumgartner R, Boyd E, Cady S, Campbell K, **Czaja A**, Damer B, Deamer D, Djokic T, Fiorentini M, Gangidine A, Havig J, Mulkidjanian A, Ruff S, Thordarson P. Terrestrial hot springs and the origin of life: Implications for the search for life beyond Earth. 49th Lunar and Planetary Science Conference,

2017 Porter S, Riedman LA, **Czaja AD**, Calver C. Early Neoproterozoic biostratigraphy: life before the Cryogenian glaciations. International Meeting of Sedimentology, Toulouse, France.

2017 Returned Sample Science Board (Carrier BL, Beaty DW, McSween HY, **Czaja AD**, Goreva YS, Hausrath EM, Herd CDK, Humayun M, McCubbin FM, McLennan SM, Pratt LM, Sephton MA, Steele A, and Weiss BP). Strategies for investigating early Mars using returned samples. 4th Conference on Early Mars, abs. #3051.

2017 Smith AJB, Beukes NJ, Gutzmer J, Johnson CM, **Czaja AD**, and De Beer FC. Insights into oncoidal morphology and sedimentology of a Mesoarchean granular iron formation from southern Africa using 3D X-ray computed tomography (µXCT), Abstracts of the V.M. Goldschmidt Conference Paris, France.

2017 Farley KA, Williford KH, Beaty DW, McSween HY, **Czaja AD**, Goreva YS, Hausrath EM, Hays LE, Herd CDK, Humayun M, McCubbin FM, McLennan SM, Pratt LM, Sephton MA, Steele A, and Weiss BP. Contamination knowledge strategy for the Mars 2020 sample-collecting rover. 48th Lunar and Planetary Science Conference, abs. #2535.

2016 Beaty DW, Weiss BP, McSween HY, **Czaja AD**, Goreva YS, Hausrath EM, Herd CDK, Humayun M, McCubbin FM, McLennan SM, Pratt LM, Sephton MA, Steele A, Hays LE, and Meyer MA. Planning for the Paleomagnetic Investigations of Returned Samples from Mars, American Geophysical Union Fall Meeting, abs. #GP23C-1350.

2016 Beaty DW, McSween HY, **Czaja AD**, Goreva YS, Hausrath EM, Herd CDK, Humayun M, McCubbin FM, McLennan SM, Pratt LM, Sephton MA, Steele A, Weiss BP and Hays LE**.** Planning for the collection of a compelling set of Mars samples in support of a potential future Mars sample return. Geological Society of America Annual Meeting, Denver, CO. *Abstracts with Programs.* Vol. 48, No. 7

2016 Beaty DW, McSween HY, **Czaja AD**, Goreva YS, Hausrath EM, Herd CDK, Humayun M, McCubbin FM, McLennan SM, Pratt LM, Sephton MA, Steele A, Weiss BP and Hays LE. Recommended maximum temperature for Mars returned samples. Lunar and Planetary Science Conference XXXXVII, The Woodlands, TX.

2013 Zambito JJ IV, Benison KC, **Czaja AD**, and Lorber KN. Possibly ubiquitous preservation of microbes in Permian halite. Geological Society of America Annual Meeting, Denver, CO.

**Research Funding**

*Pending External Grants*

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| 2018­–2021 | NASA Exobiology Program, “Trace element biosignature for microbial life in modern and ancient ecosystems: implications for the search for evidence of extraterrestrial life” | PI | $980,654 |

*Funded External Grants*

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| 2016­–2017 | National Science Foundation, “Novel Molecular and Geochemical Approaches to Watershed Analysis” | Co-I | $34,937 |
| 2014–2015 | National Geographic Society (Waitt Grant for Exploration), “Exploration of the 2.5-billion-year-old Biosphere of South Africa” | PI | $10,680 |
| 2016 | Paleontological Society (Meeting Fund), “Midwest Geobiology Symposium” | PI | $1,000 |
| 2016 | Agouron Institute, “Midwest Geobiology Symposium” | Co-I | $8,000 |
| 2016 | Ohio Space Grant Consortium, “Midwest Geobiology Symposium” | Co-I | $2,000 |
| 2015–2016 | Paleontological Society (Outreach/Education Program), “Exploring invisible worlds with students using homemade microscopes” | PI | $2,500 |
| 2010 | American Philosophical Society, Lewis and Clark Field Scholar in Astrobiology, “Field trip to explore Archean and Proterozoic geology of Western Australia” | PI | $4,925 |

