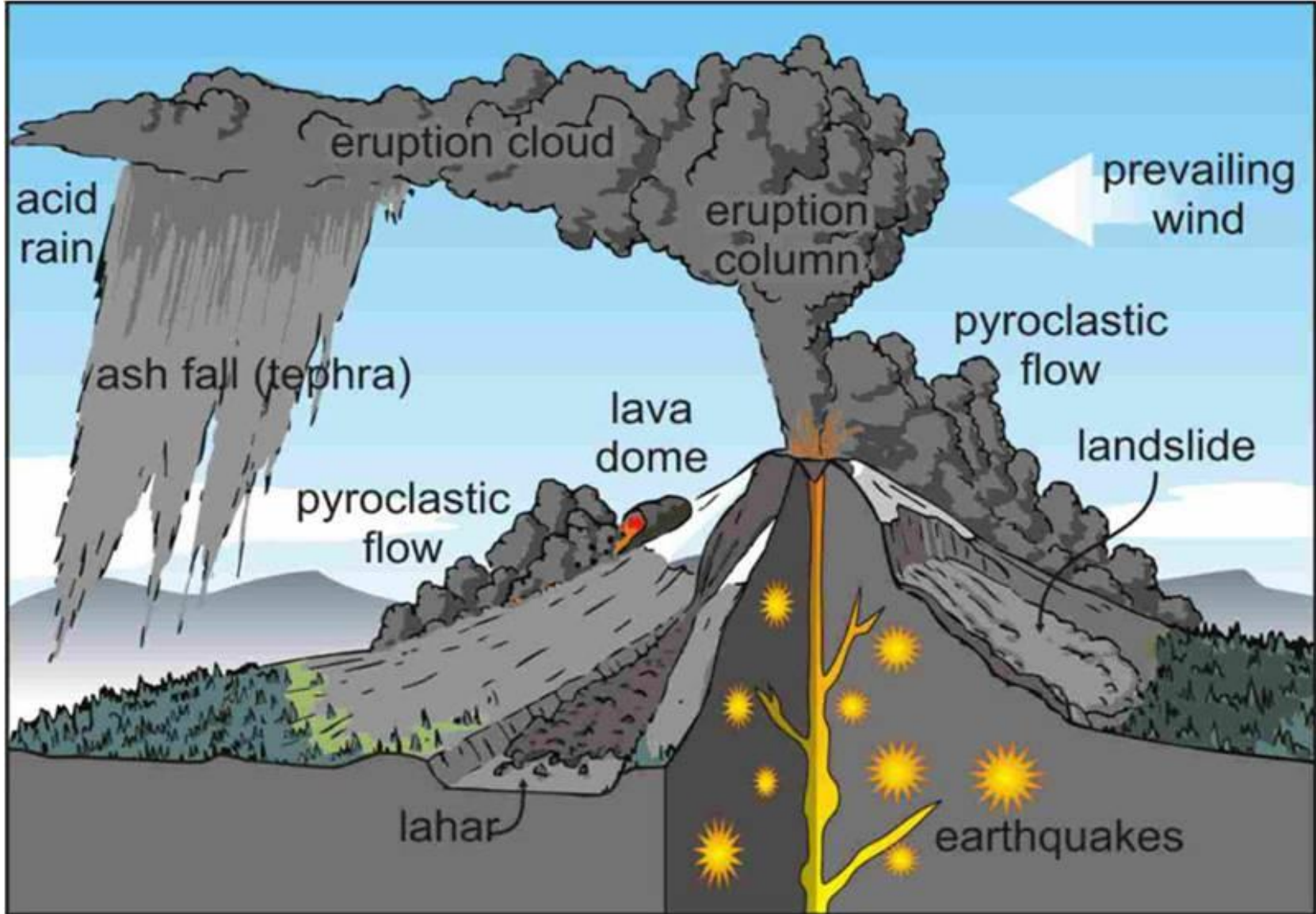
