

GEOL 5317 Aqueous Geochemistry

Fall 2022

Office Hours: MW 8:30-10, TR 8:30-9:30, T 1:30-2:30 and by appointment

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, 2<sup>nd</sup> 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. Review of the YSI 556 multiprobe. Students need to review the TCEQ SWQM Volume 1 Chapters 1-3, 5, 6 and 8

Alkalinity titration lab exercise; review provided via 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 a local site. 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 HCO<sub>3</sub> and CO<sub>2</sub>
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. 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

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.**

week	date	Topic	Lecture Reading -
1	8/23	Introduction, Hydrologic cycle	1
2	8/25	Chemistry review	2
	8/30	Chemistry review, start carbonate equilibria	2, 3
3	9/1	Carbonate equilibria, PHREEQC review	3
	9/6	Carbonate equilibria	3
4	9/8	Alkalinity, titration curves, lab exercise	3
	9/13	Clay minerals and cation exchange	4
5	9/15	Exam 1	4
	9/20	Adsorption	5
6	9/22	Adsorption	5
	9/27	Organic compounds	6
7	9/29	Redox equilibria	7
	10/4	Redox equilibria	7
8	10/6	Redox in natural waters	8
	10/11	Redox in natural waters	8
9	10/13	Heavy metals	9
	10/18	Silicate equilibria	10
10	10/20	Kinetics	11
	10/25	Kinetics	11
11	10/27	weathering and water chemistry	12
	11/1	Exam 2	12
12	11/3	Isotopes	14
	11/8	Isotopes	14
13	11/10	Evaporation	15
	11/15	Literature	
14	11/17	Literature	
	11/22	Literature	
	11/23	<b>Thanksgiving</b>	
15	11/29	Presentation	
	12/5	Final Exam Monday 10:15 AM	

Americans with Disabilities Act: Sul Ross State University is committed to equal access in compliance with the Americans with Disabilities Act of 1973. It is the student's responsibility to initiate a request for accessibility services. Students seeking accessibility services must contact Mary Schwartz, M. Ed., L.P.C., in Counseling and Accessibility Services, Ferguson Hall, Room 112. The mailing address is P.O. Box C-122, Sul Ross State University, Alpine, Texas 79832. Telephone: 432-837-8203 8691. E-mail: [mschwartz@sulross.edu](mailto:mschwartz@sulross.edu)

**ADA Statement**

SRSU Disability Services. Sul Ross State University (SRSU) is committed to equal access in compliance with Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. Alpine Students seeking accessibility/accommodations services must contact Rebecca Greathouse Wren, LPC-S, SRSU's Accessibility Services Coordinator at 432-837-8203 (please leave a message and we'll get back to you as soon as we can during working hours), or email [mschwartz@sulross.edu](mailto:mschwartz@sulross.edu). Our office is located on the first floor of Ferguson Hall (Suite 112), and our mailing address is P.O. Box C122, SUI Ross State University, Alpine. Texas, 79832.

**Library Information**

The Bryan Wildenthal Memorial Library in Alpine offers FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library's website, [library.sulross.edu](http://library.sulross.edu). Off-campus access requires logging in with your LoboID and password. Librarians are a tremendous resource for your coursework and can be reached in person, by email ([srsulibrary@sulross.edu](mailto:srsulibrary@sulross.edu)), or phone (432-837-8123).

**SRSU Distance Education Statement**

Students enrolled in distance education courses have equal access to the university's academic support services, such as library resources, online databases, and instructional technology support. For more information about accessing these resources, visit the SRSU website. Students should correspond using Sul Ross email accounts and submit online assignments through Blackboard, which requires secure login. Students enrolled in distance education courses at Sul Ross are expected to adhere to all policies pertaining to academic honesty and appropriate student conduct, as described in the student handbook. Students in web-based courses must maintain appropriate equipment and software, according to the needs and requirements of the course, as outlined on the SRSU website. Directions for filing a student complaint are located in the student handbook.

**Academic Integrity**

Students in this class are expected to demonstrate scholarly behavior and academic honesty in the use of intellectual property. A scholar is expected to be punctual, prepared, and focused; meaningful and pertinent participation is appreciated. Examples of academic dishonesty include but are not limited to: Turning in work as original that was used in whole or part for another course and/or professor; turning in another person's work as one's own; copying from professional works or internet sites without citation; collaborating on a course assignment, examination, or quiz when collaboration is forbidden.

**Classroom Climate of Respect**

Importantly, this class will foster free expression, critical investigation, and the open discussion of ideas. This means that all of us must help create and sustain an atmosphere of tolerance, civility, and respect for the viewpoints of others. Similarly, we must all learn how to probe, oppose and disagree without resorting to tactics of intimidation, harassment, or personal attack. No one is entitled to harass, belittle, or discriminate against another on the basis of race, religion, ethnicity, age, gender, national origin, or sexual preference. Still we will not be silenced by the difficulty of fruitfully discussing politically sensitive issues.

**Diversity Statement**

I aim to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, socioeconomic class, age, nationality, etc.). I also understand that the

crisis of COVID, economic disparity, and health concerns, or even unexpected life events could impact the conditions necessary for you to succeed. My commitment is to be there for you and help you meet the learning objectives of this course. I do this to demonstrate my commitment to you and to the mission of Sul Ross State University to create an inclusive environment and care for the whole student as part of the Sul Ross Familia. If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. I want to be a resource for you.