

ERS 441 Glaciers and Our Landscape Fall 2005

There is some flexibility, but in general, we will adhere to the following schedule:

Class	Topics	Readings
Sep. 7	Why study glaciers? Discovery of the ice ages	B+G 1-6 Imbrie and Imbrie p. 11-46
Sept. 9	History of ice on earth/CO ₂ and the Greenhouse Effect	B+G 7-28 Raymo and Ruddiman 1992
Sept. 12	Life in the late Pleistocene glacial world	Broecker, 1993, p. 1-19
Sept. 14	Cyclicality of Quaternary climate change/ Where are we headed in the future?	Imbrie and Imbrie p. 69-75, 97-111
Sept. 16 No Class – Climate Change Institute Field Trip		
Sept. 19	Abrupt climate change/Little Ice Age and the effect on human societies	Grove, p.13-63 Weart, 2003
Sept. 21	Geographic extent of glaciers and their use by present societies	Benn and Evans, p. 39-64
Sept. 23	Classification systems	
Sept. 26	Mass balance/Snowlines	B+G 29-33 Paper topic due
Sep 28 and 30 – No Class West Antarctic Ice Sheet Meeting		
		Work on Papers!
Oct. 3	How do glaciers move?	B+G 33-64
Oct. 5	Glacier movement II	
Oct. 7	Thermal characteristics and their importance in determining the present-day landscape and resources	TBA
Fall Break Oct. 10		

Oct. 12	Meltwater systems, the hazards of outburst floods, and the cost to human societies	B+G 65-82 Clarke 1986 Schoonmaker, 1998
Oct. 14	Glacial surges - characteristics and hazards	Raymond, 1987
Oct. 17	Review session	
Oct. 19	Exam	
Oct. 21	How does a glacier erode?	B+G 83-107
Oct. 24	Small-scale erosional forms/ ice-flow directions in Maine	B+G 108-116 Lowell et al. 1990
Oct. 26	Intermediate-scale erosional forms	B+G 116-147
FIELD TRIPS OCTOBER 29 and 30		
Oct. 28	Large-scale erosional forms/the Maine landscape	Lowell, 1989
Oct. 31	Debris entrainment and transport/glaciotectionics	B+G 148-166, 216-229
Nov. 2	Direct glacier sedimentation/ the production of till	B+G 167-199 Mills, 1977 Lawson, 1981 First Draft of Paper Due
Nov. 4	Glaciofluvial sedimentation/ associated environmental and economic issues	B+G 199-214 Miall, 1977
Nov. 7	Review session	
Nov. 9	Exam	
Nov. 11	A different world: Polar sediments and landforms	Hall et al., 1997
Nov. 14	Subglacial landforms/drumlins, flutes Are they the product of outburst floods?	B+G 235-258 Gordon et al., 1992
Nov. 16	Subglacial landforms/eskers/	B+G 258-260,272-286

The Katahdin esker system

Nov. 18	Ice-marginal landforms/moraines Use in reconstructing climate	B+G 229-235 Boulton, 1986
Nov. 21	Ice-marginal landforms/kame terraces, outwash plains	B+G 260-271
Nov. 28	Periglacial processes and landforms/engineering problems	The Frozen Earth, 1-26
Nov. 30	Glacial lacustrine processes and sediments	B+G 287-295 Ashley, 1989

Thanksgiving Break

Dec. 2	Glacial marine processes and sediments/ The Presumpscot Formation - economic uses and hazards	B+G 295-315 Oldale, 1989 Powell and Molnia, 1989
Dec. 5	Landforms deposited in water The Pineo Ridge delta-moraine complex and the blueberry barrens	B+G 316-335
Dec. 7	Relative/Absolute dating	Taylor, 2000 Ivy-Ochs 1996, 7-22
Dec. 9	Interpreting landscapes - patterns of erosion and deposition, expected stratigraphy	B+G 336-356 Kleman 1994 Final Paper Due
Dec. 12	Glaciation of Maine	Borns et al. 2003
Dec. 14	RSL Change	TBA
Dec. 16	Review session	

