

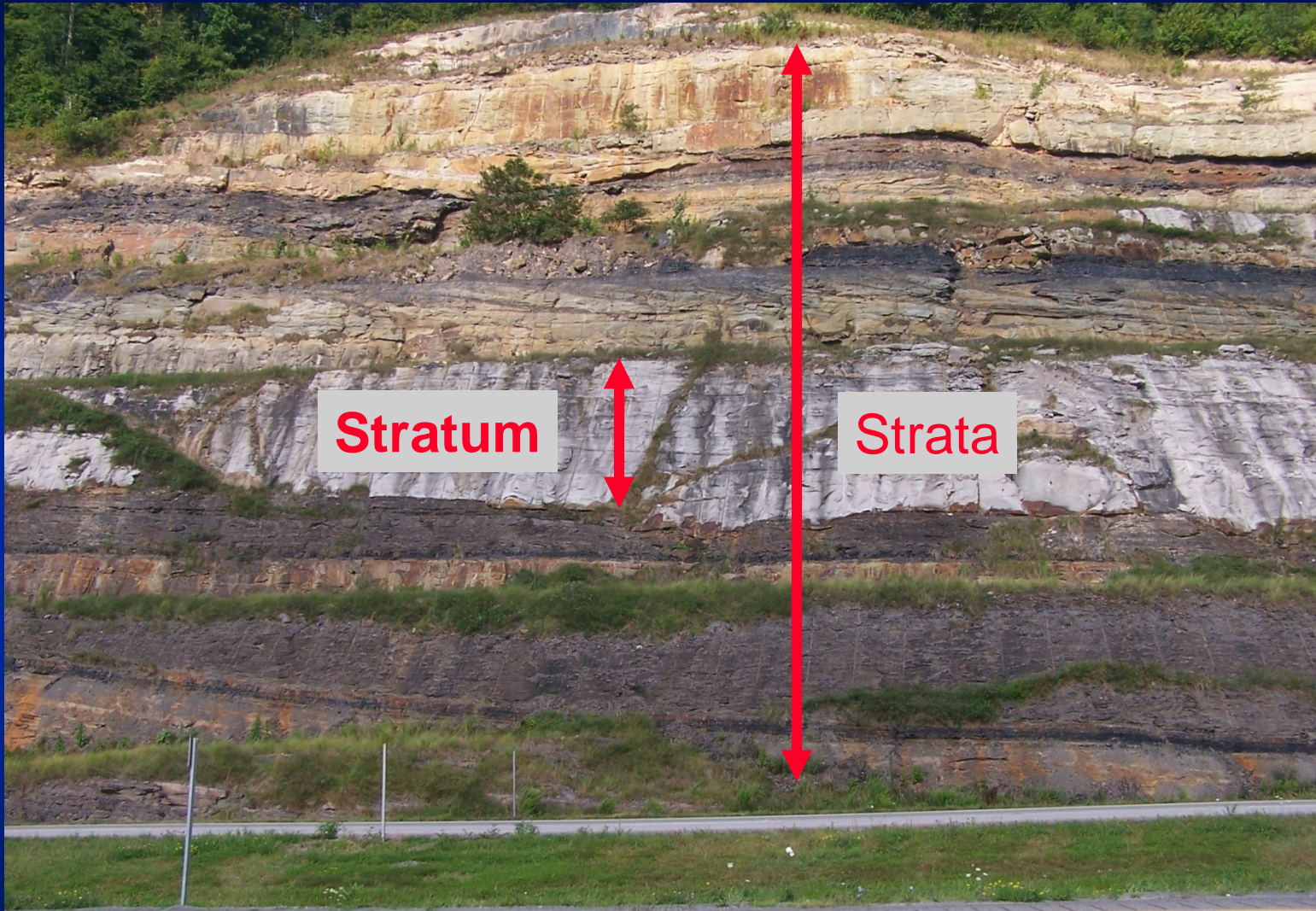
Outline 3:
Fundamental Principles of
Historical Geology

Terms to Learn

- Contact - a distinct surface between two unlike bodies of rock.
Unconformities and bedding planes are both contacts.
- Stratum - a single bed
- Strata - a group of beds
- Stratigraphy - the study of strata

Terms to Learn

- Formation - a body of rock with distinctive lithology that is bounded by contacts. Must be thick enough to map (>20 feet thick).
- Outcrop or Exposure - where rocks are exposed at the earth's surface.



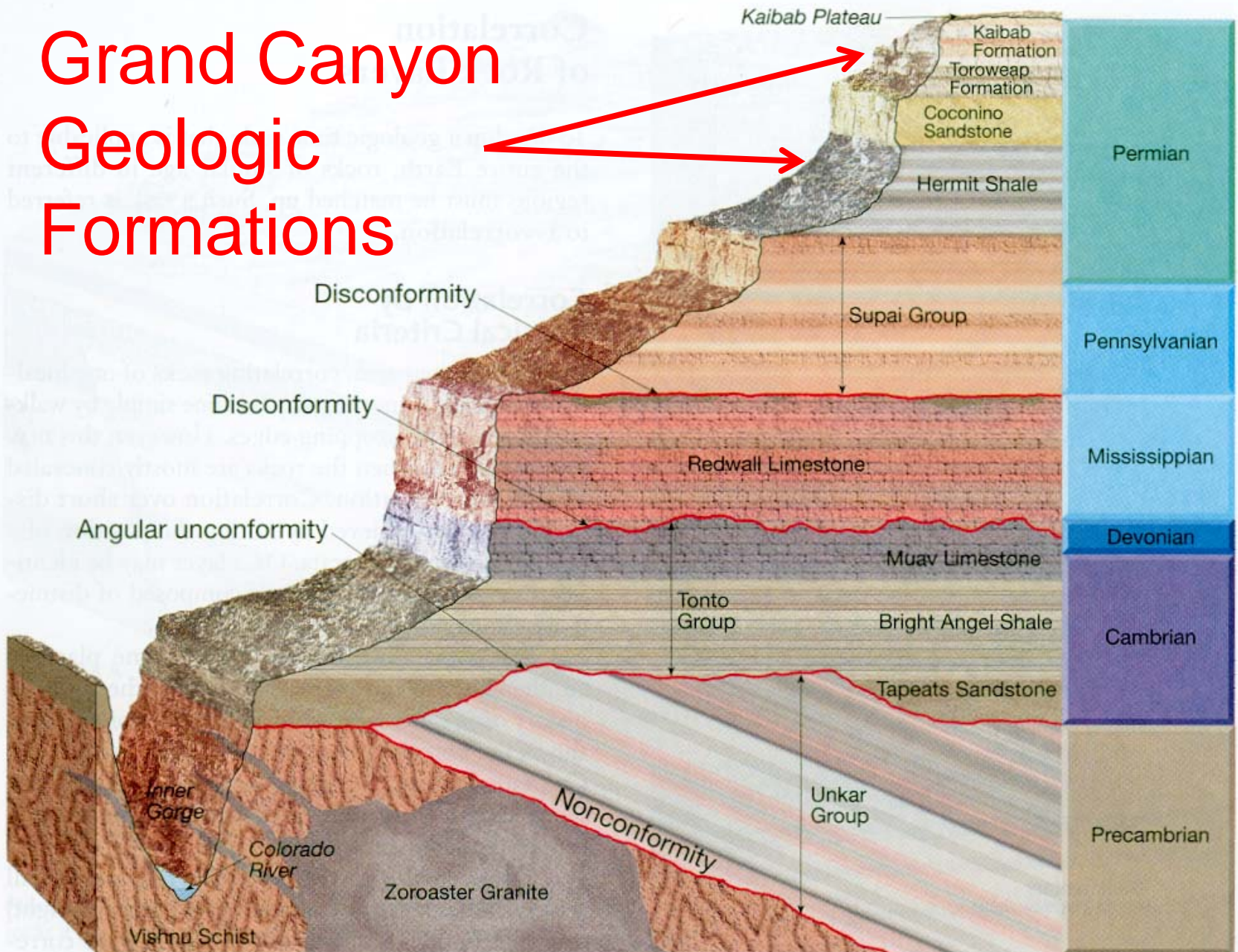
Outcrop or Exposure, Summers County, WV

Example of a
contact between
two geologic
formations.

