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From Construction to Destruction: The Development of an Excavation Protocol for Pottery Kilns.

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Abstract:	The recent preventive excavations at Famars and Montescourt-Lizerolles, with almost thirty new kilns discovered, have prompted the development of an excavation protocol adapted to kilns, complex edifices that are mostly cut through or emptied of their fillings. The new data showed that much more information could be obtained when following a rigorous method of cleaning, considering the position of artefacts in the fillings, and totally deconstructing the separate parts of the structure, by removing clay linings, supports and floors. Awareness of the diverse construction variations, applied material, and gestures lead to more exhaustive examination, even in the context of preventive archaeology where time pressure is important. The meticulous stripping of the structure has led to the demonstration of different elements, including the presence of channels to counteract humidity, the use of mudbricks or ritual deposits and gestures. This way, the authors hope to sensitise archaeologists to consider kilns with more care.
Suggested Reviewers:	Mario Denti, Dr Professor, University of Rennes mario.denti@univ-rennes2.fr Prof. Denti has organized a conference on Pottery Craft Spaces and has good knowledge of excavation methods based on his research of kilns in South-Italy
	Frédéric Hanut, Dr Pottery specialist, Agence wallon du Patrimoine, BE frederic.hanut@awap.be Dr. Hanut is a renewed pottery specialist who has contributed in the excavation of several pottery kiln sites in Belgium
	Steven Willis, Dr Professor, University of Kent S.Willis@kent.ac.uk Dr Willis is specialised in Roman pottery and has great experience in excavating
	Sofie vanhoutte, Dr Researcher, Flanders Heritage Agency sofie.vanhoutte@rwo.vlaanderen.be Dr Vanhoutte has great experience in digging and in Roman pottery research
	Caterina Paola Venditti, Dr Researcher, Government of Italy Ministry of Heritage Cultural Activities and Tourism caterinapaola.venditti@cultura.gov.it Dr Venditti is interested in Roman pottery and new methodologies and has organized a session on coarse wares and new classifications
Opposed Reviewers:	Xavier Deru, Dr Professor, University of Lille xderu@uliege.be

	Prof. Deru was prohibited by the French government from excavating, on the grounds of a problematic excavation method. I therefore think that he is not able to judge others on their methods.

Cover letter

The present article “From Construction to Destruction” aims at sensitizing archaeologists to consider the excavation of pottery kilns in more detail, even in the context of preventive archaeology. The recent preventive excavations at Famars and Montescourt-Lizerolles, with almost thirty new kilns discovered, have prompted the development of an excavation protocol adapted to these complex edifices that are mostly cut through or emptied of their fillings. It was presented during the study day at Paris Sorbonne “Exploring Craft Spaces: A new Insight in the Archaeology of Pottery Production”, focusing specifically on methodology to obtain more insight in the organisation of craft spaces.

The new data showed that much more information could be obtained when following a rigorous method of cleaning, considering the position of artefacts in the fillings, and totally deconstructing the separate parts of the structure, by removing clay linings, supports and floors.

Awareness of the diverse construction variations, applied material, and gestures lead to more exhaustive examination, even in the context of preventive archaeology where time pressure is important. The meticulous stripping of the structure has led to the demonstration of different elements, including the presence of channels to counteract humidity, the use of mudbricks or ritual deposits and gestures. This way, the authors hope to sensitise archaeologists to consider kilns with more care.

Title:

From Construction to Destruction: The Development of an Excavation Protocol for Pottery Kilns.

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Abstract

The recent preventive excavations at Famars and Montescourt-Lizerolles, with almost thirty new kilns discovered, have prompted the development of an excavation protocol adapted to kilns, complex edifices that are mostly cut through or emptied of their fillings. The new data showed that much more information could be obtained when following a rigorous method of cleaning, considering the position of artefacts in the fillings, and totally deconstructing the separate parts of the structure, by removing clay linings, supports and floors. Awareness of the diverse construction variations, applied material, and gestures lead to more exhaustive examination, even in the context of preventive archaeology where time pressure is important. The meticulous stripping of the structure has led to the demonstration of different elements, including the presence of channels to counteract humidity, the use of mudbricks or ritual deposits and gestures. This way, the authors hope to sensitise archaeologists to consider kilns with more care.

Key Words:

Pottery kilns, excavation methodology, craft spaces, mudbricks, waste management, ritual deposits

1. Introduction: Incentives, and Issues

When consulting articles or monographs on pottery manufacturing sites, whether belonging to the Roman or the Medieval period, the absence of images showing the different stages of the

exhumation process of kilns is striking. In the context of rescue excavations under major time pressure, most production structures are simply emptied, and its content mostly interpreted as filling. The kilns are illustrated with overviews of the cleaned-out structure, and the construction's profile is examined by cutting through the structure. In recent years several conferences have concentrated on craft spaces, trying to renew the study of kiln sites within a wider setting (Thuillier, Louis eds., 2015; Rivet, 2019), but most of the descriptions remain limited. An excellent attempt was made at the 2014 Rennes Conference, where organisation ritual as well as methodological aspects were considered (Denti, Villette, 2019), of which some of the research questions led to new approaches (Willems, Favennec, 2019). Consciousness was rising of the complexity of information these craft spaces could yield, building on several PhD dissertations (Thuillier, 2003; Pastor, 2010; Favennec, 2016; Willems, 2019) and research programs such as the "Atlas of pottery productions" (Willems *et al.*, 2023). Recent excavations by the *Institut national de recherches archéologiques preventives* (*Inrap*) at Bavay (Labarre, Willems, 2019), Montescourt-Lizerolles (Maréchal *et al.*, 2019) and Famars (Favennec *et al.*, 2019) raised more awareness and incited the development of a specialized procedure for the study of kiln structures. The present article retraces the most important steps of the protocol and hopes to sensitise archaeologists to consider these complex structures with care.

The unearthing of a kiln aims to understand the architecture, the use of different materials (daub, natural soil, wood, bricks and tiles, pottery sherds…) and the identification of specific features such as a loading entrance or impermeability channels, as well as to the comprehension of its use, leaving indications of its firing conditions (oxidized or reduced atmosphere, temperature…) and repairs (change of orientation, rebuilding by widening or narrowing the flue, renovation of the baking plate…), and finally its abandonment, with phases of deconstruction, ritual gestures and filling up. These three different steps in the life of a kiln should be unveiled by the excavation.

The protocol resulted from experiences on the pottery kiln sites of Fanjeaux (Favennec, 2018), Magalas (Favennec, 2019) (Aude, South-France) and Famars-*Technopôle phase 1* (Favennec *et al.*, 2019), and tested during the excavations of twenty kilns at Montescourt-Lizerolles (see Flahaut *et al.,* in the same issue), and at Famars-*Technopôle phase 2* (in preparation, excavations 2019-2020).

2. Methodology and principles: the different steps in the excavation process

2.1.Principles.

Kilns are complex edifices, and a wide variation in their morphology is noted. Some of them are installed at a shallow depth or even on the ground level, as examples from Pompei show (e.g., Boutique 29, Cavassa *et al.,* 2014, p. 9 or Saint-Pargoire, Mauné, 2009, p. 112-113). According to Stéphane Mauné (Mauné, 2009, p. 113), the construction of non-excavated structures reflects the haste of execution due to kiln defaults, imposing their replacement during the firing season, or to enhance the production capacity. The limited re-digging would mean an important time gain. The Pompei case, though, suggests that kilns did not need to be installed in the natural soil if they were protected by stone buildings, with a ceiling high enough to avoid fires.

