Earth’s architecture: Structural geology

- Tectonic activity often deforms the rocks in the crust.
- That is how we get complex structures of mountains.

Deformation: Stress and strain

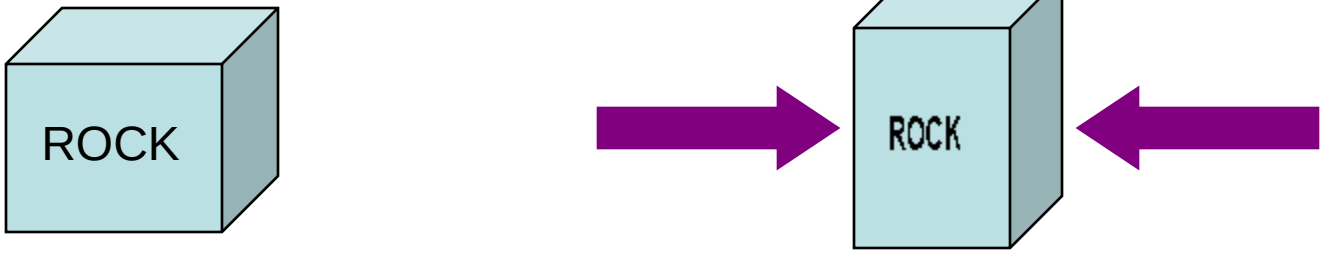
Some important terms:

Deformation: Any change in size, shape, orientation or position of a rock mass.

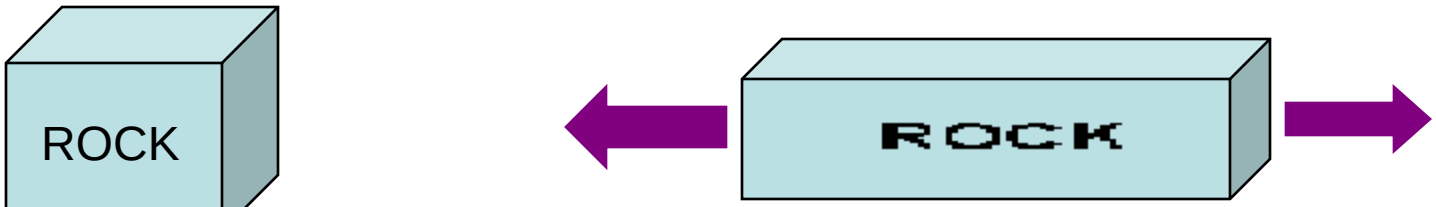
Stress: The amount of force applied to a given area.

Types of stresses:

Compressional:



Tensional:



Shear:

Types of deformation

- Elastic deformation up to elastic limit
  - Springs back to original shape
- Brittle failure (it breaks)
  - Causes: 1. subjected to great stress that exceeds the yield point AKA elastic limit, OR
  - Subjected to sudden stress AKA “impact”
- Plastic deformation
  - Does not spring back … keeps deformed shape
  - Demo Chewing gum
  - Cause can be high temperature – near melting or high pressure … squeezed like a ball of clay

Factors affecting rock deformation

- Intensity of applied stress
- Heat –Temperature of the Rock
- Amount of Time the Stress is applied
- Rock Composition

How does the rocks deform?

As stress is applied, the rocks could

-Break

-Flow / bend

Whether a rock is going to break or flow depends on several factors, such as,

- Temperature: Rocks near the surface vs. deep down

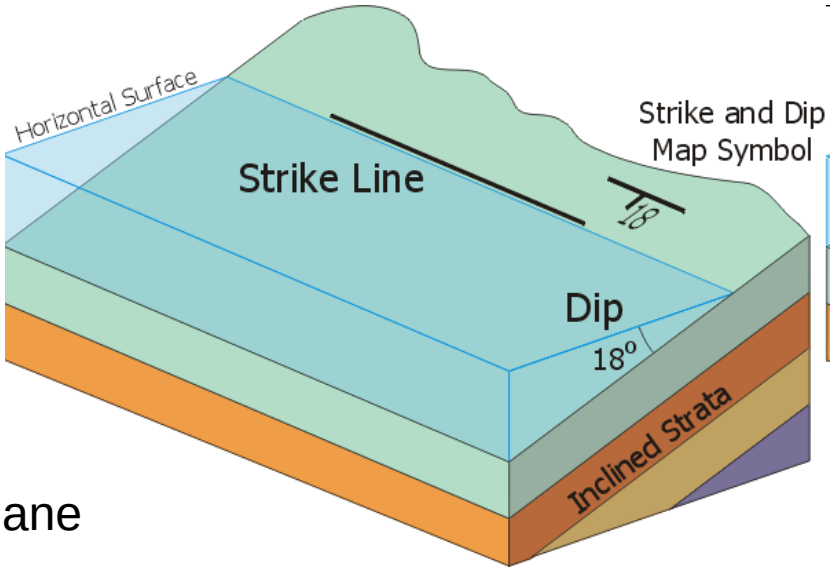
- Rock type: Crystalline rocks vs. non-crystalline rocks

