

Light Stable Isotopes in Biogeochemistry

INSTRUCTOR

Dr. Benjamin Brunner
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MEETING PATTERN & LOCATION

TR 09:00am-10:20am Geology Building 404, 3 credits

Upper level UG student (GEOL 4315, CRN 27221)

MS students (GEOL 5315, CRN 27220)

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.

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

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.

SCHEDULE OF TOPICS – *subject to change!*

Date:	Topic:	Reading
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	Part 2. Biogeochemistry and the classical redox-tower in marine sediments	tbd
Week 7	Part 2. Case-study carbon cycle I: the bicarbonate system (C, O isotopes)	tbd
Week 8	SPRING BREAK	
Week 9	Part 2. Case-study carbon cycle II: methane cycling in marine sediments (H, C, O isotopes)	tbd
Week 10	Part 2. Case-study nitrogen cycle: N-cycling in marine oxygen minimum zones (N, O isotopes)	tbd
Week 11	Part 2. Case-study sulfur cycle I: S-cycling at sediment-water interface in marine upwelling system (S, O isotopes)	tbd
Week 12	Part 2. Case-study sulfur cycle II: S-cycling at sediment-water interface in marine upwelling system (S, O isotopes)	tbd
Week 13	Part 2. Case-study phosphorus cycle: P limitation and the role of enzymes (O isotopes)	tbd
Week 14	<i>Part 2. Student project presentations (Selected topics/examples) Handouts to be prepared by individual presenters</i>	<i>Handouts</i>
Week 15	Part 3. Novel isotope tools: Multiple isotopes (O, S) & Clumped isotopes (i.e. C-O)	tbd
Week 16	Course review	

Grades: Exam Part 1 (30%), Participation in discussion (30%), Project presentation and handout (40%)

Assessment of 4315 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 4315 and 5315 students. A higher level of performance is expected for the 5315 students for the project presentation and handout portion of the class.