GEOL 5317 Aqueous Geochemistry
Fall 2016
Office hours MW 10-11, TR 8:30 – 9:30

Instructor: Dr. Urbanczyk
Office: WSB 320

Course Description: This course is designed to introduce the student to the application of chemical principles to low-temperature aqueous systems. We will explore topics varying from basic thermodynamics to the controls on surface and ground water composition.

Expected Learning Outcomes: Upon completion of this course, students will apply critical reasoning and problem solving skills to:

- Understand the hydrologic cycle
- Understand carbonate equilibria and controls on pH
- Understand stoichiometry and thermodynamics as they apply to basic mineral-water reactions
- Predict the effects on water solute concentrations of the naturally occurring processes of cation exchange, adsorption, variations in oxidation state, phase changes, bedrock weathering, interaction with organic materials, interactions with soil solutions, mixing, evapotranspiration, and acid deposition
- Understand chemical analysis and analytical techniques in both a field and a laboratory environment
- Manipulate chemical analyses via spreadsheet techniques and be able to assess data quality and to model chemical evolution
- Understand the characteristics of natural waters in the Trans Pecos region and relate the chemistry to processes listed above
- Predict the evolution of water based upon a chemical analysis

Assessment: Student progress will be tracked on the basis of two Midterm Exams, One Final exam, one term paper, and several homework assignments. The exams will assess the application of critical reasoning and problem solving skills through short answer, multiple choice, chemical/algebraic problem, and essay questions. The graded exams will be reviewed by discussing the logic of the answers to and content of the questions. The term paper will require individual research on a specific topic related to the course content. Graded homework will assess student problem solving skills in applying, describing, and explaining the characteristics and geochemical evolution of natural waters and will include lab-type out of class projects.

Grades will be posted on Blackboard. The semester grade will be based upon:
Homework/Lab/Field projects 40%, Term Paper 15%, 3 Exams 45%

The research paper will cover a topic related to aqueous geochemistry, and will consist of a minimum of 10 pages text (12 point font, 1 inch margins). All figures and the reference list (at least 15 references required, all from peer reviewed journals) will be on additional pages. A class presentation will be required.

Method of Instruction: The class meets on Tuesday and Thursday for one hour and 15 minutes. Outside reading, project work and homework will be required.

Class Attendance Policy: Attendance is required. Exams and exercises cannot be made up at a later time unless prior arrangements have been made. Late homework will be deducted 10 points for each day the homework is late.

Text:

Drever, J., 1997. The Geochemistry of Natural Waters, Prentice Hall, 437 pp

Optional texts:

Geochemistry, groundwater and pollution, Appelo and Postma, 2nd edition, CRC Press

Garrels, R. M. and Christ, C. L., 1965. Solutions, Minerals, and Equilibria, Freeman Cooper, 450 pp.

Langmuir, D., 1997. Aqueous Environmental Geochemistry, Prentice Hall, 600 pp.

Richardson, S.M., and McSween, H. Y. Jr., 1989. Geochemistry Pathways and Processes, Prentice Hall, 488 pp.

Examples of lab and project related work:

Field equipment review. Class will meet in the 1st floor lab for a review of the YSI 556 multiprobe. Students need to review the TCEQ SWQM Volume 1 Chapters 1-3, 5, 6 and 8

Class will meet in the 1st floor lab for departure for the "Clean Rivers" program sampling at Kokernot Spring; review same material as above

Alkalinity titration lab exercise; review provided alkalinity literature

Field trip (s) to collect data on hydrology and water chemistry

Homework / Project examples:

1. Provide a summary of the field sampling project at Kokernot springs. Include a discussion of the instrument calibration, field parameters determined, samples collected, and shipping details (including copies of all forms required).
2. Learn PHREEQC: an exercise will be provided to teach the basic functions of the PHREEQC
3. Alkalinity titration summary: provide a summary of the lab alkalinity titration including all pertinent calculations for converting ANC to mg/L HCO3 and CO2
4. Data mining: pick a Texas aquifer and compile a data summary of the water chemistry in that aquifer. Limit the number of samples to no more than 30, make sure that they are similar to each other (not just a random group of samples), assess quality of analysis, make stiff and piper diagrams, make graph of EC to TDS, make graph of field EC and calculated EC, write summary of all
5. Dionex chromatography review: attend demonstration of Dionex instrument, analyze a sample and discuss results
6. Varion Atomic Absorption review: attend demonstration of Varion AA instrument, analyze a sample and discuss results
7. Clean rivers data report and interpretation: use the data returned from the Clean Rivers lab from the Kokernot Spring sample and assess the quality of the analysis and discuss the details of the water chemistry

week	date 2016	Topic	Lecture Reading - Drever	
1	23-Aug	Introduction, Hydrologic cycle	1	
	25-Aug	Chemistry review	2	
2	30-Aug	Chemistry review, start carbonate equilibria	2, 3	
	1-Sep	Carbonate equilibria, PHREEQC review	3	
3	6-Sep	Carbonate equilibria	3	
	8-Sep	Alkalinity, titration curves, lab exercise	3	
4	13-Sep	Clay minerals and cation exchange	4	
	15-Sep	Clay minerals and cation exchange	4	
5	20-Sep	Adsorption	5	
	22-Sep	Adsorption	5	
6	27-Sep	Organic compounds	6	KMU at GSA
	29-Sep	Redox equilibria	7	Boq?
7	4-Oct	Redox equilibria	7	Boq?
	6-Oct	Redox in natural waters	8	Thanksgiving break (W-F)
8	11-Oct	Redox in natural waters	8	
	13-Oct	Heavy metals	9	
9	18-Oct	Silicate equilibria	10	KMU in Boquillas Cyn
	20-Oct	kinetics	11	KMU in Boquillas Cyn
10	25-Oct	kinetics	11	
	27-Oct	weathering and water chemistry	12	
11	1-Nov	weathering and water chemistry	12	
	3-Nov	Isotopes	14	
12	8-Nov	Isotopes	14	
	10-Nov	Evaporation	15	
13	15-Nov	Literature		
	17-Nov	Literature		
14	22-Nov	Literature		
	24-Nov	Presentation		
15	29-Nov	Presentation		
	5-Dec	Final Exam 10:15-12:15		

The final grade scheme is based upon the standard 90-100 = A, 80-90 = B, 70-80 = C, 60-70 = D, and <60 = F.

Conduct: Students are expected to observe the University's Code of Student Conduct (see Student Handbook). **Please turn OFF all cellular phones, IPODs, MP3s, etc.**

Disability: "It is Sul Ross State University policy to provide reasonable accommodation to students with disabilities. If you would like to request such accommodations because of a physical, mental, or learning disability, please contact the Disabilities Services Coordinator in Ferguson Hall, Room 112, or call (432) 837-8203."