METHANOGEN USE OF INSOLUBLE CARBONATES AND THE IMPLICATIONS FOR LIFE ON MARS

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Introduction: The discoveries that liquid water existed on the surface of Mars [1] and that methane currently exists in the Martian atmosphere [2] have fueled the possibility of extant or extinct life on Mars. One possible explanation for the methane in the Martian atmosphere would be the presence of methanogens in the subsurface. Methanogens are microorganisms in the domain Archaea that can metabolize molecular hydrogen as an energy source, carbon dioxide as a carbon source, and produce methane. Carbon dioxide is the predominant gas in the Martian atmosphere, but what about deep down in the subsurface? In 2008, The Phoenix Lander detected carbonate at its landing site [3]. Carbonate has also been found on some of the Martian meteorites including ALH84001. If carbonate is present in the deep subsurface, can methanogens use it as a sole carbon source? Here we present evidence that certain methanogenic strains can metabolize using carbonate as a sole carbon source.

Methods: The methanogens tested were *Methanothermobacter wolfeii, Methanosarcina barkeri, Methanobacterium formicicum* and *Methanococcus maripaludis*. Cells were grown in standard methanogenic growth media, then transferred to the same media containing $CaCO_3$ or $MgCO_3$ (1% [wt/vol]), some with carbon dioxide and some without. Methane was measured by gas chromatography.

Results: When carbonate was the sole source of carbon, all four methanogens were able to produce methane, although at much reduced levels (approximately 1%) compared to cells supplied with carbon dioxide and carbonate (10% or higher).

Conclusions: If carbonate is present in the deep subsurface of Mars, there is no reason that methanogens cannot use it as a sole source of carbon. This is additional evidence that suggests that methanogens may inhabit the subsurface of Mars.

References: [1] Squyres S. W. et al. (2006) *Science, 313*, 1403-1407. [2] Mumma M. J. et al. (2009) *Science, 323*, 1041–1045. [3] Boynton W. V. et al. (2009) *Science, 325*, 61-65.