THE MESOLITHIC-NEOLITHIC TRANSITION THROUGH THE IBERIAN SHELL MIDDENS

A REVIEW OF CURRENT EVIDENCE AND INTERPRETATIONS

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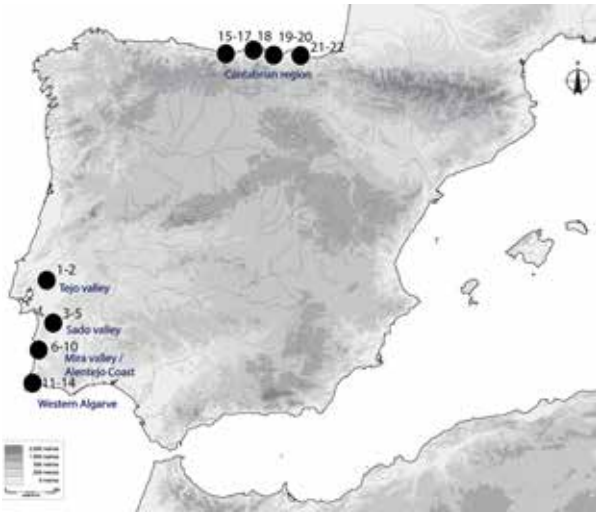
ABSTRACT Shell middens have been crucial to the discussion about the Mesolithic/Neolithic transition in the Iberian Peninsula from the earliest researches, as in other regions of the Atlantic Europe. Commonly associated to Mesolithic hunter-gatherer groups, shell middens have been subject of extensive research in recent years, stressing their potential as relevant sources of information about these populations. On the other hand, a global decline of shell middens at the beginning of the Neolithic has been widely observed and attributed to changes in settlement and subsistence strategies. However, several cases in the Iberian Peninsula show that the available archaeological data are still limited to firmly support this view. Therefore, it is imperative to critically review the role of these archaeological sites within this historical discussion.

KEYWORDS Shell middens, Mesolithic-Neolithic transition, Iberian Peninsula

INTRODUCTION

In the Iberian Peninsula, it is mostly during the Mesolithic, principally the Late Mesolithic, that shell middens have been identified with higher frequency and size (Arnaud, 1987, 2000; González *et al.*, 2004; Bicho *et al.*, 2010; Gutiérrez-Zugasti *et al.*, 2011). Over the past years, shell middens have been mainly seen as evidence of hunting-gathering-fishing economies with a considerable importance of mollusc gathering, but also integrated the Neolithisation debates (Arias, 1996; González, 1999; Zilhão, 1998, 2000; Carvalho, 2008). It has been assumed that the Neolithic process involved the decrease of the relevance of aquatic resources on the human diet (Anderson, 2007), and consequently, the importance of shell middens in the settlement systems. However, Mesolithic-Neolithic temporal overlaps have been observed for some Iberian shell middens. In addition, elements of 'Neolithic package' found in shell middens led to discussions about their historical significance and the stratigraphical integrity and interpretation of these sites.

In this paper, several areas occupied during the Late Mesolithic or/and Early Neolithic where shell middens were found are highlighted – in Portugal, the Tejo and Sado valleys, the Mira estuary, the Alentejo Coast and Algarve; in Spain[1], the Cantabrian region (figure 1).



1. Location of the Iberian shell middens attributed to Late Mesolithic or/and Early Neolithic periods, mentioned in this text. 1-2:Tejo valley complex (Cabeço da Amoreira, Cabeço da Arruda); 3-5: Sado valley complex (Amoreiras, Cabeço do Pez, Poças de São Bento); 6-10: Mira valley and Alentejo Coast (Fiais, Montes de Baixo, Medo Tojeiro, Vidigal, Samouqueira I); 11-14: Western Algarve (Rocha das Gaivotas, Castelejo, Alcalar 7, Ribeira da Alcantarilha); 15-22: Cantabrian region (15-17: Cuevas del Mar III, Las Madalenas, Mazaculos II, 18: Barcenilla, 19-20: Pico Ramos, Los Gitanos, 21-22: Santimamiñe, Kobaederra).

