Probing the limits of photosynthesis in the Namib Desert

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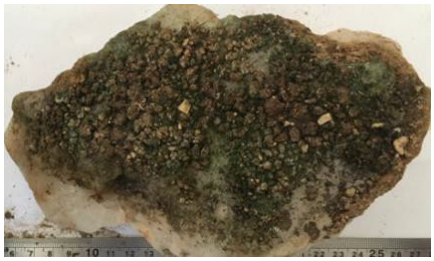

Figure 1. Photograph of a hypolith removed from the desert and turned upside down. Green biomass is composed mainly of cyanobacteria.

Introduction: In hyper-arid soil environments, photosynthetic microorganisms such as cyanobacteria are largely restricted to hypolithic habitats. They occupy the ventral surfaces of translucent pebbles in desert pavements.

Methodology: We combined fluorometric, spectroscopic, biochemical and metagenomic approaches to investigate the light transmission properties of quartz stones in the Namib Desert and to assess the photosynthetic activity of the underlying hypolithic cyanobacterial biofilms.

Results and Discussion: Quartz pebbles greatly reduced the total photon flux to the ventral surface biofilms and filtered out primarily the short wavelength portion of the solar spectrum. Chlorophylls d and f were not detected in biofilm pigment extracts; however, hypolithic cyanobacterial communities showed some other evidence of adaptation to sub-lithic conditions, like the prevalence of genes encoding Helical Carotenoid Proteins, which are associated with desiccation stress. Under water-saturated conditions, hypolithic communities showed no evidence of light stress, even when the quartz stones were exposed to full midday sunlight. This work adds to an understanding of the mechanisms behind the unique robustness of photoautotrophic organisms in extreme environments.

Reference: Gwizdala, M., Lebre, P.H., Maggs-Kölling, G., Marais, E., Cowan, D.A., Krüger, T.P.J., Sub-lithic photosynthesis in hot desert habitats, Environ. Microbiol. 23:3867–3880 (2021) (link)

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