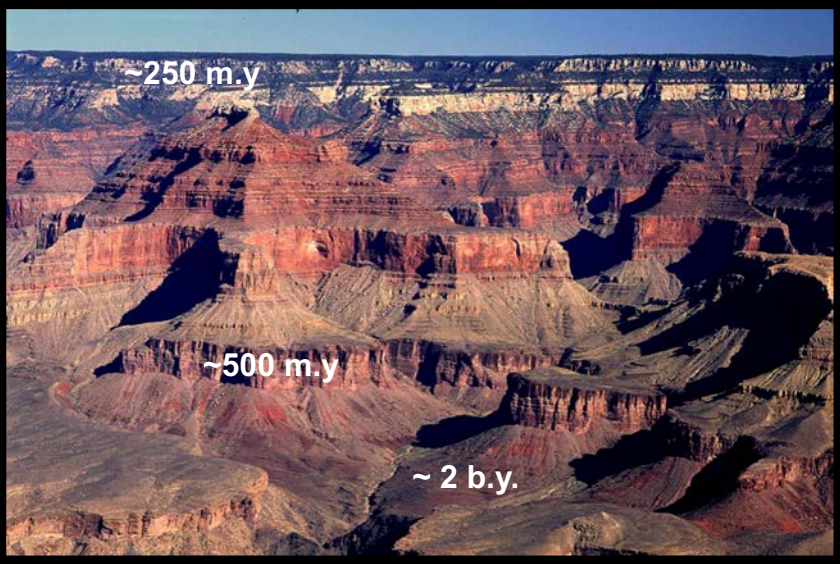
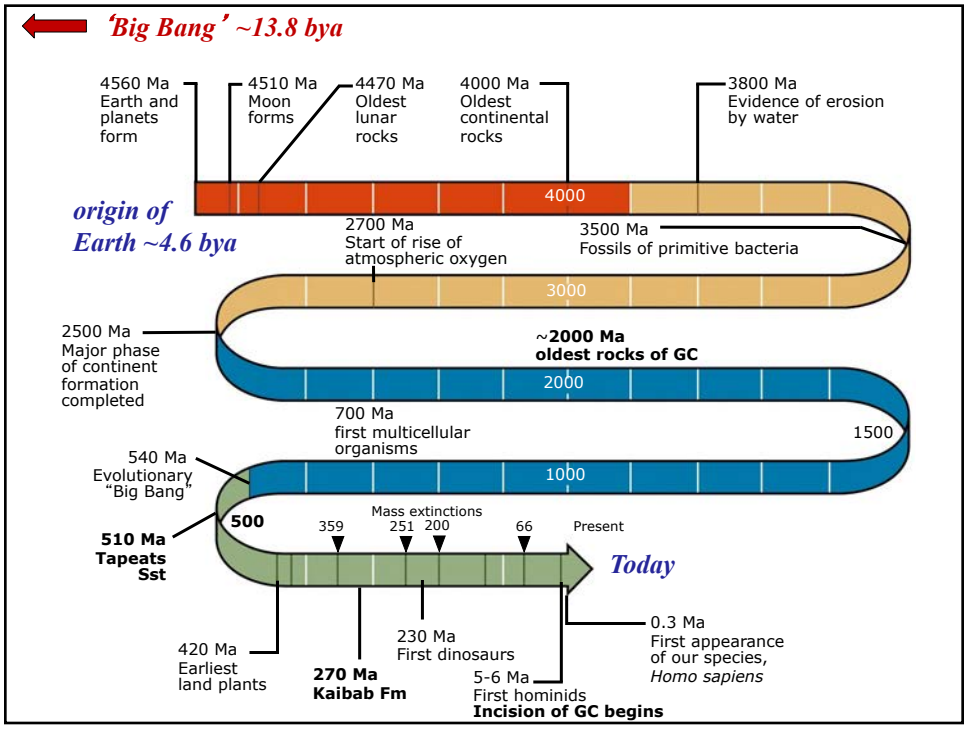
Geologic Time (aka "Deep Time")



