

Structural Geology (GEOL 335) Fall 2011

Instructor: Angie Moore Office: Frank 215A E-mail: amoore@guilford.edu Phone: 316-2263 (office)

Lecture: Tues/Fri 1:00-2:15, Frank 206; Lab: Thursday 2:30-5:20 p.m., Frank 206

Office Hours Monday 11:30a.m. -1:30p.m.; Tuesday 10:30a.m.-12:30p.m. Thurs 11:30-12:30

Feel free to drop by at other times, if I am not busy I will be happy to help! Also, I am more than willing to schedule appointments if you need to meet at another time.

SYLLABUS

Structural geology is concerned with deformation of the rocks that make up the Earth, and can be observed at many different scales. Attention is given to deformed features as small as the individual mineral grains or clastic particles which make up larger rock bodies, as well as to such large-scale features as mountain belts and lithospheric plate boundaries. Structural analysis in this course will be examined from several major perspectives:

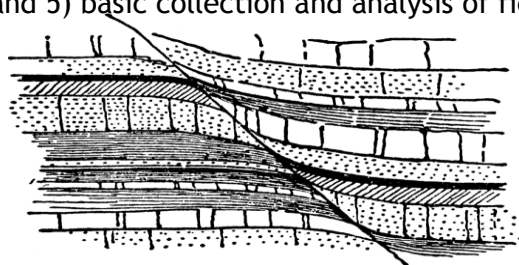
- **A study of rock mechanics** includes investigation of the fundamental concepts of stress and strain, including basic vector analysis as well as a qualitative understanding of brittle and ductile processes. This approach seeks to deduce, or at least to estimate, the conditions under which the deformation took place. In order to do this, we must know how different rock types behave under a variety of conditions, including such factors as temperature, confining pressure, contained fluid, and the amount and orientation of the deforming stress.

- **Descriptive analysis** takes a geometric approach. Our purpose here is to know the shape and position of separate rock units and their mutual relationships, and how these structures appear on a geologic map as well as in 3 dimensions.

- **Tectonics** is the study of the plate movements and forces that produce local and regional-scale geologic features, and includes detailed analysis of complex settings to unravel the geologic history of the region. This topic is often a complete course (or two!) in graduate level programs, and we will not be able to cover as much as I would like; each student, instead, will choose a region to examine in detail and present to the class at the end of the semester. This will allow you to 'put together' what you have learned in the class, and become an expert on a specific area without excessive lecturing on the topic of tectonics.

Structural geology contributes essential information to our investigation of the Earth, which is used both for the pragmatic purpose of resource exploration and development, and for the more esoteric purposes of expanding our knowledge of the Earth's history and improving our understanding of those dynamic processes that have shaped and reshaped its rocks, mountain ranges, and drifting continents throughout geologic time.

Specific Learning Objectives : Skills and knowledge you should gain from the course include 1) the development of 3-dimensional thinking regarding the earth's geologic structures 2) the ability to interpret geological maps, to generate structural cross-sections, and to infer tectonic histories; 3) an understanding of the mechanisms of stress and strain 4) the ability to identify specific geologic structures and their likely origins and 5) basic collection and analysis of field data with respect to geologic structures.



Text

Required: *Structural Geology* by Haakon Fossen. 2010. Cambridge University Press, 463 p.
Slides and homework assignments (as relevant) will all be posted on Moodle or handed out in class.

Grading

	Percentage of final grade (%)	Points
Two in-class exams (2 x 100 points each)	20	200
Final Exam (cumulative)	16	160
In class participation, activities	5	50
Laboratory work	32	320
Smokies field trip, participation and analysis	8	80
Pilot Mountain field trip	3	30
Tectonics case study	8	80
Homework sets	8	80
Total 100		1000

90 -100%, A- to A ; 80-89.9% B- to B+; 70-79.9%, C- to C+; 60-69.9% D- to D+, 0-59.9% F

There will be no additional field trips, if you miss a field trip there will be no 'make up' work permitted. There will be **no extra credit assignments** given in this class, so please plan accordingly.

