

Light Stable Isotopes in Biogeochemistry

INSTRUCTOR

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MEETING PATTERN & LOCATION

TR 3:00 pm - 4:20 pm Geology Building 302, 3 credits

MS students (GEOL 5315)

PhD students (GEOL 6315)

COURSE DESCRIPTION

Light elements such as hydrogen (H), carbon (C), nitrogen (N), phosphorous (P) and sulfur (S) are essential building blocks for every living organism. For the investigation of how organisms affect our environment, Earth's geologic past or the detection of extraterrestrial life, light stable isotope biogeochemistry is a powerful tool.

In the first part of this course, we will learn the language of isotope biogeochemists, learn basic principles of isotope fractionation, learn how to use mass balances to decipher isotope fingerprints, and gain a basic understanding on how isotope compositions are measured.

In the second part of this course, we will apply our gained knowledge to the study of selected examples of H, C, N, P and S cycling in the environment and develop numerical models to explore biogeochemical processes.

The third and last part of the course is dedicated to an introduction of two novel isotope tools – multiple isotope fractionation and clumped isotopes.

REQUIRED TEXTBOOK

Journal articles and review papers will be discussed throughout the course.

RECOMMENDED READING

Fry B. *Stable Isotope Ecology*. Springer 2006

COURSE OBJECTIVES

- 1) Learn the fundamentals of stable isotope biogeochemistry
- 2) Gain insight into key biogeochemical processes in H, C, N, S, P cycling.
- 3) Learn how to use isotope mass balances to understand processes
- 4) Apply learned concepts to examples of H, C, N, S, P cycling
- 5) Gain insight into multiple isotope fractionation and clumped isotopes

YOUR PARTICIPATION IS ESSENTIAL (SEE GRADES)

Please contact Dr. Brunner about any concerns, schedule conflicts, etc. in advance or otherwise as soon as possible! A significant portion of your grade is based on participation, so any missed classes and assignments must have proper documentation or your grade will drop. Valid excuses include illness, absence with the instructor's prior approval, official University business, etc.

Accommodations are possible for active duty military and others, but arrangements must be made in a timely manner. If you are in the military with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact the instructor as soon as possible.

If you think you may have a disability or if you are experiencing learning difficulties, please contact the Disabled Student Services Office (DSSO) at (915) 747-5148. They are located in Union East room 106 or you can reach them by email at dss@utep.edu. The student is responsible for presenting to the instructor any DSS accommodation letters and instructions.

Important notes:

- 1) During the classes and as homework assignments, there will be various exercises. In class, students who struggle with the exercises will have the opportunity to work with the instructor in a smaller group to overcome specific hurdles. This is by no means meant to single out students who do not reach the goals of the lecture/exercises – it is an attempt to give everybody a fair chance to immediately address the encountered challenges, and to stay on track with the class. Students who take advantage of this opportunity but still encounter difficulties can schedule additional tutoring with Dr. Brunner.
- 2) **Learning in teams** is much more effective than learning alone, and is highly encouraged.
- 3) This is partly a front-loaded class: reading assignments or exercises will precede the corresponding class. This will allow us to address the tricky issues of the topic in class. Doing these assignments before the lecture is the absolute key to the success of this form of teaching and learning.
- 4) **Drop date deadline: November 1, 2019.**
- 5) **Grades:** Exam Part 1 (30%), Participation in discussion (30%), Project presentation and handout (40%)

SCHEDULE OF TOPICS – *subject to change!* – *second part of course intentionally left open!*

Date:	Topic:	Reading / Assignments / Be ready for quiz
Week 1	Part 1. Introduction to light stable isotopes I: from isotope to isotopologue. Evaluation of to-be-selected topics/examples with course participants	
Week 2	Part 1. Introduction to light stable isotopes II: from isotope pools to isotope fractionation. Selection of topics/examples with course participants	Handouts
Week 3	Part 1. Introduction to light stable isotopes III: from mass balance to isotope mass balance, and from isotope fractionation to isotope mixing	Handouts
Week 4	Part 1. Introduction to light stable isotopes III: Expression of isotope effects and reversibility Repetition of part 1, exercises.	Handouts
Week 5	<i>Part 1. Exam, evaluation of part 1 exam</i>	
Week 6	Isotope mass balance exercises (group exercise mixing by diffusion)	tbd
Week 7	Isotope mass balance exercises (Anammox, microbial transformation of gypsum and hydrocarbons into calcium carbonate and sulfide)	tbd

Week 8	Isotope mass balance exercises (Anammox, microbial transformation of gypsum and hydrocarbons into calcium carbonate and sulfide)	tbd
Week 9	<i>Recap Part 1.</i> A tour of what we have done so far	
Week 10	<i>Planning of Part 2 and Part 3</i>	tbd
Week 11	tbd	tbd
Week 12	Clumped isotopes	tbd
Week 13	tbd	tbd
Week 14	tbd	tbd
Week 15	tbd	tbd
Week 16	Class Review	

Assessment of 6315 vs 5315 students: There will be no discrimination for the Part I exam grading or for the participation in discussion (you are all expected to participate and do well on the exam) between 6315 and 5315 students. A higher level of performance is expected for the 6315 students for the project presentation and handout portion of the class.