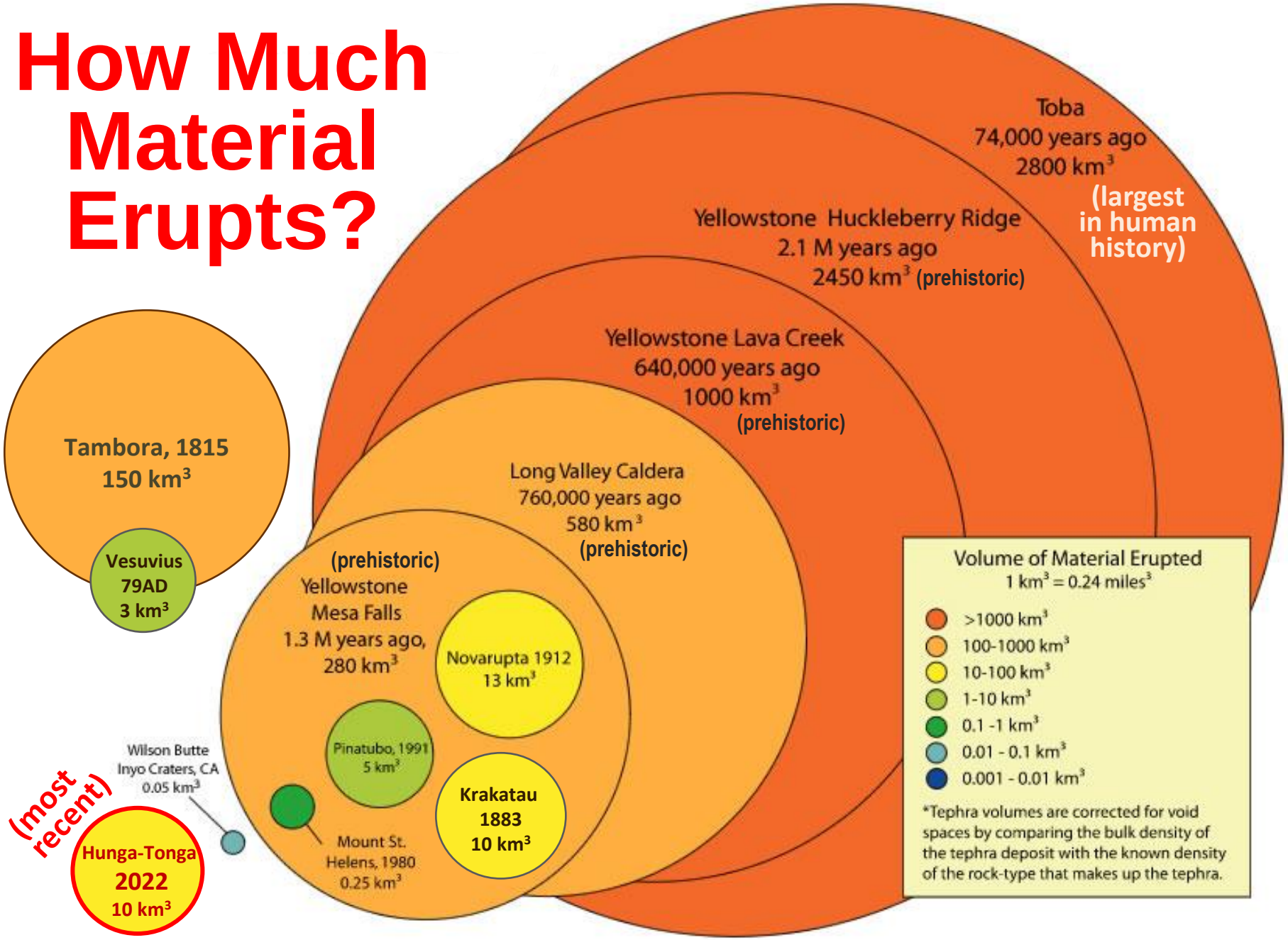
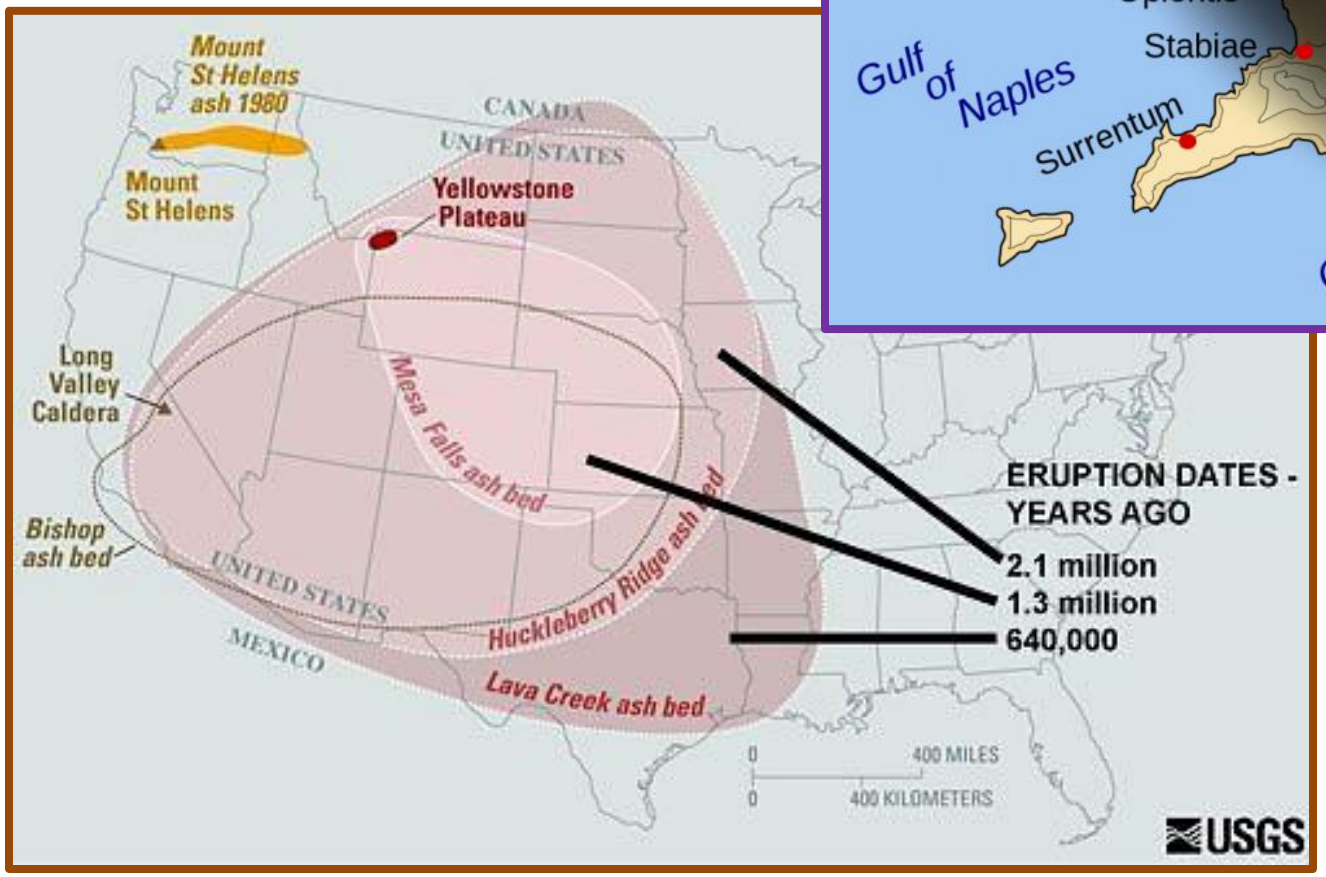
How Much Material Erupts?



