Chapter 7

Volcanoes

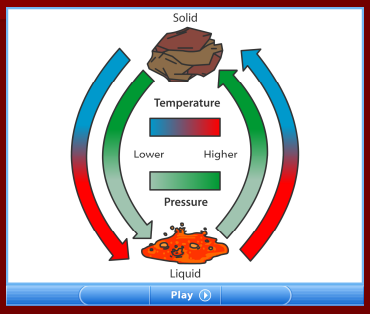
Chapter 7, Section 1

Volcanoes and Plate Tectonics

7.1 Volcanoes and Plate Tectonics

- Most of mantle is solid due to high pressure, even though the mantle is hot enough to melt rock.
- Magma: hot, liquid rock below the surface.
- Magma forms when mantle material flows to areas of lower pressure quickly
- Also forms when water is added to mantle (like at subduction zones)

Magma Formation



Volcanism

- Volcanism: any activity that includes the movement of magma towards the surface of the Earth.
- Magma rises because it is less dense than solid crustal rock.
- Lava: magma that erupts onto the surface
- Vent: the opening in the surface where lava flows onto the surface
- Volcano: the structure formed by the vent and the material that builds up on the surface.

Major Volcanic Zones

- Like earthquakes, most volcanoes occur in zones near both convergent and divergent plate boundaries of lithospheric plates.

Eldfell ("fire mountain" in Icelandic) is a volcano on the island of Heimaey in the Vestmannaeyjar archipelago 15 miles (25 km) south of Iceland. In January of 1973, an eruption began along a 1.5 mile (2 km) long fissure not far from the center of the town of Vestmannaeyjar. The fissure extended across the entire island, producing a spectacular curtain of fire. Nearly all of the island's 5,300 residents were evacuated to the mainland.

Subduction Zones

- When one plate moves under another plate, we call this subduction.
- When oceanic plates meet continental plates, the oceanic plate is subducted.
- Water is carried down into the asthenosphere, melting the mantle and forming magma.
- Some of this magma rises and erupts through the surface as lava.

Subduction Zones

These pix are in your book on page 118.

Mid-Ocean Ridges

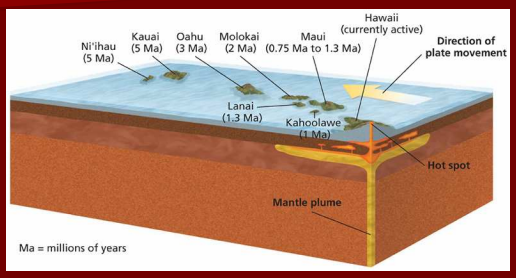
- The greatest amount of magma comes to the surface at mid-ocean ridges.
- As the plates pull apart, magma fills the space, solidifies, and adds new material to the lithosphere along the rift.
- Fissures: cracks through which lava flows.

- http://volcano.und.nodak.edu/vwdocs/volc_images/europe_west_asia/heimaey/heimaey.html

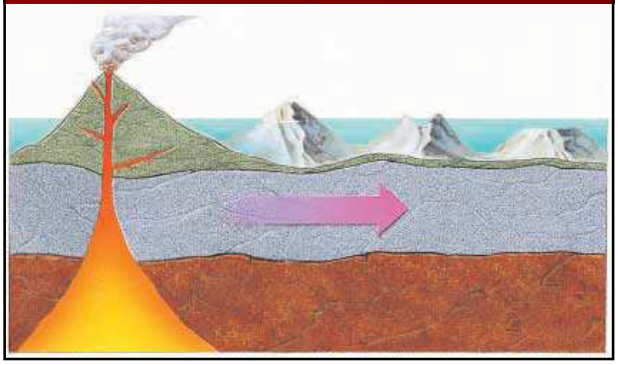
Hot Spots

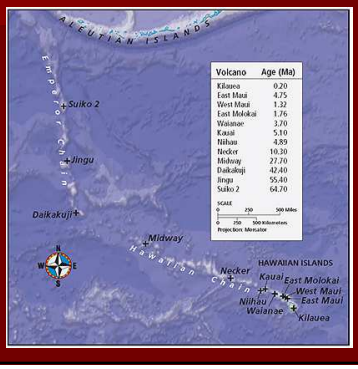
- Not all volcanoes develop at plate boundaries.
- Areas of volcanism within lithospheric plates are called hot spots.
- The Hawaiian islands are an example of an island arc formed by hot spot activity.

