

Studies in Heritage Glazed Ceramics

The majolica azulejo heritage
of *Quinta da Bacalhôa*



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PREFACE

Studies in Heritage Glazed Ceramics was forcefully interrupted for almost two years due to the COVID-19 crisis, but returns with its third number, the first of a special series of four volumes dedicated to the renaissance majolica azulejo heritage of *Palácio e Quinta da Bacalhôa* in Azeitão, Portugal.

The azulejos of Bacalhôa have a legendary status in the studies of renaissance majolica in the Iberian Peninsula in general, because of their extraordinary variety and quality and the fact that its most mythical panel, representing the biblical episode of *Susanna and the Elders*, is dated "1565" – a chronology hardly compatible with the then-recent production of azulejos in Portugal. Several hypotheses were advanced over the years to cope with this seemingly impossibility, almost always involving Flemish potters immigrated to the Peninsula.

Another problem stems from the assortment of patterned tiles, often depicting variations in the design or the quality of the workmanship only explainable by the involvement of, not one, but several workshops... But what could those workshops be? Who were the potters and painters behind such artistic achievement? What is the approximate chronology of the different (non-dated) panels and linings with patterned tiles? And most of all: how does the unrivalled treasure of renaissance tiles of Bacalhôa fit within the history of the diffusion of the majolica technology and its firm establishment in Spain and Portugal, where azulejos developed to become a cultural trait still flourishing today?

Following the studies in the early production of majolica azulejos in Portugal, published in the first two numbers of this journal, a multidisciplinary research team was formed to try and reply (within the bounds of the possible) to those questions, as well as to shed light on a number of other perplexing details related to the surviving panels. The research lasted for two years and the results will be published in a dedicated special series. This first volume includes four articles which deal with the basic issues and establish the basis for the detailed study of the panels and patterned tiles that will follow. Four more articles will be published in the second volume, in January 2022, and the last eight articles will be published in the third and fourth volumes within the following 12 months.

The scientific production stands on several pillars, one of them the peer-reviewers of the authors' papers, whose names are often unknown but whose importance in the final output is singular. The editors wish to heartily thank the reviewers for this number: Professor Nuno Senos of *Instituto de História da Arte* of *Universidade Nova de Lisboa*, Doctor Alexandre Nobre Pais, Director of *Museu Nacional do Azulejo* and Doctor António dos Santos Silva of *Laboratório Nacional de Engenharia Civil* (LNEC) who have graciously accepted the hardship of the revisions.

LNEC thus presents this third number of its journal dedicated to azulejos and other glazed ceramics with a set of articles resulting from the cooperation of the tools of Humanities and Natural Sciences aiming to support in solid foundations the study and understanding of one of today's most prized cultural heritages of Portugal.

The Editors

EDITORS

João Manuel Mimoso (LNEC), Alexandre Nobre Pais (MNAz), José Delgado Rodrigues (LNEC) & Sílvia R. M. Pereira (HERCULES & LNEC)

SCOPE

Studies in Heritage Glazed Ceramics is dedicated to the results of scientific studies in the field with a particular emphasis on analytical results, conservation issues and historical studies and very specially to multidisciplinary research in the domain.

The contents will include:

- Archaeometry studies, namely the application of analytic methods to the identification of materials and the establishment of technologies, provenance or the setting of chronologies;
- The artistic and historical context of productions, materials and evolving technologies, as well as the origin, preparation and trade routes of pigments and other raw materials;
- Decay of glazed ceramics, techniques and materials for conservation;
- Other innovative research results in the field.

Juan Flores: azulejo works in Spain and connection to the Bacalhôa Palace in Portugal

Alfonso Pleguezuelo, Angél Sánchez-Cabezudo, João Manuel Mimoso, Maria Augusta Antunes, Sílvia Pereira, Álvaro Silva

ABSTRACT

In 1550 Jan Floris de Vriendt (Antwerp 1520/24 - Talavera, Spain 1567) became the first painter of majolica to acquire the status of master in the painters' Guild of Saint Luke in Antwerp. In his *Het Schilder-Boeck*, published in Haarlem in 1604, Karel van Mander writes: "Jan Floris was a potter of glazed ceramics more skilful and famous than any other in the Low Countries, and because of his talent he was called to Spain to work in the service of King Philip (...)." And yet, no work of his is known to survive in his native Antwerp.

Although no reference to a Jan Floris has ever been found in Spain, several documents contemporary to his presumed presence in the country mention a certain Juan Flores, a Flemish master of majolica tiles in the service of King Philip II (1527-1598) until 1567, who can be identified as Jan Floris with a Castilianised name.

This paper reviews Juan Flores' career in Spain together with his known works there, as well as his presumed sojourn in Portugal where he may have come to work for Brás [Afonso] de Albuquerque (1500-1581) producing majolica panels and patterned tiles for the decoration of the palace and gardens of Bacalhôa, near Lisbon. It also includes the results of an analytical characterization on samples collected in the Spanish panels and tiles attributed to Juan Flores, in order to determine and assess their morphologic features and chemical composition.

RESUMO

Em 1550 Jan Floris de Vriendt (Antuérpia 1520/24 - Talavera, Espanha 1567) tornou-se o primeiro pintor de faiança a adquirir o estatuto de mestre na Corporação de São Lucas, em Antuérpia. No *Het Schilder-Boeck* (Livro dos Pintores), publicado em Haarlem em 1604, Karel van Mander escreve: "Jan Floris era o oleiro de cerâmica vidrada mais hábil e famoso dos Países Baixos, e devido ao seu talento foi chamado a Espanha para trabalhar ao serviço do Rei Filipe (...)". E, no entanto, não se conhece qualquer obra sua em Antuérpia.

Embora nenhuma referência a um Jan Floris tenha sido encontrada em Espanha, vários documentos contemporâneos da sua presumível presença no país mencionam um certo Juan Flores, mestre flamengo de azulejos ao serviço de Filipe II de Espanha (1527-1598) até 1567, que pode ser identificado como Jan Floris com um nome castelhanizado.

Este artigo revê a carreira de Juan Flores em Espanha, juntamente com as suas obras conhecidas no país, bem como a sua suposta estadia em Portugal onde terá trabalhado para Brás [Afonso] de Albuquerque (1500-1581) na decoração do palácio e jardins da Bacalhôa com azulejos de faiança. Também inclui os resultados de uma caracterização analítica realizada em amostras colhidas em azulejos existentes em Espanha e atribuídos a Flores, discutindo a morfologia dos vidrado e as composições químicas.

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KEYWORDS: Renaissance majolica; Azulejos; Palace of Bacalhôa; Jan Floris; Juan Flores

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Our sincere thanks to Reverend Father Nicolás Rivero Porras of Garrovillas de Alconétar (Cáceres) and to Reverend Father Roberto Rubio Domínguez of Cañaveral (Cáceres) for receiving us and allowing the sampling of tiles at, respectively, the Church of Saint Peter and the Church of Saint Marina.

Sections 2 and 3 translated from the Spanish by Judith Wilcock.

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1. INTRODUCTION

In 1550 Jan Floris de Vriendt (Antwerp 1520/24 - Talavera, Spain 1567) became the first painter of majolica to acquire the status of master in the painters' Guild of Saint Luke in Antwerp. In his *Het Schilder-Boeck*, published in Haarlem in 1604, Karel van Mander praised Floris as having once been the most skilled and famous potter of glazed ceramics in the Low Countries. And yet, no work of his is known to survive in his native Antwerp.

Although no reference to a Jan Floris has ever been found in Spain, several documents contemporary to his presumed presence in the country mention a certain *Juan Flores*, a Flemish master of majolica tiles in the service of King Philip II (1527-1598) until 1567, who can be identified as Jan Floris with a Castilianised name.

This paper discusses Juan Flores' career in Spain together with his known works there, as well as his presumed sojourn in Portugal where he may have worked for Brás [Afonso] de Albuquerque (1500-1581) on the tiling at the Palace of Bacalhôa, near Lisbon. It also includes the results of an analytical characterization on samples collected in the Spanish panels and tiles attributed to Juan Flores, in order to determine and assess their morphologic features and chemical composition for comparative purposes.

Floris/Flores work in the Iberian Peninsula is more than sufficient in itself to ensure him a special place in the field of renaissance majolica in Europe. But it is also worth noting that a number of Spanish potters and painters of majolica are known to have undertaken their apprenticeship with Flores, which means that his brief career in the Iberian Peninsula bore fruit, not only in an outstanding set of works in azulejos, but also in the assurance of a continuity that would certainly contribute to give Talavera its fame in the field.

2. A BIOGRAPHY AND WORKS OF JUAN FLORES IN SPAIN

Juan Flores was born in Antwerp circa 1520–1524 where he trained in a family setting alongside his three artist brothers: Frans Floris (c. 1519-1570) (easel painter), Cornelis Floris (1514-1575), sculptor, architect and engraver, and Jacob Floris (1524-1581), painter of stained-glass windows [1, p. 25]. He worked in his native city as a painter, achieving masterhood in the Guild of Saint Luke in 1550 [2, p. 237]. None of the works from his Flemish period is known. The following year he was mentioned in a document as being absent from Antwerp [2, p. 237]. Although we cannot be certain where he was in 1551, he is thought to have been in Spain, but four years later, in 1555, a “Joan Floris” is cited in a process opened by the Lisbon Inquisition against a furrier claiming to be his friend [3, pp. 102-103]. That document records him as living in Lisbon,¹ at Rua Cata Que Farás – in other words, in the Ribeira das Naus quarter, near the royal palace. Although his occupation is mentioned only as “painter”, it is likely that the person in question was *the* Juan Flores. If that were the case, we do not know how long he stayed in Lisbon or when he left for Extremadura in Spain; neither do we know if, as has been thought until now, he had already established himself in Plasencia (Cáceres) before his possible stay in Portugal.

1 The Portuguese word used in the document is “morador”, which means that he resided in the town at the time.

He presumably made the azulejo works he dated respectively in 1559 and 1560 in Plasencia (Cáceres), where he is recorded as residing in March and April 1561 [4, pp. 93-94]. The most important of these works, as the only one signed with his initials and the date (1559), is the set of tiles nowadays preserved in the parish church of San Pedro in Garrovillas de Alconétar (Cáceres), a village near the River Tagus [5]. This work has enormous significance as the basis for attributing to this author other sets where only the date is visible, and even certain works that bear neither signature nor date. We do not know what the Garrovillas work looked like originally because it has reached us as a recomposed, incomplete set that nowadays occupies a different location in the church. However, we can gain an approximate idea of the initial ornamental structure from the various types of motifs that decorate the extant azulejos, whether in situ or in the parish storerooms. Some of these form figures leaning on pedestals, shown against a neutral backdrop of curtains behind which is an ornamental pattern of intertwining ribbons and leaves. Two of these figures are complete and depict Saint Paul and Saint Andrew (Figure 1). Other azulejos, nowadays held in the storerooms, show fragments of a third apostle from the same series as the previous set and with the same backdrop, although the iconography is less identifiable. Lastly, several azulejos appear to have formed part of an image of the Virgin and Child. Once again, the image stands out against a curtain in the background, behind which we see another ornamental pattern that coincides with the one we find in Room 1 of the Pleasure House at Bacalhôa, as we shall refer later on (Figure 9). Numerous azulejos with this same pattern complete the set.



Figure 1. Juan Flores, 1559 *Iglesia de San Pedro*, Garrovillas de Alconetar (Cáceres). Left side: Saint Paul; Right side: Saint Andrew.

