Geology and Geophysics 303
Structural Geology
Recap

Active Geologic Structures: Kilauea Dikes

http://volcanoes.usgs.gov/Imgs/Jpg/Photoglossary/fissure4_large.JPG

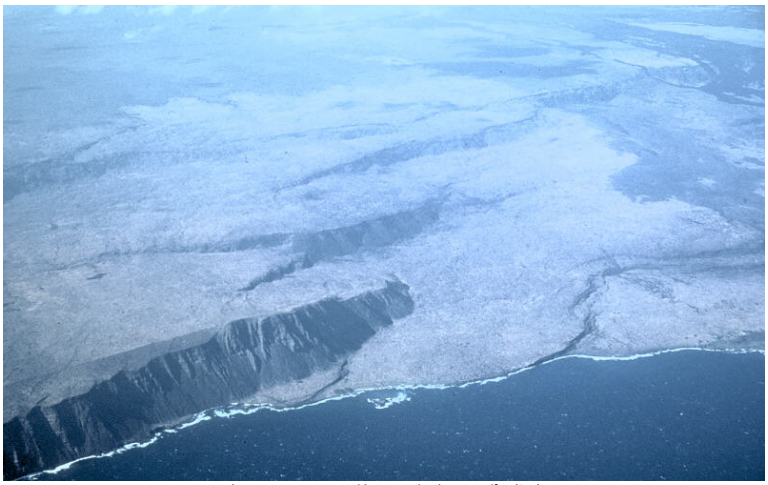
Fossil Geologic Structures: Ship Rock Dikes

http://www.rci.rutgers.edu/~schlisch/structureslides/shiprock_LJM.jpg

Large Fold King Oscar Fjord, East Greenland

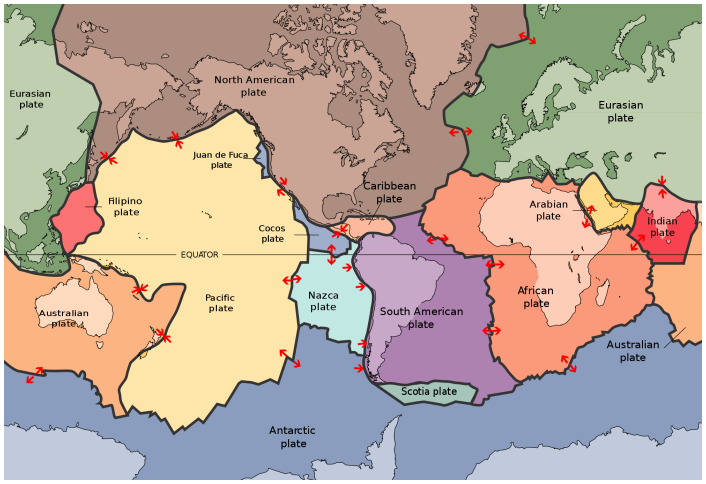
http://en.wikipedia.org/wiki/King_Oscar_Fjord

Active Fold and Faults in Hawaii
Hilina Pali



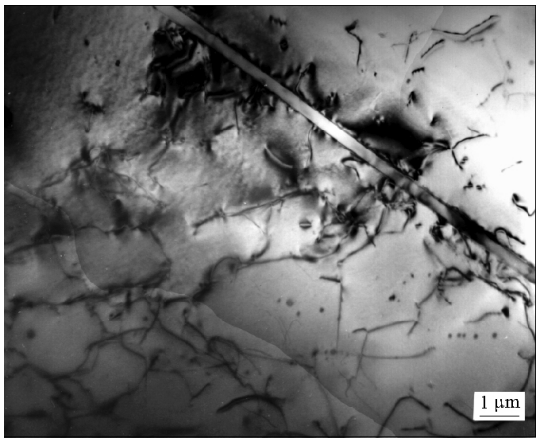
volcanoes.usgs.gov/ images/pglossary/fault.php

Large Geologic Structures:
Plate Boundaries



http://upload.wikimedia.org/wikipedia/commons/thumb/8/8a/Plates_tect2_en.svg/2000px-Plates_tect2_en.svg.png

Small Geologic Structures
Dislocation in a Crystal



http://www.geol.ucsb.edu/faculty/hacker/geo102C/lectures/dislocation2.jpg

31. RECAP

I Main Topics
- A Course philosophy
- B An approach to practicing structural geology
- C Mathematical and physical fundamentals
- D Fieldwork, theory, and experiment
- E Practice good habits

31. RECAP

III Course philosophy

A Geology can be treated as a scientific discipline

B Course is intended to challenge students

C Course emphases

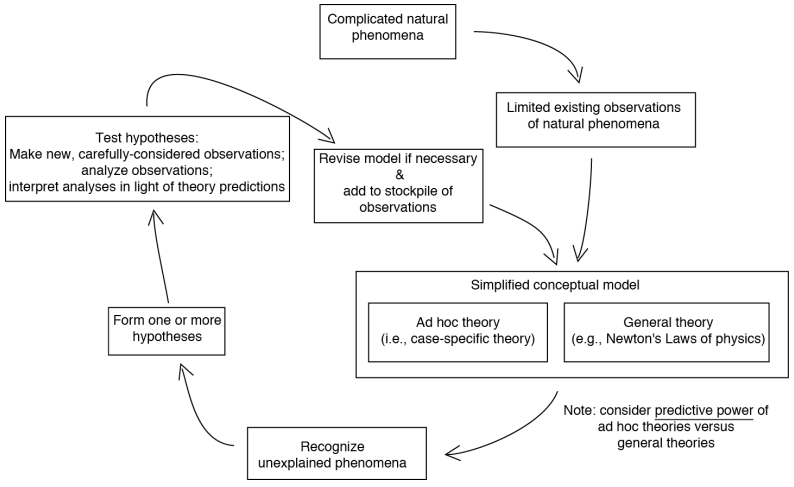
1 Concepts (not vocabulary)

