Universidade de Trás-os-Montes e Alto Douro

Neolithic pottery characterization from two regions in the Iberian hinterland

Doutorado em Quaternario, Materiais e Culturas

International Doctorate in Quaternary and Prehistory

Candidate:

Darko Stojanovski

Supervisors:

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Composition of the Jury:

Prof. Dr. Luís Herculano Melo de Carvalho (president); Prof. Dr. Luiz Miguel Oosterbeek; Prof. Dr. Marta Arzarello; Prof. Dr. Rui José dos Santos Teixeira; Prof. Dr. Alexandra Figueiredo; Dr. Enrique Cerillo Cuenca

Vila Real, 2017

Declaração de autoria do texto

Declaro ser o autor deste trabalho, que é original e inédito.
Os autores e trabalhos consultados encontram-se devidamente referenciados no texto e constam da lista de referências bibliográficas incluída.

ACKNOWLEDGMENTS AND GRATITUDE

This text is the outcome of my encounter with, for me, very challenging area of European prehistory. Although demanding, it turned out to be a very interesting journey as well. All the obstacles encountered were balanced by the great number of good friends and colleagues, which always turned out in the right place at the right time. Above all, I appreciate and acknowledge the kindness, incredible patience and unselfishly shared experience of my supervisors Luiz Oosterbeek, Marta Arzarello and Laurens Thissen.

All the expenses related to this research during the past three years were covered by a PhD grant, awarded to me by the International Doctorate of Quaternary and Prehistory consortium, and provided by the Erasmus Mundus program of the European Commission.

The research rely on the study of pottery collections excavated at different times in the past, today stored in the Centre for Prehistory at the Polytechnic Institute of Tomar and the Provincial Museum of Badajoz. I would like to thank the Director of the CPH Ana Rosa Cruz and her team for welcoming me and providing all the necessary conditions for my work in Tomar. Equally welcoming were the Director of the museum in Badajoz Guillermo S. Kurtz Schaefer and his entire team, especially Beatriz. Special gratitude is reserved for Hipolito Collado for agreeing on this collaboration, for sharing field information, drawings, unpublished data, providing samples for radiocarbon dating, as well as for the very constructive discussions on the Cueva de los Postes conundrum.

The lipid analyses would not have been possible without the people in the Organic Geochemistry Unit of the Bristol University. I would like to thank especially Richard Evershed and Mélanie Roffet-Salque for guiding me through the unknown territory of organic chemistry.

A personal gratitude is owed to Professor Artur Sá at UTAD for his continuous support during this dissertation, especially in the field of, for me not so familliar administrative algorithms.

The formation of my knowledge about Iberian prehistory have largely benefited from the numerous formal and informal accounts with the Maçao research group, especially Nelson who was eager to help whenever help needed. The University of Ferrara provided great working and social environment during my six months stay. Many friends and colleagues have made that experience better, among which I would like to thank Julie Arnaud, Giuseppe Lembo and Brunella Mutillo.

Pedro Peça, Alma Nankela and Gabrielle Berruti have all contributed in different ways to make the past three years more pleasant.

In the end, I would like to express my love and gratitude to my family for their constant support, especially to my wife Stefanija for the beautiful pottery drawings, but mostly for her patience and endurance in this PhD episode of our lives.

ABSTRACT

The thesis presents data and interpretations, relevant to the Neolithic period and the neolithisation process of the hinterland of southwest Iberia. More specifically, the pottery collections from a cave in Portuguese Estremadura (Gruta do Cadaval), a passage grave from the Zêzere Valley (Anta 1 de Val da Laje) and a cave in the south of Spanish Extremadura (Cueva de los Postes) - three sites with different chronology and socio-cultural contexts, are studied from several aspects. First is the assessment of the formal typology on morphology and decoration. Basic morphometric and technological observations are made as well. After the classification is established, 78 samples were analysed for ancient lipid remains, which provided a socio-economic assessment of the Neolithic societies through their subsistence base. Through inter-regional comparison, conclusions are being made about the nature of the Neolithic landscape, the people in it and the existence of extra-regional communication networks.

Key words: Neolithic Iberia, pottery typology, megaliths, organic residue, isotopes.

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INTRODUCTION

After a long and fruitful history, pottery studies have experienced a certain set-back in popularity during the past few decades. At least this is the feeling I obtained from my short but intense interactions with non-pottery circles in European archaeology so far. The attitude might find its justification, mainly in the exhaustion and overuse of the typological approach in ceramic studies since the early days of archaeology, but at the same time, these prejudices, as any other, are a great injustice to the greater part of the study field. The fact remains that generally since the Neolithic, ceramics are among the most abundant artefacts retrieved from excavations. To begin this introduction, I believe a very short history of "collaboration" between pottery studies and natural sciences is required[1].

Besides typology, which is constantly associated to "pre–processual" thinking, archaeometry has also been widely embraced by ceramic specialists since at least the mid 19th century, when chemical analyses were applied to archaeological pottery to assess the chemical composition of the fabrics, thus laying the foundations of the provenance studies. Rice (1987, p.311) refers to Layard's work in the mid 19th century in Mesopotamia as one of the earliest compositional studies in pottery. Layard led several archaeological expeditions to Nineveh, Babylon and other parts of Mesopotamia in the late 1840's, a result of which are several volumes of beautiful narratives about his adventures, excavations and the uncovered artefacts (among which pottery), written in the spirit of his time (Layard 1853). Towards the end of the century, Theodore Richards (1895), a scientist who was later to become the first American Nobel Prize winner in chemistry, performed a chemical analysis of five shards of Athenian pottery. In his short report he notes: "While the interest of these analyses was mainly archaeological, turning upon the question of the identity of the source of these remains with that of others found in other cities, a brief statement of the result may not be uninteresting to those working upon the subject of clays in general" (Richards 1895, p. 152-153).

Provenance studies received a decisive impulse by the use of the microscope in mineralogical observations of pottery thin-sections by Bamps (1883, cited in Rice 1987, p. 311) and Nordenskiöld (1893, cited in Rice 1987, p. 311). This, besides the identification of

[1] For a more recent structured history of pottery studies, the reader is referred to Orton & Hughes (2013).

minerals in the pottery fabric, provided the opportunity to link the different appearances of pottery, with the variety of reactions of its minerals under different environmental conditions.

The new century brought new technology. The electron microscope was invented in the 1930s. The use of X-ray diffraction finally revealed the crystalline structure of clays. Great names in archaeology, like Anna O. Sheppard, were vigorously heading the advance of technology studies in pottery; even though the emblematic synthesis of her work was published later (Shepard 1956), it was based on her work in America during the first half of the century. This period was indeed the period of synthesis, systematization and standardization of the methods used in ceramic studies, largely supported by institutions in the USA, such as the Museum of Anthropology at the University of Michigan, and which was crowned in 1938 with the organization of the first Conference of Archaeological Technology in Ceramics (Rice 1987, p.312).

During the rest of the century, with interdisciplinary foundations firmly established, the natural sciences were constantly present in ceramic analysis, and as technology advanced, pottery specialists were ready to jump on anything from the "cutting-edge" and implement it if suited their needs. Pottery technology studies were a regular part of scientific conferences and publications. By the end of the 20th century, an integrated multidisciplinary scientific interest in ceramics was surpassing way over the frames of archaeology and constituted the back-bone of large parts of the global industry. Today, from bricks to cell-phones and space technology, ceramic materials are still an indispensable part of culture. Yet, deciphering their exact role in prehistoric societies remains a challenge.

The same challenge stands in front of this work as well. The general goal of Archaeology, of course, is to understand past societies, the dynamics of development, the interactions, the mistakes and triumphs which led to modern society. Pottery study is not a self-sufficient entry door, but certainly a very important complementary part of a much wider scientific thrust towards this long term goal. More specifically for the case at hand, with the following chapters I aim to present at least a glimpse of that part of prehistory when pottery vessels were beginning to be used in parts of the south-western Iberian Peninsula, a time coinciding with the appearance of domestic species, reared and exploited around permanent settlements, a general increase in population and the number of settlements, as well as few other socio-political and cultural changes, together considered as the beginning of the Neolithic.

Three collections, coming from three systematically excavated sites – Cueva de Los Postes, Gruta do Cadaval and Anta 1 de Val de Laje – are the subject of this study: the first is

a cave site in the Spanish Extremadura with occupational phases from the Middle Palaeolithic to Roman Age; Cadaval is a cave in a lime-stone massif in Alto Ribatejo in Portugal, used as a burial place at the end of the 5th and throughout the 4th millennium cal BC; Anta 1 from Val de Laje is not far from Cadaval, but is located in a completely different geological setting. It represents a megalithic monument, whose immediate surroundings show activities from the Mesolithic until the Early Bronze Age. Despite the partial synchrony (parts of the 5th and 4th millennium BC), the sites have differences in terms of geography, geology, site formation and taphonomy, artefact typology and culture and so on. For this reason, each site will be presented individually, thus providing a technological but also a temporal sequencing (chapter 3)[2]. To overcome these differences in favour of an unbiased, objective, scientific representation, I applied a common methodology for the three collections. There are two aspects in which the pottery is being analyzed: the first is a morpho-typological characterization of the complete ceramic assemblages; the second aspect concerns detecting and analysing residual organic matter on the molecular level in the pottery fabric, indicative for vessel function, cooking process and diet, which, combined with the archaeological context and the results from the characterization of the pottery, will add an important social dimension to the study (a detailed description of the methodology is given in chapter 2). But no archaeological site is an isolated entity and the results from any scientific studies would be useless data, if no regional context is provided. For this reason, chapter 1 presents the current state of affairs in the study of the transition from hunter-gatherer societies to permanent agricultural villages in Iberia, with an accent on pottery appearance. The approach in chapter 1, reviewing the "state of the art" by smaller regions, is determined by the increasingly obvious diversity in material culture, especially during the early Neolithic period. Special attention is paid to the specific regions to which the subjected sites belong and the surrounding areas.

After the scene is set (chapter 1) and the sites and the methodology are presented (chapter 2 and 3), in chapter 4 the detailed results from the analyses are given, again, for each site separately. This substantial body of information is discussed in the next chapter (chapter 5), where the raw data is implemented into structure and the ceramic assemblages are compared. The last chapter (chapter 6) is the conclusion. Here, the patterns deriving from the previous chapters are incorporated "in the field" again, and the newly emerging picture is being promoted for evaluation or further exploration, for no scientific work is ever final.

[2] A specific comparative synchronic focus will be restricted to the layers that offer a similar chronology.

Being a foreigner to Iberia, both to the countries and to the prehistoric archaeology schools, is certainly a handicap for writing a synthesis of the current state of affairs in the Iberian Neolithic. But on the other hand, looking from a different perspective might bring a fresh impulse in the ongoing discussions. With hopes for the later, I will try to present the fundaments on which later the results from the pottery analyses can be placed and, hopefully, integrated.

Figure 1.1 Satellite photo of the Iberian Peninsula; view from the southwest (Source: www.nasa.gov)

CHAPTER 1: NEOLITHIC ARCHAEOLOGY IN IBERIA

1.1. A short history

In both Portugal and Spain, the beginnings of a scientific approach towards prehistory can be traced back to the 19th century. In Portugal it is usually attributed to the *Comissão Geológica* (1857 – 1886) and the work of Carlos Ribeiro, Francisco Pereira da Costa and Joaquim Filipe Nery Delgado (Cardoso 2002). With methodology firmly based in geology and palaeontology, they liberated archaeology from the antiquarian's frame of mind of the time and started excavating at the Mesolithic shell-middens on Muge (Cabeço da Arruda in 1863 and 1880), the Estremadura cave sites (Gruta da Casa de Moura in 1865 and Gruta da Furninha in 1879) and some passage-graves as well. The publication of their work (Costa 1865; Delgado 1867), as well as their active role in promoting Portuguese archaeology in contemporary European circles was recognized by entrusting them the organization of the 9th session of the International Congress of Prehistoric Anthropology and Archaeology (CIAAP, the predecessor of UIPPS) in Lisbon in 1880. This was the congress that accepted the anthropic nature of some of those middens, following a lengthy discussion that included a site visit to the Muge shell-middens in the Tagus basin (Arnaud 2002, p. 58).

A few years later (1884-1885) the excavations at Muge were continued by F. de Paula e Oliveira, who added a palaeoanthropological dimension to the study (Arnaud 2002, p. 57), but fieldwork was also being carried out in other regions in Portugal: A. dos Santos Rocha was active in Figueira de Foz and Algarve; Estácio da Veiga was working and publishing in Algarve; Martins Sormento was active in fieldwork on megalithic monuments in Minho; Rocha Peixoto and Ricardo Severo established the "Portugalia" magazine in Porto, where important archaeological works were published and promoted (Cardoso 2002, part I). Probably the biggest impact on the popularization of archaeology in Portuguese society at this time was the establishment of the Portuguese Ethnology Museum in 1893 and the work of its first director Leite de Vasconcellos. The beginning of the 20th century in general, as far as archaeology is concerned, is mainly associated with the name of Vasconcellos, who, besides the museum, was also heading the newly established Faculty of Letters at the University of Lisbon (since 1911).

During the second half of the 19th century, the socio-political and cultural circles in Spain were living the process of establishment and consolidation of a common national

identity. Prehistorians were busy with defining the "Celtiberians" - an amalgamation of ancient ethnic groups which was supposed to serve as a base for the modern Spaniards. The most notable works of the time are those of Lafuente, Góngora and Lasalde (Ruiz et al. 2002). In 1893 *Historia de España* was published, employing archaeology once again in a political agenda. The "paniberianism" (the predominance of Iberians over Celts in Spanish origins) was propagated, mainly as a political tendency to distinguish and establish Spain as different from, but equal to the rest of the European nations (Ruiz et al. 2002).

It did not take long before regional nationalist movements became active, among which the Basque and the Catalan had the most evident impact on archaeology. Arana for example (1892, cited in Ruiz et al. 2002) rejects both an Iberian and Celtic descent of the Basques. In Catalonia, the engaged archaeological interpretations by the members of the *Reinaxença* circle accepted the existence of a pure Iberian component, and they identified it with the modern Catalan component of Spain, demarcated on linguistic and archaeological grounds (Almirall 1886; de la Riba 1906; cited in Ruiz et al. 2002). But the impact of Catalan archaeology became far more serious during the second and third decade of the 20th century. With the establishment of the Archaeological Investigation Service in 1914, archaeology as a course of its own in the University of Barcelona in 1916 and with the emergence of the restless prehistorian Pere Bosch-Gimpera, archaeology was not only institutionalized and professionalized, but the Catalan school, through Gimpera's publications, had an important impact on archaeologists in Spain, Portugal and wider in Europe (Díaz-Andreu & Cortadella Morral 2006; Ruiz et al. 2002).

The same process of institutionalization was going on at the central Spanish level as well. As a reaction to the slightly diffident position of Spanish archaeology in comparison to some Central and North European schools (especially the French), who were very active in Iberia throughout the 19th century, the Commission for Paleontological and Prehistoric Research (CIPP) was formed in 1912. Eduardo Hernandez Pacheco, a professor at the University of Madrid, was heading the institution and, being a geologist, kept a close relation between archaeology and the natural sciences. Unfortunately, the role of CIPP was soon diminished and since 1922 archaeological research was headed by Hugo Obermaier, a highly respected German prehistorian who in the same year was appointed chair professor at the newly established Faculty of Arts in Madrid University (Díaz-Andreu & Cortadella Morral 2006).

Back in Portugal, we can also claim the beginnings of institutionalization and professionalization of archaeology to around this time, complementing the pioneering work

of the Geological Commission with the aforementioned establishment of the Portuguese Ethnology Museum (the predecessor of the modern National Museum of Archaeology) in 1893 and the Faculty of Letters at Lisbon University in 1911. As head of both institutions, Vasconcellos emerges as one of the greatest names in early 20th century archaeology in Portugal, and he is credited for the further development of the discipline and for the formation of the next generations of archaeologists. At his retirement in 1928, he was substituted on both posts by his student Manuel Heleno – another great name in 20th century Portuguese archaeology. During the forty-plus years of active professorship in archaeology and prehistory, the legacy which he left behind in terms of personal research and teaching (legacy which, insufficiently published, is still being evaluated), as well as the support and collaboration with teams throughout Portugal which he generated, earned him great respect among generations of archaeologists to this day (L. J. Cardoso et al. 2013).

During the 1930's, both Spain and Portugal had turbulent socio-political movements, which in both cases ended in dictatorships. This affected archaeology in different ways. In Spain Franco's regime was seeking to fortify a single Spanish nationality, only this time preferring the Celts as the ethnic origin instead of the Iberians. The regional nationalist movements were diminished; Obermaier was forced to renounce his position in Madrid and Bosch - Gimpera was exiled to Mexico, where he spent the rest of his life; one of the main protagonists in prehistoric archaeology became the politically correct Martinez Santa Olalla, one of Obermaier's students (Díaz-Andreu & Cortadella Morral 2006). His contribution to archaeology is the theory of the settling sequence of Iberia, first by North African and Mediterranean populations from the Neolithic through the Bronze Age, followed by four consecutive Indo-European invasions, bringing the main Celtic substrate of the Spanish Nation (Ruiz et al. 2002). The "celtism" did not last long however, and by the end of the 1940's "paniberianism" re-emerged again. The employment of archaeology by the political elites at this time might be a negative turn, but it also brought an actualization and involvement of the discipline as a subject in the educational system, which turned out to have a positive effect on the research growth after World War II.

The regime of Salazar also aimed at strengthening the national feelings in the Portuguese people by celebrating the glory of the Middle Ages, and archaeology was mainly employed in research, conservation and reconstruction of medieval monuments (Cardoso 2002, p. 41). Archaeological research in general was reduced and was regulated by the newly established *Junta Nacional de Educação* (1932 – 1977). The teaching of archaeology in Portuguese higher education could never obtain a status similar to the one in Spain, and only

after the democratic revolution of 1974 conditions appeared for this status to be overcome[3]. There are exceptions however; a few institutions had the freedom to develop prehistoric research projects, most of them thanks to the position Manuel Heleno still enjoyed as the director of the National Ethnology Museum (Cardoso 2002, p. 34-43). Under his leadership, a vast fieldwork project for investigations of the megalithic monuments in Portugal was initiated in the 1930's. With his support, Prof. Dr. Mendes Corrêa, prominent investigator in the fields of medicine, geography, ethnography and archaeology, and one of the founders of the Portuguese Society for Anthropology and Ethnology in Porto, initiated excavations at the Cabeço de Amoreira shell-midden at Muge. Also in the 1930's the Sado shell-middens were discovered and excavations were organized. Heleno was also supportive of the activities of different smaller professional organizations. One of them, active during the 1940's and 1950's, was the *Centro de Estudos de Ethnologia Peninsular*, among whose activists were Abel Viana, Fernando de Almeida, Camarate França, Eduardo da Cunha Serrão and Octávio da Veiga Ferreira. Another organization active in prehistory during this period was the Portuguese Association of Archaeologists, still active today under the guidance of José Morais Arnaud. Probably the least politically affected were the Geological Services of Portugal, whose activities in prehistory re-emerged with the one-year service of Henri Breuil. During WWII, Zbyszewski and Breuil had made an extensive survey on the Tagus terraces, located a number of Palaeolithic stations and created a significant stone-tool collection of surface finds. The post-war resurrection of the prehistory is also associated with this institution, and especially with the name of Octávio da Veiga Ferreira (Cardoso 2008). With over four hundred publications in palaeontology, geology and archaeology, from Palaeolithic to Roman Age, and with an active career until the 1990's, he is one of the pillars on which modern Portuguese archaeology stands. It is important to note here, for our subject at hand, that Ferreira together with Jean Guilaine are the co-authors of one of the first periodization of the early Neolithic in Portugal (Guilaine & da Veiga Ferreira 1970).

If during the 19th century Iberian archaeology was slightly lagging behind in comparison to Central and Northern Europe, by the 1960's any gap was completely invisible. The latest methodological and theoretical innovations in prehistory were already well implemented and Spanish and Portuguese scientists were regularly lecturing at international conferences and prominent universities throughout the world. Archaeology as a discipline became highly diversified and archaeologists more specialized. It is beyond the scope of this

[3] An important indicator is the fact that by 1974 there was not a single PhD in Prehistory in Portugal, while there were several in Spain.

thesis to name and number people and publications, for the amount of research projects during the last 40 years would require a project on its own. For the more recent developments in archaeology, a more adequate approach would be a thematic review of the current theories. The general theme, relevant for this study, is the emergence and early stages of the Neolithic way of life in Iberia.

1.2. The Neolithic of Iberia: modelling, framing and reframing

The Neolithic is a period from later prehistory, marked by several changes in the social and technological spheres of people's lives. Regarding Iberia, among the most obvious changes are: the implementation of containers made of baked clay; concentration of activities on a more permanent location; appearance of new types of artefacts (knapped and especially polished stone tools), features (silos, farmyards) and biofacts (bones and seeds from domestic animal and plant species), testifying to agricultural activities of the inhabitants. Therefore, the term "neolithisation" stands for the processes behind the initial introduction of these novelties (either by local innovation, importation or transmission of know-how) and the resulting developments in a given society during the transformation into a fully agro-pastoral community. The speed of the neolithisation process depends on many factors, among which are resource and raw material availability, environment productivity, population density and level of social organization. Therefore, in a vast area like the Iberian Peninsula, with extremely diverse landscapes, geomorphology and environmental conditions, the Neolithic developed at different times and tempos in different areas.

The economic benefits from the political union of Europe allowed for intensive infrastructural and cultural developments during the past three or four decades in Spain and Portugal, which directly or indirectly led to an abrupt increase of archaeological fieldwork and raw data input. With the parallel increase in numbers of professional archaeologists, this data is constantly worked and reworked, and our knowledge of the neolithisation process is constantly being updated. Along this line, and depending on the level of document accessibility and their worldviews, prehistorians are differentiated around a few interpretative narratives. The several neolithisation models existing in the literature, each one of them with their own level of relevance, are showing the complexity of the questions concerning the neolithisation process. Most of the models agree on some of the issues about later prehistory, like the character of the pre-Neolithic communities, the general time of appearance of pottery in the peninsula, the importance of absolute dates, the taphonomic problems with sites (especially caves) and so on. But the dividing points are some of the most important questions. What is the mechanism behind the neolithisation process? Who were the main protagonists and what was the role of the indigenous hunter-gatherers? How did the Neolithic novelties actually integrate and how big was their part in the daily routines of the people who were using them? And who was producing and reproducing them anyway? The rich

artefactual record to some extent permits freedom of interpretation. But at the same time, the increasing empirical diversity questions the relevance of any universal model.

The concept of archaeological cultures was slowly developed in German prehistoric circles in the late 19th century. Gustav Kossinna further developed this concept to give rise to the new theoretical movement in archaeology – the culture-historical paradigm. Bosch-Gimpera attended Kossinna's lectures during his stay in Germany and, heavily influenced, implemented his teacher's ideas in Iberian prehistory (Díaz-Andreu & Cortadella Morral 2006, p. 301-302). For the Neolithic specifically, he divided the peninsula into four major cultures: the Almerian, the caves culture (South and Southwest Iberia), the Portuguese culture (referring to the megalithic monuments) and the Pyrenean (Oosterbeek 1997, p. 25).

Cultural – historical ideas had very limited influence outside of Germany in the beginning, probably because of the extreme nationalistic tones in the lectures of Kossinna. It was Vere Gordon Childe, another pioneer of the theoretical school, who defined an archaeological culture as the constant recurrence of "certain types of remains – pots, implements, ornaments, burial rites, house forms – […] together. Such a complex of regularly associated traits we shall term a 'cultural group' or just a 'culture'. We assume that such a complex is the material expression of what today would be called a people" (Childe 1929, p. v-vi), and introduced the concept in British and European prehistoric circles. More importantly, he structured the idea of the Neolithic as one of the revolutions in the history of humanity. This revolution would primarily take place in the Near East and then spread to Europe through the Balkan-Danube route (Childe 1929; Childe 1957). This idea lies at the root of most of the neolithisation theories coined in Europe during the 20th century, which involve migration of people or diffusion of knowledge.

One of them, relevant for the Western Mediterranean, is the work of Bernabó Brea. Following the excavation of the Arene Candide cave in Liguria, North Italy he proposed a model where pottery (previously dispersed from the Near East all the way to South Italy) would spread from Liguria to France and Spain (Bernabò Brea 1956). Among the most notable feature of the material culture associated with this expansion would be the Cardial pottery. This archaeological horizon, carried by westward migrating groups, would represent the initial Neolithic "wave" in the western Mediterranean. Cardial pottery will remain the guideline artefact for the earliest phase of the Neolithic in western Mediterranean Europe throughout most of 20th century archaeology.

Soon after the discovery of the Ligurian case, excavations in Southeast Spain confirmed the position of the Cardial pottery. The encounter of this type of pottery, together with cereals and domestic animal bones (sheep and goat) in the earliest Neolithic layers in cave sites like Cova de l'Or and Cova de la Sarsa south of Valencia (Fletcher 1963; San Valero Aparisi 1950), and Cova de la Carigüela in Northeast Andalucía (Pellicer 1964) helped the establishment of several positions valid at the time: 1) there is a clear break between the previous hunter-gatherer and the earliest Neolithic material culture; 2) this Neolithic kit of items is from external (eastern) origin and is universal for the earliest Neolithic sites throughout the western Mediterranean; 3) the coast of Valencia was the first Iberian region settled by farmers and it served as a core area for the further neolithisation of the rest of the peninsula (Vicent Garcia 1997).

In the meantime in Portugal, on the western coast of the peninsula, a slightly different prehistoric pattern was being unravelled. Even though Cardial pottery was discovered and was being integrated into periodisation systems, the dominant features of the Neolithic landscape were the megalithic monuments. Starting in the 1930s, Vera and Georg Leisner have dedicated their lives studying these monuments. At a 1964 colloquium in Groningen, Vera Leisner presented one of the earliest periodisation of the Portuguese Neolithic, initially published in German, and only twenty years later republished in Portuguese (Leisner 1983). She defines nine different phases of Neolithic development, each with its own characteristic features in the material culture, but more importantly, she does not claim that all these phases are part of the same sequence. Basically, Vera Leisner is describing a long neolithisation process of two separate cultures. One is the decorated pottery complex from the Mondego and Maior rivers, including the Cardial and the incised/impressed/grooved pottery cave complexes as two "stratigraphically non-separated" phases, Ia and Ib respectively (Leisner 1983, p. 8). The other is the megalithic "culture" of the interior, which has its roots in the local Mesolithic. The initial phase of the later (phase IIa in the periodization, or Pre- and Proto-Megalithic), was at least partially contemporaneous to the first one and had cultural interchange, especially with the phase Ib corpus. Besides the continuous contacts, there is no cultural convergence among the two "cultures". The decorated pottery group, known almost exclusively namely by that pottery, have maintained their traditions until the Bronze Age. The groups of the interior, known also for the megalithic monuments, have developed variations in the burial architecture, the pottery, and the lithic tools and weapons typology throughout several sub-phases until the Bronze Age, and, according to Leisner, experienced influences from Andalusia and Africa. Even though one of the earliest, the periodisation of

Leisner is also one of the most progressive for its time and stands as an early herald of the later integrationist models in Portuguese prehistory.

Soon after, in a paper published in 1970, Guilaine and Ferreira offered their systematisation of the Early Neolithic record in Portugal. They studied the available museum collections, consisting mainly of surface and limited excavation pottery artefacts and produced a sequence, which for many is valid until today (Guilaine & da Veiga Ferreira 1970):

- Cardial Early Neolithic; as in the rest of the Western Mediterranean, in Portugal the earliest Neolithic is characterized by pottery decorated with *Cardiidae* cockles' impressions (Cardial pottery); this pottery has been recognized in assemblages from Algarve (Cabranosa in this case is referred as the "station at the Sagres point"), inner Alentejo (Gruta de Escoural), three sites at the Mondego estuary (Junqueira, Forno da Cal, Várzea do Lirio), two caves from Alcobaça region (Gruta III de Cabeço da Ministra and Gruta IV de Calatras), Eira Pedrinha (near Coimbra) and Galeria da Cisterna (Torres Novas); to this group the authors added the "Santarem vessel" and the "Cartaxo vessel" – two well preserved pots with cardial decoration, but without exact known provenance, even though their labels suggest they belong to the Early Neolithic group of Estremadura.
- Furninha horizon (Cave decorated pottery); the following stage of Neolithic development is characterized by the disappearance of cardial pottery; vessels are now decorated with various types of impressions, incisions and relief cordons; the main material for this phase comes from Estremadura, from the Furninha cave, but also from Casa da Moura and Olelas; this phase is deriving directly from the cardial group and is equivalent to the Epicardial in the rest of the Western Mediterranean.

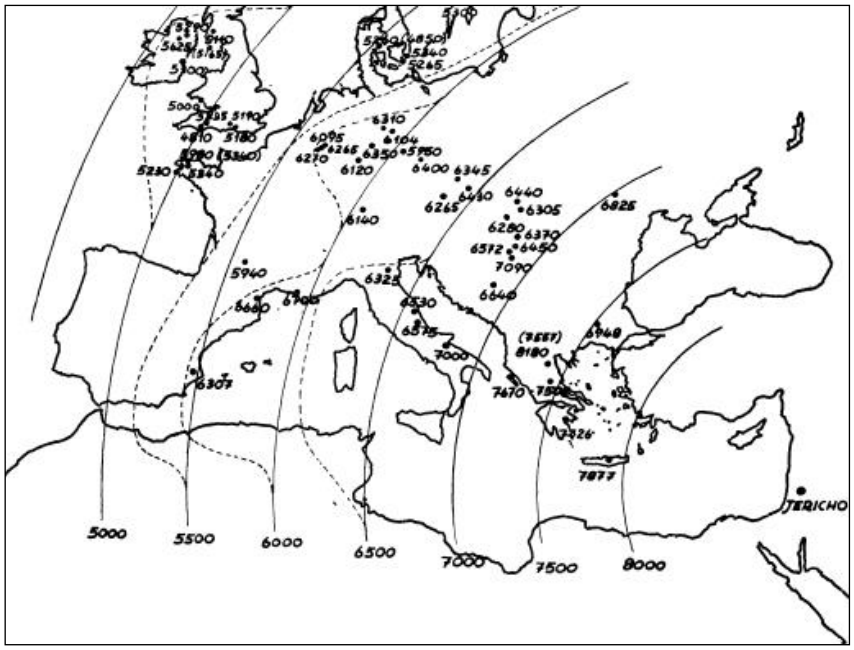


Figure 1.2 Graphic representation of the "wave of advance" model (Ammerman & Cavalli-Sforza 1971, fig. 6, p. 685)

On a larger territory scale, a milestone in the history of neolithisation studies is the "wave of advance" model of Albert Ammerman and Luigi Cavalli-Sforza (fig 2; 1971). This model, combining material culture, radiocarbon dates and genetic markers, presents the neolithisation of Europe as a steady and continuous process of demic diffusion – a gradual spread of people from the Near East to North-western Europe, mathematically calculated as 1km per year (Ammerman & Cavalli-Sforza 1984). Since the publication of this model, paleogenetic studies in the context of neolithisation have been diversified in scope, approach and methods, attempting to evaluate the significance of the Near Eastern genetic material in the Neolithic and modern European gene-pool (King & Underhill 2002; Gkiasta et al. 2003; Richards 2003; Budja 2005; Pinhasi et al. 2005; Zeder 2008; Sjödin & François 2011; Olalde et al. 2015; Szécsényi-Nagy et al. 2015; Zeder 2015). Even though far from unanimous, among the benefits are the confirmation of the complexity of the process, far more complex than single rate calculations and straight lines of radial diffusion, as well as the support in the introduction of integrated interpretations, thus overcoming the migration *versus* cultural diffusion duality (for important theoretical and practical issues, establishing an integrative approach in archaeological studies, see for example Zvelebil 2001).

By the 1970s and 1980s, enough evidence was gathered from sites all over Europe (including the eastern coast of Spain), which did not fit the "slow continuous expansion" of

human groups, as proposed in the "wave of advance" model. The diversity of assemblages was obvious and some sites, like Cocina cave, revealed Neolithic novelties associated with Mesolithic stone-tool assemblages. As a response, the "dual model" was presented in Iberian archaeology. This model proposed the existence of two parallel groups in Iberia during the early Neolithic. The first one, considered as "pure" Neolithic, represents the exogenous factor, responsible for the introduction of the Neolithic, as previously established at sites like Cova de l'Or. The second group lumps together all the anomalous discoveries and attributes them to a substrate of not fully acculturated local hunter-gatherers. The difference between the two groups is in the approach towards the separate parts of the Neolithic "package". While there was an overall converging tendency in the subsistence patterns and lifestyles of both groups, the latter still demonstrated traces of the hunter-gatherer mentality, like lower ratios of domestic/wild bone remains and the exclusive use of domesticated species for meat (i.e. supplement to hunting provisions), the absence of cultivated plant species, different stone and bone tool kits and even art (Martí Oliver & Juan-Cabanilles 1997; Vicent Garcia 1997; Bernabeu Aubán 2002; Guilaine & Manen 2007). Concerning terminology, the incoming settlers are part of the Cardial Neolithic of the western Mediterranean, and the local substrate has been labelled as "Pericardial" (Guilaine & Manen 2007, p. 44), but more commonly Epicardial. Crediting the genesis of the Epicardial to an entity which is separate from the Cardial groups permits an assumption of at least partial chronological overlap between the two, instead of seeing them only as related parts of a single sequence, where the first derives from the second (Guilaine & Manen 2007).

There are however alternative interpretations of the rich Neolithic record of Iberia. One of them, constructed specifically on the record from South Portugal, is the cultural diffusion model of Soares and Silva, where the main catalyst in the neolithisation process is the hunter-gatherer element and the social, economic and technological transformations taking place inside their societies since the early Holocene: decrease in mobility and diversification in the subsistence pattern (Silva & Soares 1981; Silva & Soares 1987; Soares 1996; Soares & Silva 2003). By the mid 6th millennium BC the societies started a selective implementation of parts of the Neolithic "package", which were available through long-distance trade or cultural osmosis from other areas in the western Mediterranean. The selective adoption of the innovations by local populations would explain the variability in the EN material culture, especially the pottery. This model is based on excavations on Neolithic sites in the Sines area on the coast of Alentejo. According to the artefactual record from Vale

Pincel I, the earliest ceramic mode in the area is not Cardial, but a pottery decorated in other manners of impression. This indigenous Neolithic style develops parallel to the Cardial.

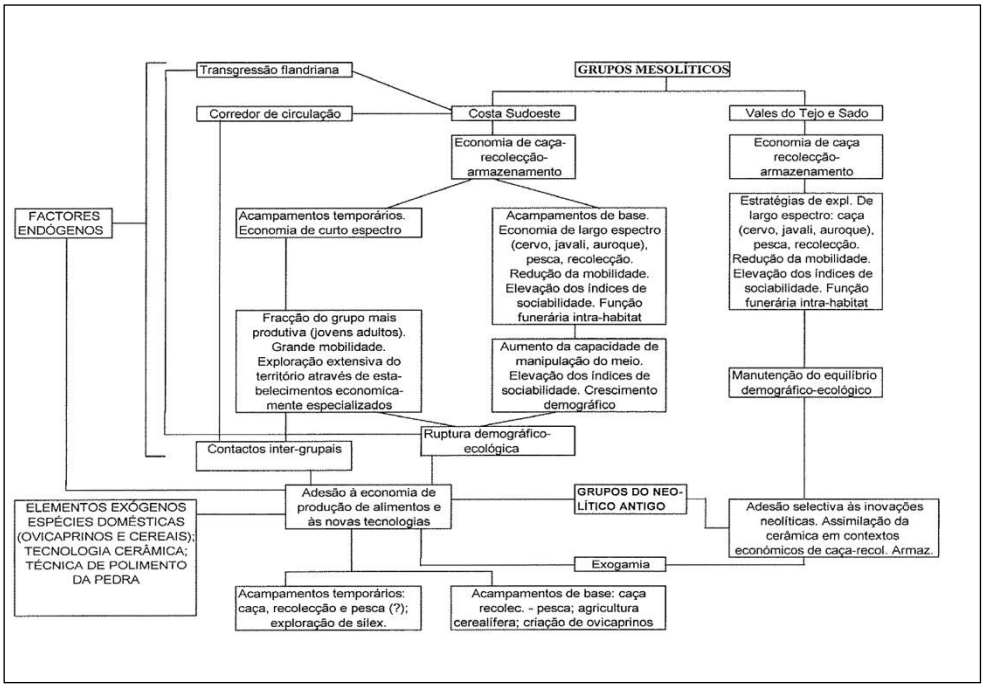


Figure 1.3 Schematic representation of the neolithisation process in South Portugal (according to Soares 1996, p. 47)

An integrative Portuguese model, allowing more than one scenario, is the model proposed by Arnaud (1982). Also concentrating on the Sines area, Arnaud includes the Mesolithic shell-middens at Sado to the pattern. The first scenario, Model A, permits a direct foreign input of people in coastal Alentejo, responsible for the introduction of the Neolithic. They would occupy areas unexploited by the indigenous hunter-gatherers, who are at the time more concentrated on the upper estuarine parts of the rivers. The latter would maintain their socio-economic system for a few centuries more before being consumed by the expansive agricultural way of life. This is indicated by the presence of Epicardial pottery shards in the final moments of the occupation of the Sado shell-middens. Model B sees both the Sines settlements and the Sado estuary shell-middens as parts of the same system, developed and maintained by local communities. By the mid 6th millennium BC their subsistence pattern would reach a level of variety, which would manifest itself in the different types of seasonal camps in different ecological settings.

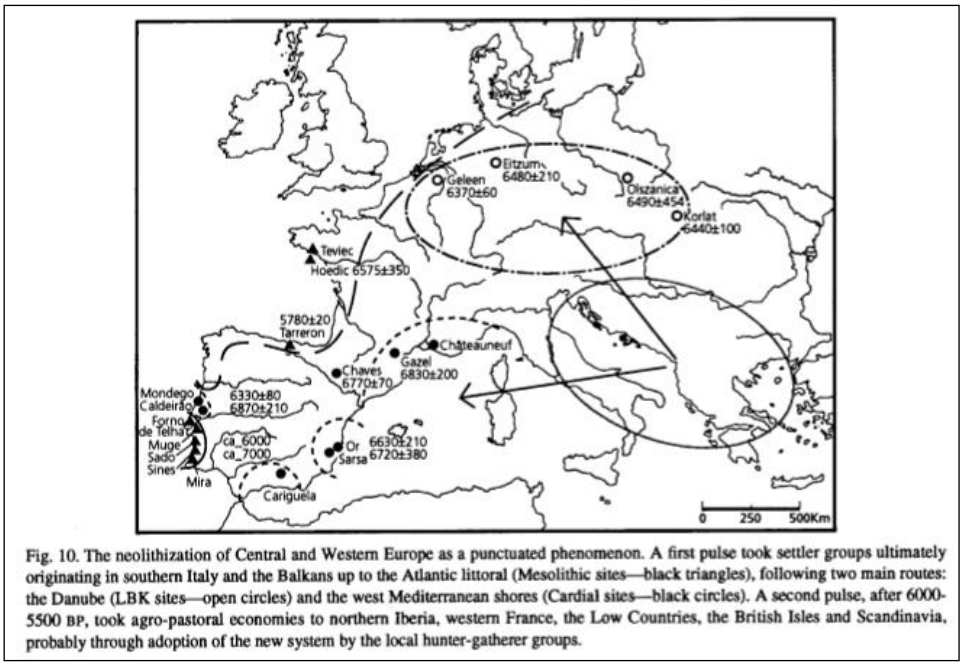


Fig. 10. The neolithization of Central and Western Europe as a punctuated phenomenon. A first pulse took settler groups ultimately originating in southern Italy and the Balkans up to the Atlantic littoral (Mesolithic sites—black triangles), following two main routes: the Danube (LBK sites—open circles) and the west Mediterranean shores (Cardial sites—black circles). A second pulse, after 6000-5500 BP, took agro-pastoral economies to northern Iberia, western France, the Low Countries, the British Isles and Scandinavia, probably through adoption of the new system by the local hunter-gatherer groups.

Figure 1.4 The formation of Neolithic enclaves and the neolithisation of Europe according to the "maritime pioneer colonisation" model (after Zilhão 1993, with original caption)

Following the excavation of several cave-sites in Central Portugal in the 1980's, João Zilhão promoted his Maritime Pioneer Colonization (MPC) model, explaining the neolithisation of the western Mediterranean (Zilhão 1993; Zilhão 2000; Zilhão 2001). Maintaining the demic diffusion paradigm and the East-to-West migration theory frames, he notes that the rates proposed by Ammerman and Cavalli-Sforza do not correspond with the absolute date record from the coasts of Italy, France, Spain and Portugal (Zilhão 2003, p. 216). The Cardial "culture" (which he accepts to be the signal of the earliest Neolithic) spreads from Italy to Central Portugal much faster than their model would project. Therefore, after rejecting on taphonomic grounds all the evidence for indigenous invention of the Neolithic or cultural diffusion through long distance trade, as an alternative to the gradual and slow wave of advance he proposed a leapfrogging migration process, where small groups of highly mobile farmers-pioneers played the key role. In selected locations these farmers would establish settlements and develop Neolithic societies (enclaves), neighbouring the local hunter-gatherer groups. The farmer life-style does not seem to be interesting to the local communities, who maintained their subsistence on local resources from hunting and gathering for several centuries after the first contact, but in time, mainly due to the higher reproduction rate of the fully sedentary immigrants and through intermarriage, the hunter-gatherers would go through an acculturation process (Zilhão 2000, p. 172). The MPC model can be seen as a contextual expansion of Arnaud's Model A. In a simplistic and selective

manner of interpretation, this model does provide explanation of the archaeological pattern found in Mediterranean France and Spain, and especially in Portugal.

On a wider geographic level, one of the most relevant models, alternative to the "mainstream" migration theories, is the capillary model. Similar to the Island Filter model (Lewthwaite 1986), it is based on two main points: the evidence for continuity between the Mesolithic and the Neolithic in Western Mediterranean and the delayed establishment of "full" Neolithic communities by at least a millennium after the first introduction of pottery and/or domesticates (Vicent Garcia 1997). Vicent Garcia however, rejects Lewthwaite's idea that the Mediterranean islands were transmitting Neolithic novelties from the East towards Iberia, simply because the absolute chronology of Corsica and Sardinia does not precede the Iberian record. Having in mind the diversity of the archaeological record, this model considers it as completely unnecessary and erroneous to imply migrations of groups of people responsible for the relatively fast spread of the Neolithic. According to Vincent Garcia, during the 7th and 6th millennium BC the Western Mediterranean was inhabited by bands of hunter-gatherers who maintained a complex network of communication and exchange among them. It seems plausible to imagine domesticates and pottery being introduced and exchanged within this network. And not only the items, but Vicent Garcia further suggests that also people, through intermarriage for example, would enter and participate in this network, transmitting also the practical knowledge and technology, and granting sustainability to the neolithisation. The structure of the network and the flow of communication depended on various socio – political, cultural, linguistic and natural conditions and therefore it is not probable a clear pattern to be revealed through archaeological investigation (Vicent Garcia 1997, p. 8). The lack of pattern in the archaeological record in Iberia, and the inability of the discussions so far to produce a common straightforward interpretation, seem to confirm this.

Maria Cruz Berrocal (2012) provided further elaboration in this direction. According to her, the Neolithic innovations (pottery and domesticates) which entered the exchange system of the Iberian hunter-gatherers were probably not very abundant in the beginning. Being rare, they had higher value and were handled, used, reused and exchanged as prestige goods. This is a slow mode of spread and the Neolithic elements would maintain their prestigious status for some time after their first introduction - a period whose dynamics would leave no special trace in the archaeological record (archaeological invisibility). The actual appearance of pottery, charred cereals and bones from domestic animals in the archaeological record is related to a later phase, when socio-political turbulences (probably triggered by the

same objects) would have caused the "reorganization of exchange networks and accumulation and immobilization of prestige elements" (Cruz Berrocal 2012, p. 145). This stage of accumulation of items, but also accumulation of labour power, is not the first in the process of transformation of the hunter-gatherer social system, but it is associated with the sites considered as the earliest Neolithic manifestations in their respective region: Cova de l'Or and Mas d'Is in Alicante area, Can Sadurní in Catalonia. The time-gap between the first introduction of Neolithic innovations and their appearance in the archaeological record would then represent a delay, or "fermentation" phase (*sensu* Guilaine 2001) of the spread of the Neolithic in Iberia.

Beyond the models, the wealth and diversity of the empirical record requires flexibility in approach and reasoning liberated from pre-designed frames. With research in higher geographic resolution and focused on the material evidence, observed from the aspect of several different natural, social and humanistic disciplines, it becomes clear that no model in the strict manner alone is capable of explaining the transition process in the entire peninsula. This is the contemporary approach which in the last twenty years brought significant advances towards clarifying the early Neolithic picture in Iberia.

Revisions of previous excavations in paradigmatic sites in Italy and France, like Arene Candide and Peiro Signado, triggered tectonic movements and re-composition of the previously established sequences (Roudil 1990; Maggi 2002). It became clear that the type – sites for the cardial pottery, from where diffusion was considered towards the western Mediterranean, had actually at the beginning of their sequences a pottery style more related to the *impressa* horizon of central West and South Italy. But the revisions also demonstrated high variability within the impressed pottery style, suggesting multi-linear communications between coastal communities in Italy and France during the first half of the 6th millennium cal BC (Guilaine & Manen 2007). The effects of these social activities will have hardly been unidirectional. In the light of this revision, the cardial pottery was now associated to a later phase of consolidation and further spread of the Neolithic towards Iberia and towards the interior, following fluvial routes (Guilaine & Manen 2007). However, recently Bernabeu et al. (2009) published the results from El Barranquet, a site south of Valencia, and not only embracing the revised sequence, but according to the pottery discovered there, they suggested that the early network of communication, during the impressed ware phase, expanded all the way to the coast of Valencia. The ceramic assemblage is associated to Peiro Signado and Pont de Roque-Haute, which on the other hand Guilaine and Manen relate to Arene Candide

and Giglio Island (Tuscany) respectively (Guilaine & Manen 2007). More sites from the eastern coast of Spain, dated in the 56th century cal BC (which became the time-frame for an initial colonization of the Spanish coast by *impressa* pottery settlers), were attributed to this pioneering phase (García Atiénzar & Javier Maestre 2011). Cova de les Cendres, Cova Ampla del Montgó, Cova d'En Pardo and the ditched settlement of Mas d'Is, together with El Barranquet, are all considered as part of the same demographic event. If this is to be accepted, then the diverse character of the pottery used by the participants in this event in France and Italy seems to be repeating here as well. In fact, García Atiénzar and Javier Maestre are rather relating the pottery assemblages from these sites to Tyrrhenian, Ligurian and French sets, than to one another (García Atiénzar & Javier Maestre 2011, p. 19 - 22). A conclusion from this updated version of the colonization paradigm would be that the European coast of the Western Mediterranean, towards the end of the first half of the 6th millennium cal BC was a vibrant place, hosting a dynamic neolithisation process with westward direction, during which small interrelated coastal enclaves were established. At this time these societies were using pottery decorated in various impression modes, and only during the subsequent stages of consolidation and growth of the enclaves, the cardial pottery would dominate the ceramic inventory.

The Iberian Peninsula however is relatively big, and geo – morphologically and environmentally diverse landmass, of which the eastern coast is only a small part. The Neolithic of Andalusia has always been regarded as a peculiar case, and the interior of the peninsula was (and by some still is) considered as an unpopulated land during the Early Neolithic. The general lack of cardial pottery has been interpreted by the previous colonization models as later penetration of agriculture and pottery in these regions. All absolute dates from sites in Andalusia and the interior, signalling age older than the accepted time frame for the "Epicardial" on the East coast, have been constantly rejected (Zilhão 1993; Zilhão 2011). However, with the demonstration that at least on the coast of Valencia, often used as a reference for the rest of the peninsula, non-cardial impressed pottery precedes cardial (and therefore the label "Epicardial" should be avoided), and the constant increase in the number of early dated sites in the interior, containing pottery and/or domesticates, some existing alternative approaches begin to gain more validity.

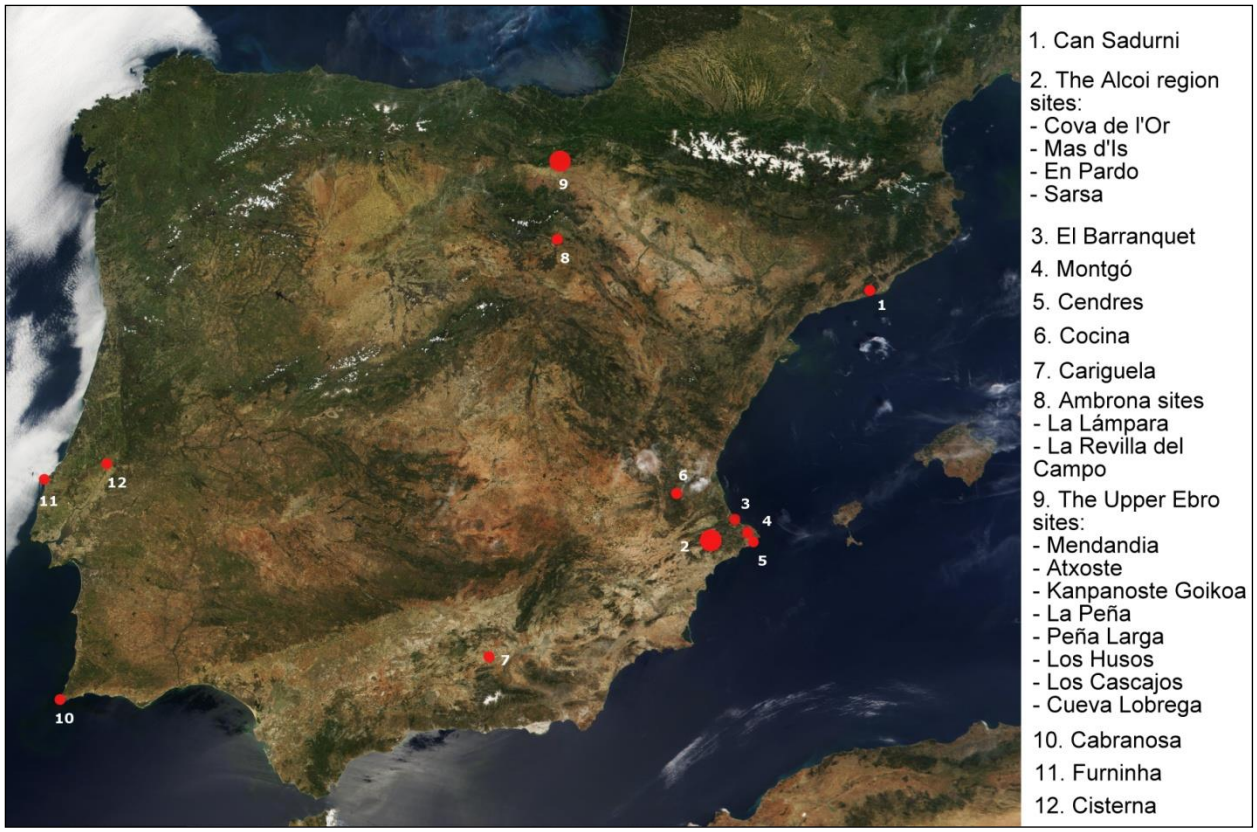


Figure 1.5 The Iberian Peninsula with the location of some of the key sites, mentioned in this section (base map source: reddit.com)

Recently, an international team of researchers published the results of their work on the transition between the Mesolithic and Neolithic on the South Iberian and the adjacent North African coasts, giving special emphasis on palaeoclimatic and environmental changes (Cortés Sánchez et al. 2012). Using combined data from multiple records, they analysed the Holocene climatic events which occurred between 8.2 and 7.2 ka cal BP (the millennium in which also the Mesolithic – Neolithic transition in the area occurred), and the potential impact these would have on the wider Western Mediterranean, focusing especially on the European coasts of Andalusia and Algarve, and the African Maghreb. This research demonstrates several points: the dry episodes brought aridity throughout Iberia and North Africa, which dramatically changed the eco-system known to the local hunter-gatherers, resulting in migration and settlement abandonment in both regions; the fate of the European hunter-gatherers is unclear, but it is suggested that "all these changes may have been instrumental in provoking the adoption of the Neolithic innovations by the Mesolithic populations" (Cortés Sánchez et al. 2012, p. 10); the North African record from the time towards the end of the same turbulent period shows the first signs of neolithisation, which seems contemporaneous to the first farming communities appearing on the Malaga and

Algarve coasts; it is suggested that the existing exchange networks in the Mediterranean facilitated the rapid dispersal of Neolithic novelties, but the proposed mechanism remains maritime pioneer colonization; the material cultures from the Maghreb, Andalusia and Algarve show special similarity, forming a separate group in this transforming world, whose neolithisation was initiated in, and dispersed from the Maghreb into the other two regions (Cortés Sánchez et al. 2012, p. 10 - 11).

Relying on coastal migration narratives, larger portions of the Neolithic research in Iberia so far have been concentrated on the coasts from Catalonia to Portugal. The inland area have been seen as unpopulated since the Upper Palaeolithic, only to be repopulated in the later, developed phases of the Early Neolithic (Zilhão 2000; but see Arias et al. 2009 for the Mesolithic population in the interior). This is of course a result from reasoning conditioned by the belief that the Cardial impressed pottery is the only pottery indicator of the initial neolithisation stages, since Zilhão himself mentions that surveys in the interior did encounter non – cardial impressed pottery (Zilhão 2000, p. 144). As recent ceramic analyses from the coastal area (presented above) have shown, both (or all) impressed ware variations (including the Cardial) are at least contemporaneous and probably different varieties of an aesthetic manifestation of generally the same cultural group, so, presenting them in a diachronic perspective is problematic.

Information from the Spanish interior is mainly coming from three areas: the upper Ebro, northern Meseta and northern Extremadura. Better understanding the early Neolithic population patterns in these regions is especially important in tackling subjects related to the exchange and communication networks throughout Iberia, following the main river valleys of Ebro, Douro and Tagus.

The population from the upper part of the Ebro valley has been communicating (directly or indirectly) with the Mediterranean coast at least since the Mesolithic, as the similarity in the microlith assemblages from the two regions demonstrates (Arias 2007; Arias et al. 2009). Arias attributes the Neolithic transition of parts of this region to such communication, since Mediterranean species of shells and pottery (from a supposed origin in Catalonia) are found in Mesolithic contexts at sites like Mendandia, Atxoste, Kanpanoste Goikoa and La Peña. There is continuity in the settlement location and lithic industry between the Mesolithic and the Neolithic in this congregation of sites. It has been proposed that an acculturation process, maintained through the traditional links, is responsible for the neolithisation of these pre-Pyrenean and pre-Cantabrian hunter-gatherers (Arias 2007, p 56;

for an alternative interpretation of the reccord, see Zilhão 2011, p. 52 - 54). A nearby group of sites however, presents a clear break between the Mesolithic and Neolithic (Peña Larga, Los Husos, Los Cascajos and Cueva Lóbrega). Out of the four sites, cardial pottery was found only at Peña Larga. These are newly settled locations by farmers whose origin is yet to be determined. The most representative early Neolithic site in upper Ebro is Los Cascajos (Arias 2007; García Gazólaz et al. 2011). Dated in the last third of the 6th millennium cal BC (eight consistent dates are reported, among which some on cereal grains and *Bos taurus* bone), the report presents a fully developed farmer village. Circular wattle-and-daub structures, querns, hearths, burials within the settlement limits, sickle blades together with cereals and domestic animals (which makes 96% of the faunal assemblage, among which, surprisingly, cattle dominates over ovicaprids) - all the elements of a fully sedentary farmer community are present (García Gazólaz et al. 2011). The upper Ebro valley presents an interesting region from a socio-technological transformation perspective. It is tempting to see the existence of two different and roughly contemporary processes. While the local hunter-gatherers were beginning to implement "exotic" objects in their community, the producers of those objects were beginning to settle permanently in their vicinity. However, detailed publications are still lacking and research is still in progress. Reliable dates are necessary in the future, especially from the sequences covering both the Mesolithic and the Neolithic, in order to understand the dynamics of all involved communities, their cohabitation and relationship.

The Ambrona valley is situated in Soria province in northern Meseta, at the watershed between the river Ebro flowing to the East towards the Mediterranean coast, Duero to the Northwest and Tagus to the Southwest, connecting the region to the Atlantic Ocean. Two early Neolithic open-air sites, La Lámpara and La Revilla del Campo, have been excavated in close proximity to one another (Rojo et al. 2008). Over 40 samples of different nature have been radiocarbon dated. All of the identified short-lived samples (cereal grains, domestic animals and human bones) cluster in the last third of the 6th millennium cal BC, providing the most probable time – frame for the beginning of the Neolithic in the area (Stika 2005). An earlier date on burned, unidentified, animal bone (mid 58th century cal BC) has been rejected as an intrusion (for discussions see Rojo et al. 2008 and Zilhão 2011).

Another important region of the interior is the middle section of the Tagus River in northern Extremadura. Until thirty years ago, the region was considered as a part of the "desert of the interior" (Cerrillo-Cuenca 1999; Cerrillo-Cuenca 2008). In the context of the neolithisation process, the main paradigm during the 1980s and 1990s was that the interior of

the peninsula was deserted since the end of the Pleistocene and was re-populated by farming communities only in the 5th millennium cal BC, more than five centuries after the first neolithisation of the coastal areas, putting the emphasis on movement of people (Zilhão 2000). This idea has been challenged by Enrique Cerrillo Cuenca and his collaborators, who have been working on a number of sites around Cáceres and have gathered enough information to be able to characterize the beginnings of sedentary life, agriculture and pottery use in this area (Cerrillo Cuenca 1999; Cerrillo Cuenca et al. 2002; Sáez et al. 2007; Cerrillo Cuenca & González Cordero 2011; Cerrillo Cuenca & González Cordero 2014). The archaeology of this region will be viewed in more details further bellow (section 1.3.4), but there are several points coming to light through these new research campaigns in the Iberian interior. First of all, more and more sites are dated in the last three centuries of the 6th millennium cal BC, and the increase of research intensity makes the coast-interior chronological gap smaller and smaller (Cerrillo-Cuenca 2008; Rojo et al. 2008; Diniz 2007). In addition, from several locations in the interior Mesolithic sites have been reported, dating throughout the first half of the Holocene (Arias et al. 2009; Cerrillo-Cuenca & González Cordero 2011). In a recent publication, Zilhão (2011) reviewed his earlier position by acknowledging the existence of Neolithic settlements in the interior by 5300 cal BC, as well as the existence of populations in the Iberian interior during the Mesolithic, excluding the late phase. Cerrillo Cuenca notes an interesting feature: the similar variability patterns of the material culture of both the Mesolithic and the Neolithic (Cerrillo-Cuenca 2008). Even though continuity or chronological overlap between hunter-gatherer and farmer communities is excluded so far, these patterns would favour a more active role in the neolithisation process of people whose collective memory is firmly attached to the local landscape.

