



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

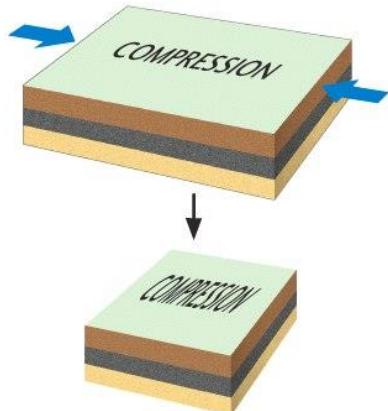
Rock Deformation-Structural Geology



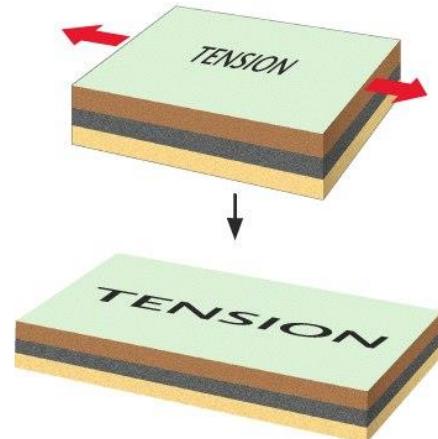
3 Types of Differential Stress:

TECTONIC STRESS LEADS TO STRAIN

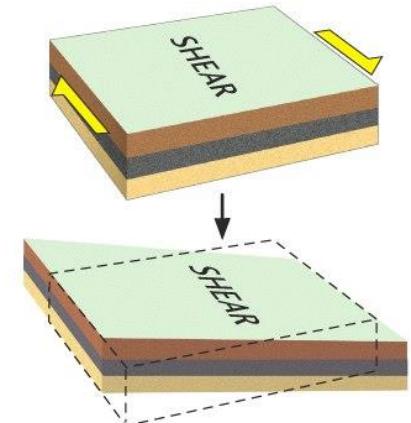
Compressive forces squeeze and shorten a body.



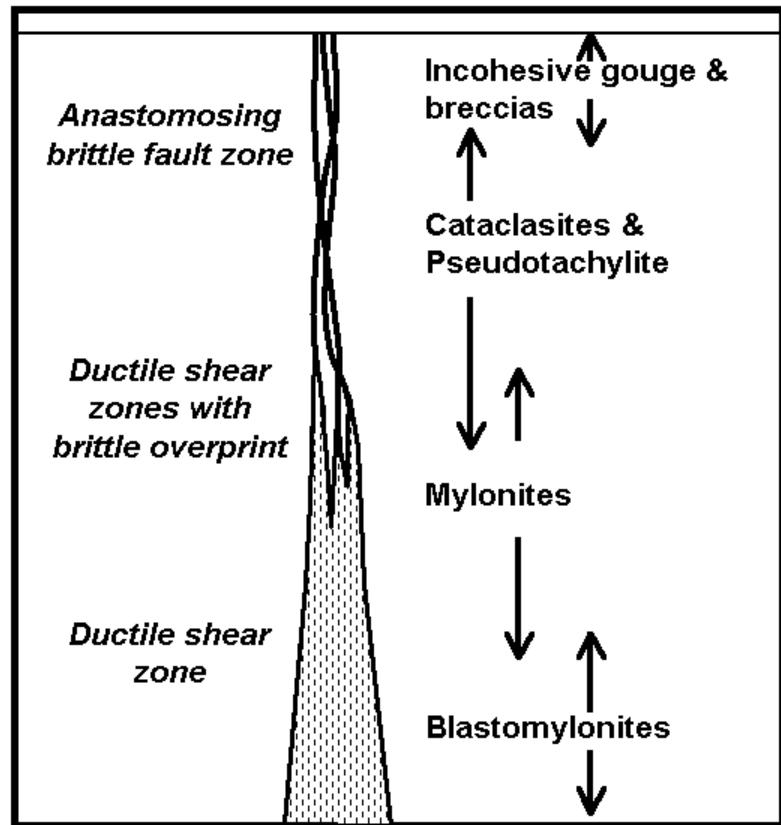
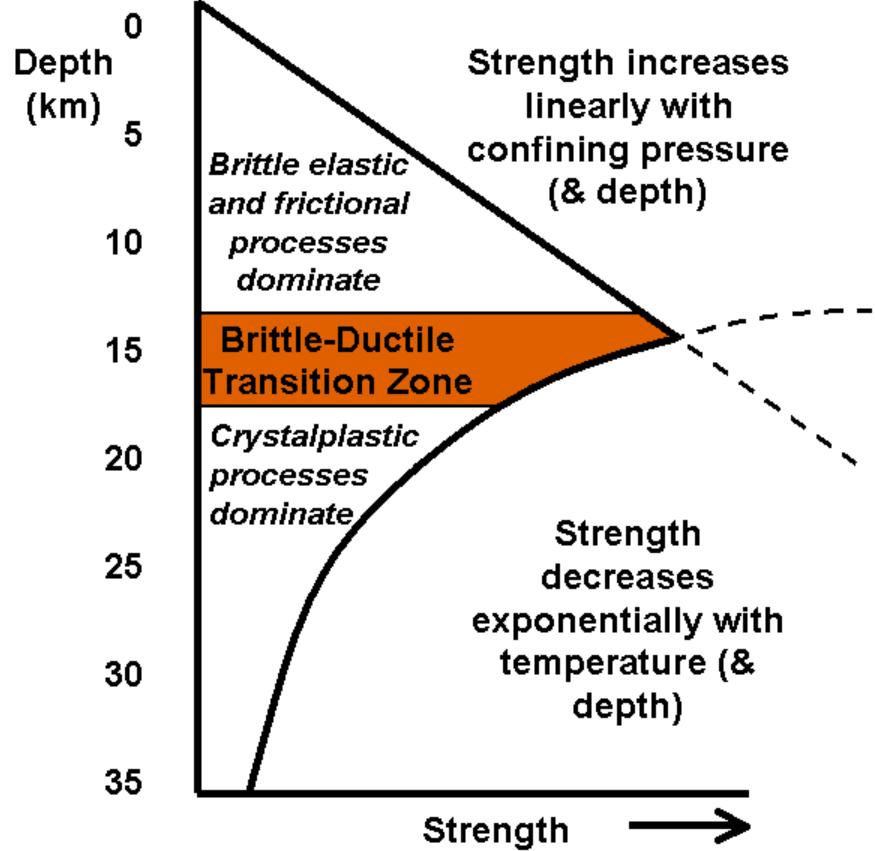
Tensional forces stretch a body and tend to pull it apart.