White intertwining ribbons with vegetal finials form both patterns for the background tiles. The ribbons stand out on green, blue, black and yellow grounds. The remaining azulejos feature a variety of motifs designed as borders around the background tiles. The

combination of these three types – figurative, background pattern and border pattern – suggests that the original work may have formed a continuous wainscot, although they could also be altar frontals composed of figures on patterned grounds.

We find another very similar set of azulejos in the parish church of Santa Marina in Cañaverol (Cáceres), another small village near the River Tagus and not far from Garrovillas [6; 7] (Figures 2, 3).

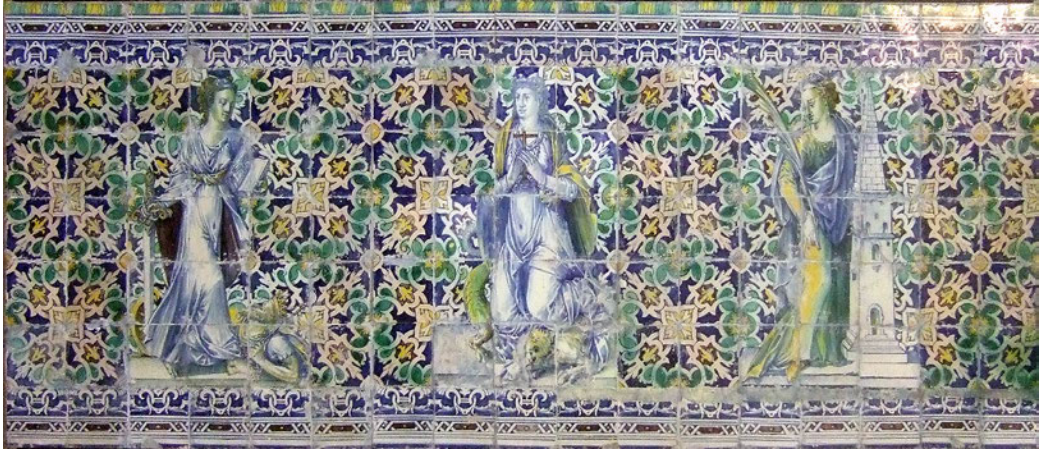


Figure 2. Juan Flores (attrib.) - *Iglesia de Santa Marina*, Cañaverol (Cáceres). From left to right Saint Catherine, Saint Margaret and Saint Barbara.

As in the previous case, it has not reached us in its original state, although there is nothing to suggest it was made for another church because one of the three figures depicted is Saint Margaret, known locally as *Santa Marina*,² to whom the church is dedicated, accompanied by Saint Barbara and Saint Catherine of Alexandria. On this panel, the images of the saints do not have curtains behind them but stand out directly against a background of patterned tiles. The pattern we see is the same one that is used in Garrovillas as the background for the apostles, which reaffirms the attribution to Flores of this set of azulejos that bears neither signature nor date, although the pictorial quality is of an even higher standard than we find in Garrovillas. A third type of azulejos features motifs designed to frame the composition, which in this case includes tassels; this suggests, as in Garrovillas, that the original set may have comprised an altar frontal imitating a textile, as was customary.

We do not yet know who commissioned the two panels, although it is interesting to note that they share the same ornamental structure and that the two towns for which Juan Flores painted them formed part of the estate belonging to the Count of Alba de Liste. At the time when these works were made, Diego Enríquez de Guzmán y Toledo (c. 1530–1604) was the fifth count. This eminent figure served as a field marshal in Flanders and gentleman-in-waiting to Philip II, and between 1585 and 1592 he was viceroy of Sicily.

² The name *St. Margaret* is a 9th century derivative of the original “St. Marina of Antioch” which, in time, was generally adopted by the Catholic Church, while the Orthodox Church retained the original name. The dragon is the attribute of St. Margaret / St. Marina of Antioch and leaves no doubt as to the identification, not to be confused with St. Marina of Águas Santas who is a different saint. The fact that the name “St. Marina” subsists in this church is interesting in itself, suggesting an ancient local devotion that conserved the original name of the saint.



Figure 3. Juan Flores (attrib.) - Church of Santa Marina. Cañaveral, Saint Catherine (detail).

Juan Flores almost certainly also painted in Plasencia the azulejos which today adorn the chapel of *El Santísimo Cristo* in Garganta la Olla (Cáceres), dated 1560, but which appear to have come from the nearby shrine of San Martín [8, p. 50]. In this case, an inscription indicates the name of the person who commissioned the work and the year: *Gaspar Enriquez de Montalvo, vecino de Oropesa, 1560* (Figure 4). This is another eminent figure who travelled to Peru in the entourage of Francisco Álvarez de Toledo y Figueroa (?- before 1548), Third Count of Oropesa [9, p. 19].

His father's family, surnamed Álvarez de Toledo, was linked not only to the county of Oropesa but also to the duchy of Alba de Tormes; his ancestors on his mother's side, surnamed Suárez de Figueroa, were dukes of Feria. Three years after painting the coat of arms of Gaspar Enriquez de Montalvo, Juan Flores appears to have had close connections with this second family. In fact, we know from a letter the artist wrote on 29 November 1563 to Gómez III Suárez de Figueroa, Fifth Count (1552–1567) and First Duke of Feria (1567–1571), that he was engaged at the time painting azulejos for the nobleman's palace in Zafra (Badajoz) [10]. As indicated by the date, Flores carried out this latter assignment, of which the tiles produced have been lost, when he was already working for the king. From the clients mentioned, it would appear that the artist had close ties with the higher nobility of Castile, all of whom had connections with Flanders and with the circle of the Duke of Alba and Philip II of Spain.

For technical and stylistic reasons, we can also attribute to Flores' hand the azulejos in the old refectory of the monastery of Santo Domingo in Plasencia (Cáceres), nowadays a Parador hotel, despite the absence of both the date and signature [11, p. 23].



Figure 4. Juan Flores, 1560 (attrib.)- *Ermита del Santísimo Cristo*, Garganta la Olla (Cáceres).

Traditional ceramic production in Plasencia adopted the form of fine earthenware made of clay firing to a deep red colour, which is at odds, at least in terms of its appearance, with the refined, light-coloured biscuits that Flores used to make the azulejos we find in this city. Neither is there any evidence of the production of azulejos in Plasencia before and after his stay there. However, although we do not know the provenance of the clay he used during this stage of his career, it seems plausible that he would have imported it from somewhere else with a tradition in tile-making. The most important and nearest candidate was Talavera, located a hundred kilometres or so from Plasencia.

We do not know whether it was in Plasencia or in Talavera that Flores painted a panel nowadays known as the *Virgen de Peñitas*, which since 1950 has adorned the chapel of the same name near Oropesa (Toledo) [9, pp. 11-21;150-151]. This is a fascinating and very different work from the previous ones because it depicts an altarpiece with Corinthian columns in which the central panel shows the seated image of the Virgin and Child. In the panel that reached the present day the architectural structure was somewhat confused due to having been moved with undue care, but the original composition has recently been recovered thanks to a meticulous restoration (Figure 5). Numerous stylistic hallmarks link this panel to the works we have already mentioned, especially the one in Garrovillas, which provides us with a reasonable idea about the manner in which this artist painted. The way the light and shadow are rendered to lend virtual volume to the panels, the Flemish-style motifs that adorn the altarpiece pedestal and the spaces between the pairs of columns, and, above all, the close resemblance between the iconographic model of this image and the fragments of the same theme that formed part of the original composition in Garrovillas are all highly significant correlations. There

is a clear iconographic parallel in the two depictions of the image of the Virgin; this is particularly discernible in the Child's anatomy and in the fruits that the two figures hold in their hand (Figure 6). The opposing directions of the two figures possibly indicate that Flores used the same engraved source and even the same stencil, employing its obverse in one case and its reverse in the other.



Figure 5. Juan Flores (attrib.) - *Ermita de Nuestra Señora de Peñitas*, Oropesa (Toledo).

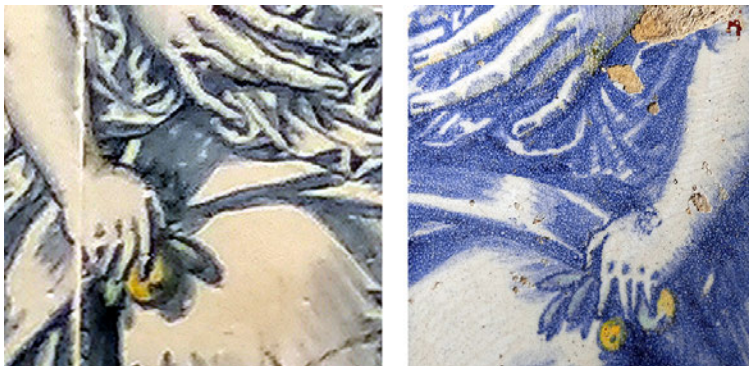


Figure 6. Left side: Juan Flores (attrib.) - *Ermita de Nuestra Señora de Peñitas*, Oropesa (Toledo); right side: Juan Flores - Church of San Pedro en Garrovillas de Alconetar (Cáceres).

The restoration of the Oropesa panel provided an opportunity to conduct a visual examination of the back of the azulejos, revealing that Flores marked each piece with an alphabetic (from top to bottom) and numerical (from left to right) code, incidentally

the exact same criterion used on some of the Bacalhôa panels. Certain tiles also have marks indicating the position in which they were placed in the kiln for their second firing [9, p. 17, figure 6].

From June 1562 until his death at the end of 1567, Flores resided in Talavera at the wishes of Philip II and pursued his profession there. However, Juan Flores was not the only member of his family who was employed in the king's service. Before he passed his painting examination in Antwerp by the Guild of St. Luke, his elder brother – and possibly his teacher – Frans Floris de Vriendt, another painter, had overseen the arrangements and ephemeral decorations for Charles V's solemn entry into Antwerp in 1549, accompanied by his son Prince Philip, the future Philip II of Spain. When years later the prince, now crowned king, decided to commission a grand altarpiece of paintings to preside over the church of the monastery of San Jerónimo el Real in Madrid, he chose the same artist. Frans Floris painted the panels for the altarpiece in Antwerp and sent them to Madrid in 1562, the exact same year in which the king appointed Juan Flores as supplier of the azulejos for the palaces he was renovating at the time. It is interesting to note, as we know from Karel van Mander's biography of the artist, that Frans kept in his own house works of his brother Jan/Juan [11]. Lastly, it was probably Jacob Floris, painter of stained-glass windows and brother of Frans and Juan, who is mentioned in connection with a payment in 1569 for bringing miscellaneous materials from Flanders to use on the stained-glass windows in the royal chambers, as well as tools for the Flemish hydraulic team working on the lakes in the gardens.³ There is no doubt that Philip II was very familiar with and admired the work of all the members of this important family of artists from Antwerp.

