



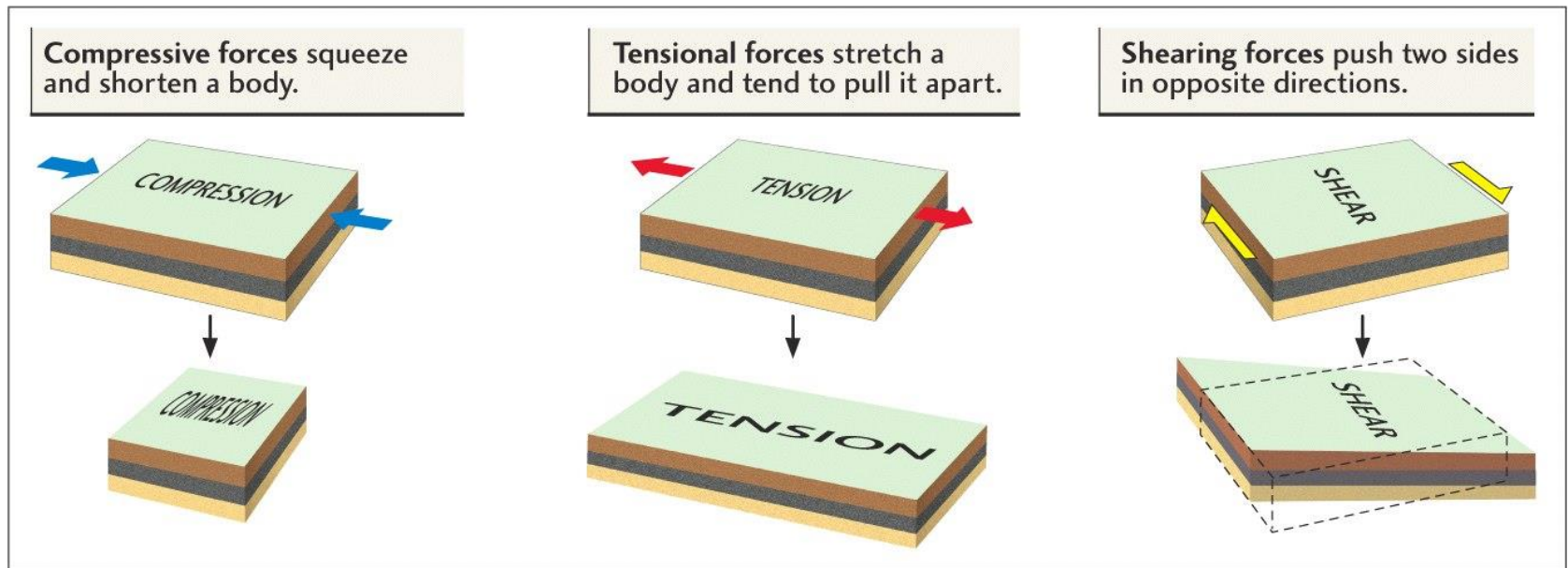
Courtesy of [Chiara Marra](#) on flickr. License: CC-BY.

# Rock Deformation-Structural Geology

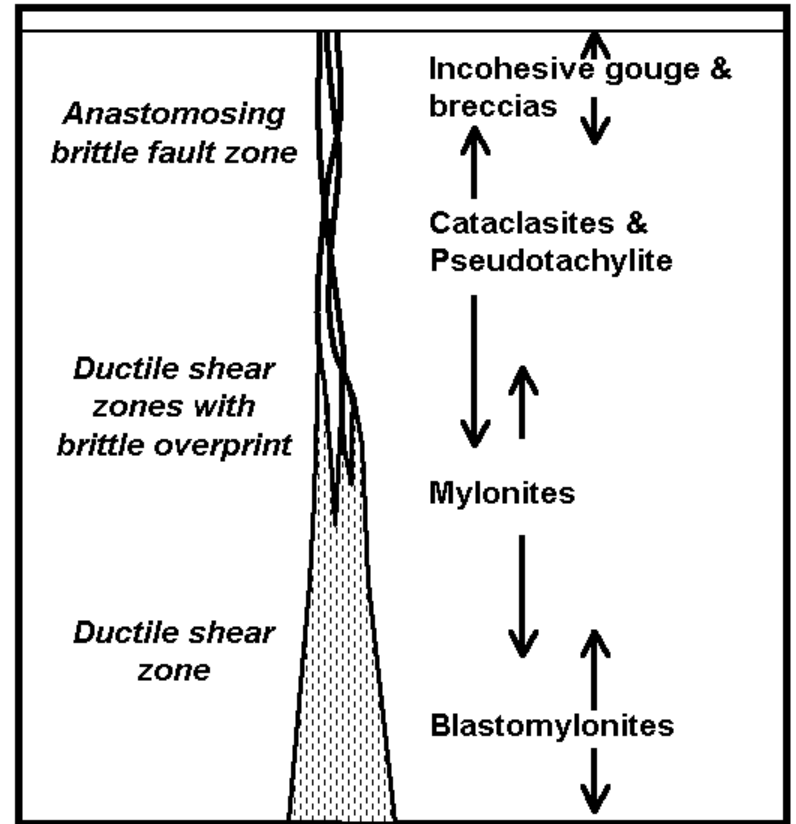
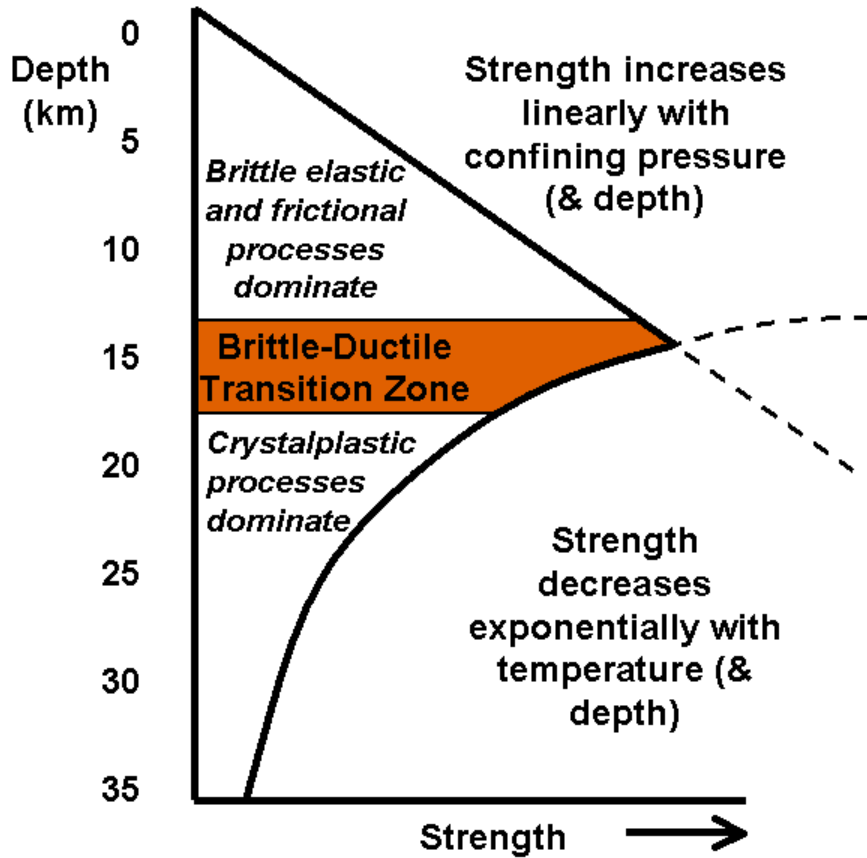


