Supporting future "search-for-life" missions: spectroscopy analysis of biosignatures after space and Mars-like environment exposure

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Mars and the Jovian and Saturnian moons (Europa and Enceladus) are the next targets to search for life in our Solar System. New life detection instruments are indeed ready to be sent to Mars in 2020 (onboard ESA/Roscomos's ExoMars2020 and NASA's Mars2020 rovers) and possibly further. Among them, spectroscopy methods such as Raman or infrared are promising techniques that can give insights on both the mineralogical context and the identification of biosignatures.

However, to support and interpret spectroscopic data correctly, as well as to guide future life detection missions, a better understanding of possibly habitable environments and potentially detectable biosignatures is of paramount importance. During the last years extensive field and laboratory investigations focused on demonstrating the capabilities of such technologies to characterize both mineral and biological samples of relevance to Mars but very few assessed potential biosignatures degradation under Mars-like or space-like conditions. To this end we are using samples from ground-based and space exposure experiments, the STARLIFE [1] and the BIOMEX [2] projects, to characterize their Raman and IR signatures after space and Mars relevant stresses. BIOMEX was part of the EXPOSE-R2 mission of the European Space Agency, which allowed a 15-month exposure on the outer side of the International Space Station and STARLIFE is an international campaign to study the role of galactic cosmic radiation in astrobiological systems. A wide range of extremophilic organisms such as cyanobacteria, permafrost green-algae, iron bacteria or methanogens and selected biomolecules exposed under these conditions will help us to define targets for future missions to Mars (and other bodies) carrying Raman, IR or LIBS spectrometers and give further clues about the potential habitability of Mars.

We report, as an example, on the preservation potential of cyanobacterial photoprotective pigments (carotenoids) in the Antarctic cyanobacterium *Nostoc* cf. *punctiforme* strain CCCryo 231-06 after high doses of gamma irradiation and after space exposure [3].

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