

## Salt damage of stone, plaster and painted layers at a medieval church, South-Hungary

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The Chapel of Pécsvárad is one of the best preserved and oldest medieval stone monument in South Hungary. It dates back to the 11th century. The interior of the chapel is decorated with wall paintings, which are later and probably originating from the late 12th century. The wall painting is partly preserved and it is located on an interior stone wall of the chapel facing to the East. The wall painting shows various forms of damage from salt efflorescence to chipping. The current research provides information on the in situ and laboratory analyses of salts, plasters, pigments and stone material suggesting mechanisms of decay that lead to partial loss of the painting. Both on site techniques and laboratory analyses were performed. Imaging techniques such as UV luminescence and IR thermography were used to identify the moist and salt covered zones on the wall surface. Portable moisture meter were also applied to map the wet zones in the interior and also at the external part of the chapel. Schmidt hammer and Duroscop were used for testing the surface strength of stone. Laboratory tests were focused on mineralogical and chemical compositional analyses. Small samples of stone, mortar, plaster and pigments were tested by optical microscopy, SEM-EDX, XRD and Thermogravimetric analyses. According to our tests the chapel was predominantly made of porous limestone and sandstone. Laboratory analyses proved that the major salt responsible for the damage of external walls are gypsum and halite, while in the interior part higher amount of halite and significant amount of sodium-nitrate were found besides gypsum. The painted layers are on Byzantine-type of plaster with organic compounds (plant fragments) and with a substrate layer rich in calcium carbonate. The identified pigments are dominantly earth pigments such as iron-oxide containing red and yellow (ochre) and green earth. A unique preservation of ultramarine blue in Hungary was found on the wall painting. The partial damage of the painting is caused by the presence of gypsum and highly hygroscopic salts and also related to the infiltration of excess water via stone wall into the interior part of the chapel.