Required Coursework



Guilford College expects average students to work three hours per week (including class time) for each credit hour. This is a four-credit course, so for a C+/B- grade, this comes out to about 12 hours of work per week for a typical student, about six and a half of which are outside of class (reading, working on labs, field trips, reviewing with others). You won't always work exactly 12 hours every week of course, and the different course activities may not take you the same amount of time as they do other students. Be sure to budget your time wisely in the final part of the semester, the tectonics case studies will require significant focus and effort outside of scheduled class time. Coursework includes exams, laboratory assignments, field trips (2), homework sets, in class activities, and a tectonic case study where you will present a topic to the class and will teach the class about the geologic history of a specified region, and will identify the structural and other geologic data that was used to develop this interpretation.

Class Participation Students are expected to attend class and discussion sessions, and to participate fully. Your participation in class discussions is a vital element in the learning process. Participation includes coming to class and individual meetings prepared and knowing what the assignments and course requirements are. Participation also suggests that you are an active and respectful discussant - meaning that you discuss your ideas and opinions in class and that you listen carefully to what others have to say. There will be no way to make-up points lost for participation if you miss class, regardless of the reason for your absence. Your participation grade also includes being an active and respectful participant in the out-of-class activities and checking Moodle on a regular basis. We may also do short in class activities, and these will be included as part of your participation grade. If you miss class for any reason, there is no way to 'make up' the participation points for that day and absences will also affect this part of your grade.

An A in participation suggests a student who is present, on-time, prepared, and actively involved during almost every class or activity. He or she contributes by asking relevant questions, providing comments, etc. She or he allows others to speak, listens attentively, and is a respectful participant. A "B" grade reflects active participation on a regular but less consistent basis. A "C" grade suggests a student who listens but rarely shares his/her own questions or comments or may not always be

paying attention, or participation may vary considerably.

Finally, while I expect each student to participate fully in class discussions and activities, participation should be respectful and always with an eye toward valuing our community of learners in the class. Rudeness, excessive side conversations, and distracting behavior do not foster this sense of community. Also, please refrain from using cell phones (silence them), texting, providing Facebook status updates, playing games or anything else that takes you out of our common activity. While I do encourage students to access the web on occasion to enhance their participation in a particular discussion, please limit your activities to those things related to our class. I use technology in class and you may too. However, there is a proper place for this.

Exams: Exams will be closed book, but I will allow you to bring in an 8.5 x 11 sheet of paper that contains any relevant formulas we have used (no other notes permitted on the sheet). Material on the exams will cover both lecture and laboratory material and the final exam will be comprehensive.

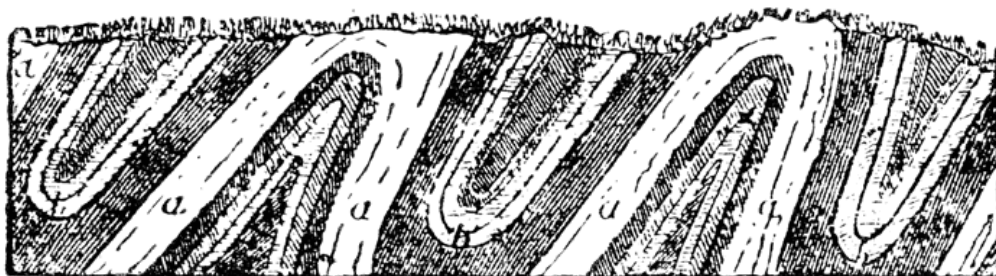
Field Trips: There are two mandatory field trips scheduled for Fall 2011. The first will be a one day trip to Pilot Mountain, and the second will be multi-day trip to the Smokey Mountains in TN. Transportation, lodging, and food will be provided for the Smokies trip. Please see the course schedule for specific dates.

Laboratory assignments General lab topics are included on the course schedule, and there will (on occasion) be reading assignments associated with the lab session. These are noted on the schedule. Laboratory exercises will vary, and will usually be due 1-2 weeks after they are handed out. Plan to spend the full amount of time in lab actively working on assignments.

