

Volcanoes

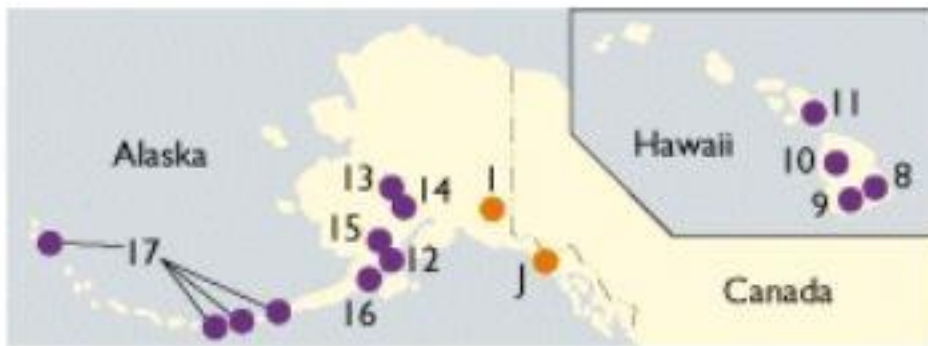
Geology Unit: Slides 72-105

Volcanoes

- Definition – accumulation of lava and debris around a vent



U.S. Active Volcanoes



Cascades		Hawaii	Alaska		
1	Mount St. Helens	8	Kilauea	12	Augustine volcano
2	Mono-Inyo craters	9	Mauna Loa	13	Redoubt volcano
3	Lassen Peak	10	Hualalai	14	Mount Spurr
4	Mount Shasta	11	Haleakala	15	Iliamna volcano
5	Mount Rainier			16	Katmai volcano
6	Mount Baker			17	Aleutian volcanoes
7	Mount Hood				

● U.S. volcanoes that appear to have eruption periodicities of 1000 years or greater and last erupted 1000 years or more ago:

Cascades		Alaska	
A	Three Sisters	I	Mount Wrangell
B	Newberry volcano	J	Mount Edgecumbe
C	Medicine Lake volcano		
D	Crater Lake (Mount Mazama)		
E	Glacier Peak		
F	Mount Adams		
G	Mount Jefferson		
H	Mount McLoughlin		

● U.S. volcanoes that last erupted more than 10,000 years ago, but beneath which exist large, shallow bodies of magma that are capable of producing exceedingly destructive eruptions:

AA	Yellowstone Caldera	DD	Coso volcanoes
BB	Long Valley Caldera	EE	San Francisco Peak
CC	Clear Lake volcanoes	FF	Socorro

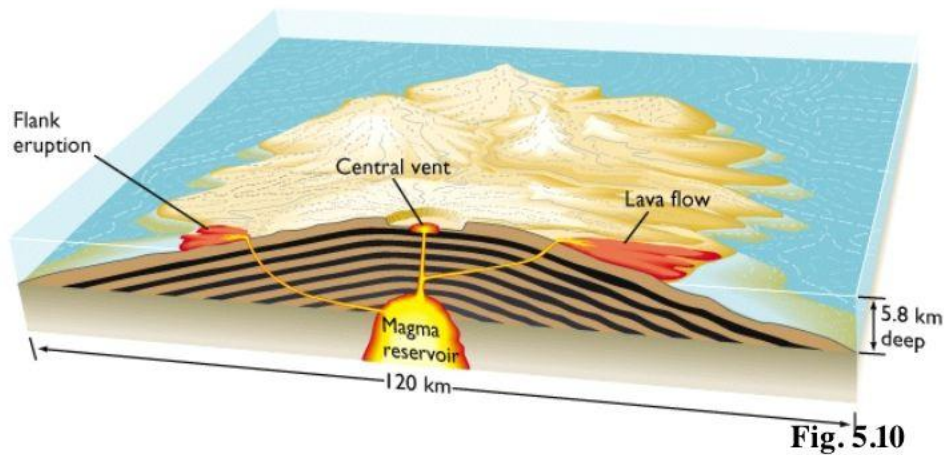
● U.S. volcanoes that have short-term eruption periodicities (100–200 years or less), or have erupted in the past 200–300 years, or both:

▲ Danger classifications are not available for Canadian volcanoes:
 Si Silverthrone BR Bridge River Me Meagher Mountain
 Ca Mount Cayley Ga Mount Garibaldi

Volcano Types

- Shield
 - Largest in size.
 - Have very gently sloping sides.
 - Have the most gentle (non-violent) eruptions.