It was therefore in 1562 that the king decided that the majolica tiles with which he hoped to clad the palaces he was renovating during the early years of his reign should be made in Talavera. According to the contract, signed on 3 September 1562 with retroactive effect from June of the same year, Flores would receive the value of the azulejos delivered thereafter as well as a daily stipend, provided he executed the king's orders before those of any other clients. A clause referring to his appointment stipulates the following:

...that while executing work for His Majesty, his main and ordinary occupations shall be to fulfil said work and make all the azulejos His Majesty ordains and commands, respecting the requested patterns and colours [12].⁴

This clause suggests that while his commitment to the Crown was not exclusive, it was preferential and he was therefore obliged to give priority to the king's assignments. However, the contract also leaves open the possibility of Flores undertaking work outside the scope of the agreement in the absence of royal commissions. With such a fine reputation, especially after this appointment, Juan Flores must have become a figure in

3 The translated text reads as follows: *Flores, he of His Majesty's garderobe. He came here a few days ago with certain things he had brought from Flanders for His Majesty, including three pieces of equipment or ornaments to decorate stained-glass windows, as well as twelve pairs of cowhide boots for dockers and people who work in water... The Spanish text is: ...flores el del retrete de su magestad vino aquí los días passados con ciertas cosas que truxo de flandes para su magestad entre las quales traya tres furnimentos o adereços de todas las herramientas para sentar y adereçar vidrieras y mas doze pares de botas de (piel) de vaca para los diqueros y gente que trabaja en el agua.* (Archivo General de Simancas, Casa y Sitios Reales, bundle 247.2, fol 42.)

4 *...entre tanto que tuviera obra de Su Magestad, su principal y hordinaria ocupación sea en dar recaudo a ello y hazer todos los azulejos que Su Magestad le ordenare y mandare, conforme a los patrones que se le mandare y de las colores que se le pidieren...*

great demand among the Peninsula elite, especially in the circle of nobles close to the Spanish king.

It is only natural that Albuquerque, a man of refined tastes with enormous financial resources, should have aspired to have the azulejos in his estate painted by the king of Spain's appointed tile painter. We do not know if Albuquerque met Flores during his presumed first stay in Lisbon circa 1555, although it is certainly plausible considering the courtly circles they both frequented and the relative proximity of their places of residence on the banks of the River Tagus, one on either side of the royal palace. However, if this were not the case, the owner of the *Quinta da Bacalhôa* would certainly have heard excellent reports about the works that the Flemish painter was carrying out in Plasencia or Talavera.

Juan Flores' fellow compatriot painters may also have been the vehicle of connection between the artist and his client. Like Flores himself, many of his colleagues who worked for the Portuguese court in the mid-16th century switched to working for the Spanish crown, and vice versa. In Spain, as in Portugal, Mannerism largely arrived through the filter of Flanders, affecting both easel painting and majolica painting. In the former case, we need look no further than figures active at both courts, such as Simón Perejns (Antwerp, c. 1530-Mexico 1589), Alonso Sánchez Coello (1531-1588), Anthonis Mor (Antonio Moro) (Utrecht c. 1519-Antwerp, c 1576-78) and Jooris van der Straeten (Jorge de la Rúa) (Ghent 1530-Paris, c. 1577) [13, pp. 27-32]. Flores worked with the latter artist on an altarpiece still extant today which they both painted in Plasencia for the Marquis of Santa Cruz [4, pp. 93-94].⁵ As regards majolica painting, let us not forget that this technique was largely introduced in the Iberian Peninsula at least by three Flemish painters: Francisco Andrea was the driving force behind this type of production in Seville, Juan Flores played the same role in Talavera, and João de Góis was responsible for its implementation in Lisbon. Besides, Góis spent some time in Seville before travelling on to Lisbon, and it seems that Floris lived in both Lisbon and Castile. At least some of these were court painters and, as such, they were not anchored to a particular territory like painters who belonged to local guilds. Instead, they went from one manorial estate to another, working for the civic and ecclesiastical nobility as well as for the monarchs who claimed their services.

3. THE AZULEJO CLADDINGS OF BACALHÔA

3.1. Antecedents

As a country with deep-rooted maritime and commercial traditions, Portugal maintained close external ties in all sectors of its economy, and ceramics was no exception. The *Palácio e Quinta da Bacalhôa* was neither the first nor the last case to be clad with azulejos produced abroad. The country has enjoyed a very rich ceramic tradition in the past in terms of the production of both common pottery and special genres, and this tradition

5 Jorge de la Rúa had trained with Frans Floris, Juan Flores' brother, in Antwerp. In 1554 he accompanied Philip II to England on the occasion of his marriage to Mary Tudor; in 1556 he received a payment from Catherine of Austria for the portrait of her grandson, the future King Sebastián; in 1559 he was in Cáceres, where he painted a picture of the Resurrection for the church of Santiago in that city; and in 1561 he painted another picture with Juan Flores in Plasencia, where the latter artist lived and had his painting and azulejo workshop.

will undoubtedly endure in the future. However, in the field of fine earthenware and the ceramic claddings of the country's architecture, the same phenomenon occurred as in other parts of the Iberian Peninsula: tableware and azulejos were habitually imported from other production centres in the Peninsula. In the late Middle Ages and Early Modern Period, the Spanish cities of Valencia and Seville were important pottery centres as well as busy commercial ports. The vast majority of azulejos reached Portugal by sea on ships that either docked along the coast or continued to inland cities up one of the wide rivers that crossed the country from east to west. These river routes were more or less extensive depending on the particular navigability conditions in each case [14; pp. 140 and 152].⁶ Portugal relied on these two Spanish production centres from the beginning of the 15th century until the second half of the 16th century when its own production commenced. The Manises floor tiles – the earliest imports – were gradually replaced by azulejos from Seville, used not only for floors but for walls and even vaulted ceilings and roofs as well. *Alicatados* (glazed tiles cut in shapes to form a mosaic) were probably the first to arrive from this city, soon followed by *cuerda seca* (dry cord) tiles and then, from the 15th until the first two thirds of the 16th century, the *arista* (raised ridge) variety. A considerable number of important Portuguese civic and religious buildings from this long time-span offer eloquent testimonies of this phenomenon, and the *Quinta da Bacalhôa* is a case in point [15]. The Sevillian azulejos shipped to the Azeitão area were probably unloaded at Sesimbra, a very active port between the late Middle Ages and the Early Modern Period.

However, in the mid-16th century both Portugal and Spain began to demand Italian-style majolica tiles. At the time, these were also made in Flanders, which was well connected to the Iberian Peninsula for geographic, commercial and political reasons. In the history of Portuguese azulejos, Bacalhôa represents an illuminating and pioneering example of this new phase, both in terms of the quantity and variety of the azulejos, and, even more significantly, due to the quality of its early majolica azulejos. Its tile panels therefore reflect the situation of the azulejo market in Western Europe in the mid-16th century and the confluence in Portugal of tiles from the three most important production centres of the day: Antwerp, Talavera (Toledo) and Seville. This process was parallel and practically simultaneous in Portugal and Spain. Furthermore, different types of testimonies prove that after the experience at Bacalhôa the two kingdoms continued to forge ties and share both works and artists. This is confirmed by certain cases mentioned generically in chronicles from the period as well as by historical and analytical testimonies that are gradually coming to light [16; 17].

The first Portuguese experience in this field was the arrival in Lisbon and Évora of azulejos from the workshop of Niculoso Pisano (?-1529) in Seville, although it seems there was no immediate repercussion on the local production [18] (Figure 7).

6 In the case of the River Tagus, we know that until 1581 it was navigable up to Abrantes [14, p. 140]. With the works designed and executed in the time of Philip II of Spain by Juan Bautista Antonelli, an Italian military engineer in the service of the Portuguese Crown, this navigability was extended up to Alcântara, that is to say up to the border between the two kingdoms [14, p. 152]. Plans were drawn up for the section from Alcântara to Toledo, which required the most costly works, but they were never implemented.



Figure 7. Niculoso Pisano – Visitation panel, originally in Lisbon (Rijksmuseum, Amsterdam).

The second occasion occurred very shortly before the Bacalhôa episode when azulejos were imported from Antwerp in 1558 to clad the palace of D. Teodósio I (1505-1558), fifth Duke of Bragança, in Vila Viçosa [19; 20]. Like the works by Niculoso, these were high-quality, imported tiles and yet neither does this second episode appear to have had any consequences for the local production that would begin in Lisbon around the same time. Meanwhile, the Quinta das Torres (Azeitão) received two exquisite panels from Italy narrating episodes inspired by Virgil's *Aeneid*, which adorn the gallery overlooking the lake and represent a unique work in the Iberian Peninsula.⁷ If we accept the approximate date proposed by Santos Simões (1907-1972) for these panels – 1560-1570 – they could be contemporaries of the ones at Bacalhôa, but we have no evidence to confirm this [15, p. 85]. Accordingly, therefore, the commission promoted by Albuquerque (c. 1565) may well be the next dated panel after Vila Viçosa (1558). This work also presented significant novelties with respect to the two former episodes. In the first place, the azulejos did not come from either Seville or the Low Countries, although the latter may have been the provenance of the majolica painters who, by then established in the Iberian Peninsula, received the assignment to make them for Bacalhôa. As mentioned above, the main majolica tile painter was probably Juan Flores, the Hispanicised name and surname of the man known in Flanders as Jan Floris de Vriendt, who was working at the time as an artist in Talavera de la Reina (Toledo). Some of the other painters who presumably worked with Flores also came from Flanders and were already established in Lisbon where the experience at Bacalhôa may have served to boost the local production in this technique, thus ushering in a tradition that would remain uninterrupted in the future. A second and important novelty was the impact on subsequent tile production in Lisbon, because a quality majolica painting technique became firmly established in Portugal.

⁷ The gallery was later closed with a windowed wall.

3.2. Brás [Afonso] de Albuquerque and the majolica tiles

The only dated azulejos at the entire Bacalhôa monument are the ones that form the panel of *Susanna and the Elders* in the central room at the Pleasure House. Although the date shown is 1565, many of the azulejos for this pavilion were almost certainly made before that year. It was probably at the beginning of the 1560s that Brás [Alfonso] de Albuquerque had the Pleasure House built and made plans to adorn the inside with a ceramic cladding. However, he must not have been content with importing the traditional *arista* tiles from Seville, by then commonly used in Portugal, because he made a decision that had important consequences for the estate and, in all likelihood, for national tile production as well.

Although we have no information about Albuquerque's library or the inventory of artworks that graced his houses in Lisbon and Azeitão, we do know from his written works and other testimonies that he was a cultured man in tune with modern tastes. Undoubtedly influenced by humanist thought, he would have admired the great paintings of his day. From his perspective at the beginning of the second half of the 16th century, Hispano-Moresque tiles may have seemed too conventional in their restrained palette and limited expressiveness, more ornamental and textile than narrative and pictorial.

Certain observations made around 1560 by Diego de Guevara (Brussels, c. 1500–Madrid, 1565), Philip II's chronicler, cast enormous light on the opinion this Spanish courtier had of tile production in Spain.⁸ Guevara was a contemporary of his counterpart in Portugal, Francisco de Holanda (Lisbon 1517–Lisbon 1584) and of Albuquerque. The erudite chronicler compares Hispano-Moresque azulejos with the majolica tiles he had seen in Italy and Flanders, both territories that he knew well:⁹

In Spain, as regards the quality of the clay, the work could be done in Talavera but the tiles could not be finished even if there were sufficient painters, which could be found; the work would lack perfection because in Spain they do not know how to fix the colours in the fire, as they do in Faenza and Pisa: neither do they know here how to use more than two or three colours. For as regards painting and glazing the clay, in Spain they are deprived of a rich variety of fine colours; in fact, the only thing they know anything about is these basic colours they use for their azulejos [21].¹⁰

Although the two types of azulejos are associated with very different artistic contexts, Guevara's harsh opinion about tile production in Spain reveals not only a radical

8 Philip II of Spain (1527-1598) was acclaimed as Philip I of Portugal in 1581 and reigned as such until he passed away.

9 Scholars date Guevara's original manuscript to around 1560, and if that is correct neither Guevara nor Philip II appear to have been aware of the works that Juan Flores was already executing in Plasencia. The text must certainly predate June 1562, when the king asked Flores to paint tiles for his palaces and when Guevara would possibly have been informed of the contract for the work.

