

Structural Geology (EART-150)
Fall Quarter 2014
Course Information and Outline

Structural geology is concerned with describing and quantifying the **strain** (deformation) observed in rocks and relating that deformation to tectonic **stresses** in the past. In this course you will learn to recognize and describe a wide variety of tectonic structures and interpret the geologic history of rocks based on your observations and measurements. You will hone your field observational skills and improve your ability to visualize structures in three dimensions.

Instructor: Jeremy Hourigan
Office: E&MS A221
Office Hours: M 2:00– 4:00 PM
Contact: 650.269.6259
email: hourigan@ucsc.edu

<u>TAs:</u>	David Finn	David Santaniello
Lab Section	Section 01 (Tu 5:30-8:30)	Section 02 (W 8:30-11:30)
Location	D250	D250
Office:	TBA	TBA
Office Hours:	TBA	TBA
email:	dfinn@ucsc.edu	dsantani@ucsc.edu

Lecture
Meeting Time: T-Th 10:00 – 11:45 AM
Location: E&MS D250

This course is fast-paced and the lecture material is challenging. To succeed you will need to keep ahead on your reading, attend all lectures and take good notes. Please, ask questions in class if you don't understand something. Structure really challenges your ability to visualize problems in three dimensions. For some this comes naturally, for others it presents a real challenge. If you are struggling, we have a veteran crew with lots of tricks and tools to help you.

There will be a ~30 minute lecture at the beginning of each lab with instructions on how to complete your lab. You will need to be on time to these sections to gain full advantage of the lecture material. Chronic tardiness will result in devaluation of your class participation grade. It is very important that you work on a given weeks lab during that lab section so that your TAs can efficiently answer inevitable questions about how to tackle problem sets. Your previous week's problems set is due at the beginning of lab, so if you are working on it during lab its already late. So, get to lab on time and be prepared to work on your new lab.

Field Trips Completion of this course requires participation in four weekend-field exercises at Natural Bridges, Pescadero State Beach, the Marin Headlands, and at the alter of extensional tectonics – Death Valley. Mark your calendar now.

<u>Date</u>	<u>Location</u>	<u>Departure Time</u>
Sat. October 4th	Natural Bridges (meet there)	12:00PM - 4:00PM
Sat October 18th	Pescadero State Beach Low Tide 2.5 @ 11:37 AM	9 AM - 3PM (TAPS)
Sun November 1st	Marin Headlands	7:30 AM (TAPS)
Tues - Sun November 11(or 12) -16th	Death Valley	TBD (E&MS)

Text

Course Text:

Structural Geology, 2nd Edition, by Haakon Fossen

The book is relatively new so used versions are likely in limited supply. The bookstore and Amazon both list some used version. You can also purchase a digital version of the book at Ebooks.com

Optional Lab Manual

Basic Methods of Structural Geology by Marshak and Mitra (Optional)

Further reading and otherwise decent structural geology resources

- (1) *Earth Structure, 2nd Edition* by Ben A. Van der Pluijm and Stephen Marshak
- (2) *Structural Geology of Rocks and Regions* by Davis and Reynolds
- (3) *The Techniques of Modern Structural Geology, Vol. 1-2* by Ramsay and Huber
- (4) *Microtectonics, 2nd Edition*, by Passchier and Trouw

Course Website

I will post my structure lectures to eCommons. Be mindful that the lectures can be very large, so you will need a fast internet connection to download them. Reviewing my Powerpoint presentations is not an adequate substitute for good note-taking or reading the textbook. If you miss something in lecture raise your hand and ask me to go back. If I write something on the board, it is important! Practice good note-taking. Read the book. Seek help early and often. If you follow these guidelines you will succeed in this class.

Supplies

-field notebook – Rite-in-the-Rain Ideal (but \$\$\$) (ask for your 109 field books back before our first field trip).

