Plutonism & Volcanism

Setting – Where volcanism (igneous activity) happens

1) Spreading centers -- basalt

2) Subduction zones – more silicic because down-going slap carries water to upper mantle, lowers melting point of surrounding rock and partial melting of lower temp. rx occurs.

   a) Diorite/andesite (e.g. Andes Mtns.)
   b) Granite/rhyolite

3) Hotspots

4) Extensional areas (e.g. continental rifting)

Intrusive (plutonic) structures (intrusions)

Usually intrude at > 8km depth

How intrusion works (the space problem):

1) Wedging – forces way through cracks and faults

2) Stoping – break off and consume country rock
   - Xenoliths (foreign rx) are evidence

3) Melting – melts country rock

<u>Two general categories:</u>

Concordant structures – parallel to the layers of the "country" rock

Discordant structures – cross-cut the layers of the "country" rock

All are "**plutons**"

Concordant

- Sill – tabular (sheet-like)
- Laccolith
- Loppolith

Discordant

- Dike -- tabular (sheet-like) cm's to 100's m across: radiating : ring
- Stock (< 100 km^2)
- Batholith (> 100 km^2) coalesced plutons over long time period (Ex. Sierra Nevada built over 20 my)

Volcanic Settings

~600 active volcanoes (many more under ocean)

~ 70% are in "ring of fire" – subduction zones

Types of volcanoes

1) Shield volcanoes

    a. Wide and low (< 5° slope) (Kiluea > 30,000 ft!)
    b. Basaltic
        i. Aa – rough blocky surface texture.
           More viscous because gas is gone
        ii. Pahoehoe – ropy, wrinkled surface texture
    c. Ex. Hawaii

2) Cinder cone

    a. Pyroclastic cone – pile of tephra (ash + lapilli)
    b. basaltic
    c. Ex. Red Hill

3) Composite (stratovolcano)

    a. Alternating layers of tephra and lava
    b. Classic cone-shape, steep sided
    c. Ex. Rainier, Shasta

4) Fissure eruption

    a. Large scale outpouring of basalt
    b. Ex. Columbia Plateau, Snake River Plain, Deccan Traps

Volcanic Hazards

1. **Volcanic Earthquakes**
    a. *Tectonic* – stress due to inflation/deflation of magma chamber
    b. *Long-period* – injection of magma into cracks
    c. Uplift, tilt, and earthquake activity are important precursors to eruption

2. **Directed Blast**
    a. Mt. St. Helens (1980) lateral blast
        i. Trees snapped 30 km away, truck overturned 26 km away
        ii. Devastated ~600 km^2

3. **Ash & Tephra**
    a. Ash fall
        i. Bishop tuff -- ~730,000 yr ago, 140mi^3 of material
            1. from Long Valley Caldera
            2. as far away a Kansas
            3. 200m thick
            4. 2,200 km^2
    b. Hazard to intake of aircraft
    c. Climate change
        i. El Chichon, Mexico – April 1982
            1. caused cooling of ~1°C for about 1 yr.
            2. Caused(?)El Niño conditions

4. **Pyroclastic flows**
    a. Cold flows (avalanches & landslides)
        i. Lahars (Indo. "mud flow") water (snow melt) & tephra
            1. 1985, Nevado del Ruiz, Armero, Columbia buried w/ ~23,000 killed
    b. Hot flows
        i. **nuée ardent** (Fr. "glowing cloud") gas & tephra
            1. up to 400 km/hr , 100 km distance
            2. example went up and over a 700 m high ridge
            3. 1902 near Mount Pelee in the town of St. Pierre, Martinique, 30,00 killed
    c. produces "welded tuff" deposit 100's m thick

5. **Lava Flows**
    a. Pahoehoe destroyed 180 homes at Kalapana 1990
    b. Attempts to divert flows – limited success in Iceland, Italy, HI, etc.
        i. 1936 -- Bombing flows from Mauna Loa to protect Hilo Dropped 20, 600-pound bombs
        ii. Lead by Lt. Col. George Patton
        iii. Flow may have stopped naturally

6. **Volcanic Gases**
    a. Killed the residents of Pompeii when Vesuvius erupted in 79A.D.
    b. CO_2 killing trees at Horseshoe Lake, Mammoth Lakes
    c. Kau Desert, HI – acid rain

7. **Tsunamis**
    a. Krakatoa (1883 – Sunda strait)
        i. 35m runnup
        ii. ~35,000 killed