

## Characterization of soluble salts on the frescoes by Saturnino Gatti in the church of San Panfilo in Villagrande di Tornimparte (L'Aquila)

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During the archaeometric study of the frescoes by Saturnino Gatti in the church of San Panfilo in Villagrande di Tornimparte (L'Aquila), 11 samples of powder and fragments were taken from different panels of the fresco in order to characterize any degradation produced by the presence of salts.

The samples were taken in areas where there were evident detachments, exfoliation and saline crystallization (efflorescences). Precisely, 9 samples were taken from panels A, C, D and E and two samples taken from the top part of the vault.

The characterization of the samples was performed using two analytical methods such as Ion Chromatography (IC) and FT-IR / ATR infrared spectroscopy. Ion chromatography was used for the quantification of the main ions and to evaluate the presence of soluble salts. Measurements of cationic ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  and  $\text{NH}_4^+$ ) and anionic ( $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{Cl}^-$ ) species were performed using an ICS-1000 HPLC system equipped with a conductivity detector. The anion analysis was performed with a column of Ion Pac AS14A using  $\text{Na}_2\text{CO}_3$  8 mM/ $\text{NaHCO}_3$  1mM, flow rate = 1.5 mL/min and for the detection a conductivity system equipped with anionic self-healing suppression ULTRA (ASRS-ULTRA). While, the determination of the cations was carried out using a CS12A column (Dionex) and 20mM of methanesulfonic acid (MSA) as eluent at a flow rate = 1.5 mL/min and for the detection a conductivity system equipped with an ULTRA self-healing cationic suppressor (CSRS-ULTRA).

Infrared spectroscopy has been used to characterize the mineralogical phases. The apparatus used is a Nicolet 380 (Thermo Electron Corporation) instrument coupled with ATR accessory Smart Orbit equipped with a diamond crystal. The spectra have been acquired in the range  $500\text{-}4000\text{cm}^{-1}$  at a resolution of  $4\text{cm}^{-1}$ .

The results indicate that some, but not all, samples show high concentrations of sulfate and calcium, attributable to probable efflorescence consisting of newly formed gypsum. Furthermore, a good correlation between sodium and chloride was observed, indicating the presence of an efflorescence composed of newly formed sodium chloride. The calcite and silicate bands attributable to the substrate were observed by FT-IR and also gypsum bands were highlighted confirming what observed by the IC technique.