Afr Archaeol Rev (2021) 38:251–274
https://doi.org/10.1007/s10437-021-09425-x

ORIGINAL ARTICLE

Revisiting the Epipalaeolithic-Neolithic Transition in the Extreme NW of Africa: The Latest Results of the Chronological Sequence of the Cave of Kaf Taht el-Ghar (Tétouan, Morocco)

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Accepted: 10 January 2021 / Published online: 9 February 2021
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Abstract This study focuses on the chronostratigraphic sequence of the Cave of Kaf Taht el-Ghar (Dar Ben Karrich, Tétouan, Morocco) excavated in 2012 in the framework of the AGRIWESTMED research project. The broad sequence reveals a series of occupations ranging from the Pleistocene (Moroccan Aterian) to recent historical times. Our research identifies a rich Early Neolithic phase (sixth millennium cal BC) containing the earliest pottery and domesticated animal and plant remains in the western Maghreb. However, this Early Neolithic level is not an immediate successor of the last traces of the Epipalaeolithic hunter-gatherer occupation, which started at the end of the Younger Dryas (10,900–9700 cal BC). An abandonment phase, spanning more than a millennium, separated them. This hiatus appears to originate from a cold climatic event that began in the late seventh millennium cal BC (ca. 6200 BC) and ended around the mid-sixth millennium cal BC.

Résumé La présente étude est centrée sur la séquence chronostratigraphique de la grotte de Kaf Taht el-Ghar (Dar Ben Karrich, Tétouan, Maroc), fouillée pour la dernière fois en 2012 dans le cadre du projet de recherche AGRIWESTMED. La séquence générale révèle une série d'occupations allant du Pléistocène (Atérien marocain) jusqu'aux temps historiques récents. Parmi les résultats les plus remarquables, on peut souligner l'identification d'une riche phase du Néolithique Ancien (6ème millénaire avant JC) contenant les plus anciens restes de poteries et de plantes et animaux domestiques datés au Maghreb occidental. Cette phase n'est. pas consécutive à l'occupation épipaléolithique, car il existe une nette rupture entre

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les deux phases, qui s'étend sur plus d'un millénaire. Cela semble coïncider en partie avec l'événement climatique froid de 6200 cal av. J.-C. Le début de l´ occupation épipaléolithique commencerait à son tour avec la fin du Dryas récent (10,900-9,700 cal av. J.-C.).

Keywords Tingitana Peninsula · Radiocarbon · North African Neolithic · Impressed pottery · Bayesian analysis

Introduction

This study contributes to the debate on the Neolithic process in North Africa, especially in the Maghreb, based on a recent investigation in the Tingitana Peninsula (northern Morocco; Fig. 1). The beginnings of agriculture and livestock economy throughout North Africa faced two challenges. The first was the ecological constraints characterized by a vast extension of arid zones incompatible with the Mediterranean cycle of agriculture (Garcea et al. 2016). The second was the potential cultural and economic resistance by dynamic and resilient local hunter-gatherer populations (Broodbank and Lucarini 2020). Nevertheless, the progressive spread of the so-called Neolithic package from the Balkan coastline to the south and west of Iberia between 6200 and 5500 cal BC would have made the Tingitana Peninsula a critical corridor for the diffusion of this process into North Africa through the Strait of Gibraltar (Linstädter et al. 2012a). However, the notion of the spread of a Neolithic economy from Mediterranean Europe to North Africa has been challenged by those who favor a North African origin of the Early Neolithic. Worth highlighting in these arguments is the notion of a Neolithic "round trip." This concept refers to the reconfiguration of the Neolithic package (Manen

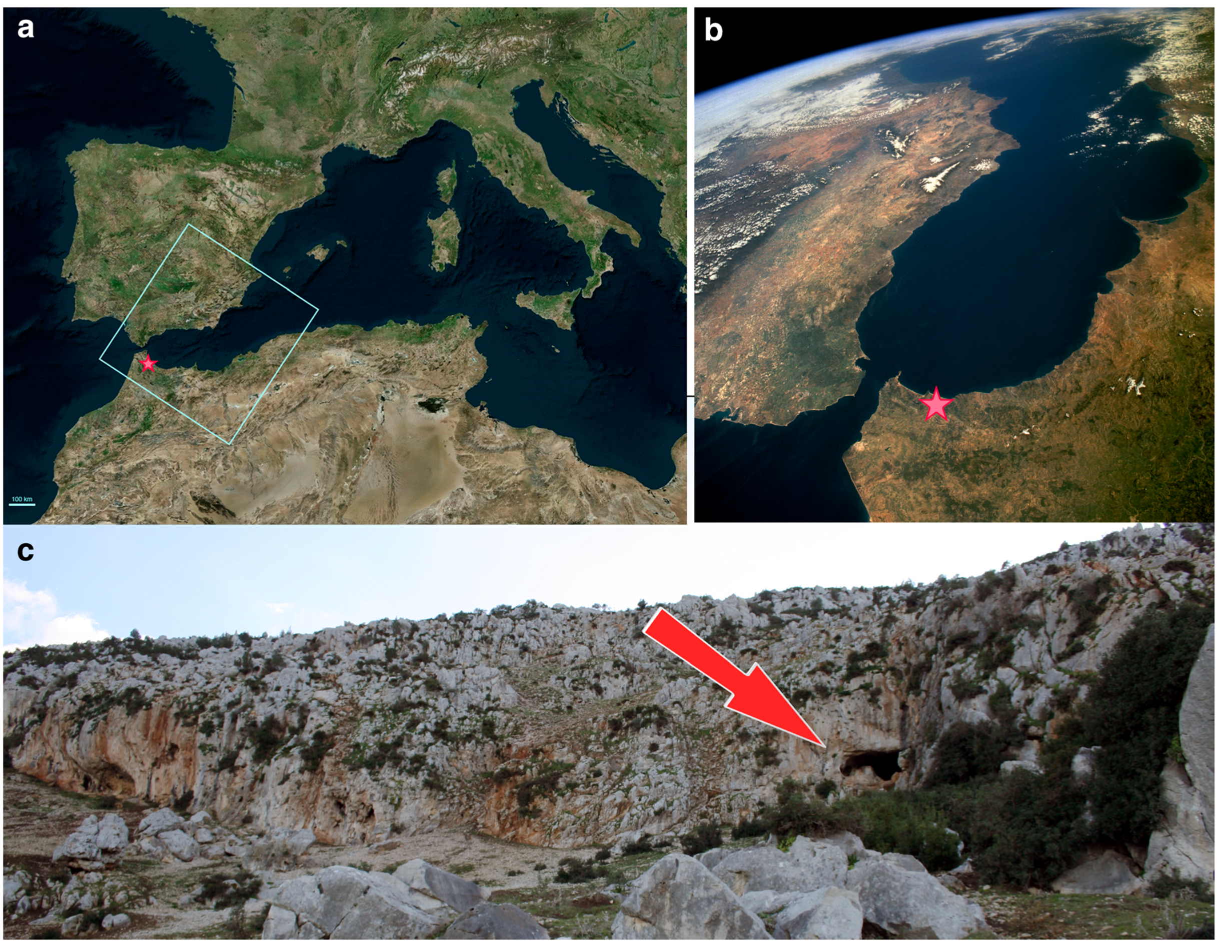

Fig. 1 Satellite views of the position of: **a** site Kat Taht el-Gar (KTG), **b** the Tingitana Peninsula and the Strait of Gibraltar, and **c** the cave's cliffside entrance

et al. 2007), initially of Iberian origin or from the south of Italy and linked to *Impresse Arcaiche* ware complexes (García Borja et al. 2014), in North Africa. This package was then blended with African elements and subsequently reintroduced to Iberia across the Alboran Sea. This argument has been used to explain some distinctive aspects of the material culture of the Andalusian Neolithic (Cortés Sánchez et al. 2012). Currently, the possible existence of an Impressed ware phase in eastern (Bernabeu et al. 2009) and southern Iberia (García Rivero et al. 2018) opens the way to view this phenomenon as more complex and heterogeneous.

Nonetheless, other processes appear to weigh in on the role of the Strait of Gibraltar in transmitting the innovations of the Mediterranean's Early Neolithic to North Africa. The first of these is the development of Early Holocene pristine pottery technology in central and eastern Sahara by hunter-gatherers (Dunne et al. 2016). Throughout the Sahara, the ancient pottery traditions laid one of the bases for the "Saharan-Sudanese Neolithic" as an endogenous process with deep roots in the African Early Holocene (Camps 1969). The second is the introduction of bovine and caprine livestock into the Nile Valley from either the Sinai, the Syrian-Palestinian coast, or the Red Sea, at the end of the seventh millennium cal BC, and its spread to Cyrenaica and Marmarica. The adoption of agriculture followed this in eastern Mediterranean Africa at the end of the sixth millennium cal BC (Salvatori and Usai 2019). Thirdly, there was a possible maritime connection between Cape Bon and Sicily, a route from which obsidian was brought to Pantelleria Island in Tunisia at the beginning of the sixth millennium (Upper Capsian) (Mulazzani et al. 2016). However, problems linked to post-depositional alterations at these sites and the absence of dating of domestic biofacts require some caution regarding the possible introduction of agriculture and livestock to the eastern Maghreb throughout the first half of the sixth millennium from the Strait of Sicily (Zilhão 2014).

In Search of Northern Morocco's Early Neolithic

Research on the origin of western Maghreb's Neolithic, specifically that of the Tingitana Peninsula, still lags far behind that of neighboring southern Iberia. This lag exists even though the Strait's privileged situation as a bridge between Africa and Europe, the Mediterranean Sea and the Atlantic, initially attracted the attention of various researchers for exploring the dynamics of intercontinental relations (Biarnay and Péretié 1912). Colonialism and other political, cultural, and social priorities greatly influenced early research. The exploration of caves near Tangier was initiated towards the end of the nineteenth century by European researchers such as Henry Koehler and André Jodin (Jodin 1958-1959). The establishment of the Spanish Protectorate then opened the way to Miquel Tarradell, who excavated the caves of Gar Cahal and Kaf Taht el-Ghar.

Also noteworthy is the *Néolithique du litoral Nord-Atlantique* project under the auspices of the *Mission Préhistorique et Paléontologique Française* in Morocco and the *GENEMAR* (*Genèse du Néolithique Marocain*), focusing on the Neolithic along Morocco's northern fringe. These studies combined the review of previously excavated materials with opening new trenches to understand the Neolithic diffusion chronology and the nature of the Bronze Age and Bell Beaker horizons in the western Maghreb. These investigations led to a reassessment of the occupation history at Kaf Taht el-Ghar, the details of which will be discussed below (Daugas 2010).