*Funded Internal Grants*

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| 2017–2018 | UC Research Council Interdisciplinary Faculty Collaboration Grant, “Water Quality and Its Impact on Pre-Industrial Civilization: Diatom, Microbiome and Microbotanical Analyses of Reservoir Sediments from the Ancient Maya City of Tikal” | PI | $49,627 |
| 2017 | UC Faculty Development Council Individual Grant, “Attending Gordon Research Conference on Geobiology” | PI | $1,825 |
| 2017 | UC Faculty Development Council Individual Grant, “Attending NASA Astrobiology Conference, 2017” | PI | $1,300 |
| 2014 | UC Faculty Development Council Individual Grant, “Learning about the Origin of Life – Conference in Nara, Japan” | PI | $3,745 |
| 2013 | UC Faculty Development Council Individual Grant, “SERC Workshop for Early Career Geoscience Faculty” | PI | $1,390 |

*Student/Postdoctoral Grants and Fellowships*

|  |  |
| --- | --- |
| 2005 | University of California, Los Angeles, Dissertation Year Fellowship |
| 2005 | Eugene Waggoner Scholarship for Sustained Academic Achievement, UCLA, Dept. of Earth & Space Sciences |
| 2004 | Geological Society of America, Student Research Grant |
| 2002 | Sigma Xi, Grants-in-Aid of Research (Fall and Spring) |
| 2000 | National Science Foundation, Graduate Research Fellowship |
| 2000 | Institute of Geophysics and Planetary Physics, Center for the Study of Evolution and the Origin of Life Fellowship (UCLA) |

*Grants Received By My Students*

|  |  |  |
| --- | --- | --- |
| 2017 | American Philosophical Society, Lewis and Clark Field Scholar in Astrobiology (Gangidine) | $2,600 |
| 2017 | Geological Society of America, Student Research Grant (Gangidine) | $1,775 |
| 2017 | Ohio Space Grant Consortium, Student Grant (Gangidine) | $5,000 |
| 2017 | Paleontological Society, Student Research Grant (Gangidine) | $800 |
| 2017 | Mars 2020 3rd Landing Site Workshop, Travel Award (Gangidine) | $750 |
| 2016 | University of Cincinnati Graduate Student Governance Association Research Fellowship (Gangidine) | $1,200 |
| 2016 | Sigma Xi, UC Chapter award (Osterhout) | $3,000 |
| 2015 | Geological Society of America, Student Research Grant (Osterhout) | $2,500 |
| 2015 | NASA Early Career Collaboration Award (Osterhout) | $5,000 |
| 2015 | NASA Early Career Collaboration Award (Lorber) | $5,000 |
| 2014 | UC Graduate Student Governance Association, Travel Grant (Osterhout) | $1,120 |

*Selected Declined Proposals*

|  |  |  |  |
| --- | --- | --- | --- |
| 2016 | NASA Exobiology Program, “Trace element biosignature for microbial life in modern and ancient organic matter” (resubmitted Fall 2017) | PI | $599,139 |
| 2015 | NASA Exobiology Program, “Detection of biochemical and diagenetic effects on preservation of microbial organic matter” | Co-I | $58,931 (UC) |
| 2014 | NASA Exobiology Program, “Life in the deep ocean in deep time: microfossil and geochemical evidence of life in deep shelf environments from the Archean of South Africa” | PI | $236,248 |
| 2014 | Department of Energy, “Rapid Linking of Microorganisms to Important Geochemical Processes” (Pre-proposal) | Co-I |  |
| 2014 | Simons Foundation, Simons Collaboration on the Origin of Life Investigator Award (Pre-proposal) | PI |  |
| 2014 | Templeton Foundation, “The world's first biosphere: discovering life and biodiversity of Earth's first two billion years” | PI | $194,855 |
| 2013 | Petroleum Research Fund, “Preservation of ancient life and ecosystems in a Mesoproterozoic evaporitic lacustrine system” | PI | $110,000 |
| 2013 | National Science Foundation, “Did changes in biogeochemical cycling end production of Paleoproterozoic iron formations?” | PI | $187,298 |

**Other research positions**

2000–2006 **Graduate Research Assistant**, UCLA, Dept. of Earth and Space Sciences. Precambrian and Eocene paleobiology, microscopic and micro-chemical characterization of permineralized fossils and microfossils

1998–2000 **Research Technician**, Univ. of Connecticut, Dept. of Ecology and Evolutionary Biology. Plant and soil ecology, plant physiology, forest ecology

