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Pastiglia relief and sgraffito: a study of the polychromy on a late Medieval English alabaster altarpiece

Pastiglia e esgrafitado: estudo da policromia de um retábulo medieval tardio inglês em alabastro

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Abstract

English late medieval alabaster altarpieces and fragments of such, are preserved in many countries in Europe. Scientific examination of the polychromy on alabaster carvings has provided new information about materials and painting techniques employed. The elaborately polychromed wooden frameworks of this type of altarpieces remain unstudied so far. Only a few original frameworks are preserved intact, amongst these one belonging to the Passion altarpiece from the convent of Reynistaður, now kept at the National Museum of Iceland. The article presents the results of the examination and analysis executed on selected features of the polychromy on this altarpiece. A sgraffito décor mimicking chain mail on the alabasters is shed light on, as well as sgraffito and pastiglia décor on the framework. Light microscopy, XRF and analysis of cross sections with SEM-EDS, Micro Raman and ATR-FTIR provide insight into the production of this group of works and the employed pigments and binders.

KEYWORDS
Late medieval
England
Altarpieces
Alabaster
Polychromy
Material analysis

Resumo

Os retábulos e fragmentos de retábulos medievais tardios ingleses em alabastro estão preservados em vários países europeus. A caracterização analítica da policromia destes alabastros tem contribuído com novas informações sobre os materiais e as técnicas de pintura utilizadas. No entanto, a policromia complexa das molduras em madeira destes retábulos continua por estudar. Apenas algumas molduras originais se mantêm intactas, entre as quais uma pertence ao retábulo da Paixão do convento de Reynistaður, atualmente no Museu Nacional da Islândia. Este artigo apresenta os resultados de exame e análise realizados sobre características particulares da policromia deste retábulo. Destacam-se a decoração em esgrafitado que imita a cota de malha nos alabastros, bem como a decoração em esgrafitado e pastiglia na moldura. A microscopia, o XRF e a análise de seções transversais com SEM-EDS, Micro Raman e ATR-FTIR contribuem para a compreensão da produção deste grupo de obras, assim como dos pigmentos e aglutinantes utilizados.

PALAVRAS-CHAVE
Medieval tardio
Inglaterra
Retábulos
Alabastro
Policromia
Análise material

Introduction

Altarpieces with carved and polychromed alabaster panels inserted into wooden polychromed frameworks from late medieval England were sought-after in the fifteenth and early sixteenth century. These were usually rectangular triptychs which could be closed by folding their lateral sections over the centre. The most common types of such altarpieces were *Passion* cycles or cycles of the *Life of the Virgin*, however, there were also cycles dedicated to other Christian saints. English late medieval altarpieces are distinctive in appearance, not only due to the late Gothic style in which they were carved, the composition of the narrative scenes, their iconography, but also in the way the framework and alabaster carvings were polychromed.

Examples of English late medieval alabaster altarpieces, series of alabaster panels, or fragments of such, are preserved in many countries in Europe [1-2]. Recent research seeks to reassess their significance within the corpus of preserved late medieval cultural heritage [3-6]. Furthermore, the study of their polychromy using scientific examination methods has provided valuable new information about materials and painting techniques employed [7-9]. The elaborately polychromed wooden frameworks, however, have remained unstudied so far. The frameworks enclosing the carved alabaster panels are often lost or heavily affected by damage, alterations, overpaint, or deterioration of painting materials. Only a few original frameworks remain intact. These exhibit pastiglia and sgraffito décor including gilded and coloured bands with patterns and floral motifs, which appears to be typical of frameworks in English late-medieval alabaster altarpieces.

A substantial number of English late medieval alabaster altarpieces or fragments of such are preserved in Iceland. Among the Icelandic corpus, the seven-panelled *Passion* altarpiece from the convent of Reynistaður stands out. It is dated to the second half of the fifteenth century and is now kept at the National Museum of Iceland, Reykjavik (Figure 1a). It has a well-preserved polychromy which appears to be without secondary additions. What is more, almost the entire framework is in place.

The study seeks to contribute to research on English alabaster altarpieces by focusing on the polychromy on the framework. In addition, a sgraffito décor mimicking chain mail is examined on the alabaster reliefs. The latter has been documented by the authors in earlier research and will be put into a broader context by comparing it with other (late medieval) polychrome sculpture [7-9]. The study of the polychromy of the altarpiece of Reynistaður may add insight about English alabaster altarpieces especially but seeks also to contribute to the discussion of late medieval polychromy more generally.

In the following section the altarpiece of Reynistaður will be viewed within the corpus of preserved altarpieces in Iceland and introduced with respect to its motifs, stylistic features and condition. The next part features a short description of the analytical instruments used for examination and analysis of the altarpiece's polychromy. The representation of chain mail on the alabaster carvings is the topic of the subsequent section. In the concluding remarks, the authors relate their findings to other English late medieval sculptures. In addition, connections are drawn between the polychromy on the framework and that on the alabasters, providing insight into the production of this group of works.

Figure 1. Reynistaður altarpiece, National Museum of Iceland inv. no. 1064, dated second-half 15th century: *a)* alabaster reliefs mounted in a wooden polychrome framework, 195 × 59 × 6 cm; *b)* detail (yellow square) of the alabaster panels depicting *The Entombment*, *The Resurrection and St Paul*.

The Reynistaður altarpiece

Cheetham's survey of preserved English alabaster altarpieces, conducted in 1984 and 2003 respectively and Nordal's study on the Icelandic corpus from 1985, catalogued a total of seven multi-panelled altarpieces. The altarpieces from Munkaþera and Reynistaður and the Trinity triptych from Selardalskirkju have their original wooden frameworks in place, while Holar, Þingeyrar, Möðruvellir and Kirkjubær have undergone varying degrees of alteration. From Hítardalur, alabaster carvings of a five-panelled altarpiece are preserved without a framework. Most alabaster altarpieces preserved in Iceland are now kept at museums such as the National Museum of Iceland in Reykjavik (Reynistaður, Hitardalur, Kirkjubær, Hvanneyri), the Museum of Akureyri (Möðruvellir), the National Museum of Danmark (Munkaþvera). The only exceptions are the altarpieces of Holar and Þingeyrar, which are still in their respective churches. In addition to these altarpieces, there are single panels or sequences of a few panels surviving which derive from English late medieval alabaster altarpieces (e.g. three panels from

Staðarfell and fragments of four panels from Hvanneyri), all now kept at the National Museum of Iceland.

