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Space Biochemistry at the Interface: Interactions Between Biospheres, Geospheres, And Atmospheres Under Planetary Conditions

Space Biochemistry addresses the question of whether and how life exists, or has existed, elsewhere in the Universe, and defines the bio(geo) chemical patterns and processes of life beyond Earth.

The search for biologically driven alterations on Mars and its potential as habitat for past life is a primary aim of current Mars exploration missions. Being a few steps away from retrieving and returning the first Mars samples, we need to gain extensive knowledge how to check them for the traces of life. The analysis of Mars samples can be developed already now based on chemolithotrophic fingerprints left on Martian mineral materials (*e.g.*, Martian meteorites). Chemolithtrophs are rock-eating, mineral-transforming microorganisms, and the most ancient life form expected on early Mars. For the life search on Mars, it is crucial to consider chemolithtrophs in Mars-relevant mineralogical settings. Our recent research on the Noachian Martian breccia NWA 7034 (~4.5 Gyr old Martian meteorite "Black Beauty") delivered a unique prototype of microbial life designed on ancient crustal material from Mars[1]. This life of a pure Martian design is a rich source of Mars-relevant biosignatures. To identify biosignatures which are well preserved under simulated Martian conditions, space exposure experiments are employed outside the International Space Station (ISS).

Outer space along with ground-based space simulating facilities provides a research tool for studying life in the Universe. Series of microbial exposure experiments have been successfully performed on board and outside the ISS under environmental conditions of low Earth orbit or mimicking planetary constraints[2]. Advanced technologies in -omics research offer an integrative program for identifying the components of molecular machinery responsible for a survival of microorganisms during interplanetary journey. Our recent proteotranscriptomic and metabolomic analyses combined with electron microscopy techniques revealed molecular machinery, which elicit microbial survival and adaptation to outer space[3].

Venusian clouds have been proposed as a potential habitable environment due to availability of S/Fe compounds as energy sources, CO_2, moderate temperatures, and favorable pressures. The possibility of Earth-like microbial life in Venusian clouds was suggested long ago and has recently been revived. For life to have evolved and survived, one key requirement is the availability of essential elements and nutrients, *e.g.*, phosphorus. We investigate phosphorus presence in the clouds of Venus and its bioavailability for a potential Venusian cloud biosphere.

By furthering our knowledge of life based on Martian materials and molecular capacities of life beyond Earth, Space Biochemistry facilitates our understanding how biological life can exist beyond Earth and which stable and detectable traces it leaves.

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Merci de nous contacter à l'adresse : cbmsec@cnrs-orleans.fr si vous souhaitez les liens de connexion