REVISED

MSL215 – MARINE GEOLOGICAL DRAMA AND UNDERSEA CATASTROPHES

Tuesday/Thursday 2:00 – 3:30 pm
214 O'Neill

INSTRUCTOR

Dr. Jennifer Reynolds, Associate Professor
Office hours: Mon and Wed 1-3 pm or by appointment
Office location: 209B O'Neill
Office phone: 474-5871 Email: jrreynolds@alaska.edu

COURSE DESCRIPTION

Case studies of geological events that disrupt the ocean environment serve as an introduction to geological oceanography and its connections to other aspects of ocean and Earth history.

Case studies covered in this course include both sudden geological events, on a time scale of minutes to weeks, and slow-motion events on a geologic time scale. Both can have dramatic or even catastrophic effects on the oceans and marine life.

Sudden geologic events include: Submarine volcanic eruptions. Tsunamis caused by earthquakes or submarine landslides. Submarine landslides caused by gas hydrate decomposition or sector collapse of volcanoes into the sea. Flooding of the Black Sea basin.

Slow-motion events include: The Archean oxygen crisis. Opening the Tasmanian Gateway. Closing the Ithsmus of Panama. Sequential growth and drowning of Hawaiian islands.

Geological concepts will be introduced as part of the background and context for each case study. These concepts will include aspects of plate tectonic theory, the shape of the ocean basins, sediments, the paleoceanographic record, and physical/chemical/biological interactions between geological materials and the water part of the oceans. Tools and methods of geologic research will also be discussed.

This is a 3-credit core course designed for lower-division undergraduate students. It is offered as part of the Minor in Marine Science, but the course is also suitable for students with an interest in geology and other Earth science.

Prerequisites: MSL111X (The Oceans) or MSL211 (Introduction to Marine Science I) or permission of the instructor. Prior knowledge of geology is not assumed, but students are expected to have a basic understanding of oceanography. Students with a background in geology instead of oceanography are invited to contact the instructor.

COURSE GOALS

Geological oceanography is one of the four core subjects in oceanography; the others are physical, chemical, and biological oceanography. This course will introduce students to topics in geological oceanography via the use of case studies. Oceanography is an inherently interdisciplinary field, and these case studies are also intended as a way to teach students about the interaction of geological activity with other aspects of the oceans such as ocean circulation, tsunamis, seawater composition, seabed ecology, and the evolutionary history of marine species.

STUDENT LEARNING OUTCOMES

Students will gain an appreciation of (a) active geological processes in the oceans; (b) the concept that the oceans function as a system including geological as well as physical, chemical and biological aspects; and (c) the capacity of rocks and sediments to record the history of the oceans. Through case studies, students

will understand selected topics in greater depth. Students will also gain experience in analyzing, discussing, and writing about scientific topics.

COURSE READINGS / MATERIALS:
Reading assigments and course materials will be drawn from a variety of sources. They will be distributed electronically, through Blackboard and/or the department's ftp site.

The one required text for this course (available in paperback) is

Noah's Flood: The New Scientific Discoveries about the Event that Changed History. William Ryan and Walter Pitman, Simon & Schuster (1998), 320 pp. ISBN 978-0684859200

ASSIGNMENTS
Homework Exercises: Four homework exercises outside of class will be assigned to improve student understanding of geological concepts and methods. These exercises will cover construction and interpretation of contour maps of the seafloor; plate motion; use of presence and absence of species in sediments to date those sediments (biostratigraphy); and evidence of geological events in marine sediments.

Discussions/presentations: Students will be asked to do two short presentations (5 minute) on supplementary readings, as part of class discussions. These will be scheduled in advance and will be connected to the short essays.

Essays: Students will write 1-2 page essays on the case studies and related topics, four during the semester. Students will each have a set of topics and due dates, to be scheduled during the first or second class period. The purpose of the essays is both investigation/discussion of the course content and experience in writing on scientific topics. Essays are expected to reflect the student's thinking on the subject, supported by content from course materials and individually assigned readings. Essays may be returned to the student for revision before grading.

Plagiarism is strictly prohibited and may result in a failing grade on the paper and/or the course. See the section below on Student Code of Conduct.

GRADING
Letter grades will be assigned. The grading scale is not curved. A = 100-93%, A- = 92-88%, B+ = 87-83%, B = 82-78%, B- = 77-73%, C+ = 72-68, C = 67-63%, C- = 62-58%, D+ = 57-53%, D = 55-51%, D- = 50, F = < 50%. Late assignments and make-up exams must be approved by the instructor in advance, except for unanticipated and unavoidable absence (e.g., illness or emergency).

