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Introduction: Like Earth, Mars is regularly bombarded by particles derived from asteroids and comets that contain organic material. Because the Martian atmosphere is thin, much of this organic material reaches the planet's surface relatively unprocessed. Ongoing investigations by the Sample Analysis at Mars instrument suite (SAM [1]) onboard the Curiosity rover have led to the first detection of Martian organics in the Cumberland samples [2] as well as hinted towards the presence of organic compounds in several other analyzed soil samples [3,4]. Even though these results are at least partly skewed by the presence of organic contaminants and Mars-indigenous calcium perchlorates [5], the Martian origin is no longer doubted. Organics on Mars can be binned into two categories: indigenously produced and exogenously delivered. Here, we discuss the exogenous contribution to the Martian organic inventory. We have modeled the accumulation of this exogenous organic material - cosmic pollution in effect - on the surface and its burial beneath the surface, taking into account decomposition due to ultraviolet radiation and galactic cosmic rays.

Organic abundance model: We computed the expected abundance of exogenous organic material both on and below the surface. The abundances were computed as a balance between the exogenous flux to the surface, chemical decomposition as a function of depth beneath the surface, and physical burial due to aeolian or sedimentation processes. We modified an existing 1-D coupled atmospheric chemistry/vertical transport model previously used to simulate planetary atmospheres throughout the solar system [6]. However, for the purposes of this study, the surface is the top boundary of the model and transport to the subsurface is what counterbalances local chemical processes:

$$\frac{dn_i}{dt} + v\frac{dn_i}{dz} = P_i - L_i$$

where z is the depth, n_i, is the concentration of the organics, v is the burial velocity and P_i and L_i are the chemical production and loss rates of species.

Organic destruction and burial rates: We divided the organics into five different groups: insoluble organics, soluble polycyclic aromatic hydrocarbons (PAHs), soluble functionalize alkyl aromatics, soluble amino acids, and soluble sugars, and searched the literature for measured or computed rates for the three decomposition processes identified above: oxidation processes, photolytic decomposition, and decomposition by ionizing radiation, particularly galactic cosmic rays. Since the search for organics on Mars has been ongoing for the past nearly forty years, one would suspect that these organics and processes have been very well characterized. However, the lack of computed and measured data on compounds other than amino acids and polycyclic aromatich hydrocarbons and on oxiation processes alltogheter meant that we had to adjust the number of model parameters, to cover only UV and cosmic ray decomposition and burial of a not further specified, averaged soluble and insoluble organic fraction

Conclusion: The conclusion of this study is twofold. (1) The computed abundance of exogenous organic material is a few parts per billion to a few parts per million by mass at the surface and for many meters beneath the surface. This material is predominantly insoluble polymeric organics. At these abundances, the meteoritic organics should be detectable by present and future landed experiments. (2) The input data used for the model in this study are based on existing experimental data. The literature review showed a severe lack of data discussing the fate of exogenous organics and especially degradation rates, due to ultraviolet and cosmic radiation and chemical processing, resulting in a tremendous gap in our understanding of the organic abundance on Mars. The amount of cosmic pollution can confound current and future plans to detect endogenous organic material that might be evidence for extinct or extant Martian life. Additional studies are much needed to understand both the exogenous and endogenous organic content of the Martian surface, especially in light of future searches for organics on Mars.

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