

Lichen resistance to extraterrestrial conditions: Viability, ultrastructure and algal growth

Annette Brandt¹, Jean-Pierre de Vera², Elke Rabbow³, Silvano Onofri⁴ & Sieglinde Ott¹

¹*Institute of Botany, Heinrich-Heine University, Düsseldorf*

²*Institute of Planetary Research, DLR, Berlin*

³*Institute of Aerospace Medicine, Radiation Biology Department, DLR, Köln*

⁴*Università degli Studi della Tuscia, Viterbo*

In the Lichen and Fungi Experiment (LIFE) the lichen *Xanthoria elegans* demonstrated considerable resistance to space and simulated Mars-analogue conditions being exposed on the International Space Station. This first European long-term exposure (559 days) of eukaryotic organisms tested their ability to cope with the combined hostile conditions of space and to cope with Mars-analogue atmosphere and insolation.

The samples showed remarkable resistance to the applied conditions, due to symbiotic features and adaptations. The algae resumed photosynthetic activity and both symbionts (photo-/mycobiont) showed high rates of metabolic activity (LIVE/DEAD staining). The results indicated 50 to 80% active algal cells and 60 to 90% active fungal hyphae.

Preliminary simulation studies focussed on viability after UV-radiation considering the protective effect of e.g. secondary lichen compounds. The present study investigated the cellular structural resistance of the anhydrobiotic lichen *X. elegans* after 1.5 years in space. The ultrastructure of the photobiont has been analysed, considering bio-membrane integrity, thylakoid-membranes, symbiotic interfaces and signs of structural damage after irradiation and vacuum effect. The current study focusses on the results obtained by culture experiments, demonstrating the algal growth capacity of the samples of *X. elegans* after being exposed 1.5 years in space.