**The Plate Tectonics Revolution – EOS 242 – Spring 2012**

Prof. Emily Peterman

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Office hours: Tuesday 1-2 pm; Friday 12–1 or by appointment\*

\*email me to set up a mutually convenient time

**Class meetings:** Tuesday & Thursday 10:00–11:35; Wednesday 1–4 pm

**Classroom:** 110 (class) & 208 (lab) Druckenmiller Hall

**Course description:** Although only ~40 years old, the theory of plate tectonics provides a global framework to understand such varied phenomena as earthquakes, volcanoes, ocean basins and mountain systems both on continents (e.g. the Himalaya, the Andes) and beneath the seas (e.g. the East Pacific Rise, the Mid-Atlantic Ridge). In-depth analysis of plate boundaries, the driving forces of plate tectonics, global plate reconstructions and the predictive power of plate tectonics.

**Readings:**

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| *Global Tectonics 3rd edition* PhilipKeary, Keith Klepeis & Fred Vine | *Plate Tectonics: An insider’s history of the modern theory of the Earth* Naomi Oreskes (e-reserves) |

*A lot of scientific papers and supplemental textbook chapters provided via Blackboard. In addition to the assigned readings, you will be responsible for researching papers pertaining to your plate.*

**How you will be evaluated:**

Weekly assignments\* 35% — drop your lowest score

Midterm exam 15%

Plate project\*\* 15%

Field trip\*\*\* 10%

Final exam 20%

Active participation 5%

\*Weekly assignments will be handed out during the lab section. These assignments will involve a combination of reading, reflection, writing, calculating, data collection, sketching, and discussion. In addition to “deliverable” assignments, you will also present 2 scientific papers to the class—one with a partner, one by yourself. Assignments are due at the *start* of class and will be marked down 5% for every day they are late—handing an assignment in at the end of class is considered 1 day late. There will be a few evening lectures this semester (one is confirmed for April 6). You will be required to attend one of them and write about it. I will keep you updated about the dates as we get more confirmations in so that you can plan accordingly.

Starting after spring break (weather/outcrop permitting), many of the labs will be conducted outdoors—I expect you to dress appropriately for the weather. Flip-flops, for example, are not appropriate. Please arrive on time with all the gear you’ll need to survive a few hours outside (field notebook, pencils, ruler with protractor, hat, gloves, boots, long pants, long-sleeve shirt(s), jacket(s), sunscreen & sunglasses).

\*\*The Plate Project will involve reconstructing the plate tectonic history over the last 500 million years. We will be compiling a lot of different datasets and working both independently and collaboratively on this project and you will be responsible for a paper and a presentation of your component of the project. More details will be coming in week 4.

\*\*\*We will have a mandatory field trip tentatively scheduled for April 14-15. On this overnight field trip, we will walk across an orogen, reconstructing a portion of the plate tectonic history of New England. The exact locations of the field trip are weather dependent, but I will provide a detailed itinerary before we leave. You will be evaluated on both your active participation in the field and the field report you write about this trip. *If you have a conflict with this date, please come talk to me.*

**Active participation:** Research has shown over and over again that people learn by actively engaging and participating. What does “active participation” mean? Examples of active participation include making observations, asking questions, writing, drawing/sketching, graphing, etc. To encourage your active participation, 5% of your grade is determined by your active participation.

**Grading:** I know that you work hard on assignments and exams, and I take grading them seriously. I spend a lot of time providing you with feedback to help achieve the learning and skill goals of this course. I ask that you take a full day to read over my comments on your assignments and exams. If you still feel that I have made an error, please come talk to me.

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| Grade | What the handbook says: | What that means in this class: |
| A | student has mastered the material of the course and has demonstrated **exceptional** critical skills and **originality** | **Outstanding** work consistently throughout the class; **synthesized** material from lectures, readings, assignments *and* current events |
| B | student has demonstrated **thorough** and **above average** understanding of the material of the course | **Thorough** understanding of material but **limited** **and inconsistent synthesis** of course materials |
| C | student has demonstrated a **thorough** and **satisfactory** understanding of the course | **Satisfactory** work during the course, understood of most of the material; **no synthesis** of the course materials |
| D | student has demonstrated a **marginally satisfactory** understanding of the **basic material** of the course | **Some** understanding of major topics only, **weak** effort, frequently handed in assignments **late** and **incomplete** |
| F | student has **not** demonstrated a **satisfactory** understanding of the **basic material** of the course | **Not satisfactory** work, consistently **late** assignments, **poor** attempt at improvement, **poor** effort, generally **careless** about course |

***Learning goals***

* Define and employ the scientific method to answer questions
* Explain the theory of plate tectonics and how it evolved as a direct result of the scientific method
* Associate geologic hazards/features with different types of plate boundaries
* Explain the geologic evolution of Eastern and Western North America through the lens of plate tectonics
* Describe the tectonic history of your plate
* Construct a 4-D timeline of your plate that starts in 1 billion years ago, extends through the present and projects into the future.
* Postulate what the earth will look like in 15 Ma, 50 Ma and 100 Ma by relying upon evidence from the current configuration of plates and their present motion (as well as changes in relative plate motion)
* Considering the regions that are particularly active tectonically today, construct a hazard assessment of the Earth, including recurrence intervals of different types of hazards.

