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Susanna Bracci – Giovanni Bartolozzi – Roberta Iannaccone – Donata Magrini – Paolo Liverani – Sara Lenzi – Rachele Manganelli Del Fà

Dedicated to the memory of Susanna Bracci,
beloved friend and colleague
who suddenly passed away in 2021.

Abstract

The so-called Villa of Poppaea in Oplontis (Torre Annunziata, Naples), which was destroyed during the eruption of Vesuvius in A.D. 79, offers a unique opportunity to examine the polychromy of one of the most lavish ensembles of Roman marble sculptures. The initial findings from this research were shared at the 8th Round Table in Paris (2016). This paper aims to present the updated results of ongoing studies focused on the sculptures, interior spaces, and gardens of the Villa of Poppaea. All the sculptures found in the villa were analysed on-site using a non-invasive analytical protocol. This included multiband imaging techniques such as visible reflected, ultraviolet-induced visible luminescence, and visible induced luminescence photography. Additionally, single spot methods like X-ray fluorescence spectroscopy and UV-VIS fibre optics reflectance spectroscopy were employed. Comprehensive documentation was also carried out using portable microscopy. By comparing the results obtained from both imaging and spectroscopic techniques with archaeological research, new information was also obtained concerning pigments and conservation history. Among the sculptures analysed, one particularly interesting piece is a small statue of Venus untying her sandal. This sculpture stands out due to its exceptionally well-preserved polychromy. Detailed findings about this artefact are presented here, including a comprehensive 3D model that maps all the information gathered during the diagnostic campaign. This model serves multiple purposes, such as communicating complex contents (material degradation, diagnostic analysis, etc.), promoting a deeper understanding of the object, and making the research easily accessible and widely shareable thanks to web applications. At the time of eruption in A.D. 79, the villa was undergoing renovations, leading to the relocation of some of the sculptures for safekeeping. This paper will propose some hypotheses concerning the original placement of these sculptures. Given that the wall paintings of the villa are still well preserved, the last part of the paper will explore various potential scenarios for the wall paintings that complemented the polychrome sculptures.

Keywords: Oplontis, Roman Sculpture, colours, pigments, multiband imaging, polychromy, non-invasive analyses, XRF (X-Ray Fluorescence), FORS (Fibre Optics Reflectance Spectroscopy), 3DHop, 3D modelling

Investigating Sculptural Polychromy at Oplontis

The archaeological site of Oplontis, known as Villa A or the Villa of Poppaea, was buried during the eruption of Vesuvius in A.D. 79. Situated close to Pompeii and Herculaneum, beneath the modern town of Torre Annunziata (Naples), this villa is traditionally believed to have been part of the imperial estates of Poppaea Sabina, the second wife of the emperor Nero. The original section of the structure was built around the mid-1st cent. B.C., with the eastern quarter added in the mid-1st cent. A.D.[1]. Nineteen sculptures were found during excavation conducted between 1964 and 1984. These findings have been discussed by various scholars, including S. De Caro and, more recently, E. Moormann[2]. Yet there has been minimal discussion about the traces of colours present on these sculptures[3]. Between 2016 and 2019, we conducted two research campaigns with the objective of tracing the remains of polychromy on fifteen sculptures.

The preliminary results of the first campaign were presented at the 8th Round Table in Paris and subsequently published in the conference proceedings[4]. The sculptures were analysed following a well-established protocol, and the use of portable and non-invasive instrumentation also enabled us to conduct the analyses within the storeroom at Oplontis[5].

In 2016, traces of colours were found on all sculptures, except for the head of a boy and two Centaurs (a male with a crater and a female with a small deer on her shoulder)[6]. The best preserved traces of colour were detected on the marble calyx crater featuring a ‹Waffentänzer›, which, according to De Caro, dates back to the late 1st cent. B.C./early 1st cent. A.D. (Fig. 1)[7]. The predominant traces consist of black, red and yellow. The black pigment visible on the shields' front derives from an organic source, while the red and yellow hues were obtained using iron based pigments (ochres). Egyptian blue was employed for depicting metal details such as the swords[8].

In 2019, additional analyses were performed on the sculptures that had not been previously investigated to obtain new data on the polychromy of marble sculptures for the project ‹Skulpturenausstattung und Architekturdekor der Villen von Oplontis› by the University of Cologne (Fig. 2)[9]. Unfortunately, no traces of residual polychromy were found on the Nike, the female figure with short chiton and the head of Venus[10]. Some traces of Egyptian blue were found on a marble fragment representing the feet[11], as decoration of the inferior edging of the chiton, and some traces of cinnabar were still visible on some details of the sundial[12]. Therefore, this paper primarily focuses on three sculptures exhibiting the most significant colour remnants: a small sculpture of Venus untying her sandal, dating to the late 1st cent. B.C. (Fig. 2 f)[13], and two Centaurs – one male with a boar and one female with a lyre – attributed by Moorman to the 1st cent. A.D. (Figs. 2 g. h)[14].

The Results of Surface Analysis

The two Centaurs exhibit faint traces of polychromy dispersed across their surfaces (Figs. 2 g. h). In particular, the male Centaur preserves an area with a black pigment on both of the fore hoofs (Figs. 3 a. b). Unfortunately, the applied analytical techniques were not conclusive with regard to the identification

1 On the villa recently Clarke – Muntasser 2014; Gazda – Clarke 2016; Clarke – Muntasser 2019.

2 De Caro 1987; Moormann 2016; Moormann 2019.

3 On the polychromy of these sculptures, see in particular De Caro 1987.

4 Bonini et al. 2019.

5 Bonini et al. 2019, 93.

6 Inv. 73299 (head of a boy), 70070 (male Centaur with crater), 70071 + 71357 (female Centaur with a deer).

7 Inv. 71406, 70717, 72724; De Caro 1987, 98.

8 More information on the polychromy of the calyx crater can be found in Bonini et al. 2019.

9 See the forthcoming monograph by C. Parigi, University of Cologne.

10 Nike: Augustan age (Parigi – Scarpati forthcoming; Moormann 2016, 193, No. 30). Inv. 72798; female figure with short chiton: end age of Nero – beginning flavian age (Parigi – Scarpati forthcoming; Moormann 2016, 194, No. 31). Inv. 73303; Head of Venus: 1st cent. B.C. (Parigi – Scarpati forthcoming; Moormann 2016, 196, No. 34). Inv. 71321.

