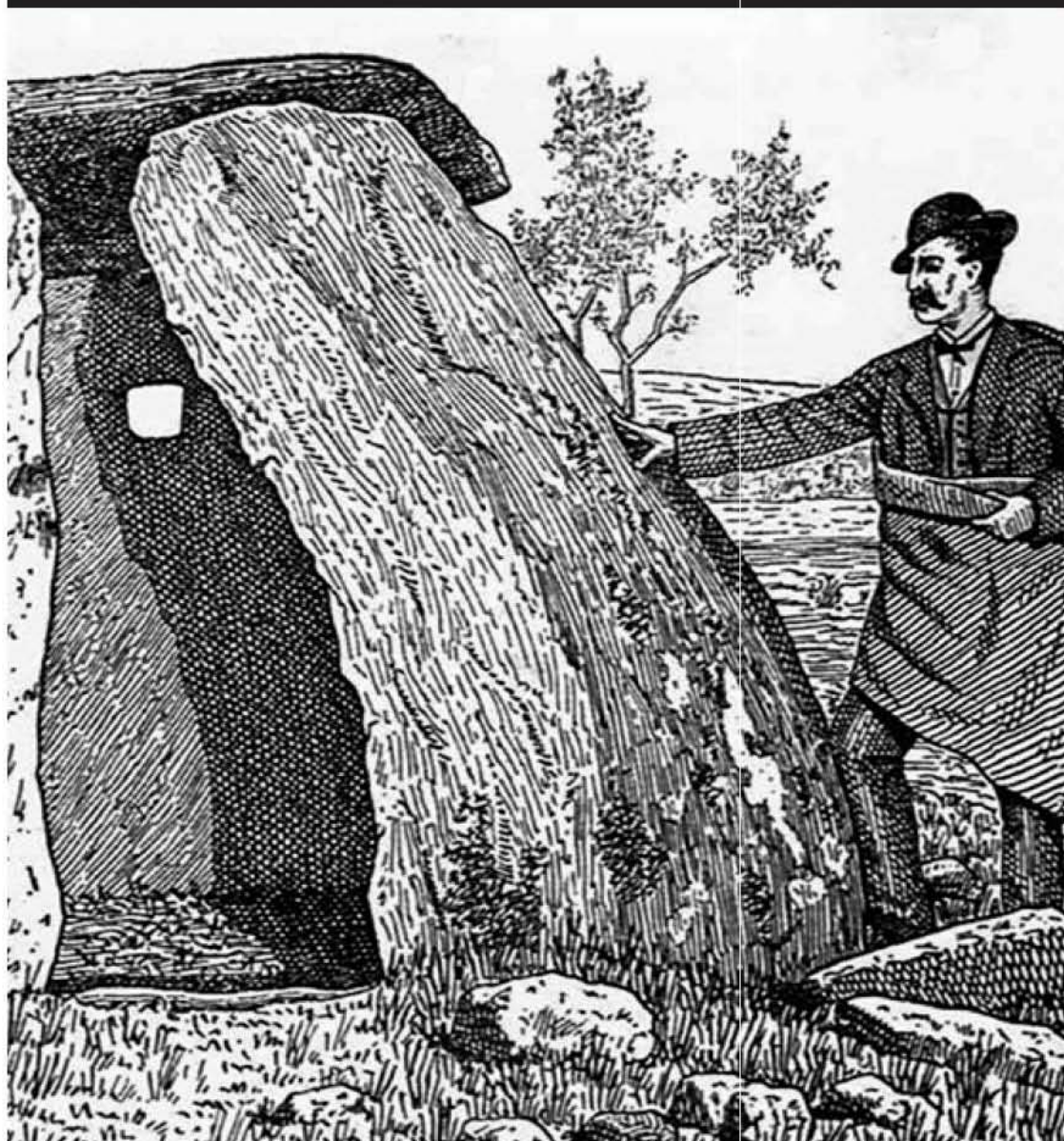


Megaliths and Geology

Edited by

Rui Boaventura, Rui Mataloto
and André Pereira



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Megaliths and Geology

Megálitos e Geologia

MEGA-TALKS 2

19-20 November 2015 (Redondo, Portugal)

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Introduction

Megaliths and Geology: a journey through monuments, landscapes and peoples

This book is the result of the MegaGeo project, under the direction of Rui Boaventura, with the purpose of analysing the raw material economy in the construction of megalithic tombs in multiple territories, showing the representation of several prehistoric communities that raised them and their relationship with the surrounding areas.

Following the meeting of the previous year, it was decided to hold MegaTalks 2, which brought together national and international experts who have developed work related to Megalithism and Geology, in its various perspectives, from the funerary depositions to the raw material construction of the tombs, as indicators of mobility and interaction with the surrounding physical environment.

Since the original meeting, held in Redondo on 19-20 November 2015, there have been several changes in the alignment of discussion and participants involved. However, the core of the analysis, regarding Megalithism and Geology, has not changed..

The alignment of the contributions sought a generically regional organisation, either in a national scale, or later in a peninsular and a European scale.

The volume opens with the presentation of a case study developed within the MEGAGEO project in the megalithic nucleus of Freixo (Redondo, Portugal) coordinated by R. Boaventura, Patrícia Moita and J. Pedro. This paper presents the analysis of the raw material of several clusters of megalithic tombs in Freixo region (Redondo, Alentejo). Broadly speaking, there was an exploration of proximity, most likely opportunistic, but in which other criteria were taken into account in the selection of the supports for the construction of monuments.

The following two contributions focus on the work carried out on the Megalithism of Beira Baixa (Central Portugal). João Luís Cardoso's work presents a general perspective on the Megalithism of this region, highlighting the documented architectural diversity, indicating structural polymorphism, contradicting linear development interpretations. The mobility of raw materials is understood essentially from the viewpoint of votive depositions in a funerary context, documenting contacts and circulation with the closest geographical regions, such as Estremadura and Alto Alentejo.

The next contribution, under the coordination of João Caninas, but using an extensive team, presents a novel investigation of Megalithism in the region of Proença-a-Nova, as well as Beira Baixa, Portugal. It is a set of works in progress revealing a diverse and complex reality that indicates contacts and circulation of goods and people at an interregional level, especially lithic artefacts. Concerning the raw material economy, there is a use of the raw material available locally, although one of the slabs may have a more distant source, more than 10 km away.

In the following chapter, Marco Andrade focuses his analysis on the raw materials of the votive objects deposited in megalithic contexts, trying to understand their sources of lithic supply, and thus seeking mobilities and circulation in the upper Alentejo's pre-history (Southern Portugal). This work presents us with a very in-depth perspective on the wide range of interaction in the upper Alentejo region for the purposes of amortization of votive objects in megalithic contexts, allowing us to understand the complexity of circulation and supply.

José António Linares brings us an innovative and detailed perspective on a region whose peculiar Megalithism has long been known. For the Sierra de Huelva (Southwest Spain), this author brings us a careful assessment of each monument and each group of tombs, which allowed him to verify the presence of a very fine and diverse knowledge of the territory and its potential. This knowledge was used for the construction of complex structures, where the different geological elements were carefully selected in response to the physical and ideological needs that presided over the construction of the tombs. The micro-analysis carried out for the Los Llanetes group, made it possible to emphasize the relevance of the Phyllite blocks. Simultaneously, the gathering and using of different types of stone for the construction of complex tumuli showed a clear chromatic and textural combination, evidencing all the effort to build the structure.

Heading north, towards the Douro River basin in Northern Spain, the work of Cristina Tejedor and Manuel Rojo present a chrono-typological perspective on the tombs of this wide and diverse region. The region presents a very different reality from the previous areas, marked by the polymorphism of the megalithic monuments that were only a small part of a diverse funerary architecture, with whom shares concepts and common cosmogonies. Architectural polymorphism, even if dependent on local developments and different diachronic processes, seems to be clearly rooted in this wide region. Despite this diversity, there is a use of essentially local raw materials, although this sometimes requires a few kilometers journey. This fact does not prevent the use of a diverse set of lithologies that allow a certainly significant chromatic combination that, in some situations, may be mimicking the landscape in which it fits, thus seeking to incorporate the geological elements of a certain landscape identity.

Following a long-time precursor line of research, Chris Scarre points out that there is a huge European affinity between Megalithism and its relationship with Landscape, an ancestral landscape certainly distinct from the current one. Thus, the author underlines the clear emergence of Megalithism in landscape contexts previously dominated by the large concentrations of stones, whether endogenous or dragged, as is the northern areas affected by glacier advance and retreat. In these landscapes of abundant stone and rock outcrops, the action of building the tombs from the local stones reinforces its connection to a territory and to the creation of a Landscape.

Mike Parker Pearson brings us a greater example of Megalithism and Geology, Stonehenge, due to its long researched history, to which is now added an important set of new data. The geological origin of the sarsen and bluestones has long motivated extensive studies and analyses, with the origin of the latter being well defined to the west, in the Preseli Mountains of Wales. However, a number of recent studies have allowed for the investigation into the specific origin of extraction such as Carn Goedog or Craig Rhog-y-felin, where ancient traces of these same works have been documented. Following this new data, it is believed possible that the bluestones were initially implanted in another stone circle, close to the extraction area. In a later moment, when it seems that a period of West-East rapprochement and union was developing, the bluestones of these ancient Welsh monuments would have been moved for the construction of Stonehenge, an area that seems to have had specific geological and historical characteristics. Stonehenge was an identity monument of that union, where the geological elements present would act as a mark of the ancestors. Different studies seem to prove that this displacement would have been accompanied by the installation of new people from the West in the Stonehenge region, being able to go back the different origins of the communities, even to the first Neolithic settlers.

At the end of the book, the results of the extensive investigation in Swedish Megalithism, in particular in the interior region of Falbygden, give us a very similar perception to the one documented on the opposite end of Europe, where we started this volume. Karl-Göran Sjögren's work shows us how the Megalithism of the Falbygden region adapts in a very particular way to the geological pre-existences, using them in a very structured way and as a reflection of the surrounding Landscape, which they

somehow mimetize. However, some choices, even in local stones, or as a result of the dragging action of glaciers, are clearly due to options that are not merely functional or structural, but rather seem to respond to symbolic perceptions inherent in certain geological choices. In this way it is believed that there are recurring choices of raw materials, all local or locally available, for the construction of specific components of the tombs, such as the slabs of the chambers or the cover stones, which are not determined by their physical characteristics or robustness. Another vector of analysis is the ability of local groups to aggregate workforce to build such a large number of monuments. Despite the lack of data, the occupation sites would not have had a large enough population needed for the construction of the monuments and, therefore, their construction should imply the aggregation of different groups, regional or not. The monument would emerge as a greater symbol of group identity, but also as an impeller of social dynamics and sense of intergroup competition in the region, representing the capacity of regimentation and cohesion of the groups that built them, even at a long distance. Geological choices, even on a local basis, seem to represent identity discourses that justify the diversity of choices. The various strontium isotope studies carried out on the populations buried in Falbygden show that a quarter of the population would be allochthonous making clear the establishment of broad networks of solidarity with more remote regions.

As an epilogue, it is important to underline some aspects. This work was born from the will and vision of Rui Boaventura, who organised it in the last moments of his life, making clear that, instead of the closed Portuguese context, Megalithism at European level was once more in a very dynamic moment, structured in areas of multilinear research, where pressing issues of the study of European Prehistory were combined, from mobility to questions of identity, including the foundation of Neolithic Landscapes.