1. The Bay of Cadiz is also an interesting region for this subject, but it was not considered here due to space limitations.

TABLE 1. Radiocarbon dates mentioned in this text (Late Mesolithic-Early Neolithic transition and Middle Neolithic).

SITE	CONTEXT	SAMPLE	LABORATORY	DATE BP	ΔR	Δ 13C(‰)	MARINE DIET (%)	CAL BC (2Σ)
Cabeço da Amoreira	Multiple burial CAM-01-01 (cairn)	Homo	Wk-26796	6329±40	140±40	-16,9	46	5197-4898
	Multiple burial CAM-01-01 (cairn)	Homo	TO-10218	6630±60	140±40	-17,1	42	5483-5237
	Multiple burial CAM-01-01 (cairn)	Homo	TO-10225	6550±70	140±40	-20,1	0	5622-5375
Cabeço da Arruda	Skeleton N	Homo	TO-356	6360±80	140±40	-15,3	59	5206-4774
Amoreiras (Sado)	c. 2a (B)	Charcoal	Q(AM85B2a)	5990±75				5197-4706
	c.2b (B)	Shells	Q(AM85B2b)	6370±70	4±103			5203-4599
	Skeleton 5	Homo	Beta-125110	7230±40		-20,8	0	6210-6021
Cabeço do Pez	Middle levels	Shells	Q-2496	6430±65	4±103			5256-4684
	Middle levels	Shells	Q-2497	6730±75	4±103			5531-5002
	Upper levels	Bones	Q-2499	5535±130				4681-4053
	2, 1956	Homo	Ua-46930	5579±41	4±103	-19,1	23	4447-4257
Poças de São Bento	?	Homo	UA-425	5390±110				4447-3982
	Upper levels	Shells	Q-2493	7040±70	4±103			5813-5347
Medo Tojeiro	C.4?	Mytillus	BM2275R	6820± 140	95 ± 15			5556-4972
	S3, C.4	Charcoal	Beta 1723	5450± 160				4677-3957
Rocha das Gaivotas	I-Fireplace 2	Patella	Wk-14793	7117±38	95 ± 15			5631-5479
	I - Fireplace 1	Patella	Wk-13692	7092 ± 48	95 ± 15			5628-5461
	II - Fireplace 3	Pistacia	Wk-14798	6820 ±51				5804-5629
	I - Layer 2c base	Patella	Wk-14794	7201 ± 39	95 ± 15			5714-5548
	I - Fireplace 2	Juniperus	Wk-14797	6862 ± 43				5841-5664
	Test 1, Artif. Lev	Patella	Wk-6075	7270 ± 70	95 ± 15			5845-5558
	I - Layer 2c top	Pollicipes	Wk-17029	6801 ± 39	95 ± 15			5380-5197
Castelejo	Middle levels	Patella	ICEN- 743	7530±60	95 ± 15			6069-5802
	Middle levels	Patella	ICEN- 745	7910±60	95 ± 15			6446-6205
	Middle levels	Charcoal	Beta-2908	7450±90				6459-6099
	Middle levels	Shells	BM-2276R	8220±120	95 ± 15			7011-6420
	Upper levels	Shells	Beta-168461	6830±60	95 ± 15			5449-5201
Alcalar 7	Shell midden	Ruditapes decussata	Sac-1608	6580± 60	69 ± 17			5224-4901
	Shell midden	Ruditapes decussata	Sac-1594	6450± 60	69 ± 17			5067-4732
	Shell midden	Ruditapes decussata	Sac-1601	6570± 70	69 ± 17			5238-4866
	Shell midden	Ruditapes decussata	Sac-1602	6520± 60	69 ± 17			5182-4833
Ribeira da Alcantarilha	Level 2	Shells	Wk-6672	6500±70	69 ± 17			5178-4790
	Test 5	Shells	Wk-6851	6540±60	69 ± 17			5195-4854