# 3 Types of Differential Stress:

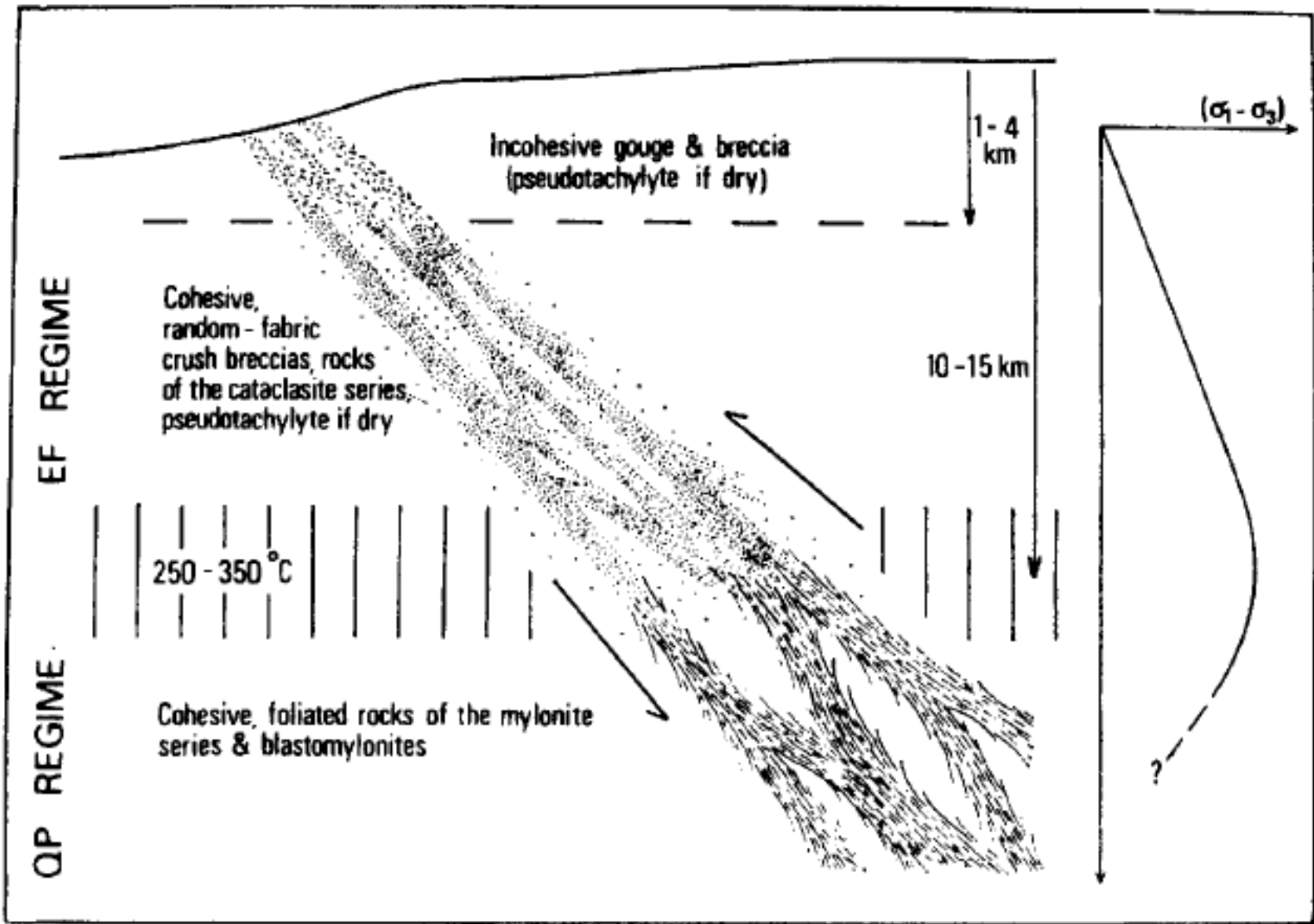
## TECTONIC STRESS LEADS TO STRAIN



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

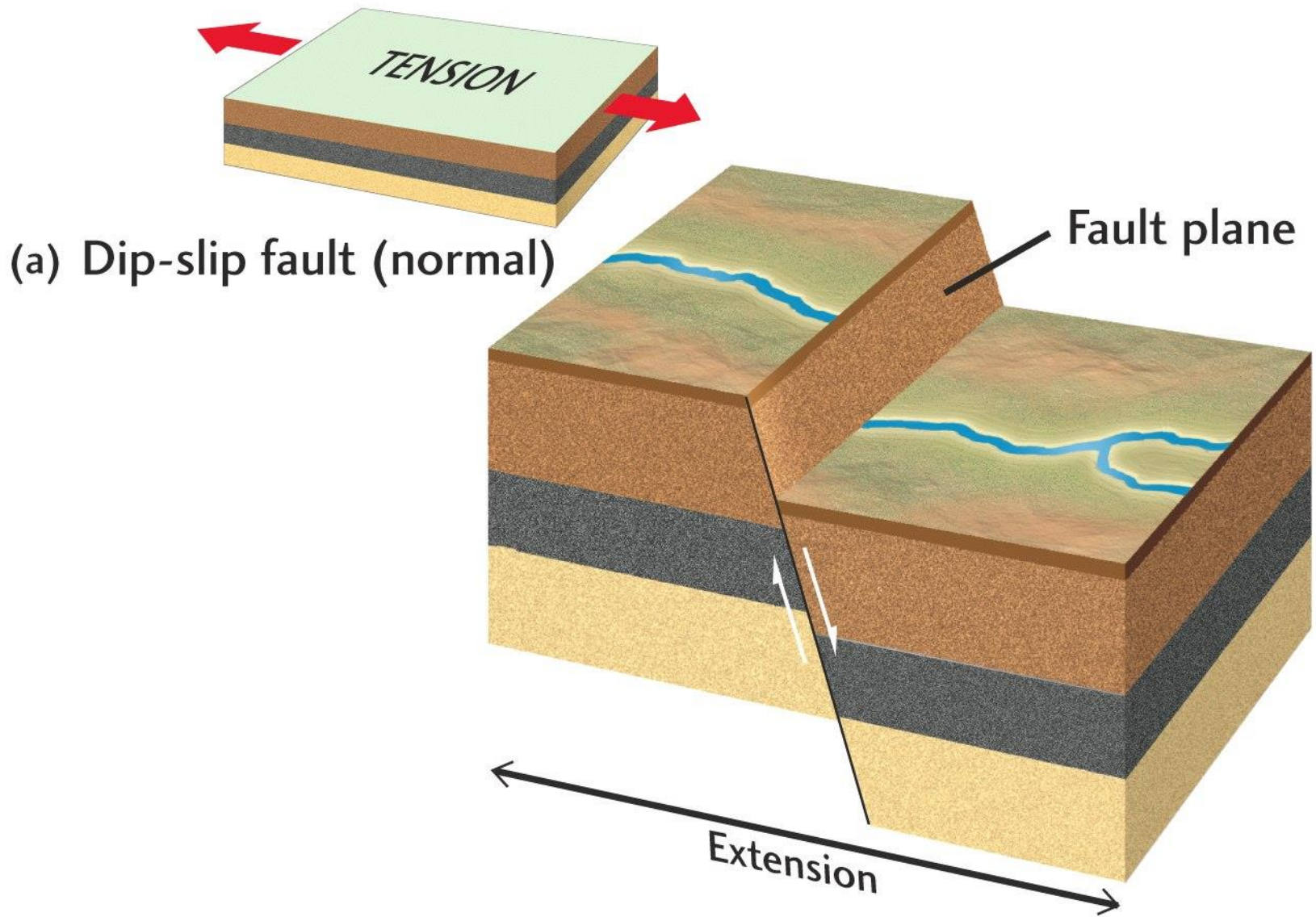


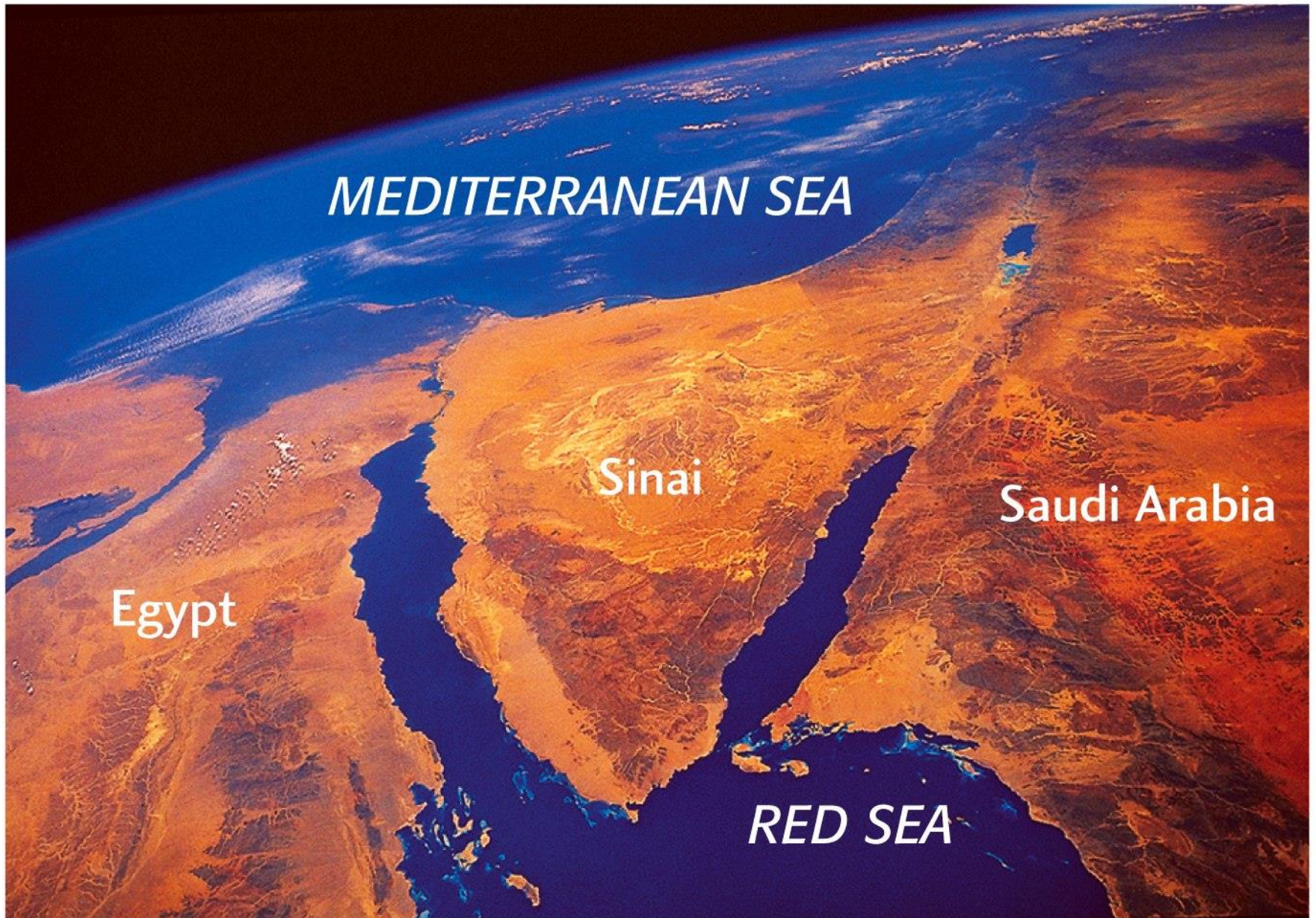
© Mike Norton. Some rights reserved. License: CC-BY-SA. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



