Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11053

Serpentinization and methanation in martian underground like conditions: an abiotic origin for CH_4 on Mars?

MR. VALENTIN M FORTIER[1,2], VINCIANE DEBAILLE[3], VÉRONIQUE DEHANT[1,4], BENJAMIN BULTEL[5,6], DAMIEN P DEBECKER[1], YASUHITO SEKINE[7], SHUYA TAN[8] AND NATSUMI NODA[8]

[1]Université Catholique de Louvain-la-Neuve (UCLouvain)
[2]Université Libre de Bruxelles (ULB)
[3]Université Libre de Bruxelles
[4]Royal Observatory of Belgium (ROB)
[5]Universitetet i Oslo (UiO)
[6]Université Côté d'Azur
[7]Earth-Life Science Institute
[8]Tokyo Institute of Technology

Presenting Author: valentin.fortier@uclouvain.be

On Earth, methane has a strong link with biological activity. First CH_4 detections on Mars in the early 2000's [1-3] have therefore been debated as a potential biotic origin. However, terrestrial CH_4 has also well-known abiotic sources [4] that must be investigated on Mars. Both its arduous detection and the incomplete comprehension of its cycle limit our understanding of martian CH_4 abiotic hypotheses [5]. Based on orbital serpentines detection on Mars [6-7]; the P-T conditions of Mars' underground [8]; and the mafic-ultramafic nature of its crust [9], the main abiotic option would be the combination of two specific reactions.

The first is serpentinization, a water-rock reaction oxidizing iron-bearing silicates such as olivine and pyroxene and reducing the water to form dihydrogen.

The second is the reaction of the so-formed H_2 with a carbon source (CO or CO_2) to form hydrocarbons, thanks to metallic catalysts.

To study the viability of such processes in martian environment, we have performed a series of experiments in martian underground conditions with 2 different setups.

The first one, denoted “Wet”, is a flexible gold-titanium reaction cell [10] focusing on water-rock reactions: mainly serpentinization, but also methanation.

The second, nicknamed “Dry”, focuses on gas-rock interactions: methanation.

Due to the destructive and high consuming nature of those experiments, we have developed and used a shergottite analogue.

Results of those experiments will be presented, including gas (H_2 and CH_4) production capacity; and secondary mineral description by XRD, TG, and SEM analyses. The martian analogue used will also be discussed [10].

References: [1] Formisano et al. (2004), *Science 306*. [2] Krasnopolsky et al. (2004), *Icarus 172*. [3] Mumma et al. (2009), *Science 323*. [4] Etiope and Sherwood Lollar (2013), *Reviews of Geophysics 51*. [5] Atreya et al. (2007), *Planetary and Space Science 55*. [6] Ehlmann B. L. et al. (2010), *Geophys. Res. Lett. 37*. [7] Bultel et al. (2015), *Icarus 260*. [8] Oze and Sharma. (2005), *Geophys. Res. Lett 32*. [9] McSween et al. (2009), *Science 324*. [10] Seyfried et al. (1987), *Hydrothermal Experimental Techniques*. [11] Fortier et al. (2022), *Poster 2221 LPSC2022*.