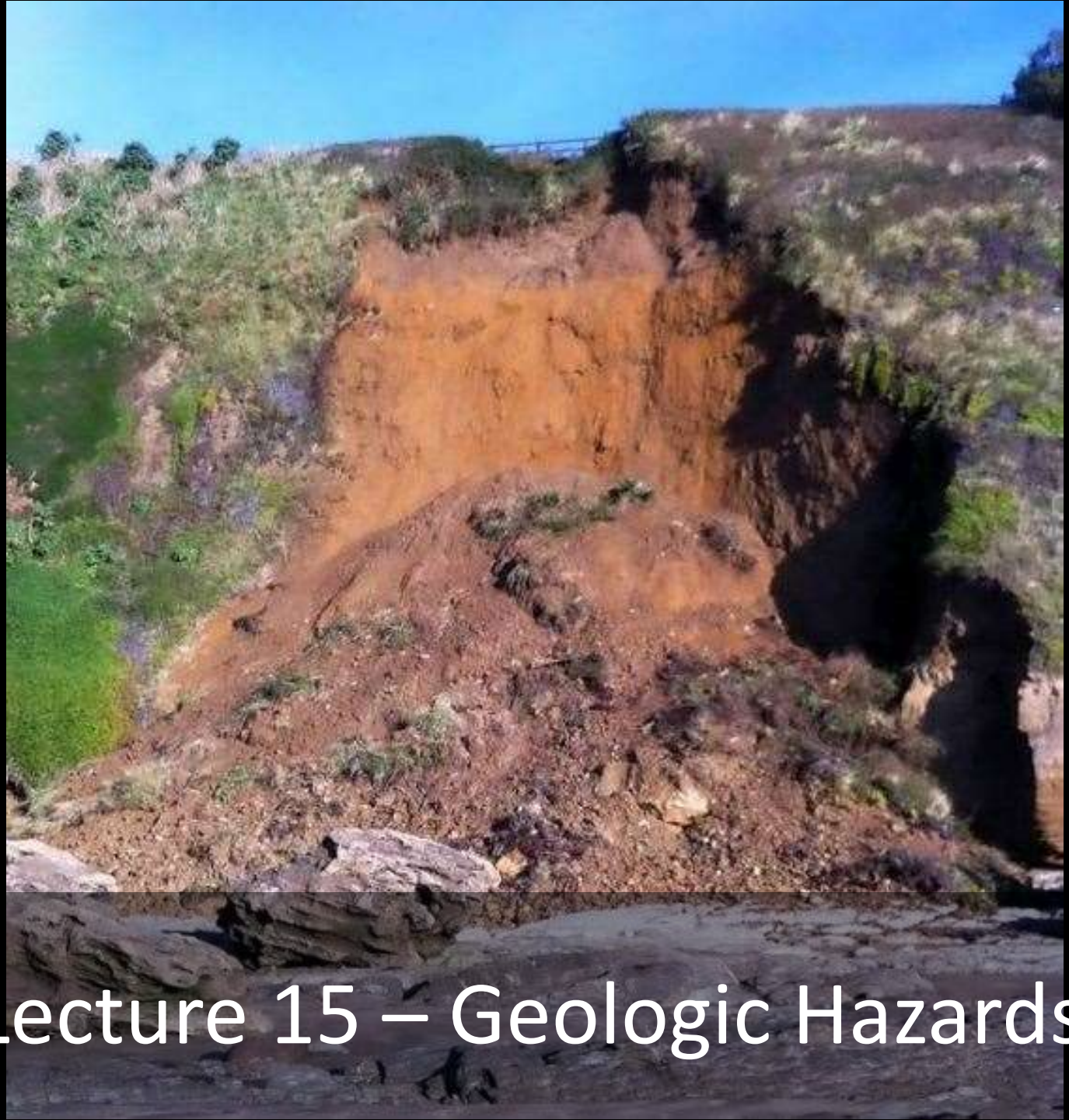


Lecture 15 – Geologic Hazards

Most important Projects:

No need to remind me of my name at the top of your work.

You created it, you did all the thinking, you did all the editing, you did all the writing; your name and your name only belongs on the top (unless you used one of the pay services to write it for you, then they should go on the top)

Earth Surface Processes

- Mass wasting
- Volcanism
- Faulting
- Rivers & Streams
- Groundwater
- Coastal processes
- Glaciers
- Wind

Driving forces?

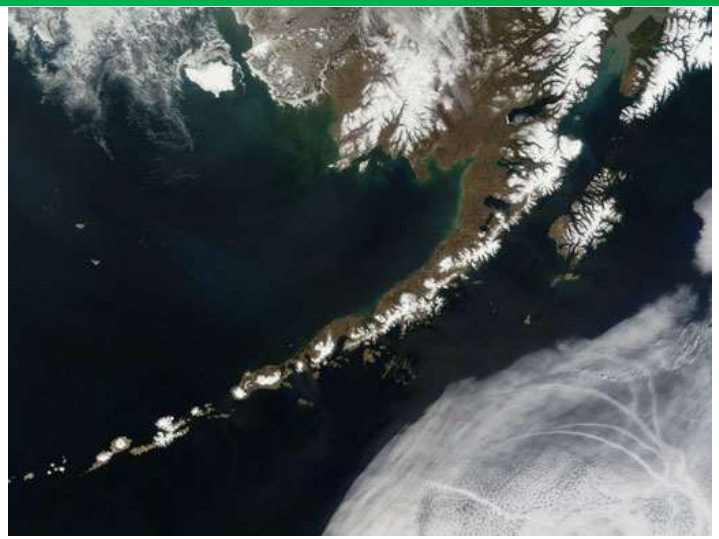
Geomorphology: study of land shapes

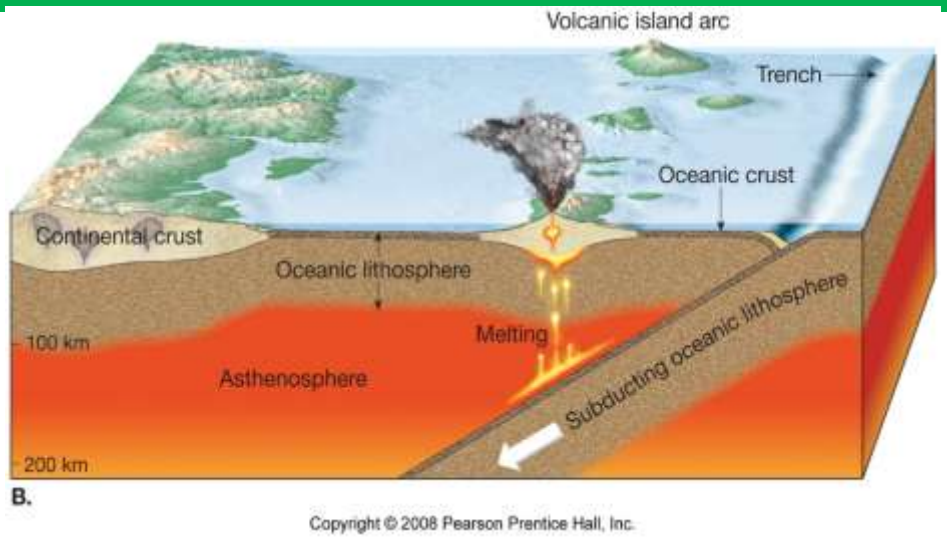
Types of landforms

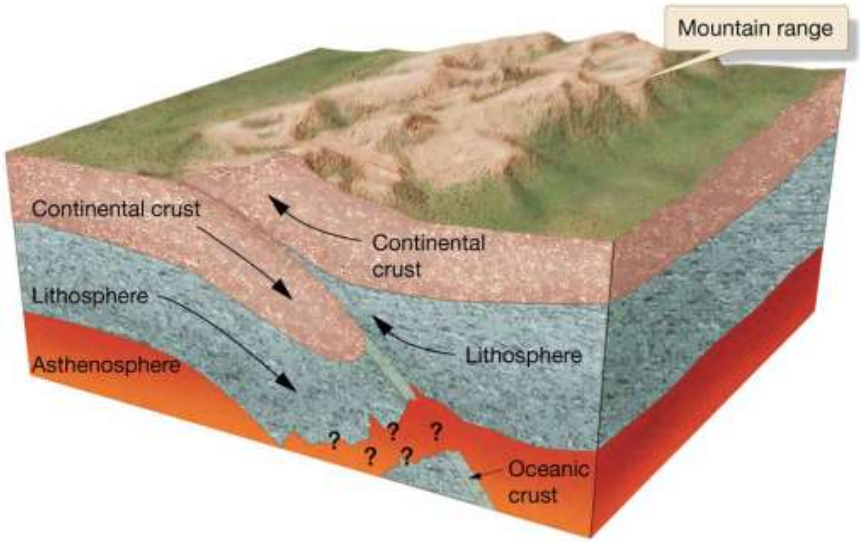
Landscapes reflect several factors:

1. Eroding or transporting agent
2. Relief
3. Climate
4. Substrate composition
5. Biologic activity
6. Tectonic activity and volcanism
7. Time