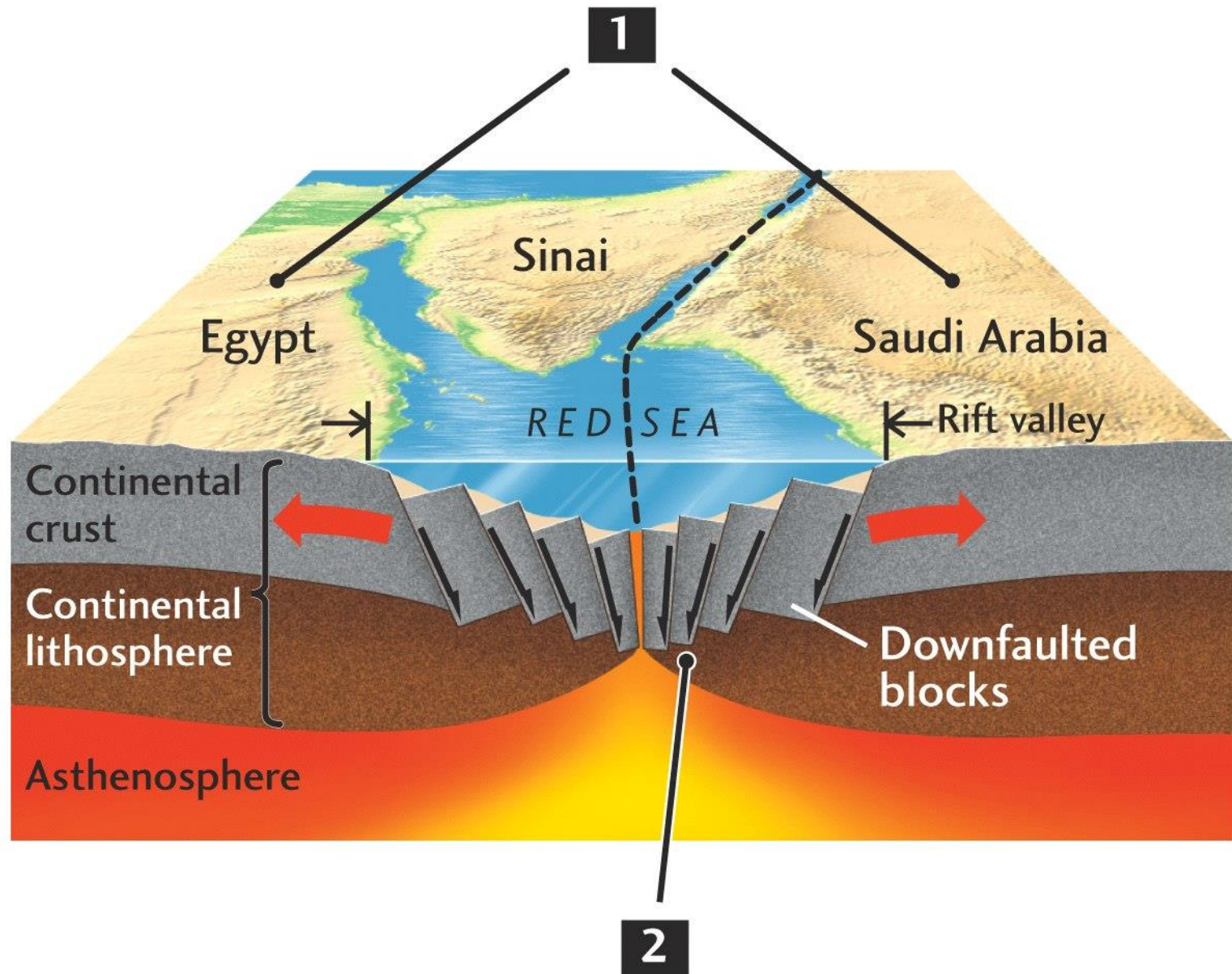
Sibson, 1977

© The Geological Society of London. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.  
 Source: Sibson, R. H. "Fault Rocks and Fault Mechanisms." *Journal of the Geological Society* 133, no. 3 (1977): 191-213.





Courtesy of NASA. Photograph in the public domain.