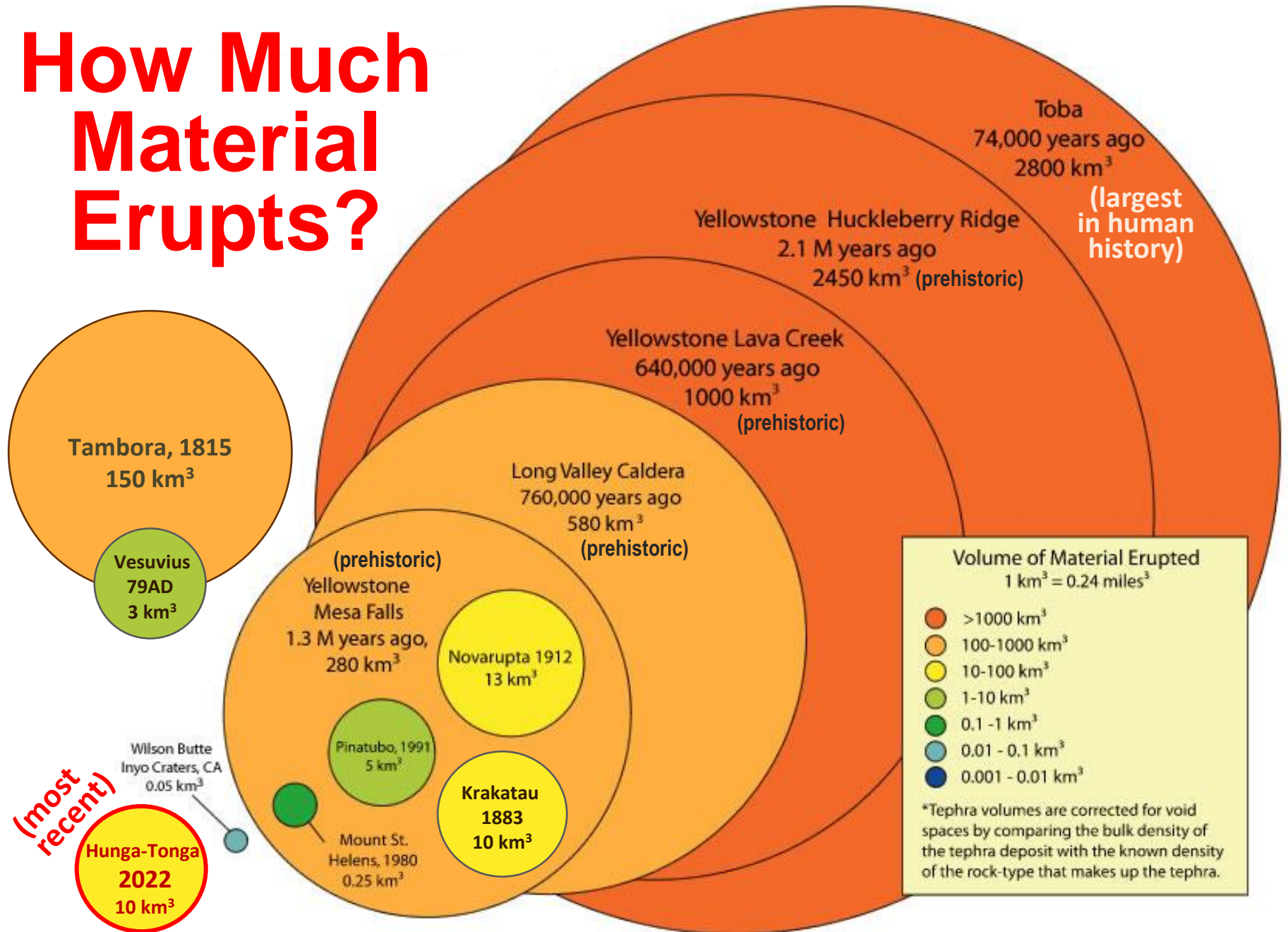


