
SINOPIA UNDERDRAWINGS AND PIGMENT MIXTURES AS EVIDENCE OF COMPLEX WALL PAINTING PRACTICES AT COLONIA DACICA SARMIZEGETUSA

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ABSTRACT:

To date, evidence of decorative wall painting from the former Roman province of Dacia remains scarce, and the fragmentary condition of the surviving examples has long hampered efforts to reconstruct local decorative practices. This paper re-examines a group of wall painting fragments recovered from the *Domus Procuratoris* area at Colonia Dacica Sarmizegetusa, building on recent physico-chemical analyses. The evidence reveals a structured and technically sophisticated painting process, including *sinopia* preparatory sketches, optical underlayers, and complex pigment mixtures that combine common earth pigments (*colores austeri*) with costly imported materials such as indigo or lead-based pigments. These technical features attest to a multi-stage and highly organized approach to wall painting, carried out by skilled artisans familiar with advanced techniques used in central imperial workshops. Although modest in scale and preservation, the technical details identified in these fragments illuminate workshop practices, and the social role of mural decoration in elite provincial settings.

REZUMAT: SINOPIA DESENE SUPRAPUSE ȘI AMESTECURI DE PIGMENȚI CA DOVEZI ALE PRACTICILOR COMPLEXE DE PICTURĂ MURALĂ LA COLONIA DACICA SARMIZEGETUSA

Până în prezent, dovezile privind pictura decorativă murală din fosta provincie romană Dacia sunt extrem de puține, iar conservarea fragmentară a acestora a îngreunat semnificativ studiul practicilor decorative în regiune. Acest articol reexaminează un grup de fragmente de pictură murală recuperate din zona *Domus Procuratoris*, Colonia Dacica Sarmizegetusa, valorificând rezultatele unor analize fizico-chimice recente. Datele obținute evidențiază un proces pictural structurat și tehnic sofisticat, care include schițe pregătitoare de tip *sinopia*, straturi optice intermediare și amestecuri pigmentare complexe ce combină pigmenți obișnuiți de pământ (*colores austeri*) cu materiale costisitoare de import, precum indigo sau pigmenți pe bază de plumb. Aceste caracteristici tehnice atestă o abordare multi-etapizată și riguros organizată a picturii murale, realizată de meșteri pricepuți, familiarizați cu tehnici avansate utilizate în atelierele centrale din imperiu. Deși modeste ca dimensiune și stare de conservare, detaliile tehnice identificate în aceste fragmente oferă informații valoroase despre practicile atelierelor și despre rolul social al picturii murale decorative în mediile provinciale de elită.

KEYWORDS: Roman wall paintings, painting technique, sinopia, undercoating, pigment mixture

CUVINTE CHEIE: pictură murală romană; tehnică picturală; sinopia; strat preparator; amestecuri de pigmenți

Introduction

Roman wall paintings hold invaluable cultural and historical significance. More than simple decoration, they reflect social status, cultural identity, and artistic innovation, offering unique glimpses into Roman life¹. These artworks combine aesthetic refinement with complex technical practices, making them one of the most compelling expressions of Roman artistic achievement. Decorative wall painting schemes adorned both public monuments and private residences across the empire, often serving as markers of wealth, education, and social status. In well-studied regions such as Italy, numerous examples of preserved murals have allowed scholars to reconstruct stylistic developments, workshop practices, and even aspects of daily life². A substantial body of research now exists on the materials, techniques, and iconography of Roman wall painting, especially at major sites like Rome and Pompeii³.

¹ Pappalardo 2009.

² Ling 1991.

³ Salvadori and Sbrolli 2021.

Similar studies have been undertaken in other provinces, including Spain, France, and northern Italy, providing a rich comparative framework for understanding Roman decorative traditions. The picture changes dramatically, however, when we turn to the empire's frontier provinces, such as Dacia, where studies are far fewer and the evidence is much more fragmentary.

