GEO 376C – Isotope Geology (Fall 2013)
Unique Number 27783
Class: SAC 5.102; MWF 10:00-11:00

Professors:
Rich Ketcham, JGB 3.316E, 471-6942, ketcham@jsg.utexas.edu
Office hours: MF 9:00 am to 10:00 am; or by appointment

Jaime Barnes, JGB 3.320A, 471-5379, jdbarnes@jsg.utexas.edu
Office hours: MF 11:00 am to 12:00 pm; or by appointment

Online course information: https://courses.utexas.edu/webapps/login/ plus your EID

Textbook:
There is no textbook for this course. We will be primarily using papers and lecture notes, which will be distributed on Blackboard, although for many topics we will be able to provide supplementary readings in the resources listed below.

Supplemental Resources:
Isotope Geology by Claude Allègre
Principles of Stable Isotope Geochemistry, by Zachary Sharp
Radiogenic Isotope Geochemistry, by Alan Dickin
Stable Isotope Geochemistry, RIMG v. 43
Stable Isotopes in High Temperature Geological Processes, RIMG v. 16
Geochemistry of Non-Traditional Stable Isotopes, RIMG v. 55
Thermochronology, RIMG v. 58

General:
This course is an introduction to the basic concepts of isotope geology with a focus on high-temperature geochemistry and applications.

Course Schedule:

Week	Date	Topic	Reading	Assignments
1	28-Aug	First day: syllabus, organization, introductions		
	30-Aug	Isotopes and mass spectrometry		
2	2-Sep	*No class- Labor Day*		
	4-Sep	Lab tours- Stable isotope, TIMS		
	6-Sep	Introduction to stable isotopes/Fractionation	Aston (1925)	hand out HW #1
3	9-Sep	Nomenclature and standards		
	11-Sep	Fractionation factors and introduction to thermometry	Epstein et al (1951); Sharp and Kirschner (1994)	
	13-Sep	Hydrosphere (Batch vs. Rayleigh fractionation)		**HW #1 due**
4	16-Sep	Hydrosphere (composition of	Musgrove and Banner (1993)	

		natural waters)		
	18-Sep	Oceans (global variations and buffering)	Muehlenbachs and Clayton (1976)	
	20-Sep	Low-temperature isotope geochemistry	Zachos et al (2001)	hand out HW #2
5	23-Sep	Low-temperature isotope geochemistry		
	25-Sep	The Mantle	Taylor et al (1983); Eiler et al (2000)- Nature	
	27-Sep	**Possible Ken Farley lecture**		**HW #2 due**
6	30-Sep	Igneous rocks	Bindeman and Valley (2000)	
	2-Oct	Metamorphic rocks (devolatilization & fluid-rock interaction)	Yui et al (1995)	
	4-Oct	Metamorphic rocks (thermometry)		hand out HW #3
7	7-Oct	Extraterrestrial Materials (^{17}O anomaly)	Clayton et al. (1973)	**Paper Review 1 Due**
	9-Oct	Extraterrestrial Materials (H, C, N)		
	11-Oct	Other "traditional" isotope systems (C, S, N)		**HW #3 due**
8	14-Oct	Non-traditional isotope systems (Fe, Si, Ca, Cl, Mg, Mo, Li)	Farquhar et al. (2000)	
	16-Oct	Non-traditional isotope systems, cont.		
	18-Oct	Radioactivity and nucleosynthesis	Rutherford (1906)	Hand out HW#4
9	21-Oct	Isotopy and isotope dilution		
	23-Oct	Dating	Strutt (1908, 1909)	
	25-Oct	Decay chains, secular equilibrium, and extinct radioactivity		**HW#4 due**
10	28-Oct	Rich systems; U-Pb, concordia		
	30-Oct	Thermochronology I: Closure T, Diffusion and Noble gases	Dodson (1979); Reiners and Shuster (2009)	Hand out HW #5
	1-Nov	Thermochronology II: FT and thermal histories		
11	4-Nov	Poor systems; Rb-Sr, isochrons, Sm-Nd, Lu-Hf, Re-Os	Kelly et al. (2011)	
	6-Nov	Pb-Pb and U disequilibria; extinct radioactivity; mixing		**HW #5 due**
	8-Nov	Cosmogenics and C-14		**Proposal abstract due**
12	11-Nov	Be-10, exposure ages	Tera et al (1986)	Hand out HW #6
	13-Nov	Calculating and considering uncertainties		**Paper Review 2 Due**
	15-Nov	More uncertainties; interpretation		

