Meteorites as potential microbial habitats on the surface of Mars

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Meteorites residing on the surface of Mars have been found by the MSL and MER rovers [1]. Although only iron meteorites have been identified to date, it is likely that stony meteorites, which are ultramafic in composition, may also be found on the martian surface. It has been suggested that putative autotrophic organisms could metabolise gases and minerals associated with ultramafic rocks deep within the martian subsurface [2]. 'Samples' from this habitat could be brought to the surface via several geological mechanisms [3] [4], where geochemically similar meteorites could then act as mini-ecosystems or lifeboats for these organisms.

For our study, we investigated the habitability of several stony meteorites from the Nullarbor Plain, Australia. We used portable instrumentation relevant to current and future Mars missions (XRD, Raman spectroscopy) to evaluate and characterise the biopreservation potential of weathering products that form within fissures in meteorites. This material consists of >75 wt.% Mg-calcite with minor amounts of gypsum, goethite, quartz (aolian), and smectite. SEM imaging revealed that the weathered interiors of meteorites (in particular Mg-calcite), were commonly colonised by 5–10 μm thick biofilms of local environmental microorgansims, displaying several morphologically distinct species. This is relevant because carbonates adsorb water from the atmosphere and have the potential to preserve molecular biosignatures for millions of years [5].

Most importantly, unlike Martian rocks, meteorites have been extensively studied on Earth, and as such are chemicaly very well defined. This makes meteorites a standard on the surface of Mars with which to best judge and compare possible biosignatures.

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