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ENDOLITHIC MICROBIAL MODEL FOR MARTIAN EXOBIOLOGY: THE ROAD TO EXTINCTION

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Martian exobiology is based on the assumption that on early Mars, liquid water was present and that conditions were suitable for the evolution of life. Assuming that this was the case, two questions arise:

(1) How did life disappear from the surface?
(2) What recognizable fingerprints of past microbial activity could have been preserved on Mars?

(1) The Antarctic cryptoendolithic microbial ecosystem is a model for extinction in the deteriorating Martian environment. Laboratory measurements and computer analysis of long-term satellite-mediated nanoclimate records indicate that individual organisms live permanently near the lower limits of their temperature range (between -10°C and +2°C) while their optima are between 15°C and 25°C. In contrast, the net photosynthetic activity of the community shows a maximum around 0°C, reflecting the ambient temperature range. This apparently paradoxical situation is a result of a shift in the primary producer/consumer ratio, an adaptive response of the community. As the organisms are pushed to the limit of their physiological adaptability, even slight further deterioration in the environment (cooling) results in cell death. Such cases have been observed in nature. Thus, the response of organisms to extreme environmental pressures which result in extinction can be studied on this model at the cellular, organismal and community levels.

(2) Extreme dry environments are not conducive for fossilization. Yet, both Antarctic and hot desert endolithic microorganisms leave behind recognizable trace fossils in rocks. These trace fossils are the result of microbial leaching and of characteristic biogenous weathering patterns. Similar fingerprints of past microbial activity may also have been preserved on the surface of Mars.