

VOLCANIC ACTIVITY

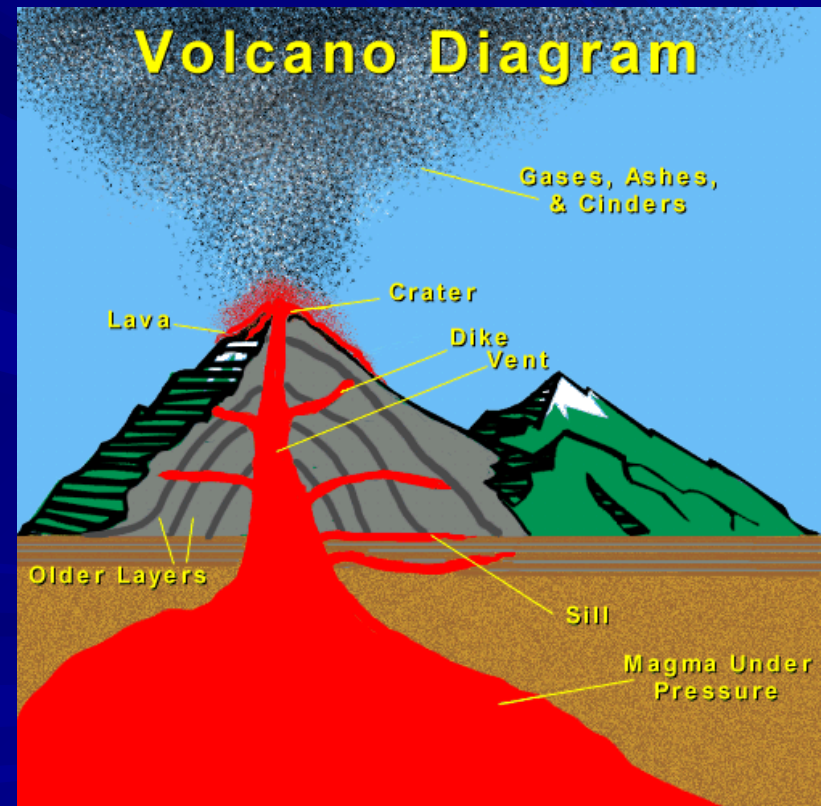
volcanism = any activity that includes movement of magma toward or onto surface

volcanologists = scientists who study volcanoes
- also called vulcanist



magma = mixture of molten rock, suspended mineral grains, and dissolved gases deep below surface

1. pockets grow due to melting of surrounding rock due to high temperatures (800°C – 1200°C)
2. will expand pushing upward into crust due to being less dense
3. slowly rises forcing its way into cracks of overlying rock
4. pressure may cause blocks to break off and melt adding to pocket
 - a. increases as depth increases
 - b. as pressure increases, temperature at which a substance melts also increases



5. presence of water influences whether rock will melt
 - a. at any given pressure, wet mineral or rock will melt at lower temperatures than same rock under dry conditions
6. viscosity depends on both temperature and composition
 - a. hotter the temperatures, lower the viscosity
 - b. as amount of silica increases, viscosity increases
7. can break through onto surface where becomes lava = magma that erupts onto earth's surface



TYPES OF MAGMA

1. basaltic magma (mafic) = same composition as basalt rock
 - a. forms when upper mantle melts
 - b. most rises rapidly to surface
 - c. reacts very little with crustal rocks due to low viscosity
 - d. has small amounts of dissolved gases and silica
 - e. these volcanoes erupt relatively quietly
 - f. tends to form at rifts and oceanic hot spots



2. andesitic magma (intermediate) = same composition as andesite rock
- a. found along continental margins where ocean crust is subducted into mantle (subduction boundaries)
 - b. source material is ocean crust or oceanic sediments
 - c. has 60% silica which results in intermediate viscosity
 - d. volcanoes will have intermediate eruptions



