

# Volcanoes & Volcanic Eruptions

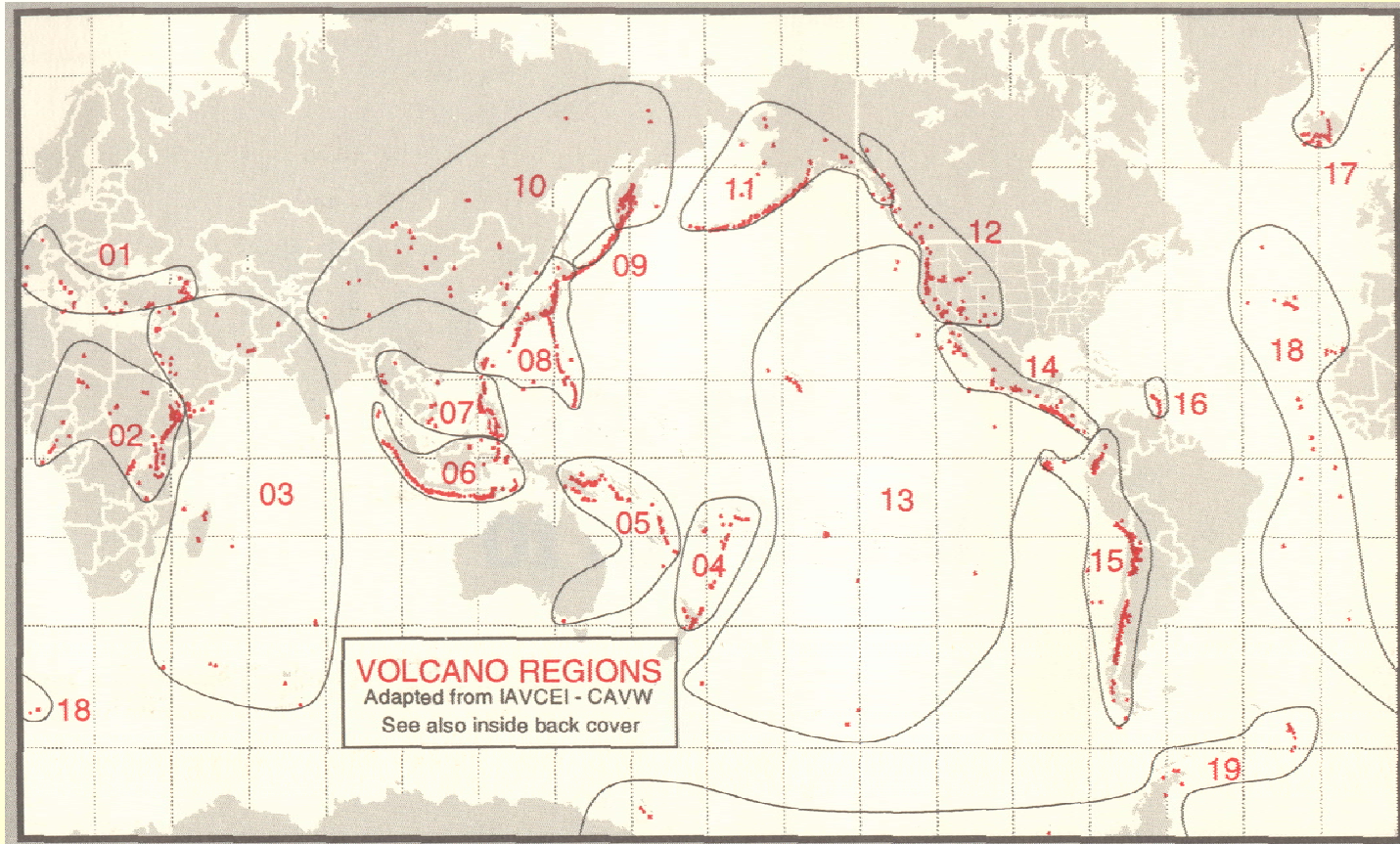
1. Volcanoes around the world
2. Explosive or not?
3. Magma Composition
4. Types of eruptions
5. Parts of volcanoes
6. Volcanic landforms



# Volcanoes around the world

- How many volcanoes are active?
  - Between 50-70 eruptions/year
  - 1500 "Recent" and "active" volcanoes (eruptions in the last 10,000 years)
- Where?
  - Submarine (mostly spreading centers)
  - Subaerial
    - Subduction zones ("Ring of Fire")
    - Spreading centers (East African Rift)
    - Hot Spots (Hawaii, Galapagos)

# Volcanoes around the world



# Volcanism

- What causes volcanic eruptions?
- Why are some explosive and others not?
- What are the characteristics of explosive and non-explosive eruptions?

