Volcanism & extrusive rocks

Extrusive – lava or ash onto the Earth surface

pyroclastic

pyro – fire

clastic – small pieces of rock

Volcanic glass – obsidian

Figure 4.9

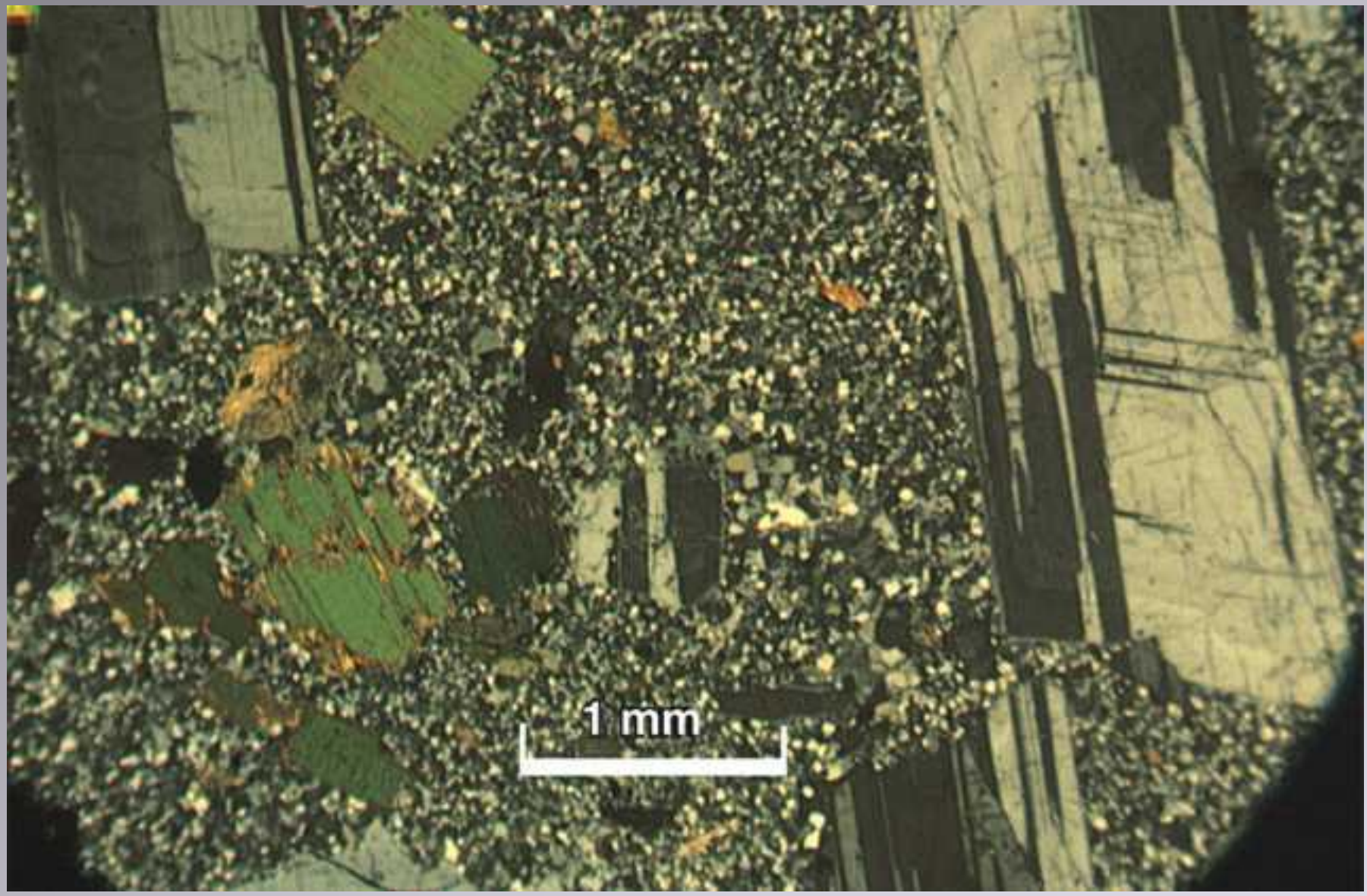
Andesite porphyry

What set of events creates a porphyry?

Figure 4.10

Porphyry thin section

Figure 4.10



Vesicular basalt

Bubbles produced by expanding gas in the magma

Figure 4.11

Pumice

A volcanic glass full of bubbles

Usually rhyolitic (lots of silica)

Figure 4.12

Pumice

Volcanic bombs

Figure 4.13

Volcanic tuff

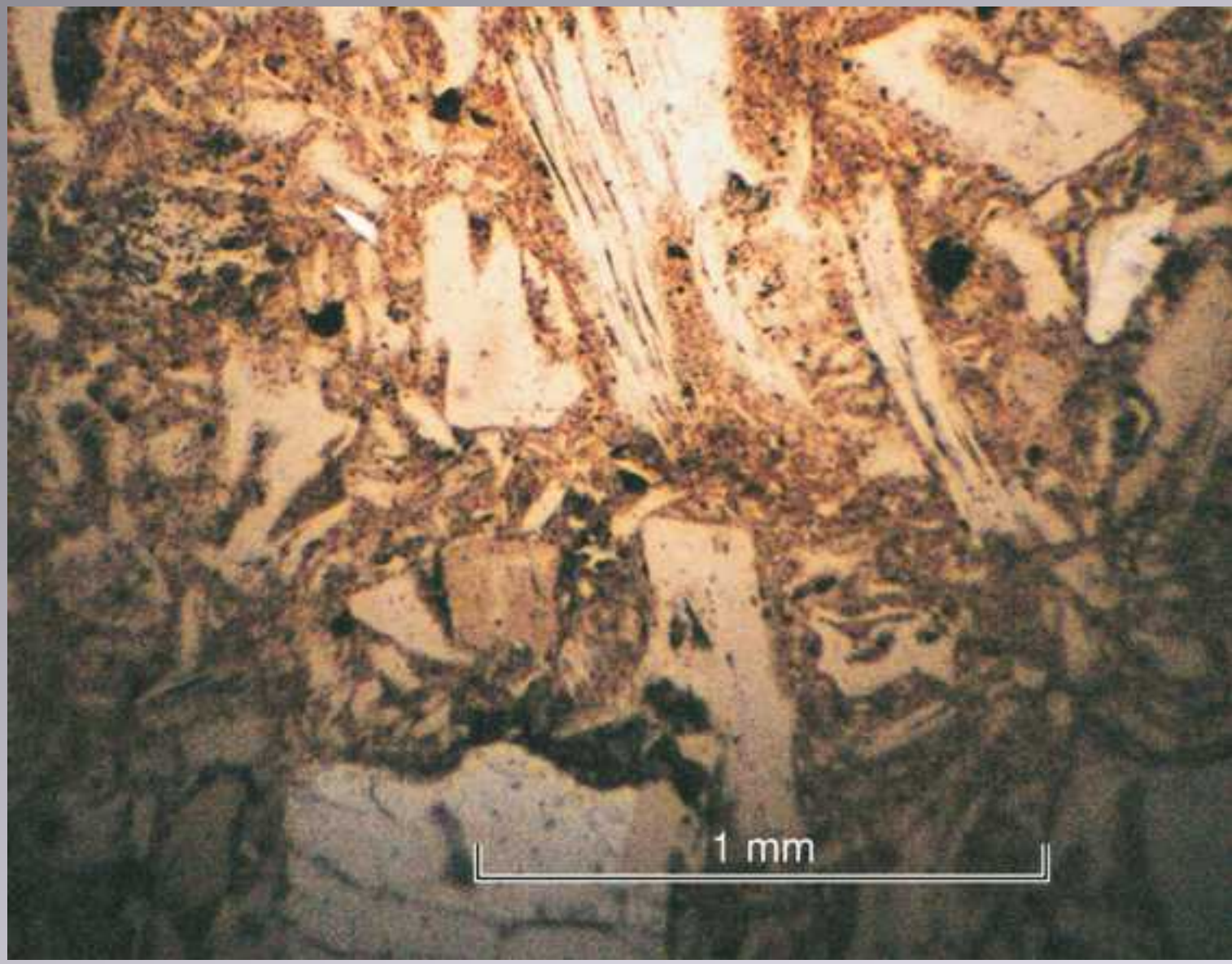
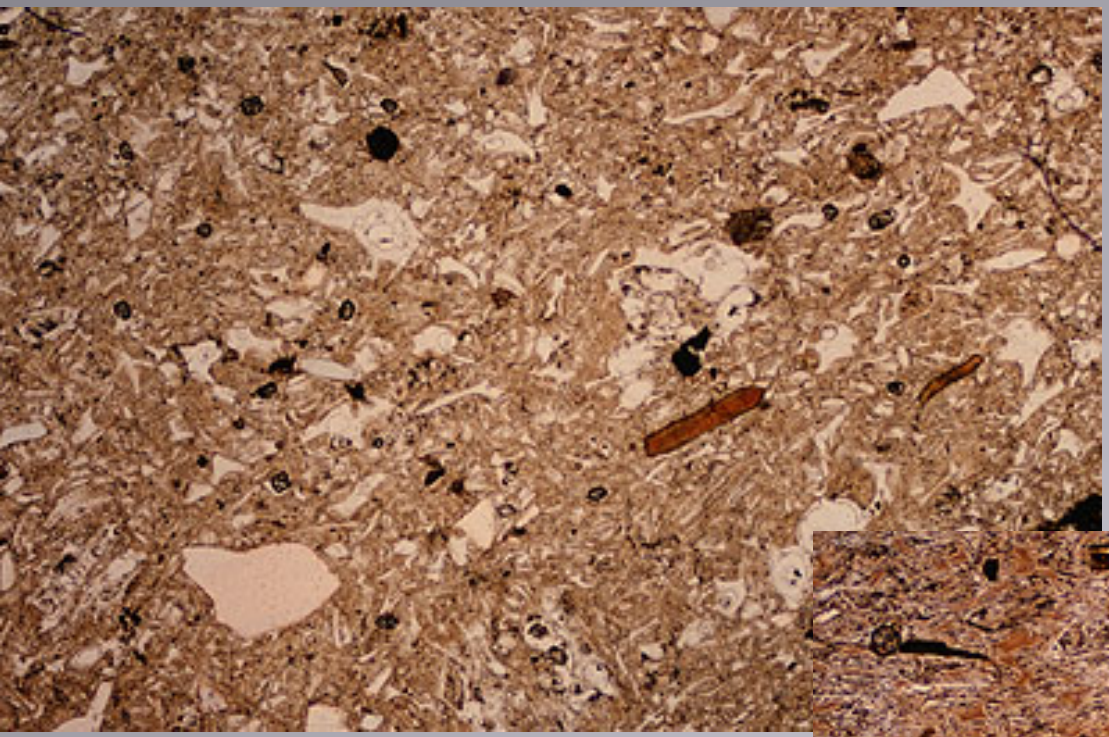