Dacia – roughly corresponding to modern-day Romania and parts of Serbia – was conquered by Rome in 106 CE and abandoned in 271 CE. As the only province entirely north of the Danube, Dacia held a strategic position, controlling access to valuable resources, including gold, and acting as a defensive frontier. In contrast to other Roman provinces, Dacia has very few preserved examples of Roman wall paintings⁴. This scarcity can be attributed to several factors, including environmental and burial conditions, recovery methods, incomplete surveys, and, importantly, cultural and functional differences.

To date, only a few examples of preserved Roman wall paintings have been found, with most discoveries limited to isolated finds. These recovered fragments are typically associated with richly decorated villas (*domūs*) belonging to high-ranking officials or members of the provincial elite, with notable examples from Apulum⁵, Colonia Dacica Sarmizegetusa⁶, and, more recently, Rapoltu Mare – La Vie⁷. Wall paintings connected to public buildings are much rarer, with discoveries so far limited to the Roman amphitheater at Porolissum⁸, and the baths at Alburnus Maior⁹ and Apulum II¹⁰. While evidence of Roman mural painting in Dacia remains fragmentary and scattered, these sites demonstrate that such decorations were present in elite structures and public buildings. However, their relative scarcity and scattered preservation underscore Dacia's understudied and fragile mural heritage compared to other Roman provinces.

The relatively short Roman occupation, followed by episodes of conflict, abandonment, and later reuse of building materials, meant that many decorated structures were rapidly destroyed or dismantled. Plaster fragments were often removed or repurposed, leaving little in situ evidence of once-elaborate interiors. Culturally, mural painting in Dacia appears to have been a specialized and limited practice, primarily associated with elite contexts such as villas, administrative buildings, and public baths. Unlike the western regions of the Roman Empire, where wall painting was a long-standing and widespread tradition, in Dacia this artistic practice was less common. Historical sources suggest that skilled craftsmen were brought in from other provinces to execute commissions for high-ranking officials and wealthy patrons, rather than relying on local workshops¹¹. As a result, large-scale mural production was relatively rare, and more modest houses were often finished simply with plain whitewashed walls, leaving fewer traces for archaeologists to uncover.

Against this challenging and complex research background, recent studies of wall painting fragments from Colonia Dacica Sarmizegetusa – the provincial capital and one of the most important urban centers in Roman Dacia – have provided rare and valuable insights¹². Analysis of some of these fragments has revealed two particularly significant features: traces of *sinopia* – red ochre preparatory sketches beneath the pictorial layers – and the deliberate mixing of pigments, sometimes including costly or imported materials such as indigo. These findings, though indirect, offer valuable clues to the existence of elaborate polychrome mural schemes that no longer survive in situ. The presence of *sinopia* points to a carefully planned creative process, while the complex pigment mixtures suggest a sophisticated approach to color, shading, and visual effects. Together, they provide a window into the technical skills of the craftsmen, the ambitions of their patrons, and the broader cultural exchanges that influenced artistic production in a frontier province.

This article examines the historical significance of these discoveries by situating them within the broader context of Roman wall painting traditions. Drawing on both archaeological remains and ancient literary sources, it explores what these technical findings reveal about workshop practices, the transmission of artistic knowledge, and the role of mural painting in expressing social and cultural identities in Roman Dacia.

⁴ Olteanu 2022.

⁵ Boroș 2003.

⁶ Țentea and Olteanu 2018, 2020.

⁷ Barbu et al. 2016.

⁸ Boroș and Duca 2008.

⁹ Țentea 2015.

¹⁰ Ciobanu 2005.

¹¹ Ciobanu 2011; Ling 1991.

¹² Cortea et al. 2024.

Archaeological context and investigated samples

Founded shortly after the Roman conquest of Dacia in 106 CE, Colonia Dacica Sarmizegetusa was the first Roman city established north of the Danube and served as the provincial capital and administrative hub throughout the second and third centuries. The city controlled access to important communication routes and oversaw the exploitation of the region's valuable resources. As the seat of the provincial governor, it functioned not only as a political and military center but also as a symbol of Roman authority and urban life in the newly conquered territory¹³.

