

Department of Geology & Geophysics, Fall 2009

GG303: Structural Geology



aerial view of fold belt in Central Pennsylvania

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Lectures: MW 10:30-11:20 in 708 POST

Labs: W 1:30-4:20 in 708 POST

Texts: Basic Methods of Structural Geology, by Marshak & Mitra (required)
Fundamentals of Structural Geology, by Pollard & Fletcher (recommended)

Web Site: www.soest.hawaii.edu/GG/FACULTY/conrad/classes/GG303/GG303.html

The Earth's crust is deformed at a variety of scales, locations, and times; this deformation produces identifiable structures such as fractures and folds. An appreciation of these structures has both enormous practical value and profound intellectual implications for how we view our planet. This class deals with ways to recognize and characterize major structures in the earth's crust and ways to gain insight into how these structures form.

To understand crustal deformation processes, we will first develop skills and techniques for visualizing structures in three dimensions. We will then develop techniques for understanding how these structures form by considering the Earth's crust as a mechanical system. To achieve this, we will build upon mathematics and physics derived from class prerequisites. This class will focus on macroscopic structures (e.g., folds and faults) but will also consider controls on these processes originating at both the microscopic (e.g., grain-size) and global (e.g., plate tectonic) scales. This course includes a laboratory and a field trip to the Big Island.

Preliminary Schedule:

Week	Day	Lecture Topic	Lab Topic	M&M Reading
1	M 8/24/09	1. Intro/Course Philosophy		
	W 8/26/09	2. Equations of Lines & Planes	1. Lines & Planes	Ch. 1
2	M 8/31/09	3. Orthographic Projections		
	W 9/2/09	4. Maps (Geologic & Contour)	2. Orthographic Proj.	Ch. 3
3	M 9/7/09	No Lecture (Labor Day)		
	W 9/9/09	5. Geologic Map Patterns	3. Maps & Cross Sec.	Ch. 3
4	M 9/14/09	6. Scalars, Vectors, & Tensors		
	W 9/16/09	7. Vectors, Tensors, & Matrices	4. Apparent Dip	Ch. 3,9
5	M 9/21/09	8. Spherical Projections (I)		
	W 9/23/09	9. Spherical Projections (II)	5. Stereonets	Ch. 5
6	M 9/28/09	10. Rotations (I)		
	W 9/30/09	11. Rotations (II)	6. Rotations	Ch. 6,7
7	M 10/5/09	12. Kinematics		
	W 10/7/09	13. Kinematics & Deformation	7. Down Plunge Cross Sec.	Ch. 13
8	M 10/12/09	Midterm Review		
	W 10/14/09	14. Strain	8. Midterm Exam	Ch. 15
9	M 10/19/09	15. Finite & Infinitesimal Strain		
	W 10/21/09	16. Stresses	9. Strain and Fabrics	Ch. 15
10	M 10/26/09	17. Mohr's Circle		
	W 10/28/09	18 & 19. Principal Stresses	10. Stress	Ch. 10
11	M 11/2/09	20. Rheology & Elasticity		
	W 11/4/09	21 & 22. Stresses around a Hole	11. Elasticity	
	Fri 11/6/09 (evening) to Sun 11/8/09 (afternoon)		Big Island Field Trip	
12	M 11/9/09	23. Dislocations		
	W 11/11/09	No Lecture (Veteran's Day)	No Lab (Veteran's Day)	Ch. 11
13	M 11/16/09	24. Faults		
	W 11/18/09	25. Faulting	12. Fault Slip	Ch. 12
14	M 11/23/09	26. Folds		Ch.
	W 11/25/09	27. Folded Surfaces	13. Folds	13, 16
15	M 11/30/09	28. Joints		
	W 12/2/09	29. Grainscale Deformation	14. Dikes	
16	M 12/7/09	Final Review		
	W 12/9/09	Conclusion	15. Lab Final	
17	M 12/14/09	Final Exam	9:45 to 11:45 AM	

Grading

The lecture and lab material are closely integrated, encouraging students to “learn by doing”. Thus, the laboratory exercises (which are to be completed as homework) are heavily weighted.

Lab Midterm	15%
Lab Final	15%
Labs & Homework	40%
Final Exam	20%
<u>Class Participation</u>	<u>10%</u>
Total	100%

- **Cooperation:** Students are encouraged to work together. “Working together” is not the same as “copying” – each student must submit their own lab writeups using their own words.
- **Format:** Neatness, clarity of expression, and completeness are essential to obtain full credit on exams, labs, and homework.
- **Due Dates:** Lab writeups are due at the start of *lecture* on the Wednesday after they are assigned (that is, one week after they are assigned, but at 10:30 AM). If you turn them in at the lab time, they will be considered 1 day late.
- **Grace Days:** Each student can utilize 3 “grace days” during the semester. These are days for which there is no penalty for submitting a late assignment. You can use all three to turn in one assignment 3 days late, or you may turn in 3 assignments 1 day late.
- **Late Assignments:** After you use your grace days, your homework grade will be reduced by **15% per day** that the assignment is late. A new day starts at 4 PM (except 10:30 AM on Wednesday, as described above).

Laboratory Items

The course involves a substantial amount of graphical work. Good drafting equipment and good paper are essential. This equipment can be purchased from a drafting or art supply store (e.g., Fischer, or online at <http://www.reuels.com/reuels/index2.html>).

Required Equipment (Bring to each lab)

- 0.5 mm mechanical pencil or drafting pencils with a pencil pointer
- Soft rubber eraser (“Jet” erasers are good)
- Pad of engineering paper (the green ones with light green gridlines)
- Pad of 8.5”x11” tracing paper (preferably with light blue grid lines). *Clearprint* is best.
- Clipboard
- Protractor (preferably 6” [15 cm] in diameter)
- 6” pencil compass
- 30-cm metric triangle scale with scales of 1:10(0), 1:20(0), and 1:50(0)
(Note: this is NOT an engineer’s scale!)
- 30° and 45° acrylic triangles (diagonal edges ~11.5” long are best)

Recommended Equipment

- French curve
- Technical drawing pen (e.g., Rapidograph 000) if you like to ink in your work

Learning Objectives

The **Department of Geology and Geophysics** has established the following undergraduate student learning objectives. All of these objectives are relevant targets for the curriculum of GG303.

1. Students can explain the relevance of geology and geophysics to human needs, including those appropriate to Hawaii, and be able to discuss issues related to geology and its impact on society and planet Earth.
2. Students can apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
3. Students use the scientific method to define, critically analyze, and solve a problem in earth science.
4. Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
5. Students can evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

Disability Access

If you have a disability and related access needs the Department will make every effort to assist and support you. For confidential services students are encouraged to contact the Office for Students with Disabilities (known as “Kokua”) located on the ground floor (Room 013) of the Queen Lili'uokalani Center for Student Services:

KOKUA Program
2600 Campus Road
Honolulu, Hawaii 96822
Office hours 7:45 AM – 4:30 PM
Voice: 956-7511
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