



The Age and Graphic Attributes of the First Potteries of the Western Sahara

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Abstract Direct ^{14}C accelerator mass spectrometry (AMS) dates obtained on a selection of pottery sherds recovered from surface sites in the Western Sahara have confirmed that the first potteries of this region appeared at the middle of the seventh millennium cal. BP. From the geographical point of view, these early results are detected all along the latitudinal gradient and from the Atlantic to the inland regions, which indicates that adoption of the new ware was fast and uniform in the entire territory. The decorative motifs are dominated by herringbones and series of short segments, always impressed with combs. These graphisms do not correspond with the abundant and widely distributed rock art motifs of the same region. However, they do appear incised on the surfaces of the pierced ostrich eggs used

as containers since the Epipaleolithic. This may indicate a certain degree of symbolic continuity between the Epipaleolithic and the Neolithic in this region.

Résumé Les datations par ^{14}C AMS obtenues sur une sélection de tessons de poterie récupérés de quelques sites en surface au Sahara Occidental ont confirmé que les premières poteries de cette région arrivent au milieu du septième millénaire cal BP. Du point de vue géographique, ces résultats anciens sont détectés de l'Atlantique jusqu'à l'intérieur du pays, aussi que tout au long du gradient latitudinal, indiquant que l'adoption du nouveau matériel a été rapide et uniforme sur l'ensemble du territoire. Les motifs décoratifs sont dominés par des chevrons et des séries de segments courts, toujours imprimés avec peignes. Ces graphismes ne correspondent pas aux motifs d'art rupestre abondants et largement diffusés dans la même région. Ils apparaissent cependant incisés à la surface des œufs d'autruche percés utilisés comme contenants depuis l'Épipaléolithique. Cela peut indiquer un certain degré de continuité symbolique entre l'Épipaléolithique et le Néolithique dans cette région.

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Introduction

Knowledge of the prehistory of the Western Sahara is still very limited due to a history of discontinued

archaeological research. More than four decades span between the first reports (Font, 1902) and the first relevant studies (Almagro, 1946) because of the lack of real control and metropolitan interest in this territory.

Archaeological research did not really increase until the 1970s, in parallel with the general development of higher studies in Spain. During this period, many of the major rock art sites were finally published (Pellicer & Acosta, 1972; Pellicer et al. 1973–1974), and a few funerary monuments could be properly excavated (de Balbín, 1973; Milburn, 1974; Pellicer & Acosta, 1991). At the same time, French teams working on the littoral of the Western Sahara and northwest Mauritania provided a first series of radiocarbon results (Delibrias et al., 1976) and undertook multidisciplinary studies in the littoral settlements, especially on shell middens (Petit-Maire, 1979). These studies were continued later in the southwest extreme of Morocco (Riser, 1996).

This productive phase ended very abruptly. All fieldwork was aborted in 1975 because of the Spanish withdrawal from its colony, the immediate Moroccan military invasion, and the consequent Sahrawi exile and resistance war. No research could be conducted until the ceasefire in 1991, when several European teams resumed their studies in the strip of land controlled by the native Western Saharan population (Soler et al., 1999).

Since then, large rock art sites have been comprehensively published (Sáenz de Buruaga & Arrurabarrena, 2015; Soler, 2007, 2012; Soler & Soler, 2016; Ventura, 2019; Ventura et al., 2018), and the funerary archaeology has been reappraised (Brooks et al., 2009; Sáenz de Buruaga, 2022). These studies have included wide-scale surveys (Clarke & Brooks, 2018; Sáenz de Buruaga, 2008) and alternative approaches focused on specific settlements (Borrell et al., 2018). Some studies have also been conducted in the territories of the Western Sahara occupied by Morocco (Al-Khatib et al., 2008; Ewague et al. 2016; Rodrigue, 2009, 2014–2015). Unfortunately, the political conflict has always hampered the research. The restart of war in 2020 definitively interrupted any fieldwork.

As a consequence of this discontinued and limited research, we still lack a well-dated sequence of the main cultural periods and cultural milestones. Considering only the post-Paleolithic periods, this list of unsolved chronological issues includes the

first domesticated species, metals, alphabetic signs, horses, and dromedaries, among others.

One of the chronological concerns is to determine the age and sequence of the main pottery production of this region during the prehistory. To contribute to this question, here, we introduce a series of new ^{14}C accelerator mass spectrometry (AMS) results obtained from pottery sherds recovered in a wide territorial range. Another series of pottery sherds from the same area were dated previously but only by the thermoluminescence method (Sáenz de Buruaga et al., 2012). Radiocarbon on pottery sherds had only been applied in one site (Borrell et al., 2018). In addition, we investigate the economic context of these first ceramic vessels and finally explore their possible relationships with other archaeological evidence showing graphic motifs.