Research on Morocco's eastern coast, in turn, only gained in intensity towards the end of the last century due to the excellent work by the *Kommission für die Archäologie Außereuropäischer Kulturen des Deutschen Archäologischen* (KAAK) and the University of Cologne in association with the *INSAP* (Morocco). Their excavations at Hassi Ouenzga, Ifri Oudadane, Ifri Armas, and Ifri n'Etsedda (Linstädter et al. 2018; Linstädter et al. 2012a), in addition to those led by a Spanish team at the open-air site of Zafrín (Chafarinas) (Rojo et al. 2010), cast new light on a previously unexplored territory and led to establishing a connection between the Tingitana Peninsula, the Moroccan Atlantic coast, and the Algerian Tell. Research from the Algerian Tell, the subject of intense focus throughout the twentieth century, has only recently begun to be published (Kherbouche et al. 2014; Sari et al. 2016).

Finally, one of the objectives of the AGRIWESTMED project, "origins and spread of agriculture in the south-western Mediterranean region" (2009–2014), coordinated by Leonor Peña-Chocarro, was to understand the chronological sequence of the western Mediterranean's Neolithic along both European and African shores. Consequently, brief excavation campaigns were undertaken at well-known Moroccan sites to review their Early Neolithic sequences and recover archaeobotanical (seeds, charcoal, phytoliths, pollen), archaeozoological (animal remains, including ichthyofauna), human skeletal samples, and technological artifacts (mainly pottery and lithic industries). These sites are Magharat el Khil (Cape Ashakar Tangier) (Caves B and C) in 2011, Kaf Taht el-Ghar in 2012, and Ifri n'Amr o'Moussa (Khemisset) in 2013 (Martínez Sánchez et al. 2018b; Peña-Chocarro et al. 2013).

Kaf Taht el-Ghar and the Archaeological Interventions

Geographic and Geological Framing

The cave of Kaf Taht el-Ghar (KTG), near the village of Dar Ben Karrich, is about 8 km southeast of the city of Tétouan at 410 m asl (35° 30′ 34.75″ N and 5° 19′ 48.68″ W). It lies in a mountainous environment about 9.2 km from the current coastline of the Ras Mazarí Cape. It is a complex cavern structured around a main "vestibule" 12 m wide and about 30 m deep. It is easily accessible through a northwest-facing entrance on a rocky cliff constituting the northeast end of the Djabal Gharghez (Fig. 1). Its geological origin is karstic, produced by the dissolution of a massive white limestone dating to the Triassic and Lower Jurassic (El Babat and Hafa Ferkennix nappes) (Domínguez Bella and Maate 2008).

Archaeological Background

This cave was first excavated by Miquel Tarradell in 1955, leading to the publication of two preliminary articles (Tarradell 1955, 1957-1958). The excavation focused on the central "vestibule," which was subdivided into seven zones or grids (A to G). In those early explorations, Tarradell identified four different archaeological levels. Level I (strata 1 and 2) was marked by historical occupations (medieval and modern) containing residual prehistoric pottery. Level II (stratum 3) contained protohistoric (identified as Punic), and recent prehistoric (Bell Beaker and Bronze Age) finds. Level III (strata 4 and 5) is a rich Neolithic phase characterized by pottery, notably Cardial ware, with a great diversity in shapes and types and impressed decorations. The final and oldest level (IV), resting on the bedrock, consisted of a sandy reddish matrix that, according to Tarradell, contained only "atypical flints" and highly carbonated bones (Tarradell 1955). This work was interrupted a year after the first research. In 1956, Tarradell accepted the Chair of Archaeology, Epigraphy, and Numismatics at the University of Valencia, and Morocco gained its full independence.

Given the nature of the excavation methods applied at the time, Tarradell's stratigraphic sequence is very schematic and condensed into four levels. A later reassessment based on a review of archaeological materials housed in the Tétouan Museum by a Spanish team from the University of Cadiz (J. Ramos and E. Vijande) revealed the existence of Early Neolithic elements characterized by a great diversity of Cardial and Channeled wares. The review also identified elements of what appeared to be advanced phases of the Neolithic, Bell Beaker, and Bronze Age, the lithic materials from the Iberomaurusian period, and bone and lithic artifacts attributed to a Mousterian complex of the Middle Palaeolithic (Ramos Muñoz et al. 2008).

Further excavations of the cave (adjacent to sector G) were carried out under the direction of J.P. Daugas, J.P. Raynal, and A. Ballouche in 1984 and 1987, in the framework of a Franco-Moroccan cooperation between the *Mission préhistorique et paléontologique française au Maroc* and the INSAP (*Programme Néolithique du littoral Nord-Atlantique*). Between 1989 and 1994, the excavation area was extended to 100 m^2 in the vestibule (zone 1) previously opened by Tarradell (El Idrissi 2001; Fig. 2a). Up to 42 stratigraphic units (SUs) were explored during this time (Table 1, Fig. 2b), and these confirm the existence of an earlier Epipalaeolithic phase and Post-Neolithic (Bell Beaker) and historical occupations. This more recent work allowed the subdivision of the Neolithic occupation into two phases. The first is an initial phase with surprisingly early datings. The second is a Cardial phase subdivided into two different periods, based on pottery form and decorations, and radiocarbon and thermoluminescence datings. The new chronological findings were published in general reviews (Daugas et al. 2008; El Idrissi 2012), and papers specifically dedicated to animal and plant remains (Ballouche and Marinval 2003; Kaoun 2008; Ouchaou and Amani 1997). The pottery analysis, identifying the Early Neolithic level, was also included in a doctoral thesis and compared with other pottery assemblages from the Tingitana Peninsula (El Idrissi 2001).

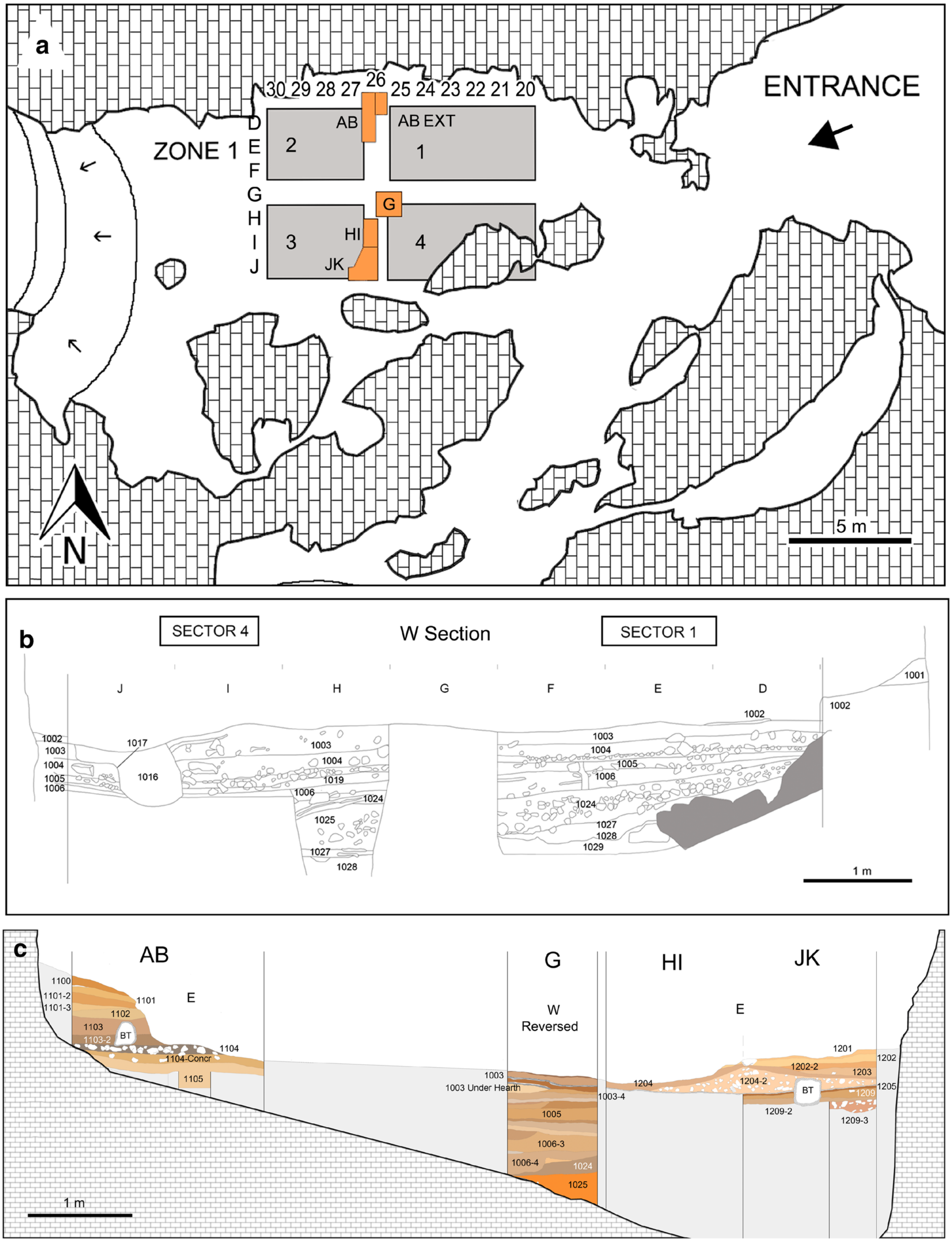

Fig. 2 **a** KTG: plan of the trenches (1–4) in the "vestibule" sunk by the Mission Prehistorique et Paleontologique Française au Maroc and the INSAP (*Programme Neolithique du Littoral Nordatlantique*) (1989–1994) superimposed by the trial trenches of 2012 (balk) (redrawn from El Idrissi 2001). **b** Stratigraphic sections of sectors 4 and 1 W by the MPPFM-INSAP (redrawn from El Idrissi 2001). **c** Stratigraphic sections of the trial trenches 26 AB/EXT, 26G, 26HI and 26JK by AGRIWESTMED (2012) (all sections are to the east of the trench except G west, inverted in the drawing)

Table 1 Overview of the sequence obtained by the MPPFM-INSAP project of the stratigraphical units of zone 1 (from Daugas et al. 2008)

