GEOCHEMISTRY (GEOLOGY 369)
Course Syllabus Spring, 2007
T Th 11:30-1:00 Harrington 217

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Office Hours: M 2-3, T 1-3, Th 9-10 and *by appointment*.

Text: McSween, Jr., H.Y., Richardson, S.M., and Uhle, Maria, 2003, *Geochemistry: Pathways and Processes*, New York, Columbia University Press, 363 p.

COURSE GOALS

Geochemistry has probably cropped up in many of your other geology classes – it is pervasive in the discipline. Without it, our knowledge of the Earth and how it works would be severely limited. The ideas presented in this course will be useful to you no matter what your interests are: from petrology to paleontology, from sedimentology to structural geology, from hydrogeology to geochronology and everything in between. My goal for this class is to teach you some of the "tools of the trade" so that you can think critically about problems in geology and utilize geochemistry to address those problems. You will learn two distinct approaches to addressing problems in geology; you will also, along the way, learn many new vocabulary words (look them up if you don't know them – there *IS* a glossary in your book), utilize mathematics in a way you may not have before and develop some geochemical "intuition". The most important thing you can take away from this class is not a bunch of memorized information but to be able to look at the technique used to address a problem and to critically evaluate that technique -- what were the assumptions, how well are key variables quantified and how well does that model or technique address the problem at hand?

A WORD ABOUT PROBLEM SOLVING:

You probably noticed that the word "problems" occurred a number of times in the Course Goals section. This class will involve a lot of "problem solving". What is problem solving? Problem solving involves moving toward a goal when the path is uncertain – if you know how to do it, it's not a PROBLEM! Problem solving also involves some error and uncertainty. Problem solving in geochemistry is no different than problem solving in life – making decisions involves uncertainty, too. To come up with a solution, we must first examine what we have and where we want to be. Then we must plan and execute a path to get there. Problems in geochemistry are solved using general-purpose tools, like pictures, equations, working backwards and approximations. And most importantly, problems in geochemistry are solved using your knowledge of geology! There is no one formula or pattern to memorize, no magic in the mathematics. Almost everything you need is up there in that little brain of yours.

ACADEMIC HONESTY AND INTEGRITY

There is a lot of opportunity to collaborate in this class (as in geology in general). Because there is often a fine line between collaboration and plagiarism, I must include a statement about plagiarism and academic honesty: **The Wisconsin Administrative Code states: "Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others academic endeavors."** (§ UWS 14.01) Plagiarism and other forms of academic misconduct are serious offenses with severe penalties. **"Academic misconduct is an act in which a student: (a) *Seeks to claim credit for the work or efforts of another* without authorization or citation; (b) Uses unauthorized materials or *fabricated data* in any academic exercise; (c) *Forges or falsifies academic documents or records;* (d) Intentionally impedes or damages the academic work of others; (e) *Engages in conduct aimed at making false representation of a student's academic performance*; or (f) Assists others in any of these acts."** (§ UWS 14.03). See the University of Wisconsin Oshkosh Student Discipline Code 2002-2003 for details about procedures, sanctions, and other relevant information. Specific questions about the provisions in the Student Discipline Code should be directed to the Dean of Students Office. I take this *VERY* seriously and if you do not understand any part of this, PLEASE see me as soon as possible.

A WORD ABOUT LATE ASSIGNMENTS:

I do <u>*NOT*</u> accept late assignments. There are several reasons for this: One, each class builds on what you have already (presumably) learned in class, so keeping up with the work is essential. Second, I do my best to correct assignments in a timely fashion so that I can hand them back and you can learn from them. If you turn an assignment in late, I cannot return your classmates' assignments to them in a timely manner. Third, late assignments give me more work, meaning I have less time to help you. The exception to this rule is in the case of an excused absence. According to the Student Handbook, an excused absence is one of the following:

> "There are certain activities, beyond the classroom, that can be considered as field trips, which are all-university in nature, e.g. athletics, debate trips, and certain music trips. The instructor or academic staff member originating the trip must verify the trip and provide a list of participating students. Students are excused from class for all-university type events and circumstances beyond the student's control such as extended illness, medical emergency, and family emergency. Students may not be penalized for these excused absences as long as *appropriate documentation* is provided to the instructor in a timely manner. In all cases of absence, excused or otherwise, *the student is responsible for completing missed work. The instructor is not required to do extra teaching*." (Emphasis added) For this course, appropriate documentation for illness is a note from a doctor, hospital or health services; appropriate documentation for family or medical emergency includes documentation from hospital or funeral home (a phone number, funeral announcement, hospital admittance form, etc.).
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> "If a student will be absent from class for emergencies, medical reasons or exceptional personal reasons, the student is responsible, if capable of doing so, for contacting instructors individually or through their departments. If the student, family member, or friend are not able to contact instructor or the student will be absent more than three (3) class days, the Dean of Students office may be asked to send notification of the absence as reported to staff.

