

What tectonic setting caused this?

A) Divergent

B) Convergent

C) Transform

D) Hotspot

E) Intracontinental

What allows a rock to deform?



What allows a rock to deform?

1) Temperature
2) Pressure
3) ….?
4) ….?

Granite vs. gypsum?





What allows a rock to deform?

1) Temperature

2) Pressure

3) Rock type

4) ….?



What allows a rock to deform?

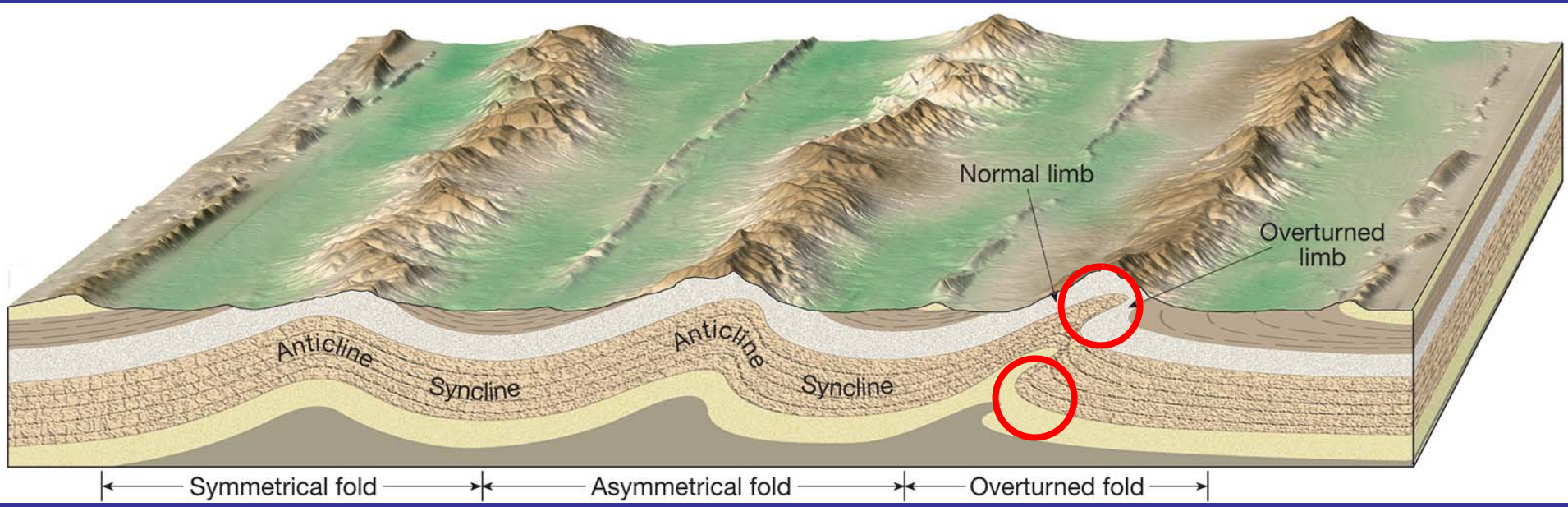
1) Temperature

2) Pressure

3) Rock type

4) Time





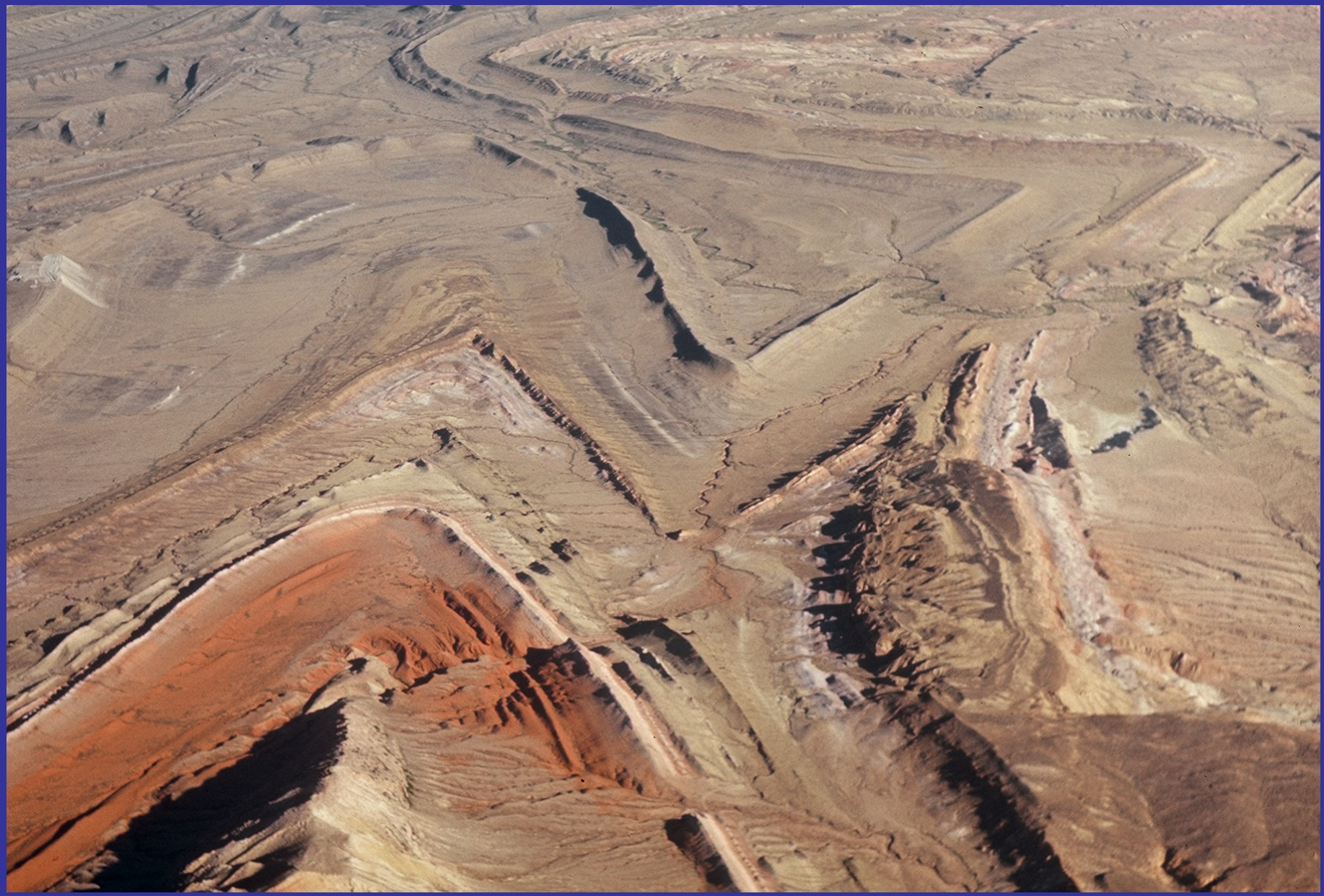




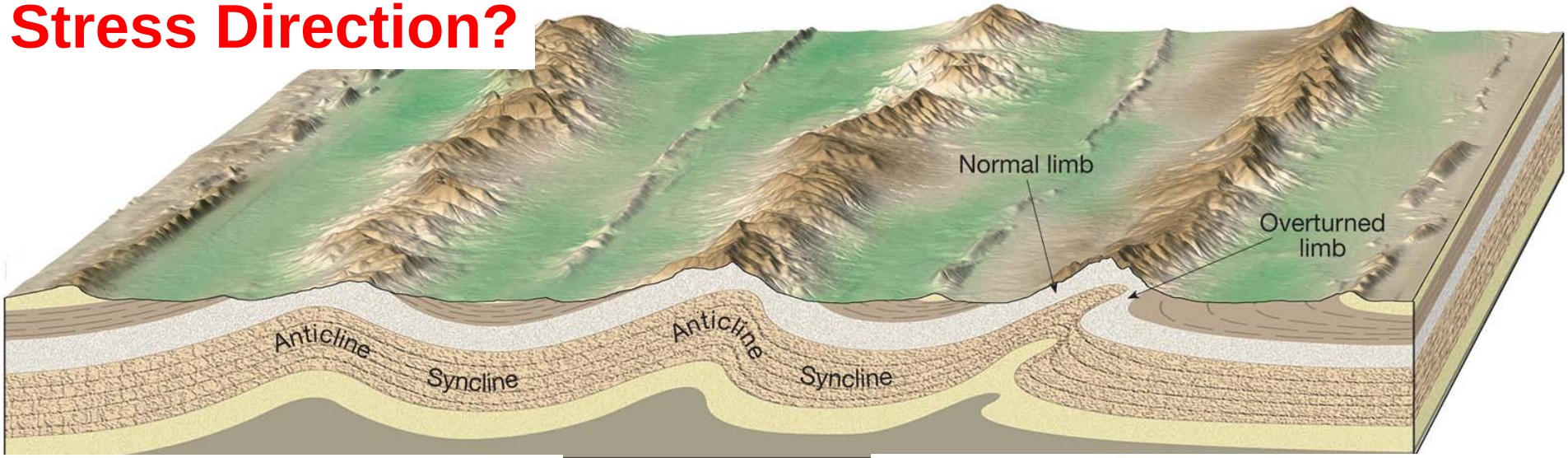


Where are the oldest rocks?

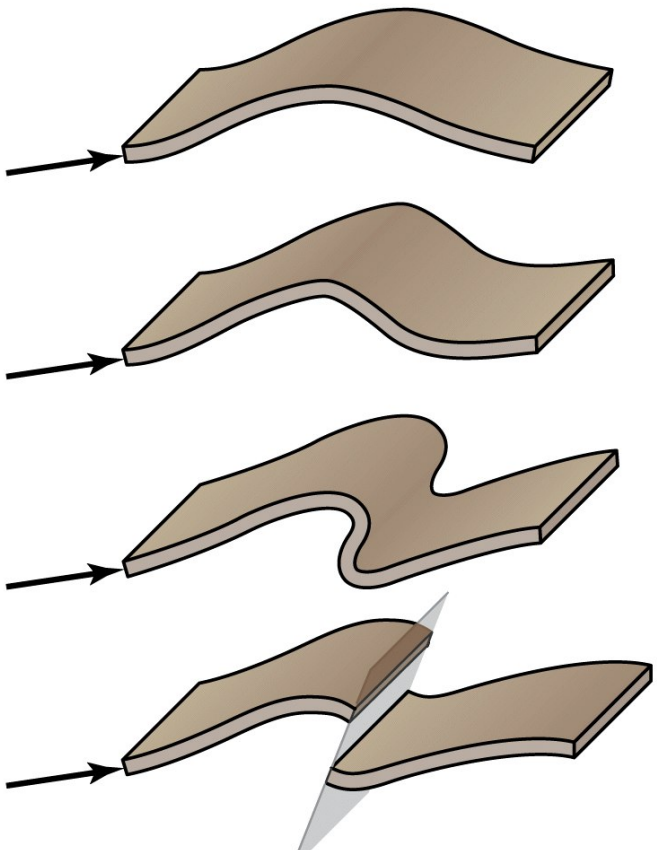
Where's the syncline? Where's the anticline?

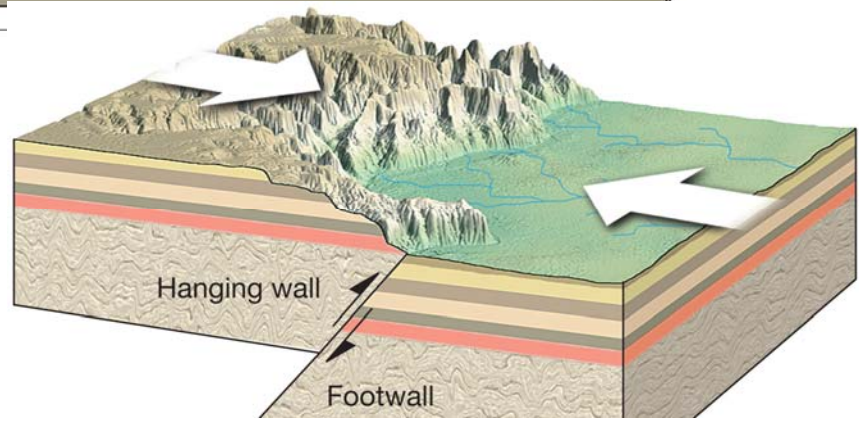


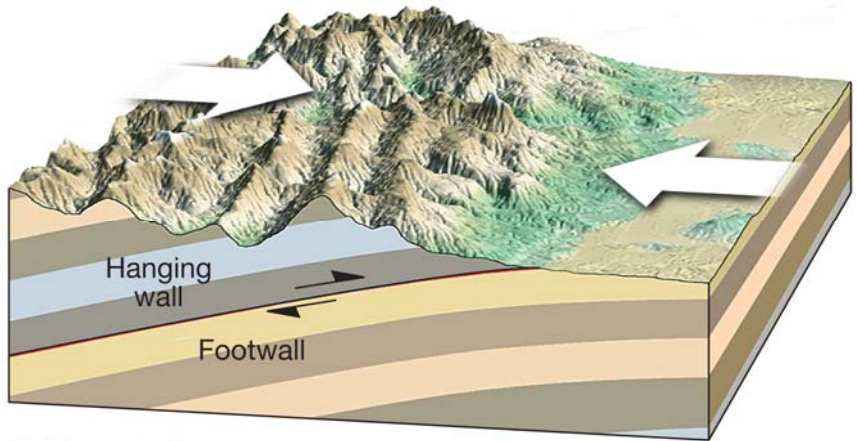
Stress Direction?



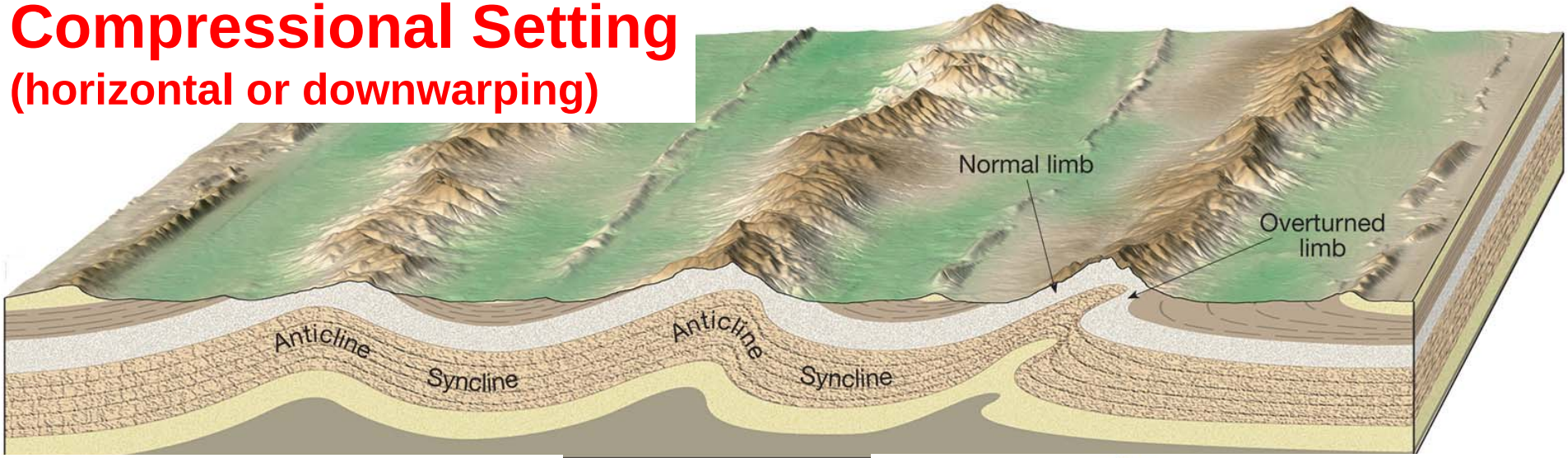
Asymmetrical fold



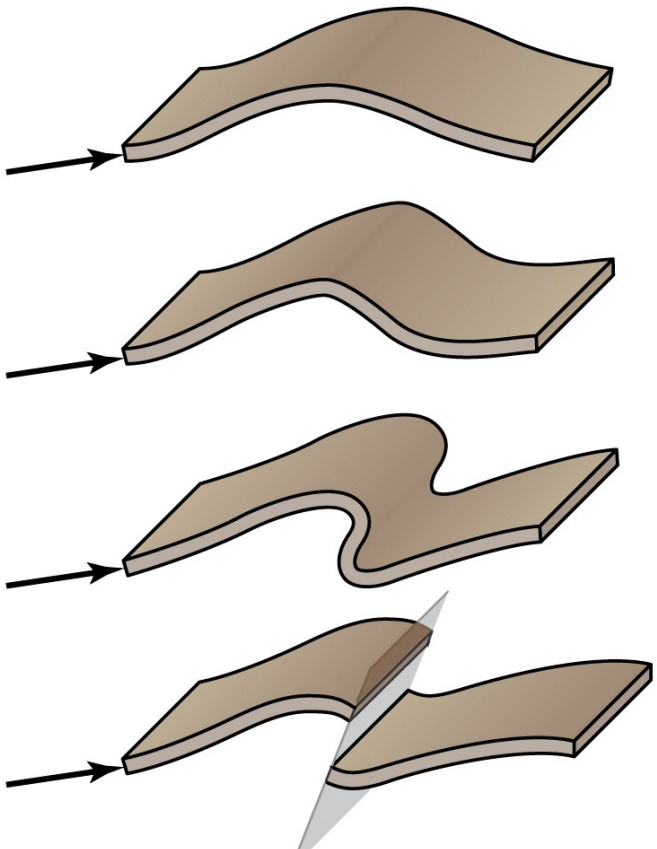




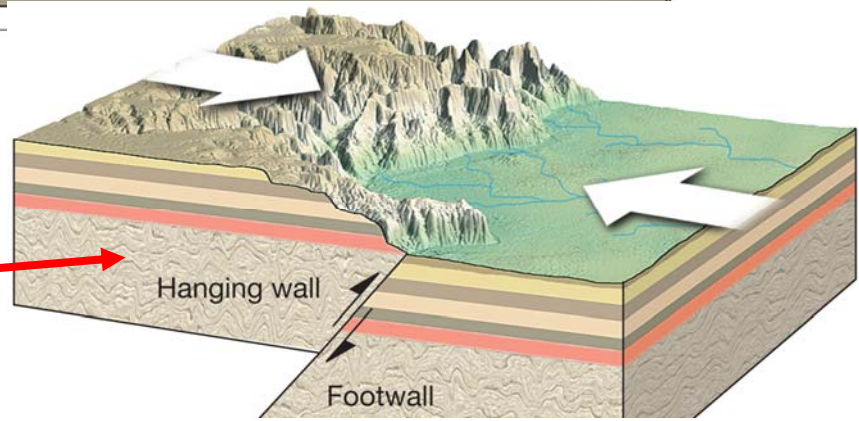
Compressional Setting
(horizontal or downwarping)