The Reynistaður altarpiece was, like several of the altarpieces preserved today, originally located in the convent at Reynistað, which was founded in 1295. According to the Icelandic art historian Bera Nordal, the Reynistaður altarpiece it is not mentioned in the church's liturgy from 1525 [10]. She concludes that it was most likely first imported to Iceland after that year or after the Reformation, when against the backdrop of violent iconoclasm in England, many Catholic altarpieces were either destroyed, hidden, or exported to other countries [10-11]. The altarpiece depicts seven narrative scenes from the Passion of Christ, flanked by figures of the apostles Saint Peter and Saint Paul. The altarpiece is 195 cm wide, 58 cm high and 5 cm deep (interior). It is however missing its original top horizontal frame member and is believed to have been approximately 1 cm higher. While the carvings may not represent the finest examples of preserved English alabaster, the altarpiece is noteworthy because it seems to have preserved all its original elements without later additions. The only modification is that the original framework has been mounted in a new wooden supporting framework tightly fitted to the original. There are substantial damages to both the alabasters and the original framework. The framework is missing the cresting; only small parts are preserved on the left part of the triptych. The middle part of the triptych is also missing the boards above the canopies. The alabaster panel depicting *The Bearing of the Cross* and *The Deposition* both have a damaged corner, while from *The Crucifixion* only fragments are preserved. Saint Paul to the right is missing both his head and the alabaster canopy above. Most of the canopies are heavily damaged or only small fragments remain. The canopy above Saint Peter seems to be intact, while the canopy above *The Bearing of the Cross* shows only minor damage.

The alabaster canopies are partially polychromed, which is typical for English alabaster altarpieces from 1460-1500 [3] (Figure 1a-b). The underside of the canopies is painted in red or blue and decorated with painted ornamentation, while the carved Gothic tracery above is mostly left unpainted apart from minor elements which are painted blue, red or are gilded. On the narrative panels the figures' garments and flesh colour are left unpainted, apart from some detailing like gilded buttons, gilded hemlines and blue or red lining on garments. The backgrounds, however, are densely polychromed from top to bottom and create a contrast to the unpainted white alabaster figures. As it is typical for English alabasters, the gilded background with round dots and the so-called daisy pattern on the green ground fill the entire space, enhancing the whiteness and lustre of the carved stone figures and providing rich embellishment. The hair of holy figures is gilded, and the faces of bad characters are painted with flesh colour and dark facial features. Objects which are important for the identification of the biblical scene or figures' attributes are polychromed, not with one single colour, but with different types of patterns or ornamentation. The column Christ is tied to in *The Flagellation* is marbled in a simple but effective way in dark purple on pink ground; Christ's cross is boldly veined using bright red colour on a light-yellow ground. Christ's tomb is painted pink and adorned with dark blue leaf-ornaments, while its profiles are contrastingly gilded or painted dark red. This effect also applies to minor objects and characteristic features of the figures. The angels' wings, halos and swords are painted red or blue and decorated with patterns in white and gilded details. Another rather laborious polychroming technique is the sgraffito technique employed to represent the armour of soldiers depicted in *The Betrayal* and *The Resurrection*. The soldiers wear suits of armour with tippets made of mail in either green or dark red colour. The latter appears darkened and discoloured today. In a later section we will take a closer look at the chain mail décor.

Methods

Portable micro X-Ray Fluorescence (μ-XRF)

For the preliminary examination of the Reynistaður altarpiece, non-destructive analyses with handheld μ-X-Ray Fluorescence Analysis (μ-XRF) were employed. Such analyses provided information on the paint stratigraphy, preliminary evaluation of paint materials and applied painting techniques, suggesting what could be important insights about the sampling areas. The XRF analyser used was a Thermo NITON XL5 plus handheld XRF (Thermo Fisher Scientific, Oslo, Norway) equipped with an extra large area silicon drift detector (1μm graphene window). Since the nature of the substance was unknown before the measurements, the proprietary "Mining Cu/Zn Testing Mode" was used. This mode one allows to detect the largest range of elements. Total measurement time was approx. 120 s for each zone and the instrument switched automatically from main (Al/Fe filter, potential: 50 kV, maximum current: 40 μA), low (Cu filter, potential: 20 kV, maximum current: 100 μA) to high (Mo filter, potential: 50 kV, maximum current: 40 μA) and light range filters. The data were collected and organised using the Niton Connect 7.1 computer software by Thermo.

Cross-sections

Altogether seven material samples were taken from the Reynistaður altarpiece. Three of these were taken from decorated stiles on the framework, the bands of gilded pastiglia décor, and the bands with red and green sgraffito décor, respectively. Another four samples were obtained from the green and red sgraffito décor mimicking chain mail on the alabaster panels *The Betrayal* and *The Resurrection*. The material samples were mounted in a mounting medium of synthetic resin (Technovit 2000 LC) and sanded with increasing grain size (220-8000).

Light microscopy

Dark field reflected light photomicrographs of the cross-sections were acquired on a Nikon Eclipse Ci POL microscope (Nikon Corporation, Tokyo, Japan) equipped with different lenses (4×, 10×, 20×, 40×, 60×). Visible and UV light were respectively provided by a 50 W (12 V) halogen lamp provided by built-in ND4 filters. Photomicrographs of the cross-sections were taken with a Nikon DS-Fi3 (Nikon Corporation, Tokyo, Japan) microscope digital camera (equipped with a 5.9 megapixels CMOS image sensor for high-resolution imaging, up to 2880 × 2048 pixels) and processed with the NIS-Elements Advanced Research software by Nikon.

Scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM-EDS)

SEM-EDX analyses were performed on all the cross-sections using a FEI Quanta 450 Scanning Electron Microscope (Thermo Fisher Scientific, Waltham, MA, USA) coupled with an Oxford X-MaxN 50 mm^2 detector, using low vacuum mode to avoid charging. Measurements were carried out at 20 kV accelerated voltage, a pressure of 40 Pa and a working distance of 10 mm.

Micro Raman

Raman spectra were collected using a confocal Raman micro-spectrometer system (InVia Renishaw, Renishaw, Wotton-under-Edge, UK). A grating of 1800 lines was used with a spectral resolution of 2 cm^{-1}. The excitation wavelength adopted for analyses was a diode laser at 785 nm. Spectral collection was achieved with a 50× objective (Leica) with a spatial resolution of the order of 3 μm. The acquisition time was 30 s with 10 accumulations. Laser power on the sample was around 1 mW. Spectra were collected using the Wire 4.2 software provided by Renishaw. Raman spectra were plotted and baseline corrected adopting the Origin Lab 2017 software. Raman spectra were gained for all layers on the cross-section of the green chain mail décor on the alabaster carvings and the pastiglia décor on the framework. In addition, ground layer and mordant were analysed with Micro Raman on cross-sections on the sgraffito décor

on the framework. Also, for the mordant in the cross-section of the red chain mail a Raman spectrum was collected.

