Questioning the evidence for Earth's oldest fossils

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Structures resembling remarkably preserved bacterial and cyanobacterial microfossils from ~3,465-million-year-old Apex cherts of the Warrawoona Group in Western Australia currently provide the oldest morphological evidence for life on Earth and have been taken to support an early beginning for oxygen-producing photosynthesis. Eleven species of filamentous prokaryote, distinguished by shape and geometry, have been put forward as meeting criteria required of authentic Archaean microfossils, and contrast with other microfossils dismissed as either unreliable or unreproducible. These structures are nearly a billion years older than putative cyanobacterial biomarkers, genomic arguments for cyanobacteria, an oxygenic atmosphere and any comparably diverse suite of microfossils. Here we report new research on the type and re-collected material, involving mapping, optical and electron microscopy, digital image analysis, micro-Raman spectroscopy and other geochemical techniques. We reinterpret[1] the purported microfossil-like structure as secondary artefacts formed from amorphous graphite within multiple generations of metalliferous hydrothermal vein chert and volcanic glass. Although there is no support for primary biological morphology, a Fischer-Tropsch-type synthesis of carbon compounds and carbon isotopic fractionation is suggested for one of the oldest known hydrothermal systems on Earth.

References

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Productivity in Cretaceous oceans: evidence from molecular markers in organic-carbon rich sediments

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Early Aptian OAE 1a from Shatsky Rise

Remarkable organic carbon contents (up to 35% Corg) attest to the extraordinary nature of the depositional conditions that led to exceptional preservation of type I kerogen rich in algal and bacterial organic matter. Hydrocarbon and ketone biomarkers show stratigraphic consistency in the compositions of compounds attributed to eukaryotes (notably sterenes and sterones), but significant variability in prokaryotic distributions and abundances. Constituents include unprecedented series of 2-methyl-17β(H),21β(H) hopanes and hopanones diagnostic of cyanobacterial contributions and alkenones, components biosynthesized only by haptophyte algae.

These results provide evidence of the biological origins of organic matter and help describe environments of deposition. They suggest changes in prokaryote populations related to the conditions that led to increased sequestration of organic matter and help describe the phytoplankton communities extant during OAE 1a.

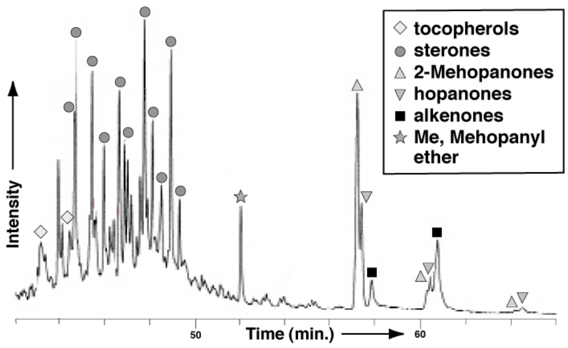

Figure 1: Partial GC-MS trace of ketone fraction of lower Aptian sample (198-1213B-8R-1 96-97 cm)

Reference

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