In the case of the studied region, two main types of kilns were present, both of them making use to their advantage of the natural soil: the double-flue horizontal one-volume kiln and the single-flue vertical updraught double-volume kiln. The upper structure may be totally open, the oven being shut down by laying tiles clayed together over the pots, or it may consist of a dome with a chimney and a loading door. Moreover, a wide variety of platforms, oven floor supports and layouts exist, illustrating traditions, knowledge transfers and identity (Willems, 2019, pp. 190-194). Their installation, use and abandonment are steps that should be precisely examined, as each phase is reflected by different traces. Kiln structures should, of course, not be explored as a reason on their own, but as a part of the overall production process. Questions regarding the « chaîne opératoire », from the choice of raw material, the clay and paste preparation to technical, functional, typological, chronological queries about the pottery, the firing strategy, as well as the management of the wasters should also be considered when studying kilns. The organisation of the pottery, the localisation of the kiln within the urban layout, or its production status in relation to the market demands are yet again necessary research questions. In the present article, we focus particularly on the excavation of the kiln structure, but the authors would like to underline the importance of keeping in mind these issues to understand the potter's gestures and decisions.

2.2.Recording Data

First, as kilns are complex compositions, it is essential to illustrate every step of the process with comprehensive photographs and overviews. The use of photogrammetry, 3D photography or orthophotography is recommended as it permits to analyse, during post-excavation, details that might have escaped attention.

Second, as kilns retain varied complex information, it is necessary to approach the architecture not only by observing, revealing, and emptying it but also by deconstructing the entire construction, as some of the features can be concealed by the finishing of the wall sides or the various layers and materials employed.

Since 1949 more than a dozen typologies have been created to categorize the different kiln forms. Nevertheless, some parts of the construction are not considered, for example, the form of firing chambers bases, and the important variations that exist make the use of such typologies rather obsolete. Moreover, the identification depends highly on the level of completeness of the structure, as well as the excavator's experience. Certain classifications using codes do not incline their use (e.g. Dufaÿ, 1996; Dufaÿ *et al.*, 1997). Pascal Duhamel, one of the first to describe pottery kilns in detail, already indicated that we should not confuse morphological classification with an archaeological typological reality (Duhamel, 1979, p. 72). To tackle the categorization, a registration file has been developed, containing keywords that can be checked and combined and that leaves space for new observations (Fig. 1, full document annexed). It is based on a meticulous analysis of the features on which these typologies were built, combined with datasets from recent discoveries (Pastor, 2010, pp. 142-149; Charlier, 2011, pp. 448-466; Favennec, 2016, p. 261, pp. 541-542 and 553-561).

The moment of deconstruction of a kiln structure is also an occasion to consider sampling. The most common one is archaeomagnetic sampling. Although the magnetic variations of the North Pole for the Roman period do not always yield best results, researchers have a good knowledge of the directional fluctuations of the Earth's magnetic field over the last two millennia in France (Le Goff *et al*., 2020; Gallet, Le Goff, 2023). New approaches (see Genevey, Gallet, in this issue) try to specify chronology for the North of Gaul, based on the assessment of wasters. Clay samplings from within the construction of the kiln, natural soil and soil from the kiln walls rubified by heat, behind the facing (e.g. clay lining), can be analysed to read the firing atmosphere. Comparison of the colour of the natural soil to the reddened sample (see e.g. Rasmussen *et al.,* 2012), combined to the thickness of the scorched walls, indicate the firing temperature. Natural soil used in the structure, such as in the upstanding baking-plate support, can be correlated to reshuffled soil and studied by micromorphology. This is specifically helpful to recognise the application of hand- or mudbricks within the construction (Cammas, 2016), something often difficult to differ from natural soil by the naked eye.

Finally, sampling of wood imbedded in the edifice (e.g. in the oven floor) and charcoal, mingled with other debris in the fillings of the oven, firing chamber and the stoke-hole should be examined by anthracology to reveal choice of the tree and shrubs used during the construction or the firing phases.

2.3.Step 1: Recognition of the structure(s)

As soon as the topsoil has been removed, generally the kiln structure appears as a reddish or orange circle, while the stoke-hole mostly is dark-coloured by the charcoal filling, reflecting burnt wood raked out from within the flue towards the stoke-hole, where the potter is keeping control over the fire (Fig. 2, A). Depending on the level of conservation, some of the internal architecture might immediately be visible, such as the oven floor, the support, or specific elements in the filling, such as intact pots. Careful observation of the outlining can already suggest whether the kiln has one, or more than one stoke-hole, one or several flues, or whether it is a composite feature or a structure with a chronological evolution. This first assessment is important because it induces the placement of the axes (Fig. 2, B), permitting the study of the structure's stratigraphy. A thorough cleaning of the archaeological level and the surface of the kiln and its surroundings is essential. It enables us to analyse the firing circles (Fig. 2, C), evidencing different periods of use and/or firing atmospheres. The rings are separately coloured according to combustion temperatures and the presence of carbon (Picon, 2002). Therefore, light-coloured circles result from a reduced/oxidised firing process, while greyish rings reflect reduced/reduced firing conditions, this way also indicating the category of pottery that might have been produced in the kiln. A succession of different circles can point out phases of repair, by applying a new clay lining on the kiln wall or by constructing a surrounding inner earthwork in mudbricks, tiles, or stone. The clay lining that is in contact with the air atmosphere or combustion will oxidise or reduce while its inner lining, the natural soil, will redden. It also permits an adaptation to the structure, e.g. at the surface it is noticed is of a one-volume type (Fig. 2, D), supplementary care will be taken of both flue zones that are often very fragile parts of this type of kiln.

Another important point is the cleaning of the archaeological surface around the kiln structure. As kilns in the North of Gaul are subjected to bad weather, negatives of wooden posts around or near the structure could reveal the presence of awnings to cover the kiln or the stoke-hole. Additional features to be expected nearby are heaps of melted wasters or clay pits (Fig. 3).

After this first step of cleaning, a longitudinal excavation axis, which can be adapted to deviating orientation, and transversal axes for each part of the structure (stoke-hole, flue, kiln) should be laid out (Fig. 2, B). Supplementary attention should go to the flue zone, often fragile. When unearthing the filling of the kiln/oven chamber and the stoke-hole, the filling of the flue could be preserved until the end, to exclude its weakening (Fig. 4, A). The axis in front of the flue permits a good view on its measurements, but also on the possible repairs of this important part of the kiln, frequently narrowed, extended, or shortened to secure a better draught during firing, or the positioning of slabs, doors, and vessels (Fig. 4, B).

2.4.Step 2: Excavating the kiln structure.

Once the axes laid out, a system of quarters is obtained. Each quarter is to be dug out, leaving a witness berm that will enable stratigraphic analysis of the filling. Layers without archaeological remains can be taken out until the level of abandonment is reached. This can be a layer of wasters, fragmentary or not, maybe resulting from a specific gesture, or just debris from the oven structure itself, mixed with clay, charcoal, tiles, or consumption material (pottery, metal, bone…). It is preferable to clear the filling of the four quarters on a same level, allowing an overview of the spatial distribution of the rubbish (Fig. 5, A). Under time pressure, this meticulous way of descending could be shortened employing photogrammetry. The protocol of going down level by level in the four quarters at once should be applied on the entirety of the kiln structure, this means in the stoke-hole, the oven or firing chamber and the flue. Special attention should be given to the presence of other finds including unfired clay or flint, used in the production process, or specific objects such as whetstones or flint axes which could have an apotropaic function, as well as to the exact location of the artefacts reflecting specific gestures or ritual implantation or abandoning. A first assessment of gestures within craft spaces has shown the intentional depositing of objects or ensembles to ceremonially install or close the kiln structures after having served (Willems, Favennec, 2019).