# Explosive or not?

- A graphic demonstration

# What causes volcanic eruptions?

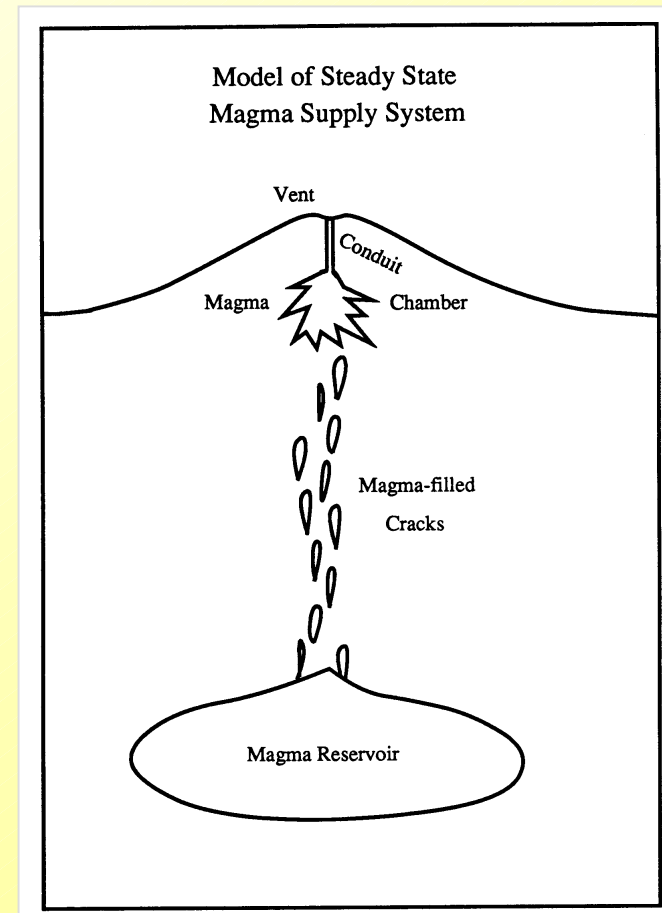
- Eruptions driven by pressure
  - Lots of pressure - big explosion
  - Little pressure - lava fountains and flows



