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Hidden colours of Albania: Fresco pigments study from an isolated church in Leshnicë, 18th–19th century

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Abstract

In the 18th and 19th centuries, fresco painting in the Balkans evolved under the influence of political shifts, religious continuity, and cultural exchange. Despite Ottoman rule, Orthodox Christian traditions remained strong, blending with local and folk elements to create a unique artistic language. These frescoes became not only religious symbols but also quiet affirmations of cultural identity and resilience, foreshadowing the region’s modern art movements. Artists primarily used natural pigments like lead white, calcite, and ochre due to their availability and durability, while rare pigments such as azurite and lapis lazuli appeared only occasionally. Although synthetic colors like Prussian blue and chrome yellow spread across Europe in the 19th century, their use in the Balkans remained limited, reflecting regional preferences and the enduring legacy of Byzantine art.

The frescoes in the Monastery of the Presentation of Christ (Ipapandia) in Leshnicë e Sipërme were analyzed in situ using **portable μ -XRF** across **34 points**, revealing that different painters likely worked at different times. The church pigments show distinct elemental profiles tied to their colors, with **Fe-rich ochers** and **Cu-containing greens** being most common. Elevated levels of **Pb**, **Hg**, and **Sb** suggest the use of **hazardous minerals** such as cinnabar, stibnite, or minium, possibly indicating regional practices or environmental contamination. The high antimony content in **red and black pigments** points to the deliberate use of **Sb-rich materials**. Overall, the results reveal complex pigment mixtures shaped by local sources and historical techniques.

Introduction

In 18th-century Europe, fresco art shifted from the dramatic Baroque to the lighter Rococo style, reflecting enlightenment ideals. Baroque focused on movement and divine themes, while Rococo used pastel tones and nature-inspired subjects. The 19th century saw a return to classical clarity with Neoclassicism and emotional, nature-focused works under Romanticism.

In the Balkans, fresco painting remained tied to Orthodox Christian traditions despite Ottoman rule. Byzantine iconography persisted, gradually blending with Ottoman and Western elements. Serbian monasteries like Studenica showed both Byzantine and Renaissance influences, later evolving with national identity. Greek monasteries, especially on Mount Athos, maintained Byzantine traditions with Venetian touches. In Bulgaria and Romania, frescoes gained national symbolism; Rila Monastery depicted saints and history as resistance, while Romanian frescoes blended Byzantine, Renaissance, and Baroque styles, as seen at Voroneț.

Albanian religious art developed a distinct style rooted in **Byzantine tradition**, enriched by regional and Western influences. Despite Ottoman pressure, this iconography endured, using medieval techniques and vibrant earth pigments. From the 17th to 19th centuries, **Orthodox fresco traditions** remained strong.

Balkan artists used traditional mineral pigments; **lead white**, **calcite**, **ochres**, and **expensive blues** like azurite and lapis lazuli for sacred figures. Synthetic pigments (e.g., Prussian blue) appeared slowly due to limited access. **Reds and greens included ochre, cinnabar, malachite, and verdigris**, while **blacks were carbon- or iron-based**.

This paper presents XRF analysis results of frescoes at the **Monastery of the Presentation of Christ in Leshnicë e Sipërme**, using the EXPLORER 5000 device. The frescoes’ authorship remains unknown.

Materials and Methods

The **Monastery of the Presentation of Christ (Ipapandia) in Leshnicë e Sipërme** (fig. 1) consists only of a **naos**. The authorship remains unclear due to the absence of an inscription at the entrance, and there is reason to believe that multiple painters may have worked on the frescoes at different periods.

Materials and Methods



Figure 1: Monastery of the Presentation of Christ (Ipapandia) in Leshnicë e Sipërme.

