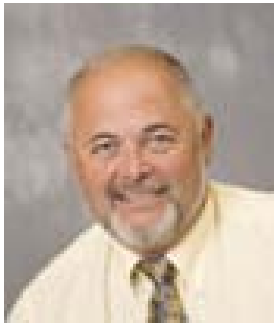
Week 4 Ch 7 PPT

EAPS 10000 Y01
Online Course
Planet Earth
Prof. Lawrence Braile

Welcome to the EAPS 10000 Y01 online course
Planet Earth *(also known as EAPS 100)!*



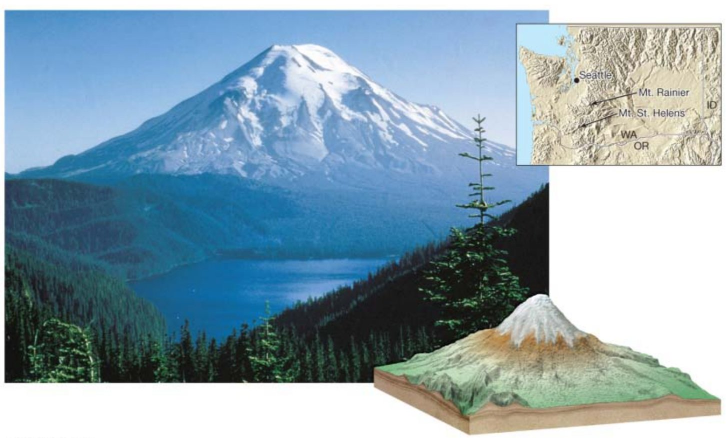
Professor Lawrence Braile
Dept. of Earth, Atmospheric, and Planetary Sciences
2271 HAMP (CIVL), Purdue University
braile@purdue.edu, (765) 494-5979

PURDUE UNIVERSITY

Earth Atmospheric Planetary Sciences

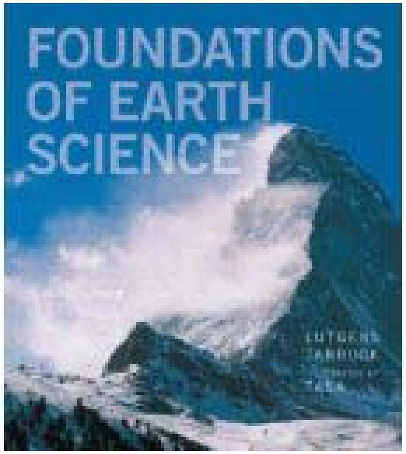
EAPS 10000 Y01 – Planet Earth (online course)
Week 4, Chapter 7 (pages 230-269, text)

Week	Chapter	Assigned Pages	Major Concepts	Important Terms
4	**7 – Fires Within**	230 – 269	Volcanic eruptions, basaltic and rhyolite/andesite volcanism, shield volcanoes, composite (strato-) volcanoes, intrusive igneous activity, plate tectonics and igneous activity, volcanic hazards	Viscosity, pyroclastic flows, basalt, rhyolite, fissure (flood) basalts, crater, caldera, plutons



Mt. St. Helens before May, 1980 eruption

Basaltic lava flow, Hawaii



EAPS 10000 Y01 – *Planet Earth* (online course)
Week 4, Chapter 7 (pages 230-269)

When you have finished reading Chapter 7 and viewing the Chapter 7 PowerPoint file, take the quiz (Quiz6; be sure to read the Syllabus for more information on quizzes). You can use your book, notes, etc. during the quiz.

The PPT files (converted to PDF files) are best viewed with the Full Screen view in browsers.

Please open the Week 4 folder (in Weekly PowerPoints) and view the Mt. St. Helens eruption animation. Select the animation (swf file) and click Play. You can listen to the audio narration and/or select Show Text.

The following slides illustrate some of the important concepts and topics of Chapter 7.

View the impressive volcano eruption videos from Martin Rietze (first three links below) (http://mrietze.com/), and the YouTube video (4th link). Depending on your browser, you may be able to link directly to these files by just clicking on them, below. Otherwise, copy and paste the web addresses into Internet Explorer to view. If you cannot open the M. Rietze videos in this way, go to http://mrietze.com/; then select **Volcanotours 2004-2010**; then select **Iceland-Eyjafjallajökull May 2010**; then find the **"view into Eyjafjallajökull crater…"** thumbnail images and place your cursor over the images until you find the files ending in **5741.MP4** and **5687.mp4**. Open and view these videos. Similarly, for the Montserrat video, select **Volcanotours 2004-2010**; then select **Montserrat-Soufriere Hills**; then scroll to the bottom of the page and open the video labeled **bigger PF** (PF is for "prytoclastic flow").

1. View into Eyjafjallajökull (Iceland) crater, 2010:
http://mrietze.com/images/Iceland10-2/MVI_5741.MP4

2. View into Eyjafjallajökull (Iceland) crater, 2010:
http://mrietze.com/images/Iceland10-2/MVI_5687.mp4

3. View of pyroclastic flow (glowing avalanche or "nuee ardent", Montserrat, Soufriere Hills, 2010:
http://mrietze.com/images/montserrat10/MVI_9618-b%20001-Desktop.m4v

4. View of low viscosity basalt flows from Hawaii, 2011:
http://www.youtube.com/watch?v=6VfsKoH-ScA

Two major types of volcanism (also see Table 7.1 in text [7th edition] and the following slide, [Table 7.1 is not correct in 2008 and 2005 editions]):

BASALTIC	RHYOLITE - ANDESITE
low $SiO_2 \approx 50\%$	high $SiO_2 \approx 70\%$
density ≈ 3 g/cm^3	density ≈ 2.7 g/cm^3
shield volcanoes	composite volcanoes
mid-ocean ridges	collision zones
melt temp. $\approx 1200°$C	melt temp. $\approx 700°$C
low viscosity (fluid flows)	high viscosity (sticky lava; also ash)
flow eruptions	**explosive eruptions**
Examples: Hawaii, mid-ocean ridge, Iceland, Craters of the Moon (ID)	Examples: St. Helens, Andes volc., Vesuvius, Mt. Pele, Pinatubo, Japan volcanoes

Table 7.1 - 6th edition, text, 2011

Table 7.1 Magmas' different compositions cause properties to vary

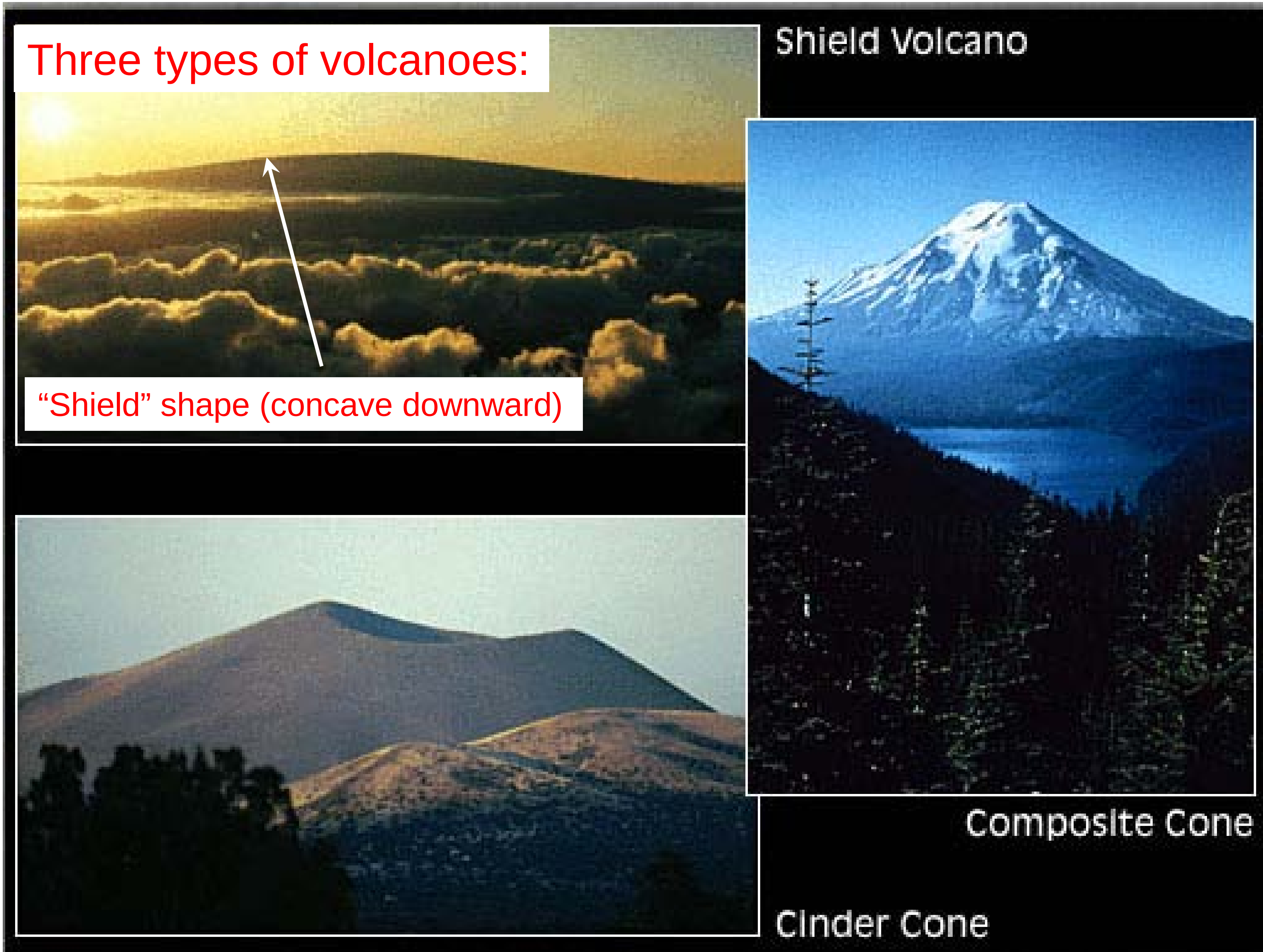
Composition	Silica Content	Viscosity	Gas Content	Tendency to Form Pyroclastics	Volcanic Landform
Basaltic (Matic)	Least (~50%)	Least	Least (1–2%)	Least	Shield Volcanoes Basalt Plateaus Cinder Cones
Andesitic (Intermediate)	Intermediate (~60%)	Intermediate	Intermediate (3–4%)	Intermediate	Composite Cones
Granitic (Felsic)	Most (~70%)	Greatest	Most (4–6%)	Greatest	Pyroclastic Flows Volcanic Domes