Archaeological investigations at the site have a long history, with the earliest excavations dating back to the nineteenth century¹⁴. Over time, systematic research has revealed a well-planned Roman city, complete with temples, fora, baths, an amphitheater, workshops, and elite residences. Despite its prominence, painted wall decoration is rare at Colonia Dacica Sarmizegetusa, and evidence has so far been limited to two major contexts, both associated with high-status residences (*domus*). Previously documented fragments of painted plaster were unearthed during excavations conducted between 1984 and 1986, in an area identified as the *Domus Procuratoris* – the residence the procurator of the province, one of the highest administrative officials in the province¹⁵. A second, more extensive discovery was made during systematic excavations between 2008 and 2011, in the central part of the city, close to the two imperial fora¹⁶. Archaeological research undertaken in this area have resulted in the discovery of an edifice that preserved large areas of decorative polychrome paintings. Three main phases of this important edifice have been identified: the first two pertain to the residence of a high-rank official, while the third phase is a temple dedicated to Palmyrian deities, reflecting the cultural presence of Palmyrene archers who had been brought to Dacia during the reign of Emperor Hadrian. Remarkably, portions of painted plaster were preserved in situ, with some sections surviving to a height of 80–100 cm. Numerous additional fragments were recovered from collapse layers and rubble, providing a substantial dataset for studying the decorative schemes of the building. When considered together, the discoveries from the *Domus Procuratoris* (1984–1986) and from the central area near the fora (2008–2011) demonstrate that, although surviving evidence is limited, wall painting traditions were present in Roman Dacia. Both contexts are closely connected to high-ranking administrative residences, underlining the role of wall painting in expressing status, power, and Roman cultural identity in the provincial capital.

This paper focuses on fragments discovered during the 1984–1986 excavations at the *Domus Procuratoris*. A recent interdisciplinary study¹⁷ carried out on several of these fragments provided detailed data on the pigments, stratigraphy, and painting techniques. In this paper, we build on those results, by interpreting selected technical characteristics in their historical context, offering new perspectives on the complexity of mural painting traditions in Roman Dacia.

Although relatively small, the investigated fragments display well-preserved pictorial layers, in some cases with multiple superimposed applications of paint. A variety of chromatic shades have been preserved, including red, pink, yellow, green, purple, blue, brown, and black, often appearing in subtle variations of hue. Macroscopic observations identified residual pigment traces that point to a broader and more intricate color scheme than what is visible today, implying that much of the original decoration has been lost. In certain fragments, for example, small blue and yellow pigment grains remain visible on the surface. These are interpreted as the remnants of an upper painted layer that was once applied over a light-green background but has since been lost due to degradation over time.

The scientific analyses identified several remarkable features. In some fragments, the presence of red *sinopia* was observed beneath the pictorial layers, providing direct evidence for preparatory sketches used to plan the compositions. Equally noteworthy is the discovery of an optical blue undercoat, a sophisticated technique used to enhance the vibrancy and depth of overlying pigments. In addition, multiple fragments displayed complex pigment mixtures, combining earth pigments with costly imported materials such as lead-based pigments and indigo. Taken together, these findings – explored in greater detail in the following sections – offer indirect yet compelling evidence of highly skilled craftsmanship and elaborate decorative schemes that once adorned the elite residences of Colonia Dacica Sarmizegetusa.

Red *sinopia* – presence of underdrawings

The recent analysis of the *Domus Procuratoris* wall painting fragments identified red *sinopia* beneath the pictorial layers, visible in the cross section of several samples. In mural painting terminology, *sinopia* refers to a preparatory

¹³ Piso 2001.

¹⁴ Piso and Țentea 2025.

¹⁵ Daicoviciu and Alicu 1984; Piso 1993.

¹⁶ Piso and Țentea 2011.

