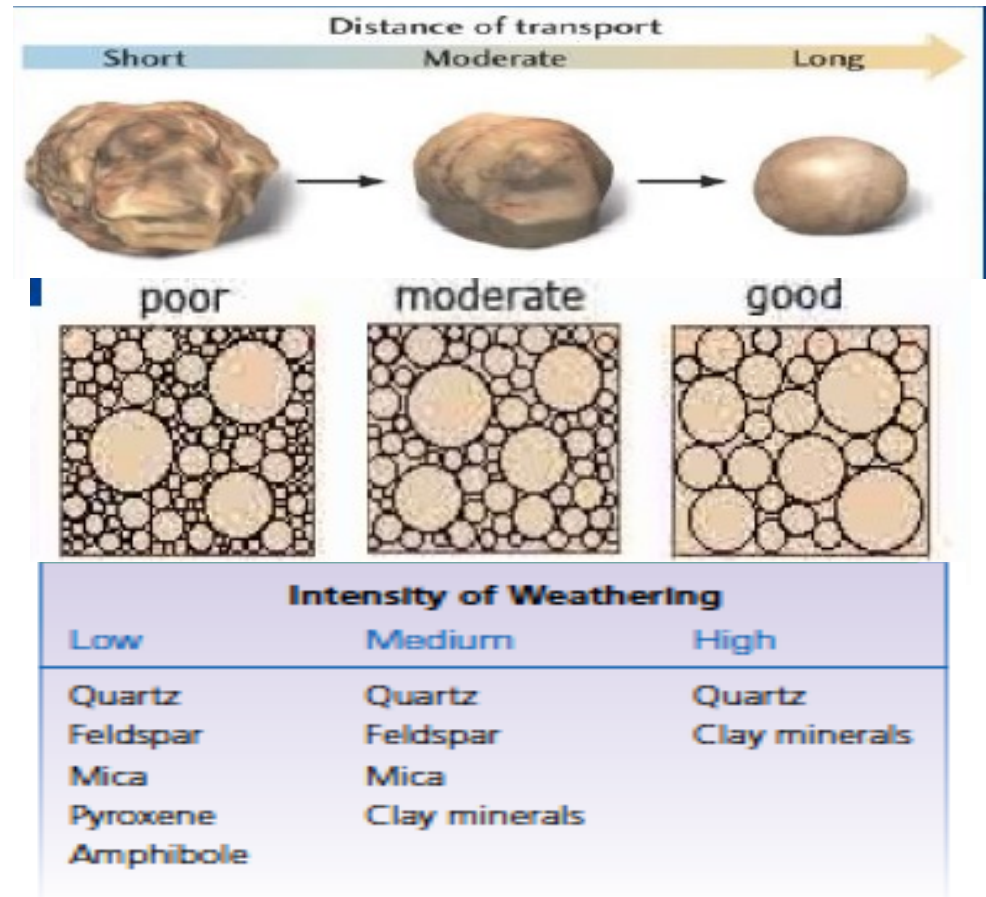


Stratigraphy, Geological Time Scale, Evolution of Life Through Time

Subhronil Mondal

Transportation of sediments

History weathering and erosion?