5th edition, text, 2008, corrections in red

Table 7.1 Variations in properties among magmas of differing compositions

Property	Basaltic Magma	Andesitic Magma	Granitic Magma
Silica content	Least (about ~50%	Intermediate (about ~60%	Most (about ~70%
Viscosity	Least ("thinnest")	Intermediate	Greatest ("thickest")
Tendency to form lavas	Highest	Intermediate	Least
Tendency to form pyroclastics	Least	Intermediate	Greatest
Melting temperature	Highest	Intermediate	Lowest

Also known as Rhyolite Magma


Three types of volcanoes:
Shield Volcano
"Shield" shape (concave downward)
Composite Cone
Cinder Cone

Igneous Activity

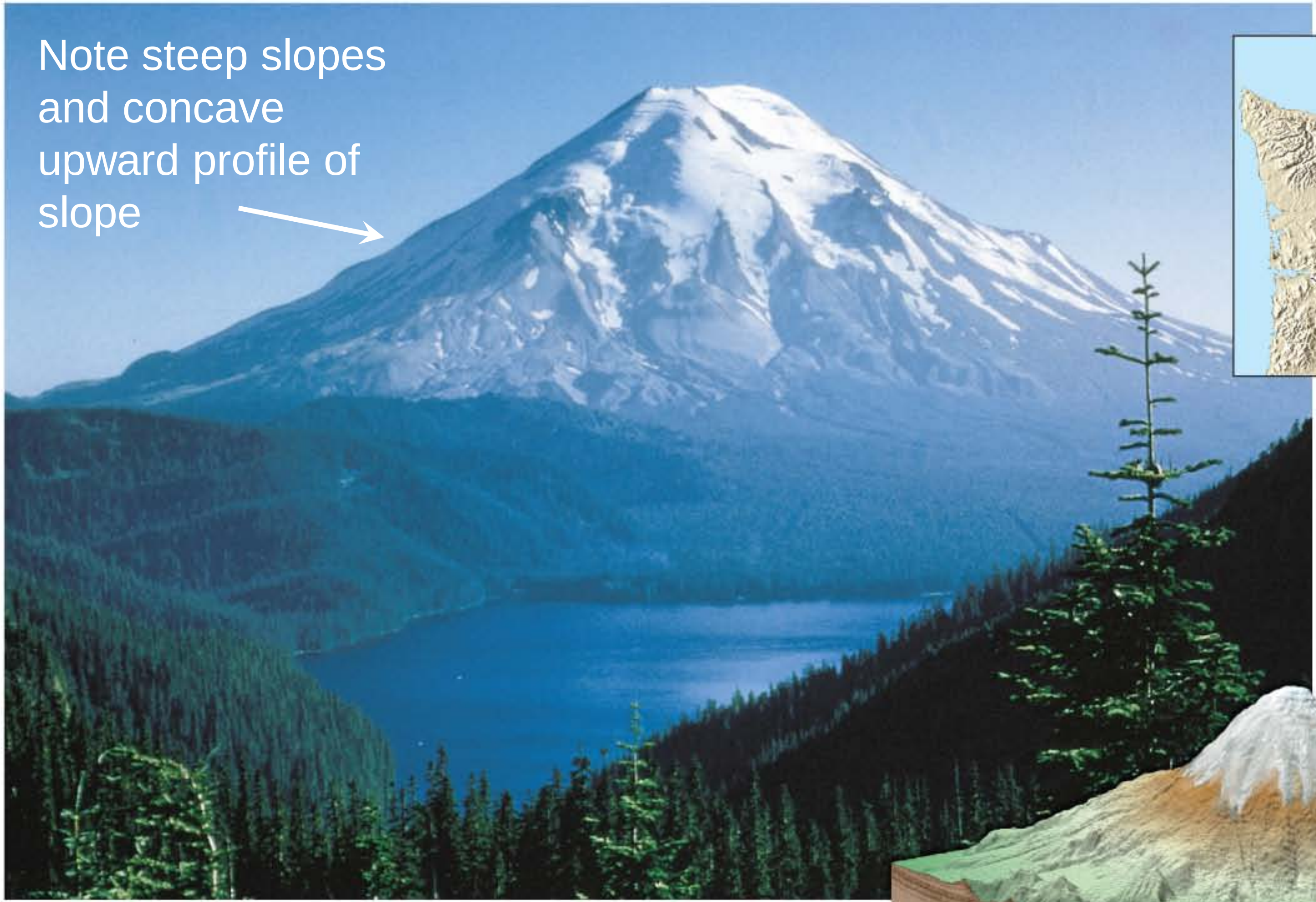
Materials Extruded During an Eruption

Basaltic Magma (low viscosity) from shield volcano – “river of lava”

• Main Menu
• Glossary
• QUIT

Due to their low silica content, basaltic magmas extrude mainly lavas that are very fluid and flow in thin, broad sheets or stream-like ribbons.