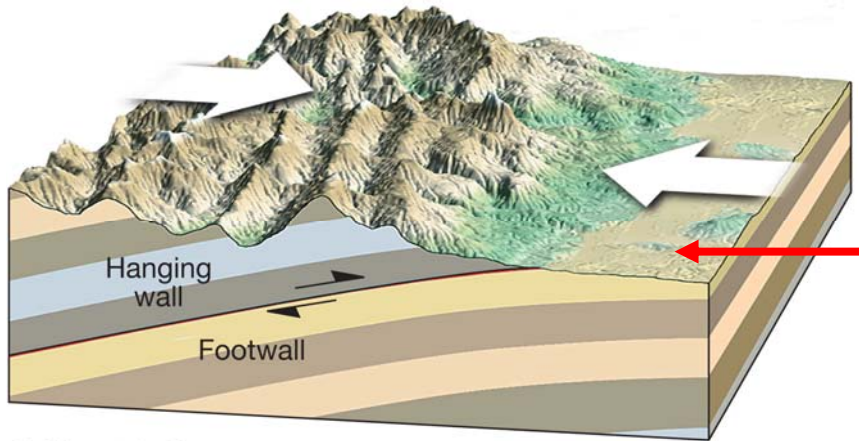


Asymmetrical fold



Reverse Fault (<45°)





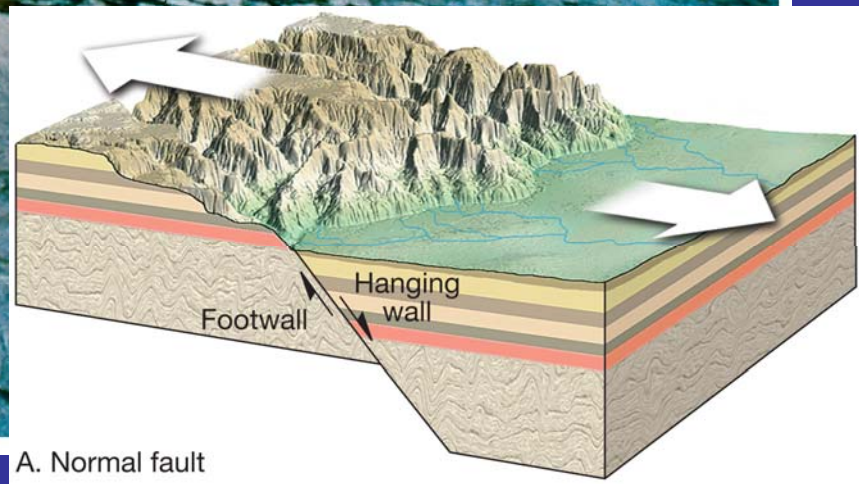
Thrust Fault (>45°)

Stress Direction?

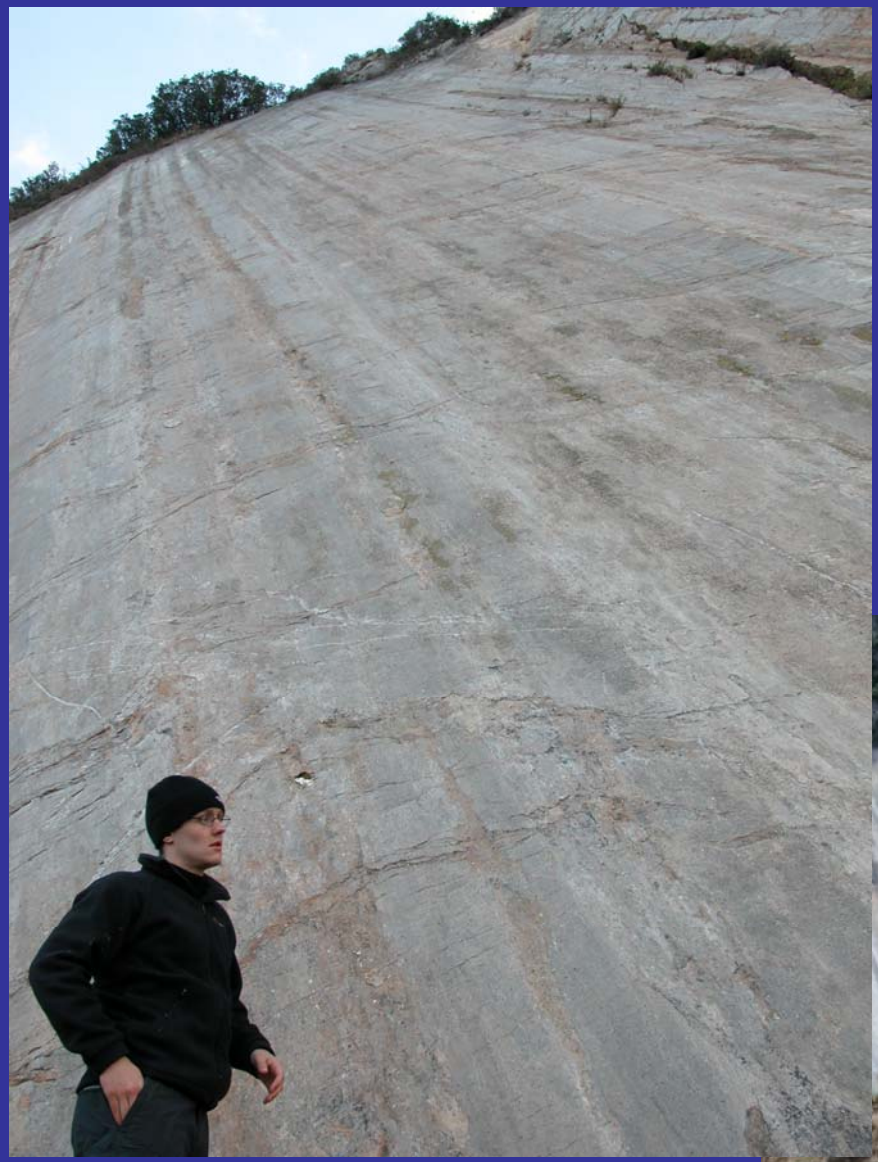


Extensional Setting – Normal Fault

(horizontal or uplifting)



A. Normal fault



Spectacular exposure of Greek fault –

What do the lines show?






Strike-slip fault – horizontal displacement only

What is the offset direction?





What is the offset direction?



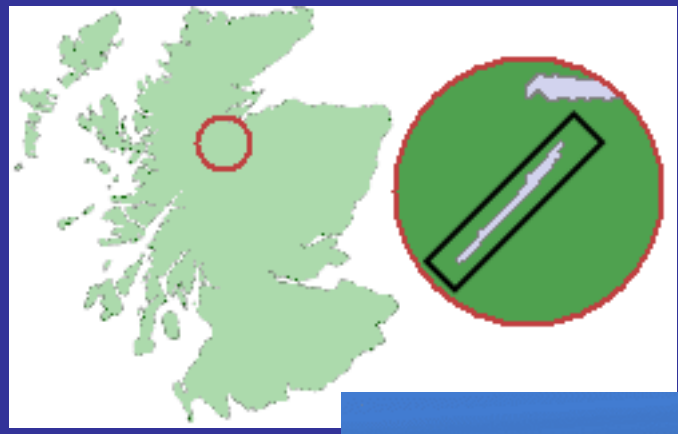
Left-lateral



Right-lateral



Loch Ness



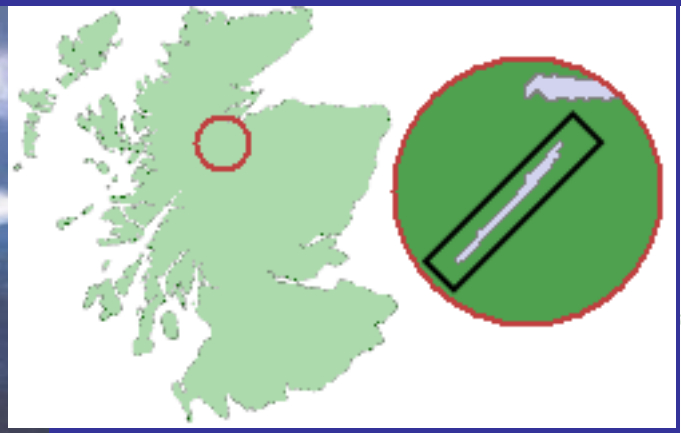


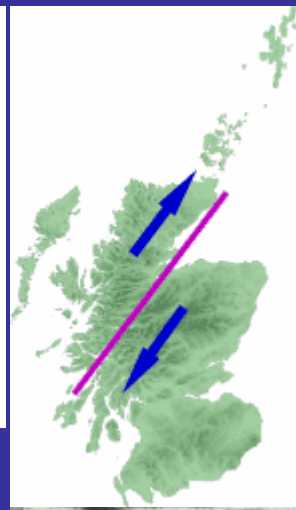


Is the Loch Ness Monster a Plesiosaur?



Loch Ness





Great Glen Fault (strike-slip)



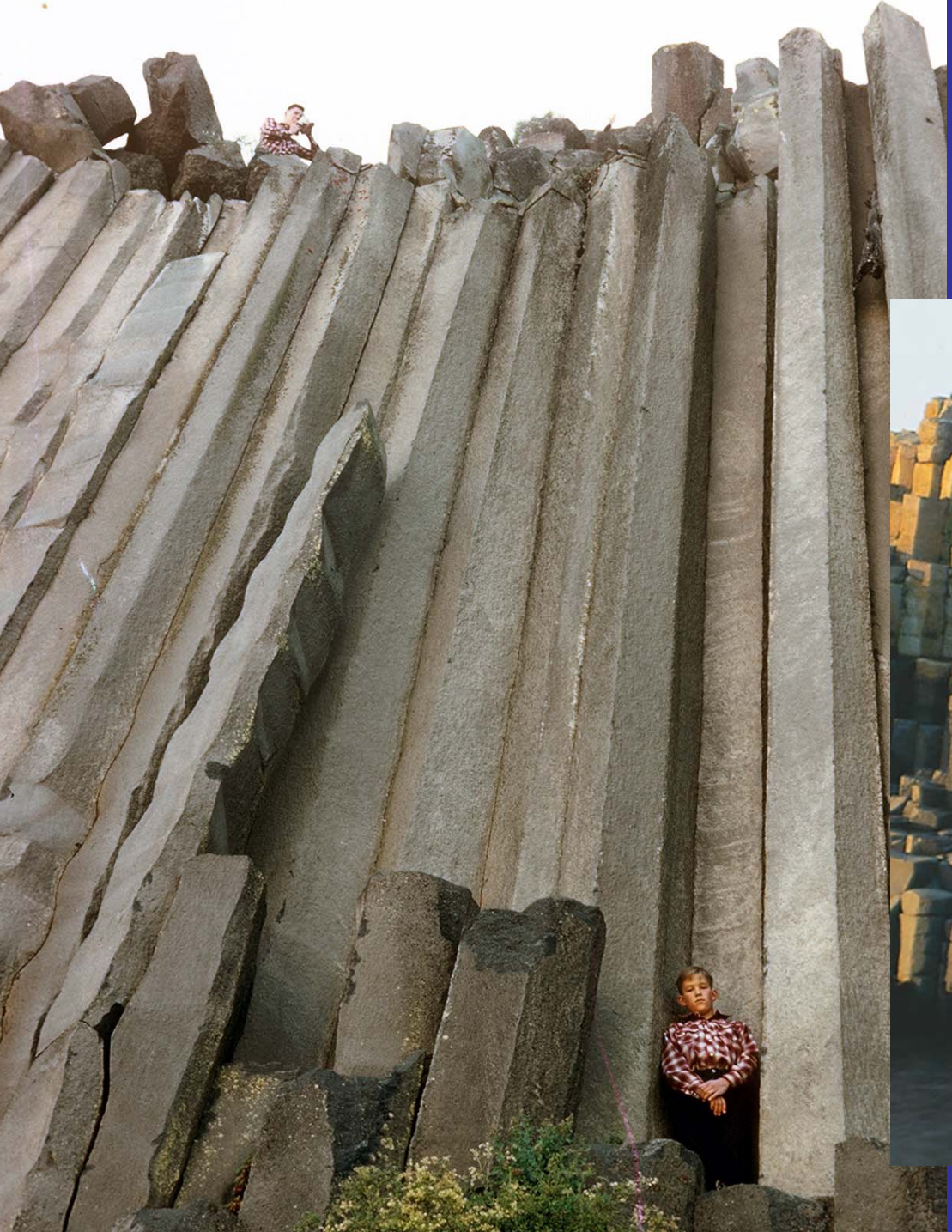


Three fault types:

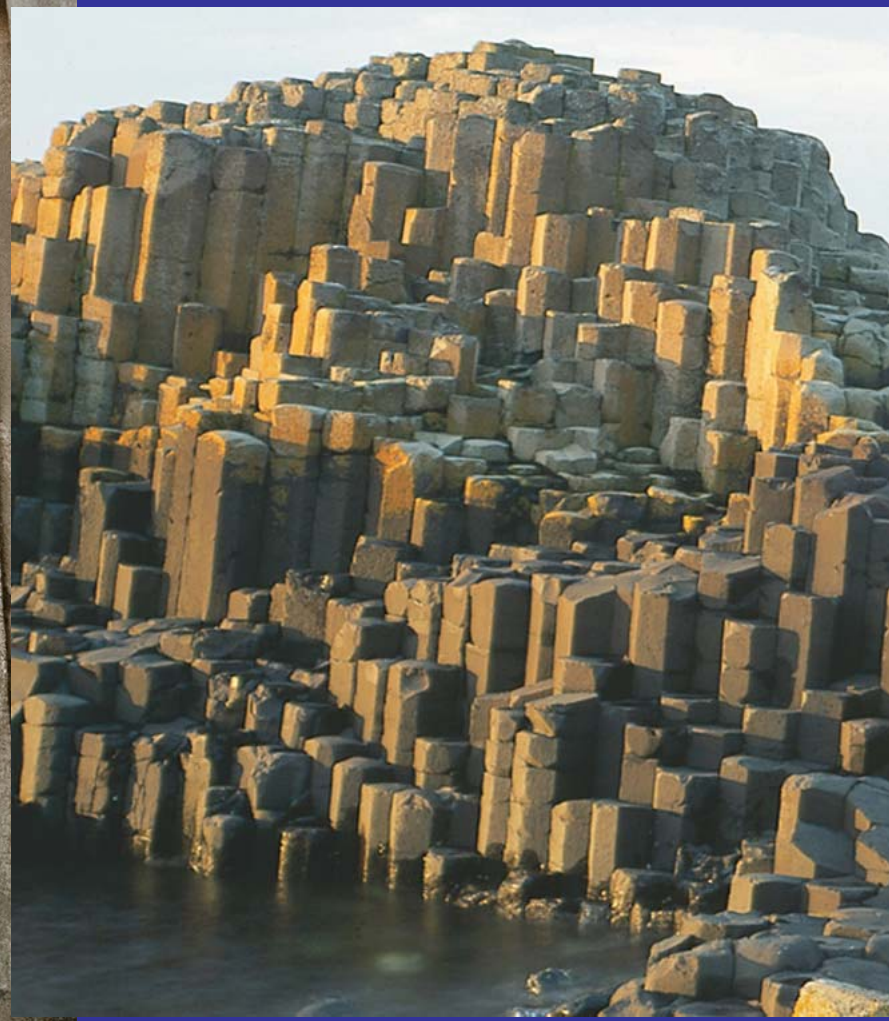
Fault	Stress regime	Motion (V/H)?
1) ?	?	?
2) ?	?	?
3) ?	?	?