***Skills you will develop***

* Search for and cite primary sources
* Read and present research papers
* Generate testable questions with multiple working hypotheses
* Collect and evaluate data
* Synthesize datasets
* Draw figures & graphs
* Develop quantitative skills

**Collaboration, Academic Honor and Conduct Codes:** Scientists seldom work alone and learning to collaborate effectively with others is a key skill that will benefit you in any career path you choose. Many class and laboratory exercises will involve collaboration. For most assignments, however, I expect that the writing and final analysis will be your own. When appropriate, please acknowledge those with whom you have worked or from whom you have received ideas. Plagiarism and cheating are unacceptable on any assignment. Please consult http://www.bowdoin.edu/studentaffairs/academic-honesty/ **or ask me** if you have questions about academic dishonesty or how to avoid plagiarism.

**Need help with writing?** The Writing Project offers drop-in conferences during evening workshops. I encourage you to use the Writing Project for your research project. You can use these conferences to get assistance with outlining your paper, feedback on a draft and other aspects of the writing process. For more information on times and locations, visit the website http://www.bowdoin.edu/writing-project/.

**General etiquette:** Please turn your cell phones off before arriving in class—I will, too.

**Incompletes:** I cannot give incompletes. If you need to file an incomplete, you must discuss this with your Dean.

**Syllabus**

Please recognize that the schedule may change as the semester proceeds. Changes to the syllabus, weekly assignments, additional resources and further details will be posted on the course page at <http://blackboard.bowdoin.edu>.

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| *Week* | *Topics discussed* | *Reading assignments* |
| 1 | Overview of course  Historical perspectives on plate tectonics  Geosynclinal theory  Continental drift | Ch. 1 & 3, *Global Tectonics*  Dietz, 1961; Mason and Raff, 1961; Bullard, 1965 |
| 2 | The scientific method  Seafloor spreading  Magnetochronology; paleomagnetism;  geochronology | Ch. 1, *Plate Tectonics (pdf)*  Ch. 4, *Global Tectonics*  Vine & Matthews, 1963  Oreskes, Ch. 3 |
| 3 | Interior of the earth  Seismology  Rheology  Composition Structure | Ch. 2, *Global Tectonics*  Oreskes Ch. 2  Sykes et al., 1968 |
| 4 | Oceanic and continental crust  Ophiolites  Island Arcs  Cratons | Ch. 2, *Global Tectonics*  Dilek & Furnes, 2011  **How to conduct EOS research – library day with Sue O’Dell** |
| 5 | Framework of plate tectonics  Relative vs. absolute plate motion  Euler poles  GPS data | Ch. 5, *Global Tectonics*  Oreskes, Ch. 11  Bullard et al., 1965  Titus et al., 2011 |
| 6 | Ocean ridges  Mid-Atlantic  Ninety East Ridge  East Pacific Rise | Ch. 6, *Global Tectonics*  Vine, 1966  Heirtzler, 1968 |
| 7 | Continental rifts & rifted margins  Bay of Fundy  East African Rift  Red Sea  Keweenawan Rift | Ch. 7, *Global Tectonics*  Ojakangas et al., 2011  **Midterm (Thursday, March 8)** |
| **SPRING BREAK** | | |
| 8 | Continental transforms & strike slip faults  Sea floor transforms  San Andreas  Altyn Tagh  New Zealand | Ch. 8, *Global Tectonics*  Wilson, 1965 |
| 9 | Subduction zones & slab pull  Hot vs. cold subduction zones  Flat slab – Chile & Argentina; Western US  Andes  Appalachian orogeny | Ch. 9, *Global Tectonics*  Kay & Abbruzzi, 1996  Ramos et al., 2002  **Field lab** |
| 10 | Mountain Building  Aleutian Islands  Cascades  Himalaya  Taconic & Appalachian | Ch. 10, *Global Tectonics*  Tapponnier et al., 2001  **Weekend field trip** |
| 11 | Supercontinent cycle  Pangaea  Gondwana  Rodinia  Plate reconstructions | Ch. 11, *Global Tectonics*  Sleep, 2005  **Field lab** |
| 12 | Mechanisms of plate tectonics  Effect of the mantle  Triple junctions  Plumes – Yellowstone, Hawaii, Iceland | Ch. 12, *Global Tectonics*  Oreskes, Ch. 15  Atwater, 1970  **Field lab** |
| 13 | Implications of plate tectonics  Environmental change  Economic geology  Hazards | Ch. 13, *Global Tectonics*  Tohoku discussion – we will select 3 papers to discuss  **Workshop day in lab for plate presentations** |
| 14 | Future directions in plate tectonics  Geodynamic modeling  Geochronology & plate tectonics | Gerya, 2011  **Plate project presentations (Wednesday, May 9)** |
| **Final Exam – May 19** | | |