

Plausible Scenarios for the Evolution of Life on Mars

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A primary characteristic of life is that it adapts to utilize its environmental resources; thus, similar resources would in principle foster similarities in organismal strategies, even if each had originated in a separate genesis. As the environmental histories of Earth and Mars appear to have diverged drastically after the first few hundred million years, so would the history of their life. The most reasonable scenarios for Mars are long dry and cold environments interspersed with warmer and wetter periods. Life could be present today on Mars in liquid water in or beneath ice sheets or glaciers, below ground, or in protected habitats like lava tubes, cracks and fissures, or caves. The potential for life is enhanced in regions where elevated heat flow may occur, such as in parts of the Tharsis and Elysium volcanic provinces. Possible organisms would be chemoautotrophic psychrophiles adapted to a nutrient-poor environment, or photoautotrophic life in selected near-surface habitats. Or, life may have evolved alternating cycles between dormant and active forms, in which case microbes could be present in dormant forms close to the surface and in proliferative forms in protected environments. Periodic liquid water on Mars could have provided opportunities for biologic activity at the surface during the short-lived climatic perturbations, as well as evolutionary progress driven by directional selection; not unlike the evolutionary innovations of organisms following Snowball Earth events. Ancient organisms from any of these environments may also have left a detectable fossil record.

