The Geochemistry of Natural Waters

BD10256_ **FALL 2012 INFORMATION**

COURSE:GEOL 416, Section 001

TIME: 9:30 am - 10:45 am T, Th, in Parkinson 110

INSTRUCTOR: **Dr. Liliana Lefticariu** (Phone: 453-7373)

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Pre-requirements: **GEOL 310, CHEM 200, 201, 210, 211; MATH 150** Office hours: M/W/f 11:00-12:00 AM; T/Th 1:00-2:00 PM, or by appointment

COURSE WEBSITE: [https://online.siu.edu/d2l/lp/homepage/](https://online.siu.edu/d2l/lp/homepage/home.d2l?ou=42030)

COURSE DESCRIPTION:

This class is an introduction to the geochemistry of natural waters and the processes that change their composition. The purpose of this class is to provide graduate students with a strong theoretical background in aqueous geochemistry, environmental geochemistry, and groundwater geochemistry for application in a wide range of research topics. My approach is to combine conceptual knowledge with quantitative skills in a cyclic fashion – to build independent understanding and “chemical intuition”. Ultimately, this class is about obtaining the problem solving skills to allow you to better analyze natural geochemical systems.

The course begins with a review of the principles of thermodynamics and their application to aqueous chemistry. Then the course will cover other topics like carbonate solubility, aqueous complexes in natural waters, silicate equilibria, redox equilibria, and the geochemistry

of iron, sulfur, and trace elements, and geochemical kinetics. The final part of the kinetics chapter describes speciation in the aqueous chemistry of selected variable valence elements, and a brief introduction to toxic compounds in natural waters.

Laboratories will cover hands-on use of instrumentation for the analyses of natural waters including field instrumentation (measurements of pH, specific conductance (SpC), dissolved oxygen (DO), and oxidation reduction potential (ORP) and laboratory analyses (atomic absorption spectroscopy, ion chromatography, and spectrophotometry).

COURSE GOALS:

• Introduce the basic principles of aqueous geochemistry

• Introduce common laboratory techniques

• Learn to collect, analyze and display geochemical data

• Improve quantitative skills

• Improve written and oral communication skills

CLASS PREREQUISITES:

Previous courses in general geology, chemistry, or other introductory science classes are beneficial. A basic understanding of chemical principles and scientific concepts is especially helpful, although all concepts are considered without presumption of any prior knowledge. If you are uncertain of any assumptions made in the class please ask for clarification.

COURSE COMPONENTS AND ASSESSMENT:

* ***Homework*****(20%):** Four problem sets (5% each) are designed to familiarize you with chemical calculations and notations, and to introduce you to the algebraic techniques applied to chemical data. Late problem sets will receive at most half credit. Please do your own work. Problem sets that are identical “twins” will not receive credit.
* ***Midterm Exam* (25%):**There will be one midterm exam. The exam will be closed book and students may bring a single sheet of paper (both sides) with handwritten notes.
* ***Laboratory* (15%)*:*** Your lab grade will be based on lab preparation and attendance, all laboratory exercises, field work and your lab notebook.
* ***Course Project*** (**30% of Grade**). The project will result in a written paper and an oral presentation given during the final exam period. Each student will complete a term paper will consist of a complete report of the collection, chemical analysis, and interpretation of these water analyses.

GRADE BREAKS: A = > = 90%; B = 75-86%; C = 65-74%; D = 55-65%; F = <55 %

***Emergency Procedures***

Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work.  Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program.  Emergency response information is available on posters in buildings on campus, available on BERT’s website at [www.bert.siu.edu](http://www.bert.siu.edu/), Department of Safety’s website [www.dps.siu.edu](http://www.dps.siu.edu/) (disaster drop down) and in Emergency Response Guideline pamphlet.  Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location.  **It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency.** The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.

TEXT AND RESOURCES:

*Recommended Text:*

* **Geochemistry of Natural Waters, by J.I. Drever, 3rd edition,** Prentice-Hall, Inc., 1997.

This text provides a general introduction to many of the course themes in a narrative format. It offers a comprehensive treatment of several of the class topics and an adequate representation of most others. Most importantly it represents a companion to the class that supplements and augments the lecture materials. Its contents are not followed directly, and topics are considered in a different order from this text.

*Additional Resources:*

* **Water Chemistry Texts**

Stumm, W. and Morgan, J. (1996) *Chemical Equilibria and Rates in Natural Waters*, 3rd Edition. John Wiley & Sons. 1022p

Morel F. M.M. & Hering J. G. (1993) *Principles and Applications of Aquatic Chemistry*, Wiley.

Garrels, R. & 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.

Brezonik, P. L.; Arnold, W. A. Water Chemistry. (2011) An Introduction to the Chemistry of Natural and Engineered Aquatic Systems; Oxford University Press: New York, 2011.

Weiner, E. R. Applications of Environmental Aquatic Chemistry: A Practical Guide, (2012) 3rd ed.; CRC Press: Boca Raton, FL.

* **Water Chemistry Laboratory Texts**

Hem, J.D. 1989. Study and Interpretation of the Chemical Characteristics of Natural Water. USGS WSP 2254. http://water.usgs.gov/pubs/wsp/wsp2254/pdf/wsp2254a.pdf

National Field Manual for the Collection of Water-Quality Data,

<http://water.usgs.gov/owq/FieldManual/>

Sawyer, C. N.; McCarty, P. L.; Parkin, G. F. Chemistry for Environmental Engineering and Science, 5th ed.; McGraw-Hill: New York, 2003.

* **Web-based Resources**

Basic Chemical Thermodynamics:

<http://orac.sunderland.ac.uk/~hs0bcl/td1.htm>

PHREEQC (Version 2)--A Computer Program for Speciation, Batch-Reaction, One-Dimensional

Transport, and Inverse Geochemical Calculations (US Geological Survey)

<http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqc/>

WEB-PHREEQ: Aqueous geochemical modeling <http://www.ndsu.nodak.edu/webphreeq/\>

WebElementsTM Periodic table (professional edition) <http://www.webelements.com/>

Geochemistry-related links <http://www.geo.cornell.edu/geology/classes/Geochemweblinks.HTML>