11 Feet: end 1st cent. B.C. – beginning 1st cent. A.D. (Parigi – Scarpati forthcoming; Moormann 2019, No. 7). Inv. 70493.

12 Sundial: 1st cent. A.D. (Parigi – Scarpati forthcoming; Moormann 2016, 183, No. 4). Inv. 71257.

13 E. g. De Caro 1976, 225; Moormann 2016, 192, Nr. 28. Inv. 71502.

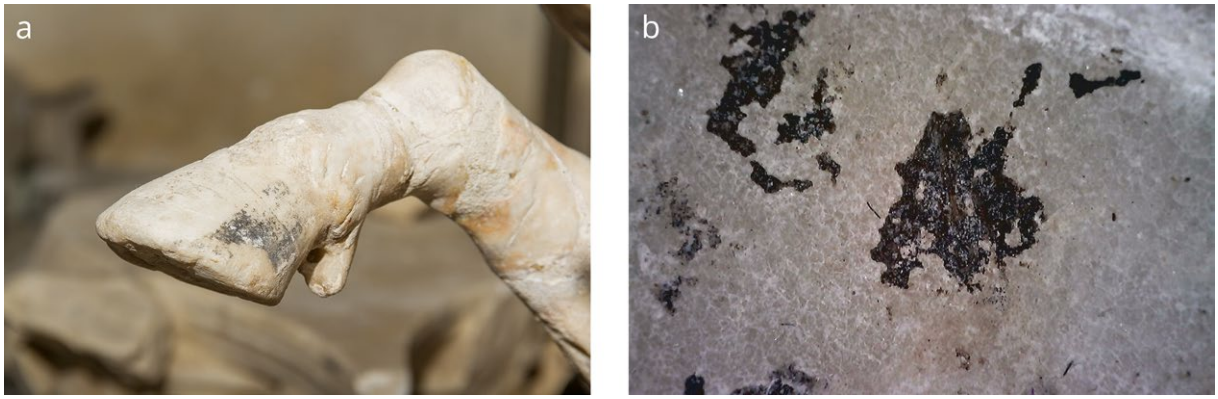
14 Moormann 2016, 194 f., No. 32. 33. Male centaur: Inv. 70068+70832 and 70649, female Centaur: 70055.

1 Calyx crater (late Augustan age; Pentelic marble)

2 Overview on the statues analysed during the campaign of 2019; a) Nike statue (Augustan age; statue: Pentelic marble; base: Parian marble); b) Female figure with short chiton (end age of Nero – beginning Flavian age; Pentelic marble); c) Fragment of feet (end 1st cent. B.C. – beginning 1st cent. A.D.; Pentelic marble); d) Sundial (1st cent. A.D.; yellowish white marble); e) Head of Venus (1st cent. B.C.; white marble, probably from Thasos or Proconnesian); f) Venus untying her sandal (late 1st cent. B.C.; white marble); g) Female Centaur with lyre (beginning of Flavian age; Parian marble lychnites); h) Male Centaur with boar (beginning of Flavian age; Parian marble lychnites)

of the black pigment, although the absence of manganese or phosphorus suggests the use of a common carbon black.

The UVL images provide some remarkable information on the geo-archaeological preservation of the different statuary fragments. On the face of the male