In this respect, the connection between Megalithism and Geology, whether in its structural aspects, in raw material economics, but also identity or symbolic aspects, is assumed as a multidisciplinary research line that needs to continue to be deepened and diversified, like Rui well knew.

Rui, you will continue to be one of the foundation stones of our Megalithism. May the Slab be with you!

From matter to essence. Sourcing raw materials for the votive artefacts of the megalithic communities in Ribeira da Seda (North Alentejo, Portugal): a preliminary approach.

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Abstract: This paper presents some preliminary readings about the procurement of raw materials for the production of votive artefacts by the megalithic communities in the area of Ribeira da Seda (North Alentejo, Portugal). A macroscopic analysis of the artefacts collected in megalithic monuments in the study area (pottery, flaked stone artefacts, polished stone artefacts, votive plaques, adornment elements, metallic artefacts, ground stone artefacts) allowed to evidence a relative diversity of the used materials – most of which, in percentage terms, corresponds to locally or regionally available raw materials, in the Ossa-Morena Meta-Volcanic Zone, reflecting the optimized maintenance of abiotic resources. Extra-regional raw materials, such as flint, have statistically lower values when comparing only the types of raw material, independently of the artefacts category and number; however, if we compare the number of artefacts *per se*, we note a marked weight of exogenous materials (for flaked stone artefacts, for instance, nearly 2/3 are produced on flint). This shows a constant procurement of this raw material, which is also associated with the presence of exotic materials (such as amber and ivory), framing the area of Ribeira da Seda in the wide interaction diagrams of the megalithic communities of the 4th and 3rd millennia BCE in Southwestern Iberia.

Keywords: Megalithic communities; Neolithic-Chalcolithic; North Alentejo; Raw material sourcing.

Da matéria à essência. Aproveitamento de matérias-primas para os artefactos votivos das comunidades megalíticas da Ribeira da Seda (Norte Alentejo, Portugal): uma abordagem preliminar.

Resumo: Este trabalho apresenta algumas leituras preliminares sobre o aproveitamento de matérias-primas para a produção dos artefactos votivos pelas comunidades megalíticas da área da Ribeira da Seda (Alto Alentejo, Portugal). Uma análise macroscópica dos artefactos recolhidos em monumentos megalíticos da área em estudo (recipientes cerâmicos, artefactos de pedra lascadas, artefactos de pedra polida, placas votivas, elementos de adorno, artefactos metálicos, artefactos de pedra afeixoadada) permite evidenciar uma diversidade relativa dos materiais utilizados – sendo que a maioria, em termos percentuais, corresponde a matérias-primas disponíveis local ou regionalmente na zona de Ossa-Morena, reflectindo a manutenção optimizada dos recursos abióticos. As matérias-primas extra-regionais, como o sílex, têm valores estatisticamente baixos quando se comparam exclusivamente os tipos de matéria-prima, independentemente das categorias e número de artefactos; no entanto, se compararmos o número de artefactos *per se*, nota-se um peso acentuado das matérias-primas exógenas (nos artefactos de pedra lascada, por exemplo, perto de 2/3 são produzidos em sílex). Evidencia-se assim a procura constante de matérias-primas siliciosas, à qual se associa igualmente a ocorrência de matérias exóticas (como o âmbar e o marfim), incluindo a área da Ribeira da Seda nos amplos esquemas de interacção das comunidades megalíticas dos 4^º e 3^º milénios a.n.e. no Sudoeste peninsular.

Palavras-chave: Comunidades megalíticas; Neolítico-Calcolítico; Alto Alentejo; Aproveitamento.

1. Research Background

It is well known the diversity of components of the votive sets of the Megalithism of Southwestern Iberia, region in which the area of Ribeira da Seda is included. This diversity of elements is obviously reflected in the diversity of raw materials needed to produce them. However, this has always been a study subject in some way neglected, with the provenance analysis summarized to the origin of orthostats, and only applied so far in just a few published cases, such as Vale Rodrigo (Dehn *et al.*, 1991; Kalb, 1996 and 2013) and Rabuje (Boaventura, 2000). Recently, this issue has major developments with the work carried out under the project MEGAGEO – *Moving Megaliths in the Neolithic: Geology Sourcing of Dolmen Slabs in Central-South Portugal* (directed by R. Boaventura) (for instance, see Boaventura & Moita, 2012; Nogueira *et al.*, 2015; Pedro *et al.*, 2015).

In the same way, in the scope of the project *New Technologies Applied to the Study of Mobility and Exchanges: Green Beads and Decorated Pottery with White Inlays from the 5th to the 2nd millennium BCE in the Iberian Peninsula* (directed by C. Odriozola, R. Villalobos García, R. Boaventura and A. C. Sousa), intensive studies have been developed in the framework of the provenance definition of raw materials used for adornment elements (for the case of megalithic contexts in Southwestern Iberia, see Linares Catela & Odriozola Lloret, 2011; Odriozola & Linares Catela, 2012; Odriozola *et al.*, 2010 and 2012).

In the general context of the Neolithic and Chalcolithic in Soutwestern Iberia, it is also necessary to point out the work conducted under the project *Mobility and Interaction in South Portugal Recent Prehistory: the Role of Aggregation Centers* (directed by A. C. Valera), which also contemplates, with the ditch enclosure of Perdigões as a case study, the definition of raw materials provenance – highlighting till the present date the case of ivory, limestone and malacological elements, including the ones collected in the adjacent funerary contexts (Valera *et al.*, 2015; Dias *et al.* 2017; Valera & André, 2016-2017; see also the case of green stones used in adornments at Perdigões in Odriozola *et al.*, 2010).

These studies, which mainly deal with material culture or other material elements of the archaeological record, can be complemented by the strontium isotopes analyses carried out so far in the context of several research projects regarding burial sites, confirming the circulation of people and animals (and therefore ideas and artefacts) between the Portuguese Estremadura and Alentejo during the Neolithic and Chalcolithic (Hillier *et al.*, 2010; Waterman *et al.*, 2013; Lillios *et al.*, 2014; Carvalho, 2014; Carvalho *et al.*, 2016).

Under the MEGAFRONT project (*Megalithism and Megalithic Communities in the Area of Ribeira Grande*) and the GEOM-RS research vector (*Geometries of the Megalithic Territory in the Area of Ribeira da Seda*), whose main objective is to define and characterize the Megalithism and the megalithic communities on the left bank of Ribeira da Seda (North Alentejo, Portugal), the identification of the possible provenance areas of the essential raw materials used for the production of artefacts was considered as vitally important, in addition to the techno-typological gauging of the votive artefacts collected from the studied megalithic monuments, with the perspective of a more rigorous characterization of the interaction diagrams of the Late Neolithic and Chalcolithic communities in Southwestern Iberia.

In this regard, some observations are advanced here, based on an empirical analysis of these materials in terms of their geological features. The data presented here are obviously not definitive and result only from a macroscopic examination of artefacts and objects. Rather it is a preliminary approach to the issue of raw material procurement, in terms of their seriation and the indication of probable provenance areas, thus establishing the conceptual basis for more detailed analyses. Either way, the data collected so far are considered to be enough to understand the regional diversity, suggesting extensive exchange networks covering the entire Southwestern Iberia during the 4th and 3rd millennia BCE.

2. Megalithism and megalithic communities in the area of Ribeira da Seda, on a bird's wing flap

In the area of Ribeira da Seda there are about three hundred references to megalithic monuments, included in the municipalities of Avis, Alter do Chão, Fronteira, Sousel, Monforte, Crato, and in part of the municipalities of Mora, Estremoz and Elvas (Andrade, 2009 and 2013).

They are included in what is commonly referred as *Megalithic Group of North Alentejo*, mainly characterized by the monuments of the areas of the Sever basin and Crato (Oliveira, 1998; Parreira, 1996). One can perceive here an interesting diversity in architectural terms, being this polymorphism probably explained by chronological and cultural factors. In fact, one can recognize here from the small simple monuments («proto-megalithic» type) to the large complex monuments with a differentiated Chamber and Corridor. No *tholos*-type monuments were identified so far in this region.

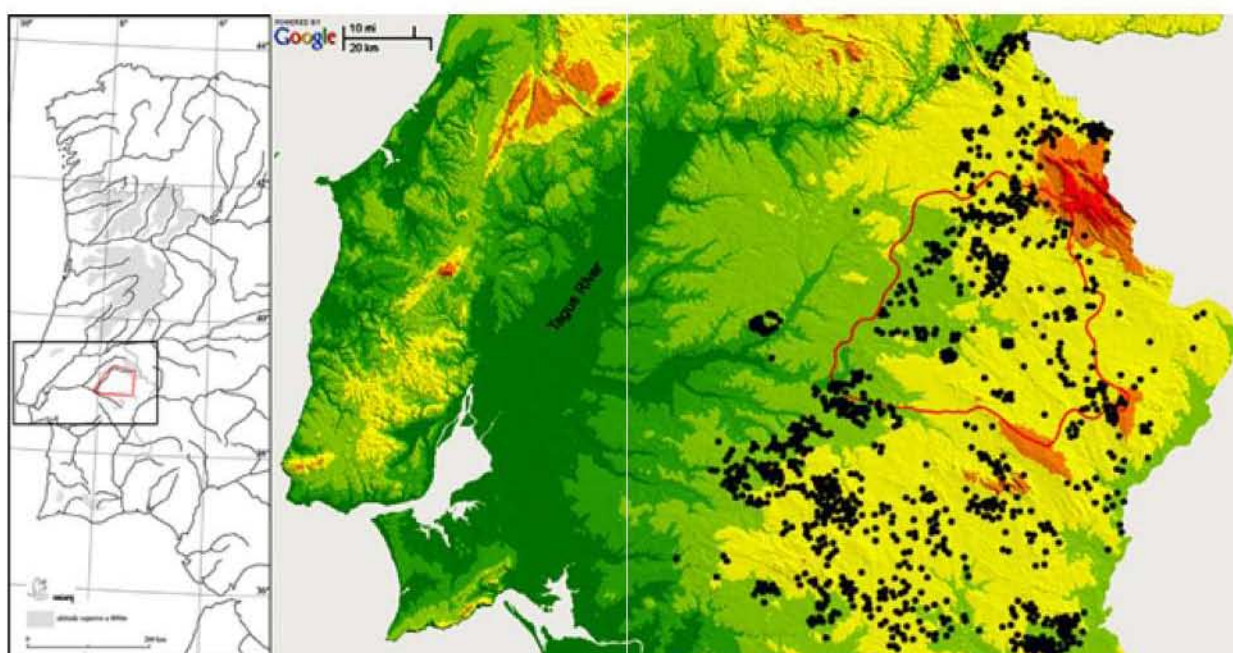


Figure 1 - Megalithic monuments in North Alentejo and Central Alentejo. The area of Ribeira da Seda (its hydrographic basin) is indicated by the red line. Cartographic base: Google Maps, 2013.

