nature of geology (chapter one)

- observational science
- there are a lot mountains on the West coast

how does geology influence where we live

- we live within a 50 mile radius of a large water body
- transportation
- need water to survive
- food (fishing)
- 1/3 of the entire food for the country comes out of the Central Valley
- nature likes to build things up and tear them down

Creatures tend to bundle where there is resource pool, be it water, food, shelter, energy, etc

what is inside earth

- upper layer is the crust (two types):
  - continental
  - oceanic
- thickest layer
  - mantle
- deepest layer:
  - iron-nickel core (molten outer core, solid inner core)

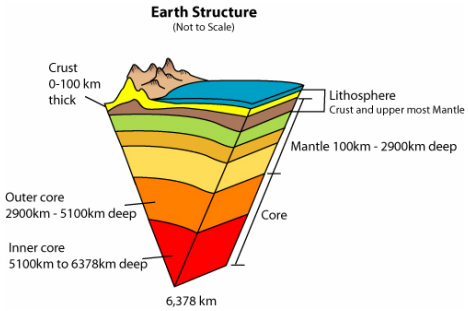

Figure 1: earth struct

some layers are stronger than others

- The top layer of the Earth is stronger than the middle.

  - For example, a tootsie pop very dense on the outside and as you approach the center, it gets chewier.
- This external layer is called the lithosphere which contains (in order):
  - continental crust
  - oceanic crust
  - lithospheric mantle
- The inner layer is called the asthenosphere
  - it is hot, weak and mostly solid

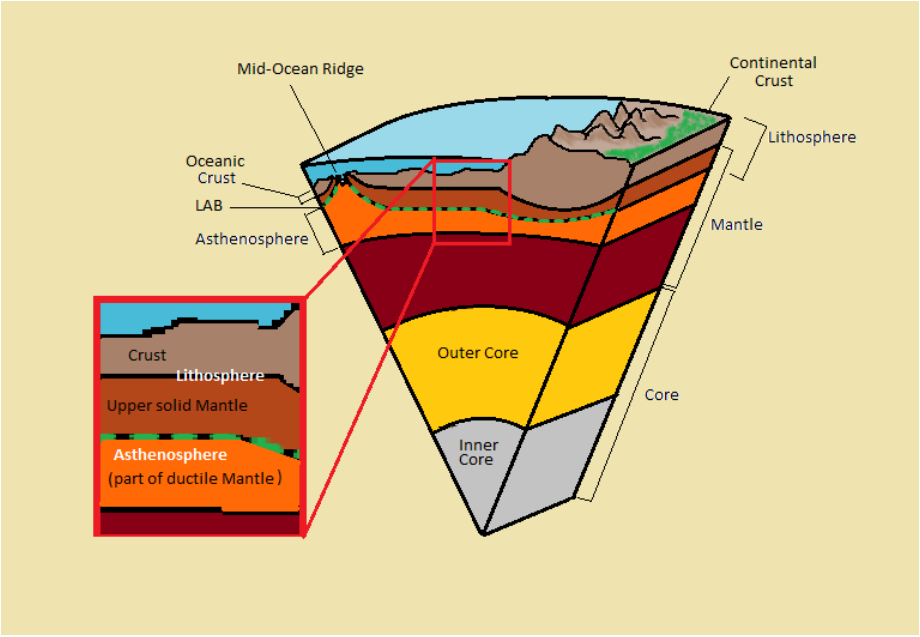

Figure 2: litho and asthen diagram

- Hot things want to rise
  - lava rises because it is less dense than the surrounding rock

Mountains get more precipitation because they are higher in elevation

- clouds get to the mountains first
- one side gets water and the other side gets nothing
- the wet side of the Andes allows for more life and the other side, Chile, its one of the driest places on earth