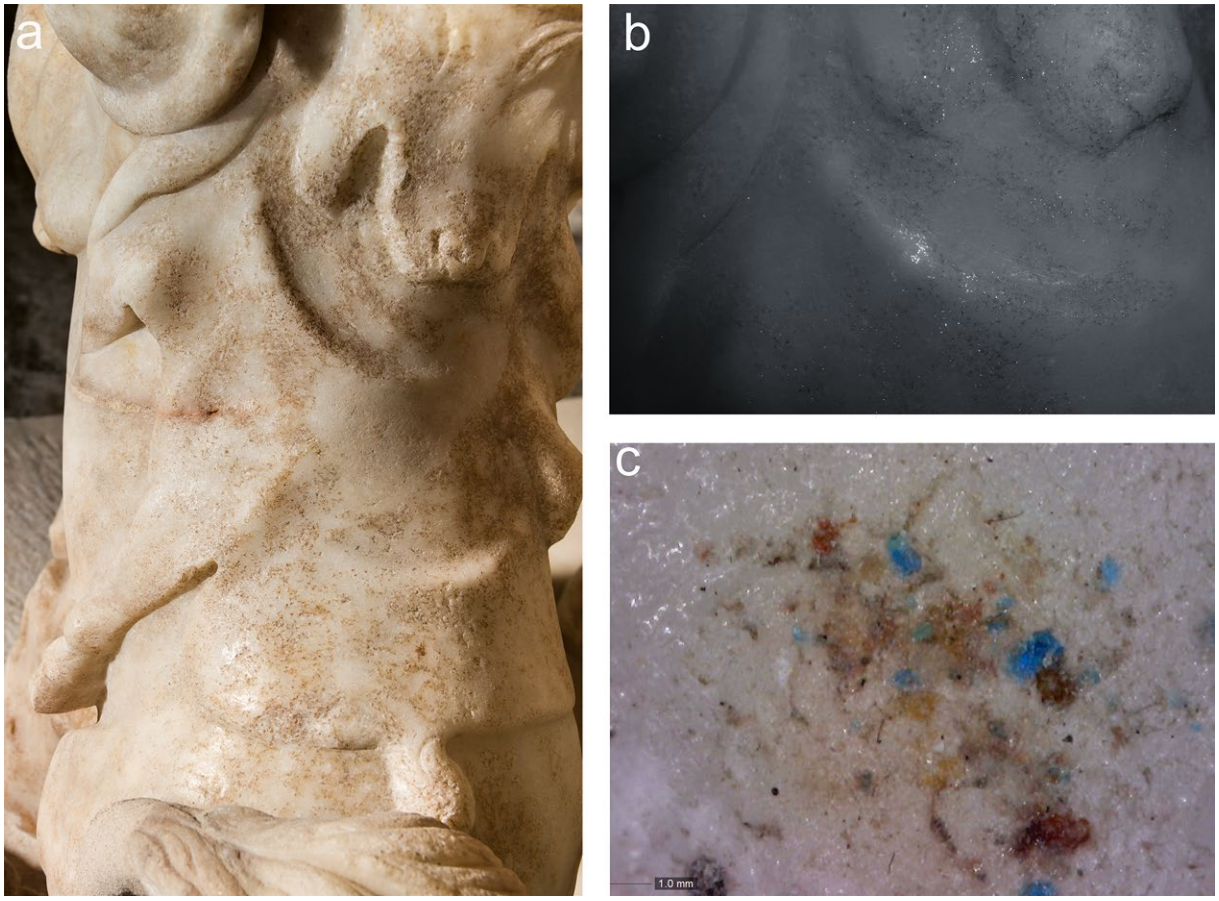


3 a) Detail of the male Centaur's right fore hoof; b) Detail at high magnification of the black traces

4 a) UVL image; b) Visible detail of the male Centaur's forehead

Centaur, for example, luminescence characteristics allowed two areas to be distinguished, which probably result from the position of the head after the eruption, with the most degraded side exposed to heat and corrosive ashes (Fig. 4)[15]. The images also highlight modern conservation treatments, such as the connection of different pieces with a mortar that emits an intense light blue luminescence. A VIL survey aimed at detecting

15 During the first phase of the A.D. 79 eruption, the villa was covered by white and grey pumice. The second phase involved pyroclastic flows of high speed and temperatures, triggered by a partial collapse of the eruptive column. Probably the first phase resulted in the collapse of the roof and fragmentation of the statue, while the second phase caused extensive deterioration of the marble surface (for the effects of the eruption on the villa see Lucibello et al. 2007).



5 a) Detail of the female Centaur's back; b) VIL image (detail) of an area corresponding to the animal skin on the back; c) High magnification image of some grains of Egyptian blue in the same area

traces of Egyptian blue on the male Centaur revealed a few scattered particles on the beard, the face, and the hair, on the right front of the hoof, and on the acanthus leaves that are part of the strut. Nonetheless, the distribution of the particles cannot conclusively indicate the presence of an Egyptian blue layer on the statue. These particles could be attributed to various scenarios, including remnant background layers, potential pigment mixtures, or inadvertent transfer from another area.

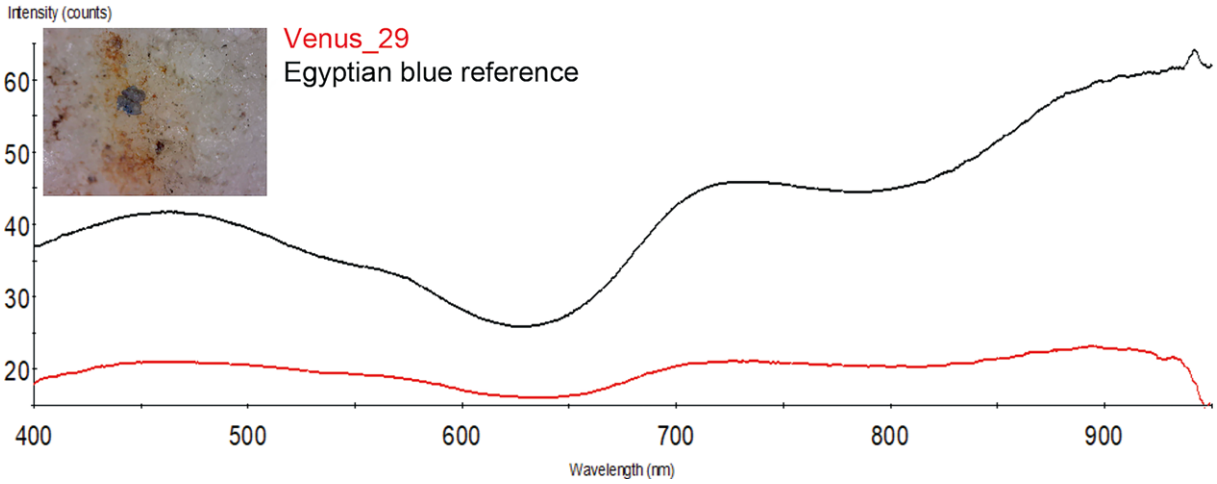
The female Centaur (Fig. 2 g) displays larger areas with evident traces of polychromy, mainly a dark red pigment visible on the shoulder, hair, thigh, and back. Analyses using FORS and XRF indicate that this red pigment is an iron oxide. VIL images reveal traces of Egyptian blue across the animal skin covering her back, especially near the upper folds. Although these traces were observed in portable microscopy images, they were too minimal and scattered for spot analysis techniques (Figs. 5 a–c). Egyptian blue signals captured by FORS were complicated by strong iron oxide signals, and copper counts in XRF spectra fell below the optical limit of detection. Portable microscopy, however, confirmed the presence of Egyptian blue in the same area as the red ochre. Isolated blue grains are also visible in the area of the right thigh, and also here they coincide with a red area. However, as the area was difficult to reach and the spots were scattered, these traces were solely documented through VIL images and portable microscopy.