Volcanic Ash Fall Zone

Can cover hundreds of thousands square miles!

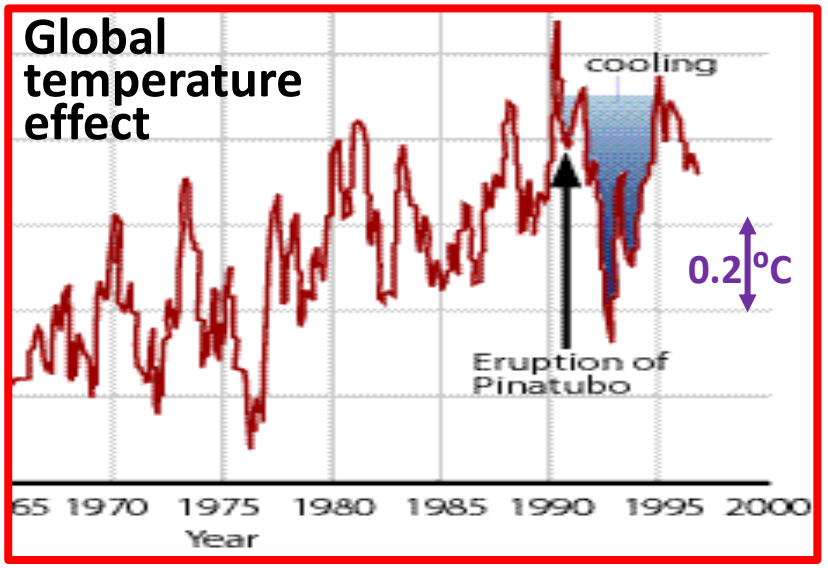


Vesuvius ash fall zone was roughly 100 times smaller than that of the latest (640,000 YA) Yellowstone eruption!

