



CHARACTERIZATION OF THE CERAMIC GLAZED TILES OF THE PALÁCIO ALMADA

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ABSTRACT

This study reports the mineralogical and chemical characterization of the ceramic body of tiles signed by Gabriel del Barco, which belong to the Palácio Almada in Lisbon [1]. Nowadays, the tile panels are not in its original place and their appearance reflect the constant changes that they have been through. Gabriel del Barco was an important tile painter from the 17th century, who began his career as an oil painter, linked to the most relevant Portuguese baroque artists. The influent Almada family was the owner of the former palace near Rossio, one of the most significant and busy squares in 17th century Lisbon.

Gabriel del Barco has been currently under investigation by the authors of this presentation through a FCT funded project [2]. In fact, the painter's characteristics and his large amount of works (both signed and ascribed), make him a unique artist in the Portuguese tile's panorama.

Powder samples carefully removed from the two panels of the palace were analysed by X-ray diffraction (DRX) and energy-dispersive X-ray spectroscopy (EDS). The results revealed that the mineralogical and chemical compositions are almost the same for the two panels. Chloride is present only in one of the panels. A comparison with the present results is made with a recent work, where signed and nonsigned tiles attributed to the artist, was made [3]. We discuss the several factors that may affect the characteristics of old tiles, which may involve differences in the manufacturing process, or environmental factors as the precipitation of water.

KEY-WORDS: Gabriel del Barco, Ceramic Glazed Tiles, X-Ray Diffraction, Energy-Dispersive XRay Spectroscopy

1. INTRODUCTION

Acknowledging the importance of glazed ceramic tiles on the cultural heritage of the south European countries, several studies devoted to tiles, have been published in the last years [4-7]. Tiles have been used as building materials in Portugal, since the 15th century. Prior to one of the most important periods of the history of Portuguese tiles, a particular Spanish painter, Gabriel del Barco, played an important role in the Portuguese arts at the time. The works painted by Gabriel del Barco



exhibit unique characteristics in terms of tonal modulations of different sorts of blue in different layers. His last signed works date from the last decade of the 17th century.

Through a FCT funded project [2], the authors of the present work have been undertaken an investigation on the works of Gabriel del Barco. This project combines historical and artistic data with results obtained by techniques such as X-ray diffraction (DRX) and energy-dispersive X-ray spectroscopy (EDS). In a recent paper [3], a detailed analysis of six panels, four signed and two panels attributed to the painter was presented. The signed panels belong to the collection of the Museu Nacional do Azulejo (MNAz), Lisbon, Portugal and one of the attributed works is the famous panel of the Grande panorama de Lisboa. We have undertaken a chemical and mineralogical analysis of the six panels in order to find any possible common features of these properties [3]. A glazed ceramic tile consists on a ceramic body covered with a glazed layer. Only the ceramic body of the tiles is analysed, as it would be very difficult to investigate the glazed part of historical pieces without damaging them. The results showed that on the Grande panorama de Lisboa, two groups or patterns of tiles with different mineralogical and chemical characteristics could be observed. One of these patterns was coincident with the one found on the signed panels. The distinction between the two patterns is based on the peak intensities of the phases calcite ($C=CaCO_3$) and gehlenite ($G=Ca_2Al[AlSiO_7]$) obtained from the X-ray diffraction results. Pattern A is characterized by $G/C \leq 1$, while samples belong to pattern B when $G/C > 1$. Also the CaO/MgO ratio, obtained from the EDS results, is higher than 15, in samples of pattern A.

Although some aspects have already been previously clarified [3], other open questions still remain, as it is not possible to establish if all the tiles of a panel were made using the same manufacturing procedure, if the raw material composition was the same or if there was one or several potteries that provide the tiles.