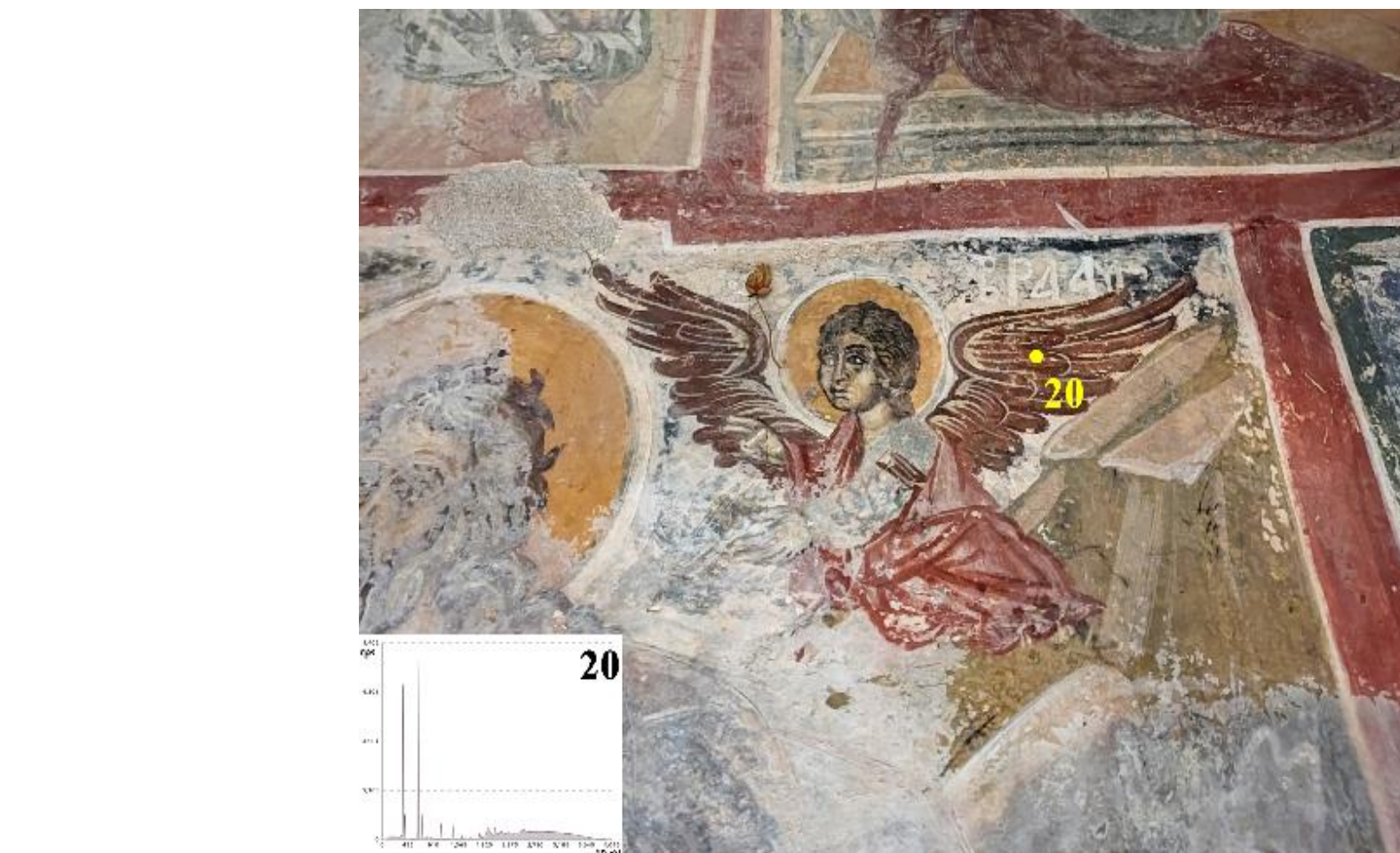