Micro Fourier-transform infrared spectroscopy (μ-FTIR)

Micro Fourier-transform infrared spectroscopy (μ-FTIR) was undertaken using a Thermo Fisher iS50 Nicolet Continuum FTIR microscope equipped with a liquid N_2 cooled MCT-A detector. Loose paint samples (of the order of μm) were analyzed by μ-transmission FTIR using a diamond compression cell. This method was employed for the analysis of mordant (layer 1) and top layers (layer 3) on samples of red and green chain mail on the alabaster carvings. 100-250 scans were collected at 4 cm^{-1} resolution across 4000 to 650 cm^{-1}. Data were processed with Spectrum 5.1 software.

A representation of chain mail

On the alabaster panels from the Reynistaður altarpiece, the impression of chain mail is generated by a pattern of interlocking semicircles which cover the surface of the soldiers' tippets (Figure 2). Studying the pattern up close reveals that this décor is made using a sgraffito technique as specified by Rolf E. Straub, as a decoration technique applied not only on murals, but also on panel paintings, for example in the imitation of precious textiles [12, pp 229-230]. For sgraffito on panel painting "fine hatchings, as well as ornamental and fine figurative drawings or letters are scraped out of a layer of paint over burnished metal leaf using a sharpened wooden stick." [12, p. 229] Cennino Cennini describes such a technique in his *Libro dell'arte o trattato della pittura* of 1417 (Chap. CXL, p. 87) as does the Montpellier *Liber diversarum arcium*, dated around 1400 (Chap. xiii, §2.13.1A, p. 142) [13-14].

In our late fifteenth century example from England, the uppermost paint layer has been removed in the shape of semicircles and the metal leaf underneath exposed. Analysis of cross-sections gave information about the stratigraphy in this type of décor (Figure 3 and Figure 4). For both the red and the green chain mail, an orange-coloured first layer was applied directly to the surface of the alabaster stone. Raman spectra of this layer show typical bands for red lead (Figure 3c), while μ-FTIR analyses made it possible to determine that the pigment is bound in a natural drying oil. Such results identify the gilding in this décor as a mordant gilding. Alabaster presents an excellent ground for painting, and paint-layers or mordants are usually applied directly to the smoothed stone surface without a preceding application of a ground layer. A second layer follows, made of metal leaf, while the third and last layer is a paint layer, which is then locally removed to expose the metal leaf underneath. EDS maps showed that silver leaf was applied as second layer in the red chain mail, while for its green counterpart, EDS maps showed the presence of both gold and silver, indicating the presence of so-called part-gold (Figure 4d). According to Nadolny "part-gold was formed by beating a layer of gold and a thicker layer of silver together until a leaf of much the same thickness as gold leaf (between 0.25-5 μm) was obtained." [15, pp. 159-160] Micro-FTIR analyses of the red top-layer characterising the red mail, would indicate the presence of the organic lake pigment cochineal carmine bound in a drying oil (Figure 5a). The μ-FTIR spectra of the green mail, evidences instead presence of the pigment verdigris also bound in a natural drying oil (Figure 5b). Micro-FTIR spectra of the cochineal lake show the typical bands of carminic acid [16]. In addition, the band located at 1707 cm^{-1} might indicate the presence of kermesic acid [16]. However, it is very difficult to confirm the presence of kermesic acid based only on FTIR bands, since the same band may also relate to the carboxylic acids of the drying oil in which the organic lake is bound [17]. The early dating of the cochineal and the possible presence of both carminic and kermesic acids could indicate cochineal from Eastern Europe, the so-called "Polish cochineal" or "Old World cochineal" as Bucklow calls it [18-20]. Cochineal carmine from America was only introduced to Europe after the discovery of Mexico in the 1520s. To date, only one instance of kermes carmine has been

identified on English alabaster carvings, namely the late fourteenth century Kettlebaston panels at the Victoria and Albert Museum. On these panels the organic lake pigment, kermes carmine was detected in a mixture with lead white in a pink paint layer [8]. Polish cochineal was more expensive than kermes and the later American cochineal [21].

Figure 2. Reynistaður altarpiece. Detail of soldiers with tippets of green and dark red chain mail on panel depicting *The Resurrection* (Figure 1b).

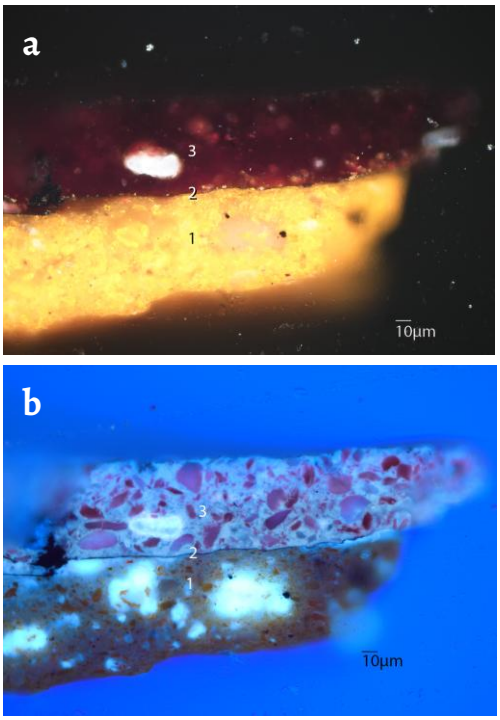

Figure 3. Cross-section of red chain mail 40× objective: *a)* Vis-light and *b)* UV light: layer 1: mordant pigmented with red lead and possibly a red bole in oil, layer 2: silver leaf, layer 3: paint layer pigmented with organic lake pigment cochineal in oil; *c)* Raman spectrum of red lead in layer 1.