The present work follows the efforts that we have carried out to the pursuit of a possible authorship of the panel Grande panorama de Lisboa to Gabriel del Barco, combining chemical and mineralogical data with historical and artistic characteristics. We describe the analysis performed to two panels signed by Gabriel del Barco, which belong to the Palácio Almada in Lisbon. Historical information is given, as well as, data obtained from X-ray diffraction (DRX) and energy-dispersive X-ray spectroscopy (EDS). A comparison between these results and the ones obtained previously is performed.

2. HISTORICAL INFORMATION

The Palácio Almada in Lisbon, also known as Palace of the Independence, holds in one of the courtyards two tile panels from the seventeenth century, signed by Gabriel del Barco (a. 1669-1703) and dated 1696, well studied by José Meco [1]. The foundation of this imposing Lisbon palace dates back to late medieval period. It is located between Rossio, a very busy part of the capital, and the old wall built by King D. Fernando. It belonged once to the influential family of Almada, also Condes de Avranches, Senhores of Pombalinho and Lagares d'el Rei. This Palace was in the possession of this noble family during centuries. D. Antão de Almada (1573?-1644), who participated Portuguese Restoration in 1640, made this building so-well known and esteemed in Lisbon. However, we should also stress the role played by his grandson D. Lourenço de Almada (1645-1729) for the history of this noble residence and its artistic heritage. This outstanding figure of the court and akin to some of the most dominant families at the time (Melo e Castro, Almeidas and Dantas da Cunha) played several key positions over the reigns of D. Pedro II and D. João V [8,9,10].¹

¹ D. Lourenço de Almada was a fidalgo escudeiro and later appointed Mestre-Sala from the Royal household. It was also Commander of the Order of Christ of S. Vicente de Vimioso and Proença-a-Velha. From the social positions held, we should



From 1684, D. Lourenço de Almada had the firm intention of expanding the houses where he lived off the Rossio, expanding the area covered both to south and west [11]. The work of expansion seemed to start only from 1713, which coincides with the license obtained to this purpose from Lisbon city council. Between these two dates, it is likely that the oldest areas of the house (north and east wings) had undergone decorative interventions inside. These works were towards the replacement of an initial foundation of Renaissance taste for a more decorative way proper to baroque times.

The application of tile panels and other decorative ornaments of noble spaces in Lisbon became common in the last quarter of 17th century, not only by importing tiles from the Netherlands, but also by domestic production of polychrome and monochrome tiles or patterned and narrative ones. This was the case of the Palácio of the Marqueses de Fronteira, one of the most magnificent examples of a noble house in Lisbon area [12,13,14]. These sorts of panels of different sizes represent one of the most achievements of Portuguese Baroque, which found in tiles an excellent opportunity to explore its many dimensions: narrative, decorative and pleasure. It is in this context of *aggiornamento* of courtier interiors, in connection to the pictorial resources and illusionistic effects proper to tiles, that we must understand the commission of tile panels to Gabriel del Barco, central object of our study.

This artist was one of the leading responsible for the generalization of the "blue and white" sense of decoration, leaving a considerable production in palaces and country houses, churches and chapels. If we take into account the dating of the panels (1696), we note that it is precisely in this last decade of the seventeenth century in which we find higher levels of production of Barco tile painting workshop. From 1695 to the end of his career (1703?), Gabriel del Barco and his apprentices were able to satisfy orders, for example, to the Dantas da Cunha family who lived nearby, to the Conde da Ponte at Junqueira and to the Ferreira de Macedo family at Santiago parish (i.e. the large panorama of Lisbon, today in MNAz). Barco was also responsible for painting to the churches of S. Bartholomeu's Charneca (Lisbon), S. Mamede and Santiago in Évora and the convent of Lóios in Arraiolos [15,16].

