**SUCCESSIOIN AND BIODETERIORATION OF MICROBIOMES ON SIMULATED SANDSTONE BLOCKS AT BEISHIKU TEMPLE, CHINA**

Fasi Wu1\*, Jie Li1, Yong Zhang2, Dongpeng He1, Ji-Dong Gu3, Huyuan Feng2

(*1National Research Center for Conservation of Ancient Wall Paintings and Earthen Sites, Dunhuang Academy, Dunhuang, 736200, Gansu, P.R. China; 2MOE Key Laboratory of Cell Activities and Stress Adaptations, School of Life Sciences, Lanzhou University, Lanzhou, 730000, P.R. China;**3Environmental Science and Engineering Group, Guangdong Technio**n - Israel Institute of Technology, 241 Daxue Road, Shantou, Guangdong 515063, P.R. China)*

\*Corresponding author, E-mail: wufs@dha.ac.cn

**Abstract:**Bioweathering, a critical factor that pose a significant threat to the preservation of Beishiku Temple, which was originally carved during the Northern Wei Dynasty (509 AD) and is located in eastern Gansu province, China. This study analyzes the morphology changes, structural alterations, and weathering potential of microbiomes on fresh sandstone blocks under local environmental conditions through portable microscopy analysis, environmental monitoring, and DNA- and RNA-based MiSeq high-throughput sequencing. The results indicate that bacteria, fungi, algae, lichens can rapidly colonize the surface layer of the simulated sandstone test blocks, leading to biological weathering. Rainfall, light intensity and specific microhabitats (*e.g*. north-facing side) are the key factors influencing biofilm establishment and biomass accumulation. A dynamic succession of microbial communities within biofilms was observed across phyla such as Cyanobacteria, Proteobacteria, Actinobacteria, and Ascomycota. Notably, RNA-based assessments revealed substantial differences in active microbial community composition and abundance compared to DNA-based analyses. Dominant genera including CENA359, norank Chroococcidiopsaceae, *Chroococcidiopsis*\_SAG\_2023, unclassified Verrucariaceae and *Knufia*. Functional prediction by community abundances related to carbon fixation, nitrogen cycling, biofilm formation, lichen symbiosis and oxidative stress tolerant exhibited temporal variability as they adapted to the harsh living conditions on sandstone surfaces, and may change their biodeterioration capabilities. Reducing available water for dwelling microbes may contribute to mitigate bioweathering of stone heritage while enhance conservation efforts.

**Keywords:** Bioweathering, Cave-temples, High-throughput sequencing, Microbial community and function prediction, Cultural heritage conservation

**Acknowledgments**: Longyuan Young Talents Project of Gansu Province (No. 00151); National Youth Top Talent Program of China.