CSUN Geology 595 L: Quaternary Geochronology, Fall 2009

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-office hours: Tuesday 2-4 PM, Thursday 9:30-11:30 AM
-class webpage: http://www.csun.edu/~rvh97413/index.html

When: Wed 2:00-4:45 PM, Rm EH2302

COURSE OBJECTIVES

This course will cover the theories, techniques, and applications of dating Quaternary (<1,800,000 year old) deposits. Topics covered will include, but not be limited to, radiocarbon (^{14}C) dating, Uranium series disequilibrium, in-situ cosmogenic nuclides (^{10}Be, ^{26}Al, ^{36}Cl), & luminescence dating. Lecture and problem-sets will be combined with field and laboratory exercises and literature reviews with the following goals in mind:

1) Become familiar with some of the most-current geochronologic techniques and methods.
2) Convert laboratory data to actual ages through mathematical equations and theory.
3) Discuss and understand the assumptions, caveats, and potential problems that underlie each method, both in the field and in the lab.

GRADING

30% 4 Problem sets
15% Final Presentation
20% Final Exam
35% Quality class participation (including paper presentations, pop-quizzes, field trips, etc)

TEXTS AND MATERIALS

No specific textbook is required for this course. Course readings will be taken from a variety of sources, and I will provide a website link to access pdf files of the readings. See the attached Bibliography for literature we will cover.

CLASS PARTICIPATION

You will get out of this class what you put into it. Please try to at least skim all the papers before class. I will give open-note pop-quizzes about the papers prior to their presentation, so you should at least understand the main conclusion and hypotheses presented in the paper. Feel free to ask questions, and we can diverge into discussions during the paper presentations if necessary.

FIELD TRIPS: There will be 3 field trips during the class. These are all REQUIRED and must be attended

1) Saturday (8 AM) –Sunday (6PM) , Sep 26-27. Owens Valley.
2) Saturday (9 AM – 3 PM), October 17. Cajon Pass.
3) Wednesday, November 18 during class. Caltech labs.

PROBLEM SETS

During the semester, you will have 4 problem sets to complete. The due dates are shown on the syllabus, and problem sets are due at the BEGINNING of class on the due date. NO LATE WORK ACCEPTED!

You can work on these individually or together, but please turn in your own work. These problem sets will require you to interpret real data to determine an age, and will pull together information from multiple sources (journals, textbook chapters, lecture) that we cover in class.

CLASS PRESENTATIONS (GRADS: 2 LEAD, 1 BACKUP; UNDERGRADS: 1 LEAD, 2 BACKUPS)

Two-thirds of class time will be spent reviewing, discussing, and presenting data from current journal articles. Each paper will have one "lead presenter" and one "backup." The lead presenter will make a 1-page handout (20-copies) that summarizes the main points of the paper, as well as provide overheads (NO POWERPOINT except in final presentation Dec 2) of the main figures, and prepare an ~20 minute presentation of the paper. Please read the "Some pointers for reading a scientific paper" below, and answer the questions there for the handout. In addition, a second student will be "back-up" on the presentation, and will be required to answer supplementary questions about the paper during class discussion. Make sure you can do the following for your presentation:

1) Summarize the contents of the paper and provide a <1 page handout for the rest of the class.
2) What are the underlying assumptions of each paper. If the paper cites other important references, you may want to examine those as well to give us (the audience) an idea about the paper background.
3) Critically evaluate the paper---are the conclusions believable or are there any interpretations that were not considered.
4) Be able to reproduce calculations presented in the text and tables. Also, make sure you pull up any supplementary data that may be archived in a data repository so the class may view it.

FINAL PRESENTATION

You will be required to present in PAIRS a short, 10-15 minute Powerpoint presentation on a geochronology technique NOT covered in class. This can include isotopic methods (e.g. Ar-Ar), sidereal methods (e.g. dendrochronology), corrlelation methods (e.g. paleomagntetism), radiogenic (fission-track) or anything else you may like to present. I will pass out more information on this presentation before Thanksgiving.

FINAL EXAM

There will be an open-book, take-home final exam. You may pick up after class on December 9. These exams will be due by 5:00 PM on Monday, December14. These exams must be done individually.