When dismantling important series of wasters with a high percentage of completeness, one should note the exact position of every pot within the kiln. Therefore, it is useful to number the different layers of wasters or to give each identified individual a number or letter that should be mentioned on the plans and images (Fig. 5, B). When removing the pots, they should be directly isolated, facilitating their reassembly during post-excavation. Work photos could be

184 annotated, helping the analysis of the assemblage afterwards. This way, the position of
185 perforated or intentionally broken pots could be studied more easily. When confronted with
186 large numbers of vessels, such as the abandonment of the last kiln load, it is recommended to
187 illustrate by using orthophotography or photogrammetry.

188 After the quarter's fillings have been excavated, the berms, showing a cross-section of the
189 backfill's stratigraphy can be recorded by drawings and photographs, before taking them out.
190 At this stage, with the berms removed, the zone at the entrance of the flue can be studied in
191 more detail. A straight section in front of the opening permits the analysis of the measurements
192 and its possible restoration or reconstruction. The filling of the flue can then be cut through,
193 focusing on intentional positioning of objects within or in front of the hole, such as tiles, stones,
194 pottery, or mudbricks (Fig. 6).

195 The entire structure is now empty and can be thoroughly cleaned for the overview. At this stage
196 it is important to complete the drawings; meaning the surface plan as well as the longitudinal
197 cross-section, where the information from sectioning of the flue's filling has to be added.
198 Specific attention should be given to the heat-discoloured natural soil around the oven. The
199 erubescence progresses proportionally in relation to the temperature, which signifies that if the
200 scorched circle shows irregularities, they reflect renovation phases in the initial kiln. For
201 example, when the erubescence widens around the flue, it often indicates an earlier flue
202 construction with different dimensions.

203 An important remark concerns the tradition of excavating the oven's reddened natural soil,
204 something particularly observed in Belgium (Kontich, Asse, Wervik, or Tongeren, e.g. Reygel,
205 Dewinter, 2017). Apart from being a waste of time, the digging away of the unfired natural soil
206 to the reddened natural soil fired by the heat emanating from the firing chamber greatly
207 destabilises the structure, the walls becoming brittle by drying out. Moreover, this method
208 constrains the transversal sectioning of the oven, as well as the comprehension of possible
209 external channels, meant to drain the surroundings of the kiln.

210 *2.5.Step 3: Detailed observation*

211 Once the kiln structure has been emptied of its fillings, a detailed observation of the different
212 elements can yield insight on its construction phases and use. Particularly when the natural soil
213 is silty, various traces are left by the deployment of different sorts of equipment, immobilised
214 in the wet clay linings or in the natural soil when the kiln is subjected to its first firing. Detailed

examination permits e.g. to recognize the sense of the digging out of the natural soil for instance in the firing chamber or underneath the baking plate, or the utilization of utensils for the plastering of the clay linings. Moreover, we must bear in mind that some of these construction remnants can be masked by the deposit of clay linings, mudbricks, or other material to alter and improve the structure, for example, for thermic reasons.

Apart from traces left by tools, timbered arrangements can sometimes be observed, in the kiln or stokehole. As well as postholes around the kiln, supporting canopies for protection against bad weather (Favennec, 2016, pp. 253-254, pp. 595-599), the wall sides or floors of the stoke-hole can be reinforced by a wooden cladding, as was viewed at the antique tile factory of Moissey (Charlier, 2011, fig. 5.4.19). Wood can also be used to support the construction before its first firing, such as stakes for the installation of the baking plate (Favennec, 2016, p. 530-531), or holes in the oven's wall sides that reflect a specific configuration facilitating the loading of pottery in the oven, as is revealed by examples from modern Sicily (Charlier, 2011, fig. 5.4.239, after Hampe, Winter, 1965).

The studying of the clay linings is another important feature, as they often show traces of gestures and repairs. The clay lining is a layer of clay mixed with organic material such as straw or leaves, which is used to finish the wall sides, supports, or baking platforms when it concerns horizontal draught kilns. The plastering probably permits a higher thermic efficacy or the impermeability of the structure cut out in the natural soil. Different layers of covering reflect mending phases or the strengthening of certain parts of the kiln. Traces such as fingerprints or tool negatives testify of the application of the coating, often detected in the kiln chamber or underneath the baking plate and on its support, where the lining is less levelled out.

Observation of blackened or reddened zones, whether scorched natural soil or covering can indicate repairing, distinct firing atmospheres within the same kiln, or the identification of an earlier kiln or parts of kilns. In the example from *La Fajolle*, Carcassonne (Guillaume, 2010, fig. 48), the erubescence edges permit the localisation of the supporting low walls (Fig. 2, A), while at Montescourt-Lizerolles the platform becomes directly visible (Fig. 2, D).

The shape of the platform or oven floor affects, on the outside, the planning of the digging out of the structure, and on the inside, the available space, which means that it influences the furnace draught and the wood consumption, as well as the weight and volume of the vessels. Studying the arrangement of the oven floor is therefore essential to understand the functioning

of the kiln. In fact, most of the existing typologies are based on the form of the oven floor and its support(s) (For an inventory, see Favennec, 2016, p. 237). Of course, even the most recent one of these classifications comprising 79 categories (Thuillier, 2003, tab. 5) focusing on the oven floor, is incomplete as the oven operators seem unlimited in their solutions. We must point out the lack of precise information given in most publications, necessary to grasp the internal organisation of the kiln chamber and oven; primarily, the construction of the floor by sapping and leaving the natural soil in place. Moreover, typologies do not consider changes of the original form, leading to combinations of platforms and supports receiving the kiln load. Potters plan a symmetrical lay-out of their kiln to attain an excellent distribution of the heat while firing. If this symmetry is not reached, it is a good indicator of modifications and repairs after the initial building of the kiln. We conclude that classifications are restrictive and impossible to use in cases where features may have disappeared by soil erosion processes.

Finally, one must be attentive to the existence of ducts or blowholes at the base of the oven, with access to the kiln chamber. The practice of using vents to rapidly augment the firing temperature is understood from Roman and Medieval lime kilns (Vaschalde, 2013), but more difficult to observe on pottery kilns. Channels can also be present just above the baking plate, to evacuate humidity between two firings, as is known at Kaiseraugst-*Liebrüti* (e.g. tile kiln 50; Charlier, 2011, fig. 5.4.367).

2.6.Step 4: Deconstruction

It is only once the visible details have been recorded that the kiln structure should be cut through. At this stage the position of the structure within the natural soil, its composition, the measurements and arrangement of the baking plate and the character of its support, the number of clay linings, the thickness of the soil scorching, the measures of the kiln chamber should all be noted in documentation.

