

Principles of Historical Geology

Geology 331

Principles

- Principle of Superposition
- Principle of Original Horizontality
- Principle of Original Lateral Continuity
- Principle of Intrusive Relationships
- Principle of Cross-Cutting Relationships
- Principle of Fossil Succession – will discuss in Biostratigraphy Section

Principle of Superposition

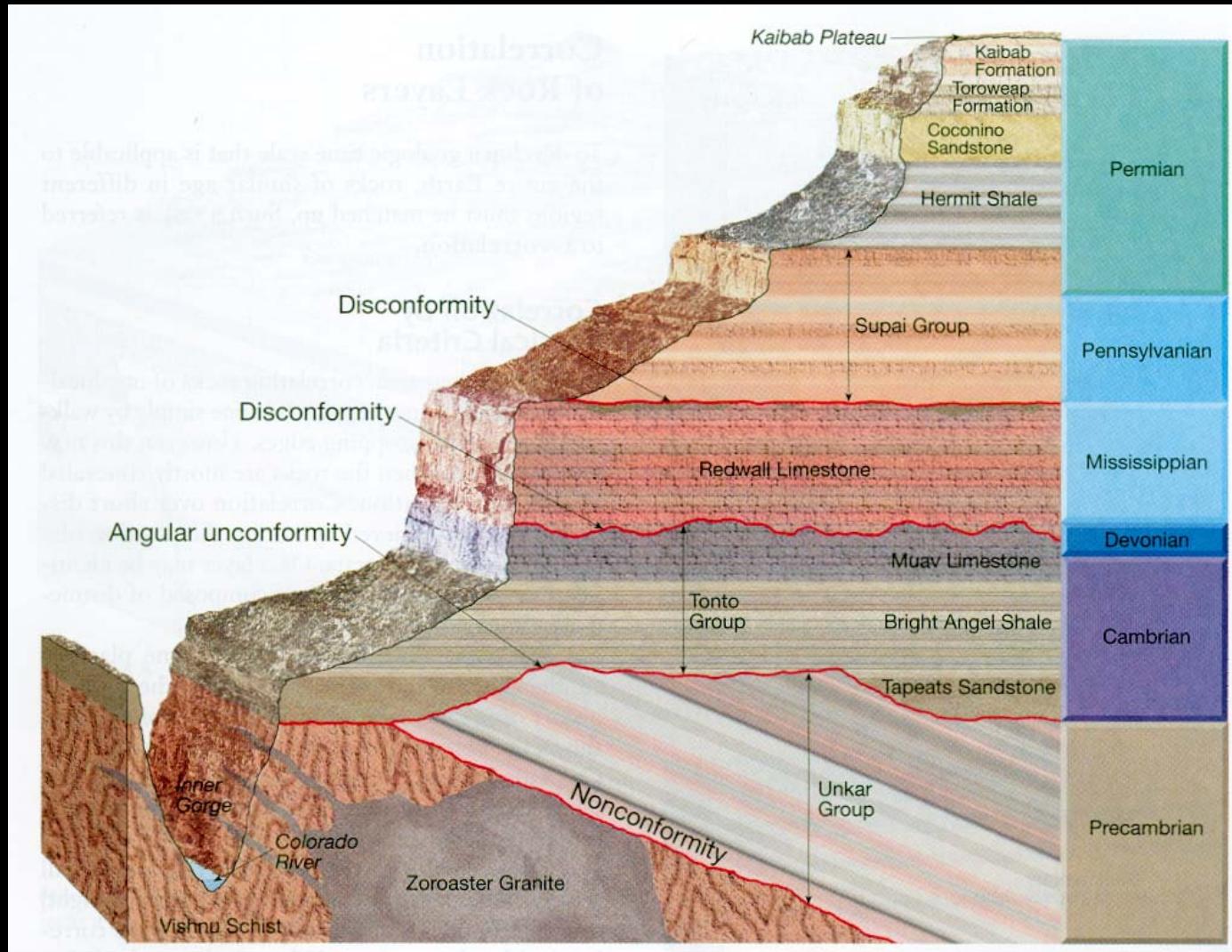
In any undeformed sequence of sedimentary rocks, each bed is younger than the one below it and older than the one above it.

This is the basis of relative ages of all strata and their contained fossils.

The Grand Canyon in Arizona



Stratigraphy of the Grand Canyon in Arizona



younger

older

Original Horizontality - Sediments usually form flat-lying deposits on the earth's surface.



Original Horizontality - Sedimentary rocks are horizontal because the original sediments were horizontal.



Original Horizontality – These layers were once horizontal. Why are they now tilted?



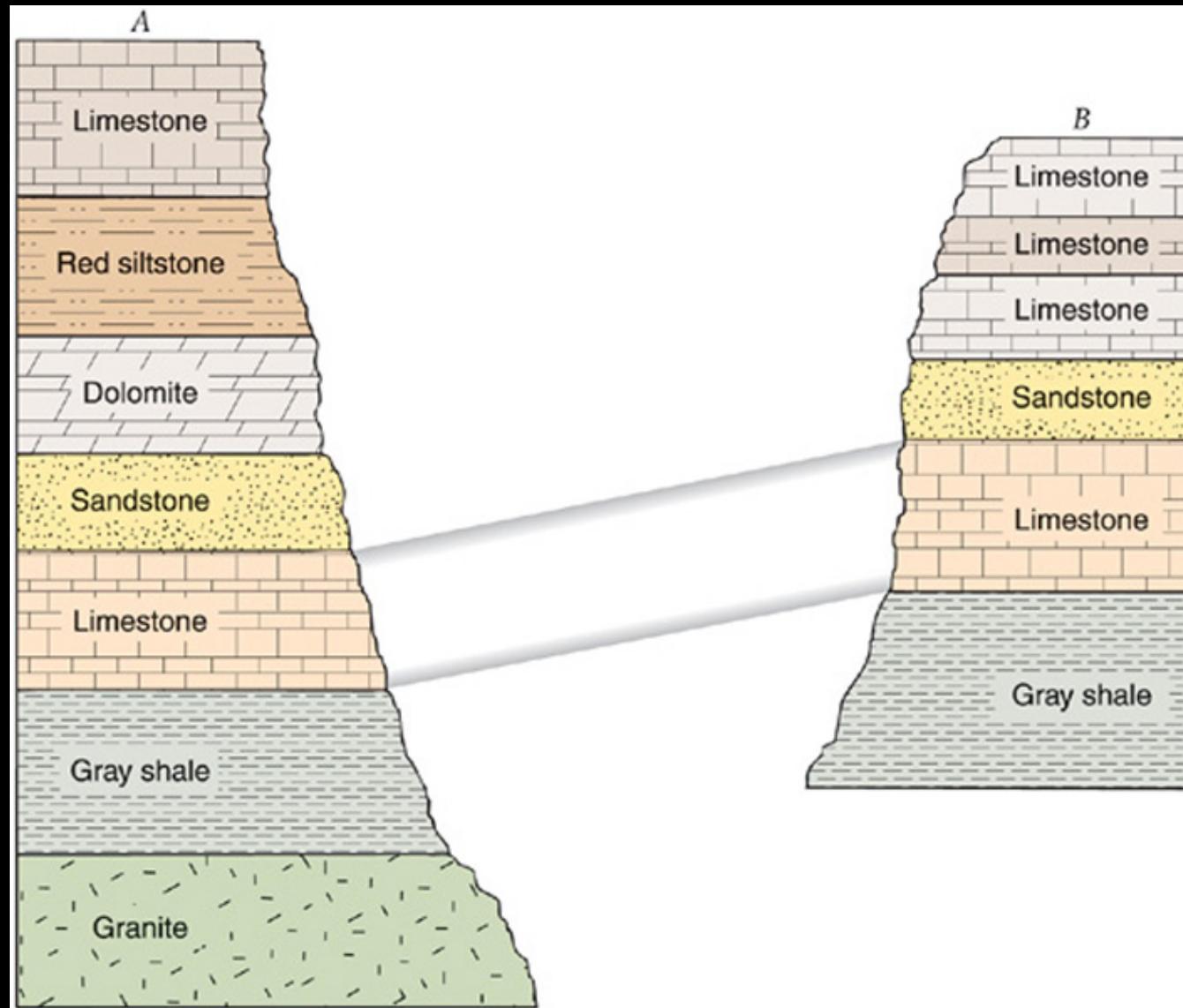
Principle of Original Lateral Continuity

- Strata originally extended in all directions until they thinned to zero at their edges of deposition.
- Thus, matching strata on opposite sides of a valley can be correlated.
- This principle is used to trace coal seams from one mountain to the next in West Virginia.

Original Lateral Continuity



Original Lateral Continuity



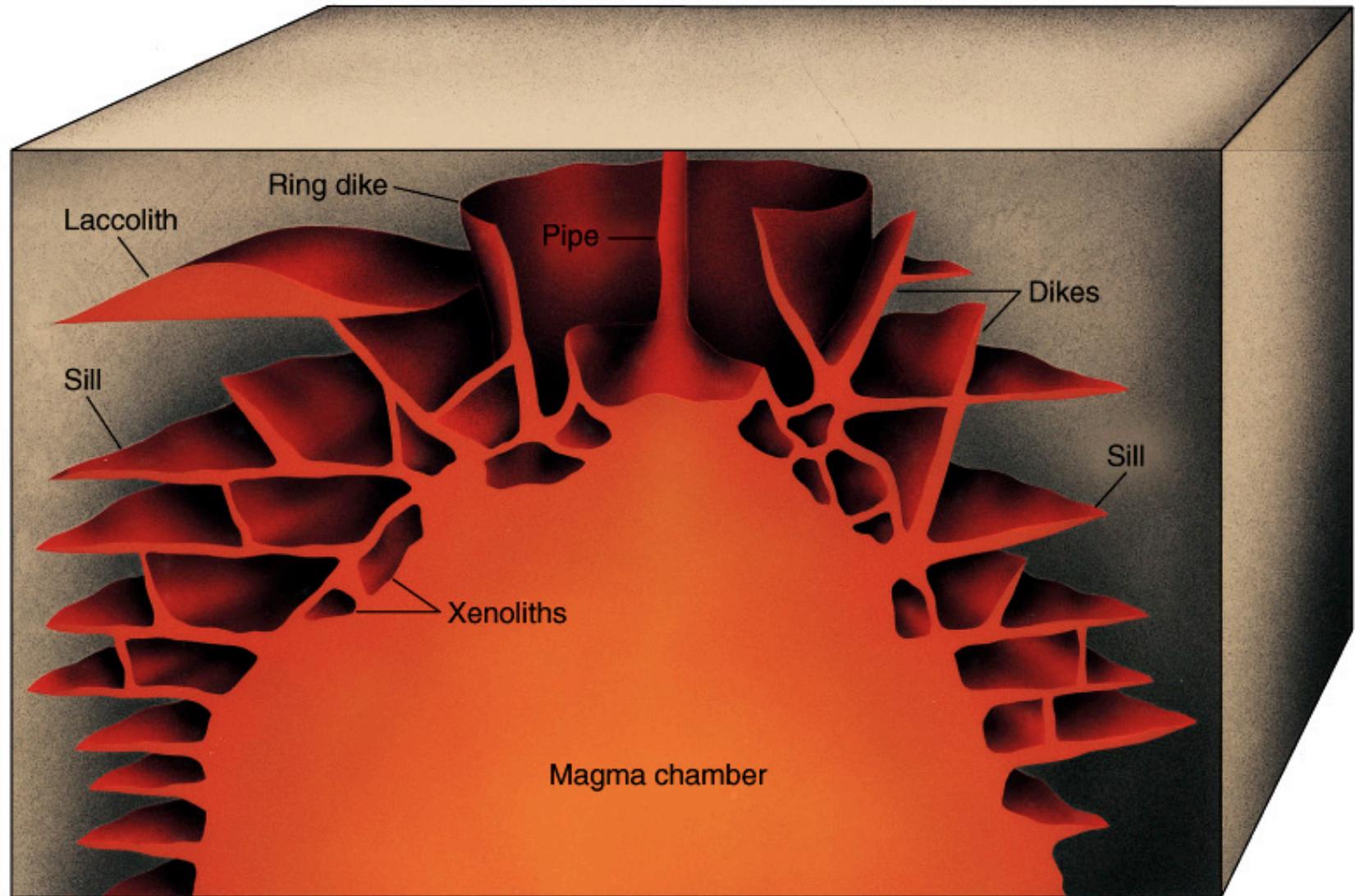
Coal Seams in WV on adjacent mountain tops



Principle of Intrusive Relationships

- Invading igneous rock is always younger than the rock it intrudes.
- This is an indicator of relative ages.