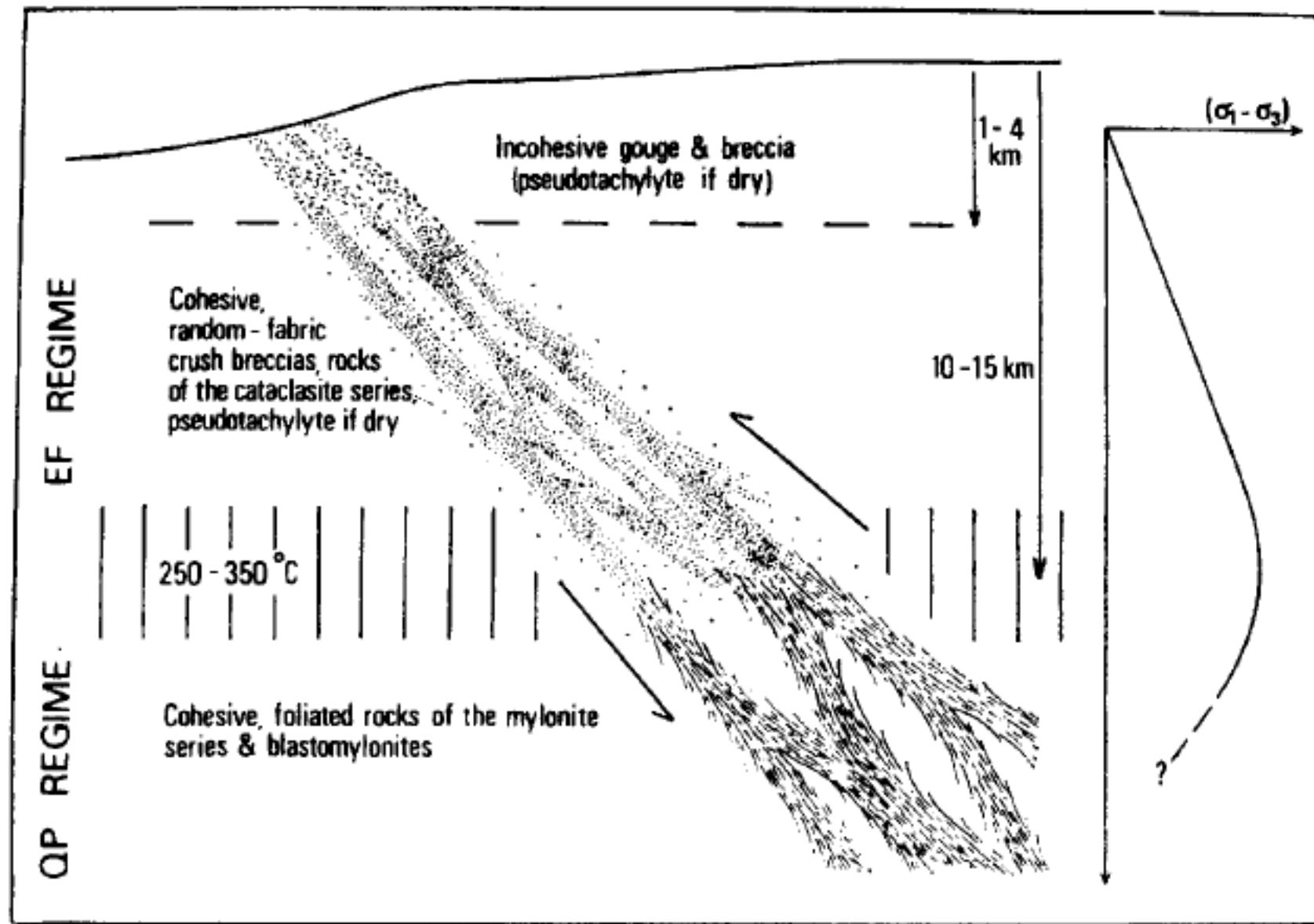


Shearing forces push two sides in opposite directions.



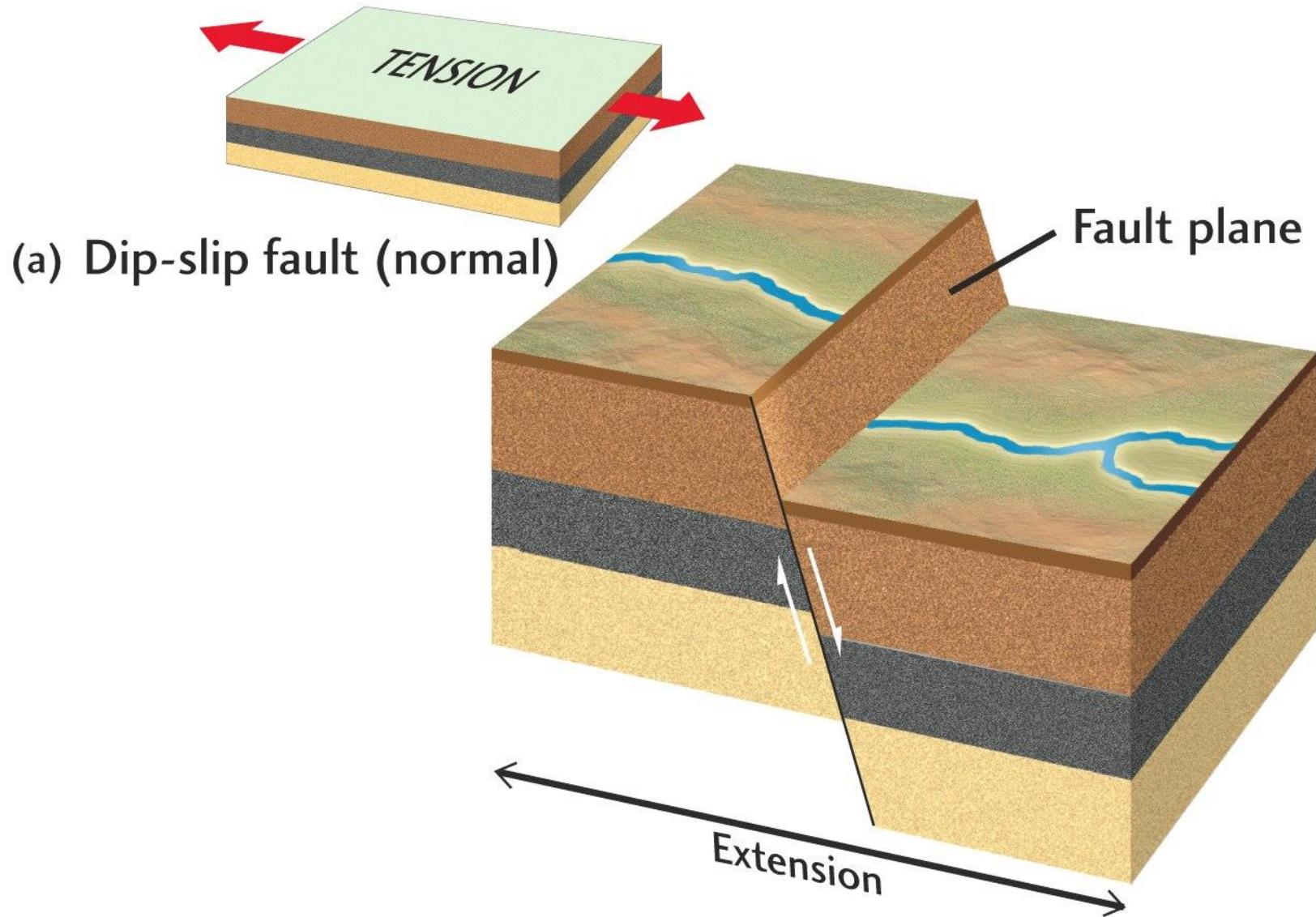
© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