The crosscut should be placed perpendicular to the flue, as this will enable the best reading of the oven support, in the case of a vertical updraught kiln. If the oven plate is still in place, half of it should be removed first, in a way that reveals the form and measures of the underlying support. The final profile should be cut out broad and deep enough to examine the installation pit, possible mudbrick walls, thickness of the natural soil scorching, vents or any other feature with a wider perimeter than the inside measurements of the kiln chamber and oven. The cutting will permit to observe the presence of construction material invisible from the outside, such as

wooden beams or trellis (Fig. 7, Vossen, 1988, abb. 3a), mudbricks or supply of reshuffled soil, pottery sherds, tiles, natural or cut stones such as millstones, to flatten, support or consolidate parts of the structure.

The identification of the usage of mudbricks is a delicate issue, as it highly depends on the sort of soil used for their production. They can be employed for the erection of oven supports or the circular base of the structure, as the example from Velaux, with surrounding mudbricks, shows (Newmann *et al*., 2011, fig. 35, kiln 1004, site Bastide-Neuve IV). Only a meticulous deconstruction of all parts of the kiln allows their recognition. If the mudbricks are made of natural soil, their existence is often only perceptible by the joints filled up with leaked-in mixed soil. If the earth has been mingled with organic material, the blocks will colour thanks to the heating of the kiln. Another possibility is to sample columns for micromorphological analysis, which will enable comparison with natural soil or permit acknowledgment of elements such as joints. In certain cases, after dismantling of the clay lining and in hot weather conditions, the mudbricks dry out and become apparent. However, they are easily distinguishable from tiles as only the outer surface is altered by the heat exposition in the kiln, their inside composition staying brittle.

The edifice must be unravelled in its entirety; this means dismantling the clay linings and demolishing the supports or the platform, in the case of a horizontal draught kiln. This enables us to consider the presence of niches or the placement of specific objects in the structure. A good example comes from Tienen where a ceramic *phallus* was found behind the clay coating of the walls of a bronze production kiln (Martens, Hayen, 2015). Moreover, the kiln should completely be removed to certify that any other construction was anterior or that a ritual deposit was installed to celebrate the moment of creation (e.g., Lezoux, Bet, Gangloff 1987).

3. Results

The testing of the portrayed protocol on kilns in Northern Gaul at the preventive digs of Famars and Montescourt-Lizérolles and in Southern Gaul at the programmed excavations of Fanjeaux and Magalas, showed that a bulk of new information resulted from this approach, leading to a much better understanding of the potter's choices and gestures. The following explanations illustrate some of the possibilities described in the methodological part of the present article. They reflect, certainly, only local situations and are therefore incomplete. Every region and each kiln are characterised by particularities arising from an adapting to different circumstances

and contexts, such as weather, available raw material or natural soil conditions, traditions, knowledge transfers, pottery types and functions or market demands. A rocky soil will, of course, not facilitate excavation of the kiln chamber and the builders will take advantage of the accessible stones, while kilns for amphora and wide-sized *dolia* will adapt to the vessel's measurements as well as to important demands from for instance wine and oil producers or market demands which will influence the kiln size and thus its construction.

3.1.Reading Soil Colours

When excavating a kiln structure, it is important to pay attention to soil colours, evidencing different kinds of natural soil, shuffled soil, clay linings or raw material that have reacted to or are the result of the distinct phases of use and repair. The erubescence of the natural soil can first be read at the surface when the topsoil has been removed and the natural level has been cleaned. Series of red and grey hues can be observed in the wall sides of kiln 2159 at Famars (fig. 8, A) indicating at least three clay linings, grey-coloured because of the reduced firing atmosphere and the local scorching of the natural soil behind the orange lining. The same is true on the flue openings, where soil has been applied, decreasing the height of the channel, probably to alter the draw in the kiln (fig. 8, B). These repairs are interesting, because they reflect a deliberate changing of the structure to improve its efficiency.

Clay lining is also smeared to consolidate parts of the structure that wear out more quickly because of specific strains. This is particularly the case for the flue, the most fragile part of the kiln, as observed on kiln 330 from Montescourt-Lizerolles (fig. 9, A). The application of clay linings can alter the functioning of the kiln, intentionally or not. On kiln 400 from the same site, the new clay linings on the wall sides of the one-volume oven changed the airflow in the laboratory. The base is surrounded as well as centrally cut through by a conduit. In the case of kiln 400 the clay lining was of a thickness eliminating the outer channel (fig. 9, B). Another example of a repair that alters the airflow is detected in kiln 420 where the platform was increased by placing a fresh layer of shuffled soil on top of the earlier scorched platform. A new clay lining finished the renovation (fig. 9, C). A similar repair was observed on kiln 12127 from Famars, where the initial central pillar (fig. 9, D; 1) was first enlarged by adding organic soil around the first column, with a new clay lining (2). This new disposition clearly did not work well enough as in a third phase the support was heightened (3). Moreover, we wonder if the extending of the central support did not entirely change the mode of operating of the kiln. The new clay lining of the walls did not present negatives of the attachment of a potential oven

floor, which would mean that the central pilaster became a platform for a one-volume horizontal draught kiln, which would explain its broadening.

The surface cleaning of the circumference of the kiln structure can also indicate particularities in the construction and functioning. This is the case for vents to augment the firing temperature in the oven (e.g. Charlier ,2011, fig. 5.4.244 and 5.4.367; Favennec, 2016, p. 588 and fig. 364). When excavating kiln 11804 at Famars-*Technopôle* phase 2, the perimeter of the kiln displayed an alternation of black and red erubescence segments, which were at first interpreted as the location of possible vents (fig. 10, A). After cross-sectioning of the kiln, a neat line was observed, showing an organic upper black layer and a lower scorched natural soil layer (fig. 10, B). Taking down the clay lining on the wall exposed discolouration as the result of mudbricks, not vents. These were clearly outlined as black organic mudbricks with joints from shuffled non-organic earth of the same colour as the natural soil (fig. 10, C). When cleaning the crosscut and considering the location of the joints and mudbricks, they became slightly visible as a pinkish pigmenting, enough to calculate the width of the mudbrick inner walls (fig. 10, D). In kiln 11804 (fig. 10, B) one can notice that they are only placed from a precise height onwards, namely only from the base of the oven up, while in another example, kiln 12141, the surrounding mudbrick wall goes down to the bottom of the installation, composing the chamber kiln and the oven (fig. 10, E).

The employment of mudbricks was also suggested for the construction of the oven base supports, but it was difficult to prove as they were not visible because of the clay lining and the shuffled natural soil that reddened homogeneously. In the support of kiln 12547, their presence was grasped through meticulously brushing -after having removed the outer clay linings-, feeling the difference between blocks and joints (fig. 11, support A), but uncertainty was taken away when after three months of Covid-19 restrictions the supports were left drying out, profiting from a heat wave. The slabs became visible, as in kiln 11800 (fig. 11 support, B) where we could measure most of the bricks before destruction. The support of kiln 11804, fired in mostly reduced atmosphere, showed a grey mass on the outside where scrubbing gave a similar result (fig. 11, C). The construction layers, particularly those with an organic composition, became apparent (fig. 11, D) with some joints more organic than the bricks themselves. As we notice, the exterior scorching of the supports behind the clay lining coloured a homogenous grey, the non-organic and organic bricks reacting identically to the firing environment. In kiln 12127 the existence of an enclosing mudbrick layer was not detected or not proven, but when destroying the clay lining, the walls came down in neat layers, suggesting the presence of

narrower mudbricks put on their small sides to build a surrounding finishing of the kiln chamber (fig. 11, E).

