

Stratigraphy, Geological Time Scale

Subhronil Mondal

Sediment and Sedimentary Rock

Origin
Of
Sediments



Sedimentary
Rock

Weathering breaks down rocks physically and chemically.

Erosion carries away particles produced by weathering.

Transportation via streams, glaciers, and wind moves particles downhill.

Deposition (or sedimentation) occurs when particles settle out or dissolved minerals precipitate.

Burial occurs as layers of sediment accumulate and compact previous layers.

Diagenesis lithifies the sediment to make sedimentary rocks.

FIGURE 5.1 ■ Several surface processes of the rock cycle contribute to the formation of sedimentary rocks.

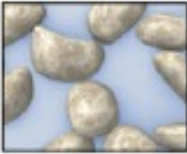
Grotzinger and Jordan

Sediment and Sedimentary Rock

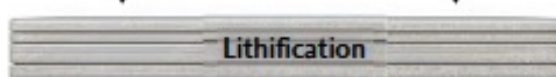
Compaction

Compaction by burial squeezes out water.

50–60% water

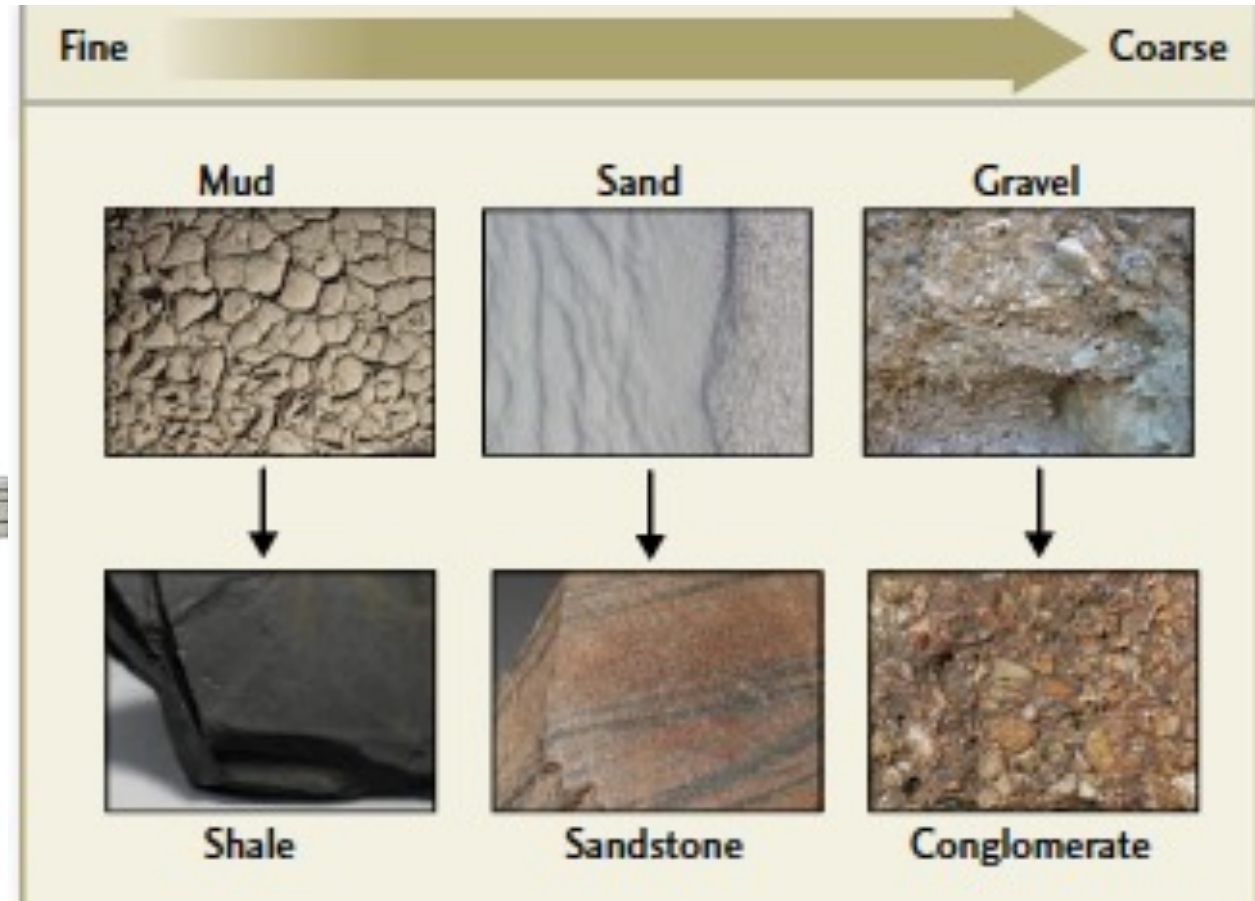


10–20% water

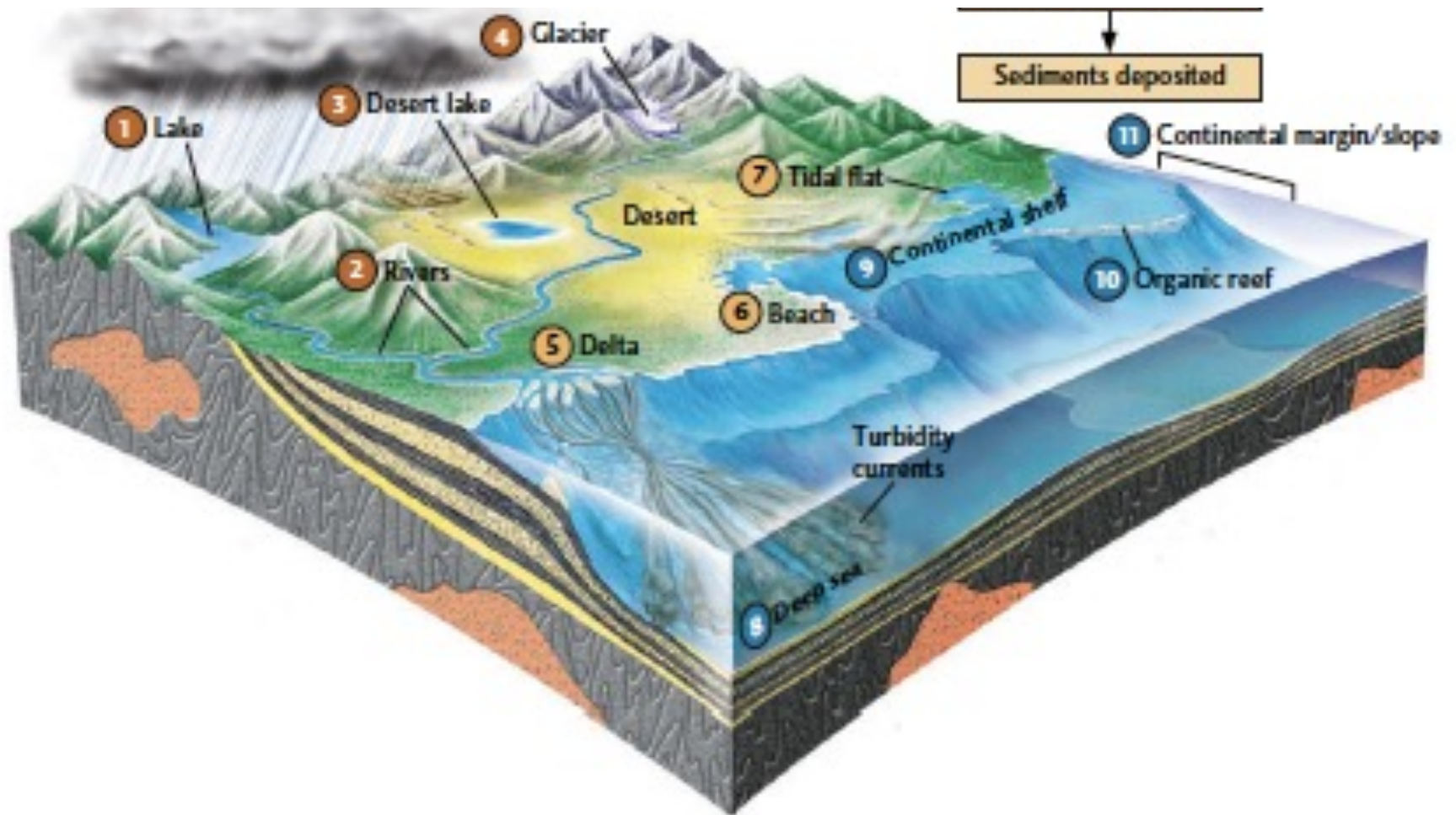


Cementation

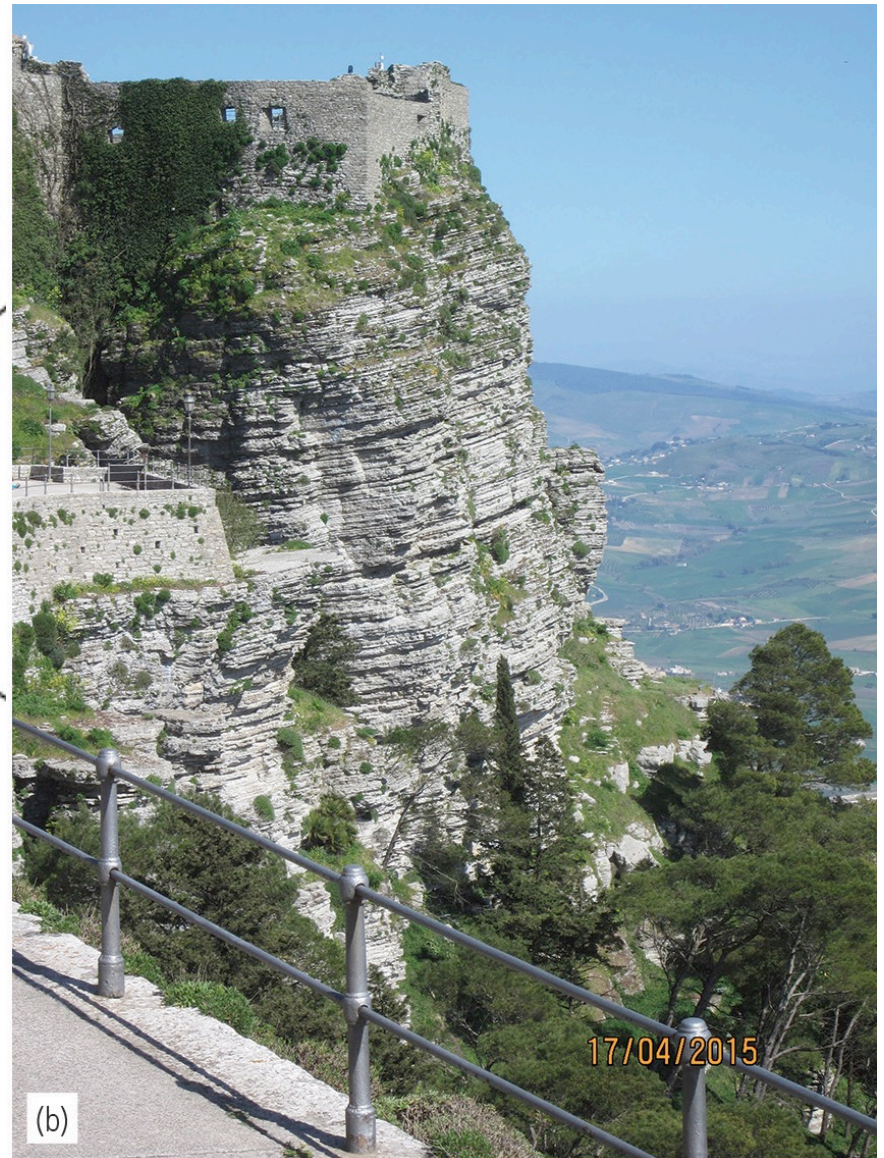
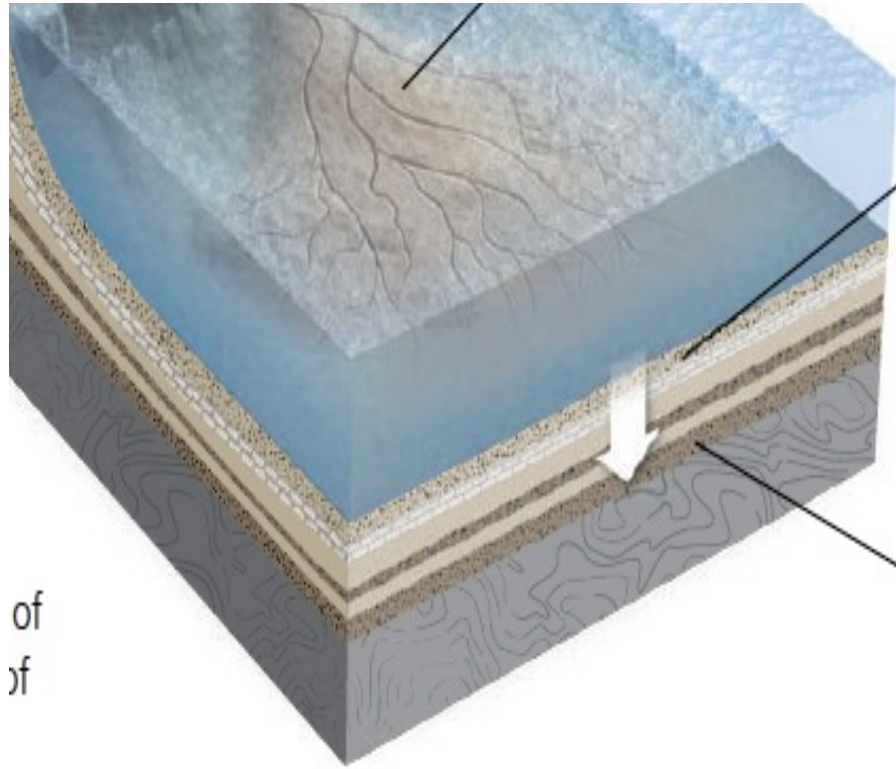
Precipitation or addition of new minerals cements sediment particles.