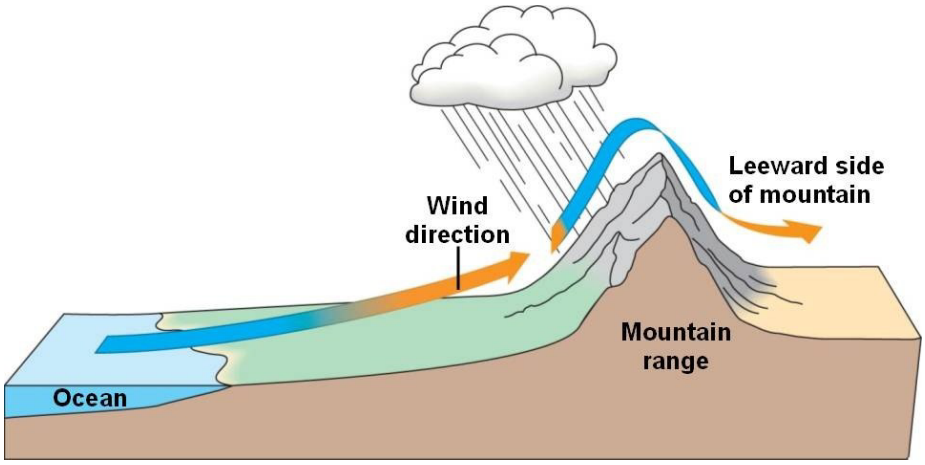

Figure 3: leeward mountain diagram

why are some regions high in elevation

- areas that have a thick continental crust tend to be higher in elevation
- these areas also are thicker than the oceanic crust it neighbors
- Thick blocks are higher than the thinner blocks around them
- Thinner blocks are lower because they are more dense
- This relationship between crustal thickness and elevation: **isostasy**

isostasy

Formal definition:

- the equilibrium that exists between parts of the earth's crust, which behaves as if it consists of blocks floating on the underlying mantle, rising if material (such as an ice cap) is removed and sinking if material is deposited.

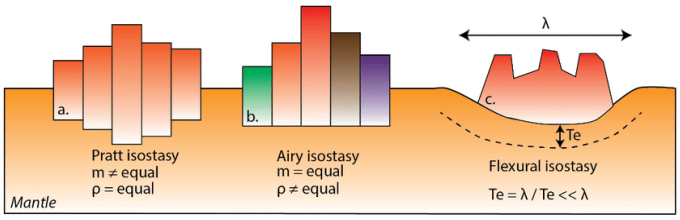

Figure 4: isostasy model

earth's forces and how they help process it's materials

Many different environmental factors help shape the Earth such as atmospheric pressure, gravity, etc

steep mountain front

- steep and angular
- have not moved far
- rocks -> sand grains

rock formation

- **igneous** rocks (fire rocks)

Figure 5: fire rock

These rocks form from magma and are expelled by volcanoes

- **metamorphic** rock (rocks that have changed)

Figure 6: changing rock

These rocks can be found away from a volcano, more specifically rocks moved by nature. Sand is an example of this as grains of sand are actually microscopic balls of rock.

- **sedimentary** (rock layers)

Figure 7: layered rock

Layered slabs of rock where the bottom is older than the top. This is the only rock to support fossils, other rocks would erode or destroy fossils.

rock cycle

The process in which rocks change between states and types.

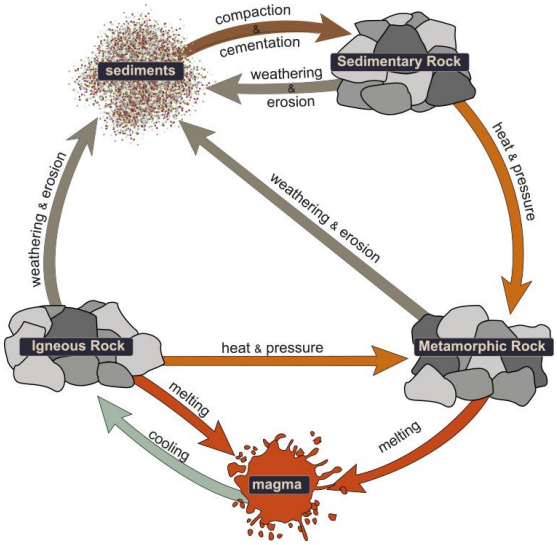

Figure 8: rock cycle

External Links

- inside the earth

File path to lecture -> ../lectures/EG5e_ch01_Nature of Geology.pdf

Investigating Geologic Questions

Things to look out for

- Observe the Mediterranean Sea, noting how it connects (or does not connect)
  - Human intervention
  - Plate tectonics allow for water to flow
- Draw what you see
- Different scales (perspectives) are different ways of viewing a scene
  - Earth from space vs microscope
- Compare this rock to deposits from two environments shown below
  - Which environment has deposits most similar to the rock
- uniformitarianism (rocks are being moved now and it can be assumed that they moved in the past)

