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NEW DATA FROM THE CARTUJA KILN COMPLEX (GRANADA, SPAIN). KILN BEIRO 7

Partially excavated by Manuel Sotomayor in the second half of the 1960s, Kiln 7 in the Beiro Sector was re-excavated during the most recent interventions at the site. This latest archaeological study has provided new data on the kiln construction process, its structure and its phases of use and abandonment.

In this work, a typological and functional analysis of it is proposed. There is also an intense search for other parallels that help clarify this interesting structure.

Based on the information compiled over the years, a proposal for the reconstruction of the pyrostructure has also been made.

Roman archaeology – Baetica – Florentia Iliberritana – pottery production – 3D reconstruction

Introduction

Archaeological excavations on the land of the present-day University of Granada Cartuja Campus began in 1963 under the direction of Manuel Sotomayor Muro, who supervised them until 1970. His campaigns revealed the remains of 10 pottery kilns of varying shapes and sizes (Sotomayor 1966a, 1966b, 1966c, 1970; Serrano 1974), as well as a series of adjacent rooms and waste dumps. Annual excavation campaigns have been carried out at the site since 2009 as part of the practical training of the University of Granada Archaeology Degree and Master's Degree.

The excavations undertaken in recent years have allowed us to determine that the pottery manufacturing industry occupied a larger part of the hill than had previously been thought (Moreno and Orfila 2017; Sánchez and Bustamante 2018). The excavations in the 1960s revealed part of a large quarter devoted to craft activity, the so-called Beiro Sector. We now know that this pottery-making quarter, located on a hill near the Roman town of *Florentia Iliberritana* (today in the El Albaicín neighbourhood of Granada), in ancient times would have occupied a large part of what is now the Cartuja University Campus.

The excavations in recent decades have brought to light different areas related to pottery manufacture. They range from clay extraction quarries in the highest part of the University of Granada Campus, mainly in the area known as Albercón del Moro, to a large number of kilns (Sánchez and Bustamante 2018) concentrated on the lower part of the hill, as well as three vats for the processing of clay.

Since the 2019 campaign, one of the objectives of the archaeological interventions in the so-called Beiro Sector

has focused on Kiln 7, whose excavation was initiated by Sotomayor. The results of this work are presented here¹.

Kiln 7 general characteristics

Located in Area 5 of the Beiro Sector, Kiln 7 stands out among the pyrostructures exhumed by Sotomayor due to its size (**Fig. 1**).

It has a 5.10 m x 6 m quadrangular ground plan. The 1960s excavations documented a Cuomo IIB type ground plan with transversal walls that acted as *suspensura* (Sotomayor 1970: 721). It has a north-south orientation with the kiln entrance to the north of the structure. The mouth is 65 cm wide with an opening of 60 cm.

The kiln was built using a mixed technique: *opus incertum* of medium-sized river pebbles for the construction of the external skeleton and *opus testaceum* on the central arch that runs throughout the kiln. To these materials we can add the use of mud for the interior lining of the walls that define the entire structure and would have hidden the stone skeleton and adobe for the bracing walls and perforated floor (**Fig. 2**).

Of particular note among the building materials is the recycling and reuse of pottery of various types, possibly not suitable for sale or the result of surpluses that did not end

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up being sold. In this respect, there are fragments of *tegulae* with obliterated tabs or even *imbrices* used in the grill work, as well as fragments of *dolia* in the construction of the furnace reinforcement buttress (Sánchez and Bustamante 2020 ;Bustamante and Sánchez 2021).

New data on the kiln construction process

The documentation and excavation tasks carried out on Kiln 7 since 2019 are providing new information about its structure

and building process. Thus, the results of the new interventions confirm that a quadrangular interface was made for the construction of the kiln. This delimited a quadrangular stone structure made of local sandstone and calcarenite whose walls were, in general, between 60-63 cm thick. In addition, this was accompanied by a pavement of large stone blocks that has only been preserved at some points and perhaps indicates the existence of a floor on which the material to be burned would have been placed with the objective of increasing and prolonging the required temperature. In addition, *opus incertum* walls were built to form the solid structure.