	PROTOHISTORY		1001		
	LATE NEOLITHIC/ BELL BEAKER		1002		
2nd Cardial Occupation	PERIOD 3		1003		
			1004		
		2004		1018	1009
	PERIOD 2	2005	1005		
			1019	1022	
			1006		
		1023	1021		
		1020			
1st Cardial Occupation	PERIOD 1	1024			
		1025			
		1026			
	INITIAL PHASE	1027			
		1028			
	GAP			1034	
		1039	1038		
	EPI		1029		

Right: stratigraphic units (SUs). EPI: Epipalaeolithic; GAP: Interfacies or *lacunae* by bioturbation

A Challenging Sequence

Although Kaf Taht el-Ghar is one of the first prehistoric sites in northern Morocco to benefit from a series of published radiocarbon datings, the results did not initially receive consensus. Indeed, the findings, together with those of Kef Boussaria (Oued Zarka), largely served as evidence of an Early Neolithic occupation in the region before the sixth millennium cal BC (Ballouche et al. 2012; El Idrissi 2012). Thus, the sequence gleaned from the Franco-Moroccan (MPPF-INSAP) intervention initially served as an argument for a hypothetical "Regional Pre-pottery Early Neolithic" set provisionally in the ninth millennium cal BC (Fig. 2b, Table 1). This argument is based on two anthropic levels (SUs 1038–1039) dated to the second half of the tenth millennium cal BC (Ly-7695 and Ly-7287) in an "Epipalaeolithic palaeontological level" (SU 1029, Ly-7289) beneath an Early Neolithic Cardial stratum. Numerous cultivated cereal grains (*Triticum dicoccum*, *T. monococcum*, *T. aestivum*/*durum*) and legumes (*Lathyrus* cf. *ochrus*) appeared in each of the levels. Despite the presence of these finds in the earlier strata devoid of pottery, they were linked to the Neolithic. The existence of a sedimentary gap, lacking archaeological finds, nonetheless leaves the door open to the possibility of bioturbations that mixed Neolithic and Epipalaeolithic materials (Daugas et al. 1998). This appears to be confirmed by new datings on cereals (*Triticum dicoccum*) (Ly-971), which aligned with earlier datings of charcoal from the so-called Early Cardial Neolithic (Ly-3821 and Ly-7288) during the second half of the sixth millennium cal BC (Ballouche and Marinval 2003).

Surprisingly, and almost simultaneously, another explanation was offered to bolster the notion of an "Early

Neolithic" devoid of evidence of domestication. This was gleaned from levels dating to the end of the seventh millennium cal BC, and containing pottery fragments similar to those collected from a contemporaneous level in Kef Boussaria rockshelter characterized by incisions (El Idrissi 2001, 2012) or shell impressions, and bearing applied motifs such as cordons (Daugas et al. 2008). The dating attributed to this phase, labeled A, is earlier than that of sample Rabat-65 (SU 1025, 7136 ± 156 BP) but younger than Rabat-66 (SU 1028, 8765 ± 176) obtained from charcoal aggregates (Ballouche et al. 2012; Daugas et al. 2008; El Idrissi 2012). The team assumed the main Neolithic occupation to be from the middle of the sixth millennium cal BC, a period of extensive occupation marked by the domestication of plants and animals. The Early Neolithic comprised of the First Cardial phase and period 2 of the second Cardial phase. The Middle Neolithic is attributed to period 3 of the second Cardial phase (Table 1).

Period 1 corresponds to sporadic visits (SUs 1024–1026) at the transition of the seventh and sixth millennium cal BC. It is characterized for the most part by smooth pottery and some fragments of channeled and shell-impressed ware (Daugas et al. 2008). Period 2, from the second half of the sixth millennium cal BC, is defined by intensive occupation and general leveling of the area (SUs 1020–1021). The occupation level was subsequently covered by a beaten-earth floor (SU 1006) dated by charcoal aggregates (Ly-3821). Several layers, each delimiting specific specialized activities (SUs 1022 and 1029, rock "paving" 1005, hearths 1018 and 1009), covered this beaten-earth floor, which contains a high percentage of shell-impressed ware with plastic cordon decorations, wares with impressions of various types, and channeled ware. The channeled ware increases in proportion from SU 1005 on, while shell impression decreases (Daugas et al. 2008). Pressure flaking appears to coexist with percussion flaking. Among the lithic artifacts are geometric microliths and notched and denticulated tools (Bouzouggar 2006), and domestic caprines is noted within the faunal assemblage (Daugas 2010). Period 3 (Middle Neolithic) is initiated with SUs 1004 and 1003. It marks a very intense occupation, perhaps linked to the cave serving as a sheepfold. Shell impressions are few, while channeled ware increases. Finally, the end of Late Prehistory is represented by SUs 1002 and 1001 and contains elements from the Late Neolithic, Bell Beaker, and protohistory (Daugas et al. 2008).

The AGRIWESTMED Investigations (2012)

KTG was selected as a key site to investigate the neolithization process and the interaction of the earlier Epipalaeolithic hunter-gatherer societies with the new economic system. We made this decision because previous studies show that KTG holds promise for understanding the evolution of Neolithic cultures in the Tingitana Peninsula during the first centuries after the adoption of the agricultural economy. The site's choice was particularly based on its advantages for studying long-term chronostratigraphic sequences in the region. A reevaluation of these sequences was essential since it was one of the key places in the Moroccan Early Neolithic with Cardial ceramics and the first to provide samples of charred cereals with direct dates, in a sequence that was nevertheless problematic. Our aim, therefore, was to redefine KTG's chronological timeline for the beginning of crop cultivation and domestic animals. We expected this to be a step forward in solving some of the earlier problems associated with dating the stratigraphic sequence (Ballouche et al. 2012; Linstädter et al. 2012a, 2012b).

The fieldwork carried out from February 13 through 29, 2012, consisted of opening four short trenches. Two of them are contiguous, in the central area of the "vestibule" (Fig. 2a, c). Although this sector was explored in previous campaigns and suffered from the collapse of profiles and recent alterations, it was possible to identify the earlier east–west balk separating sectors 1–4 and 2–3 of the 1989–1994 interventions. This permitted correlating the new stratigraphic sequences with those of previous excavations. Taking advantage of the previously labeled alphanumeric grid system, cipher 26 was retained to identify the different trenches broken down from E to W: 26AB, 26G, 26HI, and 26JK.

A total of 11 stratigraphic units were recorded in the N–S section of unit 26AB, across a maximum depth of 105 cm (Fig. 3a; Table 2). Unit 26G (85 × 80 cm), in the center of zone 1, was dug at the intersection of the N–S and E–W balks (Fig. 3b). Its maximum depth in the E–W profile (with 25 stratigraphic units) is 132 cm (Table 2). Units 26HI and 26JK are two trial trenches in the westernmost area of the E–W balk, measuring 130 × 60 cm and 127 × 110 cm, respectively (Fig. 3c). The stratigraphic sequence for each comprises 11 units visible in the southern profile. The cultural deposits are 76 cm deep. The stratigraphic units and their relationships are listed in Table 2.

Results

The excavations, bolstered by radiocarbon datings (Table 3) and statistical modeling, revealed an extensive sequence of five phases lasting from the Palaeolithic (Aterian) to historical times. The stratigraphic findings of the AGRIWESTMED project, therefore, differ significantly from those of earlier fieldwork carried out by the Franco-Moroccan team MPPF-INSAP (Daugas et al. 2008; El Idrissi 2001). For example, during this study no cereals were found at Epipalaeolithic levels and occupation levels were identified that do not appear in the sequence of previous studies. This section explains how each phase manifests in the four excavation units and the implications of the radiocarbon dates, especially those obtained from domestic and short-lived materials during the 2012 fieldwork.

The radiocarbon dates of these short-lived samples are arranged into a chronostratigraphic scheme using Bayesian modeling (OxCal v4.4.2, Bronk Ramsey 2017) and application of the northern hemisphere's IntCal20 calibration curve (Reimer et al. 2020). The radiocarbon dates were grouped into three phases, considering the existence of hiatuses between at least two phases. This led to separating the dates associated with phases 5 (Epipalaeolithic), 3 (Early Neolithic), and 2 (Middle Neolithic), all gleaned from short-lived elements only. The dates from charcoal or with a high standard deviation are not included in the analysis. Hence, the study retained a total of eight dates with an agreement greater than 84.1% (at a maximum of 106.8%). This is relevant when considering that the minimum acceptable value is 60%, and the model reveals no outliers (Fig. 4, Table 4). As a result, we propose the following as the site's chronological sequence from the earliest to the most recent.

Phase 6: Palaeolithic (PAL)

This period is only recorded in 26G, the only unit with bedrock. The unit is subdivided into two different periods. The first, SU 1025, is represented by a thick, homogeneous, orange-colored deposit dating to the Middle Palaeolithic (Aterian). The bone remains in this stratigraphic level have heterogeneous color suggestive of transport and redeposit. This level is a sort of facies or palimpsest, integrating elements accumulated from different events. The fauna remains include large carnivores such as bears and lions. The lithic artifacts resemble the ones from Aterian sites in extreme northwest Africa. They consist of quartzite and flint discoidal cores, tanged points, a flat-faced point, and a few scrapers, including a carinated example (Fig. 5: 1–6). Similar artifacts were collected at sites around Tangier, such as Mugaret el Aliya (Henken 1948; Kozlowski et al. 2004). There was no radiocarbon dating at this level (SU 1025) because the archaeological deposits are outside the range of the radiocarbon dating method. In any case, it is reasonable to assume that the phase spans the Middle Pleistocene through the first half of the Upper Pleistocene based on the similar lithic techno-complex from Ifri n-Ammar (Eastern Rif) (Linstädter et al. 2012c; Nami and Moser 2010; Richter et al. 2012).

The second Upper Palaeolithic level is an Iberomaurusian sequence (SU 1024) containing a flint and quartzite industry characterized by backed pieces (Fig. 5: 7–10). Although it was not possible to date the bones from this level because of the absence of collagen, the charcoal dated by the Franco-Moroccan team from this level falls in the Upper Palaeolithic range (Ly-7289, 13,300 ± 180 BP). However, due to its large standard deviation, this date was not included in the modeling. Its stratigraphic unit (1029) correlates to SU 1024, which contains a lithic assemblage characteristic of the Upper Palaeolithic materials (Daugas et al. 2008). The earliest elements of the sequence, characterized by backed pieces, coincide with finds with similar datings at Taforalt in the Eastern Rif (sector 8, Y1–Y2, 10,135–14,630 BP; Barton et al. 2014).