The Neolithic and Copper Age studies in Extremadura, especially the funerary aspects, are closely associated with the megalithic phenomenon. According to Cerrillo Cuenca, even though the practice of burying people in natural caves predates the building of artificial structures, these two rituals later run parallel as part of the same cultural entity (Cerrillo-Cuenca & González Cordero 2014; Cerrillo-Cuenca & González Cordero 2011). The material culture accompanying the dead is the same in the different monuments. The choice of burial structure is conditioned by the local geology (presence/absence of caves, availability of suitable rock material for building monuments etc.). A similar interplay in time and territory between different entities of the material culture is emerging in the region down the Tagus River, in the Alto Ribatejo in Portugal, from where two sites are also included in the present study.

1.3. The Neolithic record from Southwest Iberia

1.3.1. Algarve (Portugal)

In line with the neolithisation theories based on a coastal seafaring population movement, one would expect Algarve to be the first Portuguese territory populated by Mediterranean farmers, being the southernmost stretch of land and the first "out of Gibraltar". But with relatively little data collected so far, mostly during the last 30 years, it is difficult to claim this. In a recent paper on the neolithisation process, which includes the Mesolithic record, Dean, Valente and Carvalho (2011) presented the work of their team in Costa Vicentina (West Algarve), where the biggest concentration of sites was noted. The study presents seven sites: Barranco das Quebradas, Rocha das Gaivotas, Praia do Castelejo, Armação Nova, Vale Santo 1, Vale Boi and Padrão 1 (Fig. 1.6).

The first four are situated on the coast and the biggest part of their stratigraphy is mollusc collecting waste from human groups during the Mesolithic; the same locations were visited only sporadically during the Neolithic, evident from ephemeral layers of malacofauna remains or few pottery shards (Valente 2014; Valente & Carvalho 2009; Dean et al. 2012). Barranco das Quebradas (BQ) is a conglomeration of five archaeological sites, located at the end of a ravine, where a sandy beach on the western coast of Algarve was formed. The earliest dates come from BQ 1, a shell accumulation under a rock-shelter, where the base unit is dated between 8500 and 8300 cal BC[4]. After several centuries without activity in this, as in any other area in Algarve, the same rock-shelter was reoccupied again around 7740 cal BC and was used for the next two centuries. Since 7550 cal BC the activities shifted several meters up the ravine on the same slope and BQ 3 and BQ 4 were established. BQ 4 was occupied for less than a century, while BQ 3, with some interruptions, was abandoned only around 6750 cal BC. During the last two or three centuries, probably the same group of hunter-gatherers were also occupying BQ 5, positioned nearby, in a smaller subsidiary ravine. While BQ 3, like BQ 1 is a rock-shelter, BQ 5 was an open-air camp. Despite being contemporary, some functional differences are observed: there is a higher concentration of stone tools (choppers and anvils) in BQ 5 and it has been implied that they could have been used for the breaking of the exoskeleton of some species, in which the edible part is harder to reach (Valente 2014, p. 28; Dean et al. 2011, p. 315). On the top surface of BQ 3 some early

[4] The dating of BQ sites was made on shells, and the consulted results are at 1σ, reservoir effect corrected (Valente 2009, p. 12, table 1).

Neolithic pottery fragments were discovered, but no associated archaeological layer has been detected (Dean et al. 2011, p. 314-315).

BQ 5, 4, 3 and the later phase of 1, are all contemporaneous with the earliest phase (layer 3) at Rocha das Gaivotas. The site is a shell midden on top of a rock, 50 meters directly above the sea. It is located two and a half kilometres down the coast South of Barranco das Quebradas. The early Mesolithic site (layer 3), divided in four phases, was more or less continuously visited between 7600 and 6800 cal BC (Valente & Carvalho 2009, p. 315, fig. 47.4). The abandonment of this site corresponds with the establishment of Armação Nova, another shell midden at the same coastal position, few meters NW from Gaivotas (Soares et al. 2005/07, cited in Carvalho et al. 2010, fig. 2). Contemporaneous with this site is Praia do Castelejo, a 2 m thick shell midden in a secluded beach, containing also an early Neolithic layer at the top of the sequence (Soares and Silva 2004, cited in Dean et al. 2011). Only during the Late Mesolithic, around 5800 cal BC, when Armação Nova was abandoned, Rocha das Gaivotas was reoccupied (layer 2 – base). Some more substantial combustion structures were discovered in this layer, which might imply a more intensive exploitation, as well as longer-lasting attachment to the location (Dean et al. 2011, p. 3). The time frame for this stage (5800-5600 cal BC) corresponds to the very end of the Mesolithic and might reflect already decreased mobility of the hunter-gatherer population.

So far, no record exists from the Mesolithic in the interior of Algarve. It appears the local hunter-gatherer groups concentrated along the sea shore, and unlike the northern estuarine groups in Sado, Mira and Tagus, they based their subsistence on aquatic resources. However, stable isotope analyses on a human tooth from Vale Boi, dated to 6500 cal BC (early Mesolithic, even though there are no associated levels at the site) showed a balanced aquatic/terrestrial diet (Dean & Carvalho 2011). Obviously, only the coastal mollusc-collecting Mesolithic stations have been discovered so far, the inland hunting camps still waiting to be recognized.

From the published absolute dates, it is difficult to consider a chronological overlap or continuity between the Late Mesolithic and the Early Neolithic in Algarve. An overlap can be proposed between the Late Mesolithic at Rocha das Gaivotas (layer 2 – base) on one side, and Cabranosa and Padrão 1 on the other (see below), but until new excavations take place and new series of absolute dates becomes available, it would be only in the domain of statistical probability of the dating method. As a conclusion in their paper, Dean et al. (2011) leave an offer of two possibilities for this transition: 1) local hunter-gatherers adopt agriculture to replace increasingly unreliable marine resources; 2) local hunter-gatherers were

pushed out by immigrant farmers with a more stable subsistence base. But before going any further in this quandary, a review of the Neolithic record in Algarve is necessary.

Figure 1.6 Map of Algarve with sites mentioned in the text (Mesolithic (white): 1. Barranco das Quebradas; 2. Armação Nova; Mesolithic and Neolithic (red): 3. Rocha das Gaivotas; 4. Castelejo; Neolithic (black): 5. Cabranosa and Vale Santo; 6. Padrão 1; 7. Vale Boi; 8. Castelo Belinho; base map: Google Earth)

As already mentioned, some of the coastal shell middens contain Neolithic layers on top of their stratigraphy; at least a century after the last abandonment by Mesolithic hunter-gatherers, Rocha das Gaivotas was inhabited again (layer 2 – top, dated at 5400 cal BC; Dean et al. 2011, p. 3); this is a thin layer of discarded mollusc shells, containing some plain and incised pottery fragments, ground-stone tools, a few small, unidentified mammal bones and two pendants; pottery - carrying groups also visited Castelejo around 5370 cal BC, and also left behind some impression decorated pottery fragments (Dean et al. 2011, p. 4). However, the earliest dates from Neolithic contexts in Algarve come from two newly established positions in the interior, Cabranosa and Padrão 1, interestingly both of them at 2 km distance from the coast. Apart from being at equal distances from the coast and being contemporary (both dated in the time frame between 5610 and 5400 cal BC), there are very few similarities between these two early Neolithic sites.

Cabranosa is located on a sand dune, next to a dry torrent. It has an emblematic status in the neolithisation studies in South Portugal, mainly because since its discovery in the 1970s, for a long times it has been the only early Neolithic settlement in Algarve. Another reason is the discovery of Cardial pottery, which became the centre of attention in constructing neolithisation models. In reality, most of the material comes from surface

collection and limited excavations in the late 1970s (Cardoso et al. 2001). Except for a few hearths little is known about settlement organisation, habitation structures and stratigraphy (vertical and horizontal). However, some of the retrieved artefacts, such as large storage vessels and polished stone adzes, permit the suggestion that Cabranosa was a permanent settlement, associated with agricultural activities (Carvalho & Cardoso 2003, p. 37). Another important notion is that the lithic and ceramic materials are local.

Padrão 1 is located on a hill top, six and a half kilometres northeast. Two menhirs are still standing, but their association with the early Neolithic site is not clear. A significant area was excavated (80 m^2) and some habitation structures have been reported, as well as a "significant" ceramic assemblage (Gomes 1994, 1997, cited in Dean et al. 2011, p. 4).

Another early Neolithic site is Vale Santo 1, located near Cabranosa. After middle Palaeolithic and Epi-Palaeolithic occupation of the area, the Neolithic layer is dated to 5300 cal BC (Dean et al. 2011, p. 4). The accumulation of material is not impressive, and in addition to a low amount of pottery fragments, the assemblage includes products from the initial stages of knapping of local flint, so, the site is interpreted as an occasionally visited knapping camp.

At the end of the 6^{th} millennium, an early Neolithic settlement was established on a valley slope in Vale Boi, 7 km further Northeast from Padrão 1 and again 2 km from the coast (Dean et al. 2012). On the upper parts of the slope an Upper Palaeolithic site was recognized (zone 1) with abundant faunal remains from terrestrial species. At "zone 2" at the base of the slope, an early Neolithic layer was dated between 5000 and 4850 cal BC (Dean & Carvalho 2011; Cortés Sánchez et al. 2012). The faunal remains of the site are dominated by lagomorphs, but also some ovicaprid bones have been identified, as well as cattle, red deer and pig. The malacofauna remains are scarce (Dean & Carvalho 2011, p. 293-295).

During recent excavations at Castelo Belinho, the ruins of a small Islamic fort turned out to be concealing an unexpected, interesting example of a Neolithic settlement from the end of the 5^{th} millennium BC. It is farther to the northeast and inland, about 10 km from the coast, on a naturally defendable position in the foothills of the Monchique Mountains. The excavations showed a fully developed settlement, with "longhouses", storage pits, decorated pottery (incisions, impressions, relief applications and red paint) and fourteen pit-burials within the settlement (Gomes 2012; Gomes 2008).

In the Maritime Pioneer Colonization narrative of Joao Zilhão (1993), sites like Cabranosa and Padrão 1 would represent the Algarvian enclaves of immigrants from the East. The success of their colonies permitted the further spread of the agricultural model of

subsistence among the already semi-sedentary hunter-gatherers. Developing this interpretation further in his very important synthesis of Portuguese prehistory, as a demonstration for the clear break between the Mesolithic and the first Neolithic settlers, João Cardoso (2002, p. 160-163) points to two key features at Cabranosa: Cardial pottery, and knapping technique (heat-treatment, pressure and indirect percussion). According to him, the mentioned pottery finds closest parallels in Cova de l'Or, Cova de La Sarsa (Alicante) and Carigüela (East Andalusia), which seems a straightforward confirmation of the maritime colonization model. Migrants from the mentioned Spanish region settled in Algarve and established a successful community, which in time would transform the entire region.

The Mesolithic/Neolithic transition of Algarve, after a delayed start of research, is slowly being illuminated by new fieldwork projects and simultaneous implementation of the new data to the existing paradigms in Iberian prehistory. The chronological and material record so far shows a gap between the last hunter – gatherers and the earliest farmers. Yet, the exact locations of some of the Mesolithic shell middens were reused by the Neolithic people, even though their main subsistence activities were gravitating more towards the interior. After a gap in the record of almost a thousand years, at the end of the 5th millennium in Castelo Belinho we see a much more diversified and complicated society.

1.3.2. Estremadura, Ribatejo and Alentejo (Portugal)

South-Central Portugal is an interesting archaeological setting from several aspects regarding the neolithisation process and the Early Neolithic. One of them is the only unambiguous and undisputed chronological overlap between hunter-gatherer and farmer communities in Iberia. The hunter-gatherer population in question had undergone one major socio-economical transformation since the end of the Ice Age. At the beginning of the 7th millennium cal BC, a gradual shift towards a more sedentary settlement pattern is noticed, together with a pronounced diversification and seasonality in the subsistence system (Bicho 1994). This transformation included movement from the coast towards the interior and would lead to the formation of the notorious Muge (Tagus) and Sado shell middens in the Portuguese estuarine environment - an ecological systems which will survive unchanged for several centuries after the first introduction of the Neolithic in their close vicinity (Zilhão 1993; Cardoso 2002).

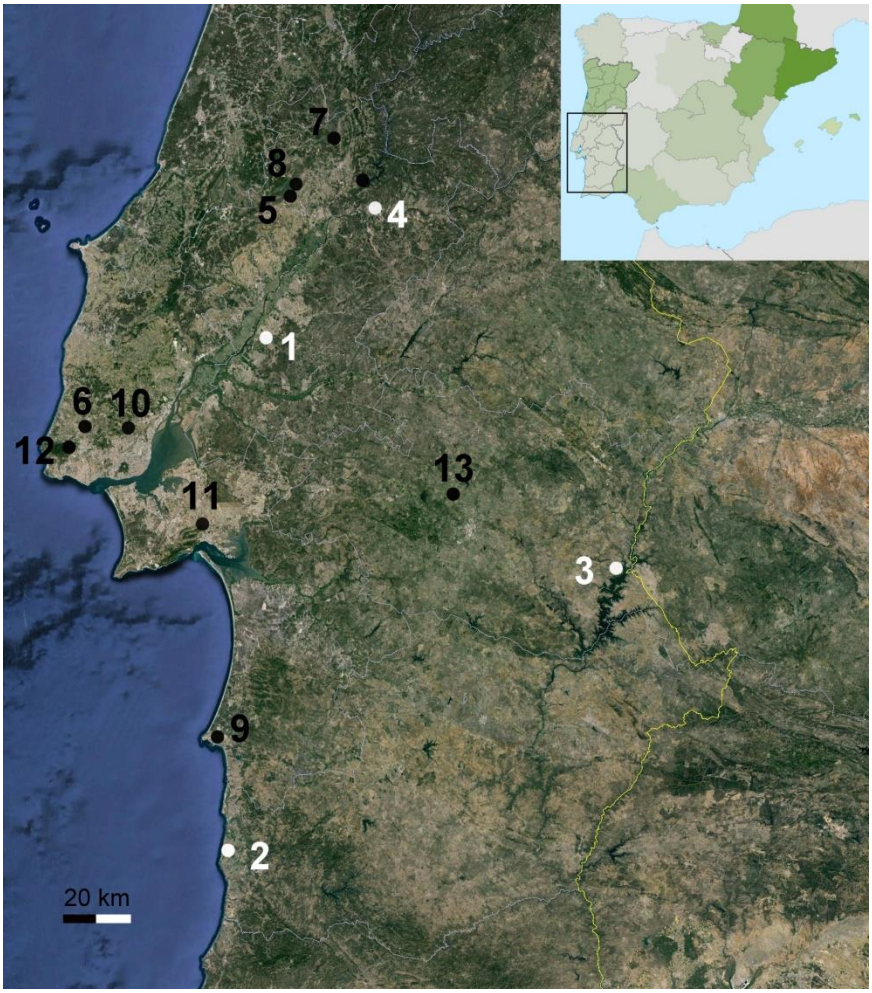


Figure 1.7 South Central Portugal with sites mentioned in the text (Mesolithic (white): 1. Cabeço da Amoreira, Cabeço da Arruda and Moita do Sebastião; 2. Palheirões do Alegra; 3. Barca do Xarez de Baixo; 4. Amoreira; Neolithic (black): 5. Cisterna; 6. Lapiás das Lameiras; 7. Caldeirão, Nossa Senhora das Lapas, Cadaval, Ossos; 8. Pena d'Agua; 9. Vale Pincel 1; 10. Correio-Mor; 11. Casal da Cerca; 12. São Pedro de Canaferrim; 13. Valada do Mato; base map: Google Earth)

The Mesolithic middens are clustered in groups in the upper peripheries of the estuaries of the Tagus and Sado rivers, while some sites are dispersed on the coast of Alentejo near the Mira River. In the Tagus valley, or more precisely on the shores of its tributary the Muge, there are an unknown number of sites (some are known to be destroyed in historical times), but three middens have received special attention so far: Cabeço da Amoreira, Cabeço da Arruda and Moita do Sebastião. Extensive dating campaigns have positioned these three sites within a range between the last two centuries of the 7th and the end of the 6th millennium cal BC, but rather as a sequential build-up of middens, than as contemporary neighbouring settlements (Jackes & Meiklejohn 2004). More recent direct dating of the burials found in the middens significantly narrowed the timeframes: the earliest

burials are from the first two centuries of the 6th millennium and all the middens seem to have been abandoned (at least for burial practices) around 5350 cal BC (Meiklejohn et al. 2009). This is also narrowing the coexistence period between these hunter-fisher-gatherer communities inhabiting the middens on one side, and the early farmers in the region to one or two centuries.

The chronology of the Mesolithic in Coastal Alentejo is similar, except that here the societies are maintained for several centuries more. Also a different settlement system is proposed, with a central base camp and seasonal stations on the coast and the interior, specialised in raw material or food procurement (Cardoso 2002; Soares & Silva 2003). It must be stressed though that the research of the middens on Sado and Mira is lacking publications and remains relatively unknown.

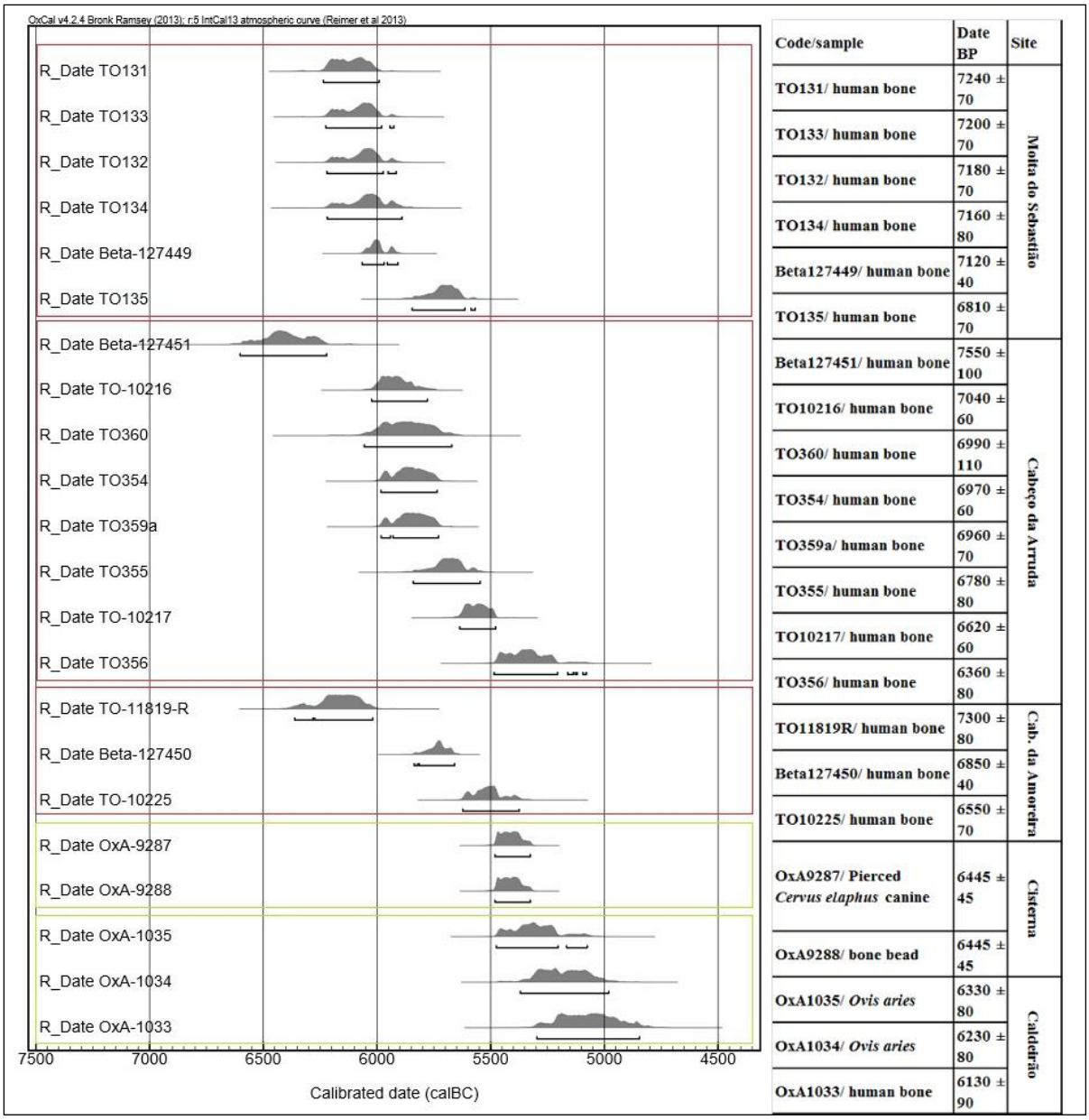
The technological approach in stone tools production remains basically the same since the Magdalenian, with a gradual increase during the Holocene of geometric microliths made in the microburin technique, which become the dominant implements in the Mesolithic middens (Bicho 1994, p. 670). However, the lithic technology was not homogeneous throughout the contemporary Portuguese territory during the Epi-Palaeolithic and the Mesolithic. A macrolithic industry producing bifacial tools, called Mirian (coastal Alentejo) or Languedocian (inland Alentejo) coexisted with the microlithic neighbouring one (Raposo & Silva 1984; Raposo 1993). The carriers of the macrolithic tools had a more mobile pattern of habitation, which resulted in more ephemeral archaeological sites, and this group is still today is not well known. It seems they had a more dispersed geographical distribution, from the coast of Alentejo towards the interior. The available dates from Palheirões do Alegra[5] on the coast and Barca do Xarez de Baixo[6] in the interior, all concentrate in the first half of the 8th millennium cal BC, i.e. before the formation of the Mesolithic shell middens in the Sado and Tejo estuaries (Cardoso 2002, p. 132; Araújo & Almeida 2003). Similar tools were also found on the coast of Algarve, at Barranco das Quebradas 5, dated several centuries later, but it remains unclear whether they belong to this techno-typological complex, or merely reflect the functionality of the site (see previous heading). Despite the ambiguity of this archaeological group, their cultural tradition (at least in stone tool production) was maintained well into the Neolithic, as the record from Northern Ribatejo shows. Languedocian tools are reported from sites like Amoreira and Anta 1 de Val de Laje, but some were also found in the nearby Gruta do Cadaval, Gruta da Nossa Senhora das Lapas,

[5] 7587 – 7305 cal BC; 8218 – 7612 cal BC; both 2σ, IntCal13.
[6] 7783 – 7578 cal BC, 2σ, IntCal13.

Gruta dos Ossos and Povoado da Fonte Quente (Oosterbeek 1997, p. 517 - 519). The contact between macro- and microlithic industries is only one of the several interesting encounters that happen during the later prehistory in this region of Central Portugal, region which is in the focus of this thesis as well.

Together with western Algarve, the lime stone massif of coastal Estremadura is one of the two early Neolithic core areas in Portugal. The leading paradigm is an external input of settlers with a complete Neolithic "package", including Cardial pottery. The earliest reliable undisputed date so far is an identical result from a bone pendant and a bone bead from Galeria da Cisterna: OxA-9287 and OxA-9288, 5477–5321 cal BC at 2σ (Zilhão 2001, table 1). The layer is a palimpsest from several archaeological periods, but Zilhão managed to correlate these ornamental items with the baroquely decorated Cardial pottery found in the same cave. Furthermore, on stylistic grounds, he correlates this combination of artefacts with the same set found at the basal levels of Cova d'Or on the eastern Iberian coast (Zilhão 2001; Zilhão 2009). Dates from short-lived samples from the latter show that these two stations with comparable material culture were also roughly contemporary. This seems to confirm a fast coastal movement of early farmers as described in the Maritime Pioneer Colonisation model, Algarve being the intermediate station (or enclave) between the two opposite coasts of the peninsula.

Another early date, obtained from *Ovis aries* bone (5450 cal BC) has recently been reported from Lapiás das Lameiras near Lisbon (Davis & Simões 2015). Future publication of the excavations would give further details on the material culture.



Code/sample	Date BP	Site
TO131/ human bone	7240 ± 70	Moita do Sebastião
TO133/ human bone	7200 ± 70	
TO132/ human bone	7180 ± 70	
TO134/ human bone	7160 ± 80	
Beta127449/ human bone	7120 ± 40	
TO135/ human bone	6810 ± 70	
Beta127451/ human bone	7550 ± 100	Cabeço da Arruda
TO10216/ human bone	7040 ± 60	
TO360/ human bone	6990 ± 110	
TO354/ human bone	6970 ± 60	
TO359a/ human bone	6960 ± 70	
TO355/ human bone	6780 ± 80	
TO10217/ human bone	6620 ± 60	
TO356/ human bone	6360 ± 80	
TO11819R/ human bone	7300 ± 80	Cab. da Amoreira
Beta127450/ human bone	6850 ± 40	
TO10225/ human bone	6550 ± 70	
OxA9287/ Pierced *Cervus elaphus* canine	6445 ± 45	Cisterna
OxA9288/ bone bead	6445 ± 45	
OxA1035/ *Ovis aries*	6330 ± 80	Caldeirão
OxA1034/ *Ovis aries*	6230 ± 80	
OxA1033/ human bone	6130 ± 90	

Figure 1.8 Mesolithic and Early Neolithic (Cardial) dates from Estremadura and Ribatejo (source: Zilhão 2001 for the Neolithic (green); Meiklejohn et al. 2009 for the Mesolithic (red))

An important early Neolithic site from the limestone massif of Estremadura is Gruta do Caldeirão. It is paradigmatic in the sense that the excavations in this cave form the base for the Maritime Colonisation Model. In reality, compared to Cisterna or the sites in Valencia, it has a poor ceramic collection. The Cardial pottery fragments represent one third of the total number of ceramic shards from the specific layer, but in absolute numbers they are only eleven and they all belong to the same vessel (Zilhão 1992, cited in Diniz 2005). According to Joao Zilhão, the Cardial style from Caldeirão represents a later stage of pottery decoration, in which the "baroque" appearance of the motifs in Cova d'Or and Cisterna are

no longer present (Zilhão 1993, p. 28). The absolute dates for this horizon, obtained on *Ovis aries* and human remains show indeed a slightly later results (Fig. 8).

So far, after almost 40 years of intensive research, Cisterna and Caldeirão remain the backbone of the Cardial body of Estremadura. This group also includes dispersed surface finds from the Mondego estuary as described by Guilaine and Ferreira (Guilaine & da Veiga Ferreira 1970), as well as the two fragments from the base of layer Eb from the Pena d'Agua rock shelter (layer otherwise dominated by other types of impressed and incised pottery and even some plastic decoration), dated on bulk charcoal sample somewhere in the second half of the 6th millennium cal BC (Carvalho 1998).

The larger part of the Early Neolithic group of Estremadura and Alentejo consists of sites where Cardial pottery is absent or extremely rare, sites often improperly labelled as Epicardial. Unfortunately, these contexts have not been dated as precisely and carefully as Cisterna for example, but several sites gave reliable dates from the 6th millennium cal BC.

A surprisingly early case is the open air settlement Vale Pincel I on the coast of Alentejo (Silva & Soares 1981; Soares & Silva 2003). From two almost identical combustion structures (according to the reports, sealed archaeological contexts), charcoals were taken for dating. One gave the result 6700±60 BP (Soares & Silva 2003), which after calibration is dated between 5719 and 5520 cal BC (ICEN 724; OxCal 4.2; IntCal13; 2σ). The other is slightly later, 6540 ± 60 BP, calibrated into 5617–5376 cal BC (ICEN 723; OxCal 4.2; IntCal13; 2σ). These sealed contexts, like the rest of the site, contained fragments of pottery decorated with short, semicircular impressions. The pottery collection of the site also contains small amounts of Cardial pottery and pottery with plastic decoration. The excavators, in the context of their neolithisation model (see section 1.2) interpret this site as one of the earliest manifestations of the gradual transition of the local hunter-gatherers into sedentary Neolithic communities (Soares & Silva 2003; for taphonomic objections and a different interpretation see Zilhão 1998 and Zilhão 2000).

The rest of the excavated sites from Estremadura and Alentejo fall well into the second half of the 6th millennium cal BC, contemporary at least with the Cardial of Gruta do Caldeirão. One of them is Gruta do Correio-Mor, situated in the southern part of the limestone massif of Estremadura, near Lisbon. A charcoal sample from a hearth and a human bone sample gave almost identical results: 6350±60 BP and 6330±60 BP (Cardoso et al. 1996). When calibrated (OxCal 4.2.4, IntCal13), these results position the site between 5470 and 5210 cal BC (at 2σ). The pottery associated with the Early Neolithic is plain, but also

there are various kinds of impressions, incisions and plastic decoration, which find parallels in a wide geographical and chronological context (Cardoso 2003, p. 261-262).

At the southernmost part of Estremadura, within the urban unit of Palmela on the small peninsula across the river from Lisbon, is the open air site of Casal da Cerca (Silva & Soares 2014). The ceramic collection is clearly dominated by incised and grooved decoration, followed by the different modes of impressions, of which the Cardial and the Boquique styles are only marginally present (four and three fragments respectively). One AMS date, made on charcoal, is available, 6160±50 BP, which when calibrated positions the Neolithic layer in the last two centuries of the 6th millennium BC.

A similar archaeological assemblage has been recovered from São Pedro de Canaferrim on Serra de Sintra near Lisbon. Two pairs of dates have been published (Simões 2003). The first pair, made on charcoal samples from different context of the same Early Neolithic layer, dates the site between 5200 and 4740 cal BC[7]. The second pair, made also on charcoal, is roughly consistent between 5300 and 5100 cal BC. The pottery decoration consists mainly of bands of short linear impressions, incised and grooved parallel lines, as well as some relief cordons. Cardial decoration is absent.

The ceramic complex of São Pedro de Canaferrim is so similar to Valada do Mato that it is tempting to suggest the latter is an outpost in the interior of Alentejo, or a direct descendant of the previous. Valada do Mato is an open air settlement near Évora (Diniz 2007; Diniz 2012). Numerous domestic and storage features have been discovered since 1995. All clay and stone material is being reported as local, except for the fine quality flint. In addition to the dominant pottery as described in São Pedro de Canaferrim, Casal da Cerca and Gruta do Correio-Mor, in Valada do Mato also marginal quantities of Cardial and Boquique style impressions are present (around 2 % each). The mentioned high quality flint industry further reinforces the connections between the hinterland of Alentejo and Estremadura, as the nearest source for such a raw material is found there. Also the strategy of pre-testing and pre-preparing the cores, before bringing them to the site for further reduction is common for both São Pedro de Canaferrim and Valada do Mato (Simões 2003; Diniz 2012). Only one date is available from Valada do Mato, made on a charcoal sample. The resulting 6030±50 BP, after calibration, date the site in the timeframe between 5053 and 4793 cal BC (2σ, IntCal13).

Contemporary with these sites from Estremadura and Alentejo is Nossa Senhora das Lapas Cave, located in Upper Ribatejo in the same gorge of the Nabão River as Caldeirão.

[7] All the dates from São Pedro de Canaferrim, taken from Simões 2003, were calibrated using OxCal 4.2 and IntCal13, reported at 2σ.

The earliest Neolithic burial (layer B) is dated by a single date at 6100±70 BP (ICEN 802; IntCal13 at 2σ: 5218 – 4841 cal BC). Unfortunately, this cave is extremely poor in ceramic artefacts. From the mentioned burial phase only three undecorated rim shards from small restricted pots were discovered (Oosterbeek 1997).

In the nearby Caldeirão Cave, according to Joao Zilhão, the Cardial phase of the Early Neolithic (intrusions in layer Eb) is followed by an Epicardial phase (layer Ea), marked by non-Cardial impressed and incised pottery (Zilhão 1993). Three dates reported in the same source place this phase widely in the first half of the 5th millennium cal BC.

1.3.3. Andalusia (Spain)

Andalusia is one of the biggest autonomous regions of Spain and occupies the entire southern coast from Portugal to Cabo de Gata, bordering on the north to Extremadura, Castilla – La Mancha and Murcia. The easternmost dry region of Almeria has a very poor Early Neolithic record so far. Archaeological research projects in the Almanzora River and Vera valley (northeast of Almeria) have detected Early Neolithic human presence having cultural affinities with the impressed pottery producing groups of Southeast and East Iberia. In Cabecicos Negros, one of the most representative sites so far, the dominant decoration technique in pottery is impressed decoration, with a high presence of the Cardial type (Cámalich et al. 2004). It is a single occupation, open air settlement where erosion played its part, and even though dates are not available, the discovered pottery belongs to the Cardial horizon of the early Neolithic of Iberia.

The most prominent representative of the Levantine Cardial in Andalusia is Carigüela Cave (Pellicer 1964). It is situated further to the west, in the mountainous hinterland of Granada province. It is more famous for its Pleistocene deposits and the late Neanderthal remains, and a modern approach study and detailed publication of the archaeological remains from the Holocene layers are lacking. The decorated pottery assemblage at the base of the Neolithic sequence is dominated by Cardial impressions, alongside other types of impressions, *almagra*, incisions, and relief cords (Pellicer 1964; Muñoz 1975; Navarrete 1976; Gavilán Ceballos 1997). On the basis of his excavations in Carigüela, Manuel Pellicer (1964) established a tripartite periodisation of the Neolithic of Andalusia: Early (abundance of Cardial pottery), Middle (the dominant pottery styles being *almagra*, incisions, relief and other types of impressions) and Late or Final (when decorated pottery had almost disappeared). Using this periodisation widely throughout the following decades caused serious debates about its validity, since none of the other Neolithic sites in Andalusia had

levels in which the Cardial is the dominant pottery style. Maria Soledad Navarrete (1976) in her PhD thesis for example, presenting a summary of the known sites by then, argues that the early phase of the Neolithic is reserved for Carigüela XVI-XIV and some pottery shards collected from the surface at two other locations, while twenty other sites (among which Nerja and Murciélagos) are attributed to the middle to final Neolithic. Today, after forty years of research and discussions, it is clear that the Carigüela stratigraphy is rather an exception in the Neolithic of Andalusia, and therefore a periodisation cannot be based on it. A recent palynological study included the Holocene layers and made a series of radiocarbon dating on organic clay samples (Fernández et al. 2007). The earliest Neolithic of Carigüela is dated at 5301 – 5216 cal BC (Fernández et al. 2007, Table 3; IntCal 13 calibrated at 2σ).

The majority of Neolithic sites of Andalusia lack or have a very scarce presence of Cardial pottery. A good example of the diversity of the Neolithic of Andalusia is the Nerja Cave complex. The cave is situated on the Mediterranean coast near Malaga and represents a large cavity with many chambers. In one of them, the "Vestíbulo Hall", no Cardial nor any Boquique pottery have been discovered (although Cardial is present in very small quantities in some of the other chambers; García Borja et al. 2010). The early Neolithic level 2 is overlaying an Epi-Magdalenian layer 4 and Geometric Mesolithic level 3. The decorated pottery is characterized by the dominance of impressions, mostly on relief bands, followed closely by various patterns of body impressions. There is also a significant presence of red paint or slip (*almagra*), as well as red and white paste incrustation of impressed motifs. A sheep bone fragment from the earliest Neolithic level was dated at 5630-5470 cal BC (at 2σ; García Borja et al. 2010, p. 112).

The coexistence of two different ceramic decoration traditions in Andalusia during the second half of the 6th millennium cal BC is beyond doubt. What can and should be discussed is the origin of the differences observed in the pottery assemblages and what do they really represent. Observing these pottery "entities", one should have in mind that the various groups might be more obvious to us today than to the Neolithic societies. Archaeologists are often inclined towards drawing strict borders, even though the lines were rarely, if ever, part of the Neolithic reality. Almagra pottery in small quantities is found even in the caves of Valencia, as Cardial is scarcely present in Nerja also.

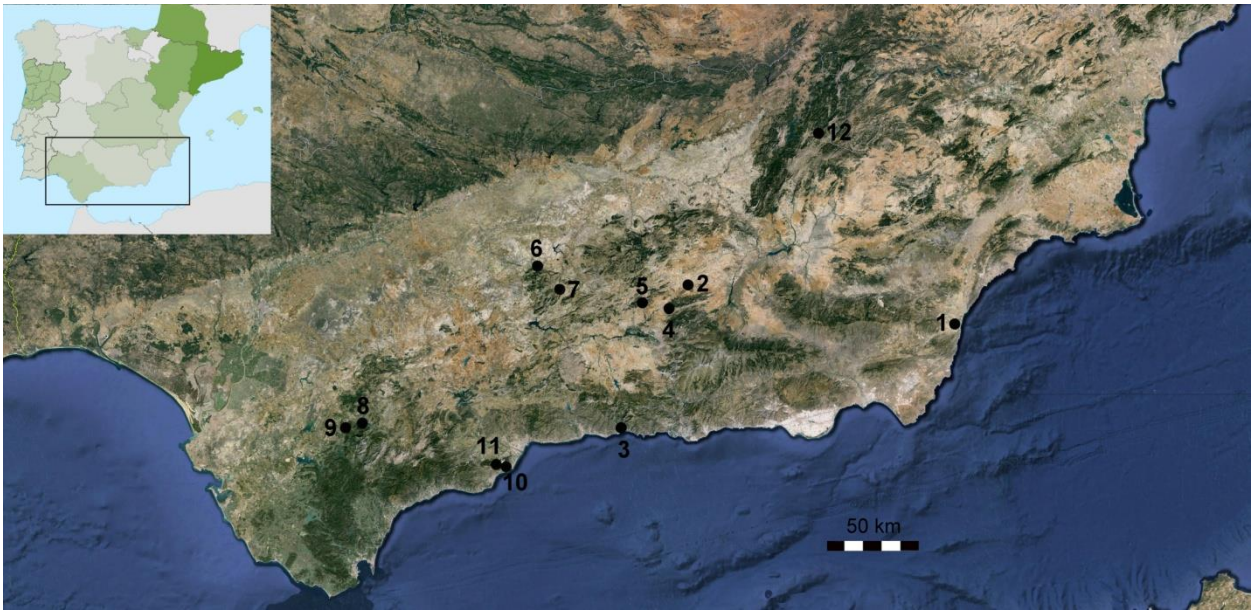


Figure 1.9 Map of Andalusia with sites mentioned in the text: 1. Cabecicos Negros; 2. Carigüela; 3. Nerja; 4. Las Majolicas; 5. Malalmuerzo; 6. Los Murciélagos; 7. Los Inocentes and Tocino; 8. Dehesilla; 9 Parralejo; 10. Roca Chica and Hostal Guadalupe; 11. Bajondillos; 12. Nacimiento (base map: Google Earth)

Nevertheless, in a general perspective, in the northeast and the extreme east of Andalusia the pottery assemblages display heavier influence from the Cardial tradition from the coast of Valencia, even though the almagra "element" is present also. This group is mainly represented by Carigüela, but surface collections from sites like Las Majolicas and Cueva de Malalmuerzo are often included (Gámiz Caro 2011). The rest of the province and the majority of early Neolithic sites from Andalusia find closest similarity with Nerja. This group of sites, represented by Nerja, includes Cueva de Los Murciélagos, Bajondillos, Roca Chica, Hostal Guadalupe, Dehesilla, Parralejo, Cueva de Los Inocentes, Cueva del Tocino and Cueva del Nacimiento among others. The problem is the scarcity of reliable radiocarbon dates. Some of the sites can probably be attributed to 5th and 4th millennia cal BC, but in terms of pottery, no significant developments can be appointed to a separate middle Neolithic phase. Therefore, recent doubts on the application of the tripartite system for this group of sites seems justified (Gavilán Ceballos & Vera Rodríguez 2001). A comparative approach towards an in-depth characterisation of pottery from a wide range of sites from Andalusia, supported by reliable radiocarbon sequences, should give a clearer view over the appearance and further development of this South Iberian ceramic group, as one of the three early Neolithic ceramic traditions in Iberia (Alday Ruiz & Moral del Hoyo 2011).

As far as origin is considered, it seems clear that the Cardial pottery of Andalusia finds its closest similarities in the region of Valencia, and with that in the general western

Mediterranean early Neolithic (Gámiz Caro 2011). On the other hand, the explanation of the origin of the *almagra* ceramic group of Andalusia has lately found a renewed interest in the African paradigm (García Borja et al. 2010; Cortés Sánchez et al. 2012; see page 19).

1.3.4. Extremadura (Spain)

Extremadura is a landlocked region in the southeast of Spain, bordering Central Portugal (Fig. 10). It is traversed by the Tagus and Guadiana Rivers. The Neolithic record so far is coming almost exclusively from the north part of the province: the Cáceres region and the Tagus fluvial system.

The Canaleja Gorge complex, featuring Canaleja 1, Canaleja 2 and Tio Republicano, has served as a series of locations for depositing human remains continuously from the early Neolithic until the end of the Chalcolithic, with sporadic use of the caves in later periods as well. Canaleja is a torrent tributary to the Tagus, northeast of Cáceres. Based on a single charcoal date from a hearth from base level 5 of Canaleja 2, Mesolithic use of the rock - shelter during the 8th millennium cal BC has been suggested (Cerrillo-Cuenca & González Cordero 2011). This shows a continuous use of the area from times preceding the Neolithic. While this claim needs to be supported by new excavations and more dates, information coming from other nearby areas seems to make it valid. A breccia unit at El Conejar cave, associated with macrolithic tools, has been dated towards the end of the 8th millennium cal BC (Canals et al. 2004). Human activities during the Mesolithic have also been reported from Cueva de los Postes in South Extremadura, a site which is also the subject of this study (see chapter 3).

In level 4 of the same shelter, sparse human remains were discovered, which led the authors to interpret the site as a place for natural excarnation of the body, before the final burial in a different position. According to the dates obtained from dispersed charcoals, these events were taking place in the last three centuries of the 6th millennium cal BC (Early Neolithic). The discovered Boquique style pottery fragments and a quern confirm this chronology, but also suggest that more mundane activities were happening around the rock-shelter as well.

The nearby caves Canaleja 1 and Tio Republicano are dated in the Middle Neolithic and the Copper Age, respectively. More complex burial practices are registered, especially in Tio Republicano, where remains from disarticulated human bodies were mixed with animal bones in an ossuary and sealed with clay. Cremation is also reported (Cerrillo Cuenca & González Cordero 2014, p. 80-82).

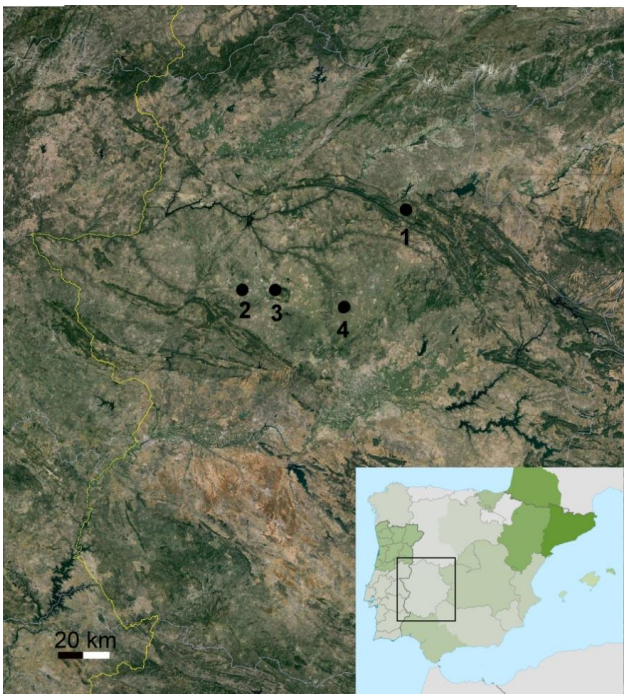


Figure 1.10 Map of Extremadura with the sites mentioned in the text: 1. Canaleja 1, Canaleja 2 and Tio Republicano; 2. Los Barruecos; 3. El Conejar; 4. Cerro de la Horca (base map: Google Earth)

Aspects of settlement life in Extremadura are best known from Los Barruecos, an open – air site 15km west of Cáceres (Cerrillo-Cuenca, García García, et al. 2006). Three phases of the Neolithic are reported, followed by Copper Age, Bell Beaker and Bronze Age levels; at the top of the stratigraphy is a disturbed layer with scattered Iron to Modern Age remains.

The beginning of the sequence, the early Neolithic phase, is dated at the transition from the 6th to 5th millennium cal BC (Cerrillo-Cuenca, Prada Gallardo, et al. 2006). Habitation structures are not discovered, but the settlement character of the site and the agricultural activities in it can be inferred from the identified hearths and storage facilities. Open shapes are most common in the ceramic vessels assemblage. The pottery is mostly plain, with a significant presence of impressed pottery (one item in Boquique style; the main part of this pottery style is marked as pottery inter-phase I-II), as well as some incised, grooved and appliqué-decorated fragments.

The Middle Neolithic phase is dated to the second half of the 4th millennium. In terms of pottery, two important developments are noted: the incisions overcome the impressions as the dominant decoration style, and pottery appears having a single horizontal groove below the rim. The second feature is also appearing regularly in megalithic contexts.

Decorated pottery almost disappears in the Final Neolithic (a few impressed, incised and some painted linear motifs), but the context representing this phase is a "V" shaped ditch, which was probably at the periphery of the main activities area.

More insights into the Early Neolithic economy were provided by pollen studies. In Barruecos, as well as in Cerro de la Horca, an open air site west of Cáceres with a complex horizontal stratigraphy, traces of cereal cultivation were detected (López Sáez 2006; López Sáez et al. 2007). The reported pottery from the latter site is comparable to Los Barruecos phase I and inter-phase I-II, with Boquique and other impressions dominating the decoration techniques.

El Conejar is a cave with a disturbed context. It was excavated in the early 1980s, and the material was revised and reinterpreted at the end of the 1990s (Cerrillo-Cuenca 1999). Beside the mentioned breccia with Mesolithic stone implements, there is a ceramic corpus, clearly associated with the Neolithic. Impressions are the dominant decoration style, among which Boquique pottery is the most abundant.

As more and more of the Neolithic of Extremadura is unravelled, it becomes clear that these territories of the Iberian interior were part of a larger Early Neolithic entity, spread over a large area including the Central Iberian Plateau, Extremadura and Central Portugal. Obviously, the Tagus and Douro rivers played a key role in the landscape of these communities, not only by providing essential subsistence resources, but also by facilitating communication networks. In general terms, the early ceramic production is marked by the Boquique style decorated pottery, even though the decoration diversity is significant. In an overview of the Iberian sites where Boquique pottery appears, Alday Ruiz and Moral del Hoyo (2011) give a chronological framework for the Boquique "dominion", the lower bar being the middle of the 6th millennium cal BC. The obtained absolute dates so far position the earliest pottery levels from North Extremadura in the last two centuries of the 6th millennium cal BC. The Early Neolithic record from South Extremadura is extremely poor so far, but this could reflect the imbalance in field research activities, since Boquique influence can be seen as far South as Cordoba.

1.4. Conclusion to chapter I

None of the progenitors of the domestic species, found in Early Neolithic sites in Iberia, are native to Western Europe. Paleogenetic studies have contributed greatly in resolving these questions (Zeder 2011; Arbuckle et al. 2014). Today, the Near Eastern origin of the domestic species of the European Neolithic is widely accepted. The results from human genetic studies however, as mentioned previously, are not so straightforward. Therefore, the issue that remains unsettled is how the domesticated plants and animals arrived to Europe. In Iberia, the far West of Europe, this is the core question of the neolithisation debates. There are two obvious possibilities. One is that they were brought by migrating groups of farmers, who were relying on them as a basis for subsistence and supporting the sustainability of the new colonies. The other possibility is that they were introduced as exchange commodities into an existing network of hunter – gatherers. More often than not, these two possibilities have been viewed as mutually exclusive theories. The abundant and diverse archaeological record however has lately inspired some more integrative models.

From pottery perspective, during the Early Neolithic period Iberia is part of the Central and Western Mediterranean group, which is characterized by impressed decoration. There is, however, large variability in the decoration patterns within this group. The peninsula represents a variegated picture of various ingredients, almost randomly dispersed throughout the territory. If generalized on the basis of the decoration modes, we can distinguish three entities. The Cardial is distributed on the eastern coast (Catalonia, Valencia and East Andalusia) and in two areas on the Atlantic coast (Western Algarve and Estremadura); on the east coast of Iberia, similar to Liguria and South France, the dominant presence of the Cardial is associated with a secondary phase of stabilisation, following an initial phase where this style played a minor role; on the Atlantic coast there is still much controversy as regards the reliability of the available radiocarbon dates; it is possible that since the early days of pottery use, two contemporary decorative traditions were present, distinguished by the presence and quantity of Cardial; while the Cardial is more localized and, as Zilhão demonstrates, linked to the sites around Valencia, the groups not sharing the Cardial preference are more widely dispersed and probably associated with the next entity.

The Boquique is found mainly in the interior of the peninsula, from Alentejo, through Central Meseta and Douro, to the Ebro Valley. Unlike the Cardial, the Boquique is always a small minority in the assemblage. Even though visually similar to *sillon d'impressions*, which is found mainly in the early phases on the south coast of France and Valencia, Alday Ruiz

and Moral del Hoyo (2011) found some technological differences, distinguishing them as two separate decoration styles. Some of the most prominent sites representing this style are La Revilla del Campo and La Lámpara in Ambrona, Los Cascajos and Atxoste in Ebro, El Mirador and La Vaquera in Northern Meseta, Canaleja I and II in North Extremadura, Valada do Mato in Alentejo and Buraco da Pala in Northern Portugal. The Boquique style is associated with the Early Neolithic phase of each of the mentioned regions.

Almagra is the Spanish term for the red ochre pigment, used for colouring the surface of the pottery vessels. It is used to name the decoration style present mainly in Central and Western Andalusia. Well represented in Early Neolithic levels in sites like Nerja, this decoration technique has a wider chronological frame and can be recognized in sites dated in later periods of prehistory.

The theoretical constructions presented in this chapter seem to agree that the common origin of the Iberian pottery is in South Italy (even though the discussions continue whether the commodity travelled as an object or as technological knowhow (or both), and whether it passed through the French coast, the islands, or the African coast). On the way, the ceramic traditions obviously underwent a process of diversification, part of a wider process of "re-composition of the Neolithic technological system" as Manen et al. (2007) and Manen & Perrin (2009) put it, manifested in the parallel existence of the three general decoration modes. These entities however, even though some patterns can be observed, should not be considered in a strictly spatio-temporal framework. Almagra is also found further north in Extremadura and Central Portugal. Boquique is present in the Cardial levels of Cisterna and Pena d'Agua in Portuguese Estremadura. Cardial shards are also present in assemblages primarily associated with the Boquique or Almagra traditions. The absolute chronology record is still not complete and is reliable if used for specific site or limited region only. In the end, what do the different pottery traditions in Iberia represent? Are the decoration styles really manifestations of different "cultures"? Probably these differences are more obvious to modern archaeologist than to the prehistoric people. After all, a very large (if not larger) part of all the ceramic assemblages is a mixture of still unsorted and unlabeled modes of impressions, incisions, plastic applications, or combinations of them.

CHAPTER 2: METHODOLOGICAL APPROACH

The pottery study approach used in this thesis can be grouped in two general categories: typological assessment, and pottery use and prehistoric diet. The first category refers mainly to the formal typology based on morphometric characteristics of the entirely or partially preserved and indentified vessel shapes. It also includes some basic technological traits and handling characteristics. As noted in further bellow (section 2.1.1), this kind of assessment provides the necessary base for any further higher-level pottery study.

The pottery use, or function, and the prehistoric diet are identified from the ancient lipids extracted from the pores of the pottery fabric. The importance of associating pottery function and shape, as well as the establishing of the subsistence pattern of prehistoric societies is self explanatory. One of the most important implications is the re-evaluation of the role of the secondary domestic animal products (in this case the milk and dairy products) among these early farmers, which also addresses other important questions regarding the palaeoeconomy, social structure, mobility etc.

Both methodological categories are embedded in a matrix of contextual assessment of the sites and the pottery collections, supported by absolute dates from radiocarbon measurements on relevant samples.

2.1 Typology

2.1.1 Morphology

Sorting the different elements that surround us into categories is a basic method of systematization, an instinctive response to our inherent need to understand reality. In this sense typology is the basic tool in archaeology when dealing with variety of artefacts from distant epochs, arriving into our reality through excavation. This process, of course, begins in the field, when artefacts are sorted into pottery, lithic artefacts, metal objects, bone remains etc. Here, we have already limited our study to the ceramic assemblages. Pottery is our reality. By recognizing morphological and physical traits in each of the units in our assemblage, we are able to sort the pottery into several groups. Sliding vertically the level of observation (whether the traits considered are primary, secondary, tertiary etc.), these groups are further divided into subgroups, which are divided into some more subgroups. This exercise gives us a clear view over our collection and, as said before, is a basic step towards more complicated reasoning, leading to more significant knowledge about past societies.

When dealing with complete vessels, or at least vessels with preserved parts of the rim, the entire length of the body, and the base, the obvious subject of classification would be the shape. The classification used here is based on five general types of vessels. A three-digit code system is used for easier data manipulation. The first digit (X00) is marking one of the four basic categories, the second is standing for subdivisions within the four major categories (XX0), and the third is reserved for further varieties within the subgroups (XXX). During the course of work it was established that a system with this size of range, with three levels - nine variations in each level, is sufficient for our assemblages. For the sake of simplicity, without relating to previous definitions of the various nominations used in pottery typology, these basic shapes will be named plates, dishes, bowls and jars.

Plates (T100) are open, shallow vessels. The rim is the widest part of the vessel, and their height is less than (or equal to) 1/3 of maximum diameter.

Bowls (T200) can also be seen as deep plates. They are also open vessels; in most of the bowls the orifice is the widest point on the body. The bowls differ from the plates in their height, which is larger than 1/3 of the mouth diameter.

Pots (T300) have inverted rims, so that the rim diameter is smaller than the maximum vessel diameter (the shoulder), but never less than 2/3 of it. They can be considered as semi – open containers; even though their rim has a closing tendency, the interior is still easily accessible (for adding, stirring or removing contents).

Jars (T400) are closed vessels. Their opening has a diameter smaller than 2/3 of the largest vessel diameter, which is the shoulder. Often they have neck and rim, but there are examples without these elements (the latter are often referred to in literature as “holemouth jars”).

Lamps (T500) are a special type of small closed vessels. They can contain small horizontal tunnel-shaped handles or not. Even though their name implies function, this is yet to be demonstrated.

Obviously, for the purposes of the morphometric criteria in this classification, measurements of the artefacts are required. These include the rim diameter, the largest diameter and height. Additionally, the wall thickness was measured in all artefacts. The size and weight of artefacts was also measured. These, together with the level of abrasion, could give useful information for the nature of the deposit and eventual post depositional movements.

Not always however the complete vessel shape is detectible. Normally, the bulk of the ceramic assemblages are small fragments, representing parts of the body, base, rim or handle. Making a typological classification of the separate elements can be very useful in detecting more subtle differences within the general shape categories, dividing them into subgroups. Furthermore the patterns of change in some of the morphological traits of the elements could reflect chronological or regional differences. For this reason, all the artefacts from our assemblage, regardless of size or which body part they are representing were assessed. This includes recording the various types of handles and bases and lips.

Handles		
1.	Tongue-shaped lug	
2.	Button	a. Round plan
		b. Trapeze plan
3.	Vertical strap handle	a. Plain
		b. Relief
4.	Horizontal strap handle	
5.	Handle with round cross section	
6.	Lug with horizontal perforation	
7.	Vertical loop	

Table 2.1 Handle typology

Handles are rare feature in all of our collections, with only few representatives in each group. There are six different types of handles, two of them having two varieties each (table 2.1):

1. Tongue-shaped lug (H1) is a small application with handling function. A pair of them is positioned symmetrically on the sides of a vessel. Usually they are attached to the upper part of the body.
2. Buttons (H2) are small lumps of clay attached to the vessel exterior, which helped for easier handling of the pots. Two varieties are present, one with round (H2.a) and another with trapeze base (H2.b).
3. Vertical strap handles (H3) are present in two of the collections, and in both cases are introduced as intrusions from later prehistory and Roman Age. There are plain straps (H3.a), or those with longitudinal grooves, giving a relief look to the handle (H3.b).
4. Horizontal straps (H4) are different from the vertical in many ways. Firstly, they are smaller; while the vertical straps were ergonomically fitted for the hand, the horizontal ones were probably equipped with ropes through their openings, which suggests different manipulation system and different function of the vessel; finally, even though our only sample comes from a disturbed context, there also might be a chronological difference, with the horizontal kind being earlier.
5. There is also only one example of handle with round cross section (H5). In terms of functionality and stratigraphic association, they are similar to the vertical straps.
6. Tunnel-shaped horizontal perforation (H6); these are often found on the vessels called lamps, present in the Chalcolithic layers of the dolmens; they are usually positioned on the prominent crest on these odd shaped vessels; the perforation is 2 or 3 mm, so only a very thin string would pass through, but that would be sufficient to support the weight of these small-sized "lamps" (Fig. 2.1).

Fig. 2.1 Upper part of a "lamp" with four perforated lugs as suspension system (source: CPH-IPT archive)

Throughout the entire ceramic assemblage from the three sites, seven different types of **base** appear:

1. Convex (B1) is the most common type of base for the ceramic vessels, especially during the Neolithic and Chalcolithic period.
2. Flat bases (B2).
3. Low flat pedestal (B3); the body is clearly distinguished from the wider base.
4. High concave pedestal (B4); the vessel stands on a relatively high pedestal; the concavity of its lower surface is more or less pronounced.
5. Low cylindrical foot (B5).
6. Ring base (B6).
7. Concave base (B7); smoothly curving concavity from the exterior towards the centre.

Another feature of the rim, whose variety is worth recording for comparative purposes, is the type of the **lip**. Eight different varieties are recorded: rounded, thinned, bulged, flattened, flaring, segmented, wavy, and lip with internal edge or crest.

2.1.2 Decoration

The pottery decoration has been one of the most frequently used attribute for typological classification. Often however, elusive or subjective labels and definitions for the different categories are used. Furthermore, excessive focusing on semantics of ornamental motifs or their varieties can be confusing and sometimes useless. With the hope of avoiding these and similar limitations, coding system has been employed here (Table 2.2).

The codes consist of three parts. First is a three-letter abbreviation of the name of the decoration technique (INC for incision, IMP for impression and so on). Added to this follows a number that represents the sub variety of the decoration technique. These sub varieties are explained in table 2.2. At the end of the code is a single letter, marking the position on the vessel where the decorative motives were applied: a) body exterior, b) body interior, c) lip, d) carination. So, an example of a decoration code would be INC.4.d, which means the artefact has short vertical notches incised on the carination.

