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Polychrome Marbles in Christian Churches: Examples from the Antependium of Baroque Altars in Apulia (Southern Italy)

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Abstract: The *antependia*, realized in polychrome marbles during the Baroque period in two Christian churches of Apulia (Southern Italy), were on-site petrographically investigated by the naked eye to obtain information regarding the types of used rocks; the precision in the making of the marble *tesserae* was also assessed. Most of the polychrome marbles recognized were taken from buildings and monuments realized during the Roman imperial period; other marbles quarried during the Baroque period, mainly from Italian geological outcrops, were also identified. The precision in the execution of the *tesserae* is generally very high and depends not only on the skill of the marble worker but also on the lithotype.

Keywords: polychrome marbles; *opus sectile*; antependium; altars; Baroque period; petrographic investigations; Southern Italy

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1. Introduction

In Italy, the use of polychrome marbles as decorative materials gained particular prominence during the Roman imperial period; later, especially in the Baroque period and in Southern Italy, their use and reuse to adorn primarily religious buildings spread throughout almost all Catholic churches. Through meticulous craftsmanship, Baroque sculptors brought inert stone to life, transforming it into a symphony of colors and shapes.

The Historical Use of Decorative Polychrome Marbles

In historical–archaeological literature, the term "polychrome marbles" refers to all polishable rocks [1] (igneous, metamorphic, and sedimentary rocks of both carbonate and non-carbonate composition), while in the petrographic context, marbles exclusively refer to metamorphosed carbonate rocks.

The use of polychrome marbles as depicting or ornamental elements has been practiced since antiquity in civil, religious, and private contexts [2–4].

One of the oldest and best-known uses of rocks as decorative materials is the hollow wooden box from Sumer known as the Standard of Ur (about 2500 B.C.) composed of exquisite inlays of lapis lazuli, limestone, and various elements, depicting scenes of war, triumph, and peace [5]. Another very famous artifact with inserts of polychrome rock is the pectoral of Tutankhamun (about 1325 B.C.); it features numerous elements in lapis lazuli, reddish chalcedony (carnelian), obsidian [6], and a central scarab made of a very particular yellow-brown glass from the Libyan desert, a glass that originated 28.5 million years ago from a comet airburst [7].

In Roman times, the art of juxtaposing different stone elements, particularly polychrome marbles, underwent significant development and refinement thanks to a new and more profitable systematic organization of quarries throughout the Mediterranean basin [8–10] and in the farer territories of the Empire. Each province, especially Lusitania,

Aquitaine, Achaia, Galatia, Egypt, Numidia, Cyrenaica, and Mauretania, contributed to the sharing of marbles to the city of Rome ([8] and references therein).

The most famous decorative technique for covering surfaces with polychrome stones is "*sectilia*" or "*opus sectile*" (marble *tesserae*), as described by *Marcus Vitruvius Pollonius* in his book "*De Architectura*" (Liber VII, Chapter I, 3, about 15 B.C.), which involves the juxtaposition of elements of various shapes on a substrate consisting of an easily flaky rock, usually slate.

Another noteworthy decorative technique is the *interraso marmore* (marble inlay), whereby elements of colored rock are inserted into specially carved marble slabs to accommodate them. By this technique, "*coepimus et lapide pingere*" (Humans begin to paint even with stone), according to Plinio il Vecchio (in *Naturalis Historia* 77–78 A.D.); in the colored parts, the pieces of rock are glued to the support using an amalgam composed of marble dust and hot vegetable resin [11–13].

This latter technique is particularly widespread starting from the 16th century in central–southern Italy onward in the Kingdom of Naples, where marbles from ruins to the Imperial age, alongside more recent stones, were reused in new artworks [14]. Here, artists from Carrara and Florence introduced a taste for polychrome marbles with geometric designs, later replaced by more precious floral decorations, which found wide use in the exquisite works of Cosimo Fanzago [14] (an Italian sculptor and architect who mainly worked in Naples).

From Naples, at that time called the capital of the Kingdom of the Two Sicilies, the *marmorari*'s works (the *marmoraro* is a master marble mason) reached other harbors to then be distributed and assembled in various countries according to the client's requests. Numerous altars in churches, made by inlay and marquetry, replaced those previously made of gilded wood or stone [14].

Among these artistic centers, the *antependia* preserved in several churches of the Apulian region (Southern Italy) are very remarkable, as they are rich in both white and colored marbles, belonging to the Roman spolia [15] or quarried during the Baroque period [14,16,17].

This paper focuses on some highly significant examples of Apulian altars adorned with polychrome marbles, even in the Baroque period, stored in the Catholic Cathedrals of Gravina and Altamura. These churches are renowned for their abundance of polychrome marbles, with the altars of Gravina and Altamura particularly distinguished by their *antependia* (*pallium altaris*, in Latin; *paliotto*, in Italian) crafted from polychrome marble inlays. The presented study aims to identify different lithologies using the common methods of field petrography, specifically on-site recognition of rock types without the use of thin sections. This approach is useful for comparing the white and polychrome marbles used in the frontlets of Apulian churches. This contributes, on one hand, to highlighting the materials, techniques, and modus operandi of the Baroque *marmorari*, and on the other hand, to reconstruct the artistic relationship between the production centers of Southern Italy.

2. Materials and Methods

The altars involved in this study are currently located in the Cathedrals of Gravina and Altamura. Firstly, detailed photographic documentation was carried out, capturing the images in digital format using a Samsung NX 500 camera (Samsung Electronics, Milano, Italy) equipped with a 28.3 Mpx BSI-CMOS sensor.

The images were then processed using Adobe Photoshop CS3 Extended (Ver. 10.0, The Apache Software Foundation) software, through which each marble element of the frontlet was modeled and isolated in a specific layer. Due to the chromatic similarity of different lithologies, only a manual outlining operation of each *tessera* allows the distinction of adjacent elements.

The lithologies identified in the *tesserae* were compared with those of polychrome marbles used from the Roman period to the Baroque period, using the main stone collections

known in the literature and the most famous and comprehensive catalogs of polychrome marble collections [2,8,9,18–25]. The identification was clearly supported by the most significant papers published to date [26–37].

Once all lithotypes represented in the digital image were identified, all corresponding layers depicting the same rock were grouped together and colored with the same color.

Using the free software JMicroVision, v.1.3.4 (https://jmicrovision.github.io/, accessed on 1 January 2024), digital images were processed, and lithologies were colored using different hues. By utilizing the "Object Extraction" function with a specific "Color Thresholding" for the chosen *tessera* color, the software calculated the number of pixels corresponding to the selected "Object" [38]. The higher the image resolution, the more precise the pixel calculation for the selected area in relation to the total will be. The images processed during this research pertain to the *antependium* of the Santa Maria del Piede altar (Gravina Cathedral) and the *antependium* and the two upper gradines of the altar of the Most Blessed Sacrament (Altamura Cathedral). These images, in a 1:1 scale and TIFF format, had a resolution of 600 dpi.

To verify the accuracy and precision of measurement obtained by the software, the areas of each tile calculated with JMicroVision were summed, and the numerical value was compared with the area of the *antependium* measured using a scale.

3. Results

3.1. The Altars of the Gravina Cathedral

In the Gravina Cathedral, the *antependia* of six altars were examined (Figure 1): the High Altar and the *Vergine al Cenacolo di Pentecoste* (Virgin at the Cenacle of Pentecost), the *San Filippo Neri* (St. Philip Neri), the *San Michele Arcangelo* (St. Michael the Archangel), the *Santa Maria del Piede* (St. Mary of the Foot), and the *Santa Maria di Costantinopoli* (St. Mary of Constantinople) altars.

