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Salt in the 4th and 3rd Millennia BC in Portugal: specialization, distribution, and consumption.

La sal en el 4º y 3º milenio AC en Portugal: especialización, distribución y consumo

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Abstract

The available information regarding salt production in the Neolithic and Chalcolithic in Portugal is presented, which in all documented cases correspond to a production through ignition and *briquetage* method. Based on that empirical data, intensive and specialized productions for exchange are identified and problems of demand, circulation and consume of salt are debated. The littoral production is related to a growing demand in the interior areas of the middle Guadiana and eastern Sado basin and its collapse in the first half of the 3rd millennium is interpreted as a possible shift in the supply areas, associated to the emergence of production centres in more interior areas of Iberia.

Key words: Salt; Late Neolithic; Chalcolithic; Interaction; Specialization; Portugal

Resumen

Se presenta la información disponible para la producción de sal en el Neolítico y Calcolítico en Portugal, que en todos los casos documentados corresponde a una producción por ignición y *briquetage*. Considerando los dados empíricos, se identifica una producción intensiva y especializada para intercambio y se debate problemas de demanda, circulación y consumo de la sal. La producción litoral es relacionada con la creciente demanda en áreas interiores de las cuencas del Guadiana y del Sado y su colapso es interpretado como un posible cambio en las áreas de aprovisionamiento, asociado a la emergencia de los centros productores en el interior ibérico.

Palabras clave: Sal; Neolítico Final; Calcolítico; Interacción; Especialización; Portugal

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1. Introduction

Contrasting with continental Europe, the research of salt production and distribution in Iberian Recent Prehistory is a late issue that has its pioneering works in La Marismilla, in the estuary of the Guadalquivir River (Escacena and Rodríguez de Zulaga, 1988; Escacena, 1994; Escacena *et al*, 1996), and in the site of Santioste, in Zamora (Delibes de Castro *et al.*, 1998). In Portugal, the first approaches to the subject occurred in the beginning of the present century, when some more explicit empirical evidences of salt production were discovered in the Tagus lower basin and in the coast of Algarve (Soares, 2000; 2001; Rocha and Barros, 1999/2000; Rocha, 2004; Valera *et al.* 2005; 2006). However, the research is still based on a small number of sites for which the salt production is empirically well supported and specific research programs to approach the exploitation, distribution, and consumption of this product, indispensable for economies dependent on agriculture and husbandry, have not yet been developed. Nevertheless, the available information allows some preliminary interpretation of the social, economic, and symbolic role of salt during the 4th and first half of the 3rd millennia BC in the Central/South Portugal (the part of the country where the known sites are located - Fig. 1), but also including the interior areas where a significant part of the production might have been consumed.

2. The available data

2.1. Monte da Quinta 2

Detected during the construction of a highway, the site belongs to the municipality of Benavente and is in a Tagus terrace partially covered by superficial sand. It is a flat area in the left bank of the Sorraia River (a tributary of the Tagus left bank), slightly sloping to the valley and bordered by two lateral streams that drain to that river (Fig.1A) (Valera *et al.*, 2005; 2006).

The geomorphological history of the Tagus basin is essential to interpret the location and the contexts of Monte da Quinta 2. The place is coincident with the maximum extension of the Flandrian transgression that formed a long interior estuary, with the penetration of salty waters as far as Santarém. As for the Sorraia River, the salty waters would have almost reached the area of Coruche (Daveau, 1980; Daveau and Gonçalves, 1985). These salty river waters would reach the site where, Monte da Quinta 2 was set (Fig. 1).

The site, with an excavated area of 482 m^2, revealed a context of intensive salt production through the method of ignition and *briquetage* (for the definition see Gouletquer and Daire, 1994). Thirty-two bulks formed by thousands of very thin pottery sherds were identified (Fig. 2, 3), presenting diversified shapes (circular, elongated, irregular) and dimensions, sometimes overlapping and crossing each other. The great majority of the

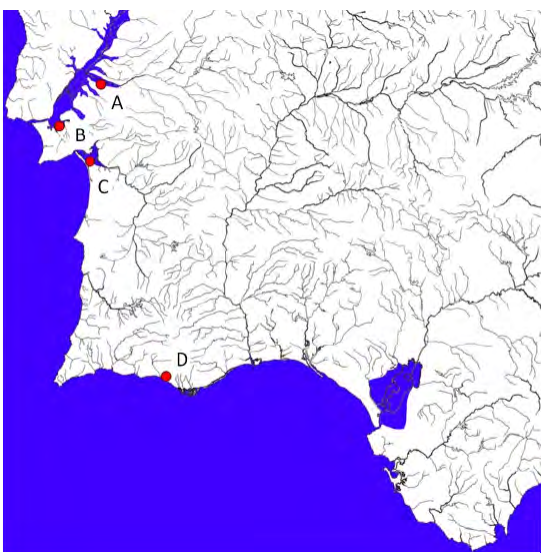

Figure 1. Location of the Portuguese Prehistoric sites with evidences indicating or suggesting salt production. A. Monte da Quinta 2; B. Ponta da Passadeira; C. Assemblage of sites from Comporta; D. Praia do Forte Novo.

Figura 1. Localización de los sitios prehistóricos portugueses con evidencias de producción de sal. A. Monte da Quinta 2; B. Ponta da Passadeira; C. Conjunto de sitios da Comporta; D. Praia do Forte Novo.