RESPECTFUL BEHAVIOR

In the Geology Department, we work hard to create classrooms with an environment of ***mutual trust and respect*** in which learning, debate, and intellectual growth can occur. Both student and instructor can only build and show mutual respect if learning in this class is not disrupted. At the most basic level, this means that each of us must ***arrive at class on time, pay attention and complete assignments and readings*** in a timely fashion. However, disagreements will inevitably arise because each of us brings a unique viewpoint, there is rarely a single right answer in geology, and discussion of disparate ideas is encouraged in this course. Although disagreement and even conflict may occur, I expect your cooperation in maintaining an atmosphere of mutual respect. When participating in discussions, it is perfectly acceptable to have strong opinions – in fact I encourage you to do so. I also encourage you to discuss your own personal experience and relate it to that of others. In the process, however, I expect you to ***respect the basic intelligence and humanity*** of each participant in the discussion. Conflict is not necessarily a bad thing, as long as there is a commitment to mutual respect.

Speech or behavior that is hateful, abusive, disrespectful or demeaning will not be tolerated in any interaction between students or between student and instructor. Whether disagreements arise about geochemistry topics, treatment of students or instructor in the course or course policies/procedures, ***please remember to be respectful*** of the person with whom you are in conflict. Consider very carefully whether it is appropriate to address your concerns in front of the whole class or one-on-one with an individual. Think about how you would like to be approached if your behavior or opinion were being called into question. If you start out "itching for a fight", you are likely to get one – or at least a knee-jerk reaction to your attack. Remember that behavior that disrupts your fellow classmates' learning is not acceptable. If you cannot maintain an atmosphere of mutual respect during discussions or other interactions, you will be asked to leave the room until you can behave appropriately.

GRADING

[1]EXAM 1 .....20%

[1]EXAM 2 .....20%

[2]Seminar.....10%

[3]Homework, in-class exercises.....15%

[4]Attendance, participation 5%

[5]Quizzes 5%

[6]Final Project 25%

[1]**Exams:** There will be two take-home exams. The exams will be open book, open notes (and open library, if you want). However, there will be a gag rule in effect -- no talking to your classmates (or anyone else) about the exam. It will be on your *honor* (which I take VERY seriously). There will be no final comprehensive exam -- instead I want you to concentrate on your final projects and the seminar. Each exam is worth 20% of your final grade.

[2]**Seminars:** Toward the end of the semester, after we have become comfortable with the tools of geochemistry, groups of you will focus on some aspect of geochemistry that interests you. In the last few weeks of class, there are some lecture periods entitled "Seminar". You and your classmates will run those classes. For these classes, groups of 3 students will chose 1-2 scientific papers on a topic of interest (handed out to the entire class one class period prior to the seminar) and will facilitate a discussion of the paper(s) in class that day. The group will also be in charge of making up a 1/2-page summary of the problem that is being addressed followed by some discussion questions. They may also make overheads and should read a few extra papers on the topic to add depth to the discussion. Leading and participating in seminar is worth 10% of your grade.

[3]**Homework, in-class exercises:** Problem sets will be assigned on a regular basis. Each assignment will indicate the date it is due. All assignments should be finished by the beginning of class on the date indicated. Since I expect you to turn assignments in on time, I will do my best to have them back to you in a timely fashion. From time to time, we will do some exercises in class, to help us to learn about geochemistry. Sometimes these will be graded; sometimes you'll get credit for just doing them. Homework and in-class exercises will be worth 15 % of your total grade.

[4]**Attendance and participation:** Attendance and promptness are extremely important. I expect each member to engage fully in this course, by reading assignments, paying attention, participating in class discussions and activities. Participation does not necessarily mean that you are required to speak up in class. It does mean that you should be engaged in class (i.e., not doing crosswords puzzles or dozing in the back or skipping class regularly). Although I do not officially take attendance, this class is small enough for me to take notice when you are not there or not fully engaged. Attendance and participation are worth 5% of your grade.