Figure 4.14

Volcanic tuff



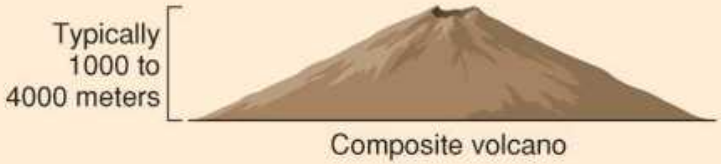
Welded tuff

Volcanic breccia

Big chunks of broken rock in a matrix of ash

Types of volcanoes

Table 4.2 Comparison of the Three Types of Volcanoes

Profile of Volcano	Description	Composition
	**Shield Volcano** Gentle slopes—between 2 and 10 degrees. The Hawaiian example rises 10 km from the sea floor.	Basalt. Layers of solidified lava flows.
	**Cinder Cone** Steep slopes—33 degrees. Smallest of the 3 types.	Pyroclastic fragments of any composition. Basalt is most common.
	**Composite Volcano** Slopes less than 33 degrees. Considerably larger than cinder cones	Layers of pyroclastic fragments and lava flows. Mostly andesite.

Another word for composite volcano:

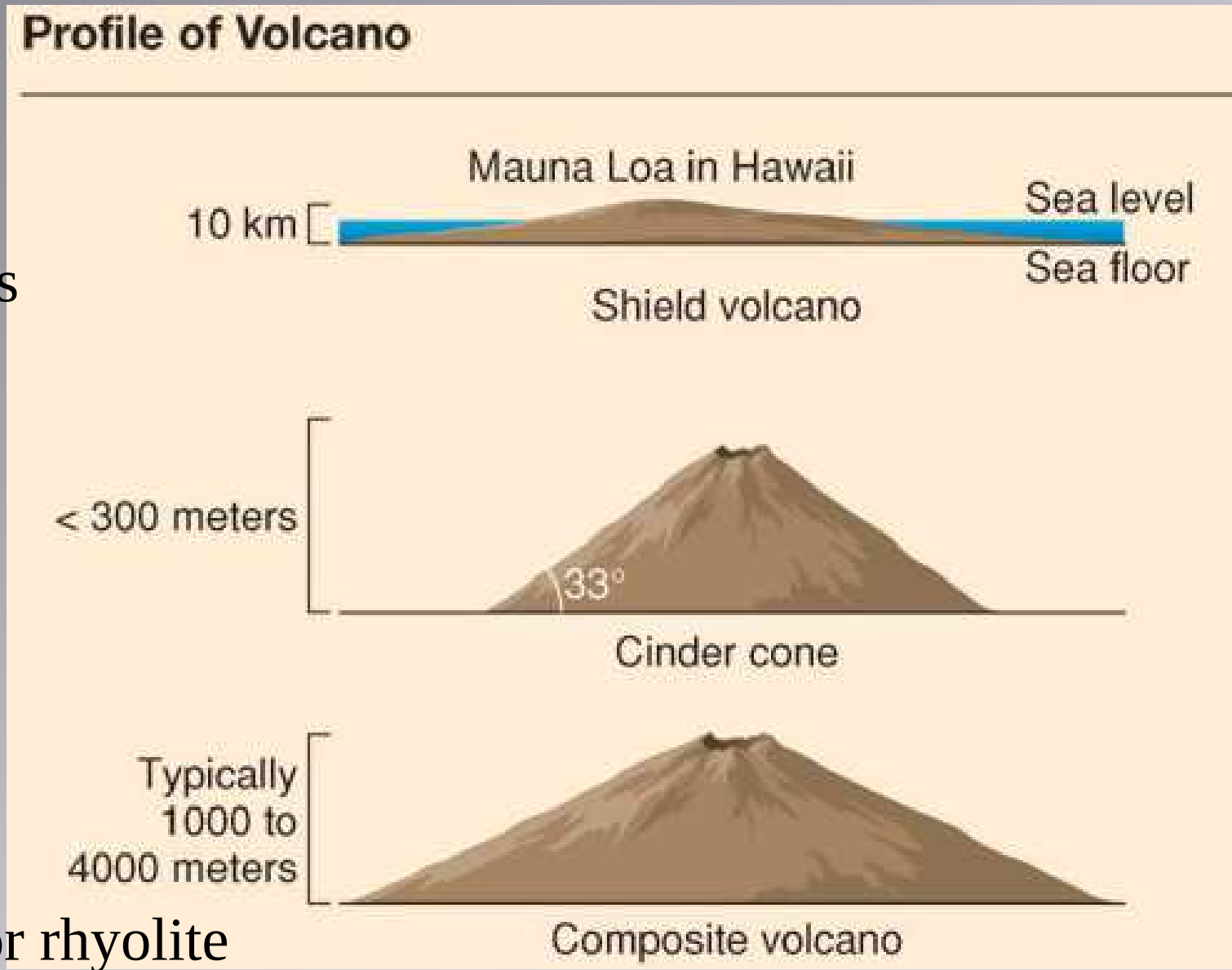
stratovolcano

Types of volcanoes

