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### Materials Applications

Microscopy and Microanalysis of an Extreme Case of Salt and Biodegradation in 17th Century Wall Paintings

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### Abstract

The present study characterizes the main deterioration mechanisms affecting the early 17th frescoes of *Casa de Fresco*, the only known example in Portugal of a semi-underground leisure room richly decorated with a balcony over a water well. Frescoes from the vault are at risk due to salt weathering and biodeterioration. The aim of the research was identification of the deterioration materials, determination of their origin, and their effect on the frescoes before future intervention. Scanning electron microscopy with an energy-dispersive X-ray detector (SEM-EDS) was used to determine salt morphology and microanalysis. The mineralogical characterization was performed by X-ray powder diffraction, complemented with  $\mu$ Raman and  $\mu$ Fourier transform infrared spectroscopy. Biological assessment was evaluated with optical microscopy and SEM-EDS. Bacterial and fungal isolation and identification were performed using standard culture media and methods according to *Bergey's Manual of Systematic Bacteriology* and from the *Compendium of Soil Fungi*. The results show that Ca and Ca-Mg carbonates from the paint renderings are the predominant salt species affecting the site. Bacterial strains from the genera *Bacillus* and *Pseudomonas* and fungal strains from the *Cladosporium* spp. and *Penicillium* spp. were isolated in the salt formations, within and between the mortar layers. Azurite, malachite, and small paint layers are the most affected by the weathering conditions.

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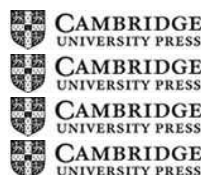
### Key words

mural painting; salts; biodegradation; SEM-EDS; XRD

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