Final Exam TBA

Reading List

- Ashley, G., 1989. Classification of glaciolacustrine sediments. In Goldthwait and Matsch eds., *Genetic Classification of Glacigenic Deposits*, Balkema, Rotterdam, 243-260.
- Benn and Evans, 1998. *Glaciers and Glaciation*, Oxford University Press.
- Borns, H., Dorion, C., Jacobson, G., Kaplan, M., Kreutz, K., Thompson, W., Weddle, T., and Lowell, T., 2003. The deglaciation of Maine.
- Boulton, G., 1972. The role of thermal regime in glacial sedimentation: In: Polar Geomorphology, ed. R.J.Price and D.E. Sugden, Institute of British Geographers Special Publication 4, 1-19.
- Boulton, G., 1986. Push moraines and glacier contact fans in marine and terrestrial environments. *Sedimentology* 33, 677-698.
- Broecker, W., 1993. *Glacial World According to Wally*, Eldigio Press, NY.
- Clarke, G., 1986. Professor Mathews, outburst floods, and other glaciological disasters. *Canadian Journal of Earth Sciences*, 23, 859-868.
- Gordon et al., 1992. The formation of glacier flutes: assessment of models with evidence from Lyngsdalen, North Norway. *Quaternary Science Reviews* 11, p. 709-731.
- Grove, J., 1988. The Little Ice Age. Methuen, London, p. 13-63.
- Hall et al., 1997. . Pliocene paleoenvironment and East Antarctic Ice Sheet behavior: Evidence from Wright Valley. *Journal of Geology*, v. 105, p. 285-294.
- Imbrie and Imbrie, 1979. *Ice Ages: Solving the Mystery*. Harvard University Press, Cambridge.
- Ivy-Ochs, S., 1996. The dating of rock surfaces using *in situ* produced ^{10}Be , ^{26}Al , and ^{36}Cl , with examples from Antarctica and the Swiss Alps. ETH Dissertation 11763.
- Kleman, J., 1994. Preservation of landforms under ice sheets and ice caps. *Geomorphology*, v. 9, p. 19-32.
- Kruger, 1993. Moraine-ridge formation along a stationary ice front in Iceland. *Boreas* 22, 101-109.
- Lawson, D., 1981. Distinguishing characteristics of diamictons at the margin of Matanuska Glacier, Alaska. *Annals of Glaciology* 2, 78-84.
- Lowell, T., 1989. LateWisconsin glacial geology of the eastern portion of Mt. Desert Island. *Studies in Maine Geology* 6, 103-118.
- Lowell, T., Kite, J.S., Calkin, P.E., and Halter, E.F., 1990. Analysis of small-scale erosional data and a sequence of late Pleistocene flow reversal, northern New England. *GSA Bulletin* 102, p. 74-85.
- Miall, A., 1977. A review of the braided river depositional environment. *Earth Science Reviews* 13, 1-62.
- Mills, H., 1977. Differentiation of glacier environments by sediment characteristics, Athabasca Glacier, Alberta, Canada. *Journal of Sedimentary Petrology* 47, 728-737.
- Oldale, R., 1989. Timing and mechanisms for the deposition of the glaciomarine mud in and around the Gulf of Maine: A discussion of alternative methods. *Studies in Maine Geology* 5, p. 1-10.
- Powell, R., and Molnia, B., 1989. Glacimarine sedimentary processes, facies, and morphology of the south-southeast Alaska shelf and fjords. *Marine Geology* 85, 359-390.
- Raymo, M., and Ruddiman, W., 1992. Tectonic forcing of late-Cenozoic climate. *Nature* 359, 117-122.

- Raymond, C., 1987. How do glaciers surge? A review. *Journal of Geophysical Research* 92, 9121-9134.
- Schoonmaker, D., 1998. Jöklhlaup. *American Scientist* 86, p. 426-427.
- Taylor, 2000. Fifty years of radiocarbon dating. *American Scientist*, 88, 60-67.
- Weart, S., 2003. The discovery of rapid climate change. *Physics Today*, p. 30-36.
- Williams and Smith, 1989. *The Frozen Earth*, Cambridge University Press.