INC	1	Unidentified complex pattern of various incised lines
	2	Horizontal row of alternating oblique short lines (“/ \”)
	3	Single horizontal incised line under the rim
	4	Short vertical notches
	5	Horizontal row of short oblique lines
	6	Horizontal rows of horizontal and oblique short notches
	7	Very shallow random “scratches”
	8	Single horizontal zigzag line
	9	Pair of short oblique lines
	10	Shallow and wide undulating vertical line
	11	Shallow and wide undulating horizontal line
	12	Fine horizontal parallel lines
	13	Comb – horizontal row of parallel undulating lines
	14	Comb + “V” (horizontal rows of straight parallel lines and repeating “V”)
	15	Comb – horizontal row of parallel straight lines
	16	Grid – formed of horizontal, vertical and oblique lines
	17	Horizontal row of short vertical zigzags
IMP	1	Fingertip
	2	Cord-wrapped tool
	3	Sharp-edged tool
	4	Small pits (impressions of blunt tool)
	5	Horizontal and vertical rows of stabbings (sharp tool)
	6	Small elliptical pits
	7	Fingernail
PNT	1	Red painted surface (“almagra”)
	2	Thin black and wide red alternating horizontal bands
	3	Red horizontal bands
	4	Black painted surface
APP	1	Horizontal seriated relief band under the rim
	2	Buttons
GRV	1	Very shallow parallel vertical grooves
	2	Very shallow parallel oblique grooves
BAR	1	Organized barbotine; unidentified complex pattern
CMB	1	Incised lines + stabbings (impressions of blunt tool point)

Table 2.2 Decoration varieties within the three pottery assemblages

2.3 Pottery use and prehistoric diet

The function of the pottery is usually inferred from its shape. In general plates and bowls are associated to food consumption. Pots were probably used in a wide variety of activities. They are the most probable candidates for the various stages of the food preparation process. Temporary storage of food is another possible role. Outside of the kitchen or household, they could also be used during communal activities, even though utilities from perishable materials were probably preferred. Jars are usually associated to storage and transportation functions. The study of the ancient lipids however, provides a more specific method from assessing vessel function.

Because of its porosity, prehistoric (unglazed) pottery retains lipid molecules of the substances which are processed or stored inside. In the early nineties Richard Evershed was the first to apply gas chromatography–combustion–isotope ratio mass spectrometry (GC–C–IRMS) on archaeological material, to extract and identify these molecules with great precision (Mottram et al. 1999, p. 210). Since then, this method was widely employed in archaeological research (Evershed et al. 1994; Dudd & Evershed 1998; Mottram et al. 1999; Copley et al. 2003; Evershed et al. 2008; Türkekul Bıyık 2009; Salque et al. 2015; Nieuwenhuyse et al. 2015). This is one of the most important collaborations between chemistry and archaeology, especially significant for the study of the neolithisation process, providing a new social perspective on pottery and domesticates by giving invaluable information about diet and human-nature interaction during such an important transitional phase of humanity.

Using high-temperature gas chromatography (HTGC), the method is set to detect biomarkers of lipid molecules, absorbed inside the microscopic pores of the pottery matrix. The procedure prior to HTGC includes: a) mechanical elimination of possible contaminations from the sample surface; b) pulverisation of the remaining body of the sample; c) using a solvent and a set of chemical procedures, the lipid remains are extracted and submitted to the chromatograph (Evershed et al. 2008; Türkekul Bıyık 2009). Of course, visible organic remains on the surface of a pot (in the form of soot or attached carbonized remains) can also be analysed, but since those are more exposed to the environment and is more likely to be affected by negative post depositional influences or contaminated from modern lipid molecules, the extracted material from the matrix is preferred. The protective environment of

the pores, where oxygen and external influence are minimal, significantly slows the degradation process of the lipids (Türkekul Bıyık 2009).

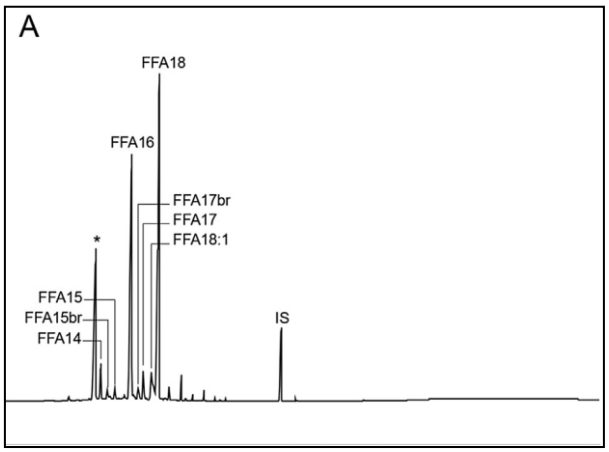


Fig. 2.2: An example of gas chromatogram of total lipid extract from pottery sample (Nieuwenhuyse et al. 2015)

The most important components on the resulting chromatogram are the palmitic ($C_{16:0}$) and stearic ($C_{18:0}$) fatty acids (fig. 2.2). The measurement of their $\delta^{13}C$ (stabile carbon isotope ratio) permits identification of their origin, and therefore the original content of the vessel (fig. 2.3). First of all, milk can be distinguished from adipose fat (meat). In the case of the later, ruminant's meat can be distinguished from pork (Copley et al. 2003). In addition, birch bark tar and wax esters deriving from beeswax can be detected (Urem-Kotsou et al. 2001; Salque et al. 2015).

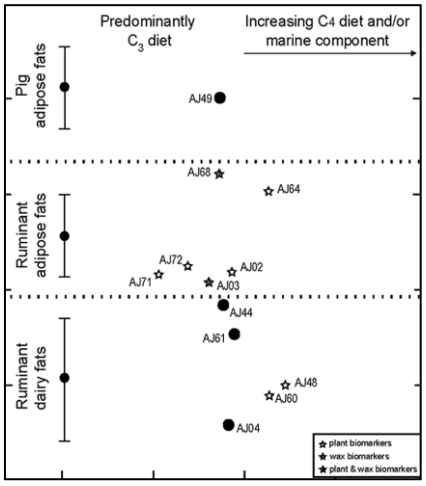


Figure 2.3: An example of $\delta^{13}C$ values scatter plot (Šoberl et al. 2014)

The significance of this kind of analysis for the archaeological debate is manifold. Since it was first presented, the "secondary products revolution" of Andrew Sherratt (1981)

was the most influential theory concerning the introduction of milk to human economy (together with other secondary products from domestic animals, like traction force and wool), according to which this event took place during the 4th millennium cal BC, i.e. there was a significant gap between the first domestication of animals and their exploitation for secondary products.

With the implementation of GC-C-IRMS however, a reliable method to test this theory was available. Copley et al. (2005) demonstrated that dairying was practiced in Britain since farming was first introduced (5th millennium cal BC). It was obvious that the origins of this craft had to be traced back on the neolithisation route. At the same time, Craig et al. (2005) tested samples from two sites in the Carpathian area and discovered that here also dairying played a role in the economy since the introduction of agriculture to the region (early 6th millennium cal BC). Richard Evershed and his team undertook a vast lipid residue analysis project, processing over 2000 pottery samples from 23 sites throughout the Near East and South-east Europe, covering the two millennia during which farming spread from the Levant to Central Europe (7th - 5th millenium cal BC; Evershed et al. 2008). They have managed to trace milk processing back to the core area of neolithisation, and also back in time to the beginning of pottery Neolithic. An important part of their results was the identification of an area in the Marmara region of NW Anatolia, where dairying was especially significant part of the economy during the second half of the 7th millennium cal BC.

Laurens Thissen, working on material from Central and North-western Turkey, has noted the relationship between pottery technology and typology on one side, and the development of new cooking techniques and vessel manipulation on the other (Thissen et al. 2010). During the first half of the 7th millennium cal BC in Çatalhyuk there is a transition from thick-walled fibber-tempered and bucket-shaped vessels towards more globular shapes with thin walls and mineral temper, featuring various handles and suspension lugs. The first are associated with cooking method which uses pre-heated stones (or clay lumps) for indirect heating of the contents. The later are already fit to be used for direct heating over the fire, where manipulation and heating temperature control were facilitated by the handles (Thissen et al. 2007; Thissen et al. 2010). The new cooking methods opened new possibilities for processing and consumption of resources which are/were unsuited for the human organism in their natural state. One of these was milk. The –13 910*T allele in human genetics, responsible for the lactose tolerance, is thought that have developed rapidly during the early Neolithic of the central and northern Balkans (Budja 2014). As a result today this allele is

more frequent in northern European populations. Milk consumption (in the form of dairy products) in 7th and 6th millennium cal BC in Anatolia and South-east Europe was made possible with the development of pottery technology and cooking strategies, which allowed better control of the cooking temperature and better vessel manipulation, both necessary for milk processing. The integrative approach of Thissen combines the chemical analysis of organic residue in pottery, with pottery technology and typology studies, providing different levels of understanding of prehistoric societies.

Archaeozoology is another complementary field which provides important collaboration with organic residue analysis. Kill-off patterns give insight into the herd management models in prehistoric societies. Such information could support each other with lipid molecules identification (Vigne & Helmer 2007; Salque et al. 2012).

These are only some of the milestones of the development of the method and its implementation in archaeological studies. The possibilities are still unexplored completely, as the method is advancing with technology and is yet to be applied in diverse regions of the World, addressing variety of archaeological questions. Iberia is one of the regions where the potential for organic residue analysis have not been tested. There are numerous open questions concerning the nature of the earliest farming communities, their relationship with the environment and the indigenous legacy. Existing archaeozoology studies confirmed the presence of domestic animals in our study region (Oosterbeek et al. 2014; Almeida et al. 2015), but we are yet to learn about the strategies of exploitation. Stable isotope ratios also provide information on the presence of marine resources in the Neolithic and Chalcolithic kitchen in the interior of SW Iberia. Some beeswax has already been detected at four sites in northern Spain (Salque et al. 2015).

Thirty-six samples from Cueva de los Postes and forty-two samples from Ana 1 de Val de Laje were taken for analyses. When possible, samples were taken from known forms. The results are combined with the information collected from typological and technological observations. The intention is to join the influx of contemporary interdisciplinary investigations of prehistory in Portugal and Spain. The organic residue results should serve as a base on which new research directions will be added in building a high resolution view on the onset of farming in Iberia, the regional differences in dynamics and the reasons for them.

CHAPTER 3: ARCHAEOLOGICAL CONTEXTS

The subject of my thesis focuses on the ceramic assemblages from three archaeological sites (Fig. 3.1). They have been systematically excavated in several campaigns during the past three decades. Some aspects of the pottery have already been presented in the past (*e.g.* Oosterbeek 1997; Fuying 2008). The ceramic material from the most recently excavated Cueva de los Postes is being studied for the first time.

Gruta do Cadaval and Anta 1 de Val de Laje are near one another, positioned in the central part of Portugal about one hundred kilometres up the Tagus valley from its estuary. The sites however are both located on the banks of two right tributaries of Tagus, the former on Nabão and the later on Zêzere.

Cueva de los Postes is a cave in the extreme south of Spanish Extremadura, in the limestone formation which marks the border with Andalusia. The Portuguese border is not far either, and the distance to Cadaval and Anta 1 is around 250 km in a beeline. The cave has been inhabited by humans at least since the Middle Palaeolithic.

The main reason for incorporating these three collections in a single study is because the sites represent the same wider geographic region – the interior of the SW part of the Iberian Peninsula (Fig. 3.1), and together, with partial overlaps, they cover the period from the onset of farming and pottery production in the region to the development of socially, politically and economically stratified societies of the Copper Age. Furthermore, the three sites are related to the same aspect of prehistoric communities – mortuary practices.

On the other hand, each of the sites represents its own unique geomorphologic and cultural history. The nature of the sites also varies – while Postes and Cadaval are caves, Anta 1 is a man-made megalithic monument. The differences extend to the material culture as well. One of the goals is to determine if these dissimilarities are the result of geography and geology, chronology, the environment, different socio-economic systems, or something else. For this reason each of the sites will be observed separately, discussing natural characteristics, the history of archaeological investigations, stratigraphy, chronology and the provenance of the pottery collections.

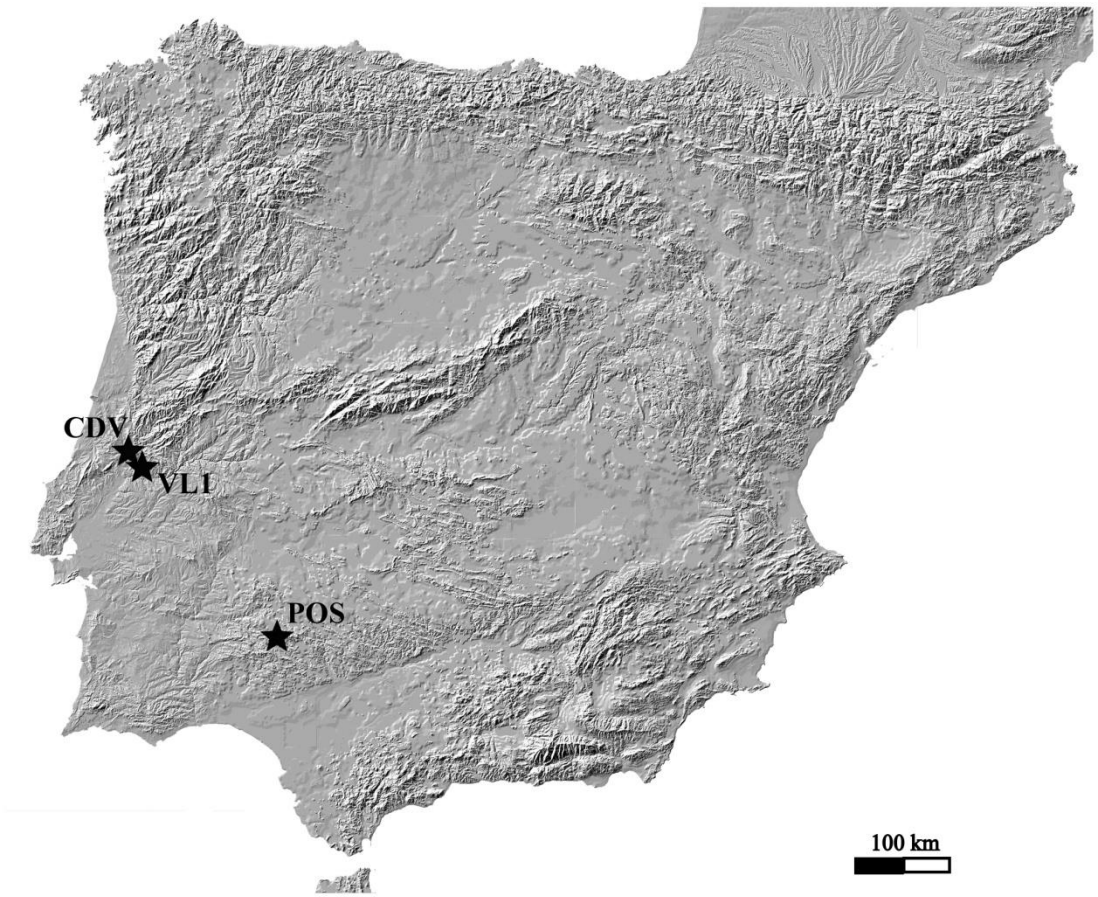


Figure 3.1 Map showing the location of the three subject sites in the frames of the Iberian Peninsula (CDV=Gruta do Cadaval, VL1=Anta 1 de Val de Laje, POS=Cueva de los Postes; source: mapknitter.org)

3.1 Cueva de los Postes (POS)

3.1.1. History of archaeological investigation

The archaeological investigations in Postes were initiated in 2004, in the context of a wider cultural heritage management project for touristic promotion of the caves of Fuentes de León Natural Park. Prior to that, the caves were explored twice. During the 1980s an amateur expedition discovered some prehistoric and Roman Age pottery in Cueva del Agua (Collado & Bello 2013). During 1997 and 1998 followed the first specialized prospection of the entire park, which documented the existence of five caves (see section 3.1.3) and two sinkholes (Sinkhole I and Cochinos sinkhole). In addition, archaeological remains were noted in three of the caves (Agua, Caballo and Postes), as well as some rock-art engravings on the walls of Agua (ibid.).

With touristic promotion of the region as a general context in mind, the excavations in Postes in 2004 were initiated near the entrance in the cave interior. This intervention discovered a significant stratigraphic sequence, covering a period stretching from the Early Neolithic to the Roman Age. As discussed in chapter 1, the interior of the peninsula (this region being part of it) has been mainly neglected in prehistoric archaeology, especially by Neolithic studies. Prior to this excavation, the archaeological record of the region included small settlements from the later Iron Age, a Roman *villa rustica* at Sexmo (whose existence is probably connected with the Roman remains in Postes) and the Medieval remains at Castillo del Cuerno. Only sporadic surface finds were known from the Copper and Bronze Age (Collado & Enríquez 2004; Olivares Marín n.d.). The importance of Postes was recognized and the excavations are still going on.

In the following years the excavations have spread in several sectors within the two chambers of the cave, as well as the outside area, and have reached Pleistocene layers with Middle Palaeolithic remains. Since the beginning the team of specialists is coordinated by Hipólito Collado. The multidisciplinary approach starts in the field and the team includes specialists in archaeology, palaeontology, anthropology, geology, sedimentology, anthracology, palynology and photography. So far, a short anthracology report has been published by Duque Espino (2011). The human remains were part of the PhD research project of Tiago Tomé (2011). The complete Holocene faunal record is part of an ongoing doctoral study by Nelson Almeida. Palynology results are also expected from the work of Cristiana Ferreira, as part of her PhD thesis. Besides few annual field reports, other unpublished partial reports exist on sedimentology, granulometry, lithic tools, faunal remains

and rock art. Building on this base, the present study tends to participate in revealing new aspects of the prehistory of the region, i.e. the typology, technology and sociology of the pottery remains. Prior to this work, a set of twelve dates, mainly on charcoal samples, were available. Together with eight new dates on human teeth provided in the framework of this thesis (see section 3.1.4), we have now a much clearer view on the stratigraphy and absolute chronology of Postes.

3.1.2. Geographic location

In terms of modern administrative boundaries, Cueva de los Postes (hereafter Postes) is located 6 km SE from the Fuentes de León town in the province of Badajoz, at the southern border of the Extremadura autonomous community of Spain. The small hill, containing Postes together with two other caves, stands above the confluence of Montemayor and Santa Cruz rivers (Fig. 3.2). The rivers flow in a general N-S direction, eventually joining Guadalquivir River and finishing in the Atlantic Ocean. The landscape is filled with elevated landforms, separated by creeks and rivulets, which constitute the westernmost parts of the Sierra Morena mountain chain.

Figure 3.2 Aerial view of the hill where the site is located

3.1.3. Geology and paleoenvironment

The group of caves in the region belong to the Fuentes de León Natural Park. Besides Postes, there are also Cueva Masero, Cueva de la Lamparilla, Cueva del Agua and Cueva del Caballo. The last two have also revealed archaeological remains, but Postes has seen the most intensive research. The natural park is a Cambrian limestone formation which saw some metamorphic and aquatic alterations during the following epochs (Collado & Enríquez 2004). In addition, the weathering process of the limestone left behind *terra rossa*. This clay soil is

present today inside and around the caves. As a result, the appearance of some of the pottery buried in it might be misinterpreted as *almagra* decoration. Another post-depositional alteration influenced by the geology is the frequent presence of calcium-carbonaceous layer on one or both surfaces of the pottery, and even there are cases where two or more artefacts are embedded together in a calcite matrix[8] (Fig. 3.3).

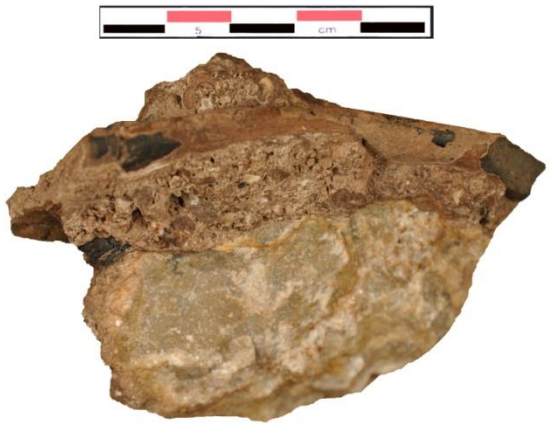


Figure 3.3 Calcite fused pottery, charcoal and stone artefacts

Recent palynology analyses of targeted stratigraphic layers from Postes failed to produce results. The sampled units simply did not produce significant quantity of pollen (Cristiana Ferreira 2016, personal communication, June).

A better insight into the environment provide the anthracology studies, according to which there is a major shift in the floral record from layer 12 to layer 5 (Duque 2011, fig. 1). The shift occurs between layer 9 and 8, and the tendency in some species continues into the following stratigraphic units. Evergreen species are scarcely present during the early Holocene. *Pinus nigra-sylvestris* appears in the record from layer 12 and 11, after which it disappears. *Juniper sp*. are present only until layer 8. Layer 11 also gives a weak signal of alder wood and willow, which do not seem to be present at any other moment in the region. The most obvious change happens with the olive tree (*Olea europaea*). This is the most abundant species until layer 9. In layer 8 it is still dominating with 70 % of the pollen record, but very soon drops to 45%, and then during layer 6 to 25 %. Oak species are present, but the oscillation in their numbers does not seem to reflect a pattern. Exception is *Quercus ilex-coccifera* which, contrary to the species mentioned so far, their number increases during and

[8] Calcification is especially present in the upper layers of the Hueco Eulogio sector in the back chamber.

after layer 8. The general post-layer 9 tendency is the increase in the quantity of smaller trees, shrubs and flowers. Among these, the most abundant are the strawberry tree (*Arbutus unedo*), *Pistacia lentiscus*, *Cistaceae sp*., *Leguminosae sp*., *Labiatae sp*. and *Rhamnus alaternus*.

According to the anthracology record, with the onset of the Neolithic a more open environment started to develop in the hills around the cave with the number of large tree decreasing, and small tree species, shrubs and flowering plants and grasses increasing. From the preliminary information that we have from the ongoing zooarchaeological study, this shift corresponds with the appearance of *Ovis/Capra* and *Sus sp*. in the record, probably starting from layer 9 onward (Nelson Almeida 2016, personal communication, 27 January). From the native wild species, Leporidae (mainly rabbits) are the most dominant, together with small carnivores like badgers and foxes. They are also present in the layers before the appearance of domestic animals. According to Almeida, their deposition in general seems to be independent from human activities. Humans probably visited the cave only sporadically for funerary purposes, and this pattern was similar before and after the introduction of farming (domesticated animals in the record). In other words, except for the new items they were leaving behind (i.e. pottery and sheep/goat and pig bones) we cannot detect a change in human behaviour pattern or their relationship with the site at the Mesolithic/Neolithic transition.

3.1.4. Stratigraphy, chronology and cultural affiliations

Postes is a cavity with an irregular shape (Fig. 3.4). It is a relatively small cave, with a total surface of 180 m^2. Two main chambers are separated by a row of stalactites and stalagmites (hence the name; *postes* in Spanish means posts). The cave is in a general W-E disposition, with a small path leading to the entrance of the first chamber from the NW. The excavations have been going on in two main locations in the interior and in one test trench outside the cave NE from the entrance (Fig. 3.4).

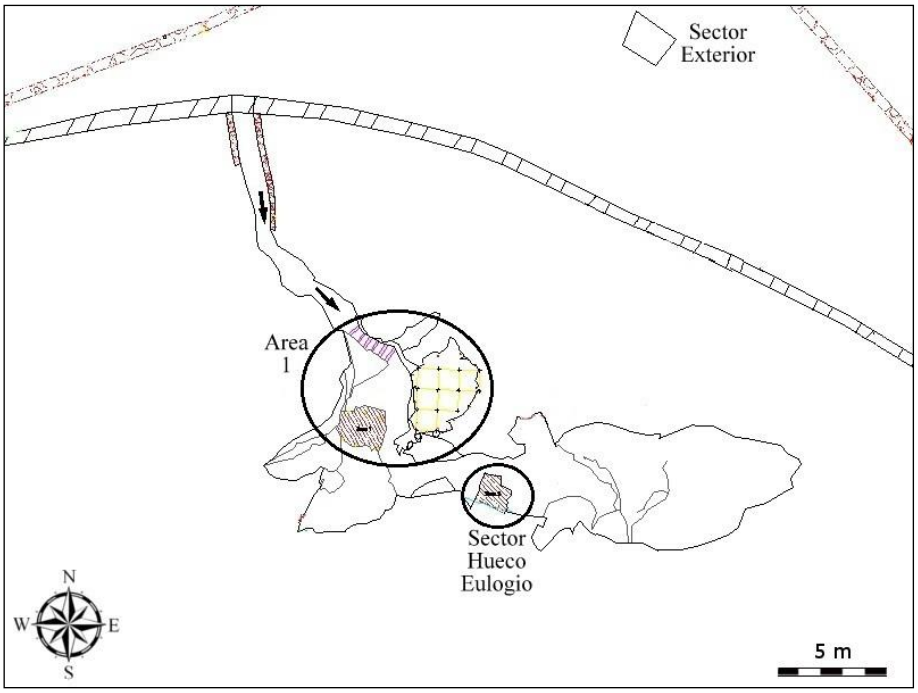


Figure 3.4 Plan of Postes; the three main excavation sectors are marked (plan base credit: H. Collado)

3.1.4.1. Area 1

The first chamber has been most extensively excavated. Starting with the adaptation of the entrance area for improving the accessibility of the cave for tourists, the following systematic excavations have spread on several other parts, covering almost the entire surface of the chamber. During the excavation, many denominations have been used for the different areas: *"zona derecha", "zona izquierda", Sector Oriental, Sector Occidental, "zona de las columnas"* etc. Since they all share the same stratigraphic sequence, for practical purposes they will be united here as Area1.

Since 2001, when Fuentes de León was proclaimed Natural Park, one trench was excavated in the interior of Postes at the entrance area without strict archaeological control, with the sole purpose of widening the approach towards the cave interior. Early in 2004 this trench was expanded 1 m towards West. Even though with better stratigraphic control, the precise information about the excavated area is lacking. Nevertheless, three geological strata were documented, containing six stratigraphic units (SU0 – SU5; Collado & Enríquez 2004). Later in 2004, the first systematic excavations were initiated. A grid of 1x1 m squares was positioned and the excavations were concentrated on 12 m^2 in the western section of the first chamber, where the stratigraphy from the entrance trenches was reconfirmed. The excavations are still going on in short annual campaigns. During the years the area in the

western part has been expanded for another eight squares, and since 2013 three more squares have been opened in the eastern part of the irregularly shaped chamber. To sum up, since the positioning of the grid, the total area under excavation in the first chamber is 23 m^2. The stratigraphy has also been expanded in some of the squares to SU 20 in depth. The entire sequence so far in Area1 belongs to the Holocene (Table 3.1).

Not considering the disturbed contexts in the first five stratigraphic units, three main chronological clusters of human activity can be distinguished in Area1 (Collado Giraldo et al. 2015). Each of them is with different length and has a different intensity. The interpretation of the stratigraphy was much aided by the absolute chronology measurements. There are eighteen available radiocarbon dates from the Postes Holocene sequence (Table 3.2), fourteen of which are from layers from Area1.

Table 3.1 schematic stratigraphy of Area1 in Postes

SU	Chronology	Relative depth
0-4	Mixed archaeological content from the Copper, Bronze, Iron and Roman Age, Medieval and recent history remains (disturbed context); Post 3rd millennium cal BC	0 to -0.4m
5-8	Middle and Final Neolithic; 4th millennium cal BC	-0.4 to -2.5m
9	Final Mesolithic/Early Neolithic; 6th and early 5th millennium cal BC	
10-14	Epipaleolithic and Mesolithic; Early to Middle Holocene	
15-20	Holocene fauna remains (no archaeological artefacts)	-2.5 to 4.26m

There is a significant stratum from the first half of the Holocene, prior to the arrival of pottery and domesticates (SU20 through SU10). The first six layers do not contain traces of human activities, only naturally deposited animal bones. SU 14 to 10 also contain faunal remains, but this time accompanied by stone tools, human bones and ornamental elements. The number of recorded layers however may be misleading. Sedimentology analysis has been performed from SU 6 to SU 14 (Hipolit Collado personal communication). According to the results, SU 10, 11, 12, 13 and 14 were formed during the same depositional process. This process was dated on charcoal samples between the 67th and the 62nd century cal BC. If we consider Poz-33225 (Figure 3.5) as an intrusion into SU 9 from the underlying layers, the timeframe is widened until the 69th century cal BC. Even though SU 15 was not included in the sedimentology study, based on the dates we can consider it as part of this continuous process of sedimentation. Dates are lacking from the underlying layers (SU 16 to 20). SU 10

and 11 were also not dated, but having in mind the sedimentology, it is unlikely they would exit the frames of the 7th millennium cal BC.

Table 3.2 List of absolute dates from the Holocene sequence of Postes (* - dates provided by Hipólito Collado)

	Lab code	SU/level	Square/sector	BP	+/-	1σ calibration	Material
1	SUERC-67523	7	A6/Area1	4435	33	3316 - 3013 cal BC	Human tooth
2	SUERC-67522	7	C6/Area1	4788	31	3638 - 3531 cal BC	Human tooth
3	SUERC-67524	8	B6/Area1	4452	45	3327 - 3024 cal BC	Human tooth
4	SUERC-67528	8	A6/Area1	4526	33	3353 - 3116 cal BC	Human tooth
5	SUERC-67529	8	B5/Area1	5089	31	3962 - 3797 cal BC	Human tooth
6	Poz-13703	8	Stone structure/Area1	5455	40	4347 - 4263 cal BC	Charcoal*
7	SUERC-67530	9	A6/Area1	4375	33	3019 - 2924 cal BC	Human tooth
8	SUERC-67531	9	A5/Area1	6025	30	4963 - 4849 cal BC	Human tooth
9	SUERC-67532	9	B5/Area1	6219	33	5286 - 5075 cal BC	Human tooth
10	Poz-33225	9	B4/Area1	7870	60	6899 - 6636 cal BC	Charcoal*
11	Poz-14616	12	B6/Area1	7360	50	6350 - 6102 cal BC	Charcoal*
12	Poz-18774	13	D6/Area1	7440	50	6376 - 6252 cal BC	Charcoal*
13	Poz-33226	14	C6/Area1	7780	60	6657 - 6510 cal BC	Charcoal*
14	Poz-18823	15(top)	B6/Area1	7630	50	6558 - 6432 cal BC	Charcoal*
15	Poz-33227	2	Hueco Eulogio	1420	50	593 - 659 cal AD	Charcoal*
16	Poz-34797	2	Hueco Eulogio	3225	35	1527 - 1448 cal BC	Charcoal*
17	Poz-33228	3/5	Hueco Eulogio	3740	40	2203 - 2045 cal BC	Charcoal*
18	Poz- 44045	3/5	Hueco Eulogio	4140	35	2864 - 2634 cal BC	Human tooth*

The archaeological remains in these Epipaleolithic/Mesolithic stratigraphic units correspond to funeral depositions by mobile groups of hunter-gatherers. Their visits to the cave were probably not very frequent, since bone remains indicate that most of the time the cave was inhabited by burrowing animals, mainly badgers and members of the *Leporidae* family (Nelson Almeida 2016, personal communication, June 16th 2016). There is however occasional deposition of human remains, which were accompanied by macrolithic stone-tools (Fig. 3.6) and engraved stone plates (Collado & García Arranz 2012). The tools find their parallels at other Epipaleolithic and Mesolithic sites in the northern and western part of the peninsula, the industry known as Languedocian, Mirian or Asturian (see section 1.3.2). There is an information that the burials were collective, and no burial or other structures were reported (Collado Giraldo et al. 2015). Three pottery fragments were found in the three uppermost Mesolithic layers (SU12, 11 and 10; one fragment in each). At this point of investigation, they will be treated as intrusions from the directly overlaying Neolithic.

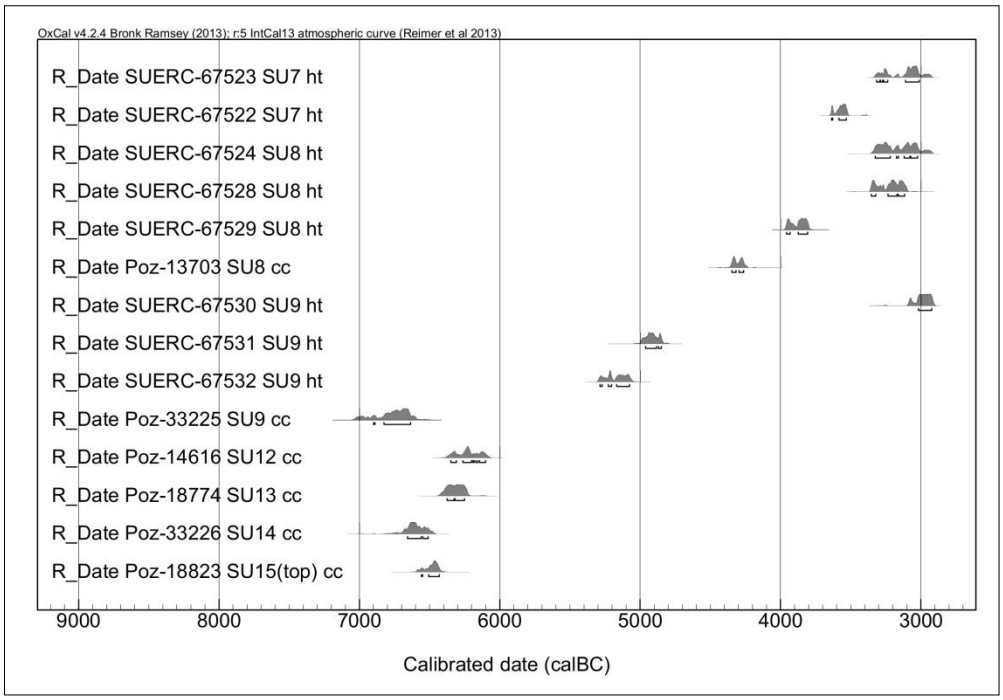


Figure 3.5 Calibration plot of radiocarbon dates from Area1, Cueva de los Postes (cc = charcoal; ht = human tooth)

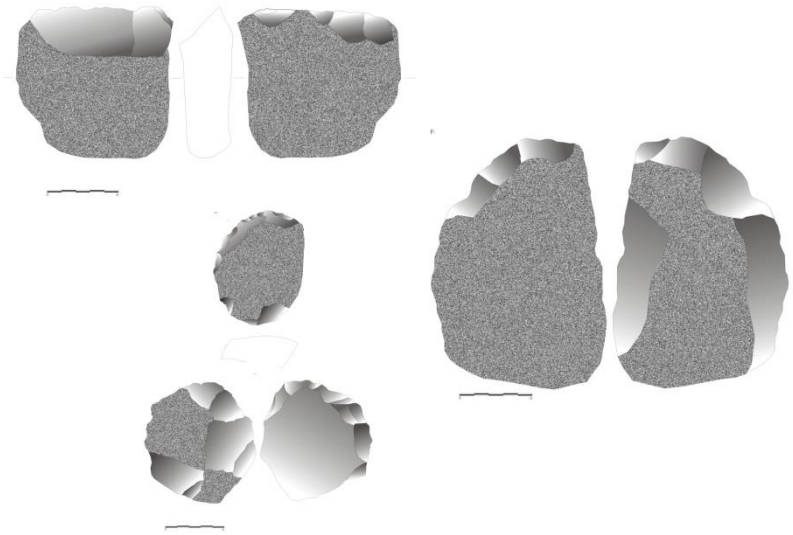


Figure 3.6 Some examples of the early Holocene stone tools from Postes (drawings source: Hipólito Collado)

Stratigraphic unit 9 contains archaeological remains from an isolated group of events, without direct continuity from previous or towards next stages. However, not being separated by sterile sediments, it is in a direct contact with SU 10 and 8. It is very probable that human activities during the formation of SU 9 affected SU 10 (acting as paleosurface), as those from SU 8 affected SU 9. In fact, the presence of pottery down to SU 12 testifies to deeper disturbances, even though no such events have been documented during excavation (Hipólito

Collado 2015, personal communication, May 2015). The vertical movement of material is also visible in the radiocarbon results. Out of the four available dates for SU 9, two are obvious outliers (Figure 3.5; Table 3.2). In fact, these two dates mark both chronological borders of the entire Area1 sequence. The first one, Poz-33225, was measured on charcoal, so, there can be other explanation for its presence in the layer (i.e. old charcoal present in the natural sediment). For the human tooth however (SUERC-67530 in Figure 3.5 and Table 3.2), it is natural to assume it was introduced from the overlying layers, either from burrowing animals or from human activities.

The remaining two samples date the layer in the final centuries of the 6th and the beginning of the 5th millennium cal BC. A total of nine pottery fragments have been discovered in this layer, from an area of 3m^2. Only one distal tibia epiphysis can possibly be attributed to ovicaprid, but because of the young age of the individual, it is difficult to be distinguished from *Capra ibex*. According to the sedimentology study, SU 9 is more related to the underlying SU 14 to 10, than it is with the more recent SU 8. It is important to distinguish the formation process of the layer from the moment (or moments) of deposition of human remains. The layer formation would be a result of predominantly natural sedimentation, in similar conditions with the formation of the stratum below. The human remains are a result of short and non-frequent visits by humans during or at the very end of the layer formation process, with the sole purpose of burying or simply depositing the remains from the deceased.

Therefore, with the results available so far, it is dangerous to propose a gap of almost a millennium between the formation of the underlying cluster (SU 15 to 10) and SU 9, as the plot in Figure 3.5 would suggest, especially because this would imply a gap between the last hunter-gatherers and the first farmers in the area. Even though this is a possible scenario, since similar cases have been reported from Extremadura (Cerrillo-Cuenca & González Cordero 2011), there are two things we should consider. One is that we are comparing dates possibly from natural processes on one side (charcoal samples from naturally occurring charcoal in the sediment) and human activities on the other (human teeth). The other is the well known liability of unidentified charcoal samples as dating material. To confirm such a gap, it is necessary for new samples from human remains to be dated, from SU 10 downwards.

At the present state of research, we can consider SU 9 as the layer containing the remains from the first Neolithic groups in the region, appearing in the 53rd century cal BC. Other contemporary events in this part of the peninsula have been recorded in the earliest

phase of Los Barruecos (Cerrillo-Cuenca, García García, et al. 2006), El Conejar (Cerrillo-Cuenca 1999), Cerro de la Horca (López Sáez et al. 2007) and Canaleja 2 (Cerrillo-Cuenca & González Cordero 2011) in North Extremadura, Valada do Mato in the interior of Alentejo (Diniz 2007), Gruta do Caldeirão (Zilhão 1993), Nossa Senhora das Lapas (Oosterbeek 1997), São Pedro de Canaferrim (Simões 2003) and Casal da Cerca (Silva & Soares 2014) in Portuguese Estremadura. Agriculture was present in these contexts, but we have yet to explore to what extent it played a part in the economy. These people were producing and using pottery, even though it was very scarce in funeral contexts like Postes. At least as far as the treatment of the deceased is concerned, the burial practices do not seem to be very different from the previous millennium. Also the role that Postes had in this perspective does not seem to have changed.

The third major period in the history of Area 1 is the fourth millennium cal BC, corresponding to the local Middle and Final Neolithic. In the stratigraphy, this stage is represented by SU 8, 7 and probably 6 and 5. The superimposed layers (SU 4 to 1) might have been a continuous development from SU 5, but unfortunately their integrity is under question due to disturbances from previous illegal excavations and use of the cave as a sheep pen (Collado Giraldo et al. 2015).

Six radiocarbon dates are available for units 8 and 7 (Table 3.2; Figure 3.5), while two samples from unit 6 failed to produce sufficient amount of collagen. The dates show at least four different events, marking different moments in the later 5th and throughout the 4th millennium cal BC. It is also evident that the chronological sequence does not follow the stratigraphic sequence. This suggests that the attributed stratigraphic units are arbitrary and the sediment is more of a palimpsest containing remains from different burial events. For this reason, the absolute dates provide the more reliable source for interpreting this particular part of the prehistory of Postes.

After the Early Neolithic phase, there seems to be a gap of five centuries before the cave was used by humans again. Poz-13703 is a charcoal sample taken from a circular stone structure in layer 8 (Figure 3.7; Collado Giraldo et al. 2015). It is difficult to discuss the function of this structure since no content was found inside and information about its dimensions is missing. Nevertheless, both the structure and the date (having in mind the regular caution for unidentified charcoal samples) represent an event in the 43rd-44th century cal BC. This is the first man-made structure inside the cave and, even if we assume it was part of the burial process, it reflects some changes in the attitude of the people towards Postes.

Figure 3.7: Circular stone structure; SU8, Area 1, Postes (photo: Hipólito Collado)

The following dated event refers directly to human burials; SUERC-67529 is a human tooth from an individual buried sometime during the first two centuries of the 4th millennium cal BC (Figure 3.5; Table 3.2). Stratigraphically it is assigned to SU 8, even though there is a gap of at least two centuries from the previous event[9]. Another burial is dated towards the end of the first half of the 4th millennium cal BC. This sample was attributed to SU 7.

The second half of the 4th millennium cal BC saw the highest intensity of human activity in the considered sequence of Postes. At least that is according to the dated samples. Three samples, two from SU 8 and one from 7, correspond well with each other between the 34th and the 31st century cal BC. They are all human teeth. The previously mentioned sample from SU 9 (SUERC-67530), which is an apparent intrusion, fits well as a last chapter within this group (at the break from the 4th to the 3rd millennium cal BC). It is also the youngest obtained date from Area 1 so far.

In a general sense, two tendencies start to appear in Southwest Iberia since the transition from Early to Middle Neolithic: the collectivisation of burials, and the appearance of man-made megalithic funerary monuments. There is general agreement about the coexistence of caves and dolmens as burial grounds. The discussions continue on the nature of the two realities. According to Cerrillo-Cuenca & González Cordero (2014), the use of

[9] Again, we should have in mind that we are comparing different types of samples and, possibly, different kind of events.

caves and the construction of dolmens are parts of the same cultural entity, where the decision for a burial practice is made solely on environmental base, i.e. presence of caves or appropriate building material in the territory which the community occupies. On the other hand, Tome and Oosterbeek (2011) perceive the existence of the two monument types in Central Portugal as two different socio – economical systems with different historical backgrounds. From the case of Postes, we can only confirm the recurrent use of the cave for burial purposes since the Epipaleolithic, probably until the Bronze Age. Except for the stone structure built at the shift from Early to Middle Neolithic (for which not much can be said), nothing seems to change in the burial practice during and after this transitional period. Another case in Extremadura is Canaleja 1 near Caceres, where the cave was used as a burial monument in the early 4th millennium. Further to the West are the caves on the banks of Nabão River in Portugal: Gruta do Morgado Superior, Gruta dos Ossos and both layers (C and D) from Gruta do Cadaval fall within the frames outlined by the dates from SU 8 and 7 from Postes. Aspects other than the burial practice during these later Neolithic phases are known from phases 2 and 3 from the open-air settlement at Los Barruecos, dated within the second half of the 4th millennium (Cerrillo-Cuenca, García García, et al. 2006).

3.1.4.2. Sector Hueco Eulogio

Significantly smaller area has been excavated in the back chamber - only one trench, with small additional extensions to the East, North and West, totalling to 6 m^2. The excavations there have been active since 2009, and they revealed a completely different stratigraphy. A Holocene stratum is separated with a thick (up to 50 cm) calcite barricade from the underlying Pleistocene sediment. A sample from the stalagmite was U/Th dated around 190 ky a go (Collado Giraldo et al. 2015). Two more dates, surpassing 250 ky ago have been obtained later from the lower portions of the Pleistocene layer (Hipólito Collado 2014, personal communication, November 2014). Fauna remains, lithic tools and a human phalange have been discovered. Thanks to the calcite barrier, the Pleistocene sequence has remained isolated and undisturbed from the following Holocene events in the cave. The archaeological remains from the Pleistocene however are beyond the scope of this work.

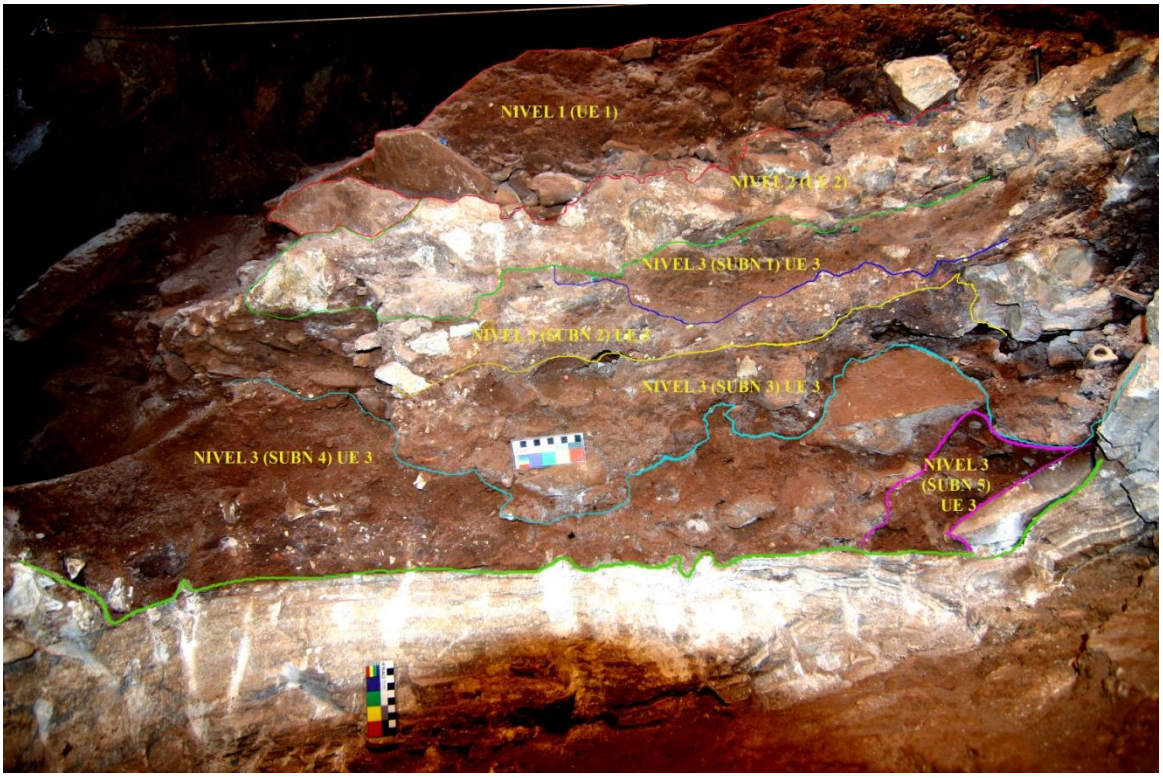


Figure 3.8 The Holocene stratigraphic sequence of Sector Hueco Eulogio, Cueva de los Postes (photo: Hipólito Collado)

The Holocene sequence in Hueco Eulogio is sediment up to 80 cm thick. Three main stratigraphic units have been recognized, of which the lowermost SU 3 is divided in 4 sublevels (Figure 3.8). SU 1 is heavily disturbed - white and blue-glazed Late Medieval and modern pottery, Roman Age *terracotta*, and Proto-historic fragments – they are all found together. SU 2 is easily recognizable from the rest by its white colour. The artefacts it contains have suffered by a significant post depositional calcite precipitation on their surfaces. The sediment trapped between SU 2 and the stalagmite layer covering the Pleistocene sequence, is SU 3. Variations in coloration and granulation were recognized, and initially this stratum was divided into five sublevels. Later sedimentation analysis showed that sublevels 4 and 5 are identical, and therefore the pottery from these two is grouped together. There are few intrusions from the top layer into SU 2 and 3, probably the deeds of burrowing animals, but they can be easily recognized and excluded from the analysis.

Lack of diagnostic artefacts and above all, the obvious disturbances in the context have made the interpretation and chronological determination of the layers difficult. It has been suggested that the oldest sublevel of SU 3 corresponds to SU 5 from Area 1 (Collado Giraldo et al. 2015). According to the radiocarbon measurements, this might be the case.

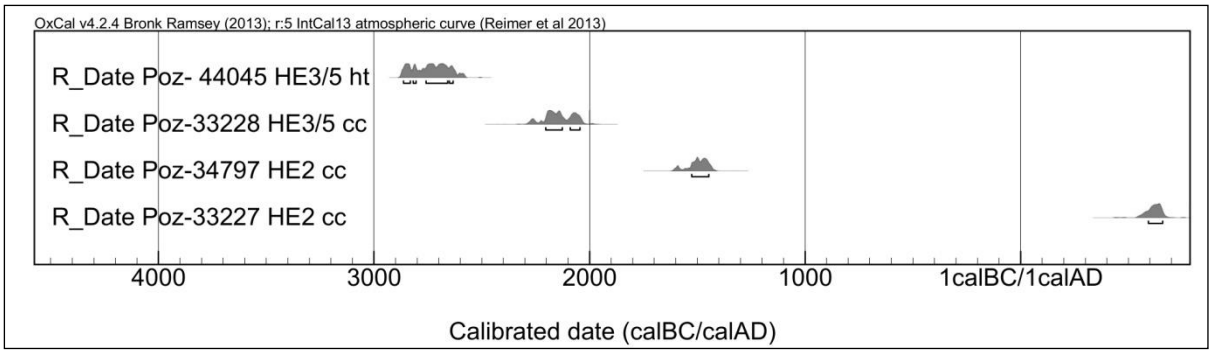


Figure 3.9 Calibration plot of 14C dates from Sector Hueco Eulogio, Cueva de los Postes

Four radiocarbon dates are available from Hueco Eulogio 3/5 and 2, two from each (Table 3.2; Figure 3.9). Except for one from the older layer (Poz-44045), the dates were measured on charcoal samples. Poz-33227 is an obvious intrusion from the Early Medieval period. The only date measured on human tooth dates the burial from the beginning of the Holocene sequence in this part of the cave to the first half of the 3rd millennium cal BC. In terms of local chronology, this is the Copper Age. A charcoal sample dates the same layer towards the end of the same millennium. SU 2 is dated in the middle of the 2nd millennium cal BC. Since Poz-44045 is the most reliable date from this sequence, it is reasonable to accept that the archaeological sequence in Hueco Eulogio starts at the onset of the Copper Age, during or right after the formation of UE 5 from Area 1.

In a conclusion, the history of Holocene human occupation of Postes begins in the first chamber of the cave during the 7th millennium, when groups of hunter-gatherers were depositing their dead. This practice has continued after the introduction of farming and pottery, and even later during the Copper Age. The sequence of historical events in Postes, based heavily on the 14C dates, was statistically tested by modelling all the dates according to the proposed scenario (Figure 3.10). For the purposes, the OxCal v.4.2.4.was used, utilising the IntCal13 atmospheric curve for calibration of the dates (Reimer 2013; Bronk Ramsey & Lee 2013)[10]. The test demonstrated a high level of agreement for the model, giving support for the proposed occupational sequence.

[10] The same software tools were used for calibrating and modelling all the dates used in this thesis.

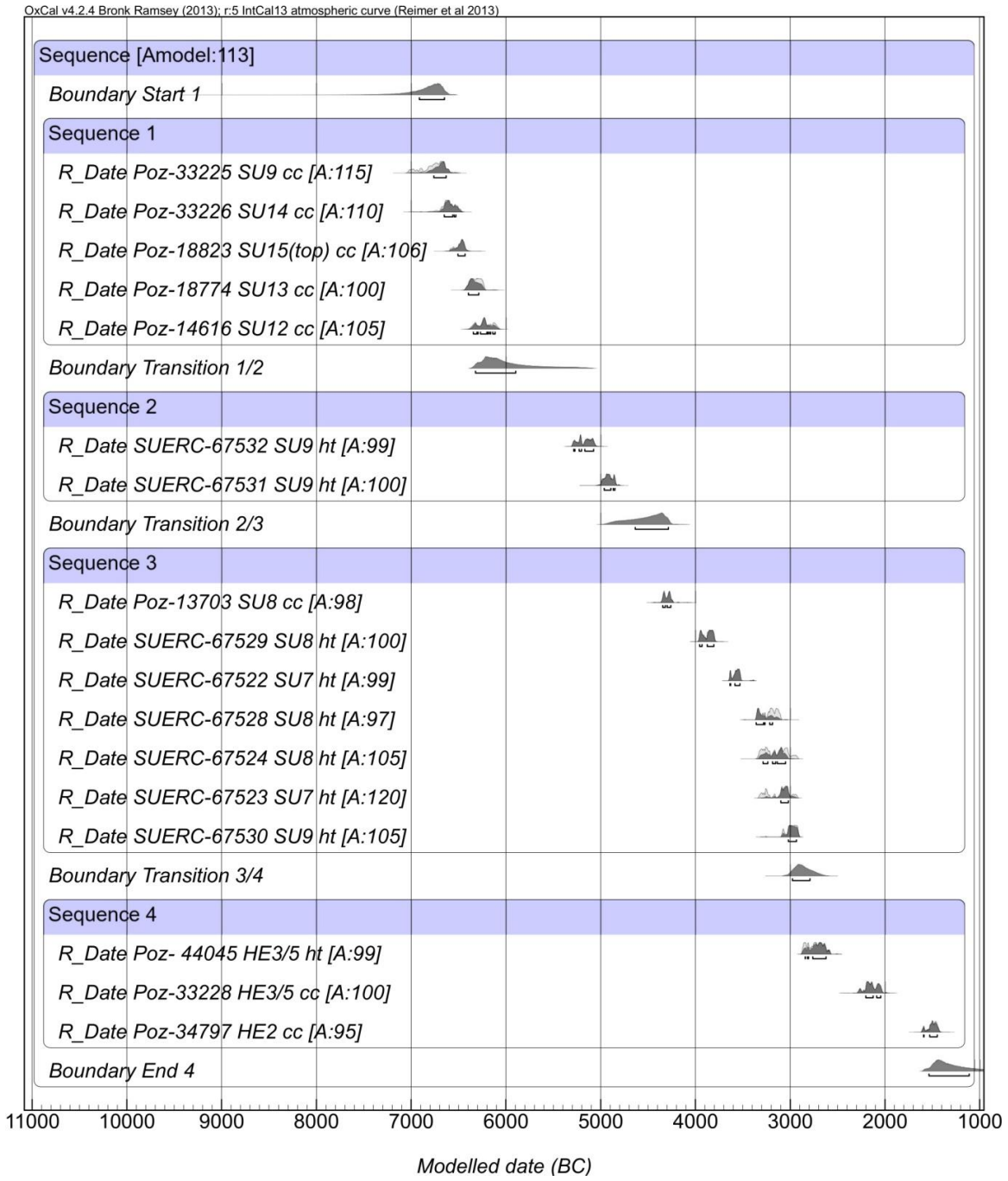


Figure 3.10: Bayesian model of the chronological phases in Postes; note that the two outliers in from SU 9 (SUERC-67530 and Poz-33225) are attributed to the phase according to their values, instead to their stratigraphic assignment; the outlier from HE 2 (Poz-33227) was not included in this model.

3.1.4.3. Sector Exterior

Outside of the cave, a test trench was started approximately 20 m NE from the cave entrance. Only one stratigraphic unit was excavated, collecting a total of 37 pottery artefacts. One third of them are wheel-made and most of them are from historical times, with few non-diagnostic pieces possibly from prehistory.

3.1.5. Pottery: provenance, quantity and sampling

At the end of the 2014 excavation campaign, there were 2726 entries in the ceramic data base of the site. The excavated material is deposited in the Archaeological Museum of Badajoz, where most of the ceramic studies took place. A relatively small portion of the collection (512 artefacts) was not available for analysis at that time. The total number of studied pottery artefacts from Postes is 2214 (Table 3.3). More than half, 1266 fragments, come from Area 1, while 374 fragments are from sector Hueco Eulogio deeper within the cave. The test trench outside of the cave gave only 37 fragments. Included in the basic assessment were also 537 pottery fragments from unknown original contexts (disturbances, sinkholes etc). Even though it is important to have a record of techno – typological characteristics of all excavated pottery, unknown or unreliable contexts would influence the results and lead to misinterpretations. Therefore, they will not participate in the data manipulation comparative process.

Table 3.3 The studied pottery of Cueva de los Postes: provenance and quantity (*average shard weight)

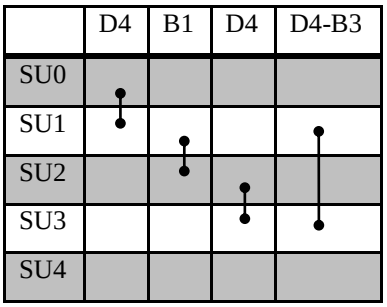
	n	%	*w* (gr.)	asw* (gr.)
Area 1	1266	57.2	38813	30.6
H. Eulogio	374	16.9	6853	18.3
Unreliable context	537	24.2	23997	44.7
Exterior trench	37	1.7	516	13.9
Total	2214	100	71108	32.1

Beside the mentioned artefacts to which no context was attributed, selection and exclusion must be applied to some of the contextualised pottery as well. In the trench outside the cave, only the surface layer has been excavated and only a small assemblage from historical periods was discovered. This material is outside the framework of this study.

The top five stratigraphic units in Area 1 (SU 4 to SU 0) are also unreliable for several reasons. First of all, there were apparent violations of the stratigraphy noticed during the excavations (Hipólito Collado 2015, personal communication, May 2015). This is further supported by the observations made on the ceramic assemblages. A significant amount of *lucernae* and *terracotta* parts and pottery from the Roman Age and later periods is present within an otherwise predominantly Pre- and Proto-historic pottery collection. Refitting exercise discovered four inter-layer pairs (Table 3.4). A similar situation was observed for

Hueco Eulogio 1. To avoid contamination of the data, these layers will not be included in the comparative analysis and the statistical operations.

Table 3.4 Schematic representation of the upper part of the Area 1 stratigraphy and pottery refitting matches



This leaves us with a significantly smaller portion of the pottery to work with. Tables 3.5 and 3.6 show the stratigraphic distribution of the ceramic material from Area 1 and Sector Hueco Eulogio. Only sixty items are considered from Area 1. A single shard of pottery appears as early in the stratigraphy as SU 12. The Mesolithic layers above have also one pottery fragment each[11]. As mentioned before, these artefacts are considered as intrusions from the Early Neolithic events in SU 9. More than double in quantity are presented from the Copper Age levels of Hueco Eulogio.

Table 3.5 Postes, Area 1; stratigraphy and pottery distribution

Stratigraphic unit	n	*w* (gr.)	asw* (gr.)	Post depositional abrasion	Residue analysis samples
SU0	137	6273	46	Light	
SU1	128	3588	28	Light	
SU2	524	19085	36	Light	
SU3	358	7582	21	Light	
SU4	59	1231	21	Light	2
SU5	24	369	15	Light	2
SU6	15	208	14	Very light	5
SU7	9	190	21	Very light /medium	3
SU8	7	144	20.5	Very light	3
SU9	3	36	12	Very light	
SU10	/	/	/	/	
SU11	1	75	75	Very light	1
SU12	1	32	32	Light	1

[11] According to the field data base, one pottery fragment was also discovered in SU 10. Unfortunately this was part of the unavailable group of artefacts.