Tectonic activity

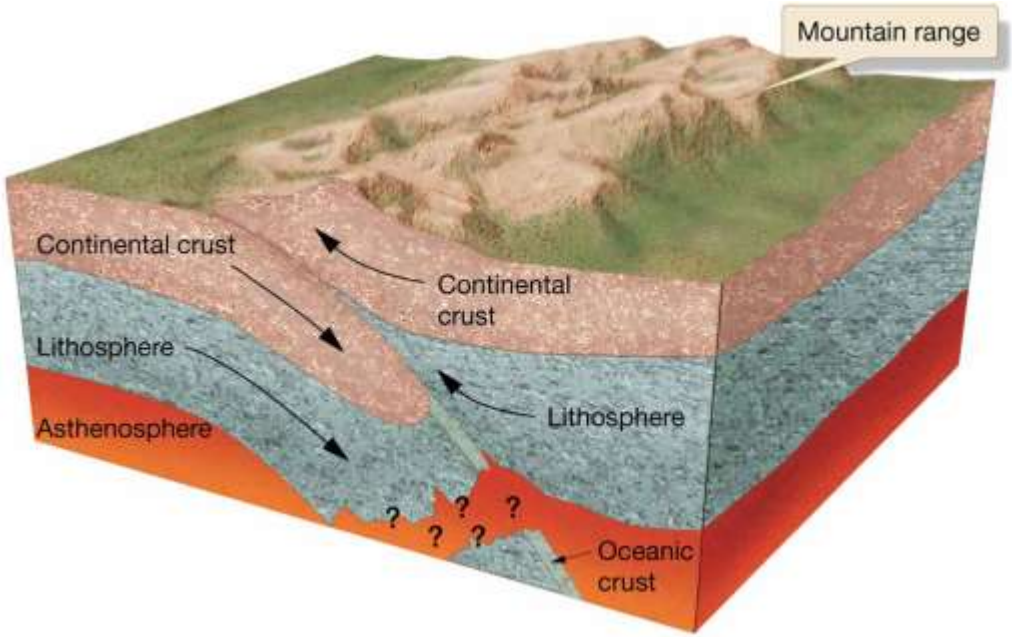




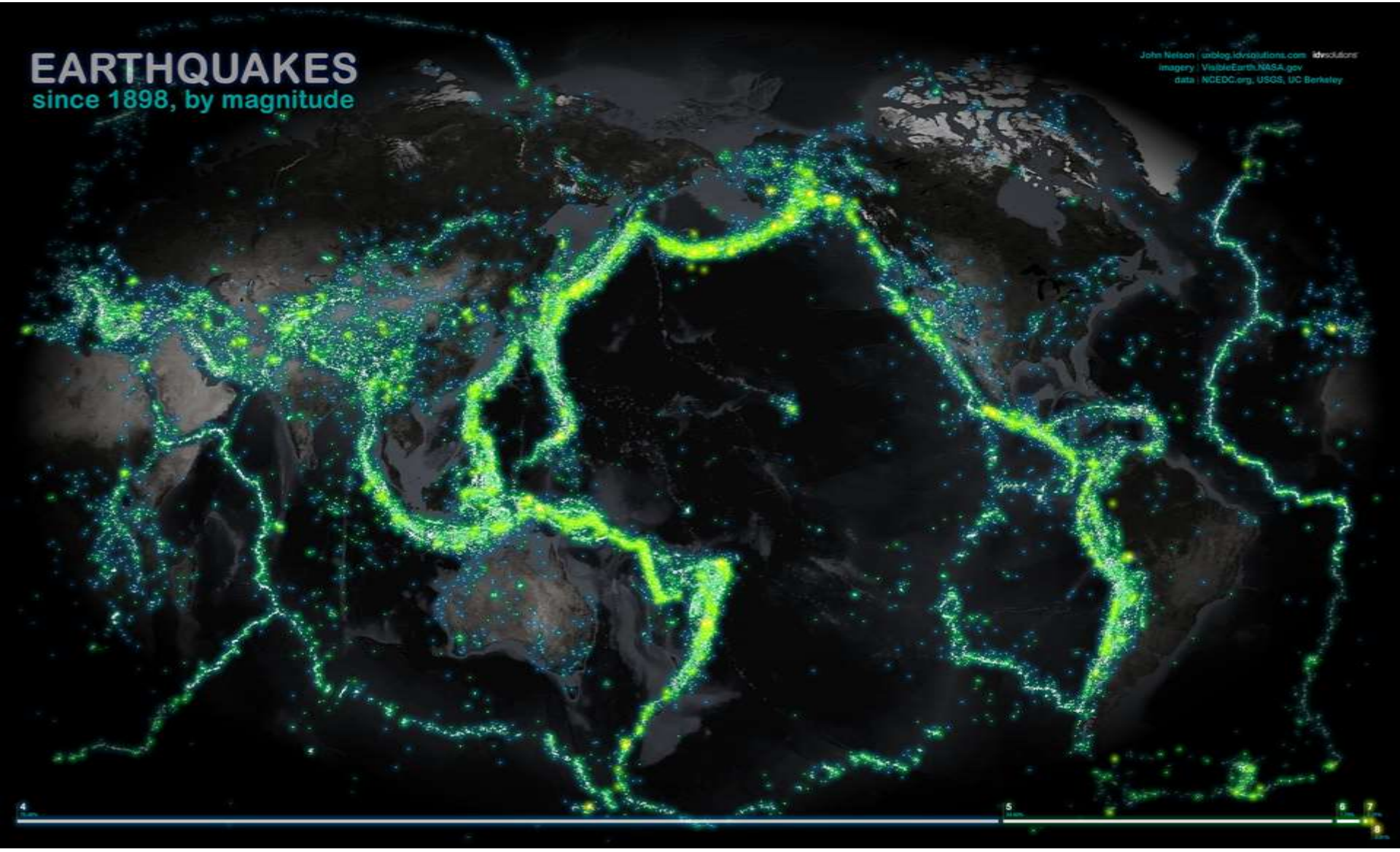


Volcanism

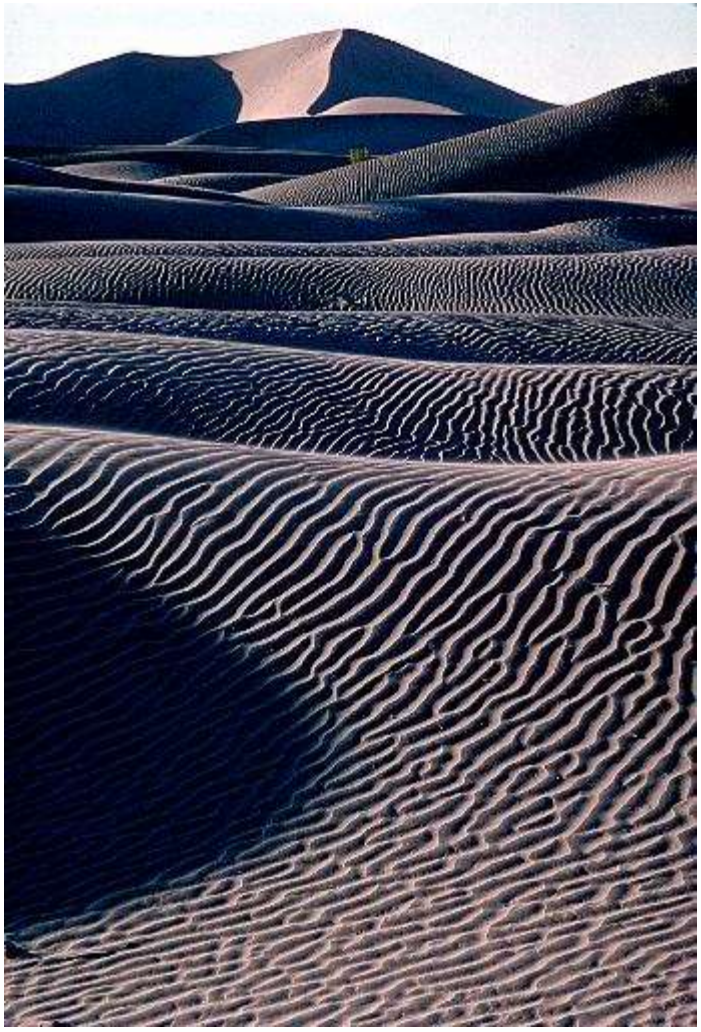
Uplift and mountain building



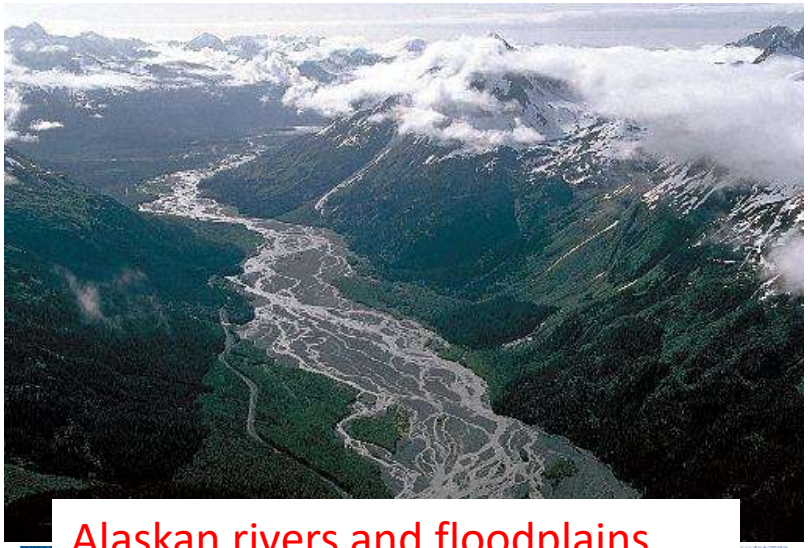
Earthquakes



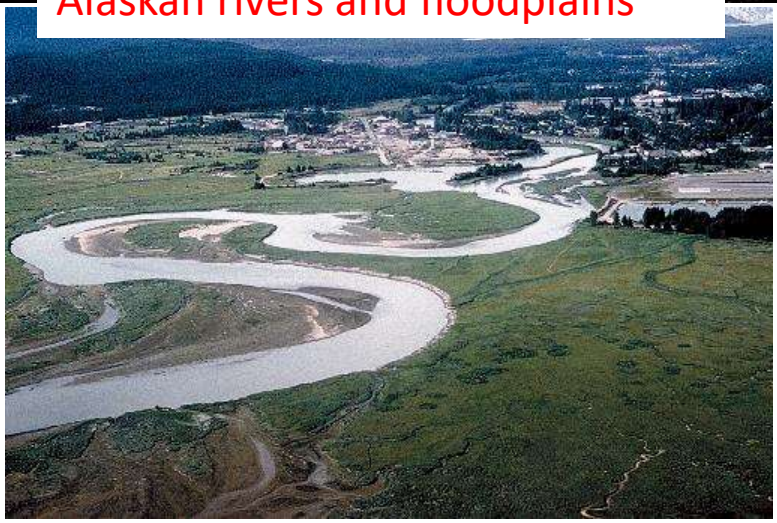
Sand dunes: Aeolian landforms



Channels, flood plains, and deltas: Fluvial landforms



Alaskan rivers and floodplains



Mississippi River delta

Shorelines shaped by oceans

Big Sur, California

Pensacola Beach, Florida

Glacial landforms carved by ice

Yosemite Valley, California


Glacier National Park, Montana

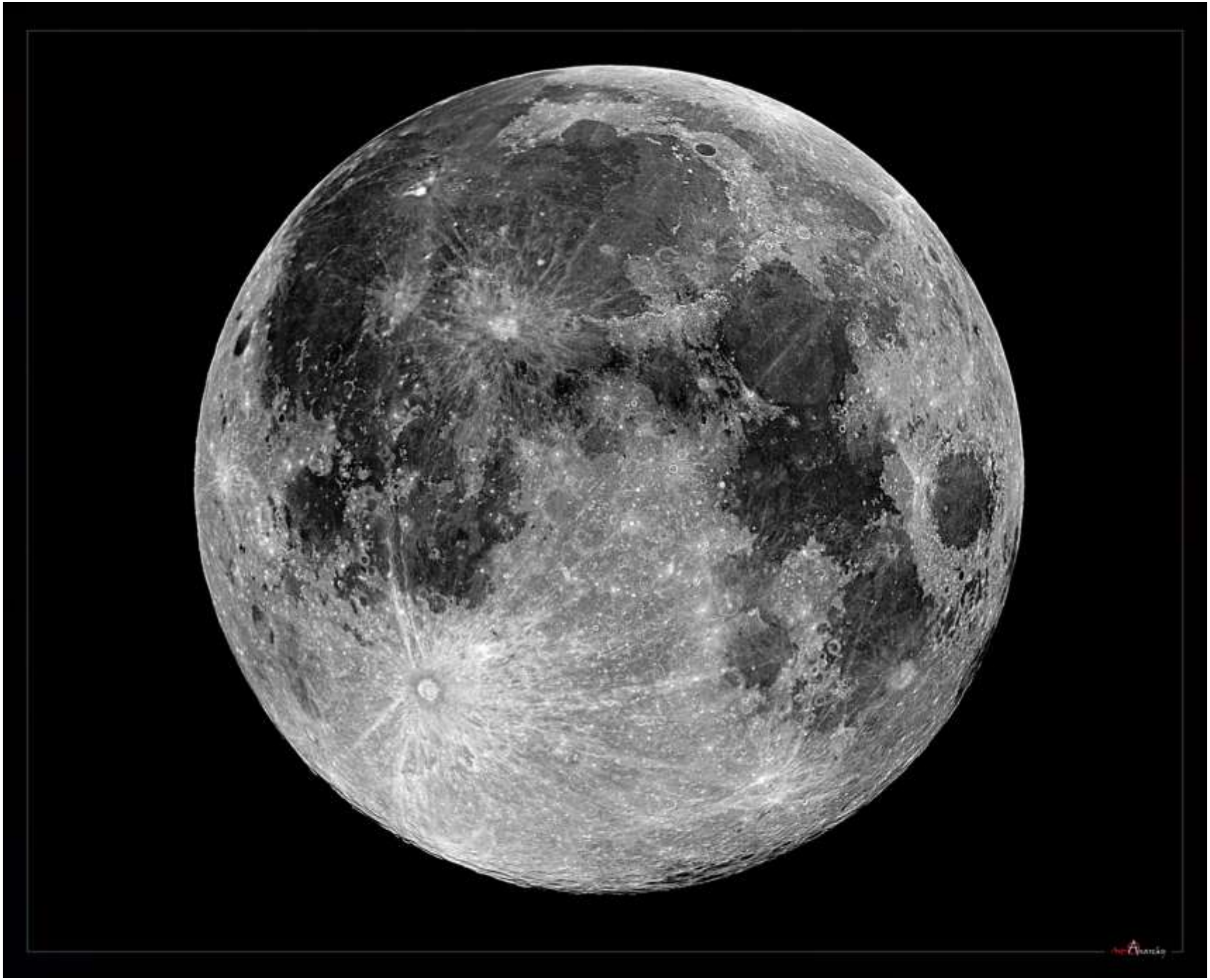
Mass wasting & landslides: Driven by gravity

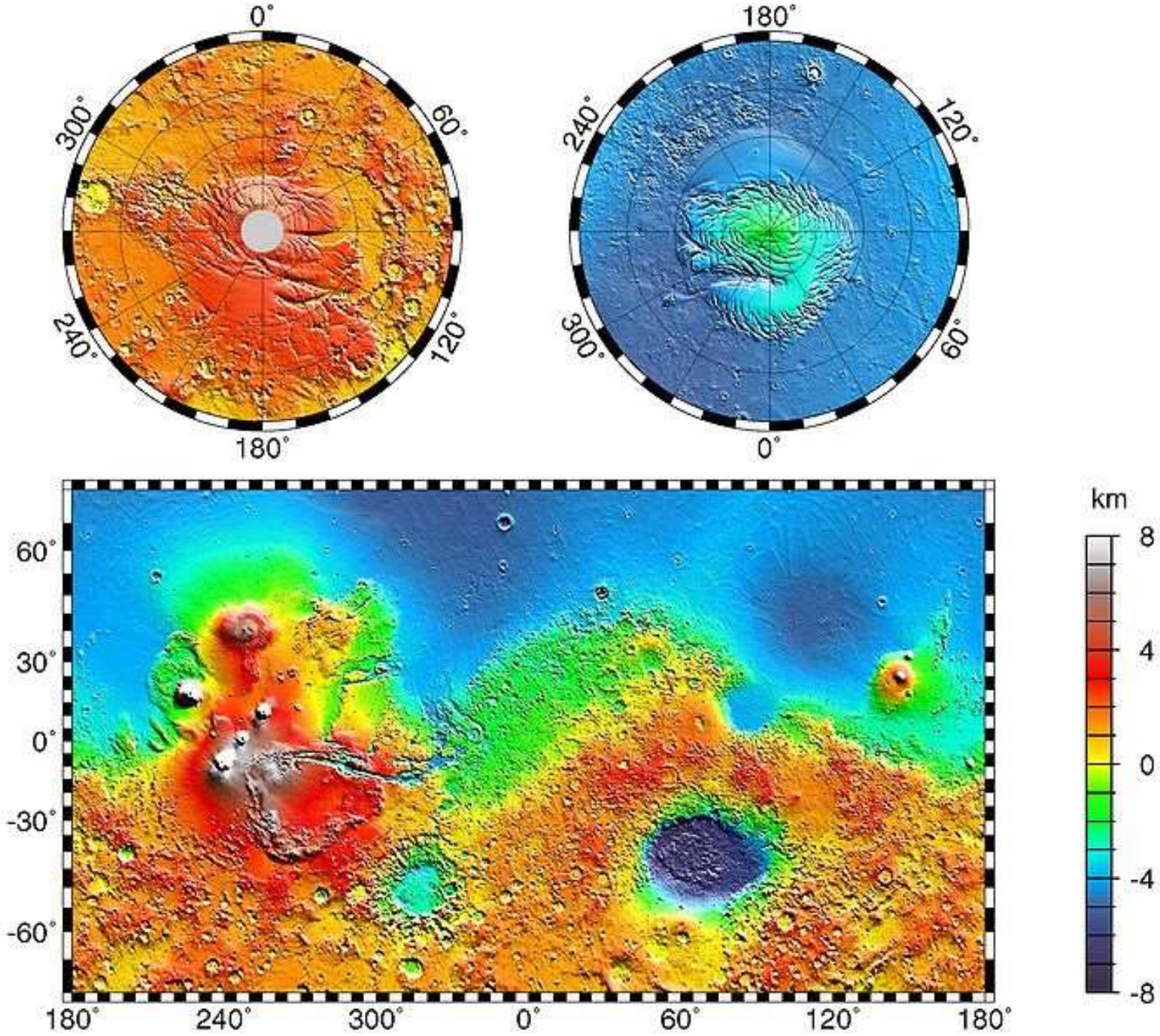
La Conchita landslide, 2005

Yosemite rockfall, 1982

How old are most landforms?

a) Thousands to a few million years old
b) Tens to hundreds of millions of years old
c) Over 1 billion years old




0°
60°
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180°
240°
300°
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300°
240°
60°
30°
0°
-30°
-60°
180°
240°
300°
0°
60°
120°
180°
km
8
4
0
-4
-8

How old are most landforms?