Mt. St. Helens -- Prior to the 1980 Eruption



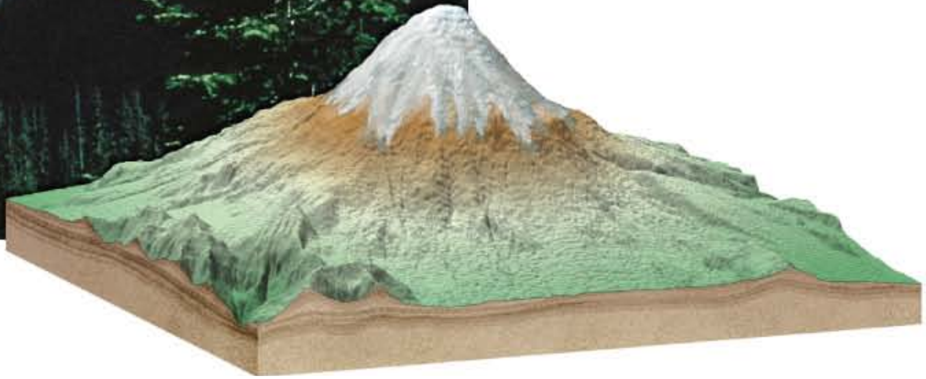
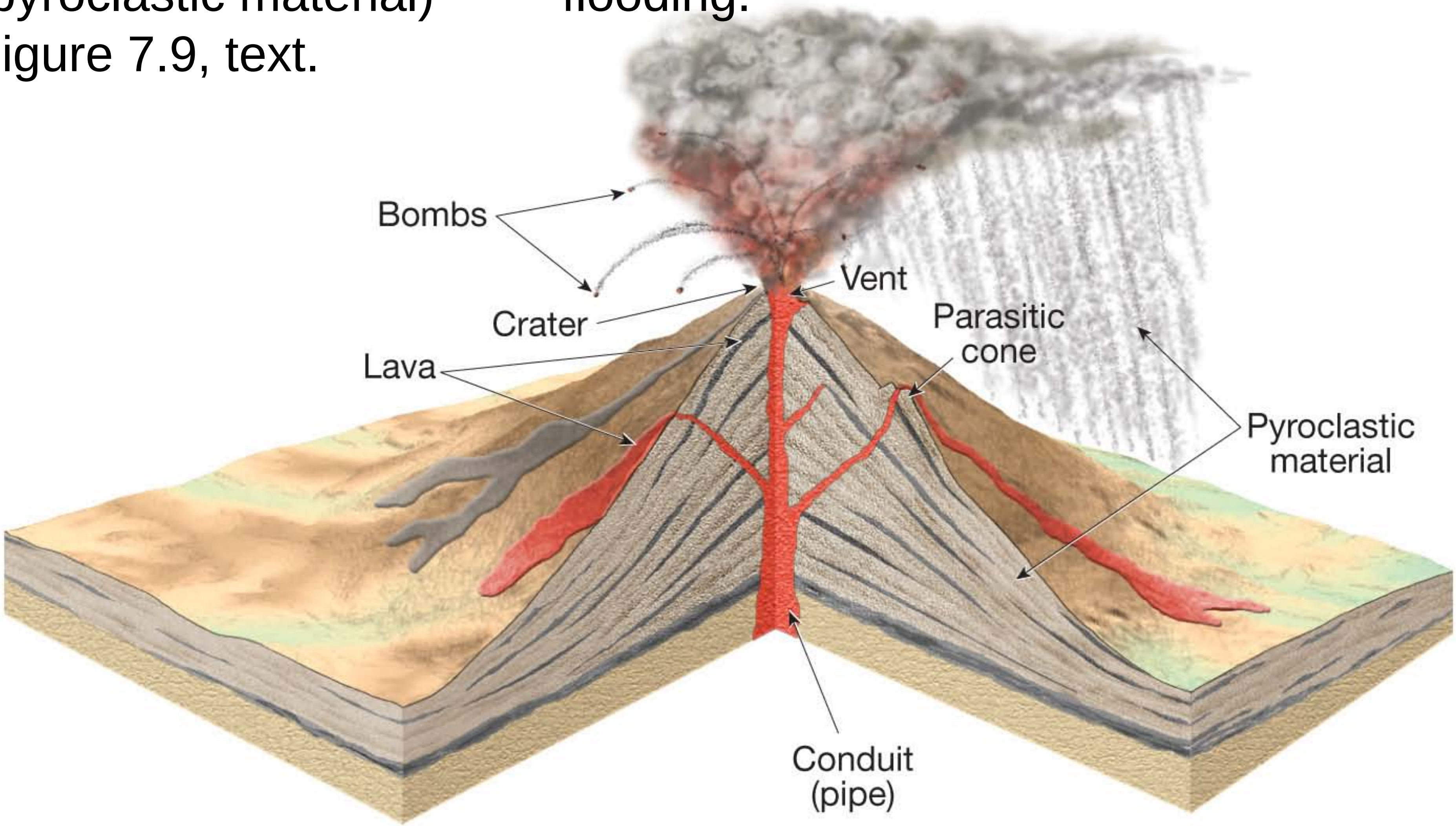


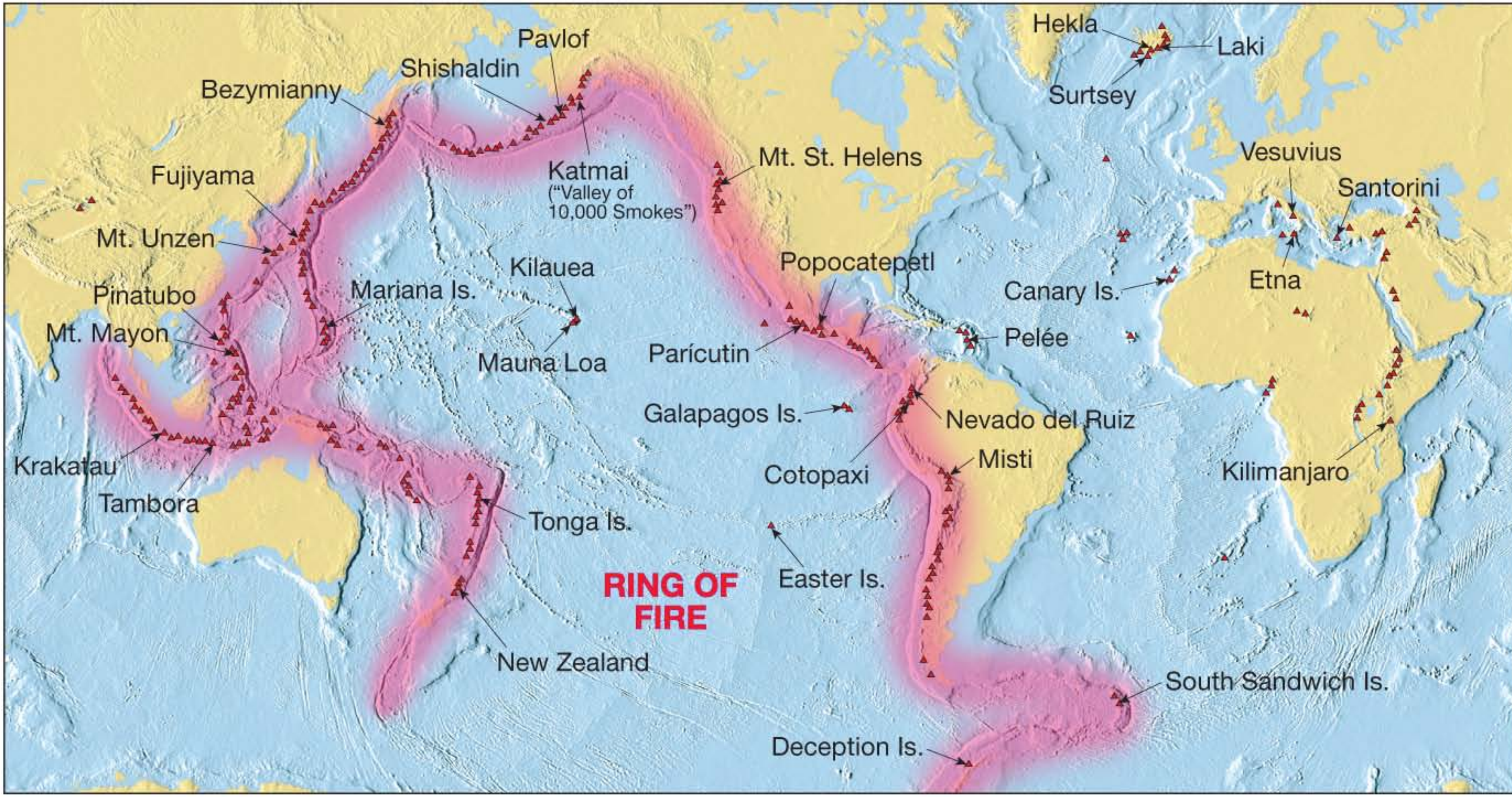
Figure 7.1, text

Composite or strato-volcano – High viscosity Rhyolite or Andesite lavas, ash and pyroclastics.

A strato- or composite volcano composed of layers of lava and ash (pyroclastic material) Figure 7.9, text.

Hazards: explosive eruption, pyroclastic flows, lava flows, volcanic bombs, ash fall, poisonous gases, mud flows, flooding.