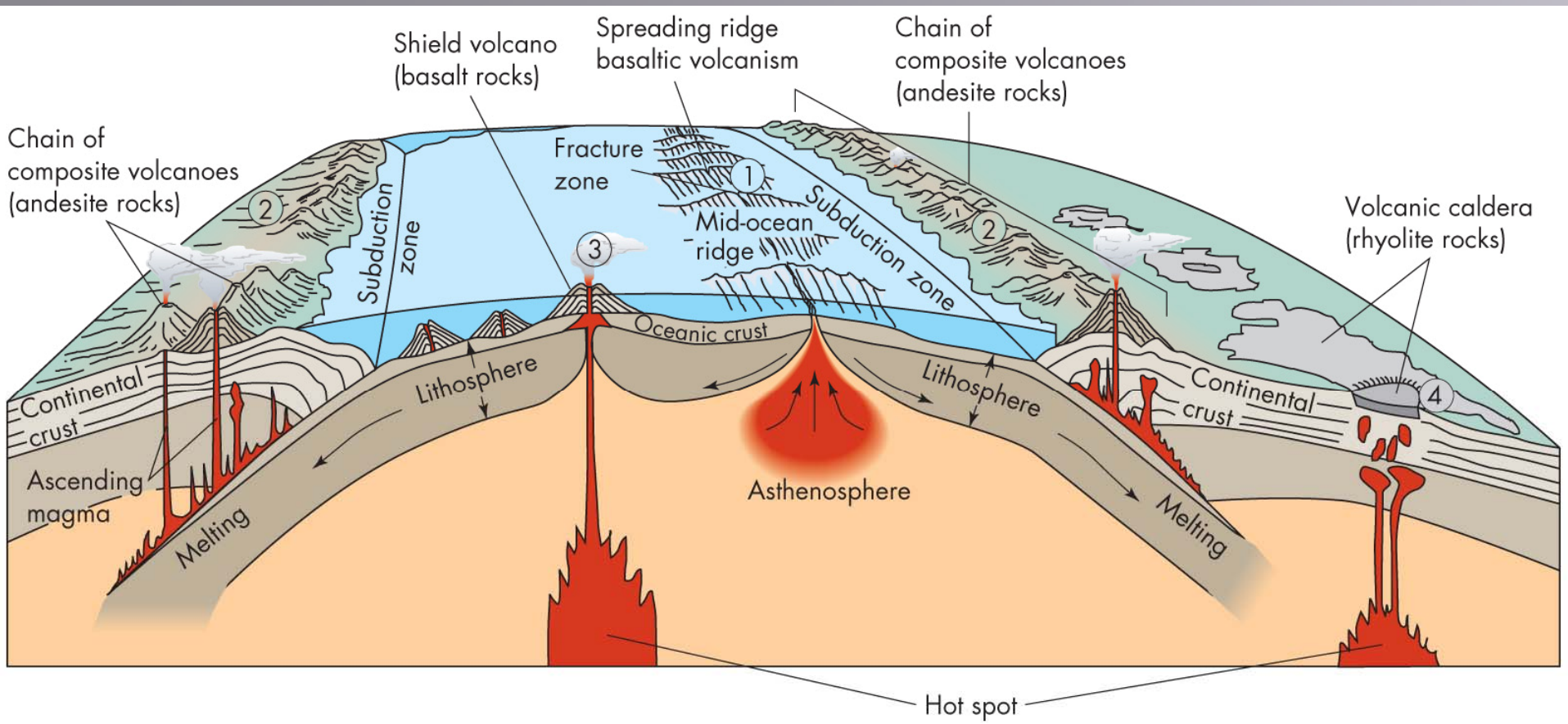
Shield
basalt flows

Cinder
coarse ash

Composite
layered
Andesite or rhyolite



Tectonic settings for volcanoes



Subduction zones Mid-ocean ridge

Hot spots Continental rifting


EURASIAN PLATE
NORTH AMERICAN PLATE
JUAN DE FUCA PLATE
Ring of Fire
PACIFIC OCEAN
ATLANTIC OCEAN
CARIBBEAN PLATE
AFRICAN PLATE
INDIAN PLATE
INDIAN OCEAN
Equator
COCOS PLATE
PACIFIC PLATE
NAZCA PLATE
SOUTH AMERICAN PLATE
AUSTRALIAN PLATE
ANTARCTIC PLATE
Convergent boundary
Divergent boundary
Volcanically active regions
0 1,500 3,000 Kilometers

Differences between magmas

Basaltic lava flows easily

Figure 4.1

Differences between magmas

Rhyolitic and andesitic lavas tend to explode
water & volatiles under pressure, viscous magma

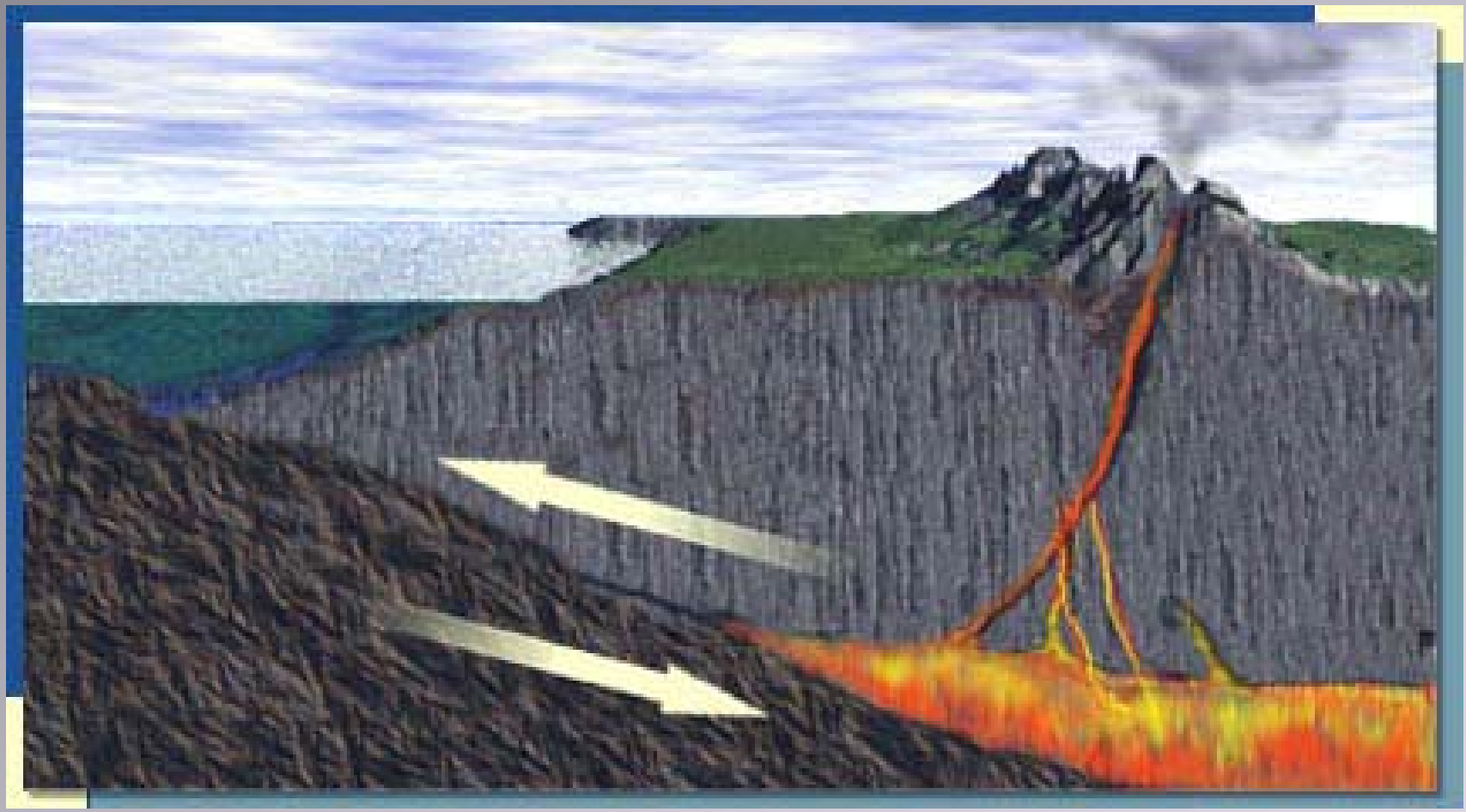
Cascades volcanoes of the Pacific Northwest