Volcanoes and Climate

Mt. Tambora, Indonesia •

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



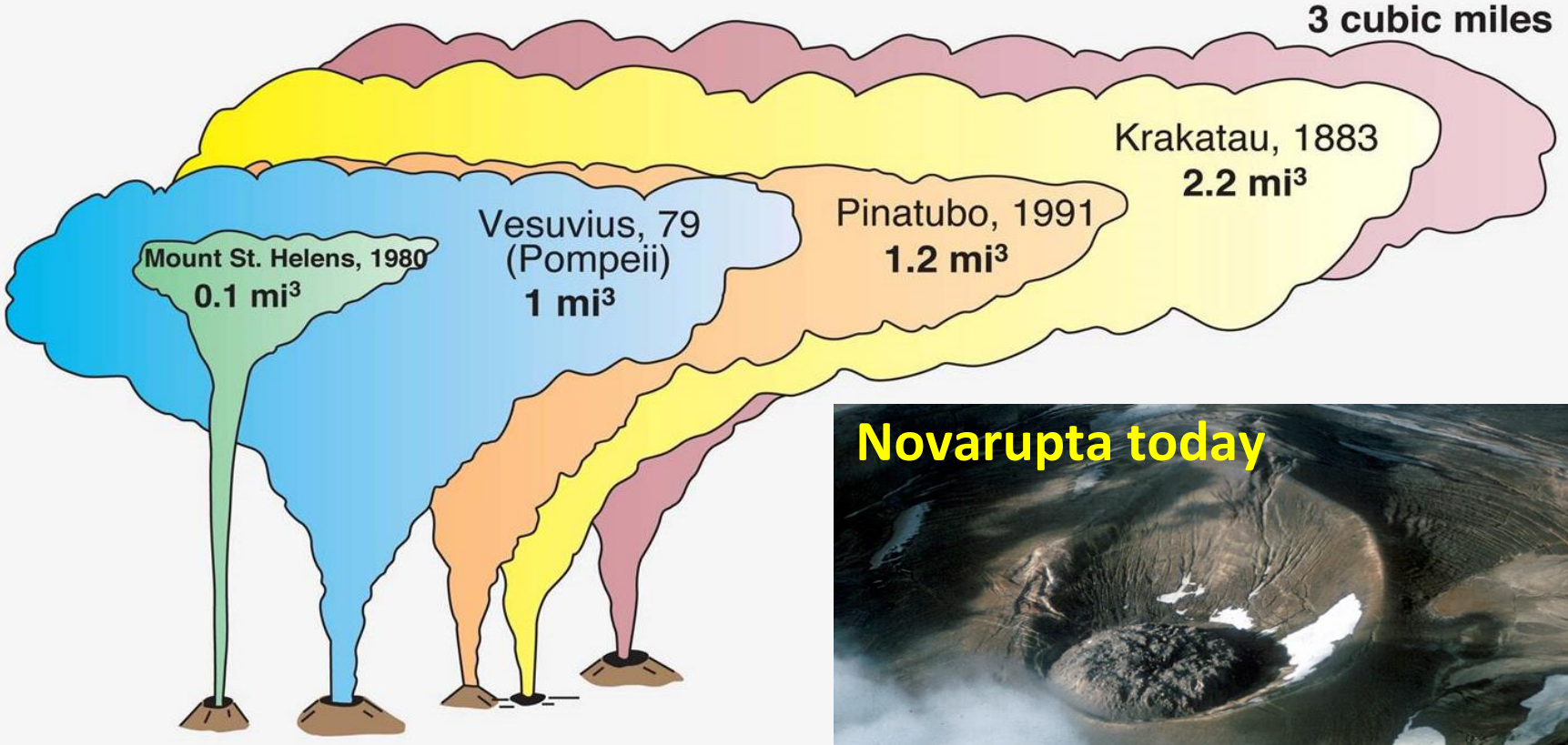
• Mt. Pinatubo, Philippines

Second largest eruption of the 20th century, June 1991.