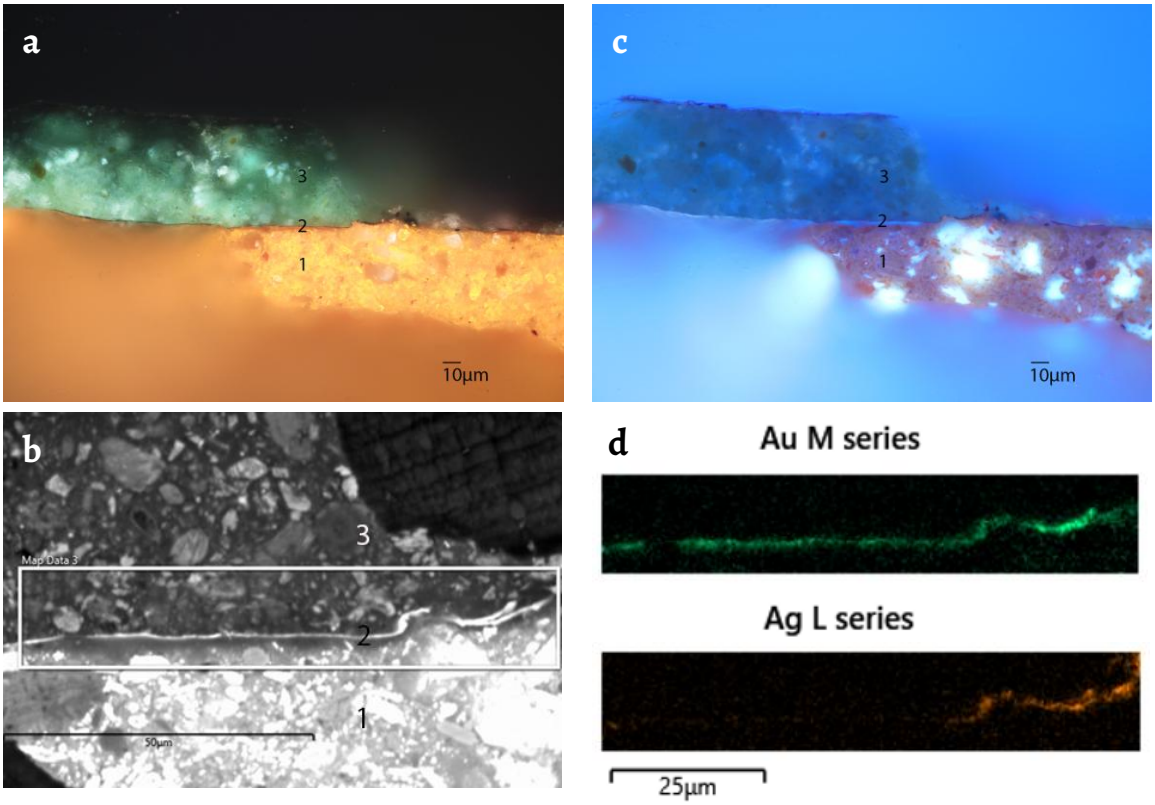

Figure 4. Cross-section of green chain mail, 40× objective: *a)* Vis-light: layer 1- mordant pigmented with red lead and possibly a red bole in oil, layer 2- part-gold leaf, layer 3- paint layer pigmented with verdigris in oil; *b)* UV light; *c)* BSE image; *d)* EDS maps of the elements Au and Ag in layer 2.

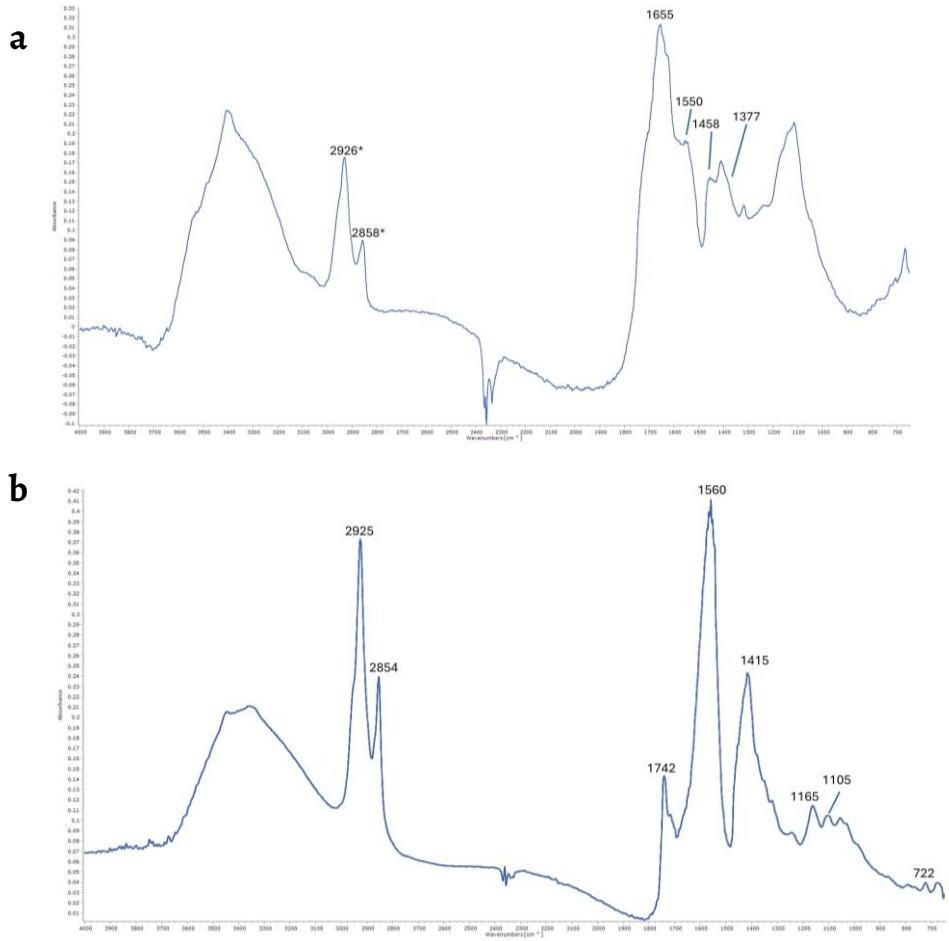

Figure 5. Micro-FTIR spectra: *a)* layer 3 on red chain mail showing typical bands for carminic acid (cochineal); *b)* top layer on green chain mail showing characteristic bands for verdigris in oil.