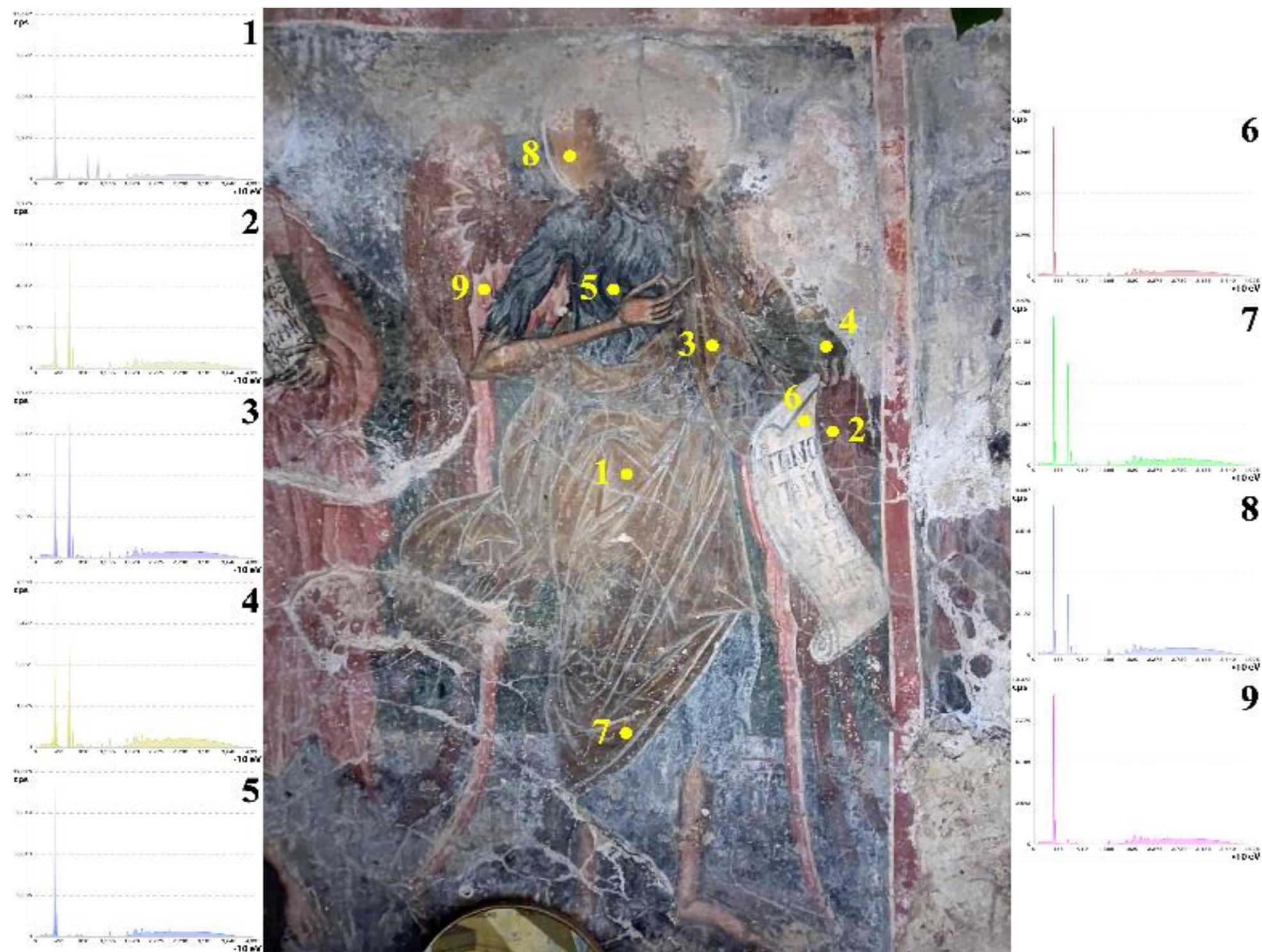