These altars, dating back to 1700, were realized by Francesco Cimafonte, a pupil of Cosimo Fanzago, a renowned architect of the Neapolitan school [14]. The altar *antependia* appear very similar to each other: from a central figure, usually a flower, two symmetrically diverging cornucopias made of Marmor Lunense, from which lush vegetation extends throughout the *antependium*, represented by a chain of racemes with leaves and flowers.

The cornucopias are enriched at the bottom with elements in *Giallo di Castronovo*, often reddish after heating [the red hues of many carbonate rocks were obtained via iron oxidation, which is usually present in the sample as a hydroxide (goethite, FeO(OH), and limonite) or as a sulfide (pyrite and marcassite, FeS_2), to hematite (Fe_2O_3) [39–44], when the sample is heated with a very hot tool], in the *Rosso di Verona*, and in one case, even in the precious Marmor Sagarium (Figure 2).

Stems and racemes are in *Libeccio antico*, Marmor Sagarium, Marmor Lunense, *Bardiglio*, Marmor Chium, *Giallo di Castronovo*, and *Rosso di Verona*. Leaves and fronds are in Marmor Thessalicum, *Verde Ranocchia*, *Verde Alpi*, Marmor Lunense, and *Bardiglio*. Petals, stamens and pistils are in Mother of Pearl, Marmor Lunense and Marmor Chium. Winged figures, even in symmetrical positions, are always made with *Libeccio antico*, Marmor Hierapolitanum, and *Rosso di Verona*. Flowers are in *Giallo di Castronovo*, often reddish after heating, *Rosso Francia* and Marmor Lunense; the corolla is sometimes embellished and enriched in the center, with an insert in lapis lazuli.

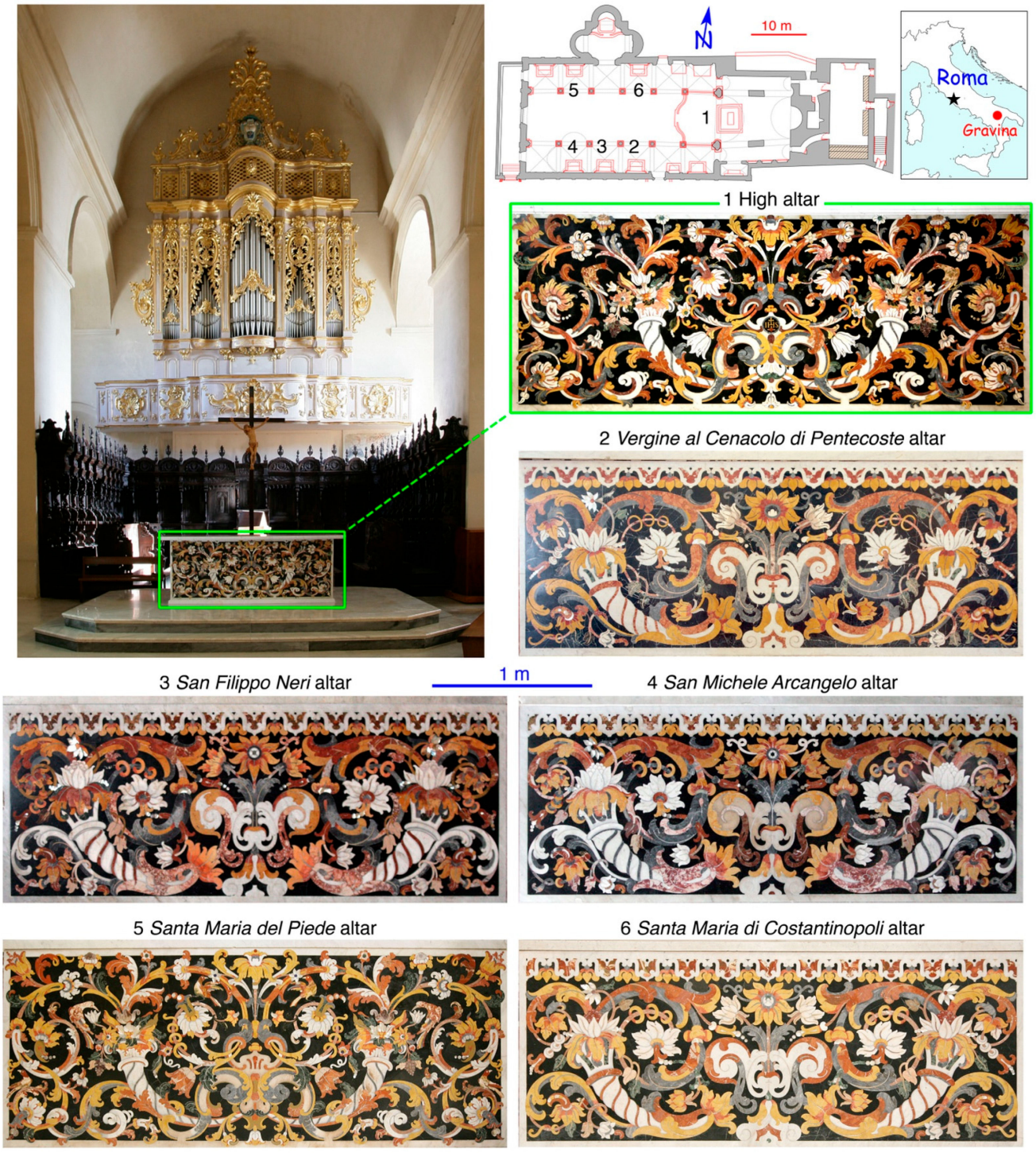


Figure 1. (**Top left**): the presbytery of the Cathedral of Gravina with the wooden choir (1561 A.D.) and the High altar arranged towards the people after the Second Vatican Council's reform (1959–1965 A.D.). (**Top right**): the plan of the Gravina Cathedral showing the position of the six Baroque altars with *antependia* made of polychrome marbles, whose images are also represented further down in the figure.

