GEOL 436/789B Principles of Biogeochemistry
Fall 2012, TuTh 2:00-3:15 pm
EGR 3106
Prof. A. Jay Kaufman
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(**Office hours: by appointment, Chemistry 0217A**)

BOOKS:

Fundamentals of Geobiology **(FOG)** by Knoll, Canfield, & Konhauser, Wiley-Blackwell ISBN 978-1-4051-8752-7
Life on a Young Planet: The First Three Billion Years of Evolution on Earth **(LYP)** by Andrew H. Knoll, Princeton University Press ISBN 0-691-00978-3

OVERVIEW:

Grades for this course taken for undergraduate credit will be calculated from classroom participation (10%) including presentations, problem sets and written assignments (10%), two midterm tests (25% each) and a final examination (30%). Readings from the textbook and from additional literature sources will be used throughout the semester; for classroom participation these should be read prior to the lecture; each student with present 5 minute reviews of short articles twice during the semester. For graduate credit, an additional 15-page research project is required, with a presentation of the material on the last day of class. A one-page outline of the proposed biogeochemical project is due October 2nd. Emphasis will be placed on good scientific writing and communication skills in all assignments, as well as the accuracy of observations. All university policies on attendance and conduct apply to this class and any related off-campus activities.

CALENDAR:

August	30	Introduction to Principles of Biogeochemistry (**FOG** ch. 1; **LYP** ch. 1/2)
September	4	Seven Clues to the Origin of Life (**FOG** ch. 17; **LYP** ch. 3/4)
	6	Origin and Evolution of Biogeochemical Cycles (**FOG** ch. 12)
	11	Bioenergetics of Redox Transformations (**FOG** ch. 2)
		Presentation: **Schopf et al. (2002) Laser-raman imagery of Earth's earliest fossils. Nature 416: 73-76.**
	13	The Global Carbon Cycle: Biological Processes (**FOG** ch. 2; LYP ch. 5)
		Presentation: **Coale et al. (1996) Control of community growth and export production by upwelled iron in the equatorial Pacific Ocean. Nature 379: 621-624.**
	18	TBD
		Reading: **Summons et al. (1999) 2-methylhopanoids as biomarkers for cyanobacterial oxygenic photosynthesis. Nature 400: 554-557.**
	20	The Global Sulfur Cycle (**FOG** ch. 5)
		Reading: **Quade et al. (1989) Development of Asian monsoon revealed by marked ecological shift during the latest Miocene in northern Pakistan. Nature 342: 163-166.**
	25	The Global Carbon Cycle: Geological Processes (**FOG** ch. 3)

		Presentation: **Fedo and Whitehouse (2002) Metasomatic origin of quartz-pyroxene rock, Akilia, Greenland, and implications for Earth's earliest life. Science 296: 1448-1452.**
	27	Photosynthesis (**FOG** ch. 2)
		Presentation: **France-Lanord and Derry (1997) Organic carbon burial forcing of the carbon cycle from Himalayan erosion. Nature 390: 65-67.**
October	2	**Midterm I**
	4	The Global Nitrogen Cycle (**FOG** ch. 4)
		Presentation: **Garvin et al. (2009) Isotopic evidence for an aerobic nitrogen cycle in the latest Archean. Science 323: 1045-1048.**
	9	The Global Iron Cycle (**FOG** ch. 6)
		Presentation: **Edwards et al. (2000) An archaeal iron-oxidizing extreme acidophile important in acid mine drainage. Science 287: 1796-1799.**
	11	The Global Oxygen Cycle (**FOG** ch. 7)
		Presentation: **Mikucki et al. (2009) A contemporary microbially maintained subglacial ferrous "ocean". Science 324: 397-400.**
	16	Stable Isotope Geobiology (**FOG** ch. 14)
		Presentation: **Farquhar et al. (2000) Atmospheric Influence of Earth's Earliest Sulfur Cycle. Science 289: 756-758.**
		Reading: **Popp et al. (1998) Effect of phytoplankton cell geometry on carbon isotopic fractionation. GCA 62: 69-77.**
	18	Stable Isotope Geobiology (**FOG** ch. 14)
		Presentation: **Watanabe et al. (2009) Anomalous fractionations of sulfur isotopes during thermochemical sulfate reduction. Science 324: 370-373.**
	23	Bacterial Biomineralization (**FOG** ch. 8)
		Presentation: **Schulz et al. (1999) Dense populations of a giant sulfur bacterium in Namibian shelf sediments. Science 284: 493-495.**
	25	Eukaryotic Skeletal Formation (**FOG** ch. 10)
		Presentation: **Mojzsis et al. (1996) Evidence for life on Earth before 3,800 years ago. Nature 384: 55-59.**
	30	Plants and Animals as Geobiological Agents (**FOG** ch. 11)
		Presentation: **Noffke (2008) Turbulent lifestyles: Microbial mats on Earths sandy beaches – Today and 3 billion years ago. GSA Today 18: 4-9.**
November	1	Biomarkers: Informative Molecules for Studies in Geobiology (**FOG** ch. 15)
		Reading: **Brocks et al. (1999) Archean molecular fossils and the early rise of eukaryotes. Science 285: 1033-1036.**

