Today:

1) Quiz- Vocabulary Chapter 8
2) Lecture on Telling Time Geologically

Next Class:

1) Go over Exam 2
2) Continue: Telling Time Geologically
3) In Class Exercise: Radiometric dating

Introduction to the Grand Canyon

James Hutton (1727-97)

"Father of Geology"

James Hutton

Charles Lyell

The Principle of Uniformitarianism

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Published in the Principles of Geology, by Lyell

The Principle of Uniformitarianism

Physical processes we observe today also operated in the past, at roughly comparable rates.

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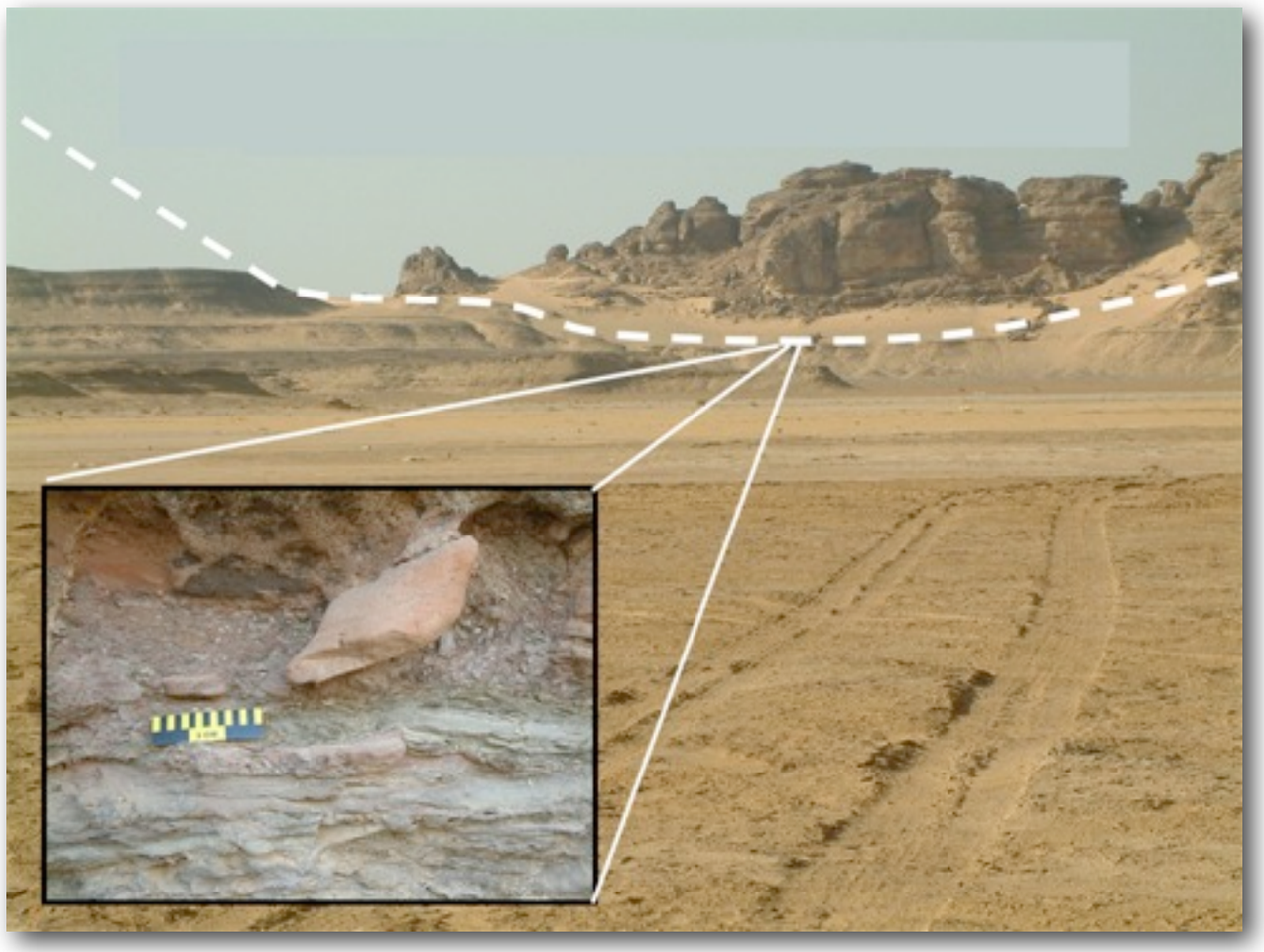

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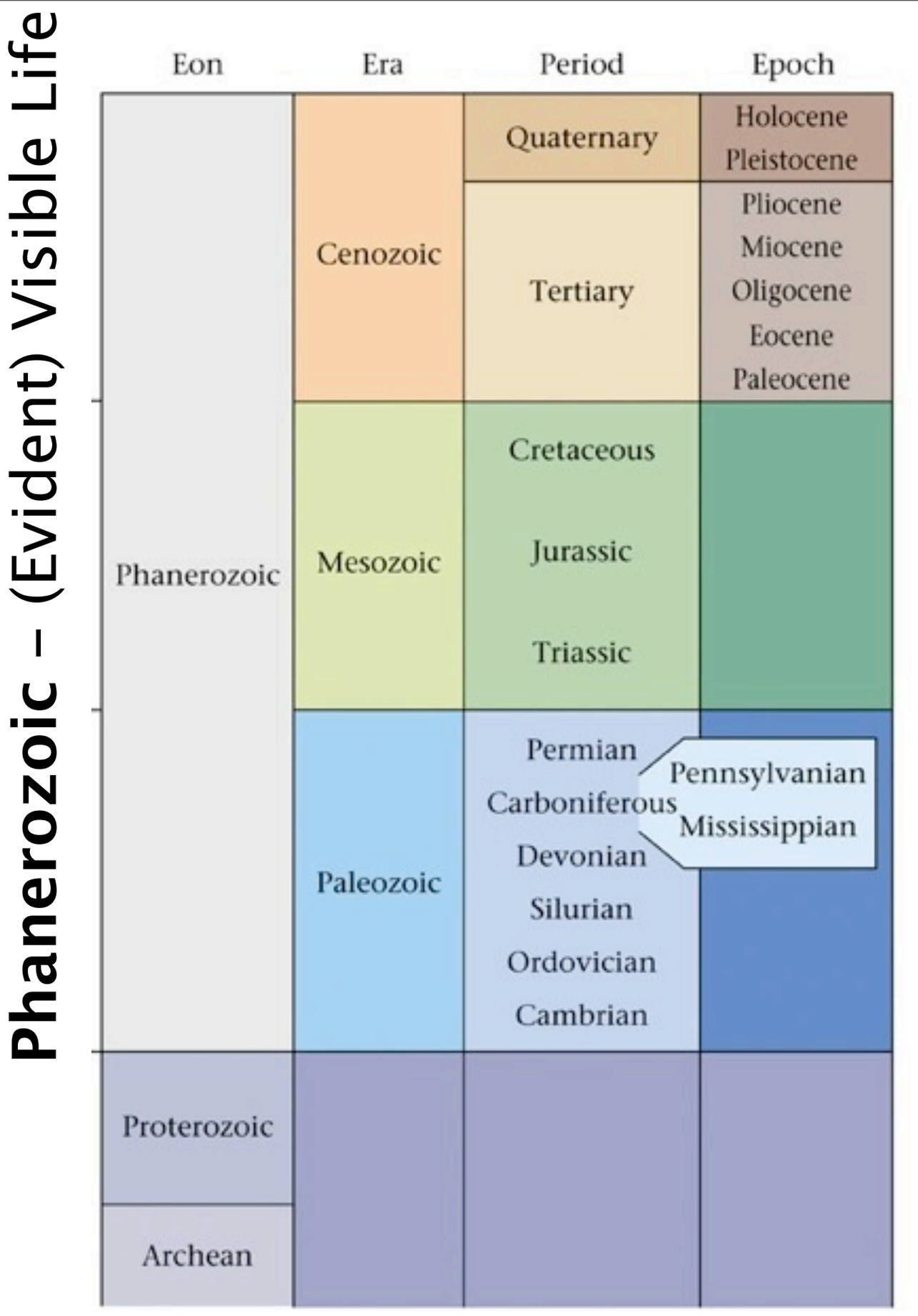
Relative Dating
vs.
Absolute Dating

Relative Dating

vs.