ERS 441- Glaciers and Our Landscape

Course Outline Fall 2005

Instructor: Dr. Brenda Hall
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Class Time: MWF 9:00-9:50

Office Hours: MW 10:00-11:00, or by appointment

Field Trips: Oct. 29, 30

Reading: Text: Bennett and Glasser, *Glacial Geology: Ice Sheets and Landforms*

Gen-Ed Requirements: Satisfies Population and the Environment and Writing Intensive

Course Objectives

Much of the present landscape of Maine and other high-latitude and temperate regions owes its development to glacial erosion and deposition. Not only did the ice ages reshape the landscape, but they also caused pronounced changes in vegetation, animal habitat, and human settlement and adaptation. Although most glaciers retreated thousands of years ago, our lives still are affected by their legacy, and we rely on glacial deposits for economic resources, including agriculture, construction materials, and water. Worldwide, many people still live in glaciated areas and must face both the benefits and hazards that result. This course explores the nature of the ice ages, as well as the work of glaciers and how they shape the earth's surface. Emphasis is on understanding the processes that resulted in the landscape and sediments we see today.

Assessment

Grades for the course consist of the following:

Exams (3)	60%
Paper	25%
Field Trip Reports	15%

Exams

There are three hour-long exams. There is no cumulative "final" exam. These exams will cover lecture material, reading, and field trip information.

Paper

The ability to write well is key for any scientific career. During this course, you will research and produce a well-organized paper in the form of a scientific manuscript. This should not exceed ten pages (double-spaced), excluding figures. Style should conform to *Geology* (check their guidance for authors on the web or look through the journal). The paper should include an

abstract, text, references, and figures. Do not rely heavily on only one source and be wary of information from the web. Professional writing counts! Watch for spelling and punctuation. Make the writing concise. Keep your thoughts in logical order. Below is a list of possible topics, but feel free to come up with one on your own after checking with me. **Topics** need to be chosen by Sept. 26. Your **first draft** is due by Nov. 2. I will critique the drafts and get them back to you with a preliminary grade and suggestions for improvement of content and writing style. **Final papers** are due by Dec. 9. Late papers will receive the preliminary grade for the first draft.

Possible Topics:

- The formation of _____ (drumlins, rogen moraines, eskers are all good ones!)
- Effect of glaciation and the ice age on human habitats
- Geohazards associated with glaciomarine clay
- Can glacial outburst floods trigger global climate change?
- Engineering problems associated with outburst floods
- Revegetation patterns following deglaciation
- Breakup of ice shelves
- Evidence for/against the Northern Maine Ice Cap, ice in Northern Eurasia

Field Trips

There are two required day-long field trips to sites in eastern Maine. The dates for these trips have already been chosen because of the difficulty in obtaining vans. If you have a conflict with one of the dates, let me know well in advance. Bring a lunch, water, warm clothes, and something with which to take notes. You will need to prepare a short report, due 1 week from the date of the trip. As the time approaches, I will pass out an example of a good report for your guidance. As always, writing counts!

Down East - This trip deals with the identification and origin of glacial landforms along the Maine coast. We explore the relationship between the ice, land level, and the sea during deglaciation. We also see how the glacial landscape and sediments have shaped current agricultural practices in the area and, unfortunately, facilitated the poisoning of whole communities. We also look at modern rates of sea-level change by examining colonial dikes at Addison.

Acadia - Some of the most spectacular scenery in the world results from glaciation and Acadia is no exception. This trip focuses on two things - glacial erosion and changes in relative sea level, both of which have shaped the coastal landscape.

Students with Disabilities

If you wish to request an accommodation for a disability, please contact either your instructor or Ann Smith, Coordinator of Services for Students with Disabilities (Onward Building 1-2319) as early as possible in the semester.

Academic Integrity

Every student in the class is expected to be familiar with the University's Student Conduct Code (<http://www.umaine.edu/handbook/>). Instances of plagiarism and cheating will result in repeating of the assignment and/or reduction in grade. Other violations of the code will result in the instructor seeking advice from the appropriate office on campus on how to deal with the student's behavior. If you have questions about this policy or want examples on what is acceptable and unacceptable behavior, please speak with the instructor.