3. rhyolitic magma (felsic) = same composition as granite rock
- a. forms when molten material rises & mixes with overlying silica and water-rich continental crust
 - b. high viscosity inhibits movement
 - c. contains about 70% silica; contains large volumes of trapped gases
 - d. these volcanoes are very explosive
 - e. tend to form where hot spots underlie continental plates



VOLCANIC ERUPTIONS

1. lava = primarily molten rock but can differ in composition to that of magma
 - a. material can be removed or added as magma rises to surface
2. types of lava:
 - a. mafic lava (basaltic) = dark colored, rich in magnesium and iron
 - 1) usually of oceanic crust origin
 - 2) very hot and thin so flows almost like water; less explosive eruptions
 - 3) pahoehoe = solidified mafic lava with a wrinkled surface



4) aa = jagged chunks of lava form by rapid cooling on surface of a lava flow

5) pillow lava = flows out of fissures on ocean floor and cools rapidly in rounded shapes

6) outer part of lava flow can cool so rapidly to form a hardened shell around liquid interior which leaves tunnels in the hardened shell

b. felsic lava = a lot of silica with less iron and magnesium

1) usually from melted continental crust

2) cooler and thicker



3. composition of lava that reaches the surface determines the force of eruption
 - a. amount of water vapor and other gases that are trapped in magma
 - b. whether it is mafic or felsic lava
4. types
 - a. quiet
 - 1) due to mafic lava
 - 2) gases can easily escape
 - 3) lava pours from volcanic vents and runs down the side of the volcano
 - 4) form volcanoes over hot spots and flow from rift zones on ocean floor



b. explosive

- 1) usually due to felsic lava
- 2) contain large amounts of trapped gases (mostly CO₂ and H₂O vapor)
- 3) when a vent or fissure opens up, pressure is reduced
- 4) dissolved gases within lava boil out explosively
- 5) this sends molten and solid particles shooting into the air



Rock Formations Created:

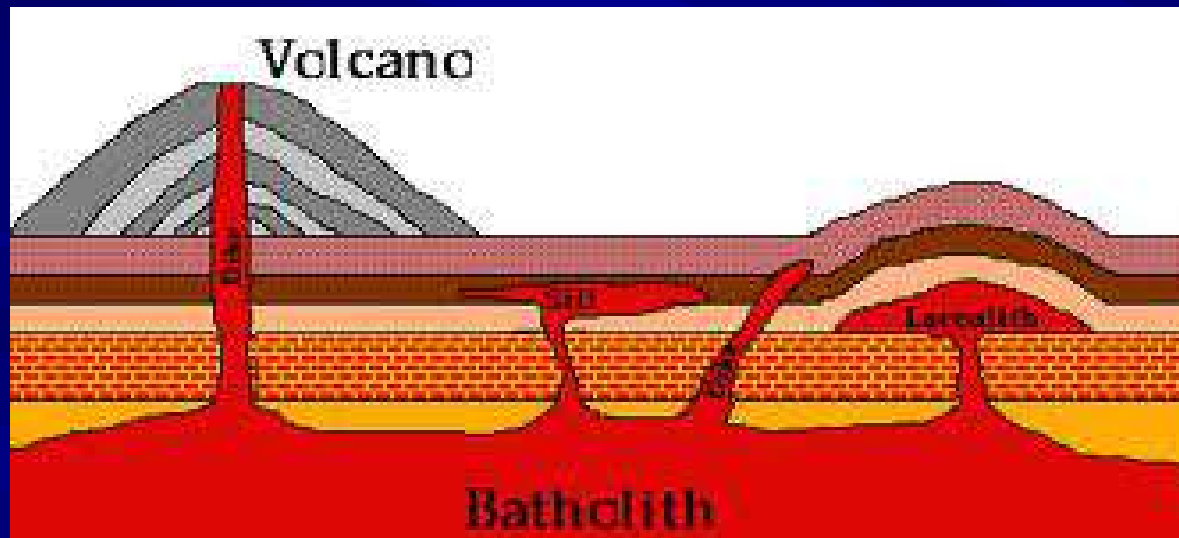
intrusions = underground rock masses

1. plutons = intrusive igneous rock body exposed at surface due to uplift and erosion; classified by size, shape, and relationship to surrounding rocks