US Geological Survey

# What causes volcanic eruptions?

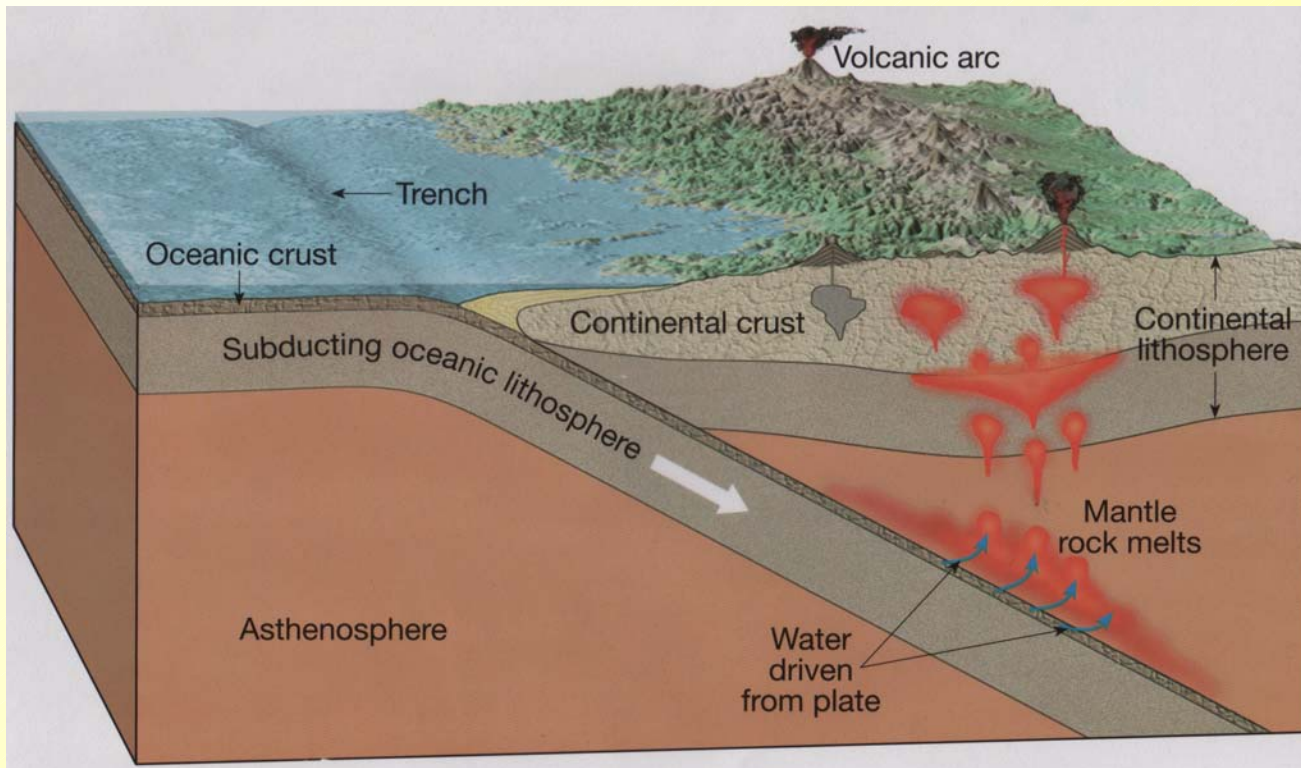
- Sources of pressure
  - Addition of magma to magma chamber (balloon swelling)
  - Expansion of gas (solubility decreases with decreased P)
- When pressure exceeds strength of surrounding rock - eruption!



Wadge, 1982

# What causes volcanic eruptions?

- Function of amount of gas
  - Felsic magmas tend to have more gas than mafic
  - Gas - primarily  $H_2O$  associated with subduction





# What causes volcanic eruptions?

- Function of viscosity (resistance to flow)
  - felsic magmas more viscous than mafic - trap gas



Basalt flow, Kilauea, HI



Rhyolite flow, South Deadman, CA

# Magma and rock types

## **SiO<sub>2</sub> CONTENT**

**~50%**

**~60%**

**~65%**

**~70%**

## **MAGMA TYPE**

**Mafic**

**Intermediate**

**Felsic (low Si)**

**Felsic (high Si)**

## **VOLCANIC ROCK**

**Basalt**

**Andesite**

**Dacite**

**Rhyolite**

# Magma and eruption type

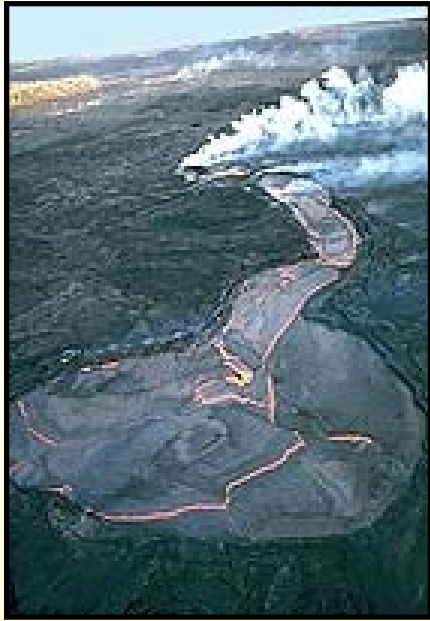
<b>SiO<sub>2</sub></b>	<b>MAGMA TYPE</b>	<b>TEMP. (Celsius)</b>	<b>VISCOSITY</b>	<b>GAS CONTENT</b>	<b>ERUPTION STYLE</b>
~50%	mafic	~1100	low	low	nonexplosive
~60%	intermediate	~1000	intermediate	intermediate	intermediate
~70%	felsic	~800	high	high	explosive

