EXPERIMENTAL STUDY OF PRESERVATION OF BIOMOLECULES ON THE GEOLOGICAL RECORD WITH APPLICATIONS FOR ASTROBIOLOGY USING RAMAN' SPECTROSCOPIC.

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Introduction: Recently, the Brazilian scientific community has joined efforts to understand the connections of life with the astrophysical environment, its origin and evolution, both on Earth and elsewhere the universe, as in some rocky exoplanets. This new branch of science is named Astrobiology, which is the junction of several traditional areas such as Biology, Chemistry, Physics, Astronomy and Geology, among others, to seek answers to questions that could hardly be answered independently.

From the moment that an organism dies and is buried, the original organic material tends to be lost, being transformed into disorganized forms of carbon, or in some cases, mineralized. Organic molecules derived from the buried body can also be fossilized, sometimes being the only trace of their existence. These are the chemofossils, or biomolecules that after burial and changes imposed by different geological processes exhibit changes in their structure, but also bringing characteristics of the original molecule, such that, in some cases, may contribute with the identification of the organism that originated the molecular signature. Chemofossils are also of interest in astrobiology, since the conditions of fossilization in extraterrestrial environments, similar to what eventually happens on Earth, may have not favored the preservation of the body, but only of its molecules.

And to understand these geological processes of major importance for understanding the evolutionary history of life on our planet and others, studies are being conducted by techniques available in the laboratories of the National Center for Research in Energy and Materials (CPEM), particularly at the Brazilian Synchrotron Light Source (LNLS), and at the Astrobiology Laboratory of the Institute of Astronomy, Geophysics and Atmospheric Sciences, University of São Paulo (AstroLab / IAG-USP). In particular, the Renishaw Invia Raman are being used for the initial characterization of the biosignature resilience.

Materials and methods: We used different substrates like (SiO_2, Al_2O_3, FeO(OH) hydroxide, $CaCO_3$, and simulated soil of Mars (JSC Mars 1A)) mixed with the poly-resistant bacterium *Deinococcus radiodurans*, for the study of the interaction of the biosignature (carotenoids) for the fossilization process.

We set pallets of substrate with bacterium and irradiate in three different environmental conditions in different doses; with solar simulator (UVA / UVB) in ambiental environmental, simulation Mars condictions in the chamber (AstroCam), and UHV in beamline TGM/LNLS. After this differentes simulations of irradiation we used Raman spectrometer with 532 nm and 785 nm to analyze the degradation of the carotenoid.

Conclusion: With theses results it was observed there is a reduction of the carotenoid as a fuction of the dose rate and there are significant differences when the sample is irradiated with different wavelengths (532 and 785 nm). The great importance of this results is associated with the strategies for Mars exploration in the future.

We believe that through a detailed study of fossilization, experimental characterization of different biomolecules, the transformations they suffered after being subjected to different environmental factors (desiccation and high rates of UV radiation), preservation (high pressure and temperature, fluid contact with acids and alkaline) in order to test its capacity to be preserved in the fossil record. It will help to understand the factors that cause chemical changes involved on the formation and preservation of chemofossils.

References:

[1] Parnell, J. et al. (2007) ¨Searching for life on Mars: selection of molecular targets for ESA's Aurora ExoMars Mission¨. Astrobiology,7(4),pp.578-604.