Some monuments have been the subject of recent excavation works, such as those of the Coudelaria de Alter do Chão (Várzea Grande, Soalheira and Horta; Oliveira, 2006), the clusters of Rabuje, Enxara and Lacraus (Boaventura, 2006; Mataloto *et al.*, 2016-2017) and the small elongated monument of Condes (Rocha & Alvim, 2015). The availability of contextualized votive sets and associable radiocarbon dates disclosed by these recent works allows to serialize the construction and use of the megalithic monuments in the area of Ribeira da Seda, although with caution due to the scarcity of the sample.

In the general context of the Megalithism of Southwestern Iberia, two generic chrono-cultural levels are recognizable (Boaventura, 2011; Boaventura & Mataloto, 2013). The first, marked out between the second and the last quarter of the 4th millennium BCE, is characterized by small simple «proto-megalithic» monuments or small monuments with a short Corridor, with votive sets consisting of scarce pottery, geometric armatures, small non retouched flint blades and polished stone artefacts (mostly axes with circular cross-section and adzes); the second moment, marked out between the last quarter of the 4th millennium and the mid-3rd millennium BCE, is characterized by monuments with a differentiated Chamber and Corridor, of medium and large size, sometimes with a long Corridor,

with votive sets constituted by abundant and diversified pottery, bifacial lithic artefacts (arrowheads, spearheads, daggers and halberds), large retouched flint blades, votive plaques (engraved schist plaques and sandstone plaques, plain or carved with anthropomorphic motifs) and polished stone artefacts (mostly axes with rectangular cross-section and a larger number of adzes).

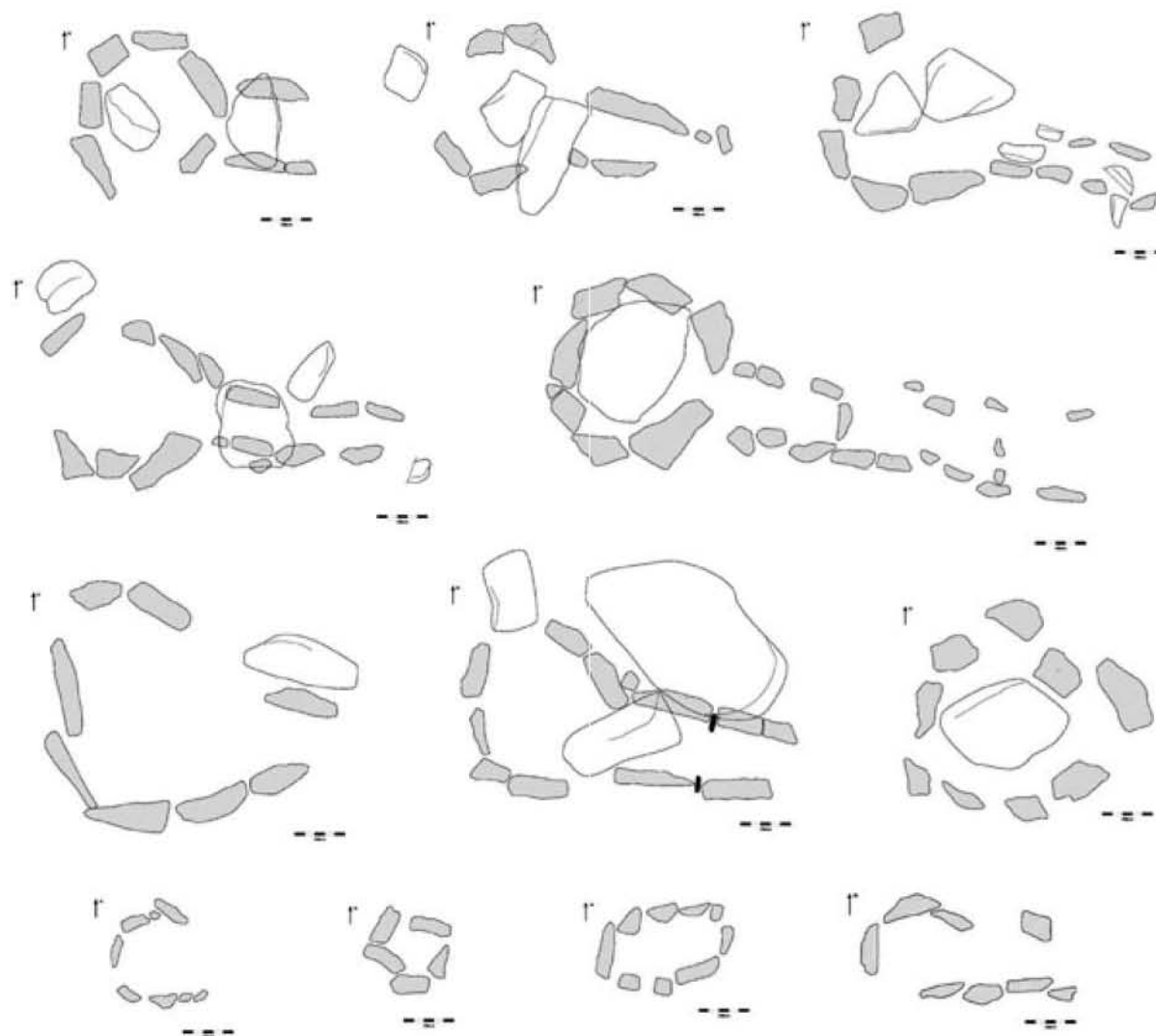


Figure 2 – Examples of the architectural diversity of megalithic monuments in the area of Ribeira da Seda.

Both chrono-cultural levels are represented in the area of Ribeira da Seda. Considering only the monuments that have absolute dates (excluding the ones with only relative dates based on the characteristics of the collected materials), the first moment is represented in Rabuje 5 (Boaventura, 2006), a small tomb originally with a simple Chamber («cistoid» type) to which a Corridor seems to be added slightly after its building (Mataloto *et al.*, 2016-2017); the votive set is not very diversified, consisting of flint bladelets, geometric armatures and few polished stone artefacts – which is compatible with the result of the radiocarbon date obtained from a sample of *Arbustus unedo* charcoal, centered around the mid-4th millennium BCE (Beta-191133: 4650±50 BP).

The second moment is represented in the monuments of Capela (Odriozola *et al.*, 2017) and Horta (Oliveira, 2006), two medium-sized tombs with a differentiated Chamber and Corridor (from medium

to long in length); the votive sets are diversified (including arrowheads, votive plaques and abundant pottery with typical forms of this chronological stage), consistent with the radiocarbon dates obtained from human bone samples, whose results are statistically arranged between the last quarter of the 4th millennium (CNA-3543: 4532±30 BP for Capela and Beta-194313: 4390±50 BP for Horta) and the second quarter of the 3rd millennium BCE (Beta-194313: 4190±50 BP for Horta).

Table 1 – Radiocarbon dates for megalithic monuments of the area of Ribeira da Seda, recalibrated in 2017 using the program Calib 7.0.1 (© M. Stuiver & P. J. Reimer, 2013), with the IntCal13.14c calibration curve (Reimer *et al.*, 2013, *Radiocarbon* 55: 4). 2σ result with 95,4% probability.

Monument	Lab Reference	Sample	Date BP	Cal BC 2σ	Bibliography
Rabuje 5	Beta-191133	Charcoal – <i>A. unedo</i>	4650±50	3630-3343	Boaventura, 2006
Capela	CNA-3543	Human bone – <i>humerus</i>	4532±30	3361-3104	Odriozola <i>et al.</i> , 2017
Horta	Beta-194313	Human bone	4390±50	3325-2900	Oliveira, 2006
Horta	Beta-194312	Human bone – <i>calcaneus</i>	4190±50	2898-2627	Oliveira, 2006

3. The votive artefacts

In the several hundred of megalithic monuments counted in the area of Ribeira da Seda, about 50 of them have known archaeological sets. About 800 individual registers of artefacts and objects, distributed by the different established categories, compose these sets, housed in several national museums and analysed in the context of the projects MEGAFRONT and GEOM-RS. This value does not account for archaeological materials collected in settlements, not included in this particular study but also under analysis in the context of the projects mentioned above.

Materials and Methods

In terms of cataloging and analysis, the artefacts collected in megalithic monuments of the area of Ribeira da Seda were serialized in the following categories: *Pottery, Flaked stone artefacts, Polished stone artefacts, Votive plaques, Adornment elements, Metallic artefacts* and *Ground stone artefacts*.

All available artefacts were individually described, assessing their specific morphological and technological characteristics.

In order to ascertain the petrographic features of the multiple raw materials, the flaked stone artefacts and polished stone artefacts, as well as the pastes of pottery elements (in order to define the components of their temper), were macroscopically analysed using a Leica MZ6 binocular stereomicroscope (45x magnification). These analyses sought to define potential sourcing areas based on the information available in the *Portuguese Geological Chart* and on the comparison with geological samples (mainly flint and amphibolites) collected and firstly analysed in the scope of other research programmes.

Macrophotographs were obtained using a Veho VMS-001 USB microscope, with 45x and 200x magnification, both in geological and archaeological samples.

Pottery

Obviously, from a perspective of optimization of efforts, one can suggest the local sourcing of clays required for the production of the pottery vessels included in the votive sets of these communities.

This proposal is ratified in some ways by the evaluation of the minerals composing the temper of votive pottery, mostly referring to quartz grains (from sub-rounded to angular), feldspar and muscovite, and minoritarily, biotite, hematite, iron oxides – which generally matches to the local geology (obviously, geo-chemical analyses are required to confirm this hypothesis).



Figure 3 – Macroscopic aspect (x50) of the ceramic pastes of pottery collected in megalithic monuments in the area of Ribeira da Seda, being evident the presence of quartz grains (angulose and sub-rounded), feldspar, muscovite, biotite, iron oxides and hematite. The scale corresponds to 2,50 mm.

Flaked stone artefacts

The set of flaked stone artefacts is diversified, not only in terms of typology of the artefacts themselves but also in terms of the raw materials used in their manufacture. Techno-typologically, the presence of blades, bladelets, bifacial points (arrowheads and spearheads), geometric armatures and bladelet cores can be highlighted. The raw materials used in their production can be serialized as follows:

- Blades: flint, opaline and rhyolite;
- Bladelets: flint, hyaline quartz and milky quartz;
- Bifacial points (arrowheads and spearheads): flint, silcrete, opal (?), opaline, siliceous schist, phyllite,

lydite, hyaline quartz and milky quartz;

- Geometric armatures: flint, chalcedony, opaline, milky quartz;

- Bladelet cores: flint, hyaline quartz.

Thus, one can perceive an interesting variety in the raw materials used, apparently not directly dependent of the artefact type.

Regarding flint, several procurement sources can be distinguished by a macroscopic analysis. Flint is generally of good quality, fine-grained, presenting scarce internal flaws. It is from opaque to semi-translucent, with a wide range of shades. The *mudstone* texture is a homogeneous feature in the set, and it is possible to observe some exceptionally rough areas that may correspond to micro and macro-quartzic zonings, as well as few poorly preserved bioclastic remains. These characteristics are typical of the Cenomanian silicifications (Cretaceous) of the Portuguese Estremadura, where flint can be found in secondary position on Miocenic deposits (cf. Aubry *et al.*, 2014; Matias, 2016). Thus, it is possible (according to certain particular features) to recognize flints from the Estremadura Limestone Massif and adjacent drainage basins, namely from Azinheira or Amieira-Arruda dos Pisões (Rio Maior) and Caxarias or Pederneira (Ourém) – the latter not so well represented and mainly used in the production of blades and some few geometric armatures. One single element, an arrowhead collected in the dolmen of Capela, appears to have been produced using Cenomanian flint from the Lisbon peninsula area, which occurs in primary and sub-primary position on the Cretaceous formations found around the Lisbon Volcanic Complex (areas of Loures-Odivelas-Amadora, Monsanto-Campolide-Alcântara, Oeiras and Sintra). Nevertheless, this attribution is not categorical, only based, besides the particular petrographic features, on the post-knapping weathered surfaces that normally characterises this type of greenish gray flint. In fact, flint with similar characteristics are also present in the area of Rio Maior (together with the typical red or brownish red flint, although in smaller amounts); therefore more detailed analyses are required to substantiate this ascription.