2. batholiths = mostly composed of granite, but can have gabbro and diorite
- a. largest intrusions, can cover 100 km²
 - b. can reach depth of several thousand meters
 - c. form core of many mountain ranges
 - d. some are exposed at Earth's surface due to erosion

Ex: granite domes of Yosemite National Park
Stone Mountain - Elkin, NC

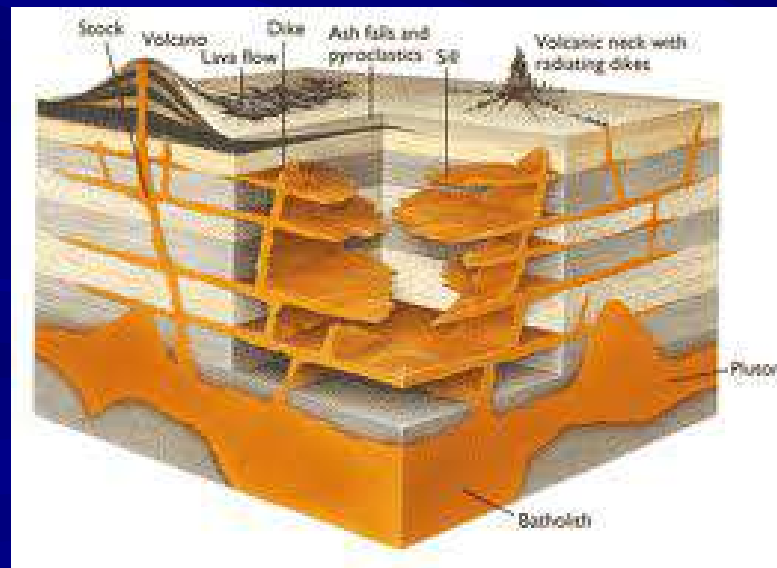


- 3. stock = similar to a batholith but covers less than 100 km²
- 4. laccolith = intrusion that pushes overlying rock layers into an arc
 - a. have round top and flat bottom
 - b. frequently found in groups
 - c. may form small dome shaped mountains

Ex: Black Hills, SD



5. sill = sheet of hardened magma that forms between and parallel to layers of rock
 - a. vary in thickness
 - b. can extend laterally for several km
6. dike = intrusion that cuts across preexisting rock layers
 - a. may follow vertical fractures or create new ones
 - b. can be few centimeters to several meters wide and up to several km wide
 - c. common in areas of volcanic activity



extrusions = surface rock masses and features

1. volcano = cone of rock surrounding a central vent through which lava flows
2. volcanic neck = solidified central vent of a volcano
 - a. forms when erosion carries away parts of the cone
 - b. resistant to erosion