Mauch Chunk
Fm. overlies the
Greenbrier
Limestone near
Elkins, WV.



Grand Canyon Geologic Formations



Key Concepts

- Superposition
- Original Horizontality
- Original Lateral Continuity
- Intrusive Relationships
- Cross-Cutting Relationships
- Fossil Succession

Principle of Superposition

- In any undeformed sequence of sedimentary rocks, each bed is younger than the one below it and older than the bed above it.
- This is the basis of relative ages of all strata and their contained fossils.

Principle of Superposition

Grand Canyon

Younger

Older



Principle of Original Horizontal

- Because of gravity sedimentary particles form horizontal (or nearly so) layers or strata.
- Thus, steeply inclined strata have been moved from their original position.

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.

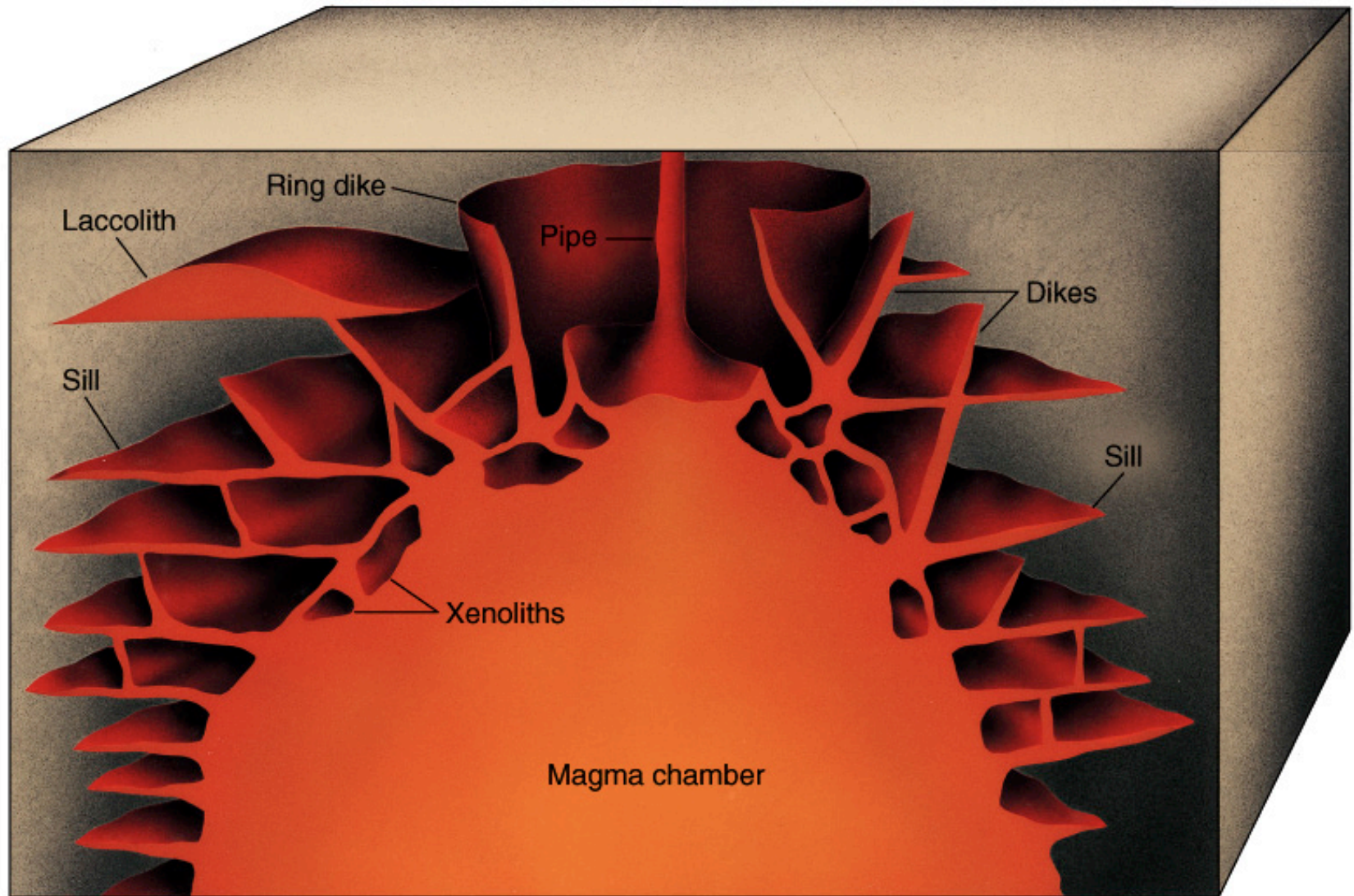
Original Lateral Continuity – trace coal seams



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)