13	18-Nov	Geological and cosmic timescales		**HW #6 due**
	20-Nov	Radiogenic geochemistry: Sr and eNd		
	22-Nov	Radiogenic geochemistry: Evolution of continents, mantle		**Proposal due**
14	25-Nov	Rare gases		
	27-Nov	The early Earth	Harrison et al. (2008); Kemp et al. (2010)	
	29-Nov	*No class- Thanksgiving holiday*		
15	2-Dec	Make-up Day/Reading Day		**Peer reviews due**
	4-Dec	Panel meeting		
	6-Dec	Panel meeting		**Revised proposal due**

(September 3rd: Last day of the official add/drop period)

Lecture:

The schedule gives the order of lectures and indicates associated reading assignments (note, the lecture schedule is subject to change as needed throughout the semester, and more reading assignments may be added). Please read the given assignment before coming to class. Many of the readings are "transformative" scientific papers. A short discussion of these papers will occur during class. The day prior to class, you will need to log onto Blackboard and post one comment, question, textbook error, etc. for the reading to be discussed the next day. By doing so, everyone should be prepared to contribute to the discussion.

Grading:

Homework (6 assignments at 5% each) = 30%
Paper summaries (2 (one radiogenic and one stable) at 10% each) = 20%
Research abstract, proposal and reviews = 35%
Participation = 15%

There are two **summaries** of papers from the peer-reviewed literature, one on a stable radiogenic paper and one on a stable isotope paper. You will be given the paper. Each summary is two pages, double-spaced. Summarize the important findings of the paper, and describe the isotope geology concepts and procedures used to both obtain and interpret the data. Paper summaries may be re-submitted after revision for re-grading, if desired.

Each of you will submit an **NSF-style proposal, including budget** (single spaced, 10-15 pages including figures but not including references or budget) on the Friday before Thanksgiving. The proposal must apply either radiogenic or stable isotope techniques (or both!) to your proposed research, and demonstrate mastery of isotope geology concepts. If you are working on an honors or other research thesis, you may use this work as part of your proposal; in any event, we hope that the proposal will be linked to your research interests. During the final week of class we will have a panel meeting to decide which proposals to "fund." You will need to provide an in-depth **peer review** of some of your colleagues' proposals (proposals to review will be assigned before the Thanksgiving break). Reviews of assigned proposals are due by email the following Monday (Dec. 2). Before the panel meeting, read the

peer reviews (posted anonymously) and familiarize yourself with those proposals that you did not peer-review.
After you have received your peer reviews, as well as feedback from the course instructors (the "program directors"), you must **revise** your proposal, taking these critiques into account. The revised proposal is due on the final day of classes, and this is the version that will contribute to your final grade.

The **proposal abstract** is to provide a concise (~1 page, or less) statement of the research problem around which you will be developing your proposal. It should include a statement of the scientific problem you are addressing, and what you intend to do about it; it should be sufficiently complete that nothing in your final proposal will surprise us. The abstract is primarily intended to ensure that your research proposal will be reasonable and aligned with class instructional objectives. The proposal abstract may be re-submitted after revision for re-grading, if desired.

Participation includes attendance, class participation, and participation in online Blackboard discussions.

Blackboard:

We will use Blackboard (https://courses.utexas.edu/webapps/login/ plus your EID) to post course materials (including reading assignments) and for online discussions. You can find support in using Blackboard at the ITS Help Desk at 475-9400, Monday through Friday, 8 a.m. to 6 p.m., so plan accordingly. Check your Blackboard and email regularly for class updates. Email is recognized as an official mode of university correspondence; therefore, you are responsible for reading your email for university and course-related information and announcements.

Special Needs:

The University of Texas is committed to helping students with special physical or learning needs. Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities (SSD) at (512) 471-6259 (voice) or 1-866-329-3986 (video phone). Students with special needs should contact one of us as soon as possible to ensure that your needs are met in a timely manner.

The University of Texas Honor Code: "The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community."

Students are expected to read and to strictly adhere to the University's Honor Code and written policies on academic dishonesty. Cheating or plagiarism will not be tolerated. Any student caught violating University policy will be referred to the Dean of Student Affairs for disciplinary action. *All written work must be in your own words!*