-Time: Wooden racks loaded with books

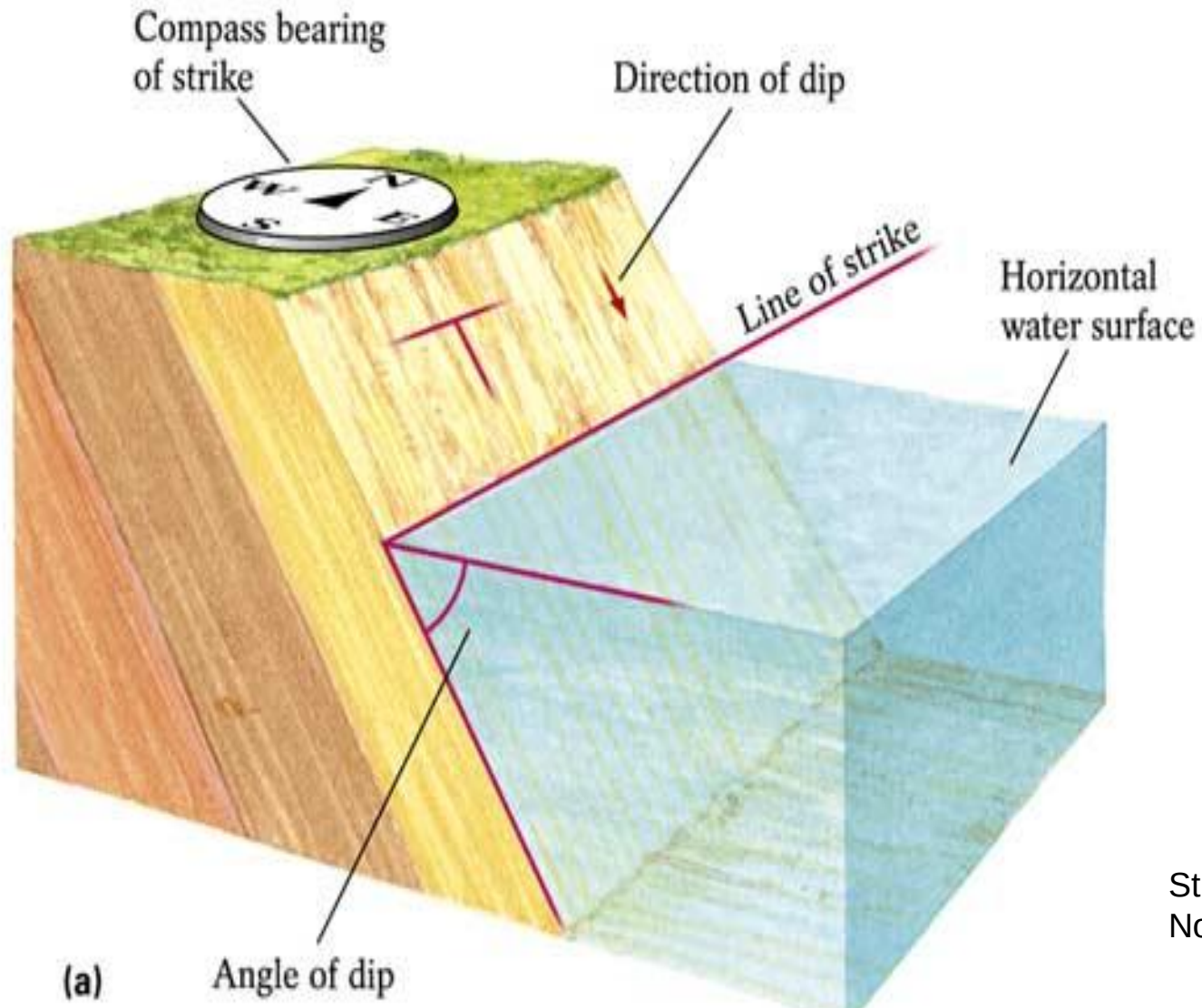
Mapping a structure:

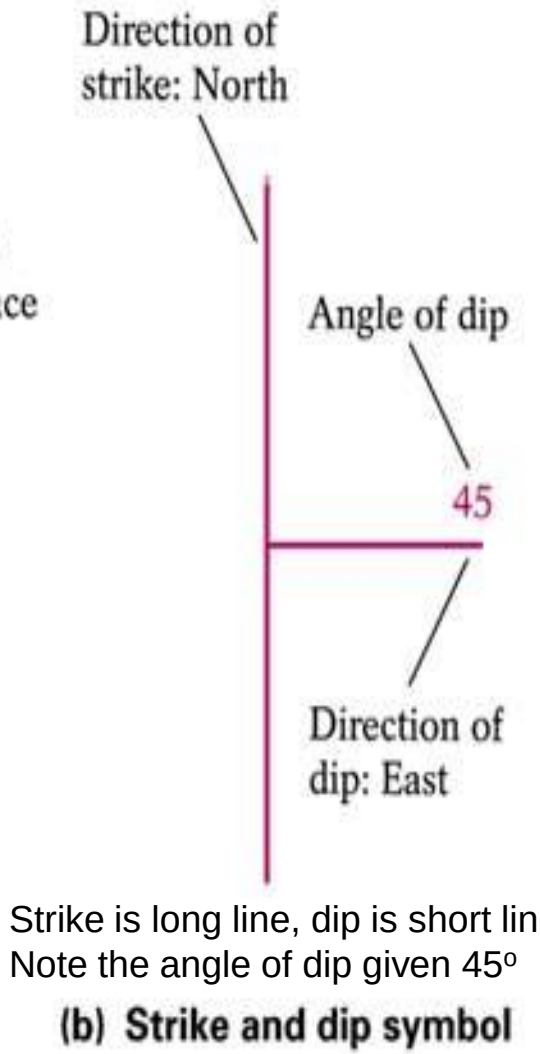
Strike: Compass direction of the structure