# Hawaiian Eruptions

- Calmest of the eruption types
  - Effusive emission of highly fluid basalt lavas
  - Characterized by steady lava fountaining and the production of thin lava flows
- ➔ Produces a shield volcano



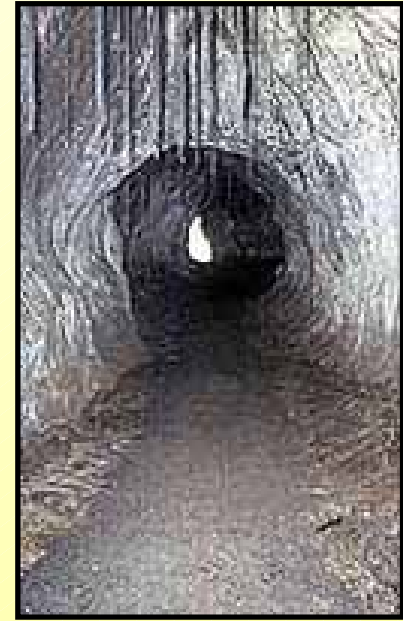
# Characteristics of Hawaiian Eruptions



Lava Lake



Lava Channel



Lava Tube

# Strombolian Eruptions

- Short-lived, explosive outbursts of pasty lava ejected a few tens or hundreds of meters into the air
- Eject fragments that travel in parabolic paths to construct the volcanic edifice



Mt. Etna, Sicily (2002)

➔ Often produces a scoria cone

# Vulcanian Eruptions

- Explosive ejection of blocky fragments.
- Eruptive columns are commonly between 5 and 10 km high



Tavurvur Volcano, Papua New Guinea

# Plinian Eruptions

- A violent explosive eruption in which pyroclastic material is released at a high velocity from a vent.
- Sustained eruptive column may extend up to 45 km high.



Lithograph "The Eruption of Vesuvius as seen from Naples, October 1822" from V. Day & Son

→ Associated with stratovolcanoes



# Plinian Eruptions



Klyuchevskaya  
eruption, Kamchatka in  
1994 as observed from  
the space shuttle

# Plinian Eruptions



Mount St. Helens, May  
18, 1980

# How Volcanoes Work

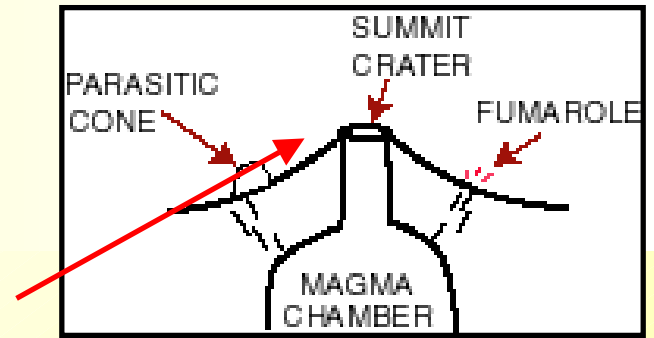
## Classifying volcanoes

### 1. Types of volcanoes

- Shield volcanoes
- Scoria cones
- Stratovolcanoes
- Calderas



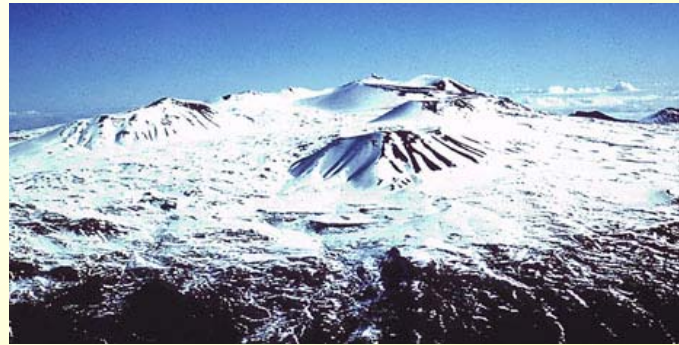
# Volcano Parts



## Volcanic Edifice



Summit Crater  
(Kirishima volcano  
Japan)



