The Lichens experiment at Foton M-2 mission: Survival capacity in space

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Lichens are one of the most resistant organisms at Earth. They live at very extreme environments: in deserts (Atacama desert), high mountains (Himalaya), Antarctica (Dry Valleys), etc. This is possible due to the symbiotic relationship between both constituents, the algae and the fungui, and to their poikilohidric nature, characteristic that allows them to survive latent when environmental conditions are very extreme, i.e. when UV radiation is very high, temperatures are extreme and dryness exists. If humidity returns and temperature tendencies turn near the optimum (around 10^{o}C), dormant lichens starts to photosynthetice.

We have selected two epilithic lichen species, for the LICHENS experiment which was included at the ESA Biopan-facility, located at the outer shell of the satellite Foton M-2, launched into low Earth orbit the 31th of Mai 2005 from Baikonur (Russia).

On of this species was *Rhizocarpon geographicum*, a bipolar epilithic lichen, which grows at high mountain regions (e.g., Sierra de Gredos, Central Spain) with continental climate, has been systematically studied in the natural environment (Plataforma de Gredos at 2000 m altitude) as well as under simulated space conditions at the space simulation facilities of the DLR. The sensitivity of the photosynthetic system (PSII) to the different environmental conditions (dryness including vacuum treatment, high temperature fluctuations, high UV intensity) was fluorometrically measured with a MINI PAM (Walz, Germany). The lichen *Rhizocarpon geographicum* was extremely resistant to the harsh natural environment of the high mountains as well as to the simulated space conditions. This results were corroborated by the surprising results after Foton M-2 flight, when lichen samples of *Rhizocarpon geographicum* and *Xanthoria elegans* were preactivated at the Eco-Physiology Laboratory of the Universidad Complutense of Madrid, showing a recovery of the photosynthetic activity in 90-100% from the activity registered before flight. Lichens have resist in an optimal form to space vacuum, wide fluctuations of temperatures, the complete spectrum of solar UV light and cosmic radiation during 15 days.

This experiment add new knowledgment to the Panspermia Theory, supporting the possibility of transfer of life between planets. The follow up experiment Lithopanspermia will answer the question if lichens transported by a meteorite can survive the

re-entry conditions into Earth’s atmosphere.