The Most Powerful Volcanic Eruption of the 20th Century

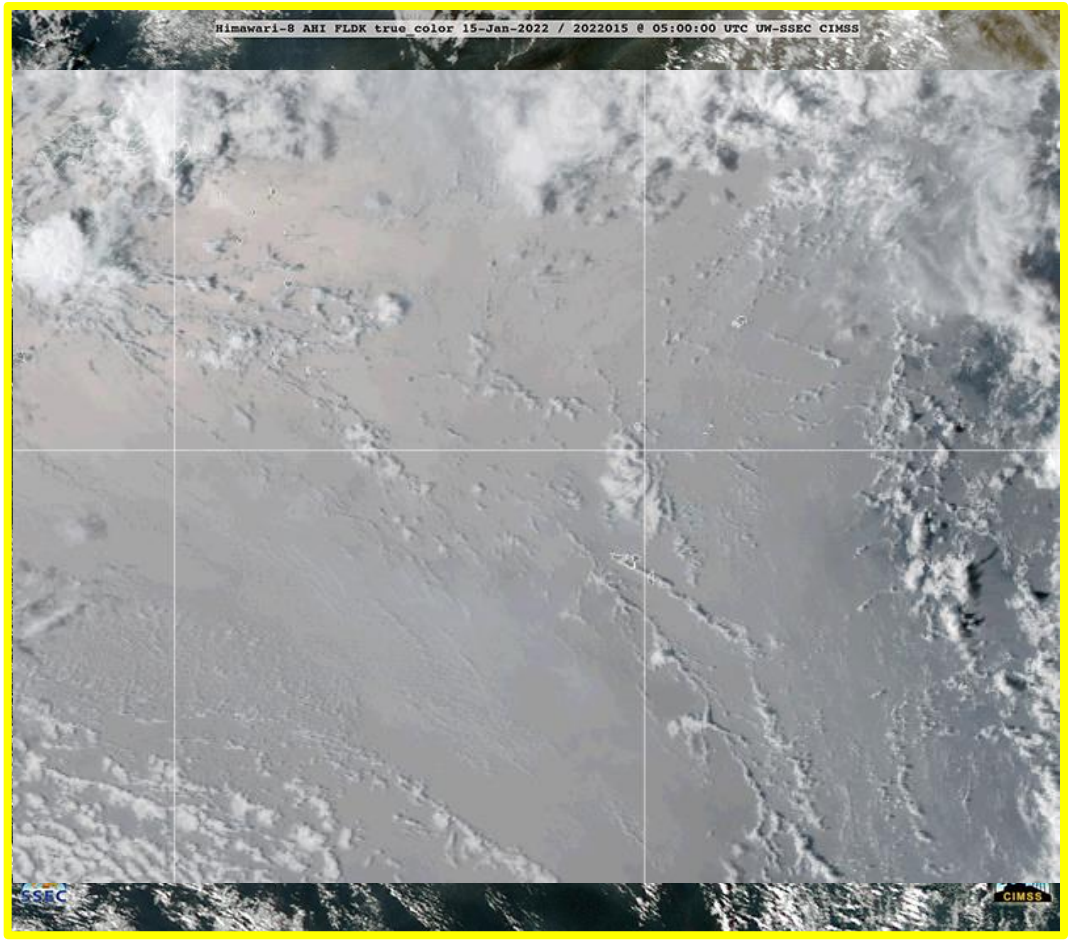
Went almost unnoticed - people in Juneau, Alaska, about 750 miles from the volcano, heard the sound of the blast – *over one hour after* it occurred.