Phase 5: Epipalaeolithic (EPI)

This phase is represented by SUs 1105 of 26AB and its extension, 1208 to 1209-3 in grids 26 H-I and 26 JK, and SUs 1003-2 to 1006-Bed of trench 26G. The sequence of 26G trench has a maximum depth of 0.90 m and includes these features: interspersed four hearths, a floor level, and a vertical element (probably a post hole). Finds associated with this phase include a vast microlithic industry characterized by backed pieces and certain geometric elements (Fig. 5: 11–24) and an ostrich eggshell bead (26JK, SU 1209-2, Fig. 6: 2). There is an absence of pottery, cultivated seeds, and domestic animals. The only plant remains are a few wild legumes and grasses (*Avena* sp.) (Morales et al. 2016). The fauna comprises gazelles, wild boar, and Barbary sheep (*Ammotragus lervia*). A noteworthy artifact is a bone fragment decorated with six fine parallel incised

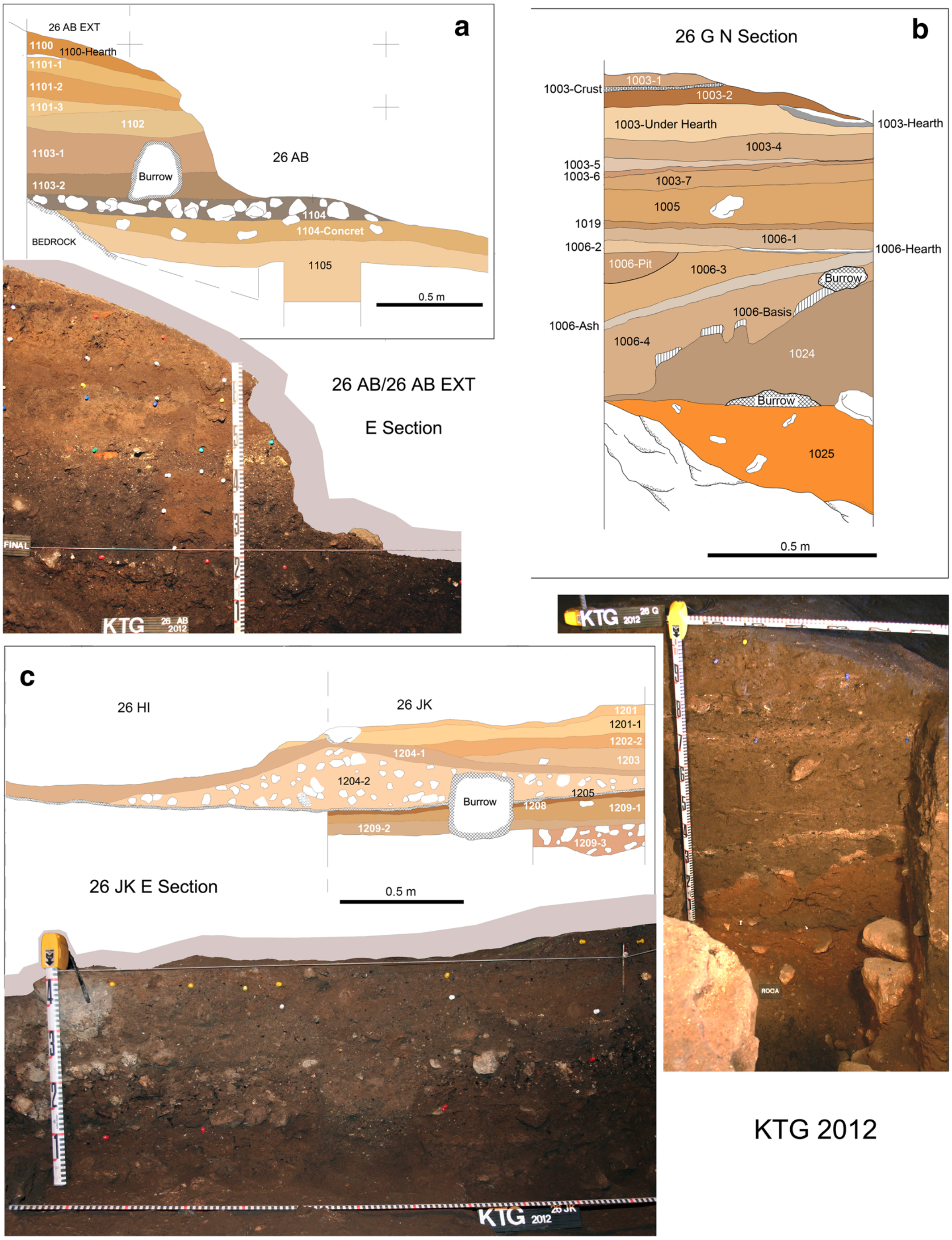

Fig. 3 Kaf Taht el Ghar, Stratigraphic breakdown of the trenches of the 2012 campaign. **a** East section of trench 26 AB/26 AB EXT. **b** North section of trench 26 G. **c** East section of trenches 26 HI and 26 JK

lines (26G, SU 1005, Fig. 6: 1) similar to examples unearthed during the fieldwork of the 1980s and 1990s (SU 1029, Epipalaeolithic; Kaoun 2008), and to a gazelle-decorated horncore from the Iberomaurusian phase of the site of Ifri El Baroud in the Eastern Rif (Mikdad and Eiwagner 2000).

Judging by the stratigraphic succession and the radiocarbon dates of three short-lived elements (Beta-411104

Table 2 Sequence of the phasing of stratigraphic units of the different excavation sectors based on the findings from the 2012 fieldwork (AGRIWESTMED)

Phases		26AB/26AB EXT	26G			26HI/26JK
		1100				
		1100 Hearth				
1	HIS	1101-1				1201
		1101-2				
						1202-1
						1202-2
2	MN	1101-3				
		1102				1203
		1103-1		1003-1		1204-1
3	EN	1103-2				1204-2
4	TRANS	1104		1003 Crust		1205
		1104 Concretion		1003-2		1208
				1003 Hearth		
				1003 Under Hearth		
		1105		1003-3		1209-1
				1003-4		1209-2
				1003-5		
				1003 Floor		
				1003-6		1209-3
				1003-7		
5	EPI			1004		
				1005		
				1019		
				1006-1		
			1006-2		1006 Hearth	
				1006 Pit		
				1006-3		
				1006-3 Ash		
				1006-4		
				1007 Interfacies		
				1006 Basis		
				1024		
6	PAL			1025		
BEDROCK						

Table 3 Kaf Taht el Ghar radiocarbon datings. The list includes both dates obtained by the AGRIWESTMED team on short-lived samples and those of prior teams. Calibration by IntCal20 atmospheric calibration curve (Reimer et al. 2020)

US/UE	Code	SAMPLE	BP	SD	Cal BC 68.3%	Cal BC 95.4%	Average	References
1202-2	Beta-331986	*Triticum dicoccum*	5400	30	4329–4244	4340–4171	4279	Morales et al. (2016)
1006	Ly-3821	Charcoal	6050	120	5206–4794	5301–4692	4964	Daugas et al. (1989)
1101-3	Beta-331985	*Triticum dicoccum*	6190	40	5211–5065	5294–5011	5130	Morales et al. (2016)
1039	Ly-971	*Triticum dicoccum*	6350	85	5469–5217	5479–5072	5323	Ballouche and Marinval (2003)
1204	Beta-331987	*Triticum dicoccum*	6390	30	5465–5319	5473–5236	5362	Morales et al. (2016)
1204-2	Beta-409693	*Ovis aries*	6410	30	5470–5330	5474–5318	5389	Martínez Sánchez et al. (2018b)
1103-2	Beta-424637	Human tooth	6410	30	5470–5330	5474–5318	5389	Martínez Sánchez et al. (2018b)
1018	Ly-7288	Charcoal	6520	80	5557–5380	5621–5326	5477	Daugas et al. (1998)
1025	Rabat-65	Charcoal	7136	156	6218–5843	6371–5722	6009	Daugas et al. (2008)
1003-2	Beta-411101	*Sus* bone	8330	40	7477–7346	7521–7194	7403	This work
1028	Rabat-66	Charcoal	8765	176	8169–7601	8289–7531	7890	Daugas et al. (2008)
1005	Beta-331849	Bone	8820	40	8165–7782	8198–7741	7914	This work
1038	Ly-7695	Charcoal	9865	75	9445–9252	9735–9221	9347	Daugas et al. (1998)
1039	Ly-7287	Charcoal	9910	50	9445–9294	9659–9263	9370	Daugas et al. (1998)
1006-Bed	Beta-411104	Monocotyledonean	10,020	40	9737–9409	9789–9369	9567	This work
1029	Ly-7289	Charcoal	13,300	180	14,307–13,789	14,611–13,522	14,049	Daugas et al. (1998)

and Beta-331849 for animal bones; Beta-411101 for charcoal from a monocot) from the upper, central, and lower strata of the Epipalaeolithic sequence, this phase consists of repeated occupations between the tenth and the outset of the seventh millennium cal BC (9800–6800 cal BC; Table 4). The Beta-411101 date came from the second phalanx of a *Sus scrofa* (SU 1003-2), yielding a range that could correspond to the last episode of the Epipalaeolithic (8330 ± 40 BP). Afterward, this area of the cave offered no evidence of occupation for more than a millennium until the earliest Neolithic phase.

The dates obtained on charcoal samples from the archaeological fieldwork of the Franco-Morrocan Project at KTG present numerous problems. Thus, the dates of the charcoal fragments from SUs 1038 and 1039 (Ly-7695, 9865 ± 75 BP; Ly-7287, 9910 ± 50 BP), falling within the tenth millennium cal BC, are not included in the current modeling. These relate to a purported hiatus between the Epipalaeolithic and the initial Neolithic phase (Daugas et al. 2008), although falling within an early period of the Epipalaeolithic occupation comparable with our more recent Beta-411104 (10,020 ± 40 BP, 1006-Bed) date of monocot charcoal (see Table 3). The Rabat-66 (SU 1028) and Rabat-65 (SU 1025) dates likewise served to delimit an initial Neolithic phase between the eighth and seventh millennium cal BP characterized by *Cardium* impressed ware (Daugas et al. 2008). However, the correlation of the older stratigraphic findings with those of the 2012 fieldwork could place SU 1028 and 1025 in the Epipalaeolithic phase. This reflects the challenges of interpreting the KTG stratigraphy and reconciling our recent work with the conclusions originating from the 1980 to 1990 fieldwork.