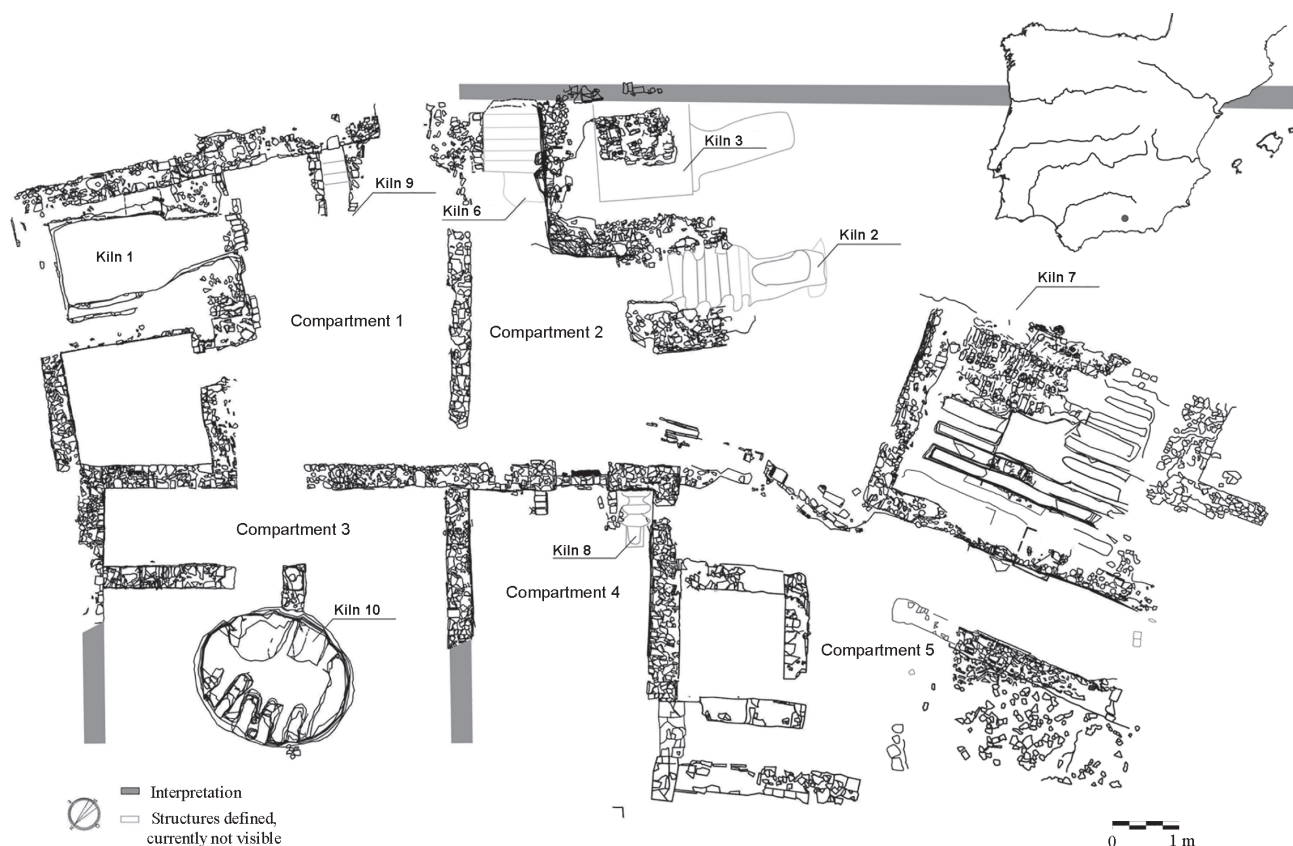


Fig. 1. Plan of the structures identified in the Beiro Sector and location of the archaeological site on the Iberian Peninsula.



Fig. 2. Condition of Kiln 7 in 1970 (photograph by M. Sotomayor).



Fig. 3. Adobe bricks fallen on the Kiln 7 grill (photograph by M. Sotomayor).

In order to avoid cracks in the stone due to the thermal oscillations that would have occurred in this underground substructure, the walls were covered with a layer of rammed earth about 50 cm thick. The plasticity of this material was able to withstand that type of oscillation.

Once the container had been formed, seven braced walls 30-32 cm wide with an east-west direction were built. They were constructed with adobe and characterised by being solid at both ends as a buttress for a central arch that ran from north to south throughout the entire kiln and would have constituted the combustion corridor itself, which was about 65 cm wide. It is interesting to note the absence of what is traditionally known as a *prae-furnium*, perhaps to avoid heat loss.

The grill would have been built on the braces (well preserved in the southeastern quadrant). For their construction, first a kind of mesh with quadrangular openings was woven from the placement of adobe bricks positioned by pressure in a zipper-type edge formation. No type of binder was used in this first part of the process. Secondly, these quadrangular holes were initially covered with a mud slurry that was spread by hand, as can be seen from the finger marks imprinted before the combustion process ended up hardening this layer. Before it set, this would be perforated again to create a smaller opening than that of the first stage to favour a more controlled rise of air.