Different types of intrusive igneous bodies



Igneous dikes in black, granite in pink



Extrusive sill (246 ± 4 my)

Dike

Sediment

Unconformity

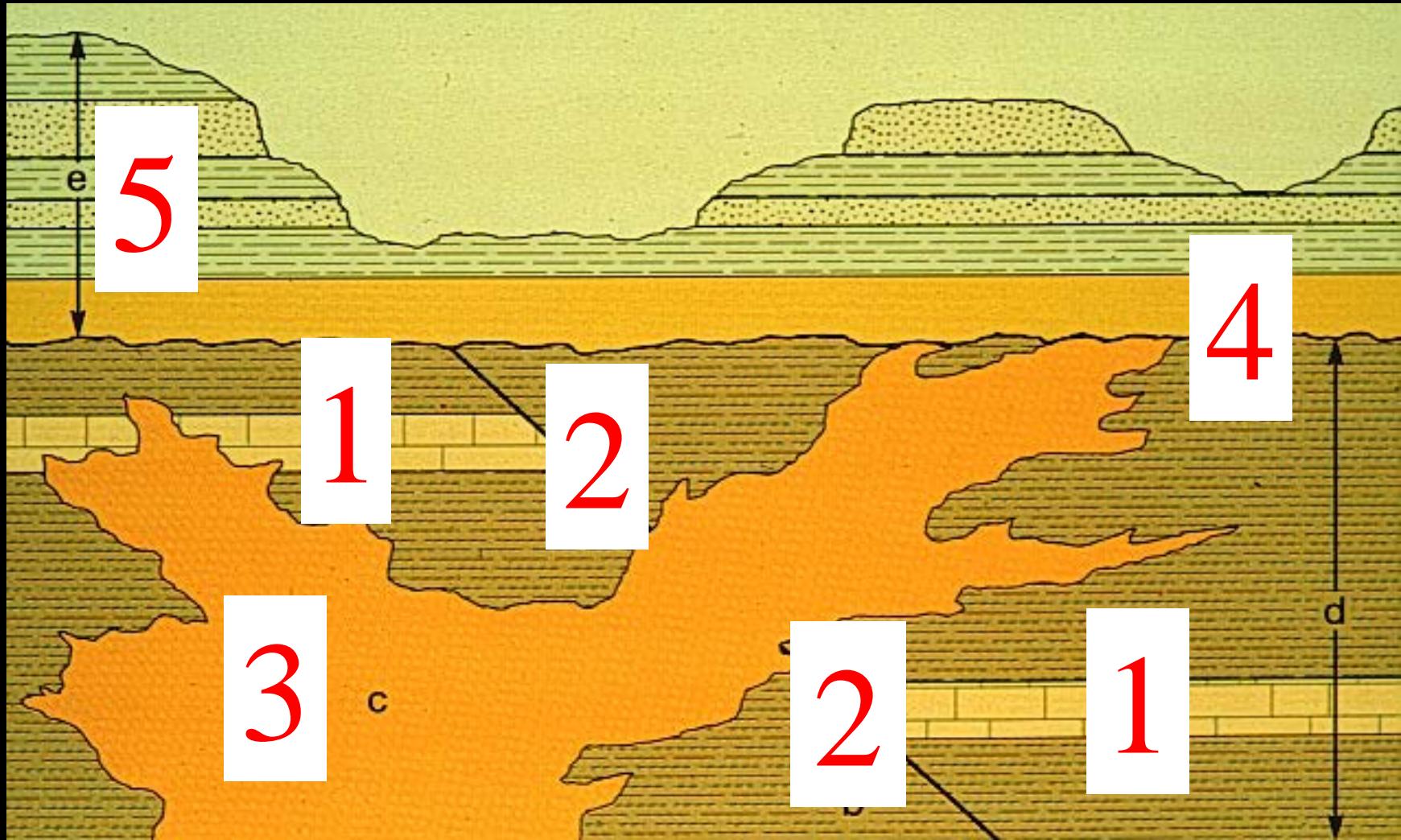
Igneous rock (274 ± 5 my)

Figure 6-10

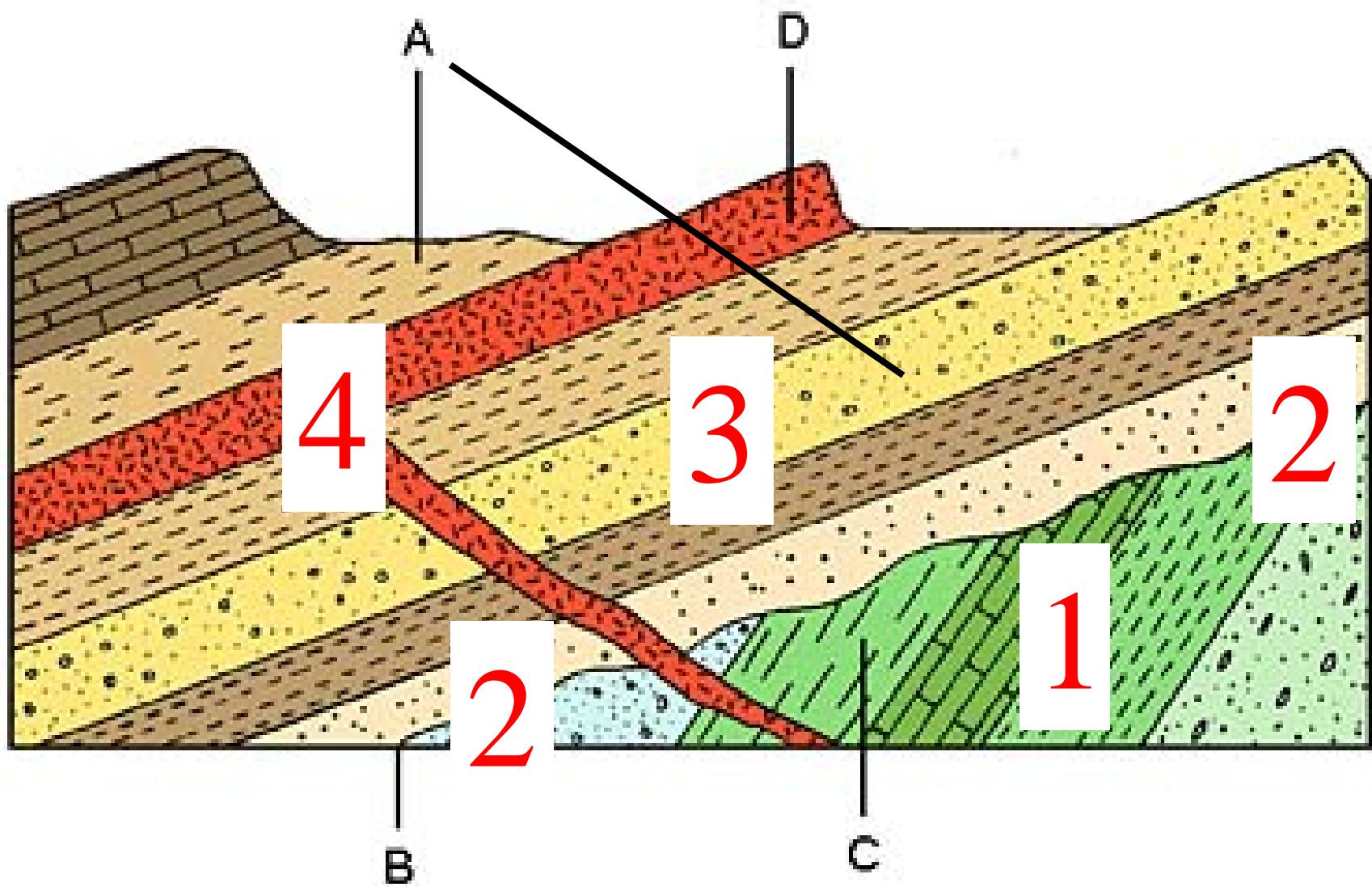
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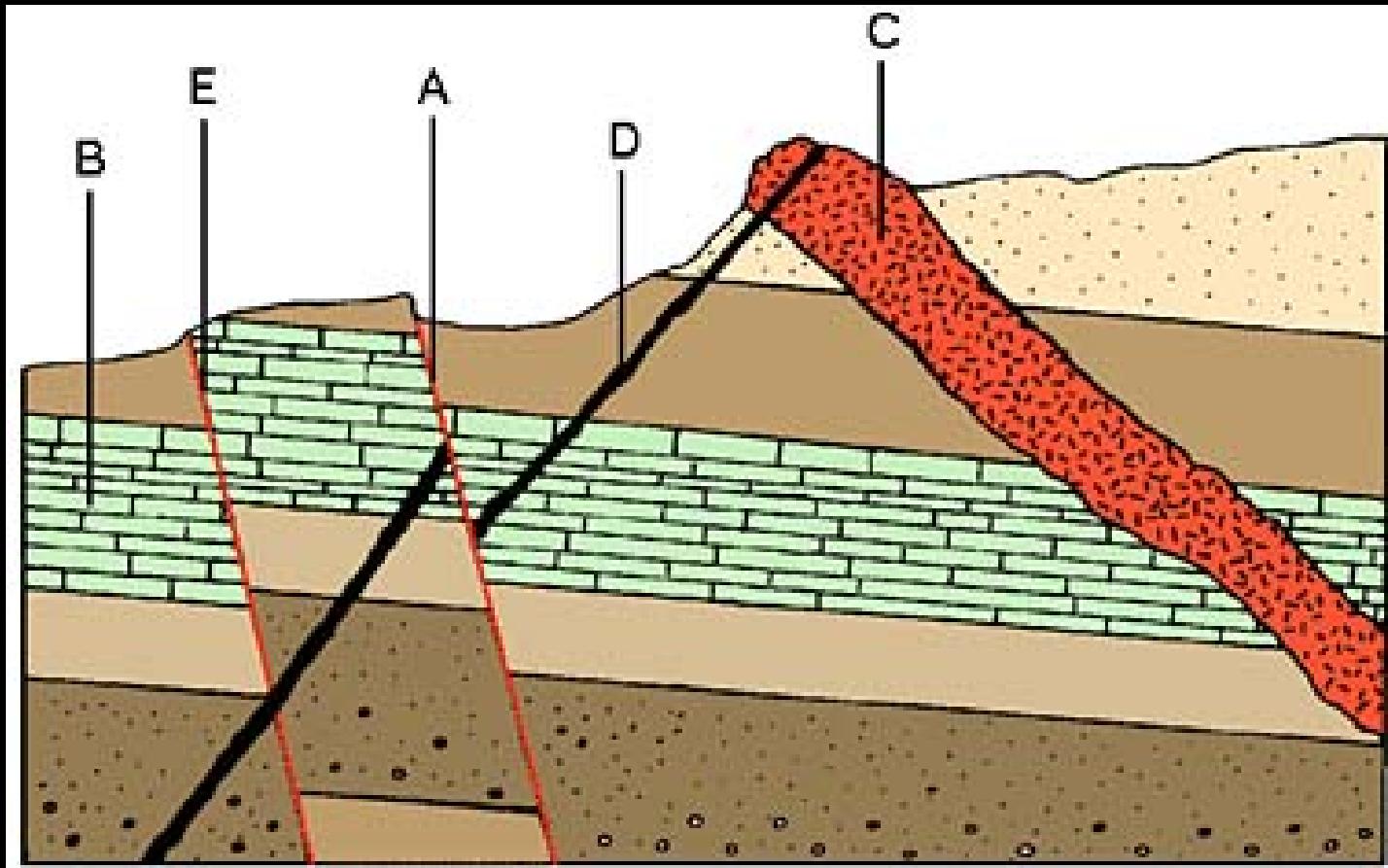
Can you interpret the sequence of geologic events using cross-cutting relationships and superposition?