Nowadays, the extension of works at the Palace Almada is unknown. From the analyses of photos of the palace in 1940's revealed by José Meco, a period coinciding with the changes and restoration operated by Direcção Geral dos Edifícios e Monumentos Nacionais, we found that there were at least four more figurative panels with respective frames, unfortunately all missing and involving at least two rooms of the Palace. According to such photographic records, it appears that already at that time, panels were not well sorted, which may indicate simultaneously a different origin or its reuse. The right timing of these changes we can not yet establish, on the assumption that, in fact, panels have always been decorating Palace Almada walls [1].²

From a whole set, today mischaracterized, it came to us just two panels with scenes of boar hunting, inspired by the engravings made by Antonio Tempesta, accordingly much to the taste of patrons of that time, which brings us back to the Dutch tiles at the Palácio of Marqueses of Fronteira [1,17].

As seen, the exact provenance of the two panels is problematic and uncertain. The marble lintels present in the photographs indicate the presence of the tiles on the main floor of the building. According to José Meco, the removal of these panels and their subsequent application in the outer walls of the upper courtyard of the palace caused them irretrievable loss [1]. In the near future, if

highlight the nominations to be Governor of Madeira (1688-90), Angola (1705-09) and Brazil (1710-11) and also Chairman of Junta do Comércio (1714-1717).

² Note that the panel "Dame à la fontange", visible in these pictures and usually ascribed to Gabriel del Barco, seems rather to be liable for pictorial aesthetic reasons dubbed to Master PMP. The panel patents full and well outlined figures contrasts with the spontaneity and imprecision inherent to the brushstrokes proper to Barco [1].



nothing is done, the current situation of the panels outside the building may indelibly compromise the integrity of tiles.

3. EXPERIMENTAL PROCEDURE

Small samples of the ceramic body of tiles signed by Gabriel del Barco at the Palacio Almada were detached with a scalpel and crushed in an agate mortar. Unfortunately, due to the degradation of the panel, there are some tiles where the glazed layer was detached. Our sampling procedure consisted precisely in removing a small piece of the ceramic body of tiles which have no glaze. Photographs of the two tile panels are shown in Fig. 1. The tile panels are at the same courtyard, side by side, at the façades of two different walls. The left- and right-hand side panels will be designated respectively by ALML (Fig. 1a) and ALMR (Fig. 1b). The panel ALMR is formed by 20×10 tiles, while the panel ALML is smaller and has only 15×10 tiles. Samples were removed from four different locations of each panel.



Fig. 1 - Photographs of the tile panels signed by Gabriel del Barco at the Palacio Almada: a) left- (ALML) and b) right-hand side (ALMR).

XRD patterns were obtained on a Philips PW 1730 diffractometer with automatic data acquisition (APD Phillips (v3.6B) software) using $\text{CuK}\alpha$ radiation ($\lambda = 1.5406 \text{ \AA}$). Diffractograms were obtained by continuous scanning from 15 to $50^\circ 2\theta$, with a step size of $0.02^\circ 2\theta$ and a time per step of 20.0 s with 40 kV and 30 mA in the X-ray tube. Due to the small amount of sample the analysis was made using oriented aggregates. To prepare it the solids were dispersed in distilled water in an ultrasonic bath at room temperature, deposited on a zero-background sample holder and allowed to evaporate.

Chemical analysis was carried out in a field emission gun scanning electron microscope (FEG–SEM) (JEOL model 7001F) with an X-ray energy-dispersive system (EDS). The samples were coated with a gold film before FEG–SEM analysis. An accelerating voltage of 20 kV was used and observations were carried out with secondary electrons. For each sample, at least four chemical analyses were performed.

4. RESULTS AND DISCUSSION

The XRD patterns displayed in Fig. 2 exemplify the results obtained with samples collected from the two panels. The mineral phases quartz (SiO_2), calcite (CaCO_3), and gehlenite ($\text{Ca}_2\text{Al}[\text{AlSiO}_7]$), a neoformed phase during firing, were identified in all samples. Diopside ($\text{CaMgSi}_2\text{O}_6$) another neoformed phase was detected in some samples always associated to very low intense diffraction

peaks. Low intensity peaks attributed to mullite ($3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$) and feldspars (albite, $\text{NaAlSi}_3\text{O}_8$; anorthite, $\text{CaAl}_2\text{Si}_2\text{O}_8$) were also found.