•NOVARUPTA
Alaska 1912



The Most Powerful Volcanic Eruption of the 21st Century

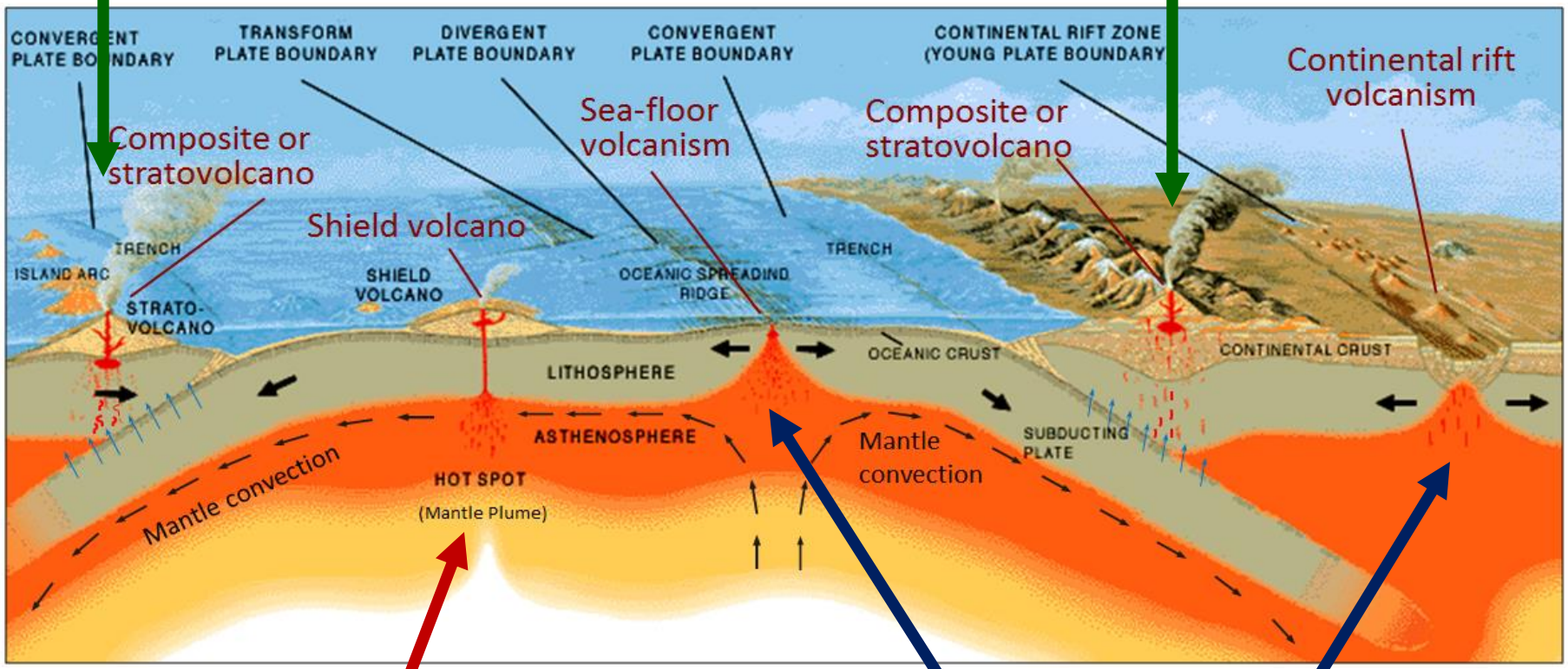
Hunga Tonga-Hunga Ha'apai, 14-15 January 2022



- **Blast as powerful as Krakatoa - biggest *boom* ever recorded!**
- **Ejected ~2 mi³ (10 km³) of material; generated an ash plume half the size of France.**

Types of Volcanism

Subduction zone volcanism (most common)



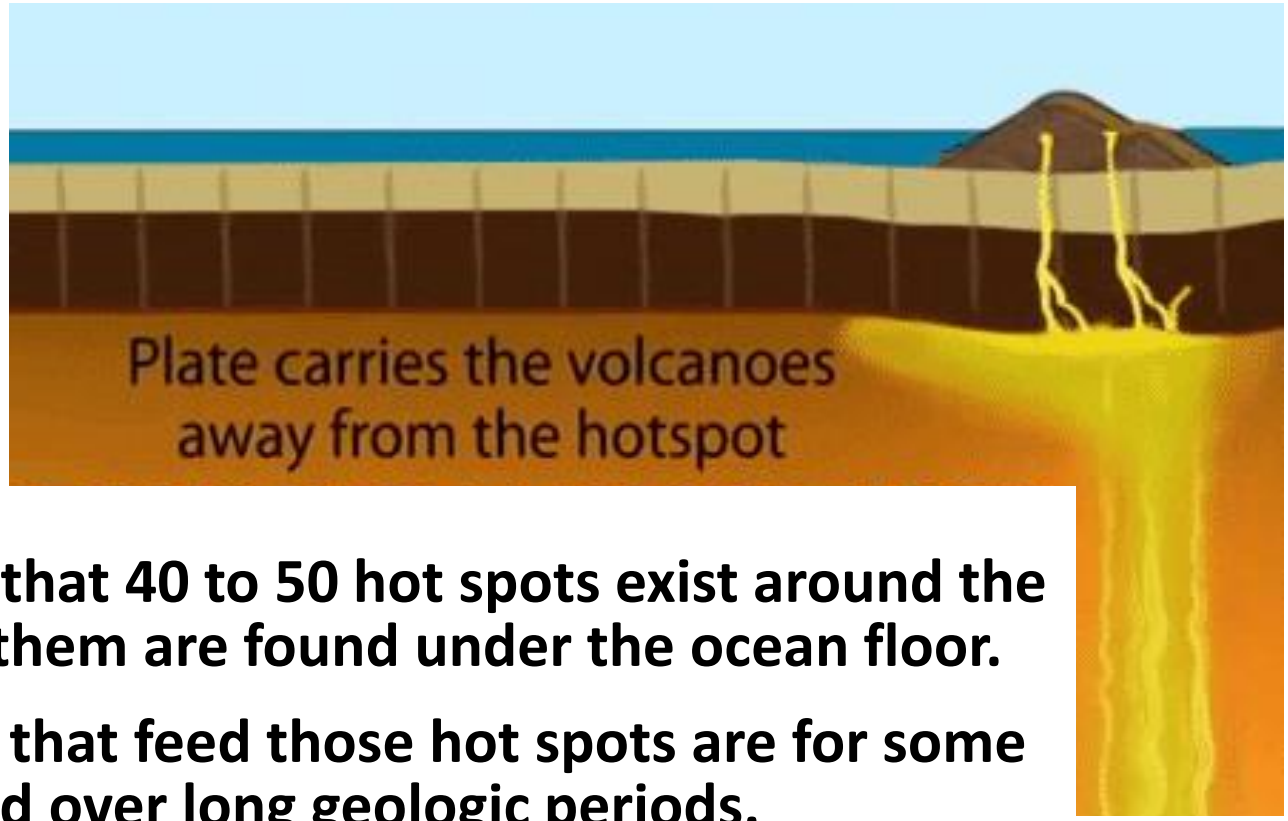
Hot spot volcanism (rare)