**Research/Technical Training**

* Visible Raman and UV resonance Raman spectroscopy, 2–D and 3–D Raman imagery
* Confocal laser scanning microscopy
* Optical microscopy
* Laser-ablation and solution-based multi-collector inductively coupled plasma mass spectrometry
* Isotope ratio mass spectrometry
* Solid-state 13C–nuclear magnetic resonance spectroscopy
* Pyrolysis–gas chromatography–mass spectrometry
* Scanning electron microscopy and energy dispersive spectroscopy
* X-ray diffraction
* Film and digital photomicrography, 2–D and 3–D image rendering/processing
* Thin section preparation

**TEACHING**

**Summary of Teaching at the University of Cincinnati**

|  |  |  |  |
| --- | --- | --- | --- |
| **Term** | **Course** | **Level** | **Enrollment** |
| Fa 2017 | Geochemistry (GEOL 3002/7010) | Upper Level Undergrad/Graduate | 29 |
|  | Astrobiology (GEOL 1016) | Introductory | 52 |
| Sp 2017 | Geology Colloquium (GEOL 4052/7025) | Undergrad/Graduate | 30 |
| Fa 2016 | Astrobiology (GEOL 1016) | Introductory | 49 |
|  | Geology Colloquium (GEOL 4052/7025) | Undergrad/Graduate | 30 |
| Sp 2016 | Microscopy and Raman Spectroscopy for the Geosciences (GEOL 4049C/6049C) | Upper Level Undergrad/Graduate | 9 |
|  | Geology Colloquium (GEOL 7025) | Graduate | 31 |
| Fa 2015 | Earth History, Life History: The Record of Deep Time (co-taught with Carl Brett) (GEOL 1001C) | Introductory | 19 |
|  | Astrobiology (GEOL 1016) | Introductory | 49 |
|  | Geology Colloquium (GEOL 7025) | Graduate | 27 |
| Sp 2015 | Earth’s Early Biosphere (GEOL 4037/6037) | Upper Level Undergrad/Graduate | 5 |
|  | Geology Colloquium (GEOL 7025) | Graduate | 25 |
| Fa 2014 | Astrobiology (GEOL 1016) | Introductory | 62 |
|  | Geology Colloquium (GEOL 7025) | Graduate | 25 |
| Sp 2014 | Geology Colloquium (GEOL 7025) | Graduate | 21 |
| Fa 2013 | Astrobiology (GEOL 1016) | Introductory | 45 |
|  | Geology Colloquium (GEOL 7025) | Graduate | 18 |
| Sp 2013 | Astrobiology (GEOL 1016) | Introductory | 44 |

**Courses developed at the University of Cincinnati**

*GEOL 1016 – Astrobiology: Life in the Universe*

Astrobiology seeks to answer the questions: "Where did we come from?" and "Are we alone?" These are fundamental questions of life that have been asked for millennia and are still unanswered. Because these are such broad scientific questions, astrobiology is necessarily an interdisciplinary field that encompasses many fields of science, including geology, biology, chemistry, planetary science, and astronomy. This course introduces students to astrobiology and many of the subfields within, but emphasizes the geological and chemical properties of planetary bodies that make them habitable and the properties of life that enable it to flourish in a wide variety of environments. We also discuss current and past astrobiology missions undertaken by NASA and other space agencies that seek to answer these fundamental questions.

Upon completion of the course, students are able to: understand what is encompassed in the field of Astrobiology; explain the requirements for life as we know it; describe the geologic conditions that make Earth habitable; analyze planetary and orbital characteristics of planets and moons in our solar system and beyond and assess the possibility for life to occur there; and understand the history of Mars and the current searches for life and habitable regions there.

I have designed this course to introduce students at all levels of preparation to the field of astrobiology as well as how and where we are searching for life outside of Earth. It is a complex topic, but I have been able to distill it down to an introductory level, while still giving students a good background in introductory physical and historical geology. On my student course evaluations, on a scale of 1 to 5, with 5 indicating “strongly agree” and 1 “strongly disagree”, the students gave ratings of 4.4 for how well they have achieved the learning outcomes and an average of 4.6 for my performance. One of the learning outcome questions asked the students if they “have a better understanding of what is and what is not science,” the average response was has steadily increased from 3.8 to 4.4 over the last 5 years. I also received many positive comments, including the following comment in response to asking if the student would recommend the class to others, “Most certainly. Not only is the subject matter of the course good, the way Professor Czaja presents the material makes for easy understanding. Not only do I recommend this specific course but Professor Czaja as well.” Other positive comments included “This was my favorite class of the semester and I enjoyed your lessons.” I also received some constructive criticism from the students including that parts of the course were too rushed and they desired more active engagement in the course. I have done my best to improve student engagement through in-class activities, and am endeavoring to increase it further in the coming years.

