Soluble salts and fungal activity in the decay of the granitic stones from the Cathedral of Lamego (N of Portugal)

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Lamego is located in the Upper Douro Winegrowing Region. The Cathedral of Lamego, dating back to the XII century, is one of the Douro region's most emblematic monuments. It underwent several interventions, thus the variety of architectural styles. Several studies were carried out to assess the causes of the present weathering forms: lithological identification; petrographic and chemical studies; weathering forms; physical-mechanical characterization; ageing tests; fungal isolation and identification by molecular techniques. At least five different granites were used and a petrographic study shows all present some evidence of hydrothermal alteration and also meteoric action, such as the presence of secondary minerals, intercrystal deformations and intra and intergranular fractures. Petrophysics and dynamic characterization confirmed the degree of weathering of all the rocks and allowed the study of their porous network. Several types of weathering forms are responsible for either some significant damage in the masonry or for denigrating their aesthetic and architectural beauty. Cartographic mapping demonstrated biological colonization, dominated by lichens and associated fungi, is the major weathering form, followed by colour changes, patina, black crusts, plates, granular disintegration, black films and fissures. Sampling and correlation with 27 species of lichens identified fifteen fungal species colonizing the monument. A mineralogical and chemical study of weathering forms and soluble minerals revealed the predominance of soluble salts such as gypsum, calcite and halite, and rare sulphate was found, making it also possible to correlate the origin of black crusts and patina with the deposition of pollutants due to the observation of fly ash. The origin of these salts is due mainly to the underground waters that ascend by capillarity through the walls.

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