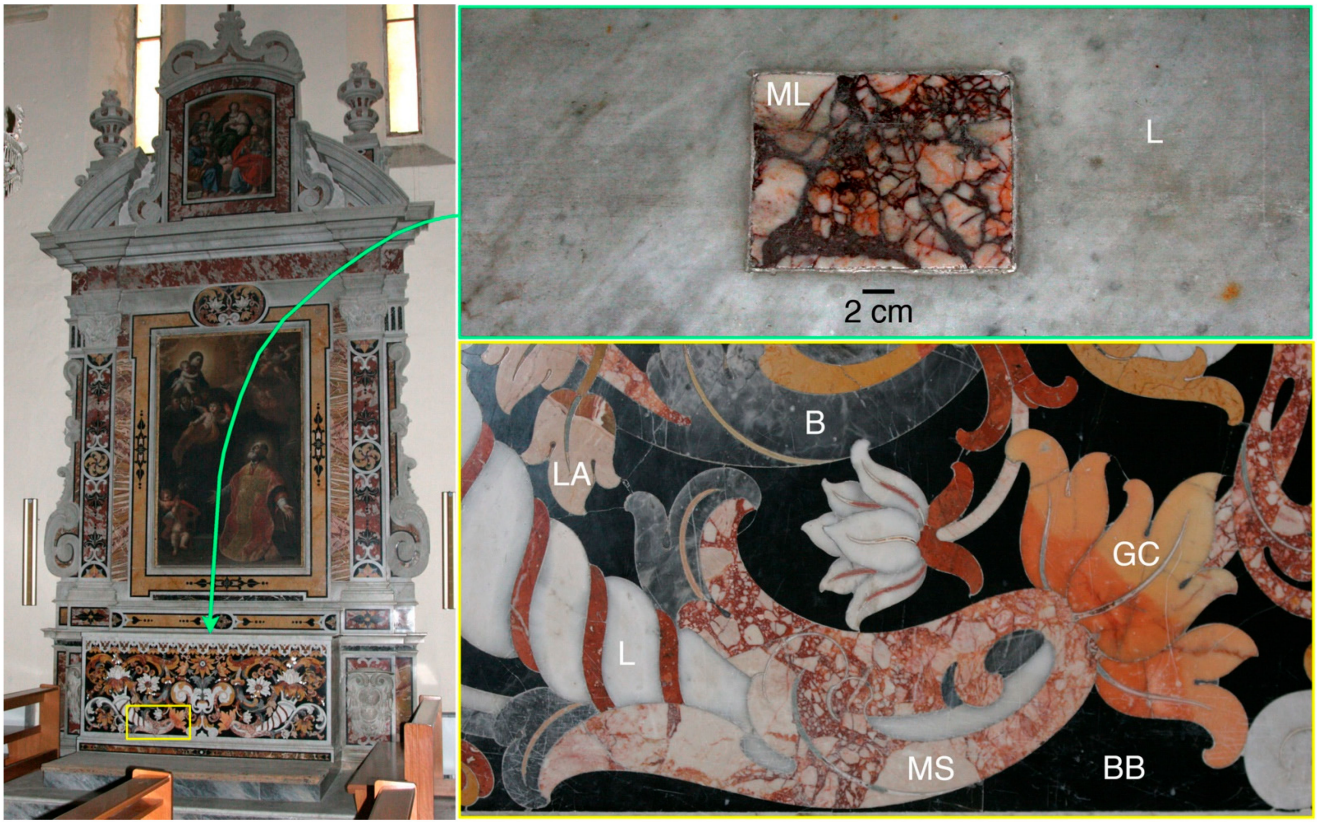


Figure 2. The San Filippo Neri altar (Cathedral of Gravina); (**top right**): a detail of the mensa in Marmor Lunense (L) with the hollow where the Saint's relic was placed, closed by a rock *tessera* made with a precious insert in Marmor Luculleum (ML). (**Below**) is a detail of the *antependium* with leaves in *Libeccio Antico* (LA), the cornucopia in Marmor Lunense and Marmor Sagarium (MS), and a flower made with *Giallo di Castronovo* (GC), partially turned reddish after its heating. B = *Bardiglio*; BB = Belgian Black.

In some altars, the mensa preserves the cavity where the relic of the Saint was deposited. Such a precious cult compartment was often covered by a marble insert of great value, as in the case of the altar of St. Philip Neri; in this altar, indeed, a precious insert in Marmor Luculleum (one of the most expensive stones during the Roman Imperial Age [2]) covers the relic of the Saint (Figure 2); in Southern Italy, during the Baroque period, the commission price for an altar was approximately three hundred silver ducats [45].

The High altar and the altar of *Santa Maria del Piede* have extremely similar designs (Figure 1); the spatial distribution of their polychrome marbles suggests significant comparisons between them:

(i) All the *tesserae* are set in a single slab of white Marmor Lunense (Figure 1), including those in Belgian Black marble, which appear to be the most abundant (Figure 3); (ii) assuming that the accuracy in the realization of symmetrical *tesserae* can be evaluated by calculating their surface area, the error made by the *marmoraro* in creating symmetrical *tesserae* generally does not exceed 1% [46]; although, in some cases, it can reach 3.5%; (iii) furthermore, the error in the realization of symmetric figures depends more on the hardness of the rock, around 1%, as in the case of the leaves made of *Verde Ranocchia* or Marmor Thessalicum, and to a lesser extent on the complexity of the design, around 0.15%, as in the case of the winged figures made of *Libeccio antico* [46].

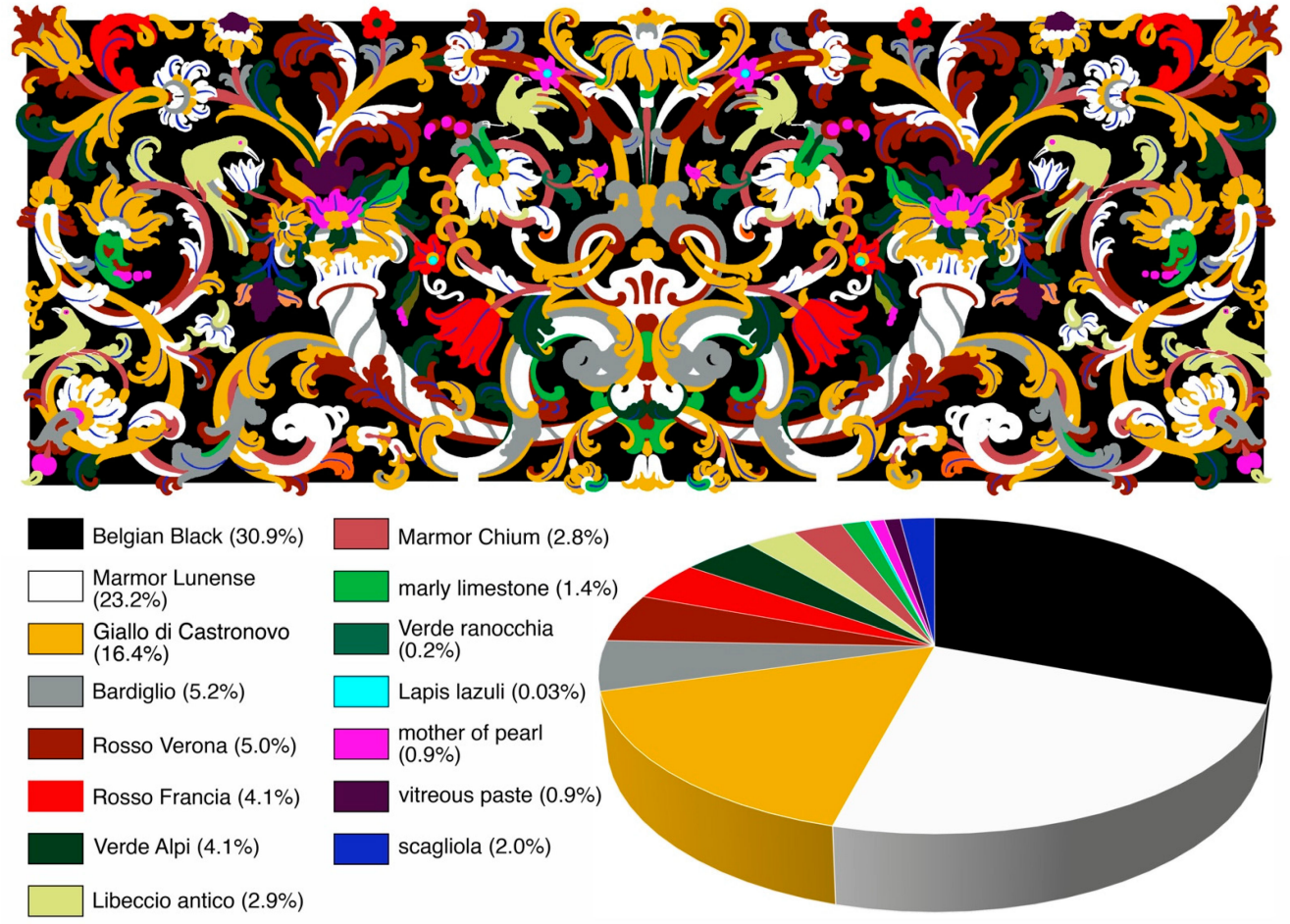


Figure 3. Distribution of polychrome marbles in the *antependium* of Santa Maria del Piede altar (Cathedral of Gravina) with relative abundance, also depicted as a pie chart.