Thirty six pottery samples were selected for lipid residue analyses (Table 3.6 and 3.7). Even though the sampling was guided by the will to extract as much as possible information from each sample, combining contextual, typological, technological and chemical data, the process was conditioned by the size of the artefacts, the potential for yielding results and the permission by the authorities. At the end, seventeen samples were collected from Area 1 and nineteen from the Chalcolithic at Hueco Eulogio.

Table 3.6 Postes, Sector Hueco Eulogio; stratigraphy and pottery distribution (*average shard weight)

Stratigraphic unit	N	*w* (gr.)	asw* (gr.)	Post depositional weathering	Residue analysis samples
Surface	4	59	14.7	Very light	
Layer 1	232	4416	19	Light	
Layer 2	26	1056	40.6	Light	
Layer 3	31	529	17	Light	7
Layer 3/3	3	13	4.3	Light	
Layer ¾	78	777	10	Light	12

3.2 Gruta do Cadaval (CDV)

3.2.1. History of archaeological investigation

The caves of the Tomar area first gained more significant archaeological interest in the late 1970's and early 1980's. A group of young archaeologists, speleologists and enthusiasts visited and surveyed the caves, recognizing their huge archaeological potential. The outcome of that was the establishment of the roots of what is today the Centre for Prehistory in the Polytechnic Institute of Tomar, as well as the initiation of several excavation campaigns.

Investigations at Cadaval began in 1983, and lasted until 1987. During this time 26 m^2 were excavated, uncovering eight stratigraphic levels. The abundant excavated archaeological material has been included together with similar context in the region in previous publications by Luiz Oosterbeek (1995; 1997) and Ana Rosa Cruz (1997), who were co-directing the fieldworks. Tomé and Oosterbeek (2011) have published a short anthropological assessment of the human remains. Short reports are also available on the animal bone remains (Oosterbeek et al. 2014; Almeida et al. 2015), while full analyses are ongoing. As far as pottery is concerned, NAA, XRD and thin-section petrography on twenty samples was undertaken by Peng Fuying as part of a Master thesis (Fuying 2007).

3.2.2. Geographic location

Cadaval cave is located on the right bank of the Nabão River, in a curvy limestone gorge section called Canteirões. This is in Central Portugal, some 6 km north from Tomar, near the village Casais Novos (Fig. 3.11). The river floats from North to South. Not far from the Canteirões it leaves the limestone massif, joins the Zêzere River, and approximately 20 km to the South from Cadaval they enter into Tagus. To reach the area is easy, but to access the cave requires local knowledge of the tiny paths on the banks and through the eucalyptus forest.

The hills around Cadaval are the north-eastern fringes of the limestone formation chain of Portuguese Estremadura, the most prominent member of which is the Serra de Aire/Serra de Candeeiros natural park. There is a curious high concentration of Neolithic/Chalcolithic burial cave sites here. In the same hill as Cadaval is Caldeirão Cave, containing a horizon from the Early Neolithic Cardial phase (Zilhão 1992). Immediately across the river from Cadaval are Nossa Senhora das Lapas, Ossos and Morgado Superior

caves, with a record of burial practices from the Early Neolithic until the Copper Age (*e.g.* Cruz et al. 2014).

Figure 3.11 Aerial view (from North) of the limestone formation where Cadaval is located (maps.google.com)

3.2.3. Geology and paleoenvironment

The Estremadura limestone elements were formed during the Jurassic and Cretaceous periods of the Mesozoic era, when geodynamic processes lifted the ocean bed in the eastern Atlantic, thus exposing the calcite sediment. Besides the predominant limestone, it contains also sandy marls and sandstones (Angelucci & Zilhão 2009; Rodrigues & Fonseca 2010). Through time natural forces have shaped the terrain configuration of small hills (the highest altitude is 680 m – the top of Serra d'Aire), separated by rivers and creeks. The soils which were formed with the weathering of the karstic terrain, from agricultural perspective are rated as poor. Even today fields are scarce and substantial agriculture is practiced only further south, once the river leaves the karst. This might be one of the reasons why permanent settlements in the area are scarce, as opposed to the high density of funeral locations.

The palynology record from the hills of the Estremadura Limestone Massif is lacking. Valuable information comes from cores made in the Tagus valley, which demonstrated a picture almost identical to the one in South Extremadura in Spain (Vis et al. 2010; Gomes et al. 2013). At the beginning of the Neolithic there is a significant presence of Pine and Oak, as well as Alder and Willow forests, while shrubs, flowers and herbs are less represented. Towards the more advanced phases of prehistory, there is a tendency of decrease in the large tree species, and better presence in the pollen record of *Gramineae* and *Plantago*. The only tree species that kept significant presence and actually increased since the Mesolithic is the

olive tree. How important is the human influence through agriculture in this deforestation is still difficult to assess.

Archaeozoology studies have been carried out on three collections from the north-eastern limits of the limestone massif, one of them being Cadaval (P Rowley-Conwy 1992; Davis 2002; Almeida et al. 2015). They all confirm the relatively high presence of domestic sheep and goat, as well as some cattle and pigs since the early phases of the Neolithic. At the same time hunting remains an important food source, as evident from the archaeozoology of Caldeirão (Davis 2002). In some of the Middle Neolithic layers, like layer C of Cadaval, remains from roe and red deer were also found (Almeida et al. 2015). Carnivores, like wolf, wildcat and badgers were obviously present in the surroundings of the caves. A synthesis of the archaeozoology from a wider area is expected from an ongoing research by Nelson Almeida.

3.2.4. Stratigraphy, chronology and cultural affiliations

Cadaval is a natural cave formation with two chambers. The interior is slightly cascading as there is a small descend from the entrance to the first chamber, and another one to reach chamber 2. The cascading effect is further enhanced by a small wall dividing the two chambers, the building of which is probably connected with not so distant past, when the cave was used for sheltering animal herds. As a result from the negative effects the temperature oscillations during the Ice Age had on the limestone, parts of the sealing collapsed and the current entrance was opened (Oosterbeek 1997, p. 103). Probably at the same time or prior to that, the previous opening, which was at the opposite side of the cave, also collapsed and was closed. The collapsed blocs created a complex paleotopography in both chambers, complicating the excavation and interpretation process. The interpretation is further obstructed by the later man and animal made disturbances of the stratigraphy. These are especially heavy in the second chamber, rendering the Holocene sequence there almost completely unreliable (Oosterbeek 1995, p. 101). In the first chamber however, the collapsing of the sealing during the Early Holocene formed an area in the centre of the chamber surrounded by blocks, which served as a sediment trap for most of the Holocene. Here the stratigraphic sequence has suffer less disturbances and will be used as a reference. The total surface of the cave does not exceed 60 m^2, of which 26 were excavated (Cruz 1997).

The sedimentation history of Cadaval shares some similarity with Postes. One is the formation of a stalagmite floor during a wet phase at the end of the Pleistocene and the beginning of the Holocene, which served as a base for the Holocene layers. The Pleistocene

is represented by two stratigraphic units, layers F and β, which contained only paleontological material. The sequence above the discontinuous stalagmite floor consists of six layers (Figure 3.12). After the formation of the calcite layer, followed the sedimentation of two separate silt deposits, layers α and E, in which no traces of human activities are detected (except for few pottery intrusions from layer D, which in some areas reach even layer F).

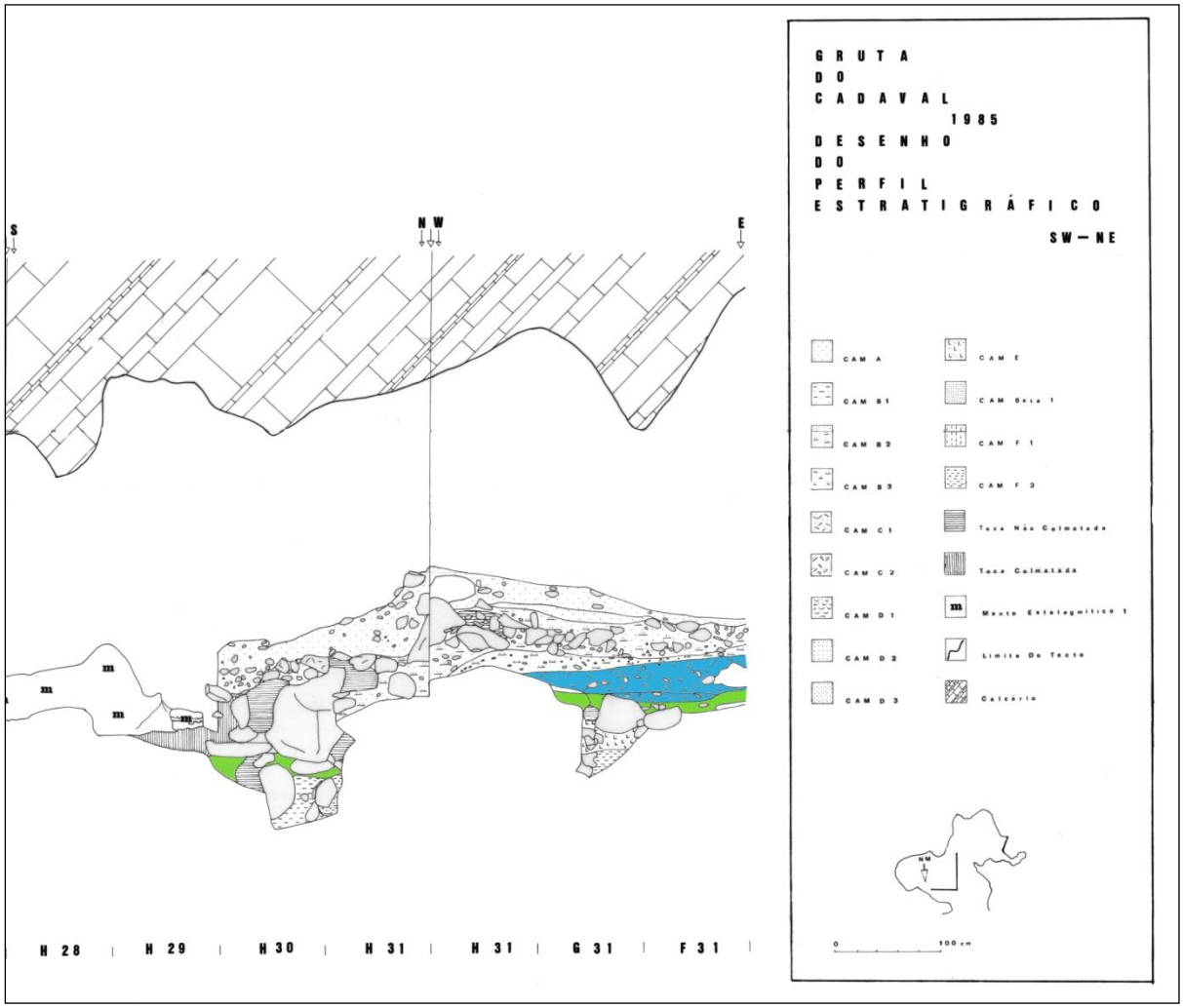


Figure 3.12 Stratigraphic sequence of chamber 1, Cadaval; the relevant layers are marked: blue = layer C, green = layer D (source: Ana Cruz, CPH-IPT, modified)

The formation of the following layers in the sequence is due to a combination of human activities and aeolian sedimentation. Layers D and C has similar physical properties. It is possible that their formation is a single continuous process, in the beginning of which a single burial was performed. These human activities are responsible for the slight difference in part of the sediment, which during excavation was labelled as layer D. This was at a

watershed moment in the evolution of burial rituals in the local Neolithic groups, as later the deceased were simply deposited on the ground in the cave interior, serving as a collective tomb. In stratigraphic perspective, the collective burials represent layer C, where at least twenty-four individuals have been recorded (Tomé & Oosterbeek 2011). The proximity of the two layers is further supported by the 14C dates (Table 3.7). When positioned in sequential order, the model gives a confident enough index of agreement (Figure 3.13).

Table 3.7 ^{14}C dates from Cadaval (Cruz 1997)

Sample	Layer	BP	Cal BC (1σ)	Sample
I-17241	C	5180±140	4228-3801	Human bone
ICEN-464	D	5160±50	4041-3824	Human bone
ICEN-803	D	5390±50	4332-4174	Human bone

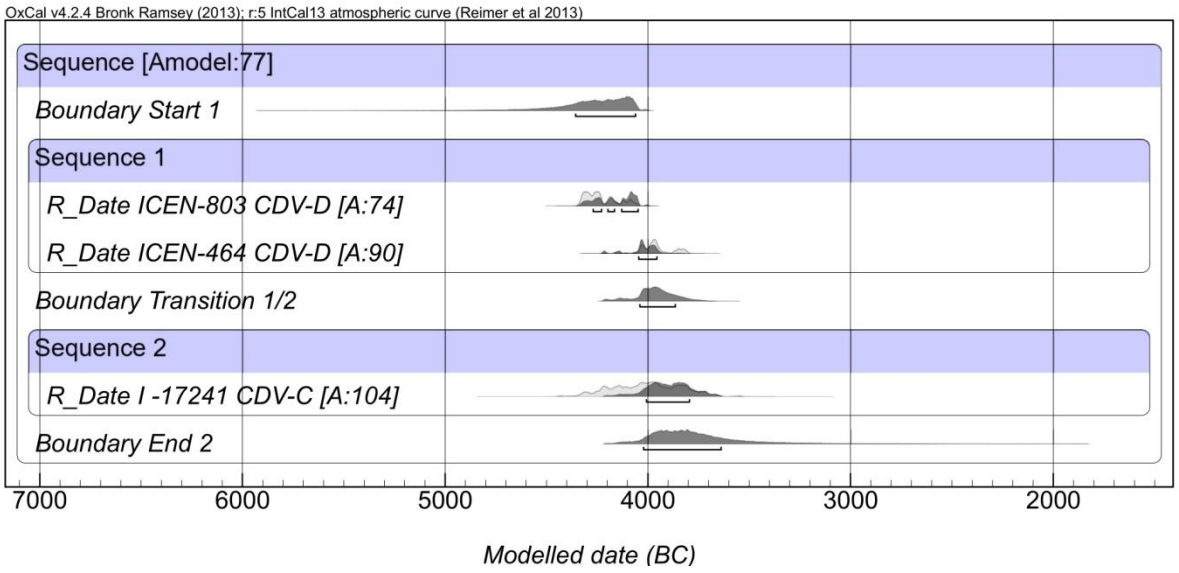


Figure 3.13 Bayesian model of available ^{14}C dates from Cadaval; OxCal v4.2.4 with IntCal13 (Bronk Ramsey & Lee 2013; Reimer 2013)

From the dated burials it becomes clear that the Early Neolithic phase is missing. Obviously this is by choice of the Neolithic people and not because their absence from the Canteirões, since Early Neolithic burials were discovered in Caldeirão and Nossa Senhora das Lapas (Zilhão 1992; Oosterbeek 1993). The sequence at Cadaval captures the initial phases of the Middle Neolithic, which makes it an interesting archaeological case in many aspects, the shift in burial behaviour being one of them. This refers directly to layers D and C, which are also the focus of this study. In terms of absolute chronology, the events recorded

here took place at the end of the 5th and the beginning of the 4th millennium cal BC. If we are to compare Cadaval with Postes, layers D and C were contemporary to the beginning of SU 8 of Area 1 and the events around the construction of the stone structure. At the top of the sequence are layers B and A, which will remain outside of the frames of this thesis. The former represents the Late Bronze Age and the later contains material from the Roman period, but both of them have modern intrusions.

Contemporary contexts are rare, but do exist in the archeologically rich Estremadura. Zilhão and Carvalho presented dates from the late 5th and early 4th millennium cal BC from two burial caves from Estremadura - Lapa Bugalheira and Lapa dos Namorados (Zilhão & Carvallo 1996), but the information is too scarce. A better known stratigraphic sequence is the one from Pena d'Agua rock-shelter, where the same transitional period as in Cadaval D and C, is presented in layers Ea and D (Carvalho 2016). Cadaval and Pena d'Agua represent two complementary aspects of the initial Middle Neolithic in Estremadura, the former being temporary encampment and the later funerary site. We can even go further and envisage the two locations as being used by the same communities, since they are seen as semi-mobile herders-hunters who were using and transporting raw material from all over Estremadura and Alentejo (Carvalho 2016). Not surprisingly, we can observe many similarities in the ceramic and lithic assemblages. We should expect markers in the landscape in a wider area from such a mobile groups, but because of their mobility those remains were probably ephemeral and hard to discover and put them in the right context. The more substantial is the record from the burial practices and these monuments are the most common from the transition towards the Middle Neolithic.

The same trend continues during the first half of the 4th millennium, a period often referred to as the full Middle Neolithic. A well studied and represented case is the Bom Santo Cave north from Lisbon (Carvalho 2014). Further to the East, in the interior of Alentejo, there are similar contemporary sites, like Vale de Rodrigo 2 and 3, and few other not well known contexts (Neves & Diniz 2014); and even further East, in Spanish Extremadura, there is the Middle Neolithic phase of Canaleja 1 (Cerrillo-Cuenca & González Cordero 2011). On one hand these burial contexts are clear continuation from the initial phase of the Middle Neolithic (Cadaval D and probably C, Pena d'Agua Ea and D); on the other, they already reflect the changes that the "full" Middle Neolithic brought: appearance of the megalithic burial structures and the "megalithisation" of the pottery (disappearance of decoration and reduction in size).

3.2.5. Pottery: provenance, quantity and sampling

This thesis includes the complete pottery assemblage from layer D and layer C of the first chamber in Cadaval Cave. One of the goals is to see if the recorded change in the burial ritual expands to the material culture as well (in this case the pottery). While the more detailed observations of the artefacts themselves are reserved for the next chapter, here we can take a look at the quantity and the dispersal of the pottery within the cave.

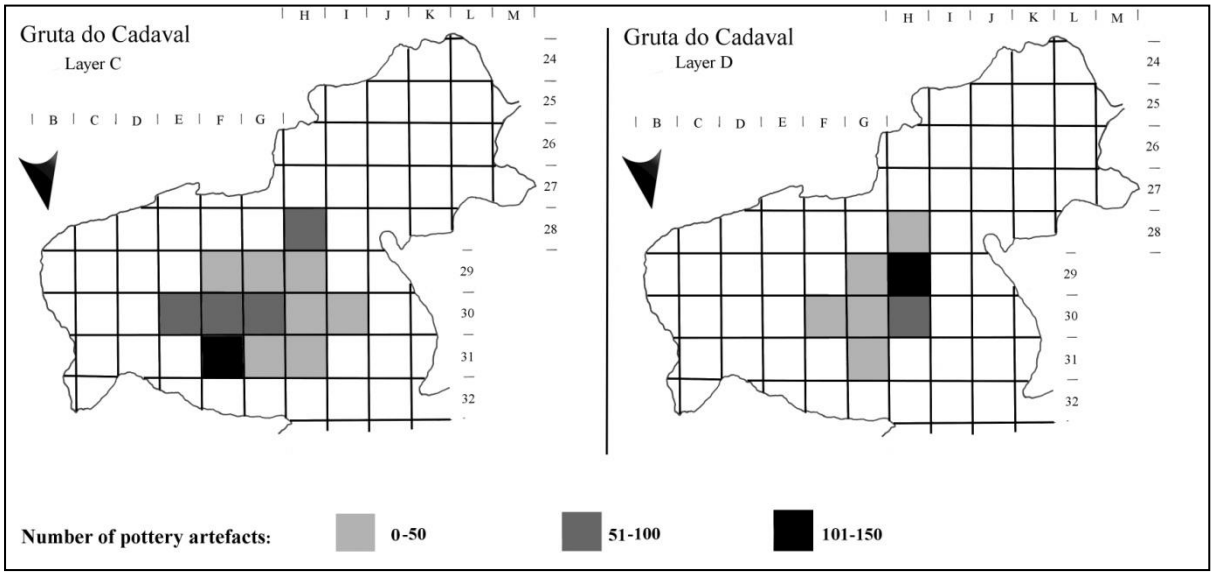


Figure 3.14 Pottery quantity and dispersal (1x1m grid); source: Ana Cruz, CPH-IPT

There are 992 units recorded in the pottery inventory for the two layers, which are deposited together with the rest of the material culture remains at the Prehistoric Centre for Prehistory of the Polytechnic Institute of Tomar (Table 3.8). About 70 % of them are from layer C and 30 % come from layer D. This difference is understandable if we have in mind that in the first chamber layer C was excavated in an area of 12 m^2, almost double than layer D (7 m^2). Figure 3.14 points to another, more important difference: the dispersal of the ceramic has different focal points in both layers. In layer C there is a higher concentration in the central-eastern part of the room (left of the entrance). In the previous phase there is a higher concentration of ceramic artefacts more towards the interior.

Table 3.8: Quantitative parameters of the pottery assemblage from layers D and C of Cadaval (*average shard weight)

Layer	**Square**	**n**	***w* (gr.)**	**asw* (gr.)**
C	E30	68	1083	16
	F29	3	26	8,6
	F30	93	1612	17,3
	F31	150	2153	14,3
	G29	37	340	9,2
	G30	97	1466	15
	G31	35	372	10,6
	H28	77	1800	23,4
	H29	48	756	15,7
	H30	33	1086	33
	H31	3	3	1
	I30	6	37	6,2
Layer C total		650	10.734	16,5
D	F30	2	12	6
	G29	33	633	19,2
	G30	12	628	52,3
	G31	38	527	13,9
	H28	7	41	5.8
	H29	117	2436	20,8
	H30	63	932	14,8
Layer D total		272	5.209	19,15
Total C + D		922	15.943	17,3

3.3 Anta 1 de Val de Laje (VL1)

3.3.1. History of archaeological investigation

During the four campaigns between 1989 and 1992, 30 m^2 were excavated, which envelops the entire monument and most of the surrounding area (Cruz 1997; Cruz 2010). The site has been visited by Luiz Oosterbeek as early as 1985, but excavations begun only later, within the frames of a wider project of the Escola Superior de Tecnologia de Tomar (ESTT - what is today the Instituto Politecnico de Tomar - IPT), studying the neolithisation process in the Tomar area. Since 1990 the excavations continued as collaboration between the Institute of Archaeology London and the ESTT. The investigations were co-directed by Luiz Oosterbeek, Ana Cruz and Peter Drewett (Drewett et al. 1991). During the four years, a large team of Portuguese and international specialists and students participated in the fieldwork at Anta 1 de Val de Laje.

Excavations began in three main trenches, following the positioning of a 2x2m square grid over the entire mound. These trenches were subsequently expanded to about 30m^2 of excavated area East and West from the dolmen (Figure 3.15 and 3.16). Beside the field reports (Drewett et al. 1991; Oosterbeek et al. 1992), Anta 1 has been also included in the doctoral thesis of Luiz Oosterbeek (Oosterbeek 1997). Today, the complete set of artefacts and field documentation is preserved in the Centre for Prehistory of the IPT.

3.3.2. Geographic location

Val de Laje is a small valley on the right bank of the Castelo de Bode artificial dam (built on the Zêzere River) near the Casalinho village, 10 km SE from Tomar, Santarem District of Central Portugal. The name of the valley itself is indicative enough about the archaeological potential of the area ("*valley of slabs*"). Five dolmens were registered (Anta 1 to Anta 5), two of which no longer exist (Drewett et al. 1991). Out of the five, Anta 1 drew the most attention to the British-Portuguese team of researchers for several reasons: it was not affected by recent disturbances; it is situated on the most dominant position in the area; it had visual contact with the other four monuments, while among themselves they did not; the position also had control over the valley, the river and the entire surrounding landscape; the team assumed that Anta 1 had a more significant nature than the rest of the monuments; therefore, the excavations started in 1989 and lasted until 1992 (Drewett et al. 1991; Cruz 1997)

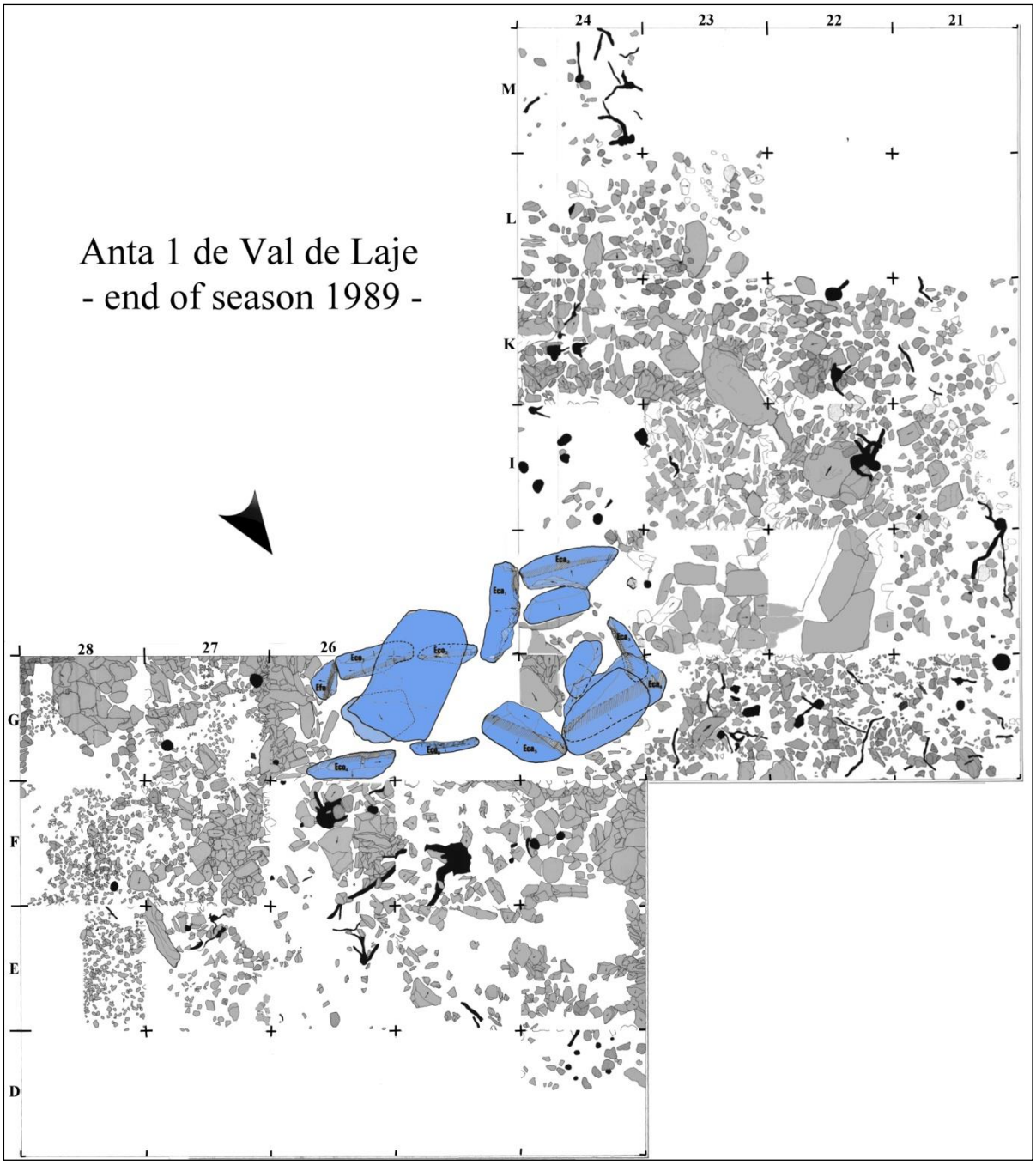


Figure 3.15 Excavated area at Anta 1 de Val de Laje; blue-chamber and corridor; gray-stones incorporated in the mound; black-roots; 2x2 m grid (modified after original drawings by Paulo Félix; source: CPH-IPT archives)

During prehistory the water level of Zêzere have been undoubtedly lower than the present man-made lake, but still would have been a reliable and near water source for the inhabitants. Not far from here Zêzere meets Nabão, and a bit further south they enter Tagus. Like in the limestone massif of Estremadura, very little is known about the settlement life of the population, especially when compared to the abundance of funerary contexts known so far, be it caves in the former or megalithic monuments from here towards East and South. We

can only assume that the other aspects of these prehistoric societies were also concentrated in the same wider area.

Because of the geographical proximity between the two regions (Cadaval is only 15 km to the NW), there is no doubt the people of Val de Laje had contacts with the limestone hilly region of Nabão. But somehow, a certain duality managed to persist between the two areas for over millennium, a duality conditioned by the environment, reflected in their material culture, and probably rooted in their heritage. This hypothesis has been introduced by Luiz Oosterbeek (1997) and has been elaborated on several occasions since then (*e.g.* Oosterbeek 2004; Tomé & Oosterbeek 2011). The proposed parallel existence of more than one cultural entity in this part of Portugal (one of them being associated with a socio-cultural continuum from the hunter-gatherers of the interior) is one of the main questions to be pursued in the next chapters.

3.3.3. Geology and environment

Even though Val de Laje is just 15 km in a beeline from Cadaval, it is in a completely different geological setting. The Canteirões of Nabão mark the eastern border of the limestone formation of Estremadura. Zêzere is already in the Central Iberian Massif (also known as Hesperic Massif). This is an ancient geological structure, formed during the Precambrian and the Palaeozoic. Metamorphic processes created an abundance of granite, quartzite and schist rocks, but greywacke is common as well – a convenient rock composition for the emerging practice of building megaliths. This lithology however is complemented with acidic soils, which are not particularly suitable for agriculture, and certainly inappropriate for the preservation of organic material. For this reason, pollen, charcoal or animal (as well as human) bone remains are almost completely lacking. Not much information can be extracted about the economy or the environment during prehistory; the settlements of these prehistoric groups are also missing from the record. Given the poor quality of the soils, a semi-mobile pattern of life, based on transhumance has been proposed. Even the emergence of the megaliths has been attributed to the nomadic pastoralism. The mobility would explain the lack of habitats in the archaeological record, which were probably of temporary character. More permanent structures were the communally built megalithic monuments, which, except for the funerary role, served also as anchors for societies inside the landscape. In order to address this lack of information about the economy, pottery samples from various contexts from Anta 1 have been picked to be tested for residual lipid molecules (see next chapter).

3.3.4. Stratigraphy, chronology and cultural affiliations

Anta 1 de Val de Laje is a 1.75 meters high oval-shaped tumulus, measuring 10 meters (N-S) by 9 (E-W) and containing a relatively well preserved passage grave. The grave has an irregular pentagonal chamber and narrow corridor, built from local gneiss monolith slabs (Figure 3.15 and 3.16; Scarre et al. 2011). The total length of the structure is 5.8 meters, more than half of which is taken by the corridor. The maximum width is at the chamber, reaching 2.2 meters. The corridor is 0.8 meters high, which is around 60 cm less than the chamber. Many of the slabs are still standing (more or less) in their positions.

Figure 3.16 Anta 1 d Val de Laje during excavations (season 1990; CPH archive)

The monument was built on a naturally formed silty-clayish paleosol, named layer D. It has no archaeological remains, except for a few pottery shards introduced from the overlying strata. Layer C represents the phase when the dolmen was constructed. During the Copper Age the structure was still in use, and the addition of a new layer rich with stones (probably as a reconstruction of the mound) formed layer B (Drewett et al. 1991, p. 15). Layer A at the top represents the modern surface, with various intrusions from Bronze Age onwards (Figure 3.17).

Because of the soil acidity, radiocarbon dating has proven useless. TL dating have been performed on ten pottery fragments (Cardoso 2009), but, besides the lack of context information for the samples, the results are inconclusive and with ranges too big for this advanced phase of prehistory. Therefore, finding the chronology of the events that took place in Anta 1, for now depends solely on techno-typological observation of the artefacts. Such an effort has already been presented by the excavators (Drewett et al. 1991; Oosterbeek 1997; Cruz 1997), and the same line of interpretation is still valid today.

The life at Anta 1 started some time during the Neolithic (layer C), following a big part of the Holocene without apparent human activities on this location (layer D). Two megalithic monuments in Alentejo - Poço da Gateira and Gorginos 2, based on pottery and lithic tool similarity, are suggested as contemporary analogies for the early phase of Anta 1. Since the early days of megalithic studies in Portugal, Vera and Georg Leisner considered these two monuments as the representatives of the earliest phase of megaliths in Alentejo (Leisner & Leisner 1951). Later TL dating confirmed their early building, relative to the other megalithic structures, placing them loosely in the 5th millennium BC (Whittle & Arnaud 1975). Therefore, the building of Anta 1 de Val da Laje is also considered to have happened during the same millennium (Oosterbeek 1997, p. 105). It remains to be clarified the relationship between the moment of the building of the dolmen, and layer C. It seems this layer was already formed (at least partially) at the time of the erection of the slabs, since preparations and levelling of its surface for this purpose are reported (Cruz 1997, p. 65). A scenario where the location is utilized during the Early Neolithic, prior to the building of the structure, seems possible. New excavations and direct dating of pottery and sediment samples might clarify the sequence of events.

This is also relevant for the following units of the stratigraphy. Layer B is defined by the artefacts as Chalcolithic, and is mainly the result of the reconstruction of the mound. It includes the formation of a ring of quartz and quartzite pebbles and schist flagstones around the dolmen, 2.5 to 4 m from the monument. This suggests that significant amount of time (generations) have passed between the building of the dolmen and its subsequent reparation. A range of interesting question can be raised, like whether or not dolmens were continuously used through the Neolithic and the Chalcolithic, or there were long gaps of inactivity, followed by minor or major renovations. Alternatively, the entire monument, the dolmen, the grave, the mound and the ring, were constructed together at a time postdating layer C. In any case, besides the socio-political oscillations reflected in the material culture, the location did not lose its meaning in the collective memory throughout the sequence. Even though the

passage grave in its original form and function was abandoned (the entrance was closed at the end of the layer B phase), the site was still visited during the Early Bronze Age, as revealed by pottery deposited in a pit in the corridor area (Drewett et al. 1991). This deposition, together with later disturbances, constitute layer A.

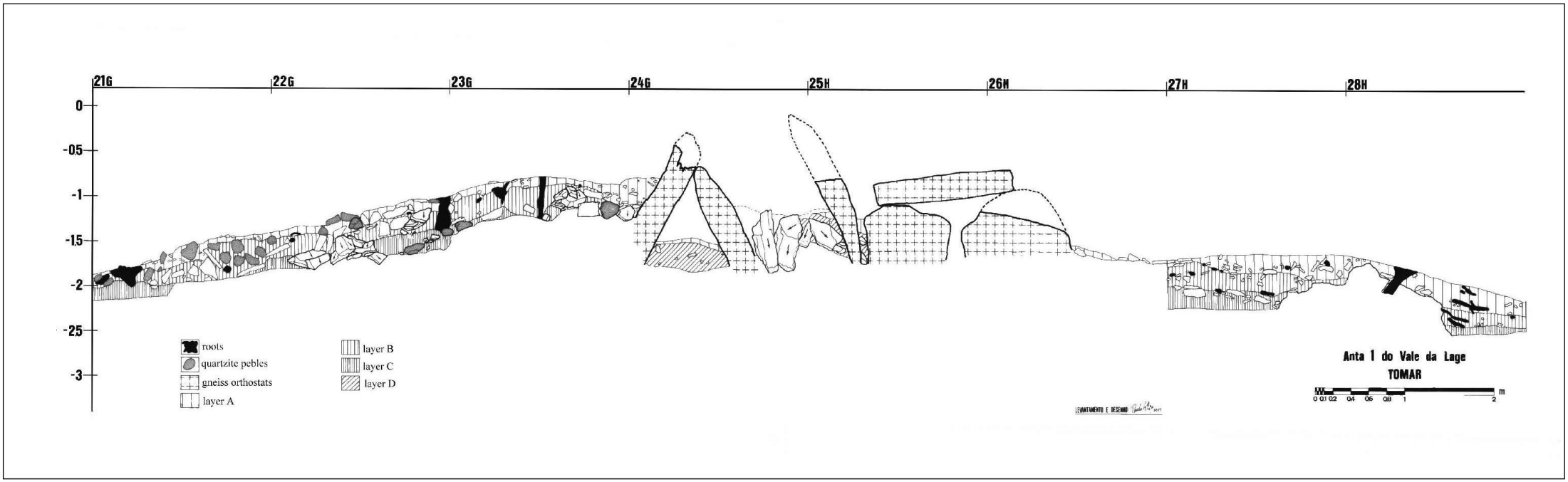


Figure 3.17: NW-SE profile section of Anta 1 de Val da Laje (source: CPH-IPT archives, modified)

3.3.5. Pottery: provenance, quantity and sampling

From the three archaeological layers at Anta 1 de Val da Laje, a total number of 2 246 entries have been recorded in the pottery assessment data base (Table 3.9). With just under 90 % of them coming from layer B, it is clear that the highest intensity around and inside the dolmen was during the Copper Age. Layer C is represented by a very small amount of pottery, but one third of them are diagnostic elements, which should provide enough information for comparative purposes. Therefore, the focus of the next chapter will be the characterisation of the entire ceramic complex from these two layers and the detection of relationship patterns between them and with other assemblages from Southwest Iberia, above all the other two sites elaborated in this work.

Table 3.9 Pottery quantity and stratigraphic distribution (*=average shard weight)

Layer	**N**	**% N**	***W* (gr)**	**% *W***	**asw* (gr)**
A	192	8,5	1 456	4,4	7,6
B	2 015	89,7	30 723	93,8	15,2
C	39	1,8	571	1,8	14,6
Total	2 246	100	32 750	100	14,6

Another perspective on the provenance of the ceramics is their horizontal distribution. Figure 3.18 displays the density of pottery per square. During excavations the interior of the dolmen – the chamber and the corridor – were treated as a single unit. This is the case in this visualisation as well.

Remains from the Neolithic (layer C) were discovered outside of the corridor, in the area immediately in front of the entrance. But the highest concentration comes from square E27, which is more than two meters NE from the entrance. No Neolithic pottery has been reported from the interior of the monument. In fact, layer C is completely missing – layer B is laying directly on the geological stratum D. This is another argument in support of the scenario where the monument is built at the end, or after the phase represented by layer B, and during the building, the base of the future monument was levelled and scraped, penetrating to layer D.

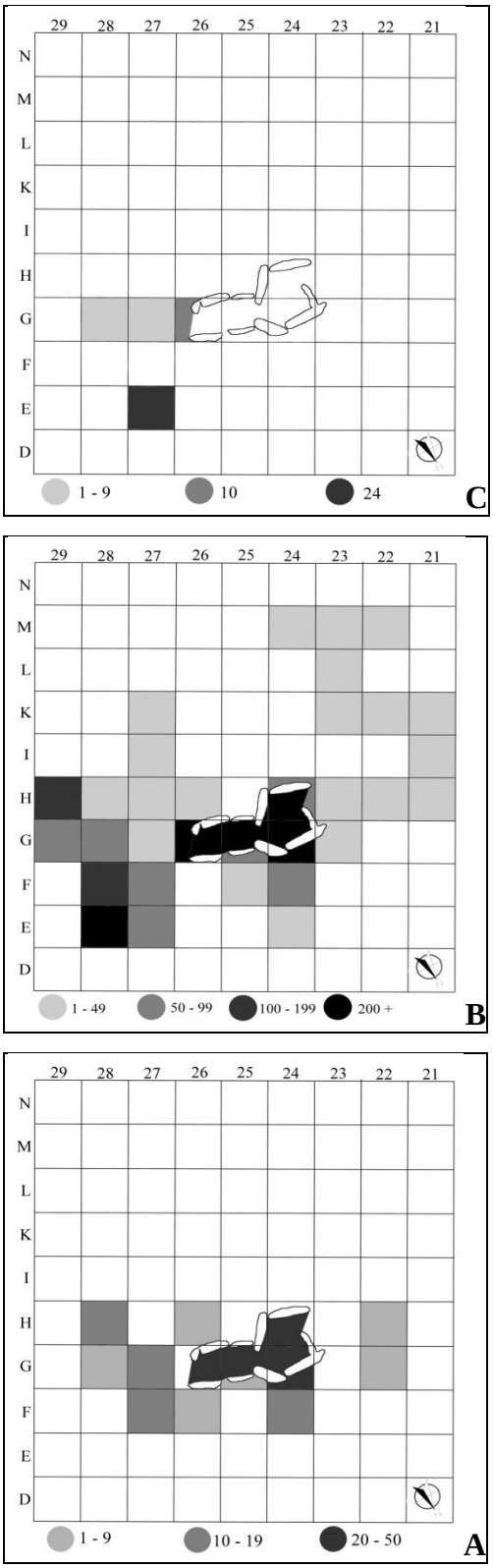


Figure 3.18 Horizontal pottery dispersal and density in layers C, B and A of Anta 1 de Val da Laje

The high intensity of activities during the next phase is reflected in the wide area of pottery dispersal (Figure 3.18, B). The most artefacts come from the chamber and corridor interior, the threshold and the area immediately in front of the entrance, and a small area next to the northern wall outside of the chamber. Two other locations are detected over 4 m to the NE and SE of the entrance. In smaller numbers, but pottery is present also on the wider area in the opposite end of the site, W and SW from the grave. We can assume that these different concentrations reflect different activity locations, and one of the goals is to establish the intra-site variability. For this reason, seven different loci were defined within this layer: Locus 1 (F28, E27, E28 and F27), Locus 2 (H29, H28, G29, and G28), Locus 3 (K27, I27, H27, H26, G27 and G26), Locus 4 (G25, G24, G23, F25, F24 and E24), Locus 5 (the chamber and corridor interior – H24, G26, G25 and G24), Locus 6 (H24 and H23) and Locus 7 (the remaining squares west from the grave). Besides the techno-typological evaluation, each locus is represented by a different number of samples for lipid residue analysis. Together with four potshards from layer C, the total number of samples from Anta 1 for laboratory assessment is forty-two.

CHAPTER 4: POTTERY ANALYSES

Pottery studies have a long history in the archaeological science. This history has accumulated a large body of terminology and definitions, the application of which very often brings confusion. For the sake of clarity, it is important at the beginning of this chapter to clarify the specific vocabulary.

Ceramic is a term covering a range of inorganic materials and the end products of their transformation or combination through pyrotechnology (Rice, 1987, p. 3). In the modern world, ceramic technology has a very important role in industry and art; but the roots of it go back deep in human prehistory, when the four natural elements were combined and permanently transformed into the first synthetic material that humankind have created. A very early manifestation of this process was the manufacture of containers made of clay, probably mimicking already existing objects from perishable materials (Gheorghiu 2009).

Ceramic technology has slowly emerged in several independent centres in the world at different moments of social development (Rice 1999). Eurasia witnessed the earliest ceramic objects discovered so far, from the Palaeolithic clay figurines of Central Europe (Farbstein et al. 2012; Farbstein & Davies 2015), through the invention of fired clay vessels by mobile hunter-gatherers of the extreme East (Kuzmin 2006; Boaretto et al. 2009; Lu 2010), to the emergence of limestone flooring and pottery in the Near East (*e.g.* Thissen 2007; Özdoğan 2009). The latter "hotspot" was the core area, from where pottery eventually spread towards the Balkans, and then very quickly covered the entire Mediterranean coast of Europe, reaching Spain and Portugal. Apparently the socio-economic conditions during the Upper Palaeolithic in Central Europe did not permit, or simply there was no necessity for the development of pottery, even though people were familiar with ceramic technology.

The term pottery refers strictly to the containers or vessels made of clay, water and non-plastic inclusions. An inaccurate equivocation is often made between pottery, sedentary lifestyle and agriculture, as the three main characteristics of the Neolithic. While this is approximately accurate for some regions of the world, a generalisation would be incorrect. Recently Peter Jordan and Marek Zvelebil (2009) edited a compilation of texts concerning pottery artefacts from hunter-gatherer contexts from Eurasia. It turns out that pottery was present in pre-farming communities and not only in the Far East as mentioned above, but also in Russia and Northern Europe as well. It also seems that pottery does not follow the same development and dispersal track as agriculture, or at least not exclusively.

Like in any industry, the production process of a ceramic pot is a sequence of interrelated operations. For a successful production session, the knowledge and the experience of the master are essential. The first knowledge to call upon is the knowledge of local clay sources and their properties. Many generations can use the same source to extract raw materials, a continuity which is often detected through archaeology. Each clay source however has its own history of origin, and with that a specific blend of clay minerals and other ingredients. Changing the raw material source (the reasons for which can range from exhaustion of the old clay bed, loss of territories, to cultural preferences) requires a period of experimentation, where again the knowledge, experience and flexibility of the potter come to stage. In order to optimize the production, a trial and error process of manipulation with inclusions is necessary.

Inclusion is a general term for all mineral and organic non-plastic elements, added or already present in the clay. The manipulation means either extracting the unwanted present inclusions, or adding certain ingredients in pursuit of the desired product. For example, if the vessel is intended to be used for cooking, an ingredient which would facilitate the recurring expansion and contraction of the walls might be added; this can be a mineral with similar thermal expansion coefficient as the clay (like calcite), crushed shards from discarded ceramic objects (grog), or vegetal particles which burn out during firing and leave voids; these voids short-circuit cracks which might develop from the frequent change of temperature of the ceramic body during usage. Otherwise, if for some reason a "fine" appearance and thin walls are required, coarse particles already present in the clay must be removed. From an archaeological perspective, it is very important to distinguish the temper, which are the particles intentionally added by the potter, from the accessories naturally occurring in the clay sediments (for an expanded insight into the range of tempers, see Rye 1981, p. 31-36).

The obtained mixture of clay, water and inclusions is usually referred to as paste, body or fabric[12]. To achieve a homogeneous plastic mass, with equally distributed moisture, a laborious process of kneading is necessary. Once the paste is ready, the forming process can begin. Rye (1981, p. 62) presents five different forming techniques: pinching/drawing, slab building, moulding, coiling and throwing. Obviously the last technique is not relevant for the parts of prehistory discussed here. Each of the techniques involves different tools and/or hand

[12] Fabric is more an archaeological than a technological term, referring to the characteristics observed on a broken piece of archaeological pottery; whether macroscopically or in thin-sections, the three main observed elements are the non-plastic inclusions, the voids and the clay matrix (the clay mass in which the inclusions and voids are imbedded).

gestures, which leave specific marks on the vessel surface (attributes). Through the detection of these attributes, the forming technique can be established. This process however, is not that straightforward. Some traces from earlier stages are covered or erased by later steps of pottery making (like burnishing or polishing). The fragmentation level of some assemblages might also prevent a solid technological assessment. There are sufficient explanations throughout the literature of all the aspects of these and other forming techniques (Rye 1981; Rice 1987; Orton & Hughes 2013). It is worth noting here that the most frequently reported technique from the Neolithic is coiling.

Once the clay products are formed, it is necessary to transform them from soft plastic to hard state. This implies evaporation of much of the water molecules present in the paste and volume shrinking (Rice 1987, p. 63-71). If this transformation happens too rapid, the shapes might deform, crack or break. That is why the long process of drying, preceding the firing, is as important as the firing process. But the drying is not a completely passive phase, as some secondary forming techniques (surface treatment, decoration, handle application etc.) happen during various drying stages (usually the later "leather-hard" stage).

Finally the containers are fired and the physical and chemical properties of the original ingredients are irreversibly altered. As the last of the water molecules are removed, the plasticity is lost and the shapes become permanent. The firing process is determined by three variables: rate (duration), maximum temperature achieved and atmosphere (oxygen availability around the objects) (Rye 1981, p. 96). A lot can be said about these parameters by looking at a piece of archaeological pottery, primarily by the external colour of the walls and the type of cross-section. The most common way of firing pottery during the Neolithic and Chalcolithic in Iberia was in open fires, either on the ground or in small pits. So far, no elaborated kiln has been discovered. It is difficult to control the firing conditions in open fires. Nevertheless, whether intentional or not, the variations in the parameters can be detected through pottery studies (Rye 1981, p. 110-122).

The finished products are distributed to the users and the technological process of pottery production ends here. The interest of archaeology however goes beyond this point, and aspects of vessel function, reparations, discard and recycle, as well as object circulation (exchange) are also important. The last aspect is most securely addressed through petrography studies, which is beyond the scope of this work.

To determine the purpose of ceramic vessels from such a remote past is not an easy task. Our modern associations between aesthetics, shape and function are not the same as during the Neolithic for example. Unlike later periods, where we can find written, graphic, or

ethnographic records for vessel function, for prehistoric collections a combination of data is necessary, including shape, fabric, traces of wear on the vessel body, context and experimental studies (Orton & Hughes 2013, p. 248-261; Vieugué 2014). More recently, a more secure determination is provided by isotope ratio mass spectrometry of identified lipid remains directly from the ceramic matrix (see further below; Evershed et al. 2008). The method can point accurately weather the vessel was used to process milk or meat, and in case of the latter, it can distinguish between processing ruminant and non-ruminant meat. This can be used to revise previously hypothesised pottery functions, based solely on typology or fabric (Thissen et al. 2010). There are however some limitations, if the method is considered only from the perspective of vessel utilisation studies; only vessels used for cooking would give positive results, since tableware, transport and storage containers do not detain molecules from their contents (Thissen et al. 2010, p. 166); furthermore, if a pot has been used for cooking only once, it will be determined as cooking vessel regardless of its previous and subsequent function(s). Nevertheless, in a wider archaeological context, the method has become an invaluable tool, especially for problems concerning the beginnings of agriculture and animal and plant exploitation (Copley et al. 2003; Craig et al. 2005; Evershed et al. 2008; Özbal et al. 2010; Salque et al. 2012; Šoberl et al. 2014; Cramp et al. 2014; Salque et al. 2015).

Orton and Hughes (2013, p. 262-264) have described several factors influencing the life-expectancy of a ceramic vessel. That people valued pottery containers and made attempts to expand their life cycle, is evident from detected repairs of broken pots (Fig. 4.1). Nevertheless, eventually all pottery becomes refuse, either discarded as waste by users themselves, or become part of archaeological deposit together with its original context. In the later case, if no post depositional disturbances occurred, the vessels are discovered *in situ* and complete, either fragmented or intact. That is however more often exception than rule in prehistoric archaeology. The more common situations are pottery deposits from waste areas of a site, or domestic or burial contexts disturbed by later activities on the same area. The majority of a pottery assemblage from excavations is usually represented by unrelated small shards. A helpful approach in determining post-depositional events is quantification of the entire collection (shard size, number, weight, and average shard weight), noting differences in pottery concentration in both inter- and intra-stratigraphic perspective, shard orientation during discovery and abrasion level. For most of the pottery, the life cycle ends when the item is no longer used. A small amount of discarded pottery is being recycled as grog temper, potters tools, flooring material etc.

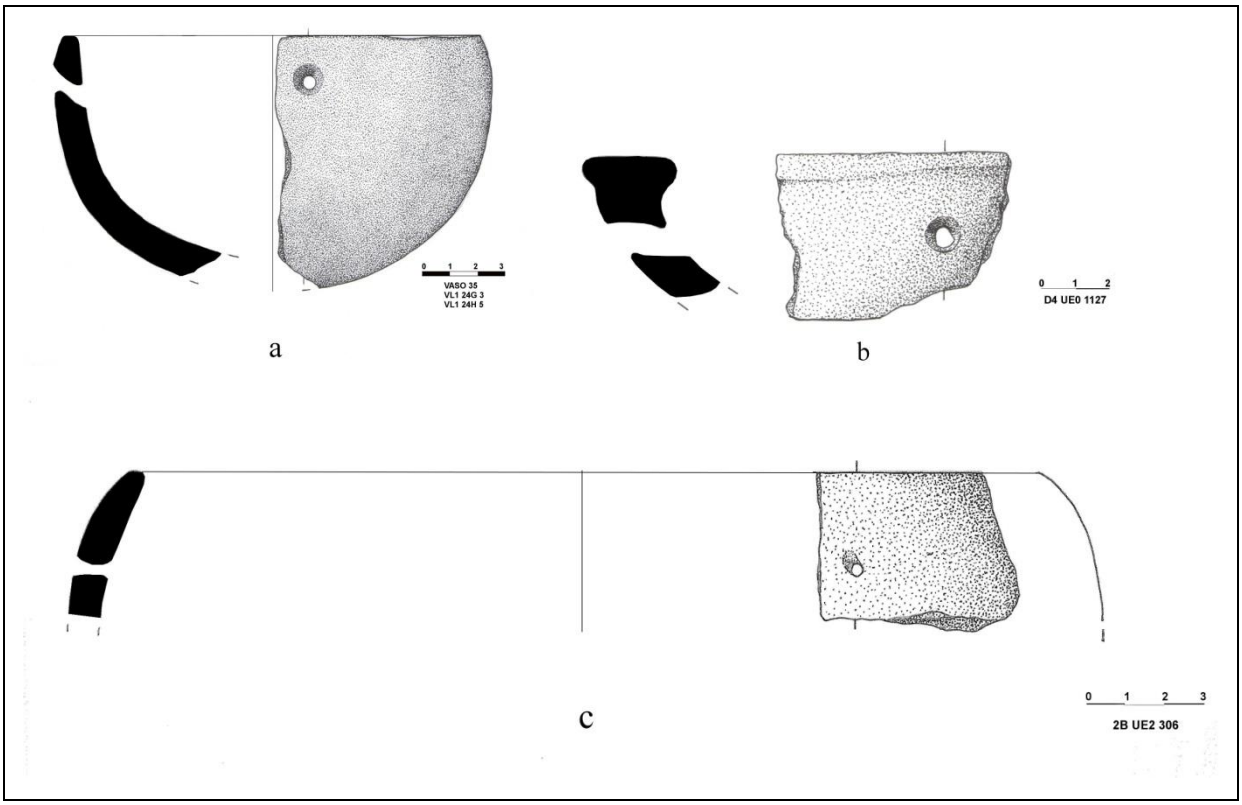


Figure 4.1 Repair drillings on pottery; a) Anta 1 de Val da Laje; b, c) Cueva de los Postes

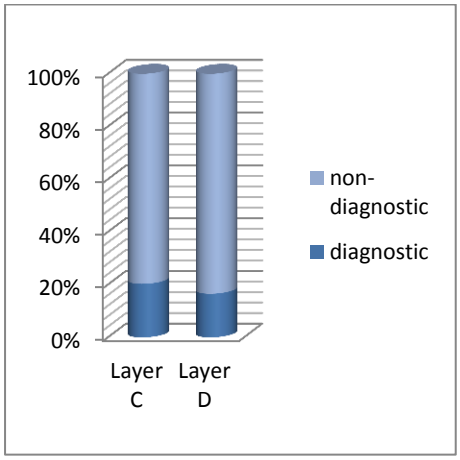
4.1 Assemblage structure

Before we characterise the physical properties of the pottery artefacts and start drawing conclusions from that, it is essential to know the structure of the group, the difference in presence between rims, handles, body parts etc., since not all of them are equally diagnostic for each of the variables in the characterisation.

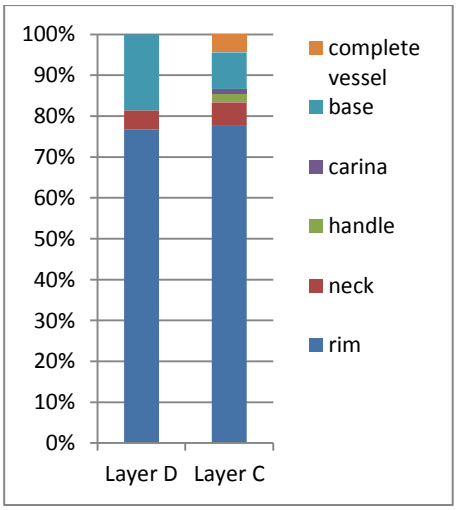
Looking at the assemblage of **Gruta do Cadaval**, the diagnostic units take between 10 and 20 percent of the pottery in both layers. The majority, as usual, consists of non-diagnostic body shards (Table 4.1; Figure 4.2, a).

Table 4.1 Quantity and structure of the Cadaval pottery assemblage

Layer	Square	N total	Diagnostic
C	E30	68	9
	F29	3	0
	F30	93	20
	F31	150	41
	G29	37	4
	G30	97	18
	G31	35	4
	H28	77	15
	H29	48	8
	H30	33	10
	H31	3	3
	I30	6	0
Layer C total		650	132
D	F30	2	0
	G29	33	1
	G30	12	1
	G31	38	10
	H28	7	0
	H29	117	23
	H30	63	10
Layer D total		272	45
Total C + D		922	177



a)



b)

Figure 4.2 Structure of the Gruta do Cadaval pottery assemblage

Observing the structure of the diagnostic unit corpus (Figure 4.2: b), we can note some differences between the two layers. The earlier layer D is missing elements such as handles and carinae.

The **Cueva de los Postes** assemblage is significantly smaller. The Neolithic remains from Area 1 contain twenty-one percent diagnostic elements, which are represented only by rims and neck parts (Fig. 4.3, a). The pottery from layer 3 at Hueco Eulogio has the lowest percentage of diagnostic pieces, but their diversity is the highest (rim, neck, base and handle parts, one complete profile of a vessel, as well as part of a ceramic ring which might have belonged to a specific category of pedestal bowls; Fig. 4.3, b). Layer 2 contains the smallest absolute number of diagnostic elements (Fig. 4.3, c). Beside the rim and neck parts, there is also part of a handle.

Table 4.2 Quantity and structure of the Postes pottery assemblage

Sector	N total	Diagnostic	% diagnostic
Hueco Eulogio 2 (2nd mill. cal BC)	26	8	31
Hueco Eulogio 3 (3rd mill. cal BC)	112	14	12.5
Area 1 (6th – 4th mill. cal BC)	58	12	21
Total	196	34	17

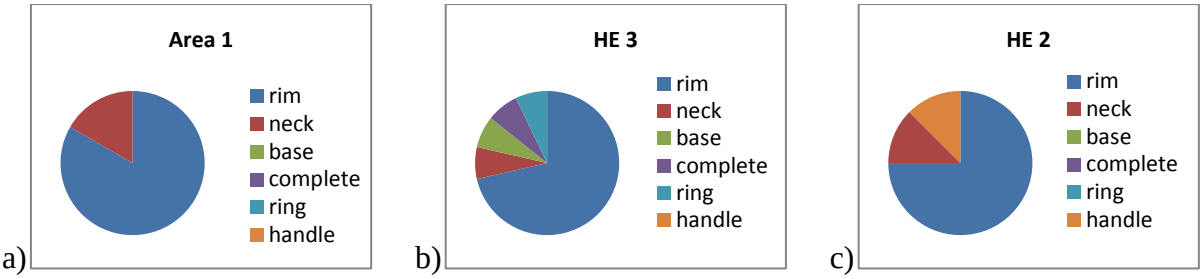


Figure 4.3 Structure of the diagnostic corpus of the Postes pottery

The passage grave of Central Portugal, **Anta 1 de Val da Laje**, has the largest pottery assemblage out of the three case studies in this thesis. Out of the 2054 items considered in this study, 2015 come from layer B, the most active phase of the site (Table 4.3). There is an obvious difference in the diversity of the diagnostic elements. Even though the diagnostic units in layer C marks a higher percentage than in layer B, in reality they consist of ten rims, one base fragment and one complete vessel profile. Variety of fragmented individual features, such as handles, neck parts and carina, present in layer B, are missing in layer C (Fig. 4.4). Comparing the two pottery collections however is not straightforward, since there is an enormous difference in size.

