

Biogeochemical Applications of traditional and non-traditional stable isotopes to diverse problems in Earth Science

SIOG 269, Spring 2022
Dr. Sarah Aarons & Dr. Anela Choy

Meeting Details	Monday & Wednesday, 2:00 - 3:20 PM. Vaughan Hall 300* *Note that VH atrium gates are locked 24/7, except for the southwest gate (next to VH100). Unless you have VH access, you will need to enter through this gate.
Credits	4
Course Website	https://canvas.ucsd.edu
Grading Mode	Letter grade or S/U
Instructors	Dr. Sarah Aarons - smaarons@ucsd.edu Dr. Anela Choy - anela@ucsd.edu
Office Hours	Available upon request. Coordinate meeting time at least 72 hours in advance.

Course Description: The biogeochemical history of our solar system and planet is recorded in the isotopic variability of elements. This course provides a broad overview of isotope geochemistry across the geosphere, hydrosphere, and biosphere, with an emphasis on marine and surficial terrestrial (e.g., atmospheric, cryospheric) systems. Based on their chemical behavior and affinities, the isotopic compositions of traditional and non-traditional (i.e. heavy) elements provide insights into processes ranging from the formation of Earth to biological uptake of key nutrients. We review the distribution and fractionation of isotopes, analytical methods, and applications of isotopes as tracers of ecological and environmental processes. The course will focus heavily on applications of the multi-collector inductively coupled plasma mass spectrometer, which has emerged as a new technique for measurement of isotopic compositions such as Li, B, Mg, Fe, Hg, and U at high precision. It has been used in applications ranging from dating of the Earth to tracking the oxygenation of the ocean to studying diet as systematic mass-dependent variations can occur with increasing trophic level.

The course is designed to serve students with already-generated (but not yet analyzed and/or interpreted) isotope data which will be workshopped, discussed, and presented in a group setting. The goal is to equip students with the fundamentals of isotope biogeochemistry, provide awareness of a range of applications and potential questions, and challenge students to identify novel research applications for their graduate work within a multidisciplinary setting. This course is appropriate for doctoral or MS students, as well as advanced BS/MS students. BS/MS and MS students should seek instructor approval prior to enrolling.

Course Format

This seminar course will consist of a mixture of lectures (from both instructors), student-led topic or principle and concept highlights (“In your own words and way”), as well as paper discussions and an end of quarter research project. We will also frequently mix in the opportunity to develop and hone “hands-on” practical skills and applications related to the broad field of isotope biogeochemistry in Earth Science. Worksheets will be provided to facilitate these skills.

For the research project, students will work with instructors to identify the analysis, interpretation, and presentation of a discrete isotope dataset relevant to their graduate research. Over the course of the seminar, research projects will be developed into mature and professional AGU/ASLO style posters. *Posters will be presented in a class symposium on the last day of instruction on Wednesday, June 1.* There is a twist, however – To improve your science communication skills and breadth of knowledge, you will be assigned to present ANOTHER student’s research poster at the symposium. Partner assignments will be handed out early in the course, after the instructors have gauged research interests and coalescence. Although each student will produce an individual research project, you should expect to develop your project in collaboration with your assigned partner throughout each stage of the research process. This will facilitate your learning and communication.

Assignments and Grading

Students taking this course to fulfill a program requirement should sign up for a letter grade. Otherwise, the course may be taken as S/U. The grade breakdown is below.

Assignment	Weight	Due Date(s)
4 Worksheets	40% (10% each)	TBD throughout the course
Presentation of papers and Participation in Class Discussions	20%	Throughout the course
Final AGU or ASLO style Poster	20%	Due at Symposium on June 1
Final AGU or ASLO style presentation (6/1)	20%	Present on June 1
	100%	

Grading Scale (Tentative)

A = 90-100% (S) **B** = 80-89% (S) **C** = 70-79% (S) **D** = 60-69% (U) **F** = 59%-below (U)

Course Requirements & Expectations

Lectures. Students are required to attend all class meetings and come well-prepared to participate in discussions and/or class activities. If you are unable to attend a meeting due to a critical research-related activity or sickness/emergency, please let the instructors know in advance and arrange to make up any relevant work.

Synchronous In-Person Instruction. Instruction will be in-person in VH300. A remote (hybrid) Zoom option will be available on days when the instructors are informed that there will be a reasonable need. The Zoom link can be found on Canvas.

Please remember that the COVID-19 pandemic is still ongoing and all students must abide by University rules and procedures, which can be found updated online - <https://returntolearn.ucsd.edu>. Masks are required in instructional settings and you should also be mindful of your travel and exposure before coming to class. In the event that you are sick on the day you present or lead a discussion, alternative arrangements will be made *if possible*. Please let the instructor know as far in advance as possible so that these alternative arrangements can be made. Permission to participate remotely via Zoom will be given on a case by case basis. Attendance in person is critical to make the class successful.

Communication with Instructors. As this is a co-taught seminar course, you should include both instructors on course-related communication. This cuts down repetitive cross-instructor re-communication. Please be mindful with your correspondence. *Canvas is the preferred venue for communication about the course.* You can expect a 48-72 hour response during the work week.

Assigned Readings. There is no formal textbook for this course but the following texts are fantastic and valuable resources, which may be referenced throughout the course for guidance. All are freely available online through UC San Diego Library access, or open publishing on the web.

[Stable Isotope Ecology](#) by Brian Fry, 2006, [Springer](#)

[Principles of Stable Isotope Geochemistry](#) by Zachary Sharp, [Second Edition](#), 2017

[Non-Traditional Stable Isotopes](#) edited by Fang-Zhen Teng, James Watkins and Nicolas Dauphas, from [Reviews in Mineralogy and Geochemistry](#), Vol. 82, 2017

Readings from the primary literature will be assigned in advance of selected meetings. Readings will be announced and posted as available on Canvas. Students are expected to read and digest assigned journal articles *before each lecture*. Given the small class size and inherent nature of graduate seminars (i.e. student-driven and self motivated), all students are expected to play an active role in the discussion of papers and the engagement with course material and will be expected to contribute to community-based learning.

Course Schedule (Tentative)

The course schedule will be updated on [this Google Document](#) and is subject to change(s). As we become acquainted with student interests, the course schedule will develop more readily. Any changes and details will be announced on Canvas.