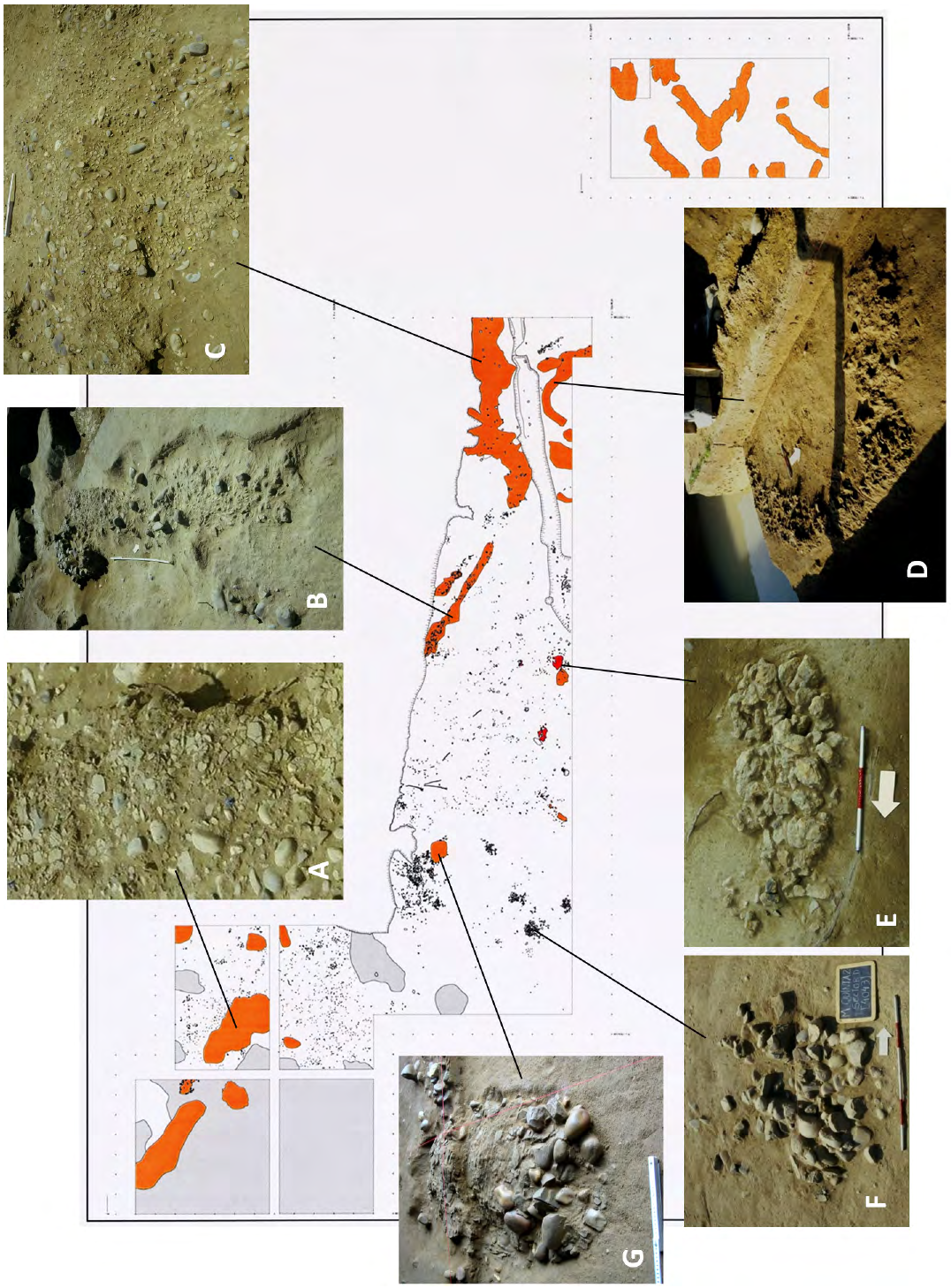

Figure 2. Excavated area in Monte da Quinta 2 with example of the recorded structures. A-D. *Briquetage* bulks; E. Clay fire structure; F. Fireplace of pebbles; G. Structure for mold production.

Figura 2. Área excavada en Monte da Quinta 2 con ejemplo de las estructuras registradas. A-D. Escombreras de Briquetage*; E. Estructuras de combustión en arcilla; F. Estructuras de combustión de cantos; G. Estructuras de producción de moldes.*

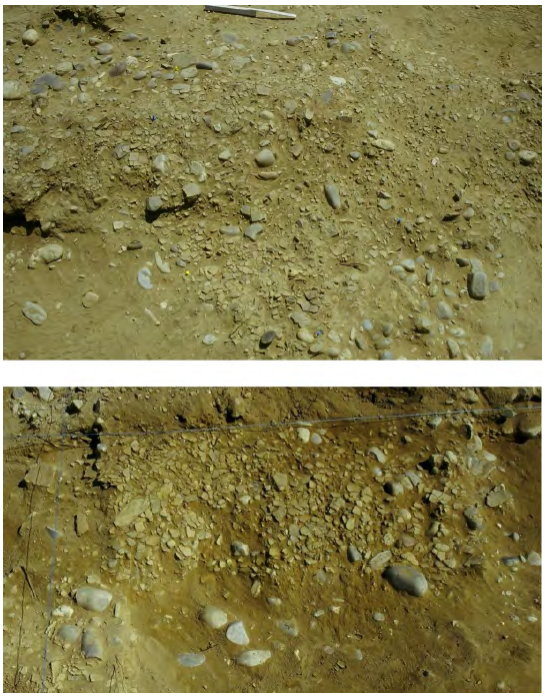

Figure 3. Monte da Quinta 2.
Examples of *briquetage* bulks.

Figura 3. Monte da Quinta 2.
Ejemplos de escombreras de briquetage.

sherds correspond to small pots with a conic profile, thin walls (2-3 cm) and pastes with few degreasing elements, roughly shaped by the outside (Fig. 4C, D). They were made using an internal conical mold, generating a high degree of patterning in shapes and sizes. In the bulks, several thousand sherds were recorded totalizing a global weight of 505 kg. An ellipsoidal pit filled with pebbles in the base and two layers of embedded thin conical pots was identified, that corresponded to a cooking structure for these ceramics at low temperatures. They were used to receive the brine and to be broken after the brine turned into crystalized salt loaves (Fig. 4A, B). The bulks also contained tools made of knapped river pebbles (Fig. 4E), fragments of ceramic brackets (Fig. 5F) and fragments of other pottery shapes, namely large bowls used to obtain the brine (Fig. 5G).

An archaeometric approach, through X-Ray Diffraction, X-Ray Fluorescence, and Neutron Activation was performed in the conical pots, bowls, ceramic brackets, and local clays (Valera *et al*., 2006). The results showed a significant similarity in the mineralogical compositions of all the analysed materials and raw materials, though the conical molds show a concern with clay decantation to obtain thinner pastes for thinner recipients, making the *briquetage* process easier. This study also showed that high temperatures were not achieved in the production of the conical molds (<500ºC), while the other pottery presents evidence of slightly higher temperatures and absence of decantation. Therefore, the production of pottery used local clays, but presents two different procedures related to the intended use of the pots: the ones planned to be used in the last stage of the salt production process, not only have shapes adapted to the function, but are also produced in a manner (decantation of clays, thin walls, low cooking temperatures) that would have made them less resistant and easier to break; and the larger bowls, with higher cooking temperatures and less concern with clay decantation, used to obtain the brine.

