The Iberian Peninsula displays extreme geographic and climatic differences, resulting in very different local preconditions. To what extent are these responsible for the heterogeneous social and cultural development in different regions observable during the 3rd mill. BC? To answer this question it is necessary to identify what was considered to be a resource and to determine how these resources were valuated.

This book aims at investigating and reconstructing the dynamics and the diversity of the sociocultural manifestations on the Iberian Peninsula in relation to the use of resources in a comprehensive way during the Chalcolithic. In general regional overviews and detailed studies of the use of infrastructure, raw materials or social relations the possibilities to identify key resources as factors in these processes are explored.
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View from the ore-rich Cerro de San Cristóbal in Logrosán (Cáceres) towards the dry lands of the Dehesa landscape in the Spanish Extremadura symbolising the abundance of mineral resources and the scarcity of water on the Iberian peninsula. Photo: Martin Bartelheim.

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Abstract

The results of the excavations, geophysical surveys, bioanthropological studies, studies of faunas and plants and radiocarbon dates of the various contexts, allowed to propose a model for the organisation of the Alcalar settlement, situated in the extreme south of Portugal, which from 2800 BCE was established as a large population agglomerate, with the functions of a power centre. The geographical diversity of the Alcalar territory, the maritime routes and land crossings provided access to a wide variety of resources to its inhabitants. The presence of exogenous materials and artefacts, although poorly represented, confirms the existence of exchange networks, mainly with Alentejo and Andalusia, but without discarding routes to Atlantic Europe and the Mediterranean.

1. History of Research

The territorial environment of the settlement of Alcalar (Algarve, Portugal), a site internationally known especially from the work of Estácio da Veiga (Veiga 1886; 1887; 1889) and the Leisners’ megalithic corpus (Leisner/Leisner 1943; 1956, 25; 1959), was studied since the late 19th cent. until present times (see Morán/Parreira 2008; Morán 2001b; Morán 2014). The concentration of megalithic funerary buildings, the size of the barrows, the uniqueness of the objects recovered in the graves (especially objects manufactured in copper, decorated gold sheets, large oolitic limestone blades, large flint points of ‘alcalarense’ type, limestone mortars, etc.) and the recognition of correlated duelling areas led different authors to question the origin and meaning of that evidence (see Morán 2014).

In the late 1980s, when programming the research and enhancement of the tomb Alc7 in the eastern cluster of the Alcalar megalithic necropolis, Rui Parreira attributed an outstanding role to the Chalcolithic settlement of Alcalar, which because of its geographical position, would have been the ‘central place’ of a territory bounded by the Monchique Mountains and the Bay of Lagos (Parreira 1993; Parreira/Serpa 1995) (see fig. 1).

The archaeological work carried out in Alcalar focused initially (1987–1996) on the diagnosis of the construction processes and modes of use of the megalithic monuments. Excavations were carried in the eastern cluster of the megalithic necropolis (owned by the Portuguese State) to conserve and restore monuments Alc7 and Alc9. The necropolis of rock cut graves of Monte Canelas was also targeted for intervention, this resulting from an archaeological rescue. Since 1997, the research carried out in Alcalar focused on the entire settlement, taking into account the results of the geophysical surveys with caesium magnetometer.

It was Helmut Becker who, since the 1990s, developed the use of this method of geophysical prospecting in Atlantic-Mediterranean Chalcolithic contexts of the Iberian Peninsula. High sensitive prospection had been based on the complete reduction of the natural and technical temporal
Geomagnetic variations (micropulsations, diurnal variation, powerlines, etc.) by measuring the difference between two sensors in vertical gradiometer or variometer mode. However, first tests with the CS2/MEP720 Picotesla system in 1995 by Helmut Becker have shown that the two sensors could be arranged horizontally, in the so-called duo-sensor configuration mounted on a man-carried staff, measuring the total intensity of the geomagnetic field at two parallel tracks at same height above ground (typically 0.3m). The survey time in the field was reduced to half: a 20m grid in 0.5/0.1m raster could be measured in less than 10 minutes, a hectare in the same raster (200,000 samples) in 4 to 6 hours. The keys to this technique were given in several papers (Becker 1999a; 2009; 2013; Becker/Fassbinder 2001).1 In Iberia, this technique was first used in the aim of a research project directed by Philine Kalb and Martin Höck in the Monfurado/Vale de Rodrigo area (Becker 1997; 1999b; Kalb/Höck 1997; Kalb 2003), where a modified caesium magnetometer SMARTMAG SM4G-Special (provided on request by the manufacturer Scintrex for archaeological prospection) was extensively and successfully tested in the duo-sensor configuration on the chalcolithic site of Monte da Ponte (Becker 1999a, 103; 1999b).