Ripple Marks

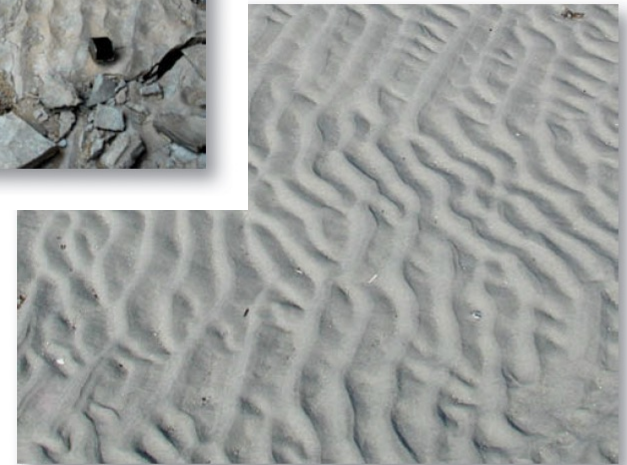
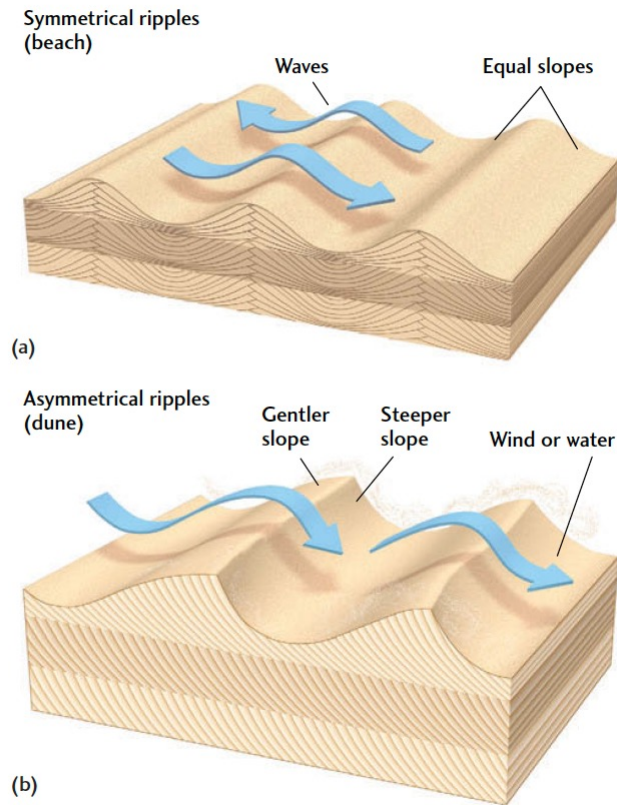


FIGURE 5.12 ■ Ripples. (a) Ripples in modern sand on a beach [Courtesy of John Grotzinger.] (b) Ancient ripple-marked sandstone. [John Grotzinger/Ramón Rivera-Moret/MIT.]

Types of Sediments

Based on origin, sediments can be classified into three types:

Inorganic {
Clastic or detrital
Chemical (may involve biological processes) – Limestone, Chert,
Evaporites,
Biological – coquina, coral

Clastic or detrital: weathering of preexisting rocks forms clastic particles that are transported and deposited.

Chemical: weathering produces dissolved ions and molecules that form chemical sediments.

Determining Geological Ages

Absolute Age - radioactive age dating techniques,

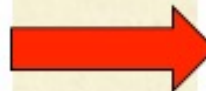
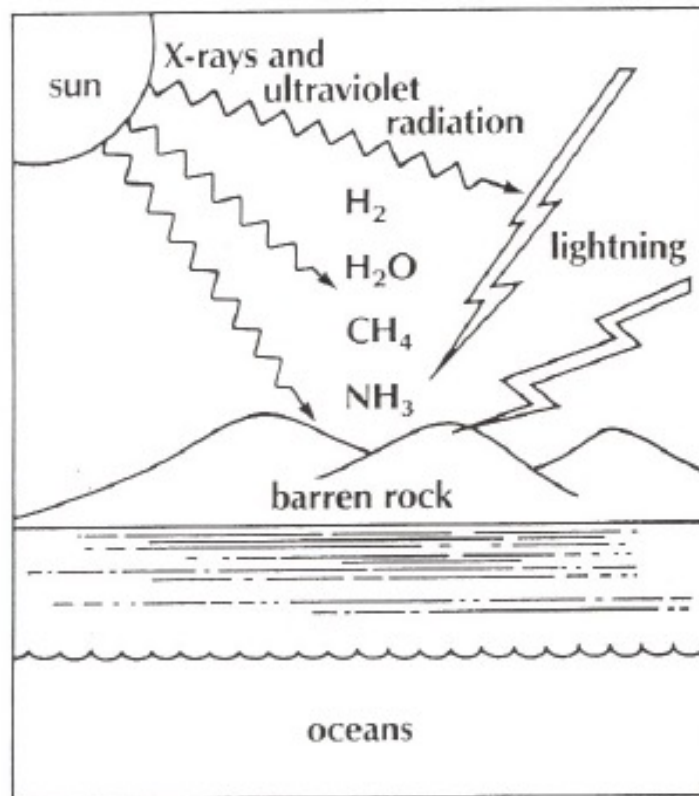
Relative Age - when absolute ages cannot be
Determined