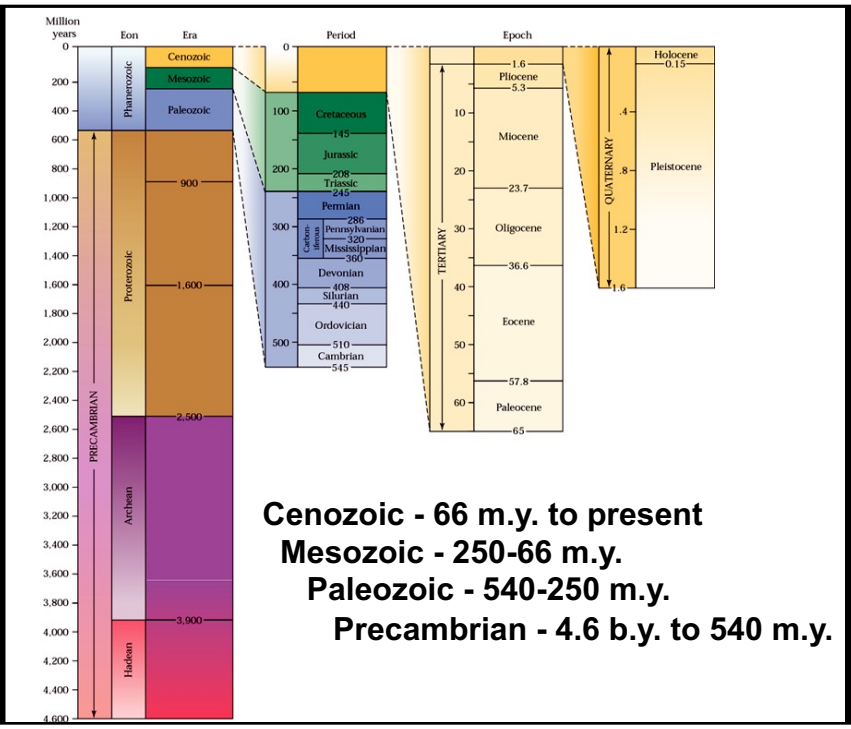
Notes / images 1C (not available yet)
Book: Ch 3 p.48-50, Ch 1 p. 24-29

three perspectives of time . . .

1



2


Million years
Eon
Era
Period
Epoch
Phanerozoic
Proterozoic
Archean
Hadean
PRECAMBRIAN
Cenozoic
Mesozoic
Paleozoic
900
1,600
2,500
3,900
Cretaceous
145
Jurassic
208
Triassic
245
Permian
286
Pennsylvanian
320
Mississippian
360
Carbon-iferous
Devonian
408
Silurian
440
Ordovician
510
Cambrian
545
TERTIARY
Pliocene
5.3
Miocene
23.7
Oligocene
36.6
Eocene
57.8
Paleocene
65
QUATERNARY
Holocene
0.15
Pleistocene
1.6
Cenozoic - 66 m.y. to present
Mesozoic - 250-66 m.y.
Paleozoic - 540-250 m.y.
Precambrian - 4.6 b.y. to 540 m.y.

3


Relative age dating vs. Numerical age dating
RELATIVE AGE
NUMERICAL AGE
Gulf War (Persian Gulf)
Falkland War (Argentina-England)
6-day War (Arab-Israeli)
Vietnam War
Bay of Pigs Invasion (Cuba-U.S.)
Korean War
World War II
Spanish Civil War
World War I
Russian Revolution
Russo-Japanese War
Boer War (South Africa)
2000
1980
1960
1940
1920
1900
Gulf War
Falkland War
Vietnam War
6-day War
Bay of Pigs
Korean War
World War II
Spanish Civil War
World War I
Russian Revolution
Russo-Japanese War
Boer War