Since 1996, the same method was also tested and continued within our Alcalar project (Morán 2014). And it was then applied in the survey of the site of Perdigões and its set of ditched enclosures (Márquez Romero et al. 2011; Valera et al. 2014) and was systematically used for the project ‘Geophysics and Archaeo-astronomy of Prehistoric Ditched Enclosures’,2 an extensive survey of prehistoric enclosures in South Portugal (see Valera/Becker 2011).

In our investigations in the settlement of Alcalar, the interpretation of magnetograms obtained with the duo-sensor configuration by Helmut

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1 See <http://becker-prospection.com/tech.html> (last access 15/06/2017).

2 See <http://portugueseenclosures.blogspot.com> (last access 15/06/2017).
Becker from 1996 was contrasted by archaeological excavation. In addition, excavations continued in the eastern cluster of the megalithic necropolis (monuments Alc7 and Alc9) and in the rock cut grave necropolis of Monte Canelas.

The results of the excavations, geophysical surveys, the bioanthropological studies, studies of fauna and plants and radiocarbon dates of the various contexts, allowed to propose a model for the organisation of the settlement and a periodisation for the Alcalar settlement area, which from 2800 BCE onward established itself as a large population agglomerate with the functions of a power centre (Morán 2001b; 2014).

2. The Settlement of Alcalar in the 3rd Millennium and its Territorial Environment

The prehistoric settlement of Alcalar is located in the interfluve of the Farelo and Torre Rivers, whose final sections set, along with the streams of Arão and Odiáxere, a lagoon area known as Ria de Alvor. This territorial environment is bordered on the south by the Bay of Lagos, which extends between the capes of Ponta da Piedade and Ponta do Altar. To the north, its natural limits are the Monchique Mountains – which separate it from the Alentejo – and to the west the mountains of Espinhaço de Cão – which separate it from the Cape (São Vicente) lands and the Vincentine Coast. To the east this territory is bounded by the courses of the Arade River and its tributary stream Ribeira de Boina.

Between the mountains and the sea, furrowed from north to south by several streams, the Alcalar territory is like a natural amphitheatre that descends from the heights of Foia and Picota, where the reliefs almost reach the 1000m, through the Barrocal to the coastal zone of Algarve with its white sand beaches. The geographic diversity and the variety of resources that is implicit cannot alone justify the intense occupation of this territory in the 3rd mill. BCE, since it is necessary to look at their objective conditions from 6500 BP, corresponding to the maximum of the Flandrian transgression, to understand how the various communities had access to natural resources, and organised themselves to produce and reproduce socially.

As a result of investigations carried out within our research project, we gathered evidence of a historical process of economic and social transformation that traces back to the 3rd mill. BCE the pristine state formation in the extreme southwest of the Atlantic-Mediterranean Iberian arc (Morán 2001b). Considering the spatial analysis and stratigraphy of the prehistoric settlement of Alcalar and the different clusters of its megalithic necropolis, as well as the 23 absolute datings carried out, Morán proposed a timeline for the occupation of the Alcalar settlement and its surroundings territory (Morán 2014).

Under this proposal, Period I shows the first archaeological evidence of human occupation in the territory after the stabilisation of the Flandrian transgression, although going back into the 5th mill. BCE, with occupation horizons, some of them associated with menhirs, which are attributed to Neolithic gatherer communities who practiced a cereal agriculture (Morán 2008, 141). Period II, which runs from the second half of the 5th to the middle of the 4th mill. BCE, is barely recognisable in this territory. But Period III corresponds to the occupations of the second half of the 4th mill. BCE, as evidenced by the rock cut tombs necropolis of Monte Canelas (Morán/Parreira 2007, 77–87; Parreira 2010; Silva/Parreira 2010) and Torre 1 (de Sá 1904), the monument Alc1 of the Alcalar necropolis, and several settlements that line the banks of the old lagoon, as indicated since da Veiga’s work in the area (Morán 2001a; Morán/Parreira 2004, 24). From all these empirical data we can infer that in the second half of the 4th mill. BCE and reaching the beginnings of the 3rd, an occupation of the territory was consolidated that led to differentiated dwelling spaces and diverse funerary architectures.