Calibration with CALIB rev. 7.0.4 (Stuiver and Reimer, 1993), based on IntCal13, Marine13 curves and their combination (Reimer *et al.*, 2013). Applied ΔR values (years 14C): 140±40 for Muge shell middens (Martins *et al.*, 2008); 4±103 for Sado shell middens (Diniz and Arias, 2012); 95±15 for Alentejo/Western Algarve Coast (Soares and Dias 2006) and 69±17 for Southern Algarve Coast (Martins and Soares, 2013).
References: Cabeço da Amoreira and Cabeço da Arruda (Bicho *et al.*, 2013; see for other radiocarbon dates); Amoreiras (Arnaud, 2000; Cunha and Umbelino, 2001); Cabeço do Pez (Arnaud, 2000; Peyroteo Stjerna, 2016); Poças de São Bento (Larsson, 2010; Arnaud, 2000); Medo Tojeiro (Lubell *et al.*, 2007); Rocha das Gaivotas (Valente *et al.*, 2014); Castelejo (Soares and Silva, 2004 apud Reis, 2013); Alcalar 7 (Morán and Parreira, 2004 *apud* Carvalho, 2010); Ribeira da Alcantarilha (Bicho *et al.*, 2000; Carvalho, 2010).

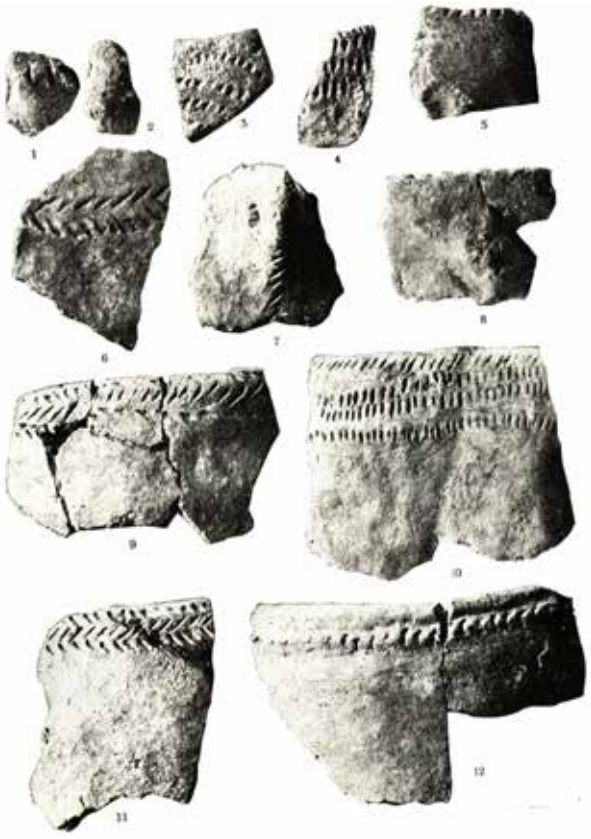
SHELL MIDDENS AND NEOLITHISATION: THE REGIONAL EVIDENCE

TEJO VALLEY

The Tejo shell middens are a complex of 12 Late Mesolithic open sites located in the estuary of Tejo, in the Muge, Magos and Vale da Fonte da Moça valleys (Santarém). Since their discovery in the 1860s (Ribeiro, 1884), they have been subject to several archaeological works and became particularly well-known for the numerous human burials (Bicho *et al.*, 2010; Gutiérrez-Zugasti *et al.,* 2011).

While various subsistence activities were documented, direct evidences of productive economies were not still recognized. Fragments of pottery with Late Early Neolithic decoration were found in Moita do Sebastião, Cova da Onça and Cabeço da Amoreira in the top layers (figure 2), expressing some continuity of the occupation of Muge area (Ferreira, 1974). Yet their late character (Epicardial) led to hypothesize a hiatus between the end of the formation of the shell middens and the ceramic deposition (Zilhão, 2000; Carvalho, 2009).