In several examples from Montescourt-Lizerolles (e.g. kiln 330) a white lime-rich encircling was noted, which was interpreted as a solution against rising humidity facilitating rapid heating. It was observed at the surface as a compact white clay and chalk-rich layer, around the outer erubescence ring. When cutting through the structure, the layer was still visible at the same level as the foot of the platform (fig. 12, A). The crosscut clearly showed its presence at the base and against the wall sides of the kiln's installation pit, with a thickness of about 20 cm, followed by a more organic part and the final clay lining (fig. 12, B).

3.2.Imbedded Traces

The meticulous cleaning and later destruction of the inner structure of the oven, kiln chamber and stoke-hole have permitted us to note various findings about how the potter worked, which tools he used, as well as which material enabled the kiln construction. These traces were left in the natural soil or imbedded in the clay linings completing the surface of the excavated walls. At Montescourt-Lizerolles, most of the kilns were finalized by employing clay by hand, which means that numerous fingerprints could be detected (fig. 13, A). In the example the walls of one-volume kiln 240 received first a clay lining, and then the base of the channel encircling the platform. The bottom shows swiping marks and the clay lining is applied on top of the finished walls. Finger marks have also been observed several kiln chambers such as Famars kiln 11800. In this case the oven base or baking-plate received supplementary support blocks that were attached to the initial walls by smearing clay on both sides of the curved and flattened block (fig. 13, B). The finishing of supports in the firing chamber was clearly not a priority but rather a practical question of consolidating structures. At Fanjeaux-*Las Cravieros,* further hand swipes have been identified, pulling the clay lining from the bottom to the upper part to level out the wall sides (fig. 14).

Clay linings also carry negatives of tools, as is shown in several kilns at Fanjeaux or at Famars. The traces sometimes reflect the form of the entire tool blade, as is the case in Famars kiln 2995 (fig. 15). The negative illustrates the deployment of a long flat pointed tool, probably for the flattening of the linings. The kilns discovered at Fanjeaux-*Las Cravieros* are excellent examples for the understanding of the instruments that are used by the oven workers and archaeologists have tried to compare the imprints to contemporary utensils. The inner walls of the kiln FR1

have been sculptured by using a rectangular bladed tool of about 5 to 10 cm large with a size of 0,8 mm thick, while in other parts of the construction a pointed tool has been used to shape the natural soil, hitting in an oblique way with a long sway (fig. 16). The oven base of FR3 has been carved by sapping with a curved tool (fig. 17, A), walls sides finished with a flat broad tool (fig. 17, B), while angular wooden tools were probably pushed through the soil, as organic fibres were observed in the holes of the plate (fig. 17, C). At Magalas-*Les Terrasses de Montfo*, similar traces were found on the inner surface of the flue, where clay had been applied with a flat tool (fig. 18).

Imprints, negatives or the remains of wood were noticed in several parts of kilns from Famars, Montescourt-Lizerolles and Magalas-*Terrasses du Montfo*. At Magalas, the clay smearing of the oven floor displayed impressions of a wooden framework used to construct the dome of the oven and the kiln chamber. Observation of the marks even leads to the identification of the essence of the tree (fig. 19), showing the utilization of branches from a resinous tree. In the kiln chamber, negatives of planks indicate the use of a cladding to sustain the structure or the clay linings before the first firing, obliterated by the heat. In Famars kiln 6323, cavities in the walls of the oven, probably a wooden setup permitting the potter to access the workspace (fig. 20, A) ahev been detected, although a loading door is located above the flue. Examples from modern Sicily can be mentioned, where the loading of the kiln is undertaken by leaning on beams imbedded in the wall sides (Fig. 20, B, Charlier, 2011, fig. 5.4.238, after Hampe, Winter, 1965). The circular holes left in the Famars kiln do not belong to flat planks but to smaller, rounded posts on which beams were maybe positioned.

Some of the wood can even be present in the kiln construction. At Famars, the wooden framework of several oven floors was still *in situ*, protected by the clay (fig. 21, A). The floor arms contained traces of wood, used to build the oven flooring (fig. 21, D). In kiln 12547, parts of the timbers were intact, arranged on the central rectangular support (fig. 21, B), while at the other end they rested on a large pottery sherd that was placed in a niche or on a bench mined in the natural soil (fig. 21, C).

But negatives, or remains of wood, are not only observed within the oven structure itself, but also in the stoke-hole, as examples from Montescourt-Lizerolles show. In kiln 340, after excavation of the stoke-hole's filling, and cleaning of the bottom surface, a series of imprints of wooden posts was discovered (fig. 21, E). It is unclear what their function is, maybe a canopy or a construction helping with the kiln's building. Another had impressions at the base of the

oven, like an outlay, guiding the installation (not illustrated). The stoke-hole can also show marks from planks or posts used to consolidate the walls or the presence of a ladder facilitating access.

3.3.Interpreting gestures

A final paragraph, after having discussed features that are linked to the construction or functioning of the kiln, concerns the analysis of the fillings, namely the nature of the artefacts it contains, but also their positioning, illustrating specific gestures such as management of wasters, abandonment of the last kiln load reflecting loading methods, and ritual closing of the kiln after its last utilization (for a first assessment, see Willems, Favennec, 2019).

The protocol has permitted to grasp some of the gestures that accompany waste management after the abandonment of the kiln. As the oven and the stoke-hole are rather deep holes exceeding 1 m, they were likely considered as bothersome and dangerous, disrupting the movements on the land plot. Therefore, after the closing use, the wasters that have been put aside for a while in the vicinity of the pottery are thrown or deposited to fill up the cavities. Several kilns from Montescourt-Lizerolles have shown that wasters are frequently disposed off in particular densities in the stoke-hole and in a specific way, probably reflecting the gesture of shedding and gliding of the pottery (fig. 22, A). The rest of the stoke-hole is packed with other debris, such as scorched clay from the dome or oven floor, ashes, and raw material. Often the volume does not take up the entirety of the hole, but is drop-formed, centred in front of the flue (fig. 22, A and B). In some of the stoke-holes rounded masses of compact clay were observed, probably raw material in baskets that had been shed. This has been detected in two kilns at Montescourt-Lizerolles, namely kiln 390 (fig. 22, C) and in 350 where the clay was disposed at the right-hand side of the flue opening.

Sometimes, the kiln is abandoned, leaving the last load in place, which enables analysis of the stapling method in the kiln. At Montescourt-Lizerolles kiln 390 contained at least four layers of wasters (fig. 22, D), while in kiln 400 the lowermost layer was preserved. In both cases one can notice how the piling up started with four pots on each corner of the half-circles of the platform (fig. 22, E), or probably two rows of vessels close to the central channel on which the rest of the load could be piled. We see that the vessels were not arranged in a particular position, as some of them were put on their bottom, others on their rim. This was also the case for the additional layers (fig. 22, D, left), with pots randomly stacked one upon another.