Depositional Environments



Sedimentary Rocks and Stratigraphy



STENO'S PRINCIPLES

Original Horizontality

All sedimentary rocks are originally deposited horizontally. Sedimentary rocks that are no longer horizontal have been tilted from their original position.
[Steno, 1669]

STENO'S PRINCIPLES

Lateral Continuity

Material forming any stratum were continuous over the surface of the Earth unless some other solid bodies stood in the way.

[Steno, 1669]

STENO'S PRINCIPLES

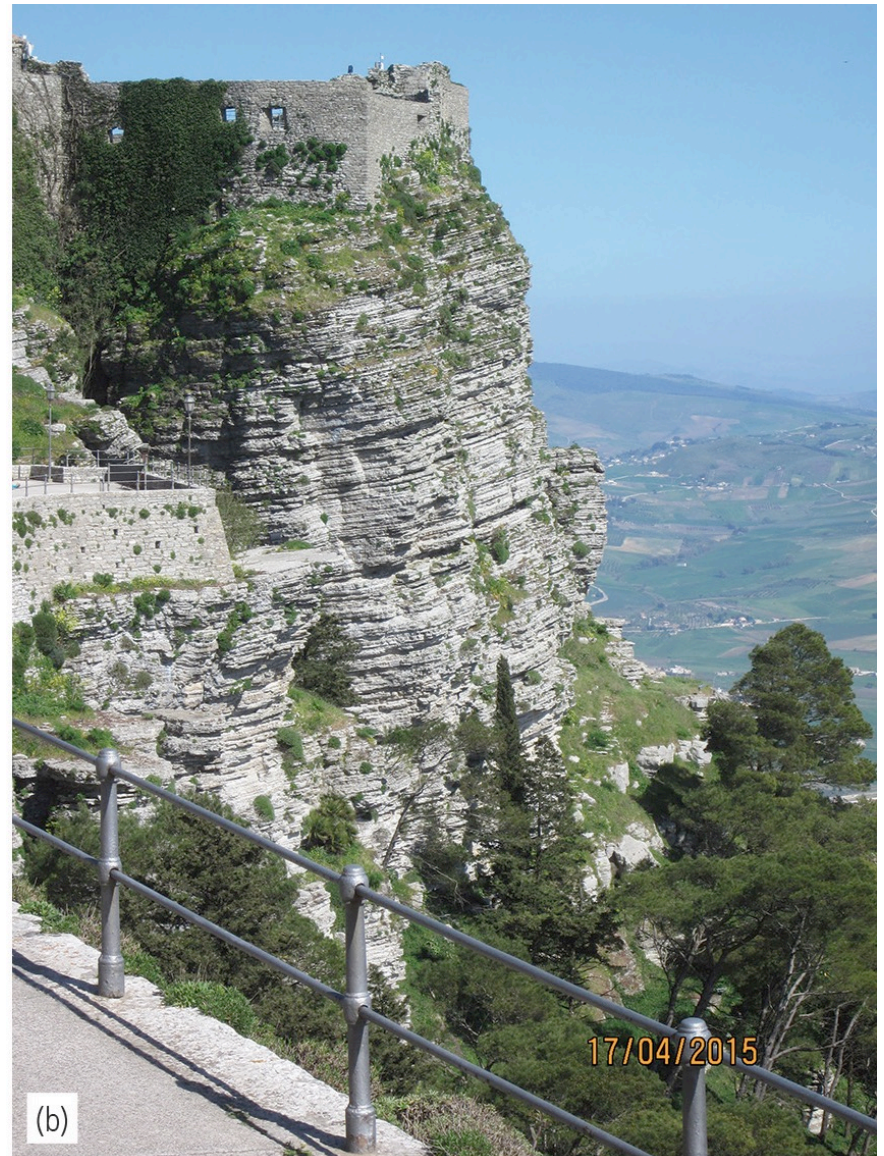
Superposition:

...at the time when the lower stratum was being formed, none of the upper strata existed.

[Steno, 1669]

Older at bottom

Younger at top



STENO'S PRINCIPLES

Cross-Cutting Relations:

If a body or discontinuity cuts across a stratum, it must have formed after that stratum.

[Steno, 1669]

Law of Inclusions- this law states that rock fragments (in another rock) must be older than the rock containing the fragments.

Refer to **Inclusions**.

STENO'S PRINCIPLES

Principle of faunal succession/Law of faunal succession

Sedimentary rock strata contain fossilized flora and fauna, and that these fossils succeed each other vertically in a specific, reliable order

COMPLETENESS OF RECORD

Information complete?
individual events not
known?

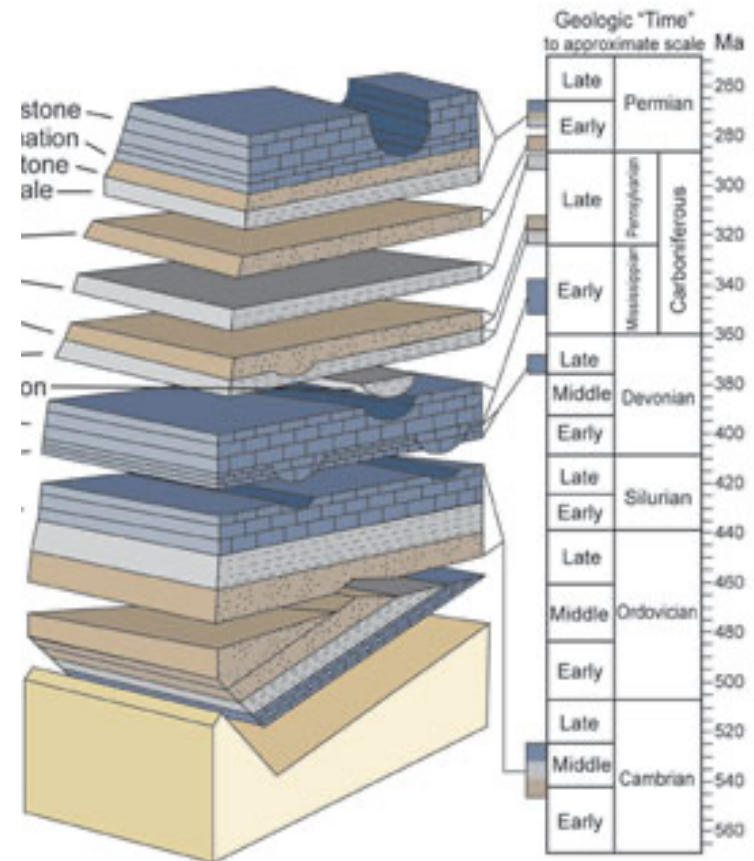


(b)

Stratigraphy and TIME



Information complete?
individual events not
known?