-clipboard for maps, either your 109 map board or a wood clip board

-fine mechanical pencils for drafting

-set of colored pencils

-erasers

-protractor

-compass

-ruler

-calculator

-Brunton compass

Provided in labs but helpful to have your own supply:

-graph paper (10 division per inch)

-tracing paper

Grading

Concurrent enrollment in lecture (EART-150) and lab (EART-150L) is required as the exercises and field trips in lab are essential to gaining a command of the material. You will receive the same grade for both sections broken down as follows:

Midterm	15%
Final Exam	35%
Class Participation/Quizzes/Homework	6%
Report Natural Bridges I	5%
Report Natural Bridges Final	7%
Report Pescadero	10%
Report Marin	12%
"Report" Death Valley (Field Presentation + Field Manual)	10%
	100%

***Laboratory Grade**

Regular Lab Exercises (9 weighted by total points and effort required) **100%**

Lab Exercise Corrections: This is challenging material and you may not get the right answer for the lab exercises on the first go around. But learning from your mistakes is a great way to get a better grasp on the subject matter. The material in this course is cumulative, so it behooves you to understand where you have made mistakes and correct them. Thus you will be able to correct lab problems and receive partial credit, with the following conditions:

- (1) Problems must be completely redone on fresh paper
- (2) Hand in both the original and corrected work; highlight where mistakes were made in the original work.
- (3) Corrections are due three days or the next class period (which ever comes later) after labs are handed back to you. Late corrections will not be accepted

Lateness Policy: Lab exercises and reports are due at the beginning of your lab section. Your maximum possible score on the lab will be discounted at a rate of 5% per day late. The grade is calculated using $G = G_0 \cdot (1 - 0.05 \cdot t)$, where t is the number of weekdays late and G_0 is your starting actual score. Work that is more than a week late will not be accepted for credit

<u>Days Late</u>	<u>G_{max}</u>
1	95%
2	90%
3	85%
4	80%
5	75%

Extra Credit: We want to encourage you to engage in research related activities outside of the classroom. To that end you can earn extra credit by attending and writing up a 0.5

page summary of one of the many Whole Earth Seminars or IGPP Seminars held this quarter.

<http://eps.ucsc.edu/news-events/whole-earth-seminars/fall-2014.html>

<http://eps.ucsc.edu/news-events/igpp-seminar/fall-2014.html>

Send your summaries to hourigan@ucsc.edu. The subject line must say "F14 EART150 Extra Credit"

Policy on Academic Integrity: Please review the University's policy on Academic Integrity at: http://www.ucsc.edu/academics/academic_integrity/undergraduate_students/ Structural geology is a challenging class and we fully expect that students will share thoughts on how to tackle specific problems; however, we also fully expect that the solutions you provide to the problems will ultimately reflect your own careful work. In terms of the structure reports you will be expected to cite all sources of information that is not "common knowledge" and the general rule of thumb is when in doubt, provide a reference.

FIELD TRIP RULES

Alcohol

We have one overnight field trip in this class. Alcohol consumption in moderation will be permitted at the conclusion of the work day provided that you are over 21. Consumption of alcohol during on any of the one-day field trips is strictly prohibited. Absolutely no open containers in vehicles participating on field trips. If empties are discovered in the vans there will be disciplinary action for all students in the van. Hard Alcohol is not permitted on the Death Valley Field Trip.

Drugs

The use of illegal drugs is strictly prohibited.

Driving

Drive university and rental vehicles safely. Speeding, tailgating or other type of vehicular misbehavior will result in loss of driving privileges. Egregious infractions may result in university-level discipline and your dismissal from class.

Guidelines regarding the use of University vehicles

- (1) Return the vehicle immediately following the trip.
- (2) Record the mileage at the beginning and end of the trip.
- (3) Refuel the vehicle prior to returning to campus.
- (4) Make sure the vehicle is in reasonably clean condition.
- (5) Fill out a damage report if any has occurred and notify the instructors.
- (6) Return the keys to the drop box.

