Aqueous Environmental Geochemistry
Fall 2010 Syllabus
Instructor: Dr. Vijay M. Vulava

1 Contact Information

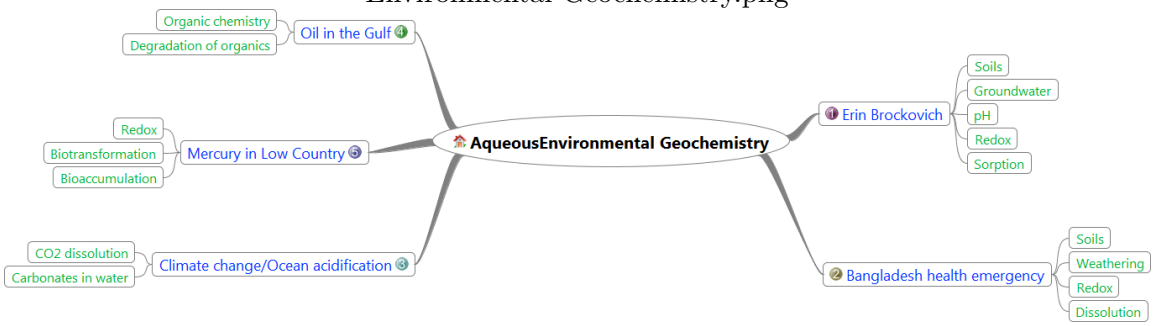
Office: RHSC 336	Office hours: Open (call/email ahead)
Lecture: RHSC 334, MWF 12:00-12:50 h	Lab: RHSC 341, W 13:00-16:00 h
Phone:	843.608.9628
Email:	vulavav@cofc.edu
Links to useful class info.:	"OAKS" on http://my.cofc.edu/
	http://blogs.cofc.edu/vulavav/

2 Course Goals and Structure

In this course you will obtain theoretical and laboratory skills required to understand how natural and anthropogenic factors influence water composition on Earth's near-surface environments. We will primarily focus on fresh water (i.e. streams, lakes, and groundwater) and shallow geological environments. The overall goal of this course is to help you (i) develop an understanding of basic principles of chemistry as it applies to geological and environmental processes, (ii) develop the requisite skills to apply these skills to solve environmental problems, and (iii) learn how to make quantitative predictions about outcomes of chemical reactions that occur in context of geological processes.

Since this may be the only environmental geochemistry-themed course you may take at the College, it will be a broad survey course and will cover a lot of topics. You will, however, have the opportunity to pursue some of the topics from this course in detail on your own as a research project. Some of the case studies/topics covered are shown the figure below:

Environmental Geochemistry.png



This course takes a very quantitative approach to understanding environmental issues. Over the course of the semester, you will also learn to use (i) PHREEQC, a very powerful hydrogeochemical modeling tool, (ii) Mathematica, a very powerful visual mathematics programming language, and (iii) Excel, to solve a lot of geochemical problems.

Several of you may be uncomfortable with arithmetic, geology, and chemistry skills - I assure you that most of you are in the same boat. Just be open to learning lots of new concepts and don't stress out – geochemistry is more fun than you can imagine! I don't expect anyone to fail in this class, but, you need to put in some effort! Class attendance is most important part of this class and you may not do well if you miss classes. *All deadlines will be strictly enforced*, unless you have a very good excuse (death in family, swine flu, etc., but being stressed out, etc. are not good excuses.)

Unlike the most other science courses you have in Environmental Studies, this course is a bit different in two regards:

1. **A case study approach:** The traditional approach of top-down incremental knowledge approach seems too contrived for this kind of a class. Instead, I've decided to take a more unstructured case study approach to understanding geochemical environmental issues. I think that this approach will help you focus on the "big picture" and develop a context for using basic chemical concepts to understand how geochemical environments work. As you try to unravel these specific environmental issues, you will learn core geochemical skills necessary to understand and predict outcomes in similar situations. Since this is a significantly different approach than what you probably see in other classes, I expect all of you to fully participate and give me periodic feedback on what is working and what isn't. I will gratefully accept and welcome all comments (positive and negative) and will attempt to incorporate any changes necessary to make your learning experience successful. I expect you to be a full partner in this course.
2. **De-emphasizing examinations:** One of the main goals of this course is to enhance your understanding of aqueous geochemical environments and be able to both qualitatively and quantitatively predict various outcomes. This requires critical thought and practice in both group settings and in individual settings. A traditional way to test your understanding is to have an exam and test your competence, but this is not the best approach for this course. Hence, there will be no exams (including final exam) in this class, instead, there will be group and solo problem-solving activities and assignments. There will be several collaborative opportunities in this class on research and problem-solving activities.

The laboratory component of this course is integral to the class' overall goals and, hence, attendance is mandatory. Be sure to attend all labs as you cannot make up any missed labs (let me know ahead of time if something comes up.) The first half of the semester, you will be introduced to basic geochemical techniques and instrumentation and will help you familiarize yourselves with basic environmental analytical skills. You will hand in brief reports (up to 1500 words including figures and data tables) that contain critical analysis of the experiments conducted. The second half of the semester will focus on your lab-based projects at the end of which you will turn in a 4500-word paper (including references, figures, and tables.) There will also be a few field-based labs over the semester that may require you to spend more than the allocated 3-hr time for the labs. Such field trips will be scheduled for the weekends to visit various sites in Charleston area (Dixie Plantation, Drayton Hall, etc.). On these trips you will have hands-on opportunities to learn about techniques that are used to assess basic environmental parameters in the field.