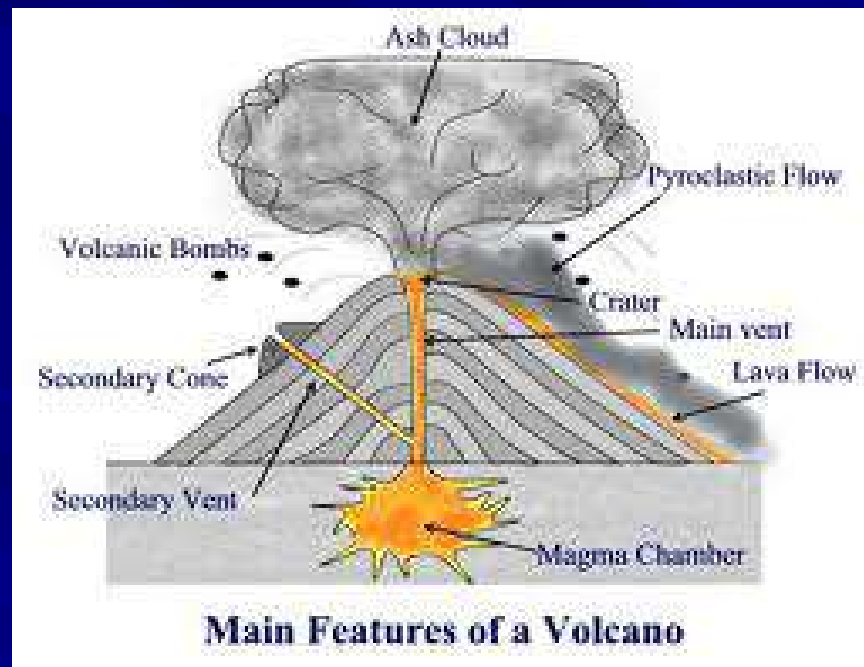


3. lava plateau = raised, flat topped areas made of layers of hardened lava
- a. develops from lava that flows from long cracks in surface
 - b. covers large area filling in valleys and covering hills
 - c. usually forms from basaltic lava



Volcano Anatomy

1. vent = opening through which magma/lava flows onto the surface
2. volcano = vent and volcanic materials that builds up on surface
 - a. most are now dormant
 - b. still more than 600 active
 - c. spew smoke, steam, ash, cinders, and flows of lava



3. craters = funnel shaped pit at the top of volcanic vent
- a. from where material is blown out of volcano by explosions
 - b. becomes wider as magma melts and breaks down walls
 - c. can have a smaller cone form within crater
 - d. usually less than 1 km in diameter



4. caldera = large, basin shaped depression
 - a. forms when magma chamber is emptied
 - b. cone may collapse
 - c. can be up to 50 km in diameter

Ex: Krakatau (volcanic island in Indonesia);
Crater Lake, OR



Kaguyak volcano,
Alaska

TYPES OF VOLCANOES

1. shield volcanoes = form from basaltic(mafic) lava
 - a. quiet eruptions spread lava out in flat layers
 - b. mountain with broad, gently sloping sides & nearly circular base
 - c. less explosive eruptions

Ex: Mauna Loa in the Hawaiian Islands



2. cinder cone volcanoes = formed from explosive eruptions
- a. made of solid fragments ejected into air which falls back to surface & piles up around vent
 - b. have very steep sides (close to 40°)
 - c. rarely more than a few hundred meters high

Ex: Mt. Pelee - Martinique
Paricutin - Mexico



3. composite volcanoes = formed from both quiet and explosive eruptions
- a. cone is formed mainly by lava flows from quiet eruptions
 - 1) explosive eruptions deposit large amounts of tephra around vent
 - 2) after many alternating eruptions a large cone forms
 - 3) also known as stratovolcanoes which often develop into high volcanic mountains



Mt. St. Helen's

- b. can see bulge on face of mountain grow, see small eruption of steam and ash
- c. eventually, earthquake can burst bulge that has been forming
- d. can create a lahar = fast moving mudflow of hot ash mixed with snow and ice on mountain