Figure 2: Portable X-ray fluorescence (XRF) Explorer 5000 device.

Fresco pigments in this church were analyzed in situ using the Explorer 5000, a **portable X-ray fluorescence (XRF) device**. This non-destructive tool provides rapid elemental analysis (20–30 seconds) and is effective for detecting heavy metals. Its EDXRF detector operates across a wide temperature range (–10°C to 50°C), making it ideal for fieldwork. While portable XRF offers valuable insights, its **results are semi-quantitative** due to **surface-only analysis, matrix effects, and lack of standardized calibration**. More precise methods like micro-XRF or SEM-EDS were not used, as sampling was not permitted.

Results

For the Monastery of the Presentation of Christ (Ipapandia) in Leshnicë e Sipërme (**34 analyzed points in total**, fig. 3), there is doubt regarding the painters of the frescoes, whether they were created by the same painters during the same period. From the photos, it appears that different painters worked at different times.



Results

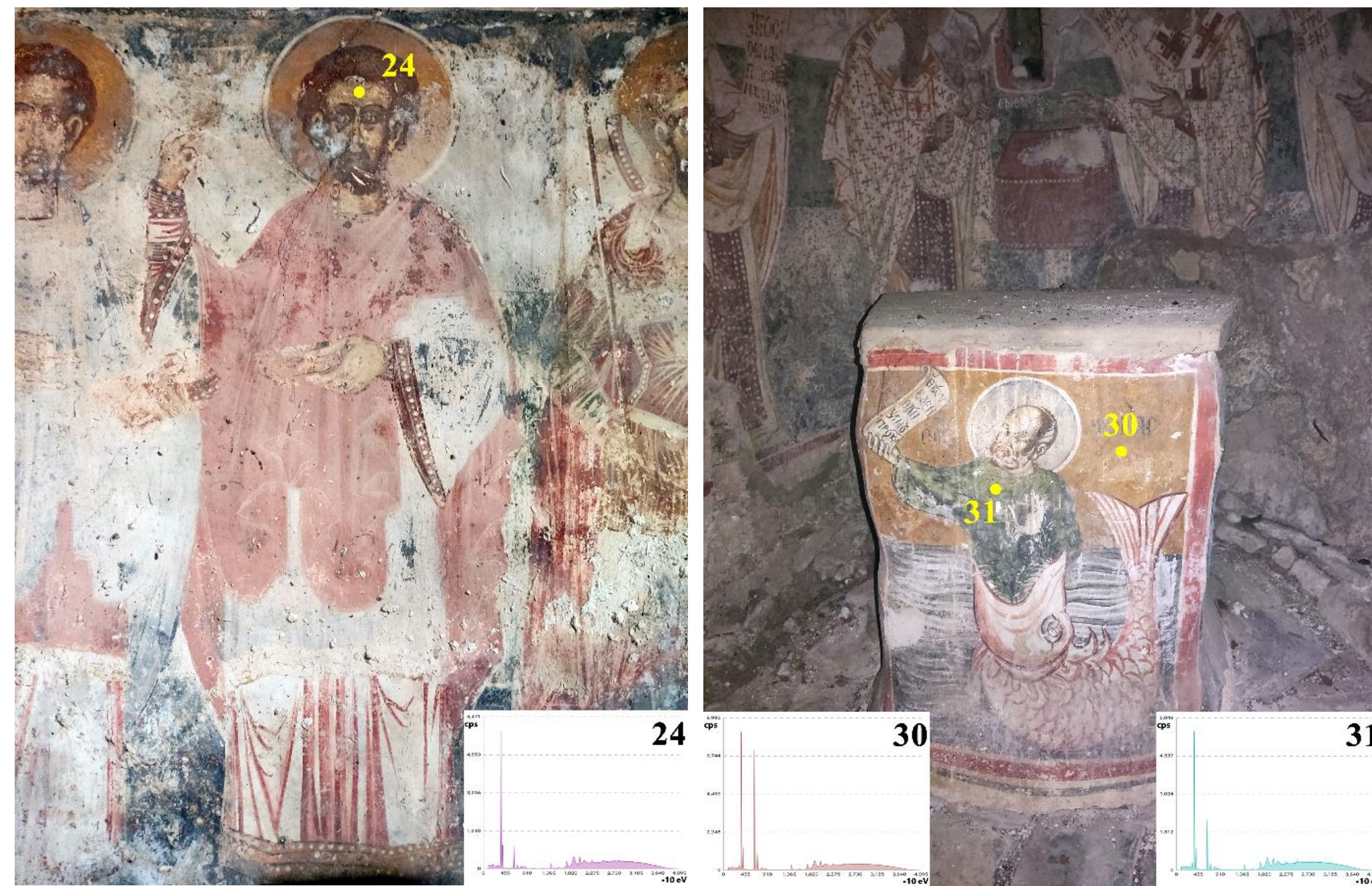


Figure 3: The analyzed points on the frescoes of Presentation of Christ Monastery (Ipapandia) in Leshnicë e Sipërme, along with the corresponding spectra.