Assignments (see above): 50%. Homework exercises (20%) will be graded on complete and accurate answers, evidence that the student understands the material, and timely submission. Class presentations (10%) will be graded on whether the content fulfills the assignment and on effective communication with the audience. Essays (20%) will be graded on evidence that the student understands the material; original content that reflects the student's thinking on the subject; presentation of the essay, i.e., spelling, grammer and coherent structure; and timely submission. Essays may be returned to the student for revision before grading.

Class participation: 15%. Students are expected to complete reading assignments on time and to contribute to thoughtful discussions of class topics, including any Blackboard discussions. Students who wish to work out a different mode of class participation may contact the instructor. This portion of the grade includes class attendance (5%).

Midterm exam: 10%. Final exam: 25%.

STUDENT CODE OF CONDUCT

Students are expected to conduct themselves according to the standards described in the UAF Student Code of Conduct (see catalog: http://www.uaf.edu/catalog/current/academics/regs3.html). The expectations for academic honesty and integrity are particularly emphasized.

Students who are unsure about plagiarism and proper attribution of the work of others are encouraged to consult with the instructor. Often the most difficult type for students to avoid is plagiarism via paraphrasing. The UAF library system provides guidance and examples (http://library.uaf.edu/ls101-plagiarism).

STUDENT SUPPORT SERVICES

The Writing Center (http://www.uaf.edu/english/writing-center/) offers tutorial and fax-tutorial assistance with grammar, composition, and style. Students connected to the UAF network (Ethernet or wireless on-campus or through VPN off-campus) have access to UAF Library catalogs, electronic journal holdings, and interlibrary loan resources. Miscellaneous support services (e.g., tutorial services, instruction in mathematics skills, academic advising, mentoring and personal support, cultural and social engagement, use of laptop computers, labs, and other technology resources, and direct financial assistance to qualified low-income participants) are available through UAF Student Support services (http://www.uaf.edu/sss/).

DISABILITIES SERVICES

The instructor welcomes students with disabilities, and will work with them to provide reasonable accomodation. Contact the instructor with any concerns.

Office of Disabilities Services: 208 WHITAKER BLDG, 474-5655

CALENDAR (Spring 2015), subject to modification:

Week 1	Jan 15	Introduction, overview of marine geology
Week 2	Jan 20	Background on mid-ocean ridges, submarine volcanic eruptions
	Jan 22	Case 1: Submarine eruptions at Axial Seamount, Juan de Fuca Ridge
Week 3	Jan 27	Case 1 continued. Homework exercise #1 due, contour maps of the seafloor.
	Jan 29	Background on subduction zone earthquakes, tsunamis
Week 4	Feb 3	Case 2: Great Sumatra-Andaman Earthquake and tsunami, 2005
	Feb 5	Background on seabed gas hydrates (clathrates) and submarine landslides
Week 5	Feb 10	Case 3: Storegga Slide in the North Sea
	Feb 12	Case 4: landslide-generated tsunami in Papua New Guinea, 1998
Week 6	Feb 17	Background on sector collapse of volcanoes and submarine landslides
	Feb 19	Case 4: Sector collapse in the Hawaiian Islands and elsewhere.
Week 7	Feb 24	Case 4 continued Homework exercise #2 due, plate motion.
	Feb 26	Discussion, review for midterm exam
Week 8	Mar 3	**Midterm exam**

	Mar 5	Case 5: The Archean oxygen crisis
Week 9	Mar 10	Background history of the Black Sea, Mediterranean Sea, ocean drilling
	Mar 12	Case 6: Flooding of the Black Sea basin
Mar 17, 19	**Spring Break**	
Week 10	Mar 24	Case 6 continued
	Mar 26	Case 6 continued
Week 11	Mar 31	Contrast the Black Sea with other marginal basins
	Apr 2	Background on hotspot volcanoes and plate tectonics
Week 12	Apr 7	Case 7: Sequential growth and drowning of Hawaiian volcanic islands
	Apr 9	Background on plate tectonics and marine geology around Antarctica
Week 13	Apr 14	Case 8: Opening the Tasman Gateway Homework #3 due, biostratigraphy.
	Apr 16	Background on geology of Central America, erosion and sedimentation
Week 14	Apr 21	Case 9: Closing the Isthmus of Panama
	Apr 23	Background on the geological time scale, Earth history
Week 15	Apr 28	Case 10: The Anthropocene (geological epoch of humans) Homework #4 due, evidence of geologic events in marine sediments.
	Apr 30	Discussion, review for final exam.
May 8	**Final Exam 10:15 am - 12:15 pm.**	

READING ASSIGNMENTS

Due Jan 20: This should be review for students who have taken MSL111 or MSL211.

- Tarbuck and Lutgens (2006), Earth, an Introduction to Physical Geology, 9th edition. Chapter 15: Plate Tectonics, pp. 482-494.

