

Physical artefacts or biological structures? The difficulty in interpreting Precambrian fossils

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The Precambrian fossil record, extending from ~4600-541 million years ago, consists only of microbial life. Communities of microorganisms were thought to have flourished in hot springs, lakes and oceans, encompassing both shallow and deeper water environments. Life from this time is preserved either as stromatolites (macro-structures that are remnants of microbial communities), or, as individual microorganisms (single cells and aggregates or chains of cells).

Age, metamorphic grade and rock type are major factors affecting the quality of preservation of a stromatolite or microfossil, that is, if these structures are even preserved in the first place, as microbes degrade on the timescale of days to weeks. Complicating the issue further, many stromatolite-like and cell-like structures can be formed abiotically, from physical rather than biological processes. Consequently, the Precambrian fossil record, especially that of the earliest examples of life on Earth, is fraught with controversy over the biogenicity of pseudo-stromatolitic or pseudo-microfossiliferous forms.

My research involves characterising a suite of microbial fossils (microfossils) at a time when there was a significant rise in atmospheric oxygen, also known as the Great Oxidation Event (GOE) at c. 2.4 Ga. I have found an apparent increase in the diversity of life preserved at this time, which may be a result of adaptation to the changing environment. However, the shape of some of the microfossils could be explained by abiological processes. Thus, these structures need to be investigated to determine their true origin. I will present examples of microfossils discovered during my research and discuss the alternative hypothesis of their abiogenic formation.