4

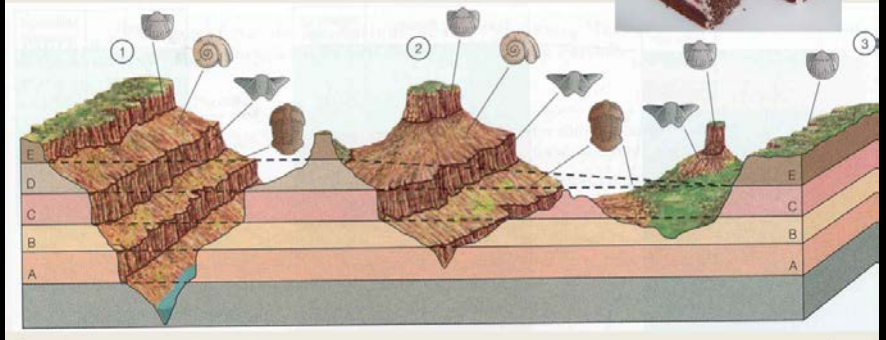
Relative age dating – fundamental principles

1. Superposition
2. Lateral continuity
3. Faunal succession

5

2 Principle of Lateral Continuity

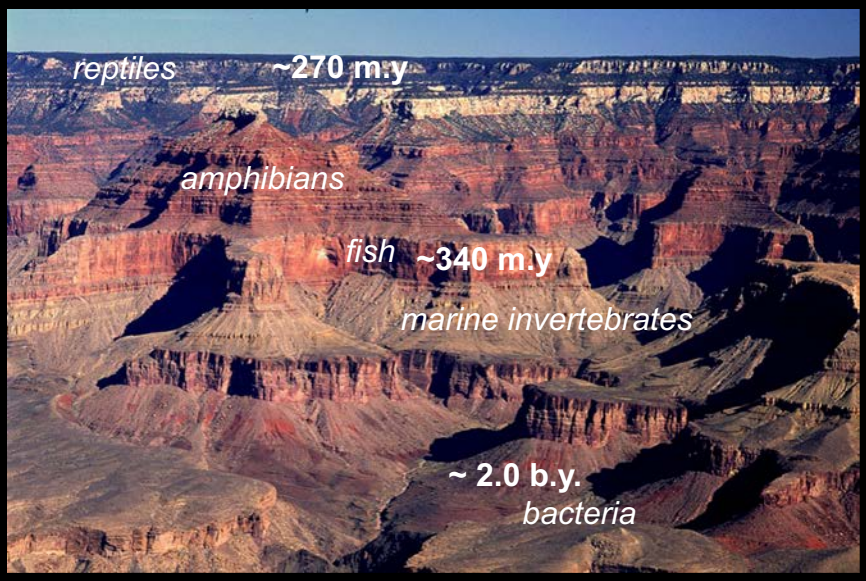
Sedimentary layers extend in all directions horizontally unless eroded



Layers on one side of the canyon match up with layers on the other side

6

3 Faunal succession **- based on progressive evolutionary change revealed by fossils**



7

Relative age dating **3 Faunal succession**

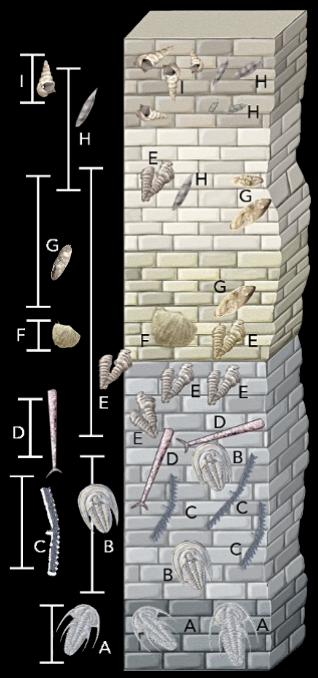
Each fossil species lived and died over a discrete interval of time