Use of personal automobiles

On rare instances, when a student needs to travel to a field trip independently they may drive their own car to the field. However, other EART 150 students will not be permitted to ride as passengers in these private automobiles. Please communicate your plan to travel independently to Jeremy well in advance of the field trip.

FALL 2014 STRUCTURAL GEOLOGY COURSE SCHEDULE

Note: This is a work in progress check the eCommons for updates on reading assignments and lecture topics.

Date	Day	Reading Assignment
WEEK 1		
2-Oct	Thurs.	What is Structural Geology and why do we study it? Introduction to the Earth's Structure and Plate Tectonics. "Crustal Strength"
		Fossen Ch.1
<i>4-Oct</i>	<i>Sat.</i>	<i>Field Trip I: Natural Bridges Field Exercise</i>
		<i>Handout</i>
WEEK 2		
7-Oct	Tues	Force and stress
		Fossen Ch. 4-5
9-Oct	Thurs.	Mechanics of Fractures and Faults
		Fossen Ch. 7,9
<i>Lab</i>		<i>Lab #1: How I learned to stop worrying and love the stereonet</i>
WEEK 3		
14-Oct	Tues	Strain: Description and Analysis DEADLINE - Natural Bridges I
		Ch. 2-3
16-Oct	Thurs.	Rheology
		Ch. 6
<i>Lab</i>		<i>Lab # 3 Mohr Circles and Rock Mechanics</i>
<i>18-Oct</i>	<i>Sat.</i>	<i>Field Trip II: Pescadero Beach - Fault and Fault Zones</i>
WEEK 4		
21-Oct	Tues	Rheology and Deformation Mechanisms DEADLINE - Natural Bridges Final
		Ch. 10
23-Oct	Thurs.	Primary Structures/Descriptive Geometry
<i>Lab</i>		<i>Lab #2: Fault slip analysis lab</i>
WEEK 5		
28-Oct	Tues	Fault Systems DEADLINE - Pescadero Final
		Ch. 8
30-Oct	Thurs.	Folds and Kinematic Analysis of Folds
		Ch. 11
<i>Lab</i>		<i>Lab # 4: Folds</i>
<i>1-Nov</i>	<i>Sat.</i>	<i>Field Trip III: The Marin Headlands - Folds</i>
<i>2.</i>	<i>Sat.</i>	
WEEK 6		
4-Nov	Tues.	Foliations and Lineations Take-Home Mid-Term Handed Out
		Ch. 12-14
6-Nov	Thrs.	Shear Zones, Microstructure DEADLINE - Take-Home Mid-Term Due
		Ch. 15
<i>Lab</i>		<i>Lab # 5: Strain Analysis</i>

WEEK 7

10-Nov	Mon	DEADLINE - Marin Report	
11-Nov	Tues	Death Valley Introduction	
13-Nov	Thurs.	Death Valley	Ch.17

11-16 Nov Tues. - Sat. Field IV: Death Valley - Continental Extension

Lab Lab #6: Shear zone rocks and crustal strength

WEEK 8

18-Nov	Tues	Tectonics: Extension	Ch.17
20-Nov	Thurs.	Tectonics: Convergence and Collision	Ch.16
		DEADLINE - Death Valley Field Exercise	

Lab Lab #7: Ductile Deformation

WEEK 9

25-Nov	Tues	Tectonics: Strike-Slip Systems	Ch.18
27-Nov	Thurs.	Thanksgiving Holiday	

Lab Yerington Cross-section Exercise

WEEK 10

2-Dec	Tues	Cross section Construction / Balancing	Ch.20
4-Dec	Thurs.	P-T-t-d	

Lab Lab # 9: Fold and Thrust Belt Cross-Section

WEEK 11

9-Dec	Tues	Himalayan-Tibetan Orogen and Western N America	
11-Dec	Thurs.	Review	

Lab Finish Cross Section Labs

FINALS WEEK

15-Dec	Mon	Final Exam 12:00 - 3:00 PM	
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