Case Study Students will work in pairs to develop a case study on an interesting geologic setting; this year's focus will be on geologic formations that serve as significant oil and/or natural gas reservoirs. The case studies will require students to effectively explain the geologic history of the selected field area, including depositional setting and a summary of major tectonic events that have affected the region. Students must also provide examples of specific data collection and analysis techniques that were used to determine the tectonic history of the region (petrographic information, structural, sedimentology/stratigraphy, relative dating, borehole data, geophysics, etc.) Students will also need to connect how the sequence of tectonic events has resulted in the formation of structural and stratigraphic 'traps' in the rocks that effectively retain the petrochemicals. Finally, a summary of the relative importance of this particular oil field is in terms of domestic and total international oil production (i.e. how much is there? How much is left? How much do they think we can extract? Etc.) Much of this information is going to be proprietary and oil companies don't give this information out freely; web searches will help but will not be sufficient, so students will need to do inter-library loan requests early in the semester to access relevant journal articles we do not have in Hege Library.

Late Policy

All assignments are due at the stated deadline, and must be handed in at the start of the respective class or lab period. Late lab assignments that are handed in within 1 week of the deadline receive a 20% penalty. No assignments will be accepted more than 1 week after the deadline, anything not turned in will receive a score of zero.



Honor Code

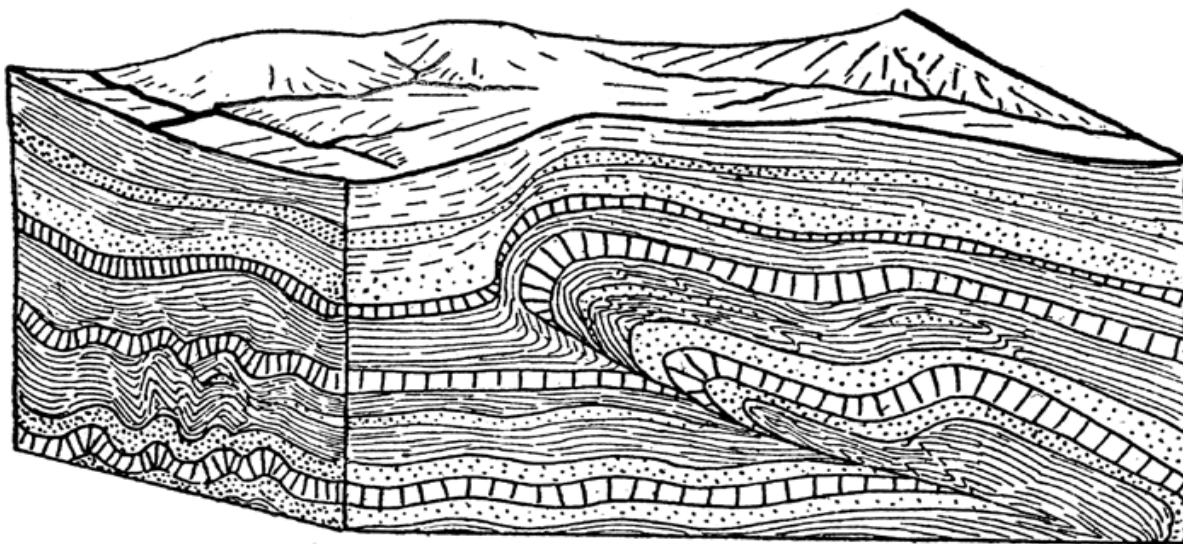
Respect for the ideas of others is absolutely central to an academic community. Under Guilford's academic honor code, academic honesty is a community standard that requires community-wide support. Specifically, in this course, exams are "closed-book", and must represent your own work. For projects and labs, you are welcome and encouraged to seek *assistance*, as long as the writing is your own and the ideas and contributions of others are clearly referenced.

Attendance policy

Exams are based on lectures and on reading, but of course the lectures cover the things I feel are especially important...so, you need to be here! The lecture schedule is subject to change so you need to attend class and pay attention to Moodle to keep up to date, and I will notify you of any changes. I allow four absences, which need not be explained or excused; of course, your daily participation for those absences will receive a score of a zero and cannot be made up. If you have five absences *you will be required to speak with me* regarding your continuation in the class and your final grade will be dropped by 10% (one letter grade); at seven absences, as per college policy, you will be dropped from the course. If you arrive late to class, three late arrivals will count as an additional absence. Attendance is mandatory for the field trips and the laboratory sessions.