In an area between the bulks several combustion structures were recorded (Fig. 5B-E). They are of two types: assemblages of pebbles with termoclasts, pottery fragments and burned ceramic brackets, and structures of burned clay. Both type of structures could be related to the process of evaporation of both phases of the ignition method (to obtain brine and after to obtain the salt loaves).

Apart from the ceramics and the knapped stone industry (possibly used for the *briquetage* process, as it also seems to have happened at Espartinas-Valiente Cánovas and Ramos, 2009), some loom weights and polished stones tools with intense marks of use were also documented, the latter possibly related to the acquisition of wood for the fires (no organic material was recorded, mainly due to the nature of the local soils).

Globally, the excavated part of the site corresponds to an intensive salt production

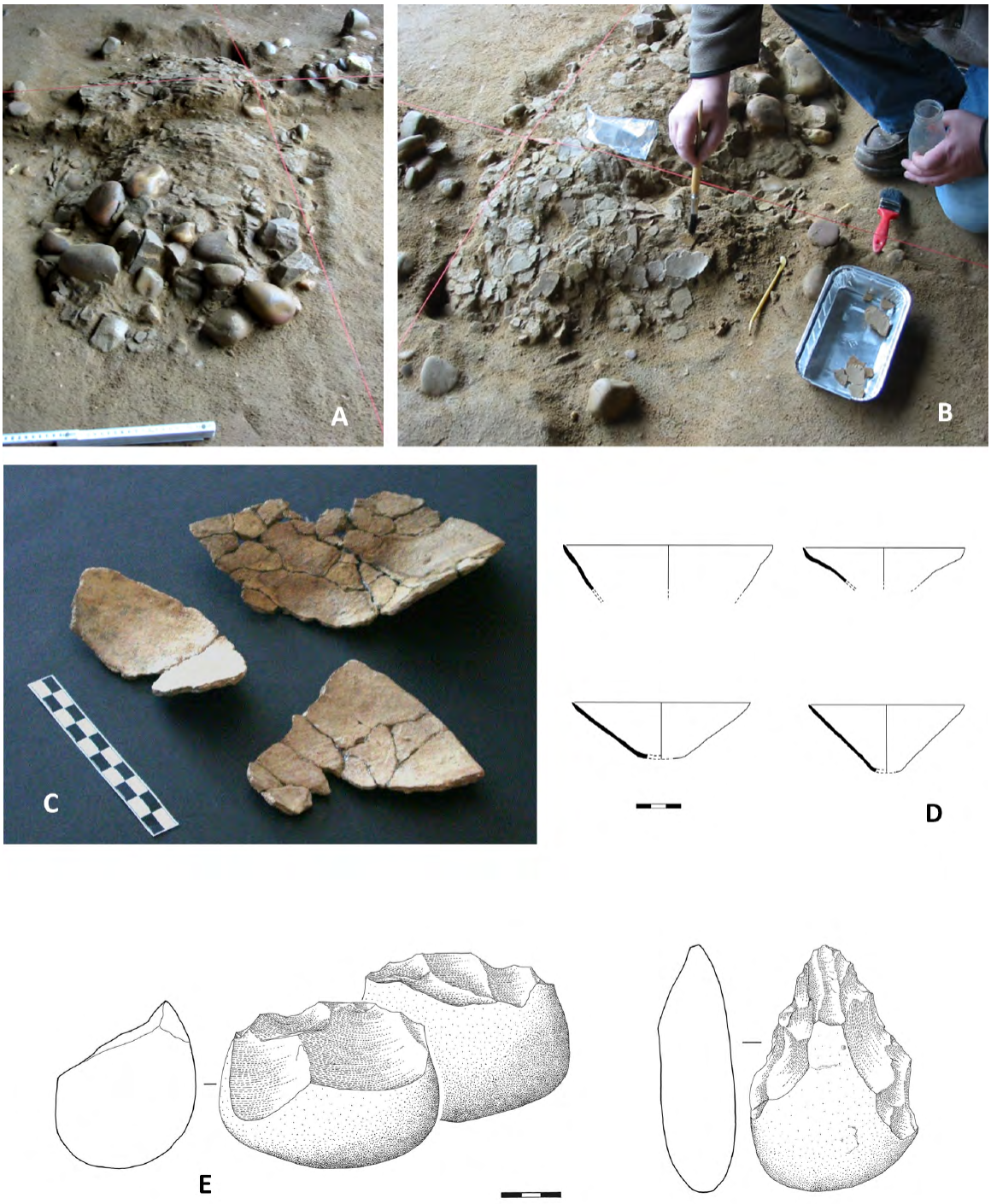

Figure 4. Monte da Quinta 2. A, B. Structure from producing the molds. C. Reassembly of fragments from the production structure, allowing the determination of shapes. D. Mold shapes. E. Examples of knapped pebbles possibly used in the fragmentation and scraping of the molds to extract the salt loaves.

Figura 4. Monte da Quinta 2. A, B. Estructura para producir moldes. C. Remontaje de fragmentos de la estructura de producción permitiendo la determinación de formas; D. Moldes; E. Ejemplos de cantos trabajados posiblemente utilizados en la fragmentación de moldes para extraer los panes de sal.