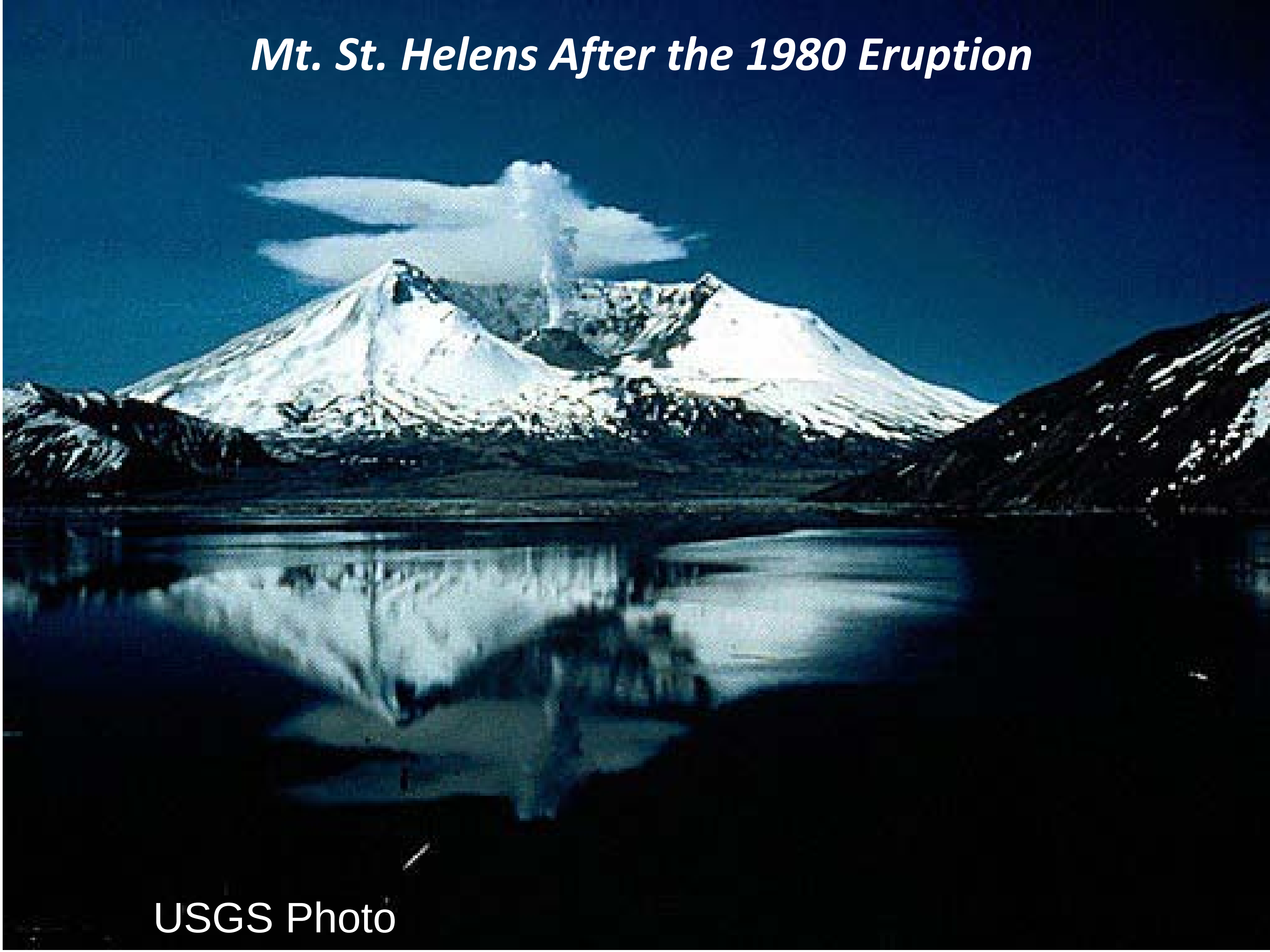
Active volcanoes; most of the circum-Pacific volcanoes ("ring of fire") are rhyolite or andesite (named for Andes mountains) composite volcanoes. Figure 7.33, text.


1980 eruption of
Mount St. Helens

Mt. St. Helens after May 18, 1980 eruption

Figure 7.1, text

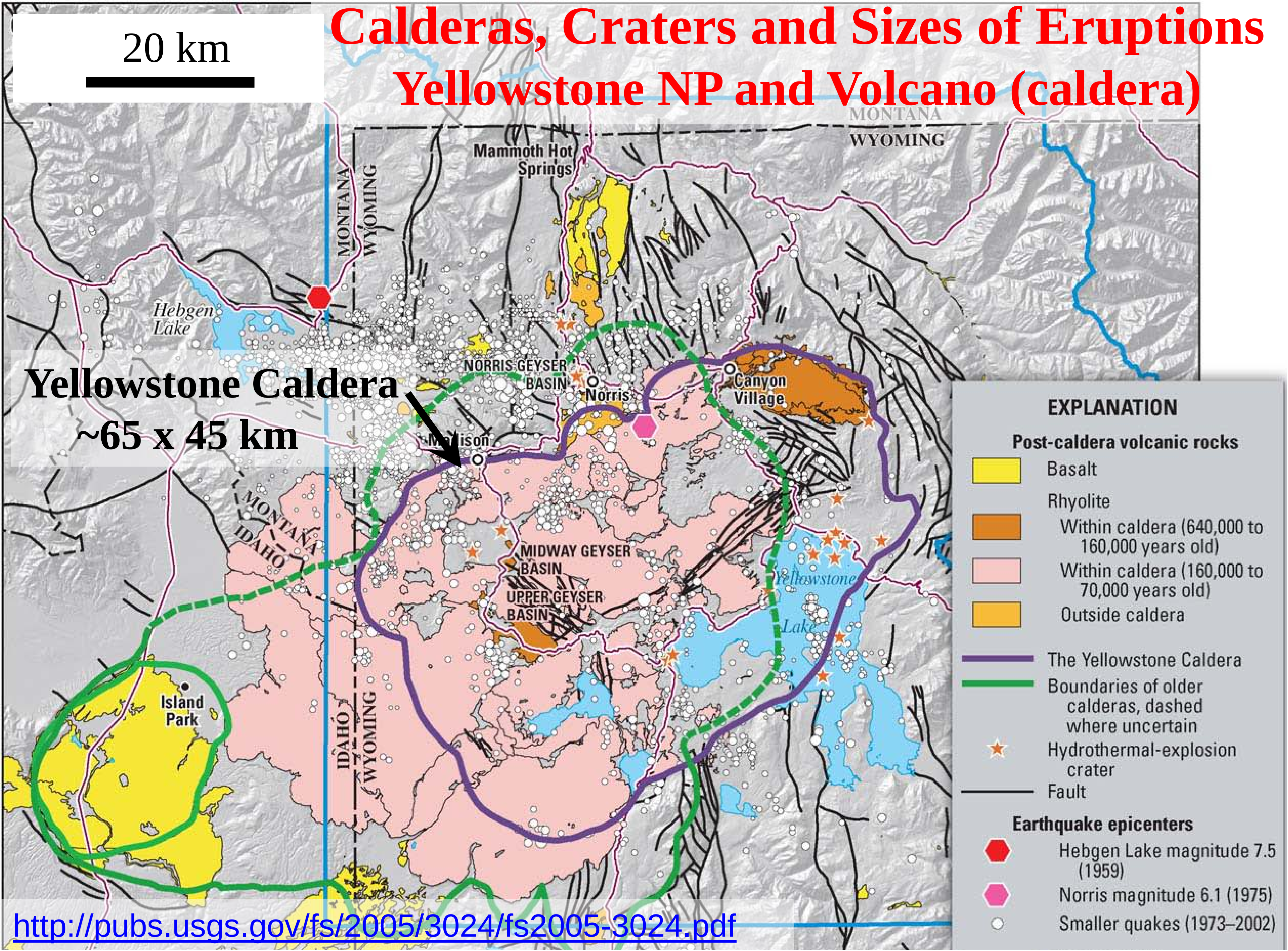
Mt. St. Helens After the 1980 Eruption



USGS Photo

Pyroclastic flow (glowing avalanche) on Mt. St. Helens (also see Figures 7.16 and 7.19)

