**Aqueous and Environmental Geochemistry, Spring 2016**

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| **Course Id:** | CHEM 609/GEOS 633 (3 cr.) |
| **Lecture:** | TR 11:30 – 1:00 (REIC 233) |
| **Instructor:** | Tom Trainor<br>Rm 176 REIC<br>474-5628<br>tptrainor@alaska.edu |
| **Office Hours:** | MW 10-2 |
| **Grading:** | 30% Problem Sets<br>35% Class participation and in-class presentations<br>35% Final project |

**Course Description**

This course is focused on topics related to the chemistry of aquatic and soil/sediment environments and the interactions between aqueous solutions and geomedia. Particular emphasis is placed on heterogeneous interactions, including dissolution/precipitation and sorption processes involved in the partitioning, transformation and transport of metal(loid) species in the environment.

**Student Learning Outcomes**

The goal is to provide students with the conceptual background required for critical review and interpretation of the current aqueous and environmental geochemistry literature. This will be developed through lectures, problem sets, class discussions and individual student projects.

**Topics**

- Natural waters: classification and general controls on composition
- Environmental solids: structure, composition and crystal chemistry
- Weathering reactions: reaction pathways and thermodynamics controls
- Mineral surfaces: sorption, surface and colloid chemistry, mineral growth and dissolution
- Student directed topics: see below

**Web pages**

Course information will be posted on the Chem 609 Blackboard page. Please contact the instructor if you have any difficulty with access.

**Text**
D. Langmuir, Aqueous Environmental Geochemistry, Prentice Hall

**Additional Sources**
D.C. Adriano, Trace Elements in Terrestrial Environments, Springer
G. Sposito, The Chemistry of Soils, Oxford University Press
M McBride, Environmental Chemistry of Soils, Oxford University Press
W. Stumm and J. Morgan, Aquatic Chemistry 3rd ed., Wiley-Interscience
F. Morel and J. Hering, Principles and Applications of Aquatic Chemistry, Wiley-Interscience
C. Bethke, Geochemical Reaction Modeling, Oxford University Press
R. Hunter, Foundations of Colloid Science, Oxford Science Publishers
H.L. Ehrlich, Geomicrobiology, Marcel Deckker

## Important Dates:

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| Jan 29 | Last day for 100% refund tuition & fees |
| Jan 29 | Last day for student-initiated and faculty-initiated drops |
| March 14-18 | Spring Break |
| March 25 | Last day for student-initiated and faculty-initiated withdrawals "W" |
| April 22 | SpringFest (no classes) |
| May 2 | Last day of classes |
| May 3-6 | Final Exams |

**Computer Lab:**
Your enrollment in this course gives you user privileges in the Department's computer lab. Information and policies are available at: *http://www.uaf.edu/chem/instrumentation/policies/.*

**Student with Documented Disabilities:**
Student with a physical or learning disability, who may need academic accommodations, should contact the Disability Services office (203 WHIT, 474-7043). Disability Services will then notify the instructor of special arrangements for course work.

**Ethical Considerations:**
The Chemistry Department Policy on Cheating is: "*Any student caught cheating will be assigned a course grade of F. The student will not be allowed to drop the course*."
The UAF Honor Code states: "*Student will not collaborate on any quizzes, in-class exams, or take-home exams that will contribute to their grade in a course, unless permission is granted by the instructor of the course. Only those materials permitted by the instructor may be used to assist in quizzes and examinations. Student will not represent the work of others as their own. A student will attribute the source of information not original with himself or herself (direct quotes or paraphrase) in compositions, these and other reports. No work submitted for one course may be submitted for credit in another course without the explicit approval of both instructors. Violations of the Honor Code will result in a failing grade for the assignment and, ordinarily, for the course in which the violation occurred. Moreover, violation of the Honor Code may result in suspension or expulsion*"

Students may collaborate on homework assignments, however, each individual should submit their own copy showing all their work. Projects are to be completed independently.

**Student directed topics and class projects**

This is an inter-disciplinary course with a focus on near surface chemical processes involving water and "geomedia". This is considered a follow-on course to an introductory course in geochemistry and/or aquatic chemistry. We will discuss a number of core topics following traditional lecture style (see topics above) then move to student directed topics at the end of the semester. This will give us an opportunity to explore individual topics that are of particular interest to one or more students in substantial detail. An outline of the work plan is below:

1) Students should consider what special topics they would be interested in seeing covered. All topics need to fit within the scope of "Aqueous and Environmental Geochemistry" (to be defined in the first lecture). Some possible topics are listed below, this is not an exhaustive list so be creative.
2) We will chose some of the special topics to cover based on class discussion. These topics will be the basis of some additional lectures/discussion at the end of the semester.
3) Early in the semester you will select a specific research topic that fits within one of the general special topic areas (ie if the general topic is As, Sb, and Se geochemistry, you might decide to choose Se as your specific research topic).
4) Each student will generate an outline and annotated bibliography (and database of research papers) for their research paper, ie a list of primary and secondary materials that will be the basis of your research paper. This will be due a few weeks into the semester – you should be working on this project throughout the semester.
5) You will also be asked to provide some reading material for the class to support the general topic lecture(s) to be presented by the instructor.
6) Towards the end of the semester the instructor will present the lectures on the general topic areas of special interest.
7) Each student will generate their own written research report on their specific topic. And based on this report prepare an in-class presentation.

Note: Your report and in-class presentation should be more in-depth than a typical literature review paper. I am looking for some in-depth analysis of a topic, (VERY) critical review of papers (e.g. some follow on analysis of published data) and possibly even some original research. Use this as a way to explore some new ideas.

Some possible topics:

- Acid rock drainage, sulfide weathering and microbial weathering
    - Fe, S, O
    - Specific sites / projects / assemblage or deposit type…
- Low temperature geochemistry of specific systems / element groups, systematics, thermodynamics and uses as proxies for processes in soils, sediments and weathering. Local/regional sources associated with mineral deposits, transport, supergene processes etc…
    - As, Sb, Se, Te
    - Pb, Zn, Cu
    - U,V,Mo, W
    - Hg, Cd,
    - Rare earths
    - Zr, Ti
- Soil development / processes
    - Arctic and Boreal soils
    - Weathering and solute / colloid delivery to Arctic and Interior Rivers

    - Influence of fire / disturbance
- Chemistry of extreme and extraterrestrial environments
    - Hydrothermal systems
    - Sea ice chemistry
    - Mars surface chemistry
- Microbial and sediment geochemistry
    - Biomineralization and weathering
    - Marine sediments
- Organic matter
    - Characterization and processing: terrestrial (Arctic, Boreal) and/or marine
    - Ion exchange and complexation
    - Chelators and controls on trace element chemistry
- CO2 sequestration
    - Carbonation of mafic and ultramafic rocks (abiotic and biotic processes)
    - Solubility of supercritical CO2 in saline brines (ie reservoir storage)