Three fault types:

Fault	Stress regime	Motion (V/H)?
1) Normal	Extension	Vertical
2) Reverse (Thrust)	Compression	Vertical
3) Strike-slip	Bi-directional	Horizontal

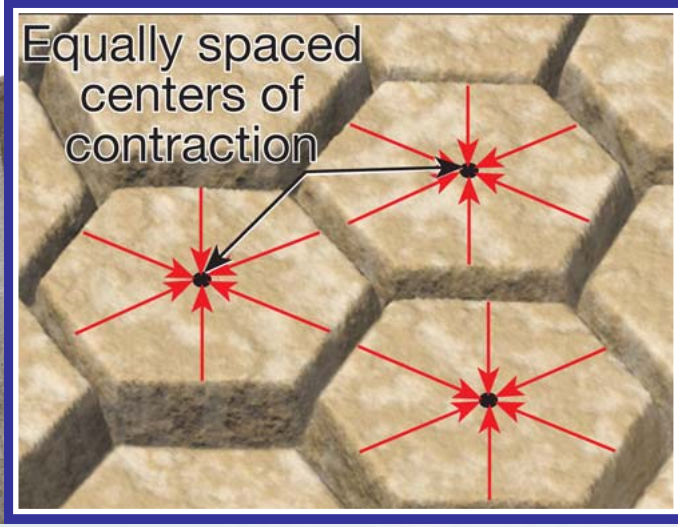


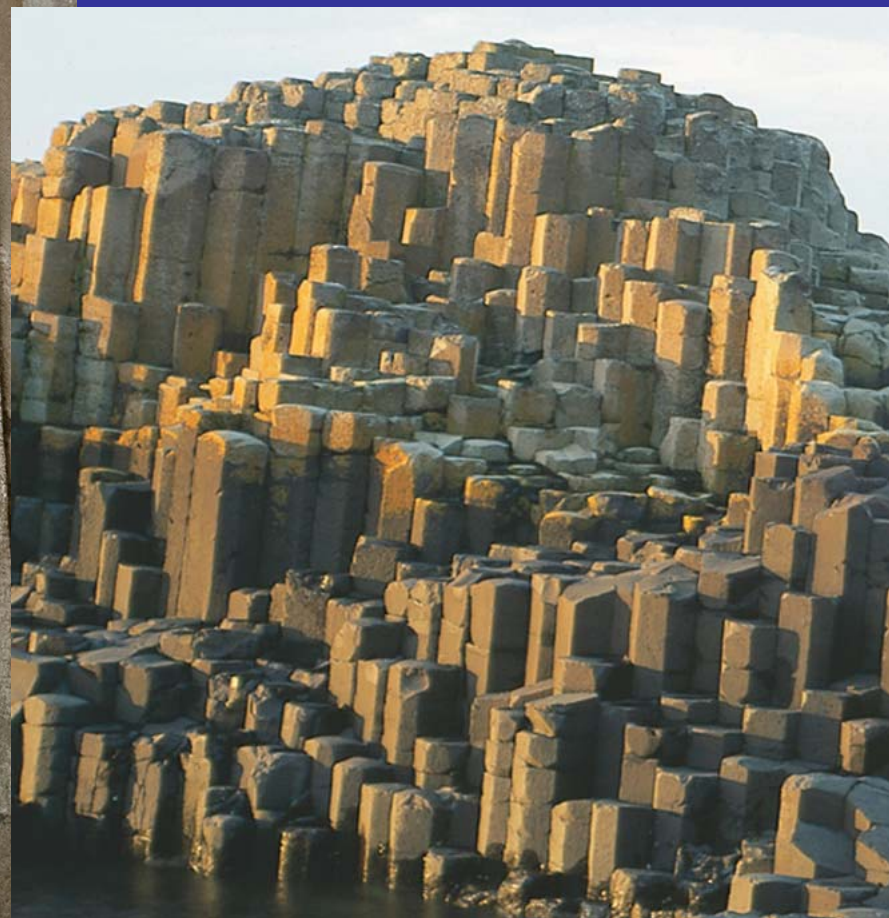
What causes this texture?








Equally spaced
centers of
contraction

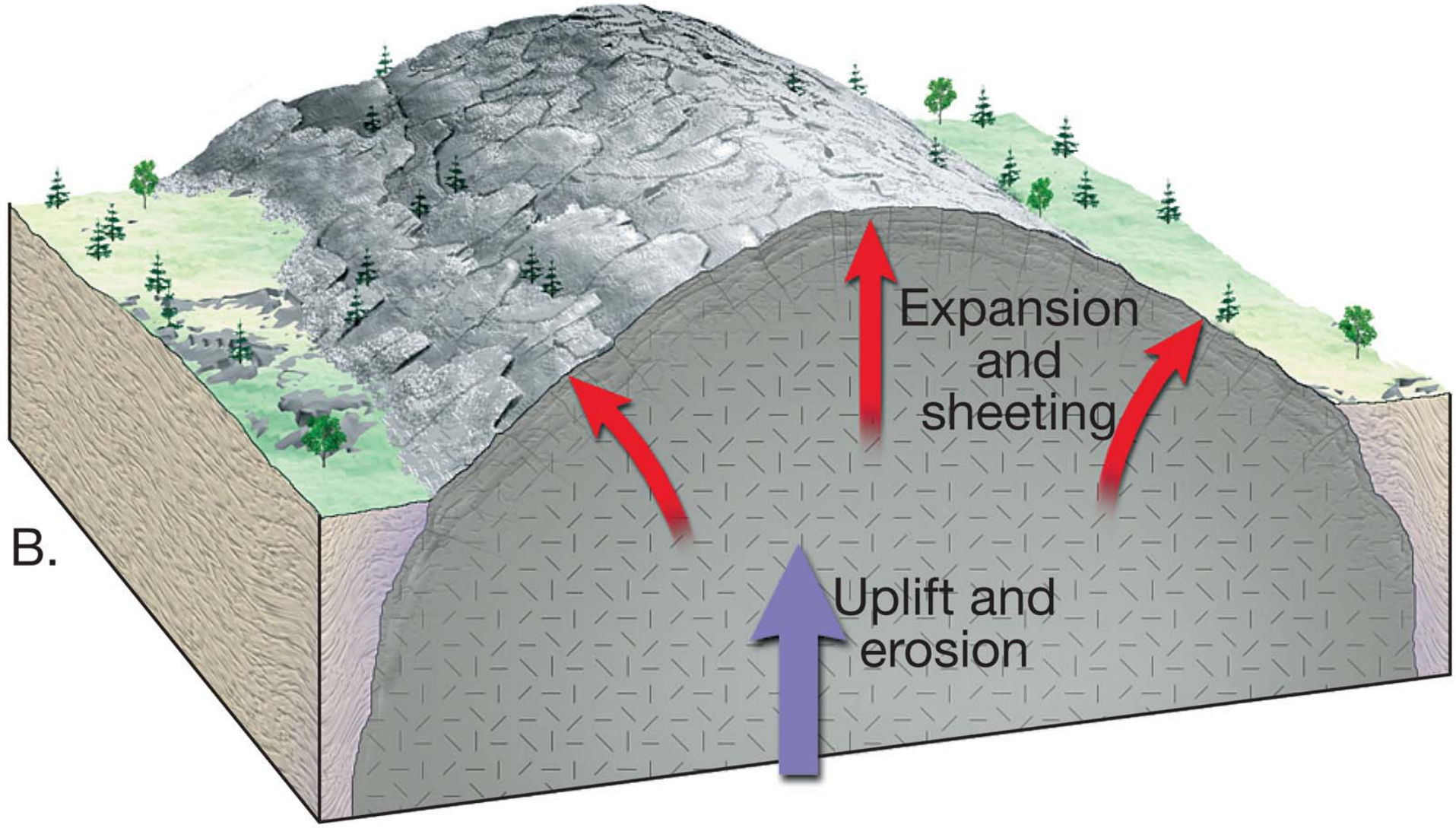




What causes this texture?



Expansion




What causes
this texture?

Joints – 3 common formation mechanisms

Joint type	Cause
1) ?	?
2) ?	?
3) ?	?

Joints – 3 common formation mechanisms

Joint type	Cause
1) Columnar	Contraction
2) Sheeting	Expansion
3) Fault zone	Prior faulting

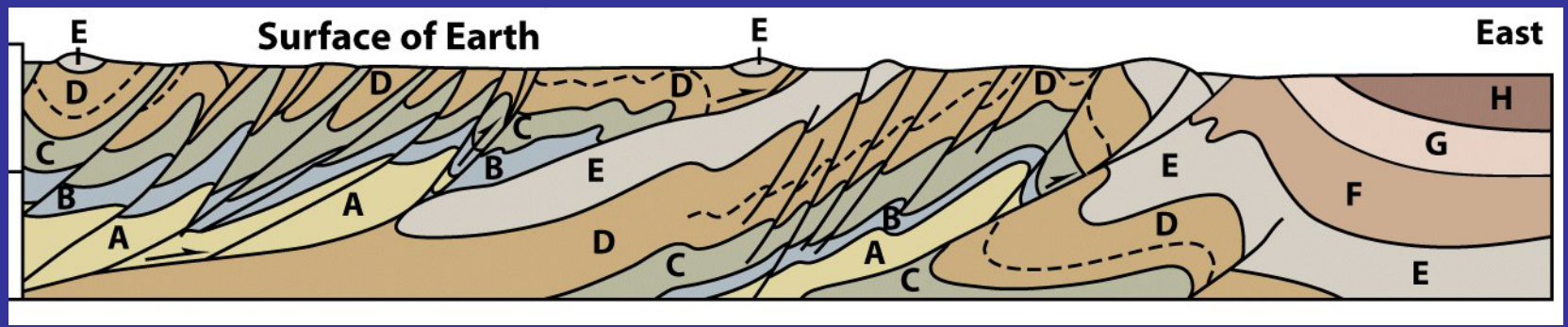
Crustal Deformation –

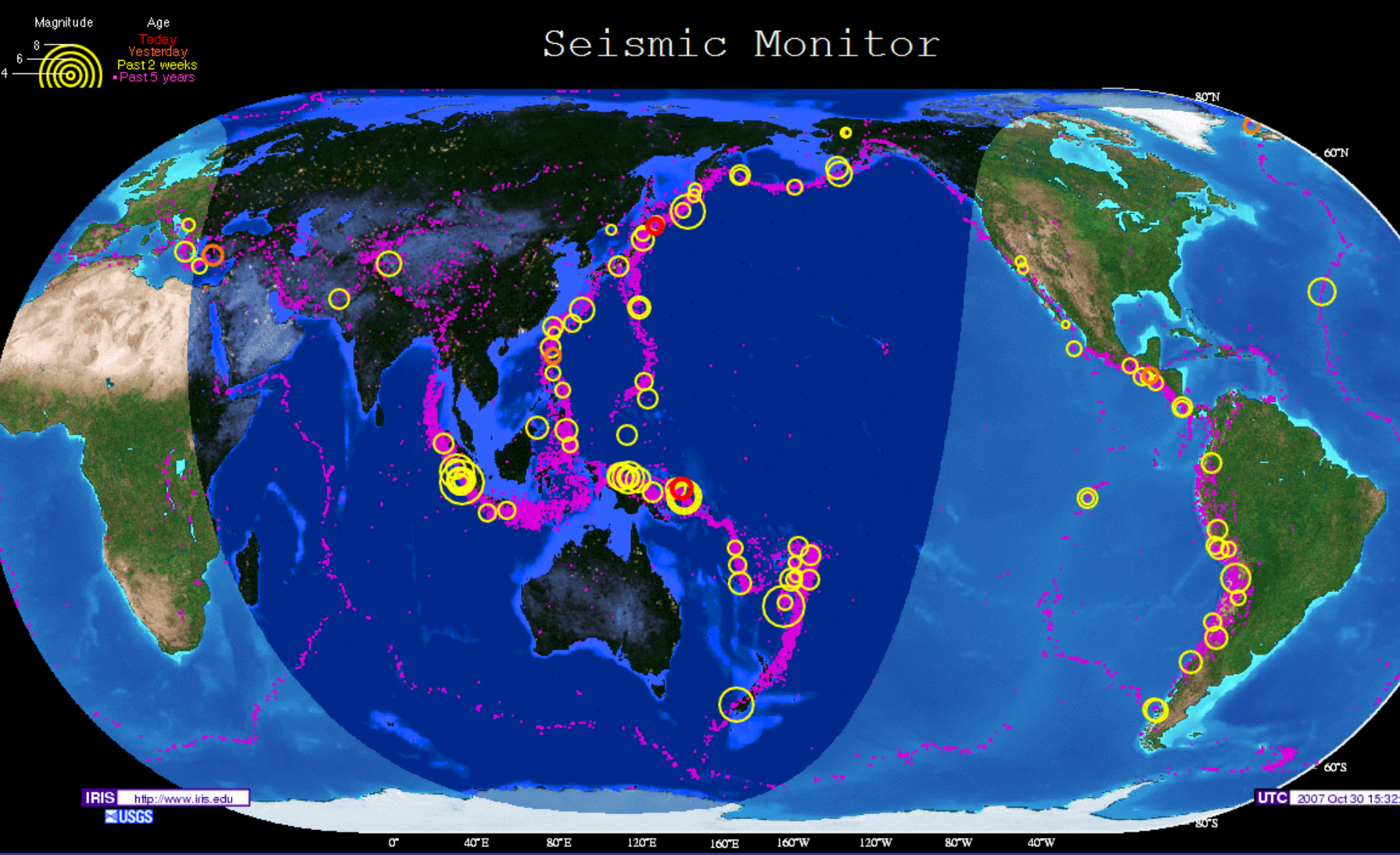
Folding

Faulting

Jointing

Give information about stresses acting on the rock

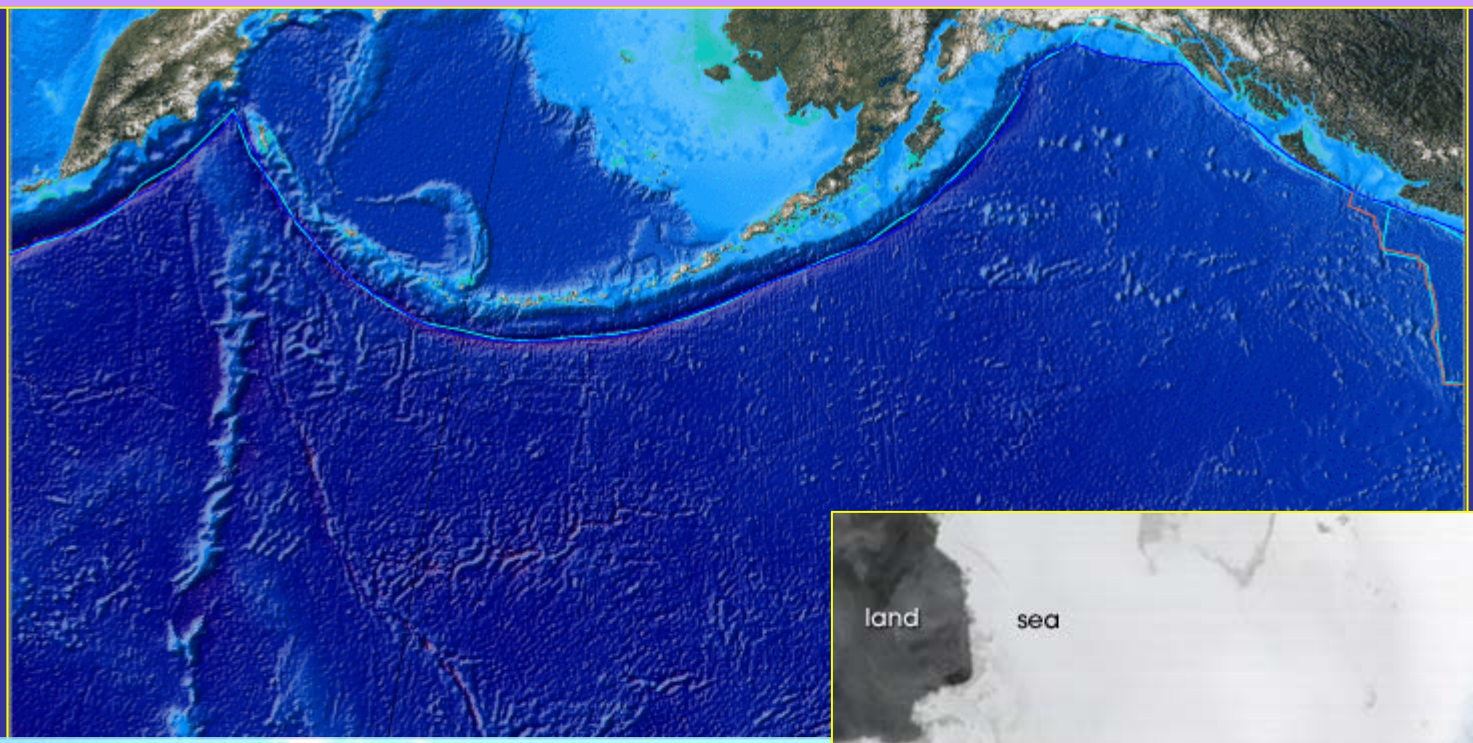




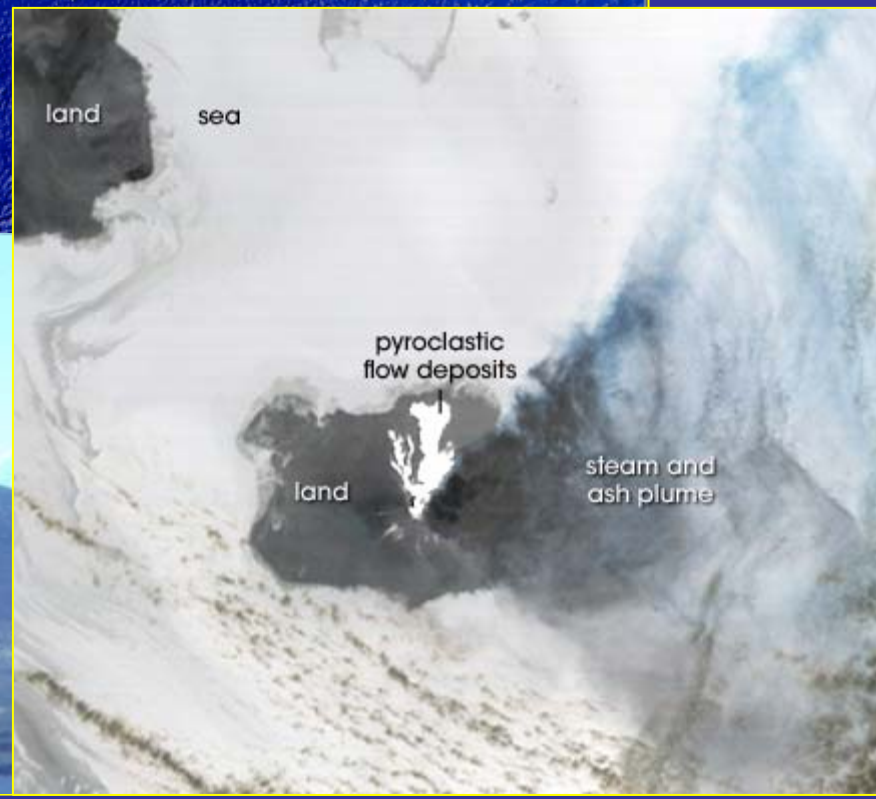
Where are the world's mountains (on land)?