# Explosive Eruption Diagram



# How Much Material Erupts?



# Solid Ejecta

Ash and **pyroclastic material** (“the solid”) is airborne material ejected by a volcano:

- **Volcanic ash**  
< 0.06 mm to 2 mm;  
composed of rock, mineral,  
and volcanic glass
- **Cinders**  
2 mm to 64 mm;  
composition same as ash  
hazardous when falling!

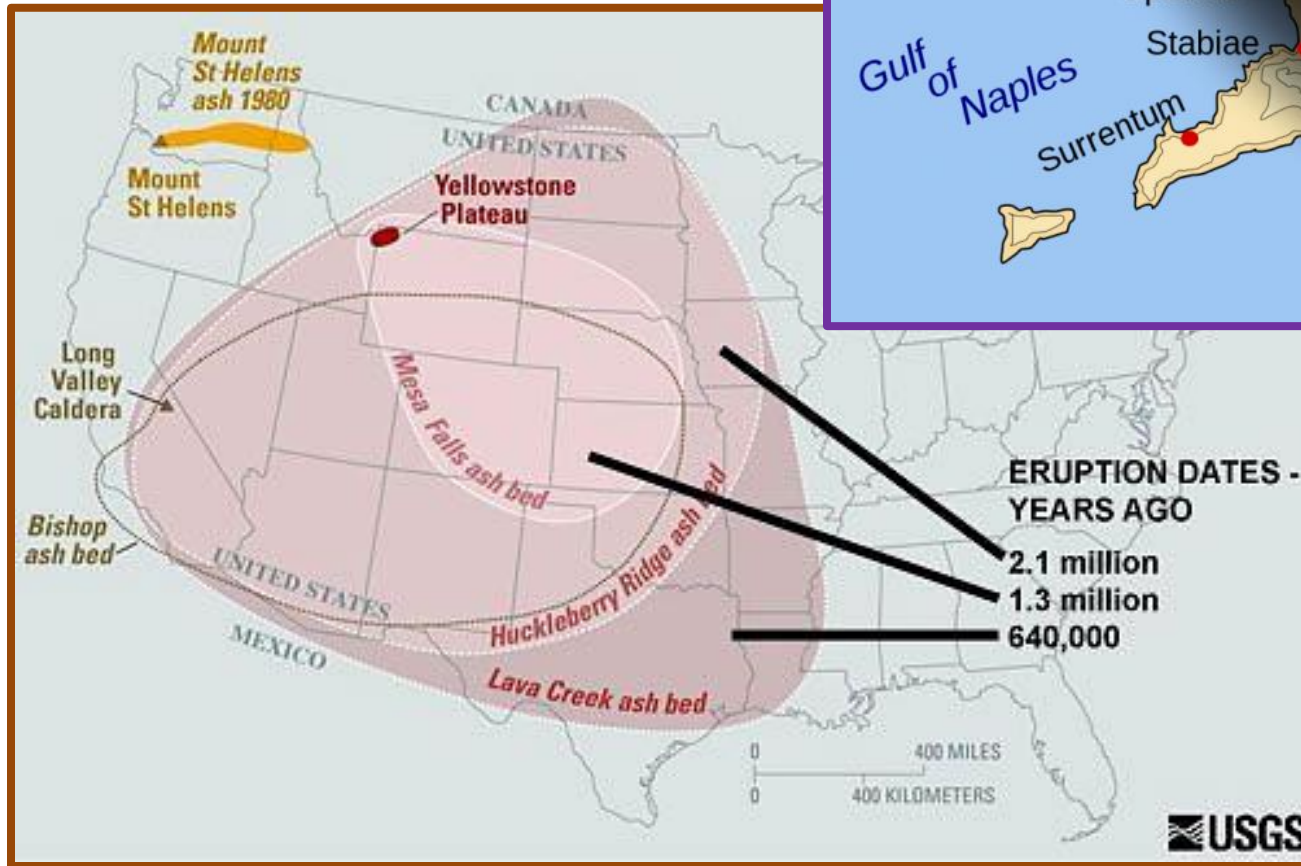


- **Bombs**  
> 64 mm, shapes vary;  
formed by molten rock  
solidifying in the air



# Volcanic Ash Fall Zone

Can cover hundreds of thousands square miles!



