

Geology 621 -- Advanced Structural Geology Fall 2006 Syllabus

Instructor: Dave Rodgers, PS 223, 282-4634, rodgdavi@isu.edu

Schedule: Mondays and Fridays, 8:45 – 10:00 AM

Course Objectives

To study the style, geometry, kinematics, and dynamics of continental rock deformation. The course will emphasize upper-crustal deformation associated with continental extension and shortening, which is spectacularly displayed in the rocks of eastern Idaho.

Course grading

Journal (15%)

You should maintain a journal of the literature you read including textbook chapters and outside readings. Include a factual account as well as your own critique of the outside readings. I will evaluate the journals twice during the semester.

Class Discussion (10%)

We will discuss the text and outside readings in class. Sometimes I will lead the discussions, other times you will. Everyone is expected to participate and provide incisive comments.

Midterm Examination (25%)

The exam will cover all class lectures and discussions from the Introduction to Continental Extension.

Lab Exercises and Mapping (35%)

Several structure labs will be assigned to investigate the principles of deformation theory and structures including dikes, faults, folds, and foliation. You will also collect and interpret field data associated with faults and folds in eastern Idaho.

Term paper (15%)

You are asked to choose a structural province or process and write a 10-20 page paper about it. If it's a province, you should describe the style, geometry, kinematics, and timing of deformation. If it's a process, you should describe it at all scales (microscopic to macroscopic) and explain the rock textures with which it is associated.

Our program is committed to all students achieving their potential. If you have a disability or think you have a disability (physical, learning disability, hearing, vision, psychiatric) which may need a reasonable accommodation, please contact the ADA Disabilities & Resource Center located in Graveley Hall, Room 123, 282-3599 as early as possible.

Class Schedule

<u>Day</u>	<u>Topic</u>	<u>Assigned Reading or Laboratory Work</u>
M -Aug 21	Introduction	
F – Aug 25	Stress vs Strain	Marrett & Peacock, 1999; Pollard, 2000; Peacock & Marrett, 2000
M -Aug 28	Elastic behavior	Price and Cosgrove-1, pgs. 18-34
F - Sept 1	Joints	Suppe-6, pgs. 169-196
M – Sept 4	Labor Day Holiday – No class	
F - Sept 9	Dikes	Holmes et al. (submitted); Field Trip to King’s Bowl
M - Sept 11	Introduction to Faults	Ramsay and Huber-23, pgs. 506-542
F – Sept 15	Active Faults	Burbank & Anderson-4, pgs. 53-77
M - Sept 18	Normal Faults - SE Idaho	Carney & Janecke, 2005
F – Sept 22	Normal Faults - Pocatello	Balanced Cross Sections; Field Trip to Inkom Quadrangle
Sept 25 – Oct 9		Independent Fieldwork
M – Oct 9	Miocene Normal Faults	Discussion of Field Results
F – Oct 13	Basin & Range extension	Proffett, 1977; Wernicke & Burchfiel, 1982
M - Oct 16	Continental extension	Hancock-11. pgs. 223-250
F - Oct 20	Midterm Exam	
M - Oct 23	Intro to Fold-Thrust belts	Boyer & Elliott, 1982
F – Oct 27	Geometry of Fold-Thrust belts	Balanced Cross-section Lab
M - Oct 30	Mechanics of Fold-Thrust belts	Davis and others, 1983
F – Nov 3	Idaho Fold-Thrust belt	
S – Nov 4	Idaho Folds	Field Trip to Arco Hills
M - Nov 6	No class	
F – Nov 10	Continental collision	Hancock-13, pgs. 264-288
M - Nov 13	Plastic behavior	Twiss & Moores-19; pgs. 386-422
F – Nov 18	Ductile rock fabrics	Hand-specimen lab
Nov 20-26	Thanksgiving Break – no class	
M - Nov 27	Shear zone geometry	Ramsay & Huber –2, 3
F – Dec 1	Ductile shear zones	Ramsay & Huber – 26, pgs. 595-640
M - Dec 4	Structural Project	Work on Term Paper
F – Dec 8	Structural Project	Work on Term Paper
Th - Dec 14	Term Paper Due	

Advanced Structural Geology Reference List

Text books

- Burbank, D.W., and Anderson, R.S., 2001, Tectonic Geomorphology (excellent up-to-date summary of active structures and the techniques used to study them).
- Hancock, P.L. (ed), 1994, Continental Deformation (first half is structural principles, second half describes tectonic provinces.)
- Pollard, D.D. and Fletcher, R.C., 2005, Fundamentals of Structural Geology (advanced textbook with an emphasis on deformational theory. Calculus-based.)
- Price, N.J., and Cosgrove, J.W., 1991, Analysis of Geological Structures (generally advanced level presentation of structural concepts. Chapters are not comprehensive but instead focus on a few topics)
- Ramsay, J.G., and Huber, M.I., 1983, The Techniques of Modern Structural Geology, Volume 1: Strain Analysis (outstanding innovative advanced textbook on finite strain analysis. Well-written, thorough, and contains material found nowhere else. Superb illustrations)
- Ramsay, J.G., and Huber, M.I., 1987, The Techniques of Modern Structural Geology, Volume 2: Folds and Fractures (another excellent advanced text, not as innovative as volume 1 but with thorough discussions on fault and fold analysis. More superb illustrations)
- Suppe, J., 1985, Principles of Structural Geology (basic to advanced text. Coverage is not comprehensive but is thorough)
- Twiss, R.J., and Moores, E.M., 1992, Structural Geology (intermediate to advanced text with a thorough coverage of most structural geology topics. Good synthesis of field, kinematic, and dynamic analyses. Short on tectonics)
- Turcotte, D.L., and Schubert, G., 2002, Geodynamics (this 2nd edition is virtually unchanged from the original 1981 version. Despite being 20 years out-of-date in terms of geological advances, it remains the best source for understanding how to quantify physical processes, including deformation, in geology.)

Papers

- Boyer, S.C., and Elliott, D., 1982, Thrust Systems: American Association of Petroleum Geologists Bulletin, v. 66, p. 1196-1230.
- Carney, S.M., and Janecke, S.U., 2005, Excision and the original low dip of the Miocene-Pliocene Bannock detachment system, SE Idaho: northern cousin of the Sevier Desert detachment?: Geo. Soc. America Bull., v. 117, p. 334-353.
- Davis, D., Suppe, J., and Dahlen, F.A., 1983, Mechanics of fold-thrust belts and accretionary wedges: Journal of Geophysical Research, v. 88, p. 1153-1172.
- Holmes, A.A.J., Rodgers, D.W., and Hughes, S.S., submitted, Kinematic analysis of fractures in the Great Rift, Idaho: implications for subsurface dike geometry, crustal extension, and magma dynamics: Journal of Geophysical Research.
- Marrett, R., and Peacock, D.C.P., 1999, Strain and stress: Journal of Structural Geology, v. 21, p. 1057-1063.
- Peacock, D.C.P., and Marrett, R., Strain and Stress: Reply: Journal of Structural Geology, v. 22, p. 1369-1378.
- Pollard, D.D., 2000, Strain and Stress: Discussion: Journal of Structural Geology, v. 22, p. 1359-1367.
- Proffett, J.M., Jr., 1977, Cenozoic geology of the Yerington district, Nevada, and implications for the nature and origin of basin and range faulting: Geological Society of America Bulletin, v. 88, p. 247-266.
- Wernicke, Brian, and Burchfiel, B.C., 1982, Modes of extensional tectonics: Journal of Structural Geology, v. 4, p. 105-115.