2 Critical thinking (not "cookbooks")

3 Fundamentals (not fashion)

4 Quantitative predictions (Where? When? How big?)

31. RECAP
II Course Philosophy: Scientific Method



31. RECAP

III AN APPROACH TO PRACTICING STRUCTURAL GEOLOGY

Topic	Subtopics
Geometry	Orthographic & stereographic projections Maps and cross sections Coordinate transformations Differential geometry
Kinematics	Strain
Mechanics	Rheology Stress Introduction to boundary value problems Stresses around a hole Stresses around a screw dislocation
Application to Geologic Structures	Opening-mode cracks Faults Folds

31. INTRODUCTION AND COURSE PHILOSOPHY

IV Mathematical and Physical fundamentals

Discipline	Topics
Mathematics	Vectors Tensors Linear Algebra Solution of simultaneous linear equations Eigenvectors and eigenvalues Differential Equations Introduction to dimensional analysis Differential geometry
Physics	Fundamentals of Continuum Mechanics

31. INTRODUCTION AND COURSE PHILOSOPHY

IV Mathematical and Physical Fundamentals

Fish Net Analogy

http://upload.wikimedia.org/wikipedia/commons/1/1c/Payallarfishing.jpg

http://upload.wikimedia.org/wikipedia/commons/b/b7/36-pesca%2CTaccuino_Sanitatis%2C_Casanatense_4182..jpg

31. RECAP

V ***Fieldwork***, Theory, and Experiment

http://www.rci.rutgers.edu/~schlisch/structureslides/shiprock_LJM.jpg

31. Recap

V Fieldwork, ***Theory***, and Experiment

- Governing Equation

$$0 = \frac{d^2 u_r}{dr^2} + \frac{1}{r}\frac{du_r}{dr} - \frac{u_r}{r^2}$$

- Boundary Conditions

$$u_r(r = a) = u_0$$

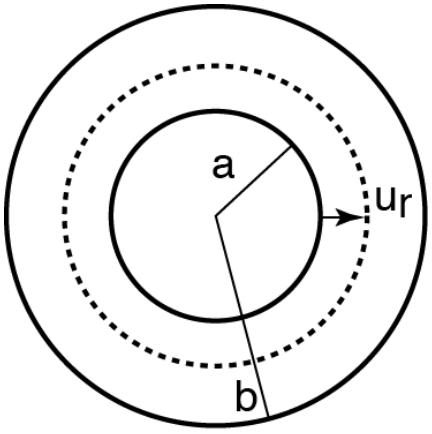
$$u_r \to \infty = 0$$

- Solution

$$u_r = u_0\left(\frac{a}{r}\right),\ u_\theta = 0$$

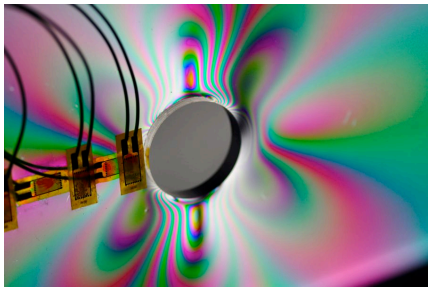
$$\sigma_{rr} = \frac{E}{(1+\nu)}\left[\frac{-u_0 a}{r^2}\right]$$

$$\sigma_{\theta\theta} = -\sigma_{rr},\quad \sigma_{\theta r} = 0$$

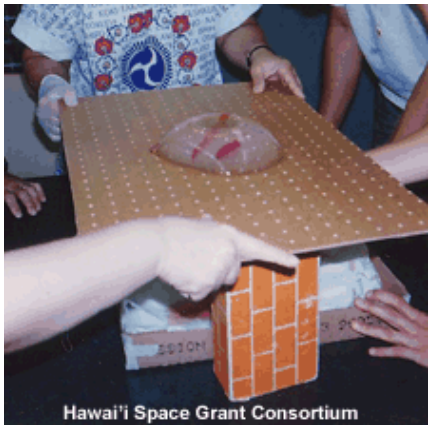


31. RECAP

V Fieldwork, Theory, and ***Experiment***



http://medesign.seas.upenn.edu/index.php/Main/HomeHistory



http://www.spacegrant.hawaii.edu/class_acts/GelVolTe.html

31. RECAP

VI Practice good habits
- A Seek the essence of phenomena (in their clearest expression)
- B Start with simple, well-defined problems
- C Draw neatly labeled diagrams
- D Check your work as you go
- E Seek different perspectives
- F Strive for high standards
- G Help others