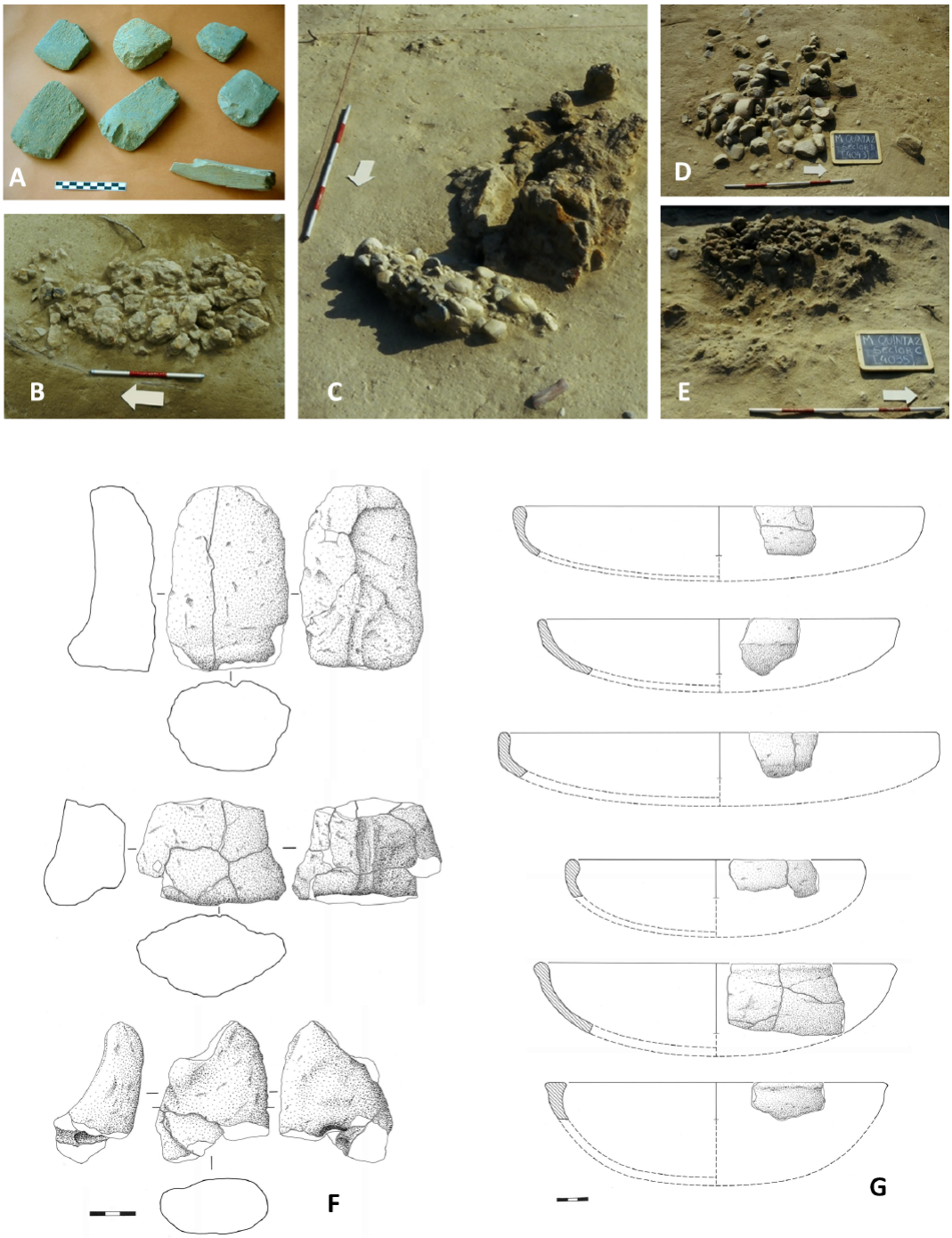

Figure 5. Monte da Quinta 2. A. Polished stone tools with intense marks of use (possibly used to collect wood for fire structures); B-E. Fire structures of pebbles and clay; F. Clay brackets to support the pottery during the evaporation process; G. Bowls used in the initial phase of evaporation to produce the brine.

Figura 5. Monte da Quinta 2. A. Instrumentos de piedra pulida con intensas huellas de uso (posiblemente para recolectar madera para las estructuras de combustión); B-E. Estructuras de combustión de arcilla y de cantos; F. Soportes de arcilla para sostener las cerámicas en el proceso de evaporación; G. Cerámicas utilizadas en las fases iniciales de la evaporación para producir salmuera.

Table 1. Radiocarbon dates for contexts associated to salt production in Portugal.

Site	Context	Sample	Lab. Reference	Date BP	Cal 2σ	Bib. Refer.
P. Passadeira	Fase I C4	Charcoal	Beta-160055	4450±50	3339-2929	Soares, 2013
P. Passadeira	Fase I C4	Hu. Bone	OxA-6389	4305±70	3309-2673	Soares, 2013
P. Passadeira	Fase I C4	Shell	Beta-193895	4740±80	3296-2872	Soares, 2013
P. Passadeira	Fase I C4	Shell	Beta-126095	4750±70	3284-2885	Soares, 2013
P. Passadeira	Fase I C4/3	Shell	Beta-126094	4650±70	3165-2727	Soares, 2013
P. Passadeira	Fase I C4/3	Shell	Beta-139711	4640±70	3114-2692	Soares, 2013
P. Passadeira	Fase II C3	Shell	Beta-126092	4600±70	3063-2654	Soares, 2013
P. Passadeira	Fase II C3	Shell	Beta-139710	4560±70	2994-2603	Soares, 2013
P. Passadeira	Fase II C3	Shell	Beta-126093	4550±70	2969-2583	Soares, 2013
Barrosinha	Layer 4	Shell	Beta-221719*	5240± 50	3686-3383	Soares, Silva 2013
Barrosinha	Layer 4	Shell	CSIC-652	4720±50	3635-3373	Soares, Silva 2013
Barrosinha	Layer 2	Shell	Beta-221720*	5080±60	3600-3184	Soares, Silva 2013
Barrosinha	Layer 2	Shell	CSIC-649	4580±50	3510-3099	Soares, Silva 2013
Possanco	Layer C2b	Shell	Beta-221717*	4920±50	3346-2990	Soares, Silva 2013
Possanco	Layer C2b	Shell	Beta-221718*	4840±60	3288-2890	Soares, Silva 2013
Possanco	Layer C2a	Shell	CSIC-653	4270±50	3023-2680	Soares, Silva 2013
Forte Novo	Fireplace	Wood	Sac-1606	4150± 80	2911-2470	Rocha, 2013
Forte Novo	Fireplace	Wood	Sac-1637	4570± 90	3617-2927	Rocha, 2013
Forte Novo	Fireplace	Wood	Sac-1700	4430± 120	3496-3460	Rocha, 2013

Calibration curve IntCal09 radiocarbon Cal (Reimer *at al.,* 2009), program CALIB REV.6.1.0 (Stuiver and Reimer, 1993). For the shells was used the marine curve 09.14c (Reimer *et al.,* 2009) with ΔR=0 (*ΔR = 85±35 14C years).

Table 2: Estimated values for the production of salt in the excavated area of Monte da Quinta 2.