Table 4.3 Quantity and structure of the VL1 pottery assemblage

Layer	N total	N diagnostic	% diagnostic
B	2015	449	22
C	39	12	30
Total	2054	451	22

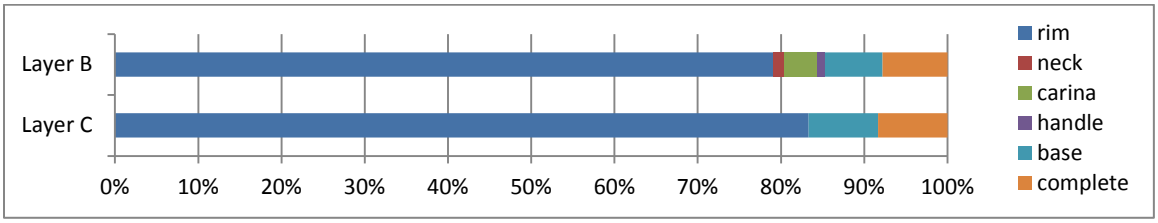


Figure 4.4 Structure of the diagnostic elements in layer B and C of VL1

4.2 Morphological classification and decorative techniques

Five general classes of vessel shapes are distinguished among the pottery assemblages from the three sites (Fig. 4.5).

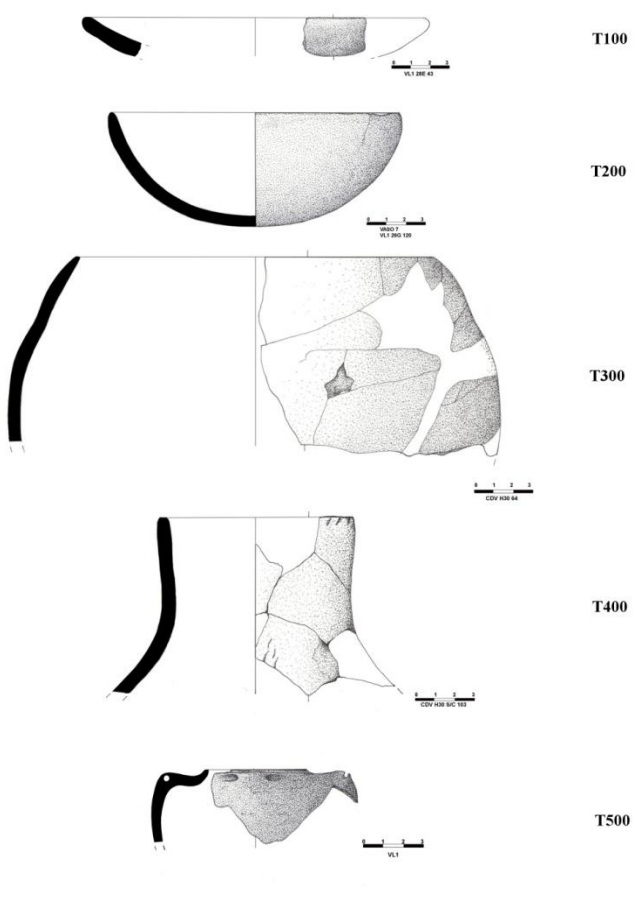


Figure 4.5 Basic classes of pottery shape typology

Plates (T100) are the most open shapes (Fig. 4.6). The orifice is the widest point on the body, while vessel height does not surpass 1/3 of the diameter of the rim. Considering their size and shape, as well as modern and ethnological analogies, they were most commonly involved in serving, consumption or presentation of non-liquid foodstuffs. Plates are among the least represented types of pottery vessels, with samples only from layer C from Cadaval and layer B at Anta 1 (Table 4.4). There is a drastic difference to bowls for example, which are vessels commonly used for consumption of liquids. This suggests that diet in prehistory, at least judging from pottery, was consisting predominantly from liquid food (see below, T200).

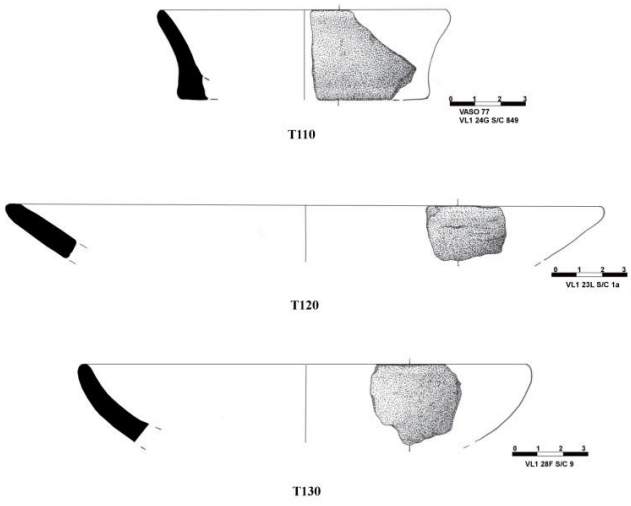


Figure 4.6 Plate shape varieties

Three sub-varieties of plates can be recognized (Fig. 4.6):

- T110 – plates with outcurving rim; this is a unique specimen from layer B in VL1; it is one of the smallest vessels, and it is also interesting for its thick flat base, which is not a very common feature in these assemblages;
- T120 – trunco-conic plates; as the name suggests, these plates have straight walls. They are not common at all, with two of them found in layer B of VL1 and only one in layer C of Cadaval.
- T130 – dome-shaped plates; these convex open vessels are the most common among the plates;

Bowls (T200) are open vessel shapes. Except for T250, the orifice is the widest part of the body. They are among the most common pottery shape. In the collections under study, bowls absolutely dominate in both layers of Anta 1; they are the only shape of vessels recognized in the prehistoric layers of Postes, and come in close second at Cadaval (Table 4.4). Bowls are usually associated with liquid food consumption. The lipid residue analyses however have demonstrated just how wrong our modern preconceptions about prehistoric pottery function can be. The majority of the samples that contained lipids, and therefore were used for cooking, are bowls, and some of them really small too (see section 4.3 below).

Generally simple shapes, still five different types of bowls were recognized within the three assemblages, with some further sub-categories (Fig. 4.7):

- T210 – trunco-conic bowls; like T120, they have straight oblique walls; unlike T120 their height is bigger than 1/3 of the rim diameter (less tilted walls); in other words, they are deeper than the trunco-conic plates; these straight-walled bowls are present in both layers of Cadaval and in layer B of Anta 1.
- T220 – hemispheric bowls; this type is also an upgrade in height (depth) from the dome-shaped plates; determined by the outline of its body, which also concerns the depth, this often most numerous category is further divided in three sub-groups:
    - T221 – shallow (horizontal ellipse)
    - T222 – regular round shape
    - T223 – deep (vertical ellipse); appropriate definition for this category would be drinking cups; they are deep, but at the same time have the smallest rim diameter

values, ranging between 70 and 100 mm (in rare cases at Postes and Cadaval up to 185 mm).

- T230 – carinated bowls; carina is an abrupt change of the angle of inclination of the wall in a vessel. In SW Iberia this feature is usually associated with the transition from early to middle Neolithic, a process also accompanied by the appearance of collective burials and the building of megalithic monuments. Here they appear only in Anta 1 and almost exclusively in layer B, with only two examples recorded in layer C. Another one was found in layer C of Cadaval.
- T240 – bowls with outcurving rim; vessels with smooth curving "S"-shaped profile. Most frequent in the early Neolithic layer D of Cadaval, two of them also appear in the following layer C (Table 4.4). They were not found at the other two sites.
- T250 – bowls with slightly incurving rim; this is a specific morphological variety which stands in the fuzzy border area between bowls and pots; obviously these vessels deviate from the general distinctive characteristic of the bowls – the gradual increase in diameter from the base towards the rim; the constriction here however is very small, the coefficient ($\frac{\text{rim d}}{\text{max d}}$) is never smaller than 0.9; in short, while the rest of the bowls have constriction coefficient 1, this subcategory slots between 1 and 0.9, and gives the transition towards the closed pottery shapes.

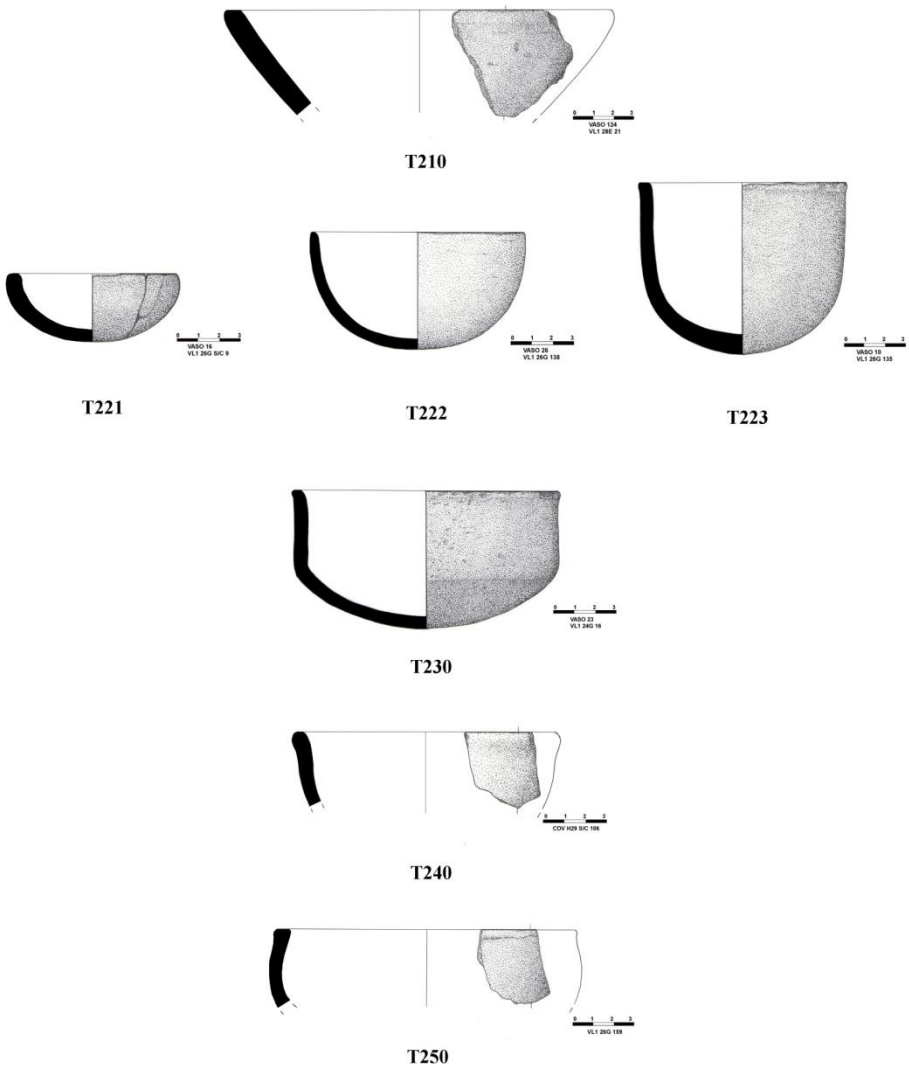


Figure 4.7 Bowl shape varieties

Pots (T300) are usually bigger ceramic vessels with more constricted orifice, but the content is still more accessible than in the case of jars (Fig. 4.8). The constriction coefficient is between 0.9 and 0.65. They are considered to be the prime candidate for food preparation, but this does not have to be an exclusive function. Out of the eight pot samples tested for lipid residue, all but one gave positive results, the negative one being from Postes where the recovery rate is poor overall.

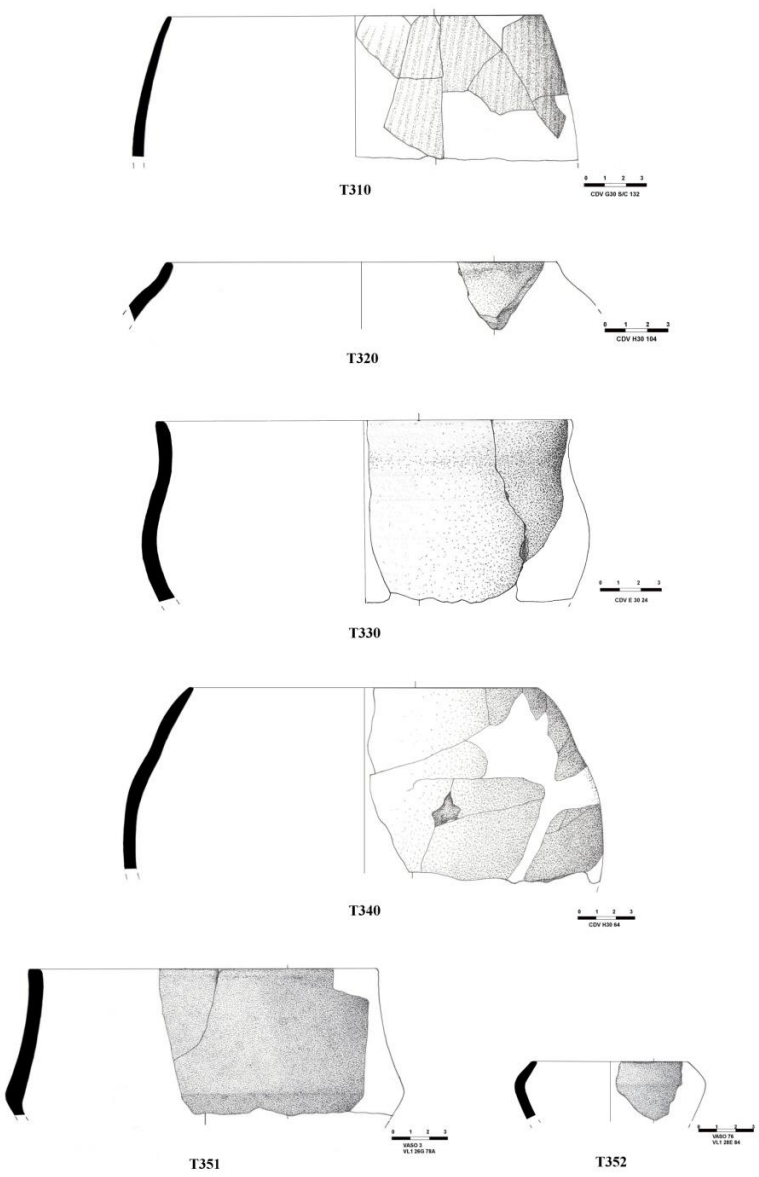


Figure 4.8 Pot shape varieties

Pots are the most frequent type of pottery vessels in both layers of Cadaval. In Anta 1 they are present only in layer B, but are significantly less numerous than the bowls. Two pots have been recognized in Postes, one in the early Neolithic sequence and the other in Hueco Eulogio 2. Five variations have been distinguished, with some further sub-groups in the last one (Fig. 4.8):

- T310 – spherical pots; round-shaped vessels, presenting the bigger part of a sphere. They are also the most common type of pots.

- T320 – collared pots; similar to the previous, with the addition of a small vertical, or slightly inclined collar (or neck) defining the orifice.
- T330 – pots with outcurving rims; only two examples are identified, and they are both found in Cadaval, one in each layer.
- T340 – pots with composite bodies; built from at least two parts, joined together before the drying and firing stages of production. Obviously the intention was for the parts to remain recognizable as separate once the vessel is finished, retaining a "composite" look and more complex outline. Two composite pots were found in layer C of Cadaval, and they are both different. The first one has two rounded parts with different sizes, the smaller one adding on top of the bigger (Fig. 4.8). The other has a rounded lower, but conical upper part. This was not a perfect fit, as the upper part was slightly smaller, forming a ridge on the exterior at the attachment point (Fig. 4.9). Another smaller and less preserved example was identified in layer B of Anta 1.

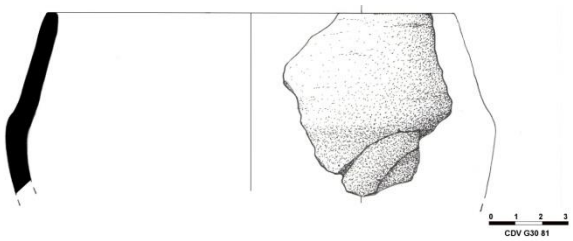


Figure 4.9 Pot with composite body (T340)

- T350 – carinated pots are even less frequent than the carinated bowls. Only two are found in layer B of Anta 1. They both differ in where the carina is positioned, so two varieties can be recognized:
    - T351 – low carina
    - T352 – high carina

Jars (T400) is not a very frequent type of pottery in our study. They are closed vessels and commonly associated with the transportation and storage of goods. The constriction index is lower than 0.65. Five examples are known only from Cadaval: four in layer C and one in layer D (Table 4.4). Even so, three different varieties can be defined (Fig. 4.10):

- T410 – hole-mouth jars
- T420 – short-necked jars
- T430 – long-necked jars

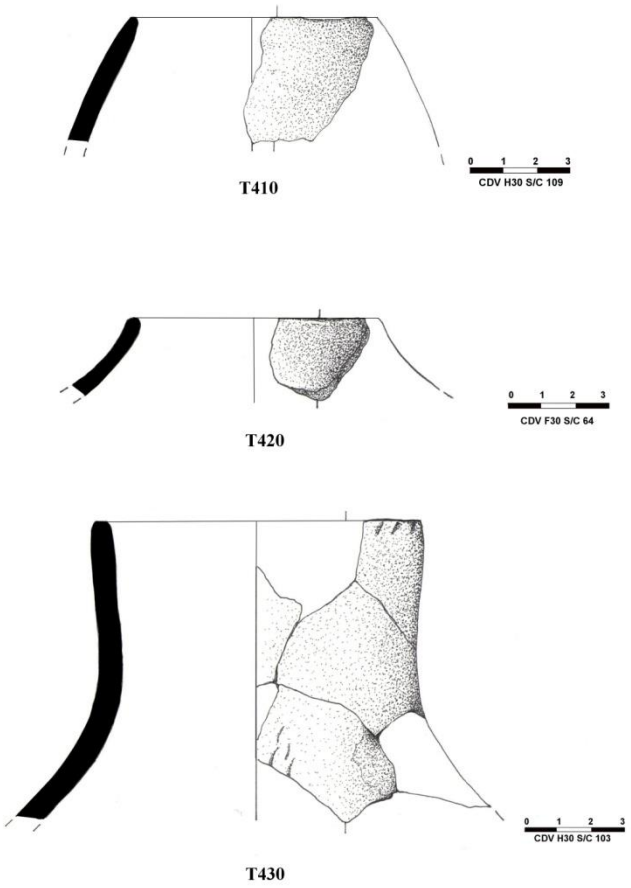
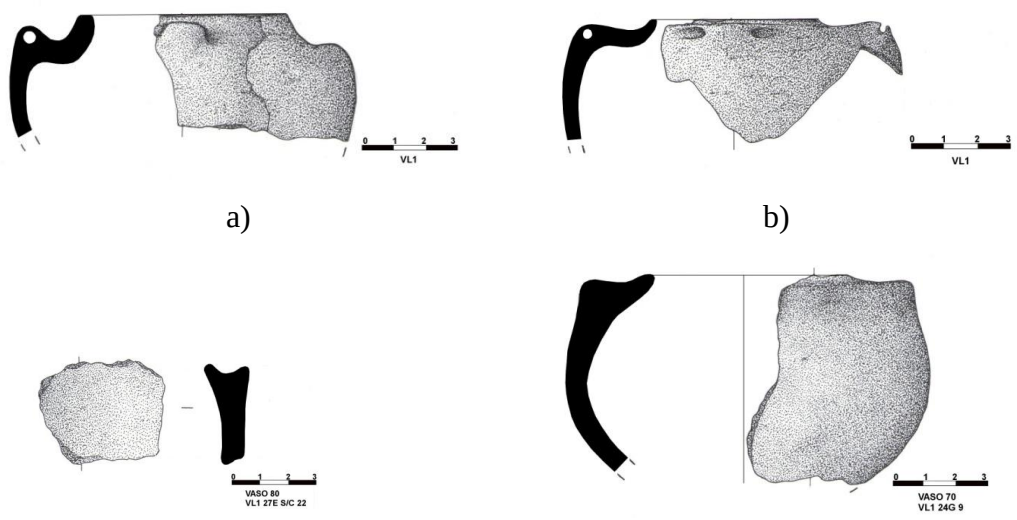


Figure 4.10 Jar shape varieties

Lamps (T500); the name is given tentatively, because the function which it implies is suggested in the field registry based on the peculiar form and features of the vessel. They are characteristic only for layer B of Anta 1 de Val da Laje[13]. Out of the four lamps discovered, two have four horizontally perforated suspension lugs, symmetrically positioned on the elevated shoulder around a narrow opening (Fig. 4.11: a, b). This was probably the case also with the third item, from which only part of the body with half of the lug was preserved (Fig. 4.11: c). The last one has identical shape as the previous, but no suspension lugs were observed on the surviving part (Fig. 4.11: d). None of them preserves the base, but from the last one it is clear the curvature from the walls continues to form a convexity.

[13] Four lamps have been discovered at VL1; unfortunately the context of two of them have been lost (Fig. 4.6: a,b), and the other two are from layer B;



a) b)

c) d)

Figure 4.11 Lamps from Anta 1 de Val da Laje

A closer look at the individual collections will give us a clearer typological identity to each layer of each site.

There is not much to be said about the small collection from **Cueva de los Postes**. Only nine artefacts gave enough information for their shape to be reconstructed. Seven of them are bowls, coming from the Neolithic and the Chalcolithic sequences (Table 4.4). Apart from one bowl with incurving rim, the other two Neolithic bowls are deep cups with smaller diameter (90 and 135 mm). Also from the Neolithic is one spherical pot. The bigger and more regular round shaped bowls are more common in the Chalcolithic. Their rim diameters vary between 155 and 225 mm, with one exception being a much wider vessel with orifice diameter of 380 mm. The only identified shape from the 2nd millennium cal BC is a large collared pot.

Irrelevant to the shape typology, there is a wide variety of lip forms in Postes. The regular rounded and flattened types seem to be preferred during the Chalcolithic. There is no other pattern in the distribution of the lip types. But any pattern proposed for Postes based on the current collection, must be controlled on a bigger collection.

The only undoubtedly decorated piece of pottery from the Neolithic of Cueva de los Postes (SU 9 to 5 in Area 1) is an incised small vessel, probably collared pot, from the earliest stratigraphic unit 9 (Fig. 4.12: a). It was decorated with rows of short horizontal and oblique

notches, incised with a sharp instrument or a fingernail before the firing (INC.6.a)[14]. From what we can see on the preserved part, the decoration was carried out on the upper part of the body towards the neck, on the exterior surface. Some shards, previously thought to be painted with very diluted red paint, are now regarded as undecorated and the red paint is attributed to a post-depositional effect of the *terra rossa* soil in the cave in which the artefacts were embedded. There are however two more convincing cases of red painted pottery, coming from layer 3 at Hueco Eulogio sector (PNT.1.a; Fig. 4.12: b). No other decorative techniques are known from this sequence. The Bronze Age at Postes (layer 2, Hueco Eulogio) brings back the incisions, but this time as more complex motifs, small part of one of which was discovered (INC.1.a; Fig. 4.12: c).

[14] For the full list of decorative techniques and graphic representations, see appendix.

Table 4.4 Quantitative representation of morphological types and variations per site

			Cueva de los Postes			Gruta do Cadaval		Anta 1 de Val da Laje	
			Area 1	HE 3	HE 2	Layer D	Layer C	Layer C	Layer B
T100	T110								1
	T120						1		4
	T130						2		8
Total T100							**3**		**13**
T200	T210					3	1		12
	T220	T221					3		10
		T222		2		1	5	2	50
		T223	2	1			2		7
	T230						1	2	18
	T240					4	2		
	T250		1	1			4	2	11
Total T200			**3**	**4**		**8**	**18**	**6**	**108**
T300	T310		1			6	13		12
	T320				1	6	2		5
	T330					1	1		
	T340						2		1
	T350	T351							1
		T352							1
Total T300			**1**		**1**	**13**	**18**		**20**
T400	T410						1		
	T420					1	2		
	T430						1		
Total T400						**1**	**4**		
T500									2
Total T500									**2**

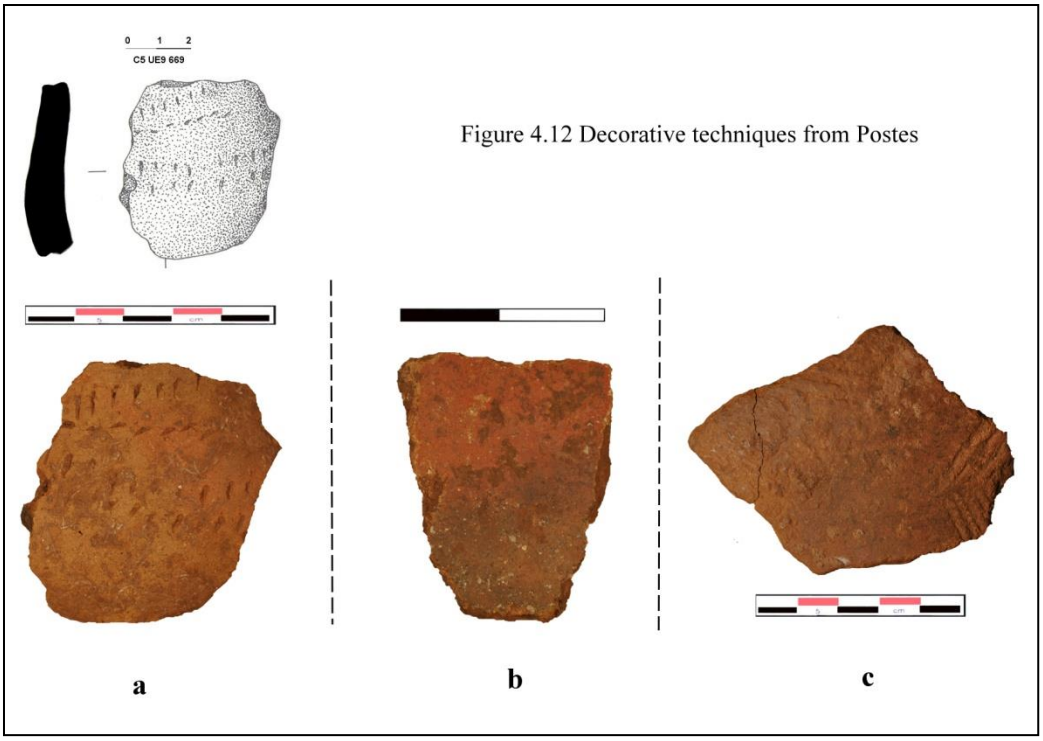


Figure 4.12 Decorative techniques from Postes

From **Cadaval** we have a bigger and more diverse collection. Plates are few and only present in layer C. Two of them are dome-shaped with smaller size (100 and 160 mm diameters), and one is a big (260 mm) trunco-conical plate.

Eighteen bowls were found in layer C, matching the pots at the top position in numbers. T222 and T250 are the most numerous, but all the other sub-categories are also represented, even though in smaller numbers. The bigger examples fall into the last two categories, T240 and T250 (diameters between 225 and 300 mm). The rest are smaller vessels with diameters rarely exceeding 200 mm. Eight bowls were identified from layer D, falling in three categories: T210, T222, and the most numerous of the three T240. Unlike in layer C, here the T240 bowls are small with diameters between 110 and 150 mm, and the rest are above 250, with one example having a rim diameter of 400 mm.

Pots are the most numerous shapes in layer D and they all fall in the first three categories. Carinated and composite shapes are missing. The only pot with outcurving rim (T330) is the smallest (145 mm rim diameter), while the others are somewhat bigger, with diameters ranging between 155 and 300 mm. In layer C there are eighteen pots. In addition to the layer D varieties,

here there are also two vessels with composite bodies (T340), but no carinated shapes. The rim diameters vary between 115 and 365 mm without clear patterns among the categories.

Jars are an exclusive feature for Cadaval. Only one was found in layer D, being of the short-necked type, with rim diameter of 110 mm. Four jars are identified in layer C, with diameters from 70 to 245 mm. Being a constricted type of vessel, the rim diameter does not reflect realistically the actual size of the jars. Generally speaking, they were the biggest ceramic containers in the prehistoric households, but they are rarely preserved completely, and unfortunately in our case we are seeing only the upper third or less.

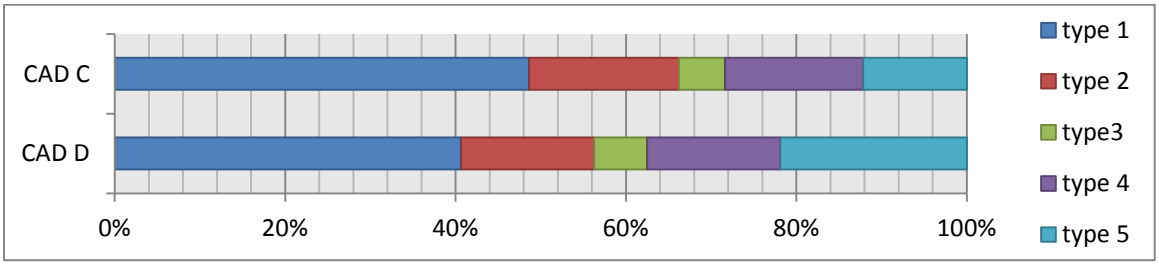


Figure 4.13 Relative distributions of lip types in Cadaval

Looking at the lip typology in the Cadaval pottery assemblage, we can see five different types represented in both layers (Fig. 4.13). The regular rounded lips are dominant in both cases. The difference between the layers is visible at the second position. During the earlier period (layer D) the flaring type of lip (type 5) was very common, outnumbered only by type 1. Later, in layer C, it loses part of the popularity in favour of an even bigger dominance of type 1, and partially in favour of type 2 (thinned) and 4 (flattened) lips. Bulged lips are present, but least popular in both layers.

Handles are not frequent at all in all the assemblages under study. In Cadaval only two small tongue-shaped protrusions (type 1) were found in layer C (Fig. 4.14). Even though their colour is not identical, they come from the same square and depth, and are very similar in shape and size, so they actually may be parts of a single vessel.

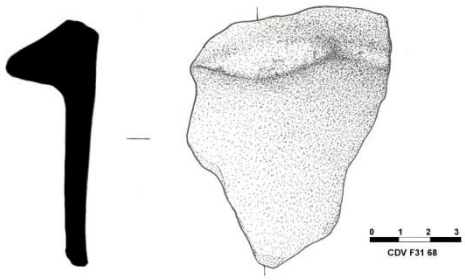


Figure 4.14 Tongue-shaped handle,

Considering base variability, in both layers of Cadaval there is only one type present – the convex base (type 1).

Table 4.5 Quantitative representation of decorative techniques

	POS Area1	POS HE 3	POS HE 2	CDV D	CDV C	VL1 C	VL1 B
INC.1.a			1				
INC.3.a					2		1
INC.6.a	1						
INC.13.a							1
INC.14.a					5		
INC.15.a				3	5		
INC.16.a					1		
INC.17.a					1		
Incisions total	1		1	3	15		2
PNT.1.a		1		1	2	1	3
PNT.1.b							1
PNT.3.a					1		
Paint total		1		1	3	1	4
IMP.2.a					1		
IMP.4.a					1		
IMP.6.a							5
IMP.6.b							1
Impressions total					2		6
GRV.2.a				3	2		
Grooving total				3	2		
COM.1.a				1	1		
COM.2.a							1
Combination total				1	1		1
APP.2.a				1			
Application total				1			

Cadaval has the biggest number of decorated pottery out of the three sites. Thirty-one decorated fragments were found from the two layers, twenty-two of which are from layer C. The variability is high (table 4.5), but as far as layer C is concerned, the most frequent technique is comb incisions (INC.15), equally frequent in combination with a row of alternating short oblique lines (INC.14). A single horizontal line, incised under the rim on the exterior (a feature considered to represent the Middle Neolithic) is appearing on two shards (INC.3.a). Equally common is the red painted pottery (exterior, PNT.1.a) and the fine oblique grooves on the

exterior surface (GRV.2.a). Less represented, with one representative each are a grid of horizontal, vertical and oblique lines on the exterior (INC.16.a), a pot with alternating horizontal rows of short oblique incisions (INC.17.a), a defined horizontal band of red paint on the body exterior (PNT.3.a), one long-necked jar with fingernail impressions (IMP.2.a), and a case with combination between incised lines and stabbings with sharp tool (COM.1.a). In layer D the comb incisions (INC.15.a) are the most frequent, together with fine oblique grooves (GRV.2.a). Also appears one red painted piece (PNT.1.a), one pot with plastic application on the upper part (APP.2.a) and one similar case of combinations like in layer C (COM.1.a).

If pots were the dominant pottery shapes in Cadaval, the **Anta 1** collection is definitely marked by bowls. In layer B they take 75 % of the total number of identified shapes, while in layer C bowls are the only identified vessels (Table 4.4).

More specifically, there are six bowls in layer C, dispersed equally in three categories: T222, T230 and T250. They come as small as 75 mm, up to 350 mm rim diameter (Annex, Fig. A.6). No pattern between shape and size is recognizable from these six samples.

There is a bigger collection from layer B, with 143 vessels identified of which 108 are bowls (Table 4.4). All defined categories, except T240, are present (Annex, Fig. A.5). The group is dominated by the simple, regularly rounded hemispherical bowls (T222; 50 examples, or 46% of the bowls corpus). Carinated shapes (T230) come second in frequency, with 18 members taking 17% from the group. Above 10% are also the trunco-conic bowls (T210) with 12 representatives (11%), and the bowls with incurving rim (T250; 11 examples, 10%). The least represented are the other versions of hemispheric shapes, the shallow hemispheric bowls (T221, n=10) and the cups (T223; n=7). Regarding the size of the bowls, only the cups (T223) are clustered between 75 and 100 mm of rim diameter. The rest of the categories are dispersed between 80 and 330 mm.

Thirteen plates have been identified from layer B, four of which are T120, one from the T110 type, and the rest are dome-shaped plates (T130). Their rim diameters vary between 95 and 350 mm and do not seem to be related to the category.

The most numerous of the pots in layer B are of the spherical type (T310). They are twelve out of a total of twenty pots. Five collared examples (T320) were also identified. All the other types, except for T330, are represented with one pot each; the mentioned T330, as all the

other “S”-shaped forms, are absent from layer B. The range of the rim diameter is between 120 and 350 mm, but there is a group of six small pots with diameters between 50 and 85mm; this however does not seem to be related to specific shapes.

Finally, there are two lamp fragments (T500) with a secure context, which is a unique feature of layer B of Anta 1.

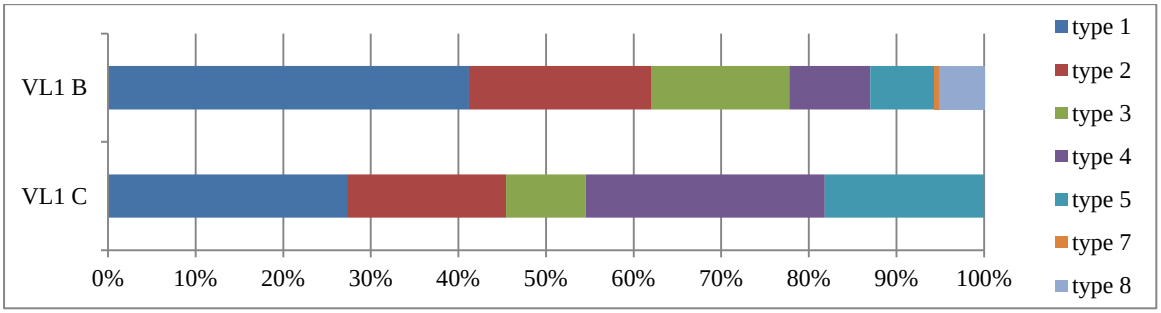


Figure 4.15 Lip typology of the Anta 1 assemblage

As figure 4.15 shows, there is a bigger diversity of lip typology in layer B than in C. But the diversification is not the only change between the two layers. While type 4, or flattened lips, were the most important in layer C (together with type 1, or the regular rounded type), in the superimposed layer this importance has diminished. Another variety which is frequent in layer C and not so frequent in B, are the characteristic flaring lips (type 5). From the decreased values of these two types in layer B benefited type 1 and type 3 (bulged lips). Also there is a shy appearance of two new types, namely the rounded lip with characteristic crest on its internal corner (type 8) and the undulating orifice (type 7).

In an assemblage dominated by bowls, it is no surprise that handles are not common. In fact, there are only five handle fragments, two of which are from the same vessel, and they are all from the same type – horizontal perforations for suspension, hanging and handling purposes (see Fig. 4.11).

Three types of bases are present in Anta 1: convex, flat and thick flat foot. The first one is absolutely dominant in layer B (n=53), and the only type present in layer C (3 examples in total). Flat base is only present in layer B (n=22), as well as two vessels elevated on a flat foot (Annex, Fig. A.2:1 and A.5:7) .

There are fourteen decorated pottery shards from the Anta 1 collection, dispersed through seven different modes of decoration. Only one of these is attributed to layer C. Having in mind the size of the assemblage, we cannot say that decoration was an important element of pottery production. The only representative from layer C, more precisely the exterior surface, was completely painted with red paint (PNT.1.a). This is also the most frequent of the individual categories in layer B (Annex, Fig. A.5:43). Table 4.5 gives advantage in numbers to the impression technique, but four out of the six representatives are from the same vessel. Also represented are two different modes of incisions, as well as a combination of shallow vertical grooves on the upper body with elliptical pits on the lip (COM.2.a; Annex, Fig. A.9:12).

4.3 Pottery use and prehistoric diet

Earlier in this chapter the various pottery types were associated with function, but it was also pointed out that function inferred from typological features has its limitations. The recent advances and introduction of methods from organic chemistry into pottery studies gave possibility for a more reliable interpretation. Explanation of the method is given in chapter 2. In short, when products are heated in a ceramic pot, lipid molecules enter the pores of the pottery matrix. Once the pottery is discarded, the matrix protects the lipids from the disintegrating processes which the environment can induce, and they can be preserved until the pottery is retrieved as an archaeological artefact. Through a chemical process (in this case a direct methanolic acid extraction) these molecules are removed from the pottery, and with GC-C-IRMS their origin can be identified.

As already mentioned, even though an attempt was made for as many varieties as possible to be sampled for these analyses (either in the typological or in the contextual sense), some limitations were also in power. In the end, we managed to process a total number of seventy-eight shards, forty-two samples from Anta 1 and thirty-six from Postes (Table 4.6).

Table 4.6 Summary of lipid residue samples

Site	Layer/sequence	*n* samples	Lipids detected	
			n	%
Anta 1	B	38	31	81
	C	4	2	50
	Total	**42**	**33**	**79**
Postes	Area 1	17	5	29
	Hueco Eulogio 3	19	7	37
	Total	**36**	**12**	**33**
Total		78	45	58

The forty-two samples from Anta 1 are representing ten of the typological categories. The jars, as well as groups T110, T120, T240, T330, T340 and T350 were not sampled. Four of the samples come from layer C, and the rest are from layer B. For this method it is recommended that the samples are taken from the rim area. At times however, only the base, the handle or the

body area were available (Table 4.7). This was a good opportunity to test the variability in concentration in different parts of the body in our assemblage, which resulted with a conclusion that there is not much difference, since high concentrations were retrieved irrelevant to the body part (Fig. 4.16). Another unexpected positive result from the analyses is the high recovery rate: thirty-three out of the forty-two samples (nearly 80%) contain ancient lipids and were submitted for isotope ratio mass spectrometry. To our knowledge, this is by far the highest recovery rate for lipid residue from archaeological pottery in Europe so far. Extremely well preservation of organic residue is also reported from Central Sahara by Julie Dunn et al. (2012), which they consider is aided by the arid climate. This is probably also aided by the implementation of the new method for extraction with acidified methanol (for method details see Correa-Ascencio & Evershed 2014). But nevertheless, such a level of preservation from acidic soil open-air site in Central Portugal, with a relatively shallow cultural sediment is still a surprise, especially because the sampling procedure was not targeting strictly "cooking vessels", or rim fragments only.

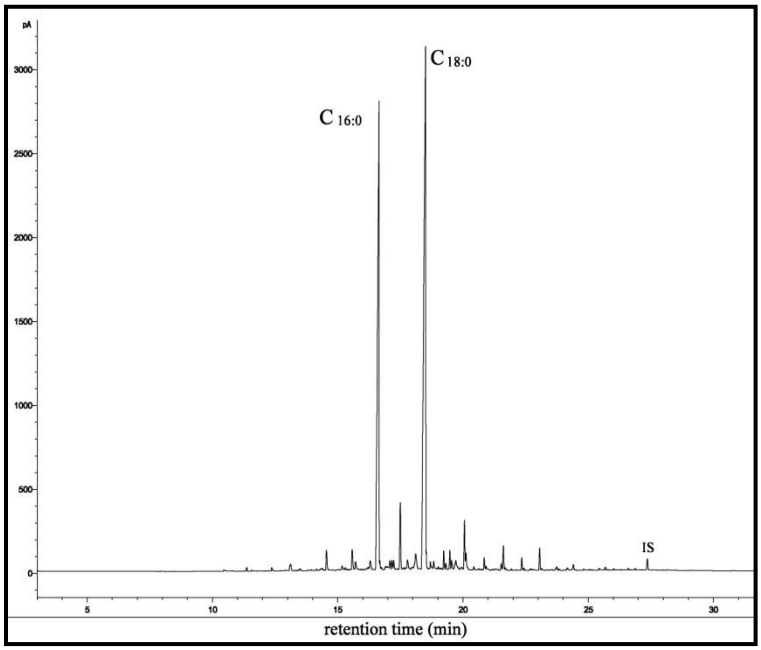


Figure 4.16 Typical chromatogram from Anta 1 with high concentration of palmitic and stearic fatty acids

From Cueva de los Postes samples were taken from various stratigraphic units from Area 1 and Hueco Eulogio 3 (Table 4.6 and 4.7). Out of the seventeen samples from the Neolithic sequence, five contained ancient lipid residue. The situation is similar at the back of the cave: seven samples yielded lipids out of the nineteen potshards tested. With recovery rates of 29%

and 37%, the sequences from Postes are in line with the usual situation with collections from Northern and Central Europe, the Balkans and the Near East (*e.g.* Evershed et al. 2008; Thissen et al. 2010; Salque et al. 2012).

Table 4.6 Complete sample list for lipid residue analyses

Sample	Provenance	Type	Part sampled	Results/ Δ13C	Lipid origin
VL01	Layer B	T222	Base	-4.55	Dairy
VL02	Layer B	T210	Bellow rim	-4.04	Dairy
VL03	Layer B	T310	Bellow rim	-3.25	Dairy
VL04	Layer B	T130	Bellow rim	Cont.	Modern?
VL05	Layer C	T250	Bellow rim	Cont.	Modern?
VL06	Layer B	T221	Bellow rim	Cont.	Modern?
VL07	Layer B	T310	Bellow rim	-3.00	Ruminant adipose
VL08	Layer B	T210	Bellow rim	-1.45	Ruminant adipose
VL09	Layer B	T500	Handle	Cont.	Modern?
VL10	Layer B	T320	Bellow rim	Cont.	Modern?
VL11	Layer B	N/A	Bellow rim	-3.07	Ruminant adipose
VL12	Layer B	T310	Bellow rim	-1.68	Ruminant adipose
VL13	Layer C	T230	Carina	Cont.	Modern?
VL14	Layer B	N/A	Body	-0.08	Non-ruminant adipose
VL15	Layer B	N/A	Body	0.15	Non-ruminant adipose
VL16	Layer B	N/A	Body	Cont.	Modern?
VL17	Layer B	T250	Body	0.04	Non-ruminant adipose
VL18	Layer B	T250	Body	-3.20	Dairy
VL19	Layer B	T223	Body	-1.62	Ruminant adipose
VL20	Layer C	T230	Body	0.12	Non-ruminant adipose
VL21	Layer C	T250	Body	-0.71	Ruminant adipose
VL22	Layer B	N/A	Body	-1.57	Ruminant adipose
VL23	Layer B	T223	Body	-3.72	Dairy
VL24	Layer B	N/A	Body	0.56	Non-ruminant adipose
VL25	Layer B	T310	Body	-4.51	Dairy
VL26	Layer B	T222	Body	-2.88	Ruminant adipose
VL27	Layer B	N/A	Body	Cont.	Modern?
VL28	Layer B	T500	Base	0.26	Non-ruminant adipose
VL29	Layer B	T310	Body	-0.34	Ruminant adipose
VL30	Layer B	T250	Bellow rim	-1.28	Ruminant adipose
VL31	Layer B	T221	Bellow rim	-3.56	Dairy

VL32	Layer B	T221	Rim	-2.58	Ruminant adipose
VL33	Layer B	N/A	Body	0.20	Non-ruminant adipose
VL34	Layer B	T250	Body	-0.05	Non-ruminant adipose
VL35	Layer B	T310	Body	-0.15	Non-ruminant adipose
VL36	Layer B	T222	Body	-4.93	Dairy
VL37	Layer B	T230	Bellow rim	-1.16	Ruminant adipose
VL38	Layer B	T221	Base	0.24	Non-ruminant adipose
VL39	Layer B	T230	Carina/base	-3.79	Dairy
VL40	Layer B	T222	Body	0.16	Non-ruminant adipose
VL41	Layer B	T222	Body	-1.17	Ruminant adipose
VL42	Layer B	N/A	Base	Cont.	Modern?
POS43	HE 3	N/A	Body	-1.35	Ruminant adipose
POS44	HE 3	N/A	Body	No FA	N/A
POS45	HE 3	N/A	Body	-4.04	Dairy
POS46	HE 3	N/A	Body	No FA	N/A
POS47	HE 3	N/A	Body	No FA	N/A
POS48	HE 3	N/A	Body	No FA	N/A
POS49	HE 3	N/A	Body	Cont.	Modern?
POS50	HE 3	N/A	Body	No FA	N/A
POS51	HE 3	N/A	Body	0.32	Non-ruminant adipose
POS52	HE 3	N/A	Body	Cont.	Modern?
POS53	HE 3	N/A	Body	Cont.	Modern?
POS54	HE 3	N/A	Body	1.67	Non-ruminant adipose
POS55	HE 3	N/A	Body	-2.15	Ruminant adipose
POS56	HE 3	N/A	Body	Cont.	Modern?
POS57	HE 3	N/A	Body	Cont.	Modern?
POS58	HE 3	T222	Bellow rim	Cont.	Modern?
POS59	HE 3	N/A	Body	Cont.	Modern?
POS60*	HE 3	N/A	Body		N/A
POS61*	HE 3	N/A	Body		N/A
POS62	SU 6	N/A	Body	Cont.	Modern?
POS63	SU 12	N/A	Body	Cont.	Modern?
POS64	SU 11	N/A	Body	Cont.	Modern?
POS65	SU 8	N/A	Body	Cont.	Modern?
POS66	SU 8	T223	Body	Cont.	Modern?
POS67	SU 6	N/A	Body	Cont.	Modern?
POS68*	SU 8	N/A	Body		N/A
POS69	SU 4	N/A	Body	Cont.	Modern?
POS70*	SU 4	N/A	Body		N/A

POS71	SU 5	N/A	Body	Cont.	Modern?
POS72	SU 5	N/A	Body	Cont.	Modern?
POS73*	SU 6	N/A	Body		N/A
POS74*	SU 6	N/A	Body		N/A
POS75	SU 7	N/A	Body	Cont.	Modern?
POS76*	SU 7	N/A	Body		N/A
POS77	SU 7	T310	Body	Cont.	Modern?
POS78	SU 6	N/A	Body	Cont.	Modern?

* These samples contain ancient lipids, but for technical reasons the isotope ratio was not determined by the thesis submission deadline.

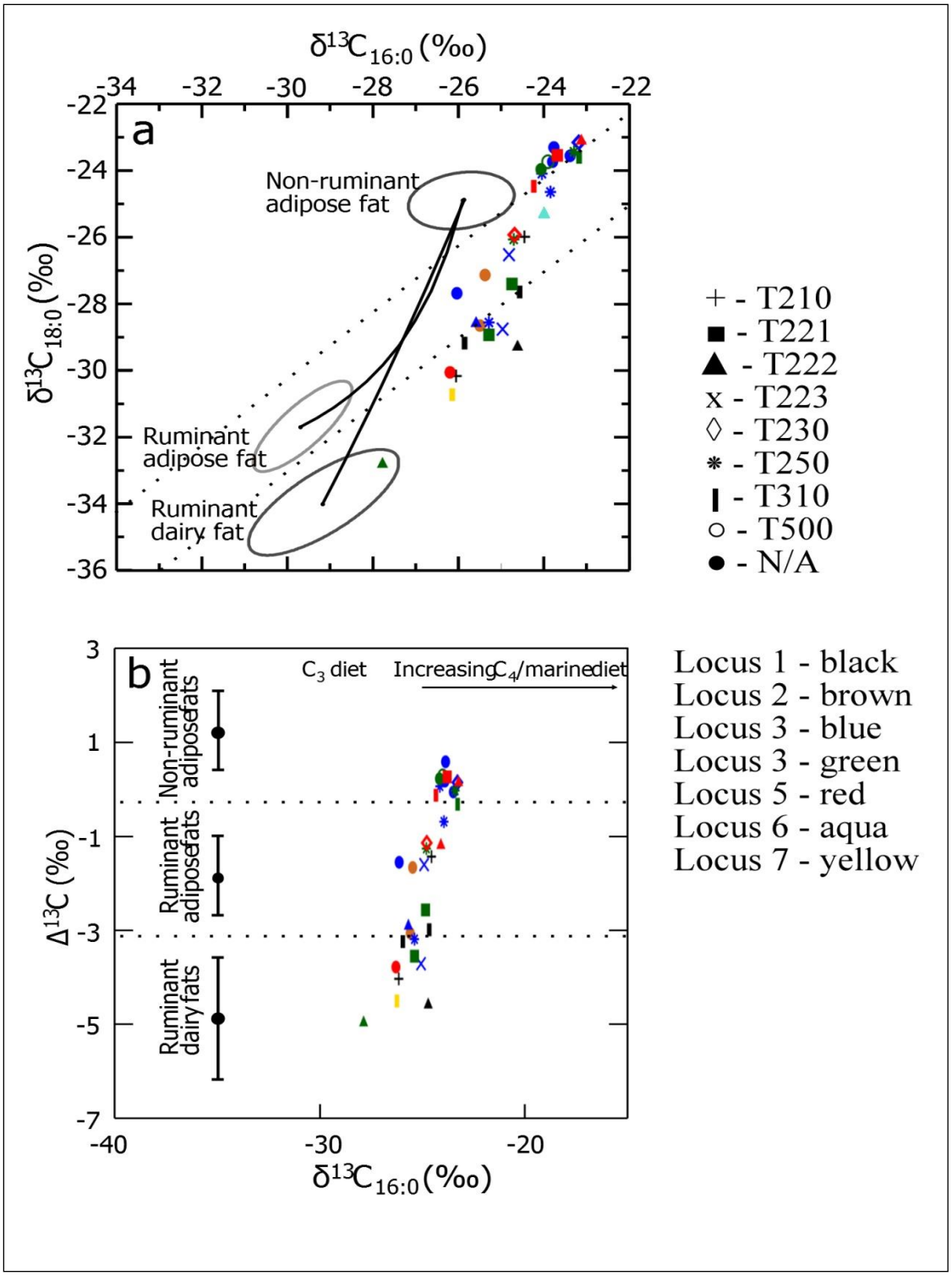


Figure 4.17 Scatter plots of isotopic values from Anta 1 de Val da Laje: a) scatter-plot of the $\delta^{13}C$ values of palmitic ($C_{16:0}$) and stearic ($C_{18:0}$) acids; b) scatter-plot of $\delta^{13}C$ values of palmitic acid and the $\Delta^{13}C$ proxy ($\delta^{13}C_{16:0} - \delta^{13}C_{18:0}$)

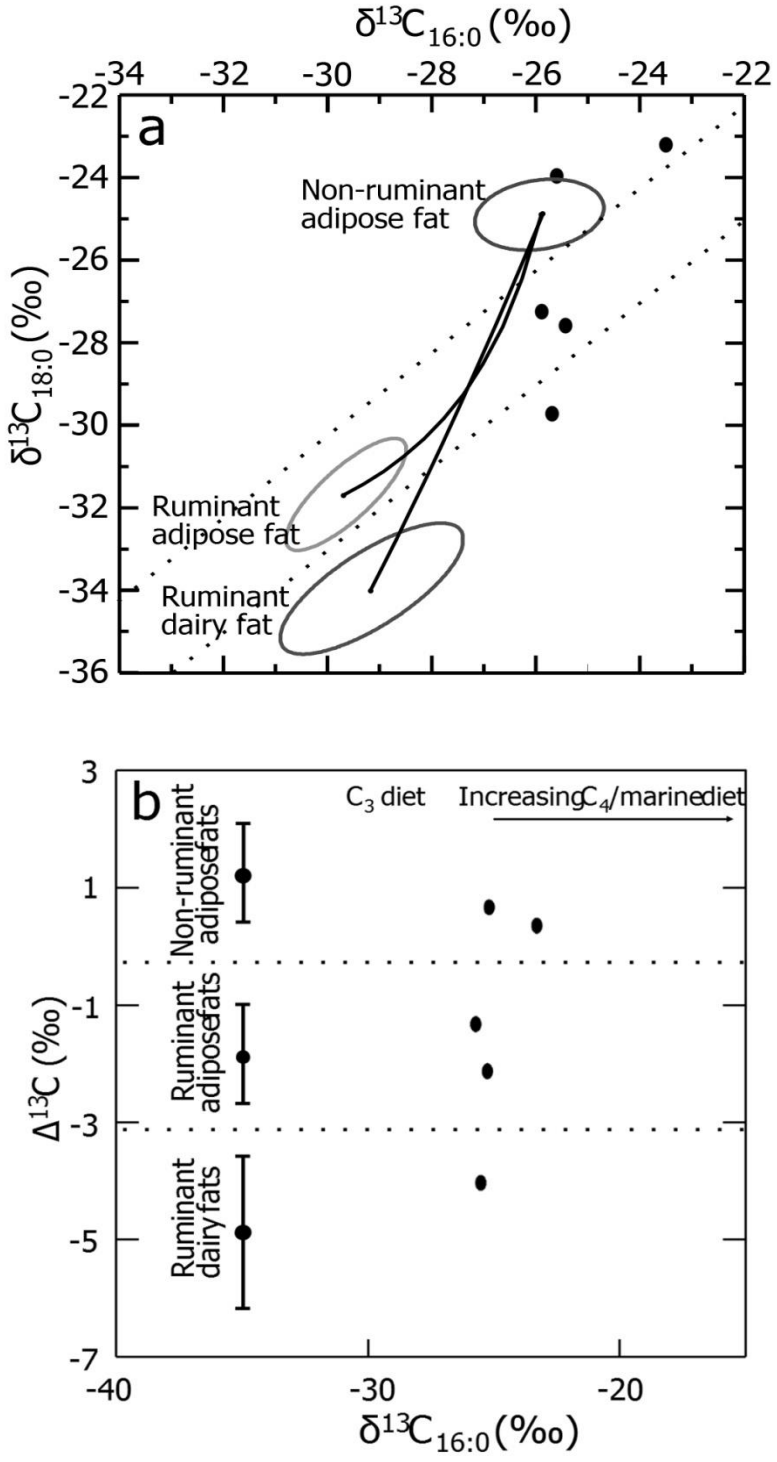


Figure 4.18 Scatter plots of isotopic values from Cueva de los Postes: a) scatter-plot of the $\delta^{13}C$ values of palmitic ($C_{16:0}$) and stearic ($C_{18:0}$) acids; b) scatter-plot of $\delta^{13}C$ values of palmitic acid and the $\Delta^{13}C$ proxy ($\delta^{13}C_{16:0} - \delta^{13}C_{18:0}$)

The dominant biomarkers in the chromatograms of the Anta 1 samples are the C16:0 and C18:0 fatty acids, clearly pointing to animal fat origin. All thirty three samples were submitted for GC-C-IRMS analyses. Even though there is a grouping into three categories of the resulting isotopic values (dairy, ruminant adipose and non-ruminant adipose), the next surprising feature of this assemblage is the 3-5 ‰ offset of the results from the established referent values (fig. 4.17: a). At the current state of investigation, the explanation for this offset is an increased input of marine resources into the diet of the domestic animals[15]. This would suggest a frequent, maybe seasonal movement of herds and flocks to marine environments, the nearest of which is the Tagus estuary less than 100 km to the Southwest. From here, another issue re-emerges - the level of sedentism of the prehistoric pastoral societies of Alto Ribatejo and Southwest Iberia, an issue discussed in the next chapter.

Regardless of the offset, three different groups of animal fats were identified from the samples (fig. 4.17: b). Thirteen of them (39.5%) have values in the range of ruminant adipose, eleven (33.5%) are non-ruminant adipose and nine (27%) plot within the range of dairy fats.

Questions regarding which morphological types were preferred for which products remain unclear. A bigger collection of samples, where each typological group is statistically sufficiently represented, might demonstrate certain patterns of preference. For now, from the current roster we can see that:

- No clear archaeological lipids were detected from plates and collared pots (they were tested with only one sample each!)
- Shapes and sizes, which were previously not considered as cooking vessels, have actually absorbed lipid molecules, and therefore have been exposed to fire together with their contents; this includes very small cups (T223) or shallow bowls (T221)
- No traces of milk were found in the carinated bowls T230 (out of three samples; fig. 4.19)
- No traces of non-ruminant adipose fats were identified in the trunco-conic (T210) and the deep bowls (T223; two samples each; fig. 4.19)

[15] There is only one spherical bowl from the area in front of the passage grave, used for milk processing, which plots perfectly within the referent values range (fig. 4.16:a); the same sample in the second plot (fig. 4.16:b) shows the least marine input.