Interpreting Evolution of Landscapes

- rain, wind, erosion etc

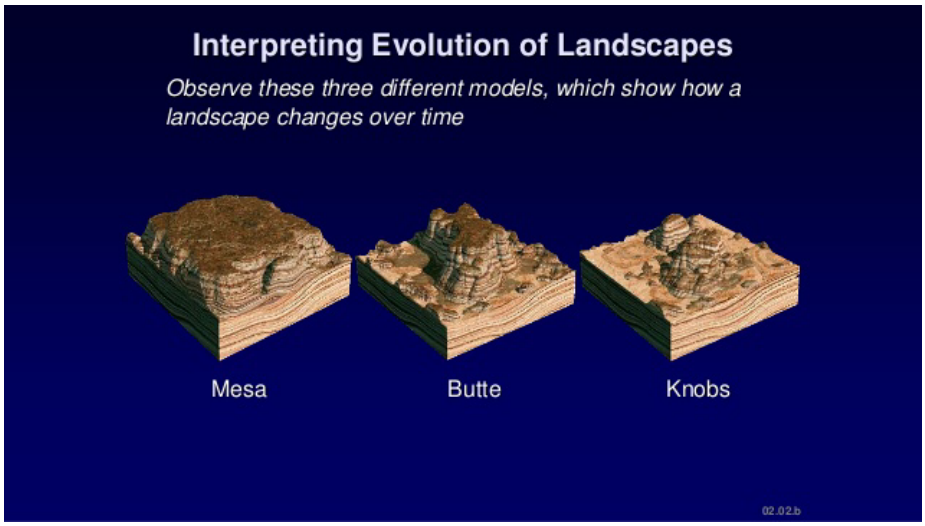

Figure 1: landscape transformation diagram

Determining Sequences of Events: Position of Layers

The bottom most layer is the oldest in the stack

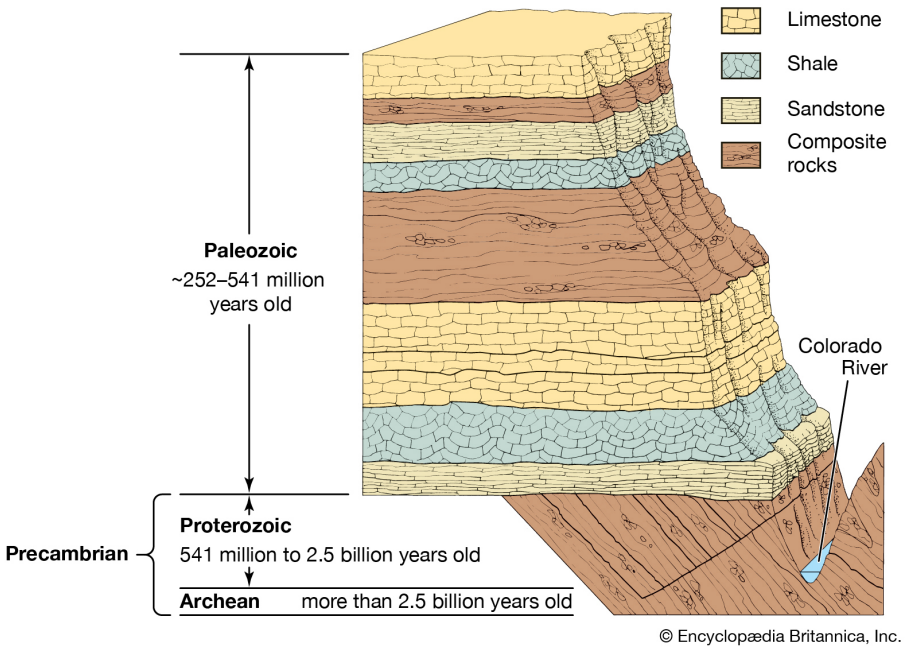

Figure 2: Positions of Layers

Cross-Cutting Relations

Faults, fractures and cracks can only occur if the layers existed first

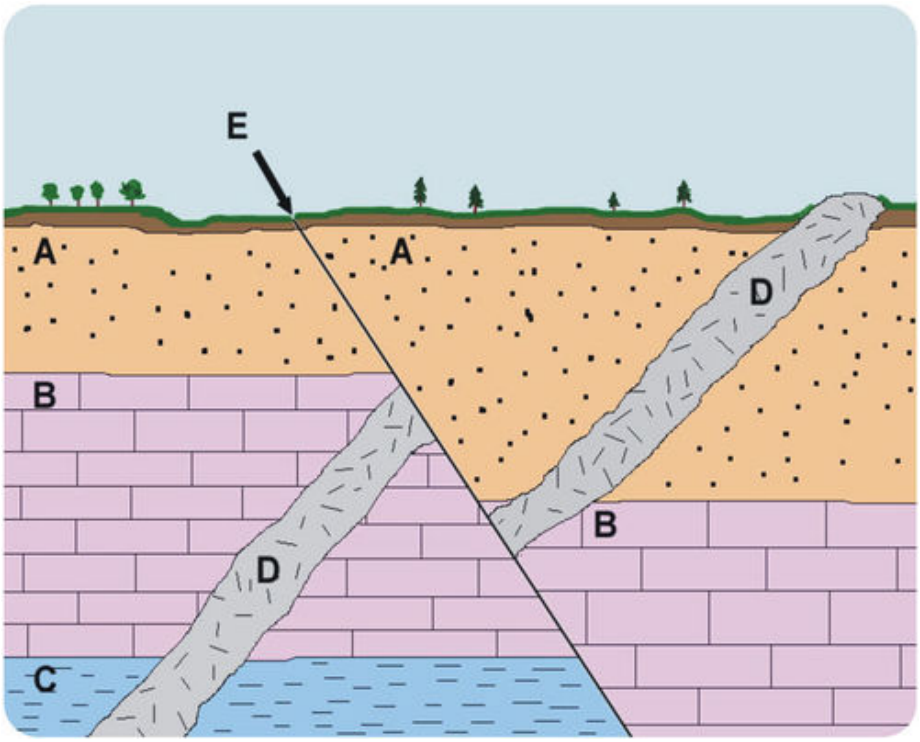

Figure 3: Cross-cutting relationship

Pieces of clast

Older rock that is trapped inside newer rock

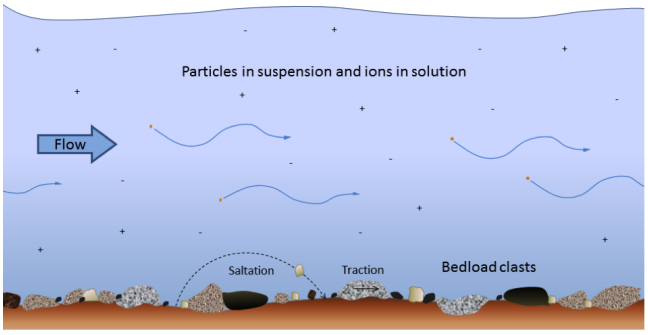

Figure 4: Clast found in an younger solution

Contact Effects

Hot molten rock burns cooler surrounding rock. This is called the "Baked Zone"

Figure 5: Baked Rock Vein

Rock layers can be different

Types of Maps

- Shaded-relief map
- Topographic map with elevation contours (change in gradient)

