Stratigraphy, Geological Time Scale, Evolution of Life Through Time

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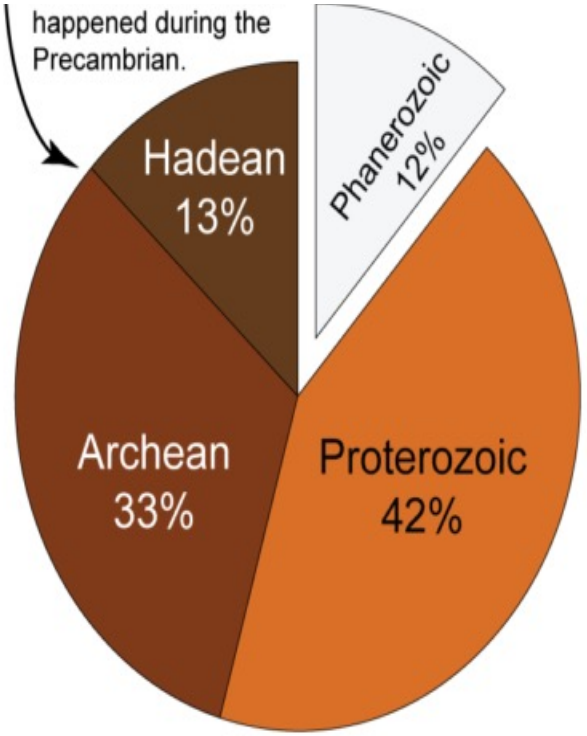
GSA GEOLOGIC TIME SCALE v. 4.0

Younger ↑ Older

Eon	Era	Period	Epoch	
Phanerozoic	Cenozoic	Quaternary	Holocene	← Today
			Pleistocene	← 11.8 Ka
		Neogene	Pliocene	
			Miocene	
		Paleogene	Oligocene	
			Eocene	
			Paleocene	← 66 Ma
	Mesozoic	Cretaceous	~	
		Jurassic	~	
		Triassic	~	← 252 Ma
	Paleozoic	Permian	~	
		Carboni-ferous	~	
			~	
		Devonian	~	
		Silurian	~	
		Ordovician	~	
		Cambrian	~	← 541 Ma
Proterozoic	~	~	~	← 2.5 Ga
Archean	~	~	~	← 4.0 Ga
Hadean	~	~	~	← 4.54 Ga