Absolute Dating

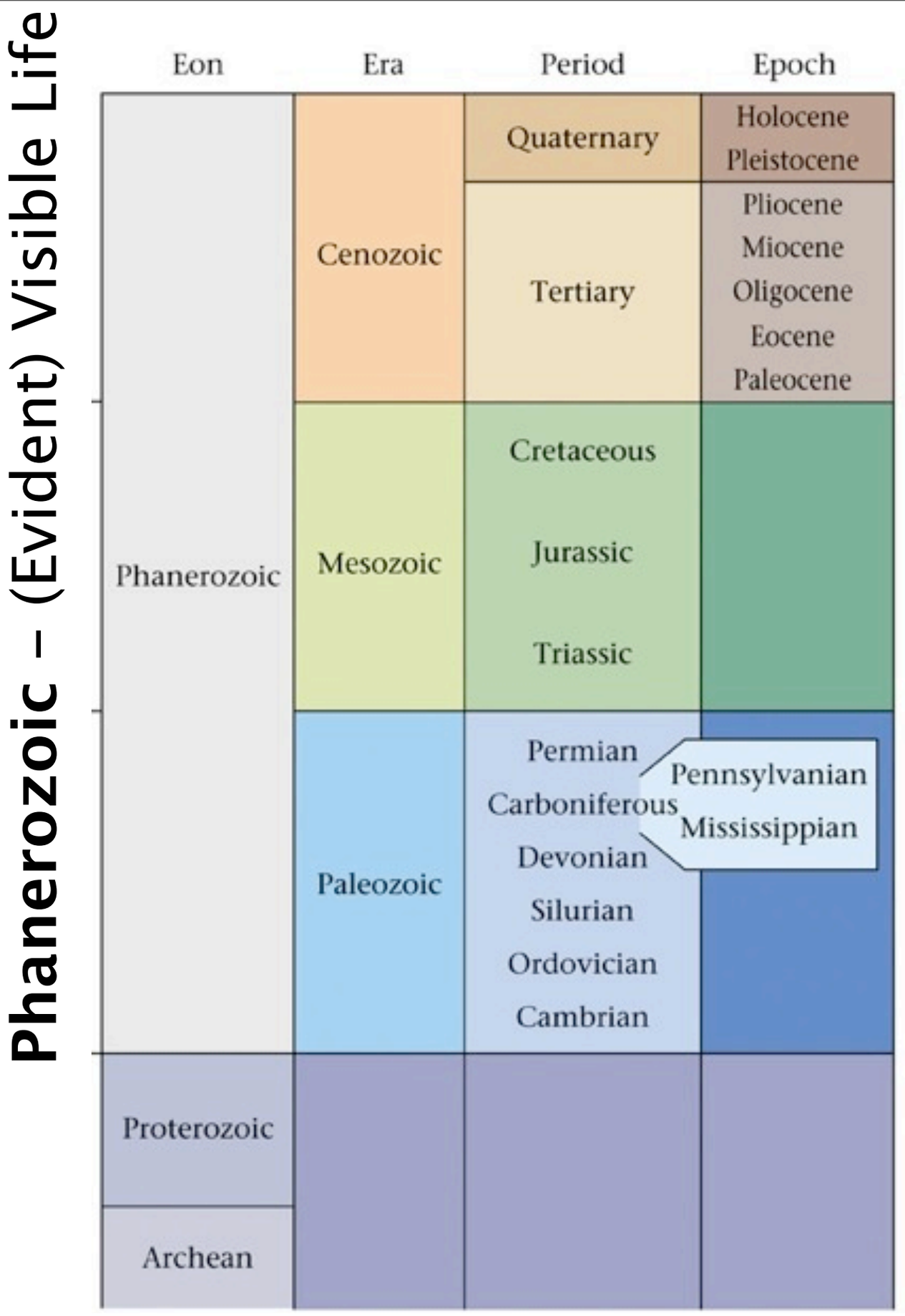
The Geologic Time Scale



Phanerozoic – (Evident) Visible Life

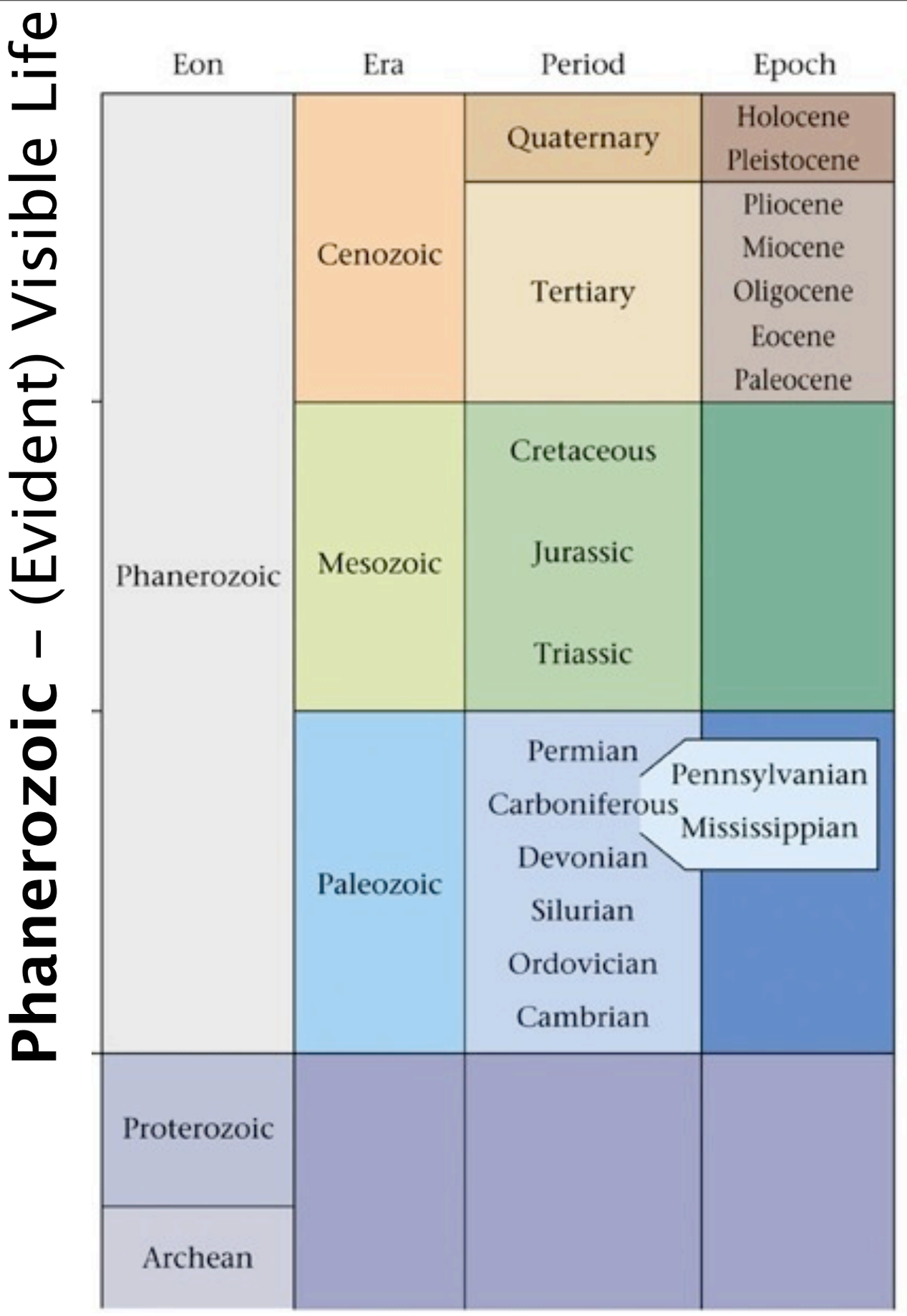
Hadean – Beneath the Earth (no Rocks)

The Geologic Time Scale



Archean–"Ancient" (Single-celled life)

The Geologic Time Scale



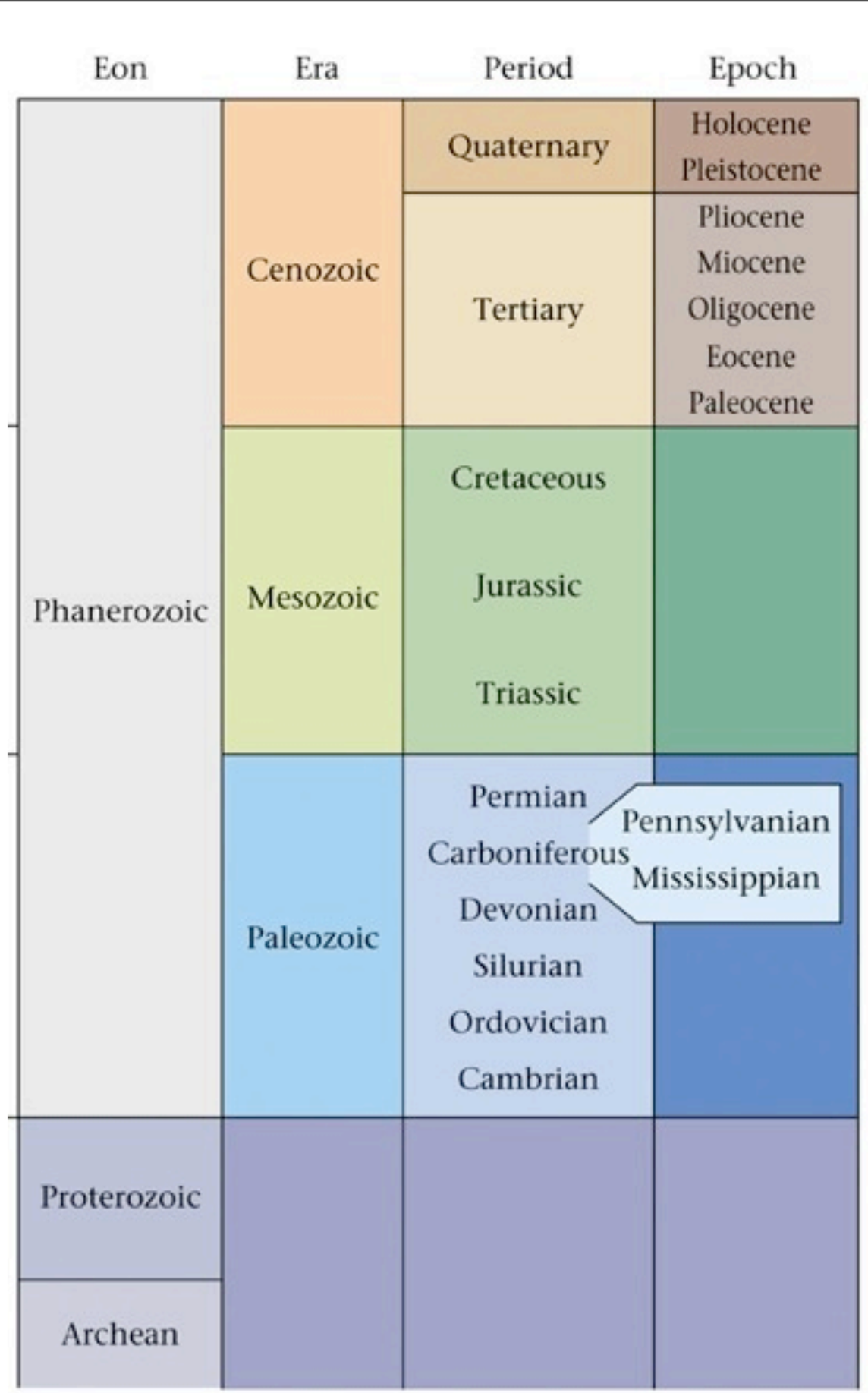
Proterozoic–Early Life (multi-cellular life)

Archean–"Ancient" (Single-celled life)

Hadean – Beneath the Earth (no Rocks)

The Geologic Time Scale

Phanerozoic – (Evident) Visible Life



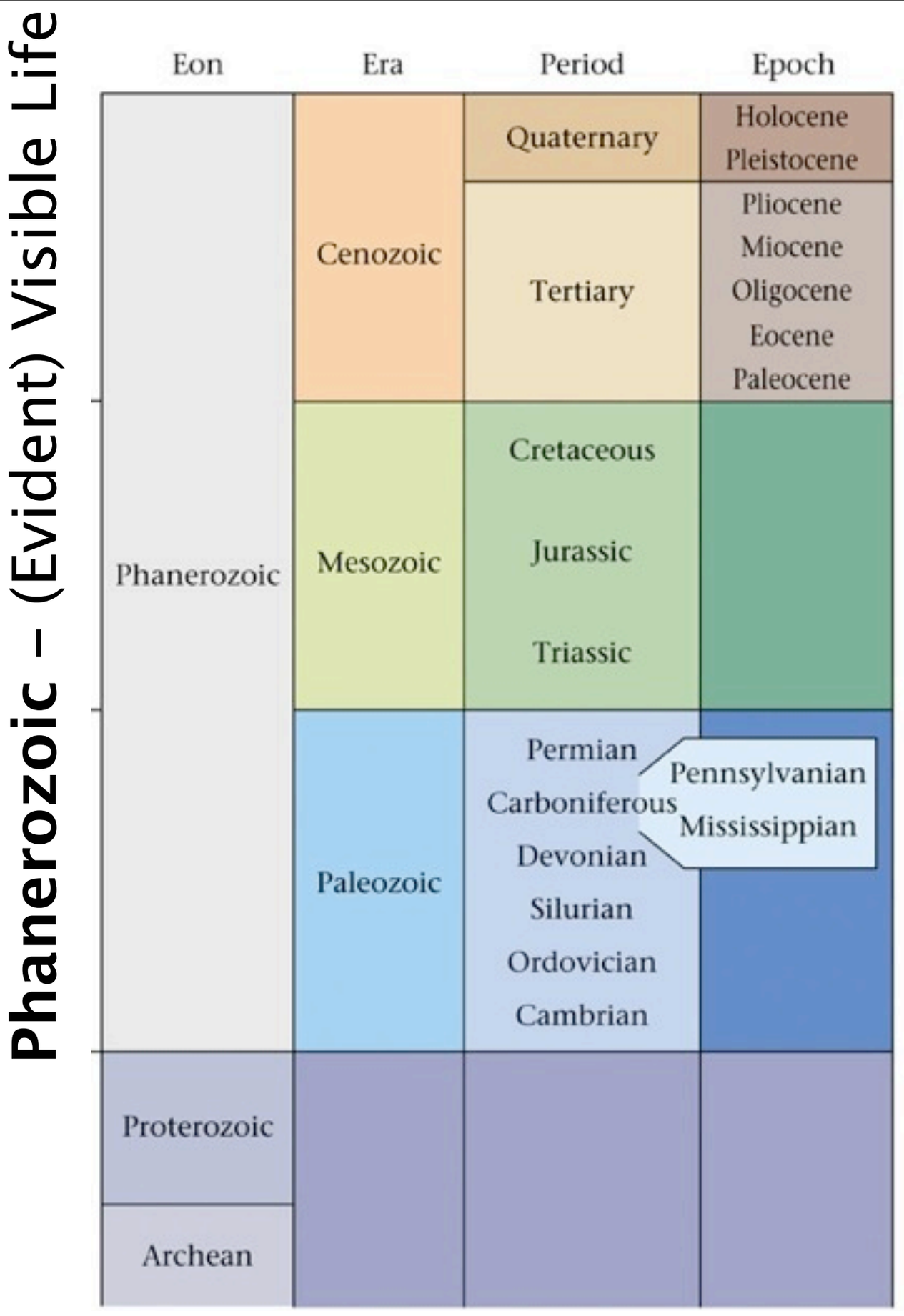
Paleozoic– "Old Life"
(complex life; coral fish, plants)

Proterozoic–Early Life (multi-cellular life)

Archean–"Ancient" (Single-celled life)

Hadean – Beneath the Earth (no Rocks)

The Geologic Time Scale



Mesozoic – "Middle Life"
(time of the Dinosaurs)

