

“Connections”

I will try to show how many of the different topics we have studied this semester are inter-related (connected); how one influences the other.

Geology is the science of the Earth, its history, processes and materials.

The scientific method is applied to observations to develop explanations for the processes.

At about _____ billion years ago, a star formed in a nebula like this that became our sun

The Earth

- ~ _____ billion years old
- Formed by accretion of colliding chunks of matter in the solar system.
- Chunks are attracted to one another (gravity).

Structure of the Earth as determined by seismic waves

Chemically Different

Crust

Continental
Oceanic

Mantle

Upper mantle
Lower mantle

Core

Outer core
Inner core

Shadow Zones - Area where seismic waves are not recorded opposite an earthquake epicenter.

Both P and S wave shadow zones form as a result of the molten outer core of the earth.

- P waves are refracted by the outer core.
- S waves disappear in the outer core.

Years of worldwide earthquakes and nuclear explosions allow the interior of the Earth to be mapped

A Unifying Theory for Geology

- There is a pattern to the earth's features such as earthquakes, volcanoes and mountain chains.
- Their location IS NOT RANDOM.
- Theory of Plate Tectonics

The **Theory of Plate Tectonics** consists of four basic concepts.

1. The outer portion of the earth, the lithosphere, is broken in units called plates.
Lithosphere = Crust + Portion of Upper Mantle (solid) Outermost portion of earth, 100-200km thick.
Asthenosphere – Within the Upper Mantle (partially molten) 100-200 km thick.
2. The plates move.
3. Most geologic activity (such as earthquakes and volcanoes) is concentrated near plate boundaries.
4. Plate interiors are relatively quiet (less active).

Plates move by _____ – A process of heat transfer in which hot material rises (due to lower density) and cool material sinks.

The movement of the plates on the surface is the manifestation of the convection in the mantle

This process is called **PLATE TECTONICS**

There are 3 major types of plate boundaries depending on **relative plate movement**.

Divergent

Convergent - **Ocean – Continent, Ocean – Ocean, Continent - Continent**

Transform

Hot spot

Faults are associated with the plate boundaries and ancient plate boundaries

Types of Faults

Strike-slip faults – side to side (horizontal) motion. Result of shear stress. What Strain _____?

– **Left-lateral** - **Right-lateral**

Vertical motion - normal and reverse : need to use the stick person to identify head (hanging wall) from footwall

Normal HW moves down. Stress = _____ **Reverse** HW moves up. Stress = _____

Types of Folds: **Anticline** - _____ **what stress?** _____ **Strain?** _____

Syncline - _____

Most geologic activity (such as earthquake and volcanoes) is concentrated near plate boundaries.

But before we can talk about volcanoes we need to know something about minerals and how minerals combine to form rocks.

What is a Mineral?

- naturally occurring
- inorganic - no organic carbon
- crystalline solid - atoms are arranged in a particular structure (ex: a cube)
- Specific chemical compound - contains particular elements in a set ratio.
 - H₂O has a set ratio. Is water a mineral? What about mineral water? Ice?

What conditions cause minerals to form?

- Lower the temperature of a liquid below its freezing point
- Liquids evaporate from a solution forming a supersaturated solution and results in precipitate
- When atoms and ions in a solid become mobile and rearrange themselves at high temperature (>250 °C)

We are consumers - almost everything we use is made from raw materials that were mined or grown. (news papers to autos)

Minerals to Rocks - Now we can combine one or more minerals to form different rocks! **Be familiar with the rock cycle**

Generation of Magma: Divergent boundaries, Hotspots, Convergent boundaries (ocean to continent and ocean to ocean)

Igneous Rocks: Intrusives (large visible crystal - slow cooling beneath the surface of the earth)

and Extrusives (small to microscopic crystal - fast cooling at or near the surface of the earth)

To summarize in terms of magma type:

Mafic magma: Low SiO₂, high Fe + Mg generally higher temperature low viscosity - like oil, flows

Intermediate magma: properties in between

Felsic magma: High SiO₂, low Fe + Mg generally lower temperature high viscosity- like toothpaste, thicker

Volcanic Eruptive Styles - Comparison Effusive-_____ Pyroclastic - _____

Effusive:

- gentle eruptions
- Lava dominates
- magma/lava low in generally low in silica (mafic)
- low viscosity
- release gas
- occur commonly at divergent boundaries and hot spots
- Ex: Kilauea, Hawaii, Mid-Atlantic Ridge

Pyroclastic

- Violent eruptions
- Mostly pyroclastics
- Lava high in silica (intermediate to felsic)
- High viscosity
- Gas is trapped
- Occur commonly at convergent boundaries and hot spots

Volcanic landforms:

Flood Basalts

- Fissure eruption
- Fluid lava (generally basalt)
- Generally flat layers

Shield Volcanoes

- Central vent
- Broad, large

Basaltic Lava types: Aa - _____, Pahoehoe-_____

Composite Volcano

- Central Vent
- Steep sided, large
- Composed of alternating lava flows and pyroclastics.

Hazards-

- Mudflows can be triggered for numerous reasons.
- Lahars are a type of mudflow that results from mountain snow and ice melting with or without a volcanic eruption.

Caldera - _____

Weathering and Erosion

- ***Physical weathering:*** reduction in size
- ***Chemical weathering:*** change in composition
- ***Erosion - Transportation:***
 - Solid particles ... clastics by water, wind, ice, gravity
 - Ions in solution ... chemical

The landscapes that surround us are the result of physical and chemical weathering and erosion.

- The last few chapters covering Mass wasting, Streams, Ground water and Karst, Glaciers
- All deal with modifying the land surface of the Earth by the agents of erosion: gravity, water ice, and wind.

From Weathering to Sedimentary Rock the breakdown of pre-existing rock

Erosion and deposition followed by lithification

Common Sedimentary Rock Textures Biochemical, Clastic, Chemical (be able to recognize in photo)
Sediments are deposited, buried, lithified (compaction and/or cementation) forming the layered sedimentary rocks of Monument Valley

Metamorphic Rocks - Rocks whose original form has changed in the solid state due to changes in temperature and/or pressure which can give rise to hot fluids.

Types of metamorphism: regional - _____,
contact- _____,
shock- _____.

Common Metamorphic Rock Textures : Foliated _____
Nonfoliated _____

Telling time geologically

- Earth's history is concealed in rocks
- One of the Goals of geology is to unraveling Earth history

Earth's geologic clock – How do we tell time?

Absolute dating - determining event's actual time

Relative dating - putting rocks/events in proper order

Principles of Relative Dating

1) Principle of original horizontality: sediments are deposited in horizontal beds.

2) Principle of superposition: In an undisturbed sequence of rocks, each layer is younger than the one beneath it and older than the one above it.

3. Faunal Succession – Fossils as timepieces ; Use of index fossils to correlate rocks from different locations

4. Unconformities: Markers of missing time. (deposition of rocks isn't continuous forever) be able to recognize

Angular Unconformity

Nonconformity

Disconformity

5. Cross-Cutting Relations:

Dike cross-cuts the three pre-existing rock layers. Therefore, it is younger than the three rock layers.

Fault cross-cuts all three rock layers. Therefore, the fault is younger than the three rock layers.