Among the sculptures analysed in this second campaign, the small Venus figure (h ca. 55 cm) showcased the best preserved colour traces (Fig. 2 f). In addition to the rich decoration that was obtained with paint, little holes on her ears suggest that she once wore metal earrings (Fig. 6 a). Abundant yellow traces are visible on the hair of the supporting figure of Eros and on the Venus, and red as well as blue traces appear in several areas. The sole of the sandal is carved, but the laces must have been painted even though we could not find any traces. UVL on the instep did not show any trace of residual luminescence related to an adhesive or to painting. On both sides of the diadem, VIL imagery showed the presence of Egyptian blue and small spots of blue were also visible all over her hair. Here, the traces of blue appeared next to a yellow pigment (Figs. 6 a–c). FORS analysis on the hair con-

6 a) Detail of Venus's hair; b) VIL images; c) high magnification image of a blue grain

firmed an iron-based oxide/hydroxide pigment (Fig. 7). At this stage, it is not possible to state with certainty whether the blue pigment was used as a ground layer for the yellow pigment or whether it was mixed with it. The most likely hypothesis is that a small amount of the blue pigment was used as a ground to obtain a dull yellow, resembling ash blonde.

Both the heads of the small female supporting figure beneath Venus's left arm and the Eros underwent analysis using VIL imaging. Although no residual traces of Egyptian blue were detected in the hair of both figures, positive indicators were found on the tie that binds the hair of the small female figure. Further traces of Egyptian blue were also detected on the base and the clothes of the female supporting figure, on the little struts behind Venus' apple, on her left sandal, and on her clothes, which lie behind the goddess, on a rock or trunk. Except for the base, where the blue pigment was visible with the naked eye, only the use of VIL revealed the other traces of blue. As for the scattered traces of red that appear on several locations on the statue, they were analysed by FORS and XRF and thus characterized as iron-based pigments, except for one area where cinnabar appears to have been used.



7 FORS spectrum of an Egyptian blue reference (in black) and spectrum of spot 29 (in red) on Venus's hair. High magnification image of the same spot where also VIL highlighted luminescence.

8 a) Detail of the decoration on the base; b) Inverted image; c) Image with enhanced contrast

This particular area was, however, too hidden and too small to acquire the XRF spectrum that could confirm the presence of mercury. Further investigations should therefore be undertaken to solve this unanswered question. It should be mentioned that UVL images that were made of the entire surface of the sculpture exclude the presence of a red lake.

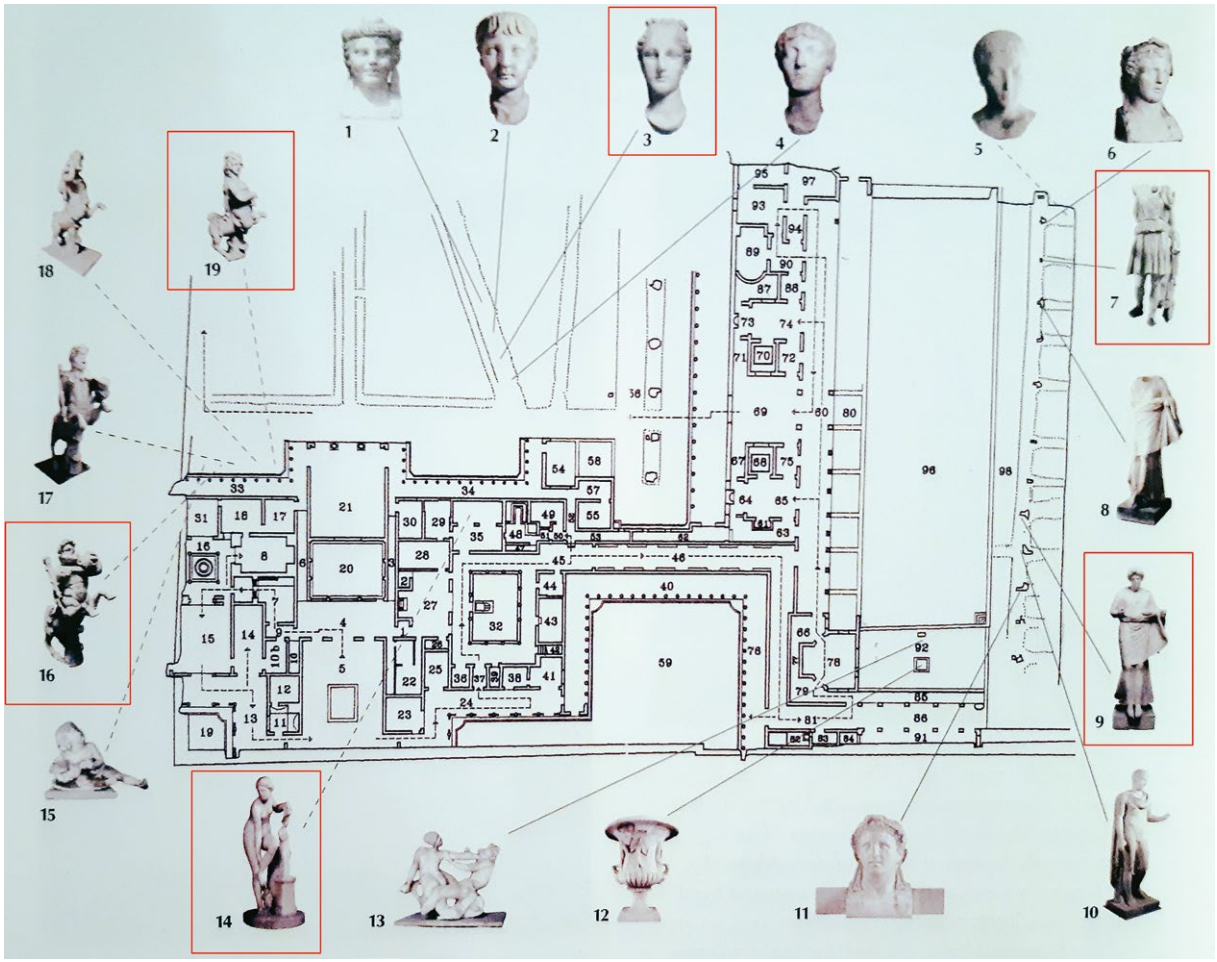
On the base of the female supporting figure, UV luminescence highlighted a vegetal motif, which was barely visible even under the microscope (Fig. 8 a). Post-production image manipulation in Adobe Photoshop (such as image inversion and contrast enhancement) helped to improve the visibility of the drawing and its distribution on the surface (Fig. 8 b. c). The ovolo moulding of the base was accentuated with red lines, one at the bottom and another at the top, both painted directly on the smooth marble surface. XRF and FORS analyses confirmed the presence of an iron-based pigment.