Subduction of Juan de Fuca plate

Figure 4.5

Volcanoes produced by subduction

Juan de Fuca plate is young, hot, low density



The Cascades, Washington and Oregon

Composite or strato-volcanoes

Composite or strato-volcanoes

Mt. Fuji, Japan

Composite volcano

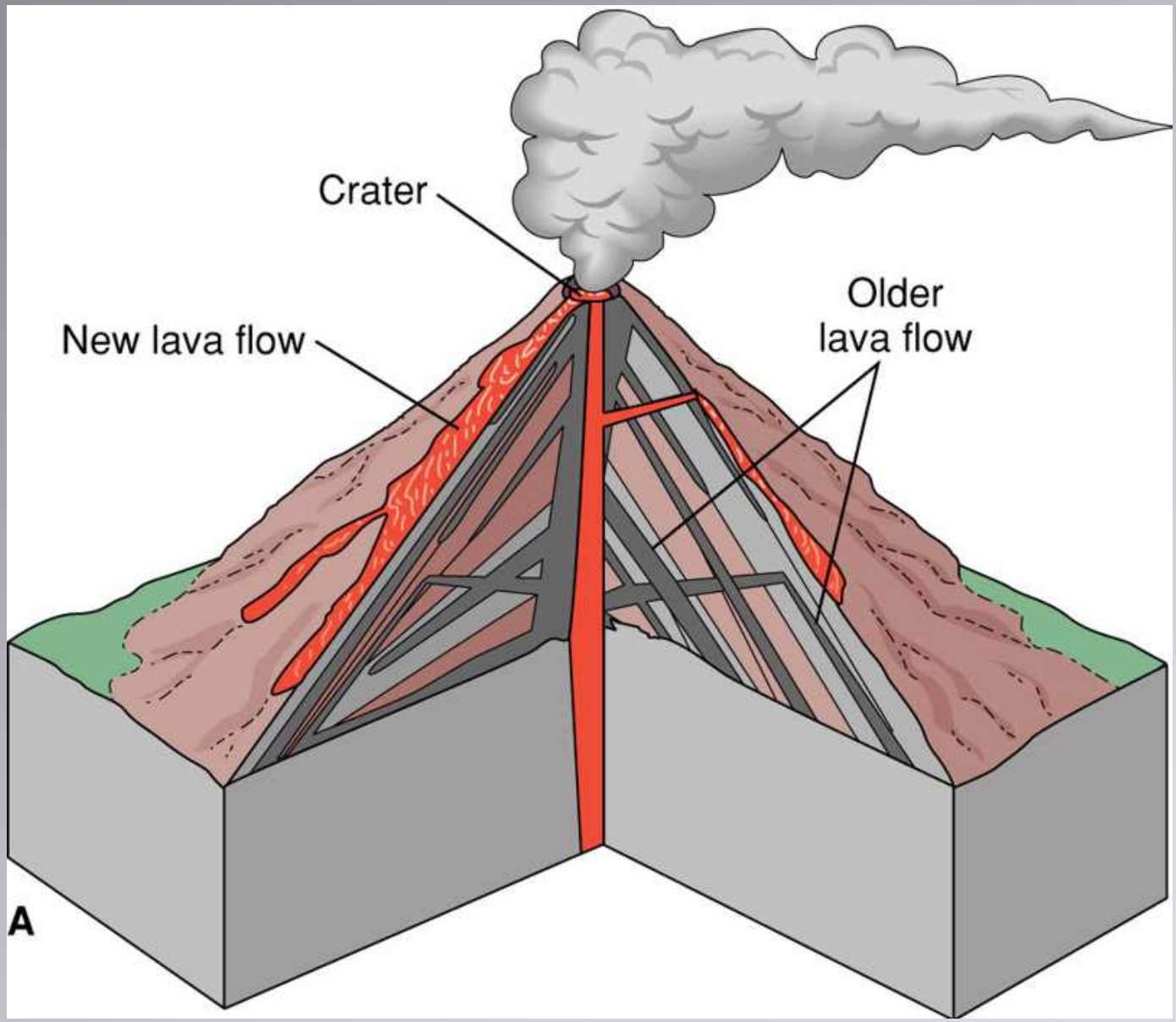
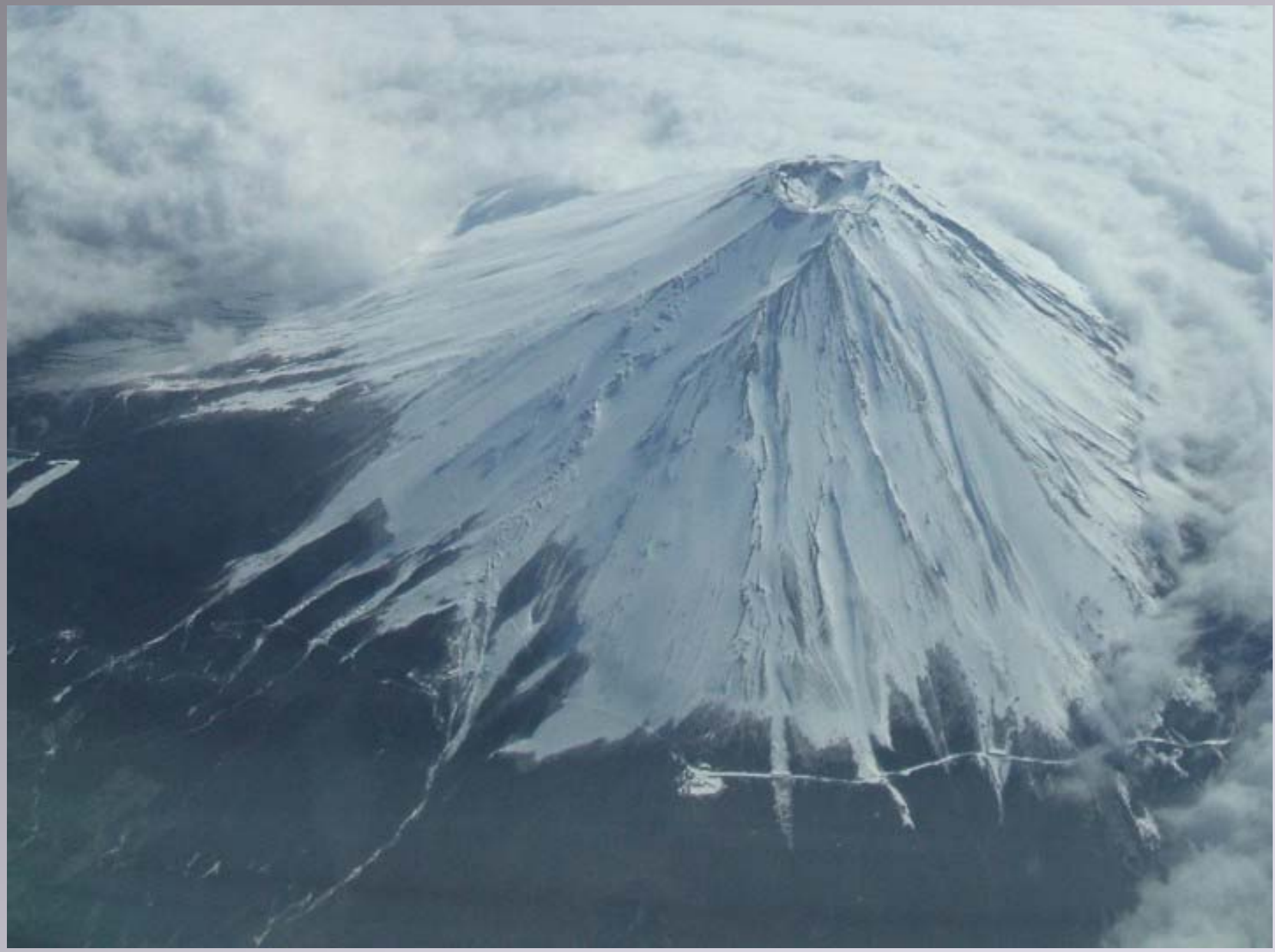