Below are some examples of the active learning exercises I use in the course.

1. A group and kinetic exercise to understand the process of science. We do not have a lecture on science at first, but rather discuss some observations I have made. One is about the distribution of birthdays throughout the year and whether or not they are randomly distributed or clumped. The other is about how my arm span and height seem to be correlated. I provide the observations so I can be prepared with the materials to test the predictions that the students come up with in class. They then split into groups and collect data on birth months as well as height and arm span measurements. We compile the data in class and then discuss which of our predictions (hypotheses) were born out. We then also discuss the possible limitations of our data set and how we might make it less limited.
2. A modified jigsaw exercise wherein the students split into groups to research and discuss answers to questions about rock types and fossils, and then report back to the rest of the class.
3. Kinetic exercise in the hall to demonstrate the size and distribution of planets in the solar system. Students volunteer to represent the planets of the solar system and they work together to distribute themselves down the hall at scaled distances from the sun (the end of the hall). We then discuss how accurate they are and this helps them appreciate the scale of the solar system.
4. Kinetic exercise where the class again goes into the hall and we demonstrate the geologic time scale through distances along the hall. I received feedback from several students that this really helped them appreciate the scope of geologic time.

*GEOL 3002/7010 – Geochemistry*

Geochemistry is a fundamental aspect of the geosciences that seeks to understand the distribution and interactions of chemical elements and isotopes in the Earth system through the study of chemical reactions and geochemical cycles. Knowledge of the modern Earth system is applied to explain signals of geochemical evolution in the rock record and to predict future change. This course builds upon previous knowledge of introductory chemistry and emphasizes fundamental geochemical concepts including oxidation-reduction reactions, thermodynamics, elemental cycling, acid-base reactions, mineral saturation, and isotopic systems. These concepts are fundamental to the geosciences because they facilitate understanding of ancient and modern interactions between the biosphere, hydrosphere, atmosphere, cryosphere, and the solid earth. This course provides a foundation for subsequent courses relating to geochemistry. Students learn the principles of common analytical equipment used in the field of Geochemistry through lecture and laboratory visits.

Upon completion of this course, students will be able to: understand the general principles of geochemistry, including acids and bases, thermodynamics, mineral stability, oxidation-reduction, geochemical cycles, and isotopic fractionation; apply the above principles to interpret and synthesize various types of geochemical data; describe the evolution of Earth’s geochemical cycles through time; understand basic principles of important analytical equipment used in geochemistry.

This is a new course in Fall 2017 that I developed to meet the needs of our newly revised curriculum. There are 3 graduates and 26 undergraduates enrolled. The student population is largely geology majors, but several are from Environmental Studies or Anthropology, and are Geology minors. As a 3000-level course, I expect a lot from the students and assign weekly homework problems. The chemical and geological background of the students is rather variable so I make time each week to meet with any students who need extra help to understand the material. I am also planning several in class and lab demonstrations, including a visit to our department’s isotope ratio mass spectrometer lab, our XRD/XRF lab, and an in-class visit from an alumnus to demonstrate geochemical modeling and discuss his experiences in the workforce using the knowledge he gained at UC.

*GEOL 4037/6037 – Earth’s Early Biosphere*

 The earliest periods of Earth history are shrouded in mystery, especially the biological record during this time. But this was a critical time when microbial life originated and began to flourish, and when the chemical compositions of our atmosphere and ocean were changing dramatically. Because of this incomplete record, the details of how early life and Earth's surface environments evolved are hotly debated. In this course we explore the known record of life through the Precambrian, with emphasis on the record of life in the Archean Eon, namely fossil microorganisms and stromatolites, as well as isotopic and other geochemical evidence. We also discuss the geochemical evolution of Earth's surface environment and how it was influenced by both biological and abiological factors, with special focus on major environmental transitions/perturbations such as the Great Oxidation Event and Snowball Earth periods. The course also covers recent advances in microscopic and analytical geochemical techniques that have provided much of the evidence for the evolution of early life and surface environments, as well as how the early Earth is an analog for potentially habitable planets and moons in our solar system and beyond.