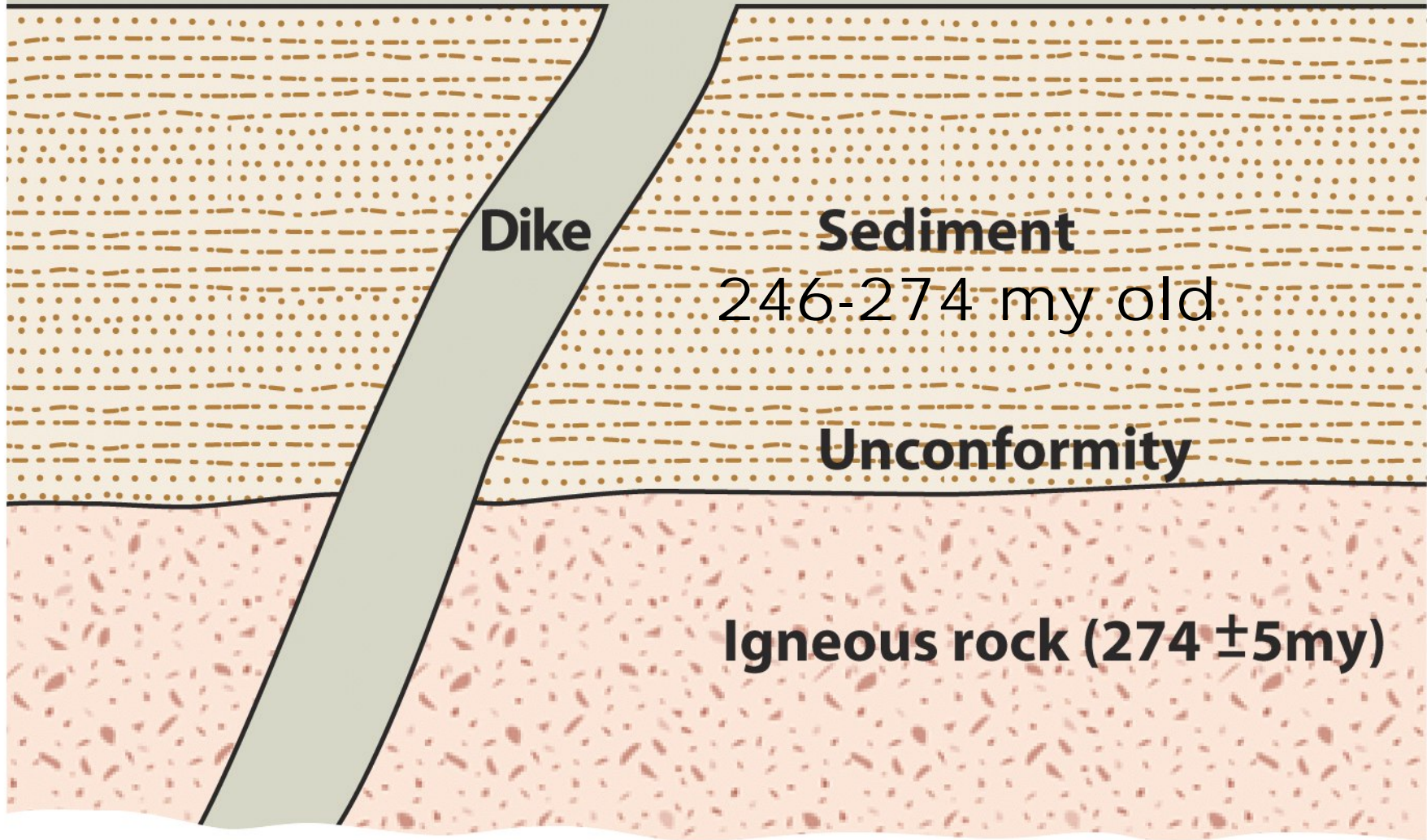


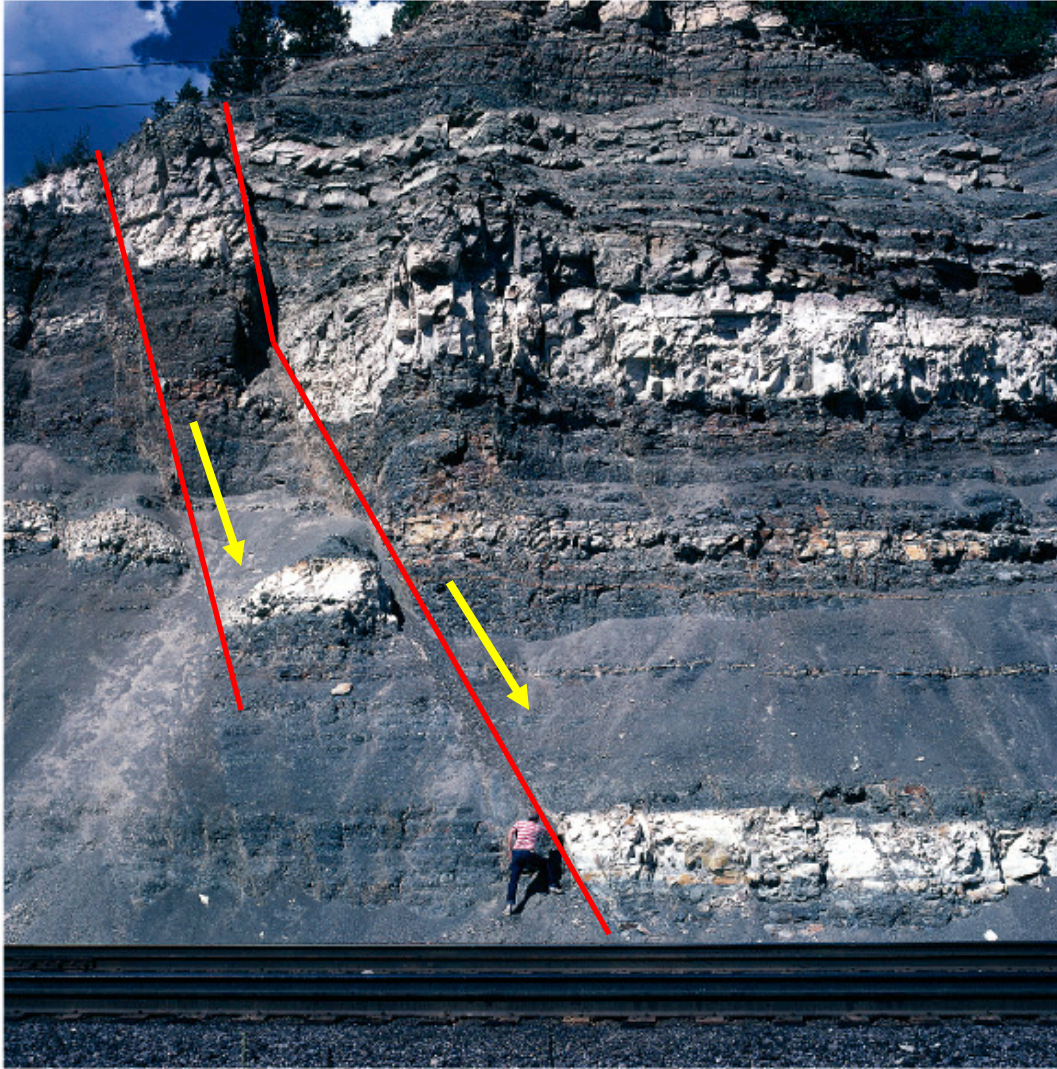
Figure 6-10
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Principle of Cross-Cutting Relationships

- Faults are younger than the rocks they cut through.
- Older faults are offset by younger faults.



Faults cutting sedimentary rocks



Faults cutting sedimentary rocks

Principle of Fossil Succession

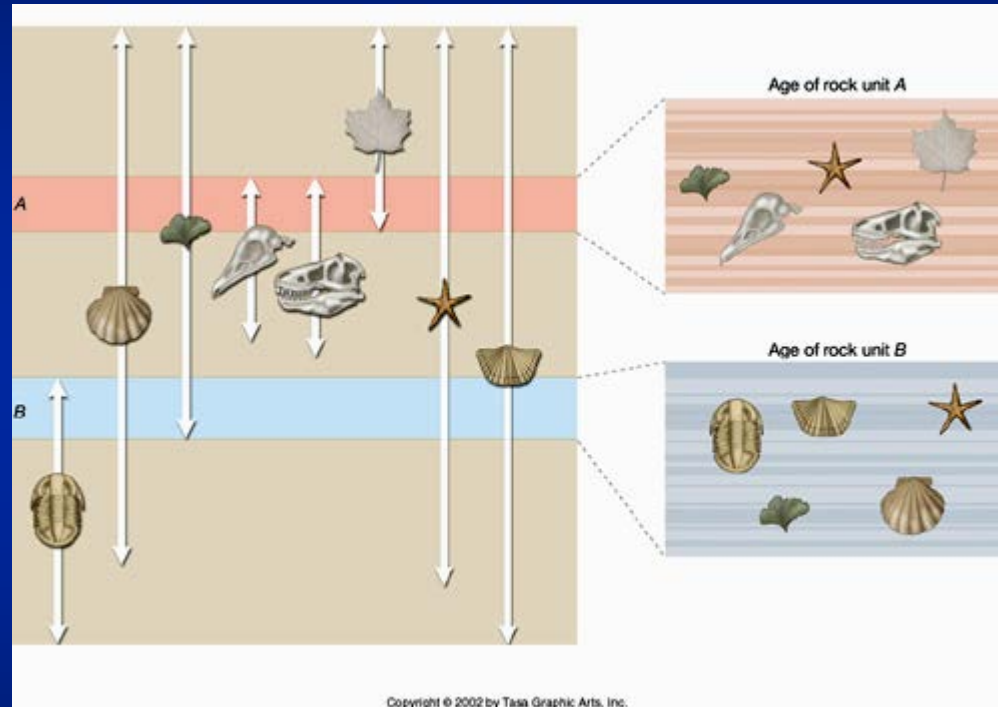
- Fossils are not randomly distributed in rocks. They occur in a unique vertical order observed from place to place.
- This allows age correlation of rocks that are widely separated.
- It allows relative ages of rocks to be determined from one area to another.