8

Relative age dating

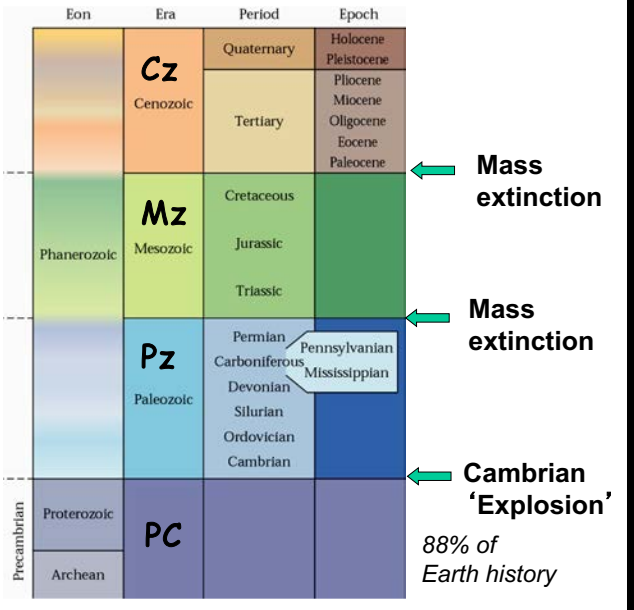
- Faunal succession

Evolutionary change creates a systematic succession of fossils with age, regardless of the location.
- i.e., the order of the fossils will always be the same, no matter where the sedimentary rocks are found



No numerical dates
Only relative order

9



Mass extinction

Mass extinction

Cambrian 'Explosion'

88% of Earth history

Boundaries between major time intervals determined on the basis of evolutionary events

(no numerical dates)

10

Relative *order of events in the Grand Canyon based on relative age-dating principles*

1. Formation of complex rocks of 'basement' within an ancient mountain range (lost to erosion)
2. Deposition of the sedimentary layers near sea level during transgressions and regressions of the sea
3. Burial, compaction & cementation
4. Tectonic uplift of the Colorado Plateau
5. Incision of the rocks by the Colorado River and its tributaries

11

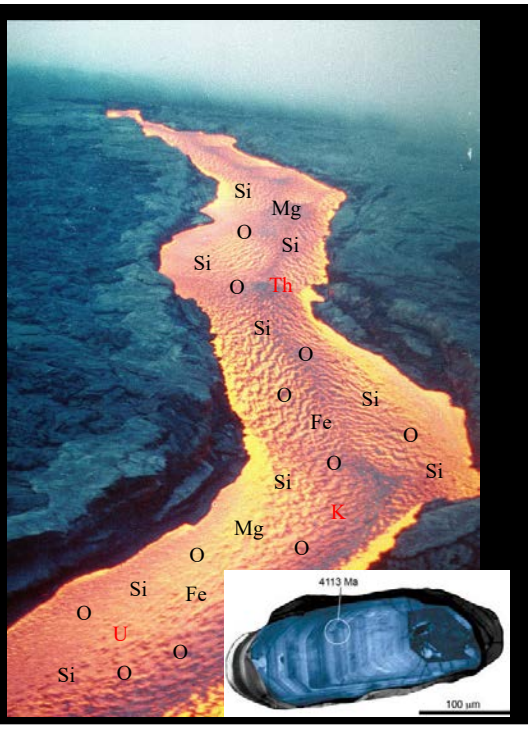
Numerical (radiometric) age dating

– placing specific ages on rocks

- works best on minerals (like zircon) that crystallize from a magma or lava (igneous rocks)

- as soon as the rocks solidify, radioactive decay begins

e.g., 512 (±1) m.y.
vs.
'younger than'
or 'older than'