Upon completion of the course, students are able to: describe the types of life that existed in the Precambrian; understand the fossil and geochemical evidence of early life and surface conditions of the early Earth and evaluate the validity of this evidence; describe the major biological and environmental transitions that occurred during the Precambrian; explain the linkages and feedbacks between the biological and geochemical worlds that lead to their co-evolution through the Precambrian.

This course is offered in the spring semesters and it will be offered again in Spring 2018. In my evaluations for this course, I received ratings of 4.8 and 4.9 for learning outcomes and my performance, respectively. The students generally praised my teaching style and ability to convey difficult concepts. One student said it was the best course he/she had taken at UC. I also received a lot of useful feedback that I will use to improve the course in the future. For example, the students really liked the hands-on experience I provided with analytical equipment in our department. However, they generally agreed that they would have benefited from additional time. In the future I plan to revamp the syllabus to include additional time in the lab exploring specimens of ancient life. I will also add a lab on fossil microbial mats and using them to reconstruct paleoenvironments, modified from a lab I developed for GEOL 1099 – Foundations of Geology as a guest lecturer (see below).

*GEOL 4049C/6049C – Raman Spectroscopy in the Geosciences.*

*In situ* analytical techniques allow us to push the boundaries of knowledge in the geosciences. Microscopy and Raman spectroscopy are two such techniques that have numerous applications to geological and geochemical investigations, including producing 3-D morphological models of microscopic objects, studying thermal alteration of organic matter, identifying minerals, and measuring physical and chemical alteration of minerals. This course introduces students to optical microscopy and Raman spectroscopy and how they apply to the geosciences. The application of these techniques to paleontological samples is particularly emphasized, but other applications are covered. The course includes lectures and readings on the various techniques and their theories of operation, but is largely based on practical experience with laboratory instruments in my lab and involves the completion of a group project. Typically graduate students work on a project related to their theses and undergraduates work on a project with the grads or with me.

Upon completion of this course, students are able to: identify the integral parts of an upright compound microscope and Raman spectrometer; define the theory and practice of each type of microscope/spectrometer for the geosciences; demonstrate the use of each type of microscope/spectrometer for geological samples (paleontological, mineralogical, or other).

This course is offered every other spring. I taught this course once in Spring 2016 as a half semester course. I will teach it again in Spring 2018 and expand it to a full semester course and focus mostly on Raman spectroscopy. As a half semester course, the students were not able to master the material as well as I would have liked. Having more time will allow them more practice and more time to digest what they are learning.

**Other courses taught at UC**

*GEOL 1001C – Freshmen Seminar I: Geology and Paleontology*

This course, the first of a two-part sequence of freshmen seminars, is designed to give introductory students a broad understanding of basic geological principles and to introduce processes in Earth and life history that occur on the scale of millions to billions of years. This seminar provides an overview of the tools by which Earth scientists interpret physical and life history, the depth of geologic time, and the forces that shape our planet's surface. This course incorporates a mixture of class and lab experiences designed to introduce students to the broad concepts of geology largely through field observations and laboratory exploration of data and specimens.

Students completing this course will be well prepared to pursue further studies in geology, paleontology, or other natural sciences. At the completion of the course students are able to: Demonstrate a general knowledge of the concepts geologic time scale, major groups of rocks, sedimentary structures, fossils, trace fossils, geologic structures, geomorphology and processes of mountain-building, igneous activity and, metamorphism; identify hand samples and know properties of common rock forming minerals, and igneous, sedimentary, and metamorphic rocks; identify, classify, and interpret common invertebrate fossils and trace fossils and sedimentary structures both in the lab and in the field; identify and interpret geologic features and specimens in the field and on geologic maps and cross sections to make inferences about geologic history and ancient environments; understand the broad outlines of Earth and life history.

 I joined Prof. Carl Brett in Fall 2015 to co-teach this course when he had obligations that took him out of the country for several weeks. In doing so, we revamped the syllabus to include a number of lectures on early Earth history and paleontology (my specialty), and added several lab exercises, in particular one on carbon isotope geochemistry that I modified from an example I found on the Carleton College Science and Education Resource Center website, and one on geologic maps that was produced in conjunction with Carl. In the course I received ratings on student evaluations of 4.5 and 4.8 for learning outcomes and my performance, respectively. In general the students reported that they liked the course and they liked that two professors taught it. Carl and I have discussed continuing this collaboration in the future and making it a permanently co-taught course.