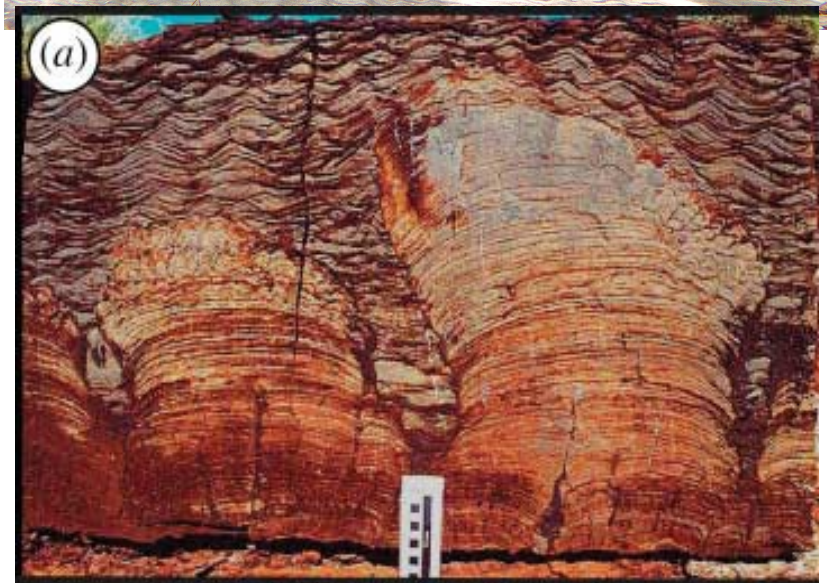


STROMATOLITES

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

Apex Chert fossils
Isua

- Organo-sedimentary structure
- 3.8 Ga to 550 Ma
- indicates photosynthesis

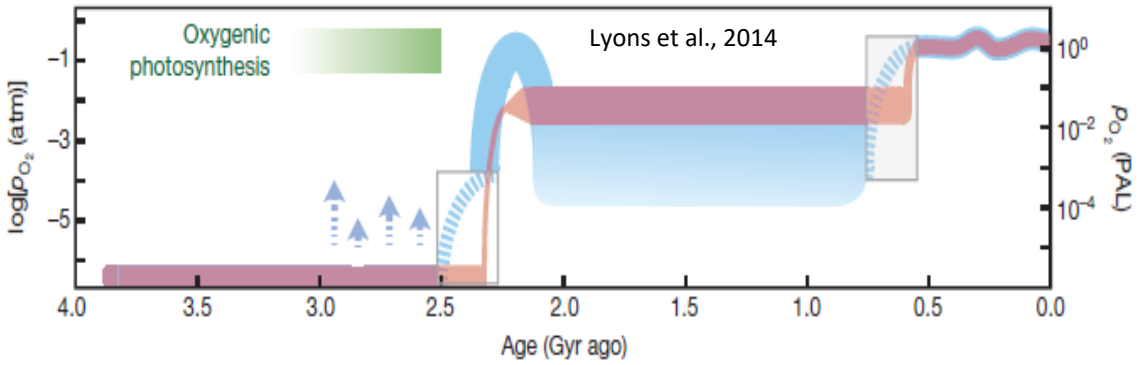


REVOLUTION: RISE OF ATMOSPHERIC OXYGEN

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

Apex Chert fossils
Isua

- ‘Great Oxidation Event’ or GOE
- 2.5-2.25 Ga
- Two-step rise
- photosynthesis

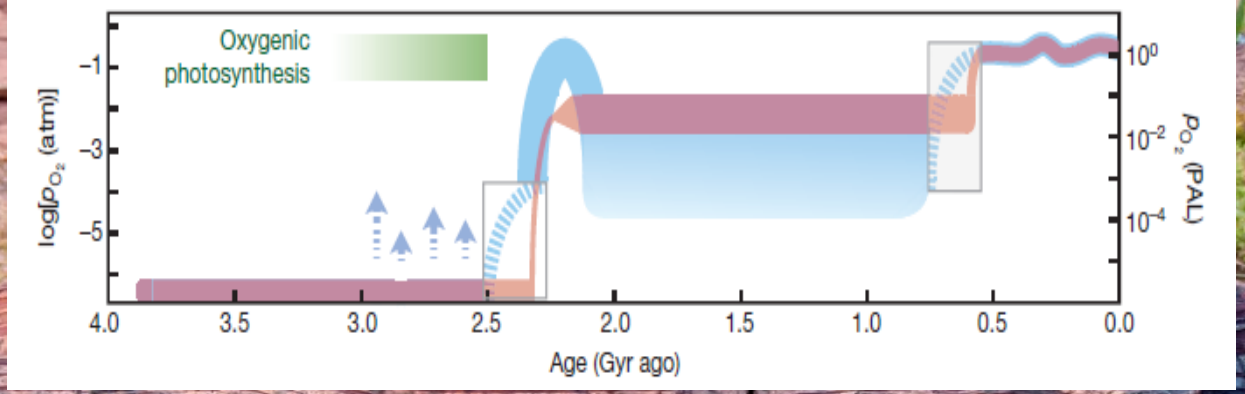


BIF: RISE OF ATMOSPHERIC OXYGEN

1. Range: 3.8-c.1.5 Ga
2. Sedimentary rocks [hematite-chert intercalation] with high Fe content.
   Magnetite, hematite, siderite, jasper, chert
3. Chemically precipitated

Formation

1. Weathering of continents and submarine volcanisms carried Fe



BIF: RISE OF ATMOSPHERIC OXYGEN

Fe_2O_3 ~ High oxygen
Precipitates from water

FeO ~ Low oxygen
Dissolved in water

Fe_2O_3 ~ High oxygen
Precipitates from water

- Iron can dissolve in water in the form of ferrous oxide (FeO), but not as ferric oxide (Fe_2O_3) which precipitates out as sediment.