10 *En España, en quanto a lo que toca al barro, fineza y delgadeza del, bien se labraría en Talavera pero no se podría dar cumplimiento a tal obra aunque oviese diseñadores bastantes para el dicho repartimiento, como se podrían hallar; porque faltaría a la tal obra la perficion a causa de que en España no saben fixar las colores en el fuego, como en Faenza y Pisa las fixan: ni tampoco saben gastar aca sino dos o tres colores tan solamente. Y es cierto que en esto que toca a teñir y vedriar el barro con diversidades y buenos colores en España están ayunos dello, y por confesar la verdad lo ignoran todo excepto estas grosserías que en los azulejos se gastan*

change in taste as far as tiles are concerned but also an irrefutable fact: the peninsula tile-makers who came after Niculoso Pisano lacked the academic training which the country's painters, sculptors and architects received. They were simple artisans, even if some of them achieved a much more industrial dimension due to their sheer volume of production. Guevara's observation therefore reveals that at the beginning of the second half of the 16th century, sophisticated clients in Spain, and in Portugal as well, sought tiles that bore a closer resemblance to easel painting, and not only in terms of the textile repertoire of patterned tiles, although they too would now acquire new versions in majolica. We do not have explicit proof of the opinion of D. Teodósio I de Bragança or of Brás [Afonso] de Albuquerque in this respect, but it would probably have been similar to the one expressed by Diego de Guevara. As early as 1521, Albuquerque would have had the chance to admire majolica tiles when he travelled to Italy as a young man. Then, in 1526, he visited Seville to attend the wedding of the emperor Charles V to Isabella of Portugal, where he would have had the opportunity to see the painted tile altars that Niculoso Pisano (active between 1502 and 1529) had made for the Catholic Monarchs in 1504. But, above all, it was probably in 1558 that he reaffirmed his aesthetic tastes after learning of the tiles imported for Vila Viçosa. Certain documents describe the Vila Viçosa palace as containing a *Casa dos Azulejos*, which scholars situate on the ground floor, opening on to the exterior [22, p. 35]. It may even have been a pleasure house in the palace gardens. Moreover, it may well be the case that when Albuquerque embarked on his project, he had seen the *Casa dos Azulejos* at Teodósio I de Bragança's palace and wished to emulate it (Figure 8).



Figure 8. Part of a Flemish azulejo panel at the Palace of Vila Viçosa, 1558.

Albuquerque moved in high circles and had connections with the Spanish nobility. Accordingly, by 1562 he would almost certainly have known that tiles of this type were being made in Spain for the renovations that Philip II was undertaking at his palaces, clad on the outside with exotic Nordic roofs of black slate and on the inside with Italianate stucco and tiles in the Flemish tradition.

3.3. A difficult choice

The first dilemma that confronted Albuquerque must have been choosing a majolica painter who could put his project into practice. He may have made this choice after 1555 if he had met Juan Flores during an early possible stay in Lisbon, or more plausibly after 1558 when the Duke of Braganza clad his Vila Viçosa palace with tiles. However, unlike the duke, he does not appear to have explored the possibility of importing tiles from Flanders, although he may have had the necessary contacts and financial means to do so. Besides, at that time, it would have been no easy task finding an artist in the Iberian Peninsula capable of executing such a novel work; very few authors would have been able to fulfil the challenging conditions it posed. To begin with, the artist had to be an excellent “painter of imagery” who had passed the guild examinations and was therefore qualified to paint narrative scenes and design ornamental patterns. Moreover, he had to have mastered the novel technique of majolica painting in the Italian manner. Very few Portuguese and Spanish painters could fulfil this second condition at that time. For reasons that we explain below, we are convinced that the artist chosen to oversee the project and execute the most delicate parts was almost certainly Juan Flores.

In addition to the aforementioned artistic skills, these works demand the use of mutually compatible raw materials to prevent technical defects. If the artist ultimately chosen did not live in the place where the work was undertaken, it would have been necessary to pay for the transportation of the azulejos from the production centre or alternatively ask the painter to take up residence in the place of the assignment and make the requested product in situ. Everything seems to suggest that both options were used successively in the case of Bacalhôa.

In view of the lack of documentary information about the azulejos made for Albuquerque, it has never been possible until now to offer any details about the works involved or the technical characteristics of the tiles. Thanks to the laboratory analyses conducted and the efforts of a multidisciplinary team working towards common scientific objectives, today we are in a position to put forward a series of well-grounded hypotheses.

3.4. An old debate about the authors of Bacalhôa majolica tiles

According to the information we have, several master painters were active in the Iberian Peninsula just before 1565 and might have aspired to receiving the commission for such a special and important project as the one carried out at Bacalhôa. Different scholars have proposed all of them as possible authors of these azulejos.

The oldest theory was formulated in 1895 by Joaquim Rasteiro (1834-1898), who judged them to be of Portuguese production based on his interpretation of an incomplete signature that reads “.....TOS”, visible on one of the azulejos [23, pp. 34-35; 24]. Rasteiro was of the opinion that this signature could be identified as that of Francisco de Matos,

who painted the tiles in one of the side chapels at the church of São Roque in Lisbon, dated to almost twenty years after the Bacalhôa azulejos. This author had no hesitation in concluding that the azulejos in the Pleasure House "... form a very valuable collection of Portuguese industry"¹¹ [23, pp. 30-31].

At the end of the 19th century, Rasteiro had no knowledge of another figure who would become known in 1903: Frans Andriés (c. 1535-?) (Francisco Andrea in Spain), who had been painting tiles of this type in Seville since before 1561 [25, pp. 223-225]. This young majolica painter was the son of Guido di Savino (Guido Andriés in his Flemish period), an Italian who had taken up residence in Antwerp in 1508 [26, pp. 192-194]. In the mid-20th century, Reynaldo dos Santos (1880-1970), familiar with the work of José Gestoso (1852-1917), published new information attributing the finest azulejos at Bacalhôa to Frans Andriés, or at least to the circle of ceramic artists active in Seville between 1558 and 1568; during this time the aforementioned Flemish Andriés and the Italians Sambarino and Pesaro were all in the Andalusian city [27, pp. 58-59]. However, knowledge of the work of these foreign artists based in Seville was and remains – for now at least – too scant to be able to attribute works to them with the appropriate degree of confidence.

The existence of Juan Flores was known through literary channels from a very early date [28, pp. 128-129] but there was no knowledge of his work until 1970. Even so, Santos Simões [29], after reiterating the hypothesis of Reynaldo dos Santos, also suggested that Juan Flores might have been the author of these azulejos. He was even of the opinion that they might have been imported from Flanders like the tiles for Vila Viçosa. However, a decade or so later, Simões changed his mind about the possible authorship of these panels and where they might have been produced, switching his proposed attribution to Flemish majolica painters established in Lisbon. Alluding once again to the aforementioned incomplete signature and without ruling out other possibilities, he suggested that the works might have been overseen by Marçal de Matos (1554-c.1613), a painter about whom there is hardly any documentary evidence but whom Simões believed to have possibly been the grandfather of Francisco de Matos (active in 1584) [15, pp. 106-107]. Today we know that Marçal could not have authored the Bacalhôa azulejos because he would have been too young [30, pp. 17-18].

Lastly, according to a new hypothesis put forward verbally in 1999 and then in published format in 2000, the author of the finer azulejos in the Pleasure House might have been Juan Flores, who could have painted them for Albuquerque in Talavera (Toledo) [31]. Several arguments that remain valid today led to the formulation of this hypothesis.

The first was an evident formal correlation because the design of the pattern used in the first room at the Bacalhôa Pleasure House (right side of Figure 9) is the same as a work that Flores had signed with his initials and the date – "I.F. 1559" – in two different parts of another complex: the tiles in the church of San Pedro in Garrovillas de Alconétar (Cáceres) (left side of Figure 9). His participation in the Portuguese project can also be inferred from the variety of ornamental patterns in his style that adorn the estate, unknown in Portugal until that time and even after this episode. Painted majolica patterned tiles were a highly novel genre with no Portuguese precedents, but Flores had already gained experience in the technique due to the works in this field that he had undertaken since his arrival in Castile.

11 ...formam uma coleção valiosíssima da industria portuguesa.



Figure 9. Left side: Church of San Pedro - Garrovillas de Alconetar (Cáceres); Right side: Quinta da Bacalhôa- Azeitão (Setúbal).

Coupled with this correlation of pattern types is another aesthetic factor: the extraordinary artistic quality of the figurative panels at Bacalhôa is identical to that of other works executed by Flores in Spain, all of which are consistent with the already mentioned praise showered on this artist by his first biographer, Karel van Mander (1548-1606), in his work *Het Schilder-Boeck*, published in Haarlem in 1604. Van Mander writes: “Juan Flores was such a skilled and famous potter of glazed earthenware that he had no equal in the Low Countries...”¹² [11, p. 238].

But as well as these formal, aesthetic and literary connections, other more concrete arguments of a documentary nature were put forward as part of the new hypothesis. Several letters written at the court of Philip II allude to the persistent delay in supplying the azulejos which Flores had promised to send from Talavera to Madrid but which had failed to arrive at the site of the royal works in the capital [31, p. 21]. Records dated 8 November 1563 show that Juan Flores had sent azulejos for the floors and walls of the king’s private chambers at the Palacio de El Pardo [32, p. 33; 31, p. 24, note 32]. However, some time before July 1564 Flores received the order to send more tiles for the monarch’s private chambers at the Real Alcázar in Madrid, but they never arrived. On that date, the king, clearly displeased, writes: *...Flores sent a number of tiles to begin with but we have received none since, and from what I have observed he has sent far fewer than what he said. Find out what is going on* [33, p.; 18, p. 24].¹³

All this would appear to suggest that during the first half of 1564 Flores was busy with another assignment that had nothing to do with the royal works. The problem may well have been that during those months he was painting azulejos for Albuquerque at his workshop in Talavera. It is also plausible that he travelled to Portugal to deliver the first batch in person, as was the custom. However, after delivering his tiles and issuing instructions on how to install them, he must have extended his stay in Portugal because, as we know from subsequent records, the complaints from the Spanish court continued due to the persistent lack of supplies. On 19 August 1565 the king’s architect, Juan Bautista de Toledo (1515–1567) informed the monarch about the status of the works at the Alcázar

12 *Jan Floris zoo’n bekwaam en vermaard bakker van geglazuurde potten, dat hij in de Nederlanden door niemand geëvenaard....*

13 *...aquel Floris començo a poner unos pocos azulejos y después no ha venido mas y a lo que yo he visto, no trae con mucho los que dijo, sabed de él lo que pasa.*

in Madrid and, among other observations, he writes:

...for the cladding of the said chamber Your Majesty said on his departure that he would summon Joan Flores but he has not yet arrived. It would be expedient for Your Majesty to write to him again and if he cannot come, he should send the designs for which the cladding was made so that the work can be arranged (with other master tile-makers)¹⁴ [31, p. 20, nota 40].

Between August and October 1565, after a longer absence than anticipated, Flores must have recommenced his work in Talavera and renewed his dispatches of tiles to Madrid, as we have documented. However, as we explain below, the king had already taken drastic decisions to avoid a repetition of this inconvenience.