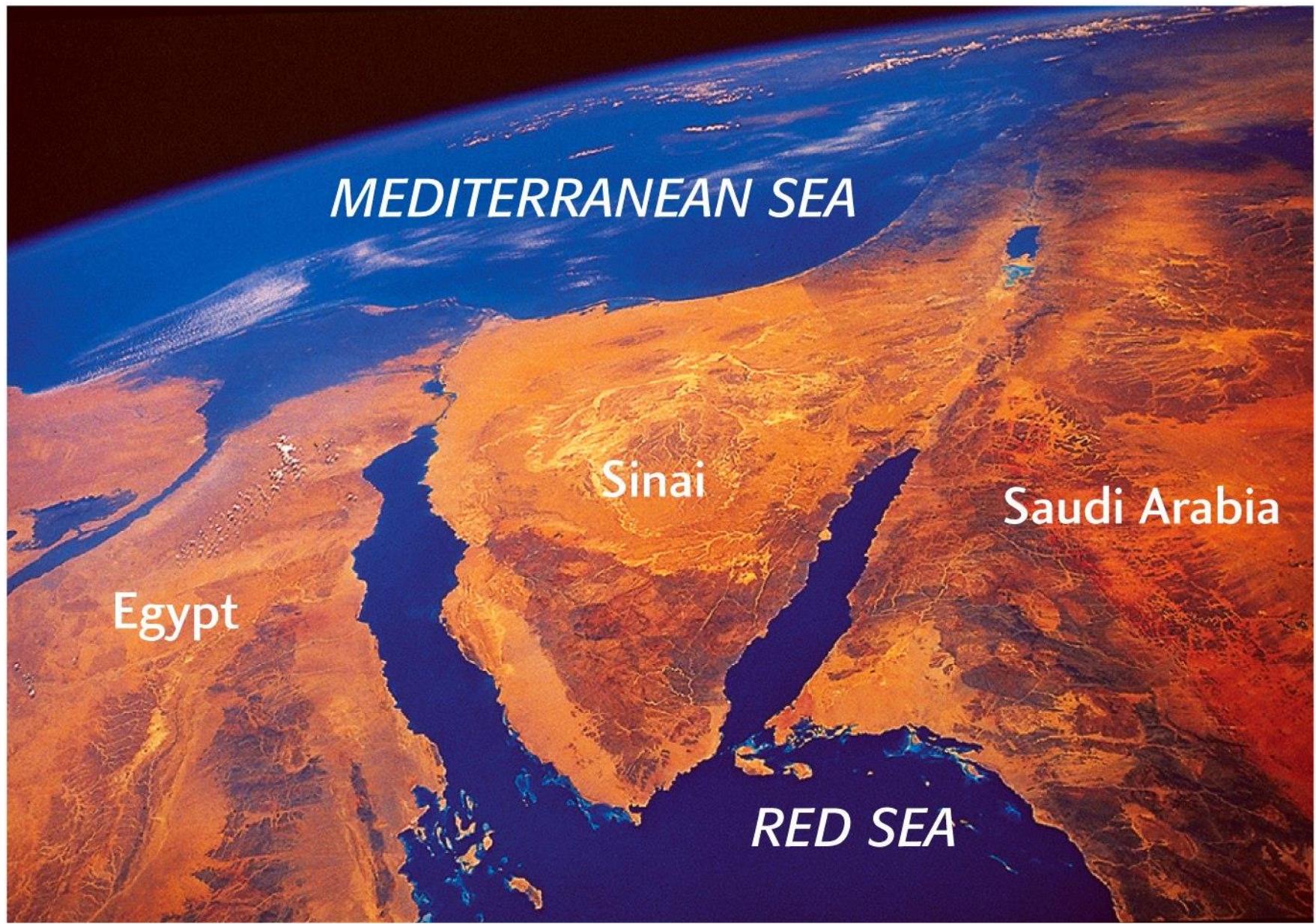


Sibson, 1977

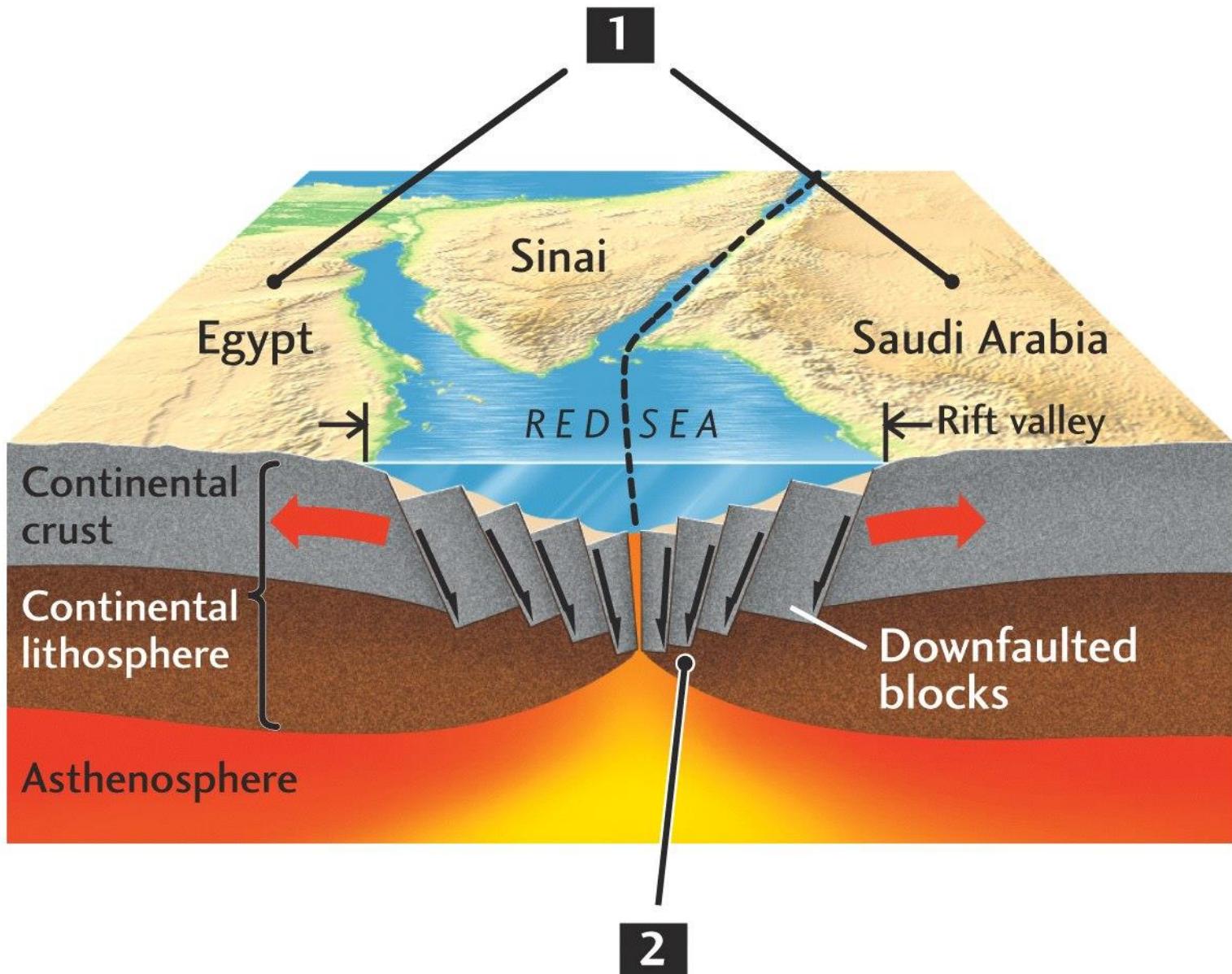
© The Geological Society of London. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.
Source: Sibson, R. H. "Fault Rocks and Fault Mechanisms." *Journal of the Geological Society* 133, no. 3 (1977): 191-213.



© 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/>.



Courtesy of NASA. Photograph in the public domain.