Dip: Angle of the structure with the horizontal plane



Strike and Dip



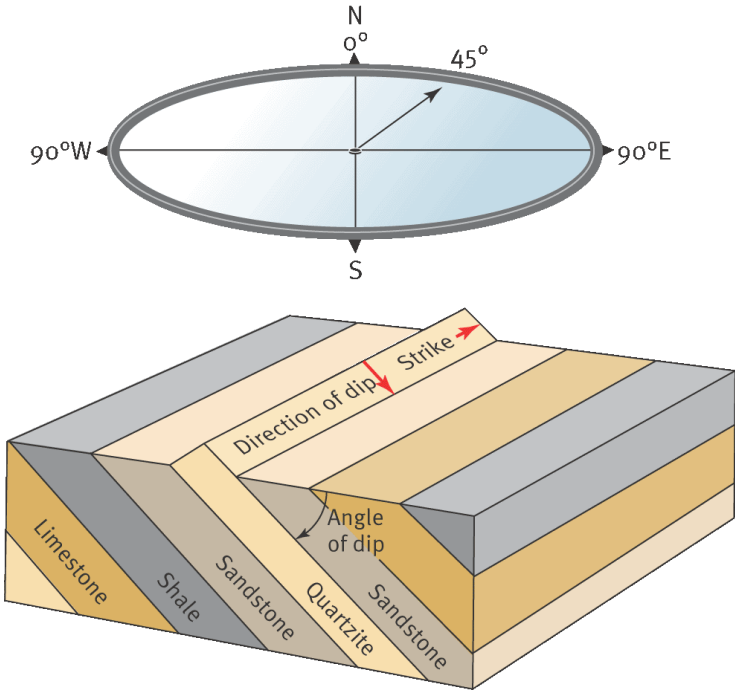


Strike is long line, dip is short line
Note the angle of dip given 45°

Strike intersection w horizontal, dip perpendicular, angle from horizontal down toward surface

Terminology of Structure

- Strike
  - Line representing the intersection of a planar feature with a horizontal plane
- Dip
  - Angle of a tilted bed relative to a horizontal plane



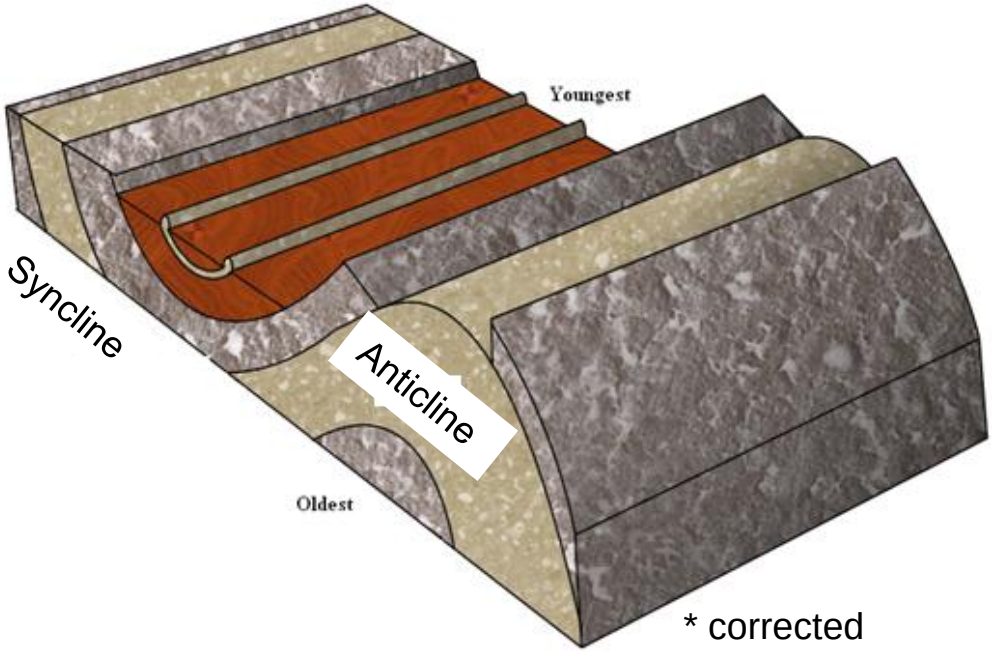
Folds

Rocks bent into a series of wavelike undulations.

Important types of folds:

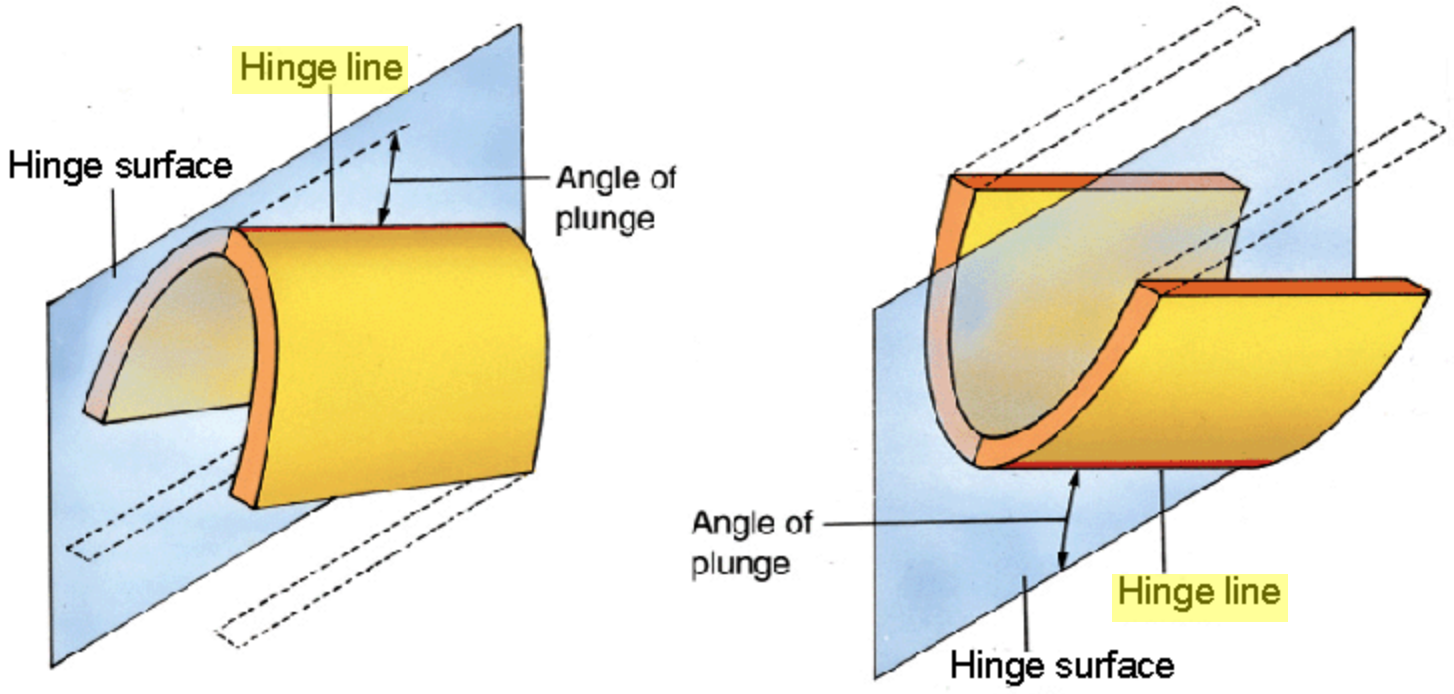
-Anticline: Old rock in the center

-Syncline: Youngest rock in the center

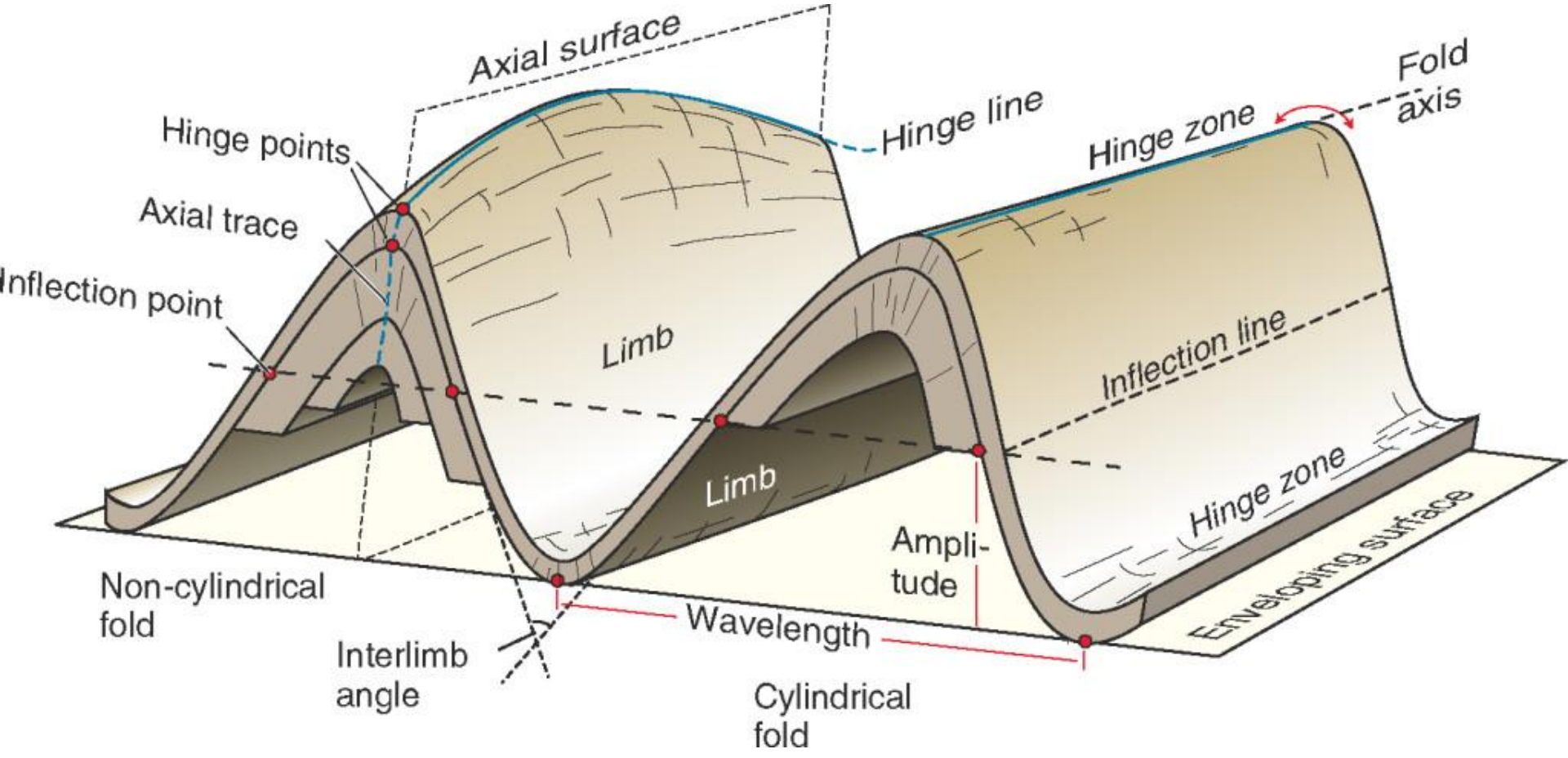


* corrected