Moreover, Neolithic short occupations around the mound were recently detected at Cabeço da Amoreira (Bicho *et al.,* 2013) (figure 3). The authors argued for a period of abandonment of several centuries subsequent to the closure of the midden with a cover of clasts, which would has been punched for a Neolithic funerary re-use of the site. However, in our view, the interpretation of this last burial phase as strictly Neolithic is arguable, considering the general overlap of radiocarbon dates with the Late Mesolithic-Early Neolithic transition (Bicho *et al.,* 2013, p. 135). From Cabeço da Arruda, a later burial (TO 356) is dated to the Late Mesolithic-Early Neolithic transition, though a more detailed cultural characterization was not attempted (Peyroteo, 2016, p. 382).



2. Early Neolithic pottery from Muge shell middens (Ferreira, 1974, Est. I).

3. Cabeço da Amoreira, Muge.

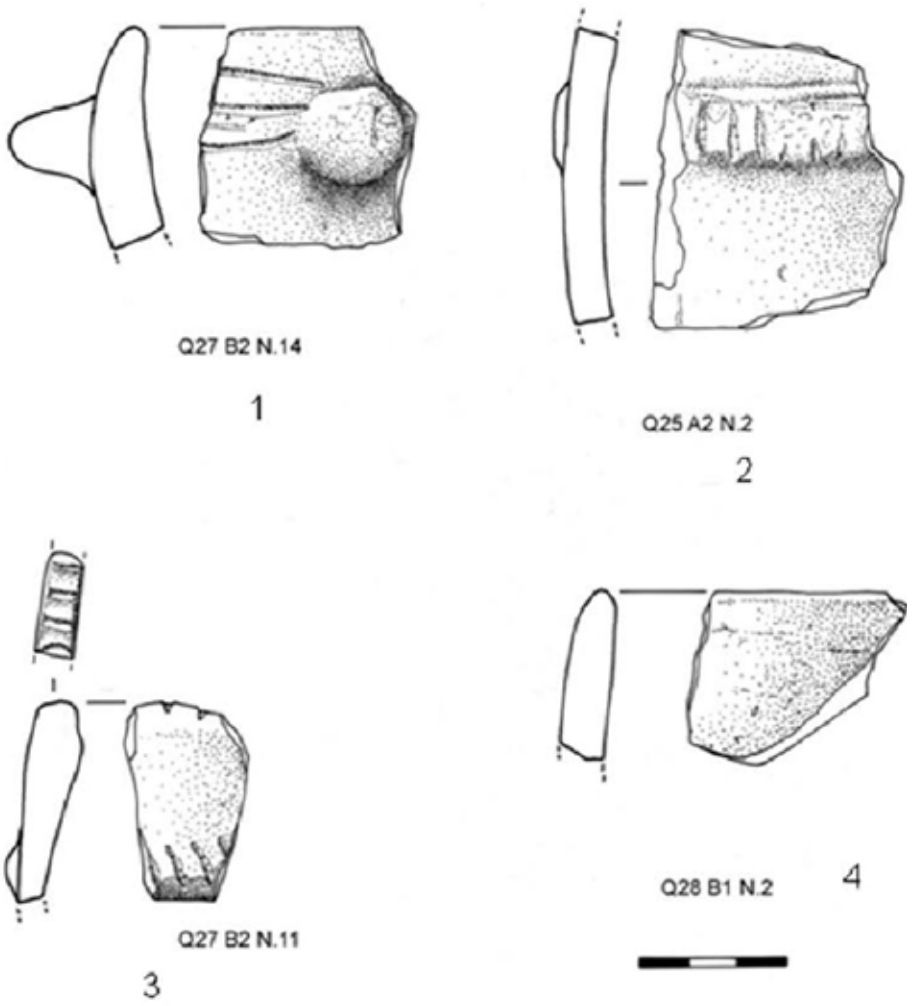
Generally, the radiocarbon dates until the 5th millennium BC reveal a coexistence of the Muge shell middens with the first Early Neolithic sites in the adjacent but non-overlapping territories of the Limestone Massif of Estremadura (Carvalho, 2008; Zilhão, 2011). Recent fieldwork recognized Late Early Neolithic occupations in the Muge area, but not from first Early Neolithic (Andrade *et al.,* 2015). Although a continuity of the occupation of this area can be suggested (even if not proven by radiocarbon dates), an interval of two to three centuries between the last Mesolithic and the first Neolithic groups was proposed (Andrade *et al.,* 2015, p. 35).