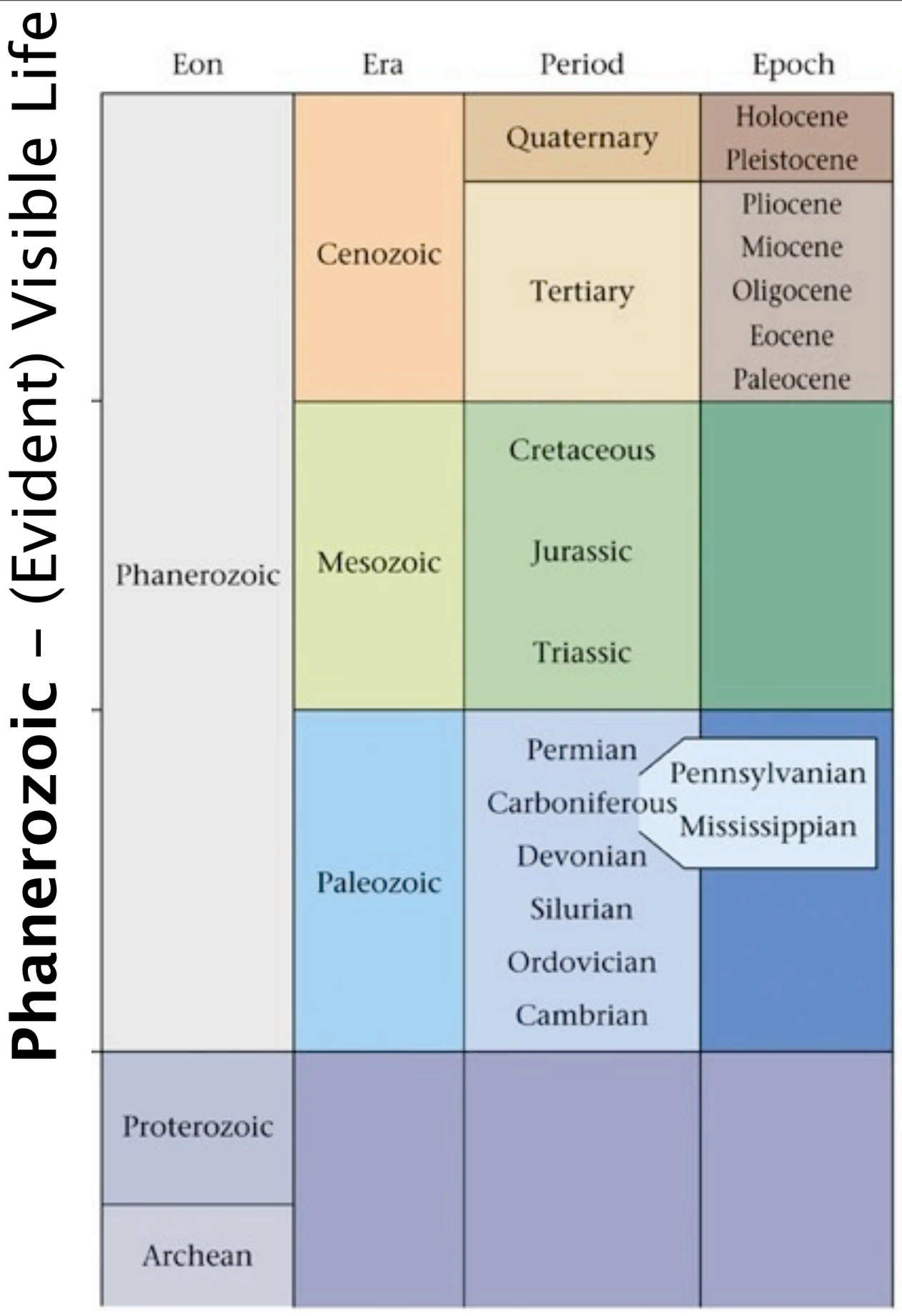
Paleozoic– "Old Life"
(complex life; coral fish, plants)

Proterozoic–Early Life (multi-cellular life)

Archean–"Ancient" (Single-celled life)

Hadean – Beneath the Earth (no Rocks)

The Geologic Time Scale



Cenozoic – "Recent Life"
(time of the mammals)

Mesozoic – "Middle Life"
(time of the Dinosaurs)

Paleozoic– "Old Life"
(complex life; coral fish, plants)

Proterozoic–Early Life (multi-cellular life)

Archean–"Ancient" (Single-celled life)

Hadean – Beneath the Earth (no Rocks)

The Scale of Geologic Time

Hadean | Archean | Proterozoic | Paleozoic | Mesozoic | Cenozoic

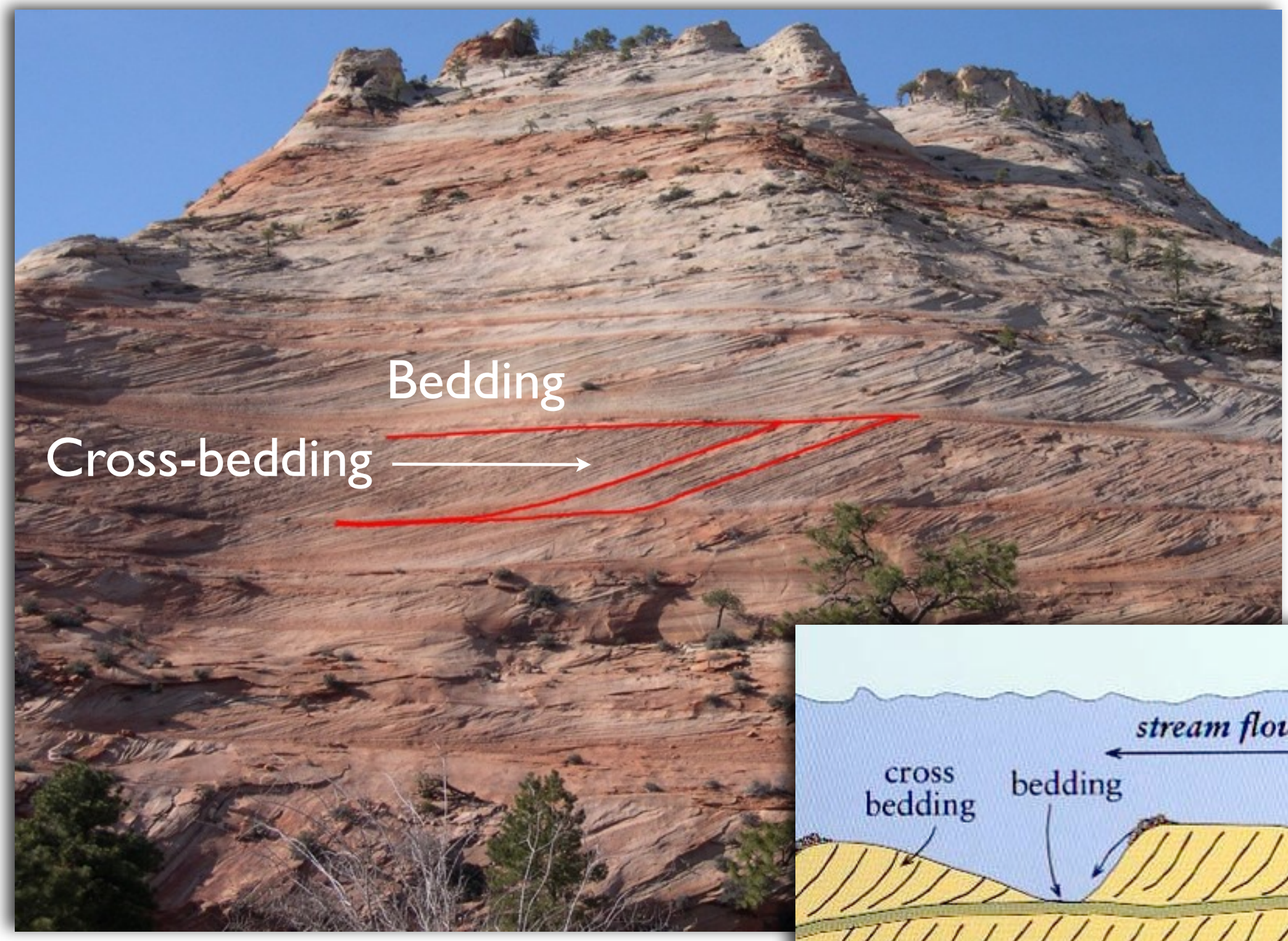
Geology: *The science of the obvious*

(DeVecchio, 2012)

Principle of Original Horizontality

Sediment on Earth settles out of a fluid in a gravitational field, and accumulates on horizontal surfaces, therefore when originally deposited they are horizontal

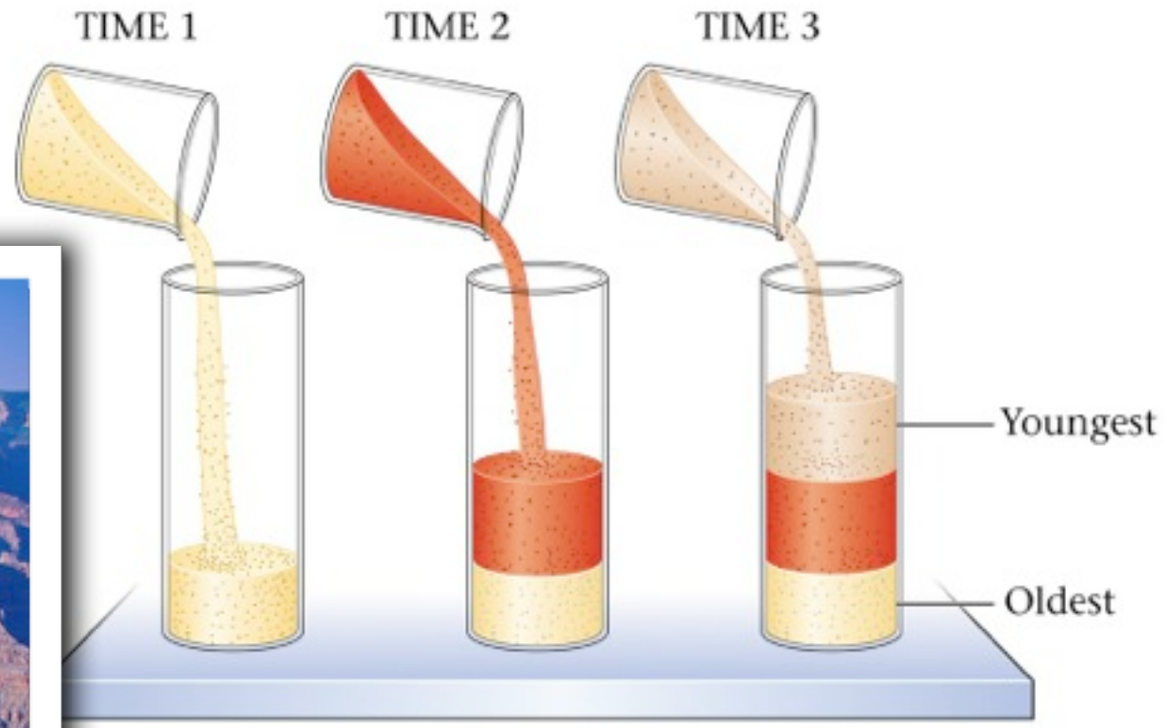
Principle of Original Horizontality



Principle of Original Horizontality

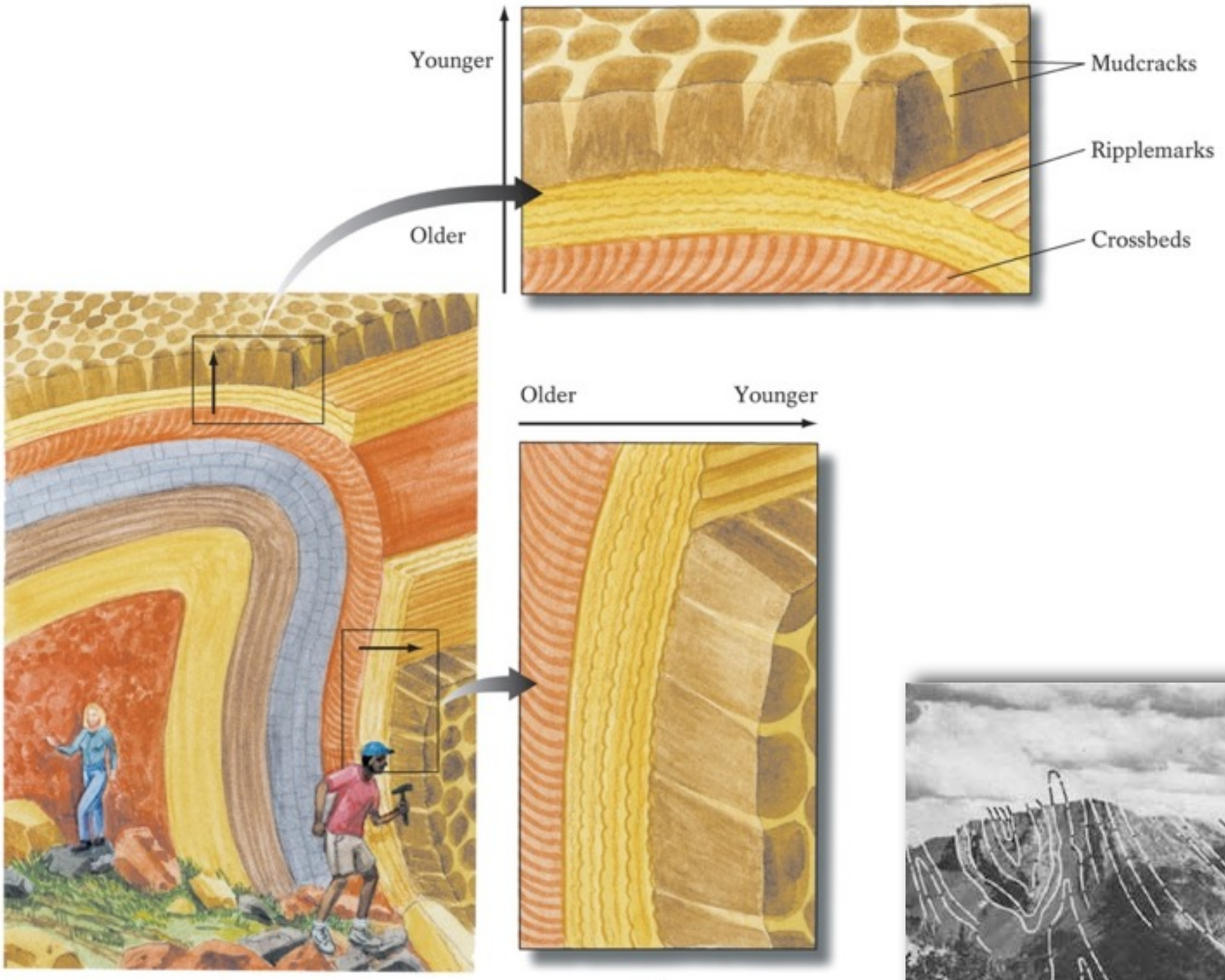
Principle of Superposition

In a sequence of sedimentary rock layers (beds), each layer must be younger than the bed below.



