Porphyrins from 1.1 Gyr benthic microbial mats

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Microbial mats are a dominant characteristic of Mesoproterozoic sedimentary successions and are commonly preserved due to a lack of grazing pressure [1]. They were present in shallow marine as well as deep oceanic settings. Phototrophic coastal mats may have produced a significant fraction of oxygen in the atmosphere, and oxygen-enriched cyanobacterial layers may have hosted the evolution and radiation of aerobic eukaryotes [2] [3]. Next to body fossils, molecular fossils (biomarkers) may yield additional insights into the microbial composition and physiology of microbial communities at the dawn of eukaryotic life.

Here we present biomarkers, bulk and compound-specific isotopes, organic petrological images, iron speciation chemistry, and elemental and minerological compositions of a Mesoptroterozoic benthic mat system. Exceptional preservation has enabled studies on porphyrins and their isotopic composition providing valuable information about the dominant phototrophic organisms. To our knowledge this is the oldest unambiguous report on sedimentary porphyrins.

The data describe a benthic microbial community that thrived beneath relatively shallow waters. The water column was predominantly ferruginous, but oscillated between euxinic and oxic conditions. Although eukaryotic fossils are found within the formation, biomarkers diagnostic for crown group eukaryotes remain beneath detection limits. Instead, the community was dominated by anoxygenic phototrophic purple and green sulfur bacteria, cyanobacteria and microaerophilic methanotrophs. The structure and N-isotopic composition of porphyrins are diverse, but indicate that cyanobacteria were the dominant phototrophic organisms.

[1] Pecoits *et al*. (2012) *Science* **336**, 1693-1696. [2] Gingras *et al*. (2011) *Nat. Geosci*. **4**, 372-375. [3] Des Marais (1991) *Palaeogeogr. Palaeoclimatol. Palaeoecol*. **97**, 93-96.