Materials and Methods

The materials directly involved in this study were recovered in the context of several exploratory archaeological missions undertaken by the University of Girona between 2001 and 2007 in collaboration with the Ministry of Culture of the Sahrawi Arab Democratic Republic. They encompass the whole latitudinal gradient of the Western Sahara, although its central areas (23° to 24° latitude north) were not surveyed as intensively.

They consist of pottery sherds collected from surface sites rather than from excavations (Fig. 1). These sites were chosen not only due to the abundance of materials but because of their proximity to decorated shelters. Even if we agree that no direct relation can be established between these materials and the rock art, with this approach, we aimed to appraise the chronology of most of the main events that occurred around the decorated places.

From these assemblages, the ceramic fragments to be dated were selected because of their decorative patterns, which are commonly considered indicative of distinct cultural phases or cultural groups (Caneva, 2022).

Seven of these pottery sherds were directly dated by ^{14}C AMS, a method that had been previously applied to Western Saharan ceramic objects with positive results (Borrell et al., 2018). In this study, the laboratory dated the bulk sherd organics contained in

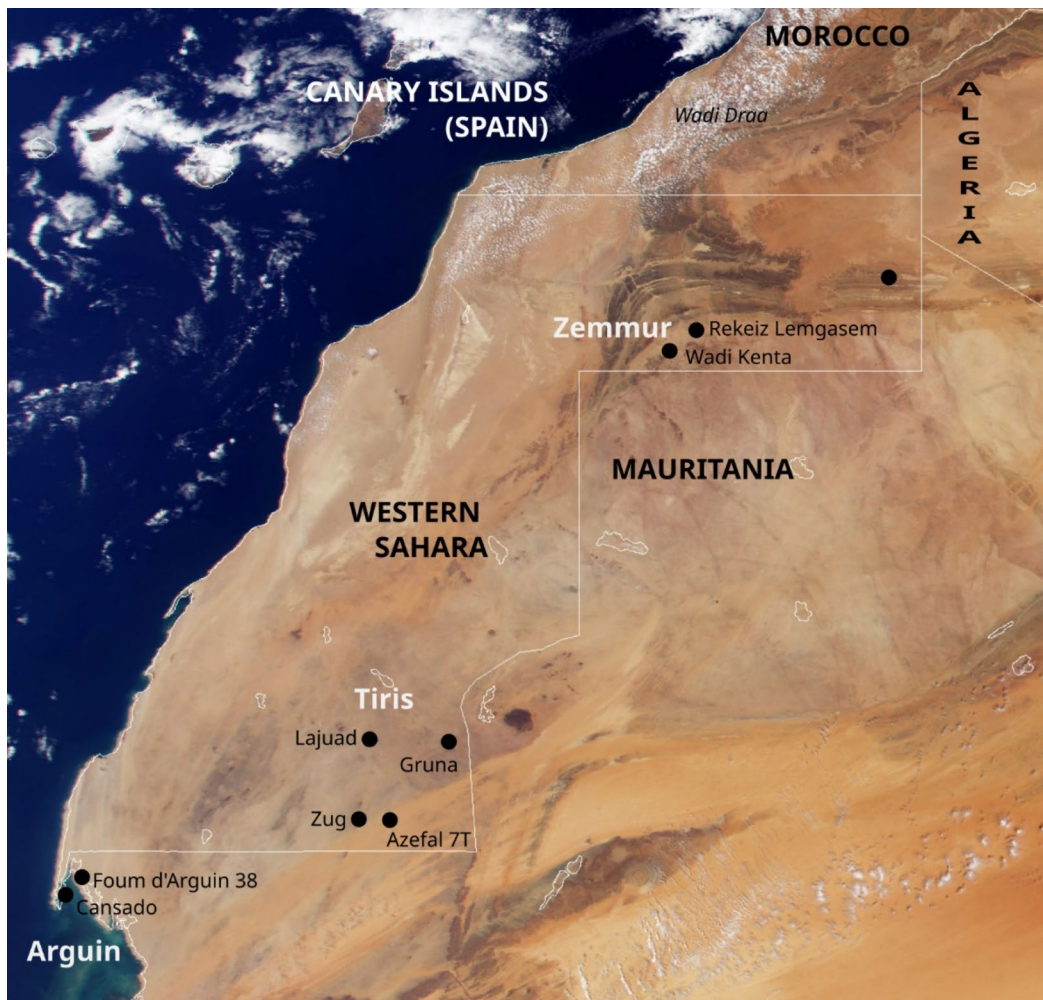


Fig. 1 Archaeological sites of the Western Sahara and Mauritania addressed in this article