Shield Volcano



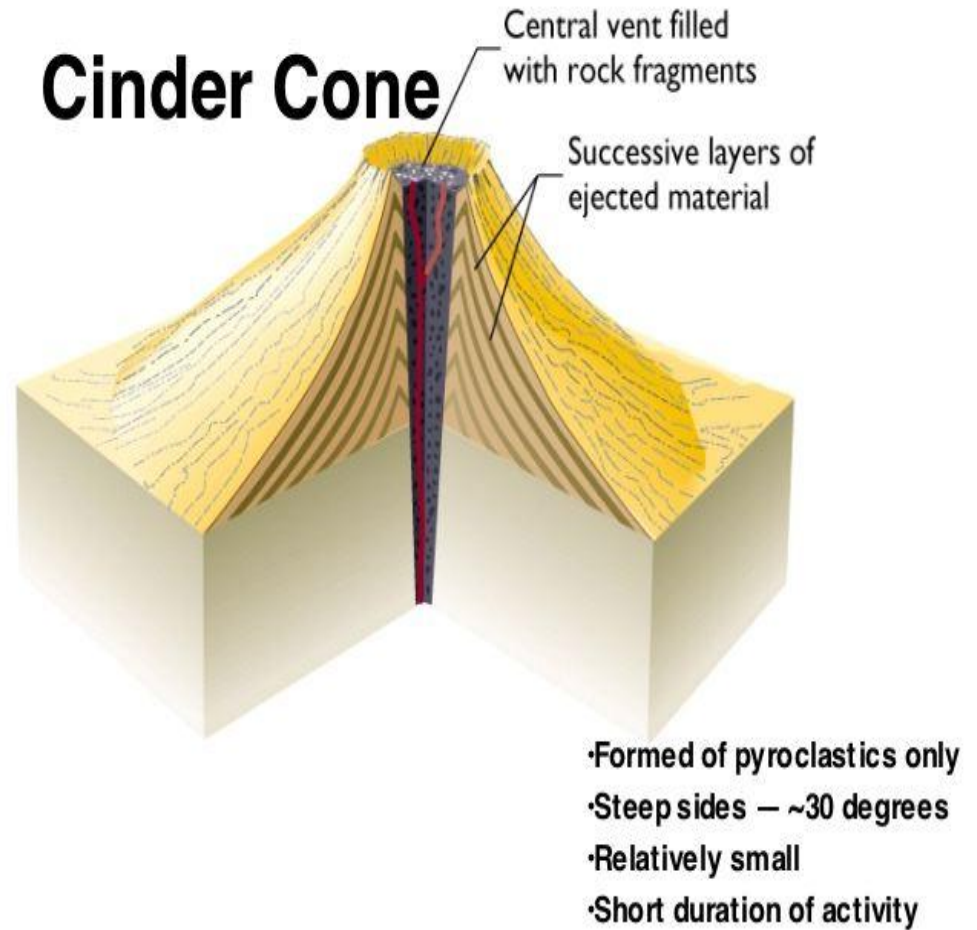


 **USGS**

USGS Photo by T. J. Casadevall, May 1979

Volcano Types

- Cinder Cone
 - Smallest in size.
 - Have very steeply sloping sides.
 - Have medium strength eruptions (not gentle, but not the most violent)



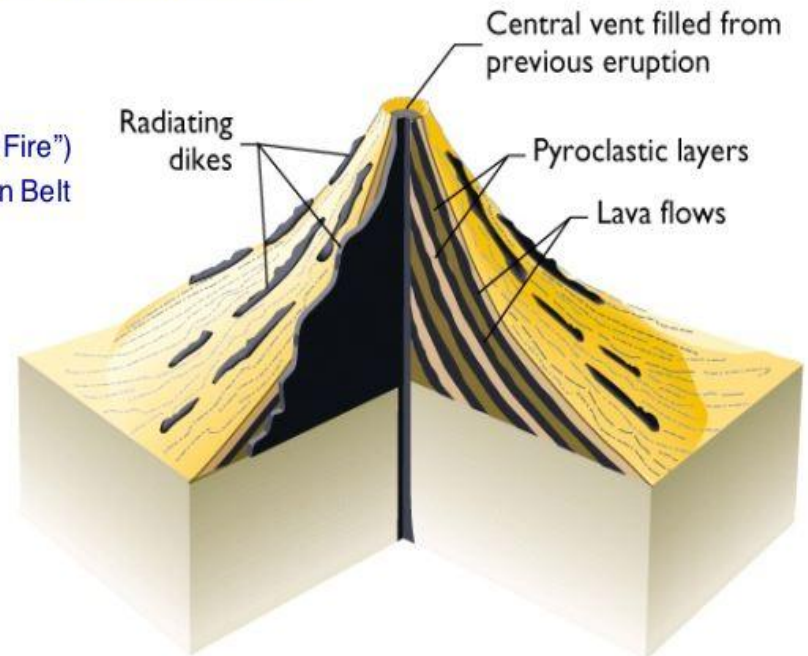


Volcano Types

- Composite Cone
 - Medium-Sized (not the largest, not the smallest)
 - They start out sloping very gently at the base and get steeper as they reach the peak.
 - Their eruptions alternate between violent and gentle.