Only two elements, two blades collected in the dolmens of Talha 2 and Outeirões 3, seem to correspond to Oxfordian flint (Jurassic) from Tomar area (respectively Agroal and Sabacheira; cf. Aubry *et al.*, 2014; Matias, 2016); however, given the intense thermic changes presented by the blade of Talha 2, it is not possible to defend this hypothesis with certainty without more detailed analyses. However, this classification is obvious in the case of the blade from Outeirões 3, even if based only on a macroscopic evaluation.

A particular type of opaque, grayish flint, with heterogenic textures (from *mudstone* to *wackestone-packstone*), is widely used in the production of the small blades and geometric armatures found in monuments attributable to the second half of the 4th millennium BCE, sometimes in roughly identical proportions to the Cenomanian flint (like in Talha 3). It presents some petrographic features apparently similar to those from Oxfordian contexts – however, it does not match exactly to any of the silicifications with this geological age recognized so far in Western Iberia (cf. Aubry *et al.*, 2014; Matias, 2016). Therefore, its precise source must still be defined.

Another element should be mentioned, collected in the dolmen of Nossa Senhora da Conceição dos Olivais. Although it corresponds to a monument located outside the limits of the hydrographic basin of Ribeira da Seda, it is located near de ridgeline between this watercourse and Ribeira da Tera, thus being territorially associable. In this monument, within the set of arrowheads produced almost exclusively in Cenomanian flint, one can find an element distinguished by its characteristics. It corresponds to a

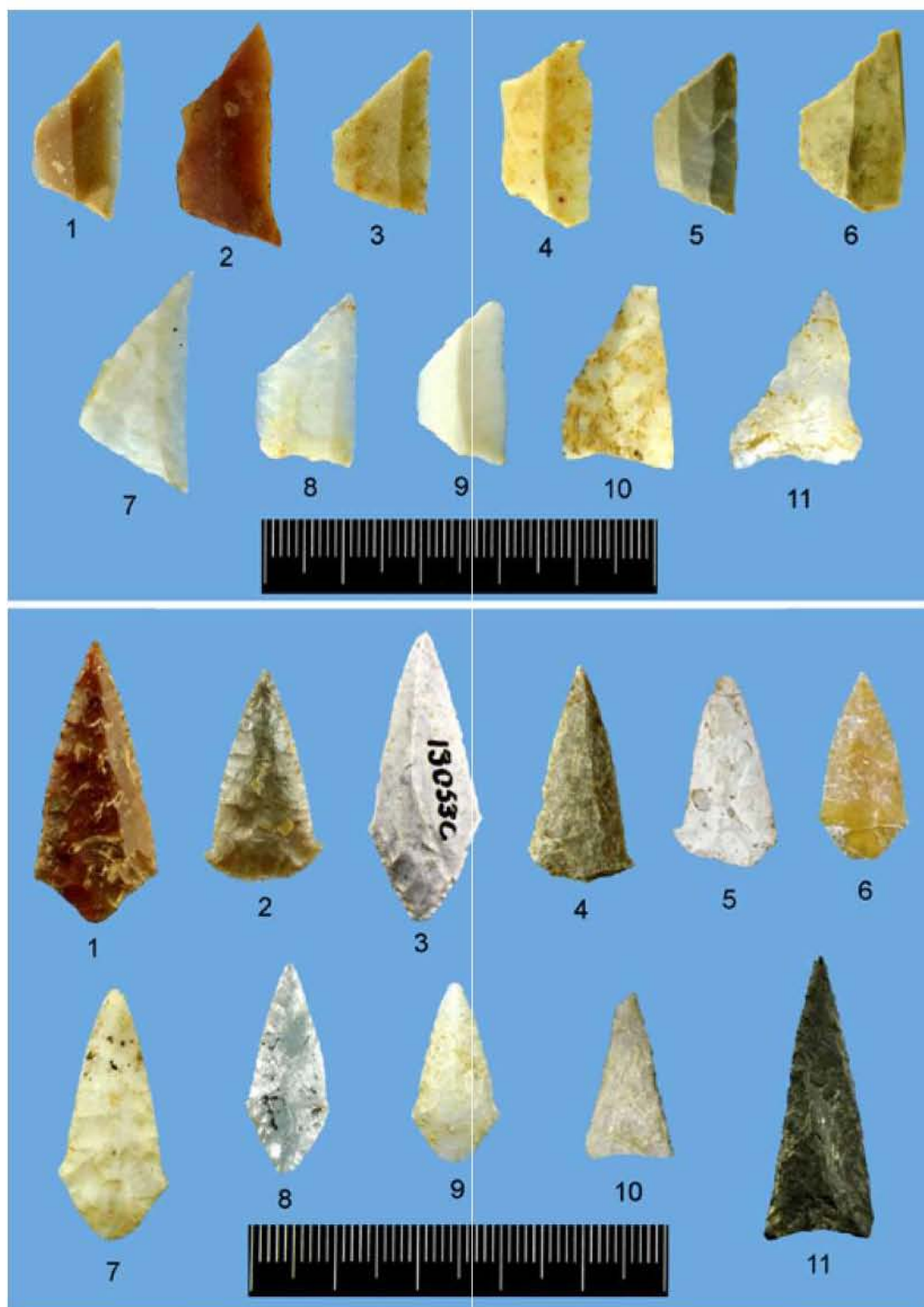


Figure 4 - Top: examples of the variability of geometric armatures collected in megalithic monuments in the area of Ribeira da Seda: Cenomanian flint from Rio Maior (1-2), Cenomanian flint from Ourém (3-4), opaque gray flint from undetermined source (5-6), chalcedony (7-8), opaline (9) and milky quartz (10-11). Bottom: examples of the variability of arrowheads collected in megalithic monuments in the area of Ribeira da Seda: Cenomanian flint from Rio Maior (1-2), Cenomanian flint possibly from the Lisbon area (3), oolitic flint (4), silcrete (5), opal? (6), opaline (7), hyaline quartz (8), milky quartz (9), phyllite (10) and lydite (11).

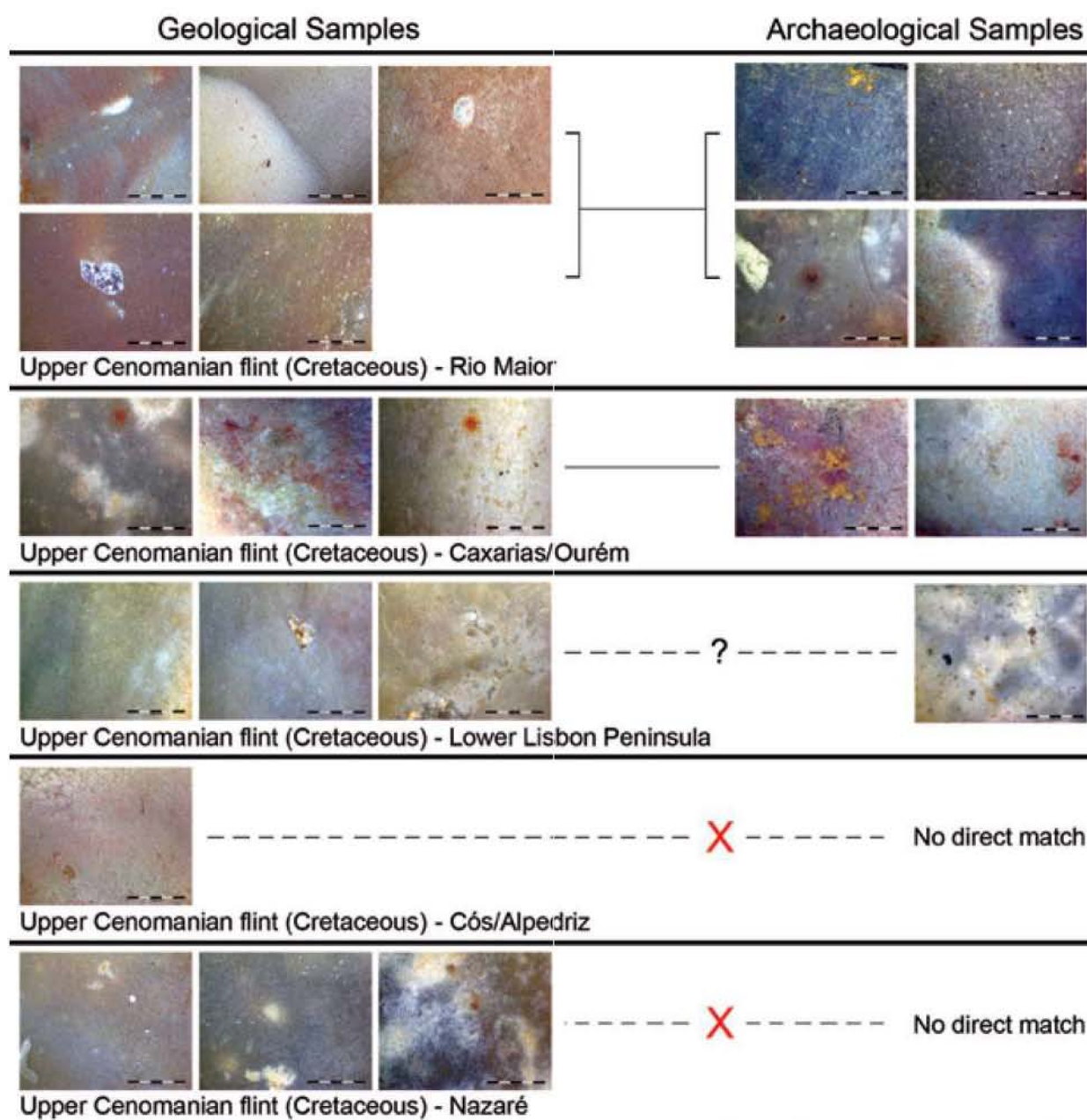


Figure 5 – Macroscopic comparison (x50) between geological samples (Cretaceous) and archaeological samples of flint collected in megalithic monuments in the area of Ribeira da Seda (blades, geometric armatures and arrowheads). The scale corresponds to 1 mm.

fine-grained flint, with *packstone-grainstone* texture and a high density of ooids composing its structure. It presents petrographic features similar to those found in the Jurassic silicifications of the Middle Sub-Betic range between Malaga and Granada (cf. Ramos Millán *et al.*, 1993; Martínez Fernández *et al.*, 2006; Morgado & Lozano, 2011; Morgado Rodríguez *et al.*, 2011). Although instances of oolitic limestone are known in Western Iberia (namely in the Estremadura Limestone Massif and Western Algarve), the presence of silicifications in these formations has not been confirmed so far.