Measuring steps	Values
Average weight of a conical pot	0,125 Kg
Average volume of a conical pot	0,32 L (0,44 Kg)
Global weight of conical pot fragments from the 33 bulks	505 Kg
Estimated number of recipients	4040
Global volume of production estimated	1293 L (1784 Kg)

area through the method of ignition and *briquetage*: salty water was collected nearby, wormed in the large bowls over ceramic brackets in fire structures to obtain the brine. A significant amount of wood combustible had to be collected and prepared, justifying the polished stone tools with intense marks of use (Fig. 5A). Hereafter the brine would be poured into the conical thin pots that were then put over ceramic brackets in braziers or directly over heated pebble assemblages until the crystallization of the salt was complete. Finally, the conic pots would be broken (possibly using the knapped pebble tools) to remove the loaves of salt, creating the bulks of pottery shards and stone tools.

2.2. Ponta da Passadeira

The Ponta da Passadeira site is in a small peninsula of sandy soils in the left margin of the Tagus estuary (Fig. 1B), just in front of Lisbon (Barreiro municipality, district of Setúbal). Preserved evidences of a *Pinus* wood, already present before the occupation, and of a paleo mallard were detected and pollen studies indicate the presence of vegetation typical of salty and sandbank environments (Soares, 2013). Two phases of occupation were detected in an excavated area of 120 m^2, dating from the Late Neolithic and Early Chalcolithic (second half of the 4th / first half of the 3rd millennium BC). The first phase presented an intensive salt production while the second phase is interpreted as a period of retraction. The identified structures correspond to concentrations of clay ovens for pottery production, fireplaces for salt production through ignition and bulks of pottery sherds interpreted as the result of *briquetage* procedures (Fig. 6). The local *Pinus* trees would have provided the wood and the paleo mallard the clay for the ceramics and combustion structures. Amongst the pottery, bowls were dominant, predominantly associated to the fireplace areas, while large troncoconic shapes (volumes around 30l) were associated to the oven areas. This dichotomy was interpreted as a technological specificity (troncoconics to produce the brine and the bowls to produce the crystallization of salt) or as a sequential technological change (Soares, 2013).

A broad-spectrum economy was identified, characterized by a recollection of molluscs, fishing, husbandry (cattle and ovicaprids) and significant hunting, and scarce evidence for agriculture was presumed based in the presence of some few gridding stones and stone polished tools (those could also be related to wood exploitation). Therefore, the site is considered to represent an amphibious way of life, corresponding not to a specialized site, but to a settlement. The presence of a human bone integrated in an oven structure suggests the proximity to funerary structures. The place would have been occupied by a local community that explored local resources for local consume but also reveals an intensive and specialized production of salt for exchange at a regional scale (the exchange of some molluscs is also suggested). This economic regime, based in fishing, recollecting and hunting complemented by husbandry and eventual small agriculture was designated as agro-maritime, and considered proper of the estuarine ecosystems (Soares, 2013).

2.3. Comporta sites

In Comporta (Setúbal) several sites dating from the Neolithic and Early Chalcolithic are known bordering the south limits of the Sado river estuary (Fig. 1C). At the time of their occupation the environment was quite different. Tróia peninsula was not yet formed and the area was more exposed to the ocean (Silva *et al.* 1986).

These sites present shell midden levels, abundant pottery and faunal remains, corresponding to habitat areas related to a diversity of exploited river and land resources (molluscs, fish, cattle, and hunt). Although in the previous studies (Silva *et al*. 1986) the salt production was not considered, in recent revisions (Soares, 2008; Soares and Silva, 2013), influenced by the discoveries of Monte da Quinta 2 and Ponta da Passadeira, it is suggested that concentrations of pottery fragments and some troncoconic shapes in the sites of Barrosinha, Malhada Alta, and upper levels of Possanco could be related to salt production through ignition and *briquetage* (Soares, 2013). Though the empirical data is less evident than in the other two sites, the hypothesis seems plausible. The same general economic regime projected for Ponta da Passadeira is suggested here.

2.4. Praia do Forte Novo

The site is set in the actual beach of Forte Novo (Quarteira, Loulé municipality) in the Algarve coast (Fig. 1D), inside the limits covered by the tides. Due to the significant retreat of the coast line known at least since the roman period (no information is available for the previous four

