

BIOMEX on EXPOSE-R2: First results on the preservation of Raman biosignatures after space exposure

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After a 15-month exposure on-board the EXPOSE-R2 space platform, situated on the outside of the International Space Station, four astrobiology experiments successfully came back to Earth in March and June 2016. Among them, the BIOMEX (BIOlogy and Mars EXperiment) experiment aims at investigating the endurance of extremophiles and stability of biomolecules under space and Mars-like conditions in the presence of Martian mineral analogues (de Vera et al., 2012). The preservation and evolution of Raman biosignatures under such conditions is of particular interest for guiding future search-for-life missions to Mars (and other planetary objects) carrying Raman spectrometers (such as the Raman Laser Spectrometer instrument on board the future ExoMars rover). The photoprotective carotenoid pigments (present either in photosynthetic organisms such as plants, algae, cyanobacteria and in some bacteria and archaea) have been classified as high priority targets for biomolecule detection on Mars and therefore used as biosignature models due to their stability and easy identification by Raman spectroscopy (Böttger et al., 2012). We report here on the first results from the analysis of two carotenoids containing organisms: the cyanobacterium *Nostoc* sp. (strain CCCryo 231-06; = UTEX EE21 and CCMEE 391) isolated from Antarctica and the green alga cf. *Sphaerocystis* sp. (strain CCCryo 101-99) isolated from Spitsbergen. Desiccated cells of these organisms were exposed to space and simulated Mars-like conditions in space in the presence of two Martian mineral analogues (phyllosilicatic and sulfatic Mars regolith simulants) and a Lunar regolith analogue and analyzed with a 532nm Raman microscope at 1mW laser power. Carotenoids in both organisms were surprisingly still detectable at relatively high levels after being exposed for 15 months in Low Earth Orbit to UV, cosmic rays, vacuum (or Mars-like atmosphere) and temperatures stresses regardless of the mineral matrix used. Further analyses will help us to correlate these results with survival potential, cellular damages or stability and the different extremophiles tested in the BIOMEX experiment.

Böttger, U., de Vera, J.-P., Fritz, J., Weber, I., Hübers, H.-W., and Schulze-Makuch, D. (2012). Optimizing the detection of carotene in cyanobacteria in a martian regolith analogue with a Raman spectrometer for the ExoMars mission. *Planetary and Space Science* 60, 356–362.

de Vera, J.-P., Boettger, U., Noetzel, R. de la T., Sánchez, F.J., Grunow, D., Schmitz, N., Lange, C., Hübers, H.-W., Billi, D., Baqué, M., et al. (2012). Supporting Mars exploration: BIOMEX in Low Earth Orbit and further astrobiological studies on the Moon using Raman and PanCam technology. *Planetary and Space Science* 74, 103–110.