Due Jan 22:

- Wilson (2012), Catching a submarine volcano in the act. Physics Today 65(8), August 2012, pp. 16-18.
- NOAA PMEL web site on Axial Seamount: http://www.pmel.noaa.gov/eoi/axial_site.html
  Be sure to view the submarine videos.
  Review the 2013 expedition web site: http://axial2013.blogspot.com/

Due Feb 3:

- Stein, S. and E. Okal (2005), Sumatra earthquake - what happened and why. The Earth Scientist 21, pp. 6-11.
- Fountain, H. (2014), A '64 quake still reverberates. New York Times, April 7, 2014.
- Haeussler, P. et al. (2014), Geophysical advances triggered by the 1964 Great Alaska Earthquake. EoS Transactions 95(17), pp. 141-142.

Due Feb 10:

- Bryn, Petter et al. (2005), Explaining the Storegga Slide. Marine and Petroleum Geology 22, pp. 11-19.

Due Feb 12:

- Tappin, D.R. et al. (2001), Offshore evidence on the source of the 1998 Papua New Guinea tsunami: A sediment slump. ITS 2001 Proceedings, Session 2, Number 2-3, pp. 381-388.
- Davies, H.L. et al. (1998), Learning from the Aitape Tsunami. The National newspaper, Papua New Guinea, Nov 3, 1998. Read online at http://nctr.pmel.noaa.gov/PNG/Upng/Learned/ or download a poster version at http://nctr.pmel.noaa.gov/PNG/Upng/Learned/poster.pdf

Due Feb 19:

- Moore, J.G. et al. (1994), Giant Hawaiian underwater landslides. Science 264, pp. 46-47.
- USGS Hawaiian Volcano Observatory web page, Volcano Watch article January 23, 2014: Slip–sliding away—Disassembling Hawaiian volcanoes. http://hvo.wr.usgs.gov/volcanowatch/view.php?id=212
- Masson, D.G. et al. (2009), Submarine landslides: processes, triggers and hazard prediction. Philosophical Transactions of the Royal Society of London A 365, **ONLY** pp. 2009-2024.

Due March 5:

- Ed Mathez, How has the Earth Evolved? Evolution of the Atmosphere. American Museum of Natural History web page http://www.amnh.org/learn/earth/Resource1 and video at http://www.amnh.org/learn/earth/Resource2.
- Zimmer, C. (2013), The Mystery of Earth's Oxygen. New York Times, Oct 3, 2013. http://www.nytimes.com/2013/10/03/science/earths-oxygen-a-mystery-easy-to-take-for-granted.html?_r=0

Due March 12:

- Ryan, W. and Pitman, W. (1998), Noah's Flood, The New Scientific Discoveries About the Event That Changed History. Section One: The Discovery of the Flood Story, pp. 21-57.

Due March 24:

- Ryan, W. and Pitman, W. (1998), Noah's Flood, The New Scientific Discoveries About the Event That Changed History. Section Two: The Discovery of a Real Flood, pp. 61-161.

Optional:

- *Ryan, W. and Pitman, W. (1998), Noah's Flood, The New Scientific Discoveries About the Event That Changed History. Section Three: Who Was There, and Where Did They Go?, pp. 165-225.*
- *Ryan, W. and Pitman, W. (1998), Noah's Flood, The New Scientific Discoveries About the Event That Changed History. Section Four: The Flood Stories Told, pp. 229-259.*

Due April 7:

- Staudigel, H. and D.A. Clague (2010), The Geological History of Deep-Sea Volcanoes. Oceanography 23(1), pp. 58-71.
- Wanucha, G. (2012), Coral Reefs and Sinking Islands: Revisiting Darwin's Other Theory. MIT news release, Oct 20, 2012. http://oceans.mit.edu/featured-stories/coral-reefs-sinking-islands-incomplete-theory-charles-darwin

Due April 14:

- Exon, N.F. et al., Antarctic-Australia Separation. ODP Greatest Hits Volume 2: 1997-2003. http://odplegacy.org/outreach/brochures.html
- Exon, N. et al. (2000), The Opening of the Tasmanian gateway drove Cenozoic paleoclimatic and paleoceanographic changes: Results of Leg 189. JOIDES Journal 26(2), pp. 11-17.

Due April 21:

- Haug, G.H. and R. Tiedemann, The Rise of Panama. ODP Greatest Hits Volume 2: 1997-2003.
- http://odplegacy.org/outreach/brochures.html
- Haug, G.H. et al. (2004), How the Isthmus of Panama Put Ice in the Arctic. Oceanus 42(2), pp. 1-4.

Due April 28:

- Zalasiewicz, J. et al. (2008), Are We Now Living in the Anthropocene? GSA Today 18(2), pp. 4-8.
- Corcoran, P.L. et al. (2014), An Anthropogenic Marker Horizon in the Future Rock Record. GSA Today 24(6), pp. 4-8.