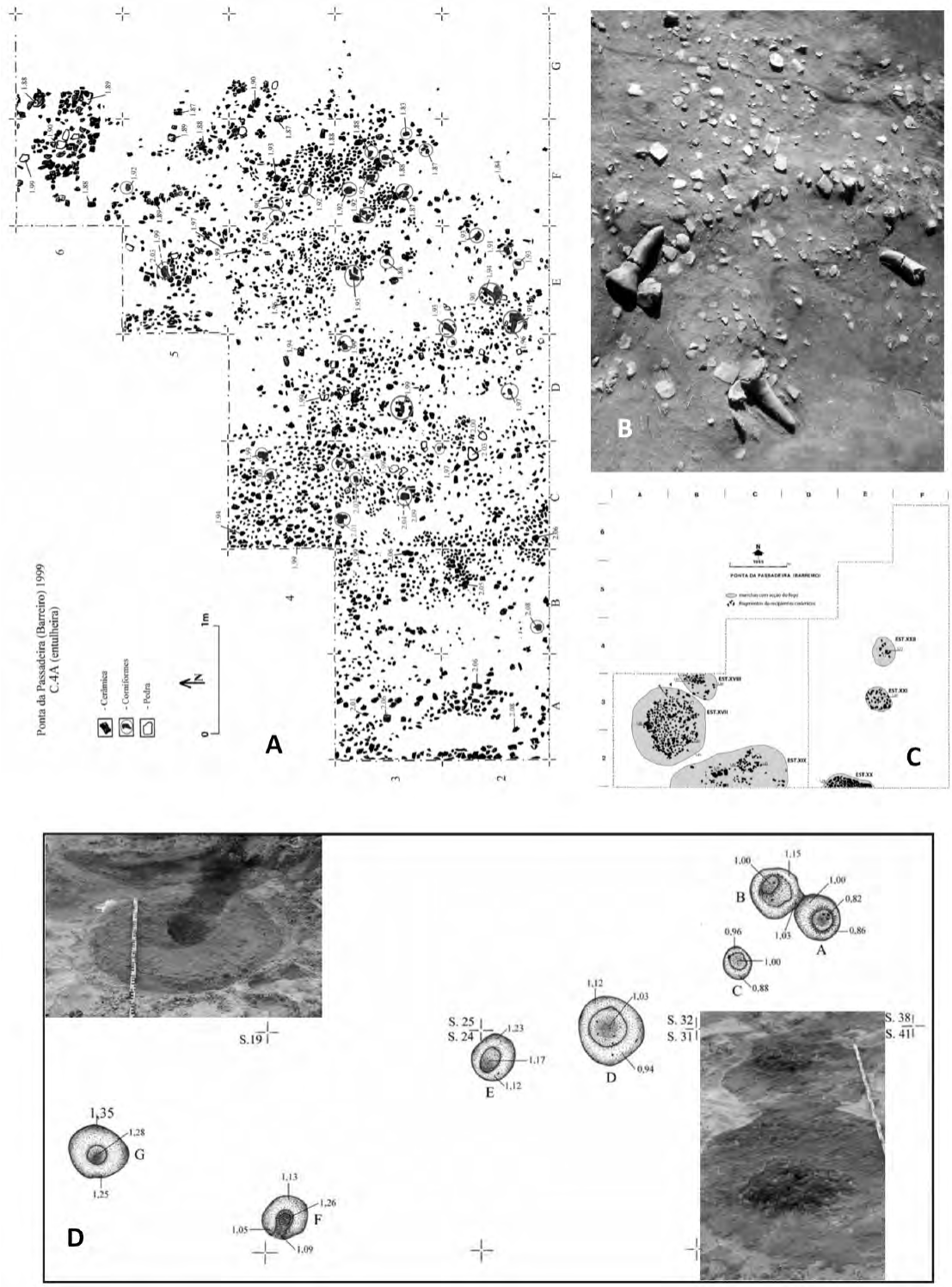

Figure 6. Ponta da Passadeira. A-B. *Briquetage* bulks; C. Fireplaces; D. Ovens. (images taken from Soares, 2014).

Figura 6. Ponta da Passadeira. A-B. Escombreras de briquetage*. C. Estructuras de combustión; D. Hornos (imágenes tomadas de Soares, 2014).*

thousand years), it is very difficult to reconstruct the implantation of the site. However, structures *in situ* show that the occupation should have been already in sandy soils near the seashore during its prehistoric use.

It was surveyed during an emergency intervention with an area of 13m^2 and the limits of the occupied area were impossible to determine (Rocha and Barros, 1999/2000; Rocha, 2004; 2013). Several combustion structures were identified in a sandy and clayish deposit. More than seven thousand pottery sherds were recovered (but only 7% were rim fragments) and the lithic industry is scarce. The pottery shapes correspond to spherical pots, bowls, some of them carenated, and the fragments identified near the fireplaces presented pastes with low compactation level suggesting the use of low temperatures during production. Based on this data the possible production of salt was suggested.

2.5. Available chronology

Four of the sites referred above have absolute chronologies for the occupations and contexts where the production of salt is suggested: Ponta da Passadeira, Barrosinha, Possanco and Praia do Forte Novo (Table 1).

These chronologies cover a period roughly between 3700-2600 Cal BC, corresponding to the final Middle Neolithic, Late Neolithic and Early Chalcolithic (following the traditional periodic division of Portuguese Recent Prehistory). Monte da Quinta did not provide datable organic materials but could be situated in the Late Neolithic / Early Chalcolithic through artefact typology, and therefore integrating the time span defined by the dated sites.

3. Discussion of available data

3.1. Specialization and production for exchange

In order to evaluate the levels of production, a volume estimate was performed for the Monte da Quinta 2 pottery (Valera *et al.,* 2006): taking advantage of the high patterning of the conical molds and of their level of preservation in the production structure, some forms were reconstituted and their volumes were calculated generating an average volume and an average weight per mold; then, all the fragments belonging to this pottery type identified in the thirty-two bulks were also weighed; based in the average weight of a mold, the approximate number of molds represented in the bulks was calculated; finally, using the average volume per mold, and global volume of production was also estimated (Table 2). Going a bit further in the exercise, and arbitrarily assuming a time span of one year, if the estimated global production was divided by 365 a daily production of 4.9 Kg would be obtained, corresponding to 11 loaves of salt. Naturally, if the production was seasonal the daily production would be higher.

Taking into consideration the fact that these values correspond only to the excavated bulks, that the dispersed fragments in the involving deposits were not considered, that several bulks surpassed the limits of the excavation, and that the highway under construction had already destroyed part of the site before its identification, it seems that we are in presence of an area of intensive production of salt. A production that certainly would exceed the needs of the community involved in it, suggesting that a significant part of the product was intended for exchange. Although a similar exercise has not yet been performed for the *briquetage* remains of Ponta da Passadeira, the same general image is suggested; pointing to an intensive production designed for regional and inter regional exchange. However, some interesting differences exist between the two sites, that are contemporaneous, only 45km apart and set in a similar environment.

At Monte da Quinta 2, with a larger excavated area, the concentration of production structures and the total absence of residential evidence points to a place specialized in salt production. However, as the site extends out of the excavated area, it is not clear if we are in presence of a specialized site or a special-

ized zone of a settlement. On the contrary, at Ponta da Passadeira, with a smaller excavated area, the situation is more diversified, showing evidences of other subsistence activities that are spatially mixed with the structures of salt production, suggesting a habitat without a clear spatial demarcation of domestic activities. It is also interesting to note the significant difference between the potteries shapes used in the salt production. If opened bowls are present in both contexts, the thin, small, and well patterned molds of Monte da Quinta 2 are absent in Ponta da Passadeira, and the large troncoconic shapes of this site are absent at Monte da Quinta 2. Both shapes have parallels in European sites where salt production has been identified or suggested: the small conic molds in Central Europe (Germany, Poland or in the Balkans area - Weller, 2015) but also with similar shapes in Iberia in the chalcolithic site of Fuente Camacho, Granada (Terán Manrique and Morgado, 2011), and the large troncoconic pots in Bulgaria (Weller, 2015) or in the western coast of France (Cassen *et al.*, 2008). However, these two shapes never appear together in a same site, suggesting that they correspond to different production goals. In fact, the production of salt using small thin molds, also made with molds that provide them with patterned shapes, has several advantages for a specialized production intended for exchange. The molds require the use of less clay, they take less time to produce, they are easier to break because they are thin and under cooked, the crystallization of the brine is much faster than in larger troncoconic shapes, the salt loaves are smaller and easier to transport as units and the patterning gives them the potential of becoming units of measure in exchange. Large blocks of crystalized salt (with 30l, the volume of some of these pots from Ponta da Passadeira) would be harder to extract maintaining the shape of the loaves and especially they would be harder to transport. If they were to be broken, then it would be difficult to maintain any pattern, implicating some sort of container to control the volumes. Given the different characteristics of the evidence in both sites, this could suggest that Monte da Quinta 2 was in fact a specialized site in salt production (evidences of subsistence activities were totally absent), possibly of temporary intermittent occupation, where all the production was to be transported elsewhere (to settlements located in the immediate hinterland) and then enter in a network of exchange. Sites like Ponta da Passadeira and Comporta might have a significant local consumption (independently of the fact that part of that production was intended to be exchanged), showing that these contemporaneous sites, present in a same environmental context, could be integrated in different systems in different ways.