3.2. The Altars of the Cathedral of Altamura

In the Cathedral of Altamura, all the altars, both in the left and right aisles, are more or less adorned with polychrome marbles reworked during the Baroque period. The recognized marbles are mainly Marmor Lunense, Marmor Thessalicum, *Broccatello*, Marmor Chium, Marmor Chalcidium, *Libeccio antico*, *Bardiglio*, *Giallo di Castronovo*, *Rosso di Verona*. Some small inserts cannot be easily identifiable due to their size.

More significant observations regarding the polychrome marbles of the altar of the Most Blessed Sacrament in the Altamura Cathedral can be assessed; this altar is located in the Chapel of the Blessed Sacrament and Nativity and is attributed to Crescenzio Trinchese [38], a Neapolitan sculptor who was also a specialist in polychrome marble inlay during the Baroque period.

The altar, raised by two steps from the floor, features a Baroque *antependium* by the Neapolitan school in polychrome marbles; above the mensa, two gradines flank the tabernacle (Figure 4).

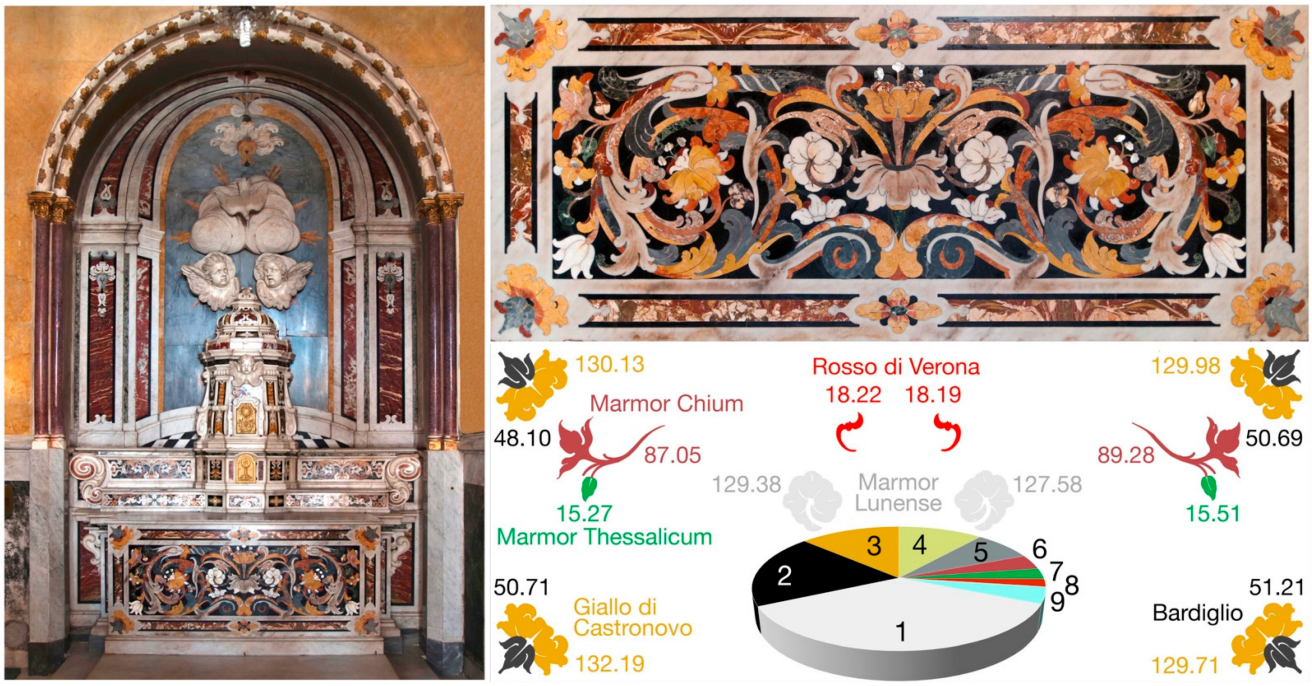


Figure 4. In the (**left**) part of the figure, the altar of the Most Blessed Sacrament (Altamura Cathedral). In the (**top right**) part of the figure, the *antependium* made of polychrome marbles. In the (**bottom right**) part of the figure, some selected and recognized symmetric polychrome marbles with the relative calculated areas expressed in square centimeters; the relative abundance of all polychrome marbles present in the *antependium* is also represented as a pie chart: 1. Marmor Lunense (41.5%); 2. Belgian Black (22.1%); 3. *Giallo di Castronovo* (14.9%); 4. *Libeccio antico* (12.6%); 5. *Bardiglio* (8.9%); 6. Marmor Chium (4.4%); 7. Marmor Thessalicum (3.2%); 8. *Rosso di Verona* (2.3%); 9. others (Mother of Pearl, gypsum of scagliola, etc.).

The *antependium* (Figure 4) consists of a slab of Marmor Lunense bordered by four bands in *Libeccio antico*; the latter are edged with thin strips of Belgian Black and are joined at the corners by four stylized floral elements in *Giallo di Castronovo* and *Bardiglio*. Furthermore, the two horizontal bands of *Libeccio antico* are interrupted at the center by a stylized floral representation: four petals in *Giallo di Castronovo*, with little insertions of Belgian Black, are joined at the center by an oval in Marmor Thessalicum.

The characteristic decorative motif of this *antependium* is the symmetrical envelopment of a chain of racemes with flowers and leaves; they emanate from a central flower carried upward by a stem in Marmor Chium. The central flower is crafted with a corolla in *Giallo di Castronovo* and inserts in Marmor Lunense and breccia; the pistils consist of gypsum of scagliola and Mother of Pearl. From the central flower, an envelope of racemes develops, primarily made of *Bardiglio*, Marmor Lunense, Marmor Chium, and *Rosso di Verona*; from the racemes, leaves of *Libeccio antico* and Marmor Thessalicum, and smaller flowers of *Giallo di Castronovo* and Marmor Chium branch out. At the center of the envelope, symmetrically on the left and right sides of the *antependium*, there is a large flower in *Giallo di Castronovo*, with reddish petals (the red color is due to heating at the tips), a corolla in Marmor Lunense, and pistils in gypsum of scagliola and Mother of Pearl.