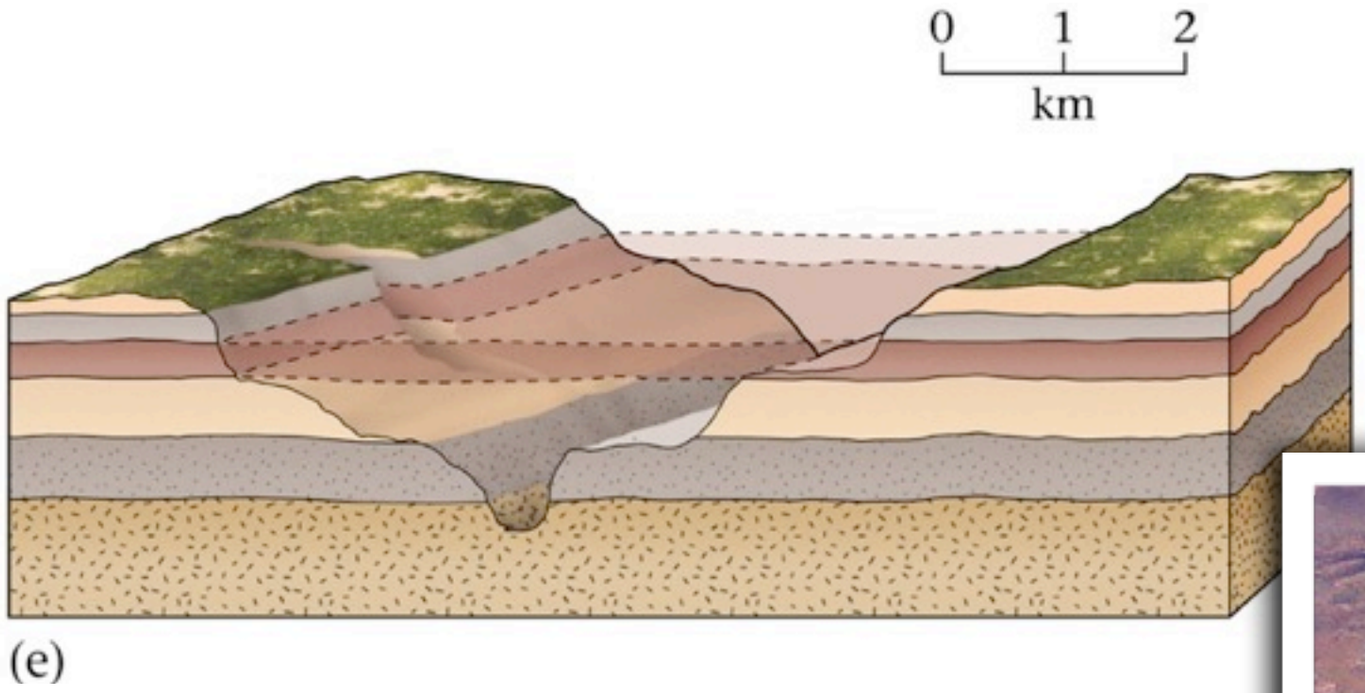
Principle applies to Sedimentary strata

Principle of Superposition



(b)

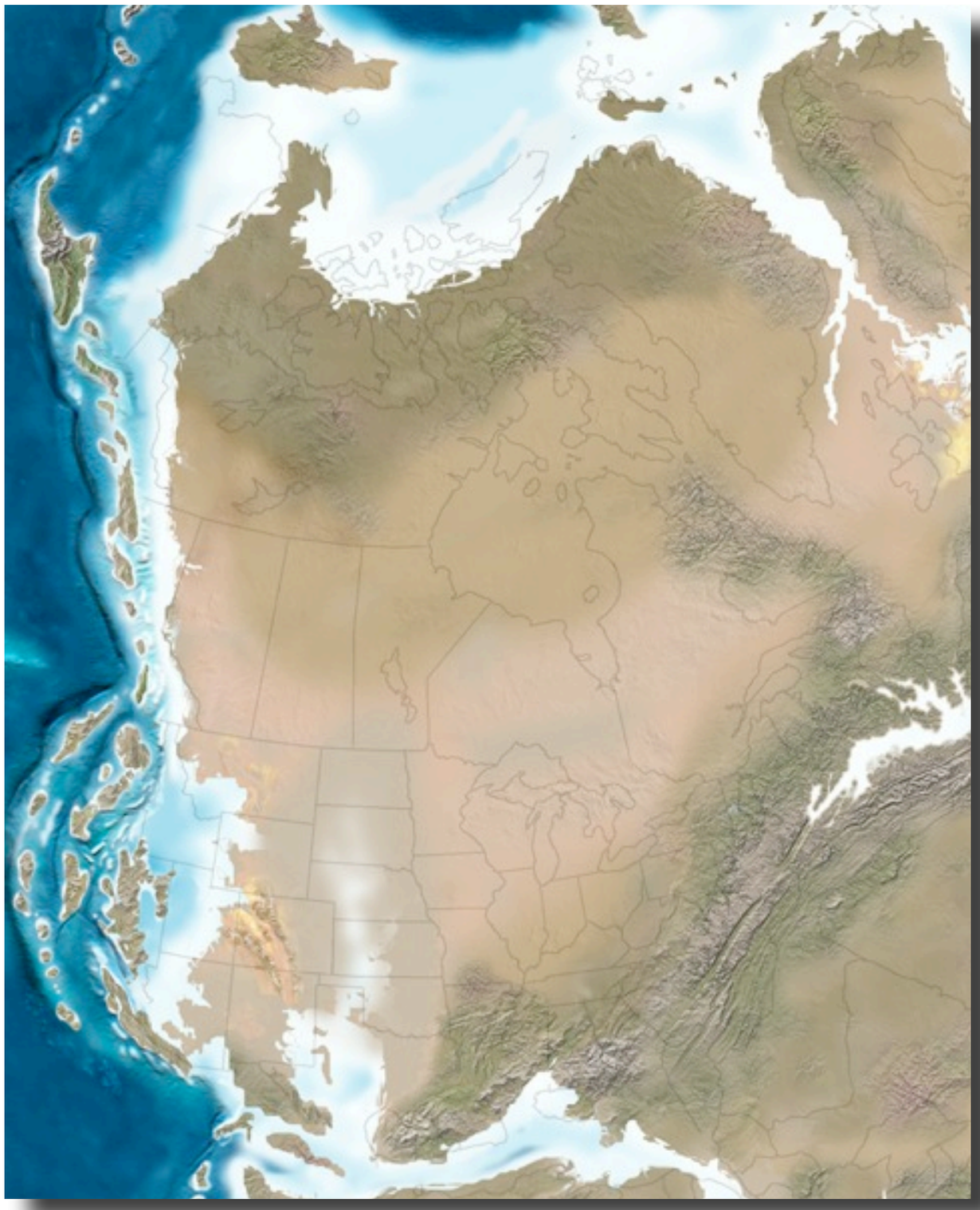
Principle of Lateral/Original Continuity

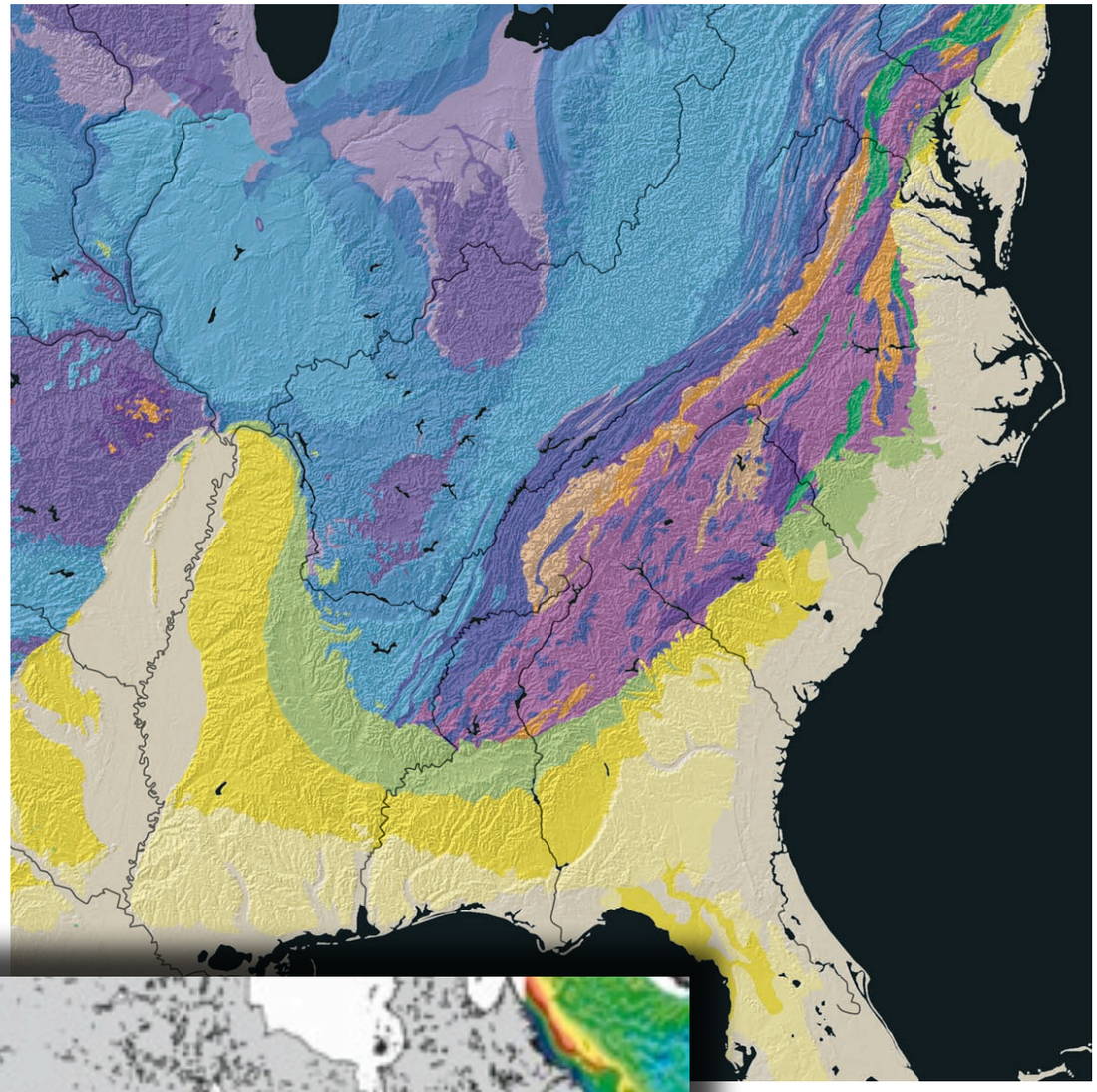


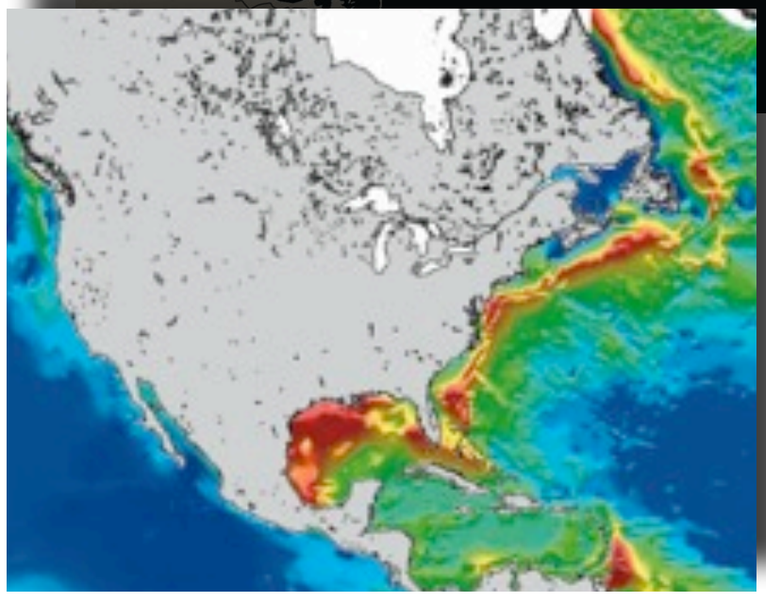
Layers of sedimentary rocks can be continuous over broad areas when first deposited. Erosion may later remove part of a layer