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

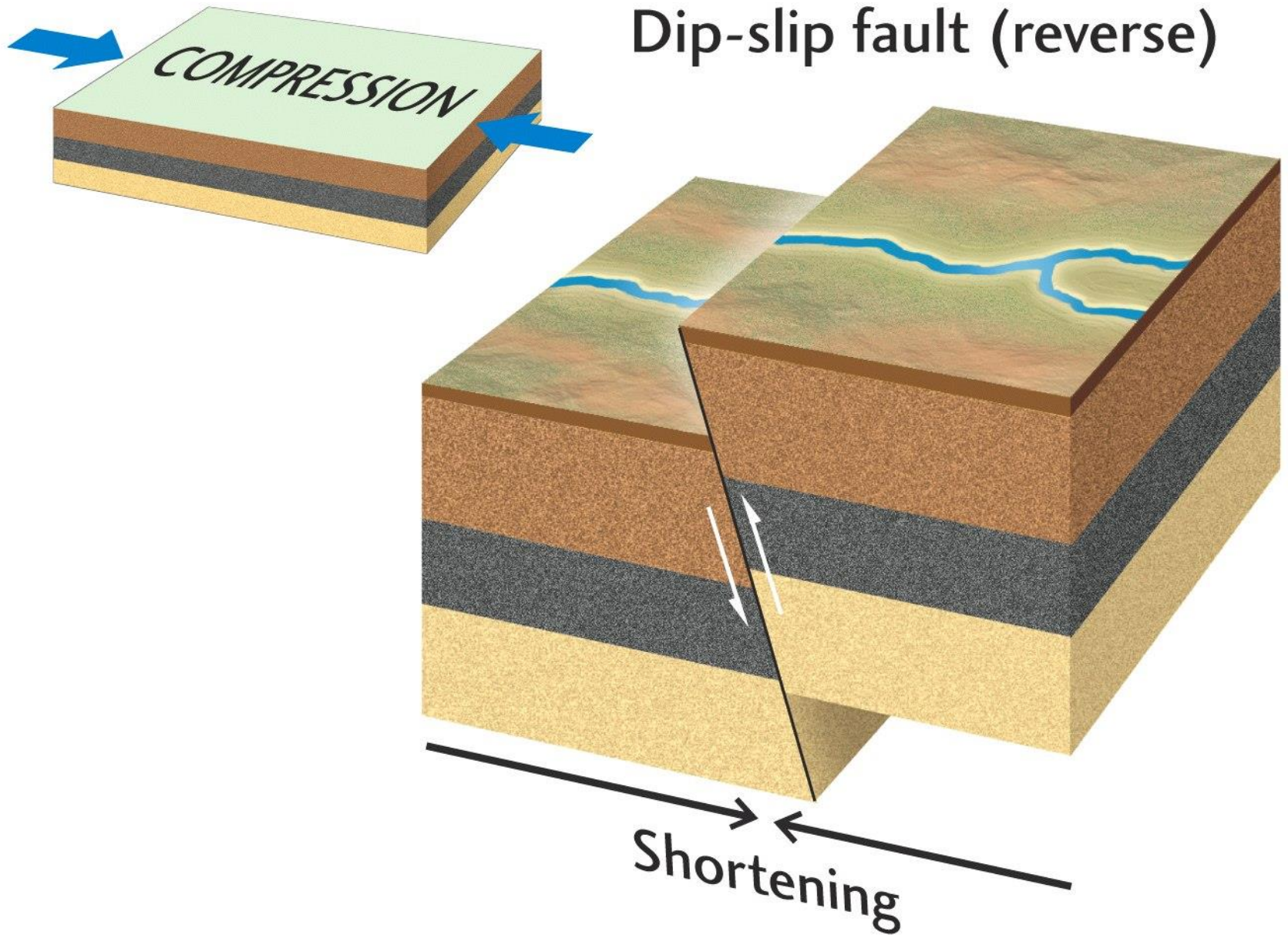




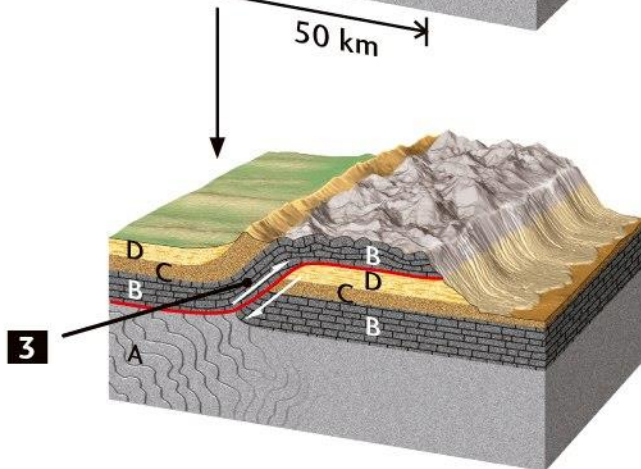
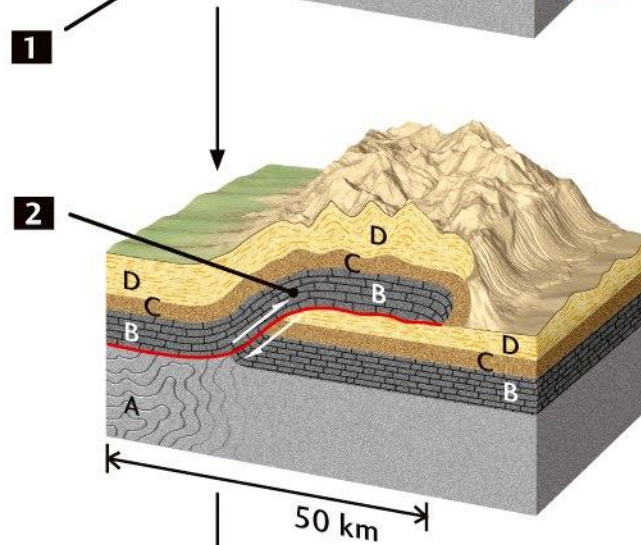
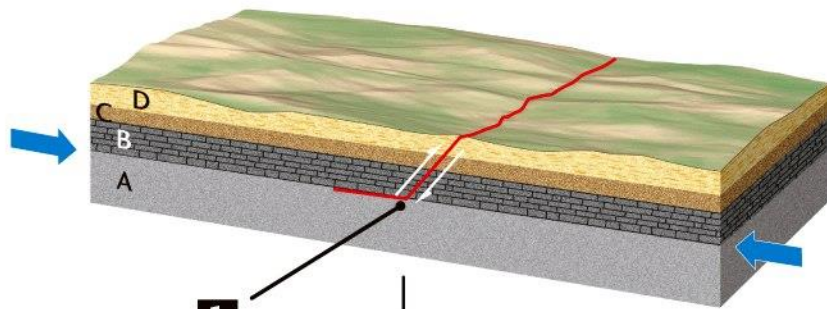
© 2009 www.DioGeneS.ethz.ch