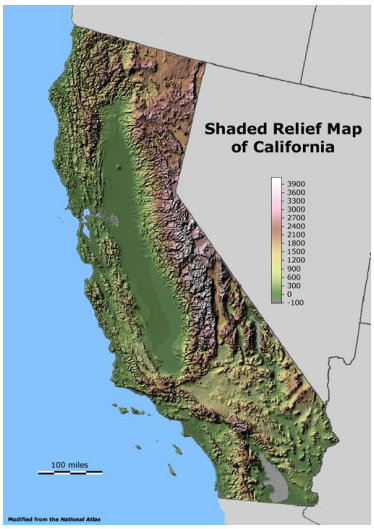

Figure 6: Shaded relief map of California

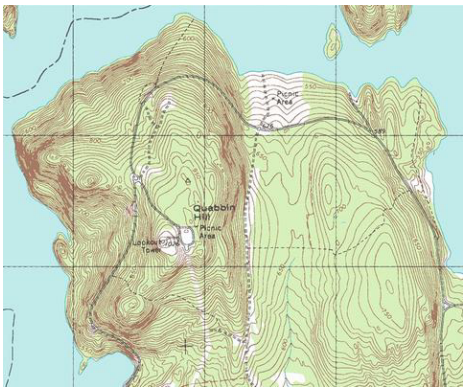

Figure 7: Topographic map of California

Qualitative vs Quantitative

- Qualitative : descriptions
- Quantitative : numeric measurements (conveyed with numbers)

Density

- Mass/Volume

Weight

- Downward force an object exerts via gravity

Chapter 3 : Plate Tectonics

, There are many plate boundaries and they have unique characteristics

Fossil Data and Continental Drift

- similar animals at boundaries between continents
- continents were all together at one time
- WW2 changed our perspective
- map where all the earthquakes happen, where all of the volcanoes were
- mountains in the belts

Three Types of Relative Plate Motions

Moving apart: divergent boundary (Atlantic ocean)

```
- magma is coming up from the bottom to fill the gap
-
```

Moving toward each other : Convergent Boundary

```
- same density
- the plate begins to melt at some depth and forms a chain of islands
```

- move horizontally past one another: transform boundary (san andres fault)
  - zig-zag pattern and is not a linear path for the fault

What moves the Plates

We are not sure what the root cause of the movement is

Earth Minerals

- Solid
- Natural
- Inorganic
- Ordered internal structure
- Specific chemical composition

Figure 1: Examples of minerals

Is ice a mineral

Ice by definition it is a mineral (when solid) but as a liquid is not.

Figure 2: Ice, ice, baby

Mineral formation in other rocks

Composed of visible or microscopic crystals: crystalline rock

Figure 3: Crystalline Rocks

Composed of pieces (clasts): clastic rocks

Figure 4: Clastic Rock

Distinguishing One Mineral from Another

Crystal formation

Cleavage

- How it shears along smooth planes parallel to the zones of weak bonding.
- Sheets joined by long bonds between sheets break along the weakest bonds
- Bonds with the same strength can break along `N` sets of planes without passing through an atom
- In other arrangements, the mineral will break in nearly any direction so it will fracture instead of cleave.

Color

Luster

How much it reflects in the light

Hardness

How strong the bonds are between the atoms

Effervescence

The foaming and fizzing reaction when certain chemicals come in contact with it

Streak

What color does it leave behind if scraped on a porcelain plate

Magnetism

Does it attract magnets

Density

What controls a crystal's shape

- Sizes and packing of atoms
- Internal structure of the mineral
- orderly arrangement of atoms in repeating patterns