Key Principles Used to Establish Relative Ages

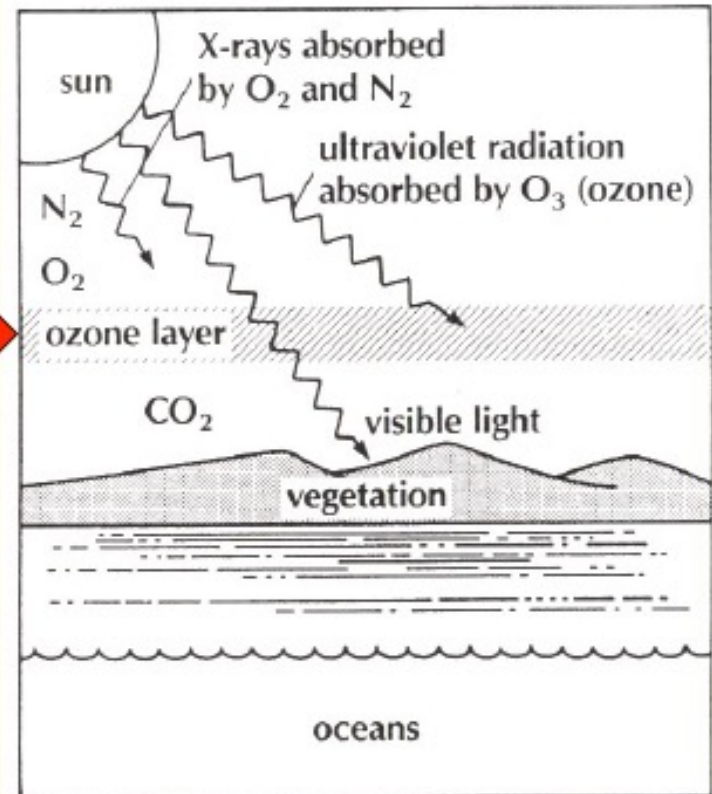
- superposition
- original horizontality
- cross cutting relationships
- inclusions
- faunal succession