A) Divergent, B) Convergent, C) Transform, D) Hotspot, E) Intracontinental

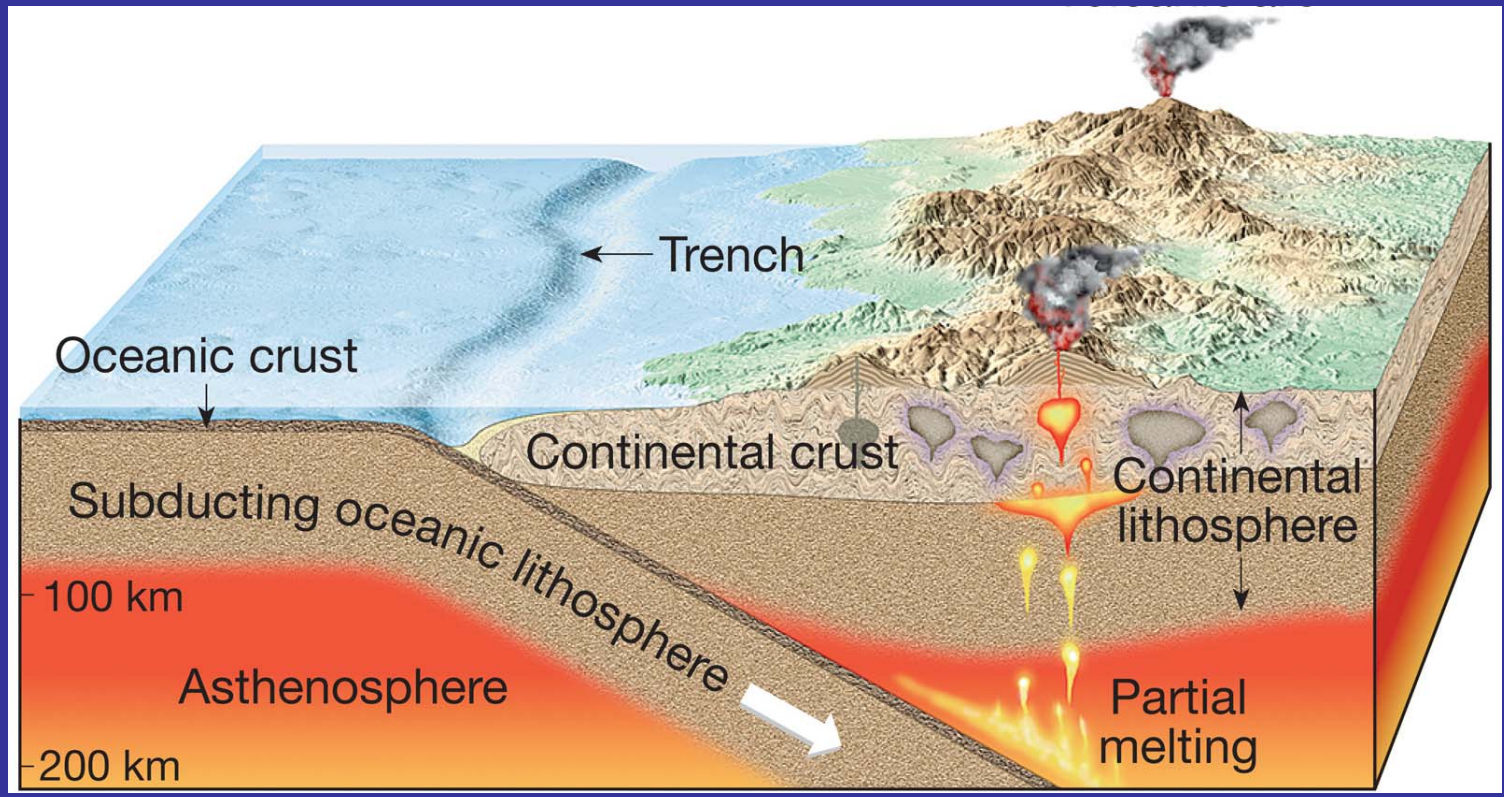
Convergent boundary – oceanic-oceanic

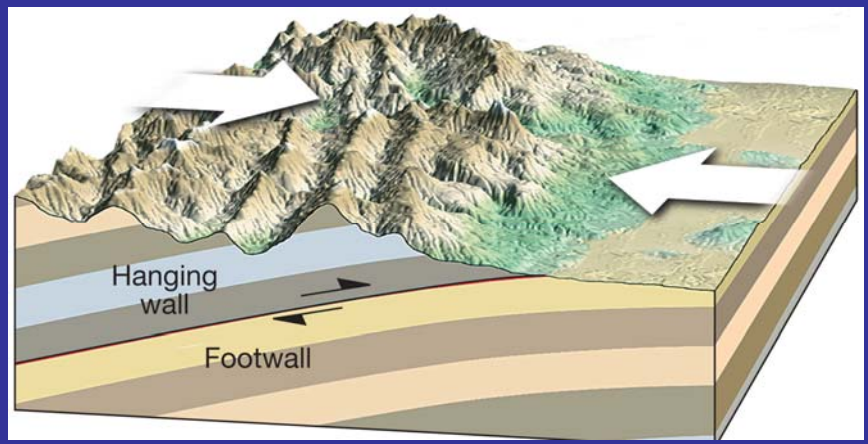


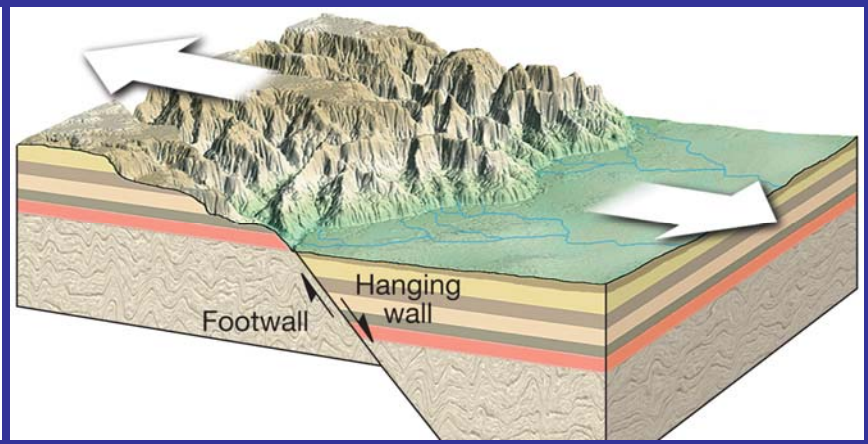




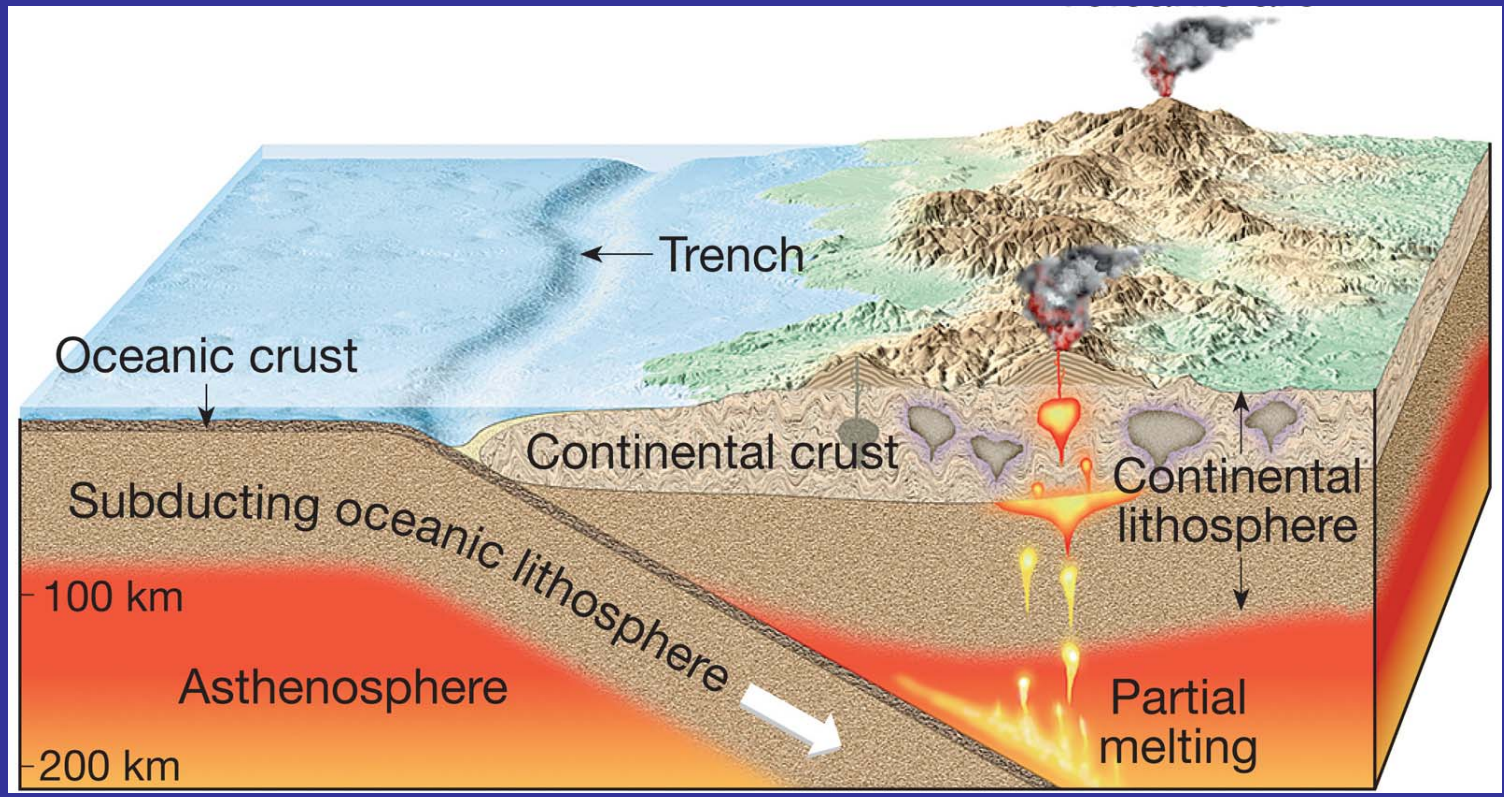
What kind of fault does a subduction zone represent?

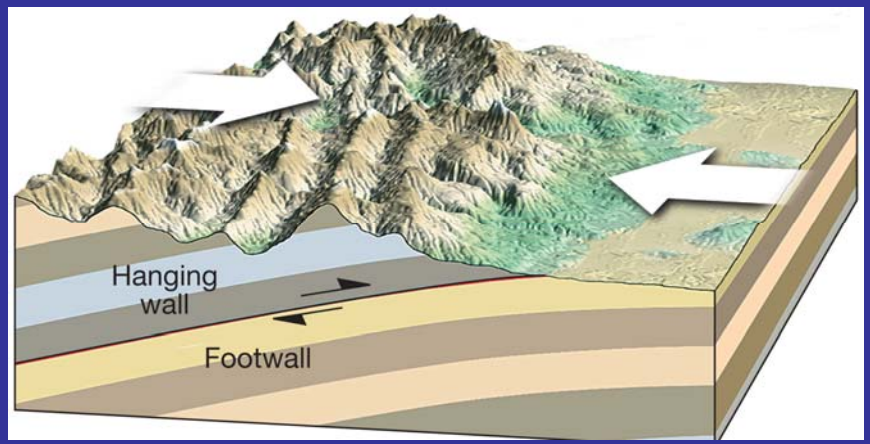






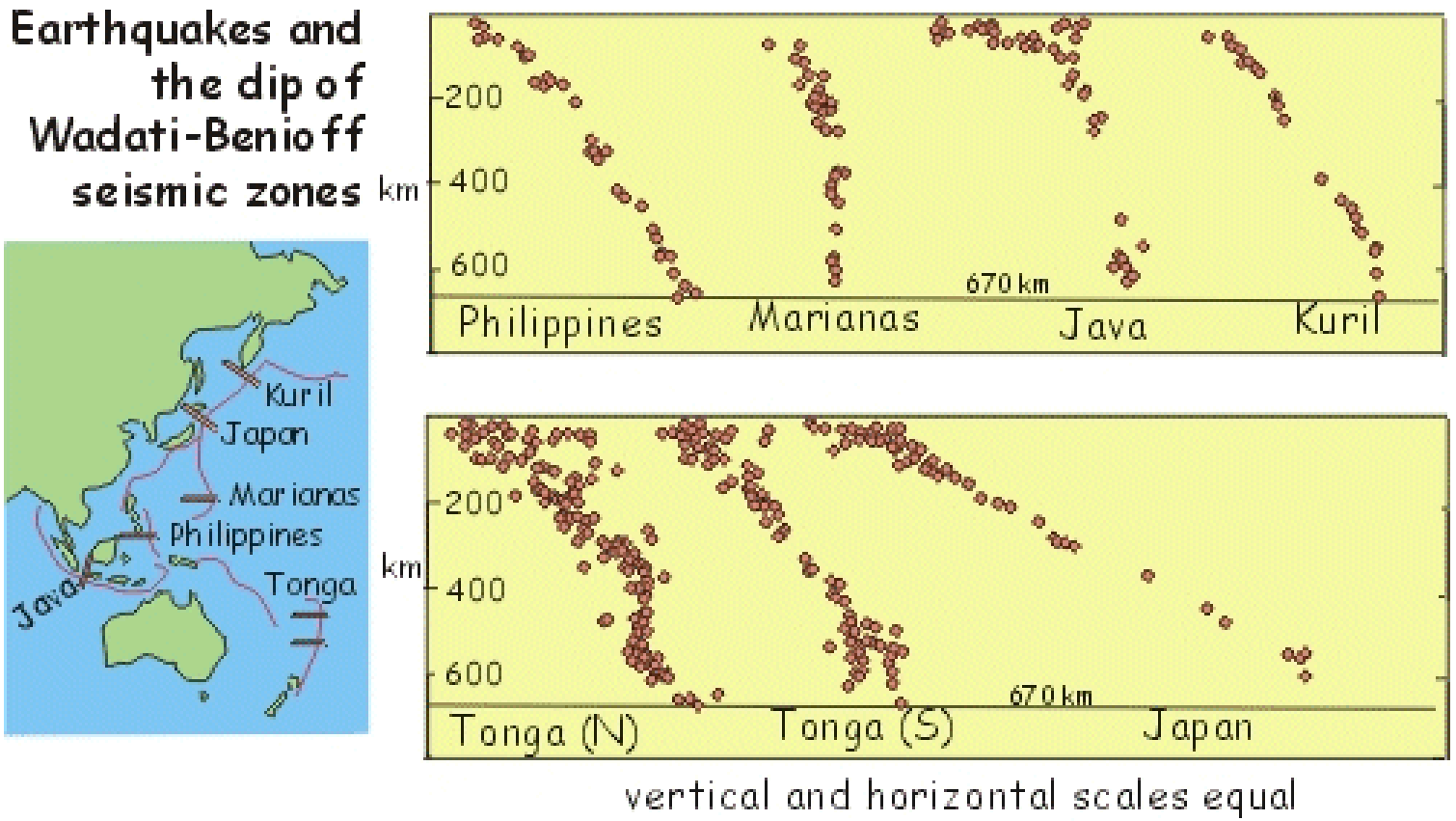
What kind of fault does a subduction zone represent?





A subduction zone is a low-angle thrust fault (reverse)

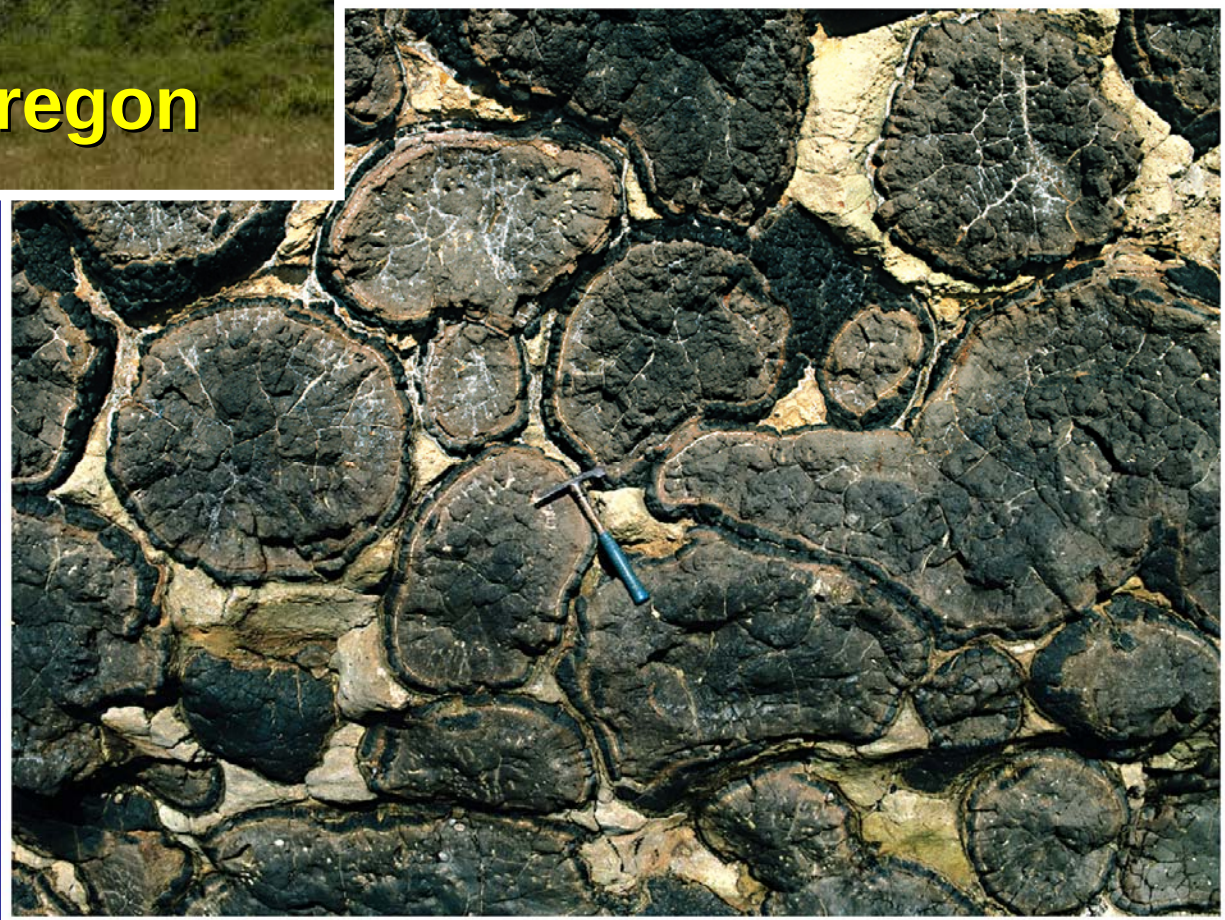
What causes subduction earthquakes?

