

HYDROGEOCHEMISTRY
GLY 5245, Section 2E45, Spring 2015

Instructor: Dr. Jon Martin
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Office Hours: 2-3 pm Mon/Weds or by appointment (call or email first)
Meeting Place: 218 Williamson Hall
Meeting Time: Mon/Wed 3rd and 4th periods
Required Text: *Aqueous Environmental Geochemistry*, Donald Langmuir
Useful texts: *Geochemistry of Natural Water, 3rd edition*, by James Drever
Aquatic Chemistry, Werner Stumm and James Morgan
The Global Water Cycle Elizabeth Berner and Robert Berner
Geochemistry, groundwater and pollution, 2nd edition, by CAJ Appelo and D. Postma

Information:

The objectives of this course are to introduce you to thermodynamic and kinetic controls on the chemical composition of “natural” water (i.e., we will not study waste or drinking water). We will apply these fundamental chemical principles to a variety of reactions, mostly between fresh water and the atmosphere, carbonate, silicate, and iron minerals, as well as reactions in seawater and with other mineral phases. The course will include lectures on material from the textbook and other sources. This lecture material will be reinforced by occasional problem sets, approximately one every week or two. I encourage you to work on the problems together, but the problems that you turn in must be your own. Tests will consist of problems similar those in the homework sets. NEATNESS COUNTS. Turn them in on time: NO LATE WORK WILL BE ACCEPTED!

Some of the problems will require the use of geochemical modeling programs including Geochemist Workbench (a commercial product), TracerLMP, and PHREEQc (both from the USGS). It will be easiest to manipulate data in Excel and then copy them into the various programs. I assume everyone is familiar with Excel, but if not, please let me know and we will go over that program as well. We will start with Geochemist Workbench. You can download a student version for free after jumping through a few hoops. You should start to get the program immediately – it will be used in the initial problem set. Check on their website at http://student.gwb.com/student_overview.php for information. We will use the other two programs later in the semester. I will provide details then, but if you are curious, you may download them at http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqc/ for PHREEQc and at http://ca.water.usgs.gov/user_projects/TracerLPM/.

Grades will be assigned on the basis of the problem sets, two in-class exams, and a written proposal. Topics for the proposal could address particular element or isotope systems, a particular group of chemical reactions between geologic materials and water, or the geochemistry of a specific aqueous system. We will discuss suitable topics during class as well as techniques for proposal writing. The proposal should be no more than 5 pages, double spaced,

excluding the reference list. Citations should be in standard styles. Proposal preparation will be on-going throughout the semester and pertinent dates are listed on the attached syllabus.

Grading policy:

Work Required	Tentative Dates	Total Value (%)
Homework	Variable	40
In class exams	February 20	20 each
Annotated bibliography	February 27	5
Extended abstract	March 27	5
Proposal	April 22	10
Total		100

Grading scale: $\geq 93 = A$; $90-92 = A-$; $87-89 = B+$; $83-86 = B$; $80-82 = B-$, etc. Values will be rounded to nearest whole numbers

Here is some more information, some common sense, other required by the University:

- 1) Make up exams are highly discouraged, but will be granted if a written excuse is brought from a doctor (for illness) or mortician (for a death in the family).
- 2) I will be posting various bits of information on the web, perhaps including my lecture materials. The current URL is:

<http://www.clas.ufl.edu/users/jmartin/website/Classes/Hydrogeochemistry/Hydrogeochemistry.html>

but this site may change during the semester. I'll let you know.

- 3) Although the class is lecture format, I encourage questions and discussion. To encourage discussion, please speak loudly enough for all in the class to hear your questions and/or comments. Whispering to your friends will not be tolerated. If you whisper to your friends, I may ask you to speak up so we can all hear.
- 4) Attend all classes – most of the test material will come from the lectures. I will not require attendance in the class unless it drops off through the semester. If I am forced to take attendance, the grading policy will shift to reflect that change.
- 5) Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.
- 6) I expect professional behavior in the class at all times. Please show up for class on time and turn off cell phones.
- 7) All students are expected to follow the University honor code: neither give nor receive unauthorized aid in doing any assignment. Not adhering to this policy will result in a failing grade.

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Topics	Topics
Introduction	Units and data presentation
	Hydrologic cycle and geochemistry
Chemical Background	Thermodynamics
	Math review & the total differential
	Gibbs Free energy and activities
	Activity coefficients
	Complexes
Inorganic carbon	P _{CO2} and alkalinity
	Carbonate mineral equilibrium
Thermo Modeling	PHREEQC
	First Exam
	Water Isotopes – H & O
Gas exchange:	Age of water
Kinetics	Introduction
	Rate laws
	Natural examples
Clays	Clay mineralogy
	Cation exchange
Redox equilibrium	Valence states and SHE
	Oxidation- reduction half reactions
	Eh-pH diagrams
Redox examples	Organic carbon, photosynthesis and respiration
	Second Exam

Important dates:

January 27: one paragraph description of proposal topic

January 29: no class

February 26: First exam (tentative date)

March 2 – 6: Spring break, no classes

March 12: annotated bibliography for proposal

March 27: extended abstract of proposal

March 31 & April 2: no class, Bahamas

April 21: Second exam

Note: *This schedule may, and probably will, change during the semester.*