3.2. Exchange, value, and the social use of salt

Considering a production orientated for exchange, it is important to question the origin and location of demand. As to the origin, the traditional use of salt is usually related to the development of an economy and diet based in agriculture and in husbandry and to the growing needs for conservation in storage, and long distance transportation in the context of inter-regional interaction networks. As to the location of demand, we should consider the regions where those social systems were generating the need of salt, but where it was not a local resource.

Considering the location of Monte da Quinta 2 and Ponta da Passadeira, in the left (south) bank of the Tagus estuary, or the sites of Comporta in the south bank of the paleo estuary of Sado river, a cultural relation with both Lisbon and Setúbal peninsulas is obvious. However, in both peninsulas the access to salty waters was easy, in the large paleo estuaries of the Tagus and the Sado rivers or in the smaller estuaries of the western coast of Portuguese Estremadura (that includes both peninsulas). In fact, even in the interior of Estremadura there was salt available in the local geology of the area of Torres Vedras and Rio Maior (Rosendahl and Silva, 2002). On the contrary, in the opposite direction, in the Alentejo hinterland, the lack of this natural resource associated to an increasing demand related to

the development of social complexity would have generated a demand capable of encouraging intensive and specialized salt production in these river side areas that had for long maintained relations with the more interior regions. So, these intensive salt production present in the lower Tagus and Sado basins have been interpreted as a response to social needs developed in the Alentejo hinterland (Valera *et al.* 2006; Soares, 2001; 2008; 2013).

The development of a production specifically intended to be exchanged at an inter-regional scale is something that is occurring along with other products during the Neolithic and Chalcolithic, as phenomena integrating the social trajectories of these periods. That led us to question the social status and economic value of salt for those communities and how that value was produced.

Contradicting the Marxist purist definition of commodity, that is inseparable from the capitalist frame of production for economic profit, Appadurai proposed a less restrictive definition that introduces the concept in other forms of society, namely prehistoric ones: commodity as a product intended to be exchanged independently of the shape exchange may assume (Appadurai, 1986). The result is that the opposition between commodities on one side (corresponding to a specific modern economic system), and gift and barter (corresponding to more "primitive" systems) on the other, is surpassed and gift or barter become specific forms of exchange commodities, where the economic calculation, even behind the "appearance of disinterestedness", is present (Bourdieu, 1977; Simmel, 1978). As Appadurai puts it, we should be "looking at the commodity potential of all things rather than searching fruitlessly for the magic distinction between commodities and other sort of things" (Appadurai, 1986). In this line of reasoning, salt would have been a commodity, a product for exchange (through barter or through some sort of gift procedures) with economic value. But that should not be restricted to an economic frame.

In fact, a suggestion to overcome Marx's origin of value of a commodity is also put forward, considering that value is not simply acquired in the production phase (value as something exterior and determined by the quantity of social work needed to produce the item), but that it is also generated in the process of exchange, circulation, and consumption (Simmel, 1978; Appadurai, 1986; Kopytoff, 1986). Everything exchangeable sees its economic and symbolic value enhanced by entering in a local, regional, or interregional interaction network and by the circumstances of consume, regardless its production costs. Value is not just an economic concept, it is a social one.

So, based in the available evidences, namely the calculations presented for Monte da Quinta 2, these Prehistoric productions of salt can be considered commodities by destination (products intended to be exchanged), and as commodities (as "things-in-motion") their value would be constructed over the processes of production-circulation-exchange-consumption. However, a problem for the evaluation of the social value of salt in prehistoric communities results from the fact that, if information about production is available, little is known about the subsequent phases: there is no empirical data on circulation, exchange methods and procedures or on forms of use and of consumption of salt. Only speculations are possible.

The need for salt is obvious in the organic life of humans and animals, as it is for several activities with emphasis in conservation of food. So, these basic functions of salt are axiomatically taken as part of its value. However, salt has other potentials, both in the production and consumption phases that could interfere with its value and circulation.

The first has to do with the production itself. Turning water into salt, in a Prehistoric cosmology, would have had a quite different explanation from the one provided by our own scientific knowledge. As every production system that generates the appear-

ance of some sort of transubstantiation (like metallurgy for instance), salt production has the potential for a symbolic and magical value. At the recently excavated site of Molino Sanchón II (Delibes de Castro *et al*. 2016), not just the presence of Bell Beaker pottery in and "industrial" area was interpreted as remains of ceremonial activities associated to salt production, but the presence of burials was considered part of compensatory ritual procedures regarding the extraction of an element from the earth. Another not exclusive interpretation concerns the possibility for propitiatory rites, developed to guarantee the good results of the tasks (this could also provide a new perspective of the human bone present in an oven structure in Ponta da Passadeira). In consuming contexts, where salt appears already carrying economic and symbolic values acquired in the production and circulation phases, the fact that it was an exotic item, with specific properties, applications and striking appearance (related to its whiteness) would generate a potential of use, not just as a product for trivial daily economic activities, but also (or mainly) as an item operating in the stages of social differentiation and social competition, like ivory, cinnabar or other exotic items, increasing the value acquired in previous phases. So, the social value of salt could be much higher and diversified in the interior contexts of reception than in the littoral contexts of production. Something difficult to measure, for salt is not easily recognizable in the archaeological record.