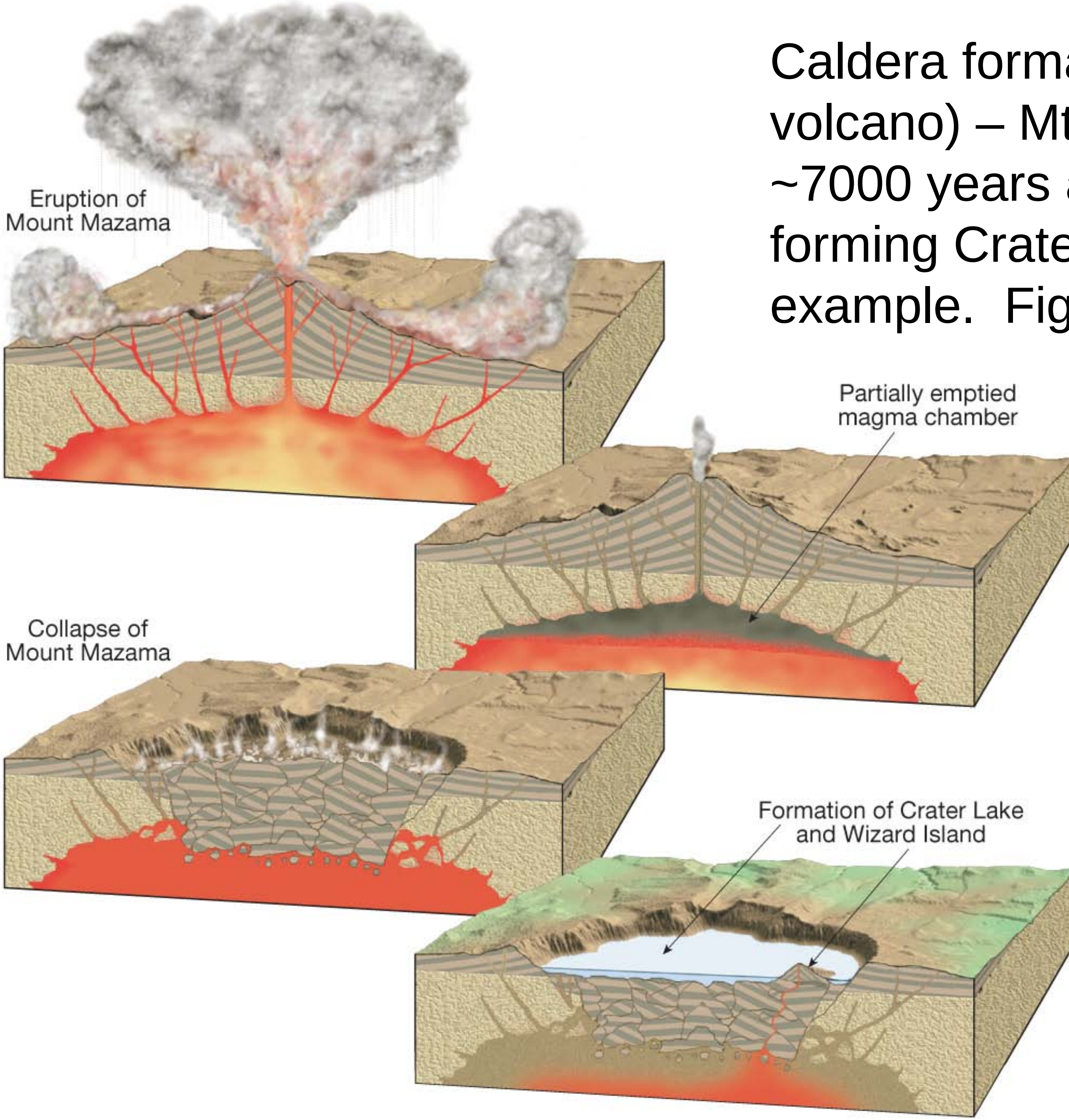
Calderas, Craters and Sizes of Eruptions
Yellowstone NP and Volcano (caldera)



http://pubs.usgs.gov/fs/2005/3024/fs2005-3024.pdf

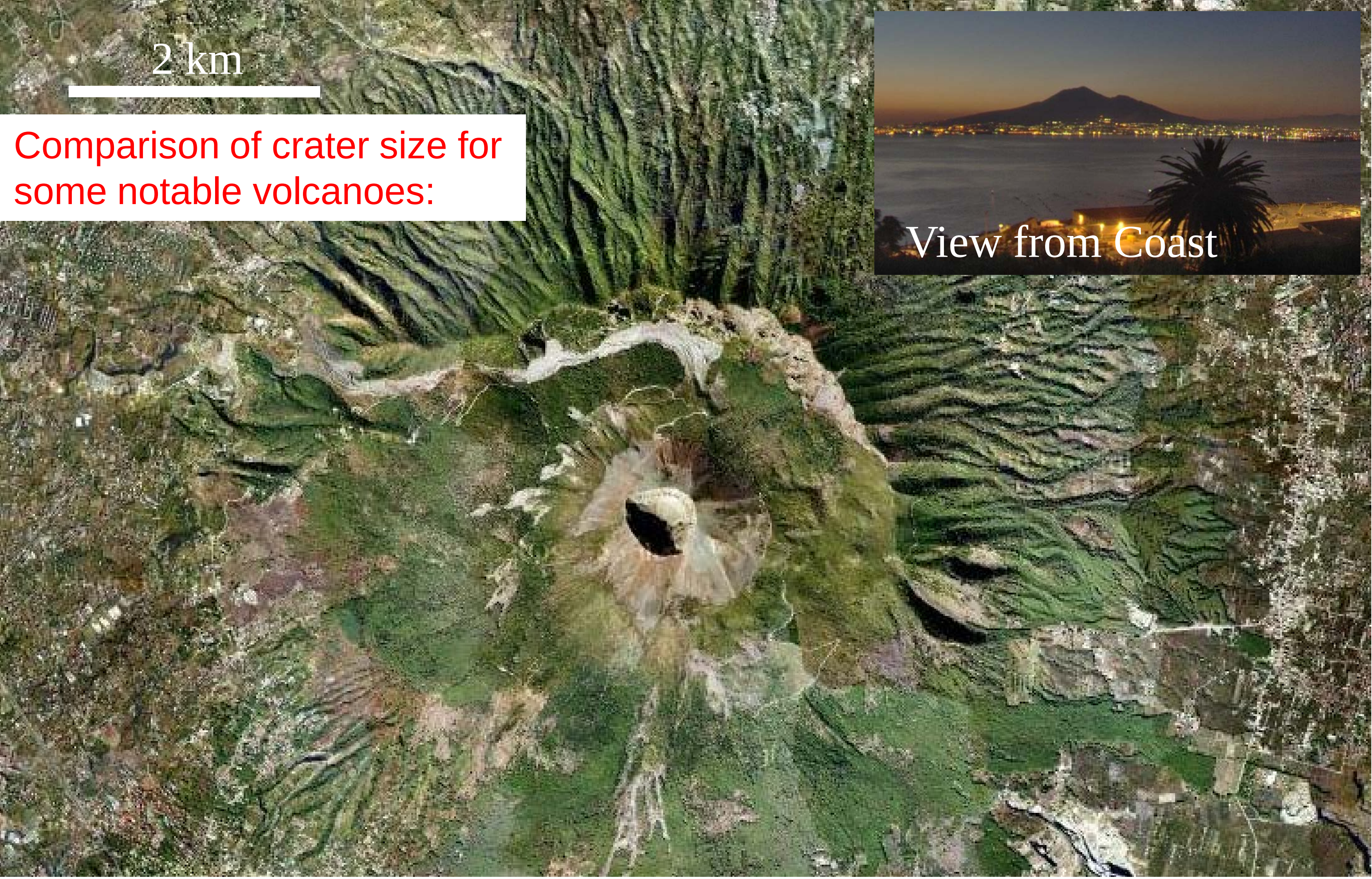
Grand Prismatic Spring (hot spring; note boardwalk for scale). Yellowstone National Park

Caldera formation (collapsed volcano) – Mt. Mazama, ~7000 years ago eruption, forming Crater Lake is a type example. Figure 7.20, text