12

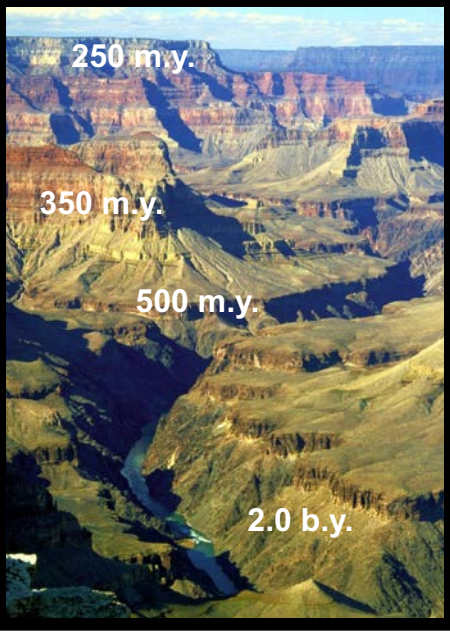
Collecting samples on Baffin Island in the Canadian Arctic

13

Numerical (radiometric) age-dating requires a mass spectrometer to count the number of atoms of specific elements. Absolute age then calculated by equations.

14

Numerical *order of events in the Grand Canyon based on integrating relative age-dating with numerical dates*



1. Formation of complex rocks of 'basement' within a **Precambrian** mountain range (~2 b.y.a.)
2. Deposition of the sedimentary layers near sea level during transgressions and regressions of the sea (500 – 250 m.y.a. – **Paleozoic**)
3. Burial, compaction & cementation (**Mesozoic**)
4. Tectonic uplift of the Colorado Plateau (**Cenozoic**)
5. Incision of the rocks by the Colorado River and its tributaries (5 – 6 m.y.a. - **late Cenozoic**)

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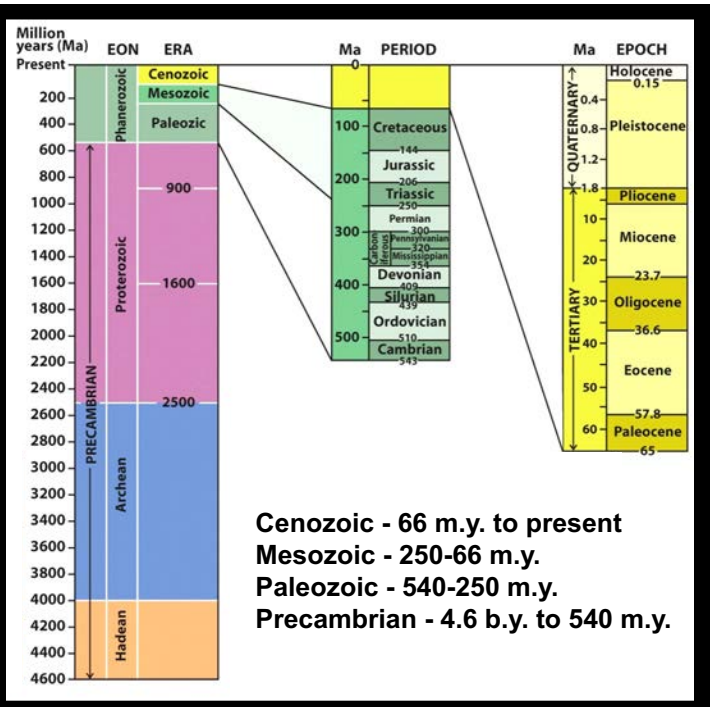
"civilization" → 0.000001%

88% of Earth history occupied by Precambrian



Cenozoic - 66 m.y. to present
Mesozoic - 250-66 m.y.
Paleozoic - 540-250 m.y.
Precambrian - 4.6 b.y. to 540 m.y.

16

Best hikes & places to stay in Grand Canyon NP

https://www.planetware.com/arizona/top-rated-hiking-trails-at-the-grand-canyon-us-az-230.htm

Bright Angel Trail
GC NP

Guide to bringing dogs to national parks

- links and articles in folder in Files continually updated

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