The detected elements across all analysis points in the church allowed for the identification of the possible pigments used (see table 1).

Table 1: Detected elements across all analyzed points and the possibly identified pigments.

Pigment	Dominant element	Phase	Secondary element
Ocher (yellow, red, dark)	Fe is the primary component (61%–87%), consistent with natural ochres	Goethite FeO(OH) Hematite Fe ₂ O ₃	Sb (up to 10% in point no 12) likely due to impurities or intentional additives; elevated Pb (up to 5.4% in point no 20) and Hg (up to 1.6% in point no 33), suggesting possible use of lead-based or mercury-based compounds (e.g., minium Pb ₃ O ₄ or cinnabar HgS mixtures)
Green	Fe remains high (62%–83%), but with notable Cu (up to 4.4%)	Verdigris Cu(CH ₃ CO ₂) ₂ ·(H ₂ O) Malachite Cu ₂ (CO ₃)·(OH) ₂ Terre verte K[(Al,Fe ₃),(Fe ₂₋₄ ,Mg)](AlSi ₃ Si ₄)O ₁₀ (OH) ₂	Zn (up to 2.2%), Pb (up to 1.9%) possible contaminations or impurities; Sb (up to 9.8% in point no 32) unusually high, possibly from stibnite (Sb ₂ S ₃)
White	Fe is present (65%–83%), but with lower heavy metals	Lead-white 2PbCO ₃ ·Pb(OH) ₂ Fe-rich clays or lime might be present	Hg (up to 3.8%) possible contamination from adjacent cinnabar (HgS) use; Sb and Pb (less than 1%) trace amounts possibly from processing tools
Black	High Fe (64%) and elevated Sb (10.3% in point no 5)	Stibnite (Sb ₂ S ₃)	Sn (up to 7%) may indicate cassiterite (SnO ₂)