Different shapes

- Cube
- Tetrahedron
- Octahedron

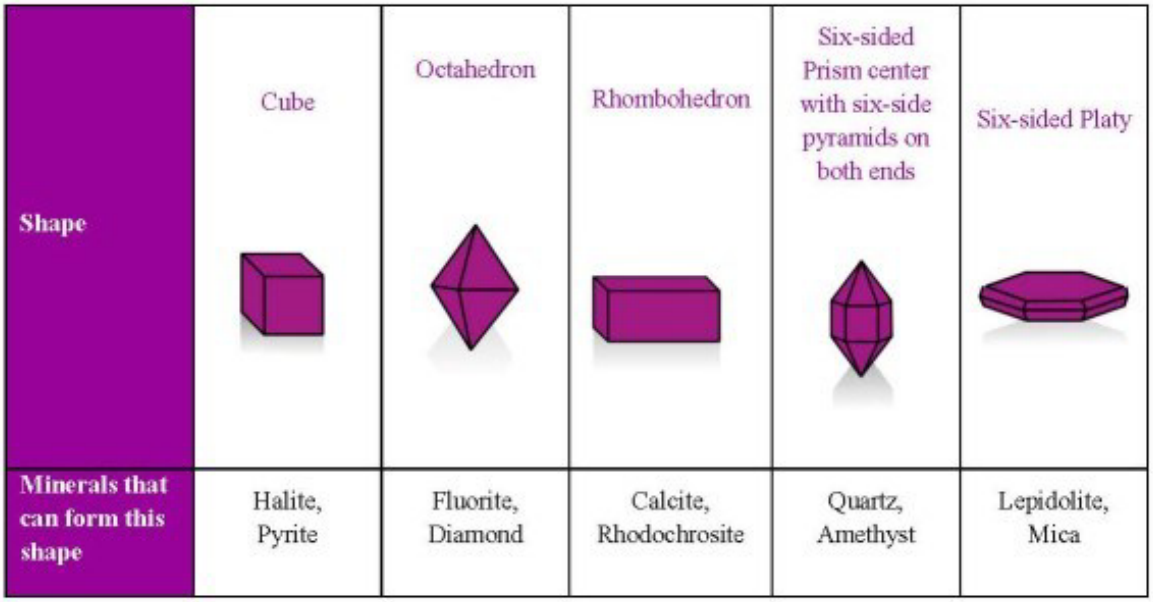

Figure 5: Crystal shape diagram

Major Classes of Rock-Forming Minerals

Silicate Minerals

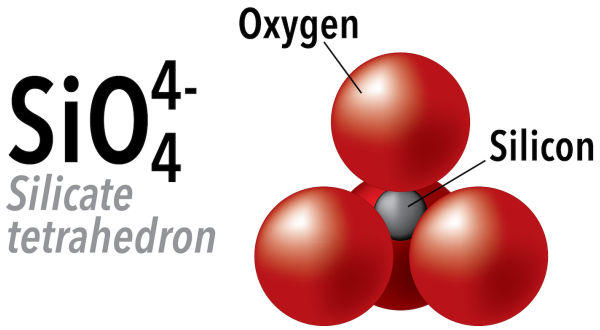

Figure 6: Silicate Tetrahedron

Can bond together and with other elements

Independent Tetrahedra

Tetrahedra bond to other elements, not other tetrahedra

Figure 7: Olivine

Single Chain

Figure 8: Pyroxene

Double Chain

Figure 9: Amphibole

Sheet Silicate

Figure 10: Mica

Frameworks

Figure 11: Quartz

Nonsilicate Minerals

Carbonates

Figure 12: Calcite

Oxides

Figure 13: Magnetite

Sulfides

Figure 14: Pyrite

Halides

Figure 15: Halite

Sulfates

Figure 16: Gypsum

How Atoms Bond

Sharing

Covalent bond

Example: water

Loaning

Ionic bond

Example: salt

Free flow

Metallic bond

Example: copper

Stick together

Intermolecular bonds

Example: Oxygen and Hydrogen bond

Crystal Structure and Bonds

- Carbon makes up both graphite and diamonds
- The only difference between the two is the bonds that make up the substance
- Diamonds have an extremely strong network of bonds

Properties of Water

- Oxygen and hydrogen share electron
- Water molecules are polar
- Helps dissolve other compounds

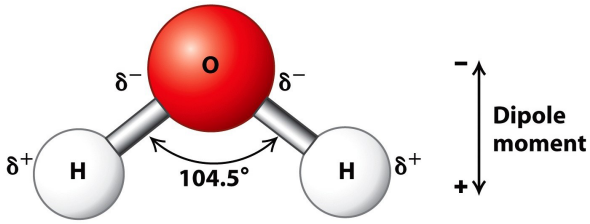

Figure 17: Water molecule diagram

GEO Lab Notes: Rock Cycle

Order for rock to enter cycle does not matter

Igneous (Initial Creation)