Composite volcano

- Alternating pyroclastic layers and lava flows
- Slopes intermediate in steepness
- Intermittent eruptions over long time span
- Mostly *andesite*
- Distribution
 - Circum-Pacific Belt ("Ring of Fire")
 - Mediterranean Belt





Volcano Formation

- Volcanoes generally form at:
 - Divergent Boundaries – very gently erupting volcanoes
 - Convergent Boundaries – more violent (because of the increased pressure)
 - Hot Spot Volcanoes – form in the middle of a plate due to an area of the mantle that is hotter than the areas around it.

Oceanic Hot Spot



Hawaii

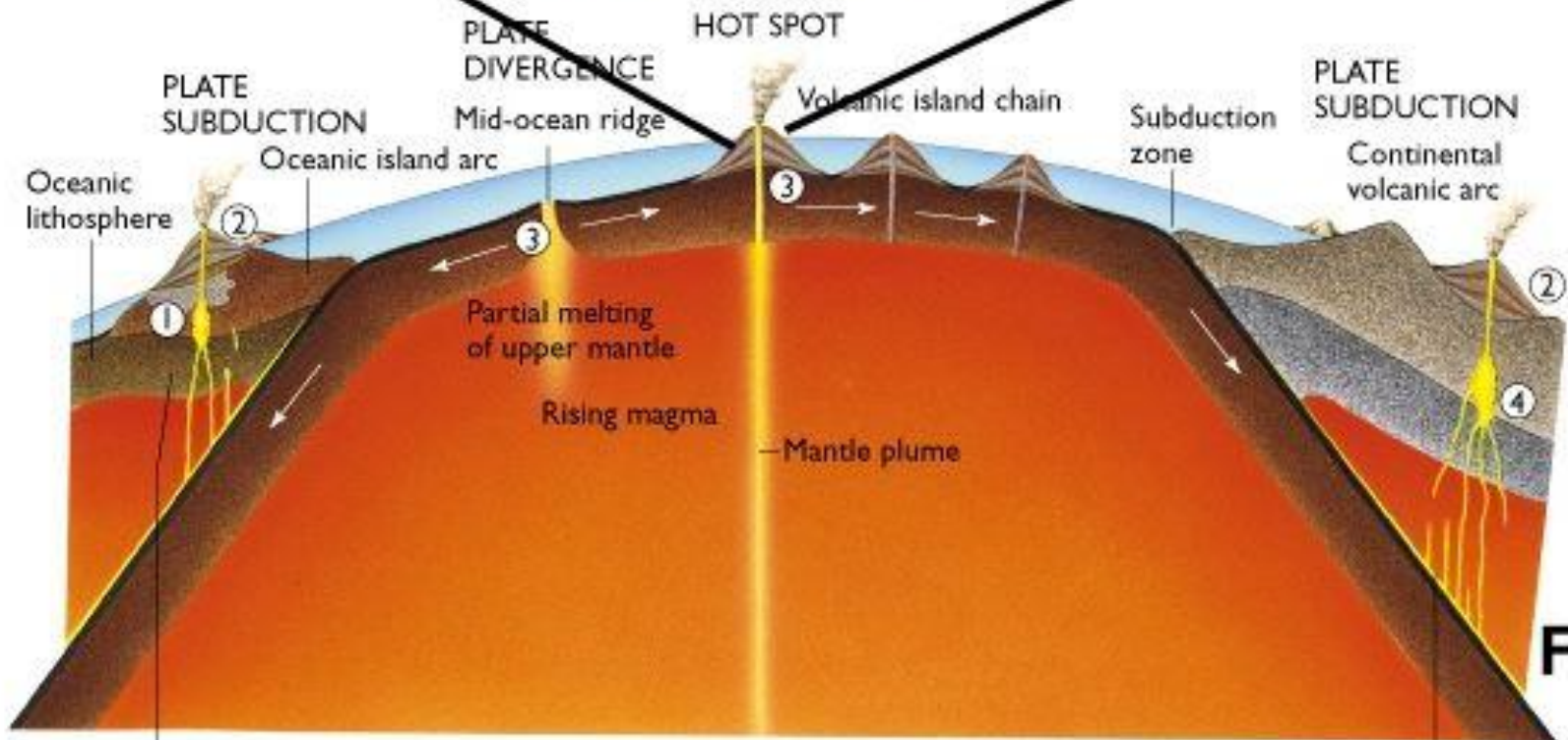


Fig. 4.8

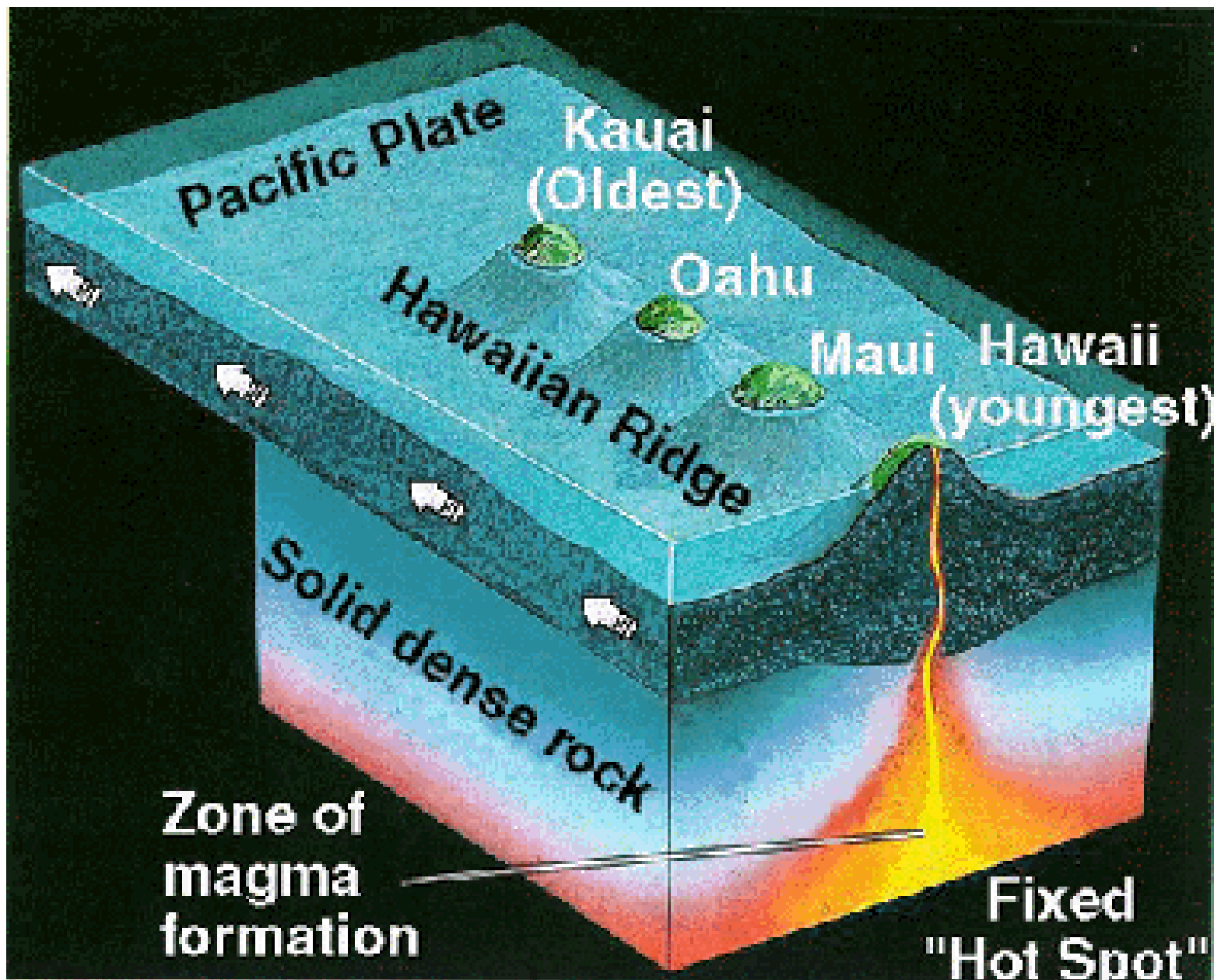
Some partial melting in mantle wedge above subducting plate