the samples. These include the total organic materials from the clay or tempering agents, other organics absorbed from food or liquids stored in the vessels, and any organic substances that adhered to the sherd later. This procedure was considered the most suitable, and the alternatives were not feasible. This is because no burned food residues were found on the interior surfaces, which is not surprising if we consider that the analyzed sherds were recovered on the surface and were highly exposed to erosive agents. Furthermore, we aimed to maximize the chances of obtaining a date and maintaining methodological consistency with previous dating results (Borrell et al., 2018). Therefore, we did not extract the tempering agents alone.

The analysis of bulk sherds may yield dates that are younger than the true age of the vessels due to the incorporation of more recent organic materials during the burial of the sherds. However, in the Western Sahara, this should not be of great concern because the arid contexts do not favor mobilization of humic acids. This has been attested by other ^{14}C AMS dating projects undertaken in Saharan funerary contexts (Paris & Saliège, 2010).

The laboratory did not report any warnings regarding the results listed in Table 1, so we consider all of them valid. For this reason, we proceeded to calibrate all of them with an IntCal20 curve (Reimer et al., 2020), using Maarten Blaauw's rintcal software (version 0.6.0).

Table 1 Results of the direct radiocarbon dates obtained on the pottery sherds. They were calibrated with an IntCal20 curve using rintcal software and expressed with two sigma. Uncalibrated dates are expressed with one sigma

Site and identification	¹⁴ C uncal BP	¹⁴ C cal. BP	Reference	Figure
7 T	4070 ± 30	4645–4507	Beta-549564	6c
Anthropomorphs' Chapel	4160 ± 30	4827–4612	Beta-549563	2c
Lejuad 1, sherd 1	4290 ± 30	4884–4826	Beta-549565	3f
Gruna 10	4390 ± 30	4991–4866	Beta-496182	4c
Gruna 9	4690 ± 30	5475–5320	Beta-496183	4b
Zug	5380 ± 30	6280–6175	Beta-549562	5c
Lejuad 1, sherd 2	5660 ± 30	6495–6395	Beta-513759	3e

Results

In the following pages, we introduce the sites that provided the dates presented in this article following a north–south latitudinal gradient (Table 1). While a few of them (notably Lejuad 1) are well described in the previous literature, most are still poorly reported. For this reason, we first contextualize each of them briefly.

Anthropomorphs' Chapel

The Anthropomorphs' Chapel is a painted rock shelter found in the sandstone cliff of Rekeiz Lemgasem, in the Zemmur region (Fig. 2a). The paintings depict a group of five men gathered around another man who

is waving a curved weapon, perhaps a throwing stick. Groups of fingerprints and other marginal and faded images complete the scene (Fig. 2b). The figures are stylistically very homogeneous and follow the graphic conventions of the Shaped Style, which is particular to this Zemmur region (Soler, 2007). Considering how this style overlaps with others documented in nearby sites, the Shaped Style could tentatively have an age posterior to 3200 BP (Soler, 2012).

In front of the rock shelter, we detected an accumulation of lithics, pottery, and highly fragmented ostrich eggshells, which was probably the result of residential activities. An assemblage of ceramic decorated materials was collected on the surface. The ensemble included both impressed and incised decorations.