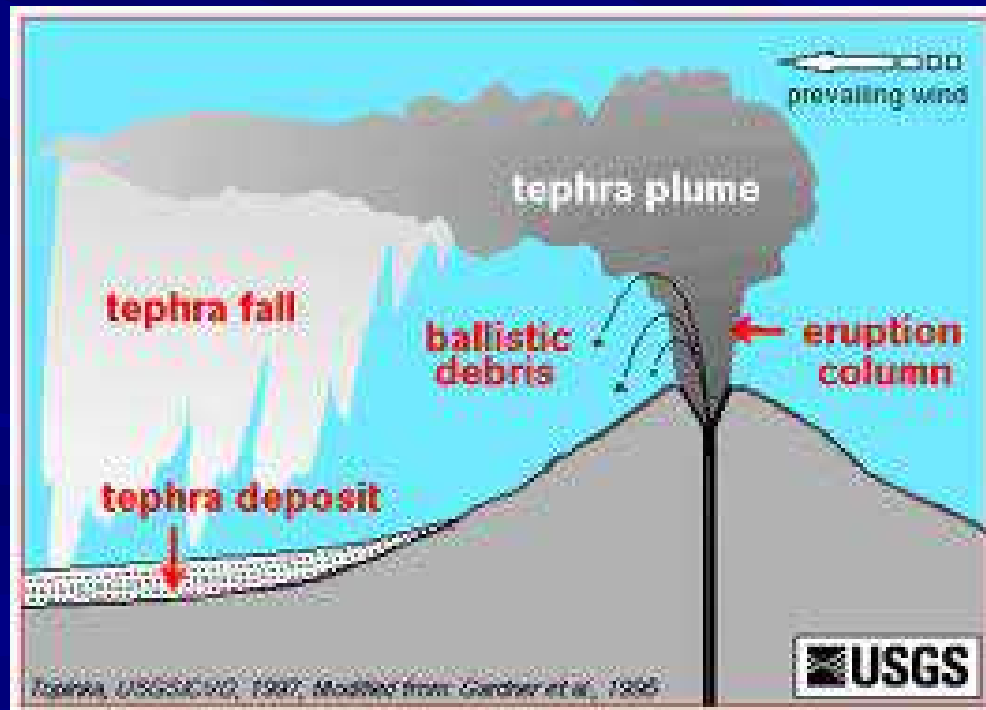


- e. after violent eruption, can remain relatively quiet for long period of time; but below surface magma may be building up pressure once again
 - f. found mostly at convergent plate boundaries above subduction zones
- Ex: Mt. Saint Helens - Washington
Mt. Vesuvius - Italy



VOLCANIC ROCK FRAGMENTS

1. tephra (pyroclastic material) = rock fragments ejected
 - a. some forms when cooling magma breaks into fragments due to rapidly expanding gases
 - b. some forms when a spray of lava cools and solidifies as it flies through the air



2. types:

a. volcanic dust = smallest particles

1) very fine

2) less than 0.25 mm in diameter

b. volcanic ash = particles more than 0.25 mm but less than 2 mm in diameter

1) about the size of rice grains

2) will fall to Earth's surface and eventually form rock

3) can be carried by the wind for great distances



c. lapilli = particles more than 2 mm but less than 64 mm in diameter

1) generally fall near the vent

2) cinders = volcanic bombs about the size of a golf ball

d. volcanic bombs = few centimeters to several meters in diameter

1) large clots of lava that spin through air, cooling and develop a round or spindle shape

2) have masses of several metric tons



e. volcanic blocks = largest tephra

1) solid rock blasted from the fissure

2) can be as big as houses

3. pyroclastic flows = rapidly moving clouds of gas, ash, and other tephra down a slope