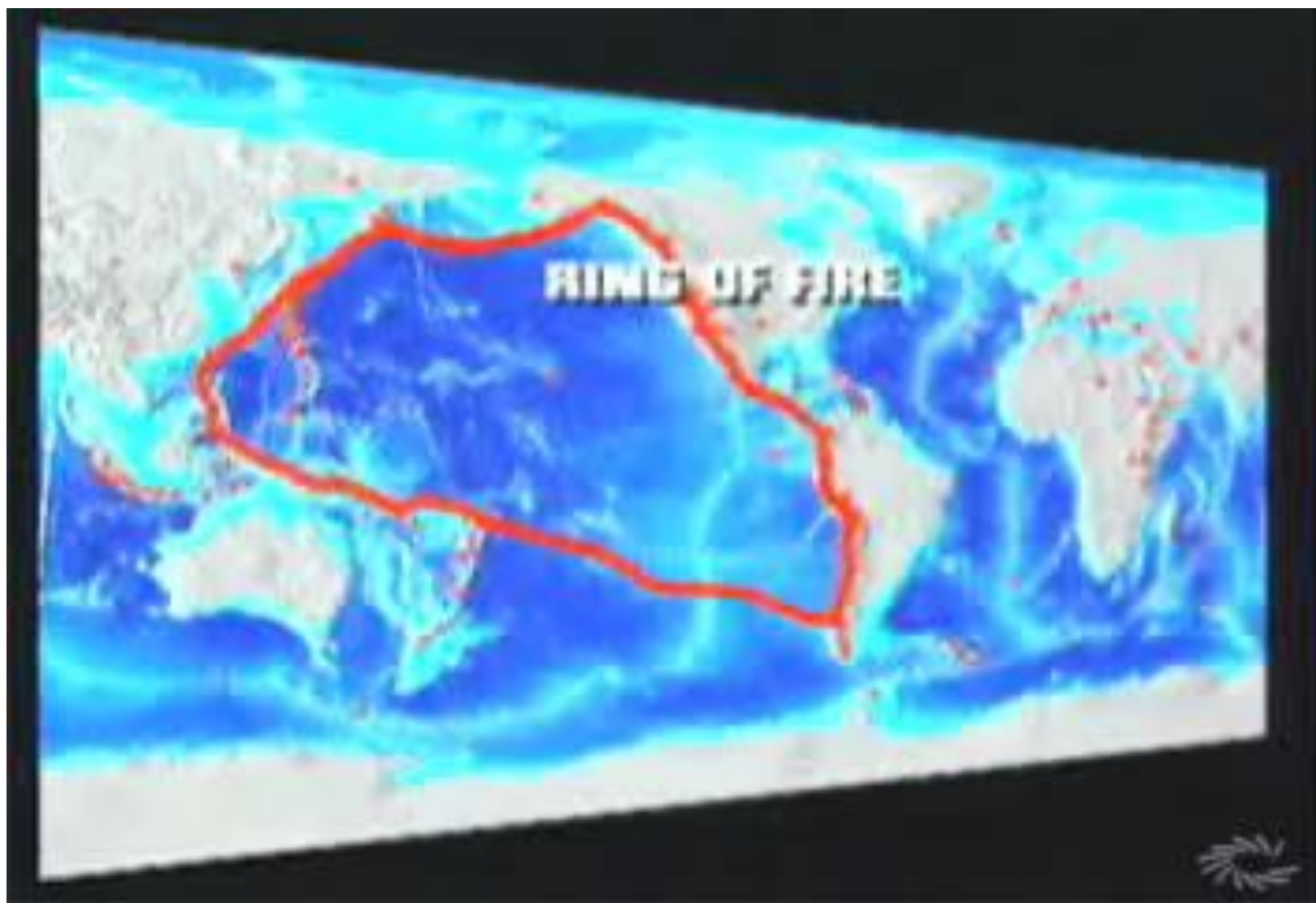
- ① Mafic to intermediate plutonism
- ② Mafic to intermediate volcanism

③ Basaltic volcanism

④ Mafic to silicic plutonism

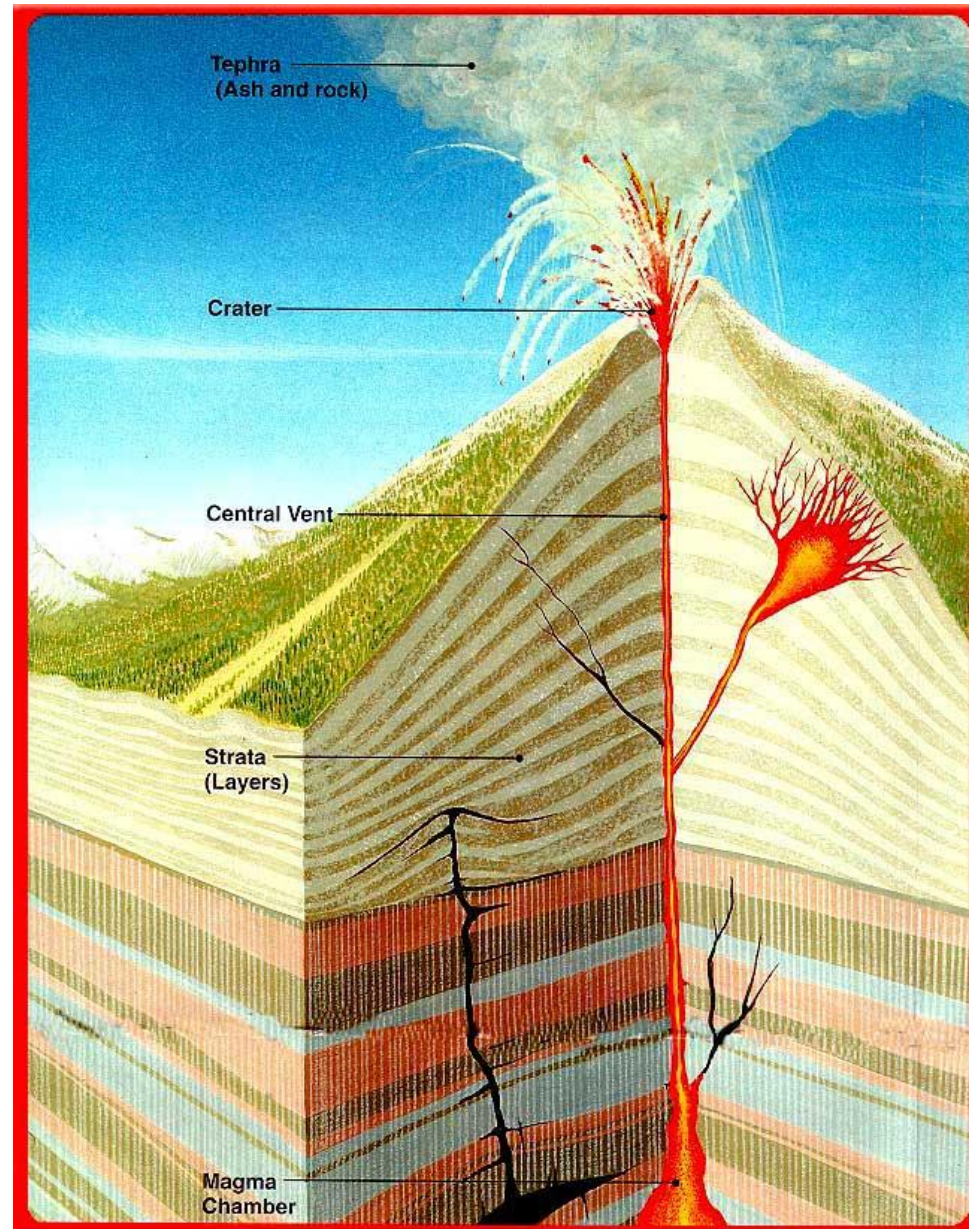
Some partial melting in mantle wedge above subducting plate





