

523-51
P.B.S. ONLY
1-7-73
B.

N89-26357

ECOLOGICAL CONSIDERATIONS FOR POSSIBLE MARTIAN BIOTA

June M. Klingler, Rocco L. Mancinelli, and Melisa R. White
NASA Ames Research Center nc473657
Moffett Field, CA 94035

Current climatic and geological evidence suggests that, like early Earth, conditions on ancient Mars may also have been favorable for the origin and evolution of life. The primordial atmospheres of the two planets were quite similar, composed primarily of CO₂, N₂, and water vapor at a total atmospheric pressure of ~ 1 bar. Each of these gases are important for the evolution of biological systems as we know them. Although there was no absolute confirmation of organic carbon in the regolith, the influx of organic material from meteorites and the production of organic material under weakly reducing atmosphere (albeit difficult), similar to early Earth, should have allowed some prebiotic synthesis. Organics should not have been in shorter supply on Mars than on Earth. One of the most crucial environmental factors limiting life and biochemical processes is the presence of adequate supplies of liquid water. Out flow channels and valley networks, suggest that abundant liquid water once flowed across the surface of Mars. The abundance of liquid water implies that the temperature of the Martian surface must have been > 0° C and therefore conducive for rapid prebiotic chemical reactions which may have led to the evolution of a living system. The higher temperature could have been maintained by geochemical cycling of CO₂ in and out of the atmosphere via the regolith (as carbonates) long enough for life to have developed on Mars. It is feasible that a thin layer of SO₂ soil from volcanic activity could have somewhat shielded a possible early Martian biota from ultraviolet radiation.

With the exception of nitrogen, there seems to have been a sufficient supply of the biogenic elements (CHOPS) on early Mars for life to have evolved. It has been postulated that primordial Mars contained only 18 mb of nitrogen in the form of N₂ given that only fixed nitrogen is utilized by living systems. Would this have been a sufficient deterrent to cease the evolution of a biological entity? Data we have gathered in the laboratory indicates that there was sufficient nitrogen in the atmosphere to allow biological fixation to occur. Under a total pressure of 1 bar, nitrogen fixing organisms were grown in nitrogen free medium under various partial pressures of dinitrogen (pN₂ 1-780 mb). The data suggest that organisms grow at pN₂'s of 18 mb or less, although the biomass and growth rates are decreased. The calculated *in vivo* Km's ranged from 46 mb to 130 mb. If organisms adapted on Earth to a pN₂ of 780 mb are capable of growing at these low partial pressures, it is conceivable that nitrogen was not the limiting factor in the evolution of life on early Mars.