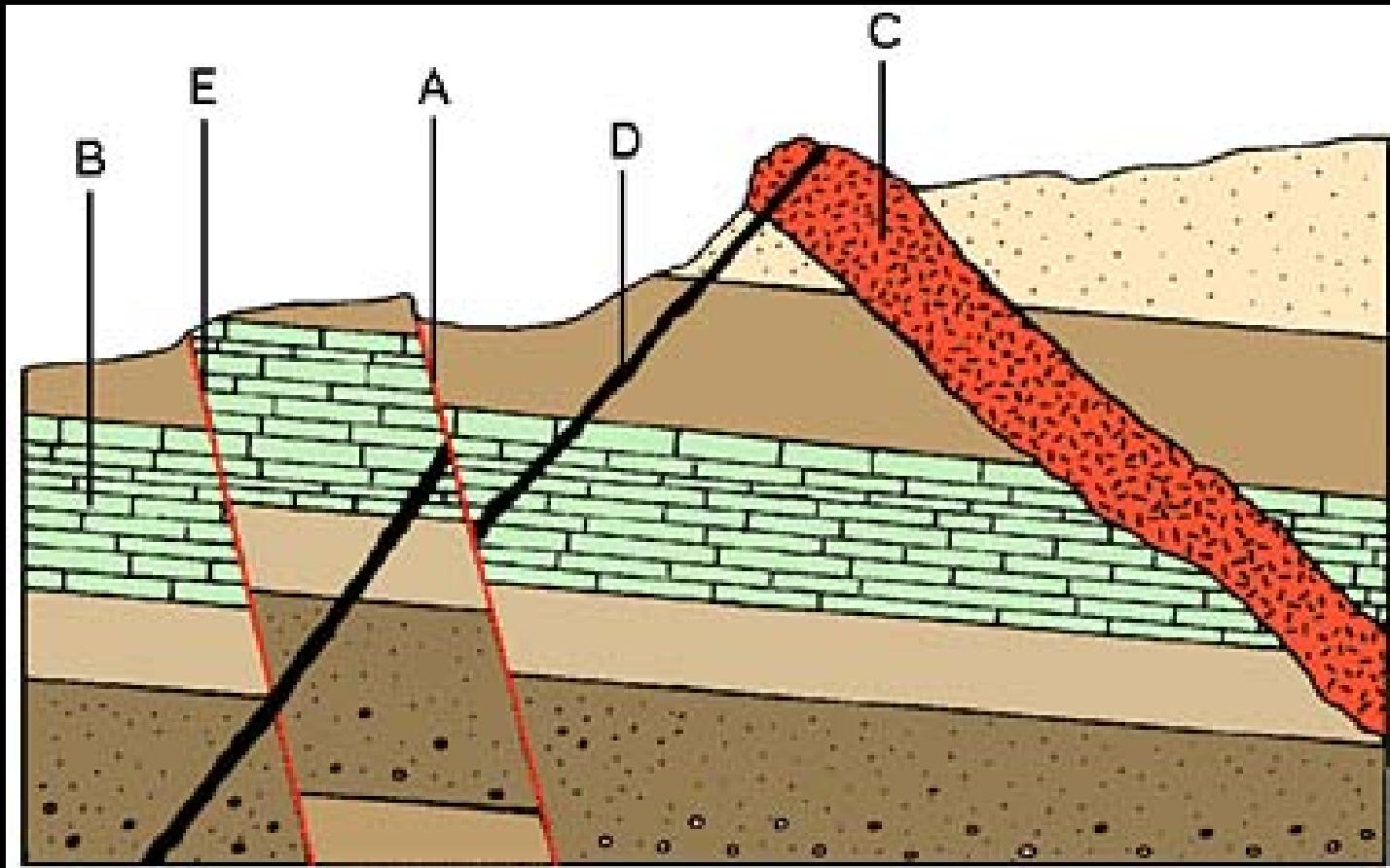
What is the sequence of events?



What is the sequence of events?



What is the sequence of events?

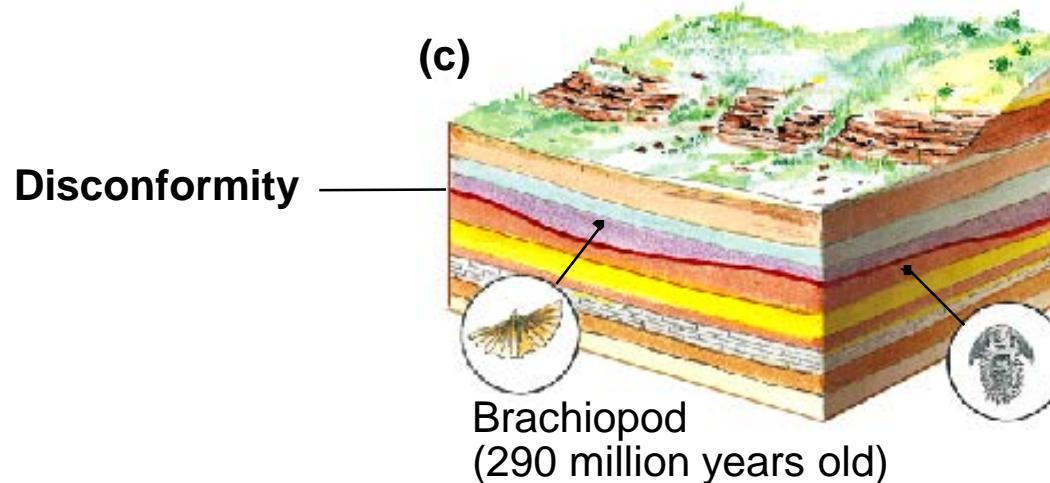
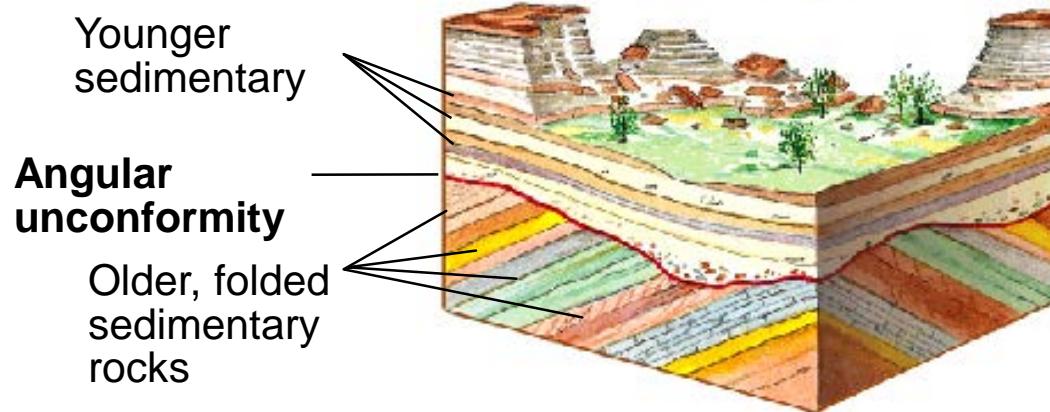
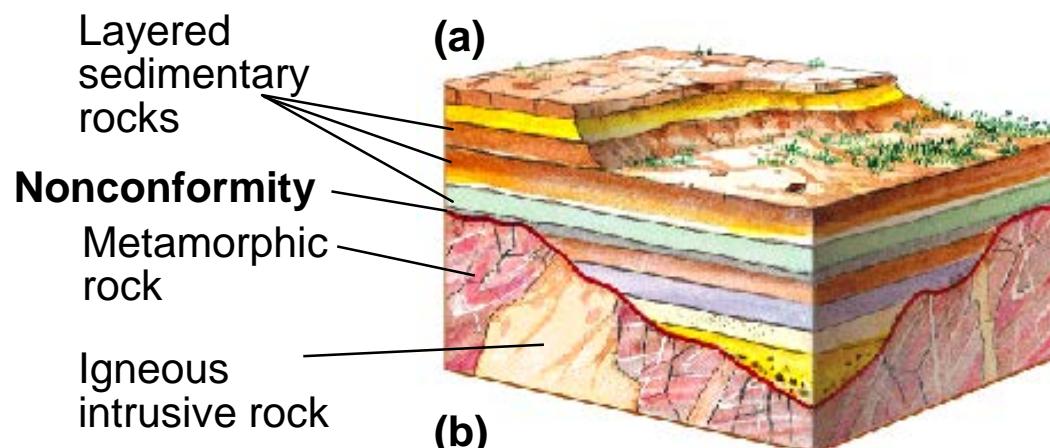


B (sed. layers), C, E, D, A

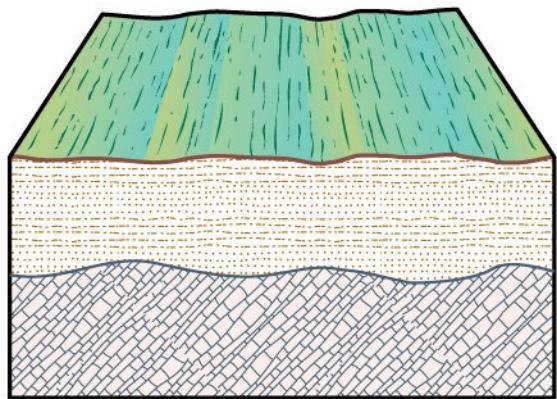
The Meaning of Unconformities

Unconformities

- Unconformities represent major gaps of time.
- They are the result of periods of erosion or non-deposition.
- They help us to understand the great age of the earth.

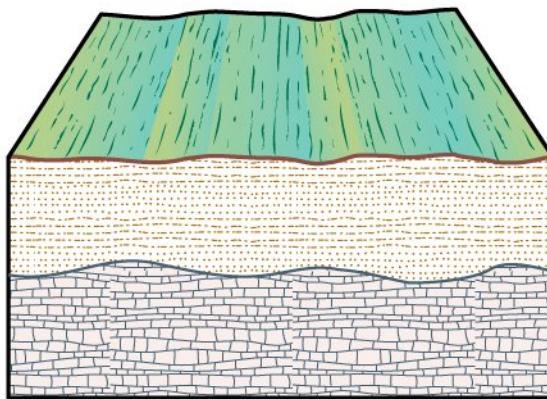


Angular unconformity



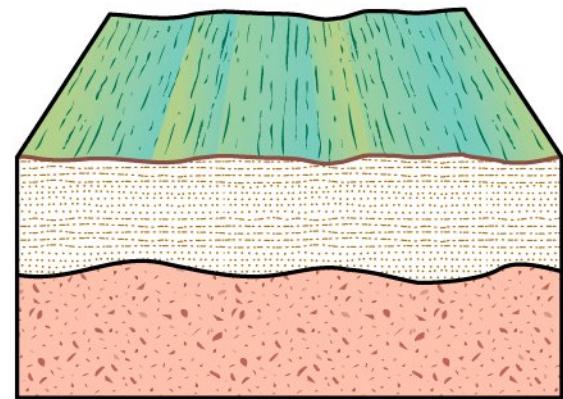
A

Disconformity



B

Nonconformity



C

Figure 1-23
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Angular Unconformity

- Recognized by tilted or deformed sedimentary rocks below flat-lying sedimentary rocks.

Angular unconformity

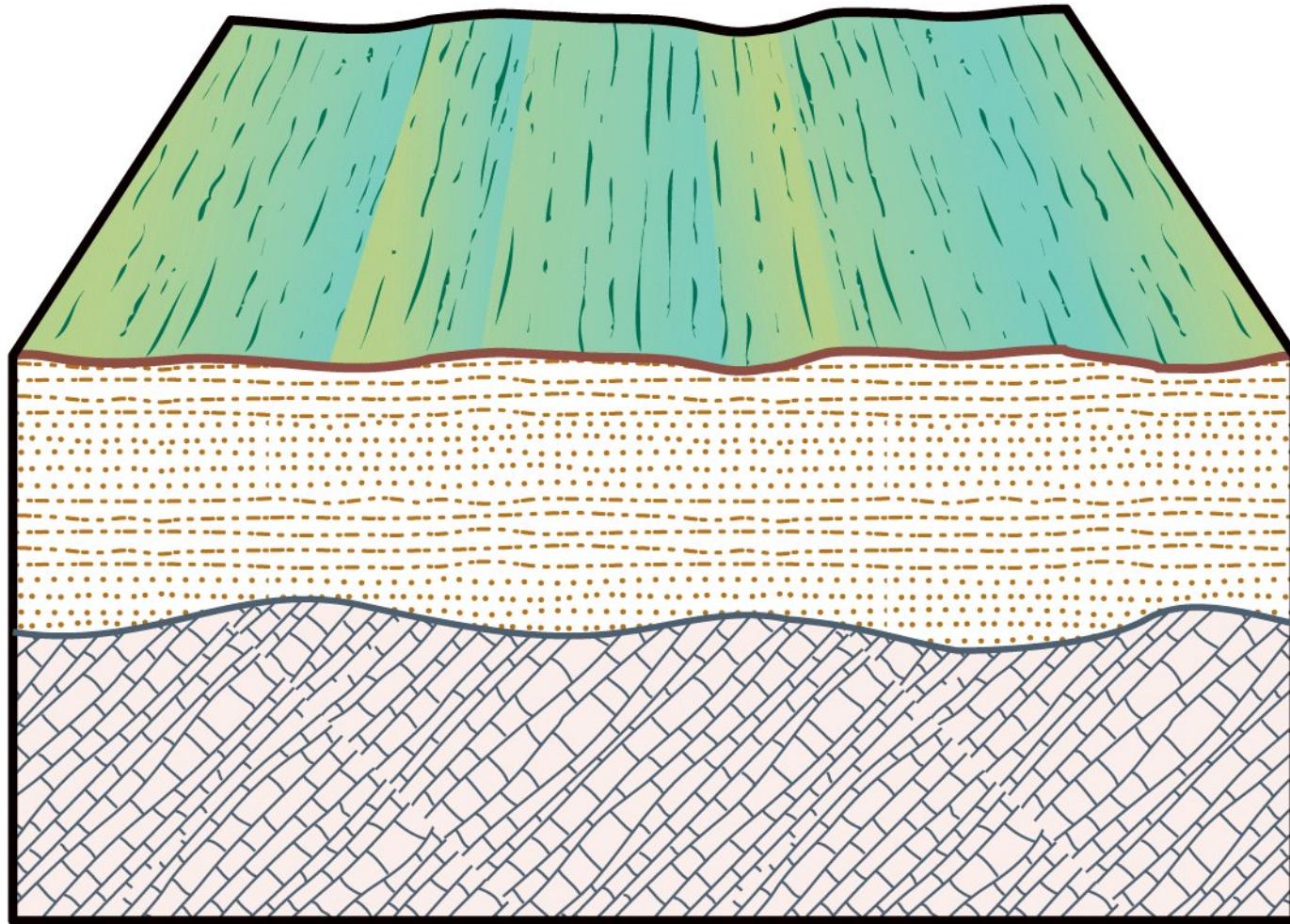


Figure 1-23a
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Disconformity

- The unconformity is an erosion surface within a sequence of flat-lying sedimentary rocks.

