

Spring 2021 | GEOL 1090 | Geochemistry

Professor: Ryan Kerrigan

Office: Krebs 227A

E-mail: kerrigan@pitt.edu

Class time: Monday, Wednesday, and Friday, 11:00 AM-11:50 AM

Office Hours: Thurs. 9-11 or by appointment

Office Phone: (814) 269-2942

Class Room: Krebs 220

Welcome to Geochemistry!

Geochemistry is an interdisciplinary subject that explores the common ground between the more traditional subject of chemistry and geology. In this context, the purpose of this course is to examine the chemistry of natural waters (both surface and subsurface), radiogenic isotopes, and trace element partitioning through the application of thermodynamic and kinetic models of geologic environments at low to moderate temperatures. The basic objective is to gain a more broad understanding of how chemical reactions control geologic processes.

Goals and Outcomes

By the end of this course, students will have:

- An understanding of basic thermodynamic and kinetic principles with respect to geochemical systems.
- An introductory knowledge of radiogenic and stable isotope systematics
- An understanding of trace element behavior in a wide range of geologic systems.
- An ability to determine fate-and-transport of various chemicals, especially common pollutants

COURSE RESOURCES AND RULES

Text (required): Introduction to Geochemistry, 2012, Misra, K.C., Wiley Publishing Company, p. 438. You can find this online for as low as \$60, however, new copies run about ~\$75 on Amazon. Additionally, I have asked the library to have a copy on reserve. You will complete assignments using it and I will refer to its contents in lecture frequently.

Web-material: Most (not all) class materials (schedule, power points, problem sets, study guides, etc.) will be posted on CourseWeb for your convenience.

Electronics: Electronics are PROHIBITED in lectures; no computers, ipads, phones, music players, beepers, pagers, watches, etc. Please turn them off and put them away. Please do not make me have to remind you.

Clean-up: Please don't make a mess, but if you choose to make a mess, please clean up after yourself.

Safety: Use your brain, do not do anything that would endanger yourself or your classmates.

Special Needs Students: Students with documented disabilities who need course adaptations or accommodations, have emergency medical information to share with me, or require special arrangements for building evacuation, should contact me after class within the first two weeks of class. I'm here to help.

Academic Integrity: Although there will be opportunities for group work in this course, all students are responsible for understanding the material and should indicate with whom they collaborated on any assignment. Group work does not mean that one person does all the work and everyone else puts their name on it...this is considered cheating. Students **should not:** claim other's ideas as their own, turn in other's work as their own, copy sources without proper citation (plagiarism), allow others to take their work or ideas, or pass off past projects as original work. If you have questions about academic honesty, see the instructor or refer to the document "Academic Integrity at the University of Pittsburgh at Johnstown." (<http://www.upj.pitt.edu/en/academics/academic-affairs/academic-advising/academic-integrity/>). Anyone found to be in violation of the Pitt-Johnstown standards for academic integrity will fail the course. We will cover scientific ethics in this course, until then use your brain.

Special Needs Students: If you have a disability for which you are, or may be, requesting an accommodation, you are encouraged to contact both the instructor and the Office of Health and Wellness (G-10 Student Union Building, 814-269-7119) to schedule an appointment as early as possible in the term. The Office of Health and Wellness will verify your disability and determine reasonable accommodations for this course.

Late Work: Any work not received by the due date and time will have points deducted, except when pre-excused by the instructor (which will require documentation). Up to 10% of the total possible points will be deducted each day late (this includes weekends and holidays). No work will be accepted after the last day of classes.

Outside Resources: Perhaps there are questions that I cannot answer, or issues you feel you cannot discuss with me, UPJ has outlets these issues. Kathy Mislér, the division administrative assistant, is a wealth of knowledge about random stuff. If you have a problem me or a problem you don't feel comfortable talking to me about please see: Chris Coughenour, the Senior Geology Professor and Steve Stern, the Natural Science Division Chair; they are my bosses.

EVALUATION

1. Problem Sets:

Problem sets will be distributed biweekly, they will be handed out on Mondays and will be collected the following two weeks later unless otherwise specified. The problem sets will be a combination of calculations, short answer, essay, or summaries of assigned reading. Problem sets will heavily reinforce topics discussed and covered in class so attendance to class will be imperative. If for some reason you are unable to attend class please contact your classmates for the missed material. The problem sets will be worth 30% of your total grade.

2. Exams:

There will be three unit exams during the semester (including the final). The tentative dates of these exams are shown on the Course Schedule found below. The exams will be a combination of short answer/drawings/labeling/calculations/etc. The exams will comprise 50% of your total grade. The first two exams will be 15% each of your total grade. The final exam will be held **DATE AND TIME in Krebs B52** and will be a cumulative exam worth 20% of your total grade.

Exams will emphasize material presented in lecture; however, students will also be tested on material contained in the readings. Exams will not just test your factual knowledge of the material; students will also be expected to *apply* your knowledge and understanding of the course material. In this regard, it is of prime importance to understand geologic concepts, more than just "facts." Some memorization will be necessary,

but is considered of secondary importance. Exams are closed-book. There are no make-up exams. If you know you will be missing an exam, see me and we may be able to arrange to have you take the exam early.

3. Research Paper and Presentation:

Students will be asked to complete a semester-long research project that will culminate in the presentation of the independent investigation. Students will be asked to report on the geology of a Pennsylvania State Park. At the beginning of the semester, you will be given supplemental material related to this project including a listing of Pennsylvania State Parks. The State Parks will be presented as one per student (i.e., multiple students cannot report on the same State Park. A separate sheet will be distributed discussing expectations, timelines, formats, and potential topics.

