Potential of weathering-derived efflorescences in meteorites for preserving biofilms, fossils and organics

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Meteorites can be used as isotopic 'standards' with which to test for the presence of biological alteration in environments where geochemical understanding is still being established [1]. Thus, meteorites are ideal targets for future astrobiology exploration on Mars [2]. Here, we investigate the preservation potential for fossils and organic biomarkers in meteorites and report on the microbial ecology of ordinary chondrites collected from the Nullarbor Plain, Australia.

Weathered meteorites contain sulfates, carbonates and smectites, which have the capacity to preserve molecular, isotopic and fossil biomarkers [2]. FEG-SEM analysis, 16S rRNA phylogenetic analysis, microbial culture work, and py-GC-MS were used to build a better understanding of the potential to preserve biomarkers within the weathering products of meteorites. We found that the microorganisms inside the meteorites were heterogeneously distributed in biofilms at the surfaces of – and within – alteration minerals, including partial encapsulation of two diatoms within carbonate-sulfate efflorescences and bacterial biofilms. The py-GC-MS results of the efflorescences yielded heteroatomic aromatic compounds that may be of biological origin [3, 4]. In addition, we found that eukaryotes and prokaryotes could be cultured from our meteorite samples and that they penetrated >300 μm into meteorites along shock related cracks, and several mm along veins of alteration minerals. We conclude that fossil and organic evidence for the presence of microorganisms can be preserved in the weathering products of meteorites and used to bolster isotopic findings.

[1] Tait *et al*. (2017a) *Geochim Cosmochim Acta*, in review. [2] Tait *et al*. (2017b), *Geochim Cosmochim Acta*, in review. [3] Gelin *et al*. (1996), *Geochim Cosmochim Acta,* **60**(7), 1275-1280. [4] Berwick *et al*. (2007), *Org Geochem,* **38**(7), 1073-1090.