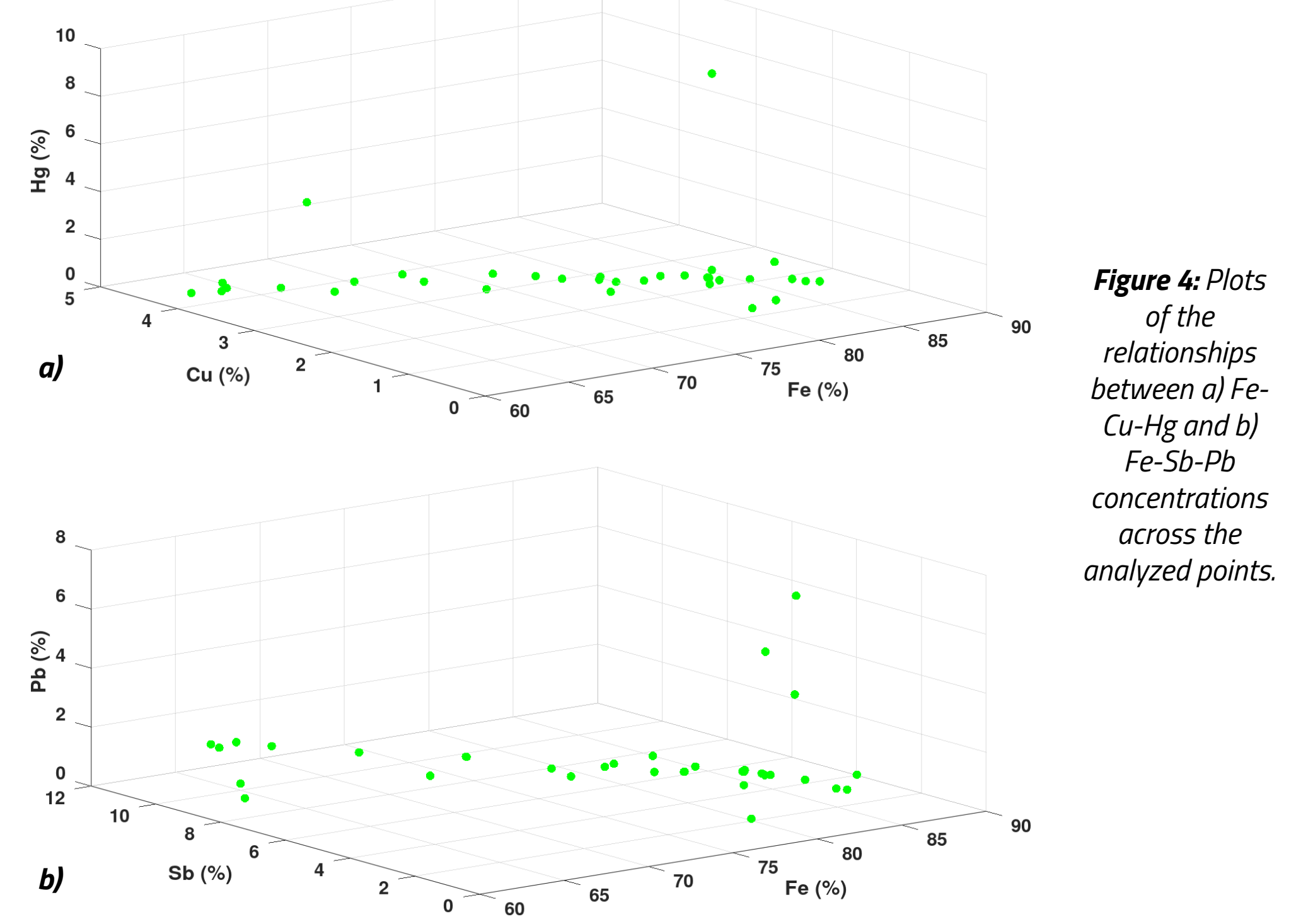


Figure 4: Plots of the relationships between a) Fe-Cu-Hg and b) Fe-Sb-Pb concentrations across the analyzed points.

Results

Pigment analysis of the Ipapandia Monastery frescoes reveals varied elemental compositions tied to color. Ocher pigments are **Fe-based (61–87%)**, with red ocher showing high **Sb (~10%)** and dark ocher containing **Pb (up to 5.4%)** and **Hg (up to 1.6%)**, likely from minium or cinnabar. Green pigments include **Fe**, **Cu (up to 4.4%)**, and **Zn**, pointing to verdigris or green earth. White pigments lack **Pb** and are **Fe-dominant**, while one black sample shows elevated **Sb (10.3%)**, suggesting use of stibnite. **Toxic elements (Hg, Pb, Sb)** appear across samples, reflecting deliberate pigment use or contamination.

Stylistic and chemical differences suggest multiple painting phases by different artists or workshops. Variations in materials and technique indicate evolving practices and regional influences, highlighting the church’s layered artistic history and its significance in **southern Albania’s religious art**.

Conclusion

The analysis of pigments from the Monastery of the Presentation of Christ (Ipapandia) in Leshnicë e Sipërme reveals a diverse and complex use of materials, with **Fe-based compounds** forming the core of most colorants, particularly in **ocher (yellow and red)**, **green**, and **white pigments**. The presence of **Sb**, **Pb**, and **Hg** in several points, especially **red, dark ocher**, and **black** suggests the use of toxic mineral additives such as **stibnite (Sb₂S₃)**, **cinnabar (HgS)**, and **lead oxides (Pb₃O₄, PbO)**, either intentionally or through contamination.

The varied elemental compositions indicate a combination of locally sourced materials and possibly imported pigments, reflecting nuanced artistic practices or regional traditions. The identification of atypical elements like **Sb** in high concentrations also points to unique formulations that may be tied to specific historical or cultural contexts. Overall, these findings underscore the complexity and specificity of pigment preparation in the site’s artwork, offering insights into both the materials technology and the environmental history of the monument. The Church of the Ipapandia Monastery in Leshnicë reveals a layered artistic history, marked by multiple painting phases and diverse contributors. Variations in style and pigment composition suggest that original frescoes were later altered or supplemented by different artists using distinct techniques and materials. The selective use of **cinnabar, antimony**, and **lead** further supports this, pointing to changes in sourcing and artistic practice over time.

Together, these findings underscore the church’s significance as a testament to the evolving traditions and regional influences in **southern Albanian clerical art**.

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