Phase 4: Epipalaeolithic-Neolithic Transition (TRANS)

At the base of Level 4 is a hardened and carbonated layer of rocks and endogenous clasts (SU 1003 Crust = 1205 and 1104) that was initially thought to be a paved floor (Fig. 7). However, this is probably a natural feature formed during a prolonged period of abandonment or infrequent visit to the cave between the last Epipalaeolithic occupation and the first Neolithic phase. Due to its characteristics and origin, it contains few anthropic materials. The exceptions are a few lithic artifacts, a bone needle (Fig. 8: 1) and two ornaments (Fig. 6: 3–4), as well as a few small Neolithic potsherds from upper levels. The layer contained no domestic elements, and the only seeds are a single wild legume and a *Pistacia lentiscus* nucule.

The hardened level appears to be the same as SU 1005 of the Franco-Moroccan team. The dating of the

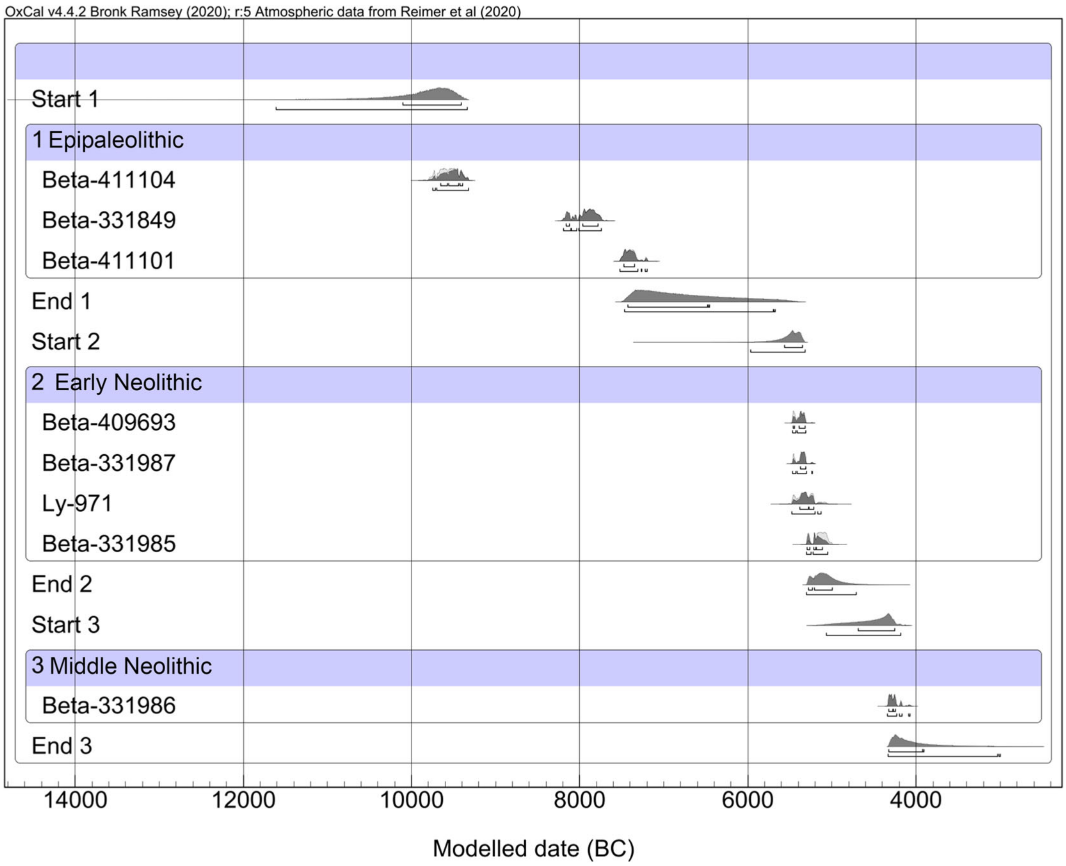

Fig. 4 Kaf Taht el-Ghar. Graphic representation of the Bayesian model of radiocarbon dates of short-lived materials depicting a sequence that can be broken down into three phases: Epipalaeolithic, Early Neolithic, and Middle Neolithic [OxCal v4.4.2 (Bronk-Ramsey 2017), using the IntCal20 atmospheric calibration curve (Reimer et al. 2020)]

levels above (SUs 1204-2 and 1101-3) and below (SU 1003-2) appeared to link it to 6800–5500 cal BC, a period devoid of significant human occupation. This nonetheless compromises the reliability of the Rabat-65 dating (charcoal, 7136 ± 156 BP), presumably falling into the abandonment range (Daugas et al. 2008). As a result, we omitted it from the Bayesian modeling due to its uncertain context and high standard deviation.

Phase 3: Early Neolithic (EN)

This phase is represented by a sequence ranging from SUs 1103-1 and 1104 (i.e., trench 26AB and its extension), SU 1003-1 to 1204-1 and 1003-Crust (i.e., SU 1205), and includes the trial trenches 26G, 26HI, and 26JK. It is undoubtedly the richest of the stratigraphic sequence, in terms of artifacts and fauna, and is characterized by dark layers saturated with charcoal and macro-plant remains, notably cultivated cereals and legumes (Morales Mateos et al. 2016). Among the seeds of this phase are cereals such as *Triticum dicoccum*, *T. aestivum/durum,* and to a lesser extent *Hordeum vulgare*. The few cases of *Lathyrus/Vicia*, *Vitis vinifera*, and *Myrtus communis* line up with the subsequent phase. Animal bones are represented by domestic caprines such as sheep (*Ovis aries*) and undifferentiated Suidae. Worked bones such as awls from domestic caprine metapodials (Fig. 8: 3) are particularly noteworthy. Ornamental elements (Fig. 6: 5–13) are common. These include beads of perforated *Columbella rustica*, a gastropod typical of the Early Neolithic of the western Mediterranean (Álvarez Fernández 2008), also recently found in other Early Neolithic sites in northern Morocco (Ifri Oudadane, Eastern Rif) (Hutterer et al. 2020).

Potsherds are particularly abundant. The decorations include striae motifs with shells and combs, channeling, incisions, and added plastic elements such as impressed cordons (Fig. 9: 1–4). Although their forms vary, most

Table 4 Bayesian modeling of the datings of eight short-lived materials at Kaf Taht el-Ghar. Based on OxCal v4 3.2 (Bronk-Ramsey 2017) using the IntCal20 atmospheric calibration curve (Reimer et al. 2020)

Name	Unmodelled (BC/AD)							Modeled (BC/AD)							Indices Amodel=95.5 Aoverall=96.2	
	From	To	%	From	To	%	*m*	From	To	%	From	To	%	*m*	*A*	*C*
Start 5								−10,100	−9410	68.3	−11,610	−9335	95.4	−9829		97
5-Epipaleolithic																
Beta-411104	−9737	−9409	68.3	−9789	−9369	95.4	−9567	−9655	−9392	68.3	−9749	−9326	95.4	−9523	98.4	99.8
Beta-331849	−8165	−7782	68.3	−8198	−7741	95.4	−7914	−8165	−7781	68.3	−8197	−7741	95.4	−7914	99.7	99.8
Beta-411101	−7477	−7346	68.3	−7521	−7194	95.4	−7403	−7478	−7351	68.3	−7523	−7195	95.4	−7409	101	99.9
End 5								−7425	−6460	68.3	−7465	−5675	95.4	−6832		99.4
Start 3								−5567	−5352	68.3	−5970	−5323	95.4	−5486		99.5
3-Early Neolithic																
Beta-409693	−5470	−5330	68.3	−5474	−5318	95.4	−5389	−5464	−5321	68.3	−5472	−5314	95.4	−5372	96.4	99.9
Beta-331987	−5465	−5319	68.3	−5473	−5236	95.4	−5362	−5379	−5315	68.3	−5471	−5232	95.4	−5354	103.3	99.9
Ly-971	−5469	−5217	68.3	−5479	−5072	95.4	−5323	−5380	−5220	68.3	−5477	−5127	95.4	−5320	106.8	99.9
Beta-331985	−5211	−5065	68.3	−5294	−5011	95.4	−5130	−5298	−5118	68.3	−5306	−5048	95.4	−5177	84.1	99.9
End 3								−5281	−4997	68.3	−5301	−4712	95.4	−5092		99.7
Start 2								−4691	−4252	68.3	−5070	−4182	95.4	−4485		99.7
2-Middle Neolithic																
Beta-331986	−4329	−4244	68.3	−4340	−4071	95.4	−4279	−4329	−4245	68.3	−4341	−4075	95.4	−4283	101	99.9
End 2								−4322	−3910	68.3	−4336	−3003	95.4	−4091		99.1

