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High survivability of micrometeorites on Mars: Sites with enhanced availability of limiting nutrients

NASA's strategy in exploring Mars has been to follow the water, because water is essential for life, and it has been found that there are many locations where there was once liquid water on the surface. Now, to narrow down the search for life on a barren basalt-dominated surface, there needs to be a refocusing to a strategy of "follow the nutrients". Here, we model the entry of metallic micrometeoroids through the Martian atmosphere, and investigate variations in micrometeorite abundance at an analogue site on the Nullarbor Plain in Australia, to determine where the common limiting nutrients available in these (e.g., P, S, Fe) become concentrated on the surface of Mars. We find that dense micrometeorites are abundant in a range of desert environments, becoming concentrated by aeolian processes into specific sites that would be easily investigated by a robotic rover. Our modeling suggests that micrometeorites are currently far more abundant on the surface of Mars than on Earth, and given the far greater abundance of water and warmer conditions on Earth and thus much more active weather system, this was likely true throughout the history of Mars. Because micrometeorites contain a variety of redox sensitive minerals including FeNi alloys, sulfide and phosphide minerals, and organic compounds, the sites where these become concentrated are far more nutrient rich, and thus more compatible with chemolithotrophic life than most of the Martian surface.

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