Figure 6. Details of chain mails: *a)* in sgraffito technique, *The Betrayal* panel (Trondheim, Norway, church of Lade); *b)* Rabastens altarpiece, *Christ before Pilate* (Toulouse, France, Musée des Augustins), *c) The Resurrection*, late 15th century, (Nantes, France, Musée Dobrée) (photography b and c: Markus Schlicht); *d)* tippet painted on gold leaf, *St George and the Dragon*, 1370-1420, alabaster, English provenance (Washington D.C., USA, National Gallery of Art, Samuel H. Kress Collection) (photography: National Gallery of Art); *e)* generated by using tin-relief technique, Tomb of Sir Edmund Crouchback Earl of Lancaster, knight in trefoil north side, 1296-1301 (Westminster Abbey) (photography: Helen Howard, Dean and Chapter of Westminster Abbey); *f)* carved, Tomb of Sir John Swinford, d. 1370-71, alabaster (Spratton Northhamptonshire, Church of St Andrew) (photograpy: Spratton Local History Society).

A similar sgraffito technique in green colour is used on the English alabaster carvings from the same period preserved in the church of Lade, Trondheim (Figure 6a). On the Lade alabasters the incised semicircles are accompanied by dots, but paint cross-sections show a similar stratigraphy as the Reynistaður alabasters including an orange layer containing yellow ochre mixed with red lead applied to the alabaster surface, followed by a metal leaf and a verdigris-pigmented oil bound paint layer in which the pattern was drawn by uncovering the metal leaf underneath with a pointed object [22]. However, for the green chain mail décor on the Lade alabasters, silver leaf was used instead of the part-gold detected at Reynistaður.

On the Reynistaður panel depicting *The Betrayal* two soldiers wear tippets of green mail, while the one grasping Christ's cloak has a tippet of red mail. This corresponds to the finds on the alabaster carvings from the church of Lade. It has previously been discussed whether the alternative colour could be a means to enhance this soldier's importance to the biblical narrative [22]. However, the *Resurrection* scene in the altarpiece of Reynistaður altarpiece depicts a total of four soldiers, where two have green tippets and the other two red ones. In this case the red mail does not seem to be used to make the soldiers stand out, rather the alternating colour may be seen as another element which contributes to creating a strikingly playful polychromy. This is mirrored in the variation between red and green sgraffito décor on the stiles of the middle

section of the framework. Alternating between areas or decorations in red and green is a frequent feature of English medieval polychromy. The background of the painted Saints on the Westminster retable may serve as an example, as well as the two-coloured columns dividing the Thornham Parva retable into sections, as well as the backgrounds to the Saints on some of the church screens in East Anglia [23].

Other examples of comparable patterns and techniques may be seen on the soldiers' tippets in the altarpiece from Rabastens kept at the Musée des Augustins, Toulouse, and an alabaster panel at the Musée Dobrée, Nantes (Figure 6b-c). These English late medieval alabaster reliefs show evidence of a similar repeating interlocking pattern but have so far not been analysed. It remains uncertain whether a sgraffito technique was used.

Similar patterns may be observed on fourteenth century English alabasters by De Beer; a sculpture depicting St George and the Dragon, now kept at the National Gallery in Washington, D. C. (Figure 6d), and two alabaster panels deriving from altarpieces: *The Betrayal*, from St Peter and Paul Church, Hawkley, Hampshire and *The Resurrection* now kept at the British Museum, London [4, p. 167]. On the sculpture of St George, the mail is golden, with semicircles which seem to be painted in a light, perhaps white colour on top of the gilded surface. Comparing these examples with our late fifteenth century sgraffito chain mail, there is not only a difference in technique, but also in style: The chain links of St George's mail are painted rather flat and not arranged in an interlocking manner. Nevertheless, as with Reynistadur and Lade, the impression of mail is created by a repeating pattern of curved lines.

Other representations of chain mail include the effigy of Edmund Crouchback (1245-1296), Earl of Lancaster and his wife Aveline de Forz at Westminster Abbey (Figure 6e). The tomb was erected between 1296 and 1301. On Sir Edmund's tippet a pattern of interlocking semi-circles has been generated using the tin-relief technique [24]. In addition, on the tomb's frieze of knights, chain mail is painted on silver leaf [24]. On the Tomb of Sir John Swinford of Spratton (ca. 1340-1371) in the Church of St Andrew in Spratton, a similar pattern of many small interlocking semicircles has been carved directly into the alabaster stone (Figure 6f) [3].

From these rather labour-intensive representations of chain mail, we can reason that portraying the armour of knights and soldiers was considered worth some effort. This is not surprising since armour may imply high status, as in the case of Sir Edmund Crouchback's and Sir John Swinford's tombs, or act as visual aid in the identification of military characters in narrative scenes, such as the Passion cycles. The different techniques that were employed in these few examples from the fourteenth and fifteenth century is evidence of the creativity employed in the representation of this feature.

Décor on the framework

The stiles dividing the Reynistaður altarpiece into sections housing one narrative panel each, had oak chamfers attached. These are richly ornamented in different decorative techniques (Figure 7). First, a red ground was applied across the chamfers, which provides a surface suitable for gilding by covering the porous wood and producing an evenly absorbing surface. At the bottom and on the top, the chamfers were highlighted by a narrow band painted in bright red. Based on μ-XRF analyses the paints in these areas might contain vermilion and realgar (or orpiment). In between the red bands the chamfers were adorned with alternate bands of gilded relief décor and sgraffito décor. None of the decorated bands look exactly the same, which indicates that the motifs were created free-hand. The chamfers flanking the raised central scene depicting *The Crucifixion* display bands of gilded, dark red or green décor, while the lateral chamfers are confined to gilded and dark red décor. The dark red colour has become matted and appears discoloured, however in areas where the red has spilled over on the adjacent gilded area, it has a red appearance. The upper part of the vertically dividing stiles are rendered contrastingly with a "Barber's Pole" décor. Here diagonally painted stripes of green and red

alternate with areas where silver leaf underneath was left exposed. The silver leaf has tarnished and now has a dark grey appearance. The chamfers flanking the saints were adorned with a simpler painted décor (Figure 1b). Bunches of three-lobed stylised leaves in white and yellow were painted freehand on a blue ground. On this décor μ-XRF measurements were carried out. The results point to the presence of an organic dye for the blue ground, perhaps indigo, but they also suggest the possible presence of lead white, orpiment and possibly vermilion for the painted leaves.

Figure 7. Detail of Reynistaður altarpiece, décor on framework flanking *The Crucifixion*. In the middle section alternate red and green sgraffito décor with gilded pastiglia décor. On the sides red sgraffito décor alternates with gilded pastiglia décor.

