Signatures of extraterrestrial life

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The pressure in the hunt for ET is rising as we almost daily find new extremophiles, new records for the survival of life, and novel types of biosignatures. With better understanding of the origin of life (perhaps) and its early evolution, as well as its environmental context, we are becoming more realistic about what we might find in the Solar System: chemotrophs would be more likely than anaerobic phototrophs. These are not over-abundant organisms. Yes, they form thick biofilms in hydrothermally influenced environments on the oxygenated Earth of today, but back on the early, anoxic Earth (more similar to environments on potentially habitable bodies in the Solar System), the biofilms were limited even in hydrothermally-rich environments. Their signatures: morphological (very difficult to detect in situ on another planet/satellite); organic (more likely to be detected if preserved from UV and other radiation); geochemical (preservable but not analysable in situ). While study of ET-analogue life forms on Earth, in vivo, in vitro, or fossilised is essential for informing our search for ET life, in situ missions to return samples for analysis in terrestrial laboratories will be the only way we can definitively conclude that we have found an independent form of life outside the Earth. I will illustrate my talk with relevant examples from the early Earth, as well as experimental data.

In terms of exoplanets, our understanding of the interactions between geological processes and life suggest that we need realistic interpretations of the geology of the exoplanets; those with water and rocks may be inhabited but unless the inhabitants are run-away methane producers or have developed a form of oxygenic photosynthesis, we can only speculate.

In the meantime, we will continue to document new ways in which life interacts with its environment, leaving a trace of its passage. By the time samples are returned from ET bodies, there will be a plethora of new and sophisticated techniques to investigate them.