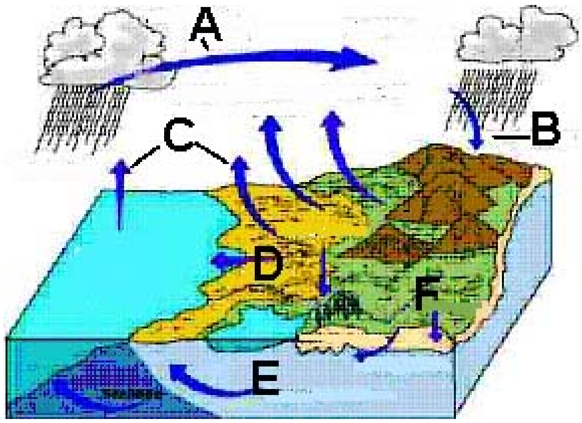

Geology 519 Spring, 2007

AQUEOUS AND ENVIRONMENTAL GEOCHEMISTRY

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Office Hours: M 2:30 – 3:30
Th 11:00 – 12:00

Class Meetings: T,Th 9:30-10:45 **(Lab) T 2:30-5:30**

Course Goals and Structure

This course deals with the natural and human influences on water composition in the Earth's near-surface environments. Our concern will be primarily with fresh water, i.e. streams, lakes, and groundwater, although we will explore some continental saline environments. In all cases, we want to examine the chemical and geological processes that govern the concentration levels of dissolved substances in aqueous systems, and in the course of this endeavor you will

- employ equilibrium thermodynamics as a problem-solving framework;
- develop proper, careful and accurate skills in laboratory and analytical methods;
- operate modern analytical instrumentation ;
- interpret the behavior of naturally complex geochemical systems;
- use computer programs designed to unravel chemical speciation in natural systems;
- apply your knowledge to field-based projects in surface- and ground-water systems;
- experience the process of designing an investigation in aqueous geochemistry;
- become familiar with the journals and technical sources in the subject;
- explain your findings and conclusions to your peers;
- write about geochemical investigations clearly and accurately.

Much of the class time during "lecture" will be devoted to discussions and analyses of readings and problems to better understand the fundamental chemical and geochemical concepts. Consequently, **you must come to class prepared** by reading the appropriate book chapters and attempting to work the assigned problems. This way, you will be a full partner in the learning enterprise. Class attendance is an important part of the process, so there will be a penalty for each class absence beyond three.

Products and Assessment

There will be two major products used to assess your understanding of the concepts and applications of geochemistry. The first will consist of a take-home mid-term exam, which will allow you to interpret the significance of geochemical data. Although you may collaborate in working through the solutions, each of you will hand in your own written interpretation. During the second half of the semester, we will focus on a field-based project to investigate aspects of a watershed geochemical system. You will be involved in the research design, data analysis, and interpretation of the results.

For the project, each research team will give an oral presentation outlining the major findings and interpretations and each team member will produce a comprehensive written report about his or her contribution to the project. The goal of the presentations is to give the other research teams an opportunity to learn from the experiences of their colleagues, and compare the approach and methods used in the project.

There will also be weekly (±) problems and written assignments that can be done collaboratively, but will be handed in and assessed individually. During the first half of the semester, we will also have a few more traditional laboratories to help learn analytical skills, for which you will hand in a brief report. There will be no conventional exams in this course. The general scheme for assigning grades is as follows:

Take-home Midterm	25%
Research Project	35%
Weekly Assignments	20%
Initial Lab Reports	10%
Attendance	10%

All products will be evaluated on the basis of scoring rubrics, which will be distributed in advance.

Projected Schedule

Owing to the "fluid" (no pun intended!) structure of the course, assigning specific topics for specific days is a little premature. However, we do want to make sure that you learn the essential concepts of geochemistry, so we will use the following schedule to guide or discussion and problem-solving during class time

Dates	Focus	Text
Jan. 30, Feb 1.	Introduction; Geochemical Principles	Chap. 1
Feb. 6, 8	Basic Thermodynamic Relationships (Lab) Orientation and Safety	Chap. 2 (p.27-36)

Feb. 13, 15	Activity and Equilibrium (Lab) Collection of first samples	Chap. 2 (p. 30-42)
Feb. 20, 22	Acidity and pH (Lab) pH and activity	Chap. 3 (p. 59-75)
Feb. 27, Mar. 1	Alkalinity and the CO_2 system (Lab) Potentiometric Titrations	Chap. 3 (p 75-90)
Mar. 6, 8	Principles of Oxidation and Reduction (Lab) Redox Measurements	Chap. 4 (p. 94–110)
Mar. 13, 15	Controls on Composition of Natural Water (Lab) ICP Spectrophotometry	Chap. 8 (p.278-294)
" 20, 22	**SPRING RECESS**	
Mar. 27, 29	Water chemistry and geology (Lab) Ion Chromatography	Chap. 9 (p.313-341)
Apr. 3, 5	Equilibrium Models Lab: Modeling your data	Reading to be assigned
Apr. 10, 12	Organics in Natural waters (Lab) Field Excursion (weather permitting!)	Chap. 5 (p.129-161)
Apr. 19 (Thurs.)	Adsorption and Complex Formation	Chap. 9 (p.341-350)
Apr. 24, 26	Metals in the Environment Lab: Project Analyses	Chap. 9 (p.350-364)
May 1, 3	Kinetic and Transport Models Lab: Project Analyses	** in Reference List p. 57- 66
May 8, 10	Topical Explorations Lab: Project Analyses	TBA
May 15	Project Reports	

Resources

Textbook:

Eby, G.N., 2004, Principles of Environmental Geochemistry, Thomson Brooks/Cole, Pacific Grove, CA 514 p.

Other useful references:

Appelo, C.A.J. and Postma, D., 1993, Geochemistry, Groundwater and Pollution; A.A. Balkema, Rotterdam; 536 p.

Domenico, P.A. and Schwartz, F.W., 1998, Physical and Chemical Hydrogeology (2^{nd} edition); John Wiley & Sons, New York; 506 p.

Drever, J.I., 1997, The Geochemistry of Natural Waters (3rd edition); Prentice-Hall, Englewood Cliffs, NJ, 436 p.

Garrels, R.M. and Christ, C., 1965, Solutions Minerals and Equilibria; Freeman, San Francisco; 450 p.

Langmuir, D. A., 1997, Aqueous Environmental Geochemistry; Prentice-Hall, Upper Saddle River, NJ., 600 p.

**Merkel, B.J. and Planer-Friedrich, B., 2005, Groundwater Geochemistry; Springer-Verlag, Berlin, 200 p.

Pankow, J.F., 1991, Aquatic Chemistry Concepts; Lewis Publishers, Chelsea, MI; 683 p. *(not in library*)

Salomons, W. and Förstner, U., 1984, Metals in the Hydrocycle; Springer Verlag, Berlin, 349 p.

Stumm, W. and Morgan, J.J., 1996, Aquatic Chemistry (3^{rd} edition); Wiley-Interscience, New York; 1022 p.