EES260: Geochemistry

Vanderbilt University, Fall 2009

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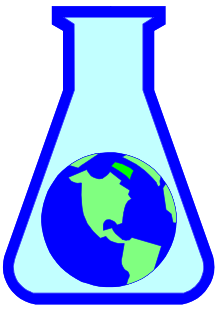
Textbook: *Principles and Applications of Geochemistry* by Gunter Faure, 2nd ed., 1998.
http://vig.prenhall.com/academic/product/1,3411,0023364505,00.html

Resources:
Treatise on Geochemistry, 2004, Volumes 1-9.
Rollinson, H., 1993, *Using Geochemical Data: Evaluation, Presentation, Interpretation*, 352 pp.
Manahan, S. (2006) *Green Chemistry*, 2nd ed.:
http://www.asdlib.org/onlineArticles/ecourseware/Manahan/GreenChem-2.pdf

Course homepage: The course web is in Blackboard: http://www.vanderbilt.edu/oak/



Introduction: The chemistry of the earth is an extraordinarily broad and complex topic. Nearly every principle known to chemistry has an example in nature, and we can be sure that nature holds the key to understanding countless undiscovered chemical principles. Recent news stories about global warming, volcanic activity, trace element contamination of groundwater, and the chemistry of Mars highlight the importance of geochemical concepts in everyday science. Geochemistry has played a central role in the development of current theories on the origin and evolution of earth and life, including global chemical cycles in the earth and their relationship to global change. Geochemistry has become a very interdisciplinary science, and learning geochemistry provides the student an opportunity to integrate and synthesize knowledge learned in many different science courses into a holistic approach to the study of earth. Finally, geochemistry has many practical applications including water quality and groundwater studies, geochemical prospecting for ores and oil, planning and remediation studies of waste storage sites, and ecological and environmental studies aimed at preservation and remediation.

Objectives: As stated in the textbook preface (p. xv Faure, 1998), "…the subject matter in this book starts with *basic principles* and emphasizes *quantitative methods of problem solving* in order to gain better *understanding* of natural phenomena." We won't be able to cover all of the major topics in geochemistry; for example, Organic geochemistry is typically covered in a separate course. However, by the end of this course you will be familiar with most current topics in geochemistry, able to read and understand articles in geochemical journals, and able to apply geochemical principles to solve many types of geological problems.

Requirements: I expect students to attend every class. There will be ~6 short homework assignments (20% of final grade), two mid-terms (20%), a final exam (20%), a term paper (20%) and presentation (10%). Participation in class discussions, which I expect to be an important part of this class, will count as 10% of the final grade. I encourage you to work together on homework assignments and to study together for tests. However, the final write-up of a problem set or term paper must be your own work.

For the term paper I will ask you early in the semester to provide a title, outline and list of references for your paper. I will make the paper due at least one month before the semester ends, grade them promptly, and then return them to you for corrections. You may then return a corrected or improved version of the paper within two weeks. Finally, you will give short presentations of your findings during the last full week of classes.

My tentative plan is to cover the following chapters in the Faure textbook and associated reading from the Treatise on Geochemistry (TOG). This year I am also adding a section on Green Chemistry.

Course Outline

Faure Chpt. #	
1	What is Geochemistry?
2	In the Beginning
3	The Solar System
4	Chemical Differentiation of the Earth
	Principles of Inorganic Geochemistry
5	The Electronic Structure of Atoms
6	The Periodic Table and Atomic Weights
7	Chemical Bonds, Ionic Radii and Crystals
8	Ionic Substitution in Crystals
TOG	Trace Elements
Manahan 10&14, Sustainability book	Green Chemistry, the Geosphere and Anthrosphere
	Aqueous Geochemistry and the Stability of Minerals
9	Acids and Bases
10	Salts and Their Ions
11	Thermodynamics
12	Mineral Stability Diagrams
14, Manahan 7	Oxidation-Reduction Reactions
	Isotope Geochemistry
16	Isotopic Geochronometers (Radioactive Isotopes)
17	Isotope Fractionation (Stable Isotopes)