Aqueous Geochemistry

Course Number: EPS S201
Instructor: Edward W. Bolton, Senior Research Scientist, KGL-323
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Distributional Designations
This course can be applied towards the following Yale College distributional requirements:
- Sciences

2021 Summer Session B (July 12-August 13) Online course
3 days/week, (MWF 1pm-3:15pm), 5 weeks
Office hours, TBA and by email request

Course description and audience:
An introductory course in aqueous geochemistry for science students interested in fresh and ocean water chemistry, water-rock interaction, and weathering of minerals in the surface environment. Topics in pH control, carbonate chemistry, and redox reactions in natural waters will also be discussed. Both equilibrium and kinetic processes will be considered.

Prerequisites:
Calculus and Introductory Chemistry, or permission of the instructor.

Textbook:
J. I. Drever, The Geochemistry of Natural Waters
1988, 2nd Edition

Additional material will draw from: William M. White: Geochemistry (2013, 2020), Garrels and Christ, Solutions, Minerals, and Equilibria (1990), and other books by Drever. Although Drever has earlier and more recent texts related to this topic, the 2nd edition conforms most closely to the scope of this course.

Topics per class period:
15 class periods of 2.25 hours
Class number (C#) and Drever (1988) chapter numbers (D#):

C1: D1. The hydrologic cycle
C2: D2. Chemical Background: (equilibrium, activity-concentration relationships)
C3: D3. Organic compounds in natural waters
C4: D4. The carbonate system and pH control
C5: D7. Kinetics
C6: D8. Weathering and water chemistry 1. Principles
C7: D9. Weathering and water chemistry 2. Examples
C8: **Midterm Exam** and overview of remaining topics
C9: D10. Acid deposition and surface water chemistry
C10: D11. Evaporation and saline waters

C11: D12. The Oceans
C12: D13. Redox equilibria
C13: D14. Redox conditions in natural waters.
C14: D16. Mathematical and numerical models
C15: **Final exam** and discussion of environmental topics

Grading:

60% Homework (5 weekly problem sets, primarily aimed at qualitative understanding)
15% Midterm
20% Final
5% Participation

The scope of homework assignments and exam questions:

Assignments and exams will include qualitative and primarily quantitative reasoning via problem solving. Examples will include the calculation of solution compositions in equilibrium with various minerals, the rates of reactions calculated from kinetic data based on the deviation from equilibrium, the pH of various carbonate solutions, estimation of residence times of elements in the ocean, and evaluation of which processes dominate in different aqueous settings.

Policy for late homework:

30% off for 1 day late
50% off for 2 days late
100% for more than 2 days late.
(Special circumstances may be accommodated)

Academic Integrity:
You must document all your source material. You must also cite any sources from which you obtain numbers, ideas, or other information. If you have any questions about what does or does not constitute plagiarism, ask! Plagiarism is a serious offense and will not be treated lightly. Plagiarism could result in a failing grade. Fortunately, plagiarism is also easy to avoid and if you are the least bit careful about giving credit where credit is due you should not run into any problems. Please be sure to review Yale's Academic Integrity Policy.
(https://poorvucenter.yale.edu/writing/using-sources/understanding-and-avoiding-plagiarism)

Accommodations for students with disabilities:
Early planning is critical to successful accommodations. If you are a student with a disability, contacting Student Accessibility Services is a required first step in the process of obtaining disability-related accommodations. Students are encouraged to register with Student Accessibility Services to verify their eligibility for appropriate accommodations.
(https://advising.yalecollege.yale.edu/student-accessibility-services)