**Vesuvius** ash fall zone was roughly 100 times smaller than that of the latest (640,000 YA) **Yellowstone** eruption!

# Volcanic Gases



**Significance?**  
Determines violence  
of an eruption:

**High gas = violent  
eruptions!**

- **Volatiles** (substances that easily boil and evaporate)

H<sub>2</sub>S – Hydrogen sulfide

H<sub>2</sub>O – Water vapor

SO<sub>2</sub> – Sulfur dioxide

CO<sub>2</sub> – Carbon dioxide

N<sub>2</sub> – Nitrogen

HCl – Hydrochloric Acid

**Effect on global climate**

← block sunlight

← greenhouse gas

# Volcanoes and Climate

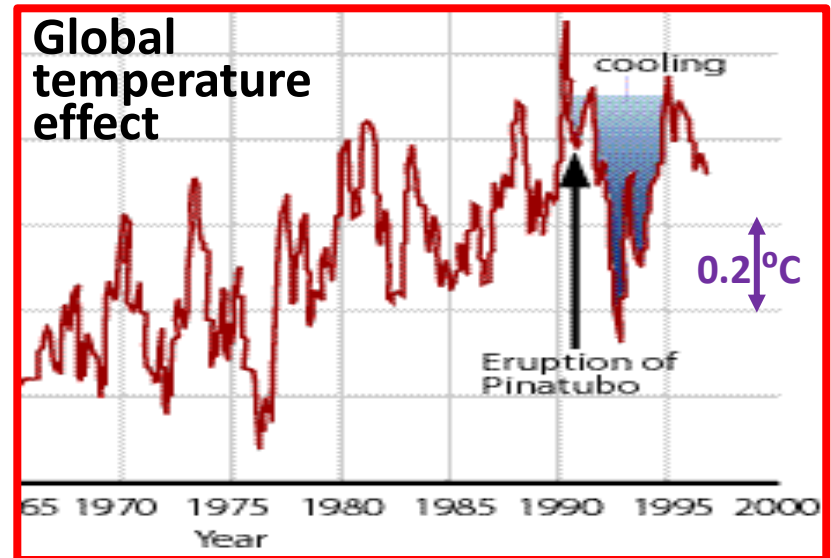
## Mt. Tambora, Indonesia •

Largest observed eruption  
in *recorded* history;  
1816 “Year Without Summer”



## • Mt. Pinatubo, Philippines

Second largest eruption of the 20<sup>th</sup> century, June 1991.