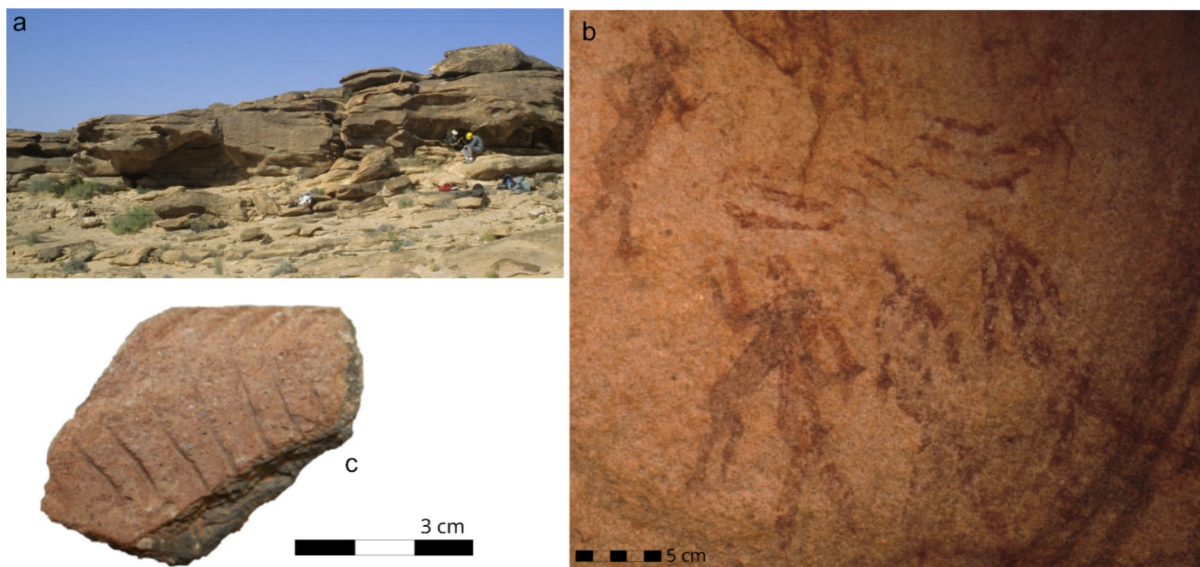


Fig. 2 Anthropomorphs' Chapel rock shelter in Rekeiz Lemgasem (a). Rock art depictions in Shaped Style found at the same site (b). Rim with incised decoration recovered in the close area to the rock shelter (c). Photographs: Narcís Soler

From this collection, an incised pottery sherd was submitted for dating (Fig. 2c). It consisted of a rim from a vessel of undetermined size depicting a herringbone motif oriented to the left. The core of the sherd was reduced, contrasting with the reddish-brown color of the outer and inner surfaces. Inside this fragment, numerous grains of quartz and other inclusions were visible to the naked eye.

Devil's Cave—Lejuad 1

Cueva del Diablo, Cueva Grande, or Lejuad 1 (also written Leyuad) is a wide shelter (Fig. 3a) containing an outstanding rock art composition on the

walls and on the floor (Fig. 3b, c), with numerous and contiguous concavities carved into its rocky soil (Fig. 4d). It is the main site in the mountains of Lejuad, an area populated with many other prehistoric artistic, residential, and funerary sites (Nowak et al., 1975; Pellicer & Acosta, 1972).

Lejuad 1 does not preserve significant sediments in the interior of the shelter. However, directly at the bottom of the main slope, there is a huge concentration of archaeological remains of former residential activities (either because the activities occurred there or because the objects accumulated in this place after rolling down from the inner part of the cavity).