UVL was also applied to search for possible traces of a painted *strophion* (bust band) or bracelets, which the presence of luminescent substances such as adhesives could indicate. The result was negative, and, remarkably, we could not find either a trace of skin colour or any painted attributes such as the ones famously known from the Venus in bikini[16]. On the other hand, UVL images brought to light the use of at least two different mortars utilized to connect the fragments of the statue: one was similar to the already mentioned material used for the Centaurs, with a light luminescence, while the other completely absorbed the ultraviolet radiation. This suggests that at least two modern restorations were done, probably at different times.

The data gathered from the analysis of the Venus statue as well as information on the applied methods is now available on a web platform (Fig. 9). One of the main tools used to contextualize this data is a digital

16 Inserra 2008, 53–55.

9 3DHOP tool by ISTI-CNR for interactive 3D model visualization. (a) The details of complex 3D models are loaded by zooming in. 3DHOP screen with (b) UVL detail, (c) clickable hotspots corresponding to punctual analyses.



10 Plan of Villa A with find spots of sculptures; highlighted red are the sculptures considered in this paper.

3D model of the Venus statue that was produced using the so-called Structure from Motion technique. Clickable hotspots on the surface of the 3D model display the investigated areas in more detail while showing actual colour traces and explaining various diagnostic techniques or states of conservation. The hotspots also allow the results of spot analyses (portable microscope, XRF, and FORS) or multiband imaging techniques (UVL and VIL) to be highlighted (Fig. 9).

Spatial and Decorative Contexts

Villa A of Oplontis presents a rare opportunity to examine the wall decorations of individual rooms and the painted marble sculptures that once furnished these spaces comprehensively. While extensive studies have been conducted on the wall paintings of Villa A, the contribution of the sculptural polychromy to the appearance of the rooms was never considered[17]. This investigation is, however, challenging due to the need for reconstructing the original spatial context of the statues. Many of the statues were likely moved in antiquity, probably during renovations that followed the earthquake of A.D. 62[18].

However, for various reasons, past scholarship has agreed that most of the nine sculptures which

17 Clarke – Muntasser 2019.

18 Recently: Gazda – Naglak 2016, 136.

were found along the villa's large natatio were originally displayed there as well (Fig. 10). Among them is the crater with its colourful dancers on a white marble background. It would have been placed at the southern edge of the natatio where it stood close to some fourth-style wall paintings featuring garden and animal scenes against a white background (Fig. 11) towards the west[19]. The crater would have appeared also against a garden with trees and other colourful sculptures towards the east and the natatio towards the north (Fig. 12)[20].

Another garden, the northern one, was enriched with portraits and herms. Unfortunately, no trace of colour was found on them. It is not possible to understand if they were originally white or if they lost their colour because of the state of conservation before the eruption.

The four Centaurs were found in porticus 33, but originally they probably stood in the small viridarium 20 (cf. Fig. 10)[21]. The wall paintings of this space featured a garden with marble basins completely rendered in white[22]. The colours of the Centaur sculptures are almost lost, but the few remains suggest that large parts of these sculptures were coloured.

The small Venus sculpture was found in room 35, which, during the restoration work prior to the eruption, served as a storage area for sculptures and marble fragments (cf. Fig. 10)[23]. According to several scholars, its original placement was in one of the rooms close to the natatio, either room 64 or 73[24], whose paintings are now indiscernible. However, the walls of all rooms around corridor 60 feature a marble socle in *breccia corallina*[25] and a stucco moulding in the upper zone, but a raw und seemingly unelaborated middle zone. According to D. Esposito, it is possible that these rooms were once decorated with wooden revetments, which are now lost but are still partially recognizable in room 78[26].

When considering the placement of sculptures in their original context, we need to keep in mind that sculptures were considered part of a house's moveable furniture. As E. Gazda succinctly notes, «Sculptures were moved around, [...] and the message they embodied could change with each iteration of their display[27]». Indeed, sculptures significantly influenced the appearance and aesthetics of a space, as they added to the wall paintings, revetments, and textiles not only iconographic statements but also additional colour elements.