Figure 4.21

Mt. Fuji, Japan

Mt. Fuji, Japan

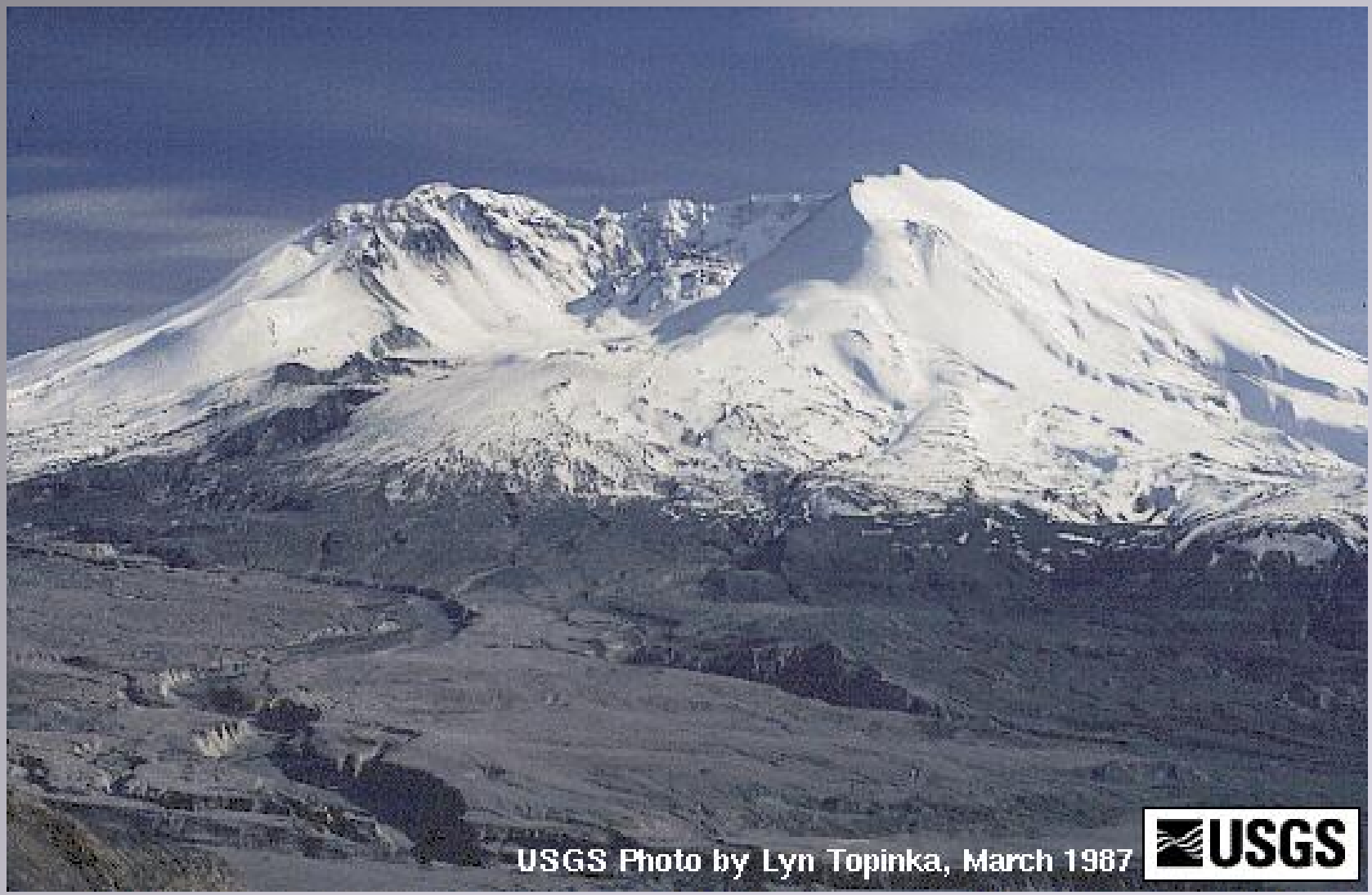


Mt. Fuji, Japan

Mount St. Helens before eruption 1980

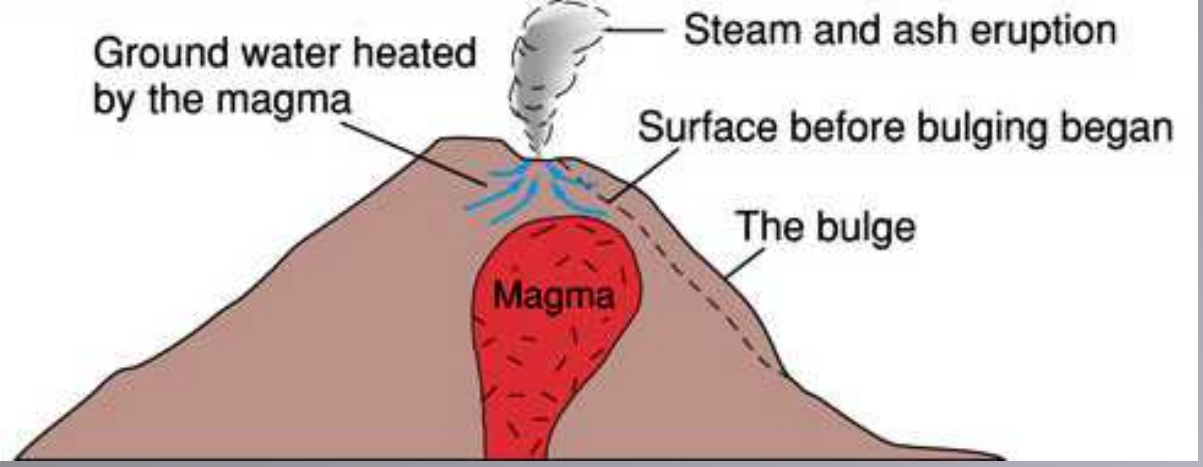
Mount St. Helens

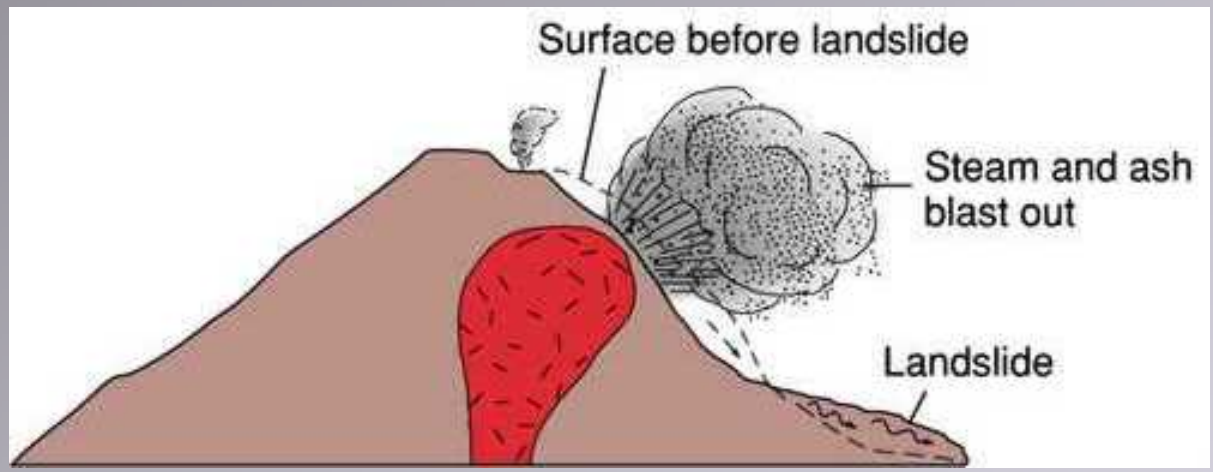
After eruption (7 years later)