THE PRIMITIVE EARTH

Primitive Earth

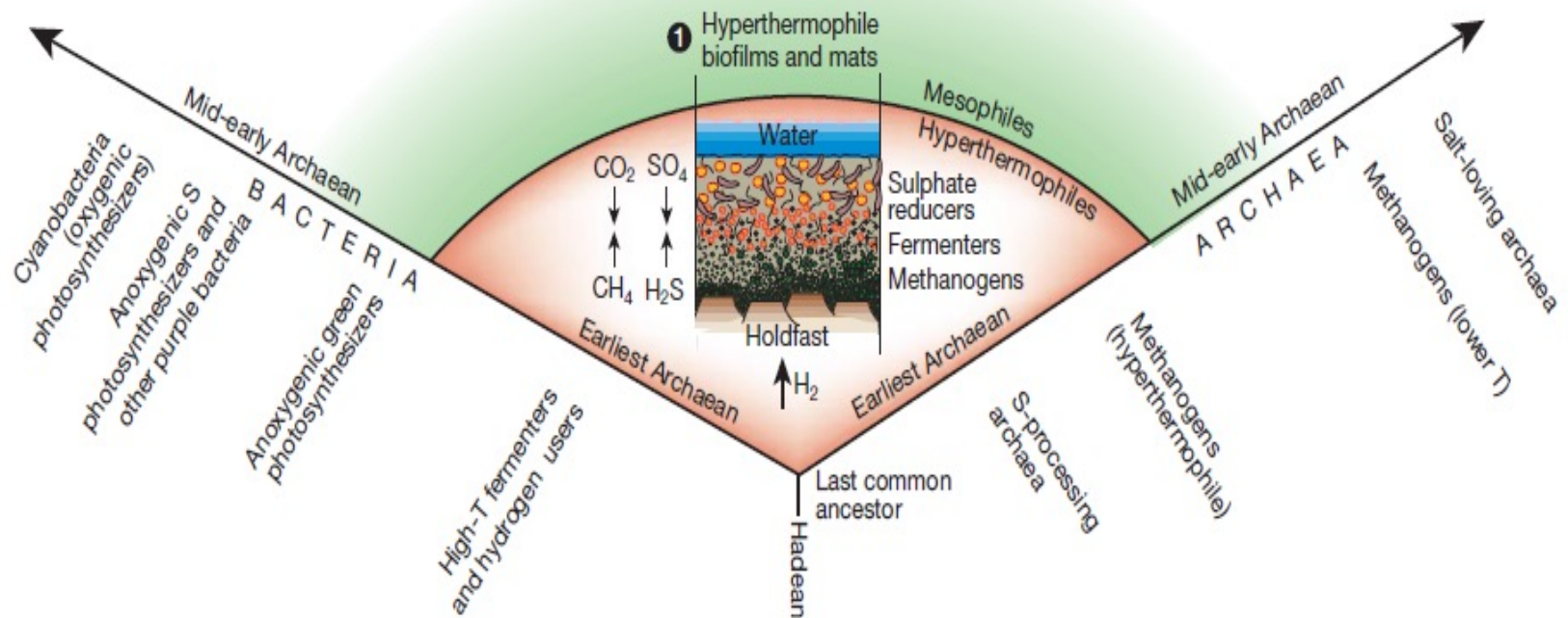


Modern Earth



THE ORIGIN

- A. Ice effect – oceans covered in ice, so protected from UV rays – origin
- B. Extra-terrestrial source [Panspermia] – Deception point [basic building proteins]
- C. *Hydrothermal vents* – *nutrients and inorganic molecules* fused together to form the basic structure



RESULT: LIFE

Most of these life forms are extinct → fossils

FOSSILS

FOSSIL

What is a fossil?

Type of preservation

Scale – organic, unicellular

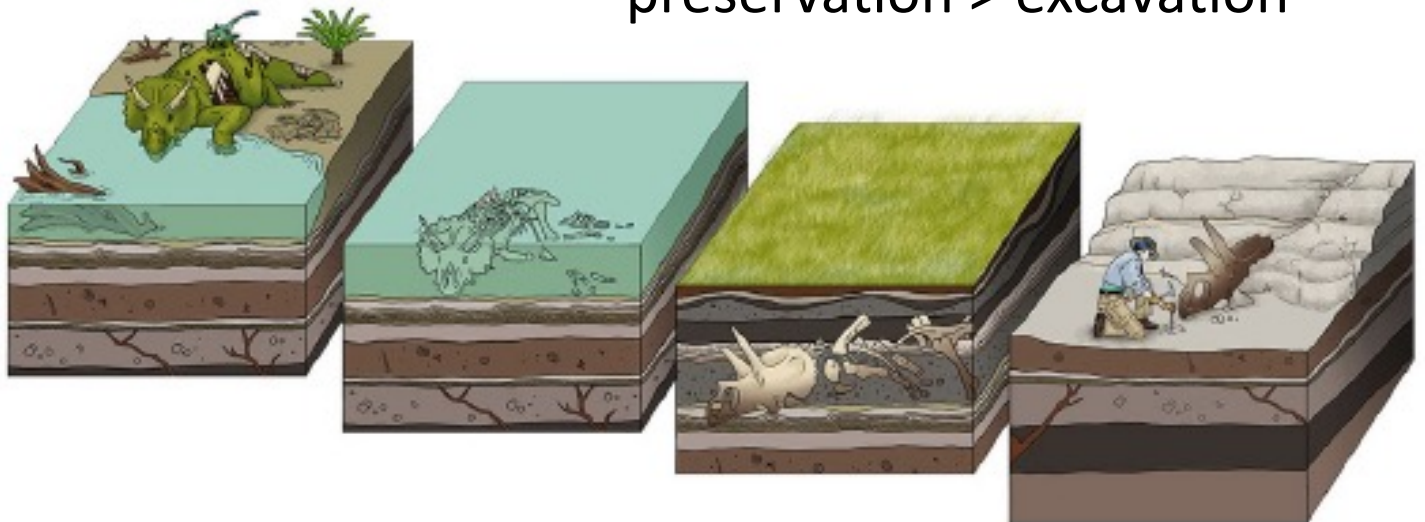
Naturally preserved? Mummies?

Types:

Trace

Body

Death -> burial ->
preservation > excavation



BODY FOSSILS



Cast



TRACE FOSSILS



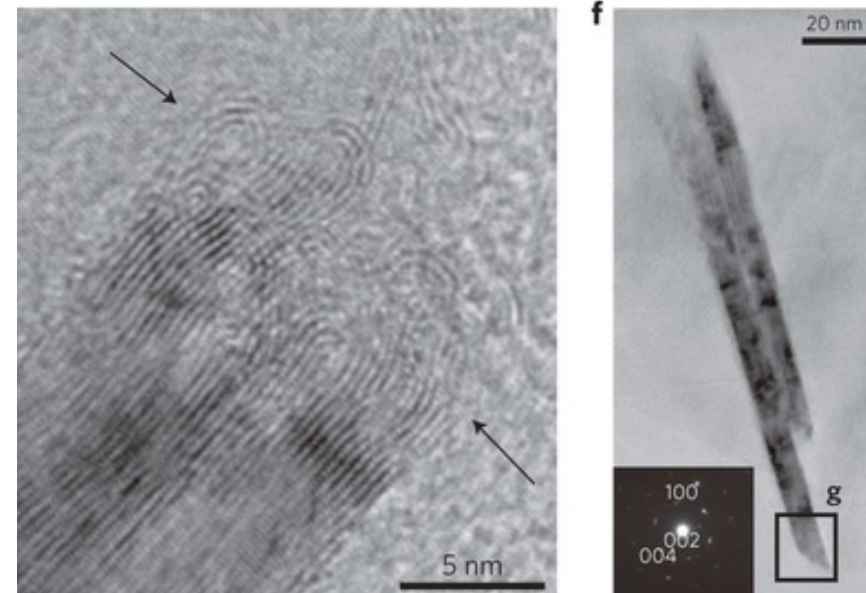
■ *Thalassinoides* (U. Triassic, Italy)

FOSSIL RECORD

Isua Metasedimentary rocks, Greenland

Eon	Era	Period	
Phanerozoic	Cenozoic	Quaternary	← Today ← 11.8 Ka
		Neogene	
		Paleogene	
	Mesozoic	Cretaceous	← 66 Ma
		Jurassic	
		Triassic	
	Paleozoic	Permian	← 252 Ma
		Carboniferous	
		Pennsylvanian	
		Mississippian	
		Devonian	
		Silurian	
		Ordovician	
		Cambrian	
Proterozoic	~	~	← 541 Ma
Archean	~	~	← 2.5 Ga
Hadean	~	~	← 4.0 Ga ← Isua ← 4.54 Ga

- 3.7 Ga
- The original clastic marine sediments had ^{13}C -depleted C at the time of deposition
- “Transmission electron microscope observations show that graphite in the schist occurs as nanoscale polygonal and tube-like grains, in contrast to abiotic graphite in carbonate veins that exhibits a flaky morphology.”

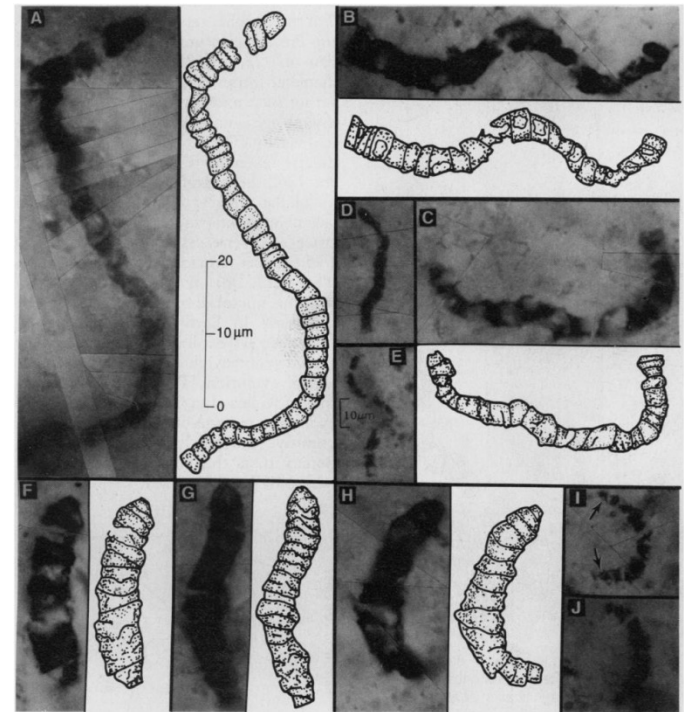


Ohtomo et al., 2014. Nature Geosciences.

Apex Chert Fossils, Australia

Eon	Era	Period	
Phanerozoic	Cenozoic	Quaternary	← Today
			← 11.8 Ka
		Neogene	
	Mesozoic	Paleogene	
			← 66 Ma
		Cretaceous	
	Paleozoic	Jurassic	
		Triassic	
			← 252 Ma
		Permian	
		Carboniferous	
		Pennsylvanian	
		Mississippian	
		Devonian	
		Silurian	
		Ordovician	
		Cambrian	
Proterozoic	~	~	← 541 Ma
Archean	~	~	← 2.5 Ga
Hadean	~	~	← 4.0 Ga
			← 4.54 Ga

- 3.5 Ga
- bacteria fossils 10–20 micrometers long
- filaments
- Questionable, as may be abiotic in origin



Apex Chert fossils
Isua

R. William Schopf