- Earth's surface is a very dynamic place…Therefore, landscapes are geologically young…
- Most of surface has been shaped during the Quaternary Period (1.8 million years ago to present).
  - Pleistocene Epoch (ice age cycles)
    - 1.8 million to 10,000 years ago
  - Holocene Epoch (our current warm period)
    - 10,000 years ago to present

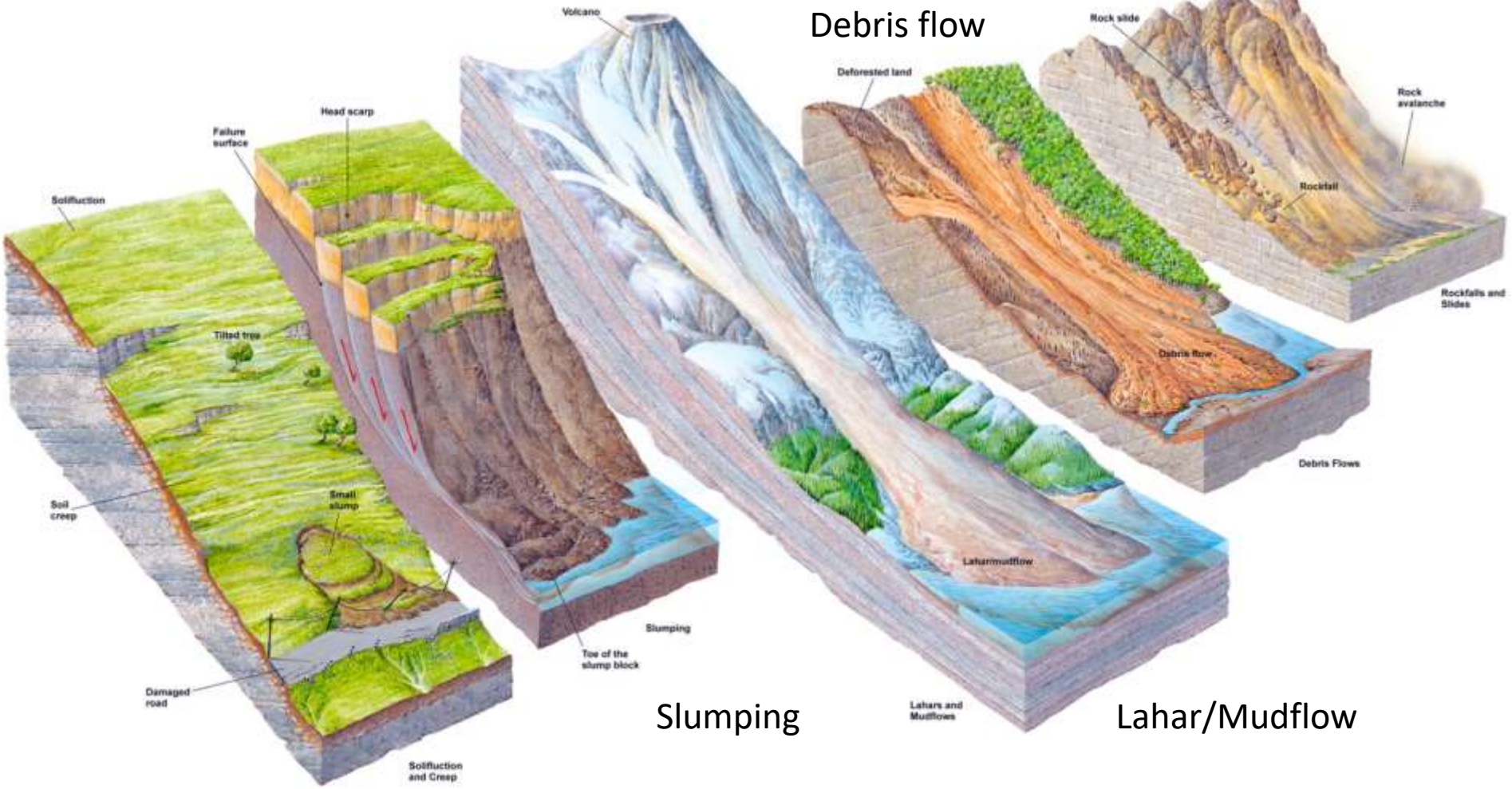
Mass movement

- Downslope transport of rock, soil, sediment, snow, ice
- A type of natural hazard which causes billions of dollars in damage to structures as well as kill thousands of people
- Especially something to be aware of in South California…

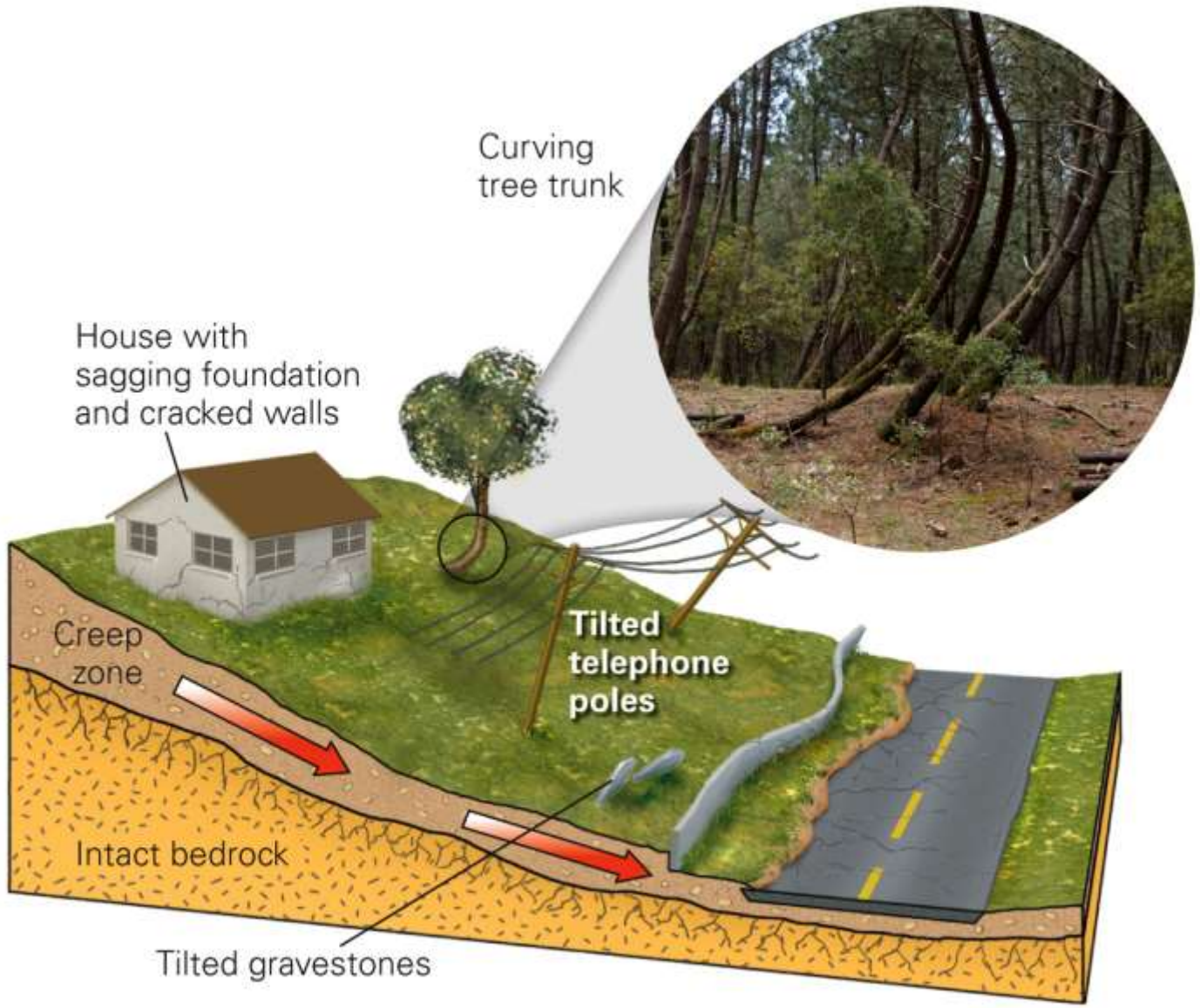
Types of mass movement

- Differ based on:
  - Type of material
  - Rate of movement
  - Character of moving mass (e.g. cloud, slurry, solid)
  - Environment (subaerial, submarine)

Types of mass movement: Subaerial

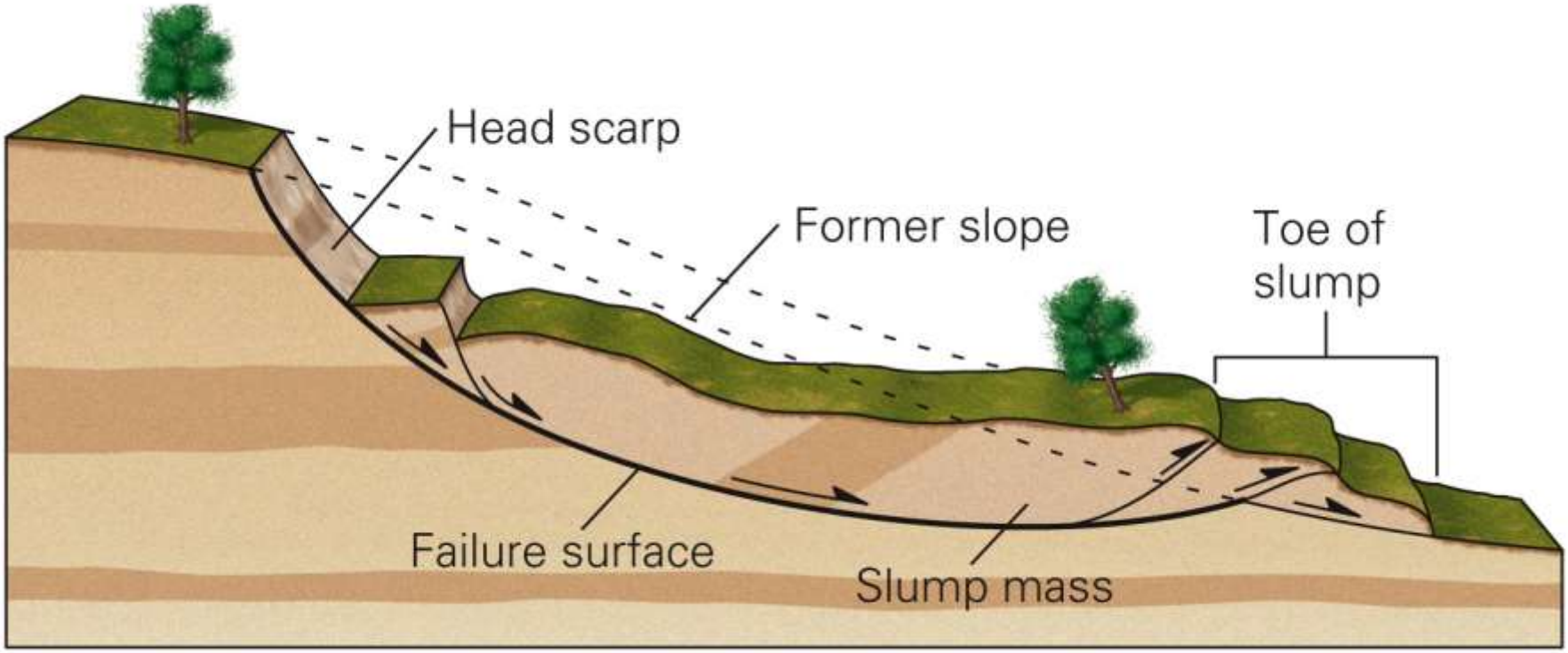


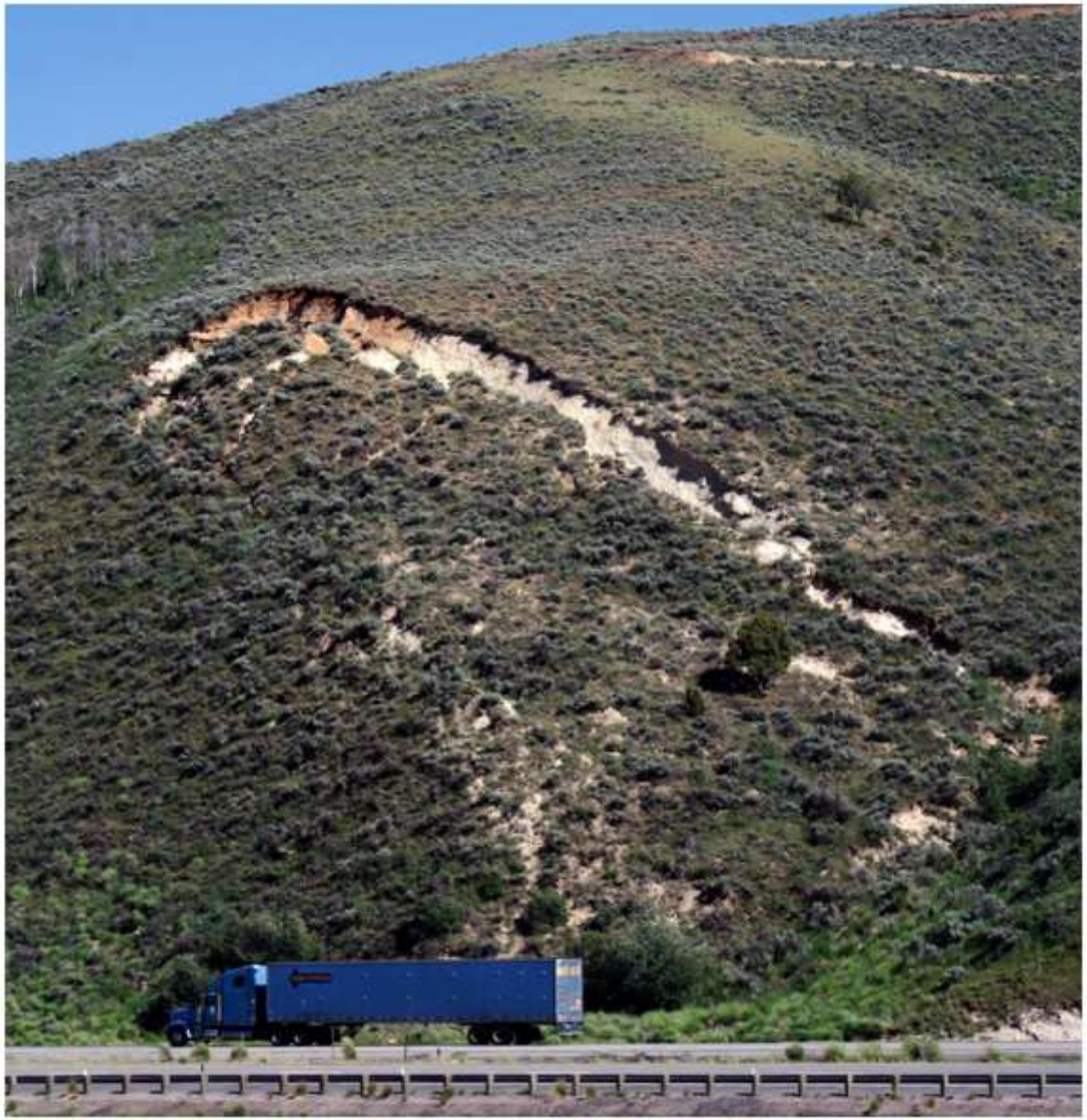
Creep


Curving
tree trunk
House with
sagging foundation
and cracked walls
Creep
zone
Tilted
telephone
poles
Intact bedrock
Tilted gravestones

