

GEOL 15 Mid-Term I Study Guide Fall 2013

Course Learning Outcomes

1. Apply the scientific method and scientific reasoning to critically evaluate geologic phenomena.
2. Communicate the basic elements of plate tectonic theory and apply these concepts in describing how earthquakes, or other geologic hazards, impact both humanity and the natural environment.
3. Apply physical science principles to describe how energy is transmitted through geologic systems.

Content and Study Questions

Scientific Method: What are the steps? Can we tell what step we are in?

Energy: How are these forms manifested in the Earth Sciences? What is energy? What is a force? What are “at a distance” forces? What is the difference between Kinetic and Potential Energy? Can energy change form?

Hazard vs. Risk: What is the difference?

Earthquakes: What are they? What causes them? What are the results of an earthquake? What is an earthquake fault?

Stress and Strain: What is stress? What is strain? Are these forms of energy transfer? If so, how is energy transferred? How do these relate to earthquakes? What three types of stress and strain are there? What is Hooke’s Law? What is elastic? What is plastic? What is brittle? What is ductile?

Elastic Rebound Theory: What is this and how does it relate to earthquakes? What is a model of this (involved a brick)? What parts of the model represent what parts of the real world? What event gave rise to this theory? What are the steps in the elastic rebound theory? What are the four earthquake stress-strain cycle models (periodic, characteristic/time predictable/slip predictable/non predictable, non-characteristic)?

Origin of the Earth and Time: What is the age of the Earth? What are the two types of time that geologists use? What is the law of superposition? What is a radioactive half-life? Can we use radiocarbon ages to evaluate the age of the earth? Why or why not?

Earth’s Structure: What are the two ways that people describe the structure of the Earth (physical properties and strength vs. mineral and chemical composition)? What are the layers (in both systems) and their relative depths/thicknesses? What is the radius of the Earth? How can you quickly calculate the radius of the Earth (What re the 2 conversion factors)? What are the average thicknesses of oceanic or continental crust? What is density? What does density do as one goes to the center of the earth? Which is more dense, oceanic or continental crust? How can you tell (hint: looking at the elevation and crustal thickness)? What is Isostasy?

Plate Tectonics: What is plate tectonic theory? What are plates? Where are they? What are in between the plates? How can we see the boundaries of the plates? Do the plates move (aliens?)? If so, why? How can we tell? What is thermal convection? How might thermal convection transfer energy from the mantle to the plates? How might thermal convection transfer energy within the mantle? What happens when plates get older and colder? What are the observations that led to plate tectonic theory? What are

magnetic anomalies (how do they form)? What can they tell us about plate motions? What can they tell us about Earth's magnetic field?

Plate Boundaries: What are the three types of plate boundaries? What type of stress and strain is each type of boundary associated with? Does crust get shortened, lengthened, or neither at which plate boundary fault? What are some examples of these plate boundaries? What are the three types of convergent plate boundaries (can you think of an example of each)? Why does the oceanic plate subduct beneath the continental plate?

Observations of Plate Movement: What are some evidences of plate movement (magnetic anomalies, GPS and other forms of "geodesy," hotspot tracks)? How can you measure plate rates (e.g. spreading rates)? Could you do this? How do you define a rate? How do you calculate a sedimentary thickness given a sedimentation rate and a time?

Faults: What are the three main types of faults? What types of stress and strain does each fault type associate with? What are the two other types of faults (modifications/combinations of the three fault types)? What types of faults associate with what types of plate boundaries? Why? What is the strike and what is the dip of a fault? What is the difference between right-lateral (San Andreas) and left-lateral? What are the two kinds of folds? What type of fault can make a fold? If a fault does not reach the surface, what is it called? Can strike-slip faults create extension (transtension) or compression (transpression)? How (with what fault configuration)? What are the hanging wall and the foot wall? How can you tell which direction a fault moved (slickenlines, offset streams, offset geologic layers)?

Earthquakes part 2: What is Seismic Intensity? What is an example scale? What are the controls on seismic shaking (initial earthquake, bedrock type, crust type (east coast US vs. west coast US), and distance from the fault)? Where are some places that I discussed examples of earthquakes? What type of plate boundaries and what type of earthquakes were they (Denali 2002, San Francisco 1906, Aleutians 2013, Sea of Okhotsk, 2013, Pakistan 2013)? Where do earthquakes occur (related to depth of hypocenter)? When might earthquakes occur at different depths? What is the difference between intraplate and interplate earthquakes? What is earthquake magnitude? How is it determined?

Seismology: Where was the first seismometer made? What are the four types of seismic waves and what are the two main categories these fit into? Could you name the wave if you saw the motions in an animation? Could you describe the seismic wave (e.g. name it, what is the propagation direction, what is the particle motion)? What are the first and second waves to arrive at a seismometer? What can seismic velocities tell us about Earth's structure? What does a seismometer (seismograph) do? What is a seismogram (what do the two axes represent)? What does Snell's Law do to waves that travel through layered media (bent straw, offset polar bear head)? What happens to a seismic wave when it crosses a boundary (what happens when the boundary goes from slower to faster; what happens when the boundary goes from faster to slower)? What are seismic shadow zones? What do they tell us about the structure of the earth and why? What are some seismic wave names and why are they named like this (P, PP, S, PKP, SKS)? What is a travel time curve? How can we locate earthquakes given seismograms and a map of the seismograph/seismometer locations?