The solution conceived by the monarch was to issue orders to ensure the availability of other ceramic artists able to supply the same type of azulejos if Flores could not do so with the necessary diligence. With this aim, the king was to be informed of the person who could go to Talavera to complete the technical training of the tile-makers who might replace the tardy Flemish artist. To this effect, on 21 November 1566, by royal order, Jerónimo Montero (?-?) travelled from Seville to Talavera to test his glazes on the local clay [25, pp. 249-252]. We do not know if Montero was a ceramic artist or a chemist, or whether he had learned the technique with Francisco Andrea who had been active in Seville since at least 1561 and was still working there in 1565 [34], but he clearly must have been a person of recognised professional standing in the field of ceramics. In the experiments conducted between 9 and 20 November 1566, Montero was accompanied by the three most important master painters in Talavera: Antonio Díaz (documented between 1561 and 1615), Juan Fernández (documented between 1566 and 1588), and Juan de Figueroa (documented between 1554 and 1566). Four additional collaborators who had completed their apprenticeship in this field were also present: Bartolomé de Plasencia (?-?), Pedro López, from Toledo (?-?), Melchor de Talavera (?-?) and Alonso de Caçalegas (?-?).¹⁵ The only significant absence in this team was precisely Juan Flores. Through other indirect evidence, it would appear that he had returned to Talavera but did not take part in these experiments, perhaps because he had not been invited to do so. It is also possible that he was reluctant to attend them, ashamed by the king's rebuke and annoyed by the suspicion that thereafter he might cease to be his exclusive supplier. However, he clearly remained in the king's service because he continued to receive his salary until December 1567, when he died in his prime. Besides, the king's accounts show new payments to Flores for azulejos delivered between 4 July 1566 and 19 July 1567 [31, p. 20, note 46].

Unfortunately, none of the azulejos that Flores made in Talavera for the king have been identified until now because the buildings in question were either destroyed by fire or have been completely remodelled. Following Flores' death that same year, the new official supplier was appointed from one of the three masters who took part in the experiments: Juan Fernández. This artist made numerous azulejos for the *Real Monasterio de El Escorial*, a building of immense proportions which in subsequent years was clad with tiles that he

14 *...para lo del chapado de la dicha alcobilla dixo V.M. a su partida que enviaría llamar a Joan flores y hasta agora no ha venido, seria bien que V.M. tornase a escribirle, y si no pudiese venir que nos embiase los diseños por los quales se hizo el chapado que aquí por ellos se concertará y asentará.*

15 As shown, the four ceramic artists are known by their Christian name followed by a toponym which as well as serving as a surname indicated their probable provenance: Plasencia, Toledo, Talavera and Caçalegas, the latter a village near the former town.

made in Talavera as well as many others which Juan de Vera (active between 1577 and 1595) – and other ceramic artists – sent from Toledo [35].

4. ANALYTICAL CHARACTERIZATION BY SEM-EDS

4.1. Samples

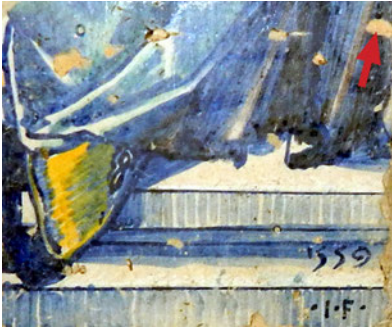
Figure 10 illustrates the panels and single tiles sampled, indicating some sampling spots and the codes attributed through which they will be referenced. Sampling was done with a scalpel in areas already damaged. In the cases of Sp001 and Sp005, obtained directly from figurative panels still integrated, the samples were less than 0.5 mm long, consisting only of glaze without biscuit attached and therefore results are to be taken cautiously, particularly as pertains the contents in tin (Sn) whose quantification needs larger areas because of the occurrence of aggregations of crystals. Besides the samples indicated, two larger fragments of biscuit collected from the Cañaveral and Oropesa panels were also used for the analytical study of the clays - these are simply referenced “Cañaveral” and “Oropesa”.

Table 1 includes data on each sample studied. The first column (Sample Ref.) includes the technical reference of the items prepared for observations and analyses. The second column (Identification) repeats the identifications in Figure 10 and includes additional data on the sample. The last column indicates how many measurements were averaged in the semi-quantification of the chemical composition of each. Note that some samples did consist of biscuit only, while others consisted only of glaze or had a narrow sectional area of biscuit allowing a perception of the interface morphology but yet too small for a reasonably accurate analysis of the clay.

Table 1. Sample references, identification of origin with details and number of analytical results averaged

Sample Ref.	Identification/ details	Total no. of results
Sp001	Garrovillas , signed & dated tile in panel. Blue glaze only; very small sample.	3 (glaze)
Sp002	Garrovillas , figurative tile in deposit. Blue glaze area.	4 (glaze); 3 (biscuit)
Sp003	Garrovillas , pattern fragment in deposit. Blue and yellow glaze area.	5 (glaze); 4 (biscuit)
Sp004/01	Garrovillas , part of figure St. Peter over pattern (top). White, blue, and yellow glaze area.	4 (glaze); 3 (biscuit)
Sp004/02	Garrovillas , same tile (back). Biscuit only.	3 (biscuit)
Sp005	Cañaveral , tile from panel. Blue glaze only; very small sample.	4 (glaze)
Sp006/01	Cañaveral , pattern tile in local deposit. Yellow and blue glaze area.	4 (glaze); 4 (biscuit)
Sp006/02	Cañaveral , same pattern tile in local deposit. Biscuit only.	4 (biscuit)
Cañaveral	Cañaveral , Biscuit only.	4 (biscuit)
Sp007/01	Oropesa , panel. Yellow-green glaze area). Biscuit very small.	4 (glaze)
Sp007/02	Oropesa , panel. Yellow glaze only.	4 (glaze)
Oropesa	Oropesa , Biscuit only.	5 (biscuit)
Sp008	Garganta la Olla , dated tile in panel. White glaze area. Biscuit very small.	4 (glaze)

Garrovillas- figure of saint signed "I.F. 1559" (Sp001)



Garrovillas- figurative tile in deposit (Sp002)



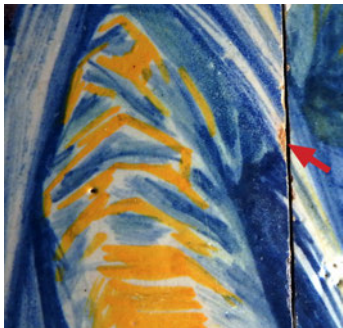
Garrovillas- pattern tile in deposit (Sp003)



Garrovillas- pattern/figurative tile in deposit (Sp004)



Cañaveral- figurative panel (Sp005)



Cañaveral- pattern tile in deposit (Sp006)



Oropesa- figurative panel (Sp007)



Garganta la Olla- figurative panel "1560" (Sp008)



Figure 10. Referenced Spanish panels and pattern tiles sampled and addressed by this paper.

4.2. Methods and instrumental means

The azulejo samples were stabilized in epoxy resin, lapped and polished to obtain a flat cross-section for observation and analysis by scanning-electron microscopy coupled with an X-ray energy-dispersive spectrometer (SEM-EDS).

SEM observations and EDS analyses were made at LNEC using a TESCAN MIRA 3 field emission microscope combined with a BRUKER XFlash 6|30 EDS system. The samples were uncoated and the observations were made in backscattered electrons mode (BSE), with a chamber pressure of typically 10 Pa, at an accelerating voltage of 20 kV with the sample sections at a distance of 14 ± 1 mm from the detector. SEM images were typically acquired at magnifications of 350 x and 700 x for the glaze and 5,000 x for inclusions in the glaze.

The selection of areas for EDS quantification avoided large inclusions in the glaze or biscuit representing more than ca. 5% of the full selected area. From our previous experience, the adequate minimum measurement areas are $200 \times 200 \mu\text{m}$ for glazes and $500 \times 500 \mu\text{m}$ for biscuits. In general, multiple measurements were made and in such case the results are averages and smaller non-overlapping areas may be used to the same effect. Whenever possible, the analyses were performed on white glazes to avoid interference from elements diffused from the blue, green or violet pigments which, when present, were neglected. The yellow pigments remain at the surface and therefore do not present the same problem. Still, in the case of zinc-bearing yellow pigments, the analyses must be performed at a safe distance from the colour.

Ancillary elements usually representing less than 1% of the compositions, such as magnesium (Mg) and iron (Fe) in the glazes, or titanium (Ti) in the biscuits were not included in the tables of results.

The quantification of tin (Sn) in the glazes may be problematic because the aggregation of crystals often results in a large variance. That problem was dealt with by using larger areas whenever aggregation was visually detected in the SEM images or, when that was not possible, averaging the results of multiple analyses on different areas.

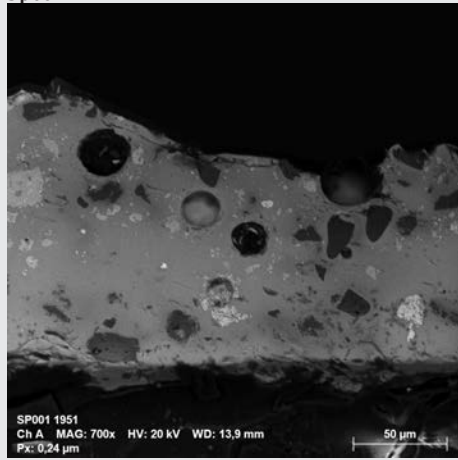
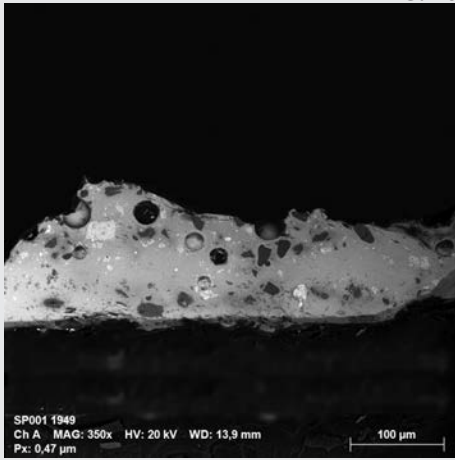
The amount of oxygen (O) was calculated through the remaining elements stoichiometry of their most commonly considered oxides (Na_2O , MgO , Al_2O_3 , SiO_2 , K_2O , CaO , Fe_2O_3 , SnO_2 , PbO) and the result was normalized to 100 %.

4.3. Results

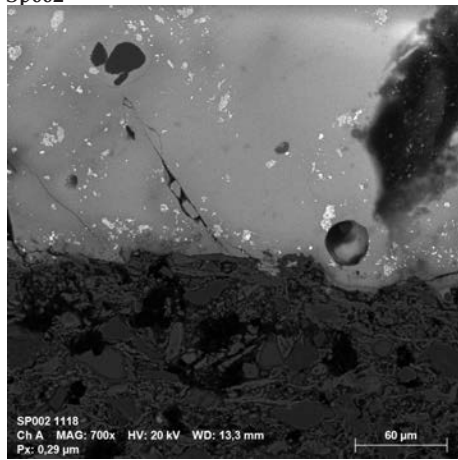
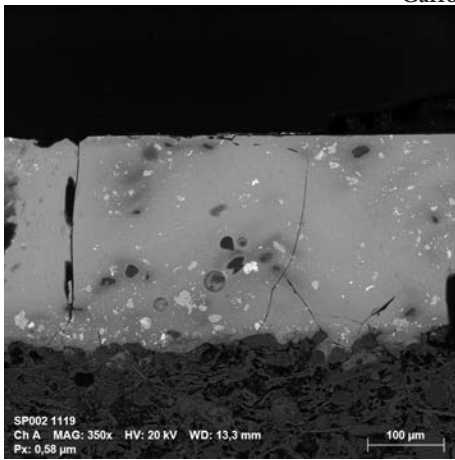
4.3.1. Morphology of the glazes

Figure 11 depicts sectional SEM images of the glaze and interface of samples at the same magnifications (350 x and 700 x). The light grey area on top is the glaze, while the dark grey area corresponds to the biscuit. Because of its colour, the inclusions in the glaze are conspicuous: round gas bubbles retained in the glass, grains of sand (larger compact dark inclusions, usually with rounded edges) and bits of feldspars, often in disaggregation. The white spots in the midst of the glaze are crystals of the opacifier (tin oxide), while a continuity of similar white spots near the surface may correspond to the lead-rich yellow pigments.