Hot Spots & Mantle Plumes



Hot Spots page 119





7.1 Review

- What is volcanism?
- Explain how magma reaches the surface.
- How does subduction produce magma?
- What would be a likely explanation for volcanic activity in the central U.S.?
- What website did the title screen image come from?

Chapter 7, Section 2

Volcanic Eruptions

Section 7.2 Review

- Explain the difference between mafic and felsic lava.
- Define *pyroclastic material* and give examples.
- Name & compare 3 types of volcanoes.
- What event forms a caldera?
- Name 3 events that may precede a volcanic eruption.
- Quiet or explosive eruptions: Which is more likely to increase the height of a volcano. Why?

7.2 Volcanic Eruptions

- Two general types of lava (mafic & felsic)
- Mafic lava: dark color, lots of magnesium and iron, forms most of the oceanic crust.
- Felsic lava: lighter color, lots of silica, lesser amounts of magnesium and iron, common in continental crust.
- Other lavas have a range of compositions and are somewhere in between the mafic and felsic types.

More Lava…

- Depending on composition and how fast it cools, we get…
- Pahoehoe (puh-HOY-hoy): wrinkled mafic lava, means "ropy" in Hawaiian.
- Aa (AH-ah): when mafic lava cools too rapidly to form wrinkles, it forms sharp, jagged blocks.
- Pillow lava: round blobs of lava from ocean floor eruptions.

Kinds of Eruptions

- Quiet or Explosive?
- Depending on the viscosity and the amount of trapped gases.
- Thin, mafic lavas flow like water. Gases escape easily, and usually produce quiet eruptions.
- Thick, felsic lavas trap gases inside, so when they erupt, the dissolved gases explode out the vent or fissure sending molten or solid particles into the air.

Volcanic Rock Fragments

- Pyroclastic material: rock fragments ejected from the volcano.
- Volcanic dust: particles <.25 mm
- Volcanic ash: particles <2 mm in diameter
- Ash & dust usually settle immediately around the volcano, but some particles may travel completely around the Earth in the upper atmosphere.

Larger Particles

- Lapilli (luh-PIL-ie): <64mm, means "little stones" in Latin. Lapilli generally fall near the vent.
- Volcanic bombs: large clots of red-hot lava, round or spindle shaped (teardrop), usually explode on impact.
- Volcanic blocks: largest pyroclastic particles, solid rock, can be as big as a house.

Shield Volcano

- Broad base, gently sloping sides
- Hot, mafic lava (fluid lava) flow out and build up the cone as the lava hardens
- Hawaiian islands are a chain of shield volcanoes.

View of the NNW flank of Mauna Loa Volcano from the south side of Mauna Kea Volcano, Hawai`i; both are shield volcanoes.

Cinder Cone

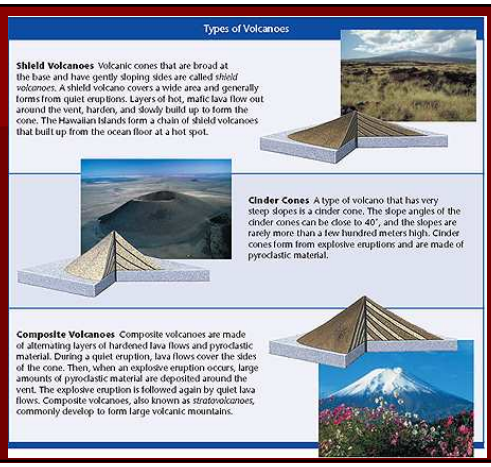
- Explosive eruptions form cinder cones from solid particles built up around the vent.
- Steep slopes.