Principle of Fossil Succession

Flowering
Plants

Dinosaurs

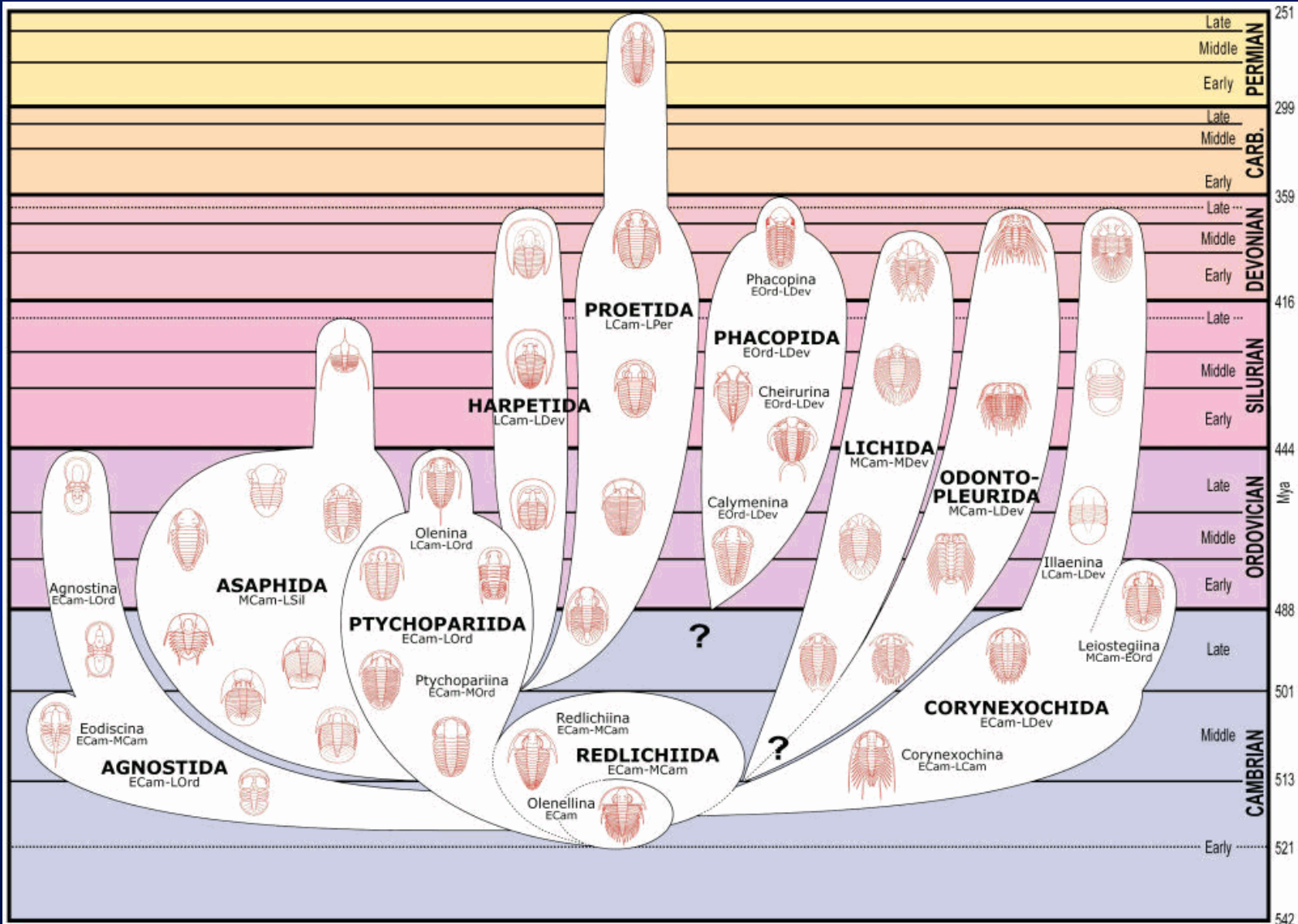
Trilobites



Trilobite Fossil, Cambrian Period



Trilobite Fossil Succession



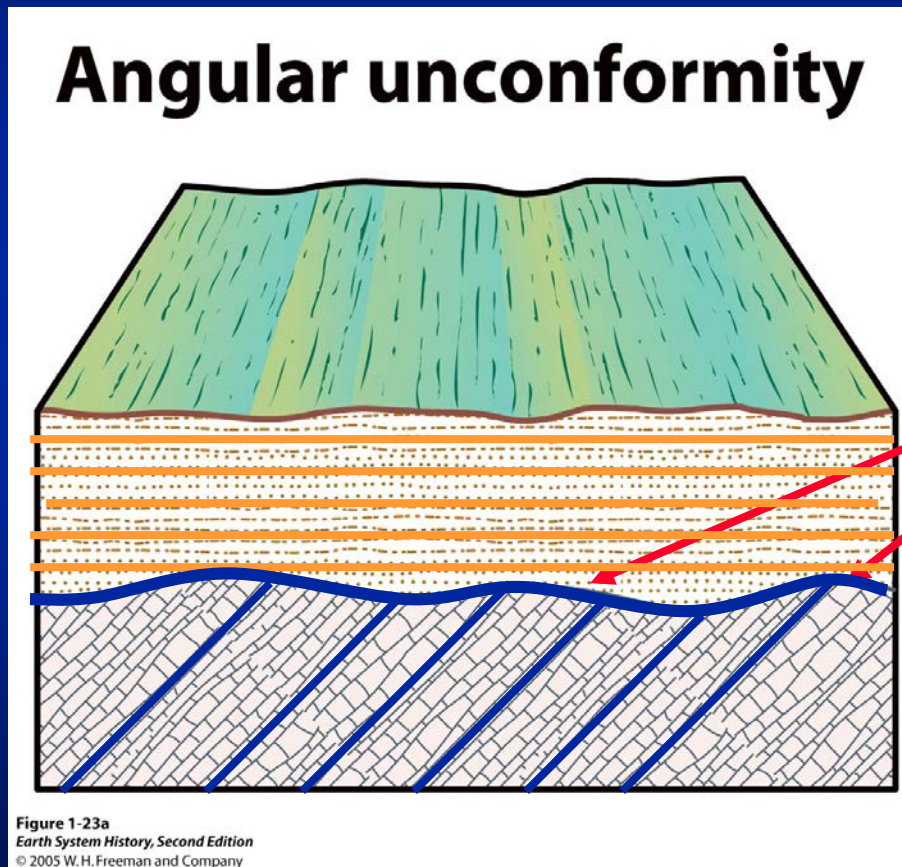
Unconformities

- 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

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

Angular Unconformity



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



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



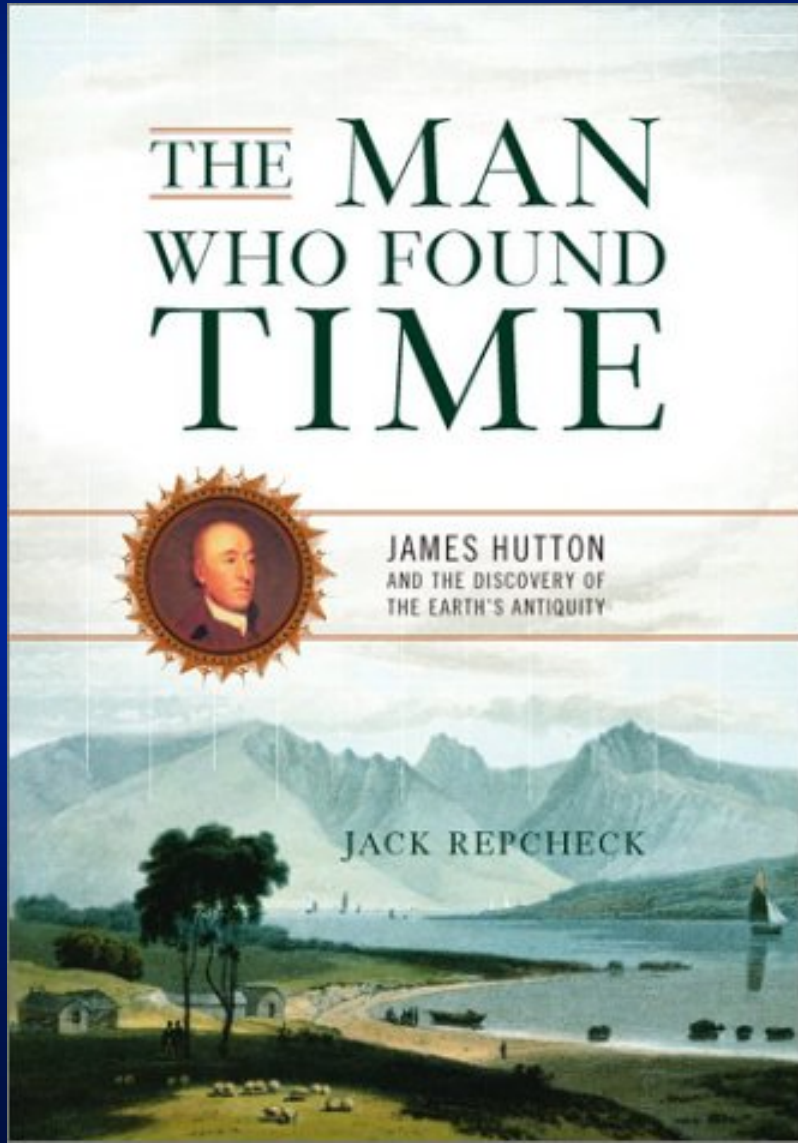
Upper Devonian, 380 M.Y.