Bands of pastiglia relief

Details and cross-section of the bands with gilded relief décor are given in Figure 8e-f. First a red layer has been applied to the framework, then drops and lines of fluid white ground followed to create decorative patterns and motifs. During sampling the first red layer proved strongly bonded to the framework and is therefore, unfortunately, not present in the cross-section. Due to the missing first layer, the numbering of layers in the cross-section starts at 2. Layer 1 is visible in photographs of the décor in areas where the white droplets have come off the ground (Figure 7). Subsequent layers must have been applied after the fluid ground had hardened. Another layer of red paint followed covering the entire band (layer 3), before the orange layer was applied (layer 4) and finally the metal leaf (layer 5). Although the motifs in the relief décor are repeating, none of them look exactly the same, meaning the white droplets were likely applied free-hand, probably with a brush. According to publications by Peter Tångeberg, Manfred Koller and Jilleen Nadolny this technique can be described as a freehand pastiglia technique, where traditionally fluid ground was applied to a ground layer for the creation of decorative patterns and motifs [15, 25-26]. Like Sgraffito décor, pastiglia relief was often used to mimic valuable goldsmith works or textiles. While Tångeberg and Nadolny concentrate on medieval examples of the use of this technique, Koller uses the term in a broader sense and includes examples from later centuries, including when the ground is oil-bound. Freehand pastiglia must be differentiated from pre-produced cast relief.

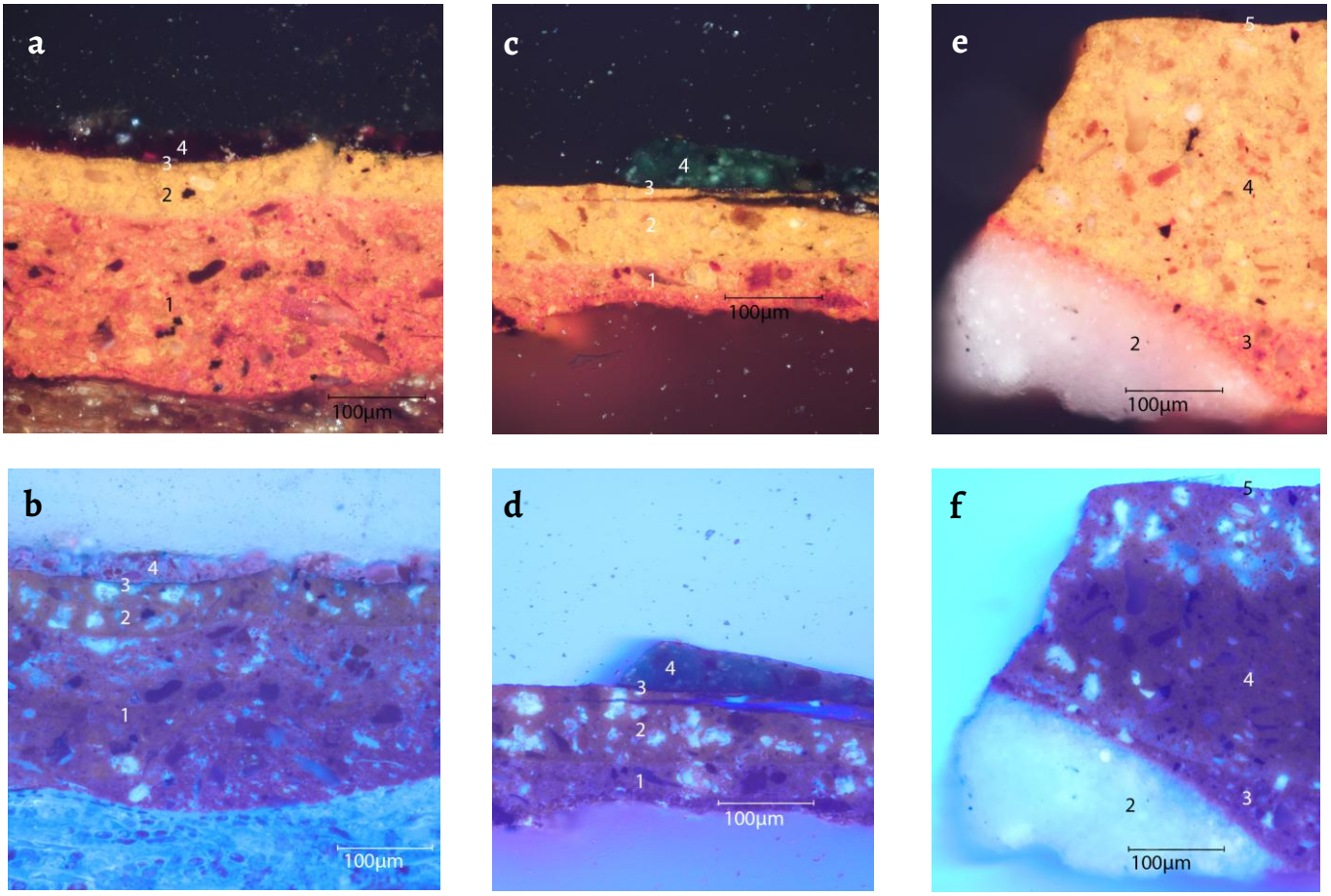

Figure 8. Cross-sections of the polychromy on the stiles dividing the framework into sections (all 20× objective): *a)* dark red sgraffito décor in VIS light: layer 1 - red ground layer of red lead and likely a red bole in oil, layer 2 - orange mordant pigmented with red lead and possibly a red bole in oil, layer 3 - silver leaf, layer 4 - dark red top layer of cochineal in oil; *b)* dark red sgraffito décor in UV light; *c)* green sgraffito décor in VIS light: layer 1 - red ground layer of red lead and likely a red bole in oil, layer 2 - orange mordant pigmented with red lead and possibly a red bole in oil, layer 3 - part-gold leaf, layer 4 - green top layer of verdigris in oil; *d)* green sgraffito décor in UV light; *e)* gilded pastiglia décor in VIS light, layer 2 - white chalk drop, layer 3 - red ground layer of red lead and likely a red bole in oil, layer 4 - orange mordant pigmented with red lead and possibly a red bole in oil, layer 5 - gold leaf; *f)* gilded pastiglia décor in UV light.