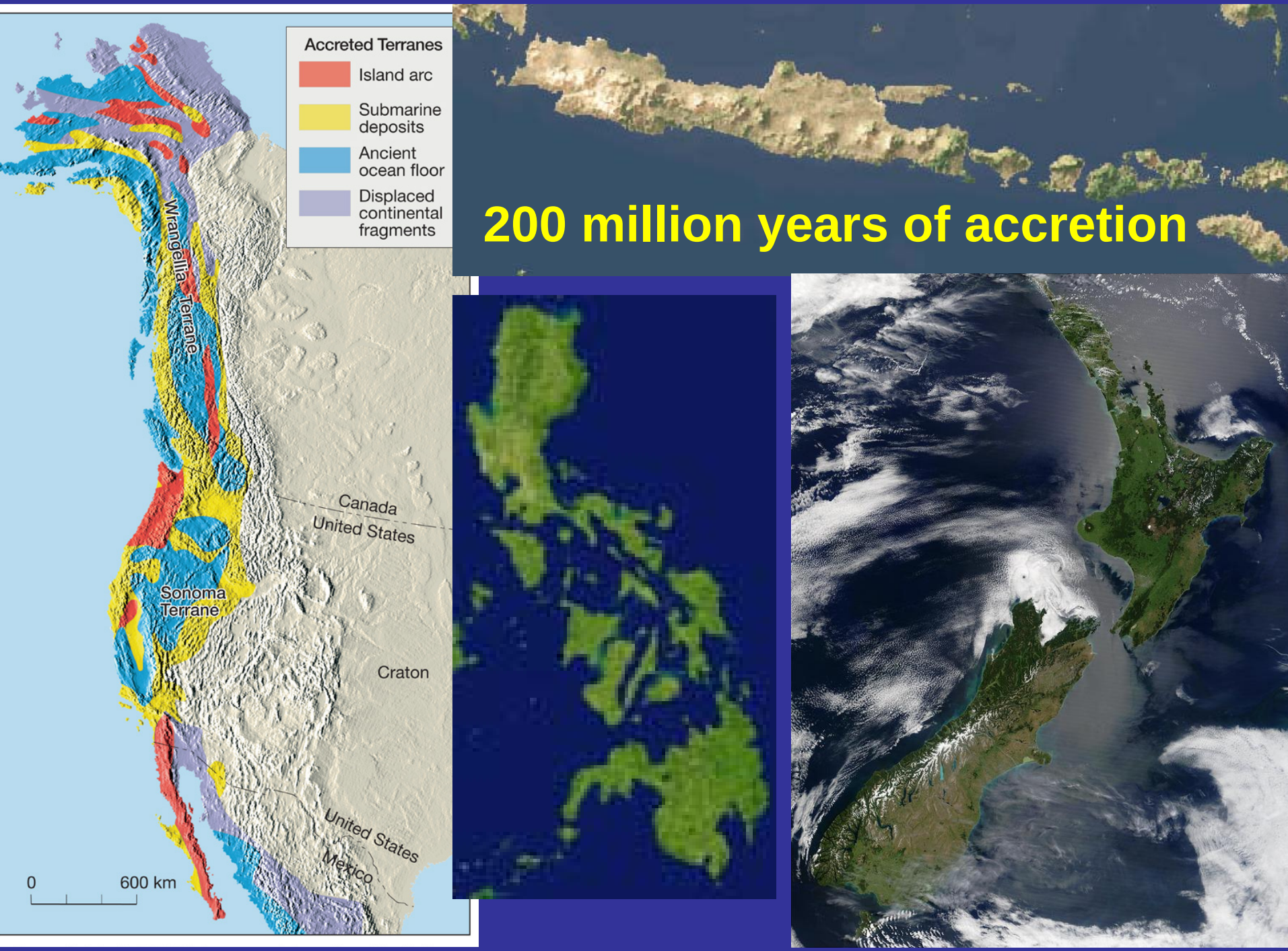


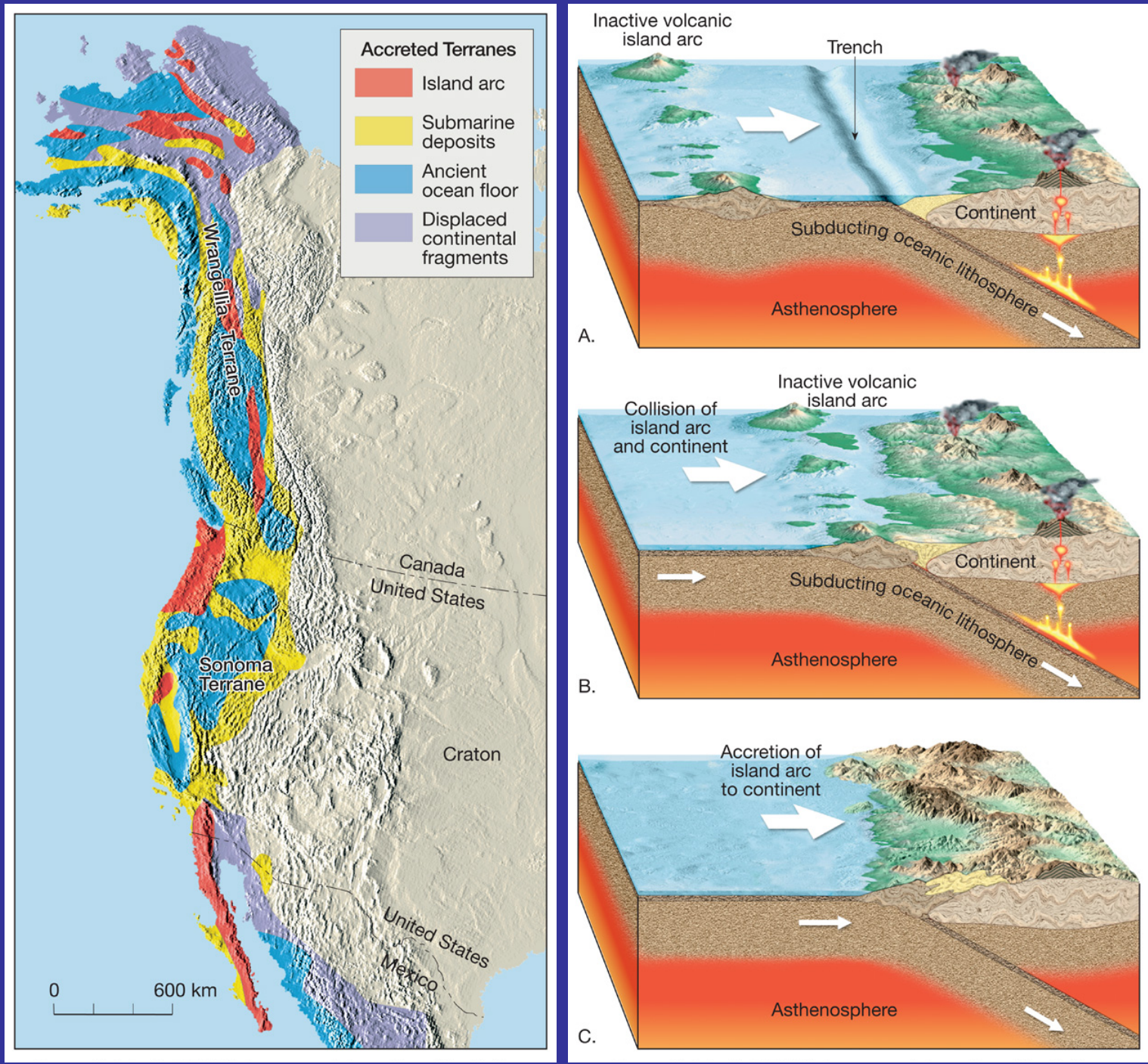


What is this texture?

A) Conglomerate
B) Pillow basalt
C) Fossil algae
D) Volcanic bombs
E) Spherules



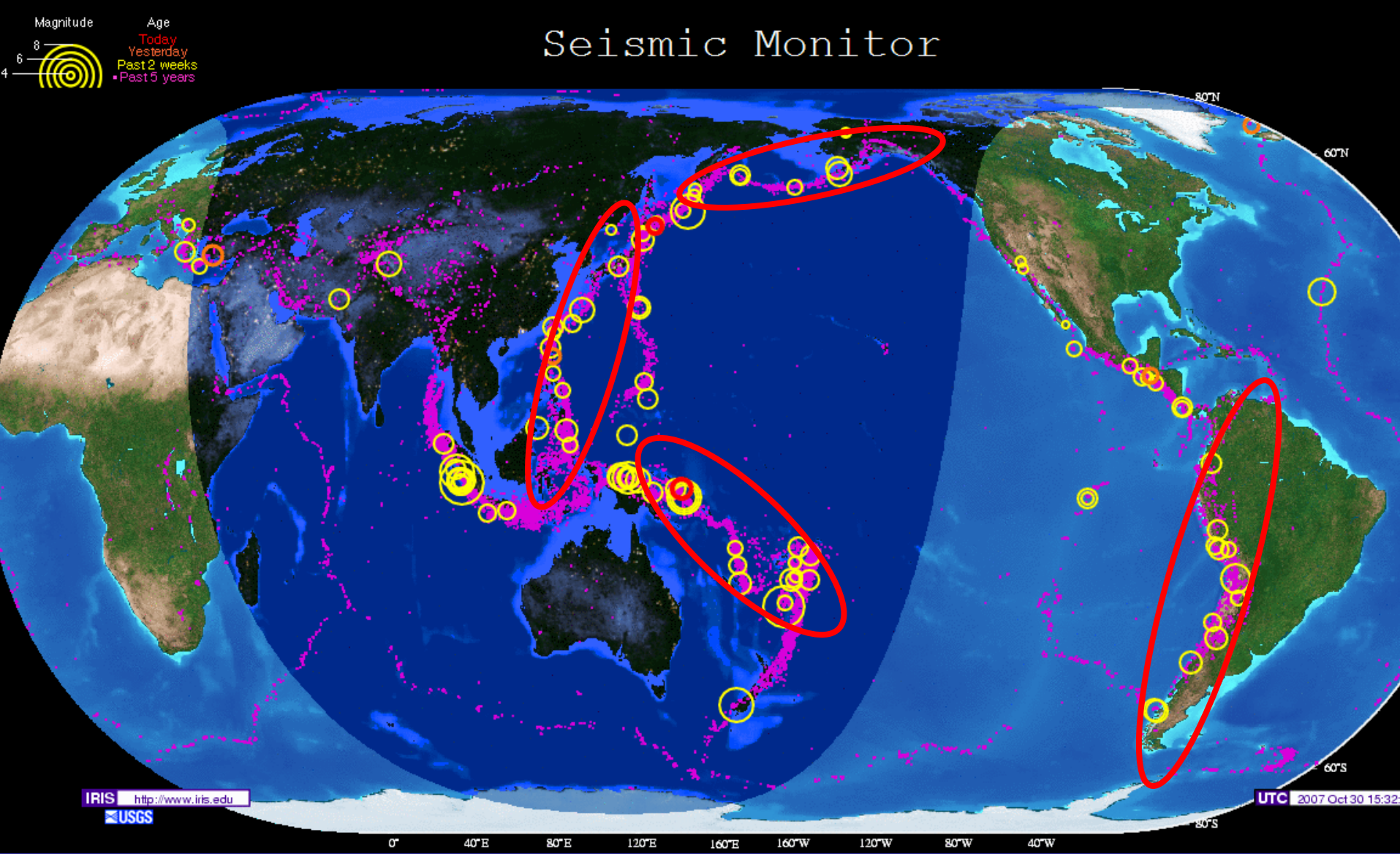

Accreted Terranes
Island arc
Submarine deposits
Ancient ocean floor
Displaced continental fragments
Wrangellia Terrane
Canada
United States
Sonoma Terrane
Craton
United States
Mexico
0
600 km
200 million years of accretion


Accreted Terranes
Island arc
Submarine deposits
Ancient ocean floor
Displaced continental fragments
Wrangellia Terrane
Sonoma Terrane
Canada
United States
Craton
United States
Mexico
0
600 km
Inactive volcanic island arc
Trench
Continent
Subducting oceanic lithosphere
Asthenosphere
A.
Inactive volcanic island arc
Collision of island arc and continent
Continent
Subducting oceanic lithosphere
Asthenosphere
B.
Accretion of island arc to continent
Asthenosphere
C.



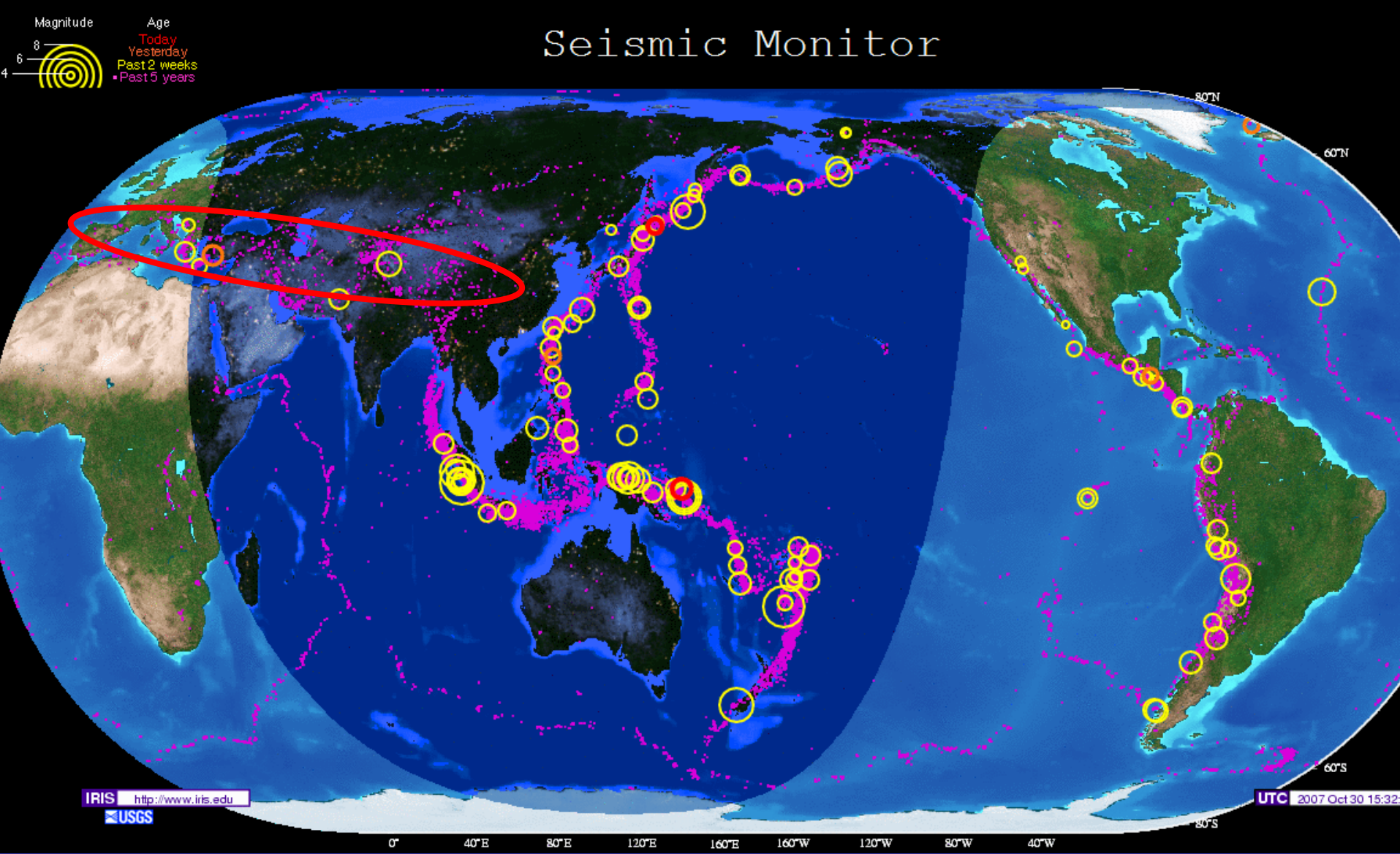
Mountain Building – 3 styles

1) Convergent (volcanic) – reverse faults
2) ?
3) ?



Where are the world's mountains?

A) Divergent, B) Convergent, C) Transform, D) Hotspot, E) Intracontinental



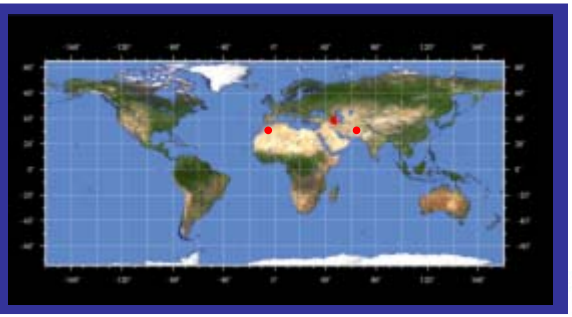
Where are the world's mountains?