Lower Silurian, 440 M.Y.



Siccar Point, Scotland, June 2004

James Hutton: first modern geologist (late 1700s) whose ideas were later the basis for uniformitarianism



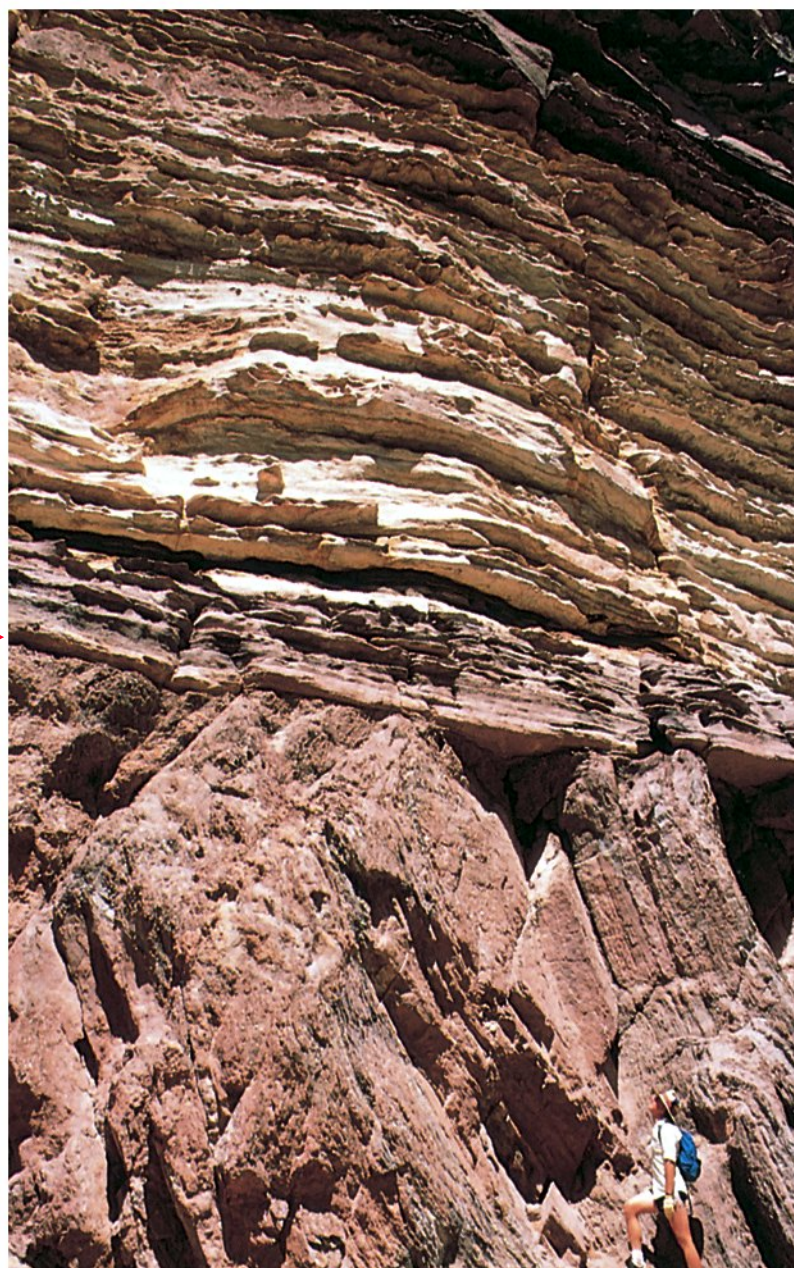
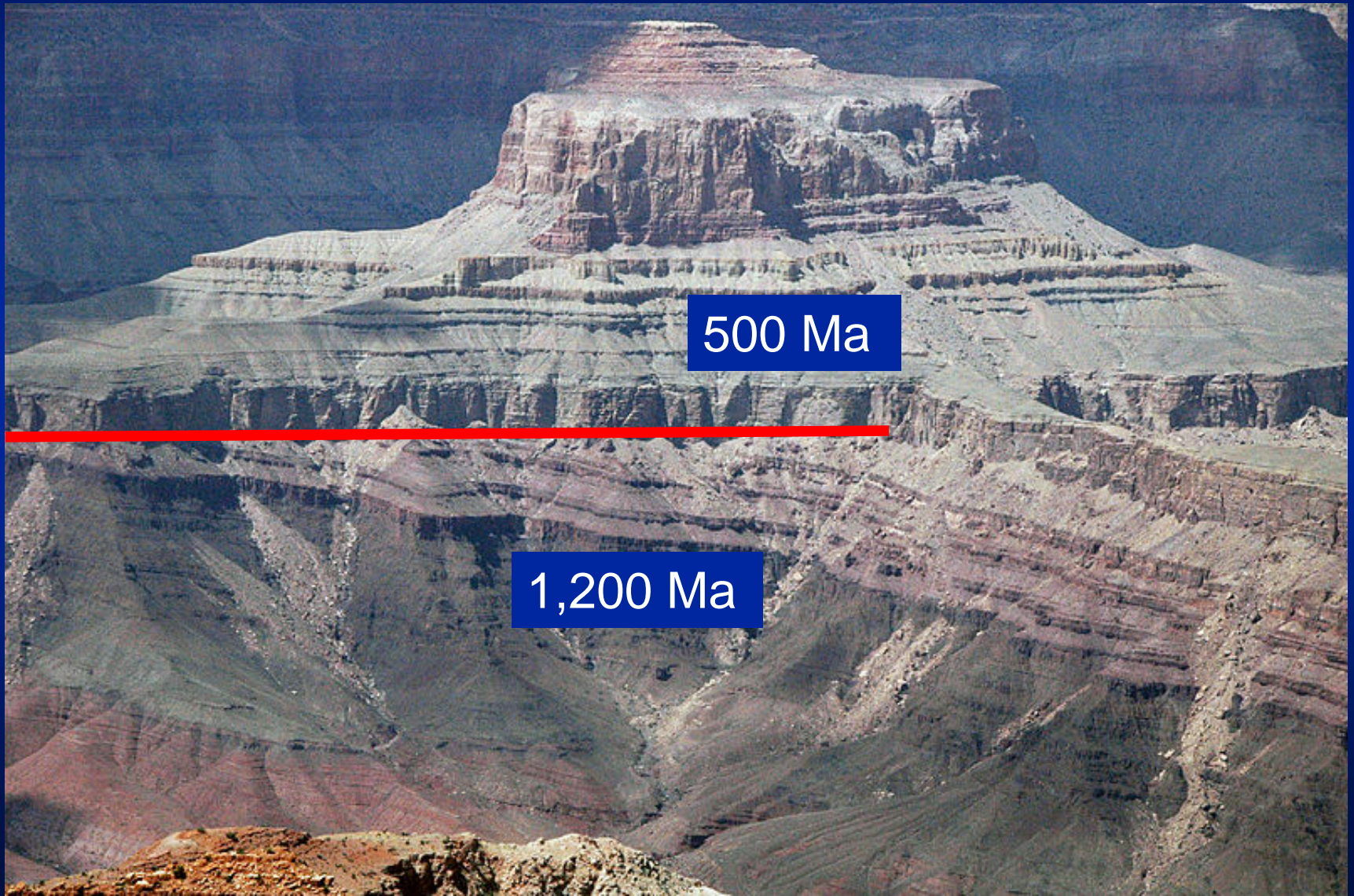