- One of the two lamps submitted for analyses revealed non-ruminant fats (T500 in fig. 4.19; the other contained big amounts of unsaturated fatty acids from modern contamination)
- There is no correlation between shape and product; most of the pottery types are associated with all three lipid categories (fig. 4.19)

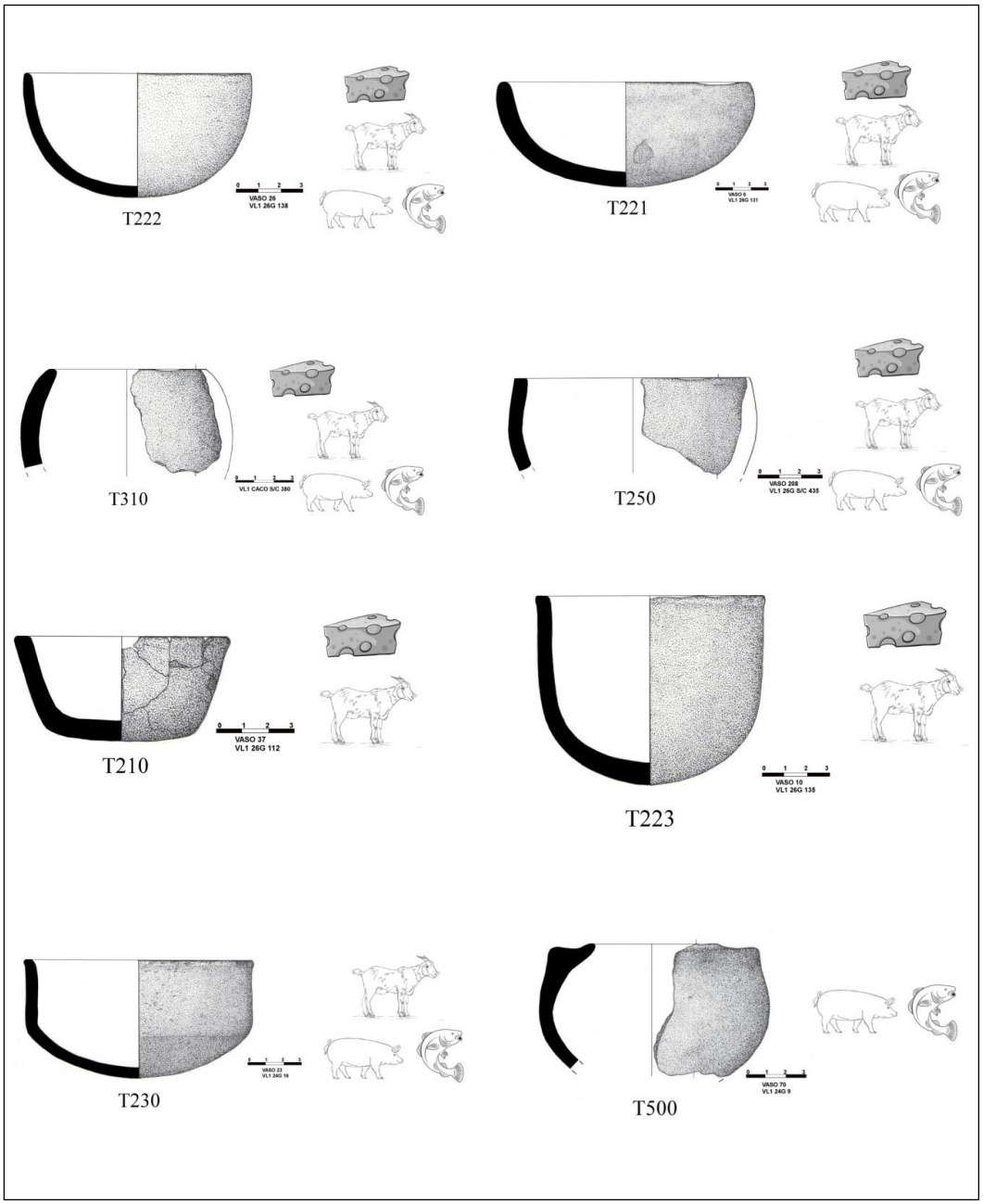


Figure 4.19 Association between pottery shapes and the three types of lipids (dairy, ruminant adipose and non-ruminant adipose)

Same remarks about the size of the sample group stand also in assessing a relation between the seven different activity areas in and around the monument, and the lipid categories. From what we have at hand, no pattern can be recognized, as the more represented loci contain all three categories of fat.

Out of the twelve samples from Postes with ancient lipid remains, only five were analysed with GC-C-IRMS so far, and they are all from the Chalcolithic sequence of Hueco Eulogio sector (layer 3). Technical problems at the laboratory prevented running the remaining seven on time. The processed samples are from body shards from vessels with unknown morphology. Fortunately, even with these five samples, we can confirm the presence of milk, as well as both ruminant and non ruminant adipose fats (fig 4.17). Interestingly enough, we see a similar offset from the referent values in the Postes samples as well (fig. 4.17:a). Furthermore, the samples show more or less equal input of marine resources, except for one sample indicating drastically higher marine diet (fig. 4.17:b). The deriving consequences and the opening possibilities from the residue analyses will be further discussed in the next chapter.

CHAPTER 5: POTTERY IN CONTEXT

The general approach of the study is to recognize similarities and differences in the pottery collections from the three chosen sites. Integral part is the chronological and spatial contextualisation, while the accent is on the typo-morphological assessment of the assemblages. The pottery is also used to extract information regarding the economy and diet of the prehistoric societies of Southwest Iberia. The basic premise is the coexistence of socio-economically and culturally diverse human groups in a territory equally diverse in geo-morphological and environmental perspectives. By comparing different parameters, we are trying to establish the boundaries between those human groups (however dynamic or symbolic they may have been), the relationships between the entities, as well as the bonds they had with their territories; and all this in a diachronic perspective, capturing the few key millennia of transition from mobile hunter-gatherers to sedentary (or rather less mobile) farmers.

The first thing to look at is the intra-site level of correspondence between the different layers (or groups of layers). In other words, we need to establish whether or not two or more stratigraphic units are the result of the same cultural group. Change in occupancy should reflect sharp change in the characteristics of the material culture. Once we have a clear view of the individual sites, we can take a more regional perspective and find similarity patterns among these three sites, as well as other known contexts from Southwest Iberia.

5.1 Cadaval

According to the absolute dates, Layers D and C of Cadaval represent two chronologically very near phases (see section 3.2.4). Observing the pottery, several things can be noted. The first most obvious difference between the assemblages from the two layers is their size – there is more than double pottery artefacts from C than from D. This is understandable if we have in mind that what is separated as layer D represents a single individual burial, while layer C contains the remains from more than 20 individuals deposited over a prolonged period of time.

Equally important are the differences in the relative abundance or presence/absence of typological forms, features or decoration techniques and motives. Plates are absent from the more ancient layer D. Three of them appear in the later phase. Bowls, which are more represented type of vessels, show greater diversity in layer C than in D (new sub-groups appear; see Table 4.4). The bowl types which are absent in D and appear later include: the shallow hemispherical type (T221), the cups (T223), one carinated bowl (T230) and the slightly constricted bowls (T250). There is a drastic increase in the abundance of the round hemispherical bowls from D (n=1) to C (n=5). This change in abundance has more meaning when looked as a relative value: from being the least represented of the bowls in D with 12% to being the most represented in C with 28% (Fig. 5.1). There is however a reverse tendency with the most represented types of bowls in D: the trunco-conical (T210) and the bowls with everted rim (T240) sharply decrease in popularity from one phase to the next.

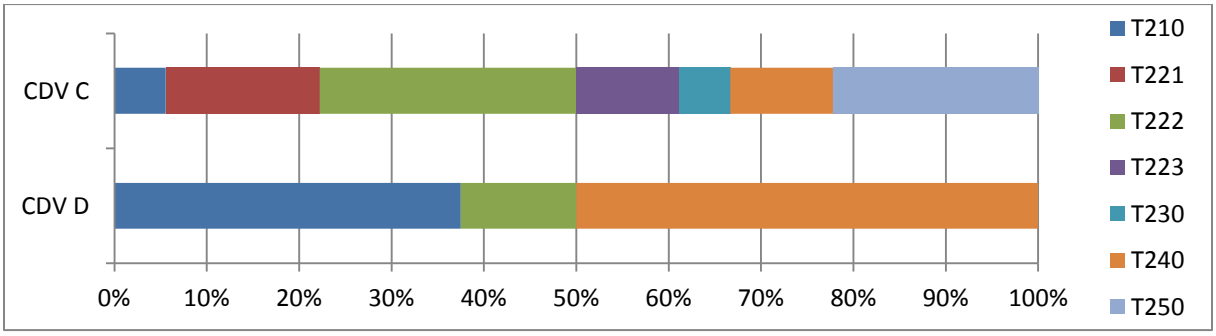


Figure 5.1 Relative abundance of bowl types in Cadaval (CDV C = Gruta do Cadaval, layer C; CDV D = Gruta do Cadaval, layer D)

There is also a shift in focus in the pot category too. The collared pots (T320) are equally represented as the spherical (T310) in layer D. The later are absolutely dominant in layer C, but here also a new type of pot appears – the composite pots (T340). These are rare shapes and we have a relatively small assemblage, but at the moment it seems that this feature appears only at the later phase. Jars are present in both layers (as expected more in layer C).

The importance of decorated pottery has not changed at all: with only 3% in both layers, the relatively low abundance was maintained. Differences however are observed in regards to the dominant decoration technique used (Fig. 5.2). The oblique shallow grooves on the vessel surface (channelling; GRV.2.a)[16], together with the comb incisions (INC.15.a), are the most frequent in layer D (for example see Annex, Fig A.7:2 and A.8:3 respectively). Incision as a technique is absolutely dominating in the later phase, but now there is a notable diversification of the motives. The comb is still present, but is often combined with a band of short oblique incisions (Annex, Fig. A.3:18). Other motifs, like bands of alternating short oblique lines (Annex, Fig. A.7:4) are also present, but an important feature that appears in this layer is the single horizontal line under the rim (Annex, Fig. A.7:1), which is associated with the transitional period from early to middle Neolithic in Estremadura, or, in more precise terms, the end of the 5th and the beginning of the 4th millennium cal BC (Neves 2015; Cardoso 2016). An appliqué decoration (round button) is present only in D (Annex, Fig. A.8:9), while the impressions appear only in layer C[17].

Table 5.1 Absolute and relative abundance of decorated pottery (CDV C = Cadaval layer C, CDV d = Cadaval layer D)

	N pottery units	**N decorated**	**% decorated**
CDV C	**650**	**23**	**3**
CDV D	**272**	**9**	**3**

[16] These grooves, being very shallow, executed with a blunt tool, and always oblique, are clearly distinct from the deep incised parallel lines, also often called grooves, which are more frequent in the Final Neolithic and Chalcolithic of Portuguese Estremadura (*e.g.* Cardoso, 2007, fig. 4)
[17] One of the two impression decorated shards is a unique long-necked jar with fingernail impressions (Annex, Fig. A.10:4). This is a type of vessel strongly reminiscent of the Cardial decorated "Santarem vessel" and other similar early Neolithic jars.

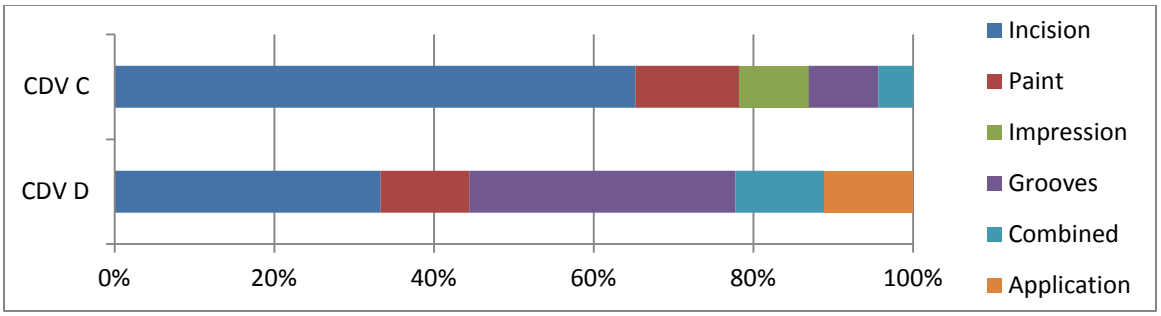


Figure 5.2 Relative abundance of various decoration techniques in Cadaval (CDV C = Cadaval layer C, CDV d = Cadaval layer D)

Considering the overall assessment of the pottery assemblage, we can confirm that there is a cultural continuity between the two phases of Cadaval. However, as evident from formal typology and decoration classification, there are certain developments.

On one hand, both layers from Cadaval demonstrate clear traditions from the early Neolithic of Estremadura, in pottery decoration (the presence of various incisions, impressions and grooves), as well as typology (predominantly spherical and hemispherical bowls and pots). The oblique grooves (Annex, Fig. A.7:2), even though maybe not in the same disposition, find parallels in Pena d'Agua Eb, Cerradinho do Ginete, Gafanheira, Forno do Terreirinho, Gruta do Almonda, Cabeço de Porto Marinho IIIS and Algar do Picoto, all of them early Neolithic sites from the karstic formations in central Estremadura (Carvalho 2008, pages 356, 363, 347, 369, 381, 395 and 373 respectively); grooving is also present at Cortiçoes, on the opposite coast of Tejo, which was also part of the same early Neolithic landscape (Cardoso et al. 2013, fig. 22: 2 and 17). The rows of short oblique incisions (Annex, Fig. A.7:4), a version of what is known in Portuguese prehistory as "false acacia leaves" are also present in early Neolithic contexts of Estremadura, at sites like Cabeço de Porto Marinho IIIS, Forno do Terreirinho and Cortiçoes (Carvalho 2008, p. 366 and 366; Cardoso et al. 2013, fig. 19: 9 and 10). The finger-nail impressions (Annex, Fig. A10.4) are often found in Iberian prehistory and Estremadura is no exception; they are seen in one of the earliest Neolithic collections in the area, the Almonda (Cisterna) cave, and also in the nearby Gafanheira (Carvalho 2008, p. 383 and 347).

On the other hand, features considered as typical for the middle Neolithic are also present, especially in layer C. At the Pena d'Agua rock-shelter, which is one of the most relevant stratigraphy for the Neolithic of Estremadura, the mode of decoration with a single horizontal line below the rim is clearly limited to the initial middle Neolithic phase (layer Db, dated at the

transition from 5th to 4th millennium cal BC; Carvalho 2016); in Cadaval, this decoration techniques only appears in layer C (Annex, Fig. A.7:1); recently, on the basis of this decorative chronological marker, several other sites from both sides of Tagus were added to the otherwise not very populated group of middle Neolithic sites (Nunes 2014; Neves & Diniz 2014; Neves 2015). The comb incised bands are another style often associated with the transition from early to middle Neolithic in Estremadura (Cardoso 2016), even though its presence have been reported from allegedly earlier contexts, e.g. at Cortiçoes (Cardoso et al. 2013, fig. 19 and 20) and Gafanheira (Carvalho 2008, p. 348); in Cadaval comb incisions, combined with other incisions or not, are one of the most used decorative technique in both layers (Table 4.5; Annex, Fig. A.3: 18, Fig. A.7: 8 and 15, Fig. A.8: 3).

As the radiocarbon dates suggest, Cadaval was used for burial purposes during the last centuries of the 5th and the firs centuries of the 4th millennium cal BC. The two layers capture an important transitional period in Portuguese prehistory. While layer D contains individual burials, where the deceased were interred in a shallow pit, Layer C represent a prolonged period of time, during which bodies were simply deposited on the cave floor, creating with time a collective burial monument. In order to create space for a newly deceased individual, the older remains were redistributed around the floor, the result of which is an ossuary-like formation of human bones without anatomical order. This is the initial phase of a changing attitude of humans towards death, a process which will develop more complex and clearly articulated practices further in the 4th millennium cal BC, as evidenced from the nearby Ossos Cave (Cruz et al. 2014). Pottery, as the material medium most sensitive on non-material changes, reflects this process.

5.2 Anta 1 da Val de Laje

The assessment of Anta 1 is more complicated, since the support from absolute chronology is less precise. Several thermally stimulated luminescence dates obtained on potshards, position the layer B in the middle of the 4th millennium BC (Cardoso, 2009). Architectonically, the passage grave has been compared to Poço da Gateira 1 and Gorginos 2, both dated in the middle of the 5th millennium BC (see section 3.3.4.). Moreover there is a drastic difference in size and shape diversity between the pottery assemblages from the two layers under study; except for the jars, all pottery shapes are represented in layer B, while only bowls were identified in C (Table. 4.4). Nevertheless, several characteristics can be highlighted, referring mostly to the more representative layer B.

The entire collection is absolutely dominated by bowls. They take 75% of the total number of identified shapes. This must be related to the nature of the site, the activities practiced around the megalithic monument obviously employed more bowls than any other morphological types. Such activities may be a communal food or beverage consumption on a large scale, probably in the frames of a festivity or ceremony accompanying the burial process, or celebrating an annual event. We still do not know much about the life of these communities outside of their megalithic constructions. Once such contexts are available, it would be interesting to compare the structure of these pottery assemblages with those from settlements for example. Another interesting characteristic about the bowls from both layers is the high percentage of the carinated type. Carinated shapes are also present among the pots of layer B, while the varieties with everted rim (both in bowls and pots) are completely absent from Anta 1. At last, considering the pottery shapes of layer B, the lamps must be mentioned as a unique feature of this layer.

Decoration is very scarce in the pottery of Anta 1 (less than 1%). However scarce, important information is the presence of the "almagra", or red painted vessels. This is a decorative technique more common with the central and south areas of the peninsula. An eastern or south-eastern influences in the megalithic complexes of Portugal is something brought out on numerous occasions by many scholars working on Iberian prehistory, one of the earliest being the periodisation of the Neolithic by Vera Leisner in the 1960es (Leisner 1983).

With the present pottery collection it is difficult to address the relationship between the different units of the stratigraphy of Anta 1, especially relying only on decoration and

morphology classification. Moreover, layer B has suffered re-depositions from Bronze Age intrusions on several occasions. A new research project, applying contemporary methods and technology, would be necessary for a more detailed reconstruction of the formation process of the monument. Recent developments in the extraction of organic matter from pottery shards, combined with advanced radiocarbon dating methodology, would bring the possibility of direct dating of the extract, and therefore the moment when the vessel and the site were in use. For an area with acidic soils, where the only organic matter preserved is the one extracted from the pottery, this is a very promising near future prospect.

As a general comment though, without entering in discussions about the relationship between layers B and C, we can say that within the pottery collection various traits point towards various phases of the Neolithic. Considering the obtained TL dates, and having in mind the mentioned parallels with Alentejo, it is probable to assume that the monument was built at the beginning, or sometime during the first half of the 4th millennium BC. The majority of the pottery represents spherical and hemispherical, open, non-decorated (basically non-diagnostic) vessels, the typical assemblage often referred to as *típo dolménico*. The emergence of this "megalithic" pottery set is attributed to the appearing megalithic culture in and around Alentejo. Parallel to this, the middle Neolithic traits of the cave complexes of Estremadura are starting to develop: sharp decrease in pottery decoration, collective burials, and the appearance of the previously mentioned decorative element – the single, horizontal, incised line under the rim.

The final Neolithic phase, or at least the pottery characteristics associated with it, also displays strong presence at Anta 1. Towards the last centuries of the 4th millennium carinated shapes become more frequent type. Twenty-two out of the hundred and forty-nine identified vessel types in both layers are carinated shapes, mostly bowls (Table 4.4). A specific type of vessel, with a carina in the upper part of the body (Annex, Figure A.9: 19), also found as a unique specimen in Cadaval C (Annex, Fig. A.3: 12), is a recurrent feature in final Neolithic contexts, both in the sites of Estremadura, like Furninha Cave (Cardoso & Carvalho 2011, Fig. 27: 17, 19, 20) and Leceia (Cardoso 2007, Fig. 4), and the megalithic territory of the interior (Anta 2 do Couto da Espanhola near Idanha-a-Nova; (Cardoso 2002, p.204, Fig. 122)). Furthermore, the most represented decorative motive, rows of pit impressions made with blunt tool, find exact parallels in the final Neolithic phase of Los Barruecos, an open air settlement further up the Tagus Valley in Spanish Extremadura (Cerrillo-Cuenca et al. 2006, p. 65, fig. 10).

5.3 Cueva de los Postes

The case of Cueva de los Postes is opposite from Anta 1 de Val da Laje. Here we have a solid sequence backed by a series of radiocarbon dates, but a very small pottery assemblage. Because of the scarcity, the pottery is divided in three major groups (Tables 4.4 and 4.5): the Neolithic (Area 1, including the early and middle Neolithic layers), the Chalcolithic (Hueco Eulogio 3) and the Bronze Age (Hueco Eulogio 2).

No forms were identified from the early Neolithic. From the middle Neolithic phase, which was investigated on a bigger area and more material was recovered, only two cups were identified (Annex, Fig. A.11: 1 and 2). There is also one bowl with slightly constricted opening (Annex, Fig. A.11: 3), which comes from the undated SU5, but can be related to the final century of the 4th millennium cal BC (final Neolithic phase; see section 3.1.4.1).

Four bowls in total were discovered in the Copper Age assemblage from layer 3 of the Hueco Eulogio sector. Two of them are hemispherical (one of them with relatively big dimensions; Annex, Fig. A.11: 4 and 5). One bowl with constricted opening was found as well, with a shy, but obvious tendency towards forming a neck (Annex, Fig. A.11: 7). One smaller vessel, probably a cub, completes the assemblage (Annex, Fig. A.11: 6).

The only vessel identified from layer 2 at Hueco Eulogio was a jar with a neck; having thick walls, probably it used to be a relatively big container. Regarding the overall tendency in wall thickness in Postes, we can conclude that thick-walled pottery and bigger vessels were more present in the Bronze Age than earlier (Fig. 5.3), something which was obvious even with a simple observation of the shards. This can be interpreted as a shift in human use of the cave for the first time in history; instead of burial grounds it was probably used for storage.

The record regarding pottery decoration techniques in Postes is even scarcer (see section 4.2 of the previous chapter). There is a single potshard from the early Neolithic (SU9) decorated with horizontal rows of fingernail incisions (Fig. 4.12: a). This is the only decorative element from the Neolithic sequence. The Chalcolithic sequence has one red-slipped fragment (Fig. 4.12: b), while the Bronze Age has one potshard with a bit more complex incised ornament (Fig. 4.12: c). Overall, nothing can be changed or added on the basis of the pottery record, to the assessment already made about Postes in chapters 3 and 4. The scarcity of the pottery assemblage does not help in the establishment of more firm relationships with the contemporaneous sites previously associated (section 3.1.4.1), but at the same time does not contradict the proposed interpretation.

Further excavations in the cave should expand the area of investigated Neolithic levels, with the hope of gaining more pottery material for a more substantial study.

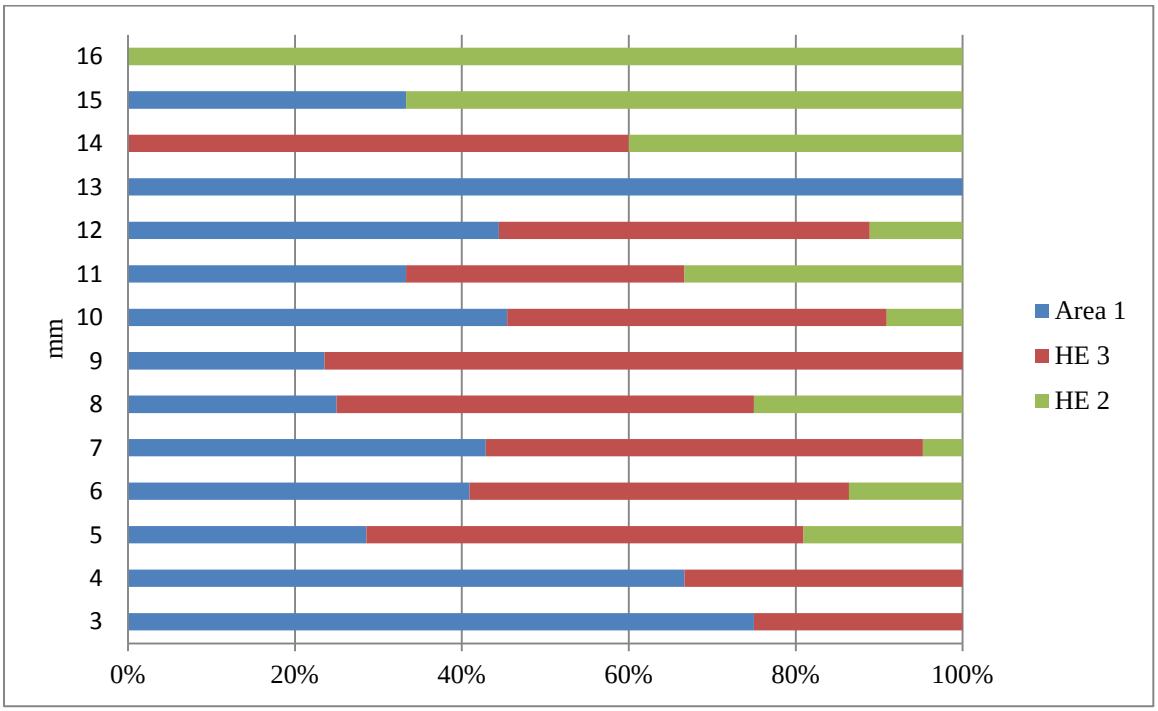


Figure 5.3 Pottery wall thicknesses in the three stratigraphic groups of the Cueva de los Postes assemblage

5.4 Pottery use and subsistence strategy of the Neolithic and Chalcolithic societies of south-west Iberia

The direct evidence for Neolithic agriculture in Iberia is patchy at best. The archaeological studies were largely preoccupied with cave sites and megalithic monuments, which were archaeologically the most visible and therefore accessible records of the past. However, they usually represent only the mortuary aspects of the prehistoric communities. From the pottery assemblages retrieved from them, certain types can be associated with grain storage, but this is an indirect assumption for agriculture at best. Only when a change in research focus occurred, and settlements were being prospected and investigated more intensely, the more "common" aspects of prehistory became more available.

Undoubtedly straightforward evidence, suggesting agriculture at least in the nearby area, is the discovery of carbonized grain remains in undisturbed archaeological context. Since the last decade of the previous century, and rare previous reports, such records became available from almost the entire territory of Spain (Zapata et al. 2004; Peña-Chacorro et al. 2013). The only Portuguese early Neolithic evidence for domestic plant use comes from the Buraco da Pala rock-shelter in Tras-os-Montes, where a range of species where identified (Rego & Aira Rodriguez 1993).

Archaeozoology is another complementary tool for firm assessment of early agriculture. Identification of domestic species from the bone remains provides an undisputed evidence for rearing and ultimately consumption of domestic animals. For the specific region under study, several studies during the past couple of decades have confirmed the presence of domestic species since the middle of the 6th millennium cal BC (*e.g.* Rowley-Conwy 1992; Diniz 2007; Oosterbeek et al. 2014; Almeida et al. 2015; Davis & Simões 2016).

Pottery as a direct evidence for agriculture is a relatively new contribution to Archaeology, which provides a much wider range of interpretations. The organic compounds extracted from the pottery can be used to identify their origin either as ruminant/non-ruminant, or dairy/adipose (see methodology section 2.3). Therefore, these chemical analyses provide a more in-depth view of the early farmers and their relationship with the domestic "assets". Furthermore, the identification of lipids from pottery opens new perspectives in pottery technology and pottery use studies as well. So far ancient lipid analyses have not been implemented systematically in Portugal. In previous studies by Salque et al. (2015) 130 samples from Iberia were included, 30

of which were from Valada do Mato, but the poor preservation prevented more significant conclusions. For this reason, the residue analyses presented in this study assume pioneering significance and provide a solid base of information for the region, especially with recovery rates as high as the ones obtained from Anta 1 de Val da Laje. From the results presented in the previous chapter, several points can be noted.

A) **There is no specialisation in pottery use**. One of the issues often raised with artefacts discovered as burial accessories is whether they were used for their normal function before being transformed into a ritual item, or were they crafted especially for the occasion? While it was clear that the pottery from the megalithic monument (at least the bigger part coming from around the monument itself) was utilitarian (even though still in service of the burial ceremony), and not intended only as a burial gift, the role of the less frequent vessels accompanying the deceased in the caves was less clear. For this reason both types of sites were sampled. In both cases, at Anta 1 de Val da Laje and Cueva de los Postes, traces of ancient lipids were detected, which suggests that, at least some of the deposited pottery was used for cooking during its lifetime.

   Another kind of specialisation in pottery use is association of certain types with certain products, as seen for example in Neolithic sites from Poland (Salque & Evershed 2015). In the Tagus valley however, no such specialisation have been noticed. For some of the types, due to their low representation, more samples must be submitted for analyses. But the general impression is that there is no preference in shapes for processing milk or cooking pork. Most of the designated pottery types can contain different lipid types (Fig. 4.19). As far as size is concerned, milk was processed in vessels with diameters less than 200 mm, while meat was identified in pots as big as 350 mm diameter (Fig. 5.4). Meat however, as well as milk, was also processed in some surprisingly small vessels (Fig. 5.4 and 5.5). This once again puts under question previous concepts for “cooking vessels”.

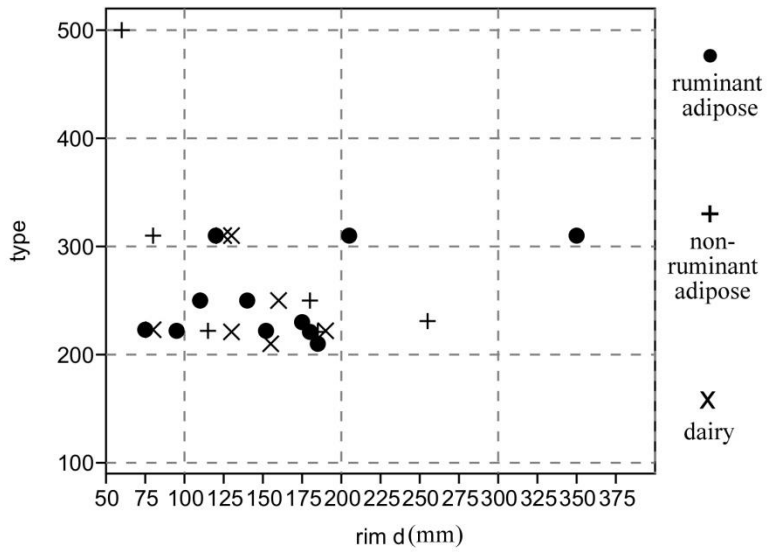


Figure 5.4 pottery samples containing ancient lipid residues: various morphologic types and rim diameter range

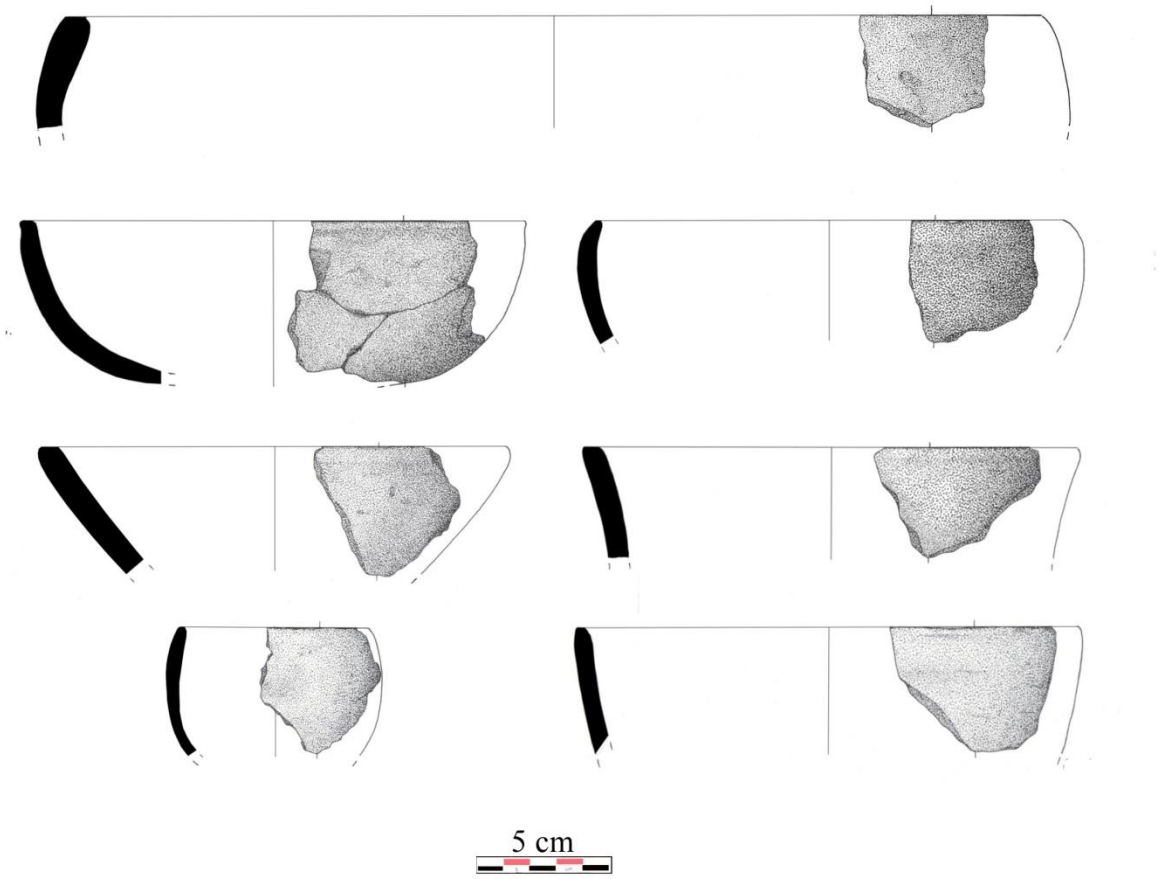


Figure 5.5 Varieties of shapes and size in the food processing pottery of Anta 1 de Val de Laje

B) **Milk was processed in the Neolithic and Chalcolithic societies of the Iberian interior.** The idea of Secondary Products Revolution, at least as far as milk processing is concerned, is no longer valid. In the last couple of decades it has been shown from samples from different parts of Europe, Asia and Africa that people were exploiting domestic animals for their milk (and probably wool), as well as for their meat, since the beginning of domestication (Copley et al. 2003; Craig et al. 2005; Evershed et al. 2008; Thissen et al. 2010; Özbal et al. 2010; Dunne et al. 2012; Salque et al. 2012; Nieuwenhuyse et al. 2015; Kherbouche et al. 2016). With this study we have demonstrated that milk products were part of the alimentary base of the megalithic culture population of southwest Iberia as well. It is important to stress that the lipids we are discovering in the potsherds were embedded in the matrix during the milk processing. Fighting with the discomforts of lactose intolerance, the Neolithic people were decreasing the lactose level in the milk by simmering and transforming it into more tolerable dairy products (cheese, curds, cream, butter etc.). According to the obtained results however (section 4.3), milk is less important food source than the meat (27% and 73% of the samples respectively).

C) **Variations in the δ13C values, caused by the animal diet**. As seen in the scatter plots in Figures 4.17 and 4.18, there is a relatively big discrepancy in the $\delta^{13}C$ values among some of the samples, as well as with the established referent values. There are several possible reasons for this, and they are all connected with the diet of the animals which provided the lipids that are being analysed:

   a. <u>C4 plants in the diet</u>. The confidentiality ellipses in scatter plots 4.17: a and 4.18: a, are representing referent values measured on samples from animals raised on pure C3 plant diet (Copley et al. 2003). An increase in C4 plant consumption means a 13C enriched diet, which has an increasing effect on the $\delta^{13}C_{16:0}$ and $\delta^{13}C_{18:0}$ values (Roffet-Salque et al. 2016). Therefore, a various admixture of C3/C4 plants (from a free range pasture for example) would reflect various increase in $\delta^{13}C$ values (Dunne et al. 2012). In the Neolithic record of southwest Iberia C4 plants are never abundant, but they are present

nevertheless. Archaeobotanical analysis from Cerro de la Horca in north Extremadura (Spain) revealed pollen from *Chenopodiaceae*, whose abundance increase significantly only in the Chalcolithic levels (López Sáez et al. 2007). It remains to be further investigated the presence of C4 plants in Iberia and their role in the economy. At present, it does not seem that their role was significant enough to influence the stable carbon isotope signature. The C4 plant that will gain a more substantial role as an animal fodder is the millet, but that is introduced in eastern Europe only later (*e.g.* Lawler 2009), and it would take even more time until it reached Iberia.

b. Plants from marine environment in the diet. This effect have been tested by Cramp et al. (2014) in their study of the earliest farmers of the British Isles. It was concluded that the δ13C values from the islands are over 1‰ higher than those from more inland area. This is explained with the effect that the salinity of the marine environments have on plant metabolism (Farquhar et al. 1989), resulting in higher stable carbon isotope signatures, finding their way through animal organisms consuming the plants and ultimately in the potshards.

c. Water-stressed plants in the diet. Similar to the effect of salinity of the marine environments, water insufficiency in the soil also affects the photosynthesis. Aridity decreases the photosynthetic process and provokes changes in the metabolism, which on the other hand reflects in the carbon isotope composition. In other words, in arid conditions C3 plants can switch to CAM photosynthetic process, which shows similar ^{13}C patterns as the C4 plants (Farquhar et al. 1989). This plant behaviour have already been mentioned as a possible reason for variations in $\delta^{13}C$ values in Neolithic pottery from Anatolia and Central Europe (Evershed et al. 2008; Salque & Evershed 2015).

D) **Mobility and pastoralism.** The last two aspectc present more realistic explanation for the variable stable carbon isotope composition, which provide more serious base for interpretation of the subsistence base and the palaeoeconomy of inland southwest Iberia. Moreover, they are not mutually exclusive. On the contrary, both factors, pastures in marine environment and water-stressed plants, could have contributed to

the 3-5‰ discrepancy between our samples and the reference samples of Copley et al. (2003) from C3 plants reared animals. On one side, the "Tagus hill country" (*sensu* Scarre et al. 2011) towards the interior of the peninsula, and especially Alentejo would have been available and accessible summer pasture, during the period when plants would have experienced a seasonal, short-term aridity stress, sufficient for the change in photosynthesis path to occur. On the other, it would make sense to include the Tagus estuary into an annual transhumance cycle, especially in the winter. The estuary is situated less than 100 km to the southwest from Anta 1 de Val da Laje. For Alentejo it is easy to see relations, considering the spread of the megalithic monuments and the material culture. For the estuary it is more difficult to argue, since the material culture on both sides of the lower Tagus is related to the Estremadura cave-sites Neolithic group, with predominantly decorated pottery. Still, the possibility remains that some parts of the estuary coast, especially on the left side, were available to the pastorals of the interior. Regarding the Postes samples however, it is more difficult to hypothesize a pastoralist route. Nevertheless, so far we only have the results from the Chalcolithic samples, a period when C4 plants in the area mark a drastic increase. In expectance of the early and middle Neolithic results, we are still at the beginning of tying the links and reconstructing the prehistoric communication networks. From the data obtained so far, another issue re-emerges - the level of sedentism of the prehistoric societies in Alto Ribatejo. Settlements are rare in Portuguese prehistory in general, and this is especially true for this region. A seasonal movement of flocks and herds might actually mirror a semi-nomadic lifestyle of the entire community, and not just a specialised group of stock herders, an issue already raised by Luiz Oosterbeek (2001). In a social order like this, passage graves like Anta 1, and burial caves like Postes, would have been the most constantly visited locations in the landscape and a sort of an anchor of the society to the land (Scarre et al. 2011; Cerrillo-Cuenca & González Cordero 2014). These are however open issues that could benefit from a renewed research intensity, excavations and larger pottery collections.

CHAPTER 6: SUMMARY

The neolithisation process of Iberia remains an open discussion among scholars. The biggest advances in the last decades are probably more of a theoretical nature, namely the overcome of the simplistic paradigms, giving way to a more complex, integrative approach, and the rejection of the idea of a universal model (i.e. turning towards more regional approaches). Analytical data, namely coming from bio-archaeology and DNA studies, are also providing relevant inputs into the discussion.

The geographic area of our interest, which is the hinterland of the southwest part of the peninsula, is specific at least for two reasons. On one side is the question of perseverance of the Mesolithic hunter-gatherers and their participation in the Neolithic society. On the other is the genesis of the megalithic communities and their role in the territory. These two issues are flanking the central discussion, weather the Neolithic way of life is completely or partially allochthonous, and what is the nature of the process itself (*e.g.* relative importance of the domestic fauna and vegetation species, nature of the settlement networks etc.). Considering the convincing genetic evidence, there is a consensus about the external origin of the domestic species which were part of the Neolithic economy of southwest Iberia. The human input is under discussion. The general working hypothesis is the existence of at least two socio-economically and culturally diverse communication networks in this region: the groups living in the karstic formations of coastal Estremadura, burying their dead in caves and producing decorated pottery, and the predominantly pastoral groups of the interior, building megalithic monuments with mainly plain pottery assemblages. For a higher resolution view, we have narrowed the field to the region around the Nabão/Zêzere valleys, where according to the spread of the sites and the material culture the "border" between the two cultures should be. One cave site was chosen from the Nabão valley in the eastern fringes of the karstic formation of Estremadura (Gruta do Cadaval), and one passage grave from the Zêzere valley, which belongs to the granitic/schist lithostratigraphy of the interior. Another cave from Spanish Extremadura, Cueva de los Postes, about 200 km to the southeast, was also selected in order to include the less known areas from deeper in the interior, which are relevant for the important questions concerning the directions of neolithisation and the complexity of the entire process.

The thesis is dealing with the pottery assemblages of the selected sites. The aspects observed in the pottery are typological classification of the artefacts from relevant context, as well as chemical analyses of ancient lipids, extracted from selected samples. The first aspect includes assessment of the decorative techniques and motifs. The second aspect expands implications on questions concerning palaeoeconomy, subsistence base, mobility patterns and pottery use. Eight samples (human teeth) from the little known Cueva de los Postes were used to precisely date and to reconstruct the occupation sequence of the cave during prehistory.

The results from the pottery study reconfirmed the previously noted difference between the caves of Estremadura and the megalithic monuments of the interior. It is obvious that we are dealing with different sets of pottery, but it is also evident that these two societies were in contact, as certain influences from the interior can be seen in Estremadura (like the disappearing tendency of the decoration in pottery, carinated shapes and the collectivisation of the burial ritual), especially during the later phases of the Neolithic. This is exactly the period when these two sites would have overlapped chronologically. The occupation of Cadaval started at the initial stages of the middle Neolithic and is a witness to the change of burial ritual from individual to collective. It was visited for the same purposes throughout the entire 4th millennium cal BC and in later period as well. Anta 1 de Val de Laje was probably built sometime around the turn to the 4th millennium and it was used intensively throughout the late Neolithic and the early Chalcolithic, with localised intrusions during the Bronze Age. Residue analyses were carried out only on samples from Anta 1, from which it was seen a great potential of the local environment for lipid preservation. Highly concentrated extracts were retrieved from 80 % of the samples. Besides meat, lipids deriving from milk were identified as well, which suggests that dairying was practiced and milk was one of the food sources in the region during prehistory.

As far as Cueva de los Postes is concerned, the small pottery collection did not permit the establishment of firm links with the other two sites. Thanks to the radiocarbon dates however, a long stratigraphic sequence of burial practice was established, starting in the Mesolithic, continuing during the early, middle and late Neolithic, shifting to the back chamber of the cave at the beginning of the Chalcolithic; from the Bronze Age until the Medieval period the function of the cave was changing, including storage and votive activities. Pottery samples from the Neolithic and the Chalcolithic were tested for organic residue. The recovery rate is lower than in

the acidic soils of middle Tagus, but still it was enough to identify the presence of milk lipids, as well as ruminant and non-ruminant adipose.

Variability range in the carbon isotope values were noted in the samples from both sites. At the present level of investigation, this is interpreted as a signal of high mobility rate of the domestic animals, and probably of the entire communities. This interpretation converges with recent studies on animal bones, human bones morphometric and DNA studies.

The region possesses great potential for a close-up study of human interaction within long distance communication networks during this dynamic, transitional period of human history. New surveys and excavations can strengthen some of the less known aspects of the prehistory of southwest Iberia. Because of the high mobility, the settlement pattern and domestic life aspects are less visible from a traditional archaeological perspective. New techniques and interdisciplinary approach, like the ancient lipid detection and isotope measurements, can be used to further expand these exact issues.

LIST OF BIBLIOGRAPHY

Alday Ruiz, A. & Moral del Hoyo, S., 2011. El dominio de la cerámica boquique: discusiones técnicas y cronoculturales. *Sagvntum*, Extra 12, p.65–81.

Almeida, N., Saladié, P. & Oosterbeek, L., 2015. Zooarqueologia e Tafonomia dos sítios neolíticos da Gruta da Nossa Senhora das Lapas e Gruta do Cadaval (Alto Ribatejo, Portugal Central). In V. S. Gonçalves, M. Diniz, & A. C. Sousa, eds. *5.º Congresso do Neolítico Peninsular. Actas.* Lisboa: UNIARQ, pp. 77–84.

Ammerman, A.J. & Cavalli-Sforza, L., 1971. Measuring the Rate of Spread of Early Farming in Europe. *Man*, 6(4), pp.674–688. Available at: http://www.jstor.org/stable/2799190.

Ammerman, A.J. & Cavalli-Sforza, L., 1984. *The Neolithic Transition and the Genetics of Populations of Europe*, Princeton University Press.

Angelucci, D.E. & Zilhão, J., 2009. Stratigraphy and formation processes of the upper pleistocene deposit at gruta da oliveira, almonda karstic system, Torres Novas, Portugal. *Geoarchaeology*, 24(3), pp.277–310.

Araújo, A.N.A.C. & Almeida, F., 2003. Barca do Xerez de Baixo : balanço de quatro anos de trabalhos arqueológicos. , 6, pp.17–67.

Arbuckle, B.S. et al., 2014. Data Sharing Reveals Complexity in the Westward Spread of Domestic Animals across Neolithic Turkey. *PLoS ONE*, 9(6), p.e99845.

Arias, P. et al., 2009. A view from the edges: the Mesolithic settlement of the interior areas of the Iberian Peninsula reconsidered. *An offprint from Mesolithic Horizons. Paper presented at the Seventh International Conference on the Mesolithic in Europe, Belfast 2005*, (June), pp.304–311.

Arias, P., 2007. Neighbours but diverse: social change in north-west Iberia during the transition from the Mesolithic to the Neolithic (5500–4000 cal BC). In A. Whittle & V. Cummings, eds. *Going Over. The Mesolithic-Neolithic Transition in North-West Europe*. The British Academy, pp. 53–71.

Arnaud, J.M., 1982. Néolithique ancien et processus de néolithisation dans le sud du Portugal. *Archéologie en Languedoc*, (Actes du Colloque International de Prehistoire), pp.29–48.

Arnaud, J.M., 2002. O Mesolitico e o Processo de Neolitização: Passado, Presente e Futuro. *Arqueologia & Historia*, 54, pp.57–78.

Bernabeu Aubán, J. et al., 2009. La cerámica Impresa mediterránea en el origen del Neolítico de la península Ibérica? *De Méditerranée et d'ailleurs... Mélanges offerts a Jean Guilaine*.

Bernabeu Aubán, J., 2002. The social and symbolic context of Neolithisation. In E. Badal, J. Bernabeu Auban, & B. Marti, eds. *El paisaje en el Neolitico mediterraneo*. Valencia: Universitat de Valencia, pp. 209–233.

Bernabò Brea, L., 1956. *Gli scavi nella caverna delle Arene Candide, (Finale Ligure) - Gli strati con ceramica. Vol. II. Campagna di scavo 1948-50* Collezione., Bordighera: Istituto Internazionale di Studi Liguri.

Bicho, N.F., 1994. The End of the Paleolithic and the Mesolithic in Portugal. *Current Anthropology*, 35(5), p.664.

Boaretto, E. et al., 2009. Radiocarbon Dating of Charcoal and Bone Collagen Associated with Early Pottery at Yuchanyan Cave, Hunan Province, China. *Proceedings of the National Academy of Sciences of the United States of America*, 106(24), pp.9595–9600.

Bronk Ramsey, C. & Lee, S., 2013. Recent and Planned Developments of the Program OxCal.

Radiocarbon, 55(2), pp.720–730.

Budja, M., 2014. Neolithic pots and potters in Europe: The end of "demic diffusion" migratory model. *Documenta Praehistorica*, 40(1), pp.39–55.

Budja, M., 2005. The process of Neolithisation in South-eastern Europe: from ceramic female figurines and cereal grains to entoptics and human nuclear DNA polymorphic markers. *Documenta Praehistorica*, 32, pp.53–72.

Cámalich, M.D. et al., 2004. The Neolithic in Almería: the valley of the Almanzora river and Vera basin. *Documenta Praehistorica*, XXXI, pp.183–197.

Canals, A., Sauceda, I. & Carbonell, E., 2004. The Project "The First Settlers in Extremadura" and the paleolithic in the Salor area. In *Acts of the XIVth UISPP. Belgium, University of Liége*. BAR, pp. 157–167.

Cardoso, G., 2009. *Cronologias Absolutas para a Península Ibérica*. Instituto Politécnico de Tomar – Universidade de Trás-os- Montes e Alto Douro.

Cardoso, J.L., 2003. A Gruta do Correio-Mor (Loures). *Estudos arqueológicos de Oeiras*, 11, pp.229–321.

Cardoso, J.L., 2007. As cerâmicas decoradas pré-campaniformes do povoado pré-histórico de Leceia: suas características e distribuição estratigráfica. *Estudos Arqueológicos de Oeiras*, 14.

Cardoso, J.L., 2016. Na Estremadura do Neolítico Antigo ao Neolítico Final: os contributos de um percurso pessoal. In M. Diniz, C. Neves, & A. Martins, eds. *O Neolítico em Portugal antes do Horizonte 2020: perspectivas em debate*. Lisboa: AAP, pp. 25–49.

Cardoso, J.L., 2008. O. da Veiga Ferreira (1917-1997): sua vida e obra científica. *Octávio da*

Veiga Ferreira : homenagem ao homem, ao arqueólogo e ao professor, pp.13–123.

Cardoso, J.L., 2002. *Pré-história de Portugal* Verbo, ed., Lisboa.

Cardoso, J.L., Carreira, J.R. & Ferreira, O. da V., 1996. Novos elementos para o estudio do Neolítico antigo da região de Lisboa. *Estudos arqueológicos de Oeiras*, 6, pp.9–26.

Cardoso, J.L., Carvalho, A.F. & Gibaja Bao, J.F., 2013. O sítio do Neolítico Antigo de Cortiçóis - Almeirim, Santarém. *Revista portuguesa de arqueologia*, 16, pp.27–61.

Cardoso, J.L., Carvalho, a F. & Norton, J., 2001. A estação do Neolítico antigo de Cabranosa (Sagres, Vila do Bispo): estudo dos materiais e integração cronológico-cultural. *O Arqueólogo Português*, 16(August 2015), pp.55–96.

Cardoso, L.J. et al., 2013. Manuel Heleno: Pioneiro do Ensino e da Investigação Arqueólogica em Portugal (1923 - 1964).

Cardoso, L.J. & Carvalho, A.F., 2011. A Gruta da Furninha (Peniche): Estudo dos Espólios das Necrópoles Neolíticas. *Estudos arqueológicos de Oeiras*, 18.

Carvalho, A.F. ed., 2014. *Bom Santo Cave (Lisbon) and the Middle Neolithic Societies of Southern Portugal*, Faro: Universidade do Algarve.

Carvalho, A.F., 1998. O Abrigo da Pena d'Água (Rexaldia, Torres Novas): resultados dos trabalhos de 1992-1997. *Revista portuguesa de arqueologia*, 1(2), pp.39–72.

Carvalho, A.F., 2016. The Pena d'Água Rock-shelter (Torres Novas, Portugal): two distinct life ways within a Neolithic sequence. *Del neolític a l'edat del bronze en el Mediterrani occidental. Estudis en homenatge a Bernat Martí Oliver.*, pp.211–223.

Carvalho, A.F. & Cardoso, J.L., 2003. A estação do Neolítico antigo de Cabranosa (Sagres).

Contribuição para o estudo da neolitização do Algarve. *Muita gente, poucas antas? Origens, espaços e contextos do megalitismo. actas do II colóquio internacional sobre megalitismo*, pp.23–43.

Carvalho, F., 2008. *A Neolitização do Portugal Meridional. Os exemplos do Maciço Calcário Estremenho e do Algarve Ocidental*,

Carvalho, F.A., Valente, M.J. & Dean, R.M., 2010. O Mesolitico e o Neolitico antigo do concheiro da Rocha das Gaivotas (Sagres, Vila do Bispo). In *Actas do 7º Encontro de Arqueologia do Algarve, Silves - 22, 23 e 24 Outubro 2009*.

Cerrillo-Cuenca, E., Prada Gallardo, A., et al., 2006. Dataciones absolutas de los niveles neolíticos del yacimiento de Los Barruecos. In E. Cerrillo Cuenca, ed. *Los Barruecos: primeros resultados sobre el poblamiento neolítico de la cuenca extremeña del Tajo*. Mérida: Junta de Extremadura, p. 85'94.

Cerrillo-Cuenca, E., 2008. From "inland Neolithic" to "Neolithic dwelling in the inland": The role of homogeneous and heterogeneous elements in the explanation of earlier agricultural stages in Central Spain. In M. Diniz, ed. *Proceedings of the XV World Congress UISPP (Lisbon, 4–9 September 2006) 18 the Early Neolithic in the Iberian Peninsula*. BAR, pp. 19–27.

Cerrillo-Cuenca, E., 1999. La Cueva de el Conejar (Cáceres): Avance al Estudio de las Primeras Sociedades Productoras en la Penillanura Cacereña. *Zephyrus*, 52, pp.107–128.

Cerrillo-Cuenca, E. et al., 2002. La secuencia cultural de las primeras sociedades productoras en Extremadura: una datación absoluta del yacimiento de Los Barruecos (Malpartida de Cáceres, Cáceres). *Trabajos de Prehistoria*, 59(2), pp.101–111.

Cerrillo-Cuenca, E., García García, M., et al., 2006. *Los Barruecos: primeros resultados sobre el poblamiento neolítico de la cuenca extremeña del Tajo* Memorias d. E. Cerrillo Cuenca, ed.,

Mérida: Junta de Extremadura.

Cerrillo-Cuenca, E. & González Cordero, A., 2011. Burial Prehistoric Caves in the Interior Basin of River Tagus: the Complex at Canaleja Gorge (Romangordo, Caceres, Spain). In P. Bueno Ramirez, E. Cerrillo Cuenca, & A. González Cordero, eds. *From the Origins : The Prehistory of the Inner Tagus Region*. BAR.

Cerrillo-Cuenca, E. & González Cordero, A., 2014. Collective Burial Caves in Spanish Extremadura: Chronology, Landscapes and Identities. In A. Cruz et al., eds. *Rendering Death : Ideological and Archaeological Narratives from Recent Prehistory (Iberia)*. BAR.

Childe, V.G., 1929. *Danube in Prehistory*, Oxford: Clarendon Press.

Childe, V.G., 1957. *The Dawn of European Civilization* 6th ed., London: Routledge and Keegan Paul.

Collado, H. & Bello, J.R., 2013. Campo Internacional de Trabajo "Cuevas de Fuentes de León 2013" Proyecto Arqueológico: Estudio de la Ocupación Humana en el Monumento Natural Cuevas de Fuentes de León y su Entorno. Campaña 2013.

Collado, H. & Enríquez, J.J., 2004. *Proyecto Arqueológico: Estudio de la Ocupación Humana en el Monumento Natural Cuevas de Fuentes de León. Campaña 2004*,

Collado, H. & García Arranz, J.J., 2012. Reassessment of rock art from post Palaeolithic hunters-gatherers groups in the Iberian Peninsula: the Pre-schematic rock art. In J. García Arranz, H. Collado Giraldo, & G. Nash, eds. *The Levantine question. Post-Palaeolithic rock art in the Iberian Peninsula*. Budapest, pp. 227–261.

Collado Giraldo, H. et al., 2015. "Orígenes": Un proyecto de investigación del monumento natural "Cuevas de Fuentes de León" y su influencia en la economía local. *Revista de Estudios Extremeños*, 71(1), pp.13–36.

Copley, M.S. et al., 2005. Dairying in antiquity. I. Evidence from absorbed lipid residues dating to the British Iron Age. *Journal of Archaeological Science*, 32(4), pp.485–503.

Copley, M.S. et al., 2003. Direct chemical evidence for widespread dairying in prehistoric Britain. *Proceedings of the National Academy of Sciences of the United States of America*, 100(4), pp.1524–1529.

Correa-Ascencio, M. & Evershed, R.P., 2014. High throughput screening of organic residues in archaeological potsherds using direct acidified methanol extraction. *Analytical Methods*, 6(5), pp.1330–1340.

Cortés Sánchez, M. et al., 2012. The Mesolithic-Neolithic transition in southern Iberia. *Quaternary Research*, 77(2), pp.221–234.

Costa, F.A.P. da, 1865. *Da existência do homem em epochas remotas no valle do Tejo. Noticia sobre os esqueletos humanos descobertos no Cabeço da Arruda*,

Craig, O.E. et al., 2005. Did the first farmers of central and eastern Europe produce dairy foods? *Antiquity*, 79(July 2004), pp.882–894.

Cramp, L.J.E. et al., 2014. Immediate replacement of fishing with dairying by the earliest farmers of the northeast Atlantic archipelagos. *Proceedings of the Royal Society B: Biological Sciences*, 281(1780).

Cruz, A., 2010. *A Pré-História recente no Vale do Baixo Zêzere: Um Olhar Diacrónico (PhD thesis)*. Universidade Trás-os-Montes e Alto Douro.

Cruz, A., 1997. *Vale do Nabão. Do Neolítico a Idade do Bronzo* Arkeos 3., Tomar: CEIPHAR.

Cruz, A., Graça, A. & Oosterbeek, L., 2014. Caves, Megalithism and Tumuli – Three diachronic

realities in funerary archaeography from Alto Ribatejo. In A. Cruz et al., eds. *Rendering Death: Ideological and Archaeological Narratives from Recent Prehistory (Iberia) Proceedings of the conference held in Abrantes, Portugal, 11 May 2013*. BAR, pp. 61–75.

Cruz Berrocal, M., 2012. The Early Neolithic in the Iberian Peninsula and the Western Mediterranean: A Review of the Evidence on Migration. *Journal of World Prehistory*, 25(3–4), pp.123–156.

Davis, S. & Simões, T., 2015. O Lapiás das Lameiras (Sintra): um sítio paradigmático para o conhecimento da Neolitização da fachada atlântica da Península Ibérica. In *O Neolítico em Portugal antes do Horizonte 2020: perspectivas em debate*. Lisboa.

Davis, S. & Simões, T., 2016. The velocity of Ovis in prehistoric times: the sheep bones from Early Neolithic Lameiras, Sintra, Portugal. In M. Diniz, C. Neves, & A. Martins, eds. *O Neolítico em Portugal antes do Horizonte 2020: perspectivas em debate*. Lisboa: AAP, pp. 51–66.

Davis, S.J.M., 2002. The mammals and birds from the Gruta do Caldeirão, Portugal. *Revista Portuguesa de Arqueologia*, 5(2), pp.29–98.