SADO VALLEY

The Sado valley's shell middens can be found around 40--50 km away from its estuary, in the district of Setúbal. Firstly excavated in the 1950's (Heleno, 1956), the 12 shell middens are primarily known for their Late Mesolithic occupations (Diniz and Arias, 2012). Yet the larger sites – Cabeço do Pez, Poças de S. Bento and Amoreiras – provided some 'Neolithic' evidence. Fragments of Neolithic pottery were documented at Amoreiras (Arnaud, 2000; Diniz, 2010), Cabeço do Pez (Santos *et al.,* 1974; Arnaud, 2000; Diniz and Cubas, 2015), Poças de S. Bento (Larsson, 2010; Diniz and Cubas, 2015) and Vale de Romeiras (Diniz and Cubas, 2015). Nevertheless, only Amoreiras and Cabeço do Pez provided radiocarbon dates which could be clearly framed in the Early Neolithic. One burial from Poças de São Bento (UA-425) and another from Cabeço do Pez (Ua-46930) were dated only to the Middle Neolithic, suggesting a Neolithic burial use of the sites, but not in the Early Neolithic. In the up-

per levels of Cabeço do Pez, J. Arnaud (2000) identified a grindstone tool and Middle Neolithic ceramic sherds. A Neolithic top layer with Cardial pottery at Poças de S. Bento is also mentioned (Larsson, 2010, p. 41).
The lower layers of the 1985's excavations in Amoreiras, containing ceramic fragments with Early Neolithic motifs (including cardial), a Mesolithic lithic industry, and the radiocarbon dates in the 6th to 5th millennium BC, led to propose Amoreiras as one of the most recent Sado shell middens and a place of interactions between Mesolithic and Neolithic groups (Zilhão, 1998; Arnaud, 2000). However, due to the likelihood of intrusions in sandy contexts and the absence of entire vessels documented in situ, it is difficult to sustain that groups with ceramic technology were responsible for the site formation (Nukushina, 2012). Moreover, pottery from later Neolithic phases was identified (Diniz, 2010) and a human burial was dated to the final of the 7th millennium cal BC (Beta-125110) (figures 4 and 5).