Assuming once again that the accuracy in creating symmetric *tesserae* can be evaluated by calculating their area, the observation of the surface of some symmetric polychrome marbles of the *antependium* of the Most Blessed Sacrament has suggested further considerations:

(i) The greatest error can be found in the *tesserae* of *Bardiglio*, whose four pieces placed at the four corners of the *antependium* reveal a maximum error of 6.5%: 51.21 cm^2 the area of the lower right detail and 48.10 cm^2 the area of the upper left detail (Figure 4); at the same time, considering the details in the bottom left and top right, the difference in square

centimeters has an error of only 0.04% (50.71 cm^2 and 50.69 cm^2, respectively, the area of each *tessera*). The error turns out to be lower when considering elements closer together: between the two left-hand *Bardiglio* details, it is 5.4% (48.10 cm^2 and 50.71 cm^2, the area of each *tessera*), and only 1% between the two right-hand *Bardiglio* details (50.69 cm^2 and 51.21 cm^2, respectively, the area of each *tessera*).

(ii) For the four different details of *Giallo di Castronovo*, also found at the four corners of the *antependium*, there is a 1.6% error between the two details on the left and a 0.2% error between the two details on the right.

(iii) The error in the execution of other tiles in different lithologies, such as Marmor Chium, Marmor Thessalicum, and *Rosso di Verona*, always shows very low errors, respectively 2.6%, 1.6%, and 0.2%.

(iv) Data related to symmetric *tesserae* indicate that errors are attributed to the hardness of the marbles to a greater extent than to the complexity of the design. It is noteworthy that *marmorari* paid special attention to ensuring that pieces were very similar when they needed to be mounted next to each other.

(v) Finally, it should be emphasized that the two central floral elements in Marmor Lunense, with a surface area of 129.38 cm^2 and 127.58 cm^2, reveal a difference in the execution of the details with an error of only 1.4%: in this case, the elements are a cut-out from the same marble slab that constitutes the support of the *antependium*, despite their execution certainly being more challenging than reproducing a marble *tessera*.

The upper gradines flanking the tabernacle (Figure 5) symmetrically terminate outward with two volutes in Marmor Lunense, within which a spiral in *Rosso di Verona* is engraved. The frontal part of the upper gradine is in Marmor Lunense with racemes in *Giallo di Castronovo*, *Rosso di Verona*, Marmor Chium, and *Bardiglio*, surrounded by leaves in Marmor Thessalicum and Marmor Hierapolitanum; the racemes end with two symmetric flowers in Marmor Lunense embellished with a central part in lapis lazuli. The floral composition is geometrically enclosed by inserts in Belgian Black (Figure 5).

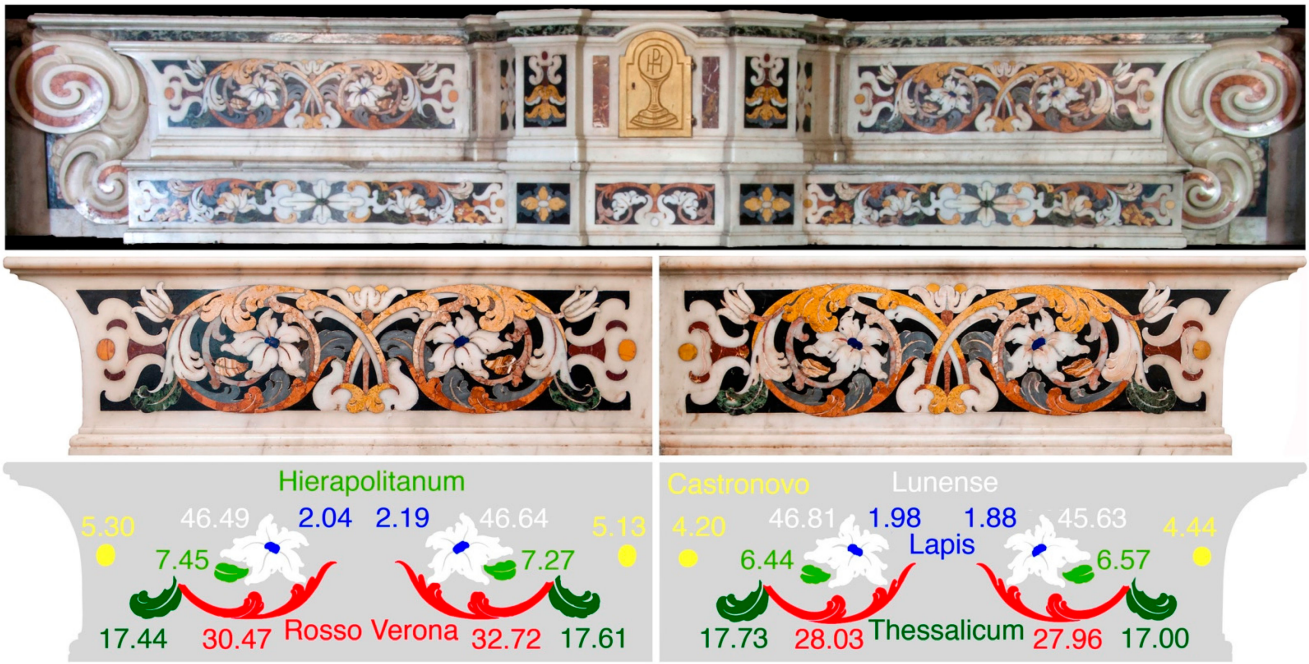


Figure 5. The two gradines of the altar of the Most Blessed Sacrament of the Cathedral of Altamura (**top**); a detail of the second gradine (**middle**) and some selected and recognized symmetric polychrome marbles (**bottom**) with the relative calculated areas expressed in square centimeters.

In addition to the analysis already conducted for the *antependium* of the altar of the Blessed Sacrament, further considerations can be made observing the details of some of

the polychrome *tesserae* of the two symmetric upper gradines, present above its mensa (Figure 5):

(i) The maximum error measured on the area of elements is primarily related to two lithologies: Lapis Lazuli, which in the left gradine shows an error of 7.4% between its symmetric pieces (2.04 cm^2 and 2.19 cm^2, the area of each *tessera*), and the *Rosso di Verona*, which once again in the left gradine presents an identical error of 7.4% (30.47 cm^2 and 32.72 cm^2, the area of each *tessera*); the latter lithology is also the one that in the right gradine shows the lowest error of 0.25% (28.03 cm^2 and 27.96 cm^2, the area of each *tessera*), among the various symmetric pairs of marble *tesserae* (Figure 5).

(ii) The other lithologies show a smaller error in the execution of symmetric tiles, which should be evaluated separately for the left and right side of the gradine: (a) *Giallo di Castronovo* shows an error of 5.7% between the symmetric tiles of the right gradine and a lower one, 3.3%, between those of the left gradine; (b) the Marmor Thessalicum exhibits an error of 4.3% in the right gradine and a 1.0% error in the left gradine; (c) Marmor Hierapolitanum has an error of 2.5% in the left gradine and a 2.0% error in the right gradine; (d) the Marmor Lunense presents an error of 2.6% in the right gradine and one of 0.3% in the left gradine.

With regard to the Marmor Lunense tiles, the considerations made for the *antependium* also apply to the two gradines; namely, despite being obtained by carving the marble slab that was supposed to host the other marble *tesserae*, they exhibit a relatively contained carving error compared to that of the other lithologies.

(iii) If we consider similar tiles belonging to the two different gradines on the left and right, the estimated error on the measurement of the areas of the *tesserae* is considerably higher: approximately 16% for Lapis lazuli and Marmor Hierapolitanum, 17% for *Rosso di Verona*, and rises to 26% for *Giallo di Castronovo*. However, it remains low for Marmor Thessalicum (4.3%) and Marmor Lunense (2.6%).