Creep

Slump





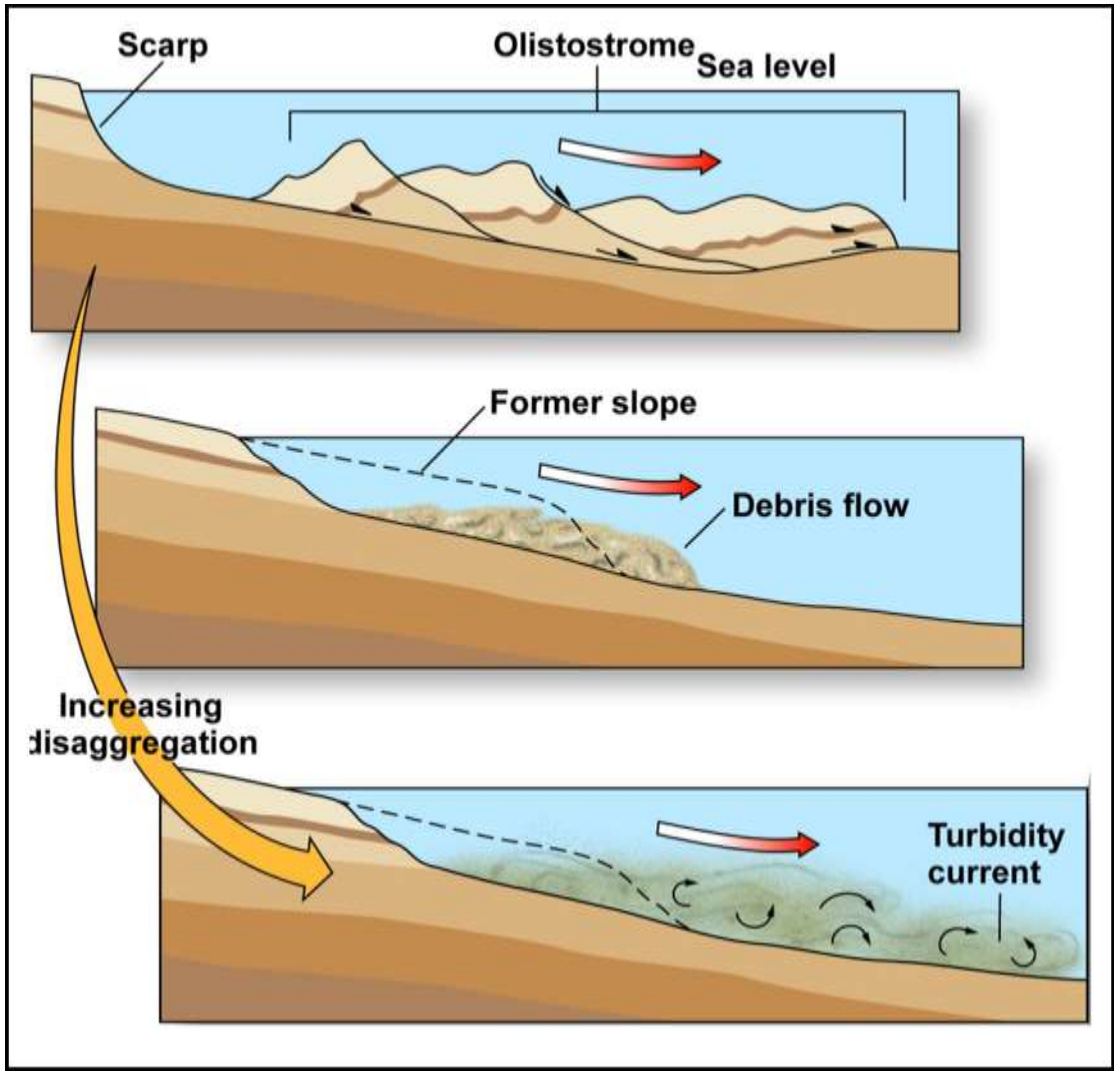
Debris Flows

Rockfall

Avalanche

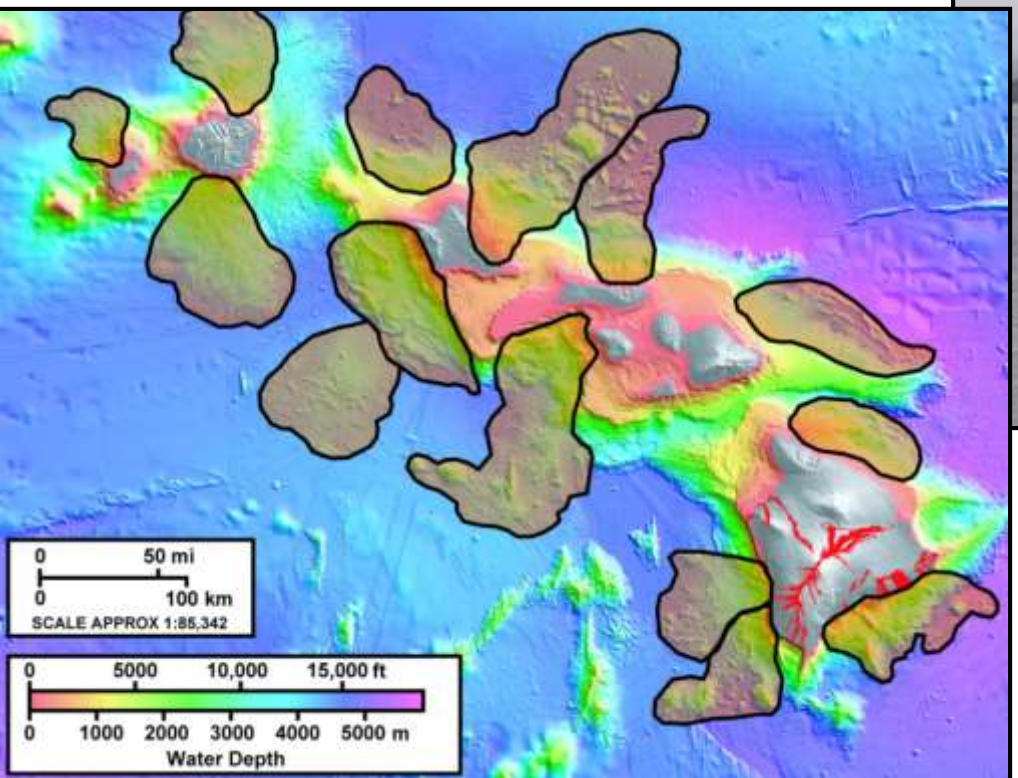
Types of mass movement: Submarine

- Submarine slumps
- Submarine debris flows
- Turbidity currents



Types of mass movement: Submarine

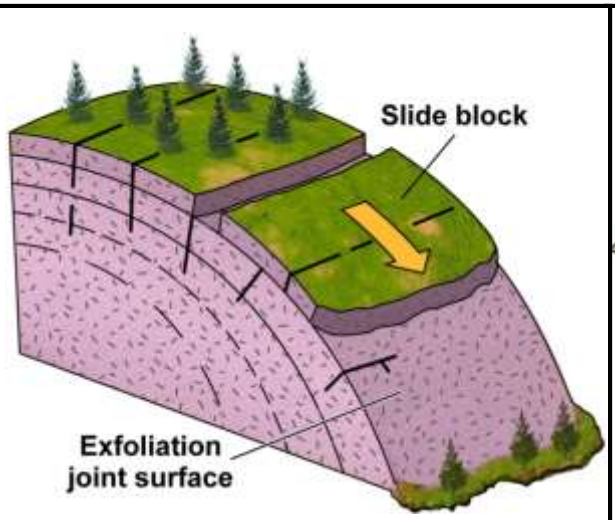
Submarine mass movements, or subaerial mass movements that interact with bodies of water can create tsunamis

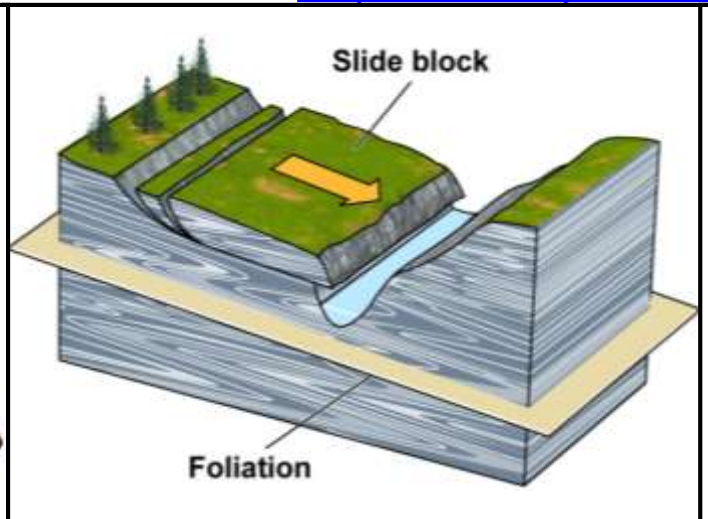


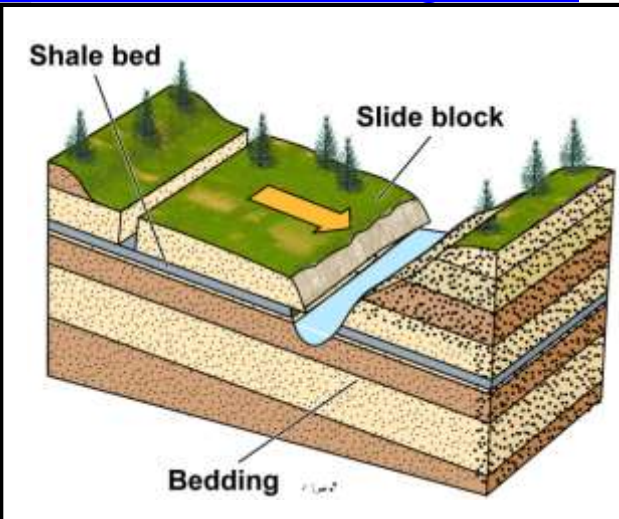
Why mass movement occurs

- Fracturing and weathering to weaken rock
- Presence of unstable slopes (so that gravity can overcome resistance and cause movement)
- Triggers of slope failure:
  - Shocks, vibrations, liquefactions
  - Changing slope angle, slope loads, slope support
  - Changing the slope strength