Regarding chalcedony, although it is known to occur in limestone contexts of the Portuguese Estremadura and of the coastal region of Alentejo, it is possible to consider perhaps its presence (not confirmed) in

secondary mineralizations in the context of closer igneous rocks (the volcanic-sedimentary complex of Estremoz, for instance). The same can be also mentioned for the case of opal (?) and opaline.

Silcrete is also available in the adjacent drainage basins of the Estremadura Limestone Massif, on Miocenic deposits, together with the Cenomanian flint.

All other raw materials are locally and regionally available; in fact veins and masses of rhyolites, siliceous schists, phyllite, lydite and quartz are mapped in the whole area of the North Alentejo, in Precambrian, Cambrian, Ordovician, Silurian and Devonian contexts.

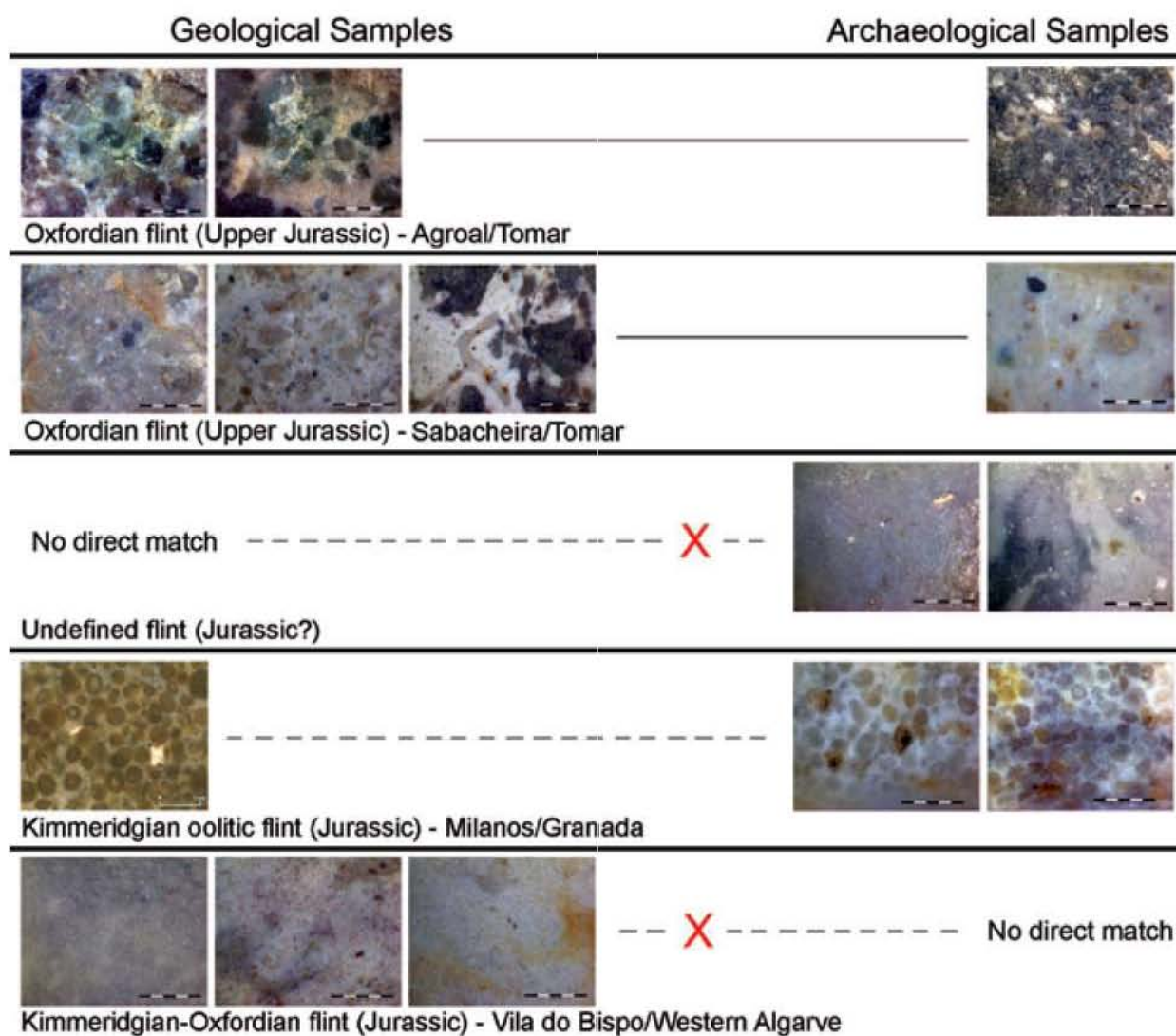
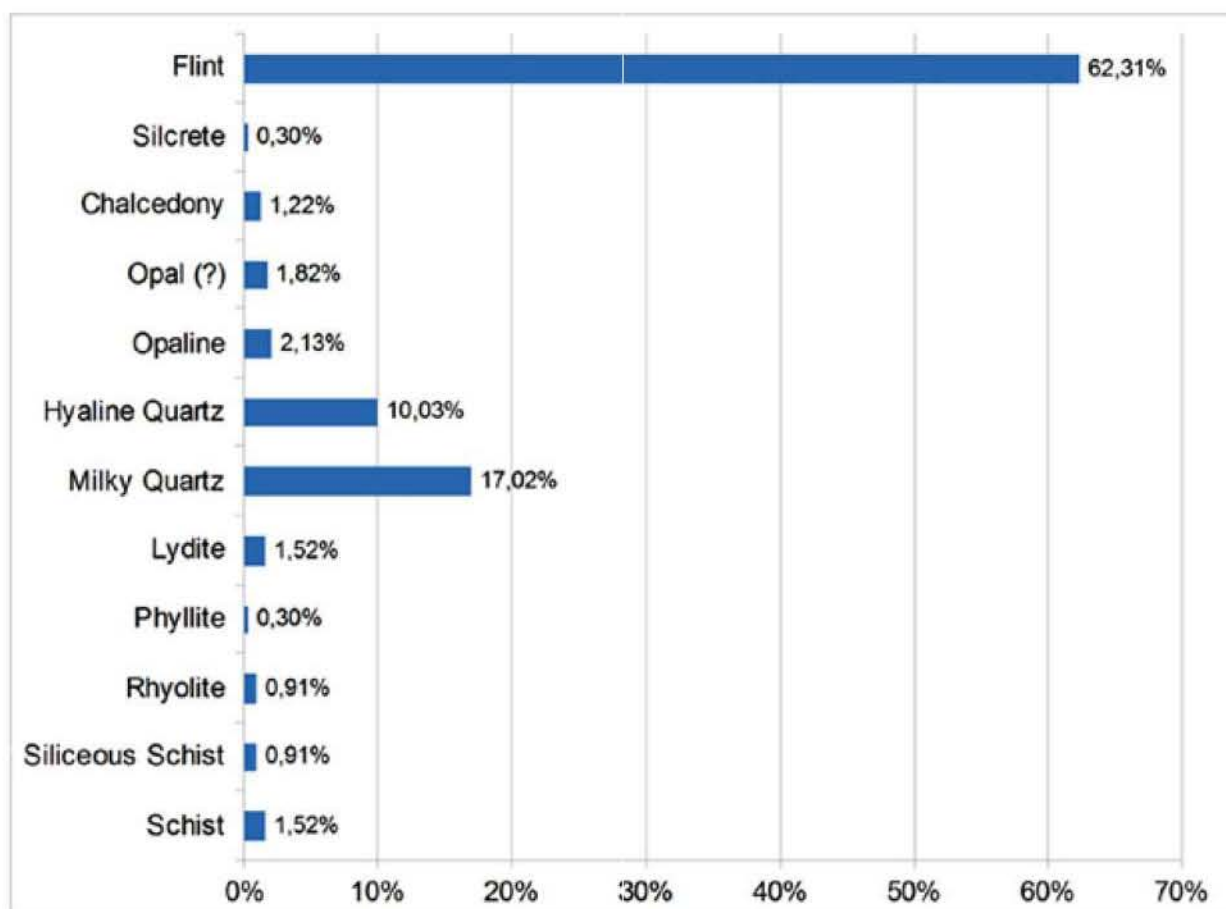


Figure 6 - Macroscopic comparison (x50) between geological samples (Jurassic) and archaeological samples of flint collected in megalithic monuments in the area of Ribeira da Seda (blades, geometric armatures and arrowheads). Macrophotograph of the oolitic flint from Granada after Morgado Rodríguez et al., 2011, fig. 5.4. The scale corresponds to 1 mm.

Chart 1 – Percent ratio, by raw material, of flaked stone artefacts (geometric armatures, arrowheads, blades and bladelets) in the area of Ribeira da Seda.



Polished stone artefacts

The polished stone tool set, including axes, adzes and chisels, is mostly produced in amphibolite (or other derived metamorphic rocks, such as amphibolic gneiss and amphibolic schist). Their local and regional availability is well-known in the areas of Abrantes, Gavião, Montargil, Ponte de Sor, Avis, Campo Maior, Mora, Pavia, Arraiolos, Montemor-o-Novo, Évora and Viana do Alentejo, being therefore easy to access these materials.

Axes produced with microgranites-diorites or dolerites are also known, although in a statistically reduced number. These raw materials are also locally and regionally available, in the areas of Avis, Alter do Chão and Crato, in the form of masses and veins in different geological settings.

Other artefacts, mainly adzes, are produced in sillimanite (fibrolite). The definition of its origin is complex; although, its procurement can be proposed in not too distant areas, being mapped occurrences of sillimanite veins on metamorphosed sedimentary formations in the areas of Montargil, Campo Maior and Arraiolos. In the same way, an adze of amphibolic rock from the dolmen of Capela presents an embedded sillimanite vein, allowing to perceive that the enclosing rock of this aluminosilicate mineral will be amphibolite (or rather amphibolic gneiss).

A mild, metamorphic rock type, of microcrystalline trend, designated as «green schist» or «weathered filonian basalt» and used in the production of adzes during the 4th millennium BCE, may correspond

to vulcanites from volcanic-sedimentary contexts. It may be locally available in Silurian and Cambrian contexts in the areas of Avis, Sousel and Alter do Chão, or regionally available in the foothills of the Anticline of Estremoz.

A single artefact presents distinct raw material, corresponding to an adze from the dolmen of São Lourenço 1, produced in siliceous schist. It can be obtained from Banded Iron Formations (BIF) of Precambrian age, possibly also locally or regionally available in the foothills of the Anticline of Estremoz or in the Syncline of Terena.



Figure 7 – Top left: adze of siliceous schist (BIF?) from the dolmen of São Lourenço 1 (Crato). Top right: sillimanite adzes from dolmens of the areas of Fronteira and Avis. Bottom: Adze of amphibolic rock from the dolmen of Capela (Avis), with a small sillimanite vein near the edge (indicated by the arrows).



Figure 8 – Macroscopic aspect (x50) of polished stone tools collected in megalithic monuments in the area of Ribeira da Seda. The last four correspond to dolerite, microgranite-diorite, sillimanite and siliceous schist (BIF?), the others correspond to amphibolite or derived amphibolic rocks. The scale corresponds to 2,50 mm.