What we are unable to provide any information about is its covering, a factor we could also extrapolate to any possible nozzles and chimney flues. It was the study undertaken by Sotomayor (1970: 721) that highlighted that the structure was very superficial at the time of its discovery, a circumstance that affected the conservation of the elevations of the kiln firing chamber. However, the photographs taken during the excavation process show the discovery of adobe remains fallen on the grill, indicating that either the roof, the chamber walls, or perhaps both, had been made of that material (Fig. 3).

The excavation of the southern enclosure of the kiln did not allow the documentation of the entire side wall, as that

must have been removed at a time it has so far not been possible to date. It did however show that, on this side, the width of the perimeter wall in the sector in which it is preserved was greater than that identified on the other sides, up to 1.09 m. This was probably an attempt to reinforce the structure against the slippage of the slope that can be seen at this point where the hill descends to the bed of the River Beiro. This hypothesis appears to be corroborated by the later construction of a buttress to reinforce the structure.

Building phases and abandonment processes

It is difficult to clearly date the construction of a structure with the characteristics of Cartuja Kiln 7. However, the find embedded in the work of Stay 7 of a fragment of Hisp. 37 with the indication of a smooth rod and the beginning of a corded circular brace allows us to propose a *terminus post quem* of the late 1st century AD.

Nevertheless, a detailed analysis of the span of the entrance arch to the central corridor has shown the possible existence of at least two construction phases, probably related to the repair of damage caused by the continued activity of the structure over a period of time (that is difficult to define). Furthermore, at a time after the furnace was built, the buttress to reinforce the southern enclosing wall was added, giving the structure stability against the downhill slope.

Regarding the abandonment phases, the excavation of the interior sedimentary levels of the kiln that had not been affected by previous interventions in the area, has only produced finds of Roman chronology, which could indicate that the structure had already been silted up in antiquity. The find of a Hayes 50 ARSW C sherd probably indicates that this could have taken place from the 3rd century on. The inactivity in the late roman period is confirmed with the discovery of a Hayes 58B ARSW-D sherd associated with an adobe structure that cut through the southeastern wall of the kiln.



Fig. 4. 3D reconstruction proposal for Kiln 7 (made by Balawat).

Reconstruction hypothesis

Based on the results of the Kiln 7 excavations, a 3D reconstruction has been proposed, at least in what is considered to be its first construction phase. However, while the elements that composed the structure up to the level of the grill and the bottom of the firing chamber walls seem clear (as described above) and allow a fairly definitive reconstruction, the information relative to the closure is very poor and only allows hypotheses to be put forward.

For this reason, parallels were sought in proposals for the reconstruction of Roman kilns with similar characteristics that would serve as a guide for the 3D modelling of Kiln 7. Thus, among the quadrangular kilns for which proposals of this type have been made are, for example, the two twin kilns with a rectangular ground plan measuring 5.2 x 3.85 m excavated in Giancola (Brindisi), a group dating from the Republican period (Pallechi 2007). Later, from the first half of the 1st century AD, there are two of the kilns at Port-la-Nautique (Narbonne): Kiln 1 (7.80 x 7.30 m) and Kiln 2 (6.60 x 5 m inside) (Sánchez, Carrato and Favennec 2011; Carrato et al. 2018). Kiln 3 at Saint-Bézard (Aspiran), from a similar chronology, measured 3.37 x 4.17 m in its first phase (Carrato 2012). From the second half of the 1st century AD we have the pottery kiln at Sivier (near Istre, Bouches-du-Rhône), which in its first phase measured 3.55 m on each side (Marty 2003), and the Ca l'Arnau kiln in Cabrera de Mar, with a built area of approximately 45 m² (Martin 2002)².

Based on these previous proposals, the modelling of Kiln 7 at the Cartuja pottery began along two different lines. Starting in both cases from an elevation of the adobe walls,

the hypotheses proposed the existence of a vaulted roof, as found in most of the proposals in the bibliography, or a domed roof, as proposed for the Port-la-Nautique kiln.

The calculations³ showed that a solution similar to that proposed for Narbonne did not fit the thickness of the walls of the Granada kiln, forcing the generation of a complex roof that used the technical resource of pendentives. On the other hand, the use of a lowered barrel vault, similar to that proposed in most of the proposals found in recent historiography, adapted better to the structure's measurements and characteristics (Fig. 4).

Final remarks

The new interventions in the Cartuja kiln complex make it possible to provide new data on one of the largest and best-preserved ceramic kilns on the peninsula. The associated materials define a productive area from the end of the 1st AD and late in the 3rd century AD. The interesting data have also allowed us to define a new reconstruction proposal that we present here.

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² The reconstruction of the kiln can be seen at <https://www.cabrerade-marpatrimoni.cat/romans/la-terrisseria/> (consulted 03-10-2022)

³ The reconstruction modelling proposal was carried out by the BALAWAT company.

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