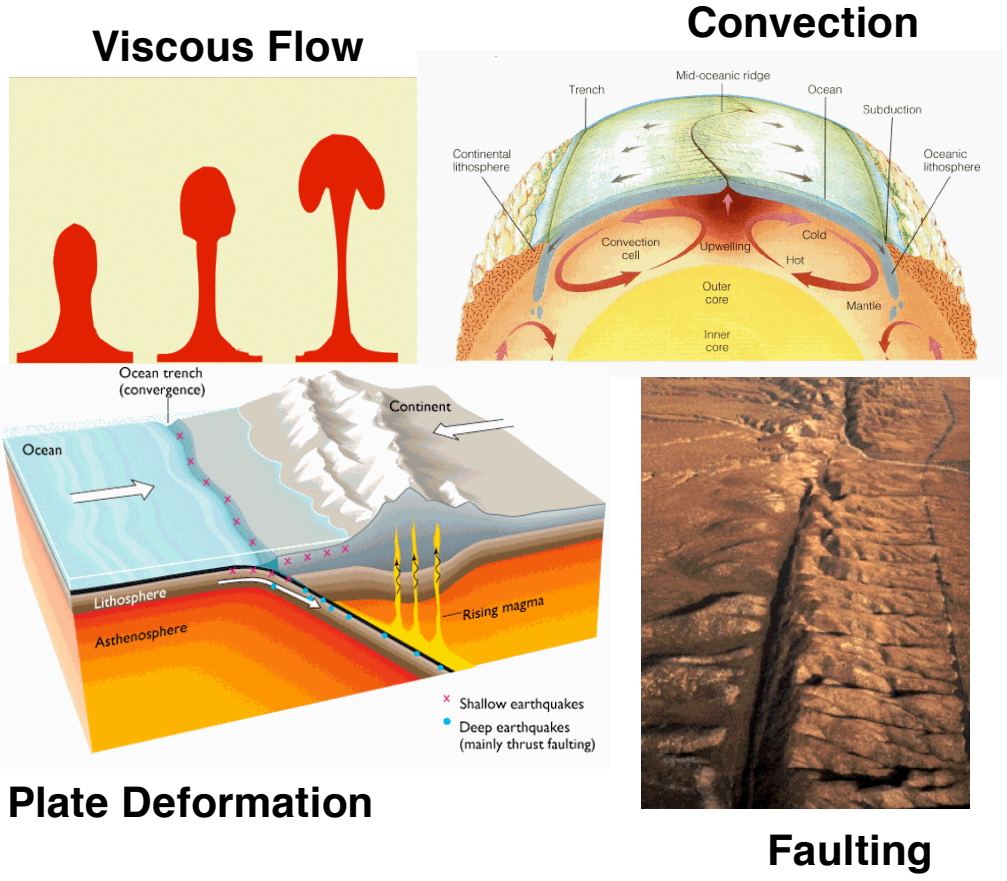
Department of Geology & Geophysics, Spring 2010

GG681: Continuum Mechanics in Geophysics



Instructor: **Clint Conrad** **804 POST, 956-6649**
clintc@hawaii.edu
office hours: after class, by appointment

Lectures: **Tues. & Thur. 9:00-10:15 in 702 POST**
Texts: **Introduction to Continuum Mechanics, by Lai, Rubin, & Krempl (required)**
Geodynamics, by Turcotte & Schebert (recommended)
Web Site: **www.soest.hawaii.edu/GG/FACULTY/conrad/classes/GG681/GG681.html**

The solid Earth deforms at a variety of length scales, locations, and time scales, and in a variety of different ways in response to a variety of different forcing mechanisms. In this class, we will use continuum mechanics, which describes the response of a material to an imposed force, to study and understand deformation of the solid earth.