© DioGeneS.ethz.ch All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

# Dip-slip fault (reverse)



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



Keystone thrust fault, southern Nevada

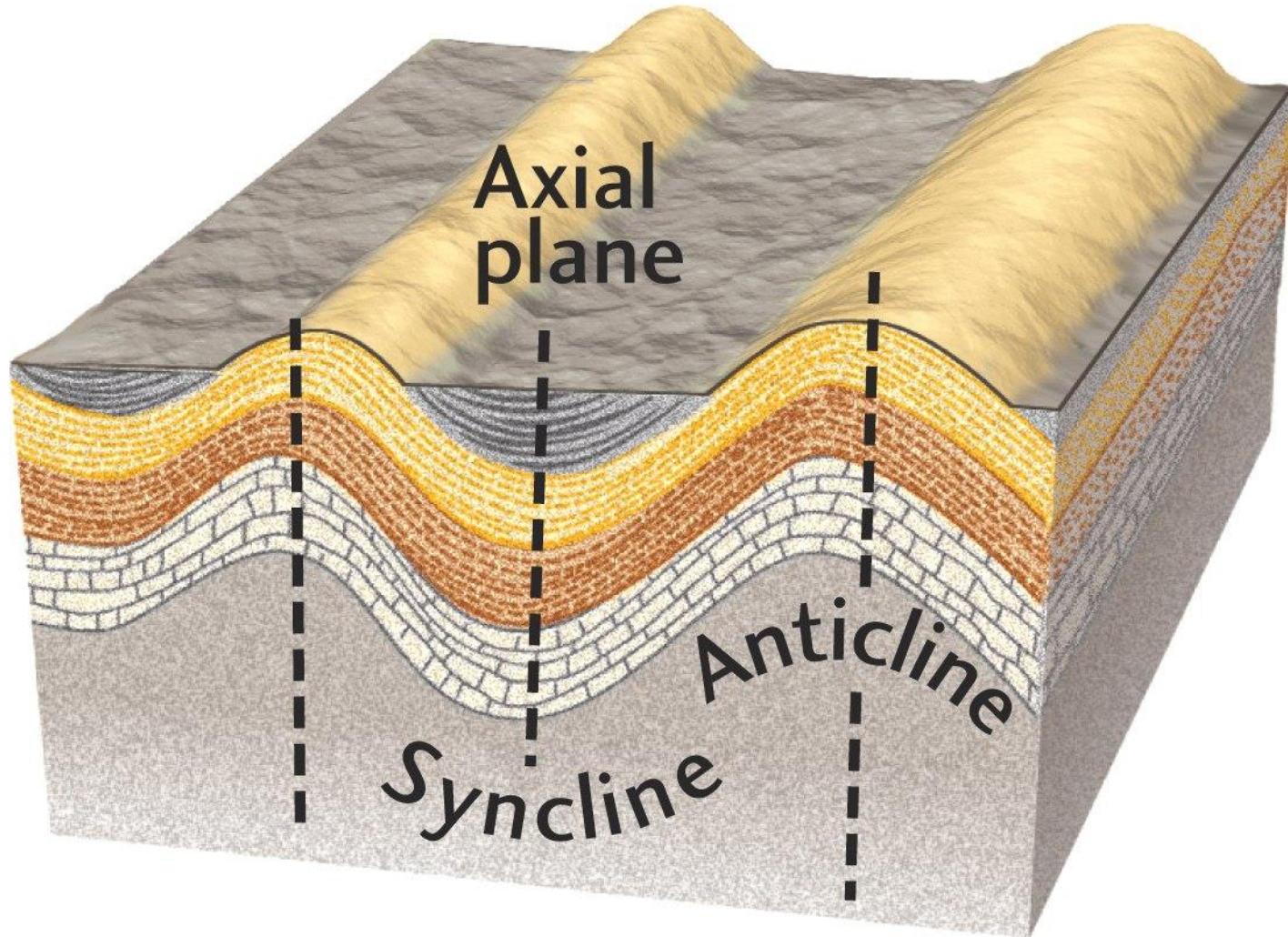


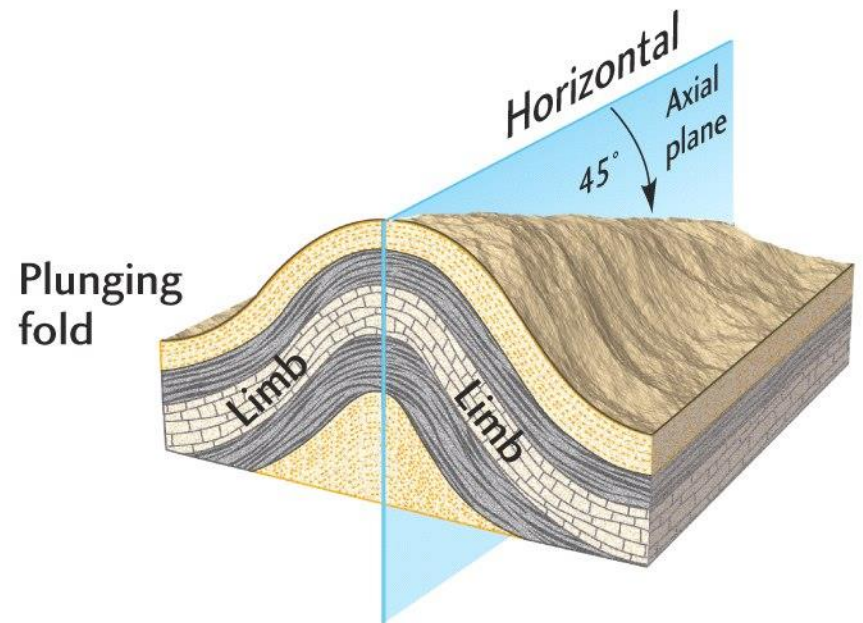
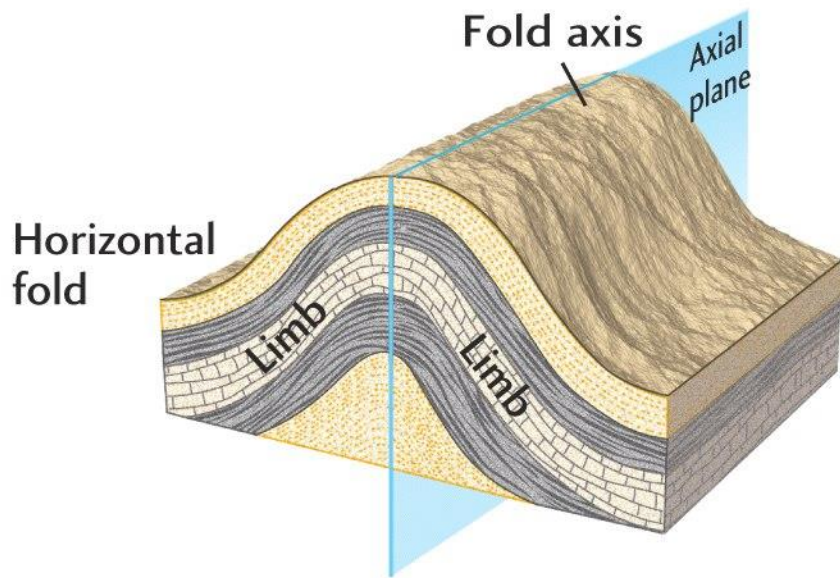
Direction of view in photo



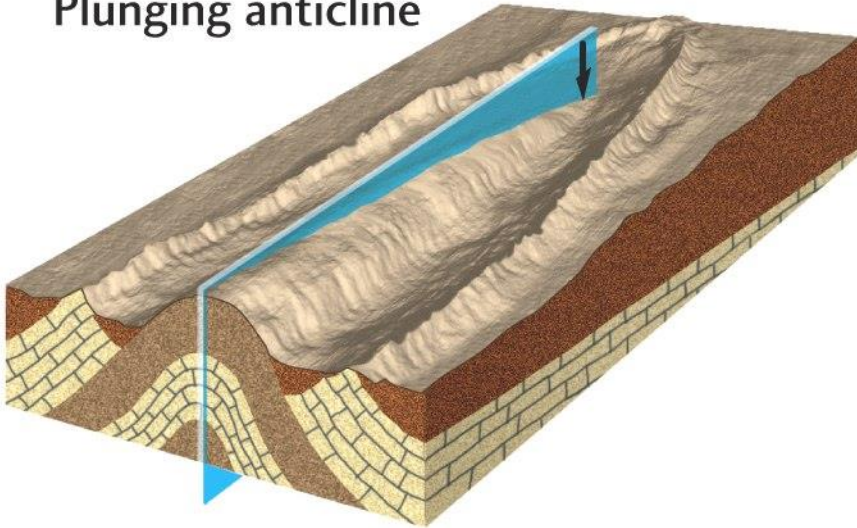
© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