4. Field Trips:

There will be one field trip associated with this course. I am still finalizing the details of the trip but it is expected that all students will attend. There will be a short assignment connected with the field trip. I will discuss everyone's schedule the first week of class and determine if people have conflicts. It is your responsibility to alert me of any conflicts within the first month of class. I need to be made aware of any conflicts you have within the first month of class and a make-up project will be assigned. If you do not make me aware of any conflicts it will be assumed you can attend and you will forfeit any chance at a make-up assignment.

ASSESSMENT

- 30% Problem Sets
- 50% Exams (first two exams will be 15% each and the cumulative final will be 20%)
- 15% Research Paper and Presentation
- 5% Field Trips
- Standard grade cut-off apply (100-96.6 =A+, 96.6-93.3=A, 93.3-90=A-, etc)

Makeups: NO MAKEUPS.

Incompletes: NO INCOMPLETES.

Extra Credit: NO EXTRA CREDIT.

TENTATIVE CLASS SCHEDULE

Course Schedule			
Week	Monday	Wednesday	Friday
1	<i>Introduction to Geochemistry</i> Chapt. 1 (1-6)	<i>Introduction to Geochemistry</i> Chapt. 1 (1-6)	<i>Atomic Structure: Principles</i> Chapt. 2 (7-22)
2	Problem Set #1 Due <i>Atomic Structure</i> <i>Chemical Behavior</i> Chapt. 2 (7-22)	<i>Chemical Bonding: Ionic & Covalent</i> Chapt. 3 (23-48)	<i>Chemical Bonding: Metallic, Hydrogen, & VdW</i> Chapt. 3 (23-48)
3	<i>Basic Thermodynamic Concepts: Chemical Equilibrium</i> Chapt. 4 (49-78)	<i>Basic Thermodynamic Concepts: Laws</i> Chapt. 4 (49-78)	<i>Basic Thermodynamic Concepts: Thermodynamic functions</i> Chapt. 4 (49-78)
4	Problem Set #2 Due <i>Basic Thermodynamic Concepts: Computation</i> Chapt. 4 (49-78)	<i>Thermodynamics of Solutions: Chemical Potential</i> Chapt. 5 (79-106)	<i>Thermodynamics of Solutions: Ideal Gases</i> Chapt. 5 (79-106)
5	<i>Thermodynamics of Solutions: Mixing Laws</i> Chapt. 5 (79-106)	<i>Geothermometry & Geobarometry: Basic thermo & barometric tools</i> Chapt. 6 (107-133)	<i>Geothermometry & Geobarometry: Univariant systems</i> Chapt. 6 (107-133)
6	Problem Set #3 Due <i>Geothermometry & Geobarometry: Exchange Reactions</i> Chapt. 6 (107-133)	<i>Geothermometry & Geobarometry: Uncertainties</i> Chapt. 6 (107-133)	EXAM I
7	<i>Reactions Involving Aqueous Sol: Activity</i> Chapt. 7 (134-166)	<i>Reactions Involving Aqueous Sol: Solubility</i> Chapt. 7 (134-166)	<i>Reactions Involving Aqueous Sol: Dissolution & Precipitation</i> Chapt. 7 (134-166)
8	Problem Set #4 Due <i>Oxidation-Reduction Reactions: Voltaic Cells</i> Chapt. 8 (167-196)	<i>Oxidation-Reduction Reactions: Oxidation Potential (Eh)</i> Chapt. 8 (167-196)	<i>Oxidation-Reduction Reactions: Oxygen Fugacity</i> Chapt. 8 (167-196)

Course Schedule

Week	Monday	Wednesday	Friday
9	<i>Kinetics of Chemical Reactions: Basic Principles Chapt. 9 (197-222)</i>	<i>Kinetics of Chemical Reactions: Temperature dependence Chapt. 9 (197-222)</i>	<i>Kinetics of Chemical Reactions: Catalysts & Diffusion Chapt. 9 (197-222)</i>
10	Problem Set #5 Due <i>Radiogenic Isotopes: Radioactive Decay Chapt. 10 (225-252)</i>	<i>Radiogenic Isotopes: Radiometric Geochronology Chapt. 10 (225-252)</i>	EXAM II
11	<i>Radiogenic Isotopes: U-Th Systematics Chapt. 10 (225-252)</i>	<i>Radiogenic Isotopes: Ratios as Petrogenetic Indicators Chapt. 10 (225-252)</i>	<i>Stable Isotopes: Isotope Fractionation Chapt. 11 (253-280)</i>
12	Problem Set #6 Due <i>Stable Isotopes: Stable Isotope Geothermometry Chapt. 11 (253-280)</i>	<i>Stable Isotopes: Evaporation and Condensation Chapt. 11 (253-280)</i>	<i>Stable Isotopes: Sulfur and Iron systems Chapt. 11 (253-280)</i>
13	<i>The Core-Mantle-Crust System: Evolution of the Earth Chapt. 12 (281-325)</i>	<i>The Core-Mantle-Crust System: Generation of Magma Chapt. 12 (281-325)</i>	<i>The Core-Mantle-Crust System: Petrogenetic Indicators Chapt. 12 (281-325)</i>
14	Problem Set #7 Due <i>The Core-Hydro-Atmos System: Evolution of the Earth's Atmos. Chapt. 13 (326-371)</i>	<i>The Core-Hydro-Atmos System: Pollution Effects Chapt. 13 (326-371)</i>	<i>The Core-Hydro-Atmos System: Hydrosphere over time Chapt. 13 (326-371)</i>
15	Research Paper Presentations	Research Paper Presentations	Research Paper Presentations
16	Day Date Time FINAL EXAM		