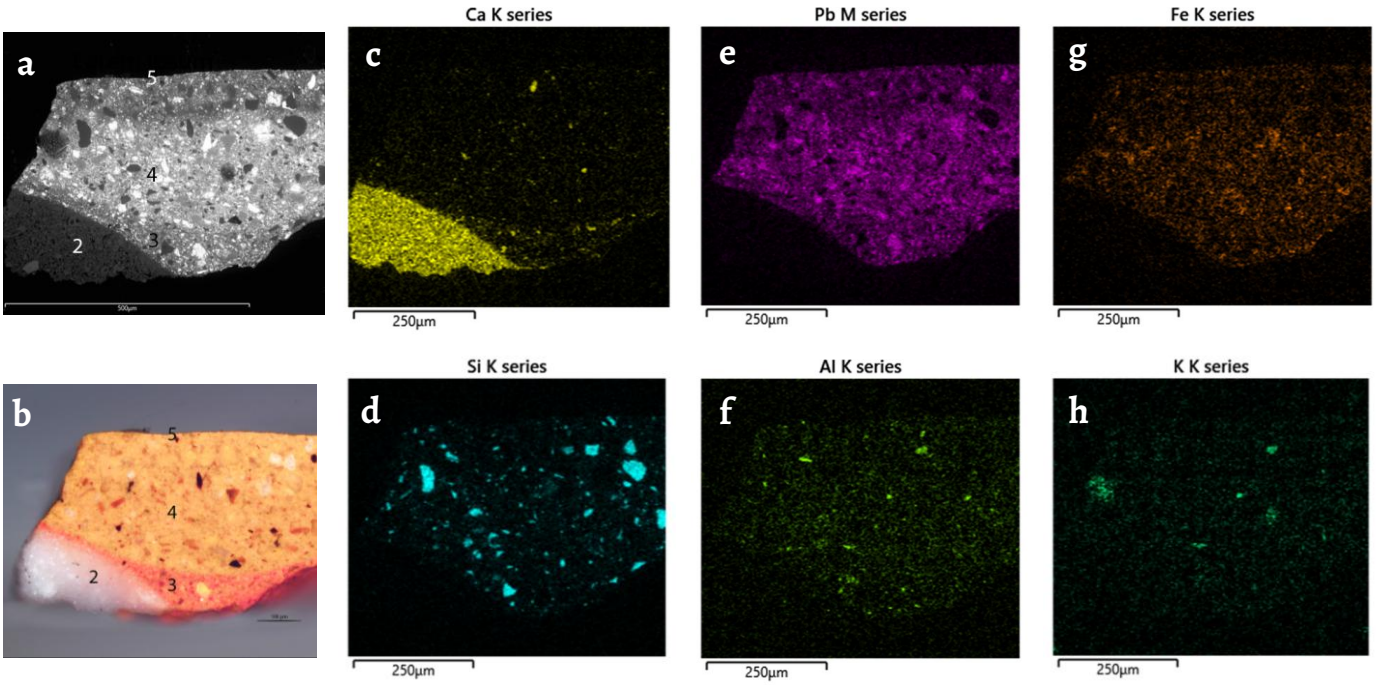

Figure 9. Cross-section of pastiglia décor on framework (10× objective): *a)* SEM BSE image; *b)* VIS light; *c)* EDS map of Ca in layer 2; *d)* EDS map of Si in layer 3-4; *e)* EDS map of Pb in layer 3-4; *f)* EDS map of Al in layer 3-4; *g)* EDS map of Fe in layer 3-4; *h)* EDS map of K in layer 3-4.

Analysis of the paint layers show that layer 2 in the cross-section, the fluid, white ground used to create a decorative pattern, consists of chalk (Figure 9c). The EDS map shows proof of a homogenous distribution of calcium and μ-Raman spectra show the characteristic bands for chalk. Due to insufficient contact between the μ-ATR-FTIR tip and the paint cross-section, it was not possible to analyse the binding medium in this layer. Raman spectra of first and second layer showed the characteristic bands for red lead. EDS maps showed a homogenous distribution of Pb in both layers (Figure 9e). In addition, EDS analyses detected the elements Si, Fe, Al and K in both layers (Figure 9). Due to the similarities in the distribution of the elements, it was not possible to distinguish between these two layers in the EDS maps, although they are clearly distinguishable under the microscope. Together the detected elements might indicate the presence of a clay-based red bole where the colouring agent is the iron oxide hematite, like in Armenian bole. It seems likely that in the first two layers red lead is mixed with a red bole. A natural drying oil could be detected as the main component of the binding medium in both layers by FTIR and μ-Raman. EDS mapping showed an even distribution of gold in the top layer of the cross-section, layer 5.

Bands of sgraffito décor

Figure 8a-d show cross-sections of the dark red and green bands of sgraffito décor on the framework. Studying this décor up close reveals that the respective top layer has been locally removed to expose the layer underneath creating a leaf- or twig-like motif in the middle and a frame of straight lines along the band's edges. Analysis of the cross-sections showed that this type of décor is built up in four layers. The first layer applied to the wooden surface of the chamfers is interpreted as a ground layer. It is red in colour and is followed by a lighter orange layer, which again is succeeded by a metal foil. The top layer of the bands constitutes the above mentioned dark red or green paint layer.

Layer 1 and 2 gave the same results as for the pastiglia decorated bands and sgraffito décor on alabaster. The binding medium is a natural drying oil and the main pigment is red lead. In addition, a red bole could be present. Analysis of the metal leaves in green and dark red sgraffito décor showed some differences. EDS maps would indicate the use of part-gold in the green sgraffito, due to the detection of both Ag and Au, while silver leaf was registered for the dark red version. The coloured top layers of the sgraffito décor on the framework were similarly pigmented as their counterparts on the chain mail in alabaster carvings: The red top layer was, identified as cochineal (likely Polish cochineal) and the green as verdigris, both bound in a natural drying oil.

Paints on the framework's interior behind the alabasters

On the inside of the framework beneath the pierced Gothic miniature architecture of the canopies, a dark red and a bright red paint were found to have been applied. None of these layers seem to serve as a ground layer, since no paint layer has been applied on top. The dark red paint covers the lower part of the area behind the canopies and is superseded by the bright red paint further up. It seems likely that these paints were intended to be visible through the pierced carved architecture and that the transition from dark red to bright red was meant to provide a glow from behind the canopies. Comparable coloration below traceries is typical of late-medieval altarpieces, at least the ones deriving from Germany [27, p. 97]. XRF measurements were taken on both red paint layers behind one of the canopies. The brighter red paint in the upper part contains Hg, As and S which points to the presence of cinnabar and realgar or orpiment. Furthermore, Al, Si, Fe and K were also detected in this layer, which may indicate a red bole, as observed in all the cross-sections. In the dark red paint neither lead nor mercury were detected. Instead, the presence of As and S suggest an arsenic-based pigment

such as realgar or orpiment. Here again the elements Al, Si, Fe and K were detected, which may point to a red bole.