Spreading ridge/rift volcanism

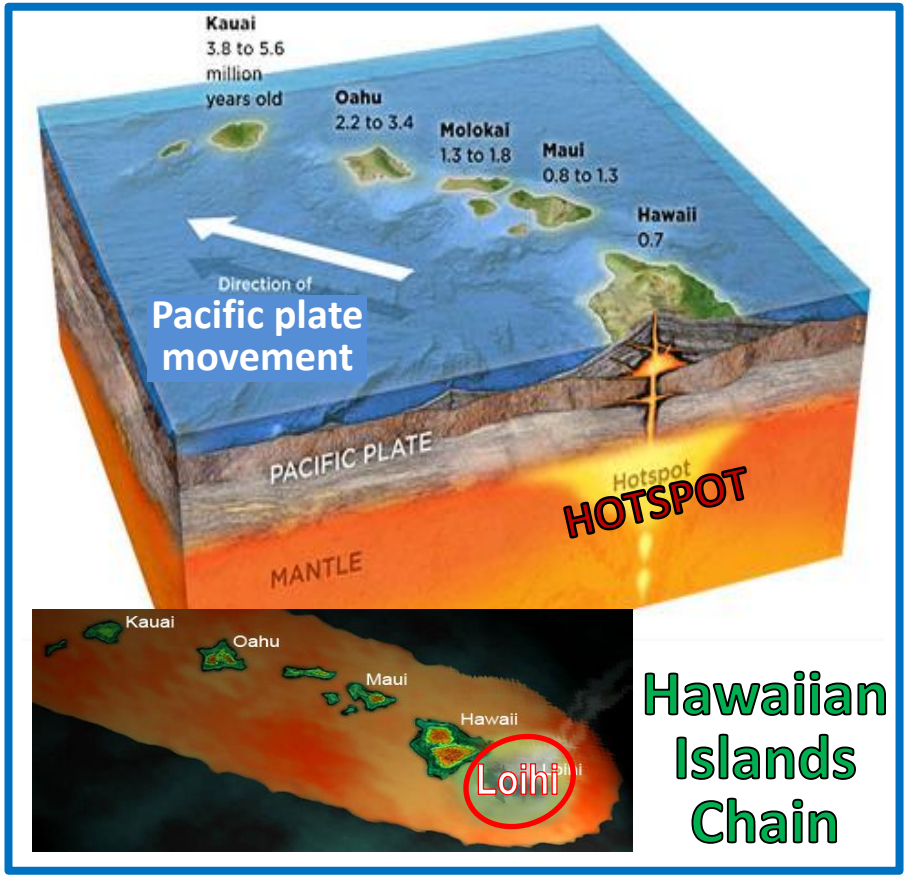
Hot Spot Volcanism

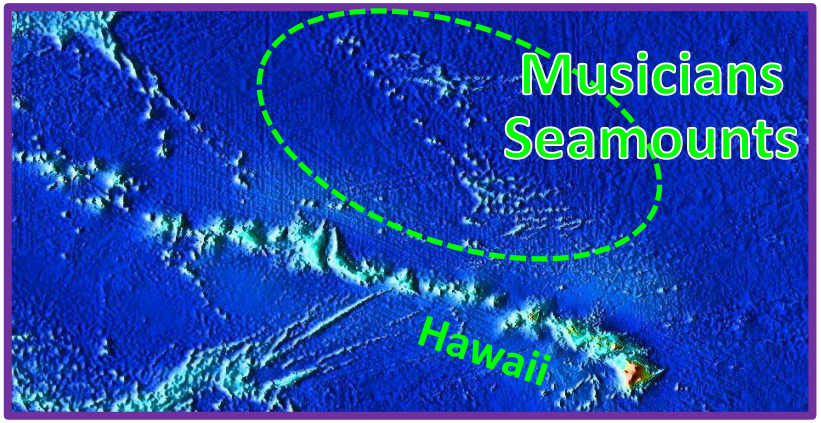
Hot spots are due to a plume of hot magma flowing up to the crust from the core-mantle boundary.

