

## Purple Spots on Historical Parchments: Confirming the Microbial Succession at the Basis of Biodeterioration

**Authors :** N. Perini, M. C. Thaller, F. Mercuri, S. Orlanducci, A. Rubechini, L. Migliore

**Abstract :** The preservation of cultural heritage is one of the major challenges of today's society, because of the fundamental right of future generations to inherit it as the continuity with their historical and cultural identity. Parchments, consisting of a semi-solid matrix of collagen produced from animal skin (i.e., sheep or goats), are a significant part of the cultural heritage, being used as writing material for many centuries. Due to their animal origin, parchments easily undergo biodeterioration. The most common biological damage is characterized by isolated or coalescent purple spots that often leads to the detachment of the superficial layer and the loss of the written historical content of the document. Although many parchments with the same biodegradative features were analyzed, no common causative agent has been found so far. Very recently, a study was performed on a purple-damaged parchment roll dated back 1244 A.D, the A.A. Arm. I-XVIII 3328, belonging to the oldest collection of the Vatican Secret Archive (Fondo 'Archivum Arcis'), by comparing uncolored undamaged and purple damaged areas of the same document. As a whole, the study gave interesting results to hypothesize a model of biodeterioration, consisting of a microbial succession acting in two main phases: the first one, common to all the damaged parchments, is characterized by halophilic and halotolerant bacteria fostered by the salty environment within the parchment maybe induced by bringing of the hides; the second one, changing with the individual history of each parchment, determines the identity of its colonizers. The design of this model was pivotal to this study, performed by different labs of the Tor Vergata University (Rome, Italy), in collaboration with the Vatican Secret Archive. Three documents, belonging to a collection of dramatically damaged parchments archived as 'Faldone Patrizi A 19' (dated back XVII century A.D.), were analyzed through a multidisciplinary approach, including three updated technologies: (i) Next Generation Sequencing (NGS, Illumina) to describe the microbial communities colonizing the damaged and undamaged areas, (ii) RAMAN spectroscopy to analyze the purple pigments, (iii) Light Transmitted Analysis (LTA) to evaluate the kind and entity of the damage to native collagen. The metagenomic analysis obtained from NGS revealed DNA sequences belonging to *Halobacterium salinarum* mainly in the undamaged areas. RAMAN spectroscopy detected pigments within the purple spots, mainly bacteriorhodopsine/rhodopsin-like pigments, a purple transmembrane protein containing retinal and present in Halobacteria. The LTA technique revealed extremely damaged collagen structures in both damaged and undamaged areas of the parchments. In the light of these data, the study represents a first confirmation of the microbial succession model described above. The demonstration of this model is pivotal to start any possible new restoration strategy to bring back historical parchments to their original beauty, but also to open opportunities for intervention on a huge amount of documents.

**Keywords :** biodeterioration, parchments, purple spots, ecological succession

**Conference Title :** ICARCH 2018 : International Conference on Architectural Restoration and Cultural Heritage

**Conference Location :** Venice, Italy

**Conference Dates :** April 12-13, 2018