GEOL 5420-3 Records and Clocks Spring 2011
Quaternary Geochronology and Quaternary Stratigraphy

Place and Time: TBA; first meeting 4-5 PM Tues, 11 Jan, BESC 380

Instructors

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The goal of this course is two-fold:

- To provide a fundamental understanding of the primary dating methods used in Quaternary research, with an emphasis on what a Quaternary "user" should know. For each method, three aspects are stressed:
  1) The principles behind the method, inherent assumptions, and how these might be violated, and how violations are accommodated.
  2) The suitable materials for each technique, and
  3) The appropriate and inappropriate types of questions that can be addressed with the technique.
- To provide a global, representative survey of key Quaternary records of environmental change and their paleoclimate implications. Timelines will focus on:
  The Cenozoic (overview of the last 65 Ma)
  The full Quaternary record (last 2.5 Ma)
  The last interglaciation (130-120 ka)
  The last glacial/interglacial/glacial cycle (e.g., the last 150 ka)
  The Holocene

The course will consist of class lectures (Miller/Marchitto/Lehman, supplemented by local experts), and focused discussions lead by students with instructor oversight. There will also be one "mandatory" field trip late in the term.

Although there is no mandatory text for the course, we suggest you have a copy of
Ray Bradley's *Paleoclimatology: Reconstructing Climates of the Quaternary*. 1999 Academic Press, San Diego, 610pp. and/or
Mike Walker's *Quaternary Dating Methods*. 2005 Wiley.
The Encyclopedia of Quaternary Science (Elsevier) also has excellent coverage of Quaternary Dating Methods and is available on line through the CUBoulder portal.

Readings will be from these texts and from other .pdf files

Overview lectures

How do we measure time
Intro to Isotope Geology
The Quaternary as seen from the marine $\delta^{18}O$ record
Orbital controls on Quaternary climate
The Quaternary as seen from the ice core $\delta^{18}O$, δD, and trace gas stratigraphies
Intro to Radioactivity

Key Dating Methods that will be covered

Radiocarbon
K/Ar and $^{40/39}$Ar
Uranium series disequilibrium (U/Th)
Surface exposure dating (cosmogenic radionuclides)
Trapped Charge Methods
Thermoluminescence (TL)
Optically-stimulated luminescence (OSL)
Electron spin resonance (ESR) (?)
Amino acid racemization
^{210}Pb, ^{137}Cs and other similar tools to constrain past 100 years
Paleomagnetics
Reversal time scale
Secular paleomagnetic change
Environmental Magnetism (susceptibility)

Other Dating Methods that could be covered

Dendrochronology
Fission-track dating
Lake sediment varves / Ice core seasonal layers
Sclerostratigraphy
Obsidian hydration
$^{87/86}$Sr
Tephrachronology/Tephrostratigraphy
Lichenometry
Ancient DNA

Relative Dating methods that will not be covered in this class

Palynology
Rock weathering
Soils/Pedogenesis
Rock varnish
Index fossils
Geomorphology

Expectations

- Each student will be responsible to **lead two ~30-minute class discussions** focusing on aspects of Quaternary Stratigraphy/Geochronology. As a general rule, these presentations will build on a method or problem we are discussing to review the method's origin, to to show how it has been applied in a particular case (well or poorly) to better our understanding of the Quaternary.

- There will be one "mandatory" **3-day field trip** to the Nebraska Sand Hills to look at Holocene eolian, lacustrine and fluvial histories, dune dams, eolian reactivation, and evolution of ephemeral lakes in the Sand Hills. Tentative date: **mid April**

- **Grading** will be based on homework assignments (15%), short (2-page) written reports (35%), leadership of class presentations 30%, and class participation in discussions (20%). It will be essential that all students have read and be ready to participate in topical discussions.