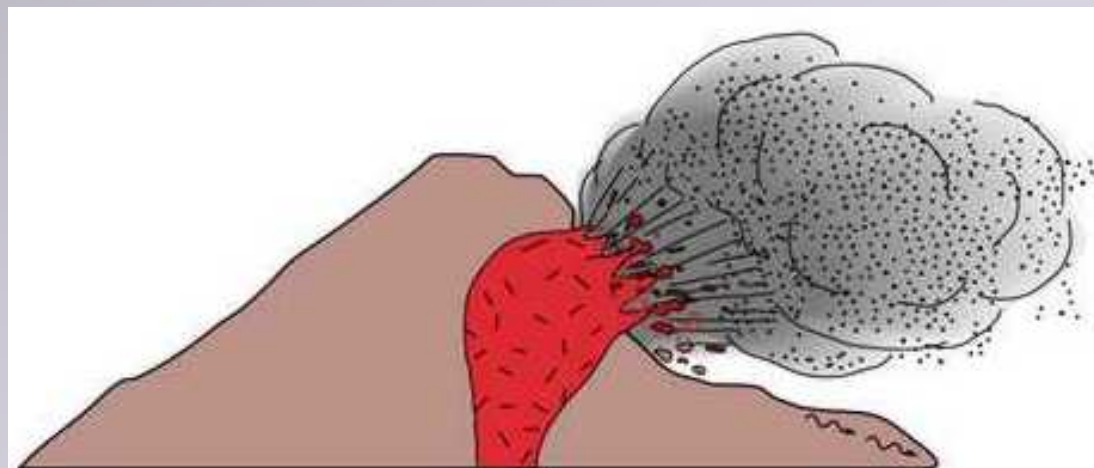


Mount St. Helens

Mt. St. Helens eruption sequence







Box 4.1

Mount St. Helens

Bulge on NE flank prior to eruption

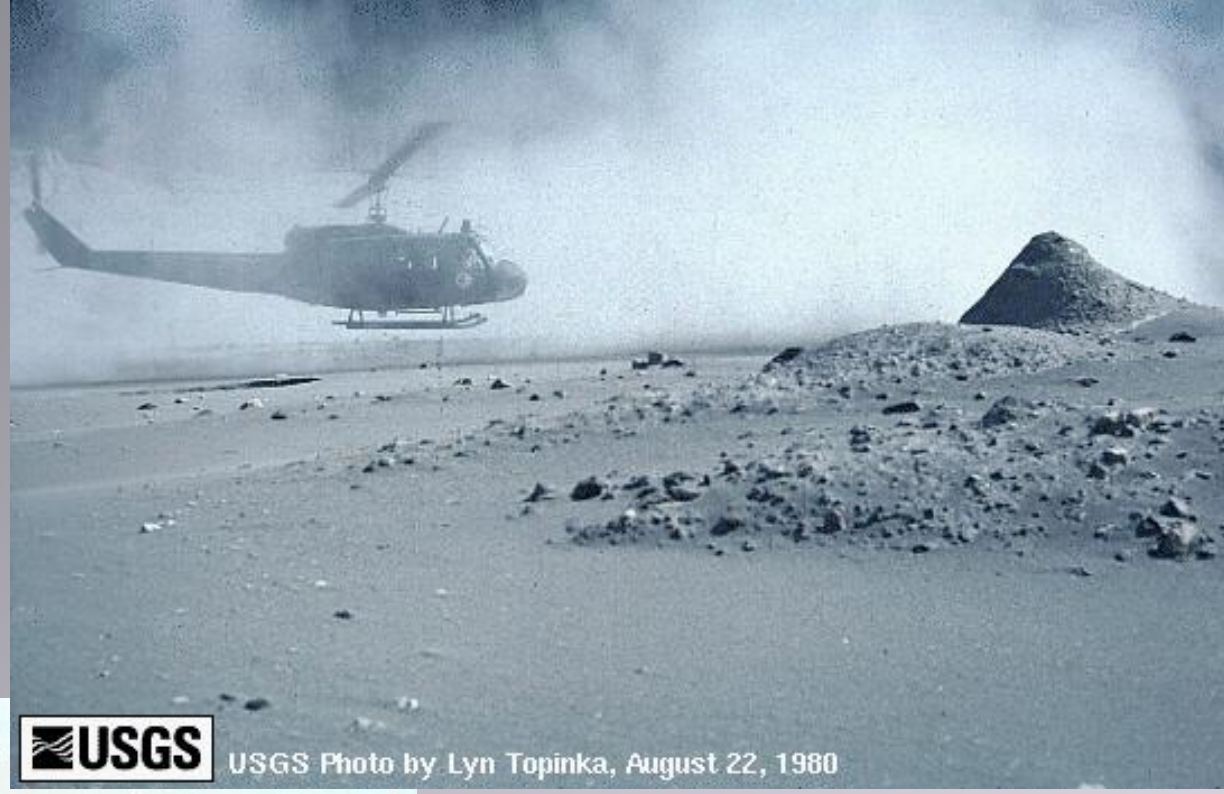
Initial blast – 500x the Hiroshima bomb

Pressure wave with 200 mph winds

Lahar – flow of hot, fluid mud

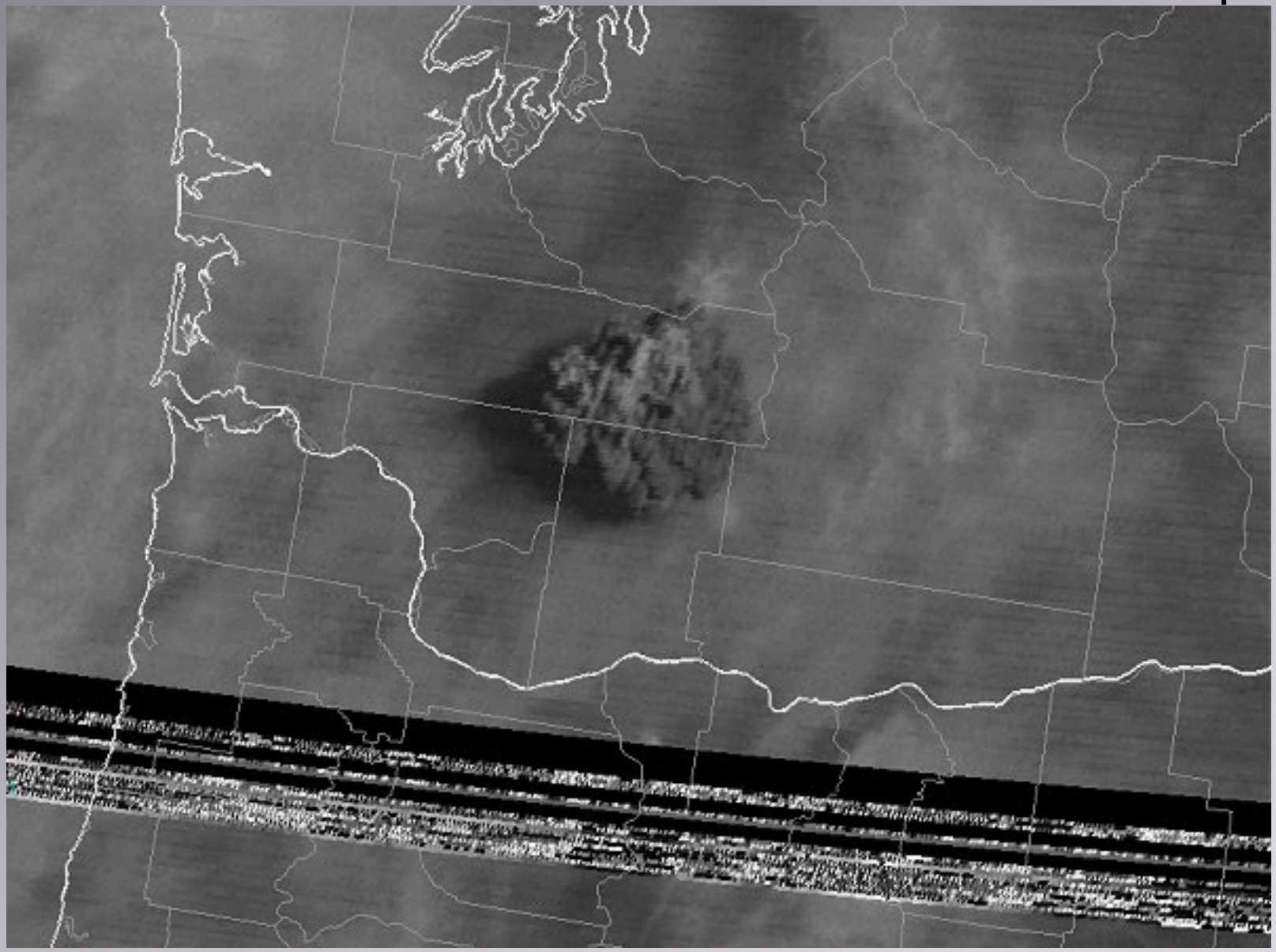
Mount St. Helens

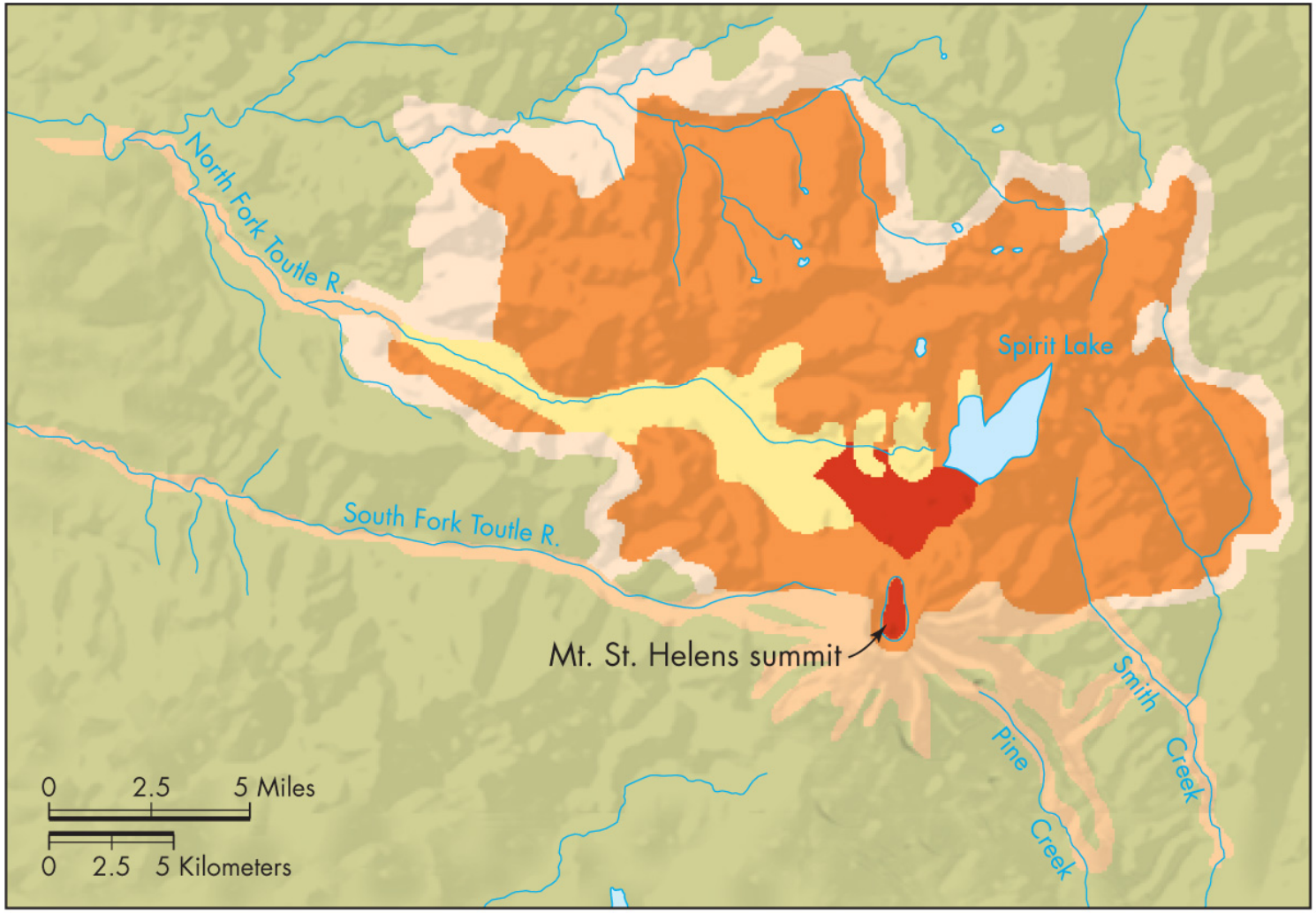
Ashfall



Eruption from space

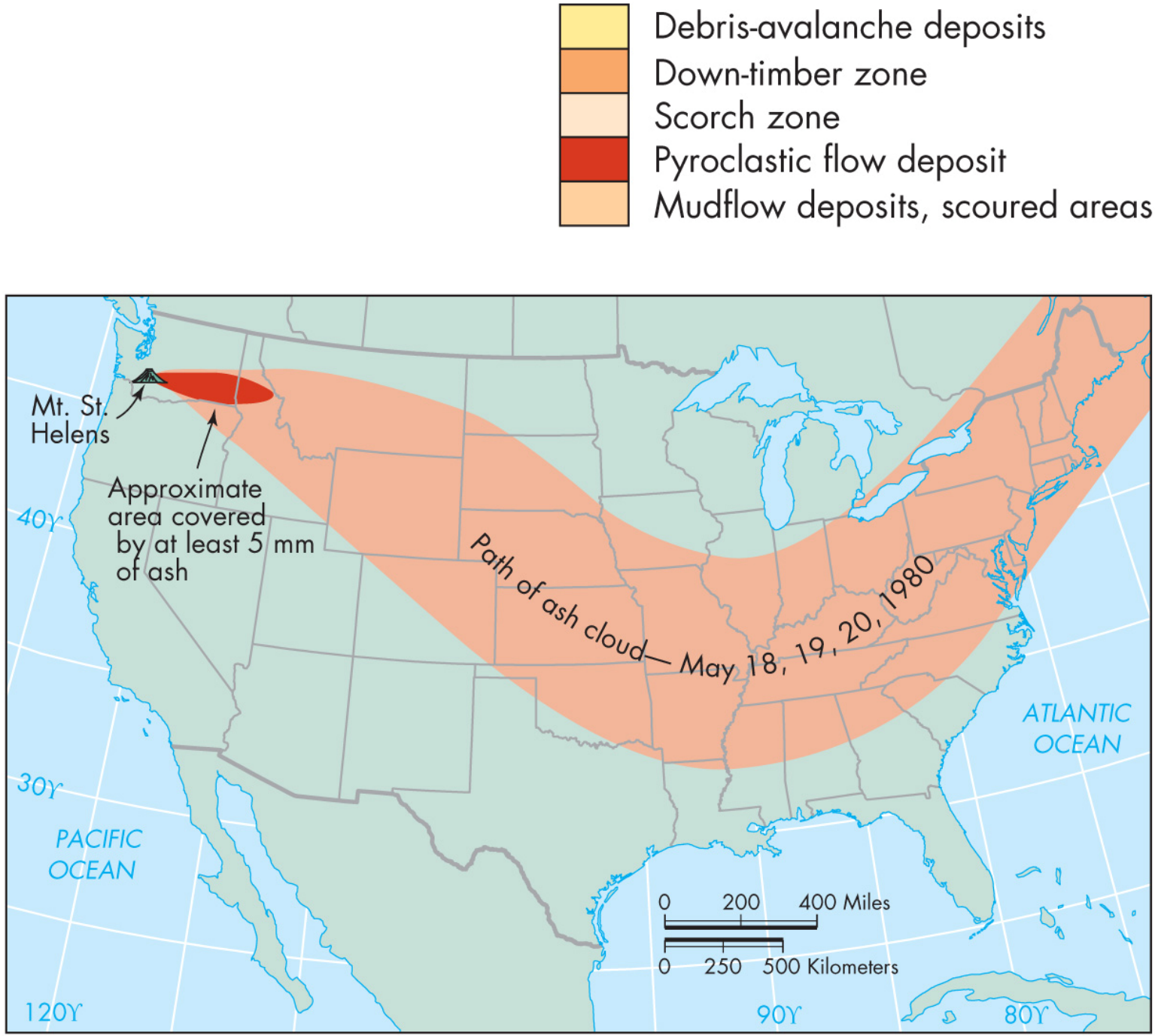