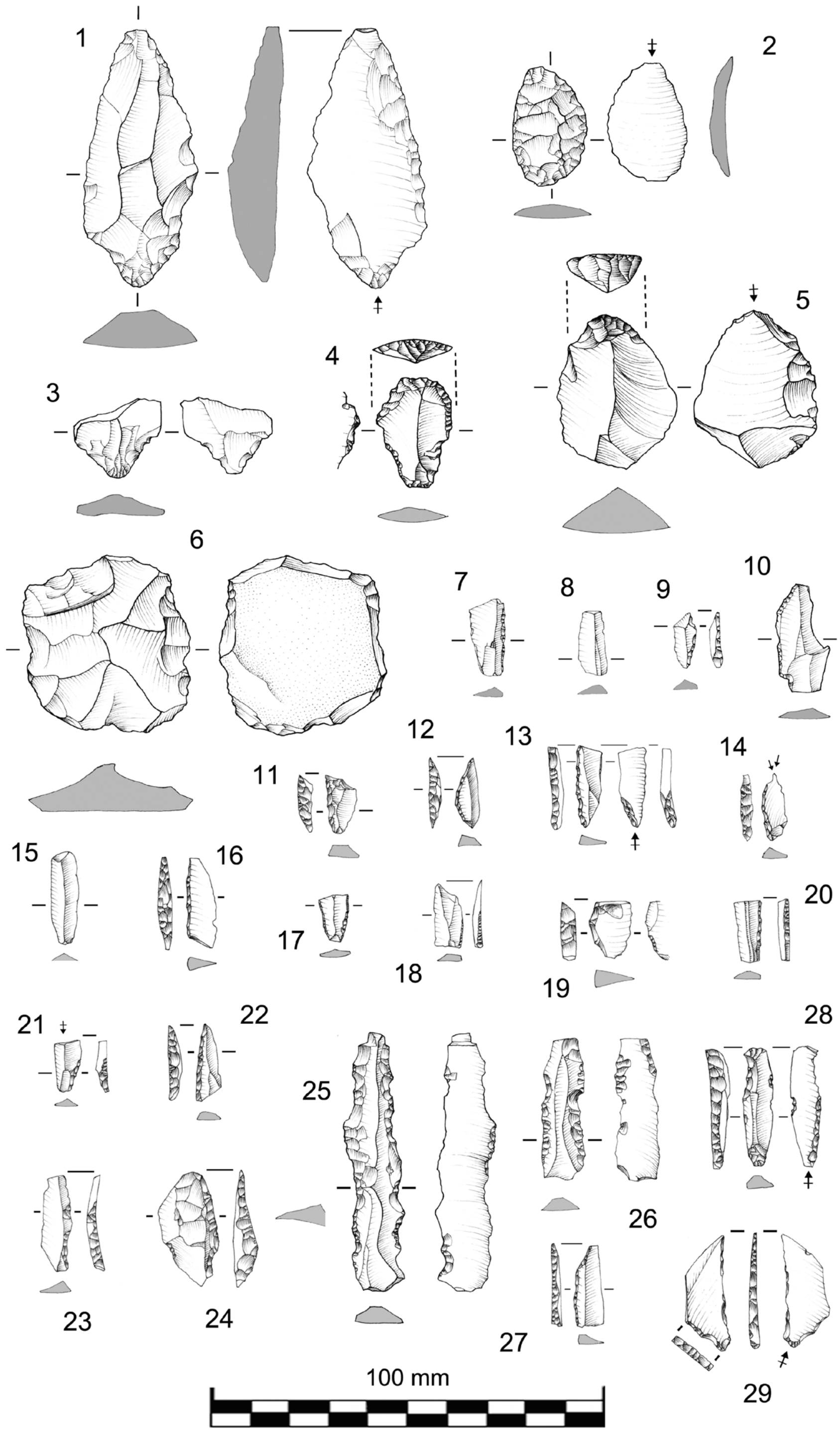

Fig. 5 Stone tools artifacts from the Palaeolithic (Aterian and Iberomaurusian) and Epipalaeolithic phases. Aterian: 1–6 SU 1025; Iberomaurusian: 7–10 SU 1024; Epipalaeolithic: 11 SU 1019; 12 SU 1003-6; 13 and 18 SU 1003-Under Hearth; 14 SU 1003 Hearth; 15 and 25 SU 1005; 16 SU 1006-3; 17 SU 1003-7, 19–22 SU 1105; 23–24 SU 1105 EXT; Early Neolithic: 25 and 26 SU 1204-2; 27 and 28 SU 1103–2; 29 SU 1204 (Drawings: Rafael M. Martínez). 1, 3: Tanged pieces; 2: flat-faced point; 4–5: scrapers; 6: Levallois/discoid flake core; 7–22: blades and bladelets, backed pieces and geometric points; 23–24: retouched pieces; 25–26, 28: notched blades; 29: geometric piece

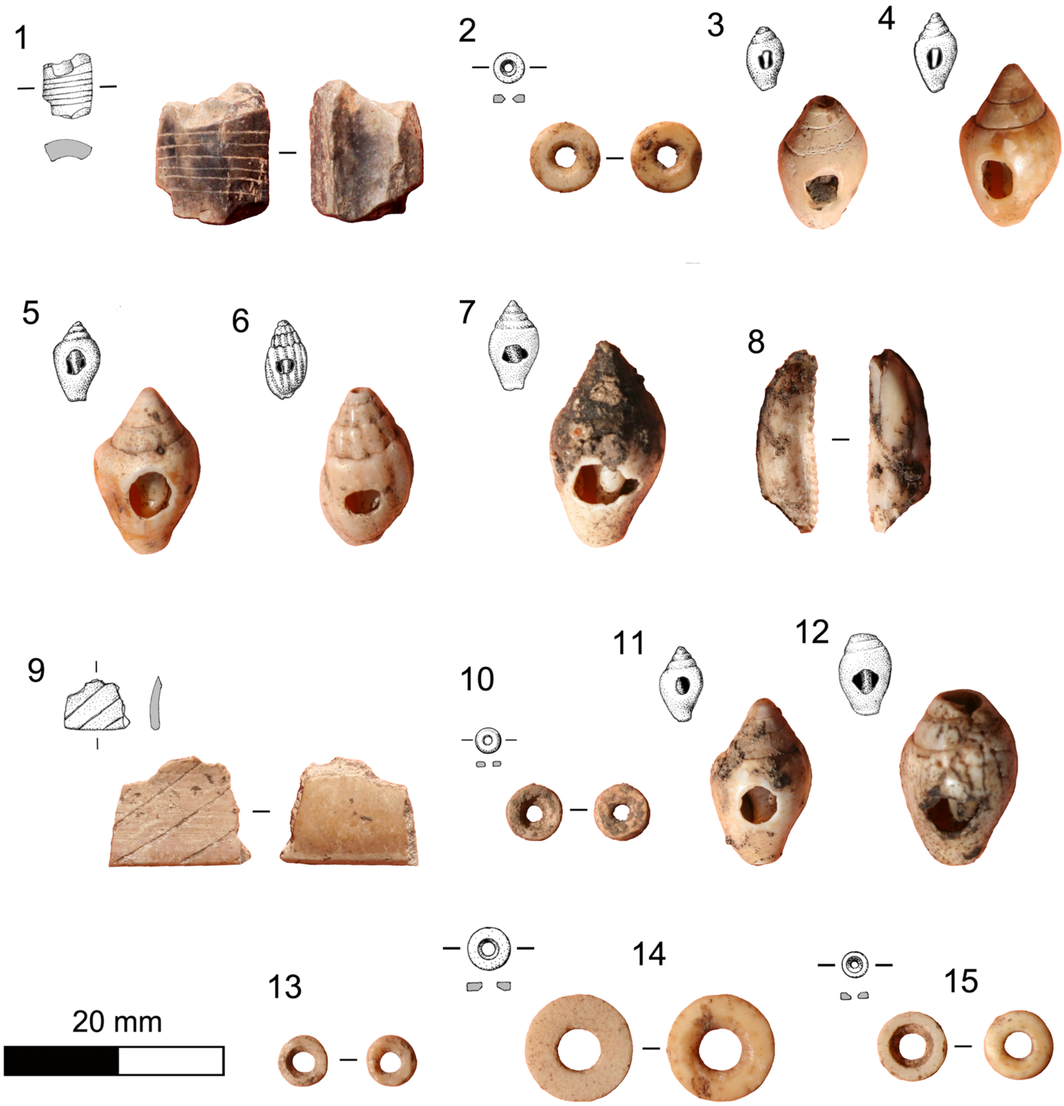

Fig. 6 Ornamental elements. Epipalaeolithic: 1, SU 1004; 2, SU 1209-2; phase 4 TRANS: 3, and 4, SU 1104; Early Neolithic: 5–8, SU 1204–2; 9–12, SU 1103–2; 13, SU 1103; Middle Neolithic: 14–15, SU 1202 (Drawings: Rafael M. Martínez). 1: Bone decorated with incised lines; 2, 10, 13–15 ostrich egg discoidal beads; 3–5, 7, 11–12: perforated *Columbela rustica*; 6: perforated *Nassarius* sp.; 8: fragment of *Zonaria pyrum*, probable ornamental element; 9: shell fragment decorated with incised lines (valve of a *Callista chione*)

of the vessels are closed forms with strangled necks and flared rims. Stone tools, somewhat scarcer than in the previous phase, are still generally characterized by blades with backed edges and certain geometric elements (Fig. 5: 25–28). This assemblage also includes macrolithic and grinding tools.

The Early Neolithic began around the mid-sixth millennium BC. Three dates (Beta-331987, Beta-409693, and Beta-424637) from this phase are included in the model. They correspond, respectively, to a grain of *Triticum dicoccum*, a sheep (*Ovis aries)* bone, and a human tooth (the results of the last two are identical). A *T. dicoccum* sample from SU 1101-3 provided the fourth date (Beta-311985) that falls into this phase, but this sample is intrusive, as will be discussed below. Other dates obtained by the Franco-Moroccan team, which fall into the Early Neolithic timeframe, came from cereal grains (Ly-971, SU 1039) and charcoal (Ly-7288, SU 1018). The latter was not included in the modeling due to

