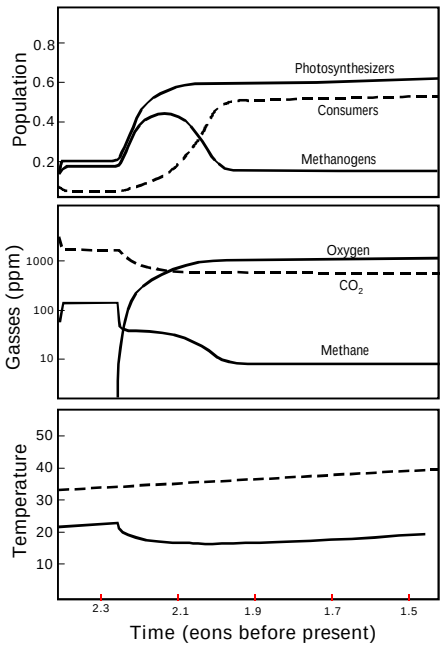
THE TRANSITION FROM ARCHEAN TO PROTEROZOIC DAISYWORLDS [1]

One of James Lovelock's Daisyworld models is for the transition from the Archaean to Proterozoic. It is not an easy model to take apart and understand. The notes below outline the sequence of events interpreted from the model. The caption from the publication says the following:

Fig 5.4 Model of the transition from the Archean to the Proterozoic. The lower panel shows climate with a lifefless world (dashed line) compared with a live world (solid line). Note the sudden fall of temperature when oxygen appears. The middle panel shows the abundance of atmospheric gasses (carbon dioxide,, cashed line; oxygen and methane, solid lines.) The upper panel illustrates the changes in population of the ecosystems as the transition is entered and passed. Note how both photosynthesizers and methanogen increase when oxygen first appears and how methanogen fall back to a steady level when the oxygen-breathing consumers (dashed line) become established.



A sequential analysis of the events taking place in the diagram are laid out below.

1. BGA evolve

   ⇨ Stromatolite population expands.

2. O_2 begins to accumulate.

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3. CO_2 begins to drop (as BGA population explodes)
   - ☞ Carbonate sequestered in petroleum, and carbonate rocks.
4. Methanogen population expands
   - ⇨ Trying to compensate for CO_2 drop, and subsequent temperature drop.
   - ⇨ But CH_4 drops anyway due to reaction with increasing O_2.
5. Drop in CO_2 and CH_4 drops temperature due to loss of greenhouse effect.
6. Methanogen population decreases as O_2 rich atmosphere establishes.
7. BUT CH_4 production limited to short but steady decline.
   - ⇨ Plateau follows
   - ⇨ O_2 attacks CH_4
   - ⇨ Evolving consumers eat organic matter before it become sequestered in the anoxic sediments where methanogens can get it.
8. Consumers expand as O_2 accumulates.
   - ⇨ Lag slightly behind O_2 rise.
9. Glaciation results from loss of greenhouse gasses.
10. Sky goes blue from bleaching effects of O_2.