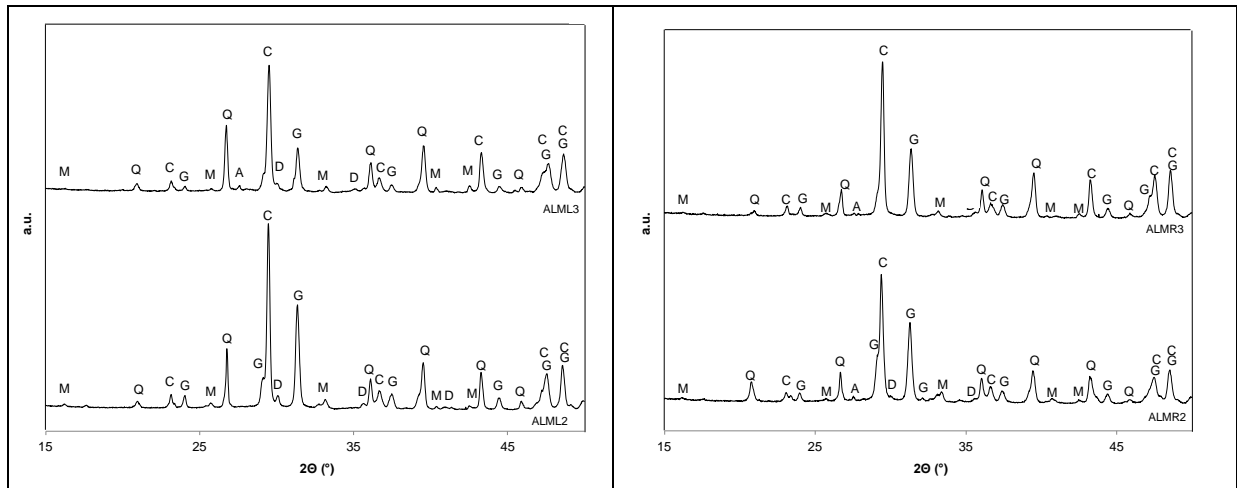


Fig. 2 - XRD patterns of samples collected from the left- (ALM2 and 3) and right-hand panels (ALMR2 and 3). (Q, quartz; C, calcite; G, gehlenite; D, diopside; A, albite/anorthite; M, mullite).

The final composition of the ceramic body depends on several factors, such as the bulk composition of the paste to manufacture the tiles, the firing temperatures and the duration of the firing step [18]. The raw materials are essentially carbonates, such as calcite and dolomite, quartz, feldspars and impurities. As mentioned in the introduction, in a previous study focused on samples from panel Grande panorama de Lisboa and panels signed by Gabriel del Barco, we used the ratio between the intensities of the major peaks of gehlenite and calcite at, respectively, around 31.5 and 29.4 °2θ (reported as G/C) as a tentative semi-quantification of the tiles manufacture procedure [3]. The ratio allowed us to classify the samples into two patterns: samples where $G/C \leq 1$ (pattern A), others where $G/C > 1$ (pattern B). The majority of the samples coming from panels signed by Gabriel del Barco presented $G/C > 1$ [3]. However, on the major panel, Grande panorama de Lisboa, the two groups or patterns of tiles, A and B, were observed [3]. The G/C ratios of the samples ALML and ALMR, determined on the present work, are less than one and consequently fall into the category A. The presence of a relative high amount of calcite can be, at least partially, originate from the precipitation from water that percolates the tile [5]. As it was previously mentioned the panels are exposed to the environmental agents and they are not in a good conservation state. We have also to take into account some possible contamination of calcite from the mortar, although we try to be careful in the sampling procedure, which desirable consists only on the removal of the ceramic body of the tiles.

Fig. 3 presents an EDS spectroscopy spectrum of X-ray energies which allow the identification of the chemical elements present in the ceramic body of the tiles. Table 1 shows the chemical compositions of the samples, converted to oxides.

