Dynamic Planet B: NJ State Outline

I. Basic descriptive geophysics/geology
- A. Earth structure (particularly relevant for seismology)
  1. Crust
  2. Lithosphere
  3. Aesthenosphere
  4. Mantle
  5. Outer Core
  6. Inner core
- B. Plate tectonics
  1. Locations of the major plates
  2. How do we know about plate motion?
  3. Why do we (currently) think plates are pulled by subduction zones?
  4. Interpreting plate motion
  5. Triple junctions of plates and their stability
- C. Rock types (important for mineral interpretation)
  1. Igneous
  2. Metamorphic
  3. Sedimentary
  4. Extrusive and Intrusive
  5. Rock cycle
- D. Bedding types (used for fault interpretation)
  1. Monocline
  2. Syncline
  3. Anticline

II. Earthquake sources
- A. Fault types
  1. Normal/tensional/gravity
  2. Reverse/compressional/thrust
  3. Transform/transcurrent/strike-slip
  4. Translational
  5. Rotational
- B. Fault interpretation
  1. Law of crosscutting relationships
  2. Hanging wall
  3. Footwall
- C. Other sources of earthquakes

1. Explosions
2. Collapses
3. Rock phase changes

D. Role of water in earthquake triggering

E. Mechanisms of plate motion

1. Slab pull
2. Basal drag

F. Fault block features

1. Horst
2. Graben

III. Seismology

A. Seismic waves- mechanisms, formulae for speeds

1. P-wave
2. S-wave
3. Rayleigh wave
4. Love waves
5. Wave propagation paths

a.) PcP
b.) PKP
c.) PKIKP
d.) PcS
e.) PP
f.) SS
g.) ScS
h.) SKS

B. Relationship of vertical motion in p-waves to earthquake types.

1. Fault plane solutions
2. Difference between fault plane solutions for thrust, normal, strike-slip faults.

C. Earthquake magnitude scales and their estimation

1. Richter magnitude
2. Mercalli intensity
3. Moment magnitude
4. Body wave magnitude
5. Surface wave magnitude

D. Seismic discontinuities, shadow zones, and the structure of the earth

1. Moho
2. Lehmann discontinuity

3. 400 km discontinuity
5. 670 km discontinuity
6. Core-mantle boundary
7. Be able to draw a profile of P and S wave velocities.

IV. Volcanoes
- A. Volcano types
  1. Shield
  2. Composite
  3. Cinder cone
- B. Relationship of volcano types to plate tectonics
  1. Subduction volcanism
  2. Mid-ocean ridge volcanism
  3. Hotspot volcanism.
- C. Eruption descriptors
  1. Strombolian
  2. Plinian
  3. Hawaiian
  4. Vulcanian
  5. Phreatic
- D. Structures forming from past vulcanism
  1. Dike
  2. Neck
  3. Diatreme
  4. Maar
  5. Lava tubes
  6. Columnar basalts

V. Other features associated with volcanic regions
- A. Geysers
- B. Fumaroles
- C. Mud volcanos

VI. Volcanic rocks and minerals
- A. Obsidian
- B. Basalts (flood vs. pillow)
- C. Kimberlite
- D. Komatite
- E. Bauxite

F. Pumice
G. Tuff
H. Dacite
I. Andesite
J. Rhyolite
K. Gabbro
L. Olivine
M. Composition: felsic vs. mafic
N. Intrusive vs. extrusive (plutonic vs. volcanic)

VII. Climatic effects of plate tectonics
A. Role of plate tectonics in the carbon cycle.
B. Volcanoes and the earth's radiation budget

IX. Famous volcanoes and earthquakes (make your own list!)

X. Volcanic hazard mitigation
A. Eruption precursors
B. Warning systems

XI. Earthquake hazard mitigation
A. Construction
B. Long-term prediction
1. Seismic gaps
2. Magnetic precursors
3. InSAR
C. Short-term prediction
D. Tsumamis
1. Formation of tsunamis (why don't all earthquakes form tsunamis?)
2. Propagation of tsunamis (speed)
3. Tsunami speed and amplitude change in shallowing water
4. Tsunami warning systems

References

Books

Bruce Bolt: Earthquakes (New York, Freeman)

Robert Decker and Barbara Decker: Volcanoes (New York, Freeman)

Websites

General geology

http://www.eas.slu.edu/People/KChauff/earth_history/

A good site at St. Louis University with a lot of information on geological context and some nice quizzes.

Lava flows

http://www.goodearthgraphics.com/virtual_tube/virtube.htmlhttp://www.goodearthgraphics.com/virtual_tube/virtube.html

A really nice site with great pictures and lots of information about volcanic features.

General vulcanology

http://volcano.oregonstate.edu/education/index.html

Some good information and pictures.]

http://volcanoes.usgs.gov/images/pglossary/index.php

A nice glossary with photos of volcanic features.

Volcanoes and climate

http://climate.envsci.rutgers.edu/robock/robock_res.html#vol

A great resource site about the effects of volcanoes on climate from one of the leading experts in the field.

Earthquake prediction

http://www.nature.com/nature/debates/earthquake/equake_frameset.html

A debate about whether earthquake prediction is a realistic goal.

Visualize propagation of earthquake waves

http://bingweb.binghamton.edu/~ajones/#Seismic%20Waves

Download the Seismic Wave program from this site and use it to visualize the waves that propagate from historical earthquakes. Try to understand why wave propagate the way they do.

Tsunami information

http://nctr.pmel.noaa.gov/

Web site for NOAA Center for Tsunami Research. Check out the measurements page in particular. Also take a look at the animations of individual tsunami events.

Earthquake Lessons

http://earthquake.usgs.gov/learning/students.php?sendLevelID=11

USGS site has a lot of good links.

More earthquake resources

http://www.iris.edu/hq/programs/education_and_outreach/resources

You should use this site to try and develop some of your own tests. The “Utah Mine Collapse Teachable Moment” is particularly interesting.