GEOL 444 Low Temperature Geochemistry
Fall 2012

TTh 8-9:15 am PLS 1158 lecture
M 3-6 pm CHEM 1330 laboratory

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We will use the first half of the text as a general guide: Principles of Environmental Geochemistry by G. Nelson Eby ISBN 0-122-29061-5, but other readings will be used to supplement material in the course and the emphasis will not necessarily be the same as the text.

Prerequisite CHEM103, or CHEM135 and CHEM136; MATH115, GEOL100, and GEOL322.

In this course you will learn basic chemical principles, thermodynamics, and kinetics of low-temperature inorganic and organic geochemical reactions in a wide range of surface environments. These geochemical tools will be used to provide a context for understanding elemental cycling and climate change. Laboratories will include problem sets as well as wet chemical techniques used in low temperature geochemistry.

Grades for this course will be based on two midterm examinations (20% each) and one final examination (30%), laboratories (25%) and problem sets (5%). Extra credit (5% to the final exam) will be given on the final if you provided an evaluation through Courseval.

• 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)."

Topics covered:

	Introduction, the atom and the Bohr model
	Labor Day Holiday (no laboratory)
	Atomic and molecular orbitals and quantum mechanics
	Basic principles of bonding - valence, ionization potential and chemical reactions
	Laboratory I Safety in the laboratory environment; Introduction to Lab Rules/Procedures; Use of pH Meters
	Structure of water, geochemical approaches to modelling
	Shared chemical properties of elements and representations of the periodic table
	Laboratory II (Problem Set: Working with pH, mixing, chemical reactions, and composition)
	Introduction to Thermodynamics
	Equilibrium thermodynamics (Free Energy, activity, fugacity, chemical potential and Keq)
	Laboratory III pH Lab - Testing and understanding pH of aqueous solutions
	Solubility of gases and temperature dependence, intro to activity coefficients
	Activity coefficients for various species
	Laboratory IV (Review)
	Intro to kinetics
	Midterm I
	Laboratory V Rock Dissolution Lab - Quantifying acidic reactions with minerals (Part I)
	Kinetics from a molecular orbital perspective
	Introduction to Acid-Base Equilibria and the dissociation of water
	Laboratory VI Rock Dissolution Lab - Using dissolution information to characterize samples(Part 2)
	Natural Waters
	Acidity and alkalinity
	Laboratory VII Rock Dissolution Lab (Part 3)
	Buffers
	Mineral buffers
	Laboratory VIII Titration of an Acid – Calibration of Acid used in previous labs; Finish Rock Dissol. Lab
	Natural waters continued (rainwater chemistry)
	Natural waters continued (seawater chemistry)
	Laboratory IX (midterm review)
	The role of pH and microbial life (Guest lecture Dr. Joost Hoek)
	Midterm II
	Laboratory X Sulfide Chemistry
	Oxidation-Reduction Reactions and the Nernst equation
	Eh-pH
	Laboratory XI Eh-pH Lab
	Eh-pH #2
	Laboratory XII Eh - pH Problem Set

	Role of Microbes in Eh-pH
	Structure and naming of organic compounds
	Laboratory XIII Organic Geochemistry/Naming Problem Set
	Functional Groups
	Carbon compounds in the environment
	Laboratory XIV (Review
	(final wrap up of Carbon)
	Official Final Examination