IGNEOUS ROCKS & PROCESSES

GEOLOGY IN THE NEWS: Icelandic volcanic eruption in fall 2014 lets scientists see new crustal rocks form

Q: Why do we care about igneous rocks & processes?

A: Volcanoes are a natural hazard & igneous rocks are often used in construction.

I. MAGMA

- What is magma?
  - Magma- rock that is in a molten state & below ground
  - Lava- magma above ground
- Melting processes
  - How to melt rock:
    - Temperature- rock will not melt at one temperature, minerals have different melting points (partial melting)
    - Wet melting- with rocks, the presence of water can affect melting point (saturated basalt melts at lower temperatures than normal)
    - Decompression melting- pressure affects melting & boiling points; as material gets closer to the surface, it loses pressure & may melt easier
- Magma Composition
  - Whatever was present in the rock will be in the magma
  - Gases- not a huge component but in some cases it is very important
  - SiO_2- amount can vary, so we use it to classify & describe magmas
- Basaltic Magma
  - Most common
  - Source- mantle; can come to the surface anywhere
  - Dry magma- wet melting doesn't really work here
  - SiO_2 content ~50%
  - temps >1100 ˚C

- Andesitic Magma
  - SiO_2 content ~60%
  - 900-1000 ˚C
  - Oceanic & continental crust, but usually only found in very specific places
  - Andesite Line aka Ring of Fire
  - Many subduction zones in/near Andesite Line
- Rhyolitic Magma
  - SiO_2 content ~70%
  - 700-800 ˚C
  - Wet magma
  - Forms in continental crust
- Note: as temperature increases, SiO_2 content decreases, become dryer
- Freezing of Magma
  - Crystallization- fancy word for freezing; liquid to solid crystals of rock
  - Partial freezing- range of temps where minerals form crystals
  - Equilibrium crystallization- as we freeze it, we keep the magma at equilibrium (everything is how it was & balanced)
  - Fractional crystallization- some of the material gets taken out of the system, chemical formula changes
- Bowen's Reaction Series- the order rocks crystallize in
  - Discontinuous: quartz, muscovite, orthoclase, biotite, amphibole, pyroxene, olivine
  - Continuous: sodium-rich to calcium-rich plagioclase
  - Temperatures range from 800˚C to 1400˚C (felsic --> intermediate --> mafic --> ultramafic)

II. IGNEOUS ROCKS

- 2 broad types
  - Plutonic/intrusive- form below the surface of the earth
  - Volcanic/extrusive- form at the surface of the earth

- 2 properties for identification
  - Texture- how big the mineral grains are
  - Composition- what minerals are there
- Plutonic rocks
  - Pluton- igneous rock formed underground
  - Sill- horizontal pipe-shaped deposit of plutons
  - Dike- vertical pipe-shaped deposit of plutons
  - Laccolith- sill with a big round bump
  - Batholith- very large deposit of plutons
- Textures of intrusive rocks
  - Pegmatitic- a lot of the grains are big chunks (> 1 inch)
  - Phaneritic- grains are < 1 inch but still easy to see
- Composition
  - Either identify each mineral present or look at the color
  - Felsic- light colored minerals mostly
  - Intermediate- very gray in color mostly
  - Mafic- very dark black or brown mostly
  - Ultramafic- greens & yellows
  - Color index- figuring out how light/dark a rock is (works well about 90% of the time)
- Volcanic rocks
  - Same composition of plutonic rocks apply
- Textures of extrusive rocks
  - Porphyritic- some grains are large enough to see, some are not (like a chocolate chip cookie)
    - Phenocrysts- grains big enough to see
    - Matrix/background- grains you can't see (magma cools down really quickly)
  - Aphanitic- most of the grains are too small to be seen; fairly typical
  - Glassy- rock that looks like it's made of glass (obsidian); magma is cooling down especially fast
    - Obsidian is black but technically felsic (almost pure SiO_2)
    - Small shards of glass can come together