- Lava - on the Earth's surface
- Magma - under the Earth's surface

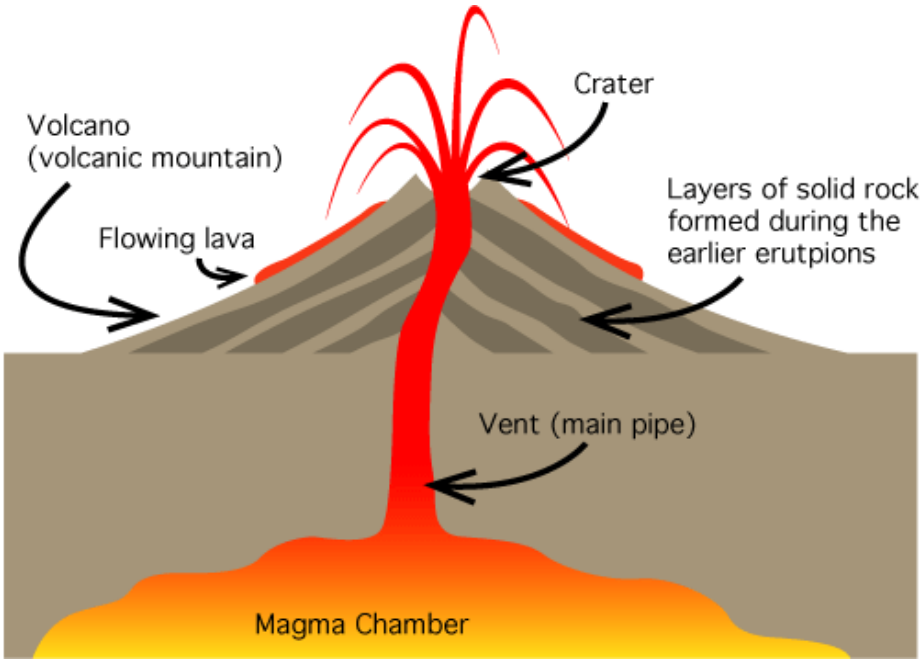

Figure 1: magma vs lava

- Extrusive: cools on the Earth's surface
- Intrusive: cools under the Earth's surface

Sedimentary (Deposition)

- Clastic: formed by mechanical weathering patterns (chunks of old rock in new rock)
- Chemical: formed when dissolved materials precipitate from solution
- Biogenic: formed by organic material

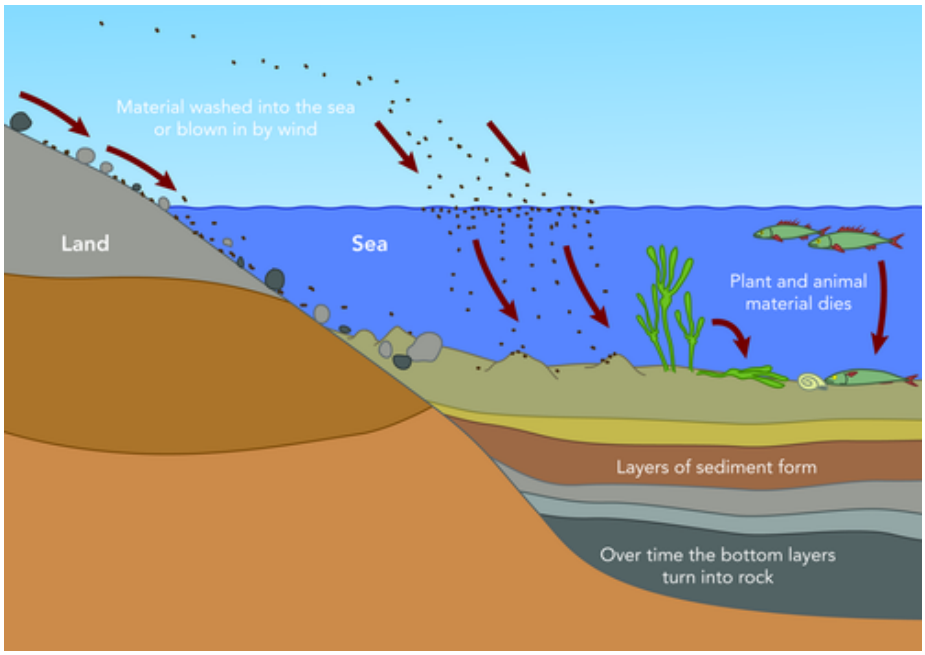

Figure 2: sedimentary rock formation

Metamorphic Rocks (Change)

Has been changed by heat, pressure and chemical

Foliated: layered or banded appearance (from heat and direct pressure)
Nonfoliated: from the accumulation of organic material

Figure 3: foliated rock

Figure 4: nonfoliated rock

See rock cycle diagram and figure 2.2 from Homework