Blast covered 150 sq miles





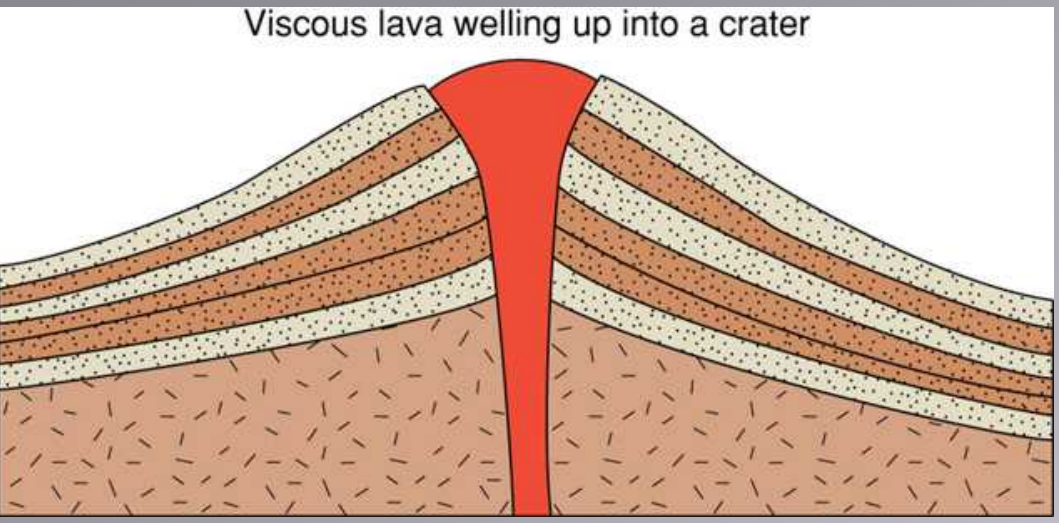
(a)

Debris-avalanche deposits
Down-timber zone
Scorch zone
Pyroclastic flow deposit
Mudflow deposits, scoured areas


Debris-avalanche deposits
Down-timber zone
Scorch zone
Pyroclastic flow deposit
Mudflow deposits, scoured areas
Mt. St. Helens
Approximate area covered by at least 5 mm of ash
Path of ash cloud— May 18, 19, 20, 1980
40°
30°
120°
90°
80°
PACIFIC OCEAN
ATLANTIC OCEAN
0 200 400 Miles
0 250 500 Kilometers

(b)