¹⁷ Cortea et al. 2024.

sketch executed on the plaster surface prior to the application of the final paint layers. These underdrawings were typically made with a brush using red ochre or, less commonly, carbon black or other pigments. Their purpose was to map out the composition, defining the scale and placement of figures, architectural elements, and decorative motifs before more detailed work began¹⁸.

The term *sinopia* has a dual meaning, referring both to the reddish-brown pigment typically used for these sketches and to the underdrawings itself. The name derives from the ancient city of Sinope, located on the Black Sea coast (modern Sinop, Turkey), which was renowned in antiquity as a major source of high-quality red ochre pigments¹⁹. According to historical sources, the finest grades of this pigment were traded widely throughout the Greek and Roman worlds and were even sold under seal to protect against adulteration, becoming known as “sealed Sinope”²⁰. Over time, the term came to be applied more broadly to similar earth pigments and, eventually, to the sketches produced with them.

Sinopias were usually executed quickly and with simple, fluid strokes to outline the overall layout of the composition. These initial sketches rarely matched the final outlines precisely, as adjustments were often made during later stages of execution. In complex figurative scenes, additional details could be traced over the first sketch, either with the same pigment or with alternatives such as carbon black. While most *sinopias* were monochrome, consisting solely of red ochre, there are known examples of polychrome sketches²¹, especially in mosaic preparation, where multiple colors were used to indicate different elements of the design. Their presence reflects a systematic and hierarchical painting process, in which preliminary planning was essential, especially for complex or large-scale compositions. As noted in previous studies, the use of *sinopia* is well documented at sites such as Pompeii and Herculaneum, where entire underdrawings have been preserved beneath detached frescoes²². However, examples from the provinces are extremely rare. The identification of *sinopia* at Colonia Dacica Sarmizegetusa is therefore particularly significant. To date, no other confirmed examples of this practice have been documented in Roman Dacia, making this the first direct evidence of preparatory sketches in the province’s mural painting tradition. Their presence demonstrates that the wall paintings of the *Domus Procuratoris* were carefully planned, and that the painters employed standardized, highly skilled methods, likely drawing on techniques transmitted from more central workshops. The use of *sinopia* implies that the artists were skilled painters, likely trained outside the province, working under the patronage of high-ranking officials who commissioned elaborate decorative schemes for their residences.

The presence of *sinopia* layers is fragmentary but unambiguous. Despite the small size of the preserved mural fragments, they clearly indicate that the painters employed sophisticated preparatory practices consistent with elite Roman traditions. Their presence beneath the painted layers confirms that the wall paintings followed a multi-step process, beginning with schematic planning, followed by application of undercoats, and culminating in complex polychrome surface decoration as discussed in the following section.

Pigment mixtures and optical effects

Following the preparatory stage evidenced by the *sinopia* traces, the next phase in the execution of the murals from the *Domus Procuratoris* reveals an equally sophisticated understanding of color layering and pigment behavior. The most recent study²³ identified complex pigment mixtures, including an optical blue undercoat (a mix with a blue appearance, not a true-blue pigment), which together demonstrate that the painters at Colonia Dacica Sarmizegetusa actively manipulated color to achieve luminous and visually dynamic effects. These findings offer rare insight into the painter’s working methods, highlighting their technical expertise and aesthetic intent within a frontier provincial context.

Among the most striking findings is the identification of an optical blue underlayer beneath the top paint layers in one of the analyzed fragments. This underlayer, composed of calcite mixed with carbon black and iron-based pigments, was found below a bluish-green surface paint layer likely made from green earth (celadonite) mixed with Egyptian blue and yellow ochre (goethite). Such underlayers are known to intensify the visual impact of the colors above, a practice well attested in ancient sources. Egyptian blue, in particular, has a relatively low tinting strength and benefits considerably from being applied over a blue or blue-grey ground, which deepens its tone and

¹⁸ Salvadori and Sbroli 2021.

¹⁹ Asscher et al. 2024; Ling 1991.