In Period IV, from 2800 BCE onward, the settlement of Alcalar was established as a large agglomeration of buildings. In its immediate surroundings, monumental graves with ceremonial related areas clustered on the hills bordering the dwelling area from the north. This settlement complex, with its dwelling and ceremonial areas, constituted in the 3rd mill. the power-centre of the surrounding territory of the Bay of Lagos (Morán 2001b; 2008, 141; 2014). Alcalar was therefore consolidated as a settlement with about 25ha, lavishly built, with houses with smashed mud walls and branches,
with centralised plan and central fire, and with fences defining functional areas, indicating a previous project adapted to the local topography. The profusion of cereal-pits in the habitat of the central area, the more or less concentric system of fences which protected it, and the sophistication of the access to the interior of the enclosures (see fig. 3), allows us to consider that there was a planning of a huge area for the storage of cereals, dried vegetables and other goods. In the immediate surroundings, different peripheral dwelling spaces were established (Morán 2014), like Poio, Mosqueiro, Amoreira and Casarão das Freiras. Other funerary areas are documented, such as, to the south, the tomb Poio 1 and the natural cave Poio 2, to the east the Monte Velho megalithic tombs and to the west, on the hill of the Serro do Algarve, the natural cave of Algueirão da Mulher Morta. Meanwhile, to the north the rock cut grave I of Monte Canelas was re-occupied, and throughout the country settlements attributable to this Period IV, as Barradas, near Arão (Silva/da Silva 2005), and Torre 4 (Marques et al. 2008) are recognised (see fig. 2).

In Period V, the transition from the 3rd to the 2nd mill. BCE, the absence of public works confirmed the dissolution of the centre of power and the emergence of small, self-sufficient settlements. In Alcalar elongated houses are now built on the former storage area, while the system of fences is no longer functional. The dwellings are now concentrated in the upper part of the settlement that additionally has a funerary function, as evidenced by pit burials near the houses.

3. The Use of Local Biotic Resources

The paleoethnobotanical studies on seeds and grains collected from the flotation of sediments from the pits of the Alcalar settlement and the studies of fauna from sediments that filled the excavated structures have shown that economy was
Fig. 3. Alcalar: settlement area with pits enclosed by a system of multiple fences with gates. Geophysical survey: H. Becker; interpretation: E. Morán (after: Morán 2014, 78 f.).
based on the exploitation of land and mainly on polyculture and animal production, predominantly pig, cow and sheep/goat, seasonally supplemented by collecting shellfish and hunting.

Moreover, the anthropological study of individuals buried in Monte Canelas shows the absence of diseases and the use of a balanced diet between protein intake of fish and shellfish and garden products. However, individuals showed moderate dental abrasion resulting from ingestion of cereals and dried fish, in this last case as a result of stone particles in the flour. Isotopic analysis based on δ¹³C values (between -19.10 and -19.70) determined in the radiocarbon dating show a predominantly terrestrial diet (Carvalho 2007). Along with this, the frequency of dental caries indicates that the diet also included fermentable carbohydrates (possibly honey, carob and figs) and the presence of tartar indicates the ingestion of meat and starch contained in some seeds and tubers (Silva 1996, 118 f.; Morán 2001a, 121).

A planned production can be inferred, presupposing a knowledge of the natural environment that facilitated access to diversified resources. Territorial controlled management allowed to maintain an ecological balance and a rich and varied diet, along with a management of productive spaces, functional differences attributed to different soils, which improved the production and generated surplus resources, minimising unpredictable adversities in the production cycle.

### 3.1. Plant Resources

Analysis by Hans-Peter Stika on the botanical remains of Alcalar (Morán 2001a, 98; Stika 2014) revealed the practice of a diversified agriculture, with horticultural products of vegetables and cereal culture, represented by the remains of barley and wheat. Along with domestic cultures, seasonal consumption of wild plants, possibly growing randomly in the irrigated orchards, has been identified. The alternation of irrigated garden or rainfed crops should have been a standard practice in agricultural land next to the settlement, to favour the recovery of the soil and therefore allow continued agricultural practice each season. We must assume that in order to fertilise the fields grazing stubble at the end of the harvest has played a key role (Bernabeu et al. 1999, 274).

Along with agricultural production seeds, lobes, endocarps and pods of some wild species (Asteraceae indet., Avena L. sp., Beta L.sp., Fabaceae indet., Malva L. sp., Medicago L. sp., Poaceae indet. and Sherardia Arvensis L.) were collected that may indicate a direct storage of produce grown without trite. The presence of many wild species may be an evidence for an intensive deforestation aimed to gain more arable land.

Trees and bushes of the nearby forests supplied fruit for human and/or animal consumption: acorns (Quercus L. sp.), hawthorn (Crataegus L. sp.) pine (Pinus pinea) and bilberries (Myrtus communis L.), in addition to the supply of wood for fire and construction.