Votive plaques

Votive plaques, one of the main elements that characterize the Megalithism of North and Central Alentejo (and generally of Southwestern Iberia) are produced in slate, chloritic schist, amphibolic schist, serpentinite, mica-schist and sandstone.

Once again their availability is local and regional. Slate is available, for instance, in Silurian contexts in Pavia; chloritic schist is also available in the Silurian contexts of Pavia and in the Precambrian contexts of Portalegre; amphibolic schist is available in the areas indicated above about the polished stone artefacts; serpentinite is available in the basites and ultrabasites (gabbro) of the Prehercynian contexts of Sousel and Portalegre; mica-schist is available in Montargil, Ponte de Sor, Pavia and Arraiolos, in Cambrian, Ordovician and Silurian contexts; sandstone is found abundantly in the Miocene and Pliocene contexts of the Tertiary filling of Tagus and Guadiana Rivers, in the areas of Castelo de Vide, Montargil, Ponte de Sor, Portalegre, Avis, Sousel, Campo Maior, Mora, Pavia and Montemor-o-Novo and in Devonian-Silurian contexts in Marvão and Assumar.



Figure 9 – Votive plaques collected in megalithic monuments in the area of Ribeira da Seda (Ordem 1, Avis): slate, serpentinite (with weathered surfaces), amphibolic schist and sandstone.

Adornment artefacts

This category includes artefacts such as necklace beads, pendants and «hair pins», produced with several types of raw materials.

Beads present a relative variety of raw materials: slate (the most common), chloritic schist, amphibolic schist, serpentinite, mica-schist, ceramic, amphibolite, sillimanite, steatite, talc and green stone (mainly muscovite, variscite being rare and resumed so far to the dolmens of Ordem 1 and Capela). All the above listed raw materials are locally or regionally available, excluding (so far) the variscite of extra-regional procurement. Pendants are produced on green stones and schist, sometimes recycling fragments of engraved schist plaques.

Since this is a matter currently under study within the project *New Technologies Applied to the Study of Mobility and Exchanges* mentioned above (including, in the study area, the dolmens of Ordem 1 and Capela), it will be useless to advance major considerations about their provenance, using the sources indicated above for the votive plaques (since the raw materials are essentially the same, with regard to slate, chloritic schist, serpentine, amphibolic schist, mica-schist and sillimanite).

One can also find bone beads, especially one of African savannah elephant ivory collected in the dolmen of Capela (Schuhmacher *et al.*, 2009). The «hair pins», some with grooved detachable head, are exclusively manufactured in bone.

The amber element from the dolmen of Capela does not necessarily correspond to a necklace bead. It is a small, apparently unworked nodule. However, it can be assumed that it is likely a component of an adornment object, complemented with an undetermined attachment/suspension implement. Its analysis revealed that it might be Sicilian simetite (Odrizola *et al.*, 2017).

Metallic artefacts

Occasionally, metallic artefacts are included in funerary sets, possibly related to later uses of the monuments, during the second half of the 3rd millennium BCE – as attested in Assobiador 2, Ordem

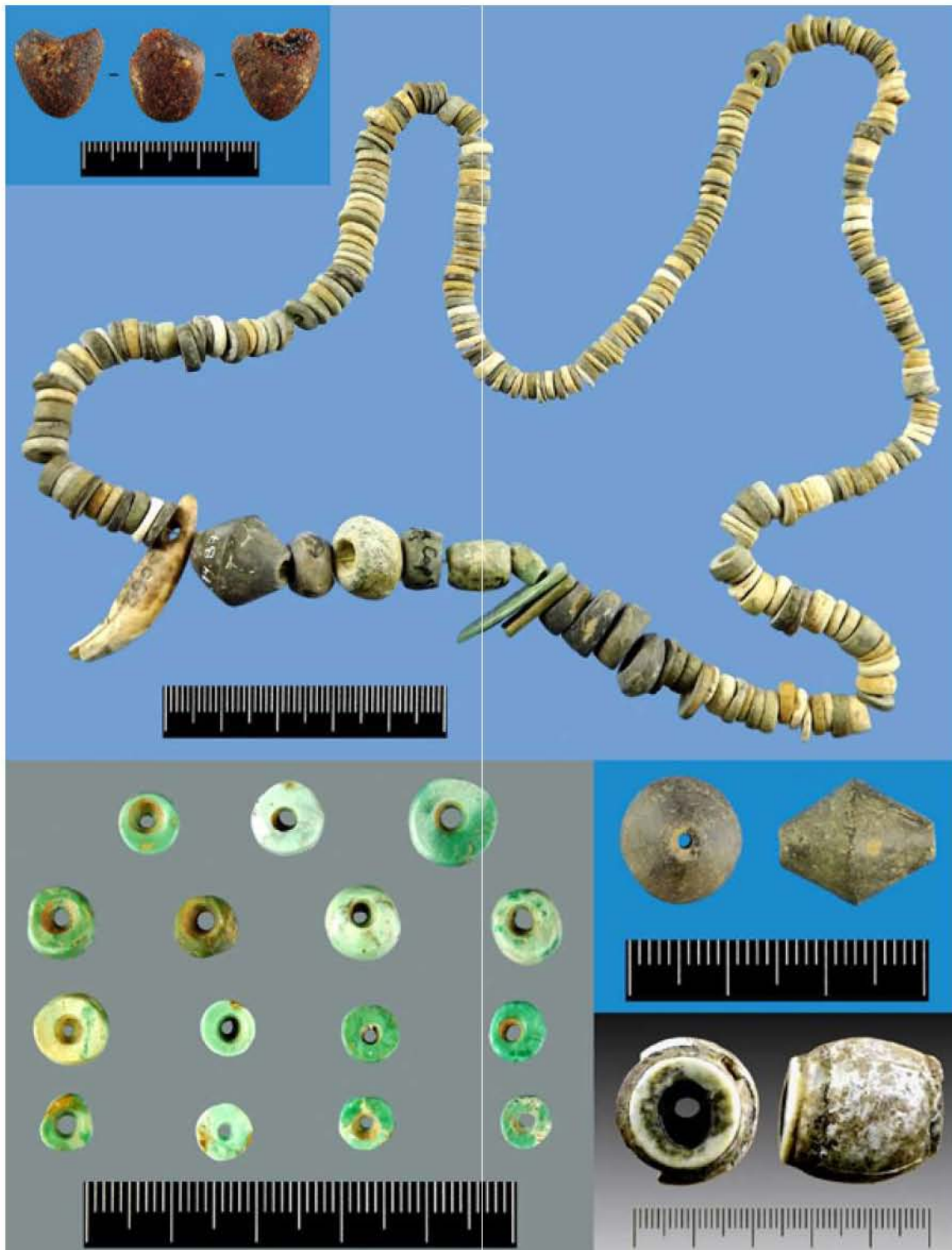


Figure 10 – Top: examples of the variability of adornment elements collected in megalithic monuments of the area of Ribeira da Seda; several types of schist, serpeninite, amphibolite, talc, green stone (muscovite), bone (including a *canis* sp. perforated canine) from the dolmen of Capela (Avis). Top left: Small amber nodule from the dolmen of Capela (Avis). Bottom left: Green stone beads (muscovite and variscite) collected in the dolmen of Ordem 1 (Avis). Bottom right (top): Ceramic bead from the dolmen of Espadanal (Estremoz). Bottom right (bottom): Large ivory bead of African savanna elephant from the dolmen of Capela (Avis).

1, Entreáguas 1, Passarinhos 1 and possibly in Torre do Ervedal 3, monuments in which copper points, daggers, blades and awls were collected. It may be suggested the local acquisition of the raw materials necessary for the manufacture of these artefacts, with copper occurrences being mapped in the areas of Monforte, Alter do Chão and Fronteira, in Cambrian contexts.

Ground stone artefacts

The presence of millstone elements is common in megalithic monuments in Alentejo, being present in the area of Ribeira da Seda both querns and handstones. They are produced on local igneous rocks, such as the ubiquitous diorite, gabbro, granite and granodiorite.

Polishers and grinders are also known in votive contexts, using local metamorphic rocks as raw material, mainly gneiss.

Other ground stone artefacts, of occasional use such as hammers and anvils, use quartz, quartzite and hornfels as support. The use of pebbles for these artefacts makes it possible to defend their local procurement, being these pebbles largely available in the watercourses beds or in the Tertiary and Quaternary terraces of the banks of Ribeira da Seda.

4. Some remarks on local, regional, extra-regional and hyper-regional procurement of raw materials by the megalithic communities of the area of Ribeira da Seda

As mentioned above, the data presented herein are based only on a macroscopic analysis of the raw materials used in the production of votive artefacts by the megalithic communities in the area of Ribeira da Seda and its confrontation with the information available on the *Portuguese Geological Chart*. Thus, it must be taken only as a preliminary approach to this issue, establishing the conceptual basis for further detailed analyses.

Extending the scheme proposed by J.-M. Geneste (1991) for the hunter-gatherer communities, as already suggested for the case of Nossa Senhora da Conceição dos Olivais (Boaventura *et al.*, 2014-2015), the following scales of immediate analysis are proposed for the megalithic communities of Southwestern Iberia, considering the mobility patterns of the Neolithic and Chalcolithic communities:

Local procurement – up to 10 km radius;

Regional procurement – between 10 and 50 km radius;

Extra-regional procurement – over 50 km radius.

Obviously, the definition of these scales is based on linear theoretical criteria, and therefore their application should be relativized, depending on several factors. First of all, the natural boundaries must be taken into account – in this case, the Ossa mountain range and the Estremoz Limestone Massif (and, a bit further away, the course of the Tagus and Guadiana Rivers), acting as obvious conditioners of transitability. Subsequently, it should be noted that movements of herds, hunting expeditions or other small-scale logistical maneuvers could cover distances of more than 10 km (and even of more than 50 km). However, these movements are always assumed to be «local» activities (in which just few days could pass between the departure and arrival to the settlement base), having as indirect repercussion the occasional sourcing of raw materials (and their consequent transport to the residential area). Similarly, we can find raw materials from areas located way over the 50 km radius, even over 100 or 200 km; in such

cases they are regarded as of hyper-regional origin, considered as exotic materials.

Obviously, it can be discussed if it were whether raw materials or finished products to be traded; however, this is not the place to deepen such matter. In any case, the provenance areas would be the same, and that is the issue that truly concerns us here. Nevertheless, and as a small contribution for this debate, it should be noted that the occurrence of workshops near the raw material sources, specifically in the cases of flint and variscite (as further mentioned), could favour the second hypothesis.