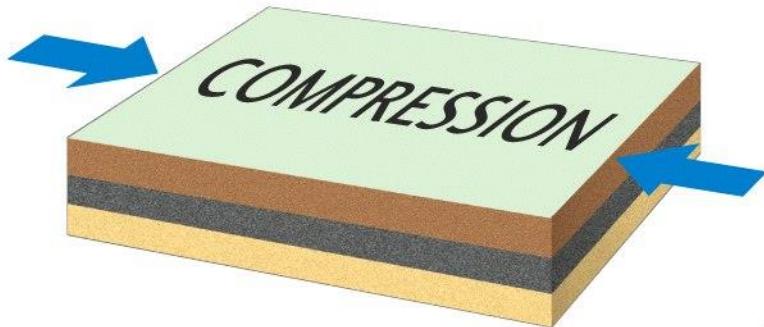


© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

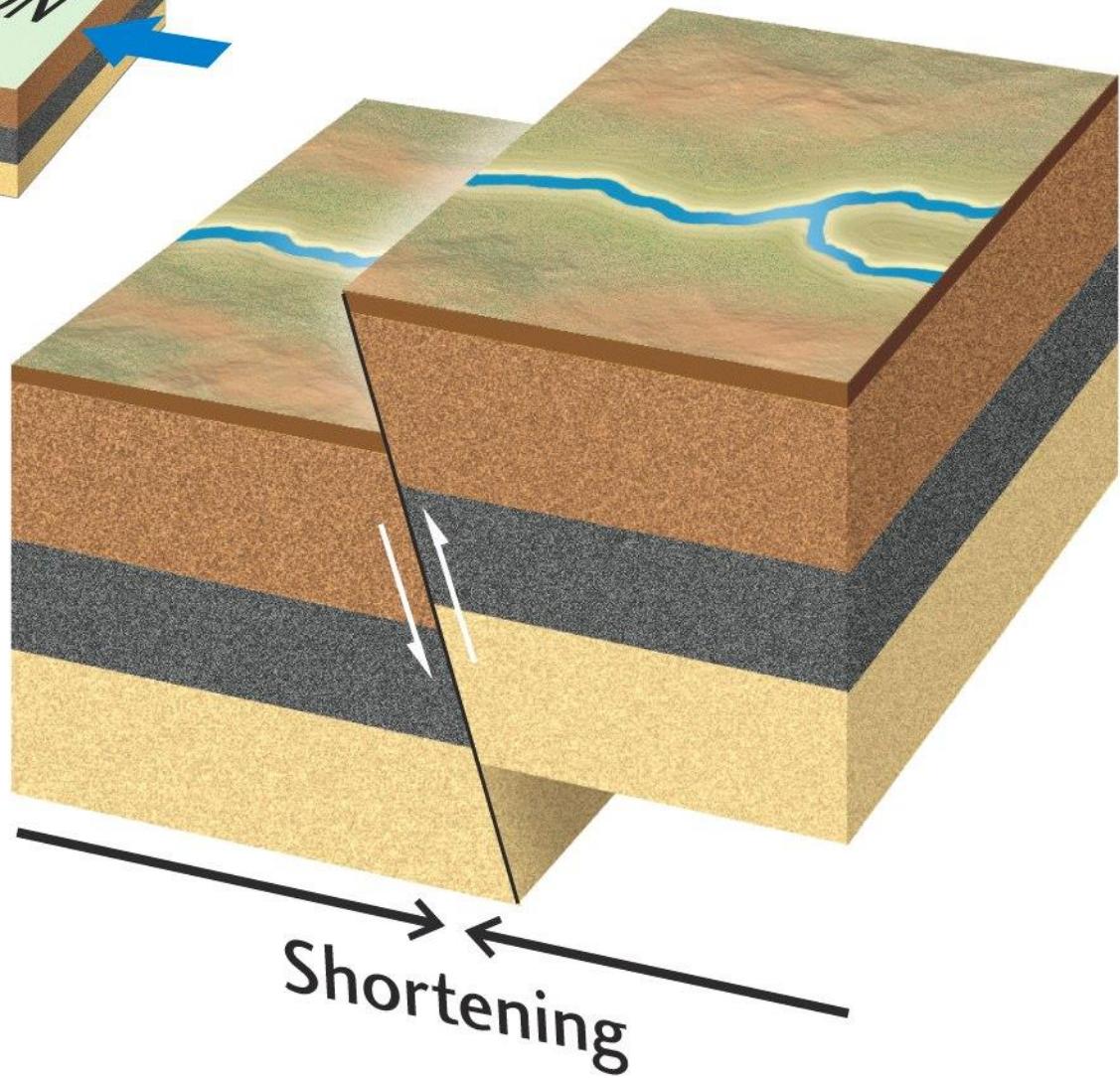


© 2009 www.DioGeneS.ethz.ch

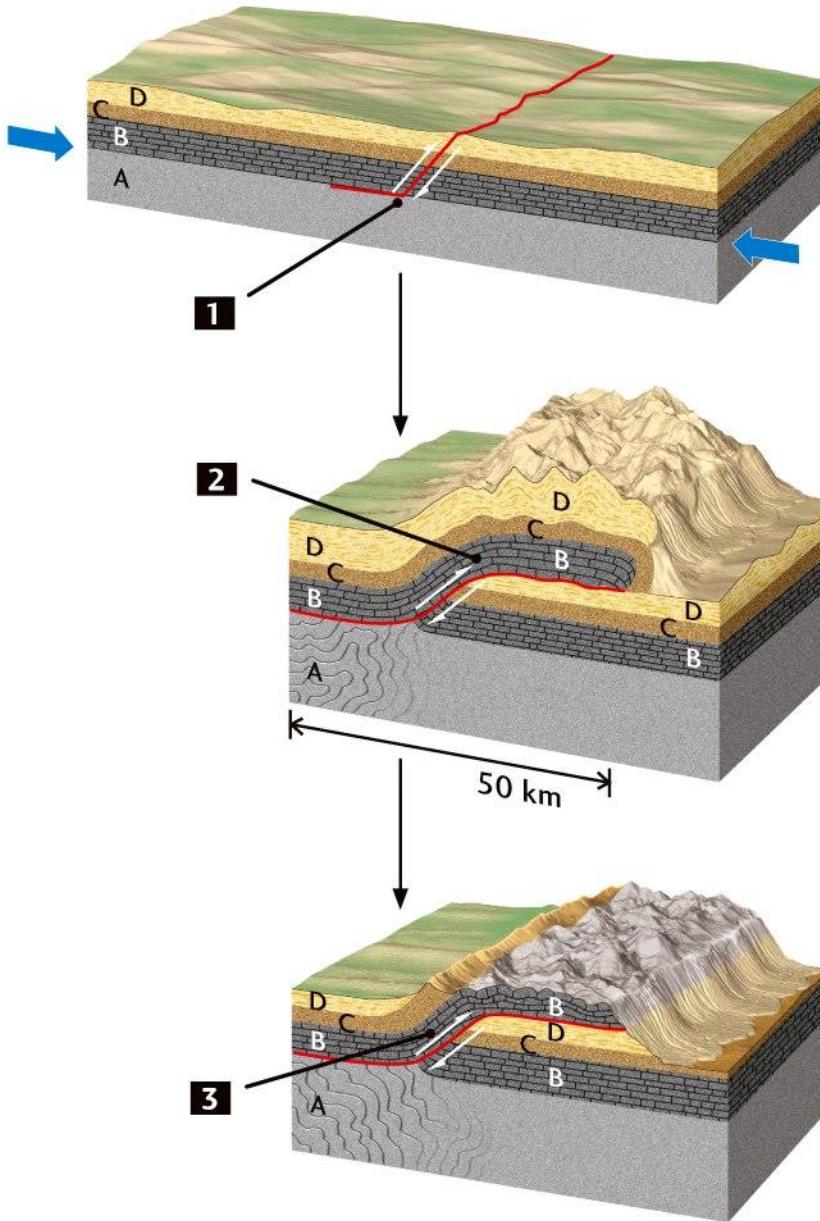
© DioGeneS.ethz.ch All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



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/>.