Although different sites and different chronologies would have shown peculiar features in the choices of colours and coloured decorations used on walls and sculptures, in Oplontis the presence of sculptures – sometimes made well before the painting of the walls – shows no effects on wall paintings. The fourth-style paintings in the possible original placement of the sculptures in Oplontis were chosen using typical colours of that period, but it is noticeable that the highest number of sculptures were in the natatio area and the main colour of the natatio's paintings is white. At least in Oplontis, white seems to be a leading colour when associated with the sculptures. However, this topic deserves further research including a comparative analysis of contemporary examples from the Vesuvian sites and their spatial contexts. One such comparative case study can be found in the Casa degli Amorini Dorati in Pompeii (VI 16, 7–38)[28]. The walls of its peristyle hosted Classical and Hellenistic marble reliefs with their original polychromy, and the surrounding fourth-style wall is painted in black, thus in a very different tone from the white walls of Oplontis. Clearly, further research is needed to understand whether the colour schemes of the sculptures and reliefs affected the patrons' choices in wall decorations.

The only immovable sculptures of Oplontis were those depicted in the wall paintings. These painted representations of white marble sculptures have been extensively discussed in scholarly literature[29], yet rarely in connection with the polychromy of the actual sculptures from Oplontis[30]. The garden which appears in the wall paintings of the viridaria 70 and 20 also include images of white calyx craters (Fig. 13), very similar in shape to the real marble crater in the natatio. Additionally, painted marble basins featuring representations of sphinges and centaurs appear (Fig. 14), not unlike our real marble centaurs. We suggest that the use of white in the wall paintings and marble sculptures at Oplontis may

19 Bergmann 2019, 254–256. About the original position of the marble centaurs: Bergmann 2019, 263.
20 Original placement for the crater: e. g. De Caro 1987, 98.
21 Lately: Bergmann 2019, 242–246. 263.
22 De Caro 1987, 88.
23 Gazda – Naglak 2016, 142.
24 Room 64 or 65: De Caro 1987, 114. Room 64, 65, 73 or 74: Gazda – Naglak 2016, 142.
25 Barker – Fant 2019, Abb. 18. 56.
26 Esposito 2019, 86 (rooms around the corridor 60); Barker – Clarke 2015 and Clarke – Barker 2019 (only for the *diaeta* 78).
27 Gazda – Naglak 2016, 138.
28 Powers 2011.
29 E. g. Moormann 1988; Bergmann 2016; Bergmann 2019 etc.
30 E. g. Bergmann 2016, 109.

11 Wall paintings in room 92

12 Marble base for the calyx crater; visible in the background are the natatio and on the right the bases for sculptures and trees.

13 Painted calix crater from a wall painting of Villa A at Oplontis

14 Painted marble basin with Centaur from Villa A at Oplontis, room 70

have had different connotations. We concur with some scholars regarding the use of the white colour as an indicator of the material (marble) of the sculptures depicted on the walls of the viridaria[31]. However, the role of white on the actual calyx crater, which retains visible polychromy yet primarily restricted to the dancing figures, raises questions. A possible answer could derive from the metallic models of this type of crater[32] and from a similar problem on the breastplate of the Augustus of Prima Porta. Here, the polychromy is limited to the relief, while the background – the breastplate itself – shows no colour additions. In that case, the white colour of the marble was seen as a possible attempt to indicate the metal of the breastplate, which was silver[33]. By comparing the Augustus with the calyx crater, we might interpret the white surface of the latter as representing a silver surface.

31 Bergmann 2019.
32 Grassinger 1991.
33 Liverani et al. 2018.

Conclusion

The study of sculptural polychromy at Oplontis enhances our understanding of the interplay between reality and representation, even doubling the stone sculpture with a painted counterpart on the walls – an image of an image, or a second-degree image. The marble sculptures were part of colourful spaces, mostly gardens, and the sculptural colouring played a role in the final appearance of the rooms they were in, although the original placement of some of these objects is still unknown.

Of the 19 sculptures at Oplontis, eight show colour traces still visible to the naked eye. The polychromy is particularly well-preserved on the small sculpture of Venus untying her sandal and on the crater, while a few traces remain on the other ones. Utilizing established protocols of non-invasive analysis allowed the detection of red and yellow ochres, cinnabar, a black pigment, and Egyptian blue (the latter reserved for clothes, metal objects or as part of hair and skin tones).

Today, a variety of analytical tools provide the basis for formulating hypotheses about original colour schemes. Given this methodological diversity behind colour reconstructions, a digital 3D model can be a useful tool to virtually verify each hypothesis on the spot, almost like a 3D database. Finally, this 3D documentation tool can provide a basis for any policy of protection, restoration and dissemination of cultural heritage.

In conclusion, we would like to emphasize that these advanced techniques and the collaborative efforts they foster between archaeological and scientific experts are imperative for enhancing our comprehension of ancient polychromy and ensuring its preservation for future generations.

Acknowledgments

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Methodologies

For Multiband imaging techniques (MBI) two cameras were used: a Canon EOS 7D with a resolution of 18 Megapixel and a modified Canon EOS 400D with a resolution of 10.10 Megapixel. Both cameras had a Canon EFS 18-135 mm f/3,5-5,6 IS lens mounted with different filters for varying each photographic technique applied. The combination of filters and cameras is summarized in the following table.

Technique	Camera	filter on flashes	filter on camera
UVL	CANON EOS 7D	B+W 403 UV black	B+W 468 UV/IR cut
VIS	CANON EOS 7D	B+W 468 UV/IR cut	B+W 468 UV/IR cut
VIL	CANON EOS 400D	B+W 468 UV/IR cut	B+W 093 IR

Table 1 MBI techniques: combinations of camera and filters

A Dinolite Premier Digital Microscope AM7013MZT-(R4) was used to acquire high magnification images at 55×.