Dean, R.M.. U.D.M.-M. (Estados U. & Carvalho, A.F.U.D.A. (Portugal), 2011. Surf and Turf: The Use of Marine and Terrestrial Resources in the Early Neolithic of Coastal Southern Portugal. *Trekking the Shore: Changing Coastlines and the Antiquity of Coastal Settlement*, pp.291–302.

Dean, R.M., Valente, M.J. & Carvalho, A.F., 2012. The Mesolithic/Neolithic transition on the Costa Vicentina, Portugal. *Quaternary International*, 264, pp.100–108.

Delgado, N., 1867. *Noticia Acerca das Grutas da Cesareda*, Lisboa: Typographia da Academia Real das Sciencias.

Díaz-Andreu, M. & Cortadella Morral, J., 2006. Success and failure: alternatives in the institutionalisation of pre-and protohistory in Spain. In *The beginnings of academic pre- and protohistoric archaeology (1830-1930) in a European perspective. Berliner Archäologische Forschungen 2*. pp. 295–306.

Diniz, M., 2005. Acerca do processo de neolitização no actual território português: modelos em debate. *Promontoria*, 3(3), pp.229–249.

Diniz, M., 2012. And what else beside Cardial pottery? Searching for Mediterranean influences in Early Neolithic settlement of Valada do Mato (Évora, Portugal). *Rubricatum*, 5, pp.479–486.

Diniz, M., 2007. *O Sítio da Valada do Mato (Évora): aspectos da neolitização no Interior/Sul de Portugal* Trabalhos., Lisboa: Instituto Português de Arqueologia.

Drewett, P. et al., 1991. Anta 1 de Val de Laje 1989/1990. The excavation of a passage grave at Tomar (Portugal). *Bulletin of the Institute of Archaeology*, 28, pp.133–148.

Dudd, S.N. & Evershed, R.P., 1998. Direct Demonstration of Milk as an Element of Archaeological Economies. *Science*, 282(5393), pp.1478–1481.

Dunne, J. et al., 2012. First dairying in green Saharan Africa in the fifth millennium BC. *Nature*, 486(7403), pp.390–394.

Duque Espino, D.M., 2011. Anthracology in the Caves of Fuentes de León (Badajoz, Extremadura, Spain): notes for the characterization of the plant environment of the neolithic communities and Roman period of the SW of the Iberian Peninsula. In E. BADAL et al., eds. *SAGVNTUM Extra-11 (5th INTERNATIONAL MEETING OF CHARCOAL ANALYSIS The charcoal as cultural and biological heritage Valencia, Spain, September 5th-9th 2011)*. Valencia: UNIVERSITAT DE VALÈNCIA Departament de Prehistòria i Arqueologia de la Facultat de Geografia i Història, pp. 175–176.

Evershed, R.P. et al., 1994. Application of isotope ratio monitoring gas chromatography-mass spectrometry to the analysis of organic residues of archaeological origin. *Analyst*, 119(5), pp.909–914.

Evershed, R.P. et al., 2008. Earliest date for milk use in the Near East and southeastern Europe linked to cattle herding. *Nature*, 455(7212), pp.528–531.

Farbstein, R. et al., 2012. First Epigravettian ceramic figurines from Europe (Vela Spila, Croatia). *PLoS ONE*, 7(7).

Farbstein, R.A. & Davies, W., 2015. Rediscovering Paleolithic art: overlooked ceramic figurines from the Pavlovian. In *Forgotten times and spaces: New perspectives in paleoanthropological, paleoetnological and archeological studies.* Brno: Masaryk university, pp. 328–339.

Farquhar, G.D., Ehleringer, J.R. & Hubick, K.T., 1989. Carbon Isotope Discrimination and Photosynthesis. *Annual Review of Plant Physiology and Plant Molecular Biology*, 40(1), pp.503–537.

Fernández, S. et al., 2007. The Holocene and Upper Pleistocene pollen sequence of Carihuela Cave, southern Spain. *Geobios*, 40(1), pp.75–90.

Fletcher, D., 1963. Nuevos datos sobre las relaciones neolíticas entre las costas españolas y del Mediterráneo oriental.

Fuying, P., 2008. Contribution to ceramics studies of the Alto Ribatejo (Gruta do Cadaval and Anta 1 de Val da Laje, Tomar, Portugal). *Annali dell'Università degli Studi di Ferrara. Museologia Scientifica e Naturalistica*, Volume Spe, pp.71–76.

Fuying, P., 2007. *Contribution to ceramics studies of the Alto Ribatejo (Gruta do Cadaval and*

Anta 1 de Val de Laje, Tomar, Portugal). UTAD/IPT.

Gámiz Caro, J., 2011. Aproximación al Neolítico de la provincia de Granada a través del estudio de la cerámica. *@rqueología y Territorio*, 8, pp.17–33.

García Atiénzar, G. & Javier Maestre, F.J., 2011. The Introduction of the First Farming Communities in the Western Mediterranean : the Valencian Region in Spain as Example. *Arqueologia Iberoamericana*, 10, pp.17–29.

García Borja, P. et al., 2010. Nuevas perspectivas sobre la neolitización en la Cueva de Nerja (Málaga-España): La cerámica de la sala del vestíbulo. *Zephyrus*, 66, pp.109–132.

García Gazólaz, J. et al., 2011. Los Cascajos (Los Arcos, Navarra). *SAGVNTVM - Las Primeras Producciones Cerámicas:el VI Milenio Cal AC en la Península Ibérica*, extra(12), pp.135–141.

Gavilán Ceballos, B., 1997. Reflexiones sobre el Neolítico Andaluz. *Spal*, 6, pp.23–33.

Gavilán Ceballos, B. & Vera Rodríguez, J.C., 2001. El Neolitíco en la Alta Andalucía: cuestiones sobre la caracterización de sus fases. *Spal*, 10, pp.177–183.

Gheorghiu, D., 2009. Early Pottery: A Concise Overview. In D. Gheorghiu, ed. *Early Farmers, Late Foragers, and Ceramic Traditions: On the Beginning of Pottery in the Near East and Europe*. Cambridge: Cambridge Scholars Publishing, pp. 1–21.

Gkiasta, M. et al., 2003. Neolithic transition in Europe: The radiocarbon record revisited. *Antiquity*, 77(January), pp.45–62. Available at: http://discovery.ucl.ac.uk/11454/.

Gomes, H., Ferreira, C. & Rosina, P., 2013. Depósitos Sedimentares e variações Paleoambientais no Pleistocénico Final e Holocénico do Alto Ribatejo (Portugal). *Techne*, 1, pp.51–60.

Gomes, M.V., 2008. Castelo Belinho (Algarve, Portugal) and the First Southwest Iberian Villages. In M. Diniz, ed. *The Early Neolithic in the Iberian Peninsula. Regional and Transregional Components*. BAR.

Gomes, M.V., 2012. Early Neolithic Funerary Practices in Castelo Belinho's Village (Western Algarve, Portugal). In J. F. Gibaja, A. F. Carvalho, & P. Chambon, eds. *Funerary Practices in the Iberian Peninsula from the Mesolithic to the Chalcolithic*. BAR, pp. 113–123.

Guilaine, J., 2001. La Diffusion de l'Agriculture en Europe : Une Hypothese Arythmique. *Zephyrus*, 53–54, pp.267–272.

Guilaine, J. & Manen, C., 2007. From Mesolithic to Early Neolithic in the western Mediterranean. *Proceedings of the British Academy*, 144, pp.21–51.

Guilaine, J. & da Veiga Ferreira, O., 1970. Le Néolithique ancien au Portugal. *Bulletin de la Société préhistorique française*, 67(1), pp.304–322.

Jackes, M. & Meiklejohn, C., 2004. Building a method for the study of the Mesolithic- Neolithic transition in Portugal. *Documenta Praehistorica*, 31, pp.89–111.

Jordan, P. & Zvelebil, M. eds., 2009. *Ceramics Before Farming. The Dispersal of Pottery Among Prehistoric Eurasian Hunter-Gatherers*, London: Institute of Archaeology, University College London.

Kherbouche, F. et al., 2016. Middle Holocene hunting and herding at Gueldaman Cave, Algeria: An integrated study of the vertebrate fauna and pottery lipid residues. *Quaternary International*, 410, pp.50–60.

King, R. & Underhill, P.A., 2002. Congruent distribution of Neolithic painted pottery and ceramic figurines with Y-chromosom lineages. *Antiquity*, 76, pp.707–714.

Kuzmin, Y. V, 2006. Chronology of the earliest pottery in East Asia : progress and pitfalls. *Antiquity*, 80(May 2005), pp.362–371.

Lawler, A., 2009. Bridging East and West. *Science*, 325(5943), pp.940–943.

Layard, A.H., 1853. *Discoveries in the ruins of Nineveh and Babylon*, New York: G. Putnam.

Leisner, G. & Leisner, V., 1951. *Antas do concelho de Reguengos de Monsaraz: materiais para o estudo da cultura megalítica em Portugal*, Lisboa: Instituto de Alta Cultura.

Leisner, V., 1983. As diferentes fases do Neolitico em Portugal. *Arqueologia*, 7.

Lewthwaite, J., 1986. The transition to food production: a Mediterranean perspective. In M. Zvelebil, ed. *Hunters in Transition. Mesolithic Societies of Temperate Eurasia and their Transition to Farming*. Cambridge: Cambridge University Press.

López Sáez, J.A., 2006. Análisis palinológico del yacimiento de Los Barruecos. In E. Cerrillo Cuenca, ed. *Los Barruecos: primeros resultados sobre el poblamiento neolítico de la cuenca extremeña del Tajo2*. pp. 95–98.

López Sáez, J.A., Cordero, A. & Cerrillo Cuenca, E., 2007. Paleoenvironment and paleoeconomy during early Neolithic and Chalcolithic in Spanish Extremadura. *Zephyrus*, 60, pp.145–153.

Lu, T.L.-D., 2010. Early Pottery in South China. *Asian Perspectives*, 49(1), pp.1–42.

Maggi, R., 2002. Le facies a ceramica impressa dell'area ligure. In M. A. Fugazzola Delpino, A. Pessina, & A. Tiné, eds. *Le ceramiche impresse nel Neolitico antico. Italia e Mediterraneo*. Roma: Istituto poligrafico e Zecca dello Stato, pp. 91–96.

Manen, C., Marchand, G. & Carvallo, A.F., 2007. Le Néolithique ancien de la péninsule

Ibérique : vers une nouvelle évaluation du mirage africain ? J. Evin, ed. *Congrés du centenaire*, 3(2007), pp.133–151.

Manen, C. & Perrin, T., 2009. Réflexions sur la genèse du Cardial « franco-ibérique ». , pp.427–443.

Martí Oliver, B. & Juan-Cabanilles, J., 1997. Epipaleolíticos y neolíticos : población y territorio en el proceso de neolitización de la Península Ibérica. *Espacio, tiempo y forma. Serie I, Prehistoria y arqueología*, 10, pp.215–264.

Meiklejohn, C. et al., 2009. Radiocarbon dating of Mesolithic human remains in Portugal. *Mesolithic Miscellany*, 20(1), pp.4–16.

Mottram, H.R. et al., 1999. New chromatographic, mass spectrometric and stable isotope approaches to the classification of degraded animal fats preserved in archaeological pottery. *Journal of Chromatography A*, 833(2), pp.209–221.

Muñoz, A., 1975. Consideraciones sobre el Neolítico español. *Memoria del Instituto de Arqueología y Prehistoria*, pp.27–40.

Navarrete, M.S., 1976. La cultura de las cuevas con ceramica decorada en Andalucia Oriental. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada*, 1.

Neves, C., 2015. A cerâmica decorada com sulco abaixo do bordo do sítio neolitico do Monte da Foz 1 (Benavente, Portugal). *Revista Arkeogazte*, Annex 1.

Neves, C. & Diniz, M., 2014. Acerca dos cenários da Acção: Estratégias de Implantação e Exploração do Espaço nos Finais do 5º e na Primeira Metade do 4º Milénio AC, no Sul de Portugal. *Estudos do Quaternário*, 11, pp.45–58.

Nieuwenhuyse, O.P. et al., 2015. Tracing pottery use and the emergence of secondary product

exploitation through lipid residue analysis at Late Neolithic Tell Sabi Abyad (Syria). *Journal of Archaeological Science*, 64, pp.54–66.

Nunes, A.J.M., 2014. *Estudo dos materiais provenientes do Cerradinho do Ginete (Torres Novas, Santarém): Contribuição para o estudo do Neolítico médio português (MA thesis)*. Universidade do Algarve, Faculdade de Ciências Humanas e Sociais.

Olalde, I. et al., 2015. A common genetic origin for early farmers from Mediterranean Cardial and Central European LBK cultures. *Molecular Biology and Evolution*.

Olivares Marín, C., *Estudio faunístico del yacimiento arqueológico "Cueva de los Postes" (Fuentes de León, Badajoz) - preliminary report*,

Oosterbeek, L., 2004. Archaeographic and conceptual advances in interpreting Iberian Neolithisation. *Documenta Praehistorica*, 31 "11th N(46), pp.59–81.

Oosterbeek, L., 1997. *Echoes from the East: Late Prehistory of the North Ribatejo* ARKEOS 2., Tomar: CEIPHAR.

Oosterbeek, L., 1993. Nossa Senhora das Lapas: excavation of prehistoric cave burials in central Portugal. *Papers from the Institute of Archaeology*, 4, pp.49–62.

Oosterbeek, L., 1995. O Neolitico e o Calcoliticona região do vale do Nabão (Tomar). In M. Kunst, ed. *Origens, Estruturas e Relações das Culturas Calcolíticas da Península Ibérica. Actas das I Jornadas Arqueológicas de Torres Vedras 3-5 Abril 1987*. Lisboa: Instituto Português do Património Arquitectónico e Arqueológico, Departamento de Arqueologia, pp. 101–112.

Oosterbeek, L., 2001. Stones, carvings, foragers and farmers in the southwest of Europe. A view from the inland. In *Prehistoria 2000*. UISPP, pp. 150–168.

Oosterbeek, L., Almeida, N. & Garcês, S., 2014. Territories revisited: identities and exclusion as seen from an archaeological perspective. In M. Lins et al., eds. *Identidades e diversidade cultural - Etnia e Gênero*. Teresina: Fundação Quixote - CEIPHAR/ITM, pp. 65–77.

Oosterbeek, L., Cruz, A. & Félix, P., 1992. Anta 1 de Val da Laje: notícia de 3 anos de escavações (1989-91). *Boletim Cultural da Câmara Municipal de Tomar*, 16, pp.31–49.

Orton, C. & Hughes, M., 2013. *Pottery in Archaeology* 2nd editio., Cambridge University Press.

Özdoğan, M., 2009. Earliest Use of Pottery in Anatolia. In D. Gheorghiu, ed. *Early Farmers, Late Foragers, and Ceramic Traditions: On the Beginning of Pottery in the Near East and Europe*. Cambridge: Cambridge Scholar Publishing, pp. 22–43.

Pellicer, M., 1964. El Neolítico y el Bronce de la Cueva de la Carigúela de Pinar (Granada). *Trabajos de Prehistoria*, 15, p.7.

Peña-Chacorro, L. et al., 2013. Neolithic Plant Use in the Western Mediterranean Region : Preliminary Results From the Agriwestmed Project. *Annali di Botanica*, 3, pp.135–141.

Pinhasi, R., Fort, J. & Ammerman, A.J., 2005. Tracing the origin and spread of agriculture in Europe. *PLoS Biology*, 3(12), pp.1–9.

Raposo, L., 1993. O sítio de Palheirões do Alegra e a ’questão do Mirense. In *Documento de Trabajo, Encuentro de Arqueologia del Suroeste*. pp. 17–36.

Raposo, L. & Silva, A.C., 1984. O Languedocense: Ensaio de caracterização morfotécnica e tipológica. *O Arqueólogo PortuguêsArque6logo Portugue*, 4(2), pp.87–166.

Rego, P.R. & Aira Rodriguez, M.J., 1993. A palaeocarpological study of Neolithic and Bronze Age levels of the Buraco da Pala rock-shelter (Bragança, Portugal). *Vegetation History and Archaeobotany*, 2(3), pp.163–172.

Reimer, P., 2013. IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP. *Radiocarbon*, 55(4), pp.1869–1887.

Rice, P.M., 1987. *Pottery Analysis: A Source Book*, Chicago: The University of Chicago Press.

Rice, P.M.., 1999. On the Origins of Pottery. *Journal of Archaeological Method and Theory*, 6(1, Mar. 1999), pp.1–54.

Richards, M., 2003. The Neolithic transition in Europe : archaeological models and genetic evidence. *Documenta Praehistorica*, 30(4), pp.159–167.

Richards, T.W., 1895. The composition of Athenian pottery. *American Chemical Journal*, 17, pp.152–154.

Rodrigues, M.L. & Fonseca, A., 2010. Geoheritage assessment based on large-scale geomorphological mapping: contributes from a Portuguese limestone massif example. *Géomorphologie : relief, processus, environnement*, 16(2), pp.189–198.

Roffet-Salque, M. et al., 2016. Impact of modern cattle feeding practices on milk fatty acid stable carbon isotope compositions emphasise the need for caution in selecting reference animal tissues and products for archaeological investigations. *Archaeological and Anthropological Sciences*, pp.1–6.

Rojo, M. et al., 2008. Paisajes de la memoria: Asentamientos del neolítico antiguo en el Valle de Ambrona (Soria, España). In *Arte y Arqueología*. Valladolid: Universidad de Valladolid.

Roudil, J.-L., 1990. Cardial et Néolithique ancien ligure dans le sud-est de la France. *Rubané et Cardial, Universit é de Liege. ERAUL*, 39, pp.383–391.

Rowley-Conwy, P., 1992. The early Neolithic animal bones from Gruta do Caldeirão. In J.

Zilhão, ed. *Gruta do Caldeirão. O Neolitico Antigo.* Lisboa: Instituto Português do Património Arquitectónico e Arqueológico, Departamento de Arqueologia, pp. 231–237.

Rowley-Conwy, P., 1992. The early Neolithic animal bones from Gruta do Caldeirão. In J. Zilhão, ed. *Gruta do Caldeirão. O Neolítico Antigo*. Lisboa: Instituto Português do Património Arquitectónico e Arqueológico, pp. 231–257.

Ruiz, A., Sánchez, A. & Bellón, J.P., 2002. The history of Iberian archaeology: one archaeology for two Spains. *Antiquity*, 76(291), pp.184–190.

Rye, O.S., 1981. *Pottery technology. Principles and reconstruction* Manuals on., Washington D. C.: Taraxacum Inc.

Salque, M. et al., 2012. New insights into the Early Neolithic economy and management of animals in Southern and Central Europe revealed using lipid residue analyses of pottery vessels. *Anthropozoologica*, 47(2), pp.45–62.

Salque, M.R.- et al., 2015. Widespread exploitation of the honeybee by early Neolithic farmers. *Nature*, 527(7577), pp.226–230.

Salque, M.R.- & Evershed, R.P., 2015. Shifting pottery use and animal management at Kopydłowo (Poland) traced through lipid residue analyses of pottery vessels. In A. Marciniak et al., eds. *Kopydłowo, stanowisko 6. Osady neolityczne z pogranicza Kujaw i Wielkopolski*. Pękowice-Poznań: Ocalone dziedzictwo archeologiczne, pp. 133–142.

San Valero Aparisi, J., 1950. la Cueva de la Sarsa (bocairente, Valencia). *Valencia: Servicio de investigacion préhist. y Museo provincial de préhist.(serie de trabaios varios)*, 12.

Scarre, C., Oosterbeek, L. & French, C., 2011. Tombs, landscapes and settlements in the Tagus hill-country. In *From the Origins : The Prehistory of the Inner Tagus Region*. Oxford: British Archaeological Reports, pp. 83–91.

Shepard, A.O., 1956. *Ceramics for the Archaeologist*, Washington, D.C.: Carnegie Institution of Washington.

Sherratt, A., 1981. Plough and pastoralism: aspects of the secondary products revolution. In I. Hodder, G. Isaac, & N. Hammond, eds. *Patterns of the Past. Studies in Honour of David Clarke*. Cambridge: Cambrdge University Press, pp. 261–305.

Silva, C.T. da & Soares, J., 1987. Les Communautés du Neólitique Ancien dans le Sud du Portugal. In *Premieres Communautés Payannes en Méditerranée Occidentale*. Paris: C.N.R.S.

Silva, C.T. da & Soares, J., 2014. O habitat do Neolítico antigo do Casal da Cerca (Palmela). *Setúbal Arqueológica*, 15, pp.61–104.

Silva, C.T. da & Soares, J., 1981. *Pré-História da Àrea de Sines.*, Lisboa: Gabinete da Área de Sines.

Simões, T., 2003. A ocupação do Neolítico antigo de São Pedro de Canaferrim: novos dados em perspectiva. In V. S. Gonçalves, ed. *Muita gente, poucas antas? Origens, espaços e contextos do Megalitismo. Trabalhos de Arqueologia 25 - Actas do II Colóquio Internacional sobre Megalitismo*. Lisboa: DGPC, pp. 115–134.

Sjödin, P. & François, O., 2011. Wave-of-advance models of the diffusion of the Y chromosome haplogroup R1b1b2 in europe. *PLoS ONE*, 6(6).

Soares, J., 1996. Para Uma Reconstrução do Processo de Neolitização em Portugal. *Ophiussa*, 1.

Soares, J. & Silva, C.T., 2003. A transição para o Neolítico na Costa Sudoeste portuguesa. *Muita gente, poucas antas? Origens, espaços e contextos do Megalitismo. Actas do II Colóquio Internacional sobre Megalitismo*, pp.45–56.

Šoberl, L. et al., 2014. Neolithic and eneolithic activities inferred from organic residue analysis of pottery from mala triglavca, moverna vas and ajdovska jama, slovenia. *Documenta Praehistorica*, 41(1), pp.149–179.

Stika, H., 2005. Early Neolithic agriculture in Ambrona , Provincia Soria , central Spain. *Vegetation History and Archaeobotany*, 14, pp.189–197.

Szécsényi-Nagy, A. et al., 2015. Tracing the genetic origin of Europe's first farmers reveals insights into their social organization. *Proceedings. Biological sciences / The Royal Society*, 282(1805), p.20150339

Thissen, L. et al., 2010. The Land of Milk? Approaching Dietary Preferences of Late Neolithic Communities in NW Anatolia. *Leiden Journal of Pottery Studies*, 26, pp.157–172.

Thissen, L., van As, A. & Jacobs, L., 2007. Some thoughts on the appearance of pottery in the Lowwer Danube Plain (Romania). *Leiden Journal of Pottery Studies*, 23(109–120), pp.40–46.

Thissen, L.C., 2007. *Die Anfänge der Keramikproduktion in der Türkei–ein Überblick*, na.

Tomé, T., 2011. *Até que a Morte nos Reúna: Transição para o Agro-Pastoralismo na Bacia do Tejo e Sudoeste Peninsular (PhD thesis)*. Universidade de Trás-os-Montes e Alto Douro.

Tomé, T. & Oosterbeek, L., 2011. One Region, Two Systems? A Paleobiological Reading of Cultural Continuity Over the Agro-Pastoralist Transition in the North Ribatejo. In P. B. Ramirez, E. C. Cuenca, & A. G. Cordero, eds. *From the Origins : The Prehistory of the Inner Tagus Region*. BAR.

Türkekul Bıyık, A., 2009. *Chemical Characterization of Lipid Residues in Neolithic and Chalcolithic Pottery from Anatolia*. Boğaziçi University.

Urem-Kotsou, D., Kotsakis, K. & Stern, B., 2001. Defining function in Neolithic ceramics : the example of Makriyalos , Greece. *Documenta Praehistorica XXIX*, 23(495), pp.109–118.

Valente, M.J., 2014. Mesolithic and Neolithic shell middens in Western Algarve : issues in ecology , taphonomy and economy, Faculty of Letters, University of Lisbon, 8th-9th March 2012. In C. Detry & R. Dias, eds. *Proceedings of the First Zooarchaeology Conference in Portugal*. BAR S2662.

Valente, M.J., 2010. O Barranco das Quebradas (Vila do Bispo) no contexto do concheiros mesoliticos no Sudoeste portugues. In *Actas do 7º Encontro de Arqueologia do Algarve, Silves - 22, 23 e 24 Outubro 2009*.

Valente, M.J. & Carvalho, a F., 2009. Recent developments in Early Holocene hunter-gatherer subsistence and settlement: a view from south-western Iberia. *Mesolithic Horizons: Papers presented at the Seventh International Conference on the Mesolithic in Europe, Belfast 2005*, 1(June), pp.312–317.

Vicent Garcia, J.M., 1997. The Island Filter Model Revisited. In S. M. Balmuth, A. Gilman, & L. Prados-Torreira, eds. *Encounters and Transformations. The Archaeology of Iberia in Transition*. Sheffield: Sheffield Academic Press Ltd.

Vieugué, J., 2014. Use-wear analysis of prehistoric pottery: Methodological contributions from the study of the earliest ceramic vessels in Bulgaria (6100-5500BC). *Journal of Archaeological Science*, 41, pp.622–630.

Vigne, J.-D. & Helmer, D., 2007. Was milk a "secondary product" in the Old World Neolithisation process? Its role in the domestication of cattle, sheep and goats. *Anthropozoologica*, 42(2), pp.9–40.

Vis, G.J. et al., 2010. Holocene flooding history of the Lower Tagus Valley (Portugal). *Journal*

of Quaternary Science, 25(8), pp.1222–1238.

Whittle, E.H. & Arnaud, J.M., 1975. Thermoluminescent dating of Neolithic and Chalcolithic pottery from sites in central Portugal. *Archaeometry*, 17(1), pp.5–24.

Zapata, L. et al., 2004. Early Neolithic Agriculture in the Iberian Peninsula. *Journal of World Prehistory*, 18(4), pp.283–325.

Zeder, M.A., 2015. Core questions in domestication research. *Proceedings of the National Academy of Sciences*, (8).

Zeder, M.A., 2008. Domestication and early agriculture in the Mediterranean Basin: Origins, diffusion, and impact. *Proceedings of the National Academy of Sciences of the United States of America*, 105(33), pp.11597–11604.

Zeder, M.A., 2011. The Origins of Agriculture in the Near East. *Current Anthropology*, 52(S4), pp.S221–S235.

Zilhão, J., 1998. A passagem do Mesolítico ao Neolítico na costa do Alentejo. *Revista portuguesa de arqueologia*, 1(1), pp.27–44.

Zilhão, J., 2000. From the Mesolithic to the Neolithic in the Iberian peninsula. In T. D. Price, ed. *Europ's First Farmers*. Cambridge University Press, pp. 144–182.

Zilhão, J., 1992. Gruta do Caldeirão: O Neolítico antigo. *Trabalhos de Arqueologia*, 6.

Zilhão, J., 2001. Radiocarbon evidence for maritime pioneer colonization at the origins of farming in west Mediterranean Europe. *Proceedings of the National Academy of Sciences of the United States of America*, 98(24), pp.14180–14185.

Zilhão, J., 2009. The Early Neolithic artifact assemblage from the Galeria da Cisterna (Almonda

karstic system, Torres Novas, Portugal). *De Méditerranée et d'ailleurs ... : mélanges offerts à Jean Guilaine*, pp.821–835.

Zilhão, J., 2003. The Neolithic Transition in Portugal and the Role of Demic Diffusion in the Spread of Agriculture across West Mediterranean Europe. In A. J. Ammerman & P. Biagi, eds. *The Widening Harvest*. Boston: Archaeological Institute of America, pp. 207–223.

Zilhão, J., 1993. The spread of agro-pastoral economies across Mediterranean Europe: a view from the far west. *Journal of Mediterranean Archaeology*, 6(1), pp.5–63.

Zilhão, J., 2011. Time is on my side …. In A. Hadjikoumis, E. Robinson, & S. Viner, eds. *The Dynamics of Neolithisation in Europe*. Oxbow Books.

Zilhão, J. & Carvallo, A.F., 1996. O Neolítico do Maciço Calcário Estremenho. Crono'estratigrafia e Povoamento. *Rubricatum*, 2(1), pp.659–671.

Zvelebil, M., 2001. The agricultural transition and the origins of Neolithic society in Europe. *Documenta Praehistorica*, XXVIII, pp.1–26.

Özbal, H. et al., 2010. Sütçülerin öncüleri:Barcın Höyük Keramiklerinde Süt Kalıntıları. In *26.Arkeometri Sonuçları Toplantısı*. T.C. Kültür ve Turizm Bakanligi, pp. 307–317.

ANNEX

Figure A.1 Plates from Cadaval, layer C

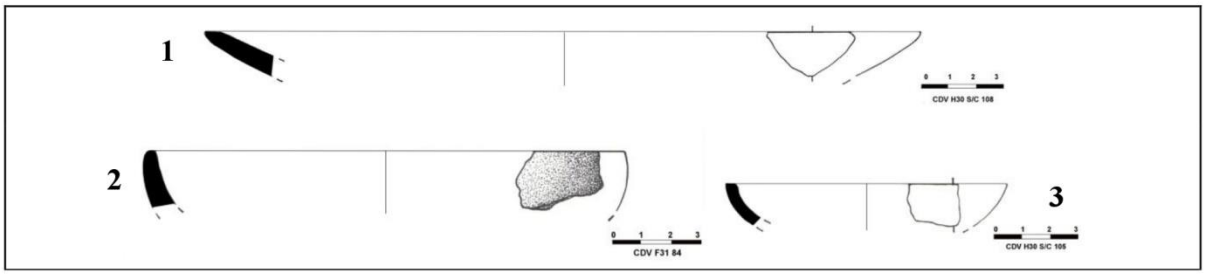


Figure A.2 Plates from Anta 1, layer B

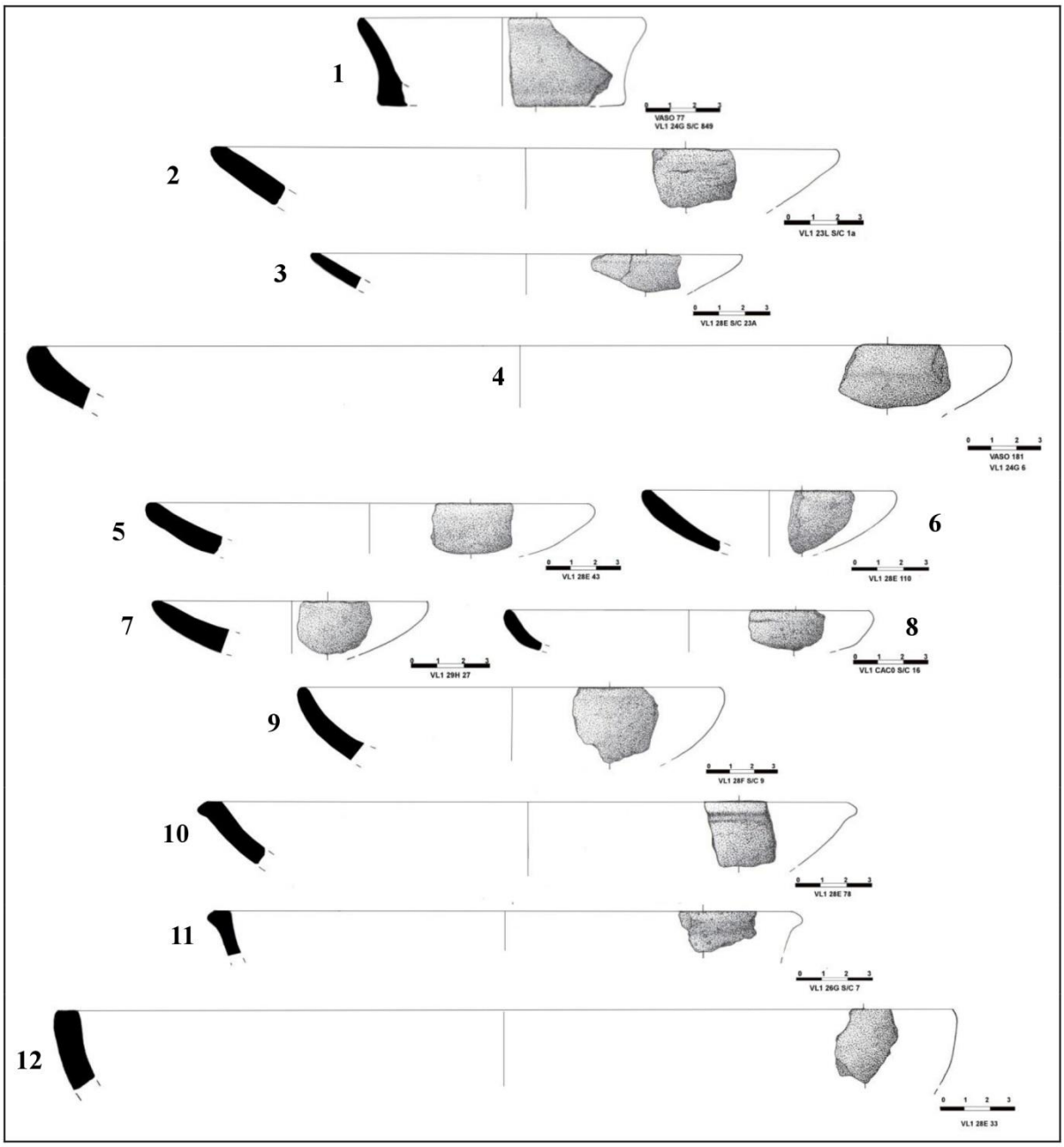
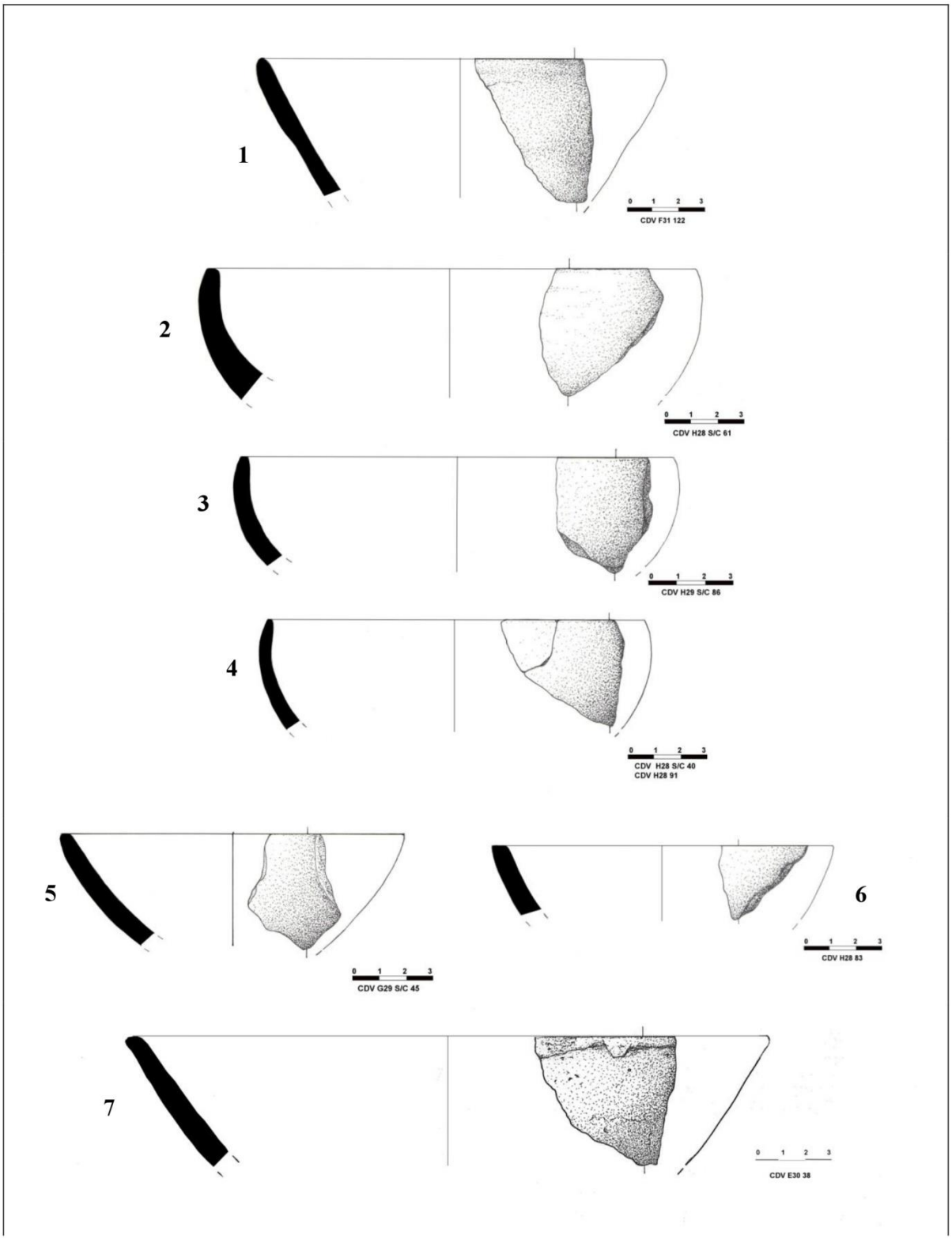
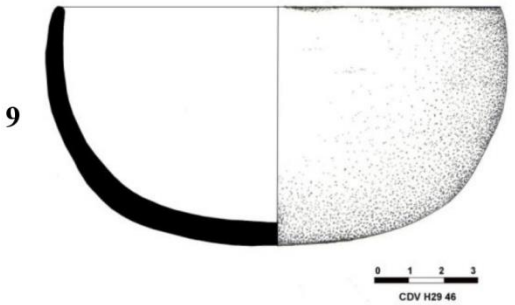
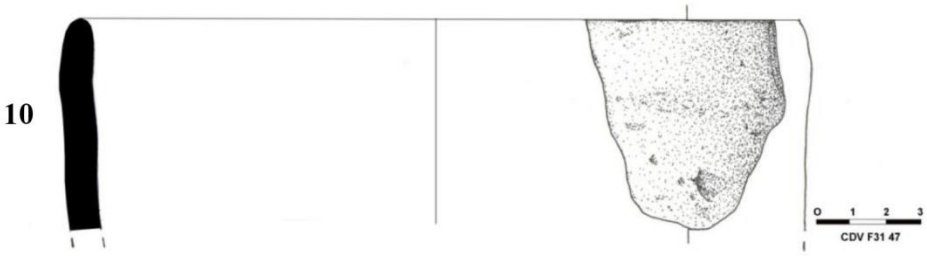


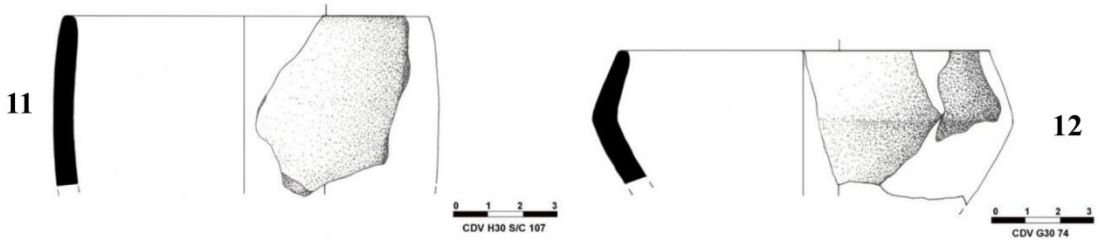
Figure A.3 Bowls from Cadaval, layer C

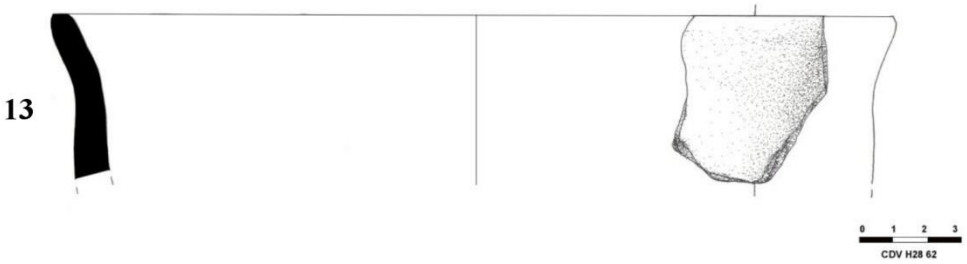


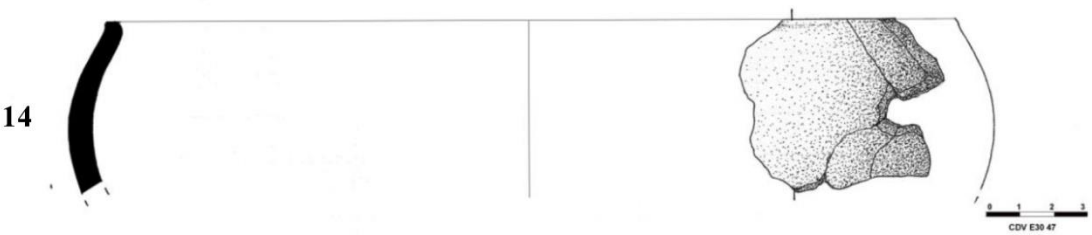

8
0 1 2 3
CDV F31 S/C 31


9
0 1 2 3
CDV H29 46


10
0 1 2 3
CDV F31 47


11
0 1 2 3
CDV H30 S/C 107
12
0 1 2 3
CDV G30 74


13
0 1 2 3
CDV H28 62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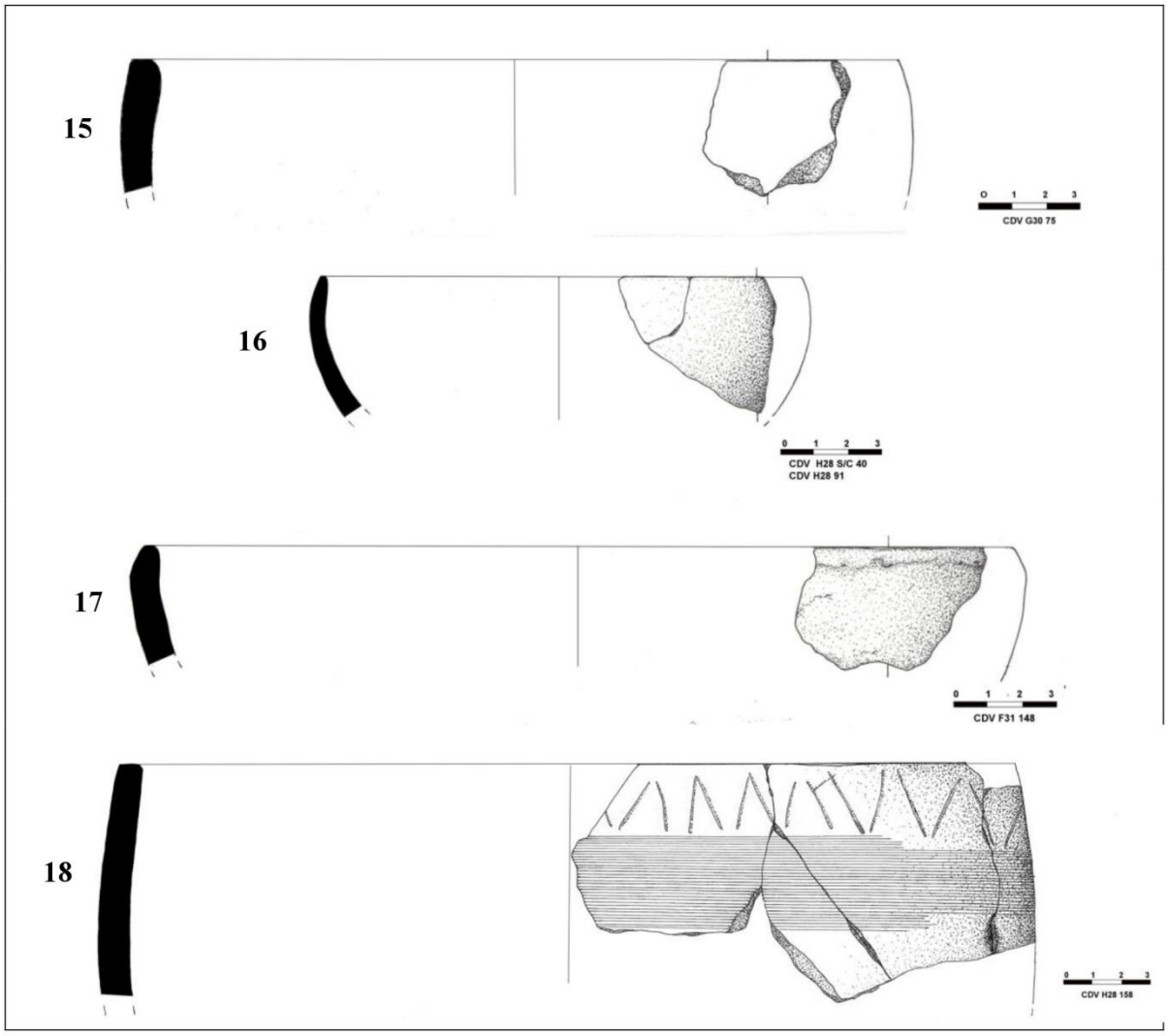
0 1 2 3
CDV E30 47


15
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CDV G30 75
16
0 1 2 3
CDV H28 S/C 40
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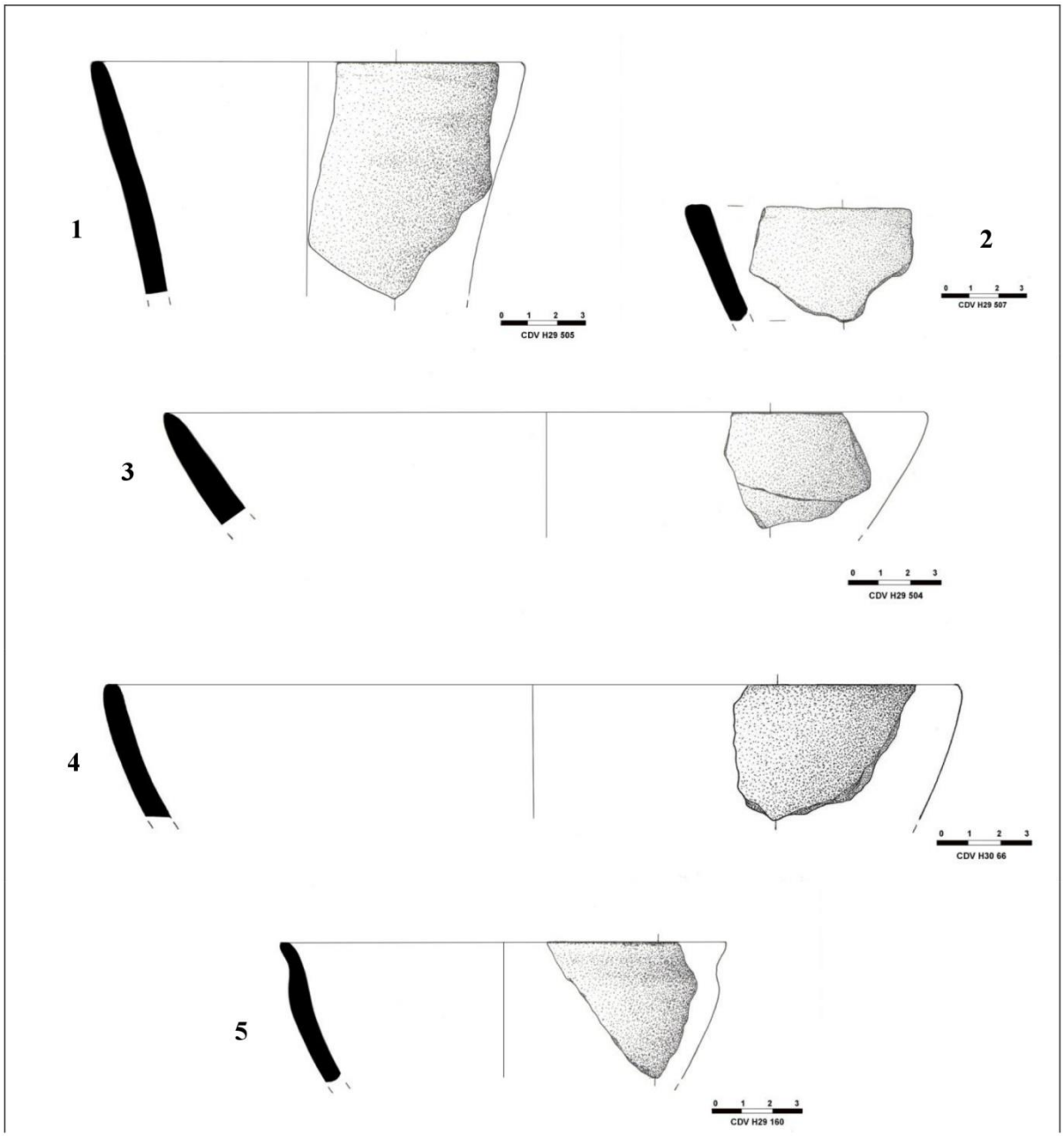
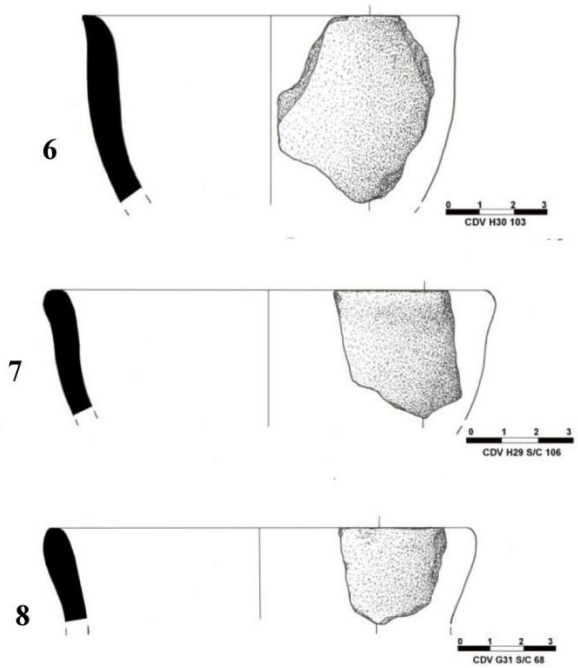
17
0 1 2 3
CDV F31 148
18
0 1 2 3
CDV H28 158

Figure A.4 Bowls from Cadaval, layer D




6
0 1 2 3
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7
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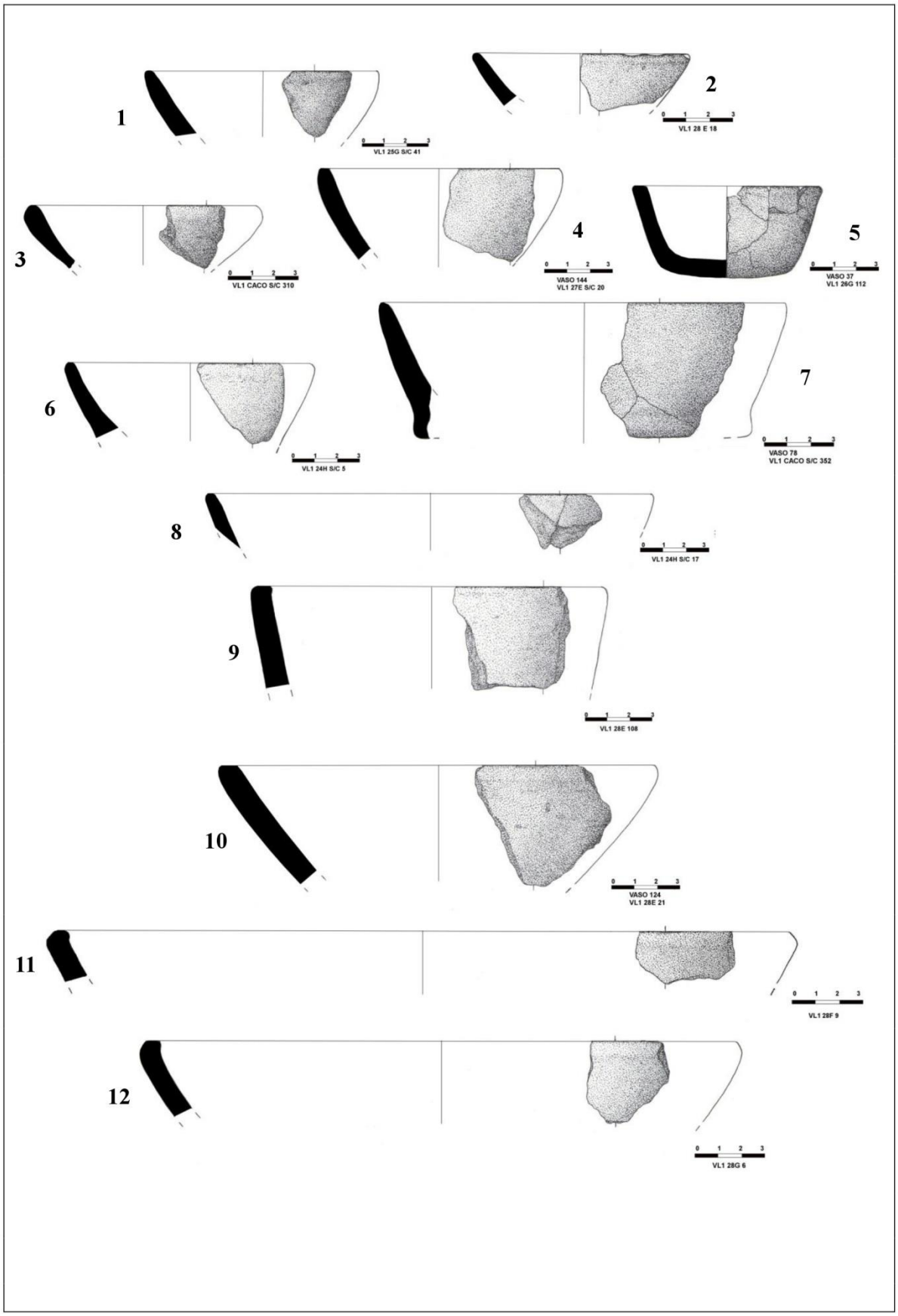
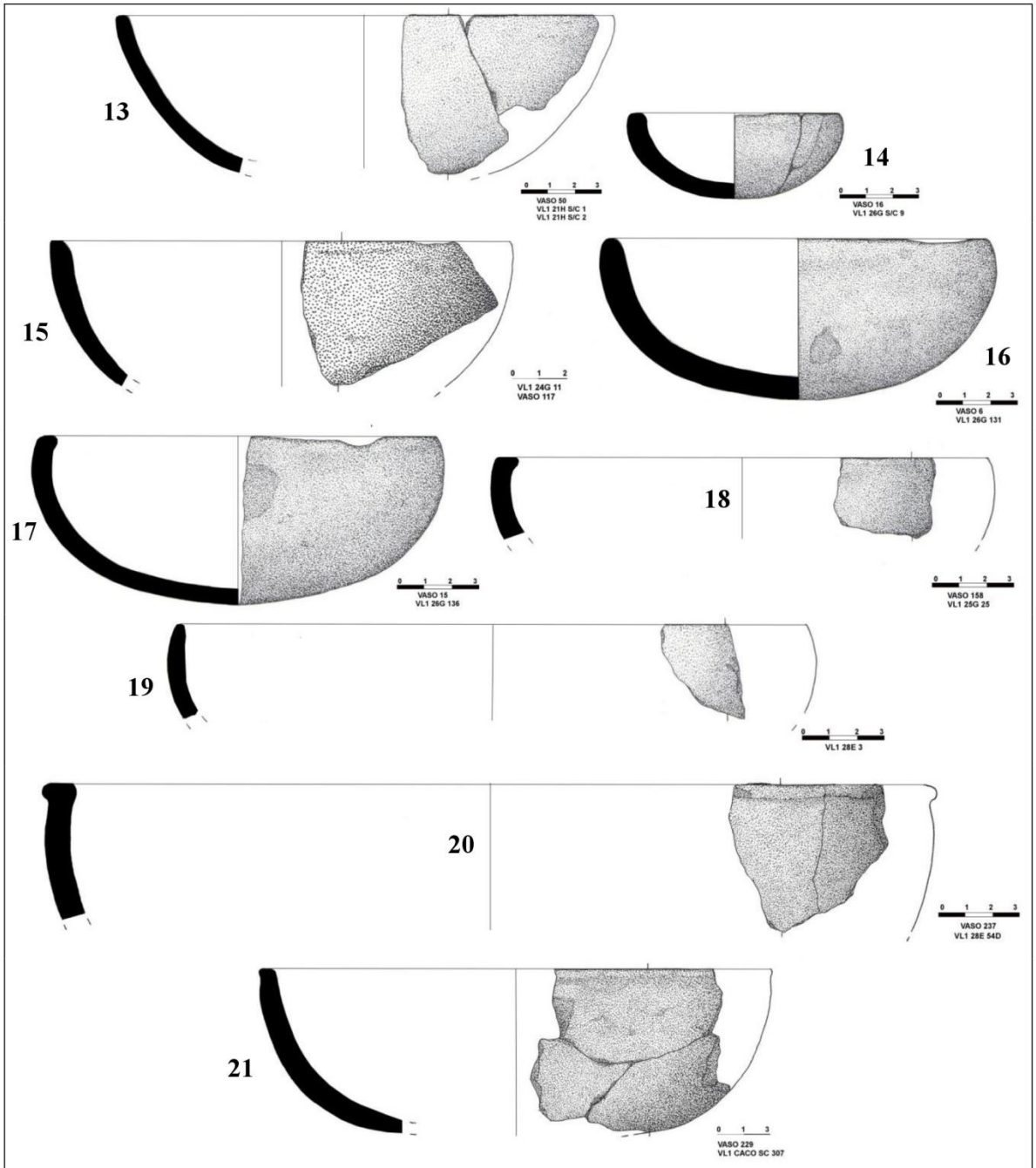
8
0 1 2 3
CDV G31 S/C 68