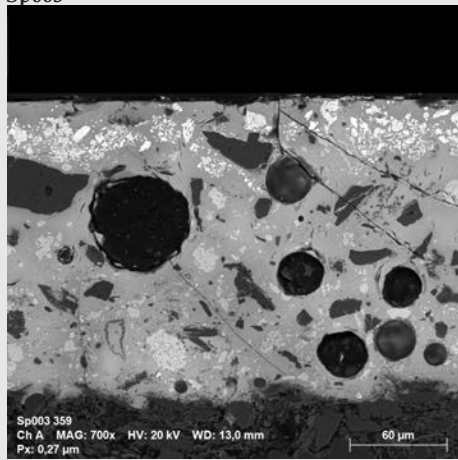
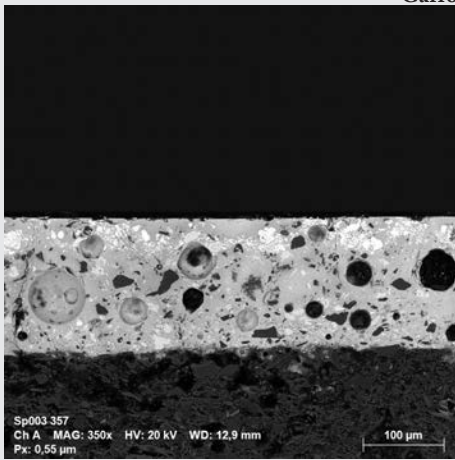
Garrovillas Sp001



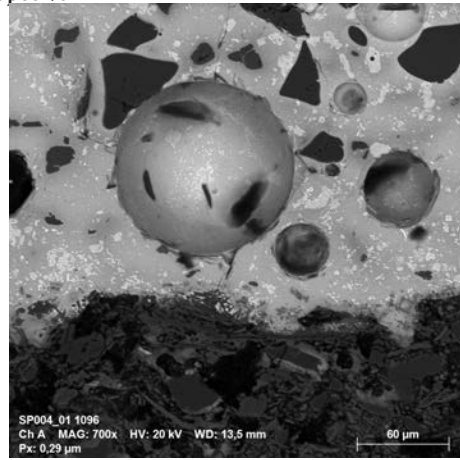
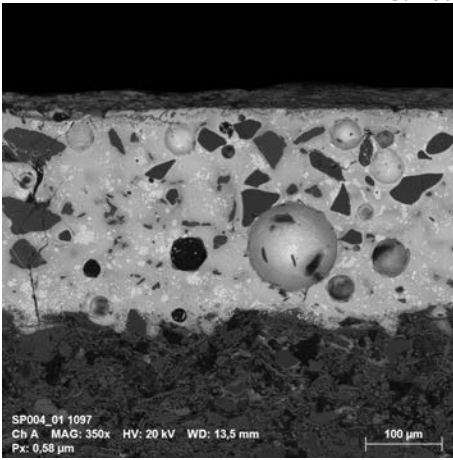
Garrovillas Sp002



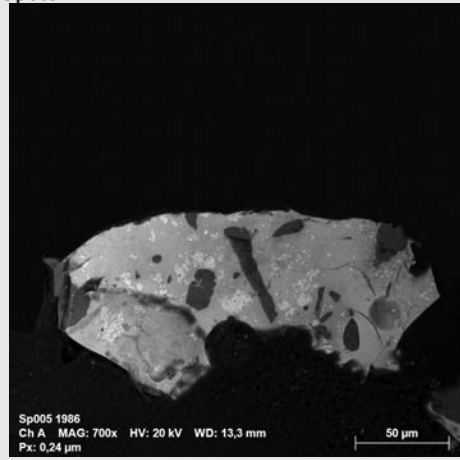
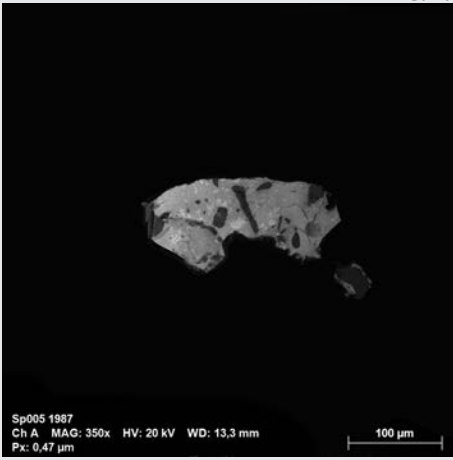
Garrovillas Sp003



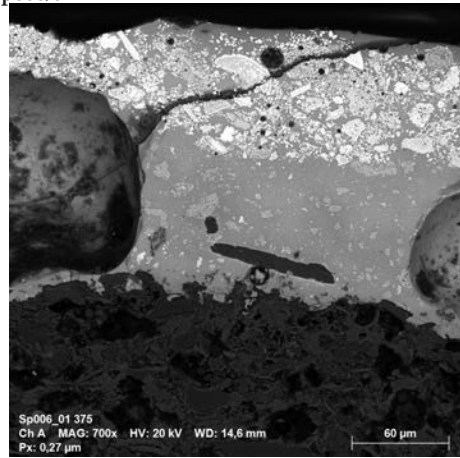
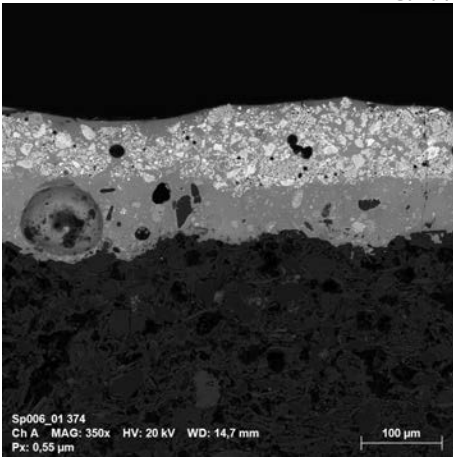
Garrovillas Sp004/01



Cañaveral Sp005



Cañaveral Sp006/01



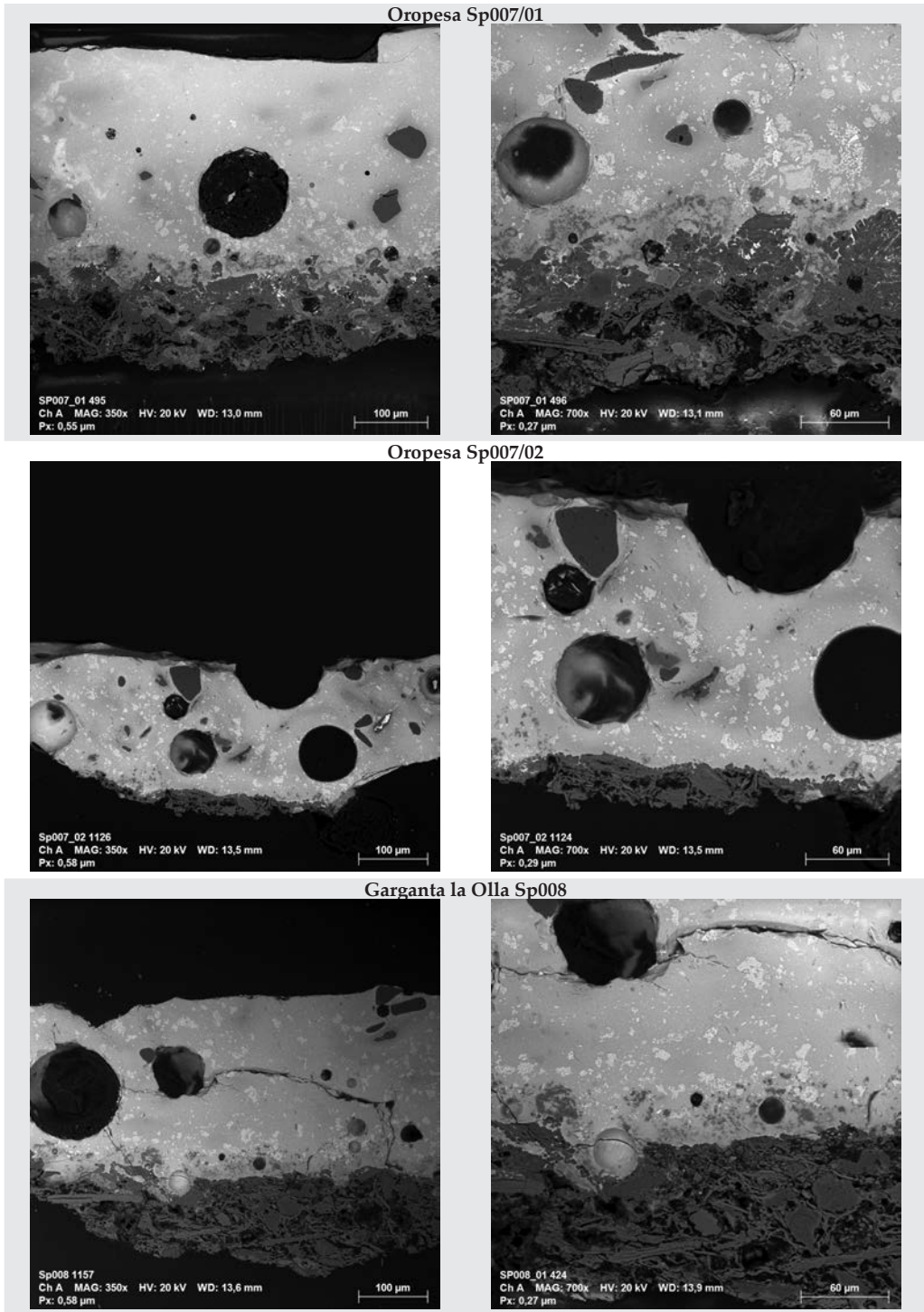


Figure 11. SEM-BSE images showing the main micro-morphological characteristics of azulejos in Spanish panels and pattern tiles attributed to Juan Flores. Left side: glaze section at 350 x; Right side: detail of the biscuit-glaze interfaces at 700 x (in Sp005 the interface is not visible).