Disconformity

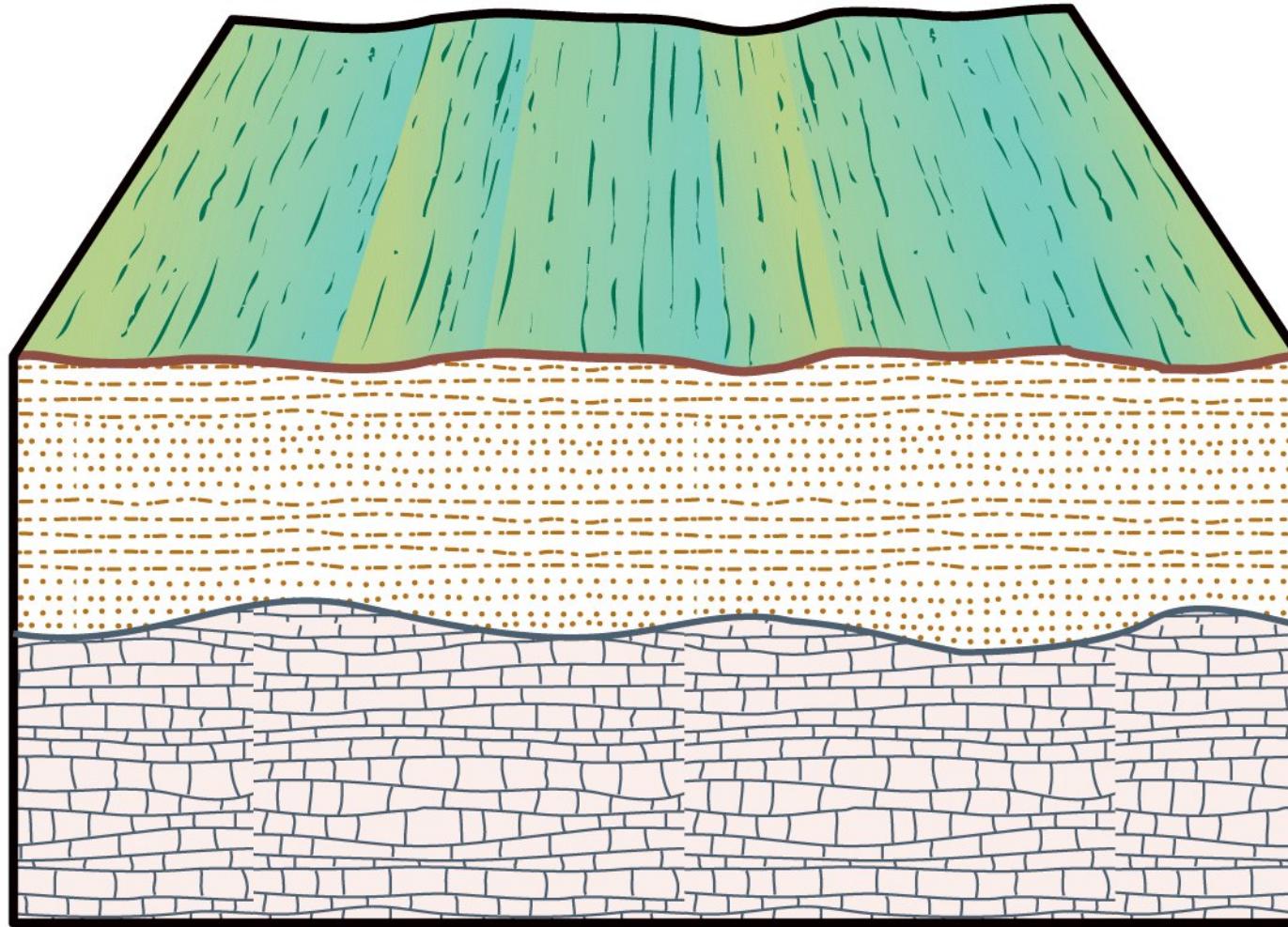


Figure 1-23b
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Nonconformity

- Recognized by sedimentary rocks resting on an eroded surface of igneous or metamorphic rocks.

Nonconformity

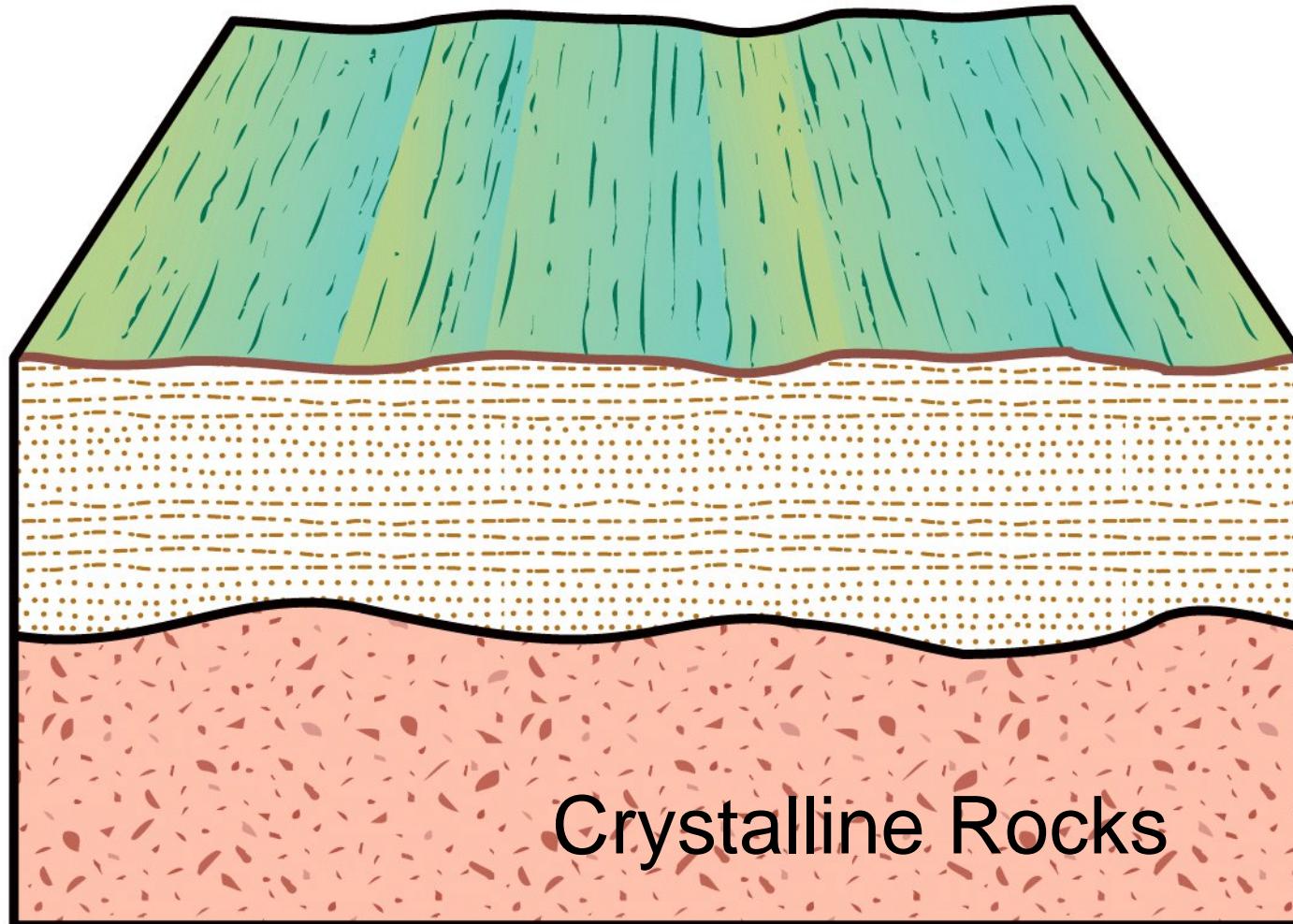


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James Hutton, 18th Century founder of Geology

Siccar Point, Scotland, where Hutton discovered the meaning of unconformities.



Siccar Point, Scotland, where Hutton discovered the meaning of unconformities.

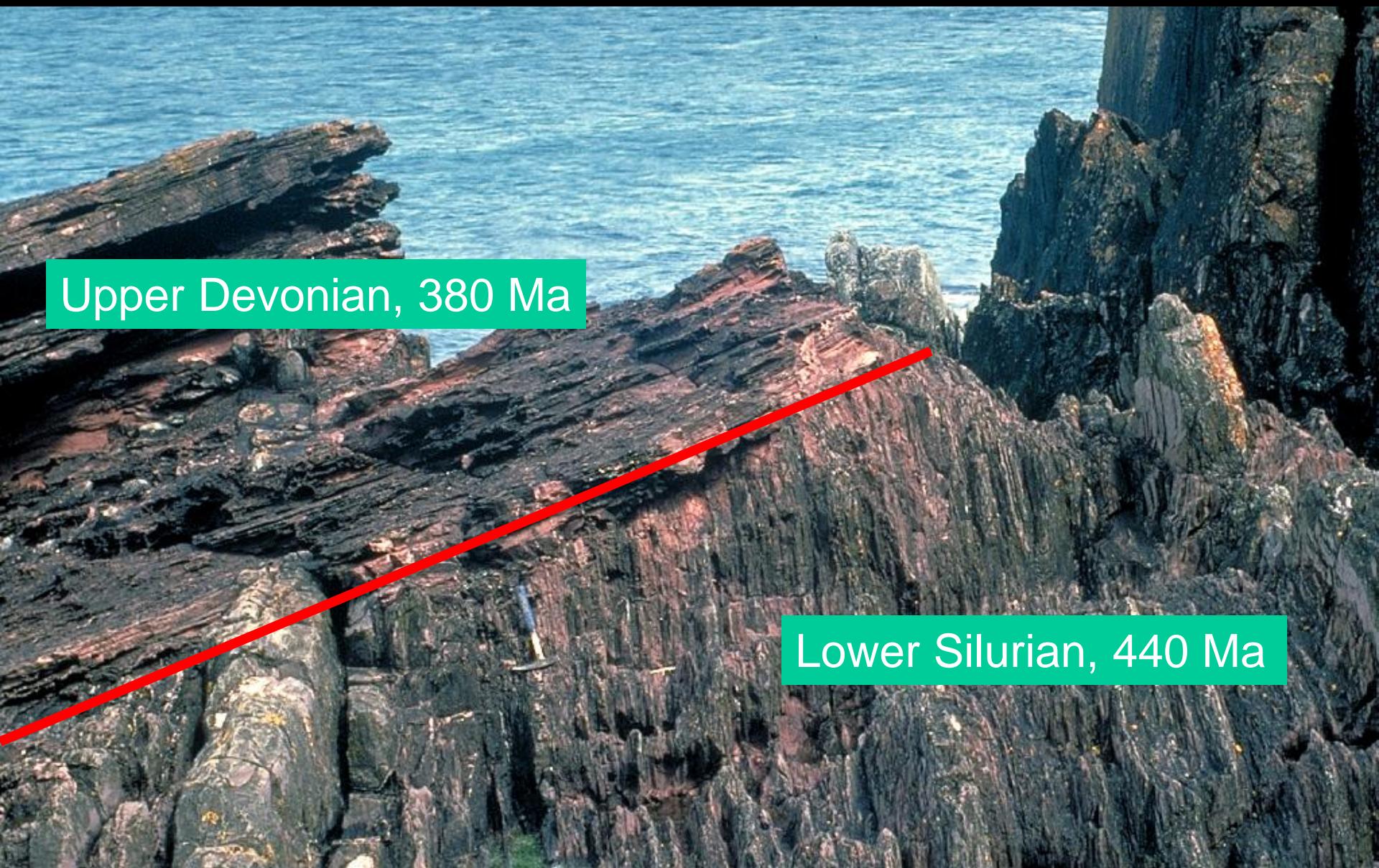




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Siccar Point, Scotland, June 2004



