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"EXPLORING A NEW WORLD: SEARCHING FOR NEW MOLECULAR INSIGHTS OF HALOARCHAEA WITHIN HALITE FLUID INCLUSIONS ON EARTH AND SPACE"

Abstract

High salt environments are ubiquitous in the solar system (Mars, Enceladus, Europa). On Mars, for example, these environments allow for the formation of evaporites. Those crystals represent a shelter for potential extant microorganisms as it can serve as a radiation shield.

As life on our planet is the only life we know of, this implies working on extremophilic microorganisms to better understand and characterized how life can thrive in such conditions. Halophilic ("salt-loving") archaea including *Halobacterium* have been isolated as "living fossils" preserved in the fluid inclusions of halite crystals (NaCl). Being able to recover archaea from halite is of great exobiological interest as halite crystals have been identified on Mars. The model halophile *Halobacterium salinarum*, have previously shown resistance to several stress factors, including UV-C, gamma irradiation and desiccation, and offers numerous data allowing for detailed "-omics" analysis, thus being an ideal candidate for further analysis. However, much remains unclear concerning the molecular mechanisms under multi-stress conditions, such as combinations of solar irradiations, and the preservation value of evaporites under terrestrial and extra-terrestrial conditions.

This project aims at understanding how *Hbt. salinarum* responds to full-spectrum solar irradiation inside and outside of halite crystals using ground-based solar simulators. Fluorescent markers added to liquid cultures will provide insights on physiological state evolution as well as impacts on their metabolic activity and structural stability. In parallel, TEM/SEM will be used to also provide data regarding radiations effects on cell structure, with particular attention to the cell envelope as it has an exciting potential as biosignature. Ground-based experiment will be compared to real space irradiation as samples will be sent on the exposure platform Exocube, which will be part of the European Space Exposure Platform (EXPO) on the ISS. For the first time, a biological exposure platform will allow for the observation of organisms' responses to the space environment in real time, using fluorescent markers and *in-situ* monitoring technology. Additional post-flight analyses of cellular structures will provide further insights into the preservation of microorganisms within halite inclusions.

Thus, this project aims at determining, on a molecular level, how *Hbt. salinarum* adapts to space-induced multi-stress irradiation, using a new *in-situ* monitoring system on the ISS as well as ground-based experiments. This will allow for a better understanding of how potential halophilic extant life can thrive inside evaporites on other planets. Additionally, post flight cell structure analysis will provide information to help characterize new biosignatures.