This cinder cone (Pu`u ka Pele) was erupted low on the southeast flank of Mauna Kea Volcano. The cone is 95 m in height, and the diameter of the crater at the top is 400 m. Hualalai Volcano in background.

Composite or Stratovolcano

- Formed by alternating quiet & explosive eruptions.
- Usually tall, mountainous cones.

Mount Mageik volcano viewed from the Valley of Ten Thousand Smokes, Katmai National Park and Preserve, Alaska. Mageik's broad summit consists of at least four separate structures built above different vents.



Craters & Calderas

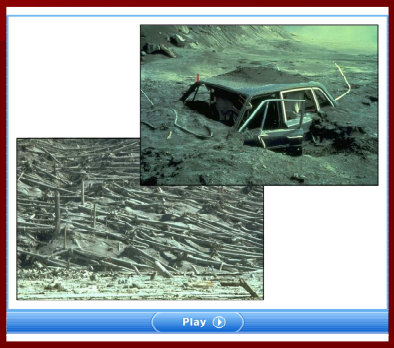
- Crater: the funnel-shaped pit at the top of a volcanic vent.
- Caldera: large depression left after the collapse of an empty magma chamber.

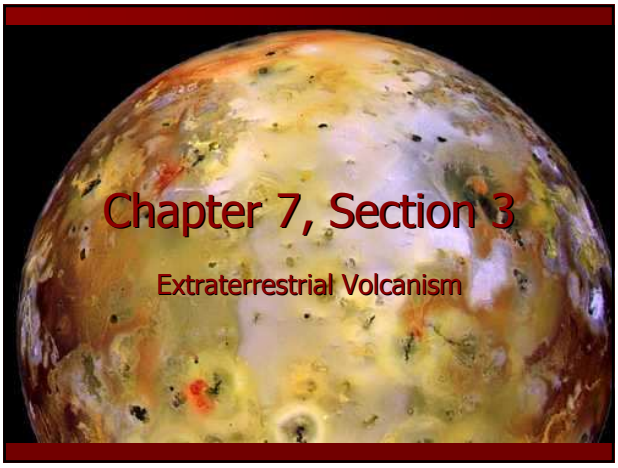

Anak Krakatau, 1960

Predicting Volcanic Eruptions

- Small earthquakes often precede volcanic eruptions.
- They result from pressure buildup as magma moves towards the surface.
- Bulging of the surface of the volcano.
- Changes in volcanic gas composition.

Effects of Volcanoes





7.3 Review

- What caused the craters on the Moon?
- What is the most likely explanation for the growth of Olympus Mons to its present size?
- Why do scientists think Io is made of sulfur dioxide?
- What evidence is there for volcanism on other planets and moons in the solar system?

7.3 Extraterrestrial Volcanism

- Evidence shows that other moons and planets in our solar system are (or were) volcanically active.
- Earth's Moon was volcanically active in the past.
- Mars has volcanoes.
- Io, one of Jupiter's moons, has many active volcanoes.

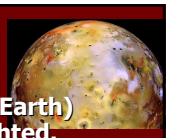
The Moon

- **Meteor impacts created craters and also deep basins that filled with lava.**
- **As the lava cooled, they became maria (the dark areas we can see from Earth).**
- **Maria are the remains of huge basaltic (mafic) lava flows.**

Mars

- Many volcanoes and volcanic features.
- Olympus Mons is the largest known volcano in the solar system.
- Type: Shield volcano
- How big? Bigger than the state of Arizona.
- Why? No plate tectonics.

Io



- First planetary body (other than Earth) where active volcanoes were sighted.
- Probably the most volcanically active body in the solar system.
- Jupiter's massive gravity pulls Io back and forth in its orbit. (tidal forces)
- Heat from friction and intense gravitational pressure probably results in the melting of Io's interior and leads to volcanism.
- Because Io is a brilliant yellow-red, scientists think Io is made of sulfur and sulfur dioxide.