Forming a dome – because of viscous lava



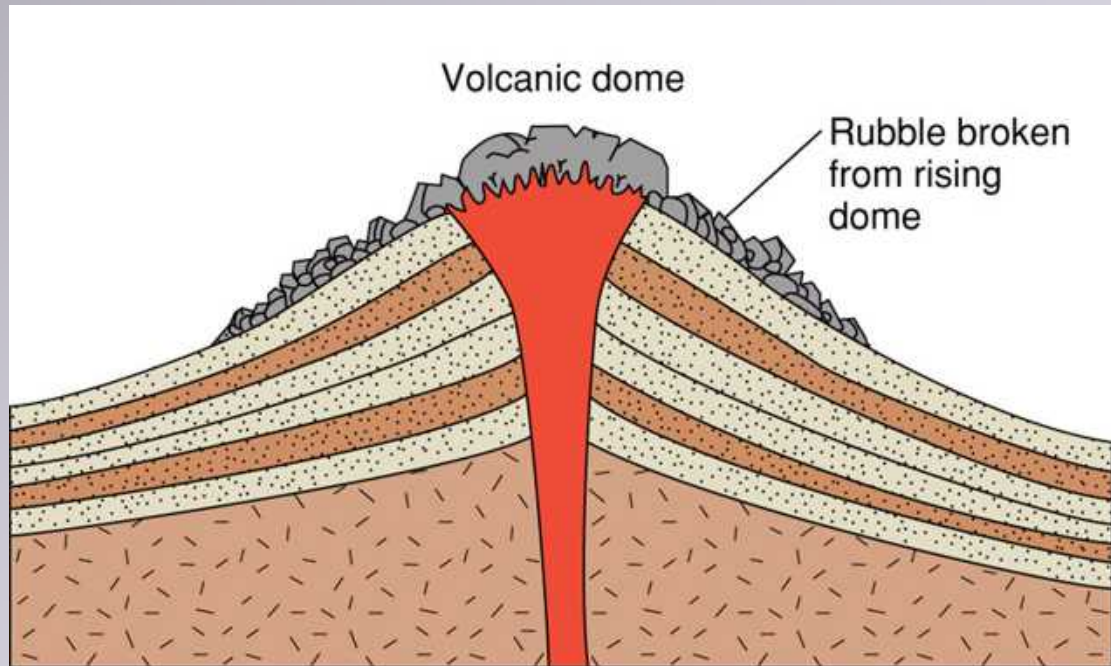
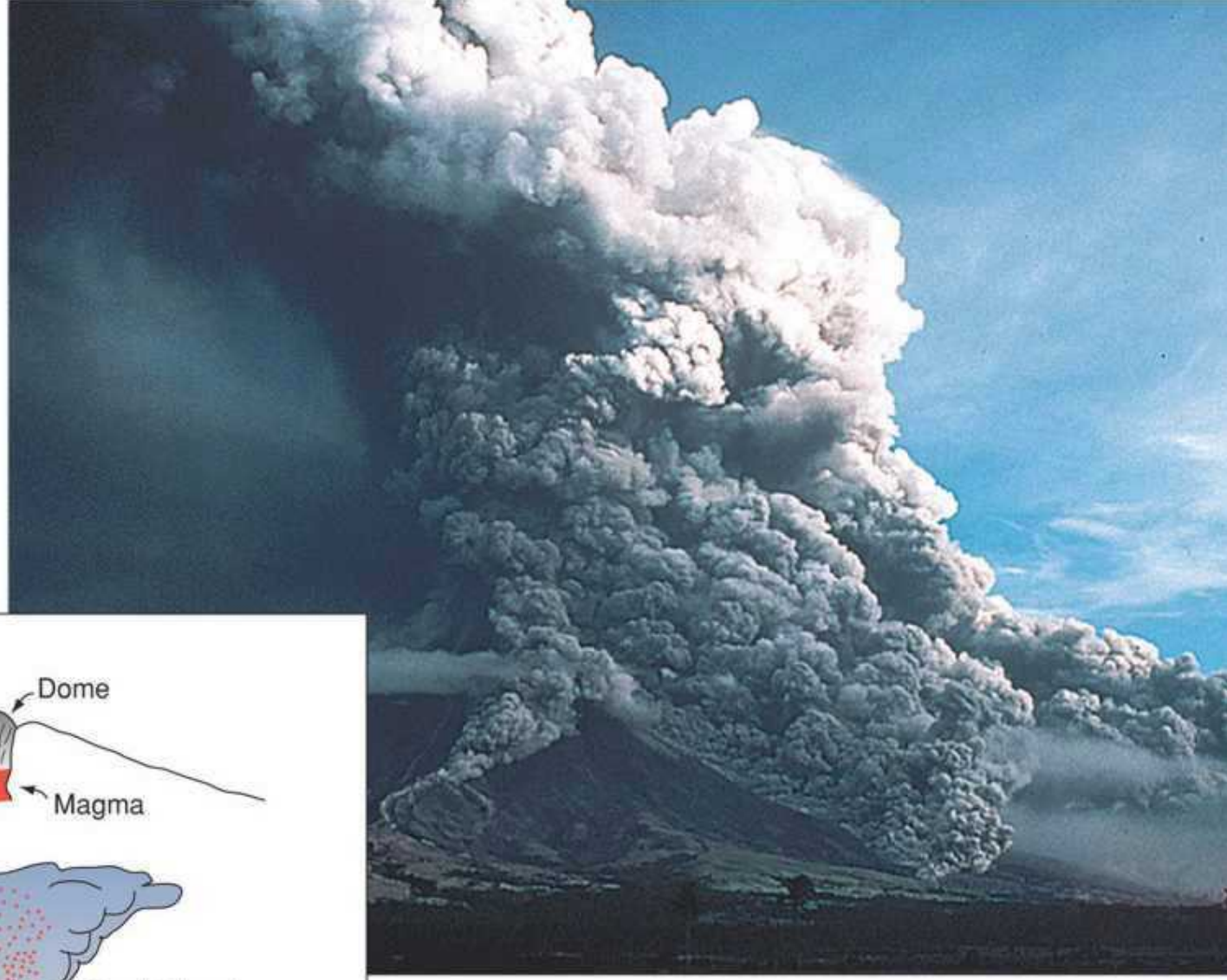
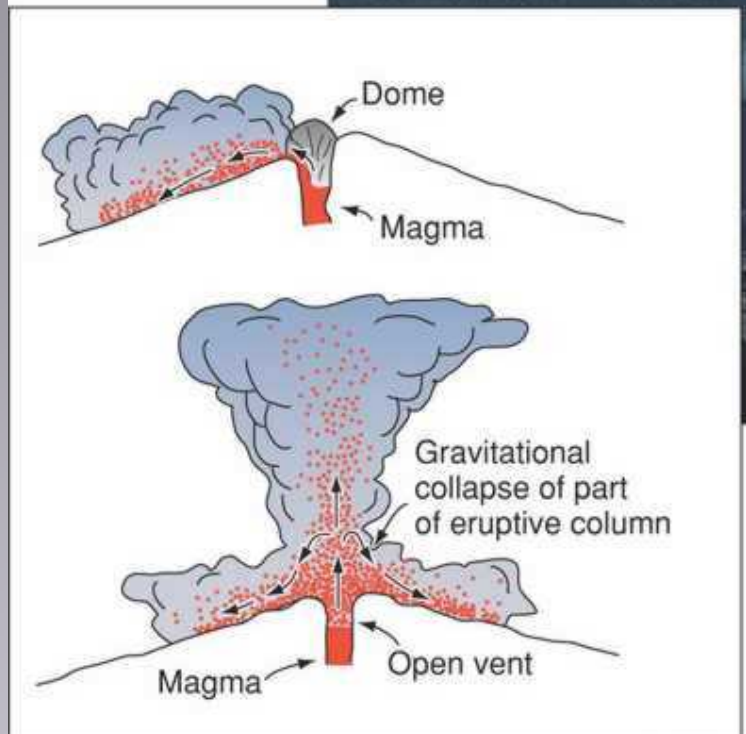


Figure 4.26

Pyroclastic flow





Cloud of hot gas and ash collapses and flows down the side

Process of pyroclastic flow

Responsible
for many of the
volcano-related
disasters in
history

Pompeii

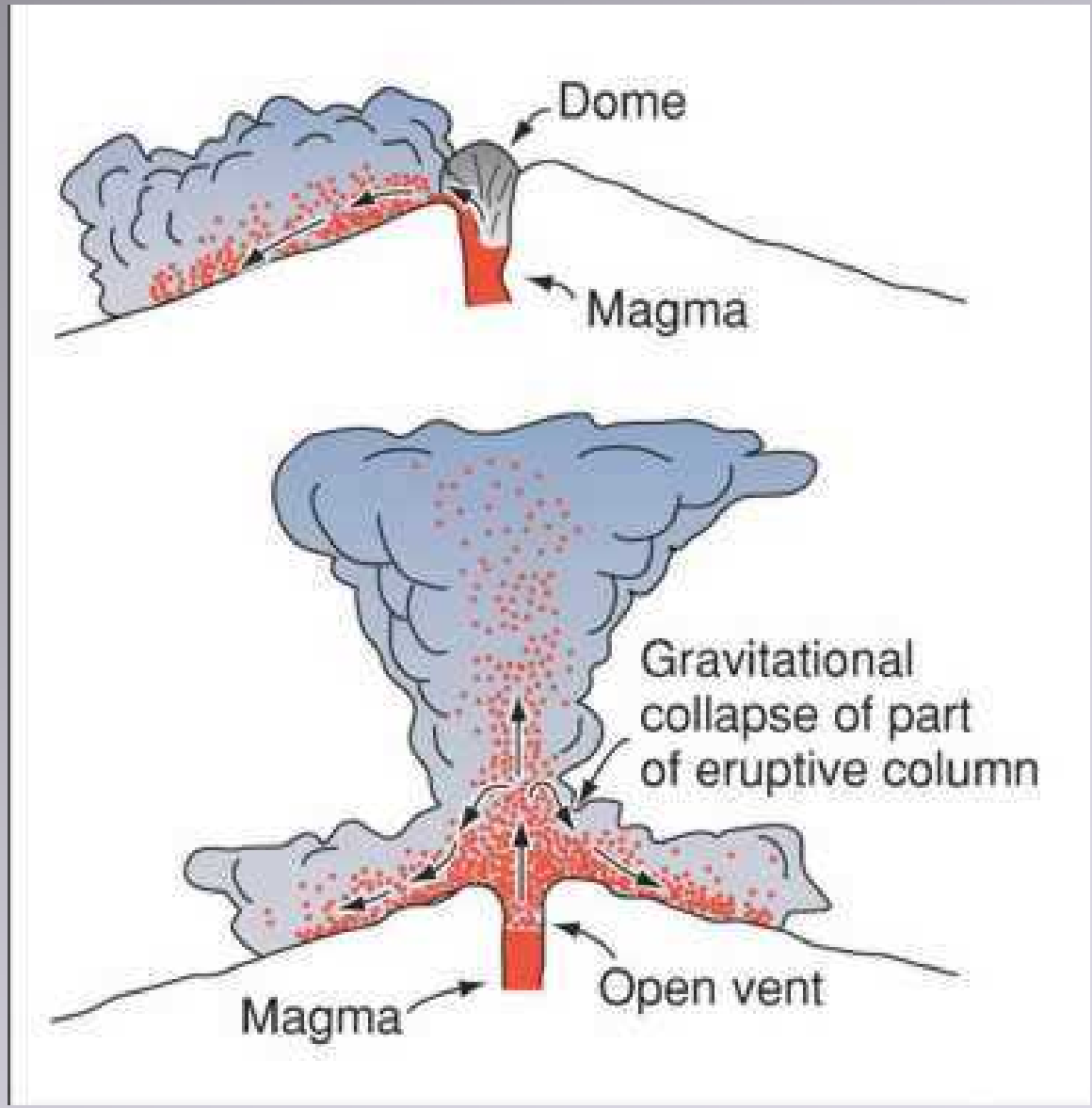


Figure 4.7

Result of pyroclastic flow

Mt. Pelée
1902

Martinique

Figure 4.8