XRF spectra were acquired through a Tracer III SD by Bruker with rhodium anode. All the points were analysed with the following working parameters, 40 kV – 12 μA and 60 sec., normalizing with respect to the Rh Kα line.

FORS spectra were acquired through an Ocean Optics (mod. HR2000) spectrometer covering the range of 390–900 nm and a measure-head configuration of 2 × 45°/0. A Spectralon® standard (99% of reflectance) was used as a white reflectance reference.

For the 3D reconstruction about 100 photos were acquired around the statue by a digital reflex camera Canon EOS 7D equipped with a Canon 28 mm lens.

The 3D model used on the web platform was created using software that performs photogrammetric processing of digital images and generates 3D spatial data.

Structure from Motion (SfM) technique[34] is the range imaging technique used to reconstruct three-dimensional models starting from two-dimensional images.

During the photo acquisition, the object is fixed, and the user moves around it at small angles, in order to photograph the object from a different point of view. All the photos must be correctly focused.

For the model, all the images were imported into the photogrammetric software. The process of generating the three-dimensional model can be summarised as follows:

- Image Matching algorithm searches for the features between the images and aligns them.
- Structure from Motion constructs an initial 3D representation of the scene (sparse point cloud).
- Multiple View Stereovision computes a dense representation of the scene by generating point clouds.

The generated point cloud usually requires cleaning operations such as: removal of detached points and noise, resampling, etc. These operations were all performed within the free point cloud management program CloudCompare. Starting from this point cloud, the software calculates the reconstruction of the 3D polygon mesh, which can then be textured using the original photographs.

Texture mapping is a way of adding surface detail, such as colour information, by projecting one or more images onto the surface of the 3D model. The mesh was processed using by MeshLab[35], an open-source 3D triangle mesh processing and editing system that provides many useful tools for processing digitised 3D data.

Nowadays, the possibility of viewing three-dimensional models without the installation of specific applications encourages the use of the web platform also for the presentation of research results in the field of cultural heritage.

We have chosen to use the 3DHOP platform for the models of the Venus statues developed by the Visual Computing Lab of the ISTI-CNR (Pisa)[36].

3DHOP[37] is a software platform developed by the ISTI-CNR to meet the needs of 3D data publishing. These requirements are an easy creation of web pages, the ability to display complex 3D models interactively and the possibility to link other data on the 3D scene to present the project information to the user.

In the 3DHOP viewer it is possible to insert clickable hotspots, a common feature in web pages, which can be used even by beginners without special instructions. In particular, on the models of the Statue of Venus, clickable hotspots were added to show the test areas for the different diagnostic techniques, focusing on the assessment of the state of conservation and the search for traces of paint. For each technique, the methodology and its application are described on the left.

The hotspots have been divided into two classes, based on the techniques used to provide information on point analysis (portable digital microscope, XRF and FORS) and images using multi-band imaging techniques (UVL and VIL).

Interface information: By clicking on the right menu, the hotspot is visible on the model, in a different colour according to the technique. By clicking on the single point in the panel on the left of the window, it is possible to read all the information about the results. Clicking on the UVL icon in the right-hand menu displays the model textured using UVL.

By clicking on the button with the ruler symbol and clicking on two points on the model it is possible to read their distance. By clicking on the question mark, the help panel will show the description for each button.

34 Westoby et al. 2012.
35 Cignoni et al. 2008.
36 http://vcg.isti.cnr.it/3dhop/ (12.01.2025).
37 Potenziani et al. 2015.

Bibliography

Barker – Clarke 2015 S. Barker – J. R. Clarke, Evidence for Wooden Wall Revetment and Marble Decoration in Diaeta 78 at Villa A (‹of Poppaea›) at Oplontis (Torre Annunziata, Italy), in: G. Trovabene (ed.), Atti del XII Colloquio AIEMA (Association Internationale pour l'Étude de la Mosaique Antique) Venezia 11–15 Settembre 2012 (Verona 2015) 501–504

Barker – Fant 2019 S. Barker – J. C. Fant, Lithic Decoration: Sources, Styles, Repairs and Spoliation, in: J. R. Clarke – N. K. Muntasser (eds.), Oplontis: Villa A (‹of Poppaea›) at Torre Annunziata, Italy 2. The Decorations: Painting, Stucco, Pavements, Sculptures (New York 2019) 765–861

Bergmann 2016 B. Bergmann, The Gardens and Garden Paintings of Villa A, in: E. K. Gazda – J. R. Clarke (eds.), Leisure and Luxury in the Age of Nero. The Villas of Oplontis near Pompeii, Exhibition catalogue Ann Arbor (Ann Arbor 2016) 96–110

Bergmann 2019 B. Bergmann, Reading the Garden Paintings in Villa A at Oplontis, in: J. R. Clarke – N. K. Muntasser (eds.), Oplontis: Villa A (‹of Poppaea›) at Torre Annunziata, Italy. 2. The Decorations: Painting, Stucco, Pavements, Sculptures (New York 2019) 240–286

Bonini et al. 2019 A. Bonini – S. Bracci – P. Liverani – G. Bartolozzi – R. Iannaccone – S. Lenzi – D. Magrini, Oplontis, 79 AD: Colours on Marble Furnishing from the Villa of Poppaea, in: B. Bourgeois (ed.), Les couleurs de l'Antique, Proceedings of the 8th International Round Table on Polychromy in Ancient Sculpture and Architecture, Paris, Centre de Récherche et de Restauration des Musées de France, 15th–16th November, 2016, Techné 48 (Paris 2019) 90–99