A) Divergent, B) Convergent, C) Transform, D) Hotspot, E) Intracontinental

Which range is youngest?



A) Atlas



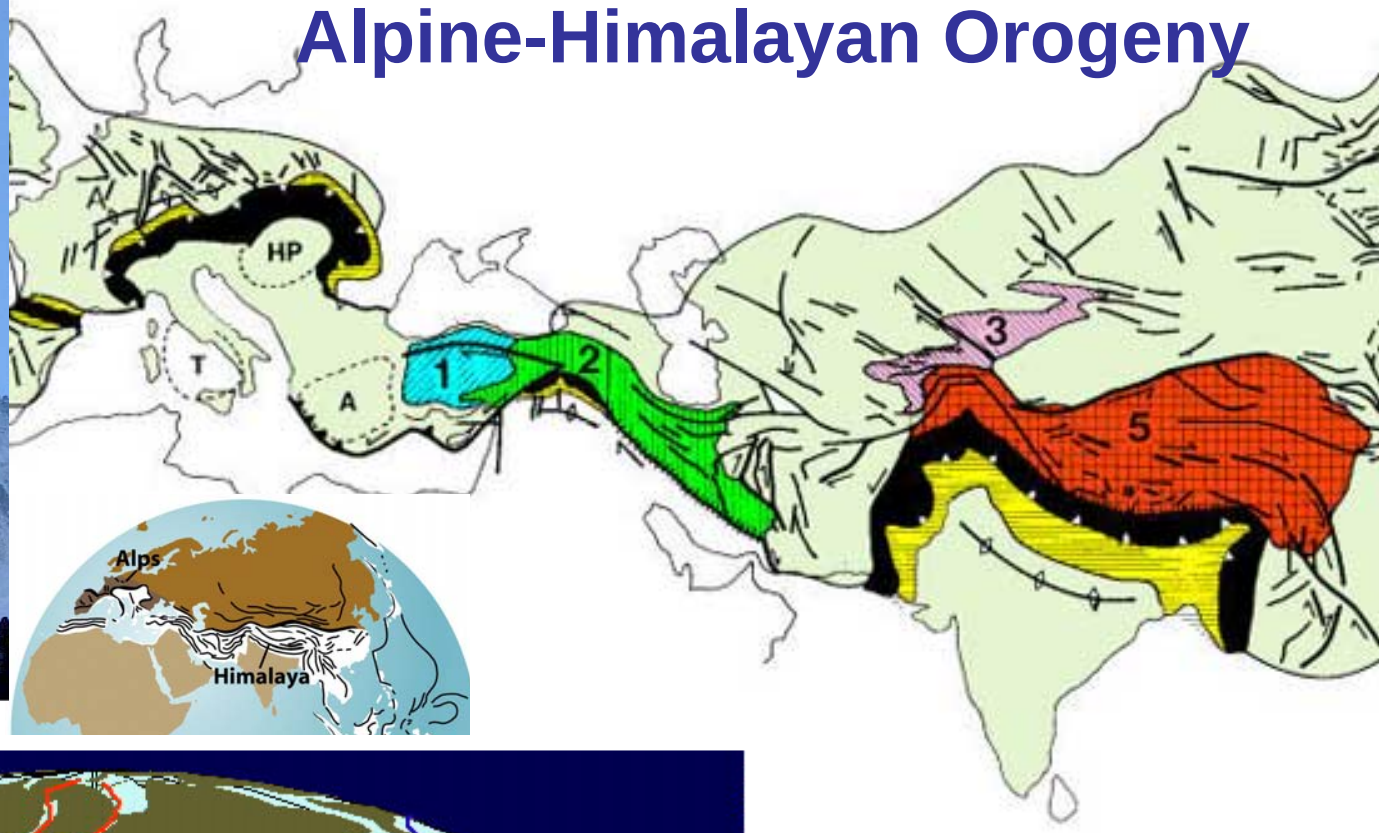


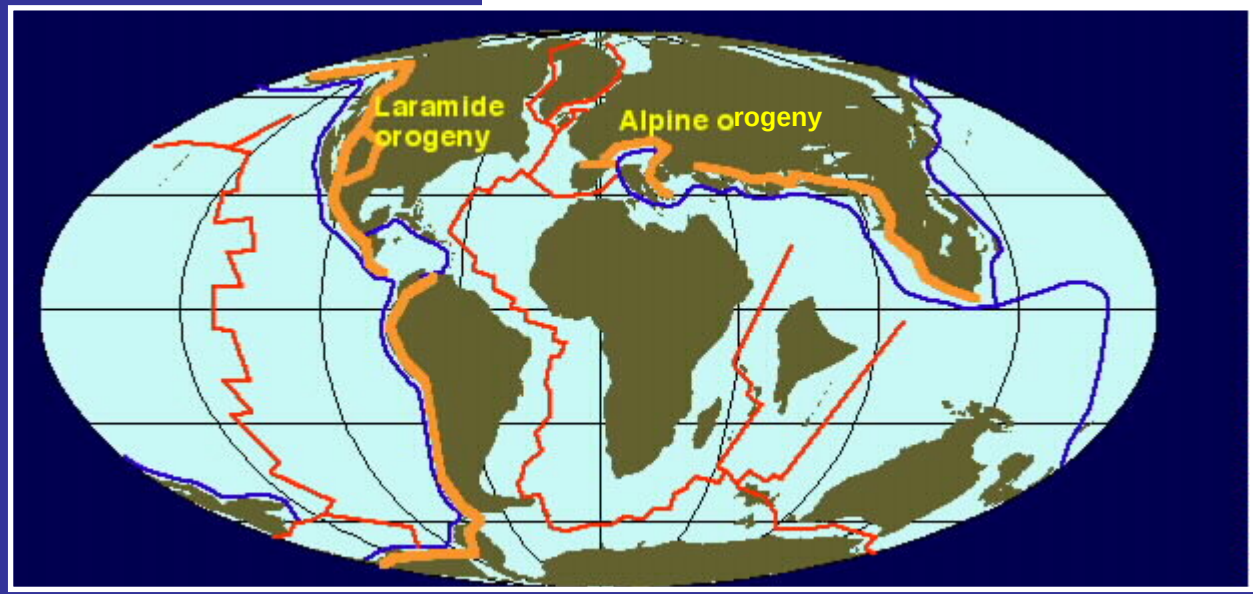
C) Karakorum

B) Alborz

Alpine-Himalayan Orogeny







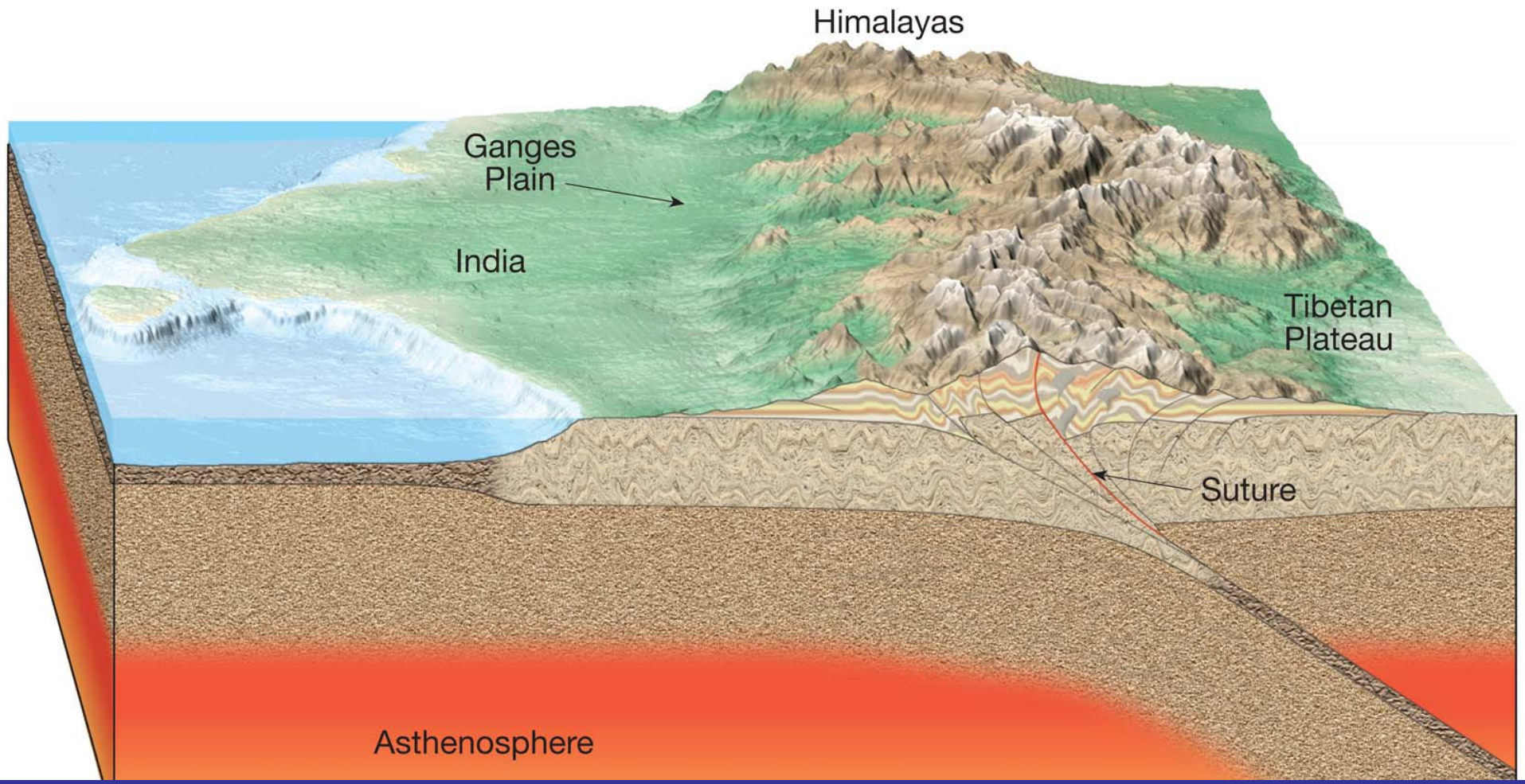
300 Mya…

…Atlas, Pyrenees, Alps, Dinaric Alps, Hellenides, Balkan, Taurus, Caucasus, Alborz, Zagros, Hindu Kush, Pamir, Karakoram, Himalayas…

…present



What kinds of crustal deformation would you expect in a continental collision zone?



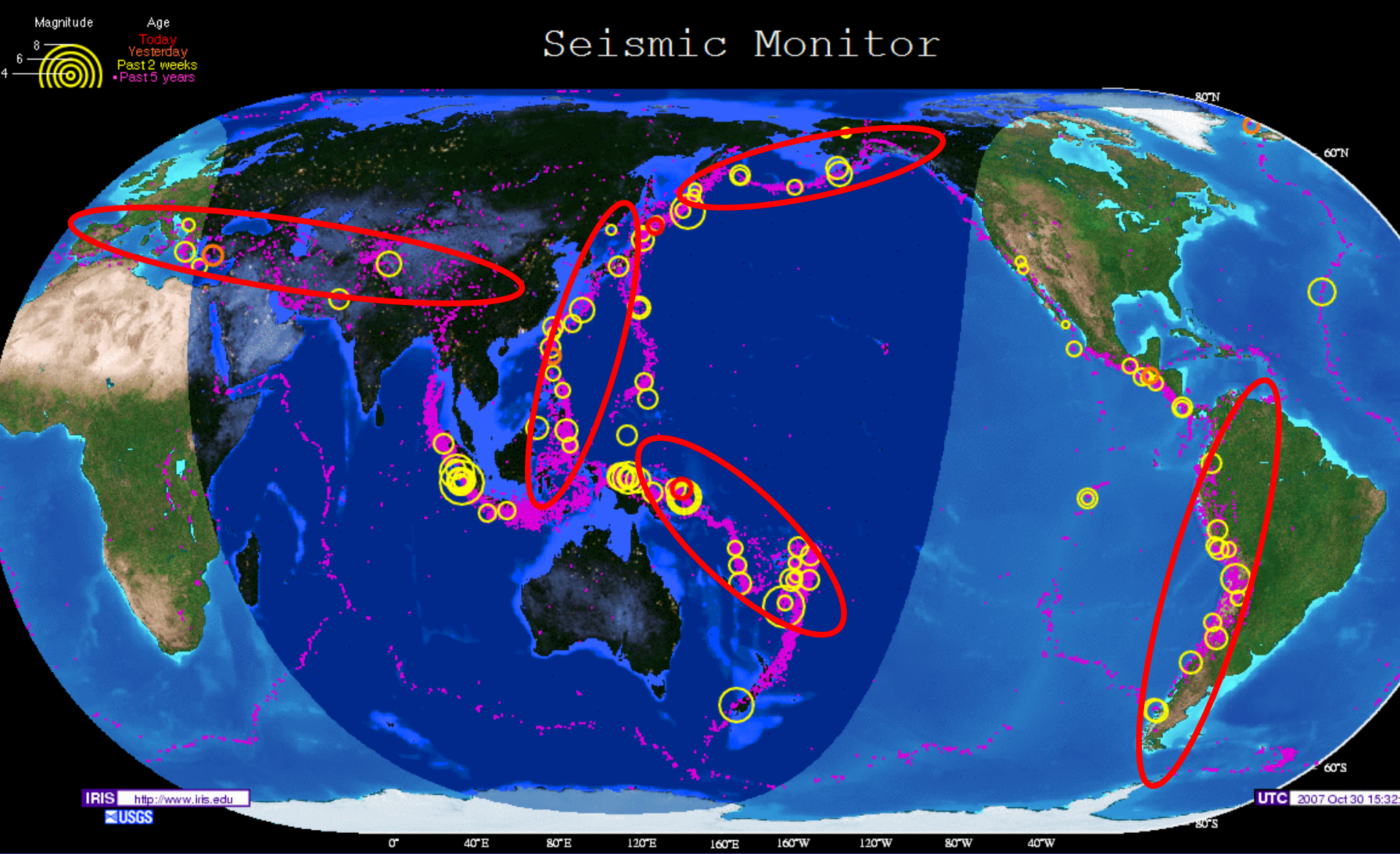
South face of Nuptse and Lhotse, Khumbu Himalaya, Nepal





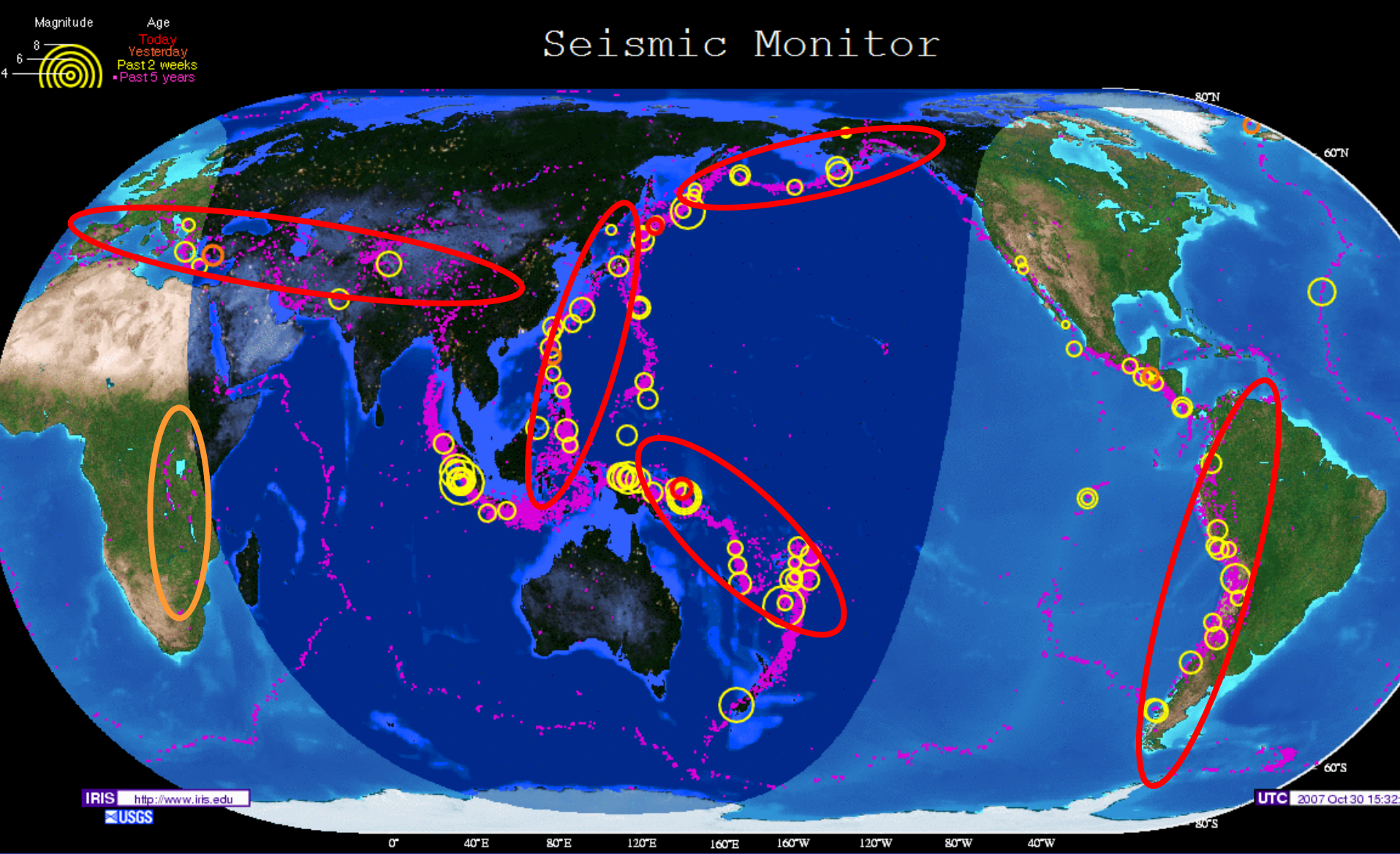
Mountain Building – 3 styles

1) Convergent (volcanic) – reverse faults
2) Convergent (collisional) – reverse faults
3) ?