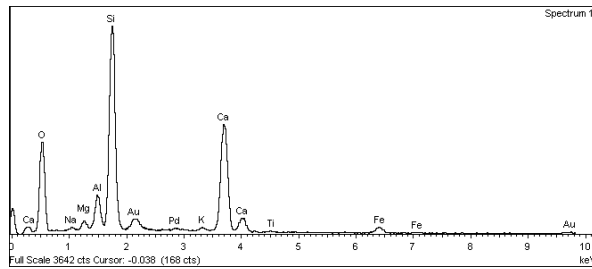


Fig. 3 - EDS spectroscopy spectrum of sample ALMR1.

Table 1 - Chemical composition (weight % oxide) of the ceramic body of samples*

	ALMR	ALML
CaO	27.80	30.66
SiO ₂	50.17	48.85
Al ₂ O ₃	7.12	10.58
Fe ₂ O ₃	2.84	4.29
MgO	1.41	2.69
K ₂ O	2.68	1.36
Na ₂ O	6.30	1.01
SO ₃	1.44	---
TiO ₂	0.24	0.57
Cl	3.97	---
CaO/MgO	19.77	11.39
SiO ₂ /CaO	1.80	1.59

* The oxides have been recalculated to 100%

The ceramic body of the tiles has a predominance of calcium oxide (27.80-30.66%) and silica (50.17-48.85%). The aluminium oxide varies from 7.12 to 10.58% and the iron oxide is in the range 2.84-4.29%. The magnesium oxide and potassium oxide quantities are in the intervals respectively of 1.41-2.69% and 1.36-2.68%. The amount of Na₂O is the interval 1.01-6.30%. Traces of other oxides are detected. Also an amount of 3.97% of chloride is detected on the panel ALMR. Although both panels are exposed to rain water, the panel designated by ALMR is more accessible to this external agent. The panels are exposed side by side, but at different walls. In fact, the panel ALMR is at the bottom of a large straight wall, while the panel ALML is fixed underneath a step of another wall. This step, eventually, may absorb some rain water, which falls from the upper part of the wall, and, at some extent, protect the panel.

The EDS results are compatible and similar to the ones found in the panel Grande panorama de Lisboa and the panels signed by Gabriel del Barco in the study previously mentioned [3]. In the previous work, the two different patterns evidenced by the XRD results were also related to the CaO/MgO ratio, that was higher than 15 for samples of pattern A [3]. The values quoted in Table 1 show that this ratio is higher than 15 for samples ALMR, while for samples ALML is lower than that value. This would suggest type A pattern for ALMR tiles, (also in accordance to the XRD data), whereas tiles from sample ALML would be closer to pattern B. However, the XRD based classification gives it as belonging to type A.

On our previous work, we also associated lower values of SiO₂/CaO to pattern A [3]. However, in the case of the samples studied on the present work, the values of this ratio are higher than the ones previously reported [3].



5. CONCLUSIONS

The present work is another step forward to characterize the Portuguese tile painting of the last years of the 17th and the first quarter of the 18th centuries. It is part of a larger interdisciplinary study focused mainly in panels signed and attributed to Gabriel del Barco.

The results obtained with samples collected from panels of the Palácio Almada signed by Gabriel del Barco revealed that the mineralogical and chemical compositions are comparable with the results previously obtained, mainly, with samples from panels attributed to this artist, as the panel Grande panorama de Lisboa. This is a very important achievement, as in our previous findings, we found that the signed panels were classified as B type, while the attributed works were from both A and B type. With the analysis to the samples of the Palácio Almada, we have found signed panels that belong to pattern A. This compatibility of the chemical and mineralogical compositions of the Palace tiles and one group of tiles exhibited by the panel Grande panorama de Lisboa, is extremely important, as indicates the same origin of the tiles that belong to the two different panels.

The fact that the Palácio Almada tiles are exposed to adverse environmental conditions and considerably damaged, requires an increase of the number of samples analysed, in order to have a representative characterization of the panel.

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