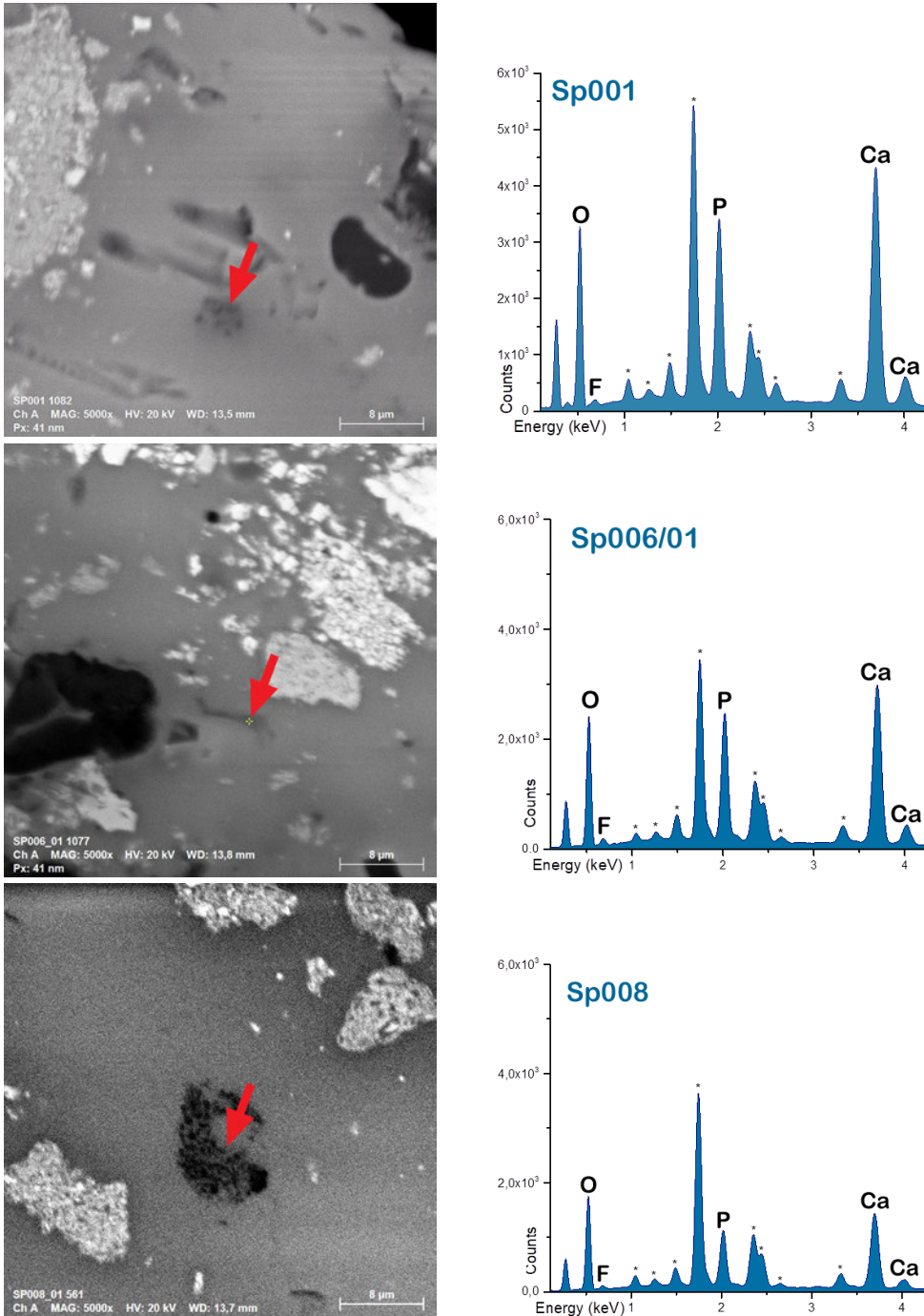


Figure 12. Particles of a substance rich in phosphorus (P) and calcium (Ca), often with fluorine (F) and sometimes with chlorine (Cl) associated, presumably resulting from the addition of bone ash to the glazes of Garrovillas (Sp001 -top), Cañaverl (Sp006 - middle) and Garganta la Olla (Sp008 - bottom). Note that the matrix effect (peaks marked by asterisks) varies but the proportion of P to Ca, as perceived from a comparison of the peak areas, is approximately the same in all three cases.

The fact that the provenance of the panels and tiles under study is known (including the objective attribution of at least the Garrovillas, Canãveral and Oropesa works to a specific master potter and painter) and the exact chronology of the Garrovillas and Garganta la Olla tiles is established by the date inscribed in the panels themselves, makes this set particularly important as a reference with which other panels and tiles of doubtful provenance or chronology may be compared. As such, a reconnaissance of unusual characteristics present in them may add important information for the same purpose. Such characteristics are better surveyed in the glazes, which are the product of a technology, than in the biscuits, and more often identified through unusual morphologies, than by the elemental compositions of the glazes which may be shared within a technological circle. Figure 12 depicts one such peculiar morphological detail: sometimes small inclusions (ca. 5 µm across) are perceived with a characteristic often diffuse aspect in BSE. An analysis shows them to be composed of calcium (Ca) and phosphorus (P), sometimes with fluorine (F). They likely result from the addition of bone ash. The purpose of such addition is uncertain but the frequent detection of chlorine (Cl) associated with these inclusions suggests that bleach may have been used during the preparation process. The addition of bone ash may have been aimed at improving the whiteness of the glaze, and the use of bone material as a white opacifier is known from other instances (e.g. [36]).

The presence of bone ash points directly to the productions of at least one of the workshops of Antwerp - that which manufactured the azulejos bought by Duke Teodósio II of Bragança to decorate his palace in Vila Viçosa, and it was when studying these tiles that we identified bone particles for the first time [37].

Bone was not added in such quantity as for individual particles of a relatively large size to be found in every small sample area, still we detected them in three of the samples researched and it may be present in all cases but went unnoticed because the sections of our particular test items did not have any such particle conspicuously visible.

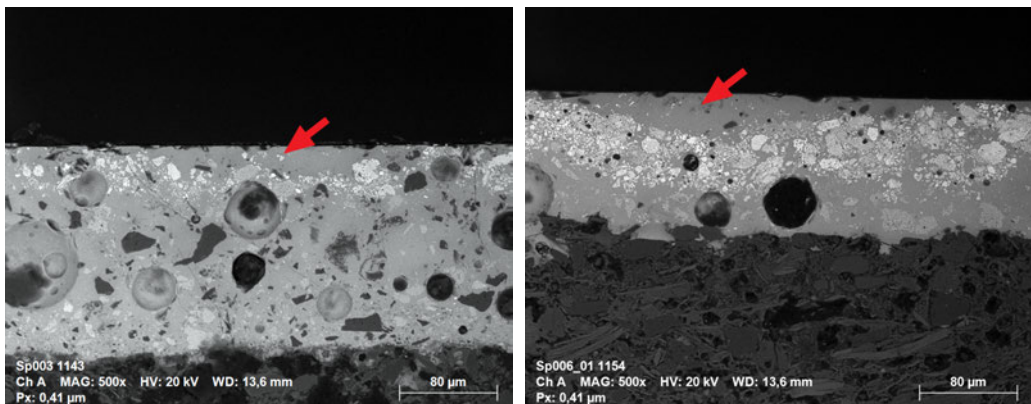


Figure 13. The use of *coperta* (clear glaze indicated by an arrow) over the yellow pigment in samples from Garrovillas (Sp003/01 - left side) and Cañaverall (Sp006/01 - right side).

Another remarkable aspect has to do with the use of *coperta* - a sprinkled layer of transparent glass applied to improve and even up the gloss, which is readily perceivable over the yellow because the pigment does not diffuse into the glaze and therefore contains the spread of the *coperta*. This is a technique stemming from Italy [38] and also used

in Antwerp [37]. Figure 13 shows SEM /BSE images of samples Sp003/01 (Garrovillas) and Sp006/01 (Cañaverl) illustrating the use of coperta over the yellow colour. Analyses show that the composition of the coperta is virtually the same as that of the glaze under the pigment, except that it does not include any tin, the opacifier that renders glaze white. Besides Garrovillas and Cañaverl, *coperta* was also used in Oropesa (confirmed in sample Sp007/02) and probably in Garganta la Olla as well, although the lack of a sample of the yellow area did not allow a confirmation.

4.3.2. Composition of the glazes

Table 2 includes the semi-quantitative results of analyses of the glazes by EDS in weight %. Each result is the average of all determinations of the element in the tiles, given with the standard deviation. The silicon/lead (Si/Pb) ratios have been determined and are also included in the table. This ratio is a technological trait set by the glaze recipe and gives important information about the firing conditions in the kiln because the lower the ratio, the lower the temperature at which the glaze could be properly fired.

Table 2. Semi-quantitative composition of the glazes of the tiles studied, determined by EDS (values in wt. % with oxygen obtained by stoichiometry and sum of all elements normalized to 100%) with Si/Pb ratios included

Sample		O	Na	Al	Si	K	Ca	Sn	Pb	Si/Pb
Sp001 Garrovillas	average	35.96	3.55	2.71	24.23	4.22	2.78	3.55	23.00	1.1
	st. deviation	--	1.32	0.46	3.56	0.07	0.09	1.43	7.77	
Sp002 Garrovillas	average	37.76	3.06	3.07	25.62	4.68	3.00	4.44	18.37	1.4
	st. deviation	--	0.40	0.33	1.64	0.17	0.30	1.35	5.37	
Sp003 Garrovillas	average	34.70	2.98	2.53	22.83	4.04	2.76	5.96	24.19	0.9
	st. deviation	--	0.24	0.66	2.07	0.30	0.43	1.23	5.84	
Sp004/01 Garrovillas	average	36.49	2.07	3.31	24.14	4.23	1.75	8.35	19.66	1.2
	st. deviation	--	0.47	0.66	2.15	0.53	0.47	0.99	6.29	
Sp005 Cañaverl	average	36.38	1.83	2.64	24.66	5.59	1.78	7.02	20.11	1.2
	st. deviation	--	0.14	0.20	1.01	0.13	0.37	1.86	2.07	
Sp006/01 Cañaverl	average	34.36	1.80	3.44	21.53	5.13	2.52	8.69	22.53	1.0
	st. deviation	--	0.14	0.38	1.54	0.32	0.43	2.02	5.03	
Sp007/01+/02 Oropesa	average	36.43	1.93	3.27	24.34	4.25	1.63	7.38	20.76	1.2
	st. deviation	--	0.11	0.24	1.46	0.59	0.50	0.96	4.53	
Sp008 Garg. la Olla	average	38.07	2.96	3.46	25.33	4.28	2.07	8.11	15.71	1.6
	st. deviation	--	0.14	0.50	1.33	0.36	0.53	0.81	4.11	

4.3.3. Composition of the biscuits

Table 3 includes the semi-quantitative results of analyses of the biscuits by EDS in weight %. Each result is the average of all determinations of the element in the tile, given with the standard deviation. Lead occurs in most cases deriving from percolation into the biscuit when the raw glaze is applied. Its content was determined but not considered because it is not part of the natural composition of the biscuit and depends on the proximity to the interface. The presence of lead renders the quantification of sulphur doubtful because of a superposition of spectrographic peaks and therefore it too was not considered, as well as elements of contents often below 1% such as phosphorus (P), chlorine (Cl) and titanium (Ti). The distinctive calcium to silicon ratios (Ca/Si) have been determined and are included in the table.