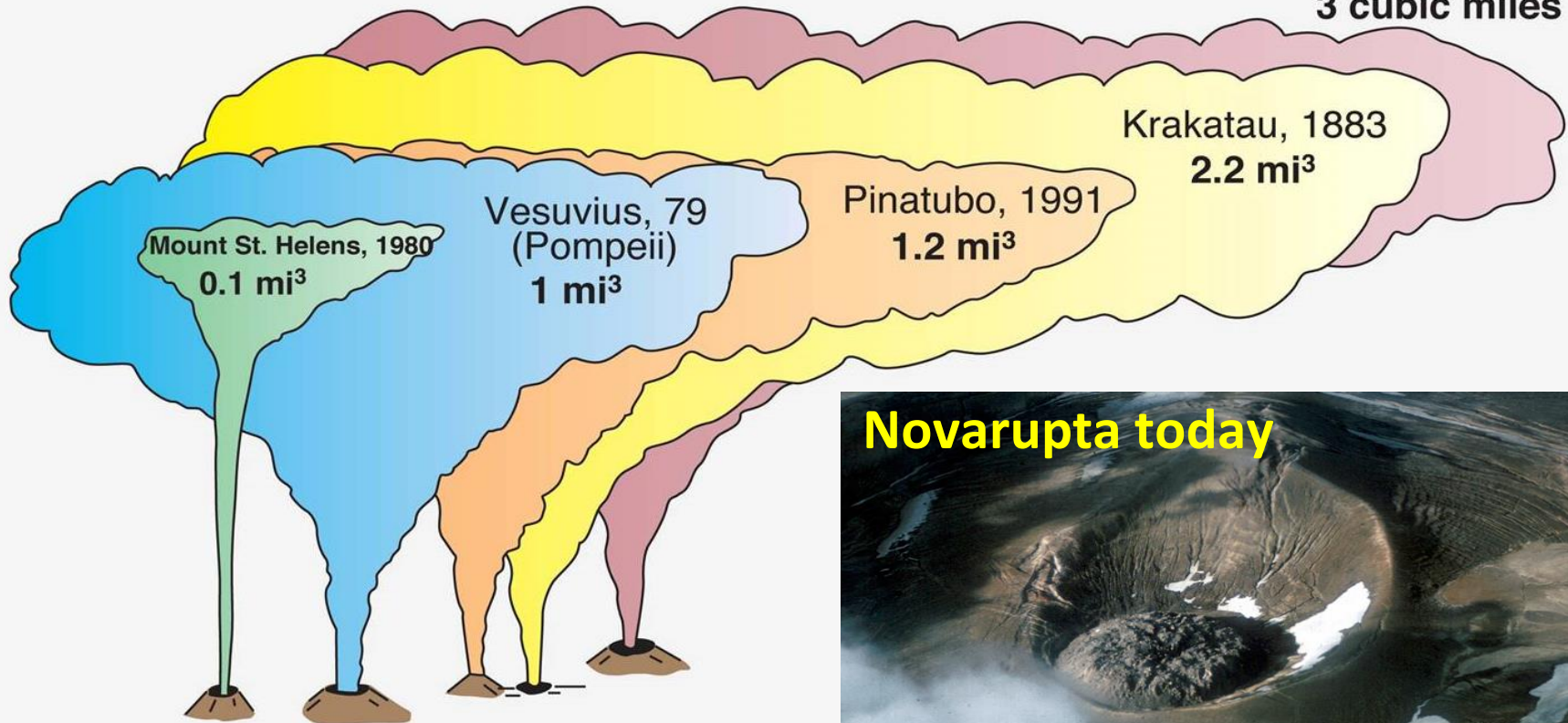


# The Most Powerful Volcanic Eruption of the 20<sup>th</sup> Century



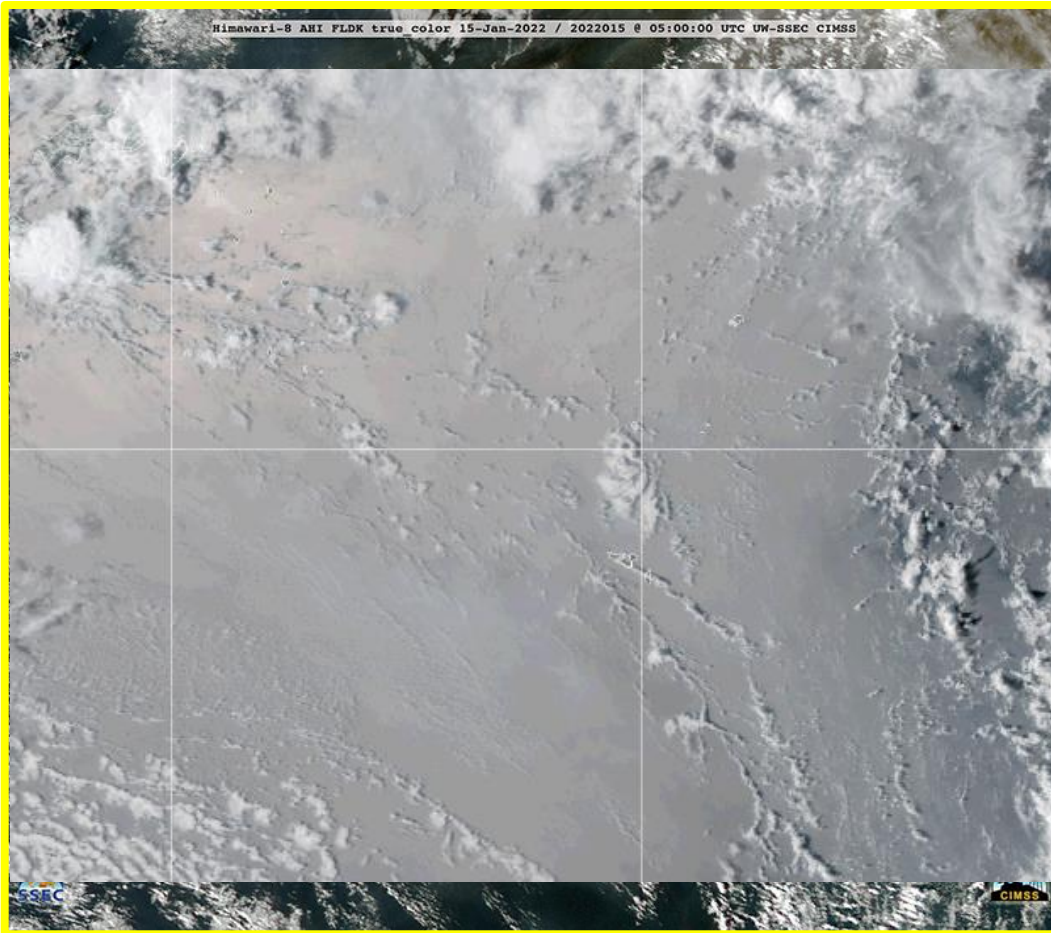
Went almost unnoticed - people in Juneau, Alaska, about 750 miles from the volcano, heard the sound of the blast – *over one hour after it occurred.*

