Advanced Structural Geology
Geo 380C – Fall 2010

Instructors: Peter Eichhubl
BEG 3.102P, 475-8829, peter.eichhubl@beg.utexas.edu
Sharon Mosher
JGB 6.218D or ROC 2.220, 471-4135, smosher@jsg.utexas.edu
Peter Hennings
713-922-6749, Peter.Hennings@conocophillips.com

Hours: Lectures – Tuesday, Thursday, 9:30-11 am in JGB 2.202
Evening project sessions – Wednesday Nov 17, Dec 1 in JGB 2.202

Office hours during teaching terms (see syllabus)
Eichhubl: MW, 2:00-3:00 in BEG 3.102P; Tu/Th, 11:00-11:30 in EPS 4.102B,
Mosher: Tu 12-1:30 pm in JGB 6.218D; W 10-11 am in ROC 2.220
Hennings: November 18 and 30, 1-4 pm, in EPS 4.102B

Topics: State of stress and traction, tensors and their graphical representation; strain ellipsoids, tensors, and measurement; strain in folds and shear zones; constitutive laws; deformation mechanisms; fault and fracture mechanics; friction and earthquake fault mechanics; mechanical-chemical interactions; applications in reservoir geomechanics; introduction to seismic structural interpretation

Materials: Drafting tools (protractor, ruler, drawing compass, pencil, eraser, gridded paper)
Calculator

Grading:
1. Seven problem sets handed out in class. (8% each: 56%)
2. Abstract of paper indicated in class. Due Sept. 2. (8%)
3. Revised version of abstract. Due September 9. (4%)
4. Research proposal on topic in structural geology/tectonics using GSA proposal guidelines. Due October 21. (8%)
4. Two 20 minute quizzes (8% each: 16%)
5. Revised version of research proposal. Due November 9. (4%)
6. Class participation. (4%)

Cheating: None.

Objectives:
1 To think like a scientist instead of a student.
2. To provide graduate students interested in structural geology/tectonics with an adequate background in continuum mechanics for more advanced courses and research.
3. To emphasize and practice the fundamentals needed to write quality technical reports and published papers.

Online resources: On Blackboard https://courses.utexas.edu/ in folder Course Documents

Reading

* posted on Blackboard: https://courses.utexas.edu/
# on reserve in Geology Library

* Feynman, R.P., 1985, O Americano, outra vez!: *in* Leighton, R., ed., Surely you're joking, Mr. Feynman!: Norton and Co., p. 199-219.

*# Hanmer, S. and Passchier, C., 1991, Shear-Sense indicators: a review: Geol. Surv. Can. paper 90-17

* Hubbert, M.K., 1981, Mechanics of deformation of crustal rocks: historical development: *in* Carter, N. L., Friedman, M., and Logan, J. M., eds., Mechanical behavior of crustal rocks, AGU Geophysical Monograph, v. 24, p. 1-9.

* Marrett, R., and Peacock, D.C.P., 1999, Strain and stress: Journal of Structural Geology, v. 21, p. 1061-1067.

* Means, W.D., 1976, Stress and strain: Springer-Verlag, 339 pp.

* Mosher, S., 1987, Strain, shape factor, and volume loss: effects of pressure solution on strain measurements for conglomerates: Jour. Struct. Geol., v. 9, no. 2, p. 221-232.

* # P & T: Passchier, C.W., and Trouw, R.A.J., 2005, Microtectonics, 2nd edition: Springer, 366 pp.

* Peacock, D. C. P., and Marrett, R., 2000, Strain and Stress: Reply: Journal of Structural Geology, v. 22, no. 9, p. 1369-1378.

* Pollard, D. D., 2000, Strain and Stress: Discussion: Journal of Structural Geology, v. 22, no. 9, p. 1359-1367.

* # P & F: Pollard, D.D., and Fletcher, R.C., 2005, Fundamentals of structural geology, Cambridge University Press, 500 pp.