Principle applies to Sedimentary strata

Principle of Lateral/Original Continuity

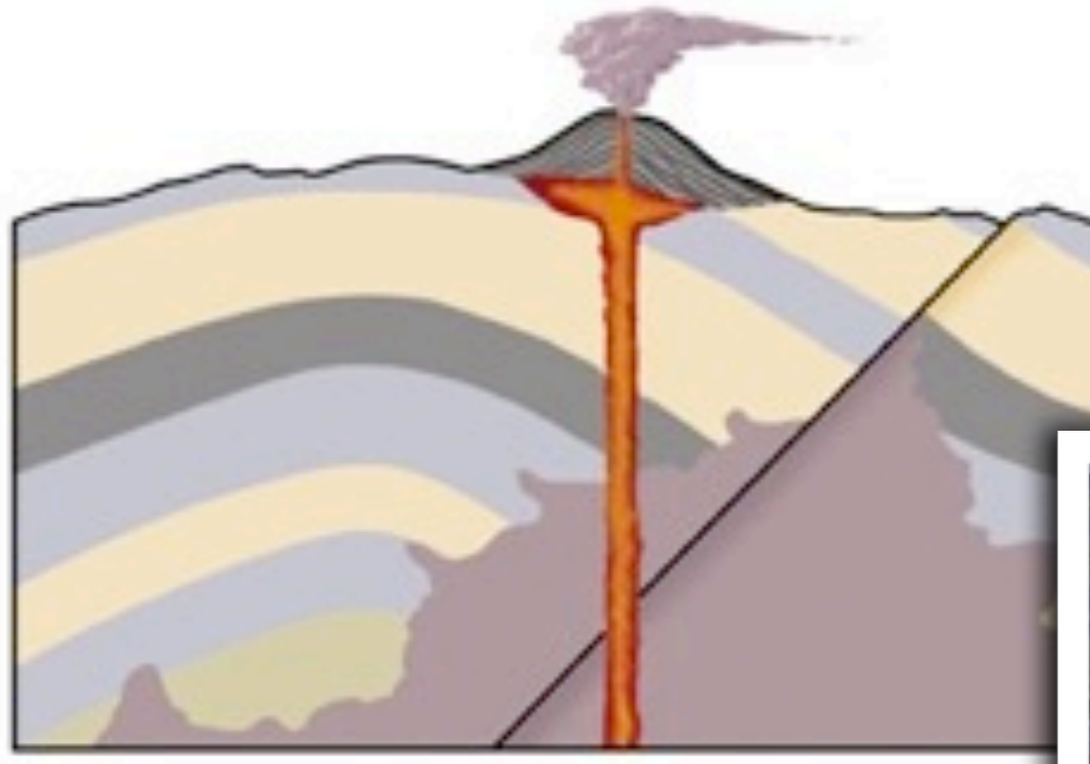






The Vermillion Cliffs, Utah

Principle of Cross Cutting Relations



If one geologic feature cuts across another, the feature that has been cut is older

Principle applies to all rock types and Geologic structures

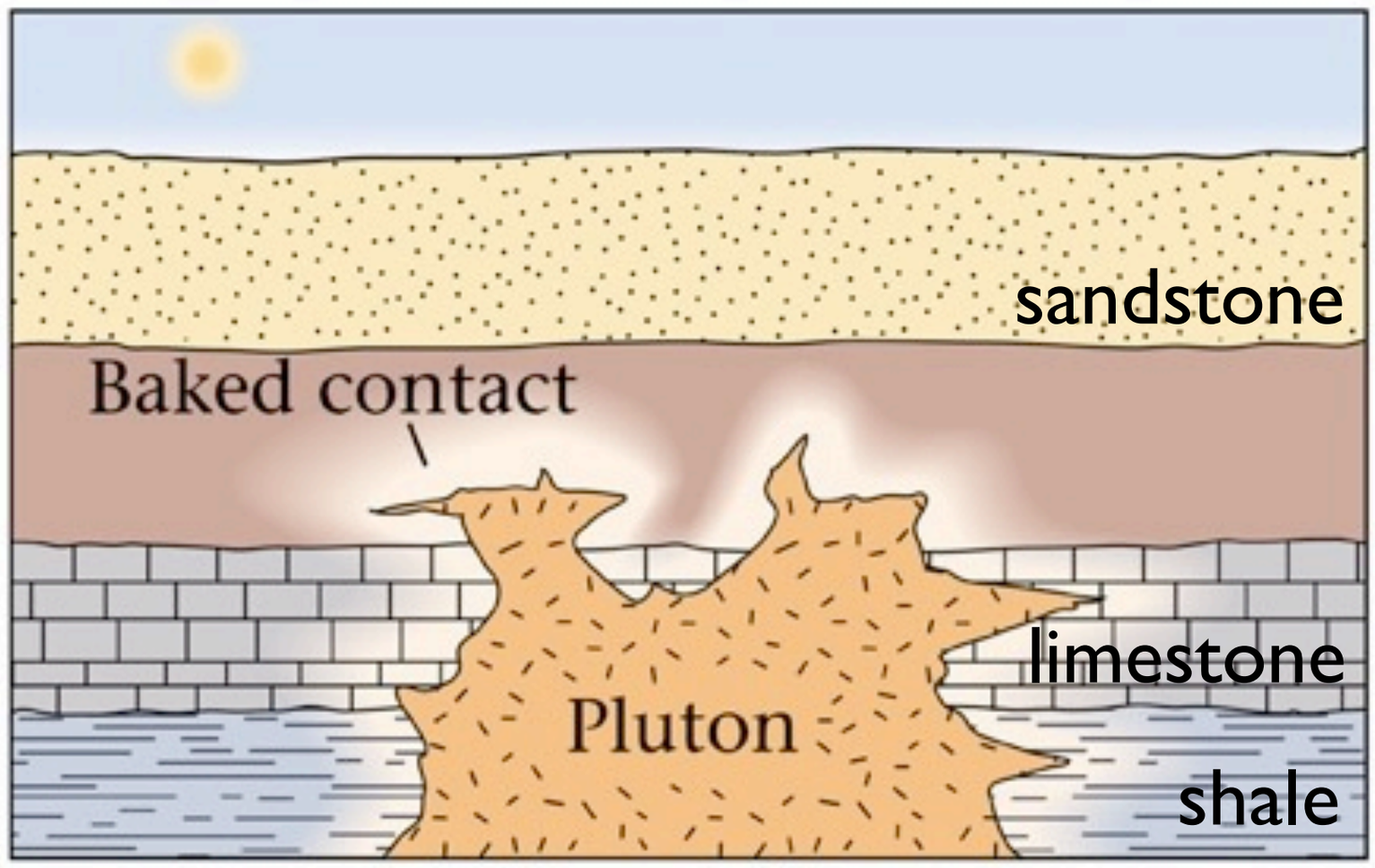
Principle of Inclusions

The rock containing the inclusion must be younger than the rock that is included

Principle applies to all rock types

Principle of Baked Contacts

An igneous intrusion "bakes" (metamorphoses) surrounding rocks. The rock that is baked must be older than the intrusion



Principle applies to all rock types

Principle of Baked Contacts

Tierra del Fuego, Chile

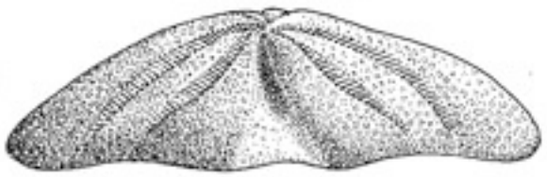
Principle applies to all rock types

Principle of Baked Contacts

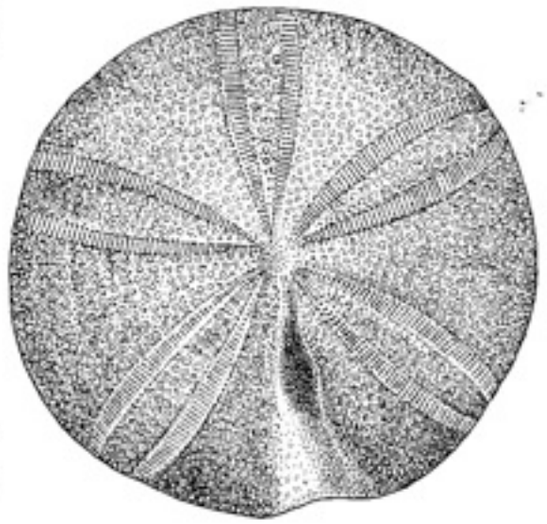
Bingham Copper mine, Salt Lake City

Principle applies to all rock types

Principle of Faunal Succession



The pound stone,
viewed from the side.