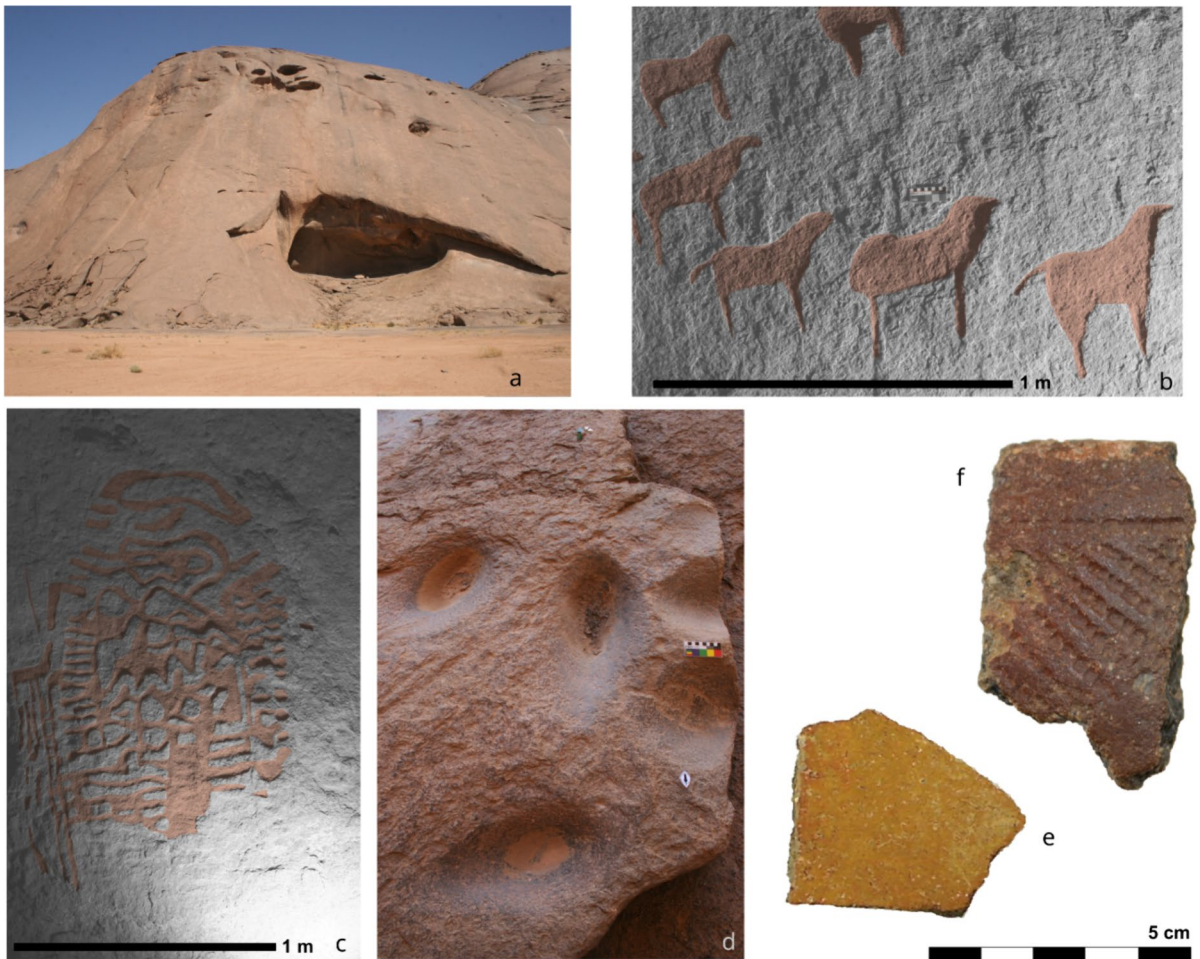


Fig. 3 Lejuad 1 cave (a) is a major rock art site that is deeply decorated with reliefs (b, c), here traced in red, and abundant carved structures on the floor, some of them also engraved (d). The dated pottery sherds (e, f) were recovered from an accu-

mulation area in front of the cave. Sherd 1 (f) and sherd 2 (e) were submitted to radiocarbon dating. Photographs: Narcís Soler. Rock art tracing: Joaquim Soler

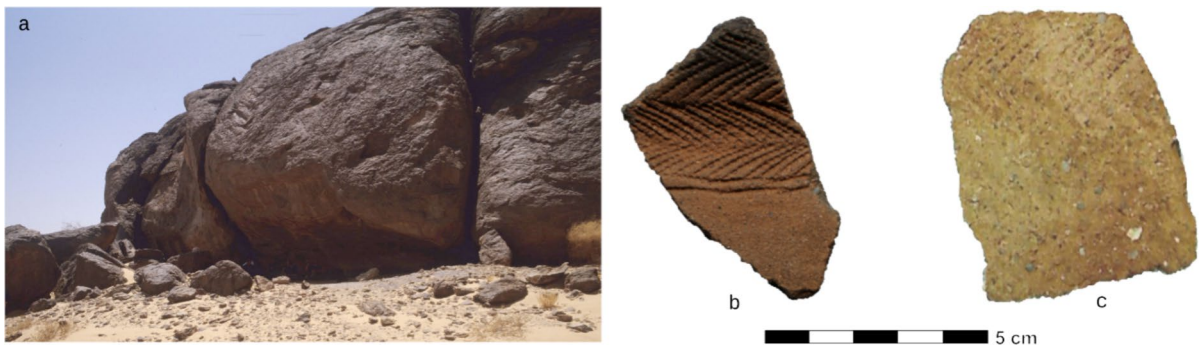


Fig. 4 Examples of the potteries recovered in the rock shelter of Gruna (a) and submitted to dating: Gruna 9 (b) and Gruna 10 (c). Photographs: Narcís Soler

During the 1970s, Rodrigo de Balbín recovered a large number of artifacts from this site, although at that time, it had already been greatly affected by looting. He assigned them to the Neolithic period, while the rock art found inside the shelter is attributed to the Bronze Age, particularly because of the depiction of horses (de Balbín & Bueno, 2009). However, some of the rock art also belongs to previous phases, as we reported after the discovery of several engravings in Dark Figures style, which is a very common style in the Zemmur area that is totally unrelated to horses or other domestic animals. Notably, the Dark Figures style has a large territorial distribution, as Lejuad 1 is its southernmost occurrence and it also occurs more than 600 km away in Laouinate, in the Wadi Draa region, on the northeastern border of the Saharan area (Searight & Martinet, 2002; Soler et al., 2012).