EUCARYOTES - METAZOANS

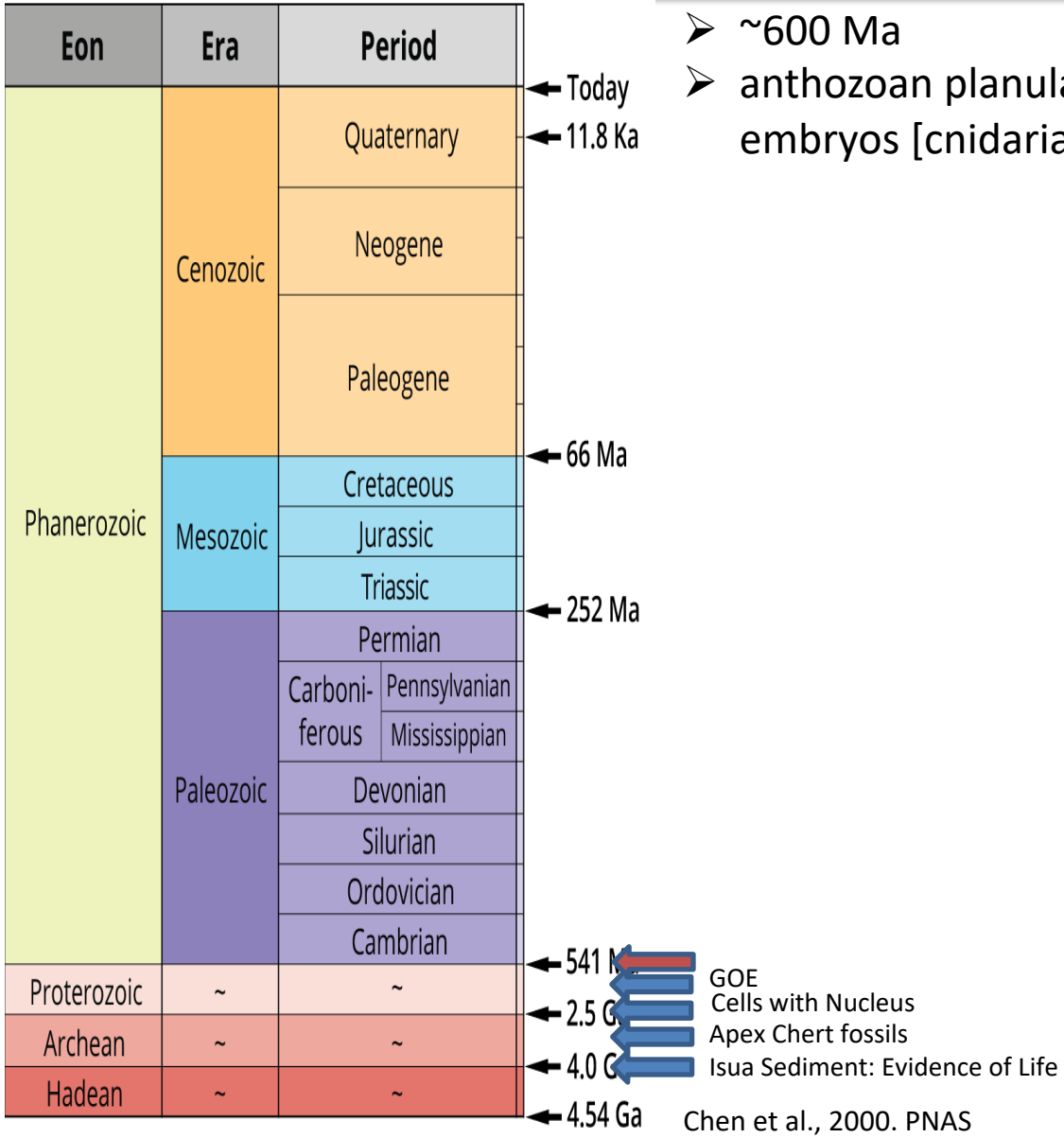
Advantages:

1. Rapid reproduction by mitosis and meosis
2. Show variation – evolutionary stable
3. Can be large and complex – complexity, diversity, body size increased
4. Multicellularity – work load distribution, variation in works, maintenance, sustenance, repairability, etc. very high

Significance:

1. aerobic, so indicate rise in atmospheric oxygen

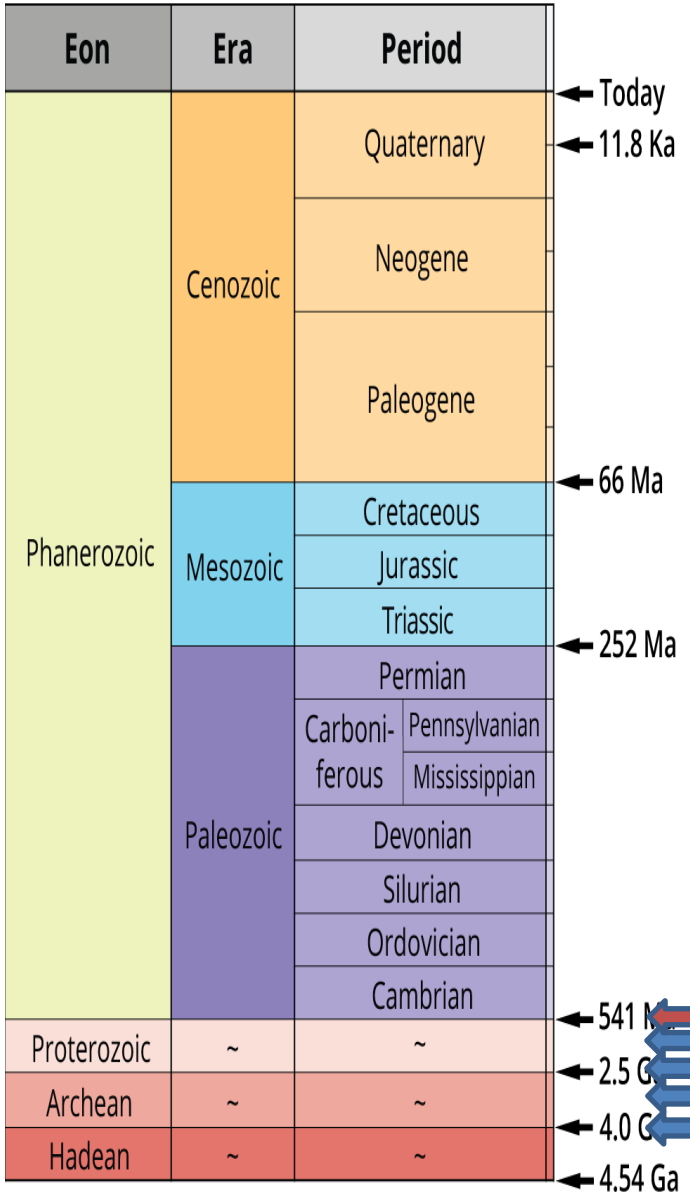
Doushantuo Embryos: China



- ~600 Ma
- anthozoan planula larvae and hydrozoan embryos [cnidarian and bilaterians]