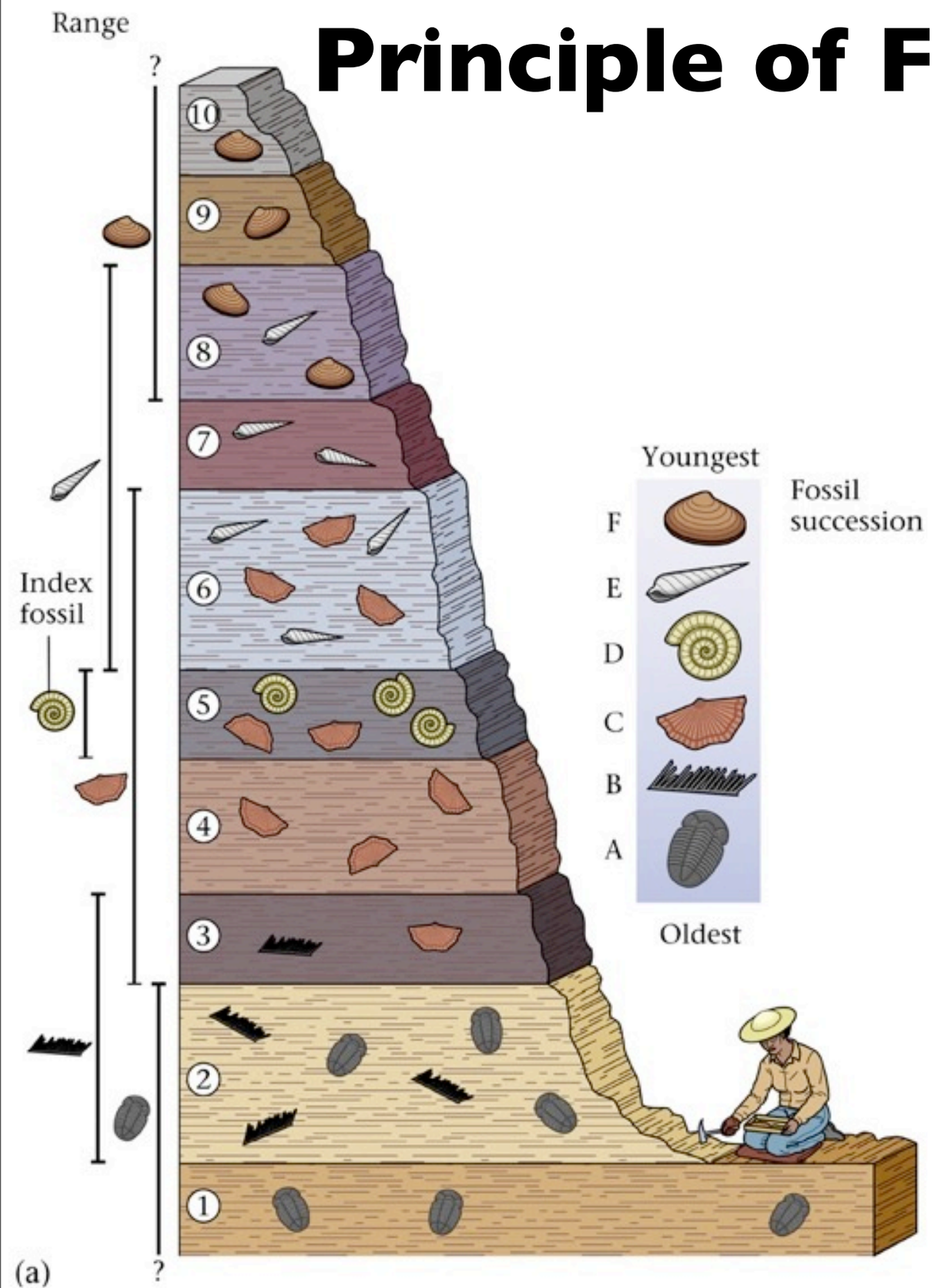


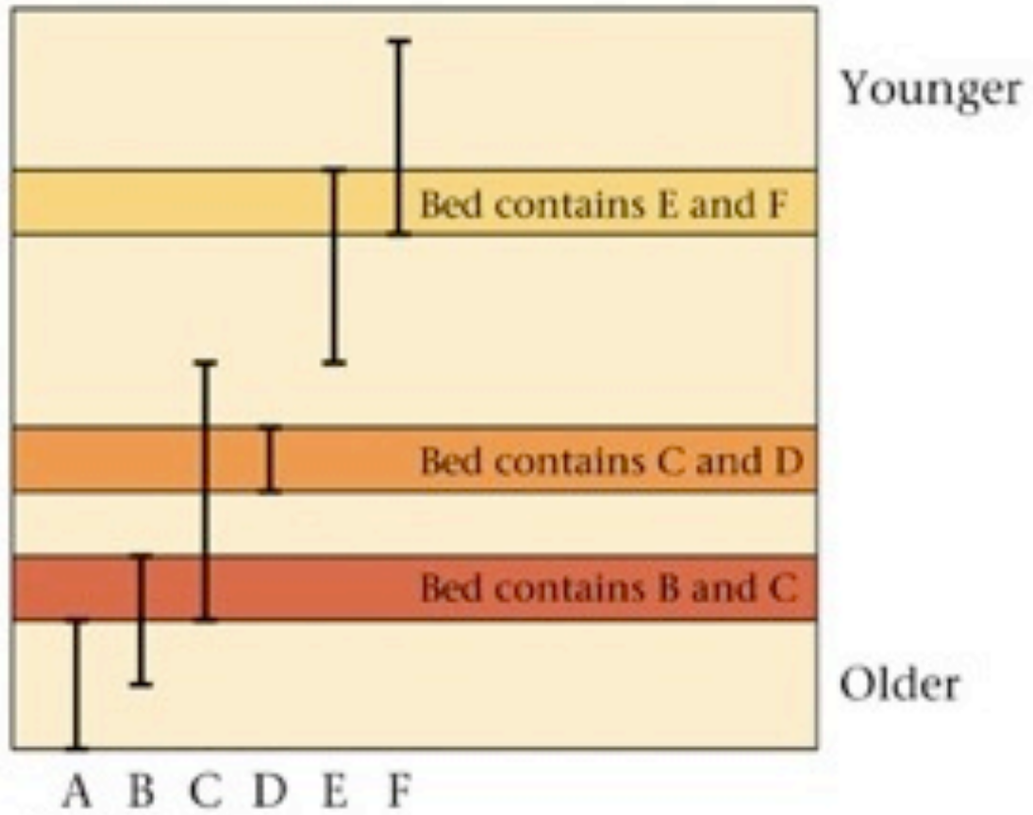
Clypeus ploti—a pound stone—
viewed from the top.

William Smith (ca. 1815)