Volcano Features

- Crater – normal, relatively small (100 - 200 m) depression at the volcano's peak
- Caldera – a very large crater (several km) that forms from erosion or explosion
- Vents – areas where lava or debris escapes from the volcano
- Magma Chamber – underground pockets of molten rock that feeds the volcano



Volcanic Eruptions

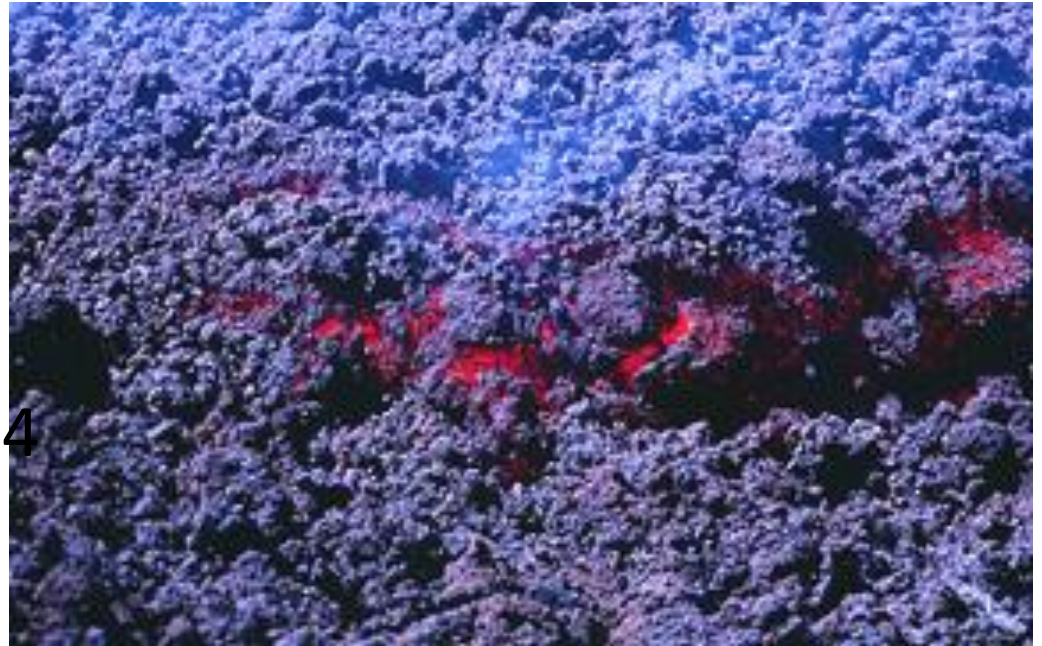
- There are two factors that affect the violence of an eruption:
 - Magma/ Lava Composition – the more felsic the lava the more violent the eruption (felsic lava is more viscous [thicker])
 - Amount of Volatiles – gasses dissolved in lava (the more gasses dissolved the more violent the eruption)

