GEOL 425/525 -- ENVIRONMENTAL GEOCHEMISTRY
Winter, 2013

Class Hours: MWTh 9:00-9:50 a.m. in Lind 103
Th 2:00-4:50 p.m. (lab) in Lind 103

Instructor: Carey Gazis
Office: 219 Lind Hall Phone: 963-2820
e-mail: cgazis@geology.cwu.edu
Office hours: MW 10-11 or by arrangement

Required Text: Principles of Environmental Geochemistry, by G. Nelson Eby (Brooks/Cole, 2004)

Prerequisites: CHEM 181, 181.1, 182, and 182.1, or permission of instructor

Course Description:
Geochemistry can be viewed both as a scientific discipline with its own basic unanswered questions and as a set of tools for answering questions in other geologic subdisciplines. In this course, both perspectives on environmental geochemistry will be examined. We will begin by discussing general geochemical principles and biogeochemical cycles. We will also discuss the influence of rocks and soils on water chemistry and the use of isotopes as environmental tracers. The course includes a class project addressing a local environmental topic (e.g., trace metal concentrations near a local waste site, or the effect of land use on soil chemistry).

Course Outcomes:
Upon successful completion of Environmental Geochemistry (GEOL 425/525):
1. Global geochemical cycles -- Students can describe geochemical cycles of water and carbon in terms of their principle reservoirs, residence times in those reservoirs and fluxes between major reservoirs. They can differentiate between long-timescale processes (such as silicate weathering) and short-timescale processes (such as anthropogenic increase in atmospheric CO_2).
2. Equilibrium thermodynamics -- Students comprehend and can describe in their own words the laws of thermodynamics. They understand how the equilibrium constant of a reaction can be derived from expressions for chemical potential and Gibbs free energy.
3. Laboratory skills -- Students have basic laboratory skills necessary to carry out a supervised geochemical study (e.g. can perform Gram titration of waters in field, can collect water samples using clean methods).
4. Water and soil chemistry -- Students have basic knowledge of water and soil chemistry, controls on pH, cation and anion concentrations.
5. Acid-base chemistry -- Students have a basic knowledge of acids and bases, their properties and behavior. Students understand the relative strengths of acids and bases and related equilibria.
6. Knowledge of different techniques -- Given an environmental geochemical problem, students are aware of geochemical techniques (isotopes, trace elements, etc.) which might be used to address that problem.
7. Current topics -- Students are aware of current topics of research in environmental geochemistry and can read and critically discuss a research article.

Required Elements:
Homework problems – Given every week or two throughout the term.
Reading assignments – Twice during the term, students will be assigned short articles from the literature. They will present oral summaries of these articles to the class.
Class project – This year, the class will perform a group research project studying the trace element chemistry of snow. All students will participate in sample collection, sample preparation, and data collection. Although data collection will be done as a group, each student will write an individual research report.
Exams – Two exams will be given throughout the quarter. The first will be given mid-quarter; the second will be given during final exam week. Both exams will be a combination of homework-like calculation problems and short answer questions.
Graduate students – Students who take GEOL 525 will be given additional work (extra homework problems, extra test questions, etc.) throughout the term. In addition, graduate students will be required to prepare and present a short proposal for a research project of their choice in the field of Environmental Geochemistry.

Homeworks = 10%
Reading Assignments = 10%
Class project = 30%
1st Exam = 25%
2nd Exam = 25%
Graduate students: subtract 2% from all of the above, Proposal = 10%

Final grades are based on % of total points. A = 90-100%; B = 80-89%;
C = 68-79%; D = 50-67%; and F = less than 50%.

SCHEDULE
(subject to change, changes announced in class)

Week 1

Dates	*Topics*	*Reading*
Jan. 3	Introduction	Eby Chapter 1

lab Jan 3 – Introduction, literature review, goals of class project

Week 2

Dates	*Topics*	*Reading*
Jan 7, 9, 10	Distribution of elements, hydrologic cycle, Controls on precipitation chemistry	Eby Chapter 1 handout, Eby 313-314,

lab Jan 10 – Sampling methods, design sampling strategy

Week 3

Dates	*Topics*	*Reading*
Jan 14, 16, 17	Biogeochemical cycles	handout, Eby 20-23 reading assignments Jan 16

lab Jan 17 – Field trip to collect snow samples

Week 4

Dates	*Topics*	*Reading*
Jan 21 (no class – MLK day)		
Jan 23, 24	Biogeochemical cycles, Equilibrium thermodynamics	handout Eby Chapter 2
lab Jan 24 – Field trip to collect snow samples		reading presentations Jan 23

Week 5

Dates	*Topics*	*Reading*
Jan 28, 30	Equilibrium thermodynamics	Eby Chapter 2
Jan 31 – Exam #1		
lab Jan 31 – ICP-MS analysis, Compilation of sample info, maps		

Week 6

Dates	*Topics*	*Reading*
Feb 4, 6, 7	Acid-Base equilibria, Acid Rain	Eby Chapter 3
lab Feb 7 – ICP-MS calibration curves and data management		

Week 7

Dates	*Topics*	*Reading*
Feb 11, 13, 14	Carbonate Systems, Intro to Isotopes	Eby Chapter 3 and 6
lab Feb 14 – ICP-MS data management, graphing geochemical data (computer lab)		

Week 8

Dates	*Topics*	*Reading*
Feb 21	Isotopes: use as tracers and for dating	Eby Chapter 6
Feb 18 (no class – President's Day)		reading assignments Feb 21
Wed Feb 20 – Exam #2		
lab Feb 21 – Statistics (computer lab)		
Feb 21 – 525 partial bibliography due		

Week 9

Dates	*Topics*	*Reading*
Feb 25, 27, 28	Guest lecture about Hanford site Environmental Mineralogy	Eby Chapter 9 reading presentations Feb 28
lab Feb 28 – Statistics, data interpretation (computer lab)		

Week 10

Dates	*Topic*	*Reading*
Mar 4, 6, 7	Environmental mineralogy, Case studies	Eby Chapter 9

Mar 4 – 525 proposal due
lab Mar 7 – Grad student proposal presentations

Tuesday Mar 12 10 a.m. –12 noon – Project write-up due