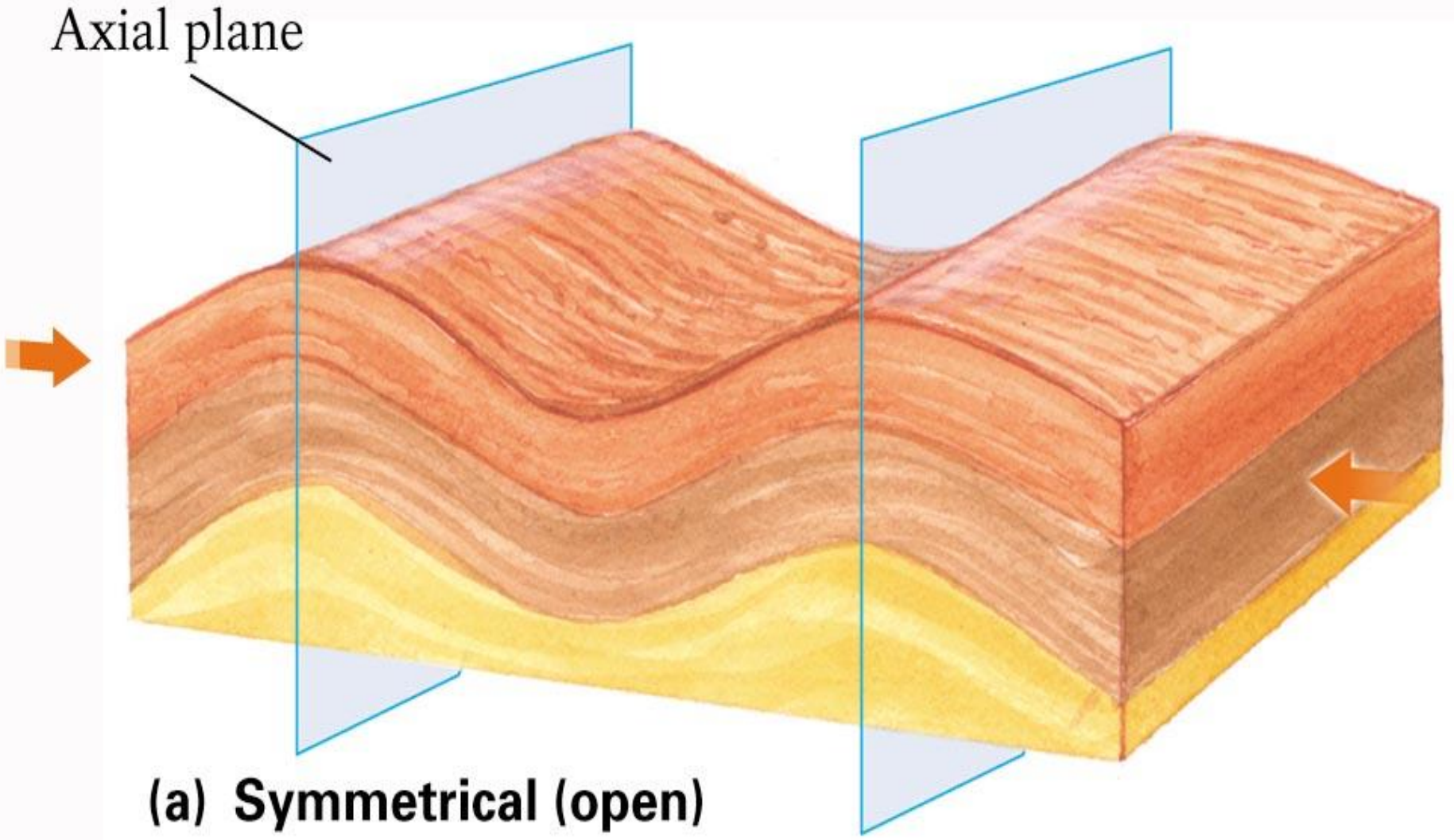
Fold Geometry



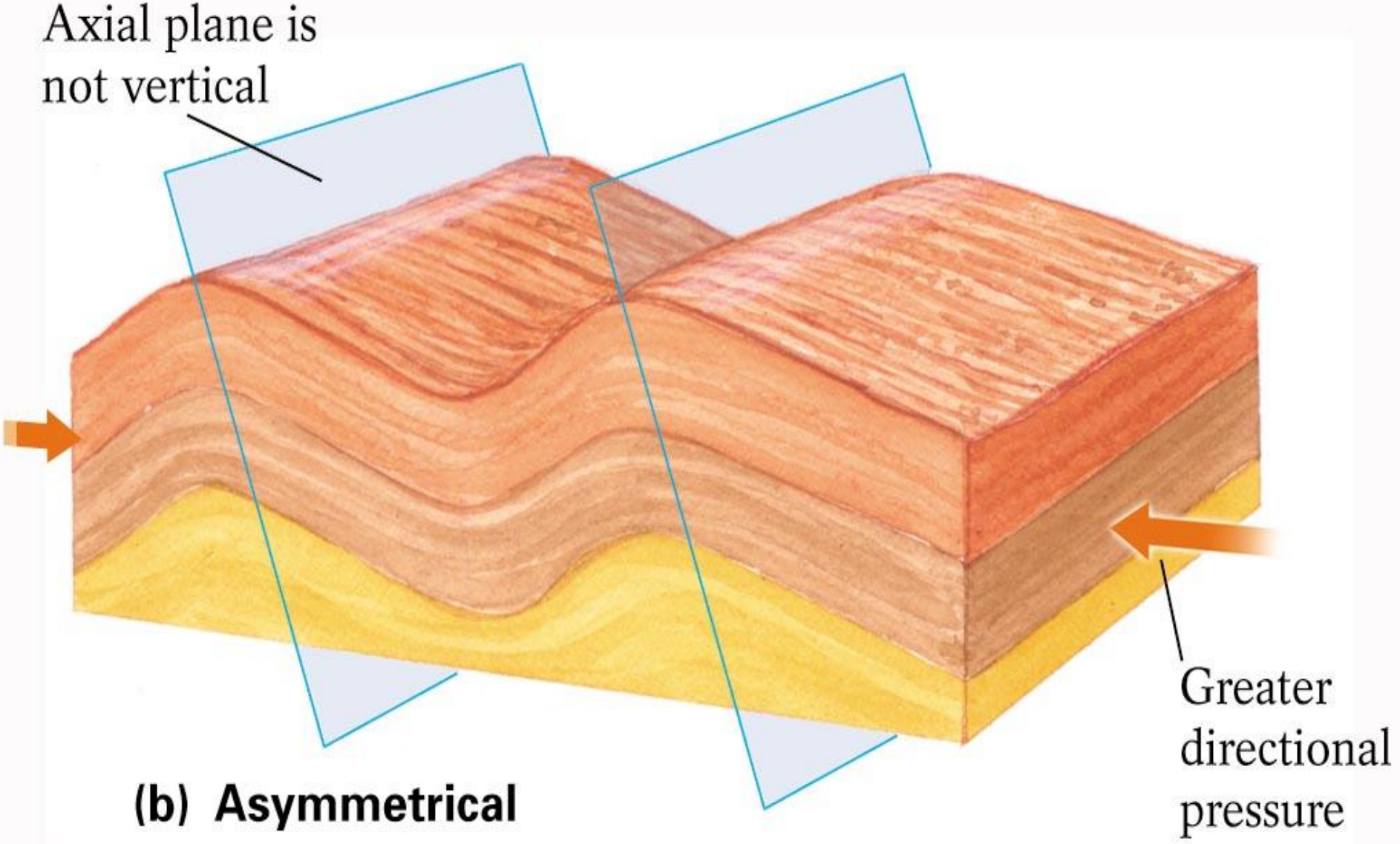
Hinge line: **The locus of all points with maximum curvature (smallest radius of curvature)**