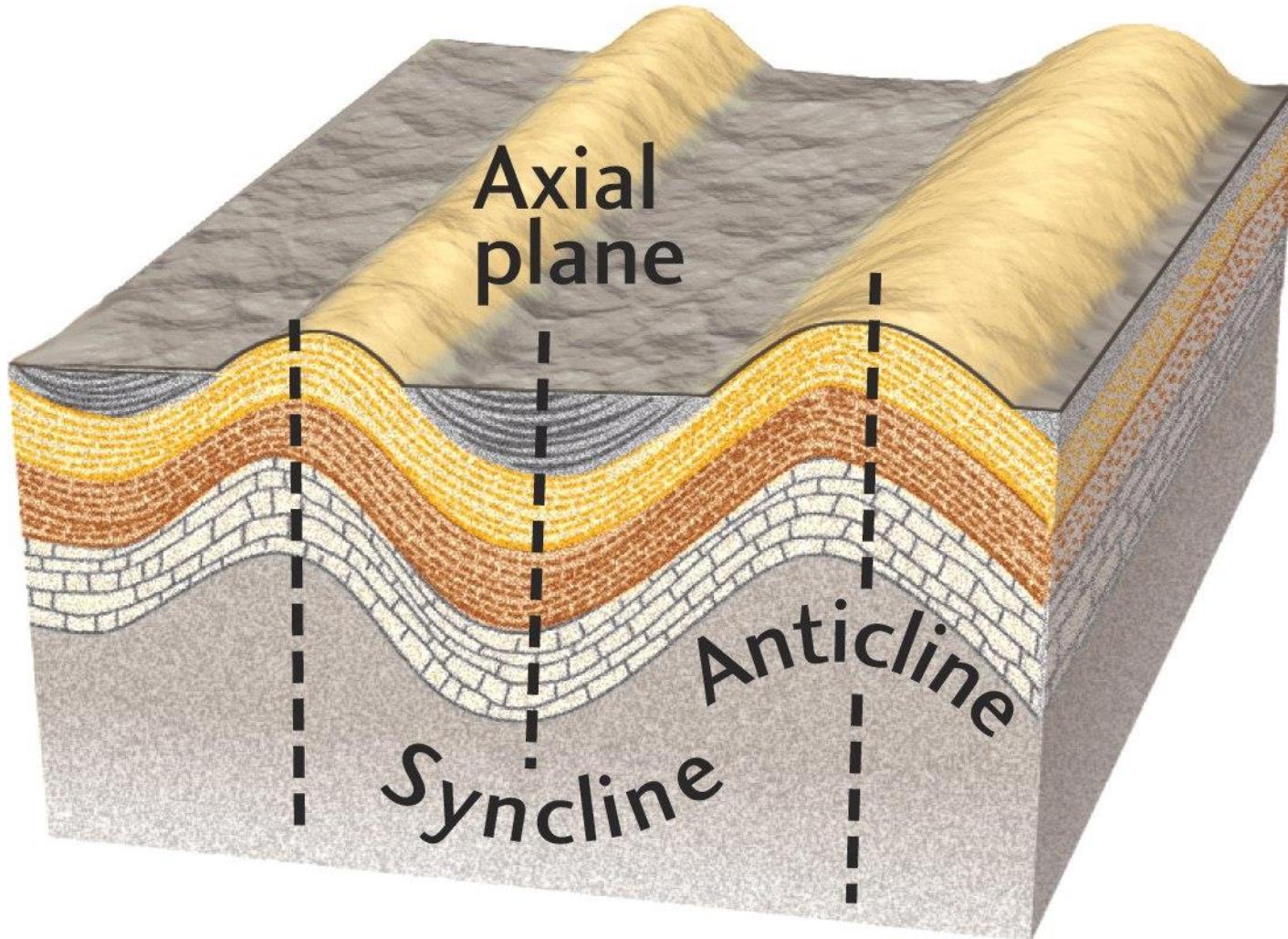
Keystone thrust fault, southern Nevada



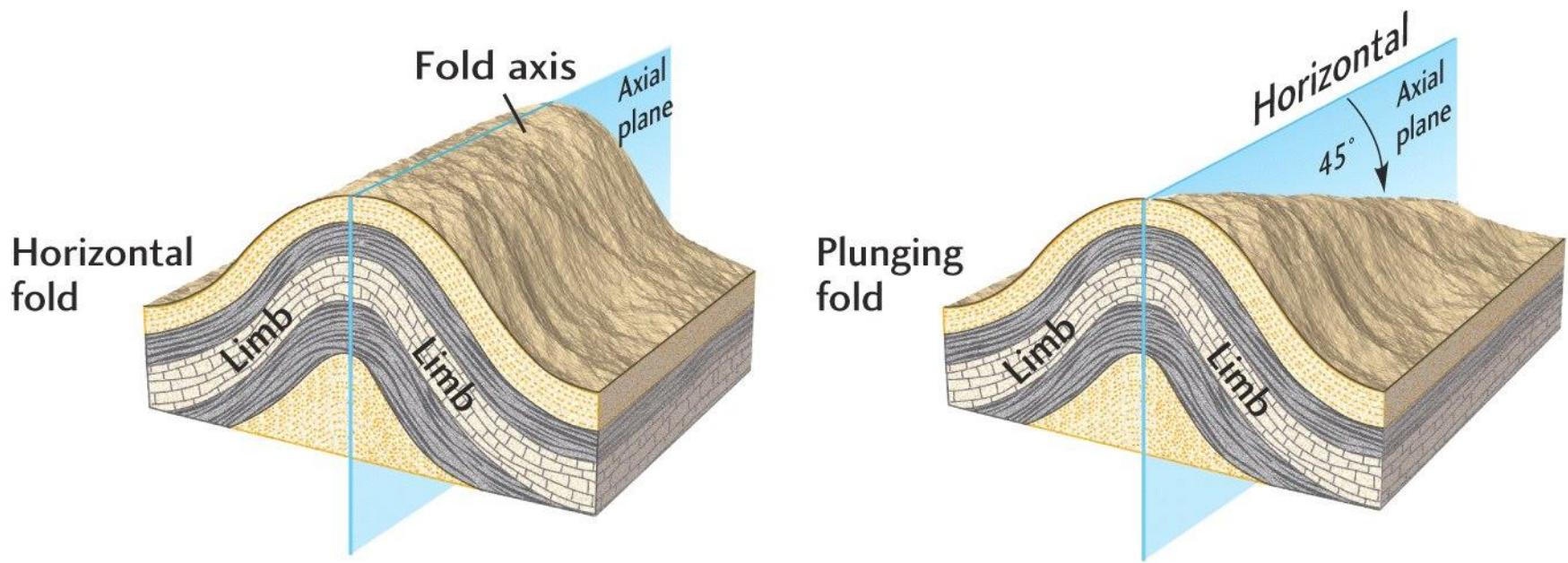


© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

Symmetrical folds

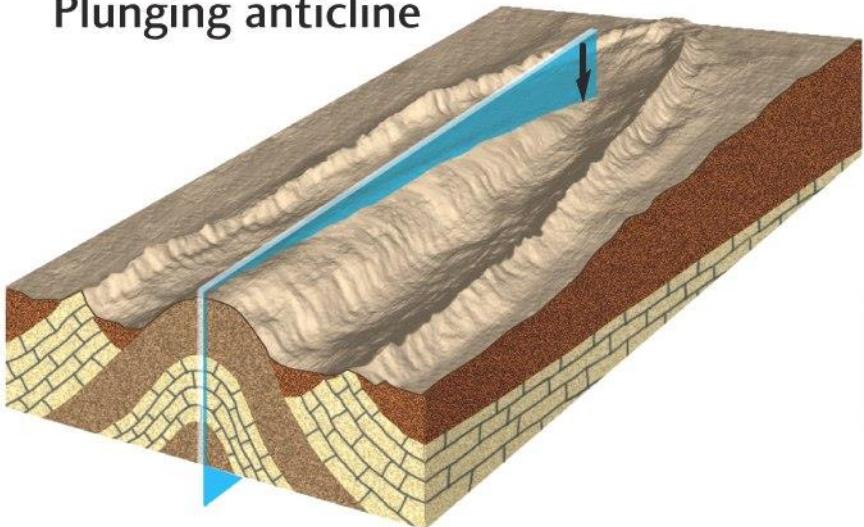


© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

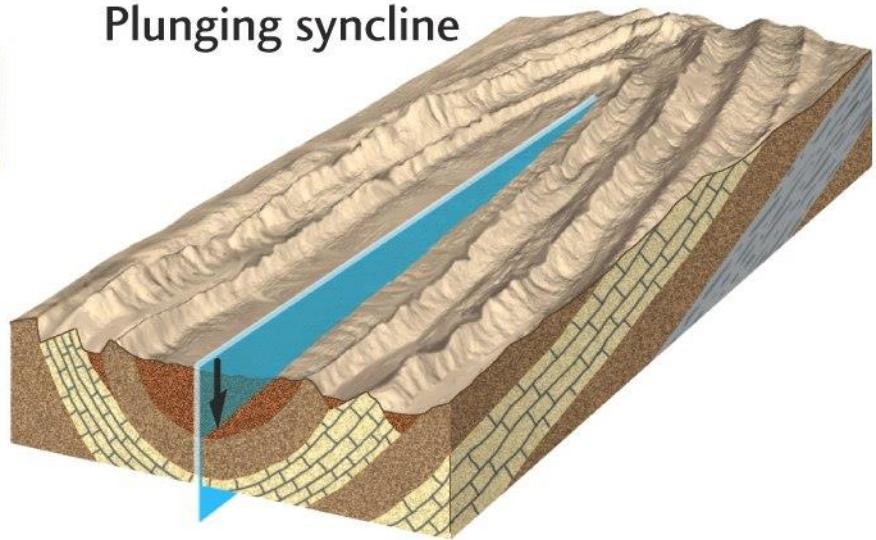


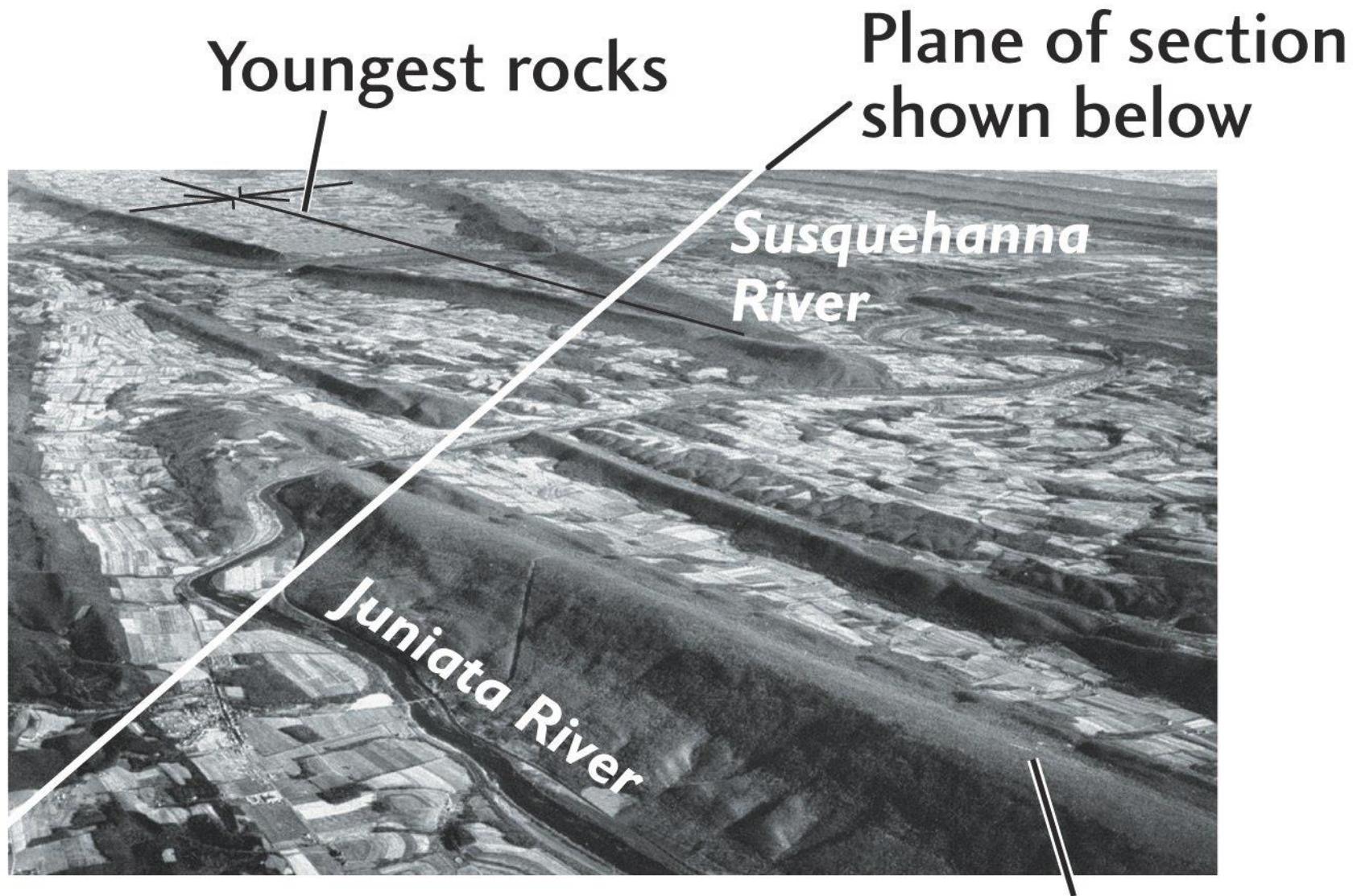
© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.

