**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 ¹²C to ¹³C 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

- **Bryce Canyon National Park—Missing Geology**
  - Red text signifies BCNP formations present.
  - Ga = “Billion years ago”  Ma = “Million years ago”

**Neoproterozoic 1 Ga–542 Ma**
- Ediacaran biota 630 Ma–542 Ma
- Cryogenian glaciations (snowball?)
- Breakup of Rodinia

**Mesoproterozoic 1.6–1 Ga**
- Rodinia supercontinent
- Sexual reproduction
- O₂ – today’s level and beyond

**Paleoproterozoic 2.5–1.6 Ga**
- Start of eukaryotic life (that’s us!)
- Huronian glaciation (snowball?)
- Banded iron formations
- Build-up of O₂

**Paleozoic 542 Ma–251 Ma**

<table>
<thead>
<tr>
<th>Era</th>
<th>Period</th>
<th>Epoch</th>
<th>Ma</th>
<th>Red text in BCNP</th>
<th>Not red where?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phanerozoic</td>
<td>Quaternary</td>
<td>Holocene, Pleistocene</td>
<td>2.6</td>
<td><strong>Not red where?</strong></td>
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<tr>
<td></td>
<td>Tertiary</td>
<td>Oligocene</td>
<td>0.9</td>
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<tr>
<td></td>
<td>Palaeozoic</td>
<td>Cambrian</td>
<td>0.5</td>
<td><strong>Not red where?</strong></td>
<td><strong>Red text signifies BCNP formations present.</strong></td>
</tr>
</tbody>
</table>

- **Neoarchean 2.8–2.5 Ga**
  - Oxygenation of atmosphere begins
  - Cyanobacteria
  - CO₂ plus H₂O photosynthesis

- **Mesoarchean 3.2–2.8 Ga**
  - Pongola - oldest ice age?
  - Vaalbara – earth’s first supercontinent?
  - Prokaryotic microfossils - life for sure

- **Paleoarchean 3.6–3.2 Ga**
  - High methane, low oxygen atmosphere
  - Stromatolites - bacterial fossils?

- **Azoarchean 3.8–3.6 Ga**
  - Formations in this era are rare
  - High ¹²C to ¹³C ratios in some formations - life possible?

- **Proterozoic 542 Ma–251 Ma**
  - **Not red where?**

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- **Phanerozoic (visible life) is shown overleaf**

**For MISSING GEOLOGY notes:** [http://www.cse.ucsd.edu/~gill](http://www.cse.ucsd.edu/~gill)

**START HERE:** Earth - Moon System Formed 4.6 Ga