# Symmetrical folds

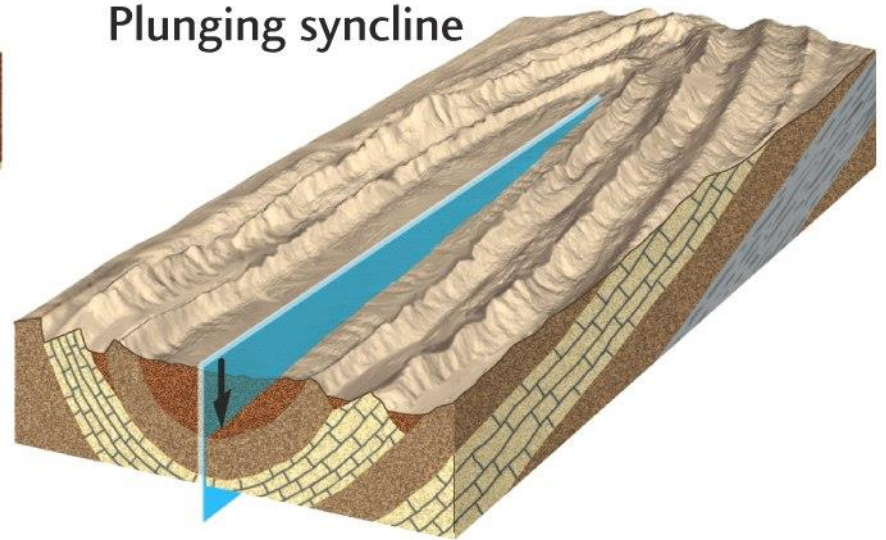




Plunging anticline

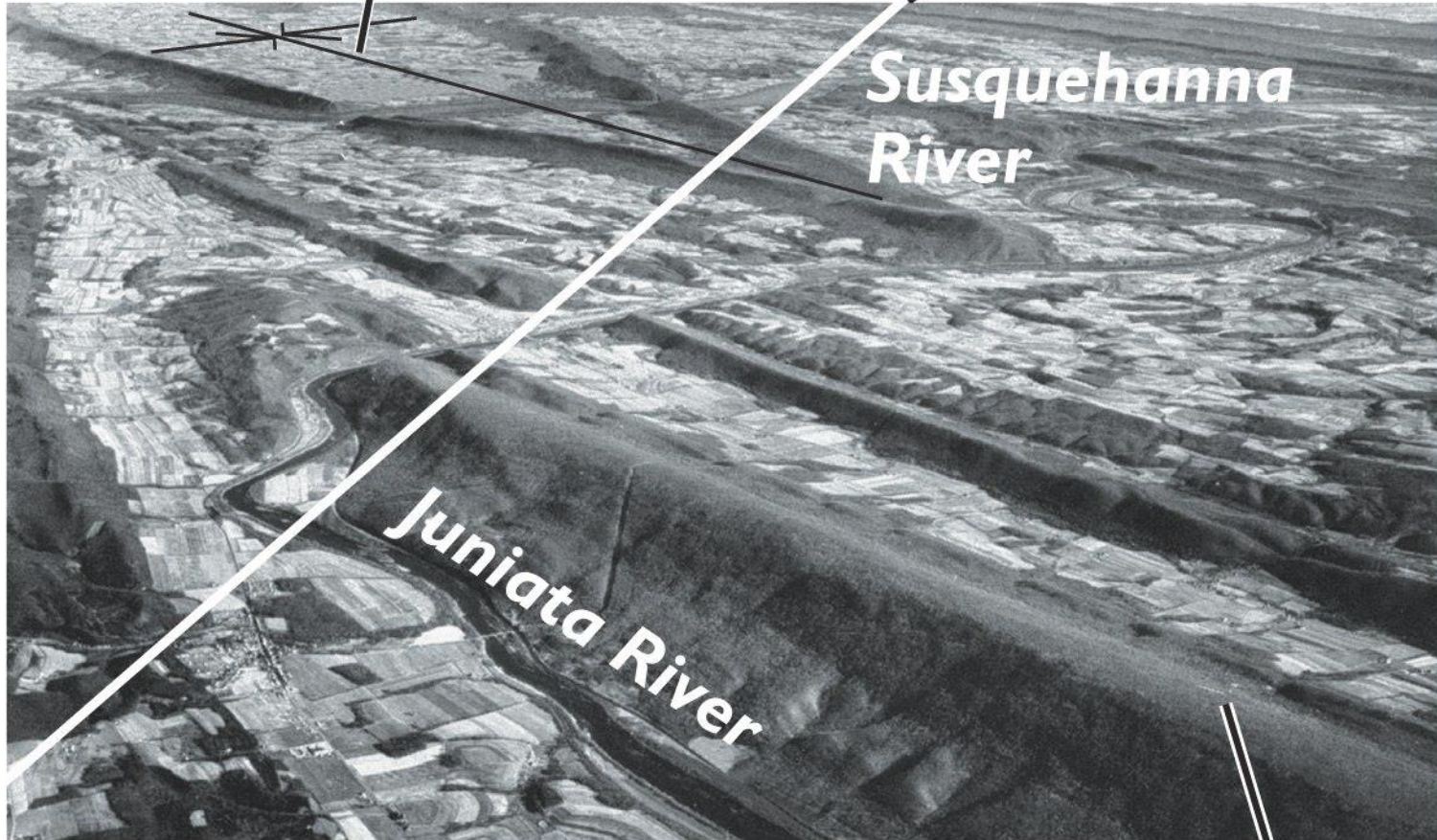


Plunging syncline



Youngest rocks

Plane of section  
shown below

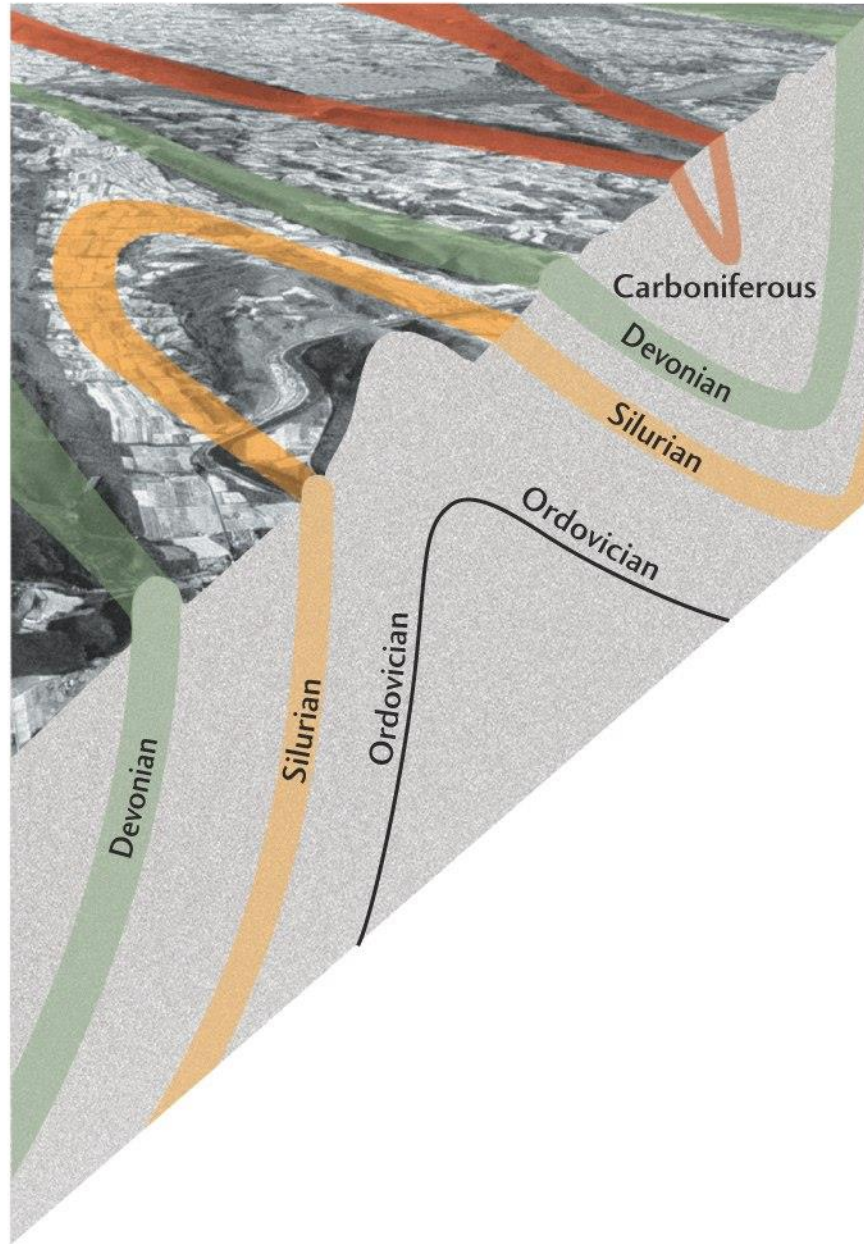


Susquehanna  
River

Juniata River

Oldest rocks





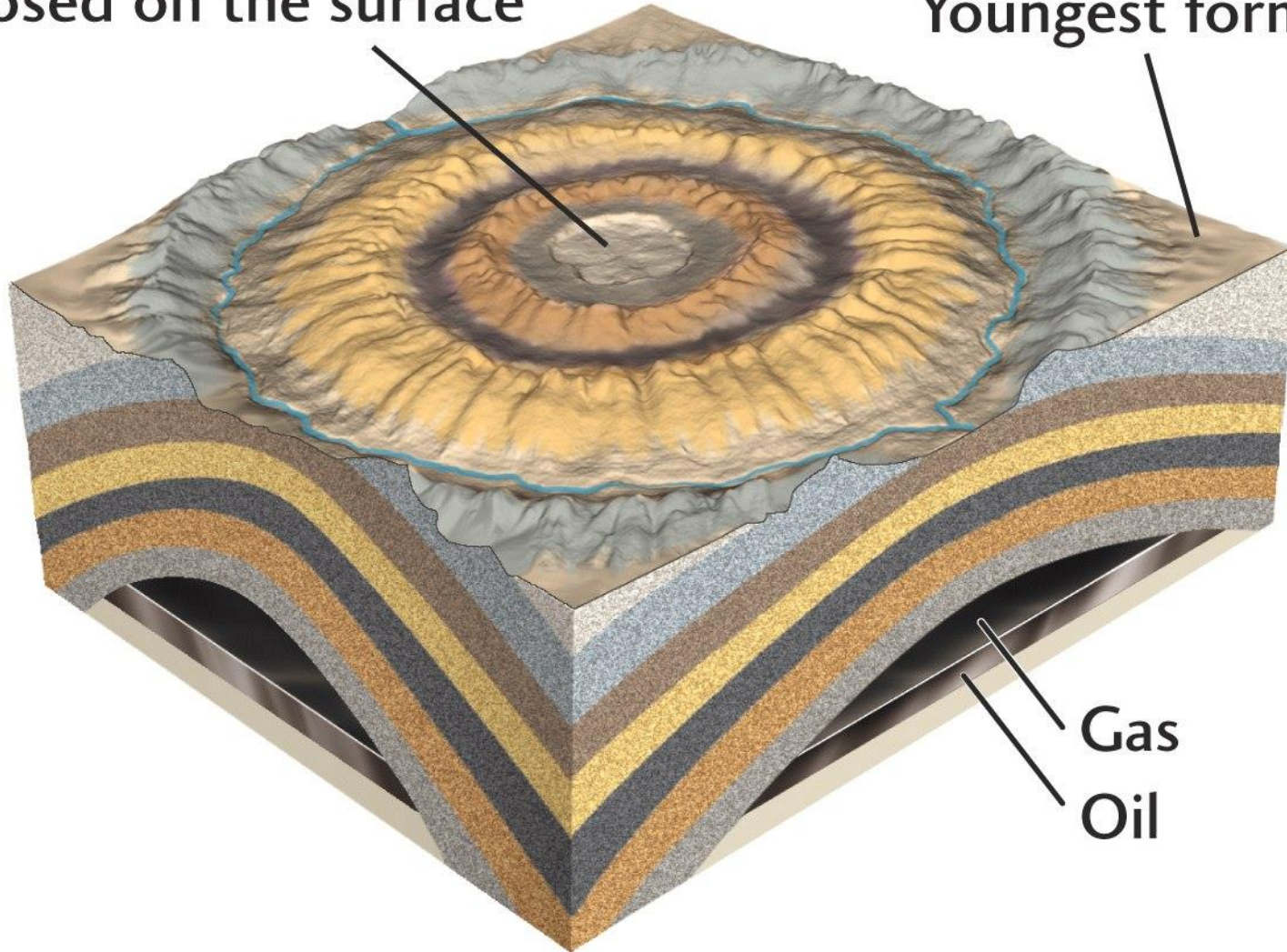
© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