Plunging anticline

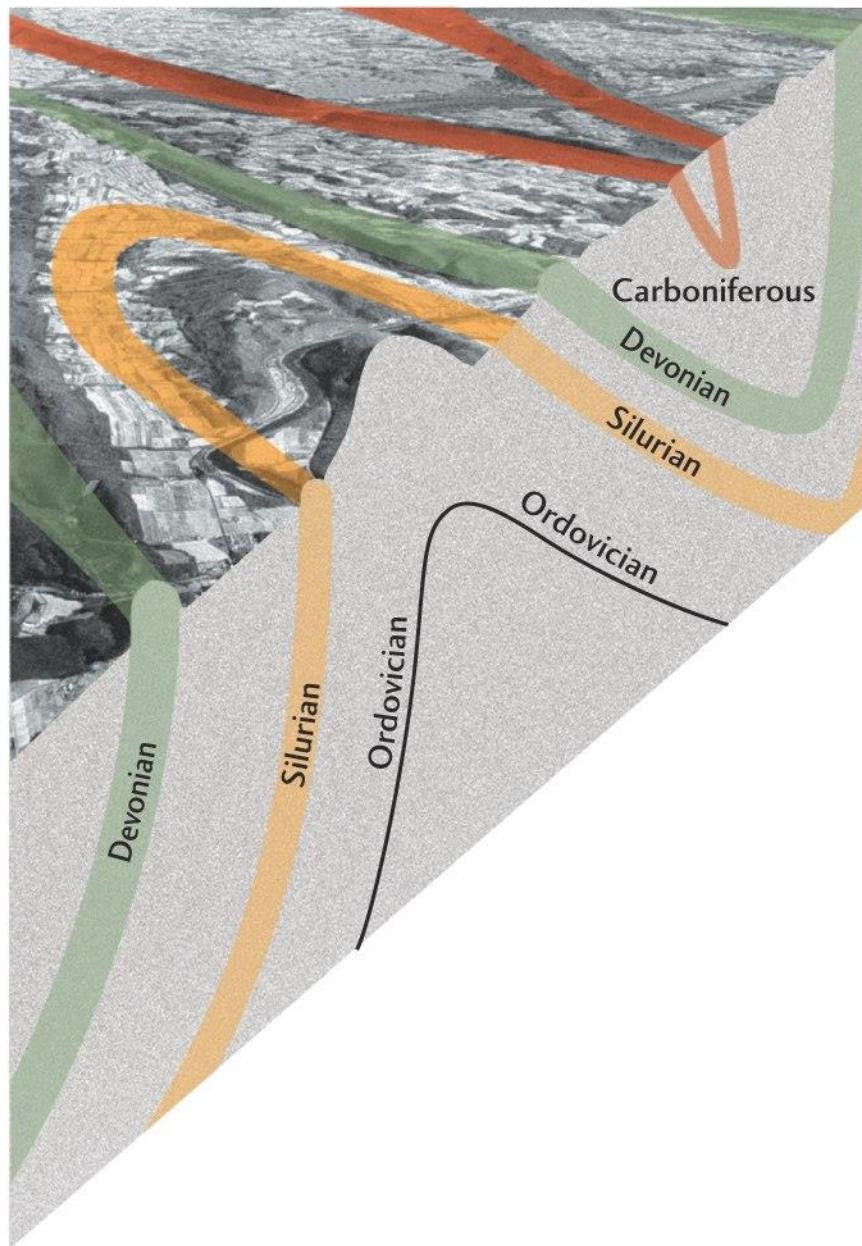


Plunging syncline

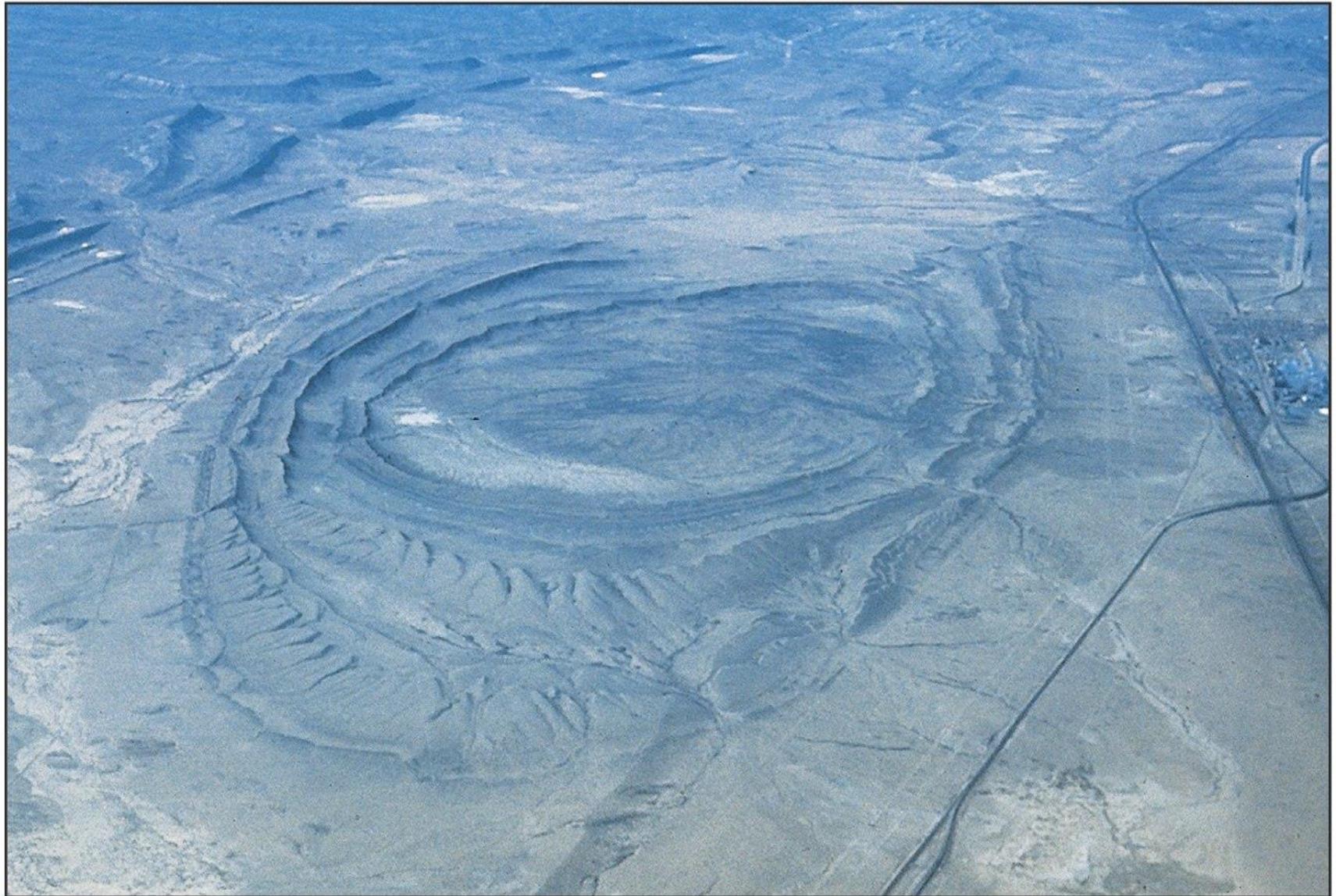




Oldest rocks

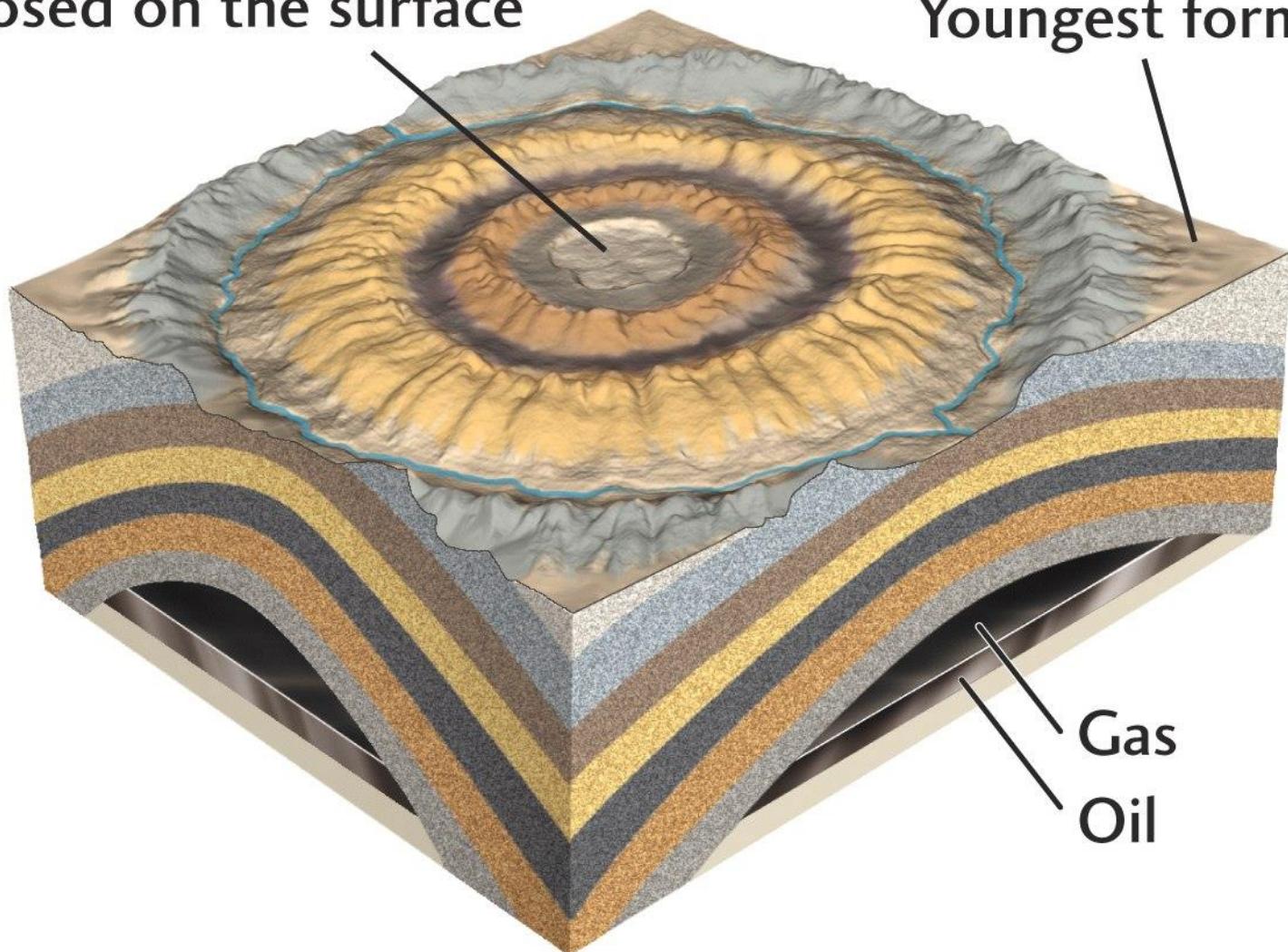


© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



© 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/>.

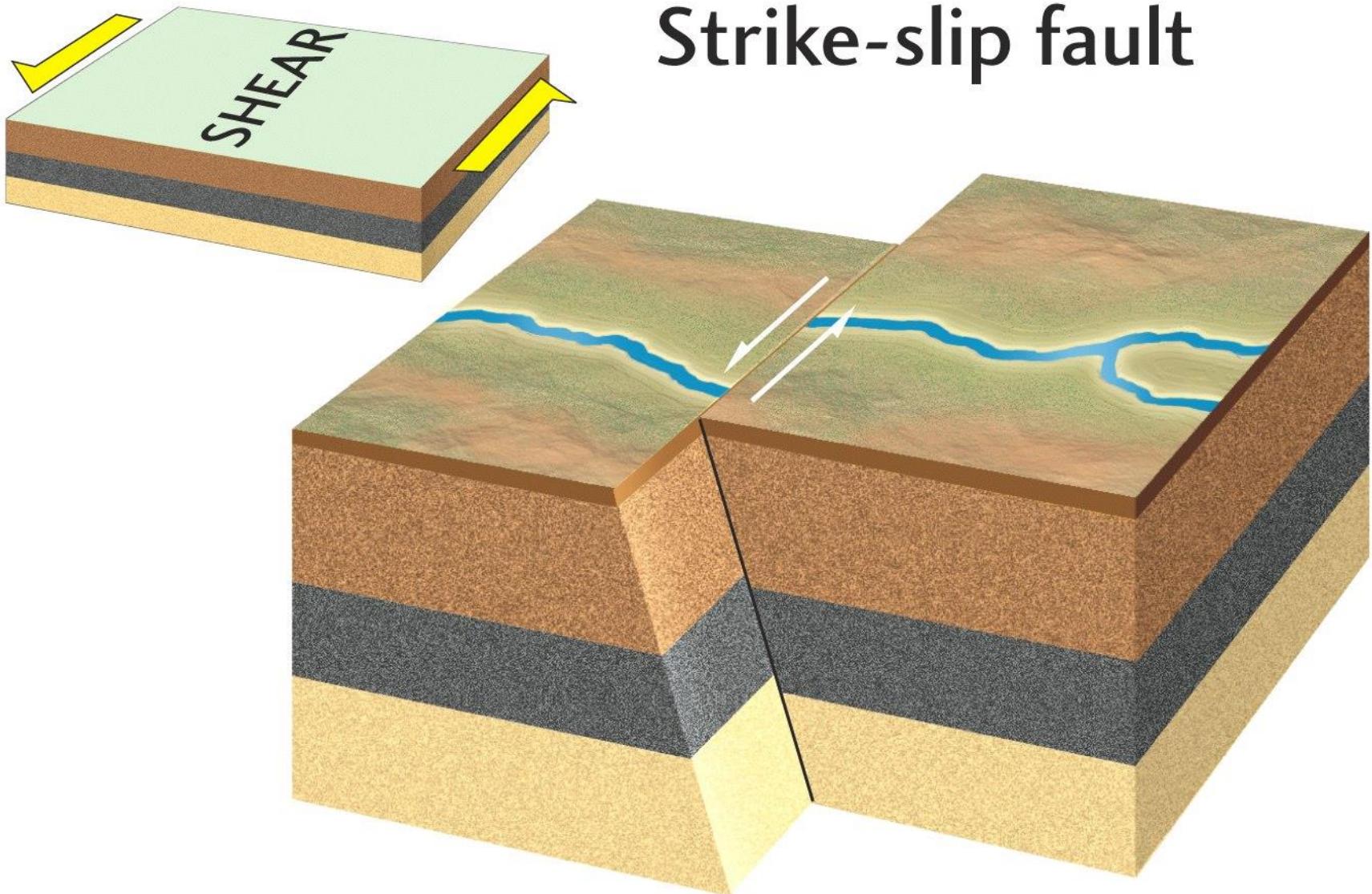
**Oldest formation
exposed on the surface**