4. View of the Sado valley and the Amoreiras hill.



5. Fragments of pottery from Arnaud's excavations at Amoreiras, Sado valley (Diniz, 2010, p. 61, fig. 5).

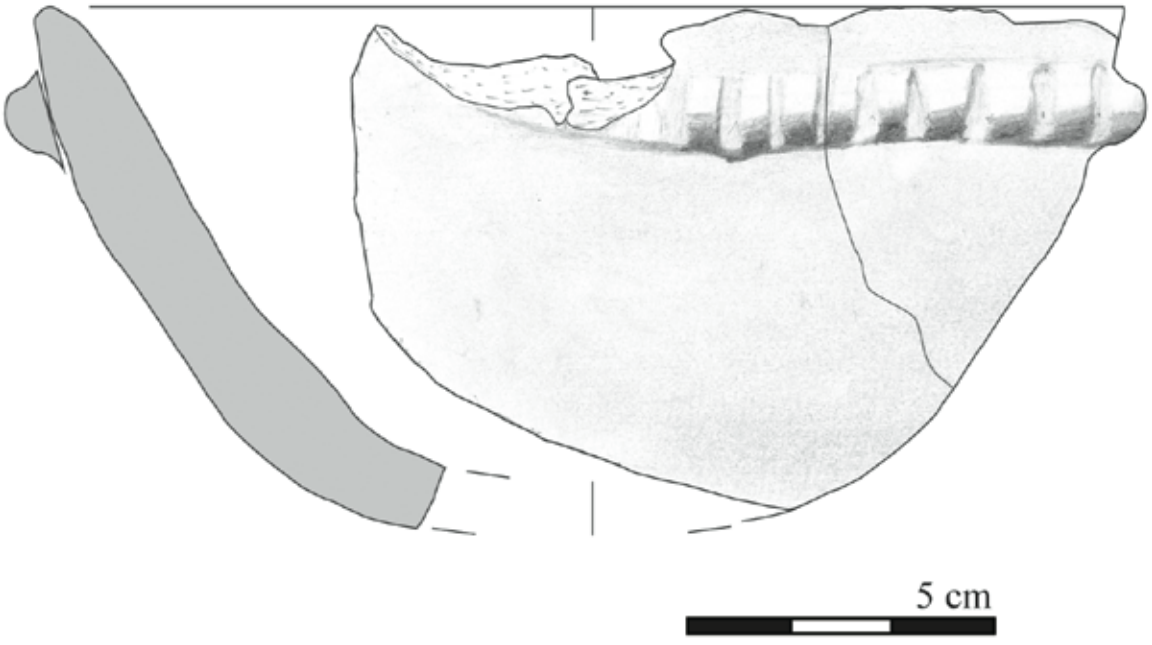
In the littoral of the Sado estuary, the Comporta area, a Middle/Late Neolithic shell middens complex is known. Although not revealing a continuity through the Early Neolithic, these sites indicate that mollusc gathering was not totally excluded from the regional economic systems after the introduction of farming (Soares and Silva, 2013). Globally, a less frequent use of the Sado shell middens from the 5th millennium BC was proposed, but no paleoenvironmental cause was recognized (Diniz and Arias, 2012, p. 142).

MIRA VALLEY, ALENTEJO COAST AND ALGARVE

Numerous middens characterize the Mira valley and the Alentejo Coast, in estuarine and littoral contexts. J. Zilhão (1998) divided them in two Late Mesolithic-Early Neolithic groups: large shell middens with no indisputably Neolithic artifacts and a fauna including only wild species, such as Fiais and Montes de Baixo (Odemira), and small shell middens with no domesticates, having few Neolithic artifacts of questionable association with the midden, such as Medo Tojeiro (Almograve) (figure 6). The chronological attribution of the latest has been difficult, due to the incongruence and weakness of the radiocarbon dates and material contexts, namely the pottery (Silva *et al.*, 1985; Soares, 1995; Zilhão, 1998; Lubell *et al.,* 2007; Carvalho, 2008; Reis, 2013) (figure 7). Cultural ascription (Mesolithic and/or Neolithic) of Vidigal and Samouqueira I (Sines) is also an issue (Soares, 1995; Zilhão, 1998; Carvalho, 2008).

In the Western Algarve, shell middens were recognized in valleys and estuaries. Rocha das Gaivotas and Praia do Castelejo (Sagres) displayed Late Mesolithic and Early Neolithic occupations (Valente *et al.,* 2014). The transition was associated with hiatuses, suggesting a depopulation or a period of marginal exploitation when the Neolithic arrived (Cortés Sánchez *et al.,* 2012, p. 225). A small Late Early Neolithic shellfish deposit was discovered in a negative structure of Alcalar 7 (Portimão), despite not being associated with preserved layers (Carvalho, 2008, p. 210). The shell midden of Ribeira da Alcantarilha (Silves) was also dated to the Early Neolithic (Carvalho, 2008, p. 260). These sites indicate a reliance on marine resources through the Early Neolithic, although of limited importance in Western Algarve (Carvalho, 2008; Cortés Sánchez *et al.,* 2012; Valente *et al.,* 2014): 1) the number of known middens decreased and the majority corresponds to less extensive reoccupations of preexisting sites (e.g. Praia do Castelejo and Rocha das Gaivotas); 2) shell layers are thin, indicating ephemeral occupations; 3) the diversity of sites appears to increase in the Early Neolithic settlement system, where shell middens are not dominant. The increasing aridity in Southern Iberia was also related with possible changes in the availability of marine resources and the abandonment of shell middens (Cortés Sánchez *et al.,* 2012, p. 230).