(iv) The error evaluated in making the *tesserae* also depends on the perimeter bounding a certain area, and therefore the smaller the area, the greater the error made in calculating the perimeter: in our case, the processed images are all high resolution and therefore the error measurement is very accurate.

In Table 1 are reported the recognized marbles with their common name, description, provenance and reference representative image.

Table 1. Recognized marbles with petrographic description, provenance, and reference representative image.

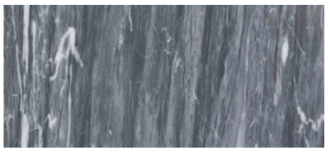
Common Name	Petrographic Description	Provenance	Reference Representative Image
Bardiglio	Dark and pale grey marble	Apuan Alps, Carrara, Italy	
Belgian Black	Black limestone with carbonaceous components	Golzinne, Gembloux, Belgium	

Table 1. *Cont.*

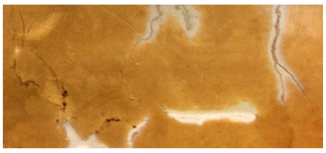
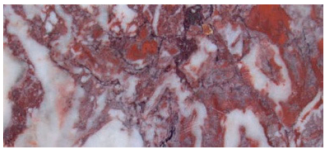
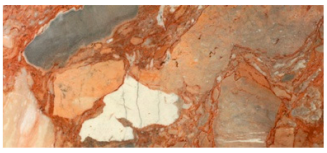
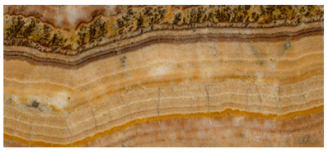
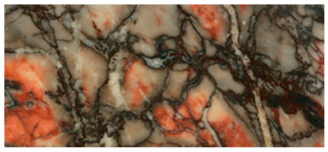
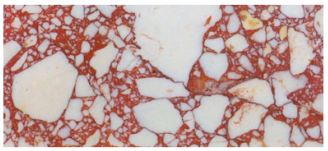
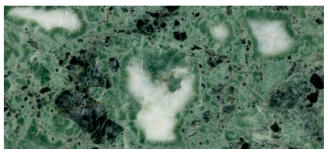
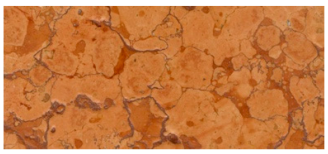
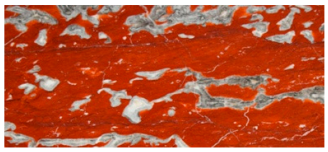
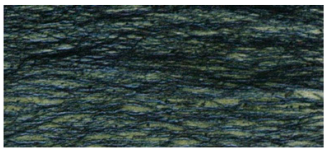
Common Name	Petrographic Description	Provenance	Reference Representative Image
Broccatello	Red and yellow fossiliferous limestone	Tortosa, Sapin	
Giallo di Castronovo	Yellow limestone with dispersed goethite and dark and thin veins	Castronovo, Palermo, Italy	
Lapis lazuli	metamorphic rock rich in lazurite	Sar-e Sang, Badakhshan, Afghanistan	
Libeccio antico	Fossiliferous, brecciated, and very variable-colored limestone	Custonaci, Trapani, Italy	
Marmor Chalcidium	Pinkish red metalimestone with large white veins	Nea Psara (ancient Eretria), Greece	
Marmor Chium	Limestone fault breccia with variable color, mainly with red cement	Chios Island, Greece	
Marmor Hierapolitanum	Fine-grained banded, compact calcite travertine	Pamukkale (ancient Hierapolis), Turkey	
Marmor Luculleum	Carbonate metabreccia with variable-colored clasts and black matrix and cement	Teos, Turkey	
Marmor Lunense	White pure sacaroid marble	Apuan Alps, Carrara, Italy	

Table 1. *Cont.*

Common Name	Petrographic Description	Provenance	Reference Representative Image
Marmor Sagarium	Carbonate breccia with white clasts and red matrix	Vezirhan, Turkey	
Marmor Thessalicum	Green ophicalcite breccia	Chasabali, Greece	
Rosso di Verona	Red limestone with ammonite fragments	Verona, Italy	
Rosso Francia	Red limestone with sparry calcite veins	Caunes-Minervois, France	
Verde Alpi	Green ophicalcite breccia	Western Alps area, Aosta, Italy	
Verde Ranocchia	Serpentinite	Wadi Umm Esh, Egypt	

4. Discussion

Antependia made of polychrome marbles are widespread throughout Apulia; among the most famous are those in the Cathedrals of Cerignola (Foggia), Canosa (Foggia), Troia (Foggia), Bari, Brindisi, and, in particular, the highly precious polychrome marbles in the San Cataldo Cathedral in Taranto. The main architects and marmorari who worked in Apulia were Cosimo Fanzago, Antonio Domenico Vaccaro, Carlo Tucci, Nicola Lamberti, and Aniello Greco [14,16,17].

Outside Apulia, still in Southern Italy, it is important to mention the use of polychrome marbles in the Church of Gesù in Naples, the Sanctuary of Montevergine (Avellino), and the Abbey of Montecassino (Frosinone). Normally, the *antependia* found in the Christian churches of Southern Italy are made of Marmor Lunense bordered on the inside by Belgian Black that enclose the floral designs realized with a very wide variety of polychrome marbles; for the most precious altars, the use of particularly valuable marbles such as lapis lazuli was reserved, with which important sacred depictions were made (e.g., the representation of the Virgin Mary in the High altar in the sanctuary of Montevergine, Avellino) or very small parts such as the center of the flower corolla (e.g., in the altar of Most Blessed Sacrament of the Cathedral of Altamura and in the High altar of San Cataldo Cathedral in Taranto).

Petrographic analysis of the lithologies of polychrome marbles used in the altar *antependia* of the Apulian Cathedrals of Gravina and Altamura certify the excellent craftsmanship required to create these marble compositions resembling paintings.

All the Baroque altar *antependia*, representing valuable examples of the Neapolitan artistic school, show the use of rocks quarried during the Roman Imperial period (such as Marmor Luculleum, Marmor Thessalicum, Marmor Chium, Marmor Sagarium, etc.) and of rocks quarried in the Baroque period (*Rosso di Verona*, *Giallo di Castronovo*, *Libeccio antico*, etc.). The complexity of the design and the accuracy in the execution of marble details suggest that the customers, generally the Catholic curia, depending on their economic capabilities, turned to more or less prestigious workshops; in fact, the *antependia* of the Gravina Cathedral show designs significantly more refined than those of the Altamura Cathedral.

The analysis of the similarity of symmetrical *tesserae* used in the same altar *antependia* or in different details of the same altar, assuming once again that the accuracy in the realization of symmetric *tesserae* can be evaluated by calculating their surface area, also shows that in the *antependium* of the High Altar of Gravina Cathedral, the maximum error between symmetric *tesserae* is 3.5%, while for the altar *antependium* of the altar of the Most Blessed Sacrament in the Altamura Cathedral, it is 6.5%, and it even exceeds 26% in their upper gradines.

The varying precision in the execution of symmetric *tesserae* in polychrome marbles certainly reflects the skill level of the different workers in the workshop: referring to the same workshop, there could be significant differences depending on whether the work was carried out by an apprentice or by someone with extensive experience.