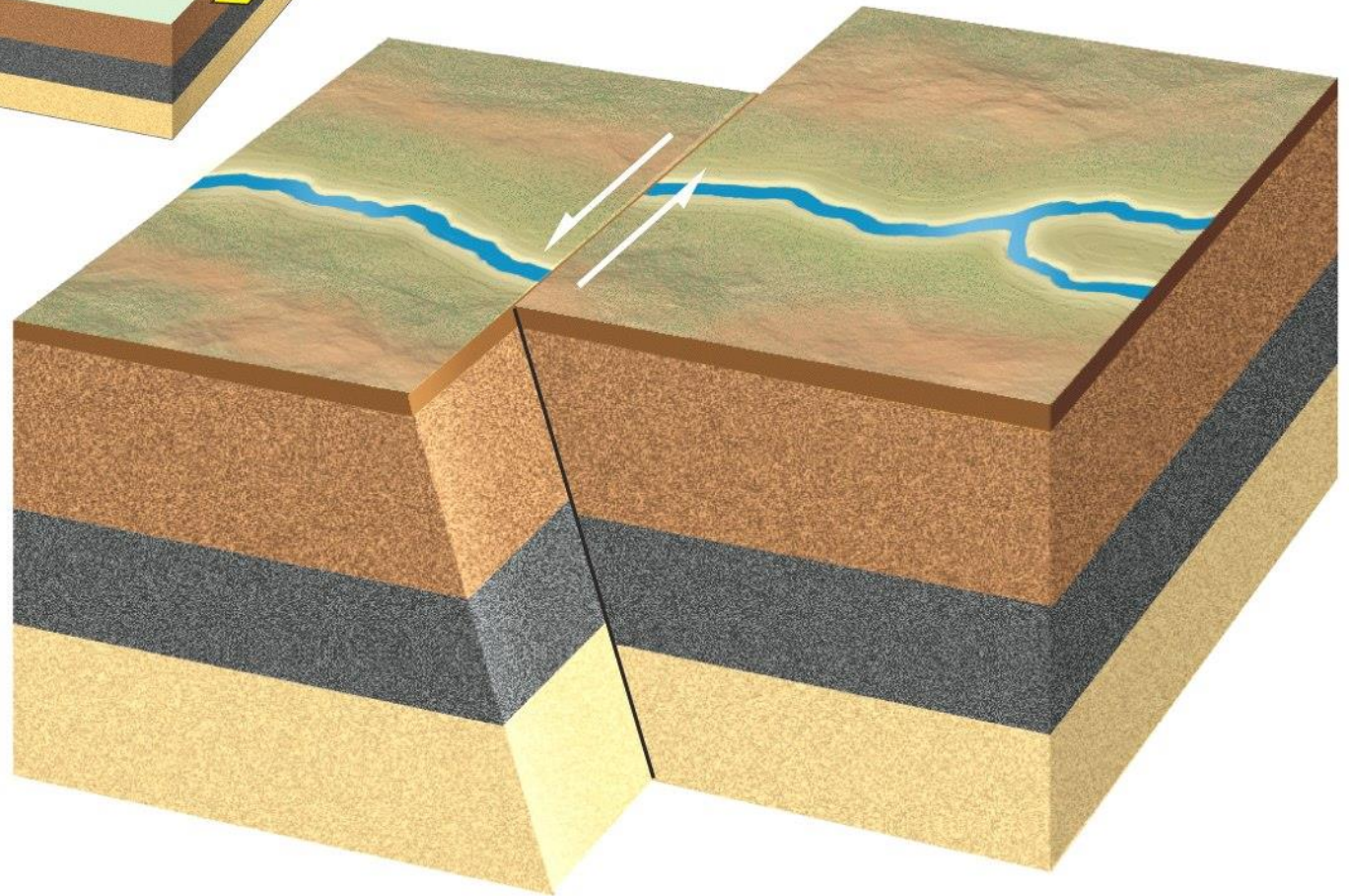
Oldest formation  
exposed on the surface

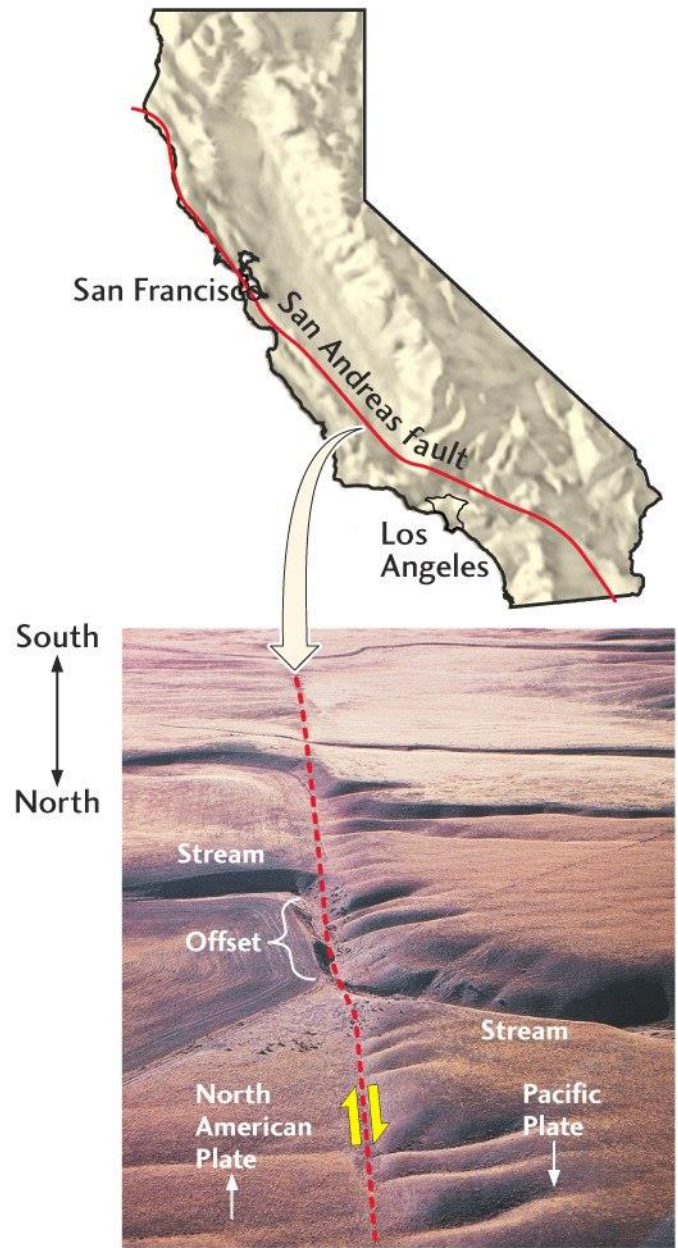
Youngest formation



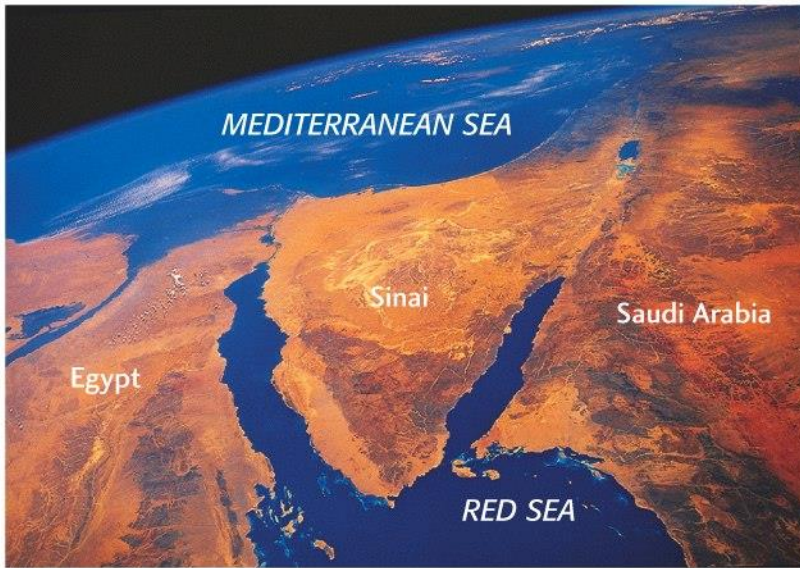
© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

