

Geology 4/527
Water Geochemistry
Fall Quarter

Professor: Dina L. López

210 Clippinger Laboratories

Phone: 593-9435

e-mail:lopezd@ohiou.edu

Office Hours:

Class:

Lab:

Course Outline

Week	Lecture	Laboratory
1	1. Introduction to water chemistry 1.1 Water systems 1.2 Water geochemical data 1.2.1 Concentration units 1.2.2 Major constituents 1.2.3 Presentation of chemical data 1.2.4 Standards for drinking water 1.3 The Hydrologic Cycle 1.3.1 Composition of rain water 1.3.2 Non-meteoric types of water	Chemical calculations
2	1.3 The Hydrologic Cycle 1.3.1 Composition of rain water 1.3.2 Non-meteoric types of water 2. Equilibrium Thermodynamics 2.1 Equilibrium and free energy 2.2 Activity and fugacity coefficients 2.3 Equilibrium constant 2.4 Activity-concentration relationships	Equipment calibration and maintenance Saturday Sept. 17, field work: Water sampling methods
3	2.5 Effects of P and T on equilibrium 2.6 Solution of equilibrium problems 2.6.1 Solubility of minerals 2.6.2 Complexes 2.6.3 Saturation states 2.7 Computer programs for equilibrium calculations	Equilibrium calculations using a computer program: Chemical speciation
4	3. The carbonate system 3.1 Carbonic acid system 3.2 Carbonate equilibria 3.2.1 CO ₂ species in water	Mid-term exam I

5	<p>3.2.2 CO₂ species in soils</p> <p>3.3 Calcium carbonate solubility</p> <p>3.4 Other carbonate minerals</p> <p>3.5 Carbonate chemistry in the oceans</p>	Analytical methods in water geochemistry: spectrophotometers, Determination of anions
6	<p>4. Ion exchange and sorption</p> <p>4.1 Adsorption, absorption and ion exchange</p> <p>4.2 Mineralogy and composition of clay minerals</p> <p>4.3 Diffusion</p> <p>4.4 Colloid properties and membrane filtration</p> <p>4.5 Ion exchange</p> <p>4.6 Retardation of pollutant cations in groundwater</p>	Analytical methods in water geochemistry: spectrophotometers Determination of cations I
7	<p>5. Mineral Equilibrium</p> <p>5.1 Mineral stability</p> <p>5.2 Congruent solution</p> <p>5.3 Incongruent solution and stability diagrams</p>	Determination of cations II
8	<p>6. Kinetics of geochemical processes</p> <p>6.1 Kinetics and equilibrium</p> <p>6.2 Chemical reactions and rate laws</p> <p>6.3 Crystal formation</p> <p>6.4 Dissolution and crystal growth</p> <p>6.5 Surface reaction mechanisms</p>	Mid-term exam II
9	<p>7. Silicate weathering</p> <p>7.1 Weathering processes and soil formation</p> <p>7.2 The mass balance approach</p> <p>7.3 Kinetics of silicate weathering</p>	Equilibrium calculations using a computer program: water mixing
10	<p>8. Redox processes</p> <p>8.1 Basic theory</p> <p>8.2 The standard hydrogen electrode</p> <p>8.3 Definition of pe and Eh</p> <p>8.4 Stability of dissolved species and gases</p> <p>8.5 Redox diagrams</p> <p>8.7 Sequences of redox reactions and redox zoning</p>	Class presentation of term project.
	Final Exam, comprehensive	

Course Administration

Homework (quantitative and analytical exercises) will be assigned every week or two and must be turned in on time. A lab report is required after each laboratory session.

Two mid-quarter exams and one final assignment will be given. The three activities are equally weighted. 60% of the final assignment will cover the last 2 weeks of class and 40% will cover the first eight weeks.

Graduate students will be assigned an additional term paper. The topic for the paper will be chosen by the student from a list given by the instructor. For the grading of homeworks and tests, graduate students will be required a higher level of understanding and problem solution's skills.

Grading:

Mid-quarter exam I	20%
Mid-quarter exam II	20%
Final assignment	20%
Laboratory exercises	20%
Homework	<u>20%</u>
Total1	100%

For undergraduate students, the final grade will be given by Total1. For graduate students, the previous activities (Total1) will be 80% of the final grade and the term paper will be 20%. Letter grades will be assigned at the end of the quarter according to the statistical distribution of total points.

Student Regulations

Refer to the Undergraduate and Graduate Catalogs for regulations regarding absences from class and academic dishonesty.

Textbook

Eby, Nelson G., Principles of Environmental Geochemistry, Thomson, Brooks/Cole, 2004, 514 pp.

Reference books:

Drever, James I., The Geochemistry of Natural Waters, 3rd. Edition, Prentice-Hall, Inc. 1997, 436 pp.

Stumm and Morgan, Aquatic Chemistry, John Wiley and Sons, 1996, 1022 pp.

Class notes, handouts, and papers throughout the quarter.