6. Medo Tojeiro, Almograve (photo by H. Reis).



7. Fragments of a pottery vessel recovered from Medo Tojeiro (surface finds) (Reis, 2013, fig. 10).

CANTABRIAN SPAIN

Large shell middens in Spain are practically restricted to the Cantabrian region, mainly to its western part, where about a hundred shell middens attributed to the Mesolithic are associated with the 'Asturian Culture'. These are mostly coastal sites located in the mouths of caves and rock shelters (González Morales *et al.,* 2004; Arias, 2007; Gutiérrez-Zugasti *et al.,* 2011).
Recent data seem to support a "mosaic" Neolithisation process in Cantabrian region, with groups of hunters and farmers living together during the first half of the 5th millennium, namely in the eastern part (Arias, 1996; 2007; Cubas and Fano, 2011; Fano *et al.,* 2015; Cubas *et al.,* 2016). Hunter-gatherer economies with rare domesticates appear to persist in the west until after the 5th millennium BC, as evidenced by the later shell middens. Pottery in shell middens has been subject to debate, due to its frequency and fragmentation, along with the difficulty in understanding the relation between these sites and the beginning of the Neolithic (Arias, 1992, 1996; González Morales, 1999; Cubas and Fano, 2011; Cubas *et al.,* 2016). González Morales (1999) argued that the ceramic in the later Asturian shell middens reveals contacts between hunter-gatherers and the first farmers without a shift in the subsistence mode. P. Arias (1996) considered that these sites correspond to a Premegalithic Neolithic phase showing continuity of a subsistence system where the new agro-pastoral resources complemented the hunting-gathering activities. Recently, Cuevas del Mar III, Las Madalenas and Mazaculos II, in Asturias, provided evidence to argue for a formation of pottery-bearing shell middens later than the 6th millennium BC (Cubas and Fano, 2011), although their cultural ascription remains difficult (figure 8).

8. Cuevas del Mar III, Asturias (photo by M. Cubas).

During the Early Neolithic in the Cantabrian region, coastal resources appear to have been exploited in way similar to that of the Mesolithic (Gutiérrez-Zugasti, 2009; Fano *et al.,* 2015). Sites such as Los Gitanos, Mazaculos II, Barcenilla or Santimamiñe are considered veritable shell middens, reflecting continuity in the mollusc exploitation in the 5th and 4th millenniums BC (Fano *et al.,* 2015; Cubas *et al.*, 2016). However, contrary perspectives were also argued (González Morales, 1999, p. 200). An increase of estuarine species was inferred (Gutiérrez-Zugasti, 2009) and shell accumulations are referred to be relatively smaller (e.g. Pico Ramos and Kobaederra) and less abundant (González Morales, 1999; Gutiérrez-Zugasti, 2009; Cubas and Fano, 2011), but detailed quantifications are lacking.

