GEOLOGY 450 – Seminar in Biogeochemistry 2011

Lecture T/Th 2:00 – 3:20 - Beneski, Room 203

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Office Hours: open or by appointment

Course Description:

Biogeochemistry: the "biotic controls on chemistry of the environment [and] with the geochemical controls of the structure and functions of ecosystems" {Howarth, 1984}

Biogeochemical cycles modify the chemical composition of all of our habitable environments. Microbial metabolism of has altered the evolutionary trajectory of all life. Microbes are found in the most extreme regions on Earth, from the upper atmosphere to the depths of our oceans as well as in the deep subsurface of Earth's crust. In this seminar, we will examine tracers and proxies for biochemical activity present in rock, sediment, soil, ocean, and porewater. Environments to be studied include hydrothermal vents, deep sedimentary basins, early Earth and the far more easily accessible Connecticut River. We will also survey the major biologically relevant elements of the periodic table (C, O, S, N, Fe, P) and examine how these elements cycle through the environment, focusing on stable isotopic tracers of biological processes. Students will gain experience with field and laboratory techniques and we will emphasize the current scientific literature in discussions.

Grading

Assignments:	10%
Participation:	10%
Article Analysis:	20%
Field/Lab work:	10%
Presentations:	10%
NSF Proposal:	40%

Date:	Topic:	Assignments:	Readings:
9/6	Intro to Biogeochemistry O, C, S, P, N, H, & trace elements		
9/8	Isotopes and Biogeochemistry	Reservoir Model	Madsen (2011) *USGS website*
9/13	Fractionation & Mixing	Isotope Mixing Model I	Gonneea et al (2004)
9/15	Nitrogen Cycle - Isotopic Examples	Isotope Mixing Model II	Costanzo et al (2001) BGC Chapter (N-Cycling)
9/20	Sulfur Biogeochemistry	Isotope Mixing Model III	BGC Chapter (S-Cycling)
9/22	Mixing Examples & Models	Isotope Mixing Model IV	Ku et al (1999) Vander Zanden (1999)
9/27	Closed & Open Systems - Detailed Fractionation	Isotope Mixing Model V	Whiticar (1998) Hu and Burdige (2007)
9/29	Early Earth Primer-The Rise of O2 *guest lecture-Dr. Steve Petsch*		BGC Chapter (O-cycling) Kasting (1993) Nisbet & Sleep (2001)
10/4	"The Canfield Ocean" - Journal Club 1		Readings A and B
10/6	"The Canfield Ocean" - Journal Club 2		Readings C and D
10/11	MID-SEMESTER BREAK		
10/13	Summing up the Neoproterozoic-Phanerozoic transition		

10/18	Phosphorous, geology, weathering & soil	Canfield Review Due:	
10/20	Journal Club 3		Vitousek et al (1987) Porder et al (2007)
10/25	Carbon Cycle		TBA
10/27	Journal Club 4		
11/1	Geomicrobiology		TBA
11/3	Biogeochemistry of the deep- *guest lecture-Dr. Steve D'Hondt*		TBA
11/4	*GEOLECTURE- UMASS "Biology of the Deep"*		
11/8	Journal Club 5		TBA
11/10	Hg & microbes		
11/15	Journal Club 6		
11/17	NSF & Lab (data review)		
11/22-24	THANKSGIVING BREAK		
11/29	Review		
12/1,6,8	Proposal Presentations		
12/13	*?*		

Field Trip
On **Sunday, October 2**, we will be going to Hamburg Cove in CT to explore the biogeochemistry of a salt water embayment including sediment coring and water sampling.

UMass Geosciences Lecture Series
On **Friday, November 4** 3:30, you ***should*** attend a lecture given by D'Hondt UMass entitled "Biology of the Deep".

Final Project
You will write a National Science Foundation style proposal on a research topic of your choice (with a few caveats from me). Deadlines for the project are set throughout the semester, so plan ahead. Your project shall attempt to identify an unresolved scientific question within the field of biogeochemistry and lay out a project that will address it. This is not a term paper in which you simply summarize existing knowledge on a subject. The proposal should include:

1. Project summary (1 page). This summary should give the reader a concise statement of the research question and the work that will address it.
2. An introduction to the problem, well referenced from the literature (4-5 pages)
3. Methods you will employ to address the problem (4-5 pages) including site description, field methods, analytical methods, and final synthesis (modeling, etc.)
4. Figures (2-5)
5. References – no limit, fully referenced in NSF format (guide available on course website)
6. Budget (1 page) – don't worry about exact dollar amounts but do think through items such as salary, travel, analysis, etc.

Undoubtedly, the most difficult part of this assignment is to propose an <u>original</u> scientific question and not turn this into a typical term paper. Start thinking early, ask for assistance, and remember it might need to be an iterative process before a final grant-justifying request can be accepted (by me, that is). To help keep you on track, here are some deadlines:

10/4 Draft of project summary

I would recommend using a modified outline format. Include a statement of the problem and your proposed solution. List methods to be applied. Don't overemphasize the "background" of your project – focus on your question and work.

11/1 Updated/Edited Project summary and a 1 page outline of full proposal

Optional: If you turn in a completed proposal (including references, figures, etc) before Thanksgiving week, I will comment on it, grade it, turn it back to you after we return from break, and you can revise it and turn it back in for a final grade.

11/21 Class Presentation. You will present your NSF idea to the class for approximately 15 minutes (10-15 slides MAX!) You will also choose an article from your project for all to read and be able to discuss it after your presentation. Slides must be submitted to me for review/discussion. References need to be uploaded to the class website by (as in before) 11/29 for presentation on 12/1, 12/1 for 12/6, and 12/8 for 12/13.