Axial surface
Hinge points
Axial trace
Inflection point
Hinge line
Hinge zone
Fold axis
Limb
Limb
Inflection line
Hinge zone
Enveloping surface
Ampli-tude
Non-cylindrical fold
Interlimb angle
Wavelength
Cylindrical fold

Various Folds



Various Folds (cont'd)



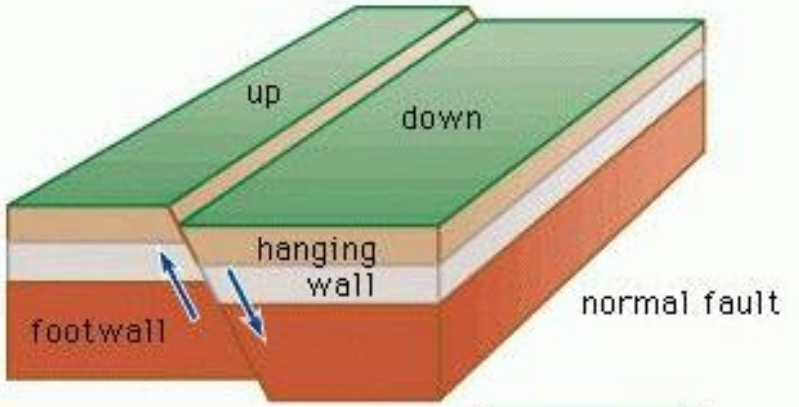
Faults

Fractures in the crust along which displacement has taken place.

Types of faults

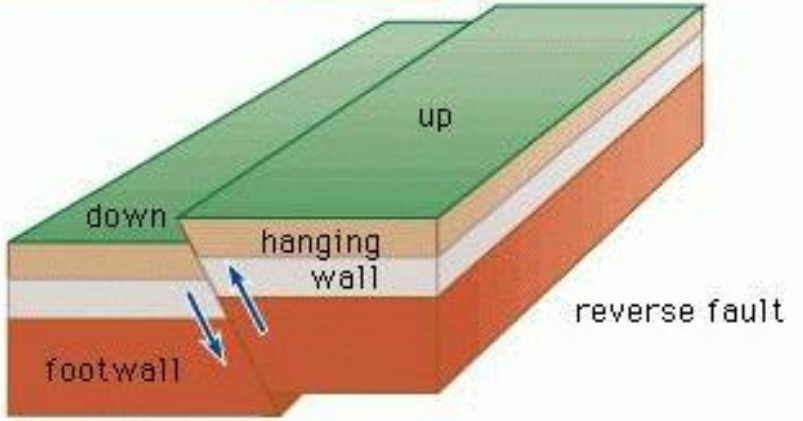
Normal fault:

- Hanging wall moves down relative to the footwall.
- Generated by extension.



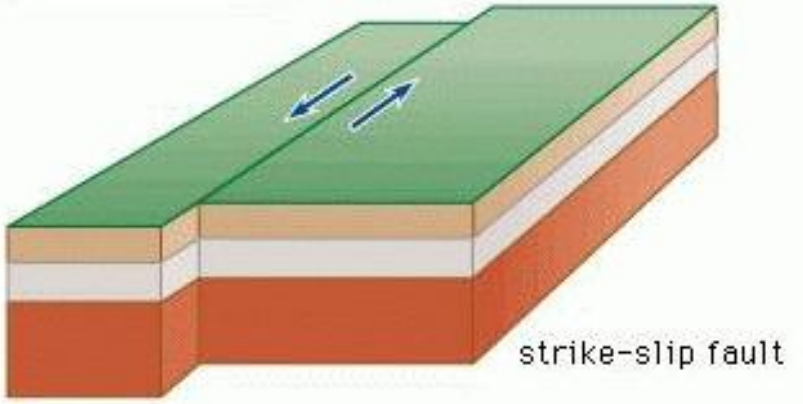
Reverse fault:

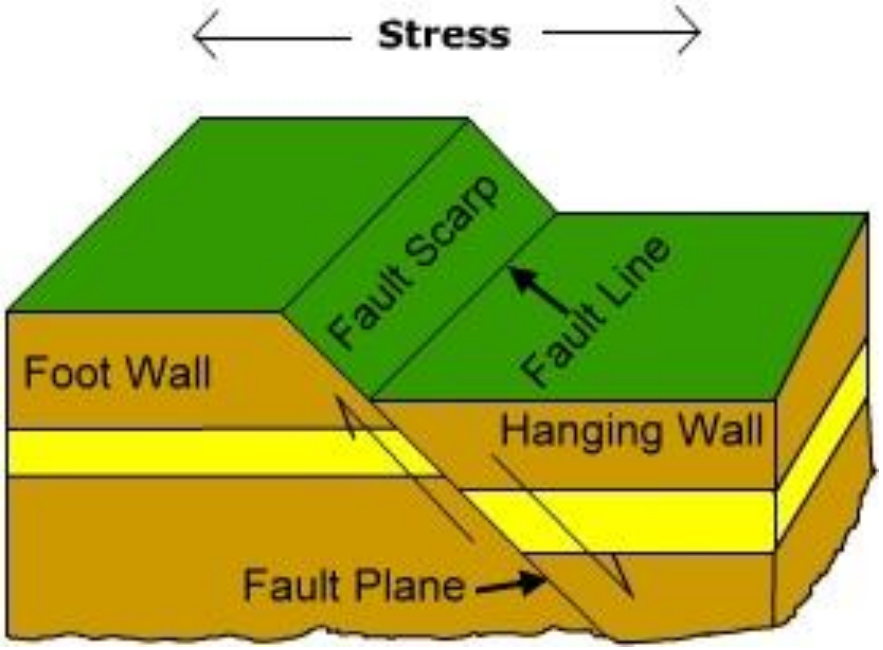
- Hanging wall moves up relative to the foot wall.
- Generated by compression.



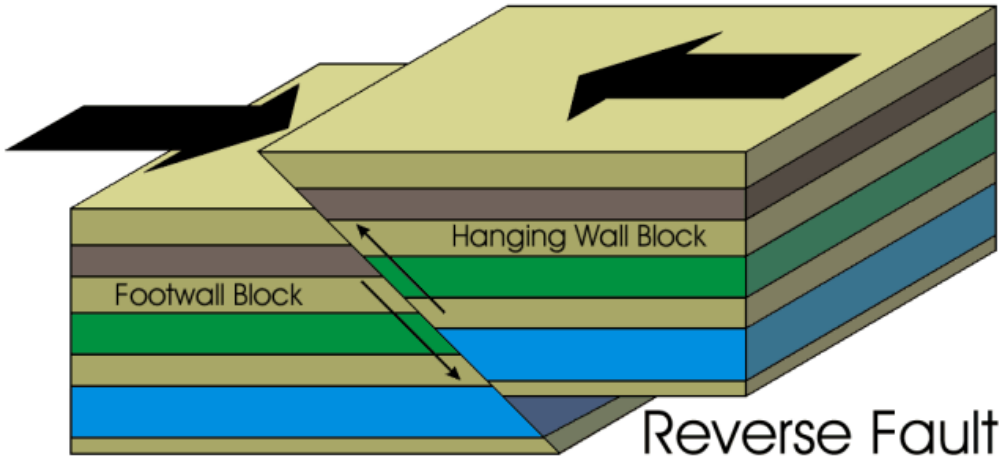
Strike-slip fault:

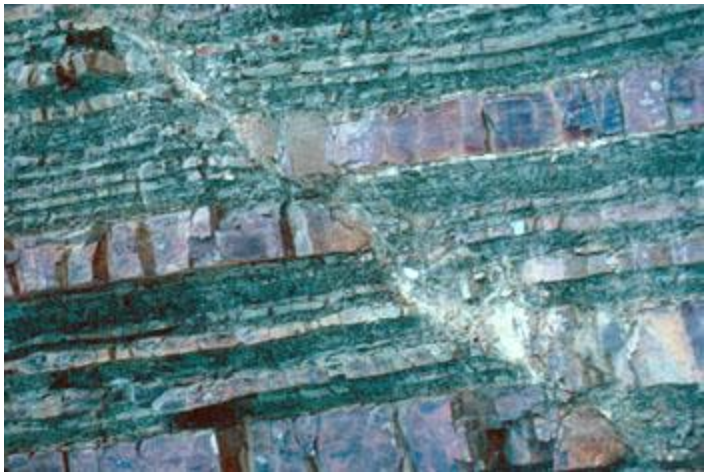
- Horizontal displacement.