https://www.youtube.com/watch?v=w40JgaKNihY

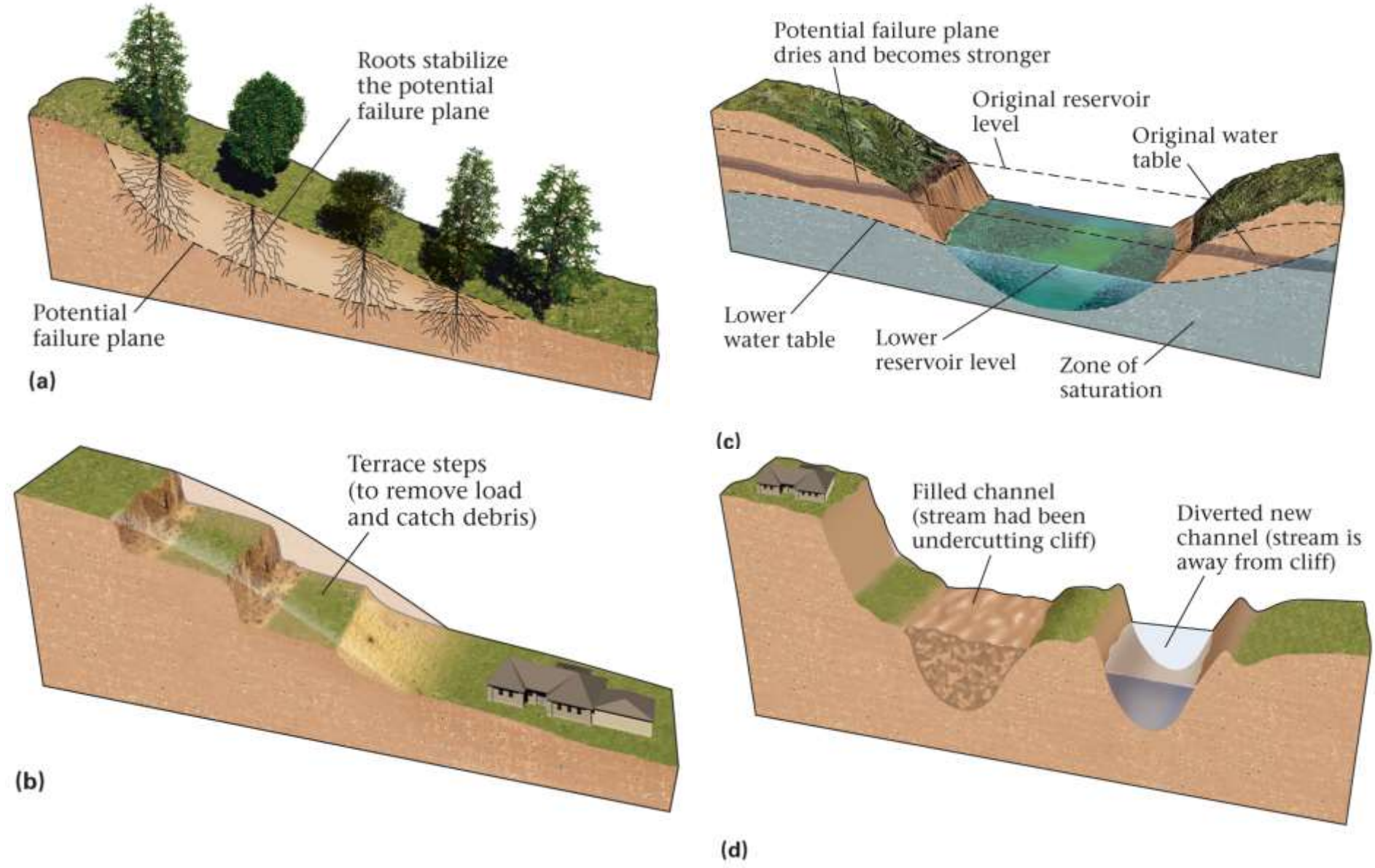




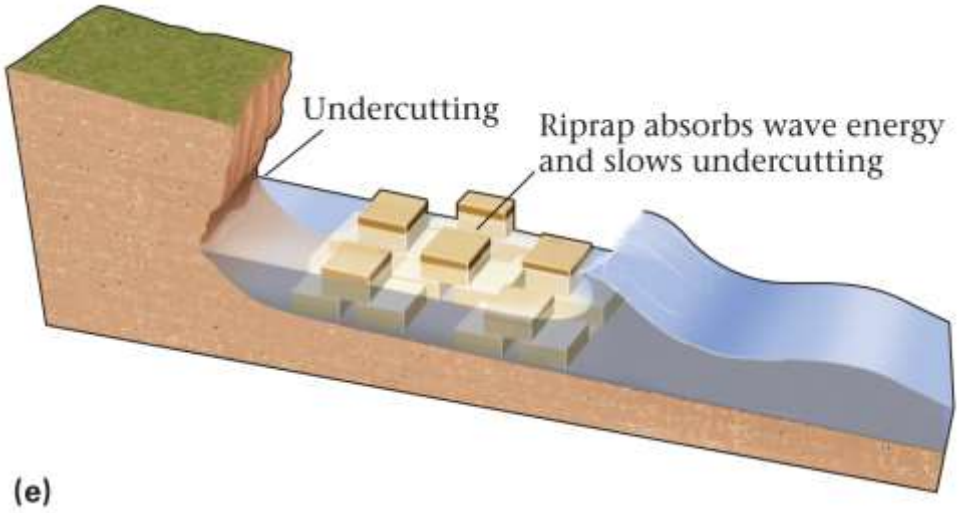


How can we protect against mass movement damage?

How can we protect against mass movement damage?



How can we protect against mass movement damage?



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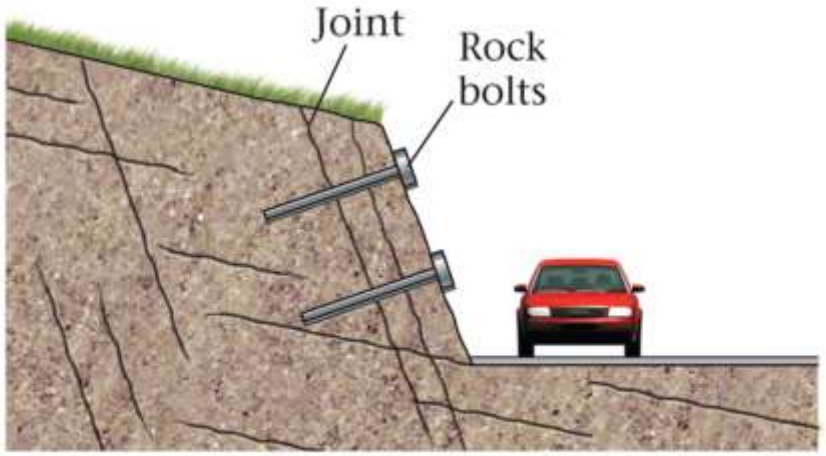

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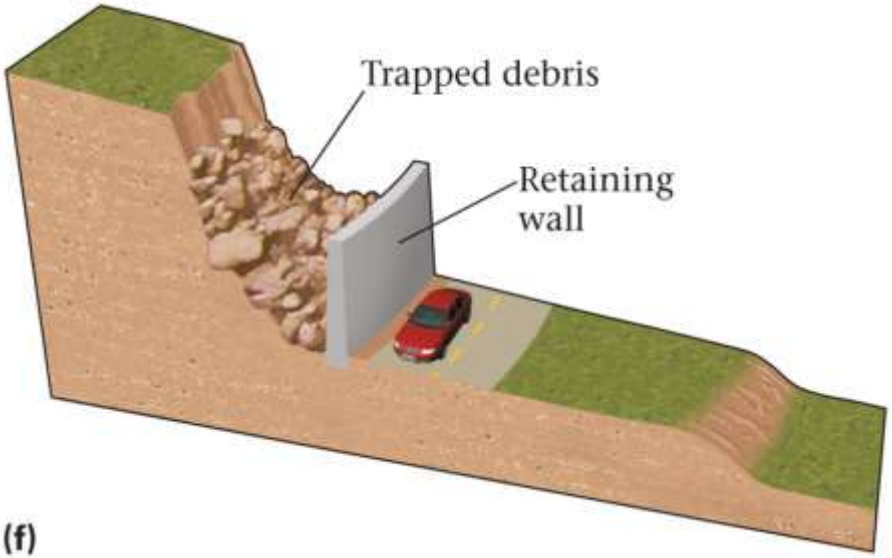

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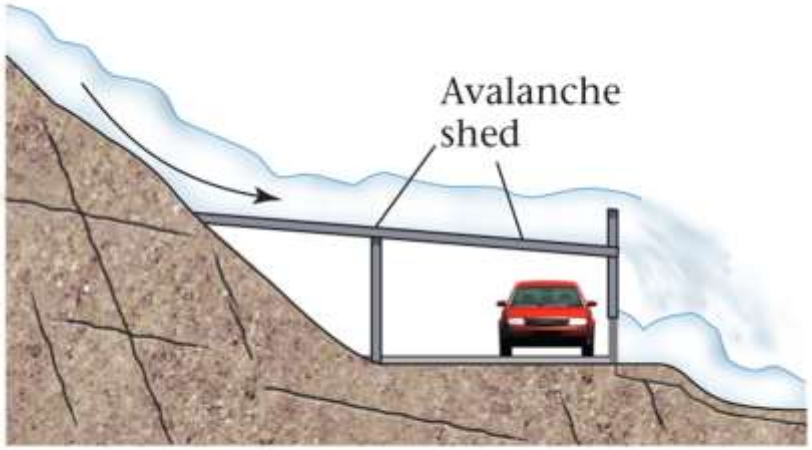


(h)

Sierra Leone (

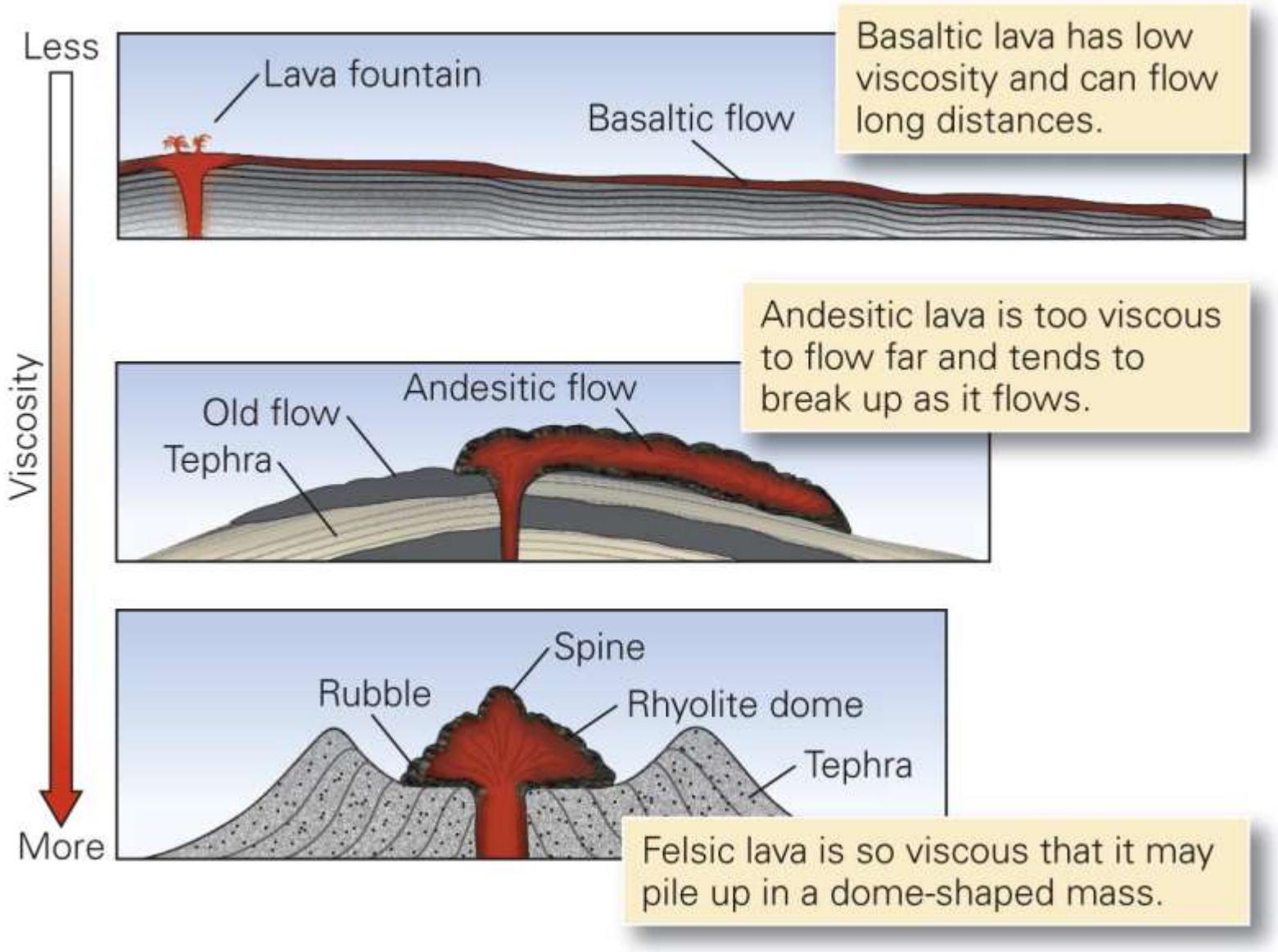
http://abcnews.go.com/WNT/video/california-mudslides-leave-thousands-stranded-24840965