Other gestures seem ritually intentional, with a choice of objects, a precise localisation in the kiln or disposition and ceremonial breaking or perforation of the vessels. Interesting examples come from Famars and Appeville-Annebault (Willems, Favennec, 2019, p. 182, fig. 13; Adrian 2021), where vessels are frequently installed in specific locations of the kiln. At Famars the kilns that produced oxidised wares systematically presented a display of jugs placed in the kiln chamber below the oven floor near the opening of the flue, in front of the central rectangular support. In the kilns firing grey wares, drinking vessels were often interlocked after having been perforated, showing the intentionality of the piling gesture after a ritual treatment. Kilns 1382 and 6323 are interesting examples. In the first case, the oven floor was entirely smashed down with the debris removed. At the opposite side of the flue opening, behind the central rectangular support that was not attached to the wall, three almost intact vessels, two pots and a bowl, were placed underneath a pile of fragmentary wasters (fig. 23, A and B). The bowl showed an intentional breaking of the foot by a blow, while the pots were perforated on the wall sides. The flue itself was blocked by sandstone fragments, three small ones in the flue and a large one at the front (fig. 23, C), which has been systematically observed in Famars. The occlusion of the flue entry is in most publications interpreted as a regulation device while firing, allowing the kiln to be shut off, controlling the temperature and firing atmosphere (Charlier, 2011, p. 436-438, pp. 700-712 and 715-716; Magerman *et al.,* 2008) This hypothesis does not stand at Famars where the blocks of sandstone are sometimes too modest to obstruct, and mostly placed on top of fragments of wasters on the bottom of the flue, indicating that the moment of closing took place after the abandonment of the structure.

Kiln 6323 is a *unicum* with a loading door localised over the flue entrance, which was sealed during firing with a mudbrick tile complete with a rectangular indentation enabling the operator to grab the slab and remove it when the firing was finished (fig. 23, D). The mudbrick tile was neatly placed in front of the flue opening after the last firing and concealed the deposition of three vessels, a bowl, and a pot of local origin, clearly wasters, and the neck and handles of an imported regional amphora. The presence of the regional amphora, as well as the delicate placing of the door tile, indicate the intentional positioning of the vessels, instead of their gliding down from the oven floor above. Many further occurrences were noted, described in more detail, and compared to examples from the North of Gaul and beyond, suggesting that craft spaces and particularly kilns are prone to ritual behaviour, as well at the installation stage of the kiln, think of imbricating whetstones or other apotropaic items into the walls or platforms, as at the phase of abandonment (for an overview see Willems, Favennec, 2019; for an analysis

of ritual contexts, see Martens, 2012). Meticulous digging and awareness of gestures, object combinations and localization of artefacts should lead to a better recognition and collecting of data of these practices.

4. Conclusions

The protocol developed for the excavation of kilns, following different steps of cleaning, observing, digging, sampling, and deconstructing aims to understand the mode of construction, its adaptation to a precise context with planning and a choice of materials, its use, repairs and finally its abandonment, with a specific interest in potters' gestures. The examples exposed at Famars, Montescourt-Lizerolles, Fanjeaux and Magalas show the importance of the method, having yielded new information. The presence of compact layers at the base of the kiln chambers, the deployment of mudbricks for the construction of the oven or the ritual deposition of vessels at the abandoning of the kiln are subjects that have rarely been discussed or recognised. Of course, its use in preventive archaeology means time and investment beyond a straightforward crosscut with a mechanical digger. Nevertheless, simple awareness of the existence of special marks such as construction negatives or ritual gestures will help the archaeologist to adapt the excavation method to the encountered features.

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NOM DU SITE

FR

Fiche d'enregistrement d'un four de potiers et/ou de tuiliers

Aire de travail

Forme

Longueur

Largeur

Profondeur

Parois de la fosse mis à part le côté accès

Type d'accès
- ☐ pente oblique
- ☐ escalier / pallier

Si oui préciser le nombre et la hauteur des marches

- ☐ Ancrage d'échelle

Si oui, préciser

- ☐ Autre ou aucun indice

Partagée avec

Orientation de l'axe principal par rapport à celui du four
- ☐ dans le même axe
- ☐ de biais

- ☐ obliques
- ☐ verticales
- ☐ brutes de creusement
- ☐ aménagées

si aménagement(s), préciser (nature, matériaux)

☐ Présence de troux de poteaux ou de dallage pour un appentis

si aménagement(s), préciser (nature, dimensions, matériaux, espacement)

Remarques sur le sol de l'aire de travail : aspect, présence de rigoles ou autres aménagements contre les eaux d'infiltration, présence de fosses annexes (fosses de stockage du bois ?)

CROQUIS PLAN FOUR

Abords immédiats du four, hors aire de travail

☐ Présence de niveaux de circulation, préciser localisation, nature, etc.

☐ Présence de troux de poteaux ou de dallage pour un appentis et/ou une palissade coupe vent

préciser (nature, dimensions, matériaux, espacement)

☐ Présence de structures pouvant protéger du vent

préciser (nom, nature, éloignement et position par rapport au four)

Alandier

☆

Attention si présence de plusieurs auréoles de rubéfaction ou dans les cas de conduits multiples non côte à côte ou non opposés = plusieurs états de fonctionnement, remplir une nouvelle fiche

Orientation ouverture vers chambre de chauffe

Longueur

Largeur creusement initial

Largeur du ou des conduits

Hauteur creusement initial

Hauteur libre totale

Hauteur libre conservée

Nombre de conduit(s)
- ☐ unique
- ☐ triple
- ☐ double
- ☐ quadruple

Parois
- ☐ non construite(s)
- ☐ lutée(s) préciser l'épaisseur
- ☐ construites, préciser si partiellement ou totalement, dimensions, matériaux

Remarques voûte

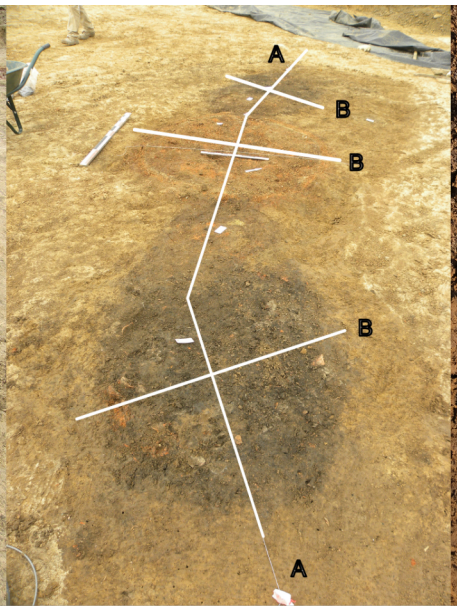
Remarques sol (dallage, pendage)

DESSINS

- ☐ Relevé en plan du four et de ses abords
- ☐ Coupe longitudinale (chambre de chauffe, alandier, fosse d'accès)
- ☐ Coupe transversale de l'alandier
- ☐ Coupe transversale de la chambre de chauffe (murets et conduits de chauffe)
- ☐ Photos avec des mires des différentes parties du four que ce soit en cours de fouille ou à la fin