Parasitic cones  
(Mauna Kea volcano,  
Hawaii)



Fumarole  
(Kilauea volcano,  
Hawaii)

# Shield Volcanoes

- Broad, low-profile edifices with a convex upward flank morphology.
- Heights are typically about 1/20th of their widths
- Composed of basalt flows



Kilauea volcano  
(erupting since 1983)

Mauna Loa, Hawaii  
(world's largest  
shield volcano)

# Scoria Cones

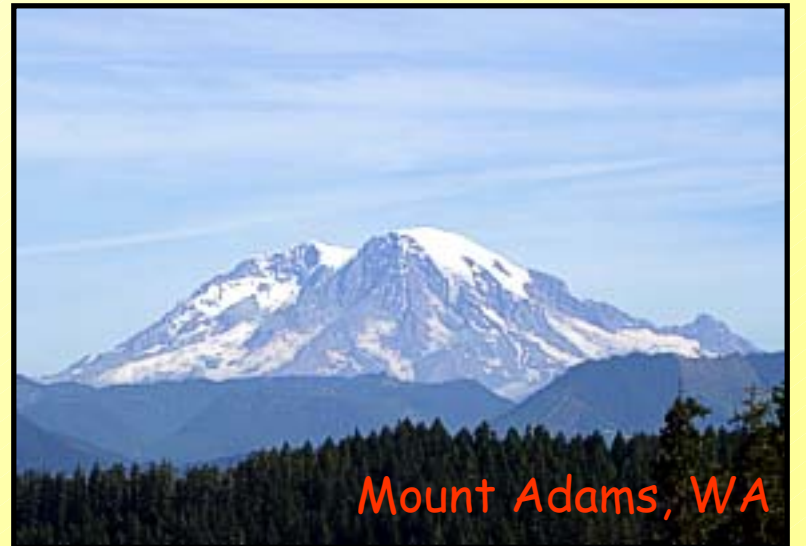
- Small (< 300 m high) steep-sided (up to 35 degrees) volcanic edifices with large summit crater
- The most common type of volcano
- Composed of **tephra**
- Also called cinder cones



Sunset crater, Arizona

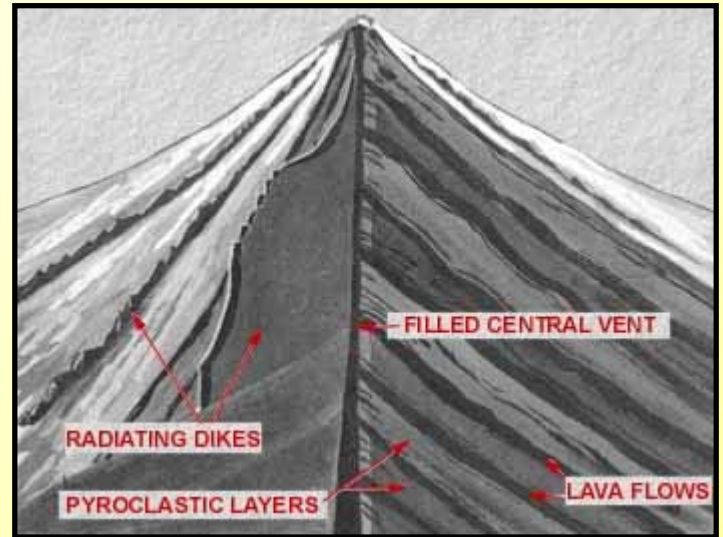
# Stratovolcanoes

- Large (1000's m high) volcanic edifices with concave-upward flank morphology and small summit crater.
- Also called composite cones
- Characterized by infrequent, highly explosive eruptions



# Stratovolcanoes

- Built from alternating lava flows, tephra, pyroclastic flows, volcanic mudflows (lahars), and/or debris flows.





# Caldera

- A basin-shaped volcanic depression  $> 1.6$  km in diameter.
- Formed when volcano collapses into magma chamber (usually from giant eruption)
- From Spanish word for cauldron



Aniachak Caldera, Alaska