Preliminary Schedule:

Week	Days	Topic	Reading
1	Jan 12-14	Introduction	
2	Jan 19-21	Tensors	Lai Ch. 2
3	Jan 26-28	Stress	Lai Ch. 4
4	Feb 2-4	Strain	Lai Ch. 3
5	Feb 9-11	Elastic Deformation	Lai Ch. 5, T&S Ch. 3
6	Feb 16-18	Mohr's Circle and Rock Failure	Lai Ch. 5, T&S Ch. 8
7	Feb 23-25	Ductile Rheology	Lai Ch. 6, T&S Ch. 7
8	Mar 2-4	Newtonian Fluids	Lai Ch. 6
9	Mar 9-11	Fluid Mechanics	Lai Ch. 6
10	Mar 16-18	Viscous Flow	Lai Ch. 6
	Mar 23-25	Spring Break	
11	Mar 30-Apr 1	Elastic Plate Flexure	T&S Ch. 3
12	Apr 6-8	Instabilities	T&S Ch. 6
13	Apr 13-15	Heat Flow	T&S Ch. 4
14	Apr 20-22	Thermal Convection	T&S Ch. 6
15	Apr 27-29	Project Reports	
16	May 4	Conclusion	
	Note:	We will deviate from this schedule as necessary!	

Grading and Assignments

Homework assignments will be assigned approximately weekly, and students will be required to present the continuum mechanics underlying current research papers periodically throughout the course. Each student will complete a research-focused class project (see below). The relative weightings of homework assignments, class participation (including in-class presentations), and class projects are as follows:

Homework	45%
Class Presentations and Participation	25%
Class Project	30%
Total	100%

Cooperation: Collaboration is encouraged in order to discuss approaches to solving problems. However, do not copy answers to problem set – work out the solutions yourself.

Class Project

An extensive class topic will be included as part of the class. Each student will be expected to develop and present some a basic research project that relates continuum mechanics to an active research area in the Earth sciences.

Other Reference Sources

Material Properties
Ranalli, G., *Rheology of the Earth*, Allen and Unwin, 1987.
Karato, S.-I., *Deformation of Earth Materials*, Cambridge Univ. Press, 2008.

Continuum Mechanics
Malvern, L. E., *Introduction to the Mechanics of a Continuous Medium*, Prentice-Hall, 1969.

Fluid Dynamics
Batchelor, G. K., *An Introduction to Fluid Dynamics*, Cambridge University Press, 1967.
Chandrasekhar, S. *Hydrodynamic and Hydromagnetic Stability*, Dover Publications, 1961.
Kundu, P., *Fluid Mechanics*, Academic Press, 1990.
Landau, L. D. and e. M. Lifshitz, 2nd ed, *Fluid Mechanics*, Pergamon, 1987.

Math and Mathematical Physics
Arfken, G., 3rd ed., Mathematical Methods for Physicists, Academic Press, 1985.
Marsden, J. D. and A. Tromba, 2nd ed., *Vector Calculus*, W. H. Freeman, 1981.
Press, W. H. S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, *Numerical Recipes in Fortran: The art of scientific computing,* Cambridge University Press, 1992.
Schey, M., *Div, Grad, Curl, and all that: an informal text on vector calculus*, Norton, 1973.

Solid Earth Geophysics
Anderson, D. L., *New Theory of the Earth*, Cambridge University Press, 2007.
Davies, G., *Dynamic Earth: Plates, Plumes and Mantle Convection*, Cambridge University Press, 1999.
Fowler, C. M., *The Solid Earth: An Introduction to Global Geophysics*, 2nd ed., Cambridge Univ. Press, 2005.
Sleep, N. and K. Fujita, *Principles of Geophysics*, Blackwell Science, 1997.
Stacey, F.D. and P.M. Davis, *Physics of the Earth*, 4th ed., Brookfield Press, 2008.
Lowrie, W., *Fundamentals of Geophysics*, 2nd ed., Cambridge University Press, 2007.

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 GG681.

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
Voice: 956-7511; Email: kokua@hawaii.edu; URL: www.hawaii.edu/kokua