+ Musdlide GIF

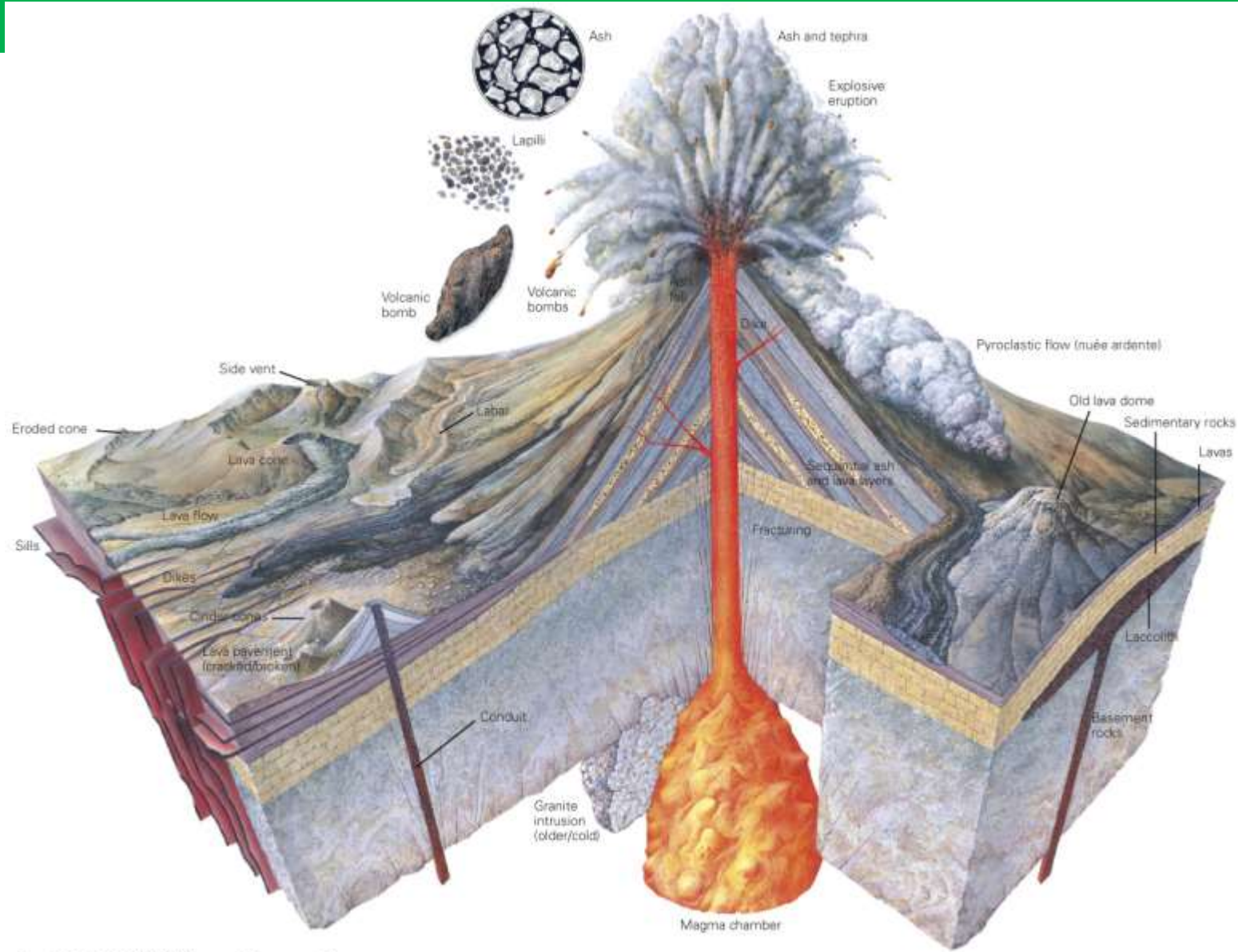
Volcanic Hazards

- Ash and debris
- Pyroclastic flow
- Lahars
- Gasses
- Lava

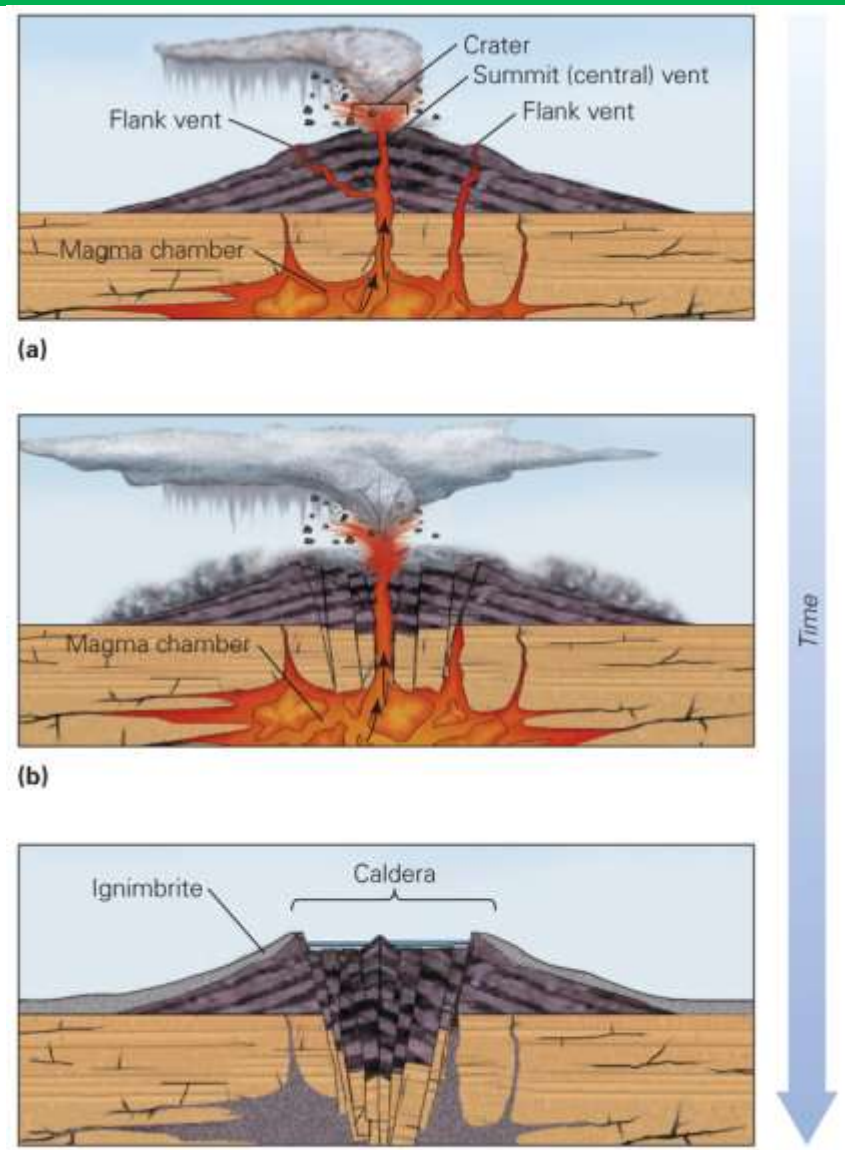
Volcanic Hazards



Volcanic Hazards

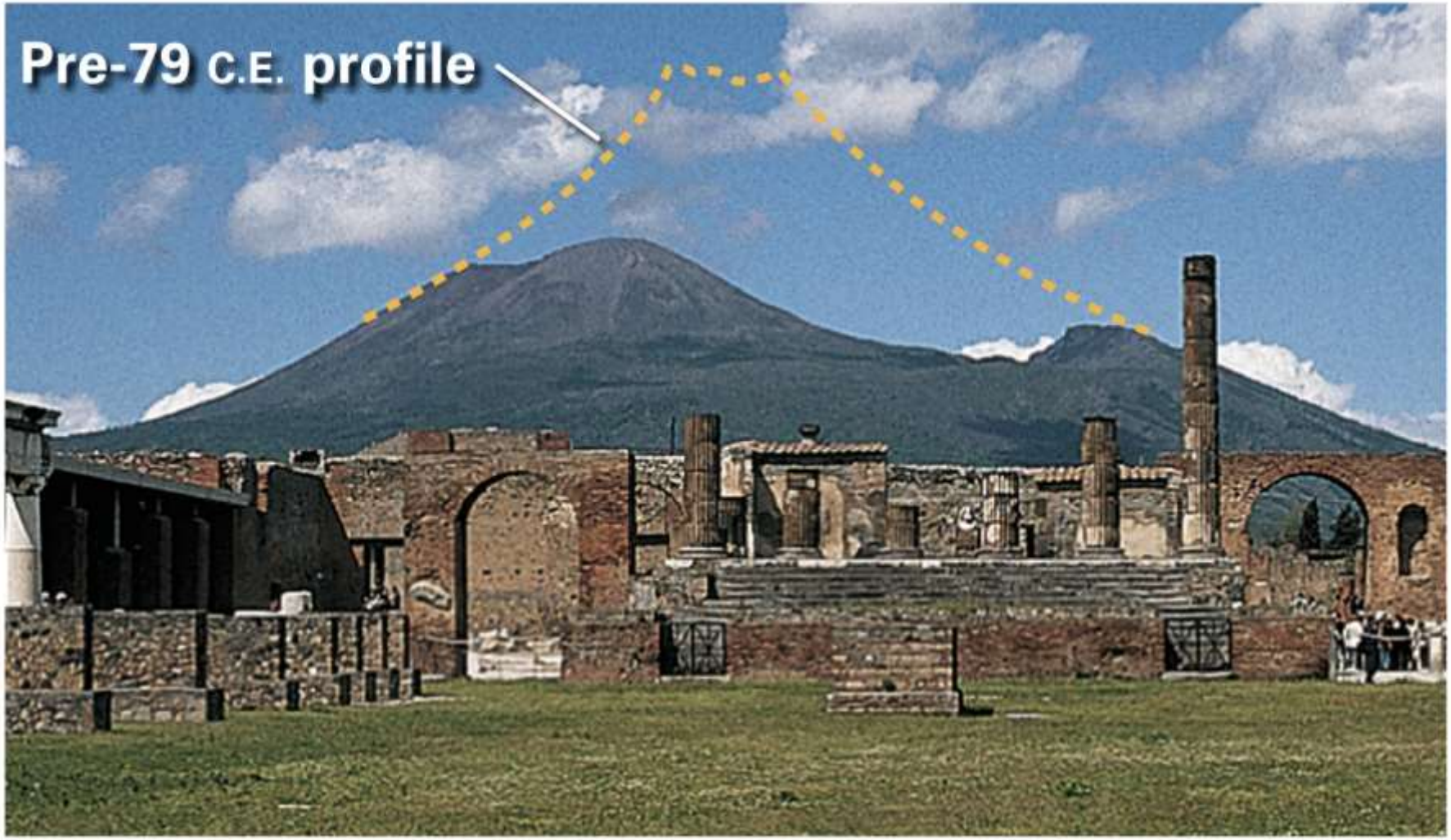


Volcanic Hazards



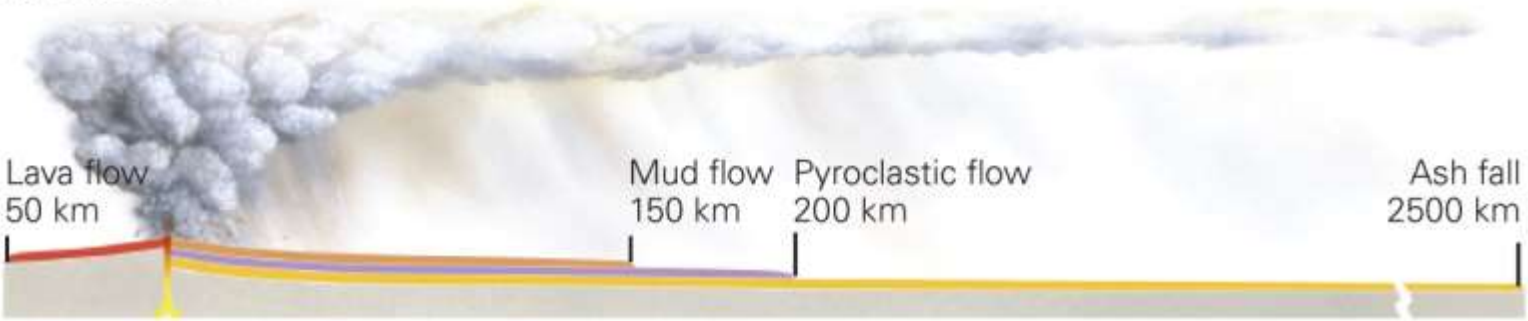
Pyroclastic

Pyroclastic



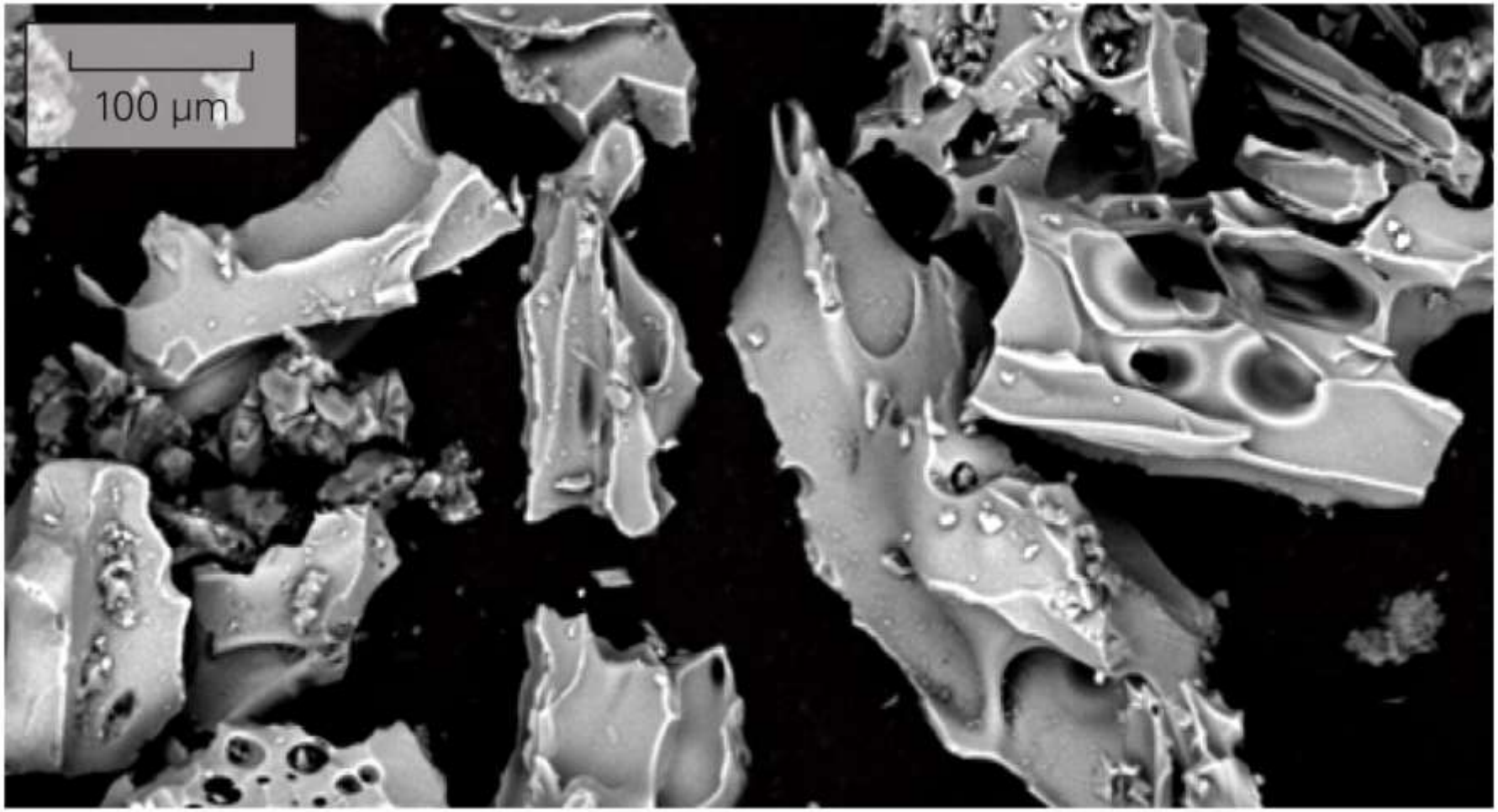
Pyroclastic flow

Plinean explosions shoot a huge column of pumice fragments up to 50 km into the atmosphere. The ash fall rains down and the column collapses back around the vent, traveling overland as a pyroclastic flow.



The distance volcanic hazards can travel from an eruption.