Slabs of slate and calcareous stones for construction could have been picked by hand and transported individually by the builders in baskets made of vegetal fibres. Limestone blocks for the lintels of passages and niches, as well as the flagstones to close the vaults of the tholoi graves, although large and in some cases weighing nearly 2t could be transported with a minimum of three people, with the help of ropes, logs and crowbars.

### 3.2. Animal Resources: Vertebrates

Studies of vertebrate faunal remains were conducted by Jose Antonio Riquelme (Riquelme 2014).

The consumption of ovicaprids – with a predominance of Ovis aries over Capra hircus – highlights the fracturing of bone material carrying muscle mass, which is also associated with the handling of the specimen for consumption (dismemberment and fracturing) and the secondary action of dogs. Although all age ranges are represented, adults dominate over young individuals. The study of fauna seems to confirm that animal sacrifice was practiced before animals reached adulthood, following a pattern of meat exploitation mainly from male individuals. In the case of female animals, secondary products (milk of sheep and goats and sheep wool) were obtained from adult individuals. In the case of male animals, some individuals...
were used for breeding, ensuring the preservation of the herds and their regeneration.

Among the identified remains of *Bos taurus*, young, juvenile, subadult and adult ages are represented, but animals were killed mainly in young adulthood. The males were slaughtered at an early age to supply meat, reserving some individuals for reproduction and traction tasks. Although there is no evidence to support the existence of pack animals, they could integrate equipment for transporting materials, taking advantage of the terrain features, with soft inclinations which would not difficult the tasks. Female animals were slaughtered as adults in order to allow milking.

Pig skeletal remains were classified as belonging to domestic species, but considering the difficulty of identification, it is possible that some of the remains are from wild boar. Particularly striking is the abundance of identifiable phalanges, which has been interpreted as pieces that, by failing to provide meat mass, have been discarded completely. The slaughtering of young males, less than two years old, is dominating.

Although domestic fauna dominates, hunted animals have been also identified: rabbits (*Oryctolagus cuniculus*) and deer (*Cervus elaphus*), among the latter both sexes and all ages are represented but adult individuals are the majority.

According to the analyses pigs are the best represented group. Their importance implies a significant presence of forests and pastures with oaks (*Quercus faginea*) necessary for feeding them. Among the ovicaprids sheep seem to be better represented, presumably because of their wool. Remains of a sheep in anatomical connection found in the ditch in sector 16L of the settlement could reflect the importance of this species among ovicaprids. Cattle are represented in fourth place in terms of minimum number of individuals, although regarding their contribution of biomass to food consumption they range in second place.

In general the killing of young animals which provide better quality meat can be observed, keeping females until adulthood, for obtaining milk (sheep, goats and cows), wool (in the case of sheep), for use in field work (cattle) and for the maintenance and regeneration of herds (in all species).

The scarcity of wild animals, represented by rabbits and deer, but also by aurochs and horses, can relate to the development of control techniques and replacement of the herds, where the consumption of wild animals should be seen as marginal and complement the meat diet of the inhabitants in the settlement, where perhaps wild animals correspond to the hunted species to protect fields and preserve food necessary to the conservation of the herds.

3.3. Faunal Resources: Shellfish

The consumption of clams, otter shells and grooved razor shells is confirmed, with scarcer occurrence of oysters, scallops, mussels and barnacles. Calibration of consumed grooved razor shells and clams allows us speculate about life cycle control and respect for the conservation of the species, surely with a distinct seasonal consumption, conciliating the reproduction of the species with a balanced intake of protein to the group diet.

4. Local and Regional Abiotic Resources

The salt obtained from seawater, was a local mineral resource widely used in the preservation of food of animal origin. In addition, the abundance of grooved razor shells and the conservation status of its shells allows us to infer the use of salt for its capture.

The rock materials involved in the construction of the monument Alc7 have been studied by Real (2004). The lithological characterisation covered an area of nearly 5km around the monument allowing to extend the conclusions from the eastern cluster of the necropolis to the settlement area, monumental necropolis, and Monte Canelas.

For the construction of megalithic monuments rocks available in the neighbourhood were used: sedimentary rocks (white limestone, compact limestone, light grey limestone, oolitic limestone, sandstone) and metamorphic rocks (greywacke and slate). In the case of Alc7, the supply came from the slate and greywacke outcrops of Monte Canelas directly from the surface and up to 1.5km away from the monument.
Quartz, quartzite and greywacke available nearby served for making tools for agricultural work. White and grey silex and – in the limestone banks of Poio – silex nodules have been documented.