Table 3. Semi-quantitative composition of the biscuits of the tiles studied, determined by EDS (values in wt. % with oxygen obtained by stoichiometry and sum of all elements normalized to 100%) with Ca/Si ratios included

Sample		O	Na	Mg	Al	Si	K	Ca	Fe	Ca/Si
Sp002 Garrovillas	average	44.80	1.64	3.51	7.94	24.66	1.56	12.66	3.23	0.5
	st. deviation	--	0.12	0.12	0.40	0.24	0.14	0.37	0.12	
Sp003 Garrovillas	average	42.95	0.92	3.06	8.77	20.94	2.53	16.96	3.86	0.8
	st. deviation	--	0.14	0.11	0.35	0.39	0.24	0.50	0.28	
Sp004/01+02 Garrovillas	average	43.77	0.85	3.00	8.47	22.64	2.26	15.34	3.67	0.7
	st. deviation	--	0.14	0.17	0.44	0.83	0.20	0.78	0.39	
Sp006/01+02 Cañaveral	average	43.35	0.89	3.91	8.53	21.48	2.20	15.91	3.74	0.7
	st. deviation	--	0.12	0.89	0.32	0.79	0.49	1.94	0.34	
Cañaveral biscuit only	average	42.99	0.92	3.97	8.20	21.25	3.14	15.44	4.09	0.7
	st. deviation	--	0.29	0.49	0.76	0.38	0.30	1.73	0.32	
Oropesa biscuit only	average	42.55	0.96	2.56	8.28	20.82	2.97	18.16	3.69	0.9
	st. deviation	--	0.25	0.31	0.48	0.62	0.68	1.30	0.33	

5. DISCUSSION OF THE ANALYTICAL RESULTS

The Ca/Si ratios of the biscuits of all samples (Table 3) vary between 0.5 and 0.9. This spread matches closely the spread of the samples from the Garrovilla panels alone. Figure 14 depicts superimposed EDS spectra of the clays of a selection of representative samples from the three sites of which biscuits could be analysed. The use of spectra rather than elemental contents allows a visual comparison of the whole compositions [39], instead of a numerical comparison element by element, and clays with obviously different elemental compositions have a counterpart in very different spectra. This is not the case for the spectra in comparison, which present marked similarities as could be expected from a single provenance of the clays used in the panels and patterned tiles of the three sites.

A Principal Component Analysis (PCA) of samples presumably all similar does not offer relevant information and may actually be misleading by lack of terms of comparison that may set a proper scale to the meaning of “similar”, but elsewhere we did a comparison of the analytical results presented here with biscuits from other provenances and concluded that the clays from Garrovillas, Cañaveral and Oropesa may be considered to cluster together [40].

The semi-quantitative results of the composition of the glazes (Table 2) shows a limited spread in the Si/Pb ratios but the spread of the results pertaining to Garrovillas alone (ca. 36%) encompasses the spread of the results of Cañaveral and Oropesa, while the Si/Pb ratio of the glaze of Garganta la Olla exceeds all others. The varying Si/Pb ratios of Garrovillas derive mostly from a variation of the contents in lead, and the standard deviations in Table 2 show that they are variable even within a single sample, while the contents in silicon are comparatively steadier.

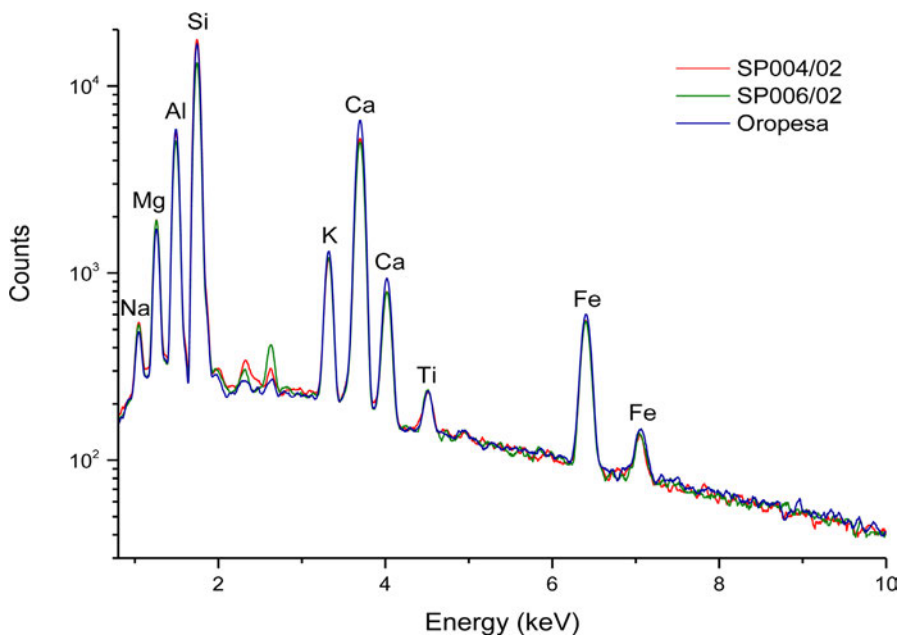


Figure 14. Graphical comparison of the compositional spectra of biscuits from three of the panels researched, showing very close matches.

Figure 15 depicts superimposed EDS spectra of the glazes from samples from the four sites analysed. Overall, the spectra are not strikingly different (for examples of the meaning of “strikingly different glaze spectra”, see e.g. [16, p. 43]), still there are marked differences in the contents of elements such as sodium (Na), tin (Sn) and lead (Pb), in line with the numerical results in Table 2. Again a PCA of the samples was published elsewhere [40] and when compared to tiles from other known provenances, it could be shown that, notwithstanding the variance of the ratios Si/Pb, all glazes could be clustered together as possibly sharing the same technological provenance. The PCA is particularly useful in cases such as this, when similarities must be weighed against disparities.

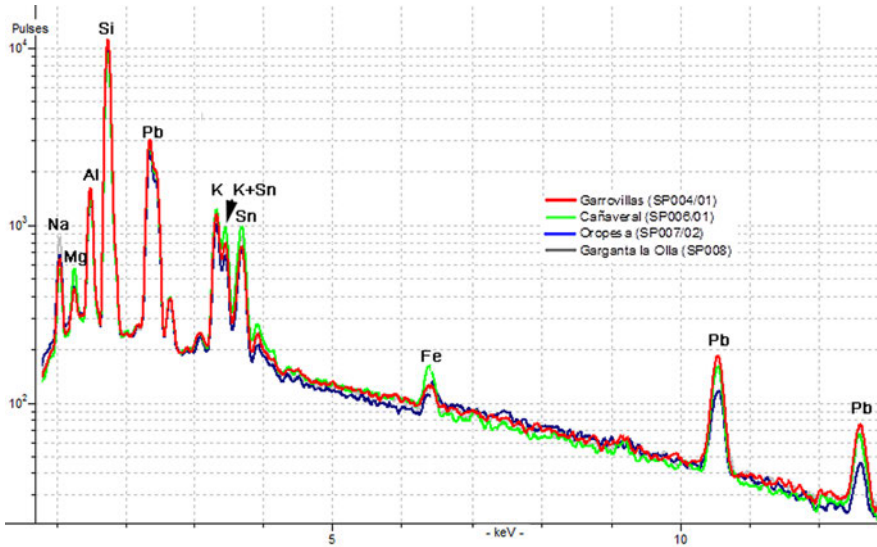


Figure 15. Graphical comparison of the compositional spectra of glazes from the four panels researched depicting an overall conformity but striking discrepancies in details.

Table 4 summarizes results pertaining to the glazes by systematizing their Si/Pb ratios as well as appraising subjectively, from Figure 11, the density of inclusions and the development of interfacial outgrowths.

As pertains the interface glaze/biscuit, it is interesting to note that the two samples from the Oropesa panel are different one from the other, possibly because of the location of the tiles inside the kiln (maybe a small kiln) resulting in different firing conditions [38, p.92]). This remark practically nullifies the worth of considering interface morphologies in this particular study because of the comparatively small development of interfacial crystals in most items, still the presence or absence of inclusions in the glaze cannot be explained likewise. The apparent high density of inclusions in two of the Garrovillas samples may be a fortuitous consequence of a local agglomeration, but may – more likely - be an indication of two different workshop practices.

Table 4. Synopsis of glaze Si/Pb ratios, together with morphological observations

	Si/Pb	Interface glaze/biscuit	Inclusions in glaze
Sp001 Garrovillas	1.1	sample of glaze only	some
Sp002 Garrovillas	1.4	almost non-extant	few
Sp003 Garrovillas	0.9	very small	many
Sp004/01 Garrovillas	1.2	small	many
Sp005- Cañaveral	1.2	sample of glaze only	some
Sp006/01 Cañaveral	1.0	very small	few
Sp007/01 Oropesa	1.2	somewhatj developed	few
Sp007/02 Oropesa		non-extant	few
Sp008 Garganta la Olla	1.6	somewhat developed	few

6. CONCLUSION

Four groups of tiles extant at four different locations, all attributed to the workshop of Juan Flores, were studied:

- Garrovillas (twice signed “IF” and twice dated “1559”) includes figures of saints and two different patterns. The original claddings have been disassembled at some time in the past and two of the figures plus pattern tiles were reapplied as a front in the main chapel, with the rest used to cover lacunae or kept in deposit. All the figures and patterns sampled correspond in style, dimensions and colours to the figures and pattern tiles cladding the low wall where they are now applied. We cannot be certain whether all the tiles were delivered in 1559 but they seem to conform to a single decorative campaign. If there are two different chronologies represented, they should not be very far apart;
- Cañaveral, includes a recently restored panel presently applied on a wall, and some pattern tiles in deposit which correspond to the same pattern used in the panel;
- Oropesa corresponds to a single figurative panel and is, as respects homogeneity, the best case within the four;
- Garganta la Olla, maybe once applied in a different local church, includes a coat of arms dated “1560”, which was the only part sampled, set amidst pattern tiles of a different chronology.

Table 5 summarizes the results of a comparison of the samples from the sites studied, considered globally as four (and only four) different groups, as pertains, both to objective artistic traits, and analytical results.

Table 5. Systematization of samples based on objective artistic traits and analytical characterization

	Use of a common pattern design	Sharing of iconography	Use of bone ash in the glaze	Use of <i>coperta</i> over the yellow colour
Garrovillas	YES	YES	YES	YES
Cañaveral	YES	No	YES	YES
Oropesa	No	YES	?	YES
Garganta la Olla	No	No	YES	?

The use of a common background pattern in tiles that make up the panels in Garrovillas and Cañaveral (Figures 1, 2 and 3) convincingly connects the panels in those two locations, while the iconographic parallel between Garrovillas and Oropesa (Figure 6) also ensures the integration of this third panel with the other two. Garganta la Olla, on the other side, is connected to at least Garrovillas and Cañaveral through the use of what we presume to be bone ash in the glaze. Analytical results also point to the use of a single clay, or maybe very similar clays from the same geographical origin in the panels in Garrovillas, Cañaveral and Oropesa, while the samples collected in Garganta la Olla did not include a sufficiently representative biscuit area for analysis. On the other side, although a higher Si/Pb ratio was determined for its glaze, it may be pointed that none of the results obtained for Garganta la Olla suggests a different provenance than that of the other three panels, while the use of bone ash strongly suggests a common technology.

All together the results obtained point to a single artistic origin for, at least, Garrovillas, Cañaveral and Oropesa, as well as to a common technological origin of the tiles in all the four locations studied, as might be expected from a single workshop over a few years of activity or a group of associated workshops with a common technological source (e.g. a master potter and one of his former apprentices). The painter of a panel and the potter who prepares and fires the glazes are not necessarily the same person and, in fact, the two slightly different densities of inclusions (Table 4), raise the possibility of the intervention of two different potters sharing a common technology in the work for Garrovillas. The panel from Garganta la Olla needs more samples and further study for a more assertive conclusion.

The possible use of the same materials and technology in some of the figurative panels and patterned tiles lining the palace and estate of Bacalhôa, in Portugal, was addressed elsewhere [40; 41].

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