Book: "The Map that Changed the World"
by Simon Winchester

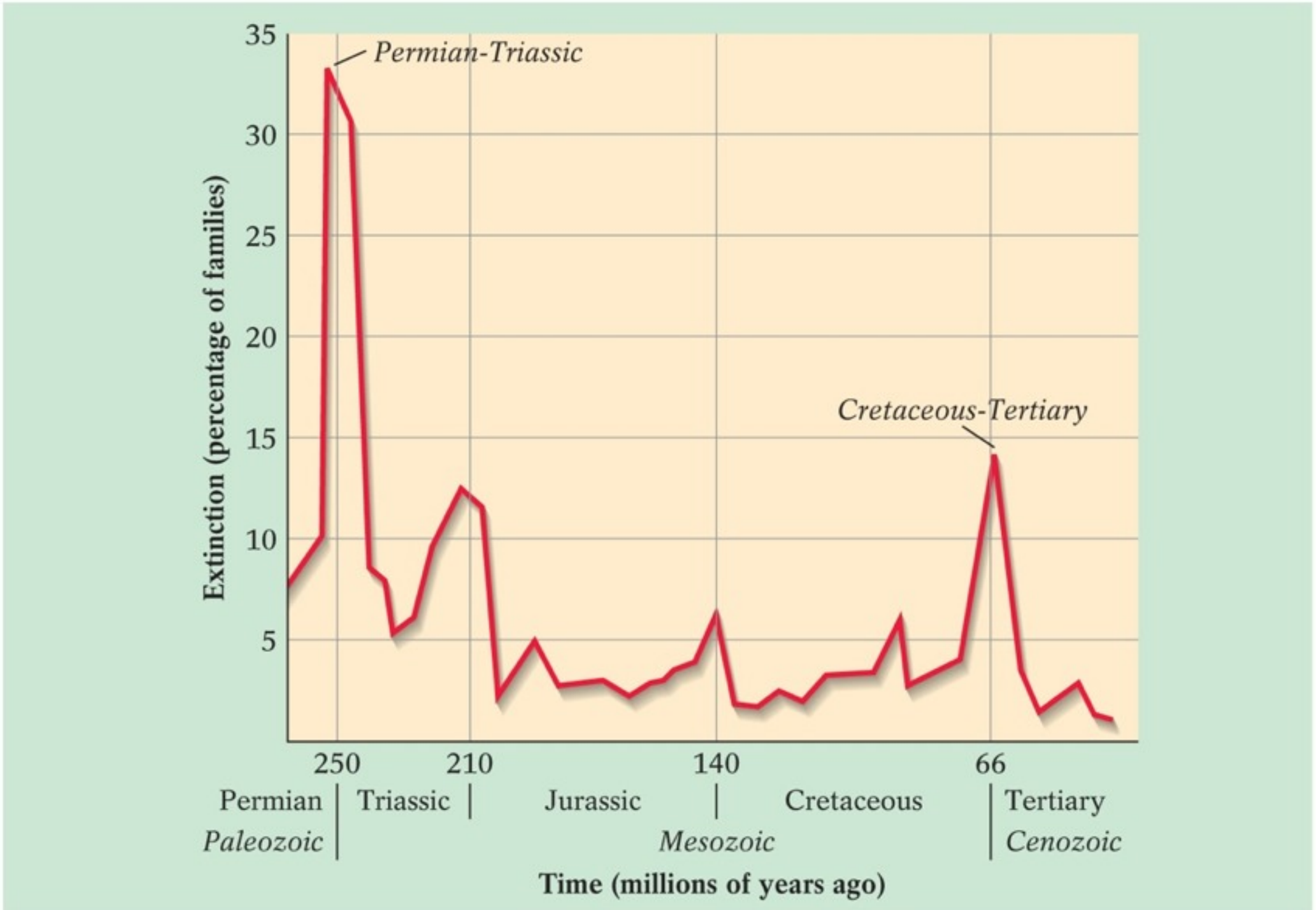
Principle of Fossil Succession



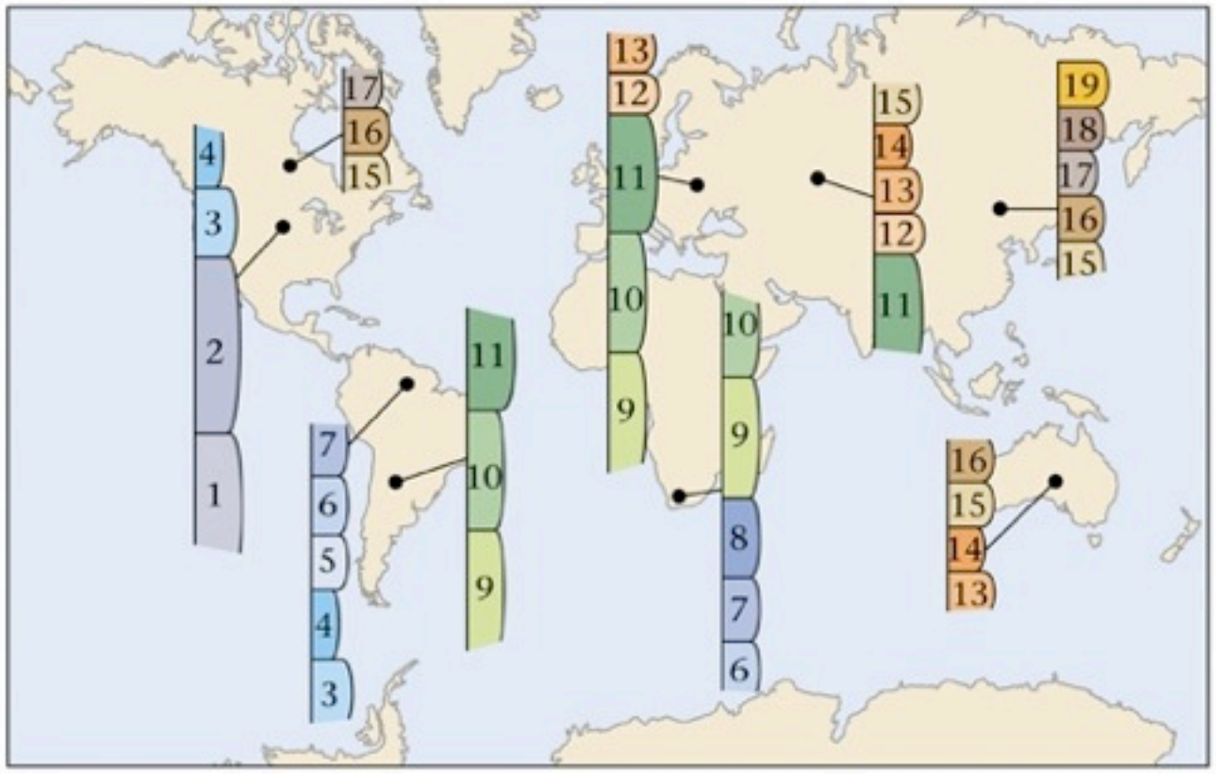


Principle applies to Sedimentary strata

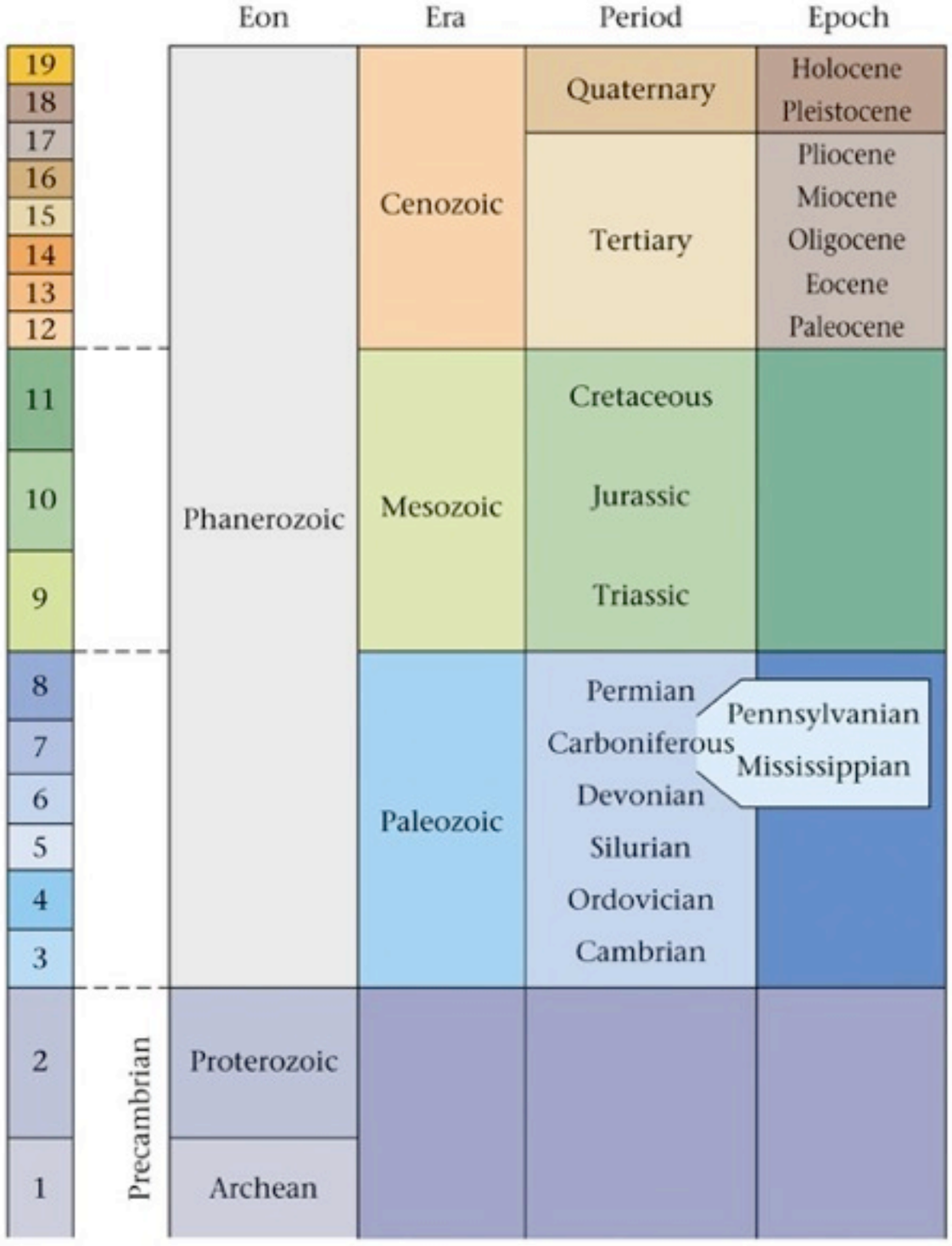
Extinction Events and Geologic time



Distribution of sedimentary Rock Ages around the world: Correlation

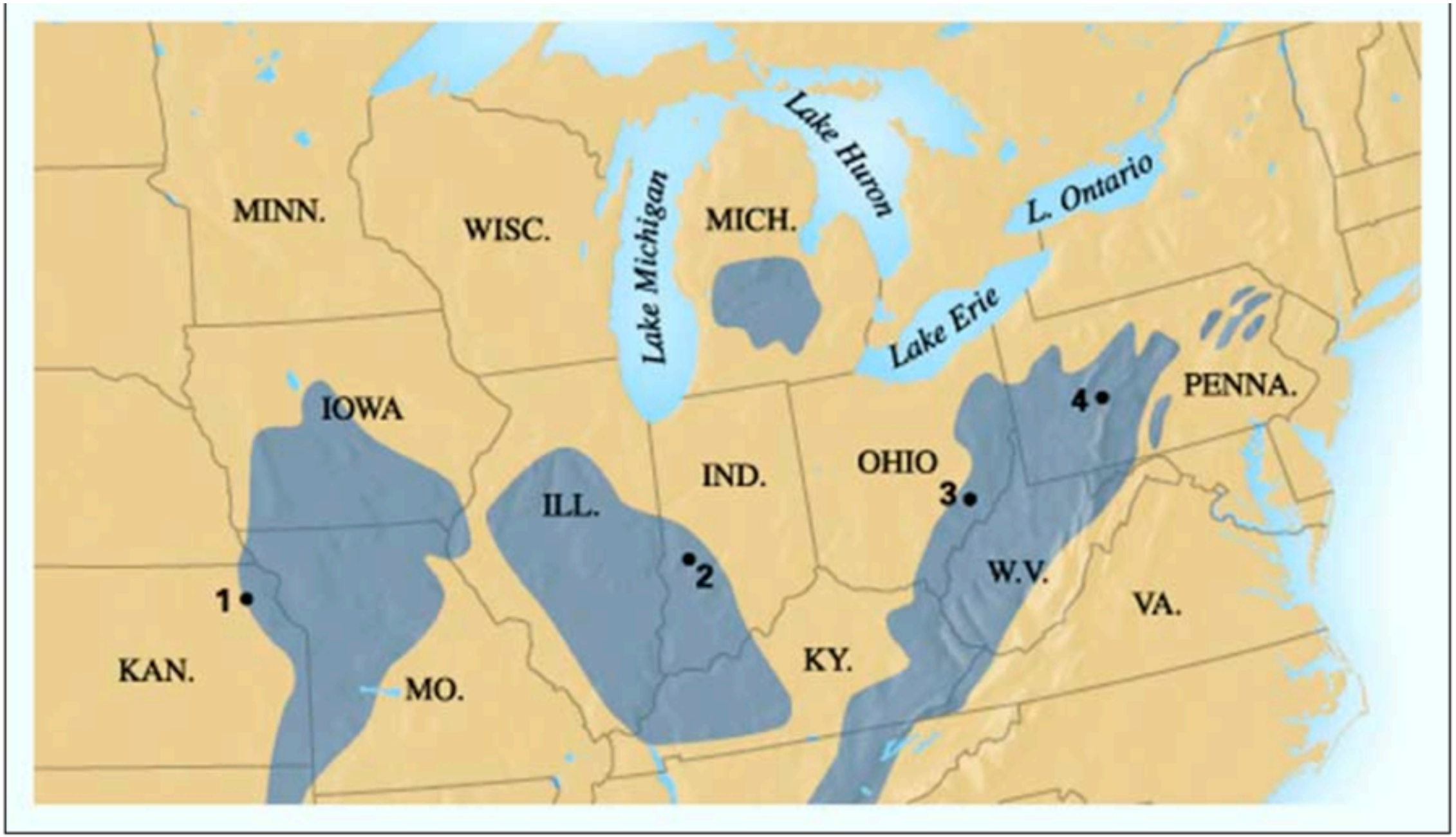


(a)

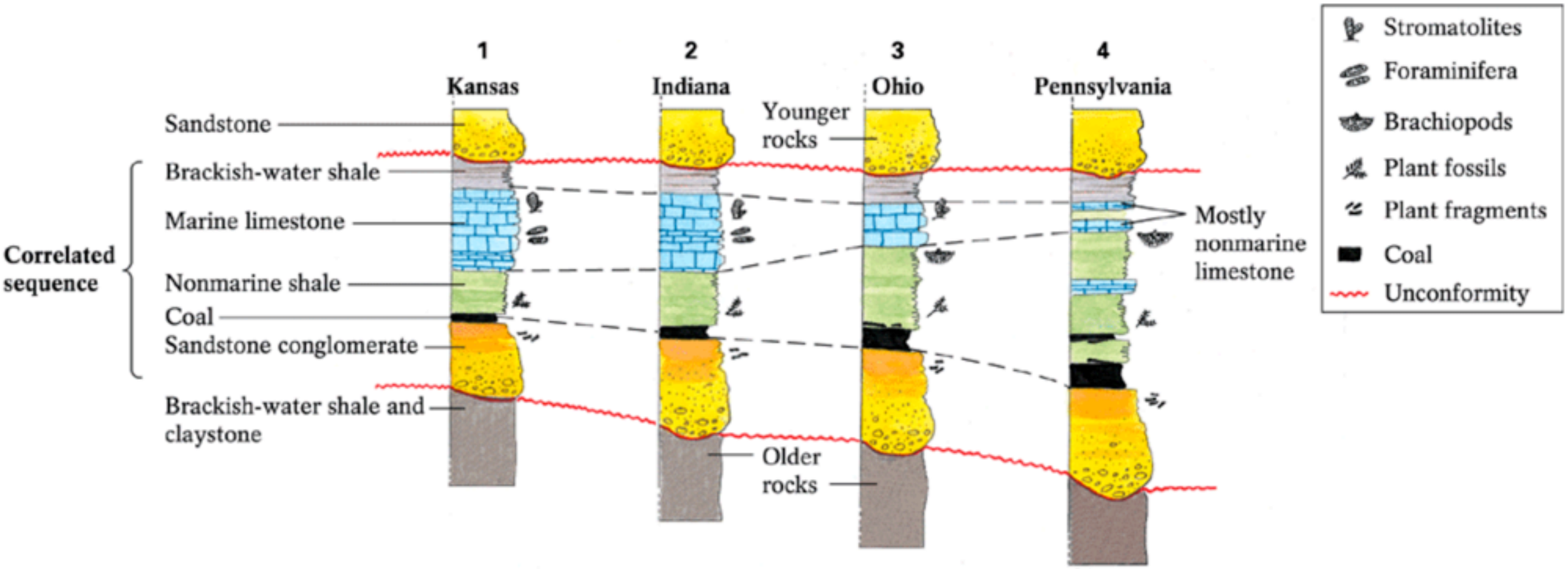


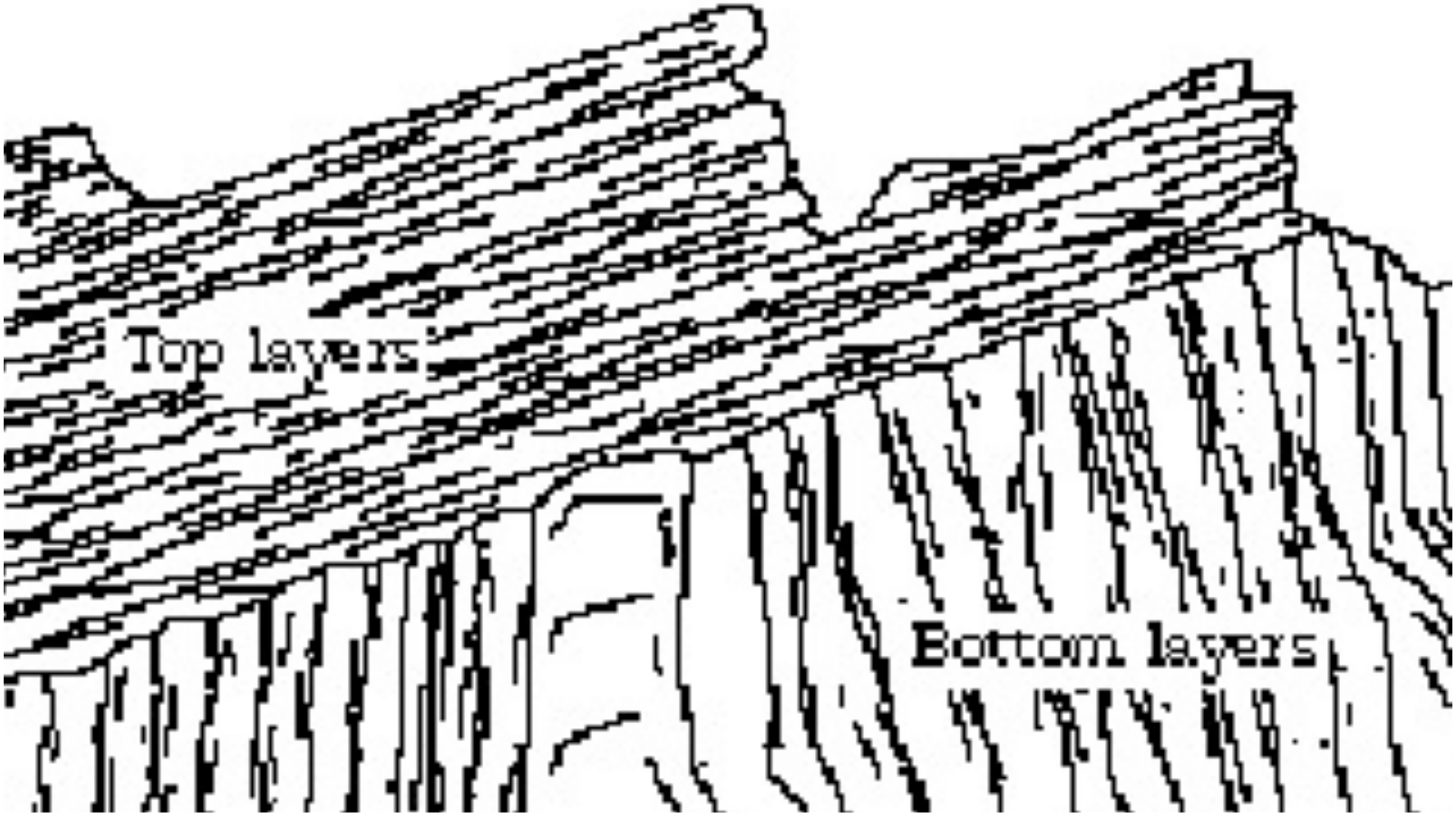
(b) Geologic Column

Correlation



Correlation





Interpretation of Siccar Point Scotland, James Hutton (ca.1780)

