

into the samples, they can be exploited to determine and quantify the bulk glass composition.

NRCA returned qualitative information that indicated the presence of Sb, Cu, As, and Pb in the bulk of some samples (Marcucci 2021), whereas PGAA was used to quantify almost all the major and minor components and some trace elements in the bulk.

ToF-ND was used in a complementary way to Raman spectroscopy, to identify the mineralogical phases acting as opacifiers dispersed in the glass matrix.

References

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P-54. FRAGMENTS OF LUXURY: OPAQUE GLASS FROM THE PALACE OF MYSTRAS, GREECE

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The present study focuses on the first study of glass findings from the Palace of Mystras, Lakonia, Greece (via SEM/EDS, Raman spectroscopy and TEM) aiming to determine their raw materials, manufacturing technology and likely provenance. Out of the overall 140 fragments, 9 were either opaque or translucent, with white or red colour. Their date cannot be determined with specificity but has to span between the mid 13th and mid 19th c. AD, the period since the construction of the site and throughout its continuous use as the administrative centre of the Despotate of Mystras.

All white glasses are opacified with calcium antimonate particles of varying size (usually less than 20 µm in diameter). The three white fragments which are opaque present a typical concentration for Na-rich glass. However, the remaining four, all translucent glasses, are K-rich. The very

low content in P and Mg suggests a similar tradition to the bohemian glasses. The two samples of opaque, vivid red glass appear swirled and present strong macroscopic similarities to glass recovered from a post-medieval shipwreck in the northern Adriatic (Garwood, 2017). Based on the SEM/EDS analysis, both samples have similar chemical composition, typical of the soda glass group of the period. FeO concentration is high (approx. 3 wt%), contrary to most published data on red glass, which do not show high levels of iron. The relatively high concentration of PbO and SnO (approx. 3 and 4 wt%, respectively) is common in red glass, since both substances are considered to improve the firing process. Copper was not identified with SEM/EDS or the Raman analysis of undissolved particles. However, through TEM analysis it was possible to identify Cu microcrystals, with a diameter less than 250 nm, which acted as the main colourant of the glasses. Another interesting feature is the significant differences shown in the Raman spectra of darker and lighter areas of the swirled body, offering hints for the production technique of the colouring pattern. Orange and brown areas show a broad band at approx. $940\text{-}970\text{ cm}^{-1}$ (band attributed to lead compounds), whereas the red areas show strong bands at 1355 and 1590 cm^{-1} (attributed to carbon-carbon vibrations in amorphous graphite-like material related to organic compounds).

The site of Mystras presents immense significance as an administrative, commercial and art centre of the late Byzantine and post-Byzantine period. Glass analyses for this period are extremely limited throughout the Balkans, while the present project is the

first analysis of glass from the extended area of Lakonia. Taking also into consideration the well-documented successive construction phases of the various buildings of the Palace, as well as the available information on the use of each building, it is possible to provide with significant insights into the commercial, artistic and technological interactions of Mystras with the Ottoman Empire and Europe.

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