Volcanic Hazards

- Lava Flows

- Aa

- Cooler, thicker lava flows
 - Move at around 4 mph



Volcanic Hazards

- Lava Flows
 - Pahoehoe
 - Hotter, more liquid lava
 - Move at around 15 mph



Volcanic Hazards

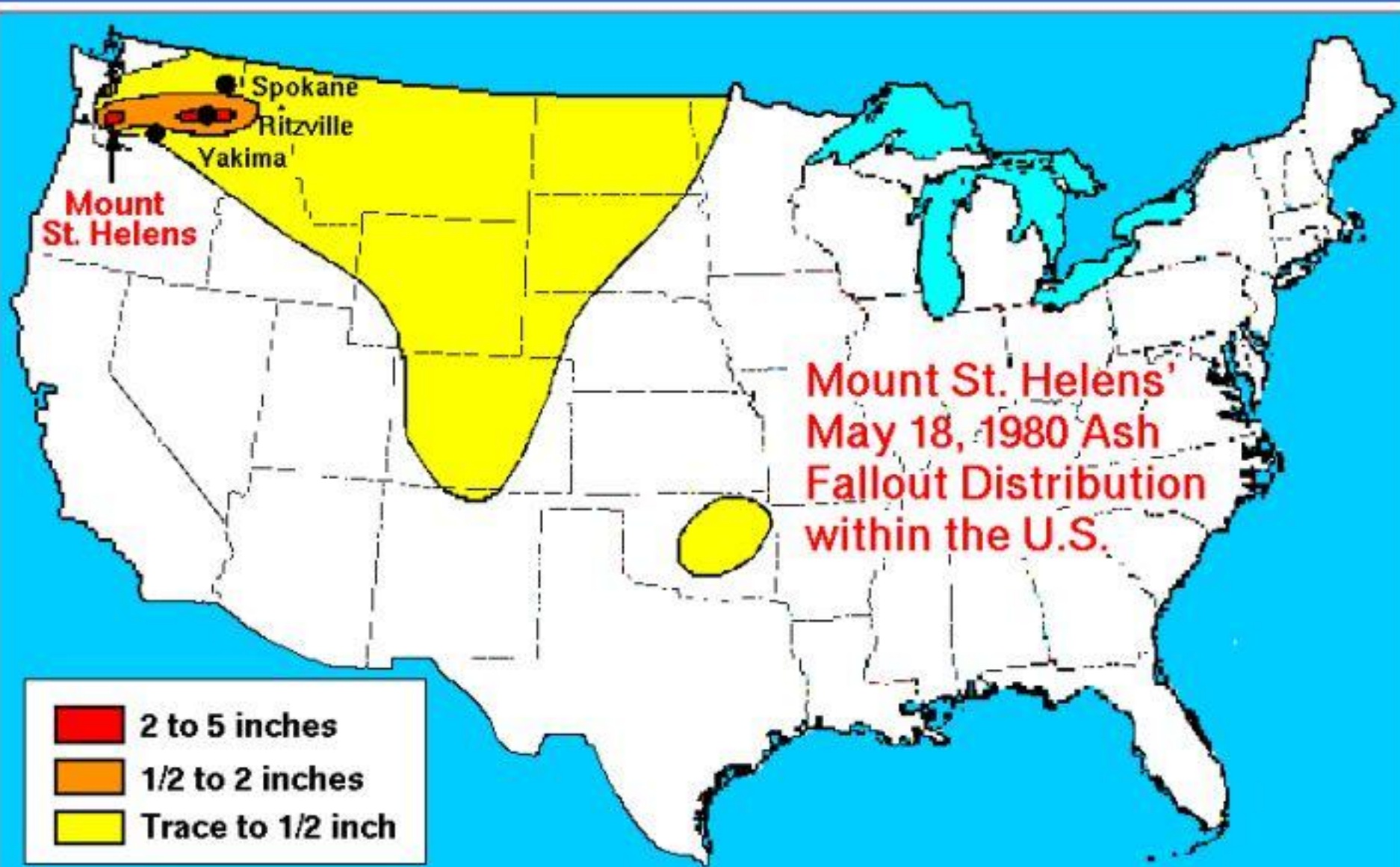
- Lava Flows
 - Base Surge
 - Explosion that occurs when lava contacts groundwater and generates underground pockets of superheated steam.



Volcanic Hazards

- Tephra (any debris that comes from a volcano)
 - Lapilli – pebbles, no more than several cm in diameter (100 – 200°C)
 - Bombs – football sized pieces of rock (travel very fast, 300 – 600°C)
 - Ash – the most damaging form of tephra (due to the areas that it covers and the weight of it as it builds up on buildings)





- 2 to 5 inches
- 1/2 to 2 inches
- Trace to 1/2 inch



Topinka, USGSICVD, 1997, Modified from: Tilling, Topinka, and Swenson, 1990, Mount St. Helens: Past, Present, and Future

Volcanic Hazards

- Pyroclastic Flows (Nuee Ardantees)
 - An avalanche of superheated gas and rock made as hotter, more dense lava erupts from the volcano.