The carved stone objects include tools related to agriculture as some of the denticulate tools may have been used in sickles to cut vegetables, while some pieces with notches and other denticulate tools possibly served in the task of shellfishing (Morán et al. 2004, 191). Some of the scrapers show evidence of a transverse edge use similar to the traces left by work on dry skin, while others with retouched notches show wear marks that suggest work scraping and dotting wood, bone and horn (Morán et al. 2004, 192).

The production of the so-called mirian axes (Carvalho 2007), here presumably used to work wood, was performed with greywacke, carving and hammering its surface (Morán et al. 2004, 204). Mill sleepers were prepared in sienit of the Serra de Monchique, although some were made of the local greywacke.

Copper is also present and although we do not know the location of mines was probably extracted from hinterland outcrops some of them reported in the nineteenth century (Veiga 1889, 37–79). Among the objects found during excavations those found in the niche of Alc3 stand out (Leisner/Leisner 1943, 238, Taf. 79). A piece of copper ore inside the house -770/-170 (the final phase of occupation of the settlement) and a gouge and punch collected in its neighbourhood confirm metallurgical activities in Alcalar (Morán 2014).

Gold was locally sourced and was used in adornments, two small bars from Alc4 and a plate from Alc11. Because of their fragmented state and because they were found during the early excavations, it is difficult to assign them to individual burials. Therefore, the exact way in which they were used remains unknown. It is assumed that all of them were used as coating of adornments or containers made of organic materials such as leather or wood (Ambruster/Parreira 1993, 201–211; Correia et al. 2013, 23 f.).

As for objects with possible ideological connotation, there is a set of cylindrical baetyloi made of local limestone – only one of them decorated in Moncarapacho type – deposited on the first section of the passage of Alc9 (Morán/Parreira 2007, 70). Numerous unfinished cylinders with surfaces in different states of completion suggest a local workshop (Morán et al. 2004, 206).

5. The Use of Foreign Resources

The geographical diversity of the Alcalar territory, the maritime routes and land crossings provided to its inhabitants access to a wide variety of raw materials for construction and for the production of artefacts. The presence of exogenous materials, although poorly represented, confirms the existence of exchange networks with the Alentejo and Andalusia, without discarding other more elongated routes to Atlantic Europe and the Mediterranean.

The raw material of polished stone tools is predominantly amphibolite of exogenous origin, followed by diorite and granite. Among the products axes and adzes dominate, in some cases they show traces of re-use altering its functionality: for instance axes reconverted into hammers, into hand mills or into strikers (Morán et al. 2004, 193–195).

An exogenous origin is confirmed for the decorated slate plates from Alc1 (Veiga 1886, 232, est. VIII) and Monte Canelas (Parreira 2010) produced in the interior Alentejo (Gonçalves 2004; Sousa/Gonçalves 2012), and an engraved plaque from the El Arteal type, which was collected in a dwelling context in the Alcalar settlement (Morán 2014, 224; 2016, 184). The large blades of silicified oolitic limestone collected in the niche of the Alc3 come possibly from the Sierra de Ronda (Nocete et al. 2005). The amber artefacts (Beck/Vilaça 1995) also have an exogenous origin. Among the materials from inside the Alc4 niche, ivory (a fragment of elephant tusk) has been registered split lengthwise with saw marks. It may have served for the local production of ivory artefacts (Veiga 1889, 213, 223; Schuhmacher et al. 2009, 994; Cardoso/Schuhmacher 2012, 101). There also was a trapezoidal shape sheet broken at the ends (Veiga 1889, 213, 223) and one plate flat on both sides with highly polished edge, which may have served as a straightener (Veiga 1889, 214, 223). Additionally numerous necklace beads made of green stones were found. They are still unexamined, but may come from the variscite mines in West Andalusia (Nocete 2001, 107).
6. The Organisation of Production and Resource Management

Alcalar was established as power centre of the Bay of Lagos in the 3rd mill. BCE assuming a hegemonic position in the territorial organisation of the Chalcolithic communities in the western Algarve. The careful planning of the habitat space responds to the need to protect a socially segregated group, which controlled the production, ensuring the survival of the community, the consumption of food, and the protected storage of crops in case of crop failures, the same group which controlled the exchange routes of scarce goods and had the exclusive use of prestige items.

Elena Morán
moran.elena@gmail.com

Rui Parreira
r.is.parreira@gmail.com

Helmut Becker
becker.mag@googlemail.com

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