SYLLABUS WINTER 2020

Class meeting time: Monday and Wednesday 12:30-1:50pm    Room: VH210
Prof: Jane Willenbring  jwillenbring@ucsd.edu
Office Hours: Fri: 1pm-2pm, Mon-Wed after class – or – e-mail me to set up a time
* Suggested pre-requisites: Introductory Chemistry or Physics and Introductory Geology

Advances in dating methods have revolutionized scientists’ understanding of how the Earth and its inhabitants have changed over time. This course is designed to give graduate students (and advanced undergraduate students) an understanding of the science behind numerical dating techniques in geological, archaeological and environmental science contexts. This course will provide a background in the physics of radioactive decay and natural radiation sources. We will also cover various radiometric dating methods, and non-radiometric alternatives. We will focus on tools and concepts and hands-on measurements made rather than ‘facts’. In this context, we will analyze numerous case studies involving questions of both geological and archaeological importance. This class will cater to students interested in geology, archeology, paleontology, physical anthropology, environmental science, soil science, tectonics, sea level change, climate change, land use change and ocean processes. All students will write a Geological Society of America-style proposal or a National Geographic Society-style proposal focusing on a technique used in their own research that may be submitted to GSA or NGS for funding. Group student projects will be prepared for submission to a peer-reviewed journal for publication.

Grading: I hope that you always focus on learning and thinking about the material that we cover. If you do this, good grades will follow. However, the obligatory grading scheme is below.

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<th>Points</th>
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<tr>
<td>Take-home Test/Group Project</td>
<td>200</td>
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<tr>
<td>Final Proposal and Presentation</td>
<td>200</td>
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<tr>
<td>Class Discussion + Participation + Homework (8 sets/25 pts. each)</td>
<td>200</td>
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<td><strong>TOTAL</strong></td>
<td><strong>600</strong></td>
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Rules:
Laptops and similar items can be used for note taking but please don’t check email during class. Homework and take home exams must be turned in at/before class time on the due date. **Late submissions will not be graded unless cleared in advance.** Just send me an email; I’m a reasonable person. E-mail submissions (of pdf or doc files) of homework are fine. **If you actively participate in class discussions, you can drop your lowest homework and double count your second lowest mark.**

Opportunities:
My hope is that this class could result in submission of one peer-reviewed publications and a proposal you can submit for funding. **Please, take advantage of the small size of this class and feel free to talk to me about problems or suggestions you have. Tell me if you are extra-interested (or confused) about any material covered in class!**
Week 1: Jan. 8, *Jan. 10*
Intro... Elements, isotopes, Cosmic radiation and Radioactive decay Dendrochronology, Varves, and Ice cores Review of the periodic table, Table of the Nuclides, isotopes, radioactive decay. Countable layers offered one of the earliest chronometers.

*Special class time: Jan 10 at 3:00pm-4:10pm in Social Sciences Building Room 107
Dr. Tammy Rittenour, Assoc. Prof./Director of the Luminescence Lab at Utah State Univ.
"A Million Years of Coastal Dunes and Linkages to Sea Level Change on the Sunshine Coast, Australia"


HANDOUT HOMEWORK 1

Week 2: Jan. 14, Jan. 16
Radiocarbon Dating
Production of $^{14}$C in the atmosphere. Incorporation into living material, preservation. Changes in atmospheric $^{14}$C concentrations over time. The radiocarbon calibration curve. AMS dating to understand forest fire timing, flooding and age of terrestrial Carbon. Pitfalls and promise. Archaeological uses.


HANDOUT HOMEWORK 2 / HOMEWORK 1 DUE

Week 3: Jan. 21, Jan. 23
Cosmogenic nuclides
Direct dating of exposed glacial deposits and buried river sediment. The cosmogenic isochron technique applied to the Peking Man. The ‘age’ of eroding soil profiles.


HANDOUT HOMEWORK 3 / HOMEWORK 2 DUE
Week 4: Jan. 28, Jan. 30

Meteoric Beryllium-10 and Introduce Student Hands-on Group Project I

Dating techniques and sediment tracing related to a long-lived fallout radionuclide. Challenges and opportunities. The cosmogenic decay technique applied to the African early hominid fossil. The ‘age’ of eroding and moving soil.


HANDOUT HOMEWORK 4 (4/22) / HOMEWORK 3 DUE (4/24)

Week 5: Feb. 4, Feb. 6

Fallout Radionuclides and Introduce Student Hands on Group Project II

Dating techniques and sediment tracing related to fallout radionuclides. Challenges and opportunities.


HANDOUT HOMEWORK 5 (4/29) / HOMEWORK 4 DUE (5/1)

May 4th *Optional* - SoCal Geomorphology mini-Symposium ALL DAY

Week 6: Feb. 11, Feb. 13

Radiation exposure dating (TL, OSL, and ESR)

Direct dating of buried geological material and archaeological remains. Case studies: Dating dunes, human migration into South America.


HANDOUT HOMEWORK 6 (5/6) / HOMEWORK 5 DUE (5/8)

Week 7: Feb. 18, Feb. 20
U-decay series dating: Use of short-lived decay products to date young materials. Applications to Quaternary climate studies, aquifer residence time and soil production.


HANDOUT HOMEWORK 7 (5/13) / HOMEWORK 6 DUE (5/15)

Week 8: Feb. 25, Feb. 27
U-Th/He and Fission Track Dating
Radioactive decay in the U-Pb system. U-Th/He dating of more recent deposits. Case studies: Dating and tracing sediments, Uplift and exhumation.


HANDOUT HOMEWORK 8 / HOMEWORK 7 DUE

Optional Field Trip – Feb. 29

Week 9: Mar. 3, Mar. 5
K/Ar and 40Ar/39Ar geochronology


HOMEWORK 8 DUE

Week 10: Mar. 10, Mar. 12
Mar. 10 Student proposal presentations. Mar 12: Group Project Work – No formal class
Final Proposal Due via email jwillenbring@ucsd.edu
Group Project -or- Takehome exam Due via email jwillenbring@ucsd.edu