Water-Rock Interactions **SPRING 2013 INFORMATION**

COURSE:GEOL 517, Section 001

TIME: 9:30 am - 10:45 am **M, Th**, in **Parkinson 113**

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

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 Pre-requirements: **GEOL 416, 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:

The Water-Rock Interactions is a topic of fundamental importance to a wide range of scientist in general and geochemists in particular from academia, industry, and government. Practically, solving even the most mundane geological problem needs a rudimentary knowledge of the field. If you are a petroleum geochemist, ore-deposits explorer, environmental geologist, or planetary scientist you need to have knowledge of reactions between geologic materials (e.g., minerals, organic matter) and aqueous solutions, including growth and dissolution, surface complexation, and acid-base and redox reactions. During this class we will explore some of these topics. Additionally, the class also encompasses discussion of high temperature processes (e.g, hydrothermal processes), environmental processes such as contaminant fate, microbe-mineral interactions, and biomineralization. Common analytical methods used in mineral-water interface studies will be introduced throughout the course. Ultimately, this class is about obtaining the problem solving skills to allow you to better analyze natural geochemical systems.

READING MATERIALS:

The assigned textbook is *Environmental Surfaces and Interfaces from the Nanoscale to the Global Scale* by Patricia A. Maurice**.** In addition,throughout the semester articles will be provided as reading assignments. Lectures notes and all other materials used in this class will be posted on class website and available over the internet.

COURSE GOALS:

• Introduce the basic principles of surface geochemistry in low-temperature aqueous systems and the processes that control their reactivity and stability;

• Introduce common laboratory techniques and analytical methods frequently used in geosciences;

• Learn to collect, analyze and display geochemical data

• Improve quantitative skills

• Improve written and oral communication skills

CLASS PREREQUISITES:

Previous courses in general geology, geochemistry, microbiology 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*****(40%):** During the semesteryou will be given approximately eight assignments (5% each) which will consist of: (1) problem sets dealing with fundamental thermodynamic and kinetic concepts which are designed to familiarize you with chemical calculations and notations, and to introduce you to the algebraic techniques applied to chemical data and (2) writing activities such as writing a critical review of a journal article provided by the instructor. 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 project* (20%):**Each student will select a research topic and write a short proposal. The proposal should fallow the format used by NSF (<http://www.nsfgrfp.org/>). More details will be provided in class.
* ***Course Project*** (**40% of Grade**). The final project will result in a written review paper (15-20 page) and an oral presentation (~ 20-25 minutes) given during the final exam period. Each student will complete a review paper on a topic of interest not covered in detail in the class. More details will be provided in class.
* 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:*

* Patricia A. Maurice **(2009)** *Environmental Surfaces and Interfaces from the Nanoscale to the Global Scale***,** Wiley-Interscience; 1 edition **ISBN-13:** 978-0470400364

This text covers aspects ranging from the theory of charged particle surfaces to how minerals grow and dissolve to new frontiers in W-R interactions such as nanoparticles, geomicrobiology, and climate change. Providing basic conceptual understanding along with more complex subject matter, Professor Patricia Maurice encourages students to look beyond the text to ongoing research in the field. Designed to engage the learner, the book features:

* Numerous case studies to contextualize concepts
* Practice and thought questions at the end of each chapter
* Broad coverage from basic theory to cutting-edge topics such as nanotechnology
* Both basic and applied science

*Additional Resources:*

* Susan L. Brantley, James D. Kubicki, Art F. White**(2007)** *Kinetics of Water-Rock Interaction*, Springer; 1 edition **ISBN-10:** 0387735623.
* Barnes, H.L. **(1997)** *Geochemistry of Hydrothermal Ore Deposits*, Wiley; 3rd Edition, **ISBN-13:** 978-0471571445.
* Cornelis Klein and Barbara Dutrow**(2007)** *Manual of Mineral Science*, Wiley; 23rd edition, **ISBN-13:** 978-0471721574.
* Stumm, W. and Morgan, J. **(1996)** *Chemical Equilibria and Rates in Natural Waters*, 3rd Edition. John Wiley & Sons. 1022p, **ISBN-13:** 978-0471511854.
* Brezonik, P. L.; Arnold, W. A. **(2011**) An Introduction to the Chemistry of Natural and Engineered Aquatic Systems; Oxford University Press: New York, **ISBN-13:** 978-0199730728.
* Kurt Konhauser**(2006)** *Introduction to Geomicrobiology*, Wiley-Blackwell; 1 edition, **ISBN-13:** 978-0632054541.
* Amanda S. Barnard and Haibo Guo **(2012)** *Nature's Nanostructures* Pan Stanford Publishing; 1 edition, **ISBN-13:** 978-9814316828.

**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/\](http://www.ndsu.nodak.edu/webphreeq/%5C)

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

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