Pyroclastic

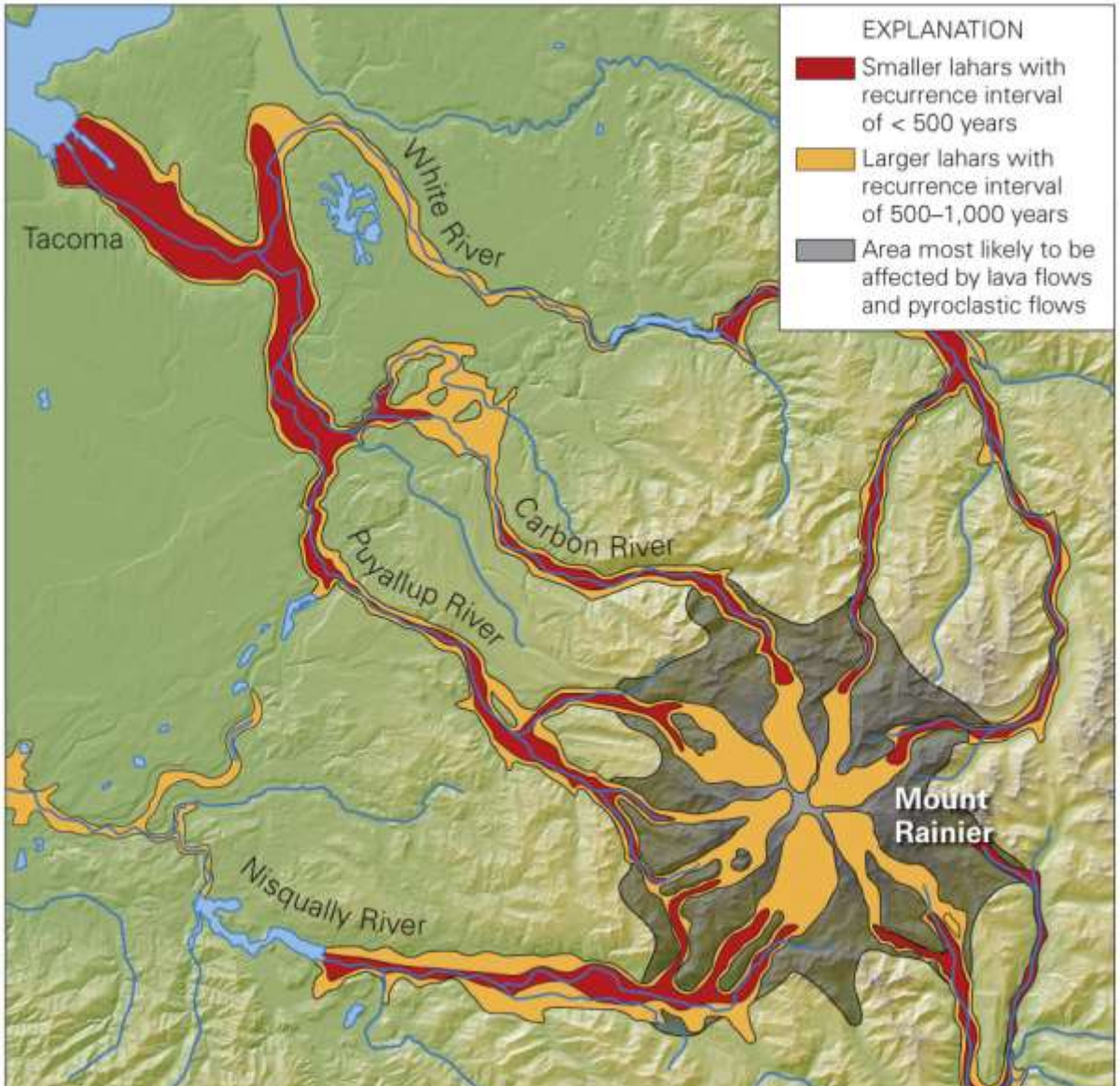


Pyroclastic

Pyroclastic

Pyroclastic

Lahars

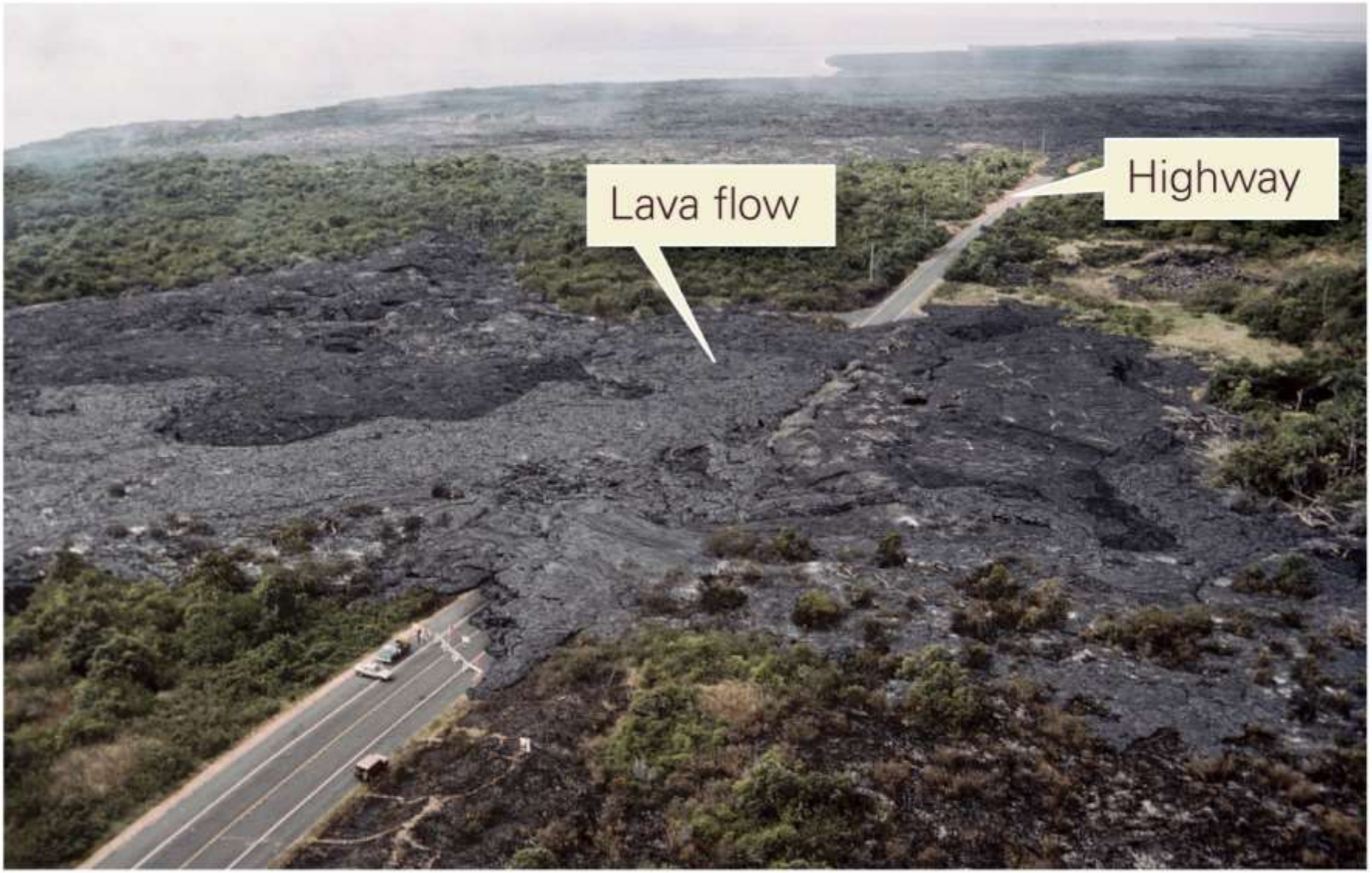

EXPLANATION
Smaller lahars with recurrence interval of < 500 years
Larger lahars with recurrence interval of 500–1,000 years
Area most likely to be affected by lava flows and pyroclastic flows
Tacoma
White River
Carbon River
Puyallup River
Nisqually River
Mount Rainier