	6	**Midterm II**
	8	The Fossil Record of Microbial Life (**FOG** ch. 16) Reading: **Rasmussen et al. (2008) Reassessing the first appearance of eukaryotic cyanobacteria. Nature 455:1101-1105.**
	13	Geobiology of the Archean Eon (**FOG** ch. 19) Presentation: **Rye et al. (1995) Atmospheric carbon dioxide concentrations before 2.2 billion years ago. Nature 378: 603-605.**
	15	The Origin of Siderite in Precambrian Banded Iron-Formation Reading: **Ohmoto et al. (2004) Evidence from massive siderite beds for a CO2-rich atmosphere before ~1.8 billion years ago. Nature 429: 395-399.**
	20	Geobiology of the Proterozoic Eon (**FOG** ch. 20; **LYP** ch. 8/9) Reading: **Guo et al. (2009) Reconstructing Earth's surface oxidation across the Archean-Proterozoic transition. Geology 37: 399-402.**
	27	The Great Oxidation Event Presentation: **Kaufman et al. (1997) Isotopes, ice ages, and terminal Proterozoic Earth history. PNAS 94: 6600-6605.**
	29	The Snowball Earth Hypothesis Presentation: **Canfield et al. (2007) Late-Neoproterozoic deep-ocean oxygenation and the rise of animal life. Science 315: 92-95.**
December	4	Origin of Animals (**LYP** ch. 10) Presentation: **Logan et al. (1995) Terminal Proterozoic reorganization of biogeochemical cycles. Nature 376: 53-56.**
	6	The Cambrian Explosion (**LYP** ch. 11) Reading: **Knoll et al. (1995) Sizing up the sub-Tommotian unconformity in Siberia. Geology 23:1139-1143.**
	11	Geobiology of the Phanerozoic (**FOG** ch. 21) Reading: **Knauth and Kennedy (2009) The late Precambrian greening of the Earth. Nature 460: 728-732.**

Final Examination: Monday, December 17th 10:30am-12:30pm

• Academic Accommodations: If you have a documented disability, you should contact Disability Support Services 0126 Shoemaker Hall. Each semester students with documented disabilities should apply to DSS for accommodation request forms which you can provide to your professors as proof of your eligibility for accommodations. The rules for eligibility and the types of accommodations a student may request can be reviewed on the DSS web site at http://www.counseling.umd.edu/DSS/receiving_serv.html.

• Religious Observances: The University System of Maryland policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious

observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period. Faculty should further remind students that prior notification is especially important in connection with final exams, since failure to reschedule a final exam before the conclusion of the final examination period may result in loss of credits during the semester. The problem is especially likely to arise when final exams are scheduled on Saturdays.

• Academic integrity: The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html

• The University of Maryland is one of a small number of universities with a student-administered Honors Code and an Honors Pledge, available on the web at http://www.jpo.umd.edu/aca/honorpledge.html. The code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents, and forging signatures. The University Senate encourages instructors to ask students to write the following signed statement on each examination or assignment: "I pledge on my honor that I have not given or received any unauthorized assistance on this examination (or assignment)."

• CourseEvalUM Fall 2012: Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations for fall semester courses in early December. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.