

GEOL 1012 Syllabus January 2009

INSTRUCTOR

Peter Crowley Ryan, 429 BH

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Office Hours:

MON 8:00 – 9:00

TUES 11:00 – 12:00

THURS 11:00 – 12:00

Or by appointment.

Lecture is in BH 417. (T-W-Th 9:00 – 11:00; M group meetings 9:00 – 11:00)

TEXTBOOK (Required):

Ruddiman, William F. (2001 or 2007) *Earth's Climate: Past and Future*. W.H. Freeman and Co, New York. (Either first or second edition is fine).

OBJECTIVES

Climate change in the 20th and 21st centuries is now well-documented. Concentrations of the atmospheric greenhouse gases CO₂, CH₄ and others have progressively increased over the past 150 years, and average global temperature has increased by approximately 0.6°C over the past century. Alpine glaciers are receding, sea level is rising, icebergs are calving off polar ice sheets, tree lines are rising, and we appear to be experiencing a mass extinction.

Our main goal in this course is to examine the geological record for evidence of past climate change events. We first will ask, What is climate and how is it studied?, then proceed to specific examples of climate change events, including climate change (1) in Precambrian time, when the earth *apparently* was periodically completely covered in ice (the snowball earth hypothesis), (2) caused by volcanic eruptions, whether they be short-lived pulses (e.g. Pinatubo) or extended periods (e.g. 10⁶ years) of volcanic activity (e.g. Columbia River Flood Basalts), (3) caused by mountain uplift (e.g. Himalaya), (4) related to extraterrestrial forces such as variation in solar intensity, earth's orbit and impacts (meteorites, comets), and (5) related to changes in oceanic circulation. We will examine cases studies and assess data, in the process learning of the various "proxies" (e.g. sedimentary records, ice cores, tree rings, paleomagnetism, stable isotopes, etc.) applied to interpreting past climates. In doing so, we will work from large-scale, tectonically-controlled climate change, to shorter term events such as mid-Holocene warming and the Little Ice Age, which ended only about 140 years ago. We will close the course by attempting to extrapolate into the future of a warming earth based on our knowledge of how various earth systems have responded to climate change in the past.

Please note that you are expected to be an active, informed participant in this class. 25% of your grade will be based on in-class participation, which can only be informed and insightful if you have done the assigned readings (textbook and assigned articles).

CLASS MEETING OUTLINE

Week 1: Background, principles

Mon 1/5: Course intro, library resources for geology research (e.g. Georef), climate basics (Ch 1)

Tues 1/6: Controls on Earth's climate, geological principles (Ch 2)

Wed 1/7: Geological proxies for paleoclimate, geological principles (Ch 3, p. 151, 243, 362)

Thur 1/8: Library research. PCR in field with EPA.

Week 2: Long-term tectonic-scale climate change (scale $\sim 10^4 - 10^6$ y)

Mon 1/12: Journal article meetings in small groups with professor

Tues 1/13: Snowball earth, past glaciations; plate tectonics, volcanism, weathering and CO₂ (Ch 4)
PAPER PROPOSAL DUE Tuesday 9AM

Wed 1/14: Long-term CO₂, greenhouse earth, K/T, mountain uplift (Ch 5,6)

Thur 1/15: Tertiary climate, cooling, Paleocene/Eocene, Eocene/Oligocene (Ch 7)

Week 3: Orbital variations, Quaternary climate change ($\sim 10^3 - 10^5$ y)

Mon 1/19: Journal article meetings in small groups with professor

Wed 1/21: Orbital controls, time series, monsoons, insolation, glaciation, Pleistocene (Ch 8-12)

Wed 1/21: Climate proxy lecture by Dave Porinchu, 4PM
HW DUE Wednesday 9AM

Thur 1/22: Last glacial maximum, deglaciation (Ch 13)

Week 4: Millennial-to-decadal climate change ($< 10^3$ y)

Mon 1/26: Journal article meetings in small groups with professor

Tues 1/27: Post-LGM climate (Ch 14,15)

RESPONSE PAPER to Porinchu climate lecture DUE 9AM

Wed 1/28: Historical changes in climate, e.g. LIA, alpine changes, ENSO (Ch 16)

Thur 1/29: Humans and climate change (Ch 17-19)

FINAL PAPER DUE 9AM in class

REQUIREMENTS AND ASSESSMENT

Participation (25%): insightful vocal participation in class.

In-Class Presentation (20%): ~30 minutes, evaluation will be based on content, argument, interpretation, style, format. You will present in pairs or groups of 3.

Homework and response paper (20%): The response paper will summarize and analyze the Porinchu climate lecture. It will 2-3 pages double-spaced plus 3 references to be used in critical assessment.

Paper Proposal (10%): One page proposal describing paper topic, issues to be analyzed (critically), ≥ 5 references to be cited in paper.

Paper (25%): Scientific format, including abstract, introduction, results, critical analysis, ~10m pages of text (double-spaced) plus figures, >10 references, figures and tables (**due Thursday 1/29 at 9AM**)