• **NOVARUPTA**  
**Alaska 1912**  
3 cubic miles



# The Most Powerful Volcanic Eruption of the 21<sup>st</sup> Century

Hunga Tonga-Hunga Ha'apai, 14-15 January 2022

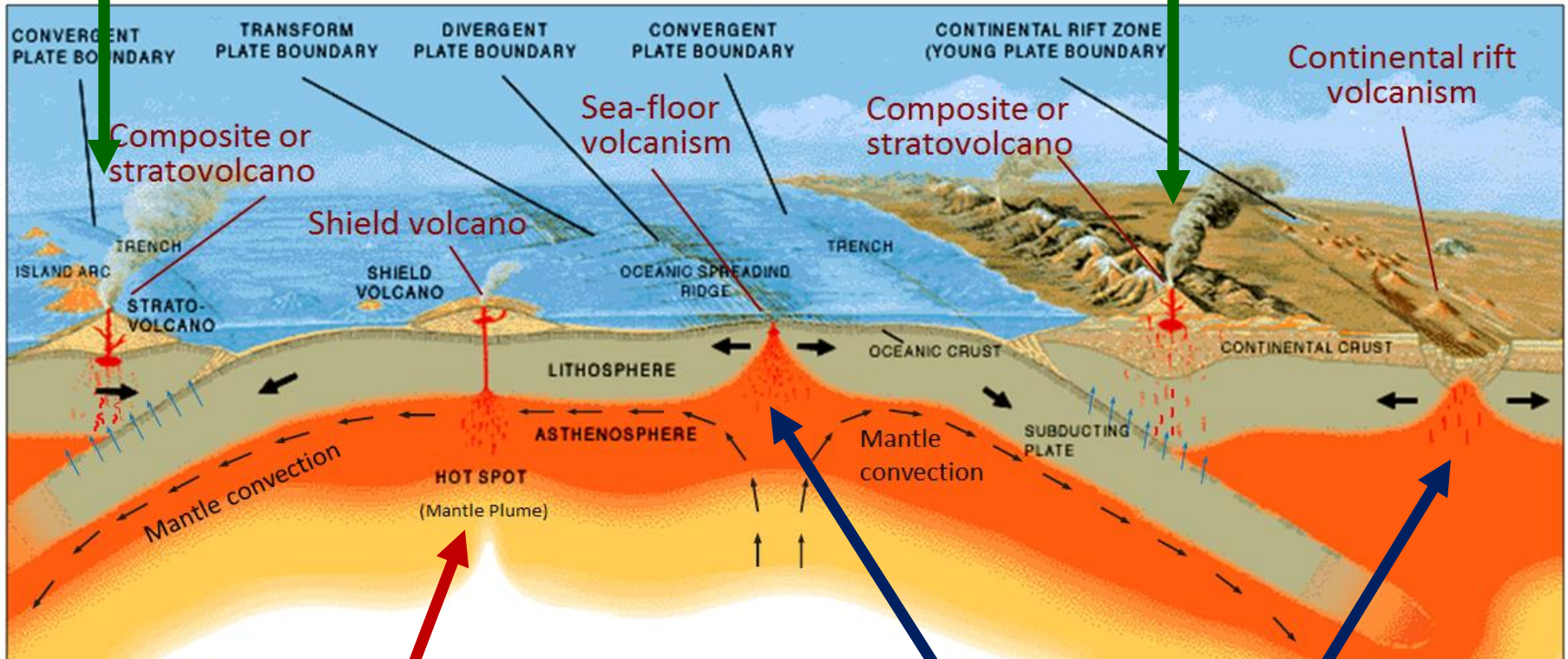


- Blast as powerful as Krakatoa - biggest *boom* ever recorded!
- Ejected  $\sim 2 \text{ mi}^3$  of material; generated an ash plume half the size of France.



