GEOL595GC: Principles and Applications of Geochronology SPRING 2013

Meeting time and place: LO1221

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Office Hours: T&Th 2-3 pm, *or by appointment*

COURSE DESCRIPTION:

This course is designed to teach you the basics of mass spectrometry and radiometric dating and to give you the tools necessary to incorporate geochronologic methods into potential research projects. We will discuss a variety of isotopic systems (U-Pb, Sm-Nd, Rb-Sr, Ar-Ar, (U-Th)/He, fission track), and how those systems are used to investigate the age of the Earth, the evolution of the crust and mantle, the growth and exhumation of orogens, petrogenesis of basalts and granites, and a number of other topics.

COURSE OBJECTIVES:

1) To understand the fundamental principles behind nuclear decay and radioisotopic dating systems.
2) To understand how, in practice, absolute ages of geologic materials, or the timing of geologic events, are determined (using geochemical preparation and mass spectrometry).
3) To understand how particular radiometric dating techniques are used to address specific geologic problems.
4) To develop and present a research proposal using a studied geochronologic method.

CLASS RULES:

1) Group work and discussion is encouraged. All written assignments and exams, however, must be done entirely by each student unless otherwise instructed.
2) Honor code violations will result in automatic NO CREDIT and are subject to class failure.
3) No texting or emailing during class. Please put away / turn off cell phones. You are required to participate and be actively engaged in the course material during every class meeting.

TEXT: Dickin, Radiogenic Isotope Geology. The online version of this text is available at http://www.onafarawayday.com/Radiogenic/
Additional suggested texts: Faure, Isotope Geology; White, Isotope Geochemistry
You will also be required to read from prepared handouts and assigned papers.

GRADING:

Midterm: 15%
Final: 15% (treated as a second midterm, but given during the appointed final time)
Problem sets: 40%
In class presentations: 15%
Written proposal: 15%

Proposed outline of topics to be discussed.

Week	Dates	Topic	Suggested Reading*	Assignments
1	**1/22**	Introduction to Geo- and Thermo-chronology Nuclear stability	Dickin, Ch. 1.1, 1.2 White, Ch. 1	
	1/24			
2	**1/29** **1/31**	Radioactive decay Thermal and mass diffusion	Dickin, Ch. 1.3, 1.4	
3	**2/5** **2/7**	Dodson's Theory; blocking temperatures Mass spectrometry	Dickin, , pg. 19 -30 Faure, pg. 56-65	
4	**2/12** **2/14**	Instrumentation I: TIMS and ICP Instrumentation II: MC-ICP, lasers, SIMS,	Handout	
5	**2/19** **2/21**	Introduction to U-Pb system (zircon and other phases) U-Pb by TIMS and CA-TIMS; Isotope dilution	Dodson, 1973	
6	**2/26** **2/28**	U-Pb by LA-ICP-MS and SHRIMP Applications of U-Pb chronology to magmatic, metamorphic, and detrital studies	Handout Dickin, ch.5	
7	**3/5** **3/7**	U-Pb case studies	Gehrels et al	
8	**3/12** **3/14**	U-Pb zircon chronology coupled with other isotopic systems Ar-Ar thermochronology I: Step heating and noble gas behavior	Kemp and Hawkesworth	
9	**3/19** **3/21**	Ar-Ar thermochronology II: Whole rock and mineral applications Isochron approaches: Sm-Nd, Rb-Sr, Lu-Hf , K-Ca	Selected readings, Harrison and McDougall	
10	**3/26** **3/28**	Model ages Fission track thermochronology	Dickin, pgs. 85 - 96 Dickin, Ch. 16	
11	**4/2** **4/4**	(U-Th-Sm)/He thermochronology Applications of low-temperature thermochronometers	Reiners review paper	
12	**4/16** **4/18**	Thermometric and barometric techniques Thermal histories of rocks	Ganguly et al	
13	**4/23** **4/25**	Case study 1: Constructing a batholith Student presentations	Papers chosen by students	
14	**4/30** **5/2**	Case study 2: Unroofing orogenic systems Student presentations	Papers chosen by students	
15	**5/7** **5/9**	Case study 3: High-temperatures and deep crust Student presentations	Papers chosen by students	

* not complete! There will be additional readings and papers!