A similar case of red colour beneath the canopies has been noted on one of the three fifteenth century wooden polychromed cases housing alabaster carvings depicting the head of St. John the Baptist, which are now kept at the Burrell Collection, Glasgow Museums. The woodwork of the relevant St. John the Baptist alabaster (Inv. 1.34) "displays remnants of red colouration, discernible through the cut-out alabaster structure [of the canopy]. Beneath the lower piece, sparse and random patches of green and red coloration have been noted." [28] These finds seem to indicate that the design of the area behind the canopies is of similar kind as that on the Reynistaður altarpiece. It remains unclear if these two independent observations suggest that (red) paint beneath the canopies may have been a frequent or regular feature in the polychroming of English alabaster altarpiece frameworks, at least in some workshops. In any case, the paints behind the canopies on the Reynistaður altarpiece seem to be deliberately applied features, rather than accidental occurrences.

The finds on the St. John the Baptist at the Burrell Collection are not limited to paints behind the canopy but include random patches of red and green behind the narrative panel. A dark red paint layer is also observed on the inside of the framework of an English alabaster altarpiece which may hail from Cluny, but which is now kept at the Bode Museum in Berlin (Inv. SI-1). Though it has undergone some changes and treatments, most of the framework of this altarpiece is understood to be original [29, pp. 518-526]. In addition, Castro et al. found remnants of dark red colour on the rear side of the panels of an English Passion alabaster from the church of Santa María Magdalena, Plentzia, Basque Country, Spain, which is dated 1440-1460 [7, p. 759]. Castro et al. assume that the reliefs "were set in a red painted wall. After the alabaster panels were pulled away, some parts of the colour have remained in the carvings." Their analysis on the remnants of dark red colour identified the elements Fe and Pb employing μ-XRF, while Raman spectra showed typical bands for red iron oxide. Considering the other examples gathered here, it is possible that the framework lost today was originally painted red, and when the alabaster panels were removed from the frame, some paint remained on the rear side.

Similarities of the polychromy between alabasters and framework

The examination of the Reynistaður altarpiece and analyses of paint layers have revealed similarities between the polychromy on the alabaster carvings and that on the wooden framework.

Analysis of the composition of the mordant has shown that the same pigments and binder are present in the mordant on the alabaster reliefs and on the wooden polychromed framework. On the reliefs the mordant was applied directly to the alabaster, while on the wooden framework it was applied on top of an oil-bound ground layer. Also, the sgraffito technique used on both the alabaster and the wooden framework is similar in its stratigraphy and its composition of layers. The same type of metal leaf was used on the alabaster carvings and framework for red and green sgraffito respectively. Moreover, the top layers of these same decorations were analogously composed of cochineal in oil and verdigris in oil respectively. Based on these findings, it seems reasonable to suggest that the polychromy on the alabasters and framework were made within the same production environment, e.g. a workshop or a group of loosely associated craftsmen.

Another characteristic feature of the polychromy that should be taken into account when discussing similarities between alabasters and framework is the painted freehand décor. A simple motif of three-lobed stylised leaves decorates Christ's tomb on the alabasters, as well as the blue painted chamfers on the framework flanking St Peter and St Paul (Figure 1b). In addition, the same motif is chosen to represent and adorn the green meadow-like ground on

the narrative alabaster panels. On the lower part of the carved alabaster canopies is a related motif, reminiscent of fleur-de-lis. The similarity of décor on the framework and alabaster, is not restricted to the choice of motif, but includes the way the leaves are painted; the "handwriting" of the craftsman as it were.

Considering to the above noted similarities in composition, motifs and style of the décor on framework and alabasters, it seems reasonable to infer that both were polychromed within the same production environment, such as a workshop. The similarities in "handwriting" of the painted décor even suggest it was the same craftsman working on the polychromy on both alabaster and woodwork.

The distinctive, colourful and labour-intensive polychromy of English alabasters

Late medieval English alabaster altarpieces were highly sought-after commissions, produced on a large scale and widely distributed across many European countries for a diverse clientele [3-4, 6]. Although the English medieval quarries for alabaster stone were located in the Midlands, near Chellaston and Tutbury [30], there is a notable lack of written sources that clearly identify the production centres of alabaster altarpieces or provide detailed information about their makers, production environments, and workshop practices [3, 30].

These alabaster altarpieces are easily recognisable due to their distinct features and painting techniques. For instance, the Reynistaður alabasters exhibit labour-intensive characteristics, such as sgraffito décor, gilded dots in the background, and meticulously painted daisy patterns on the grounds. These elements contributed to the creation of a colourful and elaborate polychromy. Furthermore, this study shows that not only the alabasters but also their wooden frameworks incorporated brightly coloured paints, gilding, freehand décor, and a variety of painting techniques, including raised pastiglia, sgraffito, and glazed metal leaf. This contradicts previous assumptions regarding the simplicity of such works.

The same sgraffito technique was employed for the polychromy of both alabasters and frameworks, showing similarities in layer composition and stratigraphy, although on alabaster lacks a ground layer. The mordants used contain the same pigments and binder, and the same types of metal leaf are employed for the green and dark red sgraffito. Additionally, the top paint layer (comprised of verdigris and cochineal) also employs the same pigments and binder. Such similarities in polychromy suggest that both the frames and reliefs were produced in the same working environment. Furthermore, similarities in style and "handwriting" indicate that the same craftsman may have worked on the polychromy for both alabaster and woodwork.

While the majority of preserved late-medieval grounds examined in Northern Europe are composed of white chalk and glue, instances of coloured grounds are documented [31], particularly in the English county of Devon, where many church screens feature a ground layer containing red ochre and red lead [32]. This phenomenon is understood to be regional, as the red ochre is sourced locally. Although the binding medium on the Devon screens has not yet been analysed due to limited study, conservators working on these screens have noted that the grounds appear to be water-soluble [33].

The red, oil-bound ground layer discussed in this article further testifies to the existence of variations within English late-medieval polychromy, as well as in late-medieval polychromy more broadly. Despite the significance of this large corpus of preserved English alabasters, few studies have been conducted on their polychromy, leaving many traditions still waiting to be discovered.

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