Some pointers for reading a scientific paper

- *Read introduction and conclusions first. Don't try to read the whole thing in one sitting. Read part, let it rest, and then go back to the paper to complete it.*
- *Make special note of who the authors are. What are their qualifications? What are potential conflicts of interest? (I'd be very wary of a paper on evolution if it came out of the Institute for Creation Research; likewise for a paper on climate change coming from an oil company.)*
- *Make special note of when the paper was published, and in what journal it was published. Has the paper been subject to peer-review? (You can assume all mainstream journals, such as those you find on the UCSB e-journals website, are peer-reviewed.)*
- *Pay close attention to the figures and tables and their captions.*
- *Don't get bogged down in the details. Don't give up if you don't understand the Materials and Methods Section or you fall asleep during the Results Section! As with the novel Moby Dick, it's often better to read different parts of a paper at different paces.*
- *Don't shut down when you come across math. Read through the equation slowly; what's the relationship between different variables? Often it's easier than you think!*
- *If you're new to a subject, the jargon may get to be too much. Keep a dictionary (preferably a geology dictionary) or Google on hand. Usually Wikipedia.org comes through in a pinch.*
- *Be an active reader, not a passive one. This means you should:*

Ask yourself big-picture questions:

- *What's the main point of this paper?*
- *How do the authors prove – or try to prove -- their point?*
- *What is the hypothesis they want to test?*
- *What are the results?*
- *How do the authors interpret these results?*
- *What are the implications of these interpretations?*
- *What are the potential weaknesses of this paper? (The answer, by the way, is hardly ever 'none'. And you don't always have to be an expert to spot weaknesses. Often all you need is the ability to think logically.)*

Take notes, even if it's just a few lines. Try your best to write in your own words. This will help you digest the information and remember it.

- *When you're done, call your mother/significant other/friend/roommate/ coworker and tell him/her you just read a really interesting/stupid/ brilliant/crazy paper. Then tell him/her what the paper was about. Succinctly. Don't cheat by looking at your notes or the paper itself. If you can't do this without cheating, you didn't understand the paper. Go back and study it again.*

These pointers are modified from Prof. S. Porter, Earth Sciences, Fall 2005

BIBLIOGRAPHY

The following textbooks are out-of-print but are highly recommended. I have placed a copy of the Faure textbook on course reserve at the library (4th floor).

Faure, G., 1986, Principles of Isotope Geology, John Wiley & Sons, Inc, 589 p.

Noller, J.S., Sowers, J.M., and Lettis, W.R., eds., Quaternary Geochronology: Methods and Applications: Washington D.C., Amer. Geophys. Union, 581 p.

REFERENCES USED IN CLASS:

^{14}C geochronology

Bard, E., Rostek, F., and Menot-Combes, G., 2004, A better radiocarbon clock: Science, v. 303, pp 178.

Beck, W., et al., 1998, Ambiguities in direct dating of rock surfaces using radiocarbon measurements. *Science* **280**, 2132-2135.

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Cowgill, E., Gold, R.D., Chen, X., Wang, X.-F., Arrowsmith, J.R., and Southon, J.R., 2009, Low Quaternary slip rate reconciles geodetic and geologic rates along the Altyn Tagh fault, northwestern Tibet: Geology, v. 37, p. 647-650.

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Hughen, K. A., Lehman, S. J., Southon, J. R., and Overpeck, J. T., Marchal, O., Heering, C., and Turnbull, J. 2004, ^{14}C activity and global carbon cycle changes over the past 50,000 years. *Science* **303**, 202-207.

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Reimer, P.J., et al.., 2006, Comment on "Radiocarbon calibration curve spanning 0 to 50,000 years BP based on paired 230Th/234U/238U and 14C dates on pristine corals" by R.G. Fairbanks et al. (Quaternary Science Reviews 24 (2005) 1781-1796) and "Extending the radiocarbon calibration beyond 26,000 years before present using fossil corals" by T.-C. Chiu et al. (Quaternary Science Reviews 24 (2005) 1797-1808): Quaternary Science Reviews, v. 25, p. 855-862.

^{10}Be, ^{26}Al, ^{36}Cl in-situ cosmogenic

Belmont, P. Pazziglia, F. J., and Gosse, J. C., 2007, Cosmogenic 10Be as a tracer for hillslope andchannel sediment dynamics in the Clearwater River, western Washington State. . Earth and Planetary Science Letters 264, 123-135.

Bierman, P.R., Gillespie, A.R., and Caffee, M.W., 1995, Cosmogenic Ages for Earthquake Recurrence Intervals and Debris Flow Fan Deposition, Owens Valley, California: Science, v. 270, p. 447-450.

Faure, G., 1986, Cosmogenic Radionuclides, *in* Principles of Isotope Geology. John Wiley and Sons, Chapter 21, p. 405-428.

Gosse, J. C. and Phillips, F. M., 2001. Terrestrial in situ cosmogenic nuclides: theory and applications. Quaternary Science Reviews 20, 147-1560.

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U-Series Disequilibrium

Bischoff, J. L. and Fitzpatrick, J. A., 1991. U-series dating of impure carbonates: an isochron technique using total-sample dissolution. Geochimica et Cosmochimica Acta 55, 543-554.

Behr, W.M., Rood, D.H., Fletcher, K.E., Guzman, N., Finkel, R., Hanks, T.C., Hudnut, K.W., Kendrick, K.J., Platt, J.P., Sharp, W.D., Weldon, R.J., and Yule, J.D., accepted (in press?), Uncertainties in slip-rate estimates for the Mission Creek strand of the southern San Andreas Fault at Biskra Palms Oasis, southern California : Geological Society of America.

