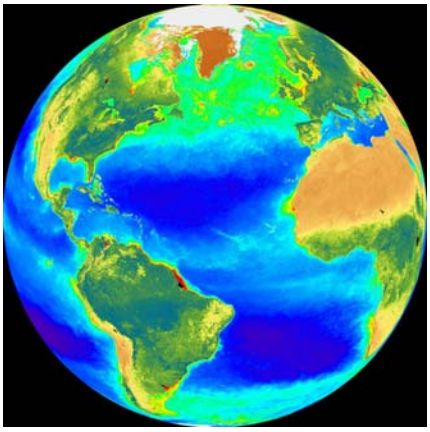
Geo-Sci 415

Introduction to Geochemistry



Fall, 2006

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Course Structure and Goals

Geochemistry is really just another way of looking at our world that focuses on the numerous reactions taking place in various parts of our planet. In this course, we want to explore the "big picture" aspects of this science, so that you will see how chemical processes are at work in geological settings. This is a large undertaking, but by studying some selected examples of geochemistry at work, you will be able to reach the following goals:

- evaluate the role of geochemistry in determining the environmental evolution of our planet;
- interpret the behavior of naturally complex geochemical systems;
- predict the outcome of geochemical processes.

In addition, by working within the realm of geochemistry, you will have the opportunity to:

- develop proper, careful and accurate research skills;
- explain your findings and conclusions to your peers;
- write about geochemical investigations clearly and accurately.

Although the class is scheduled for three "lectures" a week, we will spend much of our time engaged in discussions and solving problems. In order for you to benefit and contribute to these discussions, you will need to prepare for each class by reading the appropriate articles available on the UMass e-reserves and writing out answers to questions that we developed in the previous class. In order for this format to work attendance at each class is required.!

Products and Assessment

There are three principal components that will be used for assessing your comprehension of geochemistry and assigning a grade.

Mini-Projects: These are short investigative tasks that will involve some original data collection, as well as evaluations and syntheses of previous studies. The research component will be done as a group project with an oral summary by the group, but each student will write his or her own report (approximately 8 to 10 pages, with supporting tables and figures). Project reports are to be written in journal-article style, using the Geological Society of America Bulletin as a format guide.. Topics and schedules as follows:

Project #1: References and one-paragraph proposal due: Sept. 27
Presentation (tentative date) Oct. 23
Written Report due: Oct. 30
General topic: For a planet other than the Earth, you will investigate what is known about the geochemistry of the interior, the crust or the atmosphere, and the processes by which that composition evolved.

Project #2: References and one-paragraph outline due: Nov. 17
Presentation Dec. 11
Report due: Dec. 13
General topic: Element cycling is an important part of the Earth system. You will investigate the levels of a particular element in different Earth materials and the processes controlling the transfer among different "reservoirs."

Assignments: These will consist of questions that you answer in class, or problems that you solve as homework. There will be an assignment of some kind in almost every class.

Course Summary: As the last component of the course I want you to write a brief summary of the three most significant learning experiences that have resulted this course. These can be related to the topics covered in class, the projects you have done on your own, some new curiosity about the Earth that has resulted from your exploration of geochemistry, or even some unexpected discoveries you have made about yourself. Approximately 5 pages should suffice, but longer is acceptable. Be sure to support your reflection with the specific evidence that will help me evaluate your understanding of the substance and application of geochemistry.

Grade Calculations:	Mini-projects	50% (25% each)
	Assignments	40%
	Course Summary	10%

Each component of the course will be evaluated using a scoring rubric, which will be distributed in advance.

Projected Schedule

Dates	Topics	Readings*
Sept. 6, 8	Origins and Geochemical Processes	
" 11, 13, 15	Radioactive Decay & Geologic Time	B 1 & 2
" 18, 20, 22	Nucleosynthesis	F 3
" 25, 27, 28	Origin of the Earth and Other Planets	M 4;
Oct. 2		RM 5 & 6
" 4, 6, 11,13	Evolution of the Earth's Core, Mantle & Crust	MRU 7; HGL 8
" 16, 18, 20	Evolution of the Atmosphere & Ocean	E+ 9
" *23*	*Presentation of First Project (tentative)*	
" 25, 27, 30	Chemical Weathering	BB 10
Nov. 1, 3	" "	"

Dates	Topics	Readings*

"	6, 8, 10, 13, 15	Stable Isotopes and Applications	F 11
"	17, 20, 22, 27, 29	Cycles: From Continents to Ocean	F 12
Dec.	1, 4, 6, 8	Oxygen and Carbon Dioxide	WD 13
		"	
"	11	*Presentation of Second Project*	
	13	*Finish Presentations; Written Project Report Due*	
	20	*Course Summary Due*	

* Numbers refer to documents on UMass e-reserves. These are excerpts from various books and articles as listed below

E-reserve List and Source Books: The numbered citations below refer to the specific readings listed in the course schedule. The books listed are good places to start for information about your research projects.

B 1 & 2: Brownlow, Arthur H., **Geochemistry (Second Edition)**, Prentice-Hall, Upper Saddle River, NJ, (1996). p. 51-61; 69-83

F 3: Faure, Gunter, **Principles and Applications of Inorganic Geochemistry (Second Edition)**. Prentice-Hall, Upper Saddle River, NJ (1998). p. 8-21

M 4: Mason, Brian, and Moore, Carleton B.,**Principles of Geochemistry (Fourth Edition)**, John Wiley & Sons, New York (1982). p. 15-19

RM 5 & 6: Richardson, Steven M., and McSween, Harry Y. Jr., **Geochemistry: Pathways and Processes.** Prentice-Hall, Englewood Cliffs, NJ (1989). p. 424-426; 429-444; 451-452

MRU 7: McSween, Harry Y., Jr., Richardson, Steven M., and Uhle, Maria, **Geochemistry: Pathways and Processes (2nd Edition).** Columbia University, New York (2003). P. 227-243.

HGL 8: Hillgren, V.J., Gessman, C.K., and Li, J., An experimental perspective on the light element in the Earth's Core; **in** Canup, Robin M., and Righter, Kevin (Editors), **Origin of the Earth and Moon,** University of Arizona Press, Tucson, AZ (2000).p. 245-263.

E+ 9: Eriksson, P.G., Altermann, W. and Ohmoto, H., Evolution of the Hydrosphere and Atmosphere; **in** Eriksson, P.G. and others (Editors), **The Precambrian Earth: Tempos and Events,** Elsevier, Amsterdam (2004). p. 359-388.

BB 10: Berner, Elizabeth Kay, and Berner, Robert A., **Global Environment: Water Air, and Geochemical Cycles.** Prentice-Hall, Upper Saddle River, NJ (1996). p. 141-171.

F 11: Faure, Gunter, **Principles of Isotope Geology (Second Edition)**, John Wiley & Sons, New York (1986). p. 429-447.

F 12: Faure, Gunter, **Principles and Applications of Inorganic Geochemistry (Second Edition)**. Prentice-Hall, Upper Saddle River, NJ (1998). p.425-433.

WD 13: Walker, J. C. G. and Drever, J. I., Geochemical cycles of atmospheric gases; **in** Gregor, C. Bryan, Garrels, Robert M., Mackenzie, Fred T., and Maynard, Barry J. (Editors), **Chemical Cycles in the Evolution of the Earth.** John Wiley & Sons, New York (1988). p. 55 – 76.