Figure 1-22
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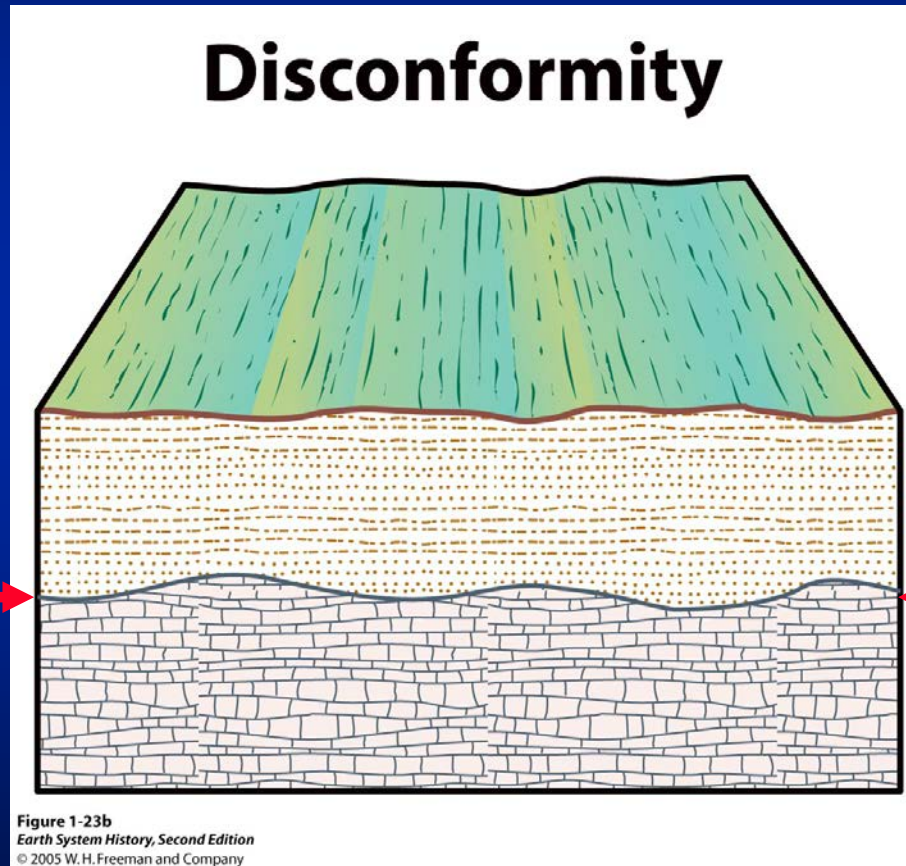
Angular Unconformity in the Grand Canyon between Proterozoic and Cambrian Rocks



Disconformity

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

Disconformity



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



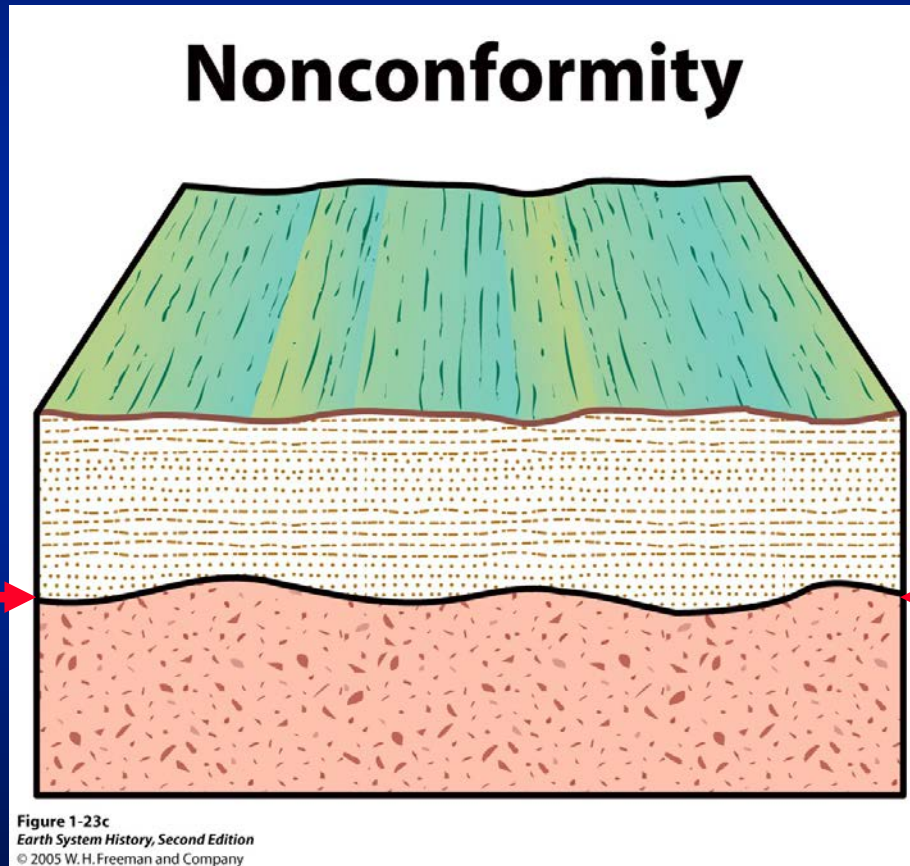
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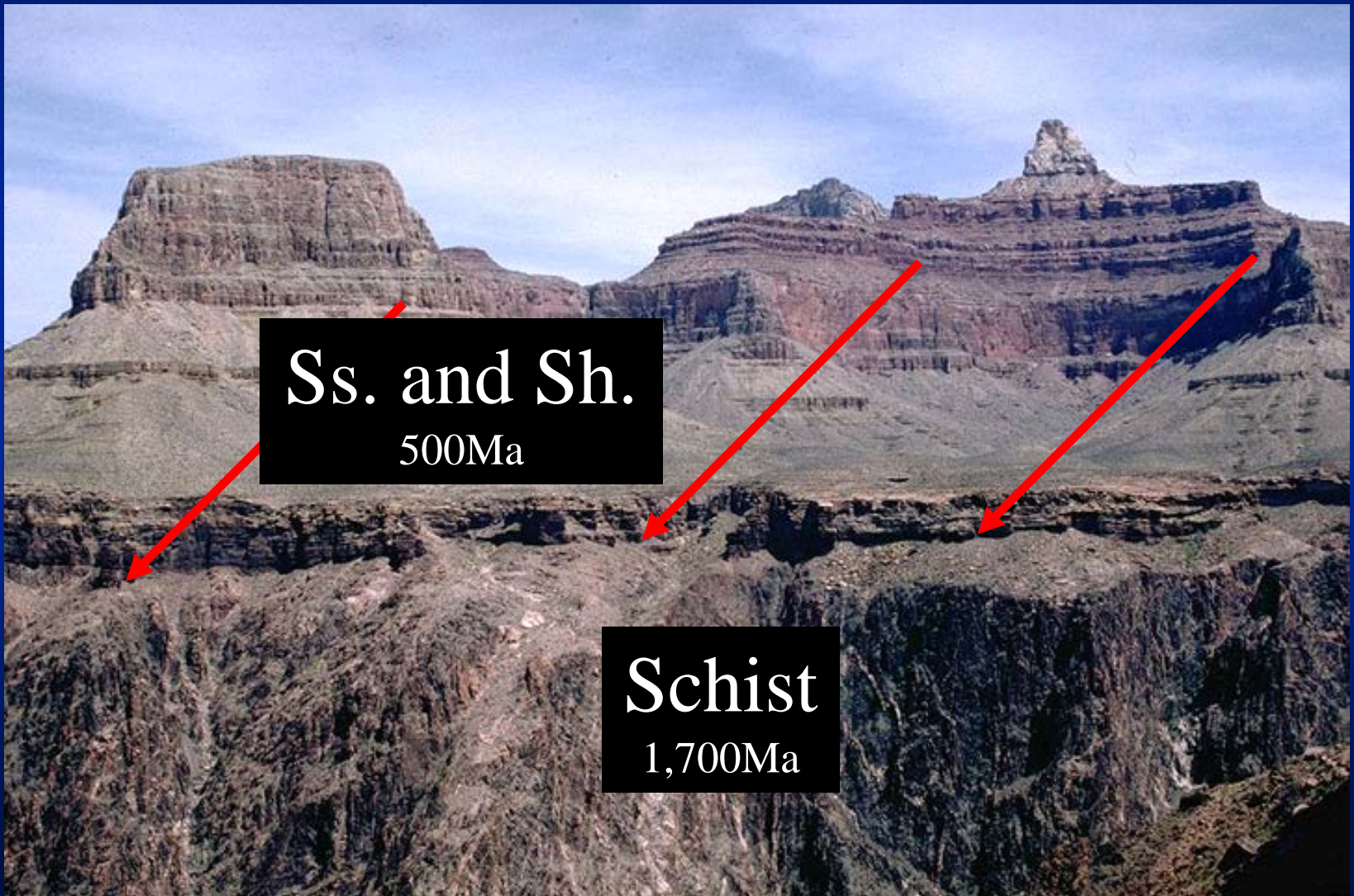
Nonconformity