Where are the world's mountains?

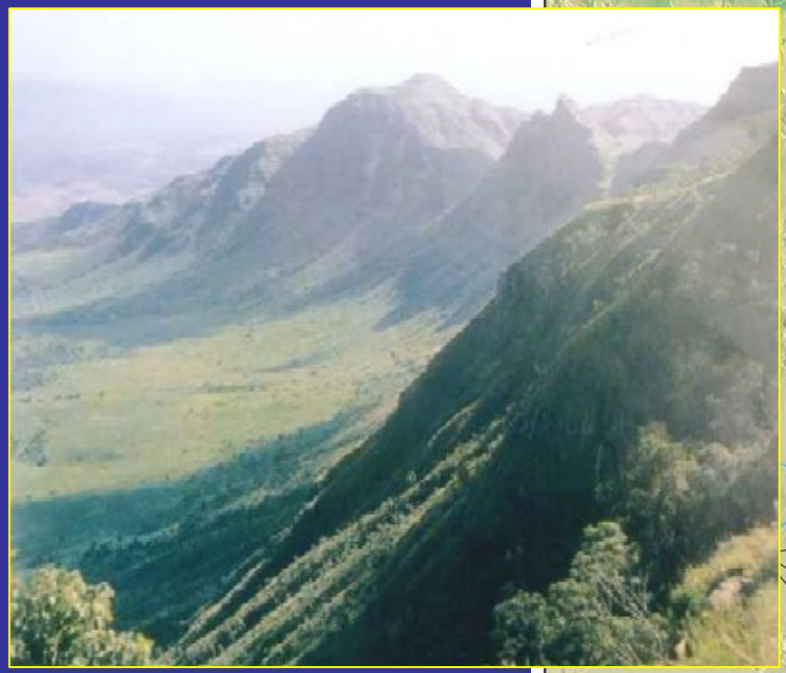
A) Divergent, B) Convergent, C) Transform, D) Hotspot, E) Intracontinental



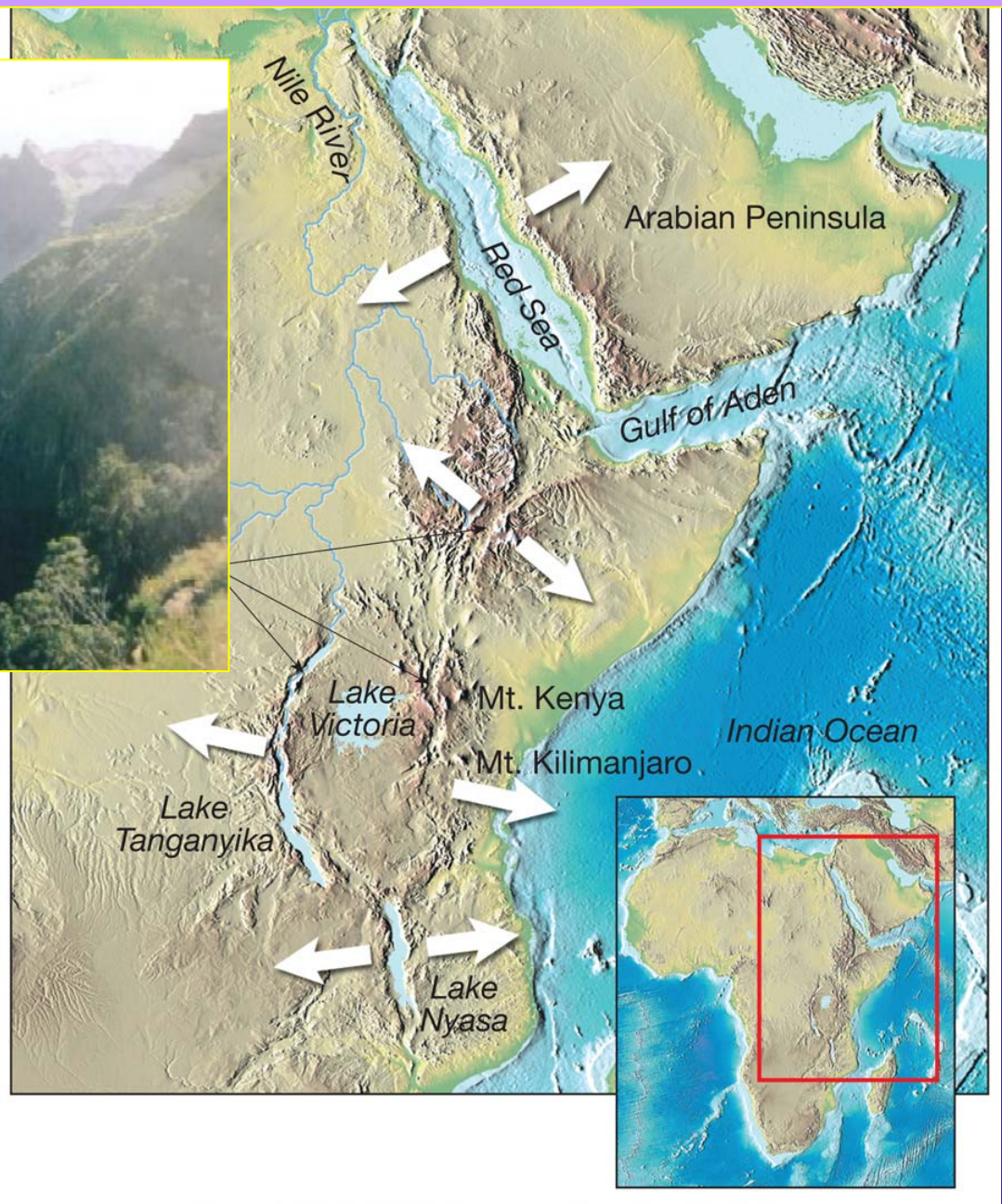
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Divergent boundary – continental rifting







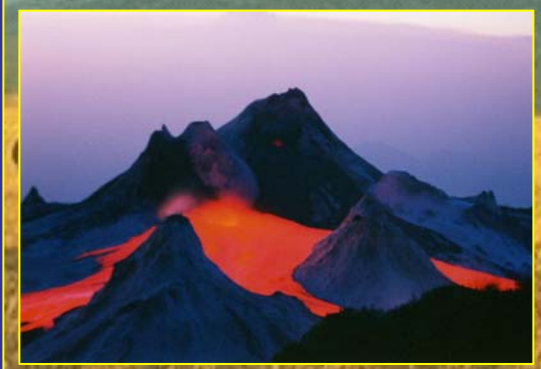
East African Rift Valley

Divergent boundary – continental rifting

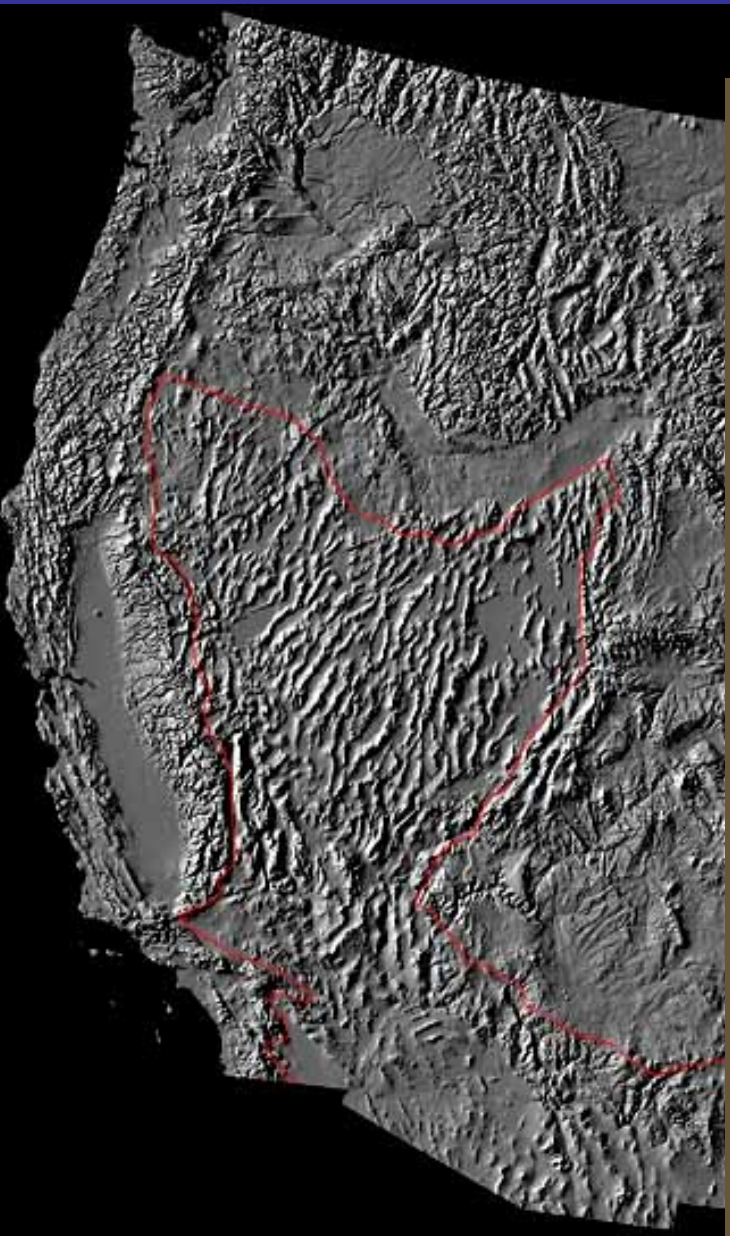


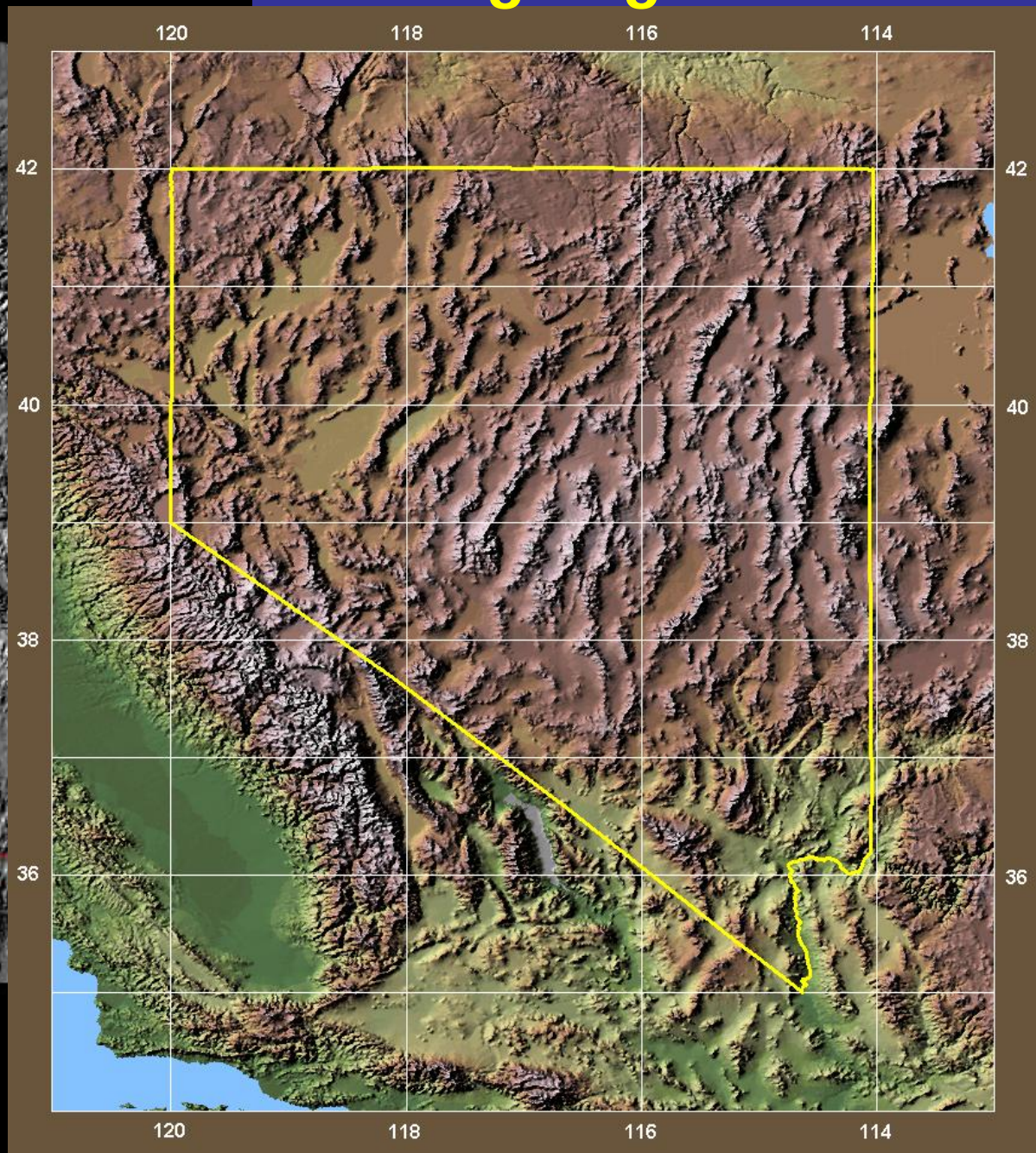
Mt. Kilimanjaro
Tanzania

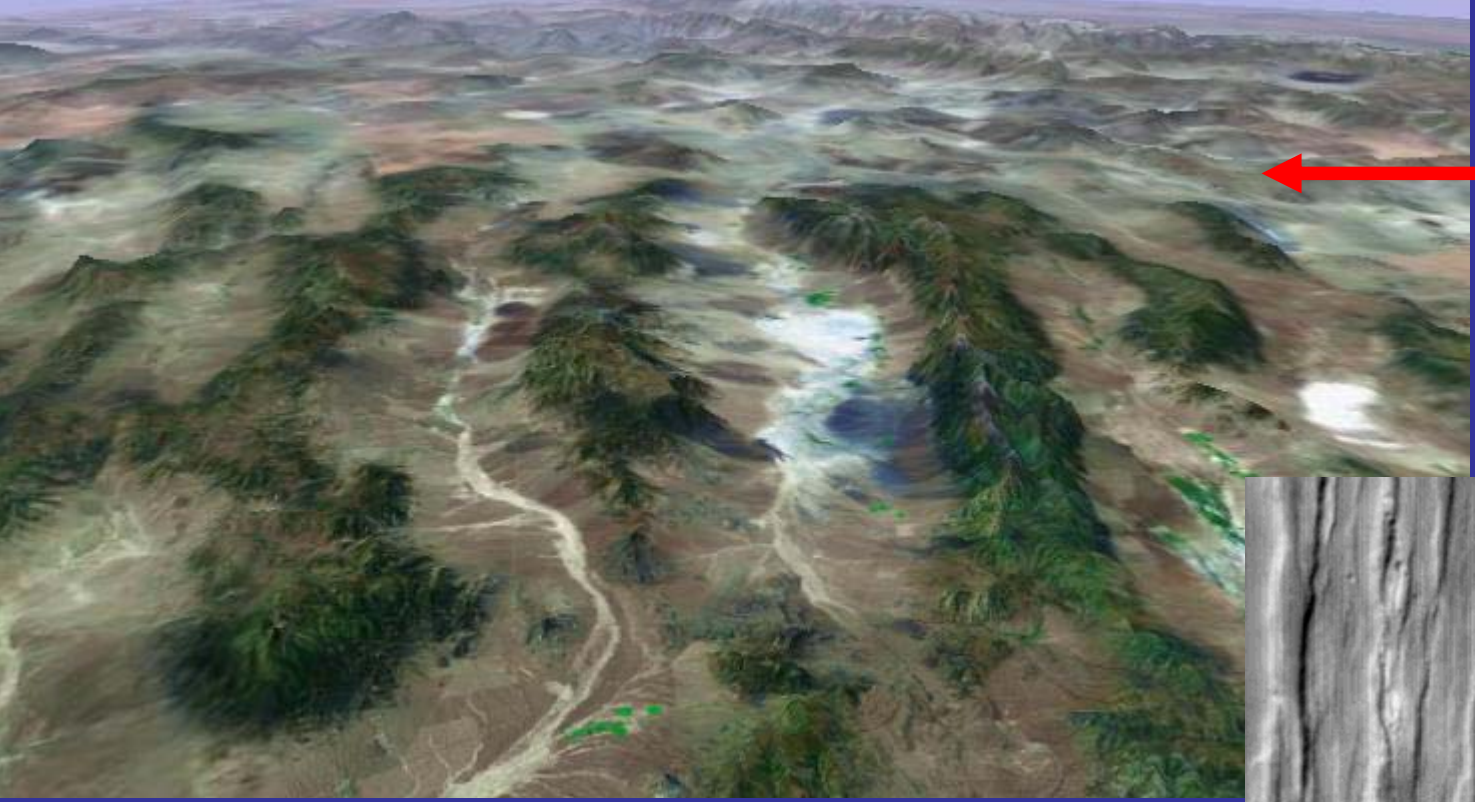
Mt. Ol Doinyo Lengai
Tanzania



What's going on here?