Finally, the question of why these littoral salt production sites decay in the Early Chalcolithic remains unanswered. To advance on that subject, it is interesting to note the present situation of chronological discrepancy between the contexts of salt production in the western/southwestern coast of Iberia and the hinterland ones. If in the littoral, the production is dated from the Neolithic / Early Chalcolithic (mainly second half of the 4th / first quarter of the 3rd millennium BC) and the sites are then abandoned and no others are known after that, in the interior of the Peninsula all the known production dates from the Late Chalcolithic / Early Bronze Age (second half of the 3rd, beginning of the 2nd millennium BC) associated to Bell Beaker contexts. That is the case of the sites of the lagoons of Villafáfila in Zamora, Santioste and Molino Sanchón (Delibes de Castro *et al*. 1998; Delibes de Castro *et al.* 2016), of Espartinas, in Ciempozuelos (Valiente Cánovas et al. 2002; Valiente Cánovas and Ramos, 2009; Valiente Cánovas, 2009) or Fuente Camacho in Granada (Terán Manrique and Morgado, 2011). It is not clear if this chronological discrepancy corresponds to an historical fact or if it is just a product of research circumstances. With the available data, it seems that productions stopped in the first half of the 3rd millennium BC in the coast and begins in the second half of that same millennium in the hinterland. Based in this present picture, it may be questioned if these two circumstances are in some way connected. If it is assumed, as above, that the intensive production of salt in the Tagus estuary was established because of the demand generated in the development of the social systems of the interior communities of the Guadiana and eastern Sado basins, then it becomes illogical that those productions sites are abandoned during the period when those demanding social systems reach their peak. In fact, in the middle / second half of the 3rd millennium BC a significant intensification of inter-regional interaction is documented in that region, for instance in large ditched enclosures like Perdigões (Valera in press). There, following evidences of significant concentrations of people and fauna (an intensification of agriculture is still more inferred than demonstrated), we can observe an increase of exogenous exotic items from several more or less distant regions: ivory from North Africa, cinnabar from the centre of South Meseta, beaker stylistic influences from central Iberia, flint long blades from central Andalucía, variscite beads from Sierra Morena, amber, or coastal items like limestone idols and pots and shell beads. In this scenario, the demand for salt, both in its functional and symbolic facets, must have also increased and, if it was not coming from the littoral, it must have been coming from the interior. In fact, the geological history of

Iberia generated important salty layers in the eastern side of the peninsula that have been exploited since prehistory until the present (Kortekaas, 2015a; 2015b), frequently with advantages due to the high concentration of salt (Fig. 7A). It is then fair to ask if this divergent and subsequent chronologies for salt production in the western cost and interior of Iberia correspond to a shift in the supply origin in the context of the social dynamics of interaction of areas like the Portuguese Guadiana basin. The recent proliferation of ditched enclosures in the Mesetas, some of them quite large and complex, documents a social trajectory that starts to match the levels of complexity known in the South (Díaz-del-Rio, 2003; Blasco *et al.,* 2011; Delibes de Castro *et al*., 2014; Barroso Bermejo, 2016; Schmitt, *in press*). In those interior areas, salt production may have started to become a strategic resource added to others in the context of inter-regional interaction of the 3rd millennium BC, especially in relation to regions that function as platforms of communication like the Middle Guadiana basin (Fig. 7B). And that increase could have had the power of generating changes in previous routes of salt supply based in littoral productions, justifying the collapse of sites like the ones known in the Tagus estuary, showing that in the 3rd millennium BC Iberia was already submitted to regional economic competition with differential effects in the production and circulation of certain goods.

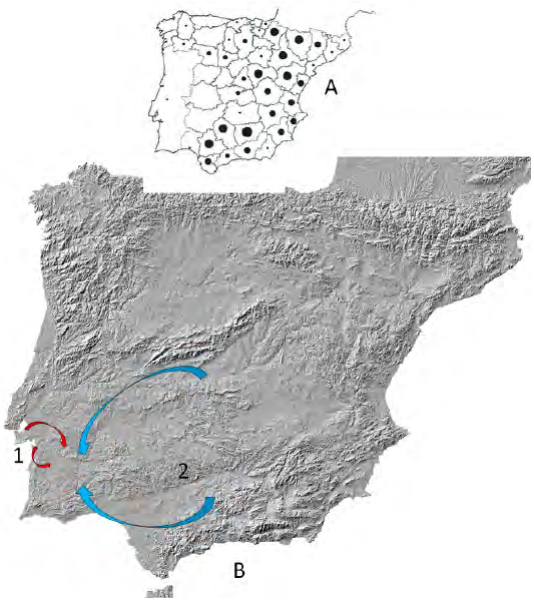

Figure 7. Hypothetic model of a shift of sources of salt for supply the Portuguese Guadiana basin. A. Actual concentration of salt production sites showing the potential resources of eastern Iberian hinterland (after Kortekaas, 2015b). B. Proposed hypothesis: 1. predominant source during the Late Neolithic- Early Chalcolithic; 2. predominant source during the Late Chalcolithic.

Figura 7. Modelo hipotético del cambio de origen del abastecimiento de la sal en la cuenca portuguesa del Guadiana. A. Concentración actual de sitios de producción de sal revelando el potencial de recursos en el interior oriental de la Península Ibérica (según Kortekaas, 2015b). B. Hipótesis propuestas: 1. origen predominante en el Neolítico final - Calcolítico inicial; 2. origen predominante en el Calcolítico final.

4. Conclusions

Available information for prehistoric production of salt in Portugal points to the existence of intensification and specialization of production through the method of ignition and *briquetage* between the Late Neolithic and Early Chalcolithic (possibly with origin in late Middle Neolithic, the lower limits of the available absolute chronology are taken into consideration) in estuarine areas of the Tagus and Sado rivers and possibly in the Algarve coast, although the production may correspond to different circumstances: specialized sites integrating complementary regimes of territorial exploitation or more specific systems adapted to particular wetlands environments.

The emergence of these contexts is related to the development of a trend of social complexity, with the probable demanding centre in the hinterland of Alentejo (Guadiana and eastern Sado basins). In that context, salt would integrate the assemblage of exogenous (and in some way exotic) products that were circulating in the increasing inter-regional networks of exchange in Iberia during the second half of the 4th and 3rd millennium BC. Salt assumed a condition of commodity that would have its value (economic, social, and symbolic) generated in the production phase, but also in its

biographical phases of circulation, exchange and consumption, where it could have played important roles as an exotic item in strategies of social differentiation and social competition.

A chronological discrepancy between the production of salt in the western coast of Iberia and the more interior areas was noted and, assuming that there is some correspondence between that discrepancy and an historical circumstance, an hypothesis of a supply shift in Anlentejo from the littoral to interior sources during the 3rd millennium BC was suggested and related to the evidences of development of social complexity in those interior areas and to the position of the Guadiana basin as a platform of communication between several Iberian regions.

Although the research on salt production, circulation and consumption is a recent issue in Portugal and no specific projects were so far designed and implemented to deal with this matter, the available information is already enough to stress the importance of this product for Neolithic and Chalcolithic communities and to put in evidence its significant social role in the development of interaction and social complexity during the period.

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