*GEOL 4052/7025 – Department of Geology Colloquium*

Graduate and undergraduate students can take our department’s colloquium series as a seminar course. The colloquium is a weekly lecture series featuring local and visiting speakers from academia, government, and industry. Students also have the opportunity to interact with the speakers during a Q&A session following the talks. Graduate students are required to give a short talk as part of the colloquium series, which helps them to practice public speaking and succinctly summarize their work to a broader audience than their own subfield. The audience (faculty and students) provides written feedback on evaluation sheets that I supply. Undergraduates taking the course are required to turn in written summaries of a number of the talks based on a prompts I provided to increase their critical thinking and writing skills.

I taught this course for 8 consecutive semesters from Fall 2013 to Spring 2017. Although I did not fully develop this course, I implemented the undergraduate section in Fall 2016 and designed the assignments and system of grading.

**Guest lectures for courses in the UC Department of Geology**

2017 GEOL 8005 *– California Field Trip*. I helped plan and lead portions of the field trip, including stops for Proterozoic stromatolites and Snowball Earth glacial deposits, and led discussions at Death Valley and Mono Lake.

2016­–2017 GEOL 1099 *– Foundations of Geology* (3 semesters). Developed a lab exercise on early life on Earth and microscopy. Students made microscopic observations of fossil microorganisms and drew what they saw. They also studied and drew different types of fossil microbial mat structures (stromatolites) to understand the different forms and use them to make paleoenvironmental reconstructions.

2014–2017 GEOL 6008C/6017 *­– Clay Mineralogy and Clay Mineralogy Seminar* (6 semesters). Lecture and demonstration on Raman spectroscopy. Helped students collect data that they used for a course project.

2015 GEOL 2003C *– Paleontology and Evolution*. Lecture on Precambrian paleontology.

2015 GEOL 6003 *– Sedimentology*. Lecture on banded iron formations

2014 GEOL 1010C – *Evolution of Earth Systems*. Lecture on Precambrian atmosphere–biosphere interactions

**Other Courses Taught**

2007 **Lecturer**, UCLA, Dept. of Earth and Space Sciences

 *ESS 5 – Environmental Geology of Los Angeles (Two academic quarters)*

2006–2007 **Lecturer**, California State University, Fullerton, Dept. of Geological Sciences

 *GEOL 101 – Physical Geology (three semesters)*

*GEOL 101L – Physical Geology* *Laboratory (three semesters)*

2000–2005 **Teaching Assistant**, UCLA

 Dept. of Earth and Space Sciences

 *ESS 1 – Introduction to Earth Science; ESS 16 – Major Events in the History of Life; ESS 17 – Dinosaurs and Their Relatives; ESS 116 –* *Paleontology*

 Dept. of Ecology and Evolutionary Biology

#  *OBEE 152 – Functional Plant Anatomy*

#  Honors College

#  *HC 70B –* *Non-Life to Life, Microbes to Man: Nature is Not Compartmentalized*

**Students Mentored**

*As primary advisor*

Jeffrey T. Osterhout, M.S. 2016, "Diversity of Microfossils and Preservation of Thermally Altered Stromatolites from Anomalous Precambrian Paleoenvironments"

Kira N. Lorber, M.S. (expected to complete in Spring 2018)

Andrew J. Gangidine, Ph.D. (expected to finish in Spring 2020)

*As a committee member*

Mike Lees, M.S. 2017, “Corrosion of brass meters in drinking water: the influence of alloy composition and water chemistry on metal release and corrosion scale”

Abigail Padgett, M.S. (expected to finish in 2018)

Evan New, M.S. (expected to finish in 2018)

Cory Perfetta, M.S. (Biological Sciences, expected to finish in 2019)

**SERVICE**

**Professional service**

2015–present Member of the Mars2020 mission Returned Sample Science Board

2015–present Member of the Mars2020 mission Landing Site Working Group

2015 NSF proposal review panelist

2014–present Geological Society of America Campus Representative

2014 Organized and chaired proposal sub-panel for the NASA PICASSO program

2013­–present NASA Astrobiology Institute Early Earth Focus Group co-chair

2008 NASA ASTID program proposal review panelist

*Ad hoc proposal reviews*

National Science Foundation (2), NASA (1), Department of Energy (1), Petroleum Research Fund (1)

*Ad hoc manuscript reviews*

*BioResources* (3), *Chemical Geology* (1)*,* *Earth and Planetary Science Letters* (1), *Environmental Geochemistry and Health* (1), *European Journal of Mineralogy* (1), *Geobiology* (2)*, Geochimica et Cosmochimica Acta* (1), *Geology* (6), *Geomicrobiology Journal* (1)*, GSA Bulletin* (2)*, Nature Communications* (1), *Nature Geoscience* (1)*, Palaios* (2), *Precambrian Research* (3)*,* *PNAS* (1) *Sedimentary Geology* (1)*, and Sedimentology* (1).