AUTEUR

A



B

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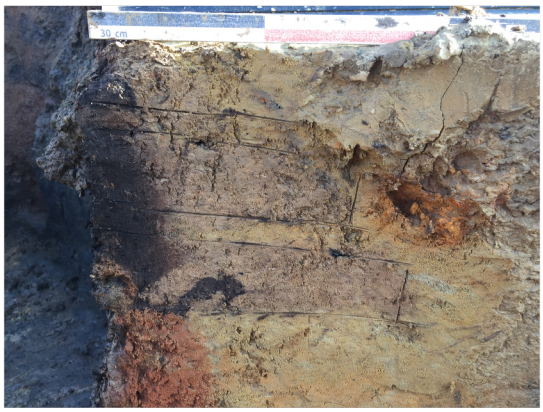
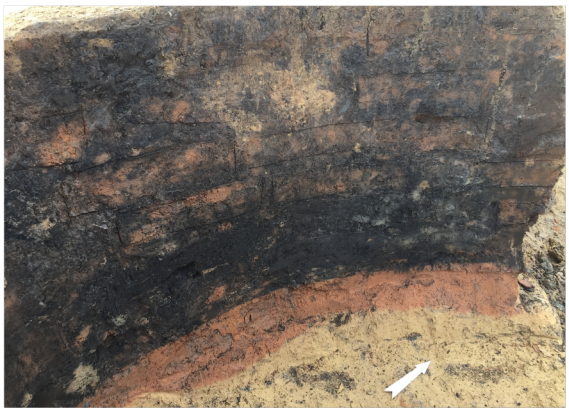


D



E

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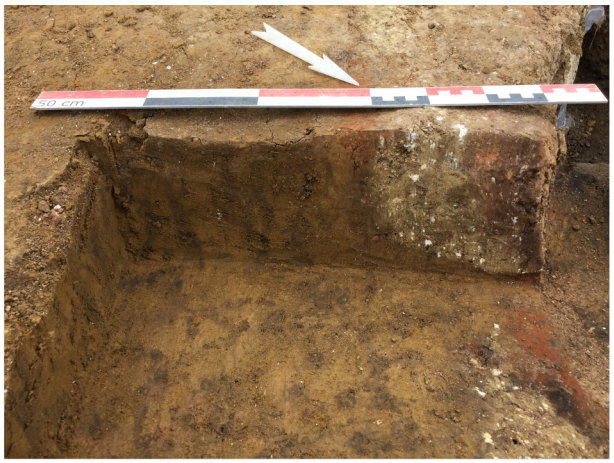

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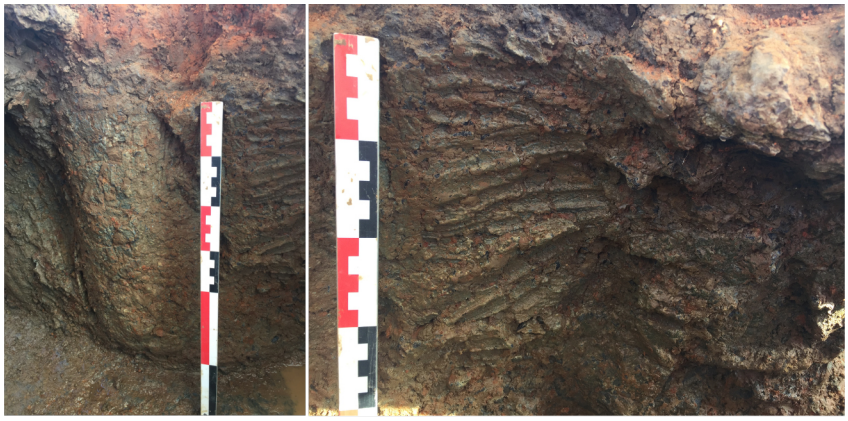

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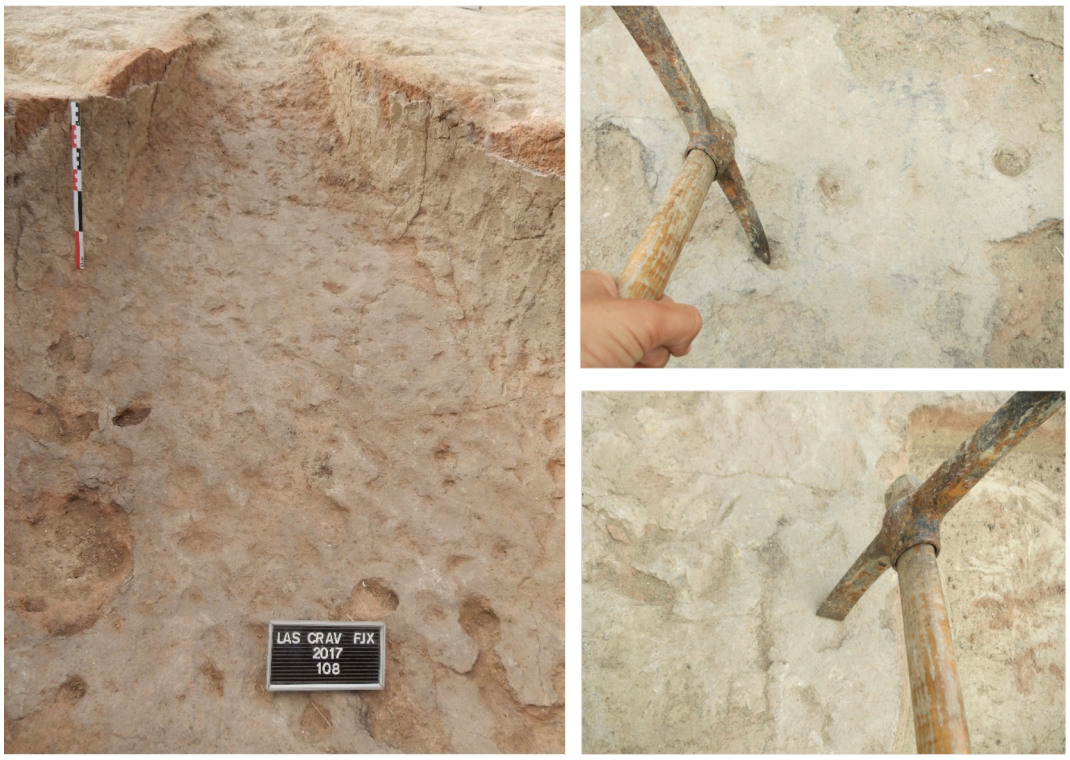

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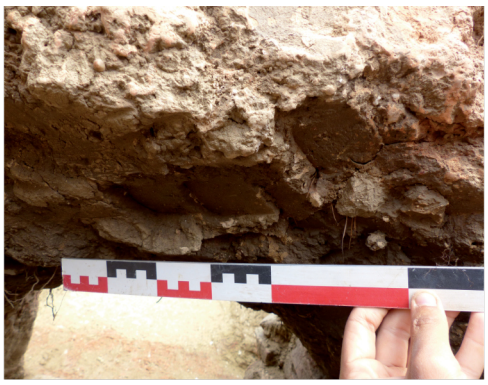