Volcanic Gasses

Lava flows

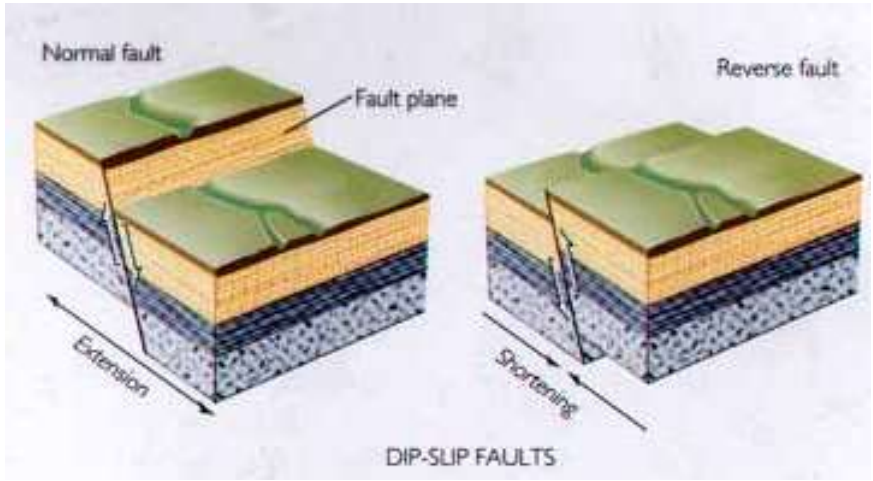
Lava Flows

Lava Flows

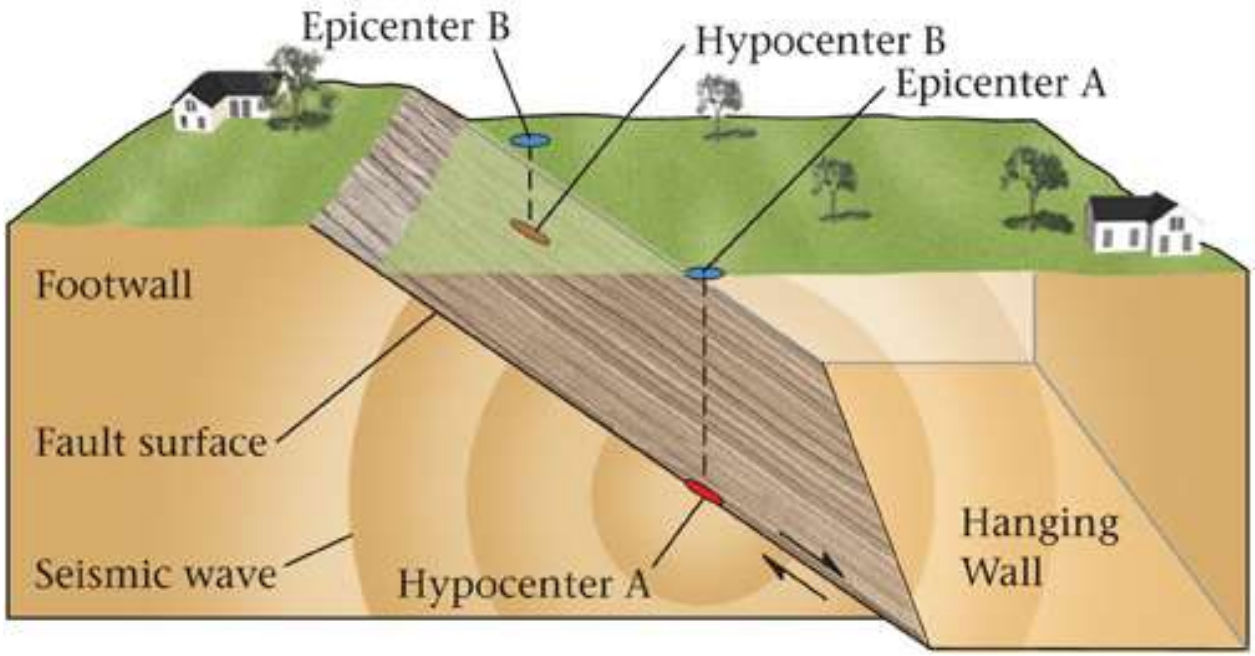


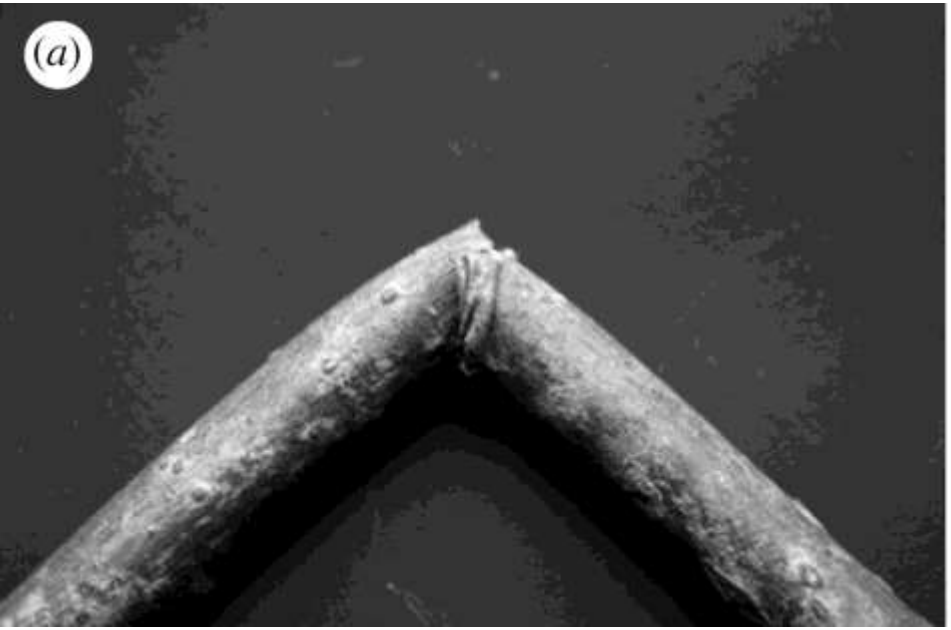
Faults

Figure 10.22
Press and Siever: ***Understanding Earth***

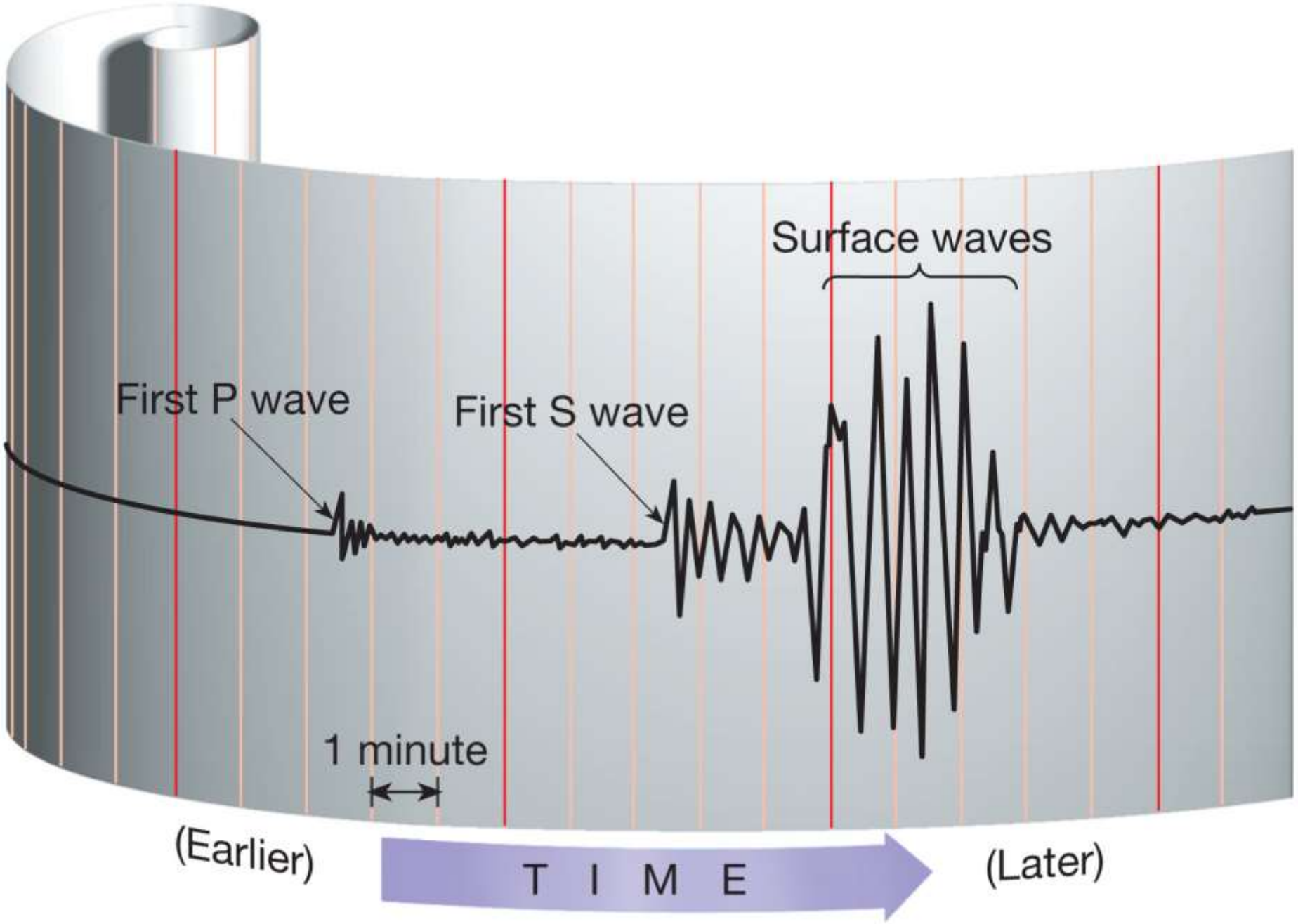


Faults


Epicenter B
Hypocenter B
Epicenter A
Footwall
Fault surface
Seismic wave
Hypocenter A
Hanging
Wall

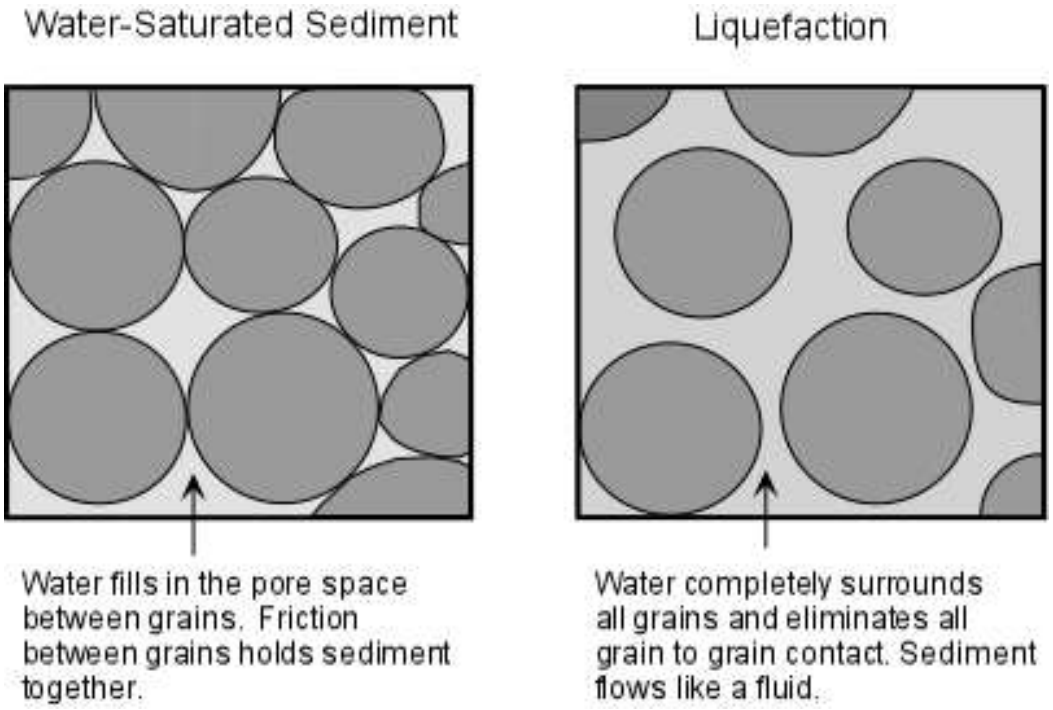

(a)


(b)



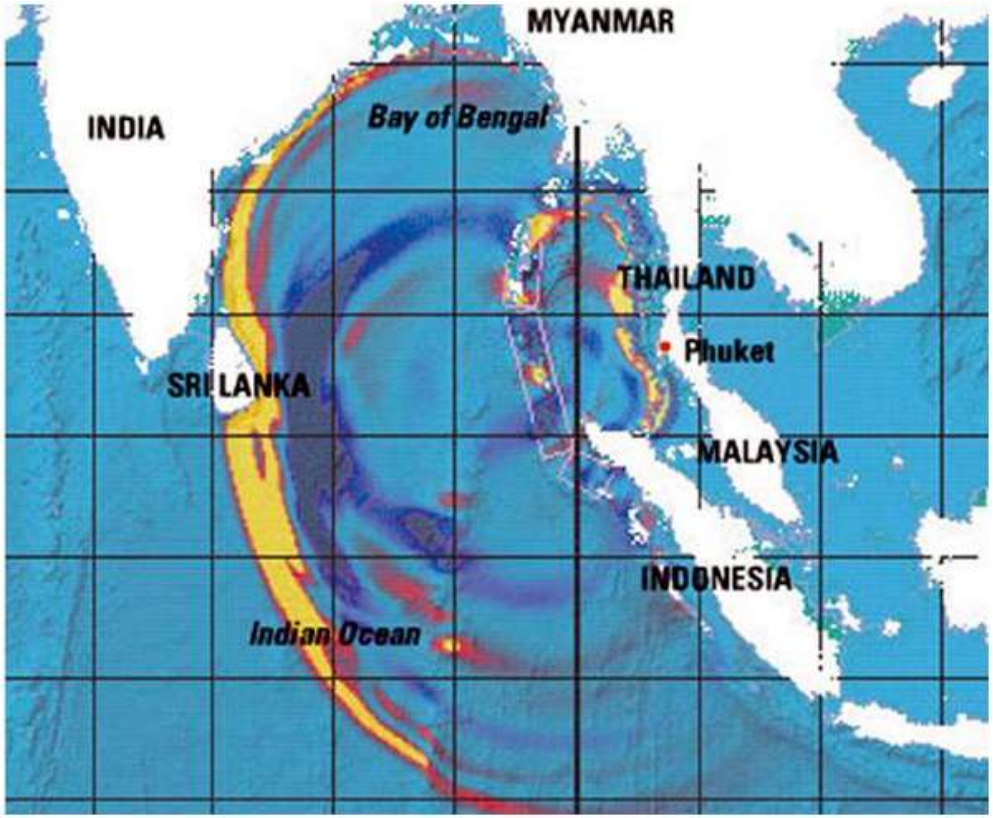
Year	Location	Death toll	Richter Scale
1556	China, Shensi	830,000	~8
1976	Tangshan, China	255,000	7.5
1138	Syria, Aleppo	230,000	
2004	Sumatra	227,898	9.1
2010	Haiti region	222,570	7.0

- Occurs when seismic waves liquefy water-filled sediments
  - High pore pressures force grains apart, reducing friction
  - Liquefied sediments flow as a slurry
  - Sand becomes “quicksand”




Denali Fault
rupture
Built-in
bends

- Dec 26th 2004
- Magnitude 9.0 (largest in 40 years)
- Displacement of 15m along 1100km!!
- Triggered tsunami of up to 15 m
- 227,787 people died
- 1.7 million displaced

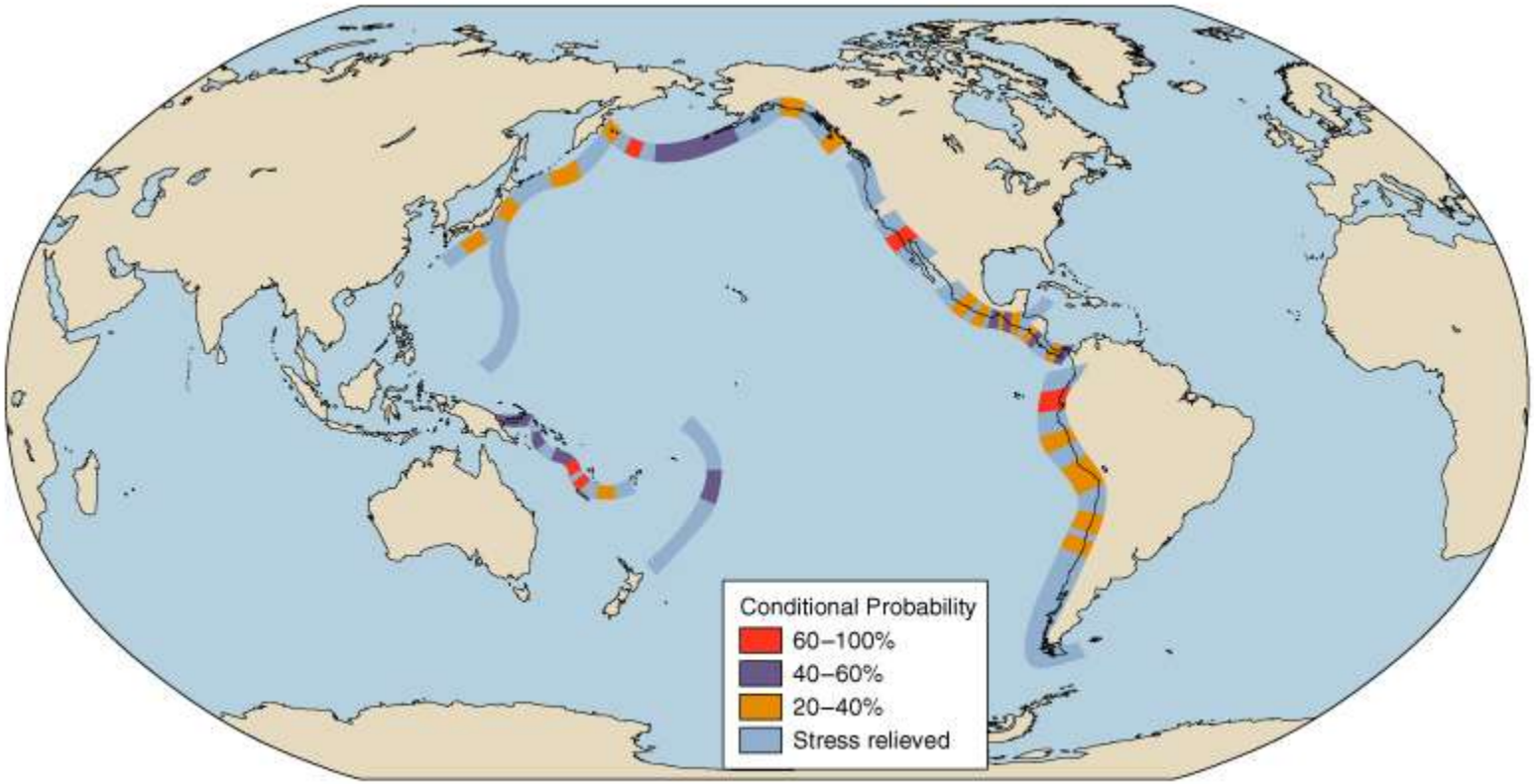


The Indian Ocean Tsunami

- Complete devastation below “run-up” elevation.
  - Dense coastal development in Banda Aceh hardest hit.
  - Entire communities were erased – buildings and people.

- Heed natural and official warnings
  - An earthquake in a coastal setting
  - Retreat of water from the shore is sign of an impending tsunami
- Expect many waves
  - Bigger waves may be next
  - Wave arrival may last for hours
- Get to high ground and stay there
  - Expect roads to be impassable
  - Climb a sturdy building or a tree
  - Grab something that floats

Seismic Gaps – places where earthquakes have not occurred in a long time, and elastic strain has been increasing



We are not currently able to predict exactly when and where an earthquake will happen but we can use probabilities based on repeat times, strain accumulation etc

http://earthquake.usgs.gov/regional/nca/simulations/shakeout/

http://pubs.usgs.gov/circ/1324/