Chen et al., 2000. PNAS

EDIACARAN BIOTA



Extinct soft-bodied groups
Complexity

GOE
Cells with Nucleus
Apex Chert fossils
Isua Sediment: Evidence of Life

Verisimilus at English Wikipedia

END-EDIACARAN EXTINCTION

Time: 545 Ma

Eon	Era	Period	
Phanerozoic	Cenozoic	Quaternary	← Today
			← 11.8 Ka
		Neogene	
		Paleogene	
			← 66 Ma
	Mesozoic	Cretaceous	
		Jurassic	
		Triassic	
			← 252 Ma
	Paleozoic	Permian	
		Carboni-ferous: Pennsylvanian	
		Carboni-ferous: Mississippian	
		Devonian	
		Silurian	
		Ordovician	
		Cambrian	
			← 541 M
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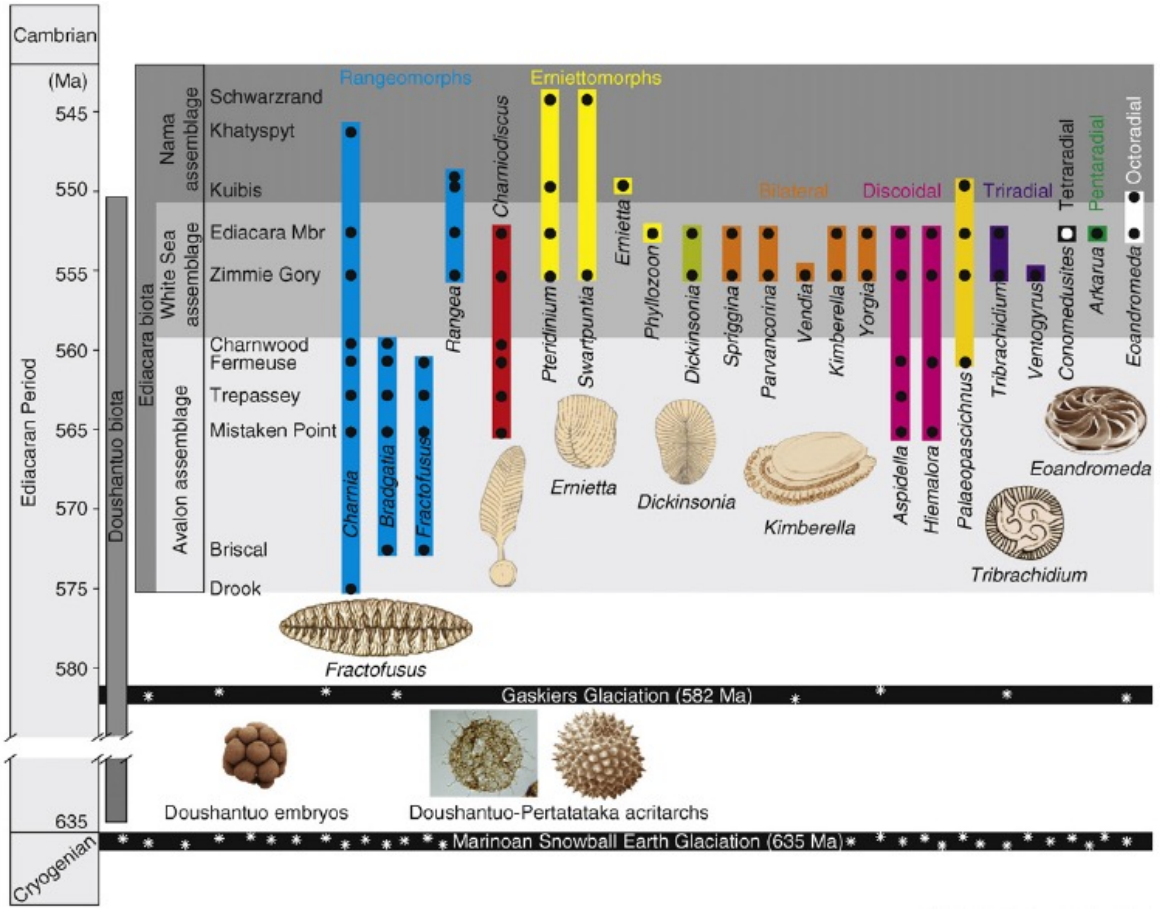
Hadean	~	~	
			← 4.54 Ga



extinct!

GOE

Cells with Nucleus

Apex Chert fossils

Isua Sediment: Evidence of Life