Furthermore, the results suggest that the *marmoraro* certainly took into account the distance between the observer and his artwork during the production of similar symmetric tiles.

In fact, in the *antependium* of the altar of the Blessed Sacrament of the Altamura Cathedral, the maximum error between the tiles in *Bardiglio* is 6.5%, and the maximum error between *Giallo di Castronovo* tiles is 1.6%, but both errors decrease dramatically to 1% in the symmetric *Bardiglio* tiles on the right side of *antependium*, which are closer together, or even down to 0.2% if we refer to the symmetric *Giallo di Castronovo* tiles of the right side.

The same occurs in the two upper gradines of the Blessed Sacrament of the Altamura Cathedral, where the error in creating symmetric tiles of the same lithology is lower when referring to the same gradine: a clear example is given by the details in *Rosso di Verona*, which show a maximum error of 17% when considering both gradines but decrease to 0.3% when considering only the two symmetric details of the right altar gradine.

In all marble creations, the error between symmetric details in Marmor Lunense remains consistently low, even although these are obtained by carving out the marble slab that would have hosted the other marble *tesserae*: perhaps characteristics and properties of rock, such as the uniformity of the marble grain, could facilitate the execution of similar pieces.

The study also reveals that the error in creating symmetric *tesserae* primarily depended on the hardness of the rock, as observed for *Verde Ranocchia* or Marmor Thessalicum, and subordinately on the complexity of the design. An example of this is Marmor Lunense, which is relatively soft compared to silicate rocks. Even with very complex designs, it consistently shows low errors. This is due to the small to medium grain size and equigranular texture of the rock, which allow for greater workability.

Furthermore, the most precious marbles were reserved for specific uses. For example, Lapis Lazuli was used in the central part of the flowers, or Marmor Luculleum (listed among the marbles at a fixed price in the edict of Diocletian from 301 AD), which covers the relics of San Filippo Neri on the mensa of the homonymous altar in the Cathedral of Gravina (Figure 2).

5. Conclusions

The study of polychrome marbles recognized in Baroque Catholic churches contributes to understanding the materials, techniques, and modus operandi of *marmorari* and allow for the reconstruction of the artistic relationship between major production centers, like the city of Naples, and various Catholic religious buildings of Southern Italy.

Rocks used to create altar *antependia* in Catholic churches can be traced back to Roman spolia or quarried during the Baroque period.

The inestimable value of the altars can be assessed not only by the preciousness of some of the marbles but also by the precision with which the *marmorari* executed the individual tiles of the *antependia*.

In addition to the skill of the *marmorari*, the lithology of the *tesserae* and, to a lesser extent, the complexity of the designs conditioned the perfection of the work.

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References

1. Corsi, F. *Delle Pietre Antiche*; Dalla Tipografia Salviucci: Rome, Italy, 1833.
2. Gnoli, R. *Marmora Romana*; Ed. rived. e ampliata, [Nachdr.]; Edizioni dell'Elefante: Rome, Italy, 1988.
3. Borghini, G. *Marmi Antichi*; De Luca Editori d'Arte: Rome, Italy, 1992.
4. De Nuccio, M.; Ungaro, L.; Pensabene, P.; Lazzarini, L. (Eds.) *I Marmi Colorati della Roma Imperiale*; Marsilio: Venezia, Italy, 2002.
5. Collins, S. *The Standard of Ur*; Object in focus; British Museum Press: London, UK, 2015.
6. El-Mageed, E.A.; Ibrahim, S.A. Ancient Egyptian Colours as a Contemporary Fashion. *J. Int. Colour Assoc.* **2012**, *9*, 32–47.
7. Saul, J.M. Flickering Flames over the Libyan Desert? *Int. Geol. Rev.* **2019**, *61*, 1340–1369. [CrossRef]
8. Lazzarini, L.; Sangati, C. I Più Importanti Marmi e Pietre Colorati Usati Dagli Antichi. In *Pietre e Marmi Antichi—Natura, Caratterizzazione, Origine Storia d'Uso, Diffusione, Collezionismo*; Lazzarini, L., Ed.; CEDAM: Padova, Italy, 2004; pp. 73–100.
9. Lazzarini, L. I Marmi e le Pietre del Pavimento Marciano. In *Il Manto di Pietra di San Marco a Venezia. Storia, Restauri, Geometrie del Pavimento*; Vio, E., Ed.; Cicero: Venezia, Italy, 2012; pp. 51–108.
10. Hirt, A.M. *Imperial Mines and Quarries in the Roman World: Organizational Aspects, 27 BC–AD 235*; Oxford classical monographs; Oxford University Press: Oxford, UK; New York, NY, USA, 2010.
11. Calvano, C.D.; Van Der Werf, I.D.; Palmisano, F.; Sabbatini, L. Revealing the Composition of Organic Materials in Polychrome Works of Art: The Role of Mass Spectrometry-Based Techniques. *Anal. Bioanal. Chem.* **2016**, *408*, 6957–6981. [CrossRef] [PubMed]
12. Bonanni, A. Interraso marmore (Plin., N.H., 35, 2): Esempi della tecnica decorativa a intarsio in età romana. *Studi Misc.* **1998**, *31*, 259–292.
13. Ribechini, E.; Orsini, S.; Silvano, F.; Colombini, M.P. Py-GC/MS, GC/MS and FTIR Investigations on LATE Roman-Egyptian Adhesives from Opus Sectile: New Insights into Ancient Recipes and Technologies. *Anal. Chim. Acta* **2009**, *638*, 79–87. [CrossRef] [PubMed]
14. Pasculli Ferrara, D. *L'Arte dei Marmorari in Italia Meridionale: Tipologie e Tecniche in Età Barocca*; Atlante tematico del Barocco in Italia; De Luca Editori d'Arte: Rome, Italy, 2013.
15. De Lachenal, L. *Spolia: Uso e Reimpiego dell'Antico dal III al XIV Secolo*; Biblioteca di archeologia; Longanesi: Milan, Italy, 1995.
16. Acquafredda, P.; Fioretti, G. Aspetti Petrografici Degli Altari in Marmi Policromi in Puglia. In *Viridarium Novum Studi di Storia dell'Arte in onore di Mimma Pasculli Ferrara*; Fonseca, C.D., Di Liddo, I., Eds.; De Luca Editori d'Arte: Rome, Italy, 2020; pp. 271–276.
17. Pasculli Ferrara, D.; Ressa, A. *Il Cappellone di San Cataldo: Il Trionfo di Giuseppe Sanmartino e dei Marmi Intarsiati Nella Cattedrale di Taranto*; De Luca Editori d'Arte: Rome, Italy, 2016.
18. Cooke, L. The 19th Century Corsi Collection of Decorative Stones: A Resource for the 21st Century? *Geol. Soc. Lond. Spec. Publ.* **2010**, *333*, 185–195. [CrossRef]
19. Matteucci, R. *Cristalli, Fossili e Marmi Antichi della Sapienza: Collezioni Storiche dei Musei di Scienze della Terra e Unità d'Italia*; Nuova Cultura: Rome, Italy, 2012.

