Aspects of the biological carbon cycle in a ca. 3.42-billion-year-old marine ecosystem

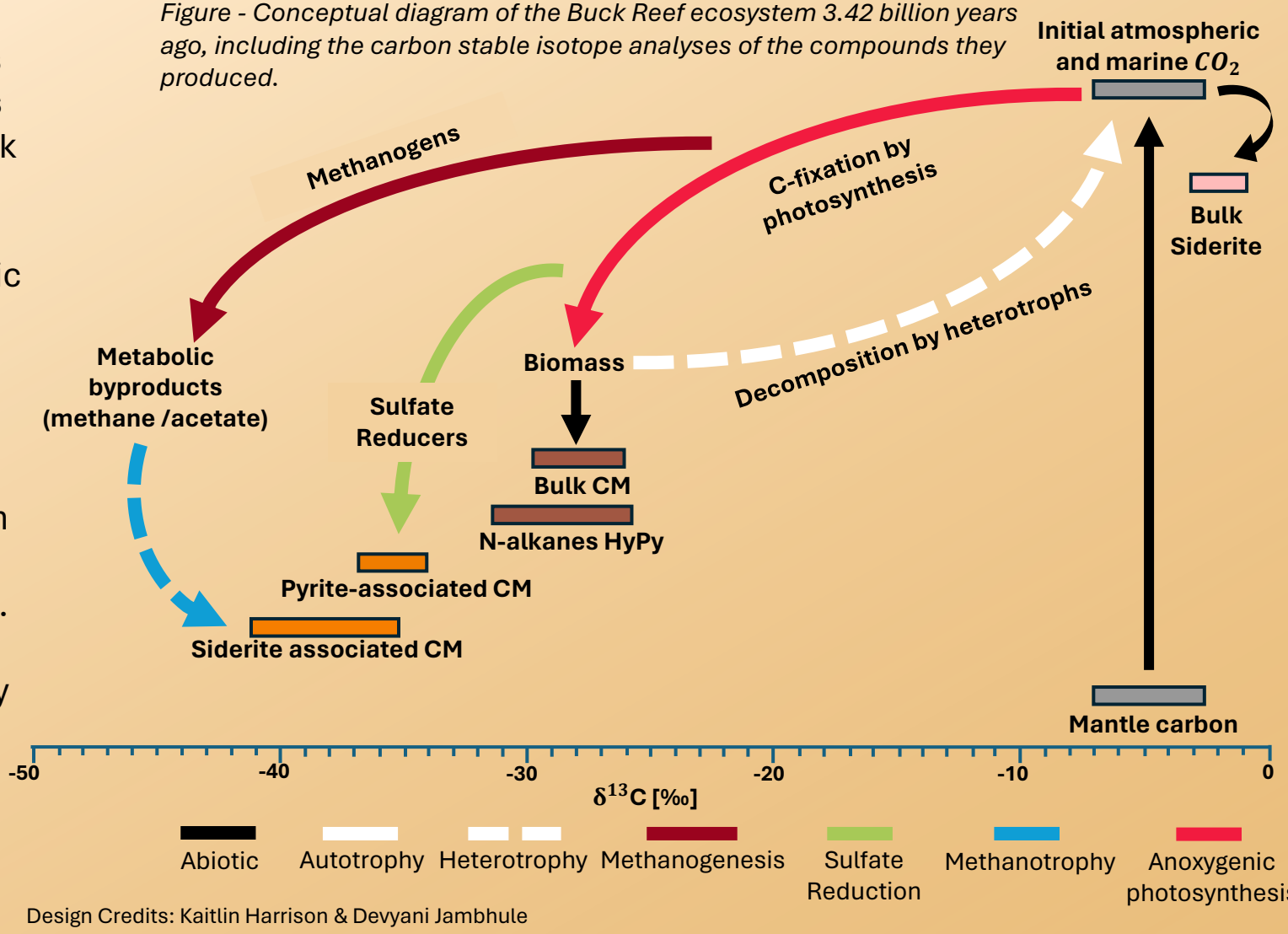
Background: Life formed on Earth sometime before 3.6 billion years ago and was well-established globally by the early Archaean era (3.6-3.2 billion years ago). The study of this early time period on Earth can help us establish what this early life looked like, as well as how quickly it was able to diversify and produce complex ecosystems. This will help us better understand what kinds of ecosystems to look for on other planets and how to assess them.

Methods & Results: Macro- & micro-scale techniques were used to investigate well-preserved carbonaceous matter in a 3.42-billion-year-old chert found in the Buck Reef in South Africa. Visible layering suggests a thick biofilm was present. ^{13}C stable isotope analysis found values consistent with carbon fixation (early anoxygenic photosynthesis!) ^{33}S and ^{34}S analysis, along with ^{13}C, suggests the presence of sulfur reducers & methanotrophs, likely supported by methanogens.

Conclusions:

- Advanced biological carbon cycle already existed in early Archaean
  - Many different methods of cycling carbon (e.g. photosynthesis & methanogenesis)
- Early life formed complex & diverse systems quickly
- As we look for life elsewhere, we must keep these kinds of complex systems in mind!

Figure - Conceptual diagram of the Buck Reef ecosystem 3.42 billion years ago, including the carbon stable isotope analyses of the compounds they produced.



NFoLD NETWORK FOR LIFE DETECTION

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