Two samples were selected from that accumulation of materials. The first corresponds to a ceramic rim showing a reduced core and oxidized external surfaces. Its decoration is organized into a band of oblique segments inclined to the right and produced by impression. All the segments are framed on the upper side with another impressed line (Fig. 3f). The rectangular shape of the pattern of individual motifs indicates that the tool employed was a comb and not a shell. From the same assemblage, another undecorated ceramic fragment with oxidized firing was selected to be dated as well (Fig. 3e).

Gruna

In the mountains of Gruna (Tiris region), several places with rock art and funerary monuments are known. The analyzed ceramic fragments were collected from a surface accumulation of lithic and ceramic archaeological materials located in front of a group of painted rock shelters (Fig. 4a).

The first dated pottery fragment no. 9 (Fig. 4b) corresponds to the neck of a ceramic container including fine quartz temper and showing a very dark core. This sherd was decorated with two overlapping bands of herringbone motifs facing opposite directions. As in the previous case of Lejuad 1, the impression was probably produced with a comb. This decorated band was also framed, in this case by two horizontal lines.

The second dated fragment no. 10 (Fig. 4c) corresponds to the edge of a wide bowl, the lip of which was decorated with comb line impressions inclined to the right. The material is coincident with that of fragment no. 9, but here, the quartz grains are slightly larger.

Zug

Zug is an open-air settlement with abundant ceramic materials, lithic industry, and grinding tools (Fig. 5a, b) (Soler et al., 1999). Rock engravings with non-figurative motifs have been documented in the vicinity (Nowak et al., 1975). Among the materials collected at this site, we selected a lip

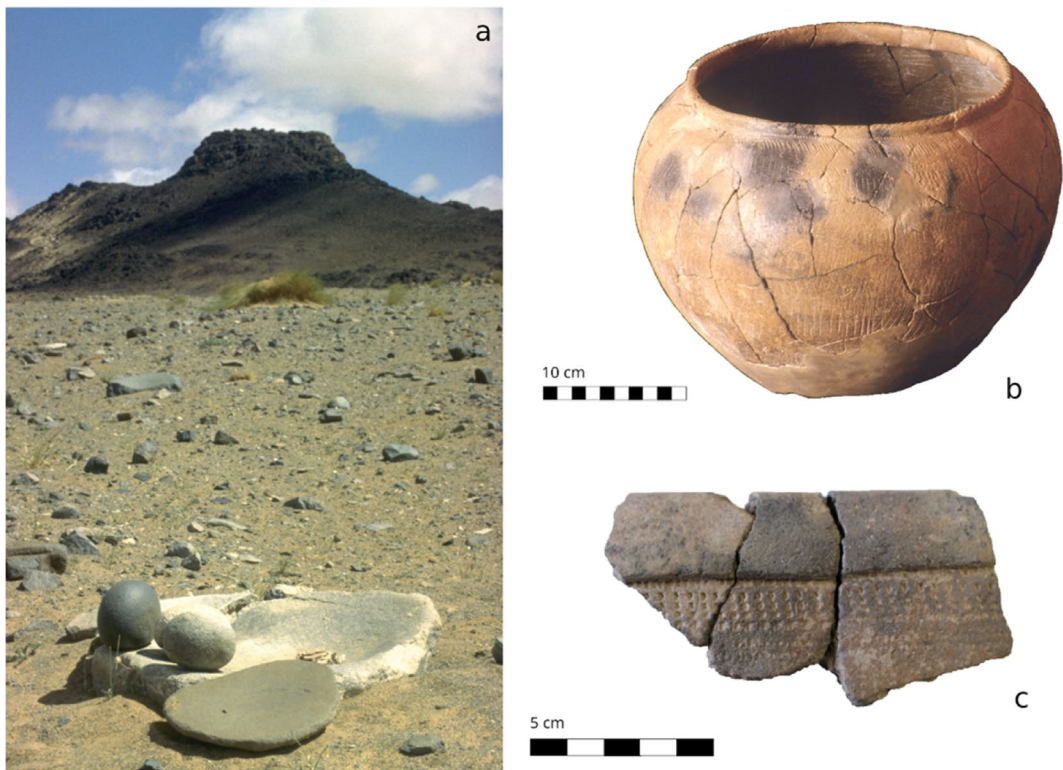


Fig. 5 The Neolithic settlement of Zug where the sample was collected shows abundant lithic artifacts, pottery and grinding equipment directly on surface (a). The pottery recovered in the prehistoric settlement in Zug has provided wide open ves-

sels decorated with impressed arcs (b, reconstructed). A rim of another large container decorated with comb line impressions produced was submitted for radiocarbon dating (c). Photographs: Narcís Soler

fragment of a large vessel with impressed segmental decorations (Fig. 5c). The inner walls of the sherd are dark gray and contain inclusions of small grains of quartz.