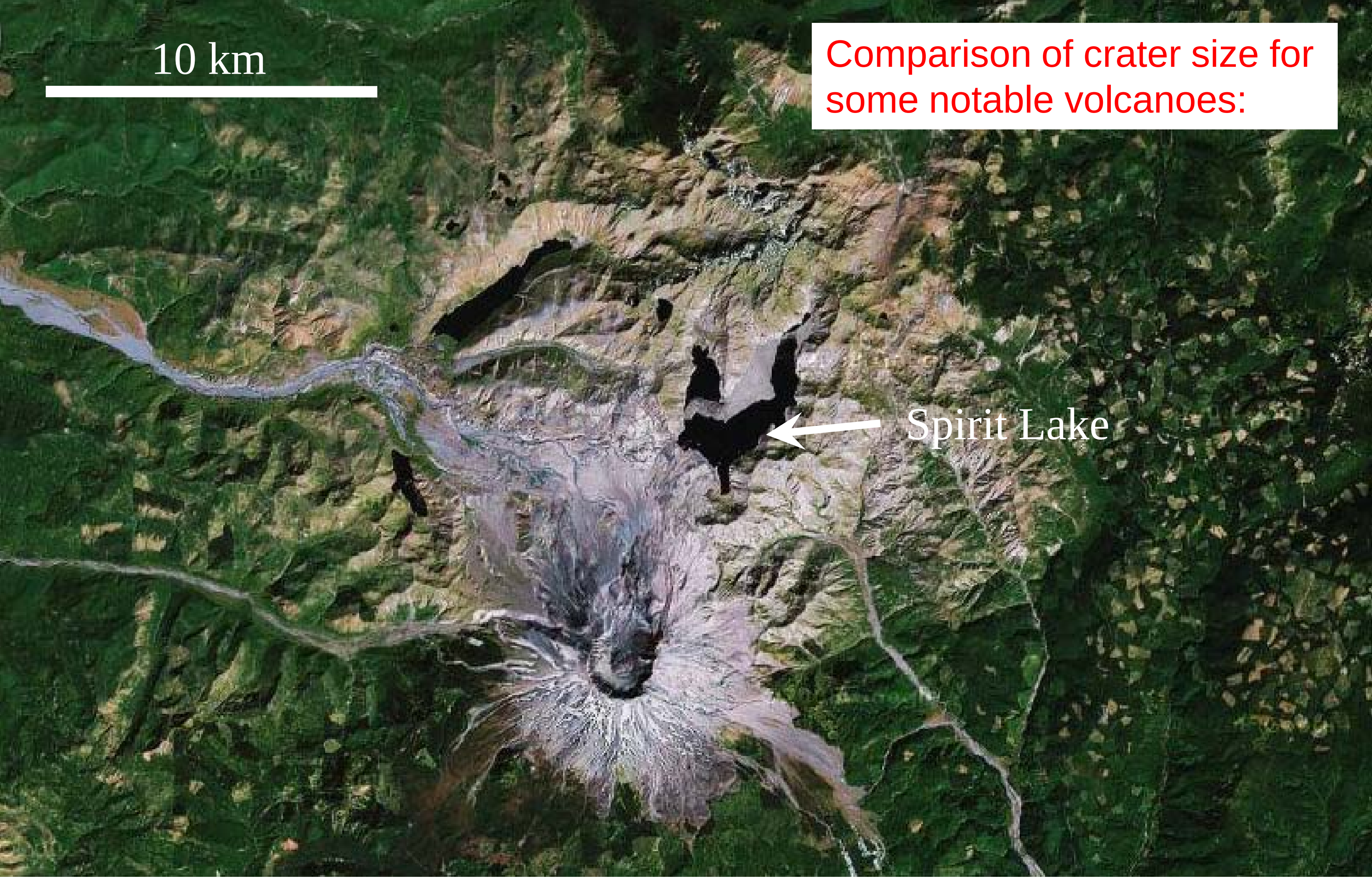
Caldera (Crater Lake, Oregon) Figure 7.20, text

Comparison of crater size for some notable volcanoes:



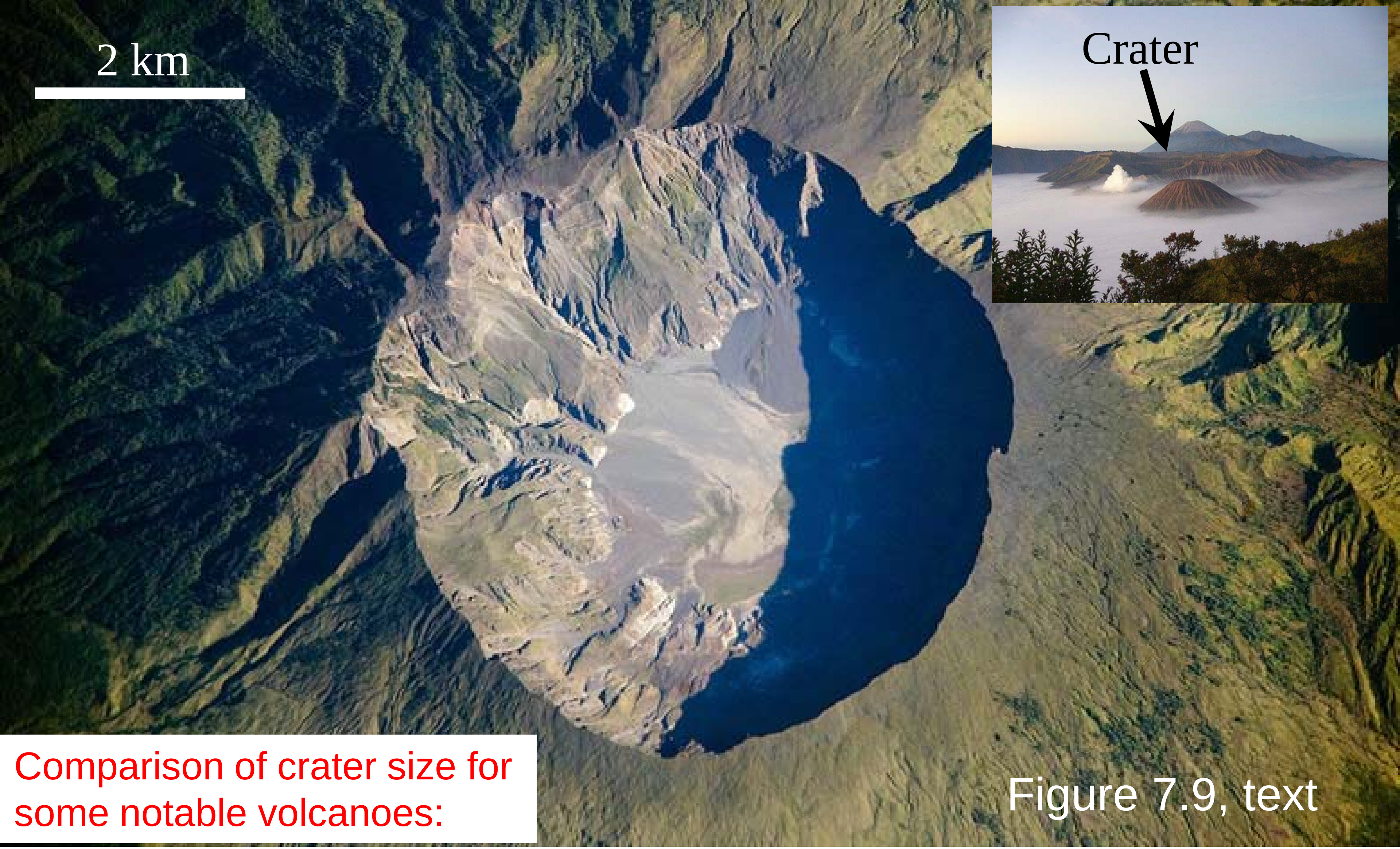
Mt. Vesuvius and Crater (~0.5 km in diameter; ~9 km from Naples, Italy) – Satellite Image. Famous eruption, pyroclastic flows that covered the cities of Pompeii and Herculaneum in 79 A.D. (~4 km^3 of ejecta). Most recent eruption was 1944.

Comparison of crater size for some notable volcanoes:



Mt. St. Helens and Crater (~2.5 km in diameter; Washington State) – Satellite Image.
Well documented explosive eruption in 1982 (~3 km^3 of ejecta) killed 57 people.
Previous eruptions (about 3300-3900 years ago) erupted ~10 km^3 of ash and lava.

