A survey of microorganisms related to the biodeterioration of prehistoric paintings in natural shelters from Aragon (Spain)

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The province of Aragon, on Northeastern Spain, presents an unusual richness of prehistoric paintings spread all over its territory. These paintings correspond to a wide chronological period ranging from the upper paleolithic to the recent prehistoric times. Current initiatives to preserve these shelters for future generations, are focusing on understanding the biogeochemical processes going on at these sites as a necessary step to better preserve these paintings. This study focuses on the microbiology of these shelters.

Molecular methods based on the use of nucleic acids were used to determine the microorganisms inhabitants of these sites. Molecular techniques are culture-independent methods. In this study, molecular techniques based on both DNA and RNA were utilized, so the cells present in these environments as well as the metabolically active microorganisms, respectively, can be differentiated during the experimental procedure.

During this study, diverse microbial communities were detected including a variety of members of different bacterial divisions. Alpha, Beta, Delta, and Gammaproteobacteria, besides Acidobacteria, Actinobacteria, Bacteroidetes, and Planctomycetes were among the bacterial groups detected in these environments. The Gammaproteobacteria were the most abundant bacterial group in most of the collected samples. Communities based on photosynthetic microorganisms such as Cyanobacteria and eukaryotic microalgae have been detected and showed visible colonizations at some areas. The obtained results show a high complexity of the microbial communities present at these shelters. Understanding the functional properties of some of the components of these microbial communities together with the analysis of the environmental characteristics at these sites will contribute to the design of adequate conservation strategies.

Keywords biodeterioration, microbial communities, prehistoric paintings