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Methane on mars: Photochemistry or life?

Photocatalytic reduction of carbon dioxide on montmorillonite and TiO_2 can explain the formation of reduced gases in neutral atmospheres. CH_4 and CO were produced during 365 nm UV irradiation of CO_2 in the presence of HCl. This photocatalytic reaction represents an approximate simulation of the Martian atmosphere. In the first part of this paper, rate constants, external quantum efficiencies and effectiveness of the reduction process are discussed and compared to those estimated on Mars. In the second part, subsequent reprocessing of the $\text{CO} + \text{CH}_4$ and N_2 containing atmosphere (with the corresponding photocatalyst still present) was exposed to shock waves induced by a high-power laser. This simulated a high energy density event (e.g. an asteroid impact) on the surface of an early planet exposed to heavy bombardment by interplanetary matter. In the resulting mixtures, glycine and RNA canonical nucleobases were found. Therefore, this process provides an explanation for the creation of reduced gases and the subsequent formation of simple biomolecules from neutral CO_2 rich atmospheres and also for the origin of CH_4 on Mars. The aim of this work was not to ultimately proclaim that the Earth's early atmosphere was globally reducing. Instead, evidence is presented to support the fact that the conversion of a CO_2 atmosphere to an atmosphere containing CH_4 and CO is possible. This conversion must be considered in models of initial early atmosphere transformations. Therefore, a complete pathway leading from a neutral atmosphere to the formation of nucleobases under early Earth conditions has been demonstrated. Additionally, for the first time, this pathway is discussed in relation to the conditions of Mars upon solar irradiation and upon exposure to shock waves generated by the impacts of asteroids or comets.

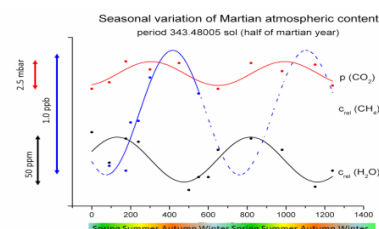


Figure: Seasonal variation of atmospheric pressure: CO_2 content (red), H_2O content (black) and CH_4 content (blue). Data points have been scaled to allow for visual comparison of their fits. The data were obtained by the NASA Mars Curiosity Rover and the OMEGA instrument aboard the Mars Express. Fits in the plot represent only trends in the data.

Biography

Svatopluk Civis had pursued his Doctor of Natural Sciences (rndr.) And Candidade of Sciences (csc.). Charles University, Prague Czech Republic. He was a Professor in Applied physics and Faculty of Nuclear Sciences and Physical Engineering in Czech Technical University in Prague. His experience includes plethora of positions as a chemistry expertise in institutes like J. Heyrovsky Institute of Physical Chemistry and Herzberg Institute of Astrophysics. As being one of the most invited speaker in International Conferences from the past few years, he focuses on improvising his latest discoveries. The research interest mainly encompasses the study on Infrared diode laser and microwave spectroscopy of molecular ions and short lived species. Environmental laser chemistry and Fourier transform spectroscopy.

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