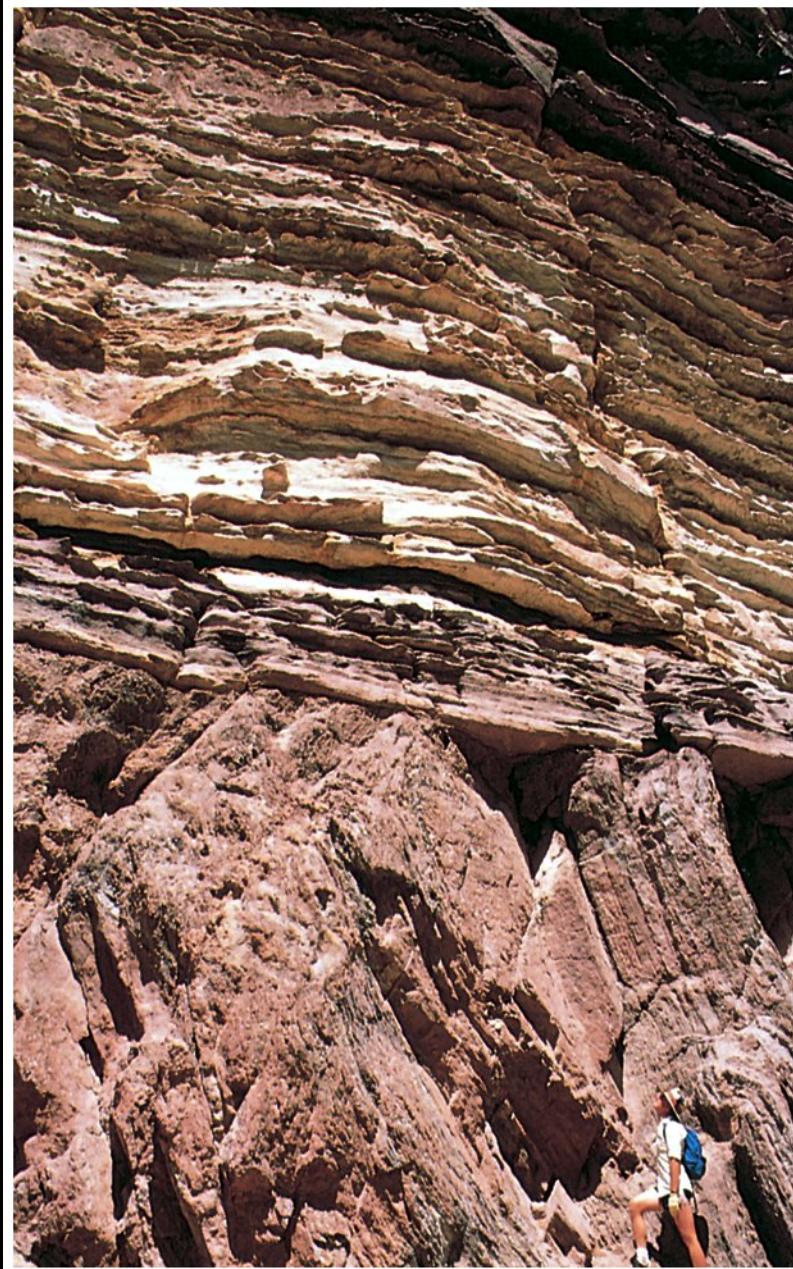
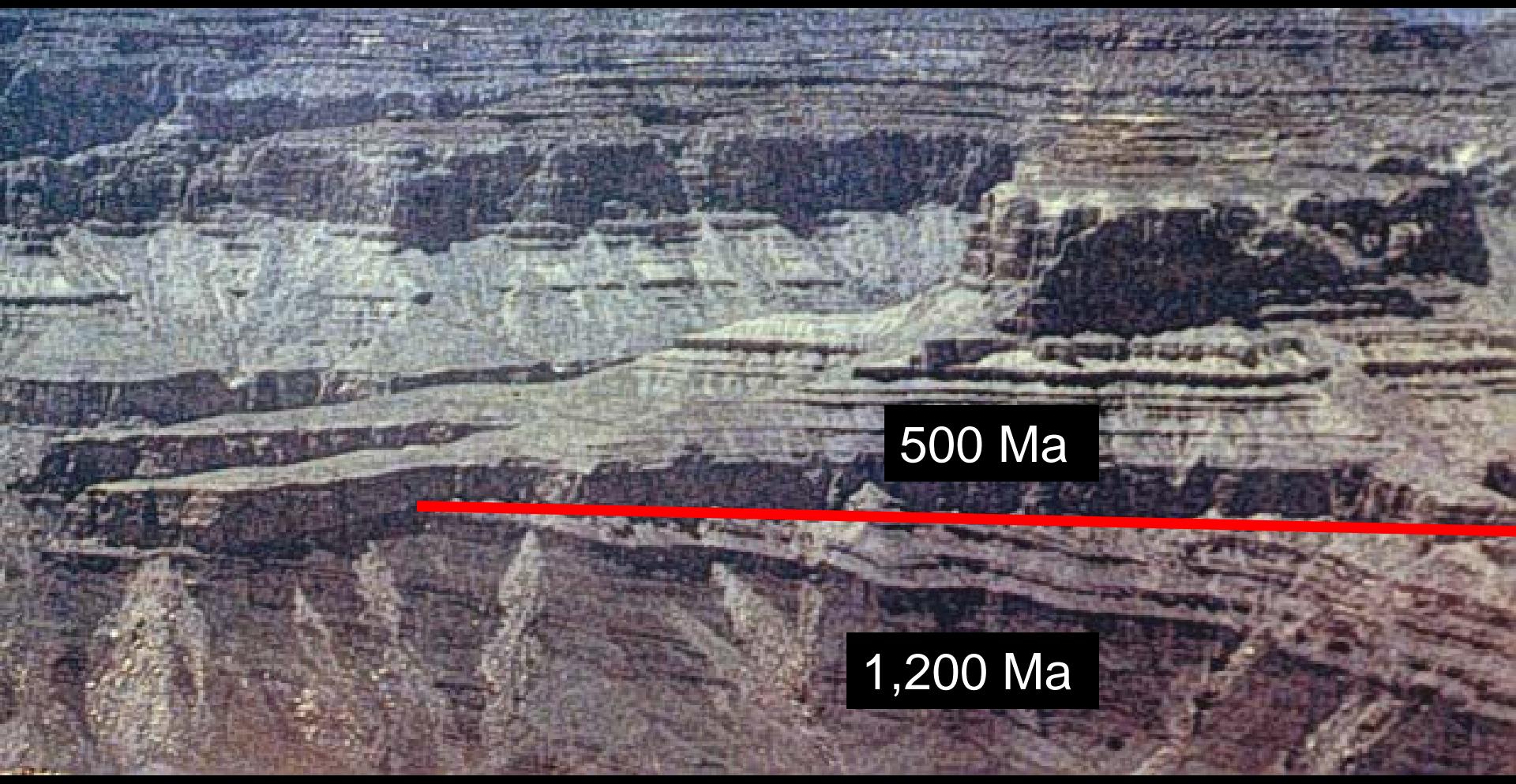
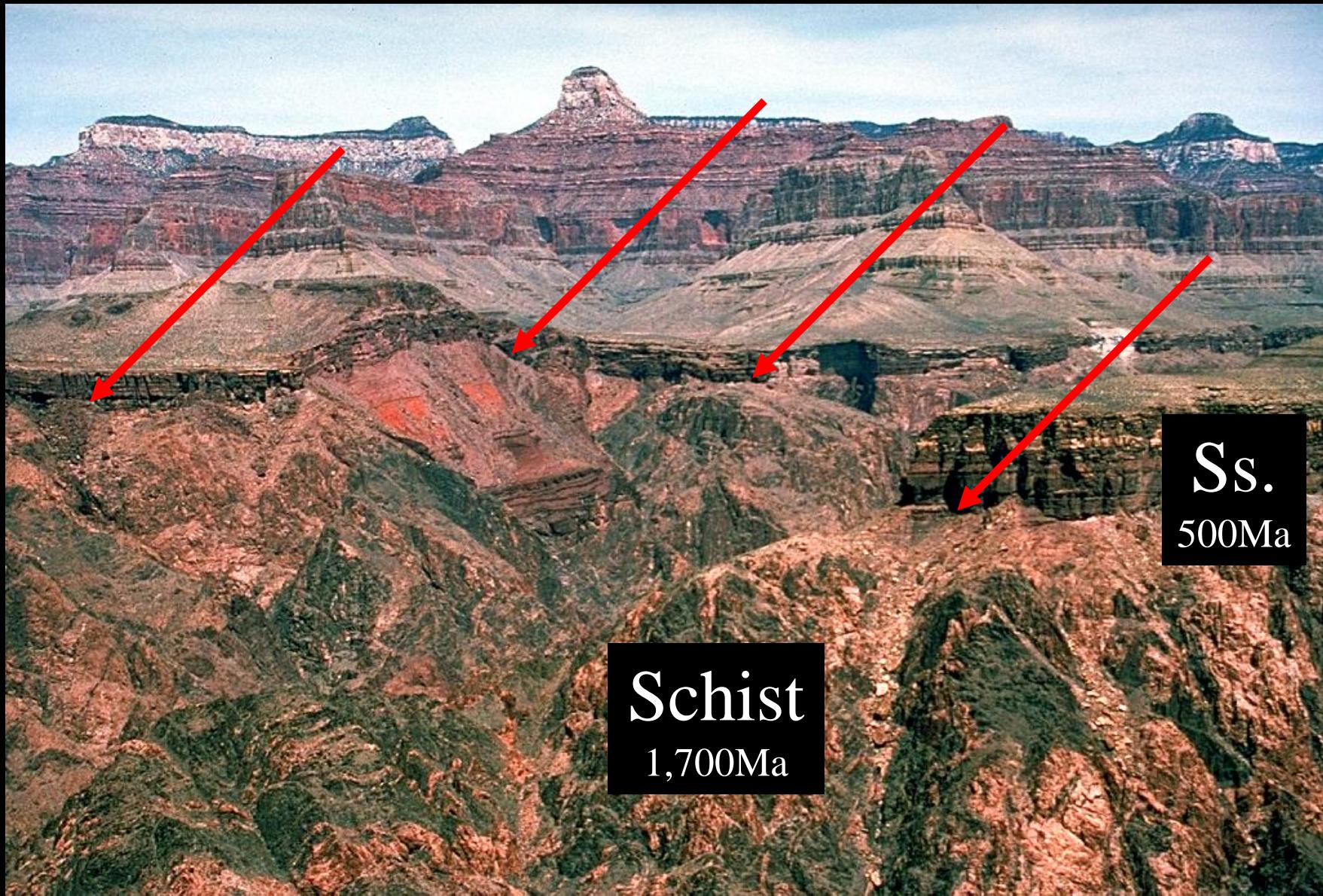


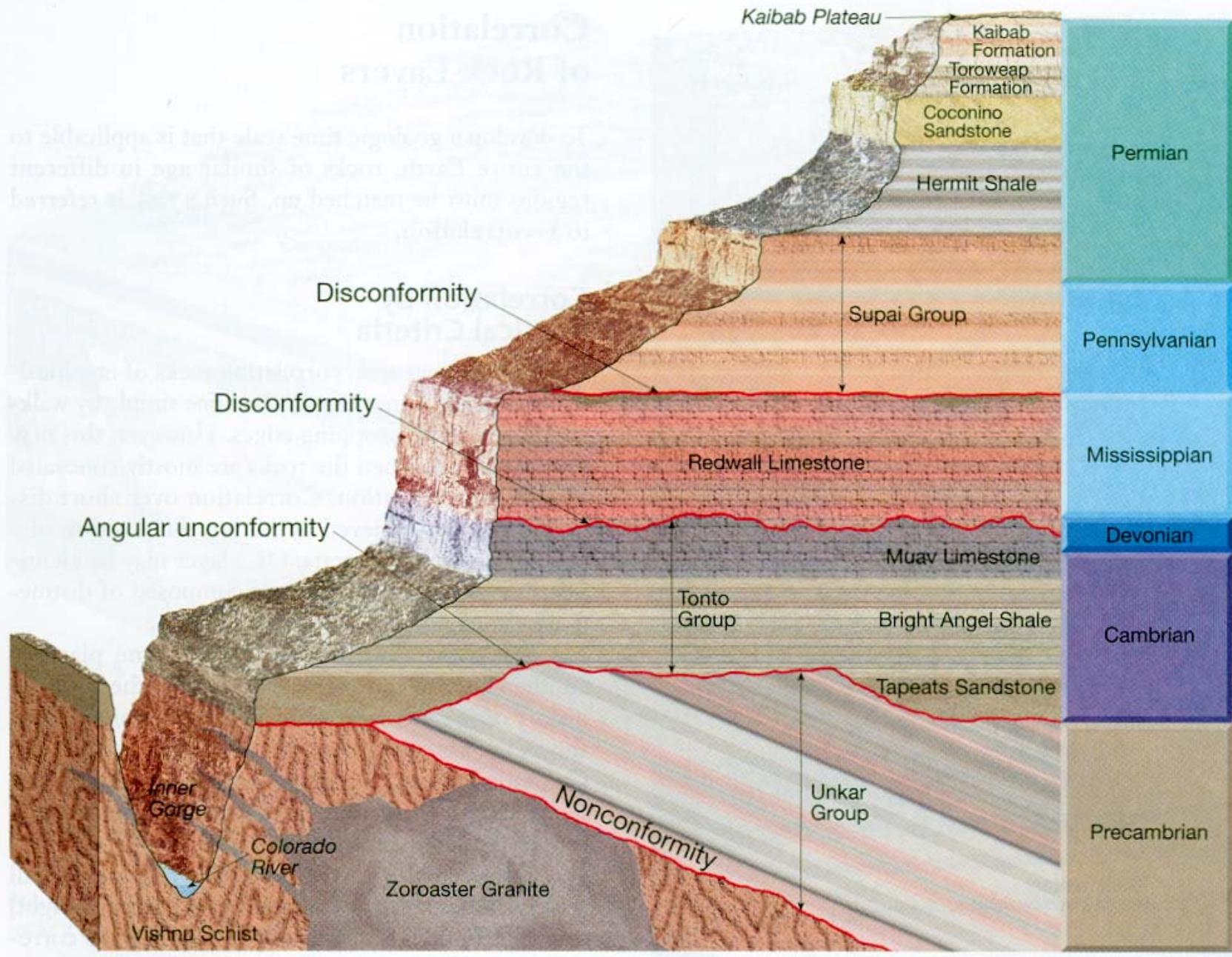
Figure 1-22
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Angular Unconformity in the Grand Canyon between Proterozoic and Cambrian Rocks