Mt. St. Helens III



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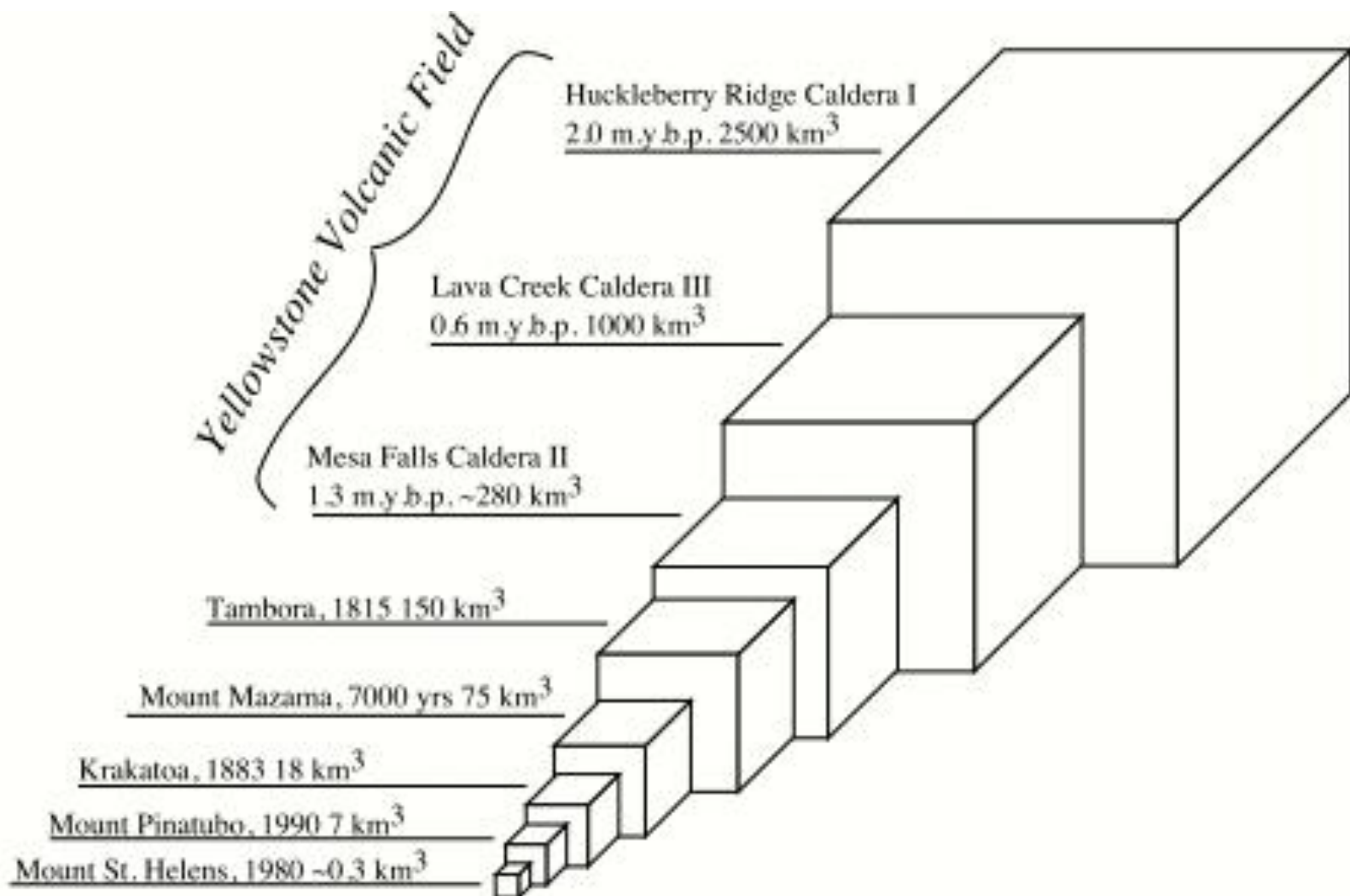


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Comparative volumes of Yellowstone giant eruptions

Volcanic Hazards

- Lahars
 - Dense, rapid mudflows created as water mixes with ash from the volcano
 - The water generally comes from rain or melted snow from the peak of the volcano.







Volcanic Hazards

- Acid Precipitation and Gasses
 - Sulfuric Acid – dissolves organic material
 - Hydrofluoric Acid – dissolves metal and glass
 - CO and CO₂ – choking gases (more dense than air so they push it out of the area as they are created)
 - SO₂ – colorless, odorless toxin that can be absorbed through the skin (attacks all major bodily systems)





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Benefits of Volcanoes

- Fertile Soils

- Nutrients and minerals in soil increased by volcanic activity

- Geothermal Energy

- Iceland generates a vast majority of their energy using the heat from volcanoes to generate electricity (extremely cheap)



Classifying Volcanic Activity

- Active – erupted in recent history
- Dormant – erupted in the past several thousand years
- Extinct – volcano has been eroded
(does **not** mean that it will never erupt again)

The World's Active Volcanoes