[5]**Quizzes:** Because I expect you to be prepared for class by completing the readings, there will be several quizzes throughout the semester. Some of them will be online quizzes, but there may be pop quizzes as well. Anything that we have covered in class up to that point is fair game. You, as a class, determine the number of quizzes we have. If you all show up for class prepared to discuss the topics and answer questions, there will be very few quizzes. If, however, you show up, fall asleep, don't ask or answer questions, be ready for a quiz. Quizzes are worth 5% of your grade.

[6]*FINAL PAPER DEADLINES AND GUIDELINES*

Since one goal of this class is to teach you about the tools of geochemistry, your final project will be a double-spaced, 12-point font, 15 pages **MAXIMUM** (10 pages minimum, see details below) research proposal. You should propose to do some innovative research in geochemistry. I highly encourage you to pursue a question/hypothesis that interests you and that you could actually address. Students might find a project and samples in the Oshkosh area, the area around field camp, or some project sponsored by someone on the faculty – you may not, however, do something that you have already completed. This could be an excellent opportunity to start on a senior thesis project (a rewarding exercise that will prepare you for graduate school or an industry research career). The following deadlines and guidelines **ABSOLUTE** and modeled after the guidelines for proposals to the National Science Foundation.

FINAL PAPER DEADLINES

Tuesday, January 30 - Thursday, February 8: arrange 15-30 minute meeting with Jen to discuss your research topic. Come in with ideas – think about rocks that you've been curious about, or larger questions in geology that you might want to answer with geochemistry. Jen has lots of ideas – please come with an area, question, rock type, or just a granule of an idea about something geologic she'll help you with the rest. *(5% of final paper grade)*

Thursday, February 15: Preliminary research proposal summary due at the beginning of lecture. This is *limited to* a *one-page double-spaced* summary of the hypothesis you will test (or question you will answer), a short description of what you plan to do (to answer the geochemical question/test the geochemical hypothesis) and why it is important. It should be concise and clear, kind of like an abstract. It should also be convincing – you are a salesperson...sell your idea. The actual proposal summary may change during the course of your research – this is to show me that you have done a little bit of research about the problem and that you are progressing. *(10% of final paper grade)*

Thursday, March 1: Detailed proposal outline due at the beginning of lecture. This outline should include some of the information that you have gathered since our meeting at the beginning of the semester. Every good proposal includes many pages of "research" into the problem and what has already been done. Your outline should include pertinent information about the question/hypothesis that you plan to address. The better and more detailed your outline; the more I will be able to help. This should include a list of the references you have gathered and plan to use. You should also have done some research on the expenses that you will incur as you do this work. I will be grading the outline on organization, clarity of writing, use of references. *(10% of final paper grade)*

Thursday, April 5: Proposal draft due at the beginning of lecture. This is expected to be a relatively complete rough draft of your proposal. At the very least, it should have a relatively complete geologic background that summarizes the importance of the hypothesis to be tested and gives some background in regards to the subject of your proposal. One or two of your peers will also review your proposal. You will get to review theirs as well. *(25% of final paper grade – completion of peer review 10%, draft 15%)*

Thursday, April 12: Peer reviews due at the beginning of lecture.

Friday, May 11, noon: Proposal due. You should turn in a completed proposal – make changes suggested by Jen and your peers on your rough draft, add new information, polish the rough draft, and make it fundable…This is an **ABSOLUTE** deadline. *(50% of final paper grade)*

Treat this as though you are a professional. In academics and industry, proposal writing will occupy a significant amount of your time; if you can do it well, you will be very successful. In this class, the final paper/proposal will make up 25% of your grade (see syllabus for details).

FINAL PAPER GUIDELINES (*more information to be added later****)***

Your proposal **MUST** be double-spaced, 12-point type, and **MUST** have the following components in this order:

1. Title page
2. Project Summary: **MAXIMUM** 1 page, double-spaced, 12-point type. The Project Summary should summarize what it is you propose to do and why it is important. ***There must be a clearly stated hypothesis that you will test.***
3. Table of Contents
4. Body of Proposal: **MAXIMUM** 15 (*minimum 10*) pages, double-spaced, 12-point type (including all figures and tables). I suggest that your proposal body include:
    a. INTRODUCTION to the problem/question/hypothesis. This is like an introduction to a paper – it should, as my graduate advisor used to say, "tell the audience what you're going to tell them". *What's the problem? What's been done? What will you add to the body of knowledge about your problem? Why is it important?*
    b. BACKGROUND summarizing the important geology and geochemistry associated with your problem and pertinent work that has already been done in this area. You may also include a discussion of the geographic/geologic setting that you have chosen to study. Think of this like a mini-research paper (the research for this section can give you ideas for your proposed work; cite early and cite often - see handout on citations for more information). What are important bits of information that reviewers need to understand the importance of this work? What have other people done that provides a basis for you to build on? Why have you chosen this particular rock type/geologic area/ material/tectonic setting /environment? This should be *the bulk of the proposal* that justifies your…
    c. PROPOSED RESEARCH detailing what new work you will do (if you have samples, this is a great place to summarize what ground-breaking results you are already obtaining as a part of your preliminary research and how that fits in). What do you expect to find with your proposed work? How do you know whether it will work? What if it doesn't work? Why is this particular approach an appropriate one?
    d. METHODS detailing how you will do the work. What geochemical techniques will you use to complete your research (you may actually have to do some research into these methods, too)? Why are these particularly useful for your research?
    e. RESEARCH SCHEDULE detailing when the work will be completed. How long will this work take (usually NSF limits proposals to about 3 years)? When do you plan to complete each portion of your research (is this summer work or year-round, will you be going to school too)? What will be done during each time period?
    f. IMPLICATIONS OF THIS WORK reminding us of how important this new work is (this is the part that my graduate advisor would call "Tell them what you told them". What will the geosciences as a whole gain from this work? What will this contribute to the broader base of knowledge in the Earth sciences?
5. References Cited: No page limit, **single**-spaced, 12-point type, listing all references ***cited*** in your proposal. (I will provide a handout in reference to citations later in the course.)
6. Budget: Detail how much it will cost to complete this research. Money is no object! However, please do a little research into reasonable costs for items (for example, $1500 is totally unreasonable for a plane ticket to Dallas, Texas, but not for a plane ticket to South Africa). Orbitz or Expedia are great (easy) ways to get an idea of how much travel items (plane tickets, rental cars, etc) will cost. Do a Google search for other items; you can at least get an idea of cost. Your proposal will lose points (and not get funded) if you have not presented a ***reasonable*** budget for the proposed research.

TENTATIVE SCHEDULE OF TOPICS (subject to change)

Week		Date	Topic	Chapter in McSween et al.
1	T	30-Jan	Math review and What is Geochemistry?	1 & Appendix A
	R	1-Feb	Elements, Atoms and the Structure of Matter	2
2	T	6-Feb	Bonding	2
	R	8-Feb	Thermodynamic Equilibrium	3
3	T	13-Feb	Thermodynamic Equilibrium	3
	R	15-Feb	Solutions – *PROPOSAL SUMMARY DUE*	4
4	T	20-Feb	Solutions	4
	R	22-Feb	Kinetics –diffusion and advection	5
5	T	27-Feb	Chemical Weathering	7
	R	1-Mar	Chemical Weathering – *DETAILED PROPOSAL OUTLINE DUE*	7
6	T	6-Mar	Oceans and Atmosphere – ***FIRST EXAM HANDED OUT***	8
	R	8-Mar	Oceans and Atmosphere	8
7	T	13-Mar	What does equilibrium really mean? – ***1ST EXAM DUE (11:30 AM)***	9
	R	15-Mar	Applying some of the equilibrium principles – changes in P and T	9
8	T	20-Mar	*NO CLASS – SPRING BREAK*	
	R	22-Mar	*NO CLASS – SPRING BREAK*	
9	T	27-Mar	Phase diagrams	10
	R	29-Mar	Phase diagrams	10
10	T	3-Apr	Kinetics and Crystallization	11
	R	5-Apr	Kinetics – Applications– *PROPOSAL DRAFT DUE*	11
11	T	10-Apr	The Solid Earth as a Geochemical System	12
	R	12-Apr	The Solid Earth as a Geochemical System – – *PEER EVALUATIONS DUE*	12
12	T	17-Apr	Stable Isotopes	13
	R	19-Apr	Stable Isotopes **– 2ND EXAM HANDED OUT**	13
13	T	24-Apr	Radioactive Isotopes	14
	R	26-Apr	Radioactive Isotopes- **2ND EXAM DUE**	14
14	T	1-May	Seminar– Topic TBA	TBA
	R	3-May	Seminar – Topic TBA	TBA
15	T	8-May	Seminar – Topic TBA	TBA
	R	10-May	Seminar – Topic TBA	TBA
	F	11-May	***FINAL PROPOSALS DUE AT NOON!!***	