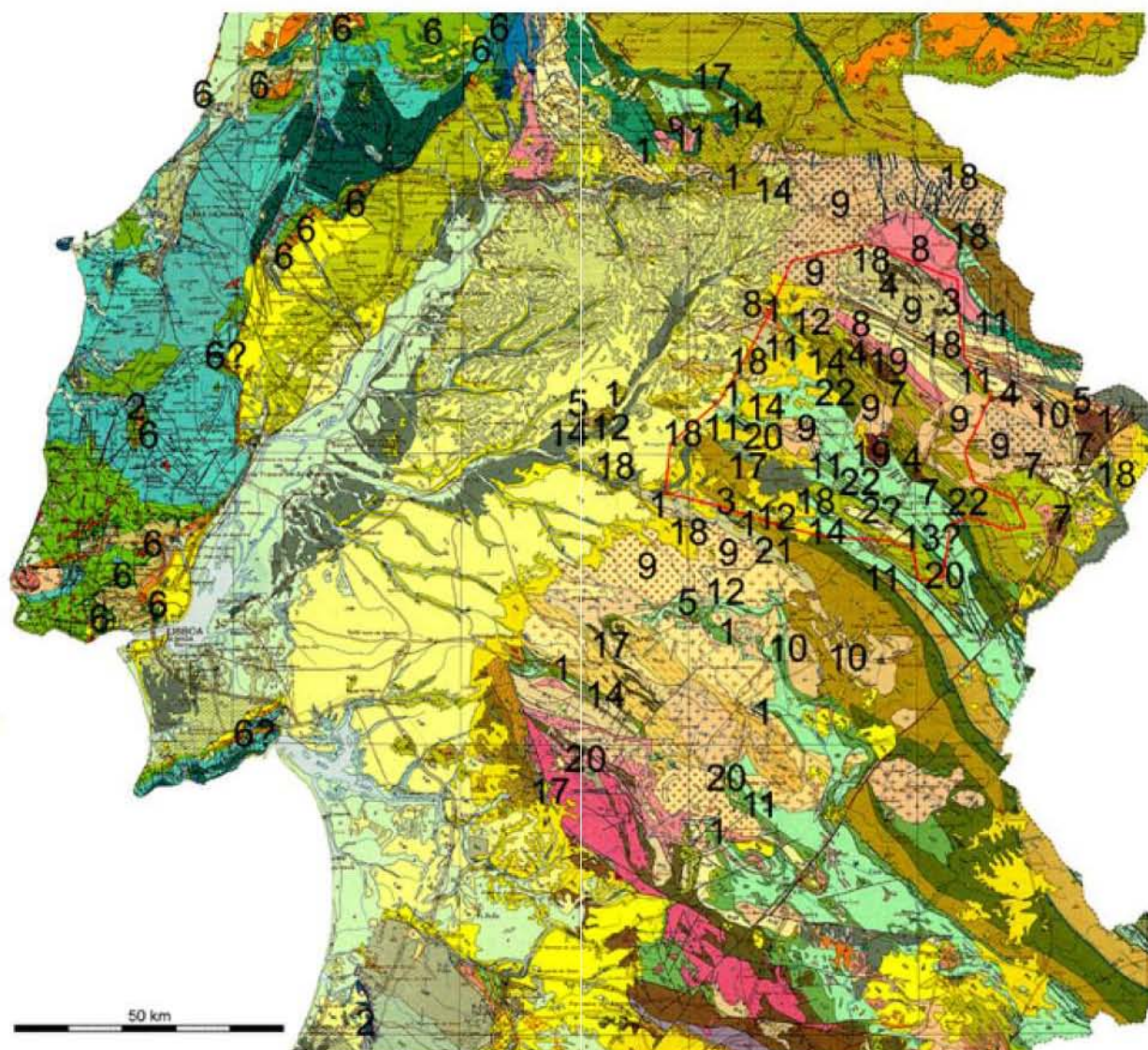


Figure 11 – Possible procurement sources of raw materials used in votive artefacts in the area of Ribeira da Seda. Note that the points do not necessarily correspond to the original procurement sources, but only to the indication of geological contexts in which raw materials can be found. 1: Amphibolite and amphibolic rocks; 2: Chalcedony; 3: Chloritic schist; 4: Diorite; 5: Fibrolite (sillimanite); 6: Flint; 7: Gabbro; 8: Gneiss; 9: Granite; 10: Granodiorite; 11: Lydite; 12: Mica-schist; 13: Opal (?) and Opaline; 14: Phyllite; 15: Quartz; 16: Quartzite; 17: Rhyolite; 18: Sandstone; 19: Serpentinite; 20: Siliceous schist; 21: Slate; 22: Vulcanites. The area of Ribeira da Seda (its hydrographic basin) is indicated by the red line. Cartographic base: Portuguese Geological Chart, scale 1:500000, 1992.

Taking into account the above mentioned, and independently of their category or number, the vast majority of raw materials used in the production of artefacts by the megalithic communities of Ribeira da Seda are mostly of local or regional origin (from the Davos-Morena Meta-Volcanic Zone), with extensive occurrences mapped in the region of North and Central Alentejo. Their availability is thus immediate, revealing no major investment in obtaining raw materials for the production of votive artefacts, reflecting an educated use and an optimized maintenance of abiotic resources.

One can only point out flint, as well as silcrete, chalcedony, opal (?) and opaline, as exogenous raw materials – excluding, in this context, the cases of variscite, amber and ivory used in adornment elements, with an obvious hyper-regional origin (Odriozola *et al.*, 2010, 2012, 2016 and 2017; Schuhmacher *et al.*, 2009; Valera *et al.*, 2015). However, for chalcedony, opal (?) and opaline, one can perhaps propose their potential local or regional presence as secondary mineralizations in volcanic-sedimentary complexes, as mentioned above.

Regarding flint, and as such, the petrographic features allow to point out as probable procurement sources the areas of the Estremadura Limestone Massif and adjacent drainage basins, referring mainly to flint of Cenomanian contexts, with a statistically irrelevant presence of flint from Oxfordian contexts and excluding the grayish, opaque flint from undefined source (cf. Aubry *et al.*, 2014; Matias, 2016 about the description of these flints). The region of Rio Maior (Azinheira and Amieira-Arruda dos Pisões, for instance) and the regions of Ourém (Pederneira and Caxarias) and Tomar (Agroal and Sabacheira) can be highlighted as probable provenance areas, over 120 km from the central area of the hydrographic basin of Ribeira da Seda. Although other potential sourcing areas with the same features are available, we highlight those ones due to the occurrence of extensive Late Neolithic and Chalcolithic flint workshops directed towards the production of bifacial tools and large blades, particularly in Rio Maior and Ourém (Zilhão, 1994 and 1997; Forenbaier, 1999; Andrade *et al.*, 2014; Andrade & Matias, 2013).

The case of the opaque, gray flint is particularly interesting. Although its specific provenance area has not been rigorously determined yet (still to be compared with Jurassic flint occurrences in the Montejunto and São Luís mountain ranges, the latter on the Setúbal peninsula), its relevance lies on the fact that it seems to have been used in the production of blades and geometric armatures only during the 4th millennium BCE, in roughly identical proportions to Cenomanian flint. Apparently, it was no longer used in the production of blades and arrowheads during the 3rd millennium BCE, when these artefacts are manufactured almost exclusively in Cenomanian flint. Therefore, its use could be regarded as a possible indicative of a specific chronological level.

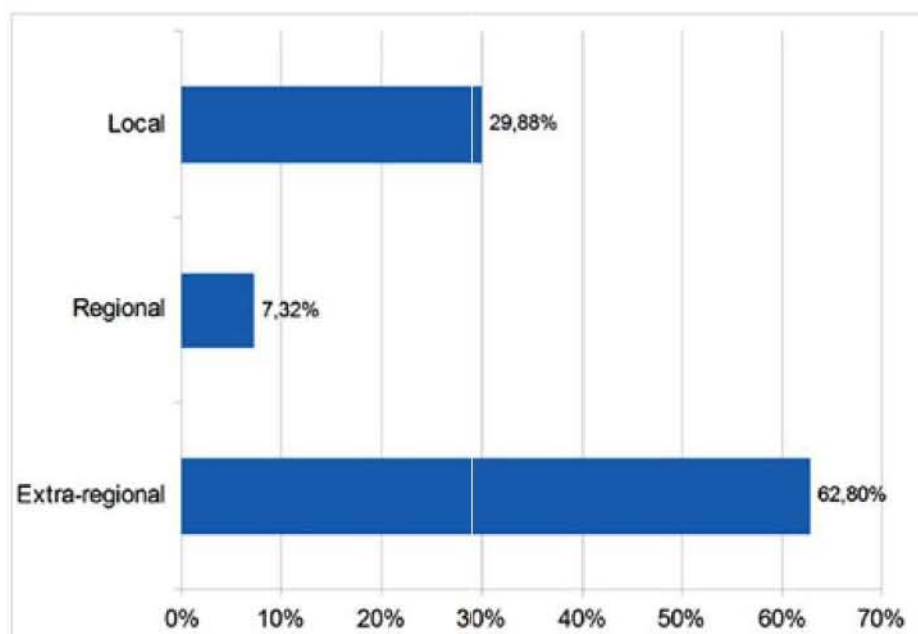
The same can be pointed out for the metamorphic rock (possibly vulcanites) used in the production of adzes during the 4th millennium BCE, apparently no longer used (or used in insignificant amounts) in the production of votive adzes during the 3rd millennium BCE. Either way, in both cases, these readings should be carried out with some caution, with more detailed petrographic analyses and a greater overall acknowledgement of the archaeological sets being required. It should be noted that these observations are based (though not exclusively) on the specific case study of the area of Ribeira da Seda – but apparently also confirmed in the case of the megalithic clusters of Deserto and Barrocal das Freiras (Montemor-o-Novo), currently under study within the project OMEGA – *The Origins of Megalithism in Central Alentejo*, directed by the author in collaboration with V. S. Gonçalves (Gonçalves & Andrade, in press).

It should be also mentioned the curious apparent absence of flint from the Cenomanian contexts of the Lower Estremadura (area of Lisbon peninsula), only documented, although without absolute certainty, in one single element in the area of Ribeira da Seda (an arrowhead from the dolmen of Capela). Whereas this type of flint is extensively and almost exclusively used by the local Neolithic and Chalcolithic communities in the Lisbon area, it seems that it has not been transacted to Alentejo, which contrasts

with the already attested introduction of amphibolites from Alentejo in Lisbon peninsula (as discussed below). Thus, considering the recognized extension of the inter-regional relations of these same communities, the absence of flint from Lisbon is not so easily explained.

The circulation of flint from the Portuguese Estremadura to the Alentejo, as roughout blocks or as finished products, is included in extensive exchange networks outlined since at least the Early Neolithic, intensified during the consolidation of stable peasant communities of the Late Neolithic and Chalcolithic. As evidence of the extent of these exchange networks, one can recall the presence of oolitic flint from the areas of Malaga and Granada where extensive mines/workshops can be found, which are also oriented towards the production of bifacial tools and blades, such as La Venta, Valle de los Gallumbares or Malaver (Ramos Millán *et al.* 1993; Aguayo & Moreno, 1998; Martínez Fernández *et al.* 2006; Lozano *et al.*, 2010; Morgado & Lozano, 2011; Morgado Rodríguez *et al.*, 2011). The presence of artefacts produced using this type of flint in Alentejo and in the adjacent area of the Spanish Extremadura (Nocete *et al.*, 2005; Cerrillo Cuenca, 2009; Morgado Rodríguez *et al.*, 2011; Boaventura *et al.*, 2014-2015; Mendonça & Carvalho, 2016; Valera & André, 2016-2017; Cardoso *et al.*, 2018) is proof enough of its large-scale geographical circulation (of over 450 km). However, as the arrowhead from Nossa Senhora da Conceição dos Olivais shows (Boaventura *et al.*, 2014-2015), not only the large bifacial tools and blades were exchanged – as usually defended (Nocete *et al.*, 2005).