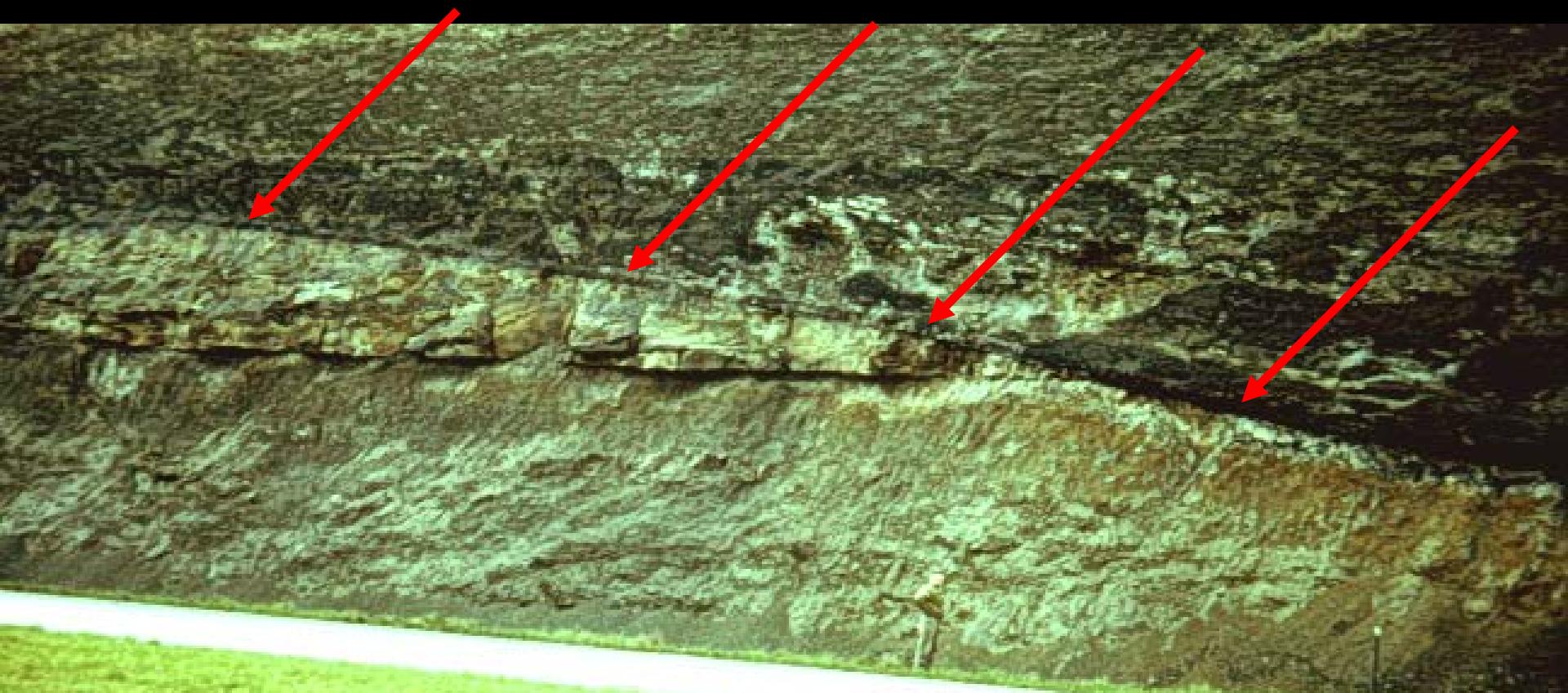


Nonconformity between schist and sandstone in the Grand Canyon





Disconformity within Pennsylvanian age rocks, West Virginia. The disconformity shows an older topography.

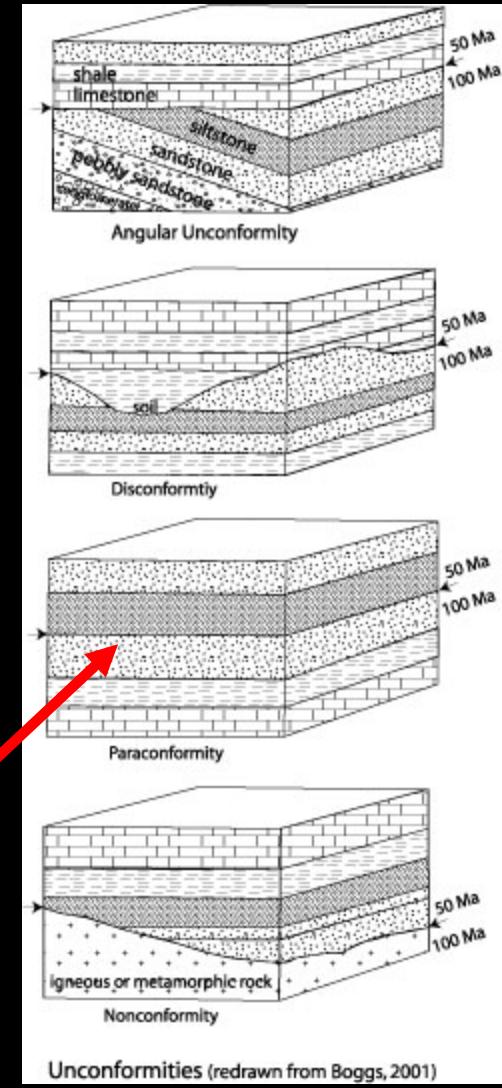


Several disconformities within
Pennsylvanian age rocks along Rt. 19,
West Virginia.

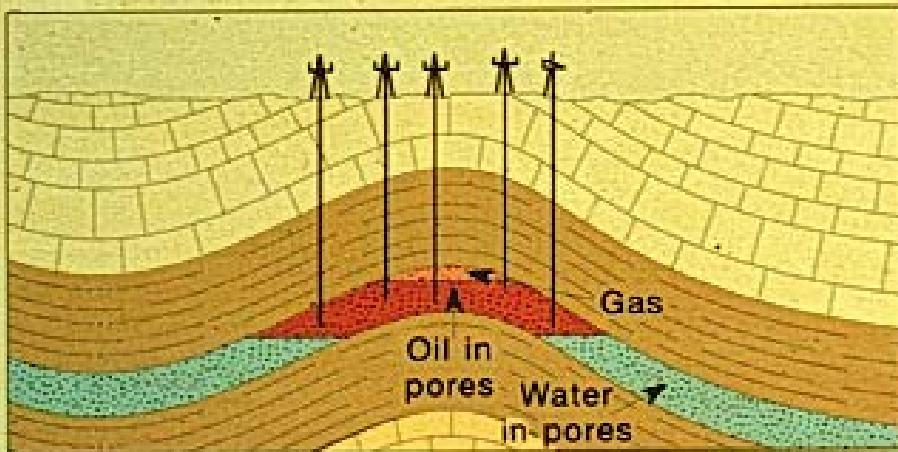


Paraconformity

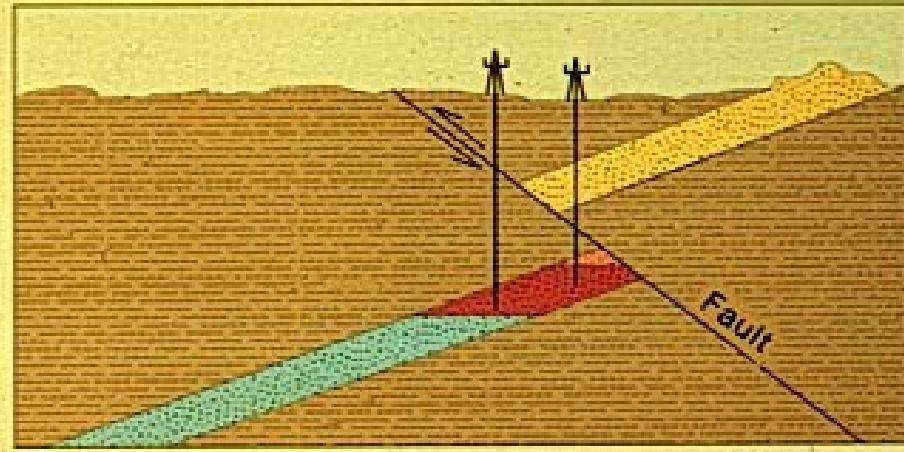
- Para means “near”, as in nearly conformable
- An unconformity with no obvious erosion surface.
- There is a distinct gap in the fossil record.



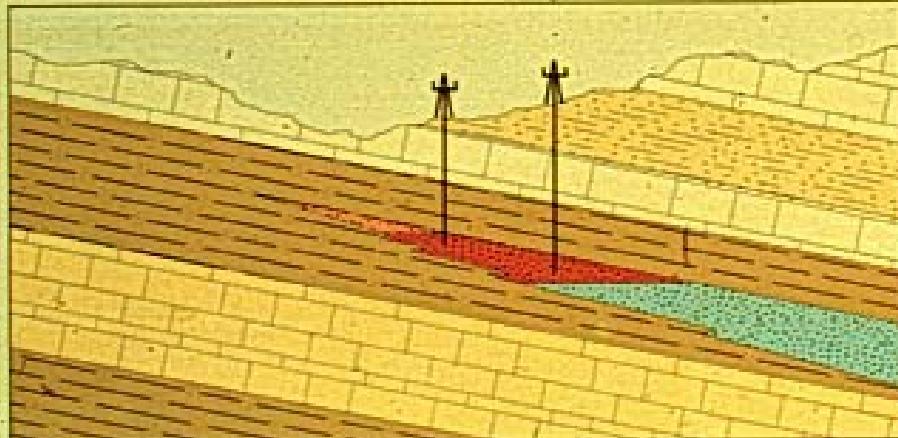
Application of the Principles of Historical Geology. Examples for finding petroleum.