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

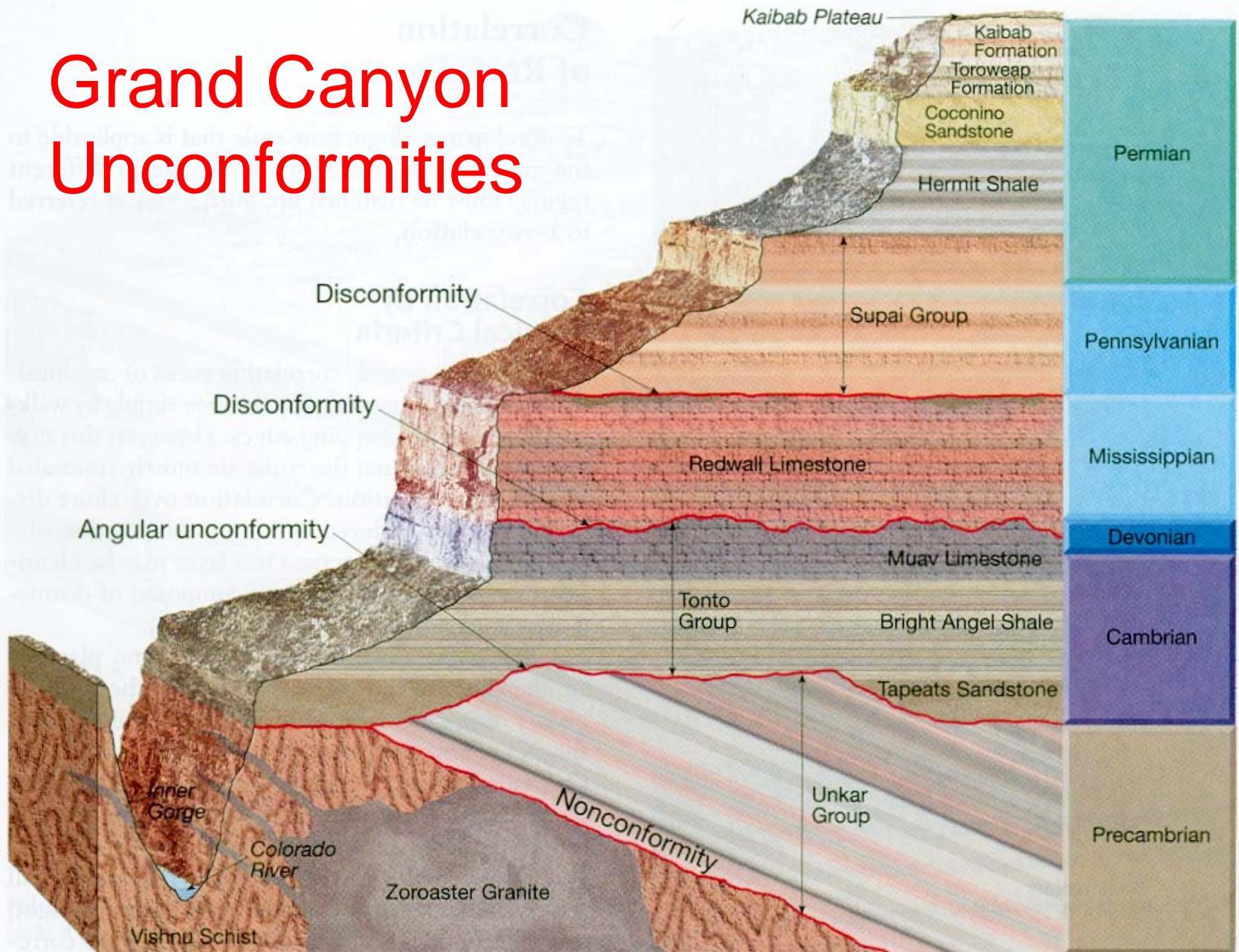
Nonconformity



Nonconformity between sandstones and shales, and metamorphic schist in the Grand Canyon

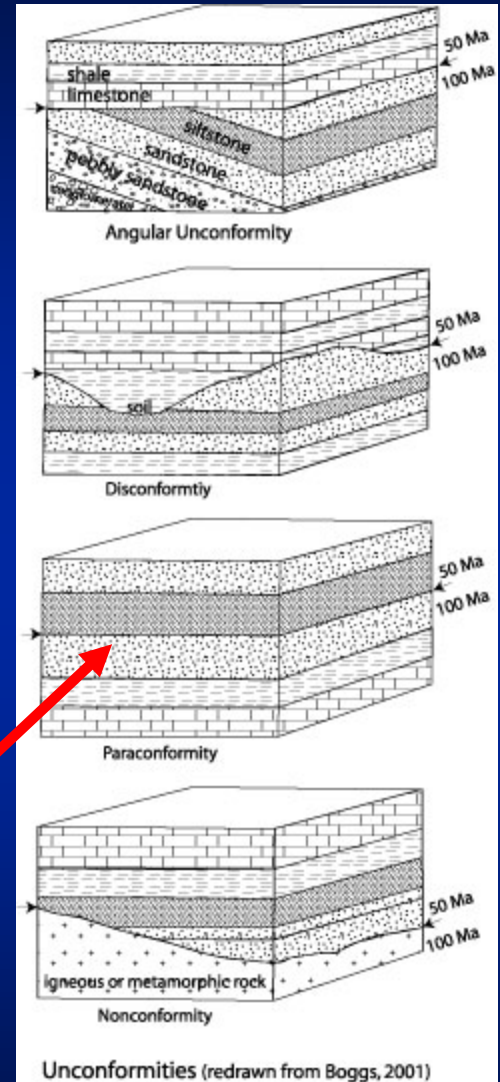


Grand Canyon Unconformities

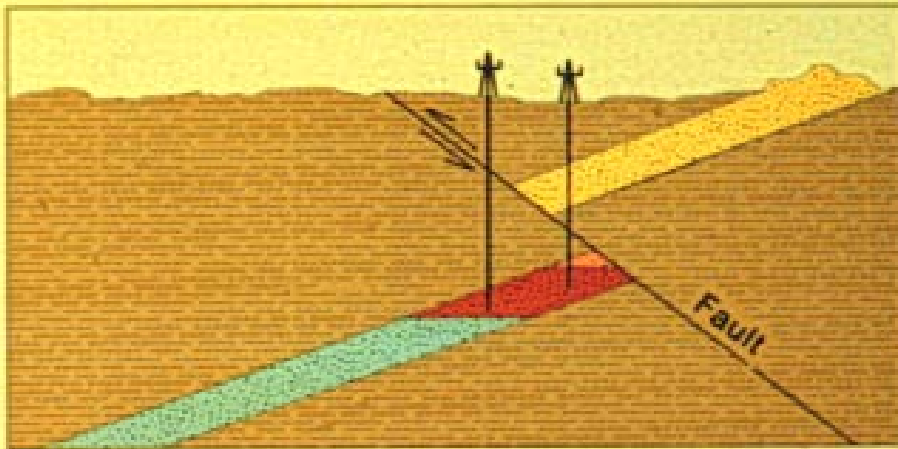


Paraconformity

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

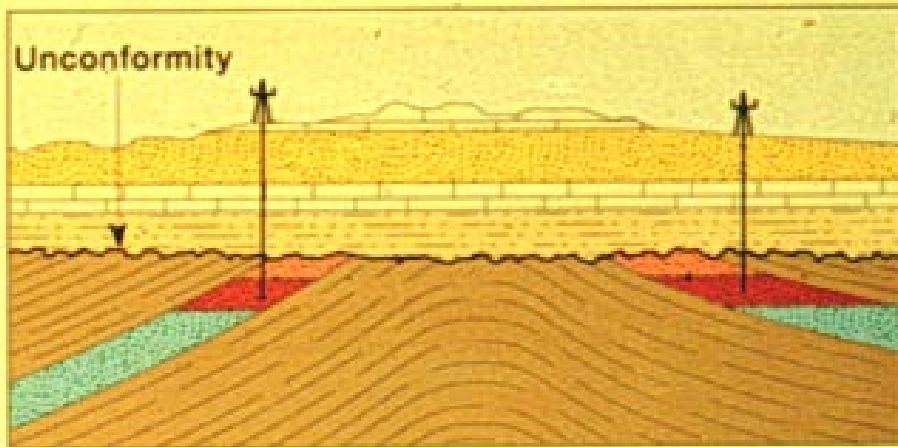


Application of the Principles of Historical Geology. Examples for finding petroleum.