Chart 2 – Percent *ratio* of flaked stone artefacts (geometric armatures, arrowheads, blades and bladelets) produced with local, regional and extra-regional (including oolitic flint) raw materials in the area of Ribeira da Seda. Although without absolute certainty, chalcedony, opal (?) and opaline were considered in the set of regional available raw materials.



Although exogenous raw materials (mainly flint) can be statistically considered as a minority when comparing exclusively the type of raw material, their presence is solid when comparing the number of artefacts *per se*. In fact, arrowheads and geometric armatures are produced mainly in flint, corresponding the local raw materials (phyllite, lydite, quartz) to lower values in percentage terms (nearly 1/3). However, raw material does not seem to influence the typology of artefacts; so, the preferential use of one or other material can not be explained by cultural factors, but only by their availability. Anyway,

this preferential use of flint for the production of bifacial points and geometric armatures indicates a constant procurement of this exogenous raw material.

As a counterpart, the area of Ribeira da Seda is one of the potential areas that would supply the Portuguese Estremadura in amphibolic rocks during the Neolithic and Chalcolithic (Cardoso & Carvalhosa, 1995; Lillios, 1997). In fact, this raw material is here abundantly available in both the exposed outcrops and in detached blocks present in the fluvial deposits of Ribeira da Seda and subsidiary watercourses. Furthermore, a possible quarry of amphibolic rocks was identified in the area of Torre de Palma (Monforte), spatially related to the Chalcolithic settlement of Pombal (R. Boaventura; personal information). Similarly, one can also mention the «supply» of the schists required for the production of votive plaques, absent in the geological context of the Portuguese Estremadura.

Moreover, it must be said also, in the context of these reciprocal exchange relationships, that organized mining instances of local raw materials for «exportation» (such as those known for flint supplying in the Portuguese Estremadura, for instance) are not known in this area so far. Indeed, amphibolic rocks (as well as quartz, quartzite and lydite) can be found in secondary deposits spread throughout this area, detached from the original outcrop, presenting therefore an immediate accessibility.

The presence of exotic raw materials of hyper-regional origin, such as variscite, ivory and amber (as well as the oolitic flint discussed above), allows to integrate the area of Ribeira da Seda into long-distance trade diagrams, encompassing the development processes of social complexity since the late 4th millennium BCE onwards.

Regarding variscite, and according to the analyses conducted under the project *New Technologies Applied to the Study of Mobility and Exchanges*, two provenance areas are known for the green beads integrating the votive sets of the megalithic communities in Southwestern Iberia. The first one is located in Palazuelo de las Cuevas (Zamora, about 400 km from the central area of the hydrographic basin of Ribeira da Seda); a second one is located in Pico Centeno (Ensinasola, Huelva; about 150 km from a central area of the hydrographic basin of Ribeira da Seda). Both these instances are spatially associated with mines and workshops oriented towards the production of variscite beads (Odriozola & Villalobos-García, 2015; Odriozola *et al.*, 2016; Villalobos García & Odriozola, 2016a and 2016b).

The comparison between the data from Anta Grande do Zambujeiro and Perdigões suggests a sourcing in Palazuelo de las Cuevas during the 4th millennium BCE and a sourcing in Pico Centeno during the 3rd millennium BCE, revealing a hypothetical shift in the variscite supply strategies between the Neolithic and the Chalcolithic in Southwestern Iberia (Odriozola *et al.*, 2010 and 2012).

The integration and importance of this mineral in long-distance exchange networks is precisely evidenced by the introduction of Iberian variscite in Brittany, possibly as early as the mid-5th millennium BCE (Querré *et al.*, 2012). As a return, one could mention the presence of axes of Breton influence in Iberia (Fábregas Valcarce *et al.*, 2011; Pétrequin *et al.*, 2012). In the specific case of the area of Ribeira da Seda, it should be mentioned in this context the perforated flat axe, of Cangas type (a Tumiatic type variant), produced in sillimanite, collected in Ervedal and clearly inspired on the Breton models (Andrade, 2014).

In relation to ivory, basically from African savannah elephant in the Southwestern edge of Iberia (as attested in the case of the bead from dolmen of Capela), it must be recognized that it comes from a «mobile» source. In this regard, it was considered the distance to the nearest potential acquisition area, namely the African side of Gibraltar Strait (about 500 km from the central area of the hydrographic basin of Ribeira da Seda).

Although the current northern natural boundary of the African savannah elephant distribution coincides with the sub-Saharan zone of the Sahel, reaching the Southern area of Mali and Senegal (more than 3000 km from the central area of the hydrographic basin of Ribeira da Seda), its occurrence in North Africa during the 3rd millennium BCE could be possible, based on some archaeographic data. Therefore, a sea route from the Atlantic coast of Morocco is suggested for its introduction in Iberia (Schuhmacher *et al.*, 2009, p. 994; Schuhmacher & Banerjee, 2012), being its introduction in Alentejo carried out from the Portuguese Estremadura (Schuhmacher & Banerjee, 2012; Valera *et al.*, 2015, p. 408-409). However, in this assumption, one must consider the direction of the Canarian current, which runs from North to South along the Northwestern African coast, making the sea-crossing to Iberia (*via Atlantic*) relatively difficult with rudimentary navigation methods.

Therefore, land routes (even if possibly following the African coastline) to the Gibraltar Strait can also be admitted, and from here directly introduced to the Southwestern Iberia (together with ostrich eggshells).

It is accepted that ivory could be traded on its raw form into the Iberian context – as demonstrated by the identification of a workshop in Valencina de la Concepción (in this case, with a large percentage of Asian elephant ivory, after Nocete *et al.* 2013) or by the presence of unworked pieces included in the votive sets of Alcalar 4 or Perdigões (Schuhmacher *et al.*, 2009; Valera *et al.*, 2015), indicating a local management of this raw material.

Regarding amber, recent analyses carried out within the scope of the project *New Technologies Applied to the Study of Mobility and Exchanges* (Odriozola *et al.*, 2017), updating some previous readings (such as those expressed in Murillo-Barroso & Martín-Torres, 2012, for instance), allowed to attest that the elements using this fossil resin present in Iberia between the Neolithic and Early/Middle Bronze Age basically correspond to Sicilian simetite (over 2000 km from the central area of the hydrographic basin of Ribeira da Seda).

Two routes can be admitted for the introduction of Sicilian amber in Iberia: a first one by the North shore of the Mediterranean, along the French coast towards the Northeastern Iberia, replicating the paths of the obsidian from the Tyrrhenian Sea during the Early Neolithic (Vaquer, 2007; Binder *et al.*, 2012; Lugliè, 2012; Gibaja Bao *et al.*, 2013; Freund & Batist, 2014; Terradas *et al.*, 2014) but with a wider geographical reach; another one by the Southern shore of the Mediterranean, *via North Africa*, meeting the ivory routes in the area of the Gibraltar Strait, entering Iberia by the Southwest.

The geographical dispersion of Sicilian amber in Iberia, from Catalonia to Algarve in a period between the Late Neolithic and the Early/Middle Bronze Age (Odriozola *et al.*, 2017), could precisely favor the first hypothesis. Also, if we admit a maritime route, the direction of the dominant currents in the Mediterranean, running towards West along the European coast and in the opposite direction along the African coast, allows us to support a diffusion path by the North side of that sea.

It is generally assumed that the large-scale dissemination of exotic materials such as ivory and amber would take place mainly with the affirmation of the Chalcolithic complex societies – especially the relations with North Africa, that currently seem to have occurred in moments prior to the second half of the 3rd millennium BCE (as suggested in Harrison & Gilman, 1977). However, the presence of such materials in the dolmen of Capela, in the inland of Alentejo, associated with a votive set that will not advanced further than the last quarter of the 4th millennium BCE or the first of the 3rd (corroborated by the result of the radiocarbon date) may suggest its distribution, even if occasionally, in moments prior to the advent of the archaeometallurgic communities.



Figure 13 – Theoretical routes for the introduction of extra- and hyper-regional raw materials in the area of Ribeira da Seda. The black dashed lines indicate de main sea currents. Cartographic base: Google Maps, 2016.

Obviously, one can not suggest direct links between the megalithic communities of the area of Ribeira da Seda (and, in general, of Southwestern Iberia) and the communities from the provenance areas of the distinct raw materials – in some cases, more than 2000 km away.

These direct relations can only be suggested in the case of the Portuguese Estremadura – according to, in addition to the well-recognized exchanges of raw materials mentioned above (such as flint and amphibolite, and even copper), the techno-typological and morphological similarities of the artefacts collected in both areas (Thomas, 2010; Sousa & Gonçalves, 2012). This fact is particularly evident in the set of votive plaques from Lapa da Galinha, a burial cave located in the Estremadura Limestone Massif, with remarkable affinities (in terms of iconography and imagerics) with the votive plaques collected in megalithic tombs in North Alentejo (Gonçalves *et al.*, 2014).

These closed-scale inter-regional relations between Alentejo and Estremadura are equally substantiated by the recent strontium isotopes analyses performed on individuals from Middle Neolithic, Late Neolithic and Chalcolithic burial sites in the latter region – namely, Algar do Bom Santo, Cabeço da Arruda 1 and Cova da Moura (Hillier *et al.*, 2010; Waterman *et al.*, 2013; Lillios *et al.*, 2014; Carvalho, 2014;

Carvalho *et al.*, 2016). The results show that at least part of the community buried therein is originally from Alentejo, which indicates an evident and direct circulation of people between both regions during the 4th and 3rd millennia BCE.

Table 2 – Relation between relative distance and main travel time (in straight hours by foot) of extra and hyper-regional raw materials localities (over 100 km radius), excluding the ones that could be locally or regionally available (such as chalcedony). Calculations *via* Google Earth (2017) in relation to a central area of the hydrographical basin of Ribeira da Seda.

Raw-materials	Locality	Distance	Travel time
Cenomanian flint (Cretaceous)	Campolide and Alcântara, Lisbon	≈160-170 km	≈31-38 h
Cenomanian flint (Cretaceous)	Azínheira and Amieira-Pisões, Rio Maior	≈135-140 km	≈28-29 h
Cenomanian flint (Cretaceous)	Pederneira and Caxarias, Ourém	≈135 km	≈28 h
Oxfordian flint (Jurassic)	Agroal and Sabacheira, Tomar	≈120 km	≈25 h
Oolitic flint (Jurassic)	Malaga and Granada	≈445-470 km	≈92-97 h
Variscite	Ensinasola, Huelva	≈150 km	≈31 h
Variscite	Palazuelo de las Cuevas, Zamora	≈400 km	≈83 h
Amber	Sicily, <i>via</i> Iberia	≈2250 km	≈307 h
Amber	Sicily, <i>via</i> North Africa	≈2650 km	≈473 h
Ivory (North African elephant)	North Africa	>500 km	>96 h

For the other regions, a scheme of indirect relations seems to be much more feasible, considering the sometimes excessively long distances between the areas of origin and the areas of destination. What is left to be defined is effectively the identity of the agents of these exchanges in the various poles of this vast territory, including the area of Ribeira da Seda on extensive exchange networks outlined throughout the Southwestern Iberia during the Late Neolithic and Chalcolithic, framed in the consolidation processes of stable ancient peasant communities.

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