* Ramsay, J. G., 1980, Shear zone geometry: a review: Jour. Struct. Geol., v. 2, p. 83-99.

R & H (1983): Ramsay, J.G., and Huber, M.I., 1983, The techniques of modern structural geology, volume 1: Academic Press, 307 pp.

R & H (1987): Ramsay, J. G., and Huber, M. I., 1987, Ductile and Brittle Shear Zones (Session 26), in *The Techniques of Modern Structural Geology: Volume 2: Folds and Fractures*; p. 595-640.

* Schumm, S.A., 1991, To interpret the Earth, ten ways to be wrong: Cambridge University Press, 133 pp.

* Skjernaa, L., 1980, Rotation and deformation of randomly oriented planar and linear structures in progressive simple shear: Jour. Struct. Geol., v. 2, 101-109.

T & M: Twiss, R.J., and Moores, E.M., 2007, Structural geology, 2nd edition: Freeman, 736 pp. **(recommended textbook and general reference book)**

* Zoback, M.D., et al., 2003, Determination of stress orientation and magnitude in deep wells: International Journal of Rock Mechanics & Mining Sciences, v. 40, p. 1049–1076.

Schedule for Advanced Structural Geology

Subject to revisions

Instructor: letter designates

E: Eichhubl, **M**: Mosher, **H**: Hennings

	Date	Topic	Reading (do **before** class)	due dates
E	8/26	introduction, sci. method		
E	8/31	force and stress	Feynman (1985) Schumm (1991) ch. 2 T & M (2007) ch. 1.1, box 1-1	
E	9/2	stress ellipsoid	T & M (2007) ch. 7 Means (1976) ch. 1-8	article abstract
E	9/7	Mohr circle	Means (1976) ch. 9	
E	9/9	brittle failure I	T & M (2007) ch. 2, 8	abstract revisions
E	9/14	stress tensor	Means (1976) ch. 10-13	
E	9/16	stress in the crust	T & M (2007) ch. 9	problem set 1
E	9/21	brittle failure II	P & F (2005) ch. 9 Hubbert (1981)	
E	9/23	faults	T & M (2007) ch. 3-6	problem set 2
M	9/28	strain and displacement	T & M (2007) ch. 12	
M	9/30	infinitesimal & finite strain	Means (1976) ch. 14, 15	
M	10/5	flow & progressive deformation	Hanmer & Passchier (1991) p. 5-19	
M	10/7	finite strain measurement	R & H (1983) ch. 5 -8	
M	10/12	strain in 3D	R & H (1983) ch. 10-11	problem set 3
M	10/14	volumetric strain	Mosher (1987)	
E	10/19	Quiz 1 (20') constitutive laws: elastic & plastic behavior	T & M (2007) ch. 16 Marrett & Peacock 1999, Pollard 2000, Peacock and Marrett 2000	
M	10/21	strain in shear zones	Ramsay (1980) R&H (1987) ch 26	research proposal
M	10/26	using strain for tectonic histories	Skjernaa (1980)	problem set 4
M	10/28	Quiz 2 (20') Folds/foliations/boudins	T & M (2007) ch. 11,13	
	11/2	*no class*—GSA meeting		
E	11/4	deformation mechanisms	T & M (2007) ch. 17 P & T (2005) ch. 3	
E	11/9	earthquakes and the SAF heat flow paradox		
E	11/11	deformation of porous and granular media chemical-mechanical interactions		
H	11/16	seismic structural interpretation		problem set 5
H	11/18	seismic structural interpretation		proposal revisions
H	<u>Thursday 11/18, 5:15-8:00 pm</u> (pizza provided) seismic structural interpretation			
	11/23	*no class*, (work seismic structural interpretation project)		
	11/25	*holiday: Thanksgiving*		
H	11/30	applications in geomechanics	Zoback et al., 2003	problem set 6
H	<u>Tuesday 11/30, 5:15-8:00 pm</u> (pizza provided) applications in geomechanics			
H	12/2	applications in geomechanics		problem set 7