Also reviewed a chapter for the book, *Biosignatures in Astrobiology*

*Professional Meeting Service*

2016 Co-organized the Midwest Geobiology Symposium at the University of Cincinnati

2015­­–2017 American Geophysical Union (AGU), session co-chair

2015 NASA Astrobiology Science Conference Student poster judge and meeting mentor for high school students

2013 Co-organized a NASA Astrobiology “Workshop without Walls” on the topic of the Hadean Earth

2012, ’15, ’17 NASA Astrobiology Science Conference, session chair

2011, 2014 AGU OSPA Judge for student presentation competition

2010, 2012 Goldschmidt Conference, session co-chair

2007 Geological Society of America Annual Meeting, session co-chair

*Professional Affiliations*

American Geophysical Union, Geochemical Society, Geological Society of America, International Society for the Study of the Origin of Life, Paleontological Society, Phi Beta Kappa, Sigma Xi

**University/Departmental Service**

2017–present Member of UC College of Arts & Sciences Gateway Concentration Committee

2017 Volunteer for *UC Helping Hands* (helping with undergrad move-in day)

2016–2017 Departmental STEM Fee Award selection committee

2016 Lead discussion of academic paths for UC Preparing Future Faculty program

2014­–present UC Department of Geology curriculum committee

2014 UC Department of Geology doctoral qualifying exam review committee

2014 Organized a student trip to the University of Kentucky for lecture by Prof. Andrew Knoll of Harvard, Spring 2014

2013 UC Department of Geology doctoral enhancement grant committee

2012­–present Faculty Advisor to UC Graduate Geoclub

2012 Reviewed UC University Research Council student grant proposals at departmental level

*Speakers hosted*

2017 Sally Potter-McIntyre, Southern Illinois University

2015 Matthew Pasek, University of Southern Florida

2015 Bethany Ehlmann, CalTech, Distinguished Lecturer for the Mineralogical Society of America

2015 Sora Kim, University of Chicago. I wrote a successful proposal to the UC LEAF program to invite Dr. Kim to speak about her research as well as work-life balance for students and faculty in the UC Department of Geology.

2014 Shuhai Xiao, Virginia Tech University

2014 Lori Peek (co-hosted), Co-director of the Center for Disaster and Risk Analysis, Colorado State Univ., for a Taft Research Center Lecture

2014 Steven Dornbos, University of Wisconsin, Milwaukee

2014 Kyle Straub, Distinguished Lecturer for the GeoPRISMS program and arranged for him to give a talk at the Cincinnati Museum Center

2014 Julie Bartley, Gustavus Adolphus College

2013 Sandra Passchier, Montclair University, Distinguished Lecturer from the Consortium for Ocean Science

2013 Jay Zambito, Wisconsin Geological and Natural History Survey

2013 Michael Mischna, Jet Propulsion Laboratory, to present Mars Science Lab results to the University

**Education/Public Outreach**

2017 Interviewed on Cincinnati Public Radio (91.7 WVXU) about my participation on the Mars 2020 rover project (See below)

2017 Judge for junior high school science fair at Annunciation Catholic School (Cincinnati, OH)

2016 Presentation on “Time and Space” to Our Lady of Grace Catholic School (Cincinnati, OH)

2015 All-day presentation on the “Invisible World” to 4 sixth grade science classes at Clifton-Fairview School (Cincinnati, OH). I instructed students on how to build and use smartphone microscopes. Materials bought with a grant from the Paleontological Society.