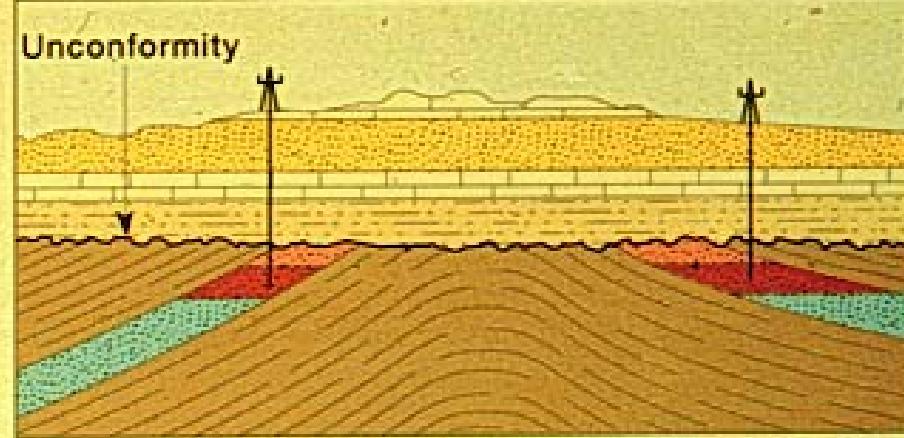
A



B

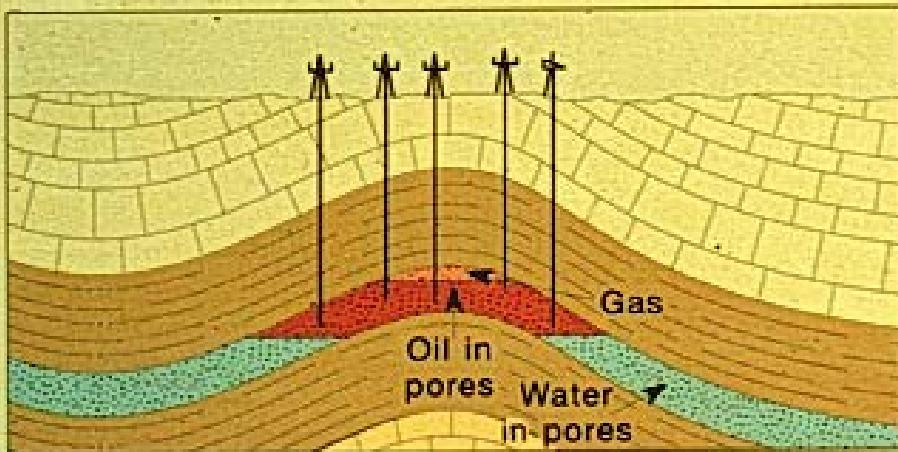


C

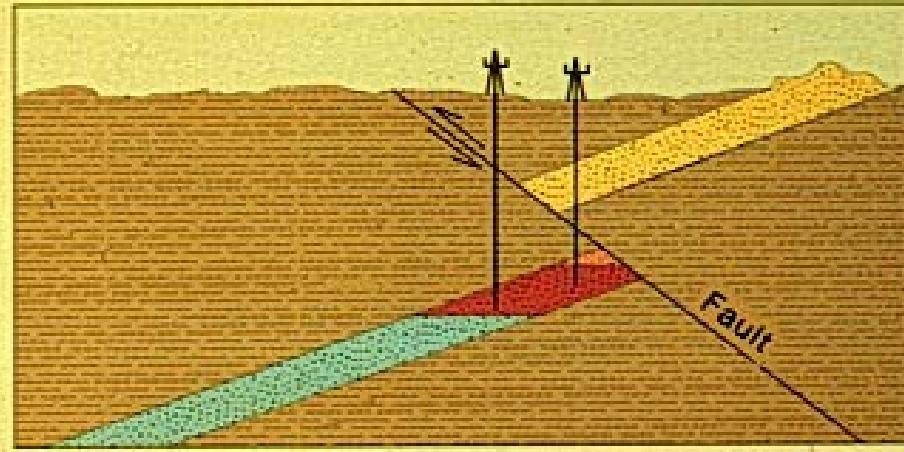


D

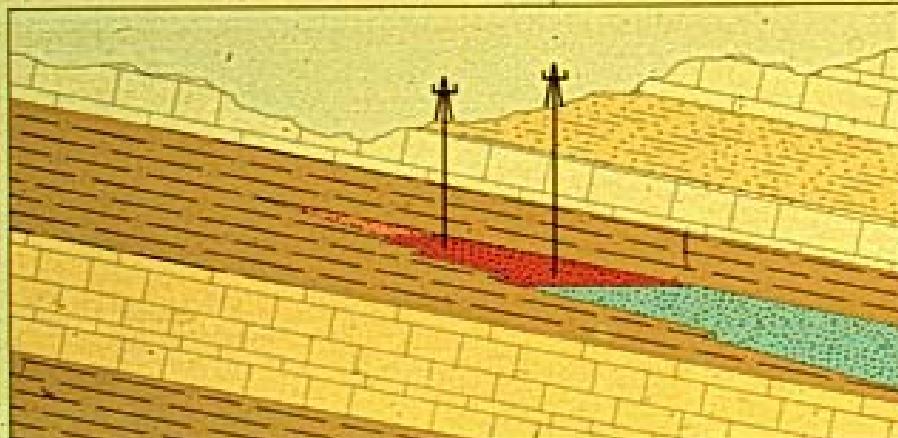
Application of the Principles of Historical Geology. Examples for finding petroleum.



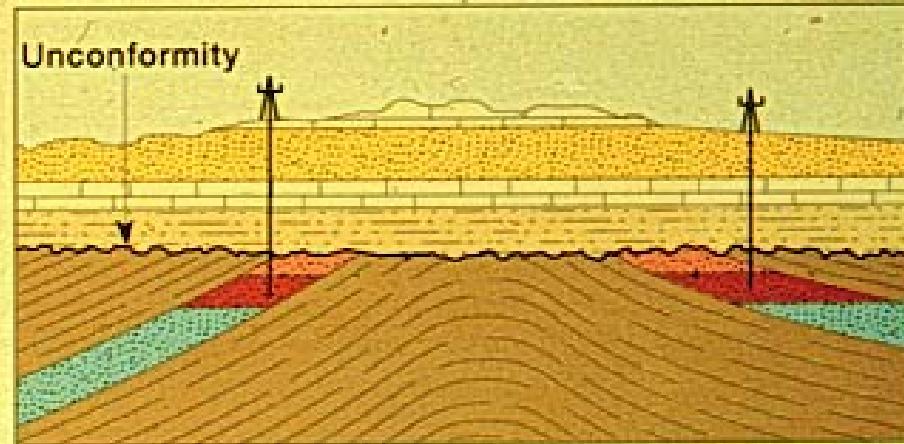
A Superposition and Original Horizontality



B Cross-cutting relationships



C Original Lateral Continuity

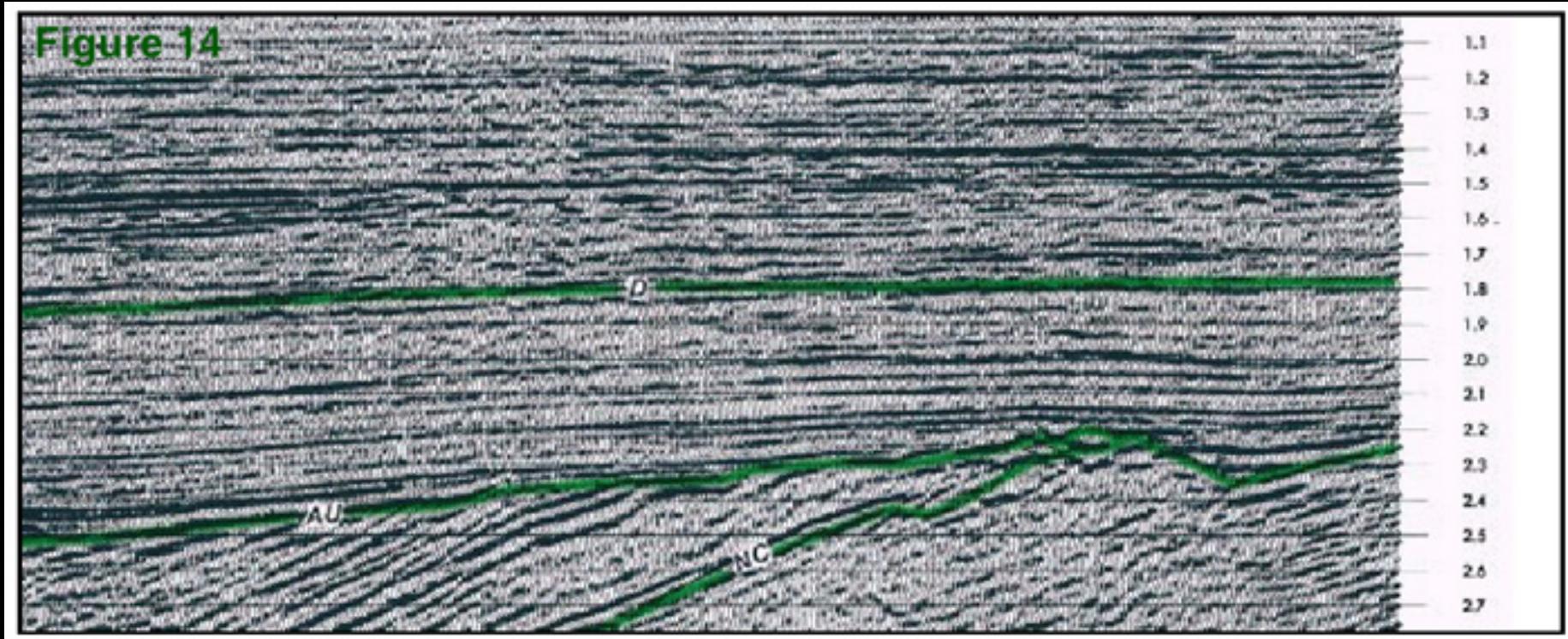


D Same as A, plus an Angular Unconformity

Application of the Principles of Historical Geology.

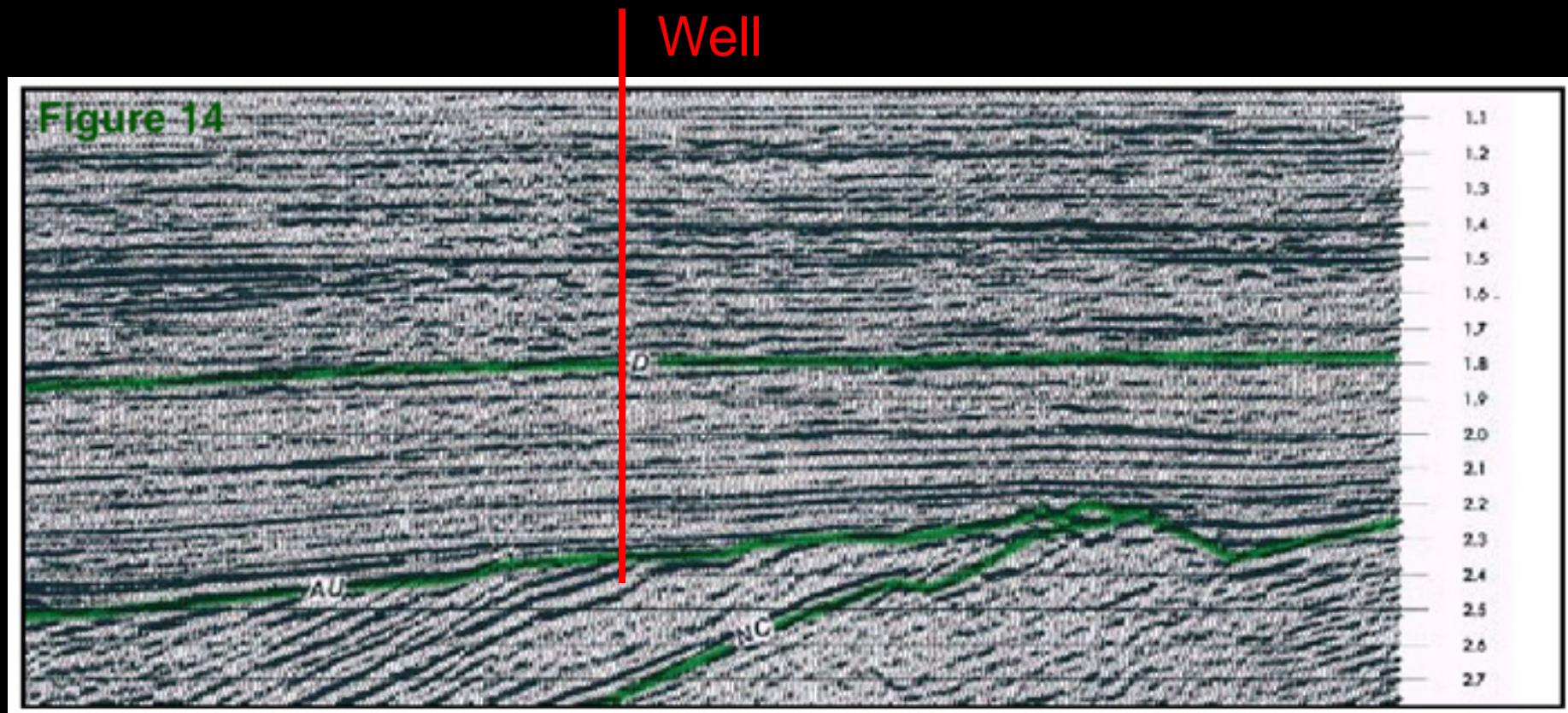
What is present on the seismic cross section below?
Where might you drill for oil and gas deposits?

Figure 14



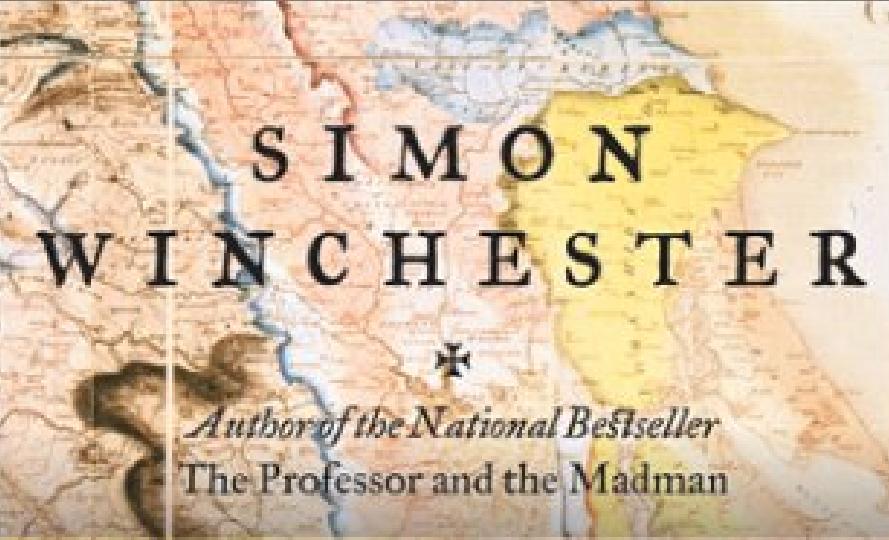
Application of the Principles of Historical Geology.

What is present on the seismic cross section below?
Where might you drill for oil and gas deposits?



William Smith,
the first 19th
Century
geologist to
understand
stratigraphy and
make
correlations.



