G201, General Geology – Final Study Guide

IMPORTANT NOTE:
This file includes only material since Midterm 2 and does not include the material covered by Midterm 1 and Midterm 2; There are separate files, one entitled Midterm 1 Study Guide and the other Midterm 2 Study Guide

The Final will cover about 1/2 of material covered since Midterm 2 and 1/4 Midterm 1 and 1/4 Midterm 2 material.

In your review of Midterm 1 and 2 material, pay attention to major rock groups, what they are, where they form, which minerals occur where, how are they classified, etc. In other words get the essence of the material without the absolute last detail.

Structural Geology – Deformation of rock
Rock either break (brittle behavior of rocks) or deform plastically (ductile behavior of rocks)

Deformation produces either folds or faults

Deformation of rocks due to a stress field; Most important deformation due to compression, extension.

Why deformation? Because plates interact with each other due plate tectonics, therefore plates collide, move apart, or slide along sideways.

Therefore, main areas for ongoing deformation are all three types of plate boundaries (convergent, divergent, transform)

What are folds? Where do they form etc.

What are faults? Normal, reverse, strike-slip faults

Normal faults – due to extension
Reverse faults – due to compression (e.g. Cascadia subduction zone)
Strike-slip faults – due to transpression (sliding of blocks sideways) (e.g. San Andeas fault)

Terms to know: angle of dip, hanging wall, foot wall, anticline, syncline, hinge line, graben, horst

Geological time, timescale, history of the Earth, and geological maps
Age of the Earth 4500 million yrs or 4.5 billion yrs;

Plate tectonics + atmospheric processes (erosion by wind, water, etc.) responsible for constant physical changes of the face of the Earth.

Age of the Earth subdivided in eras, periods, and epochs; each covers a certain time span;
Which are some example for these (Table 8.2)

Relative and absolute dating techniques

Principles of relative dating
Principle of superposition
Principle of original horizontality
Principle of faunal succession
Law of correlation
Cross-cutting relationships
Inclusions
Unconformities
Index fossils

Law of superposition
In an undeformed sequence of sedimentary rocks (or layered igneous rocks), the oldest rocks are on the bottom

Principle of original horizontality
Layers of sediment are generally deposited in a horizontal position
Rock layers that are flat have not been disturbed
On the other hand, if sedimentary beds are inclined, they have been put under stress (in most cases)

Principle of faunal successions
Vertical arrangement in a stratigraphic column, establishment of evolution within species (e.g. the simplest forms are on the bottom and most complex on top)

Principles of cross-cutting relationship
A disrupted pattern is older than the cause of disruption
Younger features cut across older feature
Disruption caused by a) erosion, b) deformation, c) magma
Principles of relative age dating
Inclusions
An inclusion is a piece of rock that is enclosed within another rock
Rock containing the inclusion is younger
Unconformity
An unconformity is a break in the rock record produced by erosion and/or nondeposition of rock units
Index fossil
Have short histories and wide geographic range
E.g., Trilobites: Paleozoic
E.g., Dinosaurs: Mesozoic

Types of unconfomity
Angular unconformity – tilted rocks are overlain by flat-lying rocks
Disconformity – strata on either side of the unconformity are parallel
Nonconformity – metamorphic or igneous rocks in contact with sedimentary strata

Correlation of rock layers
Matching of rocks of similar ages in different regions is known as correlation
Correlation often relies upon fossils
Principle of faunal succession – fossil organisms succeed one another in a definite and determinable order, and therefore any time period can be recognized by its fossil content

What are superposition features between rock units one can observe in the field to determine relative ages of their formation.

Absolute age dating
Radiometric age dating based on natural radioactive elements. Radioactive elements are those that undergo spontaneous fission according to constant decay scheme involving constant time intervals between fission events

All absolute ages are derived through radiometric dating
Radiometric dating based on radioactive decay
Radioactive decay involves the transition from a parent atom (e.g. Potassium) to a daughter atom (e.g. Argon)
Decay happens systemically and according to a given rate
Knowing: a) how many parent atoms are present, b) how many daughter atoms are present, c) the rate of decay (half-live); yields: the time how long the decay has been going on and thus the age of the sample (how old the sample is)

A radioactive decay curve
Radiometric dating
Radioactive elements (isotopes) used for dating:
Carbon (C^{14}) - Halflive: 5730 years
Potassium (K^{40}) - Halflive: 1.25 billion years
Uranium (U^{235}) - Halflive: 0.71 billion years
Thorium (Th^{232}) - Halflive: 14.1 billion years
Age dating limitation: 10 Halflives
Mainly igneous and metamorphic rocks contain Potassium, Uranium, Thorium
C^{14} method to date charcoal, shells, other organic materials carbon

Geologic time scale
The geologic time scale – a "calendar" of Earth history
Subdivides geologic history into units

Originally created using relative dates
Structure of the geologic time scale
Eons (e.g. Phanerozoic)
Era (e.g. Cenozoic)
Periods (Quaternary)
Epochs (Pleistocene)

Difficulties in age dating
Not all rocks can be dated by radiometric methods
Grains comprising detrital sedimentary rocks are not the same age as the rock in which they formed
The age of a particular mineral in a metamorphic rock may not necessarily represent the time when the rock formed
Datable materials (such as volcanic ash beds and igneous intrusions) are often used to bracket various episodes in Earth history and arrive at ages

Geological maps show not only the distribution (two dimensions) of the outcropping rocks (rocks that are exposed at the surface) but also include 3. Dimension with help of topographic lines; furthermore 4. Dimension (Time) and 5. Dimension (type of rock) is depicted with help of colors, patterns and symbols printed on the map.

Earthquakes/Earth Interior

What are earthquakes, earthquakes occur when rocks break

What is the Richter scale

Plate boundaries are areas with the most earthquakes, why?

Seismographs are the instruments that record earthquakes

Epicenters, locus

What waves are generated, mainly P- and S- waves.

What is difference between P and S waves and how do they travel trough the earth