Cignoni et al. 2008 P. Cignoni – M. Callieri – M. Corsini – M. Dellepiane – F. Ganovelli – G. Ranzuglia, MeshLab: An Open-Source Mesh Processing Tool, in: V. Scarano – R. De Chiara – U. Erra (eds.), Eurographics Italian Chapter Conference, Salerno July 2nd–4th 2008 (Geneve 2008) 129–136

Clarke – Barker 2019 J. R. Clarke – S. Barker, Reconstructing the Decorative Program of Diaeta 78, in: J. R. Clarke – N. K. Muntasser (eds.), Oplontis: Villa A (‹of Poppaea›) at Torre Annunziata, Italy 2. The Decorations: Painting, Stucco, Pavements, Sculptures (New York 2019) 549–579

Clarke – Muntasser 2014 J. R. Clarke – N. K. Muntasser, Oplontis: Villa A (‹of Poppaea›) at Torre Annunziata, Italy 1. The Ancient Setting and Modern Rediscovery (New York 2014)

Clarke – Muntasser 2019 J. R. Clarke – N. K. Muntasser, Oplontis: Villa A (‹of Poppaea›) at Torre Annunziata, Italy 2. The Decorations: Painting, Stucco, Pavements, Sculptures (New York 2019)

De Caro 1976 S. De Caro, Sculture della Villa di Poppea in Oplontis, CronPomp 2, 1976, 184–225

De Caro 1987 S. De Caro, The Sculptures of the Villa of Poppaea at Oplontis: A Preliminary Report, in: E. B. MacDougall (ed.), Ancient Roman Villa Gardens, Dumbarton Oaks Colloquium on the History of Landscape Architecture 10 (Washington D.C. 1987) 77–133

Esposito 2019 D. Esposito, Esempi di ‹non-finito› nella decorazione parietale delle città vesuviane, in: M. Papini (ed.), Opus imperfectum. Monumenti e testi incompiuti nel mondo greco e romano, ScAnt 25, 3 (Rome 2019) 85–99

Gazda – Clarke 2016 E. K. Gazda – J. R. Clarke, Leisure and Luxury in the Age of Nero. The Villas of Oplontis near Pompeii, Exhibition catalogue Ann Arbor, Kelsey Museum Publication 14 (Ann Arbor 2016)

Gazda – Naglak 2016 E. K. Gazda – M. C. Naglak, Mutable Meanings in the Sculpture from Villa A, in: E. K. Gazda – J. R. Clarke (eds.), Leisure and Luxury in the Age of Nero. The Villas of Oplontis near Pompeii, Exhibition catalogue Ann Arbor (Ann Arbor 2016) 136–147

Grassinger 1991 D. Grassinger, Römische Marmorkratere, MAR 18 (Mainz 1991)

Inserra 2008 N. Inserra, Regiones I-II-III, in: A. Carella – L. A. D'Acunto – N. Inserra – C. Serpe (eds.), Marmora Pompeiana nel Museo Archeologico Nazionale di Napoli. Gli arredi scultorei delle case pompeiane, Studi della Soprindenza archeologica di Pompei 26 (Rome 2008) 15–62

Liverani et al. 2018 P. Liverani – U. Santamaria – G. Verri, La quarta dimensione della scultura: il colore, in: C. Márquez Moreno – D. Ojeda Nogales (eds.), Escultura romana en Hispania VIII. Homenaje a Luis Baena del Alcazár, Córdoba 5–8 octubre 2016 (Córdoba 2018) 121–138

Lucibello et al. 2007 E. Lucibello – G. Perrella – P. Petrosino – M. Fraldi – L. Lirer – L. Nunziante, La distruzione di Oplontis: relazione tra le fasi

dell'eruzione del 79 d.C. e i danni rilevati nella villa di Poppea, Quaderni di Studi Pompeiani 1, 2007, 187–200

Moormann 1988 E. M. Moormann, La pittura parietale romana come fonte di conoscenza per la scultura antica, Scrinium 2 (New Hampshire 1988)

Moormann 2016 E. M. Moormann, Garden Sculptures, in: E. K. Gazda – J. R. Clarke (eds.), Leisure and Luxury in the Age of Nero. The Villas of Oplontis near Pompeii, Exhibition catalogue Ann Arbor (Ann Arbor 2016) 192–198

Moormann 2019 E. M. Moormann, Marble Sculpture and Architectural Elements, in: J. R. Clarke – N. K. Muntasser (eds.), Oplontis: Villa A (‹of Poppaea›) at Torre Annunziata, Italy 2: The Decorations: Painting, Stucco, Pavements, Sculptures (New York 2019) 580–682

Parigi – Scarpati forthcoming C. Parigi – G. Scarpati (eds.), I Marmi di Oplontis. Sculture ed elementi architettonici dalla Villa A, Studi e Ricerche del Parco Archeologico di Pompei 52 (Rome forthcoming)

Potenziani et al. 2015 M. Potenziani – M. Callieri – M. Dellepiane – M. Corsini – F. Ponchio – R. Scopigno, 3DHOP: 3D Heritage Online Presenter, Computers & Graphics 52, 2015, 129–141

Powers 2011 J. Powers, Beyond Painting in Pompeii's Houses: Wall Ornaments and their Patrons, in: E. Poehler – M. Flohr – K. Cole (eds.), Pompeii. Art, Industry and Infrastructure (Oxford 2011) 10–32

Westoby et al. 2012 M. J. Westoby – J. Brasington – N. F. Glasser – M. J. Hambrey – J. M. Reynolds, ‹Structure-from-Motion› Photogrammetry: A Low-cost, Effective Tool for Geoscience Applications, Geomorphology 179, 2012, 300–314

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