MORE GAPS THAN RECORD

Image: S. Windsor

MORE GAPS THAN RECORD

Incompleteness

- > diastem
- > hiatus
- > Non-deposition

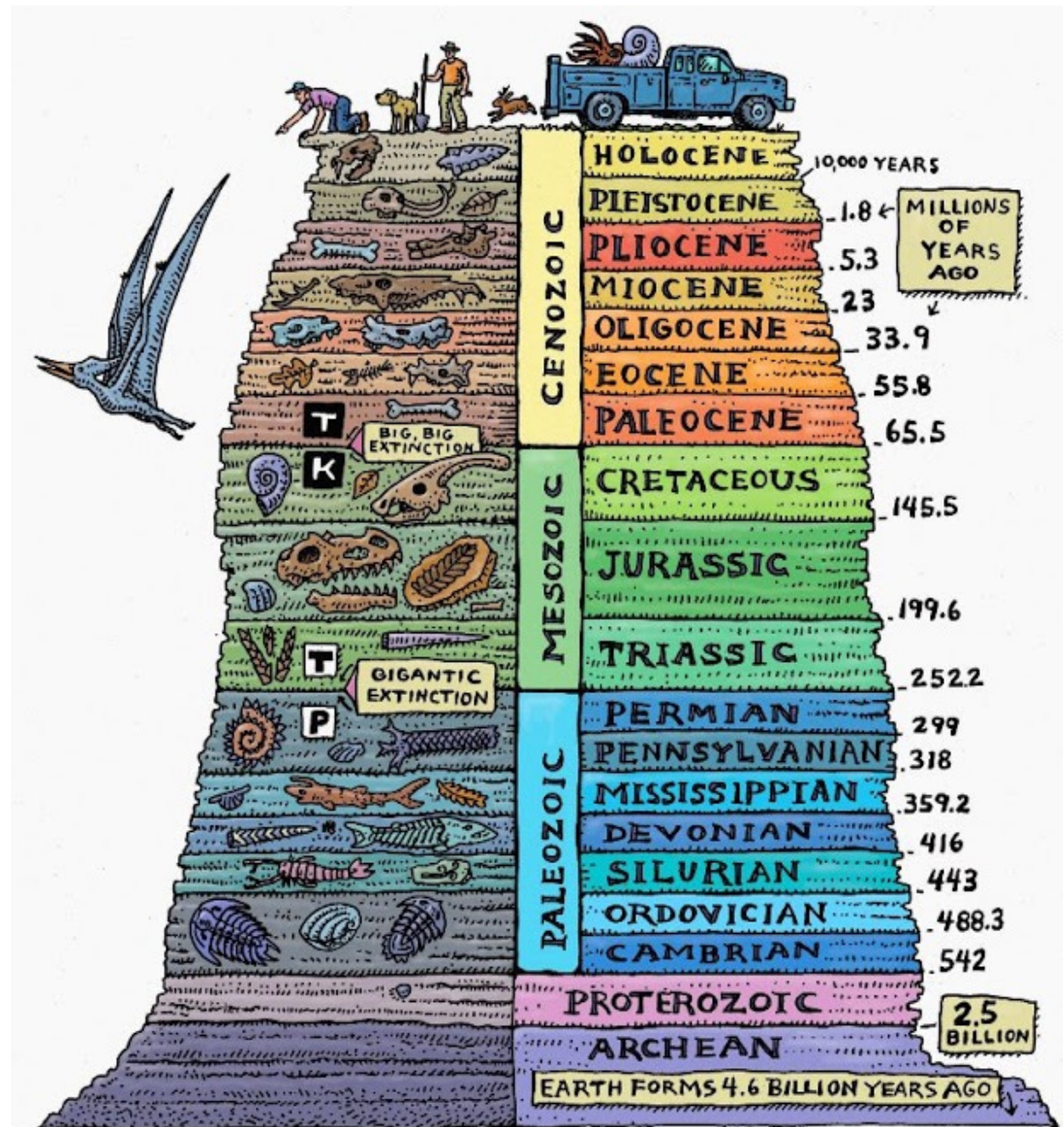
Loss of record

- > erosion
- > compaction
- > tectonic disturbances
- > bioturbation



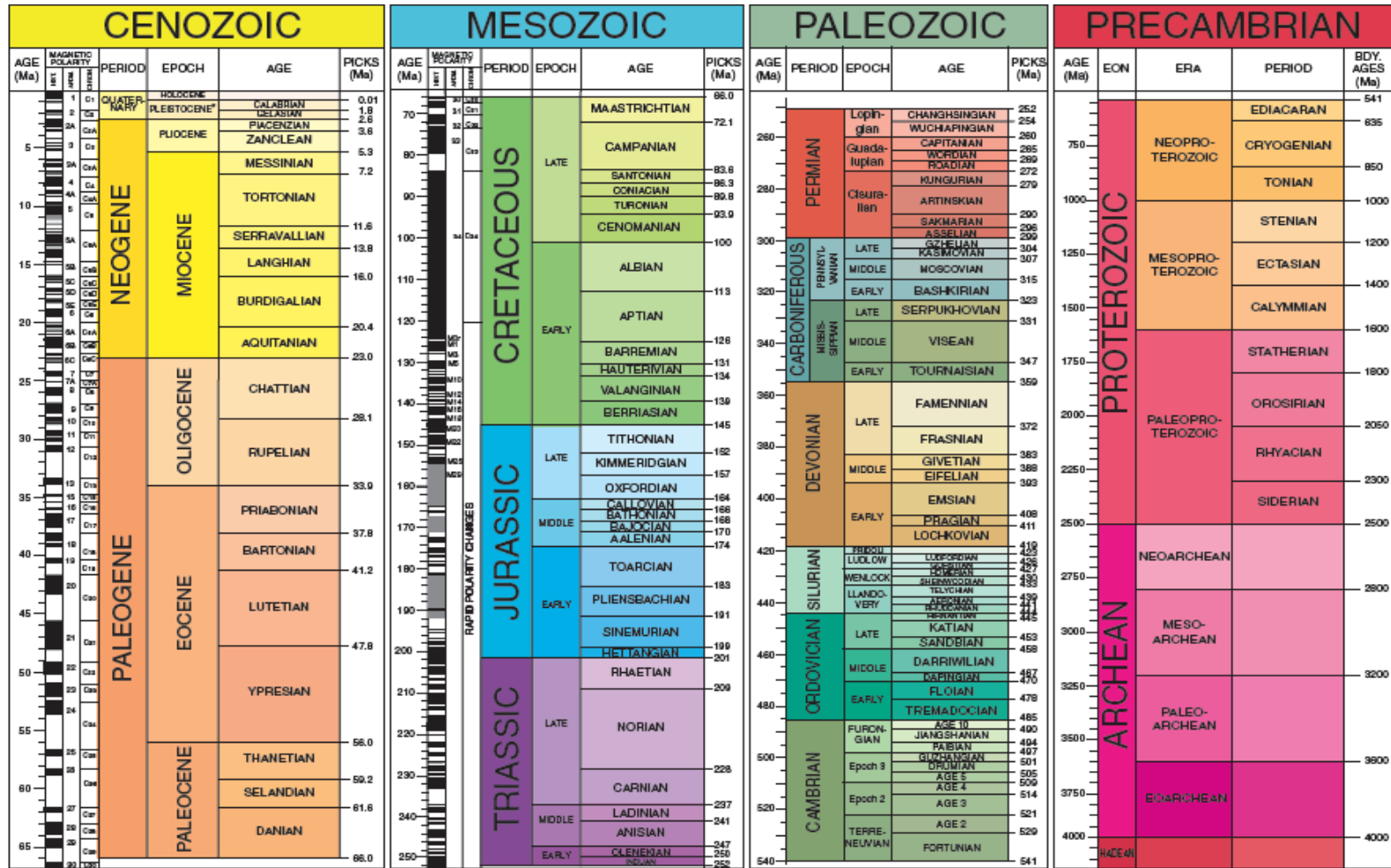
Stratigraphy and TIME

Image Credit: Ray Troll



Deep time

GSA GEOLOGIC TIME SCALE v. 4.0



Determining Geological Ages

Absolute Age - radioactive age dating techniques,

Relative Age - when absolute ages cannot be
Determined

Key Principles Used to Establish Relative Ages

- superposition
- original horizontality
- cross cutting relationships
- inclusions
- faunal succession