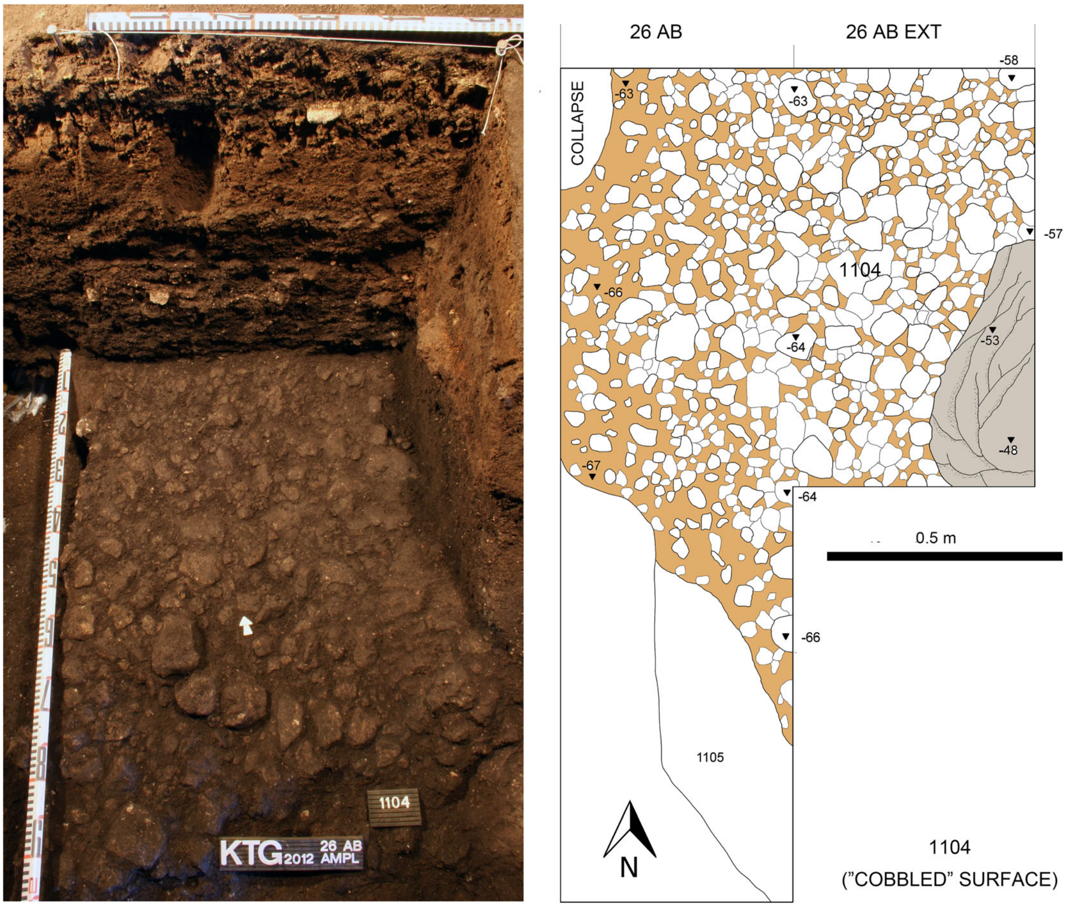

Fig. 7 The surface of SU 1104 in trial trenches 26 AB and 26 AB EXT, consisting of a compact natural "paving" of rocks of different sizes. Phase 4, TRANS: hiatus or transition between the last Epipalaeolithic occupation and the Early Neolithic

its high standard deviation and link to the so-called Second Cardial Occupation (Daugas et al. 2008). The Early Neolithic phase appears to extend until the end of the sixth millennium cal BC (Beta-331985). This also corresponds to the date of a charcoal sample from SU 1006 (Ly-3821, not included in the modeling) associated with the Second Cardial Occupation. The pottery of this occupation phase was heterogeneous, characterized by various decorations, including shell and comb impressions, and other undetermined impressed motifs, as well as channeling and incisions.

Phase 2: Middle Neolithic (MN)

Lesser organic sediments and fewer artifacts mark the Middle Neolithic. This phase comprises levels SUs 1101-3 and 1102 from trenches 26AB (and their extension) and SUs 1202-1 to 1203 in units 26HI and 26JK, from which the seeds of naked wheat (*Triticum aestivum/durum*), legumes (*Lathyrus/Vicia*), and fruits (*Pistacia lentiscus* and *Vitis vinifera*) were found (Morales Mateos et al. 2016). The most characteristic artifacts of the Middle Neolithic are Ashakar type potsherds bearing a reddish or beige slip. The forms are diverse, with a majority being straight walls, and there are some instances of reinforced rims and flat bases. Their decorations are often cord-rouletted motifs filled with white paste (Fig. 9: 5–8). There are some potsherds, considered residual (from the Early Neolithic phase), consisting of impressed ware of various types and channeled ware with cowrie impressions. Among the ornaments are discoidal ostrich eggshell beads (Fig. 6: 14–15). The Middle Neolithic is the most recent of the prehistoric sequence observed during the AGRIWESTMED project. The Beta-331986 (SU 1202-2) date of a *Triticum dicoccum* places it in the second half of the fifth millennium cal BC (ca. 4200 cal

Fig. 8 Worked bone. 1 needle; 2 awl or pointed element possibly carved from an equid lateral metapodial; 3 awl carved from the side of a caprine metatarsus; 4 awl from a bone diaphysis; 5 spatula from a macromammal rib. Phase 4 TRANS, SU 1104: 1, Early Neolithic, SU 1103-2: 2, SU 1103: 3, SU 1204: 4 and 5

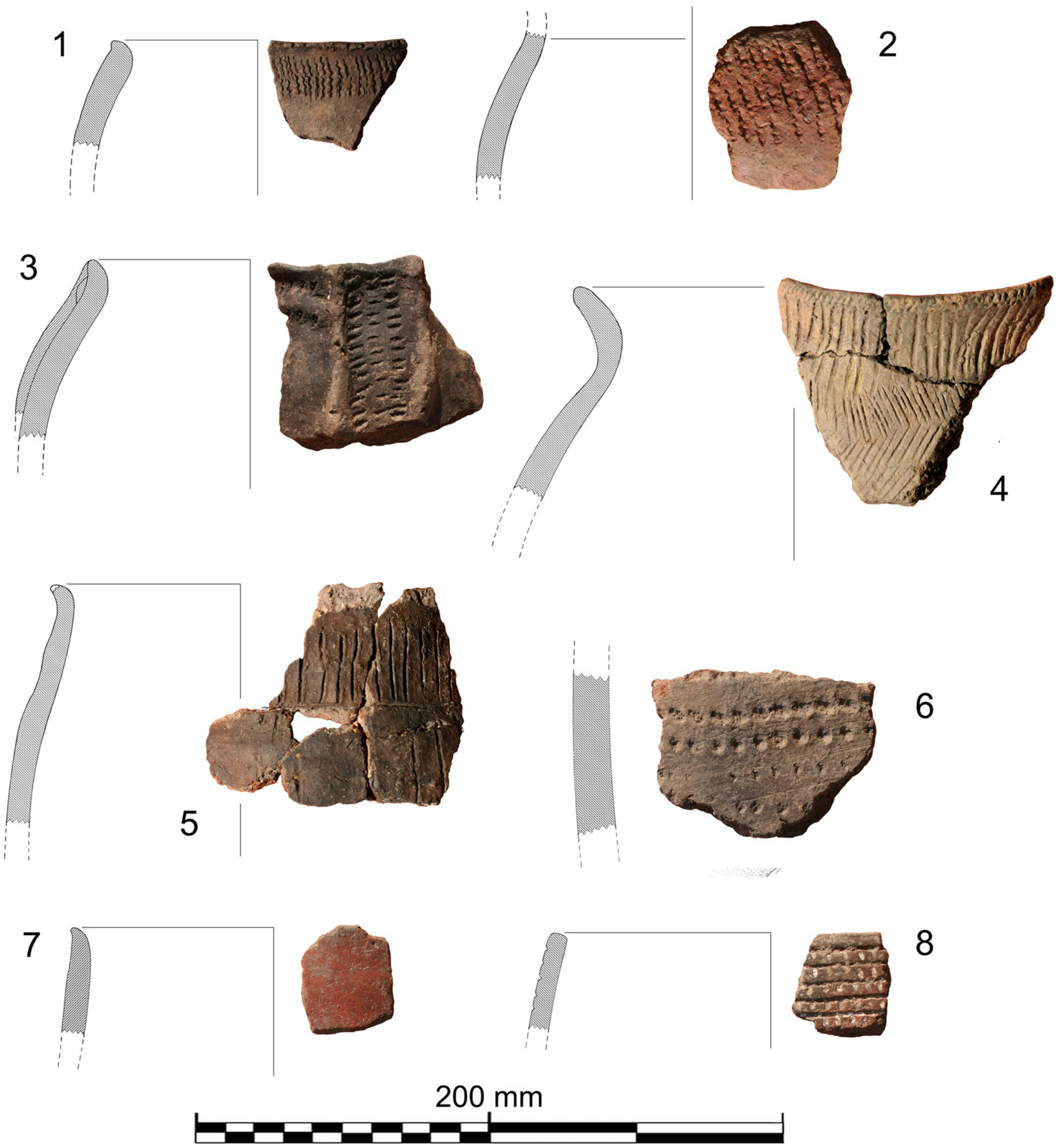

Fig. 9 Selection of potsherds from the 2012 campaign. Phase 3, Early Neolithic: 1–3, SU 1204-2; 4, SU 1103-2 (Potsherds with striae of shell impressions, with tool impressions between applied cordons, and channeled ware). Phase 2, Middle Neolithic: 5, SU 1103 EXT; 6 and 7, SU 1203; 8, SU 1102 EXT (incised ware ware, red slip and cord roulette of Ashakar type)

BC). Contrary to the findings published by the Franco-Moroccan team, our excavation in zone 1 revealed no traces of stratigraphical units dating to either the Late Neolithic or Bell Beaker despite the presence of potsherds from these periods.

Phase 1: Historical Period (HIS)

This phase, represented by SUs 1100 to 1101-2, was brought to light in unit 26AB. It contains medieval wheel-made pottery alongside Neolithic and other potsherds corresponding to advanced phases of Late Prehistory. This phase's main feature is a hearth (SU 1100) in the upper section of the unit.

Discussion

The Moroccan Puzzle

The Maghreb's northwest is one of the last regions to show a chronological timetable associated with the

Mediterranean Neolithic. Some recent events in the history of the region seem to have affected archaeological research. The dependence on other countries for research funding, the poor coordination between the different international teams, and the lack of research continuity in some instances seem to have slowed the rate of knowledge accumulation and our understanding of the North African Late Prehistory. Nevertheless, in all the Maghreb, Morocco has benefitted the most from recent research activities (Broodbank and Lucarini 2020; El Hajraoui et al. 2012; Linstädter et al. 2018).

The original classification of the neolithization process largely followed guidelines established for the southern Iberian Peninsula (Ramos Muñoz et al. 2008). This is problematic due to methodological differences, the difficulty of reading complex depositional palimpsests (Bernabeu et al. 2001; Zilhão 1993), and the absence of radiocarbon dates from short-lived, preferably domestic, samples (Zilhão 2001). These have led to contradictory hypotheses and interpretations even when derived from the same data and sites, such as the case of the Tingitana Peninsula. Examples of these include the notion of an "Aceramic" Neolithic from the ninth millennium BC (Daugas et al. 1998), the supposed existence of pottery throughout the seventh millennium BC, and the assumption of an introduction of plants and domestic livestock at the second half of the sixth millennium BC (Daugas et al. 2008; El Idrissi 2012). Although some of these interpretations can be explained by taphonomic problems, the presence of the Neolithic Package before the sixth millennium cal BC at KTG and Kef Boussaria lacks merit. Yet, these notions continue to appear in more recent publications (Ballouche et al. 2012; El Idrissi 2008, 2012).