Azefal Site 7 T

Site 7 T is a residential settlement located on a dune in the southern Azefal region with abundant ceramic and lithic objects, including grinding equipment (Fig. 6a). The walls of the ceramic vessels found on that site, which are mostly wide, open bowls, are decorated with herringbone and chevron motifs, probably impressed with a comb as reported in the previous examples. Some of the rims show oblique impressed motifs as well (Fig. 6c–f). In this site, these open forms coexist with globular and very enclosed vessels, decorated with short and shallow impressions covering the entire vessel (Fig. 6b).

As in the other cases, the dated sherd is too partial to infer the original shape of the vessel, but it clearly belongs to the group of open bowls. Its surface is dark brown, while its core is totally black and contains grains of quartz of heterogeneous size used as temper, which are clearly visible on the outer surfaces too. It is decorated with abundant criss-crossed lines produced by the impression technique (Fig. 6c), probably with a comb. Here, again, the decorative pattern is organized into a horizontal band and framed by two horizontal impressed lines.

Discussion

The oldest dates obtained in this study, from the sites of Lejuad 1 (sherd 2) and Zug, are consistent with the age of the earliest potteries found in the nearby Mauritanian sites of Fom d'Arguin



Fig. 6 Pottery recovered from the 7 T site (**a**) comprises enclosed (**b**) open shapes (**c**, **d**, **e**, **f**). Both classes are mostly decorated with herringbone (**d**), vertical (**e**) or inclined (**f**) motifs produced with the impression technique. They extend

over the entire vessel (**b**) or are organized in horizontal bands. All these impressions were probably produced in all cases with a comb. The fragment decorated with impressed crisscrossed lines (**c**) was submitted to dating. Photographs: Narcis Soler

38 (5440 ± 80 uncal BP, NIA-339) and Cansado (5325 ± 80 uncal BP, Pa-2066) (Vernet, 2007). They also coincide with the age of the layer of the Ashash rock shelter (Wadi Kenta, Zemmur) containing pottery, where a direct ^{14}C AMS date on a sherd yielded 5620 ± 30 uncal (Beta-432144) (Borrell et al., 2018). They are similar to the results obtained previously by the alternative method of thermoluminescence on a different assemblage of pottery that was collected on the surface (Sáenz de Buruaga et al., 2012).

Therefore, the new dates introduced in this paper further confirm that the first introduction of pottery in the Western Sahara occurred in the middle of the seventh millennium cal. BP. They underline the synchronous nature of this process throughout the territory,

as the early dates are found in northern (Zemmur) and southern sites (Tiris).

These results are comparable with the dates reported in the Atlantic and Mediterranean regions of northern Morocco (Linstädter, 2017) but are clearly more recent than those obtained in the central Saharan massif of Aïr, where pottery was already present between the tenth and eighth millennium BP (Jesse, 2010; Roset, 1996).

In that central Saharan area, the introduction of ceramic vessels has been interpreted in relation to more intensive consumption of grains and the development of agriculture (Jesse, 2010). However, this interpretation cannot be extended to our region of interest. For example, during the seventh millennium cal. BP, the nearby Arguin region (northwest

Mauritania) was not settled by farmers but by nomadic hunters and herders subsisting from the highly productive coastal areas. They left an archaeological record dominated by shell middens and traces of temporal residential sites settled over the dunes that covered the wide lacustrine around the Arguin gulf. These mobile communities used pottery but had not adopted agriculture. Remains of domestic animals (bovines) are not detected until the first quarter of the fifth millennium uncal BP (Vernet, 2007).

In the Western Sahara, the available archaeological evidence is much weaker than in Mauritania. The littoral settlements attest the exploitation of marine resources but do not provide evidence about domesticated fauna (Petit-Maire et al., 1979). In the hinterland, the few excavations of residential contexts that have been undertaken to date do not allow determination of the economic system of the communities living in that region. The abundance of lithic projectiles detected in the excavation of the Ashash rock shelter is only indicative of a high degree of prolongation of the hunting activities in this phase (Borrell et al., 2018).

Despite their geographical and ecological distance from the Western Sahara, the Mediterranean, and Atlantic regions of Morocco offer additional elements for comparison. There, it appears that Epipaleolithic coastal communities adopted pottery, farming, and husbandry in the context of a broad-spectrum economy, in which food production activities were present but not predominant. Meanwhile, nearby Epipaleolithic groups occupying the hinterlands adopted pottery but not food production (Dunne et al., 2022; Linstädter, 2017).