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

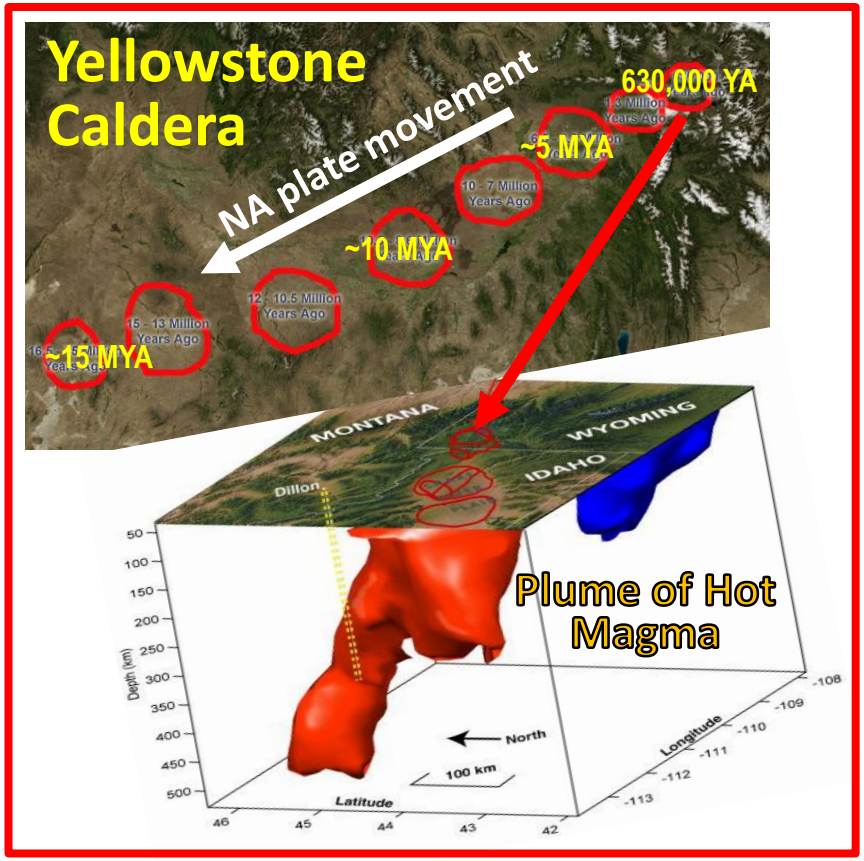


- **Scientists think that 40 to 50 hot spots exist around the world; most of them are found under the ocean floor.**
- **Magma plumes that feed those hot spots are for some reason sustained over long geologic periods.**
- **Volcanoes carried far away from the hot spot become extinct.**


Kauai
3.8 to 5.6 million years old
Oahu
2.2 to 3.4
Molokai
1.3 to 1.8
Maui
0.8 to 1.3
Hawaii
0.7
Direction of
Pacific plate movement
PACIFIC PLATE
Hotspot
HOTSPOT
MANTLE
Kauai
Oahu
Maui
Hawaii
Loihi
Hawaiian Islands Chain


Musicians Seamounts
Hawaii


Kermadec Trench
Louisville Seamount Chain
New Zealand


Yellowstone Caldera
NA plate movement
630,000 YA
~5 MYA
~10 MYA
~15 MYA
10 - 7 Million Years Ago
12 - 10.5 Million Years Ago
15 - 13 Million Years Ago
MONTANA
WYOMING
IDAHO
Dillon
Plume of Hot Magma
Depth (km)
50
100
150
200
250
300
350
400
450
500
North
100 km
Latitude
46
45
44
43
42
Longitude
-108
-109
-110
-111
-112
-113

Volcanic Landforms: Caldera

(Spanish for "cooking pot")

Volcano rapidly empties its magma chamber, and support is lost. Overlying material collapses into the magma chamber: a caldera forms.