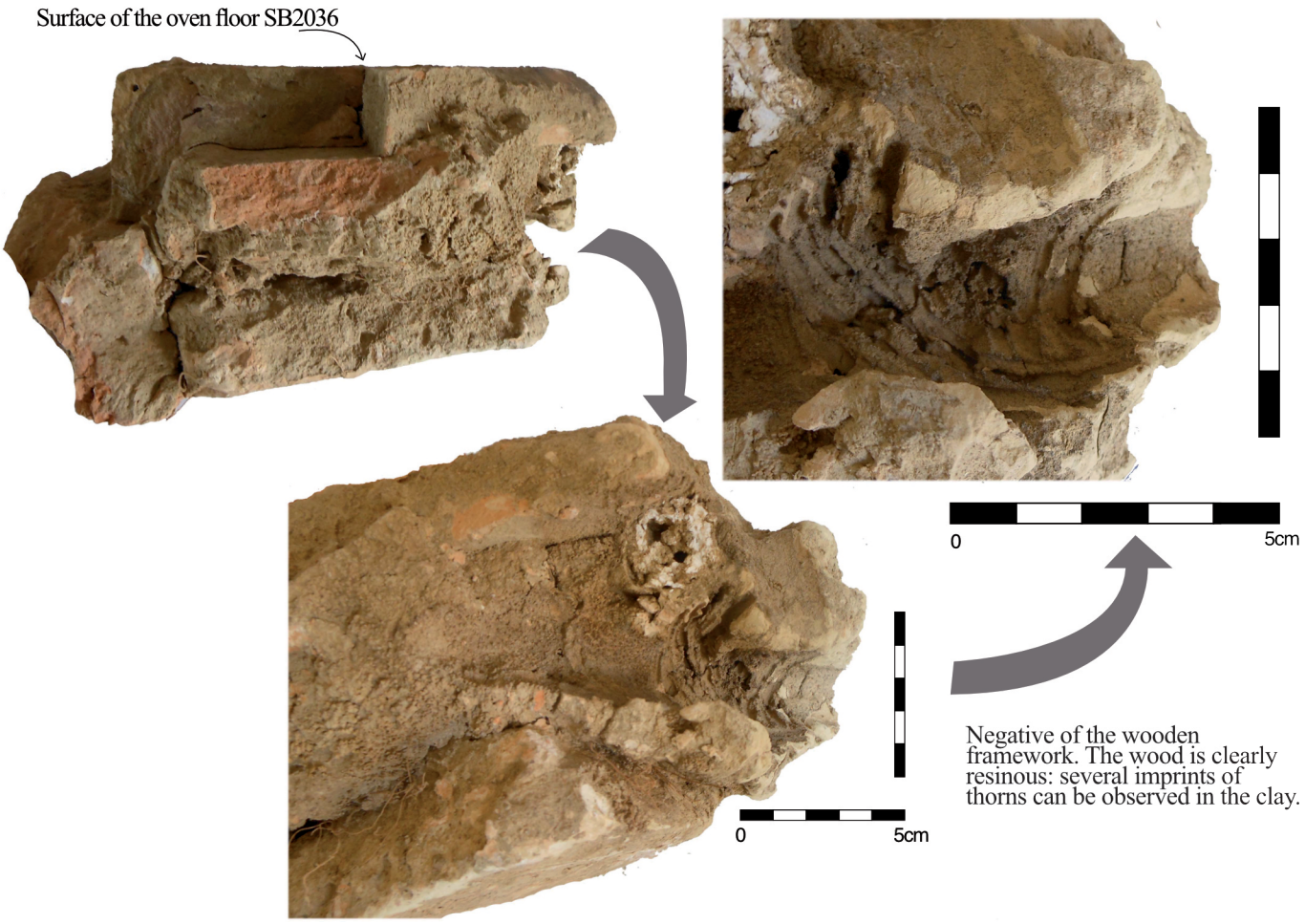

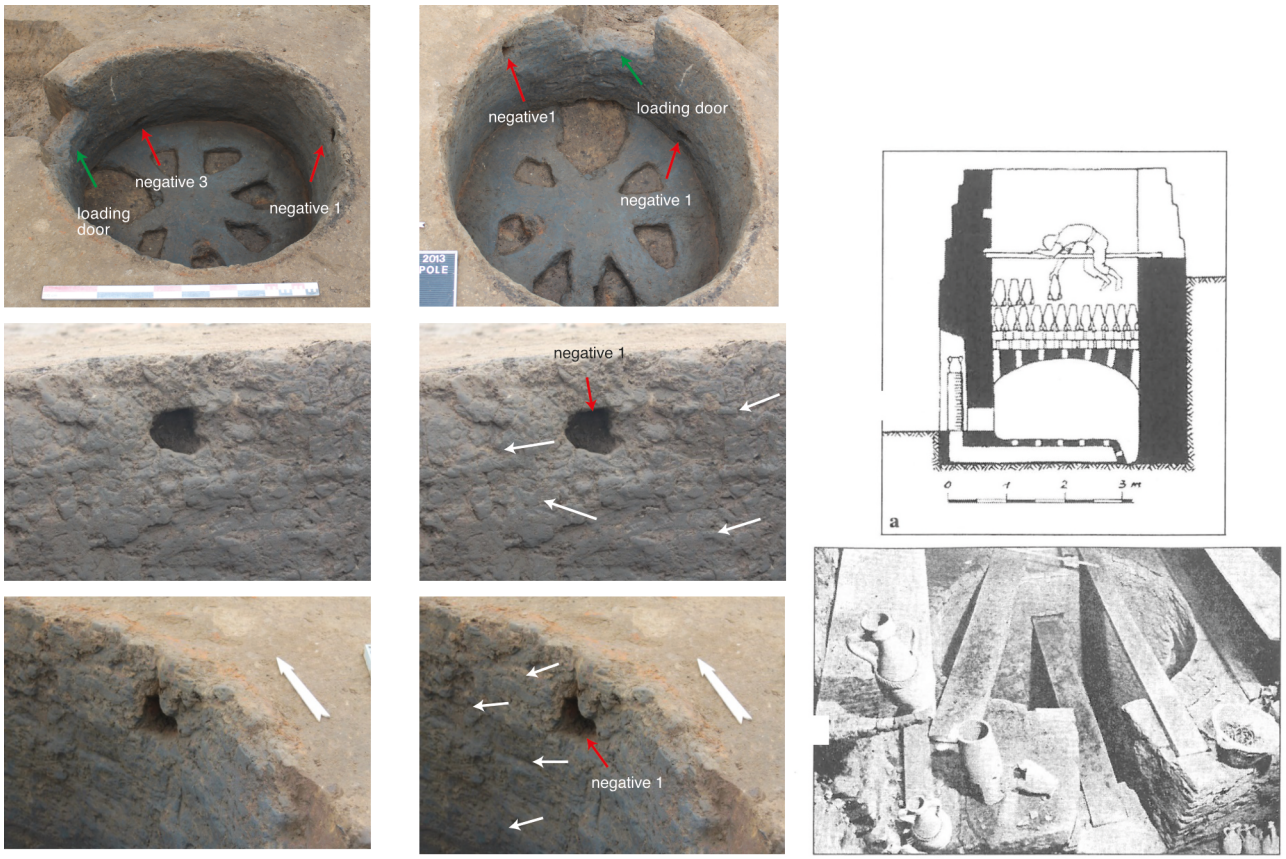

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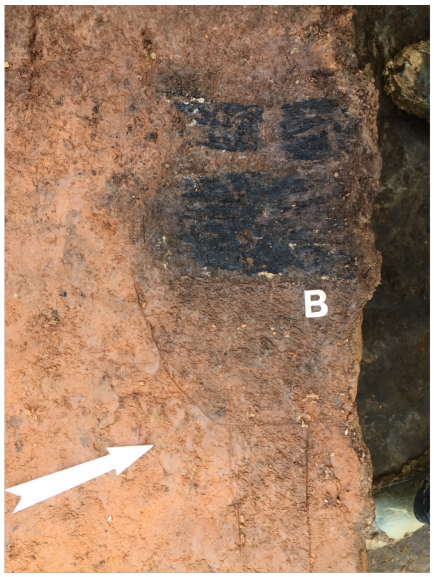

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