TRANSVERSAL PROBLEMS

"SHELL MIDDENS WITH POTTERY"

For several Early Neolithic sites in Iberia, pottery is the single 'Neolithic evidence' recovered, without associated domesticates (Fano and Cubas, 2012; Diniz and Cubas, 2015). Nevertheless, overlap and contacts between Mesolithic and Neolithic groups were frequently postulated through the presence of sherds in shell middens. The examples of Amoreiras in the Sado valley or Medo Tojeiro illustrate the problems of ceramic record – for the last site, due to the disagreement about its stratigraphical provenance between the excavators (Silva *et al.*, 1985; Zilhão, 1998; Lubell *et al.,* 2007).
Following the proposal of Arias (1996) for the Cantabrian region, Iberian 'shell middens with pottery' can be divided into two groups - contaminated sites with later ceramics (intrusions reflecting Neolithic occupations without cultural interaction with the previous hunter-gatherer societies), and shell middens with a clearer presence of ceramic in shell layers. Yet this division has not always been evident: 1) pottery in shell middens usually corresponds to isolated fragments, in the upper layers, lacking entire vessels or those fragmented *in situ*; 2) solid information about the stratigraphical provenance of pottery is scarce, namely from old excavations. Also, post-depositional episodes are recurrent in these sites (mainly in sandy contexts) and facilitate the intrusion of ceramic fragments. As a consequence, who produced and used the ceramic (either hunter-gatherer or Neolithic groups) remains as a permanent question.

SHELL MIDDENS AND NEOLITHIC RADIOCARBON CHRONOLOGIES

The scarcity of radiocarbon dates prevents a proper understanding of site formation and chronology. This concerns not only the small sites with limited evidence other than shells, but also the huge accumulations, whose final moments of occupation are badly known. Moreover, radiocarbon dating of elements of the 'Neolithic package' in Mesolithic contexts is lacking (Zilhão, 2011). To some extent, the frequency of 'hiatus' proposals concerning the end of the formation of shell middens and the beginning of Neolithic can be related with these data gaps.
For authors like J. Zilhão (2011), the shell middens of the Tejo and Sado valleys, occupied at least until the 5th millennium BC, exemplify the long-term coexistence between the Early Neolithic and a continued Meso-

lithic settlement in adjacent territories. A recent work (Peyroteo Stjerna, 2016) pointed out the central role of the burial activity in the middens, with the radiocarbon results suggesting a general decrease around 5500 cal BC, coeval with the beginning of the Early Neolithic. However, the type and extension of the later occupations of shell middens is still a matter of debate.

'NEOLITHIC' IMPLIES THE DECLINE OF SHELL MIDDENS?

Mollusc gathering and shell middens did not disappear with the Neolithisation. However, the known Early Neolithic settlement is widely characterized by a greater diversity of sites, shell middens with minor dimensions or later occupations of main-Mesolithic middens (see Carvalho, 2008).
Defining the final moments of occupation of wider shell middens has been difficult (i.e. Sado complex; Diniz and Arias, 2012). For some regions, as Western Algarve, the disappearance of shell middens is partially attributed to the sedimentation of the local valleys (Valente *et al.,* 2014, p. 90). For Cantabria, P. Arias (1996, p. 409) suggested a relatively abrupt ending of the importance of molluscs, despite the scarcity of radiometric data; after the beginning of the 4th millennium BC, the dissipation of shell middens appears to be parallel to the increase in Neolithic evidence, implying the abandonment of an intensive broad-spectrum exploitation of resources from a limited area.

MAIN CONCLUSIONS

Although shell middens in Iberia have provided abundant information about the last hunter-gatherer groups, data related with the Mesolithic-Neolithic transition seem to be more controversial.
First, the antiquity of most excavations carried out in these sites has severely limited the possibilities of research. In addition, large scale excavations are still uncommon. Second, the stratigraphical interpretation of these sites, particularly the sandy environments, is complex. Moreover, the distinction between Mesolithic and Neolithic contexts has not been evident, due to the lack of direct evidence of domesticates for the Early Neolithic. Finally, accurate radiocarbon dating is still insufficient, especially for the final moments of occupation.
The decline in size or/and quantity of shell middens throughout the Neolithic transition has been generally admitted, although Neolithisation archaeological evidence is still scarce and somewhat indefinite. Thus, further research addressing the last occupations of mainly-Late Mesolithic shell middens and post-Mesolithic sites is needed, in order to enable a better understanding of the impacts of the Neolithisation process on shell midden formation.

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