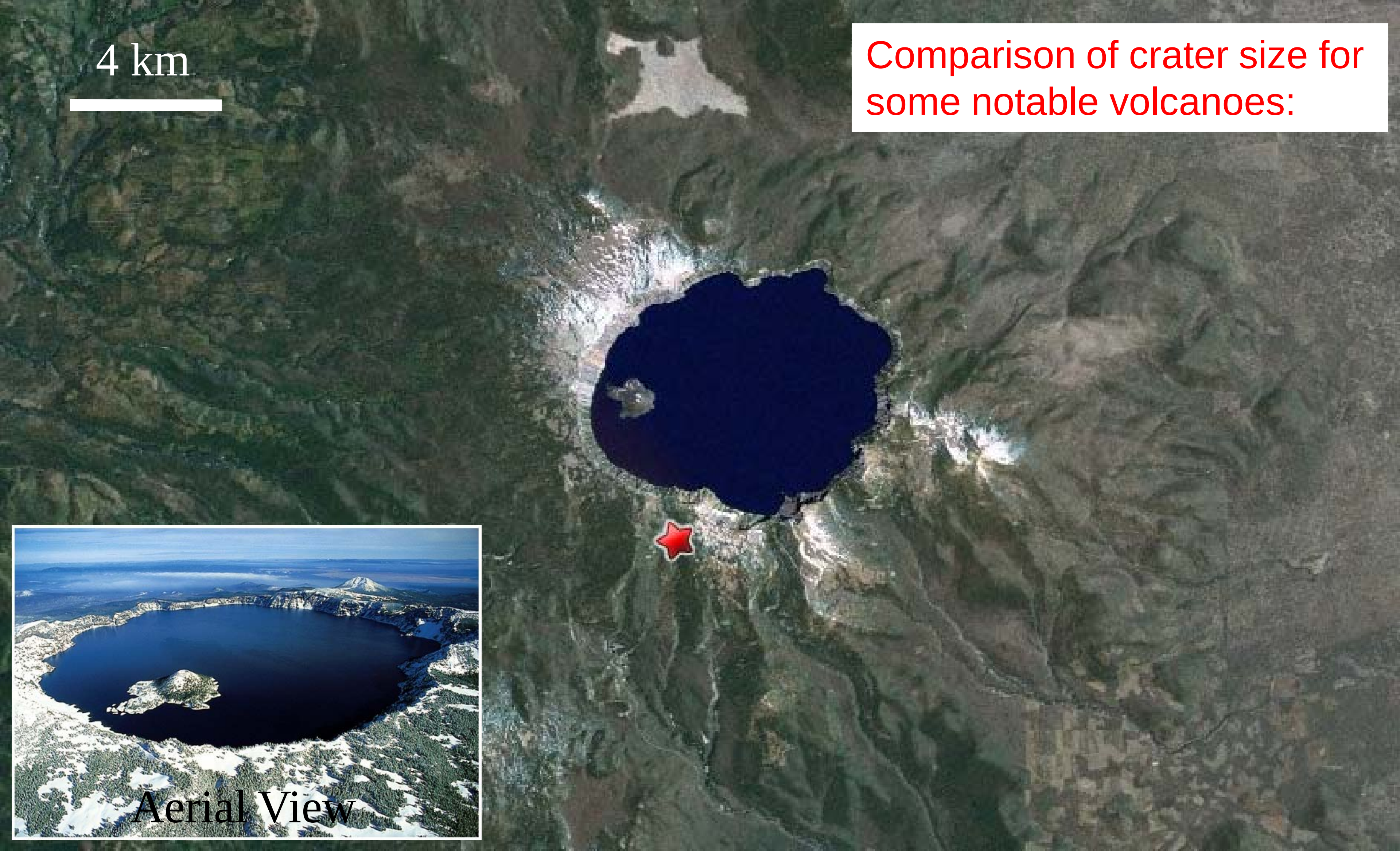
Close-up View of Mt. St. Helens Crater – Satellite Image.



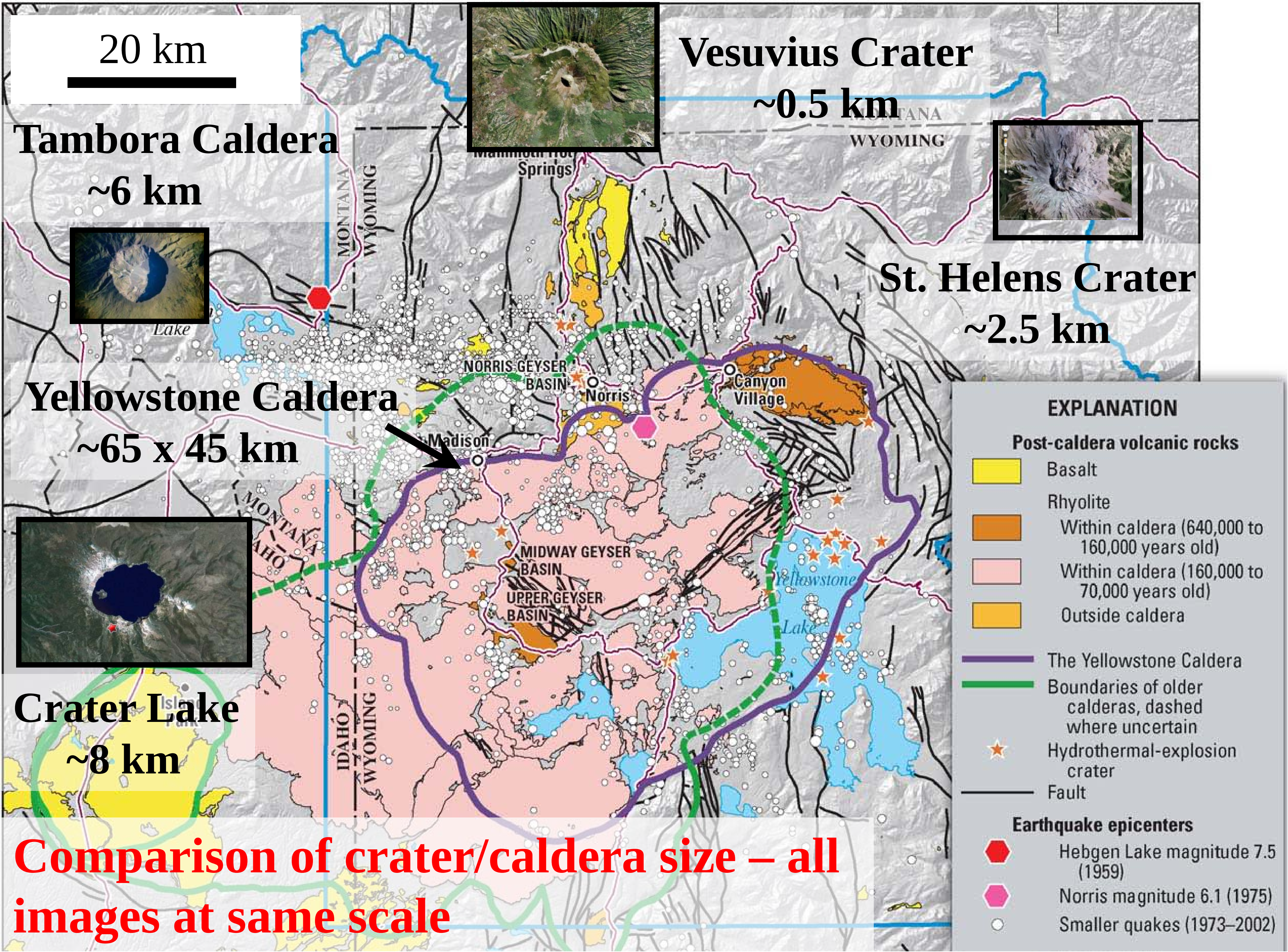
Comparison of crater size for some notable volcanoes:

Tambora Volcano (Indonesia) and Crater (~6 km in diameter) – Satellite Image. Explosive eruption in 1815 (~160 km^3 of ejecta) was the largest in historic time, lowered the Earth's atmospheric temperature by 3 ^oC, and produced the "year without a summer" in North America in 1816.

