

RECORDS OF EARLY LIFE: CONTEXT AND PRESERVATION ARE KEY

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In searching for life on Mars, and elsewhere throughout our solar system, we seek 'biosignatures' – mineralogical, chemical or morphological features that, on Earth, are indicative of life processes. However, it is difficult to definitively say whether a feature from the early Earth rock record was formed by biological or non-biological processes, let alone a potential biosignature from another planet. So, to be able to best determine the biogenicity of extra-terrestrial features, it is vital to have multiple lines of evidence that preferably include: ample contextual information about the surrounding rocks that supports a past habitable environment; well preserved samples with low-temperature metamorphic history; organic biomarkers; and morphological (macro or micro) fossils.

The Precambrian fossil record on Earth reveals that early life inhabited three main types of environments: fresh water bodies (e.g., lakes), marine systems (spanning intertidal to deeper-water habitats), and terrestrial hot springs. There is evidence that these three types of environments exist, or existed, elsewhere in our solar system, such as on Mars and Europa. Knowing the geological setting of early life on Earth directs search efforts towards the 'best' places to look for organic or morphological biosignatures within our solar system.

This paper will link the environments that early life on Earth inhabited with comparable environments on Mars and Europa, summarising what we might expect to find in terms of biosignatures of extant or fossilised life.