B

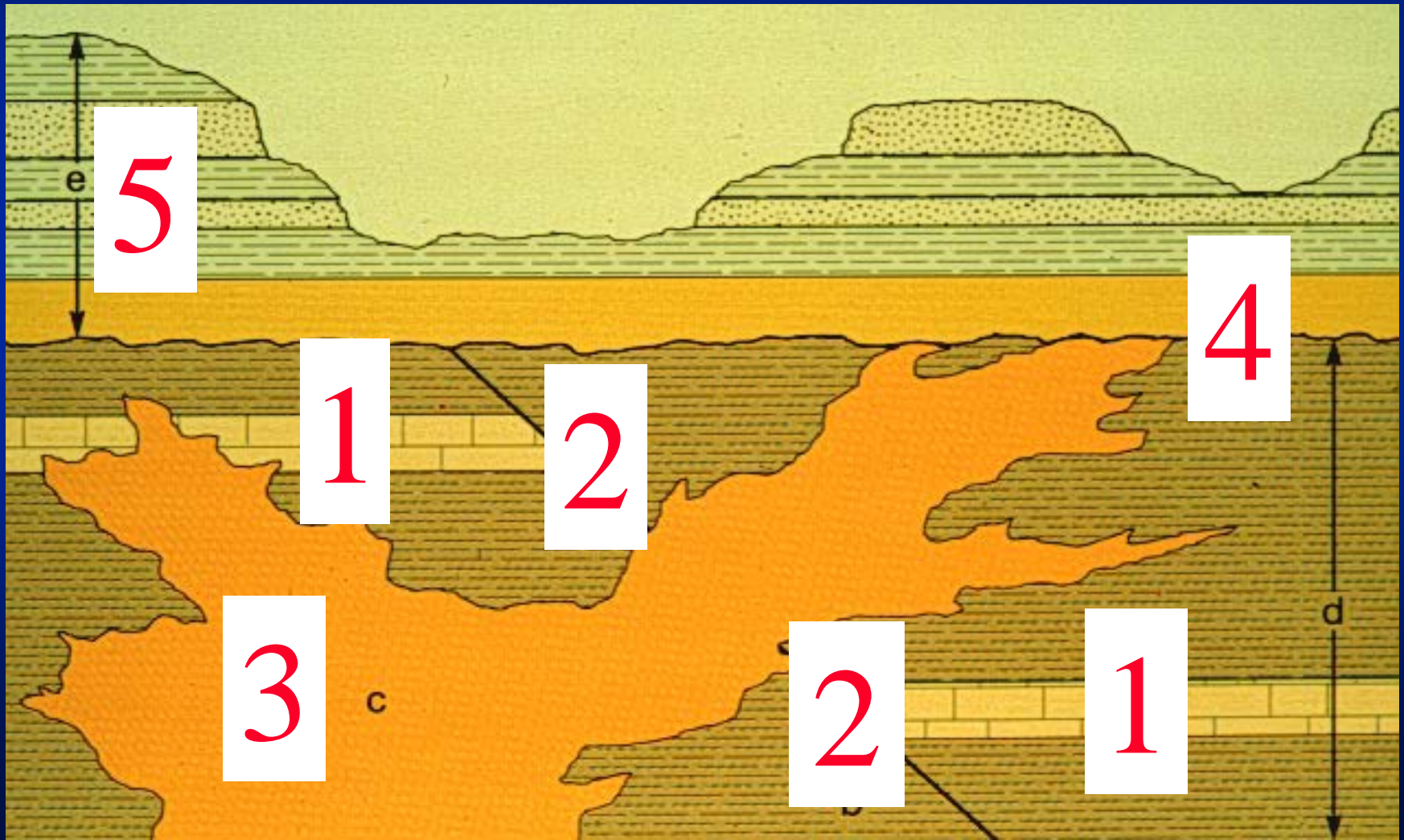
Cross-Cutting Relationships



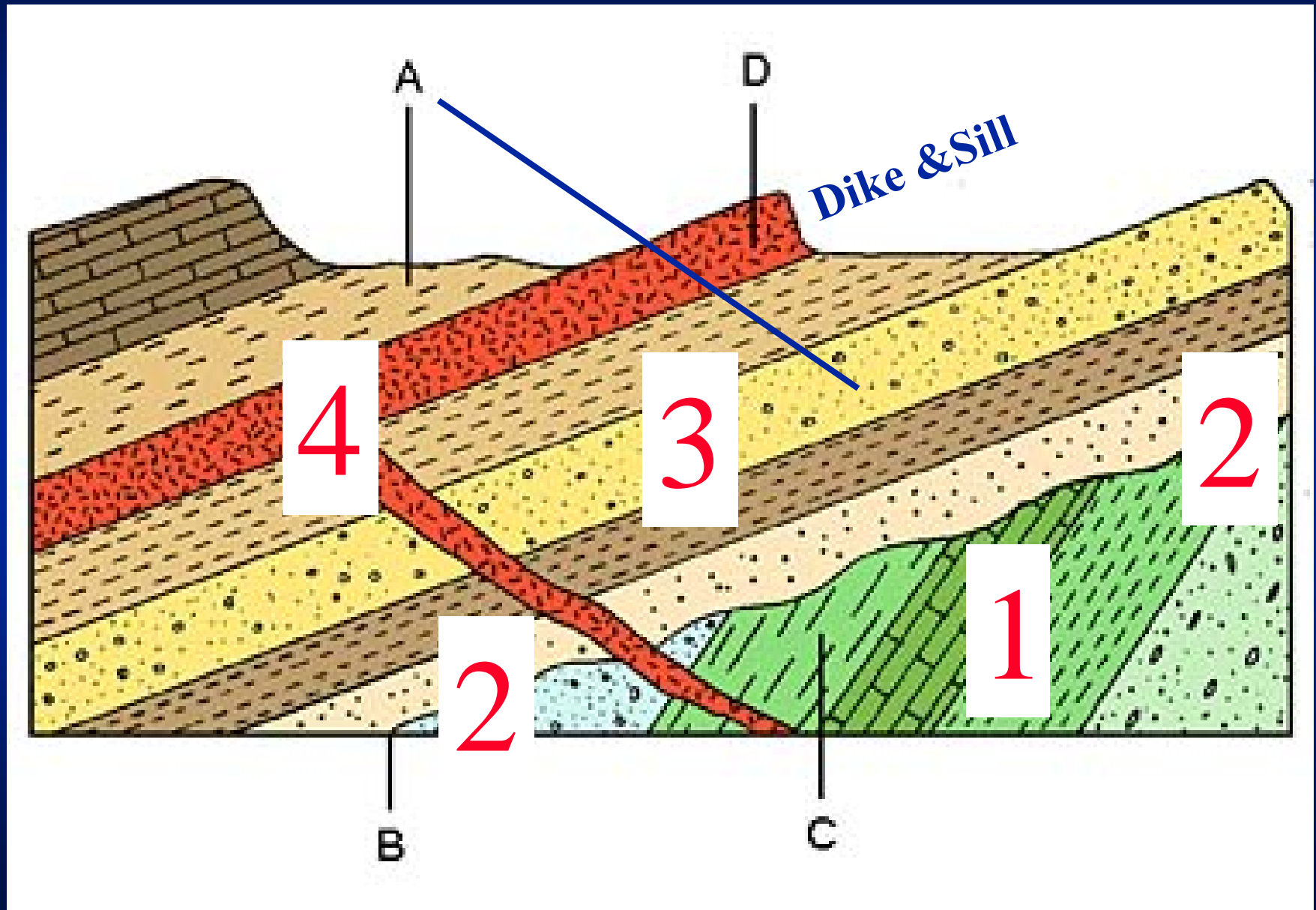
D

Angular Unconformity

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



What is the sequence of events?





STRESS



How would we sort out this mess?