Earth - Moon System Formed 4.6 Ga

Late Heavy Bombardment (4.1-3.8 Ga)
Earliest rock formations known (4 Ga?)
Earliest zircons studied (4.4 Ga)

Formations in this era are rare
High $^{12}$C to $^{13}$C ratios in some formations - life possible?
High methane low oxygen atmosphere
Stromatolites - bacterial fossils?

Pongola - oldest ice age?
Vaalbara – earth’s first supercontinent?
Prokaryotic microfossils - life for sure
Oxygenation of atmosphere begins
Cyanobacteria
CO$_2$ plus H$_2$O photosynthesis

Death Valley National Park—Missing Geology


EON | ERA | Period | Date (Ma) | Epoch | Edge of EON
--- | --- | --- | --- | --- | ---
Phanerozoic | Neoproterozoic | 1 Ga–542 | Ediacaran biota 630 Ma–542 Ma | Cryogenian glaciations (snowball?) | Breakup of Rodinia
| Mesoproterozoic | 1.6–1 | Rodinia supercontinent | Sexual reproduction | O$_2$ – today’s level and beyond
| Paleoproterozoic | 2.5–1.6 | Start of eukaryotic life (that’s us!) | Huronian glaciation (snowball?) | Banded iron formations | Build-up of O$_2$
| Proterozoic | Neoproterozoic | 2.8–2.5 | Oxygenation of atmosphere begins | Cyanobacteria | CO$_2$ plus H$_2$O photosynthesis
| Carboniferous | Permian | 251 | High methane low oxygen atmosphere | Stromatolites - bacterial fossils?
| Cretaceous | Jurassic | 201.6 | Forms in this era are rare | High $^{12}$C to $^{13}$C ratios in some formations - life possible?
| Triassic | 49 | (Extinction event) | Flowering plants, broad-leaf trees, figs, magnolias, bees, mammals, dinosaurs, butterflies, moths, crocodiles
First flowering plants, ginkgoes, birds, sauropods, theropods, pterosaurs, ichthyosaurs, plesiosaurs, ancestral Sierra Nevada, Peninsular Ranges | Modern corals, first mammals, frogs, lizards, ancestral Andes, Pangea supercontinent

Phanerozoic EON | (New to geology? Try [UC Museum of Paleontology](http://www.ucmp.berkeley.edu/)) | 4.6–3.8 Ga | Late Heavy Bombardment (4.1-3.8 Ga) | Earliest rock formations known (4 Ga?) | Earliest zircons studied (4.4 Ga)

"Ma=“Million years ago” Dates taken from 2009 Geologic Time Scale (overleaf)
For MISSING GEOLOGY notes: [http://www.cse.ucsd.edu/~gill](http://www.cse.ucsd.edu/~gill)