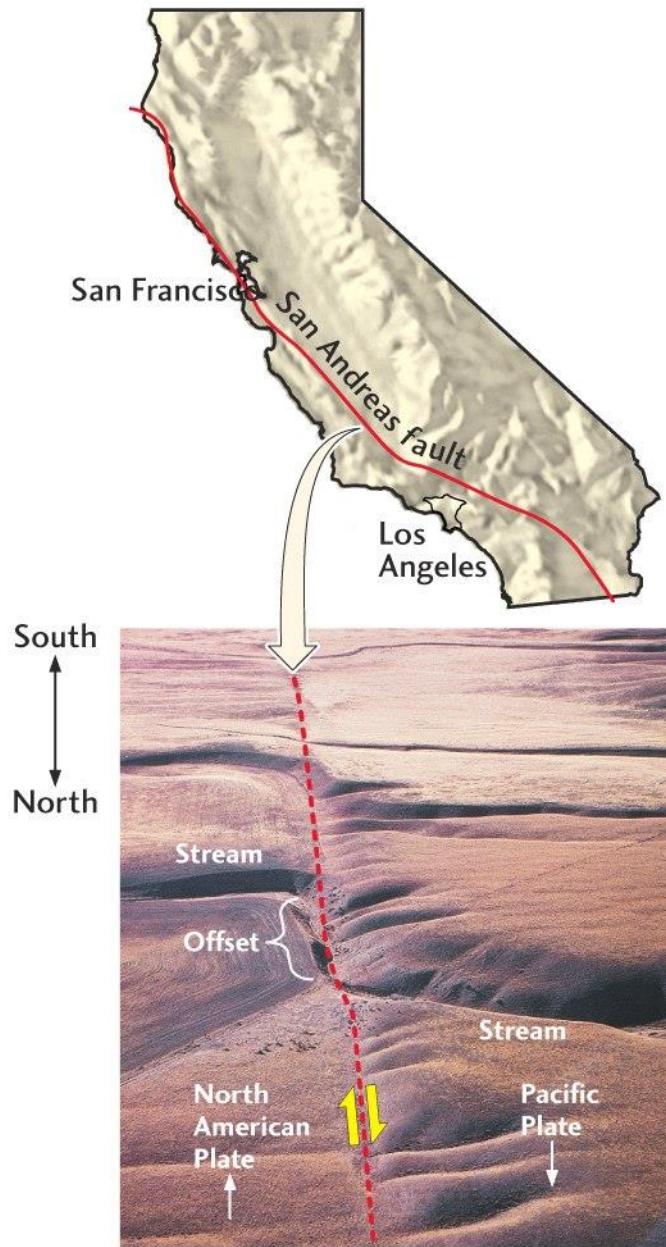
Youngest formation

**Gas
Oil**

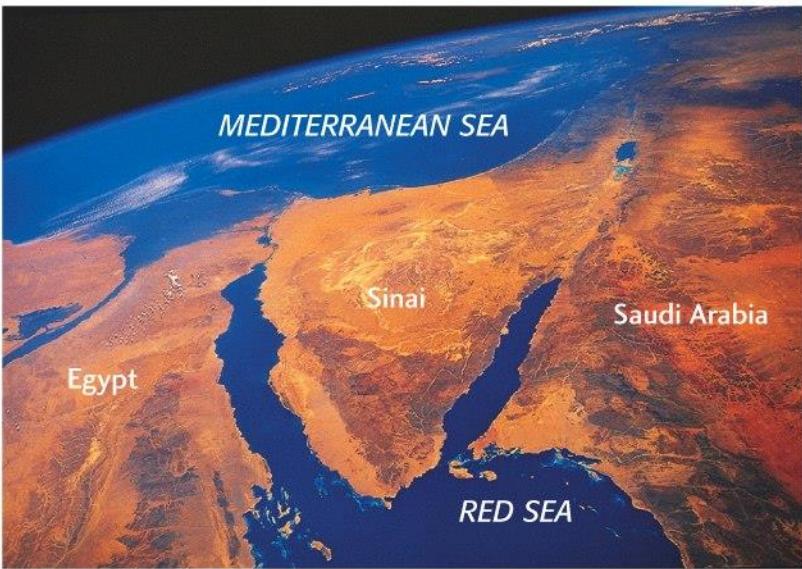
Strike-slip fault



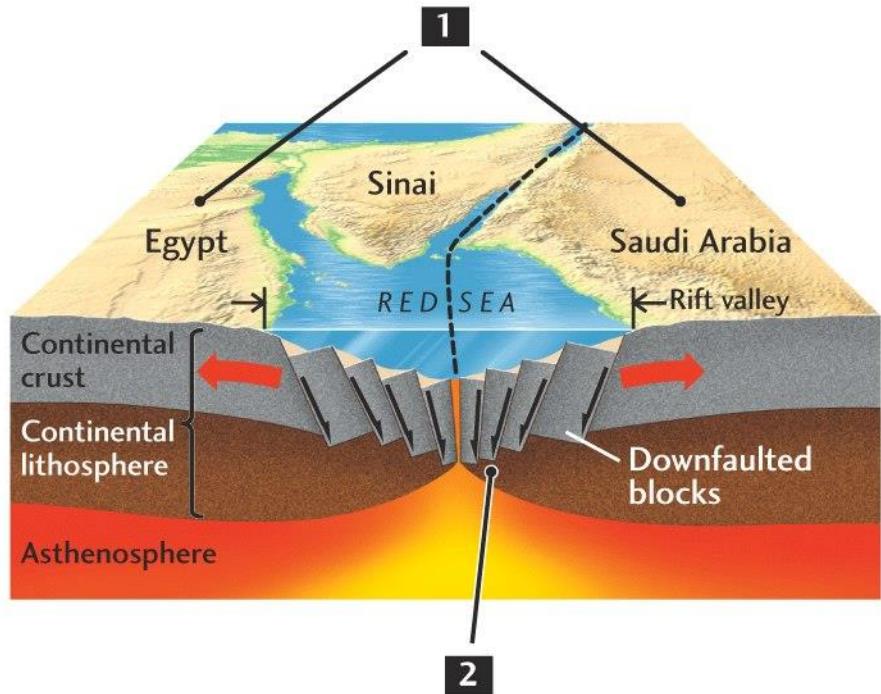
© source unknown. All rights reserved. This content is excluded from our Creative Commons license. For more information, see <http://ocw.mit.edu/help/faq-fair-use/>.



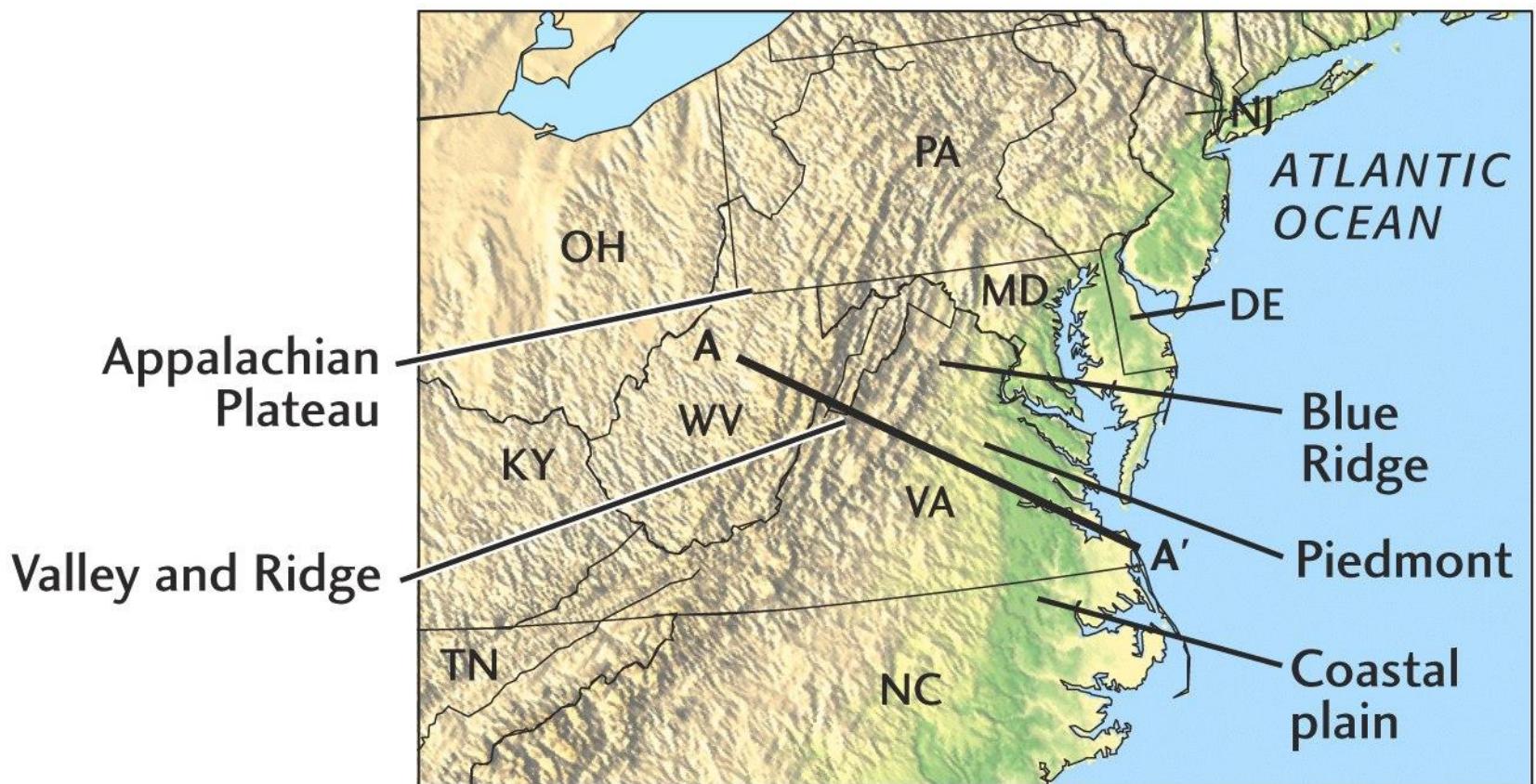
Courtesy of Ron Schott. Used with permission.



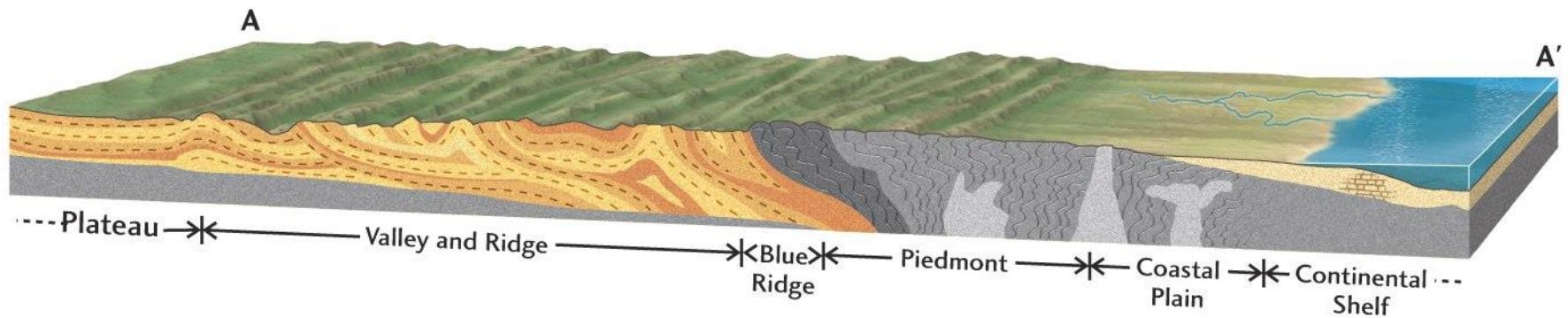
Courtesy of NASA. Photograph in the public domain.



© 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>.