Since this class is about the environment and ultimately related to sustainable practices,

we'll *try to limit use of paper as much as possible*. Email me all your assignments, labs, and project reports in MS Word format (PC format only). If you have to print, use the duplex option on the printer and recycle all paper. Obviously, several assignments will be hand-written - if that is the case, scan and email me the worked sheets from the Department copy machine in RHSC 336. (I can show you how.) All hand written exercises need to be cleanly and clearly written - if the turned in work looks messy, I will not grade them.

3 Prerequisites

While this course is designed for students that have a two-course sequence of introductory geology (GEOL 101/103 and 105) and chemistry (CHEM 111 and 112), those that are deficient can also do well in this course. Such students may need to spend additional time getting up to speed with the basics. Also, basic arithmetic is used throughout this class (logarithms, manipulating and solving simultaneous equations, etc.), so if you're out of practice, either look up basic math (Math 101/102) textbooks or come and see me if you need additional help.

4 Textbooks

Main Text: C.A.J. Appelo and D. Postma. 2005. Geochemistry, Groundwater and Pollution (Paperback), 668 pages, Taylor & Francis; 2 edition, ISBN-10: 0415364280. An excellent book about various aspects of aqueous geochemistry. Includes a lot of field data and applications with several practice problems with answers. Also check out the website of the author at http://bit.ly/9dY6g0. Costs about $48 on Amazon.com. (http://amzn.to/aaLpHb)

Reference Text: R.A. Hites. 2007. Elements of Environmental Chemistry (Paperback), 224 pages, Wiley-Interscience, ISBN-10: 047199815X. Compact introduction to various concepts in environmental chemistry.

Reference Text: Werner Stumm and J.J. Morgan. 1996. Aquatic Chemistry (Paperback), 1040 pages, Wiley-Interscience; 3rd edition, ISBN-10: 0471511854. The BIBLE of aqueous geochemistry - there is no better reference book than this. Includes several practice and worked problems and also in-depth coverage of several topics.

Reference Text: R. Chang. 2005. Chemistry, 9th Ed. 1152 pp., McGraw-Hill, NY. A good introductory chemistry book used at the College for CHEM 111/112 and CHEM 101.

Assigned readings and handouts: Will be available on OAKS.

5 Assessment

You performance in this course will be assessed based on your understanding of geochemical concepts and the demonstration of your ability to apply this knowledge. This will involve a combination of (i) group problem-solving exercises – you will work in groups of about 2-3 students, (ii) solo problem-solving exercises (about 5-6 total), (iii) paper and presentation associated with your research and laboratory projects, and (iv) class participation.

1. Group problem-solving exercises will include solving problems and synthesis and interpretation of published data - there will be approximately 10 of these – 20% of total grade. Notes: All students in the group get identical grade and hence it is important to work well together. It is not necessary to work in a group, but, strongly encouraged. I'll clearly specify if the exercise can be worked as a group assignment.
2. Solo problem-solving exercises include similar problems as above - there will be about 5-6 exercises total – 40% of total grade.
3. A 4500-word research paper that is an extensive research paper of a lab/field project. Come and see me before you create an outline to discuss your topic. Use "Applied Geochemistry" as a model for your paper (see http://bit.ly/nN3bz for instructions on preparing the project report in a manuscript form) – 20% of total grade. Notes: Grade includes project execution and attention to detail. Check course schedule for deadlines.
4. A 12 minute presentation of your project results to the class towards end of the term – 5% of total grade.
5. Laboratory projects will involve collaborative efforts, but each of you will synthesize and submit your own reports – 15% of total grade.

The grade you earn by the end of the semester will be based on this scale: Excellent (A), Good (B+), Fair (B), Poor (< B)

A	93-100	B+	92-87	C+	80-75	F	< 70
		B	86-81	C	74-70		

6 Tentative Class Schedule

Wk.	Dates	Lecture & Discussion Topic	Events & Deadlines
1	8/25-8/27	Introduction	
2	8/30-9/3		
3	9/6-9/10		
4	9/13-9/17	Cr contamination in groundwater	Outline for project due
5	9/20-9/24		
6	9/27-10/1		
7	10/4-10/8		
8	10/13-10/15	As water contamination	10/11-12, Fall Break
9	10/18-10/22		
10	10/25-10/29	Global Warming	1st draft of paper due
11	11/1-11/5		
12	11/8-11/12		
13	11/15-11/19	Oil in the Gulf	
14	11/22		11/24, 11/26 - Thanksgiving
15	11/29-12/3	Low Country issues	Research presentations begin
16	12/6		Research paper due

7 Course Product (or What you will get from this course)

On successful completion of this course, you will be able to

- Critically understand processes related to geological processes
- Interpret the behavior of naturally complex environmental systems
- Critically analyze environmental data and explain your findings and conclusions to your peers
- Integrate various basic sciences (chemistry, biology, geology, etc.) and mathematical skills to solve multidisciplinary problems
- Collaboratively develop research projects
- Develop other ancillary skills:
  - Become familiar with journals and technical sources in subject area
  - Become proficient in conducting literature reviews
  - Improve your presentation and science writing skills
  - Learn how to use generic software (Excel, etc.) to analyze geochemical data

8 CofC's Honor Code and Academic Integrity

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved.

Incidents where the instructor determines the student's actions are clearly related more to a misunderstanding will handled by the instructor. A written intervention designed to help prevent the student from repeating the error will be given to the student. The intervention, submitted by form and signed by both the instructor and the student will be forwarded to the Dean of Students and placed in the student's file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student's transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

Students should be aware that unauthorized collaboration–working together without permission–is a form of cheating. Unless the instructor specifies that students can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as an iPhone or other smartphones), copying from others' exams, fabricating data, and giving unauthorized assistance.

Research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the instructor.

Students can find the complete Honor Code and all related processes in the Student Handbook at http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.

php.