# Types of Volcanism

**Subduction zone volcanism  
(most common)**



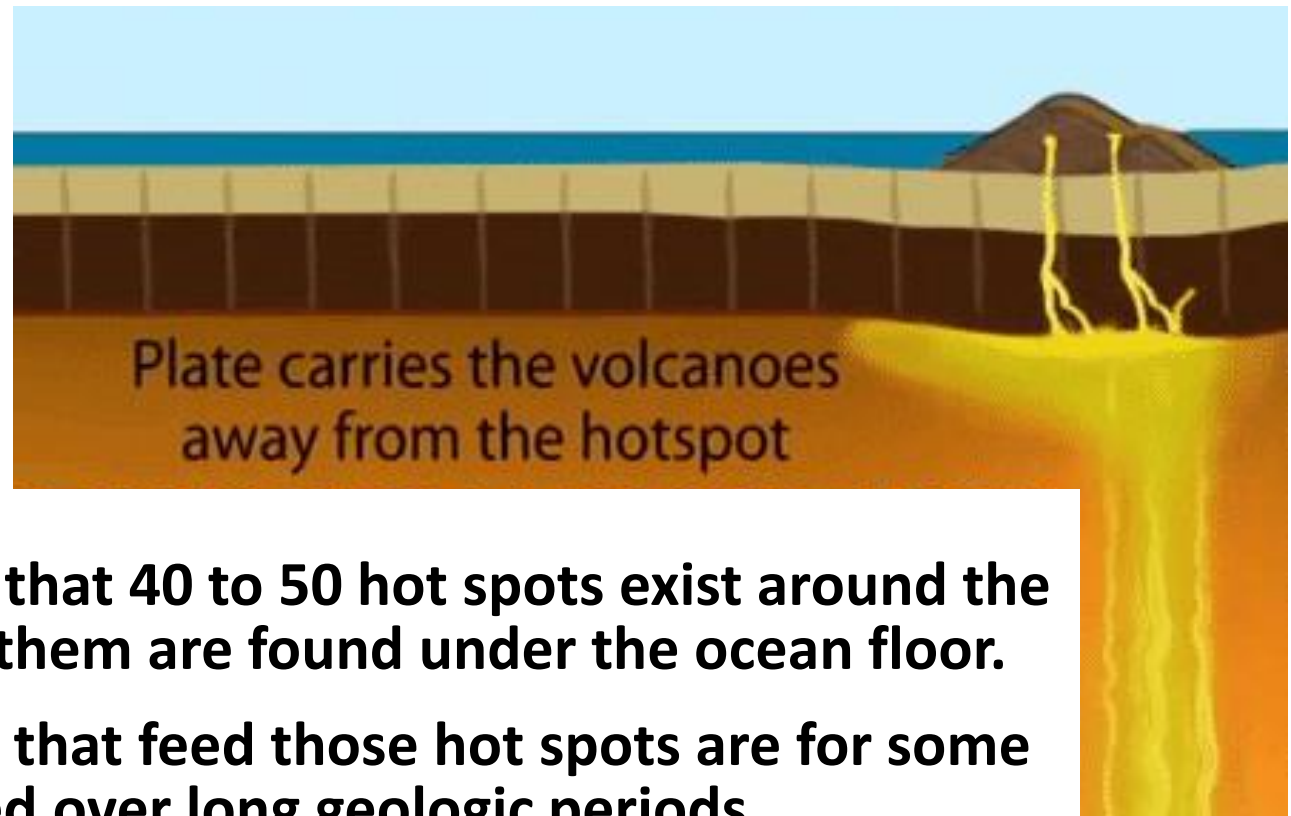
**Hot spot  
volcanism (rare)**

**Spreading  
ridge/rift volcanism**

# Hot Spot Volcanism

Hot spots are due to a **plume of hot magma** flowing up to the crust from the core-mantle boundary.

- Over time, the **tectonic plates of the Earth move over** the hot spots leaving a **trail of volcanoes**.



- Scientists think that 40 to 50 hot spots exist around the world; most of them are found under the ocean floor.
- Magma plumes that feed those hot spots are for some reason sustained over long geologic periods.
- Volcanoes carried far away from the hot spot become **extinct**.