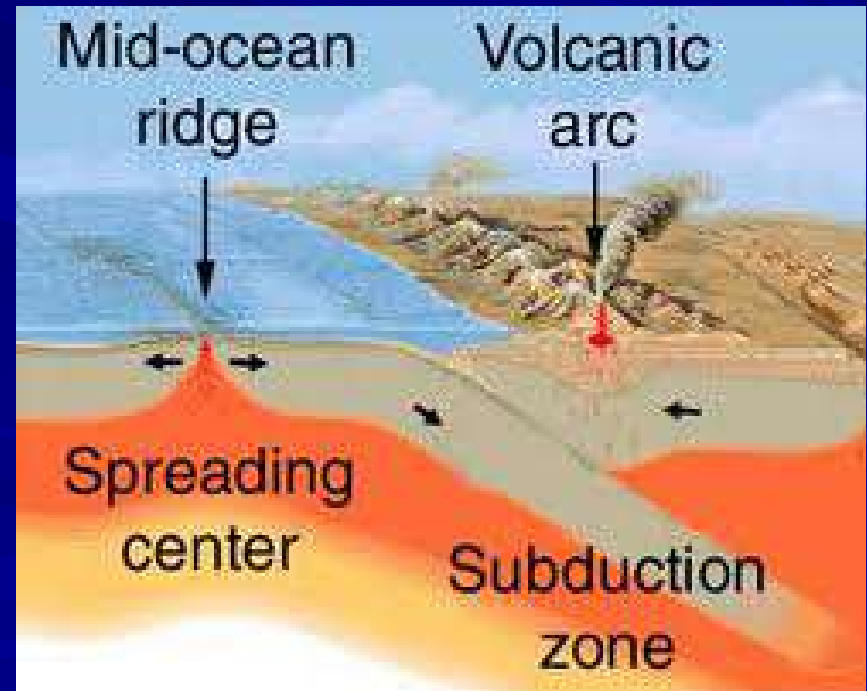
a. can travels at speeds up to 200 km/h

b. contain hot, poisonous gases



MAJOR VOLCANIC ZONES

1. subduction zones (convergent boundaries) [about 80%]
 - a. ocean-continental plates collide
 - 1) deep trench forms on ocean floor
 - 2) line of volcanic mountains form along edge of continent
 - 3) major active area is Pacific Ring of Fire (Circum-Pacific Belt)
 - b. two ocean plates
 - 1) deep trench formed
 - 2) line of volcanic islands form along trench = island arcs



2. mid-ocean ridges (divergent boundaries)

- a. magma rises to surface through rifts at rift zones
- b. most eruptions go unnoticed due to below ocean surface
- c. sometimes this can rise above sea level forming islands
 - 1) fissures = cracks through which lava flows
 - 2) eruption can be seen when on an island created by ridge

Ex: Iceland



- c. plate above continues to drift slowly carrying volcano on surface away which causes activity to stop
- d. new volcano will begin to form in seamount chain
- e. islands form in line because plate is moving over area
- f. can form flood basalts = erupt from fissures and form flat plains or plateaus rather than volcanic mountains

Ex: Hawaiian Islands



VOLCANIC ACTIVITY

1. active = one that erupts either continually or periodically

Ex: Lassen Peak, California;
Mt. Saint Helens, Washington;
Mount Katmai, Alaska

2. dormant = one that has been known to erupt within modern times but is now inactive

Ex: Mount Rainier, Washington;
Mount Hood, Oregon

3. extinct = one that is not known to have erupted within modern history

- some of these have even proven to be unpredictable

PREDICTING ERUPTIONS

1. seismographs are used to monitor small earthquakes
 - a. number of earthquakes often increase until they are continuous just before eruption
 - b. increase in strength may also be a signal
2. slight bulging of surface of volcano
 - a. upward movement of magma may push surface out
 - b. instruments used to measure changes in distance and tilt of ground surface
3. changes in composition of gases given off
4. requires knowledge of previous eruptions

EXTRATERRESTRIAL VOLCANISM

1. moon

- a. ~15% covered with basaltic lava flows
- b. sometime in past active volcanoes were present
- c. radioactive elements beneath moon's surface probably provided energy for volcanic activity

2. Mars

- a. has numerous shield volcanoes and volcanic features
- b. Olympus Mons = largest
 - 1) shield volcano
 - 2) rises 28 km above surface, base is 600 km across, caldera 70 km across

(could cover the state of Colorado)

- c. Martian crust does not move so allow lava source for millions of years



3. Venus

- a. has more than 1600 large volcanoes and volcanic features
- b. has countless numbers of small volcanoes
- c. most are shield volcanoes
- d. may still be active which would account for extreme surface temperatures (860°F)



4. Io = one of Jupiter's moons; most volcanically active place in solar system
- a. nine active volcanoes sighted
 - 1) photographs and data gathered by Voyager 1 and Voyager 2
 - 2) ejects several thousand metric tons of material each second
 - b. volcanoes appear to be more powerful than those on earth
 - 1) volcanic material reach heights of hundreds of km
 - 2) plumes shaped like giant umbrella
 - c. part's of surface regularly move up and down by as much as 100 m
 - d. friction resulting is due to pull of gravity of Jupiter and other moons of Jupiter which provides energy for volcanic activity

