



Role of impacts in facilitating elementary life on Mars

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Terrestrial permafrost and polar ices are habitats for various species of microorganisms that are a model for possible martian life. Hostile radiative and oxidising conditions probably confine life below the surface, where low light levels and nutrients are limiting. A further limitation is the lack of transport, apart from in rare flooding episodes of short duration. Low levels of vapour may provide sufficient water in the vicinity of ground-ice or polar cap ice under sun-warmed surfaces. We postulate that meteorite impacts are significant in re-supplying nutrients, transporting them across the planet and facilitating eco-diversity, just as impacts are thought to be significant in mobilising martian water. Metre-sized meteorites impacting the north polar cap break off sections of south-facing cliffs, scattering fragments of microorganism-bearing crust. Winds take them further so they can colonise new habitats once they are covered by seasonal frosts or buried under several frost and wind-blown dust layers. Impacts at mid-latitudes similarly eject microorganism-bearing fragments of ground-ice and soil or crust overlying it, but their new environment is likely to be hostile and highly desiccated even if they get quickly covered by dust. The rare impacts of km-size bolides offer other prospects in that the vapour plume blows through the atmosphere ejecting fragments over planetary scales, these potentially landing in relatively friendly polar habitats. The more frequent km-sized cratering events (one per 10-100 kyr) create a melt-water lake if in ice or permafrost. We explore models of the refreezing ice under diurnal heating that apply to these lakes and to the Elysium flood. A dirt crust accumulates as the ice thickens, analogous to the case of sub-crustal pools on comets, providing a protected watery environment for flourishing micro-life for weeks to years until refreezing is complete. The dirt crust itself is a habitat for psychrotrophic microbes, metabolising slowly at sub-zero temperatures while bathed in the vapour from the underlying sublimating ice. Meteorite impacts are the mechanism linking – on the kyr to Myr timescale – such isolated environmental niches to the planet as a whole.

Hoover R B, *et al.*, in *Instruments, Methods, and Missions for Astrobiology VIII*, SPIE 5163, 191-202, 2004 (www.astrobiology.cf.ac.uk/SPIE2004.pdf)

Wallis M K, *Adv. Space Res.* **15**(4) 113-116, 1995

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