²⁰ Thompson 1956.

²¹ Piovesan, Maritan, and Neguer 2014.

²² Clarke 2013.

²³ Cortea et al. 2024.

prevents the underlying white plaster from washing it out²⁴. When spread directly onto a white substrate, Egyptian blue can appear pale, whereas a darker blue-grey base produces a more saturated and luminous hue. Roman artists employed the same strategy with other colors as well: for instance, red paint layers were frequently laid over a yellow ground, and in the case of cinnabar, this helped achieve a vivid, intense orange-red while using only a thin layer of the expensive pigment²⁵. Such evidence demonstrates that Roman painters possessed a sophisticated understanding of optical effects, using a relatively limited palette to create remarkable depth, brilliance, and variety in their decorative schemes.

The same analytical study²⁶ revealed a series of pigment mixtures, often combining common earth pigments with more costly or imported materials such as lead-based pigments and indigo. The analyses revealed that the painters skillfully expanded the color palette through deliberate pigment manipulation. The chromatic variety was achieved by mixing, diluting, or concentrating pigments, and by modifying grain size, particularly in the case of red ochre. Compared to previously studied wall painting fragments from the region²⁷, the fragments from the *Domus Procuratoris* display a greater diversity of pigment mixtures.

Several distinct chromatic strategies could be identified. Pink hues were produced through the admixture of red ochre and lime white. The light green hues were produced by mixing green earth with small amounts of Egyptian blue and yellow ochre, while purple shades were likely obtained through combinations of indigo, carbon black, and a lead-based pigment. Light blue tones appear to result from mixtures of lazurite, calcite, and possibly indigo, whereas dark brown shades derive from iron-rich ochres blended with carbon black. As noted in ancient written sources concerning wall painting technique²⁸, the addition of carbon black not only modified hue, but also increased opacity when combined with more translucent earth pigments. Similar mixtures are described for underlayers beneath cinnabar or red lead, suggesting that such preparatory paint layers may once have been present in the original decoration, though now lost due to fragmentary preservation.

Conclusions

The fragments from the *Domus Procuratoris* at Colonia Dacica Sarmizegetusa currently provide the strongest evidence for technical complexity in Roman mural painting in Dacia. They reveal a structured and technically advanced artistic process – from preparatory sinopia sketches to layered undercoats and refined pigment mixtures – demonstrating the painters' high level of technical expertise and their ability to manipulate materials to achieve specific chromatic and visual effects. Such complex technical features have not been observed in previous studies of mural fragments from the region, suggesting that the decoration of this residence may have occupied a special artistic and social category within the provincial context, although the current picture is undoubtedly influenced by uneven preservation and the limited scope of past investigations.

The technical choices demonstrate both aesthetic intent and advanced material knowledge, while also reflecting the patron's wealth and ambition. According to historical sources, only the elite could afford elaborate wall paintings in expensive colors, with the household itself responsible for supplying such rare materials. It is therefore highly plausible that these fragments derive from some of the most finely decorated rooms of the *Domus Procuratoris*, where colored grounds, optical effects, and meticulous layering were deliberately employed to enhance the visual impact of interior spaces.

Although modest in scale and preservation, the surviving fragments clearly point to the work of skilled artisans employing methods consistent with those of imperial workshops elsewhere in the Roman world. Their careful planning, controlled execution, and deliberate color strategies suggest that the original decorative schemes were far more elaborate and visually ambitious than the surviving fragments alone imply. Even in the absence of large mural surfaces, the evidence reflects a complex artistic culture in which wall painting played a significant social and symbolic role in elite provincial settings. These findings underscore the importance of continued interdisciplinary research to recover and interpret the fragile mural heritage of Roman Dacia.

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²⁴ Pye 2000.

²⁵ Bearat 1996.

²⁶ Cortea et al. 2024.

²⁷ Cortea et al. 2020, 2021; Ion et al. 2022; Filip et al. 2025.

²⁸ Rackham 1938.

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