Accommodations

Guilford complies with the Americans with Disabilities Act by providing a process for disclosing disabilities and arranging for reasonable accommodations. The policy can be found online on the Guilford College website. Students who require accommodations must complete a disabilities disclosure form and submit it to the Dean for Campus life. The disability services committee will decide which accommodations are granted, and the student will then meet with the appropriate specialist. It is the student's choice to disclose difference/disability information to individual instructors. However, only students who provide their instructors with an Accommodations Agreement (504 form) can receive accommodations. If you require extended time for exams or other accommodations, please see me at the beginning of the semester with your forms and we can discuss how to provide the best environment possible to promote your learning.



Course Schedule for GEOL 335 (subject to change with advance notice)

	Date	General Topic	Reading and Assignments	Lab topic (tentative)
Tues	08/23/11	Intro, nontectonic structures	Chpt 1-2; HW 1 assigned	
Fri	08/26/11	Deformation	Chpt 2 (2.1-2.5; 2.7-2.15 -don't worry about the linear algebra)	Observing nontectonic structures ; visualizing in 3D using block diagrams
Tues	08/30/11	Deformation	Chpt. 2 (2.24, 2.30) HW 1 DUE	Strain lab (Chpt. 3)
Fri	09/02/11	Stress, Mohr's circles	Chpt. 4	
Tues	09/06/11	Stress	Chpt 5	Learning to use a Brunton, field map simulation
Fri	09/09/11	Rheology	Chpt 6	
Sat	09/10/11	Saturday Field Trip: Pilot Mountain State Park		
Tues	09/13/11	Rheology, start fractures	Chpt 7 (7.1-7.7)	Constructing cross sections
Fri	09/16/11	Fractures and veins	Chpt 7 (7.1-7.7) HW 2 assigned	
Tues	09/20/11	Faults	Chpt 8	Outcrop patterns, three point problems, more cross sections
Fri	09/23/11	Faults	Chpt 8	
Tues	09/27/11	Folds	Chpt. 11 HW2 Due	EXAM 1 (up through faults and outcrop patterns)
Fri	09/30/11	Folds	Chpt 11 HW 3 More 3 pnt probs	
Tues	10/04/11	Cleavage and foliation	Chpt 12	Choosing topics for petroleum field case studies
Fri	10/07/11	Foliation, lineation, boudinage	Chpt 12, skim 13 & 14	Finish up three point problem lab
Tues	10/11/11	Convergent tectonics	Chpt. 16	Field trip preparation,
Fri	10/14/11	Convergent tectonics	HW 3 DUE	Brunton review, sandstone classification
FALL BREAK, FIELD TRIP scheduled for October 23-25th, leaving at 8:00 a.m. Thursday returning on Sunday (possibly Sat night)				

	Date	General Topic	Reading and Assignments	Lab topic (tentative)
Tues	10/25/11	Field trip recap	No Reading	Stereonets
Fri	10/28/11	Basic Petroleum Geology	Chapter handout	
Tues	11/01/11	Mylonites, shear zones, kinematic indicators	Chpt 15; HW 4 More stereonets	Revisiting the Saurtowns: processing fracture data and comparison with published data.
Fri	11/04/11	Extentional tectonics	Chpt 17	
Tues	11/08/11	Strike slip regimes	Chpt 18	Balancing cross sections
Fri	11/11/11	Salt tectonics	Chpt 19 HW 4 Due	
Tues	11/15/11	Work day (must attend)		
Fri	11/18/11	Work day (must attend)		EXAM 2
Tues	11/22/11	TBA		No Lab, Turkey Day holiday
Fri	11/25/11	Thanksgiving, no class		
Tues	11/29/11	Case studies		Tectonics and Petroleum Case Studies
Fri	12/02/11	Case studies		
Tues	12/06/11	Course wrap up		No lab, reading day
		Final Exam (Comprehensive) Tuesday December 15th 2009 3:00 - 5:30 p.m.		