AOGS 2006

Organics, Oxidants, and the Disequilibrium Chemistry of Mars

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The lack of detection of organics on the surface of Mars by the Viking Life Science Experiments was most likely due to the presence of a powerful oxidant, hydrogen peroxide. Surface oxidants could also shorten the lifetime of the only organic molecule, methane, ever detected on Mars. This would imply a larger source to explain the amount of methane measured in the atmosphere. In this paper we will discuss how conventional photochemistry of the Martian atmosphere is inadequate for explaining the previous and newly observed phenomena on Mars. In particular, we find that triboelectricity generated during the Martian dust devils and storms as well as in normal saltation process can result in electrochemical changes that surpass the role of photochemistry close to the surface, at least locally and perhaps globally. A very large presence of hydrogen peroxide in the surface is expected from such a process, far exceeding any photochemically produced amounts including their diffusion into the regolith [1]. Changes in other molecules such as ozone are also expected due to electrochemistry. The surface oxidants would have the effect of hastening the loss of methane from the atmosphere. We will discuss potential scenarios for producing methane on Mars, including chemical, hydrogeochemical, and biogenic sources, and how they will be modified in view of the possibility of the loss of methane by surface oxidants. Detailed and precise measurements of the composition including key isotopes of the atmosphere, surface subsurface, and the rock samples will be carried out with a GC-MS and a Tunable Laser Spectrometer on the SAM Suite (Sample Analysis at Mars) on NASA's Mars Science Laboratory in order to address the above questions of organics and to study habitability of Mars. References [1] Atreya, S. K., Mahaffy, P. R., Wong, A. S., 2006. Methane and related trace species on Mars – origin, loss, implications for life, and habitability, Planet Space Sci., Special Issue on Mars, in press. See also other recent work cited in this paper.