# Strike-slip fault

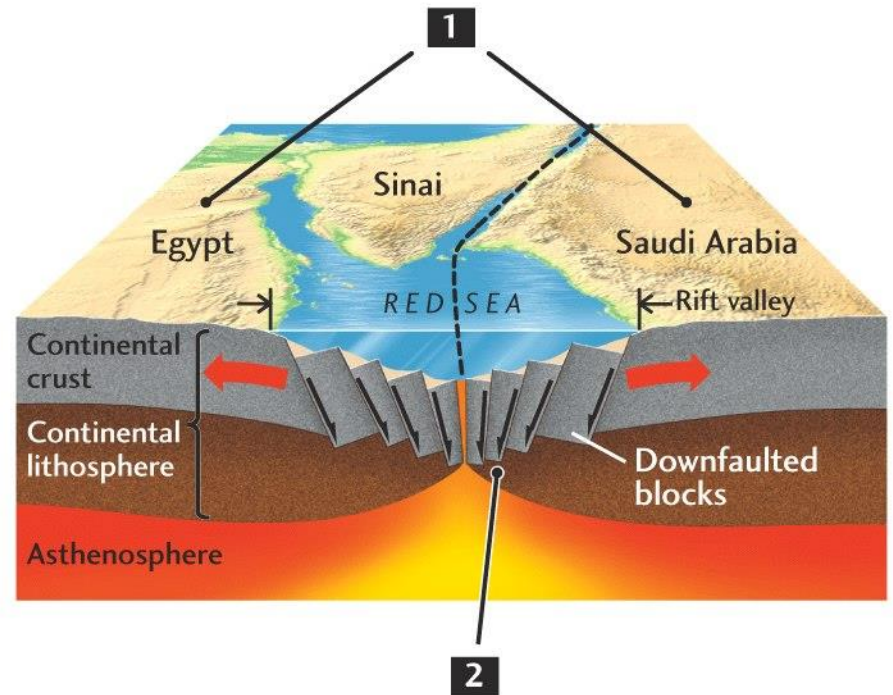




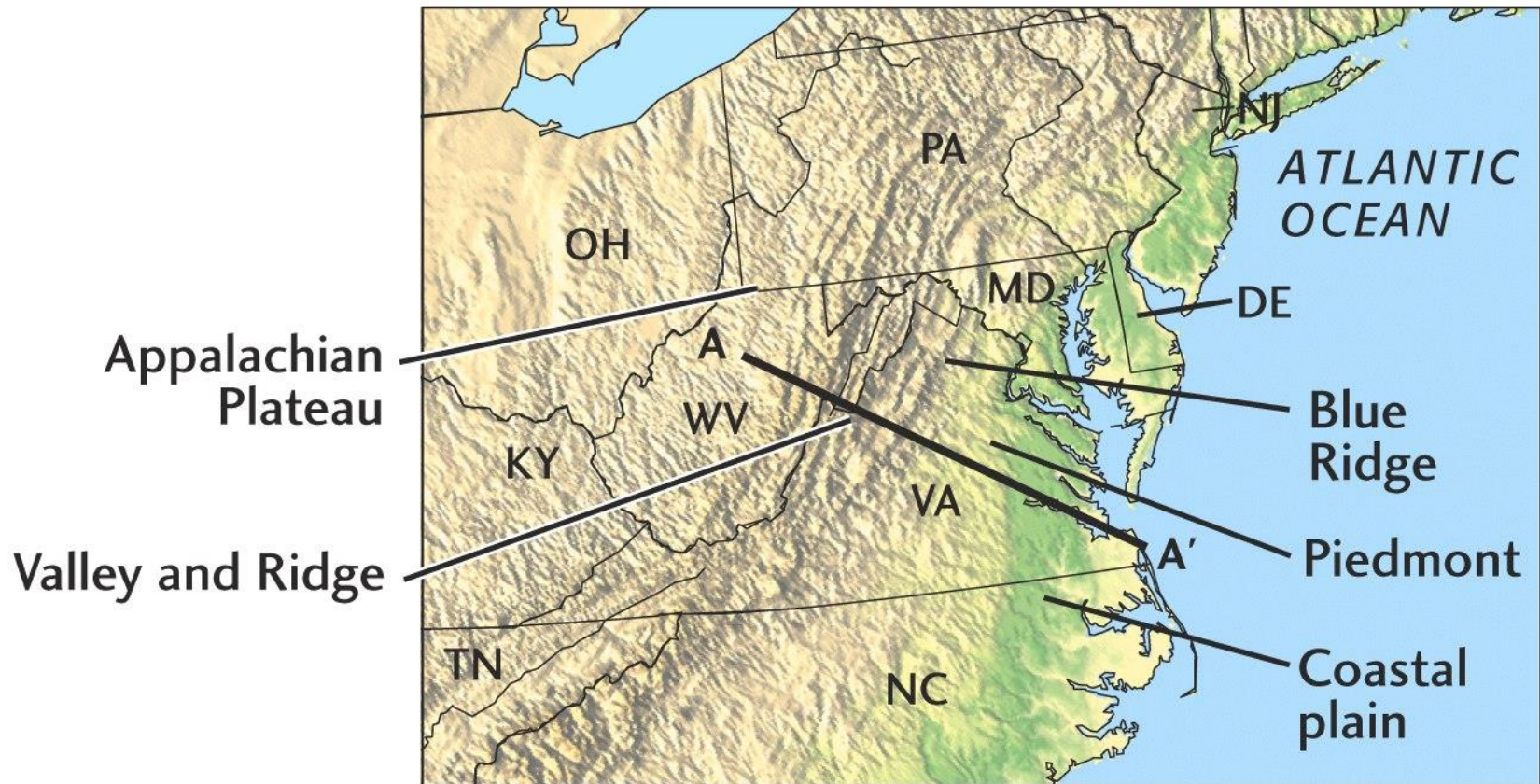
Courtesy of [Ron Schott](#). Used with permission.



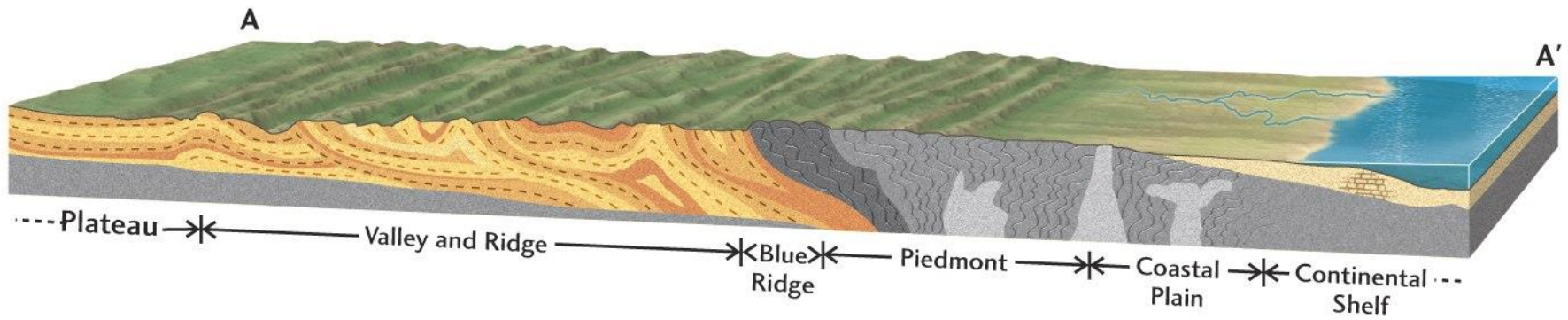
Courtesy of NASA. Photograph in the public domain.



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



# **Structural Geology - the study of rock deformation.**

Features of rock deformation are collectively referred to as structure or structural features.

**Stress and strain - terms used to describe the**  
type of rock deformation

# Stress: *force applied to a body/unit area*

## 2 Types:

- **1. Uniform or confining stress** - force on a body that is equal in all directions.  
Does not usually deform a rock (change shape) but may result in a change in size or metamorphism.
- **2. Differential stress** - stress that is not equal in all directions and is caused by tectonic forces.  
Usually causes a change in shape, but not in size.

## 3 Types of Differential Stress:

- **1. Tension** - a stretching stress. Rocks have very little strength under tensional stress and break apart easily.
- **2. Compression** - a squeezing stress. Rocks are relatively strong under compression.
- **3. Shear** - stress operates in opposite directions across the body

## Strain:

- ***Deformation*** or change of shape a rock body experiences when under differential stress.

### 3 Types of Strain

- **1. Elastic strain /deformation** - recoverable strain.
- **2. Plastic strain/ ductile deformation** - permanent strain. When stress exceeds the strength of the rock the rock will bend or fold
- **3. Brittle strain/deformation** - permanent strain.

When stress exceeds the strength of the rock the rock will break or fracture

- ***Elastic strain /deformation = recoverable strain.***

When stress is removed, object regains original shape. (Ex: rubber band).

- ***elastic limit*** - limiting stress beyond which the rock can not return to its original shape and will be permanently deformed.

Depends on type of rock involved and temperature.

- ***Plastic strain/ ductile deformation = permanent strain.***

When rock is stressed beyond elastic limit and when stress is removed, object remains deformed by bending.

- ***Brittle strain/deformation - permanent strain.***
- When stress exceeds the strength of the rock
- the rock will break or fracture (Ex: Chalk).



- **Factors that influence the type of permanent strain**
- **in rocks experiencing the same amount of stress:**
  - *Pressure/Temperature*
  - *Confining stress*
  - *Time and strain rate*
  - *Composition* - important in 2 ways:
    - *Mineral composition*
    - *Amount of water (fluid) in rock*

MIT OpenCourseWare  
<http://ocw.mit.edu>

12.001 Introduction to Geology  
Fall 2013

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.