

Field: Earth Science/ Geoscience/ Environment

**Introductory Speakers:
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**Session Topic:
Early Life**

Title: Chemosynthesis- vs. photosynthesis-based ecosystems

The Earth accreted approximately 4600 million years ago, but no rocks older than 4000 million years have been found, leaving the history of the first 600 million years missing. The oldest evidence for life can be traced back to between 3800 and 3500 million years and is based on chemical signatures, putative microfossils, and layered rocks known as stromatolites. Based on phylogenetic analyses it has been suggested that the first organisms were hyperthermophilic prokaryotes living at temperatures above 80°C. These organisms used energy derived from the oxidation of chemical compounds to build up biomass – a mode of life referred to as chemosynthesis. The chemical compounds that are required for chemosynthetic primary production are not distributed evenly on the Earth, but are restricted to particular sites like submarine volcanoes or cavities in deep crustal rocks. Only the advent of another mode of primary production allowed organisms to spread across the whole planet. Unlike chemosynthetic organisms, photosynthetic organisms use sunlight as energy source to build up biomass. This innovation increased biological activity by an order of magnitude (Rosing et al., 2006). The oldest photosynthetic organisms were bacteria that produced no oxygen – so called anoxygenic phototrophs. This group of organisms thus provides the means to understand the origin of photosynthesis (Hanada, 2003), a process that dramatically changed the face of Earth. Anoxygenic phototrophs are also held responsible for the production of massive rock formations on early Earth (Kappler et al., 2005). Later on, another group of photosynthetic bacteria evolved: the cyanobacteria. These started to produce an aggressive toxin that posed severe problems to ancient ecosystems: molecular oxygen. Only much later did organisms evolve that were able to cope with limited amounts of oxygen and some organisms even arose that became dependant on it.

References:

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- Kappler A, Pasquero C, Konhauser KO, Newman DK (2005) Deposition of banded iron formations by anoxygenic phototrophic Fe(II)-oxidizing bacteria. *Geology* **33**, 865-868.
- Rosing MT, Bird DK, Sleep NH, Glassley W, Albarede F (2006) The rise of continents – An essay on the geologic consequences of photosynthesis. *Palaeogeography, Palaeoclimatology, Palaeoecology* **232**, 99-113