Geologic Unconformity

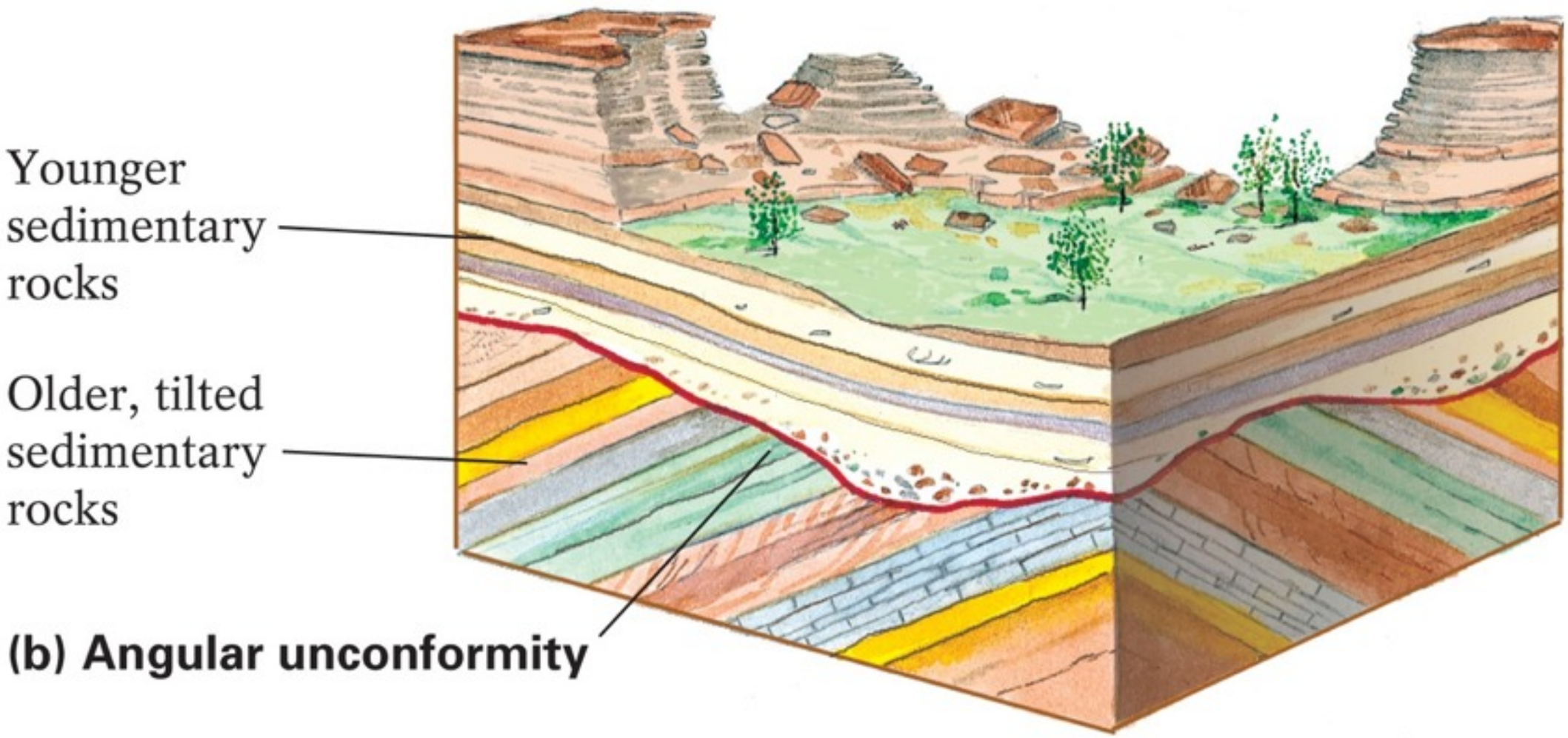
An unconformity is a buried erosion surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous.

"A gap in the Geologic Time Record"

Geologic Unconformity

Angular unconformity

Separates sedimentary that have different degrees of angular bedding dips

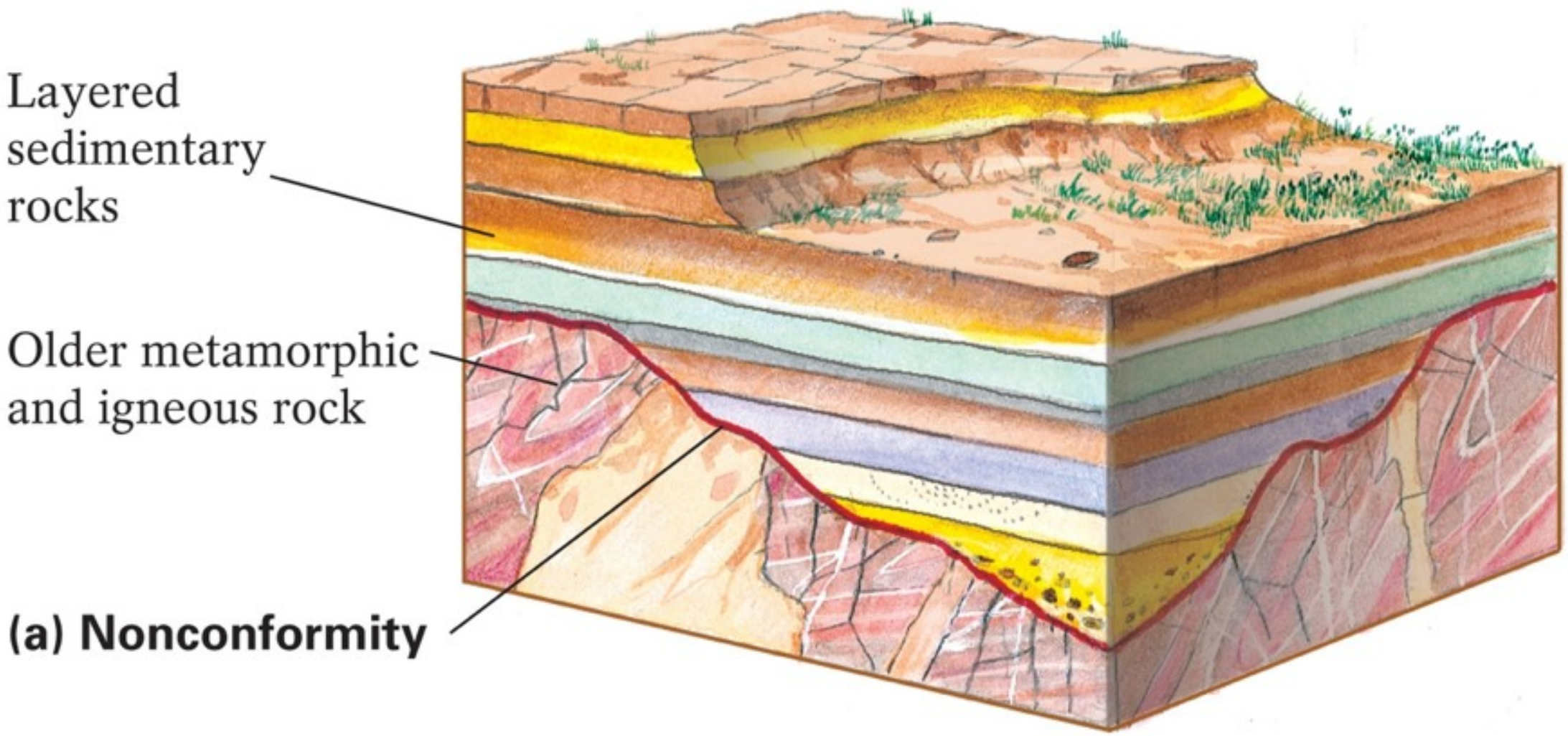


(b) Angular unconformity

Geologic Unconformity

Nonconformity

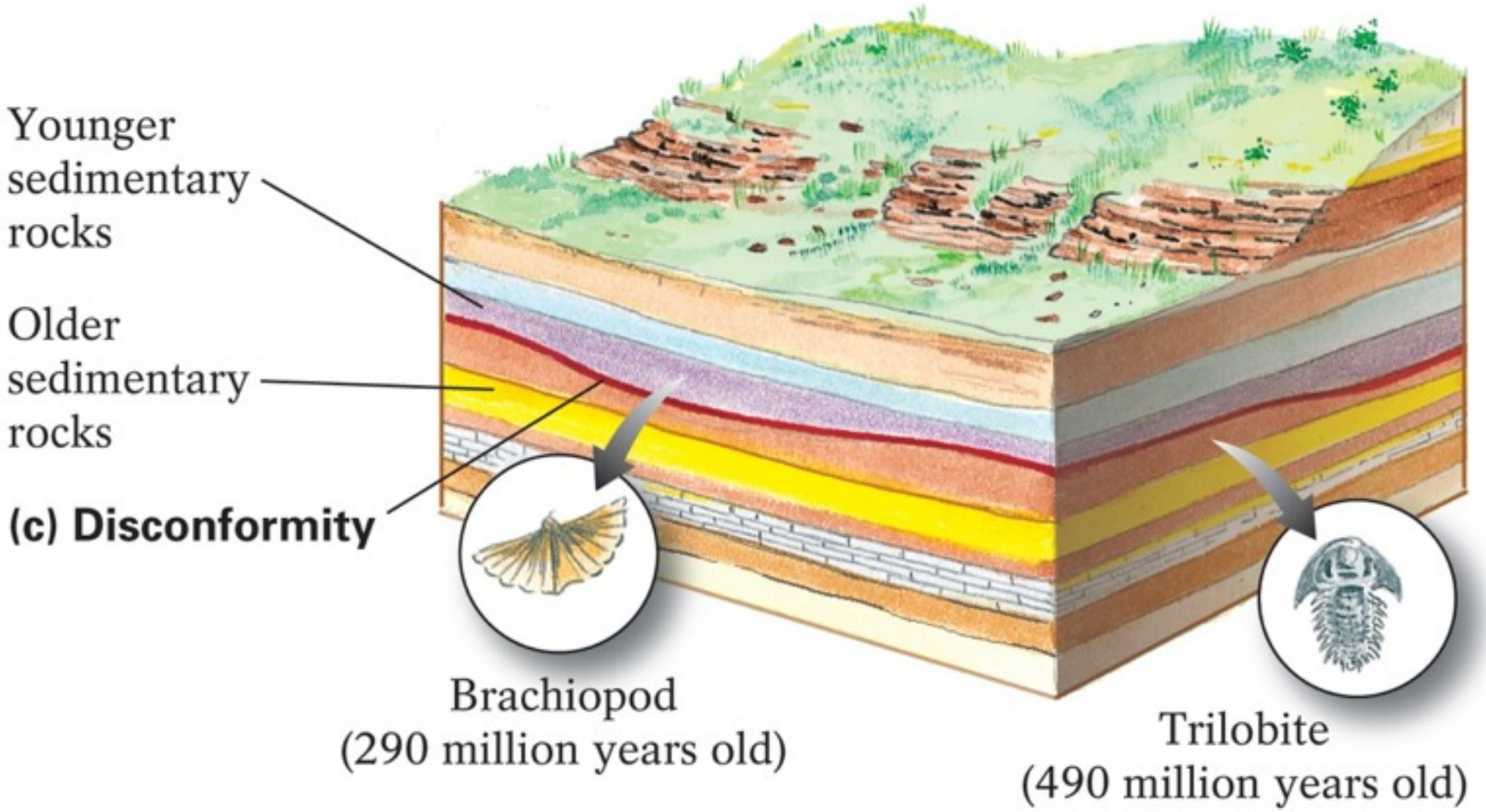
Separates older non-layered igneous and metamorphic rocks from younger layered sedimentary rocks



Geologic Unconformity

Disconformity

Separates sedimentary strata that are parallel but have discontinuous ages



Animation