Likewise, it is essential to focus on "chronometric hygiene," that is, restrict analyses to short-lived radiocarbon samples (domestic elements) and discard those susceptible to yielding a high standard deviation. Most of the previous radiocarbon dates in the western Maghreb (including KTG) were obtained from charcoal, which yielded excessively early dates marked by a high standard deviation (old wood effect). Moreover, researchers in the 1980s and 1990s turned to alternative radiometric dating techniques and experimental methods, such as pottery thermoluminescence (TL) (Ousmoi 1989), optically stimulated luminescence (OSL), and racemization of amino acids of continental gastropods shells (Daugas et al. 1998). All of these yielded results that can hardly be compared with those of the radiocarbon method. Also, due to the high standard deviation of thermoluminescence dates, it is difficult to determine if the pottery samples belong to prehistoric or more recent periods.

There have been doubts about the KTG chronological record since the outset of the site's publications. This debate comprised, on the one hand, defenders of the chronological and cultural connection between the North African Neolithic and southwestern European Neolithic, refusing to recognize the presence of pottery in the Tingitana Peninsula centuries earlier than anywhere else in the western Mediterranean (Linstädter et al. 2012a, 2012b; Linstädter et al. 2018, Zilhão 2014). The second view proposes an earlier origin of the Maghrebian Neolithic with links to the Sahara from where pottery and pastoral economy were adopted (Ballouche et al. 2012; El Idrissi 2012).

A Sequence Integrated into a Regional Context

The initial phase of the Epipalaeolithic sequence seems to coincide with the end of the Younger Dryas, ca. 9800 cal BC—a cold event (ca. 10,900–9700 cal BC) that discouraged human occupation throughout Morocco and resulted in the decline of archaeological records towards the end of the Iberomaurusian period (Linstädter et al. 2012c). A demographic rise is observed throughout the central-western Sahara towards the close of this event and the return to climate warming (Manning and Timpson 2014). This climate event led to an unprecedented expansion of Epipalaeolithic hunter-gatherer societies (also known as the "Typical Capsian") in Mediterranean Africa (Broodbank and Lucarini 2020). Their archaeological signatures include vast accumulations of terrestrial gastropods (*scargotières* or *ramadiya*) in the inland Sahara and the coastal Mediterranean strip, giving rise to the term *The Age of Snails* (Camps 1974). These deposits are parallel to others identified in the eastern Rif, notably at Ifri Etsedda (INES-3 and 4) (Linstädter et al. 2016). In the Tingitana Peninsula, the thickness and the excellent state of preservation of the Epipalaeolithic levels of Kaf Taht el-Ghar are central to understanding the first half of the region's Holocene.

The Epipalaeolithic occupation appears to be interrupted after 6800 cal BC giving way to a hiatus stretching for a millennium. The next occupation, after 5500 cal BC, was characterized by a fully developed Neolithic. The millennium-long occupation break appears to coincide, at least partially, with a colder and dryer event of 6200 cal BC marked by a decrease in rainfall throughout the Maghreb (Padgett et al. 2019). Changes in the western Mediterranean Thermohaline Circulation seem to have also led to a reduction in marine productivity along the Alboran coastline between 6200 and 5300 cal BC (Cortés Sánchez et al. 2012; Jiménez Espejo et al. 2007). The result was a population decrease in the western Maghreb in the seventh millennium cal BC, as indicated by different modelings based on palynological sequences and radiocarbon analyses (Cheddadi et al. 1998, 2019). However, a cool climate event in the mountains during this period led to an increase in deciduous and perennial forests, as detected in mid-mountain areas such as the Rif (Cheddadi et al. 1998, 2016), and a notable recovery of cedar forests in the Atlas (Campbell et al. 2017). Nevertheless, these are in contrast with those of the whole of the Sahara (Manning and Timpson 2014).

The first Neolithic occupation in KTG dates from 5500 cal BC when the first evidence of pottery, crops (cereals and legumes), and domestic caprines, notably sheep, appeared in the archaeological sequence. These subsistence innovations may have arrived from the slightly older manifestation of the Neolithic package in southern Iberia (García Borja et al. 2010; García Rivero et al. 2018), which in turn stemmed from the Central Mediterranean (Pardo Gordó et al. 2019). Pollen and isotope studies in northern Morocco point to a progressive increase in temperature and human impact on the environment, more evident in the lowlands than in mountainous areas (Yanes et al. 2018). These are highlighted by markers of human-induced fire and an increase in cereal pollen as a result of grazing and farming (Cheddadi et al. 2019).

The current data affirm that the site of Kaf Taht el-Ghar and the Tingitana Peninsula, in general, offer the earliest evidence of the arrival of the Neolithic package to the Maghreb in the middle of the sixth millennium. The proximity of KTG to the European Mediterranean coastline made it a gateway of the Neolithic package into northwest Africa. However, proposals defended by other authors place the start of the Neolithic Package in the Eastern Rif Mountains, more or less simultaneous with its first arrival along the Iberian coast, in the framework of a circuit of interaction between the two shores of the Alboran Sea: the Al Hoceima territory of northern Africa and the coastal Málaga-Almería strip of Iberia. The proponents of this hypothesis argue that the initial Neolithic horizon inherited a marked hunter-gatherer stamp where agriculture and livestock only played incipient and complementary roles (Linstädter et al. 2012a; Linstädter et al. 2018). This interpretation has had a significant impact on the most recent interpretation of the historical processes of neolithization in Iberia and the western Maghreb (e.g., Broodbank and Lucarini 2020; Dunne et al. 2020). However, this so-called Early Neolithic A, based on evidence from Ifri Oudadane and Hassi Ouenzga, is questioned in other studies based on taphonomic problems (Martins et al. 2015; Zilhão 2014).

It is important to recognize that the earliest records of domestic elements in the eastern Rif date to about 5100 cal BC (Ifri Oudadane: Early Neolithic A, *Pisum sativum*; Beta-341129, 6160 ± 30; Early Neolithic B, Beta-318608, 6140 ± 30, *Triticum* sp.) (Morales Mateos et al. 2013, 2016). Ifri n'Ammar ou Moussa (Khemisset) also yielded a similar date on a *Hordeum vulgare* (OxA-34042, 6128 ± 27 BP) (Martínez Sánchez et al. 2018b). Therefore, the eastern Rif region and the foothills of the Middle Atlas seem to be later than the Tingitana Peninsula in the adoption of these new cultural and economic forms.

The Middle Neolithic phase includes only one date in the second half of the fifth millennium. In KTG and other archaeological sites, this phase is characterized by Ashakar ware, a ceramic complex described mainly in Magharat el Khil site (Tangier) (Gilman 1975). This pottery was identified in the Tingitana Peninsula and Temara region (northern Morocco). It comprises red slip, cord roulette motifs, and occasional impressions filled with a white paste-like similar to those described at El-Kiffen (Bailloud and Mieg de Boffzheim 1964). Here, a chronological redefinition (4500–4300 cal BC) of the Ashakar ware assemblages in the Tangier region and sepulchral contexts of El Kiffen and Skhirat by Martínez Sánchez et al. (2018a) suggests that the fourth millennium cal BC inaugurated an archaeological void labeled as "the dark millennia" (Broodbank and Lucarini 2020). In the eastern Rif, the progressive deterioration of environmental conditions and widespread abandonment of sites between 4200 and 4000 cal BC has led to doubt of the utility of using the term Middle Neolithic (Linstädter 2016). In any case, the end of the fifth millennium BC coincided with the progressive aridification of North Africa, resulting in an increase in Saharan dust in the Atlantic (Linstädter 2016).

Moreover, the dwindling of human settlements that began in the eastern Rif towards ca. 4000 cal BC, and the vacuum of the fourth and third millennia throughout the western Maghreb, applies to the Tingitana Peninsula. More research is needed in this region, especially in open-air sites, such as those carried out in the Tangier-Tetouan region (Raissouni et al. 2015), to shed some light on the human settlement during those centuries. The occasional Bell Beaker ware finds, and other material evidence shows the western Maghreb as a region open to transcontinental contacts with the Iberian Peninsula (Nekkal and Mikdad 2012). The former adopted technical and stylistic elements such as Bell Beaker and Palmela-type points from the Iberian Peninsula and exported raw materials such as African ivory and ostrich eggs (Schuhmacher and Banerjee 2012).

Conclusions

KTG offers evidence of the earliest livestock farming and cereal agriculture in the Maghreb. The site is key to understanding the processes of diffusion of the production economy in the extreme northwest of the African continent. This process is characterized by a cultural and economic legacy inherited from the Neolithic groups who made Impressed and Cardial ware, and were responsible for spreading the Neolithic package into Italy and the Iberian Peninsula, and on to the Maghreb. KTG is close to the European coastline through the Strait of Gibraltar, which served as a bridgehead linking the Tingitana Peninsula to Iberia. Between them lies a maritime stretch no more than 14 km wide, which could easily be crossed with the nautical technology of the time.

The chronological sequence gleaned from the 2012 AGRIWESTMED archaeological campaign sheds new light on the human occupation and subsistence economy of the Early and Middle Holocene. The Epipalaeolithic phase seems to span two particularly cold and dry episodes—the Younger Dryas (10,900–9700 cal BC) and the 8.2 ky event (6200 cal BC) with no evidence of a permanent occupation of the cave. In this phase, indicators of human activity are represented by lithic artifacts tending towards microlithization, characteristic of the Typical Capsian. There are also signs of a hunting-gathering economy marked by a few wild seeds and mammals and the absence of livestock, domestic plants, and pottery.

The Neolithic phase, in turn, began after 5500 cal BC and is characterized by Cardial pottery. The middle of this phase, based on a single radiocarbon date (the second half of the fifth millennium cal BC), is marked by potsherds bearing traits similar to Ashakar ware from the area of Tangier. The upper layers of the KTG sequence, in turn, contain a combination of materials dated to Late Prehistory (i.e., Bell Beaker and Bronze Age) as well as the wheel-turned ware and other artifacts of the historical times. Therefore, the cave of Kaf Taht el-Ghar offers an invaluable record of human occupation in northwestern Africa, stretching over several millennia. Our results have contributed to elucidate specific aspects of the Holocene sequence, but the site still bears great potential for future research as its stratigraphic sequence is still intact. Therefore, it is our hope that this rich monument of Moroccan heritage will be protected from the encroaching stone quarrying activities that seriously threaten its archaeological integrity.

Acknowledgments This study was funded by a European Research Council Advanced Grant AGRIWESTMED (*Origins and spread of agriculture in the western Mediterranean region*) coordinated by L.P.-CH. It is dedicated to the memory of two dear colleagues, Lydia Zapata and Mustapha Nami, with whom we shared many passionate discussions aimed at a better understanding of this remarkable site.

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