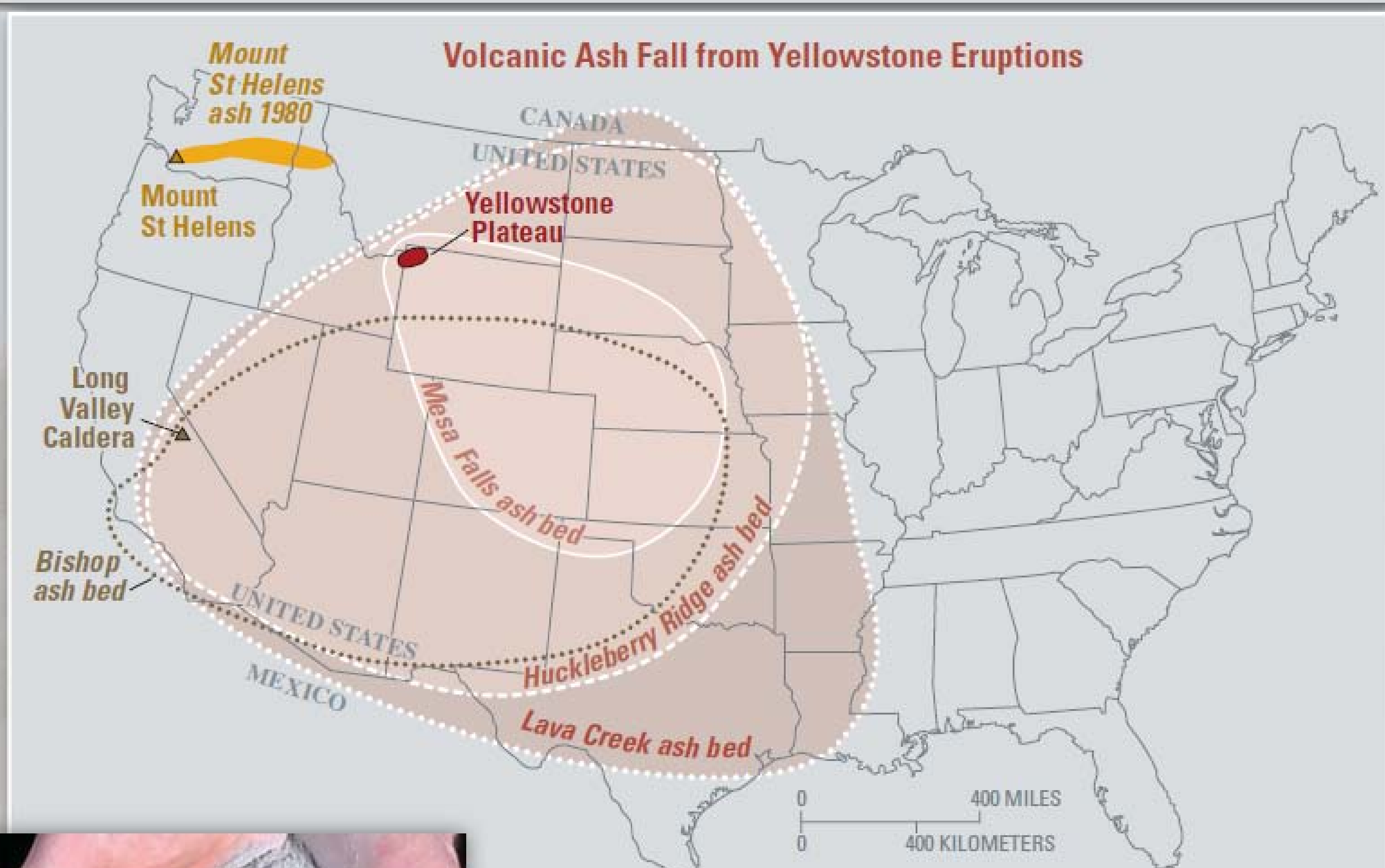
Comparison of crater size for some notable volcanoes:



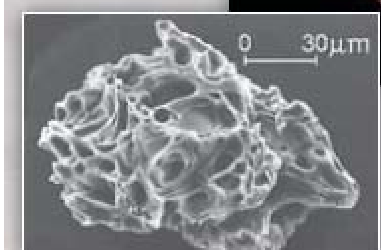
Crater Lake (formerly Mt. Mazama), Oregon(~8 km in diameter) – Satellite Image. Explosive eruption about 6700 years ago (~50 km^3 of volcanic ejecta, and about 50 km^3 of the 3700 m tall mountain was blasted away)



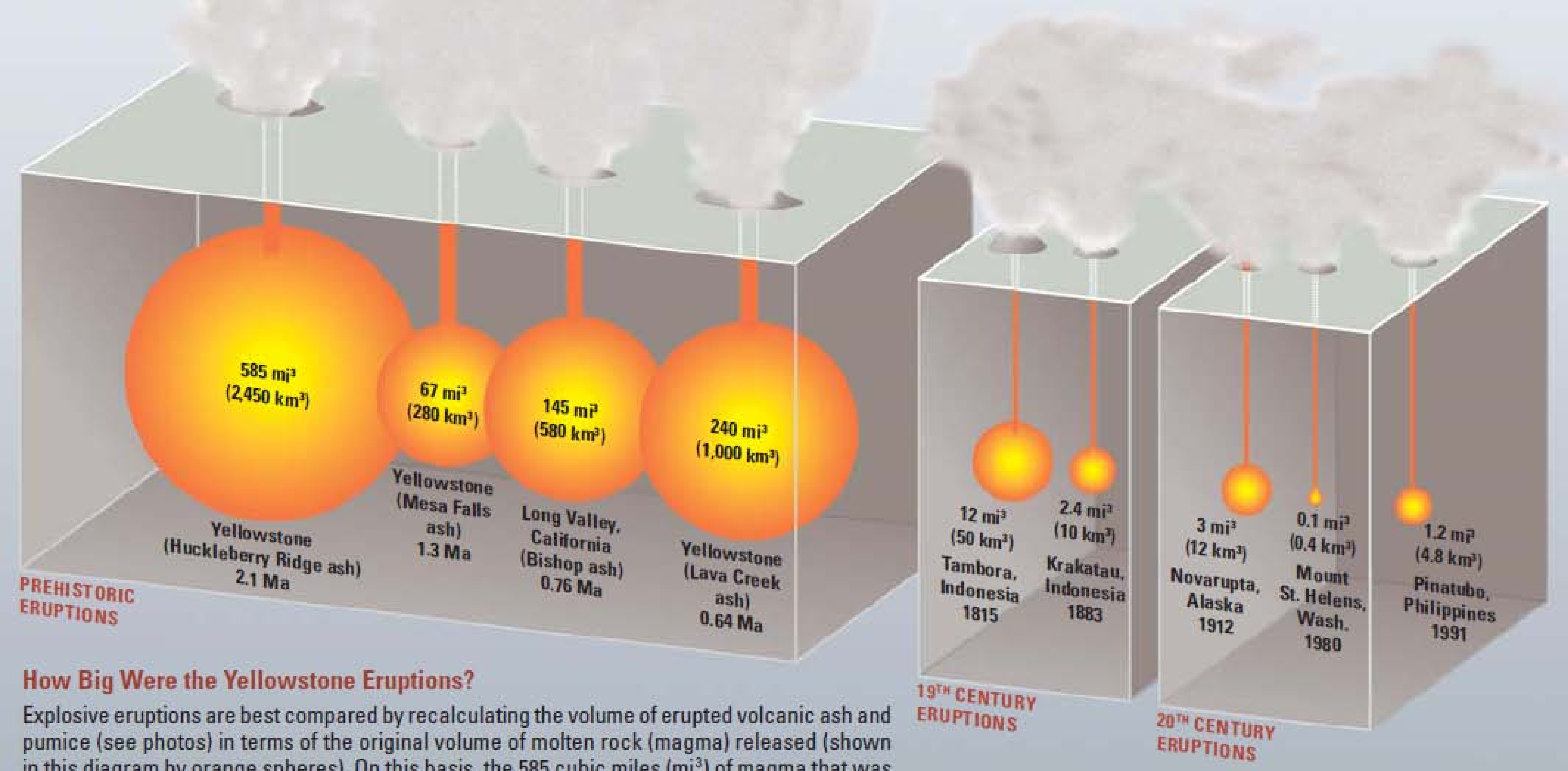
Comparison of crater/caldera size – all images at same scale



http://pubs.usgs.gov/fs/2005/3024/fs2005-3024.pdf



Volcanic ash, like this ash from the 1980 eruption of Mount St. Helens, is made up of tiny jagged particles of rock and glass (see inset, magnified about 200 times). Even a light dusting of volcanic ash can pose a health hazard to people and animals and damage crops, electronics, and machinery. Heavy ash fall, such as that from a large caldera-forming eruption, would devastate the surrounding area and affected areas downwind. (USGS photographs.)



How Big Were the Yellowstone Eruptions?

Explosive eruptions are best compared by recalculating the volume of erupted volcanic ash and pumice (see photos) in terms of the original volume of molten rock (magma) released (shown in this diagram by orange spheres). On this basis, the 585 cubic miles (mi³) of magma that was erupted from Yellowstone 2.1 million years ago (Ma) was nearly 6,000 times greater than the volume released in the 1980 eruption of Mount St. Helens, Washington, which killed 57 people and caused damage exceeding $1 billion. Even the 1815 Tambora, Indonesia, eruption—the largest on Earth in the past two centuries—was more than five times smaller than the smallest of Yellowstone's three great prehistoric eruptions at 1.3 Ma.

Others: Long Valley, CA 760,000 yrs ago, ~580 km³; Valles, NM 1.1 mya, ~600 km³; Toba, Indonesia 70,000 yrs ago, ~500 km³.

http://pubs.usgs.gov/fs/2005/3024/fs2005-3024.pdf

How Big Were the Yellowstone Eruptions? About 6,000 times larger than the 1980 eruption of Mt. St. Helens!!!