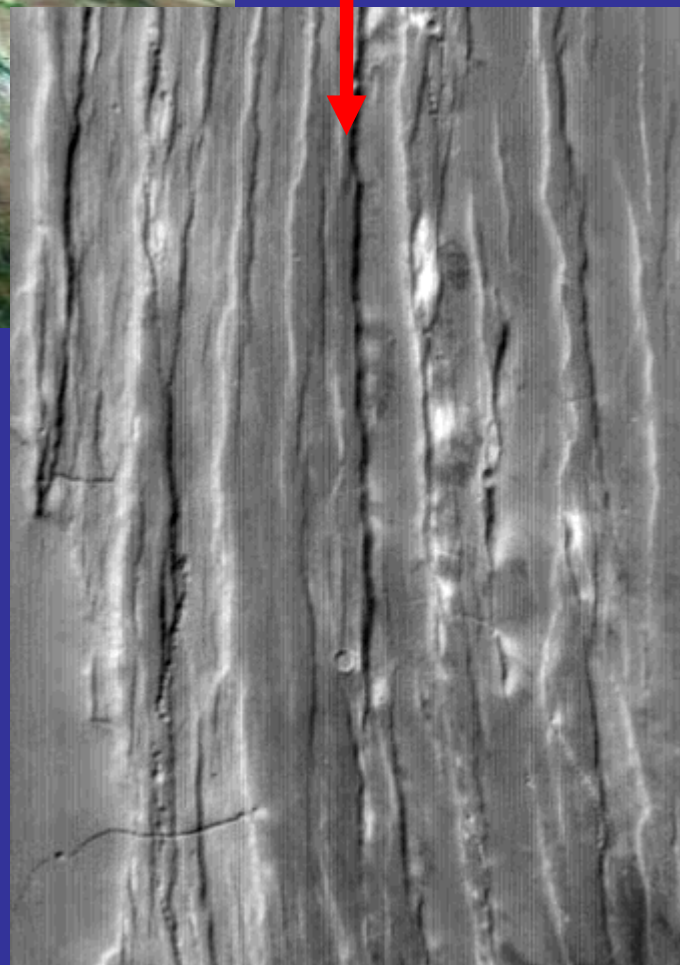






Nevada

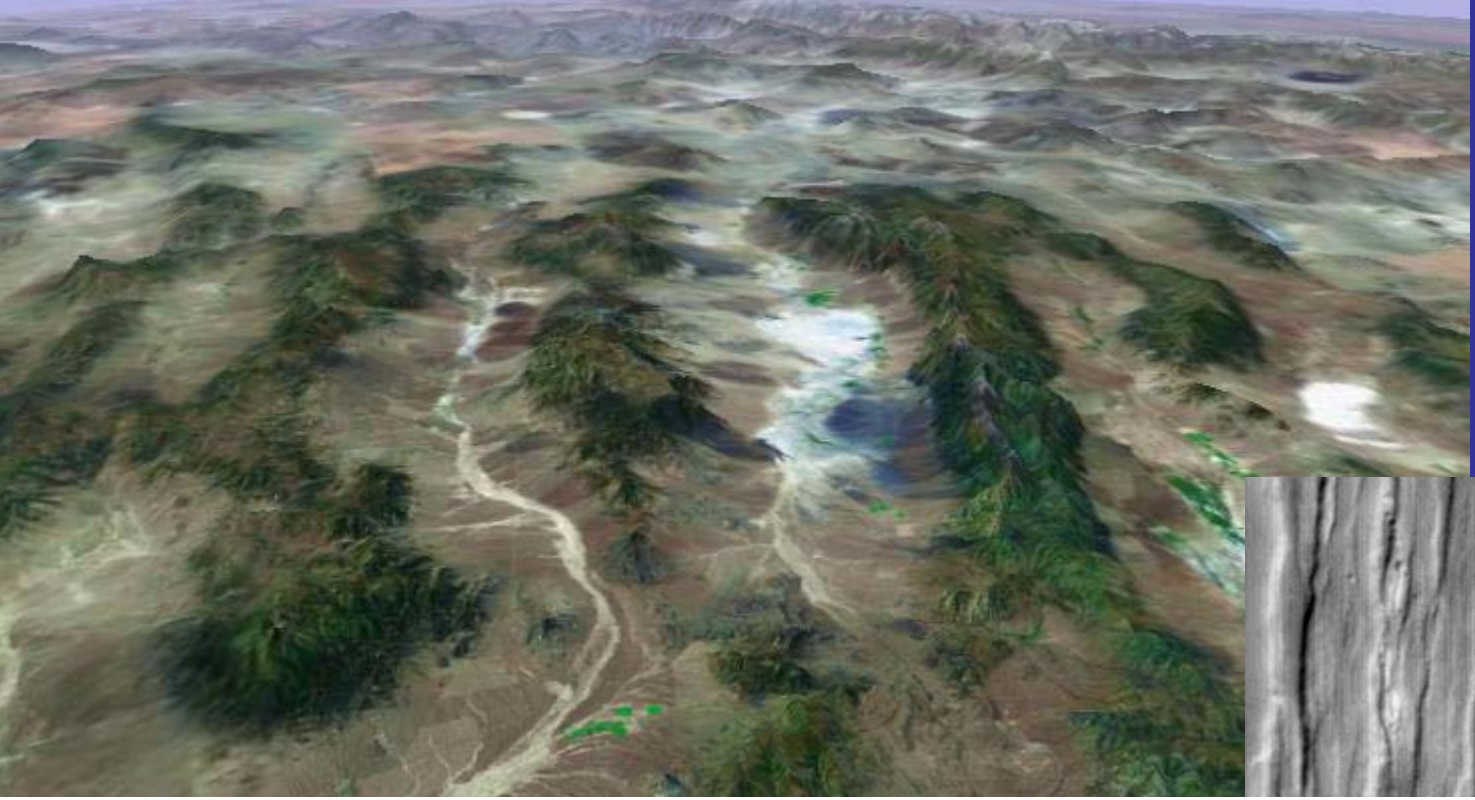
Mars

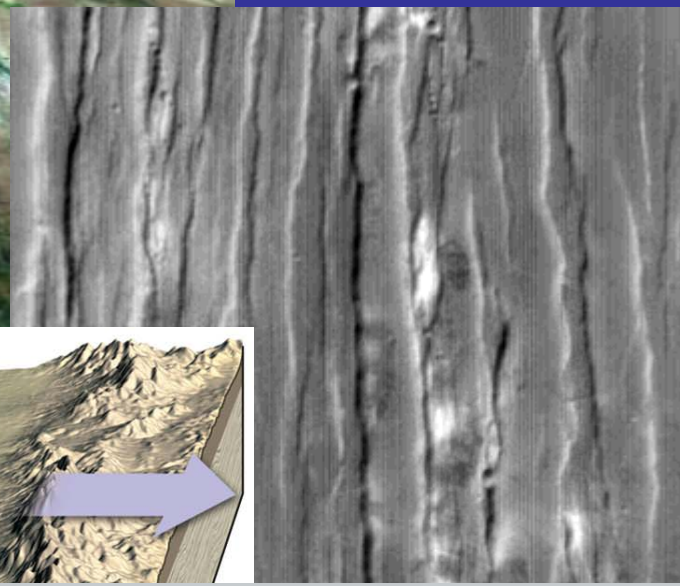


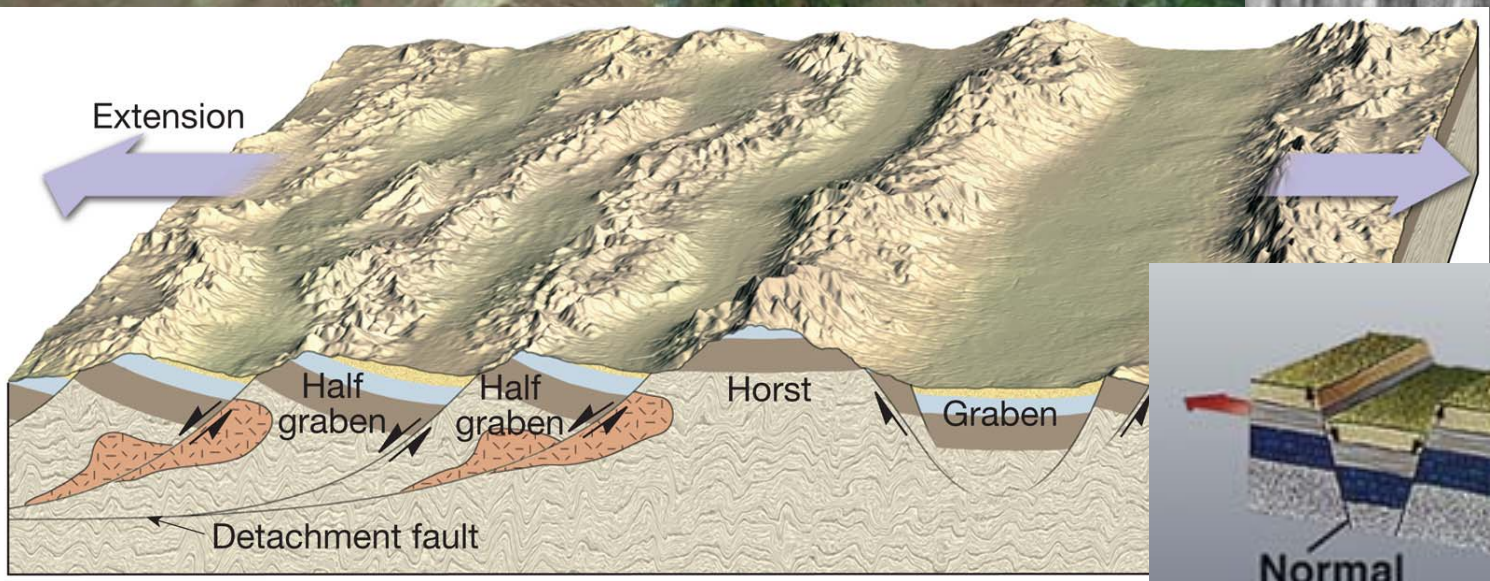
What kind of stress regime does this <u>basin and range</u> topography represent?

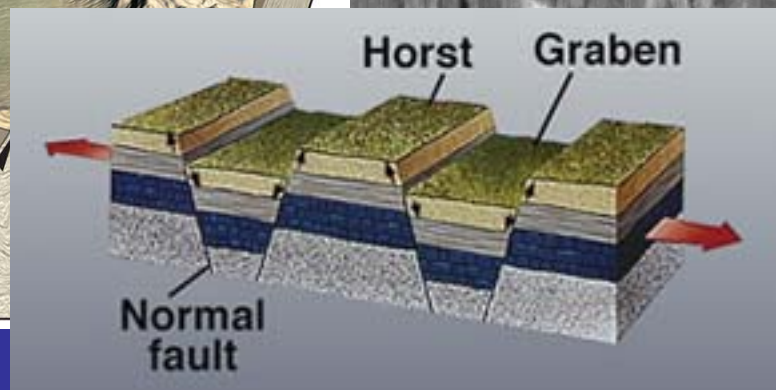
A) Extensional, B) Compressional

Extension produces <u>normal</u> faulting



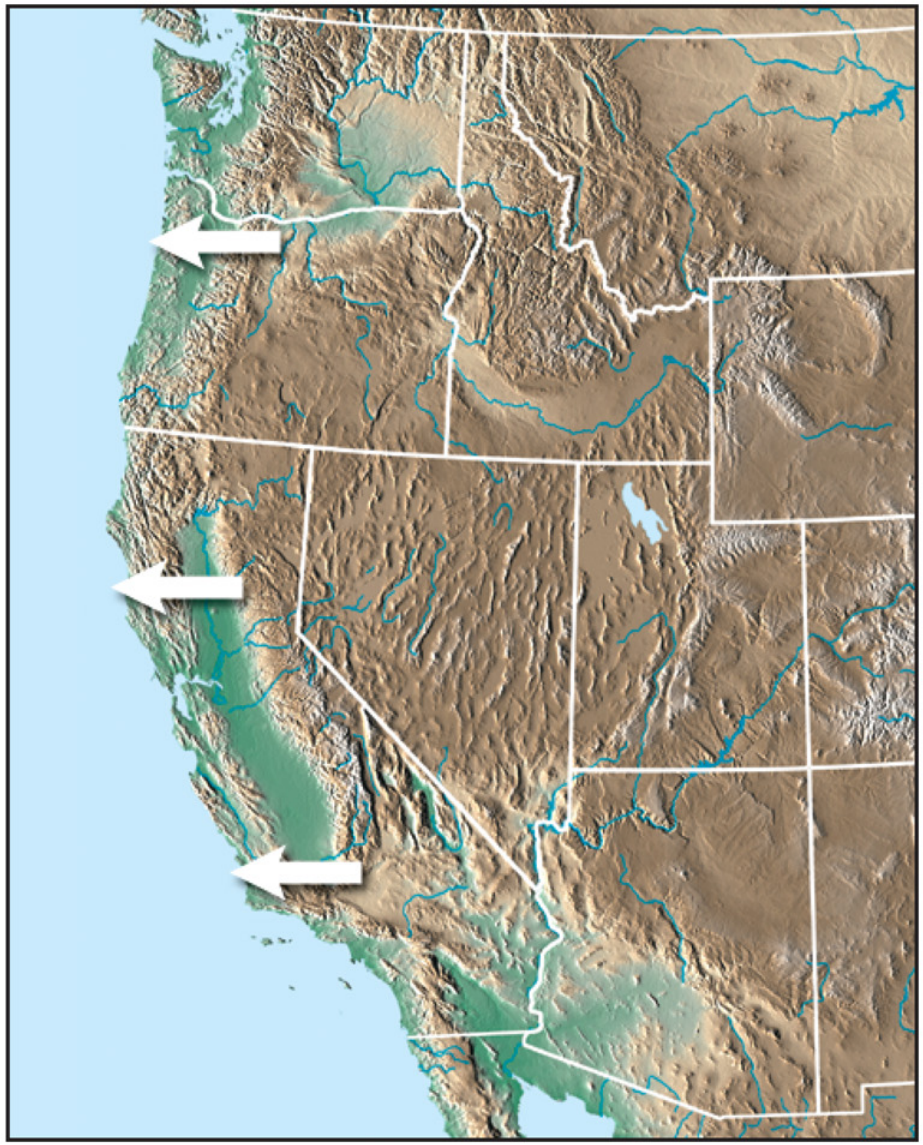






Extension caused by upwarping from mantle flow over last 20 million yrs.

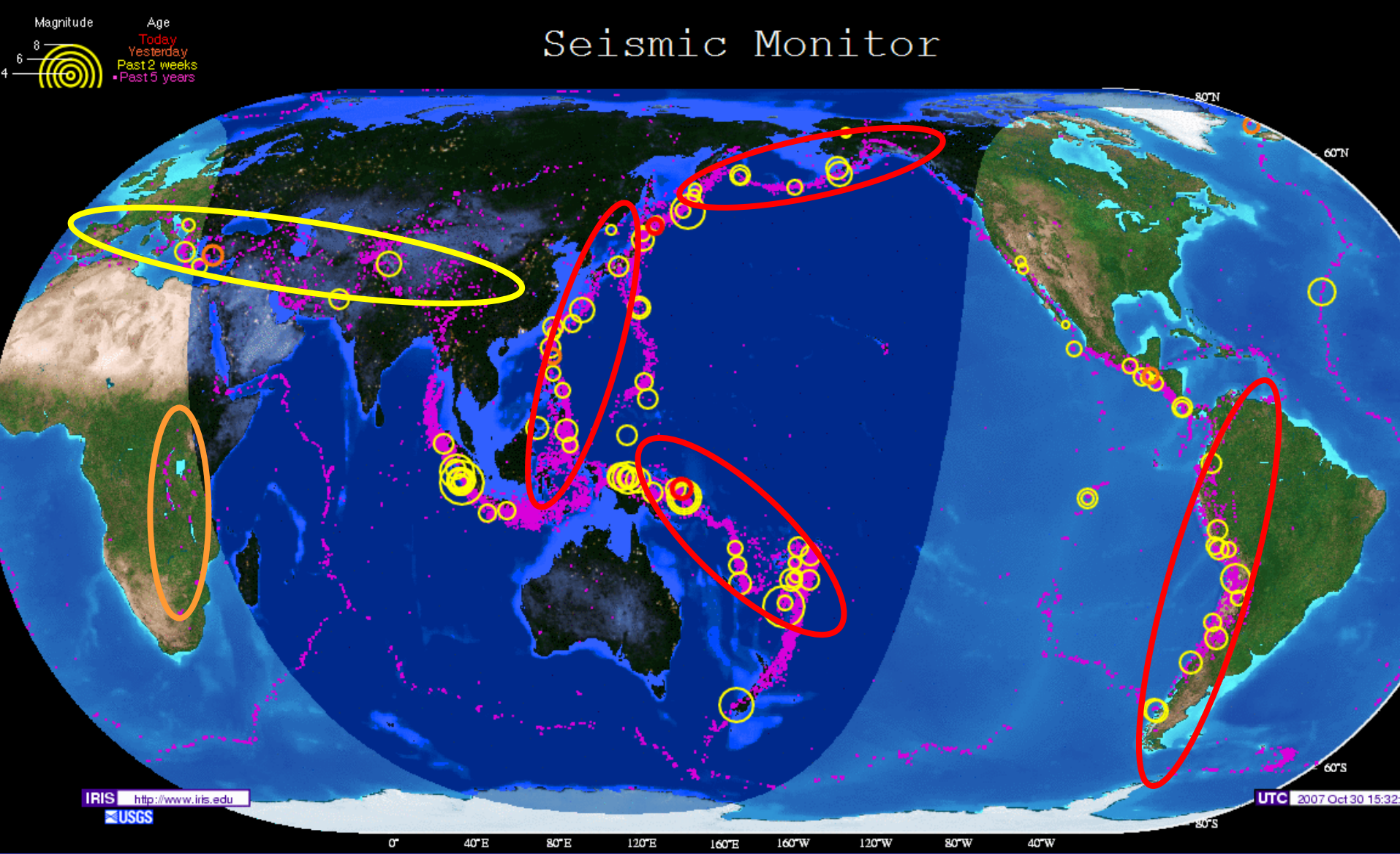






Mountain Building – 3 styles

1) Convergent (volcanic) – reverse faults
2) Convergent (collisional) – reverse faults
3) Fault block mountains – normal faults



Where are the world's earthquakes?

A) Divergent, B) Convergent, C) Transform, D) Hotspot, E) Intracontinental