2015 Lecture on “Life as a Precambrian Paleobiologist/Astrobiologist” for students at North Adams High School. Short lecture and Q&A session by video conference (Cincinnati, OH)

**Media Attention**

*My work with the Mars 2020 Returned Sample Science Board and Landing Site Working Group*

Miller, M. “[Mars or bust](http://magazine.uc.edu/editors_picks/recent_features/mars2020.html)”, University of Cincinnati Magazine, online edition, June 22, 2017, <http://magazine.uc.edu/editors_picks/recent_features/mars2020.html>

Heyne, M. “In Search Of Life On Mars” Radio interview, Cincinnati Edition 91.7 FM WVXU, July 12, 2017, <http://wvxu.org/post/search-life-mars#stream/0>

*Press for my 2016 paper in Geology on 2.52-billion-year-old sulfur-oxidizing bacteria*

Schefft, M. “Life before oxygen”, University of Cincinnati Magazine, online edition, November 28, 2016, <http://magazine.uc.edu/editors_picks/recent_features/bacteria.html>.

Pappas, S. “2.5-Billion-Year-Old Fossils Predate Earth's Oxygen”, Live Science, December 1, 2016, <https://www.livescience.com/57051-ancient-life-fossils-predate-earth-oxygen.html>

 Schefft, M. “Geologist uncovers 2.5 billion-year-old fossils of bacteria that predate the formation of oxygen” Phys.org, November 29, 2017 <https://phys.org/news/2016-11-geologist-uncovers-billion-year-old-fossils-bacteria.html>.

Shivni, R. “How Early Life Thrived without Oxygen”, Biotechniques News, January 11, 2017 <http://www.biotechniques.com/news/How-Early-Life-Thrived-without-Oxygen/biotechniques-365418.html?autnID=344275#.WHUKXJL89mU>.

O’Hare, R. “Life before oxygen: Fossils of 2.5 billion-year-old bacteria reveal organisms thrived despite early Earth's harsh conditions”, DailyMail.com, November 30, 2016, <http://www.dailymail.co.uk/sciencetech/article-3985582/Life-oxygen-Fossils-2-5-billion-year-old-bacteria-reveal-organisms-thrived-despite-early-Earth-s-harsh-conditions.html>.

[TimesLive (South Africa) http://www.timeslive.co.za/scitech/2016/11/30/Ancient-fossil-find-in-Northern-Cape-rocks-geologists-world](http://www.timeslive.co.za/scitech/2016/11/30/Ancient-fossil-find-in-Northern-Cape-rocks-geologists-world)

**Collaborators**

David Agresti (UAB)

Julie Bartley (Gustavus Adolphus)

Brian Beard (UW-Madison)

Nicolas Beukes (U. Johannesburg)

Rohit Bhartia (JPL)

Punit Boolchand (UC Elec. Engineering)

Zoe Cardon (MBL)

George Cody (CIW)

Brooke Crowley (UC Geology)

Francois d'Abzac (U. Geneva)

Aaron Diefendorf (UC Geology)

Craig Dietsch (UC Geology)

Stephen Dornbos (UW-Milwaukee)

Jennifer Eigenbrode (NASA Goddard)

James Farquhar (U. Maryland)

Philip Fralick (Lakehead U.)

Vadim Guliants (UC Chem. Engineering)

Zixiao Guo (Chinese Academy of Sciences)

Jeff Havig (U. of Cincinnati)

Tom Hegna (Western Illinois U.)

John Isbel (UW-Milwaukee)

Clark Johnson (UW-Madison)

Cynthia Jones (UConn)

Linda Kah (U. Tennessee)

Anatoliy Kudryavtsev (UCLA)

David Lentz (UC Biology)

Weiqiang Li (Nanjing U.)

Ashley Manning-Berg (U. Tennessee)

Stephen Moorbath (Oxford)

Drew Muscente (Harvard)

Thomas Nägler (Univ. Bern)

Jeff Osterhout (UCLA)

Susannah Porter (UCSB)

Peir Pufahl (Acadia U.)

Leigh Anne Riedman (Harvard)

Eric Roden (UW-Madison)

James Schauer (UW-Madison)

J. William Schopf (UCLA)

Jane Shen-Miller (UCLA)

Albertus Smith (U. Johannesburg)

Michael Storrie-Lombardi (Kinohi)

Abhishek Tripathi (SpaceX)

John Valley (UW-Madison)

Martin Van Kranendonk (UNSW)

Pati Vitt (Chicago Bot. Gard.)

Andrea Voegelin (Univ. Bern)

Matt Vrazo (Smithsonian Inst.)

Thomas Wdowiak (UAB)

Martin Wille (Tubingen)

Kenneth Williford (JPL)

Dylan Wilmeth (USC)

Shuhai Xiao (Virginia Tech)

Kosei Yamaguchi (Toho U.)

James Zambito (WGNHS)