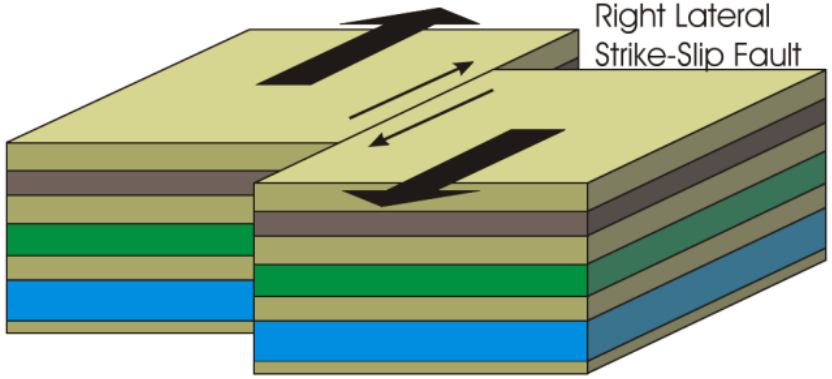


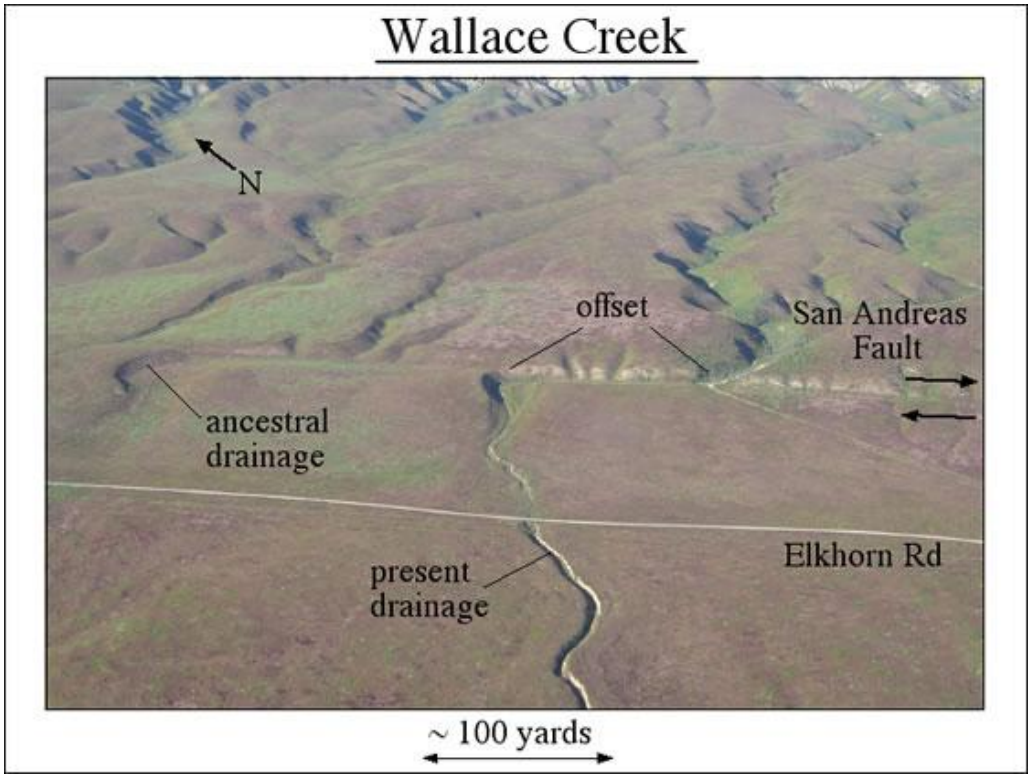
- In a normal fault, the hanging wall <u>slips down</u> relative to the footwall





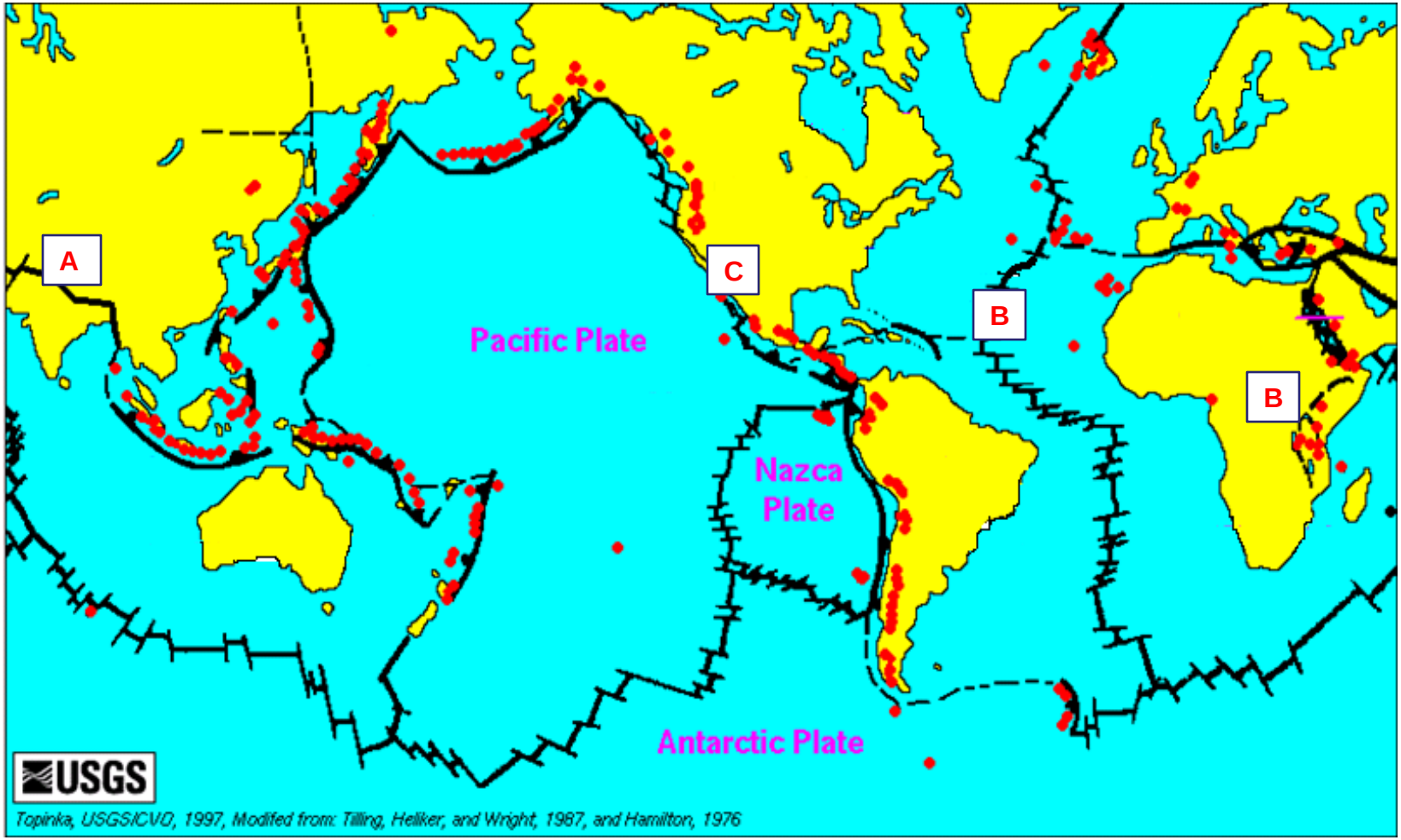
- In a reverse fault, the hanging wall <u>moves up</u> relative to the footwall





- San Andreas fault is a strike-slip fault with little up or down motion

Example



A. Compression: Fold, Reverse fault
B. Extension: Normal fault
C. Shearing : Transform fault