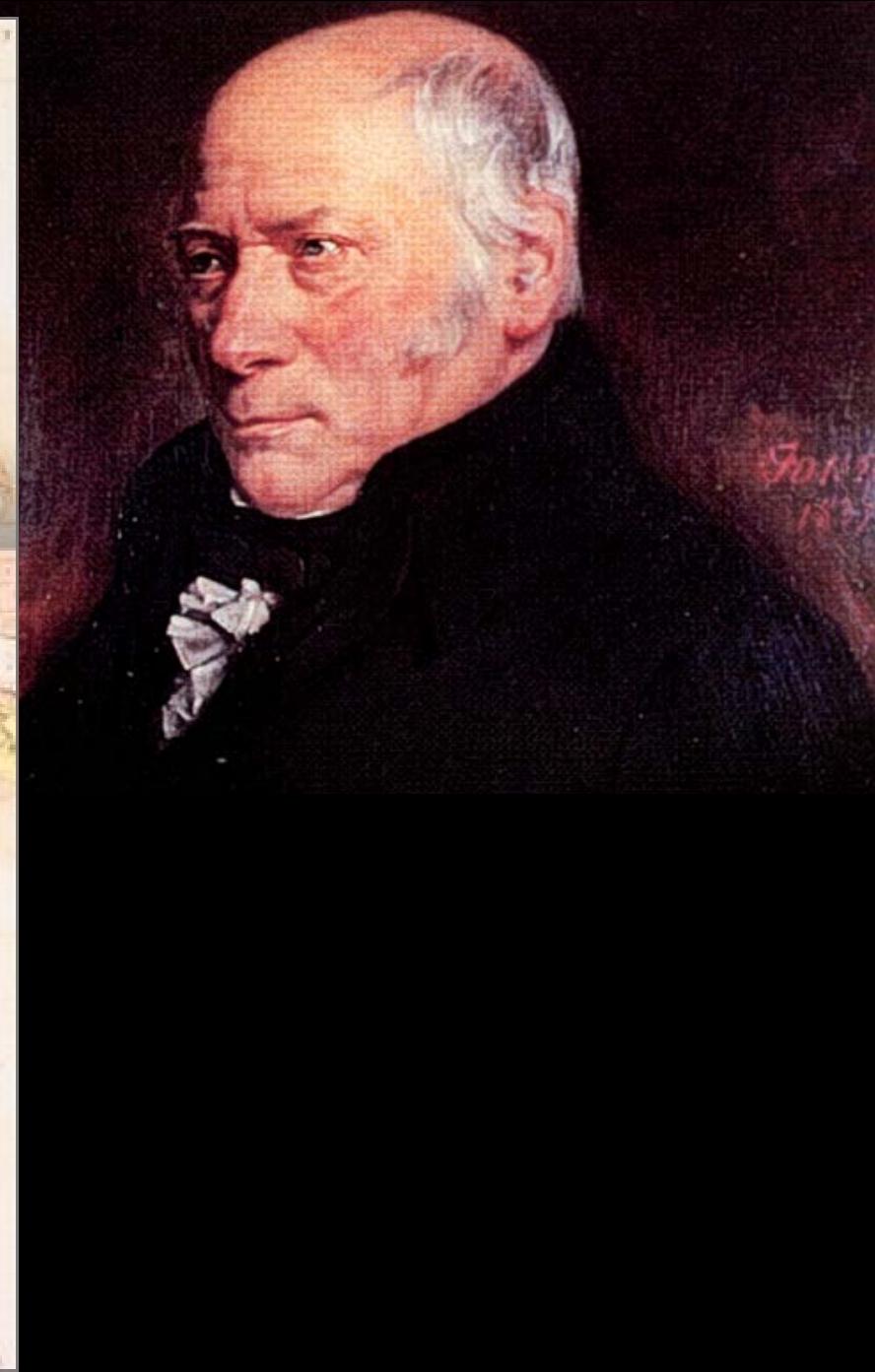


SIMON
WINCHESTER

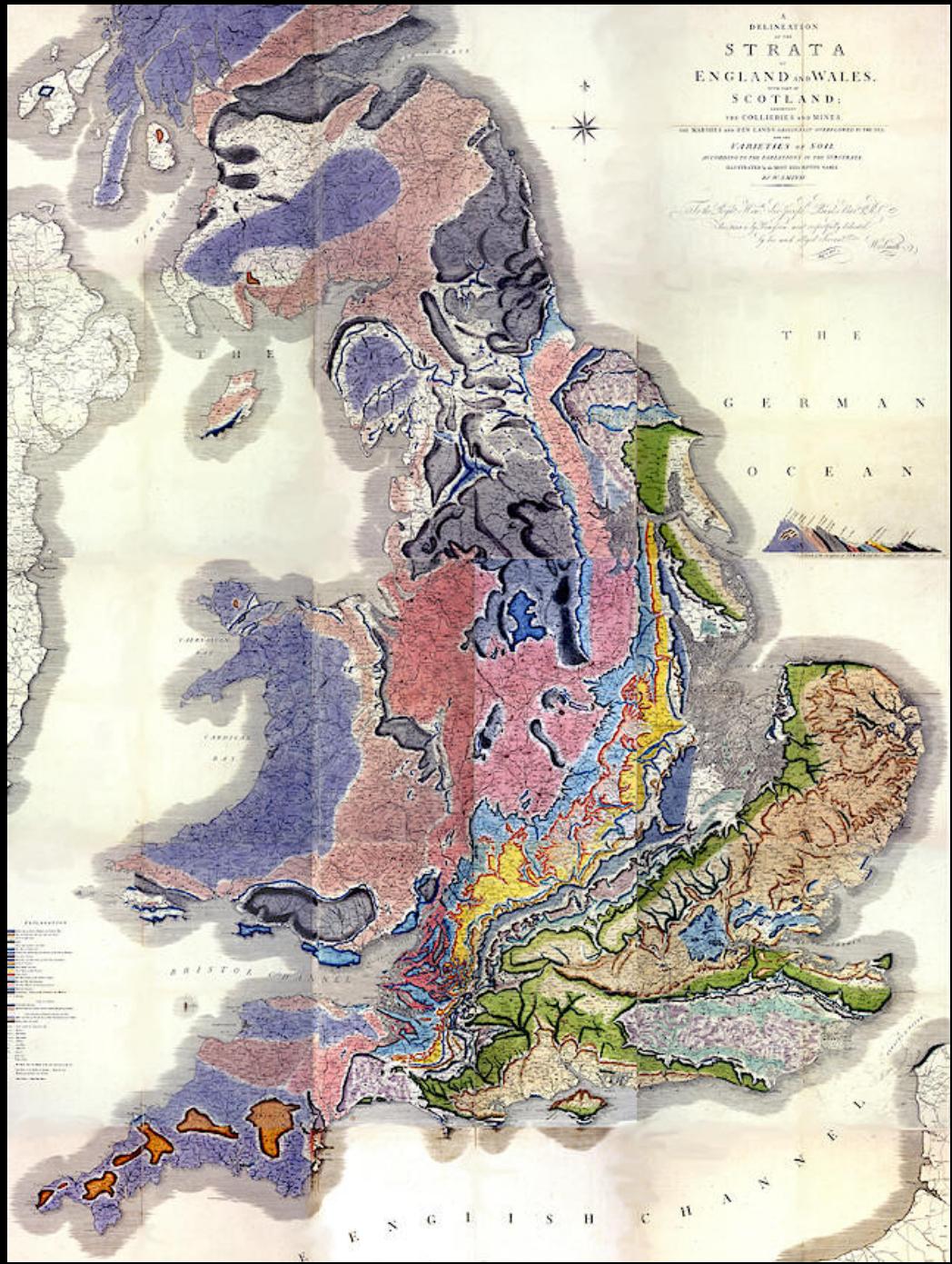
Author of the National Bestseller
The Professor and the Madman

the
MAP THAT
CHANGED
the WORLD

William Smith and the Birth of Modern Geology



William Smith's Geologic Map of England and Wales



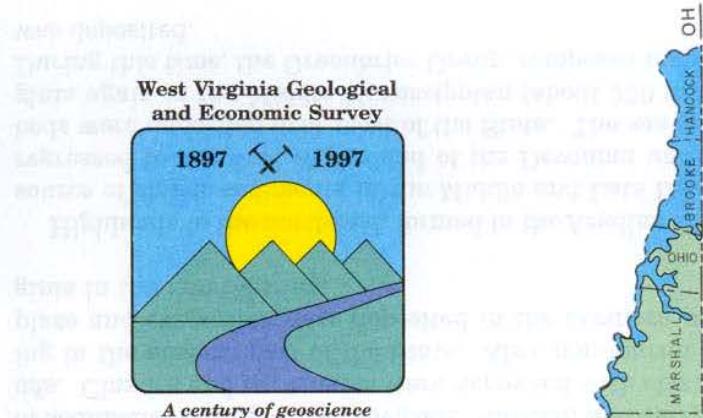
William Smith's Geologic Map of part of England



West Virginia Geological
and Economic Survey

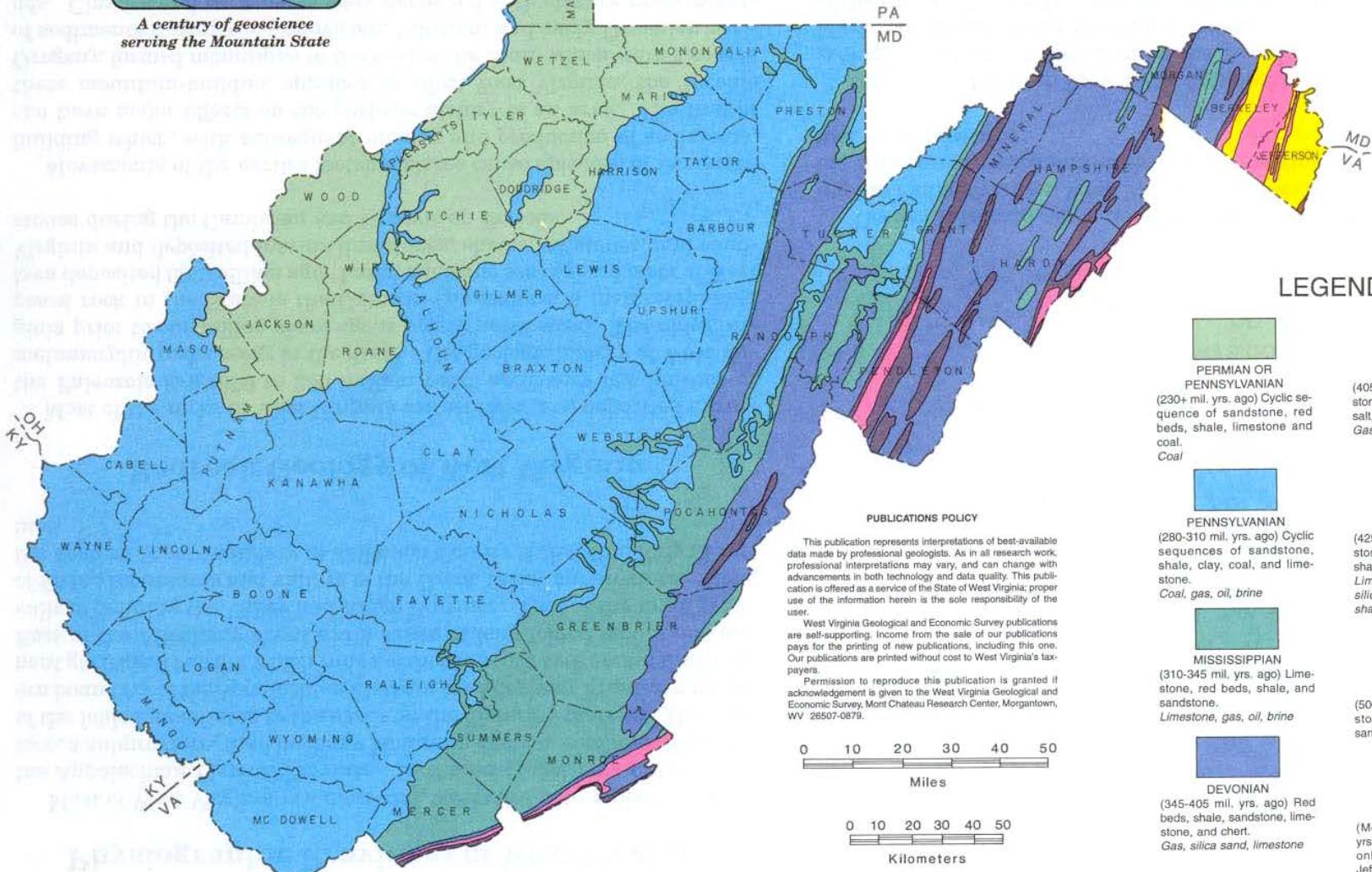


A century of geoscience
serving the Mountain State



GEOLOGIC MAP OF WEST VIRGINIA

West Virginia Geological and Economic Survey
MAP-25 1969



THE DATA IS IN THE STRATA