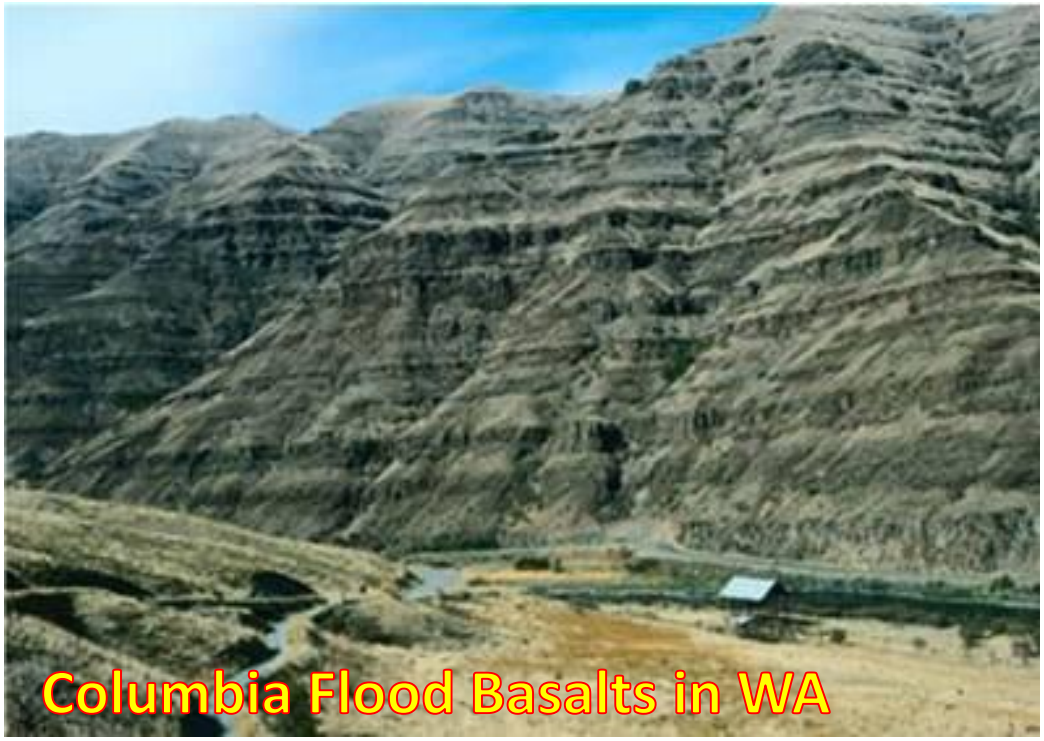
- **Explosive calderas**

  Silica-rich magma feeding these volcanoes has high viscosity; gases tend to become trapped at high pressure within the magma, resulting in explosion.

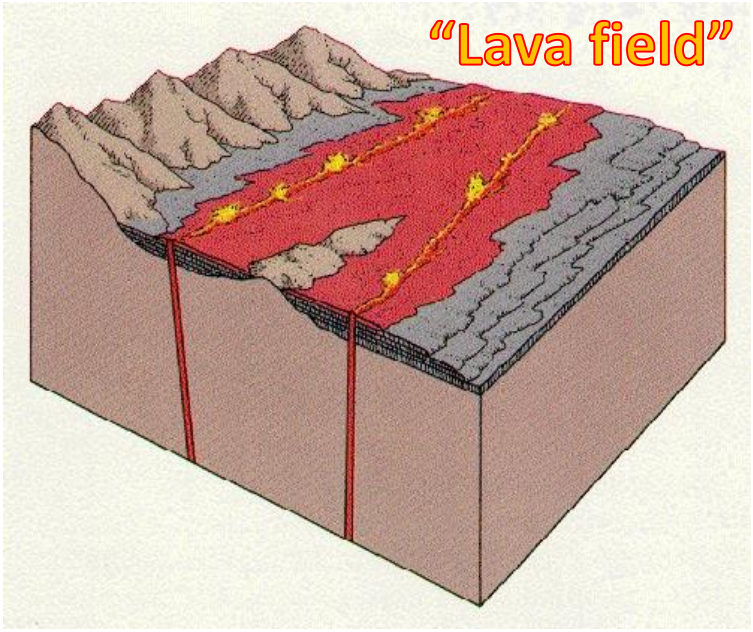
- **Non-explosive calderas**

  Basaltic magma feeding these volcanoes is silica poor and much less viscous; the magma chamber is drained by large lava flows rather than by explosive events.

Volcanic Landforms: Flood Basalts



- Large (10-100 square miles) outpourings of very low viscosity basaltic lava



- Multiple, "quiet" eruptions
- Lava *plateau* forms
- Flood basalt volcanism has been connected to major mass extinction events in the past.