20. Mielsch, H.; Antikenmuseum Berlin (Eds.) *Buntmarmore aus Rom im Antikenmuseum Berlin*; Staatliche Museen Preußischer Kulturbesitz: Berlin, Germany, 1985.
21. Giardini, G.; Colasante, S. *Collezioni di Pietre Decorative Antiche «Federico Pescetto» e «Pio de Santis»*; Istituto Poligrafico dello Stato: Rome, Italy, 2001.
22. Dolci, E.; Cioffarelli, A. *Marmi Antichi da Collezione la Raccolta Grassi del Museo Nazionale Romano*; Dolci, E., Nista, L., Eds.; Museo Civico del Marmo Carrara: Pisa, Italy, 1992.
23. Pensabene, P.; Bruno, M.; Stuto, G. (Eds.) *Il Marmo e Il Colore: Guida Fotografica, i Marmi della Collezione Podesti*; L'Erma di Bretschneider: Rome, Italy, 1998.
24. Napoleone, C. Il Collezionismo dei Marmi e Pietre Colorate dal Secolo XVI al Secolo XIX. In *Marmi Antichi*; Borghini, G., Ed.; Edizioni de Luca: Rome, Italy, 1992; pp. 99–116.
25. Fioretti, G.; Acquafredda, P.; Monno, A.; Montenegro, V.; Francescangeli, R. Roman Marble Collections in the Earth Sciences Museum of the University of Bari (Italy): A Valuable Heritage to Support Provenance Studies. *Heritage* **2023**, *6*, 4054–4071. [CrossRef]
26. Antonelli, F.; Lazzarini, L. An Updated Petrographic and Isotopic Reference Database for White Marbles Used in Antiquity. *Rend. Lincei* **2015**, *26*, 399–413. [CrossRef]
27. Antonelli, F.; Nestola, F. An Innovative Approach for Provenancing Ancient White Marbles: The Contribution of X-ray Diffraction to Disentangling the Origins of Göktepe and Carrara Marbles. *Sci. Rep.* **2021**, *11*, 22312. [CrossRef] [PubMed]
28. Brilli, M.; Antonelli, F.; Giustini, F.; Lazzarini, L.; Pensabene, P. Black Limestones Used in Antiquity: The Petrographic, Isotopic and EPR Database for Provenance Determination. *J. Archaeol. Sci.* **2010**, *37*, 994–1005. [CrossRef]
29. Antonelli, F.; Lazzarini, L.; Cancelliere, S. 'Granito del foro' and 'Granito di Nicotera': Petrographic features and archaeometric problems owing to similar appearance. *Archaeometry* **2010**, *52*, 919–936. [CrossRef]
30. Lazzarini, L.; Antonelli, F. L'identificazione Del Marmo Costituente Manufatti Antichi. In *Pietre e Marmi Antichi—Natura, Caratterizzazione, Origine Storia d'Uso, Diffusione, Collezionismo*; Lazzarini, L., Ed.; CEDAM: Padova, Italy, 2004; pp. 65–71.
31. Antonelli, F.; Lazzarini, L.; Cancelliere, S.; Dessandier, D. On the white and coloured marbles of the Roman town of *Cuicul* (Djemila, Algeria). *Archaeometry* **2009**, *52*, 575–596. [CrossRef]
32. Attanasio, D.; Bruno, M.; Prochaska, W.; Yavuz, A.B. A Multi-Method Database of the Black and White Marbles of Göktepe (Aphrodisias), Including Isotopic, EPR, Trace and Petrographic Data: The Black and White Marbles of Göktepe (Aphrodisias). *Archaeometry* **2015**, *57*, 217–245. [CrossRef]
33. Biricotti, F.; Severi, M. A Non-Destructive Methodology for the Characterization of White Marble of Artistic and Archaeological Interest. *J. Cult. Herit.* **2004**, *5*, 49–61. [CrossRef]
34. Maniatis, Y.; Tambakopoulos, D.; Lazzarini, L.; Sturgeon, M.C. Provenance Investigation of Three Marble Relief Sculptures from Ancient Corinth: New Evidence for the Circulation of the White Marble from Mani. *Archaeometry* **2021**, *63*, 685–704. [CrossRef]
35. Fioretti, G.; Acquafredda, P.; Calò, S.; Cinelli, M.; Germanò, G.; Laera, A.; Moccia, A. Study and Conservation of the St. Nicola's Basilica Mosaics (Bari, Italy) by Photogrammetric Survey: Mapping of Polychrome Marbles, Decorative Patterns and Past Restorations. *Stud. Conserv.* **2020**, *65*, 160–171. [CrossRef]
36. Bracci, S.; Vettori, S.; Cantisani, E.; Degano, I.; Galli, M. The Ancient Use of Colouring on the Marble Statues of Hierapolis of Phrygia (Turkey): An Integrated Multi-Analytical Approach. *Archaeol. Anthropol. Sci.* **2019**, *11*, 1611–1619. [CrossRef]
37. Attanasio, D.; Brilli, M.; Bruno, M. The properties and identification of marble from Proconnesos (Marmara Island, Turkey): A new database including isotopic, EPR and petrographic data. *Archaeometry* **2008**, *50*, 747–774. [CrossRef]
38. Acquafredda, P. Marmi policromi nella Cattedrale di Altamura: Aspetti petroarcheometrici. *Geol. Territ.* **2015**, *12*, 3–14.
39. Kullerud, G.; Yoder, H.S. Pyrite stability relations in the Fe-S system. *Econ. Geol.* **1959**, *54*, 533–572. [CrossRef]
40. Hall, A.J. Pyrite-pyrrhotine redox reactions in nature. *Mineral. Mag.* **1986**, *50*, 223–229. [CrossRef]
41. Nicholson, R.V.; Gillham, R.W.; Reardon, E.J. Pyrite oxidation in carbonate-buffered solution: 1. Experimental kinetics. *Geochim. Cosmochim. Acta* **1988**, *52*, 1077–1085. [CrossRef]
42. Lazzarini, L. Archaeometric aspects of white and coloured marbles used in antiquity: The state of the art. *Period. Mineral.* **2004**, *73*, 113–125.
43. May-Crespo, J.; Martìnez-Torres, P.; Quintana, P.; Alvarado-Gil, J.J.; Vilca-Quispe, L.; Camacho, N. Study of the Effects of Heating on Organic Matter and Mineral Phases in Limestones. *J. Spectrosc.* **2021**, *2021*, 9082863. [CrossRef]
44. Vigroux, M.; Sciarretta, F.; Eslami, J.; Beaucour, A.-E.; Bourgès, A.; Noumowé, A. High temperature effects on the properties of limestones: Post-fire diagnostics and material's durability. *Mater. Struct.* **2022**, *55*, 253. [CrossRef]

45. Russo, G. I Maestri Marmorari Napoletani della Seconda Metà del Settecento nel Cosentino. Alcuni Documenti Sulla Committenza degli Altari. *Arch. Stor. Calabr. Lucania* **2015**, *81*, 87–135. Available online: https://www.academia.edu/21810490/_I_maestri_marmorari_napoletani_della_seconda_met%C3%A0_del_Settecento_nel_Cosentino_Alcuni_documenti_sulla_committenza_degli_altari_in_Archivio_Storico_per_la_Calabria_e_la_Lucania_LXXXI_2015_pp_87_135_ISSN_0004_0355?uc-g-sw=19888868 (accessed on 12 May 2024).
46. Acquafredda, P.; Clemente, M.; Susca, M. I marmi policromi degli altari della Cattedrale di Gravina. In *La Cattedrale di Gravina nel Tempo*; Lorusso, G., Calculli, L., Clemente, M., Eds.; LAB Edizioni, Altamura: Bari, Italy, 2013; pp. 245–261. ISBN 978-88-97796-09-1.

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