Figure A.5 Bowls from Anta 1, layer B

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VL1 21H S/C 1
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14
VASO 16
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15
VL1 24G 11
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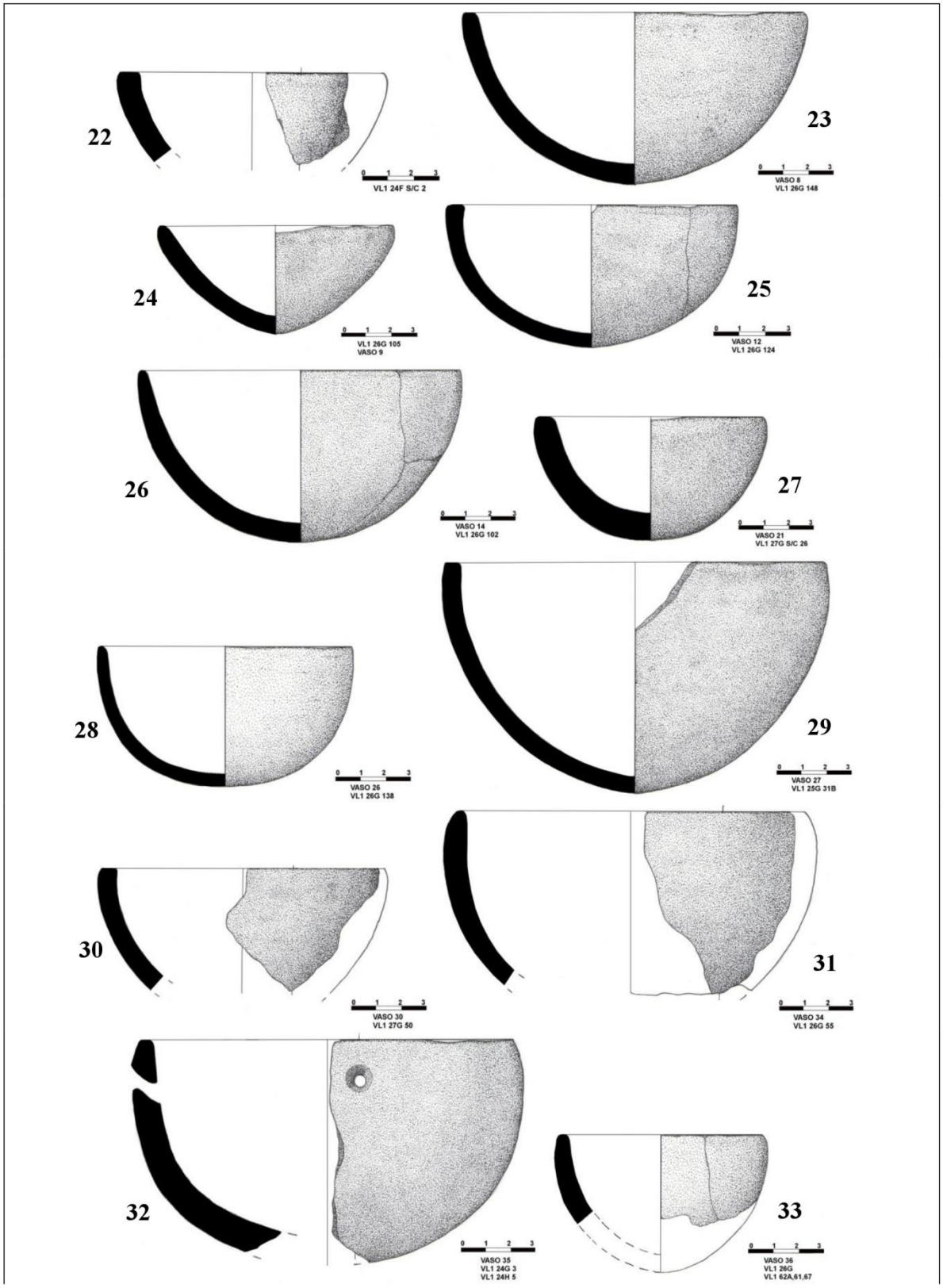
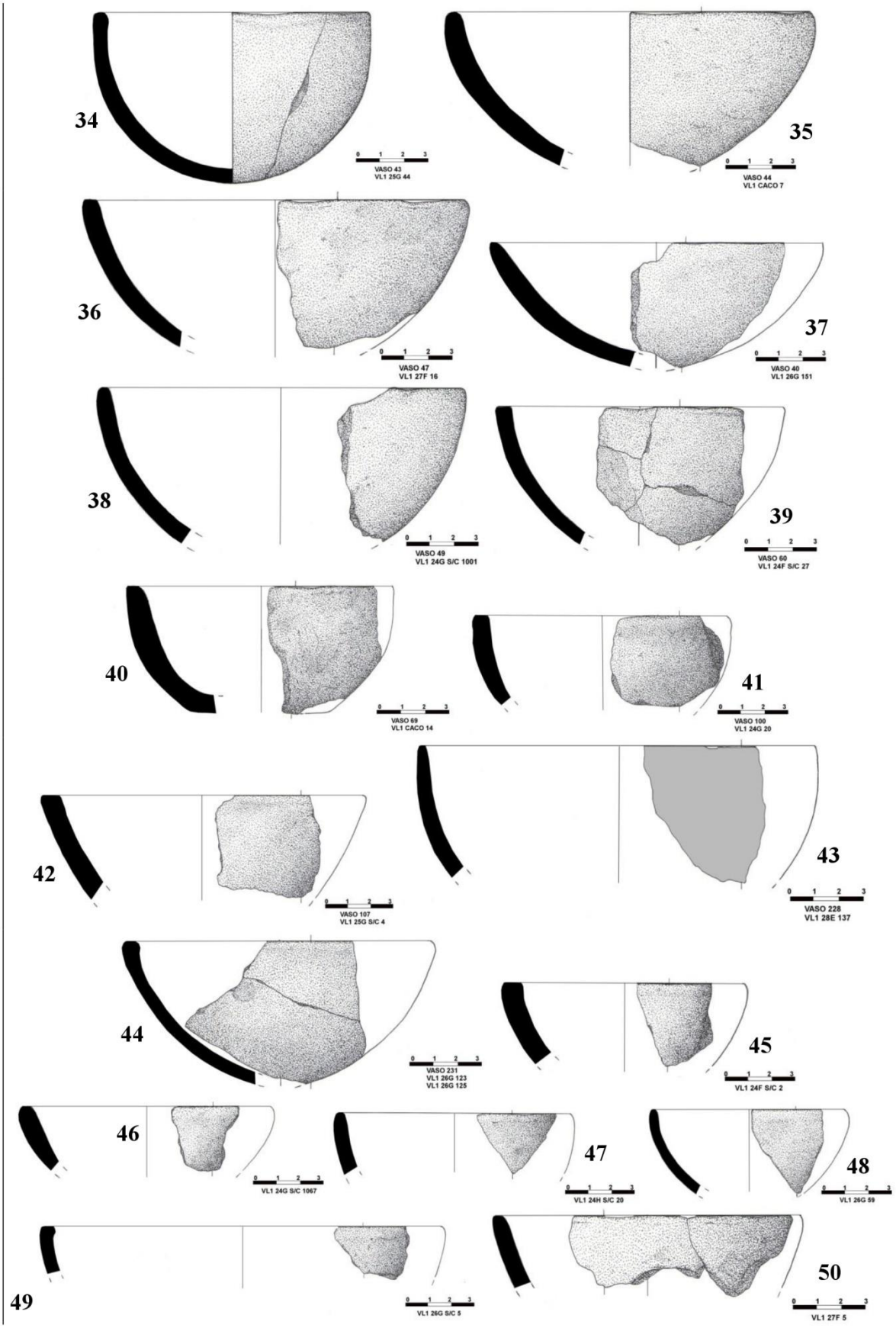
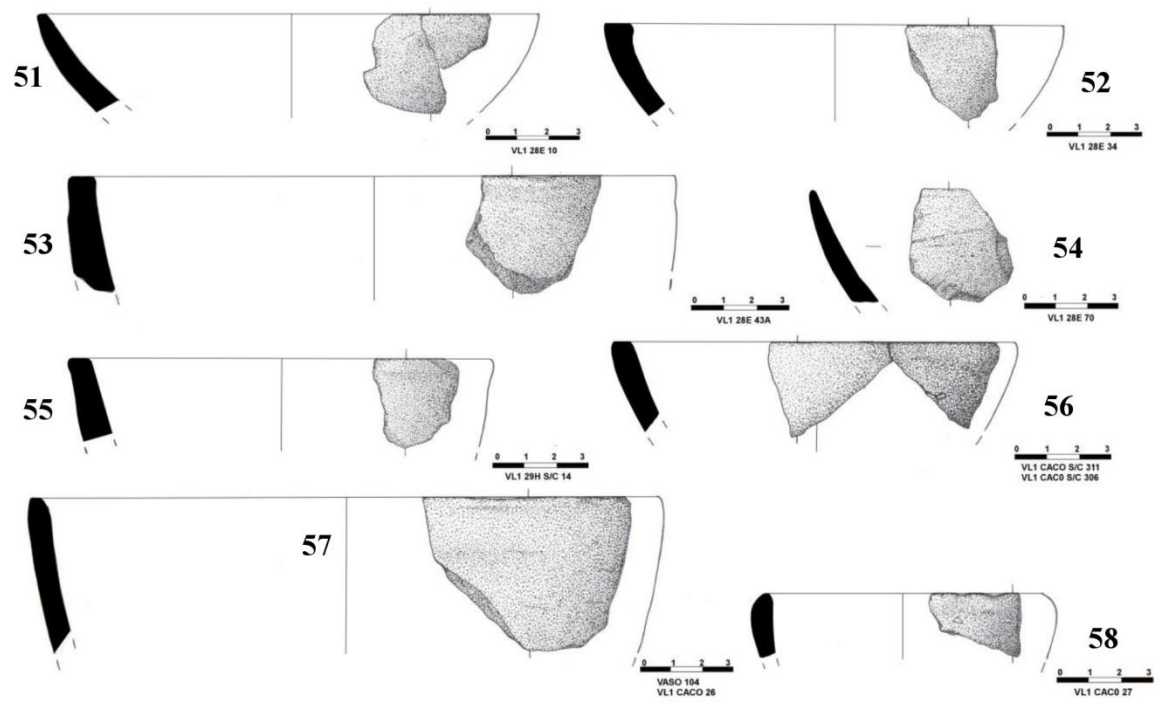
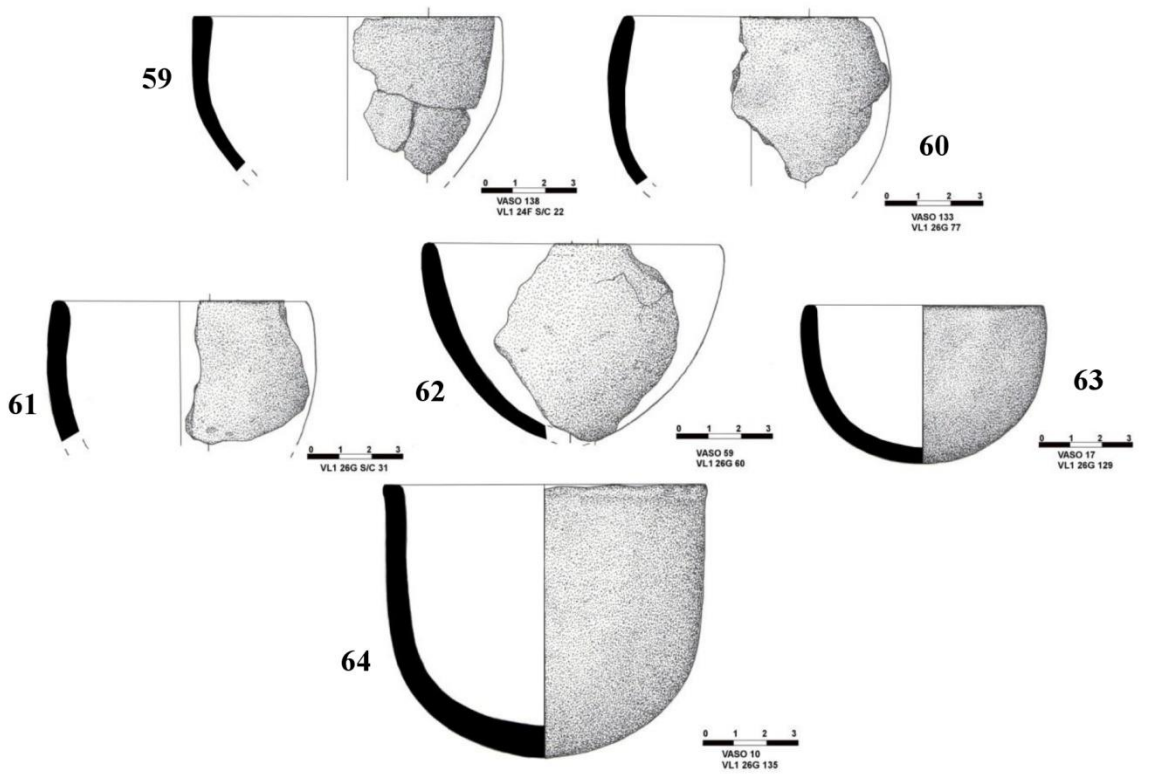
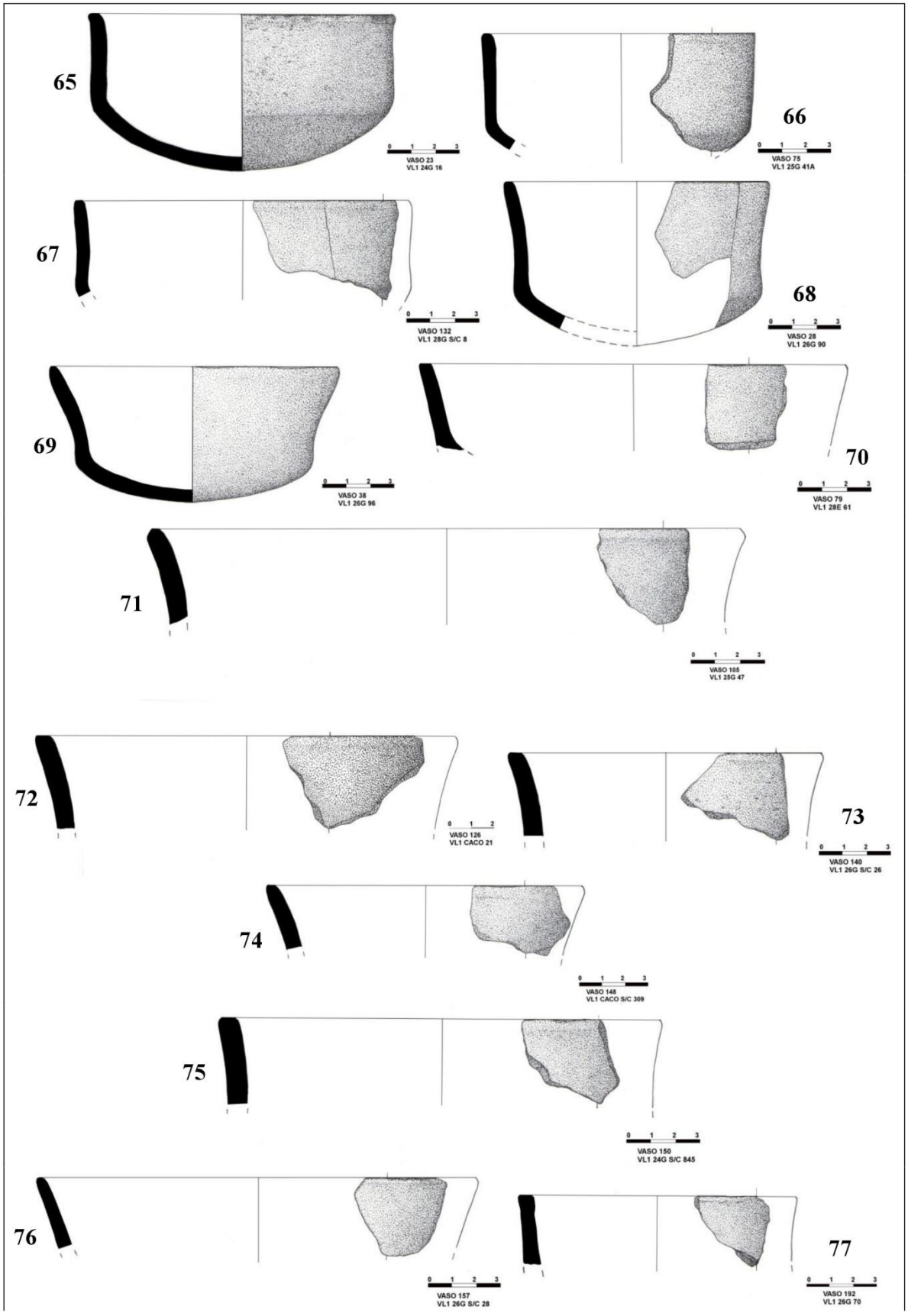
16
VASO 6
VL1 26G 131
17
VASO 15
VL1 26G 136
18
VASO 158
VL1 25G 25
19
VL1 28E 3
20
VASO 237
VL1 28E 54D
21
VASO 229
VL1 CACO SC 307

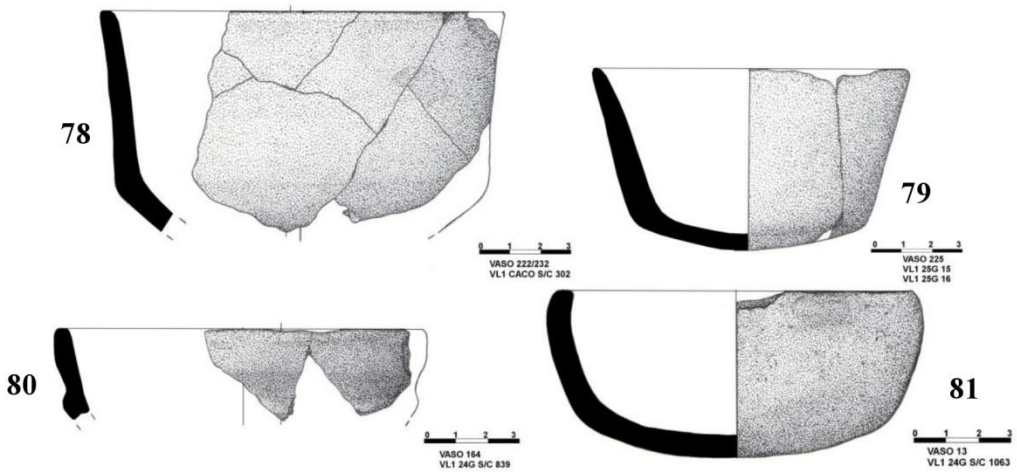

22
VL1 24F S/C 2
23
VASO 8
VL1 26G 148
24
VL1 26G 105
VASO 9
25
VASO 12
VL1 26G 124
26
VASO 14
VL1 26G 102
27
VASO 21
VL1 27G S/C 26
28
VASO 26
VL1 26G 138
29
VASO 27
VL1 25G 31B
30
VASO 30
VL1 27G 50
31
VASO 34
VL1 26G 55
32
VASO 35
VL1 24G 3
VL1 24H 5
33
VASO 36
VL1 26G
VL1 62A,61,67

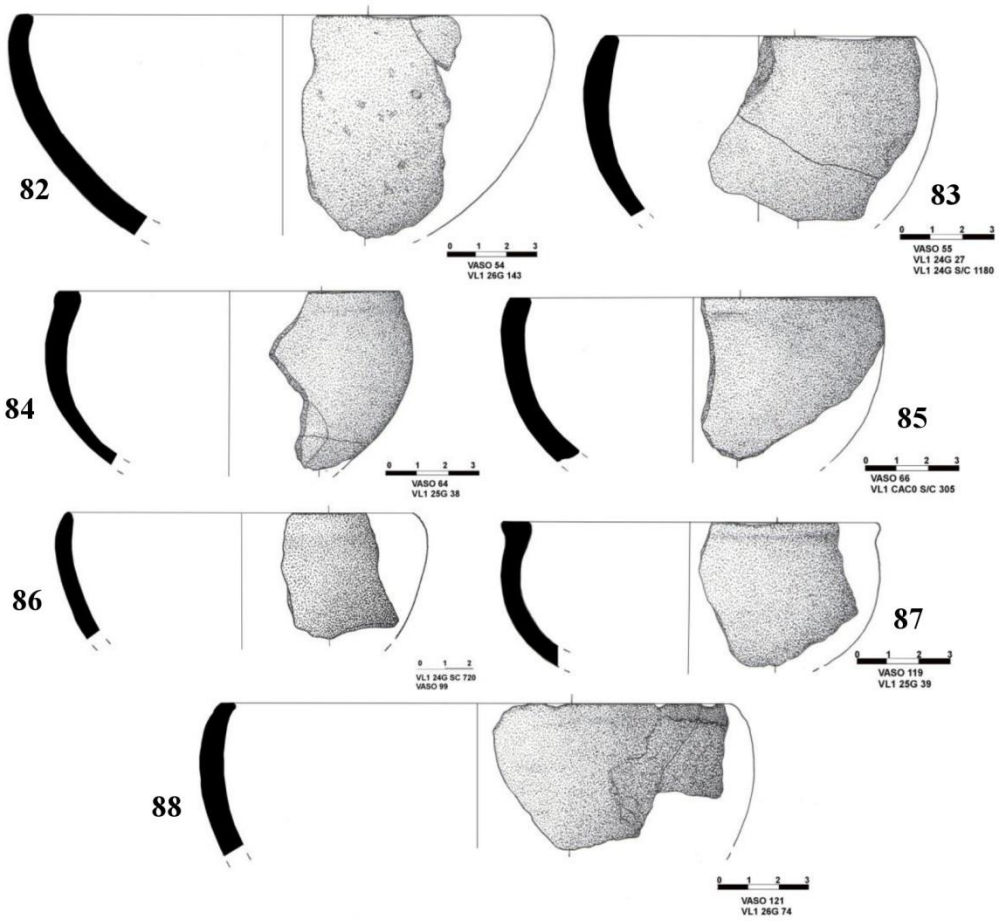

34
VASO 43
VL1 25G 44
35
VASO 44
VL1 CACO 7
36
VASO 47
VL1 27F 16
37
VASO 40
VL1 26G 151
38
VASO 49
VL1 24G S/C 1001
39
VASO 60
VL1 24F S/C 27
40
VASO 69
VL1 CACO 14
41
VASO 100
VL1 24G 20
42
VASO 107
VL1 25G S/C 4
43
VASO 228
VL1 28E 137
44
VASO 231
VL1 26G 123
VL1 26G 125
45
VL1 24F S/C 2
46
VL1 24G S/C 1067
47
VL1 24H S/C 20
48
VL1 26G 59
49
VL1 26G S/C 5
50
VL1 27F 5


51
VL1 28E 10
52
VL1 28E 34
53
VL1 28E 43A
54
VL1 28E 70
55
VL1 29H S/C 14
56
VL1 CACO S/C 311
VL1 CAC0 S/C 306
57
VASO 104
VL1 CACO 26
58
VL1 CAC0 27


59
VASO 138
VL1 24F S/C 22
60
VASO 133
VL1 26G 77
61
VL1 26G S/C 31
62
VASO 59
VL1 26G 60
63
VASO 17
VL1 26G 129
64
VASO 10
VL1 26G 135


65
0 1 2 3
VASO 23
VL1 24G 16
66
0 1 2 3
VASO 75
VL1 25G 41A
67
0 1 2 3
VASO 132
VL1 28G S/C 8
68
0 1 2 3
VASO 28
VL1 26G 90
69
0 1 2 3
VASO 38
VL1 26G 96
70
0 1 2 3
VASO 79
VL1 28E 61
71
0 1 2 3
VASO 105
VL1 25G 47
72
0 1 2
VASO 126
VL1 CACO 21
73
0 1 2 3
VASO 140
VL1 26G S/C 26
74
0 1 2 3
VASO 148
VL1 CACO S/C 309
75
0 1 2 3
VASO 150
VL1 24G S/C 845
76
0 1 2 3
VASO 157
VL1 26G S/C 28
77
0 1 2 3
VASO 192
VL1 26G 70


78
VASO 222/232
VL1 CACO S/C 302
79
VASO 225
VL1 25G 15
VL1 25G 16
80
VASO 164
VL1 24G S/C 839
81
VASO 13
VL1 24G S/C 1063


82
VASO 54
VL1 26G 143
83
VASO 55
VL1 24G 27
VL1 24G S/C 1180
84
VASO 64
VL1 25G 38
85
VASO 66
VL1 CAC0 S/C 305
86
VL1 24G SC 720
VASO 99
87
VASO 119
VL1 25G 39
88
VASO 121
VL1 26G 74

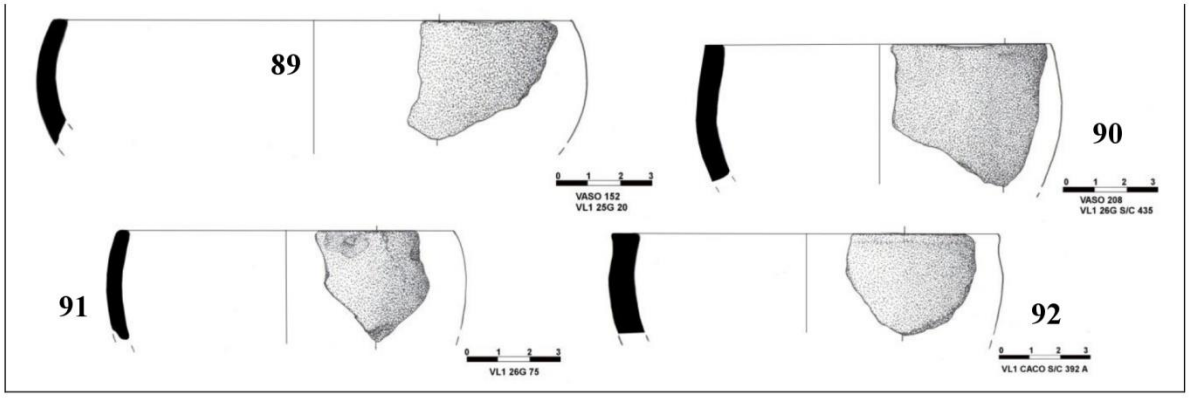

89
0 1 2 3
VASO 152
VL1 25G 20
90
0 1 2 3
VASO 208
VL1 26G S/C 435
91
0 1 2 3
VL1 26G 75
92
0 1 2 3
VL1 CACO S/C 392 A

Figure A.6 Bowls from Anta 1, layer C

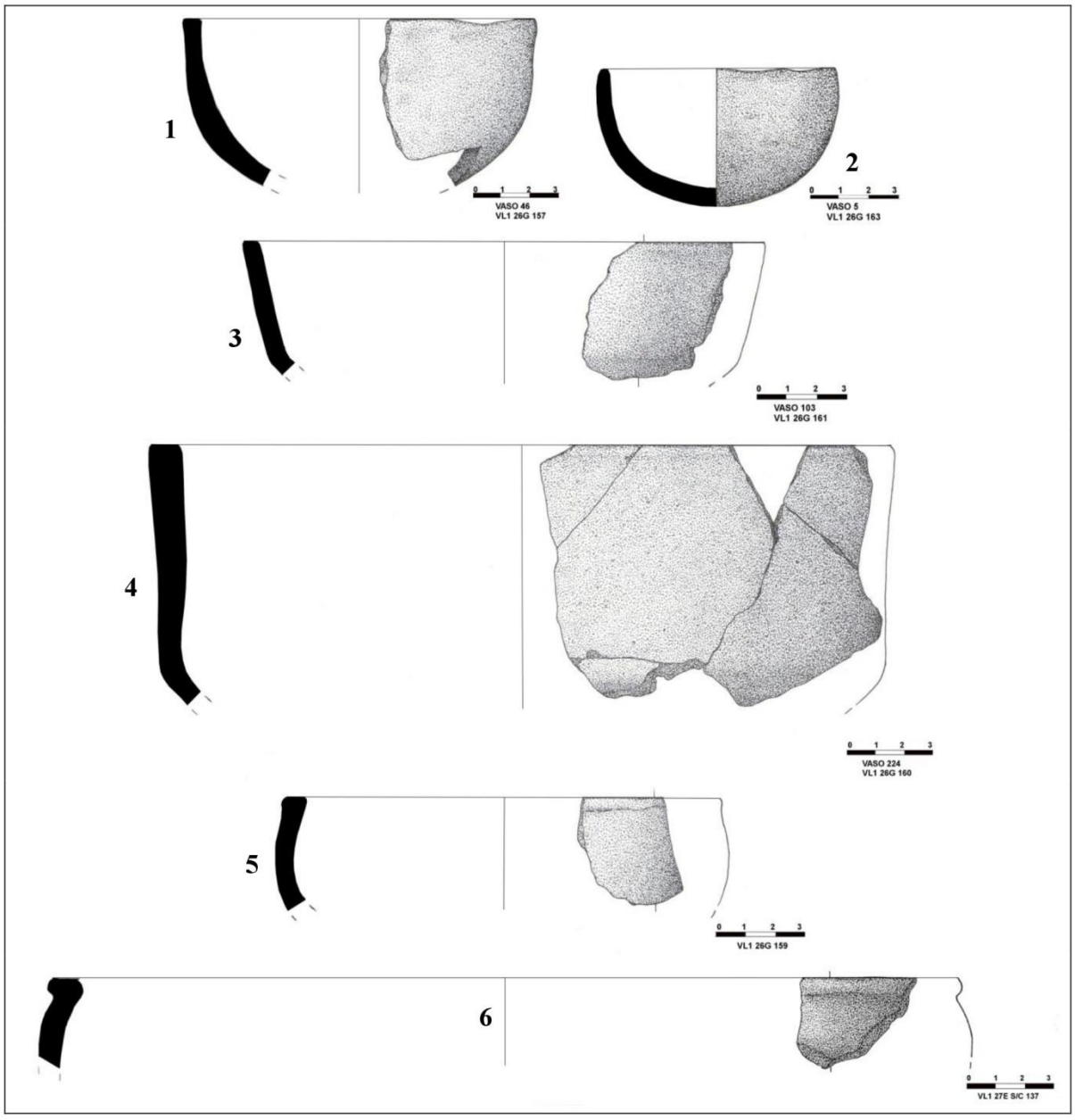
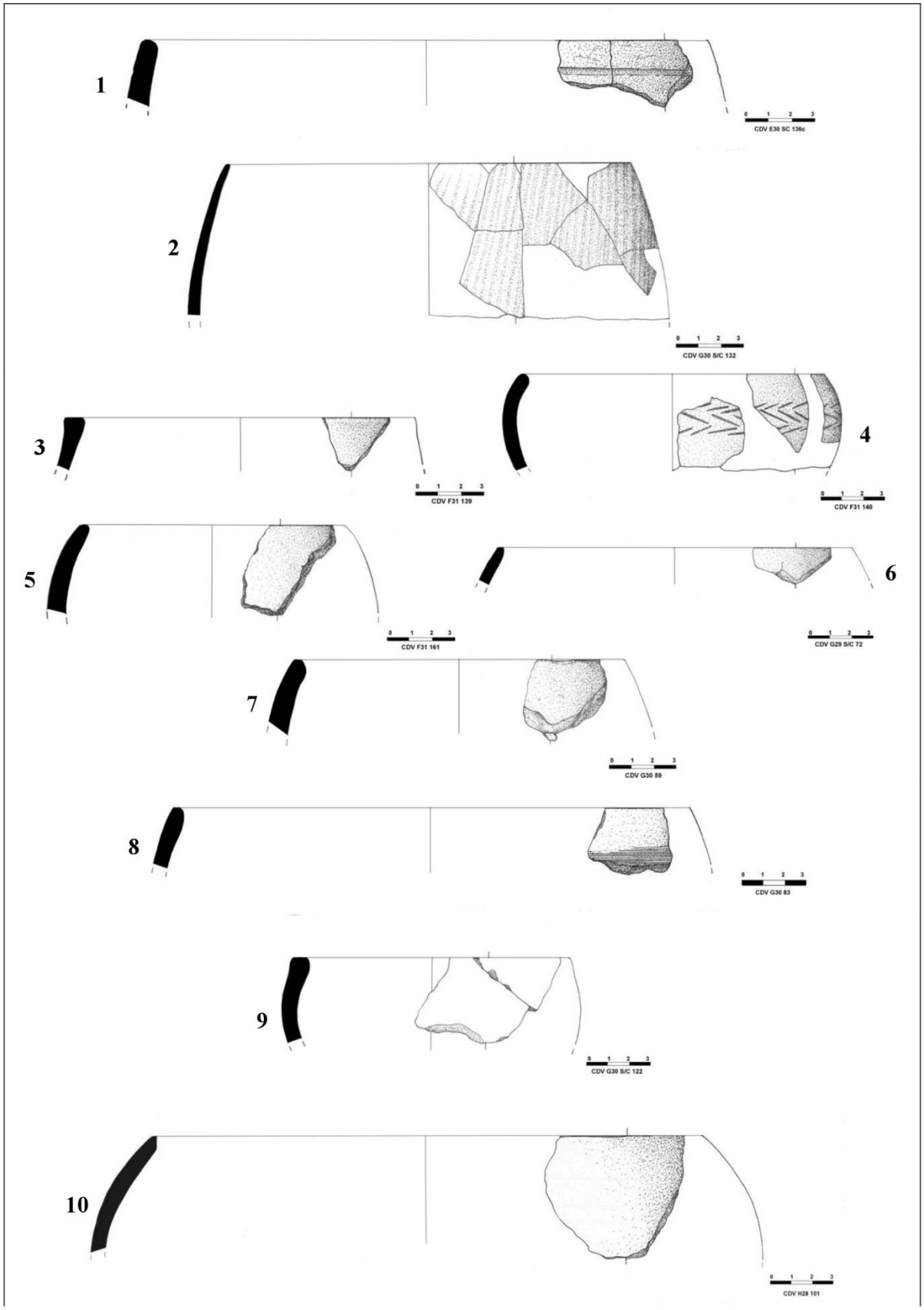
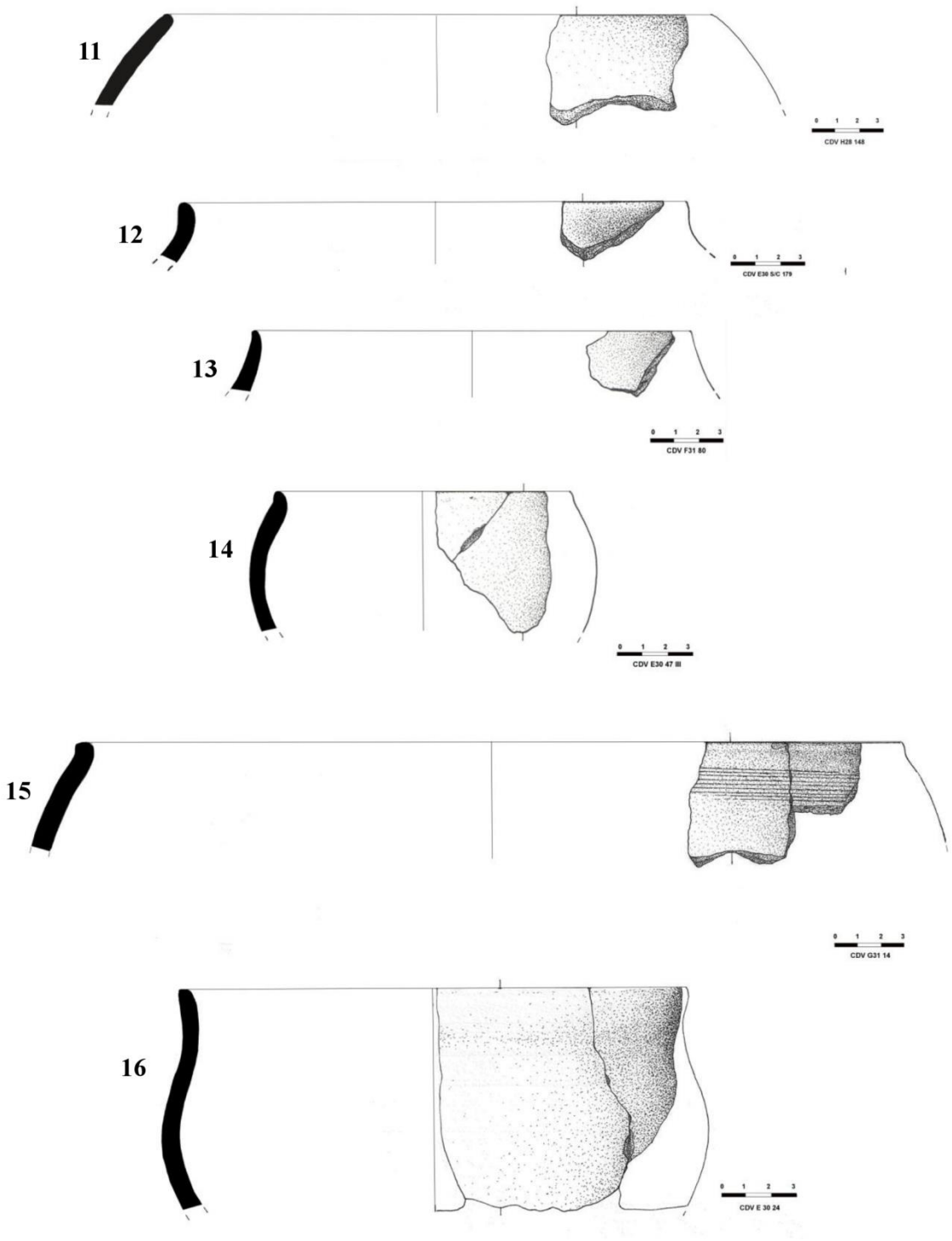


Figure A.7 Pots from Cadaval, layer C




11
0 1 2 3
CDV H28 148
12
0 1 2 3
CDV E30 S/C 179
13
0 1 2 3
CDV F31 80
14
0 1 2 3
CDV E30 47 III
15
0 1 2 3
CDV G31 14
16
0 1 2 3
CDV E 30 24

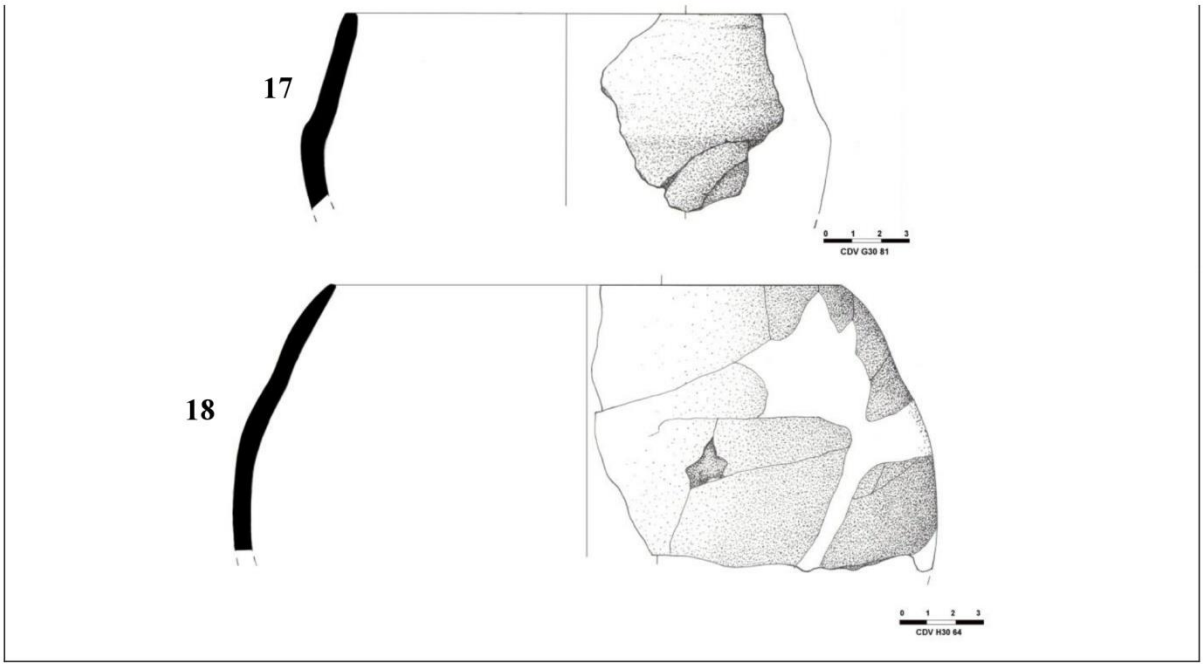
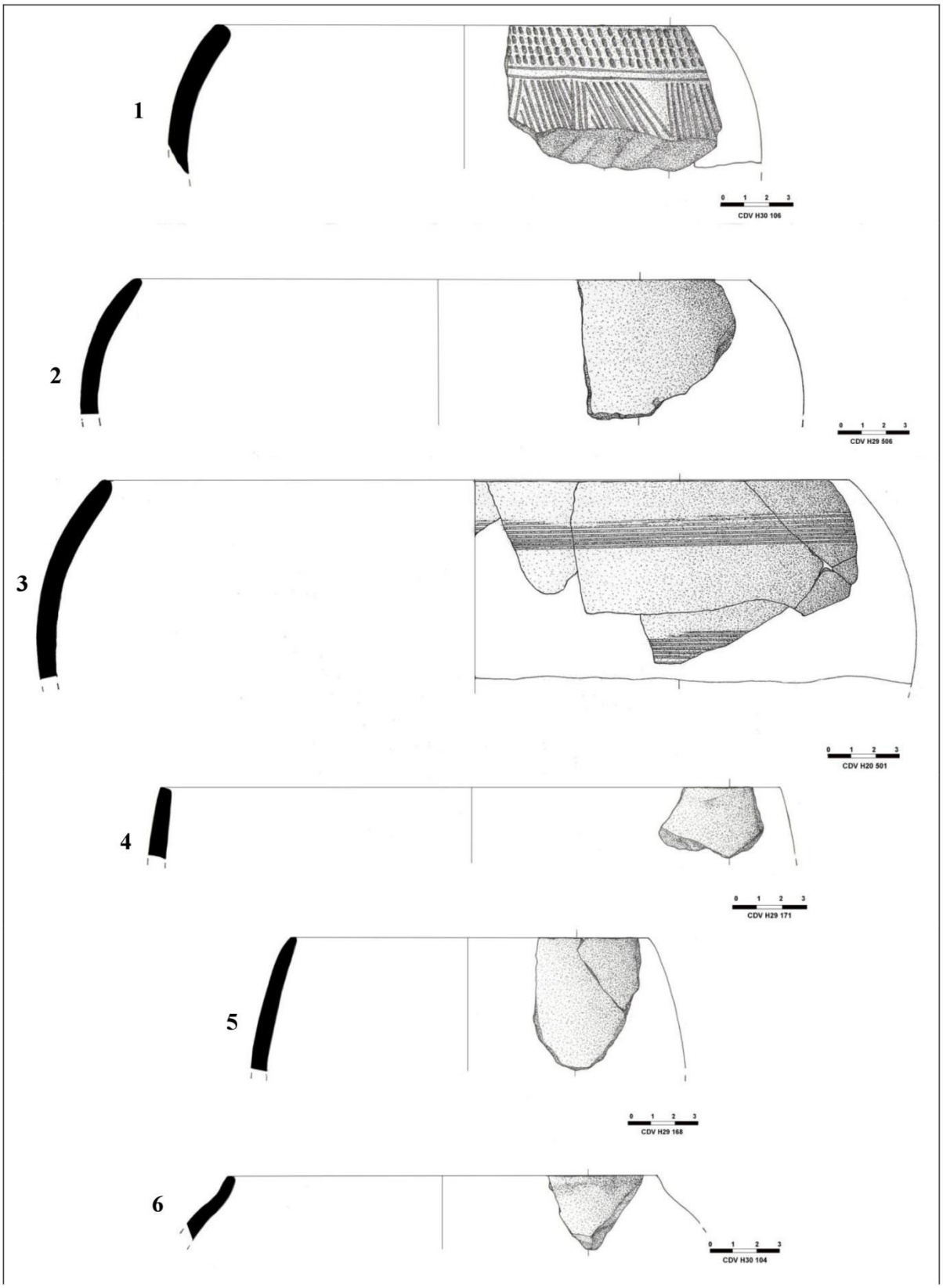

17
0 1 2 3
CDV G30 81
18
0 1 2 3
CDV H30 64

Figure A.8 Pots from Cadaval, layer D



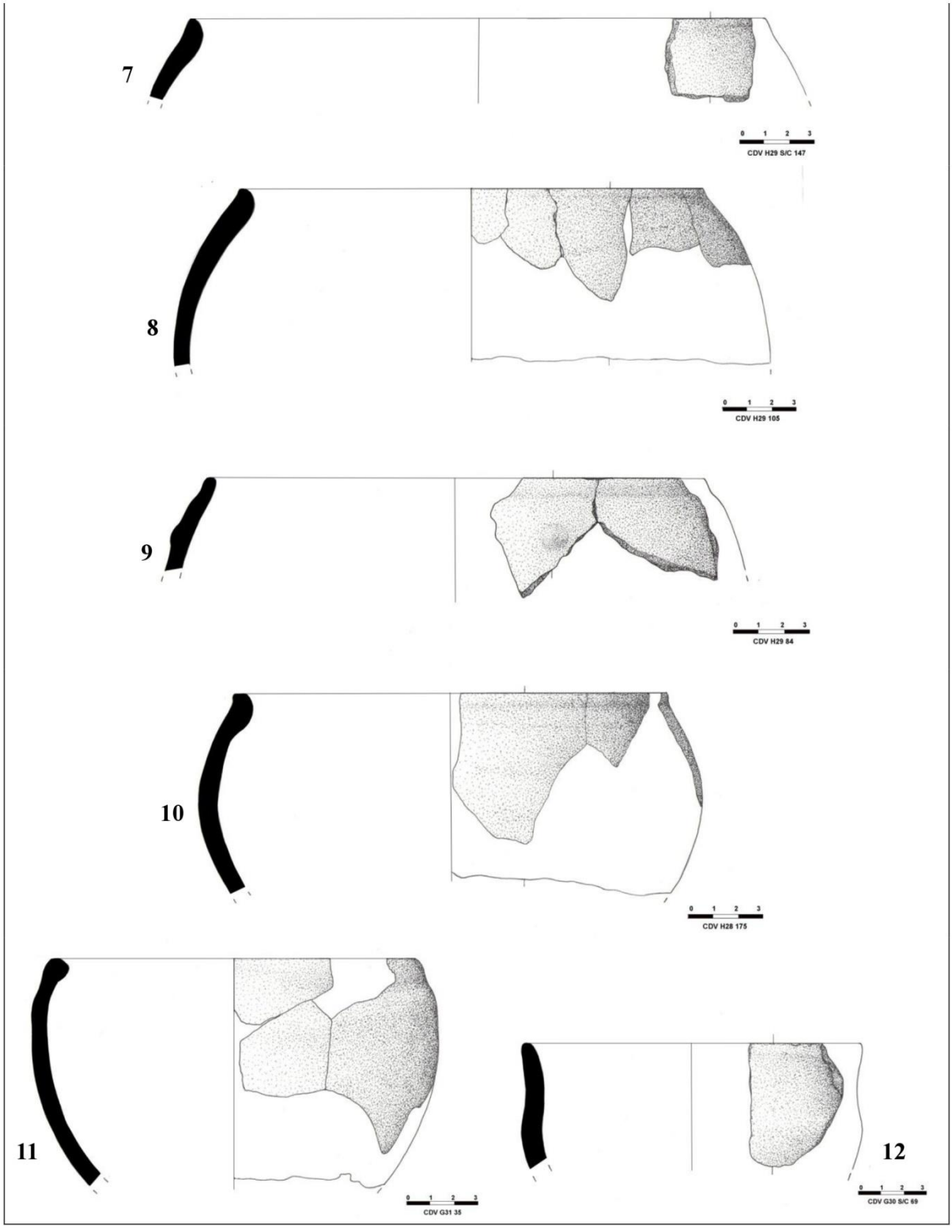
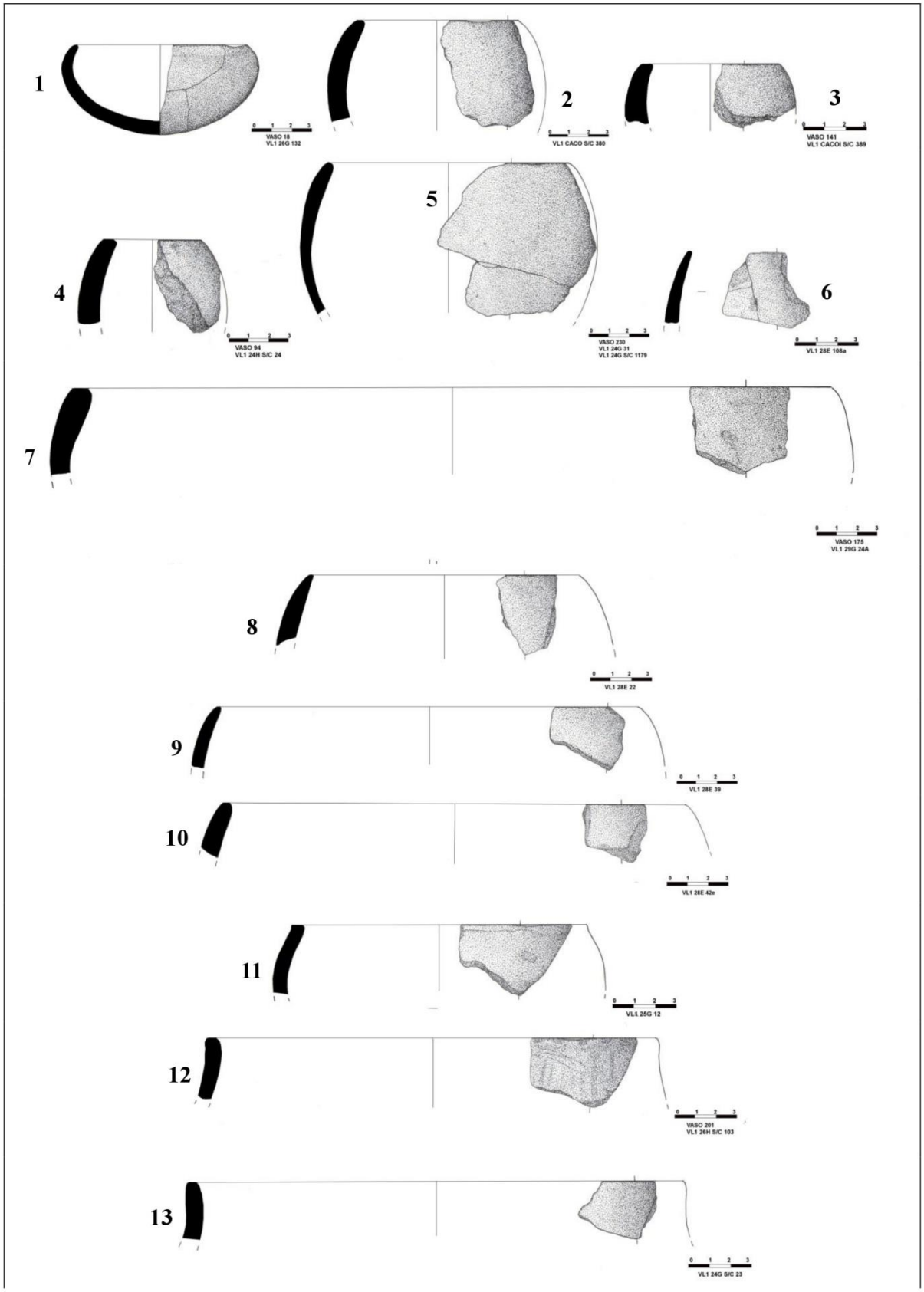

7
0 1 2 3
CDV H29 S/C 147
8
0 1 2 3
CDV H29 105
9
0 1 2 3
CDV H29 84
10
0 1 2 3
CDV H28 175
11
0 1 2 3
CDV G31 35
12
0 1 2 3
CDV G30 S/C 69

Figure A.9 Pots from Anta 1, layer B



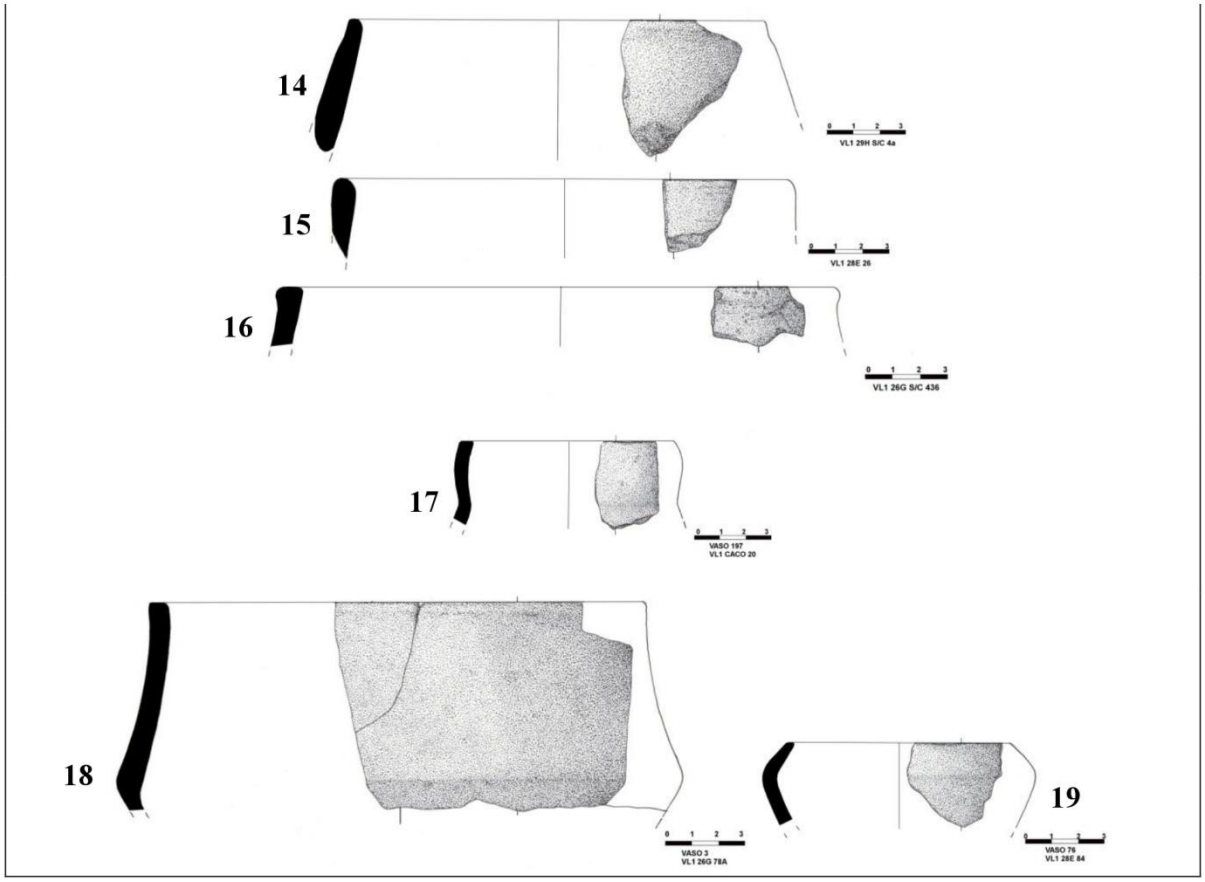

14
VL1 29H S/C 4a
15
VL1 28E 26
16
VL1 26G S/C 436
17
VASO 197
VL1 CACO 20
18
VASO 3
VL1 26G 78A
19
VASO 76
VL1 28E 84

Figure A.10 Jars from Cadaval, layer C (1, 2, 3 and 4) and D (5)

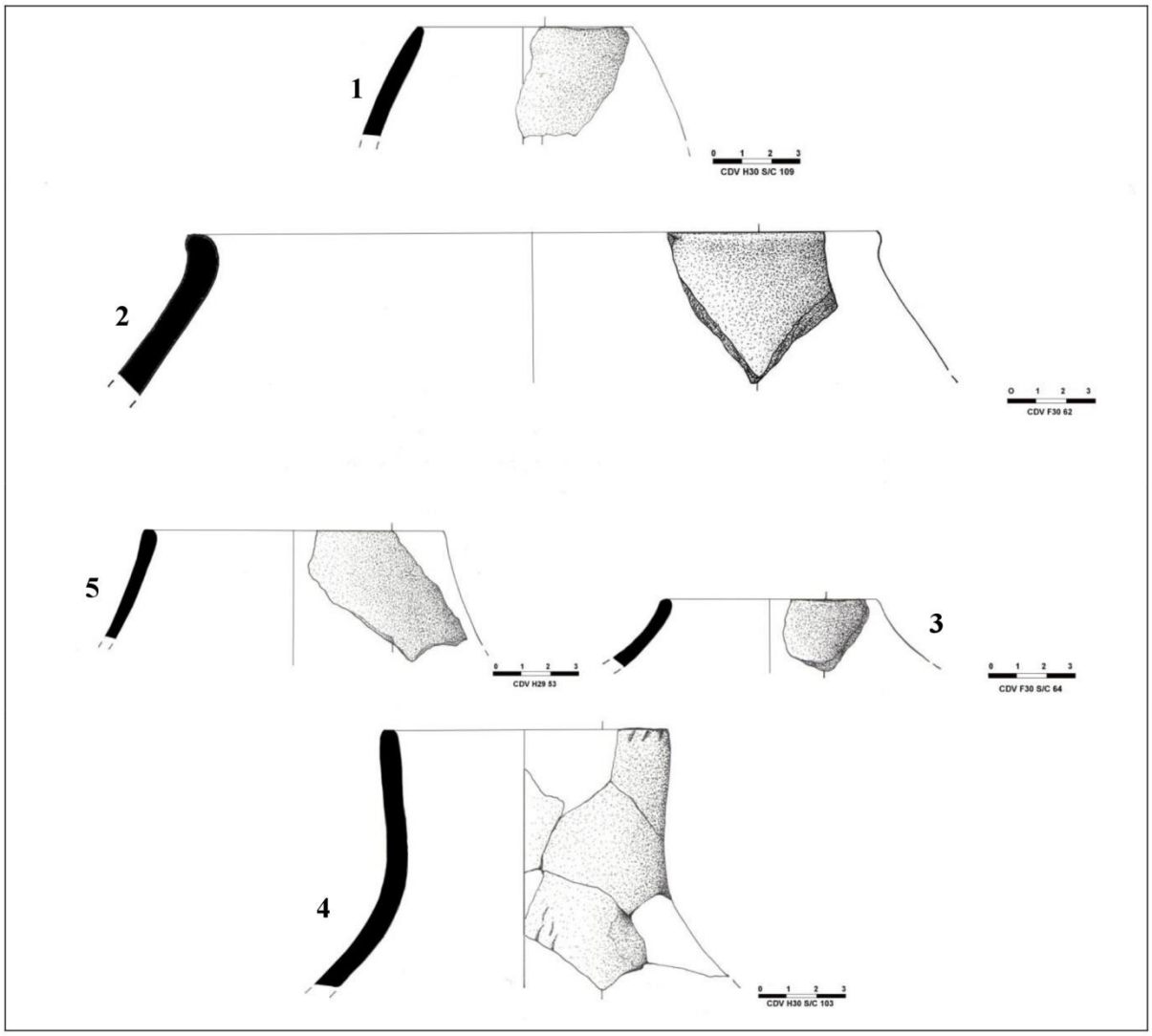


Figure A.11 Identified shapes from Postes: cups (1 and 2) and a constricted bowl (3) from Area 1 (Neolithic); hemispheric bowls (4 and 5), cup (6) and a constricted bowl (7) from Hueco Eulogio 3 (Chalcolithic); big necked pot (8) from Hueco Eulogio 2 (Bronze Age)