This could also be the case of the Western Saharan communities that incorporated pottery during the seventh millennium cal. BP, both in littoral areas and inland, probably without adopting other Neolithic innovations at the same time. This model fits well with the available evidence for the Western Sahara, in which pottery seems to be incorporated without being related to major disruptions. For example, the archaeological record shows a high degree of residential continuity between the sites with and without pottery. Neolithic sites can hardly be distinguished from those of the Epipaleolithic, apart from the presence of scarce pottery and bifacial flat retouched arrowpoints. Due to this scarce and elusive archaeological evidence and considering that the new data introduced in this article only come from surface sites, we cannot go beyond this point when we try to describe the

economic basis of the Western Saharan communities that adopted pottery for the first time.

However, there is enough knowledge on the prehistoric art of this territory to compare the graphic motifs impressed in the potteries with the depictions and engravings found in both rock and mobile art. As described previously, the motifs used in pottery mostly consist of oblique segments, herringbones or arcs impressed with combs. The same non-figurative signs are found throughout the dated sequence. In the oldest phases, objects that were in part or totally undecorated (for example, Lejuad Fig. 3e and Ashash) coincide with those that organize decorations in bands (Gruna, Lejuad 1 Fig. 3f, 7 T Figs. 6c–f). They can also coexist with other styles that have shallow decoration everywhere (Zug Fig. 5b and Azefal 7 T Fig. 6b). Similar decorations are found in a wide area during the same period, both in nearby Saharan areas (Vernet, 2007) and even far to the north of Morocco (Linstädter et al., 2016).

The example of Gruna is illustrative of the degree of thematic and technical continuity in the graphic domain: the two analyzed sherds from this site share the same impressed decoration but their analysis produced dates of 5500 and 4900 uncal BP. This indicates not only the wide timespan of the residential activities that occurred around this shelter but also the endurance of the impressed decorations depicting segmented and herringbone motifs. In contrast, in the context of this study, incised segments and herringbones were only documented much later at the end of the fifth millennium cal. BP (Anthropomorphs' Chapel).

These graphic motifs, all of which are non-figurative, are not correlated with the rock art styles of the Western Sahara. Considering that they have been tentatively attributed to much later periods than the dated sherds (Soler, 2012), this should not be a motive of particular concern.

However, the comparison of the decorations found on the pottery with those incised over the containers produced using pierced ostrich eggshells during the Epipaleolithic, and were continued during the Neolithic, reveals a suggestive coincidence. While these containers also depict abundant zoomorphs, some of them show herringbone motifs and other segments isolated or organized in circular bands (Almagro, 1946; Klenkler et al., 2016; Onrubia-Pintado & Balouche, 1996; Vernet, 2007; Vernet et al., 2016, but

see Vernet & Le Quellec, 2016–2017). This may constitute an argument to support a certain degree of cultural continuity between both phases. However, the low graphic complexity of these motifs and the long permanence until recent times of these containers should also be considered before taking this idea for granted (Grébenart, 1974; Vernet, 2007).

Conclusions

The direct ^{14}C AMS dates obtained on an assemblage of pottery sherds recovered from surface sites widely distributed in the territory of the Western Sahara has confirms that the first potteries in this region date to the beginning of the second half of the seventh millennium cal. BP. These results also indicate that the arrival of pottery was not constrained to certain areas but was common throughout the entire territory at roughly the same time. As the samples were from surface accumulations rather than rich, well-preserved archaeological contexts, we cannot further consider the economic nature of the communities that were involved.

The analyzed potteries, with a chronology spanning between 6500 and 4500 cal. BP, show an ensemble of persistent decorations dominated by herringbone and segments impressed with combs. At the present time, it is not possible to define different periods only on the basis of the graphisms considered in this study. They do not correspond with the rock art motifs distributed in this wide region, but they do coincide with some of the motifs in the organic containers produced on ostrich eggshells since the Epipaleolithic.

As the limitations of pure chronologic approaches have been revealed, future research should include sites with well-preserved stratigraphy and additional elements of the archaeological record. We hope to contribute to this effort with the future analysis of Lejuad 2, a rock shelter with rock art that was discovered during the colonial period, where we conducted an archaeological excavation. This residential site preserves a rich assemblage of lithic artifacts, pottery sherds, faunal remains (both terrestrial and aquatic), and charcoal, the analysis of which with a monographic and multidisciplinary approach might give us a more complete picture of the processes sketched in this article.

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