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G203 Lecture Notes

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Evidence for Archean Life:

Carbon isotope fractionation (controversial)

Carbon has two stable isotopes:

C^{12} = 6 protons, 6 neutrons

C^{13} = 6 protons, 7 neutrons

Abiotic systems typically have a ratio of C^{13}/C^{12} of 1/89.

Life favors C^{12} because it is slightly lighter and reacts faster.

Indirect Evidence in heavily metamorphosed rocks ~3.8 b.y. old in the form of Kerogen.

Stromatolites are present in greenstone belts as early as 3.5 b.y. ago.

They are dome or conical shaped layered mounds of sediments.

Modern Stromatolites are created by micro organisms including cyanobacteria.



Image found at: <http://paleontology.edwardtbabinski.us/vendian/stromatolites.jpg>

3.2 billion years ago are the agreed upon oldest fossils.

3.4 billion year ago Strelley Pool Chert

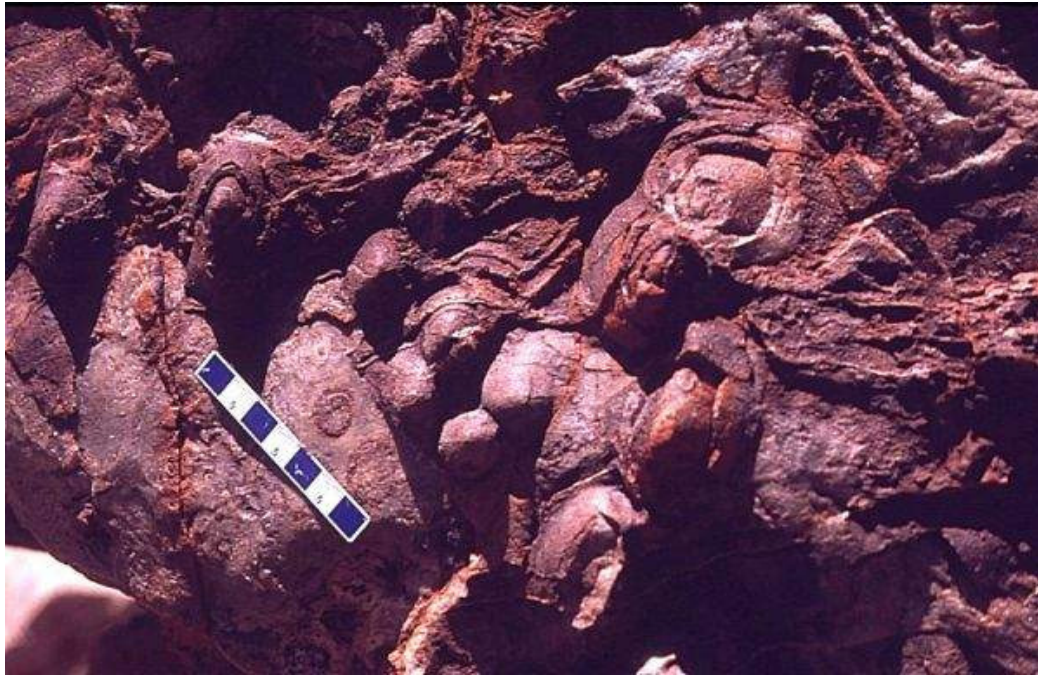


Image found at: <http://jfmoyen.free.fr/IMG/jpg/Stromato-Fig31.jpg>

Oldest banded iron formations are 3.0 b.y. old.

The first life on earth was not cyanobacteria!

BIFs mainly form in Proterozoic not Archean

Organisms closest (to common ancestor) are prokaryotes and thermophilic.

Bacteria/Archaea/Eukarya

(common ancestor)

Life probably began at hydrothermal vents and involved chemosynthesis rather than photosynthesis.

But.....maybe life started at hydrothermal vents associated with large impact craters.

Archean = time of continental crust growth that created 6 major crustal provinces.

Proterozoic

(2.5-0.544 b.y. ago)

- modern plate tectonics (rifting/subduction)
- evidence of more complex microorganisms
- appearance of large (soft body) organisms at end of Proterozoic
- BIFs cease to form
- red beds appear
- widespread glaciations

Late Proterozoic (900-544 m.y. ago)

Growth and break up of Rodinia

Middle (1600-900 m.y ago)

Greenville Orogeny midcontinent rift (1st complete rock record)

Early (2.5-1.6 b.y. ago)

Growth of Laurentia (North American Continent)

Wopmay Orogeny

Proterozoic rocks are separated from Archean rocks by a major unconformity!

60% of present continental crust present at start of Proterozoic and almost 100% by end of this era.

Wilson Cycle:

1. rifting of continents to form ocean basins
2. drifting of rifted cont. fragments, creating passive margins/continental shelves
3. closing of ocean basins by subduction of oceanic crust and subsequent collision of continents.

Wopmay Orogeny records the earliest known completely preserved Wilson Cycle.

- 1st evidence for passive margin sediments 2.3-2.1 b.y. ago.

- 1st aulocogen (failed rift).

- 1st clearly recognizable thrust and fold belt

- 1st ophiolite

Early Proterozoic (2.5-1.6 b.y. ago)

- 6 Archean provinces sutured together (Laurentia)

- 1st of 2 large Precambrian ice ages

- after 2 b.y. beginning of red beds (oxygen levels have increased)

- 1% to 10% oxygen level increase in atmosphere

Middle Proterozoic (1.6 b.y – 900 m.y. ago)

- Last pieces added to Laurentia

- Greenville Orogeny

- 1st fossil eukaryotes