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Genty, D. and ten others, 2006, Timing and dynamics of the last deglaciation from European and north African d13C stalagmite profiles–comparison with Chinese and south hemisphere stagmites. Quaternary Science Reviews 25, 2118-2142.

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Placzek, C., Quade, J., and Patchett, J., 2006, Geochronology and stratigraphy of late Pleistocene lake cycles on the southern Bolivian Altiplano: implications for causes of tropical climate change. Geological Society of America Bulletin 118, 515-532.

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Stokes, S, Bray, H. E., and Blum, M. D., 2001, Optical resetting in large drainage basins: tests of zeroing assumptions using single-aliquot procedures. Quat. Sci. Reviews 20, 879-885.

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Weldon, R.J., and Sieh, K.E., 1985, Holocene rate of slip and tentative recurrence interval for large earthquakes on the San Andreas fault in Cajon Pass, southern California: Geological Society of America Bulletin, v. 96, p. 793-812.

ACADEMIC HONESTY

Group work and discussion is strongly encouraged. All written assignments and exams, however, must be done entirely by each student unless otherwise instructed (final presentation). Ideas that arise from collaboration should be individually evaluated in the write-up. Any data presented from outside readings should be clearly referenced. Honor code violations will result in automatic NO CREDIT.

Quaternary Geochronology 595L, Fall 2009 Syllabus

day	Date	TOPIC	READINGS (*general references listed in italics*, normal font items will be presented by students)
Wed	26-Aug	introduction to geochronology of the Quaternary: radioactivity, time, and fundamentals	*Burbank & Anderson, ch 3** *Faure, ch 22**
Wed	2-Sep	^{14}C intro cont., 2 presentations	*Faure, ch 22 ** 1)Guilderson et al., (2005), Bard et al., (2004) 2) Hughen et al., (2004)
Wed	9-Sep	^{14}C paper presentations (3)	1) Chiu et al., (2005) 2) Reimer et al., (2006) 3) Pigati et al (2004)
Wed	16-Sep	^{14}C paper discussions (2) in-situ cosmogenic introduction lecture	1)Oviatt (1997) 2)Beck et al. (1998) 3)Dorn et al. (1998)
Wed	23-Sep	in-situ cosmogenic introduction cont. in-situ cosmogenic paper (2) DUE: ^{14}C problem set	*Faure, ch 23*, Gosse & Phillips (2001), Zreda and Phillips (2000), Lal (1991)* 1)Nichols et al. (2006) 2)Phillips et al. (1996) 3)Bierman et al. (1995)
Sat-Sun	Sep 26-27	Owens Valley Field Trip (Depart 8 AM, Return 6 PM)	
Wed	30-Sep	NO CLASS!	
Wed	7-Oct	in-situ cosmogenic papers (3)	1)Matmon et al. (2006) 2)Von Blackenburg (2006) 3)Stock et al. (2004)
Wed	14-Oct	in-situ cosmogenic papers (2)	1) Phillips et al. (1997) 2) Belmont et al. (2007)
Friday	16-Oct	Problem Set #2: cosmogenic DUE	

Sat	17-Oct	FIELD TRIP: Cajon Pass (depart 9 AM, return ~2 PM)	Behr et al., (in press) Weldon and Seih (1985)
Wed	21-Oct	U-Series disequilibrium Introduction U-Series paper (2)	*Bischoff & Fitzpatrick (1991), Faure ch 21, Luo and Ku (1991)* 1) Gallup et al. (2002) 2)Onac er al.(2005)
Wed	28-Oct	U-Series disequilibrium (3)	1)Wang et al. (2008) 2) Genty et al. (2006) 3) Ma et al (2004)
Wed	4-Nov	U-Series Disequilibrium (2) Introduction to Luminescence	1) Placzek et al. (2006) 2) Sharp et al (2003) LUMINESCENCE INTRO: Forman (2000), Aitken (1994), Murry and Roberts (1997), Murray and Wintle (2000), Murray and Wintle (2003)
Wed	11-Nov	NO CLASS: Veterans Day	
Wed	18-Nov	Field trip to Caltech to view geochronology laboratories	
Wed	25-Nov	Luminescence Dating Intro Cont. Luminescence Dating Papers (2) DUE: Problem Set #3 (OSL and U-series)	1)Cupper (2006) 2)Stokes (2001) 3)Litchfield & Rieser (2005)
Wed	2-Dec	Luminscence Dating Papers (2) DUE: Luminescence Problem Set	1)Owen et al. (2007) 2)Folz et al. (2001) 3)DeLong et al. (2007)
Wed	9-Dec	In-Class Presentations pick up final after class.	Pairs, 12 minute presentations, 3 min questions.
Monday	14-Dec	Take-Home final exam Due 5:00 PM	